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UTC2000 Evaluation Kit User's Guide

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

Derek Carlson
VP Development Tools

12-Sep-14
Date

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 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 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 Website
- 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"**

Note: USB Type-C™ USB-C™ are trademarks of USB Implementation Forum.

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
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- Technical Support

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

DOCUMENT REVISION HISTORY

Revision	Section/Figure/Entry	Correction
DS50002399A (07-30-15)	Initial Release of Document	
DS50002399B (11-20-15)	**Section 2.1 "Contents of the Kit"**	Updated grammar.
	Section 2.2.2 "EVB-UTC2000-DFP Legacy Charging Operation"	Updated first paragraph to replace 56 k? with 56 kΩ.
	Section 2.2.4 "3.0A Charging Operation"	Updated steps to reflect correct information.
	Figure 3-3	Updated image to remove black square in middle of the diagram.
	Figure 3-6	Added trademark symbol to USB Type-C™.
	Figure 3-7	Replaced incorrect image.
	Figure 3-8	Added trademark symbol to USB Type-C™.
	Appendix A. "UTC2000 Schematics"	Updated all images to remove extraneous information.
	Appendix B. "EVK-UTC2000 BOM"	Fixed inconsistent text size.

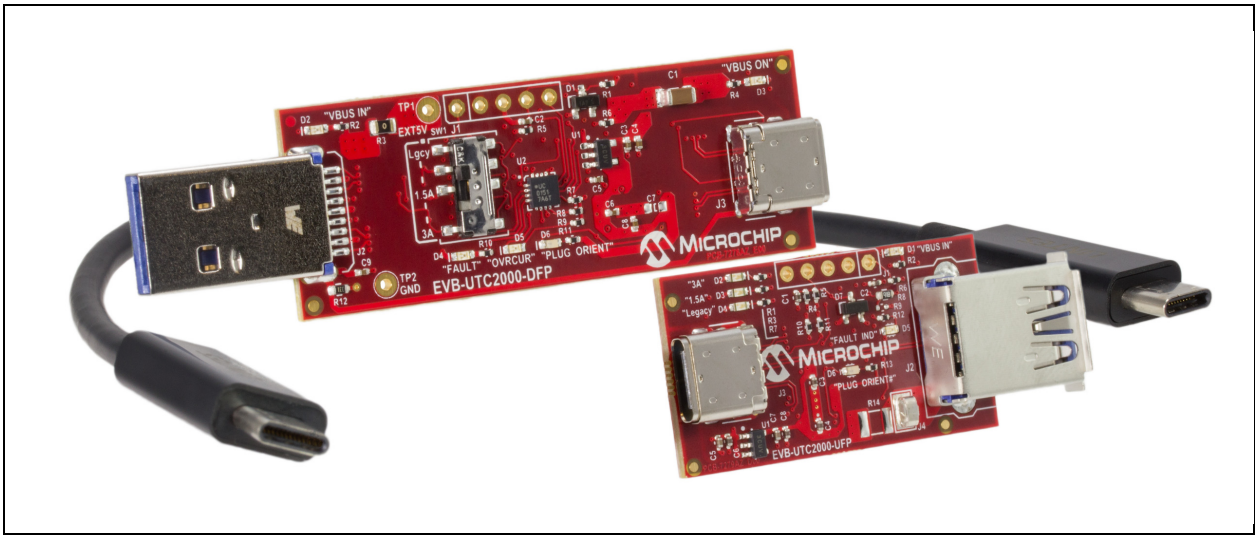
Chapter 1. Overview

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* host port, the UTC2000 EVK and any USB 2.0 or USB 3.1 device. See **Section 1.2 "Features"** for more information.

> **Note:** EVK-UTC2000 is enabled with a USB 3.1 Gen 1 switch. USB 3.1 Gen 2 can be supported by using a compliant USB 3.1 Gen 2 switch.

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 host ports and devices
- Supports basic USB Type-C 5V charging at:
  - Legacy 500mA (USB 2.0)/900mA (USB 3.1)
  - 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
- DP3T switch on DFP board for legacy, 1.5A, 3.0A charging mode selection
- Reversible USB Type-C receptacle
- USB 3.1 passive Type-C Cable

1.3 GENERAL DESCRIPTION

FIGURE 1-2: EVB-UTC2000-DFP BLOCK DIAGRAM

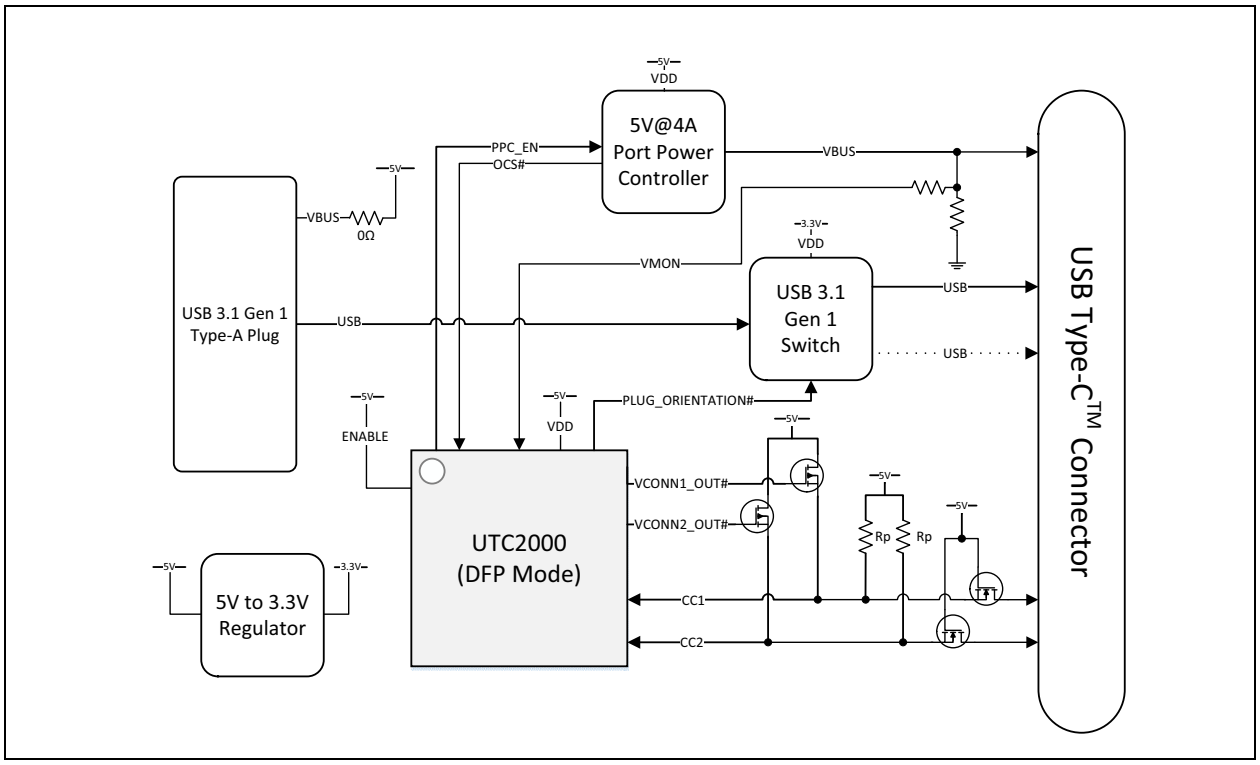
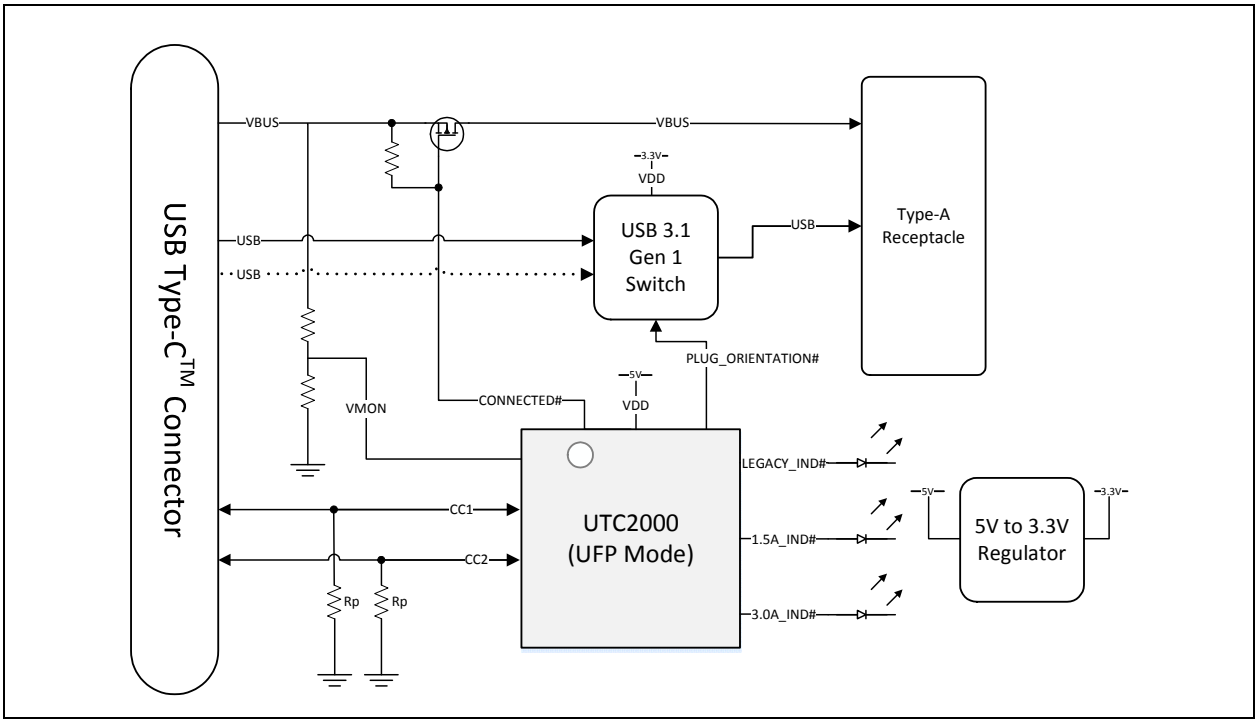


FIGURE 1-3: EVB-UTC2000-UFP BLOCK DIAGRAM



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

NOTES:

Chapter 2. Getting Started

2.1 CONTENTS OF THE KIT

The UTC2000 Evaluation kit includes the basic equipment necessary for evaluation. The items included 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 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 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 kΩ 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 1.5A Charging Operation

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

To test 1.5A charging mode, 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 “Power Source”**.

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 3.0A Charging Operation

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

To test 3.0A charging mode, perform the following steps:

1. Remove R15 and R17 56k Rp pull-up resistors.
2. Populate R24 and R27 with 10k, 0402 footprint resistors.
3. Set SW1 to the "3.0A" 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 "Power Source"**.

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)

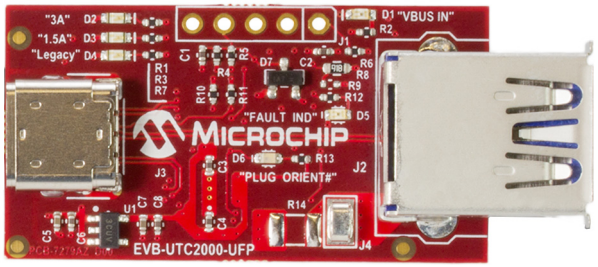
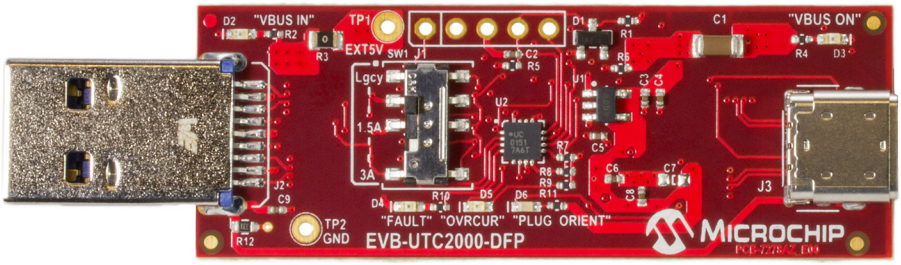


FIGURE 3-2: EVB-UTC2000-DFP (TOP-SIDE)

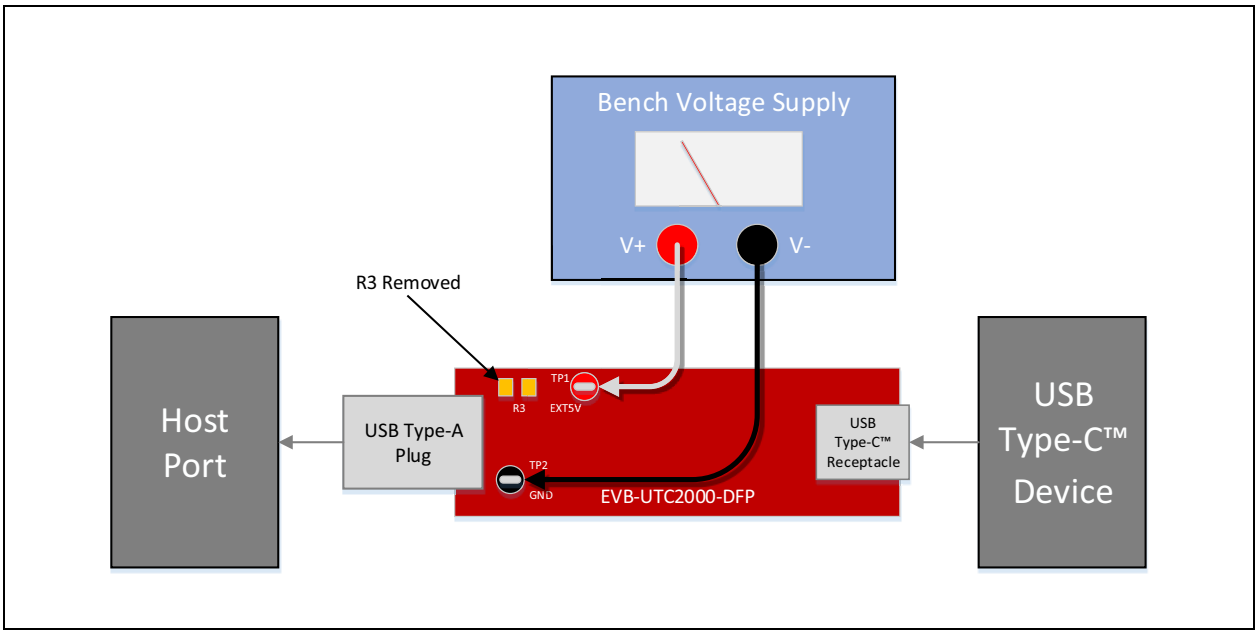


3.1.1 Power Source

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-UFP is always powered from VBUS supplied by the downstream facing port it is attached to.

3.1.2 LED Indicators for EVB-UTC2000-DFP

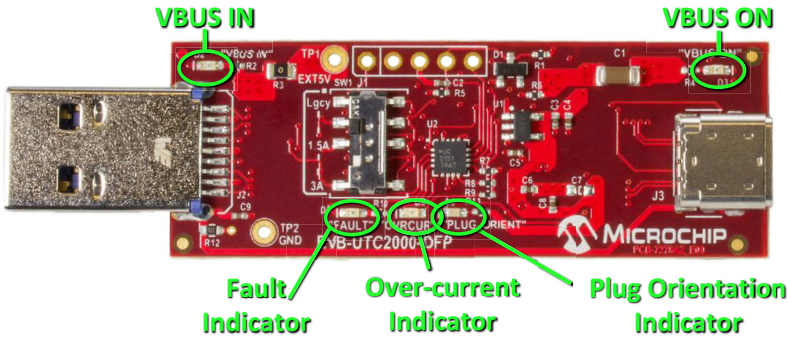
Table 3-1 describes the LED indicators included on the EVB-UTC2000-DFP.

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.

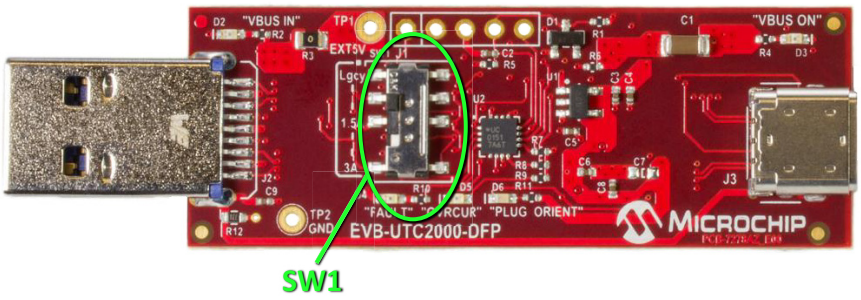
TABLE 3-2: SWITCH DESCRIPTIONS

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 **Section 2.2.3 “1.5A Charging Operation”**/**Section 2.2.4 “3.0A Charging Operation”** for information on testing 1.5A/3.0A modes respectively.

Figure 3-5 shows their location on the PCB.

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



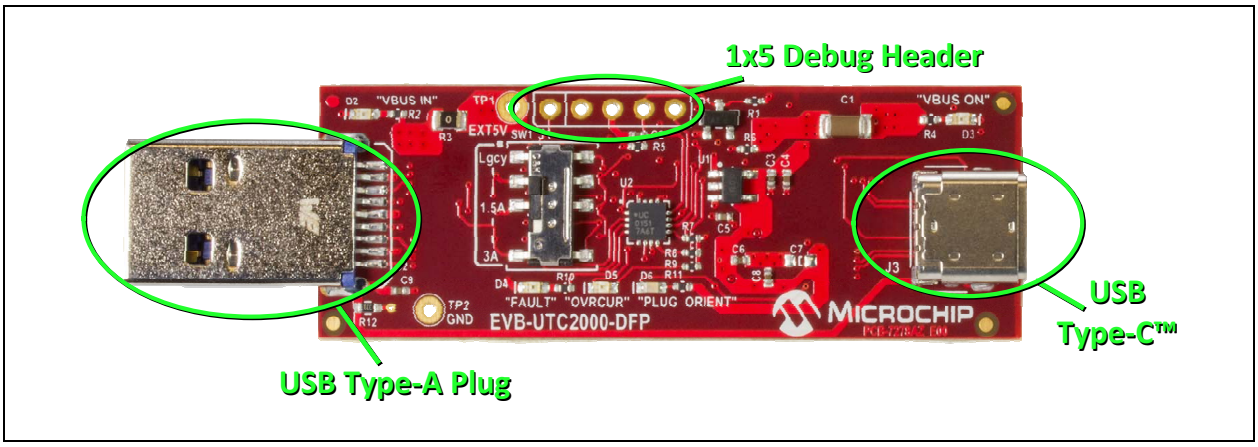
3.1.4 Connector Descriptions for EVB-UTC2000-DFP

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 Type-A Plug	-	Type-A male plug
J3	USB 3.1 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

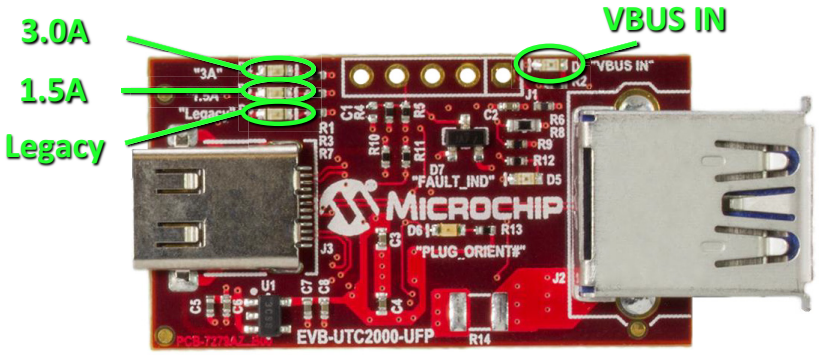
Table 3-5 describes the LED indicators included on the EVB-UTC2000-UFP.

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) 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.

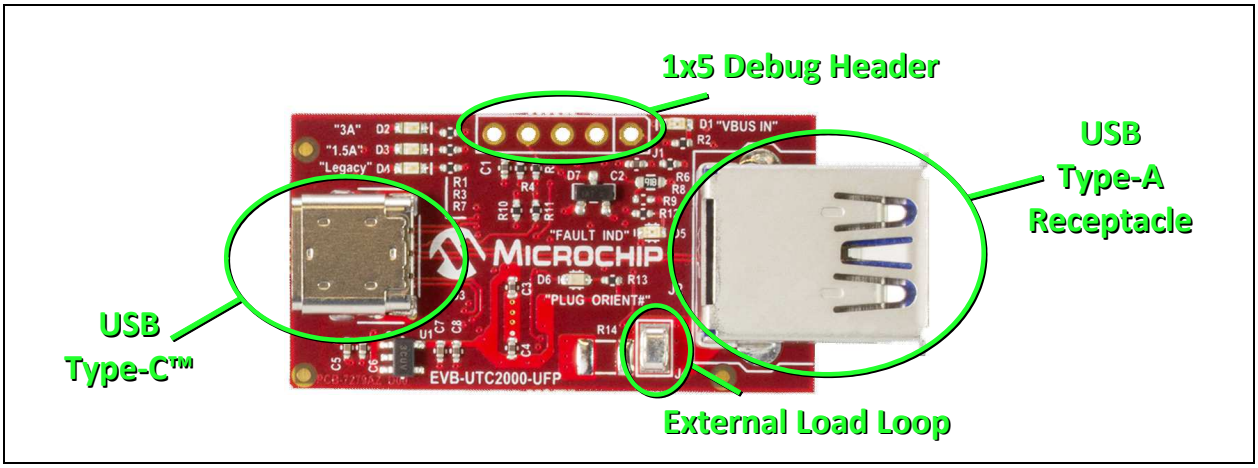
3.1.8 Connector Descriptions for EVB-UTC2000-UFP

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 Type-A Plug	-	USB Type-A receptacle
J3	USB 3.1 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)

FIGURE 3-8: EVB-UTC2000-UFP CONNECTOR LOCATIONS



3.1.9 Test Points on EVB-UTC2000-UFP

There are no test points available on the EVB-UTC2000-UFP.

Appendix A. UTC2000 Schematics

A.1 INTRODUCTION

This appendix shows the UTC2000 Evaluation Kit Schematic.

FIGURE A-1: UTC2000 EVALUATION KIT SCHEMATICS

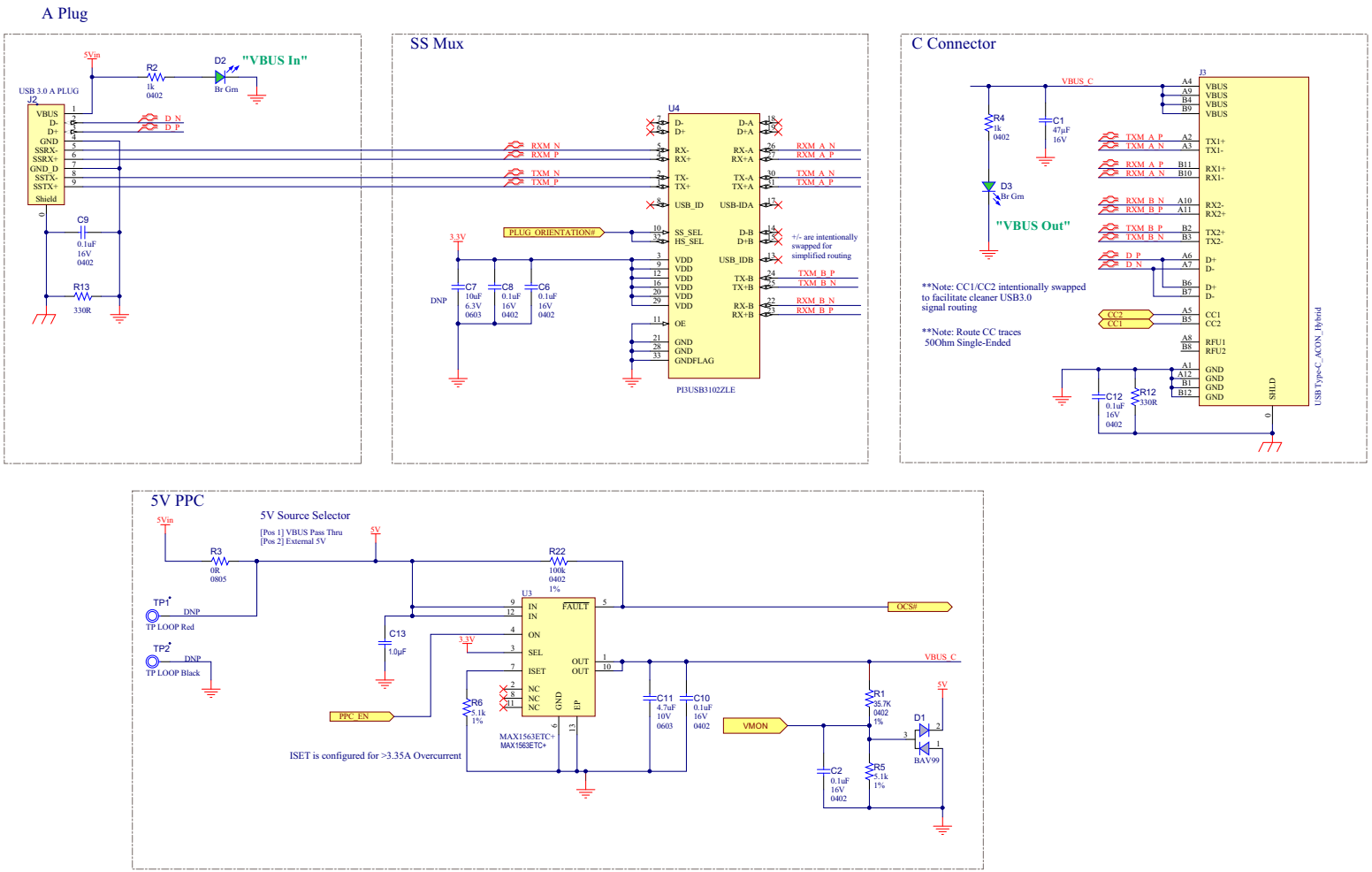


FIGURE A-1: UTC2000 EVALUATION KIT SCHEMATICS (CONTINUED)