



**Most I & T CO., Ltd.**

**2.5" Flash Disk Module**

**Product Specification**



## TABLE OF CONTENTS

1.	Scope.....	4
2.	Introduction.....	4
3.	System Features.....	4
4.	Product Specifications.....	5
4.1.	<i>System Environmental Specification</i> .....	5
4.2.	<i>System Power Requirement</i> .....	5
4.3.	<i>System Performance</i> .....	5
4.4.	<i>System Reliability</i> .....	6
4.5.	<i>Physical Specifications</i> .....	6
4.5.1.	<i>Physical Specifications</i> .....	6
4.5.2.	<i>Dimension - Unit: mm</i> .....	7
4.6.	<i>Flash Disk Module Capacity Specification</i> .....	8
4.6.1.	<i>The Card Configurations</i> .....	8
4.6.2.	<i>The specific capacity for the various models and the default number of cylinders, heads and sectors/track.</i> .....	9
5.	Interface Description.....	10
5.1.	<i>Pin Assignments</i> .....	10
5.2.	<i>Pin Descriptions</i> .....	11
6.	Electrical Specification.....	12
6.1.	<i>Power Pin Description</i> .....	12
6.2.	<i>Absolute Maximum Rating</i> .....	12
6.3.	<i>Recommended Operating Conditions</i> .....	12
6.4.	<i>DC Characteristics</i> .....	12
6.5.	<i>DC Characteristics</i> .....	13
6.6.	<i>AC Characteristics</i> .....	14
6.6.1.	<i>True IDE Mode Access Read AC Characteristics</i> .....	14
6.6.2.	<i>True IDE Mode Access Write AC Characteristics</i> .....	14
6.7.	<i>Power Management</i> .....	15
7.	Installation Guide.....	16
7.1.	<i>Procedure</i> .....	16
7.1.1.	<i>ESD Precautions</i> .....	16
7.1.2.	<i>Configuration</i> .....	16
7.1.3.	<i>Connector</i> .....	16
7.1.4.	<i>Mounting</i> .....	17
7.1.5.	<i>Computer Setup</i> .....	18
7.1.6.	<i>Partition</i> .....	18

7.1.7. <i>Format</i> .....	18
7.1.8. <i>Jumpers</i> .....	19
7.1.9. <i>Master/Slave</i> .....	19
7.1.10. <i>Factory Default – Master</i> .....	19
7.2. <i>IDE Interface</i> .....	20
8. <i>Maintenance</i> .....	20
APPENDIX .....	21
A. <i>Order Information</i> .....	21
1. <i>Part Number</i> .....	21
2. <i>Part Number Decoder</i> .....	21

## 1. Scope

This document describes the features and specifications and installation guide of AFAYA's 2.5" IDE Flash Drive products.

## 2. Introduction

The AFAYA's 2.5" Flash Disk Module Drive combines 3S advanced Flash controller technology and NAND Type SLC flash memory. The AFAYA's 2.5" Flash Disk Module Drives come with commercial operating temperature grade (0°C ~+70°C) and industrial operating temperature grade (-40°C ~+85°C) to fulfill various specialized applications in normal or harsh operating environments. With the great advantages of non-volatile and solid state, the 2.5" Flash Disk Module Drives are ideal replacements of conventional hard disk drives. The industry standard ATA interface simplifies the integration of flash disk into almost any computing platform. No system modifications are required to place an IDE hard disk drive in an existing application, making it easy to upgrade computing platform reliability to all solid state performance. AFAYA's 2.5" Flash Disk Module Drives are ideal solutions for critical applications which request for long term supply with consistent key components.

## 3. System Features

- ATA/True IDE Mode compatible
- Very low power consumption
- Very high performance
- Rugged environment is working well
- Automatic error correction and retry capabilities
- Supports power down commands and Auto Stand-by / Sleep Mode
- +5 V  $\pm 10\%$  or +3.3 V  $\pm 5\%$  operation
- Low weight
- Noiseless
- Standard IDE compatible
- Master/Slave Selectable
- MTBF > 1,000,000 hours
- Minimum 10,000 insertions
- Support O/S: Windows 31/95/98/Me, Windows NT/2000/XP/2003, WinCE, QNX, Linux, DOS and more
- Capacity: 16MB, 32MB, 64MB, 128MB, 256MB, 512 MB, 1GB, 2GB, 4GB.(unformatted)

## 4. Product Specifications

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

### 4.1. System Environmental Specification

		Standard Temperature Products	Wide Temperature Products
2.5" Flash Disk Module Referral Part Number		FDK-25SHXXXMB	FDK-25SHXXXMB-I
Temperature	Operating: Non-operating:	0°C ~ +70°C -20°C ~ +85°C	-40°C ~ +85°C -50°C ~ +95°C
Humidity	Operating & Non-operating:	5% ~ 95% non-condensing	
Vibration	Operating & Non-operating:	15G peak-to-peak maximum	
Shock	Operating & Non-operating:	1000 G maximum	
Altitude	Operating & Non-operating:	80,000 feet maximum	

### 4.2. System Power Requirement

		Standard Temperature Products		Wide Temperature Products	
2.5" Flash Disk Module Referral Part Number		FDK-25SHXXXMB		FDK-25SHXXXMB-I	
DC Input Voltage (VCC) 100mV max. ripple (p-p)		3.3V±5%	5V±10%	3.3V±5%	5V±10%
+5V Current (Maximum average value)	Sleeping Mode:	< 200µA	< 500µA	< 200µA	< 500µA
	Reading Mode:	< 25mA	< 50mA	< 200µA	< 500µA
	Writing Mode:	< 30mA	< 60mA	< 25mA	< 50mA

**Note:**

- (1). All values quoted are typical at 25°C and nominal supply voltage.
- (2). Sleeping mode currently is specified under the condition that all card inputs are static CMOS levels and in a "Not Busy" operating state.

### 4.3. System Performance

Data Transfer Rate To/From Flash		20Mbytes /sec burst
Data Transfer Rate To/From Host		16.6Mbytes /sec burst
Maximum Performance	Sequential Read	8Mbytes / sec Max.
	Sequential Write	6Mbytes / sec Max.

#### 4.4. System Reliability

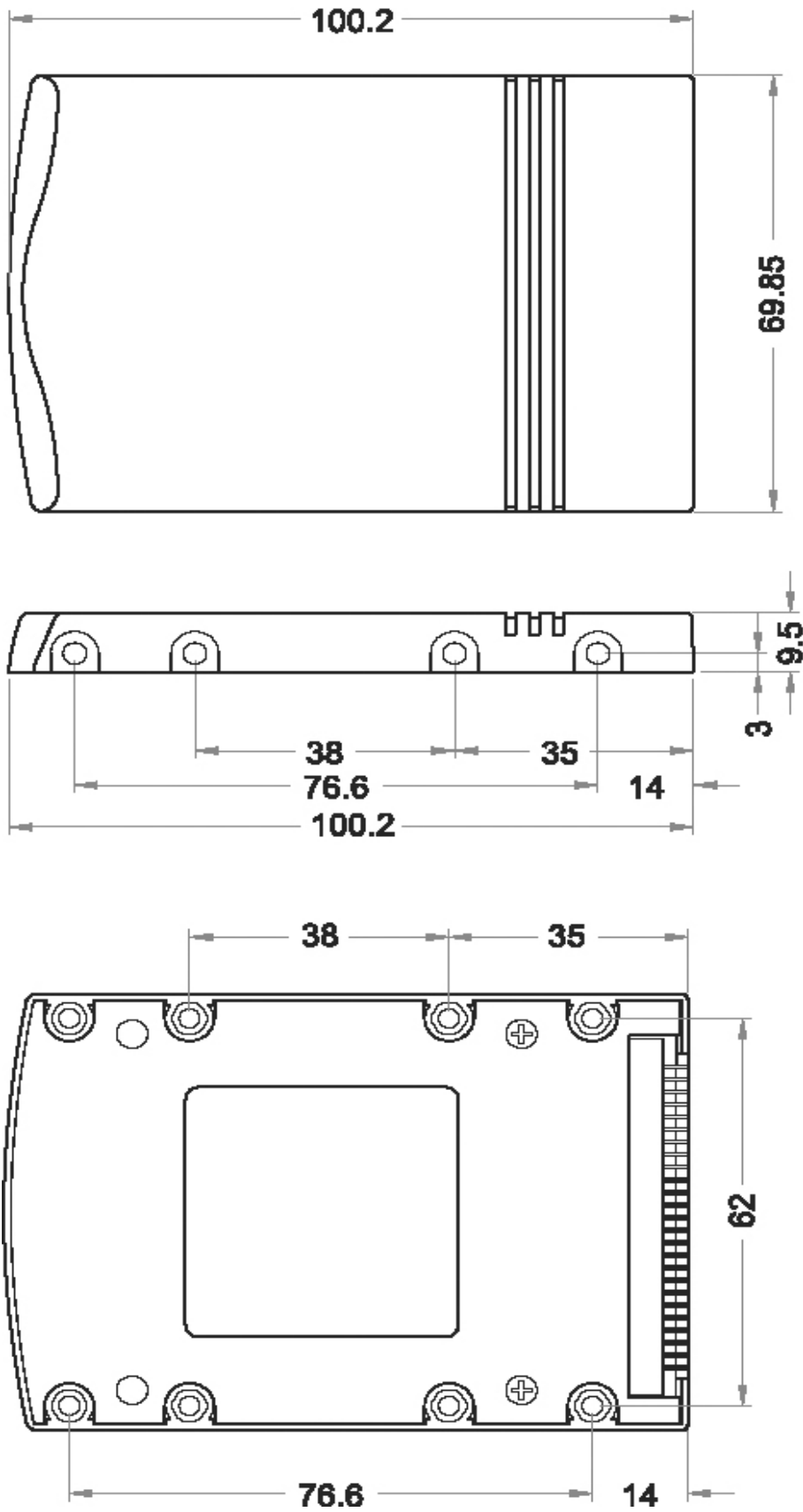
MTBF	> 1,000,000 hours
Data Reliability	< 1 non-recoverable error in $10^{14}$ bits read < 1 erroneous correction in $10^{20}$ bits read
Wear-leveling Algorithms	Supportive
ECC Technology	4 bits Error Correction Code
Endurance	Greater than 1,000,000 cycles Logically contributed by Wear-leveling and advanced bad sector management
Data Retention	10 years

#### 4.5. Physical Specifications

##### 4.5.1. Physical Specifications

<b>2.5" Flash Disk Module</b>	
Length:	100.4 mm $\pm$ 0.5 mm
Width:	70.9 mm $\pm$ 0.5 mm
Thickness:	9.5 mm $\pm$ 0.5 mm
Weight:	150 g maximum

4.5.2. Dimension - Unit: mm



#### 4.6. Flash Disk Module Capacity Specification

##### 4.6.1. The Card Configurations

Disk Capacity	Samsung SLC Flash Memory Part Number * Q'TY	
16MB	Commercial Grade:	K9F2808UOA-YCB0 (128Mb) or equipollent * 1
	Industrial Grade:	K9F2808UOA-YIB0 (128Mb) or equipollent * 1
32MB	Commercial Grade:	K9F5608UOA-YCB0 (256Mb) or equipollent * 1
	Industrial Grade:	K9F5608UOA-YIB0 (256Mb) or equipollent * 1
64MB	Commercial Grade:	K9F1208UOA-YCB0 (512Mb) or equipollent * 1
	Industrial Grade:	K9F1208UOA-YIB0 (512Mb) or equipollent * 1
128MB	Commercial Grade:	K9F1G08UOA-YCB0 (512Mb) or equipollent * 1
	Industrial Grade:	K9F1G08UOA-YIB0 (512Mb) or equipollent * 1
256MB	Commercial Grade:	K9F2G08UOA-YCB0 (1Gb) or equipollent * 1
	Industrial Grade:	K9F2G08UOA-YIB0 (1Gb) or equipollent * 1
512MB	Commercial Grade:	K9K4G08UOA-YCB0 (2Gb) or equipollent * 1
	Industrial Grade:	K9K4G08UOA-YIB0 (2Gb) or equipollent * 1
1GB	Commercial Grade:	K9W8G08UOA-YCB0 (4Gb) or equipollent * 1
	Industrial Grade:	K9W8G08UOA-YIB0 (4Gb) or equipollent * 1
2GB	Commercial Grade:	K9W8G08UOA-YCB0 (8Gb) or equipollent * 2
	Industrial Grade:	K9W8G08UOA-YIB0 (8Gb) or equipollent * 2
4GB	Commercial Grade:	K9W8G08UOA-YCB0 (8Gb) or equipollent * 4
	Industrial Grade:	K9W8G08UOA-YIB0 (8Gb) or equipollent * 4

\*Note:(Support both Toshiba and Samsung NAND Flash).

**4.6.2. The specific capacity for the various models and the default number of Cylinders, Heads and Sectors/track.**

<b>Unformatted Capacity</b>	<b>Flash Chip Capacity</b>	<b>Default Cylinder</b>	<b>Default Head</b>	<b>Default Sector</b>	<b>Defaulted CHS Capacity</b>
<b>16MB</b>	16,252,928	248	04	32	16,777,216
<b>32MB</b>	32,505,856	496	04	32	33,554,432
<b>64MB</b>	64,094,208	978	04	32	67,108,864
<b>128MB</b>	134,217,728	978	8	32	128,188,416
<b>256MB</b>	268,435,456	978	16	32	256,376,832
<b>512MB</b>	536,870,912	993	16	63	512,483,328
<b>1,024MB</b>	1,073,741,824	1,985	16	63	1,024,450,560
<b>2.04GB</b>	2,147,483,648	3,954	16	63	2,040,643,584
<b>4GB</b>	4,294,967,296	7889	16	63	4,071,481,344

## 5. Interface Description

### 5.1. Pin Assignments

Pin #	Pin Name	Pin Type	Pin #	Pin Name	Pin Type
1	-RESET	I	2	GND	Ground
3	Data 7	I/O	4	Data 8	I/O
5	Data 6	I/O	6	Data 9	I/O
7	Data 5	I/O	8	Data 10	I/O
9	Data 4	I/O	10	Data 11	I/O
11	Data 3	I/O	12	Data 12	I/O
13	Data 2	I/O	14	Data 13	I/O
15	Data 1	I/O	16	Data 14	I/O
17	Data 0	I/O	18	Data 15	I/O
19	Ground	Power	20	Power Pin	Power
21	Reserved	--	22	GND	Ground
23	-IOW	I	24	GND	Ground
25	-IOR	I	26	GND	Ground
27	IORDY	O	28	Reserved	--
29	Reserved	--	30	GND	Ground
31	IRQ	O	32	-IOIS16 (-IOCS16)	O
33	A1	I	34	-PDIAG	I/O
35	A0	I	36	A2	I
37	-CS0	I	38	-CSI	I
39	DASP	I/O	40	GND	Ground
41	VCC	Power	42	VCC	Power
43	GND	Ground	44	Reserved	--

## 5.2. Pin Descriptions

Signal Name	Dir.	Pin	Description
RESET	I	1	This pin Host Reset. Reset signal is from the host and it is active low.
Data [15:0]	I/O	3-18	These lines carry Data, Command and Status information between the host and controller.D0 is LSB and D15 is MSB.
IOW	I	23	The I/O Write Strobe pulse is used to clock I/O data on the Data bus into the controller registers. The clocking will occur on the negative to the positive edge of the signal (trailing edge).
IOR	I	25	This is an I/O Read strobe generated by the host. This signal gates I/O data into the bus from the controller. The clocking will occur on the negative to the positive edge of the signal (trailing edge).
IRQ	O	31	This is an interrupt request from the controller to host, asking for service. The output of this signal is tri-state when the interrupt are disabled by the host.
A[2:0]	I	33,35,36	A[2:0] are used to select the one of eight registers in the Task File.
CS0,CS	I	37,38	-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.
IORDY	O	27	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.
IOIS16	O	32	This open drain output signal is asserted low by the controller to indicate to the host the current cycle is a 16-bit (word) data transfer.
PDIAG	I/O	34	This bi-directional open drain signal is asserted by the slave after an Execute Diagnostic command to indicate to the master it has passed it's diagnostics.
DASP	I/O	39	This open drain output is asserted low any time the disk is active. In a Master/Slave configuration, this signal is used the slave to inform the master which has slave present.
GND		02,19,22,24,26, 30,40,43	Ground
VCC		20,41,42	+5V or 3.3V Power

## 6. Electrical Specification

The following table defines all D.C. Characteristics for the Flash Disk Module Series. The conditions are:

Commercial Temperature Products	Industrial Temperature Products
V <sub>cc</sub> = 5V ±10% V <sub>cc</sub> = 3.3V ± 5% T <sub>a</sub> = 0°C to 70°C	V <sub>cc</sub> = 5V ± 10% V <sub>cc</sub> = 3.3V ± 5% T <sub>a</sub> = -40°C to 85°C

### 6.1. Power Pin Description

Pin Name	I/O	Description
VCCQ	Power	Host VCC
VCC 3.3V	Power	3.3V VCC
GND	Power	GND

### 6.2. Absolute Maximum Rating

Symbol	Parameter	Rating	Unit
VCC	Power Supply	-0.3 to 3.6	V
VIN	Input Voltage	-0.3 to VCC +0.3	V
VOU	Output Voltage	-0.3 to VCC +0.3	V
VCCQ	Power supply for host I/O and embedded regulator	-0.6 to 6.0	V
VIN5	Input voltage for host I/O	-0.3 to VCC +0.3	V
VOU5	Output voltage for host I/O	-0.3 to VCC +0.3	V
TOPR-I	Operating temperature for industrial grade	-40° to +85°	°C
TOPR	Operating temperature for commercial grade	0° to +70°	°C
TSTG	Storage temperature	-55° to 150°	°C

### 6.3. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VCC	Power Supply Voltage	3.0	3.3	3.6	V
VIN	Input Voltage	-0.3	-	VCC+0.3	V
VCCQ	Power Supply for Host IO	3.0	-	5.5	V
VIN5	Input Voltage for Host IO	-0.3	-	VCCQ+0.3	V

### 6.4. DC Characteristics

(TOPR = -40°C ~ +85°C; TOPR-I = -40°C ~ +85°C, VCC = VCCQ 3.0V ~ 3.6V)

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Symbol	Parameter	Condition	Min	Typ	Max	Unit
IIL	Input Leakage Current	No pull-up or pull down	-1	-	1	μA
IOZ	Tri-State Leakage Current		-1	-	1	μA
CIN	Input Capacitance* <sup>1</sup>	VIN=0V, F=1MHz			15	pF
COUT	Output Capacitance* <sup>1</sup>	VOUT=0V, F=1MHz			15	pF
VIL	Input Low Voltage	CMOS			0.2*VCC	V
VIH	Input High Voltage	CMOS	2.3			V
VT-	Schmitt trigger negative going threshold voltage	CMOS	0.9			V
VT+	Schmitt trigger positive going threshold voltage	CMOS			2.5	V
VOL	Output Low Voltage	IOL=4.8mA			0.4	V
VOH	Output High Voltage	IOH=4.8mA	VCC-0.8			V
RT	Input Pull-up/down resistance	VIL=0V or VIH=VCC		75		KΩ
IACT	Active Current			25	30	mA
ISLP	Sleep Current			0.5	1.0	mA

**Note:**

(1). This parameter is sampled and not 100% tested.

### 6.5. DC Characteristics

**TOPR = -40°C ~ +85°C; TOPR-I = -40°C ~ +85°C, VCC= 3.0V ~ 3.6V; VCCQ=4.5V to 5.5V**

Symbol	Parameter	Condition	Min	Typ	Max	Unit
IIL	Input Leakage Current	No pull-up or pull down	-1	-	1	μA
IOZ	Tri-State Leakage Current		-1	-	1	μA
CIN	Input Capacitance* <sup>3</sup>	VIN=0V, F=1MHz			15	pF
COUT	Output Capacitance* <sup>3</sup>	VOUT=0V, F=1MHz			15	pF
VIL	Input Low Voltage	CMOS* <sup>1</sup>			0.2*VCC	V
VIH	Input High Voltage	CMOS* <sup>1</sup>	2.0			V
VILQ	Host I/F Input Low Voltage	TTL* <sup>2</sup>			0.8	V
VIHQ	Host I/F Input High Voltage	TTL* <sup>2</sup>	2.0			V
VT-	Schmitt trigger negative going threshold voltage	VCCQ* <sup>2</sup>	0.8			V
VT+	Schmitt trigger positive going threshold voltage	VCCQ* <sup>2</sup>			2.0	V
VT-	Schmitt trigger negative going threshold voltage	VCC* <sup>1</sup>	0.9			V
VT+	Schmitt trigger positive going threshold voltage	VCC* <sup>1</sup>			2.5	V
VOL	Output Low Voltage	IOL=4.8mA			0.4	V
VOH	Output High Voltage	IOH=4.8mA	VCC-0.8			V
VOLQ	Host I/F Output Low Voltage	IOL=4.8mA			0.4	V
VOHQ	Host I/F Output High Voltage	IOH=4.8mA	VCC-0.8			V
RT	Input Pull-up/down resistance	VIL=0V or VIH=VCC		75		KΩ
IACT	Active Current			25	30	mA
ISLP	Sleep Current			0.5	1.0	mA

**Note:**

(1). For the pins, which are driven by VCC.

(2). For the host interface pins only, which were driven by VCCQ.

(3). This parameter is sampled and not 100% tested.

## 6.6. AC Characteristics

**TOPR = 0°C ~ +70°C; TOPR = - 40°C ~ +85°C, VCC=3.0V ~ 3.6V, VCCQ=4.5V ~ 5.5V, output loading = 35pF**

### 6.6.1. True IDE Mode Access Read AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Data delay after IORD	td(IORD)	-	-	50	ns
Data hold following IORD	th(IORD)	5	-	-	ns
IORD width time	tw(IORD)	70	-	-	ns
Address setup before IORD	tsuA(IORD)	15	-	-	ns
Address hold following IORD	ThA(IORD)	10	-	-	ns
CE setup before IORD	tsuCE(IORD)	5	-	-	ns
CE hold following IORD	thCE(IORD)	10	-	-	ns
IOIS16 delay falling from address	tdfIOIS16(ADR)	-	-	35	ns
IOIS16 delay rising from address	tSiois16(ADR)	-	-	35	ns

### 6.6.2. True IDE Mode Access Write AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Data delay after IOWD	td(IOWD)	20	-	-	ns
Data hold following IOWD	th(IOWD)	10	-	-	ns
IORD width time	tw(IOWD)	70	-	-	ns
Address setup before IOWD	tsuA(IOWD)	15	-	-	ns
Address hold following IOWD	ThA(IOWD)	10	-	-	ns
CE setup before IOWD	tsuCE(IOWD)	5	-	-	ns
CE hold following IOWD	thCE(IOWD)	10	-	-	ns
IOIS16 delay falling from address	tdfIOIS16(ADR)	-	-	35	ns
IOIS16 delay rising from address	tSiois16(ADR)	-	-	35	ns

## **6.7. Power Management**

AFAYA's 2.5" Flash Disk Module provides automatic power saving mode.

There are three modes on this system:

- 1. Standby Mode:** When the Flash Disk Module finished initialization after power reset or hardware reset, it goes into Standby Mode to wait for Command In or Soft Reset.
- 2. Active Mode:** If the Flash Disk Module received any Command In or Soft Reset, it goes into Active Mode. In Active Mode, it is capable of executing any ATA commands. The power consumption is the greatest in this mode.
- 3. Sleep Mode:** The Flash Disk Module will enter Sleep Mode if there is no Command In or Soft Reset from the host for about 4ms or sleep command is asserted. This time interval can be modified by firmware if necessary. Sleep Mode provides the lowest power consumption. During Sleep Mode, the system main clock is stopped. This mode can be waked up from hardware reset, software reset or any ATA command asserted.

## **7. Installation Guide**

### **7.1. Procedure**

#### **7.1.1. ESD Precautions**

Before handling the 2.5" Flash Disk Module, please observe the following precautions to avoid ESD damage to the unit:

- Keep the disk in its shielded bag until ready to install.
- Ground yourself by touching a grounded chassis frame of the computer, or use a grounded wrist strap before and during the installation process.
- Do not touch the exposed drive electronics or connectors. Always handle the disk by the edges or mounting rails.

#### **7.1.2. Configuration**

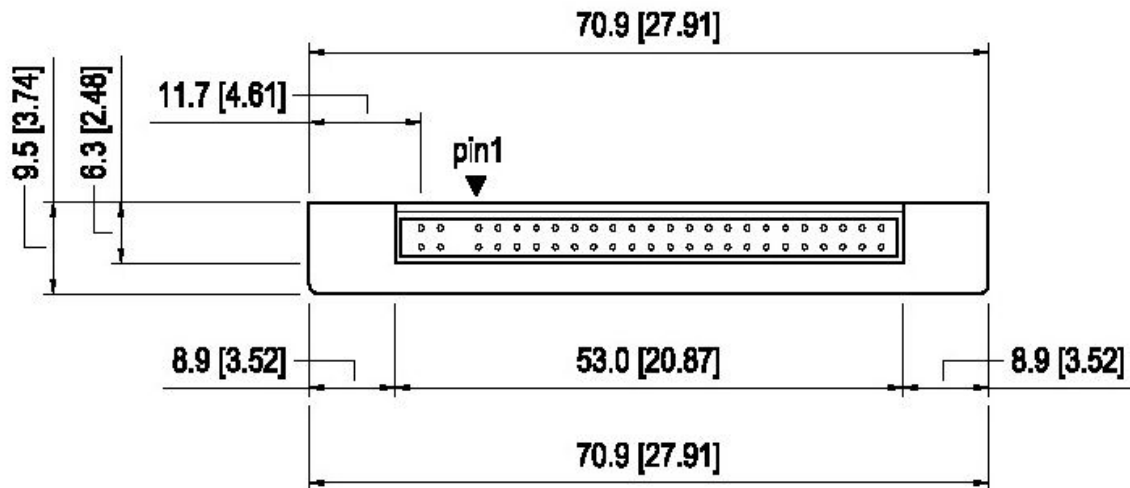
Configure the disk using the jumper diagrams given in Section 3.2. The disk is shipped configured for a single drive system or as the master in a two-drive system. Change the configuration as required. Never attempt to change the jumpers while the disk is plugged in or power is applied.

#### **7.1.3. Connector**

The 2.5" Flash Disk Module may be interfaced directly to a standard 2.5" 2mm IDE socket connector or a standard 2mm, 44-pin IDE ribbon cable. A separate power cable is not required since the 2mm socket or ribbon cable connector supplies both signals and power.

See drawing below for pin 1 location. Care should be taken when installing the 2.5" Flash Disk Module into the system, as misalignment can permanently damage the disk interface connector or electronics.

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2.5" Flash Disk Module Product

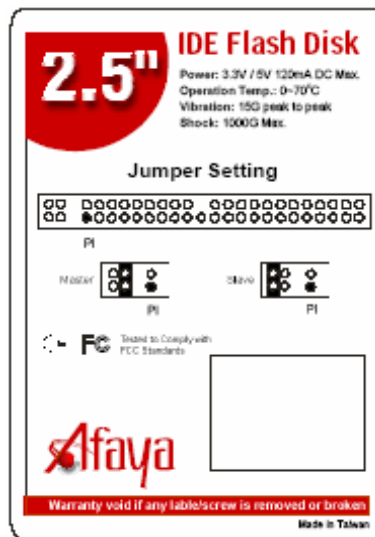


**[2.5" Flash Disk with 44-pin IDE Connector]**

**7.1.4. Mounting**

The 2.5" Flash Disk Module may be mounted in any orientation. A total of eight bottom and eight side mounting holes are available for installation

The diagram given below is valid for all capacities of the 2.5" Flash Disk Module. Please refer to the following drawing for dimensions and mounting holes location.



**[Mechanical Dimensions]**

### **7.1.5. Computer Setup**

To be recognized by the computer, the disk translation information must typically be entered into the System Setup or CMOS Setup utility. For non-PC compatible computers, this may not apply. The 2.5" FLASH DISK MODULE supports automatic detection and configuration if offered by the BIOS. If the disk configuration must be manually entered, select drive type USER and use the table below to determine proper setup parameters. Automatic CHS translation and LBA mode is supported. Note that a MB is equal to 1024\*1024 bytes.

<b>Physical Capacity</b>	<b>Cylinders</b>	<b>Heads</b>	<b>Sectors</b>	<b>Available Capacity</b>
16MB	248	04	32	16,252,928
32MB	496	04	32	32,505,856
64MB	978	04	32	64,094,208
128MB	978	8	32	134,217,728
256MB	978	16	32	268,435,456
512MB	993	16	63	536,870,912
1GB	1,985	16	63	1,073,741,824
2GB	3,954	16	63	2,147,483,648
4GB	7,889	16	63	4,294,967,296

### **7.1.6. Partition**

The Disk must be partitioned using the system's FDISK utility or equivalent. For operating systems other than DOS, please refer to your OS operating guides. Note that changing the partition information will erase all data currently on the disk. Refer to your OS manual for information regarding partitioning a hard disk.

### **7.1.7. Format**

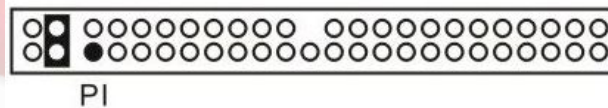
The 2.5" FLASH DISK MODULE is low-level formatted at the factory, which establishes the 512-byte sector size. A high-level format is required after the partition has been established on the disk. Refer to your OS manual for information regarding hard disk drive format procedures.

### 7.1.8. Jumpers

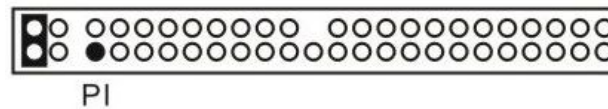
The following diagram illustrates the location of the disk configuration jumpers on the 2.5" FLASH DISK MODULE. The jumpers control the disk selection – master and slave. The jumper required is a 2-pin vertical header on 2mm centers.

### 7.1.9. Master/Slave

The master/slave jumper allows the disk to be configured as either master or slave. Installing the jumper allows the disk to be configured as a slave. With the jumper off, the disk is configured as a master.

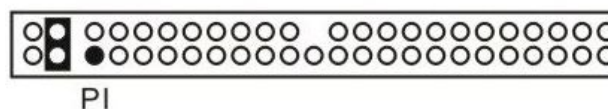


[Master Jumper Configuration]



[Slave Jumper Configuration]

### 7.1.10. Factory Default – Master



[Master Jumper Configuration]

**The factory default configuration is as the master drive with no jumpers installed.**

## **7.2. IDE Interface**

The 2.5" FLASH DISK MODULE uses a 44-pin 2.0 mm connector mounted on the PCB to create both a power and signal connection to the host. Recommended cable length is **12 inches or less**, especially if advanced PIO transfer modes are used.

## **8. Maintenance**

No maintenance is required during the normal use of this drive. If data is to be archived for long periods of time (> 10 years), it is recommended that the data on the disk be refreshed every 5 to 10 years. The manufacturer of the NAND E<sup>2</sup>PROM devices will only guarantee data integrity for a period of 10 years. Programs such as Norton Speedisk<sup>®</sup>, which reallocates all sectors on the disk, or Microsoft<sup>®</sup> Scandisk, which writes and reads every sector on the disk during its surface test, achieve this end very well.



# APPENDIX

## A. Order Information

### 1. Part Number

2.5" Flash Disk Module		
Capacity	Standard Temp.	Industrial Temp.
16MB	FDK-25S016MB	FDK-25S016MB-I
32MB	FDK-25S032MB	FDK-25S032MB-I
64MB	FDK-25S064MB	FDK-25S064MB-I
128MB	FDK-25SH128MB	FDK-25SH128MB-I
256MB	FDK-25SH256MB	FDK-25SH256MB-I
512MB	FDK-25SH512MB	FDK-25SH512MB-I
1GB	FDK-25SH01GB	FDK-25SH01GB-I
2GB	FDK-25SH02GB	FDK-25SH02GB-I
4GB	FDK-25SH04GB	FDK-25SH04GB-I

### 2. Part Number Decoder

$X_1X_2X_3-X_4X_5X_6X_7X_8X_9X_{10}X_{11}-X_{12}$

$X_1 \sim X_3$  = Product Model Name

**MDM: MicroDisk Module**

**FDK: Flash Disk Module**

**ATA: Pcmcia ATA Flash Card**

**CF: Compact Flash Card**

$X_5$  = form-factor

**25 = 2.5"      35 = 3.5"**

$X_6X_7$  = Controller Type

**S = 883XA2      SH = 886XA1**

$X_8X_9 X_{10}X_{11}$  = Card Capacity

$X_{12}$  = Controller Grading And Flash Memory IC Grading

**I = Industrial Grade**

Note:  $X_{12}$  for industrial product.