

---

---

## 5th Generation Hi-Speed USB Flash Media and IrDA Controller with Integrated Card Power FETs

---

---

### IrDA Controller

- IrDA v1.1 FIR and SIR Compliant Controller, with 9.6K, 19.2K, 38.4K, 57.6K, 115.2K, 0.576Mbps, 1.152Mbps and 4Mbps data rate support.

### Flash Media Controller

- Complete System Solution for interfacing SmartMedia™ (SM) or xD Picture Card™ (xD)<sup>1</sup>, Memory Stick™ (MS), High Speed Memory Stick (HSMS), Memory Stick PRO (MSPRO), MS Duo™, Secure Digital (SD), High Speed SD, Mini-Secure Digital (Mini-SD), TransFlash (SD), MultiMediaCard™ (MMC), Reduced Size MultiMediaCard (RS-MMC), NAND Flash, Compact Flash™ (CF) and CF Ultra™ I & II, and CF form-factor ATA hard drives to Hi-Speed USB
  - Supports USB Bulk Only Mass Storage Compliant Bootable BIOS
- Support for simultaneous operation of all above devices. (only one at a time of each of the following groups supported: CF or ATA drive, SM or XD or NAND, SD or MMC)
- On-Chip 4-Bit High Speed Memory Stick and MS PRO Hardware Circuitry
- On-Chip firmware reads and writes High Speed Memory Stick and MS PRO
- 1-bit ECC correction performed in hardware for maximum efficiency
- Hardware support for SD Security Command Extensions
- On-chip power FETs with short circuit protection for supplying flash media card power
- USB Bus Power Certified
- 3.3 Volt I/O with 5V input tolerance on VBUS/ GPIO3
- Complete USB Specification 2.0 Compatibility for Bus Powered Operation
  - Includes Hi-Speed USB Transceiver
  - A Bi-directional Control and two Bi-directional Bulk Endpoints are provided.
- 8051 8 bit microprocessor
  - Provides low speed control functions
  - 30 Mhz execution speed at 1 clock per instruction cycle average
  - 12K Bytes of internal SRAM for general purpose scratchpad
- 768 Bytes of internal SRAM for general purpose scratchpad or program execution while re-flashing external ROM
- Two, Double Buffered Bulk Endpoints
- Two, Bi-directional 512 Byte Buffers for Bulk Endpoints
- 64 Byte RX Control Endpoint Buffer
- 64 Byte TX Control Endpoint Buffer
- Internal or External Program Memory Interface
  - 76K Byte Internal Code Space or Optional 128K Byte External Code Space using Flash, SRAM or EPROM memory.
- On Board 24Mhz Crystal Driver Circuit
- Can be clocked by 48MHz external source
- On-Chip 1.8V Regulator for Low Power Core Operation
- Internal PLL for 480Mhz Hi-Speed USB Sampling, Configurable MCU clock
- Supports firmware upgrade via USB bus if “boot block” Flash program memory is used
- 12 GPIOs for special function use: LED indicators, button inputs, power control to memory devices, etc.
  - Inputs capable of generating interrupts with either edge sensitivity
- Attribute bit controlled features:
  - Activity LED polarity/operation/blink rate
  - Full or Partial Card compliance checking
  - Bus or Self Powered
  - LUN configuration and assignment
  - Write Protect Polarity
  - SmartDetach - Detach from USB when no Card Inserted for Notebook apps
  - Cover Switch operation for xD compliance
  - Inquiry Command operation
  - SD Write Protect operation
  - Older CF card support
  - Force USB 1.1 reporting
  - Internal or External Power FET operation
- Compatible with Microsoft WinXP, WinME, Win2K SP3, Apple OS10, Softconnex, and Linux Multi-LUN Mass Storage Class Drivers
- Win2K, Win98/98SE and Apple OS8.6 and OS9 Multi-LUN Mass Storage Class Drivers available from Microchip
- 128-Pin TQFP RoHS Compliant package (1.0mm height, 14mmx14mm footprint)

---

<sup>1</sup>.xD Picture Card not applicable to USB2229.

# USB2229/USB2230

---

---

## TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at [docerrors@microchip.com](mailto:docerrors@microchip.com). We welcome your feedback.

### Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Web site at:

<http://www.microchip.com>

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000000A is version A of document DS30000000).

### Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

- Microchip's Worldwide Web site; <http://www.microchip.com>
- Your local Microchip sales office (see last page)

When contacting a sales office, please specify which device, revision of silicon and data sheet (include -literature number) you are using.

### Customer Notification System

Register on our web site at [www.microchip.com](http://www.microchip.com) to receive the most current information on all of our products.

## Table of Contents

- 1.0 General Description ..... 4
- 2.0 Pin Table ..... 6
- 3.0 Block Diagram ..... 9
- 4.0 Pin Configuration ..... 10
- 5.0 Pin Descriptions ..... 11
- 6.0 DC Parameters ..... 18
- 7.0 Package Information ..... 22
- 8.0 GPIO Usage ..... 23
- Appendix A: Data Sheet Revision History ..... 24
- The Microchip Web Site ..... 25
- Customer Change Notification Service ..... 25
- Customer Support ..... 25
- Product Identification System ..... 26

# USB2229/USB2230

---

## 1.0 GENERAL DESCRIPTION

The USB2229/USB2230 is a Hi-Speed USB IrDA and Bulk Only Mass Storage Class Peripheral Controller. The Bulk Only Mass Storage Class Peripheral Controller supports CompactFlash (CF) in True IDE Mode only, SmartMedia (SM), Memory Stick (MS) including both serial and parallel interface and Secure Digital/MultiMediaCard (SD/MMC) flash memory devices. It provides a single chip solution for the most popular flash memory cards in the market. In addition, the IrDA controller consists of the Microchip IrCC block, which includes a Synchronous Communications Engine (SCE).

The IrCC SCE supports FIR and SIR IrDA. The IrCC offers flexible signal routing and programmable output control through the Raw mode interface, General Purpose Data pins and Output Multiplexer. Chip-level address decoding is required to access the IrCC register set.

The device consists of a USB2.0 PHY and SIE, buffers, Fast 8051 microprocessor with expanded scratchpad, and program SRAM, and IrDA, CF, MS, SM and SD controllers. The SD controller supports both SD and MMC devices.

Provisions for external Flash Memory up to 128K bytes for program storage is provided (note: when Bank switching is enabled the upper 64K will map into the 8051 ROM space, otherwise, only the first 64K bytes is used).

12K bytes of scratchpad SRAM and 768Bytes of program SRAM are also provided.

Twelve GPIO pins are provided for indicators, external serial EEPROM for OEM ID and system configuration information, and other special functions.

Internal power FETs are provided to directly supply power to the xD/SM, MMC/SD and MS/MSPro cards.

The internal ROM program is capable of implementing any combination of single or multi-LUN CF/SD/MMC/SM/MS reader functions with individual card power control and activity indication. Microchip also provides licenses\*\* for Win98 and Win2K drivers and setup utilities. Note: Please check with Microchip for precise features and capabilities for the current ROM code release.

## 1.1 Acronyms

<b>SM:</b>	SmartMedia
<b>SMC:</b>	SmartMedia Controller
<b>FM:</b>	Flash Media
<b>FMC:</b>	Flash Media Controller
<b>CF:</b>	Compact Flash
<b>CFC:</b>	CompactFlash Controller
<b>SD:</b>	Secure Digital
<b>SDC:</b>	Secure Digital Controller
<b>MMC:</b>	MultiMediaCard
<b>MS:</b>	Memory Stick
<b>MSC:</b>	Memory Stick Controller
<b>TPC:</b>	Transport Protocol Code.
<b>ECC:</b>	Error Checking and Correcting
<b>CRC:</b>	Cyclic Redundancy Checking

## 1.2 Reference Documents

1. SmartMedia™ Electrical Specification Version 1.30
2. SmartMedia™ Physical Format Specifications Version 1.30
3. SmartMedia™ Logical Format Specifications Version 1.20
4. SMIL (SmartMedia Interface Library) Software Edition Version 1.00, Toshiba Corporation, 01, July, 2000
5. SMIL (SmartMedia Interface Library) Hardware Edition Version 1.00, Toshiba Corporation, 01, July, 2000
6. MultiMediaCard System Specification Version 2.2
7. SD Memory Card Specifications, Part 1, Physical Layer Specification Version 1.10, April 2003, SD Group
8. SD Memory Card Specifications, Part 2, File System Specification Version 1.01, April 15<sup>th</sup>, 2001, SD Group
9. SD Memory Card Specifications, Part 3, Security Specification Version 1.01, April 15<sup>th</sup>, 2001, SD Group

10. SD Card Specification, Part E1, Secure Digital Input/Output (SDIO) card Specification, Version 1.00, October 2001, SD Group.
11. Memory Stick Standard Excerpt from Format Specification v1.3, July, 2000, Sony Corporation.
12. Memory Stick Standard Format Specifications ver 2.0 (Memory Stick PRO). Tentative Release 0.81, February, 2002
13. CompactFlash Specification Rev 1.4
14. CF+ & CF Specification Rev. ATA-5 Draft 0.2
15. Universal Serial Bus Specification Rev 2.0
16. Samsung K9K2G08Q0M Data Sheet
17. xD Picture Card, Card Specification Version 1.10 (Jan 31, 2004)
18. xD Picture Card, Format Specification Version 1.10 (Jan 31, 2004)
19. xD Picture Card, Host Guideline Version 1.10 (Jan 31, 2004)
20. xD Picture Card, Compliance Guideline Version 1.10 (Jan 31, 2004)

# USB2229/USB2230

## 2.0 PIN TABLE

### 2.1 128-Pin Package

**TABLE 2-1: USB2229/USB2230 128-PIN PACKAGE**

<b>CompactFlash INTERFACE (28 Pins)</b>			
CF_D0	CF_D1	CF_D2	CF_D3
CF_D4	CF_D5	CF_D6	CF_D7
CF_D8	CF_D9	CF_D10	CF_D11
CF_D12	CF_D13	CF_D14	CF_D15
CF_nIOR	CF_nIOW	CF_IRQ	CF_nRESET
CF_IORDY	CF_nCS0	CF_nCS1	CF_SA0
CF_SA1	CF_SA2	CF_nCD1	CF_nCD2
<b>SmartMedia INTERFACE (17 Pins)</b>			
SM_D0	SM_D1	SM_D2	SM_D3
SM_D4	SM_D5	SM_D6	SM_D7
SM_ALE	SM_CLE	SM_nRE	SM_nWE
SM_nWP	SM_nB/R	SM_nCE	SM_nCD
SM_nWPS			
<b>Memory Stick INTERFACE (7 Pins)</b>			
MS_BS	MS_SDIO/MS_D0	MS_SCLK	MS_INS
MS_D1	MS_D2	MS_D3	
<b>SD INTERFACE (7 Pins)</b>			
SD_CMD	SD_CLK	SD_DAT0	SD_DAT1
SD_DAT2	SD_DAT3	SD_nWP	
<b>USB INTERFACE (10 Pins)</b>			
USBDP	USBDM	ATEST	RBIAS
VDD18PLL	VSSPLL	VDDA33	VSSA
XTAL1/CLKIN	XTAL2		
<b>MEMORY/IO INTERFACE (27 Pins)</b>			
MA0/CLK_SEL0	MA1/CLK_SEL1	MA2/SEL_CLKDRV	MA3/TX_POL
MA4	MA5	MA6	MA7
MA8	MA9	MA10	MA11
MA12	MA13	MA14	MA15
MD0	MD1	MD2	MD3
MD4	MD5	MD6	MD7
nMRD	nMWR	nMCE	
<b>MISC (15 Pins)</b>			
GPIO1	GPIO2	GPIO3	GPIO4
GPIO5	GPIO6/ROMEN/MA16	GPIO7	GPIO8/ CRD_PWR0
GPIO9	GPIO10/ CRD_PWR1	GPIO11/ CRD_PWR2	GPIO12
nTEST0	nTEST1	nRESET	
<b>IrDA (3 PINS)</b>			
IR_TXD/TX	IR_RXD/RX	IR_MODE	

# USB2229/USB2230

**TABLE 2-1: USB2229/USB2230 128-PIN PACKAGE (CONTINUED)**

DIGITAL, POWER, GROUND & NC (14 Pins)			
(5)VDD33	(2)VDD18	(7)VSS	
<b>Total 128</b>			

## 2.2 128-Pin List Table

**TABLE 2-2: USB2229/USB2230 128-PIN TQFP**

Pin #	Name	MA	Pin #	Name	MA	Pin #	Name	MA	Pin #	Name	MA
1	MA13	8	33	CF_D1	8	65	SM_D0	8	97	VSS	-
2	MA14	8	34	CF_D2	8	66	SM_D1	8	98	RBIAS	-
3	VDD33	-	35	CF_D3	8	67	SM_D2	8	99	ATEST	-
4	MA15	8	36	CF_D4	8	68	SM_D3	8	100	VDD33	-
5	MD0	8	37	CF_D5	8	69	SM_D4	8	101	VDD18PLL	-
6	MD1	8	38	CF_D6	8	70	SM_D5	8	102	XTAL1/ CLKIN	-
7	MD2	8	39	CF_D7	8	71	SM_D6	8	103	XTAL2	-
8	MD3	8	40	CF_D8	8	72	SM_D7	8	104	VSSPLL	-
9	MD4	8	41	CF_D9	8	73	SM_ALE	8	105	GPIO9	8
10	MD5	8	42	GPIO8/ CRD_PWR0	8	74	SM_nWP	8	106	VDD18	-
11	MD6	8	43	VDD33	-	75	SM_CLE	8	107	GPIO7	8
12	MD7	8	44	GPIO11/ CRD_PWR2	8	76	SM_nWPS	-	108	VDD33	-
13	nMRD	8	45	CF_D10	8	77	SM_nB/R	-	109	GPIO6/ ROMEN/ MA16	8
14	nMWR	8	46	CF_D11	8	78	SM_nCD	-	110	GPIO5	8
15	VSS	-	47	VSS	-	79	GPIO10/ CRD_PWR1	8	111	GPIO4	8
16	VSS	-	48	CF_D12	8	80	VDD33	-	112	VSS	-
17	nMCE	8	49	VDD18	-	81	SM_nRE	8	113	nRESET	8
18	MS_INS	-	50	CF_D13	8	82	SM_nWE	8	114	GPIO2	8
19	MS_D0/ MS_SDIO	8	51	CF_D14	8	83	SM_nCE	8	115	GPIO1	-
20	MS_D1	8	52	CF_D15	8	84	VSS	-	116	MA0/ CLK_SEL0	8
21	MS_D2	8	53	CF_nCD1	-	85	VSS	-	117	MA1/ CLK_SEL1	8
22	MS_D3	8	54	CF_nCD2	-	86	VSSA	-	118	MA2/ SEL_ CLKDRV	8
23	MS_ SCLK	8	55	CF_IRQ	8	87	USBDM	-	119	MA3/ TX_POL	8
24	MS_BS	8	56	CF_IORDY	8	88	USBDP	-	120	MA4	8
25	SD_nWP	-	57	CF_nIOR	8	89	VDDA33	-	121	MA5	8
26	SD_DAT0	8	58	CF_nIOW	8	90	IR_MODE	8	122	MA6	8
27	SD_DAT1	8	59	CF_nRESET	8	91	IR_RXD/RX	8	123	MA7	8
28	SD_DAT2	8	60	CF_nCS0	8	92	IR_TXD/TX	8	124	MA8	8

# USB2229/USB2230

---

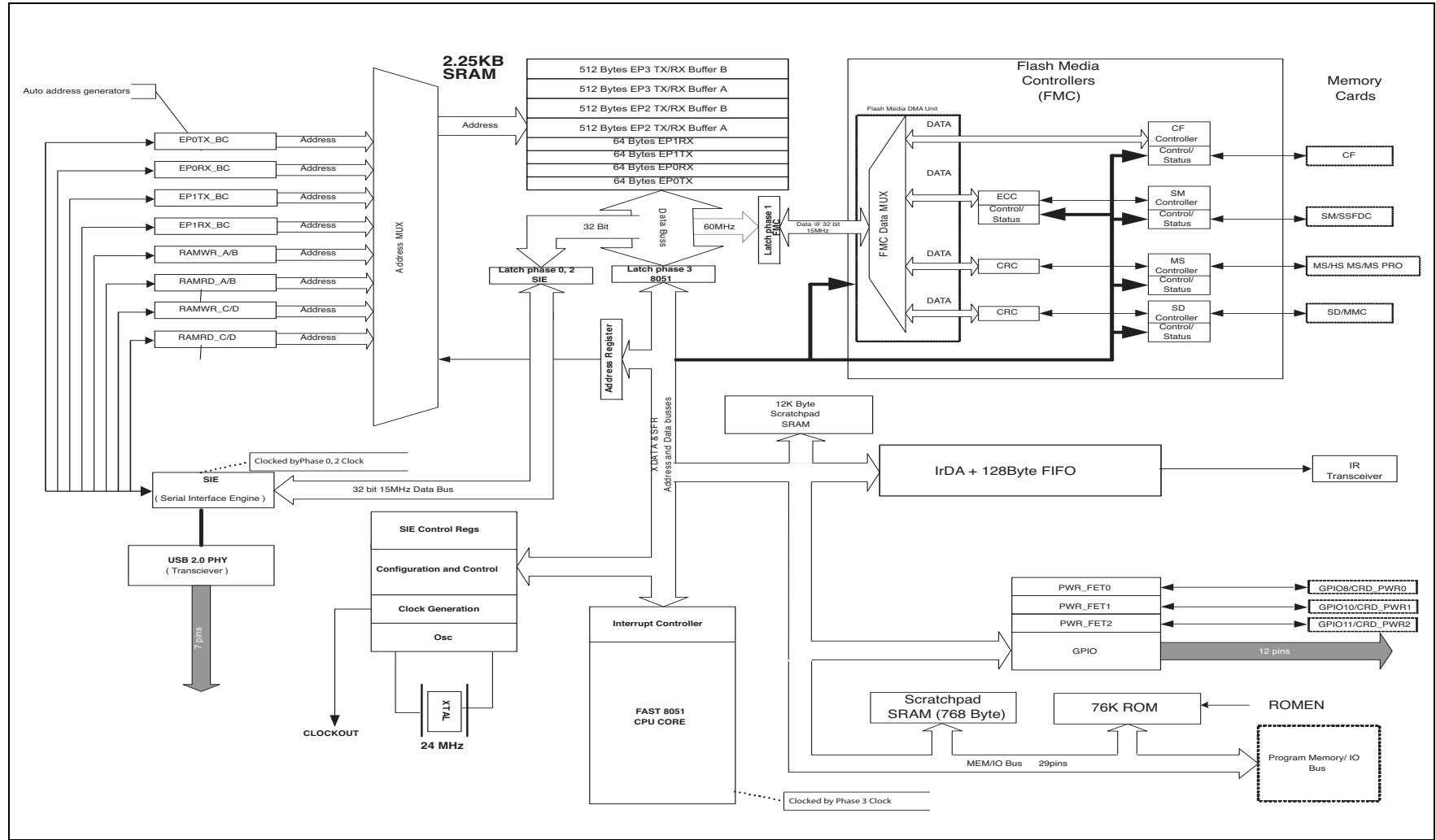
---

**TABLE 2-2: USB2229/USB2230 128-PIN TQFP (CONTINUED)**

Pin #	Name	MA	Pin #	Name	MA	Pin #	Name	MA	Pin #	Name	MA
29	SD_DAT3	8	61	CF_nCS1	8	93	GPIO12	8	125	MA9	8
30	SD_CMD	8	62	CF_SA0	8	94	GPIO3	8	126	MA10	8
31	SD_CLK	-	63	CF_SA1	8	95	nTEST1	-	127	MA11	8
32	CF_D0	8	64	CF_SA2	-	96	nTEST0	-	128	MA12	8



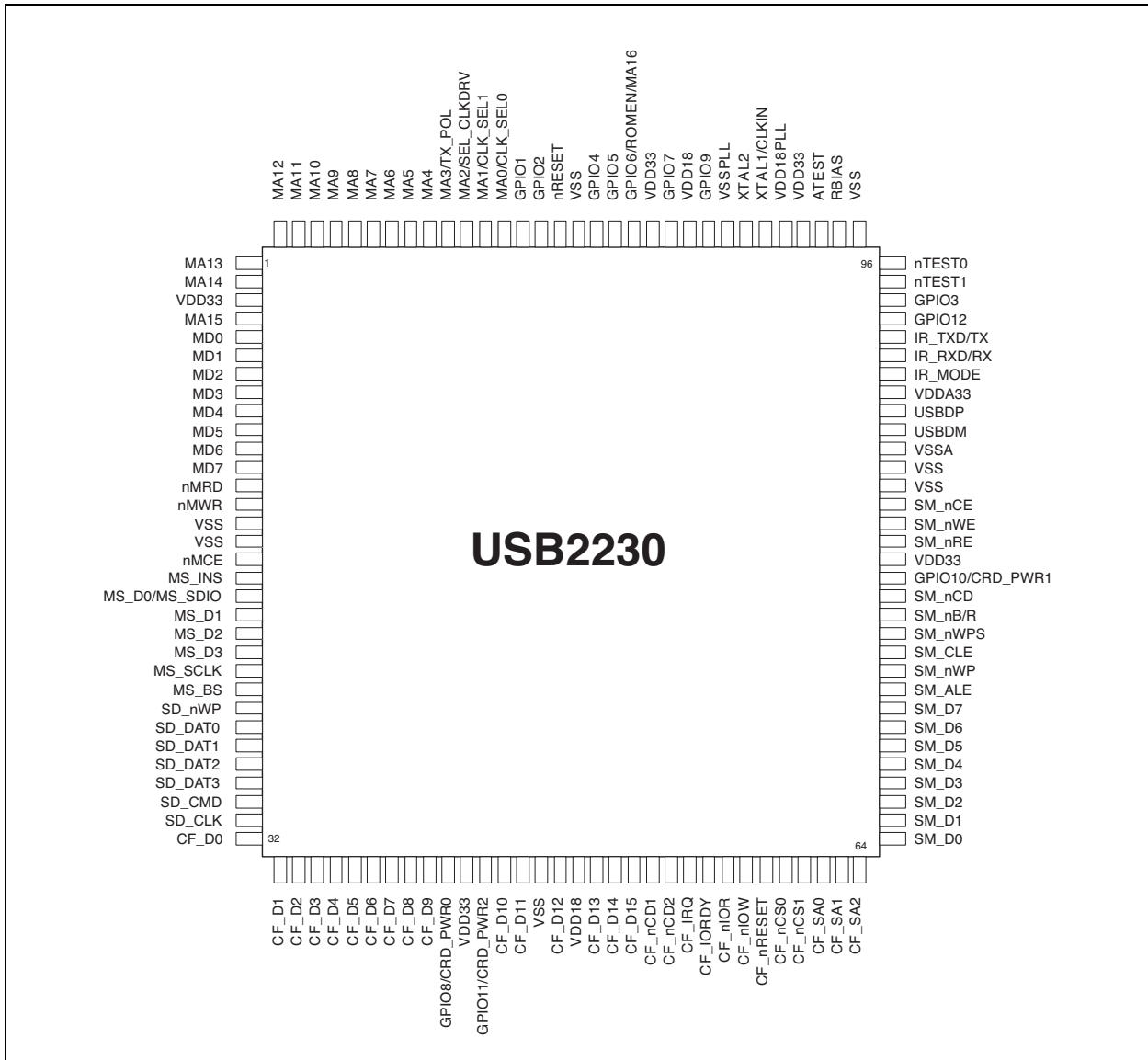
### 3.0 BLOCK DIAGRAM



# USB2229/USB2230

## 4.0 PIN CONFIGURATION

FIGURE 4-1: USB2229/USB2230 128-PIN TQFP



## 5.0 PIN DESCRIPTIONS

This section provides a detailed description of each signal. The signals are arranged in functional groups according to their associated interface.

The “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 before the signal name, the signal is asserted when 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” signal. 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.

### 5.1 Pin Descriptions

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS**

Name	Symbol	Buffer Type	Description
<b>CompactFlash (In True IDE Mode) INTERFACE</b>			
CF Chip Select 1	CF_nCS1	O8PU	This pin is the active low chip select 1 signal for the CF ATA device
CF Chip Select 0	CF_nCS0	O8PU	This pin is the active low chip select 0 signal for the task file registers of CF ATA device in the True IDE mode.
CF Register Address 2	CF_SA2	O8	This pin is the register select address bit 2 for the CF ATA device.
CF Register Address 1	CF_SA1	O8	This pin is the register select address bit 1 for the CF ATA device
CF Register Address 0	CF_SA0	O8	This pin is the register select address bit 0 for the CF ATA device.
CF Interrupt	CF_IRQ	IPD	This is the active high interrupt request signal from the CF device.
CF Data 15-8	CF_D[15:8]	I/O8PD	The bi-directional data signals CF_D15-CF_D8 in True IDE mode data transfer.  In the True IDE Mode, all of task file register operation occur on the CF_D[7:0], while the data transfer is on CF_D[15:0].  The bi-directional data signal has an internal weak pull-down resistor.
CF Data7-0	CF_D[7:0]	I/O8PD	The bi-directional data signals CF_D7-CF_D0 in the True IDE mode data transfer. In the True IDE Mode, all of task file register operation occur on the CF_D[7:0], while the data transfer is on CF_D[15:0].  The bi-directional data signal has an internal weak pull-down resistor.
IO Ready	CF_IORDY	IPU	This pin is active high input signal.  This pin has an internally controlled weak pull-up resistor.
CF Card Detection2	CF_nCD2	IPU	This card detection pin is connected to the ground on the CF device, when the CF device is inserted.  This pin has an internally controlled weak pull-up resistor.
CF Card Detection1	CF_nCD1	IPU	This card detection pin is connected to ground on the CF device, when the CF device is inserted.  This pin has an internally controlled weak pull-up resistor.
CF Hardware Reset	CF_nRESET	O8	This pin is an active low hardware reset signal to CF device.
CF IO Read	CF_nIOR	O8	This pin is an active low read strobe signal for CF device.

# USB2229/USB2230

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
CF IO Write Strobe	CF_nIOW	O8	This pin is an active low write strobe signal for CF device.
<b>SmartMedia INTERFACE</b>			
SM Write Protect	SM_nWP	O8PD	This pin is an active low write protect signal for the SM device.  This pin has a weak pull-down resistor that is permanently enabled
SM Address Strobe	SM_ALE	O8PD	This pin is an active high Address Latch Enable signal for the SM device.  This pin has a weak pull-down resistor that is permanently enabled
SM Command Strobe	SM_CLE	O8PD	This pin is an active high Command Latch Enable signal for the SM device.  This pin has a weak pull-down resistor that is permanently enabled
SM Data7-0	SM_D[7:0]	I/O8PD	These pins are the bi-directional data signal SM_D7-SM_D0.  The bi-directional data signal has an internal weak pull-down resistor.
SM Read Enable	SM_nRE	O8PU	This pin is an active low read strobe signal for SM device.  When using the internal FET, this pin has an internal weak pull-up resistor that is tied to the output of the internal Power FET.
		O8	If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used, and should be connected to the applicable Card Power Supply).
SM Write Enable	SM_nWE	O8PU	This pin is an active low write strobe signal for SM device.  When using the internal FET, this pin has an internal weak pull-up resistor that is tied to the output of the internal Power FET.
		O8	If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used, and should be connected to the applicable Card Power Supply).
SM Write Protect Switch	SM_nWPS	IPU	A write-protect seal is detected, when this pin is low.  This pin has an internally controlled weak pull-up resistor.
SM Busy or Data Ready	SM_nB/R	I	This pin is connected to the BSY/RDY pin of the SM device.  An external pull-up resistor is required on this signal. The pull-up resistor must be pulled up to the same power source that powers the SM/NAND flash device.
SM Chip Enable	SM_nCE	O8PU	This pin is the active low chip enable signal to the SM device.  When using the internal FET, this pin has an internal weak pull-up resistor that is tied to the output of the internal Power FET.
		O8	If an external FET is used (Internal FET is disabled), then the internal pull-up is not available (external pull-ups must be used, and should be connected to the applicable Card Power Supply).

# USB2229/USB2230

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
SM Card Detection	SM_nCD	IPU	This is the card detection signal from SM device to indicate if the device is inserted.  This pin has an internally controlled weak pull-up resistor.
<b>MEMORY STICK INTERFACE</b>			
MS Bus State	MS_BS	O8	This pin is connected to the 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 System Data In/Out	MS_SDIO/MS_D 0	I/O8PD	This pin is a bi-directional data signal for the MS device.  Most significant bit (MSB) of each byte is transmitted first by either MSC or MS device.  The bi-directional data signal has an internal weak pull-down resistor.
MS System Data In/Out	MS_D[3:1]	I/O8PD	This pin is a bi-directional data signal for the MS device.  The bi-directional data signals have internal weak pull-down resistors.
MS Card Insertion	MS_INS	IPU	This pin is the card detection signal from the MS device to indicate, if the device is inserted.  This pin has an internally controlled weak pull-up resistor.
MS System CLK	MS_SCLK	O8	This pin is an output clock signal to the MS device.  The clock frequency is software configurable.
<b>SD INTERFACE</b>			
SD Data3-0	SD_DAT[3:0]	I/O8PU	These are bi-directional data signals.  These pins have internally controlled weak pull-up resistors.
SD Clock	SD_CLK	O8	This is an output clock signal to SD/MMC device.  The clock frequency is software configurable.
SD Command	SD_CMD	I/O8PU	This is a bi-directional signal that connects to the CMD signal of SD/MMC device.  This pin has an internally controlled weak pull-up resistor.
SD Write Protected	SD_nWP	IPD	This pin is an input signal with an internal weak pull-down.  This pin has an internally controlled weak pull-down resistor.
<b>USB INTERFACE</b>			
USB Bus Data	USBDM USBDP	IO-U	These pins connect to the USB bus data signals.
USB Transceiver Bias	RBIAS	I	A 12.0kΩ, ± 1.0% resistor is attached from VSSA to this pin, in order to set the transceiver's internal bias currents.
Analog Test	ATEST	AIO	This signal is used for testing the analog section of the chip and should be connected to VDDA33 for normal operation.
1.8v PLL Power	VDD18PLL		1.8v Power for the PLL
PLL Ground Reference	VSSPLL		Ground Reference for 1.8v PLL power
3.3v Analog Power	VDDA33		3.3v Analog Power
Analog Ground Reference	VSSA		Analog Ground Reference for 3.3v Analog Power.

# USB2229/USB2230

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
Crystal Input/External Clock Input	XTAL1/ CLKIN	ICLKx	24Mhz Crystal or external 24/48 MHz clock input. This pin can be connected to one terminal of the crystal or can be connected to an external 24/48Mhz clock when a crystal is not used.  <b>Note:</b> The 'MA[2:0] pins will be sampled while nRESET is asserted, and the value will be latched upon nRESET negation. This will determine the clock source and value.
Crystal Output	XTAL2	OCLKx	24Mhz Crystal This is the other terminal of the crystal, or left open when an external clock source is used to drive XTAL1/CLKIN. It may not be used to drive any external circuitry other than the crystal circuit.
<b>MEMORY/IO INTERFACE</b>			
Memory Data Bus	MD[7:0]	IO8	When ROMEN bit of GPIO_IN1 register = 0, these signals are used to transfer data between the internal CPU and the external program memory.  These pins have internally controlled weak pull-up resistors.
Memory Address Bus	MA[15:3]	O8	These signals address memory locations within the external memory.
Memory Address Bus	MA3/ TX_POL	I/O8PU	MA3 Addresses memory locations within the external memory.  During nRESET assertion, TX_POL will select the operating polarity of the IR LED (active high or active low) and the weak pull-up resistor will be enabled. When nRESET is negated, the value on this pin will be internally latched and this pin will revert to MA3 functionality, the internal pull-up will be disabled.
Memory Address Bus	MA2/ SEL_CLKDRV	I/O8PD	MA2 Addresses memory locations within the external memory.  SEL_CLKDRV. During nRESET assertion, this pins will select the operating clock mode (crystal or externally driven clock source), and a weak pull-down resistor is enabled. When nRESET is negated, the value will be internally latched and this pin will revert to MA2 functionality, the internal pull-down will be disabled.  '0' = Crystal operation (24MHz only) '1' = Externally driven clock source (24MHz or 48MHz) <b>Note:</b> If the latched value is '1', then the MA2 pin is tri-stated when the following conditions are true:  1. IDLE bit (PCON.0) is 1. 2. INT2 is negated 3. SLEEP bit of CLOCK_SEL is 1.  If the latched value is '0', then the MA2 pin will function identically to the MA[15:3] pins at all times (other than during nRESET assertion).

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
Memory Address Bus	MA[1:0]/CLK_SEL[1:0]	I/O8PD	<p>MA[1:0]. These signals address memory locations within the external memory.</p> <p>SEL[1:0]. During nRESET assertion, these pins will select the operating frequency of the external clock, and the corresponding weak pull-down resistors are enabled. When nRESET is negated, the value on these pins will be internal latched and these pins will revert to MA[1:0] functionality, the internal pull-downs will be disabled.</p> <p>SEL[1:0] = '00'. 24MHz            SEL[1:0] = '01'. RESERVED            SEL[1:0] = '10'. RESERVED            SEL[1:0] = '11'. 48MHz</p> <p><b>Note:</b> If the latched value is '1', then the corresponding MA pin is tri-stated when the following conditions are true:</p> <ol style="list-style-type: none"> <li>1. IDLE bit (PCON.0) is 1.</li> <li>2. INT2 is negated</li> <li>3. SLEEP bit of CLOCK_SEL is 1.</li> </ol> <p>If the latched value is '0', then the corresponding MA pin will function identically to the MA[15:3] pins at all times (other than during nRESET assertion).</p>
Memory Write Strobe	nMWR	O8	Program Memory Write; active low
Memory Read Strobe	nMRD	O8	Program Memory Read; active low
Memory Chip Enable	nMCE	O8	<p>Program Memory Chip Enable; active low.</p> <p>This signal is asserted, when any of the following conditions are no longer met:</p> <ol style="list-style-type: none"> <li>1. IDLE bit (PCON.0) is 1.</li> <li>2. INT2 is negated</li> <li>3. SLEEP bit of CLOCK_SEL is 1.</li> </ol> <p><b>Note:</b> This signal is held to a logic 'high' while nRESET is asserted.</p>
<b>MISC</b>			
General Purpose I/O	GPIO1	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O	GPIO2	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O	GPIO3	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O	GPIO4	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O	GPIO5	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.

# USB2229/USB2230

**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
GPIO6, ROMEN, Memory Address 16	GPIO6/ROMEN/ MA16	I/P	This pin has an internal weak pull-up resistor that is enabled or disabled by the state of nRESET. The pull-up is enabled when nRESET is active. The pull-up is disabled, when the nRESET is inactive (some clock cycles later, after the rising edge of nRESET).  The state of this pin is latched internally on the rising edge of nRESET to determine if internal or external program memory is used. The state latched is stored in ROMEN bit of GPIO_IN1 register.
		I/O8	After the rising edge of nRESET, this pin may be used as GPIO6 or RXD.  When pulled low via an external weak pull-down resistor, an external program memory should be connected to the memory data bus. The USB2229/USB2230 uses this external bus for program execution.  When this pin is left unconnected or pulled high by a weak pull-up resistor, the USB2229/USB2230 uses the internal ROM for program execution.
		I/O8	For Bank Switching support, MA16 addresses the external 128k memory above the standard 64k range (the upper 64k is mapped into the 64k addressable ROM space)
General Purpose I/O	GPIO7	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O Or Card Power	GPIO8/ CRD_PWR0	I/O8	GPIO: This pin may be used either as input, edge sensitive interrupt input, or output. CRD_PWR: Card Power drive of 3.3V @ 100mA.
			General Purpose I/O
General Purpose I/O Or Card Power	GPIO10/ CRD_PWR1	I/O8	GPIO: This pin may be used either as input, edge sensitive interrupt input, or output. CRD_PWR: Card Power drive of 3.3V @ 100mA.
			General Purpose I/O Or Card Power
General Purpose I/O	GPIO12	I/O8	These pins may be used either as input, or output.
RESET input	nRESET	IS	This active low signal is used by the system to reset the chip. The active low pulse should be at least 1µs wide.
TEST Input	nTEST[1:0]	I	These signals are used for testing the chip. User should normally tie them high externally, if the test function is not used.
<b>IrDA</b>			
IR MODE	IR_MODE	O8	IR_MODE, declares the operating speed of the IR link.
IR Receive Data or UART RX	IR_RXD/RX	I	IR_RXD, can be used as IR receiver or as the UART RX line.
IR Transmit Data or UART TX	IR_TXD/TX	O8	IR_TXD, can be used as IR transmitter or as the UART TX line.
<b>DIGITAL POWER, GROUNDS, and NO CONNECTS</b>			
1.8v Digital Core Power	VDD18		+1.8V Core power  All VDD18 pins must be connected together on the circuit board.



**TABLE 5-1: USB2229/USB2230 PIN DESCRIPTIONS (CONTINUED)**

Name	Symbol	Buffer Type	Description
3.3v Power & Voltage Regulator Input	VDD33		3.3V Power & Regulator Input. Pins 100 & 108 supply 3.3V power to the internal 1.8V regulators.
Ground	VSS		Ground Reference

**Note 1:** Hot-insertion capable card connectors are required for all flash media. It is required for SD connector to have Write Protect switch. This allows the chip to detect MMC card.

**2:** nMCE is normally asserted except when the 8051 is in standby mode.

## 5.2 Buffer Type Descriptions

**TABLE 5-2: USB2229/USB2230 BUFFER TYPE DESCRIPTIONS**

Buffer	Description
I	Input
IPU	Input with internal weak pull-up resistor.
IPD	Input with internal weak pull-down resistor.
IS	Input with Schmitt trigger
I/O8	Input/Output buffer with 8mA sink and 8mA source.
I/O8PU	Input/Output buffer with 8mA sink and 8mA source, with an internal weak pull-up resistor.
I/O8PD	Input/Output buffer with 8mA sink and 8mA source, with an internal weak pull-down resistor.
O8	Output buffer with 8mA sink and 8mA source.
O8PU	Output buffer with 8mA sink and 8mA source, with an internal weak pull-up resistor.
O8PD	Output buffer with 8mA sink and 8mA source, with an internal weak pull-down resistor.
ICLKx	XTAL clock input
OCLKx	XTAL clock output
I/O-U	Analog Input/Output Defined in USB specification
AIO	Analog Input/Output

# USB2229/USB2230

## 6.0 DC PARAMETERS

### 6.1 Maximum Ratings

Operating Temperature Range.....	0°C to +70°C
Storage Temperature Range .....	-55° to +150°C
Lead Temperature Range (soldering, 10 seconds) .....	+325°C
Positive Voltage on GPIO3, with respect to Ground.....	5.5V
Positive Voltage on any signal pin, with respect to Ground.....	4.6V
Positive Voltage on XTAL1, with respect to Ground.....	4.0V
Positive Voltage on XTAL2, with respect to Ground.....	2.5V
Negative Voltage on GPIO8, 10 & 11, with respect to Ground (see <a href="#">Note 6-2</a> ).....	-0.5V
Negative Voltage on any pin, with respect to Ground .....	-0.5V
Maximum $V_{DD18}$ , $V_{DD18PLL}$ .....	+2.5V
Maximum $V_{DD33}$ , $V_{DDA33}$ .....	+4.6V

\* Stresses above the specified parameters could cause permanent damage to the device. This is a stress rating only and functional operation of the device at any other condition above those indicated in the operation sections of this specification is not implied.

**Note 6-1** When powering this device from laboratory or system power supplies, it is important that the Absolute Maximum Ratings not be exceeded or device failure can result. Some power supplies exhibit voltage spikes on their outputs when the AC power is switched on or off. In addition, voltage transients on the AC power line may appear on the DC output. When this possibility exists, it is suggested that a clamp circuit be used.

**Note 6-2** When internal power FET operation of these pins is enabled, these pins may be simultaneously shorted to ground or any voltage up to 3.63V indefinitely, without damage to the device as long as  $V_{DD33}$  and  $V_{DDA33}$  are less than 3.63V and  $T_A$  is less than 70°C.

### 6.2 DC Electrical Characteristics

( $T_A = 0^\circ\text{C} - 70^\circ\text{C}$ ,  $V_{DD33}$ ,  $V_{DDA33} = +3.3\text{ V} \pm 0.3\text{ V}$ ,  $V_{DD18}$ ,  $V_{DD18PLL} = +1.8\text{ V} \pm 10\%$ .)

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
<b>I,I<sub>PU</sub> &amp; IPD Type Input Buffer</b>						
Low Input Level	$V_{ILI}$			0.8	V	TTL Levels
High Input Level	$V_{IHI}$	2.0			V	
Pull Down	PD		72		$\mu\text{A}$	
Pull Up	PU		58		$\mu\text{A}$	
<b>IS Type Input Buffer</b>						
Low Input Level	$V_{ILI}$			0.8	V	TTL Levels
High Input Level	$V_{IHI}$	2.0			V	
Hysteresis	$V_{HYSI}$		500		mV	
<b>ICLK Input Buffer</b>						
Low Input Level	$V_{ILCK}$			0.4	V	
High Input Level	$V_{IHCK}$	2.2			V	

# USB2229/USB2230

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
<b>Input Leakage</b> (All I and IS buffers)						
Low Input Leakage	$I_{IL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0$
High Input Leakage	$I_{IH}$	-10		+10	$\text{mA}$	$V_{IN} = V_{DD33}$
<b>O8, O8PU &amp; O8PD Type Buffer</b>						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 8 \text{ mA} @ V_{DD33} = 3.3\text{V}$
High Output Level	$V_{OH}$	$V_{DD33} - 0.4$			V	$I_{OH} = -8 \text{ mA} @ V_{DD33} = 3.3\text{V}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0 \text{ to } V_{DD33}$ (Note 6-3)
Pull Down	PD		72		$\mu\text{A}$	
Pull Up	PU		58		$\mu\text{A}$	
<b>I/O8, I/O8PU &amp; I/O8PD Type Buffer</b>						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 8 \text{ mA} @ V_{DD33} = 3.3\text{V}$
High Output Level	$V_{OH}$	$V_{DD33} - 0.4$			V	$I_{OH} = -8 \text{ mA} @ V_{DD33} = 3.3\text{V}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0 \text{ to } V_{DD33}$ (Note 6-3)
Pull Down	PD		72		$\mu\text{A}$	
Pull Up	PU		58		$\mu\text{A}$	
<b>IO-U</b> (Note 6-4)						

# USB2229/USB2230

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
<b>Integrated Power FET for GPIO8 &amp; GPIO10</b>						
Output Current	$I_{OUT}$	100			mA	GPIO8 or 10; $V_{drop_{FET}} = 0.23V$
Short Circuit Current Limit	$I_{SC}$			140	mA	GPIO8 or 10; $V_{out_{FET}} = 0V$
On Resistance	$R_{DSON}$			2.1	$\Omega$	GPIO8 or 10; $I_{FET} = 70mA$
Output Voltage Rise Time	$t_{DSON}$			800	$\mu s$	GPIO8 or 10; $C_{LOAD} = 10\mu F$
<b>Integrated Power FET for GPIO11)</b>						
Output Current	$I_{OUT}$	200			mA	GPIO11; $V_{drop_{FET}} = 0.46V$
Short Circuit Current Limit	$I_{SC}$			181	mA	GPIO11; $V_{out_{FET}} = 0V$
On Resistance	$R_{DSON}$			2.1	$\Omega$	GPIO11; $I_{FET} = 70mA$
Output Voltage Rise Time	$t_{DSON}$			800	$\mu s$	GPIO11; $C_{LOAD} = 10\mu F$
Supply Current Unconfigured	$I_{CCINIT}$		45	60	mA	@ $V_{DD18}, V_{DD18PLL} = 1.8V$
			10	20	mA	@ $V_{DD33}, V_{DDA33} = 3.3V$
Supply Current Active (Full Speed)	$I_{CC}$		35	60	mA	@ $V_{DD18}, V_{DD18PLL} = 1.8V$
			15	30	mA	@ $V_{DD33}, V_{DDA33} = 3.3V$
Supply Current Active (High Speed)	$I_{CC}$		45	70	mA	@ $V_{DD18}, V_{DD18PLL} = 1.8V$
			15	30	mA	@ $V_{DD33}, V_{DDA33} = 3.3V$
Supply Current Standby	$I_{CSBY}$		160	180	$\mu A$	@ $V_{DD18}, V_{DD18PLL} = 1.8V$
			215	240	$\mu A$	@ $V_{DD33}, V_{DDA33} = 3.3V$

**Note 6-3** Output leakage is measured with the current pins in high impedance.

**Note 6-4** See Appendix A for USB DC electrical characteristics.

**Note 6-5** The Maximum power dissipation parameters of the package should not be exceeded.

**Note 6-6** The assignment of each Integrated Card Power FET to a designated Card Connector is controlled by both firmware and the specific board implementation. Firmware will default to the settings listed in [Table 8-1, "GPIO Usage \(ROM Rev -11\)," on page 23.](#)

## 6.3 Capacitance

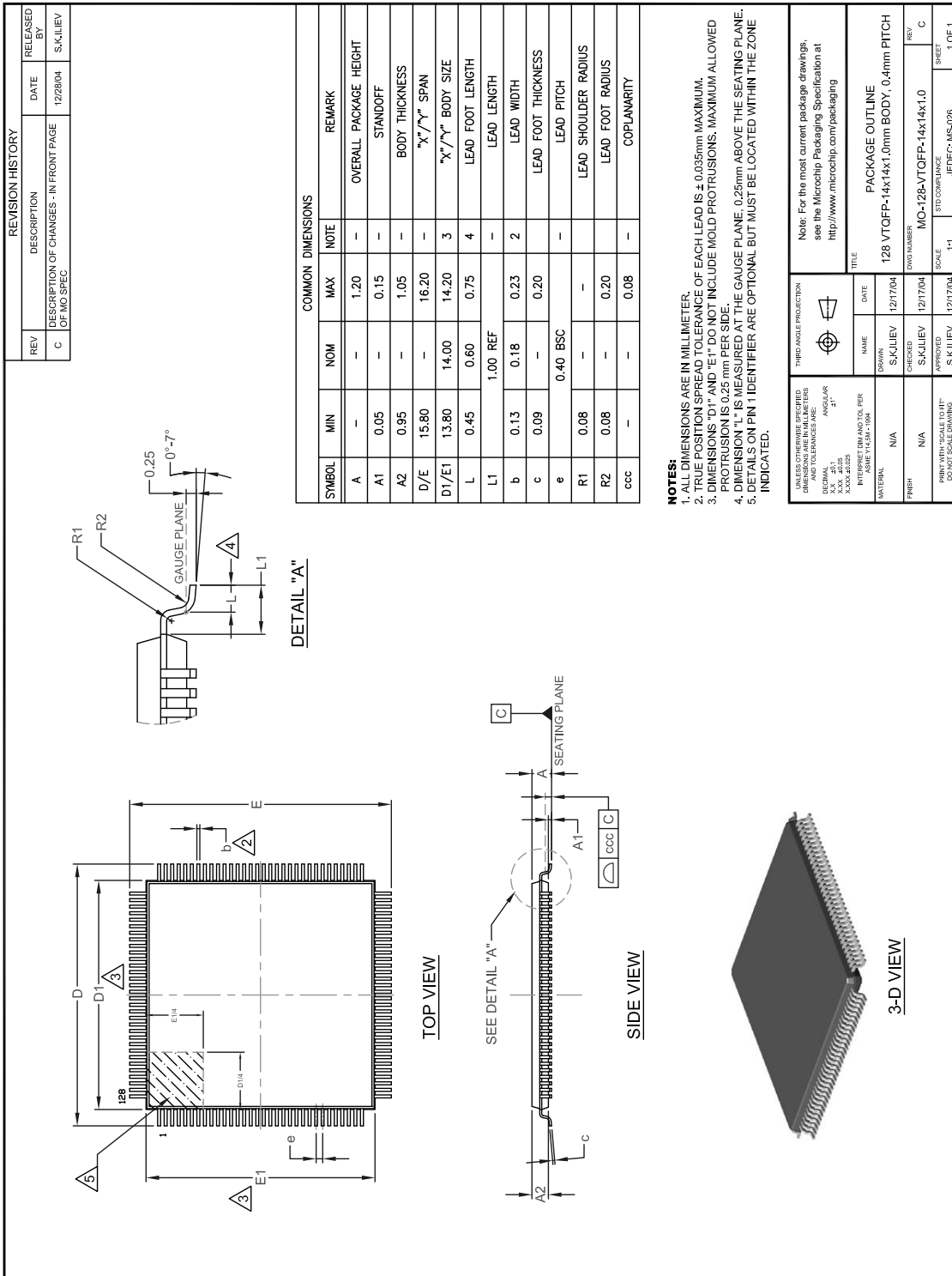
TA = 25°C; fc = 1MHz; VDD18, VDD18PLL = 1.8V

Parameter	Symbol	Limits			Units	Test Condition
		MIN	TYP	MAX		
Clock Input Capacitance	C <sub>IN</sub>			20	pF	All pins except USB pins (and pins under test tied to AC ground)
Input Capacitance	C <sub>IN</sub>			10	pF	
Output Capacitance	C <sub>OUT</sub>			20	pF	

# USB2229/USB2230

## 7.0 PACKAGE INFORMATION

FIGURE 7-1: USB2229/USB2230 128-PIN TQFP PACKAGE, 14X14X1.0MM BODY, 0.4MM PITCH



## 8.0 GPIO USAGE

**TABLE 8-1: GPIO USAGE (ROM REV -11)**

Name	Active Level	Symbol	Description and Note
GPIO1	H	Flash Media Activity LED/ xD_Door	Indicates media activity. Media or USB cable must not be removed with LED lit. Also may be used for xD Door functionality
GPIO2	H	EE_CS	Serial EE PROM chip select
GPIO3	H	V_BUS	USB V bus detect
GPIO4	H	EE_DIN/EE_DOUT/xDID	Serial EE PROM input/output and xD Identify
GPIO5	L	HS_IND/SD_CD	HS Indicator LED or SD Card Detect Switch input
GPIO6	H	A16/ROMEN	A16 address line connect for DFU or debug LED indicator optional.
GPIO7	H	EE_CLK/ UNCONF_LED	Serial EE PROM clock output or Unconfigured LED.
GPIO8	L	MS_PWR_CTRL/ CRD_PWR0	Memory Stick Card Power Control, or Internal Power FET0.
GPIO9	L	CF_PWR_CTRL	CompactFlash Card Power Control
GPIO10	L	SM_PWR_CTRL/ CRD_PWR1	SmartMedia Card Power Control, or Internal Power FET1.
GPIO11	L	SD/MMC_PWR_CTRL/ CRD_PWR2	SD/MMC Card Power Control, or Internal Power FET2.
GPIO12	H	MS_ACT_IND/ Media Activity	Memory Stick Activity Indicator, or Media Activity LED.

# USB2229/USB2230

---

## APPENDIX A: DATA SHEET REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision	Section/Figure/Entry	Correction
DS00002252A (07-28-16)	Replaces previous SMSC version Rev. 1.4 (09-14-07)	



## THE MICROCHIP WEB SITE

Microchip provides online support via our WWW site at [www.microchip.com](http://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 (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](http://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 web site at: <http://www.microchip.com/support>**

# USB2229/USB2230

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	[X]	-	XXX	-	[X]
Device	Temperature Range		Package		Internal Microchip Code
<b>Device:</b>	USB2229, USB2230				
<b>Temperature Range:</b>	Blank	=	0°C to +70°C		
<b>Package:</b>	NU	=	128-pin TQFP		

**Examples:**

- a) USB2229-NU-02  
128-pin TQFP RoHS Compliant package, Commercial Temp, Tray
- b) USB2230-NU-02  
128-pin TQFP RoHS Compliant package, Commercial Temp, Tray

**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.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

#### Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KeeLoq, KeeLoq logo, Klear, LANCheck, LINK MD, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC32 logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, ETHERSYNCH, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and QUIET-WIRE are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PureSilicon, RightTouch logo, REAL ICE, Ripple Blocker, Serial Quad I/O, SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2005-2016, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 9781522408284

**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.*



# MICROCHIP

## 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](http://www.microchip.com/support)

Web Address:

[www.microchip.com](http://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

#### Cleveland

Independence, OH

Tel: 216-447-0464

Fax: 216-447-0643

#### 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

#### Los Angeles

Mission Viejo, CA

Tel: 949-462-9523

Fax: 949-462-9608

#### New York, NY

Tel: 631-435-6000

#### San Jose, CA

Tel: 408-735-9110

#### Canada - Toronto

Tel: 905-695-1980

Fax: 905-695-2078

### ASIA/PACIFIC

#### Asia Pacific Office

Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon

#### Hong Kong

Tel: 852-2943-5100

Fax: 852-2401-3431

#### Australia - Sydney

Tel: 61-2-9868-6733

Fax: 61-2-9868-6755

#### China - Beijing

Tel: 86-10-8569-7000

Fax: 86-10-8528-2104

#### China - Chengdu

Tel: 86-28-8665-5511

Fax: 86-28-8665-7889

#### China - Chongqing

Tel: 86-23-8980-9588

Fax: 86-23-8980-9500

#### China - Dongguan

Tel: 86-769-8702-9880

#### China - Guangzhou

Tel: 86-20-8755-8029

#### China - Hangzhou

Tel: 86-571-8792-8115

Fax: 86-571-8792-8116

#### China - Hong Kong SAR

Tel: 852-2943-5100

Fax: 852-2401-3431

#### China - Nanjing

Tel: 86-25-8473-2460

Fax: 86-25-8473-2470

#### China - Qingdao

Tel: 86-532-8502-7355

Fax: 86-532-8502-7205

#### China - Shanghai

Tel: 86-21-5407-5533

Fax: 86-21-5407-5066

#### China - Shenyang

Tel: 86-24-2334-2829

Fax: 86-24-2334-2393

#### China - Shenzhen

Tel: 86-755-8864-2200

Fax: 86-755-8203-1760

#### China - Wuhan

Tel: 86-27-5980-5300

Fax: 86-27-5980-5118

#### China - Xian

Tel: 86-29-8833-7252

Fax: 86-29-8833-7256

### ASIA/PACIFIC

#### China - Xiamen

Tel: 86-592-2388138

Fax: 86-592-2388130

#### China - Zhuhai

Tel: 86-756-3210040

Fax: 86-756-3210049

#### India - Bangalore

Tel: 91-80-3090-4444

Fax: 91-80-3090-4123

#### India - New Delhi

Tel: 91-11-4160-8631

Fax: 91-11-4160-8632

#### India - Pune

Tel: 91-20-3019-1500

#### Japan - Osaka

Tel: 81-6-6152-7160

Fax: 81-6-6152-9310

#### Japan - Tokyo

Tel: 81-3-6880-3770

Fax: 81-3-6880-3771

#### Korea - Daegu

Tel: 82-53-744-4301

Fax: 82-53-744-4302

#### Korea - Seoul

Tel: 82-2-554-7200

Fax: 82-2-558-5932 or

82-2-558-5934

#### Malaysia - Kuala Lumpur

Tel: 60-3-6201-9857

Fax: 60-3-6201-9859

#### Malaysia - Penang

Tel: 60-4-227-8870

Fax: 60-4-227-4068

#### Philippines - Manila

Tel: 63-2-634-9065

Fax: 63-2-634-9069

#### Singapore

Tel: 65-6334-8870

Fax: 65-6334-8850

#### Taiwan - Hsin Chu

Tel: 886-3-5778-366

Fax: 886-3-5770-955

#### Taiwan - Kaohsiung

Tel: 886-7-213-7828

#### Taiwan - Taipei

Tel: 886-2-2508-8600

Fax: 886-2-2508-0102

#### Thailand - Bangkok

Tel: 66-2-694-1351

Fax: 66-2-694-1350

### EUROPE

#### Austria - Wels

Tel: 43-7242-2244-39

Fax: 43-7242-2244-393

#### Denmark - Copenhagen

Tel: 45-4450-2828

Fax: 45-4485-2829

#### France - Paris

Tel: 33-1-69-53-63-20

Fax: 33-1-69-30-90-79

#### Germany - Dusseldorf

Tel: 49-2129-3766400

#### Germany - Karlsruhe

Tel: 49-721-625370

#### Germany - Munich

Tel: 49-89-627-144-0

Fax: 49-89-627-144-44

#### Italy - Milan

Tel: 39-0331-742611

Fax: 39-0331-466781

#### Italy - Venice

Tel: 39-049-7625286

#### Netherlands - Drunen

Tel: 31-416-690399

Fax: 31-416-690340

#### Poland - Warsaw

Tel: 48-22-3325737

#### Spain - Madrid

Tel: 34-91-708-08-90

Fax: 34-91-708-08-91

#### Sweden - Stockholm

Tel: 46-8-5090-4654

#### UK - Wokingham

Tel: 44-118-921-5800

Fax: 44-118-921-5820

06/23/16