# DiskOnChip® 2000 DIP
## MD2200/2/3

## Features

- Single-chip plug-n-play flash disk
- Low power, single 3.3V or 5V power supply
- 16MB to 576MB capacity (1GB in 2002)
- Pinout and structure compatible with DiskOnChip Millennium DIP 8MB
- Simple, easy-to-integrate interface
- 32-pin DIP, JEDEC standard, EEPROM-compatible pinout
- 8KB sized memory window
- Boot OS capability
- Embedded TrueFFS® software provides:
  — Full hard disk read/write emulation
  — Third-generation wear leveling
  — Automatic block management
- Operates with DiskOnChip SDK in OS-less environments, ANSI-C source code kit
- Error Detection and Correction (EDC/ECC) for higher data reliability
- Low power consumption – Static Operation
- Broad OS support: DOS, Windows NT4.0/5.0, Windows CE, BE, pSOS+, QNX, VxWorks, and others
- Compatible with major processors: x86, MediaGX, Geode SCxxxx, PowerPC, 68K, MIPS, SHx, StrongARM, and others

## Applications

- Embedded systems
- Internet access devices
- Internet set-top boxes/ITV, Web browsers
- WBT, thin clients, network computers
- Routers, networking
- Web phones, car PCs, DVD, HPC
- Point of sale, industrial PCs
- Telecom, medical

# Table of Contents

# 1 General Description

The DiskOnChip 2000 product line is the second-generation of M-Systems' DiskOnChip series of products. The 2000 series provides a small, single-chip, solid-state flash disk in a standard 32-pin DIP package. Combining a disk controller with flash memory on a single chip, DiskOnChip 2000 is *the* solution where minimal weight, space, and power consumption are essential. In consequence, the 2000 series finds use today in a wide range of products, such as information appliances, set-top boxes, thin clients, thin servers, network computers, and embedded, portable computers.

By placing DiskOnChip 2000 in a standard socket, physical space requirements are reduced. Unlike standard IDE drives, no cables or extra space are required. DiskOnChip 2000 has no moving parts, resulting in significantly decreased power consumption and increased reliability. It is easy to use and reduces integration overhead. DiskOnChip 2000 is therefore a very attractive alternative to conventional hard and floppy disk drives.

Using TrueFFS technology, DiskOnChip 2000 delivers full hard disk emulation. As such, the design and integration stages can be considerably reduced, thereby enabling very fast time-to-market and ease of production. Combined with its very attractive cost structure, DiskOnChip 2000 is a superior alternative to resident flash array (RFA).

DiskOnChip 2000 products are available in capacities ranging from 16MB to 576MB. In addition, they are 100% pinout and software compatible with the DiskOnChip Millennium DIP 8MB package. In future versions, the capacity will be dramatically increased (up to 1GB during 2002). Since the same pinout will be retained, the socket on the target platform will not have to be changed to accommodate the larger capacities.

DiskOnChip technology provides broad support for all major operating systems and processors in the market, enabling it to be readily integrated with any architecture.

DiskOnChip 2000 is shipped as a plug-and-play device that is fully tested and formatted, and programmed with a DOS driver. Future driver, software or content upgrades, or formatting, can be made on-board or off-board using DiskOnChip utilities and accessories provided by M-Systems.

# 2    Detailed Feature List

## TrueFFS Technology

For a flash disk to emulate a hard disk, a software management layer is required. TrueFFS is M-Systems' patented flash file system management technology that allows flash components to fully emulate hard disks, so they can be written to and read from like any other hard disk.

TrueFFS software simplifies and enhances flash memories by:

- Using third-generation wear leveling, which ensures that all blocks are erased an equal number of times. This increases the life of the flash media by orders of magnitude.

- Using virtual blocking of the flash device to make erasure of large blocks transparent to the operator.

- Automatic block mapping.

- Implementing a robust power-loss recovery mechanism to guarantee absolute protection of data.

- Providing conventional address support for various architecture configurations.

- The TrueFFS driver supports 8-bit, 16-bit, and 32-bit bus architectures. Support for the 16-bit and 32-bit bus architectures, typically used in RISC processors, can be achieved by using the LSB of the data bus as follows:

    - For 16-bit address boundary shifts, shift the address lines by *one*, so that the host address line A1 connects to DiskOnChip 2000 address line A0, the host address line A2 connects to DiskOnChip 2000 line A1, and so on.

    - For 32-bit address boundary shifts, shift the address lines by *two*, so that the host address line A2 connects to DiskOnChip 2000 address line A0, the host address line A3 connects to DiskOnChip 2000 line A1, and so on.

    Refer to Application Note AP-DOC-030 for more details.

## Low Power Consumption

The internal functions are synchronized with the CPU's read and write strobes. This innovation eliminates the need for an external clock and dramatically reduces power consumption. DiskOnChip 2000 requires only a single 3.3V or 5V power supply, which helps simplify integration.

These features make DiskOnChip 2000 the best cost/performance solution for computers that require minimal weight, space, and power consumption, providing a very attractive alternative to conventional hard and floppy disk drives.

## Temperature Range

DiskOnChip 2000 is available in both commercial (0 ºC to +70 ºC) and extended (-40 ºC to +85 ºC) temperature ranges.

* DiskOnChip 2000 192MB and 576MB capacities are available only for commercial temperature ranges.

## Easy to Integrate

Fast integration is ensured by the following DiskOnChip 2000 features:

- Compatibility with standard EEPROM DIP pinout

- Support for local bus and ISA bus interface

- Small memory map window size – only 8KB

- Static operation – no clock required

- 16mA output drive (18mA at 3.3V)

## Robust Error Correction

The DiskOnChip family utilizes a Reed-Solomon Error Detection Code (EDC) and Error Correction Code (ECC), providing the following error immunity for each 512-byte block of data:

- Corrects up to two 10-bit symbols, including two random bit errors

- Corrects single bursts of up to 11 bits

- Detects single bursts of up to 31 bits, and double bursts of up to 11 bits

- Detects up to 4 random bit errors

## High Reliability

DiskOnChip 2000 can be inserted into standard DIP sockets, eliminating the need for mechanical disk drives, bulky ribbon cables and connectors. The design of DiskOnChip 2000 ensures high reliability even when subjected to levels of shock, vibration, and temperature changes that would destroy a conventional magnetic disk drive.

## High Speed

DiskOnChip 2000 implements an integrated architecture for data transfers, which eliminates bottlenecks typical in this area. Additionally, it doubles read performance and significantly improves write performance, in comparison to competitive alternatives. DiskOnChip 2000 can sustain system write speeds of over 550KB per second, read speeds of more than 1.4MB per second (measured in ISA no wait state environment) and read/write burst transfer rates of nearly 5MB per second.

## Compatibility with 8MB DiskOnChip Millennium Series

DiskOnChip 2000 is a 32-pin Dual Inline Package (DIP) that provides 100% pinout compatibility with M-Systems' DiskOnChip Millennium DIP (8MB). DiskOnChip 2000 is fully software compatible with M-Systems' DiskOnChip Millennium DIP (8MB), for version 1.21 and higher.

## Broad Support for Operating Systems and Processors

The DiskOnChip family of products, supplied with TrueFFS firmware, supports a wide range of operating systems (OS), including DOS, Windows 2000, Windows CE, Windows NT, Windows Embedded NT, BE, QNX, VxWorks, pSOS, Linux, FreeBSD, PharLap ETS, VRTX and more.

In addition, leading operating systems such as Windows CE and Tornado, offer native support for the DiskOnChip family of products for easy integration.

For OS-less applications and customized solutions, M-Systems offers its DiskOnChip TrueFFS SDK, an ANSI-C source code kit designed specifically to support these environments.

The DiskOnChip family of products is compatible with all major processors, supporting popular processors such as x86, 68K, MediaGx, Geode SCxxxx, PowerPC, MIPS, SHx, StrongARM, and many others.

## Portable Solution – Shorter Time to Market

The development and integration time for implementing a flash disk is greatly reduced by DiskOnChip's standard software interface, which provides portability to other operating systems and processors and thereby shortens your time to market.

## Complete Solution

The DiskOnChip 2000 series offers a full flash disk solution that includes different voltage and temperature options, software drivers tailored to your operating system, data sheets, application support and online email support.

Using DiskOnChip evaluation boards (EVB), you can develop your software before the target hardware is ready.

The DiskOnChip GANG Programmer reduces your production time, and facilitates fast response time to application software changes during production stages.

In all, DiskOnChip offers a complete set of tools for delivering a complete solution whenever your application can use a flash disk.

# 3 Package Description and Pin List
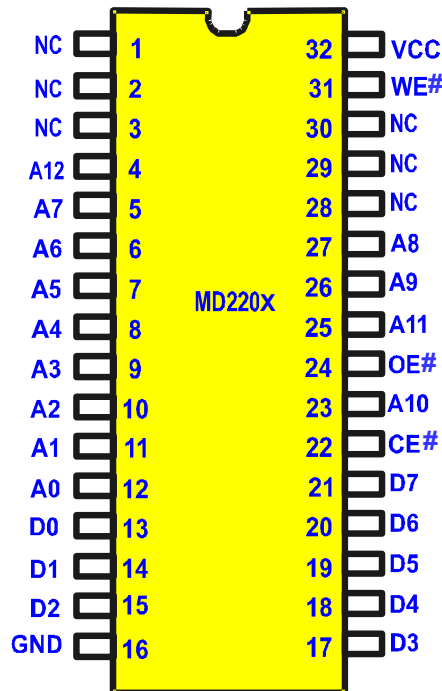


*Figure 1: Package Description and Pinout*

| Pin Name | Description | Pin Number | Direction |
|----------|-------------|------------|-----------|
| A0 - A12 | Address bus | 4 to 12, 23, 25 to 27 | Input |
| D0 – D7 | Data bus | 13 to 15, 17 to 21 | I/O |
| CE# | Chip Enable, active low | 22 | Input |
| OE# | Output Enable, active low | 24 | Input |
| WE# | Write Enable, active low | 31 | Input |
| NC | Not Connected. These pins may be left floating, tied to Vcc, GND or logic levels. Absolute Maximum Ratings must be observed. | 1, 2, 3, 28, 29, 30 | |
| VCC | Power | 32 | |
| GND | Ground | 16 | |

# 4 Designing with the DiskOnChip 2000 Flash Disk

## 4.1 Hardware

DiskOnChip 2000 should be connected as a standard memory device, using standard memory interface signals. Typically, DiskOnChip 2000 can be mapped to any free 8KB memory space. In PC architectures, if the memory window allocated to DiskOnChip 2000 is larger than 8KB, an automatic anti-aliasing mechanism prevents the firmware from being loaded more than once. Figure 1 illustrates a typical interface between DiskOnChip 2000 and a system.
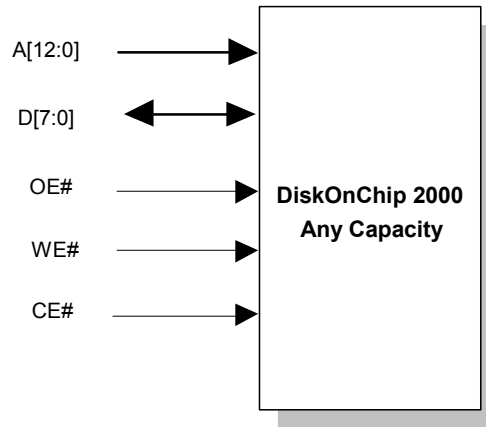


*Figure 2: Simplified I/O Diagram*

## 4.2 Software

DiskOnChip 2000, under control of TrueFFS, is accessed using standard file system calls like any other block device. Applications can write to and read from any sector on DiskOnChip 2000, which is compatible with all diagnostic utilities, applications and file systems.

The flash memory within DiskOnChip 2000 is accessed by TrueFFS through an 8KB window in the CPU's memory space. TrueFFS handles the paging of this window in the flash array, as well as providing flash disk emulation that includes flash table management, wear leveling, mapping out bad blocks, and background space reclamation of unused flash blocks.

The same 8KB address space will be retained in future versions of DiskOnChip 2000 that offer greater capacities.

## 4.3 Designing DiskOnChip 2000 into PC Architecture

When used in PC-compatible architectures, DiskOnChip 2000 is allocated an 8KB memory window in the BIOS expansion memory range, which is usually located between 0C8000h and 0EFFFFh. Figure 3 illustrates the DiskOnChip 2000 memory window in relation to the PC memory map.

```
                    Extended
                    Memory
0FFFFFh                          1MB
              |   BIOS   |
0F0000h       |          |
              | DiskOnChip |      } 8KB
0C8000h       |          |
              |  Display |
0A0000h       |          |       640KB
              |          |
              |   RAM    |
              |          |
              |          |       0
```
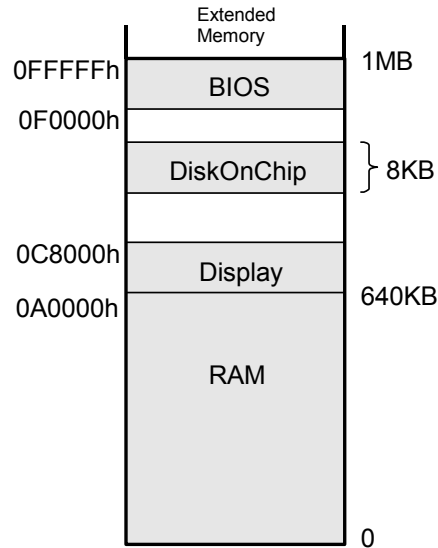
*Figure 3: PC Memory Map*

After reset, the BIOS executes the POST (Power On Self-Test), and then searches for all expansion ROM devices. When DiskOnChip 2000 is found, the BIOS executes the Initial Program Loader (IPL) code located in the boot-block area of DiskOnChip 2000. This code loads the TrueFFS driver into system memory, installs DiskOnChip 2000 as a disk in the system, and then returns control back to the BIOS code. The operating system subsequently attempts to identify disks that are available and the DiskOnChip 2000 software (TrueFFS) responds by emulating a hard disk.

From this point onward, DiskOnChip 2000 is identified by the system as a standard disk drive. It is assigned a drive letter and it can be used by any software application. No BIOS setup modifications, autoexec.bat/config.sys modifications or external software are required.

- DiskOnChip 2000 can be used as the only disk in the system, in which case it will be accessed as drive [C:].

- DiskOnChip 2000 can operate with or without a floppy drive, or with additional hard disks. When working with a hard disk, DiskOnChip 2000 can be configured as the last drive (the default configuration). In this case, the hard disk will be drive [C:] and DiskOnChip 2000 will be drive [D:].

- DiskOnChip 2000 can also be configured as the first drive. In this case, the hard disk will be drive [D:] and DiskOnChip 2000 will be drive [C:].

- DiskOnChip 2000 can be used as the boot device when configured as drive [C:]. In this configuration, you must format DiskOnChip 2000 as a bootable device by copying the OS files onto the disk. When running DOS, use the SYS command for this purpose.

# 5    Disk Capacities and Contents

The capacities for the various models are detailed in the following two tables.

## 5.1    Low-Profile

| Model | Formatted Capacity (bytes) | Sectors | Formatted Capacity under DOS 6.22 (bytes) | Sectors under DOS 6.22 |
|---|---|---|---|---|
| MD2202-D16 | 16,375,808 | 31,984 | 16,324,608 | 31,884 |
| MD2200-D24 | 24,592,384 | 48,032 | 24,516,608 | 47,884 |
| MD2202-D32 | 32,800,768 | 64,064 | 32,724,992 | 63,916 |
| MD2202-D48 | 49,233,920 | 96,160 | 49,092,608 | 95,884 |
| MD2202-D64 | 65,683,456 | 128,288 | 65,525,760 | 127,980 |
| MD2202-D96 | 98,566,144 | 192,512 | 98,390,016 | 192,168 |
| MD2202-D192 | 197,279,744 | 381,300 | 103,829,024 | 385,280 |

## 5.2    High-Profile

| Model | Formatted Capacity (bytes) | Sectors | Formatted Capacity under DOS 6.22 (bytes) | Sectors under DOS 6.22 |
|---|---|---|---|---|
| MD2203-D80 | 82,116,608 | 160,384 | 81, 989, 632 | 160,136 |
| MD2203-D112 | 114,999,296 | 224,608 | 114, 786, 304 | 224,192 |
| MD2203-D144 | 147,881,984 | 288,832 | 147, 578, 880 | 288,240 |
| MD2203-D160 | 164,331,520 | 320,960 | 164, 151, 296 | 320,608 |
| MD2203-D192 | 197,214,208 | 385,184 | 196, 980, 736 | 384,728 |
| MD2203-D224 | 230, 031, 360 | 449, 280 | 229, 584, 896 | 448, 408 |
| MD2203-D256 | 262, 930, 432 | 513, 536 | 262, 647, 808 | 512, 984 |
| MD2203-D288 | 295, 796, 736 | 577,728 | 295, 624, 704 | 577,392 |
| MD2203-D576 | 591, 790, 080 | 1,142,970 | 311, 427, 072 | 1,155,776 |

## 5.3    Media Contents

DiskOnChip 2000 products are shipped from M-Systems fully tested, already formatted, and come with a DOS driver.
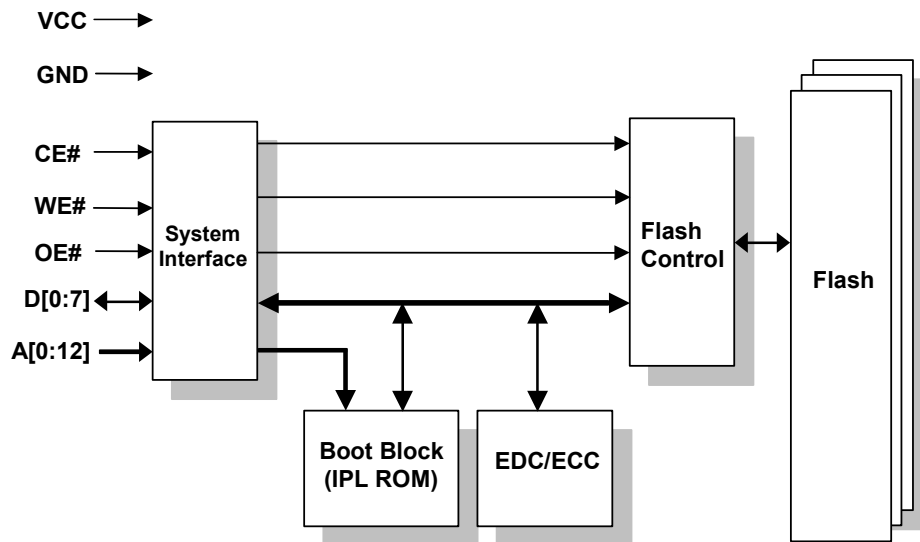
# 6    Theory of Operation



*Figure 4: DiskOnChip 2000 Simplified Block Diagram*

DiskOnChip 2000 appears to the system's hardware as a standard EEPROM, via the System Interface block. The host cycles are passed to the Flash Control block, to be written to or read from the flash device.

To ensure the highest level of reliability, each cycle is monitored by the EDC/ECC (Error Detection and Correction) block. In write cycles, the EDC/ECC block generates a syndrome for every sector that contains data, which is stored in the flash together with the sector. When the sector is read, the syndrome is regenerated for the data and compared with the original syndrome. When a mismatch is detected, it is repaired.

The boot block is responsible for answering the BIOS expansion search in PC architectures. After the BIOS identifies DiskOnChip 2000 as a valid BIOS expansion device, it executes the code stored in the boot block. The BIOS then loads the TrueFFS software from the flash memory into the host memory, delivering full disk capabilities to the operating system. This code is identical for all DiskOnChip 2000 capacities, since TrueFFS automatically detects the memory capacity of DiskOnChip 2000.

## 6.1    Error Detection and Correction (EDC/ECC)

DiskOnChip 2000 uses the Reed-Solomon EDC/ECC algorithm to ensure high data reliability. Each time a block of data is written to the flash, a 6-byte checksum is also written. Each time the data is read back from the flash, a new 6-byte code is computed. TrueFFS uses these checksums for error detection and, if necessary, error correction.

# 7    Specifications

## 7.1    Absolute Maximum Ratings

| Parameter | Symbol | 3.3V Model Rating[1] | 5V Model Rating[1] | Units | Notes |
|---|---|---|---|---|---|
| DC supply voltage | $V_{CCS}$ | -0.5 to 4.6 | -0.3 to 6.0 | V | |
| Input pin voltage[2] | $V_{IN}$ | -0.5 to $V_{CC}$ + 0.3 | -0.3 to $V_{CC}$ + 0.3 | V | |
| Input pin current | $I_{IN}$ | Not Specified | -10 to 10 | mA | +25 °C |

**Note 1**: Permanent device damage may occur if absolute maximum ratings are exceeded. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Note 2**: The voltage on any pin may undershoot to -2.0V or overshoot to Vcc+2.0V for periods <20ns.

## 7.2    Capacitance

| Symbol | Parameter | Conditions | 3.3V Model Rating | 5V Model Rating | Unit |
|---|---|---|---|---|---|
| $C_{I/O}$ | Input/Output Capacitance | MD2200/2, $V_{IN}$ = 0V | 12 | 15 | pF |
| | | MD2203, $V_{IN}$ = 0V | 36 | 45 | pF |

**Note**: Capacitance is not 100% tested.

## 7.3    Temperature Ranges

Commercial operating temperature:        0 ºC to +70 ºC*

Extended operating temperature:        -40 ºC to +85 ºC

Storage temperature:        -50 ºC to +85 ºC

**\***DiskOnChip 2000 192MB and 576MB capacities are available only for commercial temperature ranges.

## 7.4    DiskOnChip Assembly

The DiskOnChip 2000 DIP device is not hermetically sealed. Therefore, it must be assembled after the PCB goes through its final rinse. Assembling DiskOnChip 2000 prior to the rinse phase may cause it to absorb moisture. Failure to adhere to the above assembly instruction can lead to device failures not covered by M-Systems' warranty.

**Note**: DiskOnChip 2000 DIP requires a DIP socket on the target platform. Due to its plastic shell and molding material, it cannot be soldered directly to the platform.

## 7.5    Humidity

10% - 90% relative, non-condensing

## 7.6 EDC/ECC

Enhanced Reed-Solomon:

- Corrects up to two 10-bit symbols, including two random bit errors.

- Corrects single bursts of up to 11 bits.

- Detects single bursts of up to 31 bits and double bursts of up to 11 bits.

- Detects up to 4 random bit errors.

## 7.7 DC Electrical Characteristics over Operating Range

### 7.7.1 Vcc = 5V Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CCS}$ | System Supply Voltage | | 4.5 | 5.0 | 5.5 | V |
| $V_{IH}$ | High-level Input Voltage | | 2.0 | | | V |
| $V_{IL}$ | Low-level Input Voltage | | | | 0.8 | V |
| $V_{OH}$ | High-level Output Voltage | $I_{OH}$ = -16mA | 2.4 | | | V |
| $V_{OL}$ | Low-level Output Voltage | $I_{OL}$ = 16mA | | | 0.4 | V |
| $I_{IL}$ | Input Leakage Current | MD2200, MD2202 | | | $\pm 10$ | µA |
| | | MD2203 | | | $\pm 30$ | µA |
| $I_{OZ}$ | Output Leakage Current | MD2200, MD2202 | | | $\pm 10$ | µA |
| | | MD2203 | | | $\pm 30$ | µA |
| $I_{VCC}$ | Supply Current | 200ns Cycle Time, Outputs open | | 40 | 60 | mA |
| $I_{STDBY}$ | Standby Current | MD2200, MD2202 | | 60 | 400 | µA |
| | | MD2203 | | 240 | 1200 | µA |

## 7.7.2   Vcc = 3.3V Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CCS}$ | System Supply Voltage | | 3.0 | 3.3 | 3.6 | V |
| $V_{IH}$ | High-level Input Voltage | | 2.7 | | | V |
| $V_{IL}$ | Low-level Input Voltage | | | | 0.6 | V |
| $V_{HYS}$ | Input Voltage Hysteresis | | 1.1 | | 1.5 | V |
| $V_{OH}$ | High-level Output Voltage | $I_{OH}$ = -18mA | 2.4 | | | V |
| | | $I_{OH}$ = 0mA | Vcc-0.1 | | | V |
| $V_{OL}$ | Low-level Output Voltage | $I_{OL}$ = 18mA | | | 0.4 | V |
| | | $I_{OL}$ = 0mA | | | 0.1 | V |
| $I_{IL}$ | Input Leakage Current | MD2200, MD2202 | | | ±10 | µA |
| | | MD2203 | | | ±30 | µA |
| $I_{OZ}$ | Output Leakage Current | MD2200, MD2202 | | | ±10 | µA |
| | | MD2203 | | | ±30 | µA |
| $I_{VCC}$ | Supply Current | 150ns Cycle Time, Outputs open | | 30 | 60 | mA |
| $I_{STDBY}$ | Standby Current | MD2200, MD2202 | | 70 | 400 | µA |
| | | MD2203 | | 300 | 1350 | µA |

## 7.8   AC Operating Conditions
Timing specifications are based on the following conditions:

| Parameter | 3.3V Model | 5V Model |
|---|---|---|
| Supply Voltage | $V_{CC}$ = 3.3V ±0.3V | $V_{CC}$ = 5V ±0.5V |
| Input Pulse Levels | 0.2V to 2.9V | 0.4V to 2.6V |
| Input Rise and Fall Times | 1ns | 5ns |
| Input and Output Timing Levels | 1.5V | 0.8V and 2.0V |
| Output Load | 100 pF | 50 pF |

## 7.9 Timing Specifications

### 7.9.1 Read Cycle Timing
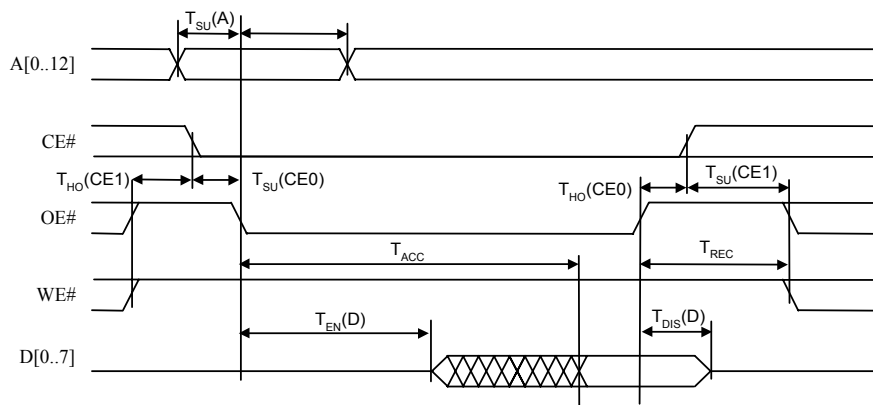


*Figure 5: Read Cycle*

| Symbol | Description | 3.3V | | 5V | | Notes |
|---|---|---|---|---|---|---|
| | | Min (ns) | Max (ns) | Min (ns) | Max (ns) | |
| $T_{SU}(A)$ | Address to OE# ↓ setup | 2 | | 10 | | |
| $T_{HO}(A)$ | OE#↓ to Address hold | 35 | | 56 | | |
| $T_{SU}(CE0)$ | CE# ↓ to OE# ↓ setup | 0 | | 0 | | 1 |
| $T_{HO}(CE0)$ | OE#↑ to CE# = 0 hold | 0 | | 0 | | 2 |
| $T_{HO}(CE1)$ | OE# or WE#↑ to CE# = 1 hold | 8 | | 42 | | |
| $T_{SU}(CE1)$ | CE#↑ to WE# or OE#↓ setup time | 8 | | 42 | | |
| $T_{REC}$ | OE#↑ to start of next cycle | 20 | | 59 | | |
| $T_{ACC}$ | Read access time | | 110 | | 130 | |
| $T_{EN}(D)$ | OE#↓ to D active delay | 15 | 75 | 7 | 91 | |
| $T_{DIS}(D)$ | OE#↑ to D Hi-Z delay | | 13 | | 44 | |

**Note 1**: CE# may be asserted any time before or after OE# is asserted. If CE# is asserted after OE#, all timing relative to OE# asserted will be referenced instead to the time CE# was asserted.

**Note 2**: CE# may be negated any time before or after OE# is negated. If CE# is negated before OE#, all timing relative to OE# negated will be referenced instead to the time CE# was negated.
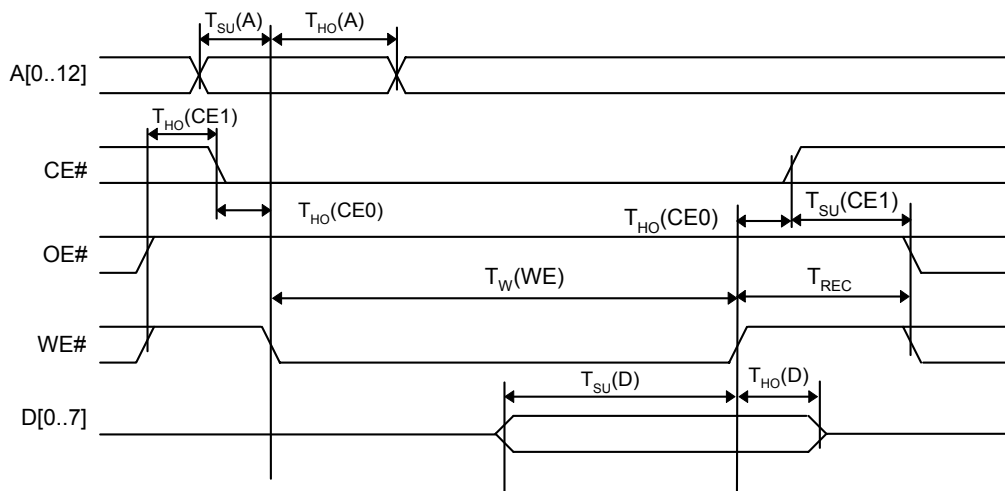
## 7.9.2 Write Cycle Timing



*Figure 6: Write Cycle*

| Symbol | Description | 3.3V | | 5V | | Notes |
|---|---|---|---|---|---|---|
| | | Min (ns) | Max (ns) | Min (ns) | Max (ns) | |
| $T_{SU}(A)$ | Address to WE#↓ setup time | 0 | | 10 | | |
| $T_{HO}(A)$ | WE#↓ to Address hold time | 35 | | 56 | | |
| $T_W(WE)$ | WE# asserted width | 62 | | 98 | | |
| $T_{SU}(CE0)$ | CE#↓ to WE#↓ setup time | 0 | | 0 | | 1 |
| $T_{HO}(CE0)$ | WE#↑ to CE# = 0 hold time | 0 | | 0 | | 2 |
| $T_{HO}(CE1)$ | OE# or WE#↑ to CE# = 1 hold time | 8 | | 42 | | |
| $T_{SU}(CE1)$ | CE#↑ to WE# or OE#↓ setup time | 8 | | 42 | | |
| $T_{REC}$ | WE#↑ to start of next cycle | 22 | | 59 | | |
| $T_{SU}(D)$ | D to WE#↑ setup time | 50 | | 48 | | |
| $T_{HO}(D)$ | WE#↑ to D hold time | 0 | | 40 | | |

**Note 1:** CE# may be asserted any time before or after WE# is asserted. If CE# is asserted after WE#, all timing relative to WE# asserted will be referenced instead to the time CE# was asserted.

**Note 2**: CE# may be negated any time before or after WE# is negated. If CE# is negated before WE#, all timing relative to WE# negated will be referenced instead to the time CE# was negated.
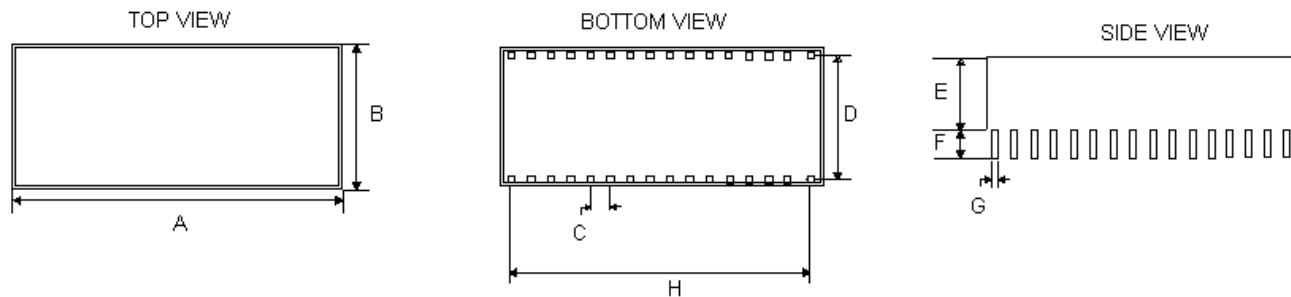
# 8    Mechanical Dimensions



*Figure 7: MD220x Mechanical Dimensions*

*Low-Profile*

|   | MD2200 Millimeters (max.) | MD2202 Millimeters (max.) |
|---|---|---|
| **A** | 41.9 | 43.95 |
| **B** | 18.05 | 18.3 |
| **C** | 2.54 | 2.54 |
| **D** | 15.24 | 15.24 |
| **E** | 5.7 | 6.0 |
| **F** | 4.0 | 4.0 |
| **G** | 0.51 | 0.51 |
| **H** | 38.2 | 38.2 |

*High-Profile*

|   | MD2203 Millimeters (max.) |
|---|---|
| **A** | 45.6 |
| **B** | 18.8 |
| **C** | 2.54 |
| **D** | 15.24 |
| **E** | 13.5 |
| **F** | 4.0 |
| **G** | 0.51 |
| **H** | 38.2 |

**Note**: The above dimensions are maximum values.

# 9 Shock and Vibration

| Reliability Test | Test Conditions | Reference Standard |
|---|---|---|
| Vibration | 100Hz~2000Hz, 15G peak, 3 cycles per axis (1hr.), 3 axes | STD-202F, Method 204D |
| Mechanical Shock | Half sine shock 50G, 11msec, +/-3 shock per axis, 3 axes | STD-202F, Method 213B |

# 10 Ordering Information

**MD2200-DCC-V-T** (Low-Profile)

| | | | |
|---|---|---|---|
| CC: | Capacity (MB) | 24 | |
| V: | Supply Voltage | Blank<br>V3 | 5V<br>3.3V |
| T: | Temperature Range (optional) | Blank<br>X | Commercial: 0 °C to +70 °C<br>Extended: -40 °C to +85 °C |

**MD2202-DCCC-V-T** (Low-Profile)

| | | | |
|---|---|---|---|
| CC: | Capacity (MB) | 16, 32, 48, 64, 96, 192* | |
| V: | Supply Voltage | Blank<br>V3 | 5V<br>3.3V |
| T: | Temperature Range (optional) | Blank<br>X | Commercial: 0 °C to +70 °C<br>Extended: -40 °C to +85 °C |

**MD2203-DCCC-V-T** (High-Profile)

| | | | |
|---|---|---|---|
| CCC: | Capacity (MB) | 80, 112, 144, 160, 192, 224, 256, 288, 576* | |
| V: | Supply Voltage | Blank<br>V3 | 5V<br>3.3V |
| T: | Temperature Range (optional) | Blank<br>X | Commercial: 0 °C to +70 °C<br>Extended: -40 °C to +85 °C |

* DiskOnChip 2000 DIP 192MB and 576MB capacities are available only for commercial temperature ranges.

# 11 Additional Information

| Document/Tool | Description |
|---|---|
| DiskOnChip Utilities | DiskOnChip Utilities User Manual |
| DiskOnChip Quick Installation Guide | DiskOnChip Quick Installation Guide |
| AP-DOC-010 | Application Note: Designing with DiskOnChip DIP |
| AP-DOC-016 | Application Note: Using DiskOnChip with QNX |
| AP-DOC-020 | Application Note: DiskOnChip Boot Developers Kit |
| AP-DOC-030 | Application Note: Designing DiskOnChip Millennium in RISC Environment |
| AP-DOC-031 | Application Note: Designing with DiskOnChip Millennium in a PC Environment |
| AP-DOC-039 | Application Note: Onboard Programming of the DiskOnChip Millennium |
| AP-DOC-047 | Application Note: Designing DiskOnChip as a Flash Disk & Boot Device Replacement |
| IM-DOC-017 | Installation Manual: Using DiskOnChip with Windows CE |
| IM-DOC-021 | Installation Manual: Using DiskOnChip with Linux O/S |
| IM-DOC-022 | Installation Manual: Using DiskOnChip with VxWorks |
| DiskOnChip TrueFFS SDK Product Brief | DiskOnChip TrueFFS SDK Product Brief |
| DiskOnChip DIP EVB | DiskOnChip DIP Evaluation Board |
| DiskOnChip GANG Programmer | DiskOnChip 1+8 DIP GANG Programmer |

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