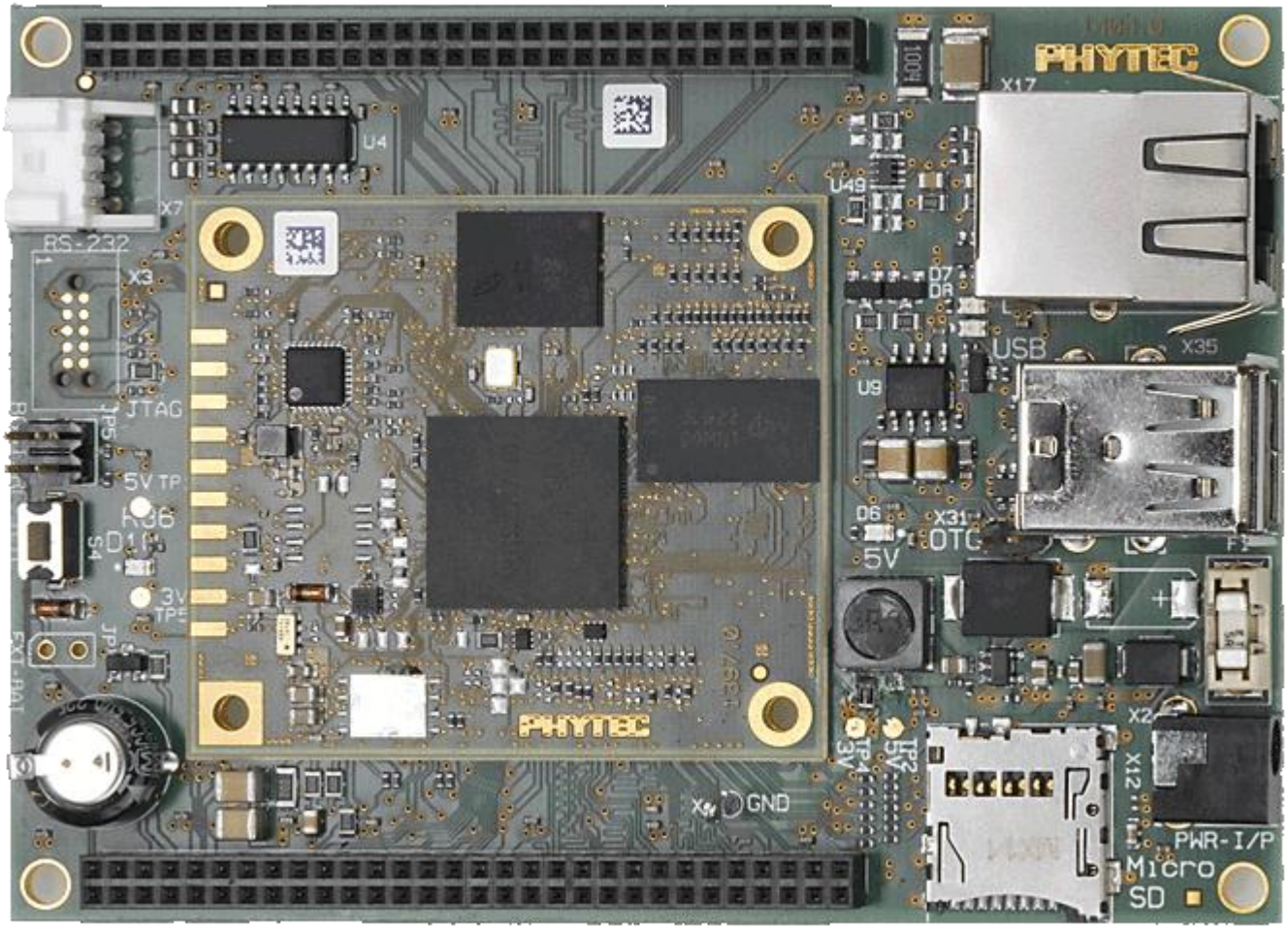
phyBOARD RANA-AM335x
Single Board Computer

Hardware Manual



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Conventions, Abbreviations, and Acronyms

Conventions

The conventions used in this manual are as follows:

- Signals that are preceded by a "/" character are designated as active low signals. Their active state is when they are driven low, or are driving low; for example : /RESET.
- Tables show the default setting or jumper position in bold, text.
- Text in blue indicates a hyperlink, either internal or external to the document. Click These links to quickly jump to the applicable URL, part, chapter, table, or figure.
- References made to the phyCORE-Connector always refer to the high density Samtec connectors on the underside of the phyBOARD-RANA-AM335x System on Module.

Abbreviations and Acronyms

Many acronyms and abbreviations are used throughout this manual. Use the table below to navigate unfamiliar terms used in this document.

Table i- 1. Abbreviations and Acronyms Used in This Manual

Abbreviation	Definition
BSP	Board Support Package (Software delivered with the Development Kit including an operating system (Windows or Linux) preinstalled on the module and Development Tools).
CB	Carrier Board; used in reference to the 1404.0
DFF	D flip-flop
EMB	External memory bus
EMI	Electromagnetic Interference
GPI	General purpose input
GPIO	General purpose input and output
GPO	General purpose output
IRAM	Internal RAM; the internal static RAM on the TI AM335x processor
J	Solder jumper; these types of jumpers require solder equipment to remove and place
JP	Solder less jumper; these types of jumpers can be removed and placed by hand with no special tools
PCB	Printed circuit board
PDI	PHYTEC Display Interface; defined to connect PHYTEC display adapter boards or custom adapters
PEB	PHYTEC Extension Board
PMIC	Power Management Integrated Circuit

PoE	Power over Ethernet
PoP	Package on Package
PoR	Power-on reset
RTC	Real-time clock
SMT	Surface mount technology

Table i-1. Abbreviations and Acronyms Used in This Manual

Abbreviation	Definition
SOM	System on Module; used in reference to the PCL-051/RANA Board System on Module
TRM	Technical Reference Manual
VBAT	SOM battery supply input

Different types of signals are brought out at the phyCORE-Connector. The following table lists the abbreviations used to specify the type of a signal.

Table i- 2. Types of Signals

Type of Signal	Description	Abbreviation
Power	Supply voltage	PWR
Ref-Voltage	Reference voltage	REF
USB-Power	USB voltage	USB
Input	Digital input	IN
Output	Digital output	OUT
Input with pull-up	Input with pull-up (jumper or open-collector output)	IPU
Input/output	Bidirectional input/output	IO
5V Input with pull-down	5V tolerant input with pull-down	5V_PD
LVDS	Differential line pairs 100 Ohm LVDS level	LVDS
Differential 90 Ohm	Differential line pairs 90 Ohm	DIFF90
Differential 100 Ohm	Differential line pairs 100 Ohm	DIFF100
Analog	Analog input or output	Analog

Preface

This phyBOARD-RANA-AM335x Board Hardware Manual describes the System on Module's design and functions. Precise specifications for the TI AM335x processor can be found in the processor datasheet and/or users manual.

In this hardware manual and in the schematics, active low signals are denoted by a "/" preceding the signal name, for example: /RD. A "0" represents a logic-zero or low-level signal, while a "1" represents a logic one or high-level signal.

Declaration of Electro Magnetic Conformity of the phyBOARD-RANA-AM335x

PHYTEC System on Modules (SOMs) are designed for installation in electrical appliances or, combined with the PHYTEC Carrier Board, can be used as dedicated Evaluation Boards (for use as a test and prototype platform for hardware/software development) in laboratory environments.

CAUTION:
PHYTEC 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. Moreover, PHYTEC products should not be operated without protection circuitry if connections to the product's pin header rows are longer than 3 mm.

PHYTEC products fulfil the norms of the European Union's Directive for Electro Magnetic Conformity only in accordance to the descriptions and rules of usage indicated in this hardware manual (particularly in respect to the pin header row connectors, power connector and serial interface to a host-PC).

Implementation of PHYTEC products into target devices, as well as user modifications and extensions of PHYTEC 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.

The phyBOARD-RANA-AM335x Board is one of a series of PHYTEC System on Modules that can be populated with different controllers and, hence, offers various functions and configurations. PHYTEC supports a variety of 8/16 and 32-bit controllers in two ways:

1. As the basis for Rapid Development Kits which serve as a reference and Evaluation platform.
2. As insert-ready, fully functional phyCORE OEM modules, which can be Embedded directly into the user's peripheral hardware design.

Implementation of an OEM-able SOM subassembly as the "core" of your embedded design allows you to focus on hardware peripherals and firmware without expending resources to "re-invent" microcontroller circuitry. Furthermore, much of the value of the phyCORE module lies in its layout and test.
Production-ready Board Support Packages (BSPs) and Design Services for our hardware further reduce development time and expenses. Take advantage of PHYTEC products to shorten time-to-market, reduce development costs, and avoid substantial design issues and risks. For more information go to:
http://www.phytec.in/services/hardware.html

Product Change Management
In addition to our HW and SW offerings, the buyer will receive a free obsolescence maintenance service for the HW provided when purchasing a PHYTEC SOM.

Our Product Change Management Team of developers is continuously processing all incoming PCN's (Product Change Notifications) from vendors and distributors concerning parts which are being used in our products. Possible impacts to the functionality of our products, due to changes of functionality or obsolesce of a certain part, are evaluated in order to take the right measures in purchasing or within our HW/SW design.

Our general philosophy here is: We never discontinue a product as long as there is a demand for it.
Therefore a set of methods has been established to fulfil our philosophy:

Avoidance strategies
- Avoid changes by evaluating longevity of a part during design-in phase.
- Ensure availability of equivalent second source parts.
- Maintain close contact with part vendors for awareness of roadmap strategies.

Change management in case of functional changes
- Avoid impacts on Product functionality by choosing equivalent replacement parts.
- Avoid impacts on Product functionality by compensating changes through HW redesign or backward compatibility

SW maintenance
- Provide early change notifications concerning functional relevant changes of our Products.

Change management in rare event of an obsolete and non replaceable part
- Ensure long term availability by stocking parts through last time buy management, according to product forecasts.
- Offer long term frame contact to customers.

We refrain from providing detailed, part-specific information within this manual, which is subject to changes, due to ongoing part maintenance for our products.

1 Introduction

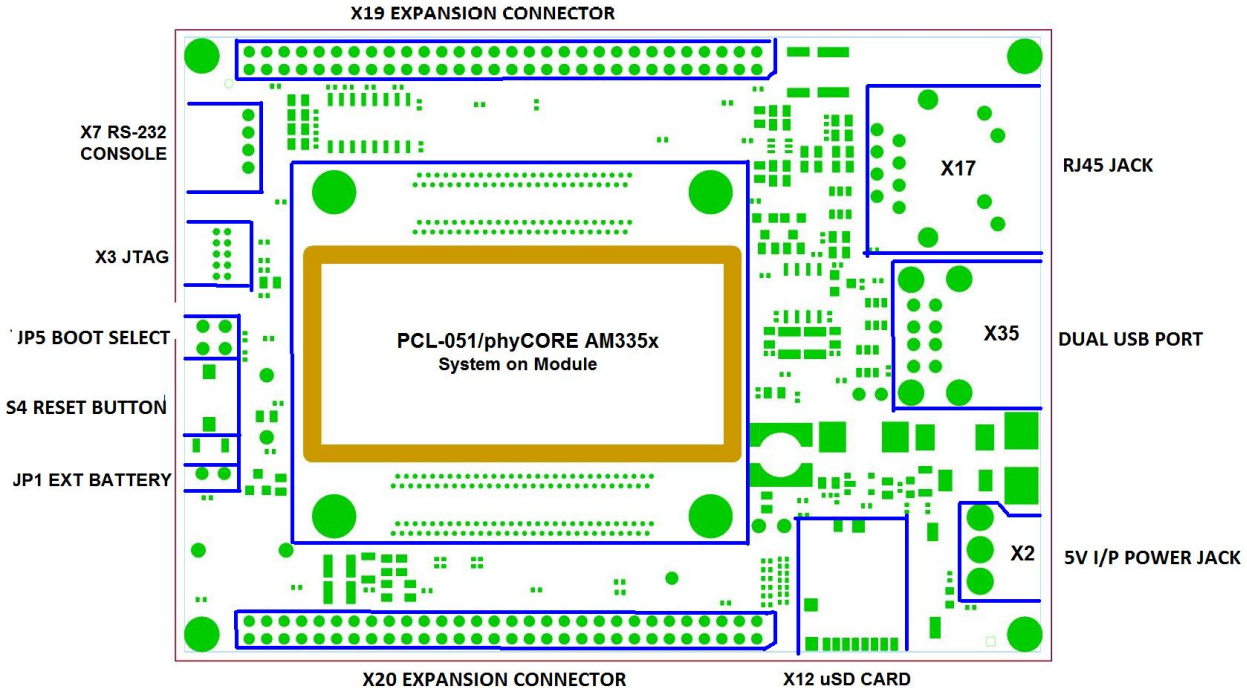

Figure 1-1. phyBOARD RANA AM335x

The RANA Board for phyCORE-AM335x is a low-cost, feature-rich software development platform supporting the TI AM335x processor families. At the core of the phyBOARD-RANA-AM335x is the PCL-051/phyCORE-AM335x System On Module (SOM) in a direct solder form factor, containing the AM335x processor, SDRAM, NAND Flash, power regulation, supervision, transceivers and other core functions required to support the phyBOARD-RANA-AM335x. Surrounding the SOM is the PBA-CD-03/ phyBOARD-RANA-AM335x Carrier, adding power input, buttons, connectors, signal breakout amongst other features.

The PCL-051 System On Module is a connector-less, BGA style variant of the PCM-051/phyCORE-AM335x SOM. Unlike traditional PHYTEC SOM products that support high density connectors, the PCL-051 SOM is directly soldered down to its Carrier Board using PHYTEC's Direct Solder Connect technology. This solution offers an ultra-low cost Single Board Computer for the AM335x processor, while maintaining most of the advantages of the SOM concept.

Adding the phyCORE-AM335x SOM into your own design is as simple as ordering the connectored version (PCM-051) and making use of our phyBOARD-RANA-AM335x Carrier Board (PBA-CD-03), or RDK Carrier Board (PCM-953) reference schematics. A summary of the phyBOARD-RANA-AM335x features, along with a block diagram are presented below.

1.1 phyBOARD-RANA-AM335x Features

- phyCORE-AM335x System On Module
- Board power over:
  - Wall Adapter Input
- High Speed USB Host Connector x 2 nos
- 10/100 Ethernet RJ-45 Jack
- Micro SD Card Slot
- RS-232 port
- Boot Selection Jumpers (NAND or SD Card)
- 1x Reset Button
- 120-pin (60 pin x 2 connectors x19 & x20)

1.2 Block Diagram

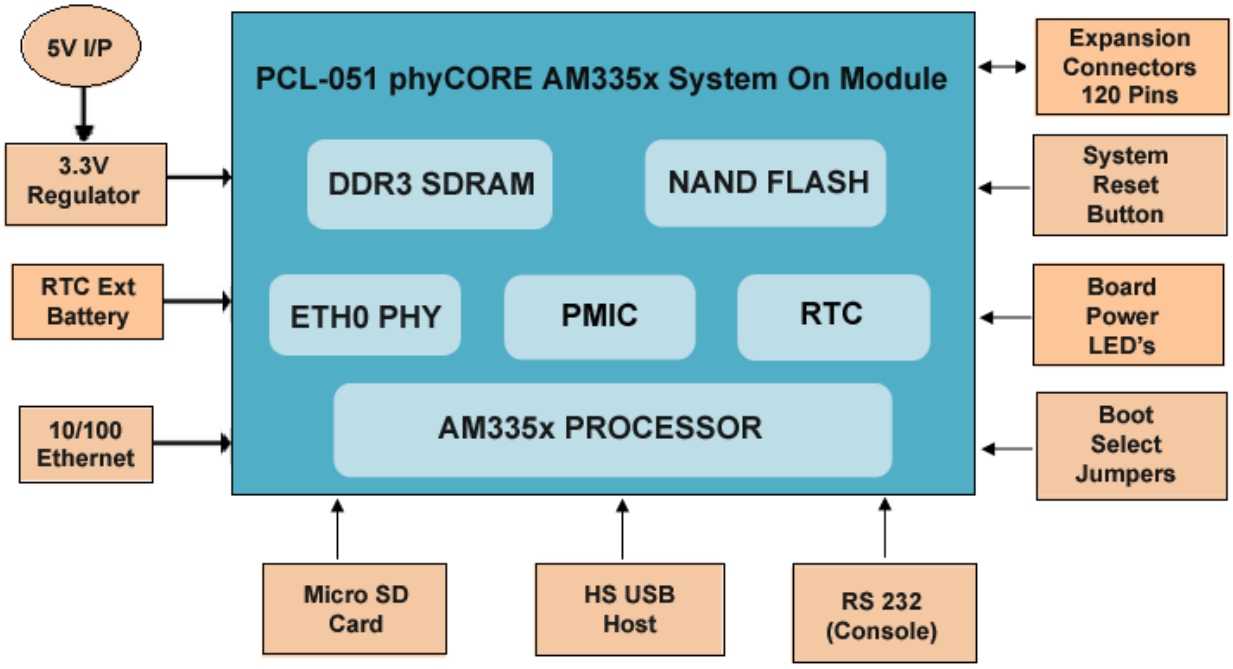

Figure 1- 2. phyBOARD-RANA-AM335x Block Diagram

2 PCL-051/phyCORE-AM335x System on Module

This chapter gives a brief introduction to the PCL-051/phyCORE-AM335x System on Module (SOM), highlighting its benefits and features. For more detailed information, please refer to the Hardware Manual for the modular, connectored version of the SOM (PCM-051) by clicking here.

The phyCORE-AM335x belongs to PHYTEC's phyCORE System on Module (SOM) family. The phyCORE SOMs represent the continuous development of PHYTEC SOM technology. Like its mini-, micro-, and nano MODULE predecessors, the phyCORE boards integrate all core elements of a microcontroller system on a sub miniature board and are designed in a manner that ensures their easy expansion and embedding in peripheral hardware developments.

As independent research indicates that approximately 70% of all EMI (Electro Magnetic Interference) problems stem from insufficient supply voltage grounding of electronic components in high frequency environments, the phyCORE board design features an increased pin package. The increased pin package allows dedication of approximately 20% of all connector pins on the phyCORE boards to ground. This improves EMI and EMC characteristics and makes it easier to design complex applications meeting EMI and EMC guidelines using phyCORE boards even in high noise environments.

phyCORE boards achieve their small size through modern SMD technology and multi-layer design. In accordance with the complexity of the module, 0402-packaged SMD components and laser-drilled Microwave are used on the boards, providing phyCORE users with access to this cutting edge miniaturization technology for integration into their own design.

The PCM-051, connectored version of the phyCORE-AM335x is a sub-miniature (44 mm x 50 mm) insert-ready SOM populated with AM335x processor. Its universal design enables its insertion into a wide range of embedded applications. All processor signals and ports extend from the processor to high-density pitch (0.5 mm) connectors aligning two sides of the board. This allows the SOM to be plugged like a "big chip" into a target application.

The PCL-051, connector less version of the phyCORE-AM335x populating the phyBOARD-RANA-AM335x is identical to the connectored version, with the exception of the connection interface. Instead of two high density connectors aligning the edges of the board, the PCL-051 solders directly down to its Carrier Board with a BGA style footprint.

Precise specifications for the processor populating the board can be found in the applicable processor user's manual and datasheet. The descriptions in this manual are based on the AM335x processor. No description of compatible processor derivative functions is included; as such functions are not relevant for the basic functioning of the RANA Board.

2.1 phyCORE-AM335x Features

- Sub-miniature (44 mm x 50 mm) System on Module (SOM) subassembly in low EMI design, achieved through advanced SMD technology
- Populated with the TI AM335x (Cortex-A8) processor
- 600 MHz (up to 1GHz) core clock frequency
- Boot from NAND Flash
- Processor signals and ports extend to two BGA-style connection interfaces aligning two sides of the board, enabling it to be soldered directly into the target application
- Single supply voltage of 3.3 V (max.1 A)
- All Processor required supplies are generated on board
- Improved interference safety achieved through multi-layer PCB technology and dedicated ground pins
- 128 MB (up to 2 GB) on-board NAND Flash
- 128 MB (up to 1 GB)DDR3 SDRAM
- Six UARTs
- Dual USB OTG 2.0 High-Speed Controller with PHY
- One 10/100 MBit Ethernet interfaces with internal L2-Switch and IEEE1588 PTP for Real time Ethernet (available as RMII TTL signals or 10/100 differential pairs)
- One I2C interfaces with System Management Bus (SMBus) support
- Display interface with 24 data bits
- Multichannel Audio Serial Ports
- One 8-channel, analog to digital (ADC) inputs
- JTAG
- 4-bit Secure Digital Host interface (SD/MMC)
- Real-Time Clock
- -40 to +85 degree Celsius operating temperature range

3 Power

3.1 Wall Power (X2)

Wall power X2 provides the necessary board voltages.

A suitable +5V DC +- 5% / 1A or greater wall power adapter should be used with a center positive contact. An appropriate power supply can be ordered with the kit at the time you place your order.

CAUTION:
Do not use a laboratory adapter to supply power to the Carrier Board! Power spikes during power-on could destroy the phyCORE module mounted on the Carrier Board. Do not change jumper settings while the Carrier Board is supplied with power.

4 Ethernet (X17)

The 10/100 ETH0 interface, derived from the TI AM335x processor RMII1 signals, is accessible at RJ-45 connector at X17. LEDs are integrated on the connector for indication of LINK (green) and SPEED (yellow).

The Ethernet PHY on the SOM supports the HP Auto-MDIX function, eliminating the need for considerations of a direct connect LAN cable or cross-over patch cable. The transceivers detect the TX and RX signals of the connected devices and automatically configure their RX and TX pins accordingly.

5 RS-232 Console (X7)

The RA (Right Angle) connector X7 provides connectivity to the phyBOARD-RANA-AM335x (UART) signals at RS-232 level. This interface does not include the phyBOARD-RANA-AM335x UART0_RTS and UART0_CTS signals for flow control. This connection is provided primarily for console access, but could be reconfigured for other purposes if needed.

A standard straight-through serial cable connected to a PC is required to access this console port. This port has the benefit of providing access to bare box and to early Linux boot log message, as opposed to the console access provided over the USB port, which provides neither. Use appropriate serial communication software such as minicom for Linux, or putty for Windows. Configure the port for 115200, 8, N, 1 (8 data bits, no handshake, 1 stop bit). Below Table gives a detailed description of the signals at X7.

Table 5- 1. Connector X7 Pin Descriptions

Pin	Signal	I/O	Description
1	N/C	-	Not connected
2	UART0_TXD_RS232	O	UART0 transmit
3	UART0_RXD_RS232	I	UART0 receive
4	GND	-	GND

6 USB Connectivity

6.1 USB Host / OTG (Configurable) (X35)

The USB0 & USB1 interface signals are routed to the connector of X35 (Dual USB A-Standard).The USB interface of the phyBOARD-RANA-AM335x processor complies with USB 2.0 HS specification and supports dual role device configuration, due to its USB-A type connector.

The USB interfaces on the phyBOARD-RANA-AM335x are equipped with ESD protection. Both the interfaces are provided 5V supply that is current limited by U4 (TPS2051B). It supports connection of different USB devices such as mass storage device, keyboard, and mouse.
The USER can also have an OTG configuration for the both USB interfaces by shorting jumper X31.

7 SD Card (X12)

The phyBOARD-RANA-AM335x provides a Micro SD card slot at X12 for connection to the phyBOARD-RANA-AM335x's MMC0 interface. The interface is powered by an instant-on 3.3 V power supply and has card detect support (CDET) via the phyBOARD-RANA-AM335x processor X64.A18 signal.

In addition to mass storage usage, the processor can boot from this interface. As the default boot mode of the phyBOARD-RANA-AM335x SOM, SD boot is selected by closing 3+4 pins of JP5.

7.1 Inserting and Removing an SD Card

Insert a micro SD Card into slot X12, label up and pins facing down. After aligning the card with the connector, push to insert. The card will make a clicking sound and latch into the connector. To eject the card, push the card in to release. The connector will click and the card will be safe to remove. To avoid damaging the connector do not attempt to pull the card directly out without first pushing inward to release the lock mechanism.

8 System Reset Button (S4)

The RANA Board is equipped with a system reset button at S4. Pressing the button will toggle the nRESET_IN signal low and generate a manual system reset driving RESETn on the phyCORE-AM335x low.

The system reset signal, nRESET_IN, is available on the Expansion connector (see Chapter 13 for more information) and can be used to reset various other peripheral devices. Refer to the PCM-051/phyCORE-AM335x Hardware Manual for details on the RESETn signal.

CAUTION:
When running Linux a proper system shutdown should be performed, or reboot executed instead of pressing the reset button. Pressing the reset button (or cutting power) without properly shutting down can cause file system errors and is not advised. Issue a poweroff or reboot command at the Linux prompt to avoid file system damage. Only use the reset button when not running Linux, or if the system freezes up.

9 Board Power LEDs

The phyBOARD-RANA-AM335x is populated with two Power LEDs D6 & D10 with VCC5V and VCC3V3 respectively to ensure the proper supplies on board.

10 Boot Selection (JP5)

Jumper JP5 provides a way to override the default boot option configured on the phyBOARD-RANA-AM335x SOM.

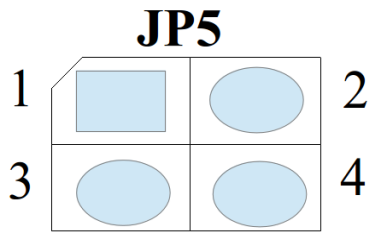

Figure 10- 1. Jumper Numbering Scheme

Figure 10-1 shows the jumper pin numbering scheme. Pin 1 on the board is marked with a cut in rectangle on the PCB silk screen. It is also visibly marked with a clipped corner on the component outline.

Table 10-1 shows the required jumper positions for configuring the desired boot device. Use jumper wires to connect the pins of JP5 based on the settings described.

By default JP5 is open, configuring the phyBOARD-RANA-AM335x for NAND boot.

Table 10- 1. Jumper Settings and Description

Jumper#	Jumper Setting		Boot Device Source
	short	open	
J5	-	1&2 3&4	NAND
	1&2 3&4	-	NOR (optional)
	3&4	1&2	MMC0

11 Real-Time Clock Options (RTC)

There are three options for an RTC on the phyBOARD-RANA-AM335x.

11.1 PMIC RTC

The Power Management IC U4 includes an integrated RTC. This RTC includes alarm and time keeping functions. The RTC is supplied by the main system power when it is on, and by the backup battery voltage VBAT_IN_4RTC, when the main system power is off and the jumper J10 has been moved from its default position of (1+2) to position (2+3).

11.2 AM335x RTC

The AM335x processor also includes an integrated RTC. However, the RTC integrated in the AM335x uses significantly more power than the RTC in the PMIC. Because of this power disadvantage, the SOM has not been designed to support the AM335x RTC with backup power.

11.3 External RTC

The AM335x processor SOM also includes External RTC IC (RV-4162-C7). This RTC is provided with External battery Backup and also given option for the USER to place own battery at JP4.

12 JTAG

The JTAG edge card connector X3 provides an easy means of debugging the phyCORE AM335x in your target system via an external JTAG probe.

Note:

The JTAG connector X3 only populated with the order. All JTAG signals are accessible from the carrier board. See Below mentioned table for details on the JTAG signal Pin assignment.

Table 12-1. JTAG Signal Map

Signal	Connector Pin	Type	Description
X_TDO	X3-6	O	JTAG test data output
X_TMS	X3-2	O	JTAG test mode select
X_TCK	X3-4	O	JTAG test clock input
X_nTRST	X3-10	I	JTAG test reset
X_TDI	X3-7	I	JTAG test data input

13 Expansion Connectors (X19, X20)

Two 2x30 2mm Expansion connectors (X19 and X20) provide easy access to many of the phyCORE-AM335x signals. All processor signals on the Expansion connector are 3.3 V. As an accessory, add-on expansion boards such as LCD and WiFi are made available through PHYTEC to connect to the Expansion connectors.

Most of the signals routed to the expansion connector have been configured for a given pin muxed function. Using these signals are alternate functions requires BSP modifications.

Tables detailing signal mapping of the Expansion Connectors are provided below. These tables list only the primary function intended on the phyBOARD-RANA-AM335x, but can be reconfigured for many other purposes. Refer to the AM335x Technical Reference manual on available operation modes.

Table 13- 1. Power Signal Map

Signal	Expansion Connector Pin	Description
VCC_5V0	X19-2, X19-4 ,X20-2	5V power from wall source
VCC_3V3	X19-1, X19-3 ,X20-1	3.3V voltage domain
VDIG1_1P8V	X19-55	Optional 1.8V from SOM
X_USB0_VBUS	X19-52	5V power from USB connector
X_USB1_VBUS	X19-49	5V power from USB connector
VBAT	X19-56	Battery Power for RTC
GND	X19-57, X19-59, X19-58, X19-60, X20-59, X20-60	Ground

Table 13-2. System Signal Map

Signal	Expansion Board Pin	Type	Description
nRESET_IN	X20-58	O	System reset signal; can be used to reset external devices.
nRESET_OUT	X20-46	O	System reset out signal from SOM; can be used to reset external devices.
X_CLKOUT1	X19-9	O	CKLOUT1; free for external use

Table 13-3. I2C Signal Map

The Inter-Integrated Circuit (I2C) interface is a two-wire, bi-directional serial bus that provides a simple and efficient method for data exchange among devices. The AM335x contains three identical and independent I2C modules. Even though the signals of all three I2C modules are available on the phyCORE connector

Signal	Expansion Board Pin	Type	Description
X_I2C0_SDA	X19-51	I/O	I2C0_SDA clock (open drain with pull-up resistor on the SOM)
X_I2C0_SCL	X19-53	I/O	I2C1_SCL data (open drain with pull-up resistor on the SOM)

Table 13-4. UART Signal Map

This device contains 6 instantiations of the UART/IrDA (UARTIRDAOCP) peripheral. There are six UART modules called UART0 – UART5. UART0 provides wakeup capability. Only UART 1 provides full modem control signals. All UARTs support IrDA and CIR modes and RTS/CTS flow control (subject to pin muxing configuration).

Signal	Exp.Board Pin	Type	Description
X_UART2_RX	X20-3	I	UART 2 receive data
X_UART2_TX	X20-4	I	UART 2 transmit data
X_UART1_TXD	X20-53	O	UART 1 transmit data
X_UART1_RXD	X20-51	I	UART 1 receive data
X_UART1_RTS	X20-52	O	UART 1 request to send
X_UART1_CTS	X20-54	I	UART 1 clear to send
X_UART3_RX	X20-55	I	UART 3 receive data
X_UART3_TX	X20-56	I	UART 3 transmit data
X_GPIO1_8	X20.5	I	UART 4 receive data
X_GPIO1_9	X20.6	I	UART 4 transmit data

Table 13- 5. ADC Signal Map

The phyCORE-AM335x provides eight analog input signals. Below Table has lists the functions assigned to the analog input signals.

Note:
To support the display touch-control feature of the phyBOARD-RANA-AM335x, the touch-control function has been assigned to the four analog input signals X_AIN0 to X_AIN3 in the BSP delivered with the module. In order to otherwise utilize these signals, the software must be changed.

Signal	Expansion Board Pin	Type	Description
X_AIN0	X20-29	Analog	ADC input0; free for external use
X_AIN1	X20-30	Analog	ADC input1; free for external use
X_AIN2	X20-31	Analog	ADC input2; free for external use
X_AIN3	X20-33	Analog	ADC input3; free for external use
X_AIN4	X20-37	Analog	ADC input4; free for external use
X_AIN5	X20-32	Analog	ADC input5; free for external use
X_AIN6	X20-35	Analog	ADC input6; free for external use
X_AIN7	X20-34	Analog	ADC input7; free for external use

Table 13-6. NAND (GPMC) Signal Map

Signal	Expansion Board Pin	Type	Description
X_GPMC_BE0n_CLE	X19-31	O	General Purpose Memory Controller interface byte enable 0 / command latch enable
X_GPMC_ADVn_ALE	X19-34	O	General Purpose Memory Controller interface address valid / address latch enable
X_GPMC_WEn	X19-36	O	General Purpose Memory Controller write enable
X_GPMC_OEn_REn	X19-38	O	General Purpose Memory Controller output enable / read enable
X_P_MII1_TXEN	X19.23	I	General Purpose Memory Controller GPMC_WPn write protect
X_GPMC_WAIT/_P_ MII1_COL	X19.35	O	General Purpose Memory Controller External wait signal
X_GPMC_AD0	X19-42	I/O	General Purpose Memory Controller interface Address/Data

Table 13-7. LCD Signal Map

The phyBOARD-RANA-AM335x provides a configurable parallel display interface with up to 24 data bits and backlight and touch-screen control.

The 24-bit integrated LCD Interface Display Driver (LIDD) of the AM335x is directly connected to the phyBOARD-RANA-AM335x Connector. The location of the applicable interface signals can be found in the table below. In addition, signal X_ECAP0_IN_PWM0_OUT can be used as PWM output to control the display brightness.

Signal	Exp. Board Pin	Type	Description
X_LCD_D0	X20-21	O	LCD data bit 0
X_LCD_D1	X20-20	O	LCD data bit 1
X_LCD_D2	X20-25	O	LCD data bit 2
X_LCD_D3	X20-26	O	LCD data bit 3
X_LCD_D4	X20-24	O	LCD data bit 4
X_LCD_D5	X20-22	O	LCD data bit 5
X_LCD_D6	X20-9	O	LCD data bit 6
X_LCD_D7	X20-10	O	LCD data bit 7
X_LCD_D8	X20-14	O	LCD data bit 8
X_LCD_D9	X20-7	O	LCD data bit 9
X_LCD_D10	X20-8	O	LCD data bit 10
X_LCD_D11	X20-17	O	LCD data bit 11
X_LCD_D12	X20-16	O	LCD data bit 12
X_LCD_D13	X20-18	O	LCD data bit 13
X_LCD_D14	X20-11	O	LCD data bit 14
X_LCD_D15	X20-12	O	LCD data bit 15
X_LCD_D16	X19-24	O	LCD data bit 16
X_LCD_D17	X19-22	O	LCD data bit 17
X_LCD_D18	X19-26	O	LCD data bit 18
X_LCD_D19	X19-28	O	LCD data bit 19
X_LCD_D20	X19-27	O	LCD data bit 20
X_LCD_D21	X19-32	O	LCD data bit 21
X_LCD_D22	X19-30	O	LCD data bit 22
X_LCD_D23	X19_29	O	LCD data bit 23
X_LCD_PCLK	X20-23	O	LCD Pixel Clock
X_LCD_AC_BIAS_EN	X20-13	O	LCD Bias enable chip select
X_LVDS_DISP_BACKLIGHT_PWM	X20-27	O	PWM output, can be used for display brightness control
X_LCD_VSYNC	X20-19	O	LCD Vertical synchronization
X_LCD_HSYNC	X20-15	O	LCD Horizontal synchronization

Touch Screen Controller

The AM335x processor includes an integrated touch screen controller for connection to a resistive touch panel such as is typically integrated in a LCD panel. The AM335x's eight analog signals, AIN[7:0], are routed to the primary phyCORE connector, X1. Some or all of These can be connected to a resistive touch panel. The phyBOARD-RANA-AM335x connects four of these signals to a touch screen integrated in a LCD display. These signals are mapped as follows:

AIN0 = TOUCH_X+
AIN1 = TOUCH_X-
AIN2 = TOUCH_Y+
AIN3 = TOUCH_Y-

Table 13-8. AIN [3:0] Signal Locations

Signal	Expansion Board Pin	Type	Description
X_AIN0	X20-29	Analog	AM335x analog input (TOUCH_X+)
X_AIN1	X20-30	Analog	AM335x analog input (TOUCH_X-)
X_AIN2	X20-31	Analog	AM335x analog input (TOUCH_Y+)
X_AIN3	X20-33	Analog	AM335x analog input (TOUCH_Y-)

Table 13- 9. Multichannel Audio Serial Ports (McASP) Signal Map

Signal	Expansion Board Pin	Type	Description
X_McASP0_AXR0	X19-11	I/O	serial data
X_McASP0_FSX	X19-12	I/O	frame synchronization transmit
X_McASP0_AHCLKX	X19-7	I/O	high frequency clock
X_McASP0_AXR1	X19-10	I/O	serial data
X_McASP0_ACLKX	X19-17	I/O	transmit bit clock

Table 13- 10. General Purpose I/O's (GPIO's) Signal Map

Signal	Expansion Board Pin	Type	Description
X_GPIO1_31	X19-5	I/O	Gpio1_31
X_GPIO1_30	X19-6	I/O	Gpio1_30
X_MMC2_CLK/_P_MDIO_MDCLK	X19-7	I/O	gpio2_1
X_MMC2_CMD/_P_MDIO_DATA	X19-8	I/O	gpio2_0
X_CLKOUT1	X19-9	I/O	gpio0_19
X_RGMII2_RD0	X19-10	I/O	gpio1_27
X_RGMII2_RD1	X19-11	O	gpio1_26
X_RGMII2_RD2	X19-12	O	gpio1_25
X_RGMII2_RCLK	X19-13	I/O	gpio1_23
X_RGMII2_TCLK	X19-14	I/O	gpio1_22
X_RGMII2_TCTL	X19-15	I/O	gpio1_16
X_RGMII2_TD1	X19-16	I/O	gpio1_20
X_RGMII2_RD3	X19-17	I/O	gpio1_24
X_RGMII2_INT	X19-18	I/O	gpio1_28
X_RGMII2_TD0	X19-19	I/O	gpio1_21
X_RGMII2_TD2	X19-20	I/O	gpio1_19
X_RGMII2_TD3	X19-21	I/O	gpio1_18
X_RGMII2_RCTL	X19-25	I/O	gpio1_17
X_GPIO3_18	X19-33	I/O	gpio3_18
X_INTR1	X19-43	I/O	gpio0_20
X_MII1_RCTL/_GPIO3_4	X19-46	I/O	gpio3_4
X_MCASP0_AXR1	X20-36	I/O	gpio3_20
X_MCASP0_FSX	X20-38	I/O	gpio3_15
X_GPIO3_17	X20-39	I/O	gpio3_17
X_MCASP0_AHCLKX	X20-40	I	gpio3_21
X_MCASP0_ACLKX	X20-42	I	gpio3_14
X_MCASP0_AXR0	X20-44	I/O	gpio3_16
X_GPIO3_19	X20-45	I	gpio3_19

Table 13- 11. Ethernet (RGMII) Signal Map

The AM335x Ethernet2 interface signals can connect to any industry-standard Ethernet transceiver or they can be used for other purposes. The AM335x processor supports MII, RMII and RGMII modes on this interface. It does not support GMII mode. It is strongly recommended to place the Ethernet PHY on the Carrier Board close to the pins of the SOM's Ethernet interface to achieve a trace length of less than 100 mm. The Ethernet2 interface signals are available on the phyBOARD-RANA-AM335x connector on the pins listed in the below Table

Signal	Expansion Board Pin	Type	Description
X_RGMII2_RD0	X19-10	I	RGMII receive data bit 0
X_RGMII2_RD1	X19-11	I	RGMII receive data bit 1
X_RGMII2_RD2	X19-12	I	RGMII receive data bit 2
X_RGMII2_RCLK	X19-13	I	RGMII receive clock
X_RGMII2_TCLK	X19-14	O	RGMII transmit clock
X_RGMII2_TCTL	X19-15	O	RGMII transmit control
X_RGMII2_TD1	X19-16	O	RGMII transmit data bit 1
X_RGMII2_RD3	X19-17	I	RGMII receive data bit 3
X_RGMII2_TD0	X19-19	O	RGMII transmit data bit 0
X_RGMII2_TD2	X19-20	O	RGMII transmit data bit 2
X_RGMII2_TD3	X19-21	O	RGMII transmit data bit 3
X_RGMII2_RCTL	X19-25	I	RGMII receive control

Table 13- 12. USB Signals Map

The Rana-AM335x provides two high speed USB Host interfaces which use the AM335x embedded HS USB-OTG PHY. The applicable interface signals can be found on the phyBOARD-RANA-AM335x Connector as shown in Table.

Signal	Expansion Board Pin	Type	Description
X_USB1_CE	X19-45	O	USB1 Phy charge enable
X_USB1_ID	X19-47	I	USB1 OTG identification
X_USB0_CE	X19-48	O	USB0 Phy charge enable
X_USB1_VBUS	X19-49	I	USB1 VBUS (input only for voltage sensing)
X_USB0_ID	X19-50	I	USB1 OTG identification
X_USB0_VBUS	X19-52	I	USB0 VBUS (input only for voltage sensing)

Table 13-13. SPI Signal Map

The Serial Peripheral Interface (SPI) is a four-wire, bidirectional synchronous serial bus that provides a simple and efficient method for data exchange among devices. The AM335x includes two SPI modules. These modules are Master/Slave configurable and each support up to two devices. The interface signals of the first module (SPI0) are identified on the phyCORE-Connector. If there is a SPI Flash installed on the SOM, it connects to SPI0_CS0

Signal	Expansion Board Pin	Type	Description
X_SPI0_MISO	X20-48	I/O	SPI0 Master In Slave Out
X_SPI0_MOSI	X20-47	I/O	SPI0 Master out slave in
X_SPIO_CS0	X20-49	I/O	SPI0 CHIP SELECT
X_SPI0_CLK	X20_50	I/O	SPI0 CLOCK

Table 13-14. CAN Signal Map

The Controller Area Network (CAN) is a serial communications protocol which efficiently supports distributed real time control with a high level of security. The AM335x includes two CAN interfaces, DCAN0 and DCAN1. These support bitrates up to 1 MBit/s and are Compliant to the CAN 2.0B protocol specification.

Signal	Expansion Board Pin	Type	Description
X_MII1_TXD3	X20-41	O	dcan0_tx (CAN0 Transmitter)
X_MII1_TXD2	X20-43	I	dcan0_rx (CAN0 Receiver)
X_GPIO1_8	X20-05	O	dcan1_tx (CAN1 Transmitter)
X_GPIO1_9	X20_06	I	dcan1_rx (CAN0 Receiver)

14 Technical Specifications

Table 14- 1. Technical Specifications

Dimensions	100 x 72mm
Weight	64.2g / 2.26oz typ.
Storage Temperature	-40 °C to +125 °C
Operating Temperature	-40°C to + 85 °C (Industrial)
Humidity	95% r.F. not condensed
Operating Voltage	+5VDC +- 5%
Power Consumption	2.05W typ.; Linux booted from Micro SD card, running ping test

15 Revision History

Table 15- 1. Revision History

Date	Version Number	Changes in this Manual
08/11/2013	Hardware Manual PBA-CD-03	Preliminary documentation. Describes the phyBOARD-RANA-AM335x With phyCORE-AM335x SOM.

16 PLACEMENT DIAGRAMS

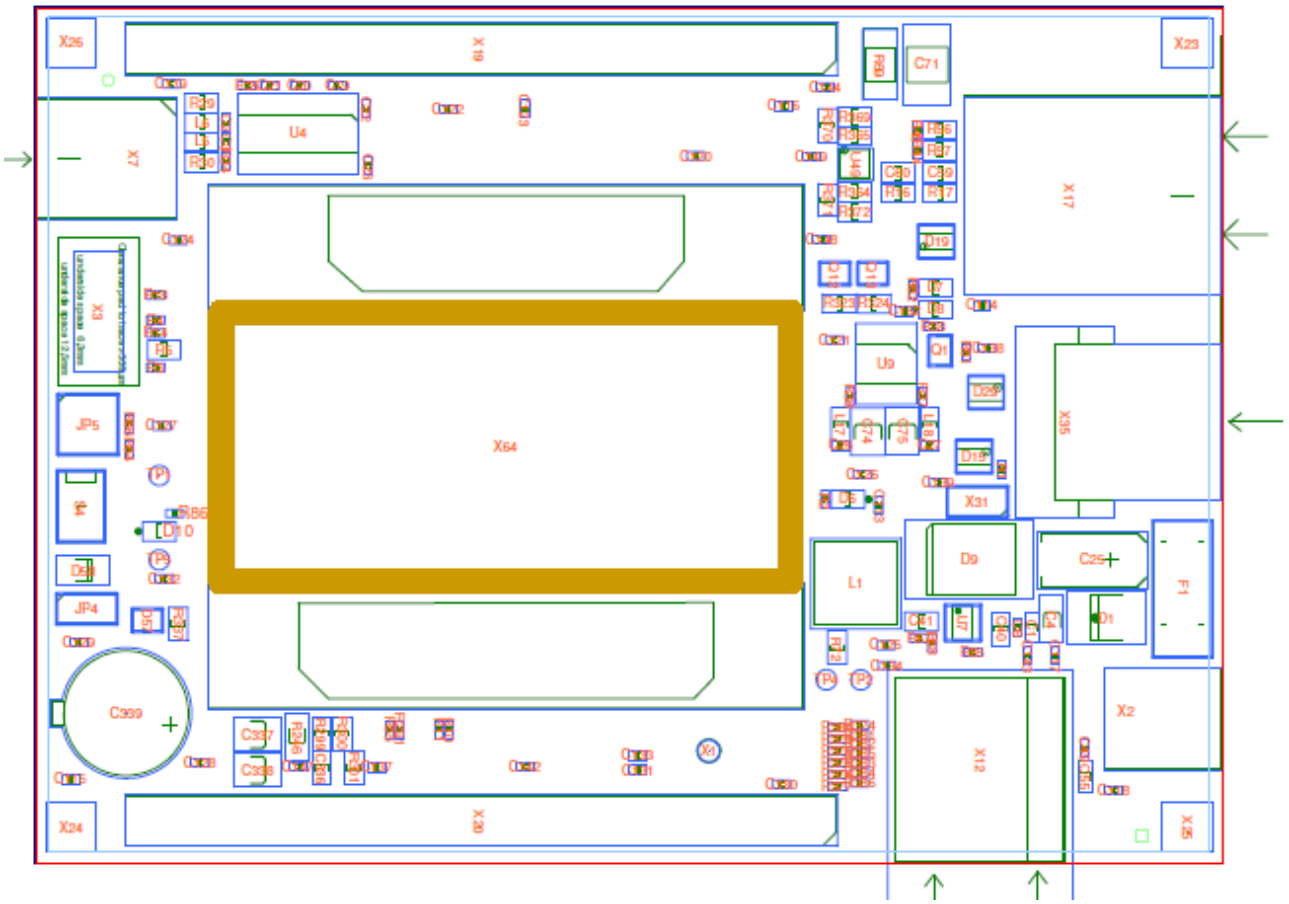

Figure 16- 2. Placement Diagram of phyBOARD-RANA-AM335x

17 Physical Dimensions Diagram of phyBOARD-RANA-AM335x

The physical dimensions of the phyBOARD-RANA-AM335x are of Pico-ITX (100 x 72mm) form factor as shown in Figure 17-1.

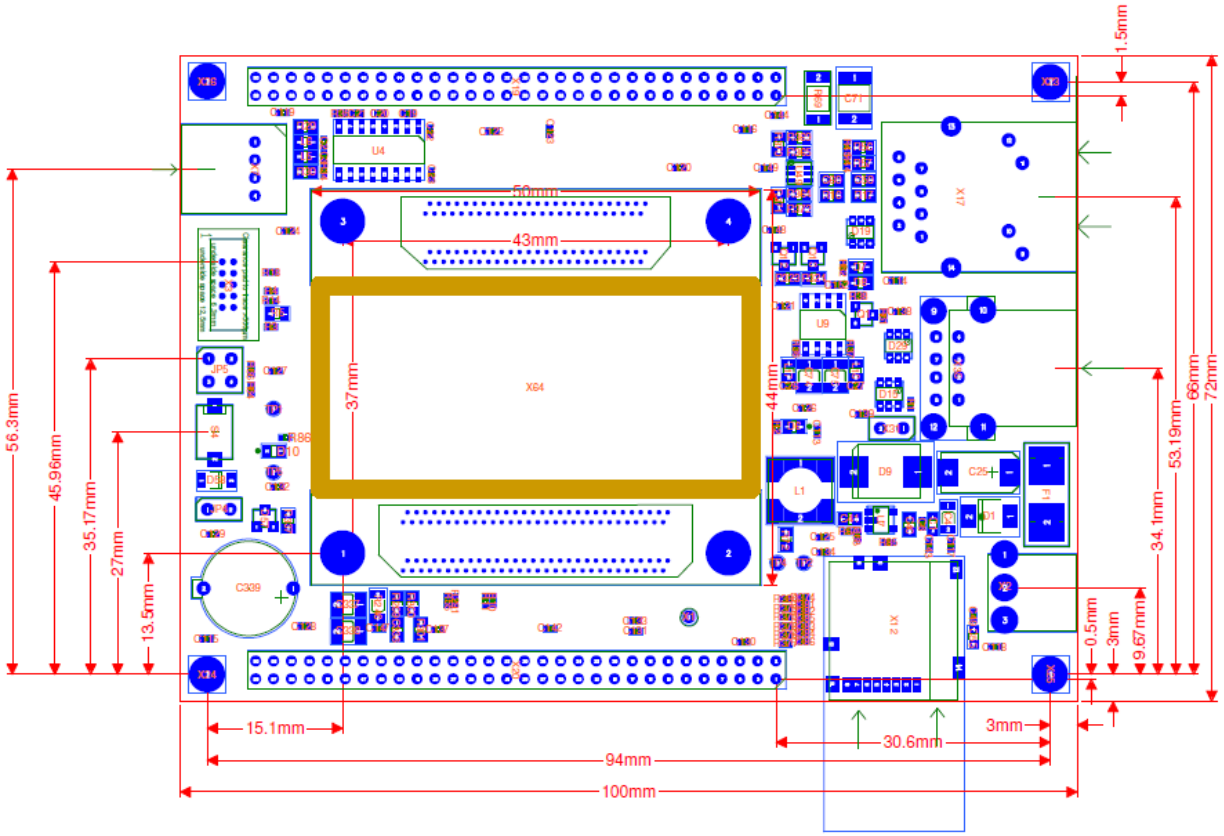

Figure 17- 3. Physical Dimensions

Get the dialog going ...
... and stay in touch

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.....We are looking forward to hear from you!.....