

PIC32 Bluetooth® Starter Kit User's Guide

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Object of Declaration: DM320018, PIC32 Bluetooth® Starter Kit

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The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
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Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

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NOTES:

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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® 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 Bluetooth 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 Bluetooth Starter Kit as a development tool to emulate and debug firmware on a target board. This document includes 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. "Layout and Schematics"** provides a block diagram, wire list, and detailed schematics of the starter kit.
- **Appendix B. "Bill of Materials"** provides the bill of material descriptions and the reference, manufacturer, and part numbers for the components used in the starter kit hardware.

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 document describes how to use the starter kit. The following Microchip documents are available and recommended as supplemental reference resources.

Bluetooth Audio Development Kit Readme Files

For the latest information on using the development kit and its related demonstrations, please consult the Readme file provided in the installation directory. The Readme file contains information on revision updates and known issues that may not be included in this reference guide.

PIC32MX1XX/2XX Family Data Sheet (DS60001168)

Consult 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

Section 27. “USB On-The-Go” (DS61126)

This section of the *“PIC32 Family Reference Manual”* provides a detailed description and overview of the functionality of the USB OTG module.

Microchip Bluetooth® Stack for PIC32

This application note provides information on the Application Programming Interfaces for various profiles, protocols, and decoders available in the Bluetooth Stack for PIC32 devices.

Note:	Please contact Microchip Marketing for information regarding this document.

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.

PICkit™ 3 In-Circuit Debugger/Programmer User’s Guide (DS50002116)

This document describes how to use the PICkit 3 as a development tool to emulate and debug firmware on a target board, as well as how to program devices.

PICkit 3 In-Circuit Debugger/Programmer Online Help File

A comprehensive help file for the debugger is included with MPLAB X IDE. Usage, troubleshooting and hardware specifications are covered. This may be more up-to-date than the printed documentation. Also, limitations are listed for various devices.

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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 (July 2014)

This is the initial release of the PIC32 Bluetooth® Starter Kit User's Guide.

Revision B (September 2014)

This revision includes updates to the Bill of Materials (see Table B-1).

NOTES:

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Chapter 1. Introduction

Thank you for purchasing the Microchip Technology PIC32 Bluetooth® Starter Kit (P/N: DM320018). This starter kit provides a low-cost solution for developing Bluetooth Serial Port Profile (SPP) applications.

> **Note:** The starter kit is preprogrammed with Bluetooth SPP full-duplex data transmission demonstration software and more demonstrations are planned in the near future. The demonstration applications are available for download with MPLAB® Harmony v0.80.02 or later. Please refer to the MPLAB Harmony documentation, which is available from http://microchip.com/harmony/ for more information on these demonstrations. An Android application for handsets is also available in this version of MPLAB Harmony to support the SPP data demonstration.

1.1 KIT CONTENTS

The starter kit ships with demonstration code that enables SPP full-duplex data transmission with many connected Bluetooth-enabled smart devices. The starter kit supplies on-board circuitry for full debug and programming capabilities and includes an integrated Bluetooth HCI module. Optionally, the starter kit board may be coupled with an expansion daughter board through its expansion header interface.

The PIC32 Bluetooth Starter Kit contains the following items:

- PIC32 Bluetooth Starter Kit development board, which includes:
  - An integrated HCI-based Bluetooth radio
  - USB host and device connectors
  - High output multi-color LED
  - Accelerometer and temperature sensor.
- USB Type-A to B-mini cable for power and debug of the development board

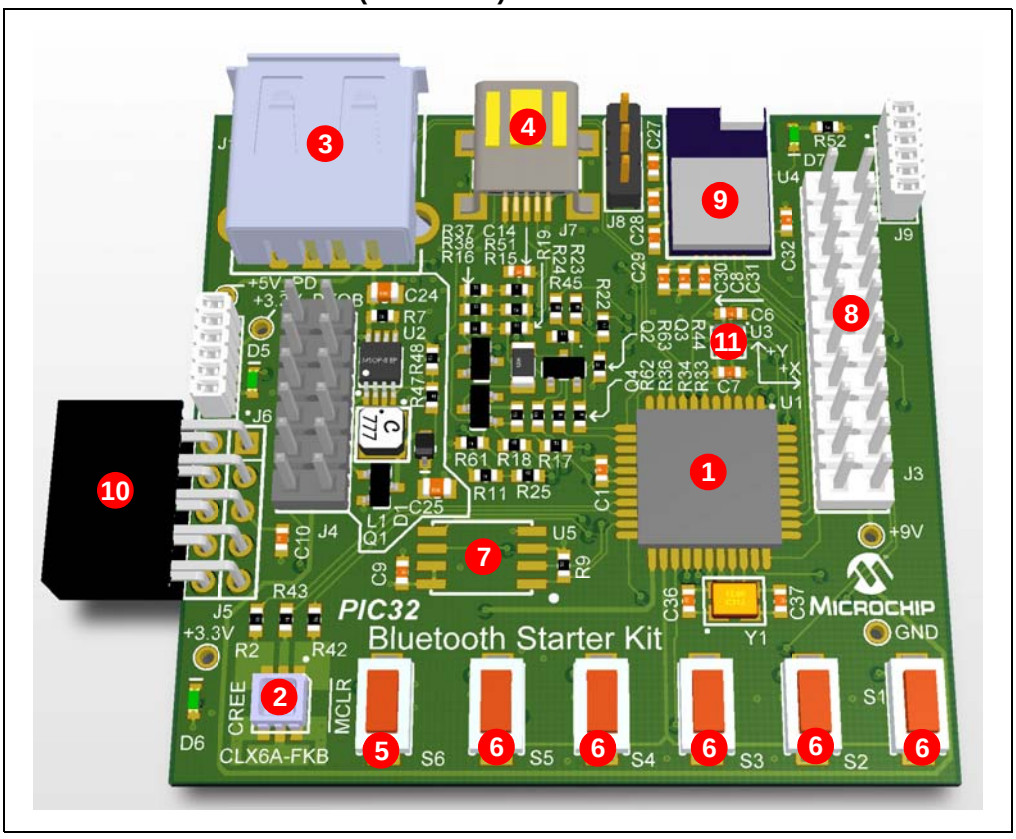
> **Note:** If you are missing any part of a kit, contact a Microchip sales office for assistance. A list of Microchip offices for sales and service is provided on the last page of this document.

1.2 PIC32 BLUETOOTH STARTER KIT FUNCTIONALITY AND FEATURES

The top assembly of the development board in the PIC32 Bluetooth Starter Kit has the following key features, as indicated by the corresponding number in Figure 1-1.

1. PIC32MX270F256D 32-bit microcontroller (U1).
2. CREE high output multi-color LED with PWM input.
3. USB Type-A connector to support USB host.
4. USB mini-B connector for on-board debugging support.
5. Device Reset push button.
6. Five user-definable push buttons (SW1-SW5).
7. SPI Serial EEPROM (2 Mb).
8. Daughter board expansion connector (DAC or codec support).
9. Integrated Certified HCI Class 1 Bluetooth radio module.
10. Authentication connector.
11. Integrated 3-axis accelerometer and temperature sensor.

FIGURE 1-1: PIC32 BLUETOOTH® STARTER KIT DEVELOPMENT BOARD LAYOUT (TOP VIEW)

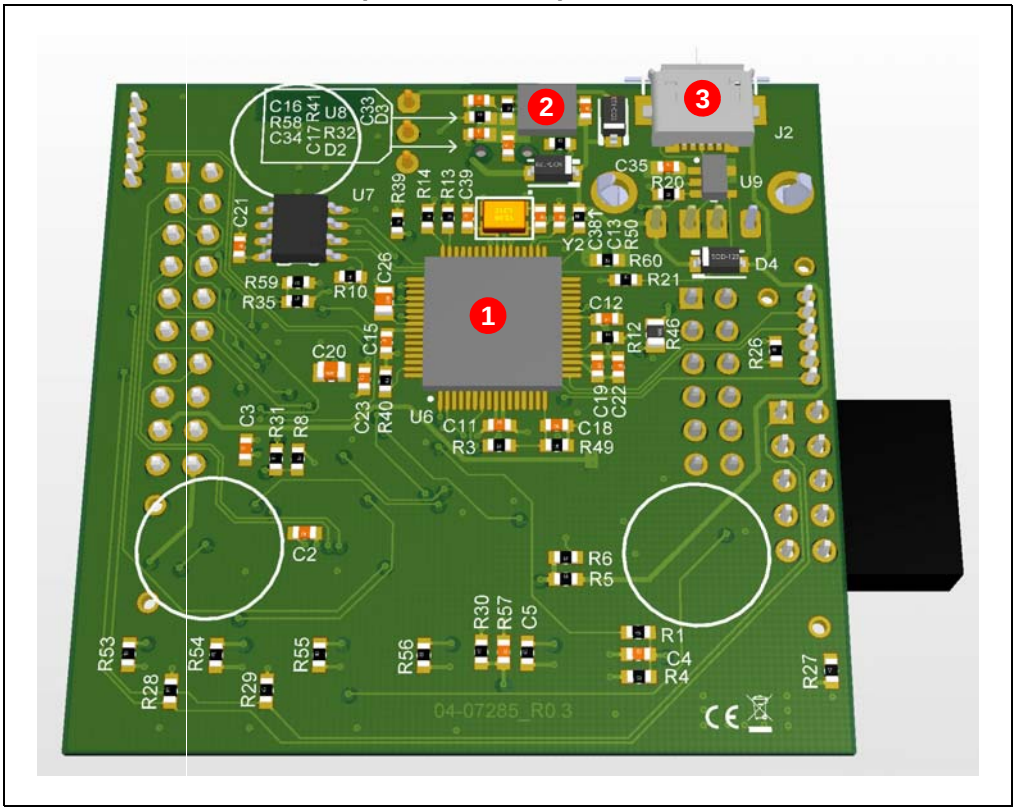


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The bottom assembly of the development board in the starter kit has the following key features, as indicated by the corresponding number in Figure 1-2.

1. PIC24FJ256GB106 USB microcontroller for on-board debugging.
2. USB micro-AB receptacle for USB Host or Device connectivity for PIC32 USB applications.
3. Regulated +3.3V power supply for powering the starter kit through USB or an expansion board.

FIGURE 1-2: PIC32 BLUETOOTH® STARTER KIT DEVELOPMENT BOARD LAYOUT (BOTTOM VIEW)



NOTES:

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Chapter 2. Hardware

This chapter describes the hardware features of the PIC32 Bluetooth Starter Kit

2.1 HARDWARE FEATURES

The following key features of the starter kit are presented in the order provided in **1.2 "PIC32 Bluetooth Starter Kit Functionality and Features"**. Refer to Figure 1-1 and Figure 1-2 for their locations on the development board.

2.1.1 Bluetooth Module

The FLC-BTM805 is a dual-mode Bluetooth HCI module that allows original equipment manufacturers to add Bluetooth wireless capability to their products. The module supports BT2.1 and later with an HCI interface, which makes it simple to design into fully certified embedded Bluetooth solutions. The module supports Bluetooth Enhanced Data Rate (EDR) and delivers up to a 3 Mbps data rate. In addition, the module supports Class 1 transmission and multiple device connection.

2.1.2 Processor Support

The development board in the starter kit is designed with a permanently mounted (i.e., soldered) PIC32MX270F256D microcontroller. Support for this microcontroller is available using the Microchip MPLAB® X IDE v2.10 and later, and with the MPLAB XC32 C/C++ Compiler v1.32 or later.

2.1.3 Powering the Starter Kit

Use one of the following methods to provide power to the starter kit:

- Connect USB bus power to the USB debug connector, J7
- Apply VBUS (+5V) power to the micro-B USB connector
- Connect an external application board with a regulated DC power supply that provides +5V to the J8 header (not populated)

2.1.4 USB Connectivity

2.1.4.1 HOST MODE

Connect the device to the Type-A connector, J1, which is located on the top of the starter kit development board.

2.1.4.2 DEVICE MODE

Connect the starter kit to the Host using a cable to port J2, which is located on the bottom of the starter kit development board.

2.1.4.3 DEBUGGING MODE

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 ICSP™ pins of the PIC32 device.

Connect the starter kit to port J7, which is located on the top side of the starter kit development board.

2.1.5 Switches

Switches, SW1-SW6, are available on the development board of the starter kit. SW6 is connected to the reset pin (RB5) of the board. When Idle, the switches are pulled high (+3.3V), and they are grounded when pressed.

2.1.6 Other Features

The starter kit is integrated with a temperature sensor, the Cree high output multi-color LED with PWM, a 3D- accelerometer, and an authentication connector. These features are used for application development purposes.

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Appendix A. Layout and Schematics

FIGURE A-1: PIC32 BLUETOOTH STARTER KIT HIGH-LEVEL BLOCK DIAGRAM

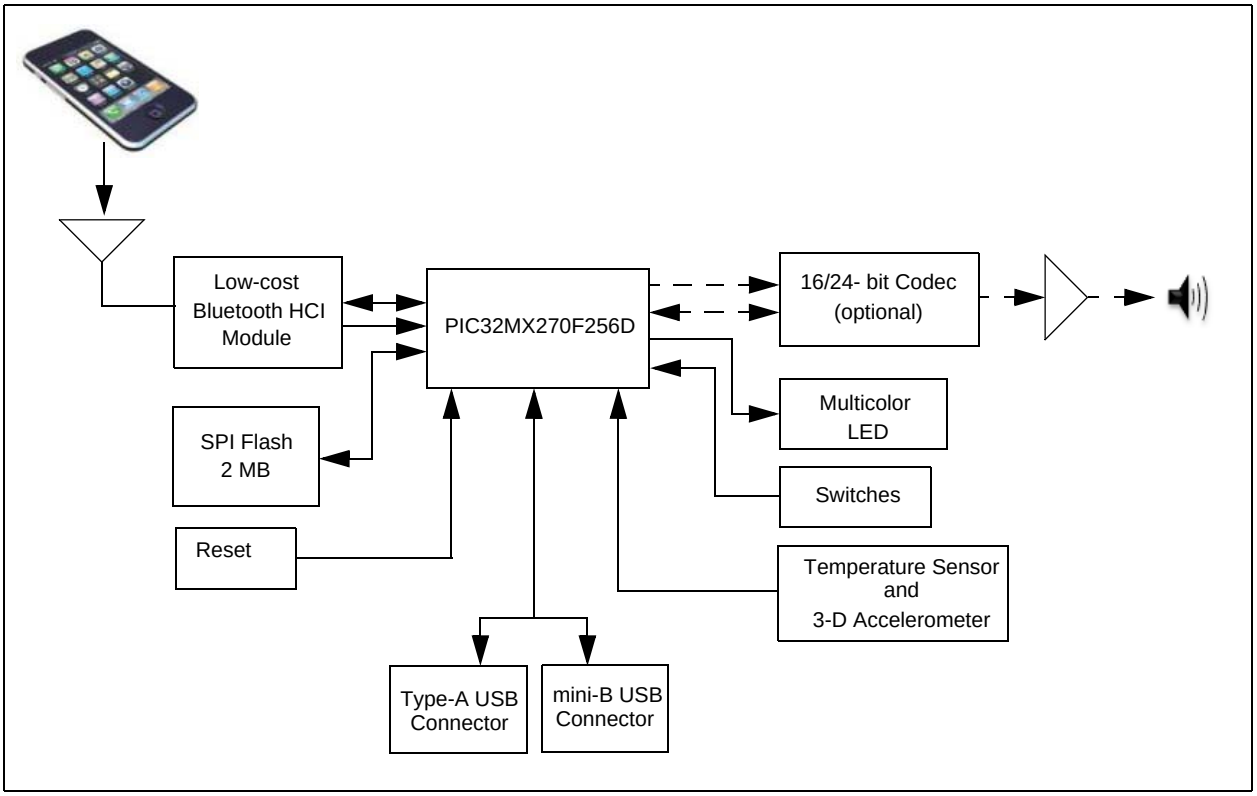


TABLE A-1: PIC32 BLUETOOTH STARTER KIT WIRE LIST

PIC32MX270F256D Pin Number	PIC32MX270F256D Pin Name	Schematic Signal Name
1	RPB9/SDA1/CTED4/PMD3	GPIO_10/I2C1_SDA
2	RPC6/MA1/RC6	GPIO_1/UART1_Rx
3	RPC7/PMA0/RC7	GPIO_2/UART1_Tx
4	RPC8/PMA5/RC8	GPIO_18/UART2_RX
5	RPC9/TED7/PMA6/RC9	LED3#
6	VSS	GND SET
7	VCAP	3.3VDD
8	PGED2/RPB10/D+/CTED11/RB10	PIC32_D+
9	PGEC2/RPB11/D-/RB11	PIC32_D-
10	VUSB3v3	—
11	AN11/RPB13/CTPLS/PMRD/RB13	GPIO_27/SPI2_SDI
12	PGED/TMS/PMA10/RA10	PGED2/PGED4
13	PGEC	PGEC2/PGEC4
14	CVREFOUT/AN10/C3INB/RPB14/VBUSON/SCK1/TED5/RB14	GPIO_6/I2S1_BCLK
15	AN9/C3INA/RPB15/SCK2/TED6/PMCS1/RB15	GPIO_22/I2S2_BCLK
16	VSS	AVSS
17	VDD	AVDD
18	$\overline{\text{MCLR}}$	PIC32_MCLR#
19	PGED3/VREF+/CVREF+/AN0/C3INC/RPA0/CTED1/PMD7/RA0	LED1#
20	PGEC3/VREF-/CVREF-/AN1/RPA1/CTED2/PMD6/RA1	LED2#
21	PGED1/AN2/C1IND/C2INB/C3IND/RPB0/PMD0/RB0	FLASH_CS#/SS2#
22	PGEC1/AN3/C1INC/C2INA/RPB1/CTED12/PMD1/RB1	GPIO_3/UART1_CTS
23	AN4/C1INB/C2IND/RPB2/SDA2/CTED13/PMD2/RB2	VBUS_SENSE
24	AN5/C1INA/C2INC/RTCC/RPB3/SCL2/PMWR/RB3	SW1#
24	AN5/C1NA/C2INC/RTCC/RPB3/SCL2/PMWR/RB3	SW2#, SW3, SW4, SW5
25	AN6/RPC0/RC0	—
26	AN7/RPC1/RC1	GPIO_5/I2S1_MCLK
27	AN8/RPC2/PMA2/RC2	GPIO_4/UART1_RTS
28	VSS	--VSS
29	VDD	--VDD
30	OSC1/CLK1/RPA2/RA2	XTAL (8Mhz)
31	OSC2/CLK0/RPA3/RA3	XTAL (8Mhz)
32	TD0/RPA8/PMA8/RA8	GPIO_11/SPI1_SDI
33	SOSCI/RPB4/RB4	GPIO_8/I2S1_LRCL
34	SOSC0/RPA4/T1CK/CTED9/RA4	GPIO_25/I2S2_SDO
35	TD1/RPA9/PMA9/RA9	GPIO_9/I2S1_SDO
36	AN12/RPC3/RC3	GPIO_20/UART2_CTS
37	RPC4/PMA4/RC4	GPIO_19/UART2_TX
38	RPC5/PMA3/RC5	—
39	VSS	-VSS
40	VDD	-VDD
41	RPB5/USBID/RB5	GPIO_12 / STBY / RST
42	VBUS	VBUS
43	RPB7/CTED3/PMD5/INT0/RB7	GPIO_21/UART2_RTS
44	RPB8/SCL1/CTED10/PMD4/RB8	GPIO_7/I2C1_SCL

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FIGURE A-2: BOOST CONTROLLER

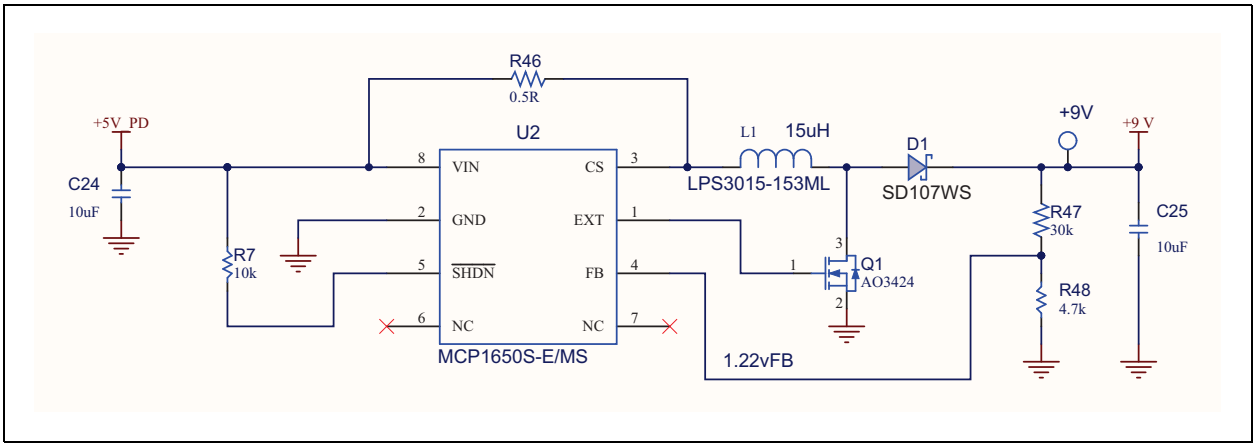


FIGURE A-3: 3-AXIS ACCELEROMETER

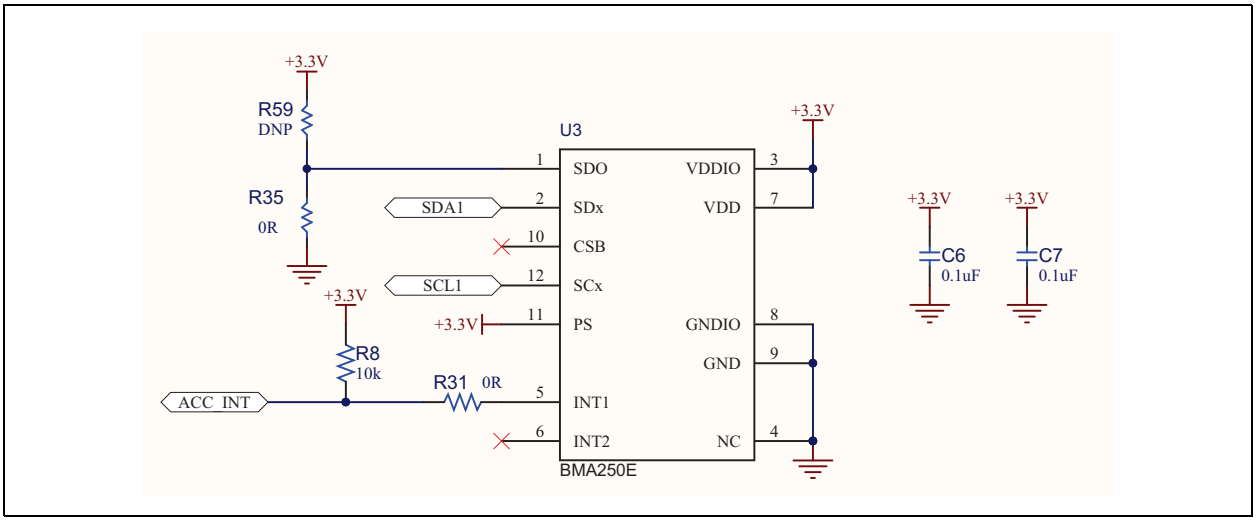


FIGURE A-4: BLUETOOTH HCI MODULE

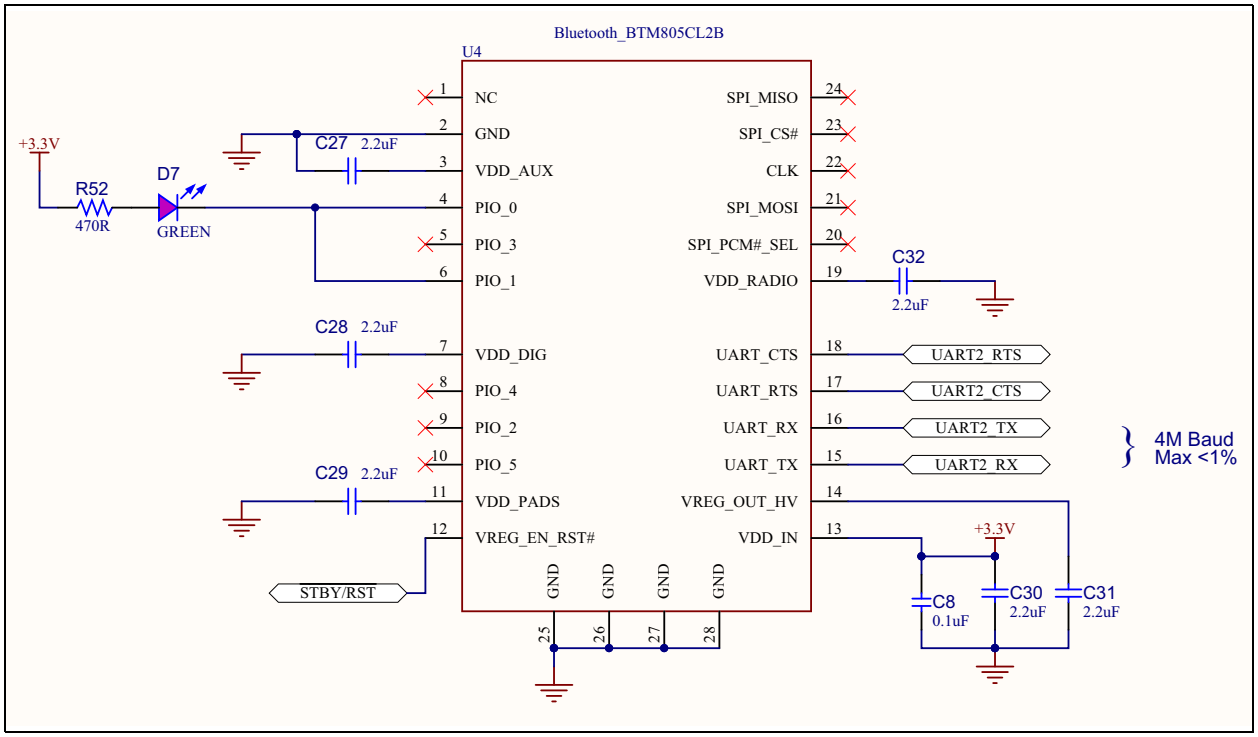


FIGURE A-5: SERIAL FLASH

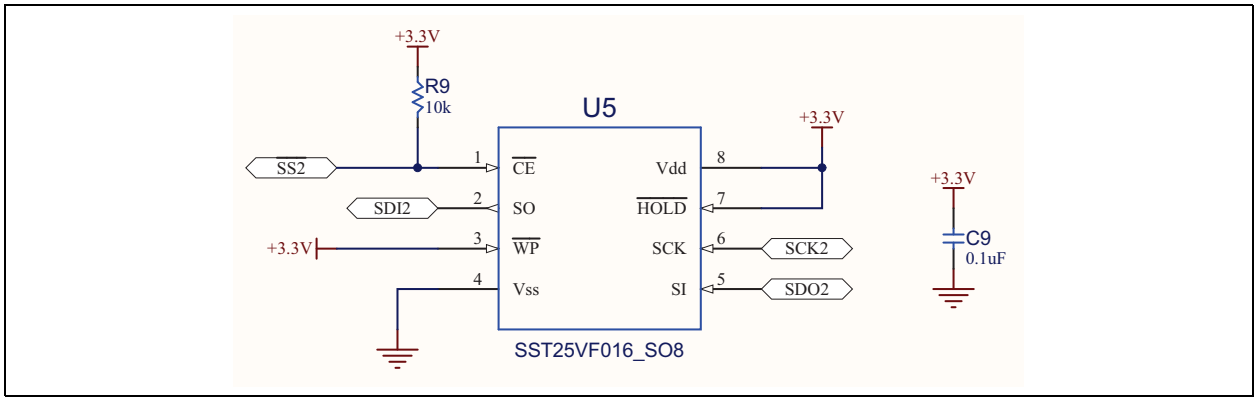
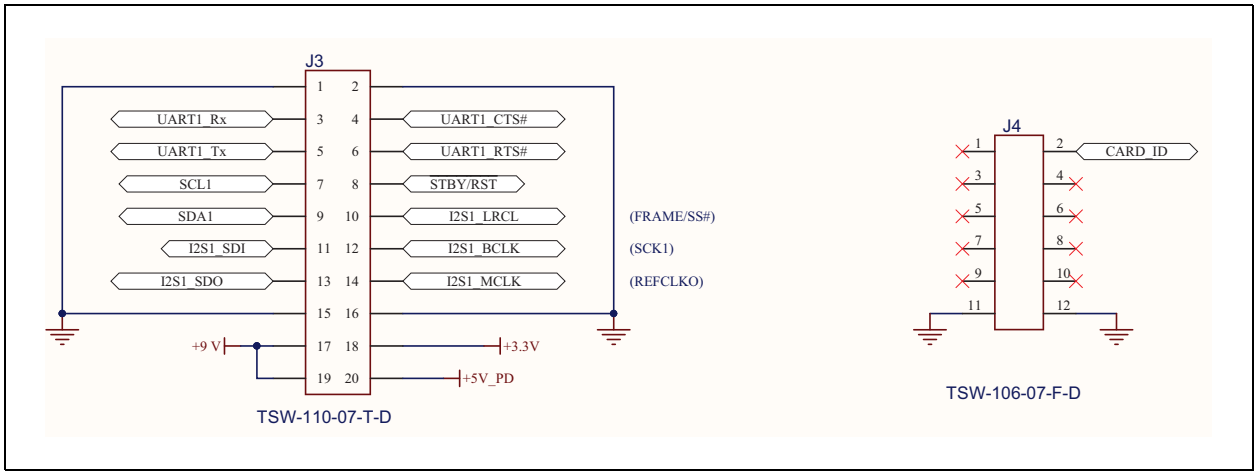


FIGURE A-6: DAUGHTER BOARD CONNECTOR



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FIGURE A-7: AUTHENTICATION CONNECTOR

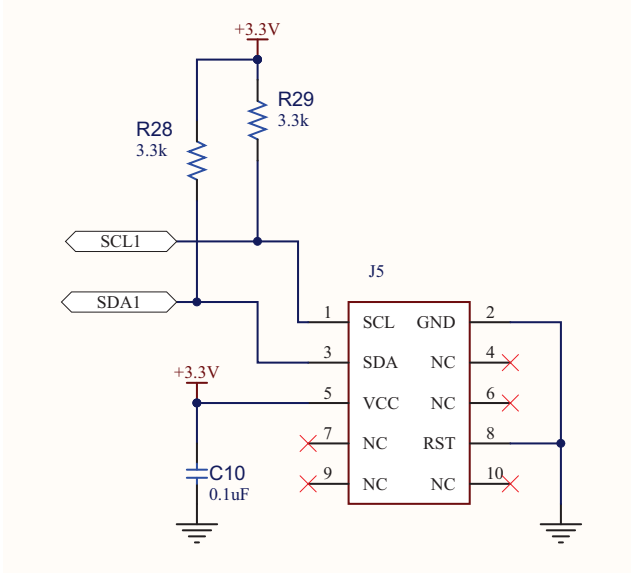
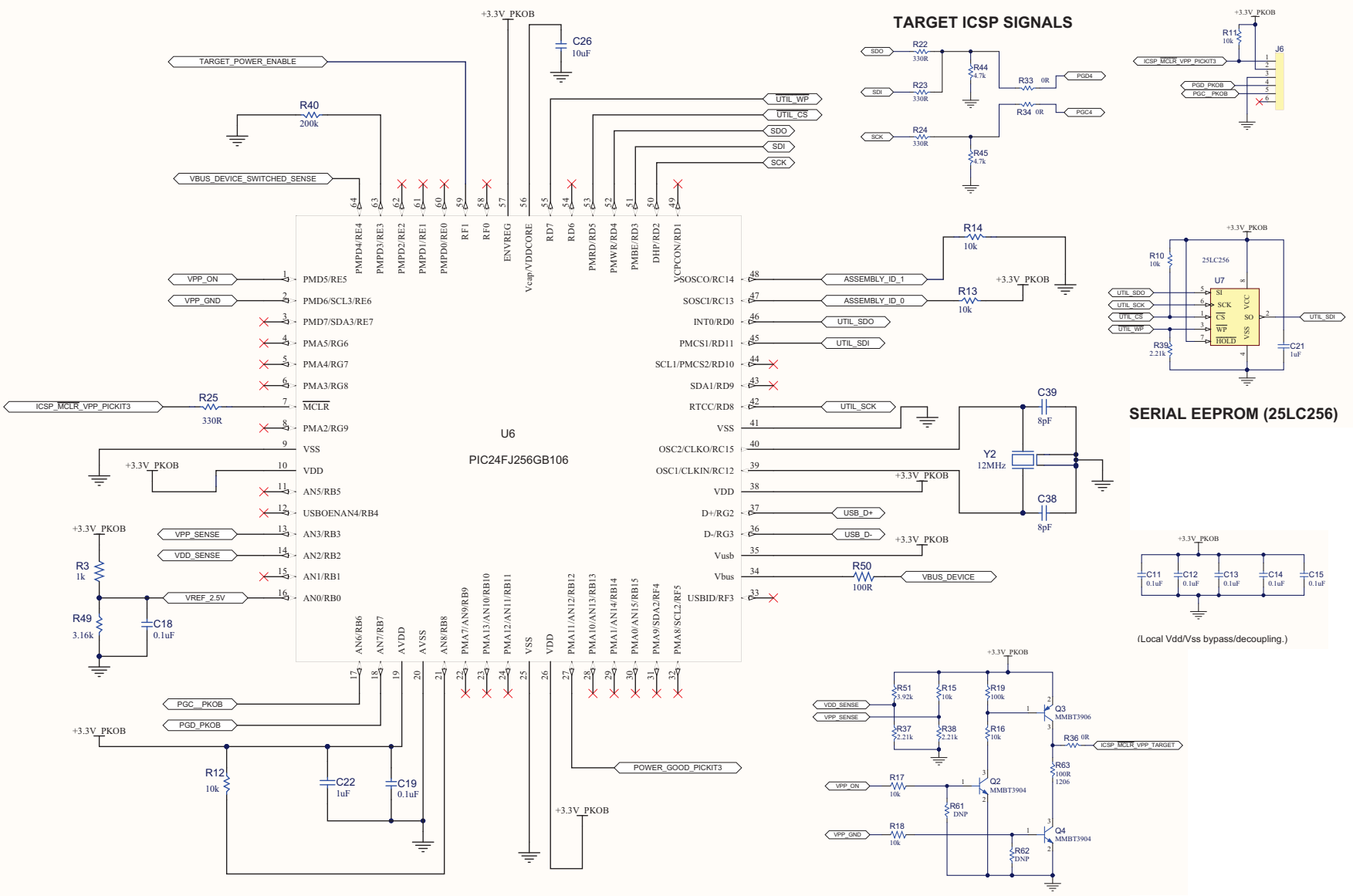


FIGURE A-8: POWER DISTRIBUTION (SHEET 1 OF 2)



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FIGURE A-9: POWER DISTRIBUTION (SHEET 1 OF 2)

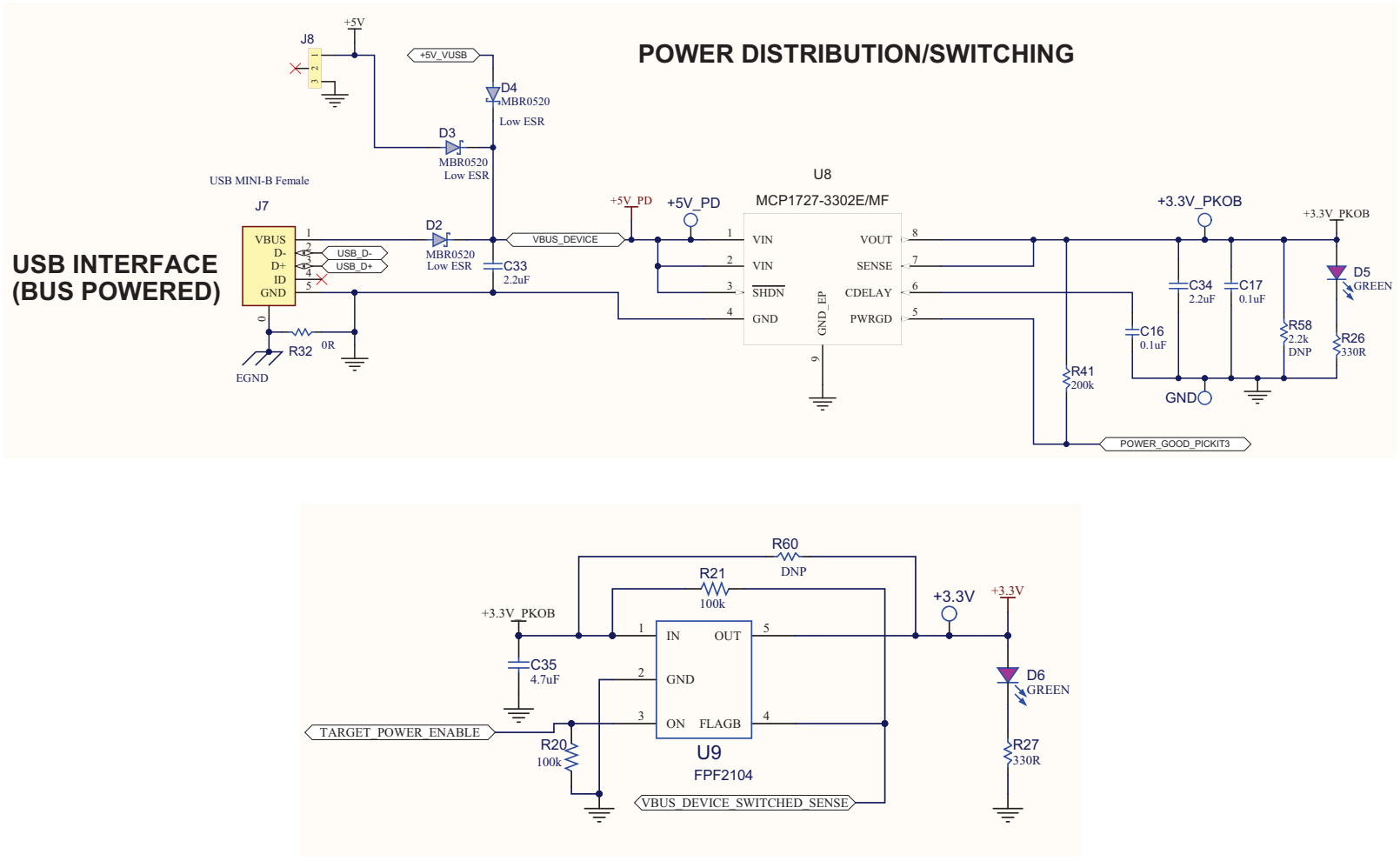
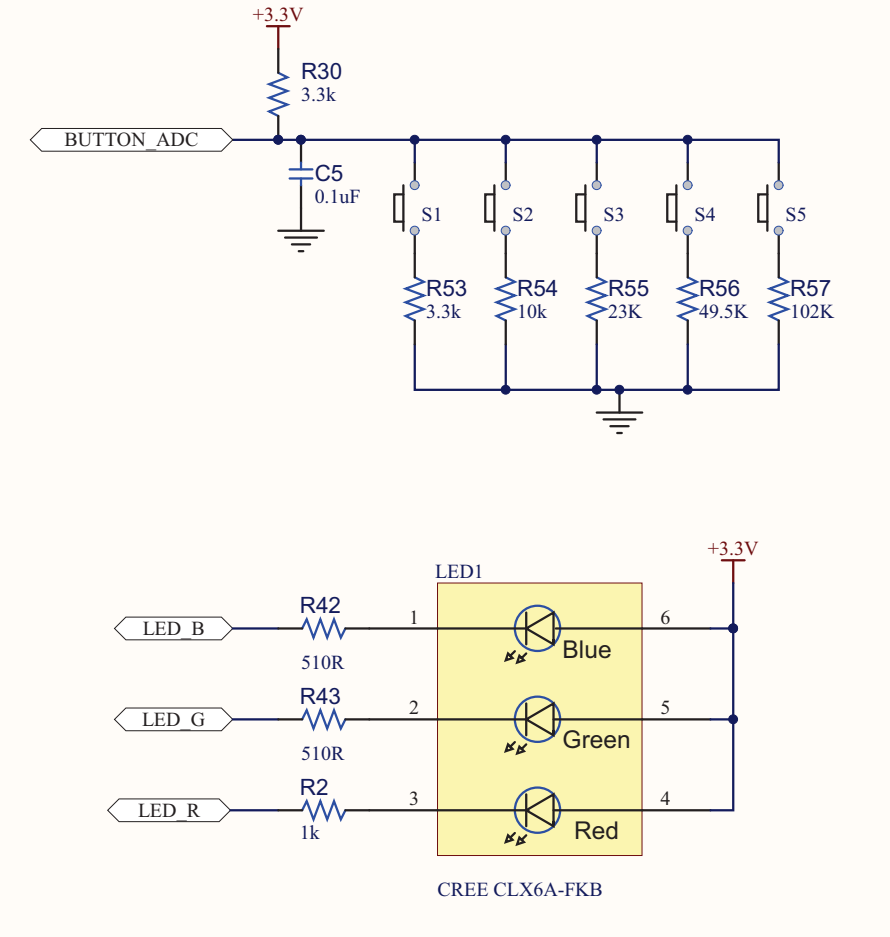


FIGURE A-10: USER SWITCHES AND LEDs



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FIGURE A-11: PIC32MX270F245D MICROCONTROLLER

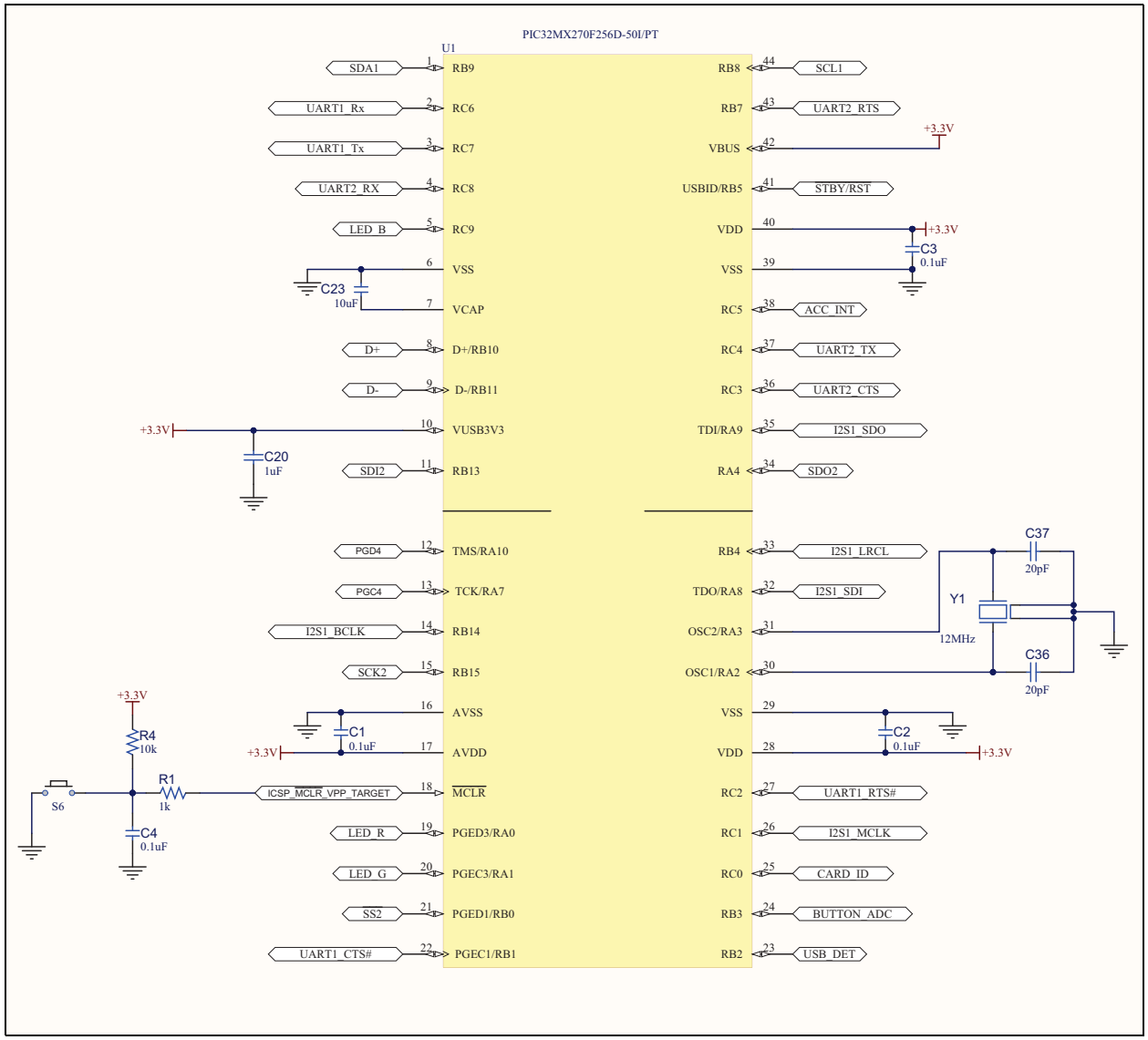
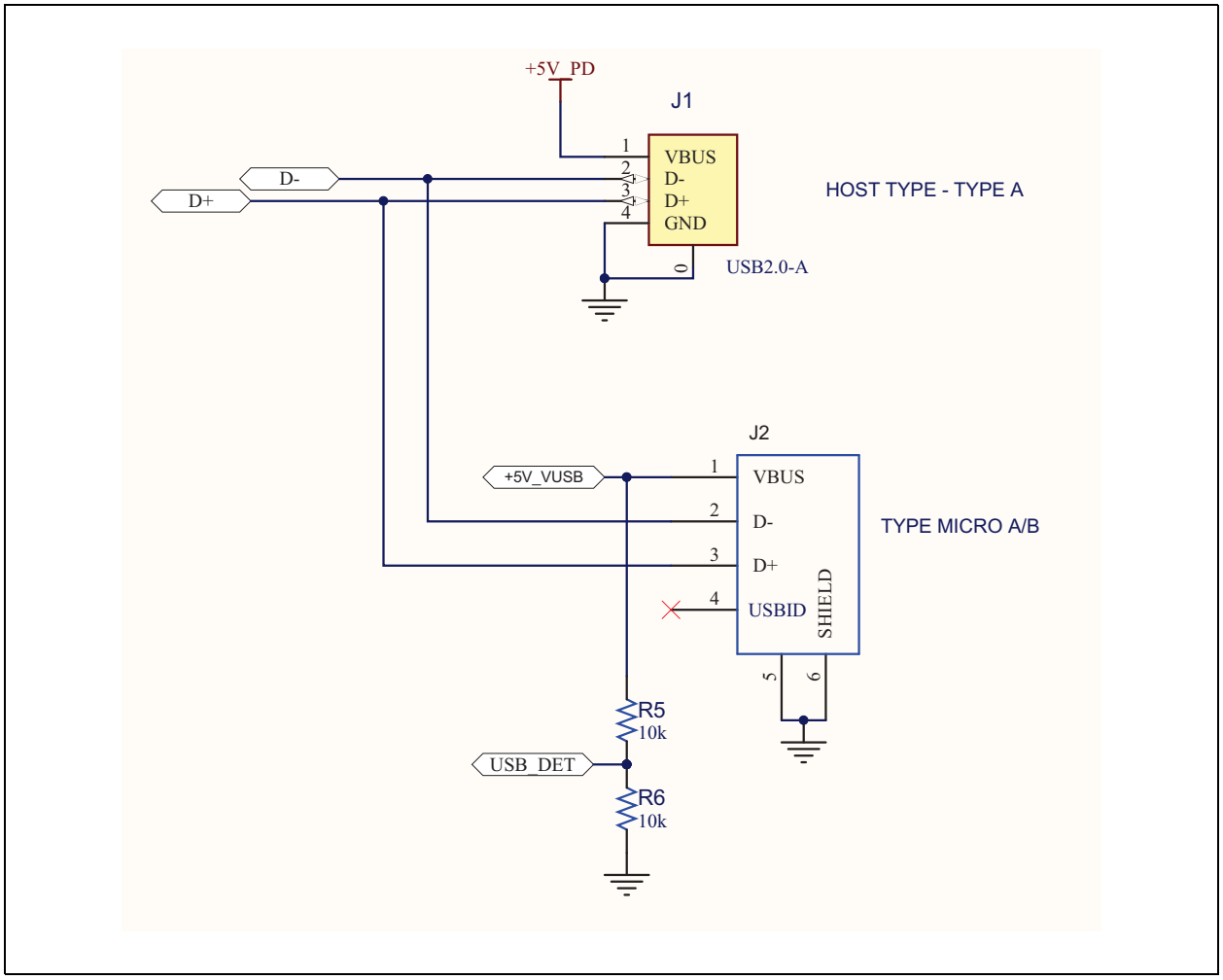


FIGURE A-12: USB CONNECTORS



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Appendix B. Bill of Materials

TABLE B-1: PIC32 BLUETOOTH STARTER KIT BILL OF MATERIALS

Designator	Description	Manufacturer	Part Number
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19	CAP CER .10 µF 50V X7R 0603	Panasonic	ECJ-1VB1C104K
C20, C21, C22	CAP CER 1 µF 16V 10% X7R SMD 0603	Taiyo	EMK107B7105KA-T
C23,C24, C25, C26	CAP CER 10 µF 16V 20% Y5V SMD 0805	Murata	GRM21BF51C106ZE15L
C27,C28, C29, C30, C31, C32, C33, C34	CAP CER 2.2 µF 16V 10% X5R SMD 0603	TDK	C1608X5R1C225K
C35	CAP CER 4.7 µF 10V 10% X5R SMD 0603	Taiyo	LMK107BJ475KA-T
C36, C37	CAP CER 20 pF 50V 5% C0G SMD 0603	Murata	GRM1885C1H200JA01D
C38, C39	CAP CER 8 pF 50V 0.5 pF C0G SMD 0603	TDK	C1608C0G1H080D
D1	DIODE SCHOTTKY 30V 100 mA SOD323	Diodes Inc.	SD107WS-7-F
D2, D3, D4	DIODE SCHOTTKY 20V 0.5A SOD123	Diodes Inc.	MBR0520L
D5, D6, D7	LED, SMD, GRN, 0603 package	Kingbright	APT1608SGC
J1	CON USB 2.0 STD-A Female TH R/A	FCI	87520-0010BLF
J2	CONN RCPT MICRO USB AB SMD R/A	Hirose Electric Co., Ltd.	ZX62-AB-5PA(11)
J3	CONN HEADER 20POS .100" DL TIN	Samtec	TSW-110-07-T-D
J4	Terminal Strip, 2 X 6, 0.100 sp, 0.025 sq. post	Samtec	TSW-106-07-F-D
J5	HDR_10POS DL .1" R/A TIN_APPLE_AUTH	Sullins	PPTC052LJBN-RC
J7	CONN RECEPT MINI USB2.0 5POS	Hirose Electric Co., Ltd.	UX60-MB-5ST
L1	15 µH +/-20%	Coilcraft	LPS3015-153ML
LED1	Cree CLX6A-FKB	Cree Inc.	CLX6A-FKB-CJNNRFJBB7A363
Q1	TRANS FET N-CH AO3424 30V 3.8A 1.4W SOT-23-3	Aplha & Omega	AO3424
Q2, Q4	TRANS BJT NPN MMBT3904 40V 200 mA 310 mW SOT-23-3	Diodes Inc.	MMBT3904-7-F
Q3	TRANS BJT PNP MMBT3906 -40V -200 mA 300 mW SOT-23-3	Diodes Inc.	MMBT3906-7-F
S1, S2, S3, S4, S5, S6	SWITCH TACTILE SPST-NO 0.05A 12V	C&K Component	PTS635SK25SMTR LFS
U3	3-AXIS ACCELEROMETER DIGITAL I/F	Bosch Sensortec	BMA250E
U4	Bluetooth HCI Radio Module	Flaircomm Microelectronics	BTM805CL2B
U9	IC SWITCH LOAD FULL FUNC SOT23-5	Fairchild	FPF2104
Y1, Y2	CRYSTAL 12 MHz 8 pF SMD NX3225SA	NDK	NX3225SA-12.000MHZ-STD-CSR-1
R1, R2, R3	RES TKF 1k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF1001V

Note: The hardware contains some components that enable modularity, testing, and integrated debugger circuits, which are not intended for volume production.

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

Designator	Description	Manufacturer	Part Number
R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R54	RES TKF 10k 1% 1/10W SMD 0603	Stackpole	RMCF0603FT10K0
R19, R20, R21	RES TF 100k 1% 1/8W SMD 0603	Vishay	MCT06030C1003FP500
R22, R23. R24, R25, R26, R27	RES TKF 330R 1% 1/16W SMD 0603	Stackpole	RMCF0603FT330R
R28, R29, R30, R53	RES TKF 3.3k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF3301V
R31, R32, R33, R34, R35, R36	RES TKF 0R 1/10W SMD 0603	Rohm	MCR03EZPJ000
R37, R38, R39	RES TKF 2.21k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF2211V
R40, R41	RES TKF 200k 1% 1/10W SMD 0603	Panasonic	RMCF0603FT200K
R42, R43	RES TKF 510R 1% 1/10W SMD 0603	Yageo	9C06031A5100FKPFT
R44, R45, R48	RES TKF 4.7k 1% 1/10W SMD 0603	Rohm	MCR03EZPFX4701
R46	RES TKF 0.5R 1% 1/4W SMD 0805	Stackpole	CSR0805FKR500
R47	RES TKF 30k 1% 1/10W SMD 0603	Stackpole	RMCF0603FT30K0
R49	RES TKF 3.16k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF3161V
R50	RES TKF 100R 1% 1/10W SMD 0603	Rohm	MCR03EZPFX1000
R51	RES TKF 3.92k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF3921V
R52	RES TKF 470R 1% 1/10W SMD 0603	Yageo	RC0603FR-07470RL
R55	RES TKF 23.2k 1% 1/10W SMD 0603	Stackpole	RMCF0603FT23K2
R56	RES TKF 49.9k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF4992V
R57	RES TKF 102k 1% 1/10W SMD 0603	Stackpole	RMCF0603FT102K
R63	RES TKF 100R 1% 1/4W SMD 1206	Yageo	RC1206FR-07100RL
U1	32-bit Microcontroller, 44-Pin TQFP	Microchip	PIC32MX270F256D-50I/PT
U2	MCP1650-E/MS_BOOST	Microchip	MCP1650S-E/MS
U5	IC Flash 16 Mbit 50 MHz 8-pin SOIC	SST	SST25VF016B-50-4C-S2AF
U6	IC PIC MCU Flash 256K 64-pin TQFP	Microchip	PIC24FJ256GB106-I/PT
U7	EEPROM SPI	Microchip	25LC256T-I/SN
U8	IC REG LDO 1.5A 3.3V 8-pin DFN	Microchip	MCP1727-3302E/MF

Note: The hardware contains some components that enable modularity, testing, and integrated debugger circuits, which are not intended for volume production.

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