

# Compute Project

## Decathlete Server Board Standard

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## 1 Scope

This standard provides board-specific information detailing the features and functionality of a general-purpose 2-socket server board for adoption by the Open Compute Project community.

## 2 Contents

1	Scope		
2	Cont	ents2	
3	Overview4		
	3.1	License4	
4	Deca	athlete Server Board Features5	
5	Serv	er Board Mechanical Dimensions6	
	5.1	Asymmetric Layout Option7	
	5.2	Symmetric Layout Option8	
6	I/O S	Support8	
	6.1	Network Interface8	
	6.2	USB9	
	6.3	SATA9	
	6.4	PCIe and Riser Card Support9	
	6.5	PCIe Mezzanine Card Support10	
7	On-b	board Connectors and Headers10	
	7.2	Front Panel USB11	
	7.3	External Serial Port12	
	7.4	Internal Serial Port12	
	7.5	Single Port AHCI SATA Connector13	
	7.6	Multiport Mini-SAS/SATA Connectors13	
8	Pow	er System14	
	8.1	Power Connection for Symmetric Board Outline15	
	8.2	Power Connection for Asymmetric Board Outline15	
	8.3	CPU VRM Efficiency15	
	8.4	Power Connections to the OCP Open Rack15	
9	Platf	orm Management16	
	9.1	Management Controller Firmware Feature Support	

## Open Compute Project • Decathlete Server Board V1.0

	9.2	Advanced Configuration and Power Interface	17
	9.3	Power Control Sources	17
	9.4	Remote BIOS Update	18
	9.5	Remote Firmware Update	18
10	Error	Handling and Alerts	18
11	Remo	ote Machine Management	19
12	Envir	onmental Requirements	19
	12.1	General Requirements	19
	12.2	Regulatory Compliance	19
	12.3	Vibration and Shock	19
13	Desig	n Standards	19
	13.1	Connector Labeling	20
	13.2	Documentation	20
14	Presc	ribed Materials	20
	14.1	Disallowed Components	20
	14.2	Capacitors and Inductors	20
	14.3	Component De-Rating	21
15	Refer	ence Documents	21



### 3 Overview

The purpose of this document is to define a dual socket server board that is capable of deployment in scale-out data centers as well as in traditional data centers with 19" rack enclosures. Considerations are made in the specification for suitable two-socket server boards that were in production when the specification was released.

This document is not intended to be used solely as a basis for a procurement of OCP compatible products. The OCP community may have additional requirements. These incremental requirements can be captured in additional procurement documentation.

Products that claim to comply with this specification SHALL provide, at a minimum, all features defined as mandatory by the use of the keyword SHALL. Such products may also provide recommended features associated with the keyword SHOULD, and permitted features associated with the keyword MAY.

#### 3.1 License

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## 4 Decathlete Server Board Features

The Decathlete Server Board is intended to meet the most common usages for 1U and 2U dual-socket servers in the scaleable data center. To insure the delivery of products that can be deployed over a period of time, and assure consistency in the services offered to the client of the cloud data server, certain features must be present in each model or generation of servers. These features are listed in the following two (2) tables.

Table 1 describes features that must be present to in order for a server board to be considered compliant.

Feature	Description				
	Support up to two processors with a thermal design point (TDP) of up to 135 W				
Brocossor Support	Minimum of eight processor cores and 16 threads				
Processor Support	Four memory channels				
	Support for dynamic overclocking				
	16 sockets for un-buffered DDR3 and registered DDR3 DIMMS				
	LR DIMM for buffered memory solutions				
	DDR3 standard I/O voltage of 1.5V and DDR3 low voltage of 1.35V				
	<ul> <li>1.5 V: 1DPC up to 1600, 2DPC up to 1333, 3DPC up to 800</li> </ul>				
Momory Expansion	• 1.35 V: 1DPC up to 13, 2DPC up to 1066				
Meniory Expansion	1 Gb, 2Gb, and 4Gb DDR3 DRAM technologies supported for these devices				
	<ul> <li>UDIMM DDR3 - SR x8 and x16 data widths, DR - x8 data width</li> </ul>				
	<ul> <li>RDIMM DDR3 - SR, DR, and QR - x4 and x8 data widths</li> </ul>				
	<ul> <li>LRDIMM DDR3 - QR - x4 and x8 data widths with direct map or with rank multiplication</li> </ul>				
	Inutriplication				
	ECC, Patrol & Demand Scrubbing, Sparing, Lockstep mode				
Memory RAS	Chainer mit offing within a socket				
	CPUI channel mirror pairs (A,B) and (C,U)				
Chinast	CPU2 channel morror pairs (E,F) and (G,H)				
Chipset	A chipset that supports Storage Option Select keys				
External I/O	Two (2) RJ45 network interface connectors supporting 10/100/1000Mb				
connections	Two (2) USB 2.0 connectors				
Internal I/O	One (1) type-A USB 2.0 connector				
connectors/neaders	One (1) SSI-EEB compliant front panel header				
	One (1) DH-10 serial port B connector				
I/O Module Options	Support all on-board I/O features, in addition to any installed I/O modules or add-in expansion cards.				
System Fans	Six (6) 10-pin managed system fan headers				
	Two (2) riser card slots with a minimum of 16 PCIe Gen3 lanes per riser				
Riser Card Support	Riser card for 1U chassis must support two half-length cards				
	Riser card for 2U chassis must support three PCIe add-in cards with at least one full length				
Video	Not required				
Storage	Two (2) single port AHCI SATA connectors capable of supporting up to 6 Gb/sec				
Storage	Two (2) SCU 4-port mini-SAS connectors capable of supporting up to 3 Gb/sec SATA/SAS				
Security Provide support for a Trusted Platform Module (TPM) security device					

#### Table 1: Decathlete Server Board Required Features



Feature	Description
Server Management	Meets the requirements of the OCP Open Hardware Management Specification for Remote Machine Management V.0.93

#### Table 2 describes optional features that should be present, or features that are acceptable and **MAY** be present.

Feature	Description			
Memory Expansion	24 memory sockets			
Chipset	Storage Option Select keys			
	DB-15 video connector			
External I/O	RJ45 serial port A connector			
connections	Two (2) additional RJ-45 network interface connectors supporting 10/100/1000Mb			
	One (1) or more USB or USB 2.0 connectors			
Internal I/O	One (1) connector to provide support for two USB 2.0 ports on the front of the system			
connectors/headers	One (1) DH-10 serial port B connector			
	Installed I/O modules SHALL be supported in addition to standard on-board features and any add-in expansion cards.			
1/0 Modulo Ontions	I/O module options that should be supported:			
	Quad port 1 GbE module     Dual port 1 GBase-T Ethernet module			
	<ul> <li>Dual SFP+ port 10GbE module</li> </ul>			
	<ul> <li>Single port FDR-speed InfiniBand module with QSFP connector</li> </ul>			
System Fans				
PCIe Adapter Card Support	Support for the PCI Express* 225W/300W High Power Card Electromechanical Specification V. 1.0.			
Video	Integrated 2D video controller			
Video	16 Mb DDR memory			
Storage				
Security				
	Support for KVM-over-IP			
Server Management	Support for USB and CD-ROM virtual media (bootable)			
Servermanagement	Integrated Baseboard Management Controller, IPMI 2.0 compliant			
	Support for DCMI 1.5			
Misc Features	Status LEDs & Diagnostics LEDs that assist maintenance personnel to identify failed devices or abnormal conditions			
	Indicators that reduce maintenance and repair times			

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#### Server Board Mechanical Dimensions 5

A server board that meets the Decathlete Standard SHALL comply with one of two layout options:

A. Asymmetric layout that supports two power supplies located on the right-hand side of the chassis (Figure 1).

B. Symmetric layout that supports one power supply located on each side of the chassis (two power supplies, total) (Figure 2).

**Note**: The asymmetric layout option **SHALL** only be used for product designs completed prior to the release of this specification. This layout option may be removed in a future update to the specification.

### 5.1 Asymmetric Layout Option







### 5.2 Symmetric Layout Option



Figure 2: Symmetric Board Layout

## 6 I/O Support

#### 6.1 Network Interface

The server board **SHALL** have one LAN device to support the RJ45 network interface connectors. The BIOS **SHALL** support PXE boot on the RJ45 network interface connectors.

Each Ethernet port **SHALL** drive two LEDs located on each network interface connector. The LED at the right of the connector is the link/activity LED. It indicates a network connection when on. It indicates transmit/receive activity when blinking. The LED at the left of the connector indicates link speed as defined in Table 3.

The table contains the preferred color and definition. Alternate color and state definitions are acceptable.

LED	Color	LED State	NIC State
	Green	Off	LAN link not established
Left		On	LAN link is established
		Blinking	LAN activity is occurring
Right		Off	10 Mb/sec data rate

#### Table 3: External RJ45 NIC Port LED Definition

Green	On	100 Mb/sec data rate
Yellow	On	1000 Mb /sec data rate

#### 6.2 USB

The server board **SHALL** provide two external USB ports. The BIOS **SHALL** support the following USB devices:

- Keyboard and mouse
- Bootable USB flash drive
- Bootable USB hard disk
- Bootable USB optical disk

#### 6.3 SATA

The server board **SHALL** support up to six (6) SATA ports.

### 6.4 PCIe and Riser Card Support

The server board **SHALL** provide support for one (1) riser card and **MAY** provide support for two (2) riser cards. The riser card slots can be configured to meet any range of usage models. Table 4 shows examples of 1U and 2U riser cards.

Description	Image
1U Chassis with one add-in card slot	
2U Chassis with three add-in card slots.	

#### Table 4: Riser Card Examples





The OEM/ODM **SHALL** provide a riser card that supports a minimum of one PCIe x16 Gen3 add-in card.

#### 6.5 PCIe Mezzanine Card Support

To broaden the standard on-board feature set, the server board **MAY** provide support for additional I/O Module options.

The **PREFERRED** card should follow the "Mezzanine Card for Intel V2.0 Motherboard" specification that can be found on the Open Compute web page (<u>http://www.opencompute.org</u>). A variety of mezzanine cards are available for Ethernet and storage connectivity. The mezzanine connector pin-out and board outline drawing appears in Section 7.

If the common I/O module design is supported, the board vendor can use the OCP interoperability lab(s) to test the motherboard function with the ecosystem of I/O modules designed to the OCP common I/O module specification. If the vendor chooses to implement a proprietary I/O module design, then testing the motherboard and I/O module interoperability is the motherboard vendor's responsibility.

Support of this module specification is optional. The board vendor may choose to support a different embedded I/O module design.

**Note**: Support for a common mezzanine card may be required in the future. Product designs completed prior to release of this specification are not required to comply.

## 7 On-board Connectors and Headers

This section identifies the functionality of the on-board connectors and headers that provide an interface to system options/features, on-board platform management, or other user accessible options/features.

#### 7.1.1 SSI Compatible Front Panel Connector

The server board **SHALL** provide a connector for front panel indicators and controls. *The functionality and behavior of these buttons and LEDs are not defined by this standard.* This connector shall follow the SSI connector definition described below.

Description	Pin#	:	Description
Power LED +	1	2	Front Panel Power
No connect	3	4	ID LED +
Power LED -	5	6	ID LED -
HDD activity LED +	7	8	Status LED Green -
HDD Activity LED -	9	10	Status LED Amber -
Power Button	11	12	NIC 1 Activity LED -
Power Button Ground	13	14	NIC 1 Link LED -
Reset Button	15	16	SMB Sensor DATA
Reset Button Ground	17	18	SMB Sensor Clock
ID Button	19	20	Chassis Intrusion
Front Panel	21	22	NIC 2 Activity LED -
NMI Button	23	24	NIC 2 Link LED -

#### Table 5: SSI Front Panel Connector Pin Information<sup>1</sup>



#### Figure 3: SSI Front Panel Connector

The server board **MAY** provide additional signals via optional pins on the SSI front panel connector.

#### 7.2 Front Panel USB

The server board **SHALL** provide one or more connectors for an external Type-A USB 2.0 connector and **SHALL** follow the connector definition described below.

1 4 5 1 5 1 1			
Pin #	Signal Name	Pin	Signal Name
1	USB_PWR45	2	USB_
3	ICH_P4N_FB	4	ICH_P5N_FB
5	ICH_P4P_FB	6	ICH_P5P_FB
7	GND	8	GND
9	KEY	10	TP_USB45_PIN10

Table 6: External USB Port Connector

<sup>2</sup> Signal names in the tables are representative of commonly used naming conventions for typical signals. An alternative

<sup>&</sup>lt;sup>1</sup> Refer to the Server System Infrastructure (SSI) Specification for further details on signals.



#### 7.3 External Serial Port

The server board **SHALL** provide an external serial connector, either a RJ45 type or a DE9 type connector and **SHALL** follow the connector definition described in Table 7 and Table 8.



Figure 4: RJ45 Connector

Pin	Signal Name
1	RTS
2	DTR
3	SOUT
4	GND
5	RI
6	SIN
7	DCD or DSR
8	СТЅ

#### Table 7: Serial Header Connector for RJ-45

#### Table 8: Serial Header Connector for DE9

Signal Name	Pin		Signal Name
DCD	1	2	S_IN
S_OUT_N	3	4	DTR
GND	5	6	DSR
RTS	7	8	стѕ
GND	9		

#### 7.4 Internal Serial Port

The server board **SHALL** provide a connector for an internal serial interface. This connector **SHALL** follow either of the connector definitions in the tables below.

Table 9: Serial Port Header Connector

Pin	Signal Name
1	DCD

Pin	Signal Name	
2	DSR	
3	SIN	
4	RTS	
5	SOUT	
6	CTS	
7	DTR	
8	RI	
9	GND	

#### Table 10: Serial Header Connector

Signal Name	Pin		Signal Name
DCD	1	2	DSR
S_IN	3	4	RTS
S_OUT_N	5	6	CTS
DTR	7	8	RI
GND	9		key

#### 7.5 Single Port AHCI SATA Connector

The server board **SHALL** provide a minimum of two (2) single-port AHCI SATA connectors capable of supporting up to 6 Gb/sec transfer rates and **SHALL** follow the connector definition in Table 11.

#### Table 11: Single Port AHCI SATA Connector

PIN	Signal Description		
9	GND (optional)		
8	GND (optional)		
7	GND		
6	SATA_TXP		
5	SATA_TXN		
4	GND		
3	SATA_RXN		
2	SATA_RXP		
1	GND		

#### 7.6 Multiport Mini-SAS/SATA Connectors

The server board **SHALL** include one or more 40-pin high-density multiport mini-SAS/SATA connectors. Each connector can support up to four SATA or SAS ports each. The SATA ports **SHALL** be capable of transfer rates of up to 6 Gb/sec.



Signal Name <sup>2</sup>	Pin		Signal Name
GND	Aı	Bı	GND
SASo_RX_C_DP	A2	B2	SASo_TX_C_DP
SAS0_RX_C_DN	A3	B3	SASo_TX_C_DN
GND	A4	В4	GND
SAS1_RX_C_DP	A5	B5	SAS1_TX_C_DP
SAS1_RX_C_DN	A6	B6	SAS1_TX_C_DN
GND	A7	B7	GND
TP_SAS1_BP_TYPE	A8	B8	SGPIO_SAS1_CLOCK
GND	A9	B9	SGPIO_SAS1_LOAD
SGPIO_SAS1_DATA_OUT	A10	B10	GND
SGPIO_SAS1_DATA_IN	A11	B11	PD_SAS1_CONTROL LER_TYPE
GND	A12	B12	GND
SAS2_RX_C_DP	A13	B13	SAS2_TX_C_DP
SAS2_RX_C_DN	A14	B14	SAS2_TX_C_DN
GND	A15	B15	GND
SAS3_RX_C_DP	A16	B16	SAS3_TX_C_DP
SAS3_RX_C_DN	A17	B17	SAS3_TX_C_DN
GND	A18	B18	GND
GND	Gı	G5	GND
GND	G2	G6	GND
GND	G3	G7	GND
GND	G4	G8	GND

#### Table 12: Multiport Mini-SAS/SATA Connector

## 8 Power System

The Decathlete server board when used in a server chassis with integrated power supplies SHALL consist of one (1) or two (2) power supplies with the output(s) connected directly to the server board. The power supplies SHALL meet the following criteria:

- N+1 capable, hot-swappable
- 80% minimum efficiency measured from 10% to 50% of the rated DC output
- PMbus interface support

<sup>&</sup>lt;sup>2</sup> Signal names in the tables are representative of commonly used naming conventions for typical signals. An alternative naming convention is allowable by the OEM/ODM as long as the purpose and functionality remains.

### 8.1 Power Connection for Symmetric Board Outline

When the server board complies with the symmetric layout as described in section 5.2, the power supply SHALL connect to the server board with a 32-position, double-sided connector. The following vendors and vendor part numbers are examples of the type of connector that MAY be used.

- Tyco 1761469 vertical connector
- Tyco 1761468 right-angle connector
- FCI 10046971-100LF Vertical connector
- FCI 10053363-200LF right angle connector

PCB Top-Side Signal Name	Pin		PCB Bottom-Side Signal Name
+ 12VDC	53-64	1-12	+12VDC
GND	41-52	13-24	GND
PSU_REMOTE_SENSE_P	40	25	TP-TACH
12V_STBY	39	26	PSU_REMOTE_SENSE_N
PS_A	38	27	TP_VIN_GOOD
РОК	37	28	CSHARE
Return	36	29	FM_PS_EN_PSU_N
SMB_SCL	35	30	PS_KILL
PSU_PRESENT_N	34	31	RESET_PS
SMB_SDA	33	32	IRQ_PMBUS_ALERT

#### Table 13: Power Connector Definition for Symmetric Layout

**Note**: Support for this power connector may become a **REQUIRED** feature for product designs completed prior to the release of this specification.

#### 8.2 Power Connection for Asymmetric Board Outline

The server board connection to the power supply is not defined for the asymmetric layout. The OEM or ODM determines the power connection. This board outline is not preferred.

#### 8.3 CPU VRM Efficiency

The minimum efficiency for the CPU VRM SHALL be 90%.

#### 8.4 Power Connections to the OCP Open Rack

The Decathlete Server Board is not intended for use with the OCP Open Rack, but **MAY** be used with a chassis that is compatible with the OCP Open Rack. When used in the OCP Open Rack, the server enclosure **SHOULD** contain a power distribution board (PDB) that provides an electrical interconnector between the 12VDC bus bars in the OCP rack and the Decathlete server board. A cable harness may also be used to provide an interconnect. Regardless of whether a PDB or discrete cable system is used, the



Decathlete board and or system **SHALL** contain logic to enable reporting of system input power to the server board.

The <u>Open Rack website</u> provides a comprehensive list of open rack specifications and design guidelines.

## 9 Platform Management

This section describes the required and optional management features of a Decathlete server board. If any requirement in this section conflicts with the OCP Open Hardware Management Specification for Remote Machine Management V.0.93, that standard is the governing specification.

#### 9.1 Management Controller Firmware Feature Support

This section outlines features that the integrated management controller firmware shall or may support. Support and use for some features is dependent on the chassis and other system-level components that may not be installed.

#### 9.1.1 Intelligent Platform Management Interface Features

The management controller **SHALL** support the following Intelligent Platform Management Interface (IPMI) features:

- IPMI Watchdog timer
- Chassis device functionality, including power/reset control and BIOS boot flags support
- Field Replaceable Unit (FRU) inventory device functionality
- System Event Log (SEL) device functionality
- Sensor Data Record (SDR) repository device functionality
- Sensor device and sensor scanning/monitoring
- Serial-over-LAN (SOL)

#### 9.1.2 Non-IPMI Features

The management controller **SHALL** support the following Intelligent Platform Management Interface (IPMI) features:

- IPMI Watchdog timer
- Chassis device functionality, including power/reset control and BIOS boot flags
   support
- Field Replaceable Unit (FRU) inventory device functionality
- System Event Log (SEL) device functionality
- Sensor Data Record (SDR) repository device functionality
- Sensor device and sensor scanning/monitoring
- Serial-over-LAN (SOL)

The following features **SHOULD** be supported:

- System Airflow Monitoring
- Ethernet Controller Thermal Monitoring
- Power management (e.g. power capping at node level)

- Diagnostic beep codes for fault conditions
- Secure lockout of certain front panel functionality
- Integrated KVM
- Management of PMBus Rev-1.2-compliant power supplies
- Power Supply Compatibility

## 9.2 Advanced Configuration and Power Interface

The server board **SHALL** support the following ACPI states listed in Table 14.

State	Supported	Description	
Sı	Yes	<ul> <li>Sleeping: Context is maintained; equate to processor and chipset clocks being stopped.</li> <li>The front panel power LED blinks at a rate of 1Hz with a 50% duty cycle</li> <li>The watchdog timer is stopped</li> <li>The front panel buttons are unprotected</li> </ul>	
		Fans may be set to a fixed state, or basic fan management may be applied.	
S5	Yes	Soft off <ul> <li>The front panel buttons are not locked</li> <li>The fans are stopped</li> <li>The power-up process goes through the normal boot process</li> </ul>	

#### Table 14: ACPI Power States

#### 9.3 Power Control Sources

The server board **SHALL** support power control from the following sources. Power control is the ability of an internal or external source to initiate a power-up or power-down activity.

Source	External Signal Name or Internal Subsystem	Capabilities	
Power button	Front panel power button	Turns power on or off	
Management controller watchdog timer	Internal management controller timer	Turns power off, or power cycle	
Command	Routed through command processor	Turns power on or off, or power cycle	
Power state Retention	Implemented by means of management controller internal logic	Turns power on when using AC power returns	
Chipset	Sleep S4/S5 signal (same as POWER_ON)	Turns power on or off	
CPU Thermal	CPU Thermtrip	Turns power off	
WOL (Wake On LAN)	LAN	Turns power on	

#### Table 15: Power Control Indicators



#### 9.4 Remote BIOS Update

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The Decathlete server board supplier **MAY** provide a BIOS file that can be updated remotely under these scenarios:

- Scenario 1: Sample/Audit BIOS settings
  - Return current BIOS settings, or
  - Save/export BIOS settings in a human-readable form that can be restored/imported (as in scenario 2)
- Scenario 2: Update BIOS with pre-configured set of BIOS settings
  - Update/change multiple BIOS settings
  - o Reboot
  - Scenario 3: BIOS/firmware update with a new revision
    - Load new BIOS/firmware on machine and update, retaining current BIOS settings
    - o Reboot

Additionally the update tools **SHOULD** have the following capabilities:

- Update from the operating system over the LAN
- Can complete BIOS update or setup change with a single reboot (no PXE boot, no multiple reboots)
- No user interaction (like prompts)
- BIOS updates and option changes do not take longer than five minutes to complete
- Can be scripted and propagated to multiple machines

#### 9.5 Remote Firmware Update

The Decathlete server board supplier **MAY** provide tool(s) to update the management engine firmware remotely as long as they do not require any physical input at the system. Remote update means either through out-of-band by the management controller or through logging into the local OS over the network. A remote firmware update may take a maximum of 5 minutes to complete and requires no more than one reset to cycle the system. The OEM/ODM tool **should** support updating the FW and BIOS together or separately, and **SHOULD** also provide an option to update only the operational FW region or the entire FW region.

## 10 Error Handling and Alerts

In general, any correctable and uncorrectable errors should be logged and an error threshold setting should be enabled for both correctable and uncorrectable errors. Once the programmed threshold is reached, an event should be triggered and logged.

The Decathlete server board standard defines a minimal set of error handling and alerts. These features may become a section of this standard, or may be a standalone specification authored by the OCP Hardware Management project.

## 11 Remote Machine Management

The Decathlete server board **SHALL** implement the requirements of the OCP Open Hardware Management Specification for Remote Machine Management (Version 0.93 at time of this release).

The latest specification is available at <u>http://opencompute.org/projects/hardware-management/</u>.

## 12 Environmental Requirements

It is desirable for the product to comply with all the requirements in this section. Due to design cycle times and the release of this specification, products designed prior to the release of this specification are not required to comply to be considered compliant.

#### 12.1 General Requirements

The board **SHOULD** meet the following environmental requirements:

- Gaseous Contamination: Severity level G1 per ANSI/ISA 71.04-1985
- Ambient operating temperature range: 0°C to +45°C
- Operating and storage relative humidity: 10% to 90% (non-condensing)
- Storage temperature range: -40°C to +70°C
- Transportation temperature range: -55°C to +85°C (short-term storage)

#### 12.2 Regulatory Compliance

The server board, when installed into any chassis, **SHOULD** comply with the following regulations:

- FCC Class A
- UL Safety

#### 12.3 Vibration and Shock

The motherboard **SHOULD** meet shock and vibration requirements according to the following IEC specifications: IEC78-2-(\*) and IEC721-3-(\*) Standard & Levels.

	Operating	Non-Operating
Vibration		1g acceleration, 3mm amplitude, 5 to 500 Hz, 10 sweeps at 1 octave / minute for each of the three axes (one sweep is 5 to 500 to 5 Hz)
Shock	2g, half-sine 11mS, 5 shocks for each of the three axes	12g, half-sine 11mS, 10 shocks for each of the three axes

Table 16: Vibration and Shock Requirements

## 13 Design Standards

The Decathlete server board is expected to conform to design standards, specifications, schematics, PCB stack-up, layout constraints, and thermal and mechanical constraints



provided by any of the device manufactures used in the design of the Decathlete server board.

#### 13.1 Connector Labeling

All ports, connectors, and memory slots shall be clearly labeled.

#### 13.2 Documentation

The supplier of the Decathlete server board **SHALL** make available documentation that contains the following information:

- Block diagram including:
- PCI to CPU mapping
- PCI speed
- BMC/out-of-band Implementation (shared vs. dedicated NICs)
- List of tools and commands that allow the flashing of firmware
- OOB/BMC OS integration requirements

## 14 Prescribed Materials

It is desirable for the product to comply with all the requirements in this section. Due to design cycle times and the release of this specification, products designed prior to the release of this specification are not required to comply to be considered compliant.

#### 14.1 Disallowed Components

The following components are not used in the design of the motherboard:

- Components disallowed by the European Union's Restriction of Hazardous Substances Directive (RoHS 6)
- Trimmers and/or potentiometers
- Dip switches

#### 14.2 Capacitors and Inductors

The following limitations apply to the use of capacitors and inductors:

- Only aluminum organic polymer capacitors made by high quality manufacturers are used; they must be rated to 105°C
- All capacitors have a predicted life of at least 50,000 hours at 45°C inlet air temperature, under the worst conditions
- Tantalum capacitors using manganese dioxide cathodes are forbidden
- SMT ceramic capacitors with a case size > 1206 are forbidden (size 1206 are still allowed when installed far from the PCB edge and with a correct orientation that minimizes the risk of cracking)
- Ceramic material for SMT capacitors must be X7R or better material (COG or NPo type are used in critical portions of the design)
- Only SMT inductors may be used. The use of through-hole inductors is disallowed.

#### 14.3 Component De-Rating

For inductors, capacitors, and FETs, a minimum 20% de-rating **SHALL** be used.

## 15 Reference Documents

- Advanced Configuration and Power Interface Specification, Revision 3.0, http://www.acpi.info/.
- Intelligent Platform Management Bus Communications Protocol Specification, Version 1.0. 1998. Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.
- Intelligent Platform Management Interface Specification, Version 2.0. 2004. Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.
- Platform Support for Serial-over-LAN (SOL), TMode, and Terminal Mode External Architecture Specification, Version 1.1, 02/01/02, Intel Corporation.
- Entry-level Electronics-Bay Specification, Version 3.0, 2001. Intel Corporation, NEC Corporation, Dell Computer Corporation, Data General, a division of EMC, International Business Machines Corporation, Silicon Graphics, Inc., and Compaq Computer Corporation.
- Trusted Platform Module (TPM) Specifications. Trusted Computing Group.
- PCI Express®225 W/300 W High Power Card Electromechanical Specification Revision 1.0.
- Intel RAID Quick Reference Guide, Version G46033-003. Intel Corporation