SUCCESS BY DESIGN

USB2227/USB2228

4th Generation USB2.0 Flash Media Controller with Integrated Card Power FETs

PRODUCT FEATURES

Datasheet

- Complete System Solution for interfacing SmartMedia™ (SM) or xD Picture Card™ (xD)[1], Memory Stick™ (MS), High Speed Memory Stick (HSMS), Memory Stick PRO (MSPRO), MS Duo™, Secure Digital (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 USB2.0 bus
  - 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 for supplying flash media card power with minimum board components
- 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 USB2.0 Transceiver
  - A Bi-directional Control and a Bi-directional Bulk Endpoint are provided.
- 8051 8 bit microprocessor
  - Provides low speed control functions
  - 30 Mhz execution speed at 4 cycles per instruction 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
- Double Buffered Bulk Endpoint
  - Bi-directional 512 Byte Buffer for Bulk Endpoint
  - 64 Byte RX Control Endpoint Buffer
  - 64 Byte TX Control Endpoint Buffer
- Internal or External Program Memory Interface
  - 64K Byte Internal Code Space or Optional 64K 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 USB2.0 Sampling, Configurable MCU clock
- Supports firmware upgrade via USB bus if “boot block” Flash program memory is used
- 15 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 SMSC
- 128 Pin VTQFP Package (1.0mm height, 14mm x14mm footprint); green, lead-free package also available

1.xD Picture Card not applicable to USB2227.

ORDER NUMBER(S):

USB2227/USB2228-NE-XX FOR 128 PIN, VTQFP PACKAGE

USB2227/USB2228-NU-XX FOR 128 PIN, VTQFP PACKAGE (GREEN, LEAD-FREE)

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Chapter 1 General Description

The USB2227/USB2228 is a USB2.0 Bulk Only Mass Storage Class Peripheral Controller intended for supporting CompactFlash (CF and CF Ultra I/II) in True IDE Mode only, SmartMedia (SM) and XD cards, Memory Stick (MS), Memory Stick DUO (MSDUO) and Memory Stick Pro (MSPRO), Secure Digital (SD), and MultiMediaCard (MMC) flash memory devices. It provides a single chip solution for the most popular flash memory cards in the market.

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

Provisions for external Flash Memory up to 64K bytes for program storage is provided.

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

Fifteen 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. SMSC also provides licenses** for Win98 and Win2K drivers and setup utilities. Note: Please check with SMSC for precise features and capabilities for the current ROM code release.

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Chapter 2 Acronyms

SM: SmartMedia

SMC: SmartMedia Controller

FM: Flash Media

FMC: Flash Media Controller

CF: Compact Flash

CFC: CompactFlash Controller

SD: Secure Digital

SDC: Secure Digital Controller

MMC: MultiMediaCard

MS: Memory Stick

MSC: Memory Stick Controller

TPC: Transport Protocol Code.

ECC: Error Checking and Correcting

CRC: Cyclic Redundancy Checking

Chapter 3 Pin Table

3.1 128-Pin Package

Table 3.1 USB2227/USB2228 128-Pin Package

CompactFlashINTERFACE (28 Pins)			
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
SmartMedia INTERFACE (17 Pins)			
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			
Memory Stick INTERFACE (7 Pins)			
MS_BS	MS_SDIO/MS_D0	MS_SCLK	MS_INS
MS_D1	MS_D2	MS_D3	
SD INTERFACE (7 Pins)			
SD_CMD	SD_CLK	SD_DAT0	SD_DAT1
SD_DAT2	SD_DAT3	SD_nWP	
USB INTERFACE (10 Pins)			
USBDP	USBDM	ATEST	RBIAS
VDD18PLL	VSSPLL	VDDA33	VSSA
XTAL1/CLKIN	XTAL2		

Table 3.1 USB2227/USB2228 128-Pin Package (continued)

MEMORY/IO INTERFACE (27 Pins)			
MA0/CLK_SEL0	MA1/CLK_SEL1	MA2/SEL_CLKDRV	MA3
MA4	MA5	MA6	MA7
MA8	MA9	MA10	MA11
MA12	MA13	MA14	MA15
MD0	MD1	MD2	MD3
MD4	MD5	MD6	MD7
nMRD	nMWR	nMCE	
MISC (18 Pins)			
GPIO1	GPIO2	GPIO3	GPIO4
GPIO5	GPIO6/ROMEN	GPIO7	GPIO8/ CRP_PWR0
GPIO9	GPIO10/ CRD_PWR1	GPIO11/ CRD_PWR2	GPIO12
GPIO13	GPIO14	GPIO15	nTEST0
nTEST1	nRESET		
DIGITAL, POWER, GROUND & NC (14 Pins)			
(5)VDD33	(2)VDD18	(7)VSS	
Total 128			

3.2 128-Pin List Table

Table 3.2 USB2227/USB2228 128-Pin VTQFP

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

Table 3.2 USB2227/USB2228 128-Pin VTQFP (continued)

PIN #	NAME	MA	PIN #	NAME	MA	PIN #	NAME	MA	PIN #	NAME	MA
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	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	GPIO2	8
18	MS_INS	-	50	CF_D13	8	82	SM_nWE	8	114	GPIO1	8
19	MS_D0/ MS_SDIO	8	51	CF_D14	8	83	SM_nCE	8	115	nRESET	-
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	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	GPIO15	8	122	MA6	8
27	SD_DAT1	8	59	CF_nRESET	8	91	GPIO14	8	123	MA7	8
28	SD_DAT2	8	60	CF_nCS0	8	92	GPIO13	8	124	MA8	8
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

Notes:

- RBIAS is connected to the Analog Ground plane VSSA via a resistor.
- When the internal 1.8V regulator is enabled, VDD18 (Pin 106) & VDD18PLL (Pin 101), MUST have a 10uf +/- 20%, (equivalent series resistance (ESR) <0.1ohm) bypass capacitor to VSSA. These capacitors must be as close to the pins as possible

Chapter 4 Pin Configuration

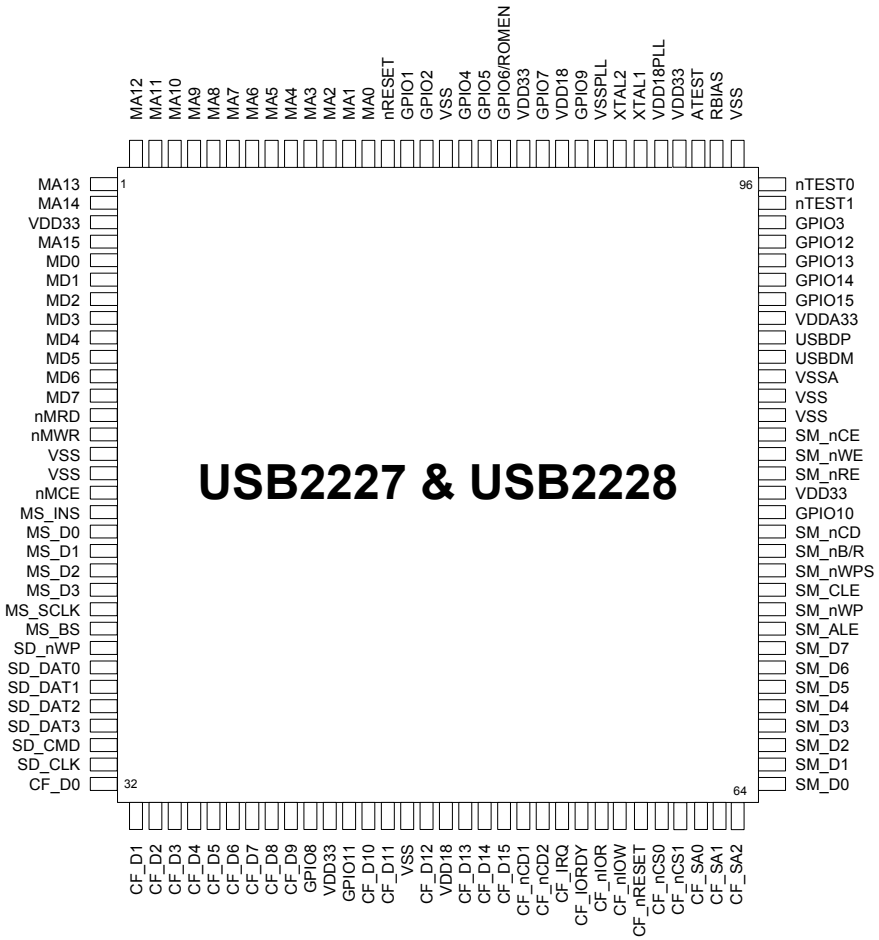
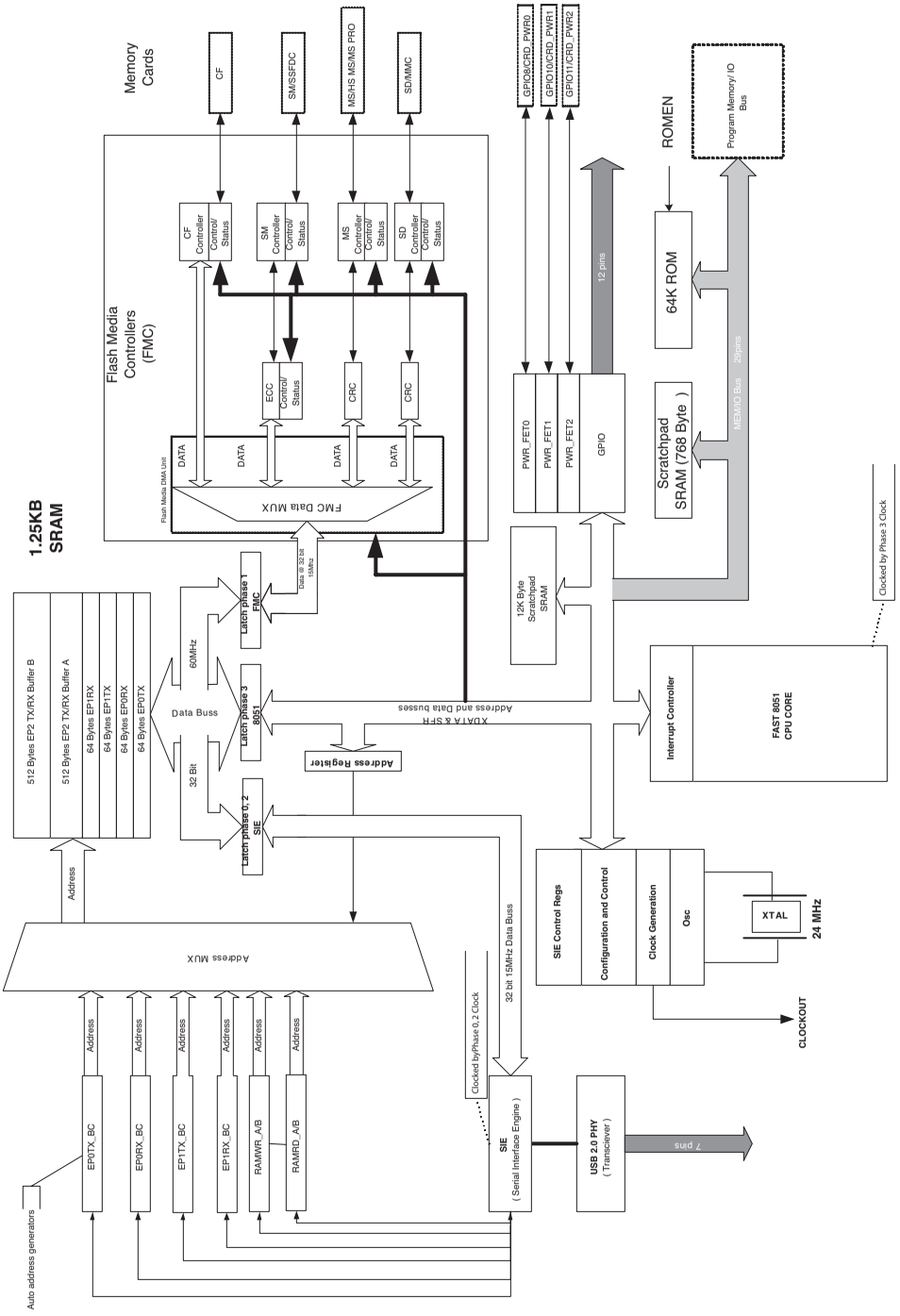


Figure 4.1 USB2227/USB2228 128-Pin VTQFP

Chapter 5 Block Diagram



Chapter 6 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.

6.1 PIN Descriptions

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
CompactFlash (In True IDE mode) INTERFACE			
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.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
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.
CF IO Write Strobe	CF_nIOW	O8	This pin is an active low write strobe signal for CF device.
SmartMedia INTERFACE			
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	08PU	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.
		08	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).

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
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.
		08	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.
		08	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 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.
MEMORY STICK INTERFACE			
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_D0	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_D1	I/O8PD	This pin is a bi-directional data signal for the MS device. This pin has internally controlled weak pull-up and pull-down resistors for various operational modes.
MS System Data In/Out	MS_D[3:2]	I/O8PD	This pin is a bi-directional data signal for the MS device. The bi-directional data signal has an internal weak pull-down resistor.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
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.
SD INTERFACE			
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.
USB INTERFACE			
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.
Crystal Input/External Clock Input	XTAL1/ CLKIN	ICLKx	24Mhz Crystal or external clock input. This pin can be connected to one terminal of the crystal or can be connected to an external 24Mhz clock when a crystal is not used. **Note:** 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.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
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.
MEMORY/IO INTERFACE			
Memory Data Bus	MD[7:0]	I/O8PU	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	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) **Note:** 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).

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
Memory Address Bus	MA[1:0]/CLK_SEL[1:0]	I/O8PD	MA[1:0], These signals address memory locations within the external memory.
			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. SEL[1:0] = '00'. 24MHz SEL[1:0] = '01'. RESERVED SEL[1:0] = '10'. RESERVED SEL[1:0] = '11'. 48MHz **Note:** If the latched value is '1', then the corresponding MA 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 corresponding MA pin will function identically to the MA[15:3] pins at all times (other than during nRESET assertion).
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	Program Memory Chip Enable; active low. This signal is asserted, when any of the following conditions are no longer met: 1. IDLE bit (PCON.0) is 1. 2. INT2 is negated 3. SLEEP bit of CLOCK_SEL is 1. **Note:** This signal is held to a logic 'high' while nRESET is asserted.
MISC			
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.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
GPIO6, ROMEN	GPIO6/ROMEN	IPU	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 USB2227/USB2228 uses this external bus for program execution. When this pin is left unconnected or pulled high by a weak pull-up resistor, the USB2227/USB2228 uses the internal ROM for program execution.
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	GPIO9	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output.
General Purpose I/O Or Card Power	GPIO10/ CRD_PWR1	I/O8	GPIO: These pins 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	GPIO11/ CRD_PWR2	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 @ 200mA.
General Purpose I/O	GPIO[15:12]	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.
DIGITAL POWER, GROUNDS, and NO CONNECTS			
1.8v Digital Core Power	VDD18		+1.8V Core power All VDD18 pins must be connected together on the circuit board.

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

Notes:

- 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.
- nMCE is normally asserted except when the 8051 is in standby mode.

6.2 Buffer Type Descriptions

Table 6.1 USB2227/USB2228 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

Chapter 7 DC Parameters

7.1 Maximum Guaranteed Ratings

Operating Temperature Range ..... 0^oC to $+70^oC$

Storage Temperature Range ..... -55^o to $+150^oC$

Lead Temperature Range (soldering, 10 seconds) ..... $+325^oC$

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 Note 7.2) ..... -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 7.1 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 7.2 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.

7.2 DC Electrical Characteristics

(T_A = 0°C - 70°C, V_{DD33}, V_{DDA33} = *+3.3 V* ± 0.3 V, V_{DD18}, $V_{DD18PLL}$ = *+1.8 V* ± 10%,)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
I,IPU & IPD Type Input Buffer						
Low Input Level	V_{ILI}			0.8	V	TTL Levels
High Input Level	V_{IHI}	2.0			V	
Pull Down	PD		72		µA	
Pull Up	PU		58		µA	

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
IS Type Input Buffer						
Low Input Level	V_{ILI}			0.8	V	TTL Levels
High Input Level	V_{IHI}	2.0			V	
Hysteresis	V_{HYSI}		500		mV	
ICLK Input Buffer						
Low Input Level	V_{ILCK}			0.4	V	
High Input Level	V_{IHCK}	2.2			V	
Input Leakage (All I and IS buffers)						
Low Input Leakage	I_{IL}	-10		+10	µA	V_{IN} = 0
High Input Leakage	I_{IH}	-10		+10	mA	V_{IN} = V_{DD33}
O8. O8PU & 08PD Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 8 mA @ V_{DD33}= 3.3V
High Output Level	V_{OH}	V_{DD33} - 0.4			V	I_{OH} = -8mA @ V_{DD33}= 3.3V
Output Leakage	I_{OL}	-10		+10	µA	V_{IN} = 0 to V_{DD33} (Note 7.3)
Pull Down	PD		72		µA	
Pull Up	PU		58		µA	
I/O8, I/O8PU & I/O8PD Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 8 mA @ V_{DD33}= 3.3V
High Output Level	V_{OH}	V_{DD33} _ 0.4			V	I_{OH} = -8 mA @ V_{DD33}= 3.3V
Output Leakage	I_{OL}	-10		+10	µA	V_{IN} = 0 to V_{DD33} (Note 7.3)
Pull Down	PD		72		µA	
Pull Up	PU		58		µA	

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
IO-U (Note 7.4)						
Integrated Power FET for GPIO8 & GPIO10 (and GPIO11 when used with Firmware version -03 or older)						
Output Current	I_{OUT}	100			mA	GPIO8 or 10; $Vdrop_{FET}$ = 0.23V
Short Circuit Current Limit	I_{SC}			140	mA	GPIO8 or 10; $Vout_{FET}$ = 0V
On Resistance	R_{DSON}			2.1	Ω	GPIO8 or 10; I_{FET} = 70mA
Output Voltage Rise Time	t_{DSON}			800	µs	GPIO8 or 10; C_{LOAD} = 10µF
Integrated Power FET for GPIO11 (only when used with Firmware version -04 or later)						
Output Current	I_{OUT}	200			mA	GPIO11; $Vdrop_{FET}$ = 0.46V
Short Circuit Current Limit	I_{SC}			181	mA	GPIO11; $Vout_{FET}$ = 0V
On Resistance	R_{DSON}			2.1	Ω	GPIO11; I_{FET} = 70mA
Output Voltage Rise Time	t_{DSON}			800	µs	GPIO11; C_{LOAD} = 10µF
Supply Current Unconfigured	I_{CCINIT}		55	80	mA	
Supply Current Active (Full Speed)	I_{CC}		75	90	mA	
Supply Current Active (High Speed)	I_{CC}		75	100	mA	
Supply Current Standby	I_{CSBY}		305	420	µA	

Note 7.3 Output leakage is measured with the current pins in high impedance.

Note 7.4 See Appendix A for USB DC electrical characteristics.

Note 7.5 The Maximum power dissipation parameters of the package should not be exceeded

Note 7.6 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 9.1, “GPIO Usage (ROM Rev 0x00),” on page 26.

7.3 Capacitance

T_A = 25°C; fc = 1MHz; V_{DD18}, $V_{DD18PLL}$ = *1.8V*

PARAMETER	SYMBOL	LIMITS			UNIT	TEST CONDITION
		MIN	TYP	MAX		
Clock Input Capacitance	C_{IN}			20	pF	All pins except USB pins (and pins under test tied to AC ground)
Input Capacitance	C_{IN}			10	pF	
Output Capacitance	C_{OUT}			20	pF	

Chapter 8 Package Outline

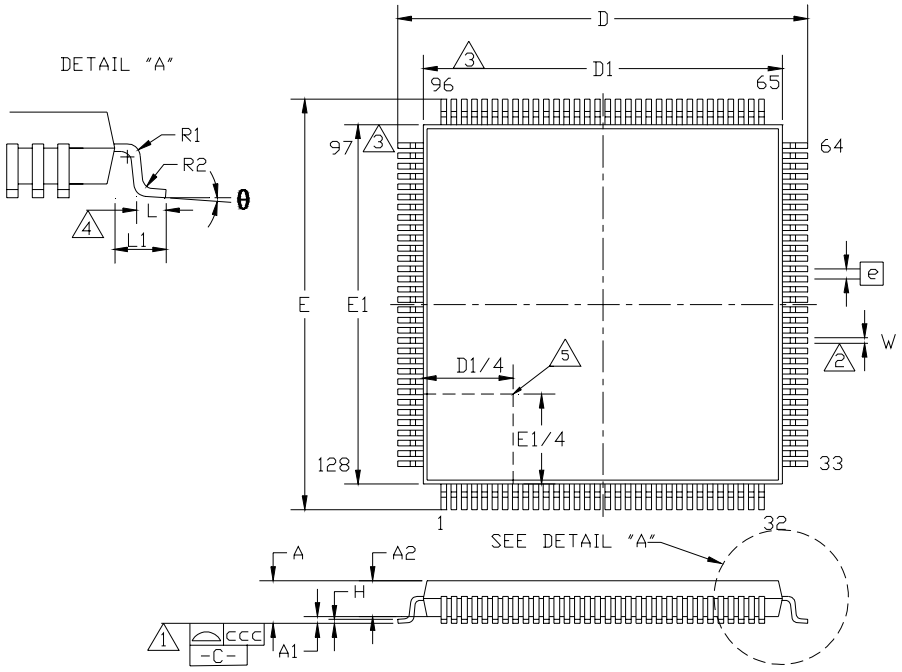


Figure 8.1 USB2227/USB2228 128-Pin VTQFP Package Outline

Table 8.1 USB2227/USB2228 128-Pin VTQFP Package Parameters

	MIN	NOMINAL	MAX	REMARKS
A	~	~	1.20	Overall Package Height
A1	0.05	~	0.15	Standoff
A2	0.95	~	1.05	Body Thickness
D	15.80	~	16.20	X Span
D1	13.80	~	14.20	X body Size
E	15.80	~	16.20	Y Span
E1	13.80	~	14.20	Y body Size
H	0.09	~	0.20	Lead Frame Thickness
L	0.45	0.60	0.75	Lead Foot Length
L1	~	1.00	~	Lead Length
e	0.40 Basic			Lead Pitch
q	0^o	~	7^o	Lead Foot Angle
W	0.13	0.18	0.23	Lead Width
R1	0.08	~	~	Lead Shoulder Radius
R2	0.08	~	0.20	Lead Foot Radius
ccc	~	~	0.08	Coplanarity

Notes:

1. Controlling Unit: millimeter.
2. Tolerance on the true position of the leads is ± 0.035 mm maximum.
   Package body dimensions D1 and E1 do not include the mold protrusion.
3. Maximum mold protrusion is 0.25 mm.
4. Dimension for foot length L measured at the gauge plane 0.25 mm above the seating plane.
5. Details of pin 1 identifier are optional but must be located within the zone indicated.

Chapter 9 GPIO Usage

Table 9.1 GPIO Usage (ROM Rev 0x00)

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	H	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.
GPIO13	H	CF_ACT_IND	CompactFlash Activity Indicator
GPIO14	H	SM_ACT_IND	SmartMedia Activity Indicator
GPIO15	H	SD/MMC_ACT_IND	SD/MMC Activity Indicator