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

**RuggedBoard – A5D2x**

**Hardware and System Reference Manual**

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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

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**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.

**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.

**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.

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• 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.

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**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.

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**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

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**2.2. RuggedBoard-Interfaces**

Fig 1: Specifications and Interfaces

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**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.

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**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

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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

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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 NO 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 NO 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

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**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.

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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**

**PINs**

**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.

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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 PA14/SPI0\_SPCK/TK1/QSPI0\_SCK/I2SMCK1/FLEXCOM3\_IO2/D 4 DOUT(0-24V)\_02

9 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

WARNING!

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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**

**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

**Pin Description Signal Name**

PD19/PCK0/TWD 1/AD0 **[By Default GPIO]**

12

13

PD20/TIOA2/TWC K1/AD1 **[By Default GPIO]**

PD30\_AIN\_SEN4 **[By Default GPIO]**

14

15

TWCK1 **13 14** AIN\_SEN4

PD27\_AIN\_SEN2

PD28\_AIN\_SEN3 **[By Default**

AIN\_SEN2 **15 16** AIN\_SEN3

**[By Default**

16 **GPIO]**

**GPIO]** 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]**

PD4 **[By Default GPIO]**

24

25

ISC\_D1 **23 24** URXD2

PD07/NWR1/NBS

PD06/PCK1/NCS2 1/PTCROW4 **[By Default**

ISC\_D0 **25 26** ISC\_D8

/PTCROW3 **[By Default**

26

**GPIO]**

**GPIO]** Ground GND **27 28** GND Ground Ground GND **29 30** GND Ground

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**MRAA MRAA Mapped**

**Mapped Pins**

**Pins**

31

**Signal Name Pin**

**Description**

**Pin Pin Pin No**

**No**

**Description Signal Name**

PD22\_I2SC0\_DI0\_

PD21\_I2SC0\_WS\_ SCL

I2SC0\_DI0\_S **[By Default**

CL **31 32** I2SC0\_WS\_

SDA

SDA **[By Default**

32

**GPIO]**

**GPIO]**

USB High-Speed

Inter-Chip Data DATA **33 34** PIOBU7 TAMPER PIN

35

PC11/ISI\_D2/TCL K4/CANRX0/A0/N BS0 **[By Default GPIO]**

PC25/ISI\_FIELD/ A14 **[By Default GPIO]**

36

37

CANRX0 **35 36** ISC\_FIELD

PC23/ISI\_HSYNC/

PC18/ISI\_D9/FLE A12

XCOM3\_IO2/A7 **[By Default**

**[By Default GPIO]**

**GPIO]**

38

39

PC23 **37 38** ISC\_D9

PA13/SDMMC0\_C

PA12/SDMMC0\_ D/FLEXCOM3\_IO 1/D8 **[By Default**

SDMMC0\_C

D **39 40** SDMMC0\_

WP

WP/IRQ/NRD/NA NDOE **[By Default**

40

**GPIO]**

**GPIO]**

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

PC16/ISI\_D7/RK0 \_IO3/URXD3/A20

/A5 **[By Default**

**[By Default GPIO]**

**GPIO]**

46

47

URXD3 **45 46** ISC\_D7

PB09/TIOA3/PW

PB07/TIOB2/PW MFI1/QSPI1\_IO2 **[By Default**

QSPI1\_IO2 **47 48** QSPI1\_IO0

MH3/QSPI1\_IO0 **[By Default**

48

**GPIO]**

**GPIO]**

Ground GND **49 50** QSPI1\_SCK

PB05/TCLK2/PW MH2/QSPI1\_SCK **[By Default GPIO]**

51

52

PB10/TIOB3/PWM EXTRG1/QSPI1\_I O3 **[By Default GPIO]**

QSPI1\_IO3 **51 52** GND Ground

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**MRAA Mapped Pins**

**MRAA Mapped Pins**

53

**Signal Name Pin**

**Description**

PB08/TCLK3/PW ML3/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 No**

**Pin Description Signal Name**

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**MRAA Mapped PIN**

**Pins PIN NO**

**DESCRIPTION SIGNAL NAME** 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.

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**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

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**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

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**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

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**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

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**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

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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

G8 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

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**PIN DESCRIPTION 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

**PIN NO**

**PIN NO SIGNAL NAME**

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**3. Ordering Information**

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

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