HB286075A1, HB286060A1, HB286045A1, HB286030A1, HB286015A1

75 Mega Byte Flash ATA Card
60 Mega Byte Flash ATA Card
45 Mega Byte Flash ATA Card
30 Mega Byte Flash ATA Card
15 Mega Byte Flash ATA Card

HITACHI

ADE-203-623B (Z)
Rev. 2.0
Feb. 28, 1997

Description

HB286075A1, HB286060A1, HB286045A1, HB286030A1, HB286015A1 are Flash ATA card. This card complies with PC card ATA standard and is suitable for the usage of data storage memory medium for PC or any other electric equipment. This card is equipped with Hitachi 64 Mega bit Flash memory HN29W6411. This card is suitable for ISA (Industry Standard Architecture) bus interface standard ,and read/write unit is 1 sector (512 bytes) sequential access. By using this card it is possible to operate good performance for the system which have PC card slots.

Features

- PC card ATA standard specification
  - 68 pin two pieces connector and type II (5 mm)
- 5V single power supply operation
- ISA standard and Read/Write unit is 512 bytes (sector) sequential access
  - Sector Read/Write transfer rate: 8MB/sec burst
  - High reliability based on internal ECC (Error Correcting Code) function
- Card density is 75 Mega bytes maximum
  - This card is equipped Hitachi 64 Mega bit Flash memory (HN29W6411)
- Internal self-diagnostic program operates at V_{CC} power on

Hitachi semiconductor

- High reliability based on wear leveling function
- Data write endurance is 100,000 cycle (min) per logical sector.
- Data reliability is 1 error in 10^{14} bits read.
- Auto Sleep Function

Card Line Up

Type No.	Card density
HB286015A1	15 MB
HB286030A1	30 MB
HB286045A1	45 MB
HB286060A1	60 MB
HB286075A1	75 MB

Card Pin Assignment

	Memory card mode		I/O card mode			Memory card mode		I/O card mode	
Pin NO.	Signal name	I/O	Signal name	I/O	Pin NO.	Signal name	I/O	Signal name	I/O
1	GND	—	GND	—	35	GND	—	GND	—
2	D3	I/O	D3	I/O	36	-CD1	O	-CD1	O
3	D4	I/O	D4	I/O	37	D11	I/O	D11	I/O
4	D5	I/O	D5	I/O	38	D12	I/O	D12	I/O
5	D6	I/O	D6	I/O	39	D13	I/O	D13	I/O
6	D7	I/O	D7	I/O	40	D14	I/O	D14	I/O
7	-CE1	I	-CE1	I	41	D15	I/O	D15	I/O
8	A10	I	A10	I	42	-CE2	I	-CE2	I
9	-OE	I	-OE	I	43	VS1	O	VS1	O
10	—	—	—	—	44	RFU	—	-IORD	I
11	A9	I	A9	I	45	RFU	—	-IOWR	I
12	A8	I	A8	I	46	—	—	—	—
13	—	—	—	—	47	—	—	—	—
14	—	—	—	—	48	—	—	—	—
15	-WE	I	-WE	I	49	—	—	—	—
16	+READY	O	-IREQ	O	50	—	—	—	—
17	VCC	—	VCC	—	51	VCC	—	VCC	—
18	—	—	—	—	52	—	—	—	—
19	—	—	—	—	53	—	—	—	—
20	—	—	—	—	54	—	—	—	—

	Memory card mode		I/O card mode			Memory card mode		I/O card mode	
Pin NO.	Signal name	I/O	Signal name	I/O	Pin NO.	Signal name	I/O	Signal name	I/O
21	—	—	—	—	55	—	—	—	—
22	A7	I	A7	I	56	—	—	—	—
23	A6	I	A6	I	57	VS2	O	VS2	O
24	A5	I	A5	I	58	+RESET	I	+RESET	I
25	A4	I	A4	I	59	-WAIT	O	-WAIT	O
26	A3	I	A3	I	60	RFU	—	-INPACK	O
27	A2	I	A2	I	61	-REG	I	-REG	I
28	A1	I	A1	I	62	BVD2	O	-SPKR	O
29	A0	I	A0	I	63	BVD1	O	-STSCHG	O
30	D0	I/O	D0	I/O	64	D8	I/O	D8	I/O
31	D1	I/O	D1	I/O	65	D9	I/O	D9	I/O
32	D2	I/O	D2	I/O	66	D10	I/O	D10	I/O
33	+WP	O	-IOIS16	O	67	-CD2	O	-CD2	O
34	GND	—	GND	—	68	GND	—	GND	—

Card Pin Explanation

Address bus (A0 to A10: input): Address bus is A0 to A10. A0 is invalid in word mode. A10 is MSB and A0 is LSB.

Data bus (D0 to D15: input/output): Data bus is D0 to D15. D0 is the LSB of the Even Byte of the Word. D8 is the LSB of the Odd Byte of the Word.

Card enable (-CE1, -CE2: input): -CE1 and -CE2 are low active card select signals. Even addresses are controlled by -CE1 and odd addresses are by -CE2.

Output enable (-OE: input): -OE is used for the control of data read in Attribute area or Common memory Task File area.

Write enable (-WE: input): -WE is used for the control of data write in Attribute memory area or Common memory Task File area.

I/O read (-IORD: input): -IORD is used for control of read data in I/O Task File area. This card dose not respond to -IORD until I/O card interface setting up.

I/O write (-IOWR: input): -IOWR is used for control of data write in I/O Task File area. This card dose not respond to -IOWR until I/O card interface setting up.

Ready/Busy, Interrupt request (+READY, -IREQ: output): In I/O card mode, this signal is -IREQ pin. The signal of low level indicates that the card is requesting software service to host, and high level indicates that the card is not requesting. In memory card mode, the signal is +READY pin. +READY pin turns low level during the card internal initialization operation at V_{CC} applied or reset applied, so next access to the card should be after the signal turned high level.

Card detection (-CD1, -CD2: output): -CD1 and -CD2 are the card detection signals. -CD1 and -CD2 are connected to ground in this card, so HOST can detect that the card is inserted or not. These signal lines should be pulled up to V_{CC} through over 10kΩ resistance by the host interface.

Write protect, 16 bit I/O port (+WP, -IOIS16: output): In memory card mode, +WP is held low because this card dose not have write protect switch. In I/O card mode, -IOIS16 is asserted that a 16-bit or odd byte only operation can be performed at the addressed port.

Attribute memory area selection (-REG: input): -REG should be high level during common memory area accessing, and low level during Attribute area accessing. Attribute memory area is located only even address, so D0 to D7 are valid and D8 to D15 are invalid in the word access mode. Odd addresses are invalid in the byte access mode. The signal must also be asserted during I/O cycles when the I/O address is on the bus.

Battery voltage detection, Digital audio output (BVD2, -SPKR: output): In memory card mode, BVD2 outputs the battery voltage status in the card. This card has no battery, so this output is high level constantly. In I/O card mode, -SPKR is held High because this card dose not have digital audio output.

Reset (+RESET: input): By assertion of +RESET signal, all registers of this card are cleared and +READY signal turns to high level when the internal initialization is completed.

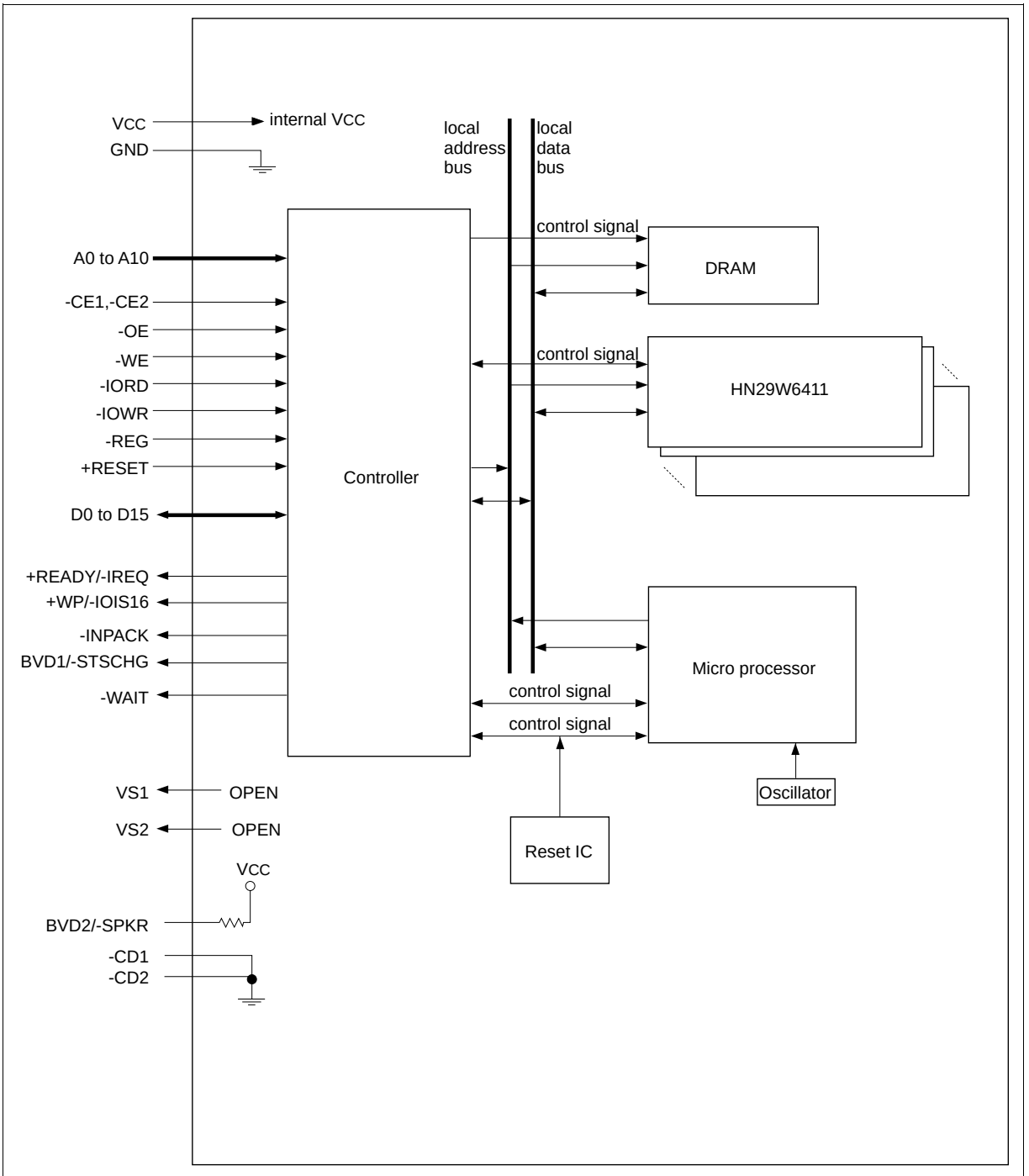
Wait (-WAIT: output): This signal outputs low level for delaying completion of memory access cycle or I/O access cycle.

Input acknowledge (-INPACK: output): This signal outputs low level when -CE and -IORD is low level and card I/O port is responding to address which on the address bus. This signal is used for the input data buffer control.

Battery voltage detection, Status change (BVD1, -STSCHG: output): In memory card mode, BVD1 outputs the battery voltage status in the card. This card has no battery, so this output is high level constantly. In I/O card mode, -STSCHG is asserted low to alert the host changes in the Ready/Busy states. Its use is controlled by configuration and status register.

V_{CC} voltage sense (VS1, VS2: output): This signals are intended to notify the socket of PC Card's CIS V_{CC} requirement. VS1 and VS2 are nonconnected in this card.

Card Block Diagram



Note: -CE2, -CE1, -OE, -WE, -IORD, -IOWR, -REG, +RESET are pulled up in card.

-CE2, -CE1, -OE, -WE, -IORD, -IOWR, -REG, +RESET pin are schmitt trigger type input buffer.

Card Function Explanation

Register construction

- Attribute region
  - — Configuration register
    - Configuration Option register
    - Configuration and Status register
    - Pin Replacement register
    - Socket and Copy register
  - — CIS (Card Information Structure)
- Task File region
  - — Data register
  - — Error register
  - — Feature register
  - — Sector Count register
  - — Sector Number register
  - — Cylinder Low register
  - — Cylinder High register
  - — Drive Head register
  - — Status register
  - — Alternate Status register
  - — Command register
  - — Device Control register
  - — Drive Address register

Host access specifications

1. Attribute access specifications

When CIS-ROM region or Configuration register region is accessed, read and write operations are executed under the condition of -REG = "L" as follows. That region can be accessed by Byte/Word/ Odd-byte modes which are defined by PC card standard specifications.

Attribute Read Access Mode

Mode	-REG	-CE2	-CE1	A0	-OE	-WE	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	High-Z	High-Z
Byte access (8-bit)	L	H	L	L	L	H	High-Z	even byte
	L	H	L	H	L	H	High-Z	invalid
Word access (16-bit)	L	L	L	×	L	H	invalid	even byte
Odd byte access (8-bit)	L	L	H	×	L	H	invalid	High-Z

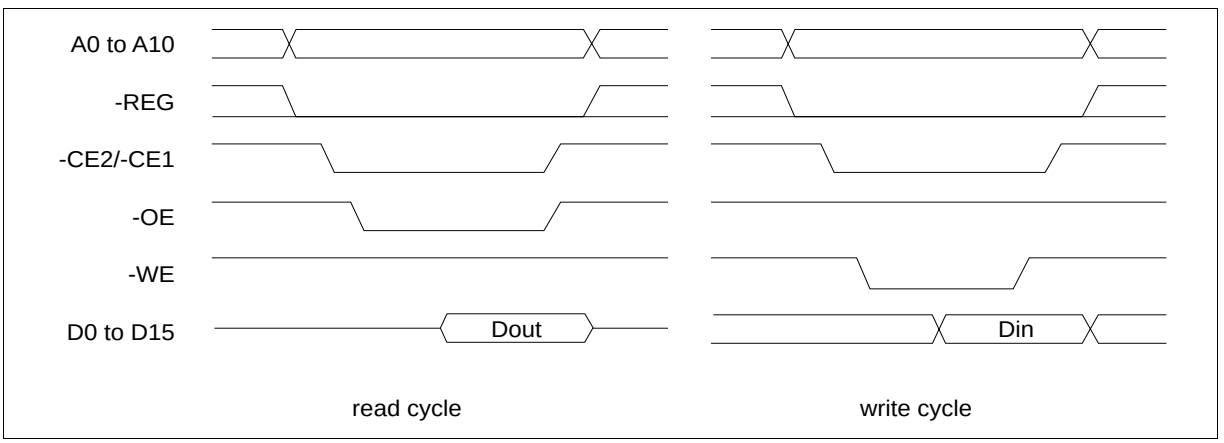
Note: ×: L or H

Attribute Write Access Mode

Mode	-REG	-CE2	-CE1	A0	-OE	-WE	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	Don't care	Don't care
Byte access (8-bit)	L	H	L	L	H	L	Don't care	even byte
	L	H	L	H	H	L	Don't care	Don't care
Word access (16-bit)	L	L	L	×	H	L	Don't care	even byte
Odd byte access (8-bit)	L	L	H	×	H	L	Don't care	Don't care

Note: ×: L or H

Attribute Access Timing Example



2. Task File register access specifications

There are two cases of Task File register mapping, one is mapped I/O address area, the other is mapped Memory address area. Each case of Task File register read and write operations are executed under the condition as follows. That area can be accessed by Byte/Word/Odd Byte mode which are defined by PC card standard specifications.

(1) I/O address map

Task File Register Read Access Mode (1)

Mode	-REG	-CE2	-CE1	A0	-IORD	-IOWR	-OE	-WE	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	×	×	High-Z	High-Z
Byte access (8-bit)	L	H	L	L	L	H	H	H	High-Z	even byte
	L	H	L	H	L	H	H	H	High-Z	odd byte
Word access (16-bit)	L	L	L	×	L	H	H	H	odd byte	even byte
Odd byte access (8-bit)	L	L	H	×	L	H	H	H	odd byte	High-Z

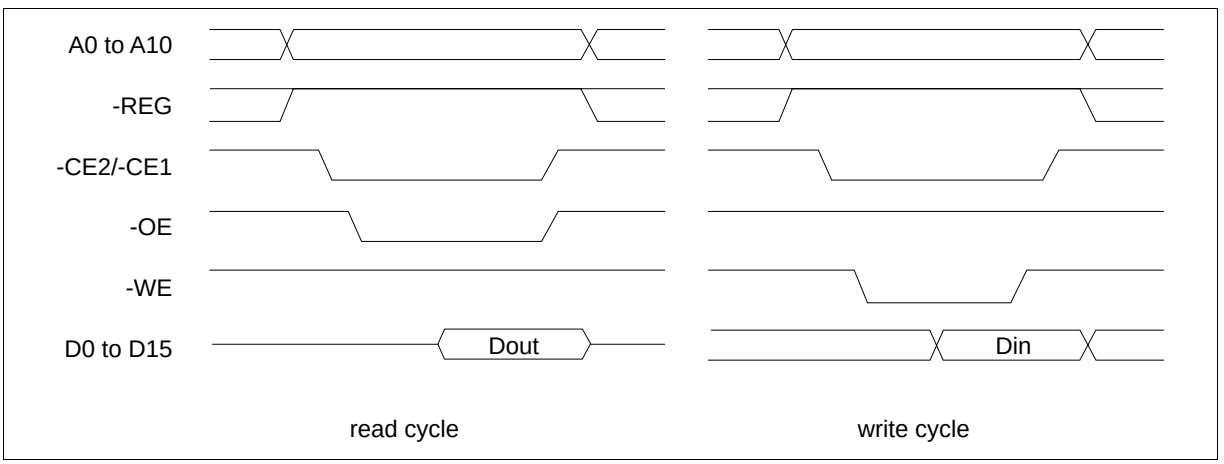
Note: ×: L or H

Task File Register Write Access Mode (1)

Mode	-REG	-CE2	-CE1	A0	-IORD	-IOWR	-OE	-WE	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	×	×	Don't care	Don't care
Byte access (8-bit)	L	H	L	L	H	L	H	H	Don't care	even byte
	L	H	L	H	H	L	H	H	Don't care	odd byte
Word access (16-bit)	L	L	L	×	H	L	H	H	odd byte	even byte
Odd byte access (8-bit)	L	L	H	×	H	L	H	H	odd byte	Don't care

Note: ×: L or H

Task File Register Access Timing Example (1)



(2) Memory address map

Task File Register Read Access Mode (2)

Mode	-REG	-CE2	-CE1	A0	-OE	-WE	-IORD	-IOWR	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	×	×	High-Z	High-Z
Byte access (8-bit)	H	H	L	L	L	H	H	H	High-Z	even byte
	H	H	L	H	L	H	H	H	High-Z	odd byte
Word access (16-bit)	H	L	L	×	L	H	H	H	odd byte	even byte
Odd byte access (8-bit)	H	L	H	×	L	H	H	H	odd byte	High-Z

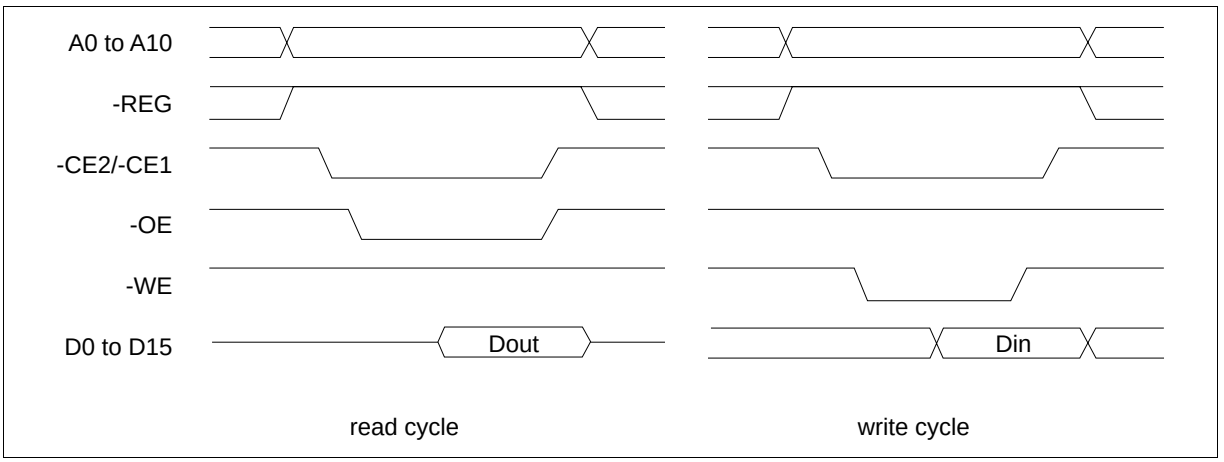
Note: ×: L or H

Task File Register Write Access Mode (2)

Mode	-REG	-CE2	-CE1	A0	-OE	-WE	-IORD	-IOWR	D8 to D15	D0 to D7
Standby mode	×	H	H	×	×	×	×	×	Don't care	Don't care
Byte access (8-bit)	H	H	L	L	H	L	H	H	Don't care	even byte
	H	H	L	H	H	L	H	H	Don't care	odd byte
Word access (16-bit)	H	L	L	×	H	L	H	H	odd byte	even byte
Odd byte access (8-bit)	H	L	H	×	H	L	H	H	odd byte	Don't care

Note: ×: L or H

Task File Register Access Timing Example (2)



Configuration register specifications

This card supports four Configuration registers for the purpose of the configuration and observation of this card.

1. Configuration Option register (Address 200H)

This register is used for the configuration of the card configuration status and for the issuing soft reset to the card.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
SRESET	LevlREQ	INDEX					

Note: initial value: 00H

Name	R/W	Function
SRESET (HOST->)	R/W	Setting this bit to "1", places the card in the reset state (Card Hard Reset). This operation is equal to Hard Reset, except this bit is not cleared. Then this bit set to "0", places the card in the reset state of Hard Reset (This bit is set to "0" by Hard Reset) . Card configuration status is reset and the card internal initialized operation starts when Card Hard Reset is executed, so next access to the card should be the same sequence as the power on sequence.
LevlREQ (HOST->)	R/W	This bit sets to "0" when pulse mode interrupt is selected, and "1" when level mode interrupt is selected.
INDEX (HOST->)	R/W	This bits is used for select operation mode of the card as follows. When Power on, Card Hard Reset and Soft Reset, this data is "000000" for the purpose of Memory card interface recognition.

INDEX bit assignment

INDEX bit								
5	4	3	2	1	0	Card mode	Task File register address	Mapping mode
0	0	0	0	0	0	Memory card	0H to FH, 400H to 7FFH	memory mapped
0	0	0	0	0	1	I/O card	xx0H to xxFH	contiguous I/O mapped
0	0	0	0	1	0	I/O card	1F0H to 1F7H, 3F6H to 3F7H	primary I/O mapped
0	0	0	0	1	1	I/O card	170H to 177H, 376H to 377H	secondary I/O mapped

2. Configuration and Status register (Address 202H)

This register is used for observing the card state.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
CHGED	SIGCHG	IOIS8	0	0	PWD	INTR	0

Note: initial value: 00H

Name	R/W	Function
CHGED (CARD->)	R	This bit indicates that CRDY/-BSY bit on Pin Replacement register is set to "1". When CHGED bit is set to "1", -STSCHG pin is held "L" at the condition of SIGCHG bit set to "1" and the card configured for the I/O interface.
SIGCHG (HOST->)	R/W	This bit is set or reset by the host for enabling and disabling the status-change signal (-STSCHG pin). When the card is configured I/O card interface and this bit is set to "1", -STSCHG pin is controlled by CHGED bit. If this bit is set to "0", -STSCHG pin is kept "H".
IOIS8 (HOST->)	R/W	The host sets this field to "1" when it can provide I/O cycles only with on 8 bit data bus (D7 to D0).
PWD (HOST->)	R/W	When this bit is set to "1", the card enters sleep state (Power Down mode). When this bit is reset to "0", the card transfers to idle state (active mode). RRDY/-BSY bit on Pin Replacement Register becomes BUSY when this bit is changed. RRDY/-BSY will not become Ready until the power state requested has been entered. This card automatically powers down when it is idle, and powers back up when it receives a command.
INTR (CARD->)	R	This bit indicates the internal state of the interrupt request. This bit state is available whether I/O card interface has been configured or not. This signal remains true until the condition which caused the interrupt request has been serviced. If interrupts are disabled by the -IEN bit in the Device Control Register, this bit is a zero.

3. Pin Replacement register (Address 204H)

This register is used for providing the signal state of -IREQ signal when the card configured I/O card interface.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	CRDY/-BSY	0	1	1	RRDY/-BSY	0

Note: initial value: 0CH

Name	R/W	Function
CRDY/-BSY (HOST->)	R/W	This bit is set to "1" when the RRDY/-BSY bit changes state. This bit may also be written by the host.
RRDY/-BSY (HOST->)	R/W	When read, this bit indicates +READY pin states. When written, this bit is used for CRDY/-BSY bit masking.

4. Socket and Copy register (Address 206H)

This register is used for identification of the card from the other cards. Host can read and write this register. This register should be set by host before this card's Configuration Option register set.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	DRV#	0	0	0	0

Note: initial value: 00H

Name	R/W	Function
DRV# (HOST->)	R/W	This fields are used for the configuration of the plural cards.

CIS informations

CIS informations are defined as follows. By reading attribute address from "000H", card CIS informations can be confirmed.

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
000H	01H	CISTPL DEVICE								Device info tuple	Tuple code
002H	04H	TPL_LINK								Link length is 4 byte	Link to next tuple
004H	DFH	Device type				WPS	Device speed			Device type = DH: I/O device WPS = 0: No WP Device speed = 7: ext speed	Device type, WPS, speed
006H	4AH	EXT	Speed mantissa				Speed exponent			400 ns if no wait	Extended speed
008H	01H	1x					2k units			2k byte of address space	Device size
00AH	FFH	List end marker								End of device	END marker
00CH	1CH	CISTPL DEVICE OC								Other conditions device info tuple	Tuple code
00EH	05H	TPL_LINK								Link length is 5 bytes	Link to next tuple
010H	00H	EXT	Reserved				V_{CC}		MWAIT	5 V, wait is not used	Other conditions info field
012H	DFH	Device type				WPS	Device speed			Device type = DH: I/O device WPS = 0: No WP Device speed = 7: ext speed	Device type, WPS, speed
014H	4AH	EXT	Speed mantissa				Speed exponent			400 ns if no wait	Extended speed
016H	01H	1x					2k units			2k byte of address space	Device size
018H	FFH	List end marker								End of device	END marker
01AH	1CH	CISTPL DEVICE OC								Other conditions device info tuple	Tuple code
01CH	04H	TPL_LINK								Link length is 4 bytes	Link to next tuple
01EH	01H	EXT	Reserved				V_{CC}		MWAIT	5 V, wait is used	Other conditions info field
020H	D2H	Device type				WPS	Device speed			Device type = DH: I/O device WPS = 0: No WP Device speed = 2: 200 ns	Device type, WPS, speed
022H	01H	1x					2k units			2k byte of address space	Device size
024H	FFH	List end marker								End of device	END marker
026H	18H	CISTPL JEDEC C								JEDEC ID common memory	Tuple code
028H	02H	TPL_LINK								Link length is 2 bytes	Link to next tuple
02AH	DFH	PCMCIA's manufacturer's JEDEC ID code								Manufacturer's ID code	JEDEC ID of PC Card ATA
02CH	01H	PCMCIA JEDEC device code								2nd byte of JEDEC ID	

Address	Data	7 6 5 4 3 2 1 0	Description of contents	CIS function
02EH	20H	CISTPL MANFID	Manufacturer's ID code	Tuple code
030H	04H	TPL_LINK	Link length is 4 bytes	Link to next tuple
032H	07H	Low byte of PCMCIA manufacturer's code	HITACHI JEDEC manufacturer's ID	Low byte of manufacturer's ID code
034H	00H	High byte of PCMCIA manufacturer's code	Code of 0 because other byte is JEDEC 1 byte manufac ID	High byte of manufacturer's ID code
036H	00H	Low byte of product code	HITACHI code for PC CARD ATA	Low byte of product code
038H	00H	High byte of product code		High byte of product code
03AH	21H	CISTPL MANFID	Function ID tuple	Tuple code
03CH	02H	TPL_LINK	Link length is 2 bytes	Link to next tuple
03EH	04H	TPLFID_FUNCTION = 04H	Disk function, may be silicon, may be removable	PC card function code
040H	01H	Reserved R P	R = 0: No BIOS ROM P = 1: Configure card at power on	System initialization byte
042H	22H	CISTPL FUNCE	Function extension tuple	Tuple code
044H	02H	TPL_LINK	Link length is 2 bytes	Link to next tuple
046H	01H	Disk function extension tuple type	Disk interface type	Extension tuple type for disk
048H	01H	Disk interface type	PC card ATA interface	Interface type
04AH	22H	CISTPL FUNCE	Function extension tuple	Tuple code
04CH	03H	TPL_LINK	Link length is 3 bytes	Link to next tuple
04EH	02H	Disk function extension tuple type	Single drive	Extension tuple type for disk
050H	0CH	Reserved D U S V	No V_{PP}, silicon, single drive V = 0: No V_{PP} required S = 1: Silicon U = 1: Unique serial # D = 1: Single drive on card	Basic ATA option parameters byte 1
052H	0FH	R I E N P3 P2 P1 P0	P0: Sleep mode supported P1: Standby mode supported P2: Idle mode supported P3: Drive auto control N: Some config excludes 3X7 E: Index bit is emulated I: Twin IOIS16# data reg only R: Reserved	Basic ATA option parameters byte 2

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
054H	1AH	CISTPL CONF								Configuration tuple	Tuple code
056H	05H	TPL LINK								Link length is 5 bytes	Link to next tuple
058H	01H	RFS		RMS				RAS		RFS: Reserved RMS: TPCC_RMSK size -1=0 RAS: TPCC_RADR size -1=1 1 byte register mask 2 byte config base address	Size of fields byte TPCC_SZ
05AH	03H	TPCC_LAST								Entry with config index of 3 is final entry in table	Last entry of config registers
05CH	00H	TPCC RADR (LSB)								Configuration registers are located at 200 H in REG space	Location of config registers
05EH	02H	TPCC RADR (MSB)									
060H	0FH	Reserved				S	P	C	I	I: CCOR, C: CCSR P: PRR, S: SCR	Configuration registers present mask TPCC_RMSK

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
062H	1BH	CISTPL_CFTABLE ENTRY								Configuration table entry tuple	Tuple code
064H	08H	TPL_LINK								Link length is 8 bytes	Link to next tuple
066H	C0H	I	D	Configuration index						Memory mapped I/O configuration I = 1: Interface byte follows D = 1: Default entry Configuration index = 0	Configuration table index byte TPCE_INDX
068H	40H	W	R	P	B	Interface type				W = 0: Wait not used R = 1: Ready active P = 0: WP not used B = 0: BVD1 and BVD2 not used IF type = 0: Memory interface	Interface description field TPCE_IF
06AH	A1H	M	MS		IR	IO	T	P		M = 1: Misc info present MS = 01: Memory space info single 2-byte length IR = 0: No interrupt info present IO = 0: No I/O port info present T = 0: No timing info present P = 1: V_{CC} only info	Feature selection byte TPCE_FS
06CH	01H	R	DI	PI	AI	SI	HV	LV	NV	Nominal voltage only follows R: Reserved DI: Power down current info PI: Peak current info AI: Average current info SI: Static current info HV: Max voltage info LV: Min voltage info NV: Nominal voltage info	Power parameters for V_{CC}
06EH	55H	X	Mantissa				Exponent			Nominal voltage = 5 V	V_{CC} nominal value
070H	08H	Length in 256 bytes pages (LSB)								Length of memory space is 2 kB	Memory space description structures (TPCE MS)
072H	00H	Length in 256 bytes pages (MSB)									
074H	20H	X	R	P	RO	A	T			X = 0: No more misc fields R: Reserved P = 1: Power down supported RO = 0: Not read only mode A = 0: Audio not supported T = 0: Single drive	Miscellaneous features field TPCE_MI

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
076H	1BH	CISTPL_CFTABLE ENTRY								Configuration table entry tuple	Tuple code
078H	0AH	TPL_LINK								Link length is 10 bytes	Link to next tuple
07AH	C1H	I	D	Configuration INDEX						Contiguous I/O mapped ATA registers configuration I = 1: Interface byte follows D = 1: Default entry Configuration index = 1	Configuration table index byte TPCE_INDX
07CH	41H	W	R	P	B	interface type				W = 0: Wait not used R = 1: Ready active P = 0: WP not used B = 0: BVS1 and BVD2 not used IF type = 1: I/O interface	Interface description field TPCE_IF
07EH	99H	M	MS			IR	IO	T	P	M = 1: Misc info present MS = 00: No memory space info IR = 1: Interrupt info present IO = 0: No I/O port info present T = 0: No timing info present P = 1: V_{CC} only info	Feature selection byte TPCE_FS
080H	01H	R	DI	PI	AI	SI	HV	LV	NV	Nominal voltage only follows R: Reserved DI: Power down Current info PI: Peak current info AI: Average current info SI: Static current info HV: Max voltage info LV: Min voltage info NV: Nominal voltage info	Power parameters for V_{CC}
082H	55H	X	Mantissa				Exponent			Nominal voltage = 5 V	V_{CC} nominal value
084H	64H	R	S	E	IO AddrLine					S = 1: 16-bit hosts supported E = 1: 8-bit hosts supported IO AddrLine: 4 lines decoded	I/O space description field TPCE_IO
086H	F0H	S	P	L	M	V	B	I	N	S = 1: Share logic active P = 1: Pulse mode IRQ supported L = 1: Level mode IRQ supported M = 1: Bit mask of IRQs present V = 0: No vender unique IRQ B = 0: No bus error IRQ I = 0: No IO check IRQ N = 0: No NMI	Interrupt request description structure TPCE_IR

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
088H	FFH	IRQ 7	IRQ 6	IRQ 5	IRQ 4	IRQ 3	IRQ 2	IRQ 1	IRQ0	IRQ level to be routed 0 to 15 recommended	Mask extension byte 1 TPCE_IR
08AH	FFH	IRQ 15	IRQ 14	IRQ 13	IRQ 12	IRQ 11	IRQ 10	IRQ 9	IRQ8	Recommended routing to any “normal, maskable” IRQ.	Maskextension byte 2 TPCE_IR
08CH	20H	X	R	P	RO	A	T			X = 0: Nomore misc fields R: reserved P = 1: Power down supported RO = 0: Not read only mode A = 0: Audio not supported T = 0: Single drive	Miscellaneous features field TPCE_MI

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
08EH	1BH	CISTPL_CFTABLE ENTRY								Configuration table entry tuple	Tuple code
090H	0CH	TPL_LINK								Link length is 12 bytes	Link to next tuple
092H	82H	I	D	Configuration INDEX						ATA primary I/O mapped configuration I = 1: Interface byte follows D = 0: No default entry Configuration index = 2	Configuration table index byte TPCE_INDX
094H	41H	W	R	P	B	interface type				W = 0: Wait not used R = 1: Ready active P = 0: WP not used B = 0: BVS1 and BVD2 not used IF type = 1: I/O interface	Interface description field TPCE_IF
096H	18H	M	MS		IR	IO	T	P		M = 0: No misc info present MS = 00: No memory space info IR = 1: Interrupt info present IO = 0: No I/O port info present T = 0: No timing info present P = 0: No V_{CC} info	Feature selection byte TPCE_FS
098H	EAH	R	S	E	IO AddrLine					R = 1: Range follows S = 1: 16-bit hosts supported E = 1: 8-bit hosts supported IO AddrLines: 10 lines decoded	I/O space description field TPCE_IO
09AH	61H	LS		AS		N range				LS = 1: Size of lengths is 1 byte AS = 2: Size of address is 2 byte NRange = 1: Address range - 1	I/O range format description
09CH	F0H									1st I/O base address (LSB)	1st I/O range address
09EH	01H									1st I/O base address (MSB)	
0A0H	07H									1st I/O length - 1	1st I/O range length
0A2H	F6H									2nd I/O base address (LSB)	2nd I/O range address
0A4H	03H									2nd I/O base address (MSB)	
0A6H	01H									2nd I/O length - 1	2nd I/O range length
0A8H	EEH	S	P	L	M	IRQ level				S = 1: Share logic active P = 1: Pulse mode IRQ supported L = 1: Level mode IRQ supported M = 0: Bit mask of IRQs present IRQ level isIRQ14	Interrupt request description structure TPCE_IR

Address	Data	7	6	5	4	3	2	1	0	Description of contents	CIS function
0AAH	1BH	CISTPL_CFTABLE ENTRY								Configuration table entry tuple	Tuple code
0ACH	0CH	TPL_LINK								Link length is 12 bytes	Link to next tuple
0AEH	83H	I	D	Configuration INDEX						ATA secondary I/O mapped configuration I = 1: Interface byte follows D = 0: No default entry Configuration index = 3	Configuration table index byte TPCE_INDX
0B0H	41H	W	R	P	B	interface type				W = 0: Wait not used R = 1: Ready active P = 0: WP not used B = 0: BVS1 and BVD2 not used IF type = 1: I/O interface	Interface description field TPCE_IF
0B2H	18H	M	MS		IR	IO	T	P		M = 0: No misc info present MS = 00: No memory space info IR = 1: Interrupt info present IO = 0: No I/O port info present T = 0: No timing info present P = 0: No V_{CC} info	Feature selection byte TPCE_FS
0B4H	EAH	R	S	E	IO AddrLine					R = 1: Range follows S = 1: 16-bit hosts supported E = 1: 8-bit hosts supported IO AddrLines: 10 lines decoded	I/O space description field TPCE_IO
0B6H	61H	LS		AS		N range				LS = 1: Size of lengths is 1 byte AS = 2: Size of address is 2 byte NRange = 1: Address range - 1	I/O range format description
0B8H	70H									1st I/O base address (LSB)	1st I/O range address
0BAH	01H									1st I/O base address (MSB)	
0BCH	07H									1st I/O length - 1	1st I/O range length
0BEH	76H									2nd I/O base address (LSB)	2nd I/O range address
0C0H	03H									2nd I/O base address (MSB)	
0C2H	01H									2nd I/O length - 1	2nd I/O range length
0C4H	EEH	S	P	L	M	IRQ level				S = 1: Share logic active P = 1: Pulse mode IRQ supported L = 1: Level mode IRQ supported M = 0: Bit mask of IRQs present IRQ level isIRQ14	Interrupt request description structure TPCE_IR

Address	Data	7 6 5 4 3 2 1 0	Description of contents	CIS function
0C6H	15H	CISTPL_VER_1	Level 1 version/product info	Tuple code
0C8H	15H	TPL_LINK	Link length is 15h bytes	Link to next tuple
0CAH	04H	TPPLV1_MAJOR	PCMCIA2.0/JEIDA4.1	Major version
0CCH	01H	TPPLV1_MINOR	PCMCIA2.0/JEIDA4.1	Minor version
0CEH	48H		‘ H ’	Info string 1
0D0H	49H		‘ I ’	
0D2H	54H		‘ T ’	
0D4H	41H		‘ A ’	
0D6H	43H		‘ C ’	
0D8H	48H		‘ H ’	
0DAH	49H		‘ I ’	
0DCH	00H		Null terminator	
0DEH	46H		‘ F ’	Info string 2
0E0H	4CH		‘ L ’	
0E2H	41H		‘ A ’	
0E4H	53H		‘ S ’	
0E6H	48H		‘ H ’	
0E8H	00H		Null terminator	
0EAH	31H		‘ 1 ’	Vender specific strings
0ECH	2EH		‘ . ’	
0EEH	30H		‘ 0 ’	
0F0H	00H		Null terminator	
0F2H	FFH	List end marker	End of device	END marker
0F4H	14H	CISTPL_NO_LINK	No link control tuple	Tuple code
0F6H	00H		Link is 0 bytes	Link to next tuple
0F8H	FFH	CISTPL_END	End of list tuple	Tuple code

Task File register specification

These registers are used for reading and writing the storage data in this card. These registers are mapped four types by the configuration of INDEX in Configuration Option register. The decoded addresses are shown as follows.

Memory map (INDEX = 0)

-REG	A10	A9 to A4	A3	A2	A1	A0	Offset	-OE = L	-WE = L
1	0	×	0	0	0	0	0H	Data register	Data register
1	0	×	0	0	0	1	1H	Error register	Feature register
1	0	×	0	0	1	0	2H	Sector count register	Sector count register
1	0	×	0	0	1	1	3H	Sector number register	Sector number register
1	0	×	0	1	0	0	4H	Cylinder low register	Cylinder low register
1	0	×	0	1	0	1	5H	Cylinder high register	Cylinder high register
1	0	×	0	1	1	0	6H	Drive head register	Drive head register
1	0	×	0	1	1	1	7H	Status register	Command register
1	0	×	1	0	0	0	8H	Dup. even data register	Dup. even data register
1	0	×	1	0	0	1	9H	Dup. odd data register	Dup. odd data register
1	0	×	1	1	0	1	DH	Dup. error register	Dup. feature register
1	0	×	1	1	1	0	EH	Alt. status register	Device control register
1	0	×	1	1	1	1	FH	Drive address register	Reserved
1	1	×	×	×	×	0	8H	Even data register	Even data register
1	1	×	×	×	×	1	9H	Odd data register	Odd data register

Contiguous I/O map (INDEX = 1)

-REG	A10 to A4	A3	A2	A1	A0	Offset	-IORD = L	-IOWR = L
0	×	0	0	0	0	0H	Data register	Data register
0	×	0	0	0	1	1H	Error register	Feature register
0	×	0	0	1	0	2H	Sector count register	Sector count register
0	×	0	0	1	1	3H	Sector number register	Sector number register
0	×	0	1	0	0	4H	Cylinder low register	Cylinder low register
0	×	0	1	0	1	5H	Cylinder high register	Cylinder high register
0	×	0	1	1	0	6H	Drive head register	Drive head register
0	×	0	1	1	1	7H	Status register	Command register
0	×	1	0	0	0	8H	Dup. even data register	Dup. even data register
0	×	1	0	0	1	9H	Dup. odd data register	Dup. odd data register
0	×	1	1	0	1	DH	Dup. error register	Dup. feature register
0	×	1	1	1	0	EH	Alt. status register	Device control register
0	×	1	1	1	1	FH	Drive address register	Reserved

Primary I/O map (INDEX = 2)

-REG	A10	A9 to A4	A3	A2	A1	A0	-IORD = L	-IOWR = L
0	×	1FH	0	0	0	0	Data register	Data register
0	×	1FH	0	0	0	1	Error register	Feature register
0	×	1FH	0	0	1	0	Sector count register	Sector count register
0	×	1FH	0	0	1	1	Sector number register	Sector number register
0	×	1FH	0	1	0	0	Cylinder low register	Cylinder low register
0	×	1FH	0	1	0	1	Cylinder high register	Cylinder high register
0	×	1FH	0	1	1	0	Drive head register	Drive head register
0	×	1FH	0	1	1	1	Status register	Command register
0	×	3FH	0	1	1	0	Alt. status register	Device control register
0	×	3FH	0	1	1	1	Drive address register	Reserved

Secondary I/O map (INDEX = 3)

-REG	A10	A9 to A4	A3	A2	A1	A0	-IORD = L	-IOWR = L
0	×	17H	0	0	0	0	Data register	Data register
0	×	17H	0	0	0	1	Error register	Feature register
0	×	17H	0	0	1	0	Sector count register	Sector count register
0	×	17H	0	0	1	1	Sector number register	Sector number register
0	×	17H	0	1	0	0	Cylinder low register	Cylinder low register
0	×	17H	0	1	0	1	Cylinder high register	Cylinder high register
0	×	17H	0	1	1	0	Drive head register	Drive head register
0	×	17H	0	1	1	1	Status register	Command register
0	×	37H	0	1	1	0	Alt. status register	Device control register
0	×	37H	0	1	1	1	Drive address register	Reserved

1. Data register: This register is a 16 bit register that has read/write ability, and it is used for transferring 1 sector data between the card and the host. This register can be accessed in word mode and byte mode.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
D0 to D15															

2. Error register: This register is a read only register, and it is used for analyzing the error content at the card accessing. This register is valid when the BSY bit in Status register and Alternate Status register are set to "0" (Ready). This register's bit assignment is different from operation mode and diagnostic mode.

(1) Operation mode: In operation mode, error information that occurred at final command operation is stored this register. When the ERR bit in Status register and Alternate Status register are set to "1" (Error), the error content is confirmed by reading this register.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
BBK	UNC	“0”	IDNF	“0”	ABRT	“0”	AMNF

bit	Name	Function
7	BBK (Bad BlocK detected)	This bit is set when a Bad Block is detected in requested ID field.
6	UNC (Data ECC error)	This bit is set when Uncorrectable error is occurred at reading the card.
4	IDNF (I D Not Found)	The requested sector ID is in error or cannot be found.
2	ABRT (ABoRTed command)	This bit is set if the command has been aborted because of the card status condition. (Not ready, Write fault, Invalid command, etc.)
0	AMNF (Address Mark Not Found)	This bit is set in case of a general error.

(2) Diagnostic mode: Diagnostic mode is available when the diagnostic command is issued. This register should be checked after the diagnostic command is issued. Diagnosed result is set this register by code.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Error code							

Error code	Error type
01H	No error
02H	Controller error
03H	Sector buffer error
04H	ECC device error
05H	Controlling microprocessor error

3. Feature register: This register is write only register, and provides information regarding features of the drive which the host wishes to utilize.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Feature byte							

4. Sector count register: This register contains the numbers of sectors of data requested to be transferred on a read or write operation between the host and the card. In this card, the plural sector transfer is available that across the Track or Cylinder. If the value of this register is zero, a count of 256 sectors is specified. In plural sector transfer, if not successfully completed, the register contains the number of sectors which need to be transferred in order to complete the request. This register's initial value is "01H".

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Sector count byte							

5. Sector number register: This register contains the starting sector number which is started by following sector transfer command.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Sector number byte							

6. Cylinder low register: This register contains the low 8 bits of the starting cylinder address which is started by following sector transfer command.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Cylinder low byte							

7. Cylinder low register: This register contains the low 8 bits of the starting cylinder address which is started by following sector transfer command.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Cylinder high byte							

8. Drive head register: This register contains the high 8 bits of the starting cylinder address which is started by following sector transfer command.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	LBA	1	DRV	Head number			

Note: DRV: Drive number
Head number: Head number

bit	Name	Function
7	1	This bit is set to "1".
6	LBA	LBA is a flag to select either Cylinder / Head / Sector (CHS) or Logical Block Address (LBA) mode. When LBA=0, CHS mode is selected. When LBA=1, LBA mode is selected. In LBA mode, the Logical Block Address is interrupted as follows: LBA07-LBA00 : Sector Number Register D7-D0. LBA15-LBA08 : Cylinder Low Register D7-D0. LBA23-LBA16 : Cylinder High Register D7-D0. LBA27-LBA24 : Drive / Head Register bits HS3-HS0.
5	1	This bit is set to "1".
4	DRV (DRiVe select)	This bit is used for selecting the Master (Card 0) and Slave (Card 1) in Master/Slave organization. The card is set to be Card 0 or 1 by using DRV# of the Socket and Copy register.
3 to 0	Head number	This bit is used for selecting the Head number for the following command. Bit 3 is MSB.

9. Status register: This register is read only register, and it indicates the card status of command execution. Other bits are invalid when BSY bit is "1". When this register is read, -IREQ is negated. And when host writes the command code to Command register, bit 0, 4 and 6 are cleared and bit 7 is set.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
BSY	DRDY	DWF	DSC	DRQ	CORR	IDX	ERR

bit	Name	Function
7	BSY (BuSY)	This bit is set when the card internal operation is executing. When this bit is set to "1", other bits in this register are invalid.
6	DRDY (Drive ReaDY)	If this bit and DSC bit are set to "1", the card is capable of receiving the read or write or seek requests. If this bit is set to "0", the card prohibits these requests.
5	DWF (Drive Write Fault)	This bit is set if this card indicates the write fault status.
4	DSC (Drive Seek Complete)	This bit is set when the drive seek complete.
3	DRQ (Data ReQuest)	This bit is set when the information can be transferred between the host and Data register. This bit is cleared when the card receives the other command.
2	CORR (CORRected data	This bit is set when a correctable data error has been occurred and the data has been corrected.
1	IDX (InDeX)	This bit is always set to "0".
0	ERR (ERRor)	This bit is set when the previous command has ended in some type of error. The error information is set in the other Status register or Error register. This bit is cleared by the next command.

10. Alternate status register: This register is the same as Status register in physically, so the bit assignment refers to previous item of Status register. But this register is different from Status register that -IREQ is not negated when data read.

11. Command register: This register is write only register, and it is used for writing the command at executing the drive operation. The command code written in the command register, after the parameter is written in the Task File during the card is Ready state.

		Used parameter						
Command	**Command code**	**FR**	**SC**	**SN**	**CY**	**DR**	**HD**	**LBA**
Check power mode	E5H or 98H	N	N	N	N	Y	N	N
Execute drive diagnostic	90H	N	N	N	N	Y	N	N
Format track	50H	N	Y	N	Y	Y	Y	Y
Identify Drive	ECH	N	N	N	N	Y	N	N
Idle	E3H or 97H	N	Y	N	N	Y	N	N
Idle immediate	E1H or 95H	N	N	N	N	Y	N	N
Initialize drive parameters	91H	N	Y	N	N	Y	Y	N
Read buffer	E4H	N	N	N	N	Y	N	N
Read multiple	C4H	N	Y	Y	Y	Y	Y	Y
Read long sector	22H or 23H	N	N	Y	Y	Y	Y	Y
Read sector	20H or 21H	N	Y	Y	Y	Y	Y	Y
Read verify sector	40H or 41H	N	Y	Y	Y	Y	Y	Y
Recalibrate	1XH	N	N	N	N	Y	N	N
Seek	7XH	N	N	Y	Y	Y	Y	Y
Set features	EFH	Y	N	N	N	Y	N	N
Set multiple mode	C6H	N	Y	N	N	Y	N	N
Set sleep mode	E6H or 99H	N	N	N	N	Y	N	N
Stand by	E2H or 96H	N	N	N	N	Y	N	N
Stand by immediate	E0H or 94H	N	N	N	N	Y	N	N
Write buffer	E8H	N	N	N	N	Y	N	N
Write long sector	32H or 33H	N	N	Y	Y	Y	Y	Y
Write multiple	C5H	N	Y	Y	Y	Y	Y	Y
Write sector	30H or 31H	N	Y	Y	Y	Y	Y	Y
Write verify	3CH	N	Y	Y	Y	Y	Y	Y

Note: FR: Feature register
SC: Sector Count register
SN: Sector Number register
CY: Cylinder register
DR: DRV bit of Drive Head register
HD: Head Number of Drive Head register
LBA: Logical Block Address Mode Supported
Y: The register contains a valid parameter for this command.
N: The register does not contain a valid parameter for this command.

12. Device control register: This register is write only register, and it is used for controlling the card interrupt request and issuing an ATA soft reset to the card.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
×	×	×	×	1	SRST	nIEN	0

bit	Name	Function
7 to 4	×	don't care
3	1	This bit is set to "1".
2	SRST (Software ReSeT)	This bit is set to "1" in order to force the card to perform Task File Reset operation. This does not change the Card Configuration registers as a Hardware Reset does. The card remains in Reset until this bit is reset to "0".
1	nIEN (Interrupt ENable)	This bit is used for enabling -IREQ. When this bit is set to "0", -IREQ is enabled. When this bit is set to "1", -IREQ is disabled.
0	0	This bit is set to "0".

13. Drive Address register: This register is read only register, and it is used for confirming the drive status. This register is provides for compatibility with the AT disk drive interface. It is recommended that this register not be mapped into the host's I/O space because of potential conflicts on bit7.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
×	nWTG	nHS3	nHS2	nHS1	nHS0	nDS1	nDS0

bit	Name	Function
7	×	This bit is unknown
6	nWTG (WriTing Gate)	This bit is unknown
5 to 2	nHS3-0 (Head Select3-0)	These bits is the negative value of Head Select bits (bit 3 to 0) in Drive/Head register.
1	nDS1 (Idrive Select1)	This bit is unknown
0	nDS0 (Idrive Select0)	This bit is unknown

ATA Command specifications

This table summarizes the ATA command set with the paragraphs. Following shows the support commands and command codes which are written in command registers.

ATA Command Set

No.	Command set	Code	FR	SC	SN	CY	DR	HD	LBA
1	Check power mode	E5H or 98H	—	—	—	—	Y	—	—
2	Execute drive diagnostic	90H	—	—	—	—	Y	—	—
3	Format track	50H	—	Y	—	Y	Y	Y	Y
4	Identify Drive	ECH	—	—	—	—	Y	—	—
5	Idle	E3H or 97H	—	Y	—	—	Y	—	—
6	Idle immediate	E1H or 95H	—	—	—	—	Y	—	—
7	Initialize drive parameters	91H	—	Y	—	—	Y	Y	—
8	Read buffer	E4H	—	—	—	—	Y	—	—
9	Read multiple	C4H	—	Y	Y	Y	Y	Y	Y
10	Read long sector	22H, 23H	—	—	Y	Y	Y	Y	Y
11	Read sector (s)	20H, 21H	—	Y	Y	Y	Y	Y	Y
12	Read verify sector (s)	40H, 41H	—	Y	Y	Y	Y	Y	Y
13	Recalibrate	1XH	—	—	—	—	Y	—	—
14	Seek	7XH	—	—	Y	Y	Y	Y	Y
15	Set features	EFH	Y	—	—	—	Y	—	—
16	Set multiple mode	C6H	—	Y	—	—	Y	—	—
17	Set sleep mode	E6H or 99H	—	—	—	—	Y	—	—
18	Stand by	E2H or 96H	—	—	—	—	Y	—	—
19	Stand by immediate	E0H or 94H	—	—	—	—	Y	—	—
20	Write buffer	E8H	—	—	—	—	Y	—	—
21	Write long sector	32H or 33H	—	—	Y	Y	Y	Y	Y
22	Write multiple	C5H	—	Y	Y	Y	Y	Y	Y
23	Write sector	30H or 31H	—	Y	Y	Y	Y	Y	Y
24	Write verify	3CH	—	Y	Y	Y	Y	Y	Y

Note: FR: Feature Register
SC: Sector Count register (00H to FFH)
SN: Sector Number register (01H to 20H)
CY: Cylinder Low/High register (to)
DR: Drive bit of Drive/Head register
HD: Head No.(0 to 3) of Drive/Head register
NH: No. of Heads
Y: Set up
—: Not set up

1. Check Power Mode (code: E5H or 98H): This command checks the power mode.

2. Execute Drive Diagnostic (code: 90H): This command performs the internal diagnostic tests implemented by the Card.

3. Format Track (code: 50H): This command writes the desired head and cylinder of the selected drive. But selected sector data is not exchange. This card excepts a sector buffer of data from the host to follow the command with same protocol as the Write Sector command.

4. Identify Drive (code: ECH): This command enables the host to receive parameter information from the Card.

Identify Drive Information

Word address	Default value	Total bytes	Data field type information
0	848AH	2	General configuration bit-significant information
1	XXXX	2	General configuration bit-significant information
2	000H	2	Reserved
3	00XXH	2	Default number of heads
4	0000H	2	Number of unformatted bytes per track
5	XXXX	2	Number of unformatted bytes per sector
6	XXXX	2	Default number of sectors per track
7 to 8	XXXX	2	Number of sectors per card (Word7 = MSW, Word8 = LSW)
9	0000H	2	Reserved
10 to 19	0000H	20	Reserved
20	0002H	2	Buffer type (dual ported)
21	0002H	2	Buffer size in 512 byte increments
22	0004H	2	# of ECC bytes passed on Read/Write Long Commands
23 to 46	XXXX	48	Firmware revision in ASCII etc.
47	0001H	2	Maximum of 1 sector on Read/Write Multiple command
48	0000H	2	Double Word not supported
49	0200H	2	Capabilities: DMA NOT Supported (bit 8), LBA supported (bit9)
50	0000H	2	Reserved
51	1000H	2	PIO data transfer cycle timing mode 1
52	0000H	2	DMA data transfer cycle timing mode not Supported
53 to 58	0000H	12	Reserved
59	010XH	2	Multiple sector setting is valid
60 to 61	XXXX	4	Total number of sectors addressable in LBA Mode
62 to 255	0000H	388	Reserved

5. Idle (code: E3H or 97H): This command causes the Card to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power down mode is disabled.

6. Idle Immediate (code: E1H or 95H): This command causes the Card to set BSY, enter the Idle (Read) mode, clear BSY and generate an interrupt.

7. Initialize Drive Parameters (code: 91H): This command enables the host to set the number of sectors per track and the number of heads per cylinder.

8. Read Buffer (code: E4H): This command enables the host to read the current contents of the card's sector buffer.

9. Read Multiple (code: C4H): This command performs similarly to the Read Sectors command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple command.

10. Read Long Sector (code: 22H or 23H): This command performs similarly to the Read Sector(s) command except that it returns 516 bytes of data instead of 512 bytes.

11. Read Sector(s) (code: 20H, 21H): This command reads from 1 to 256 sectors as specified in the Sector Count register. A sector count of 0 requests 256 sectors. The transfer begins at the sector specified in the Sector Number register.

12. Read Verify Sector (code: 40H or 41H): This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host .

13. Recalibrate (code: 1XH): This command is effectively a NOP command to the Card and is provided for compatibility purposes.

14. Seek (code: 7XH): This command is effectively a NOP command to the Card although it does perform a range check.

15. Set Features (code: EFH): This command is used by the host to establish or select certain features.

16. Set Multiple Mode (code: C6H): This command enables the Card to perform Read and Write Multiple operations and establishes the block count for these commands.

17. Set Sleep Mode (code: E6H or 99H): This command causes the Card to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

18. Stand By (code: E2H or 96H): This command causes the Card to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

19. Stand By Immediate (code: E0H or 94H): This command causes the Card to set BSY, enter the Sleep mode(which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

20. Write Buffer (code: E8H): This command enables the host to overwrite contents of the Card's sector buffer with any data pattern desired.

21. Write Long Sector (code: 32H or 33H): This command is provided for compatibility purposes and is similar to the Write Sector(s) command except that it writes 516 bytes instead of 512 bytes.

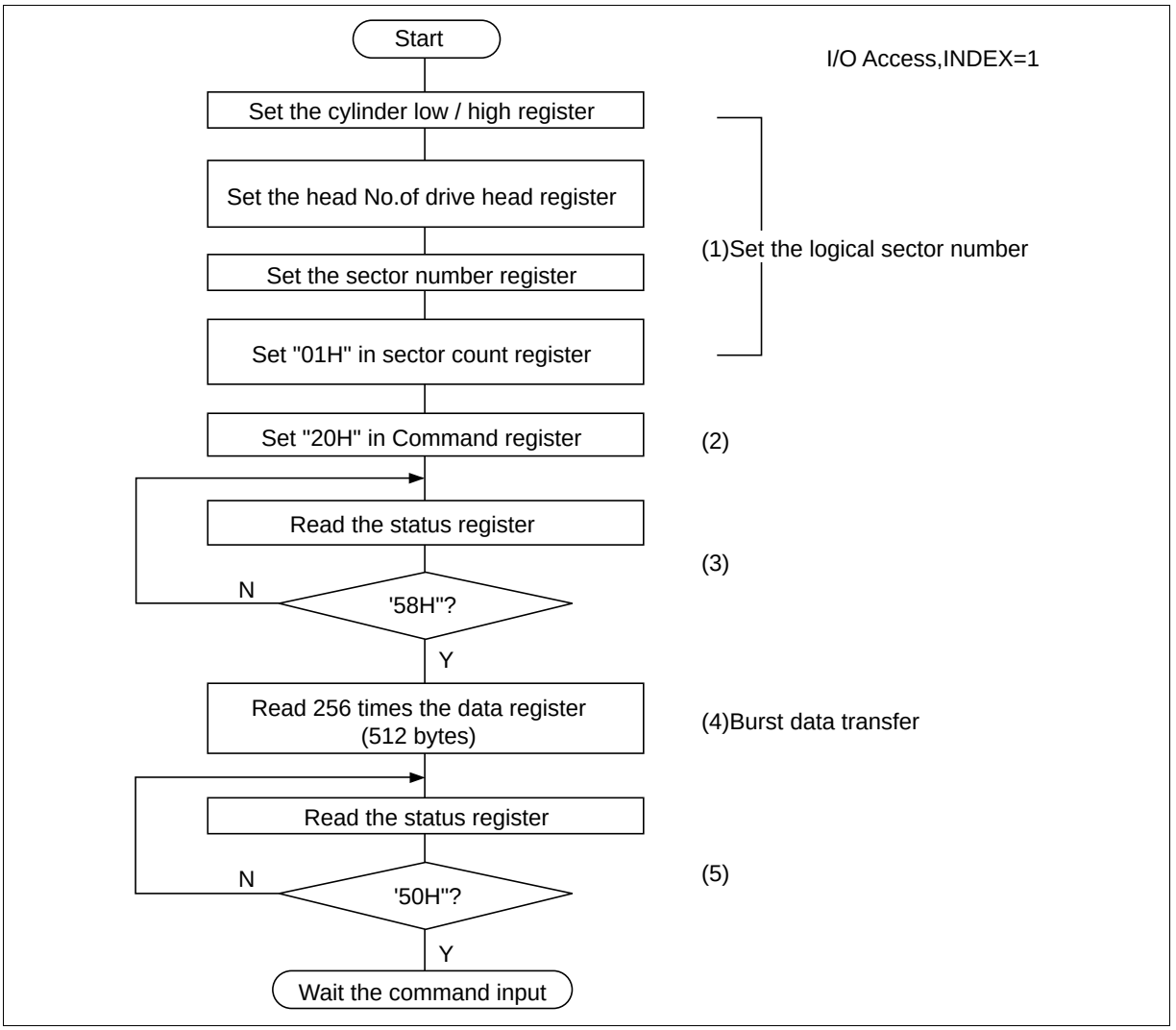
22. Write Multiple (code: C5H): This command is similar to the Write Sectors command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

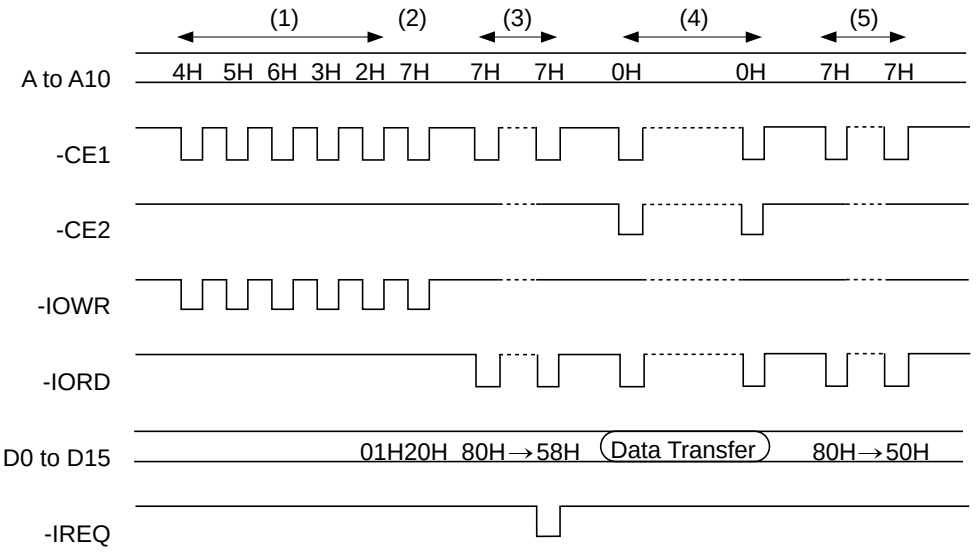
23. Write Sector(s) (code: 30H or 31H): This command writes from 1 to 256 sectors as specified in the Sector Count register. A sector count of zero requests 256 sectors. The transfer begins at the sector specified in the Sector Number register.

24. Write Verify (code: 3CH): This command is similar to the Write Sector(s) command, except each sector is verified immediately after being written.

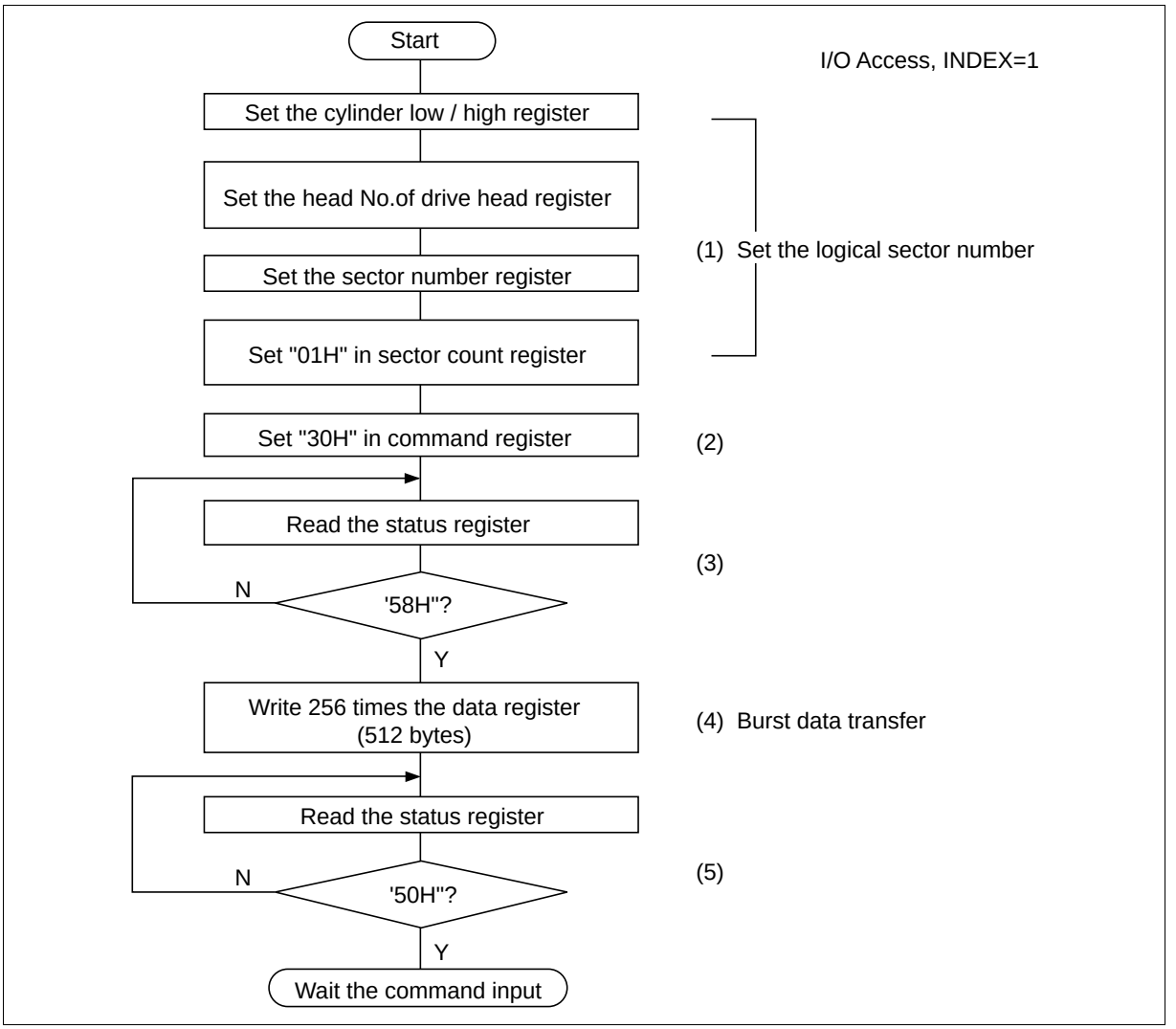
Sector Transfer Protocol

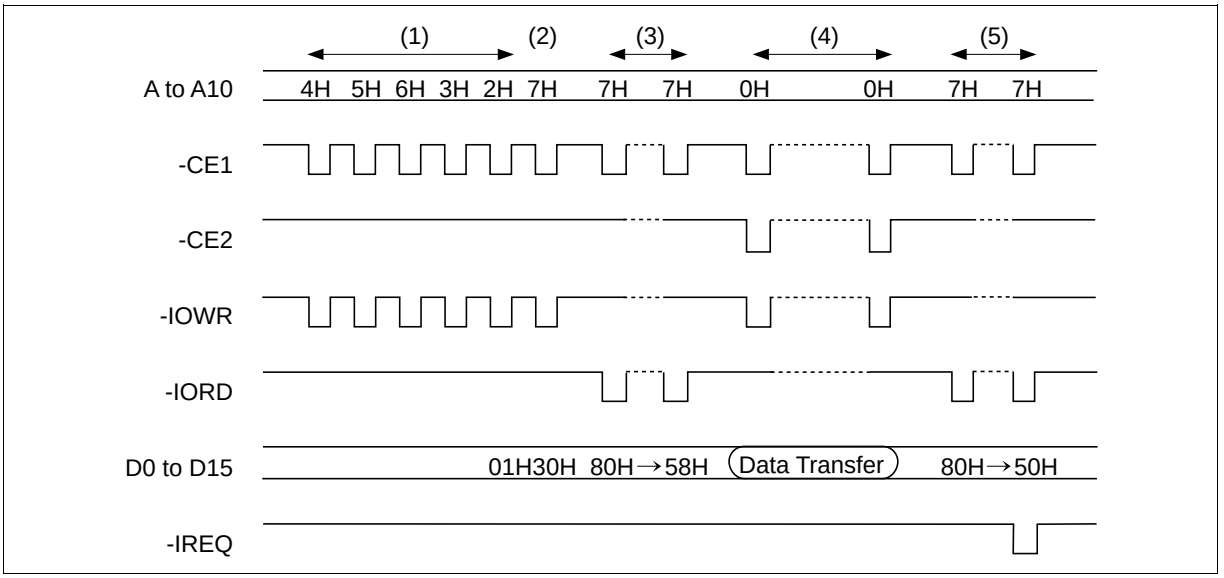
1. Sector read: 1 sector read procedure after the card configured I/O interface is shown as follows.




(1)
(2)
(3)
(4)
(5)
A to A10
4H 5H 6H 3H 2H 7H 7H 7H 0H 0H 7H 7H
-CE1
-CE2
-IOWR
-IORD
D0 to D15
01H20H 80H→58H
Data Transfer
80H→50H
-IREQ

2. Sector write: 1 sector write procedure after the card configured I/O interface is shown as follows.




(1)
(2)
(3)
(4)
(5)
A to A10
4H 5H 6H 3H 2H 7H 7H 7H 0H 0H 7H 7H
-CE1
-CE2
-IOWR
-IORD
D0 to D15
01H30H 80H→58H
Data Transfer
80H→50H
-IREQ

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	Note
All input/output voltages	Vin, Vout	–0.3 to V_{CC} + 0.3	V	1
V_{CC} voltage	V_{CC}	–0.3 to +6.5	V	
Operating temperature range	Topr	0 to +60	°C	
Storage temperature range	Tstg	–20 to +65	°C	

Note: 1. Vin, Vout min = –2.0 V for pulse width ≤ 20 ns.

Recommended DC Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Note
Operating temperature	Ta	0	25	60	˚C	
V_{CC} voltage	V_{CC}	4.5	5.0	5.5	V	

Capacitance (Ta = 25˚C, f = 1MHz)

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
Input capacitance	Cin	—	—	35	pF	Vin = 0 V
Output capacitance	Cout	—	—	35	pF	Vout = 0 V

System Performance

Item	Performance
Set up times (Reset to ready)	250 ms (max)
Set up times (Sleep to idle)	2 ms (max)
Data transfer rate to/from host	8 MB/s burst
Controller overhead (Command to DRQ)	2 ms (max)
Data transfer cycle end to ready (Sector write)	2 ms (typ)

DC Characteristics-1 (Ta = 0 to +60˚C, V_{CC} = 5.0 V ± 10%)

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions	Note
Input leakage current	I_{LI}	—	—	± 1	µA	Vin = GND to V_{CC}	1
Input voltage (CMOS)	V_{IL}	–0.3	—	0.8	V		
	V_{IH}	4.0	—	V_{CC} + 0.2	V		
Input voltage (schmitt trigger)	V_{IL}	—	2.0	—	V		
	V_{IH}	—	2.8	—	V		
Output voltage	V_{OL}	—	—	0.4	V	I_{OL} = 8 mA	
	V_{OH}	V_{CC} – 0.8	—	—	V	I_{OH} = –8 mA	

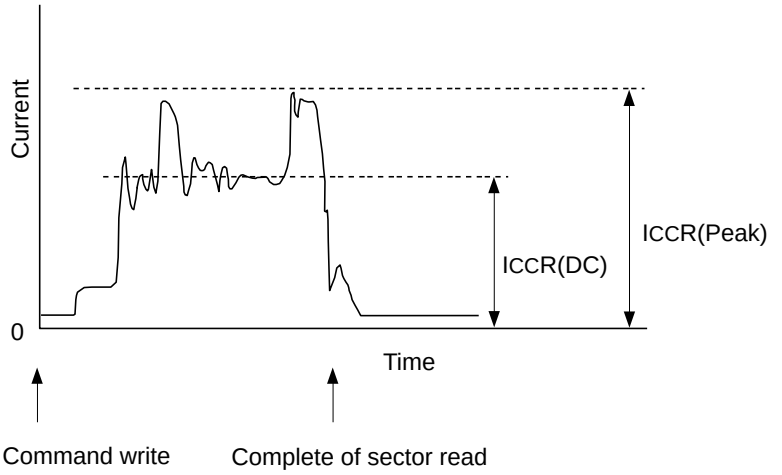
Note: 1. Except pulled up input pin.

DC Characteristics-2 (Ta = 0 to +60˚C, V_{CC} = 5.0 V ± 10%)

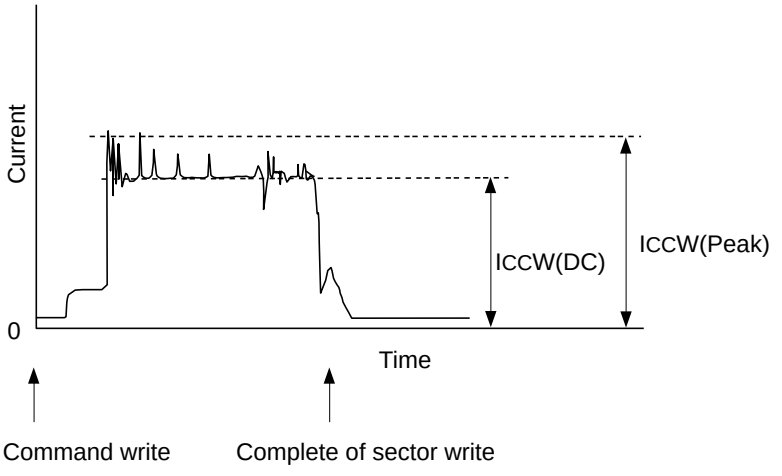
Parameter	Symbol	Typ	Max	Unit	Test conditions
Sleep/standby current	I_{SP1}	2	3	mA	CMOS level (control signal = V_{CC} – 0.2 V)
Sector read current	I_{CCR} (DC)	70	100	mA	CMOS level (control signal = V_{CC} – 0.2 V) between sector read transfer
	I_{CCR} (Peak)	100	150		
Sector write current	I_{CCW} (DC)	70	100	mA	CMOS level (control signal = V_{CC} – 0.2 V) between sector write transfer
	I_{CCW} (Peak)	100	150		

DC Current Waveform (Example of sector read or write: V_{CC} = 5 V, Ta = 25˚C)

Sector Read



Sector Write

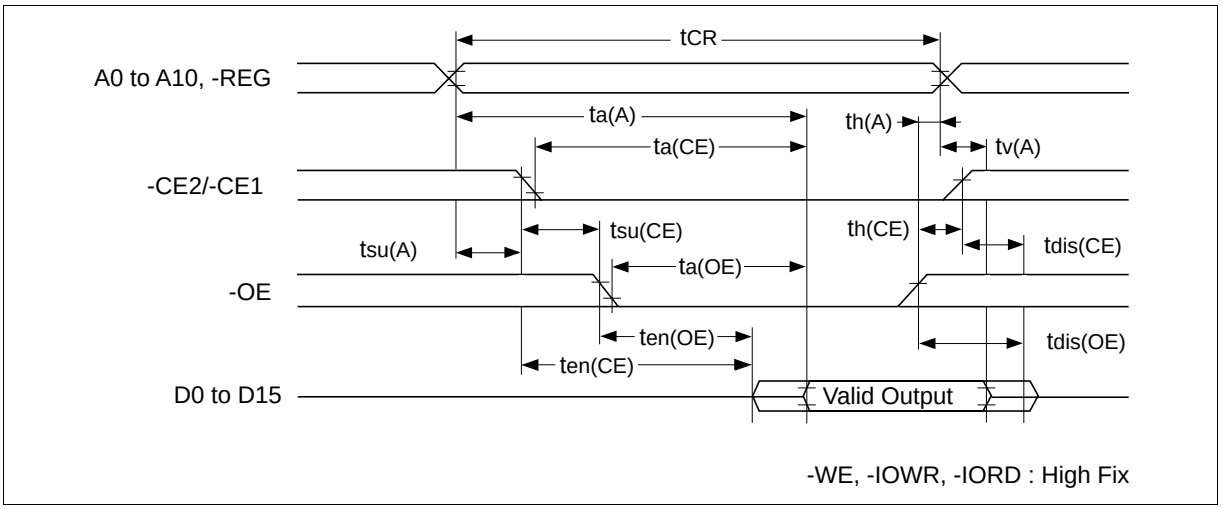


AC Characteristics (Ta = 0 to +60˚C, V_{CC} = 5 V ± 10%)

Attribute Memory Read AC Characteristics

		250 ns			
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Read cycle time	tCR	250	—	—	ns
Address access time	ta(A)	—	—	250	ns
-CE access time	ta(CE)	—	—	250	ns
-OE access time	ta(OE)	—	—	125	ns
Output disable time (-CE)	tdis(CE)	—	—	100	ns
Output disable time (-OE)	tdis(OE)	—	—	100	ns
Output enable time (-CE)	ten(CE)	5	—	—	ns
Output enable time (-OE)	ten(OE)	5	—	—	ns
Data valid time (A)	tv(A)	0	—	—	ns
Address setup time	tsu(A)	30	—	—	ns
Address hold time	th(A)	20	—	—	ns
-CE setup time	tsu(CE)	0	—	—	ns
-CE hold time	th(CE)	20	—	—	ns

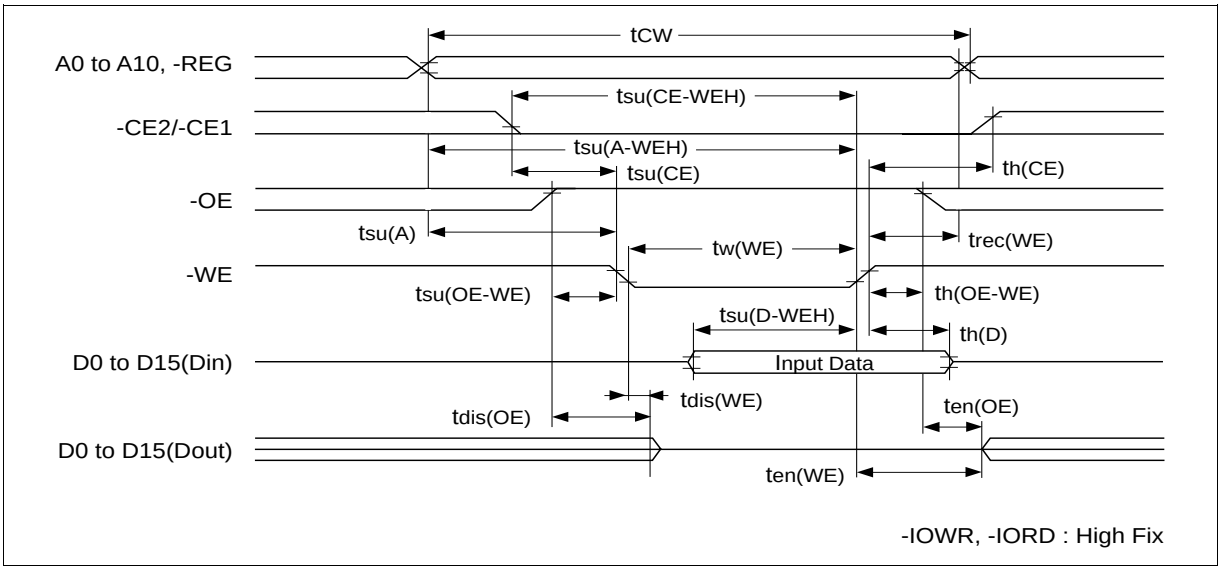
Attribute Memory Read Timing



Attribute Memory Write AC Characteristics

		250 ns			
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Write cycle time	tCW	250	—	—	ns
Write pulse time	tw(WE)	150	—	—	ns
Address setup time	tsu(A)	30	—	—	ns
Address setup time (-WE)	tsu(A-WEH)	180	—	—	ns
-CE setup time (-WE)	tsu(CE-WEH)	180	—	—	ns
Data setup time (-WE)	tsu(D-WEH)	80	—	—	ns
Data hold time	th(D)	30	—	—	ns
Write recover time	trec(WE)	30	—	—	ns
Output disable time (-WE)	tdis(WE)	—	—	100	ns
Output disable time (-OE)	tdis(OE)	—	—	100	ns
Output enable time (-WE)	ten(WE)	5	—	—	ns
Output enable time (-OE)	ten(OE)	5	—	—	ns
Output enable setup time (-WE)	tsu(OE-WE)	10	—	—	ns
Output enable hold time (-WE)	th(OE-WE)	10	—	—	ns
-CE setup time	tsu(CE)	0	—	—	ns
-CE hold time	th(CE)	20	—	—	ns

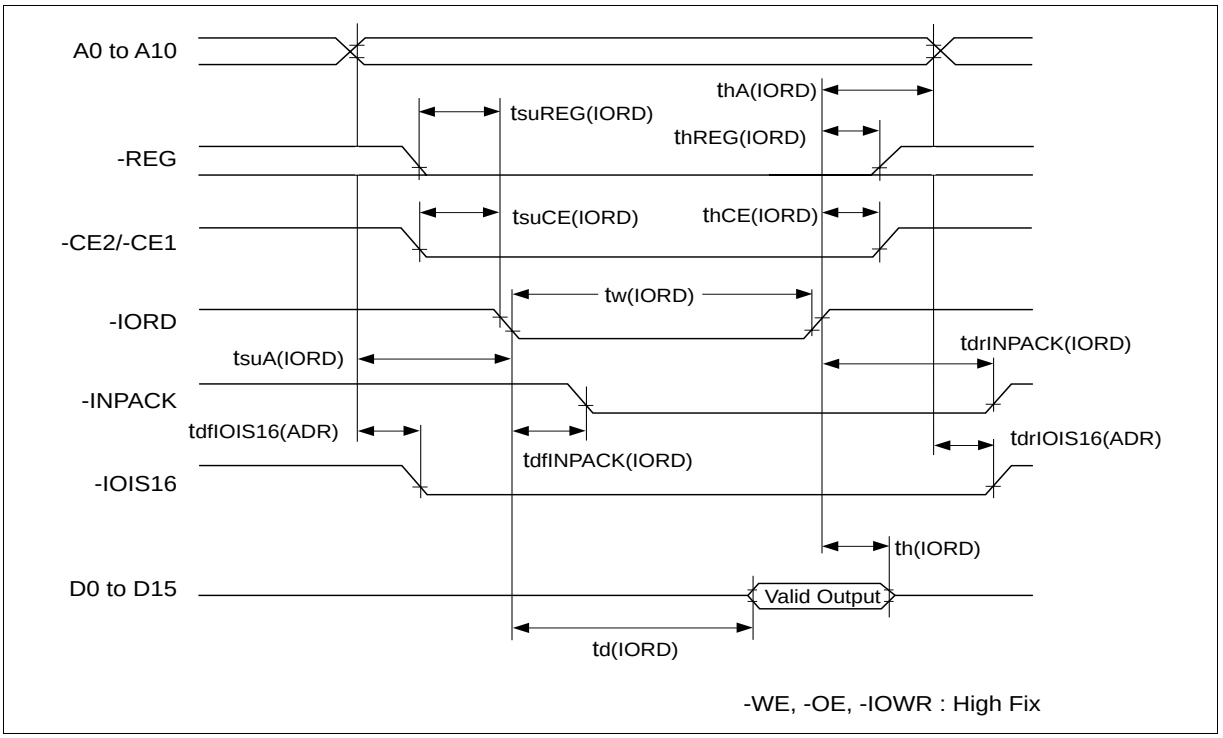
Attribute Memory Write Timing



I/O Access Read AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Data delay after -IORD	td(IORD)	—	—	100	ns
Data hold following -IORD	th(IORD)	0	—	—	ns
-IORD pulse width	tw(IORD)	165	—	—	ns
Address setup before -IORD	tsuA(IORD)	70	—	—	ns
Address hold following -IORD	thA(IORD)	20	—	—	ns
-CE setup before -IORD	tsuCE(IORD)	5	—	—	ns
-CE hold following -IORD	thCE(IORD)	20	—	—	ns
-REG setup before -IORD	tsuREG(IORD)	5	—	—	ns
-REG hold following -IORD	thREG(IORD)	0	—	—	ns
-INPACK delay falling from -IORD	tdfINPCAK(IORD)	0	—	45	ns
-INPACK delay rising from -IORD	tdrINPACK(IORD)	—	—	45	ns
-IOIS16 delay falling from address	tdfIOIS16(IORD)	—	—	35	ns
-IOIS16 delay rising from address	tdrIOIS16(IORD)	—	—	35	ns

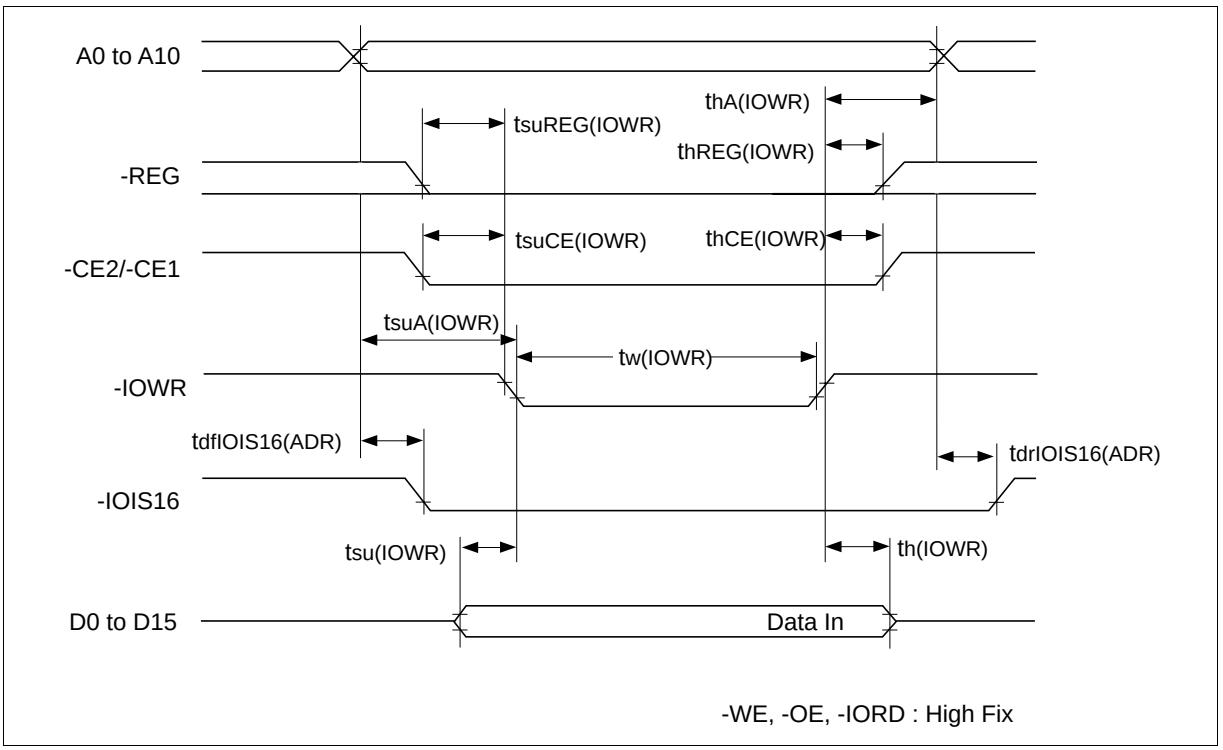
I/O Access Read Timing



I/O Access Write AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Data setup before -IOWR	tsu(IOWR)	60	—	—	ns
Data hold following -IOWR	th(IOWR)	30	—	—	ns
-IOWR pulse width	tw(IOWR)	165	—	—	ns
Address setup before -IOWR	tsuA(IOWR)	70	—	—	ns
Address hold following -IOWR	thA(IOWR)	20	—	—	ns
-CE setup before -IOWR	tsuCE(IOWR)	5	—	—	ns
-CE hold following -IOWR	thCE(IOWR)	20	—	—	ns
-REG setup before -IOWR	tsuREG(IOWR)	5	—	—	ns
-REG hold following -IOWR	thREG(IOWR)	0	—	—	ns
-IOIS16 delay falling from address	tdfIOIS16(ADR)	—	—	35	ns
-IOIS16 delay rising from address	tdrIOIS16(ADR)	—	—	35	ns

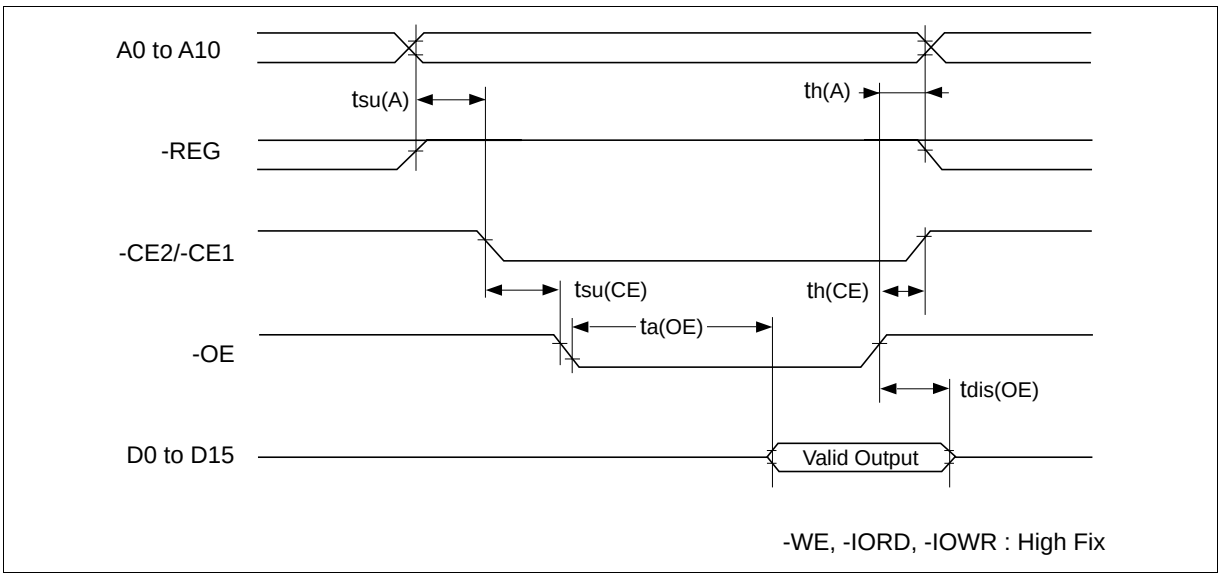
I/O Access Write Timing



Common Memory Access Read AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
-CE access time	ta(OE)	—	—	125	ns
Output disable time (-OE)	tdis(OE)	—	—	100	ns
Address setup time	tsu(A)	30	—	—	ns
Address hold time	th(A)	20	—	—	ns
-CE setup time	tsu(CE)	0	—	—	ns
-CE hold time	th(CE)	20	—	—	ns

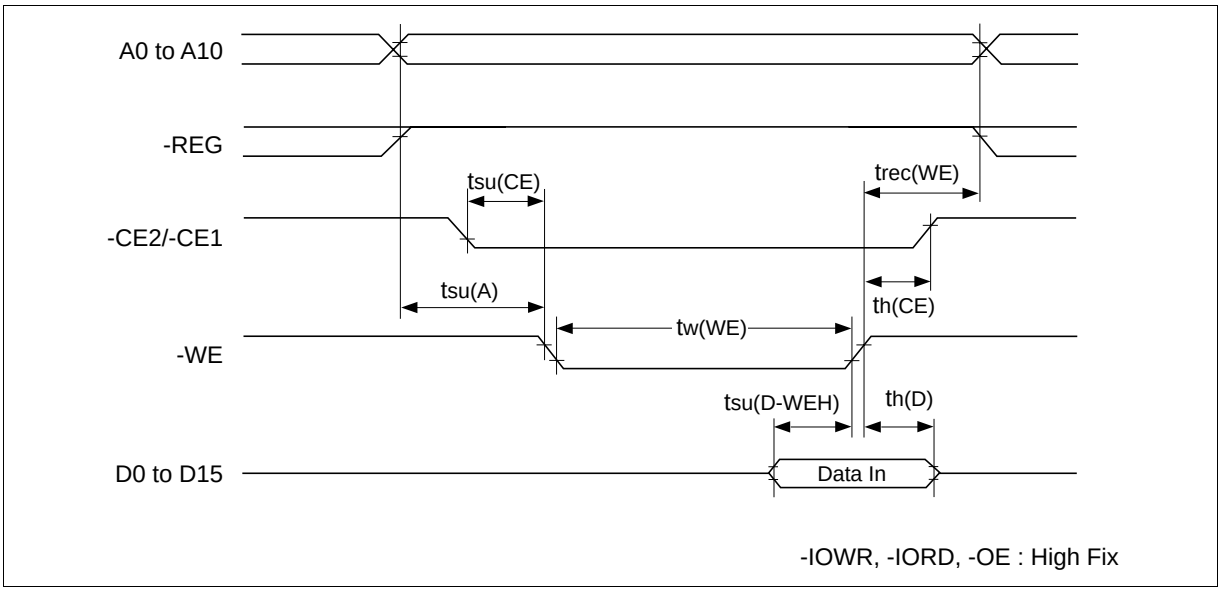
Common Access Read Timing



Common Memory Access Write AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Data setup time (-WE)	tsu(D-WEH)	80	—	—	ns
Data hold time	th(D)	30	—	—	ns
Write pulse time	tw(WE)	150	—	—	ns
Address setup time	tsu(A)	30	—	—	ns
-CE setup time	tsu(CE)	0	—	—	ns
Write recover time	trec(WE)	30	—	—	ns
-CE hold following -WE	th(CE)	20	—	—	ns

Common Access Write Timing



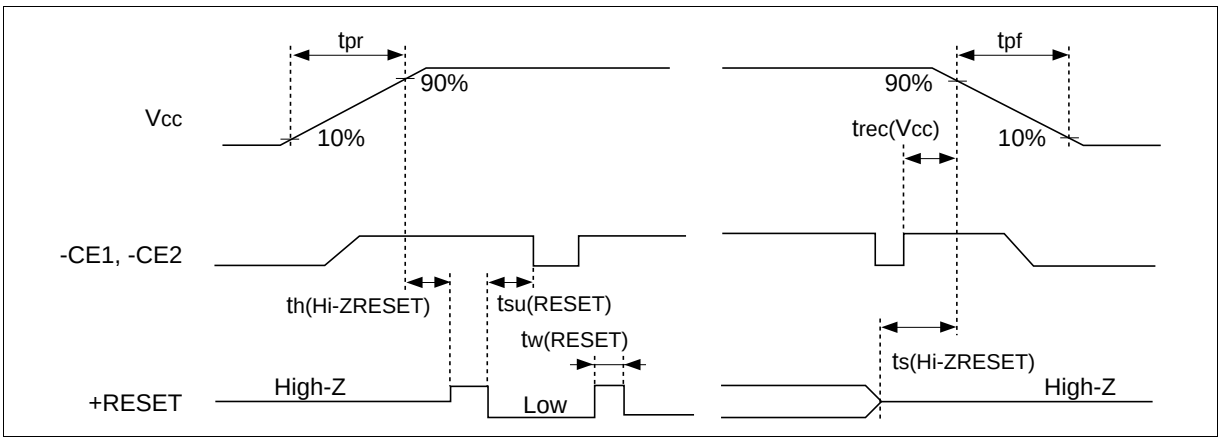
-IOWR, -IORD, -OE : High Fix

Reset Characteristics

Hard Reset Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
Reset setup time	tSU(RESET)	250	—	—	ms	
-CE recover time	tREC(VCC)	1	—	—	µs	
VCC rising up time	tpr	0.1	—	100	ms	
VCC falling down time	tpf	3	—	300	ms	
Reset pulse width	tW(RESET)	10	—	—	µs	
	th(Hi-ZRESET)	1	—	—	ms	
	ts(Hi-ZRESET)	0	—	—	ms	

Hard Reset Timing

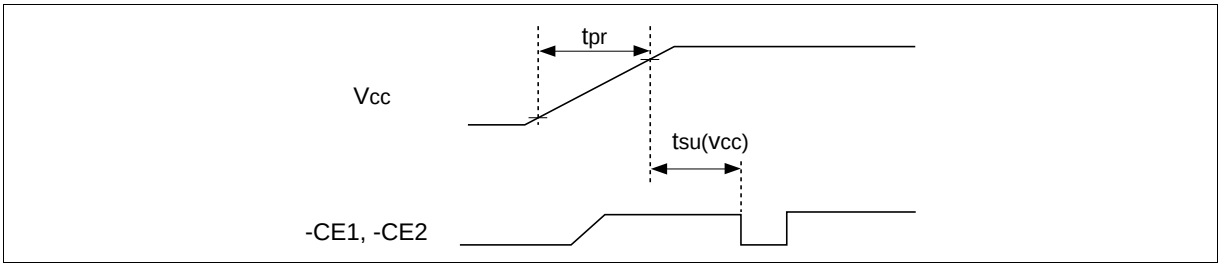


Power on Reset Characteristics

All card status are reset automatically when V_{CC} voltage goes over about 2.3 V.

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
-CE setup time	tSU(VCC)	250	—	—	ms	
VCC rising up time	tpr	0.1	—	100	ms	

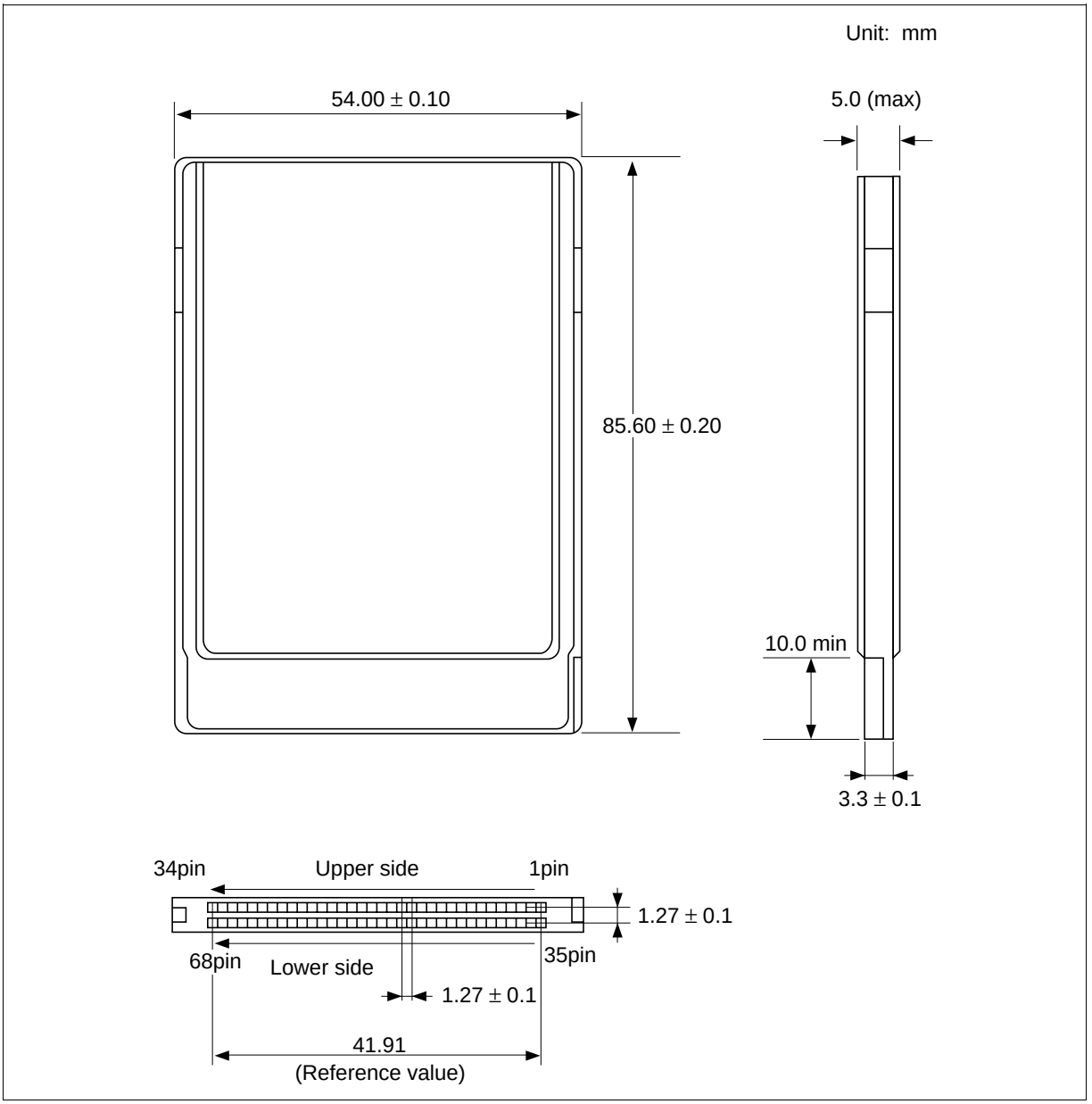
Power on Reset Timing



Attention for Card Use

- In the reset or power off, all register informations are cleared.
- All card status are cleared automatically when Vcc voltage turns below about 2.5V.
- After the card hard reset, soft reset, or power on reset, the card cannot access during +READY pin is "low" level.
- Please notice that the card insertion/removal should be executed after card internal operations completed (status register bit 7 turns from "1" to "0").

Physical Outline



When using this document, keep the following in mind:

1. This document may, wholly or partially, be subject to change without notice.
2. All rights are reserved: No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without Hitachi's permission.
3. Hitachi will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user's unit according to this document.
4. Circuitry and other examples described herein are meant merely to indicate the characteristics and performance of Hitachi's semiconductor products. Hitachi assumes no responsibility for any intellectual property claims or other problems that may result from applications based on the examples described herein.
5. No license is granted by implication or otherwise under any patents or other rights of any third party or Hitachi, Ltd.
6. MEDICAL APPLICATIONS: Hitachi's products are not authorized for use in MEDICAL APPLICATIONS without the written consent of the appropriate officer of Hitachi's sales company. Such use includes, but is not limited to, use in life support systems. Buyers of Hitachi's products are requested to notify the relevant Hitachi sales offices when planning to use the products in MEDICAL APPLICATIONS.

HITACHI

Hitachi, Ltd.
Semiconductor & IC Div.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100, Japan
Tel: Tokyo (03) 3270-2111
Fax: (03) 3270-5109

For further information write to:

Hitachi America, Ltd.
Semiconductor & IC Div.
2000 Sierra Point Parkway
Brisbane, CA. 94005-1835
U S A
Tel: 415-589-8300
Fax: 415-583-4207

Hitachi Europe GmbH
Electronic Components Group
Continental Europe
Dornacher Straße 3
D-85622 Feldkirchen
München
Tel: 089-9 91 80-0
Fax: 089-9 29 30 00

Hitachi Europe Ltd.
Electronic Components Div.
Northern Europe Headquarters
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA
United Kingdom
Tel: 0628-585000
Fax: 0628-778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 0104
Tel: 535-2100
Fax: 535-1533

Hitachi Asia (Hong Kong) Ltd.
Unit 706, North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon
Hong Kong
Tel: 27359218
Fax: 27306071

Revision Record

Rev.	Date	Contents of Modification	Drawn by	Approved by
0.0	Jun. 31, 1996	Initial issue	T. Kikuchi	K. Inoue
1.0	Nov. 20, 1996	Change of description for Card Pin Explanation Change of Socket and Copy register Change of CIS informations Change of Task File register specification Sector Transfer Protocol Change of timing waveforms: Sector read and Sector write System Performance Start up times max: 2 s (15MB)/10 s (75MB) to 250 ms DC Characteristics (1) Addition of note1 DC Characteristics (2) I_{SP1} typ: 1 mA to 2 mA I_{SP1} max: 2 mA to 3 mA AC Characteristics Common Memory Access Write AC Characteristics Addition of th(CE) min: 20 ns Change of Common Access Write Timing Power on Reset Characteristics tpr max: 300 ms to 100 ms Physical Outline Card width: 5.0 ± 0.20 to 5.0 (max)	T. Kikuchi	K. Inoue
2.0	Feb. 28, 1997	Change of description for Card Pin Explanation Change of description for Card Function Explanation Change of Task File register specification AC Characteristics Reset Characteristics tSU(RESET) min: 20 ms to 250 ms Power on Reset Characteristics tSU(VCC) min: 20 ms to 250 ms Change of Physical Outline		