

phyBOARD[®]-Wega Expansion Boards

Application Guide

Document No.: **L-793e_0**

Product: **Power Module (PEB-POW-01)**

PCB. No.: **1410.0**

Product: **Evaluation Board (PEB-EVAL-01)**

PCB. No.: **1413.0**

Product: **HDMI Adapter (PEB-AV-01)**

PCB. No.: **1406.0**

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Conventions, Abbreviations and Acronyms

This application guide describes the first three expansion boards for the PB-00802-xxx Single Board Computer (SBC) in the following referred to as phyBOARD-Wega-AM335x. The manual specifies the expansion board's design and function. Precise specifications for the used ICs can be found in the manufacturers' Data Sheet/User's 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 high-level signal.
- The hex-numbers given for addresses of I²C 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.

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) preinstalled on the module and Development Tools).
CB	Carrier Board; used in reference to the phyBOARD-Wega 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
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 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-AM335x module
SMT	Surface mount technology.
SOM	System on Module; used in reference to the PCL-051 /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

Preface

As a member of PHYTEC's new phyBOARD[®] product family the phyBOARD-Wega-AM335x is one of a series of PHYTEC System on Modules (SBCs) that 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 phyBOARD[®] OEM modules, which can be embedded directly into the user's peripheral hardware design.

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.

PHYTEC's new phyBOARD[®] product family consists of a series of extremely compact embedded control engines featuring various processing performance classes.

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. 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 you will be able to bring your new ideas to market in the most timely and cost-efficient manner.

For more information go to:

<http://www.phytec.de/de/leistungen/entwicklungsunterstuetzung.html>

or

www.phytec.eu/europe/oem-integration/evaluation-start-up.html

In order to receive product specific information on changes and updates in the best way also in the future, we recommend to register 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 support section of our web site which provides product specific information, such as errata sheets, application notes, FAQs, etc.

<http://www.phytec.de/de/support/faq/faq-phyBOARD-Wega-AM335x.html> or
<http://www.phytec.eu/europe/support/faq/faq-phyBOARD-Wega-AM335x.html>

**Declaration of Electro Magnetic Conformity of the PHYTEC
phyBOARD-Wega-AM335x Expansion Boards**



PHYTEC Expansion Boards for phyBOARD-Wega-AM335x (henceforth products) are designed for installation in electrical appliances 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, 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 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).

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.

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

When buying 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 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 obsolescence of a certain part, are being 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 demand for it.**

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

Avoiding strategies

- Avoid changes by evaluating long-livety of parts during design in 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 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 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

The PHYTEC Expansion Boards PEB-AV-01, PEB-EVAL-01 and PEB-POW-01 are the first three add-on modules for PHYTEC's phyBOARD-Wega Single Board Computer. These add-on modules allow easy development of complex applications with off-the-shelf components.

PHYTEC Expansion Boards PEB-xxx-xxx are designed to be plugged into connectors X67 (power connector), X69 (expansion connector), or X70 & X71 (A/V connector) on the phyBOARD-Wega PB-00802-xxx.

All add-on modules are supported within the BSPs¹ available for the phyBOARD SBC.

Precise specifications for the components populating the board can be found in the applicable *User's Manuals* or *Data Sheets*.

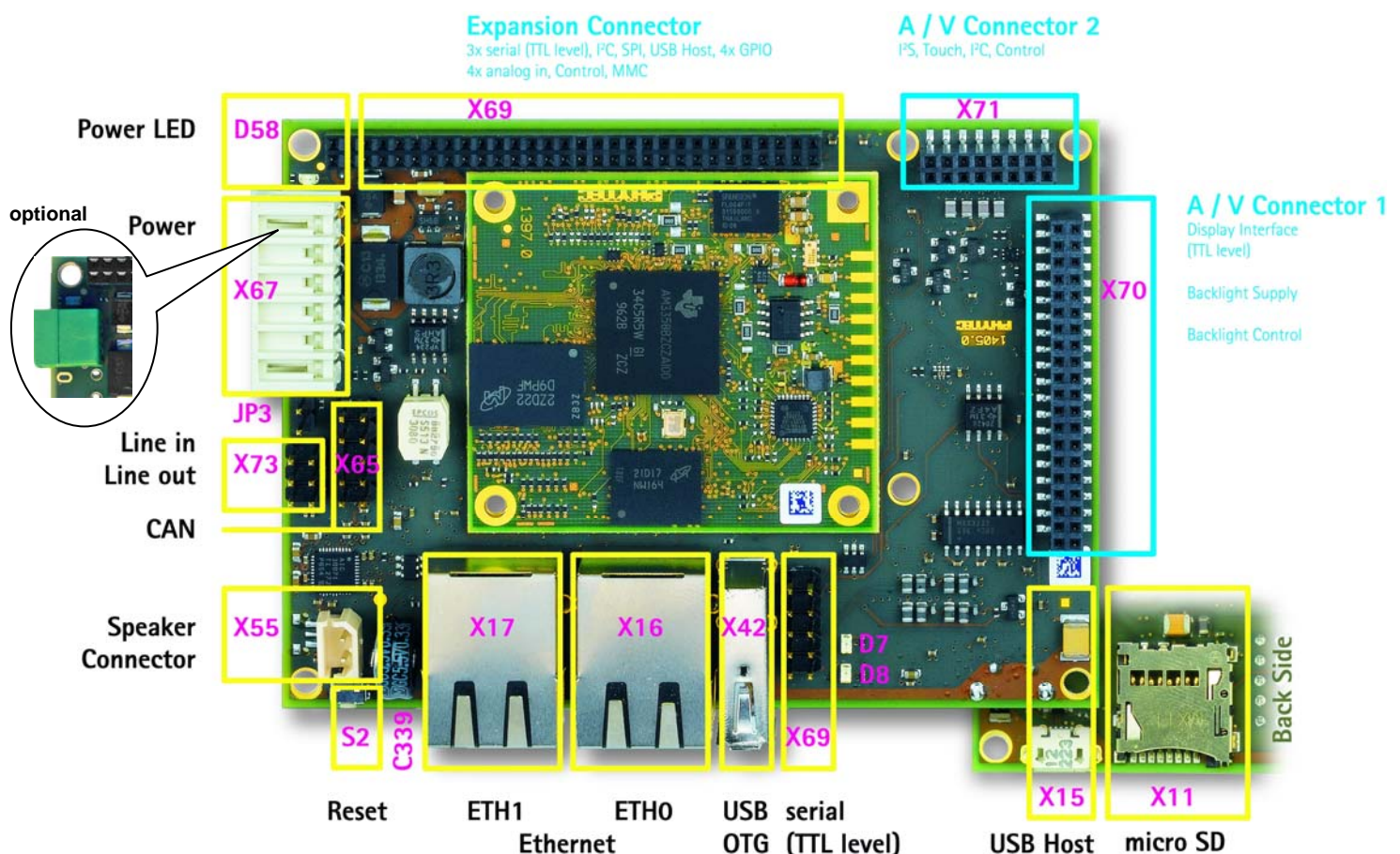


Figure 1: View of the phyBOARD-Wega with A/V- and Expansion Connector

¹: To ensure that the PEB of your choice is supported by the BSP use only the latest BSP, or check on the PHYTEC website from which version on the driver is implemented.

2 Power Module (PEB-POW-01)

The Power Module offers the following features:

- Subminiature Expansion Board (72 x 45 mm) achieved through modern SMD technology
- 12 V - 24 V input voltage
- 5 V and 3.3 V output voltage
- Power good signal (connected to nRESET_IN on the phyBOARD-Wega)

Please note that all module connections are not to exceed their expressed maximum voltage or current. Maximum signal input values are indicated in the corresponding controller manuals/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 Block Diagram

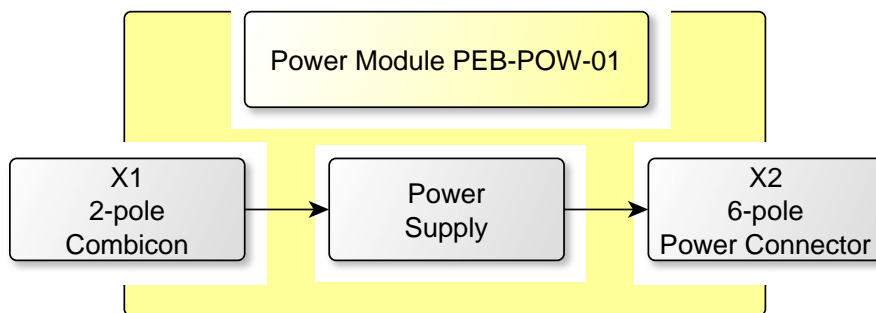


Figure 2: Block Diagram Power Module (PEB-POW-01)

2.2 View of the PEB-A-002

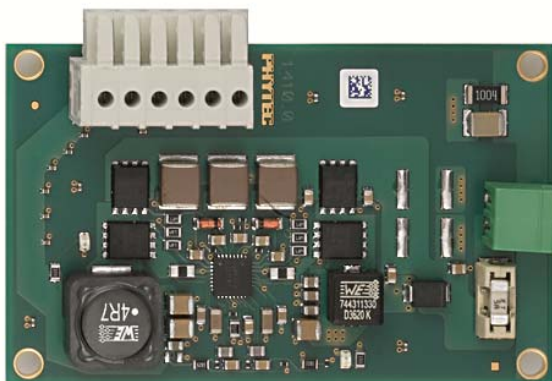


Figure 3: View of the Power Module (PEB-POW-01)

2.3 Pin Description:

2.3.1 Pinout of the Power Input X1:

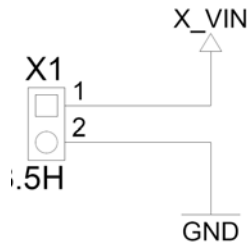


Figure 4: Pinout of the Power Input Connector X1

Pin	Signal	Description
1	X_VIN	12 V - 24 V input voltage
2	GND	Ground

Table 2: Pin description of the Power Input Connector X1

2.3.2 Pinout of the Power Output X2:

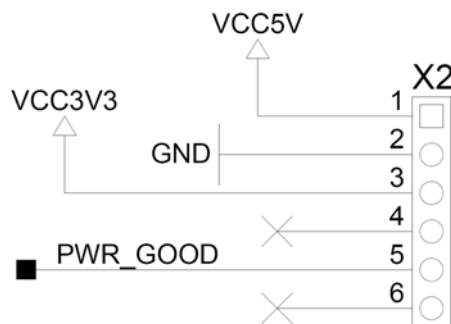


Figure 5: Pinout of the Power Output Connector X2

Pin	Signal	Description
1	VCC5V	+5 V power supply
2	GND	Ground
3	VCC3V3	+3.3 V power supply
4	N.C.	Not Connected
5	PWR_GOOD	Power good signal (connected to nRESET_IN on the phyBOARD Wega)
6	N.C.	Not Connected

Table 3: Pin description of the Power Output Connector X2

2.4 Status LEDs (D13 and D14)

The Power Module provides two green status LEDs (D13 and D14) on board.

D13 illustrates the availability of the VCC5V generation and D14 indicates the presence of VCC3V3.

3 Evaluation Board (PEB-EVAL-01)

The Evaluation Board offers the following features:

- Subminiature Expansion Board (72 mm x 72 mm) achieved through modern SMD technology
- Three User LEDs and three switches¹
- JTAG interface for AM335x
- RS232 interface (UART 0)
- Second expansion socket to connect another expansion board

Please note that all module connections are not to exceed their expressed maximum voltage or current. Maximum signal input values are indicated in the corresponding controller manuals/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.

3.1 Block Diagram

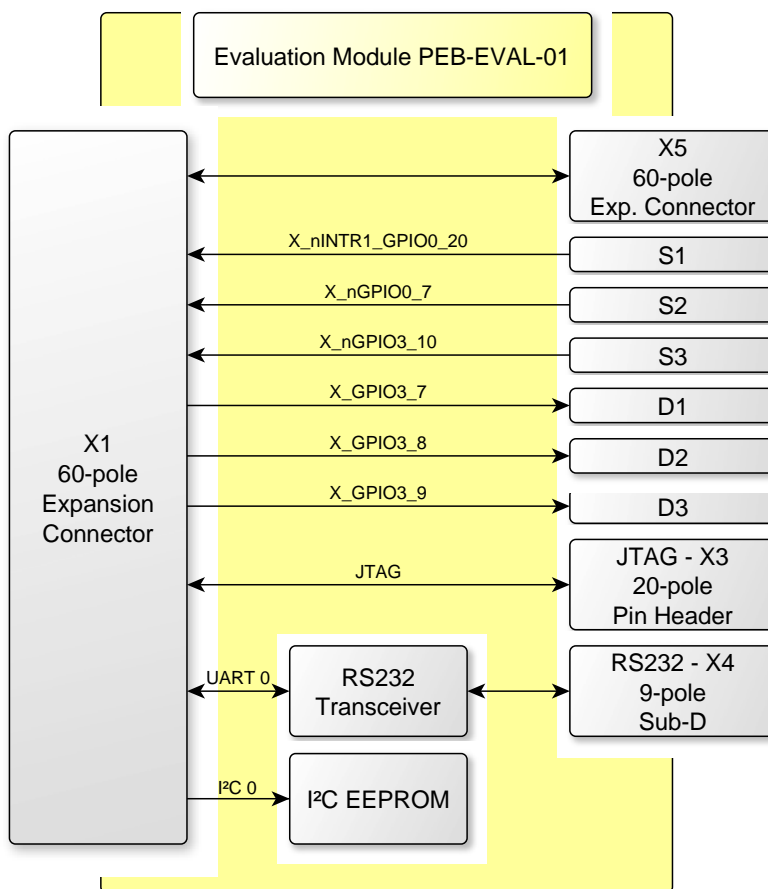


Figure 6: Block Diagram Evaluation Board (PEB-EVAL-01)

¹: **Note:** User LEDs D1 and D2 are not available for PCB version 1413.0!

3.2 View of the PEB-A-002

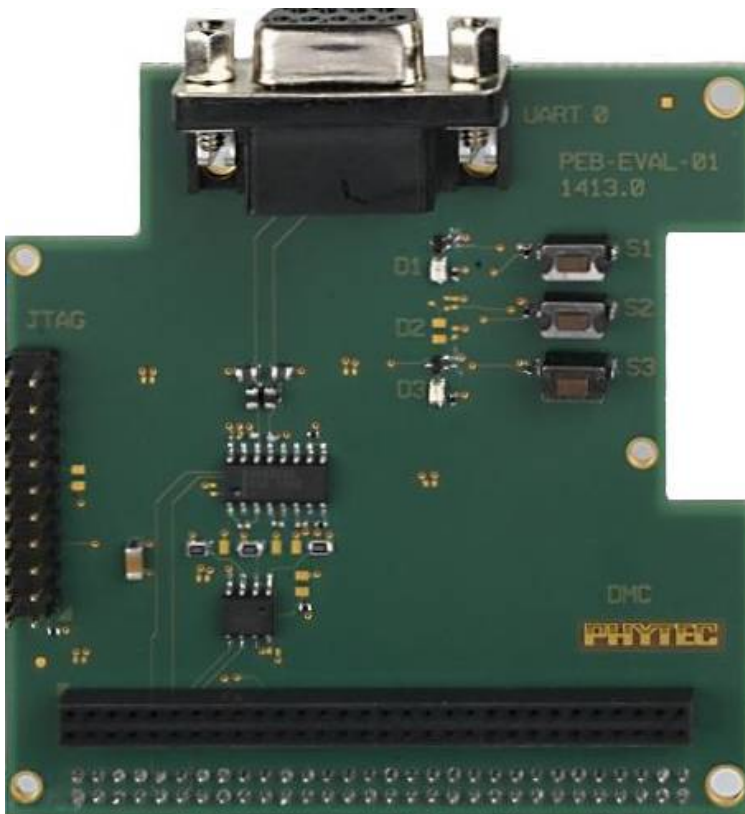


Figure 7: View of the Evaluation Board (PEB-EVAL-01)

3.3 RS-232 Connectivity (X4) :RS-232

Connector X4 is a female DE9 sub-connector and provides a connection interface to UART0 of the AM335x. The TTL level signals from the phyBOARD-Wega-AM335x are converted to RS-232 level signals. [Figure 8](#) below shows the signal mapping of the RS-232 level signals at connector X4.

The RS-232 interface is hard-wired and no jumpers must be configured for proper operation.

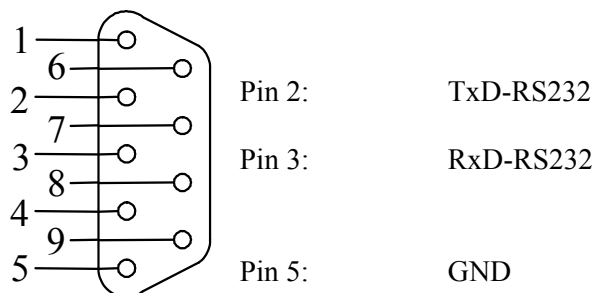


Figure 8: RS-232 Connector P1 Signal Mapping

3.3.1 Software Implementation

`/dev/ttyO0` for UART0 has been implemented within the BSP. `/dev/ttyO0` is the standard console, mainly used for debugging and control of software updates.

3.4 Debug Interface (X3)

The Evaluation Board is equipped with a JTAG interface for downloading program code into the external flash, internal controller RAM or for debugging programs currently executing. The JTAG interface extends to a 2.54 mm pitch pin header at X3 which allows for attaching a 2x10 pin, 2.54 mm pitch socket. [Figure 7](#) shows the position of the debug interface (JTAG connector X3) on the phyBOARD-Wega-AM335x module.

See the following table for details on the JTAG signal pin assignment. The pull-up or pull-down resistors can be located in the phyCORE schematics.

Signal	Pin Row*		Signal
	A	B	
VSUPPLY (VCC3V3)	2	1	TREF (VCC3V3 via 100 Ω)
GND	4	3	X_nJTAG_TRST (10 k Ω pull-up)
GND	6	5	X_JTAG_TDI (10 k Ω pull-up)
GND	8	7	X_JTAG_TMS (10 k Ω pull-up)
GND	10	9	X_JTAG_TCK (10 k Ω pull-down)
GND	12	11	X_JTAG_RTCK Connected to X_JTAG_TCK on phyCORE
GND	14	13	X_JTAG_TDO (10 k Ω pull-up)
GND	16	15	X_nRESET_OUT ³
GND	18	17	NC
GND	20	19	NC

Table 4: JTAG Connector X3 Signal Assignment

³ Same Signal as X_nRESET_IN but after Reset Supervisor IC. For more information look at phyCORE schematics.

3.5 User LEDs (D1, D2, D3)

The Evaluation Board provides three user LEDs on board, a red (D1), a yellow (D2) and a green (D3).

Caution:

User LED D1 and D2 are not available for PCB version 1413.0! Moreover GPIO3_7 must not be declared as output for PCB version 1405.0 of the phyBOARD-Wega, otherwise the system will not be reset by a software reboot!

3.5.1 Software Implementation

D3 can be controlled by setting GPIO3_9 to the desired output level. A high-level turns the LED on, a low-level turns it off.

For setting and resetting the green user LED on the expansion board just enter:

```
cd /sys/devices/platform/leds-gpio/leds/peb_eval_01:green:led3
echo 1 > brightness
echo 0 > brightness
```

3.6 Switches (S1, S2, S3)

The Evaluation Board features three switches (S1, S2, S3) which can be freely assigned to custom specific functions.

3.6.1 Software Implementation

S1 extends to GPIO0_20. S2 is connected to GPIO0_7 and S3 switches GPIO3_10. Touching one of the switches results in a low-level at the corresponding GPIO.

For getting values from the three user buttons on the expansion board just enter

```
cd /sys/class/gpio
echo 20 > export
echo 7 > export
echo 106 > export
```

and get the values with

```
cat gpio20/value
cat gpio7/value
cat gpio106/value
```

4 HDMI Adapter (PEB-AV-01)

The HDMI Adapter offers the following features:

- Subminiature Expansion Board (72 mm x 22 mm) achieved through modern SMD technology
- HDMI interface
- Audio over I²S

The High-Definition Multimedia Interface (HDMI) Adapter (PEB-AV-01) converts the parallel display signals from the phyCORE-AM335x processor to HDMI signals. The used IC (TDA19988BHN/C1) is compliant to HDMI 1.4a, DVI 1.0 and supports a maximum pixel clock of 165 MHz for the RGB input signals. Audio streams via I²S-bus reaches a sampling rate up to 192 kHz. Please refer to the *AM335x Technical Reference Manual* and *TDA19988 Product data sheet* for more information. The HDMI interface brought out at a standard HDMI type A connector (X3) on the HDMI Adapter comprises the following signal groups: three pairs of data signals, one pair of clock signals, an I²C bus which is exclusively for the HDMI interface, the Consumer Electronics Control (CEC) signal and the hot plug detect (HPD) signal. Level shifters shift the I²C interface signal from IO voltage (VCC3V3) to 5 V, while the data and clock signals extend directly from the HDMI transceiver to the HDMI receptacle. The hot plug detect signal is pulled down to ground.

The actual software supports a resolution of XGA (1024 × 768) and 720p (1280 × 720) at a pixel clock rate of 75 MHz for the RGB input signals.

Please note that all module connections are not to exceed their expressed maximum voltage or current. Maximum signal input values are indicated in the corresponding controller manuals/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.

4.1 Block Diagram

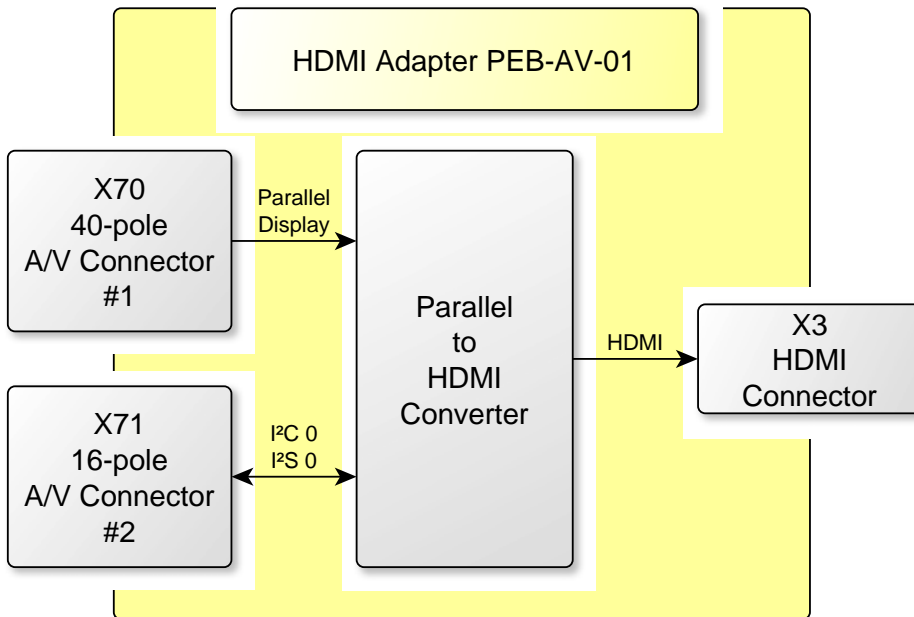


Figure 9: Block Diagram Power Module (PEB-POW-01)

4.2 View of the PEB-AV-01



Figure 10: View of the HDMI Adapter (PEB-AV-01)

4.3 Pinout of the HDMI Connector X3:

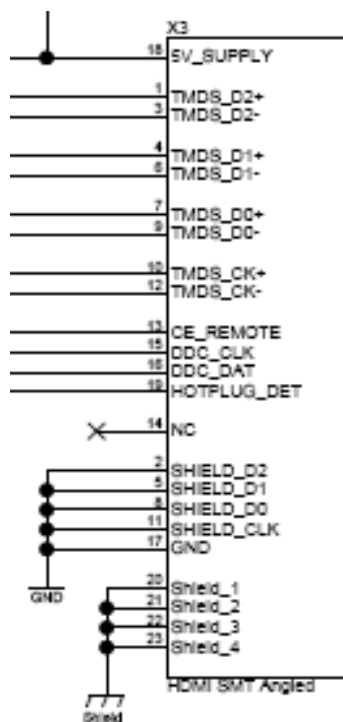


Figure 11: HDMI Connector X3 Pinout

Pin #	Signal name	ST	SL	Description
2, 5, 8, 11, 17	GND			Ground
1	HDMI_TX2+	O	HDMI	HDMI data channel 2 negative output
3	HDMI_TX2-	O	HDMI	HDMI data channel 2 positive output
4	HDMI_TX1+	O	HDMI	HDMI data channel 1 positive output
6	HDMI_TX1-	O	HDMI	HDMI data channel 1 negative output
7	HDMI_TX0+	O	HDMI	HDMI data channel 0 negative output
9	HDMI_TX0-	O	HDMI	HDMI data channel 0 positive output
10	HDMI_TXC+	O	HDMI	HDMI clock positive output
12	HDMI_TXC-	O	HDMI	HDMI clock positive output
13	HDMI_CONN_CEC	I/O	3.3 V	HDMI consumer electronic control
14	NC	-	-	Not connected
15	HDMI_CONN_DSCL	I/O	5 V	HDMI I ² C clock signal
16	HDMI_CONN_DSD A	I/O	5 V	HDMI I ² C data signal
18	HDMI_5V	O	5 V	5 V power supply
19	HDMI_CONN_HPD	I	5 V	HDMI hot plug detection
20, 21, 22, 23	Shield			

Table 5: HDMI Connector X3 Pinout

4.4 Jumper

The HDMI core and CEC core of the HDMI transmitter can be access through I2C0 bus from the phyBOARD-Wega.

Jumpers J1 and J2 allow to configure the lower address bits A0 and A1 of the TDA19988 at U1 on the HDMI adapter. The six upper address bits of the device are fixed at ‘11100’ for the HDMI core and at ‘01101’ for the CEC core (see TDA19988 Product data sheet). The remaining two lower address bits of the seven bit I²C device address are configurable using jumpers J1 and J2. J1 sets address bit A0 and J2 address bit A1.

Table 5 below shows the resulting seven bit I²C device address for the four possible jumper configurations.

HDMI core	J2	J1	CEC core
11100 00	1 + 2	1 + 2	01101 00
11100 01	1 + 2	2 + 3	01101 01
11100 10	2 + 3	1 + 2	01101 10
11100 11	2 + 3	2 + 3	01101 11

Table 6: U1 HDMI I²C Address via J1 and J2⁴

4.5 Software Implementation

The driver of the HDMI adapter board gains access to its HDMI connector via device node `/dev/fb0`.


In the Barebox script `/env/video/display` you can select between DVI_XGA (default) and DVI_720P (16:9) by simply modifying comments of the lines

```
#Displays
display=DVI_XGA
#display=DVI_720P
```

A simple test of the framebuffer feature can then be run with:
`fbtest`

This will show various pictures on the display.

You can check your framebuffer resolution with the command
`fbset`

	<p><i>fbset</i> cannot be used to change display resolution or color depth. Depending on the framebuffer device different kernel command line are mostly needed to do this.</p>
---	---

⁴: Defaults are in **bold blue** text

5 Revision History

Date	Version #	Changes in this manual
25.11.2013	Manual L-793e_0	First edition. Describes the Power Module (PEB-POW-01); PCB. No.:1410.0 Evaluation Board (PEB-EVAL-01); PCB. No.: 1413.0 HDMI Adapter (PEB-AV-01); PCB. No.: 1406.0

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