EVB-USB5816 Evaluation Kit User's Guide

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our website (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 EVB-USB5816 Evaluation Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- The Microchip Website
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the EVB-USB5816 Evaluation Kit as a demonstration platform optimized for portable applications.The manual layout is as follows:

- **Chapter 1. "Overview"** – This chapter shows a brief description of the EVB-USB5816 Evaluation Kit.
- **Chapter 2. "Getting Started"** – This chapter provides information about setup and operation of the EVB-USB5816 Evaluation Kit.
- **Chapter 3. "Hardware Configuration"** – This chapter includes information about the hardware configuration of the EVB-USB5816 Evaluation Kit.
- **Appendix A. "Schematics"** – This appendix shows the EVB-USB5816 Evaluation Kit schematics.
- **Appendix B. "Bill of Materials"** – This appendix includes the EVB-USB5816 Evaluation Kit Bill of Materials (BOM).
- **Appendix C. "Silk Screens"** – This appendix includes the EVB-USB5816 Evaluation Kit silk screen.

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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
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
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) { ... }`

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- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLABCC compilers; all MPLAB assemblers (including MPASM™ assembler); all MPLAB linkers (including MPLINK™ object linker); and all MPLAB librarians (including MPLIB™ object librarian).
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB® REAL ICE and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit 3 debug express.
- **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 IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART Plus and PIC-kit 2 and 3.

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

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Technical support is available through the website at:
http://www.microchip.com/support

DOCUMENT REVISION HISTORY

Revisions	Section/Figure/Entry	Correction
DS50002948A (01-16-2020)	Initial release	

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Chapter 1. Overview

1.1 INTRODUCTION

The EVB-USB5816 Evaluation Kit is a demonstration and evaluation platform that provides the necessary requirements and interface options for evaluating the EVB-USB5816, a 6-port SuperSpeed (SS) USB SmartHub™ IC on a four-layer RoHS-compliant Printed Circuit Board (PCB). This allows users to gain an understanding of the product and accelerate the integration of the EVB-USB5816 into their design.

The EVB-USB5816 is compliant with the USB 2.0 Hi-Speed (HS), Full-Speed (FS), and Low-Speed (LS) USB signaling. The EVB-USB5816 is also compliant with USB 3.2 Gen1 on the upstream port and on downstream ports 1 to 5.

The evaluation platform supports six downstream ports: one USB3.1 Gen1 Type-C® port, four USB3.1 Gen1 ports and one USB2.0 port with Type-A connectors. The EVB-USB5816 platform also supports battery charging on all six downstream ports (maximum of 10A at any one time. See Note 1).

The EVB-USB5816 has two configurations for operation through internal default settings and supports custom configurations through the external 16-Mbit SPI Flash device.

The EVB-USB5816 demonstrates driver compatibility with Microsoft® Windows® 10, Windows 8.x, Windows 7, Windows XP, Mac OS® X 10.4+, and Linux® hub drivers.

For more information about EVB-USB5816, see **Section 1.2 "Features"**.

Note 1: Requires a 12V, 85W supply.

1.2 FEATURES

- Microchip's PortSwap, PHYBoost™, and VariSense™ technologies
- EVB-USB5816 in a 100-pin QFN RoHS-compliant package
- USB 3.2 compliant (Gen1 operation)
- USB 2.0 compliant (HS, FS, and LS operation)
- 5V-tolerant USB pins
- Self-powered operation
- USB Gen1 Type-B upstream port
- Six downstream USB ports:
  - Five Gen1 downstream ports (Port 1 is a Type-C port.)
  - One USB 2.0-only downstream port
- All downstream ports support individual port power and overcurrent sense.
- All downstream ports can be enabled for battery charging with the battery charging select switches on SW3 (BC1.2 or SE1, 2.1A maximum per port)
- Onboard SPI Flash for external downloadable firmware
- Operates from a single-voltage (+12.0V, regulated) external power supply
- Onboard 25 MHz crystal or oscillator input
- Single onboard +5.2V, 15A regulator
- Single onboard +3.3V, 0.5A regulator

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- Single onboard +1.2V, 2A regulator
- Port Power LED indicators
- SPI Flash activity blue LED indicator
- Reset red LED indicator
- Green LED indicators for 5V, 3.3V, and 1.2V regulator outputs
- Terminal block connector for use with an external 12 VDC bench supply
- Barrel connector for use with a Microchip 12V power supply
- Removable or non-removable downstream ports options can be configured with select switches on SW4.
- Bridge peripheral functions:
  - USB-to-I^2C

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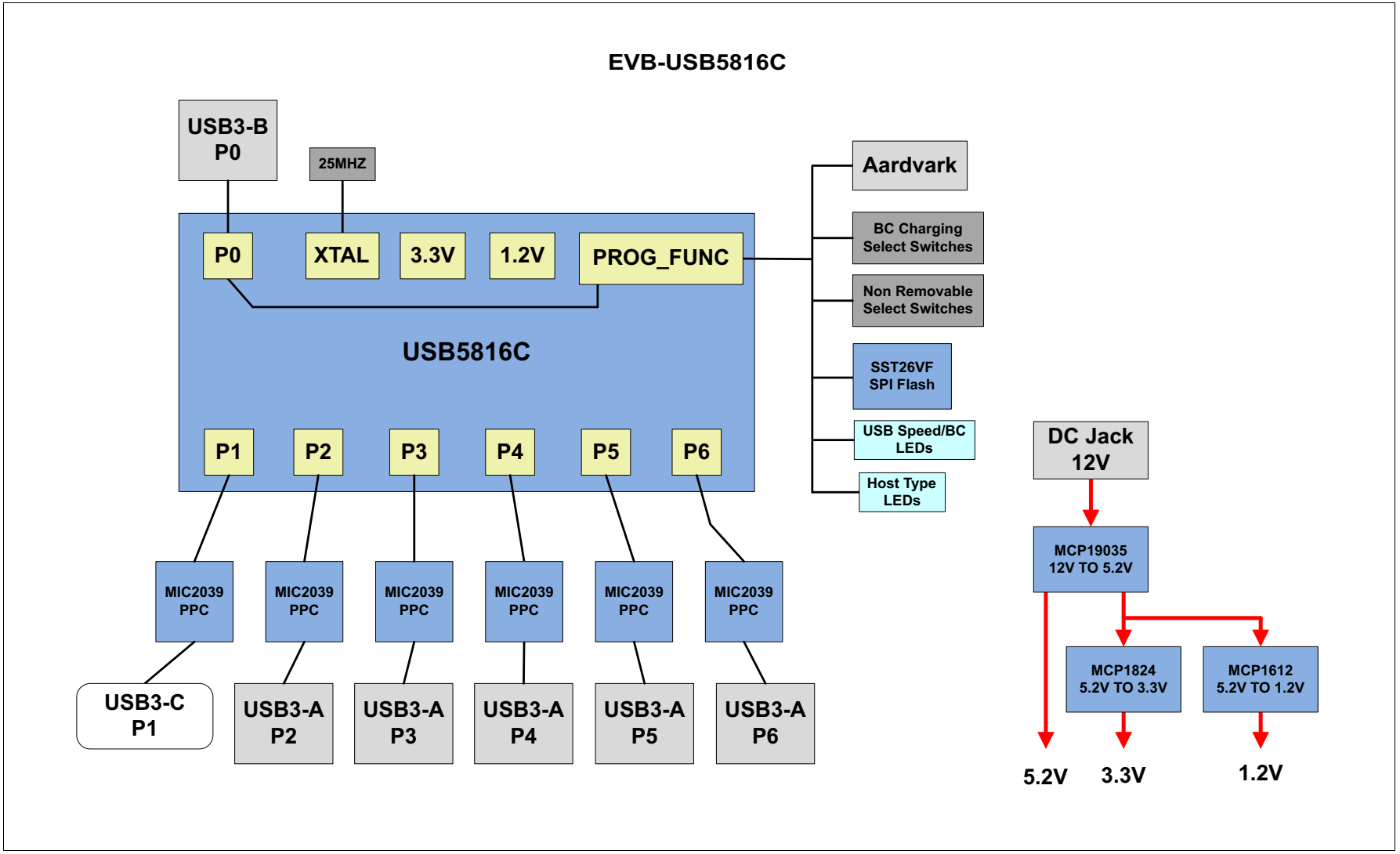
1.3 BLOCK DIAGRAM

FIGURE 1-1: BLOCK DIAGRAM



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1.4 REFERENCES

Concepts and materials available in the following documents may be helpful when reading this document. Visit www.microchip.com for the latest documentation.

- *AN2316 Configuration Options for the USB58xx and USB59xx*
- *USB5816 6-Port USB 3.1 Gen 1 Smart Hub w/Support for a Single USB Type-C DFP Data Sheet*
- *USB58xx/USB59xx Silicon Errata and Data Sheet Clarification*
- *AN1998 USB to I^2C Bridging with Microchip USB 3.1 Gen 1 Hubs Application Note*
- *MPLAB® Connect Configurator GUI User's Guide*
- *MPLAB® Connect Configurator CLI User's Guide*

1.5 ACRONYMS AND DEFINITIONS

TABLE 1-1: ACRONYMS AND DEFINITIONS

Acronym	Definition
BC1.2	The latest USB-IF specified USB battery charging standard
CDP	Charging Downstream Port, a BC1.2-compliant port that allows simultaneous USB data and USB charging
DCP	Dedicated Charging Port, a BC1.2-compliant port which is only capable of USB charging (no data)
DFP	Downstream Facing Port
EVB	Evaluation Board
OTP	One-Time-Programmable Memory
SDP	Standard Downstream Port, a standard USB port with no high-current battery charging capabilities
SE1	A type of Battery Charging (non-USB compliant) which sets both the USB D+/D– to logical high state (a.k.a. "SE1" or "Single-Ended 1" state) to communicate a charging capability
Type-C	Reversible USB Connector
USB-IF	USB Integrators Forum, a collection of corporate sponsored members responsible for developing USB specifications
Gen1	USB Specification 3.1 Gen1

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Chapter 2. Getting Started

2.1 INTRODUCTION

The Microchip EVB-USB5816 Evaluation Kit is designed for flexible configuration solutions. It can be configured via default internal register settings, via a downloadable external firmware to an onboard SPI Flash (OTP memory), via SMBus, or via the onboard configuration switches. When configured with the default internal register settings, the device operates as a USB 3.1 Gen1 hub with one upstream Gen1 port, five downstream Gen1 ports, and one downstream USB 2.0 port, with Microchip's standard VID/PID/DID settings.

Microchip provides a comprehensive software programming tool, MPLAB® Connect Configurator (MPLABCC), for configuring EVB-USB5816 functions, registers, and OTP memory. EVB-USB5816 requires MPLABCC version 2.1.0 or greater.

For additional information on the MPLABCC programming tool, refer to Software Libraries within the Microchip EVB-USB5816 product page at www.microchip.com/USB5816.

2.2 KIT CONTENTS

The EVB-USB5816 Evaluation Kit includes the basic equipment necessary for evaluation. The items included in the kit are:

- EVB-USB5816 Evaluation Board
- Type-A to Type-B USB cable

2.3 QUICK START

Perform the following steps to quickly start using the board:

1. Connect a 12V power supply to the barrel connector (J4) or the terminal block (J3) on the EVB-USB5816.
2. Using a Type-A to Type-B USB cable, connect the EVB-USB5816 to a USB host via the upstream "Port 0" USB Type-B receptacle (J7).
3. Devices may now be connected to any of the downstream ports to enumerate and use those devices with the USB host.
4. To perform additional configuration or evaluate specific features, launch the MPLABCC software on your USB host or manipulate the included hardware configuration options detailed in the next sections.

NOTES:

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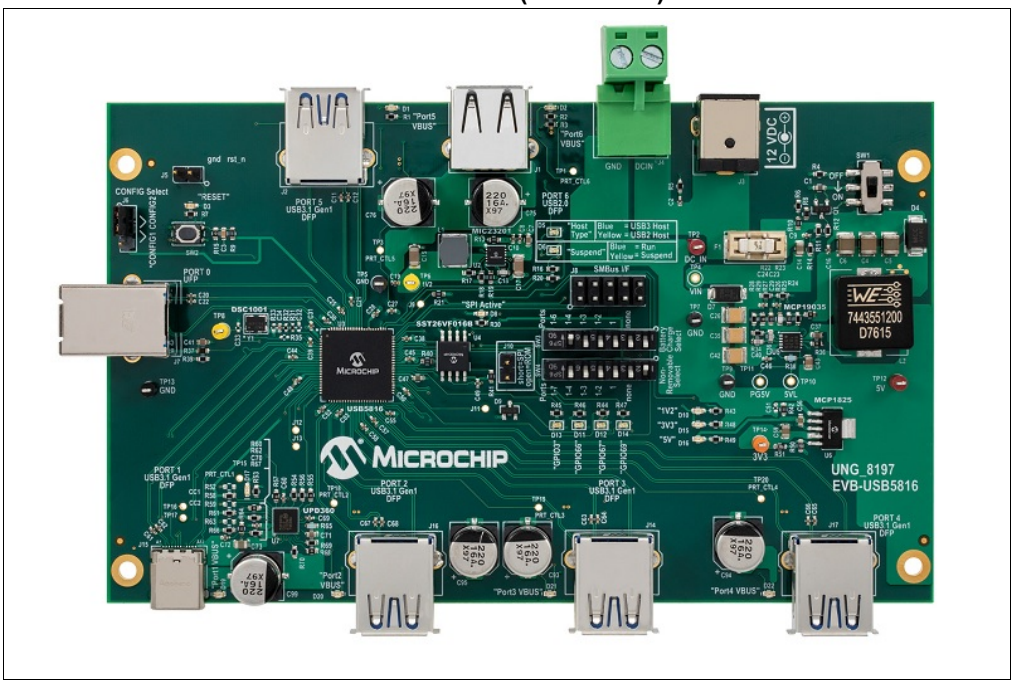
Chapter 3. Hardware Configuration

3.1 HARDWARE CONFIGURATION OPTIONS

Figure 3-1 shows the top view of the EVB-USB5816.

FIGURE 3-1: EVB-USB5816 REV B (TOP VIEW)



3.1.1 Configuration

3.1.1.1 EXTERNAL SPI FLASH

Upon power-up, the EVB-USB5816 first searches an external SPI Flash device and a valid signature in the Firmware image. If a valid firmware image is found, the code execution is initiated from the external SPI Flash device.

To enable operation from the SPI device, install shunts to pins 1 and 2 of J6. When code is executing from an SPI ROM device, a blue LED "SPI-ACTIVE" (D8) illuminates.

Note 1:	CFG_BC and CFG_Non-Rem options are deselected when the SPI shunt is installed on J6. When operating in SPI mode, all configuration is handled by the code executing from the SPI ROM device.
2:	If the SPI Flash is not properly programmed or has an invalid signature, the USB5816 reverts to internal defaults even if the SPI ROM is selected.

3.1.1.2 SMBUS

If an SPI Flash device is not found, the firmware checks if SMBus is enabled.

To select SMBus configuration, select OPTION2 from the CFG_STRAP header, shunt pins 1-2 of J6. The SMBus signals may be accessed at J8, where pin 1 is the clock and pin 3 is data (pin 2 is ground).

If configuration OPTION2 is selected, and SMBus is enabled (i.e., SMBusclock and data are pulled up), the EVB-USB5816 waits indefinitely for data from the SMBus interface and will not enumerate to the USB host until the special USB Attach command is sent.

See the *AN2316 Configuration Options for the USB58xx and USB59xx* for additional details.

3.1.1.3 INTERNAL DEFAULT CONFIGURATIONS WITH STRAPPING OPTIONS

When the EVB-USB5816 does not detect a valid SPI Flash image and does not look for SMBus configuration upon power-up, the EVB-USB5816 uses internal default register settings. It also sets the Vendor ID, Product ID, Language ID, and Device ID, and additional settings from the internal ROM code.

If configuration is not done through SPI or SMBus, additional configuration is available through two functions: CFG_BC_EN and CFG_NON-REM. The controls are configured by selecting one of the six resistor values for each pin. The EVB-USB5816 demonstrates two of the six possible resistor values for each of CFG_BC_EN and CFG_NON-REM. These straps are sensed by the EVB-USB5816 device at power-on to determine the resultant configuration of the device.

To select the CFG_BC_EN and CFG_NON-REM modes, switches must be set on SW3 and SW4.

To use the battery charging strap options or the NON_REM strap options, refer to the strap select table on schematic page 2. (see Figure A-2.)

3.1.2 Power Source – Self Powered

The EVB-USB5816 only supports self-powered operation. Power is supplied through one +12.0V regulated external power supply. The power supply is connected to the 2.5 mm connector J1 on the board. Alternatively, an external voltage can be supplied to the screw terminal "12V" (J2). The +12.0V feeds a 15A regulator that outputs +5.2V (nominal) across the board and also supplies the +3.3V regulator and the 1.2V regulator.

CAUTION

The supplied 12.0V external power supply cannot support simultaneous battery charging on all downstream ports. Use a higher power supply if the required test use case exceeds the power capability of the supply. Failure to heed to this warning could result in damage to the 12.0V external power supply.

3.1.3 Downstream Port Power Control

USB power to the four downstream ports is controlled via port power controllers with auto-discharge functionality. All downstream ports support BC 1.2 battery charging.

The downstream USB Type-C® port is capable of up to 3A of current at 5V. The remaining five downstream USB Type-A ports are capable of up to 2.1A at 5V.

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3.1.4 USB Type-C® Port

The EVB-USB5816 has a single USB3.1 Gen 1 PHY for Type-C support. This eliminates the need for an external multiplexer. The EVB-USB5816 also features integrated Type-C control signal (CC) detection to determine when and in what orientation a USB Type-C® attach has been made. It powers only the USB3.1 Gen 1 PHY needed for USB communication. To reduce power, the EVB-USB5816 powers down unused USB3.1 Gen 1 PHYs. In the case where no USB Type-C attach is detected, the USB3.1 Gen 1 PHY associated with that port is powered down.

3.1.5 LED Indicators

Table 3-1 describes the LED indicators on the EVB-USB5816 Evaluation Kit.

TABLE 3-1: EVB-USB5816 LED INDICATORS

Ref. Des.	Label	Description
D1	VBUS5	Illuminates when 5V to upstream PORT5 VBUS is present
D2	VBUS6	Illuminates when 5V to upstream PORT6 VBUS is present
D3	RESET	The RST_N signal is asserted.
D5	Host Type	Indicates Host Type: - Yellow = USB2 Host - Blue = USB3 Host
D6	SUSPEND	Suspend Indicator: - Yellow = Run - Blue = Suspend
D8	SPI-ACTIVE	Indicates SPI Flash Memory activity
D10	1V2	Illuminates when 1.2V is present from the 3.3V voltage regulator
D11	GPIO66	GPIO66 Indicator: - Yellow = Output Low - Blue = Output High - Off = Input (Hi-Z)
D12	GPIO67	GPIO67 Indicator: - Yellow = Output Low - Blue = Output High - Off = Input (Hi-Z)
D13	GPIO3	GPIO3 Indicator: - Yellow = Output Low - Blue = Output High - Off = Input (Hi-Z)
D14	GPIO69	GPIO69 Indicator: - Yellow = Output Low - Blue = Output High - Off = Input (Hi-Z)
D15	3V3	Illuminates when 3.3V is present from the 3.3V voltage regulator
D16	5V	Illuminates when 5V is present from the 3.3V voltage regulator
D19	VBUS1	Illuminates when 5V to upstream PORT1 VBUS is present
D20	VBUS2	Illuminates when 5V to upstream PORT2 VBUS is present
D21	VBUS3	Illuminates when 5V to upstream PORT3 VBUS is present
D22	VBUS4	Illuminates when 5V to upstream PORT4 VBUS is present

3.1.6 Switches

Table 3-2 describes the switches on the EVB-USB5816.

TABLE 3-2: EVB-USB5816 SWITCH DESCRIPTIONS

Ref. Des.	Label	Description
SW1	ON/OFF	Connects or disconnects the 12 VDC supply
SW2	RESET	Momentary push-button switch to assert RST_N

3.1.7 Connector Descriptions

Table 3-3 describes the connectors included on the PCB.

TABLE 3-3: EVB-USB5816 CONNECTOR DESCRIPTIONS

Ref. Des.	Type	Label	Description
J1	USB Type-A Connector	PORT6	Downstream Type-A USB 2.0 Port 6 USB connection
J2	USB Type-A Connector	PORT5	Downstream Type-A Gen1 Port 5 USB connection
J3	Barrel Jack	12VDC	12 VDC supply connection (center pin positive)
J4	2-pin terminal block	—	Alternative 12 VDC supply connection. Pin 1 is positive.
J5	2x1 Header	Ext.Reset	Connection for an external reset switch
J6	1x3 Header	CONGFIG SELECT	Configuration Select: - 1–2 = CONFIG2 - 2–3 = CONFIG1 - No Shunt = Not Allowed
J7	USB Type-B Connector	PORT0	Upstream Type-B Gen1 connection
J8	2x5 Header	Aardvark	SMBus Interface Header
J10	1x2 Header	—	Default = DNP (PROG_FUNC) - [1-2] = SPI Flash
J14	USB Type-A Connector	PORT3	Downstream Type-A Gen1 Port 3 USB connection
J15	USB Type-C® Connector	PORT1	Downstream Type-C Gen1 Port 1 USB connection
J16	USB Type-A Connector	PORT2	Downstream Type-A Gen1 Port 2 USB connection
J17	USB Type-A Connector	PORT4	Downstream Type-A Gen1 Port 4 USB connection
J18	Terminal Plug	—	Populated at Final Assembly

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3.1.8 Test Points

Table 3-4 describes the test points on the EVB-USB5816. A header may be permanently installed on the through-hole test points if needed.

TABLE 3-4: EVB-USB5816 TEST POINT DESCRIPTIONS

Ref. Des.	Type	Description
TP1	Test Pad	PRTCTL6
TP2	Test Pad	12V
TP3	Test Pad	PRTCTL5
TP4	Test Pad	12V
TP5	Test Loop (Black)	Ground
TP6	Test Loop (Yellow)	VCORE
TP7	Test Loop (Black)	Ground
TP8	Test Loop (Yellow)	STBY#
TP9	Test Loop (Black)	Ground
TP10	Test Loop (Red)	5VL
TP11	Test Loop (Blue)	PG5L
TP12	Test Loop (Red)	5V
TP13	Test Loop (Black)	Ground
TP14	Test Loop (Orange)	3V3
TP15	Test Pad	PRTCTL1
TP16	Test Pad	CC1 Port 1
TP17	Test Pad	CC2 Port 1
TP18	Test Pad	PRTCTL2
TP19	Test Pad	PRTCTL3
TP20	Test Pad	PRTCTL4

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NOTES:

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Appendix A. Schematics

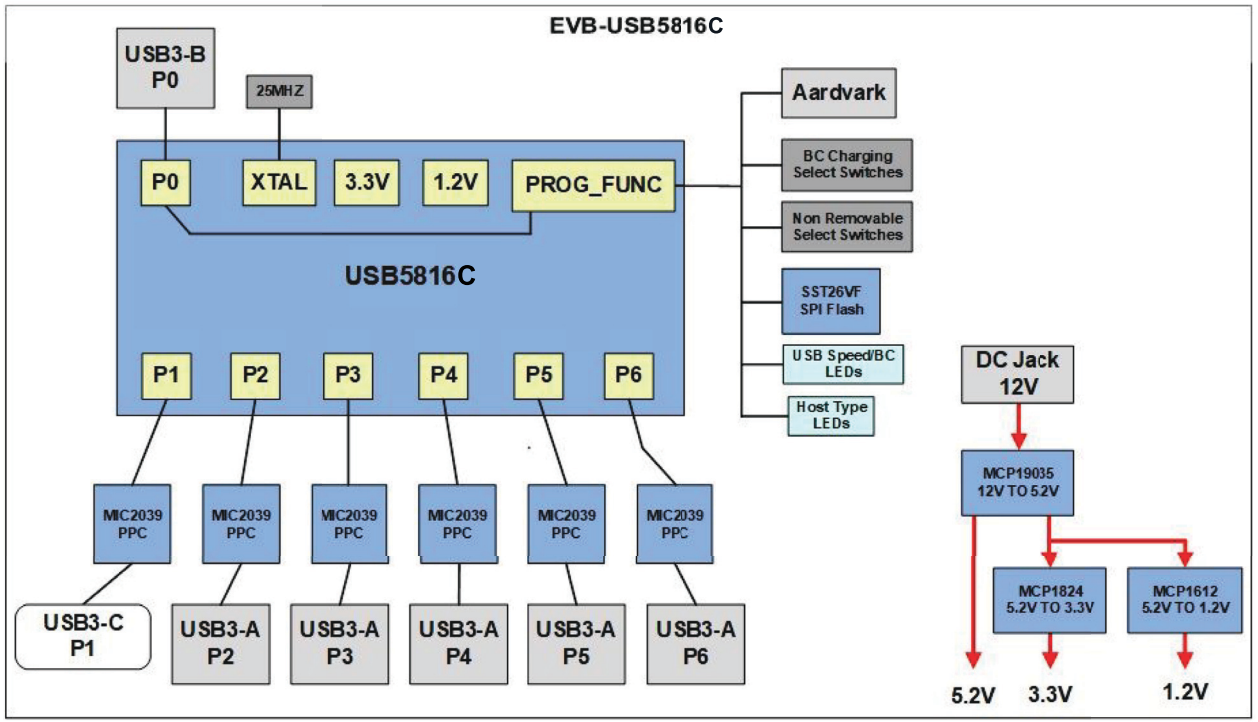
A.1 INTRODUCTION

This appendix shows the EVB-USB5816 Evaluation Kit schematics.

FIGURE A-1: EVB-USB5816 SCHEMATIC 1

Table of Contents	
Sheet	Description
1	Table of Contents, Revision History, Block Diagram
2	USB58016, SST26VF SPI Flash
3	USB Type-C Downstream Port 1
4	USB Type-A Downstream Ports 2-6
5	DC Regulators

Revision History			
Revision	Date	Revision Summary	Author
A	11/7/2018	Initial Schematic for Review	A. Rogers
1.0	6/7/2019	Minor Reworks based on Compliance Test Results	M. Davis
1.1	1/7/2020	Minor Schematic Changes to reflect Silicon Revision C	M. Davis



LABEL1
02- -R1
JIT
LABEL Need Help Small

Drawn By: Mick Davis
Engineer: Mick Davis
PartNumber: EVB-USB5816
Project Title: EVB-USB5816C
Variant: [No Variations]
Sheet Title: Table of Contents, Revision History, Block Diagram
Size: Tabloid
Scl #:03-10988
Revision: 2.1
Date: 1/7/2020 1:53:15 PM
Sheet 1 of 5
File: 1-TOC.SchDoc
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FIGURE A-2: EVB-USB5816 SCHEMATIC 2

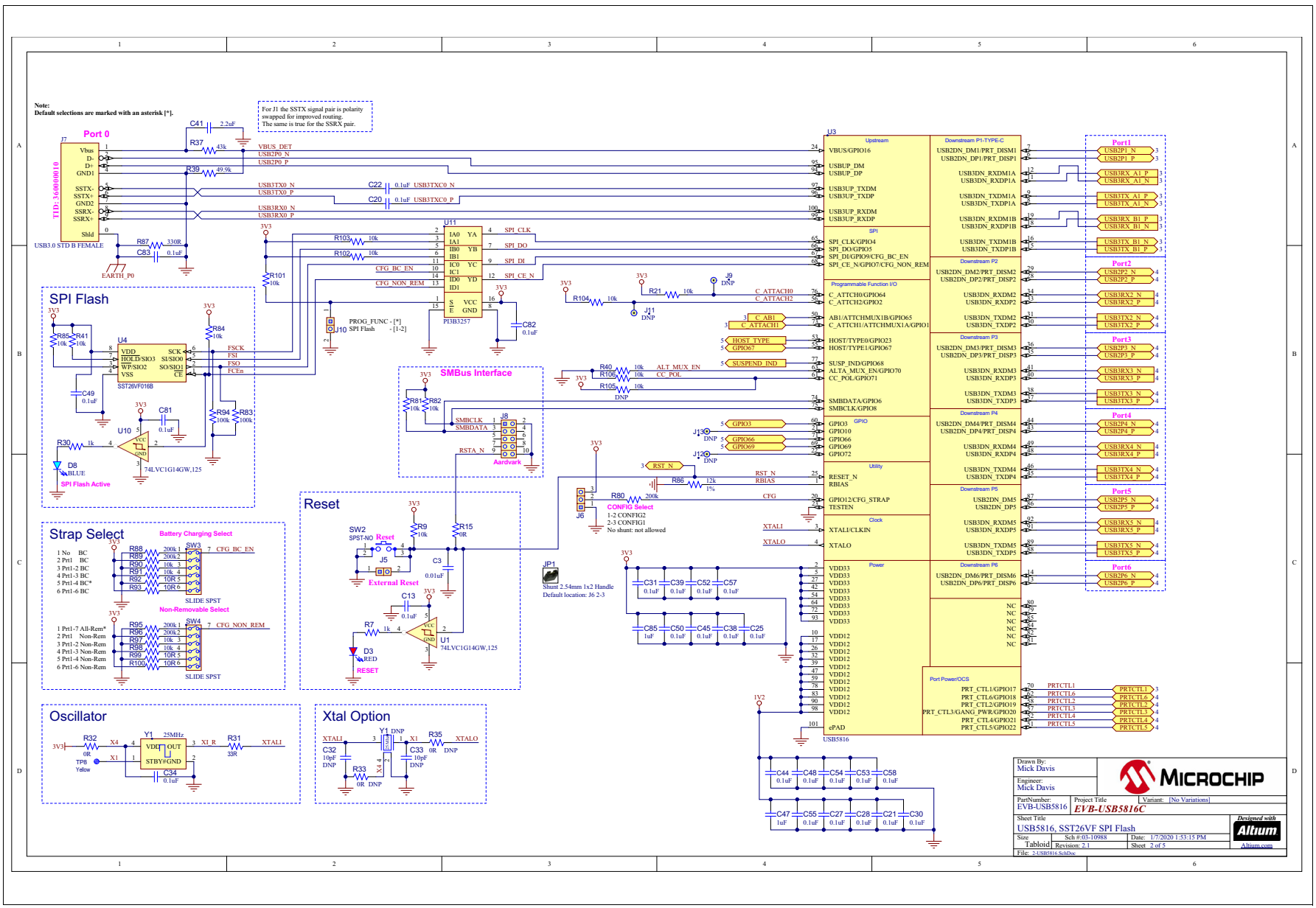

FIGURE A-3: EVB-USB5816 SCHEMATIC 3

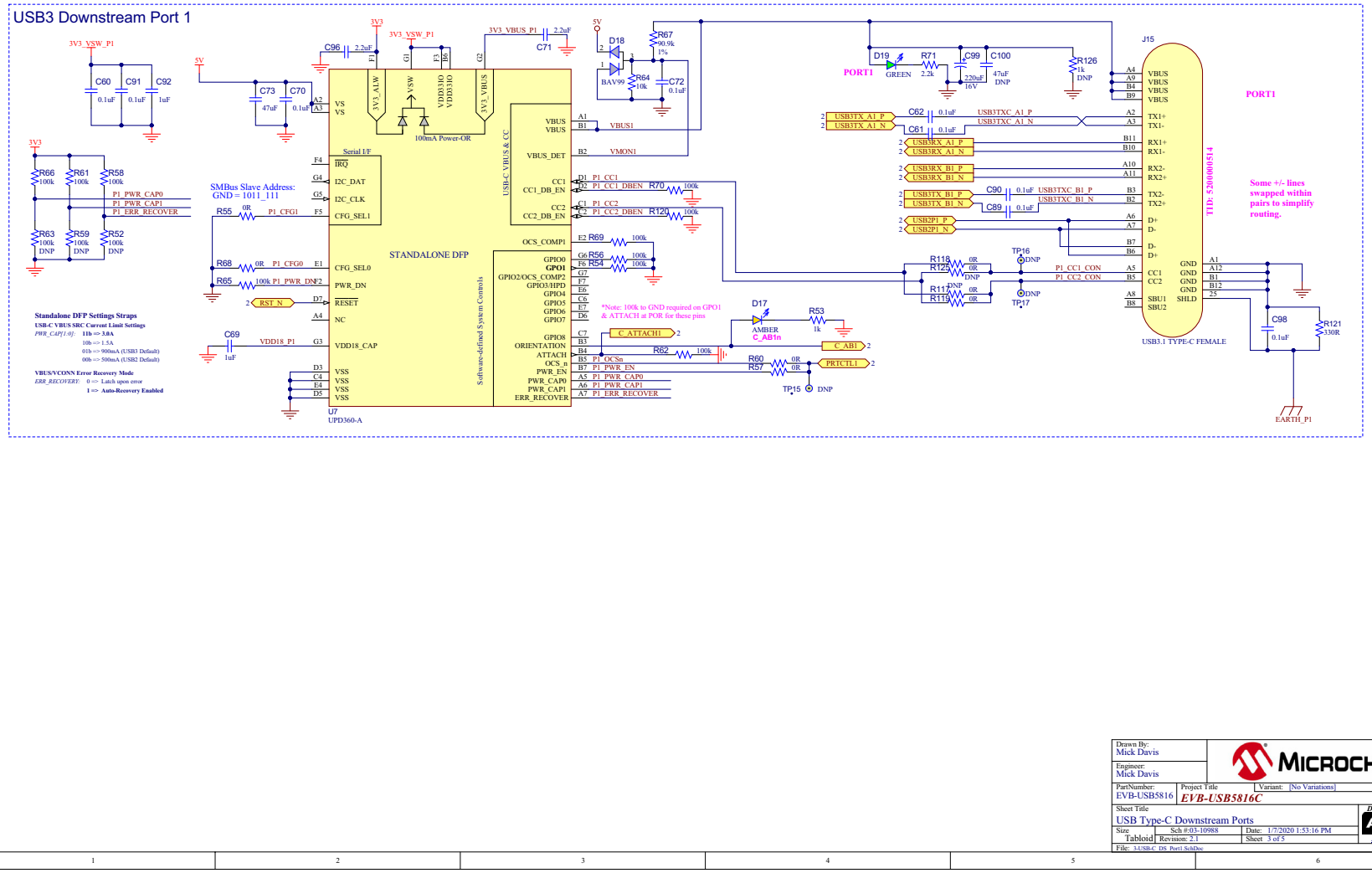

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FIGURE A-4: EVB-USB5816 SCHEMATIC 4

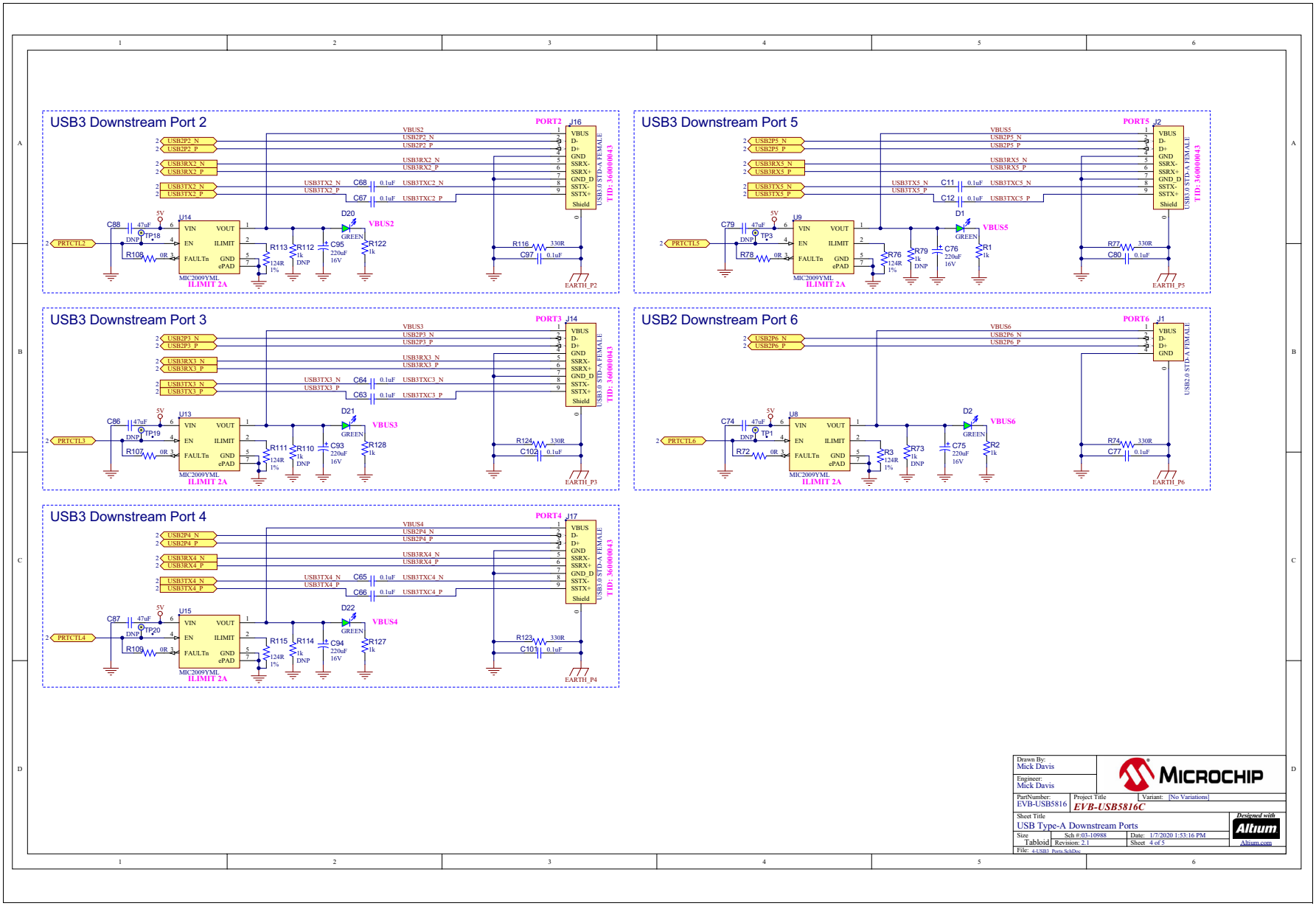
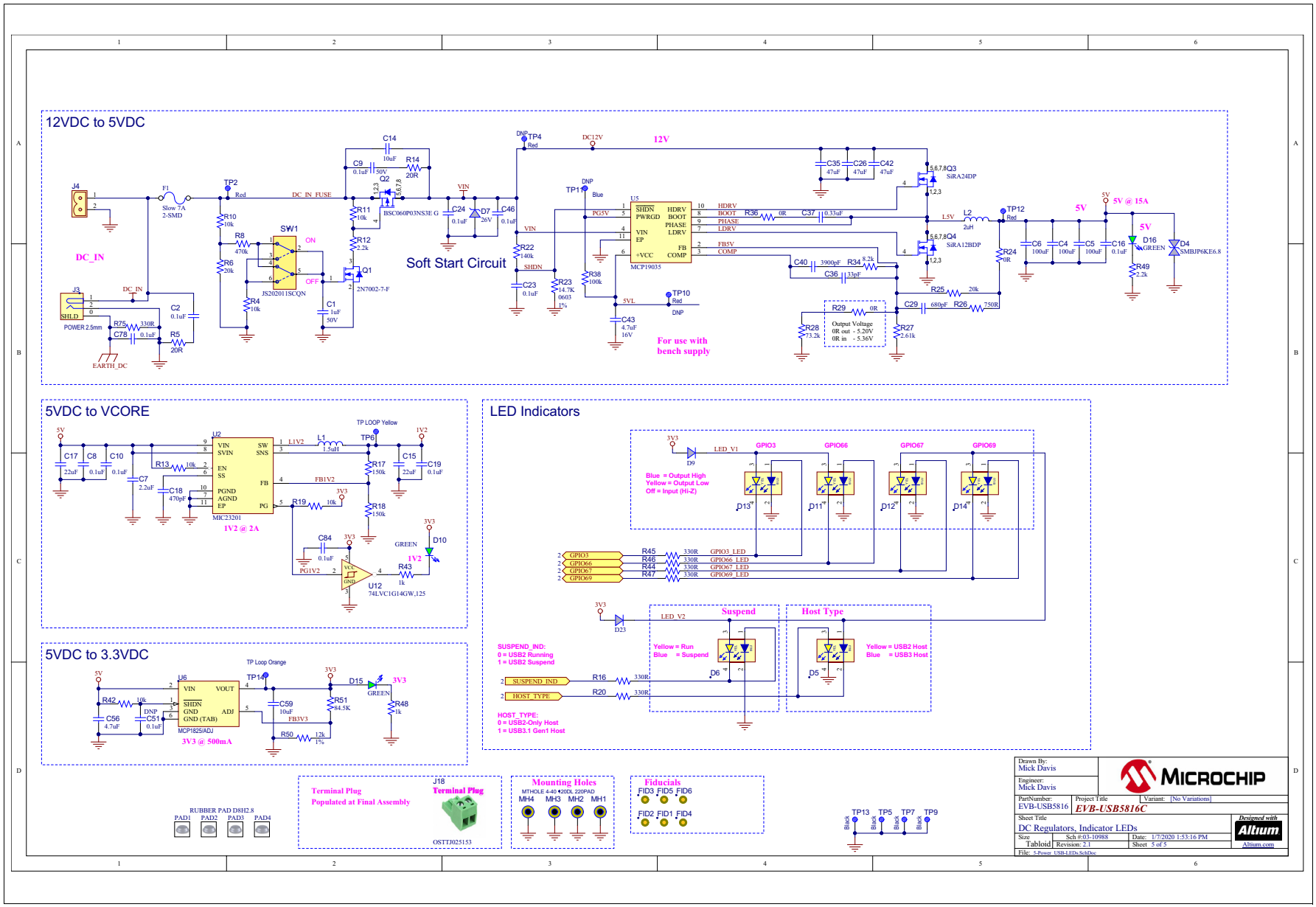


FIGURE A-5: EVB-USB5816 SCHEMATIC 5



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Appendix B. Bill of Materials

B.1 INTRODUCTION

This appendix contains the EVB-USB5816 Bill of Materials (BOM).

TABLE B-1: EVB-USB5816 BILL OF MATERIALS

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
1	1	C1	CAP CER 1 µF 50V 10% X5R SMD 0603	Yes	Taiyo Yuden	LMK107BJ105KA-T
2	52	C2, C8, C10, C11, C12, C13, C16, C19, C20, C21, C22, C23, C25, C27, C28, C30, C31, C38, C39, C44, C45, C48, C49, C50, C52, C53, C54, C55, C57, C58, C61, C62, C63, C64, C65, C66, C67, C68, C72, C77, C78, C80, C81, C82, C83, C84, C89, C90, C97, C98, C101, C102	CAP CER 0.1 µF 16V 10% X7R SMD 0402	Yes	Murata	GRM155R71C104KA88D
3	1	C3	CAP CER 0.01 µF 50V 20% X7R SMD 0603	Yes	KEMET	C0603C103M5RAC
4	3	C4, C5, C6	CAP CER 100 µF 10V 20% X5R SMD 1210	Yes	Taiyo Yuden	LMK325BJ107MM-T
5	4	C7, C41, C71, C96	CAP CER 2.2 µF 10V 10% X7R SMD 0603	Yes	Murata	GRM188R71A225KE15D
6	4	C9, C24, C34, C46	CAP CER 0.1 µF 50V 10% X7R SMD 0402	Yes	TDK Corporation	C1005X7R1H104K050BB
7	1	C14	CAP CER 10 µF 16V 10% X5R SMD 0805	Yes	Wurth Electronics Inc	885012107014
8	2	C15, C17	CAP CER 22 µF 10V 10% X7R SMD 1206	Yes	Samsung Electro-Mechanics America, Inc	CL31B226KPHNNNE
9	1	C18	CAP CER 470 pF 25V 5% NP0 SMD 0603	Yes	AVX	06033A471JAT2A
10	3	C26, C35, C42	CAP CER 47 µF 16V 20% X5R SMD 1210	Yes	Yageo	CC1210MKX5R7BB476
11	1	C29	CAP CER 680 pF 50V 5% NP0 SMD 0603	Yes	Panasonic	ECJ-1VC1H681J
12	2	C32, C33	CAP CER 10 pF 50V 5% NP0 SMD 0402	DNP	Murata	GRM1555C1H100JZ01D
13	1	C36	CAP CER 33 pF 50V 5% NP0 SMD 0603	Yes	Cal-Chip	GMC10CG330J50NTLF
14	1	C37	CAP CER 0.33 µF 16V 10% X7R SMD 0603	Yes	Murata	GRM188R71C334KA01D
15	1	C40	CAP CER 3900 pF 50V 5% C0G SMD 0603	Yes	TDK	C1608C0G1H392J080AA
16	1	C43	CAP CER 4.7 µF 16V 20% Y5V SMD 0805	Yes	Panasonic	ECJ-2FF1C475Z
17	2	C47, C85	CAP CER 1 µF 6.3V 10% X5R SMD 0603	Yes	Panasonic	ECJ-1VB0J105K
18	1	C51	CAP CER 0.1 µF 16V 10% X7R SMD 0402	DNP	Murata	GRM155R71C104KA88D
19	1	C56	CAP CER 4.7 µF 10V 10% X5R SMD 0603	Yes	Taiyo Yuden	LMK107BJ475KA-T
20	1	C59	CAP CER 10 µF 16V 10% X5R SMD 0805	Yes	Murata	GRM21BR61C106KE15L
21	3	C60, C70, C91	CAP CER 0.1 µF 35V 20% X7R SMD 0402	Yes	TDK Corporation	CGA2B3X7R1V104M050BB
22	2	C69, C92	CAP CER 1 µF 10V 10% X5R SMD 0402	Yes	Murata Electronics North America	GRM155R61A105KE15D
23	1	C73	CAP CER 47 µF 6.3V 20% X5R SMD 0805	Yes	Taiyo Yuden	JMK212BJ476MG-T
24	5	C74, C79, C86, C87, C88	CAP CER 47 µF 16V 10% X5R SMD 1210	Yes	Murata Electronics North America	GRM32ER61C476KE15K
25	6	C75, C76, C93, C94, C95, C99	CAP ALU 220 µF 16V 20% SMD E	Yes	Panasonic	EEE-1CA221UP
26	1	C100	CAP CER 47 µF 16V 20% X5R SMD 1210	DNP	Yageo	CC1210MKX5R7BB476
27	9	D1, D2, D10, D15, D16, D19, D20, D21, D22	DIO LED GREEN 2V 30 mA 35 mcd Clear SMD 0603	Yes	Lite-On	LTST-C190KGKT

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TABLE B-1: EVB-USB5816 BILL OF MATERIALS (CONTINUED)

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
28	1	D3	DIO LED RED 2V 30 mA 2 mcd Clear SMD 0603	Yes	Lite-On	LTST-C190EKT
29	1	D4	DIO TVS SMBJP6KE6.8CA 5.8V 600W DO-214AA_SMB	Yes	Micro Commercial Co	SMBJP6KE6.8CA-TP
30	6	D5, D6, D11, D12, D13, D14	DIO LED BI BLUE, YELLOW 3.3V, 2.0V 20 mA SMD 0603	Yes	Kingbright	APHB1608QBDSYKC
31	1	D7	DIO TVS SMAJ26A 26V 400W DO-214AC_SMA	Yes	Littlefuse	SMAJ26A
32	1	D8	DIO LED BLUE 2.8V 20 mA 15 mcd Clear SMD 0603	Yes	Lite-On	LTST-C193TBKT-5A
33	2	D9, D23	DIO RECT MMBD914-7-F 1.25V 200 mA 75V SMD SOT-23-3	Yes	Diodes Incorporated	MMBD914-7-F
34	1	D17	DIO LED AMBER 2.1V 25 mA 2 mcd Clear SMD 0603	Yes	Lite-On Inc.	LTST-C190AKT
35	1	D18	DIO RECTARR BAV99 1.25V 200 mA 70V SOT-23-3	Yes	Fairchild	BAV99
36	1	F1	RES FUSE 7A 72 VAC 60V DC SLOW 2-SMD	Yes	Littelfuse Inc.	0154007.DRT
37	1	J1	CON USB2.0 STD-A FEMALE TH R/A	Yes	TE Connectivity AMP Connectors	292303-1
38	4	J2, J14, J16, J17	CON USB3.0 STD-A FEMALE TH R/A	Yes	Wurth Electronics Inc	692121030100
39	1	J3	CON POWER 2.5 mm 5.5 mm TH R/A	Yes	CUI Inc.	PJ-063BH
40	1	J4	CON TERMINAL 5.08 mm 1X2 Male 20A TH RA	Yes	On Shore Technology Inc.	OSTOQ025451
41	2	J5, J10	CON HDR-2.54 Male 1x2 Gold 5.84 MH TH VERT	Yes	FCI	77311-118-02LF
42	1	J6	CON HDR-2.54 Male 1x3 Gold 5.84 MH TH VERT	Yes	FCI	68000-103HLF
43	1	J7	CON USB3.0 STD-B FEMALE TH R/A	Yes	Advanced-Connectek Inc.	TBR20-9B6300
44	1	J8	CON HDR-2.54 Male 2x5 Tin 5.84 MH TH VERT	Yes	Sullins	PEC05DAAN
45	12	J9, J11, J12, J13, TP1, TP3, TP15, TP16, TP17, TP18, TP19, TP20	TEST Pad, PIN sized, 51pad, 36 FHS	DNP		
46	1	J15	CON USB3.1 TID TYPE-C Female SMD R/A	Yes	Amphenol Commercial Products	12401610E4#2A
47	1	J18	MECH HW CON TERM BLOCK 1X2 MALE	Yes	On Shore Technology Inc.	OSTTJ025153
48	1	L1	INDUCTOR 1.5 µH 3A 20% SMD L5W5H2.2	Yes	Murata Electronics North America	LQH5BPN1R5NT0L
49	1	L2	INDUCTOR 2 µH 23A 20% SMD L12.8W12.8H6.2	Yes	Wurth Electronics Inc.	7443551200
50	1	LABEL1	LABEL, ASSY W/REV LEVEL (SMALL MODULES) PER MTS-0002	MECH		
51	1	Q1	TRANS FET N-CH 2N7002-7-F 60V 170 mA 370 mW SOT-23-3	Yes	Diodes Inc	2N7002-7-F
52	1	Q2	TRANS FET P-CH BSC060P03NS3E G -30V -100A 83W PG-TDSON-8	Yes	Infineon Technologies	BSC060P03NS3EGATMA1
53	1	Q3	MCHP ANALOG MOSFET N-CH 25V 100A 0.006R MCP87050-U/MF PDFN-8	Yes	Microchip	MCP87050T-U/MF

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TABLE B-1: EVB-USB5816 BILL OF MATERIALS (CONTINUED)

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
54	1	Q4	MCHP ANALOG MOSFET N-CH 25V 100A 0.0026R MCP87022T-U/MF PDFN-8	Yes	Microchip Technology	MCP87022T-U/MF
55	10	R1, R2, R7, R30, R43, R48, R53, R122, R127, R128	RES TKF 1k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1001V
56	5	R3, R76, R111, R113, R115	RES TKF 124R 1% 1/10W SMD 0603	Yes	Panasonic Electronic Components	ERJ-3EKF1240V
57	2	R4, R11	RES TKF 10k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1002V
58	2	R5, R14	RES TKF 20R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF20R0V
59	1	R6	RES TKF 20k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2002V
60	1	R8	RES TKF 470k 1% 1/10W SMD 0603	Yes	Vishay	CRCW0603470KFKEA
61	22	R9, R10, R13, R19, R21, R40, R41, R42, R64, R81, R82, R84, R85, R90, R91, R97, R98, R101, R102, R103, R104, R106	RES TKF 10k 1% 1/10W SMD 0603	Yes	Vishay	CRCW060310K0FKEA
62	3	R12, R49, R71	RES TKF 2.2k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2201V
63	15	R15, R24, R29, R36, R55, R57, R60, R68, R72, R78, R107, R108, R109, R118, R119	RES TKF 0R 1/10W SMD 0603	Yes	NIC Components	NRC06Z0TRF
64	14	R16, R20, R44, R45, R46, R47, R74, R75, R77, R87, R116, R121, R123, R124	RES TKF 330R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF3300V
65	2	R17, R18	RES TKF 150k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1503V
66	1	R22	RES TKF 140k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1403V
67	1	R23	RES TKF 14.7k 1% 1/10W SMD 0603	Yes	Panasonic Electronic Components	ERJ-3EKF1472V
68	1	R25	RES TKF 20k 1% 1/10W SMD 0603	Yes	Yageo	9C06031A2002FKHFT
69	1	R26	RES TKF 750R 1% 1/10W SMD 0603	Yes	Vishay	CRCW0603750RFKEA
70	1	R27	RES TKF 2.61k 1% 1/16W SMD 0603	Yes	MULTICOMP	MC 0.063W 0603 1% 2K61
71	1	R28	RES TKF 73.2k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF7322V
72	1	R31	RES TKF 33R 1% 1/16W SMD 0402	Yes	Rohm Semiconductor	MCR01MRTF33R0
73	1	R32	RES TKF 0R SMD 0402	Yes	Panasonic	ERJ-2GE0R00X
74	2	R33, R35	RES TKF 0R SMD 0402	DNP	Panasonic	ERJ-2GE0R00X
75	1	R34	RES TKF 8.2k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF8201V
76	1	R37	RES TKF 43k 1% 1/10W SMD 0603	Yes	Vishay	CRCW060343K0FKEA
77	4	R38, R65, R83, R94	RES TF 100k 1% 1/8W SMD 0603	Yes	Vishay	MCT06030C1003FP500
78	1	R39	RES TKF 49.9k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF4992V
79	2	R50, R86	RES TKF 12k 1% 1/10W SMD 0603	Yes	Yageo	RC0603FR-0712KL
80	1	R51	RES TKF 84.5k 1% 1/10W SMD 0603	Yes	Yageo	RC0603FR-0784K5L
81	3	R52, R59, R63	RES TKF 100k 1% 1/10W SMD 0603	DNP	Panasonic	ERJ-3EKF1003V

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TABLE B-1: EVB-USB5816 BILL OF MATERIALS (CONTINUED)

Item	Quantity	Designator	Description	Populated	Manufacturer	Manufacturer Part Number
82	9	R54, R56, R58, R61, R62, R66, R69, R70, R120	RES TKF 100k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1003V
83	1	R67	RES TKF 90.9k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF9092V
84	6	R73, R79, R110, R112, R114, R126	RES TKF 1k 1% 1/10W SMD 0603	DNP	Panasonic	ERJ-3EKF1001V
85	5	R80, R88, R89, R95, R96	RES TKF 200k 1% 1/10W SMD 0603	Yes	Vishay	CRCW0603200KFKEA
86	4	R92, R93, R99, R100	RES TKF 10R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF10R0V
87	1	R105	RES TKF 10k 1% 1/10W SMD 0603	DNP	Vishay	CRCW060310K0FKEA
88	2	R117, R125	RES TKF 0R 1/10W SMD 0603	DNP	NIC Components	NRC06Z0TRF
89	1	SW1	SWITCH SLIDE DPDT 6V 300 mA JS202011SCQN SMD	Yes	C&K	JS202011SCQN
90	1	SW2	SWITCH TACT SPST 16V 50 mA PTS810 SJM 250 SMTR LFS SMD	Yes	C&K Components	PTS810 SJM 250 SMTR LFS
91	2	SW3, SW4	SWITCH SLIDE SPST 20V 10 mA SPA06B TH	Yes	C&K Components	SPA06B
92	2	TP2, TP12	MISC, TEST POINT MULTI PURPOSE MINI RED	Yes	Keystone	5000
93	2	TP4, TP10	MISC, TEST POINT MULTI PURPOSE MINI RED	DNP	Keystone	5000
94	4	TP5, TP7, TP9, TP13	MISC, TEST POINT MULTI PURPOSE MINI BLACK	Yes	Keystone	5001
95	2	TP6, TP8	MISC, TEST POINT PC MINI, 0.040" D YELLOW	Yes	Keystone	5004
96	1	TP11	CON TP LOOP BLUE Ag TH	DNP	Keystone Electronics	5117
97	1	TP14	CON TP LOOP Orange TH	Yes	Keystone Electronics	5003
98	3	U1, U10, U12	74LVC1G14GW,125 SCHMITT-TRG INVERTER	Yes	NXP	74LVC1G14GW,125
99	1	U2	MCHP ANALOG SWITCHER Buck 0.95V to 3.6V 2A MIC23201YML-TR MLF-10	Yes	Microchip Technology	MIC23201YML-TR
100	1	U3	MCHP INTERFACE USB 3.1 HUB CTLR VQFN-100	Yes	Microchip	USB5816-I/KD
101	1	U4	MCHP MEMORY SERIAL FLASH 16M 104 MHz SST26VF016B-104I/SM SOIJ-8	Yes	Microchip Technology	SST26VF016B-104I/SM
102	1	U5	MCHP ANALOG PWM CONTROLLER 600 kHz MCP19035-BAABE/MF DFN-10	Yes	Microchip Technology	MCP19035-BAABE/MF
103	1	U6	MCHP ANALOG LDO ADJ MCP1825T-ADJE/DC SOT-223-5	Yes	Microchip	MCP1825T-ADJE/DC
104	1	U7	MCHP INTERFACE USB I^2C UPD360-A/6H BGA-44	Yes	Microchip	UPD360-A/6H
105	5	U8, U9, U13, U14, U15	MCHP ANALOG POWER SWITCH 5.5V 2A MIC2009YML-TR MLF-6	Yes	Microchip Technology	MIC2009YML-TR
106	1	U11	IC LOGIC PI3B3257 MUX/DEMUX SW QSOP-16	Yes	Diodes Incorporated	PI3B3257QEX
107	1	Y1	MCHP CLOCK OSCILLATOR SINGLE 25 MHZ DSC1001CI2-025.0000T CDFN-4	Yes	Microchip Technology	DSC1001CI2-025.0000T

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NOTES:

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Appendix C. Silk Screens

C.1 INTRODUCTION

This appendix shows the top and bottom silk screen images of the EVB-USB5816.

FIGURE C-1: EVB-USB5816 TOP SILK SCREEN IMAGE

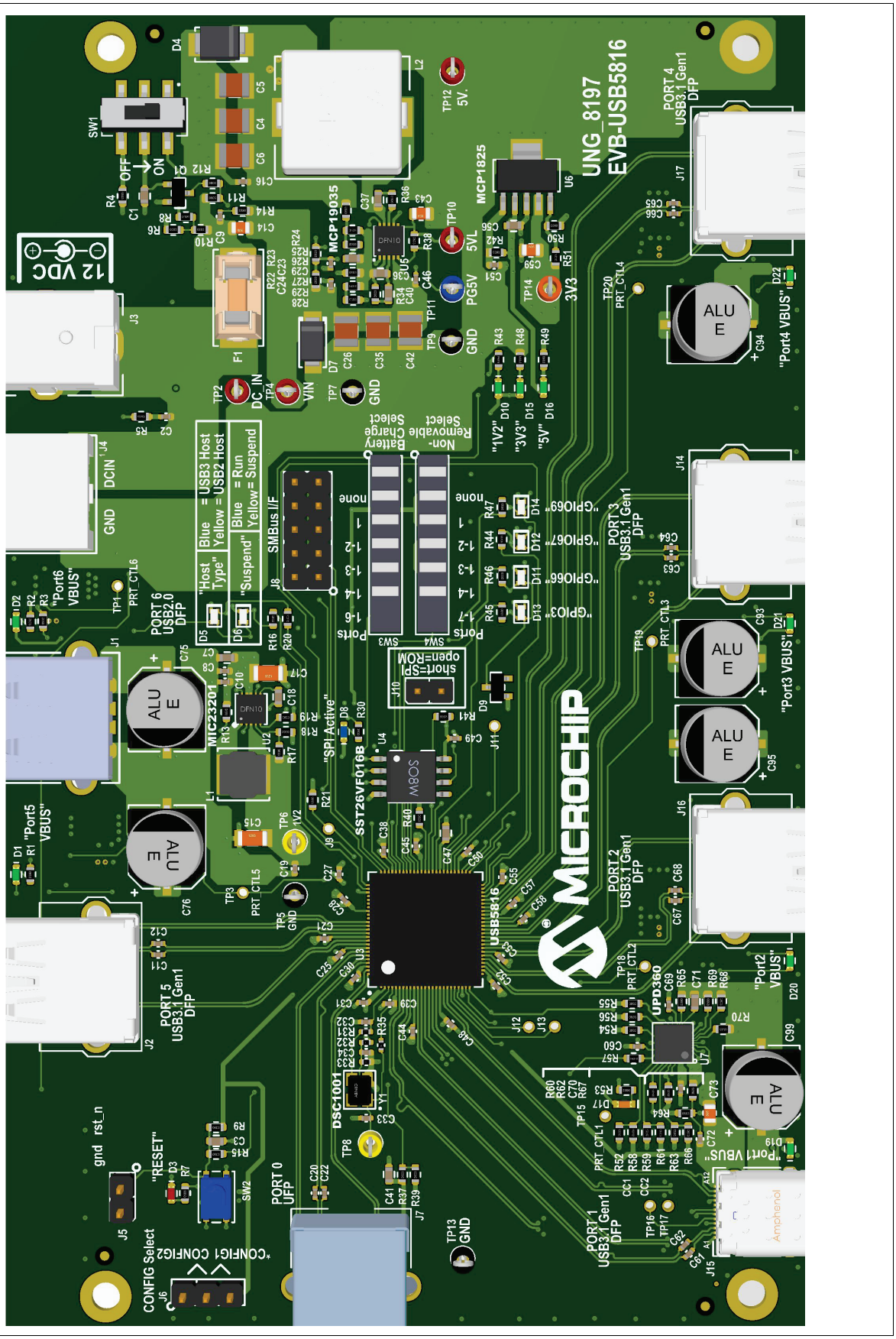

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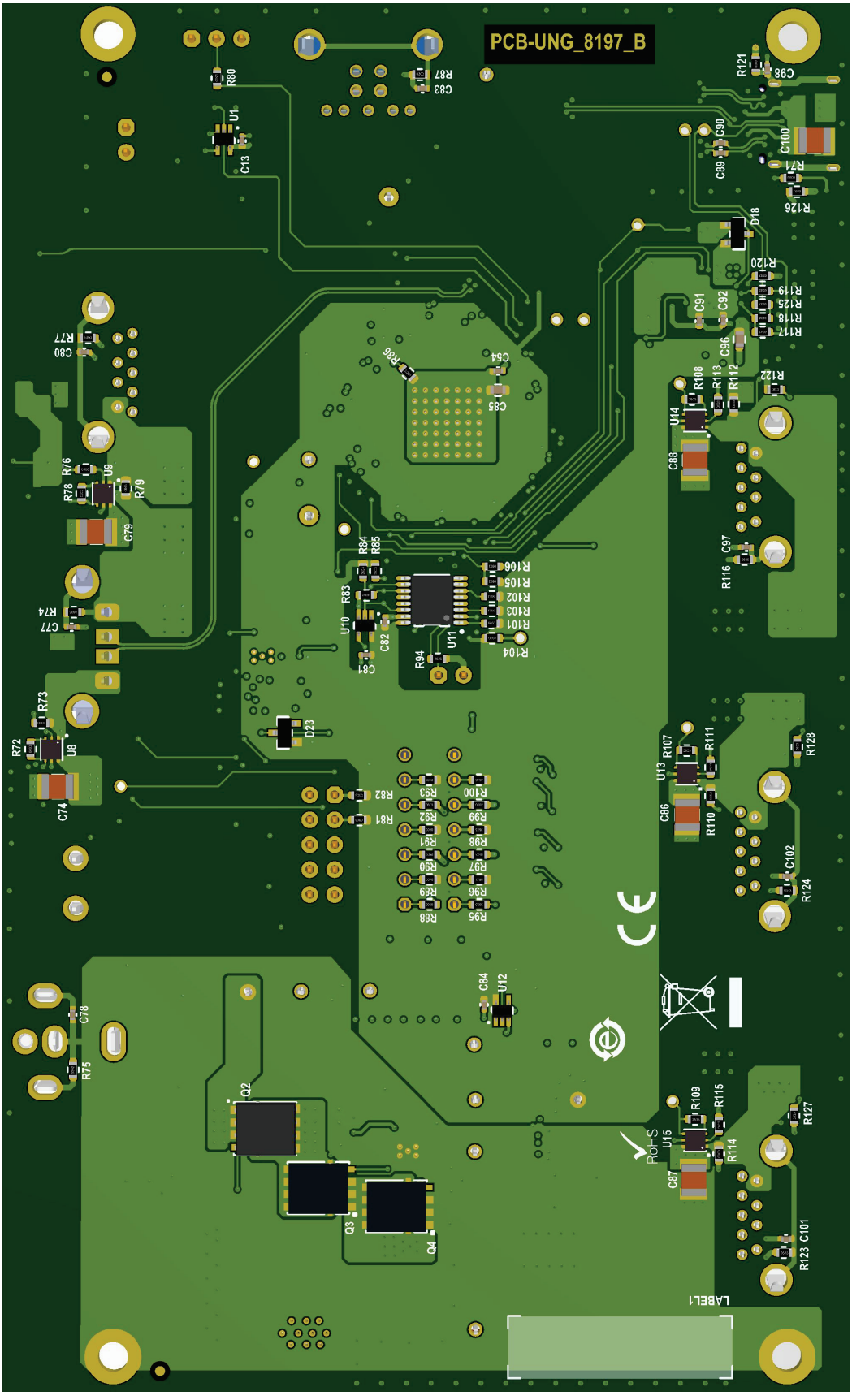
FIGURE C-2: EVB-USB5816 BOTTOM SILK SCREEN IMAGE



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China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
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