

# **CompactFlash™ Disk**

## **INDUSTRIAL GRADE**

### *W7CFxxxA-H Series*

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## Revision History

| Revision | Month    | Year | History                                                                                                                                                                                                                                                                                                                               |
|----------|----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.0      | February | 2006 | -ROHS Spec Release                                                                                                                                                                                                                                                                                                                    |
| 2.1      | June     | 2006 | -Add Title Page & Revision History<br>-Update Table 28: Identify Drive Information<br>-Update Table 37: Attribute Memory Read AC Characteristics<br>-Update Table 38: Attribute Memory Write AC Characteristics                                                                                                                       |
| 2.2      | June     | 2006 | -Update Table 28: Identify Drive Information<br>-Update Tables 37~42<br>-Update Table 43: True IDE Mode I/O Read/Write Timing<br>-Update Table 44: True IDE DMA Mode I/O Read/Write Timing<br>-Update Figures 14~19<br>-Update Figure 20: True IDE Mode I/O Timing Diagram<br>-Update Figure 21: True IDE DMA Mode I/O Timing Diagram |
| 2.3      | December | 2006 | -Update Table 37 Attribute Memory Read Timing<br>-Update Table 38 Attribute Memory Write Timing<br>-Update Table 39 I/O Access Read Timing<br>-Update Table 41 Common Memory Access Read Timing                                                                                                                                       |
| 2.4      | May      | 2007 | -Update DMA pins' description, Pin 43 DMARQ and 44 DMACK<br>-Update Table 7 Layout                                                                                                                                                                                                                                                    |
| 2.5      | March    | 2008 | -Update new naming scheme for the CF card                                                                                                                                                                                                                                                                                             |
| 2.6      | May      | 2008 | -Update Table 48 Ordering Information and naming guide                                                                                                                                                                                                                                                                                |
| 2.7      | October  | 2008 | -Add section 4.1 Labeling and Marking                                                                                                                                                                                                                                                                                                 |
| 2.8      | November | 2008 | -Add 16GB capacity to the specification                                                                                                                                                                                                                                                                                               |
| 2.9      | January  | 2009 | -Update table 48 with 8GB Real Capacity<br>-Update table 48 key with firmware options                                                                                                                                                                                                                                                 |
| 2.10     | January  | 2010 | -Update the ordering information with firmware options                                                                                                                                                                                                                                                                                |

# CompactFlash™ Card

## INDUSTRIAL GRADE

*WxCfxxxA-H Series ROHS 6/6 Compliant*

### Features

#### GENERAL

- Type I Density up to 16-GB
- 32-bit RISC/DSP Controller
- Solid State Data Storage
- Dual 3.3V / 5V Interface
- Industry Standard Compatibility
- Specialized for High-Reliability
- ROHS 6/6 Compliant

#### PERFORMANCE

- True IDE Mode Capable
  - PIO Mode 0-4
  - DMA Mode 0-2 (Optional)
- High Performance 16.7 MB/s Burst
- Low Power Consumption
- ATA-2 Compliant (w/DMA Enable)

#### RELIABILITY

- > 2,000,000 Program/Erase Cycles
- Industrial Wear Leveling
  - Includes Static Block Management
- Spares & Bad Block Management
- On-Board ECC
  - Corrects up to 6-bytes/Sector
- High Environmental Tolerance
- 10-Year Data Retention
- Unlimited Reads

#### COMPATIBILITY

- CFA Spec, Revision 4.1, Feb 2007
- PCMCIA PC Card Standard, 7.0, February 1999
- PCMCIA PC Card ATA Spec, 7.0, Feb 1999



Wintec Type I CompactFlash™ Card

### Configuration Options

- Industrial Temperature
- Fixed / Removable Disk
- DMA Mode Enable
- Data Programming Service
- Custom Labeling

#### NOTE:

1. See Section 5.0 for Configuration & Ordering Guide

### DESCRIPTION

The Wintec Industries W7CFxxxA-H series of ROHS Compliant Industrial Grade CompactFlash™ Memory Cards are constructed with Samsung NAND-type single-level-cell (SLC) flash memory devices paired to a powerful 32-bit RISC/DSP-based system controller for virtual-to-physical address mapping and other flash management functions.

Wintec Industrial CompactFlash™ Cards employ a variety of sophisticated error checking and flash management utilities allowing for maximum levels of data reliability and card endurance. Patented wear-leveling methods ensure even wear of flash blocks across the entire card capacity. Background operations track erase counts, prioritize new writes to blocks with lower wear, and relocate static data to blocks with higher wear. Bad-block Management routines replace worn blocks with spare blocks reserved by the controller on card initialization. Reed-Solomon based ECC algorithms capable of detecting and correcting up to 6 bytes per 512 byte sector are implemented on the fly without performance degradation to ensure data reliability through user data transfers and background wear-leveling operations. Additional information regarding the specifics of wear leveling, ECC methods, and application-specific card life calculations are available upon request and under NDA.

Industrial grade reliability, industry standard compatibility, and the ability to emulate IDE hard disk drives make Wintec CompactFlash™ Cards ideal for industrial, military, and other high endurance applications.

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## 1.0 General Product Specification

For all the following specifications, values are defined at ambient temperature and nominal supply voltage unless otherwise stated.

**Table 1: Performance Specifications**

| Parameter                         |                          | Spec         |
|-----------------------------------|--------------------------|--------------|
| Burst Transfer Rate To/From Host  |                          | 16.6 MB/s    |
| Burst Transfer Rate To/From Flash |                          | 20.0 MB/s    |
| Sustained Read (Typical)          |                          | 8.0 MB/s     |
| Sustained Write (Typical)         |                          | 6.0 MB/s     |
| Active-to-Sleep Delay             |                          | Programmable |
| Command-to-DRQ (Max.)             |                          | 50.0 ms      |
| Startup Times                     | Sleep-to-Write (Max.)    | 2.5 ms       |
|                                   | Sleep-to-Read (Max.)     | 20 ms        |
|                                   | Reset-to-Ready (Typical) | 50.0 ms      |
|                                   | Reset-to-Ready (Max.)    | 400.0 ms     |

NOTE:

1. All performance figures are based on testing done in True IDE PIO Mode 4.

**Table 2: Card Endurance**

| Parameter            | Spec               |
|----------------------|--------------------|
| Program/Erase Cycles | > 2,000,000 Cycles |
| Read Cycles          | Unlimited          |
| Data Retention       | 10 Years (Min.)    |
| MTBF                 | > 4,000,000 Hours  |

**Table 3: Card Data Reliability**

| Parameter              | Spec                        |
|------------------------|-----------------------------|
| Non-Recoverable Errors | < 1 in $10^{14}$ Bytes Read |
| Erroneous Correction   | < 1 in $10^{20}$ Bytes Read |
| ECC Correctability     | 6 Bytes/Sector              |
| ECC Detectability      | 6 Bytes/Sector              |

**Table 4: Environmental Specifications**

| Parameters  |                  | Operating                     | Non-Operating                 |
|-------------|------------------|-------------------------------|-------------------------------|
| Temperature | Standard Temp.   | 0°C to 70°C                   | -55°C to 95°C                 |
|             | Industrial Temp. | -40°C to 85°C                 | -55°C to 95°C                 |
| Humidity    |                  | 8% to 95%<br>(Non-Condensing) | 8% to 95%<br>(Non-Condensing) |
| Vibration   |                  | 16.3 G rms                    | N/A                           |
| Altitude    |                  | 80,000 ft. (Max.)             |                               |
| Shock       |                  | 2,000 G (Max.)                |                               |
| Acoustic    |                  | 0 db                          |                               |

**Table 5: Power Consumption**

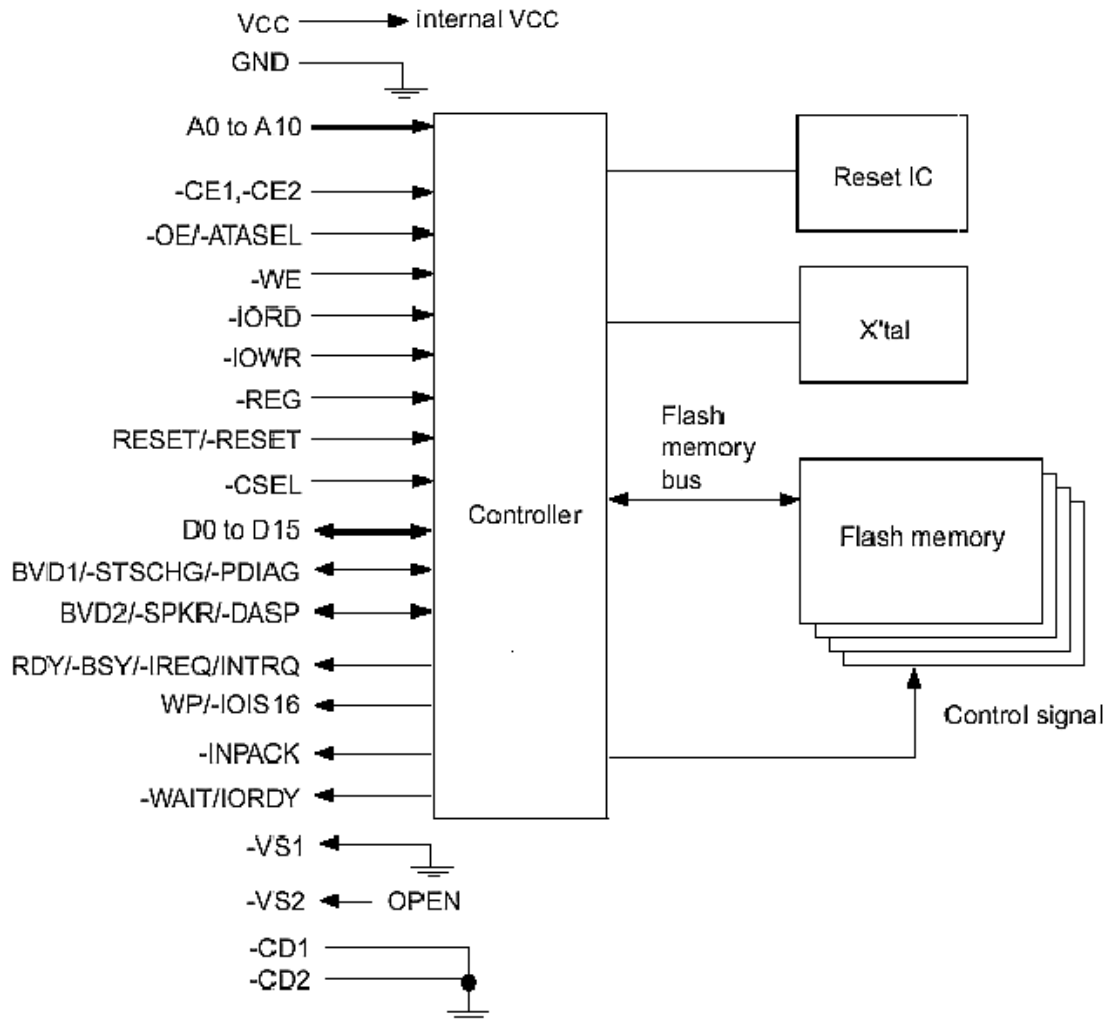
| Capacity | Sleep (Max) | Read/Write (Typical) | Read/Write (Max) |
|----------|-------------|----------------------|------------------|
| 32MB     | 300 $\mu$   | 40 mA                | 50 mA            |
| 64MB     | 300 $\mu$   | 40 mA                | 50 mA            |
| 128MB    | 300 $\mu$   | 40 mA                | 50 mA            |
| 256MB    | 300 $\mu$   | 40 mA                | 50 mA            |
| 512MB    | 450 $\mu$   | 45.02mA              | 60.10mA          |
| 1-GB     | 450 $\mu$   | 45.02mA              | 60.10mA          |
| 2-GB     | 600 $\mu$   | 45.06mA              | 60.30mA          |
| 4-GB     | 600 $\mu$   | 45.06mA              | 60.30mA          |
| 8-GB     | 600 $\mu$   | 45.06mA              | 60.30mA          |

NOTE:

1. Input voltage 3.3V ( $\pm 5\%$ ) or 5V ( $\pm 10\%$ ) with a maximum ripple of 100mV peak-to-peak.

2. All values listed are at 25°C and nominal supply voltage.

3. Stated figures are based on primary configurations and may vary as larger density component NAND flashes are released.



**Figure 1: Card Block Diagram**

**NOTE:** -CE1, -CE2, -OE, -WE, -IORD, -IOWR, -REG, -RESET, -CSEL, -PDIAG, -DASP pins are pulled up in card. -CE1, -CE2, -OE, -WE, -IORD, -IOWR, -REG pins are Schmitt trigger type input buffer.

**Table 6: Card Pin Assignment**

| PC Card Memory Mode |                   |        | PC Card I/O Mode |                   |        | True IDE Mode |                   |        |
|---------------------|-------------------|--------|------------------|-------------------|--------|---------------|-------------------|--------|
| Pin                 | Signal            | Type   | Pin              | Signal            | Type   | Pin           | Signal            | Type   |
| 1                   | GND               | Ground | 1                | GND               | Ground | 1             | GND               | Ground |
| 2                   | D03               | I/O    | 2                | D03               | I/O    | 2             | D03               | I/O    |
| 3                   | D04               | I/O    | 3                | D04               | I/O    | 3             | D04               | I/O    |
| 4                   | D05               | I/O    | 4                | D05               | I/O    | 4             | D05               | I/O    |
| 5                   | D06               | I/O    | 5                | D06               | I/O    | 5             | D06               | I/O    |
| 6                   | D07               | I/O    | 6                | D07               | I/O    | 6             | D07               | I/O    |
| 7                   | -CE1              | I      | 7                | -CE1              | I      | 7             | -CS0              | I      |
| 8                   | A10               | I      | 8                | A10               | I      | 8             | A10 <sup>2</sup>  | I      |
| 9                   | -OE               | I      | 9                | -OE               | I      | 9             | -ATA SEL          | I      |
| 10                  | A09               | I      | 10               | A09               | I      | 10            | A09 <sup>2</sup>  | I      |
| 11                  | A08               | I      | 11               | A08               | I      | 11            | A08 <sup>2</sup>  | I      |
| 12                  | A07               | I      | 12               | A07               | I      | 12            | A07 <sup>2</sup>  | I      |
| 13                  | VCC               | Power  | 13               | VCC               | Power  | 13            | VCC               | Power  |
| 14                  | A06               | I      | 14               | A06               | I      | 14            | A06 <sup>2</sup>  | I      |
| 15                  | A05               | I      | 15               | A05               | I      | 15            | A05 <sup>2</sup>  | I      |
| 16                  | A04               | I      | 16               | A04               | I      | 16            | A04 <sup>2</sup>  | I      |
| 17                  | A03               | I      | 17               | A03               | I      | 17            | A03 <sup>2</sup>  | I      |
| 18                  | A02               | I      | 18               | A02               | I      | 18            | A02               | I      |
| 19                  | A01               | I      | 19               | A01               | I      | 19            | A01               | I      |
| 20                  | A00               | I      | 20               | A00               | I      | 20            | A00               | I      |
| 21                  | D00               | I/O    | 21               | D00               | I/O    | 21            | D00               | I/O    |
| 22                  | D01               | I/O    | 22               | D01               | I/O    | 22            | D01               | I/O    |
| 23                  | D02               | I/O    | 23               | D02               | I/O    | 23            | D02               | I/O    |
| 24                  | WP                | O      | 24               | -IOIS16           | O      | 24            | -IOCS16           | O      |
| 25                  | -CD2              | O      | 25               | -CD2              | O      | 25            | -CD2              | O      |
| 26                  | -CD1              | O      | 26               | -CD1              | O      | 26            | -CD1              | O      |
| 27                  | D11 <sup>1</sup>  | I/O    | 27               | D11 <sup>1</sup>  | I/O    | 27            | D11 <sup>1</sup>  | I/O    |
| 28                  | D12 <sup>1</sup>  | I/O    | 28               | D12 <sup>1</sup>  | I/O    | 28            | D12 <sup>1</sup>  | I/O    |
| 29                  | D13 <sup>1</sup>  | I/O    | 29               | D13 <sup>1</sup>  | I/O    | 29            | D13 <sup>1</sup>  | I/O    |
| 30                  | D14 <sup>1</sup>  | I/O    | 30               | D14 <sup>1</sup>  | I/O    | 30            | D14 <sup>1</sup>  | I/O    |
| 31                  | D15 <sup>1</sup>  | I/O    | 31               | D15 <sup>1</sup>  | I/O    | 31            | D15 <sup>1</sup>  | I/O    |
| 32                  | -CE2 <sup>1</sup> | I      | 32               | -CE2 <sup>1</sup> | I      | 32            | -CS1 <sup>1</sup> | I      |
| 33                  | -VS1              | O      | 33               | -VS1              | O      | 33            | -VS1              | O      |
| 34                  | -IORD             | I      | 34               | -IORD             | I      | 34            | -IORD             | I      |
| 35                  | -IOWR             | I      | 35               | -IOWR             | I      | 35            | -IOWR             | I      |
| 36                  | -WE               | I      | 36               | -WE               | I      | 36            | -WE <sup>3</sup>  | I      |
| 37                  | RDY/BSY           | O      | 37               | IREQ              | O      | 37            | INTRQ             | O      |
| 38                  | VCC               | Power  | 38               | VCC               | Power  | 38            | VCC               | Power  |
| 39                  | -CSEL             | I      | 39               | -CSEL             | I      | 39            | -CSEL             | I      |
| 40                  | -VS2              | O      | 40               | -VS2              | O      | 40            | -VS2              | O      |
| 41                  | RESET             | I      | 41               | RESET             | I      | 41            | RESET             | I      |
| 42                  | -WAIT             | O      | 42               | -WAIT             | O      | 42            | IORDY             | O      |
| 43                  | -INPACK           | O      | 43               | -INPACK           | O      | 43            | DMARQ             | O      |
| 44                  | -REG              | I      | 44               | -REG              | I      | 44            | -DMACK            | I      |
| 45                  | BVD2              | I/O    | 45               | -SPKR             | I/O    | 45            | -DASP             | I/O    |
| 46                  | BVD1              | I/O    | 46               | -STSCHG           | I/O    | 46            | -PDIAG            | I/O    |
| 47                  | D08 <sup>1</sup>  | I/O    | 47               | D08 <sup>1</sup>  | I/O    | 47            | D08 <sup>1</sup>  | I/O    |
| 48                  | D09 <sup>1</sup>  | I/O    | 48               | D09 <sup>1</sup>  | I/O    | 48            | D09 <sup>1</sup>  | I/O    |
| 49                  | D10 <sup>1</sup>  | I/O    | 49               | D10 <sup>1</sup>  | I/O    | 49            | D10 <sup>1</sup>  | I/O    |
| 50                  | GND               | Ground | 50               | GND               | Ground | 50            | GND               | Ground |

**NOTE:**

1. These signals are required only for 16-bit access and not required when installed in 8-bit systems. For lowest power dissipation, leave these signals open.
2. Should be grounded by the host.
3. Should be tied to VCC by the host.

**Table 7: Card Pin Explanation**

| Signal Name                                     | Type | Pin #                 | Description                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------|------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A10 - A0<br>(PC Card Memory Mode)               | I    | 8, 10, 11, 12, 14 -20 | These address lines along with the –REG signal are used to select the following: The I/O port address registers within the Compact Flash Card, the memory mapped port address registers within the card, a byte in the card's information structure and its configuration control and status registers. |
| A10 - A0<br>(PC Card I/O Mode)                  |      |                       | This signal is the same as the PC Card Memory Mode signal.                                                                                                                                                                                                                                              |
| A2 - A0<br>(True IDE Mode)                      |      | 18, 19, 20            | In True IDE Mode only A[2:0] is used to select the one of eight registers in the Task File.                                                                                                                                                                                                             |
| A10 - A3<br>(True IDE Mode)                     |      |                       | In True IDE Mode these remaining address lines should be grounded by the host.                                                                                                                                                                                                                          |
| BVD1<br>(PC Card Memory Mode)                   | I/O  | 46                    | This signal is asserted high as the BVD1 signal since a battery is not used with this product.                                                                                                                                                                                                          |
| -STSCHG<br>(PC Card I/O Mode)<br>Status Changed |      |                       | This signal is asserted low to alert the host to changes in the RDY/ -BSY and Write Protect states, while the I/O interface is configured. Its use is controlled by the Card Config and Status Register.                                                                                                |
| -PDIAG<br>(True IDE Mode)                       |      |                       | In the True IDE Mode, this input/output is the Pass Diagnostic signal in the Master/Slave handshake protocol.                                                                                                                                                                                           |
| BVD2<br>(PC Card Memory Mode)                   | I/O  | 45                    | This output line is always driven to a high state in Memory Mode since a battery is not required for this product.                                                                                                                                                                                      |
| -SPKR<br>(PC Card I/O Mode)                     |      |                       | This output line is always driven to a high state in I/O Mode since this product does not support the audio function.                                                                                                                                                                                   |
| -DASP<br>(True IDE Mode)                        |      |                       | In the True IDE Mode, this input/output is the Disk Active/Slave Present signal in the Master/Slave handshake protocol.                                                                                                                                                                                 |
| -CD1, -CD2<br>(PC Card Memory Mode)             | O    | 25, 26                | These Card Detect pins are connected to ground on the Compact Flash Card. They are used by the host to determine if the card is fully inserted into its socket.                                                                                                                                         |
| -CD1, -CD2<br>(PC Card I/O Mode)                |      |                       | This signal is the same for all modes.                                                                                                                                                                                                                                                                  |
| -CD1, -CD2<br>(True IDE Mode)                   |      |                       | This signal is the same for all modes.                                                                                                                                                                                                                                                                  |

**Table 7: Card Pin Explanation Cont.**

| Signal Name                                        | Type | Pin #                                 | Description                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------|------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -CE1, -CE2<br>(PC Card Memory Mode)<br>Card Enable | I    | 7, 32                                 | These input signals are used both to select the card and to indicate to the card whether a byte or a word operation is being performed. -CE2 always accesses the odd byte of the word. -CE1 accesses the even byte or the Odd byte of the word depending on A0 and -CE2. A multiplexing scheme based on A0, -CE1, -CE2 allows 8 bit hosts to access all data on D0 -D7. |
| -CE1, -CE2<br>(PC Card I/O Mode)<br>Card Enable    |      |                                       | This signal is the same as the PC Card Memory Mode signal.                                                                                                                                                                                                                                                                                                              |
| -CS0, -CS1<br>(True IDE Mode)                      |      |                                       | In the True IDE Mode -CS0 is the chip select for the task file registers while -CS1 is used to select the Alternate Status Register and the Device Control Register.                                                                                                                                                                                                    |
| -CSEL<br>(PC Card Memory Mode)                     | I    | 39                                    | This signal is not used for this mode.                                                                                                                                                                                                                                                                                                                                  |
| -CSEL<br>(PC Card I/O Mode)                        |      |                                       | This signal is not used for this mode.                                                                                                                                                                                                                                                                                                                                  |
| -CSEL<br>(True IDE Mode)                           |      |                                       | This internally pulled up signal is used to configure this device as a Master or a Slave when configured in the True IDE Mode. When this pin is grounded, this device is configured as a Master. When this pin is open, this device is configured as a Slave.                                                                                                           |
| D15 - D00<br>(PC Card Memory Mode)                 | I/O  | 2-6, 21, 22, 23,<br>27-31, 47, 48, 49 | These lines carry the Data, Commands and Status information between the host and the controller. D00 is the LSB of the Even Byte of the Word. D08 is the LSB of the Odd Byte of the Word.                                                                                                                                                                               |
| D15 - D00<br>(PC Card I/O Mode)                    |      |                                       | These signals are the same as the PC Card Memory Mode signal.                                                                                                                                                                                                                                                                                                           |
| D15 - D00<br>(True IDE Mode)                       |      |                                       | In True IDE Mode all Task File operations occur in byte mode on the low order bus D00 -D07 while all data transfers are 16 bits using D00 -D15.                                                                                                                                                                                                                         |
| GND<br>(PC Card Memory Mode)                       | -    | 1, 50                                 | Ground.                                                                                                                                                                                                                                                                                                                                                                 |
| GND<br>(PC Card I/O Mode)                          |      |                                       | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                  |
| GND<br>(True IDE Mode)                             |      |                                       | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                  |

|                                                    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -INPACK<br>(PC Card Memory Mode)                   | O | 43 | This signal is not used in this mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| -INPACK<br>(PC Card I/O Mode)<br>Input Acknowledge |   |    | The Input Acknowledge signal is asserted by the Compact Flash Card when the card is selected and responding to an I/O read cycle at the address that is on the address bus. This signal is used by the host to control the enable of any input data buffers between the card and the CPU.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| DMARQ<br>(True IDE Mode)                           |   |    | <p>This signal is a DMA Request that is used for DMA data transfers between host and device. It shall be asserted by the device when it is ready to transfer data to or from the host. For Multiword DMA transfers, the direction of data transfer is controlled by DIOR- and DIOW-. This signal is used in a handshake manner with DMACK- before negating DMAREQ, and reasserting DMAREQ if there is more data to transfer.</p> <p>DMAREQ shall not be driven when the device is not selected.</p> <p>While a DMA operation is in progress, -CS0 and -CS1 shall be held negated and the width of the transfers shall be 16 bits.</p> <p>If there is no hardware support for DMA mode in the host, this output signal is not used and should not be connected at the host. In this case, the BIOS must report that DMA mode is not supported by the host so that the device driver will not attempt DMA mode.</p> <p>A host that does not support DMA mode and implements both PCMCIA and true-IDE modes of operation need not alter the PCMCIA mode connections while in True-IED mode as long as this does not prevent proper operation in any mode.</p> |
| -IORD<br>(PC Card Memory Mode)                     | I | 34 | This signal is not used in this mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| -IORD<br>(PC Card I/O Mode)                        |   |    | This is an I/O Read strobe generated by the host. This signal gates I/O data onto the bus from the Compact Flash Card when the card is configured to use the I/O interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| -IORD<br>(True IDE Mode)                           |   |    | In True IDE Mode, this signal has the same function as in PC Card I/O Mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Table 7: Card Pin Explanation Cont.**

| Signal Name                       | Type | Pin # | Description                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -IOWR<br>(PC Card Memory Mode)    | I    | 35    | This signal is not used in this mode.                                                                                                                                                                                                                                                                                                           |
| - IOWR<br>(PC Card I/O Mode)      |      |       | The I/O Write strobe pulse is used to clock I/O data on the Card Data bus into the Compact Flash controller registers when the card is configured to use the I/O interface. The clocking will occur on the negative to positive edge of the signal (trailing edge).                                                                             |
| - IOWR<br>(True IDE Mode)         |      |       | In True IDE Mode, this signal has the same function as in PC Card I/O Mode.                                                                                                                                                                                                                                                                     |
| -OE<br>(PC Card Memory Mode)      | I    | 9     | This is an Output Enable strobe generated by the host interface. It is used to read data from the Compact Flash Card in Memory Mode and to read the CIS and configuration registers.                                                                                                                                                            |
| -OE<br>(PC Card I/O Mode)         |      |       | In PC Card I/O Mode, this signal is used to read the CIS and configuration registers.                                                                                                                                                                                                                                                           |
| -ATA SEL<br>(True IDE Mode)       |      |       | To enable True IDE Mode this input should be grounded by the host.                                                                                                                                                                                                                                                                              |
| RDY/-BSY<br>(PC Card Memory Mode) | O    | 37    | In Memory Mode this signal is set high when the Compact Flash Card is ready to accept a new data transfer operation and held low when the card is busy. The host memory card socket must provide a pull-up resistor.                                                                                                                            |
| - IREQ<br>(PC Card I/O Mode)      |      |       | At power up and at Reset, the RDY/-BSY signal is held low (busy) until the Compact Flash Card has completed its power up or reset function. The RDY/-BSY signal is held high (disabled from being busy) whenever the following condition is true: The Compact Flash Card has been powered up with +RESET continuously disconnected or asserted. |
| -INTRQ<br>(True IDE Mode)         |      |       | I/O Operation – After the Compact Flash Card has been configured for I/O operation, this signal is used as – Interrupt Request. This line is strobed low to generate a pulse mode interrupt or held low for a level mode interrupt.                                                                                                             |
|                                   |      |       | In True IDE Mode, this signal is the active high Interrupt Request to the host.                                                                                                                                                                                                                                                                 |

**Table 7: Card Pin Explanation Cont.**

| Signal Name                                              | Type | Pin #  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------|------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -REG<br>(PC Card Memory Mode)<br>Attribute Memory Select | I    | 44     | This signal is used during Memory Cycles to distinguish between Common Memory and Register (Attribute) Memory accesses. High for Common Memory, Low for Attribute Memory.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| -REG<br>(PC Card I/O Mode)                               |      |        | The signal must also be active (low) during I/O Cycles when the I/O address is on the Bus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| -DMACK<br>(True IDE Mode)                                |      |        | <p>This is a DMA Acknowledge signal that is asserted by the host in response to DMAREQ to initiate DMA transfers.</p> <p>While DMA operations are not active, the card shall ignore the –DMACK signal, including a floating condition.</p> <p>If DAM operation is not supported by a True-IDE Mode only host, this signal should be driven high or connected to VCC by the host.</p> <p>A host that does not support DMA mode and implements both PCMCIA and True-IDE modes of operation need not alter the PCMCIA mode connections while in True-IDE mode as long as this does not prevent proper operation all modes.</p> |
| -RESET<br>(PC Card Memory Mode)                          | I    | 41     | When the pin is high, this signal resets the Compact Flash Card. The card is Reset only at power up if this pin is left high or open from power-up. The card is also reset when the Soft Reset bit in the Card Configuration Option Register is set.                                                                                                                                                                                                                                                                                                                                                                        |
| -RESET<br>(PC Card I/O Mode)                             |      |        | This signal is the same as the PC Card Memory Mode signal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| -RESET<br>(True IDE Mode)                                |      |        | In the True IDE Mode this input pin is the active low hardware reset from the host.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| VCC<br>(PC Card Memory Mode)                             | -    | 13, 38 | +5, +3.3V power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| VCC<br>(PC Card I/O Mode)                                |      |        | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| VCC<br>(True IDE Mode)                                   |      |        | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| -VS1, -VS2<br>(PC Card Memory Mode)                      | O    | 33, 40 | Voltage Sense Signals. –VS1 is grounded so that the Compact Flash Card CIS can be read at 3.3 volts and –VS2 is open and reserved by PCMCIA for a secondary voltage.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| -VS1, -VS2<br>(PC Card I/O Mode)                         |      |        | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| -VS1, -VS2<br>(True IDE Mode)                            |      |        | This signal is the same for all modes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**Table 7: Card Pin Explanation Cont.**

| Signal Name                    | Type | Pin # | Description                                                                                                                                                                                                                                                  |
|--------------------------------|------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -WAIT<br>(PC Card Memory Mode) | O    | 42    | This signal is not asserted for all modes.                                                                                                                                                                                                                   |
| -WAIT<br>(PC Card I/O Mode)    |      |       | This signal is not asserted for all modes.                                                                                                                                                                                                                   |
| -IORDY<br>(True IDE Mode)      |      |       | This signal is not asserted for all modes.                                                                                                                                                                                                                   |
| -WE<br>(PC Card Memory Mode)   | I    | 36    | This is a signal driven by the host and used for strobing memory write data to the registers of the Compact Flash Card when the card is configured in the memory interface mode. It is also used for writing the configuration registers.                    |
| -WE<br>(PC Card I/O Mode)      |      |       | In PC Card I/O Mode, this signal is used for writing the configuration registers.                                                                                                                                                                            |
| -WE<br>(True IDE Mode)         |      |       | In True IDE Mode this input signal is not used and should be connected to VCC by the host.                                                                                                                                                                   |
| -WP<br>(PC Card Memory Mode)   | O    | 24    | Memory Mode – The Compact Flash Card does not have a write protect switch. This signal is held low after the completion of the reset initialization sequence.                                                                                                |
| -IOIS16<br>(PC Card I/O Mode)  |      |       | I/O Operation – When the Compact Flash Card is configured for I/O Operation, Pin 24 is used for the –I/O Selected is 16 Bit Port (-IOIS16) function. A Low signal indicates that a 16 bit or odd byte only operation can be performed at the addressed port. |
| -IOCS16<br>(True IDE Mode)     |      |       | In True IDE Mode this output signal is asserted low when this device is expecting a word data transfer cycle.                                                                                                                                                |

## 2.0 Card Function Explanation

### 2.1 Attribute Access Specifications

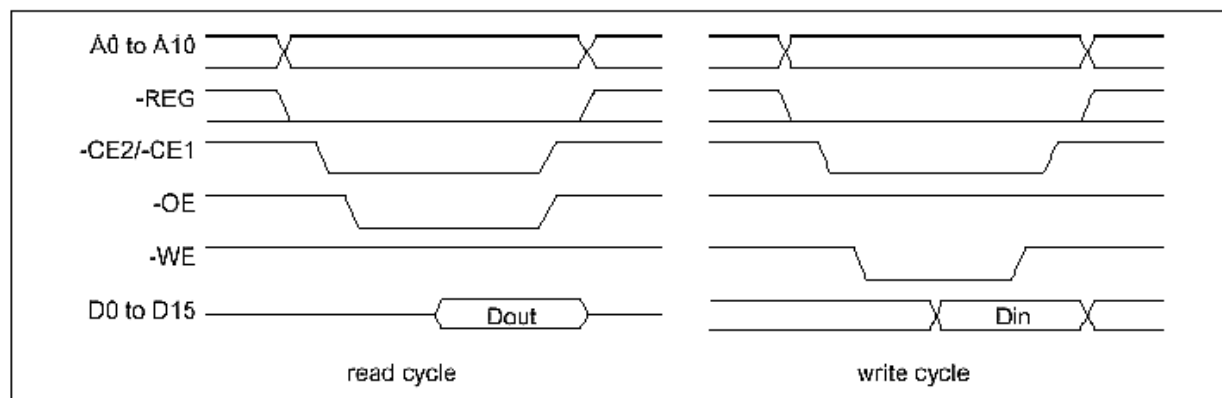
When CIS-ROM region or Configuration register region is accessed, read and write operations are executed under the condition of -REG = "L" as follows. That region can be accessed by Byte/Word/Odd-byte modes, which are defined by PC card standard specifications.

**Table 8: Attribute Read Access Mode**

| Mode                    | -REG | -CE2 | -CE1 | A0 | -OE | -WE | D8 -D15 | D0 -D7    |
|-------------------------|------|------|------|----|-----|-----|---------|-----------|
| Standby mode            |      | 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    |

**Table 9: Attribute Write Access Mode**

| Mode                    | -REG | -CE2 | -CE1 | A0 | -OE | -WE | D8 -D15    | D0 -D7     |
|-------------------------|------|------|------|----|-----|-----|------------|------------|
| Standby mode            |      | 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 |



**Figure 2: Attribute Access Timing Example**

## 2.2 Task File Register Access Specifications

There are two cases of Task File register mapping, one is mapped I/O address area, and 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 modes, which are defined by PC card standard specifications.

### 2.2.1 I/O Address Map

Table 10: Task File Register Read Access Mode (i)

| Mode                    | -REG | -CE2 | -CE1 | A0 | -IORD | -IOWR | -OE | -WE | D8 -D15  | D0 -D7    |
|-------------------------|------|------|------|----|-------|-------|-----|-----|----------|-----------|
| Standby mode            |      | 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    |

Table 11: Task File Register Write Access Mode (i)

| Mode                    | -REG | -CE2 | -CE1 | A0 | -IORD | -IOWR | -OE | -WE | D8 -D15    | D0 -D7     |
|-------------------------|------|------|------|----|-------|-------|-----|-----|------------|------------|
| Standby mode            |      | 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 |

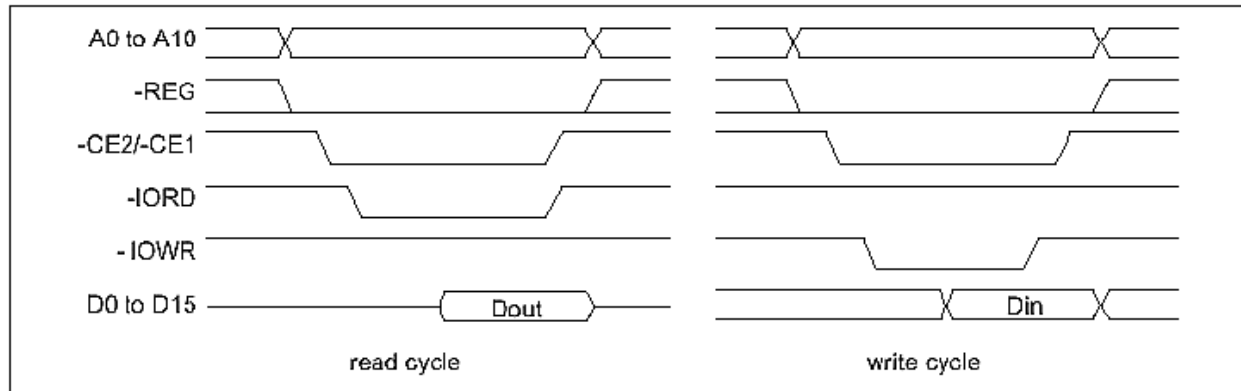


Figure 3: Task File Register Access Timing Example (i)

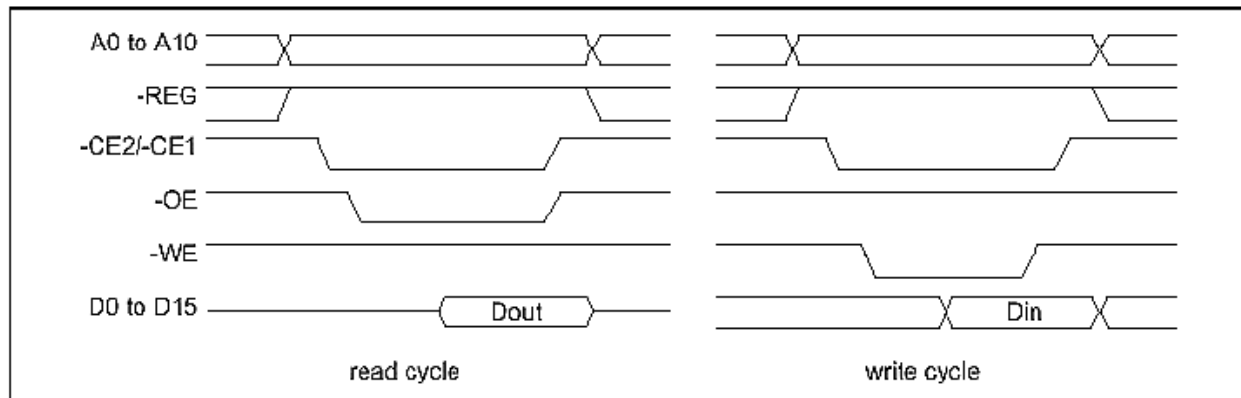
## 2.2.2 Memory Address Map

### Task File Register Read Access Mode (ii)

| Mode                    | -REG | -CE2 | -CE1 | A0 | -IORD | -IOWR | -OE | -WE | D8 -D15  | D0 -D7    |
|-------------------------|------|------|------|----|-------|-------|-----|-----|----------|-----------|
| Standby mode            |      | 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    |

**Table 13: Task File Register Write Access Mode (ii)**

| Mode                    | -REG | -CE2 | -CE1 | A0 | -IORD | -IOWR | -OE | -WE | D8 -D15    | D0 -D7     |
|-------------------------|------|------|------|----|-------|-------|-----|-----|------------|------------|
| Standby mode            |      | 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 |



**Figure 4: Task File Register Access Timing Example (ii)**

### 2.2.3 True IDE Mode

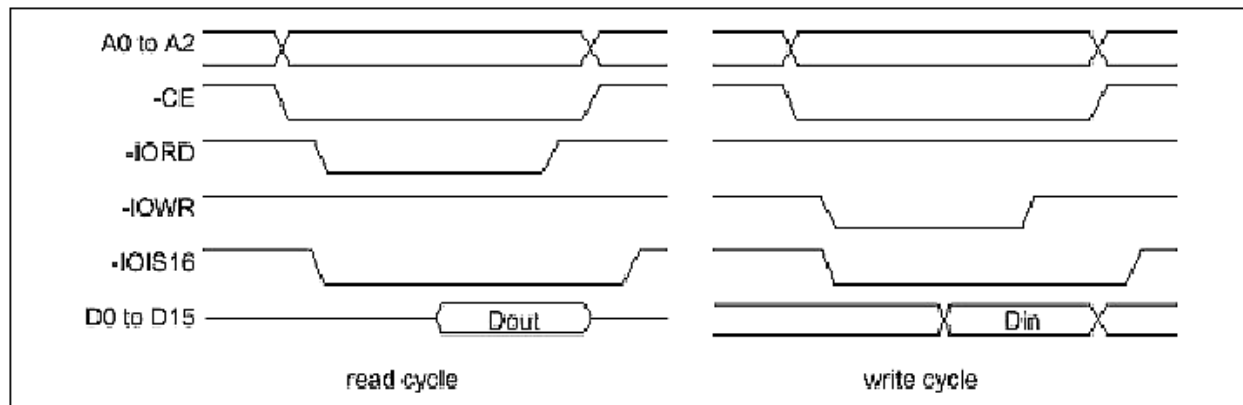
The card can be configured in a True IDE Mode of operation. This card is configured in this mode only when the –OE input signal is asserted GND by the host. In this True IDE Mode Attribute Registers are not accessible from the host. Only I/O operation to the task files and data registers are allowed. If this card is configured during power on sequence, data registers are accessed in word (16-bit). The card permits 8-bit accesses if the user issues a Set Feature Command to put the device in 8-bit mode.

**Table 14: True IDE Mode Read I/O Function**

| Mode                    | -CE2 | -CE1 | A0 -A2 | -IORD | -IOWR | D8 -D15  | D0 -D7     |
|-------------------------|------|------|--------|-------|-------|----------|------------|
| Invalid mode            | L    | L    |        |       |       | High-Z   | High-Z     |
| Standby mode            | H    | H    |        |       |       | High-Z   | High-Z     |
| Data register access    | H    | L    | 0      | L     | H     | Odd byte | Even byte  |
| Alternate status access | L    | H    | 6H     | L     | H     | High-Z   | Status out |
| Other task file access  | H    | L    | 1-7H   | L     | H     | High-Z   | Data       |

**Table 15: True IDE Mode Write I/O Function**

| Mode                    | -CE2 | -CE1 | A0 -A2 | -IORD | -IOWR | D8 -D15    | D0 -D7     |
|-------------------------|------|------|--------|-------|-------|------------|------------|
| Invalid mode            | L    | L    |        |       |       | Don't care | Don't care |
| Standby mode            | H    | H    |        |       |       | Don't care | Don't care |
| Data register access    | H    | L    | 0      | L     | H     | Odd byte   | Even byte  |
| Alternate status access | L    | H    | 6H     | L     | H     | Don't care | Control in |
| Other task file access  | H    | L    | 1-7H   | L     | H     | Don't care | Data       |



**Figure 5: True IDE Mode I/O Access Timing Example**

## 2.3 Configuration Register Specification

This card supports four configuration registers for the purpose of the configuration and observation of this card. These registers can be used in memory card mode and I/O card mode. In True IDE mode, these registers cannot be used.

### 2.3.1 Configuration Option register (Address 200H)

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

| bit 7  | bit 6   | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|--------|---------|-------|-------|-------|-------|-------|-------|
| SRESET | LevlREQ | INDEX |       |       |       |       |       |

NOTE:

1. Initial value: 00H

Table 17: Option Register Function

| 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 bit 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.                                                                                                                                                                                                                                                                                     |

Table 18: INDEX bit assignment

| INDEX Bit |   |   |   |   |   | Task File register address | Mapping mode          |
|-----------|---|---|---|---|---|----------------------------|-----------------------|
| 5         | 4 | 3 | 2 | 1 | 0 |                            |                       |
| 0         | 0 | 0 | 0 | 0 | 0 | 0H to FH, 400H to 7FFH     | Memory Mapped         |
| 0         | 0 | 0 | 0 | 0 | 1 | xx0H to xxFH               | Contiguous I/O Mapped |
| 0         | 0 | 0 | 0 | 1 | 0 | 1F0H to 1F7H, 3F6H to 3F7H | Primary I/O Mapped    |
| 0         | 0 | 0 | 0 | 1 | 1 | 170H to 177H, 376H to 377H | Secondary I/O Mapped  |

### 2.3.2 Configuration and Status Register (Address 202H)

This register is used for observing the card state.

| bit 7 | bit 6  | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------|--------|-------|-------|-------|-------|-------|-------|
| CHGED | SIGCHG | IOIS8 | 0     | 0     | PWD   | INTR  | 0     |

NOTE:

1. Initial value: 00H

**Table 19: Configuration and Status Register Function**

| Name            | R/W | Function                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CHGED (HOST->)  | 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 one 8-bit data bus (D7 to D0).                                                                                                                                                                                                                                                                                                                          |
| PWD (HOST->)    | R/W | When this bit is set to "1", the card enters sleep stat (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 (HOST->)   | 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.                                                                             |

### 2.3.3 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.

| bit 7 | bit 6 | bit 5     | bit 4 | bit 3 | bit 2 | bit 1     | bit 0 |
|-------|-------|-----------|-------|-------|-------|-----------|-------|
| 0     | 0     | CRDY/-BSY | 0     | 1     | 1     | RRDY/-BSY | 0     |

NOTE:

1. Initial value 0CH

**Table 20: Pin Replacement Register Function**

| 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 |

### 2.3.4 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 Configuration Option register is set.

| bit 7 | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 0     | 0     | 0     | DRV#  | 0     | 0     | 0     | 0     |

NOTE:

1. Initial value: 00H

**Table 21: Socket and Copy Register Function**

| Name          | R/W | Function                                                                                                                                                                                                                |
|---------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DRV# (HOST->) | R/W | This field are used for the configuration of the plural cards. When host configures the plural cards, written the card's copy number in this field. In this way, host can perform the card's master/slave organization. |

## 2.4 Task File Register Specification

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

**Table 22: Memory map (INDEX=0)**

| -REG | A10 | A9 -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  | 0  | 0  | 2H     | Sector count register   | Sector count register   |
| 1    | 0   |        | 0  | 0  | 0  | 1  | 3H     | Sector number register  | Sector number register  |
| 1    | 0   |        | 0  | 1  | 1  | 0  | 4H     | Cylinder low register   | Cylinder low register   |
| 1    | 0   |        | 0  | 1  | 1  | 1  | 5H     | Cylinder high register  | Cylinder high register  |
| 1    | 0   |        | 0  | 1  | 1  | 0  | 6H     | Drive head register     | Drive head register     |
| 1    | 0   |        | 1  | 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  | 1  | 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       |

**Table 23: Contiguous I/O map (INDEX=1)**

| -REG | A10 -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                |

**Table 24: Primary I/O Map (INDEX=2)**

| -REG | A10 | A9 -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                |

**Table 25: Secondary I/O Map (INDEX=3)**

| -REG | A10 | A9 -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                |

**Table 26: True IDE Mode I/O Map**

| -CE2 | -CE1 | A2 | A1 | A0 | -IORD=L                | -IOWR=L                 |
|------|------|----|----|----|------------------------|-------------------------|
| 1    | 0    | 0  | 0  | 0  | Data register          | Data register           |
| 1    | 0    | 0  | 0  | 1  | Error register         | Feature register        |
| 1    | 0    | 0  | 1  | 0  | Sector count register  | Sector count register   |
| 1    | 0    | 0  | 1  | 1  | Sector number register | Sector number register  |
| 1    | 0    | 1  | 0  | 0  | Cylinder low register  | Cylinder low register   |
| 1    | 0    | 1  | 0  | 1  | Cylinder high register | Cylinder high register  |
| 1    | 0    | 1  | 1  | 0  | Drive head register    | Drive head register     |
| 1    | 0    | 1  | 1  | 1  | Status register        | Command register        |
| 0    | 1    | 1  | 1  | 0  | Alt. status register   | Device control register |
| 0    | 1    | 1  | 1  | 1  | Drive address register | Reserved                |

### 2.4.1 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. This register overlaps the Error and Feature register.

| bit 15    | bit 14 | bit 13 | bit 12 | bit 11 | bit 10 | bit 9 | bit 8 | bit 7 | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-----------|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| D0 to D15 |        |        |        |        |        |       |       |       |       |       |       |       |       |       |       |

### 2.4.2 Error Register

This register is a read only register, and is used for analyzing the error content during card accessing. This register is valid when the BSY bit in Status Register and Alternate Status Register are set to “0” (Ready).

| bit 7 | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 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 (ID 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.                                                                                           |

### 2.4.3 Feature Register

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

| bit 7        | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|--------------|-------|-------|-------|-------|-------|-------|-------|
| Feature byte |       |       |       |       |       |       |       |

### 2.4.4 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. 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”.

| bit 7             | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|
| Sector count byte |       |       |       |       |       |       |       |

### 2.4.5 Sector Number Register

This register contains the starting sector number, which is started by following sector transfer command.

| bit 7              | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|--------------------|-------|-------|-------|-------|-------|-------|-------|
| Sector number byte |       |       |       |       |       |       |       |

### 2.4.6 Cylinder Low Register

This register contains the low 8-bit of the starting cylinder address, which is started by following sector transfer command.

| bit 7             | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|
| Cylinder low byte |       |       |       |       |       |       |       |

## 2.4.7 Cylinder High Register

This register contains the high 8-bit of the starting cylinder address, which is started by following sector transfer command.

| bit 7              | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|--------------------|-------|-------|-------|-------|-------|-------|-------|
| Cylinder high byte |       |       |       |       |       |       |       |

## 2.4.8 Drive Head Register

This register is used for selecting the Drive number and head number for the following command.

| bit 7 | bit 6 | bit 5 | bit 4 | bit 3  | bit 2 | bit 1 | bit 0 |
|-------|-------|-------|-------|--------|-------|-------|-------|
| 1     | LBA   | 1     | DRV   | Head # |       |       |       |

NOTE:

1. DRV: Drive 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:<br>LBA07 - LBA00: Sector Number Register D7 - D0.<br>LBA15 - LBA08: Cylinder Low Register D7 - D0.<br>LBA23 - LBA16: Cylinder High Register D7 - D0.<br>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 -0 | Head number        | This bit is used for selecting the Head number for the following command. Bit 3 is MSB.                                                                                                                                                                                                                                                                                                                                                                   |

## 2.4.9 Status Register

This register is read only register, and it indicates the card status of command execution. When this register is read in configured I/O card mode (INDEX = 1, 2, 3) and level interrupt mode, -IREQ is negated. This register should be accessed in byte mode. In word mode, it is recommended that Alternate status register may be used as this register.

| bit 7 | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 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 Full)    | 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. |

## 2.4.10 Alternate Status Register

This register is the same as Status register in physically, so the it assignment refers to previous item of Status register. But this register is different from Status register that –IREQ is not negated when data read.

## 2.4.11 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.

| Command                     | Command Code | Used Parameter |    |    |    |    |    |     |
|-----------------------------|--------------|----------------|----|----|----|----|----|-----|
|                             |              | 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   |
| Erase sector                | C0H          | N              | Y  | Y  | Y  | Y  | Y  | Y   |
| 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   |
| Request sense               | 03H          | 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   |
| Translate sector            | 87H          | N              | Y  | Y  | Y  | Y  | Y  | Y   |
| Wear level                  | F5H          | N              | N  | N  | N  | Y  | Y  | 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 multiple w/o erase    | CDH          | N              | Y  | Y  | Y  | Y  | Y  | Y   |
| Write sector                | 30H or 31H   | N              | Y  | Y  | Y  | Y  | Y  | Y   |
| Write sector w/o erase      | 38H          | 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.

### 2.4.12 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 -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".                                                                                                                                                                                                           |

### 2.4.13 Drive Address Register

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

| bit 7 | bit 6 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
|       | nWTG  | nHS3  | nHS2  | nHS1  | nHS0  | nDS1  | nDS0  |

| bit  | Name                      | Function                                                                                   |
|------|---------------------------|--------------------------------------------------------------------------------------------|
| 7    |                           | This bit is unknown.                                                                       |
| 6    | nWTG (WriTing Gate)       | This bit is unknown.                                                                       |
| 5 -2 | nHS3 -0(Head Select3 - 0) | These bits are 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.                                                                       |

## 2.5 ATA Command Specification

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

**Table 27: ATA Command Set**

| No. | Command                     | Command Code | FR | SC | SN | CY | DR | HD | LBA |
|-----|-----------------------------|--------------|----|----|----|----|----|----|-----|
| 1   | Check power mode            | E5H or 98H   | -  | -  | -  | -  | Y  | -  | -   |
| 2   | Execute drive diagnostic    | 90H          | -  | -  | -  | -  | Y  | -  | -   |
| 3   | Erase sector                | C0H          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 4   | Format track                | 50H          | -  | Y  | -  | Y  | Y  | Y  | Y   |
| 5   | Identify Drive              | ECH          | -  | -  | -  | -  | Y  | -  | -   |
| 6   | Idle                        | E3H or 97H   | -  | Y  | -  | -  | Y  | -  | -   |
| 7   | Idle immediate              | E1H or 95H   | -  | -  | -  | -  | Y  | -  | -   |
| 8   | Initialize drive parameters | 91H          | -  | Y  | -  | -  | Y  | Y  | -   |
| 9   | Read buffer                 | E4H          | -  | -  | -  | -  | Y  | -  | -   |
| 10  | Read multiple               | C4H          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 11  | Read long sector            | 22H, 23H     | -  | -  | Y  | Y  | Y  | Y  | Y   |
| 12  | Read sector                 | 20H, 21H     | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 13  | Read verify sector          | 40H, 41H     | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 14  | Recalibrate                 | 1XH          | -  | -  | -  | -  | Y  | -  | -   |
| 15  | Request sense               | 03H          | -  | -  | -  | -  | Y  | -  | -   |
| 16  | Seek                        | 7XH          | -  | -  | Y  | Y  | Y  | Y  | Y   |
| 17  | Set features                | EFH          | Y  | -  | -  | Y  | Y  | -  | -   |
| 18  | Set multiple mode           | C6H          | -  | Y  | -  | -  | Y  | -  | -   |
| 19  | Set sleep mode              | E6H or 99H   | -  | -  | -  | -  | Y  | -  | -   |
| 20  | Stand by                    | E2H or 96H   | -  | -  | -  | -  | Y  | -  | -   |
| 21  | Stand by immediate          | E0H or 94H   | -  | -  | -  | -  | Y  | -  | -   |
| 22  | Translate sector            | 87H          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 23  | Wear level                  | F5H          | -  | -  | -  | -  | Y  | Y  | -   |
| 24  | Write buffer                | E8H          | -  | -  | -  | -  | Y  | -  | -   |
| 25  | Write long sector           | 32H or 33H   | -  | -  | Y  | Y  | Y  | Y  | Y   |
| 26  | Write multiple              | C5H          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 27  | Write multiple w/o erase    | CDH          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 28  | Write sector                | 30H or 31H   | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 29  | Write sector w/o erase      | 38H          | -  | Y  | Y  | Y  | Y  | Y  | Y   |
| 30  | 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 register (to)  
DR: DRV 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

## 2.5.1 ATA Command Set Description

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. Erase Sector(s) (code: C0H): This command is used to erase data sectors.
4. Format Track (code: 50H): This command writes the desired head and cylinder of the selected drive. But selected sector data is not exchanged. This card accepts a sector buffer of data from the host to follow the command with same protocol as the Write Sector command.
5. Identify Drive (code: ECH): This command enables the host to receive parameter information from the Card.

**Table 28: Identify Drive Information**

| Word Address | Default Value | Total Bytes | Data Field Type Information                                                             |
|--------------|---------------|-------------|-----------------------------------------------------------------------------------------|
| 0            | 848Ah         | 2           | General Configuration:<br>848Ah: Removable Disk (Default)<br>044Ah: Fixed Disk (Option) |
| 1            | XXXX          | 2           | Number of cylinders                                                                     |
| 2            | 0000h         | 2           | Reserved                                                                                |
| 3            | 00XXh         | 2           | Number of heads                                                                         |
| 4            | 0000h         | 2           | Number of unformatted bytes per track                                                   |
| 5            | XXXX          | 2           | Number of unformatted bytes per sector                                                  |
| 6            | XXXX          | 2           | Number of sectors per track                                                             |
| 7-8          | XXXX          | 4           | Number of sectors per card (Word 7 = MSW, Word 8 = LSW)                                 |
| 9            | 0000h         | 2           | Reserved                                                                                |
| 10-19        | aaaa          | 20          | Serial Number in ASCII (Right Justified)                                                |
| 20           | 0002h         | 2           | Buffer type: Dual ported multi-sector                                                   |
| 21           | 0002h         | 2           | Buffer size in 512 byte increments                                                      |
| 22           | 0004h         | 2           | # of ECC bytes passed on Read/Write Long Commands                                       |
| 23-26        | aaaa          | 8           | Firmware revision in ASCII. Big Endian Byte Order in Word                               |
| 27-46        | aaaa          | 40          | Model number in ASCII (Left Justified) Big Endian Byte Order in Word                    |
| 47           | 0001h         | 2           | Maximum of 1 sector on Read/Write Multiple command                                      |
| 48           | 0000h         | 2           | Double Word not supported                                                               |
| 49           | 0200h         | 2           | Capabilities:<br>Bit 9: LBA Supported                                                   |
| 50           | 0000h         | 2           | Reserved                                                                                |
| 51           | 0200h         | 2           | PIO data transfer cycle timing mode 2                                                   |
| 52           | 0000h         | 2           | DMA data transfer cycle timing mode (Not Supported)                                     |
| 53           | 0003h         | 2           | Field validity                                                                          |
| 54           | XXXXh         | 2           | Current number of cylinders                                                             |
| 55           | XXXXh         | 2           | Current number of heads                                                                 |
| 56           | XXXXh         | 2           | Current sectors per track                                                               |
| 57-58        | XXXXh         | 4           | Current capacity in sectors (LBAs) (Word 57 = LSW, Word 58 = MSW)                       |
| 59           | 010Xh         | 2           | Multiple Sector Setting is valid                                                        |
| 60-61        | XXXX          | 4           | Total number of sectors addressable in LBA Mode                                         |
| 62           | 0000h         | 2           | Reserved                                                                                |
| 63           | 0000h         | 2           | Multiword DMA Transfer:<br>0000h: Not Supported                                         |
| 64           | 0003h         | 2           | Advanced PIO Modes supported                                                            |
| 65           | 0000h         | 2           | Minimum DMA transfer cycle time per word                                                |

|                |       |     |                                                         |
|----------------|-------|-----|---------------------------------------------------------|
| <b>66</b>      | 0000h | 2   | Recommended DMA transfer cycle time.                    |
| <b>67</b>      | 0078h | 2   | Minimum PIO transfer cycle time without flow control    |
| <b>68</b>      | 0078h | 2   | Minimum PIO transfer cycle time with IORDY flow control |
| <b>69-127</b>  | XXXXh | 130 | Reserved                                                |
| <b>128-159</b> | 0000h | 64  | Reserved Vendor Unique Bytes                            |
| <b>160-255</b> | 0000h | 192 | Reserved                                                |

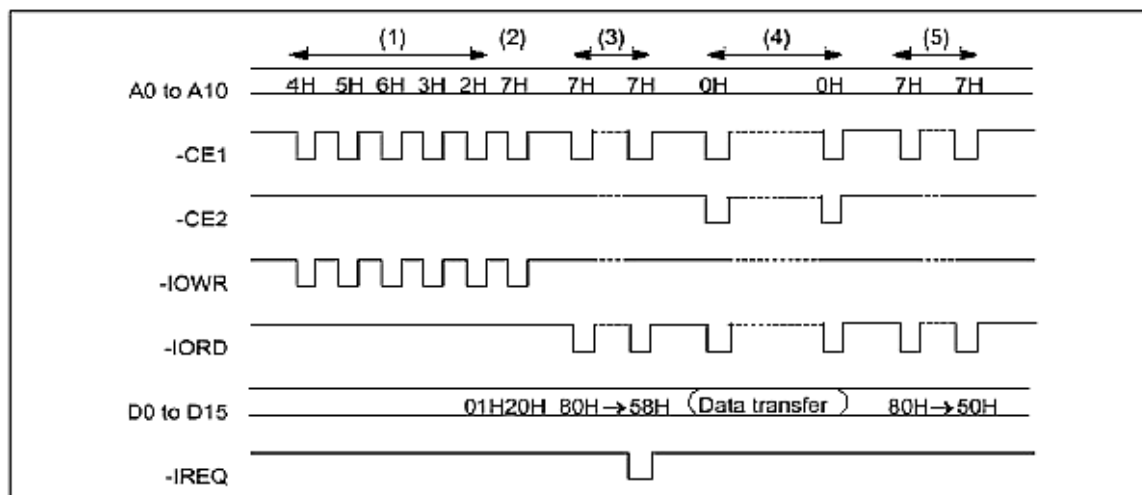
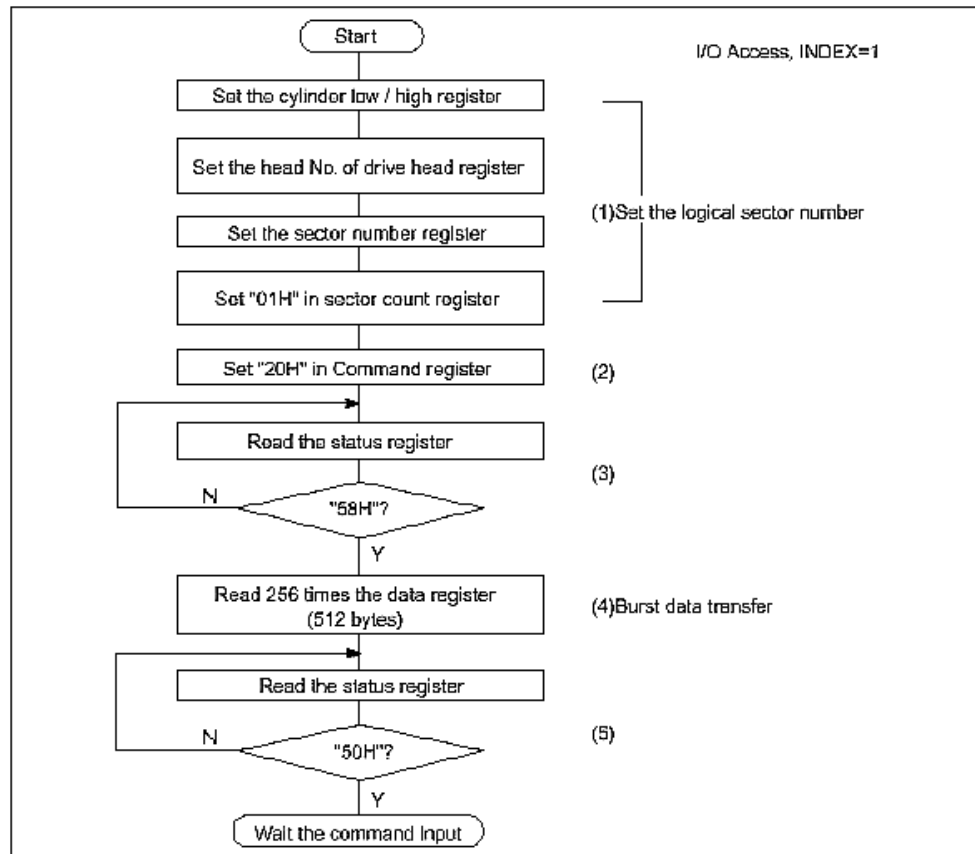
6. Idle (code: E3H or 97H): This command causes the PC Card to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power down mode is disabled.
7. Idle Immediate (code: E1H or 95H): This command causes the Card to set BSY, enter the Idle (Read) mode, clear BSY and generate an interrupt.
8. 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.
9. Read Buffer (code: E4H): This command enables the host to read the current contents of the PC card's sector buffer.
10. 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.
11. Read Long Sector (code: 22H, 23H): This command performs similarly to the Read Sector(s) command except that it returns 516 bytes of data instead of 512 bytes.
12. 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.
13. Read Verify Sector(s) (code: 40H, 41H): This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.
14. Recalibrate (code: 1XH): This command is effectively a NOP command to the Card and is provided for compatibility purposes.
15. Request Sense (code: 03H): This command requests an extended error code after command ends with an error.
16. Seek (code: 7XH): This command is effectively a NOP command to the Card although it does perform a range check.
17. Set Features (code: EFH): This command is used by the host to establish or select certain features.

| <b>Feature</b> | <b>Operation</b>                                                      |
|----------------|-----------------------------------------------------------------------|
| 01H            | Enable 8-bit data transfers.                                          |
| 55H            | Disable Read Look Ahead.                                              |
| 66H            | Disable Power on Reset (POR) establishment of defaults at Soft Reset. |
| 81H            | Disable 8-bit data transfer.                                          |
| BBH            | 4 bytes of data apply on Read/Write Long commands.                    |
| CCH            | Enable Power on Reset (POR) establishment of defaults at Soft Reset.  |

18. 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.
19. 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.
20. 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.
21. 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.
22. Translate Sector (code: 87H): This command allows the host a method of determining the exact number of times a user sector has been erased and programmed.
23. Wear level (code: F5H): This command is effectively a NOP command and only implemented for backward compatibility. The Sector Count Register will always be returned with a 00H indicating Wear Level is not needed.

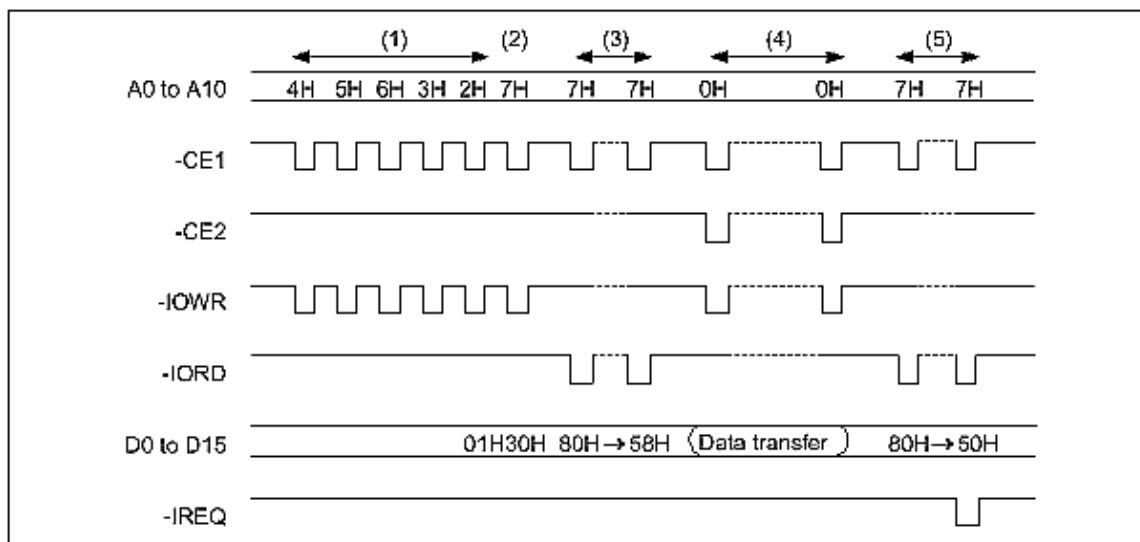
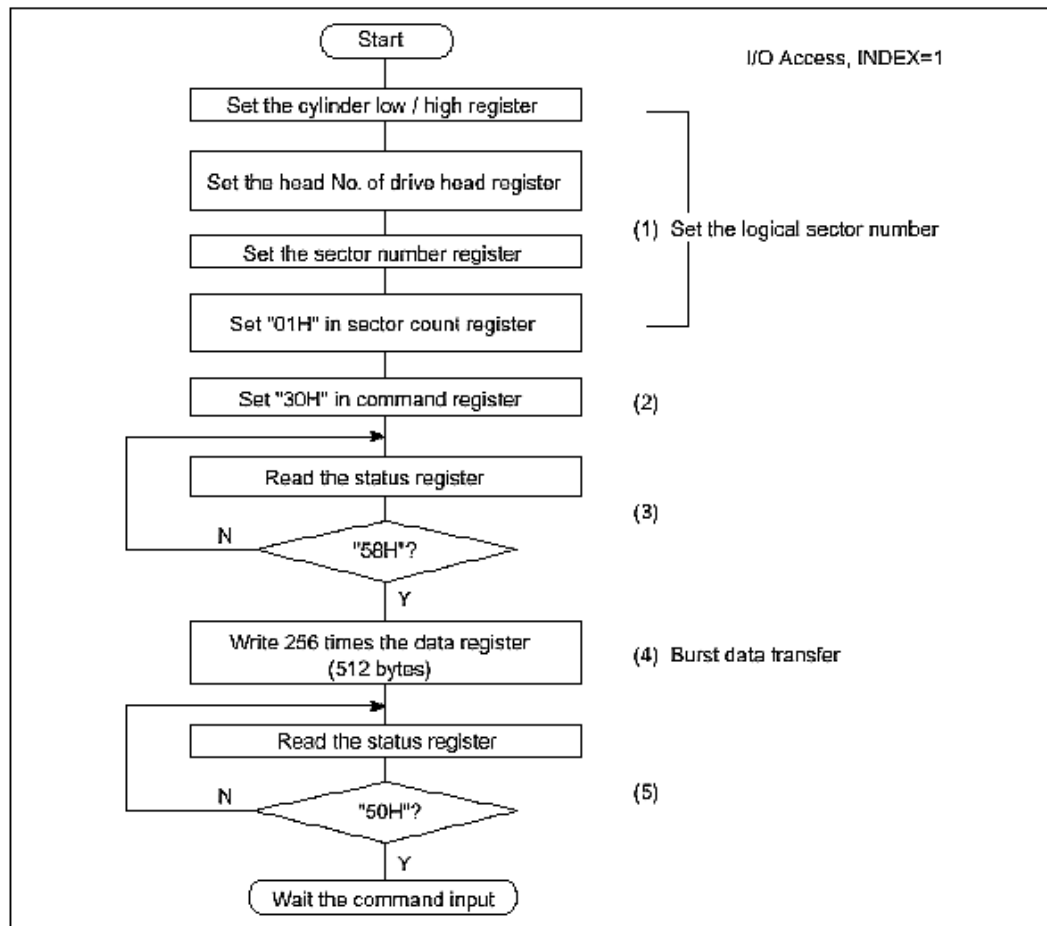
24. Write Buffer (code: E8H): This command enables the host to overwrite contents of the Card's sector buffer with any data pattern desired.
25. Write Long Sector (code: 32H or 33H): This command is provided for compatibility purposes and is similar to the Write Sector(s) command except that it writes 516 bytes instead of 512 bytes.
26. Write Multiple (code: C5H): This command is similar to the Write Sector 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.
27. Write Multiple without Erase (code: CDH): This command is similar to the Write Multiple command with the exception that an implied erase before write operation is not performed.
28. 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.
29. Write Sector(s) without Erase (code: 38H): This command is similar to the Write Sector(s) command with the exception that an implied erase before write operation is not performed.
30. Write Verify (code: 3CH): This command is similar to the Write Sector(s) command, except each sector is verified immediately after being written.

## 2.5.2 Sector Transfer Protocol



**Figure 6: Sector Read**

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



**Figure 7: Sector Write**

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

## 3.0 Electrical Specification

### 3.1 General

**Table 29: Absolute Maximum Ratings ( $V_{CC}=3.3V \pm 5\%$  or  $V_{CC}=5V \pm 10\%$ )**

| Symbol             | Parameter                                              | Min  | Max            | Units |
|--------------------|--------------------------------------------------------|------|----------------|-------|
| $V_{CC}$           | $V_{CC}$ With Respect to GND                           | -0.3 | 6.5            | V     |
| $V_{IN} / V_{OUT}$ | All Input/Output Voltages <sup>1</sup>                 | -0.3 | $V_{CC} + 0.3$ | V     |
| $T_A$              | Operating Temperature (Standard Temp)                  | 0    | 70             | °C    |
| $T_A$              | Operating Temperature (Industrial Temp)                | -40  | 85             | °C    |
| $T_S$              | Storage Temperature                                    | -55  | 125            | °C    |
| $V^*$              | Voltage on any Pin Except $V_{CC}$ with Respect to GND | -0.5 | 0.5            | V     |

NOTE:

1.  $V_{IN} / V_{OUT}$  Min. = -2.0V for Pulse Width 0.20ns

**Table 30: Input Leakage Control**

| Symbol | Parameter             | Type | Conditions                     | MIN | MAX  | Units   |
|--------|-----------------------|------|--------------------------------|-----|------|---------|
| IL     | Input Leakage Current | IxZ  | $V_{ih} = V_{cc}/V_{il} = Gnd$ | -1  | 1    | $\mu A$ |
| RPU1   | Pull Up Resistor      | IxU  | $V_{cc} = 5.0V$                | 50k | 500k | Ohm     |
| RPD1   | Pull Down Resistor    | IxD  | $V_{cc} = 5.0V$                | 50k | 500k | Ohm     |

NOTE: The minimum pull-up resistor leakage current meets the PCMCIA specification of 10k ohms but is intentionally higher in the Compact Flash Memory Card to reduce power use.

**Table 31: Input Characteristics**

| Type | Parameter                             | Symbol               | $V_{cc} = 3.3 V$ |            |     | $V_{cc} = 5.0 V$ |            |     | Units |
|------|---------------------------------------|----------------------|------------------|------------|-----|------------------|------------|-----|-------|
|      |                                       |                      | MIN              | TYP        | MAX | MIN              | TYP        | MAX |       |
| 1    | Input Voltage CMOS                    | $V_{ih}$<br>$V_{il}$ | 2.4              |            | 0.6 | 2.4              |            | 0.8 | V     |
| 2    | Input Voltage CMOS                    | $V_{ih}$<br>$V_{il}$ | 1.5              |            | 0.6 | 2.0              |            | 0.8 | V     |
| 3    | Input Voltage CMOS<br>Schmitt Trigger | $V_{ih}$<br>$V_{il}$ |                  | 1.8<br>1.0 |     |                  | 2.8<br>2.0 |     | V     |

**Table 32: Output Drive Type**

| Type | Output Type           | Valid Conditions |
|------|-----------------------|------------------|
| OTx  | Totempole             | Ioh & Iol        |
| OZx  | Tri-State N-P Channel | Ioh & Iol        |
| OPx  | P-Channel Only        | Ioh only         |
| ONx  | N-Channel Only        | Iol only         |

**Table 33: Output Drive Characteristics**

| Type | Parameter                 | Symbol | Conditions             | MIN   | TYP | MAX          | Units |
|------|---------------------------|--------|------------------------|-------|-----|--------------|-------|
| 1    | Output Voltage            | Voh    | Ioh = -4 mA            | Vcc   |     |              | V     |
|      |                           | Vol    | Iol = 4 mA             | -0.8V |     | GND<br>+0.4V |       |
| 2    | Output Voltage            | Voh    | Ioh = -8 mA            | Vcc   |     |              | V     |
|      |                           | Vol    | Iol = 8 mA             | -0.8V |     | GND<br>+0.4V |       |
| 3    | Output Voltage            | Voh    | Ioh = -8 mA            | Vcc   |     |              | V     |
|      |                           | Vol    | Iol = 8 mA             | -0.8V |     | GND<br>+0.4V |       |
| X    | Tri-State Leakage Current | Ioz    | Vol = Gnd<br>Voh = Vcc | -10   |     | 10           | μA    |

**Table 34: Capacitance (Ta = 25°C, f = 1MHz)**

| Parameter          | Symbol | Condition | Min | Max | Unit |
|--------------------|--------|-----------|-----|-----|------|
| Input capacitance  | Cin    | Vin = 0V  | -   | 35  | pF   |
| Output capacitance | Cout   | Vout = 0V | -   | 35  | pF   |

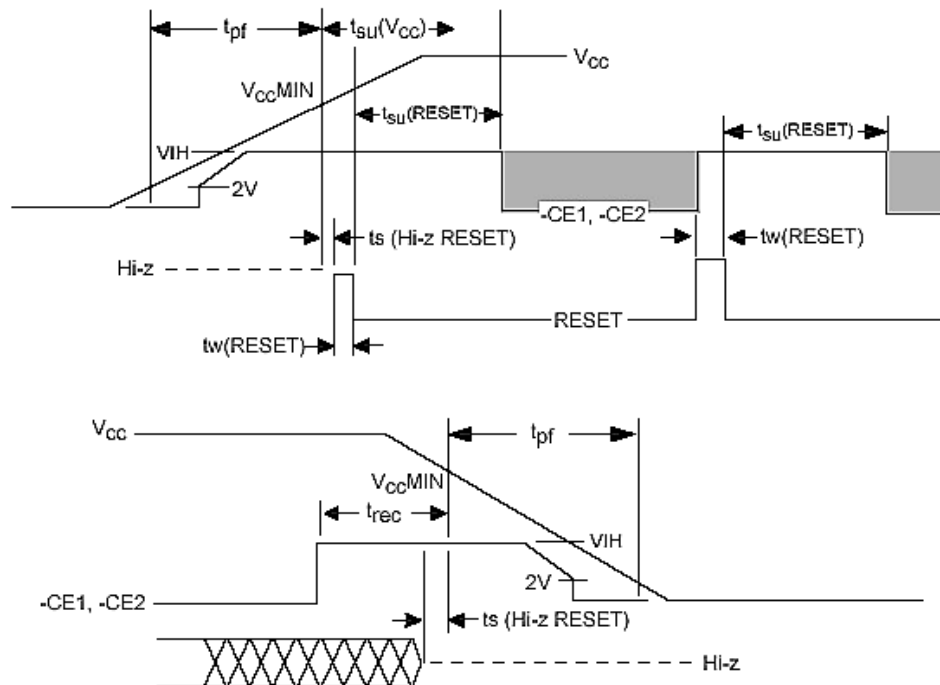
**Table 35: Power-up/Power-down Timing**

The timing specification was defined to retain data in the Flash Card during power-up or power-down cycles and to permit peripheral cards to perform power-up initialization.

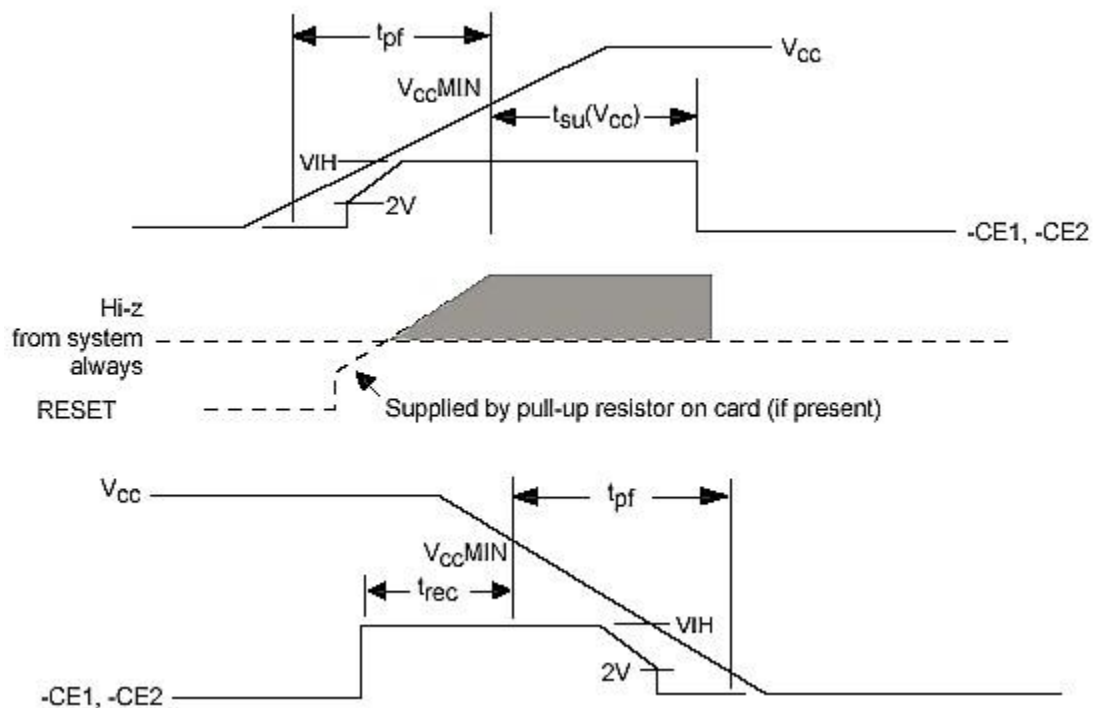
| Item                         | Symbol          | Condition               | Value      |       |      |
|------------------------------|-----------------|-------------------------|------------|-------|------|
|                              |                 |                         | Min        | Max   | Unit |
| CE signal level <sup>1</sup> | Vi (CE)         | 0V < Vcc < 2.0V         | 0          | ViMAX | V    |
|                              |                 | 2.0V < Vcc < VIH        | <Vcc – 0.1 | ViMAX |      |
|                              |                 | < VIH < Vcc             | VIH        | ViMAX |      |
| CE Setup Time                | Tsu (Vcc)       |                         | 20         |       | ms   |
|                              | Tsu (RESET)     |                         | 20         |       | ms   |
| CE Recover Time              | Trec (Vcc)      |                         | 0.001      |       | ms   |
| Vcc Rising Time <sup>2</sup> | tpr             | 10% → 90% of (Vcc + 5%) | 0.1        | 300   | ms   |
|                              | tpf             | 90% of (Vcc – 5%) → 10% | 3.0        | 300   | ms   |
| Reset Width                  | Tw (RESET)      |                         | 10         |       | μs   |
|                              | Th (Hi-z Reset) |                         | 1          |       | ms   |
|                              | Ts (Hi-z Reset) |                         | 0          |       | ms   |

**NOTE:**

1. ViMAX means Absolute Maximum Voltage for Input in the period of 0V < Vcc < 2.0V, Vi (CE) is only 0V - ViMAX.
2. The tpr and tpf are defined as “linear waveform” in the period of 10% to 90% or vice-versa. Even if the waveform is not “linear waveform,” its rising and falling time must be met by this specification.



**Figure 8: Power Up/Power Down Timing**



**Figure 9: Power Up/Power Down Timing for Systems Not Supporting RESET**

## 3.2 DC Characteristics

Table 36: (Ta = 0 to +70°C, Vcc = 5V ± 10%, 3.3V ± 5%)

| Parameter                          | Symbol                 | Conditions                                | V <sub>CC</sub> = 3.3V ± 5% |     |     | V <sub>CC</sub> = 5V ± 10% |     |     | Unit           |
|------------------------------------|------------------------|-------------------------------------------|-----------------------------|-----|-----|----------------------------|-----|-----|----------------|
|                                    |                        |                                           | Min                         | Typ | Max | Min                        | Typ | Max |                |
| Input leakage current <sup>1</sup> | I <sub>LI</sub>        | V <sub>IN</sub> = GND to V <sub>CC</sub>  | -                           | -   | 0.1 | -                          | -   | 0.1 | mA             |
| Output voltage                     | V <sub>OL</sub>        | I <sub>OL</sub> = 8 mA                    | -                           | -   | 0.4 | -                          | -   | 0.4 | V              |
|                                    | V <sub>OH</sub>        | I <sub>OL</sub> = -8 mA                   | V <sub>CC</sub> -0.8        | -   | -   | -                          | -   | -   | V <sub>I</sub> |
| Input voltage (CMOS)               | V <sub>IL</sub>        | -                                         | -                           | -   | 0.6 | -                          | -   | 0.8 | V              |
|                                    | V <sub>IH</sub>        | -                                         | 2.4                         | -   | -   | 4.0                        | -   | -   | V              |
| Input voltage (Schmitt trigger)    | V <sub>IL</sub>        | -                                         | -                           | 1.0 | -   | -                          | 2.0 | -   | V              |
|                                    | V <sub>IH</sub>        | -                                         | -                           | 1.8 | -   | -                          | 2.8 | -   | V              |
| Sleep/Standby Current              | I <sub>SP1</sub>       | Ctrl = V <sub>CC</sub> -0.2V <sup>2</sup> | -                           | -   | 0.3 | -                          | 0.5 | 1.0 | mA             |
| Sector Read Current                | I <sub>CCR</sub> (DC)  | Ctrl = V <sub>CC</sub> -0.2V <sup>2</sup> | -                           | 25  | 50  | -                          | 40  | 75  | mA             |
|                                    | I <sub>CCR</sub> (Max) |                                           | -                           | 50  | 80  | -                          | 80  | 120 |                |
| Sector Write Spec                  | I <sub>CCR</sub> (DC)  | Ctrl = V <sub>CC</sub> -0.2V <sup>2</sup> | -                           | 25  | 50  | -                          | 45  | 75  | mA             |
|                                    | I <sub>CCR</sub> (Max) |                                           | -                           | 50  | 80  | -                          | 80  | 120 |                |

NOTE:

1. Except Pulled-Up Input Pin
2. CMOS Level in Memory Card & I/O Mode

### 3.2.1 Current Waveform (Vcc = 5V, Ta = 25°C)

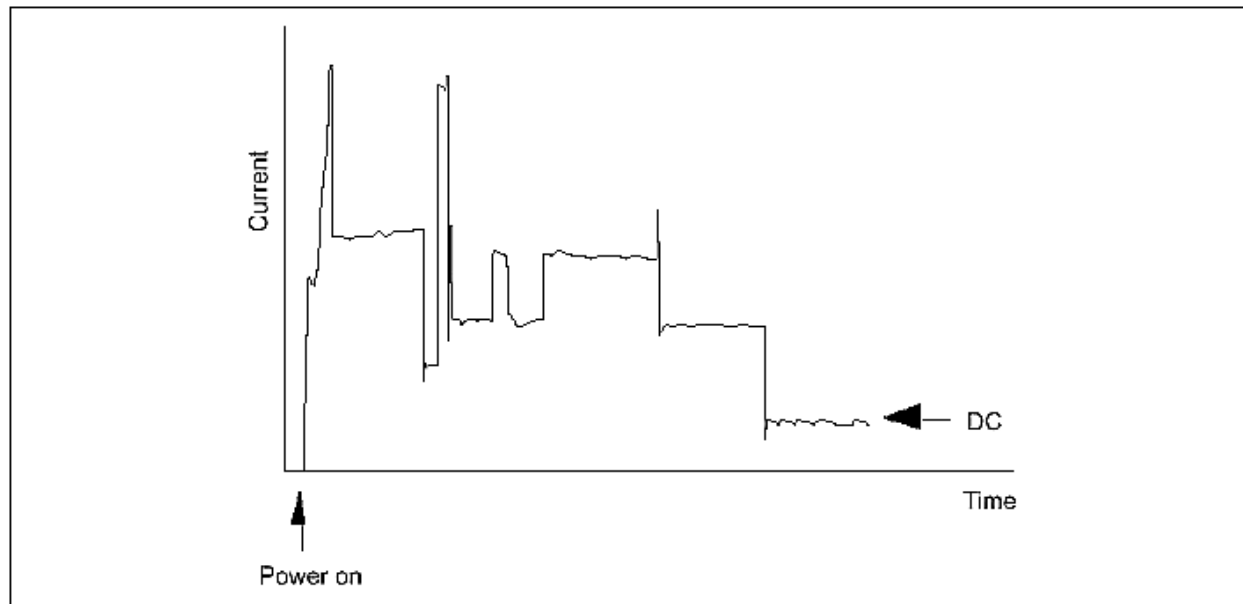


Figure 11: Power on Operation (Reference Only)

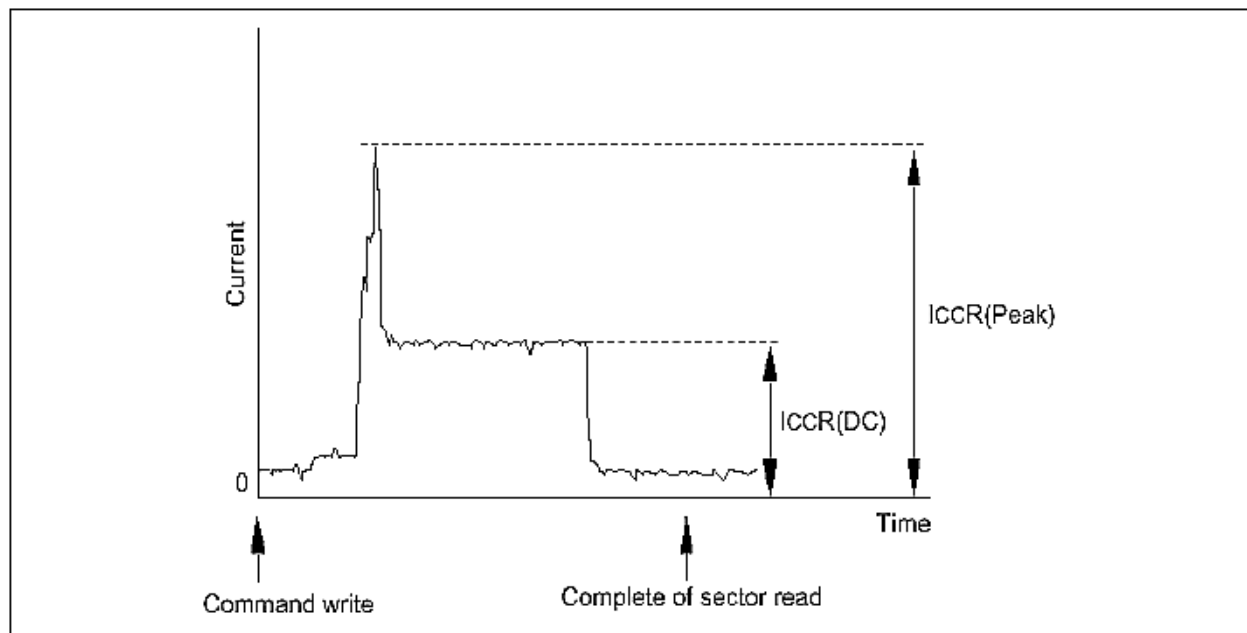


Figure 12: Sector Read

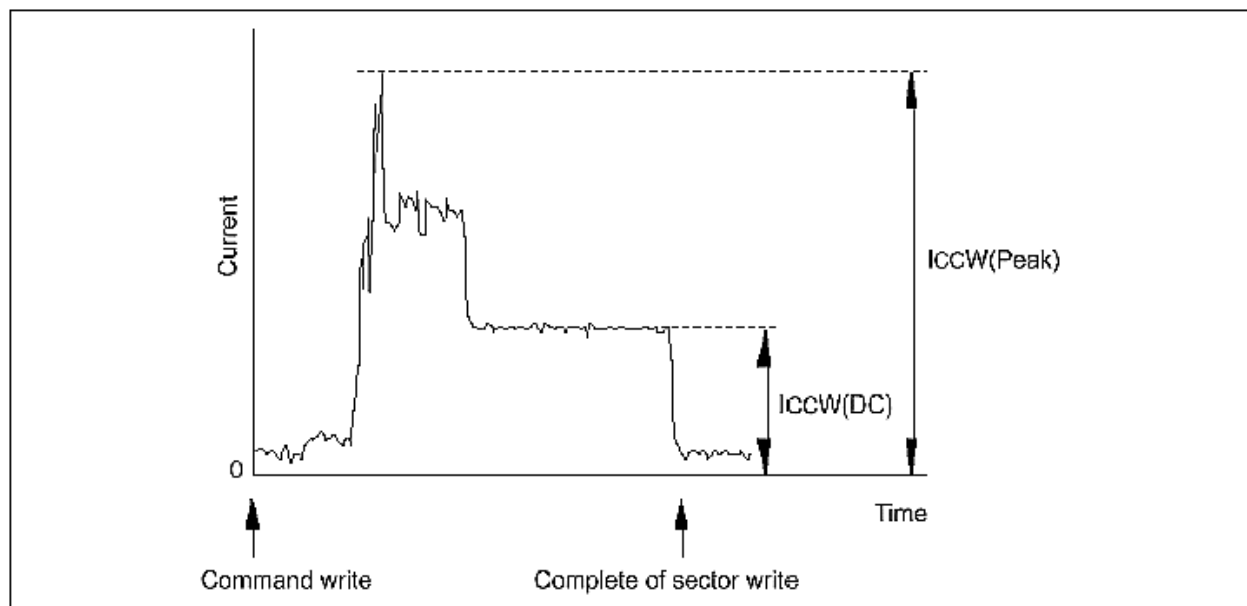


Figure 13: Sector Write

### 3.3 AC Characteristics

( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{cc} = 5V \pm 10\%$ ,  $3.3V \pm 5\%$ )

#### 3.3.1 General

Attribute Memory access time is defined as 300 ns. Detailed timing specifications are shown in Table 37.

Table 37: Attribute Memory Read Timing

| Speed Version                  |          |             | 300ns    |          |
|--------------------------------|----------|-------------|----------|----------|
| Item                           | Symbol   | IEEE Symbol | Min (ns) | Max (ns) |
| Read cycle time                | tCR      | tAVAV       | 120      | -        |
| Address access time            | ta(A)    | tAVQV       | -        | 75       |
| Card Enable access time        | ta(CE)   | tELQV       | -        | 75       |
| Output Enable access time      | ta(OE)   | tGLQV       | -        | 50       |
| Output disable time (-CE)      | tdis(CE) | tEHQZ       | -        | 30       |
| Output disable time (-OE)      | tdis(OE) | tGHQZ       | -        | 30       |
| Address setup time             | tsu(A)   | tAVGL       | 30       | -        |
| Output enable time (-CE)       | ten(CE)  | tELQNZ      | 5        | -        |
| Output enable time (-OE)       | ten(OE)  | tGLQNZ      | 5        | -        |
| Data valid from Address Change | tv(A)    | tAXQX       | 0        | -        |

Note: All times are in nanoseconds. Dout signifies data provided by the CompactFlash Card to the system. The -CE signal or both the -OE signal and the -WE signal shall be de-asserted between consecutive cycle operations.

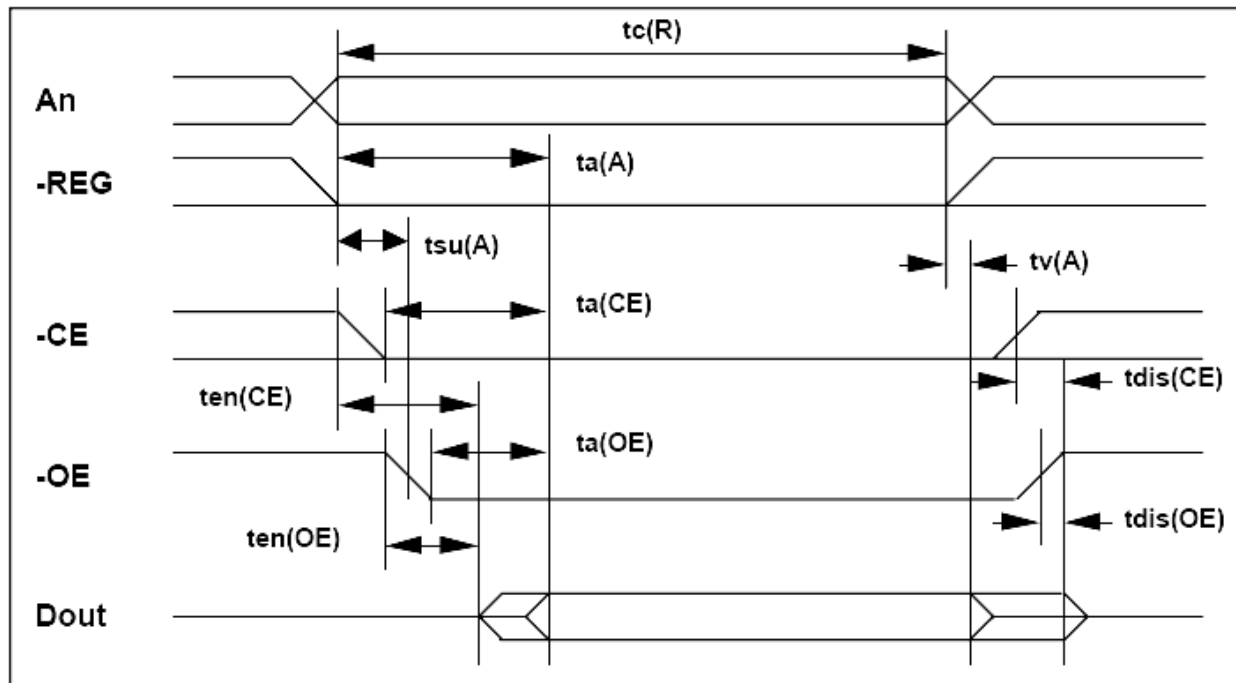


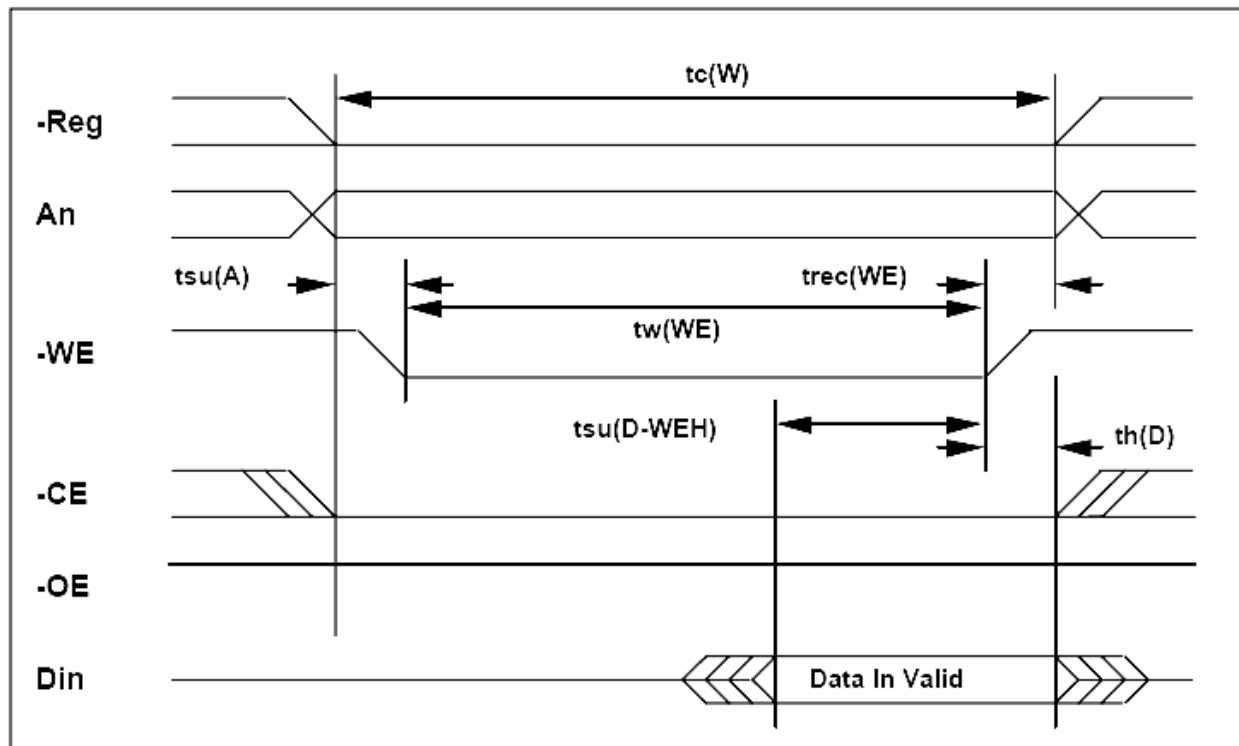
Figure 14: Attribute Memory Read Timing Diagram

The Card Configuration Register (Attribute Memory) write access time is defined as 250ns. Detailed timing specifications are shown in Table 38.

**Table 38: Attribute Memory Write Timing**

| Speed Version          |            |             | 250 ns   |          |
|------------------------|------------|-------------|----------|----------|
| Item                   | Symbol     | IEEE Symbol | Min (ns) | Max (ns) |
| Write cycle time       | tCW        | tAVAV       | 120      | -        |
| Write pulse width      | tw(WE)     | tWLWH       | 70       | -        |
| Address setup time     | tsu(A)     | tAVWL       | 30       | -        |
| Write recover time     | trec(WE)   | tWMAX       | 30       | -        |
| Data setup time for WE | tsu(D-WEH) | tDVWH       | 20       | -        |
| Data hold time         | th(D)      | tWMDX       | 10       | -        |

Note: All times are in nanoseconds. Din signifies data provided by the system to the CompactFlash Card.



**Figure 15: Attribute Memory Write Timing Diagram**

Table 39: I/O Access Read Timing

| Item                               | Symbol          | IEEE Symbol | Min (ns) | Max (ns) |
|------------------------------------|-----------------|-------------|----------|----------|
| Data delay after –IORD             | td(IORD)        | tIGLQV      | -        | 100      |
| Data hold following –IORD          | th(IORD)        | tIGHQX      | 0        | -        |
| -IORD pulse width                  | tw(IORD)        | tIGLIGH     | 165      | -        |
| Address setup before –IORD         | tsuA(IORD)      | tAVIGL      | 70       | -        |
| Address hold following –IORD       | thA(IORD)       | tIGHAX      | 20       | -        |
| -CE setup before –IORD             | tsuCE(IORD)     | tELIGL      | 5        | -        |
| -CE hold following –IORD           | thCE(IORD)      | tIGHEH      | 20       | -        |
| -REG setup before –IORD            | tsuREG(IORD)    | tRGLIGL     | 5        | -        |
| -REG hold following –IORD          | thREG(IORD)     | tIGHRGH     | 0        | -        |
| -INPACK delay falling from –IORD   | tdfINPACK(IORD) | tIGLIAL     | -        | 45       |
| -INPACK delay rising from –IORD    | tdrINPACK(IORD) | tIGHIAH     | -        | 45       |
| -IOIS16 delay falling from address | tdfIOIS16(ADR)  | tAVISL      | -        | 35       |
| -IOIS16 delay rising from address  | tdrIOIS16(ADR)  | tAVISH      | -        | 35       |
| Wait Delay Falling from IORD       | tdWT(IORD)      | tIGLWTL     | -        | 35       |
| Data Delay from Wait Rising        | td(WT)          | tWTHQV      | -        | 0        |
| Wait pulse width                   | tw(WT)          | tWTLWTH     | -        | 350      |

Note: Maximum load on –WAIT, -INPACK, and –IOIS16 is 1 LSTTL with 50 pF total load. All times are in nanoseconds. Minimum time from –WAIT high to –IORD high is 0 nsec, but minimum –IORD width shall be met. Dout signifies data provided by the CompactFlash Card to the system. Wait pulse width meets PCMCIA specifications of 12μs but is intentionally less in this specification.

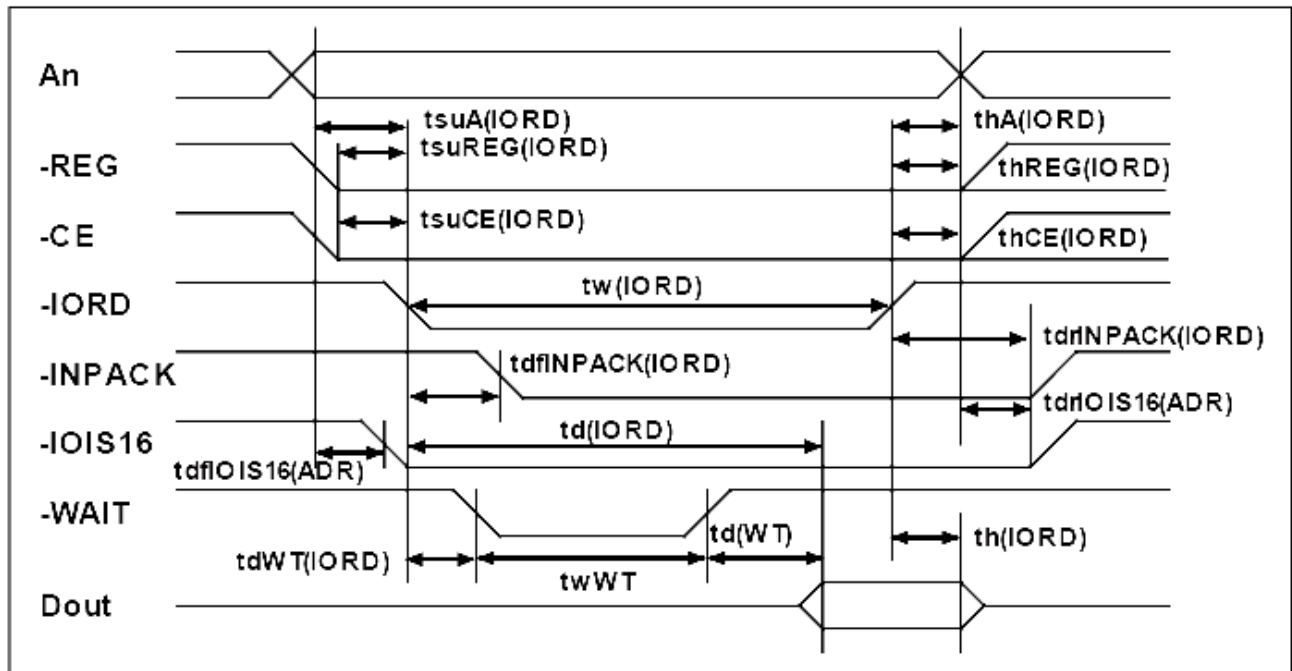


Figure 16: I/O Access Read Timing Diagram

Table 40: I/O Access Write Timing

| Item                               | Symbol         | IEEE Symbol | Min (ns) | Max (ns) |
|------------------------------------|----------------|-------------|----------|----------|
| Data setup before – IOWR           | tsu(IOWR)      | tDVIWH      | 60       | -        |
| Data hold following – IOWR         | th(IOWR)       | tIWHDX      | 30       | -        |
| - IOWR pulse width                 | tw(IOWR)       | tIWLWH      | 165      | -        |
| Address setup before – IOWR        | tsuA(IOWR)     | tAVIWL      | 70       | -        |
| Address hold following – IOWR      | thA(IOWR)      | tIWHAX      | 20       | -        |
| -CE setup before – IOWR            | tsuCE(IOWR)    | tELIWL      | 5        | -        |
| -CE hold following – IOWR          | thCE(IOWR)     | tIWHEH      | 20       | -        |
| -REG setup before – IOWR           | tsuREG(IOWR)   | tRGLIWL     | 5        | -        |
| -REG hold following – IOWR         | thREG(IOWR)    | tIWHRGH     | 0        | -        |
| -IOIS16 delay falling from address | tdfIOIS16(ADR) | tAVISL      | -        | 35       |
| -IOIS16 delay rising from address  | tdrIOIS16(ADR) | tAVISH      | -        | 35       |
| Wait Delay Falling from IOWR       | tdWT(IOWR)     | tIWLWTL     | -        | 35       |
| IOWR high from Wait high           | tdrIOWR(WT)    | tWTJIWH     | 0        | -        |
| Wait pulse width                   | tw(WT)         | tWTLWTH     | -        | 350      |

Note: Maximum load on –WAIT, –INPACK, and –IOIS16 is 1 LSTTL with 50 pF total load. All times are in nanoseconds. Minimum time from –WAIT high to –IORD high is 0 nsec, but minimum –IORD width shall be met. Din signifies data provided by the CompactFlash Card to the system. Wait pulse width meets PCMCIA specifications of 12μs but is intentionally less in this specification.

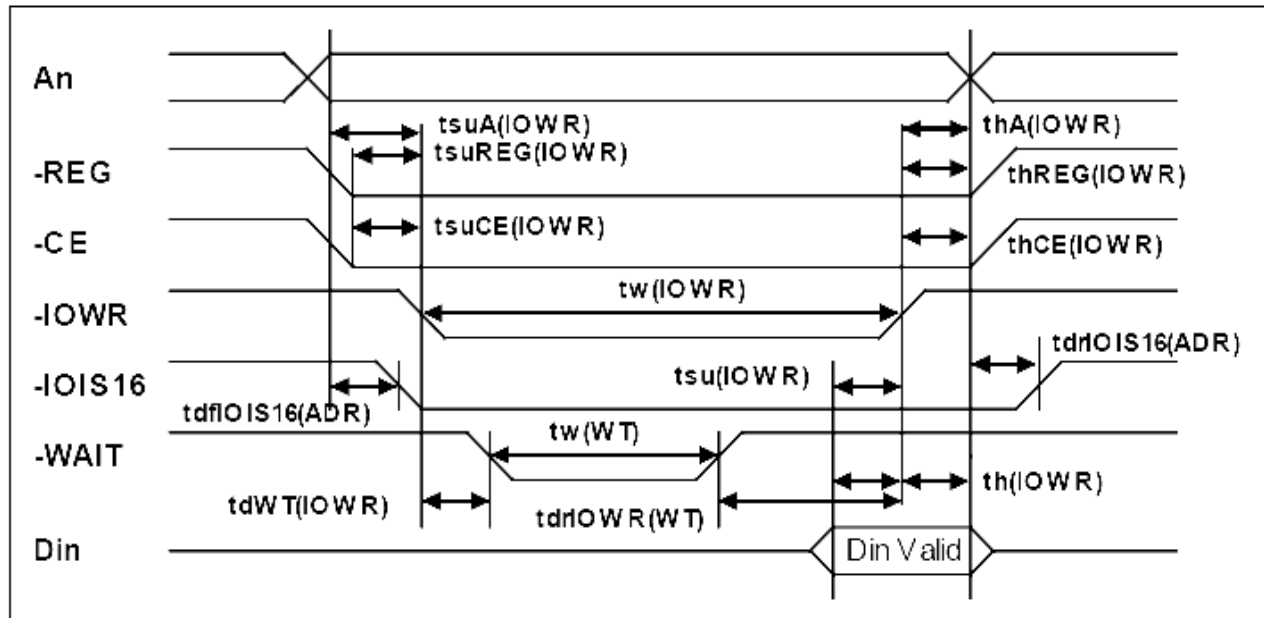


Figure 17: I/O Access Write Timing Diagram

Table 41: Common Memory Access Read Timing

| Item                        | Symbol    | IEEE Symbol | Min (ns) | Max (ns) |
|-----------------------------|-----------|-------------|----------|----------|
| Output Enable access time   | ta(OE)    | tGLQV       | -        | 50       |
| Output disable time (-OE)   | tdis(OE)  | tGHQZ       | -        | 30       |
| Address setup time          | tsu(A)    | tAVGL       | 30       | -        |
| Address hold time           | th(A)     | tGHAX       | 20       | -        |
| -CE setup time              | tsu(CE)   | tELGL       | 0        | -        |
| -CE hold time               | th(CE)    | tGHEH       | 20       | -        |
| Wait Delay Falling from OE  | tv(WT-OE) | tGLWTV      | -        | 35       |
| Data Setup for Wait Release | tv(WT)    | tQVWTH      | -        | 0        |
| Wait pulse width            | tw(WT)    | tWTLWTH     | -        | 350      |

Note: Maximum load on -WAIT is 1 LSTTL with 50 pF total load. All times are in nanoseconds. Dout signifies data provided by the CompactFlash Card to the system. The -WAIT signal may be ignored if the -OE cycle to cycle time is greater than the Wait pulse width. The Wait pulse width meets PCMCIA specifications of 12μs but is intentionally less in this specification.

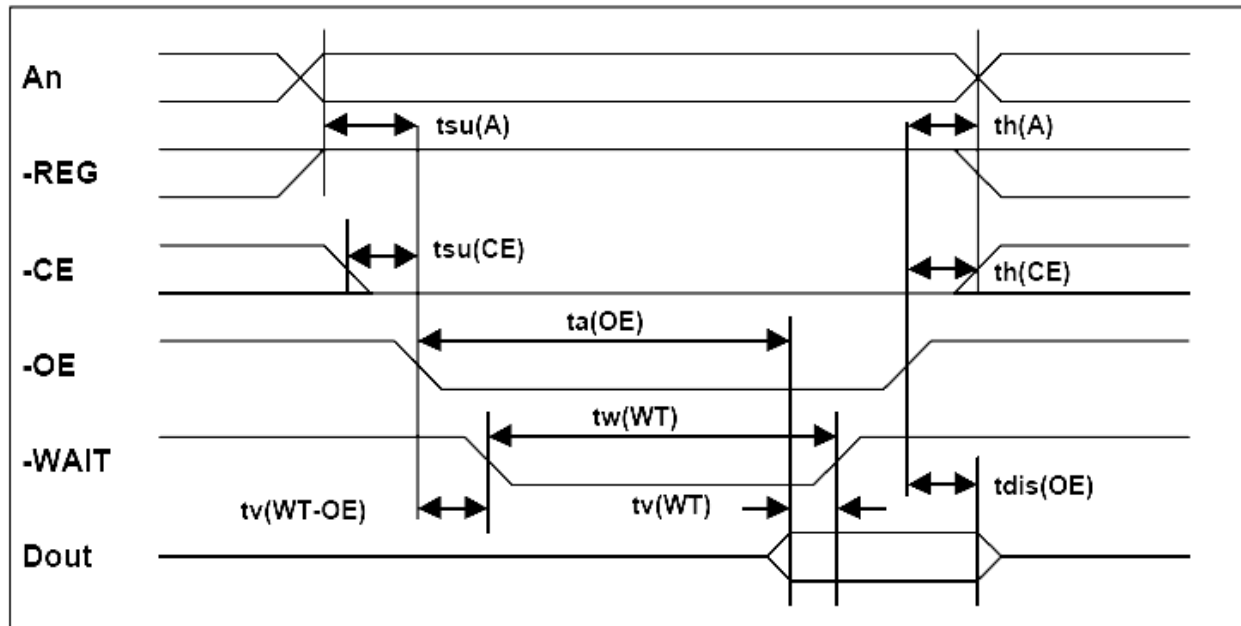


Figure 18: Common Memory Access Read Timing Diagram

Table 42: Common Memory Access Write Timing

| Item                       | Symbol     | IEEE Symbol | Min (ns) | Max (ns) |
|----------------------------|------------|-------------|----------|----------|
| Data setup time (-WE)      | tsu(D-WEH) | tDVWH       | 20       | -        |
| Data hold time             | th(D)      | tWMDX       | 10       | -        |
| WE pulse time              | tw(WE)     | tWLWH       | 70       | -        |
| Address setup time         | tsu(A)     | tAVWL       | 30       | -        |
| -CE setup time             | tsu(CE)    | tELWL       | 0        | -        |
| Write recover time         | trec(WE)   | tWMAX       | 30       | -        |
| Address hold time          | th(A)      | tGHAX       | 20       | -        |
| -CE Hold following WE      | th(CE)     | tGHEH       | 20       | -        |
| Wait Delay Falling from WE | tv(WT-WE)  | tWLWTV      | -        | 35       |
| WE High from Wait Release  | tv(WT)     | tWTHWH      | 0        | -        |
| Wait pulse width           | tw(WT)     | tWTLWTH     | -        | 350      |

Note: Maximum load on -WAIT is 1 LSTTL with 50 pF total load. All times are in nanoseconds. Din signifies data provided by the CompactFlash Card to the system. The -WAIT signal may be ignored if the -WE cycle to cycle time is greater than the Wait pulse width. The Max Wait pulse width can be determined from the Card Information Structure. The Wait pulse width meets PCMCIA specifications of 12μs but is intentionally less in this specification.

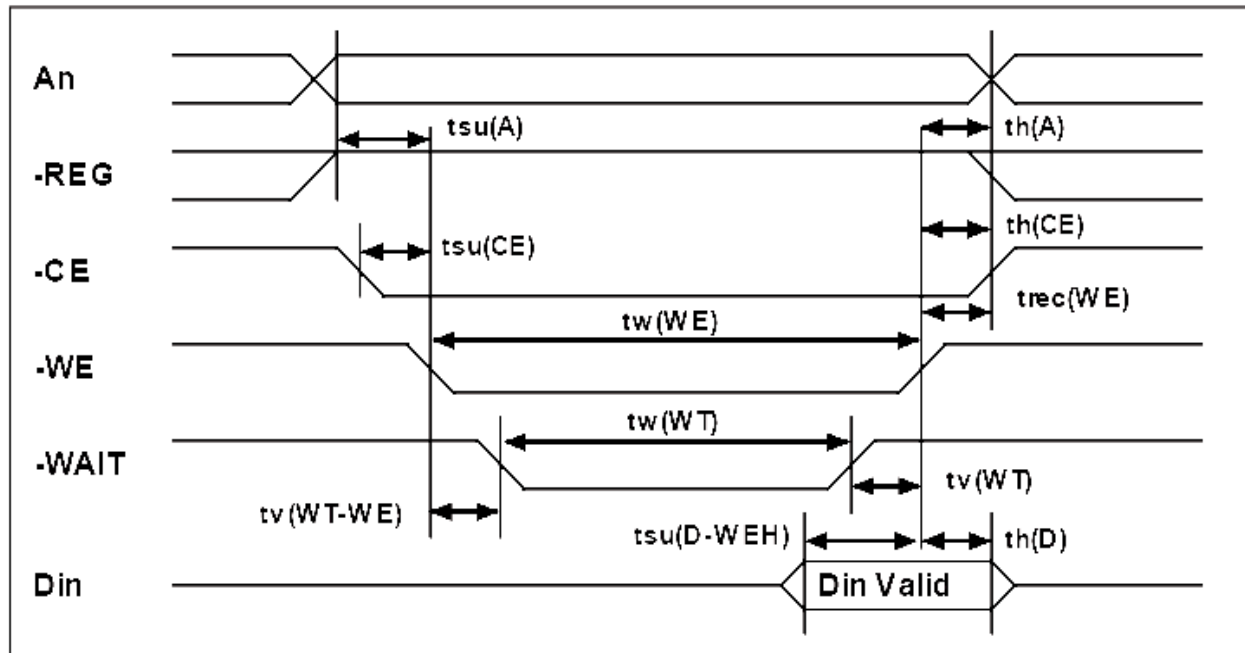


Figure 19: Common Memory Access Write Timing Diagram

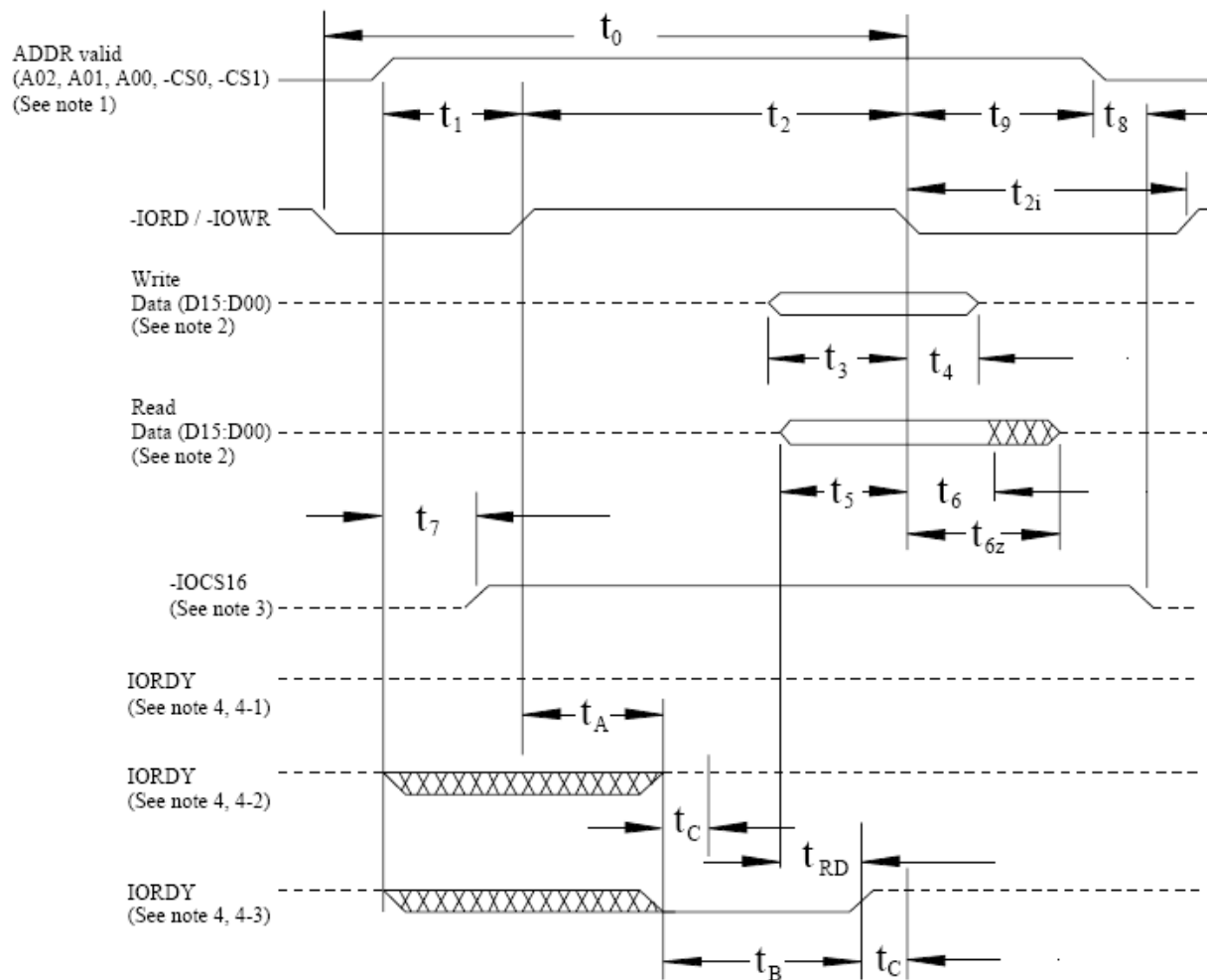
The timing diagram for True IDE mode of operation in this section is drawn using the conventions in the ATA-4 specification, which are different than the conventions used in the PCMCIA specification. Signals are shown with their asserted state as high regardless of whether the signal is actually negative or positive true. Consequently, the – IORD, the –IOWR, and the –IOCS16 signals are shown in the diagram inverted from their electrical states on the bus.

**Table 43: True IDE Mode I/O Read/Write Timing**

|     | Item                                                                   | Mode 0<br>(ns) | Mode 1<br>(ns) | Mode 2<br>(ns) | Mode 3<br>(ns) | Mode 4<br>(ns) | Note |
|-----|------------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------|
| t0  | Cycle time (min)                                                       | 600            | 383            | 240            | 180            | 120            | 1    |
| t1  | Address Valid to –IORD/–IOWR setup (min)                               | 70             | 50             | 30             | 30             | 25             |      |
| t2  | –IORD/–IOWR (min)                                                      | 165            | 125            | 100            | 80             | 70             | 1    |
| t2  | –IORD/–IOWR (min) Register (8 bit)                                     | 290            | 290            | 290            | 80             | 70             | 1    |
| t2i | –IORD/–IOWR recovery time (min)                                        | -              | -              | -              | 70             | 25             | 1    |
| t3  | –IOWR data setup (min)                                                 | 60             | 45             | 30             | 30             | 20             |      |
| t4  | –IOWR data hold (min)                                                  | 30             | 20             | 15             | 10             | 10             |      |
| t5  | –IORD data setup (min)                                                 | 50             | 35             | 20             | 20             | 20             |      |
| t6  | –IORD data hold (min)                                                  | 50             | 5              | 5              | 5              | 5              |      |
| t6Z | –IORD data tristate (max)                                              | 30             | 30             | 30             | 30             | 30             | 2    |
| t7  | Address valid to –IOCS16 assertion (max)                               | 90             | 50             | 40             | n/a            | n/a            | 4    |
| t8  | Address valid to –IOCS16 released (max)                                | 60             | 45             | 30             | n/a            | n/a            | 4    |
| t9  | –IORD/–IOWR to address valid hold                                      | 20             | 15             | 10             | 10             | 10             |      |
| tRD | Read Data Valid to IORDY active (min), if IORDY initially low after tA | 0              | 0              | 0              | 0              | 0              |      |
| tA  | IORDY Setup time                                                       | 35             | 35             | 35             | 35             | 35             | 3    |
| tB  | IORDY Pulse Width (max)                                                | 1250           | 1250           | 1250           | 1250           | 1250           |      |
| tC  | IORDY assertion to release (max)                                       | 5              | 5              | 5              | 5              | 5              |      |

Notes: The maximum load on –IOCS16 is 1 LSTTL with a 50 pF total load. All times are in nanoseconds.  
Minimum time from –IORDY high to –IORD high is 0 nsec, but minimum –IORD width shall still be met.

- 1) t0 is the minimum total cycle time, t2 is the minimum command active time, and t2i is the minimum command recovery time or command inactive time. The actual cycle time equals the sum of the actual command active time and the actual command inactive time. The three timing requirements of t0, t2, and t2i shall be met. The minimum total cycle time requirement is greater than the sum of t2 and t2i. This means a host implementation can lengthen either or both t2 or t2i to ensure that t0 is equal to or greater than the value reported in the device's identify drive data. A CompactFlash Card implementation shall support any legal host implementation.
- 2) This parameter specifies the time from the negation edge of –IORD to the time that the data bus is no longer driven by the CompactFlash Card (tri-state).
- 3) The delay from the activation of –IORD or –IOWR until the state of IORDY is first sampled. If IORDY is inactive then the host shall wait until IORDY is active before the PIO cycle can be completed. If the CompactFlash Card is not driving IORDY negated at tA after the activation of –IORD or –IOWR, then t5 shall be met and tRD is not applicable. If the CompactFlash Card is driving IORDY negated at the time tA after the activation of –IORD or –IOWR, then tRD shall be met and t5 is not applicable.
- 4) t7 and t8 apply only to modes 0, 1 and 2. For other modes, this signal is not valid.



Notes:

- (1) Device address consists of -CS0, -CS1, and A[02::00]
- (2) Data consists of D[15::00] (16-bit) or D[07::00] (8-bit)
- (3) -IOCS16 is shown for PIO modes 0, 1 and 2. For other modes, this signal is ignored.
- (4) The negation of IORDY by the device is used to extend the PIO cycle. The determination of whether the cycle is to be extended is made by the host after  $t_A$  from the assertion of -IORD or -IOWR. The assertion and negation of IORDY is described in the following three cases:
  - (4-1) Device never negates IORDY: No wait is generated.
  - (4-2) Device starts to drive IORDY low before  $t_A$ , but causes IORDY to be asserted before  $t_A$ : No wait generated.
  - (4-3) Device drives IORDY low before  $t_A$ : wait generated. The cycle completes after IORDY is reasserted. For cycles where a wait is generated and -IORD is asserted, the device shall place read data on D15-D00 for  $t_{RD}$  before causing IORDY to be asserted.

**ALL WAVEFORMS IN HIS DIAGRAM ARE SHOWN WITH THE ASSERTED STATE HIGH.  
NEGATIVE TRUE SIGNALS APPEAR INVERTED ON THE BUS RELATIVE TO THE DIAGRAM.**

**Figure 20: True IDE Mode I/O Timing Diagram**

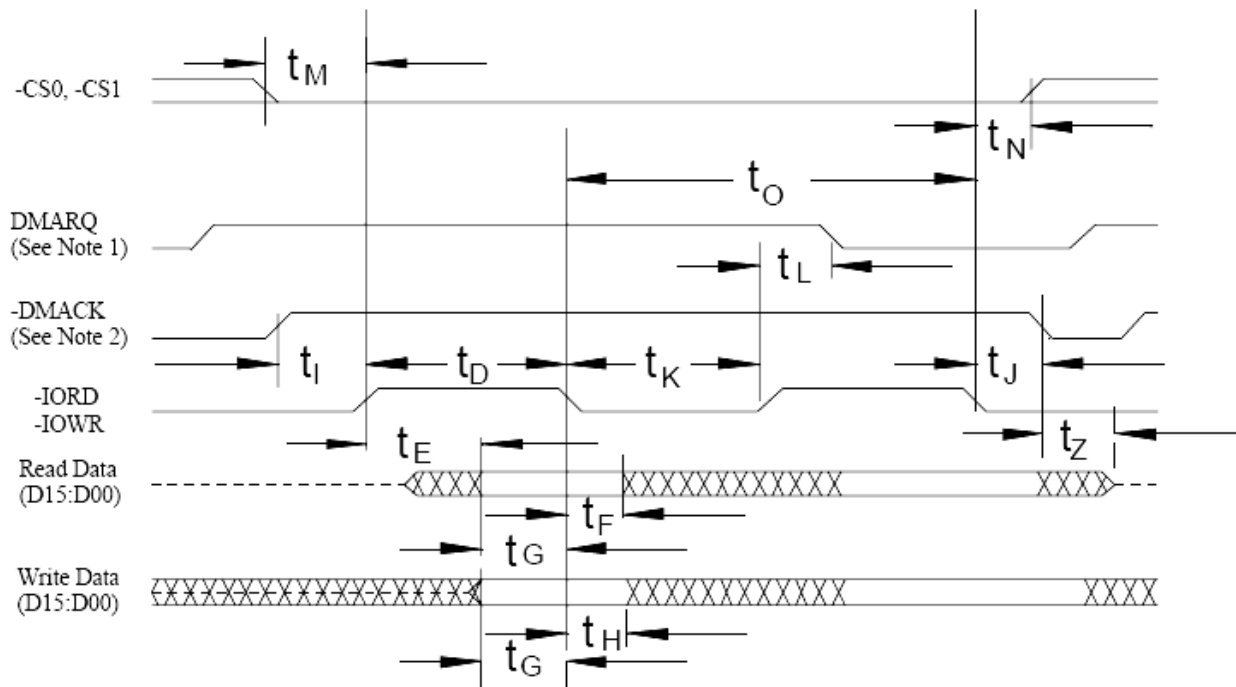
The timing diagram for True IDE DMA mode of operation in this section is drawn using the conventions in the ATA-4 specification, which are different than the conventions used in the PCMCIA specification. Signals are shown with their asserted state as high regardless of whether the signal is actually negative or positive true. Consequently, the  $\overline{\text{IORD}}$ , the  $\overline{\text{IOWR}}$ , and the  $\overline{\text{IOCS16}}$  signals are shown in the diagram inverted from their electrical states on the bus.

**Table 44: True IDE DMA Mode I/O Read/Write Timing**

|          | Item                                                                                    | Mode 0<br>(ns) | Mode 1<br>(ns) | Mode 2<br>(ns) | Note |
|----------|-----------------------------------------------------------------------------------------|----------------|----------------|----------------|------|
| $t_O$    | Cycle time (min)                                                                        | 480            | 150            | 120            | 1    |
| $t_D$    | $\overline{\text{IORD}}/\overline{\text{IOWR}}$ asserted width (min)                    | 215            | 80             | 70             | 1    |
| $t_E$    | $\overline{\text{IORD}}$ data access (max)                                              | 150            | 60             | 50             |      |
| $t_F$    | $\overline{\text{IORD}}$ data hold (min)                                                | 5              | 5              | 50             |      |
| $t_G$    | $\overline{\text{IORD}}/\overline{\text{IOWR}}$ data setup (min)                        | 100            | 30             | 20             |      |
| $t_H$    | $\overline{\text{IOWR}}$ data hold (min)                                                | 20             | 15             | 10             |      |
| $t_I$    | DMACK to $\overline{\text{IORD}}/\overline{\text{IOWR}}$ setup (min)                    | 0              | 0              | 0              |      |
| $t_J$    | $\overline{\text{IORD}}/\overline{\text{IOWR}}$ to $\overline{\text{DMACK}}$ hold (min) | 20             | 5              | 5              |      |
| $t_{KR}$ | $\overline{\text{IORD}}$ negated width (min)                                            | 50             | 50             | 25             | 1    |
| $t_{KW}$ | $\overline{\text{IOWR}}$ negated width (min)                                            | 215            | 50             | 25             | 1    |
| $t_{LR}$ | $\overline{\text{IORD}}$ to DMARQ delay (max)                                           | 120            | 40             | 35             |      |
| $t_{LW}$ | $\overline{\text{IOWR}}$ to DMARQ delay (max)                                           | 40             | 40             | 35             |      |
| $t_M$    | CS(1:0) valid to $\overline{\text{IORD}}/\overline{\text{IOWR}}$                        | 50             | 30             | 25             |      |
| $t_N$    | CS(1:0) hold                                                                            | 15             | 10             | 10             |      |
| $t_Z$    | $\overline{\text{DMACK}}$                                                               | 20             | 25             | 25             |      |

Notes:

- 1)  $t_O$  is the minimum total cycle time and  $t_D$  is the minimum command active time, while  $t_{KR}$  and  $t_{KW}$  are the minimum command recovery time or command inactive time for input and output cycles respectively. The actual cycle time equals the sum of the actual command active time and the actual command inactive time. The three timing requirements of  $t_O$ ,  $t_D$ ,  $t_{KR}$ , and  $t_{KW}$  shall be met. The minimum total cycle time requirement is greater than the sum of  $t_D$  and  $t_{KR}$  or  $t_{KW}$  for input and output cycles respectively. This means a host implementation can lengthen either or both of  $t_D$  and either of  $t_{KR}$ , and  $t_{KW}$  as needed to ensure that  $t_O$  is equal to or greater than the value reported in the device's identify drive data. A CompactFlash Card implementation shall support any legal host implementation.



Notes:

- (1) If the Card cannot sustain continuous, minimum cycle time DMA transfers, it may negate DMARQ within the time specified from the start of a DMA transfer cycle to suspend the DMA transfers in progress and reassert the signal at a later time to continue the DMA operation
- (2) This signal may be negated by the host to suspend the DMA transfer in progress.

**ALL WAVEFORMS IN HIS DIAGRAM ARE SHOWN WITH THE ASSERTED STATE HIGH.  
NEGATIVE TRUE SIGNALS APPEAR INVERTED ON THE BUS RELATIVE TO THE DIAGRAM.**

**Figure 21: True IDE DMA Mode I/O Timing Diagram**

### 3.4 Reset Characteristics (Memory Card Mode & I/O Card Mode)

Table 45: Hard Reset Characteristics

| Parameter             | Symbol         | Min | Typ | Max | Unit |
|-----------------------|----------------|-----|-----|-----|------|
| Reset setup time      | tsu(RESET)     | 100 | -   | -   | 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-Z RESET) | 1   | -   | -   | ms   |
|                       | ts(Hi-Z RESET) | 0   | -   | -   | ms   |

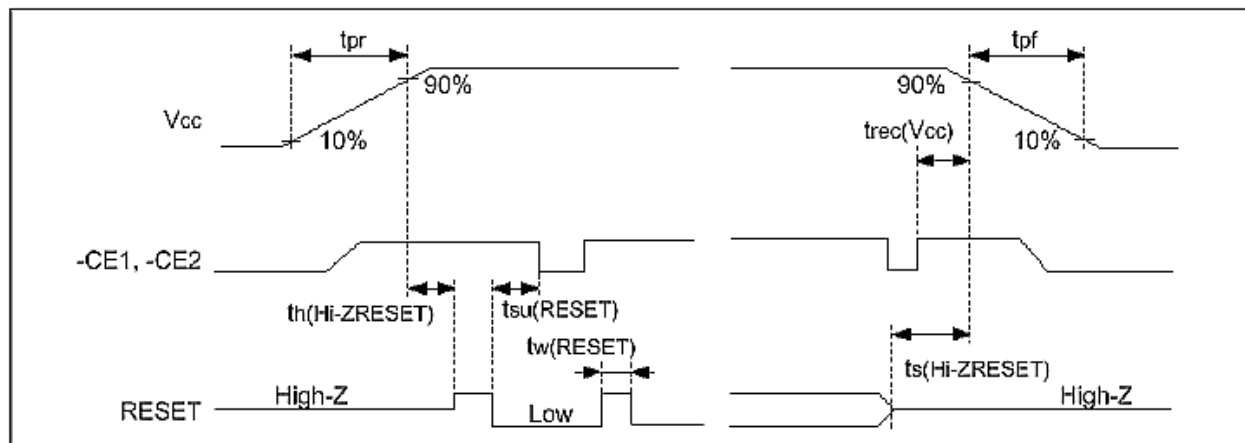


Figure 22: Hard Reset Timing

Table 46: Power on Reset Characteristics

| Parameter          | Symbol   | Min | Typ | Max | Unit |
|--------------------|----------|-----|-----|-----|------|
| -CE setup time     | tsu(VCC) | 100 | -   | -   | ms   |
| VCC rising up time | tpr      | 0.1 | -   | 100 | ms   |

NOTE:

1. All card status is reset automatically when Vcc goes over 2.3V.

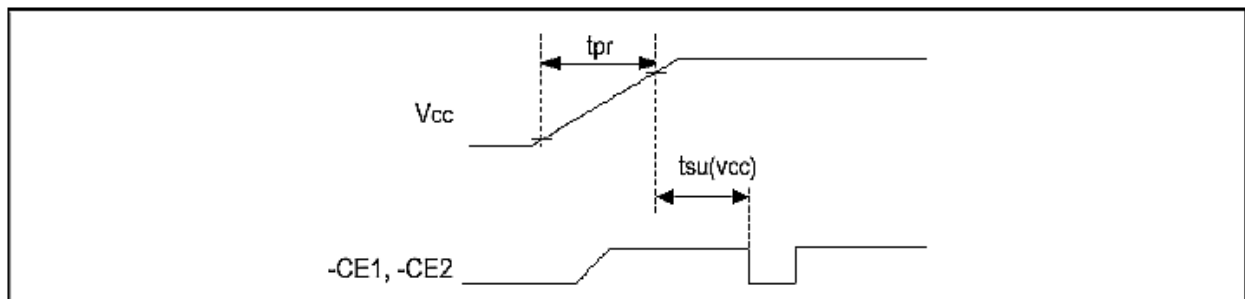


Figure 23: Power on Reset Timing

## 3.5 User Notes

In the reset or power off, all register information is cleared. All card status is cleared automatically when Vcc voltage turns below about 2.5V. Notice that the card insertion/removal should not be executed when host is active in True IDE Mode. After card hard reset, soft reset, power-on reset, or ATA reset, the card cannot be operated until +RDY/-BSY pin is moved from “low”. Notice that the card removal should be executed after card internal operations are completed. Before the card insertion, Vcc cannot be supplied to the card. After confirmation that -CD1, -CD2 pins are inserted, supply Vcc to the card. -OE must be kept at the Vcc level during power on reset in memory card mode and I/O card mode. -OE must be kept constantly at the GND level in True IDE Mode.

## 4.0 Physical Specifications

Table 47: Physical Specifications

|                   |                                                    |
|-------------------|----------------------------------------------------|
| <b>Weight:</b>    | 11.4 g (0.40 oz) typical, 14.2 g (0.50 oz) maximum |
| <b>Length:</b>    | 36.40 ± 0.15 mm (1.433 ± 0.006 in)                 |
| <b>Width:</b>     | 42.80 ± 0.10 mm (1.685 ± 0.004 in)                 |
| <b>Thickness:</b> | 3.3 ± 0.10 mm (0.13 ± 0.004 in) – Excluding Lip    |

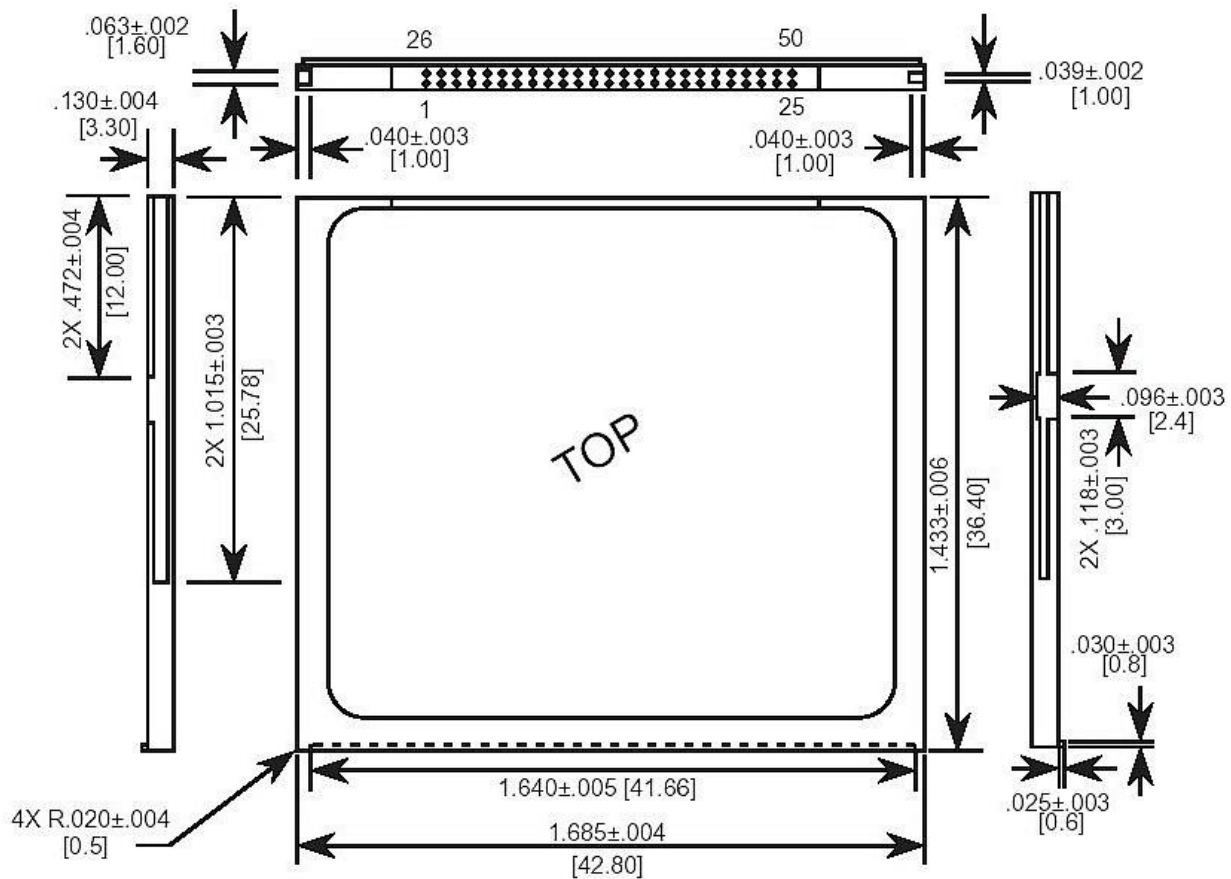
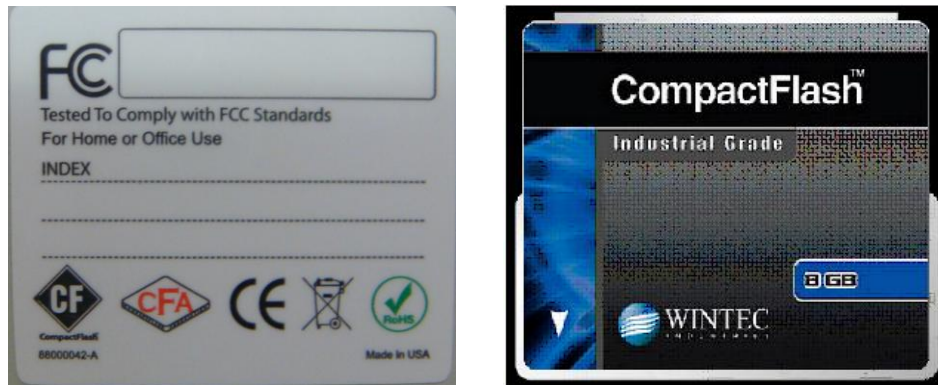


Figure 24: Physical Dimensions

## 4.1 Labelling and Marking



**Fig 25 & 26 CF Card Back and Front Labels**

The standard labels used for Wintec Industrial CF cards are shown in figs 25 & 26. The front label will indicate the capacity of the card and will indicate if the card is Industrial Temperature (no marking if not). The back label will contain the various logos indicating compliance with appropriate bodies and regulations. The back label will also be inked in marked area with the part number and lot numbers of the cards. Customized labeling is available upon request.

## 5.0 Ordering Information

**Table 48: Product Availability List & Naming**

| Card Capacity  | Part Number               | Real Capacity | Total Sectors/Card (Max LBA+1) | Cylinders | Heads | Sectors |
|----------------|---------------------------|---------------|--------------------------------|-----------|-------|---------|
| <b>32 MB</b>   | W7CF032M1vA(I)-w0Px-yyy.z | 32,636,928    | 63,744                         | 498       | 4     | 32      |
| <b>64 MB</b>   | W7CF064M1vA(I)-w0Px-yyy.z | 65,536,000    | 128,000                        | 1,000     | 4     | 32      |
| <b>128 MB</b>  | W7CF128M1vA(I)-w0Px-yyy.z | 131,334,144   | 256,512                        | 1,002     | 8     | 32      |
| <b>256 MB</b>  | W7CF256M1vA(I)-w0Px-yyy.z | 262,930,432   | 513,536                        | 1,003     | 16    | 32      |
| <b>512 MB</b>  | W7CF512M1vA(I)-w0Px-yyy.z | 526,417,920   | 1,028,160                      | 1,020     | 16    | 63      |
| <b>1 – GB</b>  | W7CF001G1vA(I)-w0Px-yyy.z | 1,054,900,224 | 2,060,352                      | 2,044     | 16    | 63      |
| <b>2 – GB</b>  | W7CF002G1vA(I)-w0Px-yyy.z | 2,118,057,984 | 4,136,832                      | 4,104     | 16    | 63      |
| <b>4 – GB</b>  | W7CF004G1vA(I)-w0Px-yyy.z | 4,244,889,600 | 8,290,800                      | 8,225     | 16    | 63      |
| <b>8 – GB</b>  | W7CF008G1vA(I)-w0Px-yyy.z | 8,455,200,768 | 16,435,440                     | 16305     | 16    | 63      |
| <b>16 – GB</b> | W2CF016G1vA(I)-w0Px-yyy.z | TBD           | 32,014,080                     | 31760     | 16    | 63      |

**NOTE:**

1. Total Sectors/Card = Sectors/Track \* # Heads \* # Cylinders
2. Real Capacity = The logical address capacity including the area used for file system and controller overhead.
3. Cards default with DMA disabled. For DMA Enable use “w1Px” Suffix.
4. (I) denotes Industrial Temperature option, leave blank for standard Commercial Temp.

**(v) Disk/Interface Options**

- X** : Removable Disk True IDE Capable
- P** : SPI Interface
- T** : Fixed Disk True IDE

**(w) Controller Options**

- H2** : Hyperstone F2
- H3** : Hyperstone F3
- S** : SMI
- T** : Toshiba

**(x) Component Flash IC Die Revision**

- A** : A- die
- B** : B- die
- C** : C- die
- D** : D- die

**(yyy) Component Flash type**

- 001: 1-Nand Flash chip
- 01D: 1-Nand, Dual Die, 1-CE
- 1D2: 1-Nand, Dual Die, 2-CE
- 1Q2: 1-Nand, Quad Die, 2-CE
- 002: 2-Nand Flash chips
- 02D: 2-Nand, Dual Die, 1-CE
- 2D2: 2-Nand, Dual Die, 2-CE
- 2Q2: 2-Nand, Quad Die, 2-CE
- 4D2: 4-Nand, Dual Die, 2-CE
- 4Q2: 4-Nand, Quad Die, 2-CE

**(z) Firmware Options**

- .00 : 060729
- .01 : 080112
- .02 : 090720
- .03 : 100924

**Firmware Revision/Options (Optional)**

Please contact the factory for the latest firmware revisions and/or custom labeling and programming identification.

### Contact Us (US & Int'l):

Wintec Industries OEM Sales  
675 Sycamore Drive  
Milpitas, CA 95035  
Ph: 408-856-0663  
Fax: 408-856-0518

[oemsales@wintecind.com](mailto:oemsales@wintecind.com)  
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