USB2224

Bus Powered USB2.0 Flash Media Controller

Datasheet

Product Features

- Complete System Solution for interfacing SmartMedia™ (SM) or xD Picture Card™ (xD), 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 Multimedia Card (RS-MMC), NAND Flash, Compact Flash™ (CF), 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
- USB Bus Power Certified
- 3.3 Volt I/O with 5V input tolerance
- 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 12Mhz Crystal Driver Circuit
- 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
    - Detach on 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
- 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 TQFP Green, Lead-free Package (1.0mm height, 14mm x14mm footprint)

DATASHEET

ORDERING INFORMATION

Order Number:

USB2224-NU-XX for 128 pin TQFP package (green, lead-free)

80 Arkay Drive
Hauppauge, NY 11788
(631) 435-6000
FAX (631) 273-3123

Table of Contents

Chapter 1 General Description 4

Chapter 2 Acronyms and Definitions 5
2.1 Acronyms 5
2.2 Definitions 5

Chapter 3 Pin Table 6
3.1 128-Pin Package 6
3.2 128 Pin List Table 7
3.2.1 128 Pin TQFP 7

Chapter 4 Pin Configuration 8
4.1 128 Pin TQFP 8

Chapter 5 Block Diagram 9

Chapter 6 Pin Descriptions 10
6.1 Pin Descriptions 10
6.2 Buffer Type Descriptions 15
6.3 GPIO Usage Table 15

Chapter 7 DC Parameters 17
7.1 Maximum Guaranteed Ratings 17
7.2 DC Electrical Characteristics 17

Chapter 8 Package Outline 20

List of Figures

Figure 8.1 - 128 Pin TQFP Package 20

List of Tables

Table 3.1 - Pinout 6
Table 6.1 - Pin Description 10
Table 6.2 - USB2224 Buffer Type Descriptions 15
Table 6.3 - GPIO Usage 15
Table 8.1 - 128 Pin TQFP Package Parameters 20

Chapter 1 General Description

The USB2224 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.

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.

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.

*Note: In order to develop, make, use, or sell readers and/or other products using or incorporating any of the SMSC devices made the subject of this document or to use related SMSC software programs, technical information and licenses under patent and other intellectual property rights from or through various persons or entities, including without limitation media standard companies, forums, and associations, and other patent holders may be required. These media standard companies, forums, and associations include without limitation the following: Sony Corporation (Memory Stick, Memory Stick Pro); SD3 LLC (Secure Digital); MultiMedia Card Association (MultiMediaCard); the SSFDC Forum (SmartMedia); the Compact Flash Association (Compact Flash); and Fuji Photo Film Co., Ltd., Olympus Optical Co., Ltd., and Toshiba Corporation (xD-Picture Card). SMSC does not make such licenses or technical information available; does not promise or represent that any such licenses or technical information will actually be obtainable from or through the various persons or entities (including the media standard companies, forums, and associations), or with respect to the terms under which they may be made available; and is not responsible for the accuracy or sufficiency of, or otherwise with respect to, any such technical information.

SMSC's obligations (if any) under the Terms of Sale Agreement, or any other agreement with any customer, or otherwise, with respect to infringement, including without limitation any obligations to defend or settle claims, to reimburse for costs, or to pay damages, shall not apply to any of the devices made the subject of this document or any software programs related to any of such devices, or to any combinations involving any of them, with respect to infringement or claimed infringement of any existing or future patents related to solid state disk or other flash memory technology or applications ("Solid State Disk Patents"). By making any purchase of any of the devices made the subject of this document, the customer represents, warrants, and agrees that it has obtained all necessary licenses under then-existing Solid State Disk Patents for the manufacture, use and sale of solid state disk and other flash memory products and that the customer will timely obtain at no cost or expense to SMSC all necessary licenses under Solid State Disk Patents; that the manufacture and testing by or for SMSC of the units of any of the devices made the subject of this document which may be sold to the customer, and any sale by SMSC of such units to the customer, are valid exercises of the customer's rights and licenses under such Solid State Disk Patents; that SMSC shall have no obligation for royalties or otherwise under any Solid State Disk Patents by reason of any such manufacture, use, or sale of such units; and that SMSC shall have no obligation for any costs or expenses related to the customer's obtaining or having obtained rights or licenses under any Solid State Disk Patents.

SMSC MAKES NO WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, IN REGARD TO INFRINGEMENT OR OTHER VIOLATION OF INTELLECTUAL PROPERTY RIGHTS. SMSC DISCLAIMS AND EXCLUDES ANY AND ALL WARRANTIES AGAINST INFRINGEMENT AND THE LIKE.

No license is granted by SMSC expressly, by implication, by estoppel or otherwise, under any patent, trademark, copyright, mask work right, trade secret, or other intellectual property right.

***To obtain this software program the appropriate SMSC Software License Agreement must be executed and in effect. Forms of these Software License Agreements may be obtained by contacting SMSC.*

Chapter 2 Acronyms and Definitions

2.1 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

XD: XD Picture Card

2.2 Definitions

Flash Media DMA UNIT (FMDU): The control logic in the flash media controller block as shown in the Block Diagram that support the data transfer from CFC, SMC, MSC and SDC to EP2 buffer directly.

SD/MMC: the built-in SD controller (SDC) supports both SD and MMC devices.

Flash Media Controller Data Multiplexer (FMC DATA MUX): The multiplexer to enable the different data path from the different flash media controllers (CFC, SMC, MSC and SDC).

Chapter 3 Pin Table

3.1 128-Pin Package

Table 3.1 - Pinout

CompactFlash INTERFACE (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 / XD 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 (13 Pins)			
USB+	USB-	ATEST	RBIAS
VDDP	VSSP	(2)VDDA	(2)VSSA
VREG	XTAL1/CLKIN	XTAL2	
MEMORY/IO INTERFACE (27 Pins)			
MA0	MA1	MA2	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)			
nRESET	GPIO1	GPIO2	GPIO3
GPIO4	GPIO5	GPIO6/ROMEN	GPIO7
GPIO8	GPIO9	GPIO10	GPIO11
GPIO12	GPIO13	GPIO14	GPIO15
nTEST0	nTEST1		
DIGITAL, POWER, GROUND & NC (11 Pins)			
(3)VDDIO	(4)VSSIO	(2)VDDCORE	(2)VSSCORE
Total 128			

3.2 128 Pin List Table

3.2.1 128 Pin TQFP

PIN #	NAME	MA	PIN #	NAME	MA	PIN #	NAME	MA	PIN #	NAME	MA
1	MA0	8	33	MS_D2	8	65	CF_nCD2	-	97	ATEST	-
2	MA1	8	34	MS_D1	8	66	CF_IRQ	-	98	*VDDP*	
3	MA2	8	35	MS_D0	8	67	CF_IORDY	-	99	XTAL2	-
4	*VDDIO*		36	MS_SCLK	8	68	CF_nIOR	8	100	XTAL1	-
5	MA3	8	37	MS_BS	8	69	CF_nIOW	8	101	*VSSP*	
6	MA4	8	38	SD_nWP	-	70	CF_nRESET	8	102	*VDDA(REF)*	
7	MA5	8	39	*VDDIO*		71	CF_nCS0	8	103	RBIAS	-
8	MA6	8	40	SD_DAT0	8	72	CF_nCS1	8	104	*VSSA(REF)*	
9	MA7	8	41	SD_DAT1	8	73	CF_SA0	8	105	*VDDA*	
10	MA8	8	42	SD_DAT2	8	74	*VDDIO*		106	USB+	-
11	MA9	8	43	SD_DAT3	8	75	CF_SA1	8	107	USB-	-
12	MA10	8	44	SD_CMD	8	76	CF_SA2	8	108	*VSSA*	
13	MA11	8	45	SD_CLK	8	77	SM_D0	8	109	nRESET	-
14	*MA12*	8	46	CF_D0	8	78	SM_D1	8	110	*VSSCORE*	
15	MA13	8	47	CF_D1	8	79	*VSSIO*		111	nTEST0	-
16	*VDDCORE*		48	CF_D2	8	80	SM_D2	8	112	nTEST1	-
17	MA14	8	49	CF_D3	8	81	*SM_D3*	8	113	GPIO1	8
18	MA15	8	50	CF_D4	8	82	SM_D4	8	114	GPIO2	8
19	MD0	8	51	*VSSIO*		83	SM_D5	8	115	GPIO3	8
20	MD1	8	52	*VSSCORE*		84	SM_D6	8	116	GPIO4	8
21	MD2	8	53	CF_D5	8	85	SM_D7	8	117	GPIO5	8
22	MD3	8	54	CF_D6	8	86	SM_ALE	8	118	GPIO6/ROMEN	8
23	*VSSIO*		55	CF_D7	8	87	SM_CLE	8	119	GPIO7	8
24	MD4	8	56	CF_D8	8	88	SM_nRE	8	120	GPIO8	8
25	MD5	8	57	CF_D9	8	89	SM_nWE	8	121	GPIO9	8
26	MD6	8	58	CF_D10	8	90	SM_nWP	8	122	GPIO10	8
27	MD7	8	59	CF_D11	8	91	*VDDCORE*		123	GPIO11	8
28	nMRD	8	60	CF_D12	8	92	SM_nCE	8	124	*VSSIO*	
29	nMWR	8	61	CF_D13	8	93	*VREG*		125	GPIO12	8
30	nMCE	8	62	CF_D14	8	94	SM_nWPS	-	126	GPIO13	8
31	MS_INS	-	63	CF_D15	8	95	SM_nB/R	-	127	GPIO14	8
32	MS_D3	8	64	CF_nCD1	-	96	SM_nCD	-	128	GPIO15	8

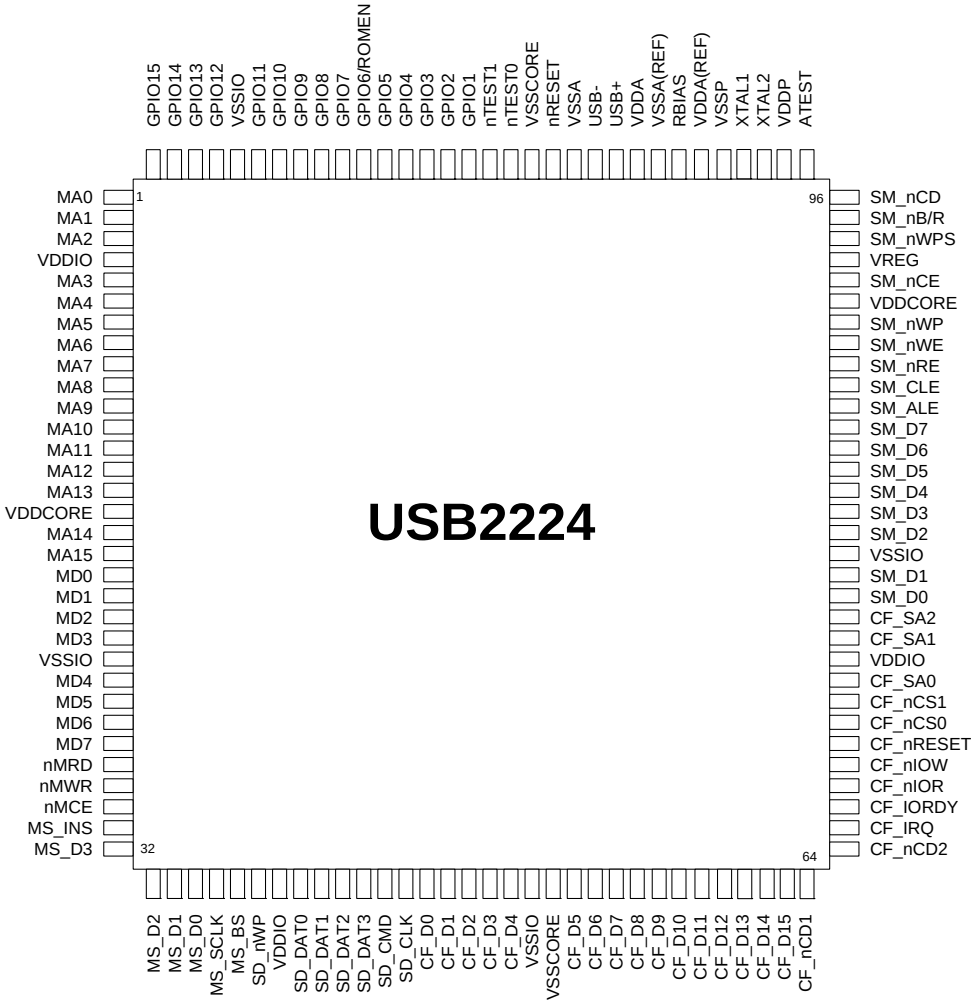
Note 1: RBIAS is connected to the Analog Ground plane VSSA(REF) via a resistor.

Note 2: When the internal 1.8V regulator is enabled, VDDCORE (91) and VDDP(98), MUST have a 10uf +/- 20%, (equivalent series resistance (ESR) <0.1ohm) bypass capacitor to VSSA.

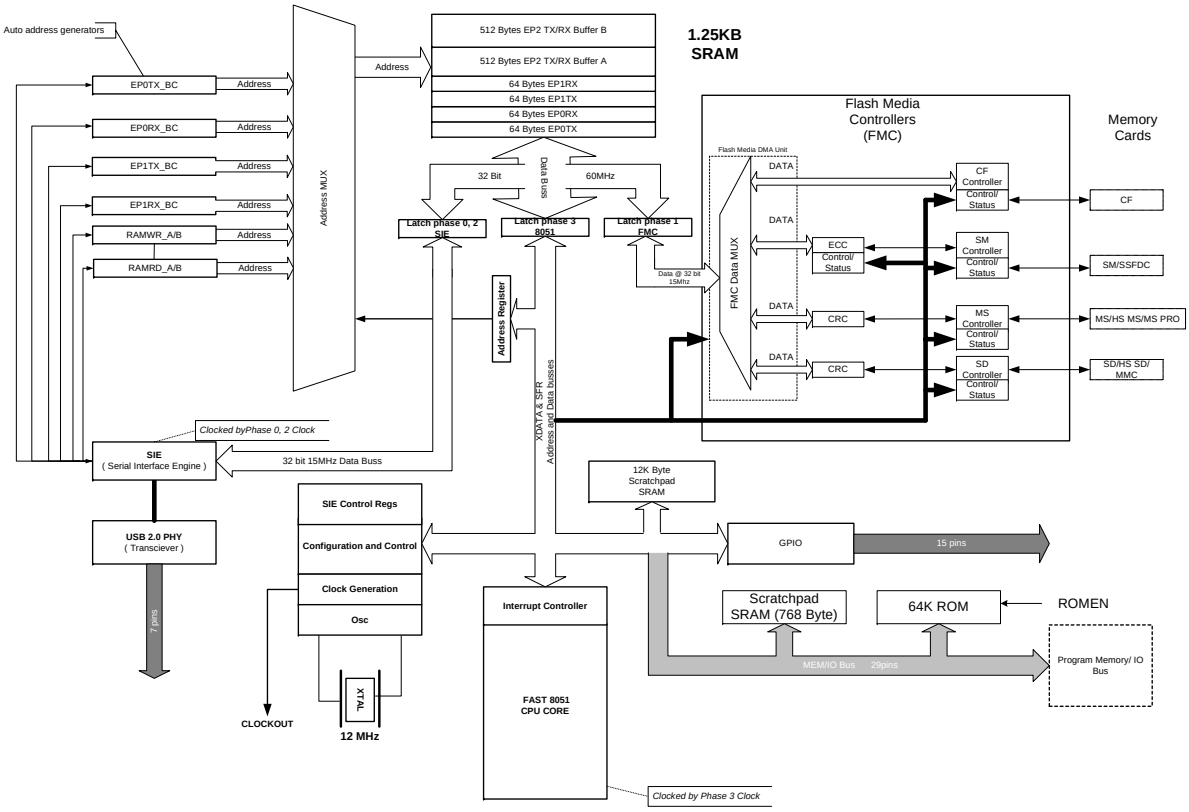
Note 3: VDDA(REF) and VSSA(REF) are same as the VDDA and VSSA respectively.

Chapter 4 Pin Configuration

4.1 128 Pin TQFP



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

Table 6.1 - Pin Description

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
CompactFlash (In True IDE mode) INTERFACE			
CF Chip Select 1	CF_nCS1	O8	This pin is the active low chip select 1 signal for the CF ATA device
CF Chip Select 0	CF_nCS0	O8	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 device.
CF Register Address 1	CF_SA1	O8	This pin is the register select address bit 1 for the CF device.
CF Register Address 0	CF_SA0	O8	This pin is the register select address bit 0 for the CF 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/O8	The bi-directional data signals CF_D15-CF_D8 in True IDE mode data transfer. The bi-directional data signal has an internal weak pull-down resistor.
CF Data7-0	CF_D[7:0]	I/O8	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 from CF card.
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.
CF Card Detection1	CF_nCD1	IPU	This card detection pin is connected to ground on the CF device, when the CF device is inserted.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
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, when the CFC is enabled.
CF IO Write Strobe	CF_nIOW	O8	This pin is an active low write strobe signal for CF device, when the CFC is enabled.
SmartMedia INTERFACE			
SM Write Protect	SM_nWP	O8	This pin is an active low write protect signal for the SM device, when the SMC is enabled.
SM Address Strobe	SM_ALE	O8	This pin is an active high Address Latch Enable signal for the SM device, when the SMC is enabled.
SM Command Strobe	SM_CLE	O8	This pin is an active high Command Latch Enable signal for the SM device, when the SMC is enabled.
SM Data7-0	SM_D[7:0]	I/O8	These pins are the bi-directional data signal SM_D7-SM_D0, when the SMC is enabled.
SM Read Enable	SM_nRE	O8	This pin is an active low read strobe signal for SM device, when SMC is enabled.
SM Write Enable	SM_nWE	O8	This pin is an active low write strobe signal for SM device, when SMC is enabled.
SM Write Protect Switch	SM_nWPS	IPU	A write-protect seal is detected, when this pin is low.
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 should be attached to the power of SM/NAND flash device.
SM Chip Enable	SM_nCE	O8	This pin is the active low chip enable signal to the SM device.
SM Card Detection	SM_nCD	IPU	This is the card detection signal from SM device to indicate if the device is inserted.
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/O8	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	IO8PD	This pin is a bi-directional data signal for the MS device. The bi-directional data signal has an internal weak pull-down resistor that is internally controlled.
MS System Data In/Out	MS_D[3:2]	I/O8	This pin is a bi-directional data signal for the MS device. The bi-directional data signal has an internal weak pull-down resistor.
MS Card Insertion	MS_INS	IPU	This pin is the card detection signal from the MS device to indicate, if the device is inserted.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
MS System CLK	MS_SCLK	O8	This pin is an output clock signal to the MS device.
SD INTERFACE			
SD Data3-0	SD_DAT[3:0]	I/O8	These are bi-directional data signals.
SD Clock	SD_CLK	O8	This is an output clock signal to SD/MMC device.
SD Command	SD_CMD	I/O8	This is a bi-directional signal that connects to the CMD signal of SD/MMC device.
SD Write Protected	SD_nWP	IPD	This pin is Write Protect Switch input signal with an internal weak pull-down.
USB INTERFACE			
USB Bus Data	USB- USB+	IO-U	These pins connect to the USB bus data signals.
USB Transceiver Bias	RBIAS	I	A 12.0KΩ ± 1% resistor is attached from ground to this pin to set the transceiver's internal bias currents.
Analog Test	ATEST	IOA	This signal is used for testing the analog section of the chip and should be connected to VDDA for normal operation.
1.8v Analog Power	VDDP		1.8v Analog Power This pin MUST have a 10uf +/- 20%, (equivalent series resistance (ESR) <0.1ohm) bypass capacitor to VSSA. This capacitor should be placed as close to the pin as possible.
Analog Ground Reference	VSSP		Analog Ground Reference for 1.8v Analog power.
3.3v Analog Power	VDDA		3.3v Analog Power
Analog Ground Reference	VSSA		Analog Ground Reference for 3.3v Analog Power.
1.8v Voltage Regulator for USB PHY	VREG		This pin is connected to 3.3v.
Crystal Input/External Clock Input	XTAL1/ CLKIN	ICLKx	12Mhz Crystal or external clock input. This pin can be connected to one terminal of the crystal or can be connected to an external 12Mhz clock when a crystal is not used.
Crystal Output	XTAL2	OCLKx	12Mhz 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]	IO8	When using external program memory, these signals are used to transfer data between the internal CPU and the external program memory. When using internal program ROM, internal weak pull up resistors are activated to prevent these pins from floating.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
Memory Address Bus	MA[15:0]	O8	These signals address memory locations within the external memory.
Memory Read 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 the device is not is SUSPEND mode. **Note:** This signal is held in a logic 'high' state (inactive) during nRESET assertion.
MISC			
GPIO6, ROMEN and RXD	GPIO6 /ROMEN	I/O8PU	This pin has an internal weak pullup resistor that can be enabled or disabled by the state of nRESET. The pullup is enabled when nRESET is active. The pullup 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. After the rising edge of nRESET, this pin may be used as GPIO6 or RXD. When pulled low via an external weak pulldown resistor, an external program memory should be connected to the memory data bus. The USB2224 uses this external bus for program execution. When this pin is left unconnected or pulled high by a weak pullup resistor, the USB2224 uses the internal ROM for program execution. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO1	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO2	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO3	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.

NAME	SYMBOL	BUFFER TYPE	DESCRIPTION
General Purpose I/O	GPIO4	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO5	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO7	I/O8	This pin may be used either as input, edge sensitive interrupt input, or output. This pin's function while operating from internal ROM is shown in Table 6.3 - GPIO Usage.
General Purpose I/O	GPIO[15:8]	I/O8	These pins may be used either as input, or output. These pins' functions while operating from internal ROM are shown in Table 6.3 - GPIO Usage.
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[0:1]	I	These signals are used for testing the chip. User should normally tie them high externally.
DIGITAL POWER, GROUNDS, and NO CONNECTS			
1.8v Digital Core Power	VDDCORE		+1.8V Core power All VDDCORE pins must be connected together on the circuit board. Pin 91 MUST have a 10uf +/- 20%, (equivalent series resistance (ESR) <0.1ohm) bypass capacitor to VSSA, and this capacitor should be placed as close to the pin as possible.
3.3v Digital I/O power	VDDIO		+3.3V I/O power
VDDCORE reference ground	VSSCORE		VDDCORE ground Reference
VDDIO reference ground	VSSIO		VDDIO ground reference

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

Note 2: nMCE is normally asserted except when the system is in standby mode.

6.2 Buffer Type Descriptions

Table 6.2 - USB2224 Buffer Type Descriptions

BUFFER	DESCRIPTION
I	Input
IPU	Input with controlled internal weak pull-up resistor.
IPD	Input with controlled internal weak pull-down resistor.
IS	Input with Schmitt trigger
I/O8	Input/Output with 8mA drive
I/OD8	Input/Open drain output … 8mA sink
O8	Output with 8mA drive
I/O8PU	Input/Output with 8mA drive controlled weak pull-up resistor
I/O8PD	Input/Output with 8mA drive controlled weak pull-down resistor
ICLKx	XTAL clock input
OCLKx	XTAL clock output
I/O-U	Analog Input/Output Defined in USB specification
O-U	Analog Output
I-U	Analog Input
OIA	Special analog Input/Output

6.3 GPIO Usage Table

Table 6.3 - GPIO Usage

NAME	ACTIVE LEVEL	SYMBOL	DESCRIPTION AND NOTE
GPIO1	H/L	ACT/DOOR	Media Activity LED / xD Door SW Input
GPIO2	H	EE_CS	Serial EE PROM chip select
GPIO3	H	V_BUS	USB V bus detect
GPIO4	H/L	EE_DIN/EE_DOUT/xDID	Serial EE PROM input/output and xD ID pin input
GPIO5	L	SD_CD	SD Card Detect SW Input. In production ROM versions, this pin must always be pulled high except to indicate SD card insertion. If no SD interface is used, this pin must still be pulled high for proper operation.
GPIO6	H	A16 (external ROM only) /ROMEN	Int/Ext ROM select. External program memory A16 address line connect for DFU.
GPIO7	H	EE_CLK	Serial EE PROM clock output
GPIO8	L	MS Power Control	Memory Stick Card Power Control
GPIO9	L	CF Power Control	CompactFlash Card Power Control
GPIO10	L	SM Power Control	SmartMedia Card Power Control
GPIO11	L	SD Power Control	SD/MMC Card Power Control

NAME	ACTIVE LEVEL	SYMBOL	DESCRIPTION AND NOTE
GPIO12	H	MS/MSPro Activity	Memory Stick(/Pro) Activity Indicator
GPIO13	H	CF Activity	CompactFlash Activity Indicator
GPIO14	H	SM/XDActivity	SmartMedia/XD Activity Indicator
GPIO15	H	SD/MMC Activity	SD/MMC Activity Indicator

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 any pin, with respect to Ground 5.5V

Negative Voltage on any pin, with respect to Ground ..... -0.3V

Maximum V_{DD}, V_{DDP} ..... +2.5V

Maximum V_{DDIO}, V_{DDA} ..... +4.0V

* 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.

Notes:

- 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.
- The name “VDD” is the same as VDDCORE

7.2 DC Electrical Characteristics

(T_A = 0°C - 70°C, V_{DDIO}, V_{DDA} = *+3.3 V* ± 10%, V_{DD}, V_{DDP} = *+1.8 V* ± 10%,)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
I Type Input Buffer						
Low Input Level	V_{ILI}			0.8	V	TTL Levels
High Input Level	V_{IHI}	2.0			V	
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	

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
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	uA	V_{IN} = 0
High Input Leakage	I_{IH}	-10		+10	uA	V_{IN} = V_{DDIO}
O8 Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 8 mA @ V_{DDIO}= 3.3V
High Output Level	V_{OH}	2.4			V	I_{OH} = -4mA @ V_{DDIO}= 3.3V
Output Leakage	I_{OL}	-10		+10	uA	V_{IN} = 0 to V_{DDIO} **(Note 7.1)**
I/O8 Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 8 mA @ V_{DDIO}= 3.3V
HIGH OUTPUT LEVEL	V_{OH}	2.4			V	I_{OH} = -4 mA @ V_{DDIO}= 3.3V
Output Leakage	I_{OL}	-10		+10	µA	V_{IN} = 0 to V_{DDIO} **(Note 7.1)**
I/O12 Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 12 mA @ V_{DDIO}= 3.3V
High Output Level	V_{OH}	2.4			V	I_{OH} = -6mA @ V_{DDIO}= 3.3V
Output Leakage	I_{OL}	-10		+10	µA	V_{IN} = 0 to V_{DDIO} **(Note 7.1)**

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
I/O24 Type Buffer						
Low Output Level	V_{OL}			0.4	V	I_{OL} = 24 mA @ V_{DDIO}= 3.3V
High Output Level	V_{OH}	2.4			V	I_{OH} = -12 mA @ V_{DDIO}= 3.3V
Output Leakage	I_{OL}	-10		+10	µA	V_{IN} = 0 to V_{DDIO} **(Note 7.1)**
IO-U						
Supply Current Unconfigured	I_{CCINIT}		45 10	60 20	mA mA	@ V_{DD}, V_{DDP} = 1.8V @ V_{DDIO}, V_{DDA} = 3.3V
Supply Current Active (Full Speed)	I_{CC}		35 15	60 30	mA mA	@ V_{DD}, V_{DDP} = 1.8V @ V_{DDIO}, V_{DDA} = 3.3V
Supply Current Active (High Speed)	I_{CC}		45 15	70 30	mA mA	@ V_{DD}, V_{DDP} = 1.8V @ V_{DDIO}, V_{DDA} = 3.3V
Supply Current Standby	I_{CSBY}		160 215	180 240	µA µA	@ V_{DD}, V_{DDP} = 1.8V @ V_{DDIO}, V_{DDA} = 3.3V

Note 7.1 Output leakage is measured with the current pins in high impedance.

CAPACITANCE T_A = 25°C; fc = 1MHz; V_{DD}, V_{DDP} = *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

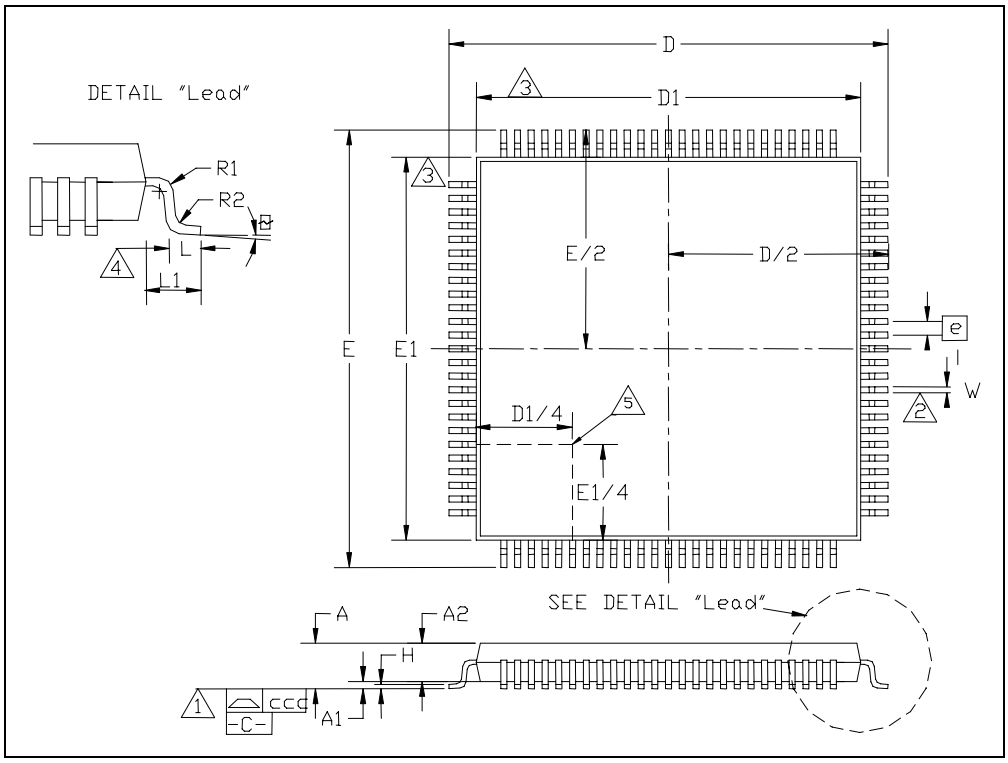


Figure 8.1 - 128 Pin TQFP Package

Table 8.1 - 128 Pin TQFP 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
θ	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.
3) Package body dimensions D1 and E1 do not include the mold protrusion.
   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.