dsPIC33E USB Starter Kit and PIC24E USB Starter Kit User's Guide

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Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

QUALITY MANAGEMENT SYSTEM
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ISO/TS 16949:2002

Table of Contents

NOTES:

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 you use the dsPIC33E USB Starter Kit or the PIC24E USB Starter Kit. Items discussed in this Preface include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- 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 one of the starter kits as a development tool to emulate and debug firmware on a target board. The document layout is as follows:

- **Chapter 1. "Introduction" –** This chapter provides a brief overview of each starter kit.
- **Chapter 2. "Hardware"** – This chapter provides the hardware descriptions for each starter kit.
- **Appendix A. "Board Layout and Schematics"** – This appendix provides a block diagram, board layouts, and detailed schematics of each 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	`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) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles you to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use the dsPIC33E USB Starter Kit or the PIC24E USB Starter Kit. The following documents are available and recommended as supplemental reference resources.

dsPIC33EPXXXMU806/810/814 and PIC24EPXXXGU810/814 Data Sheet (DS70616)

Refer to this document for detailed information on dsPIC33E and PIC24E 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

dsPIC33E/PIC24E Family Reference Manual Sections

Family Reference Manual sections are available, which explain the operation of the dsPIC® DSC family architecture and peripheral modules. The specifics of each device family are discussed in the individual family's device data sheet.

dsPIC33E/PIC24E Flash Programming Specification (DS70619)

Refer to this document for information on instruction sets and firmware development. This document may be obtained from the Microchip web site or your local sales office.

MPLAB® C Compiler for PIC24 MCUs and dsPIC® DSCs User's Guide (DS51284)

This document details the use of Microchip's MPLAB C Compiler for PIC24 MCUs and dsPIC DSC devices to develop an application. The MPLAB C Compiler is a GNU-based language tool, based on source code from the Free Software Foundation (FSF). For more information about the FSF, visit www.fsf.org.

MPLAB® IDE User's Guide (DS51519)

This document describes how to use the MPLAB IDE Integrated Development Environment (IDE), as well as the MPLAB project manager, MPLAB editor and MPLAB SIM simulator. Use these development tools to help you develop and debug application code.

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 website at: http://www.usb.org.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. 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://www.microchip.com/support

DOCUMENT REVISION HISTORY

Revision A (November 2010)

This is the initial released version of this document.

Revision B (May 2011)

This revision includes the following updates:

- Replaced OTG with the word “device” in the last bullet item in **1.1 “Starter Kit Contents”**
- Removed item 10 from **1.2.1 “Top Assembly”** and Figure 1-1
- Removed micro-A and USB OTG from item 3 in **1.2.2 “Bottom Assembly”**
- Removed USB OTG and micro-A from Figure 2-1 in **2.1 “High-Level Block Diagram”**
- Updated the second item in the bulleted list in **2.2.2 “Power Supply”**
- Removed OTG mode from the bulleted list and the corresponding paragraph in **2.2.4 “dsPIC33E/PIC24E USB Connectivity”**
- Replaced OTG with DEVICE in the Power Distribution/Switching schematic (Figure A-4) and added “Do not populate” in the USB Connections schematic (Figure A-8) in **A.2 “Application Hardware Schematics”**

NOTES:

Chapter 1. Introduction

Thank you for purchasing a Microchip Technology dsPIC33E USB Starter Kit or PIC24E USB Starter Kit. Depending on the starter kit purchased, the board included provides a low-cost, modular development system for Microchip's enhanced 16-bit Digital Signal Controllers (DSCs) or High-Performance Microcontrollers (MCUs).

The starter kit comes preloaded with demonstration software for the user to explore the new features of the dsPIC33E DSC family (dsPIC33E USB Starter Kit) or the PIC24E MCU family (PIC24E USB Starter Kit). 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:

- Starter Kit Contents
- Starter Kit Functionality and Features

The software for the demo application that is preprogrammed into the dsPIC33E or PIC24E device 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 dsPIC33E or PIC24E device 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 demonstration code as a platform for further experimentation and evaluation.

Note: Refer to the Readme file provided with the starter kit demonstration software for instructions on how to run the demonstration application. Refer to the information sheet that is provided with the starter kit package for additional resources and instructions on how to use the starter kit for programming and debugging application software.

1.1 STARTER KIT CONTENTS

The starter kit contains the following items:

- dsPIC33E or PIC24E USB Starter Kit Development Board
- dsPIC33E or PIC24E USB Starter Kit Information Sheet
- 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 - USB cable to communicate with the dsPIC33E/PIC24E USB device port

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

1.2 STARTER KIT FUNCTIONALITY AND FEATURES

This section describes the top and bottom board layout assembly of the dsPIC33E or PIC24E USB Starter Kit.

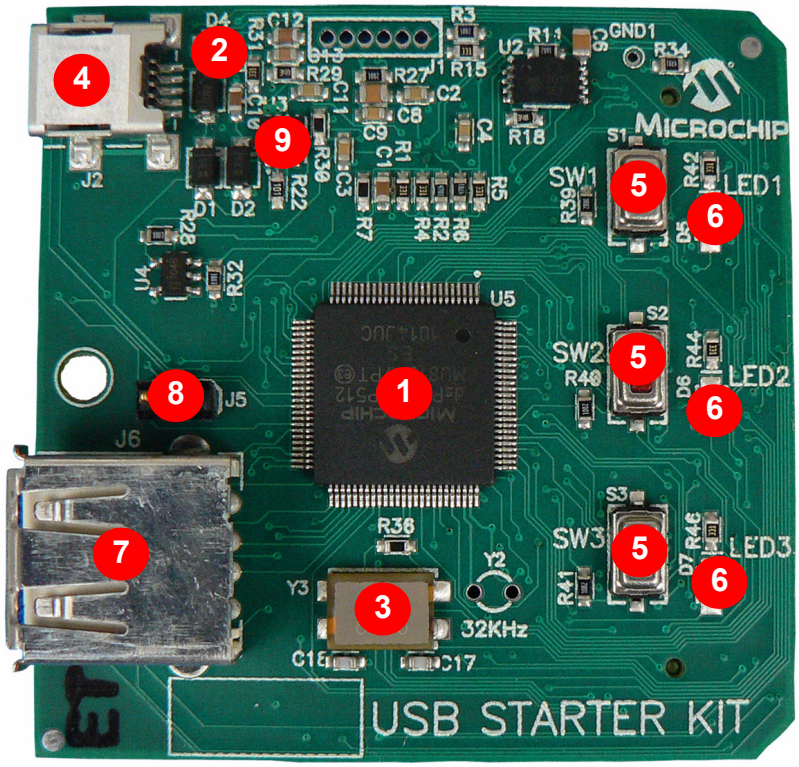
1.2.1 Top Assembly

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

1. dsPIC33EP512MU810 16-bit DSC device (dsPIC33E USB Starter Kit) or PIC24EP512GU810 16-bit MCU (PIC24E USB Starter Kit).
2. Green power indicator LED (D4).
3. 8 MHz crystal (Y3) for precision microcontroller clocking.
4. USB connectivity for on-board debugger communications (J2).
5. Three push button switches (SW1, SW2, SW3) for user-defined inputs.
6. Three user-defined indicator LEDs (LED1, LED2, LED3).
7. USB Type A receptacle (J6) connectivity for dsPIC33E/PIC24E USB host-based applications.
8. HOST mode power jumper (J5).
9. Regulated +3.3V power supply for powering the starter kit via USB or an expansion board.

Note: When running USB device applications, open the jumper J5 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: STARTER KIT LAYOUT (TOP SIDE)



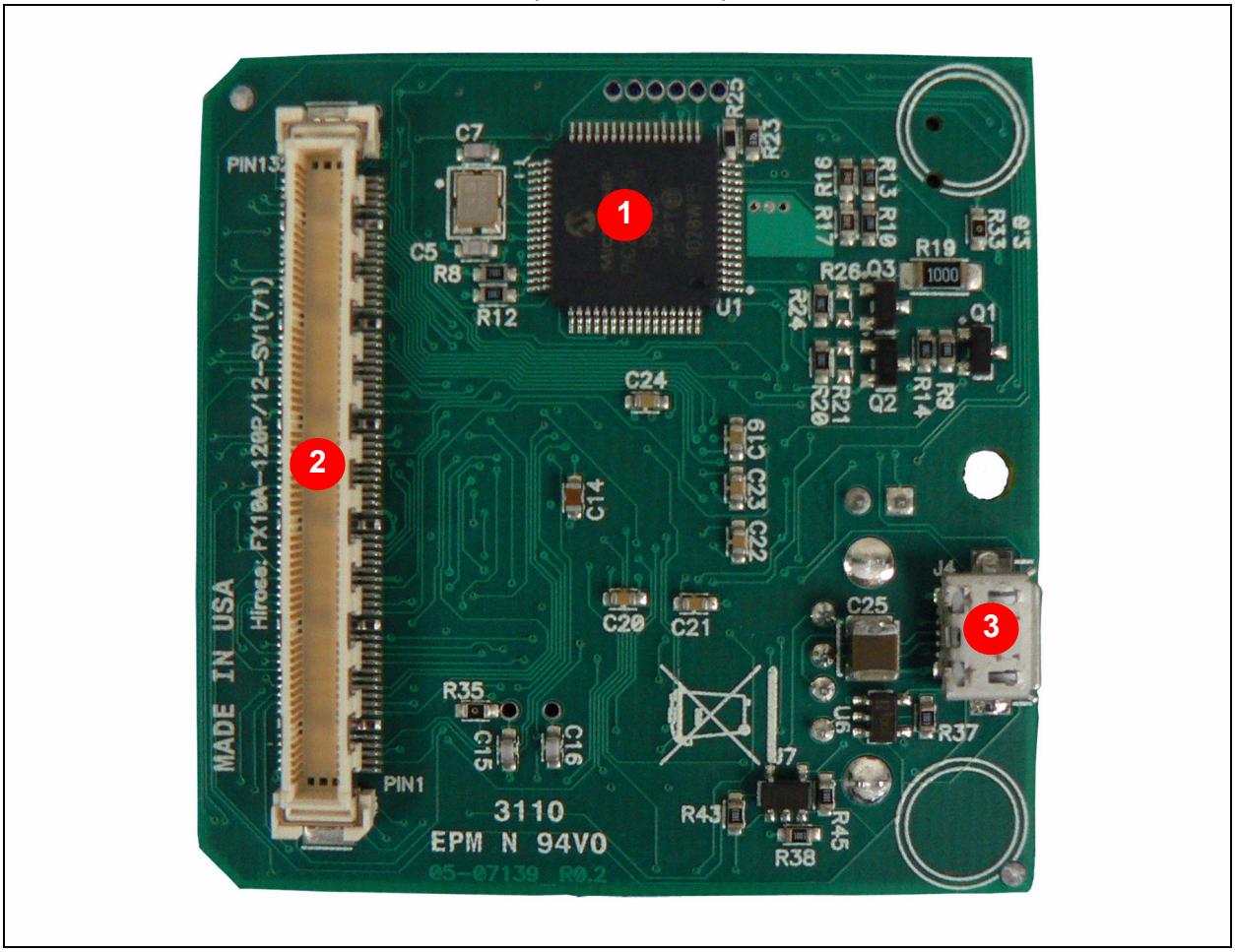
1.2.2 Bottom Assembly

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

1. PIC24FJ256GB106 USB microcontroller (U1) for on-board debugging.
2. Connector (J3) for various expansion boards such as the Multimedia Expansion Board (MEB) or the I/O Expansion Board.
3. USB Type micro-B receptacle (J4) for USB Device connectivity for dsPIC33E/ PIC24E USB device-based applications.

Note: Refer to **Appendix A. "Board Layout and Schematics"** for details on the mapping of device pins to the pins on the expansion connector.

FIGURE 1-2: STARTER KIT LAYOUT (BOTTOM SIDE)



NOTES:

Chapter 2. Hardware

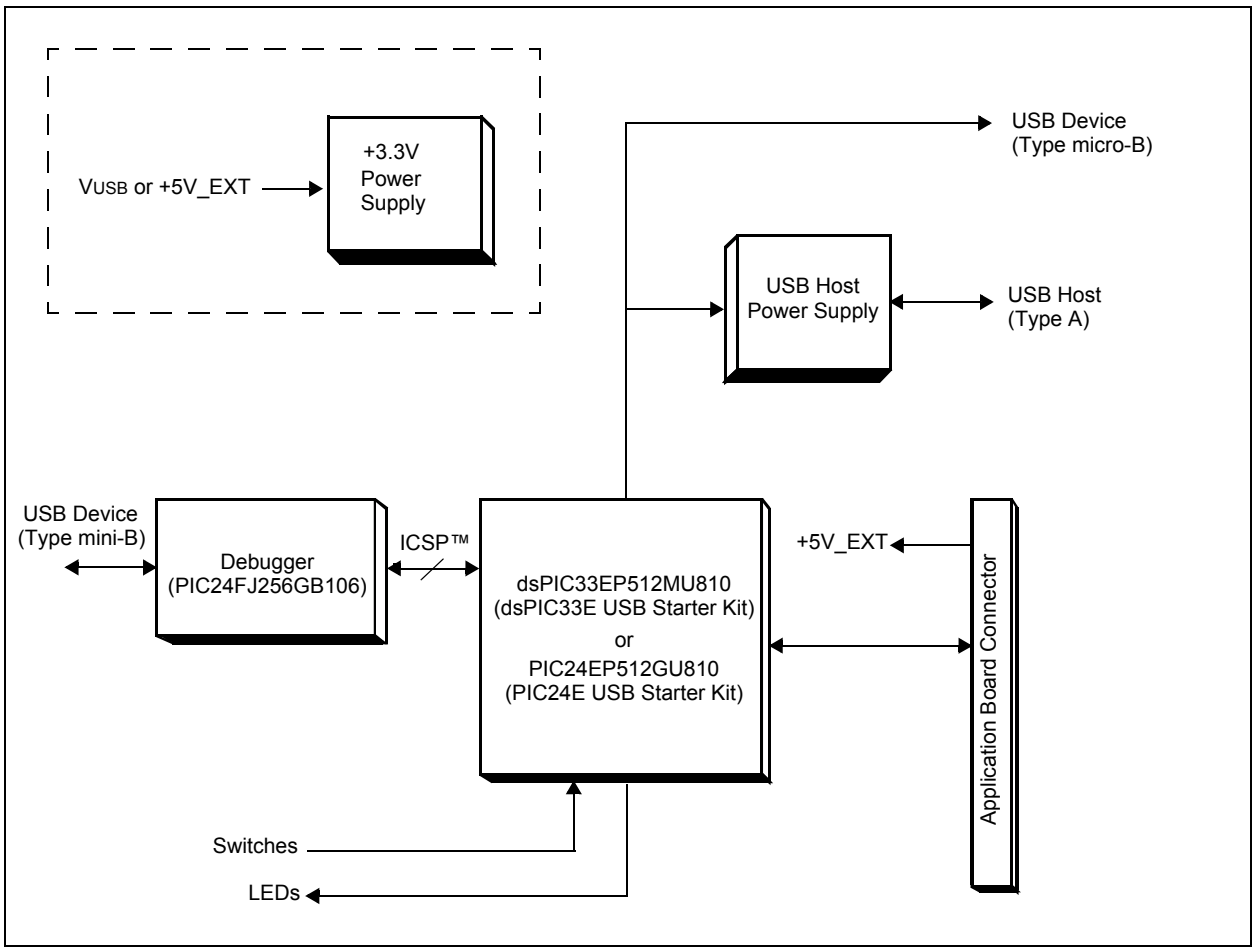
This chapter describes the hardware features of the starter kit. Topics covered include:

- High-Level Block Diagram
- Features

2.1 HIGH-LEVEL BLOCK DIAGRAM

Figure 2-1 illustrates a high-level block diagram of the dsPIC33E/PIC24E USB starter kit.

FIGURE 2-1: HIGH-LEVEL BLOCK DIAGRAM



2.2 FEATURES

This section describes the key features of the starter kit. Refer to Figure 1-1 and Figure 1-2 in **Chapter 1. "Introduction"** for their actual locations on the board.

2.2.1 Processor Support

The dsPIC33E USB Starter Kit is designed with a permanently mounted (i.e., soldered) dsPIC33EP512MU810 DSC. Similarly, the PIC24E USB Starter Kit is designed with a permanently mounted (i.e., soldered) PIC24EP512GU810 MCU.

2.2.2 Power Supply

There are two ways to supply power to the dsPIC33E or PIC24E USB Starter Kit:

- Connect the USB Debug connector J2 to a PC running MPLAB using the supplied mini-B to full-sized A cable
- An external application board with a regulated DC power supply that provides +5V can be connected to the application board connector (J3) that is provided on the bottom side of the board

One green LED (D4) is provided to show that the dsPIC33E or PIC24E device is being powered.

2.2.3 Debug USB Connectivity

The dsPIC33E or PIC24E USB Starter Kit includes a PIC24FJ256GB106 USB microcontroller that provides debugger connectivity over USB. The PIC24FJ256GB106 is hard-wired to the dsPIC33E or PIC24E device to translate the I/O pins of the PIC24FJ256GB106 device to the ICSP™ pins of the dsPIC33E or PIC24E device. The debugger circuit also includes a 25LC256 Serial EEPROM device for data storage.

The programming/debugging circuit on the dsPIC33E or PIC24E USB Starter Kit is similar in functionality and feature-set to the MPLAB PICkit™ 3 debugger.

2.2.4 dsPIC33E/PIC24E USB Connectivity

There are three possible ways to connect to the dsPIC33E or PIC24E USB microcontroller:

- Host mode

  Connect the device to the type-A connector J6, 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 for the application, an external supply must be connected to the application board and jumper J5 must be removed to prevent back-powering the debug USB port.
- Device mode

  First, connect the debug mini-B USB cable to port J2. Next, connect the starter kit to the USB Host using a cable with a type-B micro plug to the starter kit's micro-B port J4, 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.

2.2.5 Switches

Push button switches (SW1, SW2 and SW3) 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 software debounce techniques. When idle, the switches are pulled high (+3.3V). When pressed, they are grounded.

2.2.6 LEDs

The LEDs (LED1, LED2 and LED3) are connected to PORT D of the processor:

- LED1: Active-high LED connected to RD0
- LED2: Active-high LED connected to RD1
- LED3: Active-high LED connected to RD2

The corresponding PORT D pins must be configured as digital outputs and set high in order to turn on the LEDs.

2.2.7 Oscillator Options

The installed DSC or MCU has an 8 MHz crystal (Y3) connected to it. This crystal is used by the microcontroller's Primary Oscillator. Use of the external crystal is required in order to develop USB applications, as the USB specification dictates a frequency tolerance of ± 0.25% for full speed. Non-USB applications can use the internal oscillators if preferred. The starter kit also has provisions for an external Secondary Oscillator (Y2); however, the crystal for this oscillator is not populated.

The PIC24FJ256GB106 device is independently clocked and has its own 12 MHz crystal (Y1).

2.2.8 120-pin Modular Expansion Connector

The dsPIC33E or PIC24E USB Starter Kit includes a 120-pin modular expansion interface (Application Board Connector J3) on its bottom side. This allows the board to be optionally used in conjunction with other Microchip development boards such as the I/O Expansion Board or the Multimedia Expansion Board (MEB), thereby extending the functionality provided by the starter kit.

TABLE 2-1: STARTER KIT CONNECTOR PART NUMBERS

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

NOTES:

Appendix A. Board Layout and Schematics

This appendix provides board layout diagrams and schematics of the dsPIC33E and PIC24E USB Starter Kits and includes the following sections:

- Starter Kit Board Layout
- Application Hardware Schematics
- Starter Kit Debugger Hardware Schematics

A.1 STARTER KIT BOARD LAYOUT

FIGURE A-1: STARTER KIT BOARD LAYOUT (TOP)

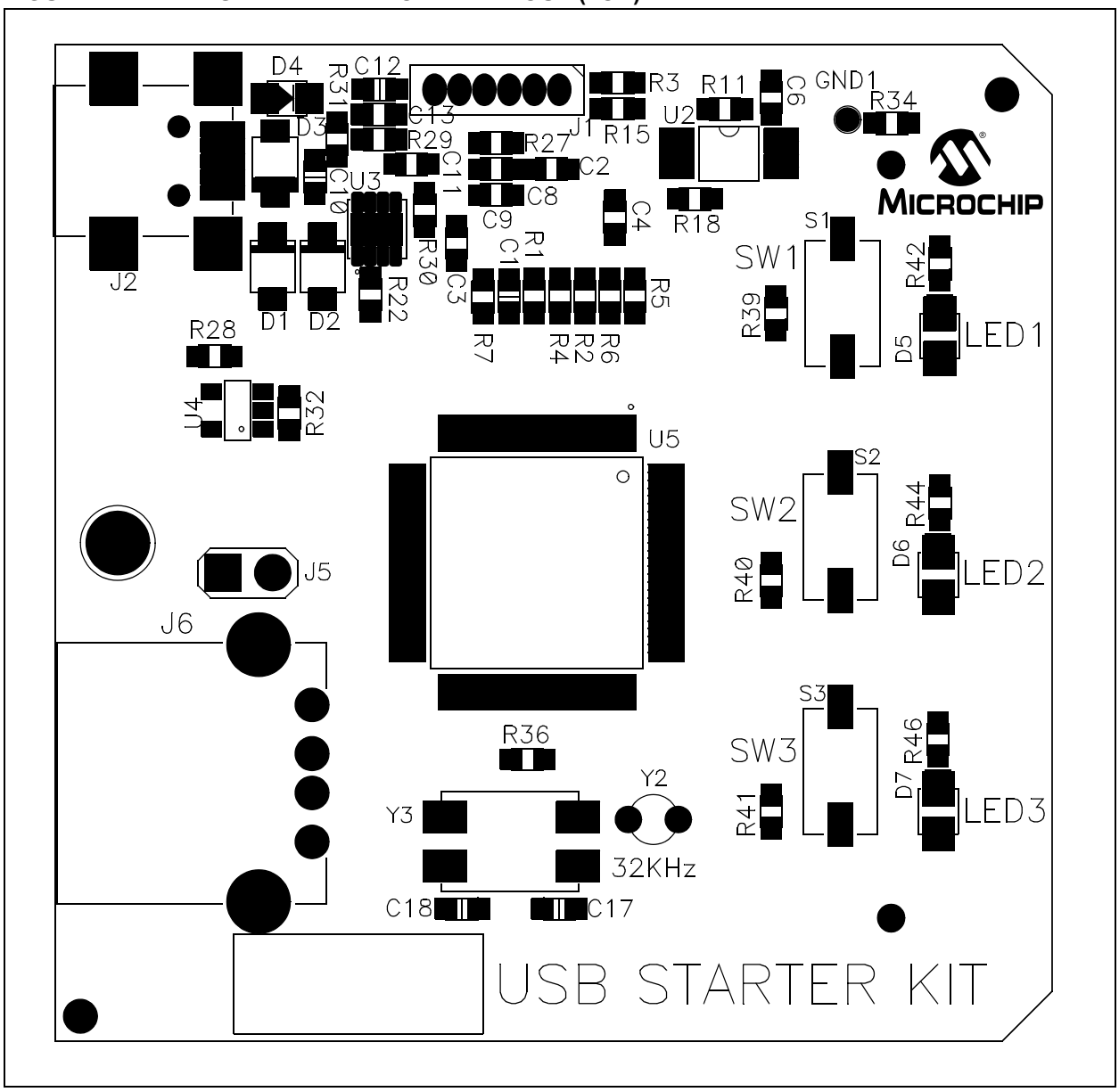
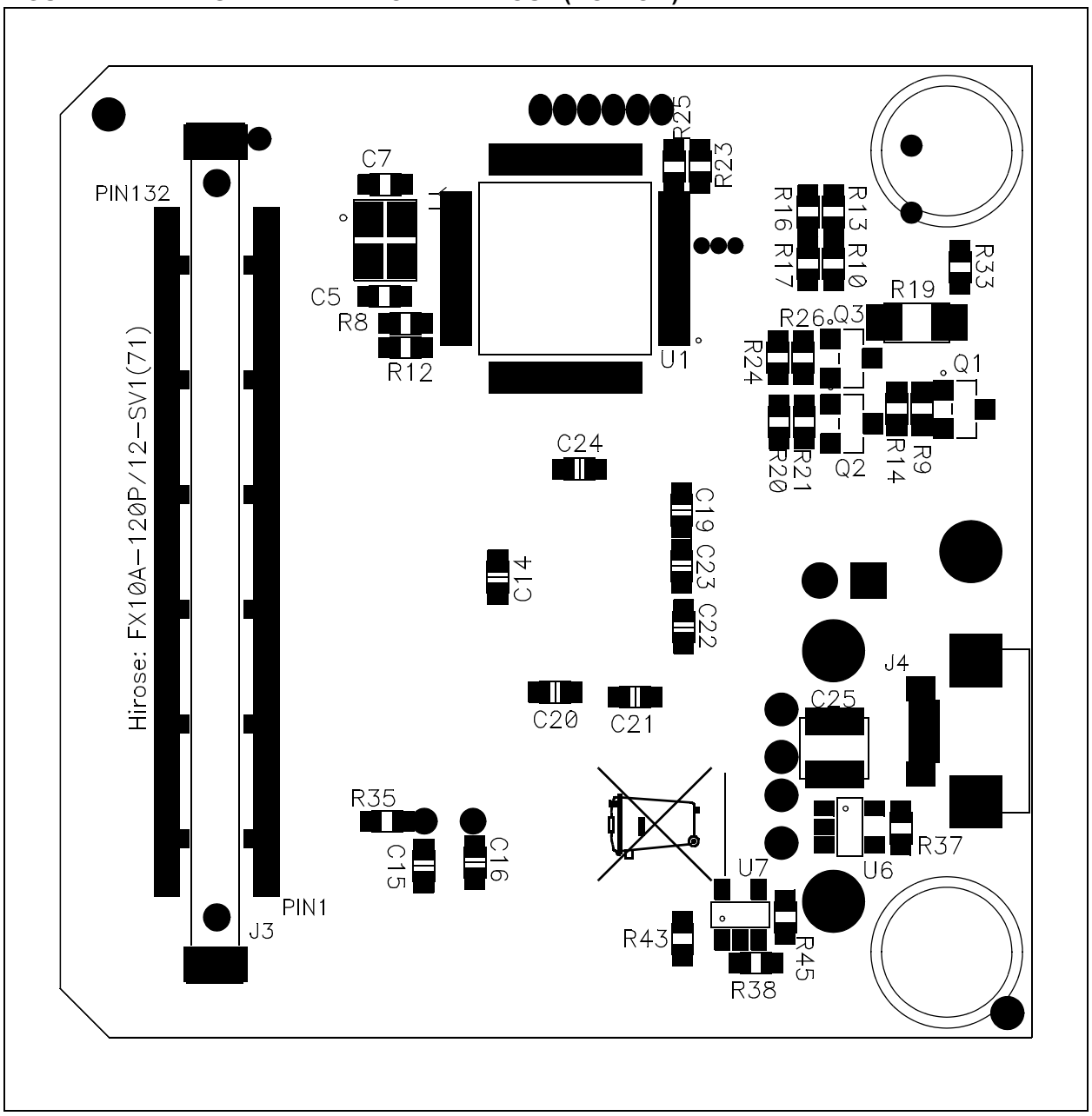


FIGURE A-2: STARTER KIT BOARD LAYOUT (BOTTOM)



A.2 APPLICATION HARDWARE SCHEMATICS

FIGURE A-3: TARGET DEVICE (dsPIC33E/PIC24E)

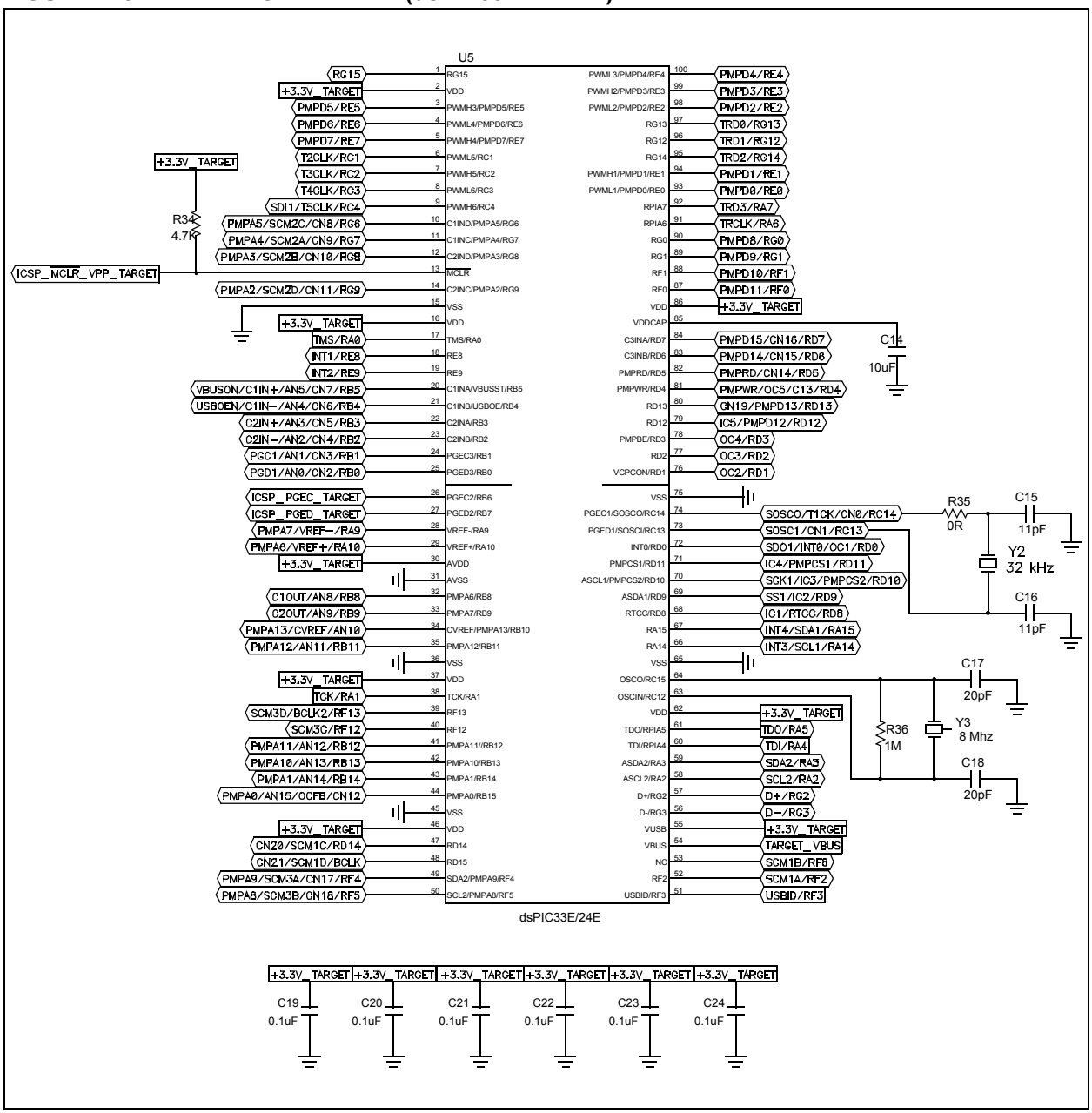


FIGURE A-4: POWER DISTRIBUTION/SWITCHING

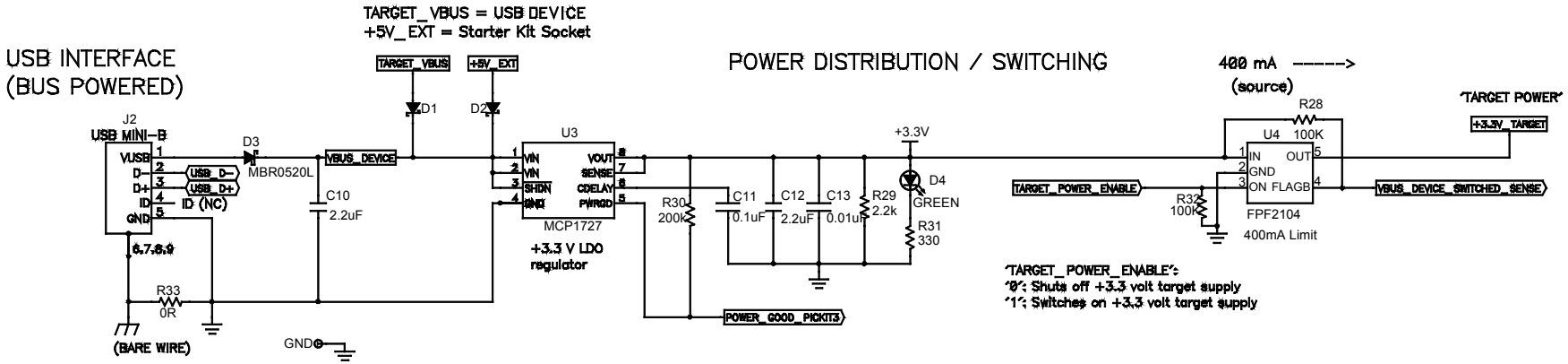


FIGURE A-5: USER LEDs

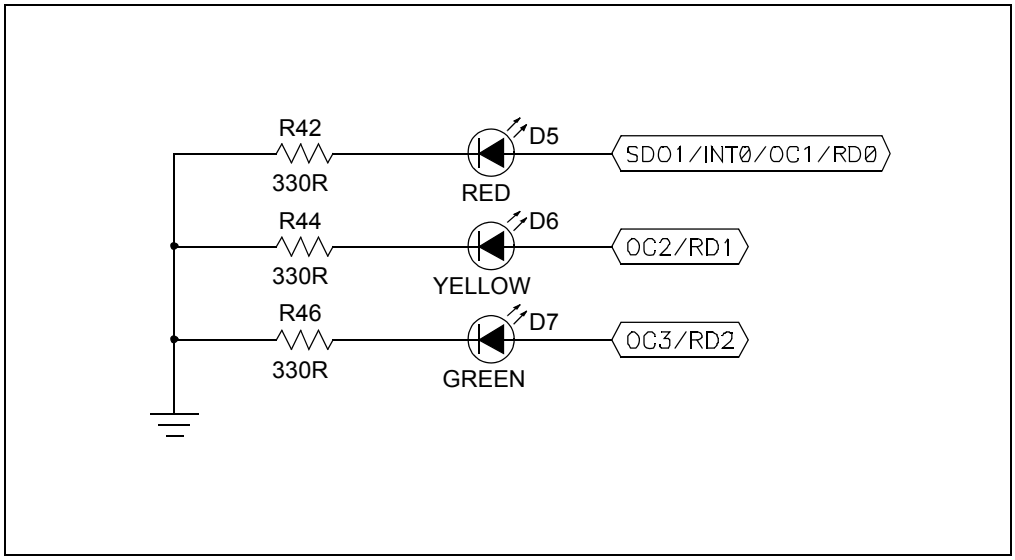


FIGURE A-6: USER SWITCHES

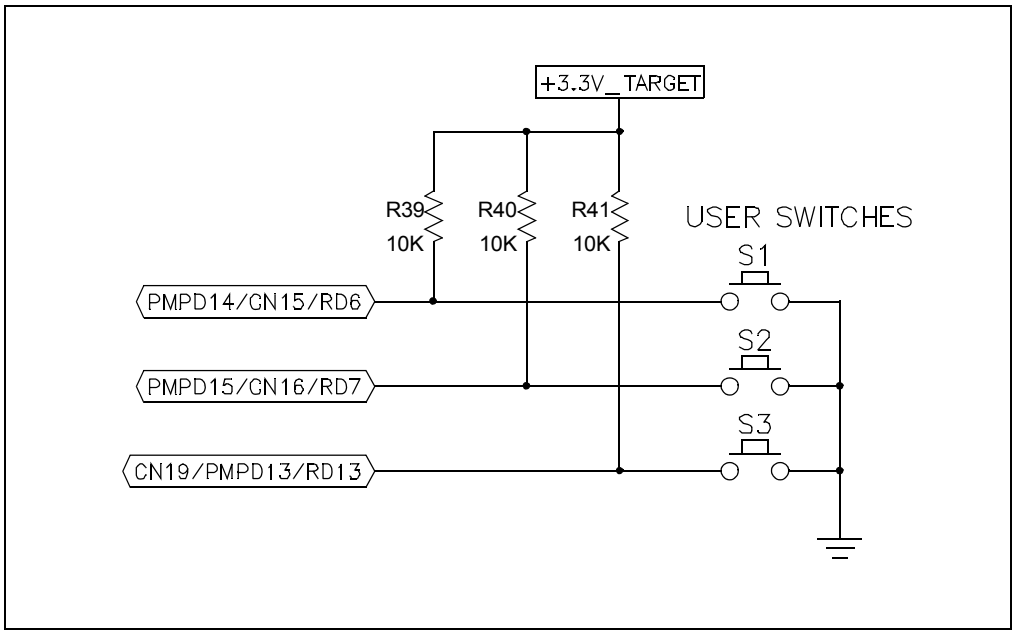


FIGURE A-7: STARTER KIT INTERFACE

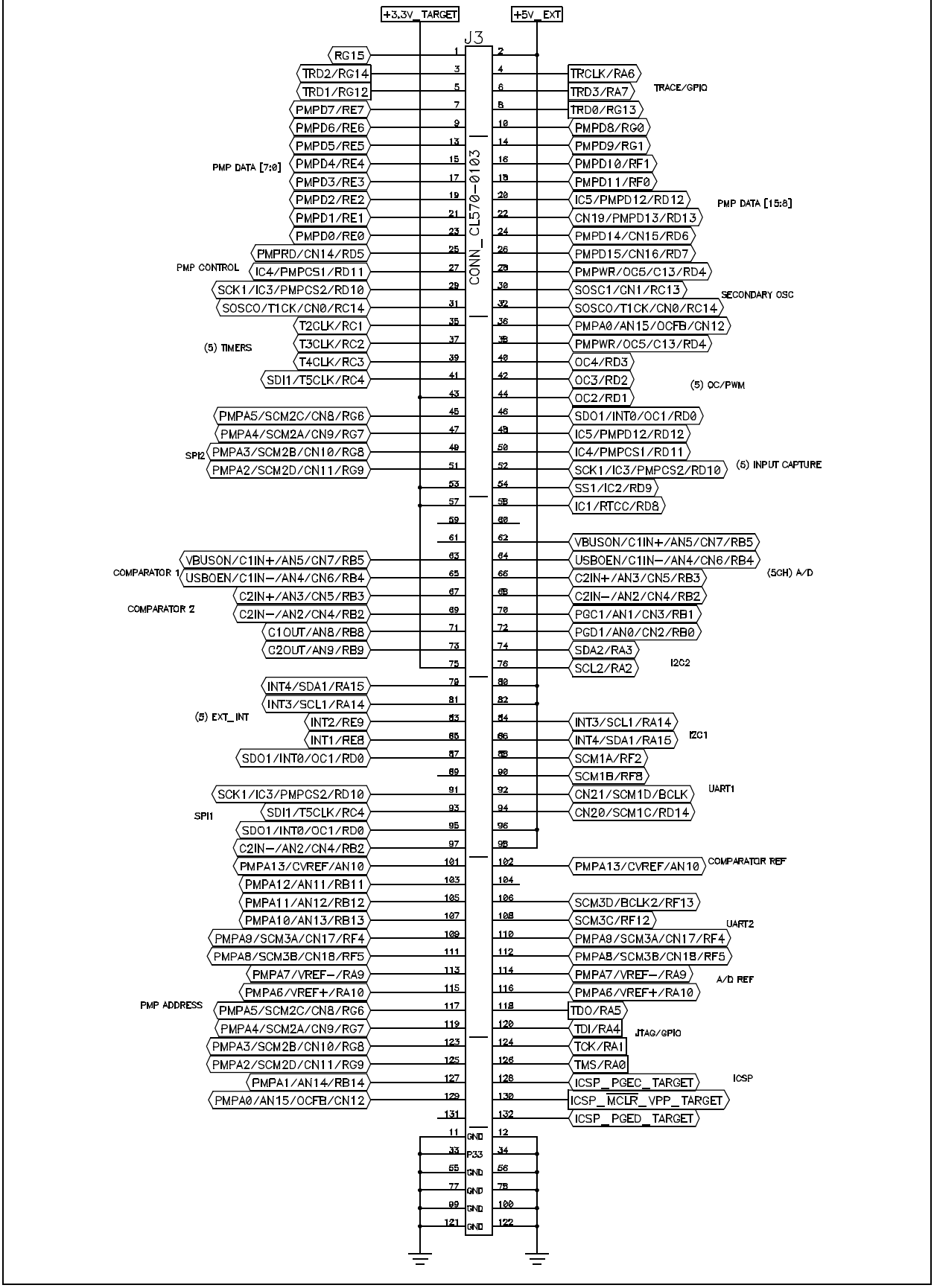
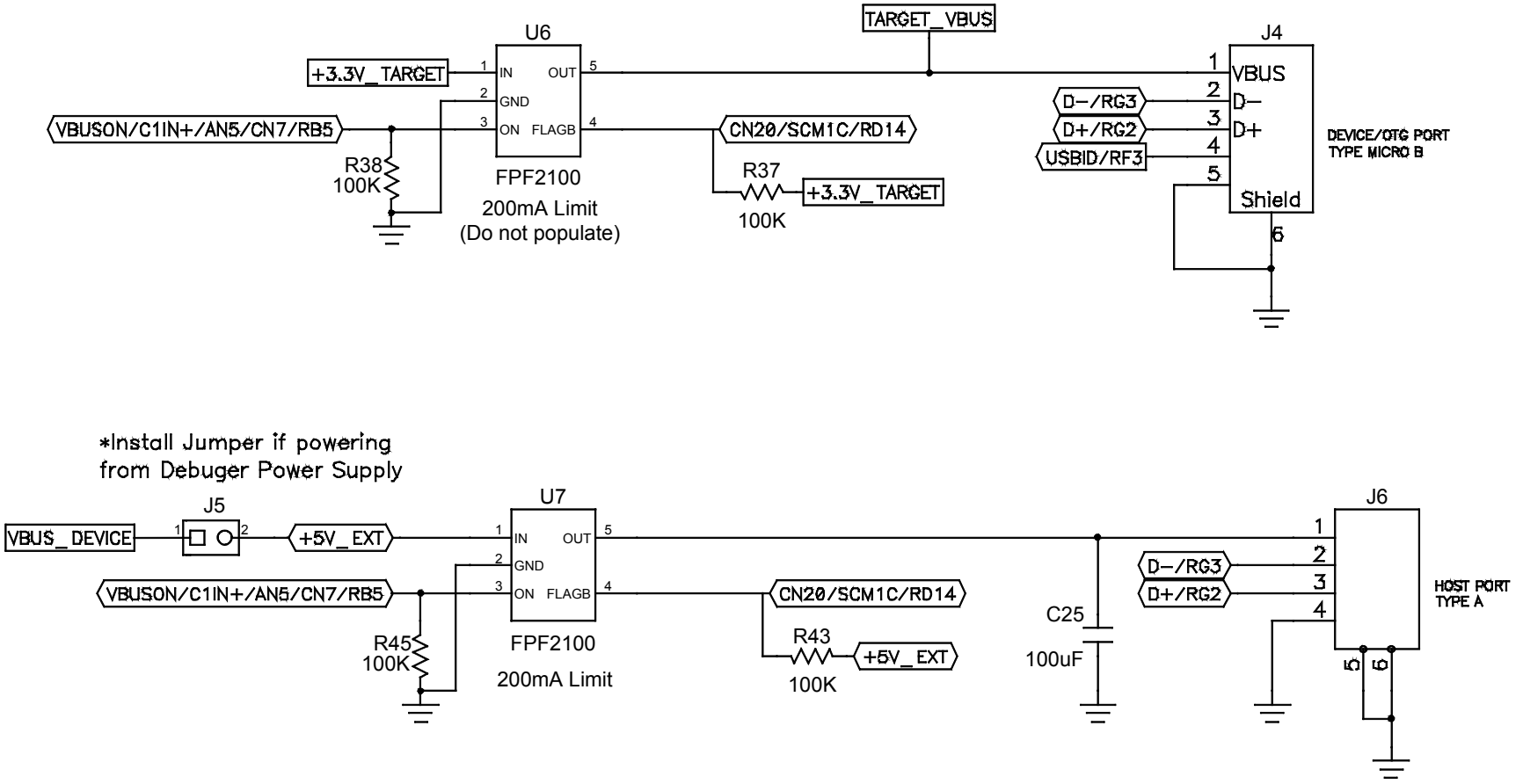


FIGURE A-8: USB CONNECTIONS



A.3 STARTER KIT DEBUGGER HARDWARE SCHEMATICS

FIGURE A-9: MINI-ICSP INTERFACE

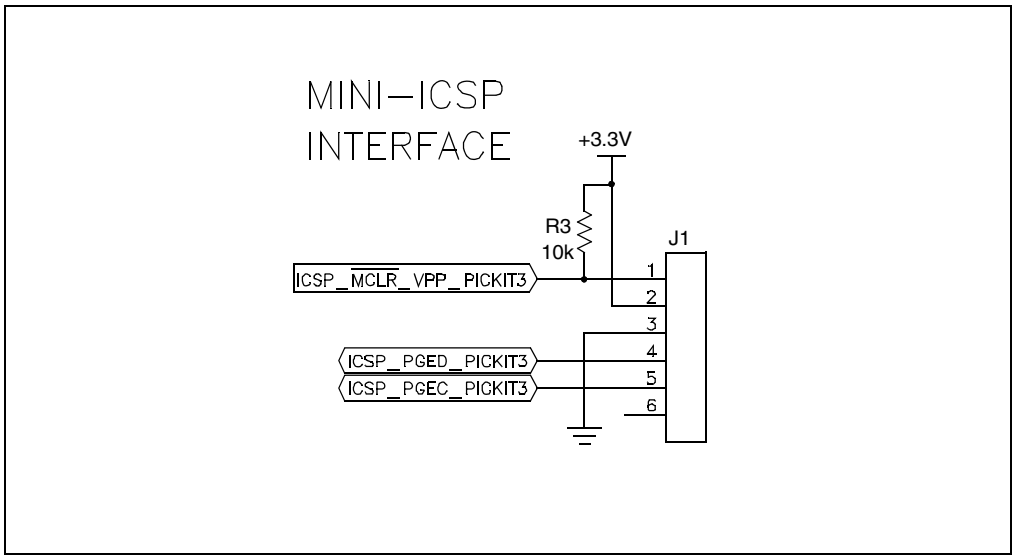


FIGURE A-10: SERIAL EEPROM

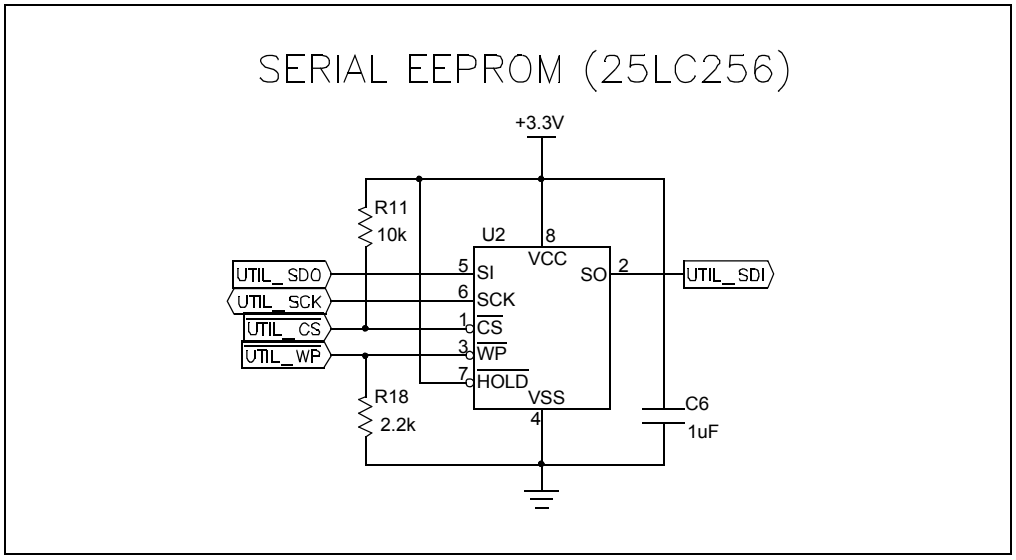


FIGURE A-11: TARGET ICSP SIGNALS

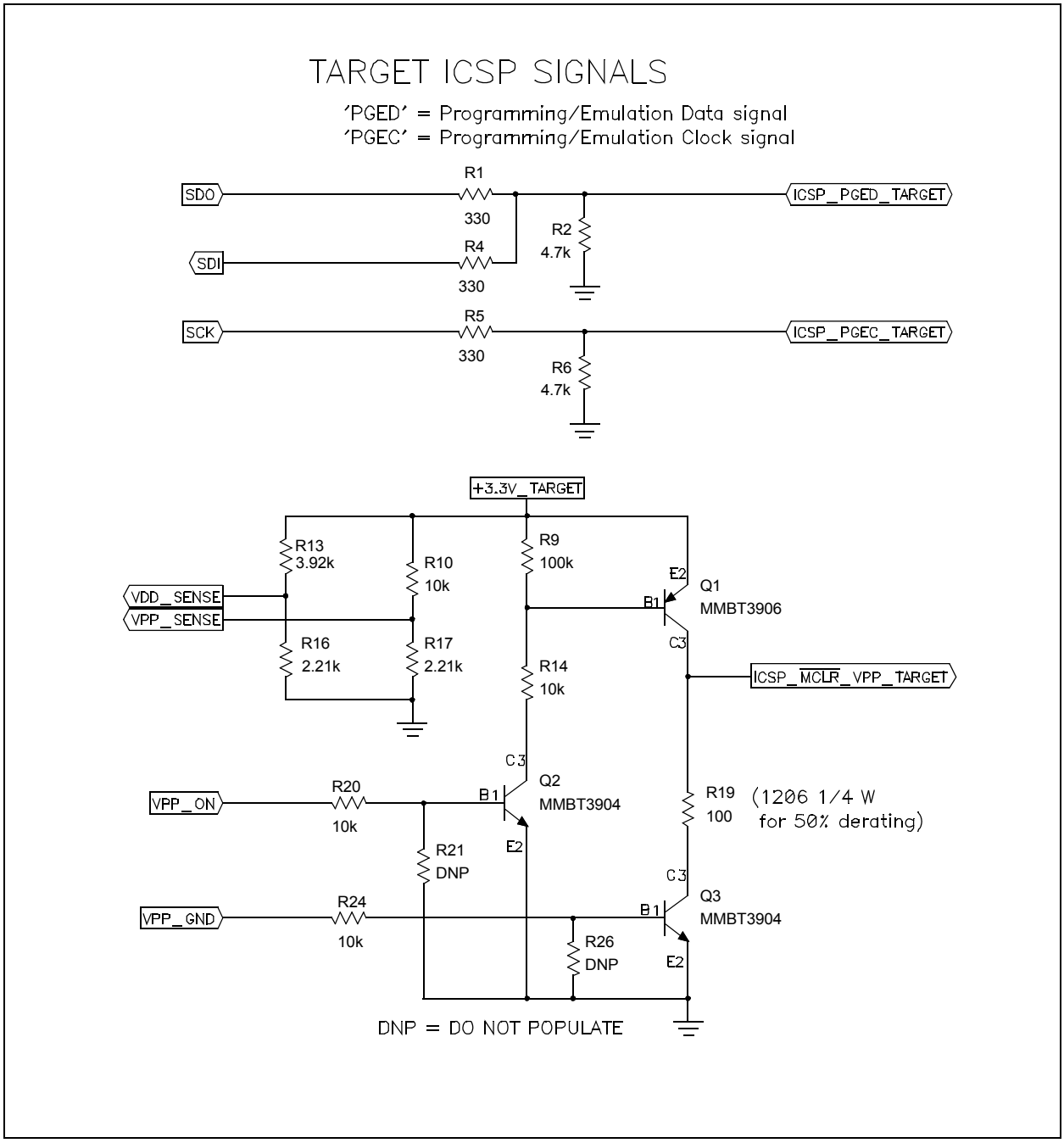
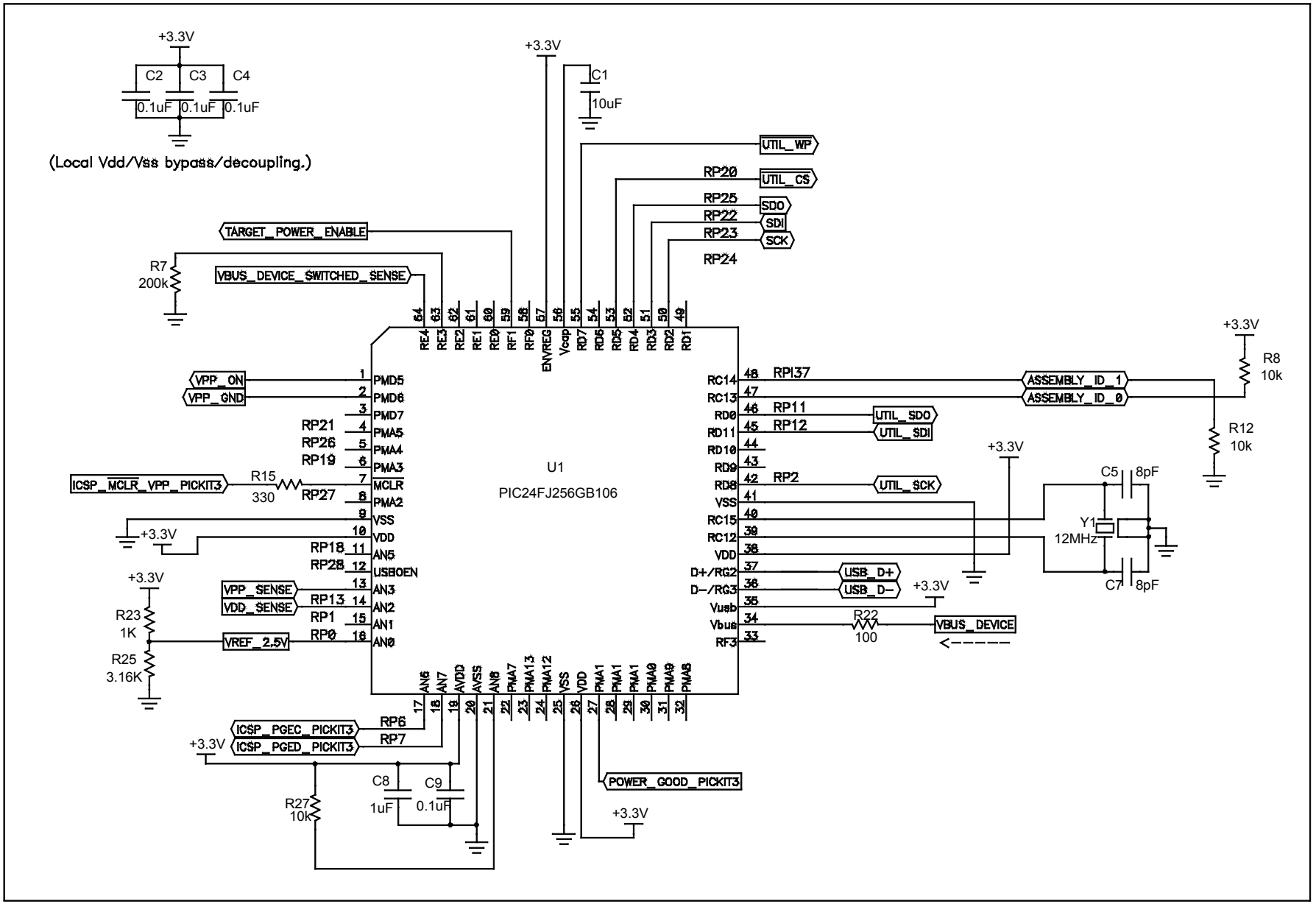


FIGURE A-12: PIC24FJ256GB106 DEBUGGER HOST



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China - Xian
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China - Xiamen
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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
Tel: 82-53-744-4301
Fax: 82-53-744-4302

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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Fax: 886-3-6578-370

Taiwan - Kaohsiung
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Taiwan - Taipei
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