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PIC32 Ethernet Starter Kit II User's Guide

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ISBN: 978-1-62077-899-9

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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 PIC32 Ethernet Starter Kit II. 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 PIC32 Ethernet Starter Kit II (all 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 and detailed schematics of the starter kit.
- **Appendix B. "Bill of Materials (BOM)"** provides the bill of materials for 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 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.

PIC32MX5XX/6XX/7XX Family Data Sheet (DS60001156)

Refer to this document for detailed information on PIC32 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® 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
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- **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 (February 2014)

This is the initial release of this document.

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PIC32 ETHERNET STARTER KIT II USER'S GUIDE

Chapter 1. Introduction

Thank you for purchasing a Microchip Technology PIC32 Ethernet Starter Kit II. This board provides a low-cost, modular development system for Microchip's line of 32-bit microcontrollers.

The starter kit comes preloaded with demonstration software for the user to explore the new features of the PIC32. 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
- PIC32 Ethernet Starter Kit II Functionality and Features

The preprogrammed example code on the PIC32 MCU is available via 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 PIC32 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 PIC32 Ethernet Starter Kit II contains the following items:

- PIC32 Ethernet Starter Kit II Development Board
- LAN8740 PHY Daughter Board
- USB mini-B to full-sized A cable – USB debug cable to debug and power the board
- USB micro-B to full-sized A cable – PIC32 USB cable to communicate with the PIC32 USB port
- RJ-45 CAT5 Ethernet patch cable – Ethernet CAT5 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 back page of this document.

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1.2 PIC32 ETHERNET STARTER KIT II FUNCTIONALITY AND FEATURES

1.2.1 Development Board

Representations of the layout of the development board in the PIC32 Ethernet Starter Kit II are shown in Figure 1-1 and Figure 1-2.

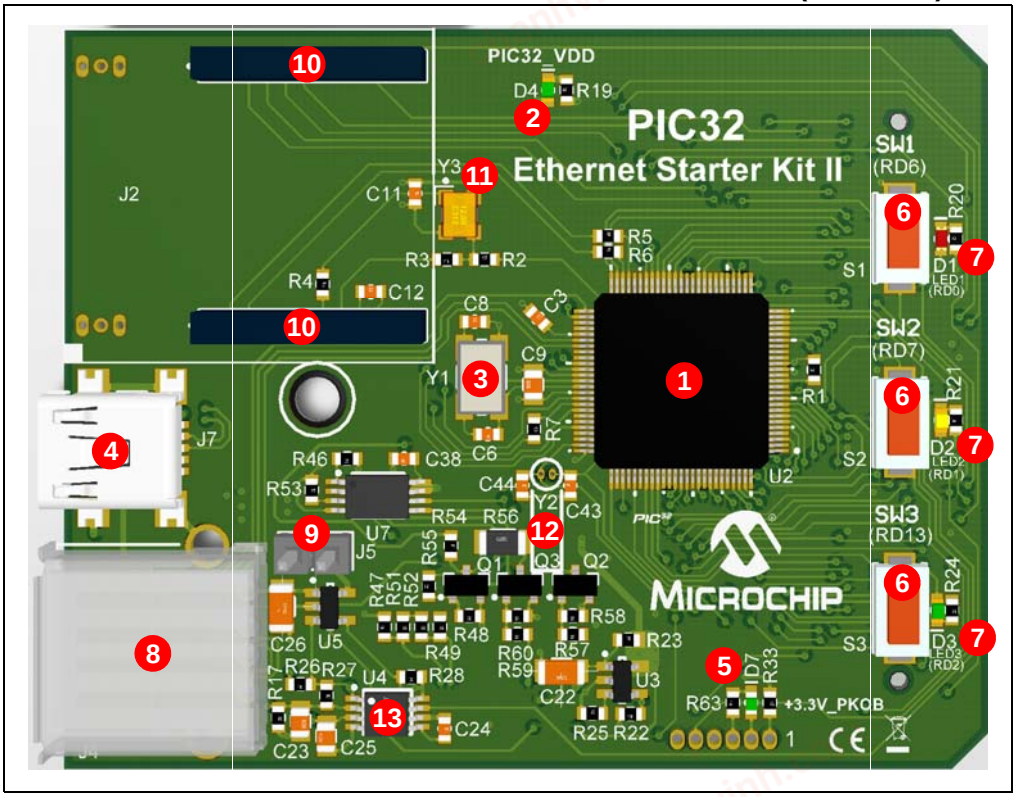
The top assembly of the board includes these key features, as indicated in Figure 1-1:

1. PIC32MX795F512L 32-bit microcontroller (U2).
2. Green power indicator LED (D4).
3. On-board crystal for precision microcontroller clocking (8 MHz) (Y1).
4. USB connectivity for on-board debugger communications (J7).
5. Debug indicator LED (D7).
6. Three push button switches for user-defined inputs (SW1, SW2, SW3).
7. Three user-defined indicator LEDs (D1, D2, D3).
8. USB Type A receptacle connectivity for PIC32 host-based applications (J4).
9. HOST mode power jumper (J5).
10. LAN8740 PHY Daughter Board headers (J2)
11. 50 MHz Ethernet PHY oscillator (Y3).
12. 32 kHz oscillator (optional) (Y2).
13. USB Host and OTG power supply for powering PIC32 USB applications (U4).

Note: When running self-powered USB device applications, open the jumper JP2 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: PIC32 ETHERNET STARTER KIT II LAYOUT (TOP VIEW)



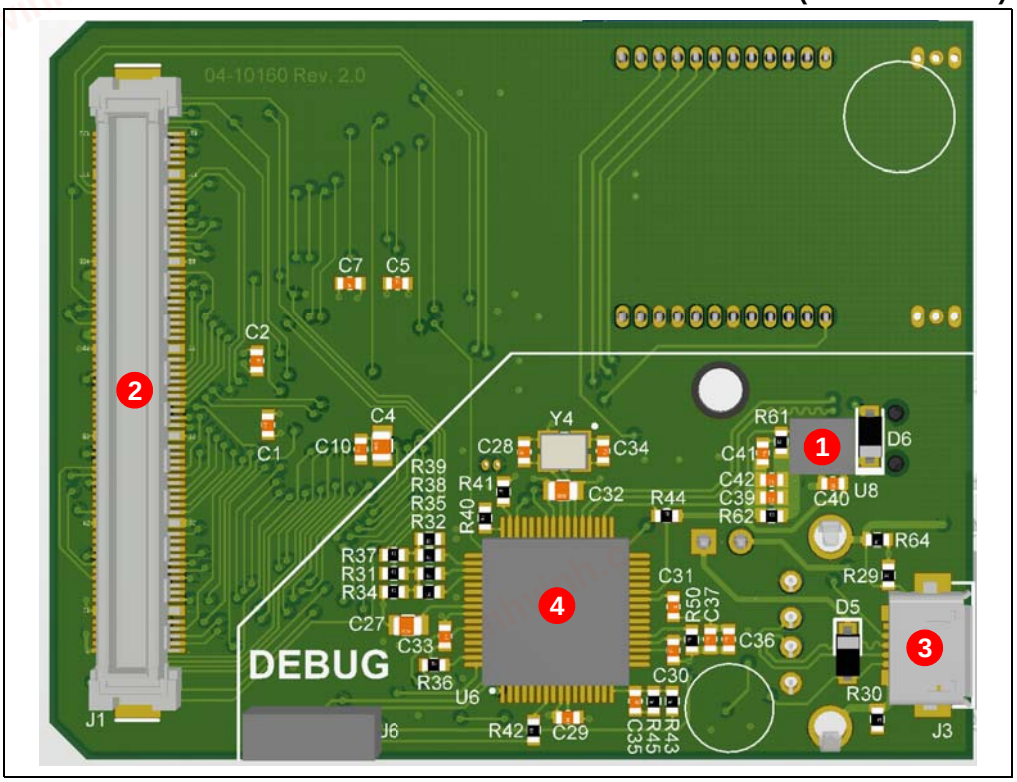
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The bottom assembly of the board includes these key features, as indicated in Figure 1-2:

1. Regulated +3.3V power supply for powering the starter kit via USB or expansion board (u8).
2. Connector for various expansion boards (J1).
3. USB Type micro-AB receptacle for OTG and USB device connectivity for PIC32 OTG/device-based applications (j3).
4. PIC24FJ256GB106 USB microcontroller for on-board debugging (U6).

FIGURE 1-2: PIC32 ETHERNET STARTER KIT II LAYOUT (BOTTOM VIEW)



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1.2.2 LAN8740 PHY Daughter Board

Representation of the layout of the daughter board in the PIC32 Ethernet Starter Kit II is shown in Figure 1-3 and Figure 1-4.

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

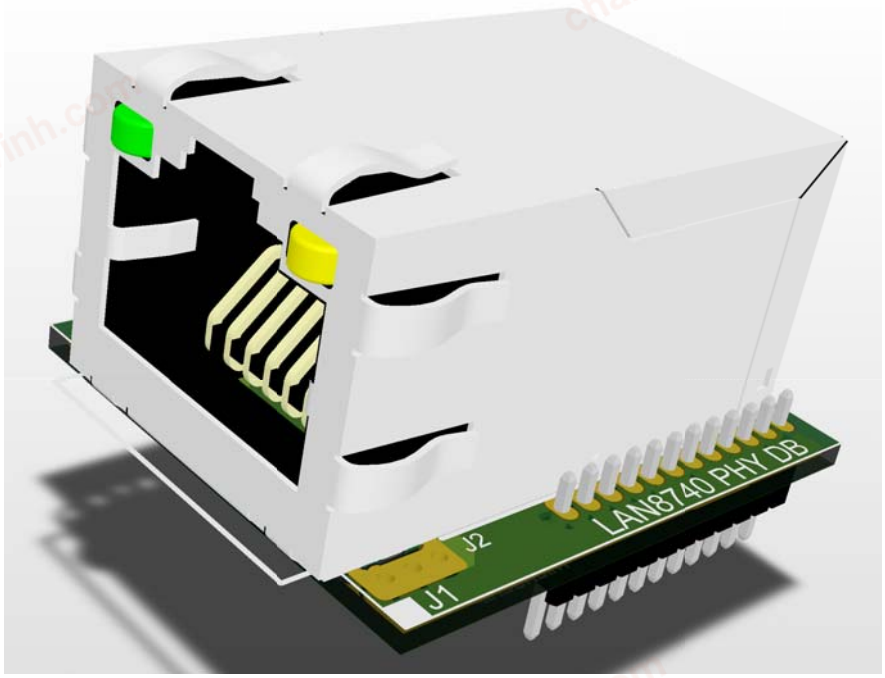
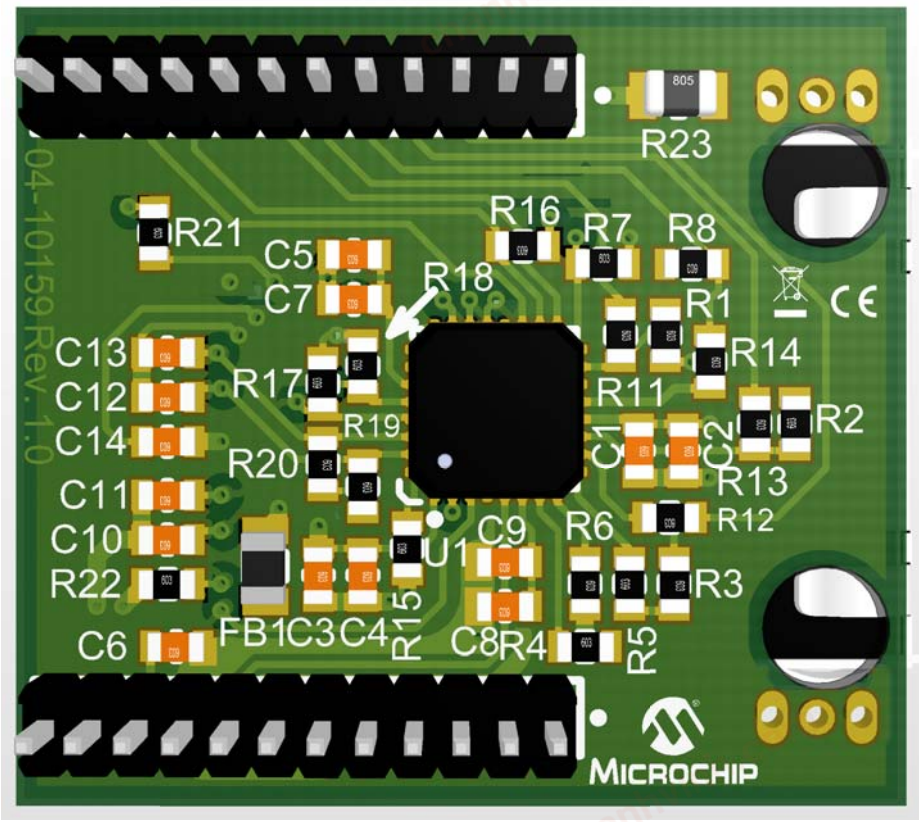


FIGURE 1-4: DAUGHTER BOARD LAYOUT (BOTTOM VIEW)



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Chapter 2. Hardware

This chapter describes the hardware features of the PIC32 Ethernet Starter Kit II.

2.1 HARDWARE FEATURES

The key features of the PIC32 Ethernet Starter Kit II are provided in the following sections. They are presented in the order given in **Section 1.2 "PIC32 Ethernet Starter Kit II Functionality and Features"**. You can refer to Figure 1-1 and Figure 1-2 for their locations on the board.

2.1.1 Processor Support

The PIC32 Ethernet Starter Kit II is designed with a permanently mounted (i.e., soldered) PIC32MX795F512L processor.

2.1.2 Power Supply

There are two ways to supply power to the PIC32 Ethernet Starter Kit II:

- USB bus power connected to USB debug connector, J7.
- An external application board with a regulated DC power supply that provides +5V can be connected to the J1 application board connector that is provided on the bottom side of the board.

One green LED (D4) is provided to show that the PIC32 microcontroller is powered up.

2.1.3 Debug USB Connectivity

The PIC32 Ethernet Starter Kit II includes a PIC24FJ256GB106 USB microcontroller that provides debugger connectivity over USB. This device is hard-wired to the PIC32 device to provide protocol translation through the I/O pins of the PIC24FJ256GB106 to the ICSP™ pins of the PIC32 device.

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 J4, located on the top side of the starter kit. If using the Debug USB port to power the Host port, install jumper J5 to short the back-power prevention diode. 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 and jumper J5 must be removed to prevent back-powering the Debug USB port.

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- DEVICE Mode – Connect the debug mini-B USB cable to port J7 and then connect the starter kit to the host using a cable with a Type-B micro-plug to the starter kit's micro-A/B port J3, located on the bottom side of the starter kit. The other end of the cable must have a Type-A plug. Connect it to a USB host. Jumper J5 should be removed.
- OTG Mode – Connect the starter kit to the OTG device using an OTG micro-A/B cable to the micro-A/B port J3, located on the bottom side of the starter kit. The starter kit provides an on-board power supply capable of providing 120 mA Max. This supply is controlled by the PIC32MX795F512L microcontroller. Jumper J5 should be removed.

2.1.5 Switches

Push button switches provide the following functionality:

- SW1: Active-low switch connected to RD6
- SW2: Active-low switch connected to RD7
- SW3: Active-low switch connected to RD13

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). When pressed, they are grounded.

2.1.6 LEDs

The RD0 through RD2 LEDs are connected to PORTD of the processor. The PORTD pins are set high to light the LEDs.

2.1.7 Oscillator Options

The installed microcontroller has an oscillator circuit connected to it. The main oscillator uses an 8 MHz crystal (Y1) and functions as the controller's primary oscillator. Use of an external crystal is required to develop USB applications. The USB specification dictates a frequency tolerance of ±0.25% for full 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, ECS-3X8, can be obtained from Digi-Key: Part no. X801-ND CMR200TB32.768KDZFTR.

2.1.8 120-Pin Modular Expansion Connector

The PIC32 Ethernet Starter Kit II has been designed with a 120-pin modular expansion interface, which allows the board to provide basic generic functionality now, 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-120P/12-SV1(71)
Application Board Connector	FX10A-120S/12-SV(71)

2.1.9 Ethernet PHY

The Microchip LAN8740 PHY Daughter Board is populated with a low-power, small-footprint, 10/100 Fast Ethernet LAN8740 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.

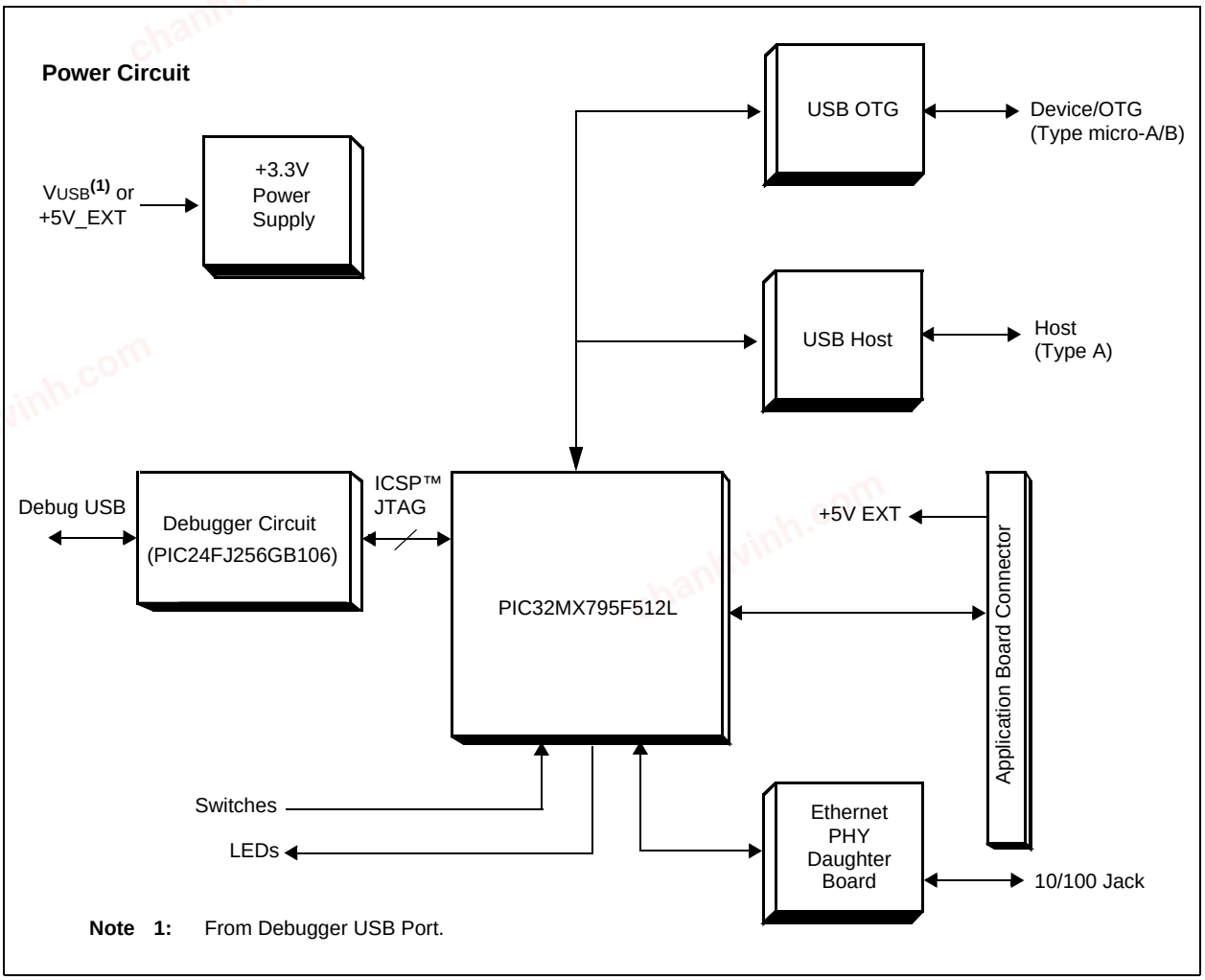
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Appendix A. Schematics

A.1 PIC32 ETHERNET STARTER KIT II BLOCK DIAGRAM

FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32 ETHERNET STARTER KIT II

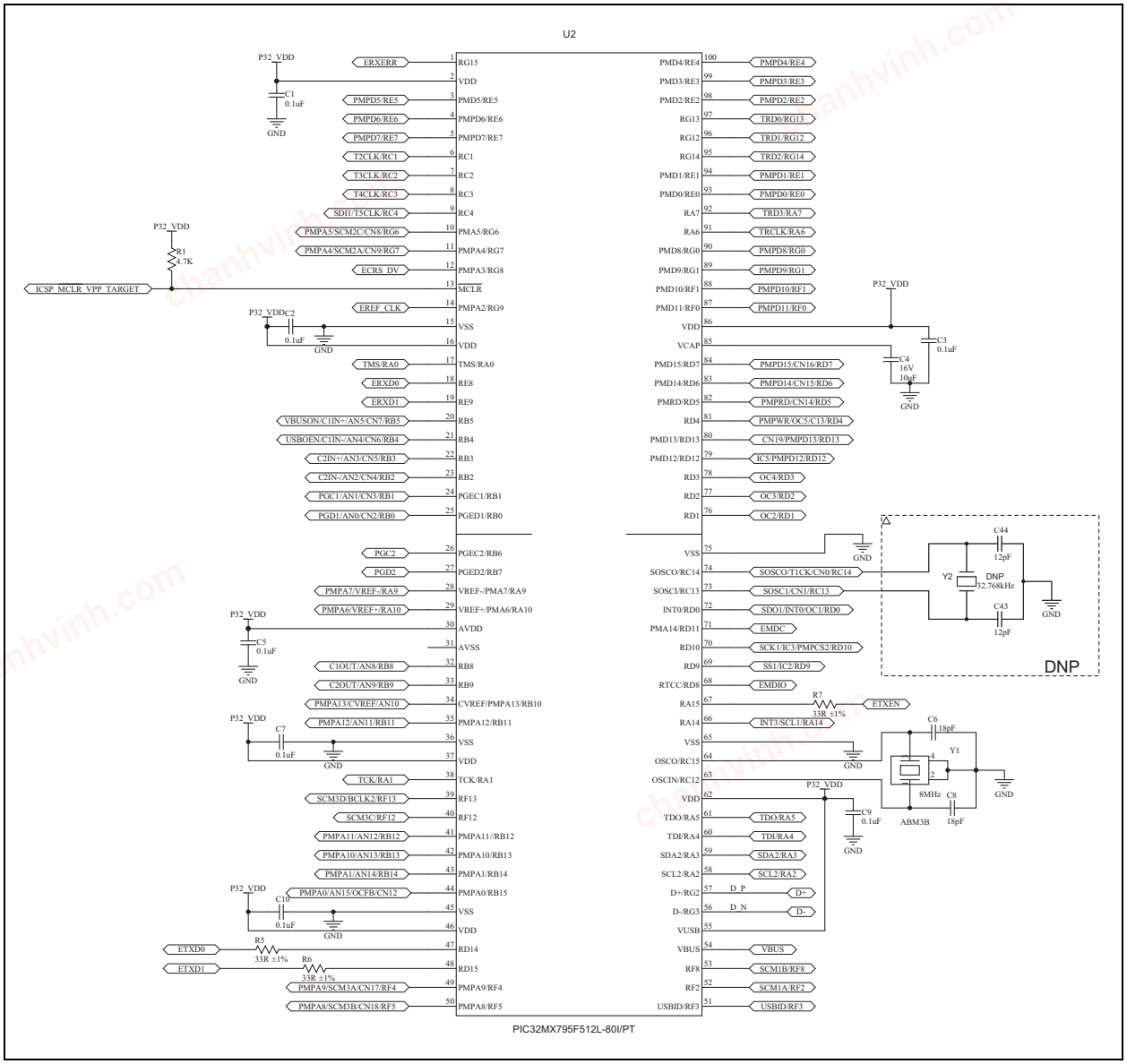


Note 1: From Debugger USB Port.

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A.2 PIC32 ETHERNET STARTER KIT II BOARD SCHEMATICS

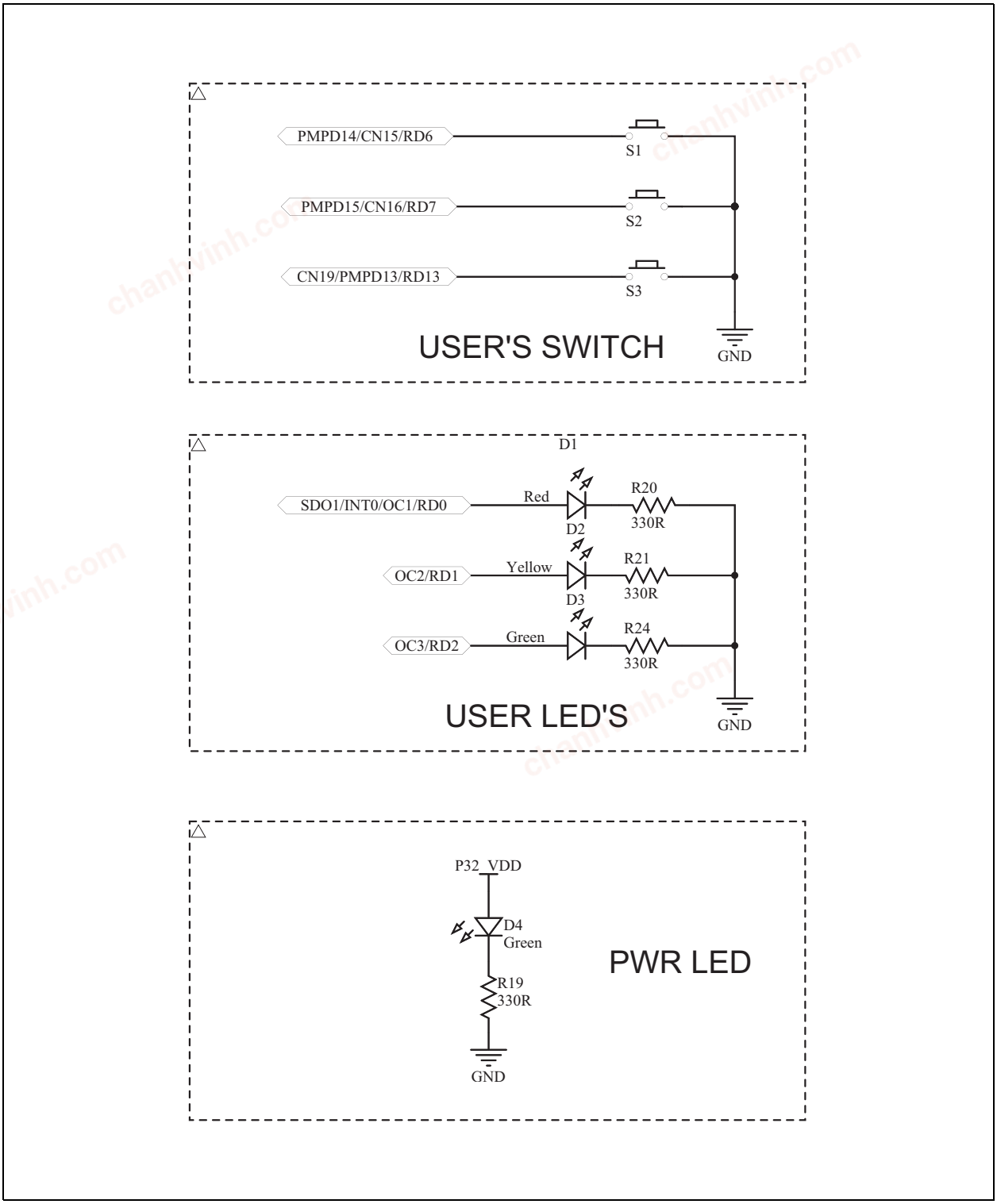
FIGURE A-2: PIC32MX795F512L CONFIGURATION



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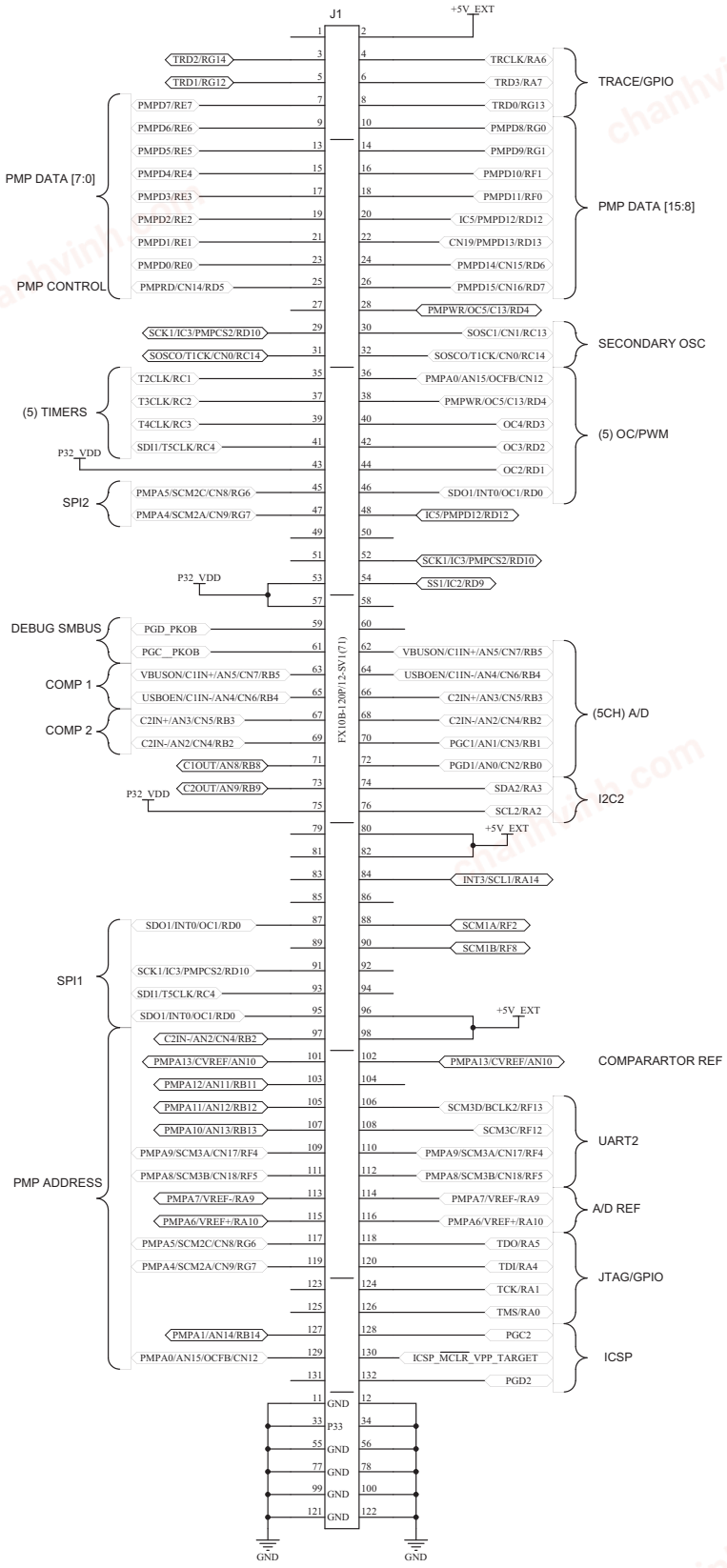
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FIGURE A-3: SWITCHES AND LEDS



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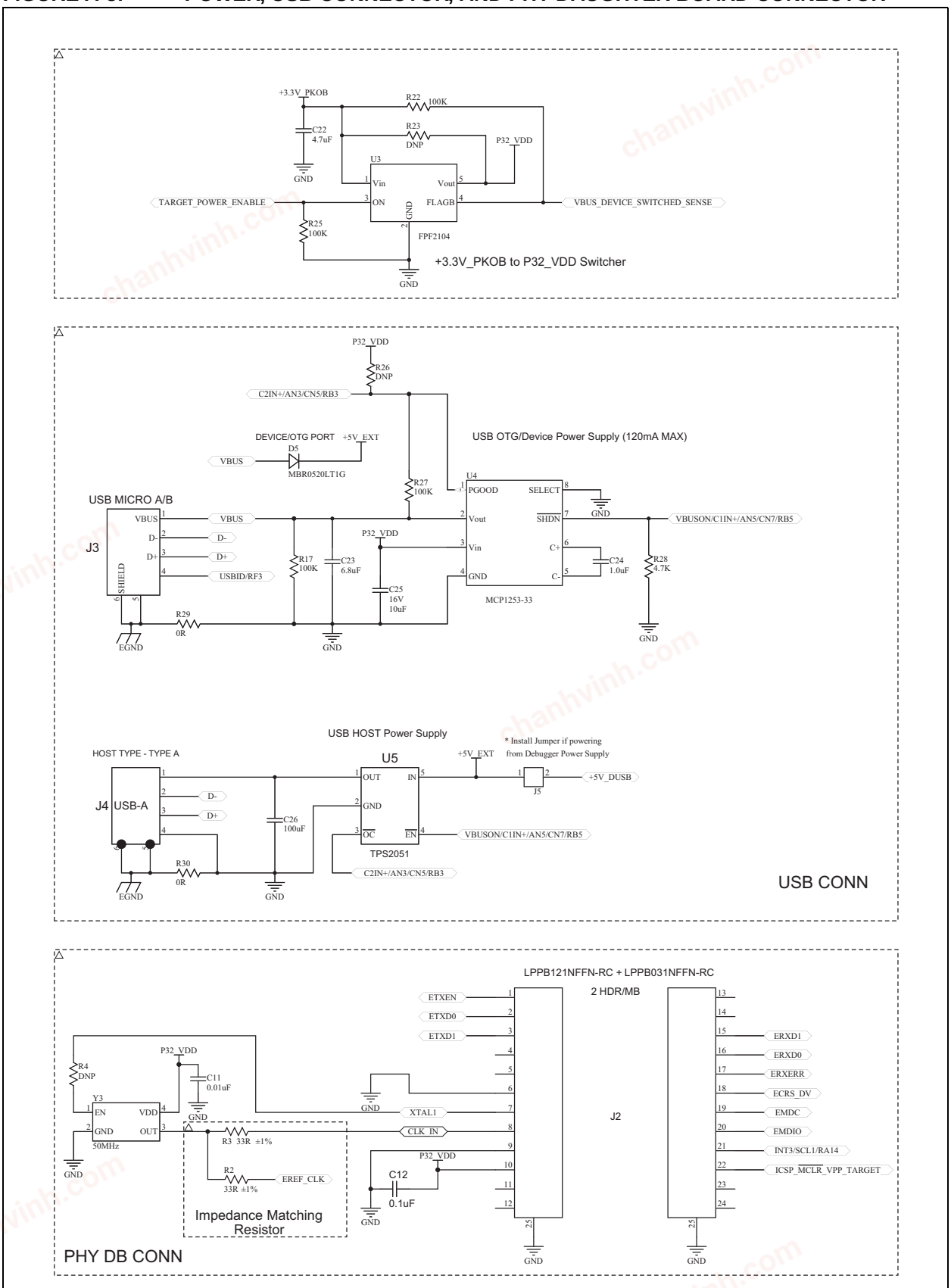
FIGURE A-4: EXPANSION BOARD CONNECTOR



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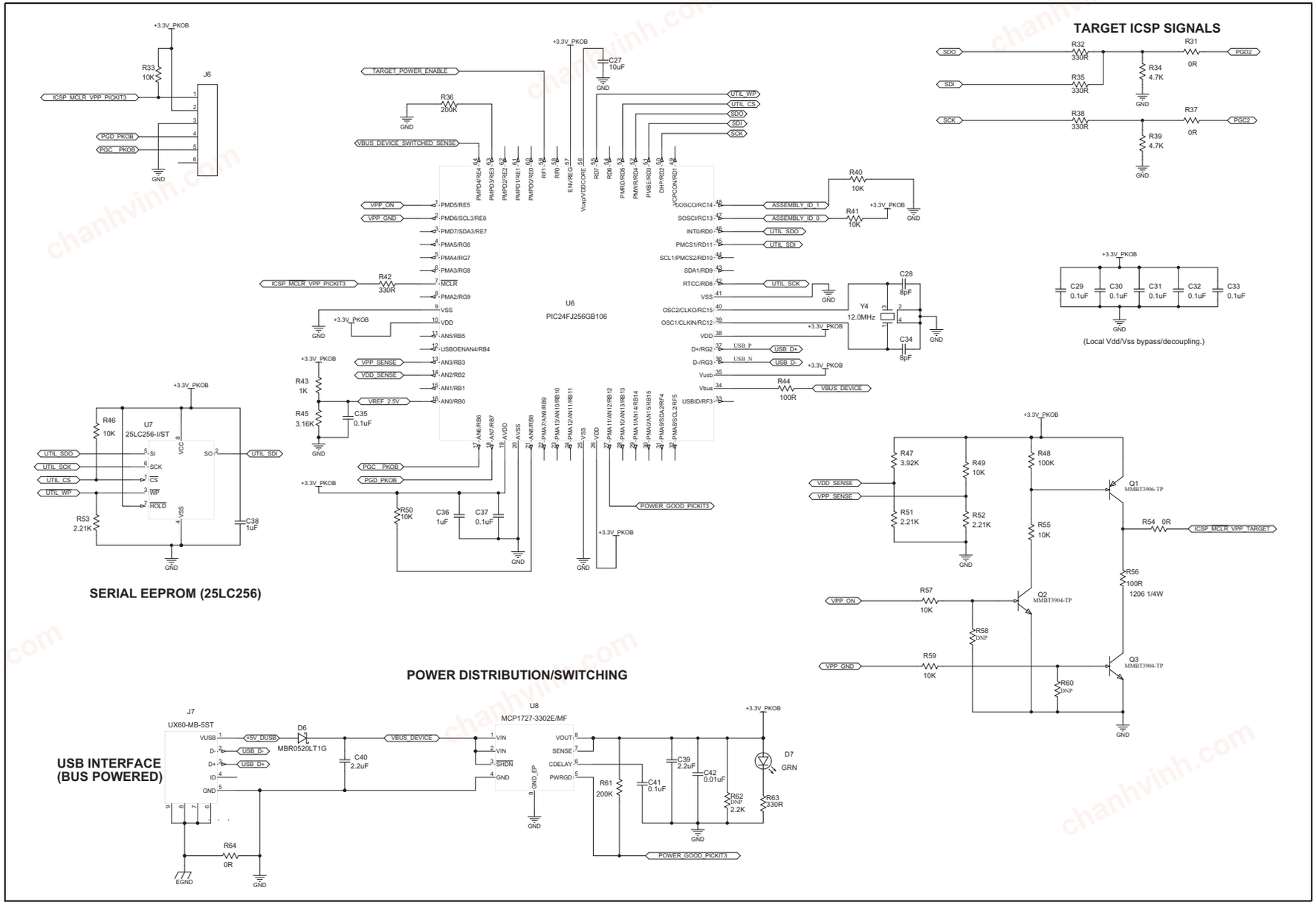
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FIGURE A-5: POWER, USB CONNECTOR, AND PHY DAUGHTER BOARD CONNECTOR



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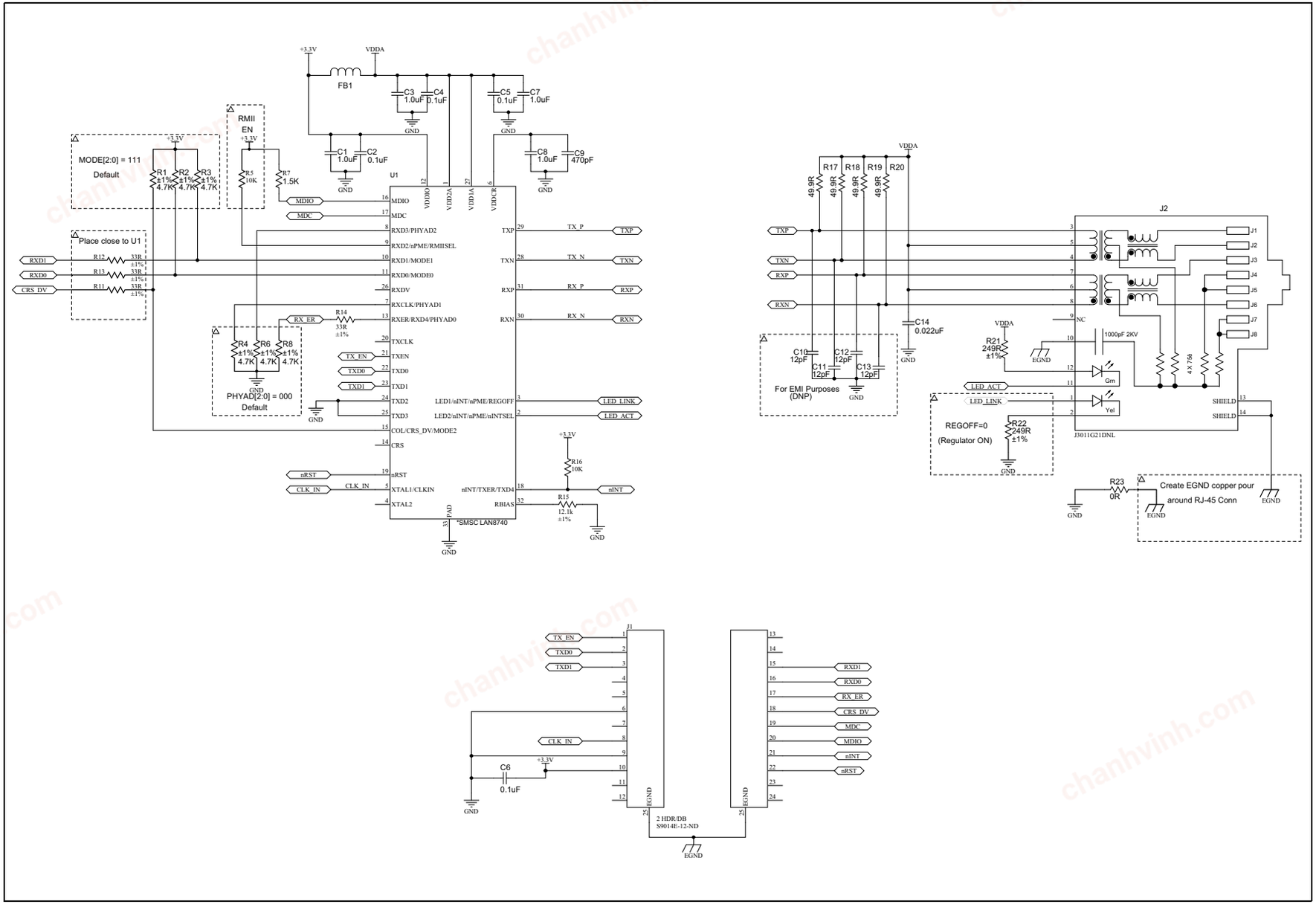
FIGURE A-6: DEBUGGER SCHEMATICS



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FIGURE A-7: LAN8740 PHY DAUGHTER BOARD SCHEMATICS



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Appendix B. Bill of Materials (BOM)

B.1 PIC32 ETHERNET STARTER KIT II BILL OF MATERIALS

TABLE B-1: PIC32 ETHERNET STARTER KIT II BOM

Reference	Description	Manufacturer	Part No.
C1, C2, C3, C5, C7, C9, C10, C12, C29, C30, C31, C32, C33, C35, C37, C41	Cap, Ceramic, 0.1 µF, 50V X7R	TDK Corporation	C1608X7R1H104M
C4, C25	Cap, Ceramic, 10 µF, 16V X5R	Taiyo Yuden	EMK212BJ106MG-T
C6, C8	Cap, Ceramic, 18 pF 50V 5% C0G 0603	Murata Electronics North America	GRM1885C1H180JA01D
C11	Cap, Ceramic, 0.01 µF, 50V X7R	TDK Corporation	C1608X7R1H103M
C22	Cap, Ceramic, 4.7 µF 25V X5R 10% 1206	TDK Corporation	C3216X5R1E475K
C23	Cap, Ceramic, 6.8 µF 16V 10% X5R 0805	TDK Corporation	C2012X5R1C685K
C24	Cap, Ceramic, 1 µF, 16V X5R	TDK Corporation	C1608X5R1C105K
C26	Cap, Ceramic, 100 µF 10V 20% X5R 1206	TDK Corporation	C3216X5R1A107M
C27	Cap, Ceramic, 10 µF 16V Y5V 0805	Murata Electronics North America	GRM21BF51C106ZE15L
C28, C34	Cap, Ceramic, 8 pF 50V NP0 0603	Murata Electronics North America	GRM1885C1H8R0DZ01D
C36, C38	Cap, Ceramic, 1.0 µF 16V X5R 10% 0603	TDK Corporation	C1608X5R1C105K
C39, C40	Cap, Ceramic, 2.2 µF 16V X5R 0603	TDK Corporation	C1608X5R1C225K
C42	Cap, Ceramic, 10000 pF 50V X7R 0603	TDK Corporation	C1608X7R1H103M
C43, C44	Cap, Ceramic, 12 pF 50V 5% NPO 0603	Yageo	CC0603JRNPO9BN120
D1	LED, SMD, RED, 0603 Package	Kingbright Corp.	APT1608EC
D2	LED, SMD, YEL, 0603 Package	Kingbright Corp.	APT1608YC
D3, D4	LED, SMD, GRN, 0603 Package	Kingbright Corp.	APT1608SGC
D5, D6	DIODE SCHOTTKY 20V 0.5A SOD123	ON Semiconductor	MBR0520LT1G
D7	LED GREEN CLEAR THIN 0603 SMD	Lite-On Inc	LTST-C191GKT
J1	CONN HEADER 120 POS W/O POST SMD	Hirose Electric Co. Ltd.	FX10B-120P/12-SV1(71)
J2	TWO CONN HEADER .050" 12POS PCB	Sullins Connector Solutions	LPPB121NFFN-RC
@J2	TWO CONN HEADER .050" 03POS PCB	Sullins Connector Solutions	LPPB031NFFN-RC
J3	CONN RCPT MICRO USB AB SMD R/A	Hirose Electric Co Ltd.	ZX62-AB-5PA(11)
J4	CONN USB TYPE A R/A BLACK	On Shore Technology Inc.	USB-A1HSB6
J5	Terminal Strip,1X2, 0.100 sp, 0.025 SQ Post	Samtec Inc.	HTSW-102-07-F-S
J6	CONN HEADER .050" 6 POS PCB GOLD	Sullins Connector Solutions	GRPB061VWVN-RC
J7	CONN RECEPT MINI USB2.0 5 POS	Hirose Electric Co. Ltd.	UX60-MB-5ST
Q1	TRANS SS PNP 40V 300 MW SOT23	Micro Commercial Co.	MMBT3906-TP
Q2, Q3	TRANSISTOR NPN GP 40V SOT23	Micro Commercial Co.	MMBT3904-TP
R1, R28	RES 4.70K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4701V
R2, R3, R5, R6, R7	RES 33 OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT33R0
R4, R23, R26, R58, R60, R62	DNP	N/A	N/A

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TABLE B-1: PIC32 ETHERNET STARTER KIT II BOM

Reference	Description	Manufacturer	Part No.
R17, R22, R25, R27	Res, 100K, 1/10W 1%	Stackpole Electronics Inc.	RMCF0603FT100K
R19, R20, R21, R24	Res, 330 OHM, 1/10W 1%	Stackpole Electronics Inc.	RMCF0603FT330R
R29, R30, R31, R37, R54, R64	RES 0.0 OHM 1/10W 0603 SMD	Panasonic - ECG, Rohm Semiconductor	ERJ-3GEY0R00V
R32, R35, R38, R42, R63	RES 330 OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT330R
R33, R40, R41, R46, R49, R50, R55, R57, R59	RES 10K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT10K0
R34, R39	RES 4.7K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT4K70
R36, R61	RES 200K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT200K
R43	RES 1K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT1K00
R44	RES 100 OHM 1/10W 5% 0603 SMD	Yageo	RC0603JR-07100RL
R45	RES 3.16K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-073K16L
R47	RES 3.92K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-073K92L
R48	RES 100K OHM 1/10W 1% 0603 SMD	Stackpole Electronics Inc.	RMCF0603FT100K
R51, R52, R53	RES 2.21K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF2211V
R56	RES 100 OHM 1/4W 1% 1206 SMD	Yageo	RC1206FR-07100RL
S1, S2, S3	SWITCH TACTILE SPST-NO 0.05A 12V	C&K Components	PTS635SK25SMTR LFS
U2	IC MCU 32BIT 512KB FLASH 100TQFP	Microchip Technology Inc.	PIC32MX795F512L-80I/PT
U3	IC SWITCH LOAD FULL FUNC SOT23-5	Fairchild Semiconductor	FPF2104
U4	IC MULT CONFIG 3.3/5V .12A 8MSOP	Microchip Technology Inc.	MCP1253-33X50I/MS
U5	IC PWR DIST SWITCH SNGL SOT23-5	Texas Instruments	TPS2051BDBVR
U6	IC PIC MCU FLASH 256K 64-TQFP	Microchip Technology Inc.	PIC24FJ256GB106-I/PT
U7	IC EEPROM 256KBIT 10MHZ 8TSSOP	Microchip Technology Inc.	25LC256-I/ST
U8	IC REG LDO 1.5A 3.3V 8DFN	Microchip Technology Inc.	MCP1727-3302E/MF
Y1	CRYSTAL 8.000 MHz, 18 pF, SMD	Abracon Corporation	ABM3B-8.000MHZ-B2-T
Y2	CRYSTAL 32.768 kHz 12.5 pF CYL	Abracon Corporation	AB26T-32.768KHZ
Y3	OSC MEMS 50.000 MHz 3.3V	Abracon Corporation	ASEMB-50.000MHZ-LC-T
Y4	CRYSTAL 12.000000 MHZ 8 pF SMD	NDK	NX3225SA-12.000000MHZ

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B.2 LAN8740 PHY DAUGHTER BOARD BILL OF MATERIALS

TABLE B-2: LAN8740 PHY DAUGHTER BOARD BOM

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 470PF 50V CERAMIC X7R 0603	Yageo	CC0603KRX7R9BB471
C10, C11, C12, C13	CAP CER 12 pF 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 500MA 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 1PORT 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	TXRX Ethernet 32QFN	Microchip Technology Inc.	LAN8740-EN

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