AN2754

USB-to-I^{2}C Bridging with USB7002, USB7050, USB7051, and USB7052 Hubs

Author: *Mick Davis*
Microchip Technology, Inc.

INTRODUCTION

The USB-to-I^{2}C bridging feature gives system designers using Microchip hubs expanded system control and potential BOM reduction. The use of a separate USB-to-I^{2}C device is no longer required and a downstream USB port is not lost as occurs when a standalone USB-to-I^{2}C device is implemented. This feature is available on the Microchip USB7002, USB7050, USB7051, and USB7052 hubs.

Commands may be sent from the USB Host to the internal Hub Feature Controller (HFC) device in the Microchip hub to perform the following functions:

- Configure I^{2}C Pass-Through Interface
- I^{2}C Write
- I^{2}C Read

Sections

References

Consult the following documents for details on the specific parts referred to in this application note:

- *Microchip USB7002 Data Sheet*
- *Microchip USB7050 Data Sheet*
- *Microchip USB7051 Data Sheet*
- *Microchip USB7052 Data Sheet*

GENERAL INFORMATION

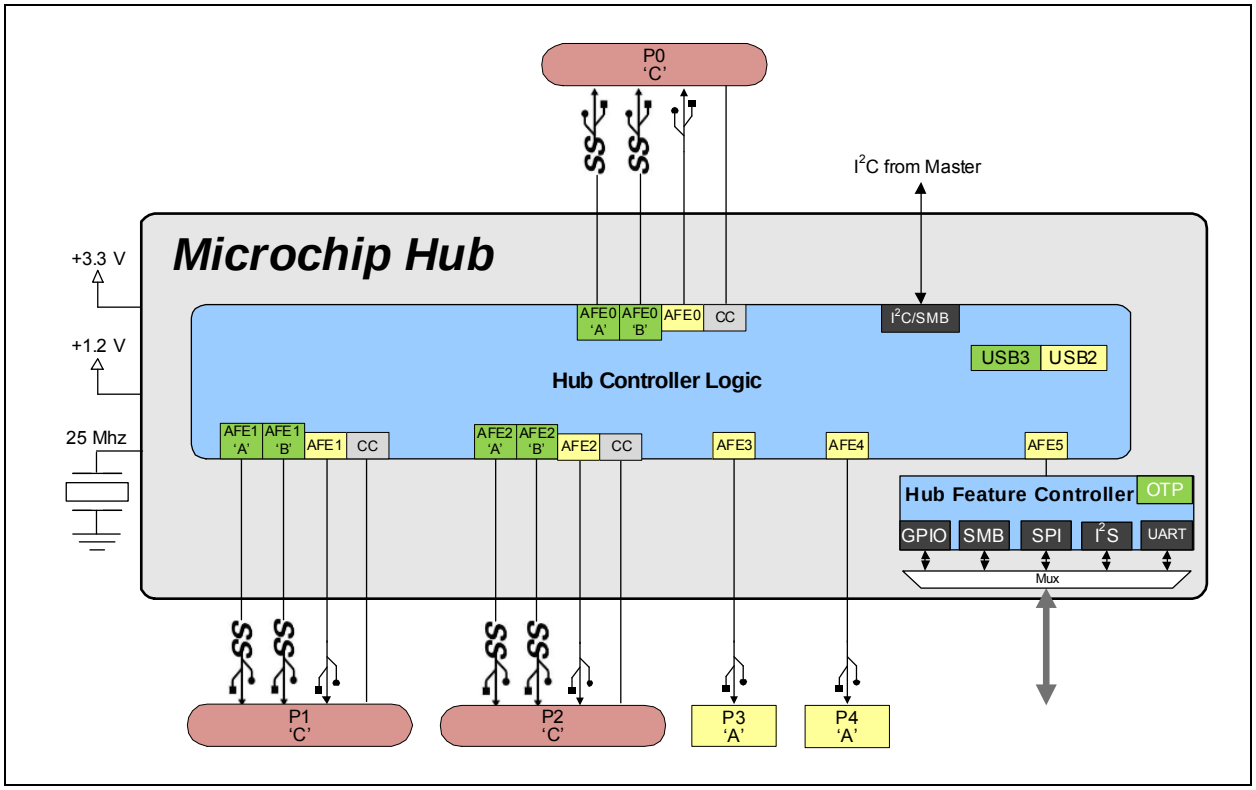
The USB Bridging features in Microchip hubs work via Host commands sent to a Hub Feature Controller embedded within the hub located on an additional internal USB port. In order for the bridging features to work correctly, this internal Hub Feature Controller must be enabled by default. Table 1 provides details on the default Hub Feature Controller settings by device.

TABLE 1: DEFAULT SETTINGS FOR THE HUB FEATURE CONTROLLER ENABLE

Part Number	Part Summary	Hub Feature Controller Default Setting
USB7002	4-Port USB3.1G1 hub – 2xUSB-C w/cc pin i/f, 2xType A DFP (2.0), No PD	Enabled by default
USB7050	4-Port USB3.1G1 hub – 2xUSB-C w/ UPD350, 2xType A DFP (2.0/3.1), PD FW	Enabled by default
USB7051	4-Port USB3.1G1 hub – 2xUSB-C w/ cc pin/350, 2xType A DFP (2.0/3.1), PD FW	Enabled by default
USB7052	4-Port USB3.1G1 hub – 2xUSB-C w/ cc pin i/f, 2xType A DFP (2.0/3.1), PD FW	Enabled by default

The Hub Feature Controller is a USB 2.0 WinUSB class device connected to an internal USB 2.0 port in the hub. For example, in a four-port hub, the Hub Controller is connected to port 6 of the USB 2.0 portion of the hub. The Product ID (PID) for the Hub Controller is 0x7040. All bridging commands are addressed to the Hub Controller and not the Hub. (See Figure 1.)

FIGURE 1: MICROCHIP HUB CONTROLLER EXAMPLE



I²C Bridging Commands

The following I²C functions are supported:

- I2C Write
- I2C Read

I²C WRITE

The I²C interface works as a complete pass-through. This means that the Host must properly arrange data payloads in the appropriate I²C-compatible format and bit order, including the I²C slave device address. Up to 255 bytes of data payload may be sent per I²C Write command sequence.

I²C READ

The I²C interface works as a complete pass-through. This means that the Host must properly arrange data payloads in the appropriate I²C-compatible format and bit order, including the I²C slave device address. Up to 255 bytes of data payload may be sent per I²C Write command sequence.

I²C Interface Setup Requirements

The I²C interface operates at 100 kHz clock speed by default. Refer to Clock Configuration for other supported speeds.

The I²C interface is supported in all configuration options.

PART NUMBER-SPECIFIC INFORMATION

Part Summary

Table 2 to Table 5 display the I^2C interface pins by part number.

TABLE 2: USB7002 I^2C INTERFACE PINS

Option 1 I^2C		Option 2 I^2C	
MSTR_I2C_CLK	PF18	MSTR_I2C_CLK	PF30
MSTR_I2C_DATA	PF19	MSTR_I2C_DATA	PF31

Note 1: Configuration Options 3 and 4 do not support I^2C Bridging.

TABLE 3: USB7050 I^2C INTERFACE PINS

Option 1 I^2C		Option 2 I^2C		Option 3 UART		Option 5	
MSTR_I2C_CLK	PF18	MSTR_I2C_CLK	PF30	MSTR_I2C_CLK	PF10	MSTR_I2C_CLK	PF10
MSTR_I2C_DATA	PF19	MSTR_I2C_DATA	PF31	MSTR_I2C_DATA	PF11	MSTR_I2C_DATA	PF11

Note 1: Configuration Option 4 does not support I^2C Bridging.

TABLE 4: USB7051 I^2C INTERFACE PINS

Option 1 I^2C		Option 2 I^2C		Option 3 UART		Option 4 FLEX	
MSTR_I2C_CLK	PF18	MSTR_I2C_CLK	PF30	MSTR_I2C_CLK	PF10	MSTR_I2C_CLK	PF10
MSTR_I2C_DATA	PF19	MSTR_I2C_DATA	PF31	MSTR_I2C_DATA	PF11	MSTR_I2C_DATA	PF11

TABLE 5: USB7052 I^2C INTERFACE PINS

Option 1 I^2C		Option 2 I^2C	
MSTR_I2C_CLK	PF30	MSTR_I2C_CLK	PF30
MSTR_I2C_DATA	PF31	MSTR_I2C_DATA	PF31

MPLAB® CONNECT CONFIGURATION

The simplest method for implementing the USB-to-I^{2}C Bridging functions is to use the publicly available MPLABCC DLL library. The MPLABConnect.dll library is available for Windows operating systems. Visit the product page on microchip.com for any of the hubs listed in this document and to download the MPLABCC package for Windows. Using the libraries available in the SDK, the bridging features can be implemented in C code.

The DLL package contains the following:

- MPLABCC Release Notes
- Library files:
  - For Windows: A *.dll*
- Example code

Commands included in the SDK

- MchpUsbI2CSetConfig: This sets up the I^{2}C interface (such as clock speed).
- MchpUsbI2CReadRead: This reads up to 255 bytes of data from an I^{2}C slave device.
- MchpUsbI2CWrite: This writes up to 255 bytes of data to an I^{2}C slave device.
- MchpUsbI2CTransfer: This reads and writes from an I^{2}C slave device.

For additional details on how to use the SDK to implement USB to I^{2}C bridging, download the MPLABCC package.

MANUAL IMPLEMENTATION

The USB-to-I^{2}C Bridging features may be implemented at the lowest level if you have the ability to build USB packets. This approach is required if you are not using a Windows Host system and cannot use the MPLABCC DLL.

The details of the I^{2}C pass-through control packets are shown below. All USB to I^{2}C bridging commands must be sent directly to Endpoint 0 of the Hub Feature Controller connected to the last downstream port of the Microchip hub (i.e. located on the port 5 of a 4 port hub).

I^{2}C Enter Pass-Through Command

The I^{2}C Enter Pass-Through command is required to enable the I^{2}C bridge. This command only needs to be issued one time for every reset/power cycle. The I^{2}C clock frequency is also configured within the wValue of this command. (See Clock Configuration for details on the possible values.)

I^{2}C Control Flags

Both the read and write commands have a special control flag parameter which is defined as show in Table 6.

TABLE 6: I^{2}C CONTROL FLAGS

Bits	Control	Usage
2-7	Reserved	N/A
2	SEND_NACK	If asserted, NACK the last byte in the transfer.
1	SEND_START	If asserted, send a Start condition as the first step in the I^{2}C command.
0	SEND_STOP	If asserted, send a Stop condition as the last step of this command.

I^{2}C Write Command

This command is used to send data to an I^{2}C peripheral connected to the USB hub. Both the I^{2}C Control flags (defined in I2C Control Flags) and the I^{2}C slave address are bundled into the wValue field. See Table 7 for more details on the command.

TABLE 7: USB SETUP COMMAND

SETUP Parameter	Value	Description
bmRequestType	0x41	Vendor-specific command; Host-to-device data transfer
bRequest	0x71	Register read command: CMD_I2C_WRITE
wValue	0xXXYY	MSB (XX): I^{2}C Control flags (See I2C Control Flags.) LSB (YY): I^{2}C Slave device address
wIndex	0x0000	Reserved
wLength	0xNN	N bytes of data to be sent in the data stage (in the OUT EP0 control transfer packets)

I²C WRITE USB TRANSACTION SEQUENCE

Command Phase: The Hub Feature Controller receives the setup packet with the parameters specified above.

Data Phase: The Host sends multiple EP0 OUT packets of 64 bytes each with a total length of N bytes.

Status Phase: If an IN-Zero Length Packet is sent from Hub Feature Controller, it would mean that the transfer was a success. If an IN-STALL packet is sent from Hub Feature Controller, there was an error during the transfer, likely due to missing ACK from the I²C slave.

I²C Read Command

This command is used to read data from an I²C peripheral connected to the USB hub. Both the I²C Control flags (defined in I2C Control Flags) and the I²C slave address are bundled into the wValue field. (See Table 8.)

TABLE 8: USB SETUP COMMAND

SETUP Parameter	Value	Description
bmRequestType	0xC1	Vendor-specific command; Device-to-Host data transfer
bRequest	0x72	Register read command: CMD_I2C_READ
wValue	0xXXYY	MSB (XX): I²C Control flags (See I2C Control Flags.) LSB (YY): I²C Slave device address
wIndex	0x0000	Reserved
wLength	0xNN	N bytes of data to be sent in the data stage (in the OUT EP0 control transfer packets)

I²C READ USB TRANSACTION SEQUENCE

Command Phase: The Hub Feature Controller receives the SETUP packet with the parameters specified above.

Data Phase: The Hub Feature Controller sends Multiple EP0 IN packets of 64 bytes each with a total length of N bytes.

Status Phase: The Host sends an OUT-Zero Length ACK packet to acknowledge receipt of data.

EXAMPLES

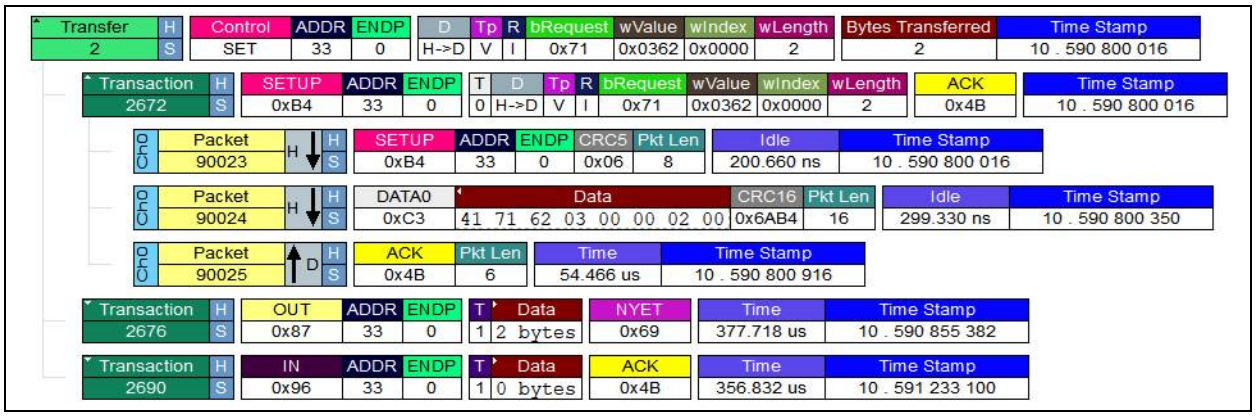
Send an I²C Write to an Attached Device

1. **Command Phase (SETUP Transaction):** I²C Address 0x61: Write a value of 0x12 to Register 0x15. Send the following SETUP Register Read Command to Endpoint 0 of the Hub Feature Controller to send an I²C Write command to the attached I²C device with the I²C Address as defined in the wValue field. (See Table 9 and Figure 2.)

TABLE 9: I²C WRITE SETUP PACKET EXAMPLE

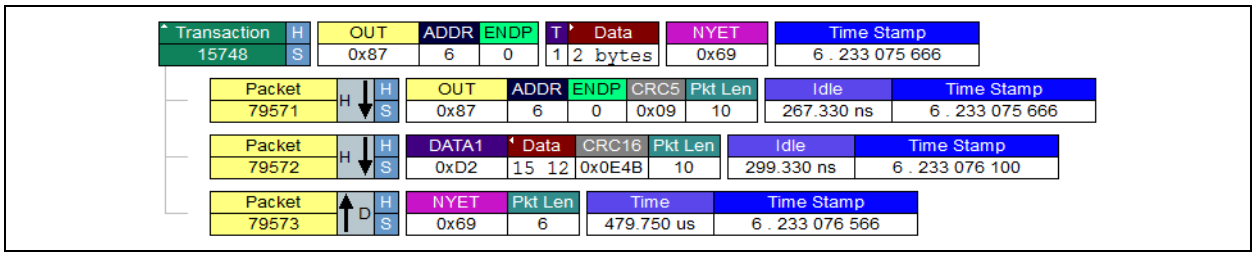
Field	Value	Note
bmRequestType	0x41	—
bRequest	0x71	—
wValue	0x0362	I²C Control flag 0x03, I²C Address 0x62 (0110 0010b)
wIndex	0x0000	—
wLength	0x0002	2 bytes of data (Register Address + 1 byte of data)

FIGURE 2: I²C WRITE SETUP TRANSACTION EXAMPLE



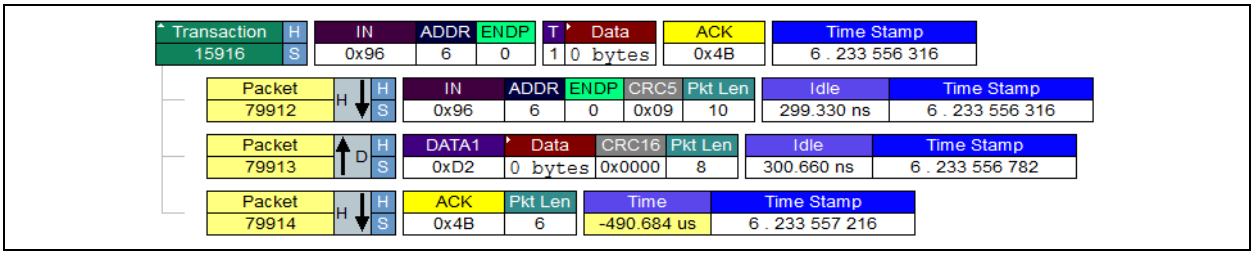
2. **Data Phase (OUT Transaction):** Host sends an OUT packet followed by the data bytes of length wLength starting from the specified address after receiving an IN packet. In this instance, Register 0x12 is being written to Register 0x15 (Data = 0x15, 0x12). Hub Feature Controller responds with a NYET after receiving the data. (See Figure 3.)

FIGURE 3: I²C WRITE IN TRANSACTION EXAMPLE



3. **Status Phase (IN Transaction):** Host sends an IN packet to complete the USB Transfer. Hub Feature Controller responds with a zero-length data packet. The Host ACKs to complete the bridging command. (See Figure 4.)

FIGURE 4: I²C WRITE OUT TRANSACTION EXAMPLE



Send an I²C Read to an Attached Device

A read requires two operations:

- Transaction 1: Write the register to be read using I²C Write.
- Transaction 2: Read the register content(s), depending on length.

1. **Command Phase 1 (SETUP Transaction 1):** I²C Address 0x62: Read Register 0x15. Send the following SETUP Register Read Command in to Endpoint 0 of the Hub Feature Controller to prepare the I²C device to return data. (See Table 10 and Figure 5.)

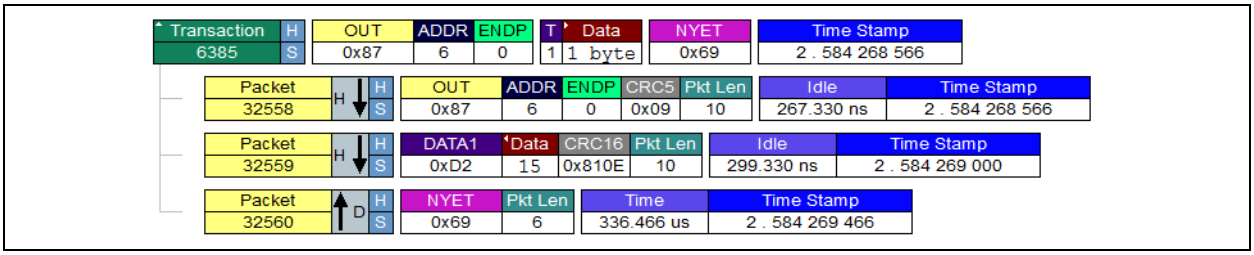
TABLE 10: I²C READ SETUP COMMAND 1 EXAMPLE

Setup Parameter	Value	Note
bmRequestType	0xC1	—
bRequest	0x72	—
wValue	0x0762	Control flag = 0x07, I²C Address = 0x62 (01100010b)
wIndex	0x0000	—
wLength	0x0001	—

FIGURE 5: I²C READ SETUP TRANSACTION 1 EXAMPLE

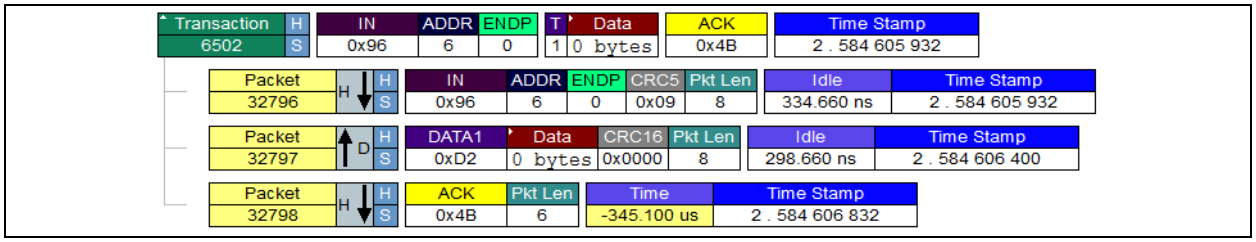
2. **Data Phase 1 (OUT Transaction 1):** Host sends an OUT packet followed by the data. The data in this instance is 0x15. Hub Feature Controller responds withe a NYET. (See Figure 6.)

FIGURE 6: I²C READ OUT TRANSACTION 1 EXAMPLE



3. **Status Phase 1 (IN Transaction 1):** Host sends an IN packet to complete the USB Transfer. Hub Feature Controller responds with a zero-length data packet. Host sends an ACK. (See Figure 7.)

FIGURE 7: I²C READ IN TRANSACTION 1 EXAMPLE

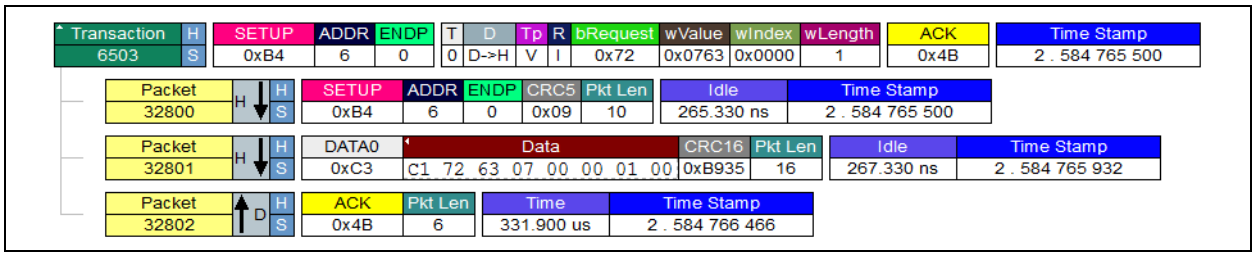


4. **Command Phase 2 (SETUP Transaction 2):** Send the following SETUP Register Read Command to Endpoint 0 of the Hub Feature Controller to retrieve the requested data. (See Table 11 and Figure 8.)

TABLE 11: I²C READ SETUP COMMAND 2 EXAMPLE

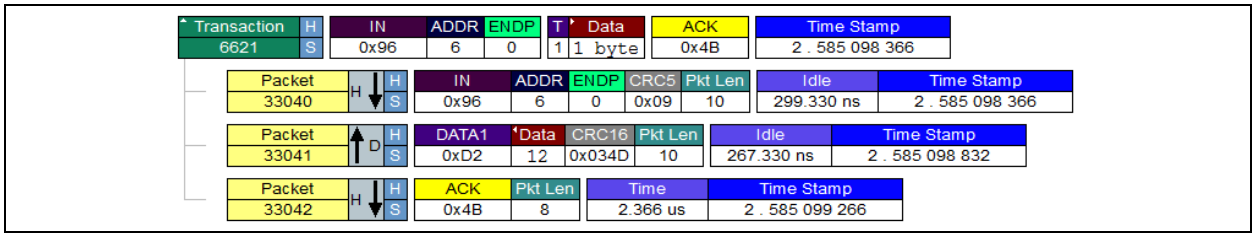
Setup Parameter	Value	Note
bmRequestType	0xC1	—
bRequest	0x71	—
wValue	0x0763	Control Flag = 0x07, I²C Address = 0x63 (01100011b)
wIndex	0x0000	—
wLength	0x0001	—

FIGURE 8: I²C ADDRESS DATA PHASE BYTE 3 TRANSACTION 2 EXAMPLE



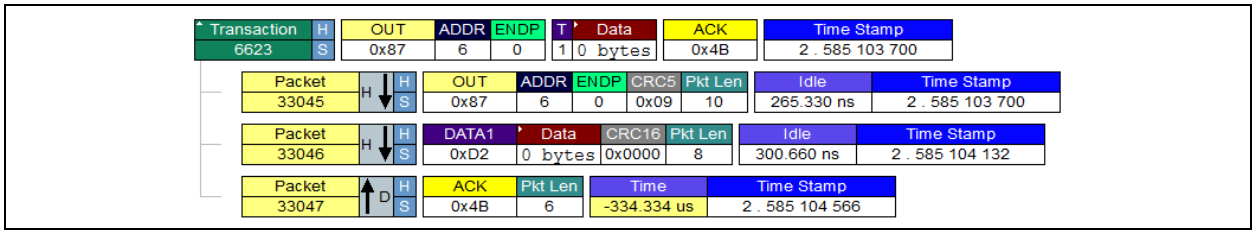
5. **Data Phase 2 (IN Transaction 2):** Host sends and IN packet, and Hub Feature Controller responds with the register contents (0x12). Host responds with an ACK. (See Figure 9.)

FIGURE 9: I²C READ IN TRANSACTION 2 EXAMPLE



6. **Status Phase 2 (OUT Transaction 2):** Host sends an OUT packet followed by a zero-data length packet. Hub Feature Controller responds with an ACK to complete the bridging command. (See Figure 10.)

FIGURE 10: I²C READ OUT TRANSACTION 2 EXAMPLE



CLOCK CONFIGURATION

There is a register to control I2C clock frequency, named bI2CInter128Delay located at address 0xBFD23410. If the DLL API is used, register bI2CInter128Delay is written automatically. The value of bI2CInter128Delay is determined using this formula:

bI2CInter128Delay = 2 * (Time period of the I2C bus clock in microseconds)

The default value is 0x14 for 100 kHz clock. A value of 0x5A creates a delay of 900 µs.

This value will be multiplied by 10 in the firmware to have some buffer time in order not to miss any byte when operating at a lower speed, thereby ensuring data integrity.

The maximum value that can be programmed in bI2CInter128Delay is 0x63.
(i.e a maximum of 99 * 10 = 990 µs can be added as the maximum Inter-128Byte delay)

To configure the USB-I2C bridge for 40 kHz clock operation, it is only necessary to write a value of 0x32 to bI2CInter128Delay after any other I2C bridge setups have been made. The bI2CInter128Delay and Bus Frequency Control register values are provided for various supported clock frequencies in Table 12.

The method for writing to registers (including bI2CInter128Delay) through the SMBus (slave) is explained in Section 2.4 of *AN2439 Configuration of the USB491x/USB492x/USB4715*. An example clock configuration is provided in the Clock Configuration Example.

TABLE 12: BUS FREQUENCY CONTROL AND B12CINTER128DELAY REGISTER VALUES FOR COMMON 12C CLOCK FREQUENCIES

Frequency (kHz)	Bus Frequency Register Value (hex)	bI2CInter128Delay Value	
		Decimal	Hexadecimal
400	0A00	5	05
250	081B	8	08
200	1818	10	0A
100 (default)	3131	20	14
80	3D3E	25	19
50	6363	40	28
40	7C7C	50	32
25	C7C7	80	50
20	F9F9	100	64

Clock Configuration Example

An example clock configuration for 40 kHz operation is provided below. (Refer to Table 13 to Table 16.)

1. Write bI2CInter128Delay located at 0xBFD23410 with a value of 0x32 (40 kHz per Table 12).

TABLE 13: CLOCK CONFIGURATION COMMAND 1 EXAMPLE

Setup Parameter	Value	Note
bmRequestType	0x40	Host-to-device data transfer
bRequest	0x03	CMD_MEMORY_WRITE
wValue	0x3410	Least Significant 16-bits of memory address in little-endian format
wIndex	0xBFD2	Most Significant 16-bits of memory address in little-endian format
wLength	0x0001	Number of data bytes to write

Data to be written: 0x32

2. Enable I^2C pass-through and set frequency.

TABLE 14: CLOCK CONFIGURATION COMMAND 2 EXAMPLE

Setup Parameter	Value	Note
bmRequestType	0x41	Host-to-device data transfer
bRequest	0x70	CMD_I2C_ENTER_PASSTHRU
wValue	0x7C7C	I^2C Clock Frequency: 40 kHz
wIndex	0x0000	—
wLength	0x0000	—

3. Write the start address from which data needs to be read.

TABLE 15: CLOCK CONFIGURATION COMMAND 3 EXAMPLE

Setup Parameter	Value	Note
bmRequestType	0x41	Host-to-device data transfer
bRequest	0x71	CMD_I2C_WRITE
wValue	0x03A0	03: I^2C Control flags (START, STOP) A0: Slave Address
wIndex	0x0000	—
wLength	0x0001	1 byte of data

Data to be written: 0x00

4. Read 2 bytes of data.

TABLE 16: CLOCK CONFIGURATION COMMAND 4 EXAMPLE

Setup Parameter	Value	Note
bmRequestType	0xC1	Host-to-device data transfer
bRequest	0x72	CMD_I2C_READ
wValue	0x07A1	07: I^2C Control flags (NACK, START, STOP) A1: Slave Address
wIndex	0x0000	—
wLength	0x0002	2 bytes of data

APPENDIX A: APPLICATION NOTE REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/ Entry	Correction
DS00002754 (08-09-18)	All	Initial release

THE MICROCHIP WEBSITE

Microchip provides online support via our WWW site at www.microchip.com. This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website 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 (FAQ), 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

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. Under "Support", click on "Customer Change Notification" and follow the registration instructions.

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 website at: http://microchip.com/support

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: 978-1-5224-3391-0

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.

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880- 3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-67-3636

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7289-7561

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820