Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

EVB-USB5534 Rev F Evaluation Board User's Guide

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

ISBN: 978-1-63276-190-3

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
═ ISO/TS 16949 ═

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

Object of Declaration: EVB-USB5534 Rev F

EU Declaration of Conformity

This declaration of conformity is issued by the manufacturer.
The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.
For information regarding the exclusive, limited warranties applicable to Microchip products, please see Microchip's standard terms and conditions of sale, which are printed on our sales documentation and available at www.microchip.com.
Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

Table of Contents

NOTES:

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-USB5534. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- 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-USB5534 Evaluation Board as a development tool for the USB5534B-60xx, 4-port USB 3.0/2.0 hub with battery charging features.

The manual layout is as follows:

- **Chapter 1. "Overview"** – Shows a brief description of the EVB-USB5534 Evaluation Board.
- **Chapter 2. "Getting Started"** – Includes instructions on how to get started with the EVB-USB5534 Evaluation Board.
- **Appendix A. "EVB-USB5534 Evaluation Board"** – This appendix shows the EVB-USB5534 Evaluation Board.
- **Appendix B. "EVB-USB5534 Evaluation Board Schematics"** – This appendix
- shows the EVB-USB5534 Evaluation Board schematics.
- **Appendix C. "Bill of Materials (BOM)"** – This appendix includes the EVB-USB5534 Evaluation Board Bill of Materials (BOM).

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) { ... }`

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **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

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's

customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

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 PIC-kit 2 and 3.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- 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

Revision A (May 2014)

- Initial Release of this Document.

Chapter 1. Overview

1.1 INTRODUCTION

The EVB-USB5534 Revision F is a demonstration and evaluation platform that provides the necessary requirements and interface options for evaluating the USB5534B-60xx Ultra Fast four port battery charging hub on a 4-layer RoHS-compliant Printed Circuit Board (PCB). This will allow the user to gain an understanding of the product and accelerate the integration of the USB5534B-60xx into the user's design. The USB5534B-60xx is compliant with the USB 3.0 USB Specification and supports SuperSpeed (SS), High-Speed (HS), Full-Speed (FS), and Low-Speed (LS) USB signaling for complete coverage of all defined USB operation speeds. The evaluation platform supports four downstream ports that are USB 2.0 and USB 3.0 compliant. The EVB-USB5534 platform also supports battery charging on all four downstream ports (maximum of 5A at any one time). The USB5534B-60xx is configured for operation through internal default settings and supports custom configurations through SMBus or through the external 64-Mbit SPI Flash device, U7. The EVB-USB5534 demonstrates driver compatibility with Microsoft® Windows® 8x, Windows 7, Windows XP, Mac OS® X 10.4+, and Linux® hub drivers.

1.2 FEATURES

The EVB-USB5534 provides the following features:

- USB5534B-60xx in a 64-pin QFN RoHS compliant package
- USB 3.0 compliant (SS, HS, FS, and LS operation)
- Self powered operation
- Four downstream USB 2.0/3.0 ports
- All downstream ports support individual port power and overcurrent sense
- All downstream ports are battery charge enabled (2.5A max per port)
- Can support up to 5A down stream Port Power at any one time
- Supports Dynamic Battery Charge Enable/Disable
- Onboard SPI Flash for external downloadable firmware
- Low-cost 4-layer space saving design
- Operates from a single voltage (+12.0 V, regulated) external power supply
- Onboard 25 MHz crystal or external clock input
- Single onboard +5.25 V, 6 Amp regulator
- Single onboard +3.3 V, 0.5 Amp regulator
- Single onboard +1.25 V, 1 Amp regulator
- +3.3 V, Port Power and Reset LED indicators
- Battery Charge Enable, Dynamic Battery Charge and Port Disable LED indicators
- Port Removable LED indicators
- Figure 1-1 and Figure 1-2 shows the top and bottom level silk screen and copper layers.

FIGURE 1-1: TOP LEVEL SILK SCREEN AND COPPER LAYER

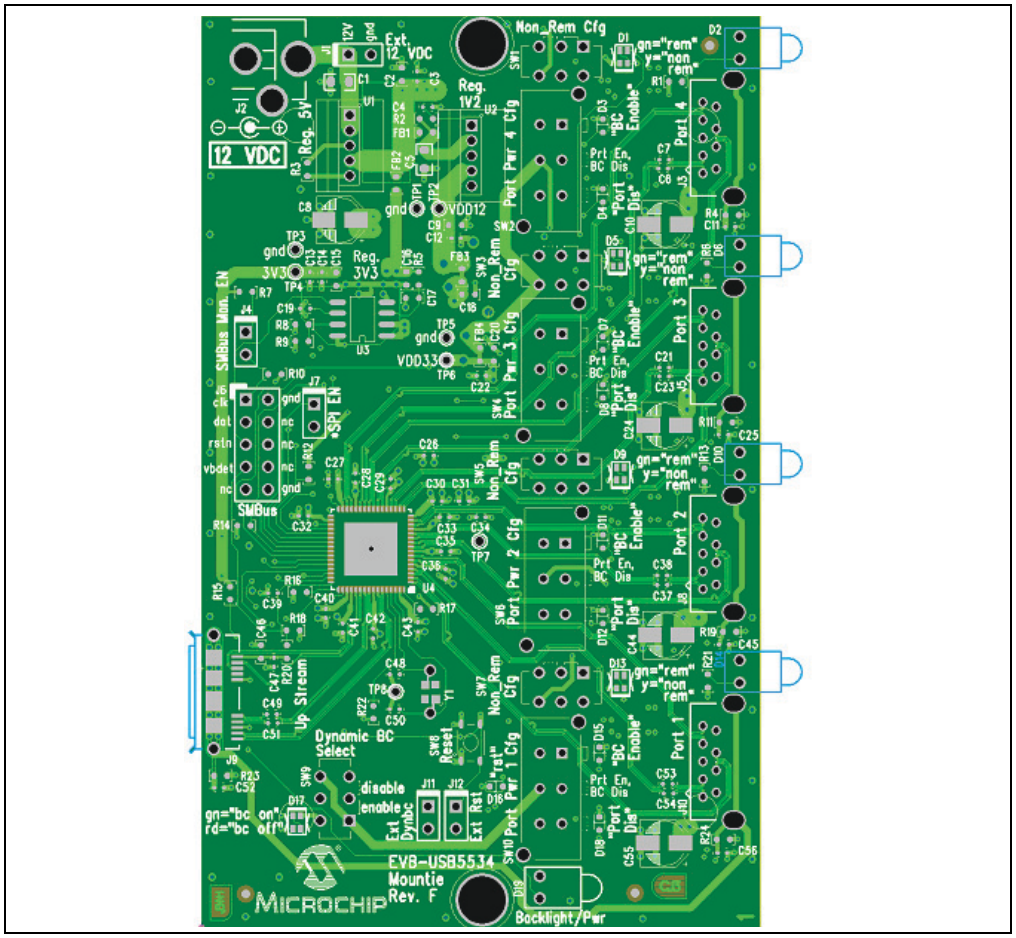
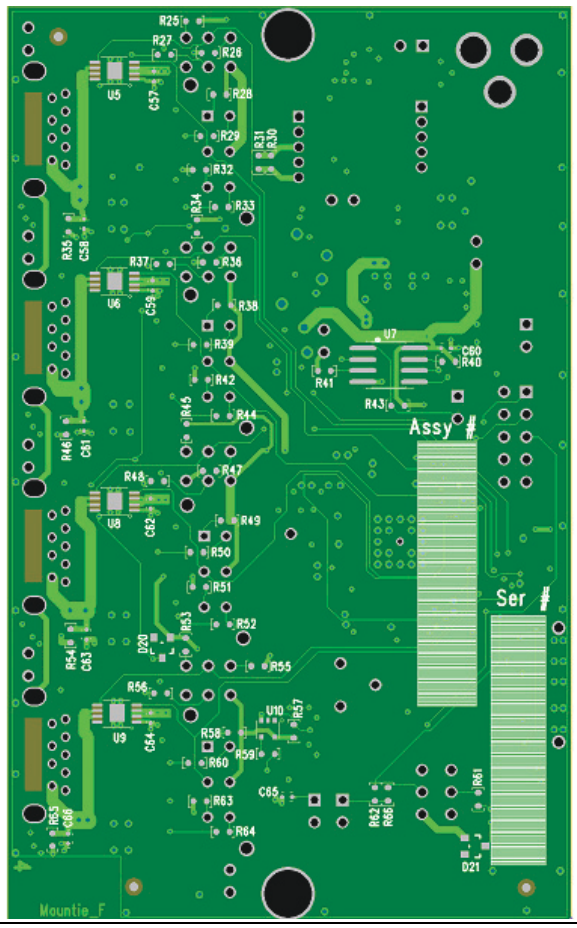


FIGURE 1-2: BOTTOM LAYER SILK SCREEN COPPER LAYER



NOTES:

Chapter 2. Getting Started

The EVB-USB5534 is designed for flexible configuration solutions. It can be configured via default internal register settings, downloadable external firmware to an onboard SPI Flash, through SMBus, or through the onboard configuration switches. When configured with the default internal register settings, the device operates as a USB 3.0/2.0 hub with four battery charge enabled USB ports and Microchip-SMSC's standard VID/PID/DID settings.

2.1 CONFIGURATION SOURCE – INTERNAL DEFAULT

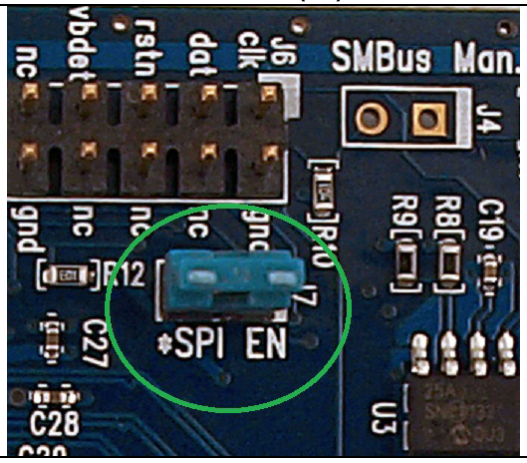
When the USB5534B-60xx does not detect a valid SPI Flash image or SMBus configuration upon powerup, the EVB-USB5534 Rev F uses internal default register settings. It also sets the Vendor ID, Product ID, Language ID, and Device ID, and additional settings from internal ROM code.

2.2 CONFIGURATION SOURCE – EXTERNAL SPI FLASH AND SMBus

Upon power-up, the USB5534B-60xx first looks for an external SPI Flash 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 device. If an SPI Flash device is not found, the firmware checks if the SMBus is enabled. The SMBus can operate in either legacy mode (USB 2.0 only) or advanced mode (access to both USB 2.0 and USB 3.0 registers). When using SMBus, the default configuration is for it to run in the advanced mode.

By default, the SPI Flash (U7) is populated. The 10 kΩ pull-up resistors (R40 and R41) on the SPI device's Write Protect (WPn) and Hold (HOLDn) pins must also be populated in order to use external flash. The 10 kΩ pull-up resistor (R14) on the SPI_SPD_SEL pin of the USB5534B-60xx must also be populated in order to select 60MHz SPI operation, as opposed to 30MHz operation. Additionally there must be a jumper placed on J7 in order to enable the SPI device. The external flash can be programmed using the Microchip ProTouch MPT software tool which can be downloaded from the Microchip website at http://www.Microchip.com/ProTouch.

FIGURE 2-1: SPI DEVICE ENABLED (J7)



SMBus data and clock can be controlled via the onboard SMBus header, J6. The SMBus interface is disabled by default through the 100 kΩ pull-down resistor (R10) on the SM_CLK pin of the USB5534B-60xx. In order to enable SMBus communication, pins 1 and 2 must be shorted on the J4 *SMBus Man. EN* header, which pulls SM_CLK high. Alternatively, if an Aardvark tool is inserted into the SMBus J6 header for programming, this tool will automatically pull SM_CLK high and then the J4 *SMBus Man. EN* header does not need to be shorted (or installed). The *SMBus Man. EN* header is not populated by default. When SMBus is enabled, the USB5534B-60xx configures the GPIOs to act as an SMBus slave. As an SMBus slave, the USB5534B-60xx will wait indefinitely for the SMBus configuration. If no external options are detected, the USB5534B-60xx will be configured from the internal default registers.

Note: Refer to the Protouch MPT User Manual on using this software to program the configuration.

2.3 POWER SOURCE - SELF-POWERED

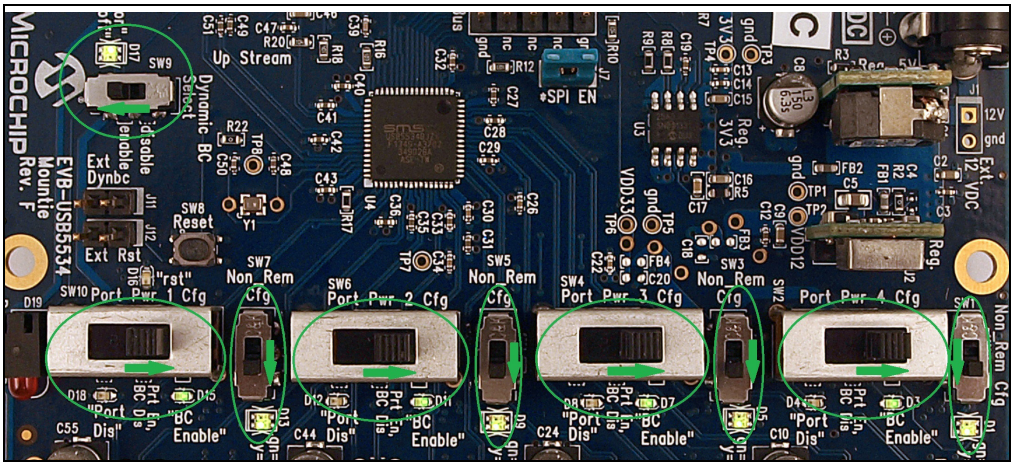
The EVB-USB5534 Rev F only supports self-powered operation, and is powered through one +12.0 V regulated 'wall wart' external power supply. The +12.0 V 'wall wart' plugs into the 2.5 mm connector J2 on the board. Alternatively, an external voltage can be injected onto the J1 *Ext. 12 V* header, which is not populated by default. The +12.0 V feeds a 6 A regulator which outputs +5.25 V across the board. This +5.25 V output controls the +3.3 V and +1.25 V onboard regulators.

2.4 DOWNSTREAM PORT POWER CONTROL

All four USB downstream port powers are controlled via four 2.5 A port power devices with autodischarge function (AP2511). The higher current capabilities of these AP2511 devices allow for all four downstream ports to support battery charging up to a maximum of 5 A total at any one time.

Before applying power to the EVB-USB5534, each downstream port must be properly configured through the onboard switches. All four downstream ports can be configured in a variety of ways described below. All of the OCS pins as well as the PRTCTL pins have configuration options available through these configuration switches. After the board has been powered, changing the position of these switches will not affect the current configuration. Any changes to the switches will require the EVB-USB5534 to have its power recycled or RESET_n asserted before the changes can take affect. The sections below describe the different configuration options available for these USB5534B-60xx strap pins.

FIGURE 2-2: INITIAL CONFIGURATION



2.4.1 OCS Strap Options: Non-Removable Select

Each OCS pin of the USB5534B-60xx has a strap option that is selectable through a 2-Position Double Pole Double Throw (DPDT) switch which are labeled “Non_Rem Cfg”. The **OCS1** pin is associated with downstream Port 1 and is tied to SW7. When SW7 is in the default position, pins 1 and 2 are shorted together as well as pins 4 and 5 on the switch. This switch position pulls the **OCS1** pin high to +3.3 V through a 10 kΩ resistor which configures downstream port 1 to be in the “Removable” state and its associated dual LED (D13) will be turned on green. To change this configuration, SW7 should be switched to the opposite position which will short pins 2 and 3 together as well as pins 5 and 6 on the switch. Once the switch position has been changed, power must be recycled on the EVB-USB5534. This switch position pulls the **OCS1** pin low to ground through a 1 kΩ resistor which configures downstream port 1 to be in the “Non-Removable” state and the dual LED (D13) will now be turned on yellow.

This same selection process can be made to the OCS pins and switches that are tied to the rest of the downstream ports. The table below describes the different OCS strap options available for all four of the OCS pins on the USB5534B-60xx.

Downstream Port	Associated Switch	Switch Position	OCS Config	LED
1	SW7	1-2, 4-5 = Removable (Default)	OCS1 Pulled High	D13 = Green
		2-3, 5-6 = Non Removable	OCS1 Pulled Low	D13 = Yellow
2	SW5	1-2, 4-5 = Removable (Default)	OCS2 Pulled High	D9 = Green
		2-3, 5-6 = Non Removable	OCS2 Pulled Low	D9 = Yellow
3	SW3	1-2, 4-5 = Removable (Default)	OCS3 Pulled High	D5 = Green
		2-3, 5-6 = Non Removable	OCS3 Pulled Low	D5 = Yellow
4	SW1	1-2, 4-5 = Removable (Default)	OCS4 Pulled High	D1 = Green
		2-3, 5-6 = Non Removable	OCS4 Pulled Low	D1 = Yellow

FIGURE 2-3: REMOVABLE STATE (DEFAULT)

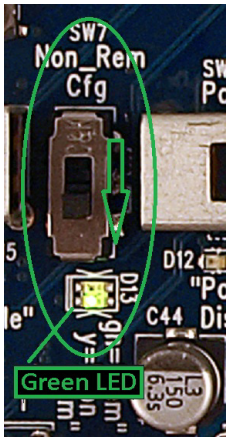
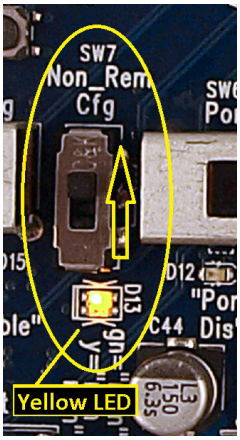


FIGURE 2-4: NON-REMOVABLE STATE



2.4.2 Port Power Strap Options: Battery Charge Enable and Port Disable Select

Each PRTCTL pin of the USB5534B-60xx has a strap option that is selectable through a 3-Position Double Pole Double Throw (DPDT) switch which are labeled "Port Pwr Cfg". The **PRT_CTL1** pin is associated with downstream Port 1 and is tied to SW10. When SW10 is in the default position, pins 1 and 2 are shorted together as well as pins 4 and 5 on the switch. This switch position pulls the **PRT_CTL1** pin high to +3.3 V through a 10 kΩ resistor which configures downstream port 1 to be in the "Battery Charge Enabled" state and its associated LED (D15) will be turned on green. Alternatively SW10 can be moved all the way down to the "Port Dis" position. This switch position short pins 2 and 3 together as well as pins 5 and 6 on the switch. This switch position pulls the **PRT_CTL1** pin low to ground through a 1 kΩ resistor which configures downstream port 1 to be disabled and therefore no power will be applied to VBUS on this downstream port. Also the "Port 1 Disable" LED (D18) will now be will turn on red. If SW10 is switched into the middle OFF position, labeled as "Prt En, BC Dis" on the EVB-USB5534, the port power controller on downstream port 1 will act as a standard non-battery charging Port Power Controller (PPC). Note again that any time the switch position has been changed, power must be recycled on the EVB-USB5534.

This same selection process can be made to the PRTCTL pins and switches that are tied to the rest of the downstream ports. Note that in either configuration mode, as long as the switch is not in the OFF position, the downstream port power LEDs (D2, D6, D10, and D14) will light up green whenever power is being applied to VBUS on the

associated downstream port. When the “Port Pwr Cfg” switch is switched into the middle OFF position, the associated downstream port power LED will be turned off which shows that no power is applied to that particular downstream port. The table below describes the different PRTCTL strap options available for all four of the PRTCTL pins on the USB5534B-60xx.

Downstream Port	Assosciated Switch	Switch Position	PRTCTL Config	LED
1	SW10	1-2, 4-5 = BC Enabled (Default)	PPWR1 Pulled High	D15 = Green
		Middle = Port Enabled, BC Disabled	Standard PPC	None
		2-3, 5-6 = Port Disabled	PPWR1 Pulled Low	D18 = Red
2	SW6	1-2, 4-5 = BC Enabled (Default)	PPWR2 Pulled High	D11 = Green
		Middle = Port Enabled, BC Disabled	Standard PPC	None
		2-3, 5-6 = Port Disabled	PPWR2 Pulled Low	D12 = Red
3	SW4	1-2, 4-5 = BC Enabled (Default)	PPWR3 Pulled High	D7 = Green
		Middle = Port Enabled, BC Disabled	Standard PPC	None
		2-3, 5-6 = Port Disabled	PPWR3 Pulled Low	D8 = Red
4	SW2	1-2, 4-5 = BC Enabled (Default)	PPWR4 Pulled High	D3 = Green
		Middle = Port Enabled, BC Disabled	Standard PPC	None
		2-3, 5-6 = Port Disabled	PPWR4 Pulled Low	D4 = Red

FIGURE 2-5: BATTERY CHARGE ENABLED (DEFAULT)

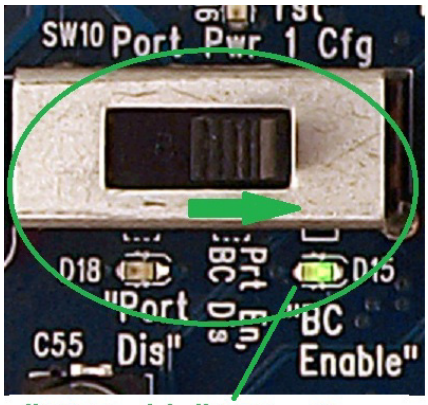


FIGURE 2-6: PORT ENABLED WITH BATTERY CHARGE DISABLED (STANDARD PORT POWER CONTROL FUNCTION)

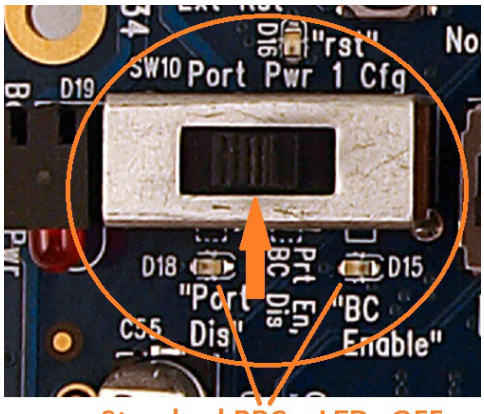
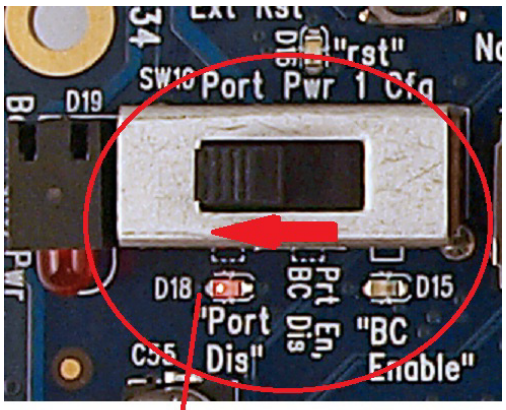


FIGURE 2-7: PORT DISABLED



2.4.3 Dynamic Battery Charge Select

The final switch to consider when configuring the USB5534B-60xx is the "Dynamic BC Select" switch, SW9. Once all four downstream ports have been configured in one of the options described above, the Dynamic Battery Charge Select switch can then be configured to either turn battery charging on for all BC Enabled ports, or turn battery charging off. To enable battery charging on all BC Enabled downstream ports, SW9 must be in the "Enable" position which shorts pins 1 and 2 and also pins 4 and 5 together on the switch (this is the default position). When battery charging is enabled, the **DYNCPDISn** (active low) pin on the USB5534B-60xx is pulled high to +3.3 V through two 4.7 kΩ resistors in series and the associated dual LED (D17) will turn on green. To disable battery charging on all downstream ports, SW9 must be in the "Disable" position which shorts pins 2 and 3 and also pins 5 and 6 together on the switch. When battery charging is disabled, the **DYNCPDISn** pin on the USB5534B-60xx is pulled low to ground through two 4.7 kΩ resistors in series and the associated dual LED (D17) will turn on red. An optional 2-pin Ext. DYNBC header is provided as well (J11) so that the user can inject a signal onto the **DYNCPDISn** pin through an external source.

FIGURE 2-8: DYNAMIC BATTERY CHARGE SELECT ENABLED (DEFAULT)

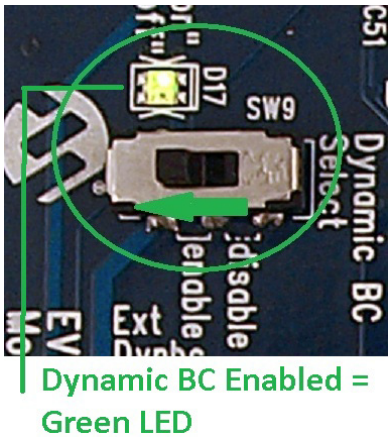
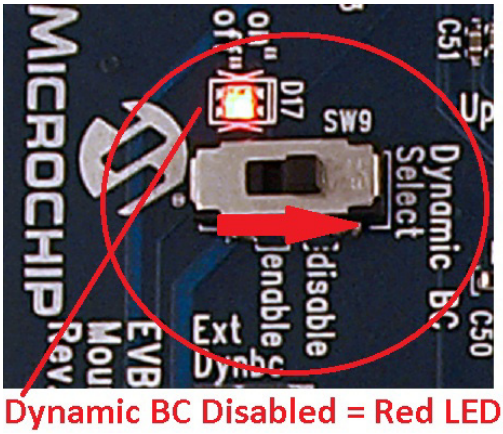


FIGURE 2-9: DYNAMIC BATTERY CHARGE SELECT DISABLED

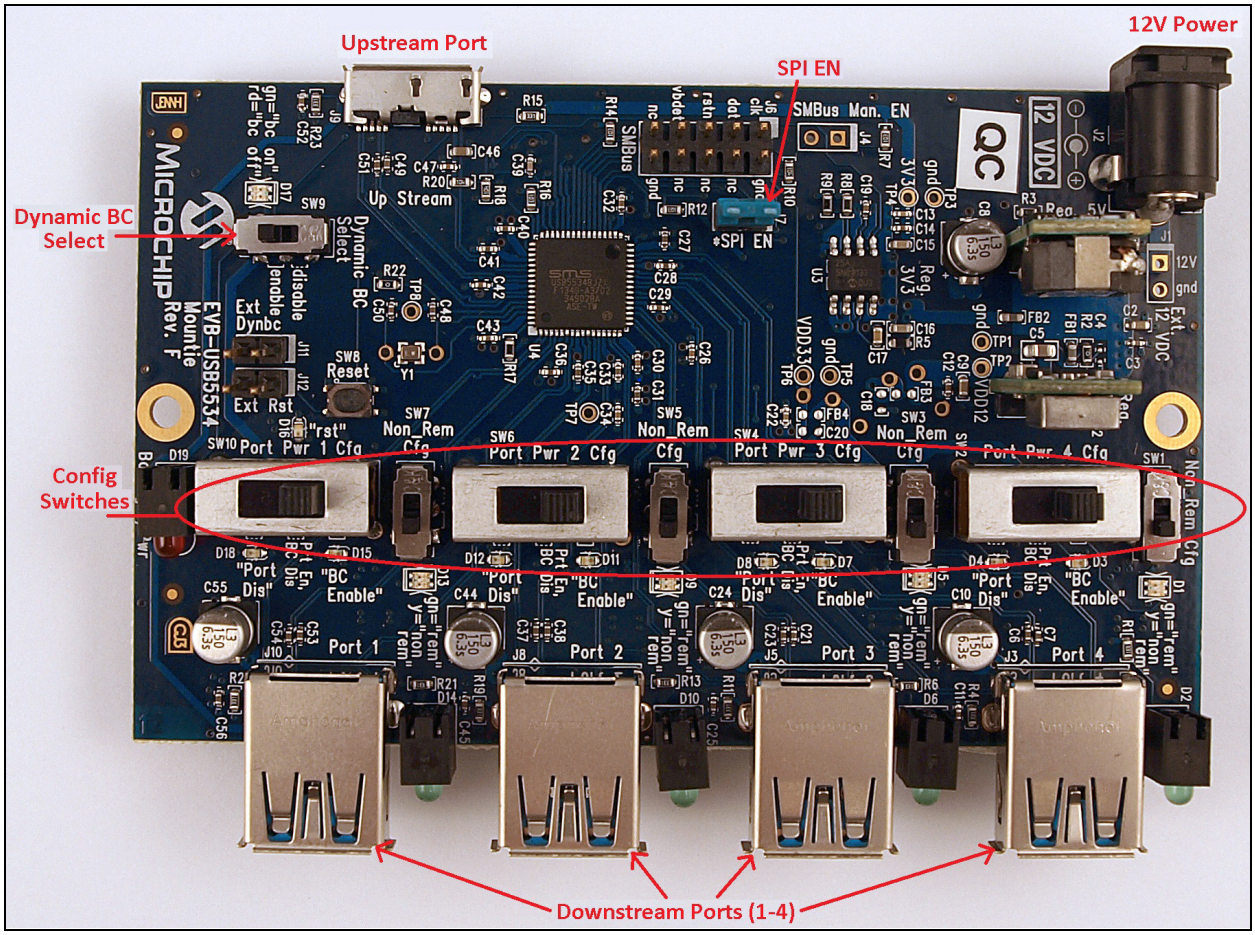


Appendix A. EVB-USB5534 Evaluation Board

A.1 INTRODUCTION

This appendix shows the EVB-USB5534 Evaluation Board.

FIGURE A-1: EVB-USB5534 EVALUATION BOARD



NOTES:

Appendix B. EVB-USB5534 Evaluation Board Schematics

B.1 INTRODUCTION

This appendix shows the EVB-USB5534 Evaluation Board Schematics.

FIGURE B-1: EVB-USB5534 EVALUATION BOARD SCHEMATIC 1