USB to ATA/ATAPI Interface Controller

1 General Description

SN11010 provides a high-performance interface to bridge USB and ATA/ATAPI compliance device. By providing a flexible and low cost single chip solution for applications intended to utilize the convenience of USB, it could be used to connect IDE hard disk, CD-ROM, CD-RW, or Compact Flash card. The external serial EEPROM interface gives users the flexibility to customize USB vendor ID and product ID for various version of products. With Sonix drivers, product with SN11010 can performs like a removable disk to Windows or Mac OS.

2 Features

USB 1.1 compatible.

Support ATA/ATAPI, PIO mode 0.

Built-in FIFO for upstream and downstream data transfer.

Pin selectable bus-power or self-power.

Three user-defined general purpose IO.

Drivers support Microsoft Win 98/Win Me/Win 2000/Mac OS8.6 ~ 9.x

Single 3.3V operation in 48-pin LQFP package.

3 Algorithm Description

N.A.

4 Architecture Description

N.A.

5 Pin Assignment

5.1 LQFP48 package
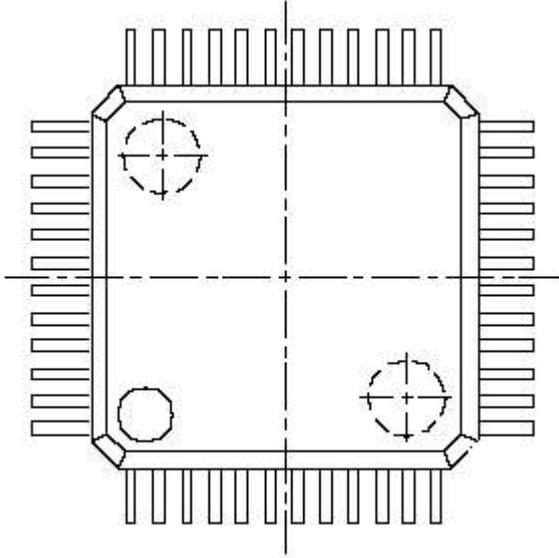
Pin#	Pin Name	Type	Drive	Special	Description
1	TEST	DI		ST, PD	Power select pin; 1:test mode 0: normal mode
2	CD	DIO	8mA	ST, SR	Card detector; active low
3	LED	DIO	8mA	ST, SR	Led drive pin;
4	ATANIOR	DO	8mA	SR	ATAPI I/O read signal, active low
5	ATANIOW	DO	8mA	SR	ATAPI I/O write signal, active low
6	ATADD3	DIO	8mA	TTL, SR	ATA data bit 3
7	ATADD11	DIO	8mA	TTL, SR	ATA data bit 11
8	ATADD4	DIO	8mA	TTL, SR	ATA data bit 4
9	ATADD12	DIO	8mA	TTL, SR	ATA data bit 12
10	ATADD5	DIO	8mA	TTL, SR	ATA data bit 5
11	ATADD13	DIO	8mA	TTL, SR	ATA data bit 13
12	ATADD6	DIO	8mA	TTL, SR	ATA data bit 6
13	XVDD	P	-	-	Oscillator power supply
14	XIN	I	-	-	Crystal input or oscillator input

15	XOUT	O	-	-	Crystal output or no connection
16	XVSS	P	-	-	Oscillator power ground
17	ATADD14	DIO	8mA	TTL, SR	ATA data bit 14
18	ATADD7	DIO	8mA	TTL, SR	ATA data bit 7
19	ATADD15	DIO	8mA	TTL, SR	ATA data bit 15
20	ATADD0	DIO	8mA	TTL, SR	ATA data bit 0
21	ATADD1	DIO	8mA	TTL, SR	ATA data bit 1
22	ATADD8	DIO	8mA	TTL, SR	ATA data bit 8
23	ATADD2	DIO	8mA	TTL, SR	ATA data bit 2
24	ATADD9	DIO	8mA	TTL, SR	ATA data bit 9
25	ATADD10	DIO	8mA	TTL, SR	ATA data bit 10
26	ATACS0	DO	8mA	SR	ATAPI chip select 0
27	ATACS1	DO	8mA	SR	ATAPI chip select 1
28	ATADA2	DO	8mA	SR	ATAPI device address 2
29	ATADA1	DO	8mA	SR	ATAPI device address 1
30	ATADA0	DO	8mA	SR	ATAPI device address 0
31	ATARSTN	DO	8mA	SR	ATA reset, active low
32	ATAIRDY	DI	-	TTL, ST	ATAPI data ready signal, active high
33	VDD	P	-	-	3.3V digital power supply
34	ROMDO	DI	-	ST	Serial data from external EEPROM
35	ROMSK	DO	4mA	SR	Clock for external serial EEPROM
36	ROMCS	DO	4mA	SR	Chip select for external EEPROM
37	ROMDI	DIO	8mA	SR, ST	Serial data to external EEPROM
38	PWRSW	DO	8mA	SR	Power down control
39	VSS	P	-	-	3.3V digital power ground
40	TAVDD	P	-	-	USB transceiver power supply
41	DPLUS	AIO	-	-	USB D+ signal
42	DMINUS	AIO	-	-	USB D- signal
43	TAVSS	P	-	-	USB transceiver power ground
44	AVSS	P	-	-	On-chip PLL power ground

45	AVDD	P	-	-	On-chip PLL power supply
46	VDD	P	-	-	3.3V digital power supply
47	VSS	P	-	-	3.3V digital power ground
48	RSTN	DI		ST, PU	Bridge reset (internal pull-up)

☐ 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.

6 Block Diagram

```
                              ┌─────────────┐
                              │    USB      │
                              │   host      │
                              └─────────────┘
                                    ↕

        ┌──────────────────────────────────────────────────┐
        │              ┌────────────────────────────┐        │
        │              │      USB transceiver        │        │
        │              ├────────────────────────────┤        │
        │              │  USB serial interface engine│        │
        │              ├────────────────────────────┤        │
        │              │     USB logic modules       │        │
        │              └────────────────────────────┘        │
        │                           ↕                         │
        │   ┌────────┐   ┌──────────────────┐   ┌──────────┐ │
6Mhz    │   │ phase  │   │                  │   │          │ │
clock───┼──▶│ lock   │   │                  │◀─▶│ IN_FIFO  │ │
        │   │ loop   │   │                  │   │          │ │
        │   └────────┘   │                  │   └──────────┘ │
        │                │   processor      │                │
GPIOs◀──┼────────────────▶                  │   ┌──────────┐ │
        │                │                  │◀─▶│ out_FIFO │ │
        │   ┌────────┐   │  power           │   │          │ │
┌──────┐│   │EEPROM  │   │  management      │   └──────────┘ │
│ext.  ││◀▶│control │   │                  │                │
│serial││   └────────┘   └──────────────────┘                │
│EEPROM││                         ↕                          │
└──────┘│              ┌────────────────────────────┐        │
        │              │ IDE interface timing control│        │
        │              └────────────────────────────┘        │
        └──────────────────────────────────────────────────┘
                                  ↕
                    ┌──────────────────────────────┐
                    │ ATA/ATAPI compliance device,  │
                    │ e.g., ide driver, compact flash card, │
                    │ ATAPI device                  │
                    └──────────────────────────────┘
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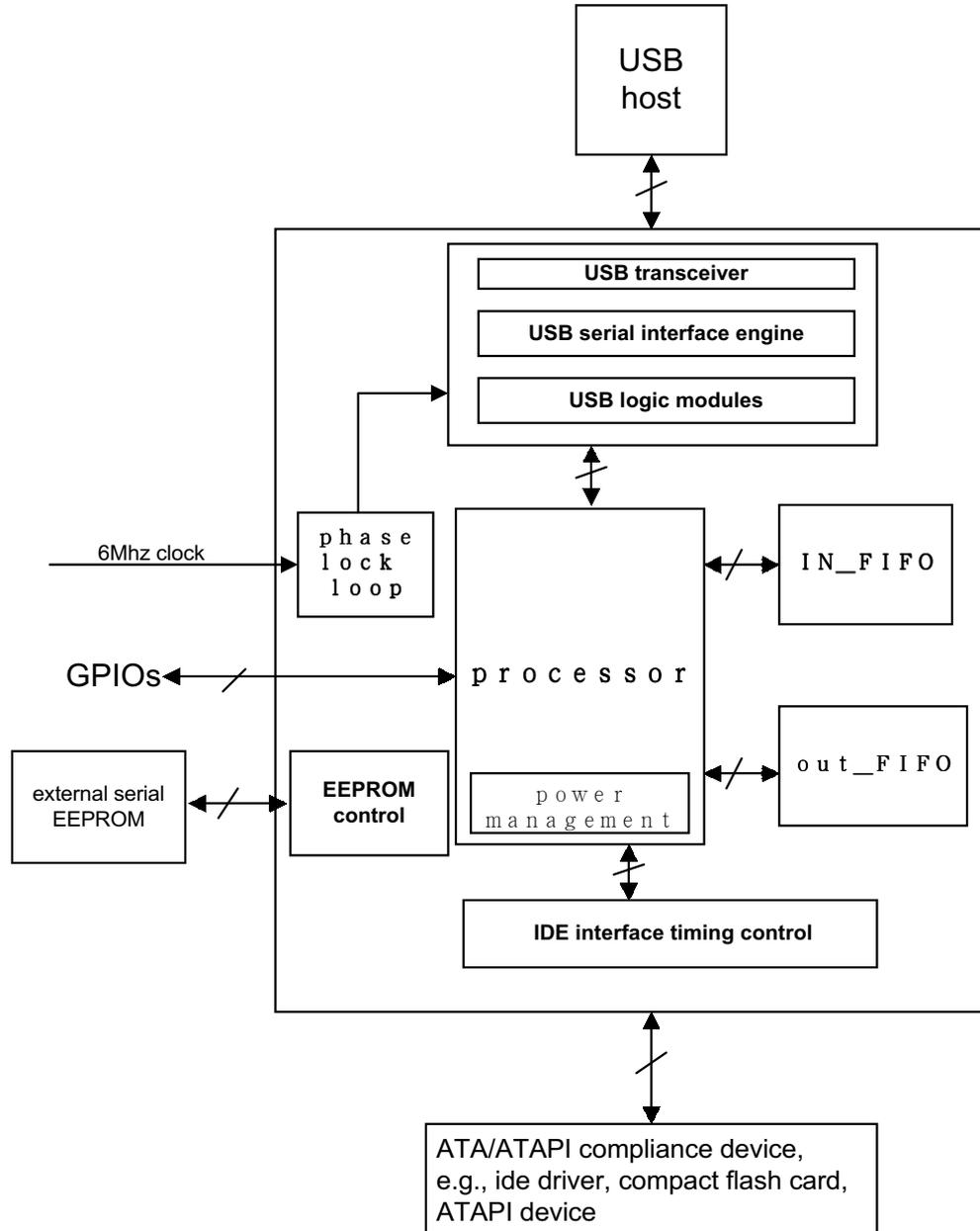
7 Operating Description

7.1 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).

7.1.1 Device Descriptor

Offset	Field	Size	Value	Descriptor
0	blength	Byte	12H	Size of this descriptor in byte
1	bdescriptorType	Byte	01H	DEVICE descriptor type
2	bcdUSB	Word	0110H	USB specification version 1.1
4	bdeviceClass	Byte	00H	Interface specific
5	bdeviceSubClass	Byte	00H	Interface specific
6	bdeviceProtocol	Byte	00H	Interface specific
7	bmaxPacketSize	Byte	40H	Maximum packet size for endpoint zero is 64
8	idVendor	Word	Note7.1.1	Vendor ID
10	idProduct	Word	Note7.1.1	Product ID
12	bcdDevice	Word	0100H	Device release 1.0
14	imanufacture	Byte	00H	Null
15	iproduct	Byte	00H	Null
16	iserialNumber	Byte	00H	Null
17	bnumConfigurations	Byte	01H	One possible configuration

☐ Note7.1.1: These values depends on the external EEPROM configuration

7.1.2 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	bConfigurationValue	Byte	01H	
6	iConfiguration	Byte	00H	Null
7	bmAttributes	Byte	E0H/	Bus/self powered; depends on PWRSEL. For Bus power:

			A0H	A0H, For Self power: E0H
8	MaxPower	Byte	32H/ FAH	Depends on PWRSEL, for Bus power: FAH, for self power: 32H

7.1.3 Interface Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	09H	Size of this descriptor in bytes
1	bDescriptor	Byte	04H	INTERFACE descriptor type
2	bInterfaceNumber	Byte	00H	Interface 0
3	bAlternateSetting	Byte	00H	
4	bNumEndpoint	Byte	02H	Support endpoint 0, 1, 2
5	bInterfaceClass	Byte	FFH	Vendor specific
6	bInterfaceSubClass	Byte	FFH	Vendor specific ass
7	bInterfaceProtocol	Byte	FFH	Vendor specific
8	iInterface	Byte	00H	

7.1.3.1   Bulk-in Endpoint Descriptor

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

7.1.3.2   Bulk-out Endpoint Descriptor

Offset	Field	Size	Value	Descriptor
0	bLength	Byte	07H	Size of this descriptor in bytes
1	bDescriptor	Byte	05H	ENDPOINT Descriptor Type
2	BEndpointAddress	Byte	02H	out Endpoint 2
3	BmAttributes	Byte	02H	This is a Bulk endpoint
4	WMaxPacketSize	Word	0040H	Maximum packet size is 64 bytes
6	BInterval	Byte	00H	Does not apply to bulk endpoints

7.2   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.

7.2.1 Standard USB Device Request

bmRequest Type	Brequest	wValue	wIndex	wLength	Data
00000000B 00000010B	CLEAR_FEATURE	Feature Selector	Zero Endpoint	Zero	None
10000000B	GET_CONFIGURATION	Zero	Zero	One	Configuration Value
10000000B	GET_DESCRIPTOR	Descriptor Type & Descriptor Index	Zero	Descriptor Length	Descriptor
10000001B	GET_INTERFACE	Zero	Interface	One	Alternate Interface
10000000B 10000001B 10000010B	GET_STATUS	Zero	Zero Interface Endpoint	Two	Device Status Interface Status Endpoint Status
00000000B	SET_ADDRESS	Device Address	Zero	Zero	None
00000000B	SET_CONFIGURATION	Configuration Value	Zero	Zero	None
00000000B 00000010B	SET_FEATURE	Feature Selector	Zero Endpoint	Zero	None
00000001B	SET_INTERFACE	Alternate Setting	Interface	Zero	None

7.2.1.1   Standard Request Codes

bRequest	Value	bRequest	Value
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		

7.2.1.2   Descriptor Types

Descriptor Types	Value
DEVICE	1
CONFIGURATION	2
INTERFACE	4
ENDPOINT	5

7.2.1.3   Feature Selectors

Feature Selector	Recipient	Value
DEVICE_REMOTE_WAKEUP	Device	1
ENDPOINT_HALT	Endpoint	0

7.2.2 Vendor Specific Request

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

7.2.2.1   Vendor Specific Request

bmRequestTy	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

7.2.2.2   Vendor Specific Request Codes

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

7.2.2.3 Implemented Requests

bmRequestType	bRequest	wValue	wIndex	wLength	Data
00000000B	01H	0001H	0000H	0000H	None
00000010B	01H	0000H	0081H 0002H	0000H	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

7.3 ATA/ATAPI Module Functional Description

Please refer to application_note.doc

7.3.1 USB Vendor Request

Three vendor requests, WRITE_BRIDGE(), READ_BRIDGE() and WRITE_DEVICE(), are supported to accelerate the device operation.

7.4 Register Map

Register name	Address offset
BCTL1	0x00
BCTL2	0x01
GPIO1	0x02
WPS	0x04
DRQSEC	0x05
READNO1	0x06
READNO2	0x07
FEA	0x09
SEC	0x0A
SEN	0x0B
CYL	0x0C
CYH	0x0D
DEV	0x0E
CMD	0x0F
RWEN	0x10
ATACTL	0x11
ASTATUS	0x16
BRGSTA	0x17

8 Electrical Characteristics

8.1 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_A	storage temperature range	-40 to +125	C
ESD (HBM)	ESD human body mode	2000	V
ESD (MM)	ESD machine mode	200	V
I_{off}	Leakage current	10	uA
I_{latch}	Minimum latch up current	100	mA

8.2 Operation conditions

symbol	parameter	value	unit
DVdd	digital supply voltage	+3 to +3.6	V
Avdd	analog supply voltage	+3 to +3.6	V
T_A	operating temperature range	0 to 70	C

8.3 AC electrical characteristics

symbol	parameter	value	unit
CLKin	system clock input to PLL	6 (typ)	MHz
	CLKin duty cycle	50 ± 2	%

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Fsk	SK pin clock frequency	200	kHz
Tsks	min setup time for DR to SK falling edge	20	ns
Tskh	min hold time for DR to SK falling edge	20	ns

8.4 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 voltage	0.7*DVdd	V
VOL	Low level output voltage	0.3*DVdd	V