

Application Note **AN530**

HBI-0305

Adaptor for Digilent Pmod™ Compatible headers for the Cortex-M Prototyping System (MPS2+)

Non-Confidential



Adaptor for Digilent Pmod™ Compatible headers

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Release Information

The following changes have been made to this Application Note.

Change History			
Date	Issue	Confidentiality	Change
31/03/2017	A	Non-Confidential	First release

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1 Conventions and Feedback

The following describes the typographical conventions and how to give feedback:

Typographical conventions

The following typographical conventions are used:

<code>monospace</code>	denotes text that you can enter at the keyboard, such as commands, file and program names, and source code.
<u>monospace</u>	denotes a permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.
<code>monospace</code> <i>italic</i>	denotes arguments to commands and functions where the argument is to be replaced by a specific value.
<code>monospace</code> bold	denotes language keywords when used outside example code.
<i>italic</i>	highlights important notes, introduces special terminology, denotes internal cross-references, and citations.
bold	highlights interface elements, such as menu names. Denotes signal names. Also used for emphasis in descriptive lists, where appropriate.

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If you have any comments and suggestions about this product, contact your supplier and give:

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- Details of the release you are using.
- Details of the platform you are using, such as the hardware platform, operating system type and version.
- A small standalone sample of code that reproduces the problem.
- A clear explanation of what you expected to happen, and what actually happened.
- The commands you used, including any command-line options.
- Sample output illustrating the problem.
- The version string of the tools, including the version number and build numbers.

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- ARM Information Center, <http://infocenter.arm.com/help/index.jsp>
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- ARM Support and Maintenance,
<http://www.arm.com/support/services/support-maintenance.php>
- ARM Glossary, <http://infocenter.arm.com/help/topic/com.arm.doc.aeg0014g/index.html>

The ARM Glossary is a list of terms used in ARM documentation, together with definitions for those terms. The ARM Glossary does not contain terms that are industry standard unless the ARM meaning differs from the generally accepted meaning.

1.1 Terms and abbreviations

Term	Meaning
FPGA	Field Programmable Gate Array
GPIO	General Purpose Input Output
HBridge	Pmod [™] Specification type 5 and type 6, control bus for stepper motors
I2C	Inter-Integrated Circuit - communication protocol and bus.
MPS2+	Cortex-M Prototyping System
Pmod [™]	A Peripheral Module interface standard created by Digilent.
SMM	Soft Macro-cell Model
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receive Transmit –serial interface.

2 Overview

2.1 Purpose of this application note

This application note details installation and operation of the adaptor for Digilent Pmod™ Compatible headers on Cortex-M Prototyping System (MPS2+).

2.2 Requirements

An FPGA SMM that supports the MPS2+ expansion alternative functions, eg. AN383.

2.3 References

- *ARM® Versatile™ Express Cortex®-M Prototyping System (V2M-MPS2) Technical Reference Manual*
http://infocenter.arm.com/help/topic/com.arm.doc.100112_0200_06_en/index.html
- 510-002, Digilent, http://www.digilentinc.com/Pmods/Digilent-Pmod_%20Interface_Specification.pdf, (accessed 10/12/2015)

3 Getting Started

The steps below show you how to set up the adapter board on the MPS2+ Motherboard.

1. Remove the two plastic spacers, supplied with MPS2+ motherboard, from the mounting holes (Figure 3-1).

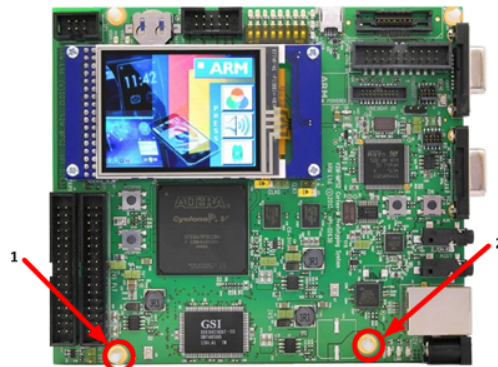


Figure 3-1 Plastic spacers removal

2. Replace them with the two spacers provided with the adaptor board as shown in Figure 3-2

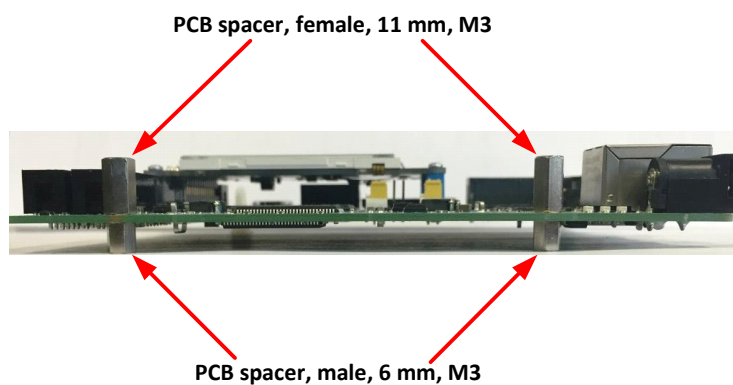


Figure 3-2 Spacers replacement

3. Install plastic standoff (Hex Nylon Standoff M3 x 11mm) on adapter board and fix it with screw (Steel Screw, M3 x 6mm) (Figure 3-3).

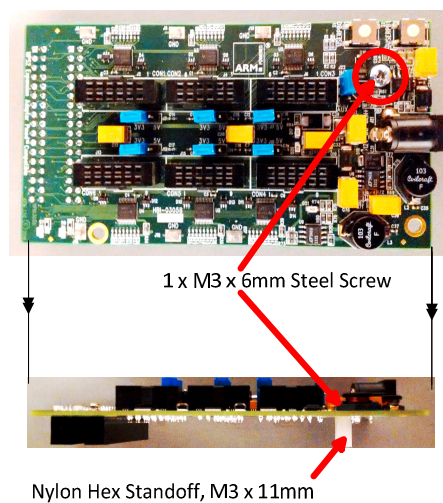


Figure 3-3 Plastic standoff

4. Place the adapter board on the expansion port of MPS2+ motherboard, and fix it with two steel screws, M3 x 6mm (see Figure 3-4).

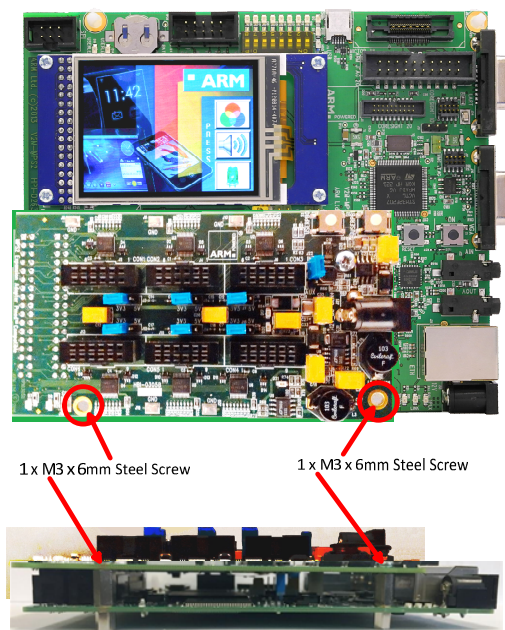


Figure 3-4 Placing Adapter board

Note that the power supply is provided by MPS2+ motherboard via its expansion ports.

The additional power connector can be used if the maximum current level provided by the MPS2+ expansion port (270 mA) is exceeded.

Functional overview

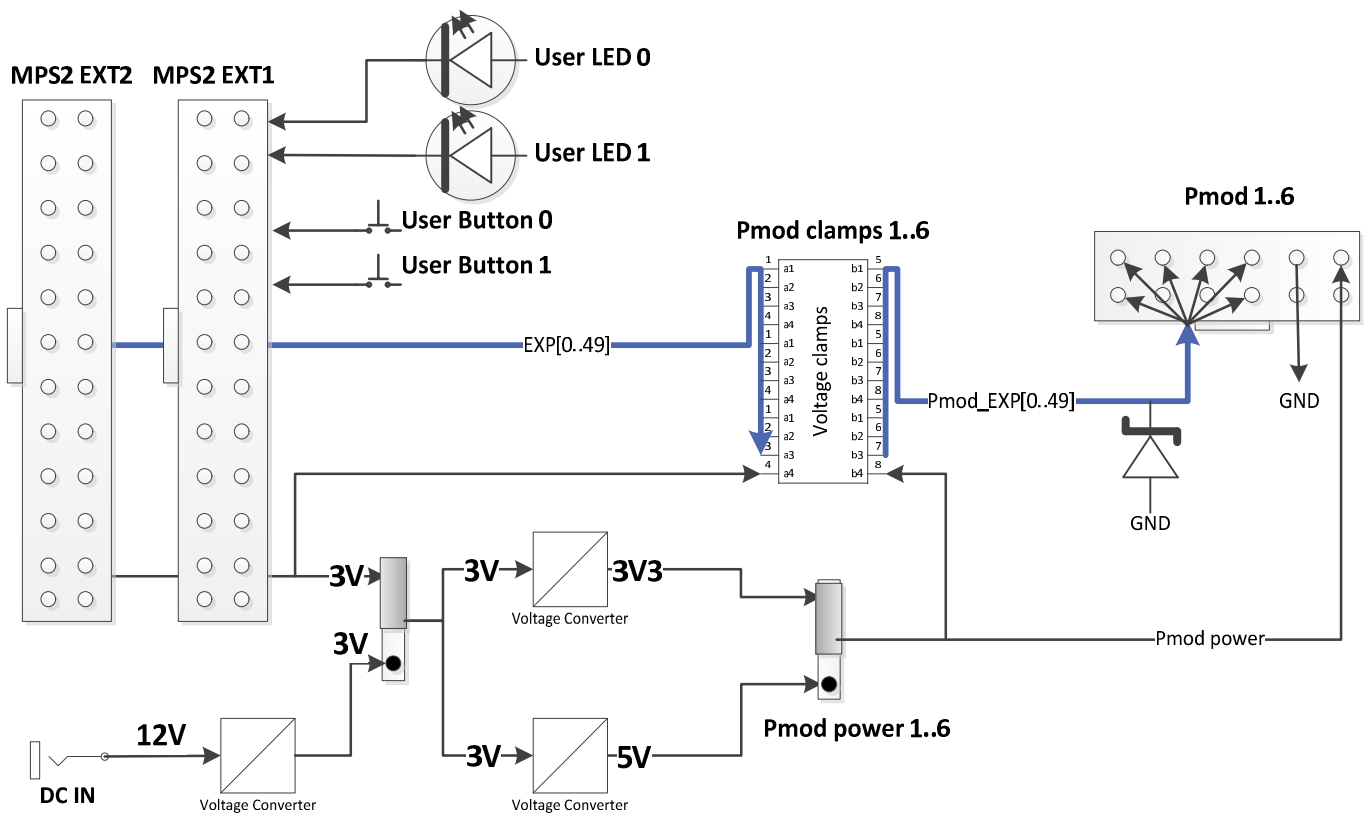


Figure 3-5 Functional Diagram

Please refer to *section 5* for headers connectivity.

3.1 Module functionality

MPS2 EXPANSION PORTS (EXT1/2)

MPS2 IDC expansion ports are used to connect the adapter board to the MPS2 motherboard.

USER BUTTONS

Two user definable push buttons are directly connected to the MPS2+ motherboard FPGA GPIO pins. These can be used to replace the MPS2+ motherboard buttons which are inaccessible when the adaptor board is fitted.

USER LEDs

Two user definable LEDs are directly connected to the MPS2+ Motherboard FPGA GPIO pins. These have no dedicated purpose and are free for the user to assign as required.

VOLTAGE CLAMPS

The voltage clamps reconcile the 3V logic level signals of the MPS2+ motherboard with PM*_VCC, the voltage level each PmodTM connector is set to (either 3V3 or 5V) on the expansion board.

DCIN CONNECTOR

The 12V DC in supply provides an alternative means of supplying power to the PmodTM headers, since the MPS2+ can only deliver 250mA before the supply collapses.

The same 3V3 and 5V are available to the PM*_VCC, the 12V is stepped down to 3V and can be selected as an alternative input to the 3V3 and 5V regulators.

With an external power source, the PM*_VCC voltage remains stable within 10% of 3V3, up to 550mA.

4 PIN MAPPING

The adapter supports six Pmod™ compatible headers, each with a specialization. Figure 4-1 shows the pin mapping:

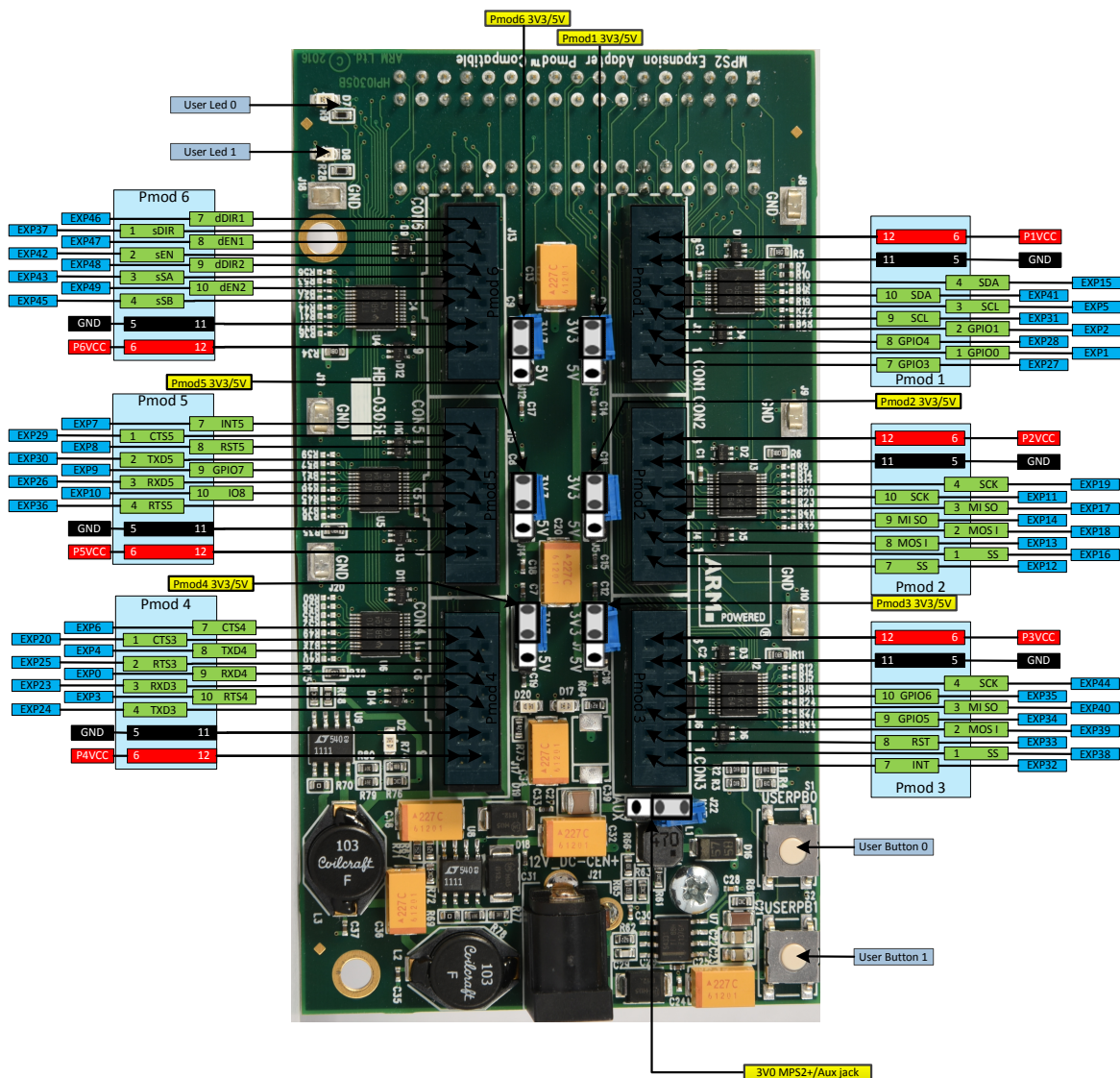


Figure 4-1 Expansion Adaptor for Pmod™ pin mapping



JUMPER ON BOARD	Position 1-2 	Position 2-3 
J22 (MPS2+/Aux)	V2M-MPS2+ supply, 270 mA	Auxiliary 12V supply, 600mA
J3 (Pmod 1 VCC)	PM1_VCC = 3V3	PM1_VCC = 5V
J5 (Pmod 2 VCC)	PM2_VCC = 3V3	PM2_VCC = 5V
J7 (Pmod 3 VCC)	PM3_VCC = 3V3	PM3_VCC = 5V
J16 (Pmod 4 VCC)	PM4_VCC = 3V3	PM4_VCC = 5V
J14 (Pmod 5 VCC)	PM5_VCC = 3V3	PM5_VCC = 5V
J12 (Pmod 6 VCC)	PM6_VCC = 3V3	PM6_VCC = 5V

Table 4-1 Jumpers options

5 CONNECTIVITY

Each Pmod™ connector has i/o pins assigned by their alternate function for the MPS2+ expansion bus (i.e. as per AN383) to support specific purposes from the Digilent Pmod™ Interface Specification.

Pmod1 supports I2C (1 x 4 pins, GND aligned, repeated top and bottom)

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod1 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[1]	GPIO 0	1		N/C
EXP[2]	GPIO 1	2		N/C
EXP[5]	SCL	3	1	SCL
EXP[15]	SDA	4	3	SDA
GND	GND	5	5	GND
VCC	VCC	6	7	VCC
EXP[27]	GPIO 3	7		N/C
EXP[28]	GPIO 4	8		N/C
EXP[31]	SCL	9	2	SCL
EXP[41]	SDA	10	4	SDA
GND	GND	11	6	GND
VCC	VCC	12	8	VCC

Table 5-1 Pmod1

Pmod2 supports SPI (Type2) (1 x 6 pins repeated top and bottom)

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod2 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[16]	ADC SPI_nCS	1	1	SS
EXP[18]	ADC SPI_MOSI	2	2	MOSI
EXP[17]	ADC SPI_MISO	3	3	MISO
EXP[19]	ADC SPI_SCK	4	4	SCK
GND	GND	5	5	GND
VCC	VCC	6	6	VCC
EXP[12]	SPI_nCS	7	1	SS
EXP[13]	SPI_MOSI	8	2	MOSI
EXP[14]	SPI_MISO	9	3	MISO
EXP[11]	SPI_SCK	10	4	SCK
GND	GND	11	5	GND
VCC	VCC	12	6	VCC

Table 5-2 Pmod2

Pmod3 supports expanded SPI (Type2A) (2 x 6 pins)

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod3 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[38]	SPI_nCS	1	1	SS
EXP[39]	SPI_MOSI	2	2	MOSI
EXP[40]	SPI_MISO	3	3	MISO
EXP[44]	SPI_SCK	4	4	SCK
GND	GND	5	5	GND
VCC	VCC	6	6	VCC
EXP[32]	GPIO (INT)	7	7	INT
EXP[33]	GPIO (RST)	8	8	RESET
EXP[34]	GPIO 5	9	9	N/C
EXP[35]	GPIO 6	10	10	N/C
GND	GND	11	11	GND
VCC	VCC	12	12	VCC

Table 5-3 Pmod3

Pmod4 supports UART (1x 6 pins, Type 3 - Top) , (1 x 6 pins, Type 4 – Bottom)

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod4 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[20]	SHIELD0/1 nRST	1	1	CTS
EXP[25]	BT_BOOT	2	2	RTS
EXP[23]	BT_UART_TX	3	3	RXD
EXP[24]	BT_UART_RX	4	4	TXD
GND	GND	5	5	GND
VCC	VCC	6	6	VCC
EXP[6]	GPIO (UART_CTS)	7	1	CTS
EXP[4]	UART_TX	8	2	TXD
EXP[0]	UART_RX	9	3	RXD
EXP[3]	GPIO (RTS)	10	4	RTS
GND	GND	11	5	GND
VCC	VCC	12	6	VCC

Table 5-4 Pmod4

Pmod5 supports Extended UART (Type 4A) (2 x 6 pins)

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod5 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[29]	GPIO (CTS)	1	1	CTS
EXP[30]	UART_TX	2	2	TXD
EXP[26]	UART_RX	3	3	RXD
EXP[36]	GPIO (RTS)	4	4	RTS
GND	GND	5	5	GND
VCC	VCC	6	6	VCC
EXP[7]	GPIO (INT)	7	7	INT
EXP[8]	GPIO (RESET)	8	8	RESET
EXP[9]	GPIO 7	9	9	N/C
EXP[10]	GPIO 8	10	10	N/C
GND	GND	11	11	GND
VCC	VCC	12	12	VCC

Table 5-5 Pmod5

Pmod6 is dedicated to the Pmod™ Specification HBridge configuration (1 x 6 pins, Type 5,Top) and HBridge Dual configuration (1 x 6 pins, Type6, Bottom) but there is no direct support in the EXP alternative function pin assignments.

MPS2+ Connection	MPS2+ Expansion alternate function	Adaptor Pmod6 Header pin	Pmod™ Specification pin	Pmod™ Specification purpose
EXP[37]	BT_SPI_CS	1	1	SDIR
EXP[42]	BT_SPI_MOSI	2	2	sEN
EXP[43]	BT_SPI_MISO	3	3	sSA
EXP[45]	BT_GPIO3	4	4	sSB
GND	GND	5	5	GND
VCC	VCC	6	6	VCC
EXP[46]	BT_GPIO4	7	1	dDIR1
EXP[47]	BT_GPIO6	8	2	dEN1
EXP[48]	BT_GPIO7	9	3	dDIR2
EXP[49]	BT_SPI_CKL	10	4	dEN2
GND	GND	11	5	GND
VCC	VCC	12	6	VCC

Table 5-6 Pmod6

Table 5- shows remaining MPS2+ expansion ports mapping not connected to Pmod™ headers.

MPS2+ Connection	MPS2+ Expansion Alternate Function	Adaptor board signal	Adaptor board function
EXP[21]	USER BUTTON 0	USER_BTN0	USER BUTTON 0
EXP[22]	USER BUTTON 1	USER_BTN1	USER BUTTON 1
EXP[50]	BT_I2C_SCL	R_E50	USER LED 0
EXP[51]	BT_I2C_SDA	R_E51	USER LED 1

Table 5-7 Connectivity