



UTC2000
Evaluation Kit
User's Guide

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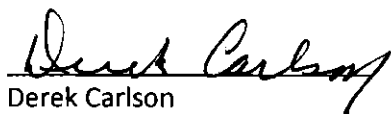
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA


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VP Development Tools

12-Sep-14
Date

NOTES:

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Preface

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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 “DSXXXXA”, where “XXXX” 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 UTC2000 Evaluation Kit User's Guide. Items discussed in this chapter include:

- Document Layout EVK-UTC2000
- Conventions Used in this Guide
- Warranty Registration
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT EVK-UTC2000

This document describes how to use the UTC2000 Evaluation Kit as a demonstration platform optimized for portable applications. The manual layout is as follows:

- **Chapter 1. “Overview”** – Shows a brief description of the UTC2000 Evaluation Kit
- **Chapter 2. “Getting Started”** – Provides information about set-up and operation of the UTC2000 Evaluation Kit.
- **Chapter 3. “Hardware Configuration”** – Includes information about the hardware configuration of the UTC2000 Evaluation Kit.
- **Appendix A. “UTC2000 Schematics”**
- **Appendix B. “EVK-UTC2000 BOM”**
- **Appendix C. “EVK-UTC2000 PCB Silk Screens”**

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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	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> 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	<u><i>File>Save</i></u>
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	<code>#define START</code>
	Filenames	<code>autoexec.bat</code>
	File paths	<code>c:\mcc18\h</code>
	Keywords	<code>_asm, _endasm, static</code>
	Command-line options	<code>-Opa+, -Opa-</code>
	Bit values	<code>0, 1</code>
	Constants	<code>0xFF, 'A'</code>
Italic Courier New	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	<code>mcc18 [options] file [options]</code>
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments; an OR selection	<code>errorlevel {0 1}</code>
Ellipses...	Replaces repeated text	<code>var_name [, var_name...]</code>
	Represents code supplied by user	<code>void main (void) { ... }</code>

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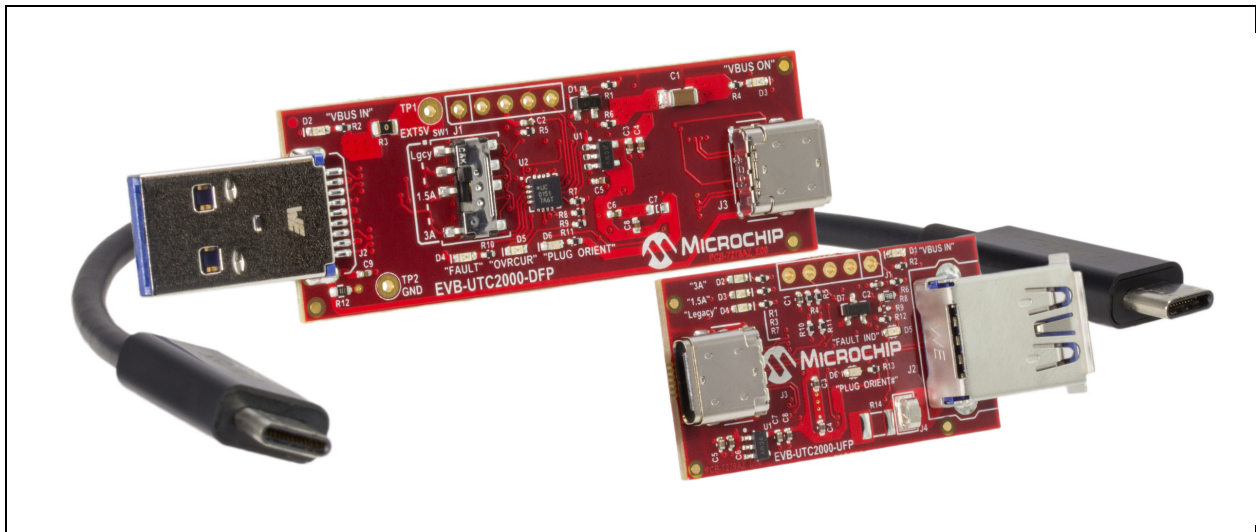
Revision	Section/Figure/Entry	Correction
DS50002399A (07-30-15)	Initial Release of Document	

Chapter 1. Overview

1.1 UTC2000 EVALUATION KIT OVERVIEW AND FEATURES

The UTC2000 Evaluation Kit is intended to demonstrate the form factor and reversibility of the USB Type-C™ cable operation as enabled by the UTC2000 basic Type-C controller. The kit includes a downstream facing port board, an upstream facing port board, and a USB Type-C cable, as shown in [Figure 1-1](#). A basic USB Type-C connection can be demonstrated with a standard USB 2.0 or USB 3.1 Gen 1 host port, the UTC2000 EVK and any USB 2.0 or USB 3.1 Gen 1 device. See [Section 1.2 “Features”](#) for more information.

FIGURE 1-1: UTC2000 EVALUATION KIT



1.2 FEATURES

- EVB-UTC2000-DFP converts any USB Type-A port to a USB Type-C port
- EVB-UTC2000-UFP converts any USB device to a USB Type-C device
- Compatible with USB 2.0 and USB 3.1 Gen 1 host ports and devices
- Supports basic USB Type-C 5V charging at:
 - Legacy 500mA (USB 2.0)/900mA (USB 3.1 Gen 1)
 - 1.5A
 - 3.0A
- LED status indicators on the downstream facing port (DFP) board include:
 - 5V board supply indicators
 - “Overcurrent” and “Fault” indicators
 - Plug orientation
- LED status indicators on the upstream facing port (UFP) board include:
 - 5 V board supply indicator
 - Legacy, 1.5A, 3.0A charging detecting indicators

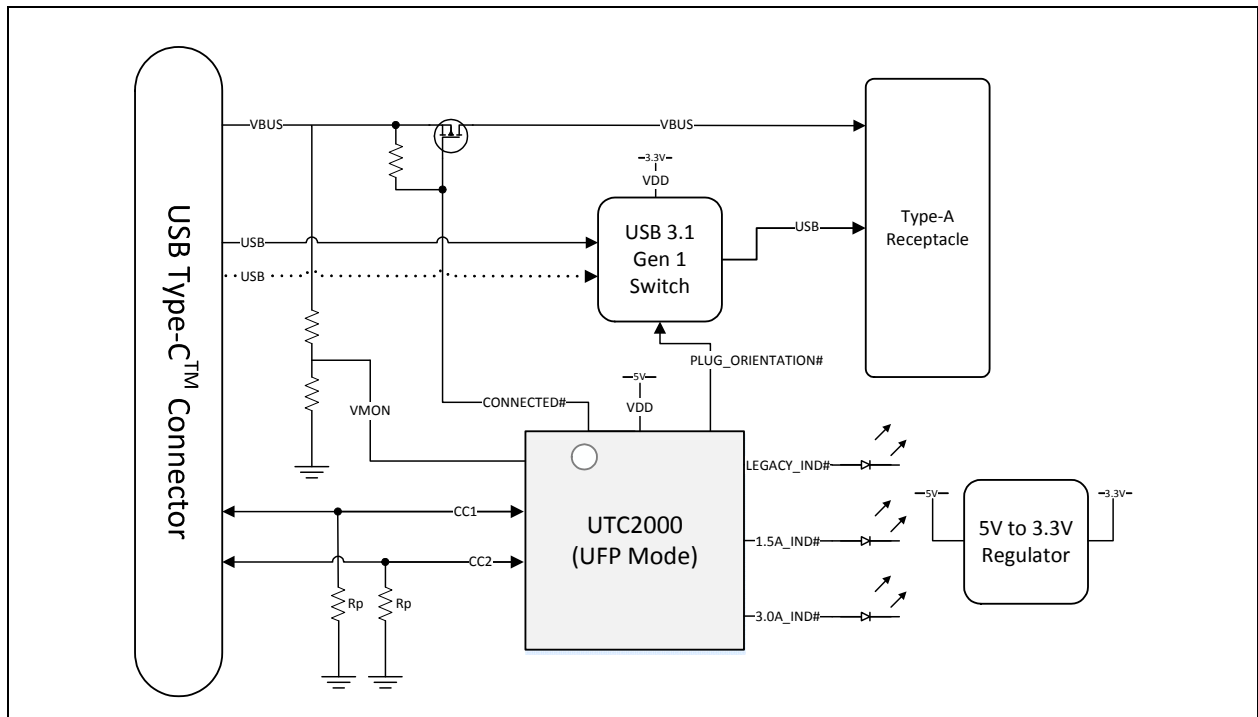
- ### 1.3 GENERAL DESCRIPTION

The diagram illustrates the internal circuitry of a USB Type-C™ Connector in DFP (Data Forward Path) Mode. Key components and connections include:

- USB 3.1 Gen 1 Type-A Plug:** Provides the initial USB signal and VBUS (5V).
- 5V@4A Port Power Controller:** Manages power delivery, receiving PPC_EN and OCS# signals, and outputting VBUS and VMON.
- 5V to 3.3V Regulator:** Converts the 5V supply to a 3.3V supply for the USB 3.1 Gen 1 Switch.
- USB 3.1 Gen 1 Switch:** Routes the USB signal and VBUS to the USB Type-C™ Connector. It is controlled by VMON and PLUG_ORIENTATION#.
- UTC2000 (DFP Mode):** The central controller managing the connection. It receives ENABLE and VBUS signals and outputs VCONN1_OUT#, VCONN2_OUT#, CC1, and CC2 signals.
- USB Type-C™ Connector:** The physical interface that connects to the external USB 3.1 Gen 1 Type-A Plug.

The diagram also shows various internal components like resistors (Rp), capacitors (Cp), and diodes (Dp) used for signal conditioning and protection.

FIGURE 1-3: EVB-UTC2000-UFP BLOCK DIAGRAM



1.4 REFERENCES

- *USB Type-C™ Specification*
- *UTC2000 Data Sheet*
- *Introduction to USB Type-C™ Application Note*
(<http://ww1.microchip.com/downloads/en/AppNotes/00001953A.pdf>)
- *Basic USB Type-C™ Upstream Facing Port Implementation*
(<http://ww1.microchip.com/downloads/jp/AppNotes/jp574170.pdf>)

1.5 DEFINITION

- **DFP** - Downstream Facing Port
- **EVB** - Evaluation Board
- **EVK** - Evaluation Kit
- **UFP** - Upstream Facing Port

Chapter 2. Getting Started

2.1 CONTENTS OF THE KIT

The UTC2000 Evaluation kit includes the basic equipment necessary for evaluation. The items include in the kit are:

1. **EVB-UTC2000-DFP Evaluation Board**
2. **EVB-UTC2000-UFP Evaluation Board**
3. **USB Type-C Cable**

2.2 BRING-UP AND TESTING

2.2.1 Setup and Requirements

- **EVB-UTC2000-DFP:** Before use, slide SW1 to the legacy charging mode. To use, simply insert the device into any USB Type-A USB 2.0 or USB 3.1 Gen 1 host port. Any USB Type-C device may now be connected to the USB Type-C port. The reversibility of the USB Type-C cable can be demonstrated by connecting it in the opposite direction.
- **EVB-UTC2000-UFP:** To use, connect to any USB Type-C host or hub port. If there is no native USB Type-C host available, the EVB-UTC2000-DFP board may be used. Insert a USB 2.0 or USB 3.1 Gen 1 device into the Type-A receptacle(J2) of the EVB-UTC2000-UFP. The device may then be used normally.

2.2.2 EVB-UTC2000-DFP Legacy Charging Operation

The EVB-UTC2000-DFP board is configured to Legacy 500mA (USB2.0)/900mA(USB3.1 Gen1) charging mode by default. Ensure that SW1 is in the "Lgcy" position. The switch will select 56 k Ω CC1/CC2 Rp pull-up resistors and set the CFG_SEL voltage to the appropriate level.

When connecting the EVB-UTC2000-DFP board to the EVB-UTC2000-UFP while in Legacy charging mode, the "Legacy" charging capability LED indicator (D4) on the EVB-UTC2000-UFP will be illuminated.

2.2.3 1.5 A Charging Operation

The EVB-UTC2000-DFP is designed to plug in and operate from any legacy USB Type-A port. In order to protect your computer from possible overcurrent issues, 1.5A and 3.0A modes have been disabled by default.

In order to test 1.5A charging mode, please perform the following steps:

1. Remove R15 and R17 56k Rp pull-up resistors
2. Populate R18 and R23 with 22k, 0402 footprint resistors
3. Set SW1 to the "1.5A" position
4. Remove R3 to isolate the 5V domain on the EVB-UTC200-DFP from the 5V domain on your host PC.
5. Connect an external power supply as shown in section 3.1.1

When connecting the EVB-UTC2000-DFP board to the EVB-UTC2000-UFP while in 1.5A charging mode, the “1.5A” charging capability LED (D3) indicator on the EVB-UTC2000-UFP will be illuminated.

2.2.4 3.0 A Charging Operation

The EVB-UTC2000-DFP is designed to plug in and operate from any legacy USB Type-A port. In order to protect your computer from possible overcurrent issues, 1.5A and 3.0A modes have been disabled by default.

In order to test 1.5A charging mode, please perform the following steps:

1. Remove R15 and R17 56k Rp pull-up resistors
2. Populate R18 and R23 with 22k, 0402 footprint resistors
3. Set SW1 to the "1.5A" position
4. Remove R3 to isolate the 5V domain on the EVB-UTC200-DFP from the 5V domain on your host PC.
5. Connect an external power supply as shown in section 3.1.1

When connecting the EVB-UTC2000-DFP board to the EVB-UTC2000-UFP while in 3.0A charging mode, the “3.0A” charging capability LED indicator (D2) on the EVB-UTC2000-UFP will be illuminated.

Chapter 3. Hardware Configuration

3.1 HARDWARE DESCRIPTION

FIGURE 3-1: EVB-UTC2000-UFP (TOP-SIDE)

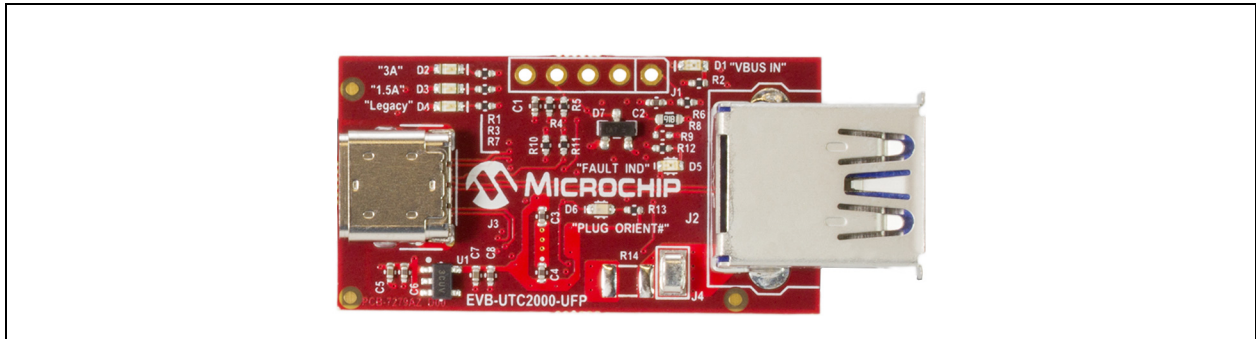
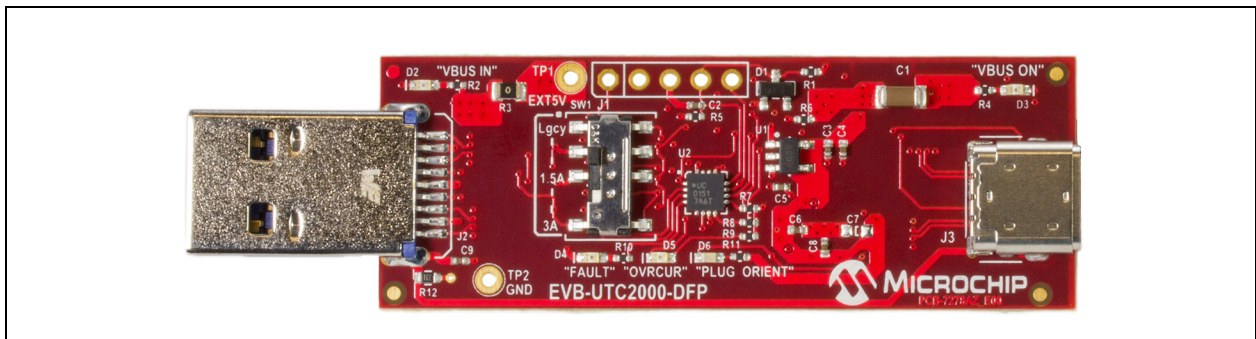


FIGURE 3-2: EVB-UTC2000-DFP (TOP-SIDE)

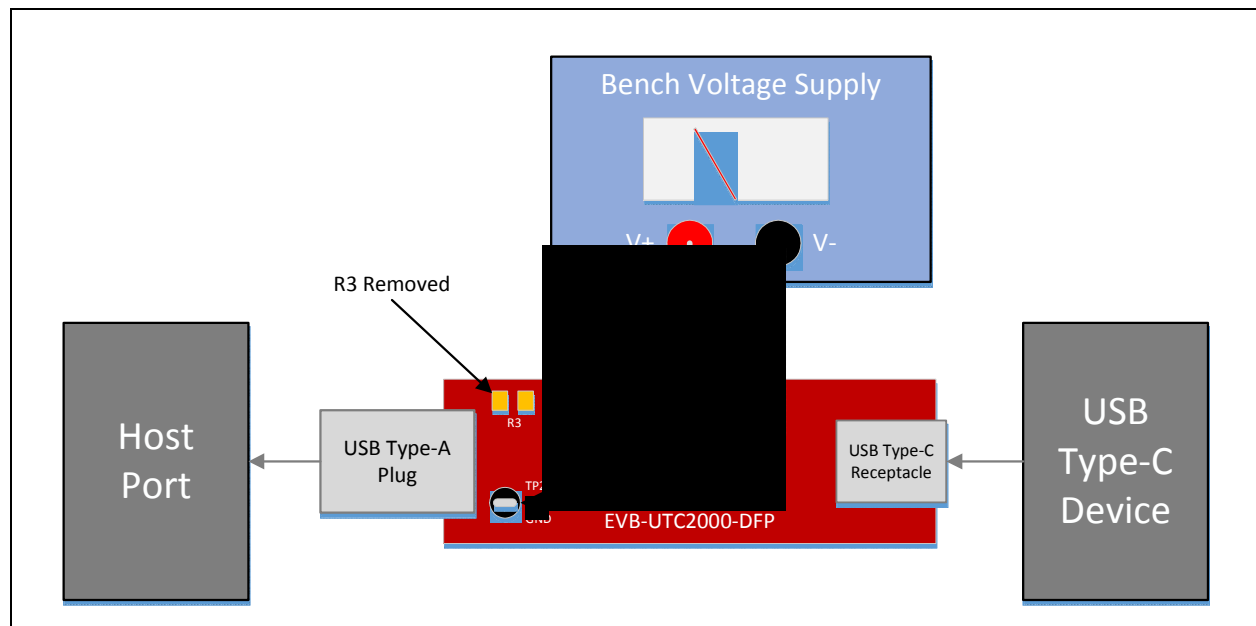


3.1.1 Power Source

The EVB-UTC2000-DFP can be powered in one of two ways:

1. **Host/Hub Port VBUS:** The board can be powered by 5V VBUS sourced from the connected host port. Do not operate with SW1 in the 1.5A or 3.0A modes and attempt to draw 1.5A or 3.0A when connected in this way, as Legacy USB Type-A host ports typically cannot support this amount of current draw.
2. **External 5V Supply:** An external 5V supply may be connected to TP1 to test 1.5A and 3.0A charging. Be sure to remove the R3 zero-ohm resistor to prevent voltage back drive to the host/hub port, as shown in [Figure 3-3](#).

FIGURE 3-3: EVB-UTC2000-DFP EXTERNAL 5V SUPPLY



The EVB-UTC2000-DFP is always powered from VBUS supplied by the downstream facing port it is attached to.

3.1.2 LED Indicators for EVB-UTC2000-DFP

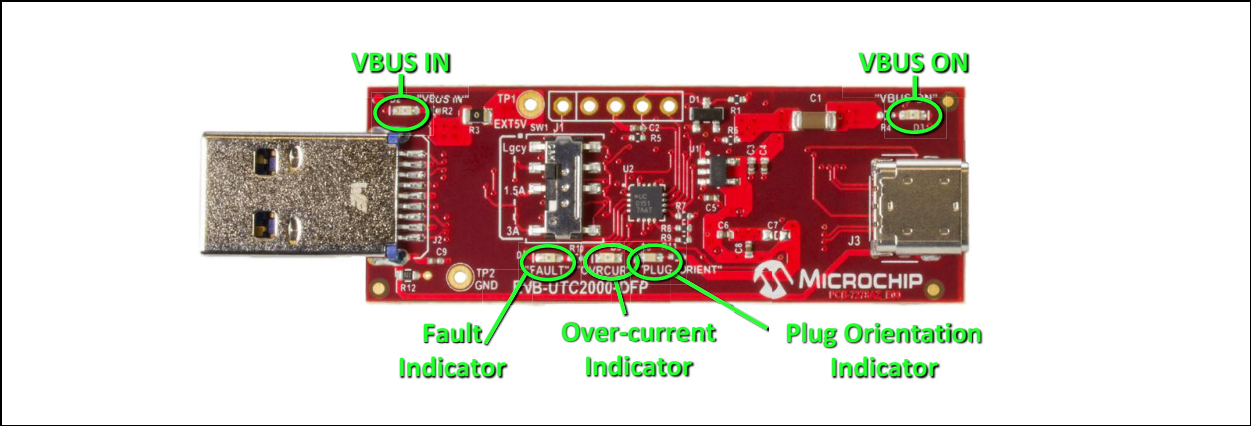
Table 3-1 describes the LED indicators included on the EVB-UTC2000-DFP.

TABLE 3-1: LED INDICATOR DESCRIPTIONS

REF. DES.	LABEL	DESCRIPTION
D2	"VBUS IN"	Indicates that 5V board power is present
D3	"VBUS ON"	Indicates 5V is being supplied to VBUS on the Type-C port
D4	"FAULT"	Indicates an overvoltage or overcurrent event has occurred. This indicator will reset with a power cycle of the board.
D5	"OVRCUR"	Indicates an overcurrent event is occurring. This signal is driven by the 5V port power controller.
D6	"PLUG ORIENT"	Indicates the state of the PLUG_ORIENTATION# signal. When illuminated, PLUG_ORIENTATION is being driven low by the UTC2000.

Figure 3-4 shows their location on the PCB.

FIGURE 3-4: EVB-UTC2000-DFP LED INDICATOR LOCATIONS



3.1.3 Switches on EVB-UTC2000-DFP

Table 3-2 describes the switches included on the EVB-UTC2000-DFP.

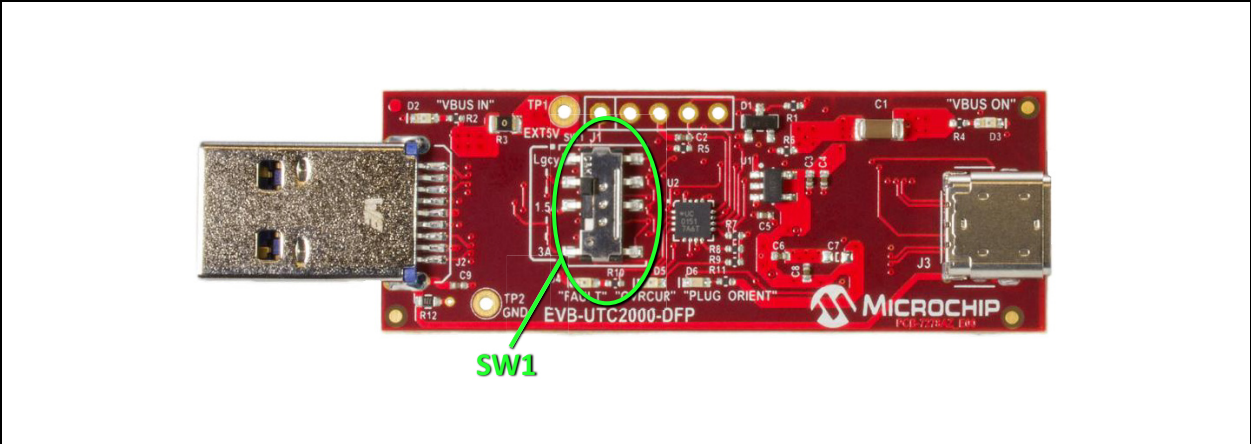
TABLE 3-2: SWITCH DESCRIPTIONS

REF. DES.	LABEL	DESCRIPTION
SW1	"Lgcy -- 1.5A -- 3A"	Selects between the DFP modes of operation: "Lgcy", "1.5A", "3.0A"

Note: The EVB-UTC2000-DFP is configured for Legacy mode of operation by default. See sections 2.2.2/2.2.3 for information on testing 1.5A/3.0A modes.

Figure 3-5 shows their location on the PCB.

FIGURE 3-5: EVB-UTC2000-DFP SWITCH LOCATIONS



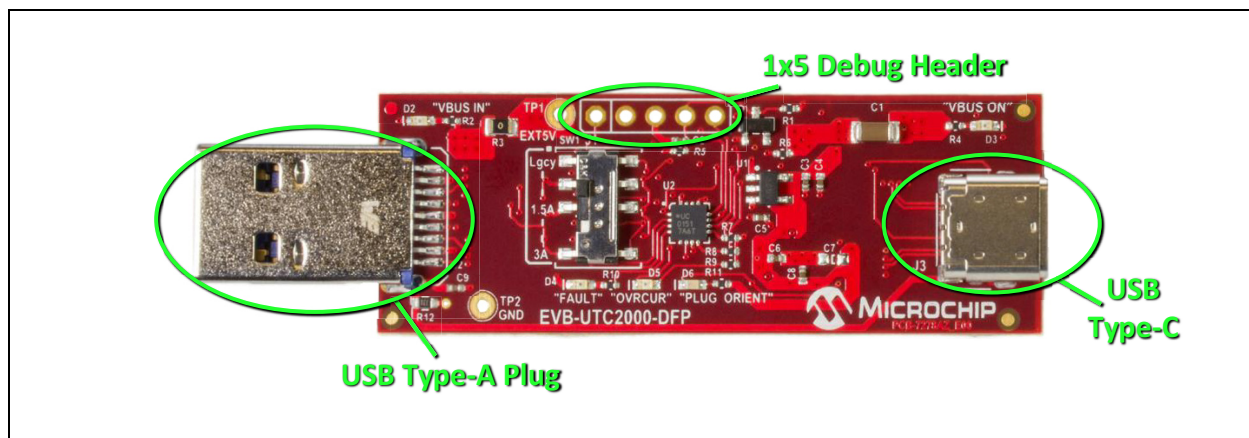
3.1.4 Connector Descriptions for EVB-UTC2000-DFP

Table 3-3 describes the connectors included on the EVB-UTC2000-DFP.

TABLE 3-3: CONNECTOR DESCRIPTIONS

REF. DES.	TYPE	LABEL	DESCRIPTION
J1	1x5 Header	-	5-pin debug header (internal MCHP use only)
J2	USB 3.1 Gen 1 Type-A Plug	-	Type-A male plug
J3	USB 3.1 Gen 1 Type-C Receptacle	-	Type-C receptacle

FIGURE 3-6: EVB-UTC2000-DFP CONNECTOR LOCATIONS



3.1.5 Test Points on EVB-UTC2000-DFP

Table 3-4 describes the test points included on the EVB-UTC2000-DFP. A header may be permanently installed on the through-hole test points if needed.

TABLE 3-4: EVB-UTC2000-DFP TEST POINT DESCRIPTIONS

REF. DES.	TYPE	DESCRIPTION
TP1	Thru-Hole	5V probe point or external 5V supply point
TP2	Thru-Hole	GND

3.1.6 LED Indicators for EVB-UTC2000-UFP

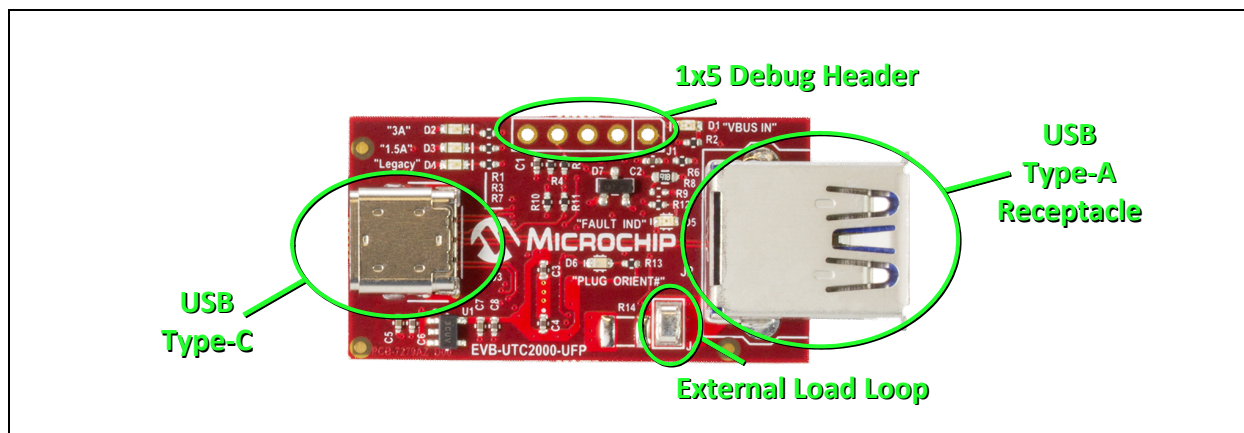
Table 3-5 describes the LED indicators included on the EVB-UTC2000-UFP.

TABLE 3-5: EVB-UTC2000-UFP LED INDICATOR DESCRIPTIONS

REF. DES.	LABEL	DESCRIPTION
D1	"VBUS IN"	Indicates that a valid VBUS (5.5V-4.0V) is being supplied to the EVB-UTC2000-UFP from the USB Type-C™ connection and that 5V is being passed to the USB Type-A receptacle.
D2	"3A"	Indicates when a 3.0 A capable DFP connection is detected.
D3	"1.5A"	Indicates when a 1.5 A capable DFP connection is detected.
D4	"Legacy"	Indicates when legacy 500 mA (USB 2.0) / 900 mA (USB 3.1 Gen 1) capable DFP connection is detected.

Figure 3-7 shows their location on the PCB.

FIGURE 3-7: EVB-UTC2000-UFP LED INDICATOR LOCATIONS



3.1.7 Switches on EVB-UTC2000-UFP

There are no switches present on the EVB-UTC2000-UFP.

3.1.8 Connector Descriptions for EVB-UTC2000-UFP

Table 3-6 describes the connectors included on the EVB-UTC2000-UFP.

TABLE 3-6: EVB-UTC2000-UFP CONNECTOR DESCRIPTIONS

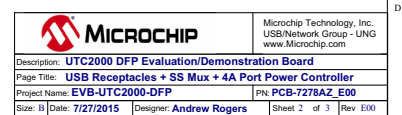
REF. DES.	TYPE	LABEL	DESCRIPTION
J1	1x5 Header	-	5-pin debug header (internal Microchip use only)
J2	USB 3.1 Gen 1 Type-A Plug	-	USB Type-A receptacle
J3	USB 3.1 Gen 1 Type-C Receptacle	-	USB Type-C™ receptacle
J4	Load Loop	-	An external load may be connected between this load loop and GND (pin 3 of J1)

Appendix A. UTC2000 Schematics

A.1 INTRODUCTION

This appendix shows the UTC2000 Evaluation Kit Schematic.

UTC2000 Schematics



UTC2000 Evaluation Kit User's Guide

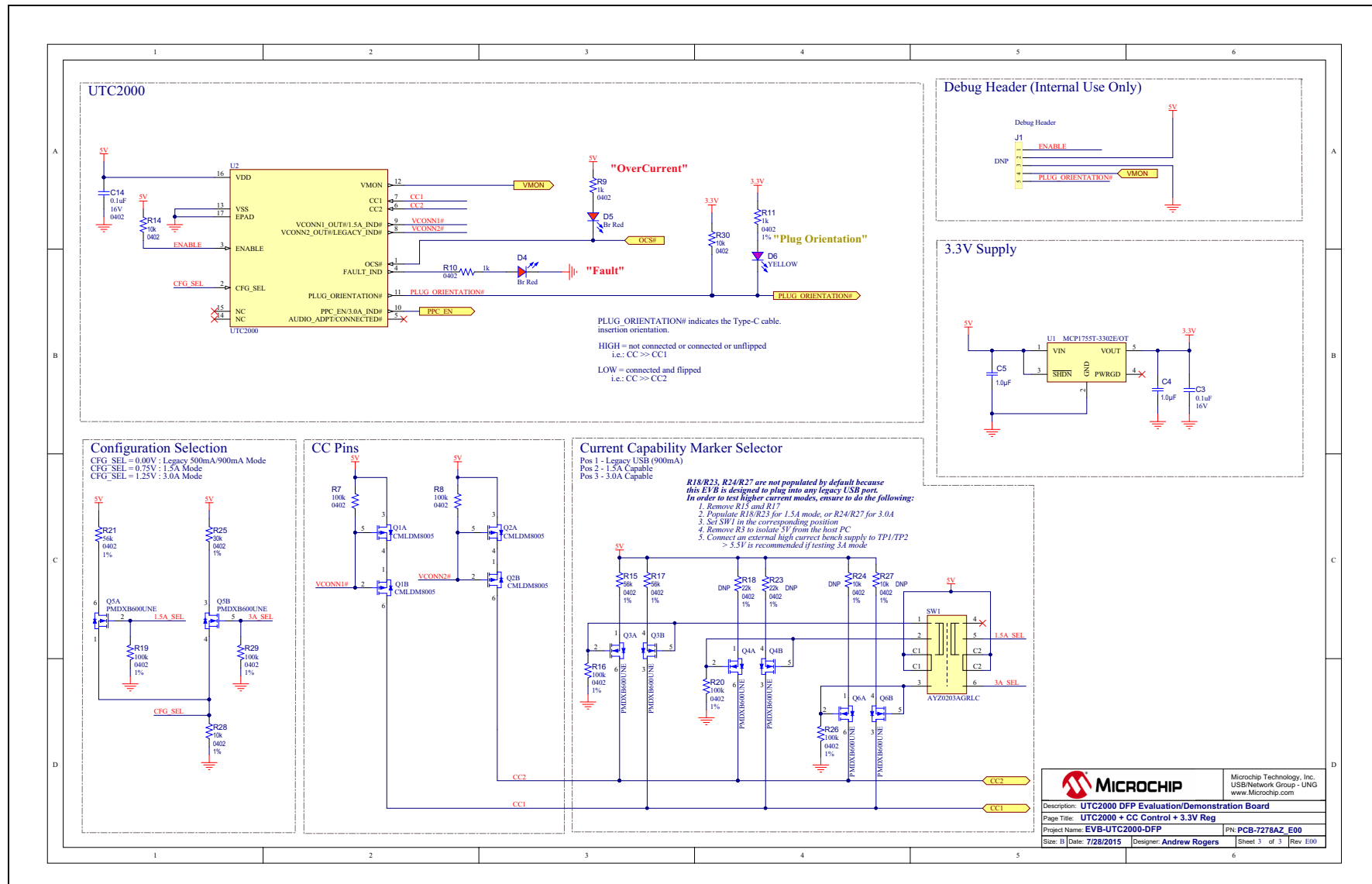
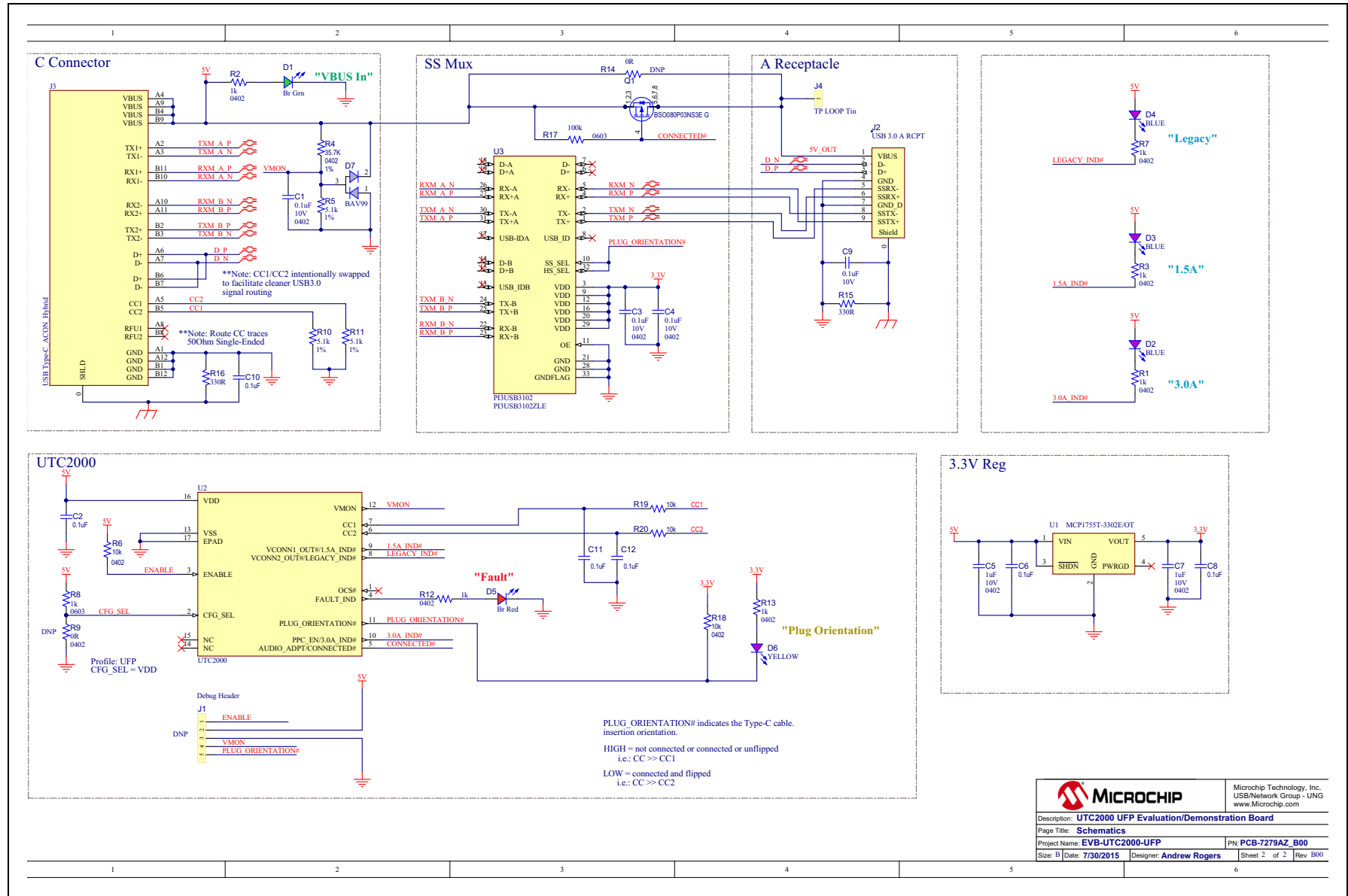


FIGURE A-1: UTC2000 EVALUATION KIT SCHEMATICS (CONTINUED)



Appendix B. EVK-UTC2000 BOM

B.1 INTRODUCTION

This appendix shows the EVK-UTC2000 Evaluation Bill of Materials.

TABLE B-1: EVK-UTC2000-DFP BILL OF MATERIALS

Item	Qty	Qty Pop'd	Reference Designator(s)	Description	Manufacturer	Manufacturer Part Number
1	1	1	C1	CAP CER, 47uF, 16V, 20%, X5R, 1206	TDK Corporation	C3216X5R1C476M160AB
2	8	8	C2, C3, C6, C8, C9, C10, C12, C14	CAP CER, 0.1uF, 16V, 80%, SMD, 0402	Yageo	CC0402ZRY5V7BB104
3	3	3	C4, C5, C13	CAP CER, 1uF, 16V, 10%, X5R, 0402	TDK Corporation	C1005X5R1C105K050BC
4	1	1	C7	CAP CER, 10uF, 6.3V, 20%, X5R SMD, 0603	AVX	06036D106MAT2A
5	1	1	C11	CAP CER, 4.7uF, 10V, 10%, X5R SMD, 0603	Taiyo Yuden	LMK107BJ475KA-T
6	1	1	D1	DIO RECTARR, BAV99, 1.25V, 200mA, 70V, SOT-23-3	Fairchild	BAV99
7	2	2	D2, D3	LED, Bright Green, 0603	Lite-On	LTST-C191KGKT
8	2	2	D4, D5	LED, Bright Red, 0603	Lite-On	LTST-C191KRKT
9	1	1	D6	DIO LED YELLOW 2V 25mA 162.5mcd Diffuse SMD 0603	OSRAM	LY Q976-P1S2-36
10	1	1	J1	CON HDR-2.54 Male 1x5 Gold 5.84MH TH VERT	Samtec	TSW-105-07-S-S
11	1	1	J2	CON USB 3.1 Gen 1 STD-A PLUG SMD R/A	Wurth Electronics Inc	692112030100
12	1	1	J3	CON USB 3.1 Gen 1 Hybrid Type-C	ACON	
13	2	2	Q1, Q2	MOSFET SMD- Small Signal P-Channel Mosfet	Central Semiconductor	CMLDM8005 TR
14	4	4	Q3, Q4, Q5, Q6	MOSFET TRENCH 2N-CH 20V 600MA SOT-1216	NXP Semiconductors	PMDXB600UNE
15	1	1	R1	RES SMD 35.7K OHM 1% 1/10W 0402	Panasonic	ERJ-2RKF3572X
16	5	5	R2, R4, R9, R10, R11	RES TKF 1k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF1001X
17	1	1	R3	RES TKF 0R 1/8W SMD 0805	Panasonic	ERJ-6GEY0R00V
18	2	2	R5, R6	RES SMD 5.1K OHM 1% 1/10W 0402	Panasonic	ERJ-2RKF5101X
19	8	8	R7, R8, R16, R19, R20, R22, R26, R29	RES TKF 100k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF1003X
20	2	2	R12, R13	RES TKF 330R 1% 1/10W SMD 0603	ROHM	MCR03EZPFX3300
21	3	3	R14, R28, R30	RES TKF 10k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF1002X
22	3	3	R15, R17, R21	RES TKF 56k 1% 1/16W SMD 0402	ROHM	MCR01MZPF5602
23	1	1	R25	RES SMD 30K OHM 1% 1/10W 0402	Panasonic	ERJ-2RKF3002X
24	1	1	SW1	SW SLIDE DP3T 12VDC 100MA SMT	C&K Components	AYZ0203AGRCLC

TABLE B-1: EVK-UTC2000-DFP BILL OF MATERIALS (CONTINUED)

Item	Qty	Qty Pop'd	Reference Designator(s)	Description	Manufacturer	Manufacturer Part Number
25	1	1	TP1	MISC, TEST POINT MULTI PURPOSE MINI RED	Keystone	5000
26	1	1	TP2	MISC, TEST POINT MULTI PURPOSE MINI BLACK	Keystone	5001
27	1	1	U1	IC REG LDO 3.3V 0.3A SOT23-5	Microchip Technology	MCP1755T-3302E/OT
28	1	1	U2	UTC2000 TYPEC CONTROLLER 16QFN	Microchip Technology	UTC2000/MG
29	1	1	U3	IC CURR-LIM SW SNGL PROG 12-TQFN	Maxim Integrated	MAX1563ETC+
30	1	1	U4	IC USB 3.1 Gen 1 & USB 2.0 SWITCH 32TQFN	Pericom	PI3USB3102ZLE

TABLE B-2: EVK-UTC2000-UFP BILL OF MATERIALS

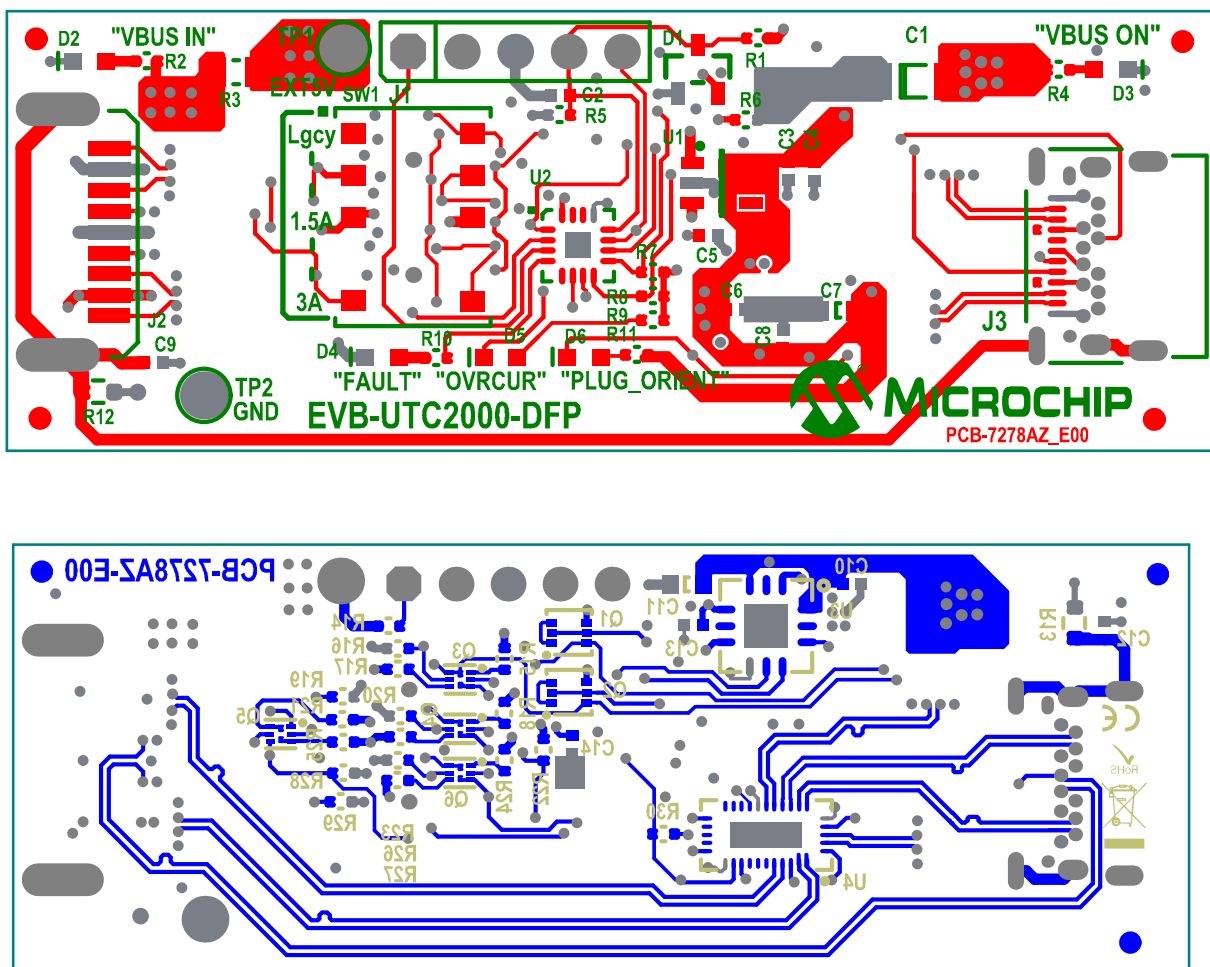
Item	Qty	Qty Pop'd	Reference Designator(s)	Description	Manufacturer	Manufacturer Part Number
1	8	8	C1, C2, C3, C4, C6, C8, C9, C10	CAP CER 0.1uF 10V 10% X5R SMD 0402	KEMET	C0402C104K8PACTU
2	2	2	C5, C7	CAP CER 1uF 10V 10% X5R 0402	Murata Electronics North America	GRM155R61A105KE15D
3	1	1	D1	LED, Bright Green, 0603	Lite-On	LTST-C191KGKT
4	3	3	D2, D3, D4	DIO LED BLUE 2.8V 20mA 15mcd Clear SMD 0603	Lite-On	LTST-C193TBKT-5A
5	1	1	D5	LED, Bright Red, 0603	Lite-On	LTST-C191KRKT
6	1	1	D6	DIO LED YELLOW 2V 25mA 162.5mcd Diffuse SMD 0603	OSRAM	LY Q976-P1S2-36
7	1	1	D7	DIO RECTARR BAV99 1.25V 200mA 70V SOT-23-3	Fairchild	BAV99
8	1	1	J1	CON HDR-2.54 Male 1x5 Gold 5.84MH TH VERT	Samtec	TSW-105-07-S-S
9	1	1	J2	CON USB 3.1 Gen 1 STD-A RCPT TH R/A	Würth Electronics Inc	692121030100
10	1	1	J3	CON USB 3.1 Gen 1 Hybrid Type-C	ACON	
11	1	1	J4	CON TP LOOP Tin SMD	Harwin Inc	S1751-46R
12	1	1	Q1	MOSFET P-CH 30V 12A 8DSO	Infineon Technologies	BSO080P03NS3E G
13	6	6	R1, R2, R3, R7, R12, R13	RES TKF 1k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF1001X
14	1	1	R4	RES SMD 35.7K OHM 1% 1/10W 0402	Panasonic	ERJ-2RKF3572X
15	3	3	R5, R10, R11	RES SMD 5.1K OHM 1% 1/10W 0402	Panasonic	ERJ-2RKF5101X
16	2	2	R6, R18	RES TKF 10k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF1002X
17	1	1	R8	RES TKF 1k 1% 1/10W SMD 0603	Yageo	RC0603FR-071KL
18	1	1	R14	RES TKF 0R 1/3W SMD 1210	Vishay	CRCW12100000Z0EA
19	2	2	R15, R16	RES TKF 330R 1% 1/10W SMD 0603	ROHM	MCR03EZPFX3300
20	1	1	R17	RES TKF 100k 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF1003V
21	1	1	U1	IC REG LDO 3.3V 0.3A SOT23-5	Microchip Technology	MCP1755T-3302E/OT
22	1	1	U2	UTC2000 TYPEC CONTROLLER 16QFN	Microchip Technology	EVK-UTC2000-UFP
23	1	1	U3	IC USB 3.1 Gen 1 & USB 2.0 SWITCH 32TQFN	Pericom	PI3USB3102ZLE

Appendix C. EVK-UTC2000 PCB Silk Screens

C.1 INTRODUCTION

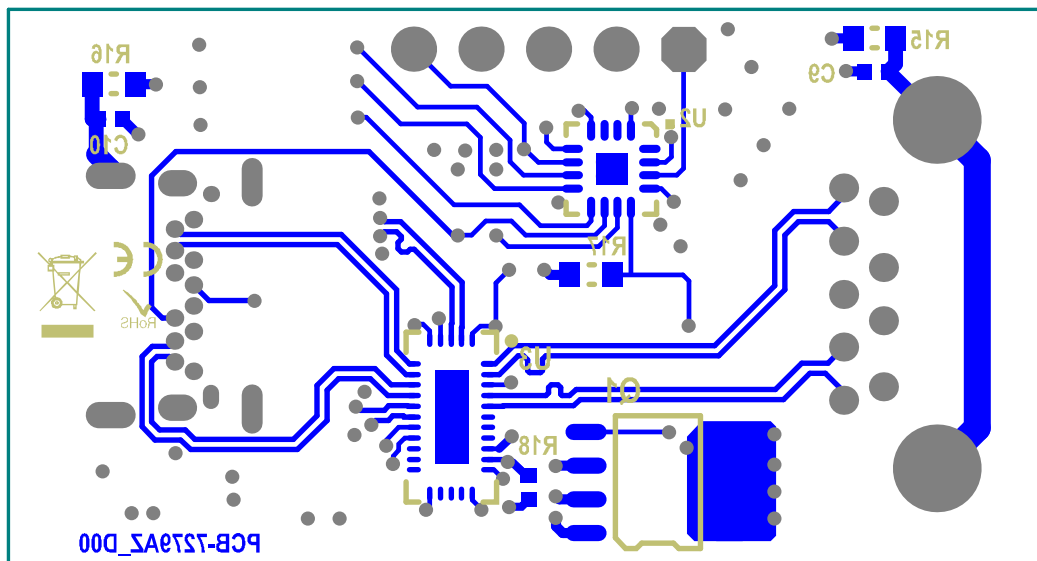
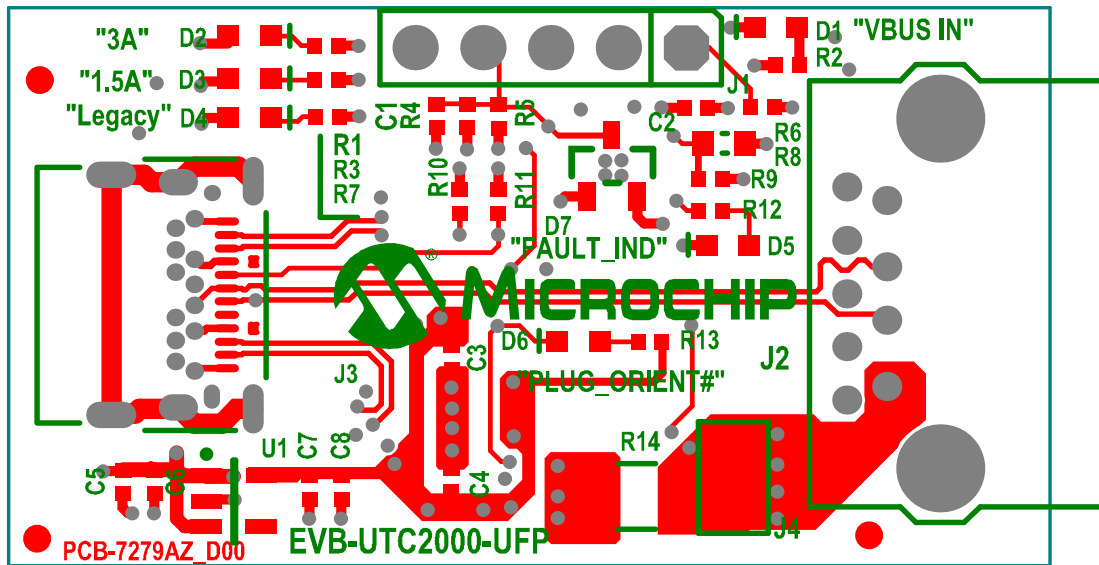
This appendix shows the EVK-UTC2000 Top and Bottom Silk Screen Images.

FIGURE C-1: EVB-UTC2000-DFP TOP AND BOTTOM SILK SCREEN IMAGES



EVK-UTC2000 PCB Silk Screens

FIGURE C-2: EVB-UTC2000-UFP TOP AND BOTTOM SILK SCREEN IMAGES



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