96Boards Consumer Edition

Low Cost Hardware Platform Specification

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Background

The 96Boards Consumer Edition (CE) Platform is intended to support:

1. Low cost Single Board Computer use
    - Low cost platform for running standard Linux-based OS including Android
2. Open Source community software development
3. Maker community
    - Requiring extensible hardware interfaces to prototype or build add on products
4. Embedded System OEMs requiring low cost off-the-shelf CPU modules
    - Example - Kiosks, Displays, Robots etc.
5. Community engineering activities, including
    - upstream development
    - allowing 'real life' benchmarking and tuning, including power management
    - being integrated into an automated test farm
    - 96Boards Community program to be run by Linaro

In all cases key design and distribution goals are:

- Low cost ($50-100 retail for a minimum configuration)
- Easy to extend with off the shelf parts available to maker community and OEMs
- Easy to purchase globally (for example, via Amazon, Alibaba, Farnell, Digikey, Mouser etc.)
- Enable a third party ecosystem to develop around expansion (mezzanine) boards/peripherals/displays etc. that can be used on any 96Boards CE compliant board

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

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

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

96Boards Consumer Edition

Hardware

96Boards CE Minimum Hardware Features

1. Ultra-small low-profile “card” form factor - 85 x 54 x 12mm
    - Footprint compatible Extended Version option - 85 x 100 x 12mm
2. Design is SoC independent (targets 32 or 64 bit SoCs)
3. 0.5GB RAM (Minimum 1GB recommended for Android)
4. MicroSDHC Socket for up to 64GB on-board or expansion flash storage
5. Wifi 802.11g/n and Bluetooth 4.0 LE
6. On Board Connectors and expansion I/O
    - 2x USB Type A or Type C host ports (USB2.x or 3.x)
    - USB Micro-B USB or Type C slave or OTG port (USB2.x or 3.x)
        - For PC connection
    - Display output must be available on one of the following:
        - HDMI/audio on HDMI full size or micro connector
        - MHL display/audio on display microUSB
        - DisplayPort/audio on USB Type C
    - Low profile 40 way female header for maker/community use
    - Low profile 60 way high speed female module header for advanced maker/OEM use with high speed interfaces including MIPI-DSI, USB and optional MIPI CSI-2
    - Board power from low profile DC Jack connector

A 96Boards CE board must implement the minimum functionality. Additional functionality may be implemented provided that the 96Boards CE specifications are implemented in full (including limitations on form factor). See below for further information.

Hardware Feature Details

96Boards CE Physical Footprint

The 96Boards CE defines a new standard for small footprint community boards. The board is defined into a credit card footprint with a total maximum height of 12.0mm:

1. Area
   The board without population of connectors **shall** fit into a 85 x 54mm footprint +/-0.25mm. Connectors should not protrude from the area footprint except as component design requires (for example USB Type A front shrouds).
   A compatible extended version is defined that **shall** fit into a 85 x 100mm footprint with the same conditions.

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2. Height

PCB	62mil (1.575mm) nominal
Below PCB	3.4 mm maximum
Above PCB	7.0 mm maximum

Total height of the board including on board connectors **shall not** exceed 12mm.

Note that the maximum height for general components on the board top side is 4mm (not including the allowed areas for connectors and larger components). The maximum height in the allowed areas is 6.5mm except for the two Type A USB connectors which can be up to 7.0mm. The extended version does allow some components to exceed the height specifications. See the keepout drawings in the Specification Appendix for further information.

SoC Location Options

The specification is designed with two possible locations for the SoC. One is on the board top surface, and the other is on the board bottom surface.

The rationale is to permit SoCs with low power dissipation to be placed on the top surface with a low profile heatsink or fan if required (to a total maximum height of 6.0mm). Then, mezzanine boards placed above this area are required to have no components on their underside corresponding keep out area above the SoC.

The second option is to place the SoC on the underside of the board. This is intended for implementations that require higher SoC power dissipation. As supplied, the board should meet the “below PCB” footprint requirement. This then allows additional thermal management in the case or enclosure for the board as required.

DRAM

The board **shall** be populated with a minimum of 0.5GB of DRAM.
It is **strongly recommended** that a minimum of 1GB DRAM is fitted where the board is expected to run Android.

eMMC/Flash

The board **may** optionally be populated with eMMC or other format flash memory.

If the SoC used is not able to boot from microSDHC then a minimum of 8MB 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 a microUSB cable into an OTG port to use FastBoot). In this case the boot option must still be user selectable.

microSDHC

A microSDHC card socket **shall** be fitted in the specified location on the board.
In the absence of on-board Flash memory, the system **shall** be capable of booting from the boot software installed on a microSDHC card at power up.

WiFi/Bluetooth LE

The board **shall** support WiFi (minimally 802.11g/n) and Bluetooth 4.0 (Bluetooth Low Energy).

It is **recommended** that WiFi 802.11ac is also supported.
A PCB or chip antenna **shall** be provided in the prescribed location.
An external antenna socket option **may** be provided.

Display Interface

Display output **shall** be one of:

1. HDMI which **shall** be provided on a full size (Type A) or a micro Type D connector
2. MHL which **shall** be provided on a 5 pin microUSB connector
3. Displayport which **shall** be provided on a USB Type C connector

In all cases the display interface **shall** include audio with support for at least 1 channel

In all cases the connector **shall** be located in the specified location.

A MIPI DSI port **shall** be provided on the expansion bus interface.
1-4 lanes are supported. An implementation **may** use less than 4 lanes.

Note that if a single DSI interface on the SoC is used to provide both (1) the high speed expansion bus interface DSI port and (2) the on board HDMI/MHL/DisplayPort interface (via suitable transmitter), then the expansion port interface **shall** be operational if a mezzanine board that uses DSI is fitted. It is then optional as to whether the on-board interface is usable at the same time.

Camera Interfaces

1 or 2 MIPI CSI-2 ports **may** be provided on the expansion bus interface.

If 1 port is provided it **shall** be located on the CSI0 port interface
From 1-4 lanes **may** be implemented on the CSI0 port interface

From 1-2 lanes **may** be implemented on the CSI1 port interface

An implementation **may** support dual (stereo) cameras through the CSI0 interface if the SoC provides the necessary functionality.

Cameras/Sensors can require additional control signals including RST, PWRDN and MCLK.

The specified GPIO and CLK signals on the expansion connectors **shall** be used for these functions if implemented.

If the cameras/sensors are not available/used then these signals **shall** be available as GPIO and CLK signals.

USB Ports

A total of 4 USB ports **shall** be provided for a board.

Two Type A or Type C USB host ports (USB 2.x or 3.x) **shall** be provided on the board.

The connectors **shall** be in the specified locations.

Two options are provided for the required third USB port, which **shall** be capable of slave operation:

1. A 5 pin microUSB USB 2.0 slave port **shall** be provided.
   The connector type **shall** be micro-AB for an OTG port or micro-B for a slave only port.
   This port **shall not** provide power to the board, due to insufficient power rating.
2. A Type C USB port shall be provided (USB 2.x or 3.x).
   This port may also be used to provide 5V external power to the board.

   In both options the connector **shall** be placed in the specified location.

   The third port **shall** be available as a slave port.

   The third port **may** be an OTG port.

A fourth USB host port **shall** be provided on the high speed expansion bus.

Implementation note: some mobile SoCs implement only a single USB OTG port. Such SoCs can be used on boards with a switch and a USB hub IC. See the Appendix to this specification for an example implementation.

Therefore, there **may** be some restrictions on simultaneous USB port usage.
Two examples:

a. it may not be possible to use the host ports simultaneously with the slave port
b. a base board port may be shared via a switch to provide the expansion port

Any such restrictions **shall** be clearly documented.

Audio

The board **shall** provide a minimum of single channel audio through the following facilities:

1. I/O via Bluetooth 4.0
2. Output through the HDMI/MHL/DisplayPort interface

An I2S/PCM audio channel **shall** be provided on the low speed expansion interface.

Other audio facilities are optional.

DC Power

Power **shall** be provided to the board by one (and only one) of the following:

1. An 8V to 18V power supply from a dedicated DC jack power connector.
   A 1.65mm center pin positive DC jack connector, CUI Inc PJ-041H or equivalent, **shall** be placed in the specified location.
2. An 8V to 18V power supply from the SYS_DCIN pins on the low speed expansion connector.
3. A USB Type C port at 5V (if fitted) according to the USB 3.1 specifications.

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

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:

1. A minimum of 7W to a mezzanine module via the SYS_DCIN line, and
2. A minimum of 5W to a mezzanine module via the regulated +5V line, and
3. A minimum of 5W to external USB devices connected to the 2 host USB ports, and
4. A minimum of 0.18W to a mezzanine module via the regulated +1.8V line

The board **shall** be able to provide the following power to external devices when powered from (a) the Expansion connector or from (b) a Type C USB port (when power does not have to be provided on the SYS_DCIN line)

1. A minimum of 5W to a mezzanine module via the regulated +5V line, and
2. A minimum of 5W to external USB devices connected to the 2 host USB ports, and
3. A minimum of 0.18W to a mezzanine module via the regulated +1.8V line

Battery Power and Low Cost Power Supplies

A board could be powered either by a low cost power supply that is only capable of providing power for the board and for low power mezzanine boards, or by an external battery (for example from the SYS_DCIN line or a separate battery connection).

Limitations on available power covering the use of smaller and/or battery power supplies **shall** be clearly documented.

Measurement, Instrumentation and Testing Facilities

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

Power Measurement

A minimum of 1 current sense resistor **shall** be placed to permit basic power measurement functions.

- The total power consumption of the board **shall** be measurable through a suitable 1% current sense resistor.
- This **may** be a developer install option (i.e. the sense resistor may be shipped as a zero ohm resistor for production boards that a developer can replace for power measurement)
- The sense resistor **shall** be placed on the main board power supply to measure the total base board power. It is optional as to whether this will measure any mezzanine board power usage.

Additional current sense resistors **may** be placed at the discretion of the board designer.

It is **recommended** that additional sense resistors are provided for the main PMIC downstream supplies to the SoC core, memory etc.

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 CE 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 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 board 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 or switch).

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 toggle 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

An external fan (for example for a case) connection is available on the low speed expansion connector by using a 2 pin male header for +5V or +12V fans.

UART

One standard UART from the SoC **shall** be made available for general purpose use on the low speed expansion connector.

A second UART (TxD/RxD only) **may** be made available on the low speed expansion connector.

Note: Off the shelf FTDI 1.8V serial USB cables may be used to interface to these interfaces.

JTAG

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

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

System and User LEDs

The following LEDs **shall** be present on the board.

The LEDs **shall** be of the specified size, color and location.

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

1. WiFi activity LED Yellow Type: 0603 SMD
2. Bluetooth activity LED Blue Type: 0603 SMD
3. User LEDs x4 Green Type: 0603 SMD

Other LEDs and UI interfaces are optional.

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 front panel connectors (Display, USB Type A and microUSB/USB Type C) 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 Connectors

Two expansion connectors **shall** be provided. The first is a low speed expansion connector carrying GPIO and other low speed interfaces. The second is a high speed expansion connector that provides high speed interfaces such as MIPI DSI, MIPI CSI-2 and MIPI-HSIC.

Mezzanine boards are expected to be used in one of two configurations:

1. Low speed expansion connector only
2. Low and high speed expansion connectors together

Low Speed Expansion Connector

A 40 pin low profile female 2mm receptacle (20x2) 4.5mm height is specified.

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 43.0x6.5mm 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
- I^2C x2
- I^2S
- GPIO x12
- Reset and Power button
- 1.8V, 5V and DC_IN power supplies

Refer to Connector Pin Specification appendix for the required pinout.

High Speed Expansion Connector

A 60 pin 0.8mm high speed Board to Board low profile receptacle connector is specified. Part numbers include

- FCI 61082-061409LF
- TE 5177983-2

Important note: unless otherwise indicated the high speed expansion connector signals are at 1.8V logic levels.

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

- MIPI DSI
- USB
- SD or SPI interface
- MIPI CSI-2 (x2 optional)
- I^2C (x2 optional, but 1 shall be provided if CSI interface(s) are provided)
- HSIC (optional)

Refer to appendix for the required pinout. These connectors have been designed to provide a board to board separation to a mezzanine board of 7.0 or 8.0mm.

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)
- FCI 61083-063400LF: High speed
- TE 5179030-2: High speed

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).

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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.

Standalone Functionality

The standalone board requires only a power supply and display connected to be used as an advanced single board computer (using wireless keyboard/mouse/WiFi & Bluetooth).

Maker Functionality

The hobby/maker community are able to use the low speed connector directly, but must be aware that the connections are direct 1.8V level to the on-board SoC.

In addition, for this community, CircuitCo Inc. plans to make available an initial low cost maker mezzanine board that will provide the following functionality:

- I/O level shifters to 3.3V/5V
- 0.1” header for easy access to low speed expansion I/O at 3.3/5V levels
- Raspberry Pi compatible CSI camera FFC connector
- Arduino Uno compatible shield interface
- Standard UART connector interface

This board will connect to any 96Boards CE compliant board.

Embedded OEM Functionality

It is intended that embedded equipment makers can easily create mezzanine boards that connect to the high speed and low speed connectors to create small form factor, low profile embedded products. An example would be a LCD panel interface with touch screen and optional keys/keyboard. Such boards will connect to any 96Boards CE compliant board.

Additional Functionality

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

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

- Additional custom storage
- Additional I/O - e.g. Ethernet, CANbus etc.
- On board external battery power/charging support for mobile applications
- PCIe interface(s) using PCIe mini or M.2 connectors mounted on the extended version or on the board underside

Any included additional functionality, headers, mezzanine or board to board connectors shall not contravene the 96Boards CE Physical Footprint specification (including height), or prevent the use of the 96Boards CE low speed or high speed connector expansion facilities.

96Boards Consumer Edition 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]

Minimum Software requirements for 96Boards certification will include:

- Boot architecture (open source implementations are strongly recommended)
    - 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 (optional)
- Accelerated graphics support
    - Accelerated graphics drivers need to be fully supported either with open source code, or through royalty free binary drivers. If binary drivers are utilized, the vendor will provide support to provide updated drivers/libraries to support new mainline Linux kernel features.
- Kernel
    - A kernel based on one of the following that is buildable from source code and any required binary blobs:
        - kernel.org latest "mainline" or "stable" kernel
        - The latest Google-supported Android kernel version
        - One of the last two kernel.org LTS kernels (for example Linaro LSK)
- Operating system
  The latest released (stable) version of one or more of the following open source distributions shall be made available for a 96Boards CE compliant design:
    - Android
    - Debian or Ubuntu
    - Fedora or Red Hat
    - An OpenEmbedded/Yocto build of a Linux distribution
- 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 will provide an open 'community portal' for 96Boards Certified products where users may go for support, software upgrades etc

References

1. CSI - http://mipi.org/specifications/camera-interface
2. SPI - http://en.wikipedia.org/wiki/Serial_Peripheral_Interface_Bus
3. DSI - http://mipi.org/specifications/display-interface
4. MHL - http://www.mhlconsortium.org
5. DisplayPort - http://www.displayport.org
6. microSDHC - http://en.wikipedia.org/wiki/Secure_Digital

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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

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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.

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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 **shall** 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	Required	
PCM_CLK	PCM/I2S Bit clock	1.8V	Output	Required	
PCM_DO	PCM/I2S Serial data out	1.8V	Output	Required	
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.
The following pins **shall** have alternate functions for DSI/CSI control if required by the display/sensor

Signal	Alternate Description	V	Type	Spec.	If not used
GPIO-F	DSI_BLCTL	1.8V	Output		
GPIO-G	DSI_VSYNC	1.8V	Input		
GPIO-H	DSI_RST	1.8V	Output		
GPIO-I	CSI0_RST	1.8V	Output		
GPIO-J	CSI0_PWDN	1.8V	Output		
GPIO-K	CSI1_RST	1.8V	Output		
GPIO-L	CSI1_PWDN	1.8V	Output		

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 Specification.

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60 Pin High Speed Expansion Connector

0.8mm 50 ohm high speed receptacle

SD_DAT0/SPI1_DOUT	Pin 1		Pin 2	CSI0_C+
SD_DAT1	Pin 3		Pin 4	CSI0_C-
SD_DAT2	Pin 5		Pin 6	GND
SD_DAT3/SPI1_CS	Pin 7		Pin 8	CSI0_D0+
SD_SCLK/SPI1_SCLK	Pin 9		Pin 10	CSI0_D0-
SD_CMD/SPI1_DIN	Pin 11		Pin 12	GND
GND	Pin 13		Pin 14	CSI0_D1+
CLK0/CSI0_MCLK	Pin 15		Pin 16	CSI0_D1-
CLK1/CSI1_MCLK	Pin 17		Pin 18	GND
GND	Pin 19		Pin 20	CSI0_D2+
DSI_CLK+	Pin 21		Pin 22	CSI0_D2-
DSI_CLK-	Pin 23		Pin 24	GND
GND	Pin 25		Pin 26	CSI0_D3+
DSI_D0+	Pin 27		Pin 28	CSI0_D3-
DSI_D0-	Pin 29		Pin 30	GND
GND	Pin 31		Pin 32	I2C2_SCL
DSI_D1+	Pin 33		Pin 34	I2C2_SDA
DSI_D1-	Pin 35		Pin 36	I2C3_SCL
GND	Pin 37		Pin 38	I2C3_SDA
DSI_D2+	Pin 39		Pin 40	GND
DSI_D2-	Pin 41		Pin 42	CSI1_D0+
GND	Pin 43		Pin 44	CSI1_D0-
DSI_D3+	Pin 45		Pin 46	GND
DSI_D3-	Pin 47		Pin 48	CSI1_D1+
GND	Pin 49		Pin 50	CSI1_D1-
USB_D+	Pin 51		Pin 52	GND
USB_D-	Pin 53		Pin 54	CSI1_C+
GND	Pin 55		Pin 56	CSI1_C-
HSIC_STR	Pin 57		Pin 58	GND
HSIC_DATA	Pin 59		Pin 60	RESERVED

Pin Descriptions

MIPI-DSI

A MIPI DSI interface **shall** be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
DSI_CLK[+-]	Differential DSI Clock	1.2V	Output	Required	NC
DSI_D0[+-]	Differential DSI data channel	1.2V	IO	Required	NC
DSI_D[1-3][+-]	Differential DSI data channel	1.2V	IO	Optional	NC

MIPI-CSI2

Two MIPI-CSI2 interfaces **may** be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
CSI[0-1]_C[+-]	Differential CSI Clock	1.2V	Output	Optional	NC
CSI[0-1]_D[0-1][+-]	Differential CSI data channel	1.2V	IO	Optional	NC
CSI0_D[2-3][+-]	Differential CSI data channel	1.2V	IO	Optional	NC

I^2C

Two I^2C interfaces **may** be provided on the high speed expansion bus.

If one or two CSI2 interfaces are implemented then at least the same number of I^2C interfaces **shall** be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
I2C[2-3]_SCL	Serial Clock	1.8V	OD/PU	Optional	NC
I2C[2-3]_SDA	Serial Data	1.8V	OD/PU	Optional	NC

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

HSIC

One MIPI-HSIC interface **may** be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
HSIC_STR	HSIC strobe	1.2V	IO	Optional	NC
HSIC_DATA	HSIC data	1.2V	IO	Optional	NC

RESERVED

One pin **shall** be reserved for future use. It shall be pulled up via 100K to 1.8V.

Signal	Description	V	Type	Spec.	If not used
RESERVED	Not used, pulled up to 1.8V	1.8V	N/A	Required	

SD/SPI

The expansion port **shall** be configured with either an SD port or a second SPI Port

SD Configuration

Signal	Description	V	Type	Spec.	If not used
SD_DAT[0-3]	Serial Data	3.3/1.8V	IO	Required	
SD_SCLK	Serial Clock	3.3/1.8V	Output	Required	
SD_CMD	Command	3.3/1.8V	IO	Required	

SPI Configuration

Signal	Description	V	Type	Spec.	If not used
SPI1_SCLK	Serial Clock	1.8V	Output	Required	
SPI1_CS	Chip Select	1.8V	Output	Required	
SPI1_DIN	Data In	1.8V	Input	Required	
SPI1_DOUT	Data Out	1.8V	Output	Required	

CLOCKS

One or two programmable clock interfaces may be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
CLK0/CSI0_MCLK	SoC Programmable Clock 0	1.8V	Output	Optional	NC or GPIO
CLK1/CSI1_MCLK	SoC Programmable Clock 1	1.8V	Output	Optional	NC or GPIO

If CSI camera(s) are supported on mezzanine boards these clocks **shall** be available as the CSI reference clocks (in case they are needed)

USB

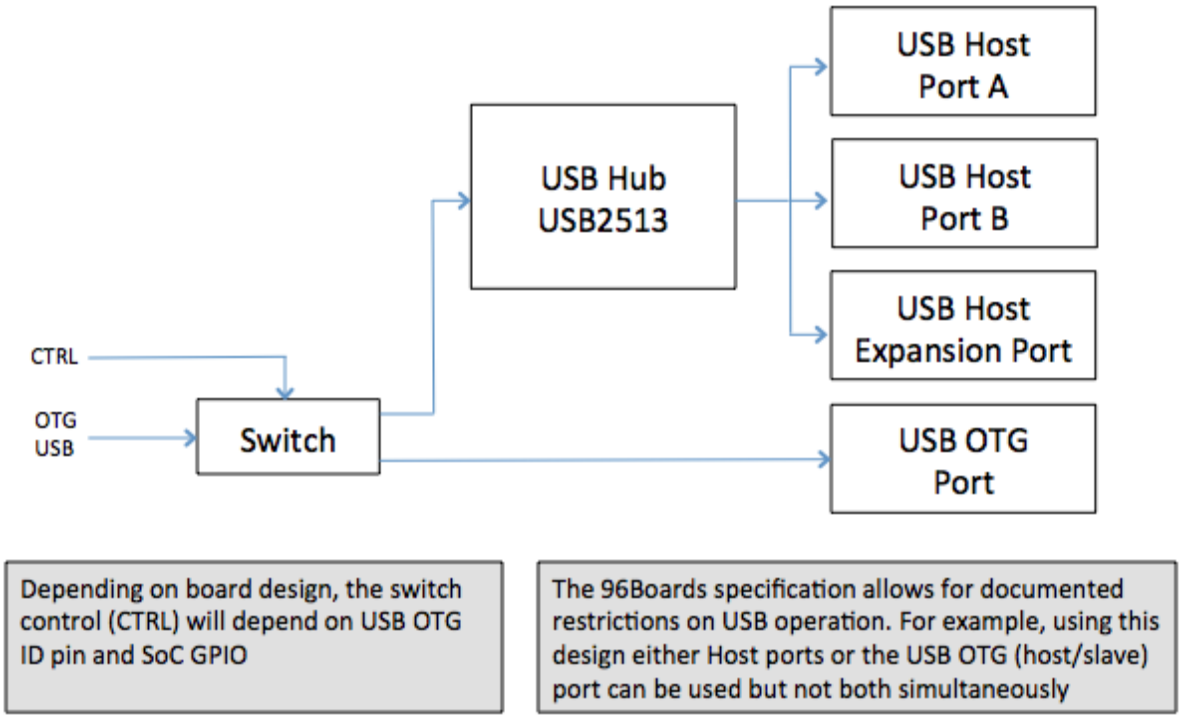
One USB host port **shall** be provided on the high speed expansion bus.

Signal	Description	V	Type	Spec.	If not used
USB_D[+-]	Differential USB data	USB	Output	Required	

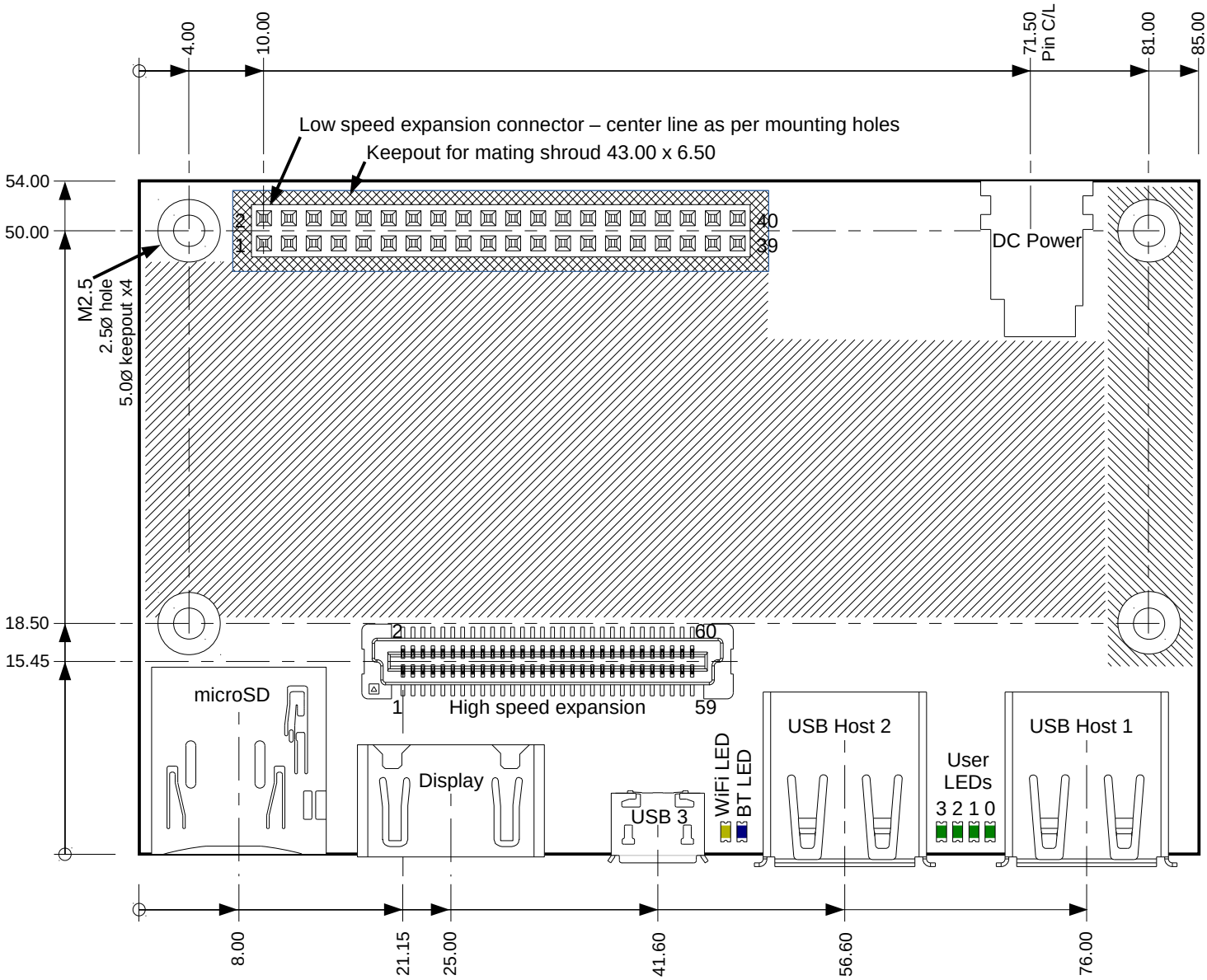
In many designs the USB port is expected to come from a USB hub solution ready for direct connect to a USB interface, therefore these signals are specified at USB PHY signal levels.

Single USB port Example

On cost-sensitive SoCs targeted at the mobile market there may only be a single USB 2.x/3.x port on the device. A typical 96Boards USB implementation needs to implement a USB hub for this situation. This can be achieved in a number of ways. One example is as follows:



2D Reference Drawing



General Top component max height = 6.5mm, except Type A USB connectors <= 7.0mm

PCB/Chip WiFi antenna on top or bottom. Follow antenna specification keepout areas.

Top component max height = 4.0mm except user link headers and thermal management such as fan/heatsink <= 6.5mm

96Boards Consumer		
TITLE: **96Boards Consumer Edition**		
VERSION: 1.0	SCALE: 1:2	DATE: 1 FEB 2015
ALL DIMENSIONS IN MM		Linaro
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96Boards Consumer Edition (Extended Version)

The Consumer Edition Extended Version is for those SoCs that require additional space (typically because of the need for additional memory devices or other required feature sets). The Extended Version is footprint compatible with the standard version.

Board designers have a choice for the extended area (shown in green and top white above)

Either:

Extended A

The extended area **shall** conform to the 4mm (except for user links and thermal management) rules as specified for the main area of the standard board. The extended rear connector area **shall** conform to the 6.5mm maximum height. This ensures that the design will work with all 96Boards program Mezzanine Boards

Or:

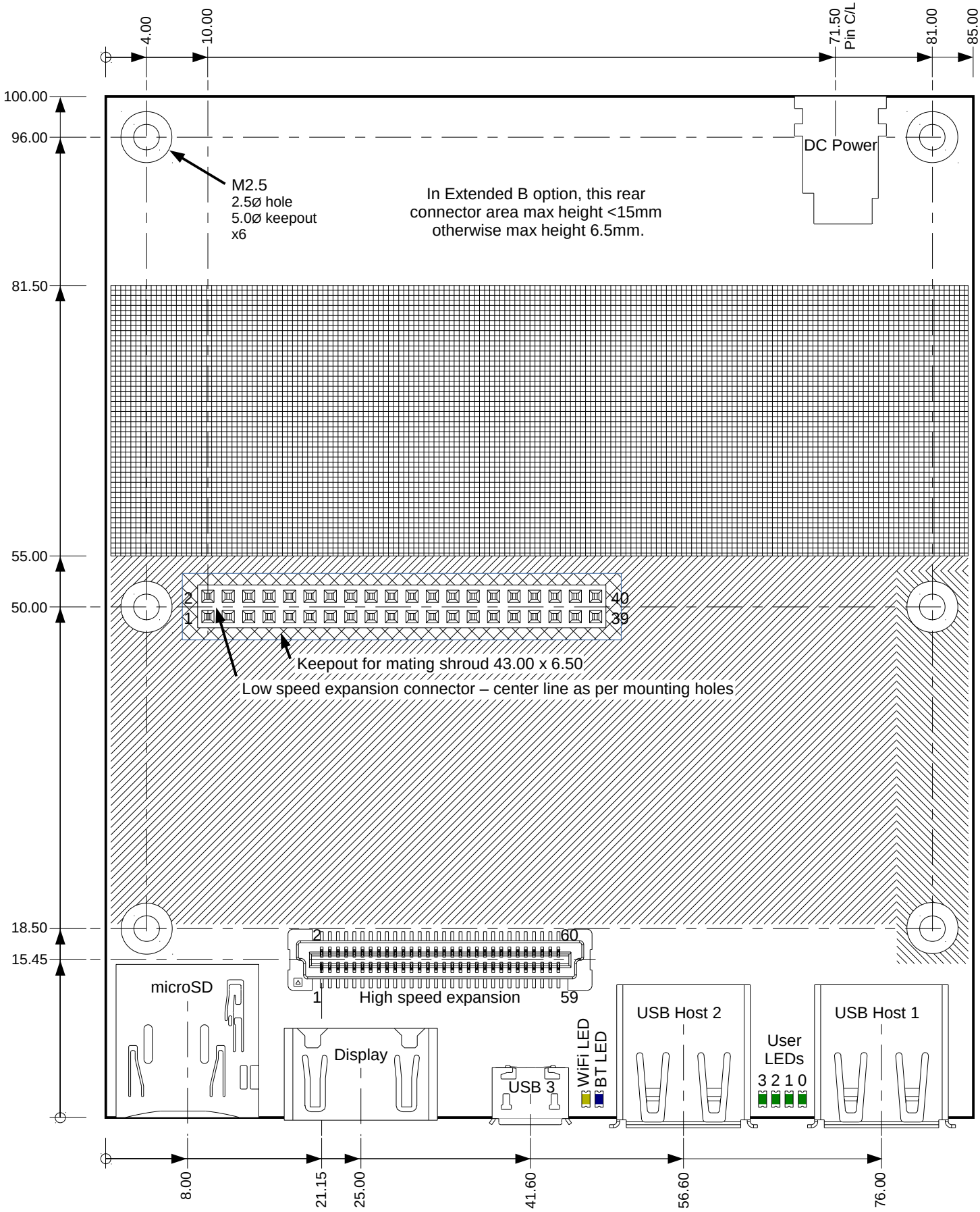
Extended B

The extended area and the extended rear connector area **shall** use components that extend to a maximum of 15.0mm above the board surface. Designers that choose this option have more flexibility in board design for SoC, component and connector positioning in the extended area, but Large Mezzanine Boards or Modules (see below) may not be compatible with the board design.

Additionally, Extended Version boards **may** exceed the underside height restrictions (for example to mount a high power SoC on the underside of the board). In this case:

The board footprint on the underside **shall** be fully documented.

Standoffs and/or additional heat management **shall** be documented or provided for when the board is used standalone or in a case.



General top component max height = 6.5mm, except Type A USB Host 1 & 2 <= 7.0mm.

PCB/Chip WiFi antenna on top or bottom. Follow antenna specification keepout areas.

Top component max height = 4.0mm except user link headers and thermal management such as fan/heatsink <= 6.5mm

Extended area see specification for height restrictions:
“Extended A” max 6.5mm or
“Extended B” max 15.0mm

96Boards Consumer		
TITLE: **96Boards Consumer Edition Extended Version**		
VERSION 1.0	SCALE 1:2	DATE 1 FEB 2015
ALL DIMENSIONS IN MM		Linaro
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Mezzanine Boards and Modules

A mezzanine board or module may be fitted on top of the board. To minimize product footprint the board has been designed to have a minimal footprint for a low cost community board. The board to mezzanine module spacing is 7.0mm, or optionally 8.0mm (depending on the mezzanine module connectors used).

Mezzanine Boards are defined in two versions.

- Small Mezzanine Boards or Modules have a maximum area of 85x54mm and do not exceed the footprint of the 96Boards CE standard board.
- Large Mezzanine Boards or Modules have no size limit. An example could be a 12” display module designed to fit directly onto any 96Boards CE design.

Consideration needs to be given to possible heat build up on the base board depending on the workload and the board used. Accordingly, provision has been made for airflow between the base board and mezzanine board by requiring component heights to be such that a fan can move air across the board between the base board and the mezzanine.

Therefore, apart from the connectors to the base board, components **shall not** be placed on the underside of an mezzanine module design in the footprint area of the base board. More complete design guidelines for mezzanine boards will be published at a later date.

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

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