

# USB to ATA/ATAPI/SD/MMC Interface Controller

## 1 General Description

This chip provides a high-performance interface to bridge USB and ATA/ATAPI/SD/MMC compliance device, therefore, it could be used to connect IDE hard disk, CD-ROM, CD-RW, Compact Flash card, MMC or SD memory card. It provides a flexible and low cost single chip solution for applications intended to utilize the convenience of USB. The maximum supported serial clock in SD/MMC interface is 12MHz and the supported block length is 2048 bytes. The external serial EEPROM gives users the possibility to customize their USB identity, i.e., the user could modify the vendor ID and product ID for various version of products and stores them in the external EEPROM.

## 2 Features

USB 1.1 compatible.

Support ATA/ATAPI, PIO mode

SD memory card specification 1.0 compatible.

MMC memory card specification 2.1.1 compatible.

SD/MMC serial clock rate is up to 12MHz.

Built-in FIFO for upstream and downstream data transfer.

Pin selectable bus-power or self-power.

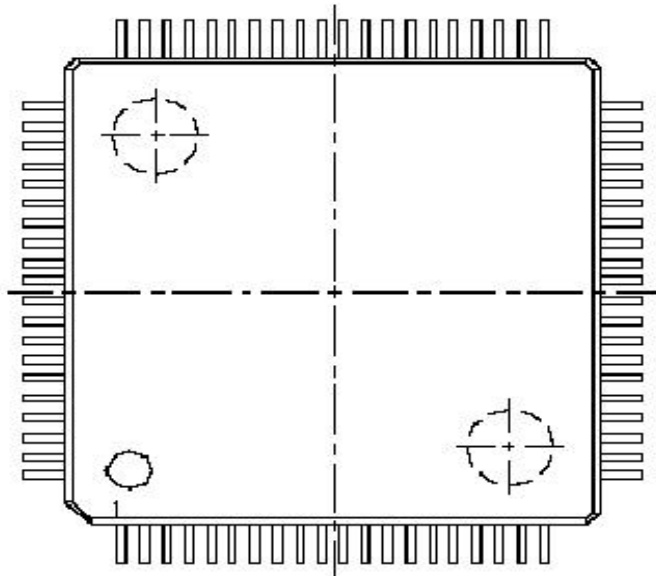
Eight user-defined general purpose IO.

Drivers support Microsoft Windows 98/Windows 2000/Mac

Single 3.3V operation in 80-pin LQFP package.

## 3. Pin Assignment

### 3.1 LQFP80 package



## HE11020F

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Pin#	Pin Name	Type	Drive	Special	Description
1	VSS	P	-	-	3.3V digital power ground
2	RSTN	DI		ST, PU	Bridge reset (internal pull-up)
3	TEST	DI		ST, PD	Test pin
4	SELPWR	DI		ST, PD	Power select pin; 0: Bus power 1: self power
5	GPIO0	DIO	8mA	ST, SR	General purpose input/output
6	GPIO1	DIO	8mA	ST, SR	General purpose input/output
7	GPIO2	DIO	8mA	ST, SR	General purpose input/output
8	GPIO3	DIO	8mA	ST, SR	General purpose input/output; Input also used as USB wakeup
9	ATANIOR	DO	8mA	SR	ATAPI I/O read signal, active low
10	NC	-	-	-	No connected
11	NC	-	-	-	No connected
12	ATANIOW	DO	8mA	SR	ATAPI I/O write signal, active low
13	ATADD3	DIO	8mA	TTL, SR	ATA data bit3
14	ATADD11	DIO	8mA	TTL, SR	ATA data bit11
15	ATADD4	DIO	8mA	TTL, SR	ATA data bit4
16	ATADD12	DIO	8mA	TTL, SR	ATA data bit12
17	ATADD5	DIO	8mA	TTL, SR	ATA data bit5
18	ATADD13	DIO	8mA	TTL, SR	ATA data bit13
19	ATADD6	DIO	8mA	TTL, SR	ATA data bit6
20	VSS	P	-	-	3.3V digital power ground
21	NC	-	-	-	No connected
22	VDD	P	-	-	3.3V digital power supply
23	XVDD	P	-	-	Oscillator power supply
24	XIN	I	-	-	Crystal input or oscillator input
25	XOUT	O	-	-	Crystal input or no connection
26	XVSS	P	-	-	Oscillator power ground
27	ATADD14	DIO	8mA	TTL, SR	ATA data bit14
28	ATADD7	DIO	8mA	TTL, SR	ATA data bit7
29	VSS	P	-	-	3.3V digital power ground
30	ATADD15	DIO	8mA	TTL, SR	ATA data bit 15
31	NC	-	-	-	No connected
32	ATADD0	DIO	8mA	TTL, SR	ATA data bit 0
33	ATADD1	DIO	8mA	TTL, SR	ATA data bit 1
34	ATADD8	DIO	8mA	TTL, SR	ATA data bit 8
35	ATADD2	DIO	8mA	TTL, SR	ATA data bit 2
36	ATADD9	DIO	8mA	TTL, SR	ATA data bit 9
37	ATADD10	DIO	8mA	TTL, SR	ATA data bit 10
38	ATACS0	DO	8mA	SR	ATAPI chip select 0
39	VDD	P	-	-	3.3V digital power supply
40	NC	-	-	-	No connected
41	VSS	P	-	-	3.3V digital power ground
42	ATACS1	DO	8mA	SR	ATAPI chip select 1
43	ATADA2	DO	8mA	SR	ATAPI device address 2
44	ATADA1	DO	8mA	SR	ATAPI device address 1
45	ATADA0	DO	8mA	SR	ATAPI device address 0
46	ATARSTN	DO	8mA	TTL, ST	ATA reset, active low
47	ATAIRDY	DI	-	TTL, ST	ATAPI data ready signal, active high
48	ATAINTR	DI	-	TTL, ST	ATA interrupt request
49	VDD	P	-	-	3.3V digital power supply
50	ROMDO	DI	-	ST	Serial data from external EEPROM
51	NC	-	-	-	No connected
52	NC	-	-	-	No connected
53	ROMSK	DO	4mA	SR	Clock for external serial EEPROM
54	ROMCS	DO	4mA	SR,	Chip select for external EEPROM
55	SDDIO0	DIO	8mA	SR, ST	SD/MMC data 0

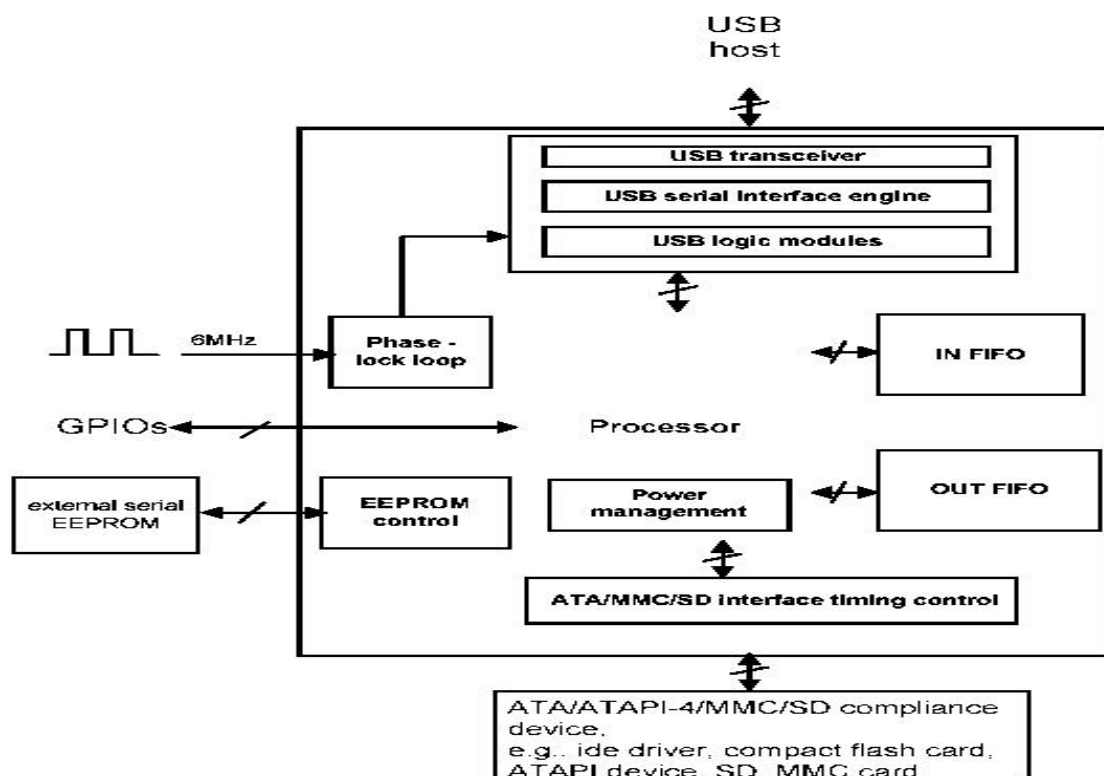
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56	SDDIO1/ROMDI	DIO	8mA	SR, ST	SD data 1/serial data to external EEPROM
57	SDDIO2	DIO	8mA	SR, ST	SD data 2
58	SDDIO3	DIO	8mA	SR, ST	SD data 3
59	SDCMD	DIO	8mA	SR, ST	SD/MMC command
60	VSS	P	-	-	3.3V digital power ground
61	VDD	P	-	-	3.3V digital power supply
62	SDCLK	DO	8mA	SR	SD/MMC bus clock
63	PWRSW	DO	8mA	SR	Power down control
64	GPIO4	DIO	8mA	ST, SR	General purpose input/output
65	GPIO5	DIO	8mA	ST, SR	General purpose input/output
66	GPIO6	DIO	8mA	ST, SR	General purpose input/output; for SD, it is the write-protect pin
67	GPIO7	DIO	8mA	ST, SR	General purpose in/output; for SD, it is the card-detect pin
68	VSS	P	-	-	3.3V digital power ground
69	TAVDD	P	-	-	USB transceiver power supply
70	DPLUS	AIO	-	-	USB D+ signal
71	NC	-	-	-	No connected
72	NC	-	-	-	No connected
73	NC	-	-	-	No connected
74	DMINUS	AIO	-	-	USB D- signal
75	TAVSS	P	-	-	USB transceiver power ground
76	AVSS	P	-	-	On-chip PLL power ground
77	AVDD	P	-	-	On-chip PLL power supply
78	VDD	P	-	-	3.3V digital power supply
79	NC	-	-	-	No connected
80	NC	-	-	-	No connected

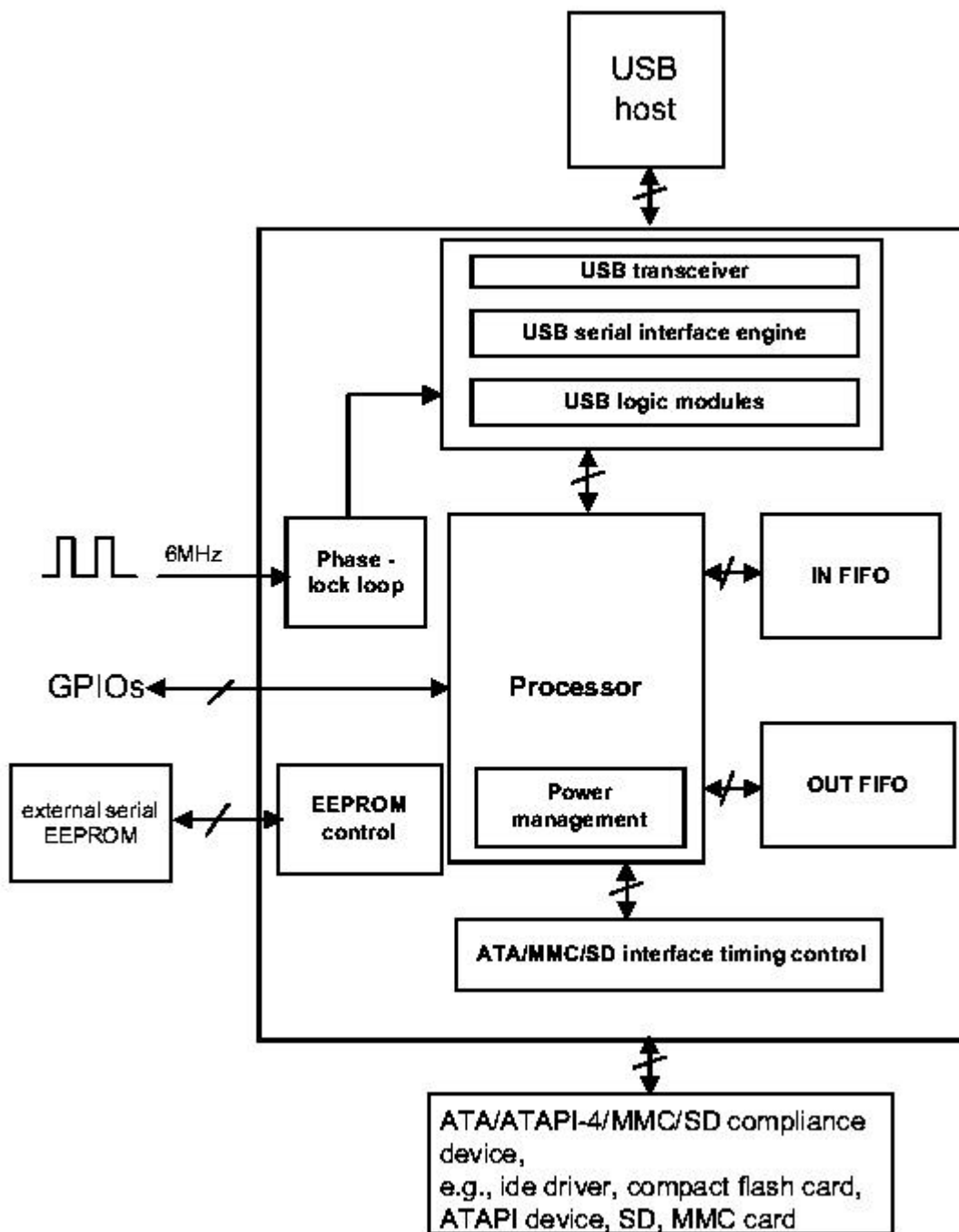
P: power pin; AI: analog input pin, AIO: analog input/output pin; DI: digital input pin; DO: digital output pin; DIO: digital input/output pin.

TTL: TTL compatible input pin; ST: schmit trigger pad, PD: pull down; PU: pull up; SR: slew rate control.

### 4. Block Diagram



4. Block Diagram



## 5. Operating Description

### 5.1 USB Descriptor

This bridge supports one device descriptor with one configuration and one interface. There are three endpoints within the interface. Endpoint 0 is the default control endpoint. Endpoint 1 is the Bulk-in endpoint ( data from device to host ) and endpoint 2 is the Bulk-out endpoint ( data from host to device ).

#### 5.1.1 Device Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	12H	Size of this descriptor in byte
1	bDescriptor Type	Byte	01H	DEVICE descriptor type
2	bcdUSB	Word	0110H	USB specification version 1.1
4	bdevice Class	Byte	00H	Interface specific
5	bdevice SubClass	Byte	00H	Interface specific
6	bdevice Protocol	Byte	00H	Interface specific
7	bmax Packet Size	Byte	40H	Maximum packet size for endpoint zero is 64
8	idVendor	Word	Note 7 . 1 . 1	Vendor ID
10	idProduct	Word	Note 7 . 1 . 1	Product ID
12	bdc Device	Word	0100H	Device release 1.0
14	imanufacture	Byte	00H	Null
15	iproduct	Byte	00H	Null
16	Iserial Number	Byte	00H	Null
17	bnum Configurations	Byte	01H	One possible configuration

Note 7 . 1 . 1 : These values depends on the external EEPROM and the GPIO configuration.

#### 5.1.2 Configuration Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	09H	Size of this descriptor in bytes
1	bDescriptor	Byte	02H	CONFIGURATION descriptor type
2	bTotalLength	Word	0020H	
4	bNumInterface	Byte	01H	The bridge has one interface
5	bConfiguration Value	Byte	01H	
6	iConfiguration	Byte	00H	Null
7	bmAttributes	Byte	E0H / A0H	Bus / self powered ; depends on PWRSEL. For Bus power : A0H, For Self power: E0H
8	MaxPower	Byte	32H / FAH	Depends on PWRSEL, for Bus power : FAH, for self power : 32H

### 5.1.3 Interface Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	09H	Size of this descriptor in byte
1	bDescriptor	Byte	04H	INTERFACE descriptor type
2	bInterface Number	Byte	00H	Interface 0
3	bAlternate Setting	Byte	00H	
4	bNum Endpoint	Byte	02H	Support endpoint 0 , 1 , 2
5	bInterface Class	Byte	FFH	Vendor specific
6	bInterface SubClass	Byte	FFH	Vendor specific
7	bInterface Protocol	Byte	FFH	Vendor specific
8	iInterface	Byte	00H	

#### 5.1.3.1 Bulk-in Endpoint Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	07H	Size of this descriptor in byte
1	bDescriptor	Byte	05H	ENDPOINT Descriptor Type
2	bEndpoint Address	Byte	81H	In Endpoint 1
3	bmAttributes	Byte	02H	This is a Bulk endpoint
4	wMax Packet Size	Word	0040H	Maximum packet size is 64 bytes
6	bInterval	Byte	00H	Does not apply to bulk endpoints

#### 5.1.3.2 Bulk-out Endpoint Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	07H	Size of this descriptor in byte
1	bDescriptor	Byte	05H	ENDPOINT Descriptor Type
2	bEndpoint Address	Byte	02H	Out Endpoint 2
3	bmAttributes	Byte	02H	This is a Bulk endpoint
4	wMax Packet Size	Word	0040H	Maximum packet size is 64 bytes
6	bInterval	Byte	00H	Does not apply to bulk endpoints

## 5.2 Requests

In addition to the standard USB device request, four vendor specific requests are supported to facilitate the data transfer to or from the external device.

## 5.2.1 Standard USB Device Request

<b>bmRequest Type</b>	<b>bRequest</b>	<b>wValue</b>	<b>wIndex</b>	<b>wLength</b>	<b>Data</b>
0000000B 00000010B	CLEAR_FEATURE	Feature Selector	Zero Endpoint	Zero	None
1000000B	GET_CONFIGURATION	Zero	Zero	One	Configuration Value
1000000B	GET_DESCRIPTOR	Descriptor Type & Descriptor Index	Zero	Descriptor Length	Descriptor
1000001B	GET_INTERFACE	Zero	Interface	One	Alternate Interface
1000000B 1000001B 10000010B	GET_STATUS	Zero	Zero Interface Endpoint	Two	Device Status Interface Status Endpoint Status
0000000B	SET_ADDRESS	Device Address	Zero	Zero	None
0000000B	SET_CONFIGURATION	Configuration Value	Zero	Zero	None
0000000B 00000010B	SET_FEATURE	Feature Selector	Zero Endpoint	Zero	None
0000001B	SET_INTERFACE	Alternate Setting	Interface	Zero	None

### 5.2.1.1 Standard Request Codes

<b>bRequest</b>	<b>Value</b>	<b>bRequest</b>	<b>Value</b>
GET_STATUS	0	GET_CONFIGURATION	8
CLEAR_FEATURE	1	SET_CONFIGURATION	9
SET_FEATURE	3	GET_INTERFACE	10
SET_ADDRESS	5	SET_INTERFACE	11
GET_DESCRIPTOR	6		

### 5.2.1.2 Descriptor Types

<b>Descriptor Types</b>	<b>Value</b>
DEVICE	1
CONFIGURATION	2
INTERFACE	4
ENDPOINT	5

### 5.2.1.3 Feature Selectors

<b>Feature Selector</b>	<b>Recipient</b>	<b>Value</b>
DEVICE_REMOTE_WAKEUP	Device	1
ENDPOINT_HALT	Endpoint	0

## 5.2.2 Vendor Specific Request

This bridge provides a set of vendor specific requests to control the function of the bridge and the external ATA / ATAPI / SD / MMC device through the control transfer.

### 5.2.2.1 Vendor Specific Request

bmRequest Type	bRequest	wValue	wIndex	wLength	Data
11000001B	READ_BRIDGE	Address	Zero	Length	Bridge register value
11000001B	READ_DEVICE	Address	Zero	Length	Device register value
01000001B	WRITE_BRIDGE	Address	Zero	Length	Bridge register value
01000001B	WRITE_DEVICE	Address	Zero	Length	Device register value

### 5.2.2.2 Vendor Specific Request Codes

bRequest	Value
READ_BRIDGE	00H
WRITE_BRIDGE	08H
READ_DEVICE	01H
WRITE_DEVICE	09H

### 5.2.2.3 Implemented Requests

bmRequest Type	brequest	wValue	wIndex	wLength	Data
00000000B	01H	0001H	0000H	0000H	None
00000010B	01H	0000H	0081H 0002H	000H	None
10000000B	08H	0000H	0000H	0001H	00H 01H
10000000B	06H	0100H	0000H	Descriptor Length	Device Descriptor
10000000B	06H	0200H	0000H	Descriptor Length	Configuration Descriptor
10000001B	0AH	0000H	0000H	0001H	00H
10000000B	00H	0000H	0000H	0002H	0000H 0001H 0002H 0003H
10000001B	00H	0000H	0000H	0002H	0000H
10000010B	00H	0000H	0000H 0080H 0081H 0002H	0002H	0000H 0001H
00000000B	05H	Device Address	0000H	0000H	None
00000000B	09H	0000H 0001H	0000H	0000H	None
00000000B	03H	0001H	0000H	0000H	None
00000010B	03H	0000H	0081H 0002H	0000H	None
00000001B	0BH	0000H	0000H	0000H	None
11000001B	00H	Address	0000H	Length	Content of bridge Register
11000001B	01H	Address	0000H	Length	Content of device Register
01000001B	08H	Address	0000H	Length	Content of bridge Register
01000001B	09H	Address	0000H	Length	Content of device Register



### 5.2.3 USB Vendor Request

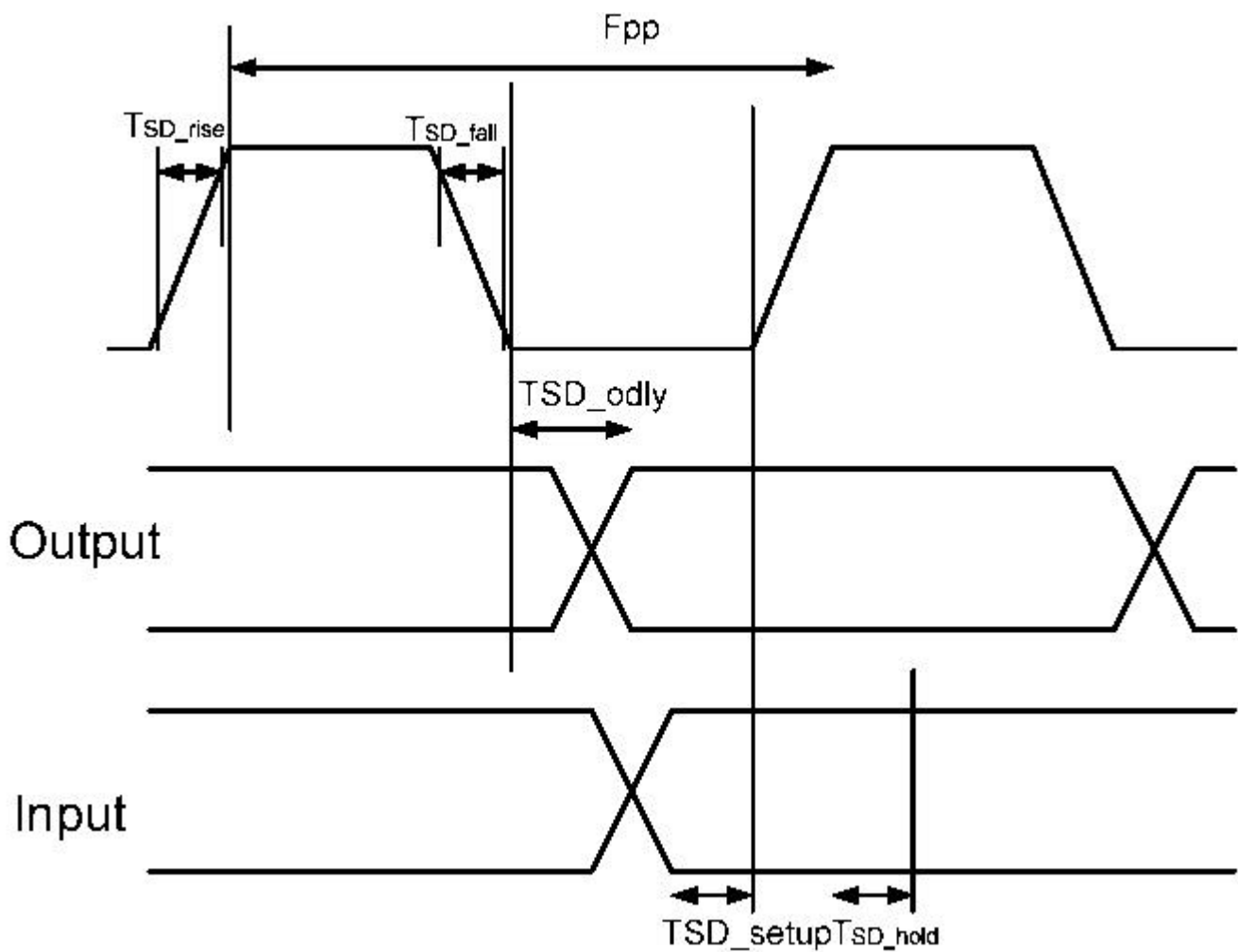
Three vendor requests, WRITE\_BRIDGE (), READ\_BRIDGE () and WRITE\_DEVICE (), are supported to accelerate the device operation. The usage of these vendor requests is detailed in the next section.

## 6. Timing

### 6.1 ATA / ATAPI Interface

Please reference ATA / ATAPI-4 specification.

### 6.2 SD / MMC Interface



Parameter	Symbol	Min.	Max.	Unit	Remark
Clock frequency ( data transfer mode )	Fpp	200K	12M	Hz	
Clock frequency ( identification mode )	FOD	94K	400K	Hz	
Clock rise time	TSD_rise	T.B.D.	T.B.D.	ns	
Clock fall time	TSD_fall	T.B.D.	T.B.D.	ns	
Inputs SDCMD, SDDIO ( reference to rising edge of SDCLK )					
Input set-up time	TSD_setup	T.B.D.	T.B.D.	ns	
Input hold time	TSD_hold	T.B.D.	T.B.D.	ns	
Outputs SDCMD, SDDIO ( reference to falling edge of SDCLK )					
Output delay time	TSD_odly	T.B.D.	T.B.D.	Ns	

## 7. Electrical Characteristics

### 7.1 Absolute maximum rating

symbol	parameter	value	unit
DVmin	min digital supply voltage	DGND – 0.3	V
DVmax	max digital supply voltage	DGND + 4.6	V
AVmin	min analog supply voltage	AGND – 0.3	V
AVmax	max analog supply voltage	AGND + 4.6	V
DVinout	Voltage on any digital input or output pin	DGND – 0.3 to 5.5	V
Avinout	Voltage on any analog input or output pin	AGND – 0.3 to Avdd + 0.3	V
T <sub>A</sub>	Storage temperature range	-40 to + 125	C
ESD ( HBM )	ESD human body mode	2000	V
ESD ( MM )	ESD machine mode	200	V
I <sub>off</sub>	Leakage current	10	uA
I <sub>latch</sub>	Minimum latch up current	100	mA

### 7.2 Opoeration conditions

symbol	parameter	value	unit
DVdd	digital supply voltage	+ 3 to + 3.6	V
AVdd	analog supply voltage	+ 3 to + 3.6	V
T <sub>A</sub>	operating temperature range	0 to 70	C

### 7.3 AC electrical characteristics

symbol	parameter	value	unit
CLKin	System clock input to PLL	6 ( typ )	MHz
	CLKin duty cycle	50 ± 22	%
Fsk	SK pin clock frequency	200	kHz
Tsks	Min setup time for DR to SK falling edge	20	ns
Tskh	Min hole time for DR to SK falling edge	20	ns

### 7.4 DC electrical characteristics

Symbol	Parameter	Value	Unit
VIH	High level input current	0.7 * DVdd	V
VIL	Low level input current	0.3 * DVdd	V
VOH	High level output current	0.7 * DVdd	V
VOL	Low level output current	0.3 * DVdd	V