96Boards Wireless SoM Edition

Low Cost Hardware Platform Specification

Version 1.0, March 2019

IMPORTANT INFORMATION

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Background

The 96Boards Wireless SoM Edition is intended to support:

1. Interchangeable wireless module applications for standard and/or proprietary wireless standards such as 802.15.4, BLE, WiFi, LoRa, NB-IoT, LTE-M etc.
2. Module use in IoT products including clients and/or edge/fog/gateway devices. Modules may be used standalone for simple sensor/controller type applications, or attached to a baseboard for smart device and/or gateway applications
3. System ODMs/OEMs requiring off-the-shelf production ready wireless/IoT modules with Long Term Support
4. Community engineering activities, including
    - Upstream Development
    - Integration into automated test farms
    - 96Boards Community program to be run by Linaro

In all cases key design and distribution goals are:

- Easy to purchase globally (for example, via Amazon, Alibaba, Farnell, Digikey, Mouser etc.)
- Enable manufacturers to flexibly configure products with multiple or different wireless standards.

A key design objective is to encourage multiple MCU/SoC vendors to build modules to this specification.

Note that the 96Boards Wireless SoM is designed for development and production environments including rugged applications. Therefore the base modules are designed for standalone use or direct soldering to a baseboard. An 8-pin header is optionally specified for external debug/programming interface. A standard programming dongle will be able to interface to a standard USB port.

The 96Boards Wireless SoM specification is designed to enable an ecosystem to evolve that will support multiple products and wireless standards , including 5G, 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. Use of the 96Boards brand requires a small per unit contribution and association with 96Boards through membership of the Steering Committee and/or Manufacturing Partner program. Members of the Mezzanine Partner program can use the 96Boards Partner logo.

96Boards Wireless SoM (SoM-W) Edition

1. Hardware

The 96Boards SoM-W specification defines the hardware requirements for the System-on-Module (SoM) as well as the interface between the SoM and a baseboard. The specification offers flexibility for developers and product designers to have support for standardization of wireless SoM formats.

To provide the flexibility in module design, development and deployment, the 96Boards SoM specification defines two different profiles. All module and baseboard design is SoC/MCU independent.

1.1 Wireless Module Profiles

Two profiles are defined to allow a variety of wireless modules to be accommodated. For example, Bluetooth, 802.15.4 and WiFi modules tend to be smaller than Cellular modules including NB-IoT and LTE-M.

SoM-WA: 15 x 15 x 5 mm SMT
SoM-WB: 27 x 18 x 5 mm SMT

It is simple to design a single baseboard footprint that will take Type A or Type B modules.

1.2 96Boards Wireless SoM Features

The Wireless SoM module **shall** provide the following minimum functions:

- MCU
- Wireless connectivity (e.g. BLE, LoRa, NB-IoT, WiFi, 802.15.4 etc.)
- Built in Antenna and/or Antenna socket
- On-board power supply
- GPIO pins
- LEDs
- Power/Debug Connector option

1.2.1 Footprint

The SoM-W is a 20-pin SMT module using castellated pads on a 1.3 mm pitch.
There **shall** be no components and no exposed copper/metal on pads/vias/tracks on the SoM underside.

1.2.2 Mandatory Components

The following components are mandatory for all SoM-W designs

LED0 Green or RGB 0805 SMT user programmable LED
LED1 Blue 0805 SMT wireless activity LED

Module designer can optionally populate below debugging facility

J1 SMT 1.27mm pitch 1x8 socket max height 4.0 mm (e.g. Harwin M50-3140845)

Notes

- The LEDs must be able to be configured as permanently off, to save power
- J1 is specified to enable
    a. Installation/use of a standardized power/programming dongle or fixture (pins 1-4)
    b. Support for a carrier board with power source and/or I2C sensor(s) and/or UART (pins 1-8)
    c. Modules may be designed with 8, 4 or no J1 pads
    d. The module vendor may install no connector, a 4 pin connector (pins 1-4) or an 8 pin connector (pins 1-8) depending on the module application.

1.2.3 Module Pin Out

Pin	Signal	I/O		I/O	Signal	Pin
1	GPIO1/PWM1/UART_TxD	I/O		I/O	GPIO20/PWM20/ADC4/I2S_SCK	20
2	GPIO2/PWM2/UART_RxD	I/O		I/O	GPIO19/PWM19/ADC3/I2S_MCLK/PCM_CLK	19
3	GPIO3/PWM3/UART_RTS/SD_DAT[0]	I/O		I/O	GPIO18/PWM18/ADC2/I2S_WS/ PCM_FS	18
4	GPIO4/PWM4/UART_CTS/SD_DAT[1]	I/O		I/O	GPIO17/PWM17/ADC1/I2S_D0/ PCM_DO	17
5	GPIO5/PWM5/SPI_CS/SD_DAT[2]	I/O		I/O	GPIO16/PWM16/ADC0/I2S_D1/ PCM_DI	16
6	GPIO6/PWM6/SPI_MOSI/SD_DAT[3]	I/O		I/O	GPIO15/PWM15/I2C1_SDA/USB_D_P	15
7	GPIO7/I2C0_SDA/SPI_MISO/SD_CMD	I/O		I/O	GPIO14/PWM14/I2C1_SCL/USB_D_N	14
8	GPIO8/I2C0_SCL/SPI_SCLK/SD_SCLK	I/O		I/O	GPIO13/SWCLK	13
9	RESET	I		I/O	GPIO12/SWDIO	12
10	GND				VDD	11

1.2.4 J1 Pin Out

Pin	Signal	I/O
1	VDD	
2	SWCLK	I
3	SWDIO	I/O
4	GND	
5	Connected to MODULE Pin 8	I/O
6	Connected to MODULE Pin 7	I/O
7	Connected to MODULE Pin 1	O
8	Connected to MODULE Pin 2	I

1.2.5 Module Voltage Configuration

The Wireless Module **shall** be designed for 3.3V +/-5% regulated power in and 1.8V I/O voltage levels.

Modules **shall not** use more than 5W peak.

1.2.6 Feature Requirements

Min	Max	Feature
0	1	UART
0	2	I2C
0	1	I2S/PCM
0	17	GPIO
0	9	PWM
0	1	SPI
0	4	ADC
0	1	SWD
0	1	SDIO
0	1	USB
1	1	Reset

All pins **shall** be populated with minimum functionality being at least one of SWD, GPIO, I2C or SPI. If any optional features are implemented, they **shall** be implemented on the specified pin locations. It is **recommended** that a universal carrier board support UART, I2C and SPI interfaces.

1.2.7 Pin Definitions

Debug Interface: The Wireless Module **shall** support Arm Serial Wire Debug (SWD), which replaces the traditional 5-pin JTAG with a 2-pin interface. Designers may wish to not implement this function on a production board for security reasons.

Signal	Description	V	Type	Spec
SWCLK	Clock signal to Module. It is recommended that this pin is pulled down on the SoM.	1.8V	I	O
SWDIO	Bi-directional data pin. This pin should be pulled up on the Module.	1.8V	I/O	O

UART

Signal	Description	V	Type	Spec
UART_CTS	Clear to Send control	1.8V	I	O
UART_TxD	Transmit serial data	1.8V	O	O
UART_RxD	Receive serial data	1.8V	I	O
UART_RTS	Request to Send control	1.8V	O	O

I2C

Signal	Description	V	Type	Spec
I2C_SCL	Serial Clock	1.8V	OD/PU	O
I2C_SDA	Serial Data	1.8V	OD/PU	O

I2S/PCM

Signal	Description	V	Type	Spec
I2S_SCK	I2S Clock	1.8V	I/O	O
I2S_MCLK/PCM_CLK	PCM/I2S Bit clock	1.8V	I/O	O
I2S_WS/PCM_FS	PCM/I2S Word Clock	1.8V	I/O	O
I2S_D0/PCM_DO	PCM/I2S Serial data out	1.8V	O	O
I2S_D1 /PCM_DI	PCM/I2S Serial data in	1.8V	I	O

SPI

Signal	Description	V	Type	Spec
SPI_SCLK	Clock	1.8V	O	O
SPI_MISO	Master In Slave Out	1.8V	I	O
SPI_MOSI	Master Out Slave In	1.8V	O	O
SPI_CS	Chip select	1.8V	O	O

SDIO

Signal	Description	V	Type	Spec
SD_DAT[0-3]	Serial Data	1.8V	IO	O
SD_SCLK	Serial Clock	1.8V	O	O
SD_CMD	Command	1.8V	IO	O

USB 2.x

Signal	Description	V	Type	Spec
USB_D_P	Differential USB data	USB	USB	O
USB_D_N	Differential USB data	USB	USB	O

Power and Reset

Signal	Description	V	Type	Spec
VDD	Power supply	3.3V	I	
RESET	Reset external request	1.8V	I	

The SoM-W module shall consume a maximum of 5W peak power.

2. External Interfaces

The SoM-W is designed to be soldered directly onto a PCB during end product manufacture. The end product may be a complete product, or a further module interface (for example a 96Boards Mezzanine module or an Arduino module).

2.1 Programming Connector

To provide a simple and consistent programming interface the SoM-W design requires

installation of a debug interface and power connector using the SWDIO and SWCLK lines.

This enables

1. all SoM-W products to be programmed using a simple USB dongle and
2. all SoM-W products to be used standalone with a simple connection to an external power supply or battery

As part of the support for the SoM-W interface Linaro will ensure availability of a USB dongle for power supply, programming and debug operations.

2.2 Antenna

All modules shall require one or both of:

- On-board (for example, chip) antenna
- SMT RF antenna connector to allow the use of a remote antenna

An area of the module is reserved for on-board antennas. Both module and baseboard should typically be designed so that such areas have a minimum of components, tracking and copper areas (including removal of any internal ground/power planes) to ensure maximum antenna performance.

3. Software

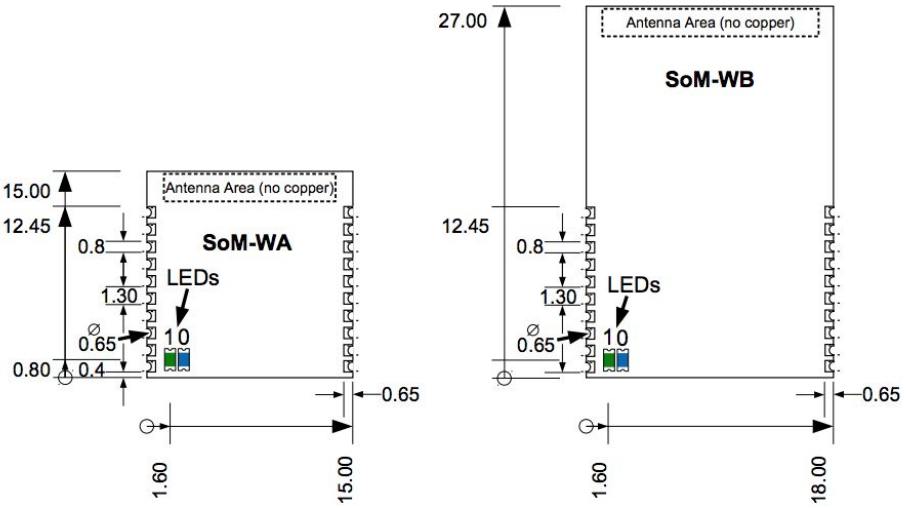
It is expected that 96Boards SoM-W modules will be required to meet the following requirements:

- Users **shall** be able to install their own applications on the module. This requires the supply and support of a software development environment. It is **strongly recommended t**hat vendors provide upstream support for a SoM-W module in one or more of the following projects:
    - Zephyr OS
    - Amazon FreeRTOS
    - Arm Mbed-OS
    - Huawei LiteOS
- It is **strongly recommended** that all modules be OTA updatable and firmware rollback. In any event users **shall** be able to use the SoM-W carrier board to power and upload new software to the module.

3.1 Security Requirements

- All modules **shall** have a unique hardware ID per unit that can be read by the user.
- While a host environment may assume that a module is inherently insecure, It is **strongly recommended** that modules have built-in security features including, but not limited to:
    - Pre-installation or ability to install a unique and immutable public key or hash of a public key with a known secret private key
    - A TRNG or suitable source of strong entropy

4. 96Boards SOM Specification 2D Reference Drawing



Top component max height = 4.0mm.
No components are permitted on underside of board.
Board thickness is 1.0mm.

96Boards		
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ALL DIMENSIONS IN MM		Linaro
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-------SPECIFICATION ENDS-------

Change History

v0.1	Nov 2017	Initial Specification
v0.2	Dec 2017	Initial feedback incorporated A/B variants developed
v0.3	Jan 2018	Further feedback incorporated J1 Pins 5-8 added and J1 options clarified Single power supply specified with 3.3V VDD and 1.8V I/O levels
V0.4	Jun 2018	J1 pins 7-8 specified as UART for automation purposes. I2S support will now require baseboard.
V0.5	Oct 2018	Drawing updated. Specification finalized for final approval.
V0.9	Jan 2019	SOM module sizes reduced and castellated connectors changed from 2mm to 1.3mm pitch.
V1.0	Feb 2019	Drawings and text updated. J1 pads have also been made optional.