PIC32MZ Embedded Connectivity with Floating Point Unit (EF) 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 Embedded Connectivity with Floating Point Unit (EF) 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 Embedded Connectivity with Floating Point Unit (EF) 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.

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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.

PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family Data Sheet (DS60001320)

Refer to this document for detailed information on PIC32MZ EF 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

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- **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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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

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

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

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DOCUMENT REVISION HISTORY

Revision A (August 2015)

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

NOTES:

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Chapter 1. Introduction

Thank you for purchasing a Microchip Technology PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family Starter Kit. This starter kit provides a low-cost, modular development system for Microchip's line of 32-bit microcontrollers.

There are two versions of the starter kit available:

- PIC32MZ EF Starter Kit (P/N: DM320007)
- PIC32MZ EF Starter Kit w/Crypto Engine (P/N: DM320007-C)

Both versions of the starter kit come preloaded with demonstration software that can be used to explore the new features of the PIC32MZ EF family of devices. It is also expandable through a modular expansion interface, which allows the user to extend its functionality. The starter kit also supplies on-board circuitry for full debug and programming capabilities.

This chapter covers the following topics:

- Kit Contents
- Starter Kit Functionality and Features

The preprogrammed example code on the PIC32MZ EF family MCU is available for download from the Microchip web site at http://www.microchip.com. All project files have been included so that the code may be used directly to restore the PIC32MZ EF family MCU on the starter kit to its original state (i.e., if the sample device has been reprogrammed with another program) or so you can use the tutorial code as a platform for further experimentation.

1.1 KIT CONTENTS

The PIC32MZ EF Family Starter Kit contains the following items:

- One development board
- One LAN8740A Ethernet PHY Daughter Board
- Two USB mini-B to full-sized A cables (one cable for debug purposes and to power the development board and one cable for USB-to-UART communication)
- One USB micro-B to full-sized A cable (to communicate with the PIC32 USB port)
- One RJ-45 CAT5 Ethernet cable (to communicate with the PIC32 Ethernet port)

Note: If you are missing any part of a 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 STARTER KIT FUNCTIONALITY AND FEATURES

1.2.1 Development Board

Representations of the layout of the development board included in the PIC32MZ EF Family Starter Kit are shown in Figure 1-1 and Figure 1-2.

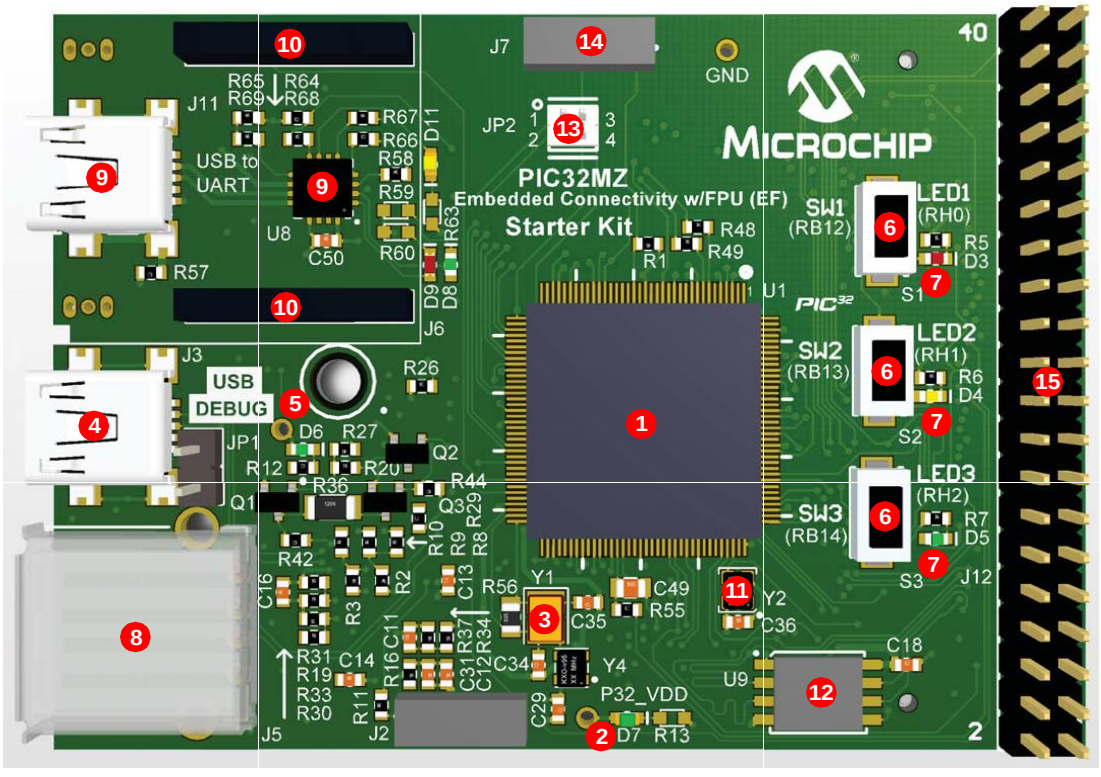
The top assembly of the board includes these key features, as indicated in Figure 1-1:

1. PIC32MZ2048EFH144-I/PH or PIC32MZ2048EFM144-I/PH (Crypto Engine) MCU.
2. Green power indicator LED.
3. On-board crystal or oscillator for precision microcontroller clocking (24 MHz).
4. USB connectivity for on-board debugger communications.
5. Green debug indicator LED.
6. Three push button switches for user-defined inputs.
7. Three user-defined indicator LEDs.
8. USB Type A receptacle connectivity for PIC32 host-based applications.
9. USB-to-UART communication.
10. Daughter board connectors for flexible Ethernet PHY options.
11. 32 kHz oscillator for RTCC and Timer1 (optional).
12. External 4 GB SQI memory for expanded memory applications.
13. Jumper for using or disconnecting the on-board debugger.
14. Connector for an external debugger such as MPLAB® REAL ICE or MPLAB ICD 3.
15. 40-pin expansion connector for adding external boards.

> **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 1-1: PIC32MZ EF FAMILY STARTER KIT LAYOUT (TOP VIEW)



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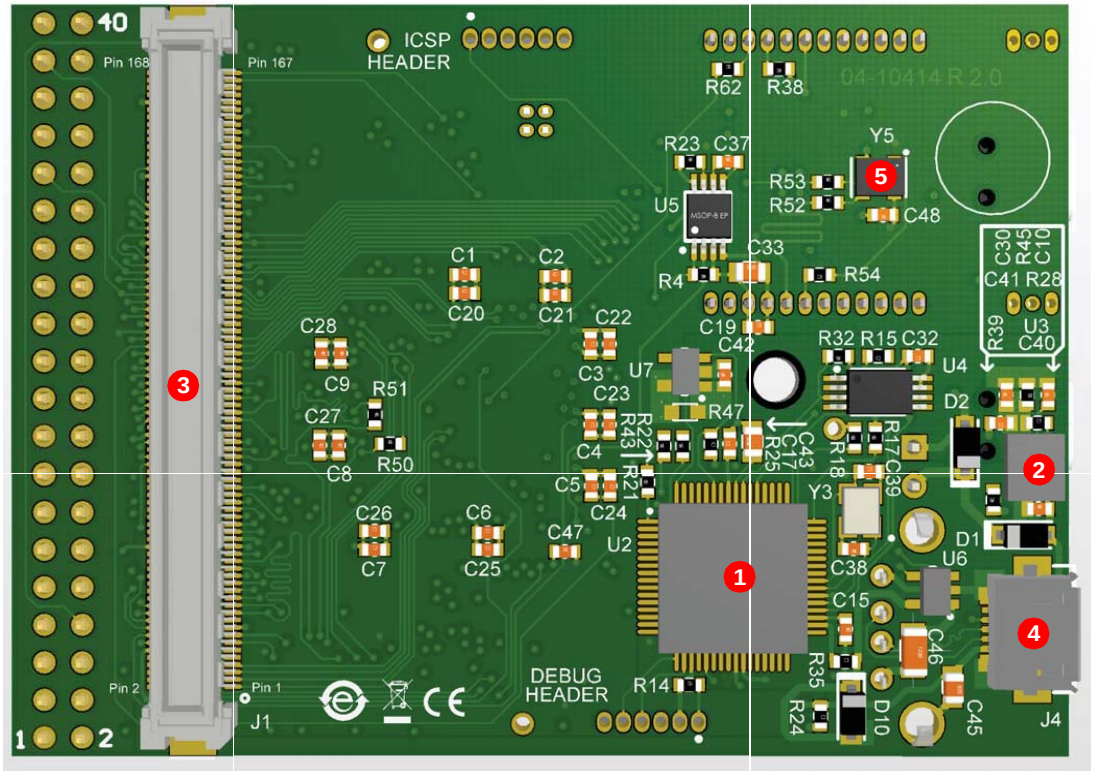
The bottom assembly of the board includes these key features, as indicated in Figure 1-2:

1. PIC24FJ256GB106 USB microcontroller for on-board debugging.
2. Regulated +3.3V power supply for powering the starter kit through USB or expansion board.
3. Connector for various expansion boards.
4. USB Type micro-AB receptacle for OTG and USB device connectivity for PIC32 OTG/device-based applications.
5. 50 MHz Ethernet PHY oscillator.

FIGURE 1-2: PIC32MZ EF FAMILY STARTER KIT LAYOUT (BOTTOM VIEW)



1.2.2 LAN8740A PHY Daughter Board

Representation of the layout of the daughter board included in the PIC32MZ EF Family Starter Kit is shown in Figure 1-3 and Figure 1-4.

FIGURE 1-3: DAUGHTER BOARD LAYOUT (TOP VIEW)

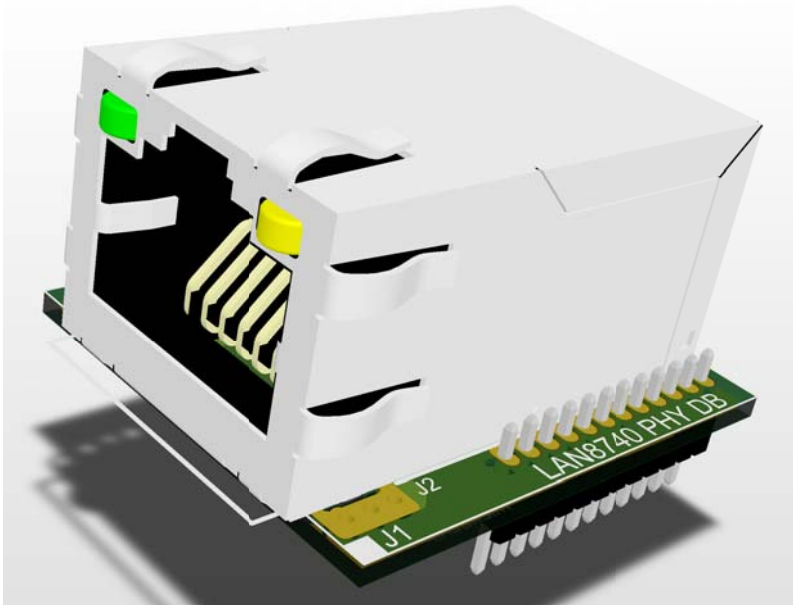
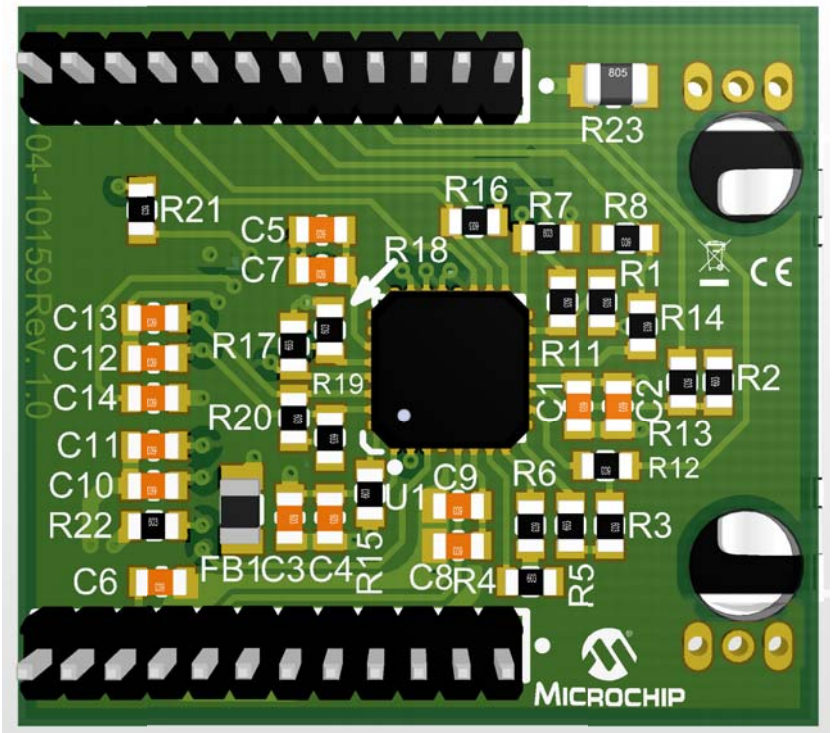


FIGURE 1-4: DAUGHTER BOARD LAYOUT (BOTTOM VIEW)



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Chapter 2. Hardware

This chapter describes the hardware features of the PIC32MZ EF Family Starter Kit.

2.1 HARDWARE FEATURES

The following key features of the starter kit are presented in the order given in **Section 1.2 "Starter Kit Functionality and Features"**. Refer to Figure 1-1 for their locations on the development board.

2.1.1 Processor Support

Depending on the starter kit purchased, the development board is designed with a permanently mounted (i.e., soldered) processor, which is either the PIC32MZ2048EFM144 (Crypto Engine) or the PIC32MZ2048EFH144.

2.1.2 Power Supply

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

- USB bus power connected to USB debug connector J1
- USB bus power connected to the micro-USB connector J4. Note that debugging does not take place through this connector.
- An external application board with a regulated DC power supply that provides +5V can be connected to the J2 application board connector that is provided on the bottom side of the board

One green LED (D3) is provided to indicate the PIC32 device is powered up.

2.1.3 Debug USB Connectivity

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

If an external debugger such as MPLAB REAL ICE or MPLAB ICD 3 are used with the starter kit, it is necessary to disconnect the on-board debugger from the PIC32 device. To do this, remove the JP2 jumper. When the on-board debugger is required, replace the JP2 jumper. When the JP2 jumper is installed, pin 1 must be connected to pin 3 and pin 2 must be connected to pin 4.

2.1.4 PIC32 USB Connectivity

There are three possible ways to connect to the PIC32 USB microcontroller:

- HOST Mode – Connect the device to the Type A connector J5, which is located on the top side of the starter kit. Note that a maximum of ~400 mA can be supplied from the Debug USB port to the Host port using this method. If the 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 J3, and then connect the starter kit to the host using a cable with a Type-B micro-connector to the starter kit's micro-A/B port J4, which is located on the bottom side of the board. The other end of the cable must have a Type-A connector. Connect it to a USB host.
- OTG Mode – Connect the starter kit to the OTG device using an OTG micro-A/B cable to the micro-A/B port J4, which is located on the bottom side of the board. The starter kit provides an on-board power supply capable of providing 120 mA Max. This supply is controlled by the PIC32MZ2048EFH144 device.

2.1.5 Switches

Push button switches provide the following functionality:

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

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

2.1.6 LEDs

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

2.1.7 Oscillator Options

A 24 MHz oscillator circuit (Y4) is connected to the on-board microcontroller. This oscillator circuit functions as the controller's primary oscillator. Depending on which is populated on the starter kit board, a 24 MHz crystal (Y1) may be used instead of Y4.

Use of an external crystal is required to develop USB applications. The USB specification dictates a frequency tolerance of ±0.25% for high speed. Non-USB applications can use the internal oscillators.

The starter kit also has provisions for an external secondary 32 kHz oscillator (Y2); however, this is not populated. A suitable oscillator, the 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.

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2.1.8 168-pin Modular Expansion Connector

The PIC32MZ Embedded Connectivity with Floating Point Unit (EF) 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.

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

2.1.9 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 the list of alternate options.

2.1.10 USB-to-UART/I^{2}C Communication

To facilitate application debug and development, a MCP2221 USB-to-UART/I^{2}C device (U8) 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 personal computer. To download the driver for the MCP2221, please visit the MCP2221 product page (www.microchip.com/MCP2221).

Libraries are also available on the MCP2221 web site that allow the host PC to communicate with the PIC32MZ EF device through the I^{2}C bus. Pull-up resistors are provided (R64 and R65).

If the features of the MCP2221 are not desired, disconnect the MCP2221 from the PIC32MZ EF device by removing resistors R66, R67, R68, and R69.

Table 2-2 lists the MCP2221 UART and I^{2}C pins that are connected to the PIC32MZ EF device.

TABLE 2-2: MCP2221 UART PIN CONNECTIONS

MCP2221		PIC32MZ EF Device		PIC32MZ Device UART/I^{2}C Function
Pin #	Function	Pin #	Full Pin Name	
4	RX	61	AN9/RPB14/SCK3/RB14	U2TX
5	TX	14	AN14/C1IND/RPG6/SCK2/RG6	U2RX
9	SCL	16	AN12/C2IND/RPG8/SCL4/RG8	SCL4
10	SDA	15	AN13/C1INC/RPG7/SDA4/RG7	SDA4

Note 1: The $\overline{CTS}$ and $\overline{RTS}$ functions are not required, but are available if desired. The MCP2221 configuration utility can be used to turn those functions on and off.

Three LEDs (D8, D9, and D11) are available to provide a visual indication of activity on the MCP2221. D8 is a red LED, which indicates receive activity (data from the PIC32). D9 is a green LED, which indicates transmit activity (data to the PIC32). D11 is a yellow LED, which indicates activity on the I^{2}C bus.

Note: Since the MCP2221 receive (RX) line shares the same pin as SW3, SW3 cannot be used in an application where the MCP2221 is also used.

2.1.11 40-pin Expansion Connector

On the back of the starter kit is a 40-pin (2 x 20) header (J12) that can be used to add expansion boards to the starter kit. The header provides 2-pin UART (through UART4 or UART6), I^2C (through I2C2), SPI (through SPI1) and GPIO capabilities. Table 2-3 lists the pins and the functions available through them.

TABLE 2-3: J12 CONNECTIONS

Function 1	Function 2	Pin	Pin	Function 2	Function 1
—	+3V3	1	2	+5V	—
RA3	SDA2	3	4	+5V	—
RA2	SCL2	5	6	GND	—
RA14	—	7	8	UxTX	RG6
—	GND	9	10	UxRX	RB14
RD0	—	11	12	—	RF2
RJ13	—	13	14	GND	—
RB3	—	15	16	—	RK1
—	+3V3	17	18	—	RK2
RF5	MOSI	19	20	GND	—
RF4	MISO	21	22	—	RK3
RD1	SCLK	23	24	—	RJ5
—	GND	25	26	—	RJ7
—	No Connect	27	28	No Connect	—
RH7	—	29	30	GND	—
RH9	—	31	32	—	RH11
RK4	—	33	34	GND	—
RK5	—	35	36	—	RK6
RD10	—	37	38	—	RH15
—	GND	39	40	—	RJ3

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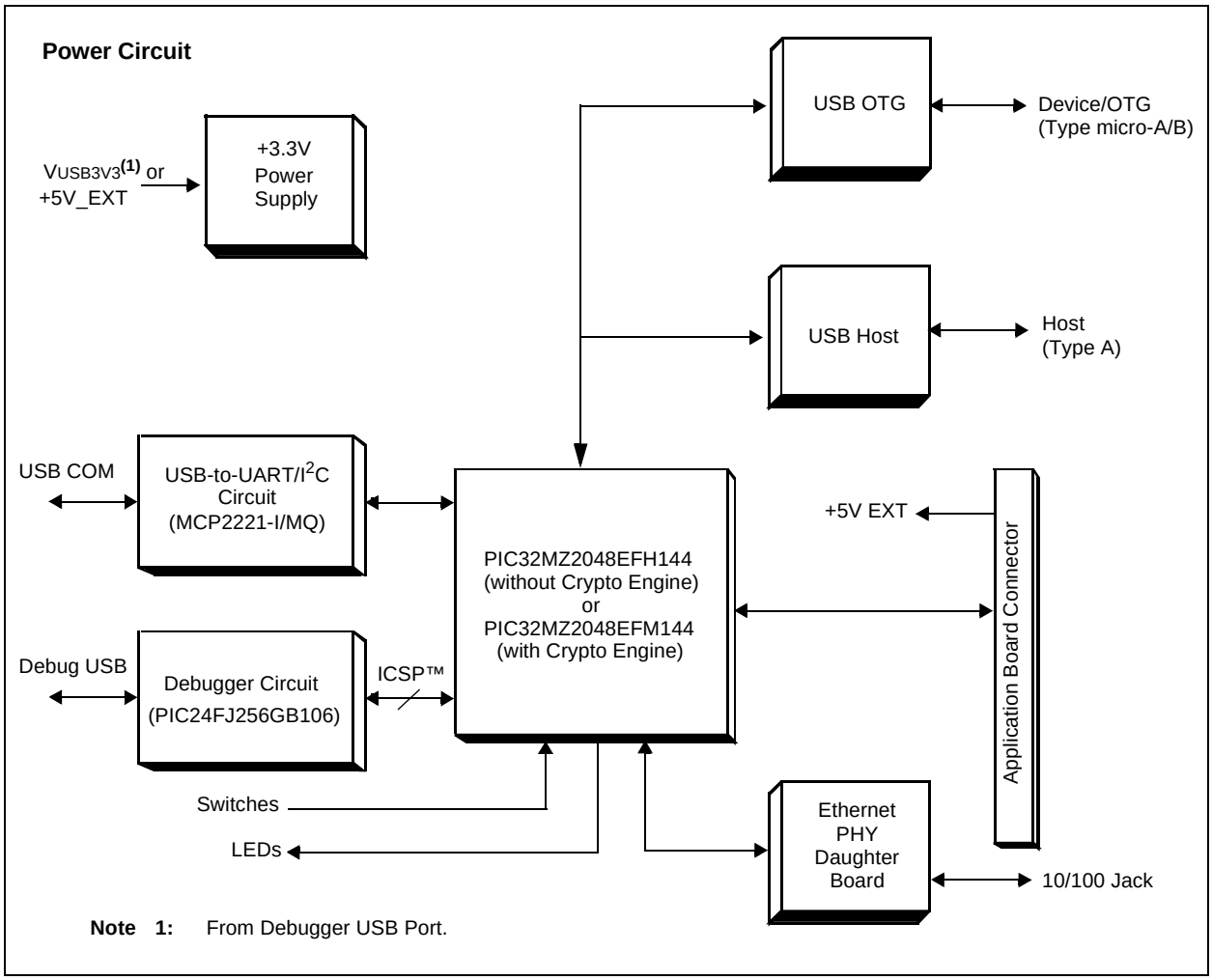
Appendix A. Schematics

A.1 BLOCK DIAGRAM

FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32MZ EF FAMILY STARTER KIT



Note 1: From Debugger USB Port.

A.2 SCHEMATICS

FIGURE A-2: PIC32MZ EF FAMILY DEVICE SCHEMATICS

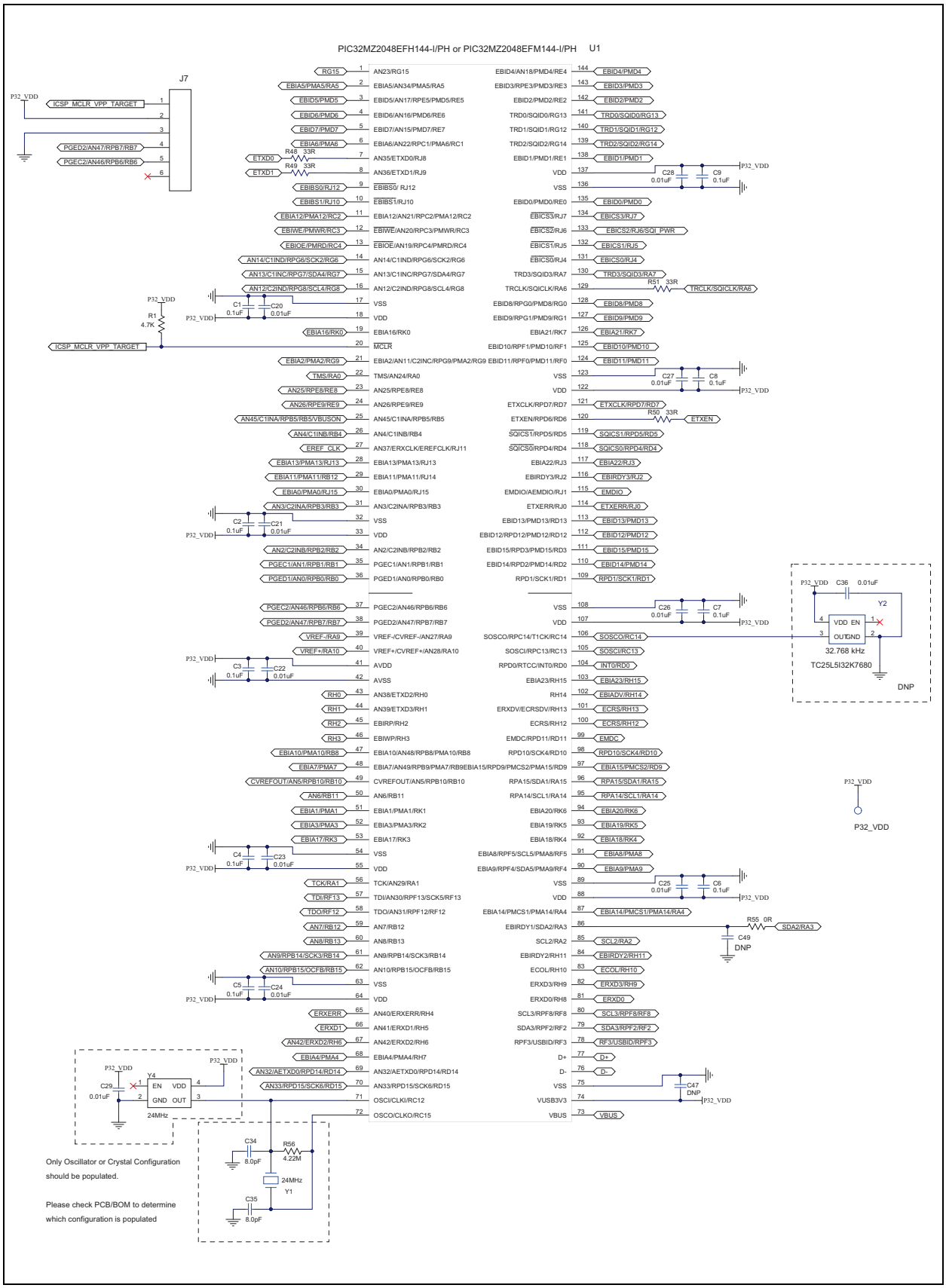


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FIGURE A-3: USB HOST AND OTG POWER SUPPLY SCHEMATICS

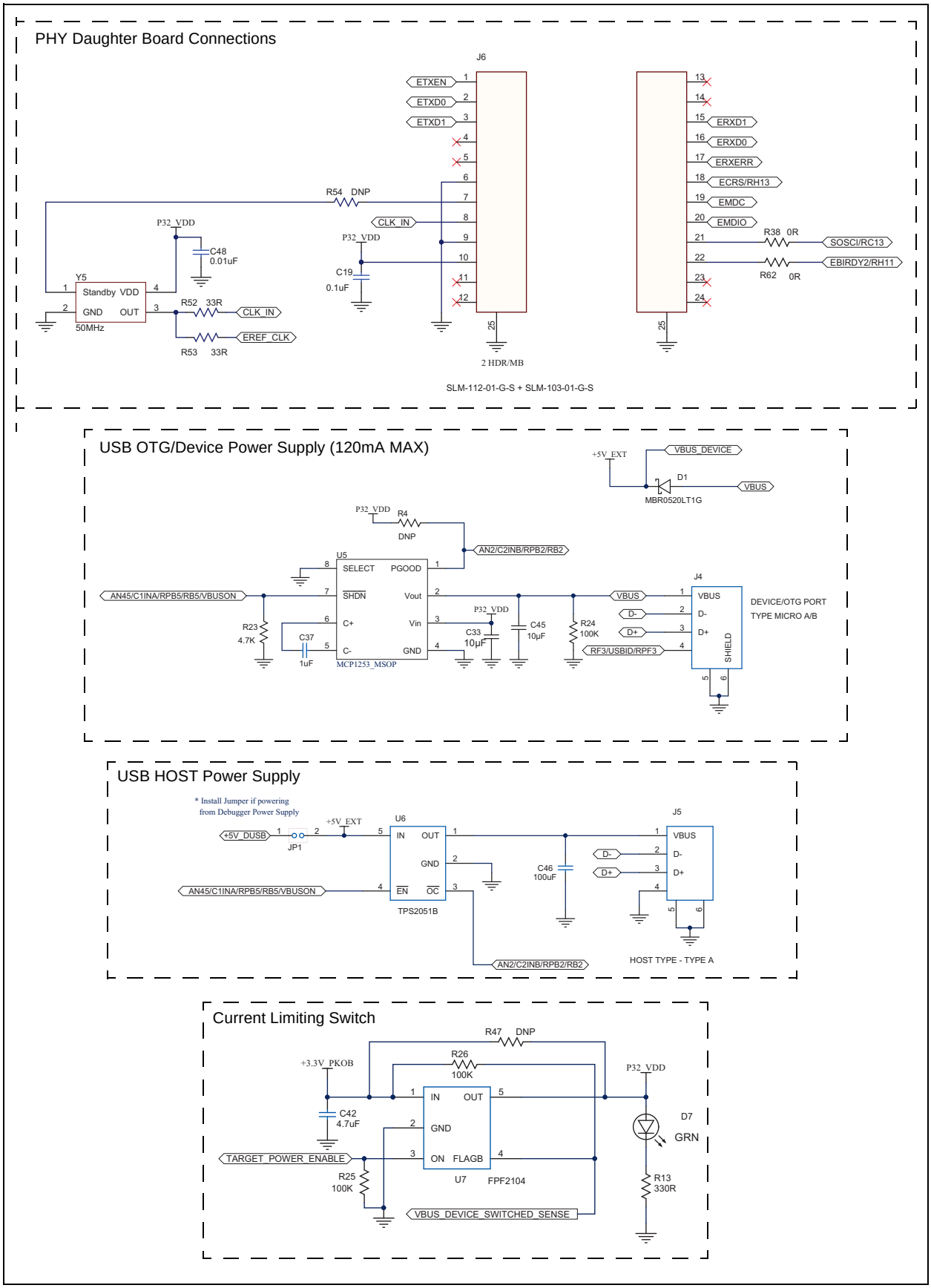

FIGURE A-4: DEBUGGER SCHEMATICS

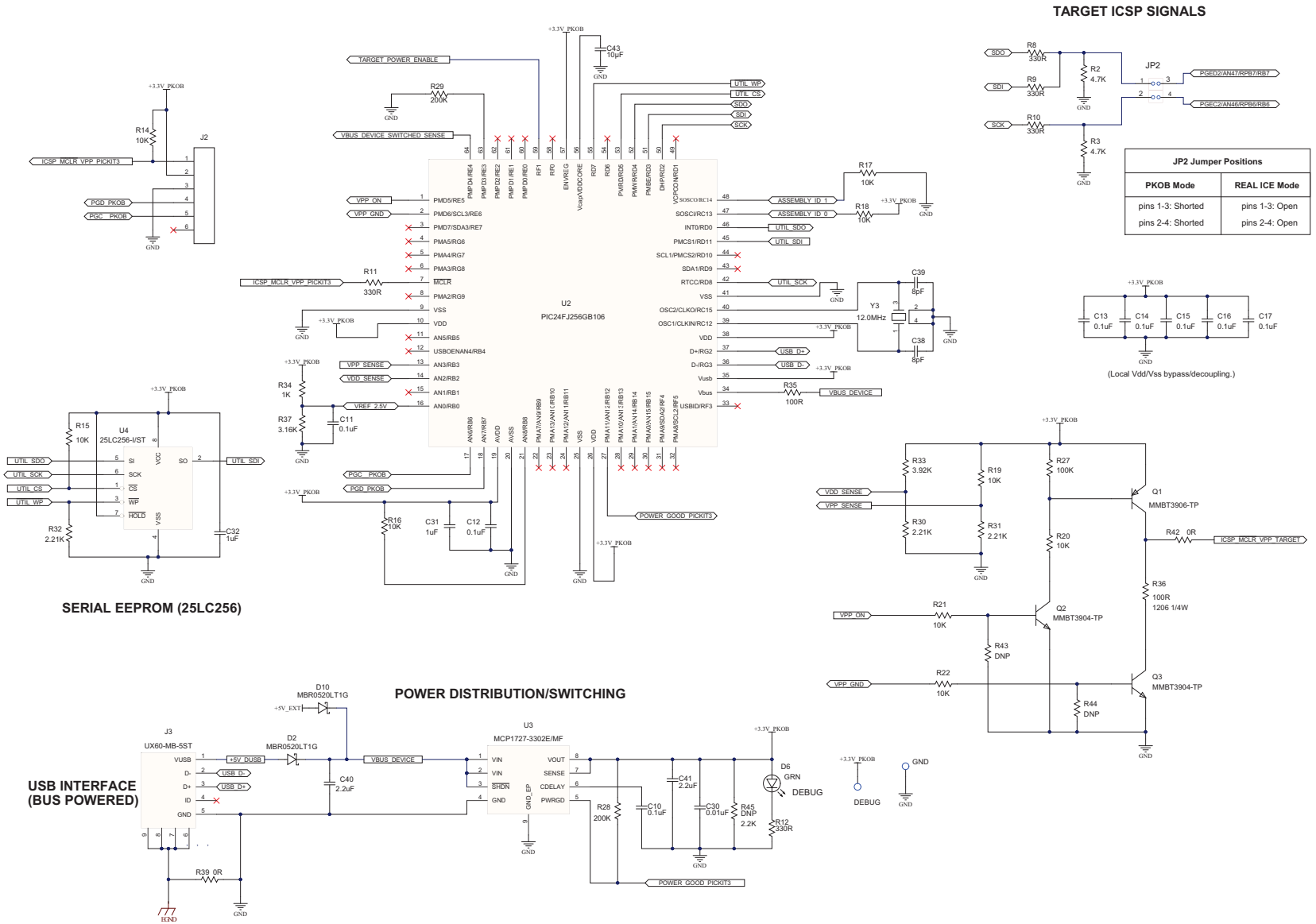

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FIGURE A-5: APPLICATION BOARD CONNECTOR, SQI MEMORY AND POWER, LEDS, AND SWITCHES SCHEMATICS

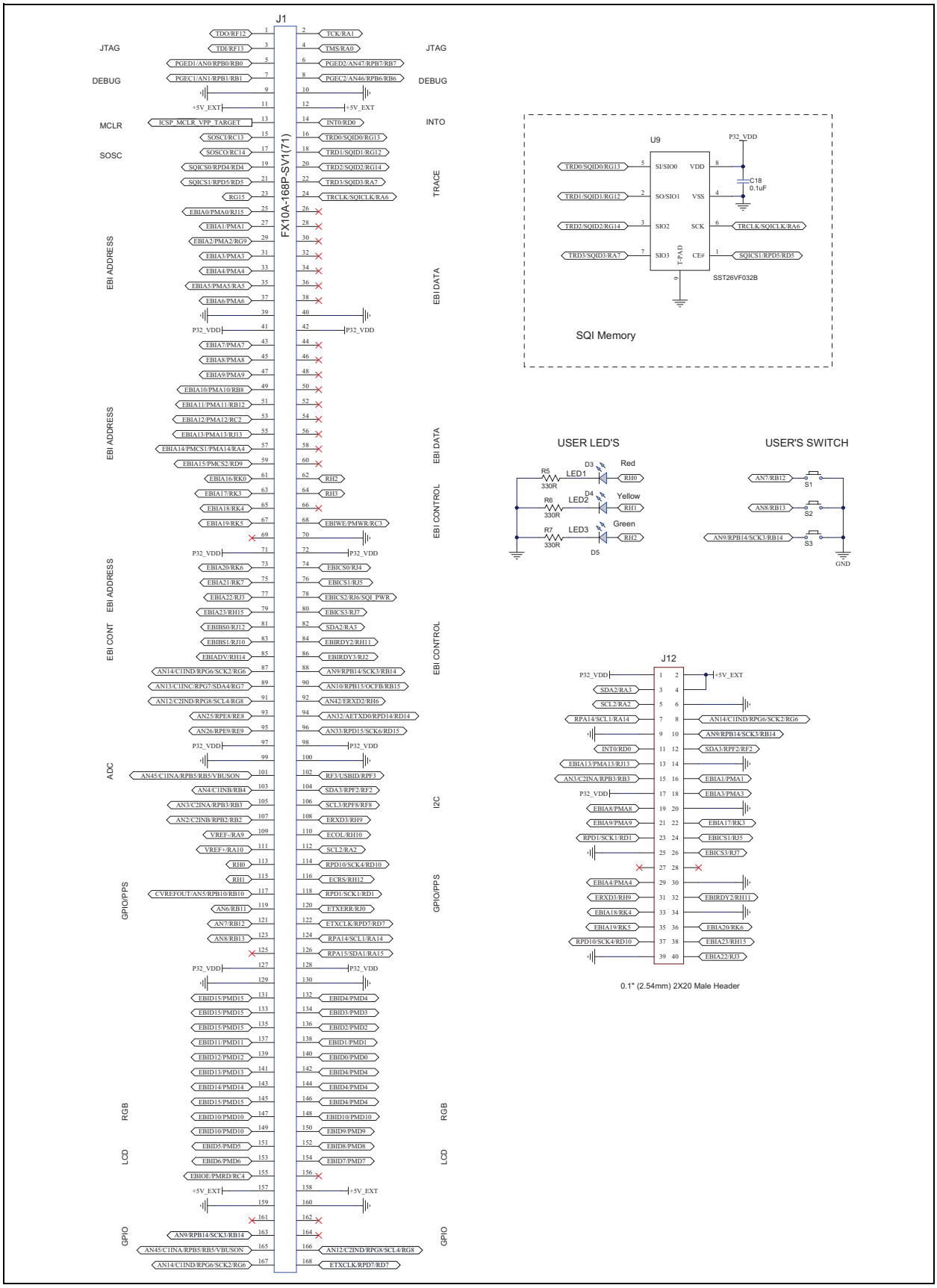
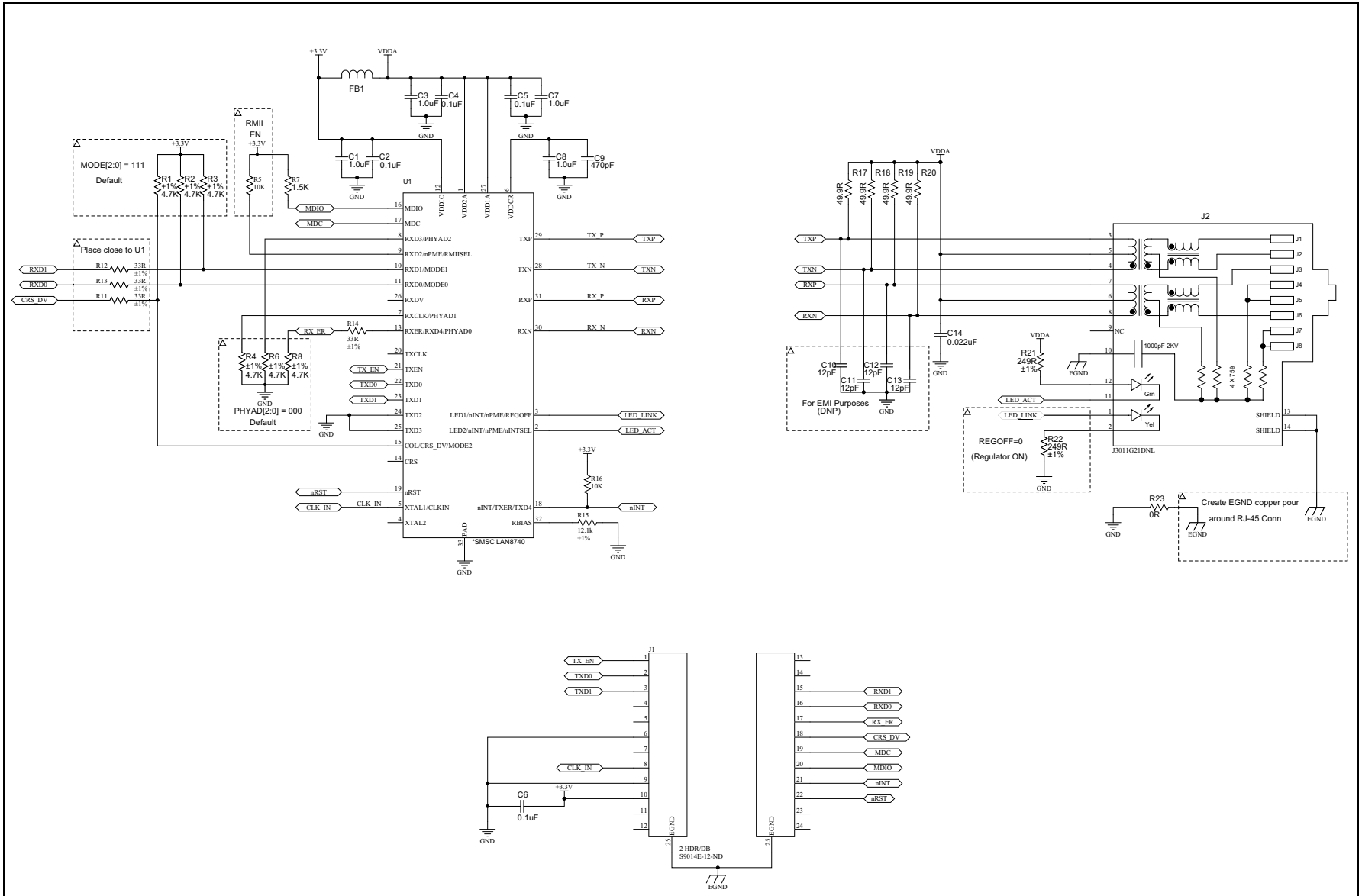


FIGURE A-6: LAN8740A PHY DAUGHTER BOARD SCHEMATICS



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Appendix B. Bill of Materials

B.1 PIC32MZ EF FAMILY STARTER KIT BILL OF MATERIALS

TABLE B-1: BILL OF MATERIALS

Reference	Description	Manufacturer	Part No.
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C50	CAP CER .10 µF 50V X7R 0603	TDK Corporation	C1608X7R1H104M080AA
C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C48	Cap, Ceramic, 0.01µF, 50V X7R, Cap,	TDK Corporation	C1608X7R1H103M080AA
C31, C32, C37	CAP CER 1.0 µF 16V X5R 10% 0603	TDK Corporation	C1608X5R1C105K080AA
C33, C43, C45	CAP CER 10 µF 16V Y5V 0805	Murata Electronics North America	GRM21BF51C106ZE15L
C38, C39	CAP CER 8 µF 50V NP0 0603	TDK Corporation	C1608C0G1H080D080AA
C40, C41	CAP CER 2.2 µF 16V X5R 0603	TDK Corporation	C1608X5R1C225K080AB
C42	CAP CER 4.7 µF 6.3V 10% X5R 0603	Taiyo Yuden	JMK107BJ475KA-T
C46	CAP CER 100 µF 6.3V Y5V 1206	Murata Electronics North America	GRM31CF50J107ZE01L
D1, D2, D10	DIODE SCHOTTKY 20V 0.5A SOD123	ON Semiconductor	MBR0520LT1G
D3, D9	LED, SMD, RED, 0603 package	Kingbright	APT1608EC
D4, D11	LED, SMD, YEL, 0603 package	Kingbright	APT1608YC
D5, D6, D7, D8	LED GREEN CLEAR THIN 0603 SMD	Kingbright	APT1608SGC
DEBUG	TEST POINT PC MINI .040"D WHITE	Keystone Electronics	5002
GND	TEST POINT PC MINI .040"D BLACK	Keystone Electronics	5001
J1	Hirose FX10_ 168 pin Header	Hirose Electric Co Ltd	FX10A-168P-SV1(71)
J7	CONN HEADER .050" 6POS PCB GOLD	Sullins Connector Solutions	GRPB061VWVN-RC
J3, J11	CONN RECEPT MINI USB2.0 5POS	Hirose Electric Co Ltd	UX60-MB-5ST
J4	CONN USB TYPE MICRO_A/B	Hirose Electric Co Ltd	ZX62-AB-5PA(11)
J5	CONN USB TYPE A R/A BLACK	On Shore Technology Inc	USB-A1HSB6
J6	12POS 0.05" SINGLE ROW TH HEADER	Sullins Connector Solutions	LPPB121NFFN-RC
J12	CONN HEADER .1" 2X20 MALE TH	Samtec	FTS-102-01-L-D
JP1	CONN HEADER .100" SNGL STR 2POS	Samtec	TSW-102-07-F-S
JP2	2X2 (0.05"x 0.05") TH HEADER	Samtec	TWS-120-08-L-D
P32_VDD	TEST POINT PC MINI .040"D RED	Keystone Electronics	5000
Q1	TRANS SS PNP 40V 300MW SOT23	Micro Commercial Co	MMBT3906-TP
Q2, Q3	TRANSISTOR NPN GP 40V SOT23	Micro Commercial Co	MMBT3904-TP
R1, R2, R3, R23, R58	RES 4.7K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc	RMCF0603FT4K70

Note 1: Depending on the starter kit purchased, the development board will be populated with either a PIC32MZ2048EFM144 (with Crypto Engine) device or a PIC32MZ2048EFH144 device (without Crypto Engine).

TABLE B-1: BILL OF MATERIALS (CONTINUED)

Reference	Description	Manufacturer	Part No.
R5, R6, R7, R8, R9, R10, R11, R12, R13, R59, R60, R63	RES 330 OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT330R
R14, R15, R16, R17, R18, R19, R20, R21, R22	RES 10K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT10K0
R24, R25, R26, R27	RES 100K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT100K
R28, R29	RES 200K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT200K
R30, R31, R32, R64, R65	RES 2.21K OHM 1/10W 1% 0603 SMD	Panasonic Electronic Components	ERJ-3EKF2211V
R33	RES 3.92K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-073K92L
R34	RES 1K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT1K00
R35	RES 100 OHM 1/10W 1% 0603 SMD	Yageo	RC0603JR-07100RL
R36	RES 100 OHM 1/4W 1% 1206 SMD	Yageo	RC1206FR-07100RL
R37	RES 3.16K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-073K16L
R38, R39, R42, R55, R57, R62, R66, R67, R68, R69	RES 0.0 OHM 1/10W 0603 SMD	Panasonic Electronic Components	ERJ-3GEY0R00V
R48, R49, R50, R51, R52, R53	RES 33 OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT33R0
S1, S2, S3	SWITCH TACTILE SPST-NO 0.05A 12V	C&K Components	PTS635SK25SMTR LFS
U1 **(see Note 1)**	PIC32MZ2048EFM144-I/PH (Crypto)	Microchip Technology Inc.	PIC32MZ2048EFM144-I/PH
U1 Alternative **(see Note 1)**	PIC32MZ2048EFH144-I/PH (Non-Crypto)	Microchip Technology Inc.	PIC32MZ2048EFH144-I/PH
U2	IC PIC MCU FLASH 256K 64-TQFP	Microchip Technology Inc.	PIC24FJ256GB106-I/PT
U3	IC REG LDO 1.5A 3.3V 8DFN	Microchip Technology Inc.	MCP1727-3302E/MF
U4	IC EEPROM 256 KBIT 10 MHz 8 TSSOP	Microchip Technology Inc.	25LC256-I/ST
U5	IC MULT CONFIG 3.3/5V .12A 8 MSOP	Microchip Technology Inc.	MCP1253-33X50I/MS
U6	IC PWR DIST SWITCH SNGL SOT23-5	Texas Instruments	TPS2051BDBVR
U7	IC SWITCH LOAD FULL FUNC SOT23-5	Fairchild Semiconductor	FPF2104
U8	IC USB TO UART 20 QFN	Microchip Technology Inc.	MCP2221-I/ML
U9	IC FLASH 32MBIT	Microchip Technology Inc.	SST26VF032BA-104I/SM
Y3	CRYSTAL 12.000000 MHZ 8 µF SMD	NDK	NX3225SA-12.000MHZ-STD-CSR-1
Y4	ASDMB-24.000MHZ-LC-T	Abracon LLC	ASDMB-24.000MHZ-LC-T
Y5	OSC MEMS 50.000 MHz_1.8V~3.3V SMD	Abracon LLC	ASEMB-50.000MHZ-LC-T
@J6	3POS 0.05" SINGLE ROW TH HEADER	Samtec	SLM-103-103-L-S
@JP1	SHUNT JUMPER .1" BLACK GOLD	3M	969102-0000-DA
installed @ JP2	SHUNT 2POS (0.05" X0.05")	SULLINS	NPB02DVFN-RC
Foot (bottom)	BUMPON CYLINDRICAL .375X.135 BLK	3M	SJ61A8
Y1	CRYSTAL 24.000 MHz 8 µF SMD	AVX Corp/Kyocera Corp.	CX3225GA24000D0PTVZ1
Y2	OSCILLATOR 32.768 kHz 3.3V SMD	CTS-Frequency Controls	TC25L5I32K7680

Note 1: Depending on the starter kit purchased, the development board will be populated with either a PIC32MZ2048EFM144 (with Crypto Engine) device or a PIC32MZ2048EFH144 device (without Crypto Engine).

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B.2 LAN8740A PHY DAUGHTER BOARD BILL OF MATERIALS

TABLE B-2: LAN8740A PHY DAUGHTER BOARD BILL OF MATERIALS

Reference	Description	Manufacturer	Part No.
C1, C3, C7, C8	Cap, Ceramic, 1 µF, 16V X5R	TDK Corporation	C1608X5R1C105K
C2, C4, C5, C6	Cap, Ceramic, 0.1 µF, 50V X7R	TDK Corporation	C1608X7R1H104M
C9	CAP 470 µF 50V CERAMIC X7R 0603	Yageo	CC0603KRX7R9BB471
C10, C11, C12, C13	CAP CER 12 µF 50V 5% NPO 0603	Yageo	CC0603JRNPO9BN120
C14	CAP CER 0.022 µF 50V 20% X7R 0603	Murata Electronics North America	GRM188R71H223MA01D
FB1	FERRITE CHIP 600 OHM 500 mA 0805	TDK Corporation	MMZ2012Y601B
J1	TWO CONN HEADER .050" 12 POS PCB GOLD	Sullins Connector Solutions	GRPB121VWVN-RC
@J1	TWO CONN HEADER .050" 3 POS PCB GOLD	Sullins Connector Solutions	GRPB031VWVN-RC
J2	CONN MAGJACK 1 PORT 100 BASE-TX	Pulse Electronics Corporation	J3011G21DNL
R1, R2, R3, R4, R6, R8	RES 4.70K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4701V
R5, R16	RES 10K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT10K0
R7	RES 1.50K OHM 1/10W 1% 0603 SMD	Vishay Dale	CRCW06031K50FKEA
R11, R12, R13, R14	RES 33 OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT33R0
R15	RES 12.1K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT12K1
R17, R18, R19, R20	RES TF 1/10W 49.9 OHM 1% 0603	Stackpole Electronics Inc.	RMCF0603FG49R9
R21, R22	RES TF 1/10W 249 OHM 1% 0603	Stackpole Electronics Inc.	RMCF0603FG249R
R23	RES 0.0 OHM 1/4W 0805 SMD	Yageo	RC0805JR-070RL
U1	TX/RX Ethernet 32-pin QFN	Microchip Technology Inc.	LAN8740A

NOTES:

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NOTES:

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