Basys MX3 Migration Guide

Welcome to the Migration Guide for the Basys MX3! This guide is intended to assist in the migration from the recently retired chiKIT Pro MX4 to the new Basys MX3. See below for the list of topics included in this guide.

The Basys MX3

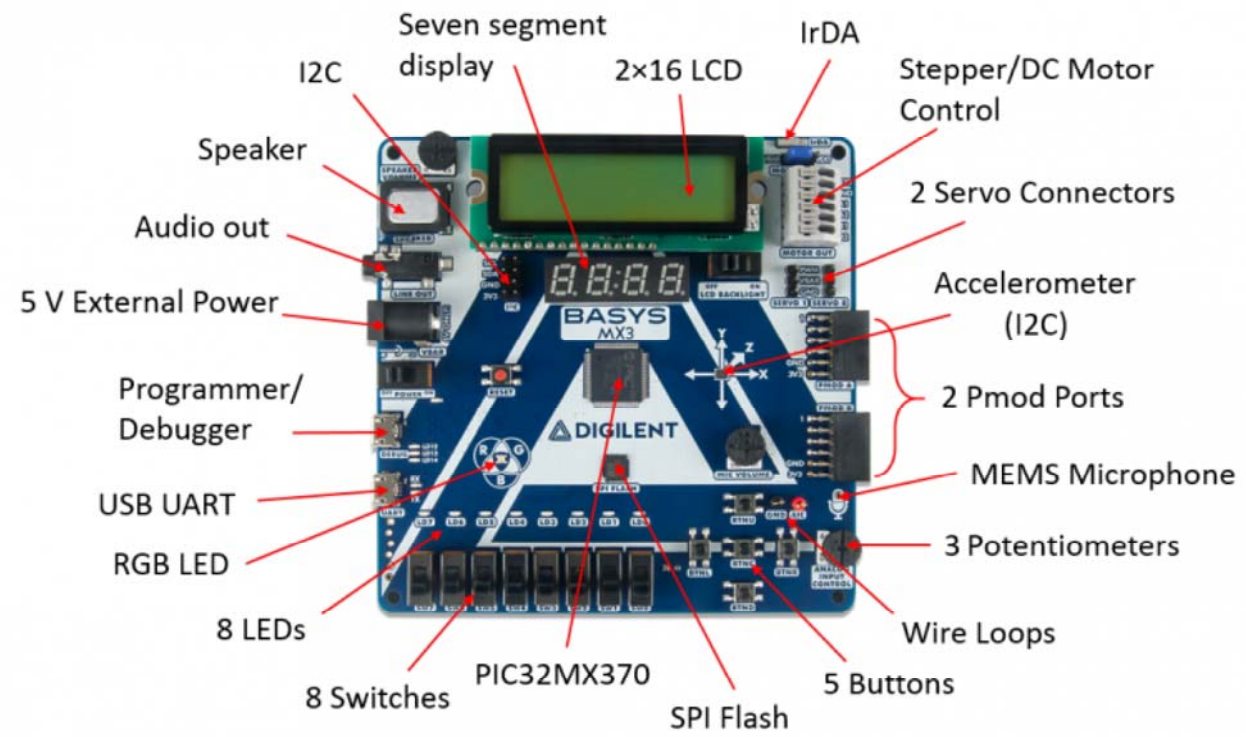
With a few minor exceptions, the Basys MX3 can do all that the chipKIT Pro MX4 could do plus much more. The Basys MX3 is now our number one recommended board for teaching undergraduate embedded systems courses. The additional collection of electronic devices, sensors, and actuators present on the Basys MX3 allow for teaching a wider range of embedded systems concepts, while still using the MPLAB X professional development toolset and a high-performance 32-bit microprocessor. In addition, the Basys MX3 comes with a complete set of free and open-source coursework, "Embedded Systems with PIC32MX370 and Basys MX3," that is deep enough to teach one to two semesters of undergraduate embedded systems courses. For those less interested in the hardware implementation details presented throughout the coursework, a full set of libraries is also provided to allow the user easy access to all of the board's peripherals.

New features

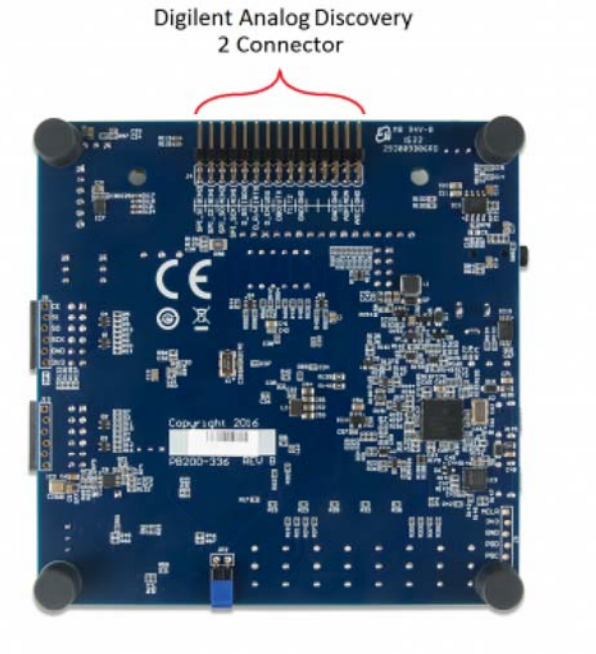
- 2 Pmod ports (16 total microcontroller I/O)
- 8 slide switches
- 5 Push buttons
- 8 LEDs, 1 RGB LED ()
- 4-digit 7-segment display, 16×2 LCD () character display
- 2 servo connectors
- 1 DC/stepper motor connector
- 1 each of a Microphone, speaker, and audio jack
- 3 Potentiometer
- 1 IrDA module
- 1 Accelerometer

A visual walkaround of the Basys MX3:
(https://reference.digilentinc.com/_detail/reference/microprocessor/basys-mx3/basys_mx3_walkaround.png?id=reference%3Amicroprocessor%3Abasys-mx3%3Amigration-guide) (https://reference.digilentinc.com/_detail/reference/microprocessor/basys-mx3/basysmx3_-_bottom.png?id=reference%3Amicroprocessor%3Abasys-mx3%3Amigration-guide)

Course material "Embedded Systems with PIC32MX370 and Basys MX3"

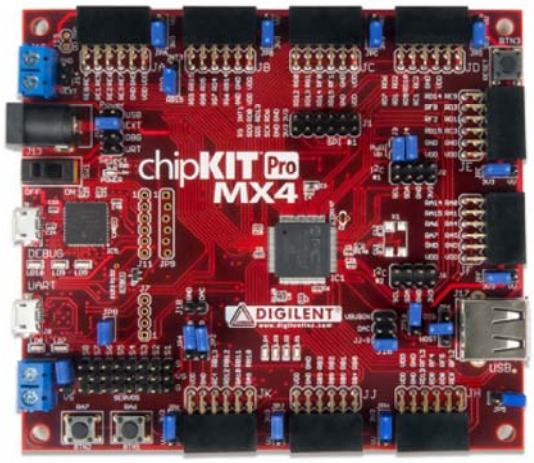


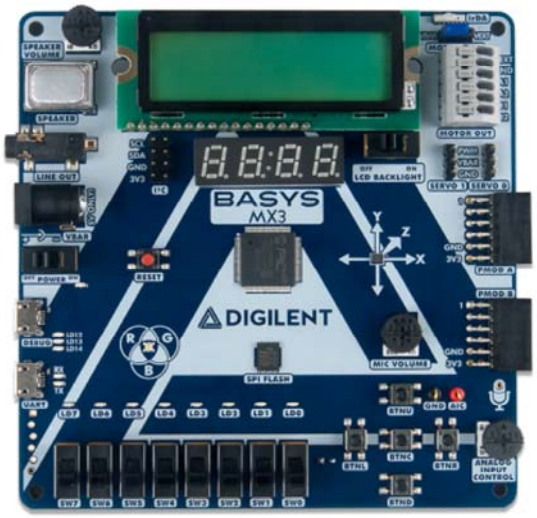
Free and completely open-source course material is available! Created in coordination with an experienced embedded systems university professor, a set of seven theoretical teaching units with 15 complete labs are available for download on the Basys MX3 Resource Center (https://reference.digilentinc.com/reference/microprocessor/basys-mx3/start). Instructors can design a new course or update an old one more easily by following our coursework exactly, or picking and choosing from our labs that range from simple digital IO to audio digital signal processing. The coursework is titled "Embedded Systems with PIC32MX370 and Basys MX3." Completed lab solutions are available to instructors upon request.



Hardware Comparison

To scale comparison between the chipKIT Pro MX4 and the Basys MX3:





(https://reference.digilentinc.com/_detail/reference/microprocessor/basys-mx3/basys_mx3_-_mx4_pro_-_comparison.png?id=reference%3Amicroprocessor%3Abasys-mx3%3Amigration-guide)

Table 1. Feature Comparison

chipKIT Pro MX4	Basys MX3
PIC32MX460F512L 32-bit processor	PIC32MX370F512L 32-bit processor
0 Pmod ports with PPS* functionality	2 Pmod ports with PPS* functionality
90 user accessible digital IO pins	26 user accessible digital IO pins
14 user accessible analog pins	3 user accessible analog pins
USB 2.0 OTG/device connector	N/A
Power input range of 3.6 to 12 V	USB or external 5 V power input
Onboard programmer/debugger	Onboard programmer/debugger
USB-UART bridge	USB-UART bridge
N/A	4 MB () of additional SPI flash
N/A	Analog Discovery 2 connector
Embedded User I/O	**Embedded User I/O**
0 Switches	8 Switches
2 Push buttons	5 Push buttons
4 LEDs	8 LEDs, 1 RGB LED ()
8 Servo connectors	2 Servo connectors
N/A	1 Stepper motor or 2 DC motor driver
N/A	2×16 LCD ()
N/A	Seven Segment display

chipKIT Pro MX4	Basys MX3
N/A	Accelerometer
N/A	Speaker
N/A	Audio line out
N/A	MEMs Microphone
N/A	FIR compatible IrDA receiver/transmitter
N/A	3 Potentiometers for analog gain control

* - Peripheral Pin Select

Table 2. Processor Comparison

PIC32MX460F512L features	PIC32MX370512L features
MIPS32® M4K® core runs up to 80 MHz () using onboard 8 MHz () oscillator	MIPS32® M4K® core runs up to 96 MHz () using onboard 8 MHz () oscillator
512 KB program flash	512 KB program flash
N/A	12 KB of boot flash
32 KB internal SRAM	128 KB internal SRAM
Serial Interfaces	**Serial Interfaces**
2 UART	5 UART
2 SPI	2 SPI
2 I2C	2 I2C
5 16-bit timers/counters	5 16-bit timers/counters
5 input capture modules	5 input capture modules
5 output compare modules	5 output compare modules
2 Analog comparators	2 Analog comparators
4/2 Programmable/Dedicated DMA Channels	4/0 Programmable/Dedicated DMA channels

Software support

As with the chipKIT Pro MX4, the Basys MX3 is designed to work with MPLAB X, as is the "Embedded Systems with Pic32MX370 and Basys MX3" coursework available on the Resource Center (https://reference.digilentinc.com/reference/microprocessor/basys-mx3/start#accessories). The Basys MX3 can also work with the Arduino IDE with the Digilent Core (https://reference.digilentinc.com/learn/software/tutorials/digilent-core-install/start). Users may also use MPLAB Harmony, although Digilent does not have any Basys MX3 dedicated materials for MPLAB Harmony at this point in time.

Completed lab solutions are available to instructors upon request.

Basys MX3 Hardware Configuration

Servos, DC motors, and Stepper Motors

The Basys MX3 comes with a pair of 3-pin servo motor headers labeled SERVO 0 and SERVO 1 on the silk screen. A 6-pin spring tension header is available in the upper right hand corner of Basys MX3 board that can support two DC motors or a single stepper motor.

All types of motors used on the Basys MX3 require external power to run, either from an external 5 V power supply connected to the barrel jack connector of the Basys MX3 or, in the case of the DC motors and stepper motor, from an alternate external power supply connected to the VEXT pin present on the 6-pin motor connector. None of the motors are wired to be able to be powered from one of the microUSB ports.

The servo motor headers use the following connections for their PWM outputs:

Servo Header	PIC32 Pin
Servo 0 PWM	RB8
Servo 1 PWM	RA15

The servo motors should also be configured to be digital outputs with the analog functionality on Servo 0 disabled:

```
TRISBbits.TRISB8 = 0;
ANSELBbits.ANSB8 = 0;

TRISAbits.TRISA15 = 0;
```

The two PWM pins for the servos are mapped to a set of OCx pins in the Basys MX3 library pack (https://github.com/Digilent/Basys-MX3-library). More details about remappable pins can be found in the corresponding section of the Basys MX3 Reference Manual (https://reference.digilentinc.com/reference/microprocessor/basys-mx3/reference-manual#remappable_pins).

```
RPB8R = 0x0B; //RB8 mapped to the OC5 peripheral

RPA15R = 0x0B; //RA15 mapped to the OC4 peripheral
```

The DC motor and stepper motor header can use an external voltage up to 11 V and can drive a pair of 1.5 A brushed DC motors. The following pins are used for the DC/stepper motor driver (a Texas Instruments DRV8835):

Basys MX3 Pin Name	Motor Driver Pin Name	PIC32 Pin
Mode	Mode	RF1
AIN1	AIN1/APHASE	RB3
AIN2	AIN2/AENBL	RE8
BIN1	BIN1/BPHASE	RE9
BIN2	BIN2/BENBL	RB5

The following configurations are used for the pins to define them as digital outputs and to disable the analog functionality on AIN1 and BIN2:

```
TRISFbits.TRISF1 = 0; //set RF1 (MODE) to be an output

TRISBbits.TRISB3 = 0; //set RB3 (AIN1) to be an output
ANSELBbits.ANSB3 = 0; //disable analog functionality for RB3 (AIN1)

TRISEbits.TRISE8 = 0; //set RE8 (AIN2) to be an output

TRISEbits.TRISE9 = 0; //set RE9 (BIN1) to be an output

TRISBbits.TRISB5 = 0; //set RB5 (BIN2) to be an output
ANSELBbits.ANSB5 = 0; //disable analog functionality for RB5 (BIN2)
```

Seven Segment Display and LCD Screen

The Basys MX3 comes with both a seven segment display and a LCD () screen, offering a nice set of built-in replacements for Pmods or other displays that may have been otherwise used.

The seven segment display can be driven by using the following pins:

Anode Pins		**Cathode Pins**			
AN0	RB12	CA	RG12	CE	RG15
AN1	RB13	CB	RA14	CF	RD7
AN2	RA9	CC	RD6	CG	RD13
AN3	RA10	CD	RG13	DP	RG14

Users will need to configure the pins to these settings:

```
//set all the pins as digital output and disable analog functionality as necessary
TRISBbits.TRISB12 = 0; //RB12 set as output
ANSELBbits.ANSB12 = 0; //RB12 analog functionality disabled

TRISBbits.TRISB13 = 0; //RB13 set as output
ANSELBbits.ANSB13 = 0; //RB13 analog functionality disabled

TRISAbits.TRISA9 = 0; //RA9 set as output

TRISAbits.TRISA10 = 0; //RA10 set as output

TRISGbits.TRISG12 = 0; //RG12 set as output

TRISAbits.TRISA14 = 0; //RA14 set as output

TRISDbits.TRISD6 = 0; //RD6 set as output

TRISGbits.TRISG13 = 0; //RG13 set as output

TRISGbits.TRISG15 = 0; //RG15 set as output

TRISDbits.TRISD7 = 0; //RD7 set as output

TRISDbits.TRISD13 = 0; //RD13 set as output

TRISGbits.TRISG14 = 0; //RG14 set as output
```

The LCD () screen can be driven using the following pins:

Control pins		Parallel Data Pins			
DISP_RS	RB15	DB0	RE0	DB4	RE4
DISP_RW	RD5	DB1	RE1	DB5	RE5
DISP_RS	RB15	DB2	RE2	DB6	RE6
		DB3	RE3	DB7	RE7

Users will need to configure the pins to these settings:

```
//set up the control pins as digital outputs with no analog functionality
TRISBbits.TRISB15 = 0; // RB15 (DISP_RS) set as an output
ANSELBbits.ANSB15 = 0; // disable analog functionality on RB15 (DISP_RS)

TRISDbits.TRISD5 = 0; // RD5 (DISP_RW) set as an output

TRISDbits.TRISD4 = 0; // RD4 (DISP_EN) set as an output

//set up the data pins as digital inputs (or outputs as needed) with no analog functiona
lity

TRISEbits.TRISE0 = 1; // RE0 (DB0) set as input (change 1 to 0 for output/write function
ality)

TRISEbits.TRISE1 = 1; // RE1 (DB1) set as input (change 1 to 0 for output/write function
ality)

TRISEbits.TRISE2 = 1; // RE2 (DB2) set as input (change 1 to 0 for output/write function
ality)
ANSELEbits.ANSE20 = 0; // disable analog functionality on RE2 (DB2)

TRISEbits.TRISE3 = 1; // RE3 (DB3) set as input (change 1 to 0 for output/write function
ality)

TRISEbits.TRISE4 = 1; // RE4 (DB4) set as input (change 1 to 0 for output/write function
ality)
ANSELEbits.ANSE21 = 0; // disable analog functionality on RE4 (DB4)

TRISEbits.TRISE5 = 1; // RE5 (DB5) set as input (change 1 to 0 for output/write function
ality)
ANSELEbits.ANSE22 = 0; // disable analog functionality on RE5 (DB5)

TRISEbits.TRISE6 = 1; // RE6 (DB6) set as input (change 1 to 0 for output/write function
ality)
ANSELEbits.ANSE23 = 0; // disable analog functionality on RE6 (DB6)

TRISEbits.TRISE7 = 1; // RE7 (DB7) set as input (change 1 to 0 for output/write function
ality)
ANSELEbits.ANSE27 = 0; // disable analog functionality on RE7 (DB7)
```

The backlight for the LCD () screen can be enabled by using the slide switch on the Basys MX3 between the LCD () screen and the seven segment display. A library for the LCD () is available from the Digilent Basys MX3 library pack; alternatively users may create their own library functions based on the commands available listed in the KS0066U display controller datasheet. A list of the predefined characters built into the display controller are available here (https://reference.digilentinc.com/_detail/pmod/pmod/clp/pmodclp_predefinedcharacters.jpg).

Accelerometer

An on-board accelerometer, NXP's MMA8652FC, is provided on the Basys MX3 to the right of the PIC32 chip with the directions of the measured Cartesian axes indicated on the silk screen. Demos using the accelerometer are available in the Basys MX3 Library Pack (https://github.com/Digilent/Basys-MX3-library).

The accelerometer can be accessed through the following pins:

PIC32 Pin	Description
SCL1/RG2	I²C Clock Signal
SDA1/RG3	I²C Data Signal
RG0	Interrupt Pin

If used, the interrupt pin should be configured as a digital input:

```
TRISGbits.TRISG0 = 1;
```

Audio: speaker and microphone

The Basys MX3 comes with a electro dynamic speaker, an audio jack, and a microphone. The two audio out components receive a PWM controlled digital signal to generate multiple values between 0 V and 3.3 V and are sent through a low pass filer to construct an analog signal. A potentiometer is located near the speakers to control the audio out volume. When using the speaker, the audio signal is first passed through a 1.2 W audio power amplifier; if the line out (headphones) connector is used instead, the on-board speaker is automatically muted.

The following pin is used for outputting an audio signal:

Signal Name	PIC32 pin
A_OUT	RB14

The following configuration is used to set the pin as a digital output and disable the analog functionality of that pin:

```
TRISBbits.TRISB14 = 0; //set as an output

ANSELBbits.ANSB14 = 0; //disable analog functionality
```

The audio library in the Basys MX3 library pack (https://github.com/Digilent/Basys-MX3-library) maps RB14 to the OC1 peripheral:

```
RPB14RR = 0x0C; //map RB14 to OC1
```

The embedded microphone is a Knowles Acoustics MEMs microphone with a SNR of 94 dB at 1 kHz (). Additional information about the microphone is available in the corresponding section of the Basys MX3 reference manual (https://reference.digilentinc.com/reference/microprocessor/basys-mx3/reference-manual#microphone).

The Basys MX3 uses the embedded PIC32's 10-bit ADC () to receive all of the data coming from the microphone. The following pin is used to do so:

Pin name	PIC32 pin
A_MIC	RB4

The following configuration for the microphone is used:

```
TRISBbits.TRISB4 = 1; //set the pin as an input

ANSELBbits.ANSB4 = 1; //enable analog functionality
```

IrDA

The IrDA module is a FIR-compatible infrared transceiver that allows users to explore a widely available part of the electromagnetic spectrum that is commonly overlooked by microcontroller platforms.

The following pins are used with the IrDA:

Pin Name	PIC32 Pin
IRDA_PDOWN	RG1
IR_TX	RB7
IR_RX	RB6

The following configurations for the IrDA are used:

```
TRISGbits.TRISG1 = 0; //set RG1 (IRDA_PDOWN) as an output

TRISBbits.TRISB7 = 0; //set RB7 (IR_TX) as an output
ANSELBbits.ANSB7 = 0; //disable analog functionality on RB7 (IR_TX)

TRISBbits.TRISB6 = 1; //set RB6 (IR_RX) as an input
ANSELBbits.ANSB6 = 0; //disable analog functionality on RB6 (IR_RX)
```

I2C

The Basys MX3 provides access to one of the two I²C ports available on the embedded PIC32 chip, I2C1. This bus is shared by the accelerometer present on the Basys MX3 and already incorporates 2.2 kOhm pullup resistors on the SDA and SCL lines, eliminating the need for most other I2C devices that may be daisy-chained onto this bus to provide their own pullup resistors. The I2C1 interface on the Basys MX3 is not remappable, so there is no concern about having to properly configure the I2C pins.

The following pins are used for the I2C interface and are physically available on the 2×4 pin header located to the right of the seven segment display:

Pin Name	PIC32 pin
SCL	SCL1/RG2
SDA	SDA1/RG3

SPI

There are two SPI ports available on the PIC32MX370F512L; the SPI2 is available to use on the Pmod A host port. The SPI1 is dedicated to the SPI flash memory present on the Basys MX3. By default the PIC32 has both SPI interfaces set to be a slave device, so pin remapping will be needed to make it a master device. The Basys MX3 library pack (https://github.com/Digilent/Basys-MX3-library) includes a library to work with the SPI2 interface.

The pins to use the SPI2 (as a slave device) are as follows:

Pmod pin names	Function	PIC32 Pin
JA1	SPI2_SS	RC2

Pmod pin names	Function	PIC32 Pin
JA2	SPI2_SI	RC1
JA3	SPI2_SO	RC4
JA4	SPI2_SCK	RG6

The following configuration is used to set SPI2 as a master SPI:

```
RPC1R = 0x06; // RC1 mapped to output SDO2

SDI2R = 0x0A; // input SDI2R mapped to pin RC4

ANSELGbits.ANSB16 = 0; //disable analog functionality on RG6 (SPI2_SCK)
```

The flash memory is a 4 MB () Spansion S25FL132 that contains 1024 sectors of 4 KB. The Basys MX3 library pack (https://github.com/Digilent/Basys-MX3-library) provides a demo to interact with the SPI flash.

The following pins are used by default for SPI1:

Pin Name	PIC32 Pin
SPI_CE	RF8
SPI_SI	RF2
SPI_SO	RF7
SPI_SCK	RF6

The following configurations are used to make SPI1 a master bus:

```
RPF2R = 0x08; //map RF2 to the SDO1 output

SDI1R = 0x0F; //map the SDI1 input to RF7
```

UART

The PIC32MX370F512L present on the Basys MX3 provides five UART interfaces, aptly named UART1, UART2, UART3, UART4, and UART5. Each of the UART interfaces can operate in 2-wire or 4-wire mode; 2-wire mode only uses the receive and transmit signals (RX and TX) while the 4-wire mode also includes the request-to-send and clear-to-send (RTS and CTS) signals.

The Basys MX3 includes a USB-UART serial converter, available via the microUSB port labeled UART just below the microUSB port labeled DEBUG. This serial converter can be mapped to either use UART4 or UART5; all of the other UART interfaces can be mapped to either one of the Pmod host ports.

The following pins are used in the aforementioned USB-UART serial converter:

Pin Name	PIC32 Pin
UART_TX	RF12
UART_RX	RF13

The following configuration is used in the UART library available in the Basys MX3 library pack (https://github.com/Digilent/Basys-MX3-library) for the USB-UART bridge:

```
TRISFbits.TRISF12 = 0; //RF12 (UART_TX) set as an output
RPF12R = 0x02; //map RF12 to the UART4 output (U4TX)

TRISFbits.TRISF13 = 1; //RF13 (UART_RX) set as an input
U4RXR = 0x09; //map the UART4 input (U4RX) to RF13
```

Connectors

Pmod Ports

chipKIT Pro MX4					
Pmod Pin	**PIC32 Pin**	**Pmod Pin**	**PIC32 Pin**	**Pmod Pin**	
JA-01	PMD0/RE0	JF-01	SCL1/INT3 ()/RA14	JA1	
JA-02	PMD1/RE1	JF-02	SDA1/INT4/RA15	JA2	
JA-03	PMD2/RE2	JF-03	TRCLK/RA6	JA3	RP(
JA-04	PMD3/RE3	JF-04	TRD3/RA7	JA4	AN16/RP(
JA-07	PMD4/RE4	JF-07	TMS/RA0	JA7	
JA-08	PMD5/RE5	JF-08	TCK/RA1	JA8	AN17/C1I
JA-09	PMD6/RE6	JF-09	TDI/RA4	JA9	AN18/C2I
JA-10	PMD7/RE7	JF-10	TDO/RA5	JA10	AN19/C2I
JB-01	PMA2/SS2/CN11/RG9	JH-01	U2CTS/RF12	JB1	
JB-02	PMA3/SDO2/CN10/RG8	JH-02	PMA8/U2TX/CN18/RF5	JB2	RPD
JB-03	PMA4/SDI2/CN9/RG7	JH-03	PMA9/U2RX/CN17/RF4	JB3	RPD
JB-04	PMA5/SCK2/CN8/RG6	JH-04	U2RTS/BCLK2/RF13	JB4	RPD
JB-07	PMA0/AN15/OCFB/CN12/RB15	JH-07	INT1 ()/RE8	JB7	SOSCO/
JB-08	PMRD/CN14/RD5	JH-08	SDO1/OC1/INT0/RD0	JB8	
JB-09	PMWR/OC5/CN13/RD4	JH-09	IC1/RTCC ()/RD8	JB9	AN
JB-10	PMALH/PMA1/AN14/RB14	JH-10	PMD13/CN19/RD13	JB10	SOS
JC-01	TRD1/RG12	JJ-01	PGD1/EMUD1/AN0/CN2/RB0		

chipKIT Pro MX4					
Pmod Pin	**PIC32 Pin**	**Pmod Pin**	**PIC32 Pin**	**Pmod Pin**	**PI**
JC-02	TRD0/RG13	JJ-02	PGC1/EMUC1/AN1/CN3/RB1		
JC-03	TRD2/RG14	JJ-03	C2IN-/AN2/CN4/RB2		
JC-04	RG15	JJ-04	C2IN+/AN3/CN5/RB3		
JC-07	PMD8/RG0	JJ-07	C1IN-/AN4/CN6/RB4		
JC-08	PMD9/RG1	JJ-08	VBUSON/C1IN+/AN5/CN7/RB5		
JC-09	PMD11/RF0	JJ-09	C1OUT/AN8/RB8		
JC-10	PMD10/RF1	JJ-10	C2OUT/AN9/RB9		
JD-01	PMD15/CN16/RD7	JK-01	CVrefout/PMA13/AN10/RB10		
JD-02	OC2/RD1	JK-02	PMA12/AN11/RB11		
JD-03	IC2/SS1/RD9	JK-03	PMA11/AN12/RB12		
JD-04	T2CK/RC1	JK-04	PMA10/AN13/RB13		
JD-07	PMD14/CN15/RD6	JK-07	PMA7/Vref-/CVref-/RA9		
JD-08	OC3/RD2	JK-08	PMA6/Vref+/CVref+/RA10		
JD-09	IC3/SCK1/PMCS2/PMA15/RD10	JK-09	PMD12/IC5/RD12		
JD-10	T3CK/RC2	JK-10	SDI1/T5CK/RC4		
JE-01	CN20/U1CTS/RD14				
JE-02	U1TX/RF8				
JE-03	U1RX/RF2				
JE-04	U1RTS/BCLK1/CN21/RD15				
JE-07	INT2 ()/RE9				
JE-08	OC4/RD3				
JE-09	IC4/PMCS1/PMA14/RD11				
JE-10	T4CK/RC3				

Analog Discovery 2 Connector

Beneath the LCD () screen on the underside of the PCB is a 2×15 pin header, providing access to a variety of analog and digital signals that can be easily viewed via an oscilloscope or logic analyzer. The following pins are present on the header with pins 21 through 24 left unconnected:

Pin #	Silk Screen Name	PIC32 Pin	Connected to / Module	Corresponding Analog Discovery Pin
1	SPI_SI	RPF2/RF2	SPI_SI / Flash memory	Digital IO 7
2	BIN2	AN5/C1INA/RPB5/RB5	BIN2 / Motor driver	Digital IO 15
3	SPI_CE	RPF8/RF8	SPI_CE / Flash memory	Digital IO 6
4	BIN1	RPE9/RE9	BIN1 / Motor driver	Digital IO 14
5	SPI_SO	RPF7/RF7	SPI_SO / Flash memory	Digital IO 5
6	AIN2	RPE8/RE8	AIN2 / Motor driver	Digital IO 13
7	SPI_SCK	RPF6/SCK1/INT0/RF6	SPI_SCK / Flash memory	Digital IO 4
8	AIN1	PGED3/AN3/C2INA/RPB3/RB3	AIN1 / Motor driver	Digital IO 12
9	D_RS	AN15/RPB15/PMA0/CTED6/RB15	DISP_RS / LCD () module	Digital IO 3
10	IRRX	PGEC2/AN6/RPB6/RB6	IR_RX / IrDA module	Digital IO 11
11	DISP_R/W	RPD5/PMRD/RD5	DISP_R/W / LCD () module	Digital IO 2
12	IRTX	PGED2/AN7/RPB7/CTED3/RB7	IR_TX / IrDA module	Digital IO 10
13	D_EN	RPD4/PMWR/RD4	DISP_EN / LCD () module	Digital IO 1
14	URX	RPF13/RF13	UART_RX / UART	Digital IO 9
15	DB0	PMD0/RE0	DB0 / LCD () module	Digital IO 0
16	UTX	RPF12/RF12	UART_TX / UART	Digital IO 8
17	T1	RPF0/PMD11/RF0	BTNC / TRIG_1 / User Buttons	T1
18	T2	AN9/RPB9/CTED4/RB9	SW7 / TRIG_2 / User Switches	T2
19	GND ()	GND ()		GND ()
20	GND ()	GND ()		GND ()
25	GND ()	GND ()		GND ()

Pin #	Silk Screen Name	PIC32 Pin	Connected to / Module	Corresponding Analog Discovery Pin
26	GND ()	GND ()		GND ()
27	AOP	analog pin	A_OUT_P / Audio out	Scope 2+
28	AON	analog pin	A_OUT_N / Audio out	Scope 2-
29	AMIC	AN4/C1INB/RB4	A_MIC / Microphone	Scope 1+
30	GND ()	GND ()		Scope 1-

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-  (https://www.youtube.com/user/DigilentInc)
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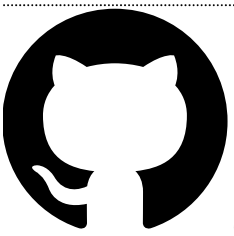
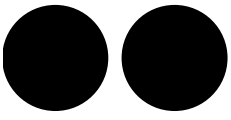
-  (https://github.com/digilent)
-  (https://www.reddit.com/r/digilent)
-  (https://www.linkedin.com/company/1454013)
-  (https://www.flickr.com/photos/127815101@N07)