PIC32 USB Starter Kit II
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 "DSXXXXXA", where "XXXXX" 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® 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 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 PIC32 (General Purpose) Starter Kit, PIC32 USB Starter Kit II, and the PIC32 Ethernet Starter Kit (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. "Board Layout and Schematics"** provides a block diagram, board layouts, and detailed schematics of the starter kit.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
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>
Courier New font:		
`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 (in source code)	`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) { ... }`

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 (DS61156)

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® C Compiler for PIC32 User's Guide (DS51686)

This document, formerly the "*MPLAB C32 C Compiler for PIC32 User's Guide*", details the use of Microchip's MPLAB C Compiler for PIC32 to develop an application.

MPLAB® IDE User's Guide (DS51519)

Refer to this document for more information pertaining to the installation and implementation of the MPLAB IDE software, as well as the MPLAB Editor and MPLAB SIM Simulator software that are 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

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 http://www.microchip.com, click **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. These include the MPLAB® C compiler; MPASM™ and MPLAB 16-bit assemblers; MPLINK™ and MPLAB 16-bit object linkers; and MPLIB™ and MPLAB 16-bit object librarians.
- **Emulators** – The latest information on the Microchip MPLAB REAL ICE™ in-circuit emulator.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 device programmer and the PICkit™ 3 development programmers.

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 (January 2010)

This is the initial release of the PIC32 USB Starter Kit II User's Guide.

Revision B (December 2010)

This revision includes the following updates:

- All references to the PIC32 Starter Kit and PIC32 Ethernet Starter Kit have been removed. User information on these two starter kits can be found in their respective user's guides, which are available from the Microchip web site.
- Formatting changes and minor text updates have been incorporated throughout the document.

NOTES:

Chapter 1. Introduction

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

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 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).

1.1 KIT CONTENTS

The PIC32 USB Starter Kit II contains the following items:

- PIC32 USB Starter Kit II Development 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

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.

1.2 PIC32 FUNCTIONALITY AND FEATURES

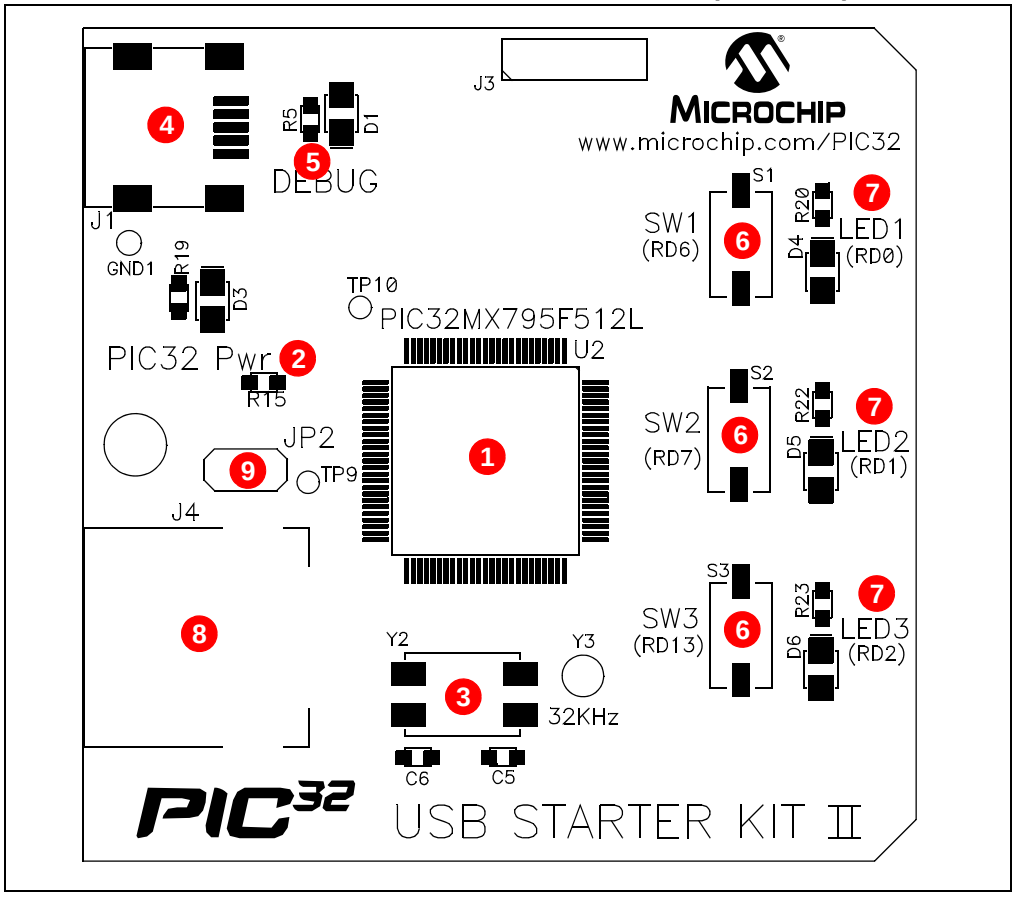
Representations of the layout of the PIC32 USB Starter Kit II are shown in Figure 1-1 and Figure 1-2.

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

1. PIC32MX795F512L 32-bit microcontroller.
2. Green power indicator LED.
3. On-board crystal for precision microcontroller clocking (8 MHz).
4. USB connectivity for on-board debugger communications.
5. Orange 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. HOST mode power jumper.

Note: When running 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).

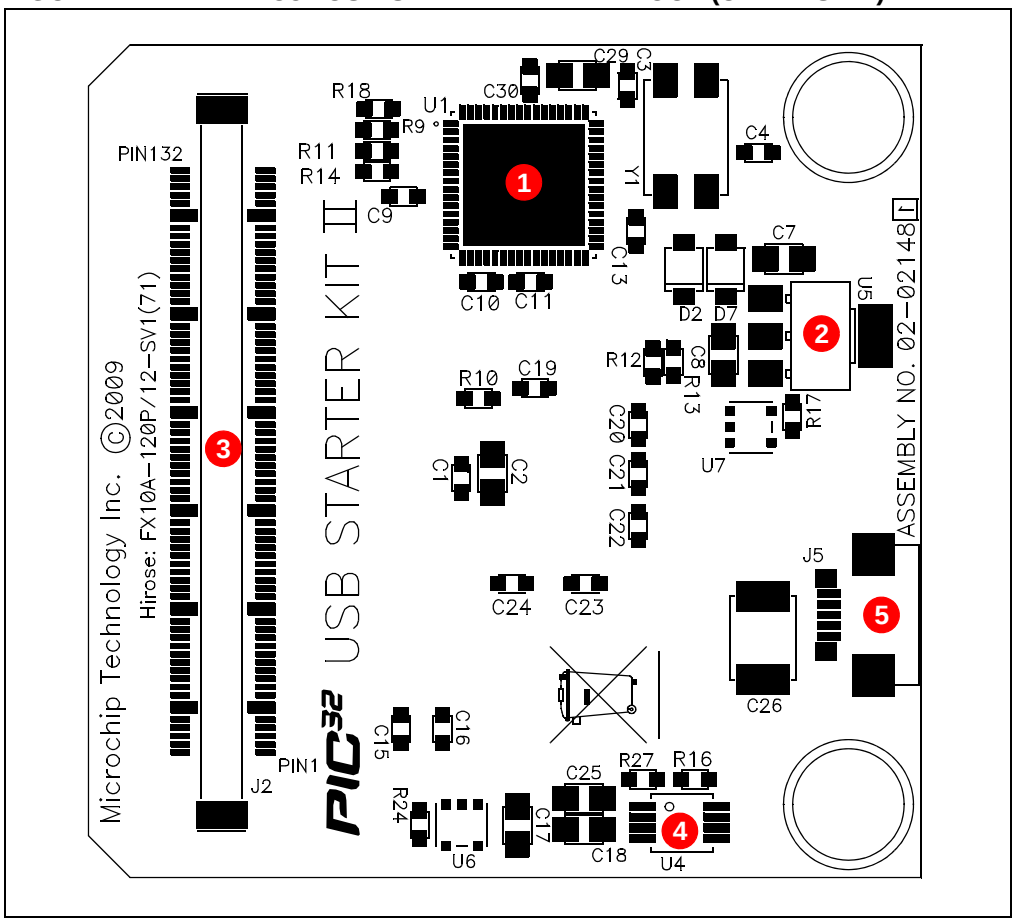
FIGURE 1-1: PIC32 USB STARTER KIT II LAYOUT (TOP SIDE)



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

1. PIC32MX440F512H USB microcontroller for on-board debugging.
2. Regulated +3.3V power supply for powering the starter kit via USB or expansion board.
3. Connector for various expansion boards.
4. USB Host and OTG power supply for powering PIC32 USB applications.
5. USB Type Micro-AB receptacle for OTG and USB device connectivity for PIC32 OTG/device-based applications.

FIGURE 1-2: PIC32 USB STARTER KIT II LAYOUT (UNDERSIDE)



NOTES:

Chapter 2. Hardware

This chapter describes the hardware features of the starter kit.

2.1 HARDWARE FEATURES

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

2.1.1 Processor Support

The PIC32 USB 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 USB Starter Kit II:

- USB bus power connected to USB debug connector J1.
- 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 show that the PIC32 microcontroller is powered up.

2.1.3 Debug USB Connectivity

The PIC32 USB Starter Kit II includes a PIC32MX440F512H USB microcontroller that provides debugger connectivity over USB. The PIC32MX440F512H is hard wired to the PIC32 device to provide two types of protocol translation:

- I/O pins of PIC32MX440F512H to the ICSP™ pins of the PIC32
- I/O pins of PIC32MX440F512H to the JTAG pins of the PIC32

The PIC32 USB Starter Kit II currently uses the JTAG pins of the PIC32 device for programming and debugging.

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 JP2 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 JP2 must be removed to prevent back-powering the Debug USB port.

- DEVICE Mode

  First, connect the debug Mini-B USB cable to port J1. Next, 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 J5, 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 JP2 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 J5, 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 JP2 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 (Y2) 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 oscillator (Y3); however, this is not populated.

The PIC32MX440F512H is independently clocked and has its own 8 MHz crystal (Y1).

2.1.8 120-Pin Modular Expansion Connector

The PIC32 USB 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.

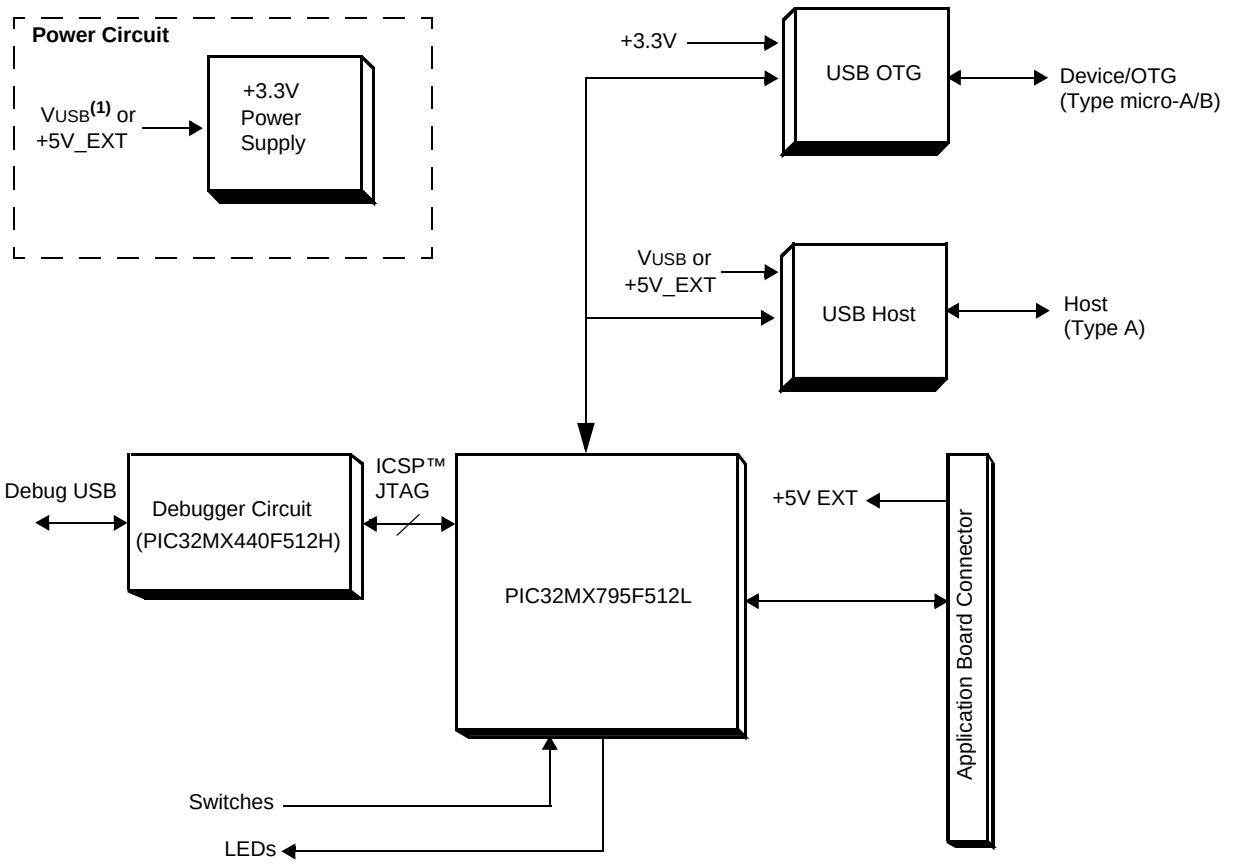
TABLE 2-1: STARTER KIT CONNECTOR PART NUMBERS

Connector	HIROSE Electric PN
Starter Kit Connector	FX10A-120P/12-SV1(71)
Application Board Connector	FX10A-120S/12-SV(71)

Appendix A. Board Layout and Schematics

A.1 PIC32 USB STARTER KIT II DEVELOPMENT BOARD BLOCK DIAGRAM

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



Note 1: From Debugger USB Port.

A.2 PIC32 USB STARTER KIT II BOARD LAYOUT

FIGURE A-2: PIC32 USB STARTER KIT II LAYOUT (TOP ASSEMBLY)

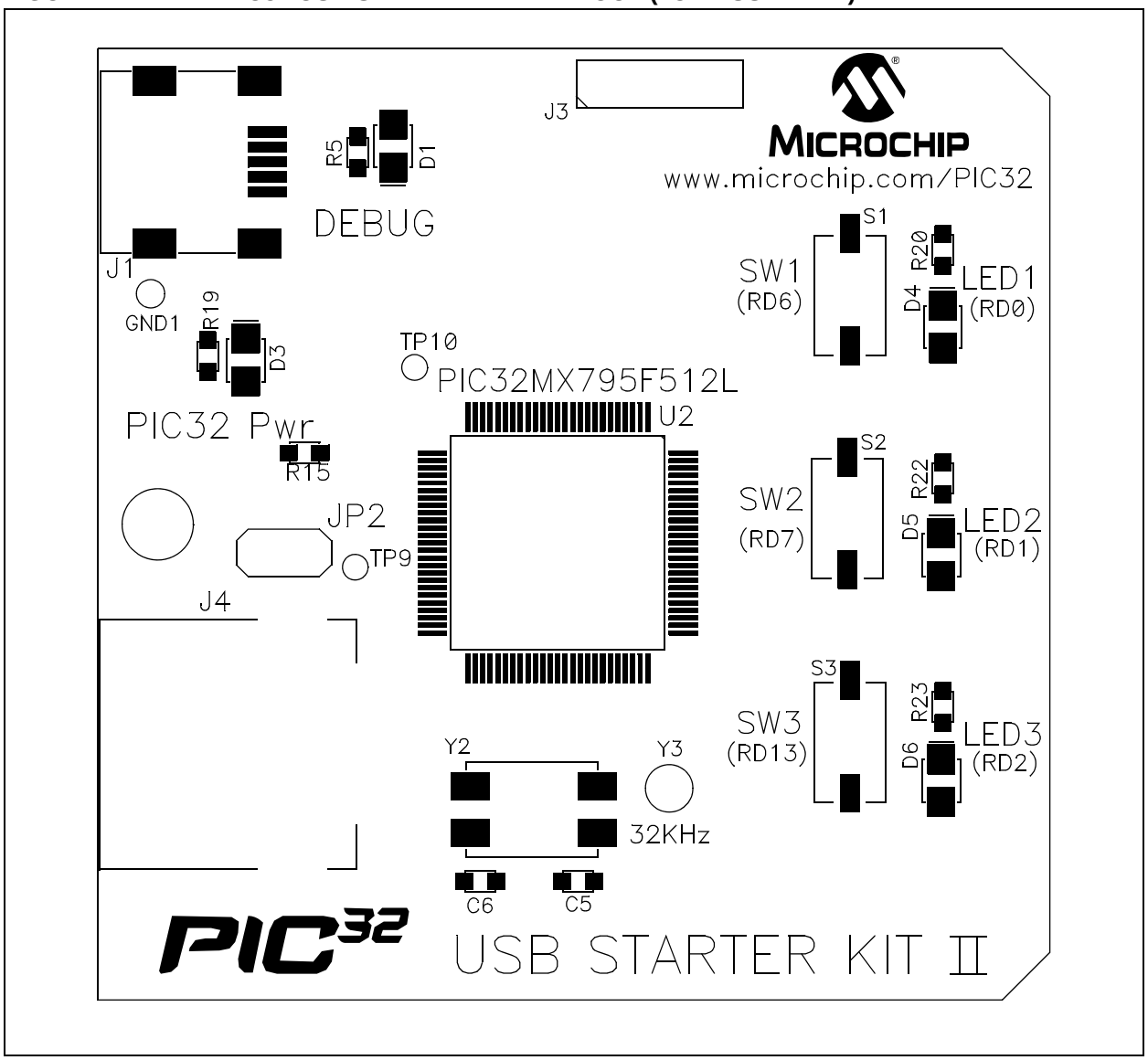
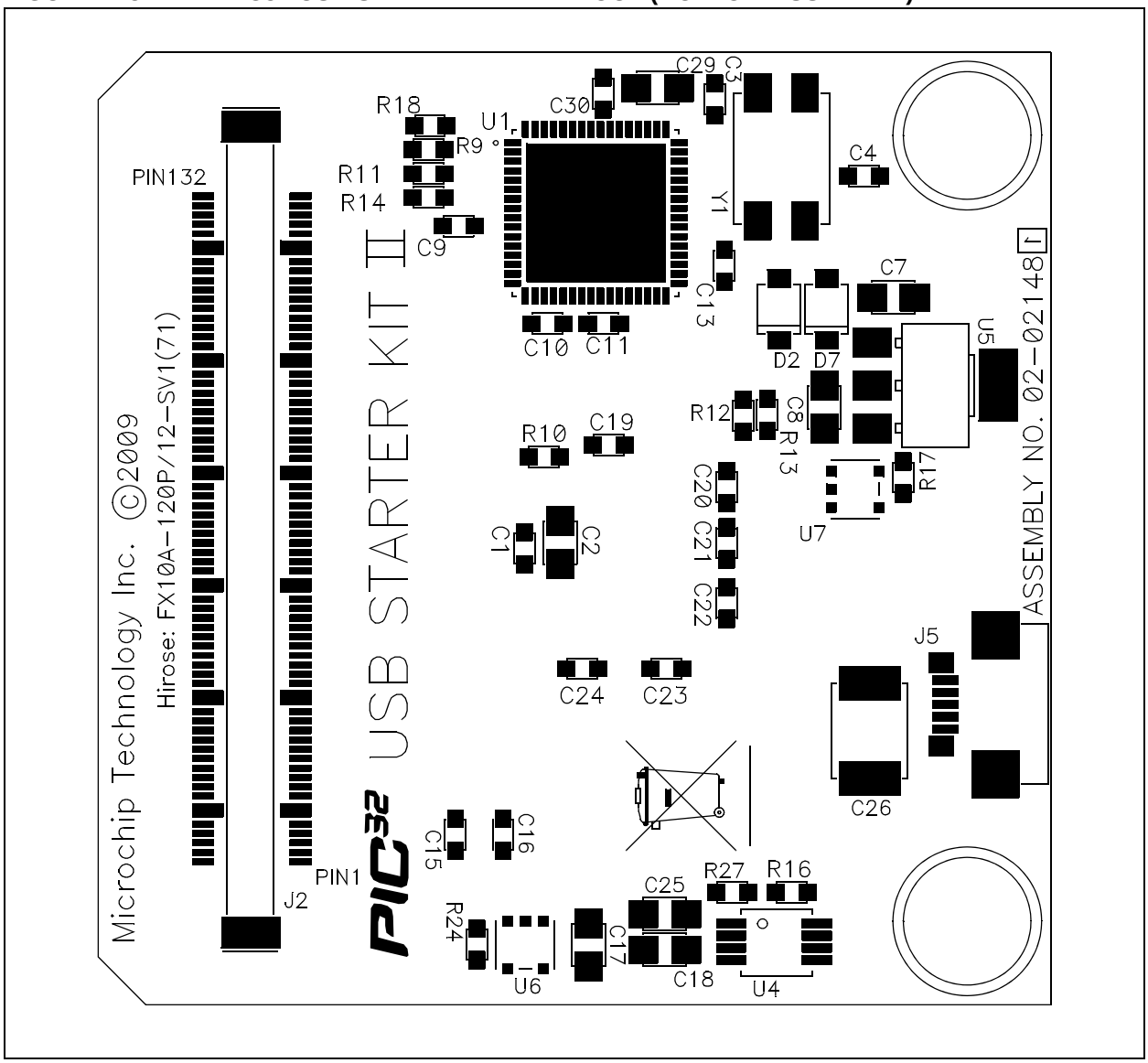


FIGURE A-3: PIC32 USB STARTER KIT II LAYOUT (BOTTOM ASSEMBLY)



A.3 PIC32 USB STARTER KIT II BOARD SCHEMATICS

FIGURE A-4: PIC32 USB STARTER KIT II SCHEMATICS (PIC32MX CPU)

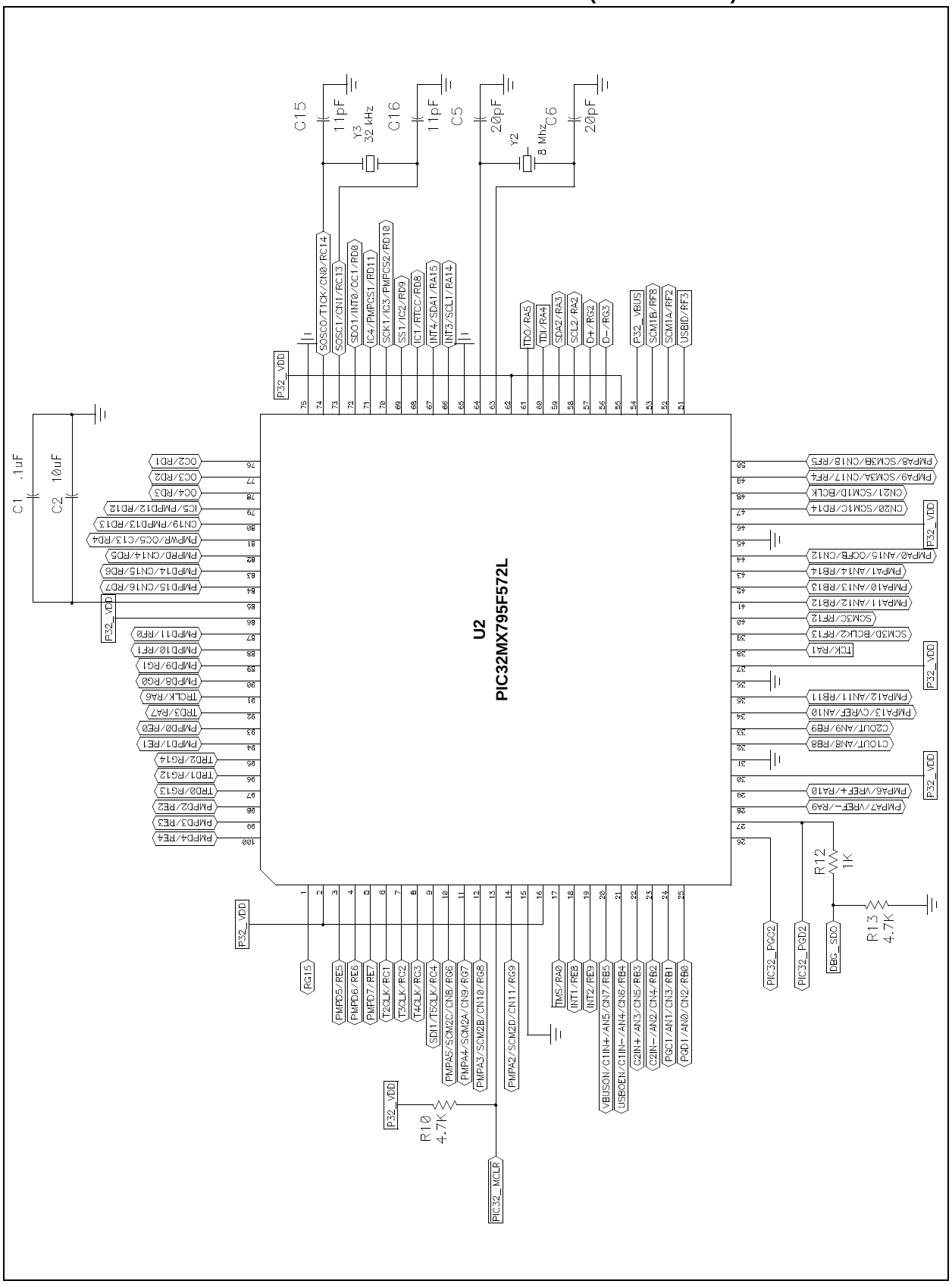


FIGURE A-5: PIC32 USB STARTER KIT II SCHEMATICS (DEBUG CPU)

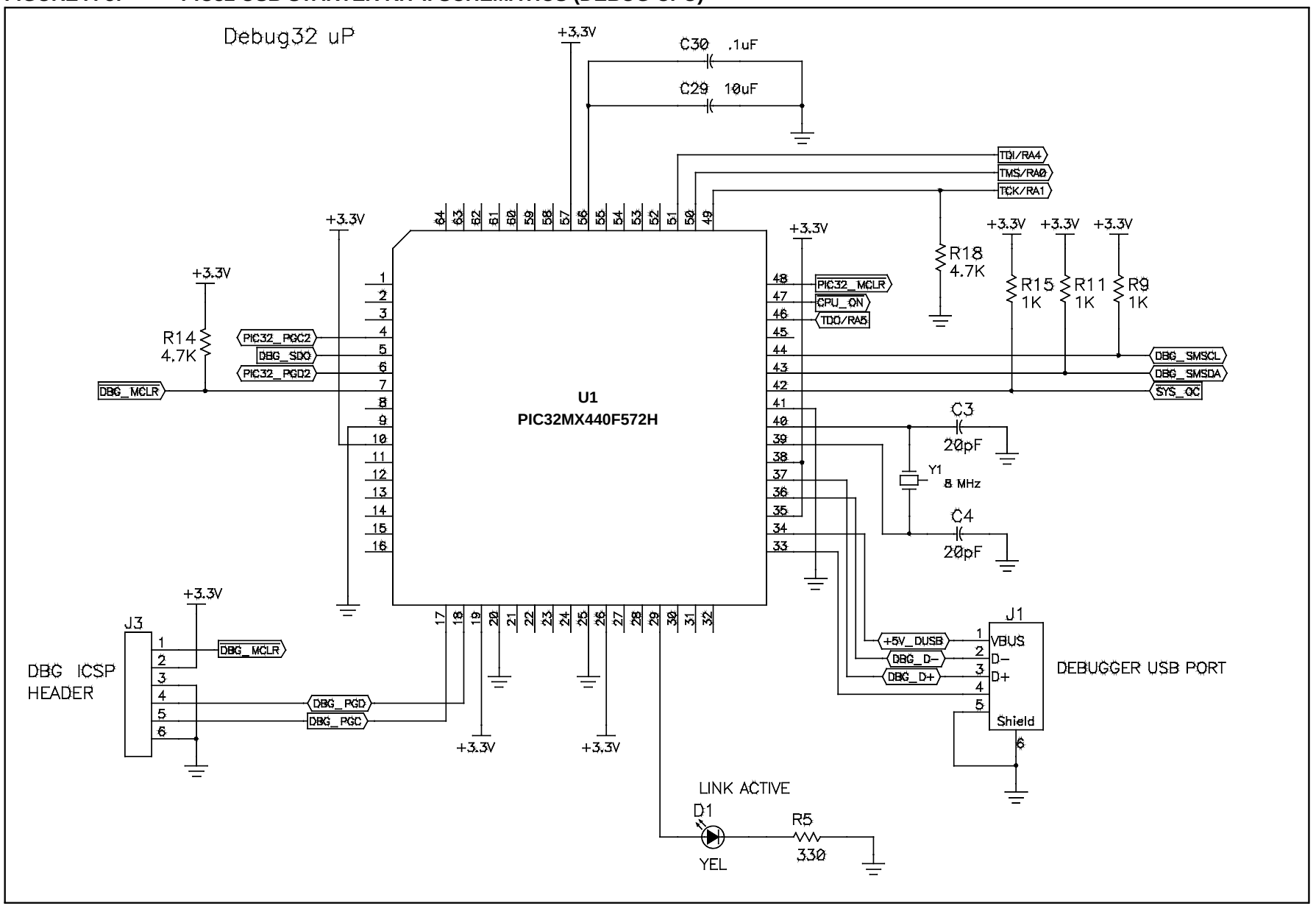


FIGURE A-6: PIC32 USB STARTER KIT II SCHEMATICS (APPLICATION BOARD CONNECTOR)

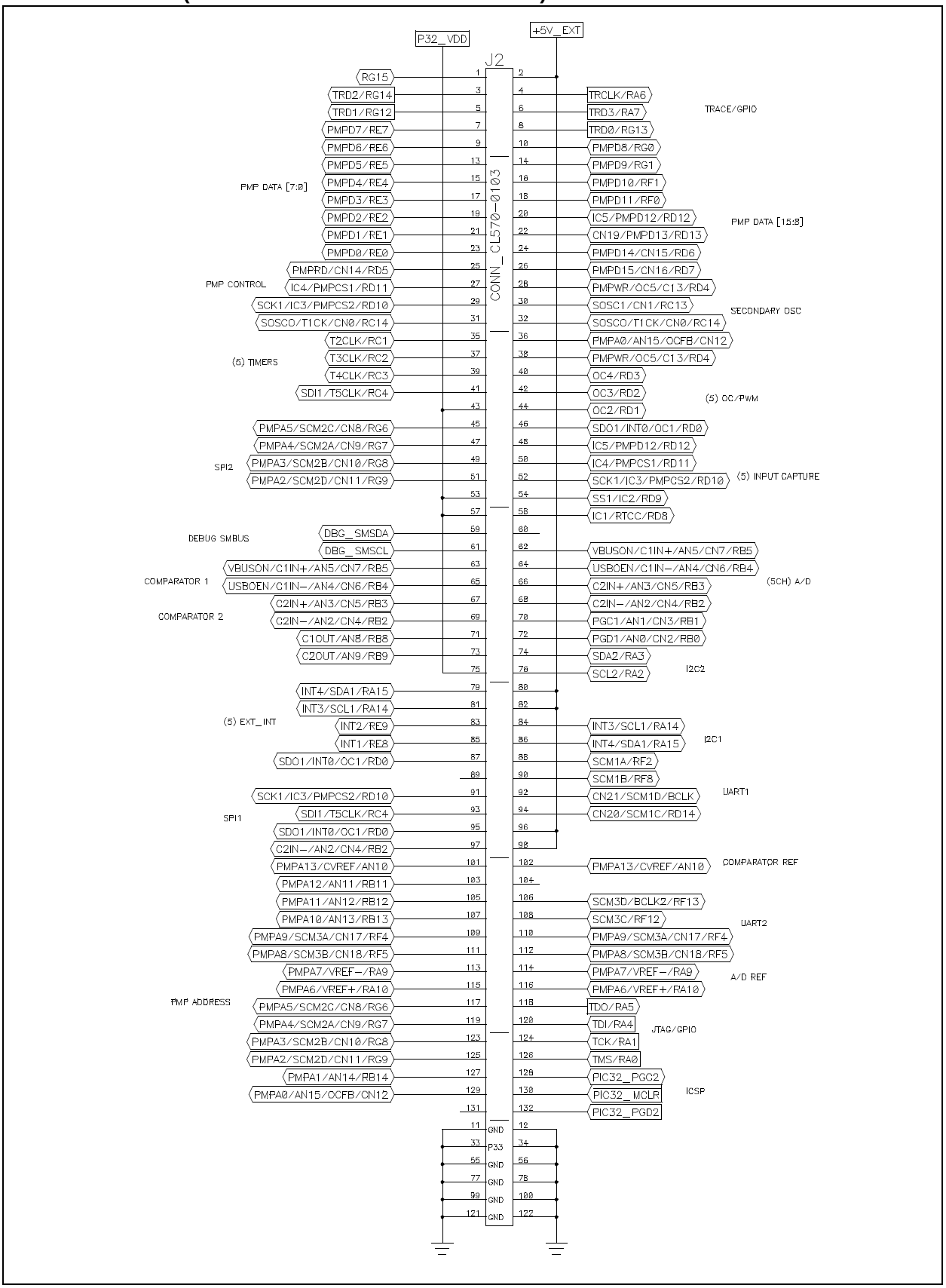


FIGURE A-7: PIC32 USB STARTER KIT II SCHEMATICS (POWER SUPPLY)

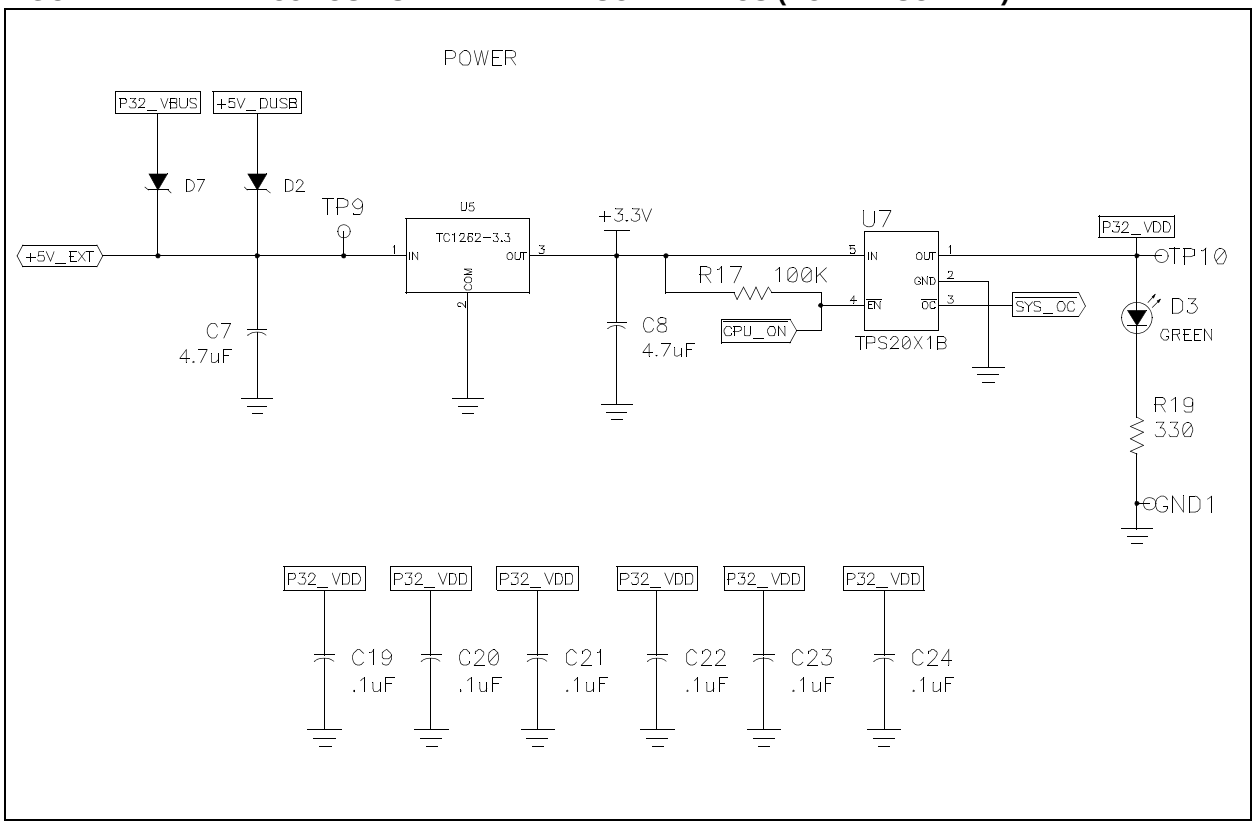


FIGURE A-8: PIC32 USB STARTER KIT II SCHEMATICS (USB OTG/DEVICE POWER SUPPLY)

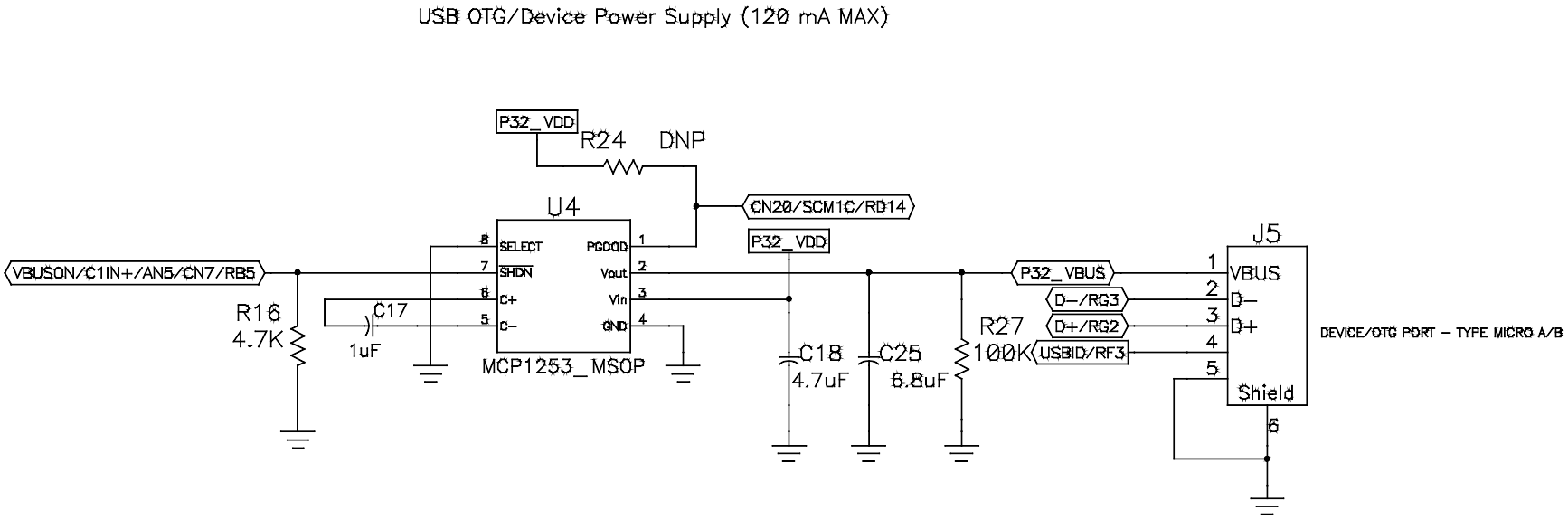


FIGURE A-9: PIC32 USB STARTER KIT II SCHEMATICS (USB HOST POWER SUPPLY)

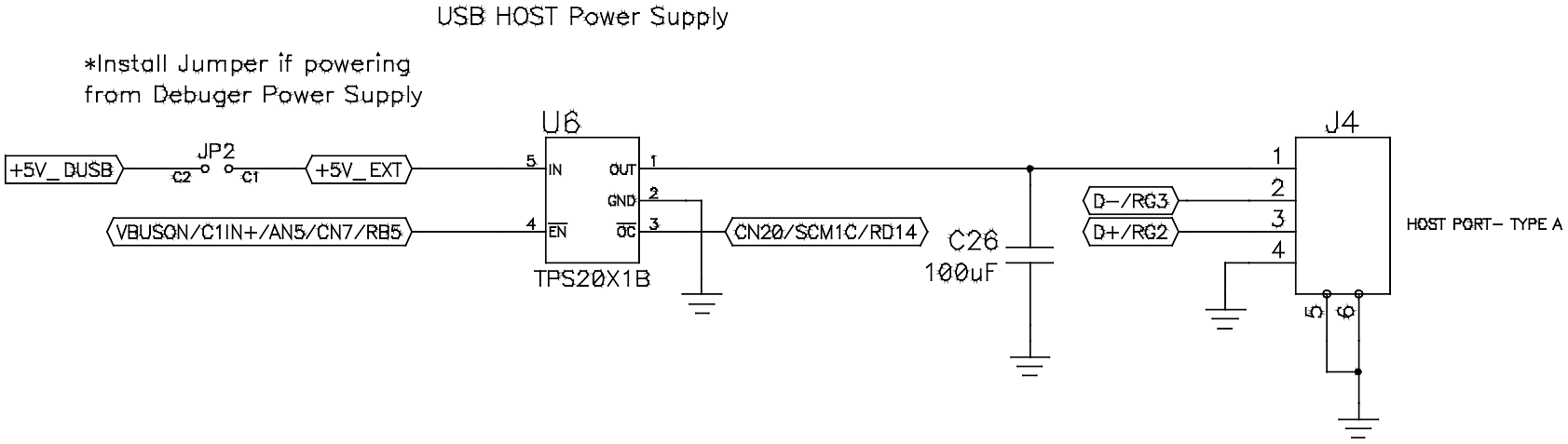
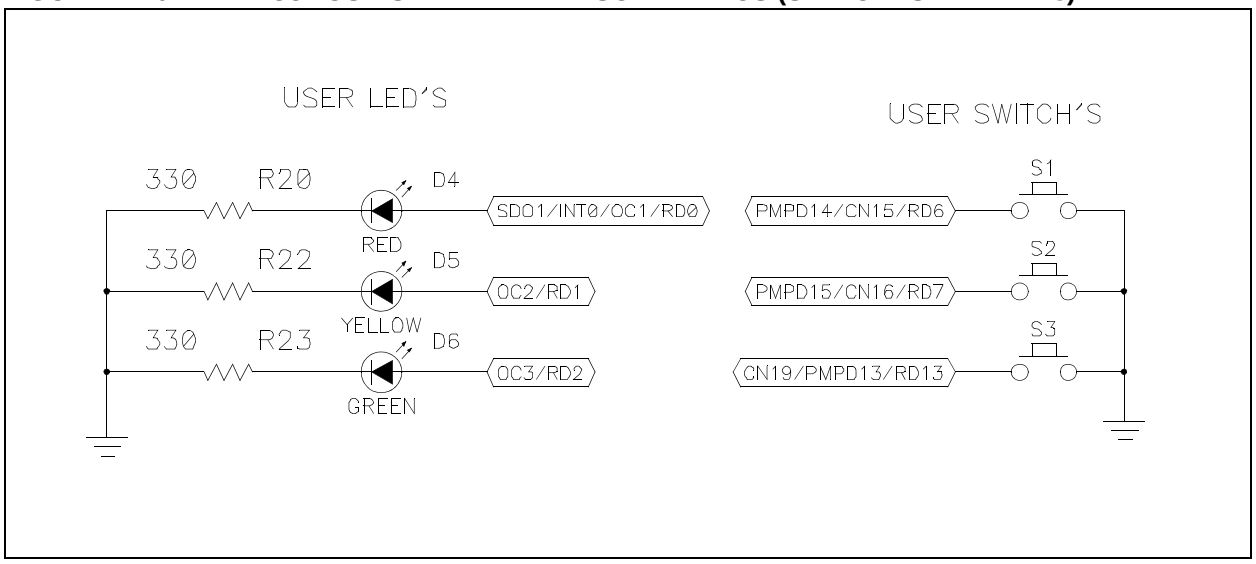


FIGURE A-10: PIC32 USB STARTER KIT II SCHEMATICS (SWITCHES AND LEDs)



Appendix B. Bill of Materials

TABLE B-1: PIC32 USB STARTER KIT II BILL OF MATERIALS

Reference	Description	Manufacturer	Part No.
U4	IC SMT, MCP1253,DC/DC Converter 3.3V 8L MSOP	Microchip	MCP1253-33X50I/MS
U1	IC SMT, PIC32MX440F512H-80I/MR 64P QFN	Microchip	PIC32MX440F512H-80I/MR
U2	IC SMT, PIC32MX795F512L 100L TQFP	Microchip	PIC32MX795F512L-80I/PT
U5	IC SMT, TC1262-3.3VDB, SOT-223	Microchip	TC1262-3.3VDBTR
C1, C9, C10, C11, C13, C30, C19-C24	CAP SMT, 0.1 µF 0603 CER 16V 10% X7R	Panasonic	ECJ-1VB1C104K
C17	CAP SMT, 1.0 µF 0805 CER 16V 10% X7R	Kemet	C0805C105K4RACTU
C2, C29	CAP SMT, 10 µF 0805 CER 6.3V 20% , X5R	Murata	GRM21BF50J106ZE01L
C7, C8	CAP SMT, 4.7 µF 0805 CER 16V +80-20% Y5V	Panasonic	ECJ-2FB0J475K
C3-C6	CAP SMT, 20 pF 0603 CER 50V, 5% C0G	Rohm	MCH185A200JK
C25	CAP SMT, 6.8uF 0805 CER 6.3V 10% X5R	Kemet	C0805C685K9PACTU
C26	CAP SMT, 100 µF 1812 CER 6.3V -20%,+80% Y5V	Panasonic	ECJ-5YF0J107Z
JP2	CONN, HDR, 1x2 Breakaway, 0.100" Pitch, 0.025 SQ Post (0.100"/0.230")	Molex	90120-0762
	CONN, Shunt, 2-Pin Shorting Shunt (.100" Spacing)	Sullins	SSC02SYAN
J1	CONN SMT, RECPT, USB Mini-B 5POS RA	Delphi	15430262-110
J2	CONN, SMT, HDR, 120P, W/Post	Hirose Electronics	FX10A-120P/12-SV1(71)
J4	CONN, RECPT, USB TYPE-A w/Board Lock	FCI	87520-0010BLF
J5	CONN, RECPT, USB Micro-B R/A	Hirose Electronics	ZX62-AB-5PA
D2, D7	DIODE SMT, Schottky 30V 0.5A SOD-123	Diodes Inc.	B0530W-7-F
U6	IC SMT, TPS20X1 0.75A Power Dist Switch 5-SOT23	Texas Instruments	TPS2051BDBVR
U7	IC SMT, TPS2041 1A PWR Dist Switch SNGL SOT23-5	Texas Instruments	TPS2041BDBVR
D4	LED SMT, 0805 Red DIFF 2x1.25 mm Thin	Lumex	SML-LXT0805IW-TR
D1, D5	LED SMT, 0805 Yellow DIFF 2x1.25 mm Thin	Lumex	SML-LXT0805YW-TR
D3, D6	LED SMT, 0805 Green DIFF 2x1.25 mm	Lumex	SML-LXT0805GW-TR
Y1, Y2	OSC SMT, 8.0 MHz Crystal 20PF	Fox Electronics	FQ7050B-8
R9, R11, R12, R15	RES SMT, 1.0 KΩ 1/10W 5% 0603	Panasonic	ERJ-3GEYJ102V
R10, R13, R14, R16, R18	RES SMT, 4.7 KΩ 1/10W 5% 0603	Panasonic	ERJ-3GEYJ472V

TABLE B-1: PIC32 USB STARTER KIT II BILL OF MATERIALS (CONTINUED)

Reference	Description	Manufacturer	Part No.
R5, R19, R20, R22, R23	RES SMT, 330Ω 1/10W 5% 0603	Panasonic	ERJ-3GEYJ331V
R17	RES SMT, 100 KΩ 1/10W 1% 0603	Panasonic	ERJ-3EKF1003V
S1-S3	Switch, Light Touch 160 gF	Panasonic	EVQ-PPBA25
C15, C16, C18, GND1, J3, R24, R27, TP9, TP10, Y3	Spare Location, Do Not Install	—	—

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China - Zhuhai
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Fax: 91-80-3090-4123

India - New Delhi
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India - Pune
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Japan - Yokohama
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Fax: 81-45-471-6122

Korea - Daegu
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Korea - Seoul
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Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
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Fax: 60-3-6201-9859

Malaysia - Penang
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Fax: 60-4-227-4068

Philippines - Manila
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Singapore
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Taiwan - Hsin Chu
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Fax: 886-3-6578-370

Taiwan - Kaohsiung
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Fax: 886-7-330-9305

Taiwan - Taipei
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Spain - Madrid
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