TPS65982BB Host Interface

Technical Reference Manual

Literature Number: SLVUBK8
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Contents

List of Figures

List of Tables

Introduction

1.1 Introduction

The TPS65982BB is a dual USB Type-C billboard device with an integrated power switch for VBUS. These functions are controlled through I^2C and GPIO from a USB Power Delivery (PD) Controller or an Embedded Controller (EC). The TPS65982BB firmware generally resides in the external flash connected to through SPI, but can also be loaded through I^2C from a PD Controller or EC.

1.1.1 Purpose and Scope

This document describes the host interface for TPS65982BB and functional operation for implementing the billboard function.

1.1.2 Theory of Operation

The TPS65982BB is connected to the USB2 D P/N on two USB Type-C ports to provide the required billboard function when the device is connected to a non-compatible host. It passes through the USB D P/N to a USB Type-A receptacle or a USB subsystem when it is connected to a compatible host. This incompatibility is driven by the USB PD alternate mode entry or failure. The initial connection for the USB2 path is determined by the GPIO, which is generally driven by the PD controller. There are two GPIO inputs that indicate which port was plugged in. The internal mux control scheme is "first come first serve", which means that the port that is connected first serves as the path for the USB2 to the USB Type-A receptacle or USB subsystem when an alternate mode is entered. It connects the TPS65982BB endpoint to the connected port when an alternate mode is not entered. When an alternate mode fails, the PD controller communicates the specific failure to the TPS65982BB through I^2C communication. This notifies the TPS65982BB which billboard messages to send when requested by the connected host.

The TPS65982BB also provides the 5 V VBUS load switch to the USB Type-A receptacle or USB subsystem. This is controlled through the GPIO for power savings or can always be left on.

There are additional GPIO connections to the PD controller or the EC that can perform system resets and notify if the TPS65982BB has booted successfully.

1.1.3 Related Documents

- Universal Serial Bus Specification, Revision 2.0, April 27, 2000 plus ECN and Errata
- Billboard Device Class Spec Revision 1.21, September 08, 2016
- USB Power Delivery Specification Revision 3.0, Version 1.0a
- USB Type-C Cable and Connector Specification Revision 1.2, March 25, 2016
- Proposed DisplayPort Alt Mode on USB Type-C Standard, Version 1, Draft 5, September 6, 2014

1.1.4 Billboard Host Interface Description

The billboard supports a register-based Unique Address Interface. The key to the protocol diagrams is in the SMBus Specification, version 2.0 and is repeated here in part in Figure 1-1.

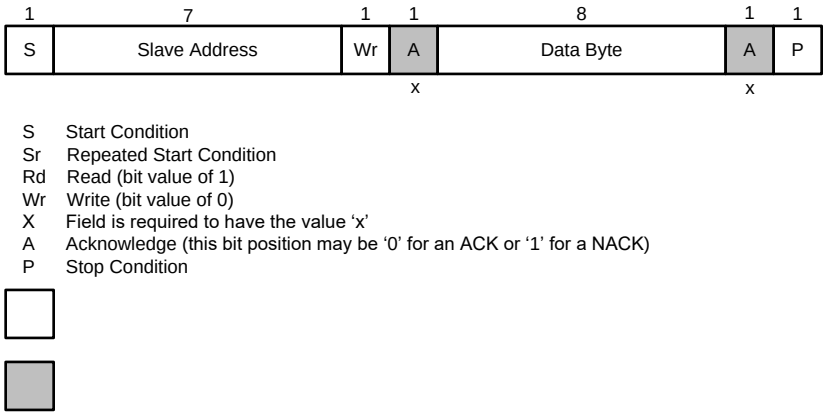

Figure 1-1. I2C Read/Write Protocol Key

The Unique Address Interface allows for complex interactions between an I^2C master and each PD Controller. The I^2C slave unique address is used to receive or respond to host interface protocol commands. Figure 1-2 and Figure 1-3 show the write and read protocols, respectively.

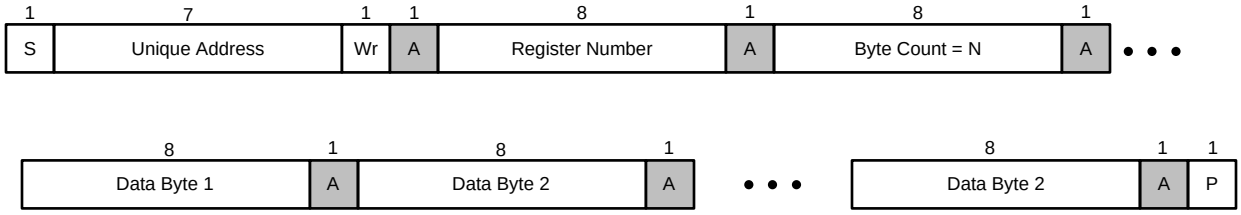

Figure 1-2. I2C Unique Address Write Register Protocol

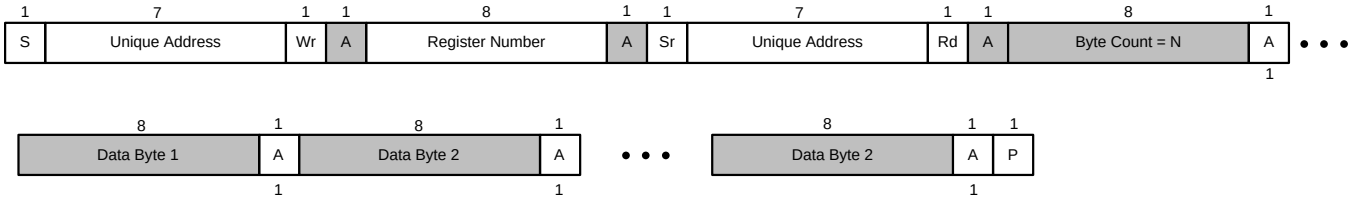

Figure 1-3. I2C Unique Address Read Register Protocol

TPS65982BB GPIO and I²C Control

2.1 TPS65982BB GPIO Controls

The GPIO controls the initial connection for the integrated USB2 mux, the enable for the 5 V VBUS load switch, and boot control signals. This section summarizes all the GPIO control.

2.1.1 TPS65982BB GPIO Summary

Table 2-1. TPS65982BB GPIO Summary

TPS65982BB GPIO		
GPIO EVENT	**INPUT/OUTPUT**	**COMMENT**
BB_ENABLE	Input	Enables the billboard function with iAdditionalInfoURL on PA_USB_P/N only.
PP_5V0_EN	Input	PP_5V0_EN = 0: Disables the 5 V. VBUS Switch PP_5V0_EN = 1: Enables the 5 V VBUS Switch.
BB_PLUG_PA	Input	BB_PLUG_PA = 0: Disconnect PA_USB_P/N (Port A Type-C USB) to USB_RP_P/N. BB_PLUG_PA = 1: Connect PA_USB_P/N (Port A Type-C USB) to USB_RP_P/N.
BB_PLUG_PB	Input	BB_PLUG_PB = 0: Disconnect PB_USB_P/N (Port A Type-C USB) to USB_RP_P/N. BB_PLUG_PB = 1: Connect PB_USB_P/N (Port A Type-C USB) to USB_RP_P/N.
HRESET	Input	BB_RESET = 0: Normal Operation BB_RESET = 1: Hardware Reset (Firmware Reload)
BB_SRST	Input	BB_SRESET = 1: Soft Reset (No Firmware Reload) BB_SRESET = 0: Normal Operation
BB_BOOT_OK	Output	BB_Boot = 0: Not Booted BB_Boot = 1: Successful Boot

2.2 TPS65982BB I²C BDCc Command Control

The TPS65982BB BDCc command sets up the USB endpoint and USB RP hardware to notify the TPS65982BB of the specific alternate mode error/success. The specific control is first written to the Data1 Register and the BDCc command is executed when written to the Cmd1 register.

2.2.1 Data1 (0x09) Register Billboard Control

Table 2-2. Data1 Register Definition 2 Bytes

INPUT TO DATA REGISTER		
BIT	**DEFINITION**	**COMMENT**
0	Enable Billboard = 1 Disable Billboard = 0	Overrides USB_RP connection when enabled
1	PA_USB_P/N Connected = 1 PB_USB_P/N Connected = 0	PA_USB_P/N Connection PB_USB_P/N Connection
2	Enable RP = 1 Disable RP = 0	Connects USB2 to USB RP
3	Enable iAdditionalinfoURL2 = 1 Disable iAdditionalinfoURL2 = 0	Uses iAdditionalinfoURL2
4:5	00: TBT Mode Entry Error 01: DP Mode Entry Error 10: CIO Mode Entry Error 11: No Mode Entry Error	Shows descriptor pertaining to which alternate mode failed
6:7	00: TBT Mode Entry Successful 01:DP Mode Entry Successful 10:CIO Mode Entry Successful 11: No Mode Entry Successful	Shows descriptor pertaining to which alternate mode entered. Use when no USB Hub or USB System present
8	0: Mode Entry Error (Capabilities Mismatch) 1: Mode Entry Failure due to no PD comm	Sets the reason why the prefered Alt Mode was not entered.
9:11	000: TBT String 001: DP String 010: CIO String 011: Reserved (Future Use) 100-111: Use Default Billboard String.	Option to force a specific Billboard String when request is received
12:15	Reserved	Write all zeros.

2.2.2 Cmd1 (0x08) BDCc - Billboard Device Control Command

Table 2-3. BDCc - Billboard Device Control Command - 4 Bytes

DATA	BYTES	COMMENT
'B"D"C"c'	4	Command register used for the BDCc command interface. Cleared to 0x0000_0000 by the billboard during initialization and after successful processing of BDCc command.

TPS65982BB Billboard String Registers

3.1 Billboard String Table

The TPS65982BB uses a string table to reference the string needed according to the alternate mode entry failure. The string table also includes the device descriptors. Index 1 to 6 can be changed in the string configuration page according to the system requirements. The default strings are provided for reference. Index 7 to 9 are not configurable, but can be updated through I^2C if needed, starting at X in the string table.

Table 3-1. Billboard String Table

INDEX	STRING TABLE	STRING
1	iSerialNumber	01.00.00
2	iProduct	TPS65982BB
3	iManfacturer	Texas Instruments
4	iAdditionalinfoURL	http://www.ti.com/interface/usb/type-c-and-power-delivery/overview.html
5	TBT String	Thunderbolt Device. For further assistance see http://thunderbolttechnology.net/tbt-alt-mode/
6	DP String	http://help.vesa.org/dp-usb-type-c
7	CIO String	CIO Device
8	Future Use String	
9	iAdditionalinfoURL2	

3.2 CIO String Registers

These registers allow the CIO string to be modified after "CIO Device. For further assistance, see http://" to a specific web address. These are accessed only through I^2C.

Table 3-2. CIO String Registers

REGISTER ADDRESS	REGISTER	SIZE	DESCRIPTION
0x90	CIO String 1	9 Bytes	CIO Device. For further assistance, see http:// (1 - 9 Characters)
0x91	CIO String 2	9 Bytes	CIO Device. For further assistance, see http:// (10 - 18 Characters)
0x92	CIO String 3	9 Bytes	CIO Device. For further assistance, see http:// (19 - 27 Characters)
0x93	CIO String 4	9 Bytes	CIO Device. For further assistance, see http:// (28 - 36 Characters)
0x94	CIO String 5	9 Bytes	CIO Device. For further assistance, see http:// (37 - 45 Characters)
0x95	CIO String 6	9 Bytes	CIO Device. For further assistance, see http:// (46 - 54 Characters)

3.3 Future Use String Registers

These string registers can be used as a descriptor that has not been defined. These are accessed only through I^2C.

Table 3-3. Future Use String Registers

REGISTER ADDRESS	REGISTER	SIZE	DESCRIPTION
0x80	Future Use String 1	9 Bytes	1 - 9 Characters
0x81	Future Use String 2	9 Bytes	10 - 18 Characters
0x82	Future Use String 3	9 Bytes	19 - 27 Characters
0x83	Future Use String 4	9 Bytes	29 - 36 Characters
0x84	Future Use String 5	9 Bytes	37 - 45 Characters
0x85	Future Use String 6	9 Bytes	46 - 54 Characters
0x86	Future Use String 7	9 Bytes	55 - 63 Characters
0x87	Future Use String 8	9 Bytes	64 - 72 Characters
0x88	Future Use String 9	9 Bytes	73 - 81 Characters
0x89	Future Use String 10	9 Bytes	82 - 90 Characters
0x8A	Future Use String 11	9 Bytes	91 - 99 Characters
0x8B	Future Use String 12	9 Bytes	100 - 108 Characters

3.4 iAdditionalinfoURL2 String Registers

These registers allow the iAdditionalURL2 Sting to be modified after "http://" to a specific web address. When this string is used, it must be configured in the BDCc 4CC command. These are accessed only through I^2C.

Table 3-4. iAdditionalURL2 String Registers

REGISTER ADDRESS	REGISTER	SIZE	DESCRIPTION
0xA0	iAdditionalURL2 String 1	9 Bytes	http:// (1 - 9 Characters)
0xA1	iAdditionalURL2 String 2	9 Bytes	http:// (10 - 18 Characters)
0xA2	iAdditionalURL2 String 3	9 Bytes	http:// (19 - 27 Characters)
0xA3	iAdditionalURL2 String 4	9 Bytes	http:// (29 - 36 Characters)
0xA4	iAdditionalURL2 String 5	9 Bytes	http:// (37 - 45 Characters)
0xA5	iAdditionalURL2 String 6	9 Bytes	http:// (46 - 54 Characters)

Static Billboard Registers

4.1 Static Billboard Registers

The Static Billboard Registers reflect specific fields in the billboard messages and can be referenced from the Universal Serial Bus Device Class Definition for Billboard Devices Revision 1.21. The default values must be used, but can be modified in run time. The changes is taken into effect at the next connection, otherwise it uses the default values. These are accessed only through I^2C.

4.1.1 bNumberOfAlternateModes Register

Table 4-1. bNumberOfAlternateModes Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB0	bNumberOfAlternateModes	1	Number of Alternate modes supported. The maximum value that this field can be set to is MAX_NUM_ALT_MODE.

4.1.2 bPreferredAlternateMode Register

Table 4-2. bPreferredAlternateMode Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB1	bPreferredAlternateMode	1	Index of the preferred Alternate Mode. System software can use this information to provide the user with a better user experience.

4.1.3 VCONN Power Register

Table 4-3. VCONN Power Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB2	VCONN Power	2	15: The adapter does not require any VCONN Power. The value in Bits 2..0 are ignored when this bit is set. 14:3: Reserved set to zero 2:0 VCONN Power 000b = 1 W 001b = 1.5 W 010b = 2 W 011b = 3 W 100b = 4 W 101b = 5 W 110b = 6 W 111b = Reserved

4.1.4 bMaxPower Register

Table 4-4. bMaxPower Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB3	bMaxPower	1	Maximum power consumption of this device container from VBUS in mA

4.1.5 idProduct Register

Table 4-5. idProduct Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB4	idProduct	2	Product ID

4.1.6 idVendor Register

Table 4-6. idVendor Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB5	idVendor	2	Vendor ID

4.1.7 bcdDevice Register

Table 4-7. bcdDevice Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB6	bcdDevice	2	Device releases number in binary-coded decimal

4.1.8 CIO SVID Register

Table 4-8. CIO SVID Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB7	CIO SVID	2	Default: 0x8088

4.1.9 Future SVID Register

Table 4-9. Future SVID Register

REGISTER ADDRESS	BILLBOARD FIELD	SIZE (BYTE)	COMMENT
0xB8	Future Use SVID	2	Default: 0xBEEF

TPS65982BB GPIO and I²C Control Flow

5.1 TPS65982BB Billboard Function

The TPS65982BB generally provides the billboard function and USB muxing for two Type-C ports. The TPS65982BB is generally controlled by the PD controller which contains the current state of the Type-C connectors. The muxed USB signals and VBUS are then connected to a USB Type-A receptacle or USB hub.

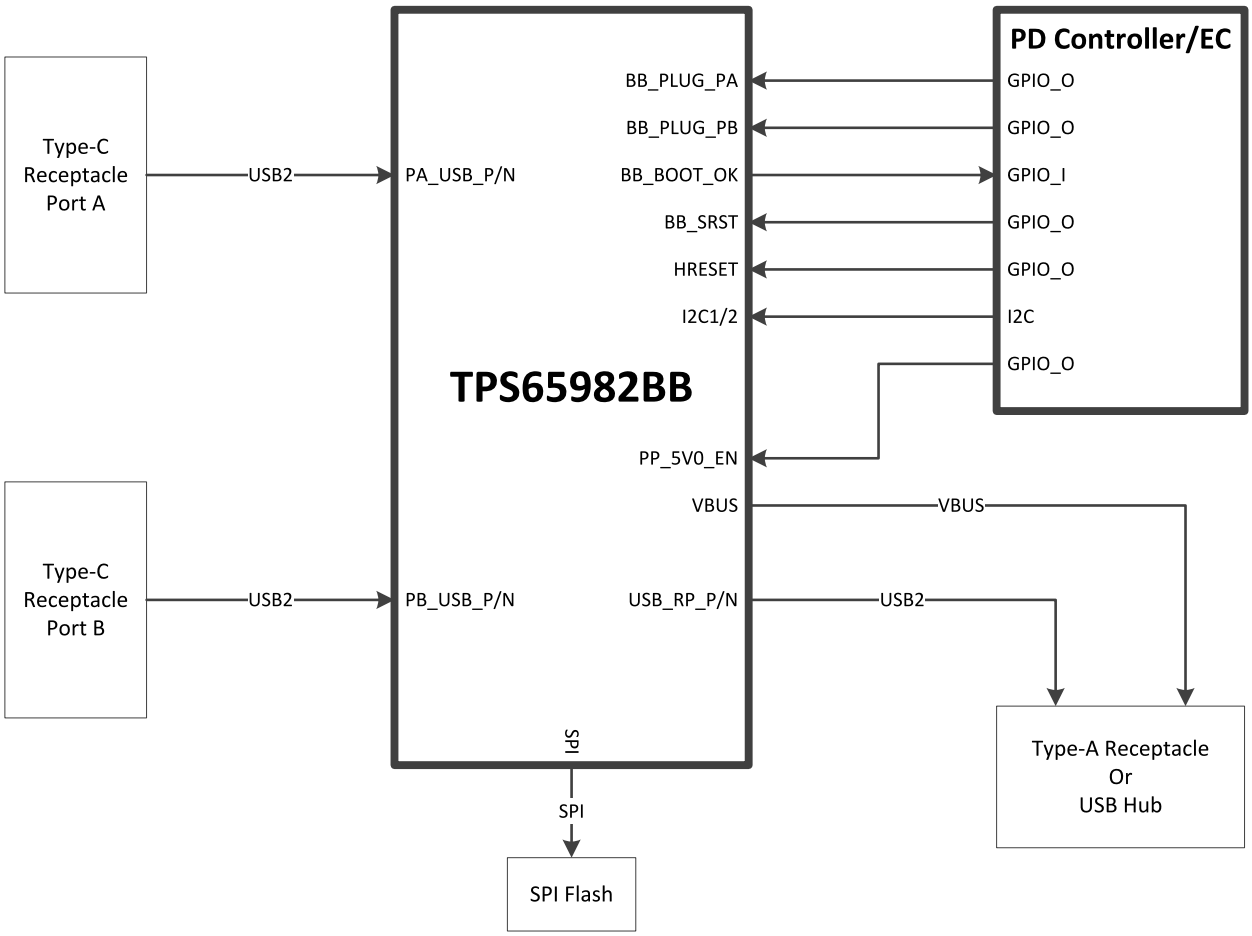

Figure 5-1. TPS65982BB System Block Diagram

5.2 TPS65982BB and PD Controller Suggested Flow

The flow below is the recommended control of the TPS65982BB. When the PD controller does not have enough GPIOs to service the BB_PLUG_PA/B, the inital mux connection can be enabled through I²C.

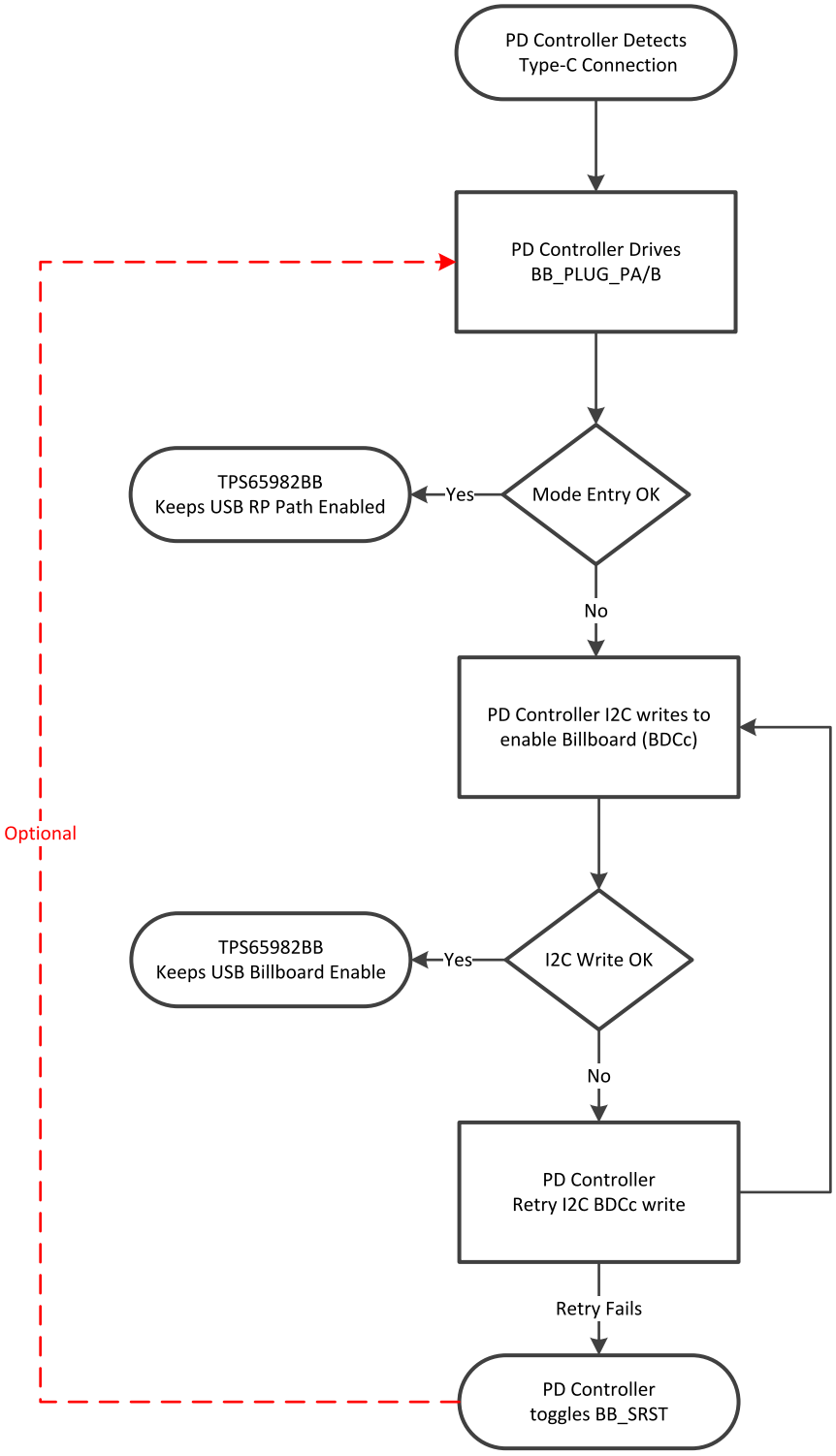

Figure 5-2. TPS65982BB and PD Controller Flow

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