phyBOARD®-Wega AM335x R2

Hardware Manual

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Conventions, Abbreviations, and Acronyms

This hardware manual describes the PB-00814-xxx Single Board Computer (SBC), hereby referred to as phyBOARD-Wega AM335xR2. The manual specifies the phyBOARD-Wega AM335xR2's design and function. Precise specifications for the Texas Instruments AM335x microcontrollers can be found in the Texas Instrument's AM335x Data Sheet and Technical Reference Manual.

Conventions

The conventions used in this manual are as follows:

- Signals that are preceded by an "n", "/", or "#" character (e.g.: nRD, /RD, or #RD), or that have a dash on top of the signal name (e.g.: $\overline{\text{RD}}$) are designated as active low signals. That is, their active state is when they are driven low or are driving low.
- A "0" indicates a logic zero or low-level signal, while a "1" represents a logic one or a high-level signal.
- The hex-numbers given for addresses of I^2C devices always represent the 7 MSB of the address byte. The correct value of the LSB which depends on the desired command (read (1), or write (0)) must be added to get the complete address byte. E.g. given address in this manual 0x41 => complete address byte = 0x83 to read from the device and 0x82 to write to the device.
- Tables which describe jumper settings show the default position in **bold, blue text.**
- Text in *blue italic* indicates a hyperlink within, or external to the document. Click these links to quickly jump to the applicable URL, part, chapter, table, or figure.
- Text in ***bold italic*** indicates an interaction by the user, which is defined on the screen.
- Text in `Consolas` indicates an input by the user, without a premade text or button to click on.
- Text in *italic* indicates proper names of development tools and corresponding controls (windows, tabs, commands etc.) used within the development tool, no interaction takes place.
- White Text on a black background shows the result of any user interaction (command, program execution, etc.)

Abbreviations and Acronyms

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

Abbreviation	Definition
A/V	Audio/Video
BSP	Board Support Package (Software delivered with the Development Kit including an operating system (Windows, or *Linux*) pre-installed on the module and Development Tools)
CB	Carrier Board; used in reference to the phyBOARD-Wega AM335xR2 Development Kit Carrier Board
DFF	D flip-flop
DSC	Direct-Solder Connect
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 Texas Instruments AM335x microcontroller
J	Solder jumper; these types of jumpers require solder equipment to remove and place
JP	Solderless jumper; these types of jumpers can be removed and placed by hand with no special tools
NC	Not Connected
NM	Not Mounted
NS	Not Specified
PCB	Printed circuit board
PDI	PHYTEC Display Interface; defined to connect PHYTEC display adapter boards, or custom adapters
PEB	PHYTEC Expansion Board
PMIC	Power management IC
PoE	Power over Ethernet
PoP	Package on Package
POR	Power-on reset
RTC	Real-time clock
SBC	Single Board Computer; used in reference to the PBA-CD-02 / phyBOARD-Wega AM335xR2
SMT	Surface mount technology
SOM	System on Module; used in reference to the PCL-060 / phyCORE-AM335x module
Sx	User button Sx (e.g. S1, S2) used in reference to the available user buttons, or DIP switches on the CB
Sx_y	Switch y of DIP switch Sx; used in reference to the DIP switch on the carrier board
VSTBY	SOM standby voltage input

Table 1: Abbreviations and Acronyms used in this Manual

	At this icon, you might leave the path of this Application Guide.
	This is a warning. It helps you avoid any annoying problems.
	You can find information to solve problems.

Note:
The BSP is configured according to the hardware configuration including the expansion board delivered with the kit. Thus, some functions of the phyBOARD-Wega AM335xR2 might not be available if the corresponding pins and drivers are needed to support an expansion board. If the expansion board is removed or exchanged, the BSP must be exchanged, too.

Preface

As a member of PHYTEC's new phyBOARD® product family, the phyBOARD®-Wega AM335xR2 is one of a series of PHYTEC System on Modules (SBCs) that offer off-the-shelf solutions for a huge variety of industrial applications. The new phyBOARD® product family consists of a series of extremely compact embedded control engines featuring various processing performance classes. All phyBOARDs are rated for industry, are cost optimized, and offer long-term availability. The phyBOARD®-Wega AM335xR2 is one of currently six industrial-grade carrier boards which are suitable for series production and that have been realized in accordance with PHYTEC's new SBCplus concept. It is an excellent example of this concept.

SBCplus Concept

The SBCplus concept was developed to meet fine differences in customer requirements with little development effort and thus to greatly reduce the time-to-market.

The core of the SBCplus concept is the SBC design library (a kind of construction set) that consists of a great number of function blocks (so-called "building blocks") which are refined constantly. The recombination of these function blocks allows a customer-specific SBC to be developed within a short time. Thus, PHYTEC is able to deliver production-ready custom Single Board Computers within a few weeks at very low costs.

The already developed SBCs, such as the phyBOARD®-Wega AM335xR2, each represent an intersection of different customer wishes. Because of this, all necessary interfaces are already available on the standard versions. This allows them to be integrated into a large number of applications without modification. For any necessary detail adjustment, extension connectors are available to enable adding of a wide variety of functions.

Cost-optimized with Direct Solder Connect (DSC) Technology

At the heart of the phyBOARD®-Wega AM335xR2 is the phyCORE®-AM335x System on Module (SOM). As with all SBCs of the phyBOARD® family, the SOM is directly soldered onto the carrier board PCB for routing of signals from the SOM to applicable I/O interfaces. This “Direct Solder Connect” (DSC) of the SOM eliminates costly PCB to PCB connectors, thereby further reducing overall system costs and making the phyBOARDs ideally suited for deployment into a wide range of cost-optimized and robust industrial applications.

Customized Expandability from PHYTEC

Common interface signals route to standard connector interfaces on the carrier board such as Ethernet, CAN, RS-232, and audio. Due to the easily modifiable phyBOARD® design approach (see "*SBCplus concept*"), these plug-and-play interfaces can be readily adapted in customer-specific variants according to end system requirements.

Some signals from the processor populating the SOM also extend to the expansion and A/V connectors of the phyBOARD®-Wega AM335xR2. This provides for customized expandability according to end user requirements. Expandability is made easy by available plug-and-play expansion modules from PHYTEC.

- HDMI and LVDS/Parallel Displays
- Power Supply, with a broad voltage range
- Industrial I/O (including WLAN)
- Home-Control Board (WiFi, KNX/EIB, I/O)
- M2M Board (GPS, GSM, I/O's)
- Debug Adapter

The default orientation of the expansion bus connectors is parallel and on the top side of the carrier board PCB. However, in custom configurations, the connectors can be mounted on the PCB's underside. Connectors in perpendicular orientation can also populate the top or underside of the PCB. This enables maximum flexibility for orientation of expansion modules on the phyBOARD®-Wega AM335xR2, as well as integrating the system into a variety of end application physical envelopes and form factors.

Easy Integration of Display and Touch

The phyBOARD® and its expansion modules enable easy connection of parallel or LVDS based displays, as well as resistive or capacitive touch screens.

OEM Implementation

Implementation of an OEM-able SBC 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 phyBOARD® SBC lies in its layout and test.

Software Support

Production-ready Board Support Packages (BSPs) and Design Services for our hardware will further reduce your development time and risk and allow you to focus on your product expertise.

Ordering Information

Ordering numbers:

phyBOARD®-Wega AM335xR2 Development Kit:	**KPB-00802-xxx**
phyBOARD®-Wega AM335xR2 SBC:	**PB-00814-xxx**

Product Specific Information and Technical Support

In order to receive product specific information on all future changes and updates, we recommend registering at:

http://www.phytec.de/de/support/registrierung.html
or
http://www.phytec.eu/europe/support/registration.html

For technical support and additional information concerning your product, please visit the download section of our website which provides product-specific information, such as errata sheets, application notes, FAQs, etc.

http://www.phytec.de/produkt/single-board-computer/phyboard-wega/#download
or
http://www.phytec.eu/product/single-board-computer/phyboard-wega/#download

Other Products and Development Support

Aside from the new phyBOARD® family, 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 OEM modules, which can be embedded directly into the user's peripheral hardware design.

Take advantage of PHYTEC products to shorten time-to-market, reduce development costs, and avoid substantial design issues and risks. With this new innovative, full system solution, new ideas can be brought to market in the most timely and cost-efficient manner.

For more information go to:

http://www.phytec.de/de/leistungen/entwicklungsunterstuetzung.html
or
http://www.phytec.eu/europe/oem-integration/evaluation-start-up.html

Declaration of Electro Magnetic Conformity of the PHYTEC phyBOARD®-Wega AM335xR2

PHYTEC Single Board Computers (henceforth products) are designed for installation in electrical appliances, as part of custom applications, or as dedicated Evaluation Boards (i.e.: 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, therefore, must 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 m.

PHYTEC products fulfill 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).

Note:
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 the implementation of the products into target systems.

Product Change Management and information in this manual on parts populated on the SOM / SBC

With the purchase of a PHYTEC SOM / SBC, you will, in addition to our HW and SW offerings, receive a free obsolescence maintenance service for the HW we provide.

Our PCM (Product Change Management) Team of developers is continuously processing all incoming PCNs (Product Change Notifications) from vendors and distributors concerning parts which are used in our products.

Possible impacts to the functionality of our products, due to changes of functionality or obsolesce of a certain part, are constantly being evaluated in order to take the right measures when purchasing or within our HW/SW design.

Our general philosophy here is: **We never discontinue a product as long as there is demand for it.**

Therefore we have established a set of methods to fulfill our philosophy:

Avoiding strategies:

- Avoid changes by evaluating the longevity of parts during the design phase.
- Ensure availability of equivalent second source parts.
- Stay in close contact with part vendors to be aware 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 compatible SW maintenance.
- Provide early change notifications concerning functional relevant changes in our products.

Change management in the 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 contract to customers.

Therefore, we refrain from providing detailed part specific information within this manual, which can be subject to continuous changes, due to part maintenance for our products.

In order to receive reliable, up to date, and detailed information concerning parts used for our product, please contact our support team through the contact information given within this manual.

1 Introduction

1.1 Hardware Overview

The phyBOARD-Wega AM335xR2 for phyCORE-AM335x is a low-cost, feature-rich software development platform supporting the Texas Instruments AM335xR2 microcontroller. Moreover, due to the numerous standard interfaces, the phyBOARD-Wega AM335xR2 can serve as the bedrock for your application. At the core of the phyBOARD-Wega AM335xR2 is the PCL-060/phyCORE-AM335x System On Module (SOM) in a direct solder form factor, containing the processor, DRAM, NAND Flash, power regulation, supervision, transceivers, and other core functions required to support the AM335x processor. Surrounding the SOM is the PBA-CD-02/phyBOARD-Wega AM335xR2 carrier board adding power input, buttons, connectors, signal breakout, and Ethernet connectivity amongst other things.

The PCL-060 System On Module is a connector-less, BGA style variant of the PCM-060/phyCORE-AM335x SOM. Unlike traditional PHYTEC SOM products that support high-density connectors, the PCL-060 SOM is directly soldered on to the phyBOARD-Wega AM335xR2 using PHYTEC's Direct Solder Connect technology (DSC). 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-060) and making use of our phyCORE Carrier Board reference schematics.

1.1.1 Features of the phyBOARD-Wega AM335xR2

The phyBOARD-Wega AM335xR2 supports the following features :

- Developed in accordance with PHYTEC's new SBCplus concept (*Preface*)
- PHYTEC's phyCORE-AM335x SOM with Direct Solder Connect (DSC)
- Pico ITX standard dimensions (100 mm × 72 mm)
- Boot from MMC or NAND Flash
- Max. 1 GHz core clock frequency
- Three different power supply options (5 V via 3.5 mm combicon or micro USB connector; or 12 V – 24 V through external power module)
- Two RJ45 jacks for 10/100 Mbps Ethernet
- One USB host interface brought out to an upright USB Standard-A connector, or at the expansion connector[1]
- One USB OTG interface available at a USB Micro-AB connector at the back side, or at the expansion connector[1]

1 : **Caution!** There is no protective circuit for the USB interface brought out at the expansion connector.

- One Secure Digital / Multi Media Memory Card interface brought out to a Micro-SD connector at the back side
- CAN interface at 2×5 pin header 2.54 mm
- Audio codec with Stereo Line In and Line Out (2×3 pin header 2.54 mm) and mono speaker (2-pole Molex SPOX)
- RS-232 transceiver supporting UART1 incl. handshake signals with data rates of up to 1 Mbps (2×5 pin header 2.54 mm)
- Reset-Button
- Audio/Video (A/V) connectors
- Expansion connector with different interfaces
- Gold Capacitor for a backup supply of RTC (lasts approx. 17 ½ days)

1.1.2 Block Diagram

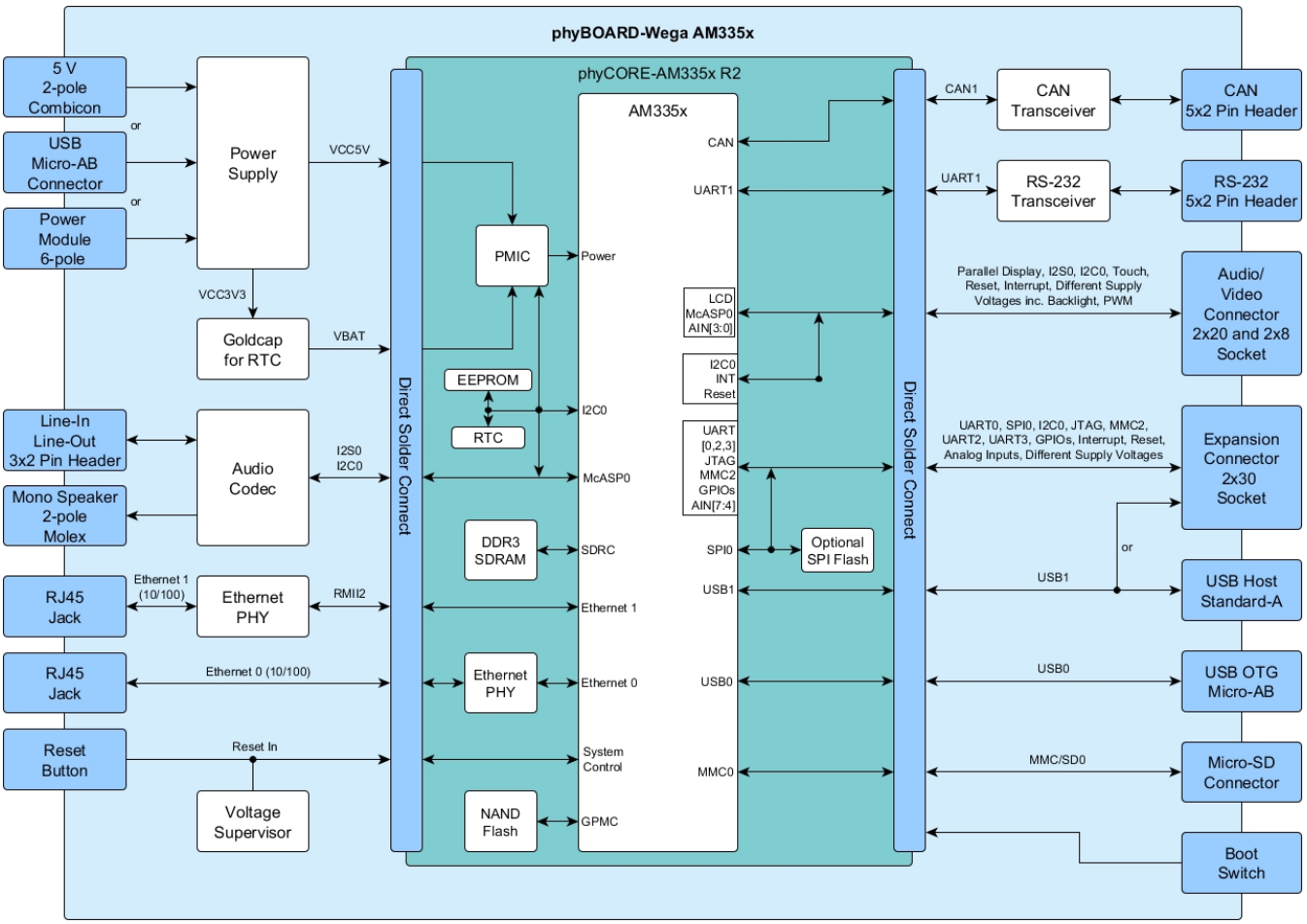


Figure 1: Block Diagram of the phyBOARD-Wega AM335xR2

1.1.3 View of the phyBOARD-Wega AM335xR2

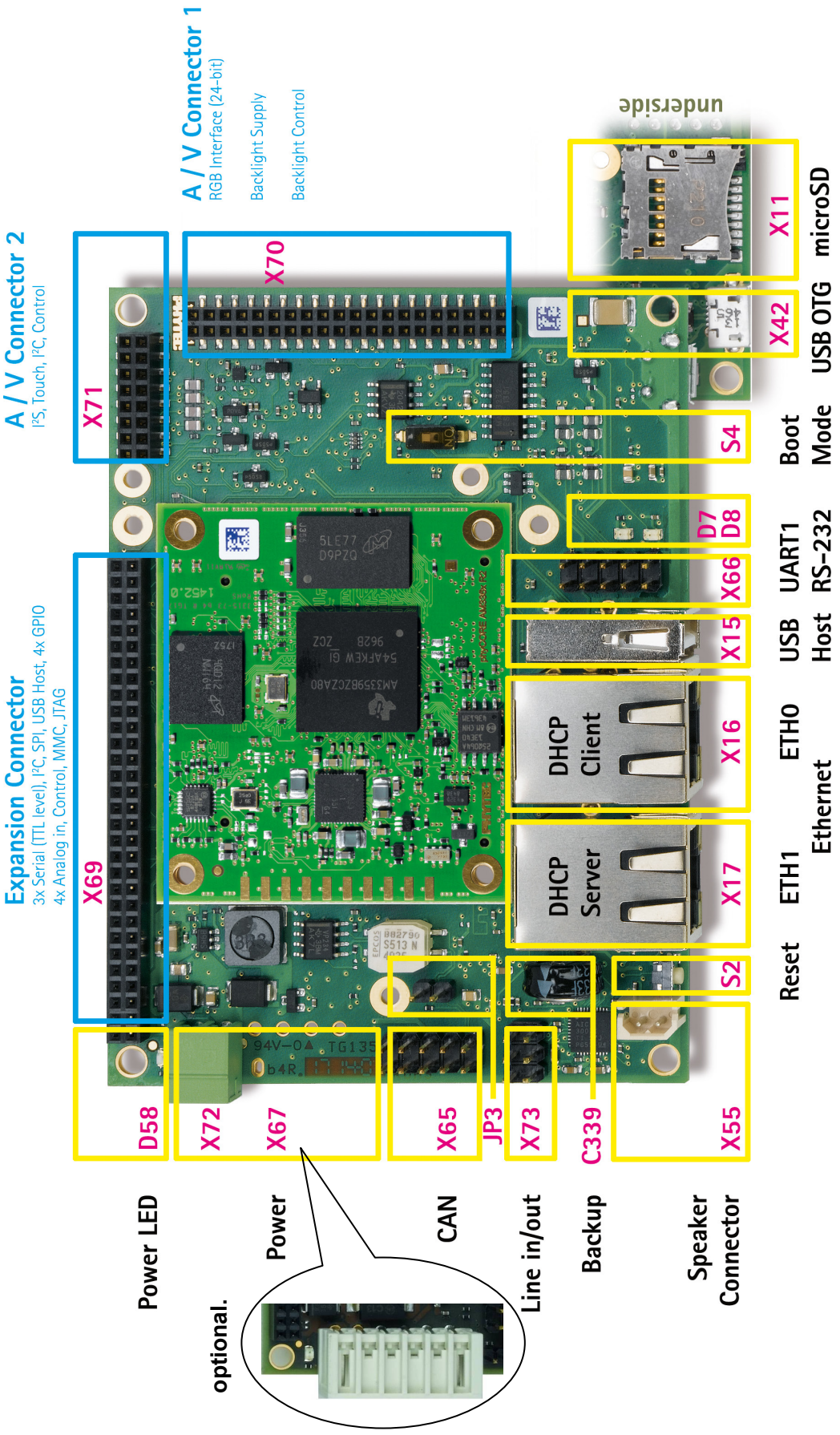


Figure 2: View of the phyBOARD-Wega AM335xR2

2 Accessing the phyBOARD-Wega AM335xR2 Features

PHYTEC phyBOARD-Wega AM335xR2 is fully equipped with all mechanical and electrical components necessary for a speedy and secure start-up.

2.1 Overview of the phyBOARD-Wega AM335xR2 Peripherals

The phyBOARD-Wega AM335xR2 is depicted in *Figure 2*. It features many different interfaces and is equipped with the components as listed in *Table 2* to *Table 5*. 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.

2.1.1 Connectors and Pin Header

Table 2 lists all available connectors on the phyBOARD-Wega AM335xR2. *Figure 2* highlights the location of each connector for easy identification.

Reference Designator	Description	Section
X11	Secure Digital / Multi Media Card (Micro-slot)	*2.2.7*
X15	USB host connector (USB 2.0 Standard-A)	*2.2.4*
X16	Ethernet 0 connector (RJ45 with speed and link LED)	*2.2.3*
X17	Ethernet 1 connector (RJ45 with speed and link LED)	
X42	USB On-The-Go connector (USB Micro-AB)	*2.2.4*
X55	Mono Speaker output (2-pole Molex SPOX, 2.5 mm pitch)	*2.2.5*
X65	CAN connector (2×5 pin header, 2.54 mm pitch)	*2.2.6*
X66	RS-232 with RTS and CTS (UART1; 2×5 pin header, 2.54 mm pitch)	*2.2.2*
X67	Power supply 5 V only (via 6-pole WAGO male header, or 2-pole Phoenix Contact MINI COMBICON base strip)	*2.2.1.1*
X69	Expansion connector (2×30 socket connector, 2 mm pitch)	*2.2.11, 3.2.5*
X70	A/V connector #1 (2×20 socket connector, 2 mm pitch)	*2.2.10, 3.2.4*
X71	A/V connector #2 (2×8 socket connector, 2 mm pitch)	
X72	Optional 5 V power supply via USB Micro-AB connector	*2.2.1.1.2*
X73	Stereo Line Out and Line In connector (2×3 pin header, 2.54 mm pitch)	*2.2.5*

Table 2: phyBOARD-Wega AM335xR2 Connectors and Pin Headers

	Ensure that all module connections do not exceed their expressed maximum voltage or current. Maximum signal input values are indicated in the corresponding controller User's Manual/Data Sheets. As damage from improper connections varies according to use and application, it is the user's responsibility to take appropriate safety measures to ensure that the module connections are protected from overloading through connected peripherals.

2.1.2 LEDs

The phyBOARD-Wega AM335xR2 is populated with three LEDs to indicate the status of the USB VBUS voltages, as well as of the power supply voltage.

Figure 2 shows the location of the LEDs. Their function is listed in the table below:

LED	Color	Description	Section
D7	green	Indicates presence of VBUS1 at the USB host interface (X15)	*2.2.4*
D8	green	Indicates presence of VBUS0 at the USB OTG interface (X42)	
D58	red	3.3 V voltage generation on the phyBOARD	*2.2.1.2*

Table 3: phyBOARD-Wega AM335xR2 LEDs Descriptions

2.1.3 Switches

The phyBOARD-Wega AM335xR2 is populated with two switches, one to reset the phyBOARD and another to configure the boot sequence.

Figure 2 shows the location of the switches. Their function is listed in the table below:

Switch	Description	Section
S2	Reset button	*2.2.9*
S4	Boot switch	*2.2.8*

Table 4: phyBOARD-Wega AM335xR2 Switches Description

2.1.4 Jumpers

The phyBOARD-Wega AM335xR2 comes pre-configured with one removable jumper (JP) and several solder jumpers (J). The jumpers allow flexible configuring of a limited number of features for development purposes to the user.

	Due to the small footprint of the solder jumpers (J), PHYTEC does not recommend manual jumper modifications. This may render the warranty invalid. Because of this, only the removable jumper is described in this section. For information on the solder jumpers, see *section 3.2*. Contact our sales team if you need jumper configurations different from the default configuration.

The function of the removable jumper on the phyBOARD-Wega AM335xR2 is shown in *Table 5*. More detailed information can be found in the appropriate section.

Figure 2 shows the location of jumper JP3.

Jumper	Description	Section
JP3	CAN Termination	*2.2.6*

Table 5: phyBOARD-Wega AM335xR2 Jumper Description

	Detailed descriptions of the assembled connectors, jumpers, and switches can be found in the following chapters.

2.2 Functional Components on the phyBOARD-Wega AM335xR2

This section describes the functional components of the phyBOARD-Wega AM335xR2. Each subsection details a particular connector/interface and associated jumpers for configuring that interface.

2.2.1 Power Supply

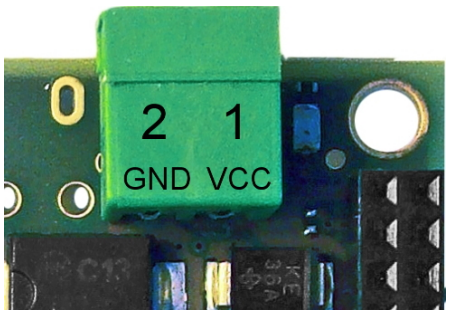
	Do not change modules or jumper settings while the phyBOARD is supplied with power!

2.2.1.1 Power Connectors (X67 and X72)

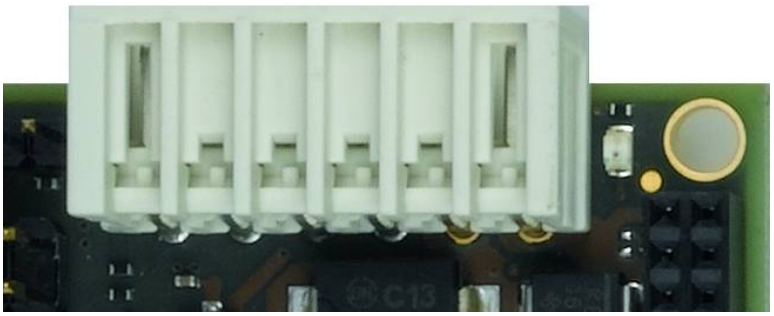
The phyBOARD-Wega AM335xR2 is available with three different power supply connectors. Depending on your order, you will find one of the following connectors on your SBC:

1. A 2-pole Phoenix Contact MINI COMBICON base strip 3.5 mm connector (X67) suitable for a single 5 V supply voltage.
2. A USB Micro-AB connector (X72) to connect a standard 5 V USB power supply.
3. A 6-pole WAGO male header (X67) to attach the Power Module for phyBOARDs (PEB-POW-01) which provides connectivity for 12 V – 24 V

The required current load capacity for all power supply solutions depends on the specific configuration of the phyCORE mounted on the phyBOARD-Wega AM335xR2, the particular interfaces enabled while executing software, as well as whether an optional expansion board is connected to the carrier board.



Phoenix MINI COMBICON base strip



WAGO male header 6-pole

Figure 3: Power Supply Connectors (X67)

2.2.1.1.1 Phoenix Contact 2-pole MINI COMBICON Base Strip (X67)

The permissible input voltage is +5 V DC if your SBC is equipped with a 2-pole Phoenix Contact MINI COMBICON base strip. A 5 V adapter with a minimum supply of 1.5 A is recommended to supply the board via the 2-pole base strip.

	Please make sure that your power supply is able to handle fast load peaks! Especially during the boot sequence, the demand of current might vary rapidly, resulting in an endless boot loop in case your power supply switches too slowly and thus does not provide the required current fast enough.

Figure 3 and the following table show the pin assignment.

Pin	Signal	Description
1	VCC5V_IN	+5 V power supply
2	GND	Ground

Table 6: Pin Assignment of the 2-pole Phoenix Contact MINI COMBICON Base Strip at X67

2.2.1.1.2 USB Micro-AB (X72)

If your board provides a USB Micro-AB female connector (X72) at the upper side of the board, a standard USB Micro power supply with +5 V DC can be used to supply the phyBOARD-Wega AM335xR2.

	Do not confuse the USB Micro connector on the upper side of the board with the one on the back side of the board which provides USB OTG connectivity. The USB Micro connector on the upper side is exclusively used for power supply and has no other USB functionality!

2.2.1.1.3 WAGO 6-pole Male Header (X67)

If a WAGO 6-pole male header is mounted on your board (*Figure 2* and *Figure 3*), your board is prepared to connect to a phyBOARD Power Module (PEB-POW-01) or a custom power supply circuitry. The ordering number of the mating connector from WAGO is EAN 4045454120610.

Use of the 6-pole connector has the following advantages:

- Higher and wider operating range of the input voltage
- External scaling potential to optimize the electrical output current, by use of customized power modules which match the requirements
- 5 V, 3.3 V, and backlight power supply

Pin assignment of the 6–pole WAGO connector:

Pin	Signal	Description
1	VCC5V_IN	+5 V power supply
2	GND	Ground
3	VCC3V3_PMOD	+3.3 V power supply
4	VCC_BL	Backlight power supply (input voltage of power module) [2]
5	PMOD_PWRGOOD	Power good signal (connected to reset nRESET_IN)
6	nPMOD_PWRFAIL	Power fail signal

Table 7: Pin Assignment of the 6-pole WAGO Connector at X67

A detailed description of the Power Module for phyBOARDs, including information on the minimum supply current, can be found in the Application Guide for phyBOARD Expansion Boards (L-793e).

2.2.1.2 Power LED D58

The red LED D58 right next to the power connector (*Figure 2*) indicates the presence of the 3.3 V supply voltage generated from the 5 V input voltage.

2.2.1.3 VBAT and RTC

The phyBOARD-Wega AM335xR2 features an external RTC mounted on the phyCORE-AM335x module. It is used for real-time or time-driven applications. To back up the RTC on the module, a Goldcap (C339) (*Figure 2*) is placed on the phyBOARD. This voltage source is connected to the backup voltage pin VBAT_IN_4RTC (A2) of the phyCORE-AM335x and supplies the RTC and some critical registers of the Power Management IC when the primary system power, VCC5V_IN, is removed. The backup supply lasts approximately 17½ days.

2: The voltage level depends on the connected power module and the voltage attached and is not specified here.

2.2.2 UART Connectivity (X66 and X69)

The phyCORE-AM335x provides up to 4 high speed universal asynchronous interfaces. On the phyBOARD-Wega AM335xR2 the TTL level signals of UART0 (the standard console), UART2 and UART3 are routed to expansion connector X69. UART1 is available at pin header connector X66 at RS-232 level.

	The Evaluation Board (PEB-EVAL-01) delivered with the kit plugs into the expansion connector and allows for the easy use of the standard console (UART0), which is required for debugging. Please find additional information on the Evaluation Board in the Application Guide for phyBOARD Expansion Boards (L-793e).

Further information on the expansion connector can be found in *section 3.2.5.*

Pin header connector X66 is located next to the USB host connector (*Figure 4)* and provides the UART1 signals of the AM335x at RS-232 level. The serial interface is intended to be used as data terminal equipment (DTE) and allows for a 5-wire connection including the signals RTS and CTS for hardware flow control. *Table 8* shows the signal mapping of the RS-232 level signals at connector X66.

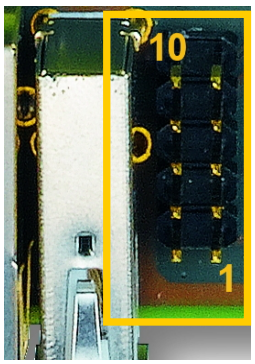


Figure 4: RS-232 Interface Connector (X66)

Pin	Signal	Pin	Signal
1	NC	2	NC
3	UART1_RXD_RS232	4	UART1_RTS_RS232
5	UART1_TXD_RS232	6	UART1_CTS_RS232
7	NC	8	NC
9	GND	10	NC

Table 8: Pin Assignment of RS-232 Interface Connector X66

An adapter cable is included in the phyBOARD-Wega AM335xR2 Kit to facilitate the use of the UART1 interface. The following figure shows the signal mapping of the adapter.

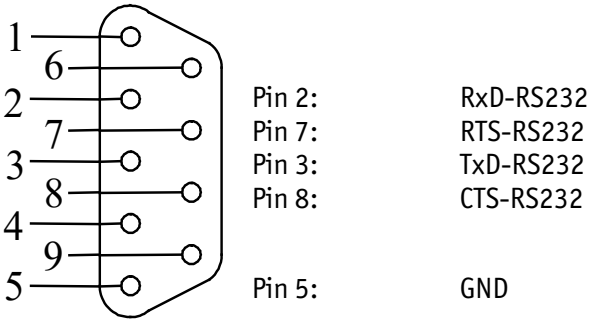


Figure 5: RS-232 Connector Signal Mapping

2.2.3 Ethernet Connectivity (X16 and X17)

The Ethernet interfaces of the phyBOARD-Wega AM335xR2 are accessible at two RJ45 connectors X16 (Ethernet 0) and X17 (Ethernet 1).

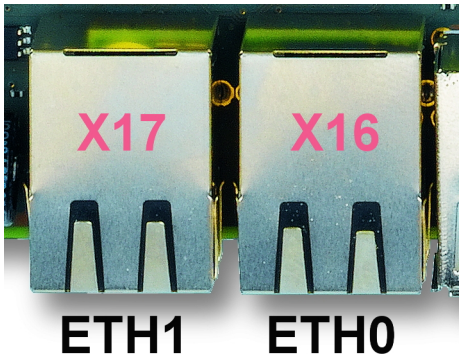


Figure 6: Ethernet Interfaces at Connectors X16 and X17

Ethernet 1 is directly brought out from the SOM's Ethernet interface ETH1, whereas Ethernet 2 is made available by an Ethernet PHY at U51 on the phyBOARD. The Ethernet PHY is connected to the SOM's MII interface ETH2.

Both Ethernet interfaces are configured as 10/100Base-T networks. The LEDs for LINK (green) and SPEED (yellow) indication are integrated into the connector. Both Ethernet transceivers support HP Auto-MDIX, eliminating the need for a direct connect LAN or cross-over path cable. They detect the TX and RX pins of the connected device and automatically configure the PHY TX and RX pins accordingly.

2.2.3.1 MAC Address

In a computer network, such as a local area network (LAN), the MAC (Media Access Control) address is a unique computer hardware number. For a connection to the Internet, a table is used to convert the assigned IP number to the hardware's MAC address.

In order to guarantee that the MAC address is unique, all addresses are managed in a central location. TI has acquired a pool of MAC addresses for their Sitara processor series. The MAC address of the phyCORE-AM335x is programmed via processor specific fuses from TI side and can be read out by software. The Barebox or the BSP reads out the unique MAC address and stores it in an appropriate variable as a 12-digit HEX value. The MAC address of the phyCORE-AM335x is also located on the barcode sticker attached to the module.

2.2.4 USB Connectivity (X15 and X42)

The phyBOARD-Wega AM335xR2 provides one USB host and one USB OTG interface.

USB0 is accessible at connector X42 (USB Micro-AB), located on the back side of the phyBOARD. It is configured as a USB OTG. USB OTG devices are capable of initiating a session, controlling the connection, and exchanging host and peripheral roles between each other. This interface is compliant with USB revision 2.0.

USB1 is accessible on the top of the phyBOARD at connector X15 (USB Standard-A) and is configured as a USB host.

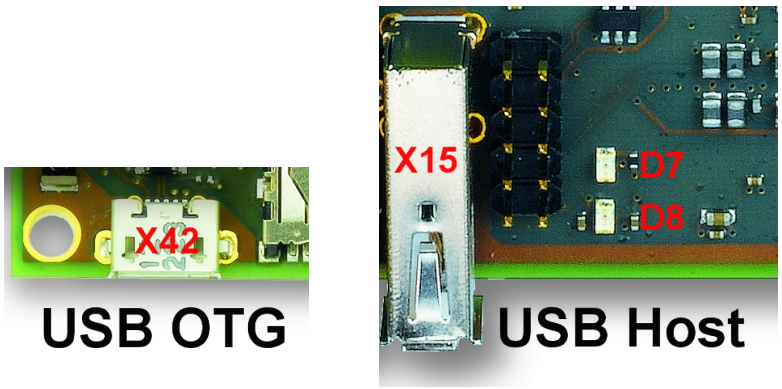


Figure 7: Components supporting the USB Interfaces

LED D8 displays the status of USB0_VBUS and LED D7 the status of USB1_VBUS.

Numerous jumpers allow configuring the USB interfaces according to your needs. Please refer to *section 3.2.1* for more information.

	The voltage level of the USB ID signal USB0_ID (X42) is 1.8 V. Steady state voltages above 2.1 V applied to this signal may damage the AM335x.

2.2.5 Audio Interface (X55 and X73)

The audio interface provides a method of exploring AM335x's audio capabilities. The phyBOARD-Wega AM335xR2 is populated with an audio codec at U35. The audio codec is connected to the AM335x's McASP0 interface to support stereo line input and stereo line output at connector X73. In addition to that, the phyBOARD-Wega AM335xR2 has one direct mono speaker output (1 W) at Molex connector X55.

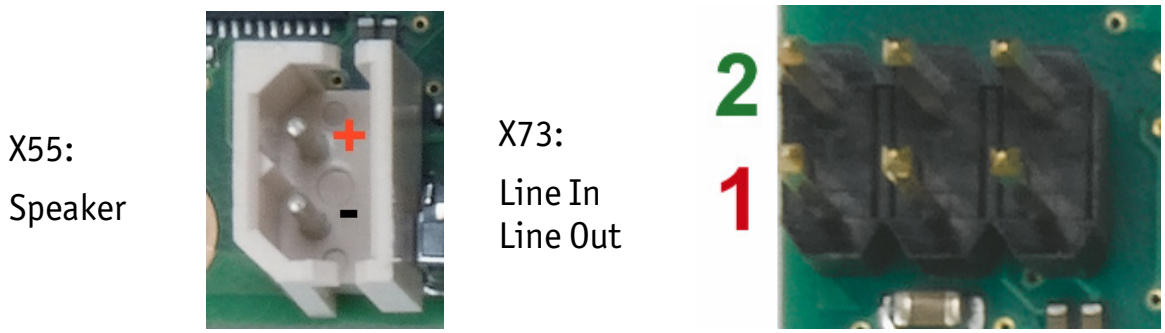


Figure 8: Audio Interfaces at Connectors (X55 and X73)

Pin	Signal	Pin	Signal
1	LINE_IN_L	2	LINE_IN_R
3	AGND	4	AGND
5	LINE_OUT_L	6	LINE_OUT_R

Table 9: Pin Assignment of Audio Connector X73

Pin	Signal	Description
1	SPOP	Class-D positive differential output
2	SPOM	Class-D negative differential output

Table 10: Pin Assignment of Audio Connector X55

The audio codec's registers can be accessed via the I2C0 interface at address 0x18 (7-bit MSB addressing)

For additional audio applications, the McASP0 interface of the AM335x including the signals X_MCASP0_AHCLKX, X_I2S_CLK, X_I2S_FRM, X_I2S_ADC, and X_I2S_DAC are routed to A/V connector X71 (please refer to *section 3.2.4* for additional information on the A/V connector).

Please refer to the audio codec's reference manual for additional information regarding the special interface specification.

2.2.6 CAN Connectivity (X65, JP3)

The Controller Area Network (CAN) bus offers a low-bandwidth, prioritized message Fieldbus for serial communication between microcontrollers. It efficiently supports distributed real-time control with a high level of security. The DCAN module of the AM335x implements the CAN protocol according to the CAN 2.0B protocol specification and supports bitrates up to 1 Mbit/s.

The second DCAN module (DCAN1) of the AM335x is accessible at connector X65 (2×5 pin header, 2.54 mm pitch).

Jumper JP3 can be installed to add a 120 Ohm termination resistor across the CAN data lines if needed.

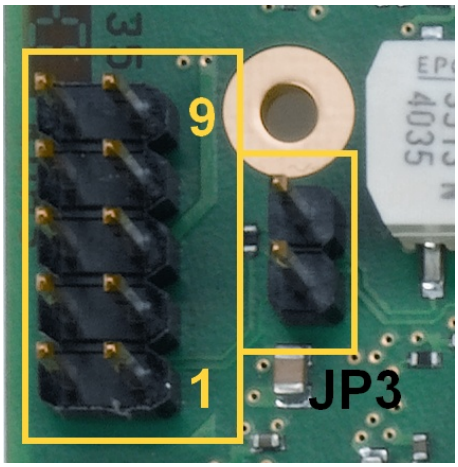


Figure 9: Components supporting the CAN Interface

Table 11 shows the signal mapping of the CAN1 signals at connector X65.

Pin	Signal	Pin	Signal
1	NC	2	GND
3	X_CANL	4	X_CANH
5	GND	6	NC
7	NC	8	NC
9	Shield	10	NC

Table 11: Pin Assignment of CAN Connector X65

An adapter cable is included in the phyBOARD-Wega AM335xR2 Kit to facilitate the use of the CAN interface. The following figure shows the signal mapping of the adapter.

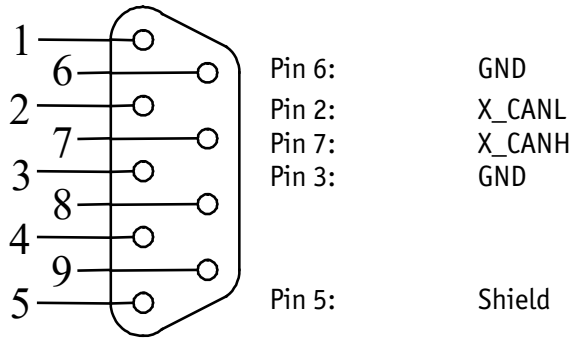


Figure 10: CAN Connector Signal Mapping

Depending on the muxing options the TTL level signals of the first DCAN module (DCAN0) are also available on expansion connector X69 (*section 3.2.5.2*).

2.2.7 Secure Digital Memory Card/ MultiMedia Card (X11)

Figure 11: MMC/SD Card Interface at Connector (X11)

The phyBOARD-Wega AM335xR2 provides a standard microSDHC card slot at X11 for connection to MMC/SD interface cards. It allows for an easy and convenient connection to peripheral devices such as SD and MMC cards. Power to the SD 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 the card.

DIP switch S4 allows the phyBOARD to toggle between NAND and SD card boot. In order to boot from SD card, S4 must be switched ON (*section 2.2.8*).

2.2.8 Boot Mode (S4)

The phyBOARD-Wega AM335xR2 has two defined boot sequences which can be selected with DIP switch S4.

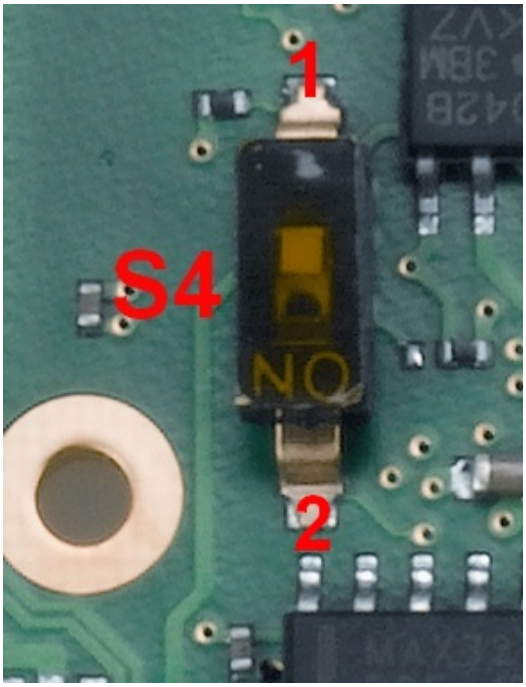


Figure 12: Boot Switch (S4)

Boot Mode	Description
Boot mode 1 (S4 = OFF)	SYSBOOT[4:0] = 10011b → NAND, NANDI2C, MMC0, UART0
Boot mode 2 (S4 = ON)	SYSBOOT[4:0] = 10111b → MMC0, SPI0, UART0, USB

Table 12: Boot Switch Configuration (S4)

2.2.9 System Reset Button (S2)

The phyBOARD-Wega AM335xR2 is equipped with a system reset button at S2. Pressing this button will toggle the X_nRESET_IN pin (X64A11) of the phyCORE SOM low, causing the module to reset. Additionally, the reset signal nRESET_OUT (X64B13) is generated on the module to also reset the peripherals on the carrier board.

Figure 13: System Reset Button S2

2.2.10 Audio/Video Connectors (X70 and X71)

The Audio/Video (A/V) connectors X70 and X71 provide an easy way to add typical A/V functions and features to the phyBOARD-Wega AM335xR2. Standard interfaces such as a parallel display, I^2S, and I^2C as well as different supply voltages are available at the two A/V female dual entry connectors. A special feature of these connectors is their connectivity from the top or bottom of the PCB.

For further information on the A/V connectors, see *section 3.2.4*. Information on the expansion boards available for the A/V connectors can be found in the Application Guide for phyBOARD Expansion Boards (L-793e).

2.2.11 Expansion Connector (X69)

Expansion connector X69 provides an easy way to add other functions and features to the phyBOARD-Wega AM335xR2. Standard interfaces such as JTAG, UART, MMC2, SPI, and I^2C as well as different supply voltages and some GPIOs and analog inputs are available at the expansion female connector.

For further information on the expansion connector and the pinout see *chapter 3.2.5*. Information on the expansion boards available for the expansion connector can be found in the Application Guide for phyBOARD Expansion Boards (L-793e).

3 System Level Customizing

3.1 About this Section

This section addresses advanced developers who want to design custom expansion boards or display adapters. It includes detailed information on the different interfaces and features of the phyBOARD-Wega AM335xR2 at a system level.

3.2 System Level Hardware Information

3.2.1 Soldering Jumpers

Numerous jumpers and 0 Ohm resistors allow a developer to configure the phyBOARD according to specific needs.

Due to the small footprint of the jumpers, PHYTEC does not recommend manual jumper modifications. This may render the warranty invalid. Please contact the PHYTEC sales team if you need one of the configurations described below.

The following table lists all jumpers and resistors and describes their function.

Jumper/ Resistor	Description	Section
R402	Connects the enabled input of the CAN transceiver at U15 to signal X_UART3_TX_GPIO2_19 which allows the software (via GPIO2_19) to turn off the CAN interface	*3.2.5.2*
R419	Configures the OTG operating mode of the USB OTG interface with the USB0_ID signal	*3.2.3.2*
J72, J73	Reroutes the USB1 interface to expansion connector X69	*3.2.3.3*
J74, J75	Reroutes the USB0 interface to expansion connector X69	
J79	Reroutes the ID signal of USB interface USB0 or USB1 to expansion connector X69	
J80	Reroutes the VBUS signal of USB interface USB0 or USB1 to expansion connector X69	
J77	Chooses the signal at pin 6 of A/V connector X71	*3.2.4*
J78	Combines the overcurrent signals of the USB interfaces	*3.2.3.1*

Table 13: Soldering Jumpers on the phyBOARD-Wega AM335xR2

3.2.2 I²C Connectivity

The I²C interface of the AM335x is available at different connectors on the phyBOARD-Wega AM335xR2. The following table provides a list of the connectors and pins with I²C connectivity.

Connector	Location
Expansion connector X69	pin 11 (X_I2C0_SDA); pin 13 (X_I2C0_SCL)
A/V connector X71	pin 16 (X_I2C0_SDA); pin 15 (X_I2C0_SCL)

Table 14: I²C Connectivity

To avoid any conflicts when connecting external I²C devices to the phyBOARD-Wega AM335xR2, the addresses of the onboard I²C devices must be considered. *Table 15* lists the addresses already in use. The table shows only the default address.

Board	Prod. No.	Device	Address used (7 MSB)
phyCORE-AM335x	PCL-060	EEPROM	memory address: 0x52 ID page address: 0x5A
		RTC	0x68
		PMIC	0x2D, 0x12
		Temperature Sensor	0x4B
phyBOARD-Wega AM335xR2	PBA-CD-02	Audio	0x18
AV-Adapter HDMI	PEB-AV-01	HDMI Core	0x70
		CEC Core	0x34
AV-Adapter Display	PEB-AV-02	GPIO Expander	0x41
		Capacitive Touch	0x38
Evaluation Board	PEB-EVAL-01	EEPROM	0x56[3]
M2M Board	PEB-C-01	GPIO Expander	0x20
		GPIO Expander	0x21
		GPIO Expander	0x22

Table 15: I²C Addresses in Use

3: This address can be configured. See the Application Guide for phyBOARD Expansion Boards (L-793e) for more information.

3.2.3 USB Connectivity (X15 and X42)

Numerous jumpers enable configuring the USB interfaces according to your needs.

3.2.3.1 Combining the Overcurrent Signals (J78 and J77)

To save one GPIO of the controller for other purposes, jumper J78 enables connecting the overcurrent signals of both USB interfaces USB0 and USB1 to one single GPIO (GPIO3_18). If the two overcurrent signals need to be evaluated separately, the OC signal of USB0 can be connected to GPIO3_19 and the OC signal of USB1 to GPIO3_18.

Table 16 shows the available configurations.

J78	Description
1+2	Separate OC signals for USB1 (nUSB1_OC_GPIO3_18) and USB0 (nUSB0_OC_GPIO3_19)
2+3	**One OC signal (nUSB1_OC_GPIO3_18) for both USB interfaces**

Table 16: USB OC Signal Configuration

If J78 is set to 1+2, J77 also has to be set to 1+2.

3.2.3.2 Configuring the OTG Operating Mode (R419)

Resistor R419 configures the OTG operating mode with the USB0_ID signal. By default, this resistor is not mounted which leaves the ID pin floating. This configures the interface as USB OTG. Mounting a 10 kΩ resistor connects the USB0_ID pin to GND and configures the OTG interface as USB host.

Typically, the configuration of a connecting device as host or slave is done automatically via the USB cable. However, given the limited number of OTG enabled devices in the embedded market, this resistor is provided to either simulate an OTG cable or force the OTG interface into host mode when OTG operation is not required.

3.2.3.3 Rerouting the USB Interfaces to different Connectors (J72 – J75, J79, and J80)

For later expansion boards, one of the two USB interfaces can be routed to the expansion connector X69 (USBx_DP pin 21, USBx_DM pin 22, USBx_ID pin 53 and USBx_VBUS pin 54). *Table 17* shows all possible configurations.

Mode	J72	J73	J74	J75	J79	J80
USB1 at USB-A connector X15 and USB0 at USB-OTG connector X42	1+2	1+2	1+2	1+2	nm	nm
USB1, USB1_VBUS and X_USB1_ID at expansion connector X69[4, 5] USB0 at USB-OTG connector X42	2+3	2+3	1+2	1+2	1+2[6]	1+2
USB0, USB0_VBUS, and USB0_ID at expansion connector X69[4, 5] USB1 at USB-A connector X15	1+2	1+2	2+3	2+3	2+3	2+3

Table 17: USB Routing Configuration

4: **Caution!** The voltage level of the USB ID signal X_USB_ID_EXP, is 1.8 V. Steady state voltages above 2.1 V applied to this signal may damage the AM335x.
5: **Caution!** There is no protective circuit for the USB interfaces brought out at the expansion connector.
6: The ID pin of USB1 is hardwired. To use the function at the expansion connector, R399 must be removed, too.

3.2.4 Audio/Video Connectors (X70 and X71)

The Audio/Video (A/V) connectors X70 and X71 provide an easy way to add typical A/V functions and features to the phyBOARD-Wega AM335xR2. Standard interfaces such as a parallel display, I^2S, and I^2C as well as different supply voltages are available at the two A/V female dual entry connectors. A special feature of these connectors is their connectivity from the bottom or the top. The pinout of the A/V connectors is shown in *Table 18* and *Table 19.*

The A/V connector is intended for use with phyBOARD Expansion Boards[7] and to add specific audio/video connectivity with custom expansion boards.

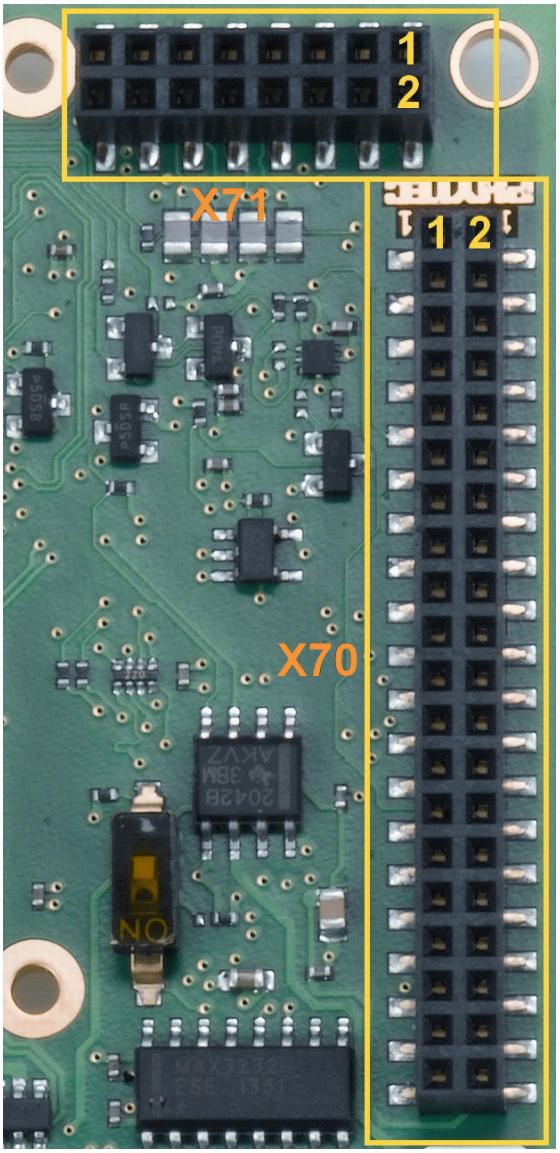


Figure 14: Audio/Video Connectors (X70 and X71)

A/V connector X70 makes all signals for display connectivity available while X71 provides signals for audio and touchscreen connectivity as well as an I^2C bus and additional control signals.

7: Please find additional information on phyBOARD Expansion Boards in the corresponding application guide (L-793e).

Pin #	Signal Name	Type	SL	Description
1	GND	-	-	Ground
2	X_LCD_D21	OUT	3.3 V	LCD data D21
3	X_LCD_D18	OUT	3.3 V	LCD data D18
4	X_LCD_D16	OUT	3.3 V	LCD data D16
5	X_LCD_D0	OUT	3.3 V	LCD data D0
6	GND	-	-	Ground
7	X_LCD_D1	OUT	3.3 V	LCD data D1
8	X_LCD_D2	OUT	3.3 V	LCD data D2
9	X_LCD_D3	OUT	3.3 V	LCD data D3
10	X_LCD_D4	OUT	3.3 V	LCD data D4
11	GND	-	-	Ground
12	X_LCD_D22	OUT	3.3 V	LCD data D22
13	X_LCD_D19	OUT	3.3 V	LCD data D19
14	X_LCD_D5	OUT	3.3 V	LCD data D5
15	X_LCD_D6	OUT	3.3 V	LCD data D6
16	GND	-	-	Ground
17	X_LCD_D7	OUT	3.3 V	LCD data D7
18	X_LCD_D8	OUT	3.3 V	LCD data D8
19	X_LCD_D9	OUT	3.3 V	LCD data D9
20	X_LCD_D10	OUT	3.3 V	LCD data D10
21	GND	-	-	Ground
22	X_LCD_D23	OUT	3.3 V	LCD data D23
23	X_LCD_D20	OUT	3.3 V	LCD data D20
24	X_LCD_D17	OUT	3.3 V	LCD data D17
25	X_LCD_D11	OUT	3.3 V	LCD data D11
26	GND	-	-	Ground
27	X_LCD_D12	OUT	3.3 V	LCD data D12
28	X_LCD_D13	OUT	3.3 V	LCD data D13
29	X_LCD_D14	OUT	3.3 V	LCD data D14
30	X_LCD_D15	OUT	3.3 V	LCD data D15
31	GND	-	-	Ground
32	X_LCD_PCLK	OUT	3.3 V	LCD pixel clock
33	X_LCD_BIAS_EN	OUT	3.3 V	LCD AC bias enable
34	X_LCD_HSYNC	OUT	3.3 V	LCD horizontal synchronization
35	X_LCD_VSYNC	OUT	3.3 V	LCD vertical synchronization

Table 18: Pin Assignment of PHYTEC A/V Connector X70

Pin #	Signal Name	Type	SL	Description
36	GND	-	-	Ground
37	GND	-	-	Ground
38	X_PWM1_OUT	OUT	3.3 V	Pulse width modulation
39	VCC_BL	OUT	NS[8]	Backlight power supply
40	VCC5V	OUT	5.0 V	5 V power supply

Table 18: Pin Assignment of PHYTEC A/V Connector X70 (continued)

Please consider that the LCD data signals X_LCD_D[15:0] shown in *Table 18* are boot configuration pins which must not be driven by any device on the baseboard during reset to avoid accidental change of the boot configuration. Please refer to *section 5 "System Configuration and Booting"* in the phyCORE-AM335x hardware manual or to the AM335x Reference Manual for more information about the boot configuration.

Pin #	Signal Name	Type	SL	Description
1	X_I2S_CLK	OUT	3.3 V	I²S bit clock
2	X_I2S_FRM	OUT	3.3 V	I²S frame synchronization
3	X_I2S_ADC	IN	3.3 V	I²S receive data (microphone)
4	X_I2S_DAC	OUT	3.3 V	I²S transmit data (speaker)
5	X_AV_INT_GPIO1_30	IN	3.3 V	A/V interrupt; GPIO1_30
6	nUSB0_OC_GPIO3_19 or X_MCASP0_AHCLKX_GPIO3_21	I/O	3.3 V	GPIO3_19 or I²S master clock (see below)
7	GND	-	-	Ground
8	nRESET_OUT	OUT	3.3 V	Reset
9	TS_X+	IN	1.8 V	Touch X+
10	TS_X-	IN	1.8 V	Touch X-
11	TS_Y+	IN	1.8 V	Touch Y+
12	TS_Y-	IN	1.8 V	Touch Y-
13	VCC3V3	OUT	3.3 V	3.3 V power supply
14	GND	-	-	Ground
15	X_I2C0_SCL	I/O	3.3 V	I²C clock
16	X_I2C0_SDA	I/O	3.3 V	I²C data

Table 19: Pin Assignment of PHYTEC A/V Connector X71

8: VCC_BL connects directly to pin 4 of power connector X67. Because of this, the voltage level depends on the connected power module and the voltage attached and is not specified here.

Jumper J77 connects either signal X_MCASP0_AHCLKX_GPIO3_21 or signal nUSB1_OC_GPIO3_19 to pin 6 of X71. *Table 20* shows the available configurations.

J77	Description
1+2	GPIO3_21 and I²S master clock, respectively (depending on the pin muxing) connected to pin 6 of X71.
2+3	**GPIO3_19 connected to pin 6 of X71.**

Table 20: A/V Jumper Configuration J77

If J77 is set to 2+3. J78 also has to be set to 2+3 to have GPIO3_19 available. If J78 is set to 1+2, the OC signal of USB1 will be present at pin 6 of X71.

3.2.4.1 Parallel LCD Interface

A/V connectors X70 and X71 provide a parallel LCD display interface with up to 24 bit and control signals. The locations of the signals are shown in *Table 18* and *Table 19*.

If the LCD interface of the phyCORE-AM335x is intended to be used with custom hardware connected to A/V connectors X70 and X71, PHYTEC strongly recommends including 50 Ohm series resistors on each of the LCD interface signals to limit overshoot.

3.2.4.2 Brightness

The PWM signal at pin 38 enables changing the brightness of the display attached to the A/V connector.

3.2.4.3 Touch Screen Connectivity

As many smaller applications need a touch screen as a user interface, provisions are made to connect 4- wire resistive touch screens to A/V connectors X71 (pins 9 - 12, *Table 19*). The signals from the touchscreen panel are routed directly to the analog inputs X_AIN0 to X_AIN3 of the phyCORE-AM335x and are processed by a touch panel controller which is integrated into the AM335x.

3.2.4.4 I²C Connectivity

Please refer to *section 3.2.2* for complete information on the I²C connectivity.

3.2.4.5 Audio I²S

A/V connector X71 provides the signals of the SOM's I²S and I²C interface to enable implementing audio connectivity with an external audio codec.

The I²S interface consists of the bit clock, the frame synchronization, and the receive/transmit data signals (*Table 19*). The I²S master clock can optionally be added to this interface by closing jumper J77 at 1+2.

3.2.4.6 User programmable GPIOs

Two pins of the A/V connector X71 are dedicated as GPIO (*Table 19*). These signals are also available/used on the corresponding expansion-boards, e.g. PEB-AV-02. For more information, please look at the Expansion Boards Application Guide (L-793e).

The BSP delivered with the phyBOARD-Wega AM335xR2 supports the GPIOs according to the configuration done in correspondence to the expansion board installed on delivery. The GPIOs might not be available if they are needed to support the functions of the expansion board. In order to apply the GPIOs for other purposes after removal of the expansion board, the BSP must be replaced too.

From BSP version AM335x-PD14.1-rc1 on, it is possible to configure the BSP in regard to the hardware configuration. This allows the BSP to be easily adapted if an expansion board is attached, removed, or exchanged. The GPIOs can then be released for other purposes.

With the appropriate BSP configuration, the GPIOs (GPIO1_30, GPIO3_19, or GPIO3_21) are available as input by default.

Table 21 lists all GPIOs, their location, their number, and their default usage.

Pin #	GPIO Name	Default Usage	Comment
5	GPIO1_30	IN	A/V interrupt
6	**GPIO3_19** or GPIO3_21	IN	selectable with jumper J77 (*Table 20*)

Table 21: GPIOs available at A/V Connector X71

3.2.5 Expansion Connector (X69)

Figure 15: Expansion Connector (X69)

Expansion connector X69 provides an easy way to add other functions and features to the phyBOARD-Wega AM335xR2. Standard interfaces such as UART, SPI, and I²C as well as different supply voltages and some GPIOs are available at the female expansion connector.

The expansion connector is intended for use with phyBOARD Expansion Boards[9] and to add specific functions with custom expansion boards.

The pinout of the expansion connector is shown in *Table 22*.

Pin #	Signal Name	Type	SL	Description
1	VCC3V3	OUT	3.3 V	3.3 V power supply
2	VCC5V	OUT	5.0 V	5 V power supply
3	VDIG1_1P8V	OUT	1.8 V	1.8 V power supply (max. 300 mA)
4	GND	-	-	Ground
5	X_SPI0_CS0	OUT	3.3 V	SPI 0 chip select 0[10]
6	X_SPI0_MOSI	OUT	3.3 V	SPI0 master output/slave input (MOSI)[11]
7	X_SPI0_MISO	IN	3.3 V	SPI0 master input/slave output (MISO) [11]
8	X_SPI0_CLK	OUT	3.3 V	SPI 0 clock output
9	GND	-	-	Ground
10	X_UART0_RXD	IN	3.3 V	UART 0 receive data (standard debug interface)
11	X_I2C0_SDA	I/O	3.3 V	I2C0 Data
12	X_UART0_TXD	OUT	3.3 V	UART 0 transmit data (standard debug interface)
13	X_I2C0_SCL	I/O	3.3 V	I2C0 Clock
14	GND	-	-	Ground
15	X_JTAG_TMS	IN	3.3 V	JTAG Chain Test Mode Select signal
16	X_nJTAG_TRST	IN	3.3 V	JTAG Chain Test Reset
17	X_JTAG_TDI	IN	3.3 V	JTAG Chain Test Data Input

Table 22: Pin Assignment of PHYTEC Expansion Connector X69

9: Please find additional information on phyBOARD Expansion Boards in the corresponding application guide (L-793e).
10: The signal is only available if the NOR_Flash on the Modul (PCL-051) is not mounted.
11: Both pins can be configured as either input or output (MOSI or MISO). The description refers to the standard configuration of the BSP delivered with the module.

Pin #	Signal Name	Type	SL	Description
18	X_JTAG_TDO	OUT	3.3 V	JTAG Chain Test Data Output
19	GND	-	-	Ground
20	X_JTAG_TCK	IN	3.3 V	JTAG Chain Test Clock signal
21	X_USB_DP_EXP	I/O	3.3 V	USB data plus (for USB0 or USB1)[14, 15]
22	X_USB_DM_EXP	I/O	3.3 V	USB data minus (for USB0 or USB1) [14, 15]
23	nRESET_OUT	OUT	3.3 V	Reset
24	GND	-	-	Ground
25	X_MMC2_CMD	I/O	3.3 V	MMC command
26	X_MMC2_DAT0	I/O	3.3 V	MMC data 0
27	X_MMC2_CLK	I/O	3.3 V	MMC clock
28	X_MMC2_DAT1	I/O	3.3 V	MMC data 1
29	GND	-	-	Ground
30	X_MMC2_DAT2	I/O	3.3 V	MMC data 2
31	X_UART2_RX_GPIO3_9	I/O	3.3 V	UART 2 receive data; GPIO3_9[12]
32	X_MMC2_DAT3	I/O	3.3 V	MMC data 3
33	X_UART2_TX_GPIO3_10	I/O	3.3 V	UART 2 transmit data; GPIO3_10[12]
34	GND	-	-	Ground
35	X_UART3_RX_GPIO2_18	I/O	3.3 V	UART 3 receive data; GPIO2_18[12]
36	X_UART3_TX_GPIO2_19	I/O	3.3 V	UART 3 transmit data; GPIO2_19[12]
37	X_INTR1_GPIO0_20	I/O	3.3 V	Interrupt 1; GPIO0_20
38	X_GPIO0_7	I/O	3.3 V	GPIO0_7
39	X_AM335_EXT_WAKEUP	IN	3.3 V	External wakeup
40	X_INT_RTCn	OUT	3.3 V	Interrupt from the RTC
41	GND	-	-	Ground
42	X_GPIO3_7_nPMOD_PWRFAIL	I/O	3.3 V	GPIO3_7; **Caution!** Also connected to power fail signal through R415.
43	nRESET_IN	IN	3.3 V	Push-button reset
44	X_GPIO1_31	I/O	3.3 V	GPIO1_31
45	X_AM335_NMIn	IN	3.3 V	AM335x non-maskable interrupt
46	GND	-	-	Ground

Table 22: Pin Assignment of PHYTEC Expansion Connector X69 (continued)

12: These pins are configured as GPIO pins. To use them as UART interface the pin muxing must be changed and additional software development is required.

Pin #	Signal Name	Type	SL	Description
47	X_AIN4	IN	1.8 V	Analog input 4
48	X_AIN5	IN	1.8 V	Analog input 5
49	X_AIN6	IN	1.8 V	Analog input 6
50	X_AIN7	IN	1.8 V	Analog input 7
51	GND	-	-	Ground
52	X_GPIO_CKSYNC	I/O	3.3 V	GPIO Clock Synchronization
53	X_USB_ID_EXP	IN	1.8 V	USB port identification (for USB0 or USB1) [13, 14]
54	USB_VBUS_EXP	OUT	5.0 V	USB bus voltage (for USB0 or USB1) [14,15]
55	X_USB1_CE	OUT	3.3 V	USB 1 charger enable
56	GND	-	-	Ground
57	VCC_BL	OUT	NS[16]	Backlight power supply
58	X_PB_POWER	IN	5.0 V	Power On for Power Management IC for AM335x
59	GND	-	-	Ground

Table 22: Pin Assignment of PHYTEC Expansion Connector X69 (continued)

13: **Caution!** The voltage level of the USB ID signals X_USB_ID_EXP is 1.8 V. Steady state voltages above 2.1 V applied to this signal may damage the AM335x. Any pull-up at the USB_ID signal should connect to 1.8 V.
14: Jumpers J72 – J75, J79 and J80 allow to configure the USB interface at the expansion connector (*Table 17*).
15: **Caution!** There is no protective circuit for the USB interface brought out at the expansion connector X69.
16: VCC_BL connects directly to pin 4 of power connector X67. Because of that the voltage level depends on the connected power module and the voltage attached, and is thus not specified here.

	If the SPI-NOR Flash on the phyCORE-AM335x is populated, the SPI signals on the expansion port cannot be used.

3.2.5.1 USB Connectivity

Depending on the configuration of jumpers J72 – JJ75, J79, and J80 either USB0 or USB1 can be connected to the expansion connector X69 (*section 3.2.3.2*). Both USB interfaces can be used as USB host as well as USB OTG interface.

	There is no protective circuit for the USB interface brought out at the expansion connector X69.
	The voltage level of the USB ID signal X_USB_ID_EXP, is 1.8 V. Steady state voltages above 2.1 V applied to this signal may damage the AM335x.

3.2.5.2 CAN Connectivity

Depending on the muxing options the TTL level signals of the first DCAN module (DCAN0) are also available on expansion connector X69. CAN0 (TX and RX) can be used instead of UART0 (RX and TX) or MMC2 (DAT1 and DAT2)[17].

	Please note, that UART0 is the standard console and used together with the Evaluation Board (PEB_EVAL_01). Thus, the muxing must not be changed to CAN as long as the Evaluation Board plugs onto the expansion connector and terminal output, or debugging is required!

R402 connects the enable input of the CAN transceiver at U15 to signal X_UART3_TX_GPIO2_19 which allows turning off the CAN interface by software via GPIO2_19.

3.2.5.3 I²C Connectivity

Please refer to *section 3.2.2* for complete information on I²C connectivity.

3.2.5.4 User programmable GPIOs

Eight pins of the expansion connector are dedicated as GPIO (*Table 22*). These signals are also available on the corresponding expansion boards, e.g. PEB-EVAL-01. For more information, please look at the Expansion Boards Application Guide (L-793e).

17: The presence of this signal depends on the configuration of the SOM mounted on the phyBOARD. These signals are available only if an Ethernet PHY is populated on the SOM at U6.

The BSP delivered with the phyBOARD-Wega AM335xR2 supports the GPIOs according to the configuration done in correspondence to the expansion board installed on delivery. Therefore, the GPIOs might not be available if they are needed to support functions of the expansion board. In order to apply the GPIOs for other purposes after removal of the expansion board, the BSP must be exchanged, too.

From BSP version AM335x-PD14.1-rc1 on it is possible to configure the BSP in regard to the hardware configuration. This allows to easily adapt the BSP if an expansion board is attached, removed, or exchanged, thus allowing to release the GPIOs for other purposes.

With the appropriate BSP / BSP configuration the GPIOs (GPIO0_20, GPIO0_7, GPIO1_31, GPIO3_7, and GPIO3_10) are available as input by default.

Table 23 lists all GPIOs, their location and default usage as configured in the standard BSP delivered with the phyBOARD-Wega AM335xR2.

Pin #	GPIO Name	Default Usage	Used on
31	GPIO3_9	LED3 out	Expansion Board PEB-EVAL-01
33	GPIO3_10	IN	
35	GPIO2_18	LED1 out	
36	GPIO2_19	LED2 out	
37	GPIO0_20	IN	
38	GPIO0_7	IN	
42	GPIO3_7	IN	phyBOARD-Wega AM335xR2 PBA-CD-02
44	GPIO1_31	IN	

Table 23: GPIOs available at Expansion Connector X69

4 Revision History

Date	Version #	Changes in this manual
30.09.2017	First Edition L-845e_1	First edition created from the former hardware manual (L-836e_1). It describes the phyBOARD-Wega AM335x R2 Carrier Board with the phyCORE-AM335xSOM (PCL-060).
05.11.2018	Second Edition L-845e.A2	New versioning used. Updated phyBOARD-Wega AM335xR2 naming. Updated CB and SOM PBC numbering

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Document number: L-845e.A2, November 2018

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Did you find any mistakes in this manual? **page**

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