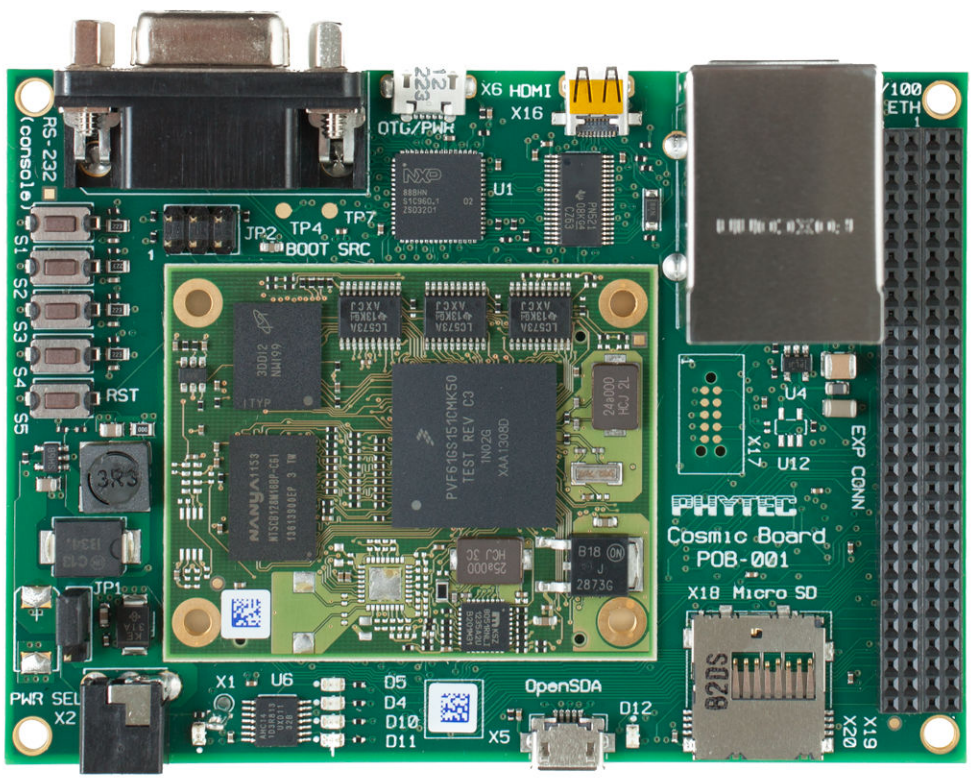
Cosmic Board for phyCORE-Vybrid

System on Module and Carrier Board

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, teal 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 Cosmic Board 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 PCM-952/Cosmic Board Carrier Board
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 Freescale VFx00 processor
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
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 PCM-052/Cosmic Board System on Module
Sx	User button Sx (S1, S2, etc.) used in reference to the available user buttons, or DIP switches on the Carrier Board
Sx_y	Switch y of DIP switch Sx; used in reference to the DIP switch on the Carrier Board
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 Pegel	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 Cosmic Board Hardware Manual describes the System on Module's design and functions. Precise specifications for the Freescale VFx00 processor can be found in the processor datasheet and/or user's 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 PHYTEC Cosmic Board

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 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.

The Cosmic 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.com/services/design-services/index.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 demand for it.
Therefore a set of methods has been established to fulfill our philosophy:

Avoidance strategies

- Avoid changes by evaluating longevity of a parts 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 contract 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

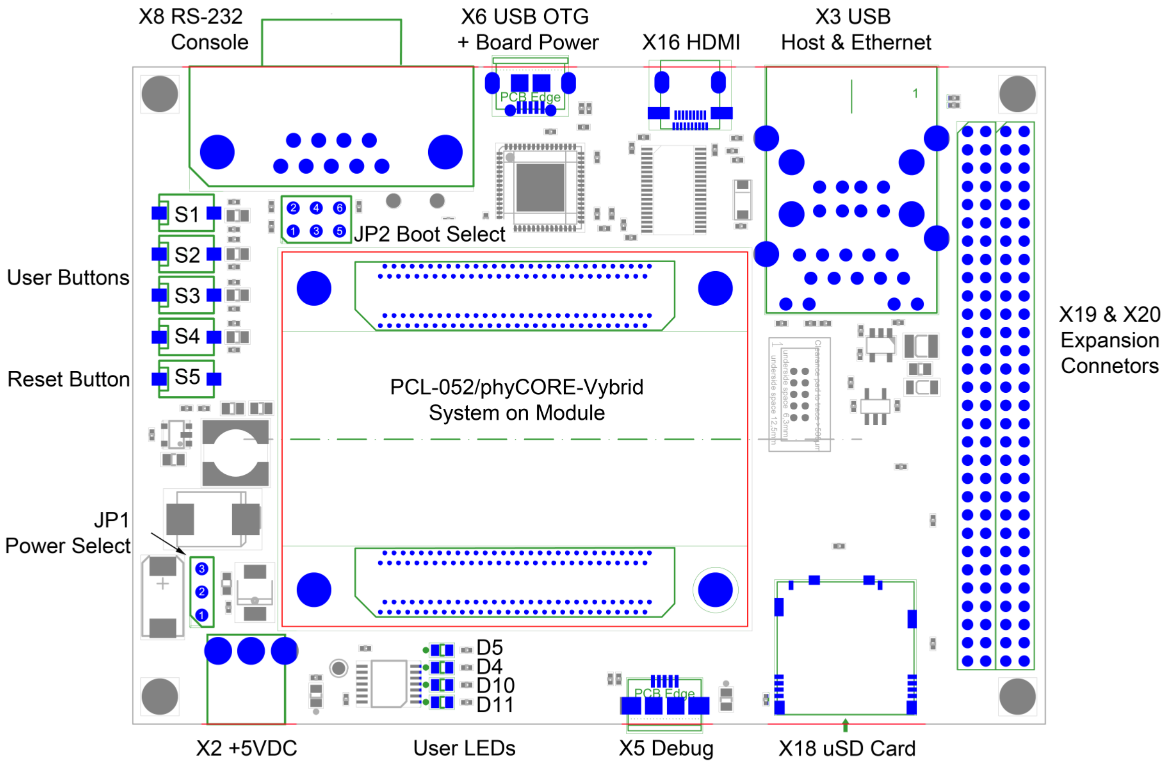

Fig. 1-1. Cosmic Board

The Cosmic Board for phyCORE-Vybrid is a low-cost, feature-rich software development platform supporting the Freescale™ Vybrid VF5xx and VF6xx processor families. At the core of the Cosmic board is the PCL-052/phyCORE-Vybrid 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 Vybrid processor. Surrounding the SOM is the POB-001/Cosmic Carrier Board, adding power input, buttons, connectors, signal breakout, and HDMI connectivity amongst other things.

The PCL-052 System On Module is a connector-less, BGA style variant of the PCM-052/phyCORE-Vybrid SOM. Unlike traditional PHYTEC SOM products that support high density connectors, the PCL-052 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 Vybrid processor, while maintaining most of the advantages of the SOM concept.

Adding the phyCORE-Vybrid SOM into your own design is as simple as ordering the connectored version (PCM-052) and making use of our Cosmic Carrier Board (POB-001), or RDK Carrier Board (PCM-952) reference schematics.

A summary of the Cosmic Board features, along with a block diagram are presented below.

1.1 Cosmic Board Features

- phyCORE-Vybrid System On Module
- Board power over:
  - USB OTG Connector
  - Wall Adapter Input
- High Speed USB Host Connector (standard A)
- High Speed USB OTG Connector (micro AB)
- 10/100 Ethernet RJ-45 Jack
- Micro SD Card Slot
- Micro HDMI connector supporting 640x480 @ 24bpp
- RS-232 Console Connectivity via DB-9
- Boot Selection Jumpers (NAND or SD Card)
- Hardware Debug via OpenSDA over USB (Cosmic+ kit only)
- 4x User Buttons
- 4x User LEDs
- 120-pin, 2mm header socket for easy access to Vybrid processor signals

1.2 Block Diagram

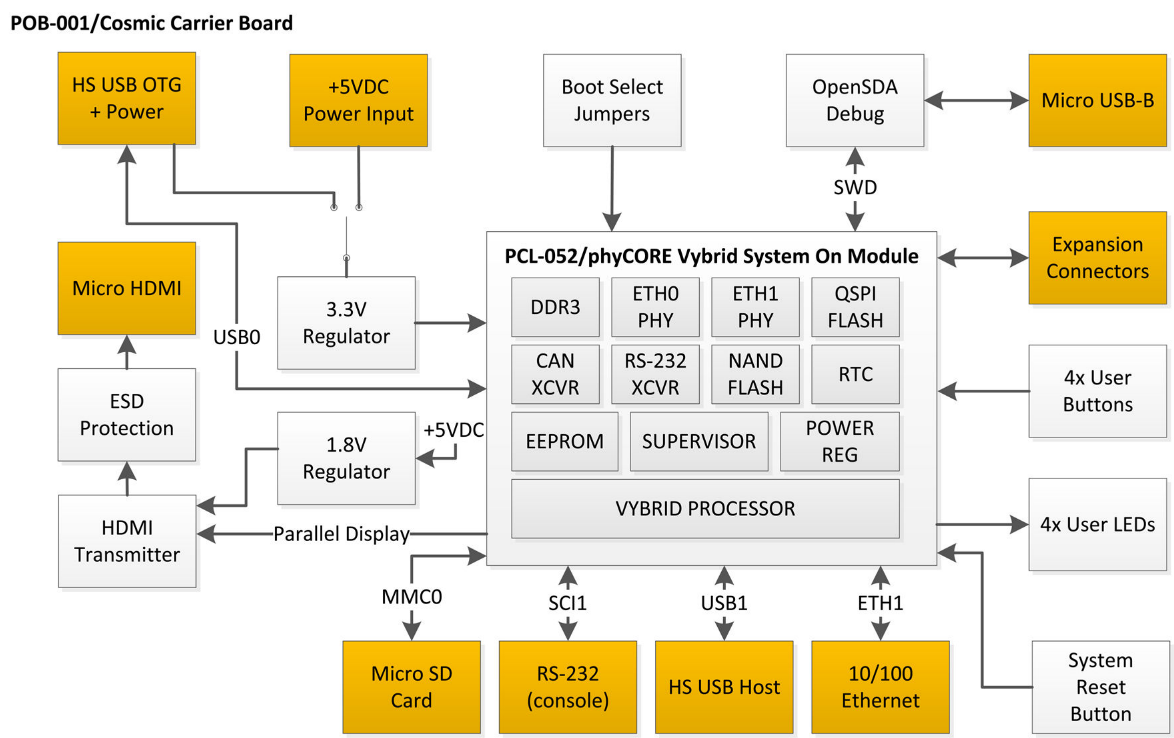

Fig. 1-2. Cosmic Board Block Diagram

2 PCL-052/phyCORE-Vybrid System on Module

This chapter gives a brief introduction to the PCL-052/phyCORE-Vybrid 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-052) by clicking here.

The phyCORE-Vybrid 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 nanoMODUL predecessors, the phyCORE boards integrate all core elements of a microcontroller system on a subminiature 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 Microvias are used on the boards, providing phyCORE users with access to this cutting edge miniaturization technology for integration into their own design.

The PCM-052, connectored version of the phyCORE-Vybrid is a sub-miniature (41 x 51 mm) insert-ready SOM populated with Freescale FVx00 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-052, connectorless version of the phyCORE-Vybrid populating the Cosmic Board 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-052 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 Freescale FVx00 processor. No description of compatible processor derivative functions is included, as such functions are not relevant for the basic functioning of the Cosmic Board.

2.1 phyCORE-Vybrid Features

- Insert-ready, sub-miniature (41 mm x 51 mm) System on Module (SOM) subassembly in low EMI design, achieved through advanced SMD technology
- Populated with the Freescale FVx00 Single (Cortex-A5) or heterogenous Dual Core (Cortex-A5 and Cortex-M4) processor
- Max. 500 MHz core clock frequency for the Cortex-A5, 167 MHz for the Cortex-M4
- Boot from NAND Flash or SPI Flash
- Controller 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 controller required supplies generated on board

- Improved interference safety achieved through multi-layer PCB technology and dedicated ground pins
- 256 MB (up to 2 GB) on-board NAND Flash[1]
- 128/256/512 MB DDR3 SDRAM [1]
- 4 kB (up to 32 kB) I2C EEPROM[1]
- 32 MB (up to 128 MB) SPI Flash
- Two RS-232 two-signal (Tx/Rx) serial interfaces, or one RS-232 interface with hardware flow control, configured through software
- Six UARTs
- Dual USB OTG 2.0 High-Speed Controller with PHY
- Two 10/100 MBit Ethernet interfaces with internal L2-Switch and IEEE1588 PTP for Realtime Ethernet (available as RMII TTL signals or 10/100 differential pairs)
- Four I^2C interfaces with SMBUS support
- Four Serial Peripheral Interfaces (SPI)
- Two Quad SPI (QSPI) supporting XIP
- Two FlexCAN interfaces with transceivers
- Display interface with 24 data bits
- I^2S audio
- Two 12-bit digital to analog converter (DAC) outputs
- Two 10-channel, 12-bit analog to digital (ADC) inputs
- JTAG
- 16-bit Trace port
- Two active and two passive tamper security signals
- 4-bit Secure Digital Host interface (SD/MMC)
- Real-Time Clock
- -40 to 85 C operating temperature range

1. The maximum memory size listed is as of the printing of this manual. Please contact PHYTEC for more information about additional, or new module configurations available.

3 Power

Power is supplied to the system using two methods:

1. USB power via connector X6
2. Wall power via connector X2

USB power provides an easy, single-cable solution for both power and console connectivity. System functionality is limited when powering the board off of USB. Most features of the board will function under USB power, with the exception of USB host and any add-on boards connected via the Expansion Connectors. Select the power option by configuring jumper JP1 using Table 3-1 below.

3.1 Jumper Settings (JP1)

Table 3-1. Jumper Settings (JP1)

Jumper Position	Description
1+2	Wall Power
2+3	**USB Power**

See Figure 1-1 for the location of jumper JP1. Pin 1 is marked on the PCB with a clipped corner on the component outline silk screen.

3.2 USB Power (X6)

USB power can be used if the USB host interface is not required, nor any add-on boards connected to the Expansion Connectors (X19, X20) are required.

Use a standard USB-A to micro-AB, or micro-B connected to a PC to power the board and provide console access. A wall-outlet charger can be used to power the board but will eliminate the use of serial over USB.

Configure the board for USB power by setting JP1 to 2+3. See Figure 1-1 for the location of jumper JP1.

3.3 Wall Power (X2)

Wall power should be used when USB host, or expansion connector add-on boards are used. Both scenarios draw additional power not available through the USB OTG connector at X6.

A suitable +5VDC +- 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.

Configure the board for wall power by setting JP1 to 1+2. See Figure 1-1 for the location of jumper JP1.

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 (X3)

The 10/100 ETH1 interface, derived from the Vybrid processor RMII1 signals, is accessible at an RJ-45 connector at X3 (USB Dual Standard A and Ethernet).

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 (X10)

The DB9 connector X10 provides connectivity to the Vybrid SCI1 (UART) signals at RS-232 level. This interface does not include the Vybrid's SCI1_RTS and SCI1_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 U-Boot and to early Linux boot log message, as opposed to the console access provided over the USB port, which provides neither. Use appropriate serial communications 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).

Figure 5-1 shows the pin numbering for the DB9 connector, while Table 5-1 gives a detailed description of the signals at X10.

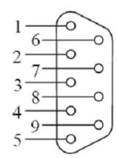

Fig. 5-1. RS-232 Connector X10 Pin Numbering

Table 5-1. Connector X10 Pin Descriptions

Pin	Signal	I/O	Description
1	N/C	-	Not connected
2	SCI1_TX_RS232	O	SCI1 transmit
3	SCI1_RX_RS232	I	SCI1 receive
4	N/C	-	Not connected
5	GND	-	GND
6	N/C	-	Not connected
7	N/C	-	Not connected
8	N/C	-	Not connected
9	N/C	-	Not connected

6 USB Connectivity

6.1 USB Host (X3)

The USB1 interface signals route to the bottom connector of X3 (USB Dual Standard A and Ethernet). Note that the top USB connector of X3 is a not used. Although the USB interface of the Vybrid processor complies with USB 2.0 HS specification and supports dual role device configuration, due to its USB-A style connector, USB1 is limited to Host operation only.

The USB1 interface on the Cosmic board is equipped with ESD protection. It has its own 5V supply that is current limited by U4 (TPS2051B). It supports connection of different USB devices such as mass storage device, keyboard, and mouse.

To use the USB Host interface the board must be configured to provide power from the wall adapter input at X2 (see Figure 1-1). Set jumper JP1 to 1+2 to configure the board for wall power.

6.2 USB OTG (X6)

The USB0 interface signals route to connector X6 (USB Micro-AB). The USB interface of the Vybrid processor complies with USB 2.0 HS specification. Firmware interaction configures the interface to act in Host or Device mode, making it a dual role device but not a true OTG controller as described in more detail in the Vybrid processor Reference Manual.

The USB0 interface on the Cosmic board is equipped with ESD protection. VBUS_USB0 is connected to VBUS of the cable meaning USB0 is powered by the host.

This interface can be used both to power the board, and to provide serial console access. Connect a USB Standard-A to Micro-B, or Micro-AB cable between a host PC and connector X6. To configure the board for USB power, set jumper JP1 to 2+3 (see Figure 1-1). Once booted, the Cosmic Board shows up as a virtual serial port over USB. Use appropriate serial communications 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).

7 SD Card (X18)

The Cosmic board provides a Micro SD card slot at X18 for connection to the Vybrid's SDHC1 interface. The interface is powered by an instant-on 3.3 V power supply and has card detect support (CDET) via the Vybrid processor PTB28 signal.

In addition to mass storage usage, the processor can boot from this interface. As the default boot mode of the phyCORE-Vybrid SOM, SD boot is selected by opening JP2 (see Figure 1-1).

7.1 Inserting and Removing an SD Card

Insert a micro SD Card into slot X18, label down and pins facing up. 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 HDMI (X16)

A High-Definition Multimedia Interface (HDMI) transmitter is connected to the parallel display interface of the processor. The interface is compliant with HDMI 1.4a specification and available through the micro HDMI connector at X16. Connection to an HDMI display is limited to 640x480 @ 24bpp due to Vybrid processor limitations and compatible display clock frequency limitations.

The 24-bit Vybrid LCD interface (3 x 8-bit RGB) along with the I^2S-bus are converted to HDMI signals by the HDMI transmitter at U1. The transmitter is configured by the processor via I^2C and although operating at 1.8V, can handle the 3.3V processor signals. Along with delivering Consumer Electronic Control (CEC) the device also supports a low power or standby mode when HDMI is not being used. A port protection and interface device at U13 provides ESD protection, integrated level shifting of HDMI signals, and a 50 mA / 5V current-limited supply to the HDMI sink device (monitor, TV, projector, etc).

For access to the HDMI output, a micro HDMI cable is required. For connection to general HDMI compliant devices, an HDMI to Micro HDMI cable will typical be used.

The display signals that are connected to the HDMI interface (PTE0 to PTE28) are available at the expansion connector so that they can be used for other purposes such as connecting to an LCD expansion board. Refer to Chapter 13 for additional information.

9 User Buttons

The Cosmic board is populated with four user accessible push buttons located at S1, S2, S3, and S4 to enable user input (see Figure 1-1). Each button is connected to a GPIO on the Vybrid processor. A detailed list of the user buttons is presented below.

S1 User Button 1 (BTN1). Pressing this button generates a debounced, active high signal to the processor at MCU_PTB3. Holding this button will keep the output to MCU_PTB3 held high. Releasing this button will keep the output to MCU_PTB3 held low.

S2 User Button 2 (BTN2). Pressing this button generates a debounced, active high signal to the processor at MCU_PTB8. Holding this button will keep the output to MCU_PTB8 held high. Releasing this button will keep the output to MCU_PTB8 held low.

S3 User Button 3 (BTN3). Pressing this button generates a debounced, active high signal to the processor at MCU_PTB9. Holding this button will keep the output to MCU_PTB9 held high. Releasing this button will keep the output to MCU_PTB9 held low.

S4 User Button 4 (BTN4). Pressing this button generates a debounced, active high signal to the processor at MCU_PTB12. Holding this button will keep the output to MCU_PTB12 held high. Releasing this button will keep the output to MCU_PTB12 held low.

10 System Reset Button (S5)

The Cosmic Board is equipped with a system reset button at S5. Pressing the button will toggle the nRESET_IN signal low and generate a manual system reset driving RESETn on the phyCORE-Vybrid low.

The system reset signal, RESETn, 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-052/phyCORE-Vybrid 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.

11 User LEDs

The Cosmic board is populated with four user programmable LEDs located at D11, D10, D4, and D5 to provide visual feedback to the user (see Figure 1-1). Each LED is connected to a GPIO on the Vybrid processor. A detailed list of the user LEDs is presented below.

D11 LED1 (Green). Connected to processor signal MCU_PTB13. Drive signal MCU_PTB13 high to turn this LED on and low to turn this LED off.

D10 LED2 (Green). Connected to processor signal MCU_PTB18. Drive signal MCU_PTB18 high to turn this LED on and low to turn this LED off.

D4 LED3 (Red). Connected to processor signal MCU_PTB26. Drive signal MCU_PTB26 high to turn this LED on and low to turn this LED off.

D5 LED4 (Red). Connected to processor signal MCU_PTB29. Drive signal MCU_PTB29 high to turn this LED on and low to turn this LED off.

12 Boot Selection (JP2)

Jumper JP2 provides a way to override the default boot option configured on the Vybrid SOM.

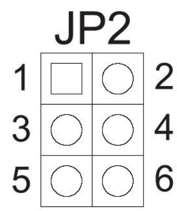

Fig. 12-1. Jumper Numbering Scheme

Figure 12-1 shows the jumper pin numbering scheme. Pin 1 on the board is marked with a number one on the PCB silk screen. It is also visibly marked with a clipped corner on the component outline.

Table 12-1 shows the required jumper positions for configuring the desired boot device. Use jumper wires to connect the pins of JP2 based on the settings described.

By default JP2 is open, configuring the Vybrid for SD card boot.

Table 12-1. Jumper Settings and Descriptions

Jumper	Setting	Boot Device
JP2	**OPEN**	**SD Card**
	1+2 3+4 5+6	NAND

13 Expansion Connectors (X19, X20)

Two 2x30 2mm Expansion connectors (X19 and X20) provide easy access to many of the phyCORE-Vybrid 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 Cosmic Board, but can be reconfigured for many other purposes. Refer to the Vybrid Technical Reference manual on available operation modes.

Table 13-1. Power Signal Map

Signal	Expansion Connector Pin	Description
VCC_5V0	X19-1, X19-3	5V power from currently selected source (wall or USB)
VCC_3V3	X19-2, X19-4	3.3V voltage domain
5V_IN	X19-5	5V power from wall adapter input
VCC_1V8	X19-6	1.8V voltage domain
VBUS_USB0	X19-8	5V power from USB OTG connector
GND	X19-7, X19-10, X19-59, X19-60, X20-1, X20-2, X20-59, X20-60	Ground

Table 13-2. System Signal Map

Signal	Expansion Board Pin	Type	Description
RESETn	X20-58	O	System reset signal; can be used to reset external devices. This is an open-drain output with a 4.7K pull-up on the SOM.
MCU_PTB11	X19-11	O	CKO2; free for external use
MCU_PTA12	X19-21	O	TRACECK; free for external use

Table 13-3. JTAG Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTA8	X19-14	I	JTCLK; connected to POB-001 K20 SW_CLK for Serial Wire Debug

Table 13-3. JTAG Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTA9	X19-16	I	JTDI; free for external use
MCU_PTA10	X19-18	O	JTDO; free for external use
MCU_PTA11	X19-20	I	JTMS; connected to POB-001 K20 SW_DO and SW_DI for Serial Wire Debug

Table 13-4. CAN Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTB14	X19-22	I	CAN0_RX; connected to PCL-052 CAN transceiver
MCU_PTB15	X19-24	O	CAN0_TX; connected to PCL-052 CAN transceiver
MCU_PTB16	X19-31	I	CAN1_RX; connected to PCL-052 CAN transceiver
MCU_PTB17	X19-33	O	CAN1_TX; connected to PCL-052 CAN transceiver

Table 13-5. I^{2}C Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTB14	X19-22	I/O	I2C0_SCL; connected to PCL-052 CAN transceiver
MCU_PTB15	X19-24	I/O	I2C0_SDA; connected to PCL-052 CAN transceiver
MCU_PTA22	X19-27	I/O	I2C2_SCL; connected to PCL-052 RTC and EEPROM with external 2.2k pull-up and POB-001 HDMI transceiver
MCU_PTA23	X19-29	I/O	I2C2_SDA; connected to PCL-052 RTC and EEPROM with external 2.2k pull-up and POB-001 HDMI transceiver
MCU_PTA30	X19-35	I/O	I2C3_SCL; free for external use
MCU_PTA31	X19-37	I/O	I2C3_SDA; free for external use

Table 13-6. UART Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTA20	X19-23	O	SCI3_TX serial transmit signal; free for external use
MCU_PTA21	X19-25	I	SCI3_RX serial receive signal; free for external use

Table 13-7. QSPI Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTD0	X19-46	O	QSPIA_SCK; free for external use
MCU_PTD1	X19-48	O	QSPIA_CS0; free for external use
MCU_PTD2	X19-50	I/O	QSPIA_IO3; free for external use
MCU_PTD3	X19-52	I/O	QSPIA_IO2; free for external use
MCU_PTD4	X19-54	I/O	QSPIA_IO1; free for external use
MCU_PTD5	X19-56	I/O	QSPIA_IO0; free for external use
MCU_PTD6	X19-58	O	QSPIA_DQS; free for external use
MCU_PTD7	X19-26	O	QSPIB_SCK; free for external use
MCU_PTD8	X19-28	O	QSPIB_CD0; free for external use
MCU_PTD9	X19-30	I/O	QSPIB_IO3; free for external use
MCU_PTD10	X19-32	I/O	QSPIB_IO2; free for external use
MCU_PTD11	X19-34	I/O	QSPIB_IO1; free for external use
MCU_PTD12	X19-36	I/O	QSPIB_IO0; free for external use
MCU_PTD13	X19-38	O	QSPIB_DQS; free for external use

Table 13-8. ADC Signal Map

Signal	Expansion Board Pin	Type	Description
ADC0SE8	X19-42	Analog	ADC input; free for external use
ADC0SE9	X19-41	Analog	ADC input; free for external use
ADC1SE8	X19-39	Analog	ADC input; free for external use
ADC1SE9	X19-40	Analog	ADC input; free for external use

Table 13-9. DAC Signal Map

Signal	Expansion Board Pin	Type	Description
DACO0	X19-44	Analog	DAC output; free for external use
DACO1	X19-43	Analog	DAC output; free for external use

Table 13-10. SDHC Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTC0	X19-45	O	SDHC0_CLK; free for external use
MCU_PTC1	X19-47	I/O	SDHC0_CMD; free for external use
MCU_PTC2	X19-49	I/O	SDHC0_DAT0; free for external use
MCU_PTC3	X19-51	I/O	SDHC0_DAT1; free for external use
MCU_PTC4	X19-53	I/O	SDHC0_DAT2; free for external use
MCU_PTC5	X19-55	I/O	SDHC0_DAT3; free for external use
MCU_PTC6	X19-57	I	SDHC0_WP; free for external use

Table 13-11. LCD Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTE0	X20-3	I/O	LCD0; connected to BOOTMOD1 with external 10k pull-up on reset and POB-001 HDMI transmitter
MCU_PTE1	X20-5	I/O	LCD1; connected to BOOTMOD1 with external 10k pull-down on reset and POB-001 HDMI transmitter
MCU_PTE2	X20-7	I/O	LCD2; connected to POB-001 HDMI transmitter
MCU_PTE3	X20-9	I/O	LCD3; available for external use
MCU_PTE4	X20-11	I/O	LCD4; connected to POB-001 HDMI transmitter
MCU_PTE5	X20-13	I/O	LCD5; connected to POB-001 HDMI transmitter
MCU_PTE6	X20-15	I/O	LCD6; connected to POB-001 HDMI transmitter
MCU_PTE7	X20-17	I/O	LCD7; connected to POB-001 HDMI transmitter. This pin is connected to RCON0 which will be driven low on reset.
MCU_PTE8	X20-19	I/O	LCD8; connected to POB-001 HDMI transmitter. This pin is connected to RCON1 which will be driven low on reset.
MCU_PTE9	X20-21	I/O	LCD9; connected to POB-001 HDMI transmitter. This pin is connected to RCON2 which will be driven high on reset.
MCU_PTE10	X20-23	I/O	LCD10; connected to POB-001 HDMI transmitter. This pin is connected to RCON3 which will be driven low on reset.
MCU_PTE11	X20-25	I/O	LCD11; connected to POB-001 HDMI transmitter. This pin is connected to RCON4 which will be driven low on reset.
MCU_PTE12	X20-27	I/O	LCD12; connected to POB-001 HDMI transmitter. This pin is connected to RCON5 which will be driven based on the boot settings (JP2).
MCU_PTE13	X20-29	I/O	LCD13; connected to POB-001 HDMI transmitter.
MCU_PTE14	X20-31	I/O	LCD14; connected to POB-001 HDMI transmitter
MCU_PTE15	X20-4	I/O	LCD15; connected to POB-001 HDMI transmitter. This pin is connected to RCON6 which will be driven based on the boot settings (JP2).

Table 13-11. LCD Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTE16	X20-6	I/O	LCD16; connected to POB-001 HDMI transmitter. This pin is connected to RCON7 which will be driven based on the boot settings (JP2).
MCU_PTE17	X20-8	I/O	LCD17; connected to POB-001 HDMI transmitter. This pin is connected to RCON8 which will be driven low on reset.
MCU_PTE18	X20-10	I/O	LCD18; connected to POB-001 HDMI transmitter. This pin is connected to RCON9 which will be driven high on reset.
MCU_PTE19	X20-12	I/O	LCD19; connected to POB-001 HDMI transmitter. This pin is connected to RCON10 which will be driven low on reset.
MCU_PTE20	X20-14	I/O	LCD20; connected to POB-001 HDMI transmitter. This pin is connected to RCON11 which will be driven high on reset.
MCU_PTE21	X20-16	I/O	LCD21; connected to POB-001 HDMI transmitter
MCU_PTE22	X20-18	I/O	LCD22; connected to POB-001 HDMI transmitter
MCU_PTE23	X20-20	I/O	LCD23; connected to POB-001 HDMI transmitter. This pin is connected to RCON12 which will be driven high on reset.
MCU_PTE24	X20-22	I/O	LCD24; connected to POB-001 HDMI transmitter This pin is connected to RCON13 which will be driven high on reset.
MCU_PTE25	X20-24	I/O	LCD25; connected to POB-001 HDMI transmitter. This pin is connected to RCON14 which will be driven high on reset.
MCU_PTE26	X20-26	I/O	LCD26; connected to POB-001 HDMI transmitter. This pin is connected to RCON15 which will be driven high on reset.
MCU_PTE27	X20-28	I/O	LCD27; connected to POB-001 HDMI transmitter
MCU_PTE28	X20-30	I/O	LCD28; connected to POB-001 HDMI transmitter

Table 13-12. FlexBus Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTD16	X20-33	I/O	FB_AD16; connected to PCL-052 NAND Flash (U17)
MCU_PTD17	X20-35	I/O	FB_AD17; connected to PCL-052 NAND Flash (U17)
MCU_PTD18	X20-37	I/O	FB_AD18; connected to PCL-052 NAND Flash (U17)
MCU_PTD19	X20-39	I/O	FB_AD19; connected to PCL-052 NAND Flash (U17)
MCU_PTD20	X20-41	I/O	FB_AD20; connected to PCL-052 NAND Flash (U17)
MCU_PTD21	X20-43	I/O	FB_AD21; connected to PCL-052 NAND Flash (U17)
MCU_PTD22	X20-45	I/O	FB_AD22; connected to PCL-052 NAND Flash (U17)
MCU_PTD23	X20-32	I/O	FB_AD23; connected to PCL-052 NAND Flash (U17)
MCU_PTD24	X20-34	I/O	FB_AD24; connected to PCL-052 NAND Flash (U17)
MCU_PTD25	X20-36	I/O	FB_AD25; connected to PCL-052 NAND Flash (U17)
MCU_PTD26	X20-38	I/O	FB_AD26; connected to PCL-052 NAND Flash (U17)
MCU_PTD27	X20-40	I/O	FB_AD27; connected to PCL-052 NAND Flash (U17)

Table 13-12. FlexBus Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTD28	X20-42	I/O	FB_AD28; connected to PCL-052 NAND Flash (U17)
MCU_PTD29	X20-44	I/O	FB_AD29; connected to PCL-052 NAND Flash (U17)
MCU_PTD30	X20-46	I/O	FB_AD30; connected to PCL-052 NAND Flash (U17)
MCU_PTD31	X20-48	I/O	FB_AD31; connected to PCL-052 NAND Flash (U17)
MCU_PTC26	X19-19	I/O	FB_TA_b; connected to PCL-052 NAND Flash (U17)
MCU_PTC27	X19-15	I/O	connected to PCL-052 NAND Flash (U17)
MCU_PTC28	X19-9	I/O	connected to PCL-052 NAND Flash (U17)
MCU_PTB24	X19-11	I/O	FB_CS4_b; connected to PCL-052 NAND Flash (U17)
MCU_PTB25	X19-17	I/O	FB_CS1_b; connected to PCL-052 NAND Flash (U17)
MCU_PTB27	X19-13	-	connected to PCL-051 NAND Flash (U17)

Table 13-13. Miscellaneous Signal Map

Signal	Expansion Board Pin	Type	Description
MCU_PTB19	X20-47	I/O	This pin is connected will be driven low on reset.
MCU_PTB20	X20-49	I/O	free for external use
MCU_PTB21	X20-51	I/O	free for external use
MCU_PTB22	X20-53	I/O	free for external use
MCU_PTB23	X20-55	I/O	free for external use
MCU_PTC30	X20-57	I/O	free for external use
MCU_PTB0	X20-50	I/O	free for external use
MCU_PTB1	X20-52	I/O	free for external use
MCU_PTB2	X20-54	I/O	free for external use
MCU_PTC31	X20-56	I/O	free for external use

14 OpenSDA Debug

USB Micro-B connector X5 provides OpenSDA and CMSIS-DAP access to the Vybrid processor for debugging purposes on the Cosmic board. OpenSDA and CMSIS-DAP debugging are implemented through a Freescale K20 processor (U3) on the Carrier Board.

The K20 circuit communicates to the host PC via USB and then to the processor via the Vybrid Debug Access Port (DAP) signals MCU_PTA8 and MCU_PTA11. The system can be reset directly with the K20's GPIO signal PTB1. Use the debugger's system reset function to reset the Vybrid processor.

A USB Standard-A to Micro-B cable connected between the Host-PC and X5 allows the processor to be interactively controlled with debugging software such as ARM Development Suite (DS-5™). Refer to the Quickstart for the Cosmic Board for more information.

NOTE:

OpenSDA debug circuit is only populated on the Cosmic+ kit version.

15 Technical Specifications

The physical dimensions of the Cosmic Board for phyCORE-Vybrid are presented in Figure 15-1. A summary of technical specifications is provided in Table 15-1.

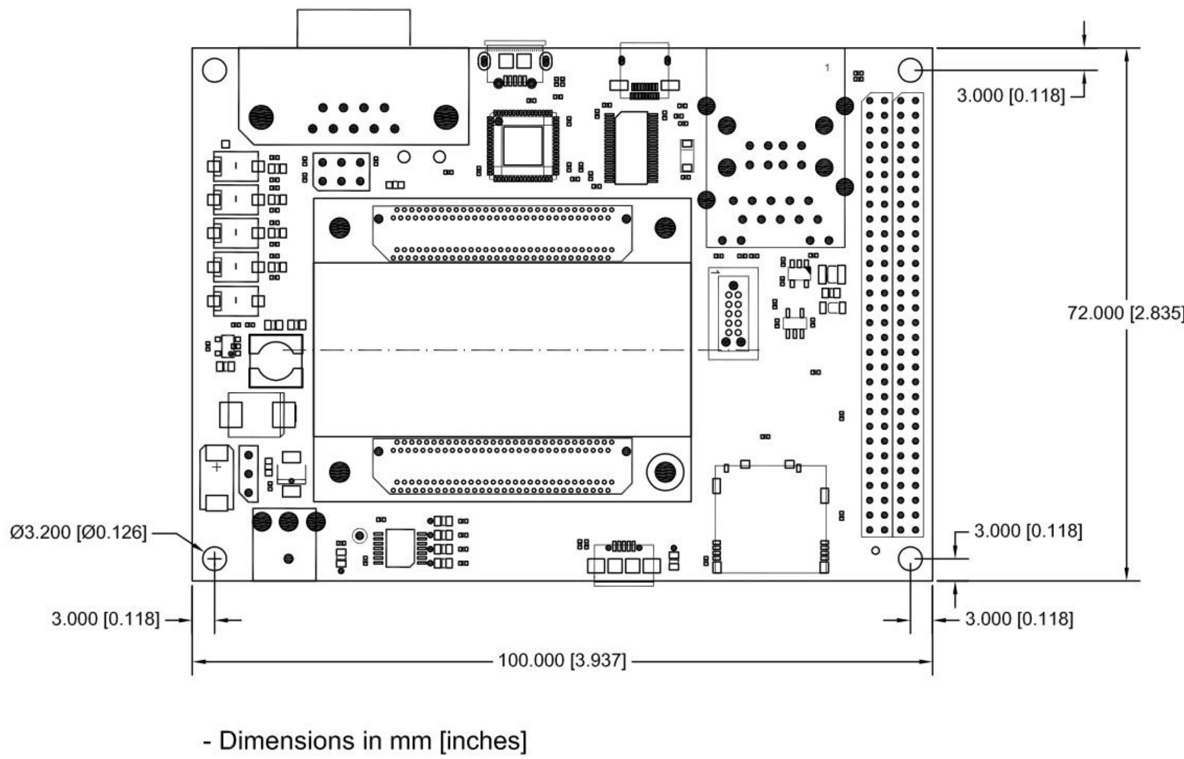

Fig. 15-1. Cosmic Board Physical Dimensions

Table 15-1. Technical Specifications[1]

Dimensions	100 x 72mm
Weight	64.2g / 2.26oz typ.
Storage Temperature	-40 °C to +125 °C
Operating Temperature	0 °C to +70 °C (commercial)
Humidity	95% r.F. not condensed
Operating Voltage	+5VDC +- 5%
Power Consumption	1.83W typ.; Linux booted from uSD card, running ping test

1. These specifications describe the standard configuration of the Cosmic Board as of the printing of this manual.

16 Component Placement Diagrams

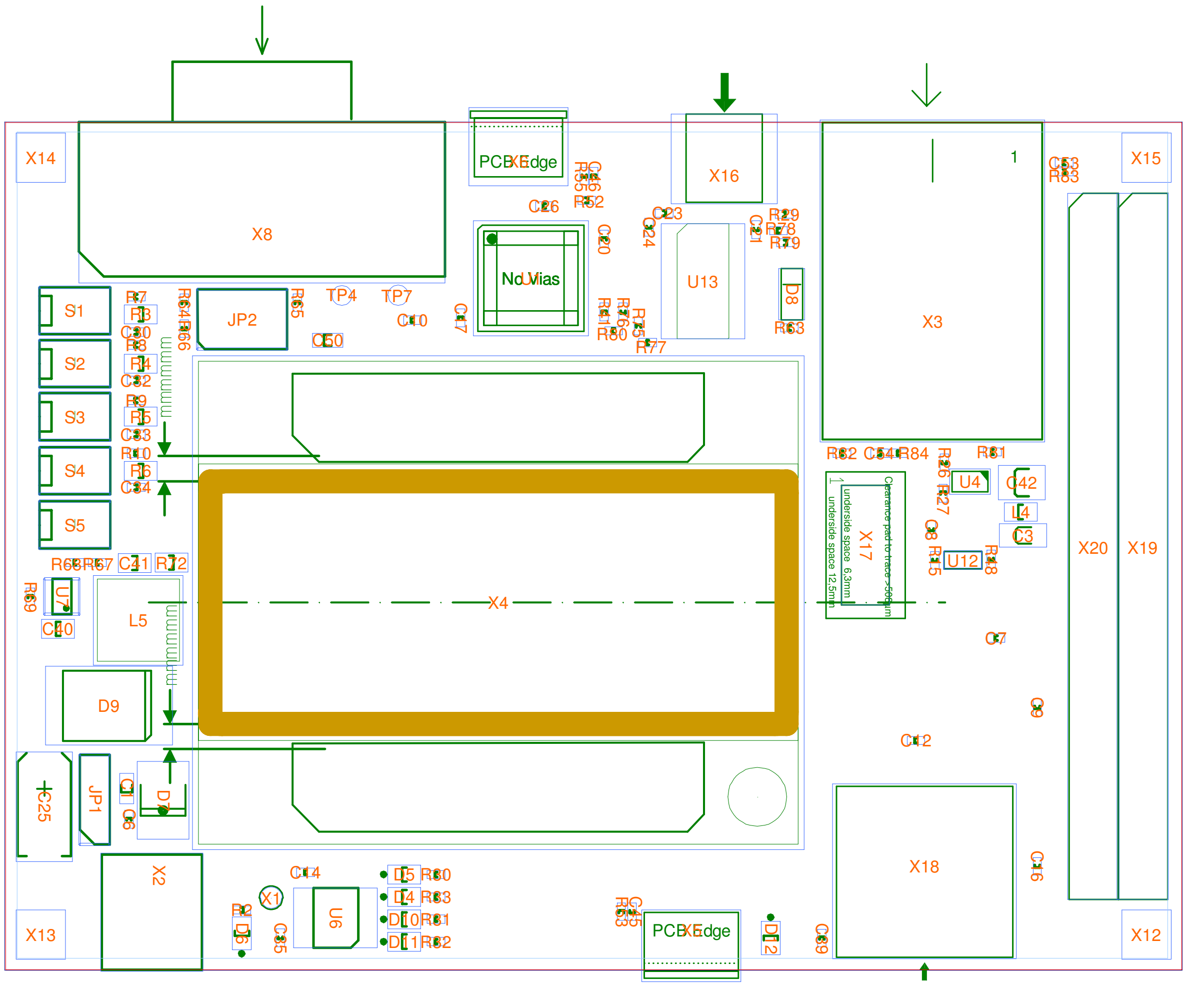

Fig. 16-1. Cosmic Board Top

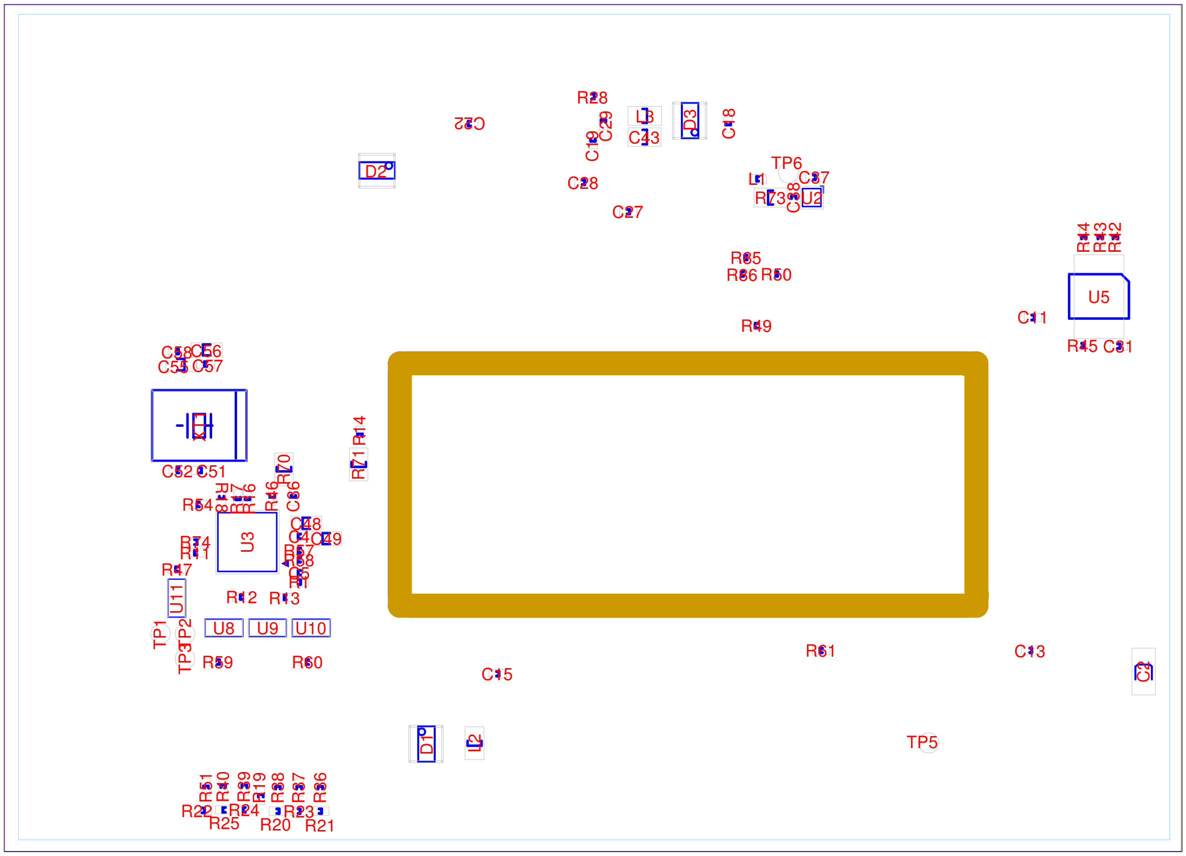

Fig. 16-2. Cosmic Board Bottom

Revision History

Table 17-1. Revision History

Date	Version Number	Changes in this Manual
09/01/2013	L-790e_1	Release