EVB-USB7016 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 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 EVB-USB7016 Evaluation Kit User's Guide. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the EVB-USB7016 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-USB7016 Evaluation Kit.
- **Chapter 2. "Getting Started"** – This chapter provides information about setup and operation of the EVB-USB7016 Evaluation Kit.
- **Chapter 3. "Hardware Configuration"** – This chapter includes information about the hardware configuration of the EVB-USB7016 Evaluation Kit.
- **Appendix A. "Schematics"** – This appendix shows the EVB-USB7016 Evaluation Kit schematics.
- **Appendix B. "Bill of Materials"** – This appendix includes the EVB-USB7016 Evaluation Kit Bill of Materials (BOM).
- **Appendix C. "PCB Silk Screens"** – This appendix includes the EVB-USB7016 Evaluation Kit silk screen.

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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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **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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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB® C 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 PICkit 2 and 3.

CUSTOMER SUPPORT

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- 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

Revisions	Section/Figure/Entry	Correction
DS50003363A (07-14-22)	Initial release	

Chapter 1. Overview

1.1 INTRODUCTION

The EVB-USB7016 is a demonstration and evaluation platform that provides the necessary requirements and interface options for evaluating the USB7016, which is a 6-port High-Speed (HS) USB smart hub on a 4-layer RoHS-compliant Printed Circuit Board (PCB). This allows the user to gain an understanding of the product and accelerate the integration of the USB7016 into the user's design.

The EVB-USB7016 is compliant with the USB 2.0 HS, Full-Speed (FS), and Low-Speed (LS) USB signaling. The EVB-USB7016 is also compliant with USB 3 Gen1 on the upstream port and on downstream Ports 1 to 5.

The evaluation platform supports a Type-C Gen1 upstream port and six downstream ports: one USB 3 Gen1 Type-C port, three USB3 Gen1 Type-A ports, and two USB2.0 ports with Type-A connectors. The EVB-USB7016 platform also supports battery charging on all four downstream ports (maximum of 10A [Note 1] at any one time). The EVB-USB7016 supports FlexConnect role reversal for any of the four downstream ports with the upstream port.

The EVB-USB7016 has four configurations for operation through internal default settings and supports custom configurations through SMBus or through the external 16-Mbit SPI Flash device.

The EVB-USB7016 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-USB7016, see **Section 1.2 "Features"**.

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

1.2 FEATURES

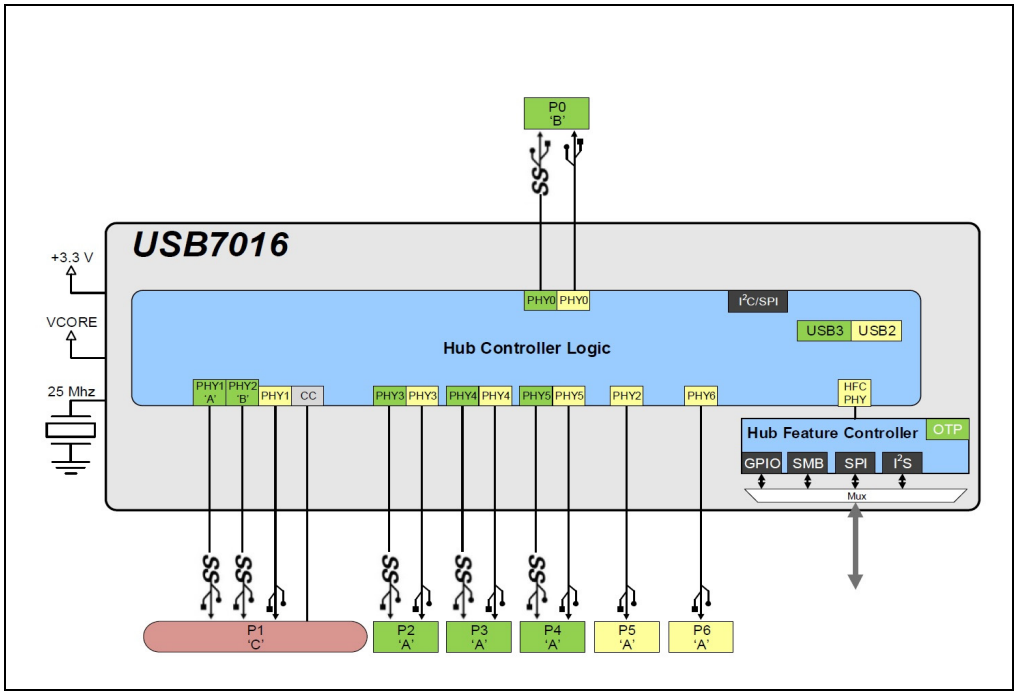
- Microchip's PortSwap, PHYBoost™, and VariSense™ technologies
- USB7016 in a 100-pin QFN RoHS compliant package
- USB 3 compliant (Gen1 operation)
- USB 2 compliant (HS, FS, and LS operation)
- 5V-tolerant USB pins
- Self-powered operation
- USB Gen1 Type-C upstream port
- Six Downstream USB ports:
  - One Type-C Gen1 downstream port
  - Three Type-A Gen1 downstream ports
  - Two Type-A USB 2.0-only downstream ports
- All downstream ports support individual port power and overcurrent sense.
- All downstream ports can be enabled for battery charging with the battery charging select shunts J1 and J20. (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
- 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 port options can be configured with select shunt on J17.
- Bridge peripheral functions:
  - USB-to-UART (CDC)
  - USB-to-I^{2}S Audio Codec
  - USB-to-SMBus
  - USB-to-I^{2}C

1.3 BLOCK DIAGRAM

Figure 1-1 shows the block diagram of EVB-USB7016.

FIGURE 1-1: EVB-USB7016 BLOCK DIAGRAM



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.

- *USB7016 6-Port USB 3.2 Gen 1 SmartHub Controller Data Sheet*

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 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	Type of Battery Charging (non-USB compliant) that sets the USB D+/D– to specific DC voltages to communicate 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 3.2 Gen1

NOTES:

Chapter 2. Getting Started

2.1 INTRODUCTION

The Microchip EVB-USB7016 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 3.2 Gen1 hub with one upstream Type-C port, one downstream Type-C port, three downstream USB 3 Type-A ports, and two downstream USB 2.0 ports, with Microchip's standard VID/PID/DID settings.

Microchip provides a comprehensive software programming tool, MPLAB® Connect (MPLABC), for configuring USB7016 functions, registers, and OTP memory. USB7016 requires MPLABC version 2.1.0 or greater.

For additional information on the MPLABCC programming tool, refer to Software Libraries within the Microchip USB7016 product page at www.microchip.com/USB7016.

2.2 KIT CONTENTS

The EVB-USB7016 Evaluation Kit includes the basic equipment necessary for evaluation. The items included in the kit are:

- EVB-USB7016 Evaluation Board
- Type-A to Type-C USB cable

2.3 QUICK START

To quickly start using the board, perform the following steps:

1. Connect a 12V power supply to the barrel connector (J5) or the terminal block (J4) on the EVB-USB7016.
2. Using a Type-A to Type-C USB cable, connect the EVB-USB7016 to a USB host via the upstream "Port 0" USB Type-C socket (J1).

Devices may now be connected to any of the downstream ports to enumerate and use those devices with the USB host.

To perform additional configuration or evaluate specific features, launch the MPLABC software on your USB host or manipulate the included hardware configuration options detailed in the next sections.

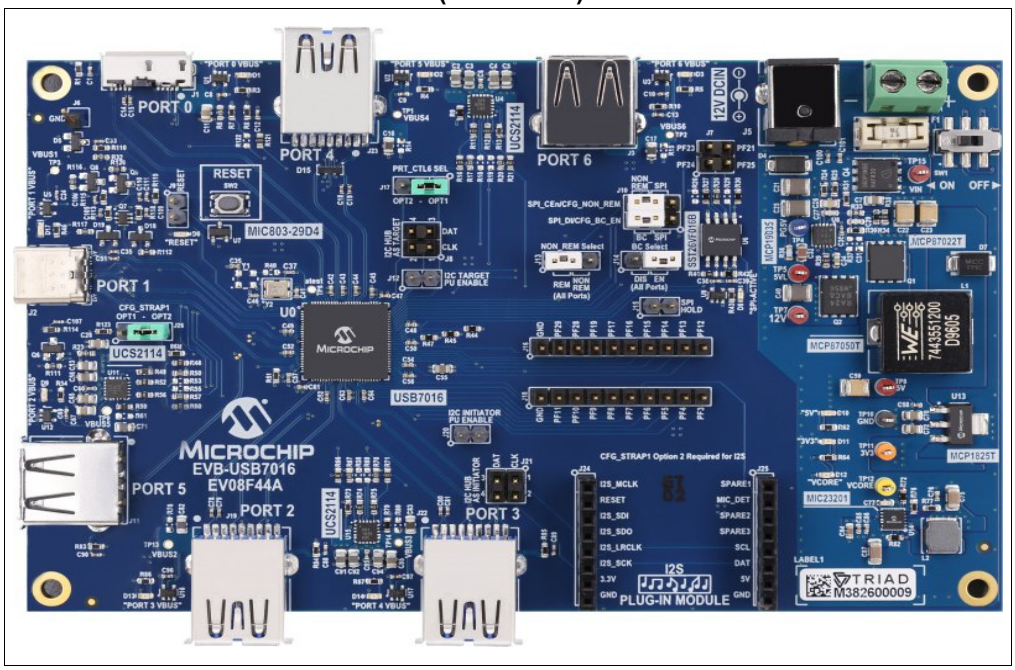
NOTES:

Chapter 3. Hardware Configuration

3.1 HARDWARE CONFIGURATION OPTIONS

Figure 3-1 shows the top view of the EVB-USB7016.

FIGURE 3-1: EVB- USB7016 (TOP VIEW)



3.1.1 Configuration

3.1.1.1 EXTERNAL SPI FLASH

Upon power-up, the USB7016 first looks for an external SPI ROM device and a valid signature in the Flash. If one is found, the external ROM is enabled and code execution is initiated from the external SPI ROM device.

To enable operation from the SPI device, install shunts to pins 1-2 and 4-5 of J10. When the 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 SPI shunts are installed on J10. 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 USB7016 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, leave J10 open to disconnect the SPI ROM. To connect the SMBus pull-up resistors, connect a shunt to J12 pins 1 and 2. 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 SMBus is enabled (i.e. SMBus clock and data are pulled up), the USB7016 waits indefinitely for data from the SMBus interface and will not enumerate to the USB host until the special USB Attach command is sent.

3.1.1.3 INTERNAL DEFAULT CONFIGURATIONS WITH STRAPPING OPTIONS

When the USB7016 does not detect a valid SPI Flash image and does not look for SMBus configuration upon power-up, the USB7016 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-USB7016 demonstrates two of the six possible resistor values for each of CFG_BC_EN and CFG_NON-REM. These straps are sensed by the USB7016 device at power-on to determine the resultant configuration of the device.

To select the CFG_BC_EN and CFG_NON-REM modes, shunts must be connected to J10, J13, and J14 headers.

To use the battery charging strap options, connect a shunt to pins 2 and 3 of J10 and connect a shunt to J14 according to Table 3-1. For the NON_REM strap options, connect a shunt to pins 5 and 6 of J10 and connect a shunt to J13 according to Table 3-2.

TABLE 3-1: BATTERY CHARGING OPTIONS (CFG_BC_EN - J14)

J14 Shunt Position	(J10 is shunted pins 2-3.)
2-3	All ports are BC 1.2-disabled.
1-2	All downstream ports are BC1.2-enabled.

TABLE 3-2: NON-REMOVABLE PORT OPTIONS (CFG_NON-REM - J13)

J13 Shunt Position	(J10 is shunted pins 5-6.)
1-2	All ports are non-removable.
2-3	All ports are removable.

3.1.2 Power Source – Self Powered

The EVB-USB7016 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 J5 on the board. Alternatively, an external voltage can be supplied to the screw terminal "12V" (J4). 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 six downstream ports is controlled via port power controllers with auto-discharge functionality. All downstream ports support BC 1.2 battery charging.

The five downstream USB 3 ports and additional USB 2 port are each capable of up to 3A of current at 5V.

3.1.4 LED Indicators

Table 3-3 describes the LED indicators on the EVB-USB7016.

TABLE 3-3: EVB-USB7016 LED INDICATOR DESCRIPTIONS

Ref. Des.	Label	Description
D8	“SPI-ACTIVE”	Indicates SPI Flash Memory activity
D6	“RESET”	The RST_N signal is asserted.
D1	“Upstream VBUS”	Illuminates when 5V to upstream PORT0 VBUS is present
D17	“PORT 1 VBUS”	Illuminates when 5V to upstream PORT1 VBUS is present
D13	“PORT 2 VBUS”	Illuminates when 5V to upstream PORT2 VBUS is present
D14	“PORT 3 VBUS”	Illuminates when 5V to upstream PORT3 VBUS is present
D2	“PORT 4 VBUS”	Illuminates when 5V to upstream PORT4 VBUS is present
D9	“PORT 5 VBUS”	Illuminates when 5V to upstream PORT5 VBUS is present
D3	“PORT 6 VBUS”	Illuminates when 5V to upstream PORT6 VBUS is present
D10	“5V”	Illuminates when 5V is present from the 5V voltage regulator
D11	“3V3”	Illuminates when 3.3V is present from the 3.3V voltage regulator
D12	“VCORE”	Illuminates when 1.2V (VCORE) is present from the 1.2V regulator

3.1.5 Switches

Table 3-4 describes the switches on the EVB-USB7016.

TABLE 3-4: EVB-USB7016 SWITCH DESCRIPTIONS

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

3.1.6 Connector Descriptions

Table 3-5 describes the connectors included on the PCB.

TABLE 3-5: EVB-USB7016 CONNECTOR DESCRIPTIONS

Ref. Des.	Type	Label	Description
J5	Barrel Jack	"12VDC"	12 VDC supply connection (center pin positive)
J4	2-pin terminal block	—	Alternative 12 VDC supply connection. Pin 1 is positive.
J1	USB Type-B Connector	"PORT0"	Upstream Type-A connection
J2	USB Type-C Connector	"PORT1"	Downstream Port 1 USB connection
J19	USB Type-A Connector	"PORT2"	Downstream Port 2 USB connection
J22	USB2 Type-A Connector	"PORT3"	Downstream Port 3 USB connection
J23	USB2 Type-A Connector	"PORT4"	Downstream Port 4 USB connection
J11	USB Type-A Connector	"PORT5"	Downstream Port 5 USB connection
J3	USB Type-A Connector	"PORT6"	Downstream Port 6 USB connection
J15	1x2 Header	"HOLD"	When shunted, disables the SPI memory
J10	2x3 Header	"SPI_DI/CFG_BC_EN" "SPI_CEn/CFG_NON_REM"	Selects between SPI memory capability and BC/NON_REM capability. For SPI, connect pins 2 and 3 as well as 5 and 6. For BC, connect pins 4 and 5. For NON_REM, connect pins 1 and 2.
J9	2x1 Header	"Ext.Reset"	Connection for an external Reset switch
J7	2x2 Header	PF24 PF23 PF25 PF21	SPI data pins provided for debugging SPI memory
J6	1x1 Header	"GND"	Circuit Ground
J18	1x10 Header	—	PF3 – PF11
J16	1x10 Header	—	PF12 – PF29
J20	1x2 Header	"PU"	Pull-up resistors, I^2C Initiator
J12	1x2 Header	"PU"	Pull-up resistors, I^2C Target
J14	1x3 Header	"BC SELECT"	See Table 3-1.

TABLE 3-5: EVB-USB7016 CONNECTOR DESCRIPTIONS (CONTINUED)

Ref. Des.	Type	Label	Description
J13	1x3 Header	“NON_REM_SELECT”	See Table 3-2.
J17	1x3 Header	“PRT_CTL6 SEL”	Default OPT 1
J24	1x8 Header	—	Audio Codec Socket
J25	1x8 Header	—	Audio Codec Socket

3.1.7 Test Points

Table 3-6 describes the test points on the EVB-USB7016. A header may be permanently installed on the through-hole test points if needed.

TABLE 3-6: EVB-USB7016 TEST POINT DESCRIPTIONS

Ref. Des.	Type	Description
TP1	Test Pad	VBUS Port 4
TP2	Test Pad	VBUS Port 6
TP3	Test Pad	VBUS Port 1
TP4	Test Pad	PG5V
TP5	Test Pad	5VL
TP6	Test Pad	ATEST
TP7	Test Loop (Red)	12V
TP8	Test Pad	5V
TP9	Test Pad	VBUS Port 5
TP10	Test Loop (Black)	Circuit Ground
TP11	Test Loop (Orange)	3.3V
TP12	Test Loop (Yellow)	VCORE (1.2V)
TP13	Test Pad	VBUS Port 2
TP14	Test Pad	VBUS Port 3
TP15	Test Loop (Red)	VIN

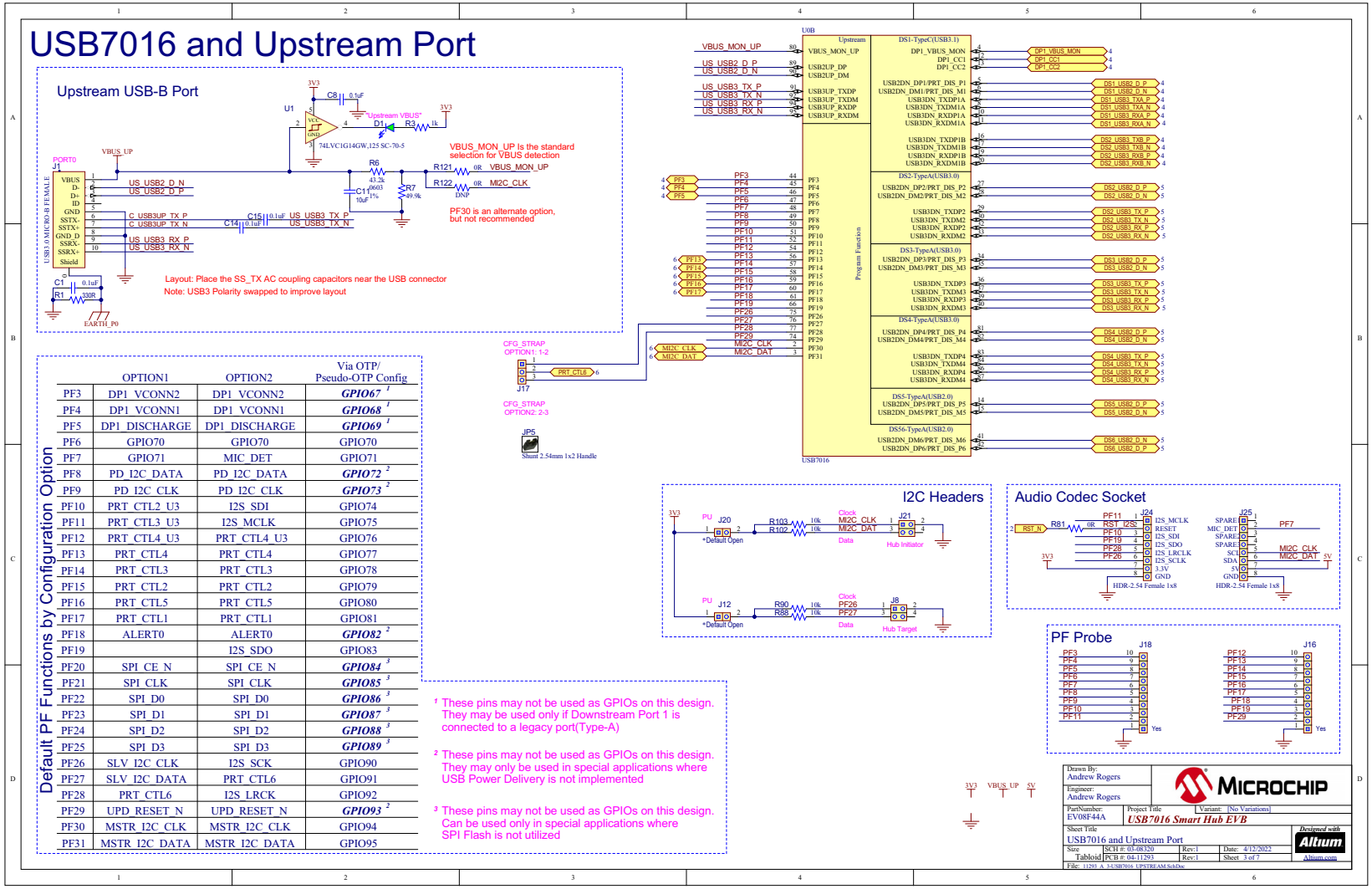
NOTES:

Appendix A. Schematics

A.1 INTRODUCTION

This appendix shows the EVB-USB7016 Evaluation Kit schematics.

FIGURE A-1: EVB-USB7016 AND UPSTREAM PORT



	OPTION1	OPTION2	Via OTP/ Pseudo-OTP Config
PF3	DP1_VCONN2	DP1_VCONN2	***GPIO67*** [1]
PF4	DP1_VCONN1	DP1_VCONN1	***GPIO68*** [1]
PF5	DP1_DISCHARGE	DP1_DISCHARGE	***GPIO69*** [1]
PF6	GPIO70	GPIO70	GPIO70
PF7	GPIO71	MIC_DET	GPIO71
PF8	PD_I2C_DATA	PD_I2C_DATA	***GPIO72*** [2]
PF9	PD_I2C_CLK	PD_I2C_CLK	***GPIO73*** [2]
PF10	PRT_CTL2_U3	I2S_SDI	GPIO74
PF11	PRT_CTL3_U3	I2S_MCLK	GPIO75
PF12	PRT_CTL4_U3	PRT_CTL4_U3	GPIO76
PF13	PRT_CTL4	PRT_CTL4	GPIO77
PF14	PRT_CTL3	PRT_CTL3	GPIO78
PF15	PRT_CTL2	PRT_CTL2	GPIO79
PF16	PRT_CTL5	PRT_CTL5	GPIO80
PF17	PRT_CTL1	PRT_CTL1	GPIO81
PF18	ALERT0	ALERT0	***GPIO82*** [2]
PF19		I2S_SDO	GPIO83
PF20	SPI_CE_N	SPI_CE_N	***GPIO84*** [3]
PF21	SPI_CLK	SPI_CLK	***GPIO85*** [3]
PF22	SPI_D0	SPI_D0	***GPIO86*** [3]
PF23	SPI_D1	SPI_D1	***GPIO87*** [3]
PF24	SPI_D2	SPI_D2	***GPIO88*** [3]
PF25	SPI_D3	SPI_D3	***GPIO89*** [3]
PF26	SLV_I2C_CLK	I2S_SCK	GPIO90
PF27	SLV_I2C_DATA	PRT_CTL6	GPIO91
PF28	PRT_CTL6	I2S_LRCK	GPIO92
PF29	UPD_RESET_N	UPD_RESET_N	***GPIO93*** [2]
PF30	MSTR_I2C_CLK	MSTR_I2C_CLK	GPIO94
PF31	MSTR_I2C_DATA	MSTR_I2C_DATA	GPIO95

FIGURE A-2: EVB-USB7016 DOWNSTREAM PORT 1

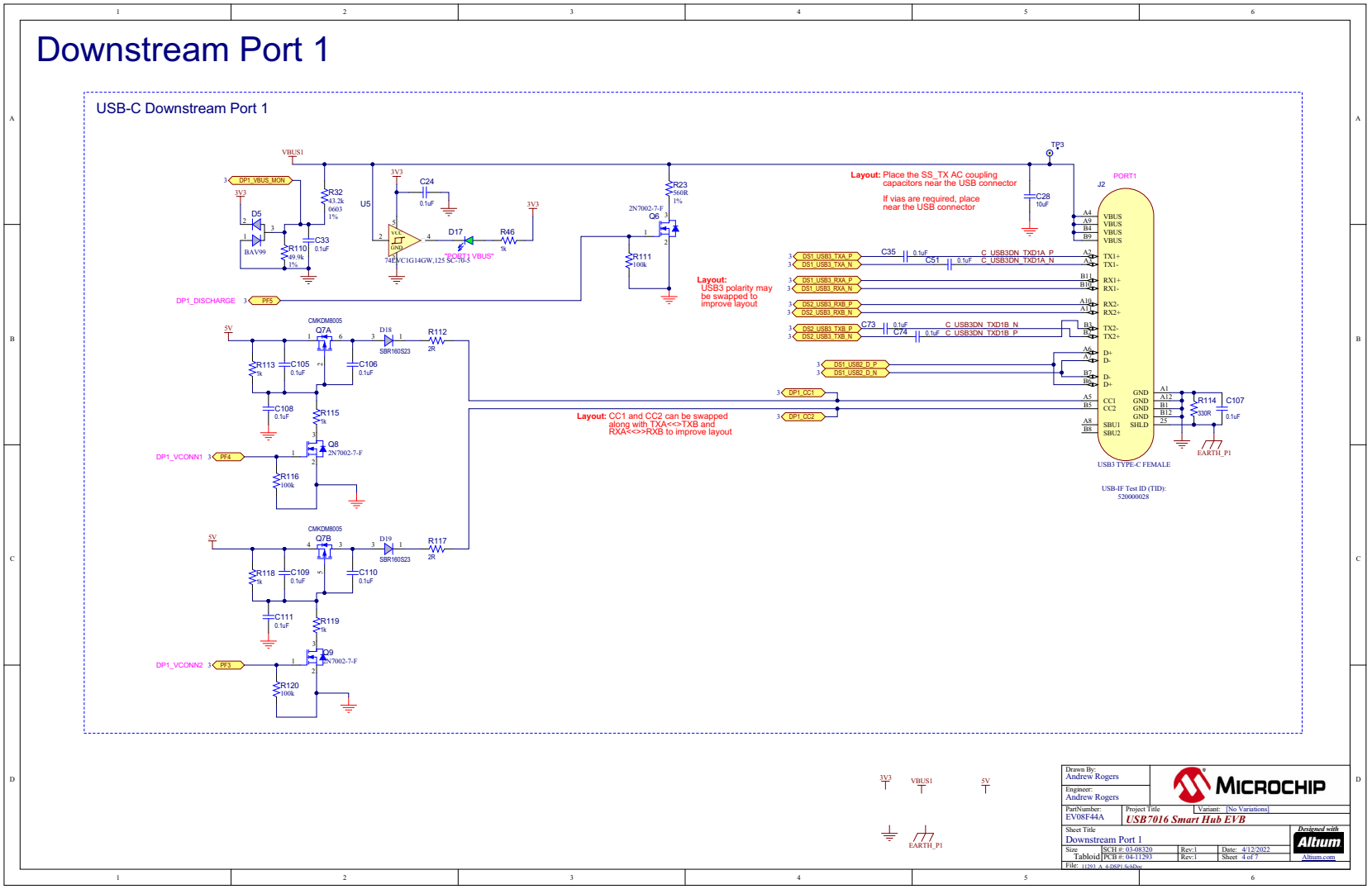


FIGURE A-3: EVB-USB7016 DOWNSTREAM PORTS 2-6

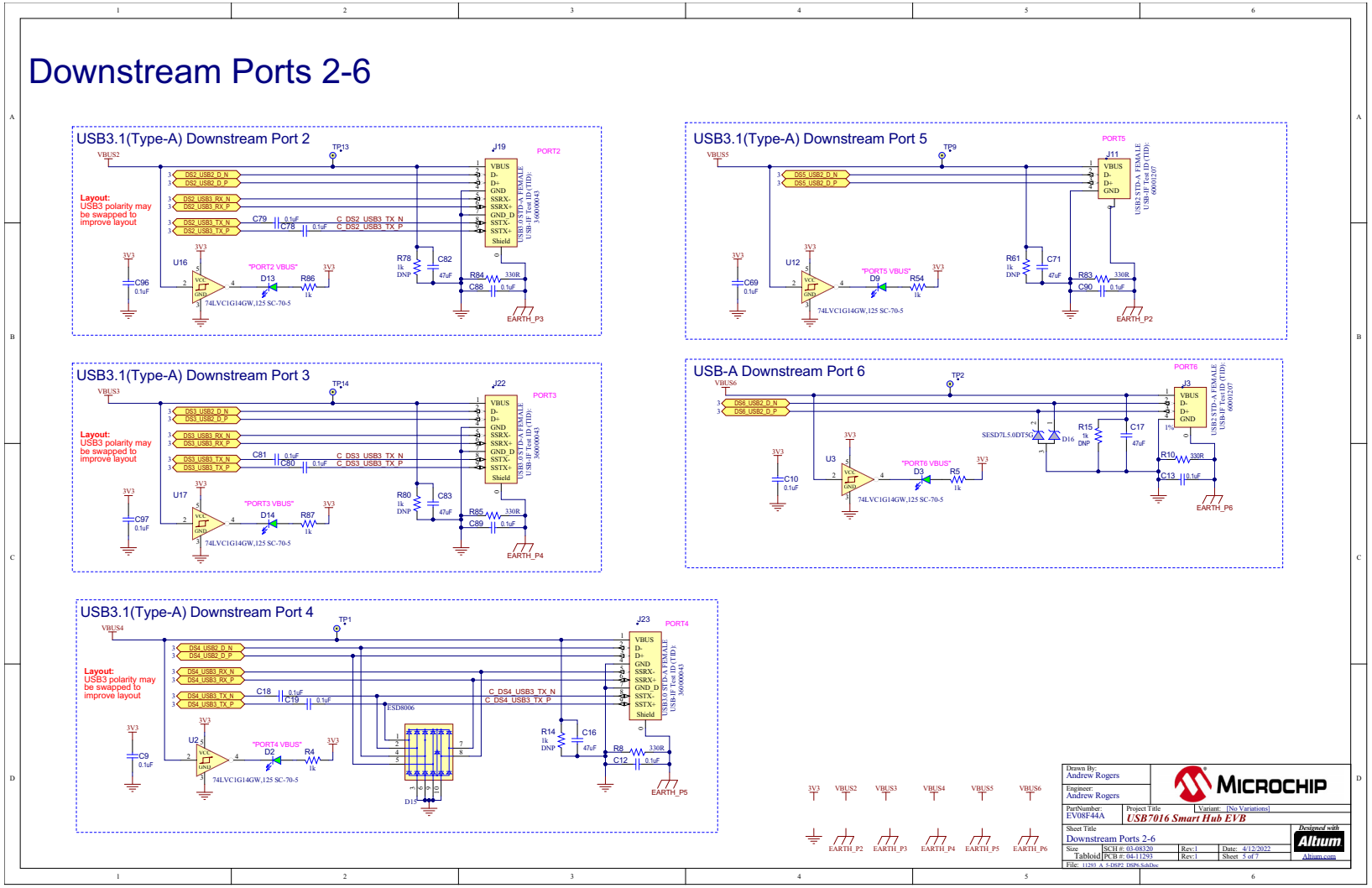


FIGURE A-4: EVB-USB7016 DOWNSTREAM PORTS POWER

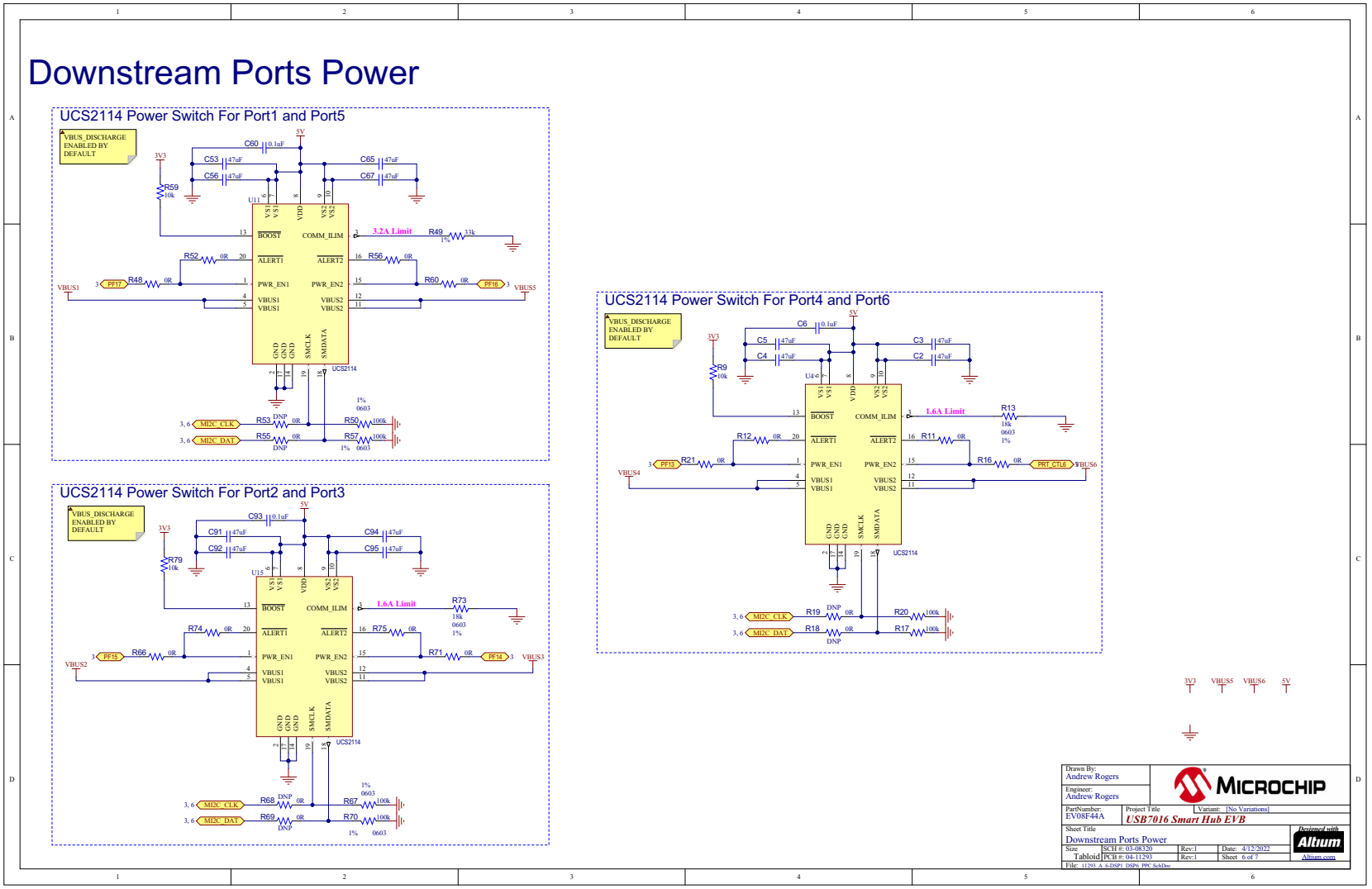
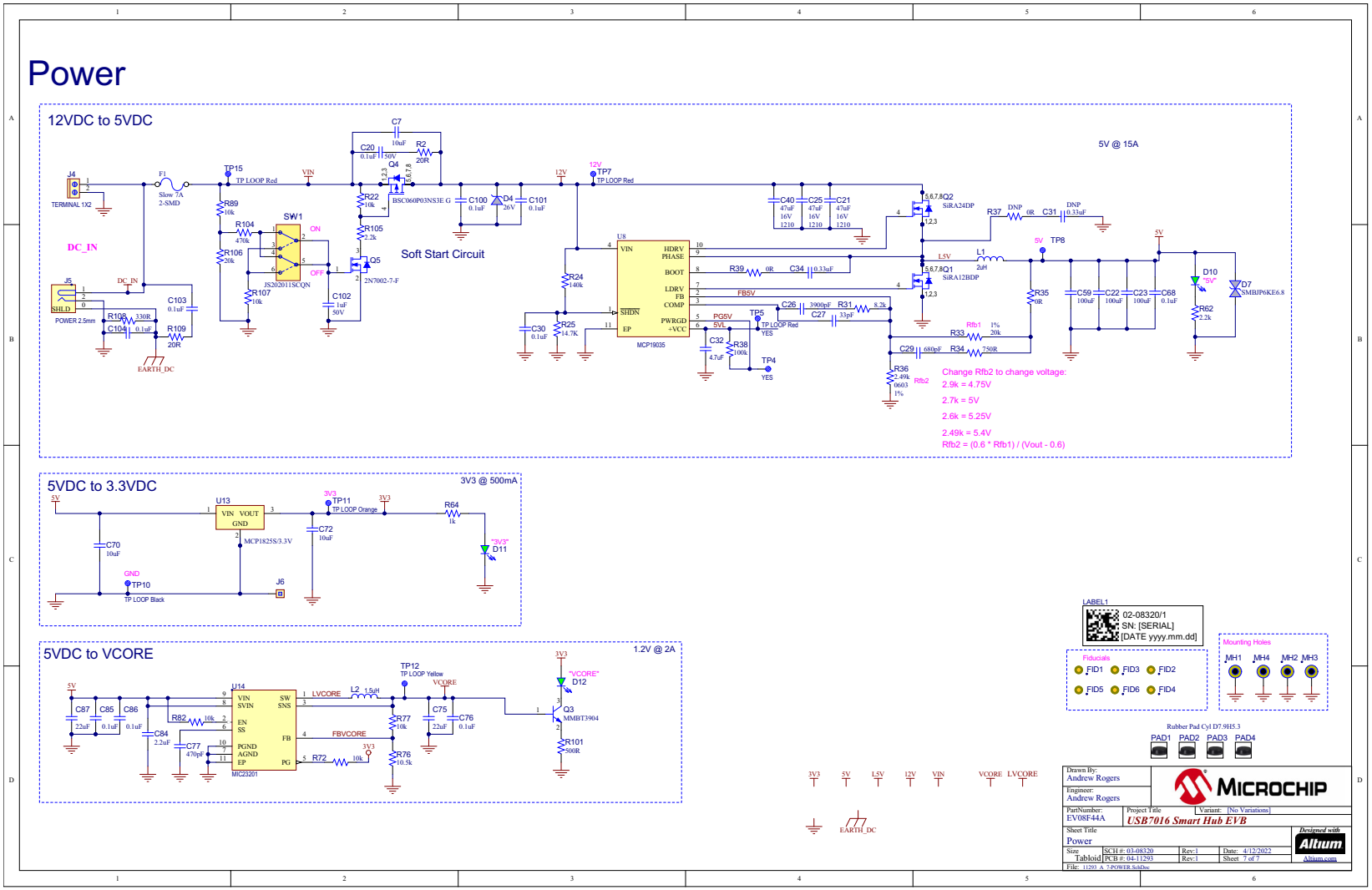


FIGURE A-5: EVB-USB7016 POWER



Appendix B. Bill of Materials

B.1 INTRODUCTION

This appendix contains the EVB-USB7016 Evaluation Board Bill of Materials (BOM).

TABLE B-1: BILL OF MATERIALS

Item	Qty	Reference	Description	Populated	Manufacturer	Manufacturer Part Number
1	35	C1, C6, C14, C15, C30, C36, C38, C39, C41, C42, C43, C44, C45, C47, C48, C49, C50, C52, C54, C57, C58, C60, C61, C62, C63, C64, C68, C76, C85, C86, C93, C98, C99, C103, C104	CAP CER 0.1 µF 16V 10% X7R SMD 0402	Yes	Wurth Electronics Inc	885012205037
2	12	C2, C3, C4, C5, C53, C56, C65, C67, C91, C92, C94, C95	CAP CER 47 µF 6.3V 20% X5R SMD 0805	Yes	Taiyo Yuden	JMK212BJ476MG-T
3	6	C7, C11, C28, C55, C70, C72	CAP CER 10 µF 16V 10% X5R SMD 0805	Yes	Wurth Electronics Inc	885012107014
4	30	C8, C9, C10, C12, C13, C18, C19, C24, C33, C35, C51, C69, C73, C74, C78, C79, C80, C81, C88, C89, C90, C96, C97, C105, C106, C107, C108, C109, C110, C111	CAP CER 0.1 µF 35V 10% X7R SMD 0402	Yes	TDK Corporation	CGA2B3X7R1V104K050BB
5	5	C16, C17, C71, C82, C83	CAP CER 47 µF 10V 20% X5R SMD 0805	Yes	TDK Corporation	C2012X5R1A476M125AC
6	3	C20, C100, C101	CAP CER 0.1 µF 50V 10% X7R SMD 0402	Yes	Taiyo Yuden	UMK105B7104KV-FR
7	3	C21, C25, C40	CAP CER 47 µF 16V 20% X5R SMD 1210	Yes	KEMET	C1210C476M4PACTU
8	3	C22, C23, C59	CAP CER 100 µF 10V 20% X5R SMD 1210	Yes	Murata Electronics North America	GRM32ER61A107ME20L
9	1	C26	CAP CER 3900 pF 50V 10% X7R SMD 0805	Yes	Yageo	CC0805KRX7R9BB392
10	1	C27	CAP CER 33 pF 50V 5% C0G SMD 0603	Yes	WURTH ELEKTRONIK	885012006054
11	1	C29	CAP CER 680 pF 50V 10% NP0 SMD 0603	Yes	KEMET	C0603C681K5GAC7867
12	1	C31	CAP CER 0.33 µF 16V 10% X7R SMD 0603	DNP	WUERTH ELEKTRONIK	885012206049
13	1	C32	CAP CER 4.7 µF 35V 10% X7R SMD 0805	Yes	TDK Corporation	C2012X7R1V475K125AE
14	1	C34	CAP CER 0.33 µF 16V 10% X7R SMD 0603	Yes	WUERTH ELEKTRONIK	885012206049
15	2	C37, C46	CAP CER 10 pF 50V 5% NP0 SMD 0402	Yes	AVX Corporation	04025A100JAT2A
16	2	C75, C87	CAP CER 22 µF 10V 10% X7R SMD 1206	Yes	Samsung Electro-Mechanics America, Inc	CL31B226KPHNNNE
17	1	C77	CAP CER 470 pF 25V 5% NP0 SMD 0603	Yes	AVX	06033A471JAT2A
18	1	C84	CAP CER 2.2 µF 10V 10% X7R SMD 0603	Yes	Murata	GRM188R71A225KE15D
19	1	C102	CAP CER 1 µF 50V 10% X5R SMD 0603	Yes	Taiyo Yuden	UMK107BJ105KA-T
20	10	D1, D2, D3, D9, D10, D11, D12, D13, D14, D17	DIO LED GREEN 2V 30 mA 35 mcd Clear SMD 0603	Yes	Lite-On Inc	LTST-C191KGKT
21	1	D4	DIO TVS SMAJ26A 26V 400W DO-214AC_SMA	Yes	Littlefuse	SMAJ26A
22	1	D5	DIO RECT ARRAY BAV99 1.25V 200 mA 70V SOT-23-3	Yes	Micro Commercial Co	BAV99-TP
23	1	D6	DIO RED 2V 20 mA 54 mcd CLEAR SMD 0603	Yes	Lite-On Inc.	LTST-C191KRKT
24	1	D7	DIO TVS SMBJP6KE6.8CA 5.8V 600W DO-214AA_SMB	Yes	Micro Commercial Co	SMBJP6KE6.8CA-TP

TABLE B-1: BILL OF MATERIALS

Item	Qty	Reference	Description	Populated	Manufacturer	Manufacturer Part Number
25	1	D8	DIO LED BLUE 2.8V 20 mA 15 mcd Clear SMD 0603	Yes	Lite-On	LTST-C193TBKT-5A
26	1	D15	DIO TVS ESD8006MUTAG 3.3V SMD UDFN-8	Yes	ON Semiconductor	ESD8006MUTAG
27	1	D16	DIO TVS ARRAY SESD7L5.0DT5G 5V AEC-Q101 SMD SOT-723	Yes	ON Semiconductor	SESD7L5.0DT5G
28	2	D18, D19	DIO SBAR SBR160S23-7 SBR 530 mV 900 mA 60V SMD SOT23-3	Yes	Diodes Incorporated	SBR160S23-7
29	1	F1	RES FUSE 7A 72VAC 60VDC SLOW 2-SMD	Yes	Littelfuse Inc.	0154007.DRT
30	1	J1	CON USB3.0 MICRO-B FEMALE SMD R/A	Yes	Hirose Electric Co Ltd	ZX360D-B-10P(30)
31	1	J2	CON USB3.1 TID TYPE-C Female SMD R/A	Yes	Amphenol Commercial Products	12401610E4#2A
32	2	J3, J11	CON USB2.0 STD-A FEMALE TH R/A	Yes	TE Connectivity AMP Connectors	292303-1
33	1	J4	CON TERMINAL 5.08 mm 1X2 Female 16-30AWG 13.5A TH RA	Yes	TE Connectivity	282836-2
34	1	J5	CON POWER 2.5 mm 5.5 mm TH R/A	Yes	CUI Inc.	PJ-063BH
35	1	J6	CON HDR-2.54 Male 1x1 Gold 5.84 MH TH VERT	Yes	TE Connectivity	5-146280-1
36	3	J7, J8, J21	CON HDR-2.54 Male 2x2 Gold 5.84 MH TH VERT	Yes	Samtec	TSW-102-07-G-D
37	4	J9, J12, J15, J20	CON HDR-2.54 Male 1x2 Gold 5.84 MH TH VERT	Yes	FCI	68001-202HLF
38	1	J10	CON HDR-2.54 Male 3x2 Gold 5.84 MH TH VERT	Yes	Samtec Inc.	TSW-102-07-G-T
39	4	J13, J14, J17, J26	CON HDR-2.54 Male 1x3 Gold 5.84 MH TH VERT	Yes	FCI	68000-103HLF
40	2	J16, J18	CON HDR-2.54 Male 1x10 Gold 5.84 MH TH VERT	Yes	Samtec Inc.	TSW-110-07-G-S
41	3	J19, J22, J23	CON USB3.0 STD-A FEMALE TH R/A	Yes	Wurth Electronics Inc.	692122030100
42	2	J24, J25	CON HDR-2.54 Female 1x8 Tin TH VERT	Yes	Sullins	PPTC081LFBN-RC
43	4	JP1, JP2, JP3, JP4	MECH HW JUMPER 2.54 mm 1x2	MECH	3M	969102-0000-DA
44	1	JP5	MECH HW JUMPER 2.54 mm 1x2 w/ Handle	MECH	TE Connectivity AMP Connectors	880584-4
45	1	L1	INDUCTOR 2 µH 23A 20% SMD L12.8W12.8H6.2	Yes	Wurth Electronics Inc.	7443551200
46	1	L2	INDUCTOR 1.5 µH 3A 20% SMD L5W5H2.2	Yes	Murata Electronics North America	LQH5BPN1R5NT0L
47	1	LABEL1	LABEL PCBA 18x6mm Datamatrix Assy# / Rev / Serial / Date	Yes	ACT Logimark AS	505462
48	4	PAD1, PAD2, PAD3, PAD4	MECH HW RUBBER PAD CYLINDRICAL D7.9 H5.3 BLACK	MECH	3M	SJ61A11
49	1	Q1	TRANS FET N-CH SiRA12BDP-T1-GE3 30V 60A 38W PPAK SO-8	Yes	Vishay Siliconix	SIRA12BDP-T1-GE3
50	1	Q2	TRANS FET N-CH SiRA24DP-T1-GE3 25V 60A 62.5W PPAK SO-8	Yes	Vishay / Siliconix	SIRA24DP-T1-GE3
51	1	Q3	TRANS BJT NPN MMBT3904 40V 200 mA 310 mW SOT-23-3	Yes	Micro Commercial Components Corporation	MMBT3904-TP

TABLE B-1: BILL OF MATERIALS

Item	Qty	Reference	Description	Populated	Manufacturer	Manufacturer Part Number
52	1	Q4	TRANS FET P-CH BSC060P03NS3E G -30V -100A 83W PG-TDSON-8	Yes	Infineon Technologies	BSC060P03NS3EGATMA1
53	4	Q5, Q6, Q8, Q9	TRANS FET N-CH 2N7002-7-F 60V 170 mA 370 mW SOT-23-3	Yes	Diodes Inc	2N7002-7-F
54	1	Q7	TRANS FET DUAL P+P CMKDM8005 20V 650 mA .360R 0.350W SOT-363	Yes	Central Semiconductor Corp	CMKDM8005 TR PBFREE
55	8	R1, R8, R10, R83, R84, R85, R108, R114	RES TKF 330R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF3300V
56	2	R2, R109	RES TKF 20R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF20R0V
57	14	R3, R4, R5, R43, R46, R54, R64, R86, R87, R92, R113, R115, R118, R119	RES TKF 1k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1001V
58	2	R6, R32	RES TKF 43k 1% 1/10W SMD 0603	Yes	Yageo	9C06031A4302FKHFT
59	2	R7, R110	RES TKF 49.9k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF4992V
60	17	R9, R27, R30, R42, R44, R45, R47, R59, R72, R79, R82, R88, R89, R90, R99, R102, R103	RES TKF 10k 1% 1/10W SMD 0603	Yes	ROHM	MCR03EZPFX1002
61	16	R11, R12, R16, R21, R35, R39, R48, R52, R56, R60, R66, R71, R74, R75, R81, R121	RES TKF 0R 1/10W SMD 0603	Yes	Stackpole Electronics Inc	RMCF0603ZT0R00
62	2	R13, R73	RES TKF 18k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1802V
63	5	R14, R15, R61, R78, R80	RES TKF 1k 1% 1/10W SMD 0603	DNP	Panasonic	ERJ-3EKF1001V
64	6	R17, R20, R50, R57, R67, R70	RES TKF 100k 1% 1/10W SMD 0603	Yes	TE Connectivity	1622827-1
65	11	R18, R19, R26, R29, R37, R40, R53, R55, R68, R69, R122	RES TKF 0R 1/10W SMD 0603	DNP	Stackpole Electronics Inc	RMCF0603ZT0R00
66	3	R22, R77, R107	RES TKF 10k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1002V
67	1	R23	RES TKF 560R 1% 1/10W SMD 0603	Yes	Yageo	RC0603FR-07560RL
68	1	R24	RES TKF 140k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF1403V
69	1	R25	RES TKF 14.7K 1% 1/10W SMD 0603	Yes	Panasonic Electronic Components	ERJ-3EKF1472V
70	6	R28, R41, R91, R111, R116, R120	RES TKF 100k 1% 1/10W SMD 0603	Yes	Vishay Dale	CRCW0603100KFKEA
71	1	R31	RES TKF 8.2k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF8201V
72	2	R33, R106	RES TKF 20k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2002V
73	1	R34	RES TKF 750R 1% 1/10W SMD 0603	Yes	Vishay	CRCW0603750RFKEA
74	1	R36	RES TKF 2.49k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2491V
75	1	R38	RES TF 100k 1% 1/8W SMD 0603	Yes	Vishay	MCT06030C1003FP500
76	1	R49	RES TKF 33k 1% 1/10W SMD 0603 AEC-Q200	Yes	Vishay	CRCW060333K0FKEA

TABLE B-1: BILL OF MATERIALS

Item	Qty	Reference	Description	Populated	Manufacturer	Manufacturer Part Number
77	6	R51, R94, R96, R98, R100, R123	RES TKF 200k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2003V
78	2	R62, R105	RES TKF 2.2k 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF2201V
79	1	R76	RES TF 10.5k 0.1% 1/10W SMD 0603 AEC-Q200	Yes	Panasonic Electronic Components	ERA-3AEB1052V
80	2	R93, R95	RES TKF 10R 1% 1/10W SMD 0603	Yes	Panasonic	ERJ-3EKF10R0V
81	1	R97	RES TKF 12k 1% 1/10W SMD 0603	Yes	Yageo	RC0603FR-0712KL
82	1	R101	RES TKF 500R 5% 1/10W SMD 0603	Yes	Vishay Dale	TNPU0603500RAZEN00
83	1	R104	RES TKF 470k 1% 1/10W SMD 0603	Yes	Vishay	CRCW0603470KFKEA
84	2	R112, R117	RES TKF 2R 1% 1/4W SMD 0603	Yes	Vishay Dale	CRCW06032R00FKEAHP
85	1	SW1	SWITCH SLIDE DPDT 6V 300 mA JS202011SCQN SMD	Yes	C&K	JS202011SCQN
86	1	SW2	SWITCH TACT SPST 16V 50 mA PTS810 SJM 250 SMTR LFS SMD	Yes	C&K Components	PTS810 SJM 250 SMTR LFS
87	1	TP4	CON TP LOOP BLUE Ag TH	Yes	Keystone Electronics	5117
88	4	TP5, TP7, TP8, TP15	MISC, TEST POINT MULTI PURPOSE MINI RED	Yes	Keystone	5000
89	1	TP10	MISC, TEST POINT MULTI PURPOSE MINI BLACK	Yes	Keystone	5001
90	1	TP11	CON TP LOOP Orange TH	Yes	Keystone Electronics	5003
91	1	TP12	MISC, TEST POINT PC MINI, 0.040" D YELLOW	Yes	Keystone	5004
92	1	U0	MCHP INTERFACE USB 3.1 TYPE-C HUB CTLR QFN-100	Yes	Microchip Technology	USB7016/KDX
93	9	U1, U2, U3, U5, U9, U12, U16, U17, U18	74LVC1G14GW,125 SCHMITT-TRG INVERTER	Yes	NXP	74LVC1G14GW,125
94	3	U4, U11, U15	MCHP INTERFACE USB Power Controller UCS2114 QFN-20	Yes	Microchip Technology	UCS2114-1-V/LX
95	1	U6	MCHP MEMORY SERIAL FLASH 16M 104 MHz SST26VF016B-104I/SM SOIJ-8	Yes	Microchip Technology	SST26VF016B-104I/SM
96	1	U7	MCHP ANALOG SUPERVISOR 2.93V MIC803-29D4VM3-TR SOT-23-3	Yes	Microchip Technology	MIC803-29D4VM3-TR
97	1	U8	MCHP ANALOG PWM CONTROLLER 600 kHz MCP19035-BAABE/MF DFN-10	Yes	Microchip Technology	MCP19035-BAABE/MF
98	1	U13	MCHP ANALOG LDO 3.3V MCP1825ST-3302E/DB SOT-223-3	Yes	Microchip	MCP1825ST-3302E/DB
99	1	U14	MCHP ANALOG SWITCHER Buck 0.95V to 3.6V 2A MIC23201YML-TR MLF-10	Yes	Microchip Technology	MIC23201YML-TR
100	1	Y1	MCHP CLOCK OSCILLATOR SINGLE 25 MHZ DSC1001CI2-025.0000T CDFN-4	DNP	Microchip Technology	DSC1001CI2-025.0000T
101	1	Y2	MCHP CRYSTAL 25 MHz 10 pF SMD L3.2W2.5H0.8	Yes	Microchip Technology	VXM7-9013-25M0000000

NOTES:

Appendix C. PCB Silk Screens

C.1 INTRODUCTION

This appendix shows the top and bottom silk screen images of the EVB-USB7016 PCB.

FIGURE C-1: EVB-USB7016 TOP SILK SCREEN IMAGE

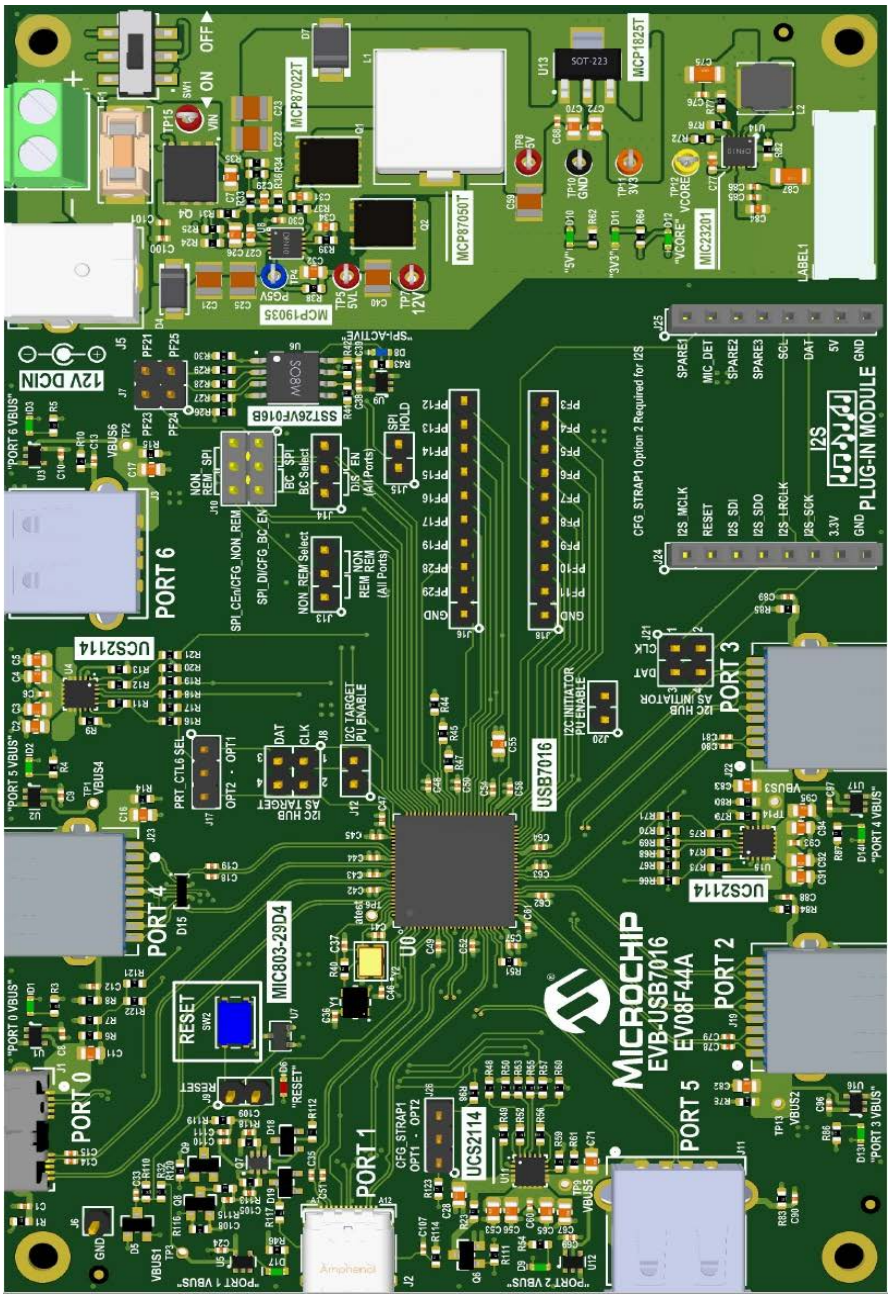
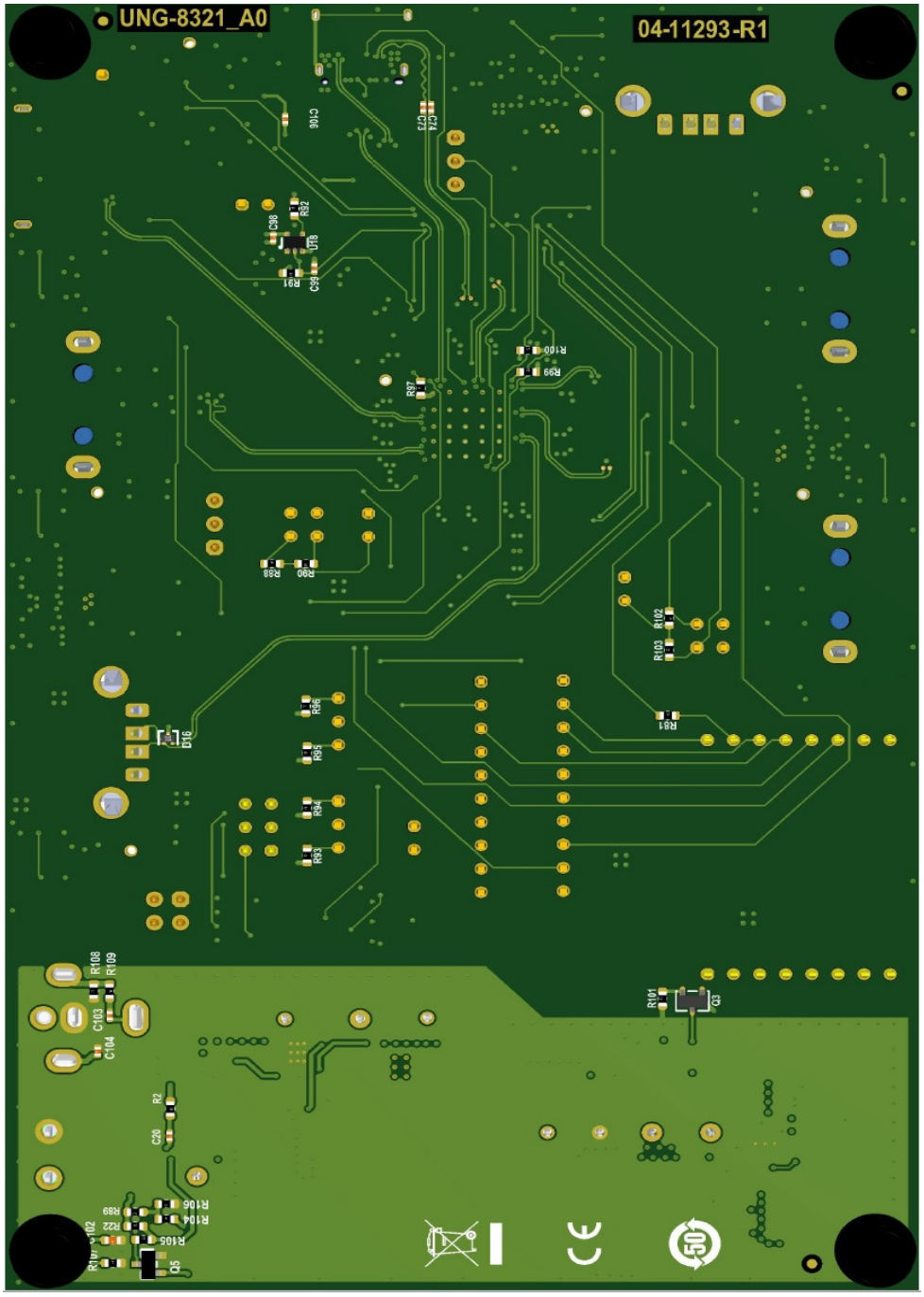


FIGURE C-2: EVB-USB7016 BOTTOM SILK SCREEN IMAGE



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