

DOM-2000 Series / FFD-2000 Series

User' s Technical Manual

0. About this manual

This manual provides information of *DiskOnModule* and *FastFlashDisk*, include the form factors, specs and installation procedures. The following information is subject to change without notice.

1. Introduction

Why you should use DOM2000?

DOM-2000 (Disk On Module) and FFD-2000 (Fast Flash Disk) series are advanced storage devices using flash memory technology. The interface of DOM and FFD products are standard IDE interface which can be used under any operation system without any special software drivers. Compare with hard disk, DOM and FFD are physically smaller, lesser heat, longer life-time, no noise, resilient to shock or vibration, therefore they are excellent storage device for embedded system, with is applied in harsh environment. The following items show the benefit of DOM-2000.

High Reliable Data Storage

The technique in DOM 2000-and FFD-2000 is based on flash memory, which is electronically erasable and re-writeable. The rewriteability of NAND type flash memory is more than 1,000,000 times. The ECC capability, defect block management and wear leveling algorithm guarantees the high reliability.

Design for Harsh Environment

DOM-2000 and FFD-2000 have good anti-vibration and anti-shock ability. The pure electronics devices inside the flash drivers are specially designed for the harsh environment. Contrast, hard disks drives are easily to be damaged under the same operation.

Good Substitute for HDD

DOM-2000 and FFD-2000 utilize low power consumption technology, and no cooling fans are expected. On the other hand, the traditional hard disks always cause a lot of heat. That' s why shortening lifetime and disaster are always accompanying with it.

Plug and Play on IDE

DOM-2000 and FFD-2000 can be plug-and-play in any standard PC platform because they utilize standard IDE interface. Since ISA bus will be phased out in Year 2000, there is no more ROM interface can place the DOC socket. Therefore, the IDE interface is the only and best choice for using flash storage devices for long product life cycle.

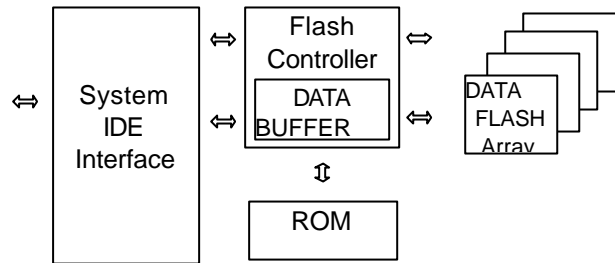
Full Range of O.S. Support

Using the IDE, DOM-2000 and FFD-2000 require no special software drivers. Any modern operating system will support this de facto standard. The DOM-2000 and FFD-2000 have been tested under Windows-95/98/NT, Windows 2000, WinCE, Embedded NT, QNX and Linux.

2. Inside DOM

Technology Inside DOM/FFD

The following block diagram shows the internal architecture of the DOM/FFD. The flash memory devices used are NAND type flash which is superior performance than the NOR type flash. The flash controller used is based on DSP technology, which provide high reliability flash control algorithm.



Defect Management

In order to gain the best management for flash memory, we developed a superior firmware based on an efficient and swift algorithm. Because the life of flash memory has been limited, we must take special care when program the flash memory and it will increase the life of our flash products by an appropriate arrangement. In flash memory, some reserved blocks will be set up and people couldn't utilize these reserved blocks to program. Once a failed block occurs, one of the reserved blocks will replace it, and data will be transformed to the new block to keep its accuracy. So the total capacity will be smaller than the one that he should be formatted. However, the life-time will be longer than the others flash devices such as flash memory card. It is trade-off between device life and capacity. When all of the reserved blocks have replaced the bad blocks, the device will be locked automatically to prevent programming, but the data can still be read out for backup.

Wear Leveling Algorithm

Because of the flash memory has a limited life, our controller does not to program data into the same physical place of the flash memory when the host writes data in the same LBA address. An embedded wear-leveling algorithm will try to write the data into every block in the DOM/FFD and read the data smartly and precisely when the host send read command.

ECC Capability

ECC (Error Correction Code) feature also be built in our hardware and firmware, it will correct 1 word (2 Bytes) errors, and detect 2 words errors when they happened. ECC ensured the data integrity and decreased the effect of the cross talking on the bus. If turn power off accidentally when programming, only the latest data (512 Bytes) will be lost, and cleared the data while power on in the next time. And for shrinking the time of the

process, we make an **Entry Table**. It recorded some data used for mapping logic blocks to physical blocks. Use the Entry Table, our firmware will work more efficiently.

3. Applications

DOM and FFD have widely be used in different field, such as mobile computer, vehicle or transportation system, military applications or industrial control system. Because of the excellent reliability, open architecture, and high access performance, the DOM and FFD will be the most suitable storage device for mission critical applications. The followings are application examples:

- Industrial Control Systems
- Data Acquisition Systems
- Embedded Systems
- Telecommunication System
- Router, Gateway, ISP Terminal, Kiosk
- Set-top-box
- POS (Point-of-Sale)
- Ticket Vending Machines
- Voting Machines
- GPS
- Security Systems
- Transportation Vehicle
- Mobile Computers, Hand-held PC
- Military Systems
- Avionics
- ATM
- Network Computer

4. Versatile Form Factors

Standard Form Factors

The variety of DOM and FFD form factor are available for different applications. The FFD is in standard 2.5" form factor with 44-pin IDE interface. The IDE interface is with power pin inside (Refer to section 7.), therefore a 44-pin to 40-pin cable is shipped with the products. The DOM also have two versions: 44 pin or 40 pin. The 44-pin versions are with power pin inside, therefore, they do not need any extra power cable. However, the 40-pin DOM needs an extra 4-pin power cable to get 5V power. It is also possible that use the IDE interface' s pin #20 to provide 5V power (Refer to section 6), however, due to the #20 pin standard IDE interface is without power, please check your computers' design if the extra power cable is necessary or not.

ODM Form Factors

We provide ODM service for any customized form factor. Based on the standard IDE interface, we can change the DOM form factor according to the special requirement or limitation of the applications.

5. What you have & Ordering Information

Please check what you have when you unpack the product box. If there is any cable missing, please contact us. Please note that the 44-pin version of DOM is without cable,

- DOM-cc-40V: 40-pin IDE interface, vertical mounting to IDE
(With 4-pin power cable or the cable has been connected on the module)
- DOM-cc-40H: 40-pin IDE interface, horizontal mounting to IDE
(With 4-pin power cable or the cable has been connected on the module)
- DOM-dd-44V: 44-pin IDE interface, vertical mounting to IDE
- DOM-dd-44H: 44-pin IDE interface, horizontal mounting to IDE
- FFD-XXX: 2.5" form factor 44-pin IDE interface

Whenever the above form factor can not meet your special applications, you are welcome to contact us for customized form factor design.

(Note 1: cc=4, 8, 16, 32, 48, 64, 80, 96, 128, 160, 192, 256 MB versions are available.)

(Note 2: dd=4,8,16,32 MB versions are available.)

(Note 3: XXX=64,128,160,256,320,512,640 MB, 1G, 2G versions are available)

(Note 4: V: vertical module, H: horizontal module)

6. Features

- ❖ Design for standard 40 or 44 pin IDE connector
- ❖ Fully compatible with IDE hard disks
- ❖ Simple, easy to install without embedded software
- ❖ Support varieties of O.S., economic solution for small O.S. applications
- ❖ Fastest data access time (<0.1ms)
- ❖ Good anti-vibration ability
- ❖ High reliability because of the ECC capability, defect block management, wear leveling algorithm
- ❖ Applicable for limited space and power consumption

7. Specifications

- ❖ Storage Capacity: 4MB to 1GB
- ❖ Flash Memory Type: NAND type flash memory, sector size: 512 bytes
- ❖ Electrical Interface: 40-pin or 44-pin IDE
- ❖ Dimension:
 - ◆ 40-pin DOM: 28.0 x 55.4 x 8.2 mm for 4.8, 16, 32 MB
 - ◆ 40-pin DOM: 35.0 x 55.4 x 8.2 mm for 48~ 256 MB
 - ◆ 44-pin DOM: 32.0 x 45.0 x 6.3 mm for 4.8, 16, 32 MB
 - ◆ FFD: 102.3 x 70.0 x 11.2 mm (Standard 2.5" HDD form factor), Weight 100g
- ❖ Performance:
 - ◆ Media Transfer Rate (Write): 1.3MB/sec (typical)
 - ◆ Media Transfer Rate (Read): 2.2MB/sec (typical)
 - ◆ To / from Host Burst Data Transfer Rate: PIO Mode 4 --16.67 MB/sec (max)
 - ◆ Average Data Transfer Rate: 1.6MB/sec (typ.)
 - ◆ Average Seek Time < 0.1 ms
 - ◆ Random Read Time: 0.2ms (typ.)
 - ◆ Random Write Time: 20ms (typ.) 6ms (min)
 - ◆ Sequential Read Time: 0.18ms (typ.)
 - ◆ Sequential Write Time: 0.25ms (typ.)
- ❖ Reliability:
 - ◆ MTBF: 1,000,000 rewrite @ 25°C
 - ◆ Error Rate 10^{-20} (ECC: 32bits /sector)
- ❖ Power Requirement: +5V +/-10%
- ❖ Power Consumption (for 32MB version)
 - ◆ Read Mode: 18mA (typical)
 - ◆ Write Mode: 90mA (typical)
 - ◆ Idle Mode: 8mA (typical)
- ❖ Operating Environment
 - ◆ Shock: 150 G (2.2ms with half-sine) for operating and non-operating
 - ◆ Vibration: 15 G p-p max for operating or non-operating
 - ◆ Relative Humidity: 5% ~95% (without condensation)
 - ◆ Operating Temperature: 0 ~70°C
 - ◆ Storage Temperature: -20 ~100°C
 - ◆ Extended operating temperature: -20°C ~80°C, for special extended version

8. Installation and Configuration

Due to the DOM and FFD are with IDE interface. Please use the standard HDD installation procedure to install the DOM or FFD.

Step 0: Before Installing

To protect DOM/FFD from static discharge by making sure you are well grounded before touching the DOM/FFD. We recommend wearing a grounded wrist strap throughout the installation process

Step 1: Install the DOM or FFD to IDE interface and apply power.

1. Make sure your computer is turned off before you open the case.
 2. Plug the DOM carefully into the IDE slot on your computer or host adapter.
 - Install FFD: Connect the 44pin IDE to any 40-pin IDE device by extra cable, and the 4-pin cable to power supply.
 - Install DOM-cc-40V/H: Please directly plug the module into 40-pin IDE socket, and connect the 4-pin cable to power supply.
 - Install DOM-cc-44V/H: Please directly plug the module into 44-pin IDE socket.
- Caution: Make sure to align pin1 on the computer or host adapter interface connector with pin 1 on your DOM/FFD. Pin 1 is indicated by a triangle on the DOM connector.**
3. Connect the power cable of the DOM to an unused power connector of the computer.
Caution: If you need to remove your DOM, use BOTH HANDS to carefully pull out it.
 4. Check all cable connections and then replace your computer cover.

Step 2: Configuration BIOS:

Before you format or partition your new drive, you must configure your computer's BIOS so that the computer can recognize your new drive.

- 1 Turn your computer on. As your computer start up, watch the screen for a message describing how to run the system setup program (sometimes called BIOS or CMOS setup). This is usually done by pressing a special key, such as DELETE, ESC, or F1. Press the appropriate key to run the system setup program.
2. If your BIOS provides automatic drive detection (an "AUTO" drive type), select this option. This allows your computer to configure itself automatically for your new drive.
3. If your BIOS dose not provide automatic drive detection, select "User-defined" drive setting and enter the CHS values according to the table in the Appendix. We recommend that use Normal/CHS mode to get the maximum formatted capacity.

(Note: For certain BIOS, for example Award Version6.0, the BIOS can not recognize the IDE device which capacity less than 256 MB, you have to use manual setting to set the IDE mode as CSH mode.)

4. Save the settings and exit the System Setup to re-boot.

Step 3: Format DOM/FFD under pure DOS.

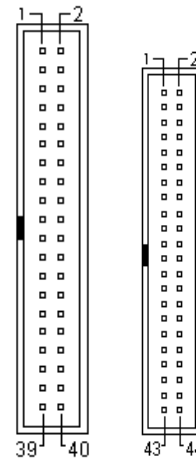
1. To partition your new DOM with Microsoft[®] DOS program :
 - If floppy is at "A:", and no hard disk, then use floppy with DOS to boot.

- If floppy is at "A:", and one hard disk at "C:", then the hard disk must with DOS, otherwise please use floppy with DOS to boot. (Note: Please do not use the DOS under Windows 98 or Windows 95.)
- Insert a bootable DOS diskette into your diskette drive and restart computer.
- Insert a DOS program diskette that contains the FDISK.EXE and FORMAT.COM utilities. Use the same DOS version that is on your bootable diskette.
- Under A: prompt, type FDISK and press ENTER.
- If you have two IDE devices installed, the FDISK menu displays five options. Option five allows you to select the drive you want to partition. Make sure that your new drive is selected.
- Select "Create DOS partition or logical DOS drive" by pressing 1. Then press ENTER
- Select "Create primary DOS partition" by pressing 1 again. Then press ENTER. Create your first drive partition. If you are creating a partition that will be used to boot your computer (drive C), make sure that the partition is marked active.
- Create an extended partition and additional logical drives as necessary, until all the space on your new hard drive has been partitioned.
- When the partitioning is complete, FDISK reboots your computer. **Caution: Make sure to use the correct drive letters so that you do not format a drive that already contains data.**
- At the A: prompt, type FORMAT C:/S, where C is the letter of your first new partition, Repeat the format process for all the new partitions you have created.
- After format DOM/FFD, reboot the system and the device is ready to use.

9. Trouble Shooting

If there is any problem when installing the DOM or FFD, please contact us, or your dealer to get help.

10. IDE Connector Pin Assignments (44-pin)



(Pin #41-44 for 44-pin only)
(+5V of Pin#20 for 40-pin DOM devices only)

Signal Name	Pin #	Pin #	Signal Name
Reset IDE	1	2	Ground
Host data 7	3	4	Host data 8
Host data 6	5	6	Host data 9
Host data 5	7	8	Host data 10
Host data 4	9	10	Host data 11
Host data 3	11	12	Host data 12
Host data 2	13	14	Host data 13
Host data 1	15	16	Host data 14
Host data 0	17	18	Host data 15
Ground	19	20	(+5V*) Key
DRQ0	21	22	Ground
Host IOW	23	24	Ground
Host IOR	25	26	Ground
IOCHRDY	27	28	Host ALE
DACK0	29	30	Ground
IRQ14	31	32	Reserved
Address 1	33	34	PDIAG-
Address 0	35	36	Address 2
Chip select 0	37	38	Chip select 1
Activity	39	40	Ground
+5V	41	42	+5V
Ground	43	44	No connect

Note: E1-E4 are for 2.5" FFD only. E1 and E2 are for installing master / slave. It is default Master and installed with jumper

Signal Descriptions

CHIP SELECT 0

This is the chip select signal from the host used to select the Command Block registers.

CHIP SELECT 1

This is the chip select signal from the host used to select the Control Block registers.

Address 2, Address 1, Address 0 (DEVICE ADDRESS)

This is the 3-bit binary coded address asserted by the host to access a register or data port in the device.

DASP – (Device active, device 1 present)

This is a time-multiplexed signal which indicates that a device is active, or that Device 1 is present. This signal shall be an open collector output and each device shall have a 10k pull-up resistor. If the host connects to the DASP- signal for the illumination of an LED or for any other purpose, the host shall ensure that the signal

level seen on the ATA interface for DASP- shall maintain VOH and VOL compatibility, given the IOH and IOL requirements of the DASP- device drivers.

DD (15:0) (Device data)

This is an 8- or 16-bit bi-directional data interface between the host and the device. The lower 8 bits are used for 8-bit register transfers.

DIOR- (Device I/O read)

This is the read strobe signal from the host. The falling edge of DIOR- enables data from the device onto the signals, DD (7:0) or DD (15:0). The rising edge of DIOR- latches data at the host and the host shall not act on the data until it is latched.

DIOW- (Device I/O write)

This is the Write strobe signal from the host. This rising edge of DIOW- latches data from the signals, DD (7:0) or DD (15:0), into the device. The device shall not act on the data until it is latched.

DMACK- (DMA acknowledge)

This signal shall be used by the host in response to DMARQ to initiate DMA transfers.

DMARQ (DMA request)

This signal, used for DMA data transfer between host and device, shall be asserted by the device when it is ready to transfer data to or from the host. The direction of data transfer is controlled by DIOR- and DIOW-. 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 re-asserting DMARQ if there is more data to transfer. This line shall be released (high impedance state) whenever the device is not selected or is selected and no DMA command is in progress. When enabled by DMA transfer, it shall be driven high and low by the device. When a DMA operation is enabled, CS0- and CS1- shall not be asserted and transfers shall be 16-bits wide.

INTRQ (Device interrupt)

This signal is used to interrupt the host system. INTRQ is asserted only when the device has a pending interrupt, the device is selected, and the host has cleared the nIEN bit in the Device Control register. If the nIEN bit is equal to one, or the device is not selected, this output is in a high impedance state, regardless of the presence or absence of pending interrupt.

The pending interrupt condition shall be set by:

- the completion of a command; or
- at the beginning of each data block to be transferred for PIO transfers except for the first data block for FORMAT TRACK, WRITE SECTOR(S), WRITE BUFFER, and WRITE LONG commands.

The pending interrupt condition shall be cleared by:

- assertion of RESET-; or
- the setting of the SRST bit of the Device Control register; or
- the host writing the Command register; or
- The host reading the Status register.

IOCS 16- (Device 16-bit I/O)

Obsolete.

IORDY (I/O channel ready)

This signal is negated to extend the host transfer cycle of any host register access (Read or Write) when the device is not ready to respond to a data transfer request. If actively asserted, the signal only be enabled during DIOR-/DIOW- cycles to the selected device. If open collector, when IORDY is not negated, it shall be in the high-impedance (undriven) state.

This use of IORDY is required for PIO modes 3 and above and otherwise optional. PDIAG - (Passed diagnostics)

This signal shall be asserted by Device 1 to indicate to Device 0 that it has completed diagnostics. A 10 k pull-up resistor shall be used on this signal by each device.

The host shall not connect to the PDIAG-signal.

RESET- (Device reset)

This signal from the host system shall be asserted beginning with the application of power and held asserted until at least 25 μ s after voltage levels have stabilized within tolerance during power on

and negated thereafter unless some event requires that the device(s) be reset following power on.

ATA devices shall not recognize a signal assertion shorter than 20 ns valid reset signal. Devices may respond to any signal assertion greater than 20 ns, and shall recognize a signal equal to or greater than 25 μ s.

CSEL (Cable select)

The device is configured as either Device 0 or Device 1 depending upon the value of CSEL.

Interface Register Definitions And Descriptions

Device addressing considerations

In traditional controller operation, only the selected device receives commands from the host following selection. In this standard, the register contents go to both devices (and their embedded controllers.) The host discriminates between the two by using the DEV bit in the Device/Head register.

Data is transferred in parallel either to or from host memory to the device's buffer under the direction of commands previously transferred from the host. The device performs all of the operations necessary to properly write data to, or read data from, the media. Data read from the media is stored in the device's buffer pending transfer to the host memory and data is transferred from the host memory to the device's buffer to be written to the media.

The devices using this interface shall be programmed by the host computer to perform commands and return status to the host at command completion. When two devices are daisy-chained on the interface, commands are written in parallel to both devices, and for all except the EXECUTE DEVICE DIAGNOSTICS command, only the selected

device executes the command. On an EXECUTE DEVICE DIAGNOSTICS command addressed to Device 0, both devices shall execute the command, and Device 1 shall post its status to Device 0 via PDIAG-.

Devices are selected by the DEV bit in the Device/Head register. When the DEV bit is equal to zero, Device 0 is selected. When the DEV bit is equal to one, Device 1 is selected. When devices are daisy chained, one shall be set as Device 0 and the other as Device 1.

I/O register descriptions

Communication to or from the device is through an I/O Register that routes the input or output data to or from registers addressed by the signals from the host (CS0-, CS1-, DA (2:0), DIOR-, AND DIOW-).

The Command Block Registers are used for sending commands to the device or posting status from the device. The Control Block Registers are used for device control and to post alternate status.

Anytime a command is in progress, that is, from the time the Command register is written until the device has completed the command and posted ending status, the device shall have either BSY or DRQ set to one. If the Command Block registers are read by the host when BSY or DRQ is set to one, the content of all register bits and fields except BSY and DRQ in the Status and Alternate Status registers is indeterminate. If the host writes to any Command Block register when BSY or DRQ is set to one, the results are indeterminate and may result in the command in progress ending with a command abort error.

When performing PIO transfers, BSY and DRQ shall both be cleared to zero within 400 ns of the transfer of the final byte of data. This assertion signals the completion of a PIO data transfer command.

Table 3 lists these registers and the addresses that select them.

Table 3 - I/O port functions and selection address

Addresses					Functions	
CS0-	CS1-	DA2	DA1	DA0	Read (DIOR-)	Write (DIOW-)
N	N	x	x	x	Data bus high impedance	Note used
					Control block registers	
N	A	0	x	x	Data bus high impedance	Note used
N	A	1	0	x	Data bus high impedance	Note used
N	A	1	1	0	Alternate Status	Device Control
N	A	1	1	1	(see note1)	Not used
					Command block registers	
A	N	0	0	0	Data	Data
A	N	0	0	1	Error	Features
A	N	0	1	0	Sector Count	Sector Count
A	N	0	1	1	Sector Number LBA (7:0) (see note 2)	Sector Number LBA (7:0) (see note 2)
A	N	1	0	0	Cylinder Low LBA (15:8) (see note 2)	Cylinder Low LBA (15:8) (see note 2)
A	N	1	0	1	Cylinder High LBA (23:16) (see note 2)	Cylinder High LBA (23:16) (see note 2)
A	N	1	1	0	Device/Head LBA (27:24) (see note 2)	Device/Head LBA (27:24) (see note 2)
A	N	1	1	1	Status	Command
A	A	x	x	x	Invalid address	Invalid address
Key: A = signal asserted, N = signal negated, x = don't care NOTES_ 1 This register is obsolete. It is recommended that a device not respond to a read of this address. If a device does respond, it shall not drive the DD7 signal to prevent possible conflict with floppy disk implementations. 2 Mapping of registers in LBA translation.						

Each register description in the following clauses contain the following format:

ADDRESS – the CS and DA address of the register.

DIRECTION – indicates if the register is read/write, read only, or write only from the host.

ACCESS RESTRICTIONS – indicates when the register may be accessed.

EFFECT – indicates the effect of accessing the register.

FUNCTIONAL DESCRIPTION – describes the function of the register.

FIELD/BIT DESCRIPTION – describes the content of the register.

PIO Data Transfers

Figure 1 defines the relationships between the interface signals for PIO data transfers. Peripherals reporting support for PIO Transfer Mode 3 or 4 shall power up in a PIO Transfer Mode 0, 1, or 2.

For PIO modes 3 and above, the minimum value of t0 is specified by word 68 in the IDENTIFY DEVICE parameter list.

IORDY shall be supported when PIO Mode 3 or 4 are the current mode of operation.

Appendix A: Table of Capacity

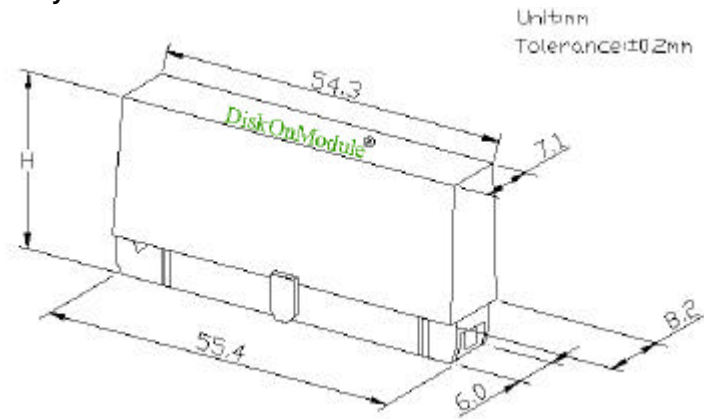
Some of the BIOS do not support the auto-detection of IDE storage devices, you have to use the user mode to type in the information about the DOM or FFD. The following shows the relation between the unformatted capacity and the CSH (cylinder, sector, head) numbers.

DOM / FFD Capacity (MB)	Unformatted Capacity (Bytes)	No. of Cylinders	No. of Sectors /Track	No. of Heads	Operation Mode	Reserved blocks ¹ (%)	Media transfer mode ²
4M	4014080	245	16	2	Byte	R=4	Normal
8M	8028160	245	32	2	Word	R=4	Normal
16M	16056320	490	32	2	Word	R=4	Normal
32M	32112640	980	32	2	Word	R=4	Normal
64M	64225280	980	32	4	Word	R=4	Normal
128M	128450560	980	32	8	Word	R=4	Normal
192M	192413696	734	32	16	Word	R=4	Normal
256M	256638976	979	32	16	Word	R=4	Normal
320M	319979520	310	63	32	Word	R=4	LBA
384M ³	385007616	373	63	32	Word	R=4	LBA
448M ³	449003520	435	63	32	Word	R=4	LBA
512M	512999424	497	63	32	Word	R=4	LBA
576M ³	576995328	559	63	32	Word	R=4	LBA
640M	640991232	621	63	32	Word	R=4	LBA
704M ³	704987136	683	63	32	Word	R=4	LBA
768M ³	770015232	746	63	32	Word	R=4	LBA
832M ³	834011136	808	63	32	Word	R=4	LBA
896M ³	898007040	870	63	32	Word	R=4	LBA
960M ³	962002944	932	63	32	Word	R=4	LBA
1024M	1025998848	994	63	32	Word	R=4	LBA

- (1) The reserved blocks are for spare storage of the defect blocks.
- (2) The LBA mode is not recommend for the capacity less than 256MB storage devices, because it waste more storage space for linear mapping the blocks.
- (3) These models are for quantity order (>50 pcs) only.

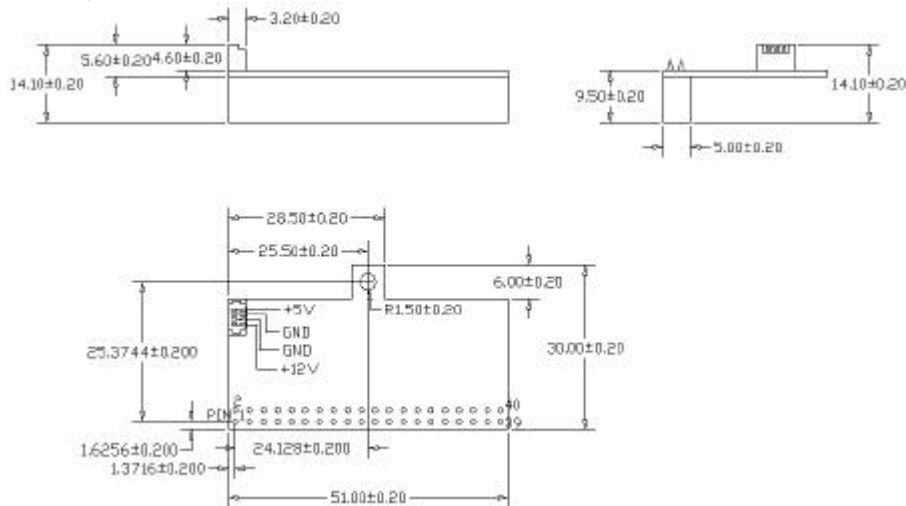
Appendix B Physical Dimension

B-1. Physical Dimension of DOM-XX-40V

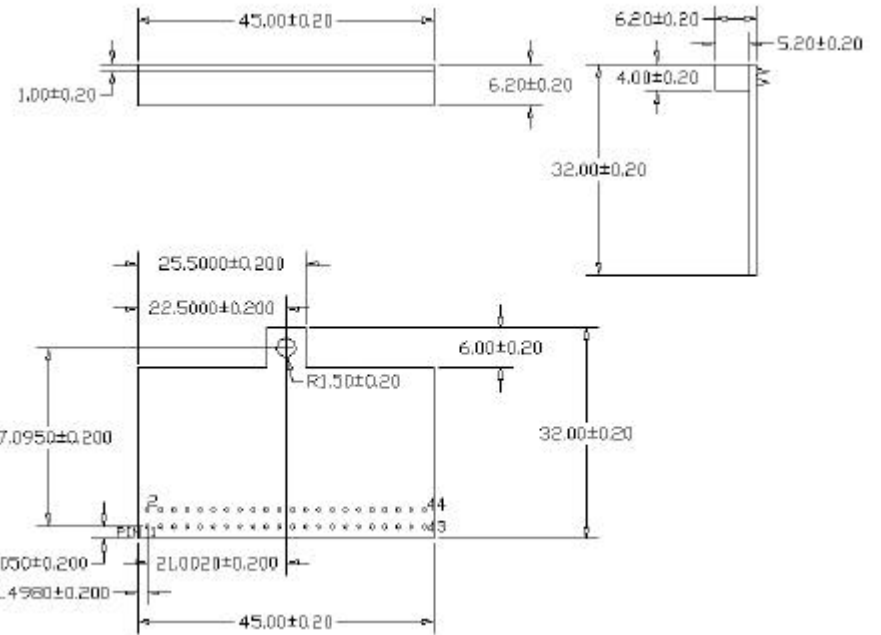


H=28.0 mm for 4MB version (DOM-4-40V) to 32MB version (DOM-32-40V)
 H=35.0 mm for 48MB version (DOM-48-40V) to 256MB version (DOM-256-40V)

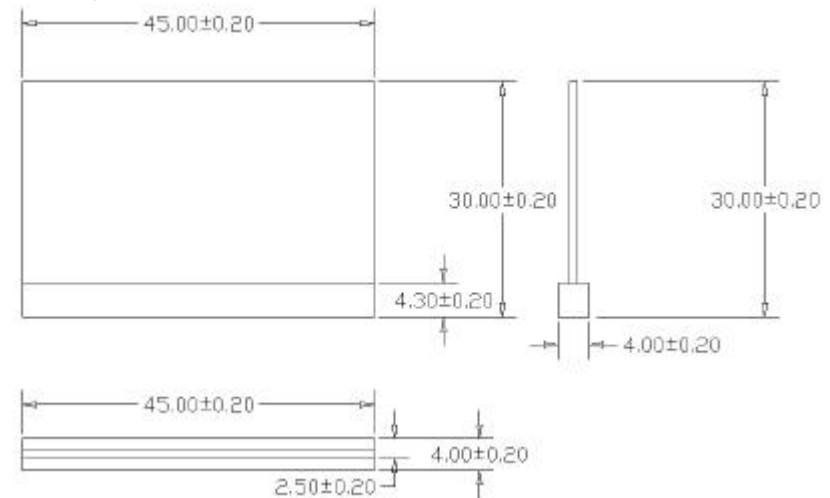
B-2. Physical Dimension of DOM-XX-40H



B-3. Physical Dimension of DOM-XX-44H



B-4. Physical Dimension of DOM-XX-44V



B-5. Physical Dimension of FFD-XXX

