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USB224X

Ultra Fast USB 2.0 Multi-Format, SD/MMC, and MS Flash Media Controllers

Highlights

The Microchip USB224x is a USB 2.0 compliant, Hi-Speed bulk only[1] mass storage class peripheral controller intended for reading and writing to popular flash media from the xD-Picture Card™ (xD)[2], Memory Stick® (MS), Secure Digital (SD), and MultiMedia-Card™ (MMC) families.

The USB224x is a fully integrated, single chip solution capable of ultra high performance operation. Average sustained transfer rates exceeding 35 MB/s are possible if the media and host can support those rates. The USB2244/44i includes provisions to read/write secure media formats.

General Features

- Low pin count 36-pin QFN (6x6 mm) RoHS compliant package
- USB2240/40I/41/41I
  - Targeted for applications in which single or "combo" media sockets are used
- Hardware-controlled data flow architecture for all self-mapped media
- Pipelined hardware support for access to non-self-mapped media
- Order number with "I" denote the products that support the industrial temperature range of -40ºC to 85ºC
- Support included for secure media format on a licensed, customized basis
  - USB2244/44I: SD Secure

Hardware Features

- Single chip flash media controller with
  - USB2240/40I/41/4I: multiplexed interface for use with "combo" card sockets
  - USB2244/44I: SD/MMC flash media reader/writer
- MMC Streaming Mode support
- Extended configuration options
  - xD player mode operation
  - Socket switch polarities, etc.

- Media Activity LED
- On board 24 MHz crystal driver circuit
- Optional external 24 MHz clock input[3]
- Internal card power FET
  - 200 mA
  - "Fold-back" short circuit protection
- 8051 8-bit microprocessor
  - 60 MHz - single cycle execution
  - 64 KB ROM | 14 KB RAM
- Supports a single external 3.3 V supply source; internal regulators provide 1.8 V internal core voltage for additional bill of materials and power savings
- Optimized pinout improves signal routing which eases implementation for improved signal integrity

Flash Media Specification Compliance

- Secure Digital 2.0
  - HS-SD, SDHC
  - TransFlash™ and reduced form factor media
- MultiMediaCard 4.2
  - 1/4/8-bit MMC
- Memory Stick Formats
  - MS 1.43, Pro 1.02, Duo 1.10
  - Pro-HG Duo 1.01
    - –MS, MS Duo, HS-MS, MS Pro-HG, MS Pro
- xD-Picture Card 1.2

Software Features

- Customizable vendor specific data
- Optimized for low latency interrupt handling
- Reduced memory footprint

Applications

- Flash media card reader/writers
- Desktop and mobile PCs
- Printers
- Consumer A/V and media players/viewers
- Compatible with
  - –Microsoft® Vista™ and Vista ReadyBoost™
  - –Windows® XP, ME, 2K SP4
  - –Apple Mac OSx®
  - –Linux Mass Storage Class Drivers

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1. Bulk only is not applicable to USB2240/40i/41/41i.
2. xD-Picture Card is not applicable to USB2241/41i.

3. Only applicable to USB2240/40i/41/41i.

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1.0   INTRODUCTION

The Microchip USB224x is a flash media card reader solution fully compliant with the USB 2.0 specification. All required resistors on the USB ports are integrated into the device. This includes all series termination resistors on D+ and D– pins and all required pull-down and pull-up resistors. The over-current sense inputs for the downstream facing ports have internal pull-up resistors.

1.1   Hardware Features

- Single chip flash media controller in low pin count 36-pin QFN, RoHS compliant package
- Commercial temperature products support 0°C to +70°C: USB2240/41 and USB2244
- Industrial temperature products support -40°C to +85°C: USB2240I/41I and USB2244I
- 8051 8-bit microprocessor
  - 60 MHz - single cycle execution
  - 64 KB ROM |14 KB RAM
- Supports a single external 3.3 V supply source; internal regulators provide 1.8 V internal core voltage for additional bill of materials and power savings

Compliance with the following flash media card specifications:

- Secure Digital 2.0
  - HS-SD and SDHC
  - TransFlash™ and reduced form factor media
- MultiMediaCard 4.2
  - 1/4/8 bit MMC
- Memory Stick 1.43
- Memory Stick Pro Format 1.02
- Memory Stick Pro-HG Duo Format 1.01
  - Memory Stick, MS Duo, HS-MS, MS Pro-HG, MS Pro
- Memory Stick Duo 1.10
- xD-Picture Card 1.2

1.2   Software Features

- If the OEM is using an external EEPROM, the following features are available:
  - Customizable vendor, product, language, and device ID's
  - 12-hex digits maximum for the serial number string
  - 28-character manufacturer ID and product strings for the flash media reader/writer
 - LED blink interval or duration

2.0   ACRONYMS

ATA: Advanced Technology Attachment

FET: Field Effect Transistor

LUN: Logical Unit Number

MMC: MultiMediaCard

MSC: Memory Stick Controller[1]

PLL: Phase-Locked Loop

QFN: Quad Flat No leads

RoHS: Restriction of Hazardous Substances Directive

RXD: Received eXchange Data

SDC: Secure Digital Controller

SIE: Serial Interface Engine

TXD: Transmit eXchange Data

UART: Universal Asynchronous Receiver-Transmitter

UCHAR: Unsigned Character

UINT: Unsigned Integer

1.Not applicable to USB2244/44i.

3.0 BLOCK DIAGRAMS

FIGURE 3-1: **USB2240/40I/41/41I BLOCK DIAGRAM**

USB2240/40I
USB2241/41I*

NOTE: xD-Picture Card is not applicable to USB2241/41i.
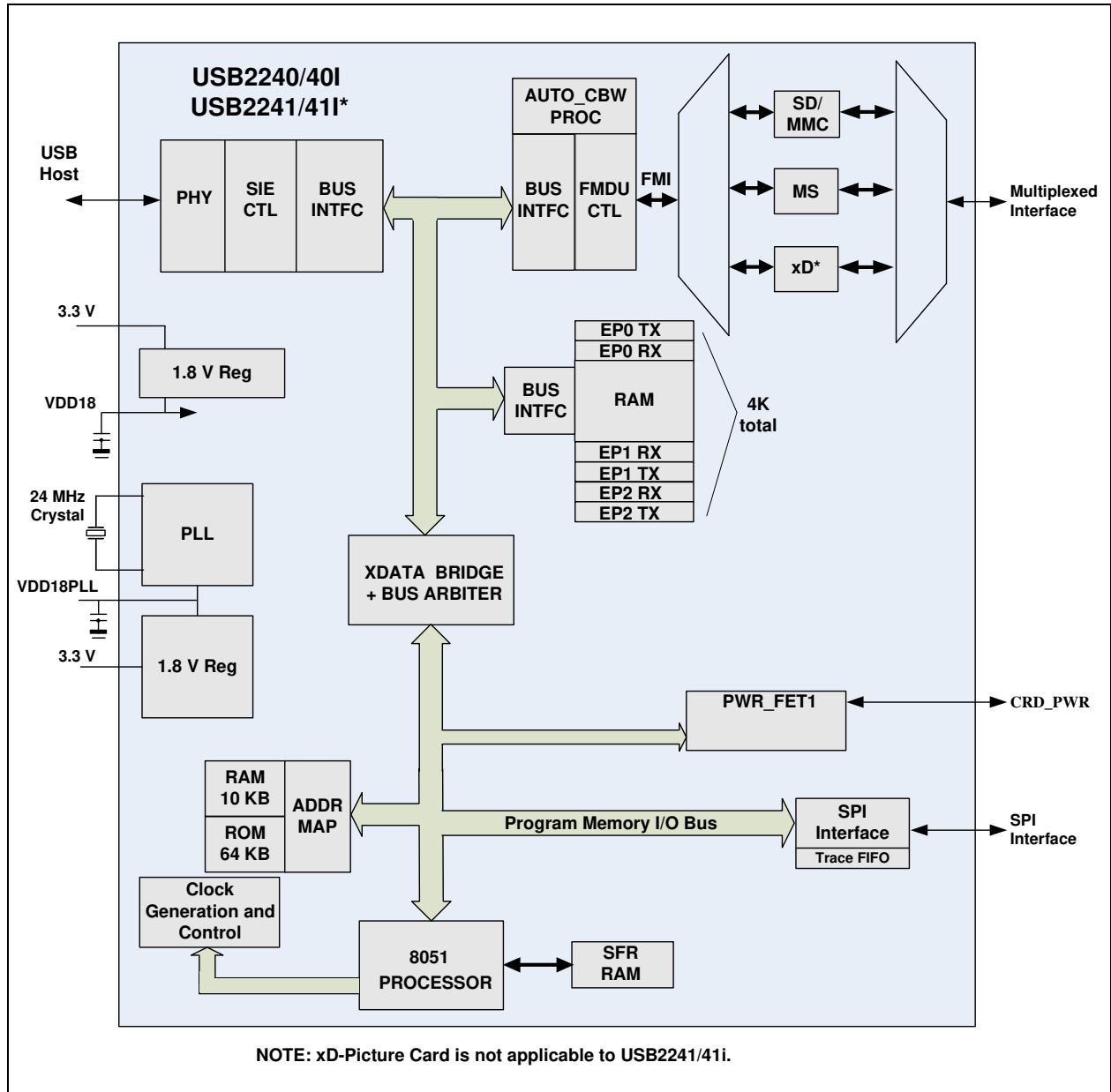
USB224X

FIGURE 3-2: **USB2244/44I BLOCK DIAGRAM**
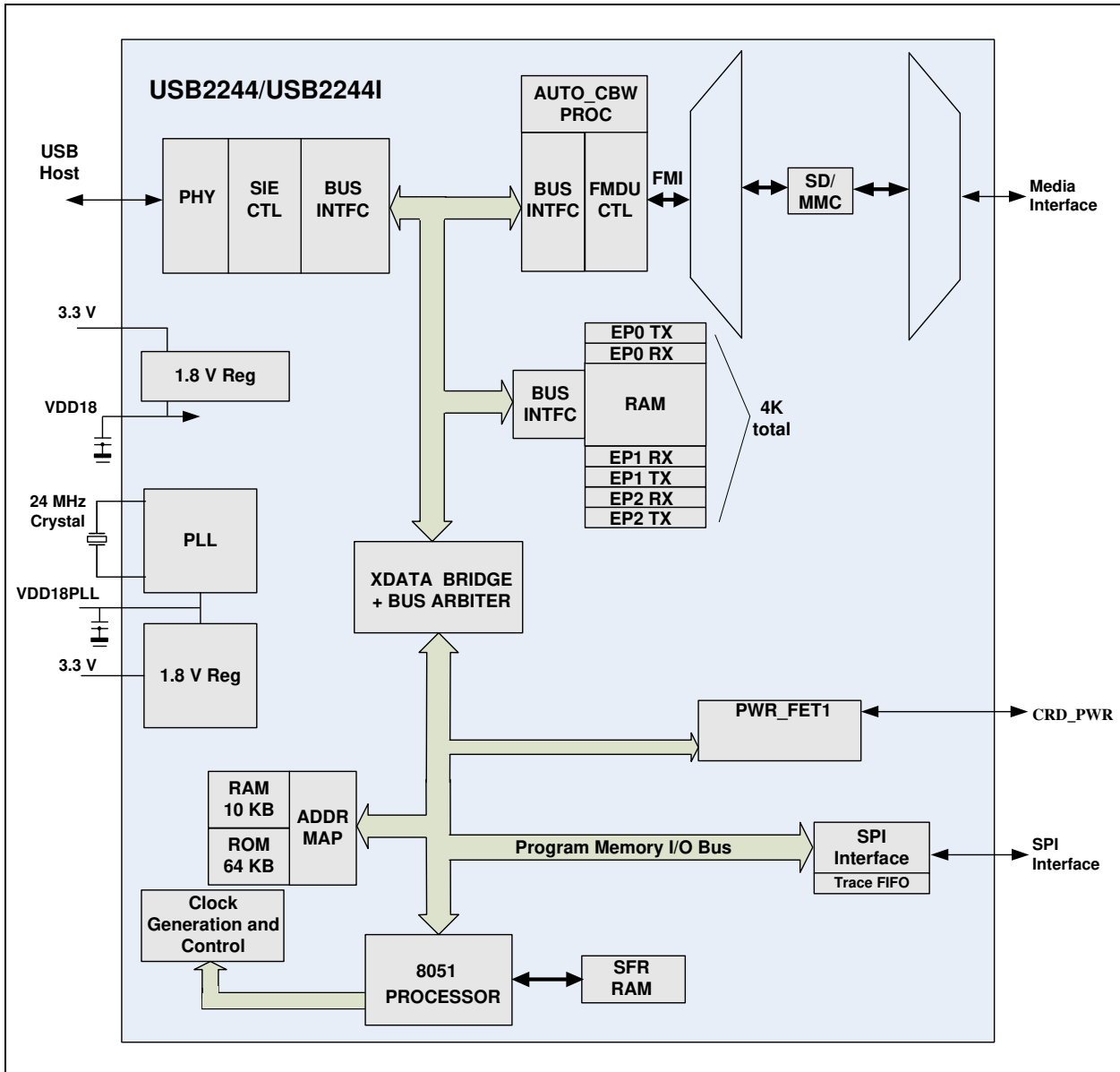
4.0   PIN CONFIGURATIONS

FIGURE 4-1:   **USB2240/USB2240I 36-PIN QFN DIAGRAM**

Indicates pins on the bottom of the device.
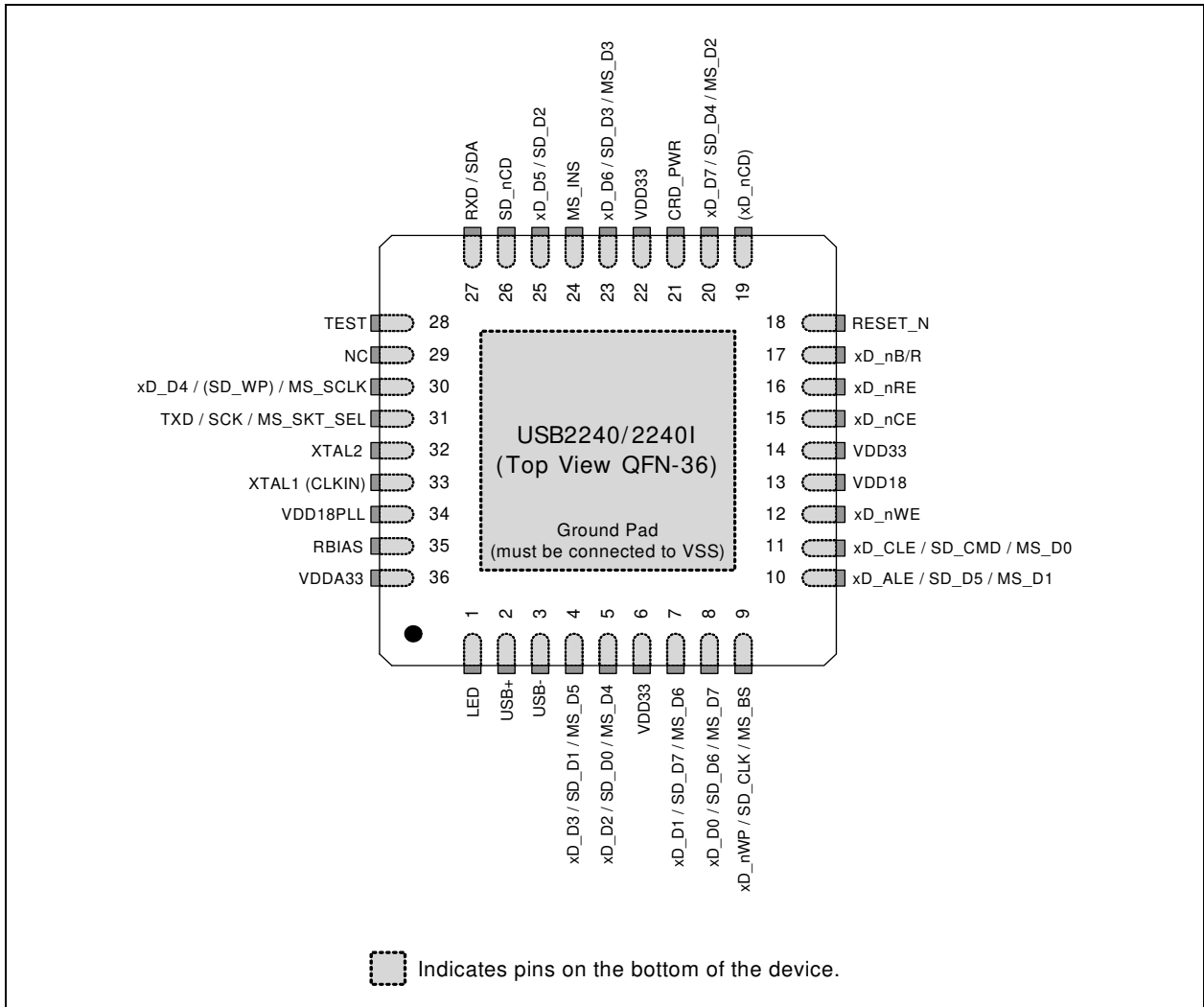
USB224X

FIGURE 4-2: **USB2241/USB2241I 36-PIN QFN DIAGRAM**

Indicates pins on the bottom of the device.
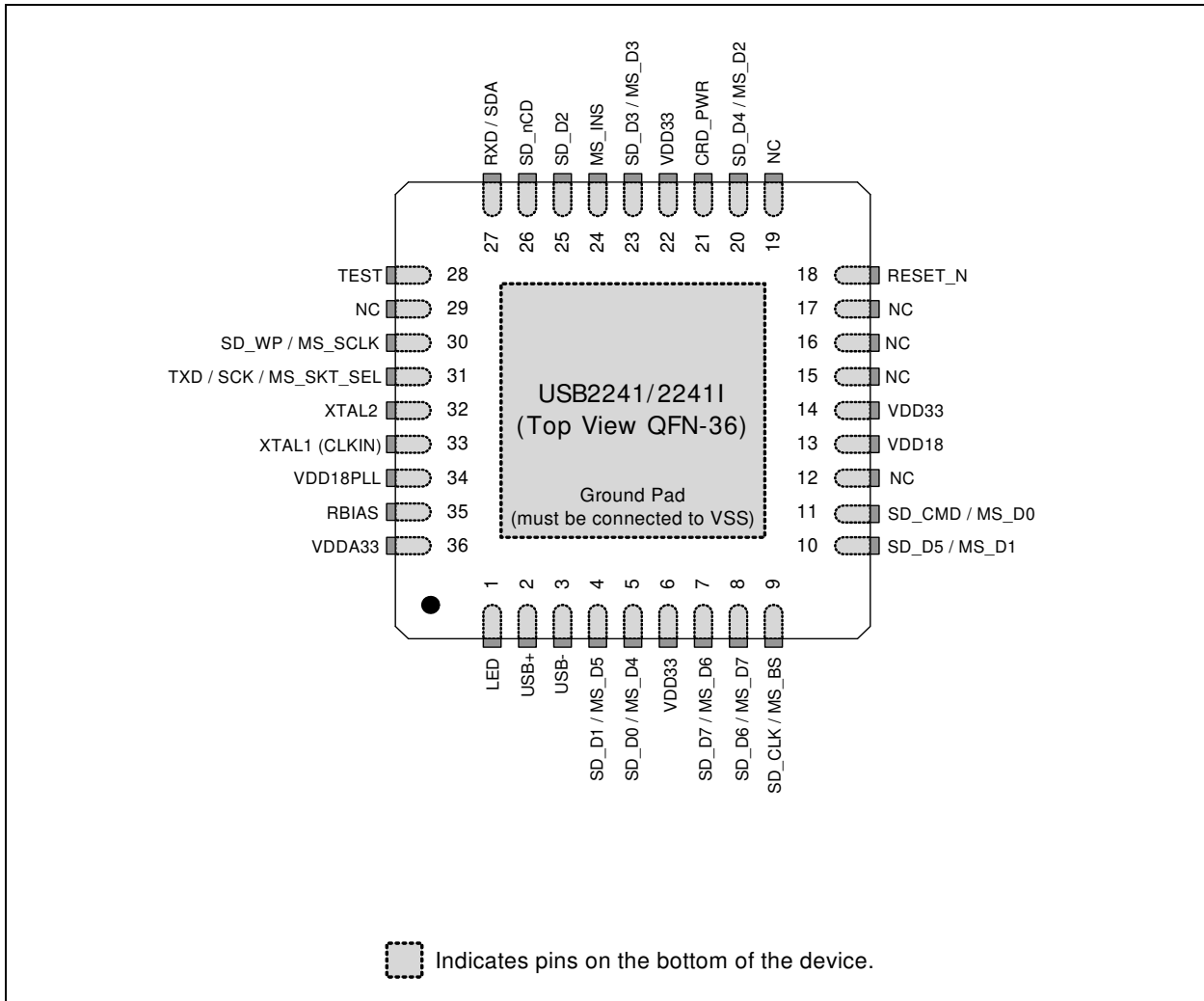
FIGURE 4-3: USB2244/USB2244I 36-PIN QFN DIAGRAM

Indicates pins on the bottom of the device.
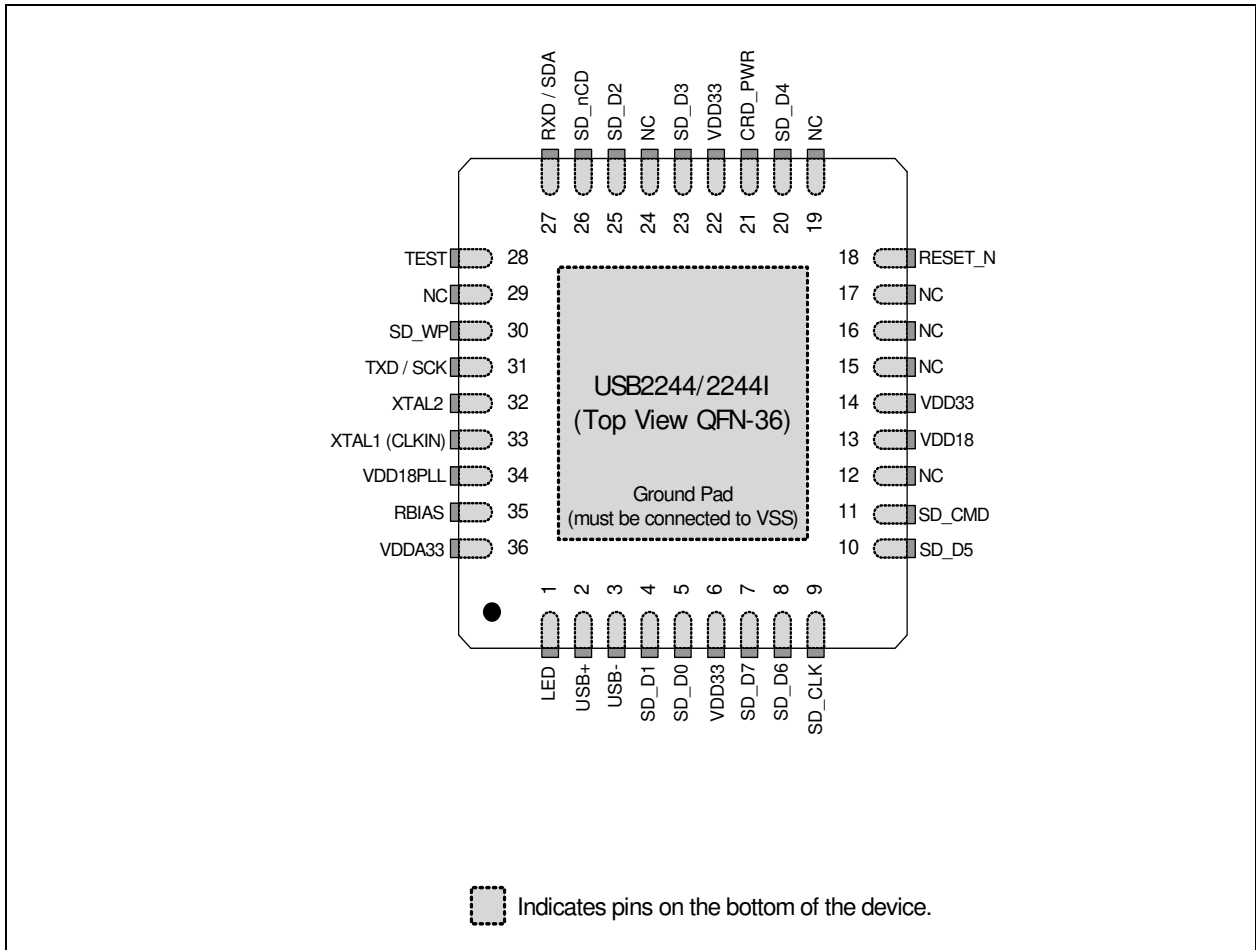
USB224X

5.0   PIN TABLES

TABLE 5-1:   USB2240/2240I 36-PIN QFN PACKAGE

xD/SD/MS INTERFACE (18 PINS)			
xD_D3 / SD_D1 / MS_D5	xD_D2 / SD_D0 / MS_D4	xD_D1 / SD_D7 / MS_D6	xD_D0 / SD_D6 / MS_D7
xD_nWP / SD_CLK / MS_BS	xD_ALE / SD_D5 / MS_D1	xD_CLE / SD_CMD / MS_D0	xD_D7 / SD_D4 / MS_D2
xD_D6 / SD_D3 / MS_D3	xD_D5 / SD_D2	xD_nRE	xD_nWE
xD_D4 / SD_WP / MS_SCLK	xD_nB/R	xD_nCE	MS_INS
xD_nCD	SD_nCD		
USB INTERFACE (5 PINS)			
USB+	USB-	XTAL1 (CLKIN)	XTAL2
RBIAS			
MISC (7 Pins)			
LED	RXD / SDA	NC	TXD / SCK / MS_SKT_SEL
CRD_PWR	TEST	RESET_N	
DIGITAL, POWER (6 PINS)			
(3) VDD33	VDDA33	VDD18	VDD18PLL
TOTAL 36			

TABLE 5-2:   USB2241/2241I 36-PIN QFN PACKAGE

SD/MS INTERFACE (14 PINS)			
SD_D1 / MS_D5	SD_D0 / MS_D4	SD_D7 / MS_D6	SD_D6 / MS_D7
SD_CLK / MS_BS	SD_D5 / MS_D1	SD_CMD / MS_D0	SD_D4 / MS_D2
SD_D3 / MS_D3	SD_D2	SD_WP / MS_SCLK	MS_INS
NC	SD_nCD		
USB INTERFACE (5 PINS)			
USB+	USB-	XTAL1 (CLKIN)	XTAL2
RBIAS			
MISC (11 Pins)			
LED	RXD / SDA	NC	TXD / SCK / MS_SKT_SEL
CRD_PWR	TEST	RESET_N	(4) NC
DIGITAL, POWER (6 PINS)			
(3) VDD33	VDDA33	VDD18	VDD18PLL
TOTAL 36			

USB224X

TABLE 5-3: USB2244/2244I 36-PIN QFN PACKAGE

SD/MMC INTERFACE (12 Pins)			
SD_D0	SD_D1	SD_D2	SD_D3
SD_D4	SD_D5	SD_D6	SD_D7
SD_CLK	SD_CMD	SD_WP	SD_nCD
USB INTERFACE (5 PINS)			
USB+	USB-	XTAL1 (CLKIN)	XTAL2
RBIAS			
MISC (13 PINS)			
LED	RXD / SDA	NC	TXD / SCK
CRD_PWR	NC	NC	(4) NC
TEST	RESET_N		
DIGITAL, POWER (6 PINS)			
(3)VDD33	VDDA33	VDD18	VDD18PLL
TOTAL 36			

6.0   PIN DESCRIPTIONS

This section provides a detailed description of each signal. The signals are arranged in functional groups according to their associated interface. The pin descriptions are applied when using the internal default firmware and can be referenced in Section 7.0, "Pin Configurations," on page 18. Please reference Section 2.0, "Acronyms," on page 4 for a list of the acronyms used.

The "n" symbol in the signal name indicates that the active, or asserted, state occurs when the signal is at a low voltage level. When "n" is not present in the signal name, the signal is asserted at the high voltage level.

The terms assertion and negation are used exclusively. This is done to avoid confusion when working with a mixture of "active low" and "active high" signals. The term assert, or assertion, indicates that a signal is active, independent of whether that level is represented by a high or low voltage. The term negate, or negation, indicates that a signal is inactive.

6.1   USB224x 36-Pin QFN Pin Descriptions

TABLE 6-1:   USB224X 36-PIN QFN PIN DESCRIPTIONS

Symbol	USB2240/40I	USB2241/41I	USB2244/44I	Buffer Type	Description
xD-PICTURE CARD (xD) INTERFACE (APPLIES ONLY TO USB2240/USB2240I)					
xD_D[7:0]	20 23 25 30 4 5 7 8			I/O12PD	xD Data These bi-directional data signals have weak internal pull-down resistors.
xD_nWP	9			O12PD	xD Write Protect This pin is an active low write protect signal for the xD device and has a weak pull-down resistor that is permanently enabled.
xD_ALE	10			O12PD	xD Address Strobe This pin is an active high Address Latch Enable signal for the xD device and has a weak pull-down resistor that is permanently enabled.
xD_CLE	11			O12PD	xD Command Strobe This pin is an active high Command Latch Enable signal for the xD device and has a weak pull-down resistor that is permanently enabled.
xD_nRE	16			O12PU	xD Read Enable This pin is an active low read strobe signal for the xD device. When using the internal FET, this pin has a weak internal pull-up resistor that is tied to the output of the internal power FET. If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used).

USB224X

TABLE 6-1: **USB224X 36-PIN QFN PIN DESCRIPTIONS (CONTINUED)**

Symbol	USB2240/40I	USB2241/41I	USB2244/44I	Buffer Type	Description
xD_nWE	12			O12PU	xD Write Enable
					This pin is an active low write strobe signal for the xD device.
					When using the internal FET, this pin has a weak internal pull-up resistor that is tied to the output of the internal power FET.
					If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used).
xD_nB/R	17			IPU	xD Busy or Data Ready
					This pin is connected to the BSY/RDY pin of the xD device.
					When using the internal FET, this pin has a weak internal pull-up resistor that is tied to the output of the internal power FET.
					If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used).
xD_nCD	19			I/O12	xD Card Detection
					This is designated by the default firmware as the xD-Picture card detection pin.
					Note: This pin can be left unconnected if the socket is not used.
xD_nCE	15			O12PU	xD Chip Enable
					This pin is the active low chip enable signal to the xD device.
					When using the internal FET, this pin has a weak internal pull-up resistor that is tied to the output of the internal power FET.
					If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used).
MEMORY STICK (MS) INTERFACE					
MS_D[7:0]	8 7 4 5 23 20 10 11			I/O12PD	MS System Data In/Out
					These pins are the bi-directional data signals for the MS device. MS_D0, MS_D2, and MS_D3 have weak pull-down resistors.
					In serial mode, the most significant bit (MSB) of each byte is transmitted first by either MSC or MS device on MS_D0.
					In parallel mode, MS_D1 has a pull-down resistor, otherwise it is disabled.
					In 4- or 8-bit parallel mode, there is a weak pull-down resistor on all MS_D7 - 0 signals.

TABLE 6-1: USB224X 36-PIN QFN PIN DESCRIPTIONS (CONTINUED)

Symbol	USB2240/40I	USB2241/41I	USB2244/44I	Buffer Type	Description
MS_BS	9			O12	MS Bus State This pin is connected to the bus state (BS) pin of the MS device. It is used to control the bus states 0, 1, 2 and 3 (BS0, BS1, BS2 and BS3) of the MS device.
MS_SCLK	30			O12	MS System CLK This pin is an output clock signal to the MS device. The clock frequency is software configurable.
MS_INS	24			IPU	MS Card Insertion This is designated by the default firmware as the Memory Stick card detection pin. **Note:** This pin can be left unconnected if the socket is not used.
SECURE DIGITAL (SD) / MULTIMEDIACARD (MMC) INTERFACE					
SD_D[7:0]	7 8 10 20 23 25 4 5	7 8 10 20 23 25 4 5		I/O12PU	SD Data The pins are bi-directional data signals SD_D0 - SD_D7 and have weak pull-up resistors.
SD_CLK	9	9		O12	SD Clock This is an output clock signal to SD/MMC device. The clock frequency is software configurable.
SD_CMD	11	11		I/O12PU	SD Command This is a bi-directional signal that connects to the CMD signal of the SD/MMC device and has a weak internal pull-up resistor.
SD_WP					SD Write Protect Detection
SD_nCD					SD Card Detect
USB INTERFACE					
USB+ USB-	2 3			I/O-U	USB Bus Data These pins connect to the USB bus data signals.
RBIAS	35			I-R	USB Transceiver Bias A 12.0 kΩ, ± 1.0% resistor is attached from VSS to this pin in order to set the transceiver's internal bias currents.
XTAL1 (CLKIN)	33			ICLKx	24 MHz Crystal (External clock input) This pin can be connected to one terminal of the crystal or can be connected to an external 24 MHz clock when a crystal is not used.
XTAL2	32			OCLKx	24 MHz Crystal This is the other terminal of the crystal, or it is left open when an external clock source is used to drive XTAL1(CLKIN).
VDDA33	36				3.3 V Analog Power

TABLE 6-1: USB224X 36-PIN QFN PIN DESCRIPTIONS (CONTINUED)

Symbol	USB2240/40I	USB2241/41I	USB2244/44I	Buffer Type	Description
VDD18PLL		34			1.8 V PLL Power +1.8 V Filtered analog power for internal PLL. This pin must have a 1.0 µF ± 20% (ESR < 0.1 Ω) capacitor to VSS.
MISC					
LED		1		I/O12	LED: Can be used as an LED output.
RXD /				I	RXD: This signal can be used as input to the RXD of UART in the device. Custom firmware is required to activate this function.
SDA				I/O12	SDA: This is the data pin when used with an external serial EEPROM.
TXD /		31		O12	TXD: This signal can be used as an output TXD of UART in the device. Custom firmware is required to activate this function.
SCK /				O12	SCK: This is the clock output when used with an external EEPROM.
MS_SKT_SEL				I	MS_SKT_SEL: On the positive edge of RESET_N, this pin is sampled to determined the Memory Stick socket size. 1 = 8-bit 0 = 4-bit
CRD_PWR		21		I/O200	CRD_PWR: Card power drive of 3.3 V at either 100 mA or 200 mA.
RESET_N		18		IS	RESET Input: This active low signal is used by the system to reset the chip. The active low pulse should be at least 1 µs wide.
TEST		28		I	TEST Input: Tie this pin to ground for normal operation.
NC		12 15 16 17	12 15 16 17		No Connect. No trace or signal should be routed/attached to these pins.
DIGITAL / POWER					
VDD18		13			+1.8 V core power. This pin must have a 1.0 µF ± 20% (ESR <0.1 Ω) capacitor to VSS.
VDD33		6 14 22			3.3 V Power and Regulator Input
VSS		ePad			Ground Pad/ePad: the package slug is the only VSS for the device and must be tied to ground with an array of 3x3 vias.

6.2   Buffer Type Descriptions

TABLE 6-2:   BUFFER TYPE DESCRIPTIONS

Buffer	Description
I	Input
IPU	Input with internal weak pull-up resistor
IS	Input with Schmitt trigger
I/O12	Input/output buffer with 12 mA sink and 12 mA source
I/O200	Input/Output buffer 12 mA with FET disabled, 100/200 mA source only when the FET is enabled
I/O12PD	Input/output buffer with 12 mA sink and 12 mA source with an internal weak pull-down resistor
I/O12PU	Input/output buffer with 12 mA sink and 12 mA source with a pull-up resistor
O12	Output buffer with 12 mA source
O12PU	Output buffer with 12 mA sink and 12 mA source, with a pull-up resistor
O12PD	Output buffer with 12 mA sink and 12 mA source, with a pull-down resistor
ICLKx	XTAL clock input
OCLKx	XTAL clock output
I/O-U	Analog input/output as defined in the USB 2.0 Specification
I-R	RBIAS

Note: The DC characteristics are outlined in Section 9.3, on page 32.

7.0   PIN CONFIGURATIONS

7.1   Card Reader

The Microchip USB224x is fully compliant with the following flash media card reader specifications:

- Secure Digital 2.0
  - HS-SD and SDHC
  - TransFlash™ and reduced form factor media
- MultiMediaCard 4.2
  - 1/4/8 bit MMC
- Memory Stick 1.43
- Memory Stick Pro Format 1.02
- Memory Stick Pro-HG Duo Format 1.01
  - Memory Stick, MS Duo, HS-MS, MS Pro-HG, MS Pro
- Memory Stick Duo 1.10
- xD-Picture Card 1.2

7.2   System Configurations

7.2.1   EEPROM

The USB224x can be configured via a 2-wire (I^2C) EEPROM (512x8) flash device containing the options for the USB224x. If an external configuration device does not exist the internal default values will be used. If one of the external devices is used for configuration, the OEM can update the values through the USB interface. The device will then "attach" to the upstream USB host.

The USBDM tool set is available in the USB224x/USB225x Card Reader software release package. To download the software package from Microchip's website, please visit:

http://www.microchip.com/SWLibraryWeb/product.aspx?product=OBJ Card Reader

to go to the OBJ Card Reader Software Download Agreement. Review the license, and if you agree, check the "I agree" box and then select "Confirm". You will then be able to download the USB224x/USB225x Card reader combo release package zip file containing the USBDM tool set. Please note that the following applies to the system values and descriptions when used:

- N/A = Not applicable to this part
- Reserved = For internal use

7.2.2   EEPROM DATA DESCRIPTOR

TABLE 7-1:   INTERNAL FLASH MEDIA CONTROLLER CONFIGURATIONS

Address	Register Name	Description	Internal Default Value
00h	USB_SER_LEN	USB Serial String Descriptor Length	1Ah
01h	USB_SER_TYP	USB Serial String Descriptor Type	03h
02h-19h	USB_SER_NUM	USB Serial Number	"000000225001" (See Note 7-1)
1Ah-1Bh	USB_VID	USB Vendor Identifier	0424
1Ch-1Dh	USB_PID	USB Product Identifier	2240
1Eh	USB_LANG_LEN	USB Language String Descriptor Length	04h
1Fh	USB_LANG_TYP	USB Language String Descriptor Type	03h
20h	USB_LANG_ID_LSB	USB Language Identifier Least Significant Byte	09h (See Note 7-2)

TABLE 7-1: **INTERNAL FLASH MEDIA CONTROLLER CONFIGURATIONS (CONTINUED)**

Address	Register Name	Description	Internal Default Value
21h	USB_LANG_ID_MSB	USB Language Identifier Most Significant Byte	04h (See Note 7-2)
22h	USB_MFR_STR_LEN	USB Manufacturer String Descriptor Length	10h
23h	USB_MFR_STR_TYP	USB Manufacturer String Descriptor Type	03h
24h-31h	USB_MFR_STR	USB Manufacturer String	"Generic" (See Note 7-1)
32h-5Dh	Reserved	-	00h
5Eh	USB_PRD_STR_LEN	USB Product String Descriptor Length	24h
5Fh	USB_PRD_STR_TYP	USB Product String Descriptor Type	03h
60h-99h	USB_PRD_STR	USB Product String	"Ultra Fast Media Reader" (See Note 7-1)
9Ah	USB_BM_ATT	USB BmAttribute	80h
9Bh	USB_MAX_PWR	USB Max Power	30h (96 mA)
9Ch	ATT_LB	Attribute Lo byte	40h (Reverse SD_WP only)
9Dh	ATT_HLB	Attribute Hi Lo byte	00h
9Eh	ATT_LHB	Attribute Lo Hi byte	00h
9Fh	ATT_HB	Attribute Hi byte	00h
A0h	MS_PWR_LB	Memory Stick Device Power Lo byte	08h
A1h	MS_PWR_HB	Memory Stick Device Power Hi byte	00h
A2h	Reserved	-	80h
A3h	Reserved	-	00h
A4h	xD_PWR_LB	xD-Picture Card Device Power Lo byte	00h
A5h	xD_PWR_HB	xD-Picture Card Device Power Hi byte	08h
A6h	SD_PWR_LB	Secure Digital Device Power Lo byte	00h
A7h	SD_PWR_HB	Secure Digital Device Power Hi byte	80h
A8h	LED_BLK_INT	LED Blink Interval	02h
A9h	LED_BLK_DUR	LED Blink After Access	28h
AAh - B0h	DEV0_ID_STR	Device 0 Identifier String	"COMBO"
B1h - B7h	DEV1_ID_STR	Device 1 Identifier String	"MS"
B8h - BEh	DEV2_ID_STR	Device 2 Identifier String	"SM" (See Note 7-3)
BFh - C5h	DEV3_ID_STR	Device 3 Identifier String	"SD/MMC"
C6h - CDh	INQ_VEN_STR	Inquiry Vendor String	"Generic"
CEh-D2h	INQ_PRD_STR	Inquiry Product String	2240
D3h	DYN_NUM_LUN	Dynamic Number of LUNs	FFh
D4h - D7h	DEV_LUN_MAP	Device to LUN Mapping	FFh, FFh, FFh, FFh
D8h - DAh	Reserved	-	00h, 03h, 07h
DBh - DDh	Reserved	-	5Ch, 56h, 97h

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TABLE 7-1: **INTERNAL FLASH MEDIA CONTROLLER CONFIGURATIONS (CONTINUED)**

Address	Register Name	Description	Internal Default Value
DEh-FBh	Not Applicable	-	00h
FCh-FFh	NVSTORE_SIG	Non-Volatile Storage Signature	"ATA2"

Note 7-1 This value is a UNICODE UTF-16LE encoded string value that meets the USB 2.0 specification (Revision 2.0, 2000). Values in double quotations without this note are ASCII values.

Note 7-2 For a list of the most current 16-bit language ID's defined by the USB-IF, please visit http://www.unicode.org or consult *The Unicode Standard, Worldwide Character Encoding*, (Version 4.0), The Unicode Consortium, Addison-Wesley Publishing Company, Reading, Massachusetts.

Note 7-3 The "SM" value will be overridden with "xD" once an xD-Picture Card has been identified.

7.2.3   EEPROM DATA DESCRIPTOR REGISTER DESCRIPTIONS

7.2.3.1   00h: USB Serial String Descriptor Length

Byte	Name	Description
0	USB_SER_LEN	USB serial string descriptor length as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bLength" which describes the size of the string descriptor (in bytes).

7.2.3.2   01h: USB Serial String Descriptor Type

Byte	Name	Description
1	USB_SER_TYP	USB serial string descriptor type as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bDescriptorType" which is a constant value associated with a string descriptor type.

7.2.3.3   02h-19h: USB Serial Number Option

Byte	Name	Description
25:2	USB_SER_NUM	Maximum string length is 12 hex digits. Must be unique to each device.

7.2.3.4   1Ah-1Bh: USB Vendor ID Option

Byte	Name	Description
1:0	USB_VID	This ID is unique for every vendor. The vendor ID is assigned by the USB Implementer's Forum.

7.2.3.5   1Ch-1Dh: USB Product ID Option

Byte	Name	Description
1:0	USB_PID	This ID is unique for every product. The product ID is assigned by the vendor.

7.2.3.6   1Eh: USB Language Identifier Descriptor Length

Byte	Name	Description
0	USB_LANG_LEN	USB language ID string descriptor length as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bLength" which describes the size of the string descriptor (in bytes).

7.2.3.7   1Fh: USB Language Identifier Descriptor Type

Byte	Name	Description
1	USB_LANG_TYP	USB language ID string descriptor type as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bDescriptorType" which is a constant value associated with a string descriptor type.

7.2.3.8   20h: USB Language Identifier Least Significant Byte

Byte	Name	Description
2	USB_LANG_ID _LSB	English language code = '0409'. See Note 7-2 to reference additional language ID's defined by the USB-IF.

7.2.3.9   21h: USB Language Identifier Most Significant Byte

Byte	Name	Description
3	USB_LANG_ID _MSB	English language code = '0409'. See Note 7-2 to reference additional language ID's defined by the USB-IF.

7.2.3.10   22h: USB Manufacturer String Descriptor Length

Byte	Name	Description
0	USB_MFR_STR _LEN	USB manufacturer string descriptor length as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bLength" which describes the size of the string descriptor (in bytes).

7.2.3.11   23h: USB Manufacturer String Descriptor Type

Byte	Name	Description
1	USB_MFR_STR _TYP	USB manufacturer string descriptor type as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bDescriptorType" which is a constant value associated with a string descriptor type.

7.2.3.12   24h-31h: USB Manufacturer String Option

Byte	Name	Description
15:2	USB_MFR_STR	The maximum string length is 29 characters.

7.2.3.13   32h-5Dh: Reserved

Byte	Name	Description
59:16	Reserved	Reserved.

7.2.3.14   5Eh: USB Product String Descriptor Length

Byte	Name	Description
0	USB_PRD_STR _LEN	USB product string descriptor length as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bLength" which describes the size of the string descriptor (in bytes). Maximum string length is 29 characters

7.2.3.15   5Fh: USB Product String Descriptor Type

Byte	Name	Description
1	USB_PRD_STR _TYP	USB product string descriptor type as defined by Section 9.6.7 "String" of the USB 2.0 Specification (Revision 2.0, 2000). This field is the "bDescriptorType" which is a constant value associated with a string descriptor type.

7.2.3.16   60h-99h: USB Product String Option

Byte	Name	Description
59:2	USB_PRD_STR	This string will be used during the USB enumeration process in the Windows® operating system. Maximum string length is 29 characters.

7.2.3.17   9Ah: USB BmAttribute (1 byte)

Bit	Name	Description
7:0	USB_BM_ATT	Self- or Bus-Power: Selects between self- and bus-powered operation. The hub is either self-powered (draws less than 2 mA of upstream bus power) or bus-powered (limited to a 100 mA maximum of upstream power prior to being configured by the host controller). When configured as a bus-powered device, the Microchip device consumes less than 100 mA of current prior to being configured. After configuration, the bus-powered Microchip device (along with all associated device circuitry, any embedded devices if part of a compound device, and 100 mA per externally available downstream port) must consume no more than 500 mA of upstream VBUS current. The current consumption is system dependent, and the OEM must ensure that the USB 2.0 Specification is not violated. When configured as a self-powered device, <1 mA of upstream VBUS current is consumed and all ports are available, with each port being capable of sourcing 500 mA of current. **80 = Bus-powered operation (default)** C0 = Self-powered operation A0 = Bus-powered operation with remote wake-up E0 = Self-powered operation with remote wake-up

7.2.3.18   9Bh: USB MaxPower (1 byte)

Bit	Name	Description
7:0	USB_MAX_PWR	USB Max Power per the USB 2.0 Specification. Do NOT set this value greater than 100 mA.

7.2.3.19   9Ch-9Fh: Attribute Byte Descriptions

Byte	Byte Name	Bit	Description
0	ATT_LB	3:0	Always reads '0'.
		4	Inquire Manufacturer and Product ID Strings '1' - Use the Inquiry Manufacturer and Product ID Strings. '0' (default) - Use the USB Descriptor Manufacturer and Product ID Strings.
		5	Always reads '0'.
		6	Reverse SD Card Write Protect Sense '1' (default) - SD cards will be write protected when SW_nWP is high, and writable when SW_nWP is low. '0' - SD cards will be write protected when SW_nWP is low, and writable when SW_nWP is high.
		7	Reserved.
1	ATT_HLB	3:0	Always reads '0'.
		4	Activity LED True Polarity '1' - Activity LED to Low True. '0' (default) - Activity LED polarity to High True.
		5	Common Media Insert / Media Activity LED '1' - The activity LED will function as a common media inserted/media access LED. '0' (default) - The activity LED will remain in its idle state until media is accessed.
		6	Always reads '0'.
		7	Reserved.
2	ATT_LHB	0	Attach on Card Insert / Detach on Card Removal '1' - Attach on Insert is enabled. '0' (default) - Attach on Insert is disabled.
		1	Always reads '0'.
		2	Enable Device Power Configuration '1' - Custom Device Power Configuration stored in the NVSTORE is used. '0' (default) - Default Device Power Configuration is used.
		7:3	Always reads '0'.
3	ATT_HB	6:0	Always reads '0'.
		7	xD Player Mode

7.2.4   A0H-A7H: DEVICE POWER CONFIGURATION

The USB224x has one internal FET which can be utilized for card power. This section describes the default internal configuration. The settings are stored in NVSTORE and provide the following features:

1.   A card can be powered by an external FET or by an internal FET.

2.   The power limit can be set to 100 mA or 200 mA (Default) for the internal FET.

Each media uses two bytes to store its device power configuration. Bit 3 selects between internal or external card power FET options. For internal FET card power control, bits 0 through 2 are used to set the power limit. The "Device Power Configuration" bits are ignored unless the "Enable Device Power Configuration" bit is set. See Section 7.2.3.19, "9Ch-9Fh: Attribute Byte Descriptions," on page 23.

7.2.4.1   A0h-A1h: Memory Stick Device Power Configuration

FET	Type	Bits	Bit Type	Description
0	FET Lo Byte MS_PWR_LB	3:0	Low Nibble	0000b Disabled
1		7:4	High Nibble	
2	**FET Hi Byte** MS_PWR_HB	**3:0**	**Low Nibble**	0000b Disabled 0001b External FET enabled 1000b Internal FET with 100 mA power limit **1010b Internal FET with 200 mA power limit**
3		7:4	High Nibble	0000b Disabled

7.2.4.2   A2h-A3h: Not Applicable

Byte	Name	Description
1:0	Not Applicable	Not applicable.

7.2.4.3   A4h-A5h: xD-Picture Card Device Power Configuration

When applicable, the "SM" value will be overridden with "xD" once an xD-Picture Card has been identified.

FET	Type	Bits	Bit Type	Description
0	FET Lo Byte xD_PWR_LB	3:0	Low Nibble	0000b Disabled
1		7:4	High Nibble	
2	**FET Hi Byte** xD_PWR_HB	**3:0**	**Low Nibble**	0000b Disabled 0001b External FET enabled 1000b Internal FET with 100 mA power limit **1010b Internal FET with 200 mA power limit**
3		7:4	High Nibble	0000b Disabled

7.2.4.4   A6h-A7h: Secure Digital Device Power Configuration

FET	Type	Bits	Bit Type	Description
0	FET Lo Byte SD_PWR_LB	3:0	Low Nibble	0000b Disabled
1		7:4	High Nibble	
2	**FET Hi Byte** SD_PWR_HB	**3:0**	**Low Nibble**	0000b Disabled 0001b External FET enabled 1000b Internal FET with 100 mA power limit **1010b Internal FET with 200 mA power limit**
3		7:4	High Nibble	0000b Disabled

7.2.4.5   A8h: LED Blink Interval

Byte	Name	Description
0	LED_BLK_INT	The blink rate is programmable in 50 ms intervals. The high bit (7) indicates an idle state: '0' - Off '1' - On The remaining bits (6:0) are used to determine the blink interval up to a max of 128 x 50 ms.

7.2.4.6   A9h: LED Blink Duration

Byte	Name	Description
1	LED_BLK_DUR	LED Blink After Access. This byte is used to designate the number of seconds that the LED will continue to blink after a drive access. Setting this byte to "05" will cause the LED to blink for 5 seconds after a drive access.

7.2.5   DEVICE ID STRINGS

These bytes are used to specify the LUN descriptor returned by the device. These bytes are used in combination with the device to LUN mapping bytes in applications where the OEM wishes to reorder and rename the LUNs. If multiple devices are mapped to the same LUN (a COMBO LUN), then the CLUN#_ID_STR will be used to name the COMBO LUN instead of the individual device strings. When applicable, the "SM" value will be overridden with xD once an xD-Picture Card has been identified.

7.2.5.1   AAh-B0h: Device 0 Identifier String

Byte	Name	Description
6:0	DEV0_ID_STR	Not applicable.

7.2.5.2   B1h-B7h: Device 1 Identifier String

Byte	Name	Description
6:0	DEV1_ID_STR	This ID string is associated with the Memory Stick device.

7.2.5.3   B8h-BEh: Device 2 Identifier String

Byte	Name	Description
6:0	DEV2_ID_STR	This ID string is associated with the xD-Picture Card device.

7.2.5.4   BFh-C5h: Device 3 Identifier String

Byte	Name	Description
6:0	DEV3_ID_STR	This ID string is associated with the Secure Digital / MultiMediaCard device.

7.2.5.5   C6h-CDh: Inquiry Vendor String

Byte	Name	Description
7:0	INQ_VEN_STR	If bit 4 of the 1st attribute byte is set, the device will use these strings in response to a USB inquiry command, instead of the USB descriptor manufacturer and product ID strings.

7.2.5.6   CEh-D2h: Inquiry Product String

Byte	Name	Description
4:0	INQ_PRD_STR	If bit 4 of the 1st attribute byte is set, the device will use these strings in response to a USB inquiry command, instead of the USB descriptor manufacturer and product ID strings.