RuggedBoard – A5D2x

Hardware and System Reference Manual

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A Product Of Rugged Board Group – An open source Hardware Platform

Revision History

Date	Change Note	Revision No.
23-APRL-2019	Draft Release	1.0
27-JAN-2020	First Release	1.1

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Abbreviations and acronyms used in this manual

SIP	System-In-Package
SOM	System On Module
DDR2-SDRAM	Double Data Rate 2 Synchronous Dynamic Random-Access Memory
DSC	Direct Solder Connection
ESD	Electrostatic discharge
Mbit	Megabit
EMI/EMC	Electromagnetic Interference/Electromagnetic Compatibility
DDR	Double Data Rate
BGA	Ball Grid Array
RTC	Real-Time Clock
USB	Universal Serial Bus
TFT-LCD	Thin Film Transistor - Liquid Crystal Display.
ADC	Analog-to-Digital Converter
PWM	Pulse width Modulation
QSPI	Queued Serial Peripheral Interface
UART	universal asynchronous receiver-transmitter
IIC	Inter-Integrated Circuit
eMMC	embedded Multi-Media Controller"
PCB	Printed Circuit Board
PMIC	Power Management IC
POR	Power On reset
GPIO	General Purpose Input/output
DNM	Not Populated/Mounted

Note:
The BSP delivered with the phyCORE-A5D2x usually includes drivers and/or software for controlling all components such as interfaces, memory, etc. Therefore, programmingclosetohardwareatregisterlevelisnotnecessaryinmostcases.Forthis reason, this manual contains no detailed description of the controller's registers, or information relevant for software development. Follow RB-Forum for any specific development requirement.

Product Specific Information and Technical Support
In order to receive product specific information on changes and updates in the best way also in the future, were commend to register at:
https://www.community.ruggedboard.com/members

Assembly options include choice of Controller; RAM(Size/Type); Size of NOR Flash, Interfaces available; Vanishing; Temperature Range; and other features. Please contact our sales team to get more information on the ordering options available. Please refer the last page of this document for the ordering information.

Caution!

RuggedBoard products lacking protective enclosures are subject to damage by ESD and, hence, may only be unpacked, handled or operated in environments in which sufficient precautionary measures have been taken in respect to ESD - dangers. It is also necessary that only appropriately trained personnel (such as electricians, technicians and engineers) handle and/or operate these products.

Note:

Implementation of RuggedBoard into target devices, as well as user modifications and extensions of RuggedBoard products, is subject to renewed establishment of conformity to, and certification of, Electro Magnetic Directives. Users should ensure conformance following any modifications to the products as well as implementation of the products into target systems.

ESD Warning:

Electronic components and circuits are sensitive to Electrostatic Discharge (ESD). When handling any circuit board assemblies including Pico Computer carrier assemblies, it is recommended that ESD safety precautions be observed. ESD safe best practices include, but are not limited to:

- Leaving circuit boards in their antistatic packaging until they are ready to be installed.
- Using a grounded wrist strap when handling circuit boards, at a minimum you should touch a grounded metal object to dissipate any static charge that may be present on you.
- Only handling circuit boards in ESD safe areas, which may include ESD floor and table mats, wrist strap stations and ESD safe lab coats.

- Avoiding handling circuit boards in carpeted areas.
- Try to handle the board by the edges, avoiding contact with components

Power Supply Warning:

Hardware Power Supply Limitation: Powering the board with higher voltages may damage the board. The recommended input voltage to RuggedBoard is **5V±5%** We recommend Supply voltage to SOM module from Carrier Board is **3.3V ± 5%.**

In addition for proper operation of the module into the target application also requires connecting all GND pins common.

This hardware manual describes about the RuggedBoard - A5D2x. This manual specifies the RuggedBoard-A5d2x design and function. Precise specifications for the Microchip A5D2x microprocessor can be found in the Microchip's A5D2x Data Sheet and Technical Reference Manual.

1 Introduction

1.1 Hardware overview

The RuggedBoard for phyCORE-A5D2x is a SIP (System in Peripheral) which is a low-cost, feature-rich software development platform supporting the Microchip's A5D2x microprocessor. Moreover, due to the numerous standard interfaces the RuggedBoard A5D2x can serve as bedrock for your application. At the core of the RuggedBoard is the phyCORE-A5D2x System On Module (SOM) in a direct solder form factor, containing the processor, Flash, power regulation, supervision, transceivers, and other core functions required to support the A5D2x processor. Surrounding the SOM is the RuggedBoard carrier board, adding power input, buttons, connectors, signal breakout, Ethernet and mikro-BUS connectivity amongst other things.

This RuggedBoardoffers an ultra-low cost Single Board Computer for the A5D2x processor, while maintaining most of the advantages of the SOM concept. Adding the phyCORE-A5D2x SOM into your own design is as simple as ordering the connector version and making use of our RuggedBoard Carrier Board reference schematics.

1.1.1 Features

The RuggedBoard has the following features

- 1 x Ethernet
- 2 x RS-232
- 1 x RS-485 (Isolated)
- 1 x CAN
- 4x DIN (Isolated)
- 4x DOUT
- 1 x LVDS Display
- 1 x Micro SD
- 1 x SIM
- 2 x USB 2.0
- 1 x mikroBUS
- 1 x 60 PIN Expansion Headers

2. Accessing the RuggedBoard Interfaces

RuggedBoardis fully equipped with all Software, Electronics, mechanical and Electrical components necessary for the speedy and secure start-up.

2.1. Interfaces

The RuggedBoard is depicted in Figure 2. It features many different interfaces and is equipped with the components as listed in Table 1. For a more detailed description of each peripheral refer to the appropriate chapter listed in the applicable table. Figure 2 highlights the location of each peripheral for easy identification.

Reference Designator	Description	See Section
P1	Power Supply 5V only (3-pole connector with dedicated Shielded ground Pin)	2.4.1
P2	USB power/ Debug Console (USB Micro-AB connector 5V Power supply)	2.4.3
P4	RS232	2.4.9
P5	Digital Input(0-24v)	2.4.10
P6	Digital Output(0-24v)	2.4.10
P7	USB 2.0	2.4.14
P8	mPCIe (Supports multiple Cellular Modules 2G/3G/4G/Cat-M/NB-IoT, Supports AI & ML VPU/TPU co-processor).	2.4.15
P9	CAN & RS-485P	2.4.8
P10	Expansion Header	2.4.11
P11	RTC Battery	2.4.19
P12	LED GPIO	2.4.5
P13	Debug port	2.4.13
J1	LCD Connector	2.4.18
P17	ATSAML 11E 16-GPIO Connector [By default DNM]	2.4.5
SW2	Reset	2.3.4
M1	mikroBUS Expansion (Supports multiple IoT wireless modules (Zigbee/BLE/LoRa/6LoWPAN), Supports multiple IoT Sensor modules based on UART/I2C/SPI Interface)	2.4.12
U14	ATSAML11E16-A (Microchip product)	
U17	ATWILC3000	2.4.15
J3	Ethernet (RJ45 10/100Mbps)	2.4.13
J4	SD card + SIM (Dual connector)	2.4.17

Table 1: Overview

2.2.RuggedBoard-Interfaces

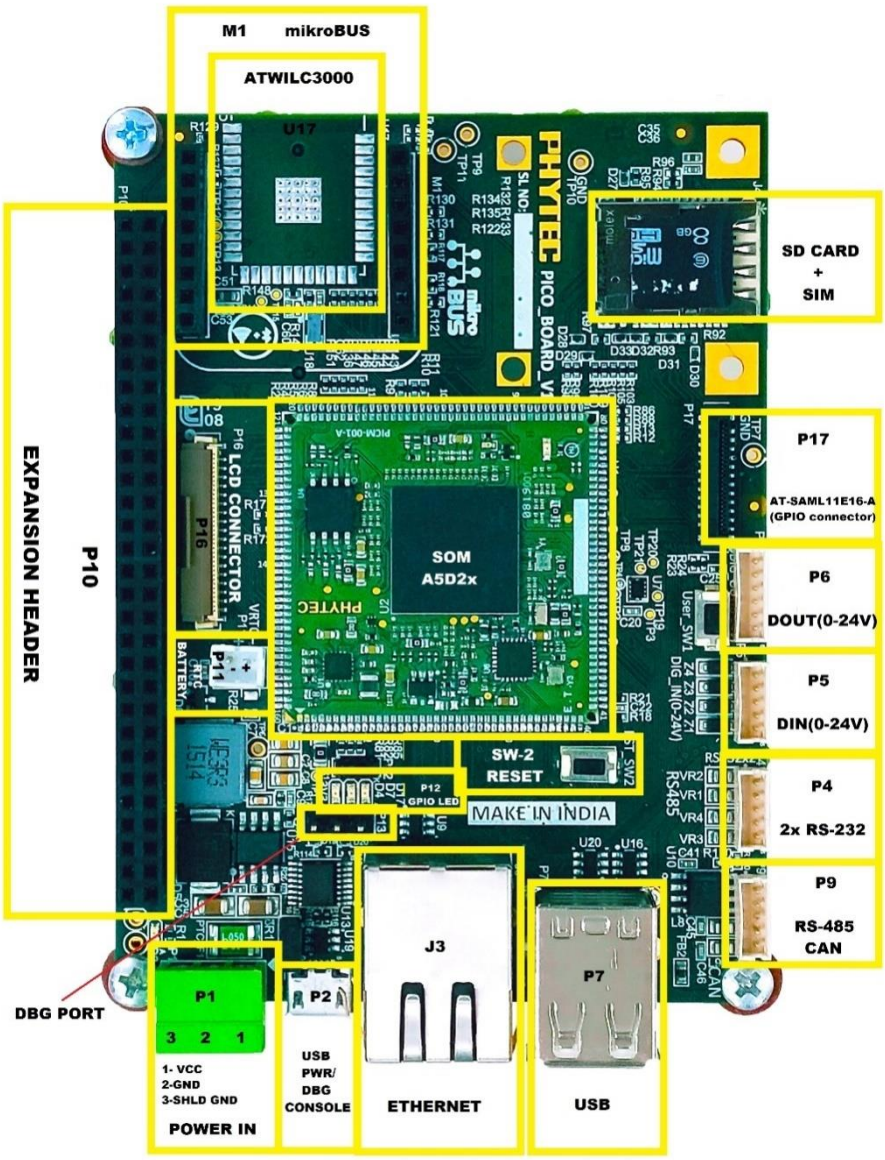


Fig 1: Specifications and Interfaces

2.3.Block Diagram

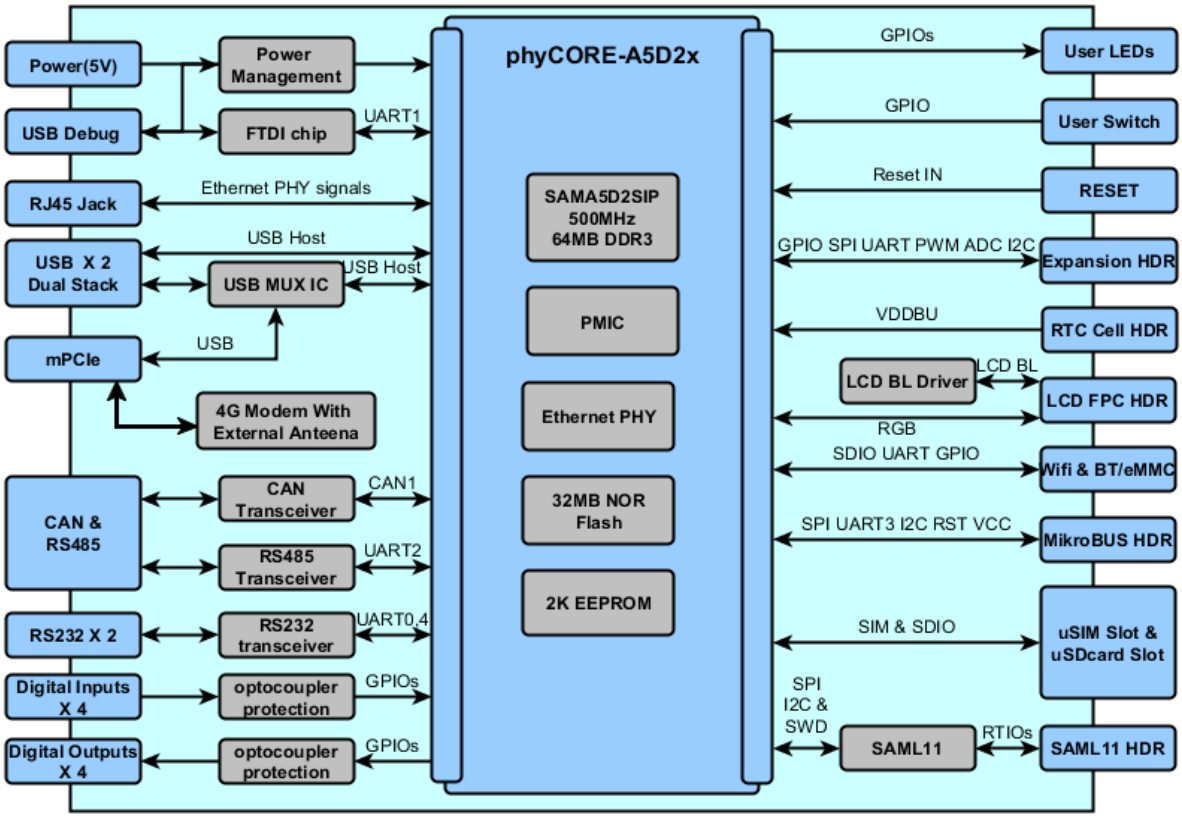


Fig 2: Block Diagram

2.4 Functional Components

This section describes the functional components of the RuggedBoard. Each subsection details a particular connector/interface and associated jumpers for configuring that interface. Figure below shows the front side of RuggedBoard-A5D2x.

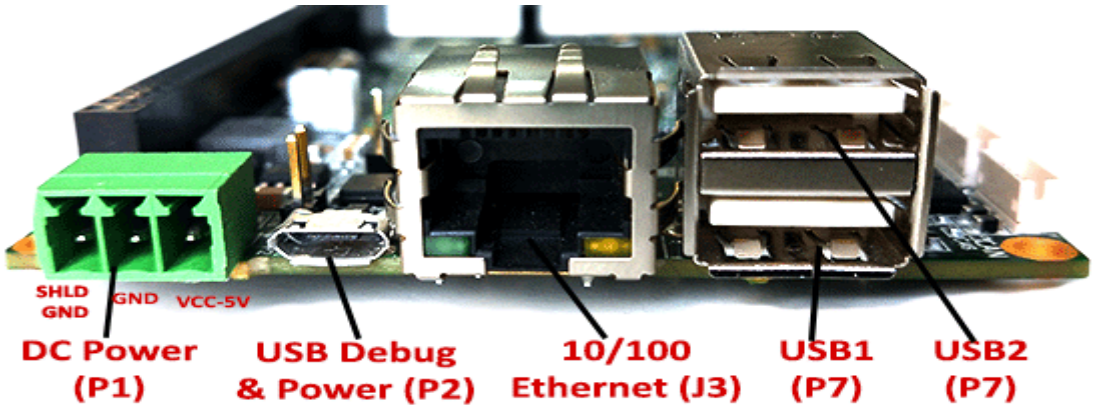


Fig 3: Front Panel

2.4.1 Power Supply

The RuggedBoard is available with two different power supply connectors. Power in through industrial standard three pin connector and microUSB connector.

2.4.1.1 Power IN (*Industrial Standard Three Pin Connector*)

Fig 4: Power Supply Connector

A 3-pole Phoenix Contact MINI COMBICON base strip 3.5 mm connector (P1) suitable for a single 5 V supply voltage (Fig. 4)

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	VCC (5V)	5V power supply
2	GND	Ground
3	SHLD (Shielded Ground)	Shielded Ground

Table 2: Power Information

2.4.2 Jumpers (J2)

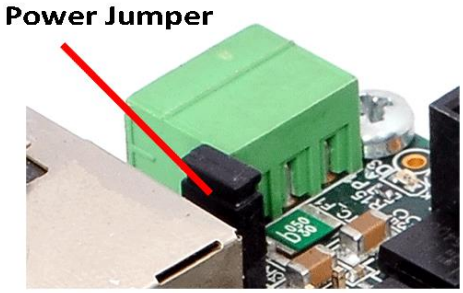


Fig 5: Power Jumper

This jumper (J2) is used to ON/OFF of the Board. If jumper (J2) is not present in the board then the board will not power on. So jumper (J2) must present on the board.

2.4.3 USB PWR / DBG Console

Fig 6: USB Power and Debugger Connector

A USB Micro-AB connector (P2) to connect a standard 5V USB power supply. Connect the USB to micro USB cable of to the board and the other end to the Host PC. Also remember to short the jumper J2.

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	DC_IN/USB	VBUS
2	Debug_D_N	DM
3	Debug_D_P	DP
4	ID	ID
5	GND	GND
6 7 8 9 10 11	SH1	SHLD_GND

Table 3: USB PWR / DBG CONSOLE

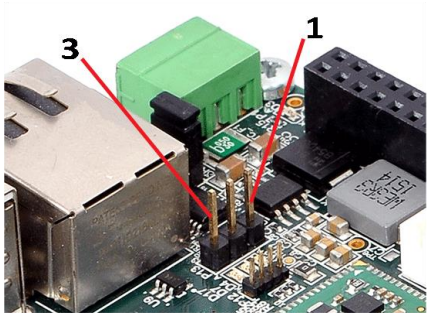


Fig 7: UART Debug Port

Debug port is a port included in a device to simplify development and debugging, which is not necessary for normal UART1 function. Debug ports are usually not removed or disabled to avoid costs of design changes, and can be used by developers to get extra functionality. TTL to USB converter can be used to debug the console of RuggedBoard-A5D2x.

The same debugging facility is also available in Micro USB connector P1.The table 15 shows the pin description of the debug port:

PIN NO	SIGNAL NAME	Software Node
1	PD2_URXD1_DBG	/dev/ttyS0
2	PD3_UTXD1_DBG	/dev/ttyS0
3	GND	

Table 4: DBG Port

2.4.4 Switches

The RuggedBoard contains three switches

a. System Reset Button(RST.SW2)

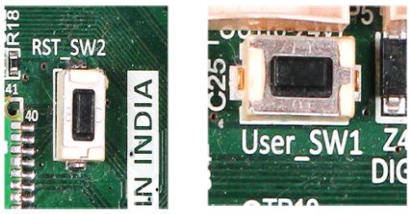


Fig 8: Reset Switch and User Level Switch

The RuggedBoard is equipped with a system reset button at RST.SW2. Pressing this button will toggle the nRST pin of the phyCORE-A5D2x low, causing the module to reset. Additionally, the reset signal nRST is generated on the module to also reset the peripherals on the carrier board.

b. User_SW1

PIN	Switch No	SIGNAL NAME	MRAA Mapped Pins
1	SW1	PC12/GPIO_EN	35

User_SW1 button is used for GPIO user level input. The User Level Switch is shown in the Figure 8.

c. Boot SEL-SW

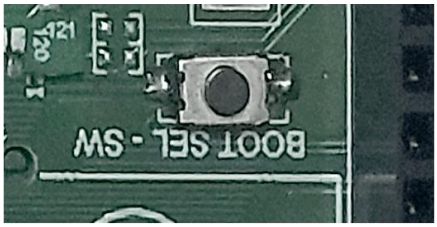


Fig 9: Boot Select Switch

This button is used to flash new image to RuggedBoard. To enable flashing mode, press this button while connecting the micro USB cable.

2.4.5 User LED (GPIO)

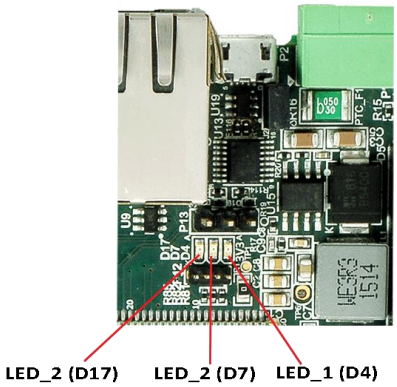


Fig10: User LEDs

The RuggedBoard populated with three user controllable LEDs.Fig.10 shows the location of the LEDs. Their functions are listed in Table given below.

PIN	LED No	SIGNAL NAME	MRAA Mapped Pins
1	LED_1 (D4)	PC13/GPIO_LED	61
2	LED_2 (D7)	PC17/GPIO_LED	62
3	LED_3 (D17)	PC19/GPIO_LED	63

Table 5: User LED GPIO

2.4.6 Industrial Field Interfaces

RuggedBoard-A5D2x equipped with multiple Industrial field interfaces. It has 1x RS485, 1x CAN, 2x RS232, 4x DIN, 4x D Out.

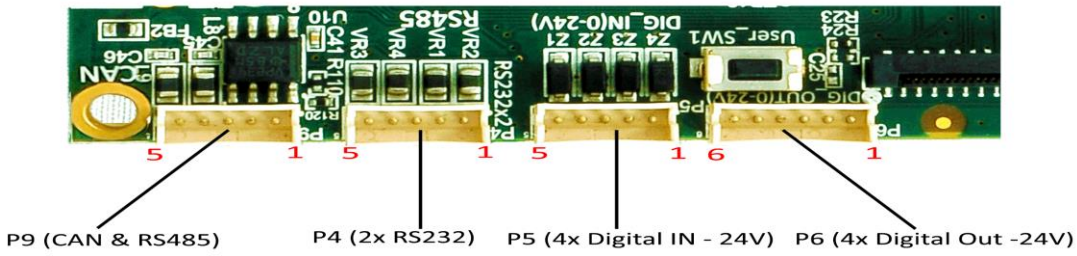


Fig 11: Field Interfaces

2.4.7 RS-485 (P9)

Fig 12: RS485 and CAN Connector

RS-485, also known as TIA-**485**(-A), EIA-**485**, is a standard defining the electrical characteristics of drivers and receivers for use in serial communications systems.... Digital communications networks implementing the standard can be used effectively over long distances and in electrically noisy environments.

An RS-485 transceiver on the RuggedBoard converts the TTL level signals of UART2 from the phyCORE-A5D2x to RS-485 level signals. The RS-485 level signals are available at the connector P9 (5 positions, 3.5 mm pitch).

Refer Table 6 from section 2.4.8 for pinout details.

2.4.8 CAN (P9)

Fig 13:RS485 and CAN Connector

The Controller Area Network (CAN) bus offers a low-bandwidth, prioritized message fieldbus for serial communication between microcontrollers. The CAN interface transmits and receives signals from the SOM. CAN pins like PC26 and PC27 are connected to the CAN Transceiver (SN65HVD234D) and the output signals from the transceiver are connected to the connector (P9) physically located on top of the RuggedBoard.

P9 Connector:

PIN NO	PIN DESCRIPTION	SIGNAL NAME	Software Node
1	CANH	PC26/CANTX1/A15	CAN 0
2	CANL	PC27/PCK1/CANRX1/A16	CAN 0
3	GND	Ground	
4	RS485 B	PD23/URXD2	/dev/ttyS2
5	RS485 A	PD24/UTXD2	/dev/ttyS2
6	RS485 DE	PC21/GPIO_RS485_EN	

Table 6: P9 Connector

2.4.9 RS-232 (P4)

Fig 14: RS2323 connector

Two RS-232 transceivers on the RuggedBoard convert the TTL level signals of UART0 and UART4 from the phyCORE-A5D2x to RS-232 level signals. The RS-232 level signals are available at the connector P4.

PIN NO	PIN DESCRIPTION	SIGNAL NAME	MRAA MAPPED	Software Node
1	RS232_TX_1	PB27_UTXD0/LCDDAT16	70	/dev/ttyS1
2	RS232_RX_1	PB26_URXD0/LCDDAT15	71	/dev/ttyS1
3	GND	Ground		
4	RS232_TX_2	PB4_UTXD4	68	/dev/ttyS4
5	RS232_RX_2	PB3_URXD4	69	/dev/ttyS4

Table 7: RS232

2.4.10 DIN and DOUT(0-24V) (P5 and P6)

Fig15: Digital Input Connector

Fig16: Digital Output Connector

The RuggedBoard comes with an isolated Digital IOs (0-24V). The RuggedBoard provides four digital IOs that are designed for processing DC-signals with up to 24 V DC. The digital output voltage depends on the input voltage of the board. Input and output signals are routed to the CPU (phyCORE-A5D2x) through two discrete opt-couplers for 3.75KV isolation. Thus, it is possible to write and read the status of every single GPIO of the RuggedBoard simultaneously.

WARNING!	Please consider that the GPIOs do not have a separate current-driver on board. In case the GPIOs are used as outputs, the current is self-limited by the output opto-coupler and should not exceed 50mA for each GPIO channel. These outputs are low-side outputs.

When the GPIOs on the RuggedBoard are used as digital inputs, they are configured active high with the following switching voltages:

Signal Level	Voltage
H Level	>11V
L Level	< 5V

Table 8: DIN and DOUT (0-24V)

P5 Connector:

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	DIN(0-24V)_01	PC20/ISI_D11/FLEXCOM3_IO0/A9
2	DIN(0-24V)_02	PC24/ISI_MCK/A13
3	DIN(0-24V)_03	PC15/ISI_D6/RD0/A4
4	DIN(0-24V)_04	PC22/ISI_VSYNC/FLEXCOM3_IO4/A11
5	DGND_ISO_IN	Isolated Ground

Table 9: P5 Connector

P6 Connector:

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	ISO_VCC_IN	Isolated Voltage 0 to 24V
2	DOUT(0-24V)_04	PD01/A24
3	DOUT(0-24V)_03	PA16/SPI0_MISO/TD1/QSPI0_IO0/I2SWS1/FLEXCOM3_IO3/D11
4	DOUT(0-24V)_02	PA14/SPI0_SPCK/TK1/QSPI0_SCK/I2SMCK1/FLEXCOM3_IO2/D9
5	DOUT(0-24V)_01	PA17/SPI0_NPCS0/RD1/QSPI0_IO1/I2SDI1/FLEXCOM3_IO4/D12
6	DGND_ISO_IN	Isolated Ground

Table 10: P6 Connector

2.4.11 Expansion Header (P10)

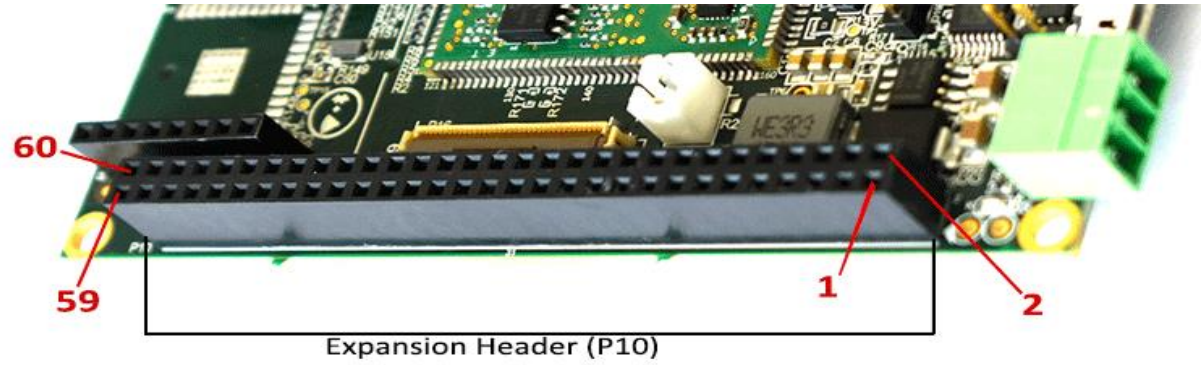


Fig 17: Expansion Connector

Expansion connector P10 provides an easy way to add other functions and features to the RuggedBoard Standard interfaces. By default, it consists of 1xI2C, 3x ADC pins, 1x QSPI, Tamper Security Pins, 1x Shutdown Controller Pin, 1x USB Inter-Chip Transceiver and other GPIO's. This GPIO's can able to mux according to the customer requirement such as UART, ISC(Image Sensor Controller),SPI and ADC. The expansion connector is intended to add specific functions with custom expansion boards. The pin-out of the expansion connector is shown in Table 11 given below:

MRAA Mapped Pins	Signal Name	Pin Description	Pin No	Pin No	Pin Description	Signal Name	MRAA Mapped Pins
	3V3 Power Supply	VCC_3V3	**1**	**2**	VCC5V_IN	5V Power Supply	
	3V3 Power Supply	VCC_3V3	**3**	**4**	VCC5V_IN	5V Power Supply	
	3V3 Power Supply	VCC_3V3	**5**	**6**	VCC5V_IN	5V Power Supply	
	Audio Clock	CLK_AUDIO	**7**	**8**	COMPP	TAMPER PIN	
	USB High-Speed Inter-Chip Strobe	STROBE	**9**	**10**	COMPN	TAMPER PIN	
	TAMPER PIN	PIOBU6	**11**	**12**	ISC_D11	PD19/PCK0/TWD 1/AD0 **[By Default GPIO]**	12
13	PD20/TIOA2/TWC K1/AD1 **[By Default GPIO]**	TWCK1	**13**	**14**	AIN_SEN4	PD30_AIN_SEN4 **[By Default GPIO]**	14
15	PD27_AIN_SEN2 **[By Default GPIO]**	AIN_SEN2	**15**	**16**	AIN_SEN3	PD28_AIN_SEN3 **[By Default GPIO]**	16
	TAMPER PIN	PIOBU4	**17**	**18**	PIOBU3	TAMPER PIN	
	TAMPER PIN	PIOBU2	**19**	**20**	AIN_SEN1	PD26_AIN_SEN1 **[By Default GPIO]**	20
	TAMPER PIN	PIOBU1	**21**	**22**	RXD	Low Power Asynchronous Receiver for TAMPER PIN	
23	PD08/NANDRDY/ PTCROW5 **[By Default GPIO]**	ISC_D1	**23**	**24**	URXD2	PD4 **[By Default GPIO]**	24
25	PD07/NWR1/NBS 1/PTCROW4 **[By Default GPIO]**	ISC_D0	**25**	**26**	ISC_D8	PD06/PCK1/NCS2 /PTCROW3 **[By Default GPIO]**	26
	Ground	GND	**27**	**28**	GND	Ground	
	Ground	GND	**29**	**30**	GND	Ground	

MRAA Mapped Pins	Signal Name	Pin Description	Pin No	Pin No	Pin Description	Signal Name	MRAA Mapped Pins
31	PD22_I2SC0_DI0_SCL **[By Default GPIO]**	I2SC0_DI0_SCL	**31**	**32**	I2SC0_WS_SDA	PD21_I2SC0_WS_SDA **[By Default GPIO]**	32
	USB High-Speed Inter-Chip Data	DATA	**33**	**34**	PIOBU7	TAMPER PIN	
35	PC11/ISI_D2/TCLK4/CANRX0/A0/NBS0 **[By Default GPIO]**	CANRX0	**35**	**36**	ISC_FIELD	PC25/ISI_FIELD/A14 **[By Default GPIO]**	36
37	PC23/ISI_HSYNC/A12 **[By Default GPIO]**	PC23	**37**	**38**	ISC_D9	PC18/ISI_D9/FLEXCOM3_IO2/A7 **[By Default GPIO]**	38
39	PA13/SDMMC0_CD/FLEXCOM3_IO1/D8 **[By Default GPIO]**	SDMMC0_CD	**39**	**40**	SDMMC0_WP	PA12/SDMMC0_WP/IRQ/NRD/NANDOE **[By Default GPIO]**	40
41	PA31/SPI0_MISO/PWML0/CLASSD_L3 **[By Default GPIO]**	SPI0_MISO	**41**	**42**	SHDN	Shutdown Control	
43	PA29/TCLK1/SPI0_NPCS1/SDMMC1_WP/CLASSD_L1 **[By Default GPIO]**	SPI0_NPCS1	**43**	**44**	GND	Ground	
45	PC31/FLEXCOM4_IO3/URXD3/A20 **[By Default GPIO]**	URXD3	**45**	**46**	ISC_D7	PC16/ISI_D7/RK0/A5 **[By Default GPIO]**	46
47	PB09/TIOA3/PWMFI1/QSPI1_IO2 **[By Default GPIO]**	QSPI1_IO2	**47**	**48**	QSPI1_IO0	PB07/TIOB2/PWMH3/QSPI1_IO0 **[By Default GPIO]**	48
	Ground	GND	**49**	**50**	QSPI1_SCK	PB05/TCLK2/PWMH2/QSPI1_SCK **[By Default GPIO]**	51
52	PB10/TIOB3/PWMEXTRG1/QSPI1_IO3 **[By Default GPIO]**	QSPI1_IO3	**51**	**52**	GND	Ground	

MRAA Mapped Pins	Signal Name	Pin Description	Pin No	Pin No	Pin Description	Signal Name	MRAA Mapped Pins
53	PB08/TCLK3/PWML3/QSPI1_IO1 **[By Default GPIO]**	QSPI1_IO1	**53**	**54**	GND	Ground	
	Reset	nRST	**55**	**56**	GND	Ground	
	Ground	GND	**57**	**58**	GND	Ground	
	Ground	GND	**59**	**60**	GND	Ground	

Table 11: Expansion Header

2.4.12 MiKroBUS Connector (M1)

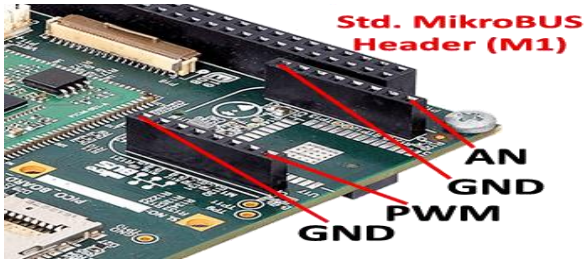


Fig 18: mikroBUS connector

The RuggedBoard host pairs female headers acting as mikrobus interface. The microbus standard defines the main board sockets and add-on boards (a.k.a. “mikrobus shield”) used for interfacing microprocessors with integrated modules with proprietary pin configuration and silkscreen markings. The pinout consists of three groups of communication pins (SPI, UART and TWI), four additional pins(PWM, interrupt, Analog input and reset) and two power groups(+3V3 and GND on the left and 5V and GND on the 1x8 header). The following table provides the pin description of all the connected pins. Info: Not all pins are always connected on all extension headers. The extension headers can be used to connect a variety of Add-On modules to RuggedBoardor to access the pins of the target microcontroller on the RuggedBoard.

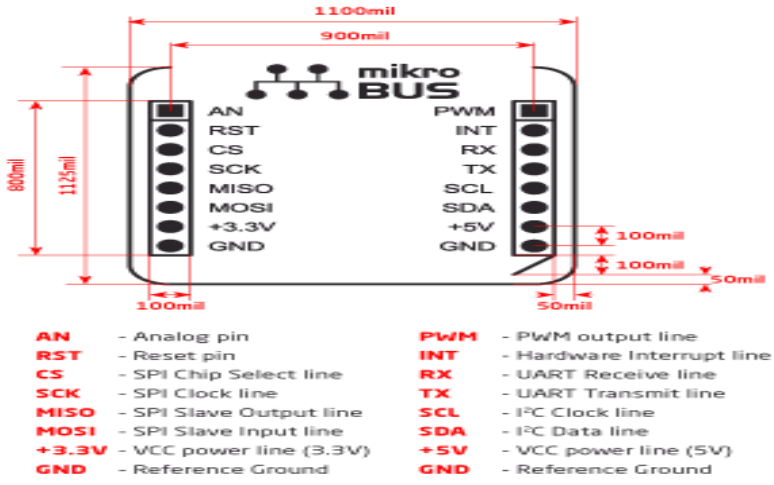


Fig 19: mikroBUS pinouts

PIN NO	PIN DESCRIPTION	SIGNAL NAME	MRAA Mapped Pins	
1	AN	PD25_AN_mBUS1	73	
2	RST	PB2_RST_mBUS1	(RST/GPIO) 76	
3	CS	PD0_NPCS1_mBUS	64	
4	SCK	PC30_SPCK_mBUS1	65	
5	MISO	PC29_MISO_mBUS1	66	
6	MOSI	PC28_MOSI_mBUS1	67	
7	3V3	VCC_3V3		
8	GND	GND		
9	GND	GND		
10	+5V	VCC5V_IN		
11	SDA	PD21_I2SC0_WS_SDA	32	I2C_2
12	SCL	PD22_I2SC0_DI0_SCL	31	I2C_2
13	TX	PB11_URXD3/LCDDAT0	77	/dev/ttyS3
14	RX	PB12_UTXD3/LCDDAT1	78	/dev/ttyS3
15	INT	PB00_INT_mBUS1	75	
16	PWM	PB01_PWM_mBUS1	72	

Table 12: microBUS Connector

2.4.13 Ethernet (J3)

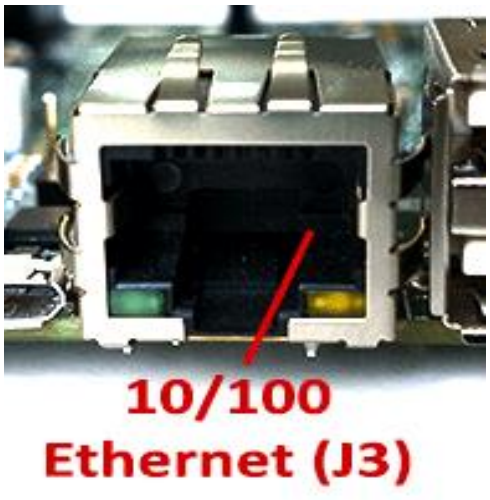


Fig 20: Ethernet connector

The on-board SOM integrates a 10/100 Mbps Ethernet controller (KSZ8081RNA) allowing direct connection to any 10/100 Mbps Ethernet-based Local Area Network, for full interaction with local servers and wide area networks such as the Internet. Eth signals from the SOM are connected to a RJ45 MagJack.

The Ethernet interfaces of the RuggedBoard are accessible at J3. Figure 9: Ethernet Interface at Connector (J3) Ethernet interface is configured as 10/100Base-T networks. The LEDs for LINK (green) and SPEED (yellow) indication are integrated in the connector. Ethernet transceiver support HP Auto-MDIX, eliminating the need for the consideration of a direct connect LAN cable, or a crossover cable. They detect the TX and RX pins of the connected device and automatically configure the PHY TX and RX pins accordingly.

PIN NO	PIN DESCRIPTION	SIGNAL NAME	Remarks
1	TD+	ETH_TX_P	
2	TD-	ETH_TX_N	
3	RD+	ETH_RX_P	
4	PoE_V+	Poe_V+/TDCT	TDCT Function Used
5	PoE_V+	Poe_V+/RDCT	RDCT Function Used
6	RD-	ETH_RX_N	
7	SHLD	Poe_V-/NC	Connected to the Ground
8	PoE_V-	Poe_V-/CH_GND	Connected to the Ground
9	NC	LED1-A	
10	NC	LED1-k	
11	ETH_LED0	LED2-k	
12	VCC_3V3	LED2-A	
13	SHIELD1	SHIELD1 Ground	
14	SHIELD2	SHIELD2 Ground	

Table 13: Ethernet

2.4.14 USB 2.0 (P7)

Fig 21: USB Dual Stack Connector

In RuggedBoard there are two stacked USB2.0 Host Ports. Both USB1 &USB2 are configured as Host. USB2 signal are also used for the mPCIe port (P8). The switching happens through USB mux switch configuration. This configuration can be done by either Software or Hardware method. By default, it is configured to Hardware Configuration by mounting the resistor R66 and R70 to pass the USB2 Signals to mPCIe connector. Please note that the USB2 on the P7 connector will be disabled if you configure to use mPCIe. For software configuration DNM the resistor R65, R66, R70 and R71. Then mount R68 and R69 with signal.

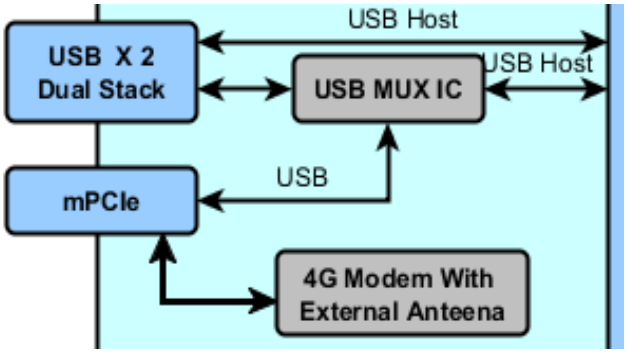


Fig 22: USB and mPCIe Connection Block Diagram

PIN DESCRIPTION	SIGNAL NAME
VBUS	VBUS_HOST1
DM	USBA_N
DP	USBA_P
GND	GND
VBUS	VBUS_HOST2
DM	USBD_HOST_N
DP	USBD_HOST_P
GND	GND
9	Shield Gnd
10	Shield Gnd
11	Shield Gnd
12	Shield Gnd

Table 14: USB 2.0

2.4.15 mPCIe Connector (P8)

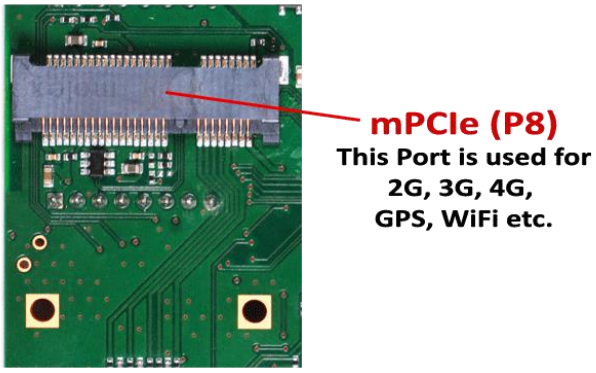


Fig 23: mPCIe Connector

The PCI express interface of the RuggedBoard-A5D2x provides USB functionality and SIM card interface pins for GSM. The USB interface is brought out at the mini PCIe connector P8 shown in the figure 23.The SIM/µSIM card signals of a connected mPCIe module can be made available at expansion connector P8. Please refer to Table for more information about the jumper settings. Soldering jumpers allow to connect the USB host interface to the Mini PCIe connector P8 (Table 15). In the following table is a complete overview of the Mini PCI Express connector pin Assignment:

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	WAKE	VCC_3V3
2	+3.3V_1	VCC_3V3
3	RSVD1	NC
4	GND7	GND
5	RSVD2	NC
6	+1.5V_1	NC
7	CLKREQ	NC
8	RSVD13	SIM_VCC
9	GND1	GND
10	RSVD14	SIM_IO
11	REFCLK-	NC

PIN NO	PIN DESCRIPTION	SIGNAL NAME
12	RSVD15	SIM_CLK
13	REFCLK+	NC
14	RSVD16	SIM_RST
15	GND2	GND
16	RSVD17	SIM_VPP
17	RSVD3	NC
18	GND8	GND
19	RSVD4	NC
20	RSVD18	VCC_3V3
21	GND3	GND
22	PERST	VCC_3V3
23	PER_N0	NC
24	+3.3V_AUX	VCC_3v3
25	PER_P0	NC
26	GND9	GND
27	GND4	GND
28	+1.5V_2	NC
29	GND5	GND
30	SMB_CLK	NC
31	PET_N0	NC
32	SMB_DATA	NC
33	PET_P0	NC
34	GND10	GND
35	GND6	GND
36	USB_D-	USB_mPCIe_N
37	RSVD5	GND
38	USB_D+	USB_mPCIe_P
39	RSVD6	VCC_3V3/GND
40	GND11	GND
41	RSVD7	VCC_3V3/GND
42	LED_WWAN	VCC_3v3
43	RSVD8	GND
44	LED_WLAN	NC
45	RSVD9	NC
46	LED_WPAN	NC
47	RSVD10	NC
48	+1.5V_3	NC
49	RSVD11	NC
50	GND12	GND
51	RSVD12	NC
52	+3.3V_2	VCC_3V3/GND
S1	GNDM1	GND
S2	GNDM1	GND
M1	GNDM3	GND
M2	GNDM4	GND

Table15: mPCIe (P8) PIN details

2.4.16 On Board WiFi or eMMC Pad (U17) – [Chip Not Mounted by default]

Fig 24:Wi-Fi/BT and eMMC Soldering pad

U17 soldering pad can be utilized for two peripherals like Wi-Fi/ BT module (ATWILC3000) core MMC. By default, both peripherals are not mounted.

1) RB-A5D2x supports eMMC Upto 32GB onto the MMC1 pad.

2)ATWILC3000 is a single chip IEEE 802.11 b/g/n RF/Baseband/MAC link controller and Bluetooth 5. This can support single stream 1x1 802.11n mode providing tested throughput of up to 46 Mbps UDP & 28 Mbps TCP/IP. The ATWILC3000 features fully integrated Power Amplifier, LNA, Switch and Power Management. Implemented in low-power CMOS technology, the ATWILC3000 offers very low power consumption while simultaneously providing high performance and minimal bill of materials.

The ATWILC3000 utilizes highly optimized 802.11-Bluetooth coexistence protocols. The only external clock sources needed for the ATWILC3000 is a high-speed crystal or oscillator and a 32.768 kHz clock for sleep operation.

- IEEE 802.11 b/g/n 20MHz (1x1) Wi-Fi plus Bluetooth 5 Low Energy Module
- Supports Personal & Enterprise IEEE 802.11 WEP, WPA, WPA2 Security
- SPI, SDIO, I2C, and UART host interfaces
- Operating temperature range of -40C to +85C
- Bluetooth 5 Certified
- Module is Agency Certified in over 75 Countries

PIN NO	PIN DESCRIPTION	SIGNAL NAME
1	GND	GND
2	SDIO/SPI_CFG	GND/SDIO MODE
3	NC	NC
4	NC	NC
5	NC	NC
6	NC	NC
7	RESETN	nRST
8	URXD3_TXD	PB11_URXD3/LCDDAT0
9	UTXD3_RXD	PB12_UTXD3/LCDDAT1
10	BT_RTS	TP12
11	BT_CTS	TP13
12	DVDDIO	VCC_3V3

PIN NO	PIN DESCRIPTION	SIGNAL NAME
13	GND	GND
14	GPIO3	NC
15	GPIO4	NC
16	UART_TXD	TP14
17	UART_RXD	TP15
18	VBAT	VCC_3V3
19	CHIP_EN	VCC_3V3
20	RTC	NC
21	GND	GND
22	SD_CLK	PA0_SDMMC0_CK
23	SD_CMD	PA1_SDMMC0_CMD
24	SD_DATA0	PA2_SDMMC0_DAT0
25	SD_DAT1	PA3_SDMMC0_DAT1
26	SD_DAT2	PA4_SDMMC0_DAT2
27	SD_DAT3	PA5_SDMMC0_DAT3
28	GND	GND
29	GPIO17	NC
30	GPIO18	NC
31	GPIO19	NC
32	GPIO20	NC
33	IRQN	NC
34	I2C_SDA_M	TP11
35	I2C_SCL_M	TP9
36	GND	GND
37	PADDLE	GND

Table 16: Wi-Fi/BT and eMMC

2.4.17 Secure digital Memory card + SIM (Dual Connector) (J4)

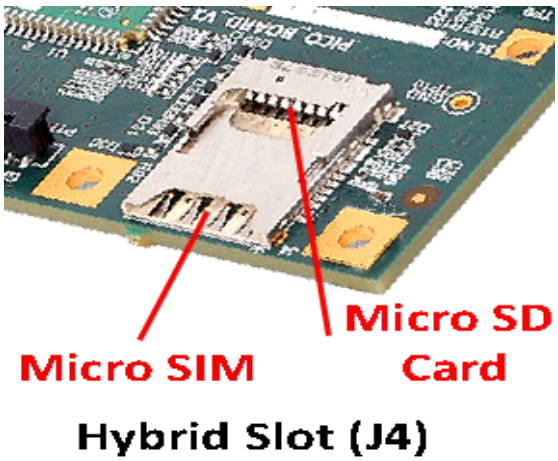


Fig 25: Memory Card and SIM Dual connector

The RuggedBoard provides a standard micro SDHC card slot at J4 for connection to MMC/SD interface cards. It allows easy and convenient connection to peripheral devices like SD-Card and MMC cards. Power to the SD-Card interface is supplied by inserting the appropriate card

into the MMC/SD connector, which features card detection, a lock mechanism and a smooth extraction function by Push-in/ Push-out of card.

PIN NAME	PIN DESCRIPTION	SIGNAL NAME
T1	DAT2	PA20_SDMMC1_DAT2
T2	DAT3	PA21_SDMMC1_DAT3
T3	CMD	PA28_SDMMC1_CMD
T4	VCC	VCC_3V3
T5	CLK	PA22_SDMMC1_CK
T6	GND	Ground
T7	DAT0	PA18_SDMMC1_DAT0
T8	DAT1	PA19_SDMMC1_DAT1
SW	SW1	PA30_SDMMC1_CD
CELLULAR MODULE SIM SIGNAL		
C1	SIM_VCC	SIM_VCC
C2	SIM_RST	SIM_RST
C3	SIM_CLK	SIM_CLK
C4	GND	SIM_GND
C5	SIM_VPP	SIM_VPP
C6	SIM_IO	SIM_IO
G1 G2 G3 G4 G5 G6 G7	GND	Ground

Table 17: Secure digital Memory card+SIM (Dual Connector)

2.4.18 LCD Connector (J1)[Not Mounted by default]

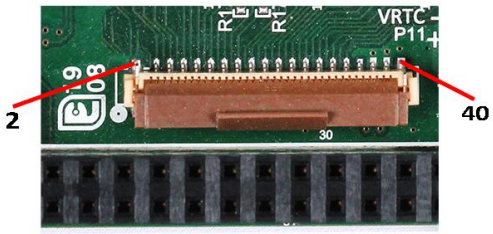


Fig 26: LCD Connector (Not mounted by default)

The Baseboard provides a FPC connector with 24bits of data and control signals to the LCD interface. Other signals are used to control the LCD and are available on connector J1:TWI, SPI and power supply lines. A 42-pin FPC (J1) header is provided on the baseboard to interface the LCD module with 24-bit parallel RGB.

In order to operate correctly out of the processor with various LCD modules, two voltage lines are available: 3V3 and 5V0.

PIN DESCRIPTION	SIGNAL NAME	PIN NO	PIN NO	SIGNAL NAME	PIN DESCRIPTION
Not Connect	NC	**1**	**2**	PD21_I2SC0_WS_SDA	NC
Not Connect	NC	**3**	**4**	PD22_I2SC0_DI0_SCL	NC
Not Connect	NC	**5**	**6**	LCDDAT18	LCD Data Bus
3V3 power supply	VCC_3V3	**7**	**8**	VCC_3V3	3V3 power supply
Ground	GND	**9**	**10**	GND	Ground
3V3 power supply	VCC_3V3	**11**	**12**	LCDDAT23	LCD Data Bus
LCD Data Enable	LCDDEN	**13**	**14**	LCDVSYNC	LCD Vertical Synchronization

PIN DESCRIPTION	SIGNAL NAME	PIN NO	PIN NO	SIGNAL NAME	PIN DESCRIPTION
LCD Horizontal Synchronization	LCDHSYNC	**15**	**16**	NC	Not Connect
LCD Pixel Clock	LCDPCK	**17**	**18**	GND	Ground
NC	PB17_I2SC1_DI0_GPIO	**19**	**20**	LCDDAT12	LCD Data Bus
LCD Data Bus	LCDDAT13	**21**	**22**	LCDDAT14	LCD Data Bus
LCD Data Bus	LCDDAT15	**23**	**24**	LCDDAT16	LCD Data Bus
LCD Data Bus	GND	**25**	**26**	LCDDAT17	LCD Data Bus
LCD Data Bus	LCDDAT7	**27**	**28**	LCDDAT8	LCD Data Bus
LCD Data Bus	LCDDAT9	**29**	**30**	LCDDAT10	LCD Data Bus
LCD Data Bus	LCDDAT11	**31**	**32**	GND	Ground
LCD Data Bus	LCDDAT22	**33**	**34**	LCDDAT0	LCD Data Bus
LCD Data Bus	LCDDAT1	**35**	**36**	LCDDAT2	LCD Data Bus
LCD Data Bus	LCDDAT3	**37**	**38**	LCDDAT4	LCD Data Bus
Test Point	TP4	**39**	**40**	PB16_I2SC1_WS	NC
Ground	GND	**41**	**42**	GND	Ground

Table 18: LCD Connector

2.4.19 RTC Battery (P11)

Fig 27: RTC Battery Connector

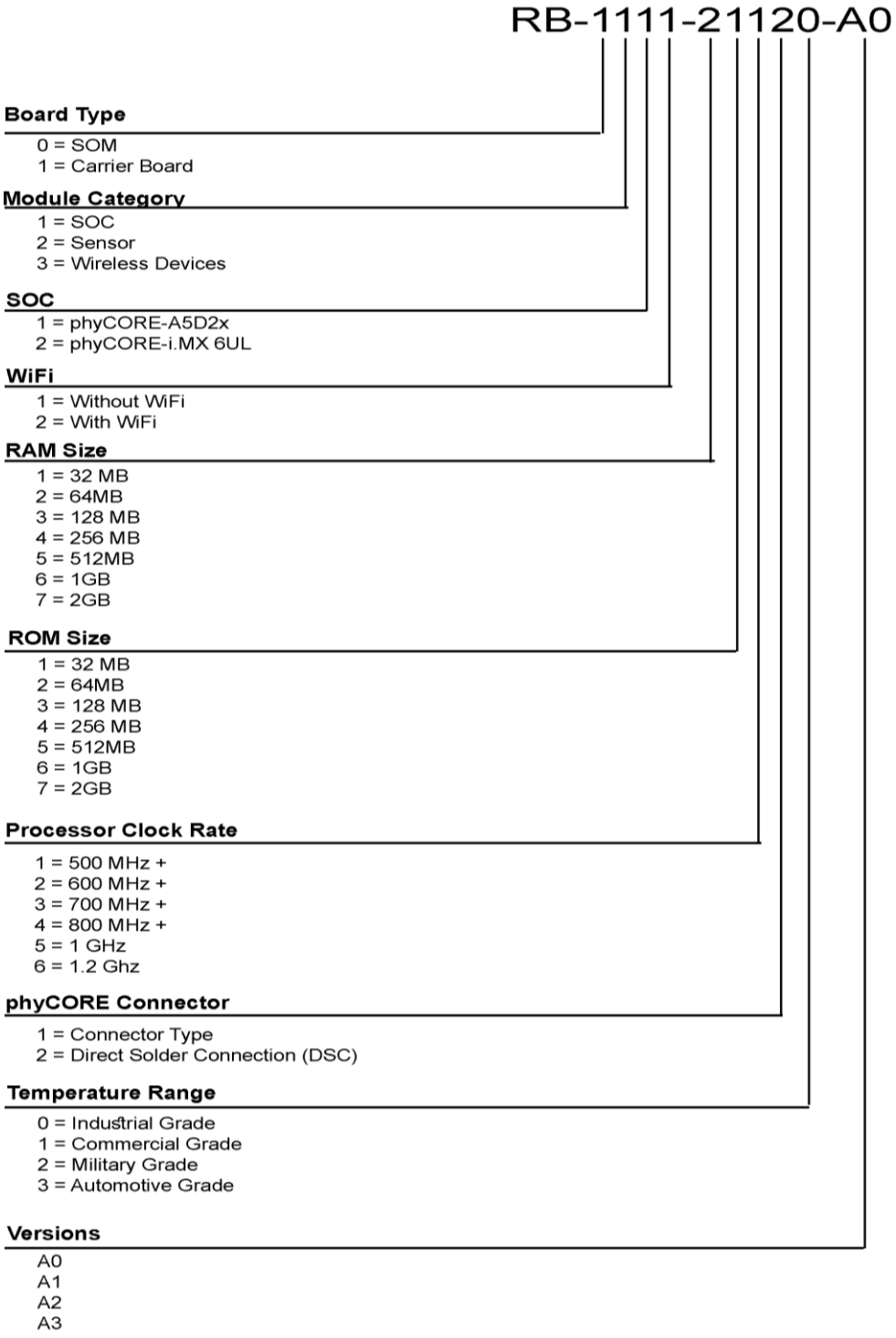
A real-time clock (RTC) keeps track of the current date & time. Since RuggedBoard-A5D2x is SIP based SOC it consists of internal RTC. Thus the RTC need to be powered by 3.3v external RTC battery on P11 connector to maintain the Date and Time. Below are the connector details.

PIN NO	PIN DESCRIPTION
1	VCC 3V
2	GND

Table 19: RTC Battery

3. Ordering Information

The part numbering of the phyCORE-A5D2x has the following structure:



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