PI5USB30216D
USB Type-C Plug Orientation (CC Pins) Detector
Version 1.1

Table of Contents

1 Introduction

Pericom's PI5USB30216D is a Type-C Configuration Channel (CC) logic IC. The device implements CC pins for port attachment, detachment, cable orientation, role detection, and Type-C Current Mode control. The device supports host only mode (Source/DFP), device only mode (Sink/UFP) and dual role port (DRP/Try.SNK DRP and Try.SRC DRP) modes with automatic configuration based on the voltage levels detected on CC pins. The device supports both pin and I2C control mode. I2C control mode allows higher flexibility of port control and communications.

Packaging: 12-contact X2QFN (1.6mmx1.6mm)

2 Settings of PI5USB30216D

The Type-C port role of PI5USB30216D can be controlled via two modes – pin control and I2C control. ADDR pin is used to select the desired mode. If ADDR pin is set to either high or low, I2C control is active. SDA/OUT1 and SCL/OUT2 are used for I2C transaction. ADDR is also to set the I2C address. If ADDR pin is floating, pin control mode is active.

ADDR pin	I2C address format	I2C address
ADDR=GND	7-bit addressing	0x1D
	8-bit address	Write:0x3A; Read:0x3B
ADDR=VDD	7-bit addressing	0x3D
	8-bit address	Write:0x7A; Read:0x7B
ADDR=FLOAT	Pin control mode	

Table 1: ADDR setting

2.1 Port Role Setting via Pin Control Mode

Default current host/DFP only mode, device/UFP only mode and default current Try.SNK DRP mode are available. PORT pin is used to configure the role of Type-C Port in pin control mode and the settings can be referred to the table below.

Port setting	PORT
Device (SNK)	GND
Dual-role port (DRP) with Try.SNK	No Connection
Host (SRC)	VDD

Table 2: Port Setting

2.2 Port Role Setting via I2C Control Mode

The settings of port role are referred to byte2 of I2C Register Description on Pericom datasheet.

0x02	Control	Bit 7 = Powersaving 0 = Enable/Active state 1 = Disable and low power state In Disable and low power state, all outputs of PI5USB30216D, with the exception of CC1 and CC2 pins, are in High-Z State. CC1 and CC2 pins are pulled low with resistor Rd. Bits [6] = Dual role 2 Try.SRC or Try.SNK setting 0 = Enable Try.SRC supported 1 = Enable Try.SNC supported Bits [5] = Accessory Detection in Device Mode 0 = Disable 1 = Enable Bits [4:3] = Charging current mode System can set the charging current mode when port is a host or dual role acting as host. These bits are ignored when port is a device or dual role acting as device. 00 = Default current mode 01 = Medium current mode (1.5A) 10 = High current mode (3A) Bits [2:1] = Port setting System can set the role of the port. 00 = Device (SNK) 01 = Host (SRC) 10 = Dual Role (DRP) 11 = Dual Role 2 (DRP) where Try.SRC or Try.SNC is supported Bit 0 = Interrupt Mask INTB pin is used to acknowledge system if there is any interrupt events triggered. When this bit is set to 0, INTB pin is pulled low when an interrupt event occur. When this bit is set to 1, INTB pin ignores all interrupt and remain High-Z. 0 = Do not mask interrupt 1 = Mask interrupt

Table 3: Port Setting Register

3 Processor Communication via I2C Control Mode

Please noted that PI5USB30216D does not have offset byte*. All registers must be read or written sequentially from 0x01. For example, in order to read address 0x04, PI5USB30216D I2C registers must be read sequentially from 0x01, 0x02, 0x03 to 0x04. In order to write address 0x02, it must be written sequentially from 0x01 to 0x02.

*Please use “I2C Transport” API instead of “I2C SMBus” API to communicate with PI5USB30216D if needed.

Processor should use following procedure to process PI5USB30216D interrupt request:

1. INTB asserted LOW, indicating Type-C port status change.
2. Processor first masks PI5USB30216D interrupt by writing a ‘1’ to Bit 0 of Control Register(0x02). INTB returned Hi-Z.
3. Processor then read Register(0x01), Control Register (0x02), Interrupt Register(0x03) and CC Status Register(0x04). Interrupt Register(0x03) indicates if an attach or detach event was detected. All interrupt flags in Interrupt Register will be cleared after the I2C read action. CC Status Register(0x04) is used to determine plugin details and charging profile. Processor can configure the power and USB channels according to information in CC Status Register.

4. Processor unmask PI5USB30216D interrupt by writing a '0' to Bit 0 of Address 0x02 before ending the interrupt service routine.

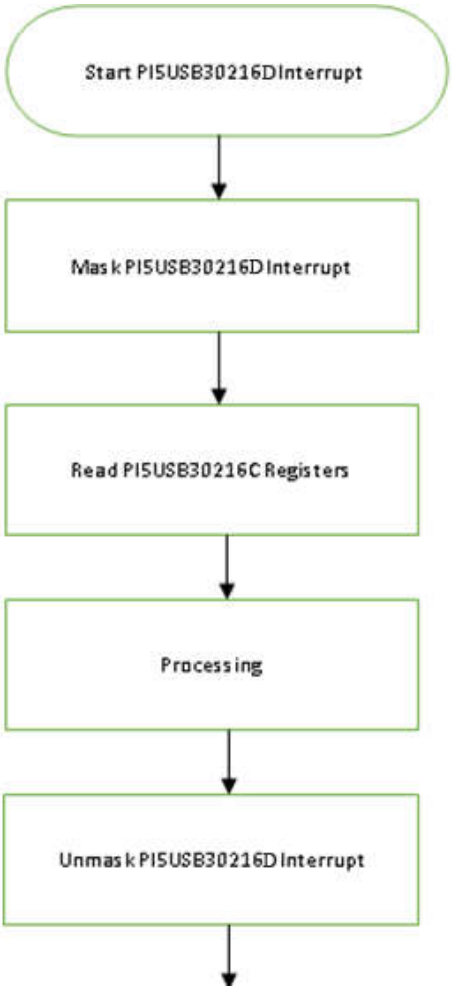


Figure 1: Suggested Flow of Processor Communication with PI5USB30216D via I2C Control Mode

3.1 I2C Configuration Sequence

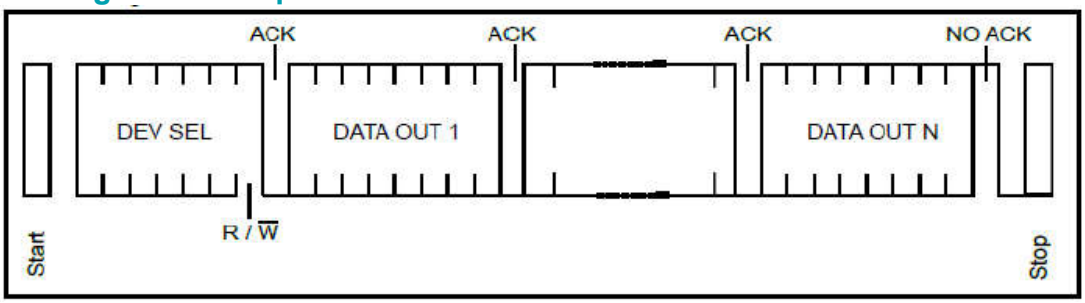


Figure 2: READ Sequence Diagram

Figure 4 below is one example for read sequence at ADDR=GND and Data Reg [1:4]=20,04,01,06.

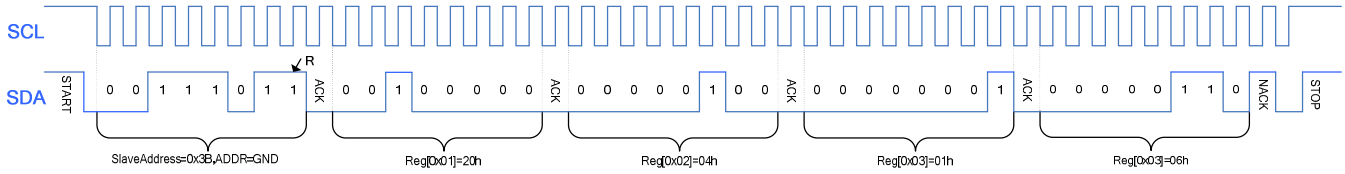


Figure 3: I²C Read Sequence Sample

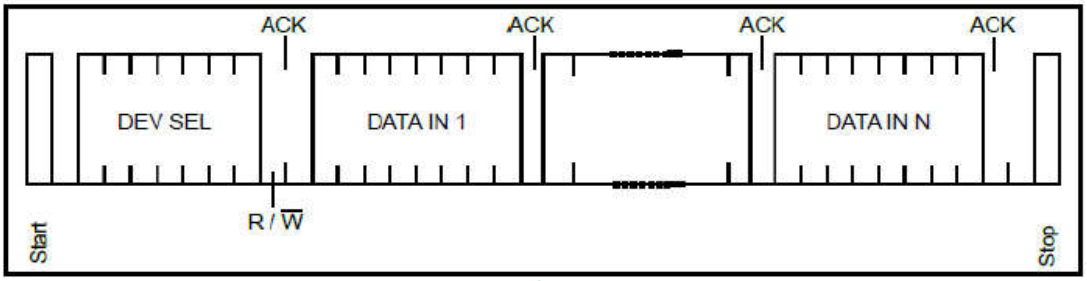


Figure 4: WRITE Sequence Diagram

Figure 6 below is one example for write sequence at ADDR=GND and Data Reg [1:2]=20,05.

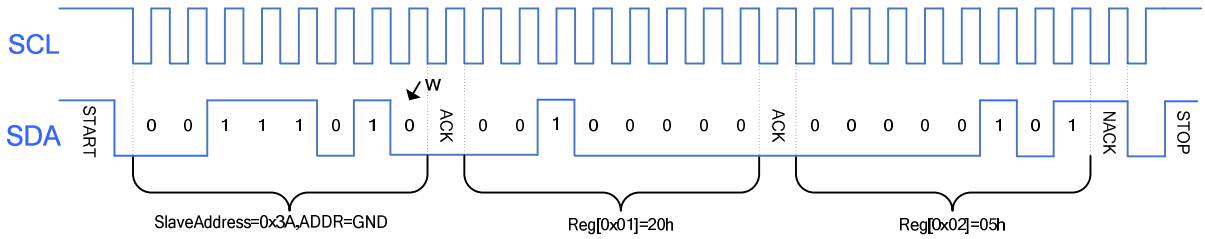


Figure 5: I²C WRITE Sequence Sample

3.2 Power-up Sequence in I2C Control Mode.

The power-up sequence for the PI5USB30216D with EN tied to VDD is as follow:

1. When system is powered off and PI5USB30216D has no VDD, CC1 and CC2 are pulled low by PI5USB30216D and the port acts as a UFP/Sink.
2. System powered on and supply VDD to PI5USB30216D. PI5USB30216D is reset by POR.
3. PI5USB30216D in I2C control mode is always initialized as UFP only mode (Reg[0x02]=00h) regardless of PORT pin setting.
4. Write Reg[0x02]=81h
5. System can change PI5USB30216D to desired mode by writing byte2 according to “Port Setting Register” in section 2.2.
   E.g. Write Reg[0x02]=46h to set the port to Try.SNK DRP default current mode.
6. PI5USB30216D monitors CC pins and VBUS for attachment and detachment.

3.3 Power-down and Power-up through EN pin

The power-down sequence for the PI5USB30216D using EN is as follow:

1. Pull low EN to disable PI5USB30216D. PI5USB30216D will pull-low INTB.
2. PI5USB30216D I2C is still accessible and the system should read PI5USB30216D I2C as usual to clean the interrupt.
3. The device is in disabled state and will pull low CC1 and CC2 and the port acts as a UFP/Sink.
4. User can re-enable the part by pull high EN pin.

3.4 Power-down and Power-up via Powersaving bit in I2C Control Mode

When EN is high, user can put PI5USB30216D into low power state via I2C as follow:

1. Write Reg[0x02]=81h to put the part in powersaving mode.
2. Read PI5USB30216D I2C to clear byte3 and byte4
3. The device will also pull low CC1 and CC2 and the port acts as a UFP/Sink.
4. User can re-enable the part by writing desired mode to byte2 according to “Port Setting Register” in section 2.2.
   E.g. Write Reg[0x02]=46h to set the port to Try.SNK DRP default current mode.

3.5 I2C Register Quick Reference Table

Reg[0x02]	PI5USB30216D Operating Mode	CC1/2 voltage when unattached	ID pin
00h	Sink/UFP; No accessory support	GND	"H"
01h	Sink/UFP; No accessory support; Mask Interrupt		
02h	Source/DFP; Default USB Power	VDD	"L" when UFP is attached
03h	Source/DFP; Default USB Power; Mask Interrupt		
04h	DRP; Default USB Power	Toggle between VDD and GND	
05h	DRP; Default USB Power; Mask Interrupt		
06h	Try.SRC DRP; Default USB Power	Toggle between VDD and GND	
07h	Try.SRC DRP; Default USB Power; Mask Interrupt		
0Ah	Source/DFP; 1.5A Type-C Current Mode	VDD	
0Bh	Source/DFP; 1.5A Type-C Current Mode; Mask Interrupt		
0Ch	DRP; 1.5A Type-C Current Mode	Toggle between VDD and GND	
0Dh	DRP; 1.5A Type-C Current Mode; Mask Interrupt		
0Eh	Try.SRC DRP; 1.5A Type-C Current Mode	Toggle between VDD and GND	
0Fh	Try.SRC DRP; 1.5A Type-C Current Mode; Mask Interrupt		
12h	Source/DFP; 3A Type-C Current Mode	VDD	
13h	Source/DFP; 3A Type-C Current Mode; Mask Interrupt		
14h	DRP; 3A Type-C Current Mode	Toggle between VDD and GND	
15h	DRP; 3A Type-C Current Mode; Mask Interrupt		
16h	Try.SRC DRP; 3A Type-C Current Mode	Toggle between VDD and GND	
17h	Try.SRC DRP; 3A Type-C Current Mode; Mask Interrupt		
46h	Try.SNK DRP; Default USB Power	Toggle between VDD and GND	
47h	Try.SNK DRP; Default USB Power; Mask Interrupt		
4Eh	Try.SNK DRP; 1.5A Type-C Current Mode	Toggle between VDD and GND	
4Fh	Try.SNK DRP; 1.5A Type-C Current Mode; Mask Interrupt		
56h	Try.SNK DRP; 3A Type-C Current Mode	Toggle between VDD and GND	
57h	Try.SNK DRP; 3A Type-C Current Mode; Mask Interrupt		
20h	Sink/UFP; Support accessory	Toggle between VDD and GND	"H"
21h	Sink/UFP; Support accessory; Mask Interrupt		

Table 4: Control Register (Reg[0x02]) Quick Reference Table

Reg[0x03]	PI5USB30216D Attach/Detach Event
00h	No attach or detect event occurred since last I^2C read.
01h	Attach event occurred since last I^2C read.
02h	Detach event occurred since last I^2C read.

Table 5: Interrupt Register (Reg[0x03]) Quick Reference Table

Reg[0x04]	Type-C Port Status	Plug Position	CC1 Voltage	CC2 Voltage	ID
00h	Unattached; The port shall not drive VBUS.	-	-	-	H
05h/15h	Attached to a Sink/UFP; The port shall drive VBUS.	CC1	Default Host: 0.4V	-	L
			1.5A Host: 0.9V		
			3A Host: 1.7V		
06h/16h	Attached to a Sink/UFP; The port shall drive VBUS.	CC2	-	Default Host: 0.4V	L
				1.5A Host: 0.9V	
				3A Host: 1.7V	
0Fh	Attached to an audio accessory. *4	Accessory	0.1V	0.1V	H
13h	Attached to a debug accessory. *4	Accessory	0.4V	0.4V	H
8Fh	Attached to a charge-through audio accessory	Accessory	0.1V	0.1V	H
93h	Attached to a debug accessory and VBUS is detected. *4	Accessory	0.4V	0.4V	H
A9h	Attached to a Host; *1	CC1	0.9V	-	H
AAh	Attached to a Host; *1	CC2	-	0.9V	H
C9h	Attached to a Host; *2	CC1	0.9V	-	H
CAh	Attached to a Host; *2	CC2	-	0.9V	H
E9h	Attached to a Host; *3	CC1	1.7V	-	H
EAh	Attached to a Host; *3	CC2	-	1.7V	H

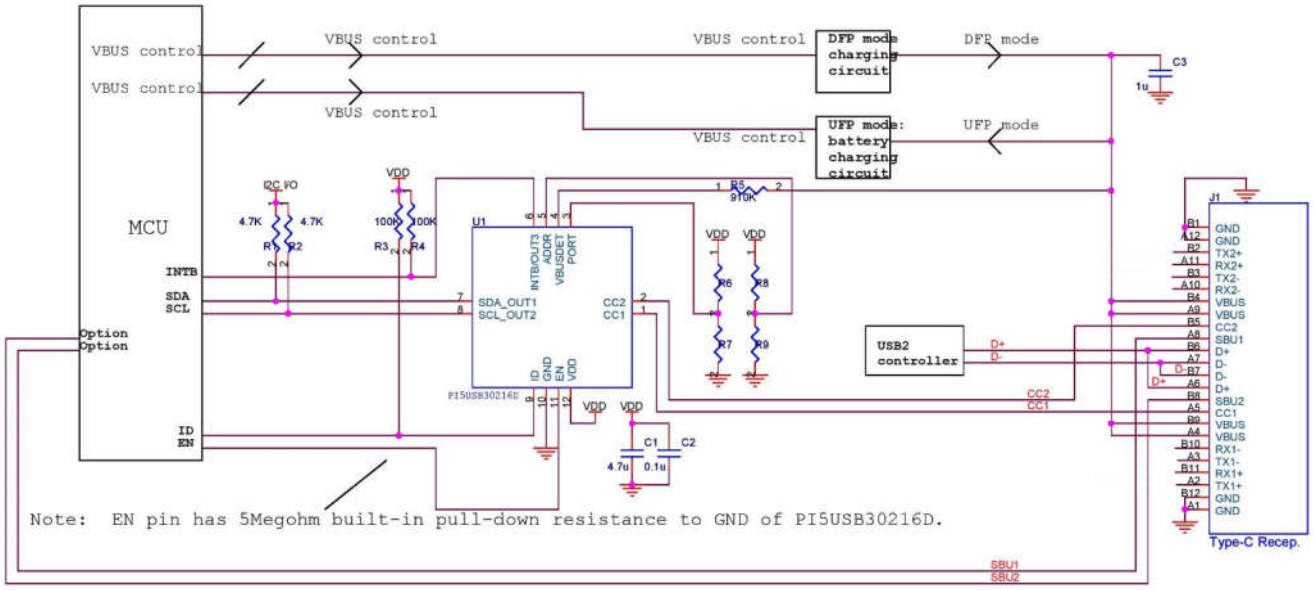
Table 6: Status Register (Reg[0x04]) Quick Reference Table

Note
*1: The port shall draw no more than the default USB power from VBUS.
*2: The port shall draw no more than 1.5A from VBUS.
*3: The port shall draw no more than 3A from VBUS.
*4: According to Type-C spec 1.1, the port shall not drive VBUS.

4 Typical Application Circuit

4.1 DRP in I2C Mode

DRP in I2C Mode



Type-C port mode	R6	R7
UFP/Sink/Device	NC	4.7K
DFP/Source/Host	4.7K	NC
DRP	NC	NC

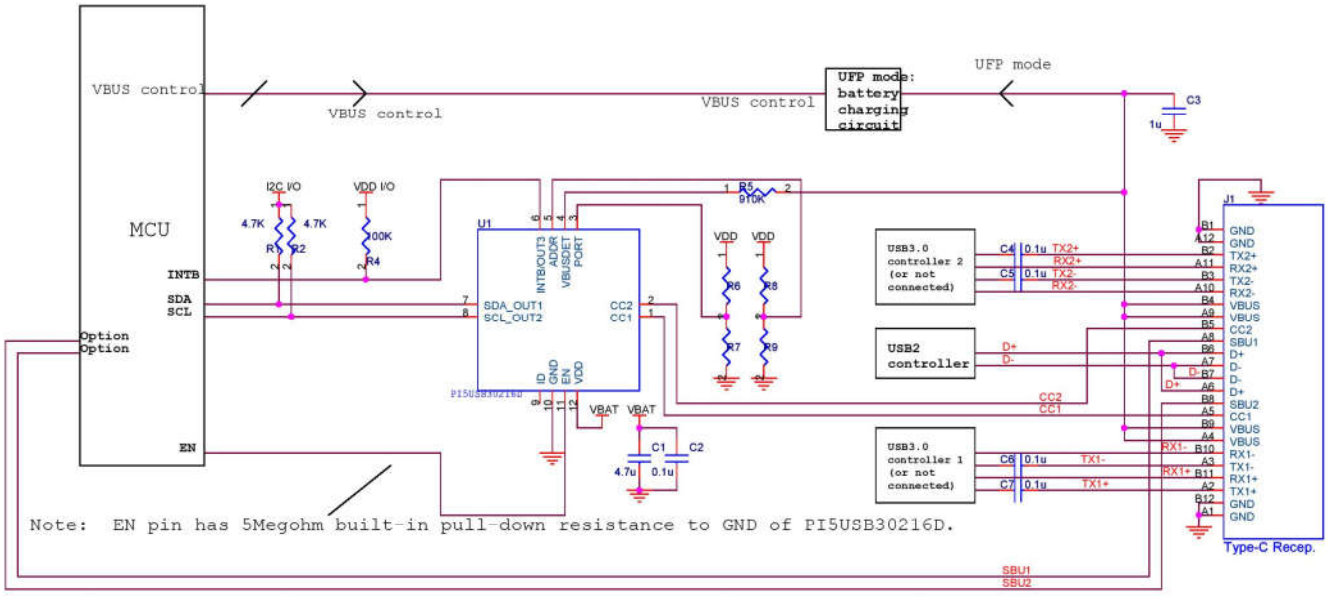
Control mode	R8	R9
I2C mode address: 7-bit addressing: 0x1D or 8-bit write address:0x3A 8-bit read address: 0x3B	NC	4.7K
I2C mode address: 7-bit addressing: 0x3D or 8-bit write address:0x7A 8-bit read address: 0x7B	4.7K	NC
Pin Control Mode	NC	NC

Figure 6: Typical Application Circuit of PI5USB30216D

4.2 UFP Mode

4.2.1 UFP in I2C Mode

UFP in I2C Mode



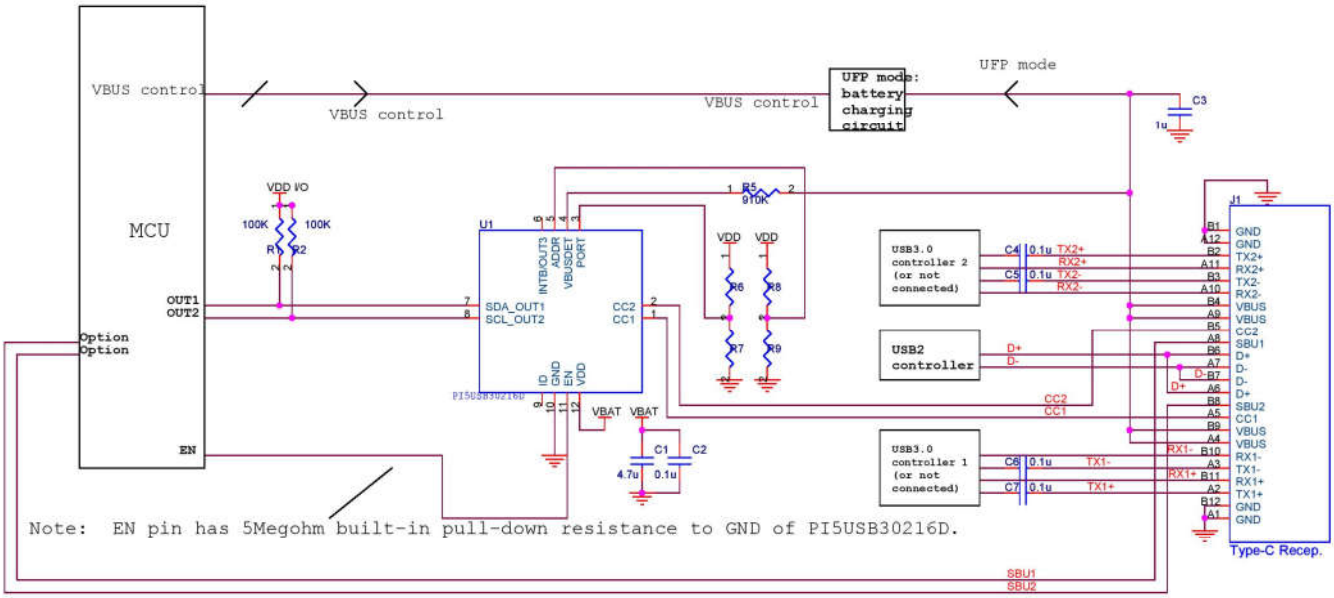
Type-C port mode	R6	R7
UFP/Sink/Device	NC	4.7K

Control mode	R8	R9
I2C mode address: 7-bit addressing: 0x1D or 8-bit write address:0x3A 8-bit read address: 0x3B	NC	4.7K
I2C mode address: 7-bit addressing: 0x3D or 8-bit write address:0x7A 8-bit read address: 0x7B	4.7K	NC
Pin Control Mode	NC	NC

Figure 7: Typical Application Circuit of PI5USB30216D in UFP I2C Mode.

4.2.2 UFP in Pin Mode

UFP in Pin Mode



Type-C port mode	R6	R7
UFP/Sink/Device	NC	4.7K

Control mode	R8	R9
I2C mode address: 7-bit addressing: 0x1D or 8-bit write address:0x3A 8-bit read address: 0x3B	NC	4.7K
I2C mode address: 7-bit addressing: 0x3D or 8-bit write address:0x7A 8-bit read address: 0x7B	4.7K	NC
Pin Control Mode	NC	NC

Figure 8: Typical Application Circuit of PI5USB30216D in UFP I2C Mode.

5 Layout Recommendation

5.1 Layout Recommendation

At least 1pc 4.7uF and 1pc 0.1uF decoupling capacitors are recommended for VDD of PI5USB30216D. Each decoupling capacitor should be connected to PCB power plane via shortest path. VDD and GND pins should be shorted to PCB power planes via shortest paths.

At least 1uF decoupling capacitor is recommended at VBUS.

5.2 Layout Example

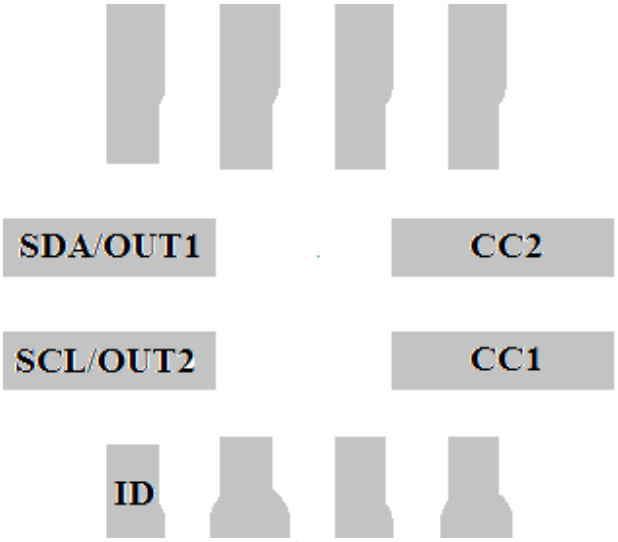


Figure 9: PI5USB30216D Layout

6. Software Example

```
char i2c_read_buf[4]={0x00,0x00,0x00,0x00};
char i2c_write_buf[2]={0x00,0x00};

void PI5USB30216D_INTN_handler (void)
{
        char int_status = 0x00;                 //Interrupt status;
        char cc_status =0x00;
        char port_status=0x00;
        char control_status;

        i2c_write_buf[1]=0x47;    //Mask PI5USB30216D interrupt.  E.g. in Try.SNK DRP mode, write Reg[0x02]=47h
        PI5USB30216D_i2c_write(PI5USB30216D_slaveAddr,i2c_write_buf,2);

        PI5USB30216D_i2c_read(PI5USB30216D_slaveAddr, i2c_read_buf, 4);
//Read PI5USB30216D registers when Interrupt occurred

        control_status=i2c_read_buf[1];

        int_status = i2c_read_buf[2];
        if(int_status&0x02)
        {
                printf("Unpluged.\n");
                switch_off_VBUS_PWR();    //CPU switch off the VBUS power supply when port unpluged
                                          //Per TypeC spec, Source removes VBUS and reaches vsafe0V within 650ms.

        }
        if(int_status&0x01)         printf("Plug in.\n");

        cc_status = i2c_read_buf[3];
        if(cc_status&0x01)          printf("CC1 connected.\n");

        if(cc_status&0x02)          printf("CC2 connected.\n");

        port_status = (i2c_read_buf[3]>>2)&0x07;
        if((cc_status&0x01)|(cc_status&0x02))
        {
                switch(port_status)
                {
                case 1:
                        printf("Device plug in.\n");
                        switch_on_VBUS_PWR(); //CPU switch on the VBUS power supply when UFP/Device plug in.
                        break;
                case 2:
                        printf("Host plug in.\n");
                        break;
                case 3:
                        printf("Audio Adapter Accessory plug in.\n");
                        break;
                case 4:
                        printf("Debug Accessory plug in.\n");
                        break;
                case 5:
```

```
                printf(Device plug in with active cable.\n”);
                switch_on_VBUS_PWR(); //CPU switch on the VBUS power supply when UFP/Device plug in.
                break;
        default:
                break;
        }
    }

    i2c_write_buf[1]=0x46;    //Unmask PI5USB30216D interrupt.  E.g. in Try.SNK DRP mode, write Reg[0x02]=46h
    PI5USB30216D_i2c_write(PI5USB30216D_slaveAddr,i2c_write_buf,2);
}

void Initial_prog(void)
{

    i2c_write_buf[1]=0x81;    //Reset
    PI5USB30216D_i2c_write(PI5USB30216D_slaveAddr,i2c_write_buf,2);
    delay(10);
    i2c_write_buf[1]=0x46;    //Support Try.SNK DRP mode
    PI5USB30216D_i2c_write(PI5USB30216D_slaveAddr,i2c_write_buf,2);
    set_EN_high();    //Enable the PI5USB30216D when EN pin by GPIO control

}

Void Power_off(void)
{

    //If power-down via powersaving bit
    i2c_write_buf[1]=0x81;    //Enter Power_saving mode when CPU power off
    PI5USB30216D_i2c_write(PI5USB30216D_slaveAddr,i2c_write_buf,2);
    delay(10);
    ///

    //If power-down via EN pin
    set_EN_Low();    //Disable PI5USB30216D via EN pin
    delay(10);
    //

    //System should read byte3 and byte4 to clear them regardless of power-down method
    PI5USB30216D_i2c_read(PI5USB30216D_slaveAddr, i2c_read_buf, 4);

}
```