96Boards Enterprise Edition

Server Hardware Platform Specification

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For further information contact: 96Boards@linaro.org

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For further information contact: steve.taylor@linaro.org

Background

The 96Boards Enterprise Edition (EE) Platform is intended to support:

- A low cost Software Development Platform for advanced ARM SoCs, targeted at the high end embedded, networking and server markets.
- Community engineering activities, including
  - Open Source upstream development
  - allowing 'real life' benchmarking and tuning, including power management
  - being integrated into an automated test farm
  - 96Boards Community program run by Linaro
- Build farms
- Early SoC evaluation

There are two versions of the EE specification.

- The Standard version is a low cost, small form factor, stand-alone board that can be simply connected on a desk to an off-the-shelf low cost power supply, network connection and storage.
- The microATX version is designed for integration with standard off the shelf ATX PC parts - for example into a pre-built chassis with ATX power supply and disk drive(s).

In all cases key design and distribution goals are

- Low cost (target $199-399 retail for the Standard version)
- Easy to purchase globally
  (for example, via Amazon, Alibaba, Farnell, Digikey, Mouser etc.)
- Enable a third party ecosystem to develop around expansion boards/peripherals etc. that can be used on any 96Boards EE compliant board

A key design objective is to encourage multiple SoC vendors to build boards to this specification. This is an evolution from previous community boards where the external ecosystem is tied to a particular SoC. The 96Boards specification is designed to enable an ecosystem to evolve that will support multiple SoCs for many years.

The specification is open - that is anyone may build a board to the specification without payment of any fees or any licensing requirements.

The 96Boards Certification Program is optional for board developers and provides hardware and software certification, a community site and software support provided by Linaro for 96Boards certified products. Participation is recommended but is not required in order to build a board to the specification.

96Boards Enterprise Edition

Hardware

96Boards EE Minimum Hardware Features

1. Small form factor
    - Standard EE version 160 x 120mm
    - microATX EE version 244 x 244mm
2. Design is SoC independent (targets 32 or 64 bit SoCs)
3. 1GB RAM (16GB strongly recommended for server software development)
4. Minimum on-board connectors and expansion I/O
    - 1x Serial over USB UART with microUSB interface
    - 2x USB
    - 1x RJ45 Ethernet
    - Standard version board power from low cost 12V DC Jack connector
    - or standard 12V high power DIN connector
    - microATX version board power from ATX power supply
    - 1x 40 pin 96Boards 1.8V expansion interface header with UART, SPI, I2C & GPIO
    - Standardized positions for PCIe connector(s), If implemented

A compliant board **shall** implement the minimum functionality.

Additional functionality **may** be implemented provided that the 96Boards EE specifications are implemented in full.

The minimum configuration board requires only a single UART on the micro-USB connector, a dual USB connector, the 96Boards 40 pin expansion connector, a single Ethernet connector and power supply connections.

Additional vendor specific connectors may be added at the discretion of the board designer.

It is expected that additional SATA, networking or USB interfaces, if required, will be placed at the back of the Standard EE board. See the 2D Reference Drawing at end of document.

Hardware Feature Details

96Boards EE Physical Footprint

The 96Boards Standard EE has a footprint of 160x120mm

The 96Boards microATX EE has a footprint of 244x244mm

1. Area
   The 96Boards Standard EE without population of connectors **shall** fit into a 160 x 120mm footprint +/- 0.25mm. Connectors should not protrude from the area footprint except as component design requires (for example Ethernet or USB Type A front shrouds).
   The 96Boards microATX EE **shall** conform to the microATX MotherBoard Specification Version 1.2. For physical compatibility across boards the footprint **shall** be 244 x 244mm and not a smaller design.
2. Height

PCB	62mil (1.575mm) nominal, minimum
Below PCB	Standard EE 6.0mm, maximum microATX EE per microATX specification

Note that there are height restrictions for certain board areas. See the keepout drawings in the Specification Appendix for further information.

It is **recommended** that the Standard board design utilize low profile components and restrict the height above the board to a maximum of 20.0mm. This allows high density of board installation into farm applications.

However, the board design **may** exceed this height at the discretion of the board designer.

Examples of higher height requirements are heatsinks and/or fans for the SoC, implementation of vertical mount DIMMs or SO-DIMMs, design for 1U racks, or implementation of a PCIe card if a PCIe connector is provided.

A 96Boards standard low speed expansion board may be added to the baseboard with a board to board separation of a minimum of 7.0mm.

DRAM

A 96Boards EE board **shall** be populated with a minimum of 1GB of DRAM or with DIMM/SO-DIMM socket(s) for user installation of RAM. If memory module socket(s) are not provided it is **strongly recommended** that a minimum of 16GB DRAM is fitted where the board is expected to be used for server/virtualization development workloads.

If SO-DIMM sockets are used their positioning is at the discretion of the board designer, subject to the 96Boards Enterprise Edition physical specifications.

Boot ROM

A minimum of 64MB of bootable flash memory **shall** be provided on the board.

Where multiple boot options are provided the choice of boot location **shall** be user selectable in hardware (links or switches).

Note that the insertion of a cable **shall not** automatically require boot from that cable (for

example the insertion of an Ethernet cable to use network booting). In this case the boot option must still be user selectable.

There **shall** be a capability of booting and programming the boot ROM without special hardware (for manufacturing or board recovery).

Flash Storage

A minimum implementation can boot from the network. However, for debug and testing an implementation shall support a storage option for at least 4GB of flash or disk storage. This requirement can be met by one or more of

- On-board 4GB flash device
- USB storage device (using the required USB port)
- SD Card interface
- SATA interface

Ethernet

The board **shall** support a minimum of one RJ45 Ethernet port.

If a management port is implemented this port **shall** be the management port.

If a management port is not implemented this port **shall** be a system ethernet port.

The RJ45 connector **shall** be in the specified location

All on-board RJ45 network connectors **shall** be the type fitted with 2 LED indicators

Additional network connections (for example RJ45 or SFP+) **may** be placed on the designer I/O connector area at the back of the Standard board.

UARTs

One debug UART **shall** be provided on a 96Boards EE.

This UART **may** be used as the startup bootloader/OS console

This UART **shall** be interfaced using a TI TUSB3410, FTDI FT230X or equivalent to a micro-B USB connector located in the specified position.

In addition one standard UART **shall** be made available on the 40 pin expansion connector

A second standard UART **may** be made available on the 40 pin expansion connector.

USB Ports

A minimum of 2 USB host ports **shall** be provided on a 96Boards EE

It is **strongly recommended** that these be USB3.0 or higher

The USB connector **shall** be located in the specified position and **shall** be a double stacked Type A or Type C connector.

Additional USB ports **may** be placed on the designer I/O connector area at the back of the Standard EE board.

DC Power

For the Standard version power **shall** be provided to the board by one (and only one) of the following:

1. A 12V supply (+/- 10%) from a DC jack power connector
   A 2.5mm center pin 8A DC jack connector, CUI Inc PJ-063BH or equivalent, **shall** be placed in the specified location if the board can be operated with a power supply of <90W
2. A 12V supply (+/- 10%) from a high power standard DIN 4 pin connector
   A 4 pin DIN connector, CUI PD40/40S or equivalent, **shall** be placed in the specified location and can provide up to 15A of power (180W) from off the shelf power supplies.

The specification does not support multiple simultaneous power supplies (ie DC jack and high power connector). If both in-specification supplies are connected there **shall not** be a safety issue and there **shall** be no damage to the board.

For the microATX EE version power **shall** be provided to the board by a standard ATX power supply. The board shall be fitted with a Molex 44206-0007 header for this purpose.

The board **shall** be able to provide the following power to external devices when a sufficiently rated power supply is connected to the DC Jack or high power connector:

1. A minimum of 6W at 12V DC to a mezzanine module via the SYS_DCIN line, and
2. A minimum of 5W to a mezzanine module via the +5V line, and
3. A minimum of 5W to external USB devices connected to the host USB ports, and
4. A minimum of 0.18W to an mezzanine module via the regulated +1.8V line, and
5. A minimum of 25W to an installed PCIe card (if implemented)

Measurement, Instrumentation and Testing Facilities

Boards **shall** support power measurement, instrumentation and testing facilities. The following facilities **shall** be provided.

Power Measurement

Current sense resistor(s) **shall** be placed to permit basic power measurement functions.

- The power consumption of the board **shall** be measurable through suitable 1% current sense resistor(s)
- This **may** be a developer install option (i.e. the sense resistor(s) may be shipped as a zero ohm resistor for production boards that a developer can replace for power measurement)
- The sense resistor(s) **shall** be placed on the main board power supply to measure the total base board power.
- Measurement of the following is optional:
  - 40 pin expansion bus
  - USB power out
  - PCIe card power

Current sense resistors **shall** be made available externally to measurement equipment. One option for interface is the ARM Energy Probe:

http://ds.arm.com/ds-5/optimize/arm-energy-probe/

The PCB design **shall** provide for low profile male 0.1" header pins to enable the connection of:

- The sense resistor connections (2 pins each)
- A single ground pin (for voltage measurement). The Low speed expansion connector may be documented as being usable for the ground pin requirement.

This header (or headers) **may** be unpopulated on a retail 96Boards EE board (enabling users to add the headers themselves).

Power Button and Reset Button

The user **shall** be able to manually power up/down and reset the 96Boards EE from the board. (For example, with one or two button switches).

It **shall** be possible to connect external switches for power on/off and for hard reset. This **shall** be implemented using the specified pins on the low speed bus connector (adjacent pins allowing direct connect of a 3 pin connector for both switches).

It **shall** be possible to configure the 96Boards EE to power up automatically if external power is removed and then re-applied. This **may** either be default operation or through a configuration option (e.g. link).

Implementation note: It is up to the designer how to implement this functionality. For example, a single push button under SoC/PMIC control could be used to turn the power on or off, with a long press to carry out a system reset. In this case the board should automatically always power up when power is newly applied. Alternatively a physical On/Off switch could be used to apply power to the board, which would automatically power up when in the On position. In this case a separate push to reset switch could be implemented.

External Fan Connection

A 12V PC style external fan connection **shall** be available using the SYS_DCIN (12V nominal) line on the Standard EE version. A standard Molex KK connector part no 22-23-2031 or equivalent shall be used. Pin 1 is GND, Pin 2 is SYS_DCIN and Pin 3 is tachometer (tachometer signal implementation is optional).

JTAG

JTAG facilities **may** be provided on a board.

If implemented it is **recommended** that the JTAG interface use the 10 pin JTAG connector (0.05” pitch).
See http://www.support.code-red-tech.com/CodeRedWiki/HardwareDebugConnections

Alternative JTAG connector interfaces **may** be provided at the discretion of the board designer.

User LEDs

4 User LEDs **shall** be placed on the board at the specified location on the Standard EE board
The User LEDs **shall** be placed on the user accessible backpanel on the microATX EE board

The User LEDs **shall** be directly programmable from the SoC

The User LEDs **shall** be Green and 0603 SMD footprint on the Standard EE board.

Other LEDs and UI interfaces are optional (other than for Ethernet RJ45 connectors)

Front Panel and DC Jack Connectors

Development boards are in general subject to high cycle life of connector attachments, and should be designed to be as mechanically strong as possible. Therefore, the panel connectors (Ethernet, USB and the DC Jack connector) **shall** include through PCB mechanical support.

While surface mount electrical connections are acceptable, a fully surface mount connector without any in/through board mechanical support **shall** not be used.

Expansion Connector

A 96Boards low speed expansion connector **shall** be implemented in the specified location on the Standard EE version, and in a designer-selected location on the microATX EE version. A corresponding height restricted area is required for components beneath an attached 96Boards mezzanine module, as defined in the reference drawing information at the end of this specification.

This connector provided standardized access to maker/developer facilities such as GPIO, I2C, SPI/SD and IoT devices on an 85x54mm board. It enables vendors to benefit from the 96Boards mezzanine ecosystem for IoT and interface devices.

A 40 pin low profile female 2mm receptacle (20x2) 4.5mm height is specified. The mating connector will provide a board to board separation of at least 7mm.

This connector is pin-out compatible with 96Boards Consumer Edition products.

Small mezzanine boards or modules that interface only to the 96Boards CE low speed expansion connector are also compatible with 96Boards Enterprise Edition products that implement this connector.

Connector Part numbers include:

- Molex 87381-4063 (SMT)
- FCI 55510-140LF (SMT)
- Samtec TLE-120-01-G-DV (SMT)
- TE 4-1470209-3 (Through hole)
- TE 4-1734506-3 (Through hole)
- FCI 63453-140LF (Through hole)

Important notes:

1. Unless otherwise indicated the low speed expansion connector signals are at 1.8V logic levels.
2. The mezzanine board connector may be shrouded or unshrouded (see example part numbers below). Since a shrouded part can be used the connector footprint should be 43.0 x 6.5mm with no other components on the board top side in this area.

The following interfaces **shall** be available except where specified as optional:

- UART0
- UART1 (optional)
- SPI bus

- I2C x2
- I2S/PCM audio (optional)
- GPIO x12
- Reset and Power button
- 1.8V, 5V and DC_IN power supplies

Refer to Connector Pin Specification appendix for the required pinout.

Expansion Board Connectors

The following mezzanine board connectors may be used to interface to the baseboard:

- MOLEX 87831-4029 Low speed 2.5mm mated height (Through hole shrouded)
- FCI 57202-G52-20LF Low speed 2.5mm mated height (SMT no shroud)
- SAMTEC TMMH-120-01-F Low speed 2.0mm body (Through hole)

Expansion Connector Notes

1. GPIO-A **shall** be capable of waking up the SoC from sleep/standby mode
2. By default all GPIO pins **should** be configured at boot as inputs to the SoC. This allows for the mezzanine board configuration to be detected from the SoC. After the configuration is known GPIO pins (pin-muxed) may be re-configured in software for mezzanine module specific functions. Through this mechanism additional support for particular SoC/mezzanine module configurations may be supported by making the appropriate SoC GPIO special function pins available on the expansion connector(s). Note that by default all GPIO pins should be usable as GPIOs (i.e. any generic mezzanine board may rely on any or all of the specified GPIO pins being available for use).
3. A mezzanine board **should not** place components (other than the required connectors) on the underside in the area of the base board.

Additional Functionality

Boards that comply to the 96Boards EE specification may provide additional functionality provided that all mandatory functionality is available.

For example a 96Boards EE board could optionally provide facilities such as:

- Additional custom storage
- Additional I/O - e.g. network interfaces, display and/or multimedia interfaces, optical I/O, fabric board interconnect etc.

The Standard EE board rear edge has an area specified for additional I/O connectors (e.g. USB, additional network connections, SATA interfaces etc.). This area is available to the board designer as required.

Any included additional functionality, headers, mezzanine or board to board connectors shall not contravene the 96Boards EE Physical Footprint specification, or prevent the use of the 96Boards EE connector expansion facilities.

Note the following for additional interfaces (if provided):

SATA

SATA support **may** be provided on a 96Boards EE

SATA connections (for example SATA, eSATA, eSATA+ etc.) **shall** be placed on the designer I/O connector area at the back of the Standard EE board.

PCIe

A PCIe expansion bus from 1-16 channels **may** be provided.

If PCIe is provided, a 16 lane connector **shall** be in the specified location and orientation regardless of whether less than 16 channels are actually offered.

Additional PCIe connectors **may** be provided.

PCIe Mini and/or M.2 connector(s) **may** be installed on the top or underside of the board.

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96Boards EE Software Requirements

Unless otherwise stated, support means

- Support in the relevant project's repositories, for example the Linux kernel git repositories at git.kernel.org
- Source and binary code packages available to download[1]

Software requirements are:

- Boot architecture (at least one open source implementation shall be available)
  - Support for bootloader such as U-Boot/FDT, UEFI/ACPI, UEFI/FDT
  - Support for a secure execution environment (optional)
  - Support for ARM Trusted Firmware (ARMv8), including PSCI APIs (recommended)
- Kernel
  - An unmodified kernel.org mainline, stable or longterm (latest two releases) kernel. *Note: Upstream mainline support is a 96Boards program goal*
  - A Linaro or vendor-supported kernel with additional patches against a kernel.org mainline, stable or longterm (latest two releases) kernel
- Operating system
  The latest released (stable) version of one or more of the following open source distributions shall be made available for a 96Boards EE compliant design:
  - Debian
  - Ubuntu
  - Fedora
  - Red Hat
  - A Linaro or vendor supported Linux using the OpenEmbedded/Yocto build system
- Other Operating Systems/Distributions
  Other operating systems or distributions may be provided for a 96Boards product and can be made available to end users on the 96Boards community portal

[1] Linaro provides an open 'community portal' at 96Boards.org for 96Boards Certified products where users may go for support, software upgrades etc

APPENDIX

Expansion Connector Signal Description

40 Pin Low Speed Expansion Connector

2x20 female 2mm header

GND	Pin 1		Pin 2	GND
UART0_CTS	Pin 3		Pin 4	PWR_BTN_N
UART0_TxD	Pin 5		Pin 6	RST_BTN_N
UART0_RxD	Pin 7		Pin 8	SPI0_SCLK
UART0_RTS	Pin 9		Pin 10	SPI0_DIN
UART1_TxD	Pin 11		Pin 12	SPI0_CS
UART1_RxD	Pin 13		Pin 14	SPI0_DOUT
I2C0_SCL	Pin 15		Pin 16	PCM_FS
I2C0_SDA	Pin 17		Pin 18	PCM_CLK
I2C1_SCL	Pin 19		Pin 20	PCM_DO
I2C1_SDA	Pin 21		Pin 22	PCM_DI
GPIO-A	Pin 23		Pin 24	GPIO-B
GPIO-C	Pin 25		Pin 26	GPIO-D
GPIO-E	Pin 27		Pin 28	GPIO-F
GPIO-G	Pin 29		Pin 30	GPIO-H
GPIO-I	Pin 31		Pin 32	GPIO-J
GPIO-K	Pin 33		Pin 34	GPIO-L
+1V8	Pin 35		Pin 36	SYS_DCIN
+5V	Pin 37		Pin 38	SYS_DCIN
GND	Pin 39		Pin 40	GND

Pin Descriptions

UART

One UART **shall** be provided on the low speed expansion bus

A second UART **may** be provided

Signal	Description	V	Type	Spec.	If not used
UART0_RxD	Receive serial data	1.8V	Input	Required	
UART0_TxD	Transmit serial data	1.8V	Output	Required	
UART0_RTS	Request to Send control	1.8V	Output	Required	
UART0_CTS	Clear to Send control	1.8V	Input	Required	
UART1_RxD	Receive serial data	1.8V	Input	Optional	NC
UART1_TxD	Transmit serial data	1.8V	Output	Optional	NC

I2C

Two I2C interfaces **shall** be provided on the low speed expansion bus

Signal	Description	V	Type	Spec.	If not used
I2C[0-1]_SCL	Serial Clock	1.8V	OD/PU	Required	
I2C[0-1]_SDA	Serial Data	1.8V	OD/PU	Required	

It is **recommended** that a 2K2R pullup is provided on each I2C signal, dependent on any relevant drive/pullup specifications of the SoC.

Power and Reset

The following controls **shall** be provided on the low speed expansion bus

Signal	Description	V	Type	Spec.	If not used
PWR_BTN_N	Power on/off external request	1.8V	Input	Required	
RST_BTN_N	Reset external request	1.8V	Input	Required	

These signals **shall** be active low.

SPI

One SPI bus master **shall** be provided on the low speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
SPI0_SCLK	Serial Clock	1.8V	Output	Required	
SPI0_CS	Chip Select	1.8V	Output	Required	
SPI0_DIN	Data In	1.8V	Input	Required	
SPI0_DOUT	Data Out	1.8V	Output	Required	

PCM/I2S

One PCM/Inter IC Sound (I2S) PCM audio data bus **may** be provided on the low speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
PCM_FS	PCM/I2S Word Clock	1.8V	Output	Optional	NC
PCM_CLK	PCM/I2S Bit clock	1.8V	Output	Optional	NC
PCM_DO	PCM/I2S Serial data out	1.8V	Output	Optional	NC
PCM_DI	PCM/I2S Serial data in	1.8V	Input	Optional	NC

GPIO

12 GPIO lines **shall** be provided on the low speed expansion bus

Signal	Description	V	Type	Spec.	If not used
GPIO-[A-L]	General Purpose I/O	1.8V	I/O	Required	

Special functions:

GPIO-A **shall** be capable of waking up the SoC from sleep.

Power Supplies

The following power supplies **shall** be provided on the low speed expansion bus

Signal	Description	V	Type	Spec.	If not used
+1.8V	1.8V Power reference (max 0.1A)	1.8V	Output	Required	
+5V	5V System Power Supply	5V	Power	Required	
SYS_DCIN	9-18V Input Power Supply	12V	Power	Required	

See the DC Power section of the 96Boards EE Specification.

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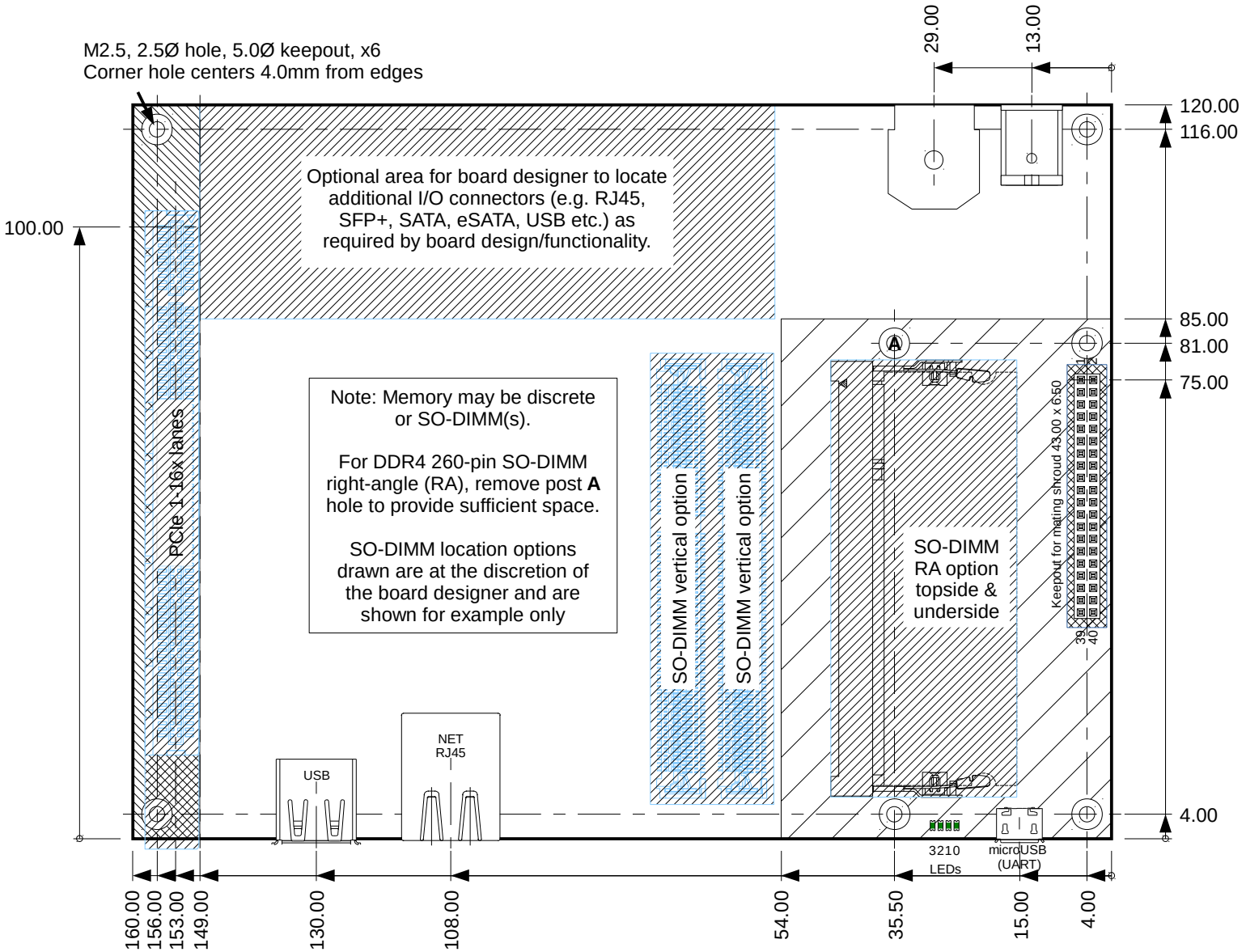
2D Reference Drawing

96Boards Enterprise Edition (Standard Version)



General Top component area

Top component keep out area

Top component max height = 6.5mm

Optional Components

TITLE **96Boards Enterprise Edition**		
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ALL DIMENSIONS IN MM		
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96Boards Enterprise Edition (microATX Version)

The Enterprise Edition microATX Version is for those SoCs that require additional space (typically because of a larger SoC footprint, the need for additional memory devices or other required feature sets) or applications where vendors want to deliver standard PC chassis, power supply and other system component compatibility.

96Boards Enterprise Edition microATX versions **shall** be 244 x 244mm. Smaller microATX boards are not permitted (in order to ensure physical compatibility between implementations)

Important Note: The 96Boards specification assumes that any developer of the microATX specification will design to the following specification:

microATX MotherBoard Specification Version 1.2
published by the Intel Corporation and available here:
http://www.formfactors.org/FFDetail.asp?FFID=2&CatID=1

Note the following:

The 96Boards Enterprise Edition microATX version shall implement all mandatory functionality in this specification.

The 96Boards 40 pin 2mm expansion connector **shall** be fitted on the microATX board at a location selected by the designer. Note that a corresponding component height restriction of 6.5mm will apply on the top of the board over an area of size 85x54mm to enable the user to attach a 96Boards Small-format Mezzanine board to the 96Boards EE product. To determine the location of the height restricted area relative to the connector position please refer to the 96Boards Standard version drawing above.

The following 96Boards required interfaces **shall** be provided on the microATX user accessible back panel:

- RJ45 for management or system ethernet port
- microUSB for bring up serial port
- 2x USB ports
- User LED indicators

-------SPECIFICATION ENDS-------

Change History

v1.0	Jun 2015	Initial Published Specification

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