

Intel® Entry Server Chassis SC5299-E

Technical Product Specification

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July 2007	2.0	Added SC5299UP to SC5299-E family.
November 2007	2.1	Added BTU information to SC5299-E family.
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May 2010	3.1	Deleted CCC and CNCA content.

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Intel Corporation server baseboards contain a number of high-density VLSI and power delivery components that need adequate airflow to cool. Intel's own chassis are designed and tested to meet the intended thermal requirements of these components when the fully integrated system is used together. It is the responsibility of the system integrator that chooses not to use Intel developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of air flow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail or the server board does not operate correctly when used outside any of their published operating or non-operating limits.

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1. Product Overview

The Intel® Entry Server Chassis SC5299-E is a 5.2U pedestal or 6U rack mountable server chassis that is designed to support the Intel® Server Boards S5000PSL, S5000XVN, S5000VSA and S3420GP series. This chapter provides a high-level overview of the chassis features. Greater detail for each major chassis component or feature is provided in the following chapters.

1.1 Intel® Entry Server Chassis SC5299-E Design Features

The Intel® Entry Server Chassis SC5299-E addresses the value server market with three power factor correction (PFC) power supply unit (PSU) configurations:

- SC5299UP – 420-W fixed PSU for single-processor server boards
- SC5299DP – 550-W fixed PSU for dual-processor server boards
- SC5299WS – 670-W fixed PSU for dual-processor workstation boards
- SC5299BRP – 650-W 1+1 redundant PSU for dual-processor server boards

The UP, DP and WS power supply configurations each include an Intel validated PSU with an integrated cooling fan and one AC line input. The BRP power supply configuration includes (1 of 2) redundant Intel validated PSU with an integrated cooling fan and one AC line input.

The cooling sub-system in the Intel® Entry Server Chassis SC5299-E consists of one 120-mm system fan and one power supply fan. A 92-mm drive bay fan is only included with the SC5299WS configuration. A 92-mm drive bay fan is also included with the optional hot swap drive bay mounting bracket kit.

A removable access cover provides entry to the interior of the chassis. The rear I/O panel conforms to the *Advanced Technology Extended (ATX) Specification, Revision 2.2*. The chassis supports six full-length expansion cards. There are two front USB port connections, and one rear knock-out location for an optional rear mounted serial port. A control panel board designed for Server Standards Infrastructure (SSI) Entry E-Bay (EEB) 3.61-compliant server boards is also provided with the server chassis.

The Intel® Entry Server Chassis SC5299-E supports up to six hard drives in all three configurations. Two 5.25-in, half-height drive bays are available for peripherals, such as CD/DVD-ROM drives and tape drives. An optional hot-swap SAS non-expander/SAS expander or SCSI drive bay kit provides an upgrade path to allow the Intel® Entry Server Chassis SC5299-E to support up to six hot-swap drives. Refer to the *Drive Cage Upgrade Kit Installation Guide* for the Intel® Entry Server Chassis SC5299-E for complete hot swap drive cage installation instructions. When installed, the hot-swap drive bay replaces the fixed hard drive bay.

The Intel® Entry Server Chassis SC5299-E makes extensive use of tool-less hardware features that support tool-less installation and removal of fans, fixed and hot swap hard drives, fixed and hot swap drive bays, PCI cards, hot swap PSU modules, fixed PSU, floppy drives, and CD/DVD ROM drives.

This specification details the key features of the product. Reference documents listed at the back of this document provide additional product specification details for the server boards, backplanes, and power supplies validated for use with this chassis. Check the compatibility, section on the support website for more details:

http://www.intel.com/p/en_US/support/highlights/server/sc5299-e.

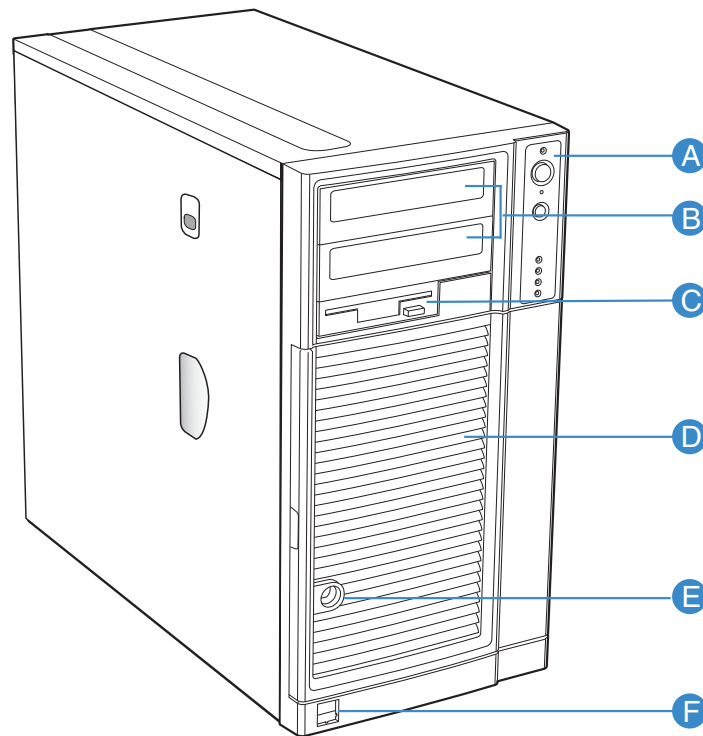
The following table summarizes the features for all chassis combinations:

Table 1. Intel® Entry Server Chassis SC5299-E UP, DP, BRP, and WS Features

Configuration	SC5299UP	SC5299DP	SC5299BRP	SC5299WS
Intel® Server Board Support	Intel® Server Board S3200SHV Intel® Server Board S3210SHLC Intel® Server Board S3210SHLX Intel® Server Board S3430GPV	Intel® Server Board S5000VSA Intel® Server Board S5000PSL Intel® Server Board S5000XSL Intel® Server Board S3420GPLC Intel® Server Board S3420GPLX	Intel® Server Board S5000VSA Intel® Server Board S5000PSL Intel® Server Board S5000XSL Intel® Server Board S3420GPLC Intel® Server Board S3420GPLX	Intel® Server Board S5000XVN
Power Delivery	420-W PFC Intel validated PSU with integrated cooling fan.	550-W PFC Intel validated PSU with integrated cooling fan.	650-W PFC Intel validated PSU with integrated cooling fan. One additional 650-W PSU can be added for redundancy.	670-W PFC Intel validated PSU with integrated cooling fan.
System Cooling	One tool-less, 120-mm chassis fan.			One tool-less, 120-mm chassis fan. One tool-less 92-mm drive bay fan.
Peripheral Bays	Two tool-less, multi-mount 5.25-in peripheral bays. One standard 3.5-in removable media peripheral bay.			
Drive Bays	Includes one tool-less fixed drive bay. Supports up to four hard drives. Optional hot-swap tool-less drive bay is available.		Includes one tool-less fixed drive bay for up to six fixed drives.	Optional hot-swap tool-less six-drive bay is available.
PCI Slots	7 slots and support for 6 full-length with tail card guide			
Form Factor	5.2U tower, convertible to 6U rack mount			
Front Panel	LEDs for NIC1, NIC2, HDD activity, power status, and system fault status. Switches for power, NMI, and reset. Integrated temperature sensor for fan speed management.			
External front	Two USB ports			

Configuration	SC5299UP	SC5299DP	SC5299BRP	SC5299WS
connectors				
Color	Black			
Construction	1.0-mm, zinc-plated sheet metal, meets Intel Cosmetic Spec # C25432			
Chassis ABS	Fire retardant, non- brominated, PC-ABS			
Dimensions Pedestal	17.8 in (45.2 cm) x 9.256 in (23.5 cm) x 19 in (48.3 cm)			
Dimensions Rack	9.256 in (23.5 cm) x 17.6 in (44.7 cm) x 19 in (48.3 cm)			

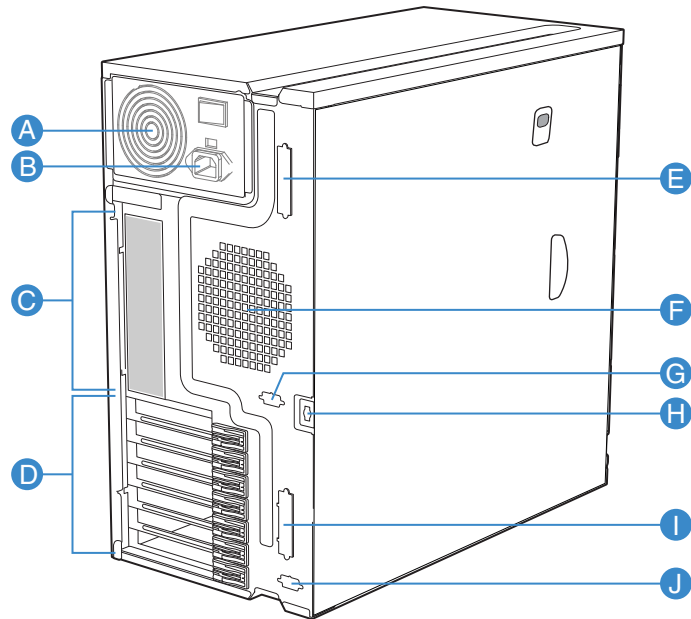
1.2 Chassis Views



TP01717

- A. Control panel controls and indicators
- B. Two half-height 5.25-in peripheral drive bays
- C. 3.5-in removable media drive bay
- D. Internal hard drive bay cage (behind door)
- E. Security lock
- F. USB ports

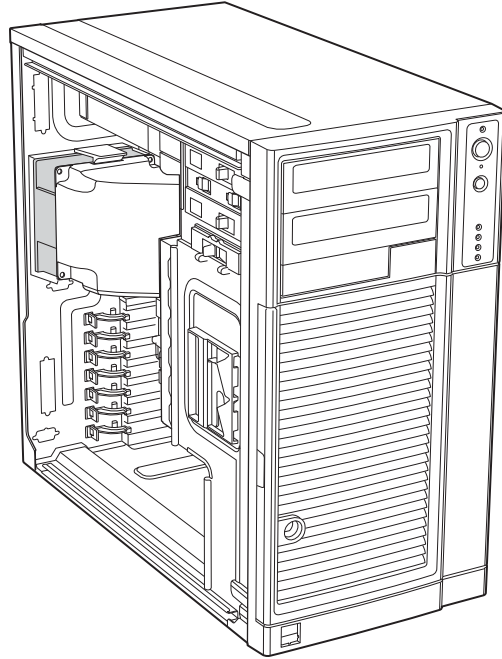
Figure 1. Front Closed Chassis View of Intel® Entry Server Chassis SC5299-E



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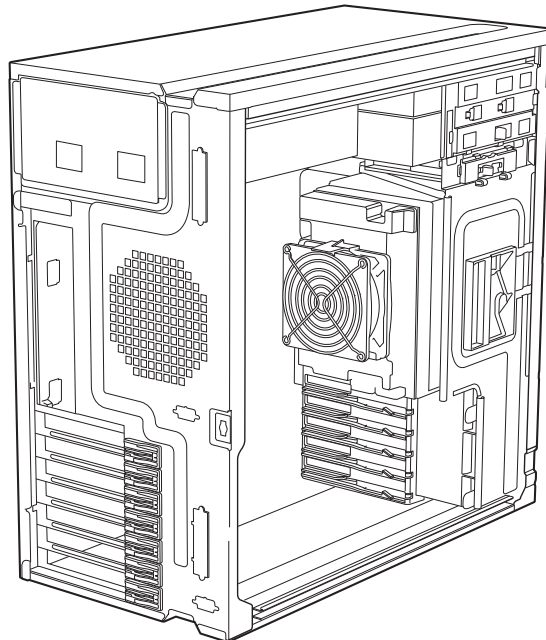
- A. Power supply (fixed power supply shown)
- B. AC input power connector
- C. I/O Ports
- D. Expansion slot covers
- E. Alternate external SCSI knockout
- F. 120-mm system fan
- G. Serial B port knockout
- H. Location to install padlock loop
- I. External SCSI knockout
- J. Alternate Serial B port knockout

Figure 2. Rear Closed Chassis View of Intel® Entry Server Chassis SC5299-E



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Figure 3. Front Internal Chassis View of Intel® Entry Server Chassis SC5299-E(DP/WS/BRP configuration shown)



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Figure 4. Rear Internal Chassis View of Intel® Entry Server Chassis SC5299-E with Optional Hot-swap Drive Bay

1.3 System Color

The Intel® Entry Server Chassis SC5299-E is offered in one color - Black (GE701)

1.4 Chassis Security

A variety of chassis security options are provided at the system level:

- A removable padlock loop at the rear of the system access cover can be used to prevent access to the microprocessors, memory, and add-in cards. A variety of lock sizes can be accommodated by the 0.270-inch diameter loop.
- A two-position key lock/switch will unlock the front bezel for DP, WS, and BRP configurations.
- A chassis intrusion switch is provided, allowing server management software to detect unauthorized access to the system side cover.

Note: See the technical product specification appropriate to the server board for a description of BIOS and management security features for each specific supported platform. Technical product specifications can be found at <http://intel.com/support>.

1.5 I/O Panel

All input/output (I/O) connectors are accessible from the rear of the chassis. The SSI E-bay 3.61-compliant chassis provides an ATX 2.2-compatible cutout for I/O shield installation. Boxed Intel® server boards provide the required I/O shield for installation in the cutout. The I/O cutout dimensions are shown in the following figure for reference.

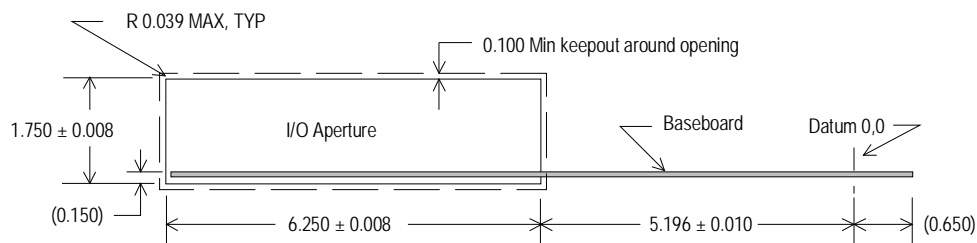


Figure 5. ATX 2.2 I/O Aperture

1.6 Rack and Cabinet Mounting Option

The Intel® Entry Server Chassis SC5299-E supports a rack mount configuration. The rack mount kit includes the chassis slide rails, rack handle, rack orientation label, screws, and manual. This rack mount kit is designed to meet the EIA-310-D enclosure specification. General rack compatibility is further described in the *Server Rack Cabinet Compatibility Guide* found at <http://intel.com/support>.

1.7 Front Bezel Features

The bezel is constructed of molded plastic and attaches to the front of the chassis with three clips on the right side and two snaps on the left. The snaps at the left attach behind the access cover, thereby preventing accidental removal of the bezel. The bezel can only be removed by first removing the server access cover. This provides additional security to the hard drive and peripheral bay area. The bezel also includes a key-locking door that covers the drive cage area and allows access to hot swap drives when a hot swap drive bay is installed.

The peripheral bays are covered with plastic snap-in cosmetic pieces that must be removed to add peripherals to the system. Control panel buttons and lights are located along the right side of the peripheral bays.

1.8 Peripheral Bays

Two 5.25-in, half-height drive bays are available for CD/DVD-ROM or tape drives as well as one 3.5-inch removable media drive bay. Drive installation is tool-less and requires no screws.

2. Power Sub-system

2.1 420-Watt Power Supply

The 420-W power supply specification defines a non-redundant power supply that supports DP Intel® Xeon™ entry server systems. The 420-W power supply has 6 outputs: 3.3V, 5V, 12V1, 12V2, -12V and 5VSB. The form factor fits into a pedestal system and provides a wire harness output to the system. An IEC connector is provided on the external face for AC input to the power supply.

The power supply incorporates a Power Factor Correction circuit. The power supply is tested as described in EN 61000-3-2: Electromagnetic Compatibility (EMC) Part 3: Limits- Section 2: Limits for harmonic current emissions and meets the harmonic current emissions limits specified for ITE equipment.

The power supply is tested as described in JEIDA MITI Guideline for Suppression of High Harmonics in Appliances and General-Use Equipment and meets the harmonic current emissions limits specified for ITE equipment.

2.1.1 Mechanical Overview

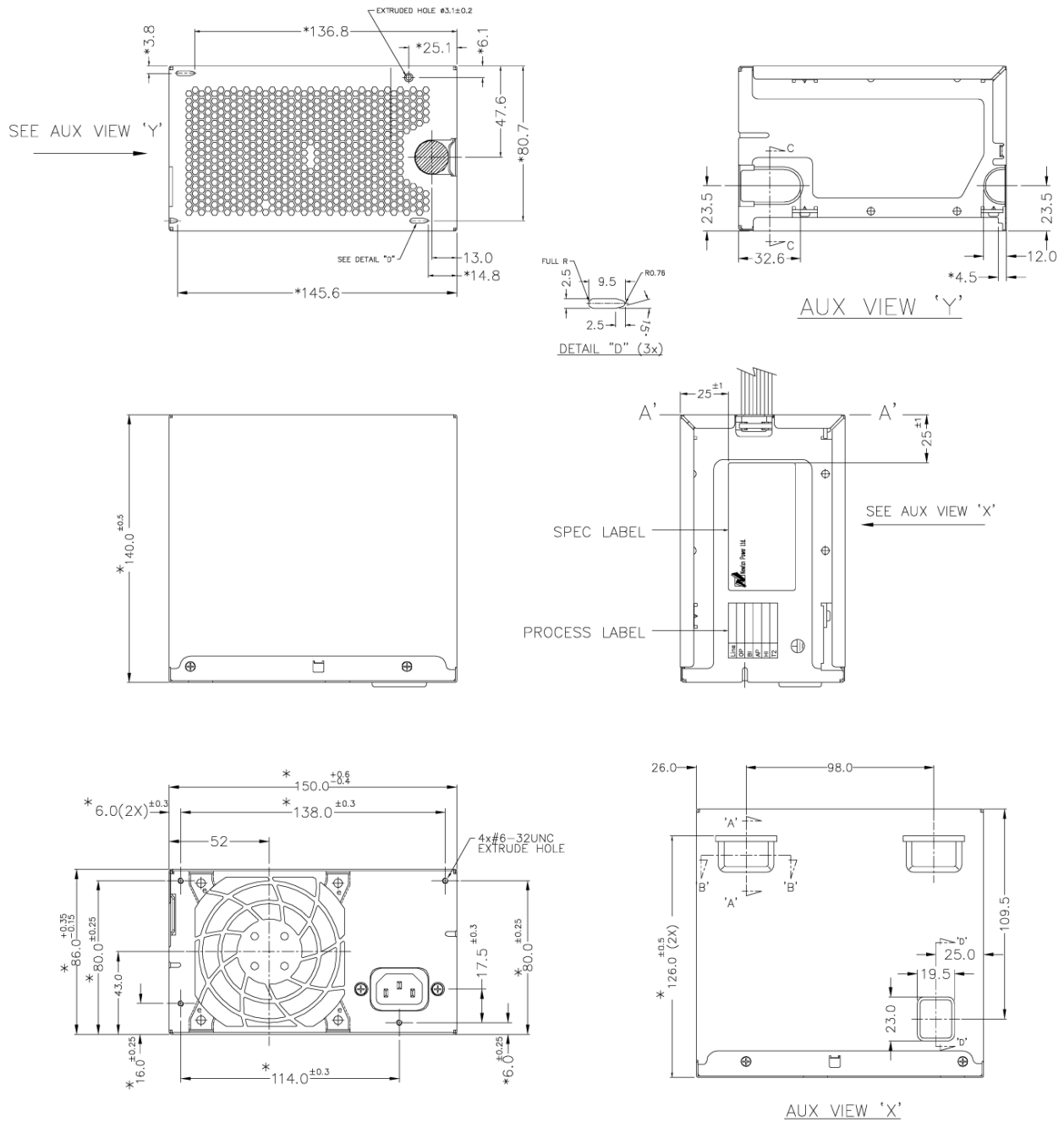


Figure 6. Mechanical Drawing for Power Supply Enclosure

2.1.2 Airflow and Temperature

The power supply operates within all specified limits over the T_{op} temperature range. The average air temperature difference (T_{ps}) from the inlet to the outlet of the power supply does not exceed 20C. All airflow passes through the power supply and not over the exterior surfaces of the power supply.

Table 2. Environmental Requirements

Item	Description	Min	Specification	Units
T_{op}	Operating temperature range.	0	50	C
T_{non-op}	Non-operating temperature range.	-40	70	C
Altitude	Maximum operating altitude		1500	m

The power supply meets UL enclosure requirements for temperature rise limits. All sides of the power supply, with the exception of the air exhaust side, are classified as “Handle, knobs, grips, etc. held for short periods of time only”.

2.1.3 Output Cable Harness

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 105 C, 300Vdc is used for all output wiring.

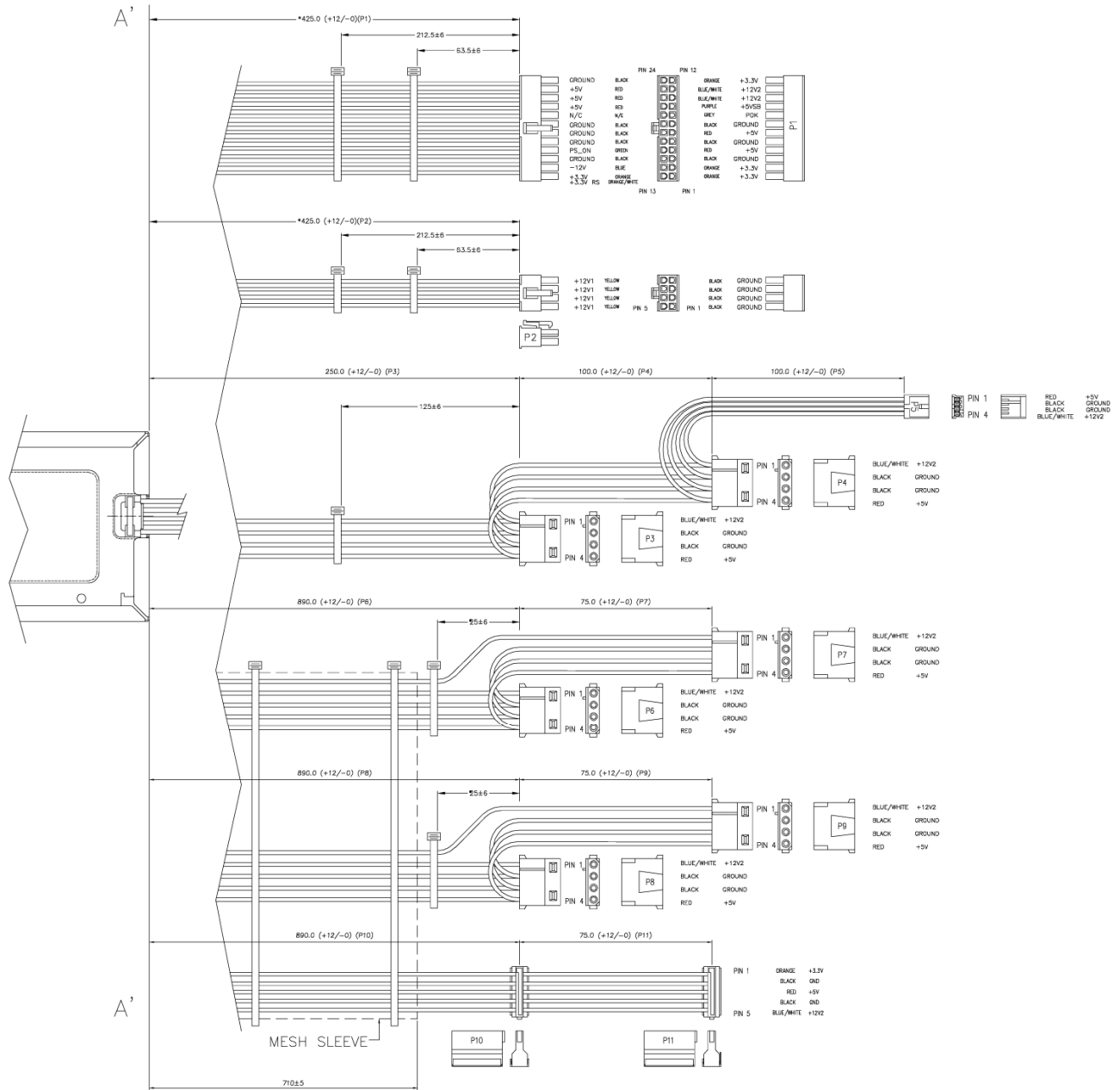


Figure 7. Output Cable Harness for 420-W Power Supply

NOTES:

1. ALL DIMENSIONS ARE IN MM
2. ALL TOLERANCES ARE +10 MM/-0 MM
3. INSTALL 1 TIE WRAP WITHIN 12MM OF THE PSU CAGE
4. MARK REFERENCE DESIGNATOR ON EACH CONNECTOR
5. TIE WRAP EACH HARNESS AT APPROX. MID POINT
6. TIE WRAP P1 WITH 2 TIES AT APPROXIMATELY 15M SPACING.

Table 3. Cable Lengths

From	To connector #	Length (mm)	No. of pins	Description
Power Supply cover exit hole	P1	425	24	Baseboard Power Connector
Power Supply cover exit hole	P2	425	8	Processor Power Connector
Power Supply cover exit hole	P3	250	4	Peripheral Power Connector
Extension	P4	100	4	Peripheral Power Connector
Extension from P4	P5	100	4	Floppy Power Connector
Power Supply cover exit hole	P6	890	4	Peripheral Power Connector
Extension	P7	75	4	Peripheral Power Connector
Power Supply cover exit hole	P8	890	4	Peripheral Power Connector
Extension	P9	75	4	Peripheral Power Connector
Power Supply cover exit hole	P10	890	5	Right-angle SATA Power Connector
Extension	P11	75	5	SATA Power Connector

2.1.3.1 P1 Baseboard Power Connector

Connector housing: 24- Pin Molex* Mini-Fit Jr. 39-01-2245 or equivalent

Contact: Molex* Mini-Fit, HCS, Female, Crimp 44476 or equivalent

Table 4. P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+3.3 VDC	Orange	13	+3.3 VDC*	Orange
2	+3.3 VDC	Orange	14	-12 VDC	Blue
3	COM	Black	15	COM	Black
4	+5 VDC	Red	16	PSON#	Green
5	COM	Black	17	COM	Black
6	+5 VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray	20	Reserved	N.C.
9	5VSB	Purple	21	+5 VDC	Red

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
10	+12V2	White/Blue Stripe	22	+5 VDC	Red
11	+12V2	White/Blue Stripe	23	+5 VDC	Red
12	+3.3 VDC	Orange	24	COM	Black

Note:

3.3V Locate Sense Double Crimped into pin 13 (with #22 AWG Orange/White stripe wire).

2.1.3.2 P2 Processor Power Connector

Connector housing: 8- Pin Molex 39-01-2085 or equivalent

Contact: Molex 44476-1111 or equivalent

Table 5. P2 Processor Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.1.3.3 P3-P9 Peripheral Connectors

Connector housing: AMP* V0 P/N is 770827-1 or equivalent

Contact: AMP* 61314-1 contact or equivalent

Table 6. P3-P6, P8-P9 Peripheral Connectors

Pin	Signal	18 AWG Color
1	+12 V2	Blue/White
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.1.3.4 P10 Right-angle, P11 SATA Power Connectors

Connector Housing:

Contact:

Table 7. P10 Right-angle SATA Power Connector

Pin	Signal	24 AWG Color
1	+3.3V	Orange
2	Ground	Black
3	+5V	Red
4	Ground	Black
5	+12V2	Blue/White

2.1.4 AC Input Requirements

The power supply operates within all specified limits over the following input voltage range, shown in the following table. Harmonic distortion of up to 10% THD must not cause the power supply to go out of specified limits. The power supply does power off if the AC input is less than 75VAC +/-5VAC range. The power supply starts up if the AC input is greater than 85VAC +/-4VAC. Application of an input voltage below 85VAC does not cause damage to the power supply, including a fuse blow.

Table 8. AC Input Rating

PARAMETER	MIN	Rated	MAX	Max Input Current	Start up VAC	Power Off VAC
Voltage (110)	90 V _{rms}	100-127 V _{rms}	135 V _{rms}	7.7 A _{rms}	85Vac +/-4Vac	75Vac +/-5Vac
Voltage (220)	180 V _{rms}	200-240 V _{rms}	265 V _{rms}	4.3 A _{rms}		
Frequency	47 Hz		63 Hz			

2.1.4.1 AC Inlet Connector

The AC input connector is an IEC 320 C-14 power inlet. This inlet is rated for 15A/250VAC.

2.1.4.2 Efficiency

The power supply has an efficiency of 68.5% at maximum load and over the specified AC voltage.

2.1.4.3 AC Line Dropout/Holdup

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout of one cycle or less the power supply meets dynamic voltage regulation requirements over the rated load. An AC line dropout of one cycle or

less (20ms min) does not cause any tripping of control signals or protection circuits (= 20ms holdup time requirement). If the AC dropout lasts longer than one cycle, the power will recover and meet all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages, frequencies, and output loading conditions. Any dropout of the AC line does not cause damage to the power supply.

2.1.4.3.1 AC Line 5VSB Holdup

The 5VSB output voltage stays in regulation under its full load (static or dynamic) during an AC dropout of 70ms min (=5VSB holdup time) whether the power supply is in the ON or OFF state (PSON asserted or de-asserted).

2.1.4.4 AC Line Fuse

The power supply has a single line fuse on the Line (Hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input fuse is a slow blow type. AC inrush current does not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply do not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.1.4.5 AC Inrush

AC line inrush current does not exceed 65A peak for up to 10ms, after which, the input current is no more than the specified maximum input current at 265Vac input, 25 degrees C and full load. The peak inrush current is less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device). For 10ms to 150ms, the inrush current should be less than 25A peak.

The power supply meets the inrush requirements for any rated AC voltage during turn on at any phase of AC voltage, during a single cycle AC dropout condition as well as upon recovery after AC dropout of any duration, and over the specified temperature range (T_{op}). AC line inrush current may reach up to 60A peak for up to 1 ms.

2.1.4.6 AC Line Surge

The power supply is tested with the system for immunity to AC Ringwave and AC Unidirectional wave, both up to 2kV, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The power supply complies with the limits defined in EN 55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.1.4.7 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”: these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage.

The power supply meets the requirements under the following AC line sag and surge conditions.

Table 9. AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
0 to 1 AC cycle	100%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>10%	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 10. AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.1.4.8 AC Line Fast Transient (EFT) Specification

The power supply meets the EN 61000-4-5 directive and any additional requirements in IEC1000-4-5:1995 and the Level 3 requirements for surge-withstand capability, with the following conditions and exception:

These input transients do not cause any out-of-regulation conditions, such as overshoot and undershoot, nor do they cause any nuisance trips of any of the power supply protection circuits

The power supply meets surge-withstand test conditions under maximum and minimum DC-output load conditions.

2.1.4.9 AC Line Leakage Current

The maximum leakage current to ground for each power supply is 3.5mA when tested at 240VAC.

2.1.5 DC Output Specifications

2.1.5.1 Grounding

The ground of the pins of the power supply output connector provides the power return path. The output connector ground pins are connected to safety ground (power supply enclosure).

2.1.5.2 Standby Output

The 5VSB output is present when an AC input greater than the power supply turn-on voltage is applied.

2.1.5.3 Remote Sense

The power supply has remote sense return (ReturnS) to regulate out ground drops for all output voltages; +3.3V, +5V, +12V1, +12V2, -12V, and 5VSB. The power supply uses remote sense (3.3VS) to regulate out drops in the system for the +3.3V output. The +5V, +12V1, +12V2, -12V and 5VSB outputs only use remote sense referenced to the ReturnS signal. The remote sense input impedance to the power supply is greater than 200 Ω on 3.3VS, 5VS. This is the value of the resistor connecting the remote sense to the output voltage internal to the power supply. Remote sense is able to regulate out a minimum of 200mV drop on the +3.3V output. The remote sense return (ReturnS) is able to regulate out a minimum of 200mV drop in the power ground return. The current in any remote sense line is less than 5mA to prevent voltage sensing errors. The power supply operates within specification over the full range of voltage drops from the power supply's output connector to the remote sense points.

2.1.5.4 Power Module Output Power/Currents

The following table defines power and current ratings for the 420-W power supply. The combined output power of all outputs does not exceed the rated output power. The power supply meets both static and dynamic voltage regulation requirements for the minimum loading conditions.

Table 11. Load Ratings

Output Voltage	Load Range		Regulation	Ripple and Noise Max. mV P-P
	Min.	Max.		
+5V	2A	20A	4.80 - 5.25V	50mV
+3V3	0.5A	17A	3.135 - 3.47V	50mV
-12V	0A	0.5A	-11.52 - -12.6V	120mV
+5VSB	0A	2A	4.80 - 5.25V	70mV
+12V1	0.5A	24A	11.40 - 12.6V	120mV
+12V2	0.5A	17A	11.40 - 12.6V	120mV

Notes:

- Noise test: noise bandwidth is from 10 Hz to 20 MHz.
- Add 0.1 uF and 10uF low ESR capacitors at output connector terminals for ripple and noise measurements.
- Main O/P shall be enabled by pulled "remote" pin to TTL low level, and disabled by pulled "remote" pin to TTL high level.
- Max combined power on +5V and +3.3V outputs does not exceed 150 W.
- 12V1 and 12V2 combined current does not exceed 30A.
- 12V1 and 12V2 combined peak current does not exceed 34 A for over 12 seconds.
- All outputs remain within regulation limits.
- Maximum power does not exceed 450 W at 25 degrees C ambient and 420 W at 50 degrees C ambient.

2.1.5.5 Voltage Regulation

The power supply output voltages are within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. All outputs are measured with reference to the return remote sense signal (ReturnS). The 5V, 12V1, 12V2, -12V and 5VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3V is measured at the remote sense signal (3.3VS) located at the signal connector.

Table 12. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+ 3.3V	- 5%/+5%	+3.135	+3.30	+3.47	V _{rms}
+ 5V	- 4%/+5%	+4.80	+5.00	+5.25	V _{rms}
+ 12V1	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+ 12V2	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
- 12V	- 5%/+4%	-11.52	-12.00	-12.60	V _{rms}
+ 5VSB	- 4%/+5%	+4.80	+5.00	+5.25	V _{rms}

2.1.5.6 Dynamic Loading

The output voltages are within limits specified for the step loading and capacitive loading specified in the following table. The step load may occur anywhere within the MIN load to the MAX load conditions.

Table 13. Transient Load Requirements

Parameter	Output Range	MAX Step	Voltage Overshoot/Undershoot
+12V1DC	0.5A TO 18A	6A	350mV (700mVpk-pk)
+12V2DC	0.5A TO 15A	6A	350mV (700mVpk-pk)
+5VDC	2A TO 20A	5A	200mV(400mVpk-pk)
+3.3VDC	0.5A TO 17A	6A	200mV (400mVpk-pk)
+5VSB	0.1A TO 2.0A	0.7A	250mV(500mVpk-pk)

2.1.5.7 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges.

Table 14. Capacitive Loading Conditions

Output	MIN	MAX	Units
+3.3V	250	6,800	F
+5V	400	4,700	F
+12V(1, 2)	500 each	11,000	F
-12V	1	350	F
+5VSB	20	350	F

2.1.5.8 Closed Loop Stability

The power supply is unconditionally stable under all line/load/transient load conditions, including capacitive load ranges. A minimum of: 45 degrees phase margin and -8dB-gain margin is required. Closed-loop stability is ensured at the maximum and minimum loads as applicable.

2.1.5.9 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in the following table. This is measured over a bandwidth of 0 Hz to 20 MHz at the power supply output connectors.

Table 15. Ripple and Noise

+3.3V	+5V	+12V1/2	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	120mVp-p	50mVp-p

2.1.5.10 Timing Requirements

The timing requirements for power supply operation are as follows. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 2 to 20ms, except for 5VSB which is allowed to rise from 1.0 to 70ms. The +3.3V, +5V and +12V output voltages should start to rise approximately at the same time. All outputs must rise monotonically. The +5V output needs to be greater than the +3.3V output during any point of the voltage rise. The +5V output must never be greater than the +3.3V output by more than 2.25V. Each output voltage shall reach regulation within 50ms (T_{vout_on}) of each other during turn on of the power supply. Each output voltage shall fall out of regulation within 400msec (T_{vout_off}) of each other during turn off. The following figure shows the timing requirements for the power supply being turned on and off via the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 16. Output Voltage Timing

Item	Description	Minimum	Maximum	Units
T_{vout_rise}	Output voltage rise time from each main output.	2.0	20	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
T_{vout_off}	All main outputs must leave regulation within this time.		400	msec

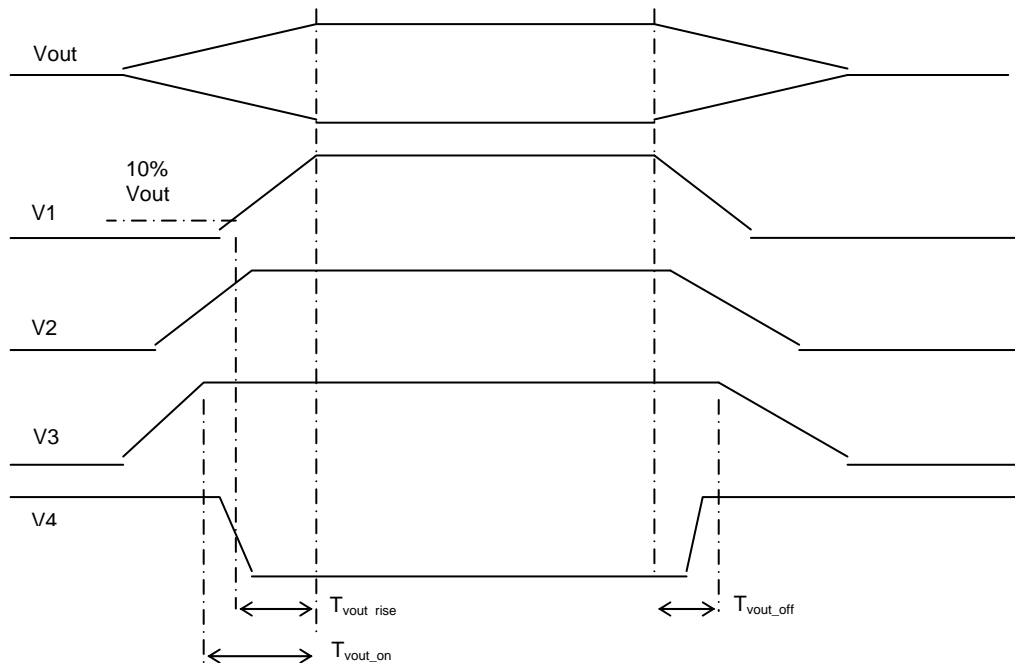


Figure 8. Output Voltage Timing

Table 17. Turn On/Off Timing

Item	Description	Minimum	Maximum	Units
$T_{sb_on_delay}$	Delay from AC being applied to 5VSB being within regulation.		1000	msec
$T_{ac_on_delay}$	Delay from AC being applied to all output voltages being within regulation.		2500	msec
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	21		msec

Item	Description	Minimum	Maximum	Units
T _{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK.	20		msec
T _{pson_on_delay}	Delay from PSON [#] active to output voltages within regulation limits.	5	400	msec
T _{pson_pwok}	Delay from PSON [#] deactive to PWOK being de-asserted.		50	msec
T _{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	1000	msec
T _{pwok_off}	Delay from PWOK de-asserted to output voltages (3.3V, 5V, 12V, -12V) dropping out of regulation limits.	1		msec
T _{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		msec
T _{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	msec
T _{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.	70		msec

2.1.5.11 Residual Voltage Immunity in Standby Mode

The power supply is immune to any residual voltage placed on its outputs (typically a leakage voltage through the system from standby output) up to 500mV. There is neither additional heat generated, nor stress of any internal components with this voltage applied to any individual output, and all outputs simultaneously. It also does not trip the protection circuits during turn on.

The residual voltage at the power supply outputs for no load condition does not exceed 100mV when AC voltage is applied.

2.1.6 Protection Circuits

Protection circuits inside the power supply cause only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15 sec and a PSON# cycle HIGH for 1sec will reset the power supply.

2.1.6.1 Over-Current Protection (OCP)

The power supply has a current limit to prevent the +3.3V, +5V, and +12V outputs from exceeding 240VA. If the current limits are exceeded, the power supply will shut down and latch off. The latch will be cleared by toggling the PSON[#] signal or by an AC power interruption. The power supply will not be damaged from repeated power cycling in this condition. -12V and 5VSB are protected under over current or shorted conditions so that no damage can occur to the power supply. An auto-recovery feature exists on the 5VSB rail.

2.1.6.2 Over Voltage Protection (OVP)

The power supply over voltage protection is locally sensed. The power supply will shut down and latch off after an over voltage condition occurs. This latch can be cleared by toggling the PSON[#] signal or by an AC power interruption. The following table contains the over voltage

limits. The values are measured at the output of the power supply's connectors. The voltage never exceeds the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage will not trip any lower than the minimum levels when measured at the power pins of the power supply connector.

Exception: +5VSB rail will recover after its over voltage condition occurs.

Table 18. Over Voltage Protection Limits

Output Voltage	MIN (V)	MAX (V)
+3.3V	3.71	4.2
+5V	5.62	6.5
+12V1,2	13.4	15.0
-12V	-13.5	-15.0
+5VSB	5.7	6.5

2.1.6.3 Over Temperature Protection (OTP)

The power supply is protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down. When the power supply temperature drops to within specified limits, the power supply will restore power automatically, while the 5VSB always remains on. The OTP circuit has a built-in hysteresis such that the power supply will not oscillate on and off due to a temperature recovering condition. The OTP trip level has a minimum of 4 C of ambient temperature hysteresis.

2.1.6.4 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +3.3V, +5V, +12V, and -12V power rails. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply.

Table 19. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to 5V located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low		4mA
Power up delay: $T_{pson_on_delay}$	5msec	400msec
PWOK delay: T_{pson_pwok}		50msec

2.1.6.5 PWOK (Power OK) Output Signal

PWOK is a power OK signal and is pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long that the power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. The start of the PWOK delay time is inhibited as long as any power supply output is within current limit.

Table 20. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=4mA	0V	0.4V
Logic level high voltage, Isource=200 A	2.4V	5.25V
Sink current, PWOK = low		4mA
Source current, PWOK = high		2mA
PWOK delay: T_{pwok_on}	100ms	1000ms
PWOK rise and fall time		100 sec
Power down delay: T_{pwok_off}	1ms	200msec

2.2 550-Watt Power Supply

The 550-W power supply specification defines a non-redundant power supply that supports dual-processor Intel® Xeon® entry server systems. The 550-W power supply has 6 outputs: 3.3V, 5V, 12V1, 12V2, -12V and 5VSB. The form factor is SSI EPS12V at 140mm or 180mm depth.

Mechanical form factor:	86-mm x 150-mm x (140-mm or 180-mm) (H x W x D) Wire harness output
Cooling:	Single 80-mm or 120-mm fan Variable fan speed based on output load and ambient temperature
Output Loading:	550W: 3.3V/24A, 5V/24A, 12Vtotal/40A, 12V1/40A, 12V2/16A, -12V/0.5A, 5VSB/3A 550W @ 45 degrees C (added 12V power)
Efficiency recommendation:	~ 70% efficiency @ 100% load, 90VAC
Acoustics:	6.5 BA @ 100% load, 45 degrees C 5.2 BA @ 60% load, 40 degrees C 4.7 BA @ 40% load, 35 degrees C
AC Input:	90VAC to 264AV Power Factor Corrected to meet EN61000-3-2
Holdup time:	12 msec @ 100% load 20 msec @ 75% load
SMBus (PSMI):	No PSMI features
Protection:	over current, over temperature, over voltage 240VA protection on 3.3V, 5V, 12V2, -12V, and 5VSB (no 240VA protection on 12V1)
LED:	No LEDs
Environmental:	45 degrees C max inlet temperature 5,000 feet altitude
EMI:	EN55022/CISPR 22 – Class A (10dB margin) @ 75% load
Reliability: 100VAC	100,000 hours MTBF and 3 year life @ 75% load, 40 degrees C, Standard Intel component de-ratings
Ecology:	RoHS compliant per directive 2002/95/EC (lead free solder)

2.2.1 Mechanical Outline

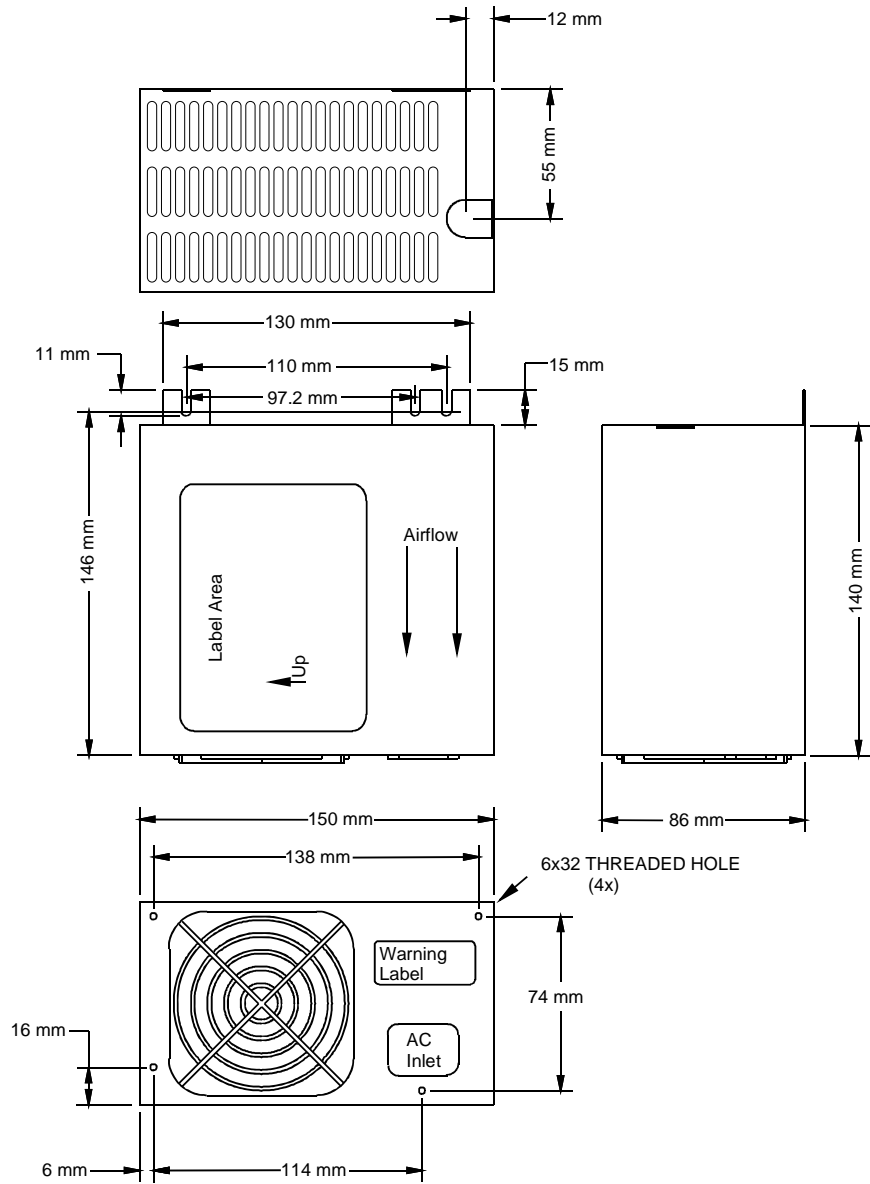


Figure 9. Mechanical Drawing for Power Supply Enclosure

2.2.1.1 Airflow Requirements

The power supply shall incorporate an 80-mm fan for self cooling and system cooling. The airflow direction shall be from the wire internal face of the power supply to the external face. The power supply shall have adequate airflow with the following system airflow restriction.

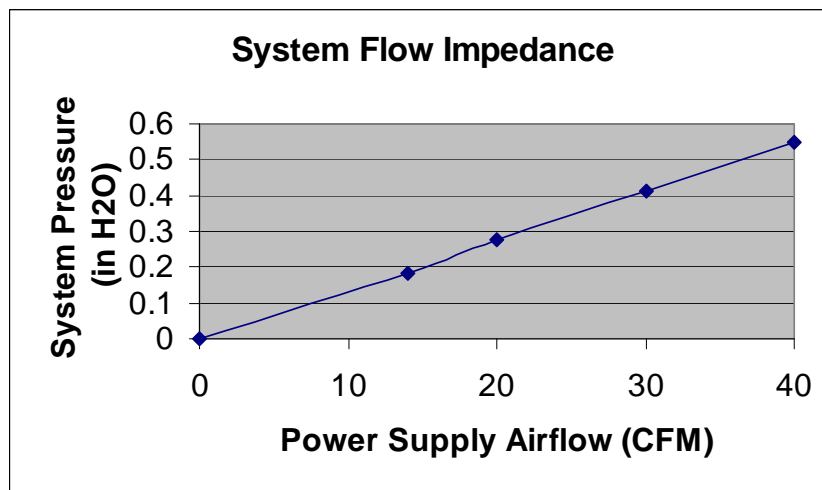


Figure 10. System Airflow Impedance

2.2.1.2 Acoustic Requirements

The fans speed shall vary linearly based on output loading and ambient temperature. The declared sound power levels (LwAd) of the power supply unit (PSU) must meet the requirements shown in the table below. Sound power must be measured according to ECMA 74 (www.ecma-international.org) and reported according to ISO 9296.

The acoustic measurement of the PSU shall be performed with the PSU fan operating at the RPM corresponding to the operating conditions shown in the table below. The PSU acoustic test report shall at the minimal include the PSU dimension, picture, fan model and size, fan voltage (or duty cycle), RPM and PSU sound power level at each operating condition. The proper RPM thermally sustainable shall be determined through PSU thermal testing, and shall be submitted as appendix to the acoustic test report.

Table 21. Acoustic Requirements

Operating Conditions	Inlet Temperature Condition	% of Maximum Loading Condition	LwAd (BA)
Maximum	45°C	100%	6.5
Operating	40 C	60%	5.2
Idle	35 C	40%	4.7

2.2.1.3 Temperature Requirements

The power supply operates within all specified limits over the T_{op} temperature range. The average air temperature difference (T_{ps}) from the inlet to the outlet of the power supply does not exceed 20 degrees C. All airflow passes through the power supply and not over the exterior surfaces of the power supply.

Table 22. Environmental Requirements

Item	Description	MIN	Specification	Units
T _{op}	Operating temperature range.	0	45	C
T _{non-op}	Non-operating temperature range.	-40	70	C
Altitude	Maximum operating altitude		1500	m

The power supply meets UL enclosure requirements for temperature rise limits. All sides of the power supply, with exception of the air exhaust side, must be classified as “Handle, knobs, grips, etc. held for short periods of time only”.

2.2.2 AC Input Voltage Requirements

The power supply operates within all specified limits over the input voltage range shown in the following table. Harmonic distortion of up to 10% THD must not cause the power supply to go out of specified limits. The power supply will power off if the AC input is less than 75VAC +/- 5VAC range. The power supply starts up if the AC input is greater than 85VAC +/- 4VAC. Application of an input voltage below 85VAC will not cause damage to the power supply, including a fuse blow.

Table 23. AC Input Rating

Parameter	MIN	Rated	MAX	Start up VAC	Power Off VAC
Voltage (110)	90 V _{rms}	100-127 V _{rms}	140 V _{rms}	85Vac +/- 4Vac	75Vac +/- 5Vac
Voltage (220)	180 V _{rms}	200-240 V _{rms}	264 V _{rms}		
Frequency	47 Hz		63 Hz		

2.2.2.1 AC Inlet Connector

The AC input connector is an IEC 320 C-14 power inlet. This inlet is rated for 15A/250VAC.

2.2.2.2 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”; these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage.

The power supply meets the requirements under the following AC line sag and surge conditions.

Table 24. AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
0 to 1 AC cycle	100%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>10%	Nominal AC voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 25. AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC voltages	50/60Hz	No loss of function or performance

2.2.2.3 Susceptibility Requirements

The power supply meets the following electrical immunity requirements when connected to a cage with an external EMI filter that meets the criteria defined in the SSI document EPS Power Supply Specification.

Table 26. Performance Criteria

Level	Description
A	The apparatus shall continue to operate as intended. No degradation of performance.
B	The apparatus shall continue to operate as intended. No degradation of performance beyond spec limits.
C	Temporary loss of function is allowed provided the function is self-recoverable or can be restored by the operation of the controls.

2.2.2.3.1 Electrostatic Discharge Susceptibility

The power supply complies with the limits defined in EN 55024: 1998 using the IEC 61000-4-2:1995 and the level 3 test standard and performance criteria B defined in Annex B of CISPR 24.

2.2.2.3.2 *Fast Transient/Burst*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-4:1995 and the level 3 test standard and performance criteria B defined in Annex B of CISPR 24.

2.2.2.3.3 *Radiated Immunity*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-3:1995 and the level 3 test standard and performance criteria A defined in Annex B of CISPR 24.

2.2.2.3.4 *Surge Immunity*

The power supply is tested with the system for immunity to AC Ringwave and AC Unidirectional wave, both up to 2kV, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The pass criteria include: no unsafe operation is allowed under any condition; all power supply output voltage levels must stay within proper spec levels; no change in operating state or loss of data during and after the test profile; no component damage under any condition.

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.2.2.4 **AC Line Fast Transient (EFT) Specification**

The power supply meets the EN61000-4-5 directive and any additional requirements in IEC1000-4-5:1995 and the Level 3 requirements for surge-withstand capability, with the following conditions and exception:

These input transients do not cause any out-of-regulation conditions, such as overshoot and undershoot, nor do they cause any nuisance trips of any of the power supply protection circuits.

The surge-withstand test must not produce damage to the power supply.

The supply meets surge-withstand test conditions under maximum and minimum DC-output load conditions.

2.2.2.5 **AC Line Dropout/Holdup**

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout, the power supply meets dynamic voltage regulation requirements. An AC line dropout of any duration does not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time, the power supply will recover and meet all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages, frequencies. A dropout of the AC line for any duration does not cause damage to the power supply.

Table 27. AC Line Dropout/Holdup

Output Wattage	Loading	Holdup Time
412.5 W	75%	20 msec
550 W	100%	12 msec

2.2.2.5.1 AC Line 5VSB Holdup

The 5VSB output voltage stays in regulation under its full load (static or dynamic) during an AC dropout of 70-ms min (=5VSB holdup time) whether the power supply is in the ON or OFF state (PSON asserted or de-asserted).

2.2.2.6 Power Recovery

The power supply recovers automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.2.2.6.1 Voltage Brown Out

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 test standard and performance criteria C defined in Annex B of CISPR 24.

In addition, the power supply meets the following Intel Requirement:

A continuous input voltage below the nominal input range shall not damage the power supply or cause overstress to any power supply component. The power supply must be able to return to normal power up state after a brownout condition. Maximum input current under a continuous brownout shall not blow the fuse. The power supply should tolerate a 3min ramp from 90VAC voltage to 0VAC after the components have reached a steady state condition.

2.2.2.6.2 Voltage Interruptions

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 and the level 3 test standard and performance criteria C defined in Annex B of CISPR 24.

2.2.2.7 AC Line Inrush

AC line inrush current does not exceed 50A peak for up to one-quarter of the AC cycle, after which, the input current should be no more than the specified maximum input current. The peak inrush current is less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

The power supply must meet the inrush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during a single cycle AC dropout condition, as well as upon recovery after AC dropout of any duration, and over the specified temperature range (T_{op}). It is acceptable that AC line inrush current may reach up to 70A peak for up to 1 ms

2.2.2.8 AC Line Isolation Requirements

The power supply meets all safety agency requirements for dielectric strength. Transformers' isolation between primary and secondary windings complies with the 3000Vac (4242Vdc) dielectric strength criteria. In addition, the insulation system complies with reinforced insulation per safety standard IEC 950. Separation between the primary and secondary circuits, and primary to ground circuits, complies with the IEC 950 spacing requirements.

2.2.2.9 AC Line Leakage Current

The maximum leakage current to ground for each power supply is 3.5mA when tested at 240VAC.

2.2.2.10 AC Line Fuse

The power supply has a single line fuse on the line (hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input fuse is a slow blow type. AC inrush current does not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply do not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.2.2.11 Power Factor Correction

The power supply incorporates a Power Factor Correction circuit.

The power supply is tested as described in EN 61000-3-2: Electromagnetic Compatibility (EMC) Part 3: Limits - Section 2: Limits for harmonic current emissions, and meets the harmonic current emissions limits specified for ITE equipment.

The power supply is tested as described in JEIDA MITI Guideline for Suppression of High Harmonics in Appliances and General-Use Equipment and meets the harmonic current emissions limits specified for ITE equipment.

2.2.3 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These are provided at three different load levels: 100%, 50% and 20%. Efficiency is tested over an AC input voltage range of 115VAC to 220VAC.

Table 28. Efficiency

Loading	100% of Maximum	50% of Maximum	20% of Maximum
Recommended Efficiency	70%	72%	65%

2.2.4 DC Output Specifications

2.2.4.1 Output Connectors

Listed or recognized component appliance wiring material (AVLV2), CN, rated minimum 105 degrees C , 300VDC is used for all output wiring.

Table 29. Cable Lengths

From	Length (mm)	To Connector #	Number of Pins	Description
Power Supply cover exit hole	425	P1	24	Baseboard Power Connector
Power Supply cover exit hole	720	P2	8	Processor Power Connector
Power Supply cover exit hole	575	P12	4	+12V1 Baseboard Power Connector
Power Supply cover exit hole	250	P3	4	Peripheral Power Connector
Extension from P3	100	P4	4	Peripheral Power Connector
Extension from P4	100	P5	4	Floppy Power Connector
Power Supply cover exit hole	740	P6	4	Peripheral Power Connector
Extension from P8	75	P7	4	Peripheral Power Connector
Power Supply cover exit hole	740	P8	4	Peripheral Power Connector
Extension from P10	75	P9	4	Peripheral Power Connector
Power Supply cover exit hole	740	P10	5	Right-angle SATA Power Connector
Extension from P12	75	P11	5	SATA Power Connector

2.2.4.2 P1 Main Power Connector

Connector housing: 24-Pin Molex* Mini-Fit Jr. 39-01-2245 or equivalent

Contact: Molex Mini-Fit, HCS, Female, Crimp 44476 or equivalent

Table 30. P1 Main Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+3.3 VDC	Orange	13	+3.3 VDC*	Orange
	3.3RS	Orange/White(24AWG)	14	-12 VDC	Blue
2	+3.3 VDC	Orange	15	COM	Black
3	COM	Black	16	PSO#	Green (24AWG)
4	+5 VDC	Red	17	COM	Black
5	COM	Black		COMRS	Black (24AWG)
6	+5 VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray	20	Reserved	N.C.
9	5VSB	Purple	21	+5 VDC	Red
10	+12V2	Yellow	22	+5 VDC	Red
11	+12V2	Yellow	23	+5 VDC	Red
	12VRS	Yellow/White (24AWG)		5VRS	Red/White (24AWG)

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
12	+3.3 VDC	Orange	24	COM	Black

Note: 5V Remote sense may be double crimped into pin 4 if required to meet voltage regulation at the output connectors.

2.2.4.3 P2 Processor Power Connector

Connector housing: 8-Pin Molex* 39-01-2085 or equivalent

Contact: Molex 44476-1111 or equivalent

Table 31. P2 Processor Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	Yellow
2	COM	Black	6	+12V1	Yellow
3	COM	Black	7	+12V1	Yellow
4	COM	Black	8	+12V1	Yellow

2.2.4.4 P12 Baseboard Power Connector

Connector housing: 4-Pin Molex* 39-01-2040 or equivalent

Contact: Molex Mini-Fit Jr, HCS, 44476-1111 or equivalent

Table 32. P12 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	3	+12V1	Yellow
2	COM	Black	4	+12V1	Yellow

2.2.4.5 P3, P4, P6, P7, P8, P9 Peripheral Power Connectors

Connector housing: AMP* 1-480424-0 or equivalent

Contact: Amp 61314-1 contact or equivalent

Table 33. P3, P4, P6, P7, P8, P9 Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12 V2	Green
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.2.4.6 P5 Floppy Power Connector

Connector housing: AMP* 171822-4 or equivalent
 Contact: Amp 170204-1 contact or equivalent

Table 34. P5 Floppy Power Connector

Pin	Signal	22 AWG Color
1	+5VDC	Red
2	COM	Black
3	COM	Black
4	+12V2	Green

2.2.4.7 P10 Right-angle SATA Power Connector

Connector housing: JWT* F6002HS0-5P-18 or equivalent

Table 35. P10 SATA Power Connectors

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V2	Green

2.2.4.8 P11 SATA Power Connector

Connector housing: JWT A3811H00-5P or equivalent
 Contact: JWT A3811TOP-0D or equivalent

Table 36. P11 SATA Power Connectors

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red

Pin	Signal	18 AWG Color
4	COM	Black
5	+12V2	Green

2.2.4.9 Output Power/Currents

The following table defines power and current ratings for the 550-W power supply. The combined output power of all outputs does not exceed the rated output power. The power supply meets both static and dynamic voltage regulation requirements for the minimum loading conditions.

Table 37. Load Ratings

Output Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3V	1.0A	24A	
+5V	2A	24A	
+12V1	0.5A	40A	48A
+12V2	1.0A	16A	22A (500msec)
-12V	0A	0.5A	
+5VSB	0.1A	3A	3.5A

Notes:

1. Maximum continuous total output power will not exceed 550 W.
2. The maximum continuous total output power capability increases at lower ambient temperatures at a rate of 3.3W/degree C up to 600 W with a 30 degrees C ambient temperature.
3. Maximum continuous load on the combined 12V output will not exceed 40A at 45 degrees C, ramping up to 44 A at 30 degrees C.
4. Peak load on the combined 12V output will not exceed 48 A.
5. Peak total DC output power will not exceed 600 W.
6. Peak power and current loading is supported for a minimum of 12 seconds
7. Combined 3.3V and 5V power should not exceed 160 W.

2.2.4.10 Power On Loading

The power supply operates at lighter load conditions when the system first powers on. Under these conditions, the voltage regulation limits are relaxed. Power on loading and voltage regulation requirements are defined in the following tables.

Time duration is 1 second during power on.

Table 38. Power On Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	0 A	9 A	
+5 V	0 A	7 A	
+12 V1	0 A	16 A	
+12 V2	0.1 A	5 A	
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A	3.5 A

Table 39. Power On Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+ 3.3V	- 10%/+10%	+2.97	+3.30	+3.63	V _{rms}
+ 5V	- 10%/+10%	+4.50	+5.00	+5.50	V _{rms}
+ 12V1	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
+ 12V2	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
- 12V	- 5%/+9%	-11.40	-12.00	-13.08	V _{rms}
+ 5VSB	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}

2.2.4.11 Grounding

The ground of the pins of the power supply output connector provides the power return path. The output connector ground pins are connected to safety ground (power supply enclosure). This grounding is well designed to ensure passing the maximum allowed Common Mode Noise levels.

The power supply must be provided with a reliable protective earth ground. All secondary circuits are connected to protective earth ground. Resistance of the ground returns to chassis does not exceed 1.0 mΩ. This path may be used to carry DC current.

2.2.4.12 Remote Sense

The power supply has remote sense return (ReturnS) to regulate out ground drops for all output voltages: +3.3V, +5V, +12V1, +12V2, -12V, and 5VSB. The power supply uses remote sense to regulate out drops in the system for the +3.3V, +5V, and 12V1 outputs. The remote sense input impedance to the power supply is greater than 200 Ω on 3.3VS, 5VS. This is the value of the resistor connecting the remote sense to the output voltage internal to the power supply. Remote sense must be able to regulate out a minimum of 200mV drop on the +3.3V output. The remote sense return (ReturnS) must be able to regulate out a minimum of 200mV drop in the power

ground return. The current in any remote sense line is less than 5 mA to prevent voltage sensing errors. The power supply operates within specification over the full range of voltage drops from the power supply's output connector to the remote sense points.

2.2.4.13 Standby Output

The 5VSB output is present when an AC input greater than the power supply turn on voltage is applied.

2.2.4.14 Voltage Regulation

The power supply output voltages are within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. All outputs are measured with reference to the return remote sense signal (ReturnS). The 5V, 12V1, 12V2, -12V and 5VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3V is measured at its remote sense signal (3.3VS) located at the signal connector.

Table 40. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+ 3.3V	- 5%/+5%	+3.14	+3.30	+3.46	V _{rms}
+ 5V	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}
+ 12V1	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+ 12V2	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
- 12V	- 5%/+9%	-11.40	-12.00	-13.08	V _{rms}
+ 5VSB	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}

2.2.4.15 Dynamic Loading

The output voltages are within limits specified for the step loading and capacitive loading specified in the following table. The load transient repetition rate is tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The step load may occur anywhere between the MIN load and MAX load conditions.

Table 41. Transient Load Requirements

Output	Step Load Size (see note 2)	Load Slew Rate	Test Capacitive Load
+3.3VDC	5.0A	0.25 A/ sec	250 F
+5V	4.0A	0.25 A/ sec	400 F

Output	Step Load Size (see note 2)	Load Slew Rate	Test Capacitive Load
+12V1	25.0A	0.25 A/ sec	2200 F ^{1,2}
+12V2	25.0A	0.25 A/ sec	2200 F ^{1,2}
+5VSB	0.5A	0.25 A/ sec	20 F

Notes:

1. Step loads on each 12V output may happen simultaneously.
2. The +12V should be tested with 2200 F evenly split between the two +12V rails.

2.2.4.16 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges.

Table 42. Capacitive Loading Conditions

Output	MIN	MAX	Units
+3.3V	250	6,800	F
+5V	400	4,700	F
+12V(1, 2)	500 each	11,000	F
-12V	1	350	F
+5VSB	20	350	F

2.2.4.17 Closed Loop Stability

The power supply is unconditionally stable under all line/load/transient load conditions, including capacitive load ranges. A minimum of 45 degrees phase margin and -10dB-gain margin is required. Closed-loop stability is ensured at the maximum and minimum loads as applicable.

2.2.4.18 Common Mode Noise

The common mode noise on any output shall not exceed 350mV pk-pk over the frequency band of 10Hz to 30MHz.

2.2.4.19 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in the following table. This is measured over a bandwidth of 0 Hz to 20 MHz at the power supply output connectors. A 10 F tantalum capacitor, in parallel with a 0.1 F ceramic capacitor, is placed at the point of measurement.

Table 43. Ripple and Noise

+3.3V	+5V	+12V1/2	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	120mVp-p	50mVp-p

2.2.4.20 Soft Starting

The power supply contains a control circuit that provides monotonic soft start for its outputs without overstressing the AC line or any power supply components at any specified AC line or load conditions. There is no requirement for rise time on the 5Vstby but the turn on/off is monotonic.

2.2.4.21 Zero Load Stability Requirements

When the power subsystem operates in a no-load condition, it does not need to meet the output regulation specification, but it must operate without any tripping of over-voltage or other fault circuitry. When the power subsystem is subsequently loaded, it must begin to regulate and source current without fault.

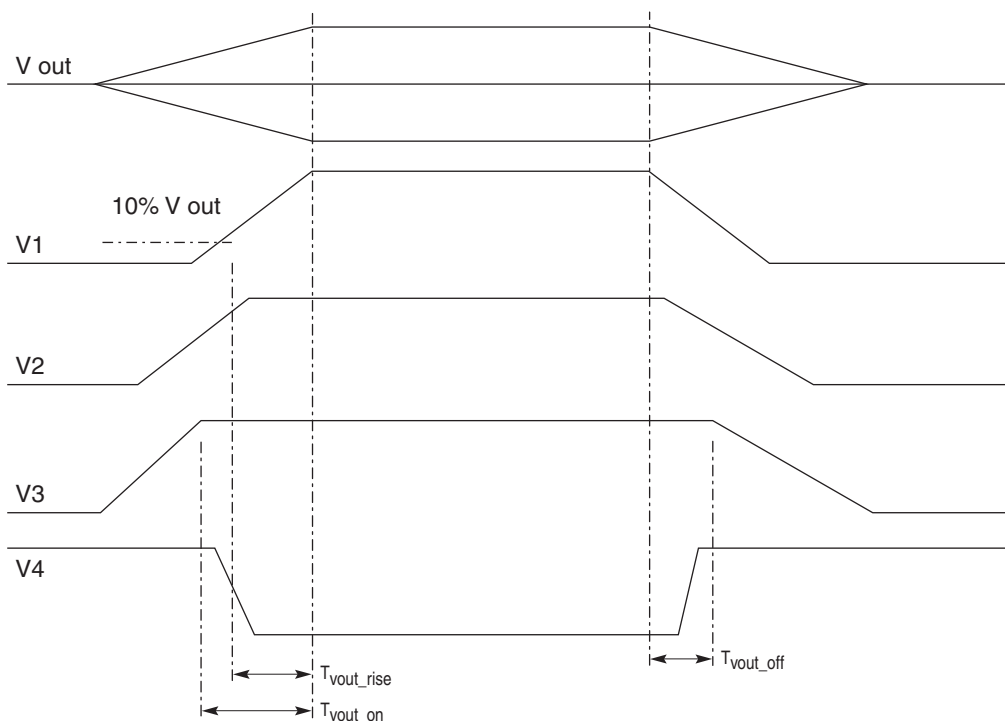
2.2.4.22 Timing Requirements

The timing requirements for power supply operation are as follows. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70ms, except for 5VSB - it is allowed to rise from 1.0 to 25ms. The +3.3V, +5V and +12V output voltages should start to rise approximately at the same time. All outputs must rise monotonically. The +5V output needs to be greater than the +3.3V output during any point of the voltage rise. The +5V output must never be greater than the +3.3V output by more than 2.25V. Each output voltage shall reach regulation within 50ms (T_{vout_on}) of each other during turn on of the power supply. Each output voltage shall fall out of regulation within 400msec (T_{vout_off}) of each other during turn off. The following figure shows the timing requirements for the power supply being turned on and off via the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 44. Output Voltage Timing

Item	Description	Minimum	Maximum	Units
T_{vout_rise}	Output voltage rise time from each main output.	5.0*	70*	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
T_{vout_off}	All main outputs must leave regulation within this time.		400	msec

* The 5VSB output voltage rise time shall be from 1.0 ms to 25.0 ms.



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Figure 11. Output Voltage Timing

Table 45. Turn On/Off Timing

Item	Description	Minimum	Maximum	Units
$T_{sb_on_delay}$	Delay from AC being applied to 5VSB being within regulation.		1500	msec
$T_{ac_on_delay}$	Delay from AC being applied to all output voltages being within regulation.		2500	msec
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	21		msec
T_{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK	20		msec
$T_{pson_on_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	msec
T_{pson_pwok}	Delay from PSON# deactive to PWOK being de-asserted.		50	msec
T_{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	msec
T_{pwok_off}	Delay from PWOK de-asserted to output voltages (3.3V, 5V, 12V, -12V) dropping out of regulation limits.	1		msec
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		msec

Item	Description	Minimum	Maximum	Units
T_{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	msec
T_{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.	70		msec

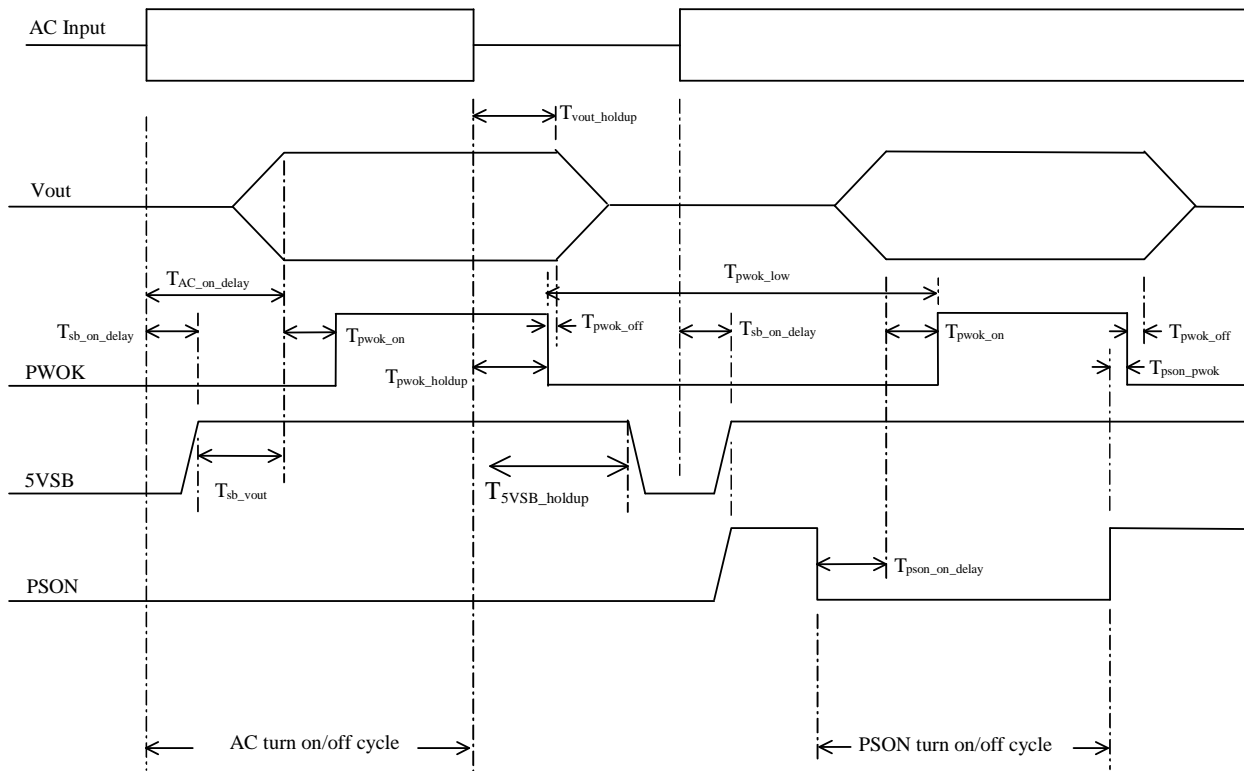


Figure 12. Turn On/Off Timing (Power Supply Signals)

2.2.4.23 Residual Voltage Immunity in Standby Mode

The power supply is immune to any residual voltage placed on its outputs (typically a leakage voltage through the system from standby output) up to 500mV. There is neither additional heat generated, nor stress of any internal components with this voltage applied to any individual output, and all outputs simultaneously. It also does not trip the protection circuits during turn on.

The residual voltage at the power supply outputs for no-load condition does not exceed 100mV when AC voltage is applied.

2.2.5 Protection Circuits

Protection circuits inside the power supply cause only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1 sec will reset the power supply.

2.2.5.1 Over-current Protection (OCP)

The power supply has a current limit to prevent the +3.3V, +5V, and +12V outputs from exceeding the values shown in the following table. If the current limits are exceeded, the power supply will shut down and latch off. The latch will be cleared by toggling the PSON[#] signal or by an AC power interruption. The power supply will not be damaged from repeated power cycling in this condition. -12V and 5VSB are protected under over-current or shorted conditions so that no damage can occur to the power supply. The auto-recovery feature is a requirement on the 5VSB rail.

Table 46. Over-current Protection

Voltage	Over-current Limit (I _{out} limit)
+3.3V	110% minimum (= 26.4A) ; 150% maximum (= 36.0A)
+5V	110% min (= 26.4A); 150% max (= 36.0A)
+12V1	50A min; 60A max
+12V2	18A min; compliant with 240VA
-12V	0.625A min; 4.0A max
5VSB	6.0A max

2.2.5.2 Over-voltage Protection (OVP)

The power supply over-voltage protection is locally sensed. The power supply will shut down and latch off after an over-voltage condition occurs. This latch can be cleared by toggling the PSON[#] signal or by an AC power interruption. The following table contains the over-voltage limits. The values are measured at the output of the power supply's connectors. The voltage never exceeds the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage will not trip any lower than the minimum levels when measured at the power pins of the power supply connector.

Exception: The +5VSB rail should be able to recover after its over voltage condition occurs.

Table 47. Over-voltage Protection Limits

Output Voltage	MIN (V)	MAX (V)
+3.3V	3.9	4.5
+5V	5.7	6.5
+12V1,2	13.3	14.5
-12V	-13.3	-15.6
+5VSB	5.7	6.5

2.2.5.3 Over-temperature Protection (OTP)

The power supply is protected against over-temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the power supply unit will shut down. When the power supply temperature drops to within specified limits, the power supply will restore power automatically, while the 5VSB remains always on. The OTP circuit must have built-in hysteresis such that the power supply will not oscillate on and off due to a temperature recovering condition. The OTP trip level has a minimum of 4 C of ambient temperature hysteresis.

2.2.6 Control and Indicator Functions

The following sections define the input and output signals from the power supply. Signals that can be defined as low true use the following convention:

signal# = low true

2.2.6.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +3.3V, +5V, +12V, and -12V power rails. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply.

Table 48. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to 5V located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low		4mA
Power up delay: T _{pson_on_delay}	5msec	400msec
PWOK delay: T _{pson_pwok}		50msec

2.2.6.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and is pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. The start of the PWOK delay time is inhibited as long as any power supply output is in current limit.

Table 49. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=4mA	0V	0.4V
Logic level high voltage, Isource=200 A	2.4V	5.25V
Sink current, PWOK = low		4mA
Source current, PWOK = high		2mA
PWOK delay: T_{pwok_on}	100ms	1000ms
PWOK rise and fall time		100 sec
Power down delay: T_{pwok_off}	1ms	200msec

2.3 650-W Power Supply Module

The 650-W power supply module specification defines a 1+1 redundant power supply that supports a dual-processor Intel® Xeon® server system. The power supply has two outputs to power the system: 12VDC and 5VSB. A separate cage (including the power distribution board) is designed to plug directly to the output connector of the power supply module and provide additional power converters to produce other required voltages. An IEC connector is provided on the external face for AC input to the power supply. The power supply contains cooling fans and meets acoustic requirements.

2.3.1 Mechanical Overview

2.3.1.1 Handle and Retention Mechanism

The power supply has a handle to provide a place to grip the power supply for removal and insertion. The power supply has a simple retention mechanism to retain the power supply once it is inserted. This mechanism withstands the specified mechanical shock and vibration requirements. The tab on the retention mechanism is green to indicate it is a hot-swap touch point. The latch mechanism is designed in such a way as to prevent inserting the power supply with the power cord plugged in. This aids the hot swapping procedure: on removal, the power cord is unplugged first, then the power supply is removed; on insertion, the power supply is inserted first and then the power cord is plugged in.

The handle protects the operator from any burn hazard.

The plastic handle is molded in the following material:

Material	Color	Designation
GE 2800	Green	GN3058
BAYER FR2000	Green	3200

2.3.1.2 Acoustic and Fan Speed Control Requirements

Sound power levels emitted by the power supply meet the requirements shown in the following table. Sound power is measured as described in ISO7779. Under a condition where inlet air temperature exceeds the limit, sound power level may exceed the limit.

The power supply incorporates a variable speed fan. The fan speed varies linearly based on output loading and ambient temperature. The declared sound power levels (LwAd) of the power supply unit (PSU) meet the requirements shown in the following table. Sound power is measured according to ECMA 74 (www.ecma-international.org) and reported according to ISO 9296.

The acoustic measurement of the power supply is performed with the power supply fan operating at the RPM corresponding to the operating conditions shown in the following table:

Table 50. Acoustic Requirements

Operating Conditions	Inlet Temperature Condition	% of Maximum Loading Condition	LwAd (BA)
Maximum (1+0 and 1+1)	45 °C	100%	< 6.5
Operating (1+0 and 1+1)	40 C	60%	< 5.2
Idle (1+0 and 1+1)	35 C	40%	< 4.7

2.3.1.3 Temperature Requirements

The power supply operates within all specified limits over the T_{op} temperature range described in the following table. The average air temperature difference from the inlet to the outlet of the power supply does not exceed 20 degrees C. All airflow passes through the power supply and not over the exterior surfaces of the power supply.

Table 51. Thermal Requirements

Item	Description	MIN	Max	Units
T_{op}	Operating temperature range	0	45	C
T_{non-op}	Non-operating temperature range	-40	70	C
Altitude	Maximum operating altitude		1524 (5,000)	m (ft)

The power supply meets UL enclosure requirements for temperature rise limits. All sides of the power supply, with exception of the air exhaust side, are classified as “Handle, knobs, grips, etc., held for short periods of time only.”

2.3.1.4 LED Marking and Identification

The LED is green or amber when lit.

2.3.2 AC Input Requirements

The 650-W power supply incorporates a universal power input with active power factor correction, which reduces line harmonics in accordance with the EN61000-3-2 and JEIDA MITI standards.

2.3.2.1 AC Inlet Connector

The AC input connector is an IEC 320 C-14 power inlet. This inlet is rated for 10A/250VAC.

2.3.2.2 Efficiency

The power supply has a minimum efficiency of 75% at maximum load and over an 90-264VAC line voltage range to guarantee proper power supply cooling while mounted in the system.

2.3.2.3 AC Input Voltage Specification

The power supply operates within all specified limits over the following input voltage range, as shown in following table. Harmonic distortion of up to 10% of rated AC input voltage will not cause the power supply to go out of specified limits. The power supply powers off at or after/below 75VAC +/-5VAC range. The power supply starts up at or before/above 85VAC +/-4VAC. Application of an input voltage below 85VAC does not cause damage to the power supply, including a fuse blow.

Table 52. AC Input Rating

Parameter	MIN	Rated	MAX	Start up VAC	Power Off VAC	Max Input Current	Max Rated Input AC Current
Voltage (110)	90 V _{rms}	100-127 V _{rms}	140 V _{rms}	85Vac +/-4Vac	75Vac +/-5Vac	9.63 A _{rms} ^{1,3}	8.7 A _{rms} ⁴
Voltage (220)	180 V _{rms}	200-240 V _{rms}	264 V _{rms}			4.82 A _{rms} ^{2,3}	4.4 A _{rms} ⁴
Frequency	47 Hz	50/60Hz	63 Hz				

Notes:

- 1 Maximum input current at low input voltage range shall be measured at 90Vac, at max load.
- 2 Maximum input current at high input voltage range shall be measured at 180VAC, at max load.
- 3 This is not to be used for determining agency input current markings.
- 4 Maximum rated input current is measured at 100VAC and 200VAC.

2.3.2.4 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout,” these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage. The power supply meets the requirements under the following AC line sag and surge conditions.

Table 53. AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Loading	Performance Criteria
Continuous	10%	Nominal AC Voltage ranges	50/60Hz	100%	No loss of function or performance
0 to 1 AC cycle	100%	Nominal AC Voltage ranges	50/60Hz	60%	No loss of function or performance

Duration	Sag	Operating AC Voltage	Line Frequency	Loading	Performance Criteria
> 1 AC cycle	>10%	Nominal AC Voltage ranges	50/60Hz	100%	Loss of function acceptable, self recoverable

Table 54. AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.3.2.5 AC Line Fuse

The power supply has a single line fuse on the line (hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input fuse is a slow blow type. AC inrush current will not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply will not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.3.2.6 AC In-rush

AC line in-rush current does not exceed 55A peak for up to one-quarter of the AC cycle, after which the input current is no more than the specified maximum input current. The peak in-rush current is less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

The power supply meets the in-rush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during a single cycle AC dropout condition, as well as upon recovery after AC dropout of any duration, and over the specified temperature range (T_{op}).

2.3.2.7 Susceptibility Requirements

The power supply meets the following electrical immunity requirements when connected to a cage with an external EMI filter that meets the criteria defined in the SSI document EPS Power Supply Specification.

Table 55. Performance Criteria

Level	Description
A	The apparatus shall continue to operate as intended. No degradation of performance.
B	The apparatus shall continue to operate as intended. No degradation of performance beyond spec limits.
C	Temporary loss of function is allowed provided the function is self-recoverable or can be restored by the operation of the controls.

2.3.2.7.1 *Electrostatic Discharge Susceptibility*

The power supply complies with the limits defined in EN 55024: 1998 using the IEC 61000-4-2:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.3.2.7.2 *Fast Transient/Burst*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-4:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.3.2.7.3 *Radiated Immunity*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-3:1995 test standard and performance criteria A defined in Annex B of CISPR 24.

2.3.2.7.4 *Surge Immunity*

The power supply has been tested with the system for immunity to AC Ringwave and AC Unidirectional wave, both up to 2kV, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The pass criteria included: No unsafe operation allowed under any condition; all power supply output voltage levels remain within proper spec levels; no change in operating state or loss of data during and after the test profile; no component damage under any condition.

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.3.2.8 **AC Line Dropout/Holdup**

Below are the AC dropout requirements.

Table 56. Holdup Requirements

Loading	Holdup Time
100%	12 msec
60%	20 msec

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout condition, the power supply meets dynamic voltage regulation requirements. An AC line dropout of any duration will not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time, the power supply recovers and meets all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration will not cause damage to the power supply.

2.3.2.8.1 AC Line 5VSB Holdup

The 5VSB output voltage stays in regulation under its full load (static or dynamic) during an AC dropout of 70ms min (=5VSB holdup time) whether the power supply is in an ON or OFF state (PSON asserted or de-asserted).

2.3.2.9 AC Line Fast Transient (EFT) Specification

The power supply meets the EN61000-4-5 directive and any additional requirements in IEC1000-4-5: 1995 and the Level 3 requirements for surge-withstand capability, with the following conditions and exceptions:

- These input transients do not cause any out-of-regulation conditions, such as overshoot and undershoot, nor do they cause any nuisance trips of any of the power supply protection circuits.
- The surge-withstand test must not produce damage to the power supply.
- The supply meets surge-withstand conditions under maximum and minimum DC-output load conditions.

2.3.2.10 Power Recovery

The power supply recovers automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.3.2.10.1 Voltage Brownout

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 test standard and performance criteria C defined in Annex B of CISPR 24.

In addition, the power supply meets the following Intel Requirement:

- A continuous input voltage below the nominal input range shall not damage the power supply or cause overstress to any power supply component. The power supply must be able to return to normal power up state after a brownout condition. Maximum input current under a continuous brownout shall not blow the fuse. The power supply should tolerate a 3min ramp from 90VAC voltage to 0VAC after the components have reached a steady state condition.

2.3.2.10.2 Voltage Interruptions

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 test standard and performance criteria C defined in Annex B of CISPR 24.

2.3.2.11 AC Line Isolation Requirements

The power supply meets all safety agency requirements for dielectric strength. Transformers' isolation between primary and secondary windings complies with the 3000Vac (4242Vdc) dielectric strength criteria. If the working voltage between primary and secondary dictates a higher dielectric strength test voltage, the highest test voltage is used. In addition, the insulation system complies with reinforced insulation per safety standard IEC 950. Separation between the

primary and secondary circuits, and primary to ground circuits, complies with the IEC 950 spacing requirements.

2.3.2.12 Power Factor Correction

The power supply incorporates a power factor correction circuit.

The power supply has been tested as described in EN 61000-3-2: Electromagnetic Compatibility (EMC) Part 3: Limits- Section 2: Limits for harmonic current emissions, and meets the harmonic current emissions limits specified for ITE equipment.

The power supply has been tested as described in JEIDA MITI Guideline for Suppression of High Harmonics in Appliances and General-Use Equipment and meets the harmonic current emissions limits specified for ITE equipment.

2.3.3 DC Output Specification

2.3.3.1 Connector

The power supply provides card edge fingers, which mate to a connector located inside the system. It is a blind-mating type of connector that connects the power supply's output voltages and signals. The card edge finger pin assignments are defined in the following table.

Table 57. Edge Finger Power Supply Connector Pin-out

Connector	Upper Side	Pin No Top.	Pin No. Bottom	Bottom Side
Gold finger edge connector: 2X24	+12V	1	2	+12V
	+12V	3	4	+12V
	+12V	5	6	+12V
	+12V	7	8	+12V
	+12V	9	10	+12V
	+12V	11	12	+12V
	+12V	13	14	+12V
	+12V	15	16	+12V
	+12V	17	18	+12V
	+12V Return	19	20	+12V Return
	+12V Return	21	22	+12V Return
	+12V Return	23	24	+12V Return
	+12V Return	25	26	+12V Return

Connector	Upper Side	Pin No Top.	Pin No. Bottom	Bottom Side
	+12V Return	27	28	+12V Return
	+12V Return	29	30	+12V Return
	+12V Return	31	32	+12V Return
	+12V Return	33	34	+12V Return
	+12V Return	35	36	+12V Return
	5VSB	37	38	A0
	SDA	39	40	+12V Sharing
	PS_KILL	41	42	POK
	PS_ON_CTL	43	44	-PS_Present
	FAN_TACH	45	46	VIN_GOOD_OUT
	SCL	47	48	-OVER_TEMP

Signals that can be defined as low true or high true use the following convention:

Signal# = low true

Reserved pins are reserved for future use.

2.3.3.2 Grounding

The ground of the pins of the power supply output connector provide the power return path. The output connector ground pins are connected to safety ground (power supply enclosure).

A reliable protective earth ground is provided on the power supply. All secondary circuits are connected to protective earth ground. Resistance of the ground returns to chassis do not exceed 1.0 mΩ. This path may be used to carry DC current.

2.3.3.3 Remote Sense

No remote sense and remote sense return signal is required on the 650-W power supply.

2.3.3.4 Output Power/Currents

The following table defines power and current ratings for the 650-W continuous (720-W pk) power supply in a 1+0 or 1+1 redundant configuration. The combined output power of both outputs does not exceed the rated output power. The power supply meets both static and dynamic voltage regulation requirements for the minimum loading conditions. Also, the power supply supplies the listed peak currents and power for a minimum of 10 seconds. Outputs are not required to be peak loaded simultaneously.

Table 58. Power Supply Module Load Ratings

Voltage	650-W		
	Min	Max	Peak
+12 V	0 A	54 A	58 A
+5 VSB	0.1 A	3.0 A	3.5 A

2.3.3.5 Standby Output

The 5VSB output is present when an AC input greater than the power supply turn-on voltage is applied.

2.3.3.6 Voltage Regulation

The power supply output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise specified in Table 61. All outputs are measured with reference to the GND. The +12V and +5VSB outputs are measured at the power distribution board output harness connector.

Table 59. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+ 12V	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+ 5VSB	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}

2.3.3.7 Dynamic Loading

The output voltages remain within limits specified for the step loading and capacitive loading presented in the following table. The load transient repetition rate has been tested between 5 Hz and 5 kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The step load may occur anywhere between the MIN load and MAX load defined in the following table.

Table 60. Transient Load Requirements

Output	Max Step Load Size	Max Load Slew Rate	Test Capacitive Load
12V	3.0 A ¹	0.5 A/ s	2200 F
+5VSB	0.5 A	0.5 A/ s	20 F

Notes:

- Step loads on each 12V output may happen simultaneously.
- The +12V should be tested with 2200 F evenly split between the three +12V rails.

2.3.3.8 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges. Minimum capacitive loading applies to static load only.

Table 61. Capacitive Loading Conditions

Output	MIN	MAX	Units
+12V	2000	11,000	F
+5VSB	1	350	F

2.3.3.9 Closed Loop Stability

The power supply is unconditionally stable under all line/load/transient load conditions, including capacitive load ranges. A minimum of 45 degrees phase margin and -10dB-gain margin are met. Closed-loop stability is ensured at the maximum and minimum loads, as applicable.

2.3.3.10 Common Mode Noise

The common mode noise on any output does not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz.

2.3.3.11 Ripple/Noise

The maximum ripple/noise output of the power supply is defined in the following table. This is measured over a bandwidth of 0Hz to 20MHz at the power supply output connectors. A 10 F tantalum capacitor in parallel with a 0.1 F ceramic capacitor is placed at the point of measurement.

Table 62. Ripple and Noise

+12V Output	+5VSB Output
120mVp-p	50mVp-p

2.3.3.12 Forced Load Sharing

The +12V output has forced load sharing. The output shares within 10% at full load. All current sharing functions are implemented internal to the power supply by making use of the 12LS signal. The power distribution board connects the 12LS signal between the two power supplies. The failure of a power supply does not affect the load sharing or output voltages of the other supplies still operating. The supplies are able to load share with up to 2 power supplies in parallel and operate in a hot-swap/redundant 1+1 configuration. The 5Vsb output is not required to actively share current between power supplies (passive sharing). The 5Vsb outputs of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system.

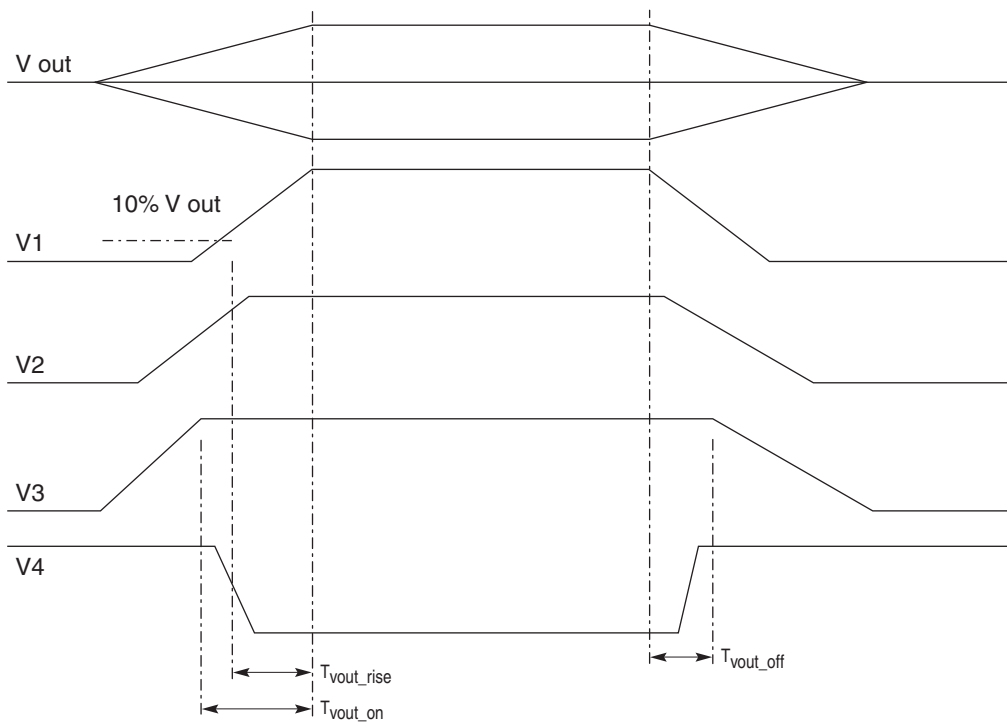
2.3.3.13 Timing Requirements

The timing requirements for power supply operation are as follows. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70 ms, except for 5VSB, which is allowed to rise from 1.0 to 25 ms. All outputs rise monotonically. The following figure shows the timing requirements for the power supply being turned on and off via the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 63. Output Voltage Timing

Item	Description	Minimum	Maximum	Units
T_{vout_rise}	Output voltage rise time from each main output.	5.0*	70*	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
T_{vout_off}	All main outputs must leave regulation within this time.		400	msec

* The 5VSB output voltage rise time shall be from 1.0 ms to 25.0 ms.



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Figure 13. Output Voltage Timing

Table 64. Turn On/Off Timing

Item	Description	Minimum	Maximum	Units
T _{sb_on_delay}	Delay from AC being applied to 5VSB being within regulation.		1500	ms
T _{ac_on_delay}	Delay from AC being applied to all output voltages being within regulation.		2500	ms
T _{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	21		ms
T _{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK	20		ms
T _{pson_on_delay}	Delay from PSON [#] active to output voltages within regulation limits.	5	400	ms
T _{pson_pwok}	Delay from PSON [#] deactive to PWOK being de-asserted.		50	ms
T _{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	1000	ms
T _{pwok_off}	Delay from PWOK de-asserted to 12V output voltage dropping out of regulation limits.	1		ms
T _{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
T _{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
T _{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.	70		ms

Note:

- 1 T_{vout_holdup} and T_{pwok_holdup} are defined under 60% loading.

2.3.3.14 Hot Swap Requirement

Hot swapping a power supply is the process of inserting and extracting a power supply from an operating power system. During this process the output voltages remain within the capacitive load limits. Up to two power supplies can be on a single AC line. The power supply hot swaps by the following method.

- Extraction: The AC power disconnects from the power supply as the power supply is extracted from the system. This can occur in standby mode or power-on mode.
- Insertion: The AC power connects to the power supply as the power supply is inserted into the system. The power supply powers on into either standby mode or power-on Mode.

In general, a failed (off by internal latch or external control) power supply may be removed, then replaced with a good power supply; however, hot swap will work with both operational as well as failed power supplies. The newly inserted power supply will get turned on into standby or Power On mode once inserted.

2.3.3.15 Residual Voltage Immunity in Standby Mode

The power supply is immune to any residual voltage placed on its 12V output (typically a leakage voltage through the system from standby output) up to 1000 mV. This residual voltage does not have any adverse effects on the power supply, including additional power dissipation or over-stressing/over-heating any internal components or adversely effect the turn-on performance (no protection circuits tripping during turn on).

While in standby mode, at no load condition, the residual voltage on 12V output does not exceed 100 mV.

2.3.3.16 Soft Starting

The power supply contains control circuits that provide monotonic soft start of its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions. There is no requirement for rise time on the 5VSB but the turn on/off is monotonic.

2.3.3.17 Zero Load Stability Requirements

When the power subsystem operates in a no-load condition in a 1+0 or 1+1 configuration, it does not need to meet the output regulation specification, but it must operate without any tripping of over-voltage or other fault circuitry. When the power subsystem is subsequently loaded, it must begin to regulate and source current without fault.

2.3.4 Protection Circuits

Protection circuits inside the power supply cause only the power supply's main outputs to shut down. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec will reset the power supply.

2.3.4.1 Over-current Protection (OCP)

The power supply has a current limit to prevent the +5VSB and +12V outputs from exceeding the values shown in the following table. If the current limits are exceeded the power supply will shut down and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply is not damaged from repeated power cycling in this condition. 5VSB is protected under over-current or shorted conditions so that no damage can occur to the power supply.

Table 65. Over-current Protection (OCP)

Output Voltage	Over-current Protection Limits
+12V	120% min (= 65.0 A min); 140% max (= 76.0 A max)
+5VSB	120% min (= 3.6 A min); 200% max (= 6.0 A max)

2.3.4.2 Over-voltage Protection (OVP)

The power supply's over-voltage protection is locally sensed. The power supply will shut down and latch off after an over-voltage condition occurs. This latch can be cleared by toggling the PSON# signal or by an AC power interruption. The following table contains the over-voltage limits. The values are measured at the output of the power supply's connectors. The voltage never exceeds the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage will never trip any lower than the minimum levels when measured at the power pins of the power supply connector.

Table 66. Over-voltage Protection Limits

Output Voltage	MIN (V)	MAX (V)
+12V	13.3	14.5
+5VSB	5.7	6.5

2.3.4.3 Over-temperature Protection (OTP)

The power supply is protected against over-temperature conditions caused by loss of fan cooling, excessive ambient temperature, or excessive loading. Sensing points are placed at hot spots. In an OTP condition, the power supply will shut down. When the power supply temperature drops to within specified limits, the power supply restores power automatically, while the 5VSB always remains on. The OTP circuit has built-in hysteresis such that the power supply will not oscillate on and off due to temperature recovery conditions. The OTP trip level has a minimum of 4 degrees C of ambient temperature hysteresis.

2.3.5 Control and Indicator Functions

The following sections define the input and output signals from the power supply. Signals that can be defined as low true use the following convention:

signal# = low true

2.3.5.1 PSON# Input Signal

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except for the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply.

Table 67. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low		4mA
Power up delay: $T_{pson_on_delay}$	5msec	400msec
PWOK delay: T_{pson_pwok}		50msec

2.3.5.2 PSKill

The purpose of the PSKill pin is to allow for hot swapping of the power supply. The PSKill pin on the power supply is shorter than the other signal pins. When a power supply is operating in parallel with other power supplies and then extracted from the system, the PSKill pin will quickly turn off the power supply and prevent arcing of the DC output contacts. T_{PSKill} (shown in the following table) is the minimum time delay from the PSKill pin un-mating to when the power pins un-mate. The power supply must discharge its output inductor within this time from the un-mating of the PSKill pin. When the PSKill signal pin is not pulled down or left open (power supply is extracted from the system), the power supply will shut down regardless of the condition of the PSON# signal. The mating pin of this signal in the system should be tied to ground. Internal to the power supply, the PSKill pin should be connected to a standby voltage through a pull-up resistor. Upon receiving a LOW state signal at the PSKill pin, the power supply will be allowed to turn on via the PSON# signal. A logic LOW on this pin by itself should not turn on the power outputs.

Table 68. PSKILL Signal Characteristics

Signal Type (Input Signal to Supply)	Accepts a ground input from the system. Pull-up to VSB located in the power supply.	
PSKILL = Low, PSON [#] = Low	ON	
PSKILL = Open, PSON [#] = Low or Open	OFF	
PSKILL = Low, PSON [#] = Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpskill = low		4mA
Delay from PSKILL=High to power supply turned off (T _{PSkill}) ¹		100 s

a. T_{PSkill} is the time from the PSkill signal de-asserting HIGH to the power supply's output inductor discharging.

2.3.5.3 PWOK (Power OK) Output Signal

PWOK is a power OK signal and is pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. The start of the PWOK delay time is inhibited as long as any power supply output is in current limit.

Table 69. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=4mA	0 V	0.4 V
Logic level high voltage, Isource=200 A	2.4 V	5.25 V
Sink current, PWOK = low		4 mA
Source current, PWOK = high		2 mA
PWOK delay: T _{pwok_on}	100 ms	1000 ms
PWOK rise and fall time		100 s
Power down delay: T _{pwok_off}	1 ms	200 ms

2.3.5.4 LEDs

There is a bi-color LED and a single color LED to indicate power supply status. The LED operation is defined in the following table.

Table 70. LED Indicators

Power Supply Condition	Status LED (AC OK/Power Supply Fail)	Power Led (Power Good)	Remarks
AC Power Off	OFF	OFF	
AC power on in Standby	Green	OFF	
AC On and All Outputs in Normal	Green	Green	
Any DC Outputs Short Circuit	Green	OFF	Power Distribution Board protection only; module OK
DC Fan Not Spinning	Amber	OFF	Module protection only
OTP	Amber	Green	Send out alert signal

The LEDs are visible on the power supply's exterior face. The LEDs' location meets Electrostatic Discharge (ESD) requirements. LEDs are securely mounted in such a way that incidental pressure on the LEDs does not cause them to be displaced.

There are bits that allow the LED states to be forced via the SMBus. The following capabilities are required:

Force Amber ON for failure conditions.

No Force (LED state follows power supply present state)

The power-on default is 'No Force'. The default is restored whenever PSON transitions to assert.

2.3.6 SMBus Monitoring Interface

The power supply and cage combination provides a monitoring interface to the system over a server management bus. The device in the power supply is compatible with SMBus 2.0 'high power' specification for I²C V_{dd} based power and drive (for V_{dd} = 3.3 V). This bus operates at 3.3V but will tolerate 5V signaling.

One pin is used for the Serial Clock [SCL] (PSM Clock). The second pin is used for Serial Data [SDA] (PSM Data). Both pins are bi-directional, open drain signals, and are used to form a serial bus. For redundant power supplies, the device(s) in the power supply are located at an address(s) determined by address pins A0 and A1. The circuits inside the power supply derive their power from the standby output. For redundant power supplies, the device(s) are powered from the system side of the or'ing device.

2.3.6.1 Device Address Locations

The power supply plus power distribution board (PS+PDB) device address locations are shown in the following table. There are two signals to set the address location of the power supply once it is installed into the system: A0 and A1.

Table 71. SMBus Device Addressing

			Reserved for future 2+2 configuration addressing	
PDB addressing A0/A1	0/0	0/1	1/0	1/1
Power supply FRU device	A0h	A2h	A4h	A6h

2.4 650-W Power Distribution Board (PDB)

This specification defines the cage for the ERP12V 650-W 1+1 redundant power supply. The cage is designed to plug directly to the output connector of the power supply(ies) and contains three DC/DC power converters to produce other required voltages: +3.3VDC, +5VDC and – 12VDC, along with additional 12V rail 240VA protection and a FRU EEPROM.

2.4.1 Mechanical Overview

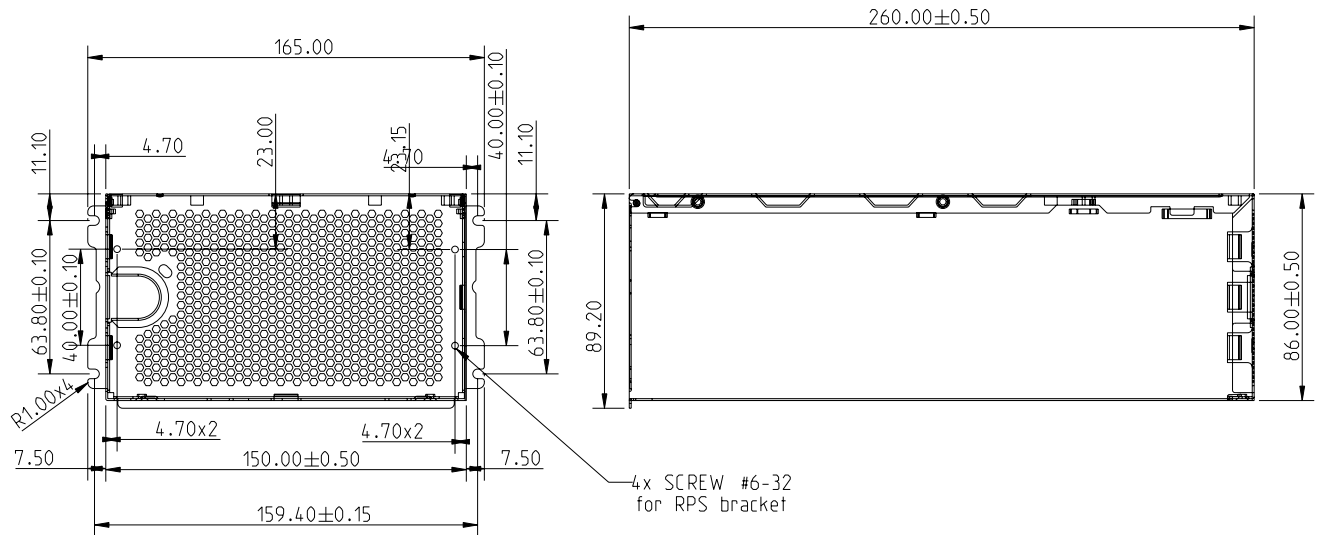


Figure 14. Mechanical Drawing for Dual (1+1 Configuration) Power Supply Enclosure

2.4.1.1 Airflow Requirements

There is no fan in the cage; the cage is cooled by the fan in the power supply module(s) when combined together in the system.

2.4.1.2 Temperature Requirements

The PDB operates within all specified limits over the T_{op} temperature range.

Table 72. Environmental Requirements

Item	Description	MIN	MAX	Units
T_{op}	Operating temperature range.	0	45	C

Item	Description	MIN	MAX	Units
T _{non-op}	Non-operating temperature range.	-40	70	C
Altitude	Maximum operating altitude		1500	m

2.4.1.3 Efficiency

Each DC/DC converter shall have a **minimum** efficiency of **85%** at Max load and over +12V line voltage range and over temperature and humidity range.

2.4.2 DC Output Specification

2.4.2.1 Input Connector (Power Supply Mating Connector)

Table 73. Edge Finger Power Supply Connector Pin-out

Connector	Upper Side	Pin No Top.	Pin No. Bottom	Bottom Side
Gold finger edge connector: 2X24	+12V	1	2	+12V
	+12V	3	4	+12V
	+12V	5	6	+12V
	+12V	7	8	+12V
	+12V	9	10	+12V
	+12V	11	12	+12V
	+12V	13	14	+12V
	+12V	15	16	+12V
	+12V	17	18	+12V
	+12V Return	19	20	+12V Return
	+12V Return	21	22	+12V Return
	+12V Return	23	24	+12V Return
	+12V Return	25	26	+12V Return
	+12V Return	27	28	+12V Return
	+12V Return	29	30	+12V Return
	+12V Return	31	32	+12V Return
+12V Return	33	34	+12V Return	

Connector	Upper Side	Pin No Top.	Pin No. Bottom	Bottom Side
	+12V Return	35	36	+12V Return
	5VSB	37	38	A0
	SDA	39	40	+12V Sharing
	PS_KILL	41	42	POK
	PS_ON_CTL	43	44	-PS_Present
	FAN_TACH	45	46	VIN_GOOD_OUT
	SCL	47	48	-OVER_TEMP

The AC input for each power supply module connects through the card edge connector from the power distribution board to the power supply module.

2.4.2.2 Output Connectors

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 105 degrees C, 300VDC is used for all output wiring.

Table 74. Cable Lengths

From	Length (mm)	To Connector #	Number of Pins	Description
Power Supply cover exit hole	450	P1	24	Baseboard Power Connector
Power Supply cover exit hole	580	P2	8	Processor Power Connector
Power Supply cover exit hole	450	P12	5	Power Signal Connector
Power Supply cover exit hole	550	P13	4	12V4 Power Connector
Power Supply cover exit hole	290	P3	4	Peripheral Power Connector
Extension from P3	100	P4	4	Peripheral Power Connector
Extension from P4	100	P5	4	Floppy Power Connector
Power Supply cover exit hole	740	P6	4	Peripheral Power Connector
Extension	75	P7	4	Peripheral Power Connector
Power Supply cover exit hole	740	P8	4	Peripheral Power Connector
Extension	75	P9	4	Peripheral Power Connector
Power Supply cover exit hole	740	P10	5	Right-angle SATA Power Connector
Extension	75	P11	5	Right-angle SATA Power Connector

2.4.2.3 Baseboard Power Connector (P1)

Connector housing: 24-Pin Molex* Mini-Fit Jr. 39-01-2245 or equivalent

Contact: Molex Mini-Fit, HCS, Female, Crimp 44476 or equivalent

Table 75. P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1*	+3.3VDC	Orange	13	+3.3VDC	Orange
	3.3V RS	Orange (24AWG)	14	-12VDC	Blue
2	+3.3VDC	Orange	15	COM	Black
3*	COM	Black	16	PSON#	Green (24AWG)
	COM RS	Black (24AWG)	17	COM	Black
4*	+5VDC	Red	18	COM	Black
	5V RS	Red (24AWG)	19	COM	Black
5	COM	Black	20	Reserved	N.C.
6	+5VDC	Red	21	+5VDC	Red
7	COM	Black	22	+5VDC	Red
8	PWR OK	Gray (24AWG)	23	+5VDC	Red
9	5 VSB	Purple	24	COM	Black
10	+12V3	Yellow			
11	+12V3	Yellow			
12	+3.3VDC	Orange			

Note: Remote Sense wire double crimped.

2.4.2.4 Processor Power Connector (P2)

Connector housing: 8-Pin Molex* 39-01-2080 or equivalent

Contact: Molex Mini-Fit, HCS, Female, Molex 44476 or equivalent

Table 76. P2 Processor Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	White
2	COM	Black	6	+12V1	White
3	COM	Black	7	+12V2	Brown
4	COM	Black	8	+12V2	Brown

2.4.2.5 12V4 Power Connector (P13)

Connector housing: 8-Pin Molex* 39-01-2040 or equivalent

Contact: Molex Mini-Fit Jr, HCS, 44476-1111 or equivalent

Table 77. P13 12V4 Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	3	+12V4	Green
2	COM	Black	4	+12V4	Green

2.4.2.6 Power Signal Connector (P12)

Connector housing: 5-Pin Molex* 50-57-9405 or equivalent

Contacts: Molex 16-02-0087 or equivalent

Table 78. Power Signal Connector

Pin	Signal	24 AWG Color
1	I2C Clock	White
2	I2C Data	Yellow
3	SMBAlert#	TBD
4	COM	Black
5	3.3RS	Orange

2.4.2.7 Peripheral Power Connectors (P3, P4, P6, P7, P8, P9)

Connector housing: Amp* 1-480424-0 or equivalent

Contact: Amp 61314-1 contact or equivalent

Table 79. Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12V4	Green
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.4.2.8 Floppy Power Connector (P5)

Connector housing: Amp* 171822-4 or equivalent

Contact: Amp 170204-1 contact or equivalent

Table 80. Floppy Power Connector

Pin	Signal	22 AWG Color
1	+5VDC	Red
2	COM	Black
3	COM	Black
4	+12V4	Green

2.4.2.9 12V4 Power Connector (P6)

Connector housing: 4-Pin Molex* 39-01-2040 or equivalent

Contact: Molex Mini-Fit Jr, HCS, 44476-1111 or equivalent

Table 81. 12V4 Power Connector

Pin	Signal	18 AWG Color
1	COM	Black
2	COM	Black
3	+12V4	Green
5	+12V4	Green

2.4.2.10 Right-angle SATA Power Connectors (P10, P11)

Connector housing: JWT* F6002HS0-5P-18 or equivalent

Table 82. SATA Power Connector

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V4	Green

2.4.2.11 Remote Sense

The cage 12V to 3.3V and 5V converters use remote sensing to regulate out voltage drops in the system for the +3.3V output. The remote sense output impedance to this DC/DC converter must be greater than 200 . This is the value of the resistor connecting the remote sense to the output voltage internal to the DC/DC converter. Remote sense must be able to regulate out of up to 300mV drop on the +3.3V and 5V outputs. Also, the power supply ground return remote sense (Returns) passes through the PDB and the output harness to regulate out ground drops for its +12V and 5Vsb output voltages. The power supply uses remote sense (12VRS) to regulate out drops up to the 240VA protection circuits on the PDB.

2.4.2.12 +12V Outputs Load Requirements

This section describes the +12V output power requirements from the cage with one or two 650-W power supplies plugged into the input of the cage. The power distribution board divides up the 12V power from power supply modules into five separate 240VA limited channels. Channels 1 through 4 supply 12V power directly to the end system. The fifth channel supplies power to the 3.3V and 5V converters. The 5th 12V doesn't need to meet the 240VA requirement.

Table 83. +12V Outputs Load Ratings

	+12V1/2/3/4/5 combined output limit = 54A/58A pk max				
	+12V1	+12V2	+12V3	+12V4	+12V5
MAX Load	16A	16A	16A	16A	18A
MIN Static/Dynamic Load	0	0	0A	0A	0A
Peak load (12 seconds)	18A	18A	18A	18A	20A
Max Output Power, see note 1	12 x16A =192W	12 x16A =192W	12V x16A =192W	12V x16A =192W	12V x18A =216W

Notes:

1. 12V maximum output current is 54 A.
2. Peak power and current loading shall be supported for a minimum of 12 seconds.
3. 12V5 is the power source for the three DC-DC converters to generate 3.3V, 5V, and -12V.

2.4.2.13 DC/DC Converters Loading

The following table defines the power and current ratings for the three DC/DC converters located on the cage; each is powered from a +12V5 rail. The three converters meet both static and dynamic voltage regulation requirements for the minimum and maximum loading conditions.

Note: 3.3V/5V combined power limit: 170 W max.

Table 84. DC/DC Converter Load Ratings

	+12VDC Input DC/DC Converters		
	+3.3V Converter	+5V Converter	-12V Converter
MAX Load	24.0A	30.0A	0.3A
MIN Static/Dynamic Load	0A	0A	0A
Max Output Power, see note 1	3.3x24=79.2W	5x30=150W	0.3x12=4.8W

Notes:

1. Maximum continuous total DC output power should not exceed 610 W..
2. Peak power and current loading shall be supported for a minimum of 12 seconds.
3. Combined 3.3V and 5V power shall not exceed 170 W.

2.4.2.14 DC/DC Converters Voltage Regulation

The DC/DC converters' output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. All outputs are measured with reference to the return remote sense signal (ReturnS). The 3.3V and 5V outputs are measured at the remote sense point; all other voltages are measured at the output harness connectors.

Table 85. Voltage Regulation Limits

Converter Output	Tolerance	MIN	NOM	MAX	UNITS
+ 3.3VDC	- 5%/+5%	+3.14	+3.30	+3.46	V _{rms}
+ 5VDC	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}
+ 12VDC (12V1/2/3/4)	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
- 12VDC	- 10%/+10%	-10.80	-12.00	-13.20	V _{rms}
+ 5VSB	See Power Supply Specification; measured at the power distribution board harness connectors.				

2.4.3 DC/DC Converters Dynamic Loading

The output voltages remain within limits specified for step loading and capacitive loading, as specified in the following table. The load transient repetition rate is tested between 50 Hz and 5

kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The step load may occur anywhere between the MIN load and MAX load conditions.

Table 86. Transient Load Requirements

Output	Max Step Load Size	Max Load Slew Rate	Test capacitive Load
+ 3.3VDC	5.0A	0.25 A/ s	250 F
+ 5VDC	4.0A	0.25 A/ s	400 F
+12VDC (12V1/2/3/4/5)	See the Power Supply specification for details.		
- 12VDC	<i>Not rated</i>	<i>Not rated</i>	F
+5VSB	See the the Power Supply specification for details.		

2.4.3.1 DC/DC Converter Capacitive Loading

All outputs of the DC/DC converter are stable and meet all requirements with the following capacitive loading ranges.

Table 87. Capacitive Loading Conditions

Converter Output	MIN	MAX	Units
+3.3VDC	250	6,800	F
+5VDC	400	4,700	F
-12VDC	1	350	F

Note: Refer to the Power Supply specification for the equivalent data on +12V and +5VSB output.

2.4.3.2 DC/DC Converters Closed Loop Stability

Each DC/DC converter is unconditionally stable under all line/load/transient load conditions, including capacitive load ranges. A minimum of 45 degrees phase margin and -10dB-gain margin is required.

2.4.3.3 Common Mode Noise

The common mode noise on any output does not exceed 350 mV peak-peak over the frequency band of 10 Hz to 30 MHz.

2.4.3.4 DC/DC Converters Ripple/Noise

The maximum allowed ripple/noise output of each DC/DC Converter is defined in the following table. This is measured over a bandwidth of 0Hz to 20MHz at the PDB output connectors. A 10 F tantalum capacitor in parallel with a 0.1 F ceramic capacitor is placed at the point of measurement.

Table 88. Ripple and Noise

+3.3V Output	+5V Output	-12V Output
50mVp-p	50mVp-p	120mVp-p

Note: Refer to the Power Supply specification for the equivalent data on +12V and +5VSB output.

2.4.3.5 Fan Operation in Standby Mode

The fans on the power distribution board continue to operate at their lowest speed (5V) when in standby mode.

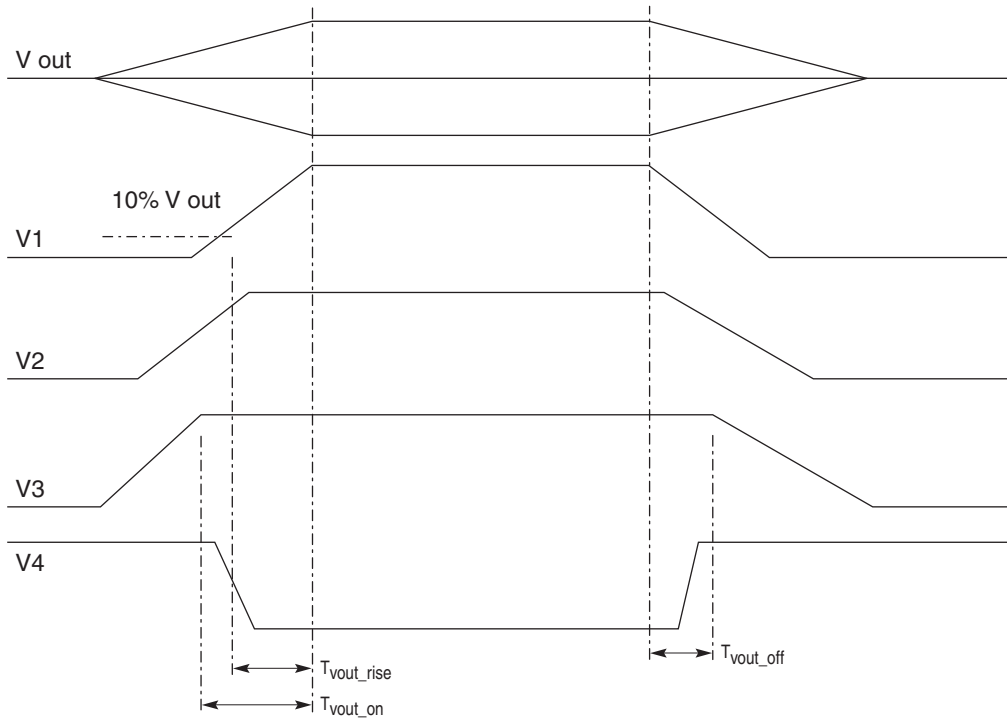
2.4.3.6 Timing Requirements

The timing requirements for the power supply/PDB combination are as follows. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70 ms, except for 5VSB, which is allowed to rise from 1.0 to 25 ms. The +3.3V, +5V, and +12V output voltages start to rise at approximately the same time. All outputs rise monotonically. The +5V output is greater than the +3.3V output during any point of the voltage rise. The +5V output is never greater than the +3.3V output by more than 2.25V. Each output voltage reaches regulation within 50ms (T_{vout_on}) of each other during turn on of the power supply. Each output voltage falls out of regulation within 400 msec (T_{vout_off}) of each other during turn off. The following figure shows the timing requirements for the power supply being turned on and off via the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 89. Output Voltage Timing

Item	Description	Minimum	Maximum	Units
T_{vout_rise}	Output voltage rise time from each main output.	5.0*	70*	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
T_{vout_off}	All main outputs must leave regulation within this time.		400	msec

* The 5VSB output voltage rise time shall be from 1.0 ms to 25.0 ms.



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Figure 15. Output Voltage Timing

Table 90. Turn On/Off Timing

Item	Description	Loading	Minimum	Maximum	Units
$T_{sb_on_delay}$	Delay from AC being applied to 5VSB being within regulation.			1500	ms
$T_{ac_on_delay}$	Delay from AC being applied to all output voltages being within regulation.			2500	ms
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	60%	21		ms
T_{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK	60%	20		ms
$T_{pson_on_delay}$	Delay from PSON [#] active to output voltages within regulation limits.		5	400	ms
T_{pson_pwok}	Delay from PSON [#] deactive to PWOK being de-asserted.			50	ms
T_{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.		100	500	ms

Item	Description	Loading	Minimum	Maximum	Units
T_{pwok_off}	Delay from PWOK de-asserted to output voltages (3.3V, 5V, 12V, -12V) dropping out of regulation limits.		1		ms
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.		100		ms
T_{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.		50	1000	ms
T_{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.		70		ms

Note:

T_{vout_holdup} and T_{pwok_holdup} are defined under 60% loading.

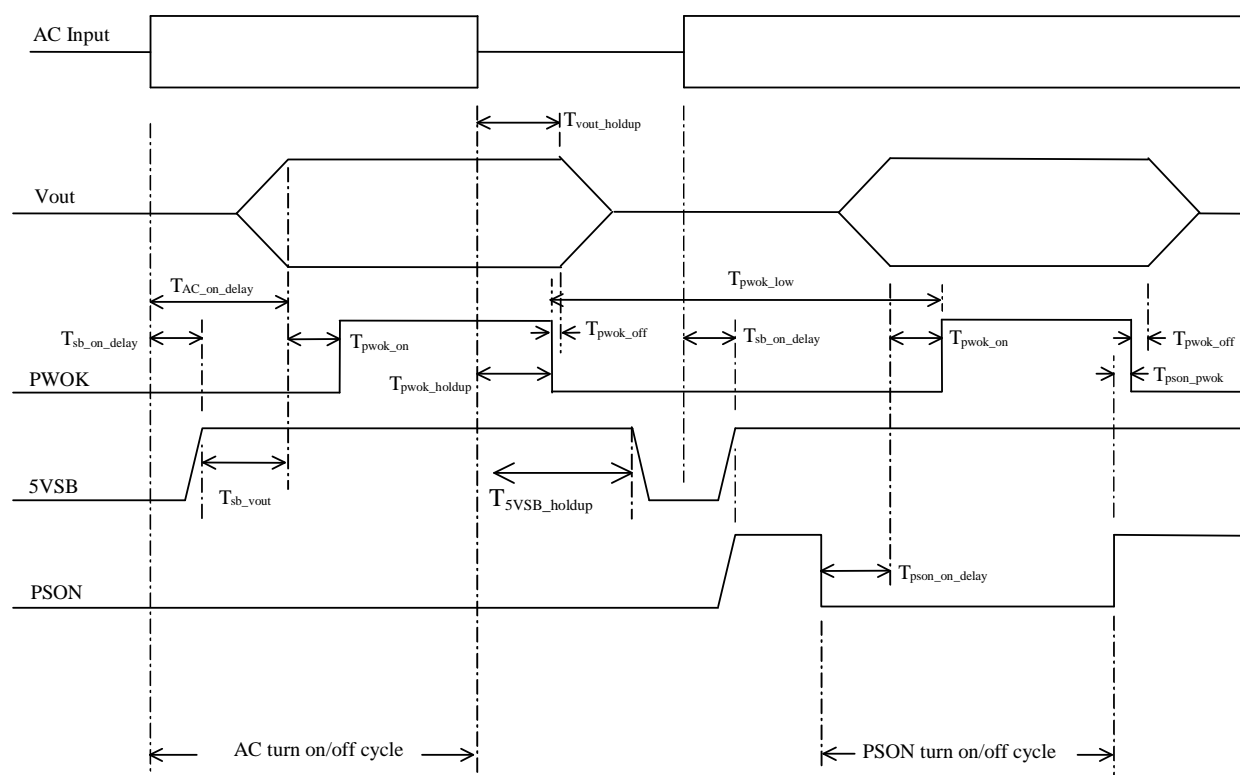


Figure 16. Turn On/Off Timing (Power Supply Signals)

2.4.3.7 Residual Voltage Immunity in Standby Mode

Each DC/DC converter is immune to any residual voltage placed on its respective output (typically a leakage voltage through the system from standby output) up to **500mV**. There is no additional heat generated, nor is there any stress of any internal components with this voltage applied to any individual output, or all outputs simultaneously. It also does not trip the power supply protection circuits during turn on.

Residual voltage at the power supply outputs for no load condition do not exceed 100mV when AC voltage is applied and the PSON# signal is de-asserted.

2.4.3.8 Soft Start Requirements

The power supply contains a control circuit, which provides monotonic soft start for its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions. There is no requirement for rise time on the 5VSB but the turn on/off is monotonic.

2.4.4 Protection Circuits

Protection circuits inside the cage (and the power supply) cause the power supply's main +12V output to shut down, thereby forcing the remaining three outputs on the cage to shut down. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15 sec min and a PSON# cycle HIGH for 1 second will reset the power supply and the PDB.

2.4.4.1 Over-current Protection (OCP)/240VA Protection

Each DC/DC converter output on the cage has individual OCP circuits. The PS+cage combo will shutdown and latch off after an over-current condition occurs. This latch is cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the PDB harness connectors. The DC/DC converters are not damaged from repeated power cycling in this condition. The +12V output from the power supply is divided on the PDB into 5 channels and each is limited to 240VA of power except for +12V5 (+12V5 is not user accessible). There are current sensors and limit circuits available to shut down the entire PS+PDB combo if the limit is exceeded. The over-current limits are listed in the following table.

Table 91. Over-current Protection Limits/240VA Protection

Output Voltage	MIN OCP Trip Limits	MAX OCP Trip Limits
+3.3V	110% min (= 26.4A min)	150% max (= 36A max)
+5V	110% min (= 33A min)	150% max (= 45A max)
-12V	0.625A	2.0A
+12V1	18A	20Amax
+12V2	18A	20Amax
+12V3	18A	20A max
+12V4	18A	20A max
+5VSB	See the Power Supply specification for details.	

2.4.4.2 Over-voltage Protection (OVP)

Each DC/DC converter output on the cage has individual OVP circuits built in and is locally sensed. The PS+cage combo will shut down and latch off after an over-voltage condition occurs. This latch can be cleared by toggling the PSON[#] signal or by an AC power interruption.

The following table defines the over-voltage limits. The values are measured at the cage harness connectors. The voltage does not exceed the maximum levels when measured at the power pins of the output harness connector during any single point of fail. The voltage does not trip any lower than the minimum levels when measured at the power pins of the cage connector.

Table 92. Over-voltage Protection (OVP) Limits

Output Voltage	OVP MIN (V)	OVP MAX (V)
+3.3V	3.9	4.5
+5V	5.7	6.5
-12V	-13.3	-14.5
+12V1/2/3/4/5	See Power Supply specification	
+5vsb	See Power Supply specification	

2.4.5 Control and Indicator Functions (Hard-wired)

The following sections define the input and output signals from the power distribution board.

Signals that can be defined as low true use the following convention:

signal[#] = low true

2.4.5.1 PSON[#] Input and Output Signals

The PSON[#] signal is required to remotely turn on/off the power supply. PSON[#] is an active low signal that turns on the +3.3V, +5V, +12V, and -12V power rails. When this signal is not pulled low by the system, or left open, the outputs (except for the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply.

Table 93. PSON# Signal Characteristics

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low		4mA
Power up delay: T _{pson_on_delay}	5msec	400msec
PWOK delay: T _{pson_pwok}		50msec

2.4.5.2 PSKILL

The purpose of the PSkill pin is to allow for hot swapping of the power supply. The mating pin of this signal on the cage input connector is tied to ground, and its resistance is less than 5 ohms.

2.4.5.3 PWOK (Power OK) Input and Output Signals

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits, or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. The start of the PWOK delay time is inhibited as long as any power supply output is within current limit.

Table 94. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=4mA	0V	0.4V
Logic level high voltage, Isource=200 A	2.4V	5.25V
Sink current, PWOK = low		4mA
Source current, PWOK = high		2mA
PWOK delay: T _{pwok_on}	100ms	1000ms
PWOK rise and fall time		100 sec
Power down delay: T _{pwok_off}	1ms	200msec

2.4.5.4 SMBAlert#

This signal indicates that the power supply is experiencing a problem that the user should investigate. The signal may be asserted due to critical events or warning events.

The SMBAlert# signal will be asserted whenever there is at least one event condition in the power supply or cage.

The SMBAlert# signal will automatically be cleared when the cause of the event is no longer present.

Table 95. SMBAlert# Signal Characteristics

Signal Type (Active Low)	Open collector/drain output from power supply. Pull-up to VSB located in system.	
Alert# = High	OK	
Alert# = Low	Power Alert to system	
	MIN	MAX
Logic level low voltage, Isink=4 mA	0 V	0.4 V
Logic level high voltage, Isink=50 A		5.25 V
Sink current, Alert# = low		4 mA
Sink current, Alert# = high		50 A
Alert# rise and fall time		100 s

2.4.6 PSMI (Power Supply Monitoring Interface)

The power supply and cage combination provide a monitoring interface to the system over a server management bus to the system. The device is compatible with both SMBus 2.0 'high power' and I²C V_{dd} based power and drive. This bus operates at 3.3V. The SMBus pull-ups are located on the server board.

The SMBUS provides power monitoring, failure conditions, warning conditions, and FRU data. Two pins have been reserved on the connector to provide this information. One pin is the Serial Clock (PSM Clock). The second pin is used for Serial Data (PSM Data). Both pins are bi-directional and are used to form a serial bus. The circuits inside the power supply are powered from the 5VSB bus and grounded to ReturnS (remote sense return). No pull-up resistors are on SCL or SDA inside the power supply. These pull-up resistors are located external to the power supply. The EEPROM for FRU data in the power supply is hard wired to allow writing data to the device.

Default Mode Operation: The LEDs and registers automatically clear when a warning event has occurred. Critical events will cause the power supply to shut down and latch the LED and SMBAlert signal. A warning event will allow the LED and SMBAlert signal to de-assert as soon as the condition driving the event clears.

The LED, SMBAlert signal, and critical event registers will still operate correctly if the power supply fails due to over-temperature shut down, over-current shutdown, over-power shutdown, or fan failure. If the power supply fails due to loss of AC or open fuse then the LED and signals will not operate because of loss of power.

2.4.6.1 Device Address Locations

The PS+PDB device address locations are shown in the following table.

Table 96. Device Address Locations

Power Supply FRU Device	A0h/A2h
PDB FRU Data	Ach
PBD Monitoring	4Ah

2.4.6.2 Summary of PSMI features for PDB

Item	Description	Scaling	Accuracy	Associated Registers
Fan monitoring	A slow fan indication shall be provided before the power supply shuts down due to slowing fan failure. Hysteresis on the fan monitoring shall be provided to prevent oscillation of the warning indicator.	TBD	NA	Event register bit Mask register bit

Item	Description	Scaling	Accuracy	Associated Registers
240VA monitoring	Indicators for sensing one of the 240VA channels have tripped and shut down the power supplies.		NA	Event register bit Mask register bit
DC/DC failure sensing	Indicators for sensing a DC/DC failure on the power distribution board.			Event register bit Mask register bit

2.5 670-W Power Supply

The 670-W specification defines a non-redundant power supply that supports entry server systems. This 670-W power supply has 8 outputs: 3.3V, 5V, 12V1, 12V2, 12V3, 12V4, -12V and 5VSB. The power supply contains a single 80-mm fan for cooling the power supply and part of the system.

2.5.1 Mechanical Overview

The physical size of the power supply enclosure is intended to accommodate power ranges up to 670 W. The power supply size is 150mm x 180mm x 86mm and has a wire harness for the DC outputs. The AC plugs directly into the external face of the power supply.

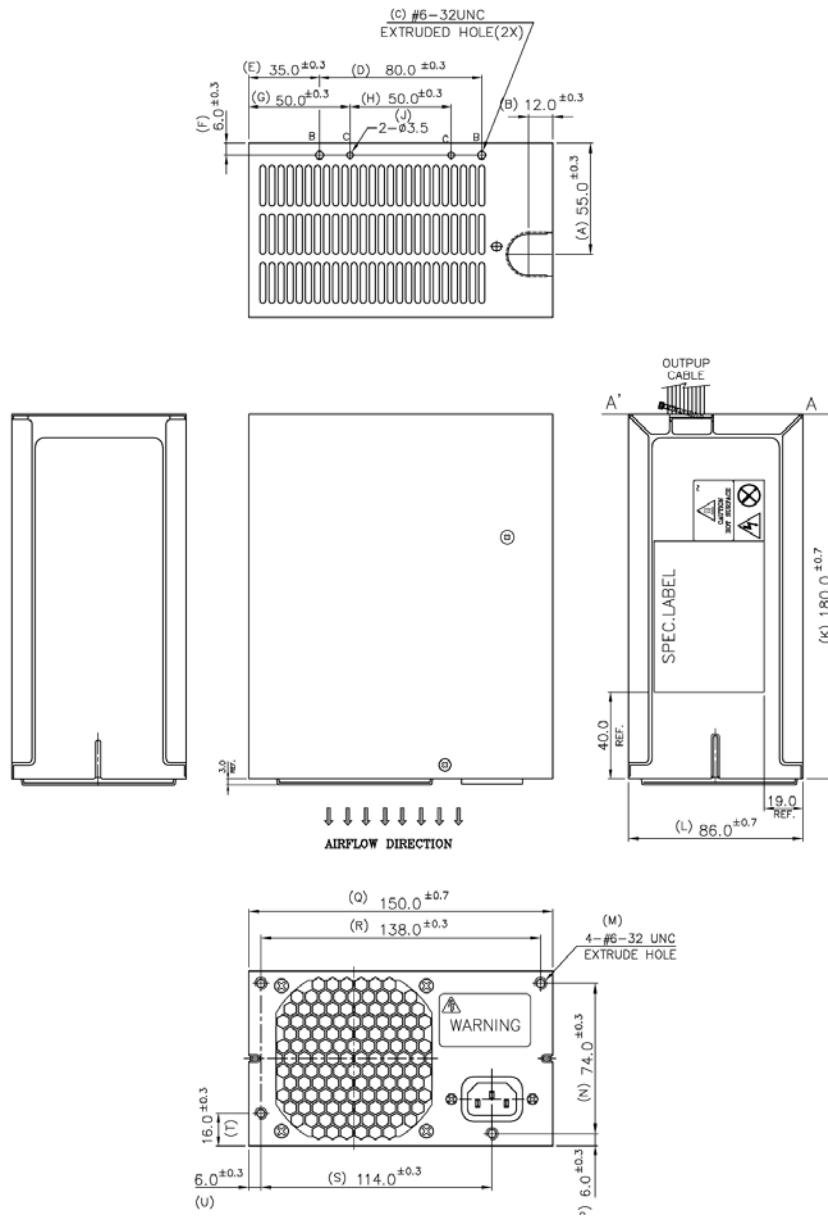


Figure 17. Mechanical Drawing of the 670-W Power Supply Enclosure

2.5.2 Acoustic Requirements

The declared sound power level of the power supply assembly does not exceed the levels specified in the following table.

Table 97. Sound Power Requirement

Operating Conditions	Inlet Temperature Condition	% of Maximum Loading Condition	LwAd (BA)
Maximum	45°C	100%	6.5
Operating	40 C	60%	4.7
Idle	35 C	40%	4.0

The declared sound power level is measured according to ECMA 74 and reported according to ECMA 109. The fan RPM settings for the two operating conditions are determined through thermal analysis and/or testing prior to the sound power level measurement. To measure the power supply assembly sound power levels corresponding to the two operating conditions, the fan in the power supply assembly is powered externally to the two RPM settings. The 45 degree C inlet temperature is derived based on standard system ambient temperature assumptions (25 degrees C and 35 degrees C), typical temperature rise within the system, and thermal impact of fan speed control.

Pure Tones: The power supply assembly does not produce any prominent discrete tones determined according to ECMA 74, Annex D.

2.5.3 Airflow Requirements

The power supply incorporates one 80-mm fan for self-cooling and system cooling. The fan provides no less than 14 CFM airflow through the power supply when installed in the system. The cooling air enters the power module from the non-AC side.

2.5.4 Temperature Requirements

The power supply operates within all specified limits over the T_{op} temperature range. All airflow passes through the power supply and not over the exterior surfaces of the power supply.

Table 98. Thermal Requirements

Item	Description	MIN	MAX	Units
T_{op}	Operating temperature range.	0	45	C
T_{non-op}	Non-operating temperature range.	-40	70	C
Altitude	Maximum operating altitude		1500	m

The power supply meets UL enclosure requirements for temperature rise limits. All sides of the power supply, with exception of the air exhaust side, are classified as “Handle, knobs, grips, etc., held for short periods of time only.”

2.5.5 Output Wire Harness Drawing

Listed or recognized component appliance wiring material (AVLV2), CN, rated min 105 C, 300VDC is used for all output wiring.

Table 99. Cable Lengths

From	Length (mm)	To Connector #	Number of Pins	Description
Power Supply cover exit hole	425	P1	24	Baseboard Power Connector
Power Supply cover exit hole	680	P2	8	Processor Power Connector
Power Supply cover exit hole	375	P14	5	Power Signal Connector
Power Supply cover exit hole	375	P15	6	PCI Express Connector
Power Supply cover exit hole	680	P16	4	12V4 Power Connector
Power Supply cover exit hole	450	P3	4	Peripheral Power Connector
Extension	100	P4	4	Peripheral Power Connector
Extension from P4	100	P5	4	Floppy Power Connector
Power Supply cover exit hole	575	P6	4	Peripheral Power Connector
Extension	75 (cover with sleeve)	P7	4	Right-angle Peripheral Power Connector
Power Supply cover exit hole	740	P8	4	Peripheral Power Connector
Extension	75	P9	4	Peripheral Power Connector
Power Supply cover exit hole	740	P10	4	Peripheral Power Connector
Extension	75	P11	4	Peripheral Power Connector
Power Supply cover exit hole	740	P12	5	Right-angle SATA Power Connector
Extension	75	P13	5	SATA Power Connector



- Notes:
1. All dimensions are in mm.
 2. All tolerances are +15 mm/-0 mm
 3. Install 1 tie wrap within 12mm of the power supply cage.
 4. Mark reference designator on each connector.
 5. Tie wrap each harness at approximately mid point.

Figure 18. Output Harness for 670-W Power Supply

2.5.6 Power Connectors

2.5.6.1 Baseboard Power Connector (P1)

Connector housing: 24-Pin Molex* Mini-Fit Jr. 39-01-2245 or equivalent
 Contact: Molex Mini-Fit, HCS, Female, Crimp 44476 or equivalent

Table 100. P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1*	+3.3 VDC	Orange	13	+3.3 VDC	Orange
	3.3V RS	Orange (24AWG)	14	-12 VDC	Blue
2	+3.3 VDC	Orange	15	COM	Black
3*	COM	Black	16	PSON#	Green (24AWG)
	COM RS	Black (24 AWG)	17	COM	Black
4*	+5 VDC*	Red	18	COM	Black
	5V RS	Red (24AWG)	19	COM	Black
5	COM	Black	20	Reserved	N.C.
6	+5 VDC	Red	21	+5 VDC	Red
7	COM	Black	22	+5 VDC	Red
8	PWR OK	Gray (24 AWG)	23	+5 VDC	Red
9	5VSB	Purple	24	COM	Black
10	+12V3	Yellow			
11	+12V3	Yellow			
12	+3.3 VDC	Orange			

* 5V Remote Sense Double Crimped

2.5.6.2 Processor Power Connector (P2)

Connector housing: 8-Pin Molex* 39-01-2080 or equivalent
 Contact: Molex 44476-1111 or equivalent

Table 101. P2 Processor Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12V1	White
2	COM	Black		12V1 RS	Yellow (24 AWG)
3	COM	Black	6	+12V1	White
4	COM	Black	7	+12V2	Brown
			8	+12V2	Brown

2.5.6.3 Power Signal Connector (P14)

Connector housing: 5-Pin Molex* 50-57-9405 or equivalent
 Contacts: Molex 16-02-0087 or equivalent

Table 102. Power Signal Connector

Pin	Signal	24 AWG Color
1	I ² C Clock	White
2	I ² C Data	Yellow
3	Reserved	N.C.
4	COM	Black
5	3.3RS	Orange

2.5.6.4 12V4 Power Connector (P16)

Connector housing: 6-Pin Molex* 39-01-2040 or equivalent
 Contacts: Molex Mini-Fit, HCS, 44476-1111 or equivalent

Table 103. 12V4 Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	COM	Black	4	+12V4	Green
2	COM	Black	5	+12V4	Green

2.5.6.5 PCI Express Connector (P15)

Connector housing: 6-Pin Mole* 455590002 or equivalent
 Contacts: Molex Mini-Fit, HCS, Female, Crimp 44476

Table 104. PCI Express Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+12V4	Green	4	COM	Black
2	+12V4	Green	5	COM	Black
3	+12V4	Green	6	COM	Black

2.5.6.6 Peripheral Power Connectors (P3, P4, P6, P8-P11)

Connector housing: Amp* 1-480424-0 or equivalent
 Contact: Amp 61314-1 contact or equivalent

Table 105. Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12 V4	Green
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.5.6.7 Right-angle Peripheral Power Connector (P7)

Connector housing: JWT* F6001HS2-4P or equivalent.

Table 106. P7 Right-angle Peripheral Power Connector

Pin	Signal	18 AWG Color
1	+12V4	Green
2	COM	Black
3	COM	Black
4	+5 VDC	Red

2.5.6.8 Floppy Power Connector (P5)

Connector housing: Amp* 171822-4 or equivalent

Contact: Amp 170204-1 contact or equivalent

Table 107. P5 Floppy Power Connector

Pin	Signal	22 AWG Color
1	+5VDC	Red
2	COM	Black
3	COM	Black
4	+12V4	Green

2.5.6.9 Right-angle SATA Power Connector (P12)

Connector housing: JWT* F6002HS0-5P-18 or equivalent

Table 108. P12 Right-angle SATA Power Connector

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V4	Green

2.5.6.10 SATA Power Connector (P13)

Connector housing: JWT* A3811H00-5P or equivalent

Contact: JWT A3811TOP-0D or equivalent

Table 109. P13 SATA Power Connector

Pin	Signal	18 AWG Color
1	+3.3V	Orange
2	COM	Black
3	+5VDC	Red
4	COM	Black
5	+12V4	Green

2.5.7 AC Input Requirements

2.5.7.1 Power Factor Correction

The power supply incorporates a power factor correction circuit.

The power supply is tested as described in EN 61000-3-2: Electromagnetic Compatibility (EMC Part 3: Limits – Section 2: “Limits for harmonic current emissions,” and meets the harmonic current emissions limits specified for ITE equipment.

The power supply is tested as described in JEIDA MITI Guideline for Suppression of High Harmonics in Appliances and General-Use Equipment, and meets the harmonic current emissions limits specified for ITE equipment.

2.5.7.2 AC Input Connector

The AC input connector is an IEC 320 C-14 power inlet. This inlet is rated for 15A/250VAC.

2.5.7.3 AC Input Voltage Specification

The power supply operates within all specified limits over the input voltage range shown in the following table. Harmonic distortion of up to 10% of the rated line voltage must not cause the power supply to go out of specified limits. The power supply does power off if the AC input is less than 75VAC +/-5VAC range. The power supply starts up if the AC input is greater than 85VAC +/-4VAC. Application of an input voltage below 85VAC does not cause damage to the power supply, including a fuse blow.

Table 110. AC Input Rating

Parameter	MIN	Rated	V _{MAX}	I _{MAX}	Start up VAC	Power Off VAC
Voltage (110)	90 V _{rms}	100-127 V _{rms}	140 V _{rms}	12 A ^{1,3}	85VAC +/- 4VAC	75VAC +/- 5VAC
Voltage (220)	180 V _{rms}	200-240 V _{rms}	264 V _{rms}	7 A ^{2,3}		
Frequency	47 Hz	50/60	63 Hz			

1. Maximum input current at low input voltage range is measured at 90VAC, at max load.
2. Maximum input current at high input voltage range is measured at 180VAC, at max load.
3. This requirement is not used for determining agency input current markings.

2.5.7.4 Efficiency

The following table provides the required minimum efficiency level at various loading conditions. These efficiency levels are provided at three different load levels: 100%, 50% and 20%. Efficiency is tested over an AC input voltage range of 115VAC to 220VAC.

Table 111. Efficiency

Loading	100% of Maximum	50% of Maximum	20% of Maximum
Recommended Efficiency	68%	72%	65%

2.5.7.5 AC Line Dropout/Holdup

Table 112. AC Line Dropout/Holdup

Output Wattage	Loading	Holdup time
670W	100%	20 ms

An AC line dropout is defined to be when the AC input drops to 0VAC at any phase of the AC line for any length of time. During an AC dropout, the power supply meets dynamic voltage regulation requirements. An AC line dropout of any duration does not cause any tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time, the power recovers and meets all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration does not cause damage to the power supply.

2.5.7.5.1 AC Line 5VSB Holdup

The 5VSB output voltage stays in regulation under its full load (static or dynamic) during an AC dropout of 70ms min (=5VSB holdup time) whether the power supply is in the ON or OFF state (PSON asserted or de-asserted).

2.5.7.6 AC Line Fuse

The power supply has one line fused in the single line fuse on the line (Hot) wire of the AC input. The line fusing is acceptable for all safety agency requirements. The input fuse is a slow blow type. AC in-rush current does not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply do not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.5.7.7 AC In-rush

AC line in-rush current does not exceed 50A peak, cold start at 20 degrees C, and no component is damaged at hot start for up to one-quarter of the AC cycle, after which, the input current is no more than the specified maximum input current listed in

Table 110. The peak in-rush current is less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

The power supply meets the in-rush requirements for any rated AC voltage during turn on at any phase of AC voltage or during a single cycle AC dropout condition, as well as upon recovery after AC dropout of any duration, and over the specified temperature range (T_{op}).

2.5.7.8 Susceptibility Requirements

The power supply meets the following electrical immunity requirements when connected to a cage with an external EMI filter that meets the criteria defined in the SSI document EPS Power Supply Specification.

Table 113. Performance Criteria

Level	Description
A	The apparatus shall continue to operate as intended. No degradation of performance.
B	The apparatus shall continue to operate as intended. No degradation of performance beyond spec limits.
C	Temporary loss of function is allowed provided the function is self-recoverable or can be restored by the operation of the controls.

2.5.7.8.1 *Electrostatic Discharge Susceptibility*

The power supply complies with the limits defined in EN 55024: 1998 using the IEC 61000-4-2:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.5.7.8.2 *Fast Transient/Burst*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-4:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.5.7.8.3 *Radiated Immunity*

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-3:1995 test standard and performance criteria A defined in Annex B of CISPR 24.

2.5.7.8.4 *Surge Immunity*

The power supply is tested with the system for immunity to AC Ringwave and AC Unidirectional wave, both up to 2kV, per EN 55024:1998, EN 61000-4-5:1995 and ANSI C62.45: 1992.

The pass criteria include: no unsafe operation is allowed under any condition; all power supply output voltage levels must stay within proper spec levels; no change in operating state or loss of data during and after the test profile; no component damage under any condition.

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-5:1995 test standard and performance criteria B defined in Annex B of CISPR 24.

2.5.7.9 AC Line Leakage Current

The maximum leakage current to ground for each power supply is 3.5mA when tested at 240VAC.

2.5.7.10 AC Line Transient Specification

AC line transient conditions are defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”; these conditions will be defined as the AC line voltage dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage.

The power supply meets the requirements under the following AC line sag and surge conditions.

Table 114. AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
0 to 1 AC cycle	95%	Nominal AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	> 30%	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 115. AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60Hz	No loss of function or performance

2.5.7.11 AC Line Fast Transient (EFT) Specification

The power supply meets the EN61000-4-5 directive and any additional requirements in IEC1000-4-5: 1995 and the Level 3 requirements for surge-withstand capability, with the following conditions and exceptions:

- These input transients do not cause any out-of-regulation conditions, such as overshoot and undershoot, nor do they cause any nuisance trips of any of the power supply protection circuits.
- The surge-withstand test must not produce damage to the power supply.
- The supply meets surge-withstand conditions under maximum and minimum DC-output load conditions.

2.5.7.12 Power Recovery

The power supply recovers automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.5.7.12.1 Voltage Brown Out

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 test standard and performance criteria C defined in Annex B of CISPR 24.

In addition, the power supply meets the following Intel Requirement:

- A continuous input voltage below the nominal input range shall not damage the power supply or cause overstress to any power supply component. The power supply must be able to return to normal power up state after a brownout condition. Maximum input current under a continuous brownout shall not blow the fuse. The power supply should tolerate a 3min ramp from 90VAC voltage to 0VAC after the components have reached a steady state condition.

2.5.7.12.2 Voltage Interruptions

The power supply complies with the limits defined in EN55024: 1998 using the IEC 61000-4-11:1995 test standard and performance criteria C defined in Annex B of CISPR 24.

2.5.7.13 AC Line Isolation Requirements

The power supply meets all safety agency requirements for dielectric strength. Transformers' isolation between primary and secondary windings complies with the 3000Vac (4242Vdc) dielectric strength criteria. In addition, the insulation system complies with reinforced insulation per safety standard IEC 950. Separation between the primary and secondary circuits, and primary to ground circuits, complies with the IEC 950 spacing requirements.

2.5.8 DC Output Specifications

2.5.8.1 Grounding

The output ground of the pins of the power supply provides the power return path. The output connector ground pins are connected to safety ground (power supply enclosure). This grounding is designed to ensure passing the maximum allowed common mode noise levels.

2.5.8.2 Remote Sense

The power supply has remote sense return (ReturnS) to regulate out ground drops for all output voltages: +3.3V, +5V, +12V1, +12V2, +12V3, +12V4, -12V, and 5VSB. The power supply uses remote sense to regulate out drops in the system for the +3.3V, +5V, and 12V1 outputs. The +12V1, +12V2, +12V3, +2V4, -12V and 5VSB outputs only use remote sense referenced to the ReturnS signal. The remote sense input impedance to the power supply is greater than 200 Ω . This is the value of the resistor connecting the remote sense to the output voltage internal to the power supply. Remote sense is able to regulate out a minimum of a 200mV drop. The remote sense return (ReturnS) is able to regulate out a minimum of a 200mV drop in the power ground return. The current in any remote sense line is less than 5mA to prevent voltage sensing errors.

The power supply operates within specification over the full range of voltage drops from the power supply's output connector to the remote sense points.

2.5.8.3 Output Power/Currents

The following table defines the power and current ratings for the 670-W power supply. The combined output power of all outputs does not exceed the rated output power. The power supply meets both static and dynamic voltage regulation requirements for the minimum loading conditions.

Table 116. Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak Load
+3.3V	1.0 A	24 A	
+5V	2.0 A	30 A	
+12V1	0.5 A	16 A	18 A
+12V2	1.0 A	16 A	18 A
+12V3	0.5 A	16 A	18 A
+12V4	1.0 A	16 A	18 A
-12V	0 A	0.5 A	
+5VSB	0.1 A	3.0 A	5A

Notes:

1. Maximum continuous total DC output power should not exceed 670 W.
2. Maximum continuous load on the combined 12V output shall not exceed 48 A.
3. Peak load on the combined 12V output shall not exceed 52 A.
4. Peak total DC output power should not exceed 730 W.
5. For 12V, peak power and current loading shall be supported for a minimum of 12 seconds.
6. For 5Vsb, 5Vsb must withstand 5 A for 500 ms long under first turn-on condition.
7. Combined 3.3V and 5V power shall not exceed 170 W.

2.5.8.4 Standby Output

The 5VSB output is present when an AC input greater than the power supply turn-on voltage is applied.

2.5.8.5 Voltage Regulation

The power supply output voltages stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. All outputs are measured with reference to the return remote sense signal (ReturnS). The +12V3, +12V4, -12V and 5VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3V, +5V, +12V1, and +12V2 are measured at the remote sense signal located at the signal connector.

Table 117. Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+ 3.3V	- 5%/+5%	+3.14	+3.30	+3.46	V _{rms}
+ 5V	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}
+ 12V1	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+ 12V2	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+12V3	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
+12V4	- 5%/+5%	+11.40	+12.00	+12.60	V _{rms}
- 12V	- 5%/+9%	-11.40	-12.00	-13.08	V _{rms}
+ 5VSB	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}

2.5.8.6 Dynamic Loading

The output voltages remain within limits specified for the step loading and capacitive loading, as shown in the following table. The load transient repetition rate is tested between 50 Hz and 5 kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The step load may occur anywhere between the MIN load and MAX load conditions.

Table 118. Transient Load Requirements

Output	Step Load Size ¹	Load Slew Rate	Test Capacitive Load
+3.3V	7.0A	0.25 A/ sec	4700 F
+5V	7.0A	0.25 A/ sec	1000 F
+12V	25A	0.25 A/ sec	4700 F
+5VSB	0.5A	0.25 A/ sec	20 F

1. Step loads on each 12V output may happen simultaneously.

2.5.8.7 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitive loading ranges.

Table 119. Capacitive Loading Conditions

Output	MIN	MAX	Units
+3.3V	250	6800	F

Output	MIN	MAX	Units
+5V	400	4700	F
+12V(1, 2, 3, 4)	500 each	11,000	F
-12V	1	350	F
+5VSB	20	350	F

2.5.8.8 Closed Loop Stability

The power supply is unconditionally stable under all line/load/transient load conditions, including capacitive load ranges. A minimum of 45 degrees phase margin and -10dB-gain margin are required. Closed-loop stability is ensured at the maximum and minimum loads, as applicable.

2.5.8.9 Residual Voltage Immunity in Standby Mode

The power supply is immune to any residual voltage placed on its outputs (typically a leakage voltage through the system from standby output) up to 500mV. There is neither additional heat generated, nor stress of any internal components with this voltage applied to any individual output, and all outputs simultaneously. It also does not trip the protection circuits during turn on. The residual voltage at the power supply outputs for no load condition does not exceed 100mV when AC voltage is applied.

2.5.8.10 Common Mode Noise

The common mode noise on any output does not exceed 350mV pk-pk over the frequency band of 10Hz to 30MHz.

2.5.8.11 Soft Starting

The power supply contains a control circuit that provides monotonic soft start for its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions. There is no requirement for rise time on the 5Vstby but the turn on/off is monotonic.

2.5.8.12 Pre-set Power-on Requirement

When the power supply turns on, the system loading maybe very light before it comes out of reset. Under these conditions, the power supply's output voltage regulation may be relaxed to +/-10% on the 3.3V and 5V rails and +10/-8% on the +12V rails. When the power supply is subsequently loaded, it must begin to regulate and source current without fault.

Table 120. Pre-set Lighter Load

Voltage	Minimum Continuous Load	Maximum Continuous Load	Peak Load
+3.3V	0 A	9.0 A	

Voltage	Minimum Continuous Load	Maximum Continuous Load	Peak Load
+5V	0 A	7.0 A	
+12V1	0.0 A	8.0 A	
+12V2	0.0 A	8.0 A	
+12V3	0.1 A	8.0 A	
+12V4	0.0 A	8.0 A	
-12V	0 A	0.5 A	
+5VSB	0.1 A	3.0 A	

Table 121. Pre-set Lighter Voltage Regulation Limits

Parameter	Tolerance	MIN	NOM	MAX	Units
+3.3V	- 10%/+10%	+2.970	+3.30	+3.630	V _{rms}
+5V	- 10%/+10%	+4.500	+5.00	+5.500	V _{rms}
+12V1	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
+12V2	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
+12V3	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
+12V4	- 8%/+10%	+11.04	+12.00	+13.20	V _{rms}
- 12V	- 5%/+9%	- 11.40	-12.00	-13.08	V _{rms}
+5VSB	- 5%/+5%	+4.75	+5.00	+5.25	V _{rms}

2.5.8.13 Ripple/Noise

The maximum allowed ripple/noise output of the power supply is defined in the following table. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10 F tantalum capacitor, in parallel with a 0.1 F ceramic capacitor, is placed at the point of measurement.

Table 122. Ripple and Noise

+3.3V	+5V	+12V (1,2,3,4)	-12V	+5VSB
50mVp-p	50mVp-p	120mVp-p	120mVp-p	50mVp-p

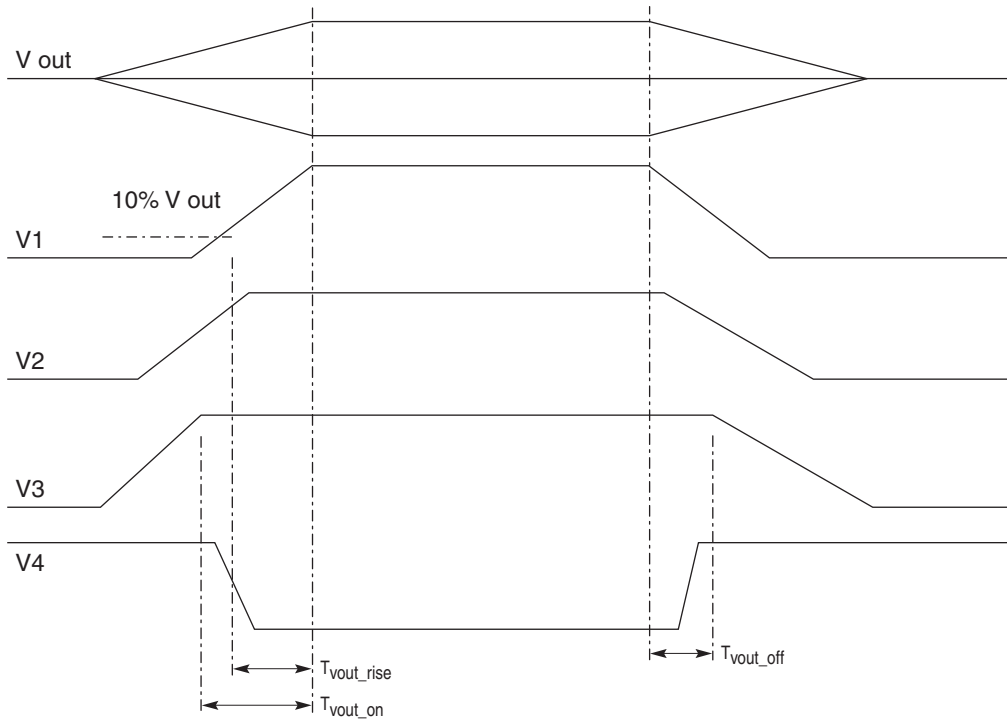
2.5.8.14 Timing Requirements

The timing requirements for power supply operation are as follows. The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70 ms, except for 5VSB, which is allowed to rise from 1.0 to 25 ms. The +3.3V, +5V and +12V output voltages should start to rise approximately at the same time. All outputs must rise monotonically. Each output voltage shall reach regulation within 50ms (T_{vout_on}) of each other during turn on of the power supply. Each output voltage shall fall out of regulation within 400msec (T_{vout_off}) of each other during turn off. The following table shows the timing requirements for the power supply being turned on and off via the AC input, with PSON held low and the PSON signal, with the AC input applied.

Table 123. Output Voltage Timing

Item	Description	MIN	MAX	Units
T_{vout_rise}	Output voltage rise time from each main output.	5.0 ¹	70 ¹	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
T_{vout_off}	All main outputs must leave regulation within this time.		400	msec

1. The 5VSB output voltage rise time shall be from 1.0 ms to 25 ms.



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Figure 19. Output Voltage Timing

Table 124. Turn On/Off Timing

Item	Description	Minimum	Maximum	Units
T _{sb_on_delay}	Delay from AC being applied to 5VSB being within regulation.		1500	ms
T _{ac_on_delay}	Delay from AC being applied to all output voltages being within regulation.		2500	ms
T _{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	21		ms
T _{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK	20		ms
T _{pson_on_delay}	Delay from PSON [#] active to output voltages within regulation limits.	5	400	ms
T _{pson_pwok}	Delay from PSON [#] deactive to PWOK being de-asserted.		50	ms
T _{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T _{pwok_off}	Delay from PWOK de-asserted to output voltages (3.3V, 5V, 12V, -12V) dropping out of regulation limits.	1		ms
T _{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal.	100		ms
T _{sb_vout}	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
T _{5VSB_holdup}	Time the 5VSB output voltage stays within regulation after loss of AC.	70		ms

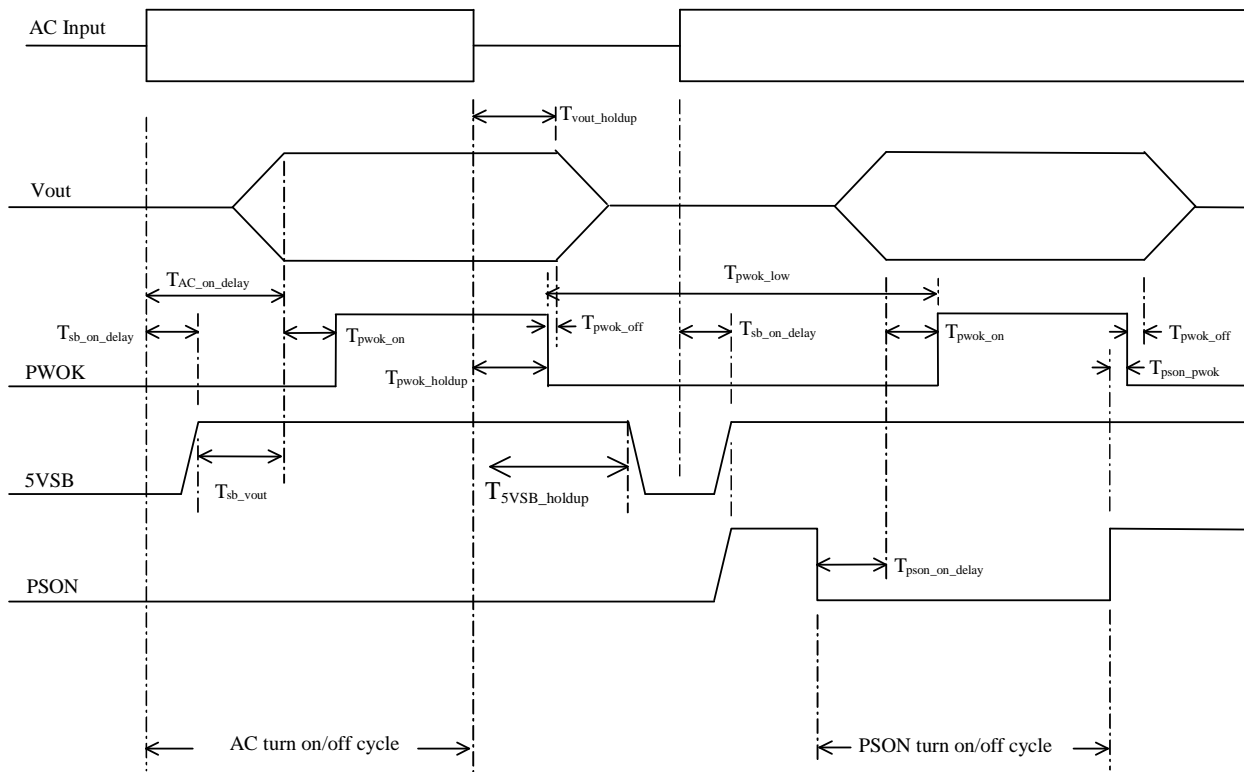


Figure 20. Turn On/Off Timing (Power Supply Signals)

2.5.9 Protection Circuits

Protection circuits inside the power supply cause only the power supply’s main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15 sec and a PSON# cycle HIGH for 1 sec will reset the power supply.

2.5.9.1 Over-current Protection (OCP)

The power supply has a current limit to prevent the +3.3V, +5V, and +12V outputs from exceeding the values shown in the following table. If the current limits are exceeded the power supply will shut down and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply will not be damaged from repeated power cycling in this condition. -12V and 5VSB are protected under over-current or shorted conditions so that no damage can occur to the power supply. The 5VSB will auto recover after removing the OCP limit.

Table 125. Over-current Protection (OCP)/240VA

Voltage	Over-current Limit		Peak Load*	
	MIN	MAX	Peak Limit	Delay
+3.3V	110% = 26.4A	150% = 36A		
+5V	110% = 33A	150% = 45A		

Voltage	Over-current Limit		Peak Load*	
	MIN	MAX	Peak Limit	Delay
+12V1	18A	20A		
+12V2	18A	20A		
+12V3	18A	20A	24A	0.5~1sec
+12V4	18A	20A	25A	0.5~1
-12V	0.625A	4.0A		
5VSB	7.0A			

1. The delay means that the 12V3/12V4 OCP circuits will allow the peak load of 24A/25A for 0.5 sec minimum before it will shut down the power supply, respectively.

2.5.9.2 Over-voltage Protection (OVP)

The power supply over-voltage protection is locally sensed. The power supply will shut down and latch off after an over voltage condition occurs. This latch can be cleared by toggling the PSON# signal or by an AC power interruption. The following table contains the over-voltage limits. The values are measured at the output of the power supply's pins. The voltage never exceeds the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage will not trip any lower than the minimum levels when measured at the power pins of the power supply connector. The +5VSB rail will auto-recover after its OVP limit.

Table 126. Over-voltage Protection Limits

Output Voltage	MIN (V)	MAX (V)
+3.3V	3.9	4.5
+5V	5.7	6.5
+12V1,2, 3, 4	13.3	14.5
-12V	-13.3	-16
+5VSB	5.7	6.5

2.5.9.3 Over-temperature Protection (OTP)

The power supply is protected against over-temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the power supply will shut down. When the power supply temperature drops to within specified limits, the power supply will restore power automatically, while the 5VSB remains always on. The OTP circuit has a built-in hysteresis such that the power supply will not oscillate on and off due to a temperature recovering condition. The OTP trip level has a minimum of 4 degrees C of ambient temperature hysteresis.

2.5.10 Control and Indicator Functions

The following sections define the input and output signals from the power supply.

Signals that can be defined as low true use the following convention:

Signal[#] = low true

2.5.10.1 PSON# Input Signal

The PSON[#] signal is required to remotely turn on/off the power supply. PSON[#] is an active low signal that turns on the +3.3V, +5V, +12V, and -12V power rails. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply.

Table 127. PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON [#] = Low	ON	
PSON [#] = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.1V	5.25V
Source current, V _{pson} = low		4mA
Power up delay: T _{pson_on_delay}	5msec	400msec
PWOK delay: T _{pson_pwok}		50msec

2.5.10.2 PWOK (Power OK) Output Signal

PWOK is a power OK signal and is pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. The start of the PWOK delay time is inhibited as long as any power supply output is in current limit.

Table 128. PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in system.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, $I_{\text{sink}}=4\text{mA}$	0V	0.4V
Logic level high voltage, $I_{\text{source}}=200 \text{ A}$	2.4V	5.25V
Sink current, PWOK = low		4mA
Source current, PWOK = high		2mA
PWOK delay: $T_{\text{pwok_on}}$	100ms	1000ms
PWOK rise and fall time		100 sec
Power down delay: $T_{\text{pwok_off}}$	1ms	200msec

3. Chassis Cooling

3.1 Fan Configuration

The cooling sub-system of the Intel® Entry Server Chassis SC5299-E consists of one system fan and one power supply fan (the SC5299WS configuration has an additional 92-mm drive bay fan). The 4-wire 120mm x 38mm fan provides cooling at the rear of the chassis by drawing fresh air into the chassis from the front and exhausting warm air out the system. This fan is PWM controlled. The server board monitors several temperature sensors and adjusts the duty cycle of the PWM signal to drive the fan at the appropriate speed. The 92-mm drive bay fan for the SC5299WS configuration and the optional hot-swap drive bay kit provides additional cooling to the drive bay by drawing fresh air from the front of the chassis through the drive bay and exhausting it into the PCI bay area.

Removal and insertion of the 120-mm or 92-mm fan can be done without tools. The power supply fan assists in drawing air through the peripheral bay area, through the power supply and exhausting it out the rear of the chassis. All versions of the Intel® Entry Server Chassis SC5299-E are optimized for server and workstation boards that have an active CPU heatsink solution.

If an optional hot-swap drive bay is installed, a 4-wire 92-mm fan is included with the mounting bracket kit for installation onto the drive bay. This fan has a PWM circuit that allows the server board to control the fan speed based on sensor readings of ambient temperature.

In addition to these pre-installed fans, locations for three additional fans are provided for customized configurations. Intel does not provide order part numbers for these customizable fan options. A 120-mm fan can be mounted to the chassis behind the PCI card guide and provide additional cooling to the PCI card area; two 80-mm fans can be mounted at the front of the chassis to the right of the hard drive bay opening to provide more cooling.

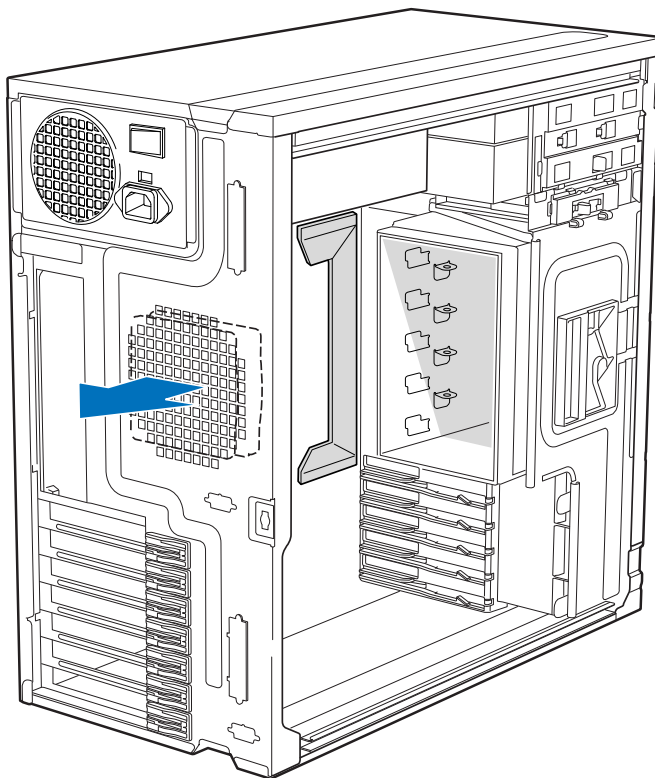
The front panel of the Intel® Entry Server Chassis SC5299-E provides a LM30 temperature sensor for SIO control. Server boards that support SIO control may use the LM30 sensor to adjust fan speeds according to air intake temperatures. Refer to the server board documentation for configuring use of the front panel sensor.

3.2 Server Board Fan Control

The fans provided in the Intel® Entry Server Chassis SC5299-E contain a tachometer signal that can be monitored by the server management subsystem for the Intel® Server Boards S5000XVN and S5000VSA. See the specific server board Technical Product Specification for details on how this feature works.

3.3 Cooling Solution

Air should flow through the system from front to back, as indicated by the arrows in the following figure.



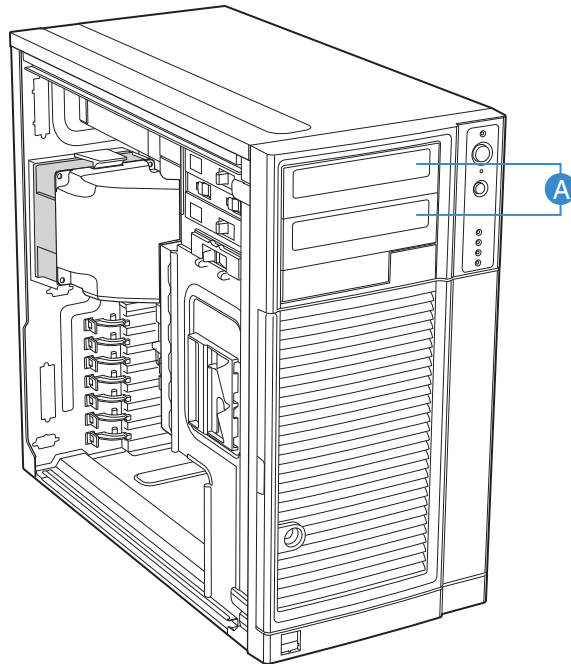
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Figure 21. Cooling Fan Configuration

The Intel® Entry Server Chassis SC5299-E is engineered to provide sufficient cooling for all internal components of the server. The cooling subsystem is dependent upon proper airflow. The designated cooling vents on both the front and back of the chassis must be left open and must not be blocked by improperly installed devices. All internal cables must be routed in a manner that does not impede airflow, and ducting provided for CPU cooling must be installed.

Active heatsinks for CPUs incorporate a fan to provide cooling. This thermal solution is included with some boxed Intel® Xeon™ processors. The Intel® Entry Server Chassis SC5299-E is engineered to work with processors that have an active heatsink solution. Proper installation of the processor cooling solution is required for circulating air toward the rear of the chassis (toward I/O connectors).

4. Peripheral and Hard Drive Support



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A. Hard Disk Drive Bay

Figure 22. Drive Bay Locations for Intel® Entry Server Chassis SC5299-E (DP/WS/BRP configuration shown)

4.1 3.5-in Peripheral Drive Bay

The Intel® Entry Server Chassis SC5299-E supports one 3.5-in removable media peripheral, such as a floppy or tape drive, below the 5.25-in peripheral bays. The bezel must be removed prior to 3.5-in removable media installation. When a drive is not installed, a snap-in EMI shield must be in place to ensure regulatory compliance. A cosmetic plastic filler is provided to snap into the bezel.

The 3.5-in bay is designed for tool-less insertion and removal so that no screws are required. On the right side of the chassis, two protrusions in the sheet metal help locate the drive. On the left side are two levers to lock the drive into place.

4.2 5.25-in Peripheral Drive Bays

The Intel® Entry Server Chassis SC5299-E supports two half-height 5.25-in removable media peripheral devices, such as a magnetic/optical disk, CD-ROM drive, or tape drive. These peripherals can be up to 9 inches (228.6 mm) deep on the non-redundant power chassis. The 650-W redundant power supply is longer in length and will limit the drives to approximately 7.5-in maximum length. As a guideline, the maximum recommended power per device is 17W.

Thermal performance of specific devices must be verified to ensure compliance to the manufacturer's specifications.

The 5.25-in peripherals can be inserted and removed without tools from the front of the chassis after taking off the access cover and removing the front bezel. The peripheral bay utilizes visual guide holes to correctly line up the position of peripheral drives. Locking slide levers push retaining pins into the drive to hold it securely in the bay. EMI shield panels are installed and should be retained in unused 5.25-in bays to ensure proper cooling and EMI conformance.

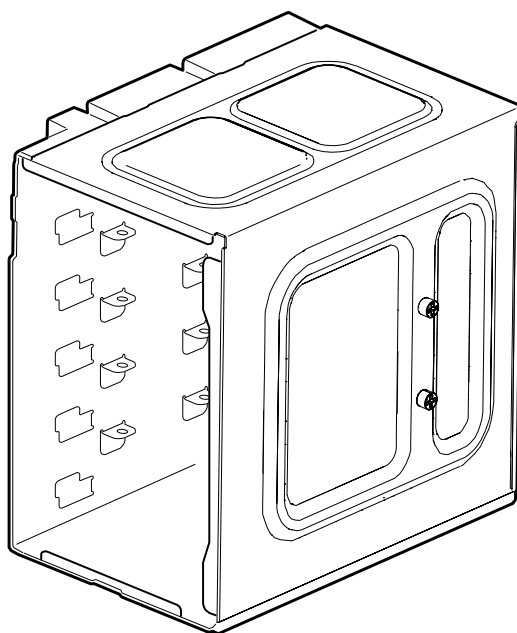
Note: Use caution when approaching the maximum level of integration for the 5.25-in drive bays. Power consumption of the devices integrated needs must be carefully considered to ensure that the maximum power levels of the power supply are not exceeded.

4.3 Hard Disk Drive Bays

4.3.1 Fixed Hard Drive Bay

The Intel® Entry Server Chassis SC5299-E comes with a removable hard drive bay that can accept up to six cabled 3.5-in x 1-in hard drives. Power requirements for each individual hard drive may limit the maximum number of drives that can be integrated into an Intel® Entry Server Chassis SC5299-E. The drive bay is designed to allow adequate airflow between drives, and no additional cooling fan is required. Drives must be installed in the order of slot 1, 3, 5 first (skipping slots) to ensure proper cooling. The drive bay is secured with a tool-less retention mechanism.

Note: The hard drive bay must be pushed forward or removed to install the server board.



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Figure 23. 6-HDD Fixed Drive Bay, Rear Isometric View

The Intel® Entry Server Chassis SC5299-E is capable of accepting a single SAS hot swap backplane hard drive enclosure in place of the fixed drive bay. Both backplanes (expanded and non-expanded) have a connector to accommodate a SAF-TE controller on an add-in card. Each backplane type supports up to six 1-in hot swap drives when mounted in the docking drive carrier.

4.3.2 SAS Non-expander/Serial-ATA (SATA) Hot Swap Back Plane (HSBP)

The Intel® Entry Server Chassis SC5299-E 6HDD SATA HSBP is a monolithic printed circuit board. The architecture is based on the QLogic* GEM424 enclosure management controller and has support for up to six SATA drives.

The Intel® Entry Server Chassis SC5299-E 6HDD SATA HSBP supports the following feature set:

- QLogic* GEM424 enclosure management controller
- External non-volatile SEEPROMs
- Three I²C interfaces
- SATA and SATA-II extension compatible
- Compliance with SATA Accessed Fault Tolerant Enclosures (SAF-TE) specification, version 1.00 and addendum
- Compliance with Intelligent Platform Management Interface 1.5 (IPMI)
- Support for up to six 1.5GHz SATA drives
- Hot-swap drive support
- Temperature sensor
- FRU EEPROM
- Two 4-pin standard hard drive power connectors

The following figure shows the functional blocks of the SATA HSBP:

SATA BACK PLANE BOARD - 6 PORT

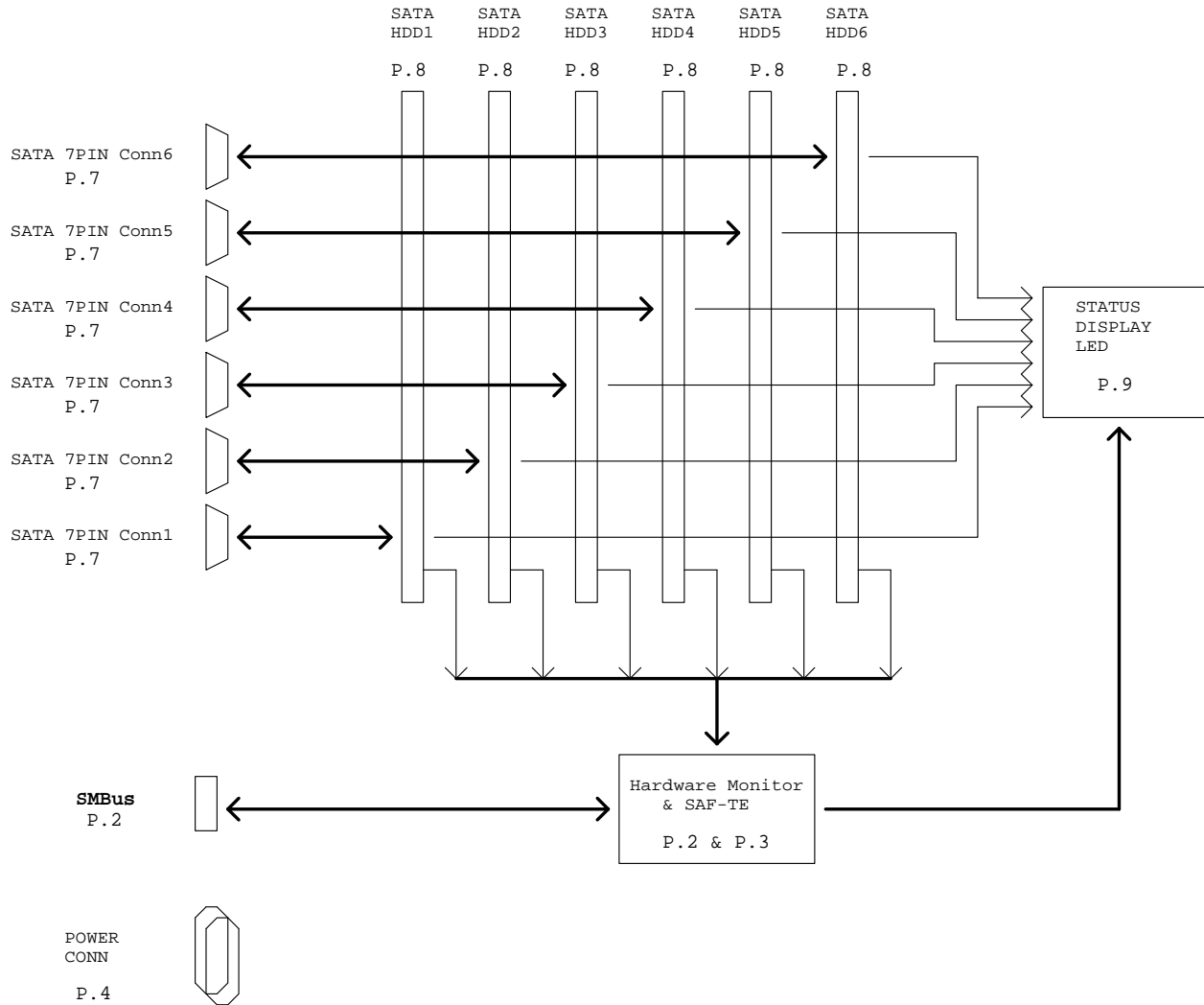


Figure 24. Intel® Entry Server Chassis SC5299-E 6HDD SATA HSBP Block Diagram

4.3.2.1 SATA Enclosure Management Controller

The QLogic* GEM424 enclosure management controller for the SATA backplane monitors various aspects of the storage enclosure. The chip provides out-of-band SAF-TE management through the SATA Host I²C interface. The GEM424 controller also supports the IPMI specification by providing management data to a baseboard management controller through the IPMB.

The GEM424 controller has general input and output pins (GPIOs) that allow for customization. These GPIOs are used for hardware drive detection and driving FAULT and ACTIVITY LEDs.

The GEM424 controller comes in an 80-pin Thin Quad Flat Pack (TQFP) package and operates from 3.3V and an input clock frequency of 20MHz.

4.3.2.2 SATA Interface

The GEM424 controller implements SAF-TE over the HBA I²C interface. The GEM424 controller supports the following SAF-TE Command Set:

- Read Enclosure Configuration
- Read Enclosure Status
- Read Device Slot Status
- Read Global Flags
- Write Device Slot Status
- Perform Slot Operation

4.3.2.3 I²C Serial Bus Interface

The GEM424 controller supports two independent I²C interface ports with bus speeds of up to 400Kbits. The I²C core incorporates 8-bit FIFOs for data transfer buffering. The I²C bus supports a National* LM75 or equivalent I²C -based temperature sensor. This enables actual temperature value readings to be returned to the host. The Intelligent Platform Management Bus (IPMB) is supported through the I²C port 0.

The following figure provides a block diagram of I²C bus connection implemented on the 6HDD SATA HSBP.

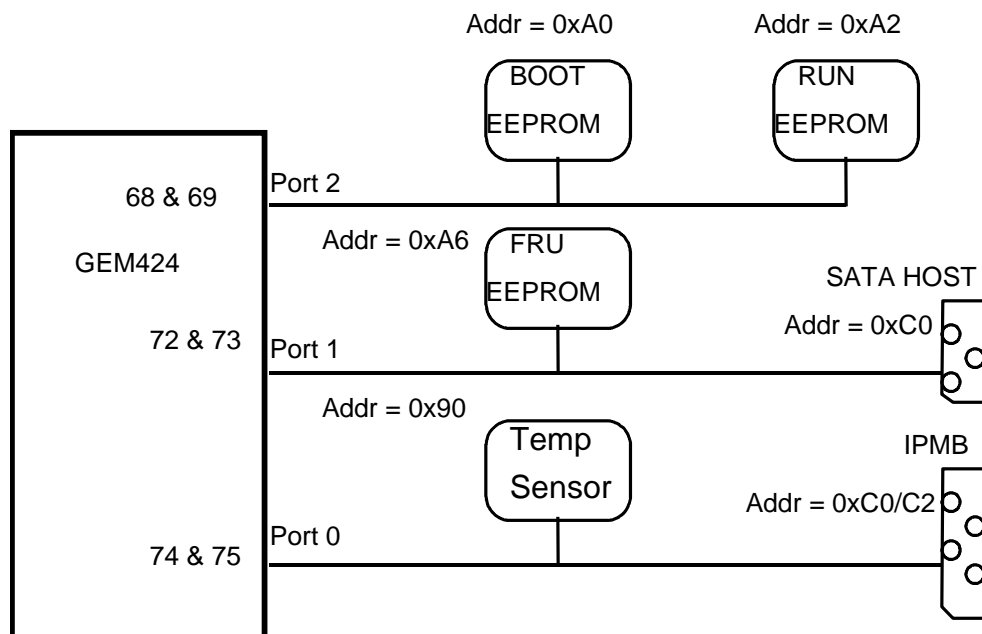


Figure 25. Intel® Entry Server Chassis SC5299-E 6HDD SATA Hot Swap Backplane I²C Bus Connection Diagram

4.3.2.3.1 I²C Bus Address and Loading

Table 129. I²C Bus Addressing

LM75 I²C Address	24C128 EEPROM I²C	24C512 EEPROM I²C	24C02 EEPROM I²C
90h	A0h	A2h	A6h

Table 130. I²C Bus Loading

Device	Power Well	V _{IH}	V _{IL}	V _{OL}	I _{leak}	CAP	I²C Address	I²C Bus Name
LM75	P5V	0.7V _{CC}	0.3V _{CC}	0.4V/3mA	6uA	20PF	94h	SDA0,SCL0
GEM424	P5V	0.7V _{CC}	0.3V _{CC}	0.4V/3mA	10uA	4PF	GEM424 allot	SDA0,SCL0
J13	P5V	0.7V _{CC} *	0.3V _{CC} *	0.4V/3mA*	10uA*	4/8P*	*	SDA0,SCL0
GEM424	P5V	0.7V _{CC}	0.3V _{CC}	0.4V/3mA	10uA	4PF	GEM424 allot	SDA1,SCL1
JP1	P5V	0.7V _{CC} *	0.3V _{CC} *	0.4V/3mA*	10uA*	4/8P*	*	SDA1,SCL1
GEM424	P5V	0.7V _{CC}	0.3V _{CC}	0.4V/3mA	10uA	4PF	GEM424 allot	SDA2,SCL2
PCA9554	P5V	0.7V _{CC}	0.3V _{CC}	0.4/3mA	10uA	10PF	40h	SDA2,SCL2

Device	Power Well	VIH	VIL	VoL	Ileak	CAP	I ² C Address	I ² C Bus Name
AT24C512	P5V	0.7VCC	0.3VCC	0.4V/2.1mA	3uA	8PF	A2h	SDA2,SCL2
AT24C128	P5V	0.7VCC	0.3VCC	0.4V/2.1mA	3uA	8PF	A0h	SDA2,SCL2
AT24C02	P5V	0.7VCC	0.3VCC	0.4V/2.1mA	3uA	8PF	A6h	SDA2,SCL2
JP2	P5V	0.7VCC*	0.3VCC*	0.4V/3mA*	10uA*	4/8P*	*	SDA2,SCL2

4.3.2.3.2 Temperature Sensor

The 6HDD SATA HSBP provides a National* LM75 or equivalent temperature sensor. The host can query the LM75 at any time to read the temperature.

The temperature sensor has an I²C address of 0x90h on Port 0 of the GEM424 controller.

4.3.2.3.3 Serial EEPROM

The 6HDD SATA HSBP provides an Atmel* 24C02 or equivalent serial EEPROM for storing the FRU information. The 24C02 EEPROM provides 2048 bits of serial electrically erasable and programmable read-only memory.

The serial EEPROM has an I²C address of 0xA6h and resides on Port 1 of the GEM424 controller.

4.3.2.4 General Purpose Input/Output (GPIO)

The GEM424 controller supports GPIO pins that are customizable. The following table lists the GPIO pins with their assigned functions.

Table 131. GEM424* Controller GPIO Assignment

GEM424 PIN NAME	I/O Type	Power Well	Programming Description	System Function	Reset State	Initial Value	Connection
GPIO0	O	3.3V	HDD0 Active LED	HD0_ACT_LED			Pull up 4.7K to 5V
GPIO1	O	3.3V	HDD1 Active LED	HD1_ACT_LED			Pull up 4.7K to 5V
GPIO2	O	3.3V	HDD2 Active LED	HD2_ACT_LED			Pull up 4.7K to 5V
GPIO3	O	3.3V	HDD3 Active LED	HD3_ACT_LED			Pull up 4.7K to 5V
GPIO4	O	3.3V	HDD4 Active LED	HD4_ACT_LED			Pull up 4.7K to 5V
GPIO5	O	3.3V	HDD5 Active LED	HD5_ACT_LED			Pull up 4.7K to 5V
GPIO6	O	3.3V	SATA HDD0 Status LED	HD0_FLT_LED_L			Pull up 4.7K to 5V
GPIO7	O	3.3V	SATA HDD1 Status LED	HD1_FLT_LED_L			Pull up 4.7K to 5V
GPIO8	O	3.3V	SATA HDD2 Status LED	HD2_FLT_LED_L			Pull up 4.7K to 5V
GPIO9	O	3.3V	SATA HDD3 Status LED	HD3_FLT_LED_L			Pull up 4.7K to 5V

GEM424 PIN NAME	I/O Type	Power Well	Programming Description	System Function	Reset State	Initial Value	Connection
GPIO10	O	3.3V	SATA HDD4 Status LED	HD4_FLT_LED_L			Pull up 4.7K to 5V
GPIO11	O	3.3V	SATA HDD5 Status LED	HD5_FLT_LED_L			Pull up 4.7K to 5V
GPIO12	I	3.3V	SATA HDD0 present detection	HD0_INSTALL_L			
GPIO13	I	3.3V	SATA HDD1 present detection	HD1_INSTALL_L			
GPIO14	I	3.3V	SATA HDD2 present detection	HD2_INSTALL_L			
GPIO15	I	3.3V	SATA HDD3 present detection	HD3_INSTALL_L			
GPIO16	I	3.3V	SATA HDD4 present detection	HD4_INSTALL_L			
GPIO17	I	3.3V	SATA HDD5 present detection	HD5_INSTALL_L			
GPIO18	O	3.3V	GPIO18				Pull up 4.7K to 5V
GPIO19	I	3.3V	FORCE UPDATE	FROCE_UPDATE_L			Pull up 4.7K to 5V
GPIO20	I	3.3V	I ² C Address control	I2C_ADDR_CNRL			Pull up 4.7K to 5V
GPIO21	O	3.3V	GPIO21				Pull up 4.7K to 5V
GPIO22	O	3.3V	GPIO22				Pull up 4.7K to 5V
GPIO23	O	3.3V	GPIO23				Pull up 4.7K to 5V

4.3.2.5 External Memory Device

The 6HDD SATA HSBP contains non-volatile 32K and 64K Serial EEPROM devices for Boot and Run-Time/Configuration code storage, respectively. These devices reside on the private I²C bus of the GEM424 controller.

The SEEPROMs operate off the 5.0V rail and are housed in 8-pin small-outline integrated circuit (SOIC) packages.

4.3.2.6 LEDs

The 6HDD SATA HSBP contains a green ACTIVITY LED and a yellow FAULT LED for each of the six drive connectors. The ACTIVITY LED is driven by the GEM424 or, for drives that support the feature, by the SATA hard drive itself whenever the drive is accessed. The FAULT LED is driven by the GEM424 controller whenever an error condition, as defined by the firmware, is detected.

Table 132. LED Function

Status LED	Definition
GREEN ON	HDD Activity
YELLOW ON	HDD Fail
YELLOW Blinking	Rebuild in progress

4.3.2.7 SATA Drive Connectors

The 6HDD SATA HSBP provides six 22-pin SATA connectors for hot-swap drives supporting a 1.5GHz transfer rate.

The following table defines the pin-out of the 7-pin SATA Control Connector (J1-J6).

Table 133. 7-Pin SATA Connector Pin-out

Connector Contact Number	Signal Name
1	GND
2	H_TXPn
3	H_TXNn
4	GND
5	H_RXNn
6	H_RXPn
7	GND

The following table defines the pin-out of the 22-pin SATA Drive Connector (J7-J12).

Table 134. 22-Pin SATA Connector Pin-out

Connector Contact Number	Signal Name
1	SATA HDD Present
2	H_TXPn
3	H_TXNn
4	GND
5	H_RXNn

Connector Contact Number	Signal Name
6	H_RXPn
7	GND
8	3.3V - NC
9	3.3V - NC
10	3.3V Precharge - NC
11	GND
12	GND
13	GND
14	5V Precharge
15	5V
16	5V
17	GND
18	
19	GND
20	12V Precharge
21	12V
22	12V
G1	GND
G2	GND

4.3.2.8 Power Connectors

The 6HDD SATA HSBP provides two standard 4-pin hard drive power connectors. The following table defines the pin-out of the 4-pin power connectors (JP4 and JP5).

Table 135. Power Connector Pin-out

Pin	Signal
1	12V
2	GND
3	GND
4	5V

4.3.2.9 Clock Generation and Distribution

The 6HDD SATA HSBP provides one clock source. A 20-MHz oscillator provides the clock to the GEM424 controller.

4.3.2.10 IPMB Header - IPMB

The following table defines the pin-out of the 4-pin IPMB Header (J13).

Table 136. IPMB Header Pin-out

Pin	Signal Name	Description
1	I ² C Address Control	IPMI interface address selection. Primary = 0xC0, Secondary = 0xC2
2	BP_I2C_SCL	Clock
3	GND	
4	BP_I2C_SDA	Data

4.3.2.11 SATA Host I²C Header - I2C_1

The following table defines the pin-out of the 3-pin SATA Host I²C Header (JP1).

Table 137. SATA Host I²C Header Pin-out

Pin	Signal Name	Description
1	BP_I2C_SDA	Data
2	GND	
3	BP_I2C_SCL	Clock

4.3.2.12 Board Layout

The following figure shows the board layout and connector placement of the SATA hot-swap backplane.

Note: Secondary side is mirrored.

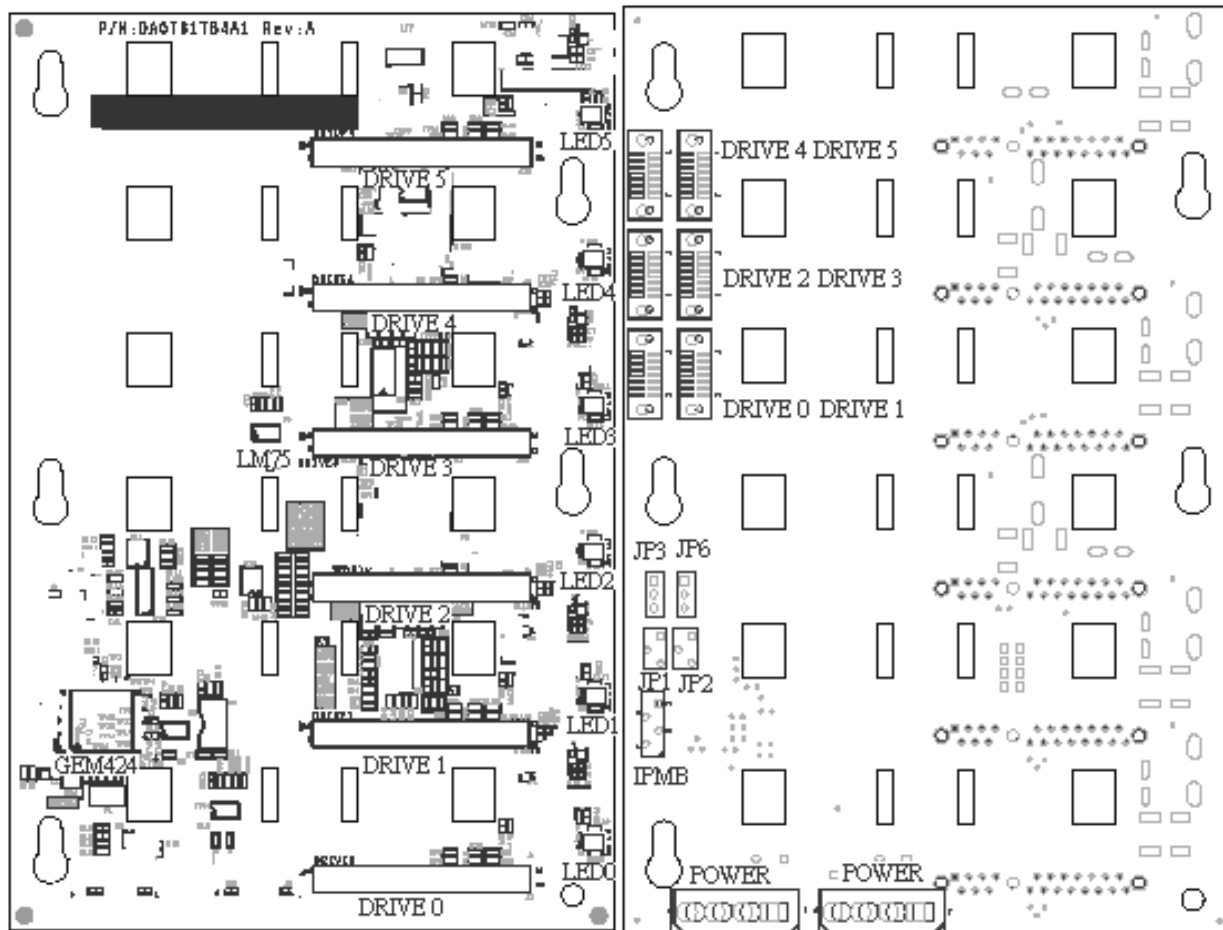


Figure 26. Intel® Entry Server Chassis SC5299-E 6HDD SATA Hot Swap Backplane Board Layout

4.3.2.13 Connector Specifications

Table 138. SATA Hot-swap Backplane Connector Specifications

Qty	Manufacturer and Part Number	Description	Reference
6	Amphenol G16A2111	SMD 7-pin SATA Control	J1 – J6
6	Foxconn LD28223-S03	THM 22-pin SATA Drive	J7 – J12
1	Molex 22-43-6040	THM 4-pin Header – IPMB J13	J13
1	Molex 22-43-6030	THM 3-pin Header – I ² C JP1, JP	JP1
2	Molex 8981-04V	THM 4-pin Connector – Power	JP4, JP5

4.3.2.14 SATA Hot Swap Drive Cage Upgrade Kit

The SATA drive cage upgrade kit allows for installation of up to six SATA drives in the server. The kit includes a SATA hot-swap drive bay with mounting hardware.

With this kit, the SATA hot-swap drive cage can be directly connected to the SATA connectors on the server board for those server boards that have integrated Serial ATA, or to a Serial ATA RAID card, such as the Intel® RAID Controller SRCS14L. The RAID level that is supported depends on the feature set of the Serial ATA controller.

Kit Order Codes

AXX6SATADB

APP4HSDBKIT

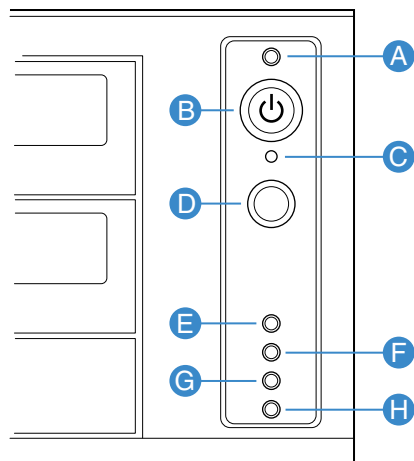
5. Standard Control Panel

The Intel® Entry Server Chassis SC5299-E control panel configuration has a three-button, five-LED control panel.

When the hot-swap drive bay is installed, a bi-color hard drive LED is located on each drive carrier (totally six) to indicate specific drive failure or activity. These LEDs are visible upon opening the front bezel door.

5.1 Control Panel

The control panel buttons and LED indicators are displayed in the following figure. The Entry Ebay SSI (rev 3.61) compliant front panel header for Intel® server boards is located on the back of the front panel. This allows for connection of a 24-pin ribbon cable for use with SSI rev 3.61-compliant server boards. The connector cable is compatible with the 24-pin SSI standard.



TP00872

- A. Power/Sleep LED
- B. Power button
- C. NMI button
- D. Reset Button
- E. LAN # 1 Activity LED
- F. LAN # 2 Activity LED
- G. Hard Drive Activity LED
- H. Status LED

Figure 27. Panel Controls and Indicators

Table 139. Control Panel LED Functions

LED Name	Color	Condition	Description
Power/Sleep LED	Green	ON	Power on
		OFF	Power off
LAN # 1- Link/Activity	Green	ON	Linked
		BLINK	LAN activity
		OFF	Disconnected
LAN # 2- Link/Activity	Green	ON	Linked
		BLINK	LAN activity
		OFF	Disconnected
Hard drive activity	Green	BLINK	Hard drive activity
		OFF	No activity
Status LED	Green	ON	System ready (not supported by all server boards)
		BLINK	Processor or memory disabled
	Amber	ON	Critical temperature or voltage fault; CPU/Terminator missing
		BLINK	Power fault; Fan fault; Non-critical temperature or voltage fault
		OFF	Fatal error during POST

Note: This is dependent on server board support. Not all server boards support all features. For additional details about control panel functions supported for a specific board, refer to the individual server board specifications.

6. Intel® Local Control Panel

The Intel® Local Control Panel (iLCP) utilizes a combination of control buttons, LEDs, and an LCD display to provide system accessibility, monitoring, and control functions independently from the operating system. Combined with an Intel Management Module, the iLCP allows a user to monitor the health of an Intel® server platform or configure an Intel server for remote IPMI management. The control panel assembly is pre-assembled and is modular in design. The module slides into a slot on the front of the chassis and is designed so that it can be adjusted for use with or without an outer front bezel.



Figure 28. SKU3 - Pedestal Server Application

Note: The Intel® Local Control Panel can only be used when either the Intel® Management Module Professional Edition or Advanced Edition is installed in the system. More information regarding the Intel® Local Control Panel can be found on the Intel support web site.

The following diagram provides an overview of the control panel features:



A	LCD Display (Variable content)
B	LCD Up Navigation Button
C	LCD Down Navigation Button
D	LCD Backup Level Navigation Button
E	LCD Command Enter Button

Figure 29. Local Control Panel Components

6.1 Internal Control Panel Headers

The control panel interface board has one internal header:

A 4-pin header provides control and status information to/from the server board via the IPMB interface. A 4-pin round cable connects the iLCP to the server board.

The following table provides the pin-out for each of these headers:

Table 140. IPMI Header

Pin #	Description
1	IPMB_5VSB_SDA
2	GND
3	IPMB_5VSB_SCL
4	P5V_STBY

7. System Interconnection

7.1 Signal Definitions

The pin-outs for the connectors referred to in this section are defined in the respective server board Technical Product Specification.

7.2 Chassis Internal Cables

7.2.1 Control Panel Cable

A 24-conductor ribbon cable with 24-pin IDC connectors links the control panel to the SSI EEB Revision 3.61-compliant server board.

7.2.2 USB Cable

An 8-conductor USB cable with a 10-pin server board connector and two 4-pin external USB connectors is used to connect the front mounted USB connectors to the server board.

7.2.3 Fan Connector

The installed system fan provides a 4-pin connector that is designed to mate with a SSI (ATX*)-3 and 4-pin compatible fan header.

7.2.4 Chassis Intrusion Cable

A 2-conductor chassis intrusion cable is included with the chassis kit. It is connected to the control panel through a 2-pin chassis intrusion header on the control panel board.

7.3 Server Board Internal Cables

Depending on the specific server board support for these features, some or all of the following cables may be included as part of the boxed board kit:

- IDE Cable: One or two 40-pin, 80-conductor DMA33/66/100 IDE cables.
- Serial Cable: One 9-conductor cable terminated in a 2x5 header at one end and a 9-pin panel mount D sub connector on the other (ships with the server board, not the chassis).
- SATA/SAS Data Cable: One or more cables with 7 contact connectors. These connectors may feature a right angle or straight housing design.

7.4 Accessory Cables

7.5 I/O Panel Connectors

The Intel® Entry Server Chassis SC5299-E provides an ATX 2.2 and SSI E-bay 3.61-compliant I/O aperture for the backside I/O. The specific panel used will be provided in the boxed server board kit. The following are typical panel connections:

- PS/2 keyboard connector
- PS/2 mouse connector
- 9-pin serial port(s)
- 25-pin parallel port
- USB port(s)
- 15-pin video port
- Ethernet RJ-45 connector(s)

7.6 Spares and Accessories

Product Code	Description
APP4RACKIT	Rack mounting kit
FXX550WPSU	Replacement 550-W power supply for DP
FPP4BRPCAGE	Replacement 650-W cage for DP
APP4650WPSU	650-W module for BRP – upgrade to redundant or replacement
FPP4PMKIT	Preventative maintenance kit: Plastic slide from fixed drive bay (2) CPU duct (2 separate parts) Intrusion switch assembly USB cable Front panel LED and switch cables (no PBA) Front panel cable (for FP PBA) Front panel board PS adapter plate (for fixed power supply) Power supply tool-less lock Chassis feet 120-mm fan (3-wire thermistor type) 120-mm Fan (4-wire type) 92-mm Fan (4-wire type)
FPP4FANKIT4W	Replacement 120-mm and 92-mm 4-wire fans
APP3HSDBKIT	Hot-swap bay mounting bracket kit (includes 2 brackets, one fan shroud, and one 92-mm fan)
APP3STDBEZEL	Standard bezel (WS, DP, BRP)
FXXPP4FPBRD	Replacement front panel board
AXX6SASDB	6-Drive SAS/SATA hot-swap cage
AXX6SCSIDB	6-Drive SCSI hot-swap cage

8. Supported Intel® Server Boards

The Intel® Entry Server Chassis SC5299-E is mechanically and functionally designed to support the following Intel® server boards:

- Intel® Server Board S5000XVN
- Intel® Server Board S5000VSA
- Intel® Server Board S5000PSL
- Intel® Server Board S5000XSL
- Intel® Server Board S3000AH
- Intel® Server Board S3200SHV, S3210SHLC and S3210SHLX
- Intel® Server Board S3430GPV, S3420GPLC and S3420GPLX

9. Regulatory, Environmentals, and Specifications

9.1 Product Regulatory Compliance

WARNING

To ensure regulatory compliance, you must adhere to the assembly instructions included with this chassis to ensure and maintain compliance with existing product certifications and approvals. Use only the described, regulated components specified in this specification. Use of other products/components will void the UL listing and other regulatory approvals of the product and will most likely result in noncompliance with product regulations in the region(s) in which the product is sold.

The final configuration of your end system product may require additional EMC compliance testing. For more information, please contact your local Intel Representative.

This is an FCC Class A device. Integration of it into a Class B chassis does not result in a Class B device.

This server chassis product, when correctly integrated, complies with the following safety and electromagnetic compatibility (EMC) regulations.

9.1.1 Product Safety Compliance

The Intel® Entry Server Chassis SC5299-E complies with the following safety requirements:

- UL60950 – CSA 60950(USA/Canada)
- EN60950 (Europe)
- IEC60950 (International)
- CB Certificate & Report, IEC60950 (report to include all country national deviations)
- GS License (Germany)
- GOST R 50377-92 - License (Russia)
- Belarus Licence (Belarus)
- Ukraine Licence (Ukraine)
- CE - Low Voltage Directive 73/23/EEE (Europe)
- IRAM Certification (Argentina)

9.1.2 Product EMC Compliance – Class A Compliance

The Intel® Entry Server Chassis SC5299-E has been tested and verified to comply with the following electromagnetic compatibility (EMC) regulations when configured with an Intel® compatible server board. For information on compatible server boards, refer to Intel's Server Builder website or contact your local Intel representative.

- FCC /ICES-003 - Emissions (USA/Canada) Verification
- CISPR 22 – Emissions (International)
- EN55022 - Emissions (Europe)

- EN55024 - Immunity (Europe)
- EN61000-3-2 - Harmonics (Europe)
- EN61000-3-3 - Voltage Flicker (Europe)
- CE – EMC Directive 89/336/EEC (Europe)
- VCCI Emissions (Japan)
- AS/NZS 3548 Emissions (Australia/New Zealand)
- BSMI CNS13438 Emissions (Taiwan)
- GOST R 29216-91 Emissions (Russia)
- GOST R 50628-95 Immunity (Russia)
- Belarus License (Belarus)
- Ukraine License (Ukraine)
- RRL MIC Notice No. 1997-41 (EMC) & 1997-42 (EMI) (Korea)

9.1.3 Product Ecology Requirements








- All materials, parts and subassemblies do not contain restricted materials as defined in Intel's Environmental Product Content Specification of Suppliers and Outsourced Manufacturers. The Environmental Content Specification includes the ban of substances noted in the European Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC – <http://supplier.intel.com/ehs/environmental.htm>.
- Plastic parts do not use brominated flame retardant or any other halogenated retardants that are not accepted by environmental programs, such as Blue Angels, Nordic White Swan, and Swedish TCO.
- All plastic parts that weigh >25gm are marked with the ISO11469 requirements for recycling. Example: >PC/ABS<
- Packaging materials may not contain more than 100 ppm (total) of lead, cadmium, chromium or mercury.
- If sold as a retail product, packaging materials must be marked with applicable recycling logos for Europe (green dot) and Japan (Eco-marks).
- All cords and cables contain <100 ppm of cadmium.

9.1.4 Certifications/Registrations/Declarations

- UL Certification (US/Canada)
- CE Declaration of Conformity (CENELEC Europe)
- FCC/ICES-003 Class A Attestation (USA/Canada)
- VCCI Certification (Japan)
- C-Tick Declaration of Conformity (Australia)
- MED Declaration of Conformity (New Zealand)
- BSMI Certification (Taiwan)
- GOST R Certification/Licence (Russia)
- Belarus Certification/Licence (Belarus)
- RRL Certification (Korea)
- IRAM Certification (Argentina)
- Ecology Declaration (International)

9.1.5 Product Regulatory Compliance Markings

This Intel® server chassis product bears the following regulatory marks.

Regulatory Compliance	Region	Marking
cULus Listing Marks	USA/Canada	
GS Mark	Germany	
CE Mark	Europe	
FCC Marking (Class A)	USA	This device complies with Part 15 of the FCC Rules. Operation of this device is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. Manufactured by Intel Corporation
EMC Marking (Class A)	Canada	CANADA ICES-003 CLASS A CANADA NMB-003 CLASSE A
C-Tick Mark	Australia/New Zealand	
VCCI Marking (Class A)	Japan	この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。VCCI-A
BSMI Certification Number & Class A Warning	Taiwan	
		警告使用者： 這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策
GOST R Marking	Russia	
RRL MIC Mark	Korea	

9.2 Electromagnetic Compatibility Notices

9.2.1 FCC Verification Statement (USA)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Intel Corporation
5200 N.E. Elam Young Parkway
Hillsboro, OR 97124-6497
Phone: 1-800-628-8686

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment. The customer is responsible for ensuring compliance of the modified product.

Only peripherals (computer input/output devices, terminals, printers, etc.) that comply with FCC Class A or B limits may be attached to this computer product. Operation with non-compliant peripherals is likely to result in interference to radio and TV reception.

All cables used to connect to peripherals must be shielded and grounded. Operation with cables connected to peripherals that are not shielded and grounded may result in interference to radio and TV reception.

9.2.2 ICES-003 (Canada)

Cet appareil numérique respecte les limites bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques", NMB-003 édictée par le Ministre Canadien des Communications.

(English translation of the notice above) This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the interference-causing

equipment standard entitled “Digital Apparatus,” ICES-003 of the Canadian Department of Communications.

9.2.3 Europe (CE Declaration of Conformity)

This product has been tested in accordance to, and complies with the Low Voltage Directive (73/23/EEC) and EMC Directive (89/336/EEC). The product has been marked with the CE Mark to illustrate its compliance.

9.2.4 Japan EMC Compatibility

Electromagnetic Compatibility Notices (International)

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

English translation of the above notice:

This is a Class A product based on the standard of the Voluntary Control Council For Interference (VCCI) from Information Technology Equipment. If this is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

9.2.5 BSMI (Taiwan)

The BSMI Certification number and the following warning is located on the product safety label, which is located on the bottom side (pedestal orientation) or side (rack mount configuration).

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

9.2.6 RRL (Korea)

Following is the RRL certification information for Korea.



1. 기기의 명칭(모델명) :
2. 인증번호 :
3. 인증받은 자의 상호 :
4. 제조년월일 :
5. 제조자/제조국가 :

English translation of the notice above:

1. Type of Equipment (Model Name): On License and Product
2. Certification No.: On RRL certificate. Obtain certificate from local Intel representative

3. Name of Certification Recipient: Intel Corporation
4. Date of Manufacturer: Refer to date code on product
5. Manufacturer/Nation: Intel Corporation/Refer to country of origin marked on product

9.3 Regulated Specified Components

To maintain the UL listing and compliance to other regulatory certifications and/or declarations, the following regulated components must be used and conditions adhered to. Interchanging or use of other component will void the UL listing and other product certifications and approvals.

- **Server Chassis** - (Base chassis is provided with power supply and fans) UL listed.
- **Server board** - Must use an Intel® server board—UL recognized.
- **Add-in boards** - Must have a printed wiring board flammability rating of minimum UL94V-1. Add-in boards containing external power connectors and/or lithium batteries must be UL recognized or UL listed. Any add-in board containing modem telecommunication circuitry must be UL listed. In addition, the modem must have the appropriate telecommunications, safety, and EMC approvals for the region in which it is sold.
- **Peripheral Storage Devices** - must be UL recognized or UL listed accessory and TUV or VDE licensed. Maximum power rating of any one device is 19 watts. Total server configuration is not to exceed the maximum loading conditions of the power supply.

9.4 End of Life/Product Recycling

Product recycling and end-of-life take back systems and requirements vary from country to country. Contact the retailer or distributor of this product for information on product recycling and/or take back.

9.5 Restriction of Hazardous Substances (RoHS) Compliance

Intel has a system in place to restrict the use of banned substances in accordance with the European Directive 2002/95/EC. Compliance is based on declaration that materials banned in the RoHS Directive are either (1) below all applicable substance threshold limits, or (2) an approved/pending RoHS exception applies.

Note: RoHS implementing details are not fully defined and may change.

Threshold limits and banned substances are noted as follows:

- Quantity limit of 0.1% by mass (1000 PPM) for:
 - Lead
 - Mercury
 - Hexavalent Chromium
 - Polybrominated Biphenyls Diphenyl Ethers (PBDE, PBB)
- Quantity limit of 0.01% by mass (100 PPM) for:

- Cadmium

9.6 Replacing the Back up Battery

The lithium battery on the server board powers the real time clock (RTC) for up to 10 years in the absence of power. When the battery starts to weaken, it loses voltage, and the server settings stored in CMOS RAM in the RTC (for example, the date and time) may be wrong. Contact your customer service representative or dealer for a list of approved devices.



WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the equipment manufacturer. Discard used batteries according to manufacturer's instructions.



ADVARSEL!

Lithiumbatteri - Eksplosionsfare ved fejlagtig håndtering. Udskiftning må kun ske med batteri af samme fabrikat og type. Levér det brugte batteri tilbage til leverandøren.



ADVARSEL

Lithiumbatteri - Eksplosjonsfare. Ved utskifting benyttes kun batteri som anbefalt av apparatfabrikanten. Brukt batteri returneres apparatleverandøren.



WARNING

Explosionsfara vid felaktigt batteribyte. Använd samma batterityp eller en ekvivalent typ som rekommenderas av apparattillverkaren. Kassera använt batteri enligt fabrikantens instruktion.



VAROITUS

Paristo voi räjähtää, jos se on virheellisesti asennettu. Vaihda paristo ainoastaan laitevalmistajan suosittelemaan tyyppiin. Hävitä käytetty paristo valmistajan ohjeiden mukaisesti.

9.7 System-level Environmental Limits

The following table defines the system level operating and non-operating environmental limits (office or computer room environment).

Table 141. System Office Environment Summary

Parameter	Limits
Operating Temperature	5°C to 40°C
Non-Operating Temperature	-40°C to 70°C
Non-Operating Humidity	35°C @ 90% RH
Acoustic noise	Workstation: TBD
Shock, operating	2g, 11 ms 1/2 Sine, 20g, 2ms, 1/2 Sine
Shock, unpackaged	25G Trapezoidal Shock
Shock, packaged	24" Free Fall, >40, <80lbs; 30" Free Fall, >20, <40lbs
Vibration, unpackaged	5Hz to 500Hz, 2.2 grms random profile
Vibration, packaged	5Hz to 500Hz, 1.09 grms random profile
ESD	2kV to 15 kV Air Discharge, 2kV to 8kV Contact Discharge
System Cooling Requirement in BTU/hr	

9.8 BTU Information

BTU, short for British Thermal Unit, is a British standard unit of energy. One BTU is equal to the amount of heat required to raise the temperature of one pound of liquid water by 1 degree Fahrenheit at its maximum density, which occurs at a temperature of 39.1 degrees Fahrenheit. One BTU is equal to approximately 251.9 calories or 1055 joules.

The heat output of computer devices is often expressed in BTUs. The following table provides the BTU information for each SKU of the Intel® Entry Server Chassis SC5299-E.

Table 142. System BTU Information Table

Power Supply	Max Continuous Output	Efficiency at 100% Loading	BTU/hr
SC5299UP (420W)	450W	70%	2192
SC5299DP (550W)	550W	70%	2679
SC5299BRP (650W)	610W	75% for power supply module 85% for DC to DC	3263
SC5299WS (670W)	670W	68%	3360

9.9 Serviceability and Availability

This system is designed to be serviced by qualified technical personnel only.

The desired Mean Time To Repair (MTTR) of the system is 30 minutes including diagnosis of the system problem. To meet this goal, the system enclosure and hardware have been designed to minimize the MTTR.

Following are the maximum times that a trained field service technician should take to perform the listed system maintenance procedures, after diagnosis of the system.

Table 143. Mean Time To Repair Estimate

Activity	Time Estimate
Remove cover	< 1 minute
Remove and replace hard disk drive	1 minute
Remove and replace 5.25-in peripheral device	1 minute
Remove and replace fixed power supply module	1 minute
Remove and replace hot-swap power supply module	< 1 minute
Remove and replace drive cage fan	5 minutes
Remove and replace system fan	1 minute
Remove and replace backplane board	5 minutes
Remove and replace control panel board	5 minutes
Remove and replace server board	5 minutes

9.10 Calculated MTBF

The calculated MTBF (Mean Time Between Failures) for the Intel® Entry Server Chassis SC5299-E, as configured from the factory, is presented in the following tables.

Table 144. Intel® Entry Server Chassis SC5299-E Component MTBF

Subassembly (Server in 35 degrees C ambient air)	Server Model			
	DP, WS		DP, WS	
	Standard Configuration		With HSBP	
	MTBF (hours)	FIT (flrs/10 ⁹ hrs)	MTBF (hours)	FIT (flrs/10 ⁹ hrs)
Power Supply	100,000	10,000	100,000	10,000
Power Supply (non-redundant with power distribution board)				
Cooling fan	500,000	2,000	500,000	2,000
Hot-swap Backplane			1,500,000	667
Front Panel Board	7,000,000	143	7,000,000	143
Intrusion Switch	25,000,000	40	25,000,000	40
Total Chassis Assembly	82100	12,183	77900	12,850

Subassembly (Server in 35 degrees C ambient air)	Server Model			
	BRP		BRP	
	Standard Configuration		With HSBP	
	MTBF (hours)	FIT (flrs/10 ⁹ hrs)	MTBF (hours)	FIT (flrs/10 ⁹ hrs)
Power Supply				
Power Supply (non-redundant with power distribution board)	90,000	11,111	90,000	11,111
Cooling fan	500,000	2,000	500,000	2,000
Hot-swap Backplane			1,500,000	667
Front Panel Board	7,000,000	143	7,000,000	143
Intrusion Switch	25,000,000	40	25,000,000	40
Total Chassis Assembly	75300	13,294	71700	13,961

Appendix A: Integration and Usage Tips

This appendix provides a list of useful information that is unique to the Intel® Entry Server Chassis SC5299-E and should be kept in mind while integrating and configuring your server.

To maintain system thermals, fixed hard drive bays must be populated in the slots in this order: 1, 3, 5, 2, 4, and 6.

To maintain system thermals, hot-swap hard drive bays must be populated with either a hard drive or drive blank.

System fans are not hot swappable.

The CPU air duct(s) must be used to maintain system thermals.

The Intel® Local Control Panel can only be used with systems configured with an Intel® Management Module.

Make sure the latest system software is loaded on the server. This includes system BIOS, FRU/SDR, BMC firmware, and hot-swap controller firmware. The latest system software can be downloaded from:

<http://support.intel.com/support/motherboards/server/>

Glossary

Word/Acronym	Definition
ACA	Australian Communication Authority
ANSI	American National Standards Institute
ATX	Advanced Technology Extended
Auto-Ranging	Power supply that automatically senses and adjust itself to the proper input voltage range (110 VAC or 220 VAC). No manual switches or manual adjustments are needed.
BMC	Baseboard Management Controller
CFM	Cubic Feet per Minute (airflow)
CMOS	Complementary Metal Oxide Silicon
Dropout	A condition that allows the line voltage input to the power supply to drop to below the minimum operating voltage.
EEB	Entry E-Bay
EMP	Emergency Management Port
FP	Front Panel
FRB	Fault Resilient Booting
FRU	Field Replaceable Unit
HSBP	Hot Swap Backplane
Latch Off	A power supply, after detecting a fault condition, shuts itself off. Even if the fault condition disappears the supply does not restart unless manual or electronic intervention occurs. Manual intervention commonly includes briefly removing and then reconnecting the supply, or it could be done through a switch. Electronic intervention could be done by electronic signals in the Server System.
LCD	Liquid Crystal Display
LCP	Local Control Panel
LPC	Low-Pin Count
Monotonically	A waveform changes from one level to another in a steady fashion, without intermediate retrenchment or oscillation.
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
Noise	The periodic or random signals over frequency band of 10 Hz to 20 MHz.
OTP	Over Temperature Protection

Word/Acronym	Definition
Over-current	A condition in which a supply attempts to provide more output current than the amount for which it is rated. This commonly occurs if there is a 'short circuit' condition in the load attached to the supply.
OVP	Over Voltage Protection
PDB	Power Distribution Board
PFC	Power Factor Correction
PSU	Power Supply Unit
PWOK	A typical logic level output signal provided by the supply that signals the Server System that all DC output voltages are within their specified range
RI	Ring Indicate
Ripple	The periodic or random signals over frequency band of 10 Hz to 20 MHz.
Rise Time	Rise time is defined as the time it takes any output voltage to rise from 10% to 95% of its nominal voltage.
Sag	The condition where the AC line voltage drops below the nominal voltage conditions
SCA	Single Connector Attachment
SDR	Sensor Data Record
SE	Single-Ended
SSI	Server Standards Infrastructure
Surge	The condition where the AC line voltage rises above nominal voltage.
THD	Total Harmonic Distortion
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VCCI	Voluntary Control Council for Interference
VSB or Stand By	An output voltage that is present whenever AC power is applied to the AC inputs of the supply.