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Object of Declaration: PIC32MX470 Curiosity Development Board

EU Declaration of Conformity

This declaration of conformity is issued by the manufacturer.
The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.
This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.

Derek Carlson
VP Development Tools

11-NOV-16
Date

NOTES:

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Chapter 1. Introduction

Thank you for purchasing a Microchip Technology PIC32MX470 Curiosity Development Board.

The PIC32MX470 Curiosity Development Board includes an integrated programmer/debugger and requires no additional hardware to get started. Users can expand functionality through MikroElectronika mikroBUS™ Click™ adapter boards, add Bluetooth® connectivity with the Microchip BM64 Bluetooth Audio module, and add audio input/output capability with Microchip audio daughter boards.

With or without expansion boards, the PIC32MX470 Curiosity Development Board provides the freedom to develop for a variety of applications, including Internet of Things (IoT), robotics development, and proof-of-concept designs.

This chapter includes the following topics:

- Kit Contents
- Development Board Functionality and Features

1.1 KIT CONTENTS

The PIC32MX470 Family Starter Kit contains the following items:

- One PIC32MX470 Curiosity Development Board
- One on-board PIC32MX470F512H microcontroller

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.

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1.2 DEVELOPMENT BOARD FUNCTIONALITY AND FEATURES

1.2.1 Development Board

The main features and top assembly of the PIC32MX470 Curiosity Development Board are shown in Figure 1-1:

1. PIC32MX470F512H 32-bit microcontroller (U9).
2. Two mikroBUS sockets to expand the functionality using MikroElectronika Click adapter boards (J5, J10).
3. X32 Header for audio I/O using Microchip audio daughter boards (J14, J15).
4. BM64 Bluetooth v4.2 Stereo Audio module footprint for Bluetooth connectivity (U10).
5. GPIO expansion header (J17).
6. Debug USB connector for programming/debugging (J3).
7. Target USB connector for PIC32 USB connectivity (Device/Host mode) (J12).
8. Header for external 5V input (J7).
9. Jumper to select power source: Debug USB connector, Target USB connector and external +5V input (J8).
10. Jumper to drive V_{BUS} in Host mode (J13).
11. Three LEDs (LED1, LED2, LED3).
12. RGB LED (LED4).
13. User button (S1).
14. Reset button ($\overline{MCLR}$).
15. ICSP Header for external debugger, such as MPLAB® REAL ICE™ or MPLAB ICD 3 (J16).
16. Jumper to select on-board debugger or external debugger (J2).
17. 20 MHz crystal oscillator (X2).

For additional information on these features, refer to **Chapter 2. "Hardware"**.

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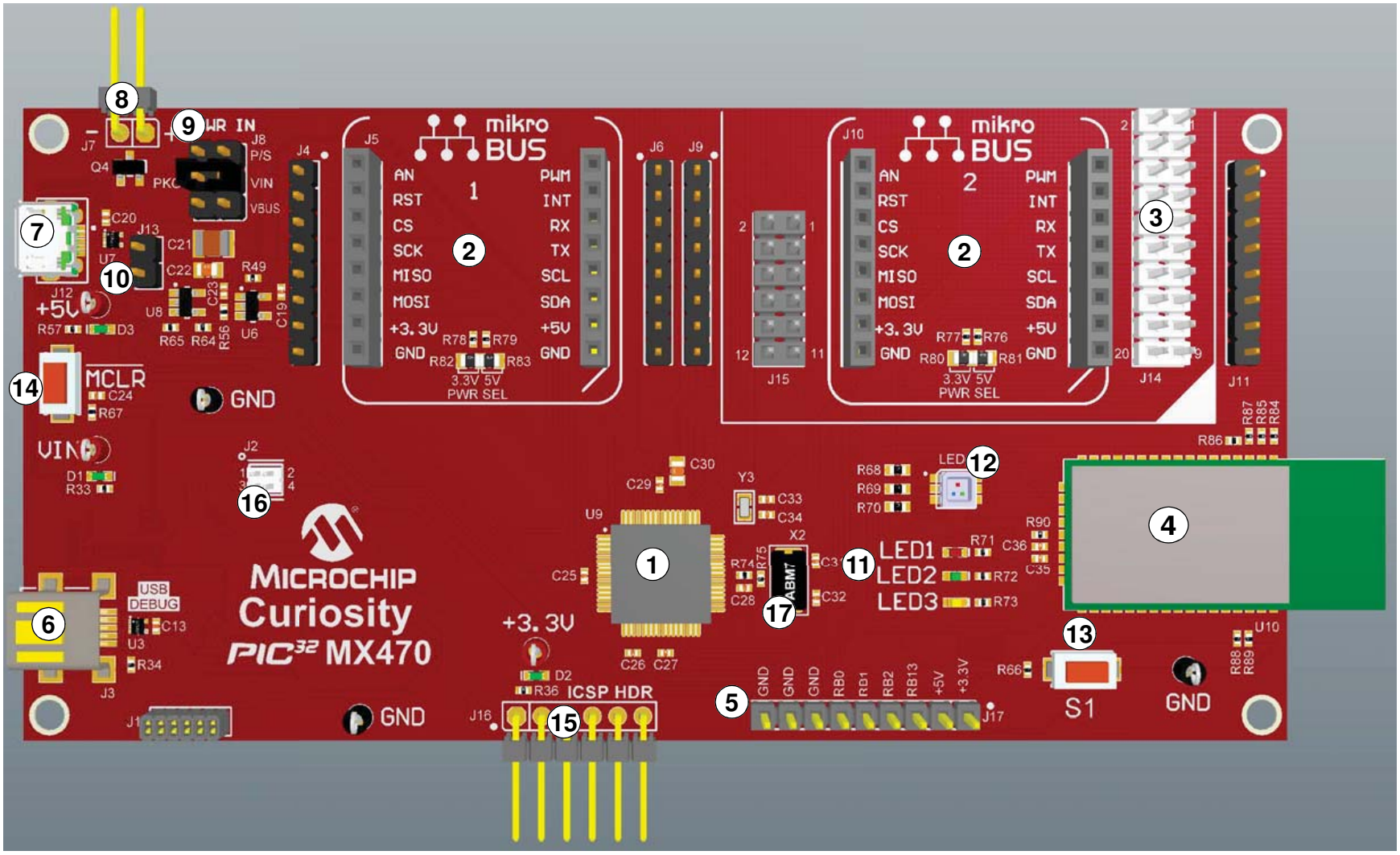
FIGURE 1-1: PIC32MX470 CURIOSITY DEVELOPMENT BOARD LAYOUT (TOP VIEW)



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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 PIC32MX470 Curiosity Development Board. 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 PIC32MX470 Curiosity Development Board 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 development board, highlighting its features and uses.
- **Chapter 2. "Hardware"** provides the hardware descriptions of the development board.
- **Appendix A. "Schematics"** provides a block diagram, board layouts, and detailed schematics of the development board.
- **Appendix B. "Bill of Materials"** provides the bill of materials for the components used in the design and manufacture of the development board.

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CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Italic characters	Referenced books	*MPLAB X IDE User's Guide*
	Emphasized text	...is the *only* 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	*File > Save*
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'`
`Italic Courier New`	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[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.

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RECOMMENDED READING

This user's guide describes how to use the starter kit. The following Microchip documents are available and recommended as supplemental reference resources.

PIC32MX330/350/370/430/450/470 Family Data Sheet (DS60001185)

Refer to this document for detailed information on PIC32MX330/350/370/430/450/470 family 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.

mikroBUS™ Specification

The purpose of mikroBUS™ is to enable easy hardware expandability with a large number of standardized compact add-on boards. See their web site at: http://www.mikroe.com/mikrobus/.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at http://www.microchip.com. This web site makes files and information easily available to customers. Accessible by most Internet browsers, the web site contains the following information:

- **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

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

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
- **Programmers** – 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.

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DOCUMENT REVISION HISTORY

Revision A (September 2016)

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

Revision B (February 2017)

The Schematics and Bill of Materials were updated for the following components:

- R22
- C24

Refer to **A.2 "Schematics"** and **B.1 "PIC32MX470 Curiosity Development Board Bill of Materials"** for the changes.

NOTES:

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Chapter 2. Hardware

This chapter describes the hardware features of the PIC32MX470 Curiosity Development Board.

2.1 HARDWARE FEATURES

Only certain features of the development board are discussed in this section. Refer to Figure 1-1 in **Section 1.2 "Development Board Functionality and Features"** for their locations.

2.1.1 Processor

The PIC32MX470 Curiosity Development Board is designed with a permanently mounted (i.e., soldered) PIC32MX470F512H microcontroller (U9).

2.1.2 Power Supply

Power can be supplied to the development board from the host PC using a Type A male-to-mini B USB cable or by using an external +5V power supply. Jumper J8 is used to select the voltage source for the development board. Table 2-1 provides the details of the power supply sources available for the development board.

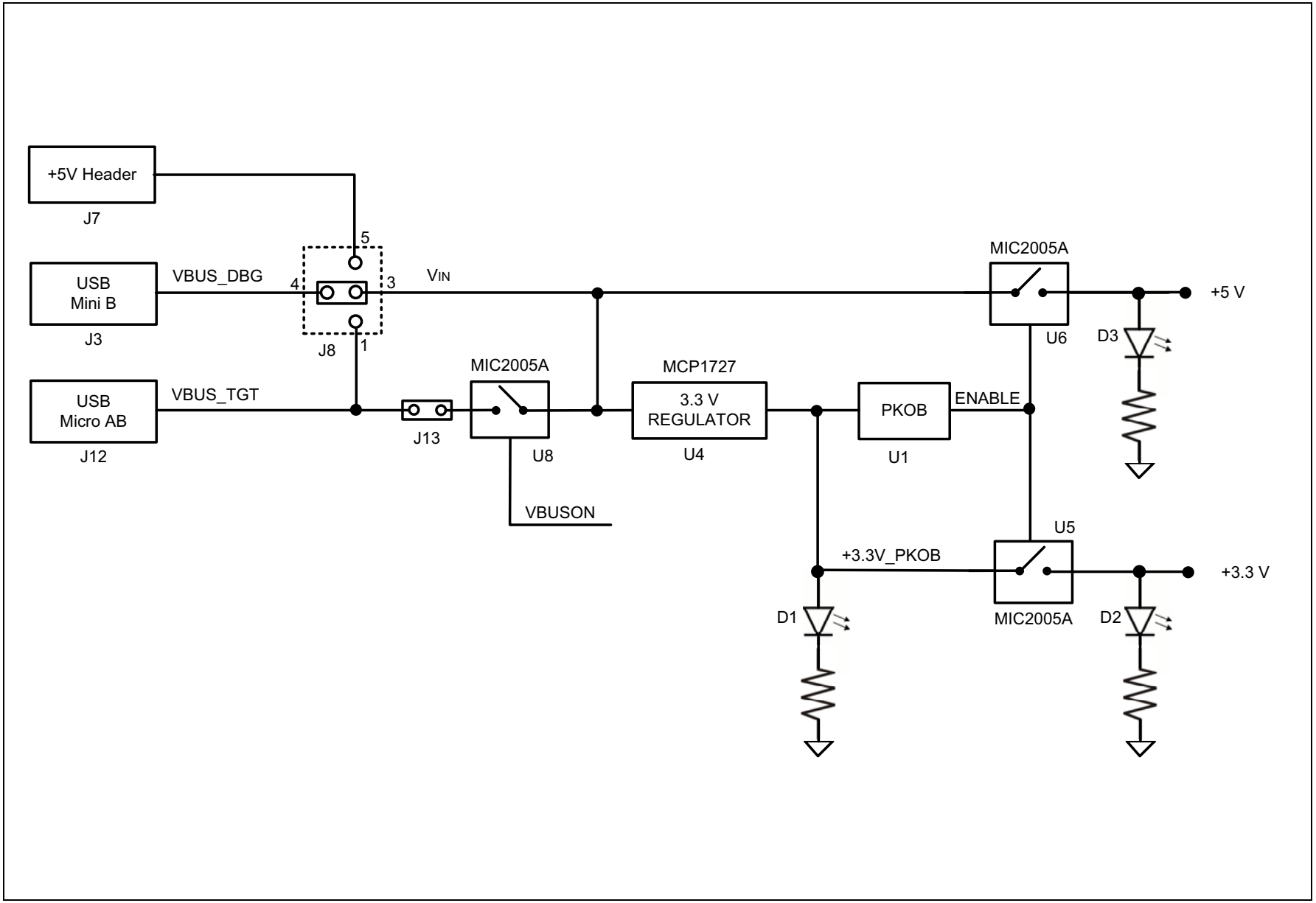
The +3.3V power supply for the microcontroller is generated by the MPC1727 voltage regulator.

TABLE 2-1: DEVELOPMENT BOARD POWER SUPPLY SOURCES

Power Input	Connection	Jumper Position (J8)
USB mini-B (J3)	Using a Type A male-to-mini B USB cable (not provided with the kit).	4-3
USB micro-AB (J12)	Using a Type A male-to-micro B USB cable (not provided with the kit).	1-3
External +5V (J7)	Connect the development board to an external 5V power supply.	5-3

If the PICkit™ on-board (PKOB) debugger is connected to a host PC, it enumerates with the host computer. Once the debugger is successfully enumerated, it turns on the main board power supply (+3.3V and +5V) using the high side power switch (MIC2005A) by driving the ENABLE signal high. Figure 2-1 shows the power topology for the development board.

FIGURE 2-1: POWER TOPOLOGY



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2.1.3 Programming and Debug

The PIC32MX470 Curiosity Development Board includes the PICkit on-board (PKOB) debugger based on the PIC24FJ256GB106 USB microcontroller. In addition, it provides the option to use external debuggers, such as MPLAB REAL ICE or MPLAB ICD 3 by connecting to the In-Circuit Serial Programming™ (ICSP™) header, J16.

By default, the on-board debugger is connected to the programming pins (PGEC and PGED) of the PIC32 device. To use an external debugger, remove jumper J2 to disconnect the on-board debugger from driving the programming pins. Table 2-2 provides details of the various debuggers.

TABLE 2-2: DEBUGGER SELECTION

J2 Jumper Positions	
On-board Debugger	**External Debugger**
Pins 1-2 shorted	Pins 1-2 Open
Pins 3-4 shorted	Pins 3-4 Open

2.1.4 USB Connectivity

The PIC32MX470F512H microcontroller has an integrated full-speed USB module that enables the user to implement the USB functionality through the micro-AB USB connector (J12). Users can connect the development board for USB functionality using any one of these modes:

- **Device Mode:** Connect the host PC to the target USB connector (J12) using the USB Type A male to micro-B male cable. Use jumper J8 to select the required power source for the board.
- **Host Mode:** Connect the USB device to the target USB connector (J12) using a USB Type A Female to micro-B male cable (this cable is not included in the kit). Install a jumper in the J13 header to drive the VBUS line in Host mode. Use jumper J8 to select the power source from either the Debug USB connector or the external 5V input.

2.1.5 Switches

The PIC32MX470 Curiosity Development Board contains two push buttons: Reset button ($\overline{MCLR}$) and user-configurable button (S1). The Reset button is connected to the PIC32 Master Clear Reset line and the other is a generic user-configurable button. When a button is pressed, it will drive the I/O line to GND. Table 2-3 provides details of the push buttons.

TABLE 2-3: PUSH BUTTONS

Push Button Name	Microcontroller Pin
$\overline{MCLR}$	$\overline{MCLR}$
S1	RD6

2.1.6 LEDs

Four user-programmable LEDs are available on the PIC32MX470 Curiosity Development Board, and these LEDs can be turned ON/OFF using the connected GPIO pins. Table 2-4 provides details of the LEDs and related GPIO pins.

The RGB LEDs (LED4) are connected to the re-mappable pins with an output compare functionality to control the color and brightness with PWM output. In the RGB LED, red is the component of the GPIO pin RB10, green is the component of the GPIO pin RB3, and blue is the component of the GPIO pin RB2.

TABLE 2-4: LEDS

LED Name	Microcontroller Pin
LED1 (red)	RE4
LED2 (yellow)	RE6
LED3 (green)	RE7
LED4 (RGB LEDs - red, green, blue)	RB10, RB3, RB2

2.1.7 Oscillator Options

A 20 MHz crystal (X2) is connected to the on-board PIC32MX470F512H microcontroller for precision clocking. The 12-Mbps USB full-speed signal rate specification requires ±0.25% or 2500 ppm clock accuracy. Therefore, an external crystal is required to meet the clock accuracy requirement for USB. Non-USB applications can use the internal RC oscillators.

The PIC32MX470 Curiosity Development Board also has provision for an external secondary 32 kHz oscillator (Y3); however, this component is not populated.

2.1.8 mikroBUS™ Sockets

Two mikroBUS sockets (J5, J10) are available on the development board, and these sockets can be used to expand the functionality using the MikroElectronika Click adapter boards. The mikroBUS connector consists of two 1x8 female headers with SPI, I^2C, UART, RST, PWM, analog, interrupt lines as well as 3.3V, 5V, and GND power lines.

The GPIO pins for the mikroBUS sockets are assigned to route, as follows:

- UART1, I2C1, SPI1 and OC1 peripheral instances to mikroBUS socket J5. The UART1 and SPI1 peripherals are also routed to the BM64 Bluetooth 4.2 Stereo Audio module.
- UART2, I2C2, SPI2 and OC2 peripheral instances to mikroBUS socket J10. The UART2, I2C2, and SPI2 peripherals are also routed to the X32 audio header.

2.1.9 X32 Audio Header

The PIC32MX470 Curiosity Development Board includes two X32 headers (J14, J15) to enable a connection to the Microchip Audio Codec daughter board. Table 2-5 provides the details of the available daughter board and for additional information, contact your local Microchip sales office.

For a complete list of currently available audio daughter boards, visit the microchipDIRECT web site (www.microchipdirect.com).

TABLE 2-5: AUDIO DAUGHTER BOARD

Daughter Board Name	Microchip Part Number
PIC32 Audio Codec Daughter Board - AK4642EN	AC320100

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2.1.10 BM64 Bluetooth 4.2 Stereo Audio Module

The PIC32MX470 Curiosity Development Board includes the footprint for the BM64 Bluetooth 4.2 Stereo Audio module to support Bluetooth audio. The PIC32 microcontroller uses the UART to send commands to the BM64 module and the I^2S interface for audio data.

2.1.11 PIC32 I/O Header

The PIC32MX470 Curiosity Development Board provides a header (J17) to access unused microcontroller GPIO pins.

2.1.12 Peripheral Resource Assignment

The MCU peripheral instances, assigned for different hardware interfaces, are provided in Table 2-6. The correct peripheral instance must be used in the application to use the respective hardware interface.

TABLE 2-6: RESOURCE ASSIGNMENT

Resource Assignment	Peripheral				
	I^2C	SPI	UART	Output Compare	Interrupt
MikroBus1 (J5)	I2C1	SPI1	UART1	OC1	INT1
MikroBus2 (J10)	I2C2	SPI2	UART2	OC2	INT0
X32 (J14, J15)	I2C2	SPI2	UART2	—	—
BM64	—	SPI1	UART1	—	—
RGB LED	—	—	—	OC3, OC4, OC5	—

NOTES:

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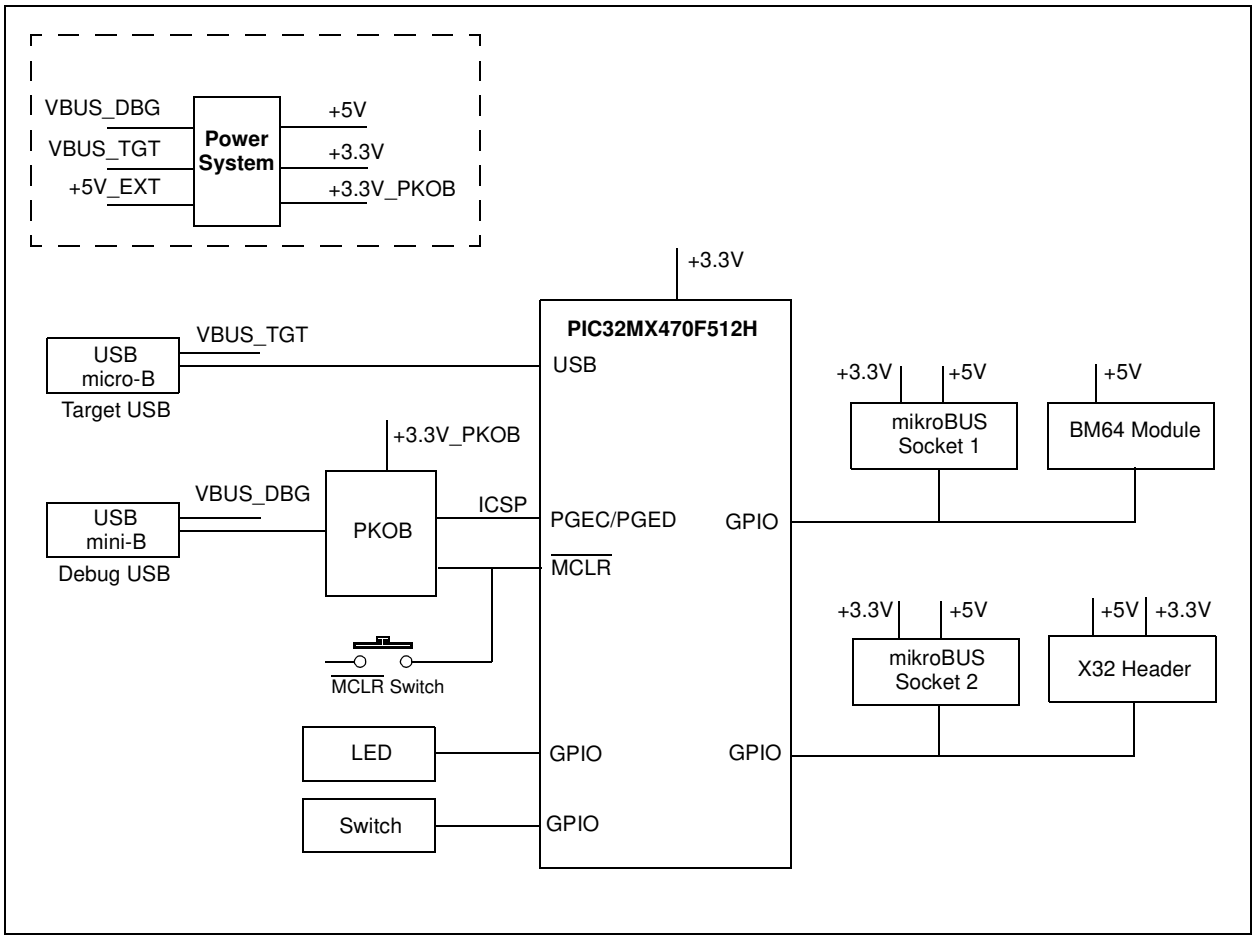
Appendix A. Schematics

A.1 BLOCK DIAGRAM

FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32MX470 CURIOSITY DEVELOPMENT BOARD



A.2 SCHEMATICS

FIGURE A-2: PIC32MX470 CURIOSITY DEVELOPMENT BOARD SHEET 1 OF 3

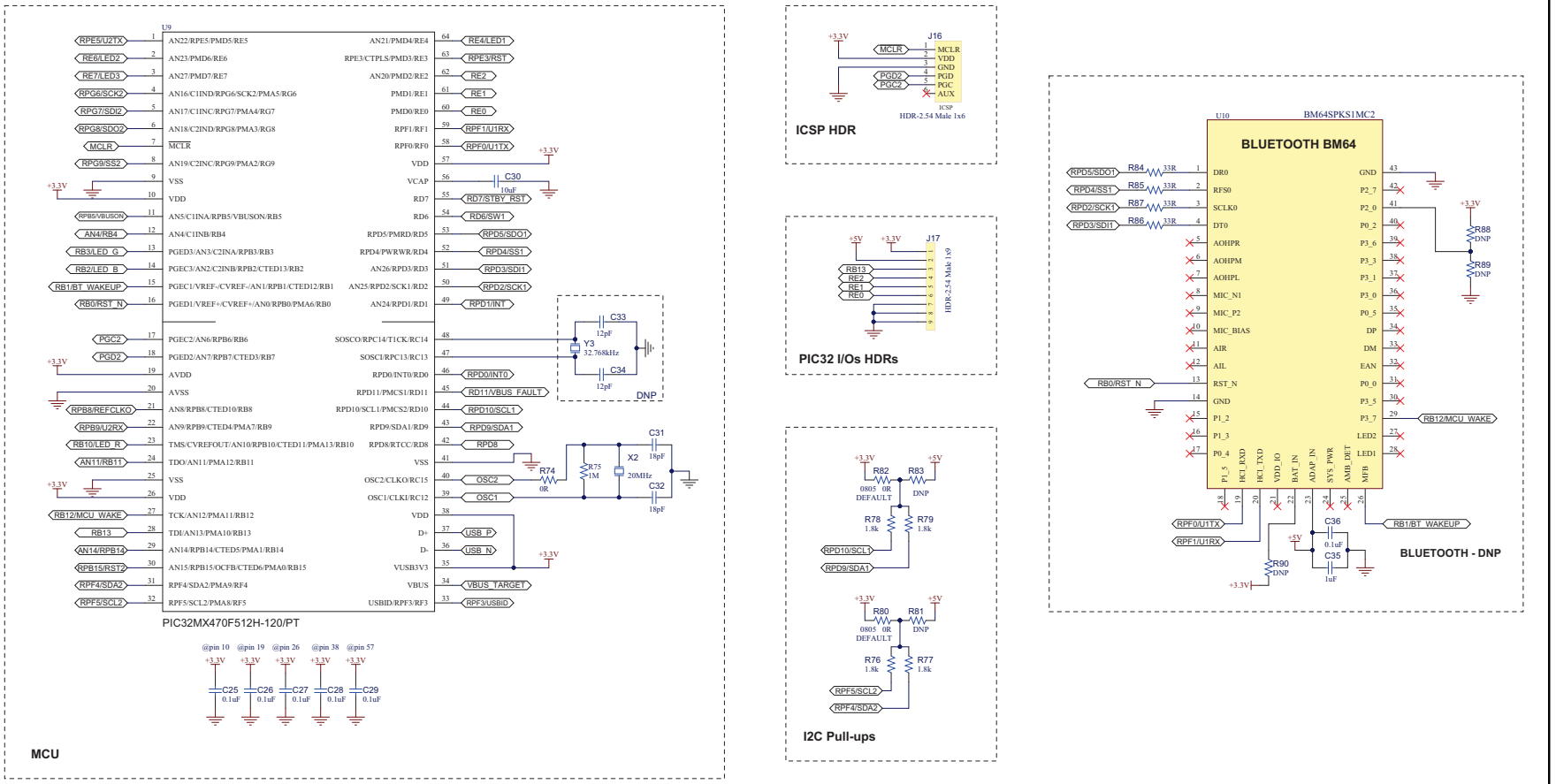


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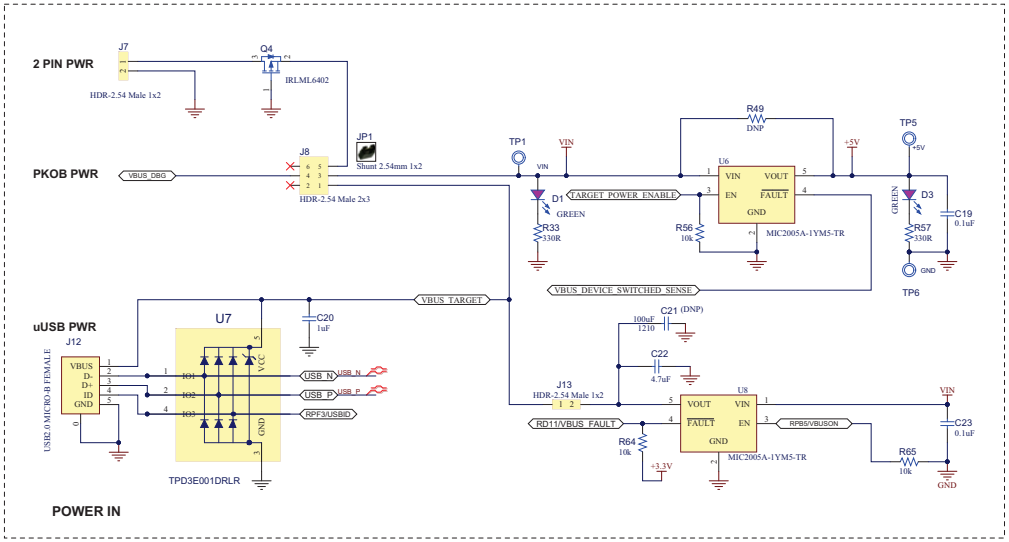
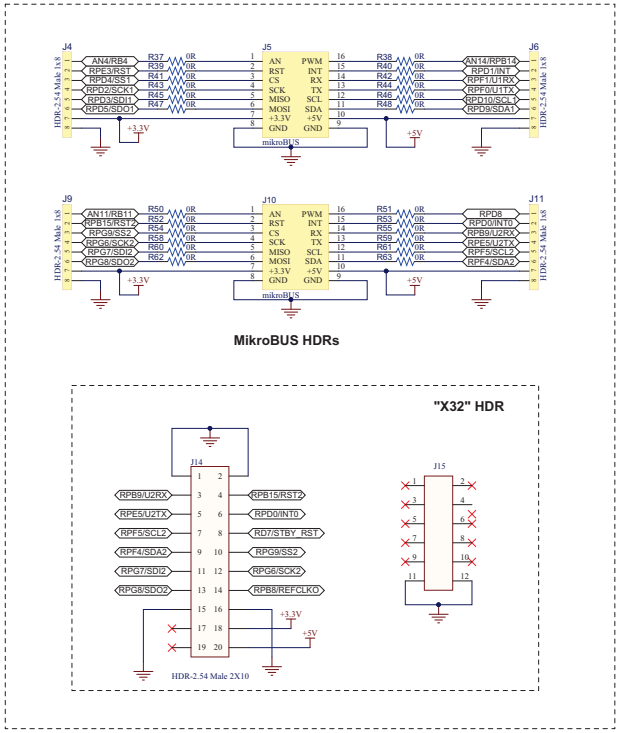
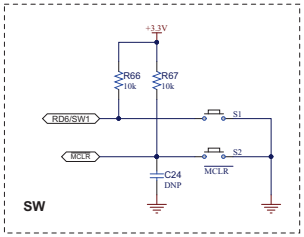
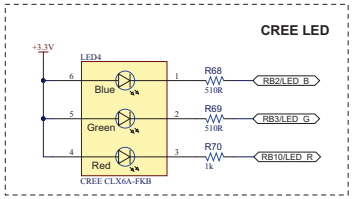
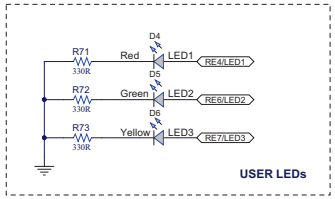
FIGURE A-3: PIC32MX470 CURIOSITY DEVELOPMENT BOARDSHEET 2 OF 3











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