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**PIC32MZ DA Family Starter Kit
User's Guide**

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Object of Declaration: PIC32MZ DA Family Starter Kit User's Guide

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This declaration of conformity is issued by the manufacturer.

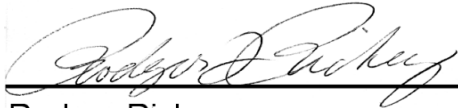
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.



Rodger Richey
Director of Development Tools



Date

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PIC32MZ DA FAMILY STARTER KIT USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXXXXXA”, where “XXXXXXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® X IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the PIC32MZ DA Family Starter Kit. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Recommended Reading](#)
- [The Microchip Web Site](#)
- [Development Systems Customer Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)

DOCUMENT LAYOUT

This document describes how to use the PIC32MZ DA Family Starter Kit (also referred to as “starter kit”) as a development tool to emulate and debug firmware on a target board. This user’s guide is composed of the following chapters:

- **Chapter 1. “Introduction”** provides a brief overview of the starter kit, highlighting its features and uses.
- **Chapter 2. “Hardware”** provides the hardware descriptions of the starter kit.
- **Appendix A. “Schematics”** provides a block diagram, board layouts, and detailed schematics of the starter kit.
- **Appendix B. “Bill of Materials”** provides the bill of materials for the components used in the design and manufacture of the starter kit.

PIC32MZ DA Family Starter Kit User's Guide

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Italic characters	Referenced books	<i>MPLAB X IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u><i>File > Save</i></u>
Bold characters	A dialog button	Click OK
	A tab	Click the Power tab
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Plain Courier New	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
<i>Italic Courier New</i>	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [options]
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses...	Replaces repeated text	var_name [, var_name...]
	Represents code supplied by user	void main (void) { ... }
Notes	A Note presents information that we want to re-emphasize, either to help you avoid a common pitfall or to make you aware of operating differences between some device family members. A Note can be in a box, or when used in a table or figure, it is located at the bottom of the table or figure.	Note: This is a standard note box.
		CAUTION This is a caution note. Note 1: This is a note used in a table.

RECOMMENDED READING

This user's guide describes how to use the PIC32MZ DA Family Starter Kit. The following Microchip documents are available and recommended as supplemental reference resources.

PIC32MZ Graphics DA Family Data Sheet (DS60001361)

Refer to this document for detailed information on PIC32MZ DA family of devices. Reference information found in this data sheet includes:

- Device memory maps
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the devices

MPLAB® XC32 C/C++ Compiler User's Guide (DS50001686)

This document details the use of Microchip's MPLAB XC32 C/C++ compiler to develop an application.

MPLAB® X IDE User's Guide (DS50002027)

Refer to this document for more information pertaining to the installation and implementation of the MPLAB X IDE software, as well as the MPLAB SIM Simulator software that is included with it.

Universal Serial Bus Specification and Associated Documents

The Universal Serial Bus is defined by the USB 2.0 specification and its associated supplements and class-specific documents. These documents are available from the USB Implementers Forum, see their web site at: <http://www.usb.org>.

THE MICROCHIP WEB SITE

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listings
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listings of seminars and events; and listings of Microchip sales offices, distributors and factory representatives

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To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools
- **Emulators** – The latest information on the Microchip in-circuit emulator, MPLAB REAL ICE™
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3
- **MPLAB X IDE** – The latest information on Microchip MPLAB X IDE, the Windows® Integrated Development Environment for development systems tools
- **Programmiers** – The latest information on Microchip programmers including the PICkit™ 3 development programmer

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: <http://support.microchip.com>.

DOCUMENT REVISION HISTORY

Revision A (May 2017)

This is the initial released version of this user's guide.

PIC32MZ DA Family Starter Kit User's Guide

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PIC32MZ DA FAMILY STARTER KIT USER'S GUIDE

Chapter 1. Introduction

Thank you for purchasing a Microchip Technology PIC32MZ DA Family Starter Kit. This starter kit provides a low-cost modular development system for Microchip's line of 32-bit microcontrollers.

The starter kit is available in four versions:

- PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (P/N: DM320008)
- PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (Crypto) (P/N: DM320008-C)
- PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (P/N: DM320010)
- PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (Crypto) (P/N: DM320010-C)

The four versions of the starter kit which are facilitated through a common base board (referred to as PIC32MZ DA SK Base Board) and four different CPU Daughter Cards (referred to as PIC32MZ2064DAx288 Daughter Card and PIC32MZ2064DAx169 Daughter Card) are given below:

- DM320008 comes with PIC32MZ2064DAA288 Daughter Card
- DM320008-C comes with PIC32MZ2064DAB288 Daughter Card
- DM320010 comes with PIC32MZ2064DAG169 Daughter Card
- DM320010-C has PIC32MZ2064DAH169 Daughter Card

Any configuration of the PIC32 Embedded Graphics Starter Kit can be used in conjunction with Multimedia Expansion Board II (MEB-II) at <http://www.microchip.com/meb2> to exercise the embedded graphics features.

For a free Microchip demonstration code and additional information, please visit the MPLAB Harmony page at: <http://www.microchip.com/MPLABHarmony>.

The MPLAB Harmony Integrated Software Framework includes several demonstrations that have configurations for the PIC32MZ DA Starter Kit. These demonstrations are available in the <install-dir>/apps folder of the MPLAB Harmony installation, where <install-dir> is either C:/microchip/harmony/<version> (for Windows OS) or ~/microchip/harmony/<version> (for MAC or Linux OS).

For additional information on demonstrations and building/running steps, refer to the documents available in the <install-dir>/doc folder.

This chapter covers the following topics:

- [Kit Contents](#)
- [Starter Kit Functionality and Features](#)

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1.1 KIT CONTENTS

The PIC32MZ DA Starter Kit contains the following items:

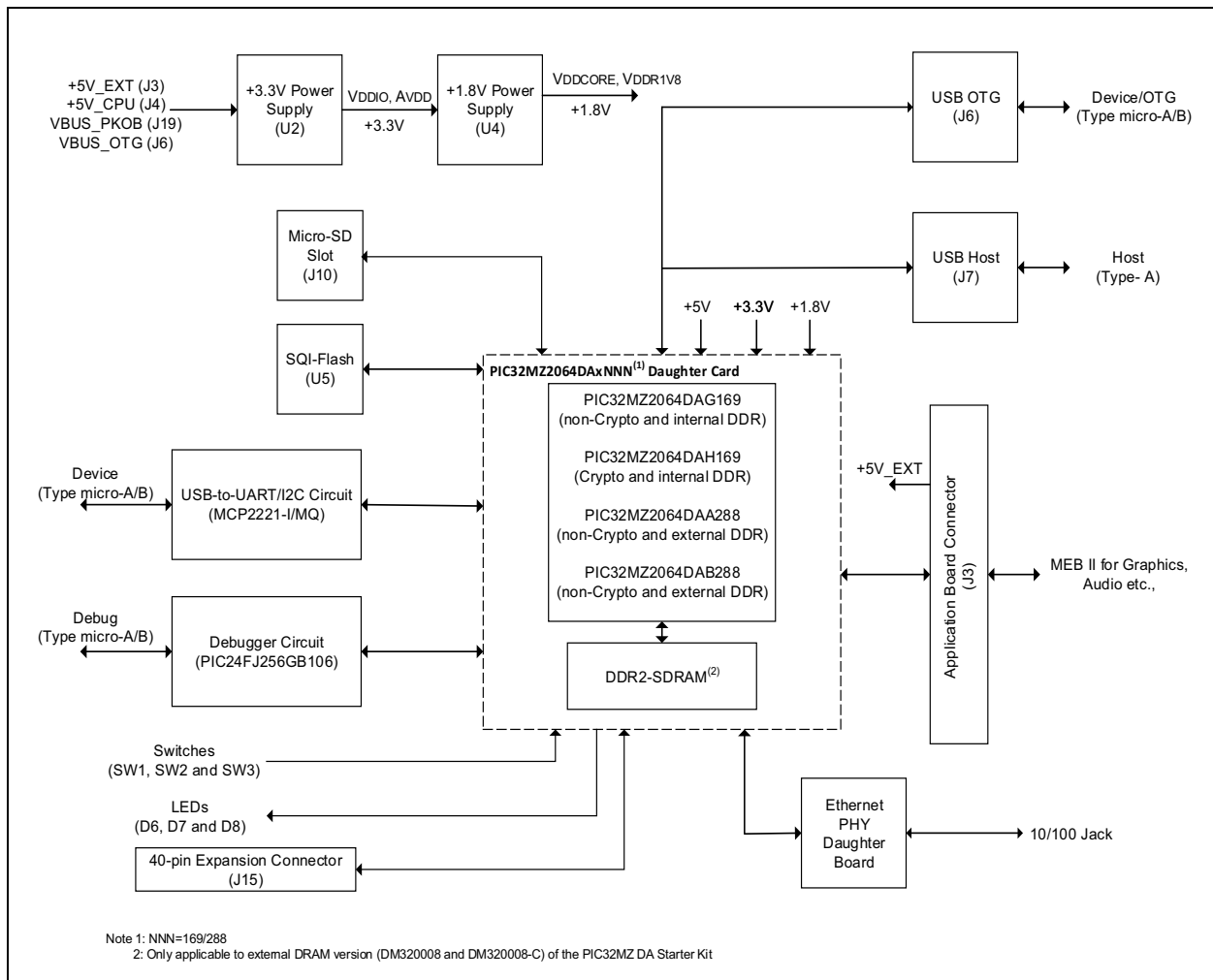
- One PIC32MZ Embedded Graphics (DA) Starter Kit
- One LAN8740A Ethernet PHY Daughter Board
- One Type-A male to Micro-B USB cable (to communicate with the PIC32 DEBUG port)
- One ETH cable
- Information sheet

Note: If you are missing any part of the kit, contact a Microchip sales office for assistance. A list of Microchip offices for sales and service is provided on the last page of this document.

1.2 BLOCK DIAGRAM

Figure 1-1 illustrates the high-level block diagram of the PIC32MZ DA Starter Kit.

FIGURE 1-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32MZ DA STARTER KIT



1.3 STARTER KIT FUNCTIONALITY AND FEATURES

1.3.1 Development Board

Representations of the layout of the development board included in the PIC32MZ DA Family Starter Kit are shown in [Figure 1-2](#) through [Figure 1-7](#).

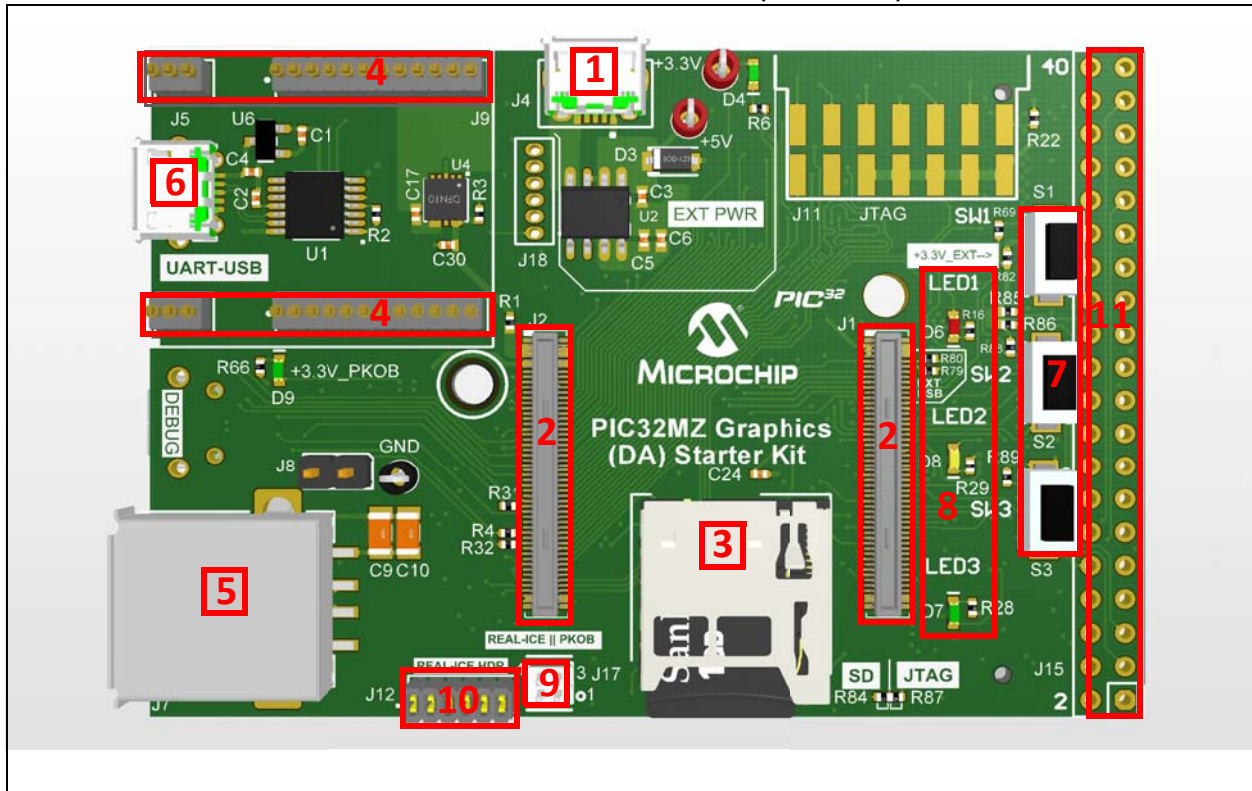
The top assembly of the PIC32MZ DA SK Base Board includes these key features, as indicated in [Figure 1-2](#).

1. USB Micro-B power supply connector (J4).
2. Headers to connect PIC32MZ2064DAx288/PIC32MZ2064DAx169 CPU Daughter Cards (J2, J3).
3. Micro-SD slot (J10).
4. Headers for flexible Ethernet PHY options (J9).
5. USB Type-A connector for PIC32 USB host based applications (J7).
6. USB Micro-B connector for USB-to-UART communication (J5).
7. Three push button switches for user-defined inputs (S1, S2, and S3).
8. Three user-defined indicator LEDs (D3, D4, and D5).
9. Jumper for using or disconnecting the on-board debugger (J17).
10. Connector for an external debugger, such as MPLAB[®] REAL ICE or MPLAB ICD 3 (J12).
11. 40-pin expansion connector for adding external boards (J15).

Note: When running self-powered USB device applications, open the jumper JP1 to prevent possibly back-feeding voltage onto the VBUS from one port on the host to another (or from one host to another).

For details on these features, refer to [Chapter 2. “Hardware”](#).

FIGURE 1-2: PIC32MZ DA SK BASE BOARD LAYOUT (TOP VIEW)

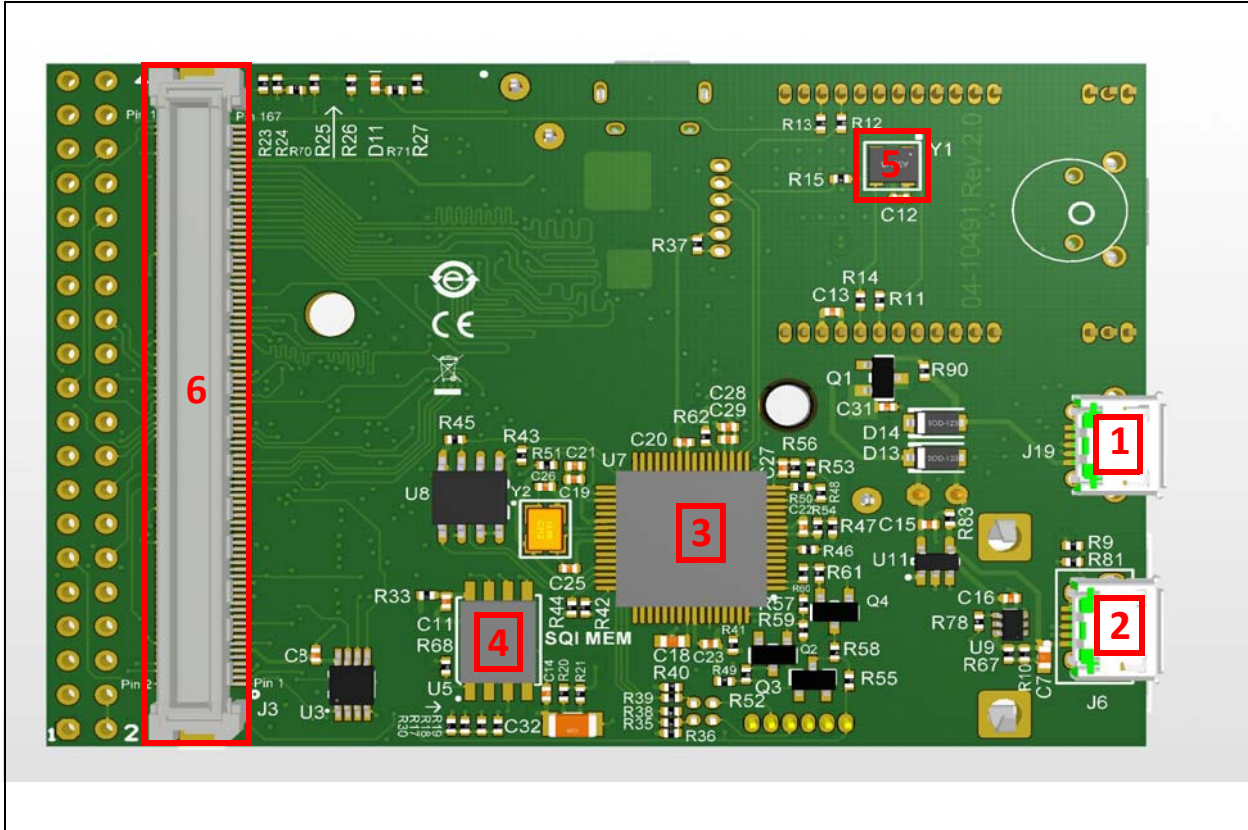


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The bottom assembly of the PIC32MZ DA SK Base Board includes these key features, as indicated in [Figure 1-3](#).

1. USB Micro-B connector for on-board debugger (J19).
2. USB Type Micro-AB receptacle for OTG and USB device connectivity for PIC32 OTG/Device-based applications (J6).
3. PIC24FJ256GB106 USB microcontroller for on-board debugging (U7).
4. SST26VF032B SQI-Flash Memory (U5).
5. 50 MHz Ethernet PHY oscillator (Y1).
6. 168-pin Hirose connector for various application boards, such as MEB-II (J3).

FIGURE 1-3: PIC32MZ DA SK BASE BOARD LAYOUT (BOTTOM VIEW)



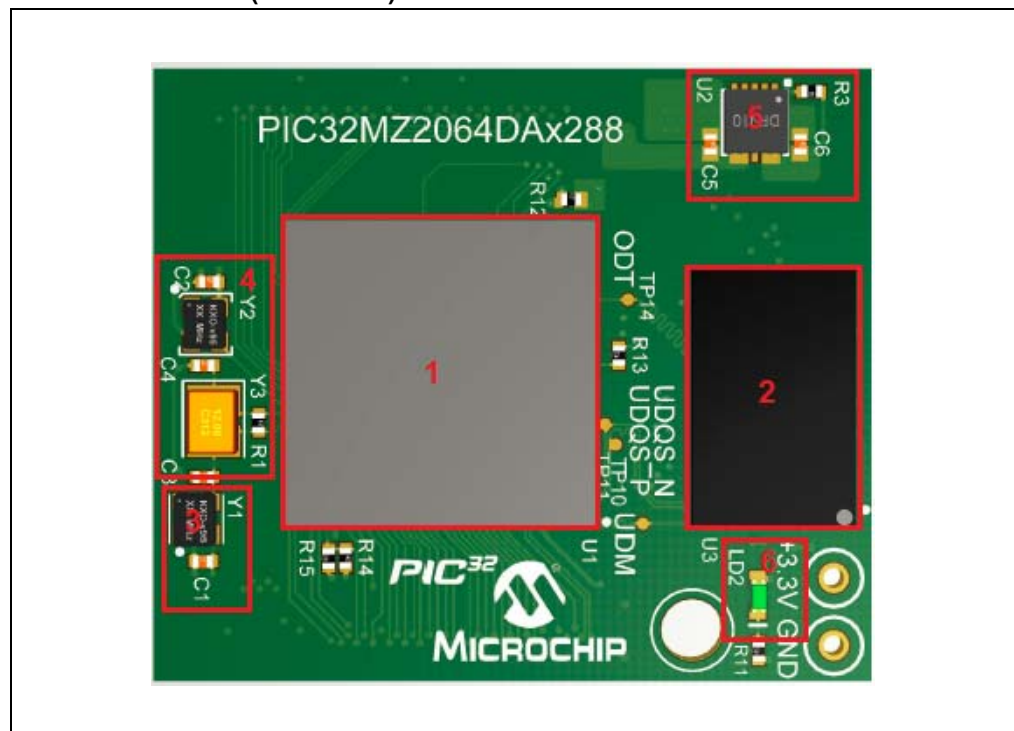
The top assembly of the PIC32MZ2064DAx288 Daughter Card includes these key features, as indicated in [Figure 1-4](#).

1. PIC32MZ2064DAA288 (DM320008) or PIC32MZ2064DAB288 (DM320008-C) (U1).
2. Micron 1 Gbit DDR2-SDRAM (MT47H64M16NF-25E) (U3).
3. 24 MHz oscillator (Y1).
4. 24 MHz crystal (Y3) and 32.768 kHz clock (Y2).

Note: Y2 and Y3 are 'Do Not Populate' (DNP).

5. 1.8V Regulator (power supply for DDR2-SDRAM, V_{DDR1V8} and V_{DDCORE}) (MIC69101) (J7).
6. 3.3V Power LED (LD2).

FIGURE 1-4: PIC32MZ2064DAx288 DAUGHTER CARD LAYOUT (TOP VIEW)

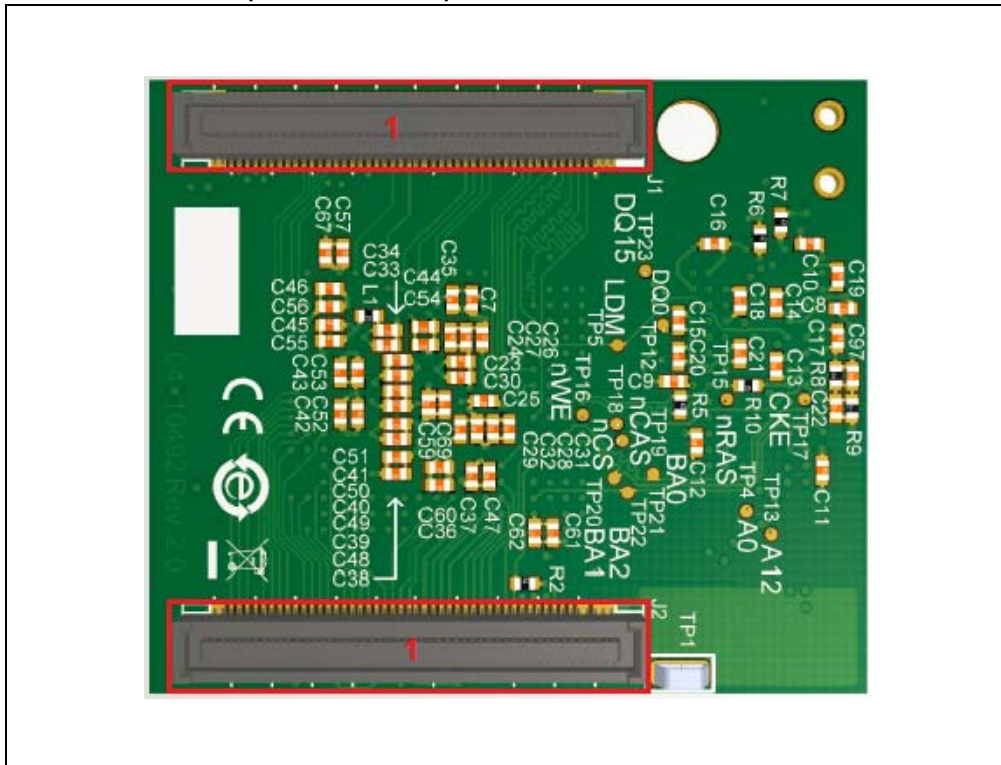


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The bottom assembly of the PIC32MZ2064DAx288 Daughter Card includes these key features, as indicated in [Figure 1-5](#).

1. Headers to connect the PIC32MZ DA SK Base Board Daughter Cards.

FIGURE 1-5: PIC32MZ2064DAx288 DAUGHTER CARD LAYOUT (BOTTOM VIEW)



The top assembly of the PIC32MZ2064DAx169 Daughter Card includes these key features, as indicated in Figure 1-6:

1. PIC32MZ2064DAA169 (DM320010) or PIC32MZ2064DAB169 (DM320010-C) (U1).
2. 24 MHz oscillator (Y2).
3. 24 MHz crystal (Y3).

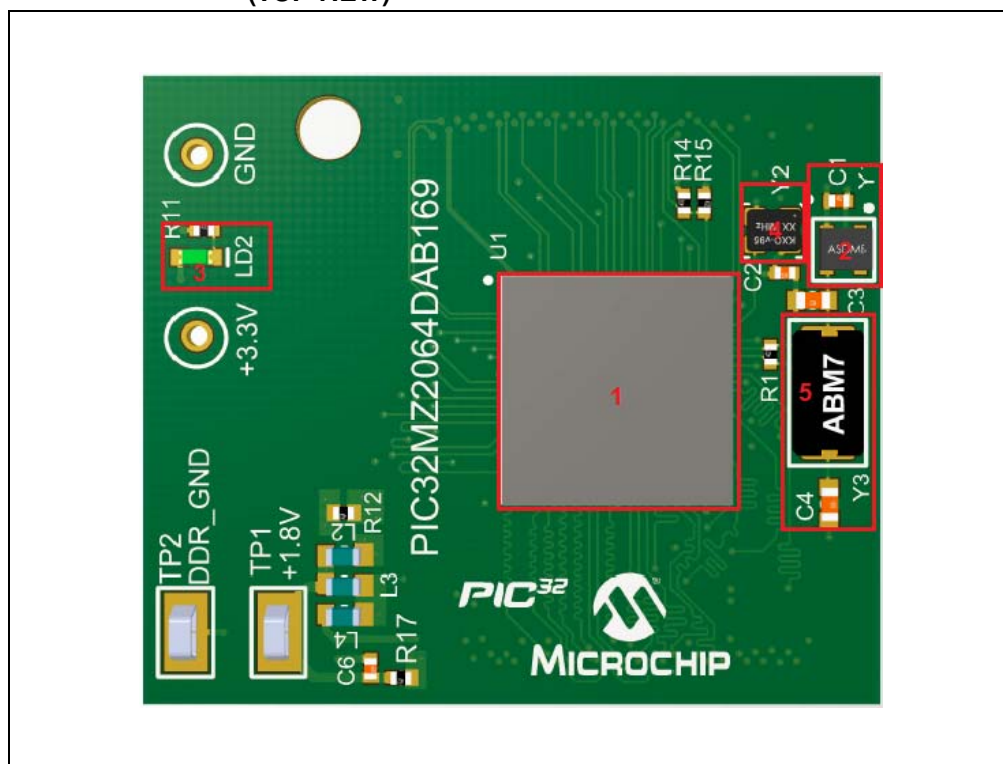
Note: Y3 is 'Do Not Populate' (DNP).

4. 32.768 kHz crystal (Y1)

Note: Y1 is 'Do Not Populate' (DNP).

5. 1.8V Regulator (power supply for DDR2-SDRAM, V_{DDR1V8} and V_{DDCORE}) (MIC69101) (J7).
6. 3.3V Power LED (LD2).

FIGURE 1-6: PIC32MZ2064DAx169 DAUGHTER CARD LAYOUT (TOP VIEW)

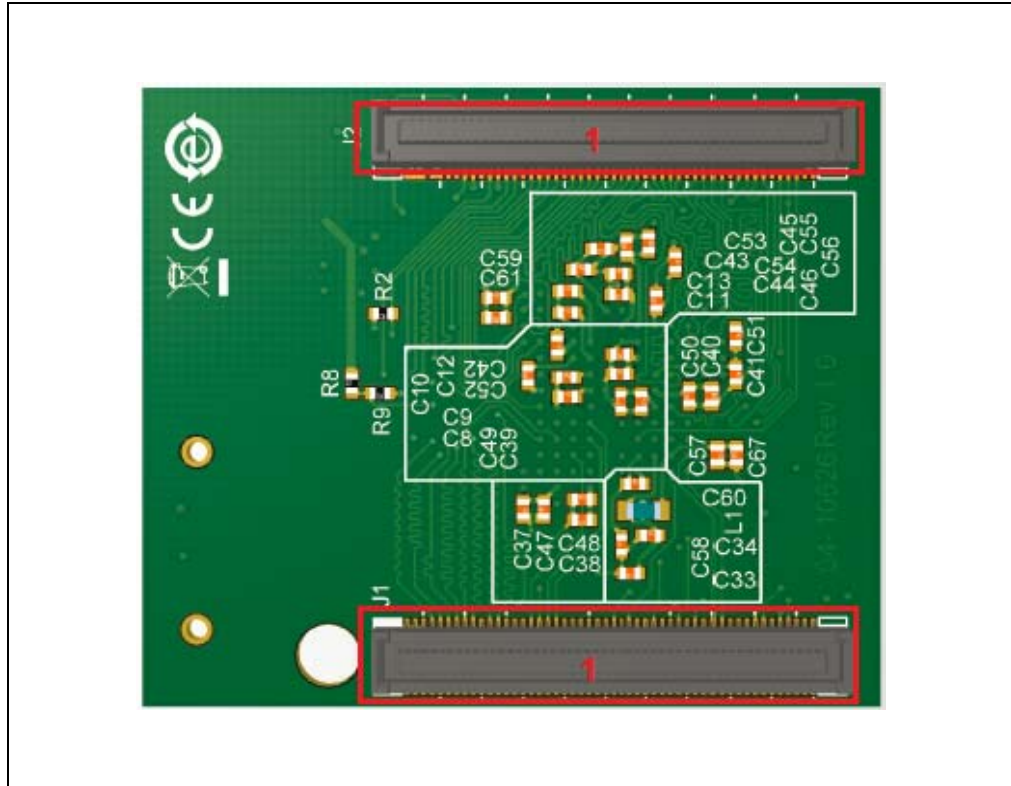


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The bottom assembly of the PIC32MZ2064DAx169 Daughter Card includes these key features, as indicated in [Figure 1-7](#).

1. Headers to connect the PIC32MZ DA SK Base Board Daughter Cards.

FIGURE 1-7: PIC32MZ2064DAx169 DAUGHTER CARD LAYOUT (BOTTOM VIEW)



1.3.2 LAN8740A PHY Daughter Board

Representation of the layout of the daughter board included in the PIC32MZ DA Family Starter Kit is shown in [Figure 1-8](#) and [Figure 1-9](#).

FIGURE 1-8: DAUGHTER BOARD LAYOUT (TOP VIEW)

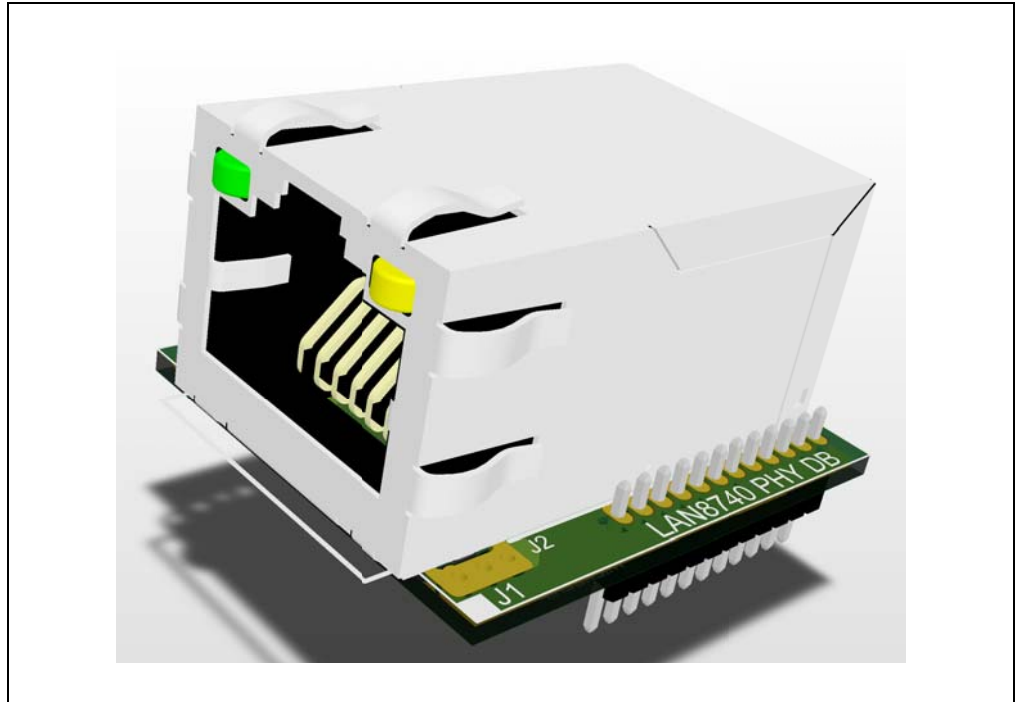
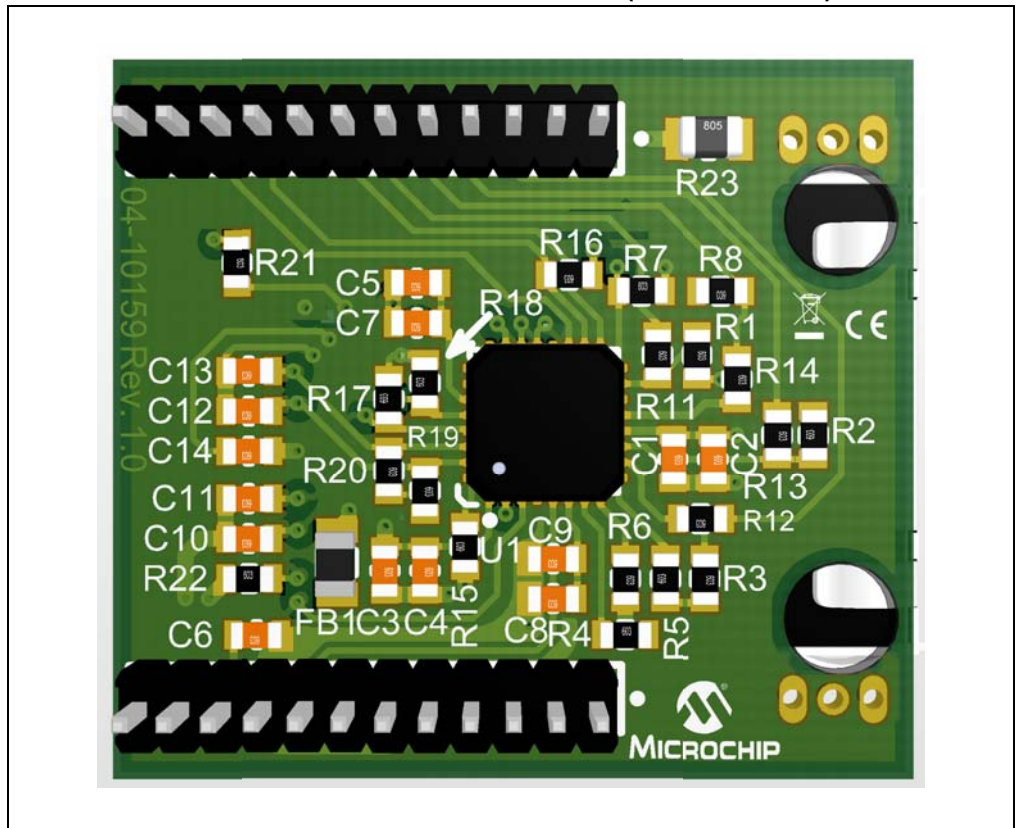


FIGURE 1-9: DAUGHTER BOARD LAYOUT (BOTTOM VIEW)



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Chapter 2. Hardware

This chapter describes the hardware features of the PIC32MZ DA Starter Kit.

2.1 HARDWARE FEATURES

The following key features of the starter kit are presented in the order given in [Section 1.3 “Starter Kit Functionality and Features”](#). You can refer to [Figure 1-2](#) through [Figure 1-7](#) for their locations on the development board.

2.1.1 Processor Support

Depending on the starter kit that you have purchased, the development board comes with a CPU Daughter Card containing a permanently mounted (i.e., soldered) processor as given below:

- PIC32MZ Embedded Graphics External DRAM (DA) Starter Kit (DM320008): PIC32MZ2064DAA288
- PIC32MZ Embedded Graphics External DRAM (DA) Starter Kit (Crypto) (DM320008-C): PIC32MZ2064DAB288
- PIC32MZ Embedded Graphics Stacked DRAM (DA) Starter Kit (DM320010): PIC32MZ2064DAG169
- PIC32MZ Embedded Graphics Stacked DRAM (DA) Starter Kit (Crypto) (DM320010-C): PIC32MZ2064DAA169

2.1.2 Power Supply

There are four ways to supply power to the starter kit:

- Through USB Micro-B connector (J4) – This enables using a wall adapter to supply more power than traditional USB as needed by the most applications (preferred).
- Through USB Micro-B DEBUG connector (J19). This connector supports debugging/programming by MPLAB tools through PKOB[®] interface.
- Through USB Micro-USB connector (J6).
- An external application board with a regulated DC power supply that provides +5V can be connected to the application board connector that is provided on the bottom side of the board (J3).

One green LED (LD2) on the PIC32MZ2064DAx288 or PIC32MZ2064DAx169 CPU Daughter Card is provided to indicate the power supply to the PIC32 device.

2.1.3 Graphics Connectivity

Multimedia Expansion Board II (MEB-II) is required to exercise embedded graphics features on the PIC32MZ DA devices. MEB-II comes with a 4.3” WQVGA (480” x 272”) PCAP display to showcase graphics. In addition, there is one 5.0” WVGA PACP Display Board that can be used to exercise higher resolution (800” x 480”) graphics. Both of these boards provide 24-bit color.

PIC32MZ Embedded Graphics Starter Kit has been designed with a 168-pin modular expansion interface, which allows the extendibility to MEB-II.

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2.1.4 Debug USB Connectivity

The starter kit includes a PIC24FJ256GB106 USB microcontroller that provides debugger connectivity over USB. The PIC24FJ256GB106 MCU is hard-wired to the PIC32 device to provide protocol translation through the I/O pins of the PIC24FJ256GB106 MCU to the In-Circuit Serial Programming™ (ICSP™) pins of the PIC32 device.

If an external debugger, such as MPLAB REAL ICE or MPLAB ICD3 are used with the starter kit, it is necessary to disconnect the on-board debugger from the PIC32 device, by removing the JP17 jumper. When the on-board debugger is required, replace the JP17 jumper. When the JP17 jumper is installed, pin 1 must be connected to pin 3, and pin 2 must be connected to pin 4.

2.1.5 PIC32 USB Connectivity

Users can connect to the PIC32 USB microcontroller using anyone of the following modes:

- Host Mode – Connect the device to the Type-A connector J7, which is located on the top of the starter kit. Using this method, a maximum of 400 mA can be supplied from the debug USB port to the host port. If full 500 mA supply is needed, an external supply must be connected to the application board.
- Device Mode – Connect the debug Mini-B USB cable to port J6, and then connect the starter kit to the host by using a cable with a Type-B micro-connector to the starter kit's Micro-A/B port J6, which can be located on the bottom of the board. The other end of the cable must have a Type-A connector, to connect it to a USB host.
- OTG Mode – Connect the starter kit to the OTG device by using an OTG Micro-A/B cable to the Micro-A/B port J6, which is located on the bottom of the board.

2.1.6 External Memory Connectivity

The following three external memory interfaces are available through hardware:

- DDR2-SDRAM – 128 MB of DDR2-SDRAM is mounted on the PIC32MZ2064DAx288 Daughter Card for the External DRAM version of the starter kits (DM320008, DM320008-C). Whereas 32 MB of DDR2-SDRAM is available within the package for the stacked DRAM version of the starter kits (DM320010, DM320010-C).
- Micro-SD slot – Supports SD, SDHC, and SDXC cards at default speed (12.5 MB/s) and high speed (25 MB/s).
- SQI Flash – 4 MB of SST26VF032B Serial Quad Flash is mounted on the bottom of the PIC32MZ DA SK Base Board.

2.1.7 Switches

Push-button switches provide the following functionalities:

- SW1: Active-low switch connected to RB13
- SW2: Active-low switch connected to RB12
- SW3: Active-low switch connected to RB14

The push-button switches do not have any debounce circuitry and require the use of internal pull-up resistors. This enables the user to investigate software debounce techniques. When Idle, the switches are pulled high (+3.3V), and when pressed, they are grounded.

2.1.8 LEDs

The LEDs, RH0 through RH2, are connected to PORTH of the processor. The LATH pins are set high to light the LEDs.

2.1.9 Oscillator Options

A 24 MHz oscillator circuit is connected to the on-board microcontroller and this oscillator circuit functions as the controller's primary oscillator. Depending on which is populated on the starter kit board, a 24 MHz crystal may be used instead of the 24 MHz oscillator circuit.

Use of an external crystal is required to develop USB applications. The USB-specification dictates a frequency tolerance of $\pm 0.25\%$ for high speed, and non-USB applications can use the internal oscillators.

The starter kit also has provisions for an external secondary 32 kHz oscillator; however, it is not populated. A suitable oscillator, ECS-3X8, can be obtained from Digi-Key: P/N-X801-ND CMR200TB32.768KDZFTR.

The PIC24FJ256GB106 is independently clocked and has its own 12 MHz crystal.

2.1.10 168-pin Modular Expansion Connector

The PIC32MZ DA Family Starter Kit has been designed with a 168-pin modular expansion interface, which allows the board to provide basic generic functionality and easy extendability to new technologies as they become available. Refer to [Table 2-1](#) for starter kit connector part numbers.

TABLE 2-1: STARTER KIT CONNECTOR PART NUMBERS

Connector	HIROSE Electric PN
Starter Kit Connector	FX10A-168P-SV1(71)
Application Board Connector	FX10A-168S-SV

2.1.11 Ethernet PHY

The Microchip LAN8740A PHY Daughter Board is populated with a low-power, small-footprint, 10/100 Fast Ethernet LAN8740A PHY, which features Energy Efficient Ethernet (IEEE 802.3az) and Wake-on-LAN functionality. This daughter board is designed for easy development of RMII Ethernet control applications when it is connected into a compatible PIC32 starter kit.

To use a different Ethernet PHY, other than what is offered, visit the microchipDIRECT website (www.microchipdirect.com) for a list of alternate options.

2.1.12 USB-to-UART/I²C Communication

To facilitate application debug and development, a MCP2221 USB-to-UART/I²C device (U1) is available. The MCP2221 creates a virtual COM port on the personal computer when a mini-USB cable is connected between J11 and the host computer. To download the driver for the MCP2221, visit the MCP2221 product page (www.microchip.com/MCP2221).