**User manual** 

#### **Document information**

Information	Content
Keywords	PCAL6416AEV, OM13260, OM13320, OM13303
Abstract	This user manual describes how to use NXP's PCAL6416AEV test board.



### PCAL6416AEV test board user manual

#### Revision history

Rev	Date	Description
v.1	20180412	Initial version

PCAL6416AEV test board user manual

### 1 Introduction

This user manual describes how to use NXP's PCAL6416AEV test board. This board is designed for testing functional characteristics of the PCAL6416AEV part, saving time for NXP customer qualification of the 16-bit Agile GPIO expander. This board works with NXP's Fm+ demo board (OM13260) or any customer I<sup>2</sup>C-bus controller. It has a socket for VFPGA24 3x3 mm, a 14-pin connector for FM+ demo board using 3.3V, and two external power supply TPs for VDDI and VDDP of the PCAL6416AEV, as well as an I<sup>2</sup>C-bus header for customer I<sup>2</sup>C controller.

### 2 Features and benefits

- Direct connection to OM13320 Fm+ Development kit
- External I<sup>2</sup>C-bus connection
- · Isolated power rail for power measurement
- · Socket of VFPGA24 3x3 mm with 0.30 mm ball size
- Flexible power supply configuration: 3.3V or external supply
- Direct connection to OM13303 GPIO Target board for I/O visualization
- Jumper configuration of device I<sup>2</sup>C address
- LED indicators for power and INT
- Scope ground connection loop

### 3 Hardware description

- 1. Socket U1 for VFBGA24 3x3 mm with 0.30 mm ball size packet
- Connection to Fm+ demo board (OM13260) port A, B, C or D: CN2 is a 2x8 female connector
- 3. Slave device address selection: J6 is a 2x2 male header
  - a. Slave device address = 0x010-0001(42h) when 1-2 is connected
  - b. Slave device address = 0x010-0000(40h) when 3-4 is connected
- VDDI power selection: J4 is a 1x3 header. This jumper header is for selection VDDI (I2C and internal logic power). The power is from Fm+ demo board 3.3V or external power from TP3
  - a. VDDI = TP3 (VDDI\_IN: external power) when J4 is opened and J5 is connected
  - b. VDDI = 3.3V from Fm+ demo board when J4: 1-2 is connected and J5 is connected
  - c. VDDI = 5V from Fm+ demo board when J8: 1-2 & J4: 2-3 are connected and J5 is connected
- VDDP (IO port) power selection: J1 is a 1x3 header. This jumper header is for selection VDDP (IO port power). The power is from Fm+ demo board 3.3V or external power form TP2.
  - a. VDDP = TP2 (VDDP\_IN: external power) when J1 is opened and J3 is connected
  - b. VDDP = 3.3V from Fm+ demo board when J1: 2-3 is connected and J3 is connected
  - c. VDDP = 5V from Fm+ demo board when J8: 1-2 & J1: 1-2 is connected and J3 is connected
- 6. VDDI external power input by TP3 (VDDI\_IN) and TP4 (GND)
- 7. VDDP external power input by TP2 (VDDP\_IN) and TP5 (GND)
- 8. External I2C SDA signal input from CN1 (SDA: Beagle master)

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- 9. External I2C SCL signal input from CN2 (SCL: Beagle master)
- 10.CN3 and CN4 are 2x5 female headers connected to OM13303 GPIO Target board for I/O visualization
- 11.LED power for INT(D1) signal and VPP(D2) power indicator
- 12.J2 is Reset jumper for PCAL6416AEV

### 4 Using NXP PCAL6416AEV with Fm+ demo board

- 1. Get I2C Fm+ Development Board Kit package at: <u>http://www.nxp.com/demoboard/</u> OM13320.html
- 2. Connect CN2 of NXP PCAL6416AEV to any port A, B, C or D on Fm+ demo board
- 3. Set jumpers:
  - J1 = 2-3 for +3V3 for VDDP\_IN
  - J3 = enabling power for VDDP
  - J4 = 1-2 for +3V3 for VDDI IN
  - J5 = enabling power for VDDI
  - J6 = 3-4 for PCAL6416AEV slave address = 0x010-0000 (40h)
- 4. Set jumpers:
  - Use multi-meter at J3 for VDDP and J5 for VDDI
- 5. Test GPIO outputs and Interrupt
  - a. Put jumper on J4:1-2 & J5 to enable power of D1 LED indicators for INT and PWR
  - b. Connect OM13303GPIO Target Boards (Fm+ demo board kit) to CN3 and CN4
  - c. Connect USB from Fm+ demo board to the PC with NXP Fm+ software



6. Use NXP Fm+ GUI software:

a. Open NXP Fm+ software

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b. Go to Device Selection > I/O Expanders > 16-bit I/O Expanders > PCAL6416A

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c. Change Slave Address to 0x40 and make sure the Slave presence light is on

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군 NXP Fm+ Evaluation Board - [PCAL6416A/PCAL9535A/PCAL9555A/PCAL9539A 16-bit Low Voltage I/O Expanders] 📃 🗖 💌					
Section Sectio	Window Help				- 7 🛛
Device Address	Auto Write On	Write All Read	All		
Input	-Output	Polarity	Configuration	Output Drive Strength	
FF 🥝 FF	FF 🕜 FF	00 🕜 00	FF 🥝 FF	FFFF 🔮	FFFF
	_0x020x03	_0x040x05	_0x060x07	CC0.7 1.00	CC1.7 1.00
00.7 01.7	♥ 00.7 ♥ 01.7	00.7 01.7	▼ 00.7 ▼ 01.7	CC0 6 1 00 •	CC1 6 1 00 •
00.6 01.6	V 00.6 V 01.6	00.6 01.6	V 00.6 V 01.6	CC0.5 1.00	
	V 00.5 V 01.5		V 00.5 V 01.5	CC0.5 1.00	CC1.5 1.00 •
	V 00.3 V 01.3	00.3 01.3	V 00.3 V 01.3	CC0.4 1.00	CC1.4 1.00
00.2 01.2	▼ 00.2 ▼ 01.2	00.2 01.2	▼ 00.2 ▼ 01.2	CC0.3 1.00 -	CC1.3 1.00 -
00.1 01.1	▼ 00.1 ▼ 01.1	00.1 01.1	▼ 00.1 ▼ 01.1	CC0.2 1.00 -	CC1.2 1.00 -
00.0 01.0	▼ 00.0 ▼ 01.0	00.0 01.0	▼ 00.0 ▼ 01.0	CC0 1 1 00 Write	CC1 1 1 00 -
	Write	Write	Write	CC0.1 1.00 Read	CC1.1 1.00
Read	Read	Read	Read	CC0.0 1.00 •	CC1.0 1.00
Input Latch	PU/PD Enable	PU/PD Selection	Interrupt Mask	Interrupt Status	PU/PD Enable
00 🙆 00	00 🙆 00	FF 🙆 FF	FF @ FF		00 @
0x44 0x45	0x46 0x47	0x48 0x49	0x4A 0x4B	_0x4C0x4D	_0x4E
	00.7 01.7				00.7
00.6 01.6	00.6 01.6	▼ 00.6 ▼ 01.6	▼ 00.6 ▼ 01.6	00.6 01.6	00.6
00.5 01.5	00.5 01.5	▼ 00.5 ▼ 01.5	▼ 00.5 ▼ 01.5	00.5 01.5	00.5
00.4 01.4	00.4 01.4	♥ 00.4 ♥ 01.4	▼ 00.4 ▼ 01.4	00.4 01.4	00.4
00.3 01.3	00.3 01.3	♥ 00.3 ♥ 01.3	▼ 00.3 ▼ 01.3	00.3 01.3	00.3
00.2 01.2	00.2 01.2	♥ 00.2 ♥ 01.2	▼ 00.2 ▼ 01.2	00.2 01.2	00.2
00.1 01.1	00.1 01.1	✓ 00.1 ✓ 01.1	V 00.1 V 01.1	00.1 01.1	00.1
00.0 01.0	01.0	V 00.0 V 01.0	V 00.0 V 01.0	00.0 01.0	00.0
Write	Write	Write	Write		Write
Read	Read	Read	Read	Read	Read
USB-I2C Hardware Not Detected I2C: 1000 kHz SPI: 1					SPI: 1 MHz 🔐

Figure 4. Change slave address to 0x40

d. The I/Os can be configured at input or output, input polarity changed, and output set high or low.

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I/O interrupt status, interrupt mask enable/disable and input latch enable/disable.

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NXP Fm+ Evaluation Board - [PCAL6416A/PCAL9535A/PCAL9555A/PCAL9539A 16-bit Low Voltage I/O Expanders]					
Device Address	Auto Write Off	Write All Read	d All		
Input	Output	Polarity	Configuration	Output Drive Strength	
FF 0x00 00.7 01.7 00.6 01.6 00.5 01.5 00.4 01.4 00.3 01.3	FF 0x02 0x03 V 00.7 V 01.7 V 00.6 V 01.6 V 00.5 V 01.5 V 00.4 V 01.4 V 00.3 V 01.3	00 00 0x04 0x05 00.7 01.7 00.6 01.6 00.5 01.5 00.4 01.4 00.3 01.3	FF   Image: FF     0x06   0x07     Image: Imag	FFFF @ CC0.7 1.00 • CC0.6 1.00 • CC0.5 1.00 • CC0.4 1.00 •	FFFF CC1.7 1.00 • CC1.6 1.00 • CC1.5 1.00 • CC1.4 1.00 •
00.2   01.2     00.1   01.1     00.0   01.0	▼ 00.2 ▼ 01.2   ▼ 00.1 ▼ 01.1   ▼ 00.0 ▼ 01.0   Write Pand	00.2 01.2 00.1 01.1 00.0 01.0 Write	▼ 00.2 ▼ 00.2 ▼ 00.1 ▼ 00.1 ▼ 01.1 ▼ 01.0 Write Pand	CC0.3 1.00 • CC0.2 1.00 • CC0.1 1.00 • CC0.0 1.00 • Read	CC1.3 1.00 • CC1.2 1.00 • CC1.1 1.00 • CC1.0 1.00 •
Tenut Lateb	BU/BD Enable	BU/BD Calaction	Totorrunt Mack	Totorrupt Status	DU/DD Eashla
00 00 00 00 00 00 00 00 00 00 00 00 00	FF @ 00 0x46 0x47	FF C FF	CFF CFF	00 00 00 00 0x4D	00 0x4F
00.7   01.7     00.6   01.6     00.5   01.5     00.4   01.4     00.3   01.3     00.2   01.2     00.1   01.1     00.2   01.2     00.1   01.1     Write   Write	♥ 00.7 01.7   ♥ 00.6 01.6   ♥ 00.5 01.5   ♥ 00.4 01.4   ♥ 00.3 01.3   ♥ 00.2 01.2   ♥ 00.1 01.1   ♥ 00.0 01.0	♥ 00.7 ♥ 01.7 ♥ 00.6 ♥ 01.6 ♥ 00.5 ♥ 01.5 ♥ 00.4 ♥ 01.4 ♥ 00.3 ♥ 01.3 ♥ 00.2 ♥ 01.2 ♥ 00.1 ♥ 01.1 ♥ 00.0 ♥ 01.0 Write	▼ 00.7 ▼ 01.7   ▼ 00.6 ▼ 01.6   ▼ 00.5 ▼ 01.5   ▼ 00.4 ▼ 01.4   ▼ 00.3 ▼ 01.3   ▼ 00.2 ▼ 01.2   ▼ 00.1 ▼ 01.1   ▼ 00.0 ▼ 01.0	00.7 01.7   00.6 01.6   00.5 01.5   00.4 01.4   00.3 01.3   00.2 01.2   00.1 01.1   00.0 01.0	00.7 00.6 00.5 00.4 00.3 00.2 00.1 00.0 Write
Read	Read	Read	Read	Read	Read
No Hardware Connected   USB-I2C Hardware Not Detected   I2C: 1000 kHz   SPI: 1 MHz					SPI: 1 MHz
Figure 6. I/O interrupt status					

If the port is set at output then that output port can change the drive strength.

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Service Address	Window Help				• • •	
0x40 -	Auto Write Off	Write All Read	All			
Input	Output	Polarity	Configuration	-Output Drive Strength-	****	
FF 🕜 FF	FF @ FF	00 🙆 00	FF @ FF	FFFF @	FEFF	
_0x000x01	0x02 0x03	0x04 0x05	0x06 0x07	<b>2 1 0 1</b>		
00.7 01.7	▼ 00.7 ▼ 01.7	00.7 01.7	▼ 00.7 ▼ 01.7	CC0.7 1.00	CC1.7 1.00	
00.6 01.6	▼ 00.6 ▼ 01.6	00.6 01.6	♥ 00.6 ♥ 01.6	CC0.6 1.00	CC1.6 1.00	
00.5 01.5	♥ 00.5 ♥ 01.5	00.5 01.5	♥ 00.5 ♥ 01.5	CC0.5 1.00 -	CC1.5 1.00 -	
00.4 01.4	▼ 00.4 ▼ 01.4	00.4 01.4	♥ 00.4 ♥ 01.4	CC0.4 1.00 -	CC1.4 1.00 -	
00.3 01.3	♥ 00.3 ♥ 01.3	00.3 01.3	V 00.3 V 01.3	CC0 2 1 00 -	CC1 2 1 00 -	
00.2 01.2	V 00.2 V 01.2	00.2 01.2	V 00.2 V 01.2	CC0.5 1.00	CC1.5 1.00	
00.1 01.1	V 00.1 V 01.1	00.1 01.1	V 00.1 V 01.1	CC0.2 1.00	CC1.2 1.00	
0.0 01.0	V 00.0 V 01.0	0.0 01.0	V 00.0 V 01.0	CC0.1 1.00	CC1.1 1.00	
	Write	Write	Write	CC0.0 1.00 Read	CC1.0 1.00	
Read	Read	Read	Read			
-Input Latch	PU/PD Enable	PU/PD Selection	-Interrupt Mask	Interrunt Status	PH/PD Enable	
00 00 00	0v46 0v47			00 00 00	00 0	
		0,007 0,017			UX4F	
	V 00.7 E 01.7	V 00./ V 01./	V 00./ V 01./		00.7	
	V 00.5 01.5	V 00.6 V 01.6	V 00.6 V 01.6		00.6	
	V 00.4 01.4	V 00.3 V 01.3	V 00.3 V 01.3		00.3	
00.3 01.3	▼ 00.3 □ 01.3	V 00.3 V 01.3	V 00.3 V 01.3		00.3	
00.2 01.2	▼ 00.2 □ 01.2	▼ 00.2 ▼ 01.2	₹ 00.2 ₹ 01.2	00.2 01.2	00.2	
00.1 01.1	▼ 00.1 □ 01.1	▼ 00.1 ▼ 01.1	▼ 00.1 ▼ 01.1	00.1 01.1	00.1	
00.0 01.0	▼ 00.0 □ 01.0	▼ 00.0 ▼ 01.0	▼ 00.0 ▼ 01.0	00.0 01.0	00.0	
Write	Write	Write	Write		Write	
Read	Read	Read	Read	Read	Read	
No Hardware C	onnected I	USB-I2C Hardware Not Detect	ed	I2C: 1000 kHz	SPI: 1 MHz	
Figure 7. Output port						

### 5 Using NXP PCAL6416AEV with customer system

- 1. Connect input power for VDDI and VDDP
  - a. VDDI power is for I<sup>2</sup>C-bus and internal logic of PCAL6416AEV. VDDI can be input from external power by TP3.
  - b. VDDP power is for I/O ports of PCAL6416AEV. VDDP can be input from external power by TP2.
- 2. Set jumpers:
  - J1 = open for external power for VDDP\_IN
  - J3 = enable power for VDDP
  - J4 = open for external power for VDDI\_IN
  - J5 = enable power for VDDI
  - J6 = 3-4 for PCAL6416AEV slave address = 0x010-0000
  - TP2 = external power 3.3V for VDDP\_IN with TP5 (GND)
  - TP3 = external power 3.3V for VDDI\_IN with TP4 (GND)
- 3. Test current of VDDI and VDDP
  - Use multi-meter at J3 for VDDP and J5 for VDDI.
- 4. Test GPIO outputs and Interrupt
  - a. Put jumper on J4 to enable power of D1 LED indicators for INT and PWR

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- b. Connect OM13303 GPIO Target Boards to CN3 and CN4
- c. Output Low to make the LED light turn on, output high to make LED light turn off



Rev. 1.0 — 12 April 2018

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## 6 Layout



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## 7 Notes

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Date of release: 12 April 2018 Document identifier: UM11111