

ICF 9000

Standard

Customer: _____

Customer

Part

Number: _____

Innodisk

Part

Number: _____

Innodisk

Model Name: _____

Date: _____

| Innodisk Approver | Customer Approver |
|--------------------------|--------------------------|
| | |

**The Total Solution For
Industrial Flash Storage**

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| 1.2 | Modify part number | Dec. 2012 |
| 1.3 | Modify performance Update CE,FCC | Jan. 2013 |
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| 1.7 | Modify part number rule | May. 2013 |
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1. Introduction

The Innodisk Industrial CompactFlash® 9000 Memory Card (iCF9000) products provide high capacity solid-state flash memory that electrically complies with the True IDE Mode that is electrically compatible with an IDE disk drive. The original CF form factor card can be used in any system that has a CF slot. Designed to replace traditional rotating disk drives, Innodisk Industrial CompactFlash® 9000 Memory Cards are embedded solid-state data storage systems for mobile computing and the industrial work place. The Industrial CompactFlash® features an extremely lightweight, reliable, low-profile form factor. Industrial CompactFlash® 9000 (iCF9000) support advanced PIO (0-6), Multiword DMA (0-4), Ultra DMA (0-7) transfer mode, multi-sector transfers, and LBA addressing.



Figure 1:iCF 9000

2. Features

The Industrial ATA products provide the following system features:

- Capacities: 1GB/2GB/4GB/8GB/16GB/32GB/64GB
- Fully compatible with CompactFlash® specification version 6.0
- Fully compatible with PC Card Standard.
- Fully compatible with the IDE standard interface, ATA Standard
- Three access modes
 - True IDE Mode
 - PC Card Memory Mode
 - PC Card I/O Mode
- ECC (Error Correction Code) function: 72 bits/ per 1 Kbyte
- +3.3V/+5V single power supply operation
- Support Auto Stand-by and Sleep Mode.
- Power Consumption

- Quad:

Active mode

Read operation: 114 mA (max.)

Write operation: 188 mA (max.)

Power Down mode: 0.7 mA (max.)

- Support transfer modes: PIO(0-6), Multiword DMA (0-4) and Ultra DMA(0-7)
- MTBF 3,000,000 hours
- R/W performance:

| Product name | | 1GB | 2GB | 4GB | 8GB | 16GB | 32GB | 64GB |
|--------------|---------------------|-----|-----|-----|-----|------|------|------|
| ICF 9000 | Sequential Read | 60 | 110 | 110 | 110 | 110 | 110 | 110 |
| | Sequential Write | 25 | 50 | 50 | 90 | 70 | 100 | 100 |

- Operating temperature range:

- Standard Grade: 0°C ~ +70°C

- Industrial Grade: -40°C ~ +85°C

- Storage temperature range: -55°C ~ +95°C

3. Pin Assignment

See Table 1 for iCF9000 pin assignments.

Table 1: iCF9000 Pin Assignments

| True IDE Mode | | | | | |
|---------------|------------------|-----|---------|---------------------|-----|
| Pin No. | Name | I/O | Pin No. | Name | I/O |
| 1 | GND | | 29 | D13 ¹ | I/O |
| 2 | D03 | I/O | 30 | D14 ¹ | I/O |
| 3 | D04 | I/O | 31 | D15 ¹ | I/O |
| 4 | D05 | I/O | 32 | -CS1 ¹ | I |
| 5 | D06 | I/O | 33 | -VS1 | GND |
| 6 | D07 | I/O | 34 | -IORD ⁷ | I |
| 7 | -CS0 | I | | | |
| 8 | A10 ² | GND | | | |
| 9 | -ATA SEL | GND | 35 | -IOWR ⁷ | I |
| 10 | A09 ² | GND | | | |
| 11 | A08 ² | GND | 36 | -WE ³ | I |
| 12 | A07 ² | GND | 37 | INTRQ | O |
| 13 | VCC | GND | 38 | VCC | |
| 14 | A06 ² | GND | 39 | -CSEL | I |
| 15 | A05 ² | GND | 40 | -VS2 | NC |
| 16 | A04 ² | GND | 41 | -RESET | I |
| 17 | A03 ² | GND | 42 | IORDY ¹ | O |
| 18 | A02 | I | | | |
| 19 | A01 | I | | | |
| 20 | A00 | I | 43 | DMARQ | O |
| 21 | D00 | I/O | 44 | -DMACK ⁶ | I |
| 22 | D01 | I/O | 45 | -DASP | I/O |
| 23 | D02 | I/O | 46 | -PDIAG | I/O |
| 24 | -IOCS16 | NC | 47 | D08 ¹ | I/O |
| 25 | -CD2 | GND | 48 | D09 ¹ | I/O |
| 26 | -CD1 | GND | 49 | D10 ¹ | I/O |
| 27 | D11 ¹ | I/O | 50 | GND | |
| 28 | D12 ¹ | I/O | | | |

Note:

- 1) These signals are required only for 16 bit accesses and not required when installed in 8 bit systems. Devices should allow for 1-state signals not to consume current.
- 2) The signal should be grounded by the host.
- 3) The signal should be tied to VCC by the host.
- 4) The mode is optional for CF+ Cards, but required for CompactFlash® Storage Cards.
- 5) The -CSEL signal is ignored by the card in PC Card modes. However, because it is not pulled up on the card in these modes, it should not be left floating by the host in PC Card modes. In these modes, the pin should be connected by the host to PC Card A25 or grounded by the host.
- 6) If DMA operations are not used, the signal should be held high or tied to VCC by the host. For proper operation in older hosts: while DMA operations are not active, the card shall ignore this signal, including a floating condition
- 7) Signal usage in True IDE Mode except when Ultra DMA mode protocol is active.
- 8) Signal usage in True IDE Mode when Ultra DMA mode protocol DMA Write is active.
- 9) Signal usage in True IDE Mode when Ultra DMA mode protocol DMA Read is active.

4. Pin Description

Table 2 describes the pin descriptions for iCF9000

Table 2: iCF9000 Pin Description

| Pin No. | Pin Name | I/O | Mode | Description |
|--|------------|-----|---------------|---|
| 18,19,20 | A2 – A0 | I | True IDE Mode | In True IDE Mode, only A[2:0] are used to select the one of eight registers in the Task File, the remaining address lines should be grounded by the host. |
| 46 | -PDIAG | I/O | True IDE Mode | In the True IDE Mode, this input / output is the Pass Diagnostic signal in the Master / Slave handshake protocol. |
| 45 | -DASP | I/O | True IDE Mode | In the True IDE Mode, this input/output is the Disk Active/Slave Present signal in the Master/Slave handshake protocol. |
| 26, 25 | -CD1, -CD2 | O | True IDE Mode | This signal is the same for all modes. |
| 7, 32 | -CS0, -CS1 | I | 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. While -DMACK is asserted, -CS0 and -CS1 shall be held negated and the width of the transfers shall be 16 bits. |
| 39 | -CSEL | I | 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 the pin is open, this device is configured as a Slave. |
| 2,3,4,5,6,3 1,30,29,2 8,27,49,4 8,47,23,2 2,21 | D15 – D00 | I/O | True IDE Mode | In True IDE Mode, all Task File operations occur in byte mode on the low order bus D[7:0] while all data transfers are 16 bit using D[15:0]. |
| 1, 50 | GND | - | True IDE Mode | This signal is the same for all modes. |

| | | | | |
|----|-------------------|---|---------------|---|
| 43 | DMARQ | O | 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 -IORD and -IOWR. This signal is used in a handshake manner with -DMACK, i.e., the device shall wait until the host asserts -DMACK before negating DMARQ, and reasserting DMARQ if there is more data to transfer. DMARQ shall not be driven when the device is not selected. While a DMA operation is in progress, -CS0 and -CS1 shall be held negated and the width of the transfers shall be 16 bits. 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 device drivers will not attempt DMA mode.</p> |
| 34 | -IORD | I | True IDE Mode | <p>In True IDE Mode, while Ultra DMA mode is not active, this signal has the same function as in PC Card I/O Mode.</p> |
| | -HDMARDY | | | <p>In True IDE Mode when Ultra DMA mode DMA Read is active, this signal is asserted by the host to indicate that the host is ready to receive Ultra DMA data-in bursts. The host may negate -HDMARDY to pause an Ultra DMA transfer.</p> |
| | HSTROBE | | | <p>In True IDE Mode when Ultra DMA mode DMA Write is active, this signal is the data out strobe generated by the host. Both the rising and falling edge of HSTROBE cause data to be latched by the device. The host may stop generating HSTROBE edges to pause an Ultra DMA data-out burst.</p> |
| 35 | -IOWR | I | True IDE Mode | <p>In True IDE Mode, while Ultra DMA mode protocol is not active, this signal has the same function as in PC Card I/O Mode. When Ultra DMA mode protocol is supported, this signal must be negated before entering Ultra DMA mode protocol.</p> |

| | | | | |
|--------|------------|---|---------------|--|
| | STOP | | | In True IDE Mode, while Ultra DMA mode protocol is active, the assertion of this signal causes the termination of the Ultra DMA burst. |
| 9 | -ATA SEL | I | True IDE Mode | To enable True IDE Mode this input should be grounded by the host. |
| 37 | INTRQ | O | True IDE Mode | In True IDE Mode signal is the active high Interrupt Request to the host. |
| 44 | -DMACK | I | True IDE Mode | This is a DMA Acknowledge signal that is asserted by the host in response to DMARQ to initiate DMA transfers. While DMA operations are not active, the card shall ignore the -DMACK signal, including a floating condition. If DMA operation is not supported by a True IDE Mode only host, this signal should be driven high or connected to VCC by the host. |
| 41 | -RESET | I | True IDE Mode | In the True IDE Mode, this input pin is the active low hardware reset from the host. |
| 13, 38 | VCC | - | True IDE Mode | This signal is the same for all modes. |
| 33, 40 | -VS1, -VS2 | O | True IDE Mode | This signal is the same for all modes. |
| 42 | IORDY | O | True IDE Mode | In True IDE Mode, except in Ultra DMA modes, this output signal may be used as IORDY. |
| | -DDMARDY | | | In True IDE Mode, when Ultra DMA mode DMA Write is active, this signal is asserted by the host to indicate that the device is ready to receive Ultra DMA data-in bursts. The device may negate -DDMARDY to pause an Ultra DMA transfer. |
| | DSTROBE | | | In True IDE Mode, when Ultra DMA mode DMA Write is active, this signal is the data out strobe generated by the device. Both the rising and falling edge of DSTROBE cause data to be latched by the host. The device may stop generating DSTROBE edges to pause an Ultra DMA data-out burst. |

| | | | | |
|----|---------|---|---------------|---|
| 36 | -WE | I | True IDE Mode | In True IDE Mode, this input signal is not used and should be connected to VCC by the host. |
| 24 | -IOCS16 | O | True IDE Mode | In True IDE Mode this output signal is asserted low when this device is expecting a word data transfer cycle. |

5. Specifications

5.1 CE and FCC Compatibility

iCF 9000 conforms to CE and FCC requirements.

5.2 RoHS Compliance

iCF 9000 is fully compliant with RoHS directive.

5.3 Environmental Specifications

5.3.1 Temperature Ranges

Operating Temperature Range:

- Standard Grade: 0°C to +70°C
- Industrial Grade: -40°C to +85°C

Storage Temperature Range: -55°C to +95°C

5.3.2 Humidity

Relative Humidity: 10-95%, non-condensing

5.3.3 Shock and Vibration

Table 3: Shock/Vibration Test for ICF9000

| Reliability | Test Conditions | Reference Standards |
|------------------|--------------------------------|---------------------|
| Vibration | 7 Hz to 2 KHz, 20G, 3 axes | IEC 68-2-6 |
| Mechanical Shock | Duration: 0.5ms, 1500G, 3 axes | IEC 68-2-27 |

5.3.4 Mean Time between Failures (MTBF)

Table 4 summarizes the MTBF prediction results for various ICF9000 configurations. The analysis was performed using a RAM Commander™ failure rate prediction.

- **Failure Rate:** The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition.
- **Mean Time between Failures (MTBF):** A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

Table 4: iCF9000 MTBF

| Product | Condition | MTBF (Hours) |
|----------------|---------------------------|---------------------|
| ICF9000 | Telcordia SR-332 GB, 25°C | 3,000,000 |

5.3.5 Write Protect Function Support

Innodisk CF card within the write-protect function could prevent the CF card from modification and deletion. Write-protected data in CF card could only be read, that is, users could not write to it, edit it, append data to it, or delete it.

When users would like to make sure that neither themselves nor others could modify or destroy the file, users could switch on write-protection. Thus Innodisk CF card would process write-protect mechanism and disable flash memory to be written-in any data. Only while the system power-off, users could switch on write-protection. Write-protection could not be switched-on, after OS booting.

5.3.6 Wear-Leveling

Flash memory can be erased a limited number of times. This number is called the **erase cycle limit** or **write endurance limit** and is defined by the flash array vendor. The erase cycle limit applies to each individual erase block in the flash device.

ICF9000 uses a wear-leveling algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page in the flash. This spreads flash media usage evenly across all pages, thereby maximizing flash lifetime.

5.3.7 Reliability

| Parameter | Value |
|-------------------------|----------------------------|
| Read Cycles | Unlimited Read Cycles |
| Wear-Leveling Algorithm | Support |
| Bad Blocks Management | Support |
| Error Correct Code | Support |
| TBW(Sequential Write) | |
| 1GB | 65.1 (Sequential write) |
| 2GB | 130.20 (Sequential write) |
| 4GB | 260.41 (Sequential write) |
| 8GB | 520.83 (Sequential write) |
| 16GB | 1041.66 (Sequential write) |
| 32GB | 2083.33 (Sequential write) |
| 64GB | 4166.66 (Sequential write) |

5.4 Mechanical Dimensions

Mechanical Dimension: 42.80±0.1/36.40±0.1/3.30±0.05mm (W/T/H)

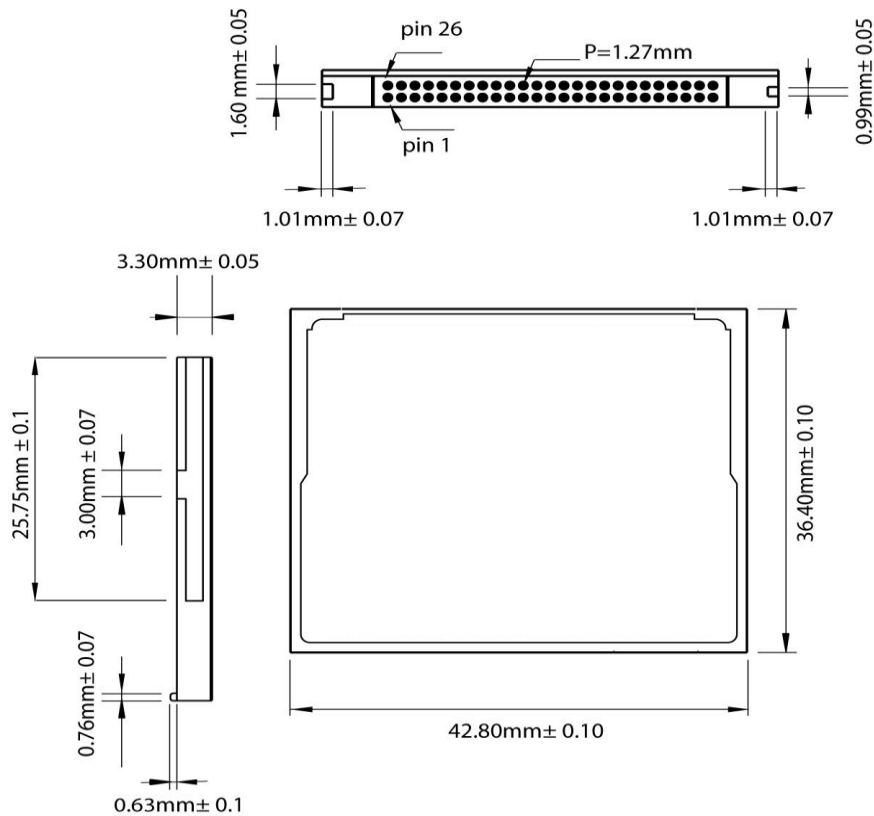


Figure 1: Mechanical Dimension of ICF9000

Mechanical Dimension: 42.80±0.1/36.40±0.1/3.30±0.05mm (W/T/H)

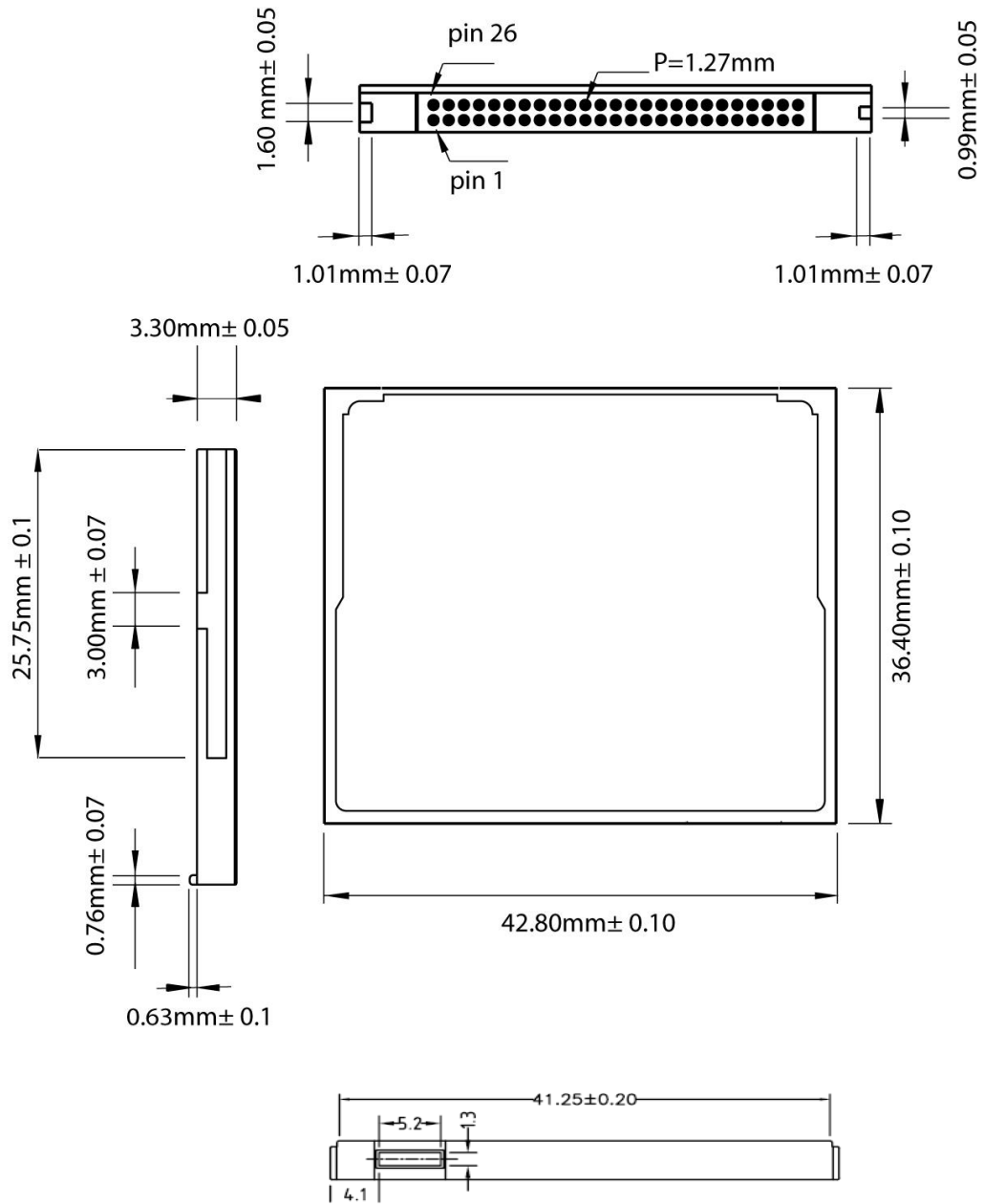


Figure 2: Mechanical Dimension of ICF9000 write protect

5.5 Electrical Specifications

5.5.1 DC Characteristic

Power supply requirement: $5V \pm 0.5V$ DC or $3.3V \pm 0.3V$

5.5.2 Timing Specifications

5.5.2.1 True IDE PIO Mode Read/Write Timing Specification

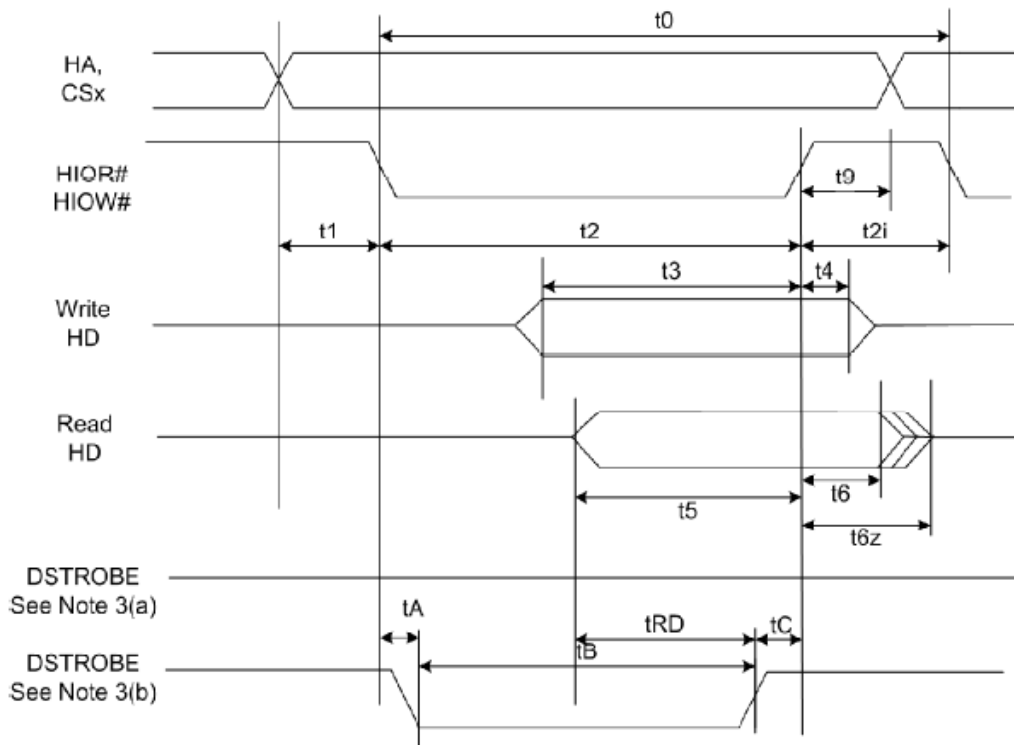


Figure 2: Read/Write Timing Diagram, PIO Mode

Note:

1. Device address comprises CS1#, CS0#, and HA[2:0].
2. Data comprises HD[15:0] (16-bit) or HD[7:0] (8-bit).
3. The negation of DSTROBE by the device is used to lengthen the PIO cycle. Whether the cycle is to be extended is determined by the host after T_a from the assertion of HIOR# or HIOW#. The assertion and negation of DSTROBE is described in the following three cases. (a) The device never negates DSTROBE: No wait is generated. (b) Device drives DSTROBE low before T_a : a wait is generated. The cycle is completed after DSTROBE is reasserted. For cycles in which a wait is generated and HIOR# is asserted, the device places read data on D15-D00 for T_{rd} before DSTROBE is asserted.

Table 5: True IDE PIO Mode Read/Write Timing

| PIO timing parameters | | Mode 0 | Mode 1 | Mode 2 | Mode 3 | Mode 4 |
|------------------------------|--|---------------|---------------|---------------|---------------|---------------|
| t ₀ | Cycle time (min.) | 600 | 383 | 240 | 180 | 120 |
| t ₁ | Address valid to HIOR-/HIOW-setup (min.) | 70 | 50 | 30 | 30 | 25 |
| t ₂ | HIOR-/HIOW- 16-bit (min.) | 165 | 125 | 100 | 80 | 70 |
| t ₂ | HIOR-/HIOW- Register 8-bit (min.) | 290 | 290 | 290 | 80 | 70 |
| t _{2i} | HIOR-/HIOW- recovery time (min.) | - | - | - | 70 | 25 |
| t ₃ | HIOW- data setup (min.) | 60 | 45 | 30 | 30 | 20 |
| t ₄ | HIOW- data hold (min.) | 30 | 20 | 15 | 10 | 10 |
| t ₅ | HIOR- data setup (min.) | 50 | 35 | 20 | 20 | 20 |
| t ₆ | HIOR- data hold (min.) | 5 | 5 | 5 | 5 | 5 |
| t _{6z} | HIOR- data tri-state (max.) | 30 | 30 | 30 | 30 | 30 |
| t ₉ | HIOR-/HIOW- to address valid hold | 20 | 15 | 10 | 10 | 10 |
| t _{R_D} | Read data valid to IORDY active (min.) | 0 | 0 | 0 | 0 | 0 |
| t _A | IORDY setup time | 35 | 35 | 35 | 35 | 35 |
| t _B | IORDY pulse width (max.) | 1250 | 1250 | 1250 | 1250 | 1250 |
| t _C | IORDY assertion to release (max.) | 5 | 5 | 5 | 5 | 5 |

5.5.2.2 True IDE Multiword DMA Mode Read/Write Timing

Specification

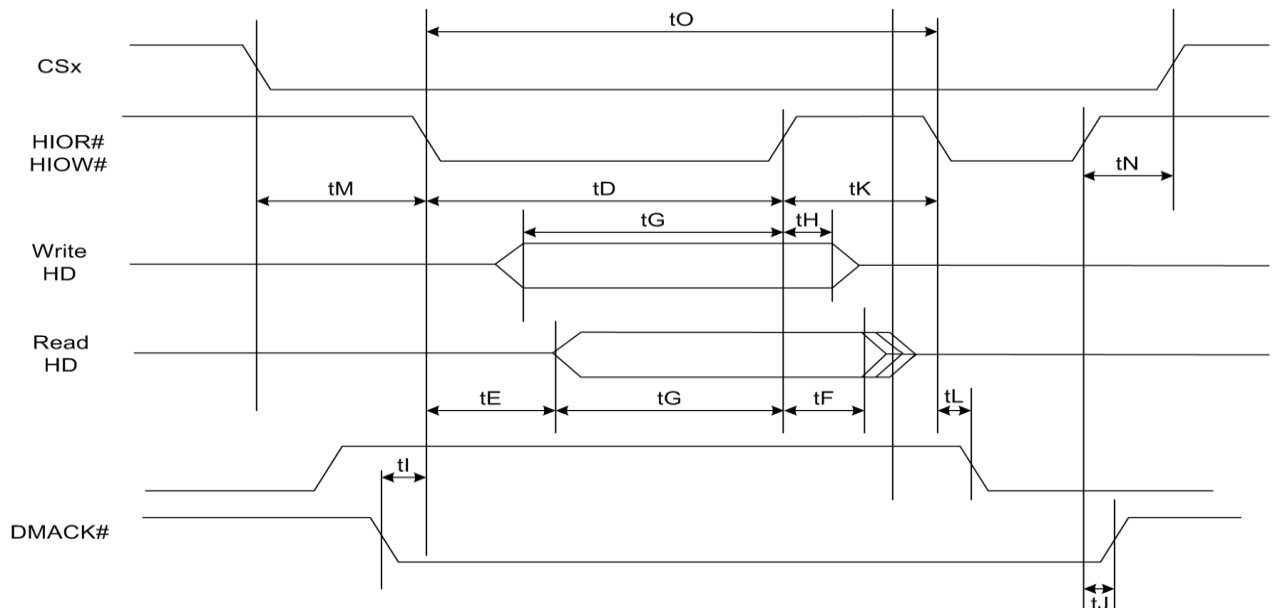


Figure 3: True IDE Multiword DMA Mode Read/Write Timing

Note:

1. If a card cannot sustain continuous, minimum cycle time DMA transfers, it may negate DMARQ during the time from the start of a DMA transfer cycle (to suspend DMA transfers in progress) and reassertion of the signal at a relatively later time to continue DMA transfer operations.
2. The host may negate this signal to suspend the DMA transfer in progress.

Table 6: True IDE Multiword DMA Read/Write Timing

| Multiword DMA timing parameters | | Mode 0 | Mode 1 | Mode 2 |
|---------------------------------|------------------------------------|--------|--------|--------|
| t_0 | Cycle time (min.) | 480 | 150 | 120 |
| t_D | HIOR-/HIOW- assertion width (min.) | 215 | 80 | 70 |
| t_E | HIOR- data access (max.) | 150 | 60 | 50 |
| t_F | HIOR- data hold (min.) | 5 | 5 | 5 |
| t_G | HIOR-/HIOW- data setup (min.) | 100 | 30 | 20 |
| t_H | HIOW- data hold (min.) | 20 | 15 | 10 |
| t_I | DMACK to HIOR-/HIOW- setup (min.) | 0 | 0 | 0 |
| t_J | HIOR-/HIOW- to DMACK hold (min.) | 20 | 5 | 5 |

| | | | | |
|----------|---------------------------------|-----|----|----|
| t_{KR} | HIOR- negated width (min.) | 50 | 50 | 25 |
| t_{KW} | HIOW- negated width (min.) | 215 | 50 | 25 |
| t_{LR} | HIOR- to DMARQ delay (max.) | 120 | 40 | 35 |
| t_{LW} | HIOW- to DMARQ delay (max.) | 40 | 40 | 35 |
| t_M | CS1-, CS0- valid to HIOR-/HIOW- | 50 | 30 | 25 |
| t_N | CS1-, CS0- hold | 15 | 10 | 10 |

5.5.2.3 True IDE Ultra DMA Mode Data Burst Timing Specification

Table 7: Timing Diagram, Ultra DMA Mode 0-6

| Ultra DMA timing parameters | | Mode 0 | | Mode 1 | | Mode 2 | | Mode 3 | | Mode 4 | | Mode 5 | | Mode 6 | |
|-----------------------------|---|--------|-----|--------|-----|--------|------|--------|------|--------|-----|--------|------|--------|-----|
| | | Min. | Max | Min. | Max | Min. | Min. | Max | Min. | Max | Max | Max | Min. | Max | Max |
| t_{2CYC} | Typical sustained average two cycle time | 240 | - | 160 | - | 90 | - | 60 | - | 60 | - | 40 | - | 30 | - |
| t_{CYC} | Cycle time allowing for asymmetry and clock variations (from STROBE edge to STROBE edge) | 112 | - | 73 | - | 39 | - | 25 | - | 25 | - | 16.8 | - | 13 | - |
| t_{2CYC} | Two cycle time allowing for clock variations (from rising edge to next rising edge or from falling edge to next falling edge of STROBE) | 230 | - | 153 | - | 86 | - | 57 | - | 57 | - | 38 | - | 29 | - |
| t_{DS} | Data setup time (at recipient) | 15 | - | 10 | - | 7 | - | 5 | - | 5 | - | 4 | - | 2.6 | - |
| t_{DH} | Data hold time (at recipient) | 5 | - | 5 | - | 5 | - | 5 | - | 5 | - | 4.6 | - | 3.5 | - |
| t_{DVS} | Data valid setup time at sender (from data bus being valid until STROBE edge) | 70 | - | 48 | - | 20 | - | 6.7 | - | 6.7 | - | 4.8 | - | 4 | - |
| t_{DVH} | Data valid hold time | 6.2 | - | 6.2 | - | 6.2 | - | 6.2 | - | 6.2 | - | 4.8 | - | 4 | - |

| | | | | | | | | | | | | | | | |
|--------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|
| | at sender (from STROBE edge until data may become invalid) | | | | | | | | | | | | | | |
| t_{LI} | Limited interlock time | 0 | 150 | 0 | 150 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 75 | 0 | 60 |
| t_{MLI} | Interlock time with minimum | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - |
| t_{UI} | Unlimited interlock time | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - |
| t_{AZ} | Maximum time allowed for output drivers to release (from being asserted or negated) | - | 10 | - | 10 | - | 10 | - | 10 | - | 10 | - | 10 | - | 10 |
| t_{ZAH} | Minimum delay time required for output drivers to assert or negate (from released state) | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - |
| t_{ZAD} | | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - |
| t_{ENV} | Envelope time (from DMACK- to STOP and HDMARDY- during data out burst initiation) | 20 | 70 | 20 | 70 | 20 | 55 | 20 | 55 | 20 | 55 | 20 | 50 | 20 | 50 |
| t_{RFS} | Ready-to-final-STROBE time (no STROBE edges shall be sent this long after negation of DMARDY-) | - | 75 | - | 70 | - | 60 | - | 60 | - | 60 | - | 50 | - | 50 |
| t_{RP} | Ready-to-pause time (time that recipient shall wait to initiate pause after negating DMARDY-) | 160 | - | 125 | - | 100 | - | 100 | - | 100 | - | 85 | - | 85 | - |
| t_{IORDYZ} | Pull-up time before allowing IORDY to be | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 |

| | | | | | | | | | | | | | | | |
|--------------|--|----|-----|----|-----|----|-----|----|-----|----|-----|----|----|----|----|
| | released | | | | | | | | | | | | | | |
| t_{ZIORDY} | Minimum time device shall wait before driving IORDY | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - |
| t_{ACK} | Setup and hold times for DMACK- (before assertion or negation) | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - | 20 | - |
| t_{SS} | Time from STROBE edge to negation of DMARQ or assertion of STOP (when sender terminates a burst) | 50 | | 50 | - | 50 | - | 50 | - | 50 | - | 50 | - | 50 | - |
| t_{FS} | First STROBE time (for device to first negate DSTROBE from STOP during a data in burst) | - | 230 | - | 200 | - | 130 | - | 120 | - | 120 | - | 90 | - | 80 |

5.6 Transfer Function

5.6.1 True IDE Mode I/O Transfer Function

The ICF9000 can be configured in a True IDE Mode of operation. The ICF9000 is configured in this mode only when $-\text{OE}$ input signal is grounded by the host during the power off to power on cycle.

Table 8: True IDE Mode I/O Function

| Function Code | -CS1 | -CS0 | -A0~A2 | -DMACK | -IORD | -IOWR | D15~D8 | D7~D0 |
|---------------|------|------|--------|--------|-------|-------|------------------|------------------|
| Invalid Mode | L | L | X | X | X | X | Undefined In/Out | Undefined In/Out |
| | L | X | X | L | L | X | Undefined Out | Undefined Out |
| | L | X | X | L | X | L | Undefined In | Undefined In |
| | X | L | X | L | L | X | Undefined Out | Undefined Out |
| | X | L | X | L | X | L | Undefined In | Undefined In |
| Standby Mode | H | H | X | H | X | X | High Z | High Z |

| | | | | | | | | |
|-------------------------------|---|---|------|---|------------|---|--------------|---------------|
| Task File Write | H | L | 1-7h | H | H | L | Don't Care | Data In |
| Task File Read | H | L | 1-7h | H | L | H | High Z | Data In |
| PIO Data Register Write | H | L | 0 | H | H | L | Odd-Byte In | Even-Byte In |
| DMA Data Register Write | H | H | X | L | H | L | Odd-Byte In | Even-Byte In |
| Ultra DMA Data Register Write | H | H | X | L | See Note 1 | | Odd-Byte In | Even-Byte In |
| PIO Data Register Read | H | L | 0 | H | L | H | Odd-Byte Out | Even-Byte Out |
| DMA Data Register Read | H | H | X | L | L | H | Odd-Byte Out | Even-Byte Out |
| Ultra DMA Data Register Read | H | H | X | L | See Note 2 | | Odd-Byte Out | Even-Byte Out |
| Control Register Write | L | H | 6h | H | H | L | Don't Care | Control In |
| Alt Status Read | L | H | 6h | H | L | H | High Z | Status Out |
| Drive Address | L | H | 7h | H | L | H | High Z | Data Out |

Note1: In Ultra DMA Data Register Write mode the signals $\bar{I}ORD$, $\bar{I}OWR$ and $IORDY$ are redefined and used as follows: $\bar{I}ORD$ as HSTROBE, $\bar{I}OWR$ as STOP and $IORDY$ as $\bar{D}DMARDY$. Data transfers with each edge of HSTROBE.

Note2: In Ultra DMA Data Register Read mode the signals $\bar{I}ORD$, $\bar{I}OWR$ and $IORDY$ are redefined and used as follows: $\bar{I}ORD$ as $\bar{H}DMARDY$, $\bar{I}OWR$ as STOP and $IORDY$ as DSTROBE. Data transfer with each edge of DSTROBE.

5.7 Configuration Register

5.7.1 Configuration Option Register (200h in Attribute Memory)

The Configuration Option Register is used to configure the cards interface, address decoding and interrupt and to issue a soft reset to the ICF9000.

Table 9: Configuration Option Register

| Operation | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----------|--------|----------|-------|-------|-------|-------|-------|-------|
| R/W | SRESET | LevelREQ | Conf5 | Conf4 | Conf3 | Conf2 | Conf1 | Conf0 |

Table 10: Information for Configuration Option Register

| Name | Description |
|----------|--|
| SRSET | Soft Reset: Setting this bit to one (1), waiting the minimum reset time and returning to zero(0) places the ICF9000 in the reset state. Setting this bit to one (1) is equivalent to assertion of the +RESET signal except that the SRESET bit is not cleared. Returning this bit to zero (0) leaves the ICF9000 in the same un-configured, Reset state as following power-up and hardware reset. Contrast with Soft Reset in the Device Control Register. |
| LevelREQ | This bit is set to one (1) then Level Mode Interrupt is selected, and zero (0) then Pulse Mode is selected. Set to zero (0) by Reset. |
| Conf5-0 | Configuration Index: Set to zero (0) by reset. It is used to select operation mode of the ICF9000 as shown below |

Note: Conf5 and Conf4 are reserved for CompactFlash Storage cards and shall be written as zero(0).

5.7.2 Pin Replacement register (204h in Attribute Memory)

Table 11: Pin Replacement Register

| Operation | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----------|----|----|--------|----|----|----|--------|----|
| Read | 0 | 0 | Cready | 0 | 1 | 1 | Rready | 0 |
| Write | 0 | 0 | Cready | 0 | 0 | 0 | Mready | 0 |

Table 12: Information for Pin Replacement Register

| Name | Description |
|--------|--|
| Cready | This bit is set to one (1) when the bit Rready changes state. This bit can also be written by the host. |
| Rready | This bit is used to determine the internal state of the READY signal. This bit may be used to determine the state of the READY signal as this pin has been reallocated for use as Interrupt Request on an I/O card. When written, this bit acts as a mask (Mready) for writing the corresponding bit Cready. |
| Mready | This bit acts as a mask for writing corresponding bit Cready. |

5.7.3 Socket and Copy Register (206h in Attribute Memory)

This register contains additional configuration information. This register is always written by the system before writing the card's Configuration Index Register. This register is used for identification of the card from the other card.

Table 13: Socket and Copy Register

| Operation | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----------|----|----|----|----------|----|----|----|----|
| Read | 0 | 0 | 0 | Obsolete | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|-------|---|---|---|-----------------------|---|---|---|---|
| | | | | (Drive #) | | | | |
| Write | 0 | 0 | 0 | Obsolete (Drive #) | X | X | X | X |

Table 14: Information for Socket and Copy Register

| Name | Description |
|-------------------|--|
| Obsolete(Drive #) | This bit is obsolete and should be written as 0. |

5.8 Software Interface

5.8.1 True IDE Mode Addressing

When the ICF9000 is configured in the True IDE mode, the I/O decoding is as follows:

Table 15: True IDE Mode I/O Decoding

| -CS1 | -CS0 | A2 | A1 | A0 | -DMACK | -IORD=0 | -IOWR=0 | Note |
|------|------|----|----|----|--------|------------------|------------------|----------------|
| 1 | 0 | 0 | 0 | 0 | 1 | PIO RD Data | PIO WR Data | 8 or 16 bit |
| 1 | 1 | X | X | X | 0 | DMA RD Data | DMA WR Data | 16 bit |
| 1 | 0 | 0 | 0 | 1 | 1 | Error Register | Features | 8 bit |
| 1 | 0 | 0 | 1 | 0 | 1 | Sector Count | Sector Count | 8 bit |
| 1 | 0 | 0 | 1 | 1 | 1 | Sector No. | Sector No. | 8 bit |
| 1 | 0 | 1 | 0 | 0 | 1 | Cylinder Low | Cylinder Low | 8 bit |
| 1 | 0 | 1 | 0 | 1 | 1 | Cylinder High | Cylinder High | 8 bit |
| 1 | 0 | 1 | 1 | 0 | 1 | Select Card/Head | Select Card/Head | 8 bit |
| 1 | 1 | 1 | 1 | 1 | 1 | Status | Command | 8 bit |
| 0 | 1 | 1 | 1 | 0 | 1 | Alt Status | Device Control | 8 bit |

5.8.2 CF-ATA Register

The following section describes the hardware registers used by the host software to issue commands to the ICF9000.

Note:

In True IDE Mode of operation, the size of the transfer is based solely on the register being addressed. All registers are 8 bit only except for the Data Register, which is normally 16 bits, but can be programmed to use 8 bit transfers for Non-DMA operations through the use of the Set Features command. The data register is also 8 bits during a portion of the Read Long and Write Long commands, which exist solely for historical reasons and should not be used.

5.8.2.1 Data Register

The Data Register is a 16 bit register, and it is used to transfer data blocks between the card and the host. This register overlaps the Error Register. This register can be accessed in word and byte mode.

Table 16: Data Register

| Data Register | | | | | | | | | | | | | | | |
|---------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.2 Error Register

This register contains additional information about the source of an error when an error is indicated in bit 0 of the Status register. The bits are defined as follows.

Table 17: Error Register

| | | | | | | | |
|-----|-----|----|------|----|------|----|------|
| BBK | UNC | 0 | IDNF | 0 | ABRT | 0 | AMNF |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.3 Feature Register

This register provides information regarding features of the card that the host can utilize. This register is also accessed in PC Card modes on data D15-D8 during a write operation to Offset 0 with $-\text{CE2}$ low and $-\text{CE1}$ high.

Table 18: Feature Register

| Feature Register | | | | | | | |
|------------------|----|----|----|----|----|----|----|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.4 Sector Count Register

This registers the number of sectors of data requested to be transferred on a read or write operation between the host and the card. If the value in this register is zero, a count of 256 sectors is specified. If the command was successful, this register is zero at command completion. If not successfully completed, the register contains the number of sectors that need to be transferred in order to complete the request.

Table 19: Sector Count Register

| Sector Count Register | | | | | | | |
|-----------------------|----|----|----|----|----|----|----|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.5 Sector Number Register

This register contains the starting sector number or bits 7-0 of the Logical Block Address

(LBA) for ICF9000 data access for the subsequent command.

Table 20: Sector Number Register

| Sector Number Register | | | | | | | |
|------------------------|----|----|----|----|----|----|----|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.6 Cylinder Low Register

This Register contains the low order 8 bits of the starting cylinder address or bits 15-8 of the Logical Block Address.

Table 21: Cylinder Low Register

| Cylinder Low Register | | | | | | | |
|-----------------------|----|----|----|----|----|----|----|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.7 Cylinder High Register

This Register contains the high order 8 bits of the starting cylinder address or bits 23-16 of the Logical Block Address.

Table 22: Cylinder High Register

| Cylinder High Register | | | | | | | |
|------------------------|----|----|----|----|----|----|----|
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

5.8.2.8 Device/Head Register

The Drive/Head register is used to select the drive and head. It is also used to select LBA addressing instead of cylinder/head/sector addressing.

Table 23: Device/Head Register

| | | | | | | | |
|----|-----|----|-----|-----|-----|-----|-----|
| 1 | LBA | 1 | DRV | HS3 | HS2 | HS1 | HS0 |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

Bit7: this bit is set 1.

Bit6: LBA is a flag to select either Cylinder/Head/Sector or Logical Block Address mode. When LBA=0, Cylinder/Head/Sector mode is selected. When LBA=1, Logical Block Address is selected.

Bit5: this bit is set 1.

Bit4: DRV is the drive number. When DRV=0, drive (card) 0 is selected. When DRV=1, drive (card) 1 is selected.

Bit3: When operation in the Cylinder/Head/Sector mode, this is bit 3 of the head number.

It is bit 27 in the Logical Block Address mode.

Bit2: When operation in the Cylinder/Head/Sector mode, this is bit 2 of the head number.

It is bit 26 in the Logical Block Address mode.

Bit1: When operation in the Cylinder/Head/Sector mode, this is bit 1 of the head number.

It is bit 25 in the Logical Block Address mode.

Bit0: When operation in the Cylinder/Head/Sector mode, this is bit 0 of the head number.

It is bit 24 in the Logical Block Address mode.

5.8.2.9 Status Register

These registers return the ICF9000 status when read by the host. Reading the Status register does clear a pending interrupt while reading the Auxiliary Status register does not.

Table 24: Status Register

| | | | | | | | |
|------|-----|-----|-----|-----|------|----|-----|
| BUSY | RDY | DWF | DSC | DRQ | CORR | 0 | ERR |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

Bit7: the busy bit is set when the ICF9000 has access to the command buffer and registers and the host is locked out from accessing the command register and buffer. No other bits in this register are valid when this bit set to a 1.

Bit6: RDY indicates whether the device is capable of performing ICF9000 operations. This bit is cleared at power up and remains cleared until the card is ready to accept a command.

Bit5: This bit, if set, indicates a write fault has occurred.

Bit4: This bit is set when the ICF9000 is ready.

Bit3: The Data Request is set when the ICF9000 requires that information be transferred either to or from the host through the Data register.

During the data transfer of DMA commands, the card shall not asserted DMARD unless either the BUST bit, the DRQ, or both are set to one.

Bit2: This bit is set when a Correctable data error has been encountered and the data has been corrected. This condition does not terminate a multi-sector read operation.

Bit1: This bit is always to 0.

Bit0: This bit is set when the previous command has ended in some type of error. The bits in the Error register contain additional information description the error.

5.8.2.10 Device Control Register

This register is used to control the ICF9000 interrupt request and to issue an ATA soft reset to the card. This register can be written even if the device is BUSY.

Table 25: Device Control Register

| | | | | | | | |
|----|----|----|----|----|--------|------|----|
| X | X | X | X | X | SW Rst | -Ien | 0 |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

Bit7-3: These bits are ignored.

Bit2: This bit is set to 1 in order to force the ICF9000 to perform a Soft Reset operation. The Card remains in Reset until this bit is reset to '0'.

Bit1: the Interrupt Enable bit enables interrupts when the bit is 0. When the bit is 1, interrupt from the ICF9000 are disabled. This bit also controls the Int bit in the Configuration and Status Register. This bit is set to 0 at power on and Reset.

Bit0: This bit is ignored.

5.8.2.11 Drive Address Register

This register is provide for compatibility with the AT disk drive interface.

Table 26: Drive Address Register

| | | | | | | | |
|----|------|------|------|------|------|-------|-------|
| X | -WTG | -HS3 | -HS2 | -HS1 | -HS0 | -Nds1 | -Nds0 |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

Bit7: this bit is unknown.

Bit6: this bit is – when a write operation is in progress; otherwise, it is 1.

Bit5: this bit is the negation of bit 3 in the Drive/Head register.

Bit4: this bit is the negation of bit 2 in the Drive/Head register.

Bit3: this bit is the negation of bit 1 in the Drive/Head register.

Bit2: this bit is the negation of bit 0 in the Drive/Head register.

Bit1: this bit is 0 when drive 1 is active and selected.

Bit0: this bit is 0 when the drive 0 is active and selected.

5.9 Hardware Reset

Table 27: Timing Diagram, Hardware Reset

| | Item | Min. | Max. | Normal | Unit |
|-------------------------|-----------------------|------|------|--------|------|
| $t_{SU}(\text{RESET})$ | Reset Setup Time | 20 | - | - | ms |
| $t_{REC}(\text{VCC})$ | -CE Recover Time | 1 | - | - | us |
| t_{PR} | VCC rising up time | 0.1 | 100 | - | ms |
| t_{PF} | VCC falling down time | 3 | 300 | - | ms |
| $t_w(\text{RESET})$ | Reset pulse width | 10 | - | - | ms |
| $t_H(\text{Hi-ZRESET})$ | | 0 | - | - | |
| $t_S(\text{Hi-ZRESET})$ | | 0 | - | - | |

5.10 Power on Reset

When the VCC power reaches to 2.7V, the disk drive will be reset.

Table 28: Timing Diagram, Power On Reset

| | Item | Min. | Max. | Normal | Unit | Note |
|------------------------|---------------------|------|------|--------|------|------|
| $t_{SU}(\text{RESET})$ | -CE Setup Time | 20 | - | - | ms | |
| t_{PR} | -VCC Rising Up Time | 0.1 | 100 | - | ms | |

Power on Reset Timing

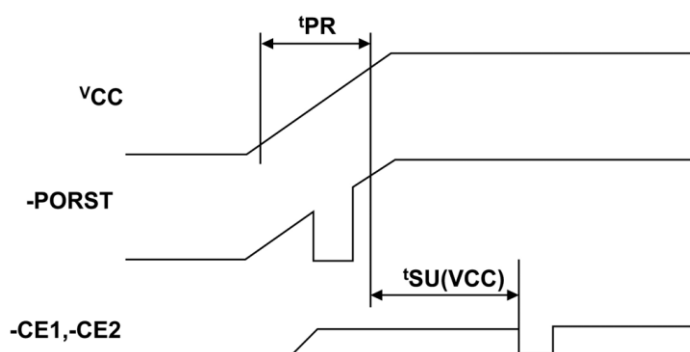


Figure 4: Timing Diagram, Power On Reset**5.11 Support IDE Commands**

ICF9000 supports the commands listed in Table 29.

Table 29: IDE Commands

| Command | Code | FR | SC | SN | CY | DH | LBA |
|---------------------------|------|----|----|----|----|----|-----|
| Check Power Mode | E5H | - | - | - | - | D | - |
| Execute Device Diagnostic | 90H | - | - | - | - | D | - |
| Flush Cache | E7H | - | - | - | - | Y | - |
| Identify Device | ECH | - | - | - | - | D | - |
| Idle | E3H | - | Y | - | - | D | - |
| Idle immediate | E1H | - | - | - | - | D | - |
| Read Buffer | E4H | - | - | - | - | D | - |
| Read DMA | C8H | - | Y | Y | Y | Y | Y |
| Read Sector(s) | 20H | - | Y | Y | Y | Y | Y |
| Read Verify Sector(s) | 40H | - | Y | Y | Y | Y | Y |
| Set Features | EFH | Y | - | - | - | D | - |
| Set Multiple Mode | C6H | - | Y | - | - | D | - |
| Set Sleep Mode | E6H | - | - | - | - | D | - |
| SMART | B0h | Y | - | - | Y | Y | - |
| Standby | E2H | - | - | - | - | D | - |
| Standby Immediate | E0H | - | - | - | - | D | - |
| Write Buffer | E8H | - | - | - | - | D | - |
| Write DMA | CAH | - | Y | Y | Y | Y | Y |
| Write Multiple | C5h | - | Y | Y | Y | Y | Y |
| Write Sector(s) | 30H | - | Y | Y | Y | Y | Y |

Defines:

FR: Feature Register

SC: Sector Count Register

SN: Sector Number Register

CY: Cylinder Registers

DH: Card/Device/Head Register

LBA: LBA Block Address Mode Supported

Y: The register contains a valid parameter for this command. For Card/Device/Head Register Y means both the CompactFlash Storage Card and head parameter are used; D – only the CompactFlash Storage Card parameter is valid and not the head parameter; C – The register contains command specific data (see command description for use).

5.11.1 Check power mode –E5h

Table 30: Check power mode information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E5h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command checks the power mode. If the CompactFlash Storage is in, going to, or recovering from the sleep mode, the CompactFlash Storage Card sets BSY, sets the Sector Count Register to 00h, clears BSY and generates an interrupt. If the CompactFlash Storage Card is in idle mode, the CompactFlash Storage Card sets BSY, sets the Sector Count Register to FFh, clears BSY and generates an interrupt.

5.11.2 Execute Device Diagnostic – 90h

Table 31: Execute device diagnostic information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | 90h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command performs the internal diagnostic tests implemented by the CompactFlash Storage Card. When the diagnostic command is issued in the True IDE Mode, the Drive bit is ignored and the diagnostic command is executed by both the Master and the Slave with the Master responding with status for both devices. The Diagnostic codes are shown in Table 34. Diagnostic Codes are returned in the Error Register at the end of the command.

Table 32: Diagnostic

| Code | Error Type |
|------|------------|
|------|------------|

| | |
|-----|---------------------------------|
| 01h | No Error Detected |
| 02h | Formatter Device Error |
| 03h | Sector Buffer Error |
| 04h | ECC Circuitry Error |
| 05h | Controller Microprocessor Error |
| 8Xh | Slave Error in True IDE Mode |

5.11.3 Flush Cache- E7h

5.11.18.1 Command Code

E7h

5.11.18.2 Protocol

Non-data

5.11.18.3 Inputs

Table 33: Flush cache command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|-----|----|---|---|---|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Command | E7h | | | | | | | |

Device register-

DEV shall specify the selected device.

5.11.18.4 Normal Output

Table 34: Flush cache command for normal output information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register-

DEV shall specify the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ will be cleared to zero

ERR will be cleared to zero.

5.11.18.5 Error Outputs

Table 35: Flush cache command for error output information

| | | | | | | | | |
|--------------|------------|------|-----|-----|------------|------|----|-----|
| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | LBA(7:0) | | | | | | | |
| LBA Mid | LBA(15:8) | | | | | | | |
| LBA High | LBA(23:16) | | | | | | | |
| Device | Obs | Na | obs | DEV | LBA(27:24) | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error register-

ABRT may be set to one if the device is not able to complete the action requested by the command.

LBA Low, LBA Mid, and LBA High, Device

Shall be written with the address of first unrecoverable error.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be cleared to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.18.6 Prerequisites

DRDY will be set to one.

5.11.18.7 Description

This command is used by the host to request the device to flush the write cache. If there is data in write cache, that data shall be written to the SSD. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

5.11.4 Identify Device- Ech

Table 36: Identify device information

| | | | | | | | | |
|----------|---|---|---|---|---|---|---|---|
| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|---|---|---|---|---|---|---|---|

| | | | | | |
|------------------|-----|---|---|-------|---|
| Command(7) | Ech | | | | |
| C/D/H(6) | X | X | X | Drive | X |
| Cylinder High(5) | X | | | | |
| Cylinder Low(4) | X | | | | |
| Sector Number(3) | X | | | | |
| Sector Count(2) | X | | | | |
| Feature(1) | X | | | | |

The Identify Device command enables the host to receive parameter information from the CompactFlash Storage Card. This command has the same protocol as the Read Sector(s) command. The parameter words in the buffer have the arrangement and meanings defined in Table 35. All reserved bits or words are zero. Hosts should not depend in Obsolete words in Identify Device containing 0. Table 35 specifies each filed in the data returned by the Identify Device Command. In Table 35, X indicates a numeric nibble vale specific to the card and aaaa indicates an ASCII string specific to the particular drive.

Table 37: IDENTIFY DEVICE information

| Word | Description | Value |
|-------|--|---------------------|
| 0 | General configuration bit-significant information: 15 0 = ATA device 14-8 Retired 7 1 = removable media device 6 Obsolete 5-3 Retired 2 Response incomplete 1 Retired 0 Reserved | 044Ah |
| 1 | Obsolete | XXXXh |
| 2 | Specific configuration | 0000h |
| 3 | Obsolete | 00XXh |
| 4-5 | Retired | XXXXh |
| 6 | Obsolete | XXXXh |
| 7-8 | Reserved for assignment by the CompactFlash™ Association | XXXXh |
| 9 | Retired | 0000h |
| 10-19 | Serial number (20 ASCII characters) | 20 ASCII characters |

| | | |
|-------|---|---------------------|
| 20-21 | Retired | 0002h |
| 22 | Obsolete | 0004h |
| 23-26 | Firmware revision (8 ASCII characters) | 8 ASCII characters |
| 27-46 | Model number (40 ASCII characters) | 40 ASCII characters |
| 47 | 15-8 80h 7-0 00h = Reserved 01h-FFh = Maximum number of sectors that shall be transferred per interrupt on READ/WRITE MULTIPLE commands | 8001h |
| 48 | Reserved | 0000h |
| 49 | Capabilities 15-14 Reserved for the IDENTIFY PACKET DEVICE command. 13 1 = Standby timer values as specified in this standard are supported 0 = Standby timer values shall be managed by the device 12 Reserved for the IDENTIFY PACKET DEVICE command. 11 1 = IORDY supported 0 = IORDY may be supported 10 1 = IORDY may be disabled 9 1 = LBA supported 8 1 = DMA supported. 7-0 Retired | 0F00h |
| 50 | Capabilities 15 Shall be cleared to zero 14: Shall be set to one 13-2 Reserved 1 Obsolete 0 Shall be set to one to indicate a device specific Standby timer value minimum. | 0000h |
| 51 | Obsolete | 0200h |
| 52 | Obsolete | 0000h |
| 53 | 15-3 Reserved 2 1 = the fields reported in word 88 are valid Reserved 0 = the fields reported in word 88 are not valid 1 1 = the fields reported in words (70:64) are valid 0 = the fields reported in words (70:64) are not valid 0 Obsolete | 0007h |
| 54 | Number of current logical cylinders | XXXXh |

| | | |
|-----------|--|----------------|
| 55 | Number of current logical heads | XXXXh |
| 56 | Number of current logical sectors per logical track | XXXXh |
| 57-58 | Current capacity in sectors | XXXXh |
| 59 | <p>15-9 Reserved</p> <p>8 1 = Multiple sector setting is valid</p> <p>7-0 xxh = Current setting for number of sectors that shall be transferred per interrupt on R/W Multiple command</p> | 01XXh |
| 60-61 | Total number of user addressable sectors | XXXXXXXXh |
| 62 | Obsolete | 0000h |
| 63 | <p>15-11 Reserved</p> <p>10 1 = Multiword DMA mode 2 is selected 0 = Multiword DMA mode 2 is not selected</p> <p>9 1 = Multiword DMA mode 1 is selected 0 = Multiword DMA mode 1 is not selected</p> <p>8 1 = Multiword DMA mode 0 is selected 0 = Multiword DMA mode 0 is not selected</p> <p>7-3 Reserved</p> <p>2 1 = Multiword DMA mode 2 and below are supported</p> <p>1 1 = Multiword DMA mode 1 and below are supported</p> <p>0 1 = Multiword DMA mode 0 is supported</p> | XX07h |
| 64 | <p>15-8 Reserved</p> <p>7-0 PIO modes supported</p> | 0003h |
| 65 | <p>Minimum Multiword DMA transfer cycle time per word</p> <p>15-0 Cycle time in nanoseconds</p> | 0078h |
| 66 | <p>Manufacturer's recommended Multiword DMA transfer cycle time</p> <p>15-0 Cycle time in nanoseconds</p> | 0078h |
| 67 | <p>Minimum PIO transfer cycle time without flow control</p> <p>15-0 Cycle time in nanoseconds</p> | 0078h |
| 68 | <p>Minimum PIO transfer cycle time with IORDY flow control</p> <p>15-0 Cycle time in nanoseconds</p> | 0078h |
| 69-70 | Reserved (for future command overlap and queuing) | 0000h |
| 71-74 | Reserved for the IDENTIFY PACKET DEVICE command. | 0000h |
| 75 | <p>Queue depth</p> <p>15-5 Reserved</p> <p>4-0 Maximum queue depth - 1</p> | 0000h |
| 76-79 | Reserved for Serial ATA | 0000h 0000h |

| | | |
|----|---|----------------|
| | | 0000h 0000h |
| 80 | <p>Major version number</p> <p>0000h or FFFFh = device does not report version</p> <p>15 Reserved</p> <p>14 Reserved for ATA/ATAPI-14</p> <p>13 Reserved for ATA/ATAPI-13</p> <p>12 Reserved for ATA/ATAPI-12</p> <p>11 Reserved for ATA/ATAPI-11</p> <p>10 Reserved for ATA/ATAPI-10</p> <p>9 Reserved for ATA/ATAPI-9</p> <p>8 Reserved for ATA/ATAPI-8</p> <p>7 1 = supports ATA/ATAPI-7</p> <p>6 1 = supports ATA/ATAPI-6</p> <p>5 1 = supports ATA/ATAPI-5</p> <p>4 1 = supports ATA/ATAPI-4</p> <p>3 Obsolete</p> <p>2 Obsolete</p> <p>1 Obsolete</p> <p>0 Reserved</p> | 0080h |
| 81 | <p>Minor version number</p> <p>0000h or FFFFh = device does not report version</p> <p>0001h-FFFEh = See 6.17.41</p> | 0000h |
| 82 | <p>Command set supported.</p> <p>15 Obsolete</p> <p>14 1 = NOP command supported</p> <p>13 1 = READ BUFFER command supported</p> <p>12 1 = WRITE BUFFER command supported</p> <p>11 Obsolete</p> <p>10 1 = Host Protected Area feature set supported</p> <p>9 1 = DEVICE RESET command supported</p> <p>8 1 = SERVICE interrupt supported</p> <p>7 1 = release interrupt supported</p> <p>6 1 = look-ahead supported</p> <p>5 1 = write cache supported</p> <p>4 Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.</p> | 742Bh |

| | | |
|----|---|-------|
| | <p>3 1 = mandatory Power Management feature set supported</p> <p>2 1 = Removable Media feature set supported</p> <p>1 1 = Security Mode feature set supported</p> <p>0 1 = SMART feature set supported</p> | |
| 83 | <p>Command sets supported.</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 1 = FLUSH CACHE EXT command supported</p> <p>12 1 = mandatory FLUSH CACHE command supported</p> <p>11 1 = Device Configuration Overlay feature set supported</p> <p>10 1 = 48-bit Address feature set supported</p> <p>9 1 = Automatic Acoustic Management feature set supported</p> <p>8 1 = SET MAX security extension supported</p> <p>7 See Address Offset Reserved Area Boot, INCITS TR27:2001</p> <p>6 1 = SET FEATURES subcommand required to spinup after power-up</p> <p>5 1 = Power-Up In Standby feature set supported</p> <p>4 1 = Removable Media Status Notification feature set supported</p> <p>3 1 = Advanced Power Management feature set supported</p> <p>2 1 = CFA feature set supported</p> <p>1 1 = READ/WRITE DMA QUEUED supported</p> <p>0 1 = DOWNLOAD MICROCODE command supported</p> | 5100h |
| 84 | <p>Command set/feature supported extension</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 1 = IDLE IMMEDIATE with UNLOAD FEATURE supported</p> <p>12 Reserved for technical report</p> <p>11 Reserved for technical report</p> <p>10 1 = URG bit supported for WRITE STREAM DMA EXT and WRITE STREAM EXT</p> <p>9 1 = URG bit supported for READ STREAM DMA EXT and READ STREAM EXT</p> <p>8 1 = 64-bit World wide name supported</p> <p>7 1 = WRITE DMA QUEUED FUA EXT command supported</p> <p>6 1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands supported</p> <p>5 1 = General Purpose Logging feature set supported</p> <p>4 1 = Streaming feature set supported</p> <p>3 1 = Media Card Pass Through Command feature set supported</p> | 4003h |

| | | |
|----|--|-------|
| 87 | <p>Command and feature sets supported or enabled</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 1 = IDLE IMMEDIATE with UNLOAD FEATURE supported</p> <p>12 Reserved for technical report-</p> <p>11 Reserved for technical report-</p> <p>10 1 = URG bit supported for WRITE STREAM DMA EXT and WRITE STREAM EXT</p> <p>9 1 = URG bit supported for READ STREAM DMA EXT and READ STREAM EXT</p> <p>8 1 = 64 bit World wide name supported</p> <p>7 1 = WRITE DMA QUEUED FUA EXT command supported</p> <p>6 1 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands supported</p> <p>5 1 = General Purpose Logging feature set supported</p> <p>4 1 = Valid CONFIGURE STREAM command has been executed</p> <p>3 1 = Media Card Pass Through Command feature set enabled</p> <p>2 1 = Media serial number is valid</p> <p>1 1 = SMART self-test supported</p> <p>0 1 = SMART error logging supported</p> | 0003h |
| 88 | <p>15 Reserved</p> <p>14 1 = Ultra DMA mode 6 is selected 0 = Ultra DMA mode 6 is not selected</p> <p>13 1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected</p> <p>12 1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected</p> <p>11 1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected</p> <p>10 1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected</p> <p>9 1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected</p> <p>8 1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected</p> <p>7 Reserved</p> <p>6 1 = Ultra DMA mode 6 and below are supported</p> <p>5 1 = Ultra DMA mode 5 and below are supported</p> <p>4 1 = Ultra DMA mode 4 and below are supported</p> | XX7Fh |

| | | |
|----|---|-------|
| | <p>3 1 = Ultra DMA mode 3 and below are supported</p> <p>2 1 = Ultra DMA mode 2 and below are supported</p> <p>1 1 = Ultra DMA mode 1 and below are supported</p> <p>0 1 = Ultra DMA mode 0 is supported</p> | |
| 89 | Time required for security erase unit completion | 0001h |
| 90 | Time required for Enhanced security erase completion | 0000h |
| 91 | Current advanced power management value | 0000h |
| 92 | Master Password Revision Code | FFFEh |
| 93 | <p>Hardware reset result. The contents of bits (12:0) of this word shall change only during the execution of a hardware reset.</p> <p>15 Shall be cleared to zero.</p> <p>14 Shall be set to one.</p> <p>13 1 = device detected CBLID- above ViH 0 = device detected CBLID- below ViL</p> <p>12-8 Device 1 hardware reset result. Device 0 shall clear these bits to zero. Device 1 shall set these bits as follows:</p> <p>12 Reserved.</p> <p>11 0 = Device 1 did not assert PDIAG-. 1 = Device 1 asserted PDIAG-.</p> <p>10-9 These bits indicate how Device 1 determined the device number: 00 = Reserved. 01 = a jumper was used. 10 = the CSEL signal was used. 11 = some other method was used or the method is unknown.</p> <p>8 Shall be set to one.</p> | XXXXh |
| | <p>7-0 Device 0 hardware reset result. Device 1 shall clear these bits to zero. Device 0 shall set these bits as follows:</p> <p>7 Reserved.</p> <p>6 0 = Device 0 does not respond when Device 1 is selected. 1 = Device 0 responds when Device 1 is selected.</p> <p>5 0 = Device 0 did not detect the assertion of DASP-. 1 = Device 0 detected the assertion of DASP-.</p> <p>4 0 = Device 0 did not detect the assertion of PDIAG-. 1 = Device 0 detected the assertion of PDIAG-.</p> <p>3 0 = Device 0 failed diagnostics. 1 = Device 0 passed diagnostics.</p> <p>2-1 These bits indicate how Device 0 determined the device number: 00 = Reserved.</p> | |

| | | |
|---------|--|-------|
| | <p>01 = a jumper was used.</p> <p>10 = the CSEL signal was used.</p> <p>11 = some other method was used or the method is unknown.</p> <p>0 Shall be set to one.</p> | |
| 94 | <p>15-8 Vendor's recommended acoustic management value.</p> <p>7-0 Current automatic acoustic management value.</p> | 0000h |
| 95 | Stream Minimum Request Size | 0000h |
| 96 | Streaming Transfer Time – DMA | 0000h |
| 97 | Streaming Access Latency – DMA and PIO | 0000h |
| 98-99 | Streaming Performance Granularity | 0000h |
| 100-103 | Maximum user LBA for 48-bit Address feature set. | 0000h |
| 104 | Streaming Transfer Time – PIO | 0000h |
| 105 | Reserved | 0000h |
| 106 | <p>Physical sector size / Logical Sector Size</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 1 = Device has multiple logical sectors per physical sector.</p> <p>12 1= Device Logical Sector Longer than 256 Words</p> <p>11-4 Reserved</p> <p>3-0 2^x logical sectors per physical sector</p> | 0000h |
| 107 | Inter-seek delay for ISO-7779 acoustic testing in microseconds | 0000h |
| 108 | <p>15-12 NAA (3:0)</p> <p>11-0 IEEE OUI (23:12)</p> | 0000h |
| 109 | <p>15-4 IEEE OUI (11:0)</p> <p>3-0 Unique ID (35:32)</p> | 0000h |
| 110 | 15-0 Unique ID (31:16) | 0000h |
| 111 | 15-0 Unique ID (15:0) | 0000h |
| 112-115 | Reserved for world wide name extension to 128 bits | 0000h |
| 116 | Reserved for technical report- | 0000h |
| 117-118 | Words per Logical Sector | 0000h |

| | | |
|----------------------------|--|-------|
| 119-120 | Reserved | 0000h |
| 121-126 | Reserved | 0000h |
| 127 | Removable Media Status Notification feature set support | 0000h |
| | 15-2 Reserved | |
| | 1-0 00 = Removable Media Status Notification feature set not supported 01 = Removable Media Status Notification feature supported 10 = Reserved 11 = Reserved | |
| | | |
| | | |
| 128 | Security Status | |
| | 15-9 Reserved | 0 |
| | 8 Security level 0 = high, 1 = Maximum | X |
| | 7-6 Reserved | 0 |
| | 5 1= Enhanced security erase supported | 0 |
| | 4 1= Security count expired | 0 |
| | 3 1 = Security frozen | X |
| | 2 1 = Security locked | X |
| | 1 1 = Security enabled | X |
| | 0 1 = Security supported | 1 |
| 129-159 | Vendor specific | 0000h |
| 160 | CFA power mode 1 | 0000h |
| | 15 Word 160 supported | |
| | 14 Reserved | |
| | 13 CFA power mode 1 is required for one or more commands implemented by the device | |
| | 12 CFA power mode 1 disabled | |
| 11-0 Maximum current in ma | | |
| 161-175 | Reserved for assignment by the CompactFlash™ Association | 0000h |
| 176-205 | Current media serial number | 0000h |
| 206-254 | Reserved | 0000h |
| 255 | Integrity word | XXXXh |
| | 15-8 Checksum | |
| | 7-0 Signature | |

5.11.5 Idle -97H or E3H

Table 38: Idle information

| | | | | | | | | |
|------------|------------|---|---|-------|---|---|---|---|
| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Command(7) | 97h or E3h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |

| | |
|------------------|---------------------------------|
| Cylinder High(5) | X |
| Cylinder Low(4) | X |
| Sector Number(3) | X |
| Sector Count(2) | Timer Count (5 msec increments) |
| Feature(1) | X |

This command causes the CompactFlash Storage Card to set BSY, enter the IDLE mode, clear BSY and generate an interrupt. If the sector count is non-zero, it is interpreted as a timer count with each count being 5 milliseconds and the automatic power down mode is enabled. If the sector count is zero, the automatic power down mode is disabled. Note that this time base (5 msec) is different from the ATA specification.

5.11.6 Idle immediate – 95H or E1H

Table 39: Idle immediate information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|------------|---|---|-------|---|---|---|---|
| Command(7) | 95h or E1h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command causes the CompactFlash Storage Card to set BSY, enter the IDLE mode, clear BSY and generate an interrupt.

5.11.7 Read Buffer – E4h

Table 40: Read buffer information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E4h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |

| | |
|-----------------|---|
| Sector Count(2) | X |
| Feature(1) | X |

The Read Buffer command enables the host to read the current contents of the CompactFlash Storage Card's sector buffer. This command has the same protocol as the Read Sector(s) command.

5.11.8 Read DMA – C8h

Table 41: Read DMA information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------------------------|-----|---|-------|------------------|---|---|---|
| Command(7) | C8h | | | | | | | |
| C/D/H(6) | 1 | LBA | 1 | Drive | Head (LBA 27-24) | | | |
| Cylinder High(5) | Cylinder High (LBA 23-16) | | | | | | | |
| Cylinder Low(4) | Cylinder Low (LBA 15-8) | | | | | | | |
| Sector Number(3) | Sector Number(LBA 7-0) | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

This command uses DMA mode to read from 1 to 256 sectors as specified in the Sector Count register. A sector count of 0 request 256 sectors. The transfer begins at the sector specified in the Sector Number Register. When this command is issued the CompactFlash Storage Card sets BSY, puts all or part of the sector of data in the buffer. The Card is then permitted, although not required, to set DRQ, clear BSY. The Card asserts DMAREQ while data is available to be transferred. The Card asserts DMAREQ while data is available to be transferred. The host then reads the (512 & sector -count) bytes of data from the Card using DMA. While DMAREQ is asserted by the Card, the Host asserts -DMACK while it is ready to transfer data by DMA and asserts -IORD once for each 16 bit word to be transferred to the Host.

Interrupts are not generated on every sector, but upon completion of the transfer of the entire number of sectors to be transferred or upon the occurrence of an unrecoverable error. At command completion, the Command Block Registers contain the cylinder, head and sector number of the last sector read. If an error occurs, the read terminates at the sector where the error occurred. The command Block Registers contain the cylinder, head, and sector number of the sector where the error occurred. The amount of data transferred is indeterminate. When a Read DMA command is received by the Card and 8 bit transfer mode has been enabled by the Set Features command, the Card shall return the Aborted error.

5.11.9 Read Sector(s) – 20h

Table 42: Read sector information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------------------------|-----|---|-------|------------------|---|---|---|
| Command(7) | 20h | | | | | | | |
| C/D/H(6) | 1 | LBA | 1 | Drive | Head (LBA 27-24) | | | |
| Cylinder High(5) | Cylinder High (LBA 23-16) | | | | | | | |
| Cylinder Low(4) | Cylinder Low (LBA 15-8) | | | | | | | |
| Sector Number(3) | Sector Number (LBA 7-0) | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

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. When this command is issued and after each sector of data (except the last one) has buffer, sets DRQ, clears BSY, and generates an interrupt. The host then reads the 512 bytes of data from the buffer.

At command completion, the Command Block Registers contain the cylinder, head and sector number of the last sector read. If an error occurs, the read terminates at the sector where the error occurred. The command Block Registers contain the cylinder head, and sector number of the sector 2 where the error occurred. The flawed data is pending in the sector buffer.

5.11.10 Read Verify Sector(s) – 40h

Table 43: Read verify sector information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------------------------|-----|---|-------|------------------|---|---|---|
| Command(7) | 40h | | | | | | | |
| C/D/H(6) | 1 | LBA | 1 | Drive | Head (LBA 27-24) | | | |
| Cylinder High(5) | Cylinder High (LBA 23-16) | | | | | | | |
| Cylinder Low(4) | Cylinder Low (LBA 15-8) | | | | | | | |
| Sector Number(3) | Sector Number (LBA 7-0) | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host. When the command is accepted, the CompactFlash Storage Card sets BSY. When the requested sectors have been verified, the CompactFlash Storage Card clears BSY and generates an interrupt. Upon command completion, the Command Block Registers contain the cylinder, head, and sector number of the last sector verified. If an error occurs, the Read Verify Command terminates at the sector where the error occurs. The Command Block Registers contain the cylinder, head and sector number of the sector where the error occurred. The Sector Count Register contains the number of sectors not yet verified.

5.11.11 Set Features – Efh

Table 44: Set feature information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------|---|---|-------|---|---|---|---|
| Command(7) | Efh | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | Config | | | | | | | |
| Feature(1) | Feature | | | | | | | |

This command is used by the host to establish or select certain features. If any subcommand input value is not supported or is invalid, the CompactFlash Storage Card shall return command aborted.

Table 45: Feature Supported

| Command Name | Code | Sub Command |
|--|------|-------------|
| Set Transfer Mode | Efh | 03h |
| Disable Read Look-ahead feature | Efh | 55h |
| Enable write cache | Efh | 02h |
| Disable reverting to power-on defaults | Efh | 66h |
| Disable write cache | Efh | 82h |
| Enable reverting to power-on | Efh | CCh |

| | | |
|----------|--|--|
| defaults | | |
|----------|--|--|

5.11.12 Set Multiple Mode – C6h

Table 46: Set multiple mode information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|--------------|---|---|-------|---|---|---|---|
| Command(7) | C6h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

This command enables the CompactFlash Storage Card to perform Read and Write Multiple operations and establishes the block count for these commands. The Sector Count Register is loaded with the number of sectors per block. Upon receipt of the command, the CompactFlash Storage Card sets BSY to 1 and checks the Sector Count Register. If the Sector Count Register contains a valid value and the block count is supported, the value is loaded and execution is enabled for all subsequent Read Multiple and Write Multiple commands. If the Sector Count Register contains 0 when the command is issued, Read and Write Multiple commands are disabled. At power on, or after a hardware or (unless disabled by a Set Feature command) software reset, the default mode is Read and Write multiple disabled.

5.11.13 Set Sleep Mode –E6h

Table 47: Set sleep mode information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E6h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command causes the CompactFlash Storage Card to set BSY, enter the Sleep mode, clear BSY and generate an interrupt. Recovery from sleep mode is accomplished by simply issuing another command (a reset is permitted but not required). Sleep mode is also entered when internal timers expire so the host does not need to issue this command except when it wishes to enter Sleep mode immediately. The default value for the timer is 5 milliseconds.

5.11.14 Standby –E2h

Table 48: Standby information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E2h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command causes the CompactFlash Storage Card to set BSY, enter the Sleep mode, clear BSY and return interrupt immediately. Recovery from sleep mode is accomplished by simply issuing another command (a reset is not required).

5.11.15 Standby Immediate –E0h

Table 49: Standby immediate information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E0h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

This command causes the CompactFlash Storage Card to set BSY, enter the Sleep mode, clear BSY and return the interrupt immediately. Recovery from sleep mode is accomplished

by simply issuing another command (a reset is not required).

5.11.16 Write Buffer – E8h

Table 50: Write buffer information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|-----|---|---|-------|---|---|---|---|
| Command(7) | E8h | | | | | | | |
| C/D/H(6) | X | | | Drive | X | | | |
| Cylinder High(5) | X | | | | | | | |
| Cylinder Low(4) | X | | | | | | | |
| Sector Number(3) | X | | | | | | | |
| Sector Count(2) | X | | | | | | | |
| Feature(1) | X | | | | | | | |

The Write Buffer command enables the host to overwrite contents of the CompactFlash Storage Card's sector buffer with any data pattern desired. This command has the same protocol as the Write Sector(s) command and transfer 512 bytes.

5.11.17 Write DMA – Cah

Table 51: Write DMA information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------------------------|-----|---|-------|------------------|---|---|---|
| Command(7) | Cah | | | | | | | |
| C/D/H(6) | 1 | LBA | 1 | Drive | Head (LBA 27-24) | | | |
| Cylinder High(5) | Cylinder High (LBA 23-16) | | | | | | | |
| Cylinder Low(4) | Cylinder Low(LBA 15-8) | | | | | | | |
| Sector Number(3) | Sector Number (LBA 7-0) | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

This command uses DMA mode to write 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. When this command is issued the CompactFlash Storage Card sets BSY, puts all or part of the sector of data in the buffer. The Card is then permitted, although not required, to set DRQ, clear BSY. The Card asserts DMAREQ while data is available to be transferred. The host then writes the (512*sector count) bytes of data to the Card using DMA. While DMAREQ is asserted by the Card, the host asserts -DMACK while it is ready to transfer data by DMA and asserts -IOWR once for each

16 bit word to be transferred from the Host.

Interrupts are not generated on every sector, but upon completion of the transfer of the entire number of sectors to be transferred or upon the occurrence of an unrecoverable error. At command completion, the Command Block Registers contain the cylinder, head and sector number of the last sector read. If an error occurs, the read terminates at the sector where the error occurred. The Command Block Registers contain the cylinder, head and sector number of the sector where the error occurred. The amount of data transferred is indeterminate. When a write DMA command is received by the Card and 8 bit transfer mode has been enabled by the Set Features command, the Card shall return the Aborted error.

5.11.18 Write Multiple- C5h

5.11.18.1 Command Code

C5h

5.11.18.2 Protocol

PIO data-out

5.11.18.3 Inputs

The LBA mid, LBA High, Device, and LBA Low specify the starting sector address to be written. The Sector Count register specifies the number of sectors to be transferred.

Table 52: Write multiple command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|--------------|----|-----|-----|------------|---|---|---|
| Features | Na | | | | | | | |
| Sector Count | Sector Count | | | | | | | |
| LBA Low | LBA(7:0) | | | | | | | |
| LBA Mid | LBA(15:8) | | | | | | | |
| LBA High | LBA(23:16) | | | | | | | |
| Device | obs | Na | obs | DEV | LBA(27:24) | | | |
| Command | C5h | | | | | | | |

Sector Count-

Number of sectors to be transferred. A value of 00h specifies that 256 sectors shall be transferred.

LBA Low-

Starting LBA bits (7:0)

LBA Mid-

Starting LBA bits (15:8)

LBA High-

Starting LBA bits (23:16)

Device –

The LBA bit shall be set to one to specify the address is an LBA.

DEV shall specify the selected device.

Bits(3:0) starting LBA bits (27:24)

5.11.18.4 Normal Output

Table 53: Write multiple command for normal output information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register-

DEV shall specify the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ will be cleared to zero

ERR will be cleared to zero.

5.11.18.5 Error Outputs

An unrecoverable error encountered during the execution of this command results in the termination of the command. The Command Block register contain the address of the sector where the first unrecoverable error occurred. The amount of data transferred is indeterminate.

Table 54: Write multiple command for normal output information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|------------|----|----|------|-----|------|----|----|
| Error | Na | WP | MC | IDNF | MCR | ABRT | NM | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | LBA(7:0) | | | | | | | |
| LBA Mid | LBA(15:8) | | | | | | | |
| LBA High | LBA(23:16) | | | | | | | |

| | | | | | | | | |
|--------|-----|------|-----|-----|------------|----|----|-----|
| Device | Obs | Na | obs | DEV | LBA(27:24) | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error register-

IDNF shall be set to one if a user-accessible address could not be found. IDNF shall be set to one if an address outside of the range user-accessible address is requested if command aborted is not returned.

ABRT shall be set to one if an error, include an ICRC error, has occurred during an Ultra DMA data transfer. ABRT shall be set to one if an address outside of the range of user-accessible address is requested if IDNF is not set to one.

LBA Low, LBA Mid, and LBA High, Device –

Shall be written with the address of first unrecoverable error.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.18.6 Prerequisites

DRDY set to one. If bit 8 of IDENTIFY DEVICE word 59 is cleared to zero, a successful SET MULTIPLE MODE command shall proceed a WRITE MULTIPLE command.

5.11.18.7 Description

This command writes the number of sectors specified in the Sector Count register.

The number of sectors per block is defined by the content of word 59 of the IDENTIFY DEVICE response.

When the WRITE MULTIPLE command is issued, the SECTOR Count register contains the number of sectors (not the number of blocks) requested. The device shall interrupt for each DRQ block transferred.

IF the number of requested sectors is not evenly divisible by the block count, as many full blocks as possible are transferred, followed by a final, partial block transfer. The partial block transfer is for n sectors, where:

$N = \text{Remainder} (\text{sector count} / \text{block count})$.

If the WRITE MULTIPLE command is received when WRITE MULTIPLE commands are disabled, the Write Multiple operation shall be rejected with command aborted.

Device errors encountered during WRITE MULTIPLE commands are posted after the attempted device write of the block or partial block transferred. The command ends with the sector in error, even if the error was in the middle of a block. Subsequent blocks are not transferred in the event of an error.

The contents of the Command Block Registers following the transfer of a data block that had a sector in error are undefined. The host should retry the transfer as individual requests to obtain valid error information. Interrupt pending is set when the DRQ bit is set to one at the beginning of each block or partial block.

5.11.19 Write Sector(s) – 30h

Table 55: Write sector information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------------|---------------------------|-----|---|-------|-----------------|---|---|---|
| Command(7) | 30h | | | | | | | |
| C/D/H(6) | 1 | LBA | 1 | Drive | Head(LBA 27-24) | | | |
| Cylinder High(5) | Cylinder High (LBA 23-16) | | | | | | | |
| Cylinder Low(4) | Cylinder Low (LBA 15-8) | | | | | | | |
| Sector Number(3) | Sector Number (LBA 7-0) | | | | | | | |
| Sector Count(2) | Sector Count | | | | | | | |
| Feature(1) | X | | | | | | | |

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. When this command is accepted, the CompactFlash Storage Card sets BST, then sets DRQ and clears BSDY, then waits for the host to fill the sector buffer with the data to be written. No interrupt is generated to start the first host transfer operation. No data should be transferred by the host until BSY has been cleared by the host.

For multiple sectors, after the first sector of data is in the buffer, BSY shall be set and DRQ shall be cleared. After the next buffer is ready for data, BSY is cleared, DRQ is set and an

interrupt is generated. When the final sector of data is transferred, BSY is set and DRQ is cleared. It shall remain in this state until the command is completed at which time BSY is cleared and an interrupt is generated. If an error occurs during a write of more than one sector, writing terminates at the sector where the error occurs. The Command Block Registers contain the cylinder, head and sector number of the sector where the error occurred. The host may then read the command block to determine what error has occurred, and on which sector.

5.11.20 Security Set Password- F1h

5.11.20.1 Command Code

F1h

5.11.20.2 Feature Set

Security Mode feature set

5.11.20.3 Protocol

PIO data-out

5.11.20.4 Inputs

Table 56: Security set password command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|----|----|---|---|---|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | Na | Na | | | |
| Command | F1h | | | | | | | |

Device –

DEV shall specify the selected device.

Normal Outputs

Table 57: Security set password command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|-----|----|---|---|---|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |

| | | | | | | | | |
|--------|-----|------|----|----|-----|----|----|-----|
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |
|--------|-----|------|----|----|-----|----|----|-----|

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be set to zero.

DRQ will be cleared to zero

ERR will be set to zero.

5.11.20.5 Error Outputs

Table 58: Security set password command for error outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|------|----|-----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.20.6 Prerequisites

DRDY set to one.

5.11.20.7 Description

This command transfer 512 byte of data from the host. Table 10 defines the content of this information. The data transferred controls the function of this command. Table 11 defines the interaction of the identifier and security level bits.

5.11.21.1 Command Code

F2h

5.11.21.2 Feature Set

Security Mode feature set

5.11.21.3 Protocol

PIO data-out

5.11.21.4 Inputs

Table 61: Security unlock command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|----|----|---|---|---|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | Na | Na | | | |
| Command | F2h | | | | | | | |

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 62: Security unlock command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion**DRDY** will be set to one.**DF** (Device Fault) will be set to zero.**DRQ** will be cleared to zero

ERR will be set to zero.

5.11.21.5 Error Outputs

The device shall return aborted if the device is in Frozen mode.

Table 63: Security unlock command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|------|----|-----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.21.6 Prerequisites

DRDY set to one.

5.11.21.7 Description

This command transfers 512 bytes of data from the host. Table13 defines the content of this information. If the Identifier bit is set to Master and the device is in high security level, then the password supplied shall be compared with the stored Master password. If the device is in maximum security level then the unlock shall be rejected.

If the Identifier bit is set to user then the device shall compare the supplied password with the stored User password. If the password compare fails then the device shall return command aborted to the host and decrements the unlock counter. This counter shall be initially set to five and shall be decremented for each password mismatch when SECURITY UNLOCK and

SECURITY ERASE UNIT commands shall be command aborted until a power-on reset or a hardware reset. SECURITY UNLOCK commands issued when the device is unlocked have no effect on the unlock counter.

5.11.22 Security Erase Prepare- F3h

5.11.22.1 Command Code

F3h

5.11.22.2 Feature Set

Security Mode feature set

5.11.22.3 Protocol

Non-data

5.11.22.4 Inputs

Table 64: Security erase prepare command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|----|----|---|---|---|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | Na | Na | | | |
| Command | F3h | | | | | | | |

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 65: Security erase prepare command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) will be set to zero.

DRQ will be cleared to zero

ERR will be set to zero.

5.11.22.5 Error Outputs

The device shall return aborted if the device is in Frozen mode.

Table 66: Security erase prepare command for error outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|------|----|-----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT shall be set to one if the device is in Frozen mode. ABRT may be set to one if the device is not able to complete the action requested by the command

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.22.6 Prerequisites

DRDY set to one.

5.11.22.7 Description

The SECURITY ERASE PREPARE command shall be issued immediately before the SECURITY ERASE UNIT command to enable device erasing and unlocking. This command prevents accidental loss of data on the device.

5.11.23 Security Erase Unit- F4h

5.11.23.1 Command Code

F4h

5.11.23.2 Feature Set

Security Mode feature set

5.11.23.3 Protocol

PIO data-out.

5.11.23.4 Inputs

Table 67: Security erase unit command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|----|----|----|----|----|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | Na | Na | Na | Na | Na |
| Command | F4h | | | | | | | |

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 68: Security erase unit command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register

DEV shall indicate the selected device.

Status register

BSY shall be cleared to zero indicating command completion**DRDY** shall be set to one.**DF** (Device Fault) will be set to zero.**DRQ** shall be cleared to zero**ERR** shall be cleared to zero.

5.11.23.5 Error Outputs

The device shall return aborted if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, if Enhance Erase is specified but not supported, or if the data area is not successfully overwritten.

Table 69: Security erase unit command for error outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|------|----|-----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT shall be set to one if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, or if the data area is not successfully overwritten. ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.23.6 Prerequisites

DRDY set to one. This command shall be immediately preceded by a SECURITY ERASE PREPARE command.

5.11.23.7 Description

This command transfer 512 bytes of data from the host. Table12 defines the content of this information. If the password does not match the password previously saved by the device, the device shall reject the command with command aborted.

The SECURITY ERASE PREPARE command shall be completed immediately prior to the SECURITY ERASE UNIT command. If the device receives a SECURITY ERASE UNIT command without an immediately prior SECURITY

| | | | | | | | | |
|----------|-----|----|-----|----|----|----|----|----|
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | Na | Na | Na | Na | Na |
| Command | F5h | | | | | | | |

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 72: Security freeze lock for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register

DEV shall indicate the selected device.

Status register

BSY shall be cleared to zero indicating command completion

DRDY shall be set to one.

DF (Device Fault) will be set to zero.

DRQ shall be cleared to zero

ERR shall be cleared to zero.

5.11.24.5 Error Outputs

The device shall return aborted if the device is in Frozen mode, not preceded by a SECURITY ERASE PREPARE command, if Enhance Erase is specified but not supported, or if the data area is not successfully overwritten.

Table 73: Security freeze lock for error outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|----|----|----|----|----|------|----|----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |

| | | | | | | | | |
|----------|-----|------|-----|-----|-----|----|----|-----|
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT shall be set to one if the device is in locked mode. ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.24.6 Prerequisites

DRDY set to one.

5.11.24.7 Description

The SECURITY FREEZE LOCK command shall set the device to Frozen mode. After command completion any other commands that update the device Lock mode shall be command aborted. Frozen mode shall be disabled by power-off or hardware reset. If SECURITY FREEZE LOCK shall be issued when the device in Frozen mode, the command executes and the device shall remain in Frozen mode.

Command disabled by SECURITY FREEZE LOCK are:

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT

5.11.25 Security Disable Password- F6h

5.11.25.1 Command Code

F6h

5.11.25.2 Feature Set

Security Mode feature set

5.11.25.3 Protocol

PIO data-out.

5.11.25.4 Inputs

Table 74: Security disable password command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|----|----|----|----|----|
| Features | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | Na | Na | Na | Na | Na |
| Command | F6h | | | | | | | |

Device register–

DEV shall specify the selected device.

Normal Outputs

Table 75: Security disable password command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device register

DEV shall indicate the selected device.

Status register

BSY shall be cleared to zero indicating command completion

DRDY shall be set to one.

DF (Device Fault) will be set to zero.

DRQ shall be cleared to zero

ERR shall be cleared to zero.

5.11.25.5 Error Outputs

The device shall return aborted if the device is in Locked mode, or device is in Frozen mode.

Table 76: Security disable password command for error outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----|----|----|----|----|------|----|----|
| Error | Na | Na | Na | Na | Na | ABRT | Na | Na |

| | | | | | | | | |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | obs | Na | obs | DEV | Na | | | |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Error Register

ABRT may be set to one if the device is not able to complete the action requested by the command.

Device register

DEV shall indicate the selected device.

Status register

BSY will be cleared to zero indicating command completion

DRDY will be set to one.

DF (Device Fault) should be set to one if a device fault has occurred.

DRQ will be cleared to zero

ERR will be set to one if an Error register bit is set to one.

5.11.25.6 Prerequisites

DRDY set to one. Device shall be in Unlocked mode.

5.11.25.7 Description

The SECURITY DISABLE PASSWORD command transfer 512 bytes of data from the host. Table 13 defines the content of this information. If the password selected by word 0 matches the password previously saved by the device, the device shall disable the Lock mode. This command shall not change the Master password. The Master password shall be reactivated when a User password is set.

Table 77: Security disable password command content

| Word | Content |
|--------|--|
| 0 | Control Word Bit 0 Identifier 0=Compare User password 1= Compare Master password Bit(15:1) Reserved |
| 1-16 | Password (32 Bytes) |
| 17-255 | Reserved |

5.11.26 SMART

Individual SMART commands are identified by the value placed in the

Feature register.

Table 78: SMART Feature register values

| Value | Command |
|-------|--------------------------|
| D0h | SMART Read Data |
| D8h | SMART ENABLE OPERATIONS |
| D9h | SMART DISABLE OPERATIONS |

5.11.27 SMART Read Data

5.11.27.1 Command Code

B0h with a Feature register value of D0h

5.11.27.2 Feature Set

Smart Feature Set

- Operation when the SMART feature set is implemented.

5.11.27.3 Protocol

PIO data-in

5.11.27.4 Inputs

Table 79: SMART command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|-----|----|----|----|----|
| Features | D0h | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | 4Fh | | | | | | | |
| LBA High | C2h | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Command | B0h | | | | | | | |

Device register-

DEV shall specify the selected device.

Normal Outputs

Table 80: SMART command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|----|---|---|---|---|---|---|---|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |

| | | | | | | | | |
|----------|-----|------|-----|-----|-----|----|----|-----|
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device Register-

DEV shall indicate the selected device.

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

5.11.27.5 Prerequisites

DRDY set to one. SMART enabled.

5.11.27.6 Description

This command returns the Device SMART data structure to the host.

Table 81: SMART data structure

| BYTE | Description |
|---------|--|
| 0-1 | Revision code |
| 2-361 | Vendor specific |
| 362 | Off-line data collection status |
| 363 | Self-test execution status byte |
| 364-365 | Total time in seconds to complete off-line data collection activity |
| 366 | Vendor specific |
| 367 | Off-line data collection capability |
| 368-369 | SMART capability |
| 370 | Error logging capability *7-1 Reserved *0 1 = Device error logging supported |
| 371 | Vendor specific |
| 372 | Short self-test routine recommended polling time (in minutes) |
| 373 | Extended self-test routine recommended polling time (in minutes) |
| 374 | Conveyance self-test routine recommended polling time (in minutes) |
| 375-385 | Reserved |
| 386-395 | Firmware Version/Date Code |
| 396-399 | Reserved |

| | |
|---------|-----------|
| 400-406 | 'SMI2236' |
| 407-511 | Reserved |
| 511 | Checksum |

5.11.28 SMART ENABLE OPERATIONS

- 5.11.28.1 Command Code
B0h with a Feature register value of D8h
- 5.11.28.2 Feature Set
Smart Feature Set
- 5.11.28.3 Protocol
Non-data
- 5.11.28.4 Inputs

Table 82: SMART Enable command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|-----|----|----|----|----|
| Features | D8h | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | 4Fh | | | | | | | |
| LBA High | C2h | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Command | B0h | | | | | | | |

Device register-

DEV shall specify the selected device.

- 5.11.28.5 Normal Outputs

Table 83: SMART command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|------|-----|-----|-----|----|----|-----|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device Register-

DEV shall indicate the selected device.

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

5.11.28.6 Prerequisites

DRDY set to one.

5.11.28.7 Description

This command enables access to all SMART capabilities within device.

5.11.29 SMART DISABLE OPERATIONS

5.11.29.1 Command Code

B0h with a Feature register value of D9h

5.11.29.2 Feature Set

Smart Feature Set

5.11.29.3 Protocol

Non-data

5.11.29.4 Inputs

Table 84: SMART DISABLE Command for inputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|-----|----|-----|-----|----|----|----|----|
| Features | D9h | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |
| LBA Mid | 4Fh | | | | | | | |
| LBA High | C2h | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Command | B0h | | | | | | | |

Device register-

DEV shall specify the selected device.

5.11.29.5 Normal Outputs

Table 85: SMART command for normal outputs information

| Register | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|----|---|---|---|---|---|---|---|
| Error | Na | | | | | | | |
| Sector Count | Na | | | | | | | |
| LBA Low | Na | | | | | | | |

| | | | | | | | | |
|----------|-----|------|-----|-----|-----|----|----|-----|
| LBA Mid | Na | | | | | | | |
| LBA High | Na | | | | | | | |
| Device | Obs | Na | obs | DEV | Na | Na | Na | Na |
| Status | BSY | DRDY | DF | Na | DRQ | Na | Na | ERR |

Device Register-

DEV shall indicate the selected device.

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

5.11.29.6 Prerequisites

DRDY set to one. SMART enabled.

5.11.29.7 Description

This command disables all SMART capabilities within device.

6. Device Parameters

ICF 9000 device parameters are listed in Table 86.

Table 86: Device parameter

| Capacity | Cylinders | Heads | Sectors | LBA | Capacity(MB) |
|----------|-----------|-------|---------|-------------|--------------|
| 1GB | 1,966 | 16 | 63 | 1981728 | 967.64 |
| 2GB | 3,900 | 16 | 63 | 3,931,200 | 1,919.53 |
| 4GB | 7,785 | 16 | 63 | 7,847,280 | 3,831.68 |
| 8GB | 15,538 | 16 | 63 | 15,662,304 | 7,647.61 |
| 16GB | 31,045 | 16 | 63 | 31,293,360 | 15,279.96 |
| 32GB | 62,041 | 16 | 63 | 62,537,328 | 30,535.80 |
| 64GB | 16,383 | 15 | 63 | 125,059,072 | 61,064.00 |

7. Part Number Rule

| CODE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--|-----------------|------------------|----------|----------|----------|-----------------------------------|----------|----------|----------|--|
| | D | C | 1 | M | - | 0 | 2 | G | D | 7 | 1 | A | C | 1 | Q | B | - | 3 | x | x | |
| Description | Disk | iCF9000 | | | - | Capacity | | Category | | | FW | Operation Temp. | Internal Control | Ch. | Flash | | Internal Code/ Customized Code | | | | |
| Definition | | | | | | | | | | | | | | | | | | | | | |
| Code 1st (Disk) | | | | | | | | | | | Code 12th (Firmware version) | | | | | | | | | | |
| D : Disk | | | | | | | | | | | A: Standard FW | | | | | | | | | | |
| Code 2nd ~ 4th (Form Factor) | | | | | | | | | | | Code 13th (Operation Temperature) | | | | | | | | | | |
| C1M : CF, Type I, | | | | | | | | | | | C : Standard Grade (0 ~ +70 °C) | | | | | | | | | | |
| C1S : CF Write Protect | | | | | | | | | | | W : Industrial Grade (-40 ~ +85 °C) | | | | | | | | | | |
| Code 6th ~ 8th (Capacity) | | | | | | | | | | | Code 14th (Internal Control Code) | | | | | | | | | | |
| 01G : 1GB | | | | | | | | | | | 1: TSOP 1 st PCB version, default setting | | | | | | | | | | |
| 02G : 2GB | | | | | | | | | | | A: BGA 1 st PCB version, default setting | | | | | | | | | | |
| 04G : 4GB | | | | | | | | | | | | | | | | | | | | | |
| 08G : 8GB | | | | | | | | | | | Code 15th (Channel of data transfer) | | | | | | | | | | |
| 16G : 16GB | | | | | | | | | | | D: Dual Channel | | | | | | | | | | |
| 32G : 32GB | | | | | | | | | | | Q: Quad Channel | | | | | | | | | | |
| 64G : 64GB | | | | | | | | | | | Code 16th (Flash Type) | | | | | | | | | | |
| | | | | | | | | | | | B: Toshiba SLC | | | | | | | | | | |
| Code 9th ~ 11th (Series) | | | | | | | | | | | Code 18th (Internal Code/ Customized Code) | | | | | | | | | | |
| D71 : iCF 9000 | | | | | | | | | | | 3: Removable Mode +UltraDMA | | | | | | | | | | |
| | | | | | | | | | | | 4: Preformat, Fixed Mode + PIO Mode 4 | | | | | | | | | | |
| | | | | | | | | | | | 5: Pre-formatted + UltraDMA 4 | | | | | | | | | | |
| | | | | | | | | | | | 6: Pre-formatted + Removable +UltraDMA 6 | | | | | | | | | | |
| | | | | | | | | | | | 7: Fixed Mode + PIO Mode 4 | | | | | | | | | | |
| | | | | | | | | | | | 8: Fixed Mode + MwdMA Mode 2 | | | | | | | | | | |
| | | | | | | | | | | | 9: Removable Mode + PIO Mode 4 | | | | | | | | | | |
| | | | | | | | | | | | A: Preformat | | | | | | | | | | |



CERTIFICATE

Issued Date: June 29, 2012
Report No. : 126319R-ITCEP07V04

This is to certify that the following designated product

Product : iCF9000
Trade name : InnoDisk
Model Number : DC1M-XXXD71#&*%\$, DC1F-XXXD71#&*%\$,
DC1S-XXXD71#&*%\$
Company Name : Innodisk Corporation.

This product, which has been issued the test report listed as above in QuieTek Laboratory, is based on a single evaluation of one sample and confirmed to comply with the requirements of the following EMC standard.

| | |
|-----------------------------|----------------------|
| EN 55022:2010 Class B | EN 55024: 2010 |
| EN 61000-3-2: 2006+A2: 2009 | IEC 61000-4-2: 2008 |
| EN 61000-3-3: 2008 | IEC 61000-4-3: 2010 |
| | IEC 61000-4-4: 2011 |
| | IEC 61000-4-5: 2005 |
| | IEC 61000-4-6: 2008 |
| | IEC 61000-4-8: 2009 |
| | IEC 61000-4-11: 2004 |

TEST LABORATORY

Vincent Lin / Manager



CERTIFICATE

Issued Date: Junu 29, 2012
Report No.: 126319R-ITUSP01V02

This is to certify that the following designated product

Product : ICF9000
Trade name : InnoDisk
Model Number : DC1M-XXXD71#&*%\$, DC1F-XXXD71#&*%\$,
DC1S-XXXD71#&*%\$
Company Name : Innodisk Corporation

This product, which has been issued the test report listed as above in Quietek Laboratory, is based on a single evaluation of one sample and confirmed to comply with the requirements of the following EMC standard.

FCC CFR Title 47 Part 15 Subpart B: 2011, Class B, CISPR 22: 2008
ANSI C63.4: 2009

TEST LABORATORY

Vincent Lin / Manager

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innodisk

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Tel: (02)2696-3000 Fax: (02)2696-2000 Internet: <http://www.innodisk.com/>

REACH Declaration of Conformity

Manufacturer Products: All Innodisk EM Flash and Dram products

1. 宜鼎國際股份有限公司（以下稱本公司）特此保證此售予貴公司之產品，皆符合歐盟化學品法案(Registration, Evaluation and Authorization of Chemicals; REACH)之規定 (<http://www.echa.europa.eu/de/candidate-list-table> **last updated: 16/12/2013**)。所提供之產品包含：(1) 產品或產品所使用到的所有原物料；(2) 包裝材料；(3) 設計、生產及重工過程中所使用到的所有原物料。

We Innodisk Corporation hereby declare that our products are in compliance with the requirements according to the REACH Regulation

(<http://www.echa.europa.eu/de/candidate-list-table> **last updated: 16/12/2013**).

Products include : 1) Product and raw material used by the product ; 2) Packaging material ; 3) Raw material used in the process of design, production and rework

2. 本公司同意因本保證書或與本保證書相關事宜有所爭議時，雙方宜友好協商，達成協議。

InnoDisk Corporation agrees that both parties shall settle any dispute arising from or in connection with this Declaration of Conformity by friendly negotiations.

立 保 證 書 人 (Guarantor)

Company name 公司名稱：InnoDisk Corporation 宜鼎國際股份有限公司

Address：9F, No. 100, Sec.1 Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan

Company Representative 公司代表人：Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱：CEO 執行長

Date 日期：2014 / 03 / 18



innodisk

宜鼎國際股份有限公司 Innodisk Corporation

Tel:(02)7703-3000 Fax:(02) 7703-3555 Internet: http://www.innodisk.com/

RoHS 自我宣告書 (RoHS Declaration of Conformity)

Manufacturer Product: All Innodisk EM Flash and Dram products

- 一、 宜鼎國際股份有限公司（以下稱本公司）特此保證售予貴公司之所有產品，皆符合歐盟 2011/65/EU 關於 RoHS 之規範要求。

Innodisk Corporation declares that all products sold to the company, are complied with European Union RoHS Directive (2011/65/EU) requirement

- 二、 本公司同意因本保證書或與本保證書相關事宜有所爭議時，雙方宜友好協商，達成協議。

Innodisk Corporation agrees that both parties shall settle any dispute arising from or in connection with this Declaration of Conformity by friendly negotiations.

| Name of hazardous substance | Limited of RoHS ppm (mg/kg) |
|--------------------------------|-----------------------------|
| Cd | < 100 ppm |
| Pb | < 1000 ppm |
| Hg | < 1000 ppm |
| Chromium VI (Cr+6) | < 1000 ppm |
| Polybromodiphenyl ether (PBDE) | < 1000 ppm |
| Polybrominated Biphenyls (PBB) | < 1000 ppm |

立 保 證 書 人 (Guarantor)

Company name 公司名稱：Innodisk Corporation 宜鼎國際股份有限公司

Company Representative 公司代表人：Richard Lee 李鐘亮

Company Representative Title 公司代表人職稱：CEO 執行長

Date 日期：2014 / 07 / 29

