Intel® Storage System JBOD 2000 Family

Hardware Guide

Revision 1.0

March 2013

Enterprise Platforms and Services Division

Revision History

Date	Revision Number	Modifications
December 2012	0.9	Pre- Production Release
March 2013	1.0	First release

Disclaimers

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1. Introduction

This Hardware Guide provides system level information for the Intel® Storage System JBOD 2000 Family.

This document will describe the functions and features of JBOD product which includes the chassis layout, system boards, power sub-system, cooling sub-system, storage sub-system options, and available installable options.
Intel® Storage System JBOD 2000 Family

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1.1 Server Product Use Disclaimer

It is the responsibility of the system integrator who chooses not to use Intel®-developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of airflow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail to operate correctly when used outside any of their published operating or non-operating limits.

1.2 Product Errata

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Product Errata are documented in the *Intel® Storage System JBOD 2000 Family Monthly Specification Update* which can be downloaded from http://www.Intel.com

2. Product Family Overview

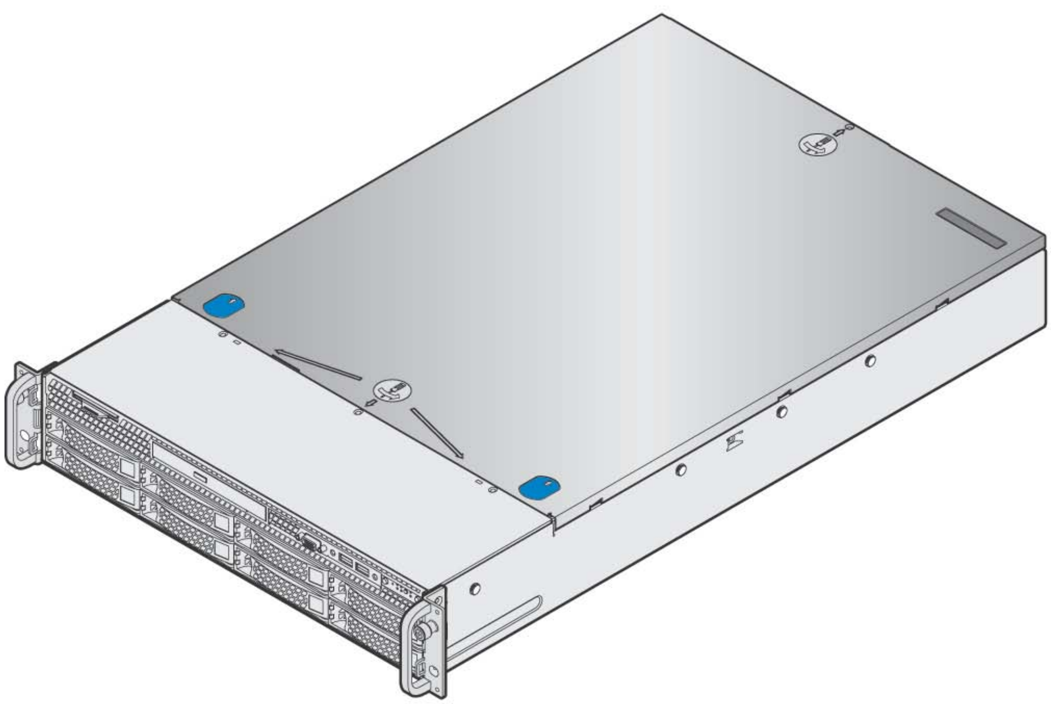
This generation of Intel® Storage System JBOD 2000 Family offers a variety of options to meet the configuration requirements of high-density high-performance computing environments. The Intel® Storage System JBOD 2000 Family is comprised of three product offerings.

Note: The following table lists features common to the Intel® Storage System JBOD 2000 Family. Features that are unique to one product in the family will be identified by denoting the full JBOD Product Code name.

Intel® Storage System JBOD 2000 Family	Description
JBOD2224S2DP	2U JBOD supports 24 x 2.5" drives, with dual port backplane.
JBOD2224S2SP	2U JBOD supports 24 x 2.5" drives, with single port backplane.
JBOD2312S2SP	2U JBOD supports 12 x 3.5" drives, with single port backplane.

Table 1. System Feature Set

This chapter provides a high-level overview of the Intel® Storage System JBOD 2000 Family features and available options as supported in different JBOD SKUs. Greater detail for each major system component or feature is provided in the following chapters.



2.1 Chassis Dimensions

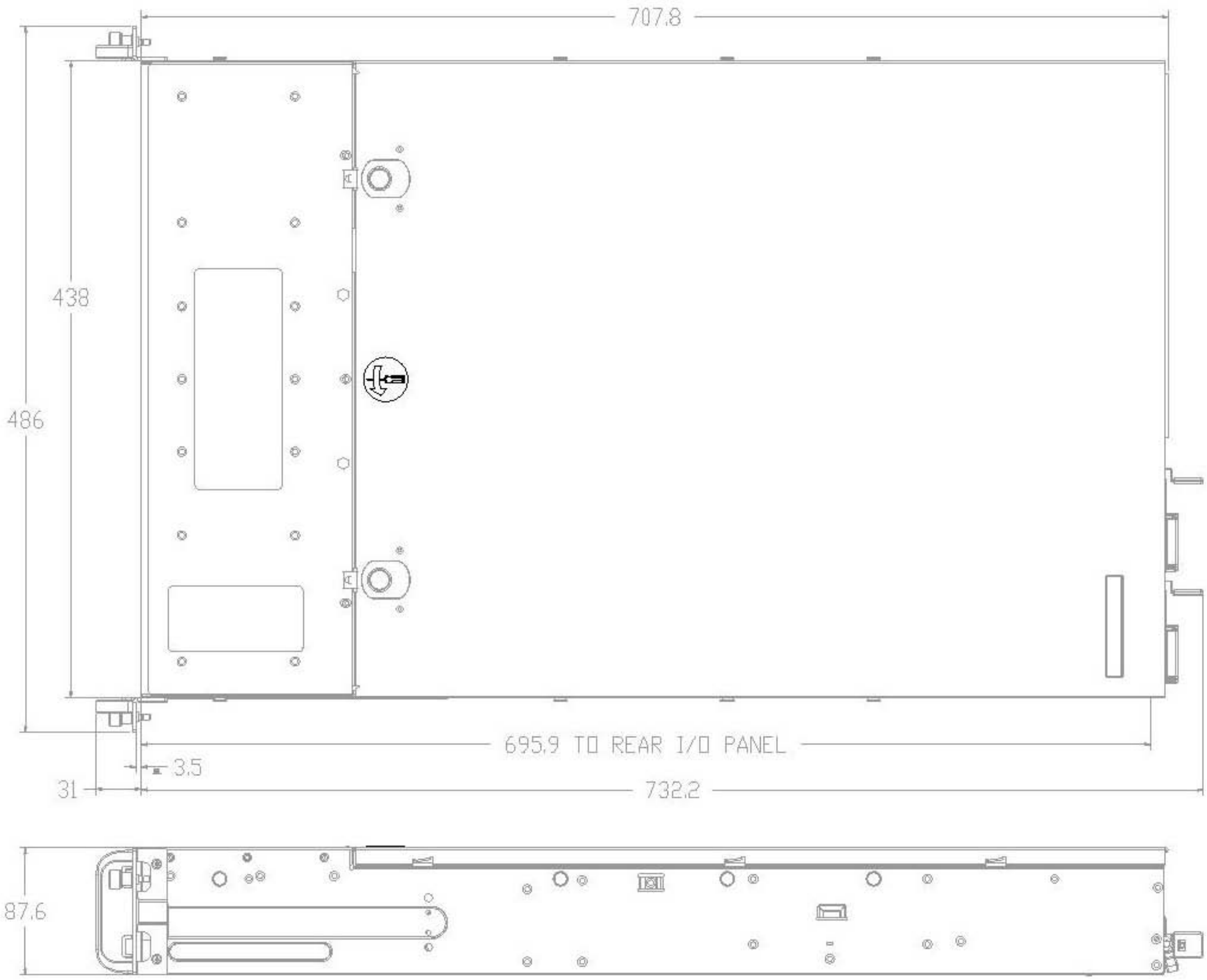


Figure 1. Chassis Dimensions

2.2 System Level Environmental Limits

To keep the system operating within supported maximum thermal limits, the system must meet the following operating and configuration guidelines:

• The system operating ambient is designed for sustained operation up to 35ºC (ASHRAE Class A2) with short term excursion based operation up to 45ºC (ASHRAE Class A4). o The system can operate up to 40ºC (ASHRAE Class A3) for up to 900 hours per year

- o The system can operate up to 45ºC (ASHRAE Class A4) for up to 90 hours per year
- o When operating within the extended operating temperature range, then system performance may be impacted.
- o There is no system reliability impact when operating at the extended temperature range within the approved limits.

The following table defines the system level operating and non-operating environmental limits.

Table 2. System Environmental Limits Summary

Parameters		**Limits**
Temperature		
	Operating	ASHRAE Class A2 – Continuous Operation. 10º C to 35º C (50º F to 95º F) with the maximum rate of change not to exceed 10°C per hour
		ASHRAE Class A3 – Includes operation up to 40C for up to 900 hrs per year.
		ASHRAE Class A4 – Includes operation up to 45C for up to 90 hrs per year.
	Shipping	-40º C to 70º C (-40º F to 158º F)
Altitude		
	Operating	Support operation up to 3050m with ASHRAE class deratings.
Humidity		
	Shipping	50% to 90%, non-condensing with a maximum wet bulb of 28° C (at temperatures from 25° C to 35° C)
Shock		
	Operating	Half sine, 2g, 11 mSec
	Unpackaged	Trapezoidal, 25 g, velocity change is based on packaged weight
	Packaged	Product Weight: ≥ 40 to < 80 Non-palletized Free Fall Height = 18 inches Palletized (single product) Free Fall Height = NA
Vibration		
	Unpackaged	5 Hz to 500 Hz 2.20 g RMS random
	Packaged	5 Hz to 500 Hz 1.09 g RMS random
AC-DC		
	Voltage	90 V AC to 132 V AC and 180 V AC to 264 V AC
	Frequency	47 Hz to 63 Hz
	Source Interrupt	No loss of data for power line drop-out of 12 mSec
	Surge Non-operating and operating	Unidirectional
	Line to earth Only	AC Leads 2.0 kV I/O Leads 1.0 kV DC Leads 0.5 kV
ESD		
	Air Discharged	12.0 kV

	Contact Discharge	8.0 kV
Acoustics Sound Power Measured		
	Power in Watts	<300 W ≥300 W ≥600 W ≥1000 W
	Servers/Rack Mount BA	7.0 7.0 7.0 7.0

2.3 System Features and Options Overview

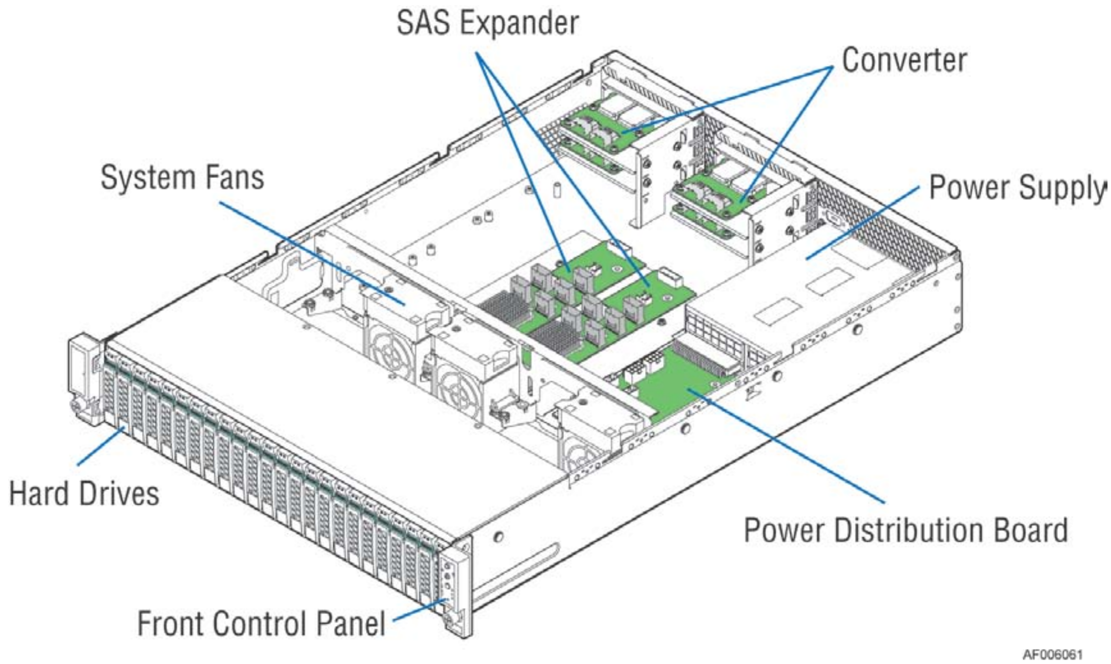


Figure 2. System Components Overview

2.3.1 Hot Swap Hard Drive Bay and Front Panel Options

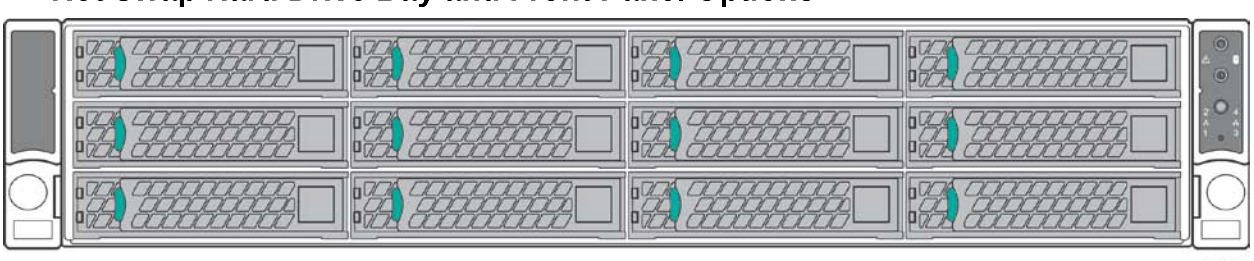


Figure 3. 3.5" Hard Drive Bay - 12 Drive Configuration

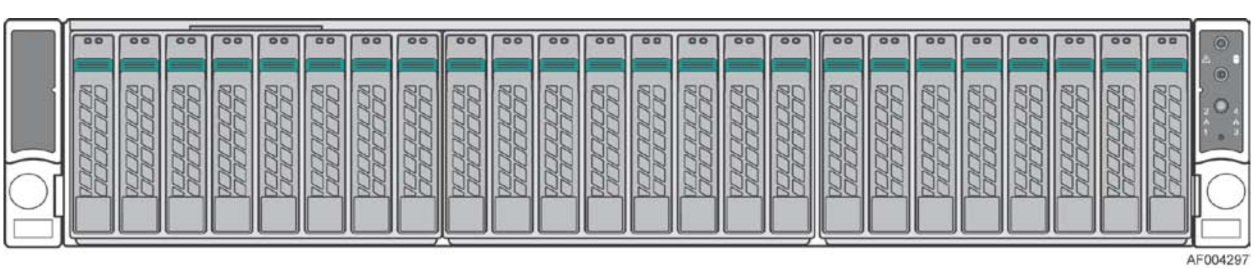


Figure 4. 2.5" Hard Drive Bay - 24 Drive Configuration

2.3.2 Back Panel Features

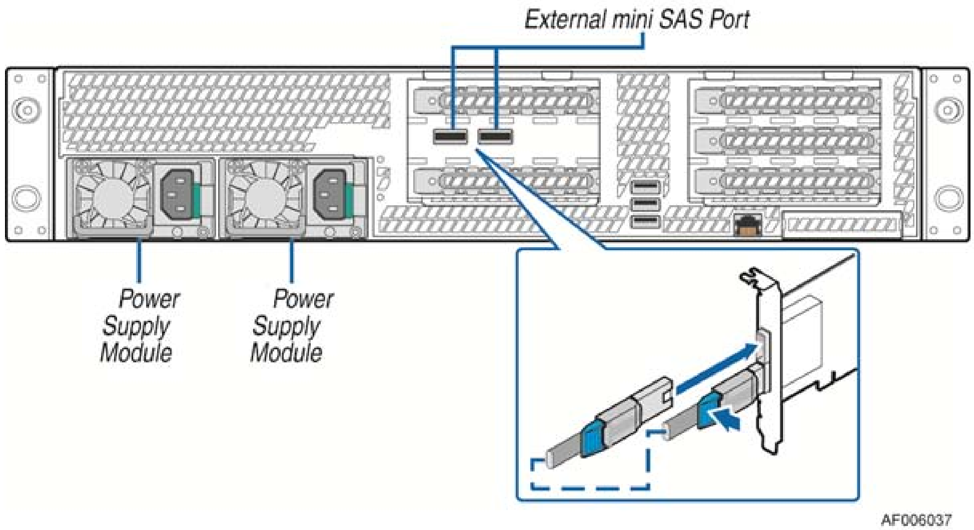
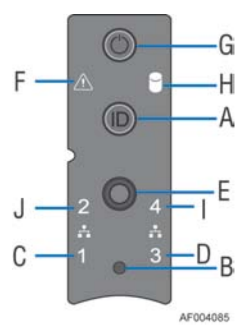


Figure 5. Back Panel Feature Identification

2.3.3 Front Panel Options



Label	Description	Label	Description
A	Non-functional	F	System Status LED
B	Non-functional	G	Power Button w/Integrated LED
C	Non-functional	H	Non-functional
D	Non-functional	I	Non-functional
E	Non-functional	J	Non-functional

Figure 6. Front Panel Options

2.4 Expander Board

Intel® RAID Expander Features:

- SAS protocol, described in the Serial Attached SCSI (SAS) Standard, version 2.0
- Serial SCSI Protocol (SSP) to enable communication with other SAS devices
- Serial Tunneling Protocol (STP) support for SATA II through expander interfaces
- Serial Management Protocol (SMP) to share topology management information with expanders
- Supports SES for enclosure management
- Output mini-SAS connectors support sideband SGPIO as per SFF-8485 specification
- Supports both Serial Attached SCSI and Serial ATA device targets
- 6.0 Gbit/s, 3.0 Gbit/s, and 1.5 Gbit/s data transfer rate
- SFF-8087 mini-SAS connectors
- Provides a low-latency connection to create and maintain transparent access to each connected SAS/SATA physical drive
- Staggered spin-up
- Hot Plug
- Native Command Queuing
- Allows multiple initiators to address a single target (in a fail-over configuration)

2.4.1 36-Port Internal Intel RAID Expander Cards

All JBOD SKU's will be using the 36-port SAS expander card.

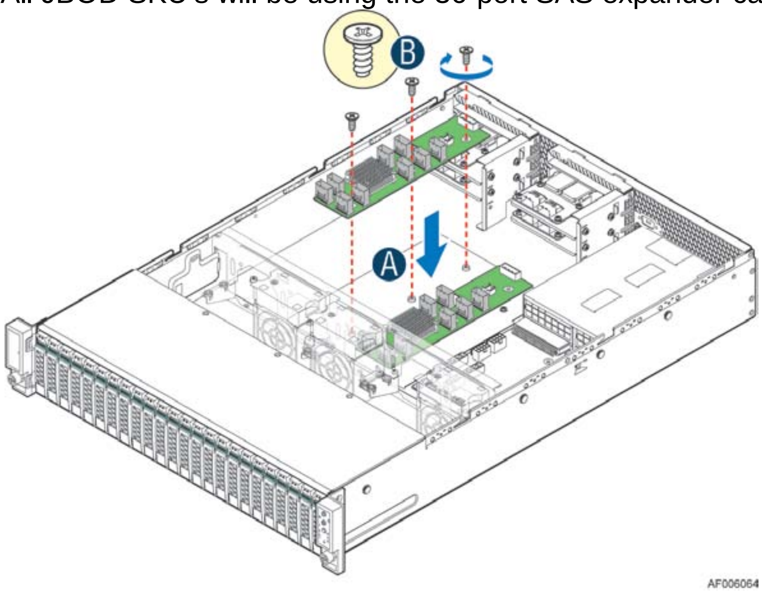


Figure 7. Internal SAS Expander location

The following diagram is used to help identify the mini-SAS connectors found on the SAS expander cards. Care should be taken when connecting connectors from the SAS expander to the connectors on the backplane because each connector is pre-programmed at the factory to provide specific drive identification mapping. Improper connections may provide undesirable drive mappings. By default, the Intel® Storage System JBOD 2000 Family has all mini-SAS cables connected.

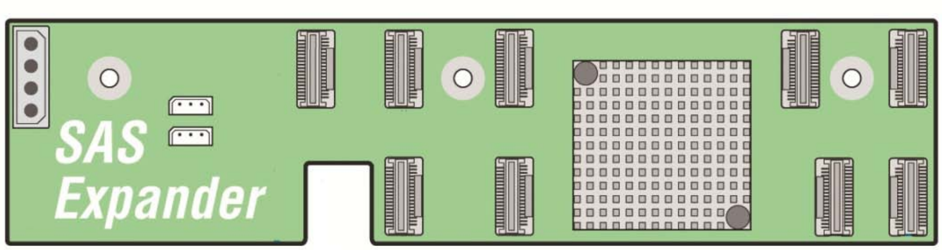


Figure 8. Internal 36-Port SAS Expander Card (RES2CV360)

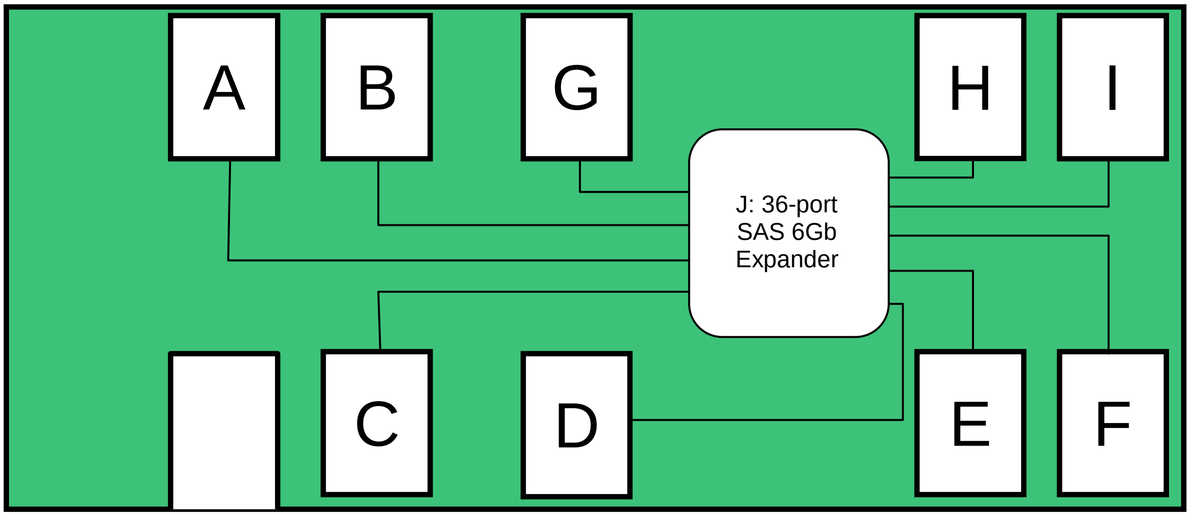


Figure 9. 36-Port Expander SAS Connector/Drive Identification Block Diagram

Label	Description	Label	Description
A	N/A	G	To Backplane Ports 20-23
B	To mini-SAS converter	H	To Backplane Ports 12-15
C	To mini-SAS converter	I	To Backplane Ports 4-7
D	To Backplane Ports 16-19	J	36-port SAS 6Gb Expander
E	To Backplane Ports 8-11		
F	To Backplane Ports 0-3		

Table 3. Expander Component Placement and Description

2.5 Power Distribution Board (PDB)

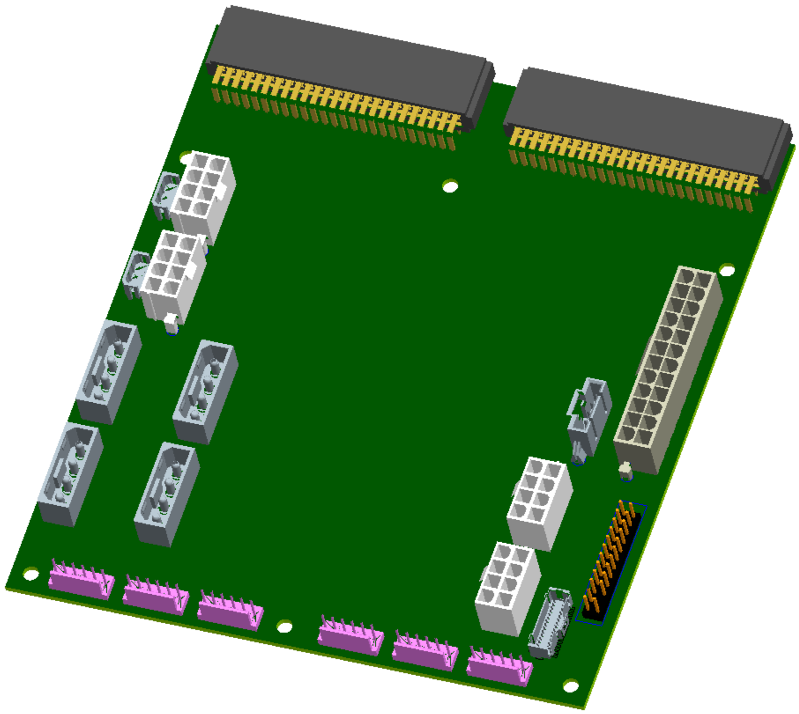
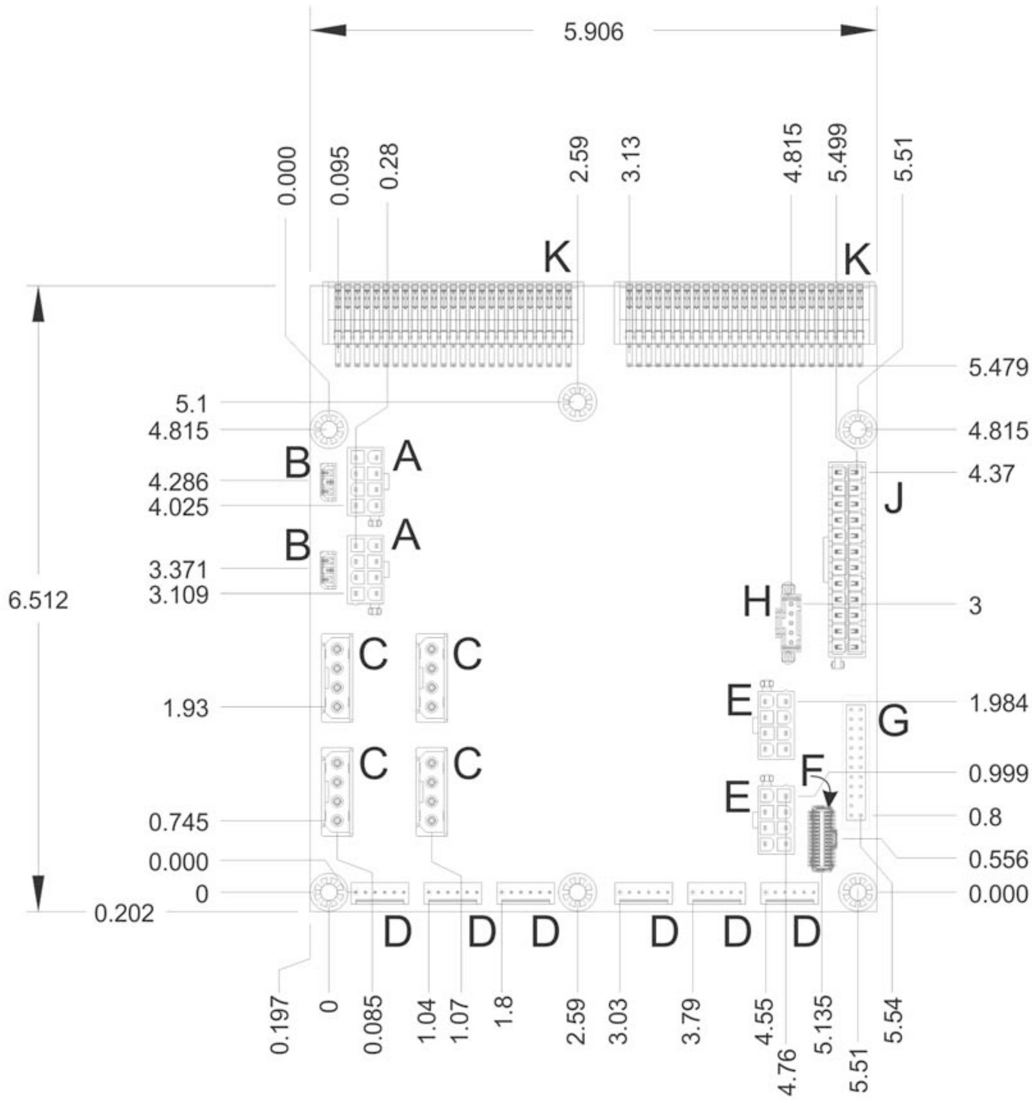


Figure 4. Power Distribution Board (PDB)



Label	Description	Label	Description
A	HSBP Power Header	G	2x12Pin Front Panel Header
B	Expander SES-2 header	H	1x5 Aux header
C	Expander Power header	J	2X12 SSI Power connector
D	FAN Header	K	Power Supply Connector
E	HSBP Power Header		
F	2x15pin Storage Mini-Front Panel Header		

Figure 5. PDB Component Placement and Description

The PDB provides power from the power supply modules to the JBOD components, and provides thermal monitoring and fan control, and includes the following features:

The PDB connects to the power supply canister through two CRPS card edge connectors.

- Optional 2x12pin SSI and 1x5pin SSI power control headers (for potential future use with 4U JBOD fixed power supply)

- Power for up to 2X Internal 36-Port SAS Expander Cards (RES2CV360) for the 2U JBOD with 2X additional connectors for future use.
- Two 2x4pin 12V power headers and an additional two 2x4pin 12V power headers for future use. Each cable is used to connect power to a single 12x 3.5" HSBP or up to three 8x 2.5" HSBPs.
- Support for hot swap redundant fan speed control solutions up to 3X system fans and identification of fan failures at front panel fault LED indicator with communication over SES2 interface to host PC.
- SMB interface for communicating enclosure status through the Expander board to the host system external host controller via SES interface. Monitoring capabilities include:
    - Fan tachs
    - 12V Voltage out from PSU
    - 12V Current from PSU
    - Temperature on front panel, HDDs and on the board behind drives
    - Ambient overtemp protection: reported to host system and fan boost only. No shutdown.
    - Degraded (PSU, FAN) state reportable to host system and on JBOD status LED

The ADT7476 thermal controller on the PDB can measure and control the speed of up to three fans. The controller provides acoustic enhancements to ensure the fans run at the lowest possible speed for the given temperature. The controller interfaces with two remote temp sensors and a local temp sensor built into the chip.

The thermal controller on the PDB is programmed using the SAS expander that comes with the Intel® Storage System JBOD 2000 Family. The SAS expander in the Intel® Storage System JBOD 2000 Family uses a firmware that programs the thermal controller when the system is turned on. If the SAS expander is not plugged into the PDB using the I2C cable, the fans will run at 100% and the thermal controller will not be programmed correctly.

The cable should be connected to the I2C port B (Port C will not program the PDB) on the expander board and then either of the I2C connectors on the PDB before the system is turned on.

If the fan runs at 100% at room temperature, there is either an issue with the SMBUS connection, the SAS expander is not getting power, or the incorrect firmware is on the expander.

When a fan fails in the Intel® Storage System JBOD 2000 Family, an interrupt register bit is set in the ADT7476 Thermal Controller that signals the fan fault (register shown below). The LSI expander chip on the SAS expander monitors this register, and when a fan fault bit is set in the interrupt register, this information is sent to the host system through SES. The ADT7476 controller also sends a signal out of its GPIOs to light the LED on the failed fan's hot-swap housing which makes replacing/diagnosing the failed fan much easier.

Interrupt Register 2 for ADT7476 (Bits 2, 3 and 4 used for fan faults):

Addr	R/W	Desc	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	De-fault	Lock-able
0x42	R	Interrupt Status Register 2	D2	D1	F4P	FAN3	FAN2	FAN1	OVT	12 V/VC	0x00	–

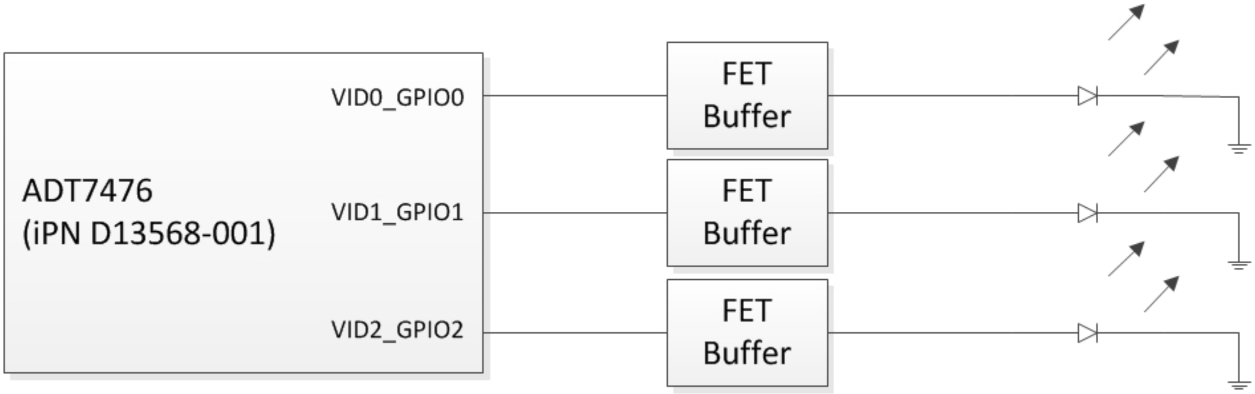


Figure 6. Fan Fault LED Block Diagram

2.6 Available Front Bezel Support

The optional front bezel is made of molded plastic and uses a snap-on design. When installed, its design allows for maximum airflow to maintain system cooling requirements. The face of the bezel assembly includes optional snap-in identification badge and wave (shown) features to allow for customization.

(Intel Product Order Code – A2UBEZEL)

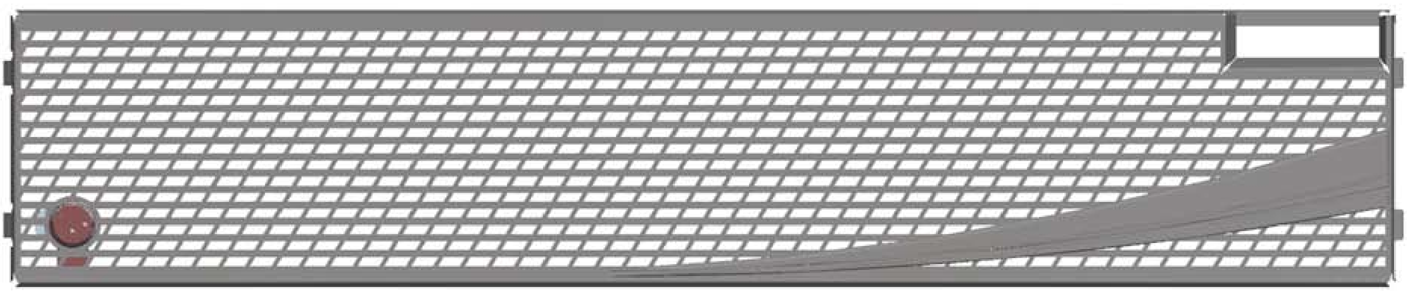
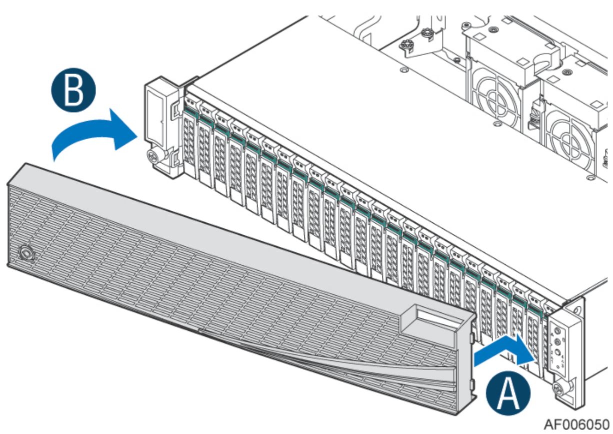


Figure 7. Optional Front Bezel



2.7 Available Rack and Cabinet Mounting Kit Options

- Tool-less rack mount rail kit – Intel Product Code – **AXXPRAIL**
    - 1U and 2U compatible

- 65 lbs max support weight
- Tool-less installation
- Full extension from rack
- Drop in system install
- Optional cable management arm support

- Value rack mount rail kit – Intel Product Code – **AXXELVRAIL**
  - 2U to 4U compatible- 438 mm Wide Intel Chassis support
  - 130 lbs max support weight
  - Tool-less chassis attach
  - Tools required to attach to rails to rack
  - 1/2 extension- Extended inner slide member from rack
  - **Advisory Note –** The AXXELVRAIL value rack mount rail kit is not designed to support shipment of the server system while installed in a rack

- Cable Management Arm – Intel Product Code – **AXX1U2UCMA** (*supported with AXXPRAIL only)
- 2-Post Fixed mount bracket kit – Intel Product Code - **AXX2POSTBRCKT**

3. Power Subsystem

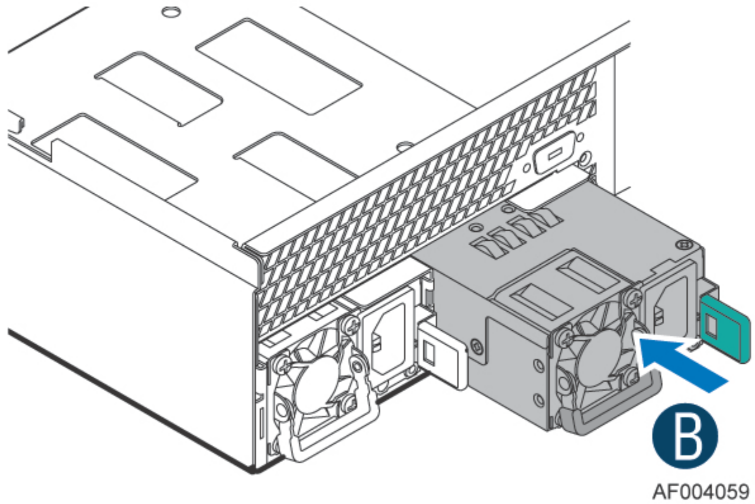
This chapter provides a high level overview of the power management features and specification data for the power supply options available for Intel® Storage System JBOD 2000 Family. Specification variations will be identified for each supported power supply.

Although this system cannot be loaded high enough to hit this mode (2+0), the Intel® Storage System JBOD 2000 Family can have up to two power supply modules installed, supporting the following power supply configurations: 1+0 (single power supply), 1+1 Redundant Power, and 2+0 Combined Power (non-redundant). 1+1 redundant power and 2+0 combined power configurations are automatically configured depending on the total power draw of the system. If the total system power draw exceeds the power capacity of a single power supply module, then power from the 2nd power supply module will be utilized. Should this occur, power redundancy is lost. In a 2+0 power configuration, total power available maybe less then twice the rated power of the installed power supply modules due to the amount of heat produced with both supplies providing peak power. Should system thermals exceed programmed limits, platform management will attempt to keep the system operational. Thermal support is open loop based on ambient temp sensor on the front panel.

The only power supply option validated for the Intel® Storage System JBOD 2000 Family is the 460W AC PS. The 750 W AC PS will fit and operate, but will not be validated in the JBOD or plan of record.

The power supplies are modular, allowing for tool-less insertion and extraction from a bay in the back of the chassis. When inserted, the card edge connector of the power supply mates blindly to a matching slot connector on the PDB board.

In the event of a power supply failure, redundant 1+1 power supply configurations have support for hot-swap extraction and insertion.



The AC input is auto-ranging and power factor corrected.

3.1 Mechanical Overview

The physical size of the power supply enclosure is 39/40mm x 74mm x 185mm. The power supply contains a single 40mm fan. The power supply has a card edge output that interfaces with a 2x25 card edge connector in the system. The AC plugs directly into the external face of the power supply

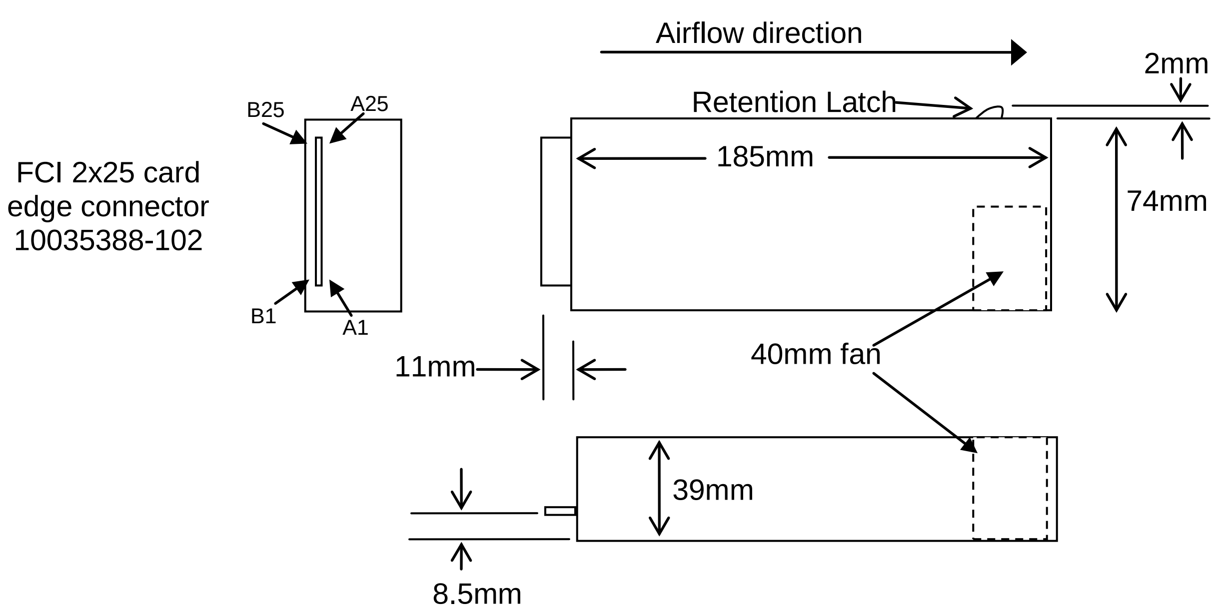


Figure 8. Power Supply Module Mechanical Drawing

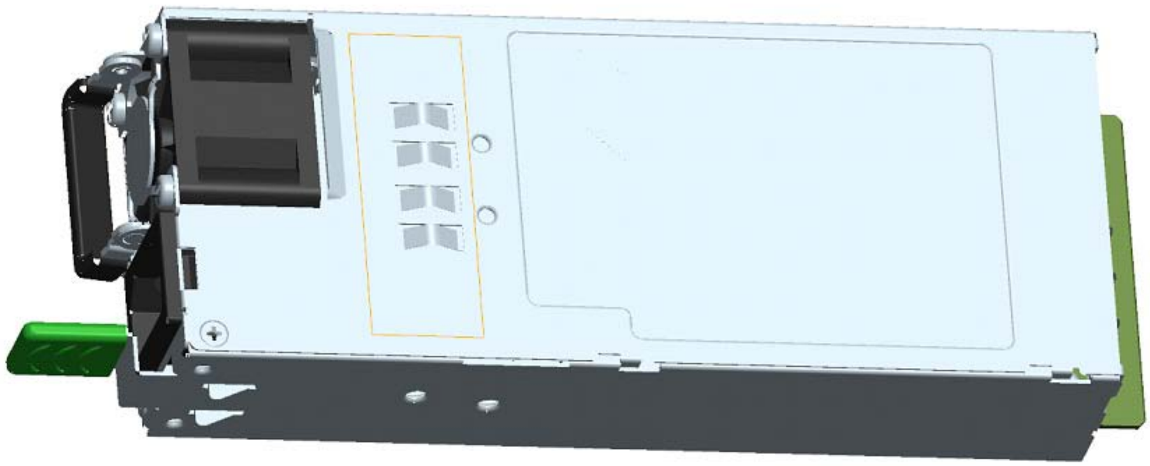


Figure 9. Power Supply Module

Figure 10. AC Power Supply - Connector View

3.2 Power Connectors

3.2.1 Power Supply Module Card Edge Connector

Each power supply module has a single 2x25 card edge output connection that plugs directly into a matching slot connector on the server board. The connector provides both power and communication signals to the server board. The following table defines the connector pin-out.

Table 4. Power Supply Module Output Power Connector Pin-out

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	GND	B2	GND
A3	GND	B3	GND
A4	GND	B4	GND
A5	GND	B5	GND
A6	GND	B6	GND
A7	GND	B7	GND
A8	GND	B8	GND
A9	GND	B9	GND
A10	+12V	B10	+12V
A11	+12V	B11	+12V
A12	+12V	B12	+12V
A13	+12V	B13	+12V
A14	+12V	B14	+12V
A15	+12V	B15	+12V
A16	+12V	B16	+12V
A17	+12V	B17	+12V
A18	+12V	B18	+12V
A19	PMBus SDA	B19	A0 (SMBus address)
A20	PMBus SCL	B20	A1 (SMBus address)
A21	PSON	B21	12V stby
A22	SMBAlert#	B22	Cold Redundancy Bus
A23	Return Sense	B23	12V load share bus
A24	+12V remote Sense	B24	No Connect
A25	PWOK	B25	Compatibility Check pin*

The JBOD's PDB provides several connectors to provide power to various system options. The following sub-sections will identify the location; provide the pin-out definition; and provide a brief usage description for each.

3.2.2 Hot Swap Backplane Power Connector

The JDOB's PDB board includes four white 2x4-pin power connectors, used to provide power to the hot swap backplanes. On the JBOD PDB, this connector is labeled as "HSBP PWR". The following table provides the pin-out for this connector.

Table 3. Hot Swap Backplane Power Connector Pin-out ("HSBP PWR")

Signal Description	Pin	Pin	Signal Description
Ground	1	5	P12V_240VA
Ground	2	6	P12V_240VA
Ground	3	7	P12V_240VA
Ground	4	8	P12V_240VA

3.3 Power Supply Module Efficiency

The following tables provide 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 115 VAC to 220 VAC.

Table 6. 460 Watt Power Supply Efficiency (Gold)

Loading	100% of maximum	50% of maximum	20% of maximum	10% of maximum
Minimum Efficiency	88%	92%	88%	80%

3.4 AC Power Cord Specification Requirements

The AC power cord used must meet the specification requirements listed in the following table.

Table 7. AC Power Cord Specifications

Cable Type	SJT
Wire Size	16 AWG
Temperature Rating	105ºC
Amperage Rating	13 A
Voltage Rating	125 V

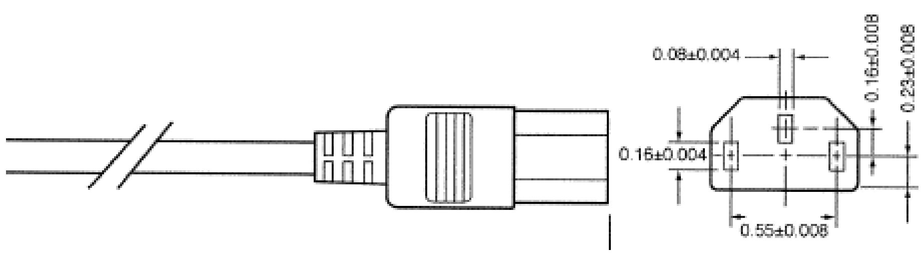


Figure 11. AC Power Cord

3.5 AC Input Specifications

3.5.1 Power Factor

The power supply must meet the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below.

Output power	10% load	20% load	50% load	100% load
Power factor	> 0.65	> 0.80	> 0.90	> 0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz

3.5.2 AC Input Voltage Specification

The power supply must operate within all specified limits over the following input voltage range. Harmonic distortion of up to 10% of the rated line voltage must not cause the power supply to go out of specified limits. Application of an input voltage below 85VAC shall not cause damage to the power supply, including a blown fuse.

Table 8. AC Input Voltage Range

PARAMETER	MIN	RATED	VMAX	Start up VAC	Power Off VAC
Voltage (110)	90 Vrms	100-127 Vrms	140 Vrms	85VAC +/- 4VAC	70VAC +/- 5VAC
Voltage (220)	180 Vrms	200-240 Vrms	264 Vrms		
Frequency	47 Hz	50/60	63 Hz		

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 requirement is not to be used for determining agency input current markings.

3.5.3 AC Line Isolation Requirements

The power supply shall meet all safety agency requirements for dielectric strength. Transformers' isolation between primary and secondary windings must comply 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 should be used. In addition the insulation system must comply with reinforced insulation per safety standard IEC 950. Separation between the primary and secondary circuits, and primary to ground circuits, must comply with the IEC 950 spacing requirements.

3.5.4 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 must meet dynamic voltage regulation requirements. An AC line dropout of any duration shall not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time the power supply should recover and meet all turn on requirements. The power supply shall meet the AC dropout requirement over rated AC voltages and frequencies. A dropout of the AC line for any duration shall not cause damage to the power supply.

Loading	Holdup time
70%	12msec

3.5.4.1 AC Line 12VSBHoldup

The 12VSB output voltage should stay in regulation under its full load (static or dynamic) during an AC dropout of **70ms min** (=12VSB holdup time) whether the power supply is in ON or OFF state (PSON asserted or de-asserted).

3.5.5 AC Line Fuse

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

3.5.6 AC Inrush

AC line inrush current shall not exceed **55A 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 shall be 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}).

3.5.7 AC Line Transient Specification

AC line transient conditions shall be 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 shall meet the requirements under the following AC line sag and surge conditions.

Table 9. AC Line Sag Transient Performance

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
0 to 1/2 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 4. AC Line Surge Transient Performance

AC Line Surge				
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

3.5.8 Susceptibility Requirements

The power supply shall meet the following electrical immunity requirements when connected to a cage with an external EMI filter which meets the criteria defined in the SSI document EPS Power Supply Specification. For further information on Intel standards please request a copy of the Intel Environmental Standards Handbook

Table 5. 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.

3.5.9 Electrostatic Discharge Susceptibility

The power supply shall comply with the limits defined in EN 55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-2: Edition 1.2: 2001-04 test standard and performance criteria B defined in Annex B of CISPR 24.

3.5.10 Fast Transient/Burst

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-4: Second edition: 2004-07 test standard and performance criteria B defined in Annex B of CISPR 24.

3.5.11 Radiated Immunity

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-3: Edition 2.1: 2002-09 test standard and performance criteria A defined in Annex B of CISPR 24.

3.5.12 Surge Immunity

The power supply shall be tested with the system for immunity to AC Unidirectional wave; 2kV line to ground and 1kV line to line, per EN 55024: 1998/A1: 2001/A2: 2003, EN 61000-4-5: Edition 1.1:2001-04 .
The pass criteria include: No unsafe operation is allowed under any condition; all power supply output voltage levels to 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 shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-5: Edition 1.1:2001-04 test standard and performance criteria B defined in Annex B of CISPR 24.

3.5.13 Power Recovery

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

3.5.14 Voltage Interruptions

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-11: Second Edition: 2004-03 test standard and performance criteria C defined in Annex B of CISPR 24.

3.5.15 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 15 seconds and a PSON# cycle HIGH for one second reset the power supply.

3.5.16 Over-current Protection (OCP)

The power supply shall have current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded the power supply shall shutdown and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition. 12VSB will be auto-recovered after removing OCP limit.

Table 6. 460 Watt Power Supply Over Current Protection

Output Voltage	Input voltage range	Over Current Limits
+12V	90 – 264VAC	47A min; 55A max
12VSB	90 – 264VAC	2A min; 2.5A max

3.5.17 Over-voltage Protection (OVP)

The power supply over voltage protection shall be locally sensed. The power supply shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption. The values are measured at the output of the power supply's connectors. The voltage shall never exceed the maximum levels when measured at the power connectors of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power connector. 12VSB will be auto-recovered after removing OVP limit.

Table 7. Over Voltage Protection (OVP) Limits

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

3.5.18 Over-temperature Protection (OTP)

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shutdown. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the 12VSB remains always on. The OTP circuit must have built in margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4°C of ambient temperature margin.

3.6 Cold Redundancy Support

Power supplies that support cold redundancy can be enabled to go into a low-power state (that is, cold redundant state) in order to provide increased power usage efficiency when system loads are such that both power supplies are not needed. When the power subsystem is in Cold Redundant mode, only the needed power supply to support the best power delivery efficiency is ON. Any additional power supplies; including the redundant power supply, is in Cold Standby state

Each power supply has an additional signal that is dedicated to supporting Cold Redundancy; CR_BUS. This signal is a common bus between all power supplies in the system. CR_BUS is asserted when there is a fault in any power supply OR the power supplies output voltage falls below the Vfault threshold. Asserting the CR_BUS signal causes all power supplies in Cold Standby state to power ON.

Enabling power supplies to maintain best efficiency is achieved by looking at the Load Share bus voltage and comparing it to a programmed voltage level via a PMB bus command.

Whenever there is no active power supply on the Cold Redundancy bus driving a HIGH level on the bus all power supplies are ON no matter their defined Cold Redundant roll (active or Cold Standby). This guarantees that incorrect programming of the Cold Redundancy states of the power supply will never cause the power subsystem to shutdown or become over loaded. The default state of the power subsystem is all power supplies ON. There needs to be at least one power supply in Cold Redundant Active state or Standard Redundant state to allow the Cold Standby state power supplies to go into Cold Standby state.

3.6.1 Powering on Cold Standby supplies to maintain best efficiency

Power supplies in Cold Standby state shall monitor the shared voltage level of the load share signal to sense when it needs to power on. Depending upon which position (1, 2, or 3) the system defines that power supply to be in the cold standby configuration; will slightly change the load share threshold that the power supply shall power on at.

Table 8. Example Load Share Threshold for Activating Supplies

	Enable Threshold for $V_{CR\_ON\_EN}$	Disable Threshold for $V_{CR\_ON\_DIS}$	CR_BUS De-asserted / Asserted States
Standard Redundancy	NA; Ignore dc/dc_ active# signal; power supply is always ON		OK = High Fault = Low
Cold Redundant Active	NA; Ignore dc/dc_ active# signal; power supply is always ON		OK = High Fault = Low
Cold Standby 1 (02h)	3.2V (40% of max)	3.2V x 0.5 x 0.9 = 1.44V	OK = Open Fault = Low
Cold Standby 2 (03h)	5.0V (62% of max)	5.0V x 0.67 x 0.9 = 3.01V	OK = Open Fault = Low
Cold Standby 3 (04h)	6.7V (84% of max)	6.7V x 0.75 x 0.9 = 4.52V	OK = Open Fault = Low

Notes:
Maximum load share voltage = 8.0V at 100% of rated output power
These are example load share bus thresholds; for a given power supply, these shall be customized to maintain the best efficiency curve for that specific model.

3.6.2 Powering on Cold Standby supplies during a fault or over current condition

When an active power supply asserts its CR_BUS signal (pulling it low), all parallel power supplies in cold standby mode shall power on within 100μsec

3.6.3 Power Supply Turn On Function

Powering on and off of the cold standby power supplies is only controlled by each PSU sensing the V_{share} bus. Once a power supply turns on after crossing the enable threshold; it lowers its threshold to the disable threshold. The system defines the 'position' of each power supply in the Cold Redundant operation. It will do this each time the system is powered on, a power supply fails, or a power supply is added to the system.

The system is relied upon to tell each power supply where it resides in the Cold Redundancy scheme.

3.7 Power Supply Status LED

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

Table 9. LED Indicators

Power Supply Condition	LED State
Output ON and OK	GREEN
No AC power to all power supplies	OFF
AC present / Only 12VSB on (PS off) or PS in Cold redundant state	1Hz Blink GREEN
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	AMBER
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Amber
Power supply critical event causing a shutdown; failure, OCP, OVP, Fan Fail	AMBER
Power supply FW updating	2Hz Blink GREEN

4. Thermal Management

Intel® Storage System JBOD 2000 Family is designed to operate at external ambient temperatures of between 10ºC- 35ºC with limited excursion based operation up to 45ºC and limited performance impact. Working with integrated platform management, several features within the system are designed to move air in a front to back direction, through the system and over critical components to prevent them from overheating and allow the system to operate with best performance.

The installation and functionality of several JBOD components are used to maintain system thermals. They include up to three managed 60mm system fans and one integrated 40mm fan for each installed power supply module. Hard drive carriers can be populated with a hard drive or supplied drive blank.

4.1 Thermal Operation and Configuration Requirements

To keep the system operating within supported maximum thermal limits, the system must meet the following operating and configuration guidelines:

- The system operating ambient is designed for sustained operation up to 35ºC (ASHRAE Class A2) with short term excursion based operation up to 45ºC (ASHRAE Class A4).
    - The system can operate up to 40ºC (ASHRAE Class A3) for up to 900 hours per year
    - The system can operate up to 45ºC (ASHRAE Class A4) for up to 90 hours per year
    - System performance may be impacted when operating within the extended operating temperature range
    - There is no long term system reliability impact when operating at the extended temperature range within the approved limits.

- All hard drive bays must be populated. Hard drive carriers can be populated with a hard drive or supplied drive blank.
- In single power supply configurations, the 2nd power supply bay must have the supplied filler blank installed at all times.
- The system must be configured with dual power supplies for the system to support fan redundancy.
- The system top-cover must be installed at all times when the system is in operation. The only exception to this requirement is to hot replace a failed system fan, in which case the top cover can be removed for no more than 3 minutes at a time

4.2 Thermal Management Overview

In order to maintain the necessary airflow within the system, all of the previously listed components and top cover need to be properly installed. For best system performance, the external ambient temperature should remain below 35ºC and all system fans should be operational. The system is designed for fan redundancy when the system is configured with two power supplies. Altitude
This option sets the proper altitude that the system will be used. Available settings include: [300m or less], **[301m-900m]**, [901m-1500m], [Above 1500m].

Selecting an altitude range that is lower than the actual altitude the system will be operating at, can cause the fan control system to operate less efficiently, leading to higher system thermals and lower system performance. If the altitude range selected is higher than the actual altitude the system will be operating at, the fan control system may provide better cooling but with higher acoustics and higher fan power consumption. If the altitude is not known, selecting a higher altitude is recommended in order to provide sufficient cooling.
Note: The above feature may or may not be in effect and depends on the actual thermal characteristics of the specified system.
]

4.3 Thermal Sensor Input For Fan Speed Control

The power distribution board uses various sensors as inputs to fan speed control. Some of the sensors are actual physical sensors and some are “virtual” sensors derived from calculations.

The following thermal sensor is used as input to fan speed control:

- Front Panel Temperature Sensor

4.4 System Fans

Three 60x38-mm fans and an embedded fan for each installed power supply, provide the primary airflow for the system. The system is designed for fan redundancy when configured with two power supply modules. Should a single fan fail (system fan or power supply fan), platform management will adjust air flow of the remaining fans and manage other platform features to maintain system thermals. Fan redundancy is lost if more than one fan is in a failed state.

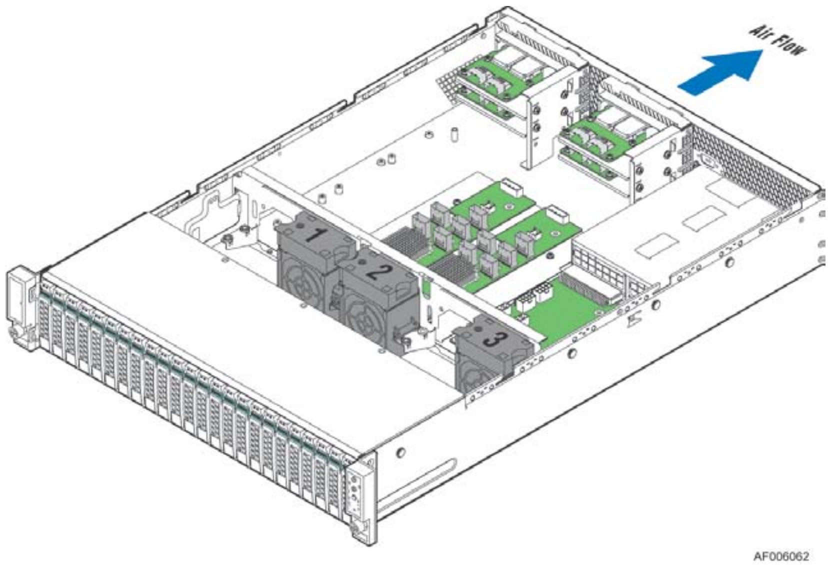


Figure 12. System Fan Identification

System Fan Assembly

The system fan assembly is designed for ease of use and supports several features.

- Each fan is hot-swappable.
- Each fan is designed for tool-less insertion and extraction from the fan assembly. For instructions on installing or removing a fan module, see the *Intel® JBOD 2000 Family Service Guide*.
- Fan speed for each fan is controlled by integrated platform management as controlled by the PDB board. As system thermals fluctuate high and low, the PDB firmware will increase and decrease the speeds to specific fans within the fan assembly to regulate system thermals.
- Each fan has a tachometer signal that allows the PDB to monitor their status.
- On top of each fan is an integrated fault LED, although currently this feature is not supported.
- Each fan has a10-pin wire harness that connects to a matching connector on the PDB.

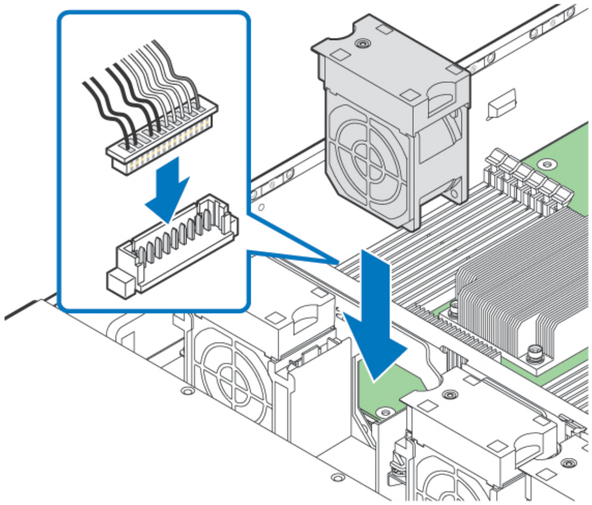


Table 10. System Fan Connector Pin-out

SYS_FAN 1		SYS_FAN 2		SYS_FAN 3	
Signal Description	**Pin#**	**Signal Description**	**Pin#**	**Signal Description**	**Pin#**
FAN_TACH1_IN	1	FAN_TACH3_IN	1	FAN_TACH5_IN	1
FAN_ BMC_PWM0_R_BUF	2	FAN_BMC_PWM1_R_BUF	2	FAN_ BMC_PWM2_R_BUF	2
P12V_FAN	3	P12V_FAN	3	P12V_FAN	3
P12V_FAN	4	P12V_FAN	4	P12V_FAN	4
FAN_TACH0_IN	5	FAN_TACH2_IN	5	FAN_TACH4_IN	5
GROUND	6	GROUND	6	GROUND	6
GROUND	7	GROUND	7	GROUND	7
FAN_SYS0_PRSNT_N	8	FAN_SYS1_PRSNT_N	8	FAN_SYS2_PRSNT_N	8
LED_FAN_FAULT0_R	9	LED_FAN_FAULT1_R	9	LED_FAN_FAULT2_R	9
LED_FAN0	10	LED_FAN1	10	LED_FAN2	10

4.5 Power Supply Module Fan

Each installed power supply module includes one embedded (non-removable) 40-mm fan. It is responsible for airflow through the power supply module. Should this fan fail, the power supply will continue to operate until its internal temperature reaches an upper critical limit. The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an over-temperature protection condition, the power supply module will shutdown.

5. System Storage and Peripheral Drive Bays Overview

The Intel® Storage System JBOD2000 product family has support for the following storage device options:

- Hot Swap 2.5" Hard Disk Drives
- Hot Swap 3.5" Hard Disk Drives

5.1 2.5" Hard Disk Drive Support

The server is available in 2.5" hard disk configurations of 24 drives as illustrated below.

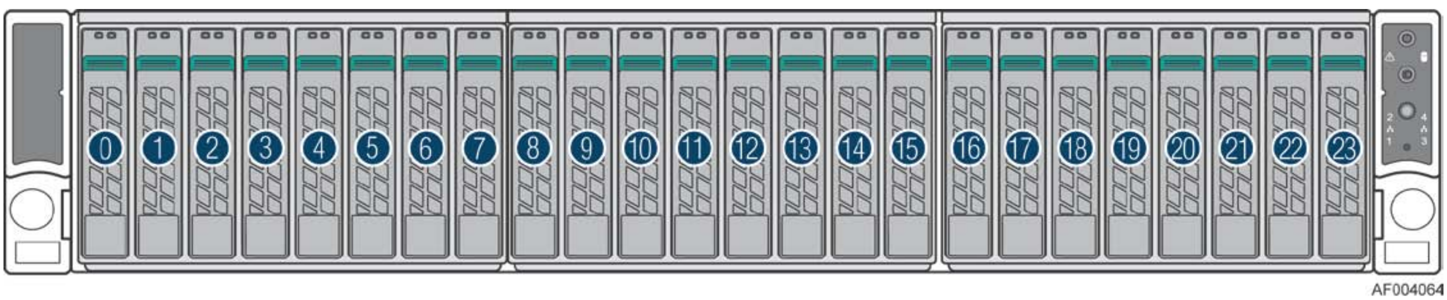
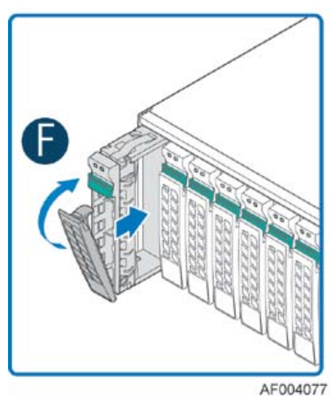


Figure 13. 2.5" Hard Drive Bay - 24 Drive Configuration

The drive bay can support either SATA or SAS hard disk drives. Mixing of drive types within a common hot swap backplane is not supported. Systems with multiple hot swap backplanes can support different drive type configurations as long as the drives attached to a common backplane are the same and the installed controller attached to the given backplane can support the drive type. Hard disk drive type is dependent on the type of host bus controller used, SATA only or SAS.

Each 2.5" hard disk drive is mounted to a drive tray, allowing for hot swap extraction and insertion. Drive trays have a latching mechanism that is used to extract and insert drives from the chassis, and lock the tray in place.



Light pipes integrated into the drive tray assembly direct light emitted from Amber drive status and Green activity LEDs located next to each drive connector on the backplane, to the drive tray faceplate, making them visible from the front of the system.

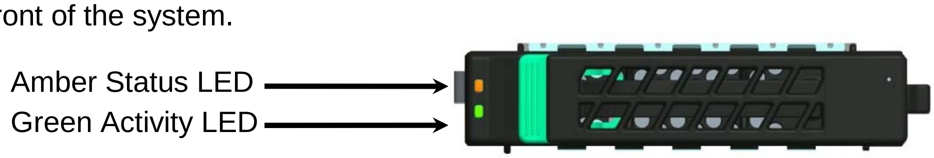


Table 17. Drive Status LED States

Amber	Off	No access and no fault
	Solid On	Hard Drive Fault has occured
	Blink	RAID rebuild in progress (1 Hz), Identify (2 Hz)

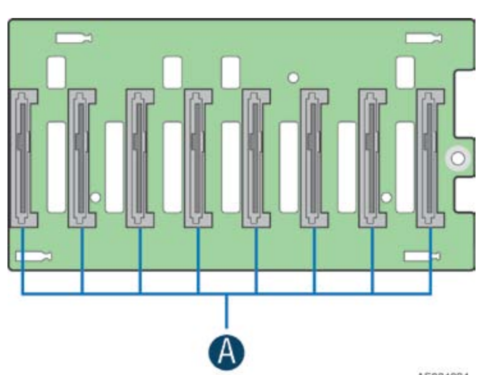
Table 18. Drive Activity LED States

	Condition	Drive Type	Behavior
Green	Power on with no drive activity	SAS	LED stays on
		SATA	LED stays off
	Power on with drive activity	SAS	LED blinks off when processing a command
		SATA	LED blinks on when processing a command
	Power on and drive spun down	SAS	LED stays off
		SATA	LED stays off
	Power on and drive spinning up	SAS	LED blinks
		SATA	LED stays off

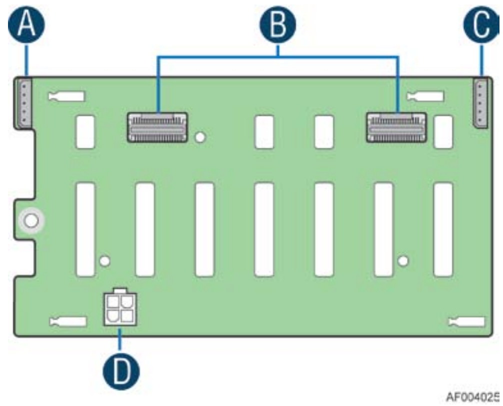
5.1.1 2.5” Drive Hot-Swap Backplane Overview

Depending on the number of hard disk drives supported by a given system SKU, a system can be configured with 1, 2, or 3 eight drive backplanes. Each backplane is attached to the back of the drive bay assembly.

On the front side of each backplane are mounted eight hard disk drive interface connectors (A), each providing both power and I/O signals to attached hard disk drives.



On the backside of each backplane are several connectors. The following illustration identifies each.



Label	Description
A	SMBus-Out cable connector for multi-backplane support
B	4-port Mini-SAS cable connectors
C	SMBus-In cable connector – From Server board or other backplane
D	Power connector

A and C – SMBus Cable Connectors – The backplane includes two 1x5 cable connectors used as a management interface between the server board and the installed backplanes. In systems configured with multiple backplanes, a short jumper cable is attached between backplanes, with connector B used on the first board and connector D used on the second board, extending the SMBus to each installed backplane.

B – Multi-port Mini-SAS Cable Connectors – The backplane includes two multi-port mini-SAS cable connectors, each providing SGPIO and I/O signals for four SAS/SATA hard drives on the backplane. Cables can be routed from matching connectors on the server board, installed add-in SAS/SATA RAID cards, or optionally installed SAS expander cards for drive configurations of greater than 8 hard drives.

D – Power Harness Connector – The backplane includes a 2x2 connector supplying power to the backplane. Power is routed to each installed backplane via a multi-connector power cable harness from the server board.

5.1.2 Cypress* CY8C22545 Enclosure Management Controller

The backplanes support enclosure management using a Cypress* CY8C22545 Programmable System-on-Chip (PSoC*) device. The CY8C22545 drives the hard drive activity/fault LED, hard drive present signal, and controls hard drive power-up during system power-on.

5.2 3.5" Hard Disk Drive Support

The server is available in 3.5" hard disk configurations of 12 drives as illustrated below.

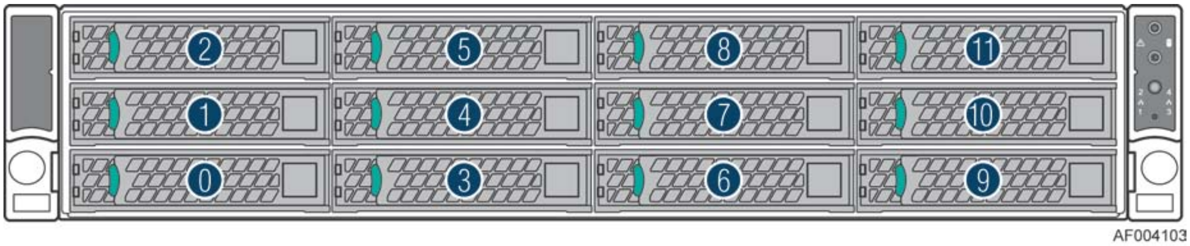
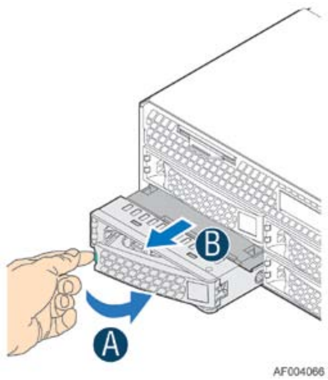


Figure 14. 3.5" Hard Drive Bay - 12 Drive Configuration

The drive bay can support either SATA or SAS hard disk drives. Mixing of drive types within the hard drive bay is not supported. Hard disk drive type is dependent on the type of host bus controller used, SATA only or SAS. Each 3.5" hard disk drive is mounted to a drive tray, allowing for hot swap extraction and insertion. Drive trays have a latching mechanism that is used to extract and insert drives from the chassis, and lock the tray in place.



Light pipes integrated into the drive tray assembly direct light emitted from Amber drive status and Green activity LEDs located next to each drive connector on the backplane, to the drive tray faceplate, making them visible from the front of the system.

Amber	Off	No access and no fault
	Solid On	Hard Drive Fault has occured
	Blink	RAID rebuild in progress (1 Hz), Identify (2 Hz)

	Condition	Drive Type	Behavior
Green	Power on with no drive activity	SAS	LED stays on
		SATA	LED stays off
	Power on with drive activity	SAS	LED blinks off when processing a command
		SATA	LED blinks on when processing a command
	Power on and drive spun down	SAS	LED stays off
		SATA	LED stays off
	Power on and drive spinning up	SAS	LED blinks
		SATA	LED stays off

5.2.1 3.5" Drive Hot-Swap Backplane Overview

Systems with 8 or 12 drive configurations have their own unique backplane. Both 8 and 12 drive backplanes share identical features. The following will be used to describe the features of both backplanes. Differences between the two will be noted.

The backplanes mount to the back of the drive bay assembly.

On the front side of each back plane are mounted eight or twelve hard disk drive interface connectors, each providing both power and I/O signals to attached hard disk drives.

On the backside of each backplane are several connectors. The following illustration identifies each.

Label	Description
A	4-port mini-SAS connectors
B	Power connectors
C	SMBus connector

A – 4-port Mini-SAS Connectors – The backplane includes two or three multi-port mini-SAS cable connectors, each providing SGPIO and I/O signals for four SAS/SATA hard drives on the backplane. Cables can be routed from matching connectors on the server board, add-in SAS/SATA RAID cards, or an optionally installed SAS expander card. Each mini-SAS connector will include a silk-screen identifying which drives the connector supports; Drives 0-3, Drives 4-7, and Drives 8-11.
B – Power Harness Connector - The backplane includes a 2x2 connector supplying power to the backplane. Power is routed to the backplane via a power cable harness from the server board

C- SMBus Cable Connectors – The backplane includes a 1x5 cable connector used as a management interface to the server board.

5.2.2 Cypress* CY8C22545 Enclosure Management Controller

The backplanes support enclosure management using a Cypress* CY8C22545 Programmable System-on-Chip (PSoC*) device. The CY8C22545 drives the hard drive activity/fault LED, hard drive present signal, and controls hard drive power-up during system power-on.

6. Storage Controller Options Overview

Intel® Storage System JBOD 2000 Family supports connection to many different external SAS HBA and SAS RAID controller solutions, to achieve single JBOD connection, multiple JBODs daisy chain connection and failover connections. This section will provide an overview of the different options available.

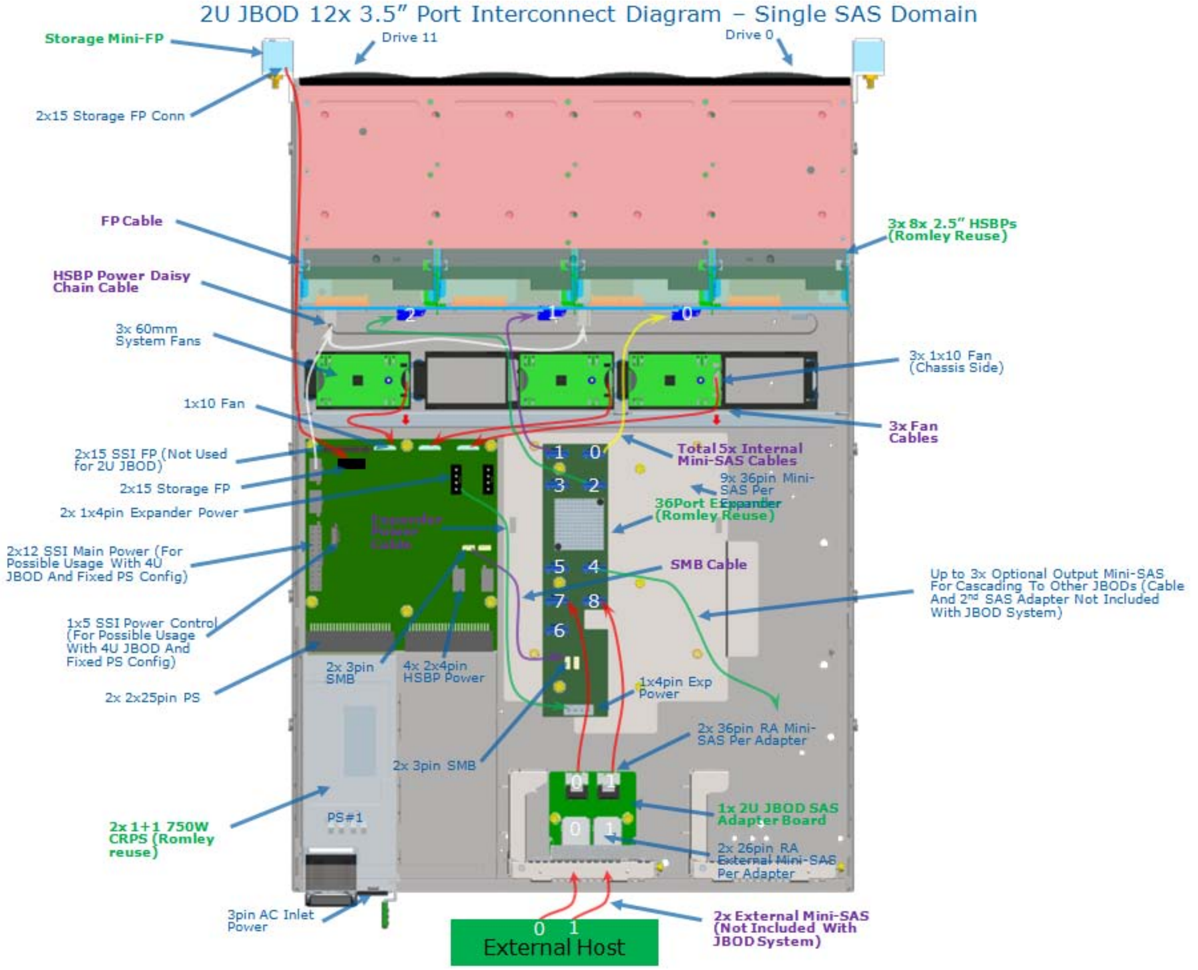
6.1 External SAS Controller support

Our current and future supported controllers will be referenced via our JBOD 2000 Family THOL or SCT. SAS connectivity is via the external SAS connectors (SFF8088) and both native SAS HBA's and RAID HBA's are supported.

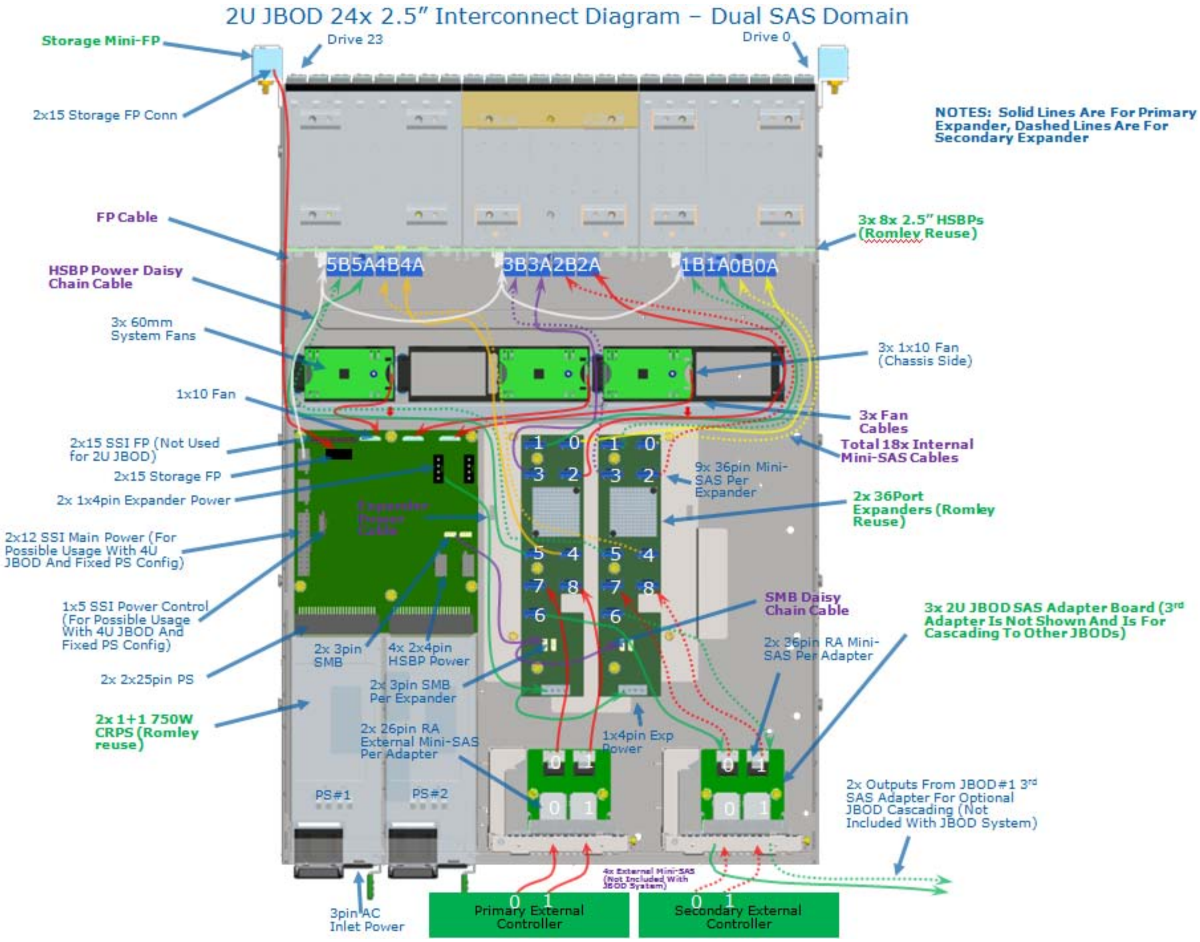
6.2 Intel® SAS Expander Support

The Intel 36 Port Expander is mounted vertically in the chassis and is designed on LSI's Bobcat expander technology. The Expander has nine SFF8087 Mini-SAS connectors that connect to either the backplane or the SAS Converter boards via SFF8087 to SFF8087 cables. The dual ported backplane version of the JBOD contains two 36 Port Expanders, while the single ported backplane versions contain one 36 Port expander.

6.2.1 Single port configuration



6.2.2 Dual port configuration



7. JBOD SAS Adapter Overview

This section describes high level hardware architecture for the external to internal SAS Adapter for Intel® Storage System JBOD 2000 Family

The JBOD SAS Adapter is an independent product - Intel® 8087-8088 Cable Connector Converter AXXRCVT8788

Intel® 8087-8088 Cable Connector Converter AXXRCVT8788 converts two internal SFF8087 x4 mini SAS connectors to two external SFF8088 SAS x4 connectors. 8x Ports of 6Gb SAS can be supported with this Adapter.

The converter includes a PCI mounting bracket that allows the converter to be mounted and retained in a rear panel PCI mounting location.

There are no power rails or power consumers or temperature sensors on the JBOD SAS Adapter Board.

The adapter board does not support 12Gb dual port functionality, a new version of this board will be required when/if 12Gb dual port infrastructure becomes available.

7.1 JBOD SAS Converter Port Numbering

Below is a suggestion for the JBOD SAS Converter board port numbering for internal and external connections.

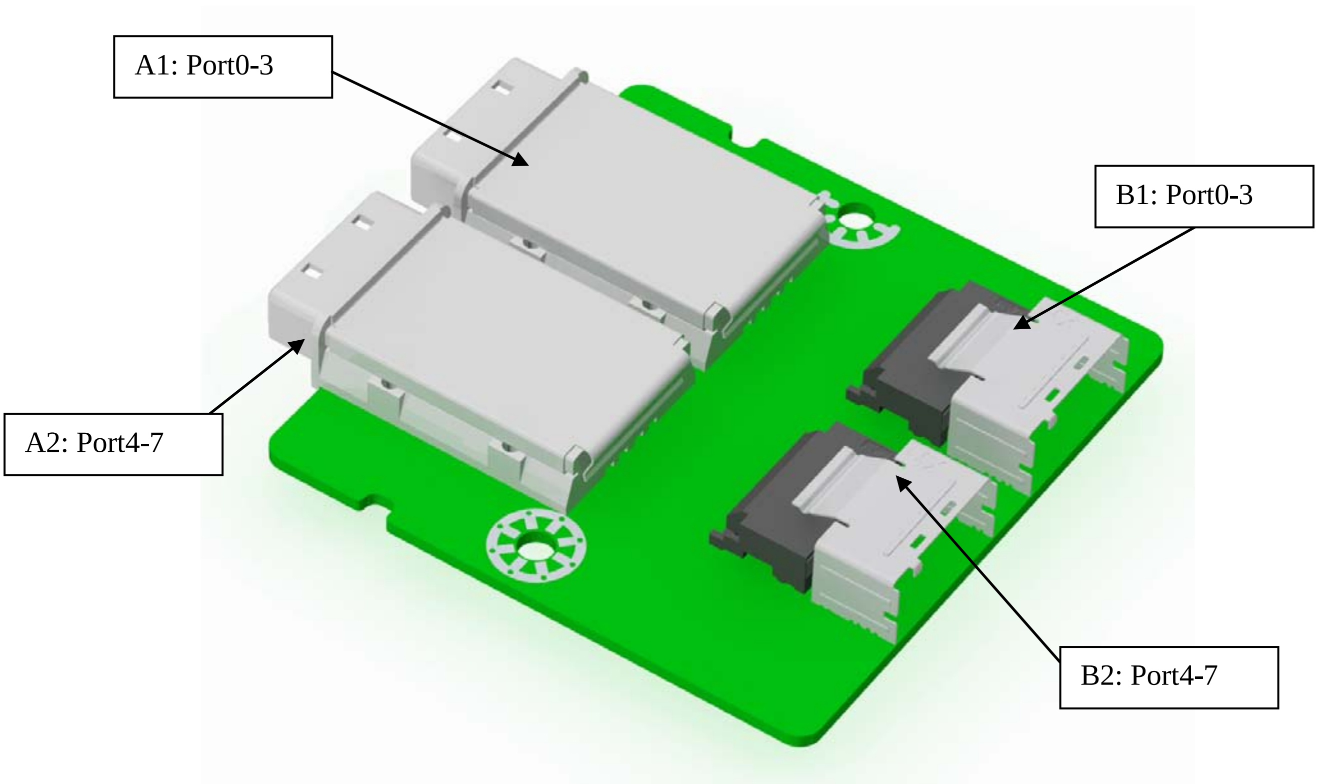


Figure 15. JBOD SAS Adapter SAS Port Numbering

Item	Description
A1	External SFF 8088 connector. Internally wired to B1.
A2	External SFF 8088 connector. Internally wired to B2.
B1	Internal SFF 8087 connector. Internally wired to A1
B2	Internal SFF 8087 connector. Internally wired to A2.

7.2 Pinouts

See the SAS Gen2 specification for correct pinout for the SAS internal and external connectors. The connection between the internal mini-SAS and external mini-SAS needs to be one to one direct connection of differential pairs with length matching on the board. Then internal mini-SAS connectors should use the ‘controller’ mini-SAS pinout. Sideband signals within the internal mini-SAS connectors need to conform to SFF-8448 specification. There is no need no pull-ups or downs on any sideband signals (including sideband 6 & 7) as these signals have no purpose when cabling externally, sidebands are only for potential debug purposes on this board.

See below pinout for SGPIO debug headers.

Ref Des	Description
-	1x5pin SATA SGPIO

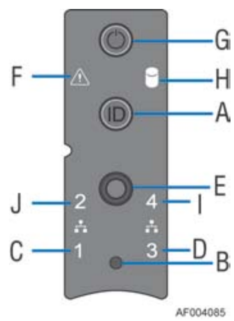
Pin	Signal Description
1	SGPIO_CLOCK_0
2	SGPIO_LOAD_0
3	GND
4	SGPIO_DATAOUT_0
5	SGPIO_DATAIN_0

NOTE: This pinout is common with all other Romley EPSD products.

8. Front Panel Overview

8.1 Front Panel Features

The system includes a front panel that provides push button system controls and LED indicators for several system features. This section will provide a description for the features.



Label	Description	Label	Description
A	Non-functional	F	System Status LED
B	Non-functional	G	Power Button w/Integrated LED
C	Non-functional	H	Non-functional
D	Non-functional	I	Non-functional
E	Non-functional	J	Non-functional

Figure 16. Front Panel Options

F – System Status LED – The System Status LED is a bi-color (Green/Amber) indicator that shows the current health of the server system. The system provides two locations for this feature; one is located on the Front Control Panel, the other is located on the back edge of the server board, viewable from the back of the system. Both LEDs are tied together and will show the same state. The System Status LED states are driven by the on-board platform management sub-system. The following table provides a description of each supported LED state.

Table 19. System Status LED State Definitions

Color	State	Criticality	Description
Off	System is not operatin g	Not ready	System is powered off (AC and/or DC).
Green	Solid on	Ok	Indicates that the System status is 'Healthy'. The system is not exhibiting any errors. AC power is present and they system is either in a standby state or has been powered on.
Ambe	Solid on	SMBUS Alert Event Encountere	P12V is out of its limits P5V is out of its limits A fan fault has been detected An overtemperature event has been detected P3V3 is out of its limits Remote 1 and/or Remote 2 temperature sensor is either open or shorted

G – Power Button – Toggles the system power on and off. Pressing this button will send a signal to the integrated PDB board, which will either power on or power off the system. The integrated LED is a single color (Green) and is capable of supporting different indicator states as defined in the following table.

Table 11. Power LED Functional States

State	Power Mode	LED	Description
Power-off	Non-ACPI	Off	System power is off
Power-on	Non-ACPI	On	System power is on

9. JBOD Daisy Chain Options

The current plan of record (POR) for this generation of the Intel® Storage System JBOD 2000 Family is a 2 level, daisy chain option. Our RAID products can support up to 4 level daisy chaining but this is not going to be validated for this initial product. For the single port backplane versions of the JBOD (JBOD2224S2SP/JBOD2312S2SP) below are 2 examples of an acceptable daisy chain solution.- TBD

Appendix A: Integration and Usage Tips

This section provides a list of useful information that is unique to the Intel® Storage System JBOD 2000 Family and should be kept in mind while configuring your server system.

Reference Documents

See the following documents for additional information:

- *Intel® Storage System JBOD 2000 Family Service Guide*