APRO Co., Ltd.

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Rev. 1.0

Product Specification
Industrial micro IDE Flash Disk
(MIF)
- Hermit Series -

Doc-No: 100-XMIFHA-01V0

Revision History

Rev. 1.0 —initial release	*2008/12/23*

CONTENTS

1. Introduction

APRO Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series products are designed to follow ATA/ATAPI-6 standard. The main used Flash memories are Samsung SLC NAND Type Flash memory chips. The available Card capacities are 128MB, 256MB, 512MB, 1GB, 2GB, 4GB and 8GB. The operating temperature grade is optional for standard grade 0°C ~ 70°C and industrial grade -40°C ~ +85°C. The APRO Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series are designed electrically compliant with the conventional IDE hard disk and support True IDE Mode. The data transfer modes supports PIO mode 0~6, Multi Word DMA 0~4, or UDMA 0~5; Default setting are PIO mode-4 or UDMA-4. Hermit Series MIF features an extremely light weight, reliable, low-profile form factor.

The APRO Industrial 40/44-pin MIF Hermit Series provides a high level interface to the host computer. This interface allows a host computer to issue commands to the Flash Disk to read or write blocks of memory. The host addresses the card in 512 byte sectors. Each sector is protected by a powerful 4 bits Error Correcting Code (ECC). APRO Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series, it uses intelligent controller which manages interface protocols, data storage and retrieval as well as ECC, defect handling and diagnostics, power management and clock control.

Figure 1 shows a block diagram of the used high tech Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series controller.

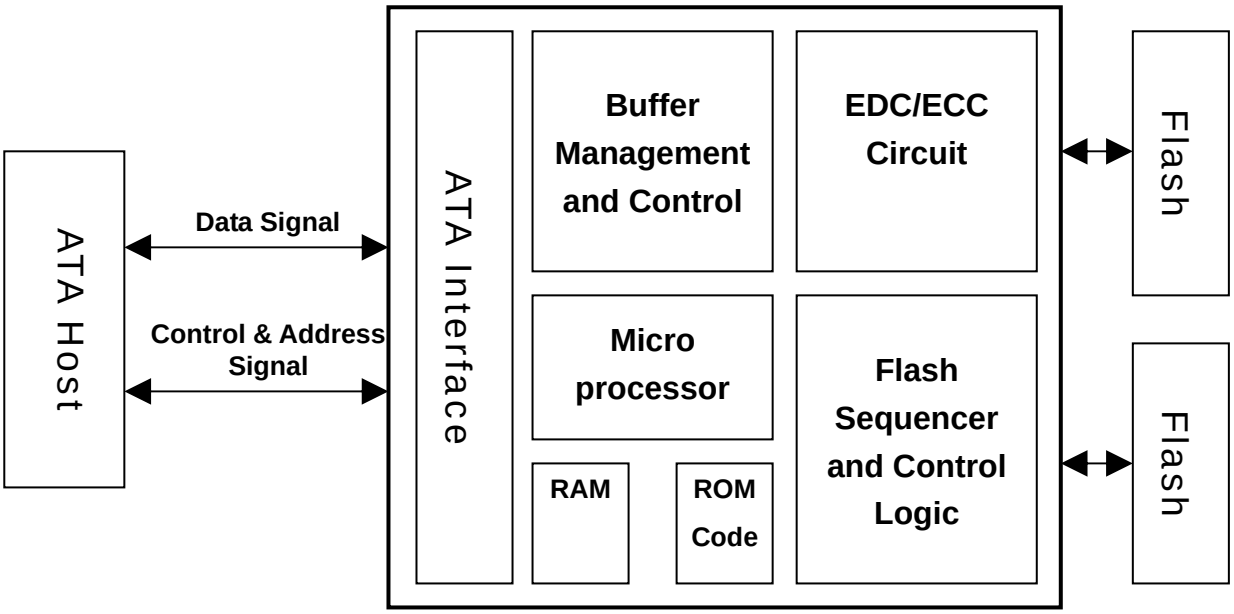

Figure 1: micro IDE Flash Disk Controller Block Diagram

1.1. *Scope*

This document describes the features and specifications and installation guide of APRO's Industrial 40/44-pin MIF Hermit Series. In the appendix, there provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

1.2. *System Features*

- Non-volatile memory and no moving parts
- SLC NAND type flash technology
- Disk capacity from 128MB to 8GB
- ATA interface and True IDE mode
- Master/Slave Switch
- Data transfer supports PIO-4 and UDMA-4 (Default setting)
- Performance up to 40.0MB/sec
- Automatic 4 bits error correction and retry capabilities
- Supports power down commands and Auto stand-by / sleep modes.
- +5 V ±10% or +3.3 V ±5% operation
- MTBF > 3,000,000 hours.
- Shock : 50g (Duration：10ms, 3 axes), compliance to IEC 68-2-27
- Vibration : 5g (7 Hz to 2000 Hz, 3 axes), compliance to IEC 68-2-6
- Rugged environment is working well
- Very high performance, very low power consumption
- Low weight, Noiseless

1.3. *ATA/ATAPI-6 Standard*

APRO Industrial 40/44-pin MIF disks are fully compatible with the ATA/ATAPI-6 standard.

1.4. *Technology Independence - Static Wear Leveling*

In order to gain the best management for flash memory, APRO Industrial CF Cards – Hermit series supports ***Static Wear Leveling technology*** to manage the Flash system. The life of flash memory is limited; the management is to increase the life of the flash product.

A static wear-leveling algorithm evenly distributes data over an entire Flash cell array and searches for the least used physical blocks. The identified low cycled sectors are used to write the data to those locations. If blocks are empty, the write occurs normally. If blocks contain static data, it moves that data to a more heavily used location before it moves the newly written data. The static wear leveling maximizes effective endurance Flash array compared to no wear leveling or dynamic wear leveling.

2. Product Specifications

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

2.1. *System Environmental Specifications*

Table 1: Environmental Specification

		Standard Grade	Industrial Grade
APRO Industrial Hermit Series MIF		**SxMIFxxxx-HACSC Series**	**WxMIFxxx-HAISI- Series**
Temperature	**Operating:** **Non-operating:**	0ºC ~ +70ºC -55ºC ~ +95ºC	-40ºC ~ +85ºC -55ºC ~ +95ºC
Humidity	**Operating & Non-operating:**	10% ~ 95% non-condensing	
Vibration	**Operating & Non-operating:**	5g (7 Hz to 2000 Hz, 3 axes), compliance to IEC 68-2-6	
Shock	**Operating & Non-operating:**	50g (Duration：10ms, 3 axes), compliance to IEC 68-2-27	

2.2. *System Power Requirements*

Table 2: Power Requirement

		Standard Grade	Industrial Grade
APRO Industrial Hermit Series MIF		**SxMIFxxxx-HACSC Series**	**WxMIFxxx-HAISI- Series**
DC Input Voltage (VCC) 100mV max. ripple(p-p)		**+5 V ±10%**	
+5V Current **(Maximum average value)**	**Reading Mode :**	Single Channel: 69mA (max.) / Duel Channel: 128mA (max.)	
	Writing Mode :	Single Channel: 48mA (max.) / Duel Channel: 118mA (max.)	
	Sleeping Mode :	Single Channel: 1.2mA (max.) / Duel Channel: 1.8mA (max.)	

2.3. *System Performance*

Table 3: System Performances

Data Transfer Mode supporting		- PIO mode : 0,1,2,3,4,5,6 (Default PIO-4) - UDMA Mode: 0,1,2,3,4,5 (Default UDMA-4)
Data Transfer Rate To/Form Host		16.6Mybtes/sec burst under PIO Mode 4 66.6Mbytes/sec burst under UDMA-4 Mode
Average Access Time		0.2 ms(estimated)
Maximum Performance	**Sequential Read**	40 Mbytes/sec Max.
	Sequential Write	17 Mbytes/sec Max.

Note:

(1). All values quoted are typically at 25oC and nominal supply voltage.

(2). Testing of the Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series maximum performance was performed under the following platform:

- Computer with AMD 3.0GHz processor

- Windows XP Professional operating system

- IDE transfer mode: Ultra DMA mode 4

- IDE Flash Disk capacity: 4GB

2.4. *System Reliability*

Table 4: System Reliability

MTBF	>3,000,000 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 Connection Code
Endurance	Greater than 2,000,000 cycles Logically contributed by Wear-leveling and advanced bad sector management
Data Retention	10 years

2.5. *Physical Specifications*

Refer to Table 5 and see Figure 3 for Industrial 40/44-pin MIF physical specifications and dimensions.

Table 5: Physical Specifications

40-pin MIF		
Orientation :	**Vertical Type**	**Horizontal Type**
Length:	60.20 mm	55.00 mm
Width:	27.79 mm	32.40 mm
Thickness:	6.40 mm	7.40 mm
G. W. :	20 gw	15 gw
44-pin MIF		
Orientation :	**Vertical Type**	**Horizontal Type**
Length:	50.25 mm	48.00 mm
Width:	27.27 mm	32.60 mm
Thickness:	5.80 mm	4.50 mm
G. W. :	15 gw	10 gw

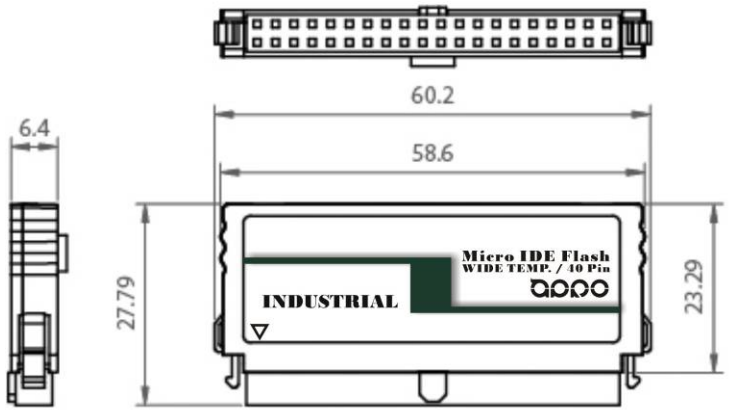

Figure 2 - 40-pin Vertical Type MIF

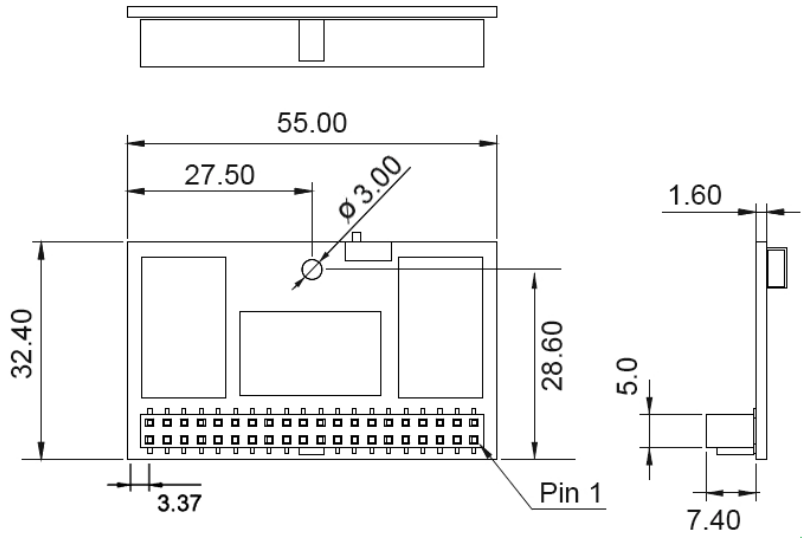

Figure 3 – 40-pin Horizontal-leftward Type MIF

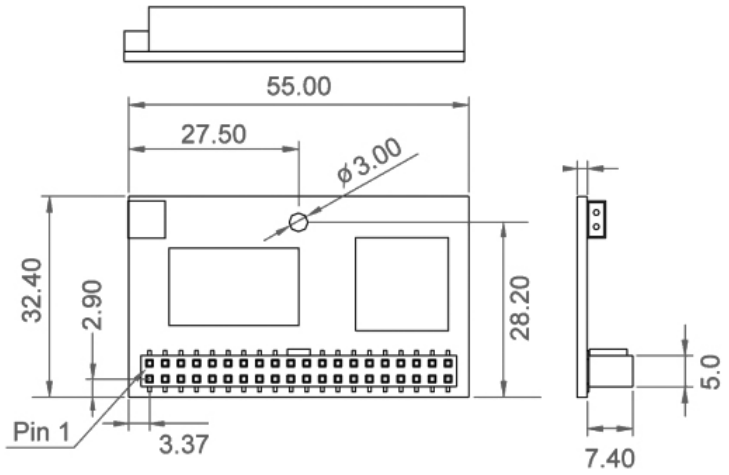

Figure 4 - 40-pin Horizontal-rightward Type MIF

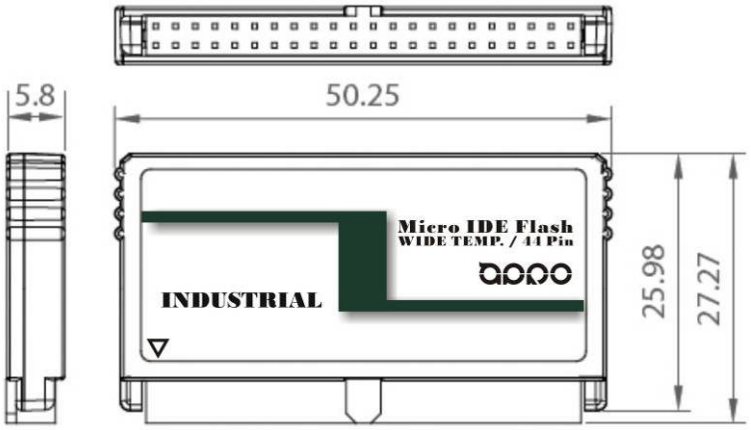

Figure 5 - 44-pin Vertical Type MIF

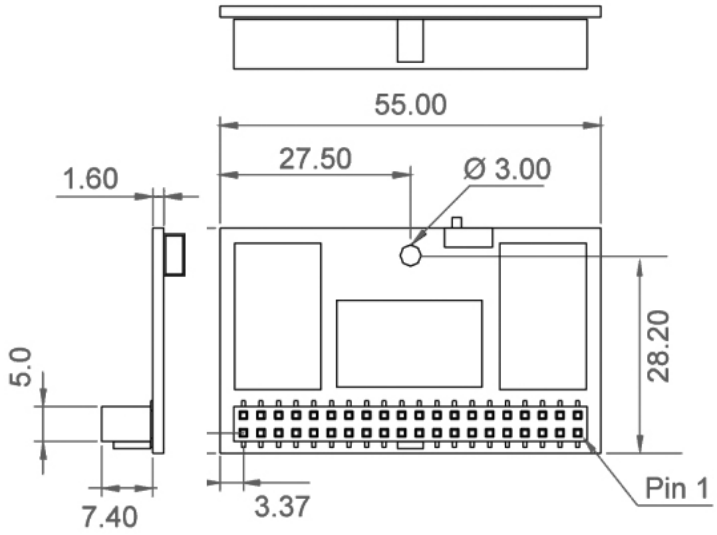

Figure 6 - 44-pin Horizontal-leftward Type MIF

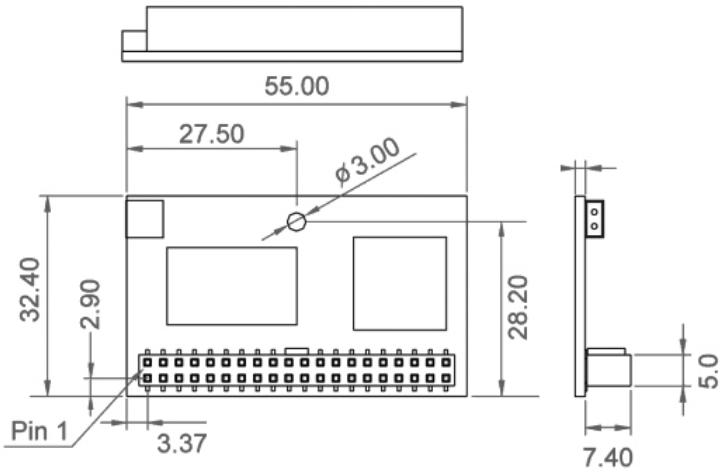

Figure 7 - 44-pin Horizontal-rightward Type MIF

2.6. *Capacity Specifications*

APRO Industrial 40/44-pin micro IDE Flash (MIF) Disks are built-in mainly Samsung NAND Type SLC Flash memory chips. The Table 6 shows the equipollent part number of applied Samsung Flash memory chips for each card.

Table 6: Card Configuration vs. Samsung NAND SLC part number

Card Capacity	Samsung SLC Flash Memory Part Number * Q'TY	
128MB	Standard Grade:	K9F1G08U0A-PCB0(1Gb) or equipollent * 1
	Industrial Grade:	K9F1G08U0A-PIB0 (1Gb) or equipollent * 1
256MB	Standard Grade:	K9F2G08U0A-PCB0 (2Gb) or equipollent * 1
		K9F1G08U0A-PCB0(1Gb) or equipollent * 2
	Industrial Grade:	K9F2G08U0A-PIB0 (2Gb) or equipollent * 1
		K9F1G08U0A-PIB0 (1Gb) or equipollent * 2
512MB	Standard Grade:	K9F4G08U0M-PCB0 (4Gb) or equipollent * 1
		K9F2G08U0A-PCB0 (2Gb) or equipollent * 2
		K9F1G08U0A-PCB0(1Gb) or equipollent * 4
	Industrial Grade:	K9F4G08U0M-PIB0 (4Gb) or equipollent * 1
		K9F2G08U0A-PIB0 (2Gb) or equipollent * 2
		K9F1G08U0A-PIB0 (1Gb) or equipollent * 4
1GB	Standard Grade:	K9K8G08U0M-PCB0 (8Gb) or equipollent * 1
		K9F4G08U0M-PCB0 (4Gb) or equipollent * 2
	Industrial Grade:	K9K8G08U0M-PIB0 (8Gb) or equipollent * 1
		K9F4G08U0M-PIB0 (4Gb) or equipollent * 2
2GB	Standard Grade:	K9WAG08U1M-PCB0 (16Gb) or equipollent *1
		K9K8G08U0M-PCB0 (8Gb) or equipollent *2
	Industrial Grade:	K9WAG08U1M-PIB0 (16Gb) or equipollent *1
		K9K8G08U0M-PIB0 (8Gb) or equipollent *2
4GB	Standard Grade:	K9WAG08U1M-PCB0 (16Gb) or equipollent *2
		K9K8G08U0M-PCB0 (8Gb) or equipollent *4
	Industrial Grade:	K9WAG08U1M-PIB0 (16Gb) or equipollent *2
		K9K8G08U0M-PIB0 (8Gb) or equipollent *4
8GB	Standard Grade:	K9WAG08U1M-PCB0 (16Gb) or equipollent *4
	Industrial Grade:	K9WAG08U1M-PIB0 (16Gb) or equipollent *4

The table 7 shows the specific capacity for the various models and the default number of heads, sectors/track and cylinders.

Table 7: Model Capacity

Unformatted Capacity	Default Cylinder	Default Head	Default Sector	Default CHS Capacity
128MB	500	16	32	256,000
256MB	1,000	16	32	512,000
512MB	1,015	16	63	1,023,120
1,024MB	2,031	16	63	2,047,248
2.04GB	4,063	16	63	4,095,504
4GB	8,146	16	63	8,211,168
8GB	16,000	16	63	16,128,000

3. Interface Description

3.1. *Physical Description*

The pin 1 ~ pin 44 are for IDE interface.

Figure 8- Vertical Type 40-pin IDE Connector

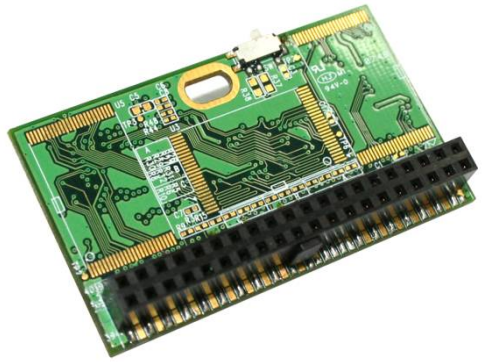

Figure 8 - Horizontal Type 40-pin IDE Connector

Figure 9 - Vertical Type 44-pin IDE Connector

Figure 10 - Horizontal Type 44-pin IDE Connector

3.2. *Pin Assignments*

Signals whose source is the host is designated as inputs while signals that the Industrial 44-pin micro IDE Flash (MIF) Disk sources are outputs. The pin assignments are listed in below table 8.

Table 8: Pin Assignments

Pin No.	Signal Name	Description	Pin No.	Pin Name	Description
1	HRESET	Host Reset	2	GND	Ground
3	HDB[7]	Host Data Bit 7	4	HDB[8]	Host Data Bit 8
5	HDB[6]	Host Data Bit 6	6	HDB[9]	Host Data Bit 9
7	HDB[5]	Host Data Bit 5	8	HDB[10]	Host Data Bit 10
9	HDB[4]	Host Data Bit 4	10	HDB[11]	Host Data Bit 11
11	HDB[3]	Host Data Bit 3	12	HDB[12]	Host Data Bit 12
13	HDB[2]	Host Data Bit 2	14	HDB[13]	Host Data Bit 13
15	HDB[1]	Host Data Bit 1	16	HDB[14]	Host Data Bit 14
17	HDB[0]	Host Data Bit 0	18	HDB[15]	Host Data Bit 15
19	GND	Ground	20	KEY[1]	Key-pin
21	DMARQ	DMA Request	22	GND	Ground
23	HIOW[3]	Host I/O Write	24	24	GND
	STOP[4]	Stop Ultra DMA burst			
25	HIOR[3]	Host I/O Read	26	GND	Ground
	HDMARDY[4]	Ultra DMA ready			
	HSTROBE[4]	Ultra DMA data strobe			
27	IORDY[3]	I/O Ready	28	CSEL	Cable select
	DDMARDY[4]	Ultra DMA ready			
	DSTROBE[4]	Ultra DMA data strobe			
29	DMACK	DMA Acknowledge	30	GND	Ground
31	INTRQ	Interrupt Request	32	IOCS16	CS I/O 16-Bit
33	HAB[1]	Host Address Bit 1	34	PDIAG	Passed Diagnostic
35	HAB[0]	Host Address Bit 0	36	HAB[2]	Host Address Bit 2
37	CS0	Chip Select 0	38	CS1	Chip Select 1
39	DASP	Drive Active	40	GND	Ground
41	VCC	Supply Voltage	42	VCC	Supply Voltage
43	GND	Ground	44[2]	NC	Not Connected

In the 44-pin version, this pin is defined as KEY, according to the ATA standard.

NC = These pins are not connected internally.

Signal usage in PIO & Multiword DMA mode.

Signal usage in Ultra DMA mode.

3.3. *Electrical Description*

The Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series is optimized for operation with hosts. .Table 9: describes the signals of 40/44-pin interface.

Table 9: Signal Description

Pin No.	Signal Name	Type	Description
1	HRESET-	I	Host reset signal, High: Reset.
37	CS0-	I	Chip select CS0
38	CS1-	I	Chip select CS1
31	INTRQ	O	Host interrupt signal.
25	HIOR-[3]	I	I/O read strobe signal.
	HDMARDY-[4]		DMA ready during Ultra DMA data in burst
	HSTROBE[4]		Data strobe during Ultra DMA data out burst
23	HIOW-[3]	I	I/O write strobe signal.
	STOP[4]		Stop during Ultra DMA data bursts
32	IOCS16-	O	Asserted in 16-bit access.
27	IORDY[3]	O	I/O Ready Signal
	DDMARDY-[4]		DMA ready during Ultra DMA data out burst
	DSTROBE[4]		Data strobe during Ultra DMA data in burst
18, 16, 14, 12, 10, 8, 6, 4, 3, 5, 7, 9, 11, 13, 15, 17	HDB[15:0]	I/O	Host data bus
33, 35, 36	HAB[2:0]	I/O	Host Address bus
28	CSEL- I	I	Master/Slave select signal (cable select signal). Low: Device operates as a master, High: Device operates as a slave. Switch used.
39	DASP-	I/O	Used as an input port to check in the master mode to see if the slave is present or not, and as an output port to check in the slave mode to see if the slave for the master is present or not.
34	PDIAG-	I/O	Used as an input port to evaluate the result of slave diagnosis in the master mode, and as an output port to return the result of diagnosis to the master.
21	DMARQ	O	DMA Request.
29	DMACK-	I	DMA Acknowledge.
20[1], 41[2], 42[2]	VCC	VCC	Connect to VCC
2, 19, 22, 24, 26, 30, 40, 43[2]	GND	GND	Connect to GND.
44[2]	NC	N/A	Not used. Please do not connect.

In the 44-pin version, this pin is defined as KEY, according to the ATA standard.

NC = These pins are not connected internally.

Signal usage in PIO & Multiword DMA mode

Signal usage in Ultra DMA mode

3.4. *Electrical Specification*

Table 11, Table 12, and Table 13 defines all D.C. Characteristics for the Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series. Unless otherwise stated, a condition is as below Table 10:

Table 10: Electrical Condition

SxMIFxxxx-HACSC Series	WxMIFxxxx-HAISI- Series
Vcch = 5V ±10% or 3.3V ± 10% Vccf = 3.3V ± 10% Ta = 0°C to 70°C	Vcch = 5V ±10% or 3.3V ± 10% Vccf = 3.3V ± 10% Ta = -40°C to 85°C

3.4.1. Absolute Maximum Rating

Table 11: Absolute Maximum Rating

Parameter	Symbol	Rating	Unit
DC Power Supply	V_{DD} - V_{SS}	-0.3 ~ +5.5	V
Input voltage	V_{IN}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Output voltage	V_{OUT}	V_{SS}-0.3 ~ V_{DD}+0.3	V
Operating Temperature	T_A	Standard: -10 ~ +70	°C
		Industrial: -40 ~ +85	°C
Storage Temperature	T_{ST}	Standard: -55 ~ +95	°C
		Industrial: -55 ~ +95	°C

3.4.2. Recommended Operating Condition

Table 12: Recommended Operating Condition

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	Vcc	3.0	3.3	3.6	V
Input Voltage	V_{IN}	-0.3	-	Vcc+0.3	V
Power Supply for Host I/O	Vccq	3.0	-	5.5	V
Input Voltage for Host I/O	V_{IN_Host}	-0.3	-	Vccq+0.3	V

3.4.3. DC Characteristics

Table 13: DC Characteristics

Parameter	Symbol	Value			Unit
		Min	Standard	Max	
Power Supply	VCCH	4.5	5.0	5.5	V
Power Supply	VCCF	3.0	3.3	3.6	V
Input low voltage	V_{IL}	-0.3		0.8	V
Input high voltage	V_{IH}	2.0		Vcc+0.3	V
Output low voltage	V_{OL}			0.45 (at	V

				4mA)	
Output high voltage	V_{OH}	2.4 (at 1mA)			V
Operating CurrentV Sleep Mode Operation	Icc			 1.4 140	 mA mA
Input Leakage Current	ILI			±10	uA
Output leakage current	L_{LO}			±10	μA
Input/output Capacitance	$C_{I/O}$			10	pF

3.4.4. Timing Specifications

PIO Mode

Figure 11: Read/Write Timing Diagram, PIO Mode

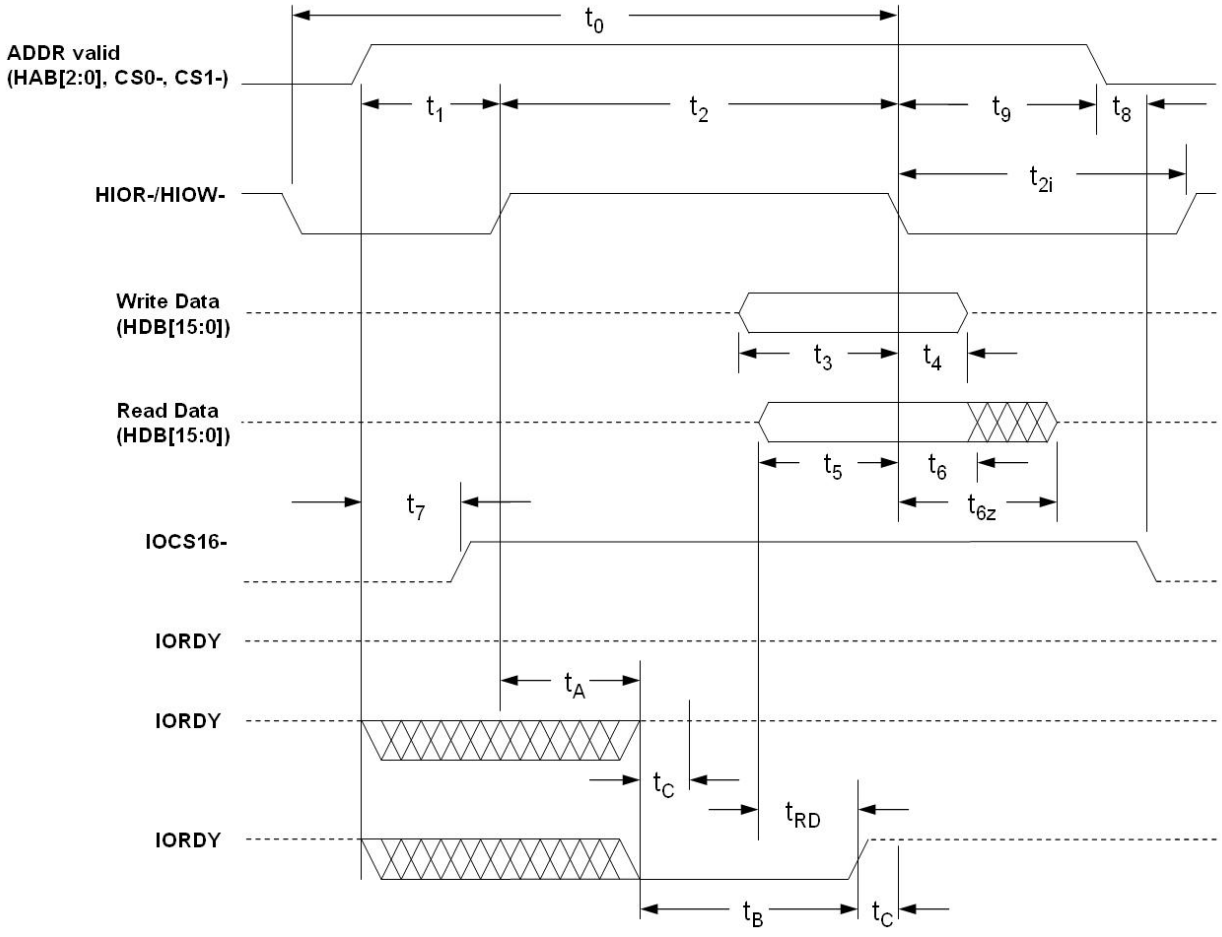

Table 14: Read/Write Timing Specifications, PIO Mode 0-4

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_7	Address valid to IOCS16- assertion (max.)	90	50	40	n/a	n/a
t_8	Address valid to IOCS16- released (max.)	60	45	30	n/a	n/a
t_9	HIOR-/HIOW- to address valid hold	20	15	10	10	10
t_{RD}	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

Multiword DMA

Figure 12: Read/Write Timing Diagram, Multiword DMA Mode

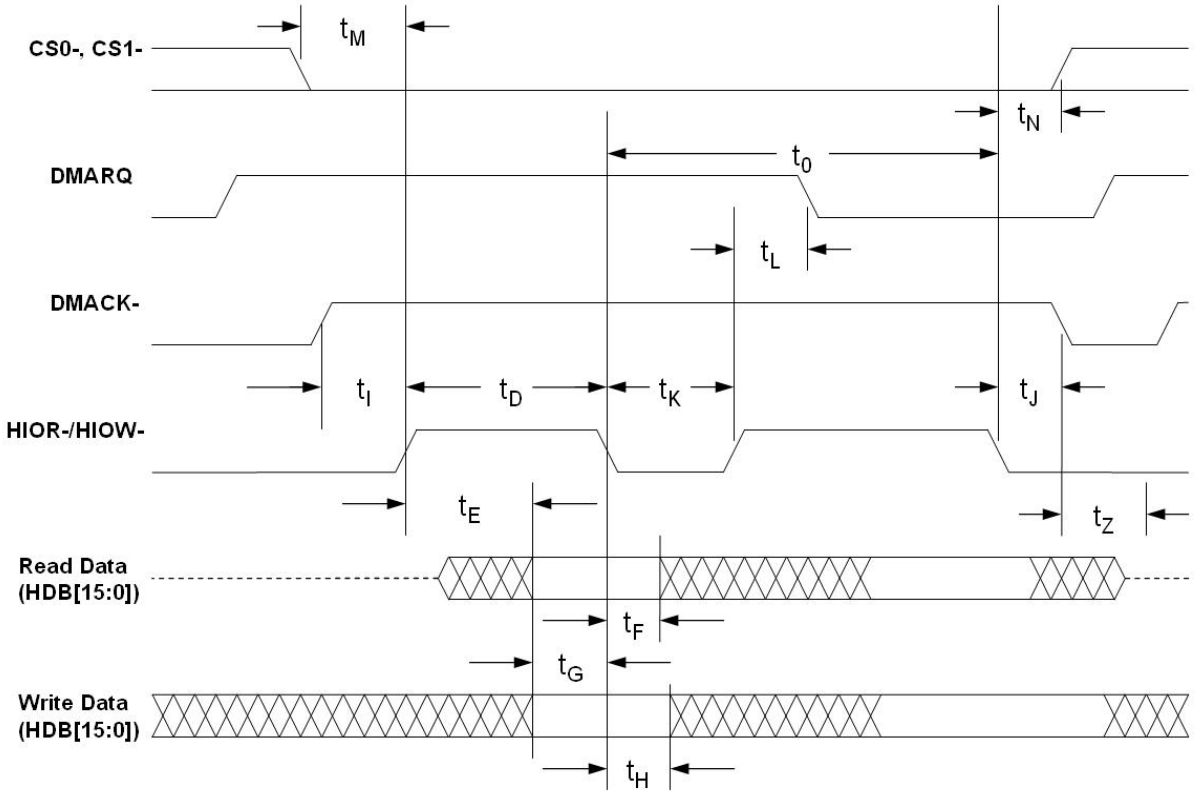

Table 15: Read/Write Timing Specifications, Multiword DMA Mode 0-2

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
t_Z	DMACK-	20	25	25

Ultra DMA mode

Figure 13: Ultra DMA Mode Data-in Burst Initiation Timing Diagram

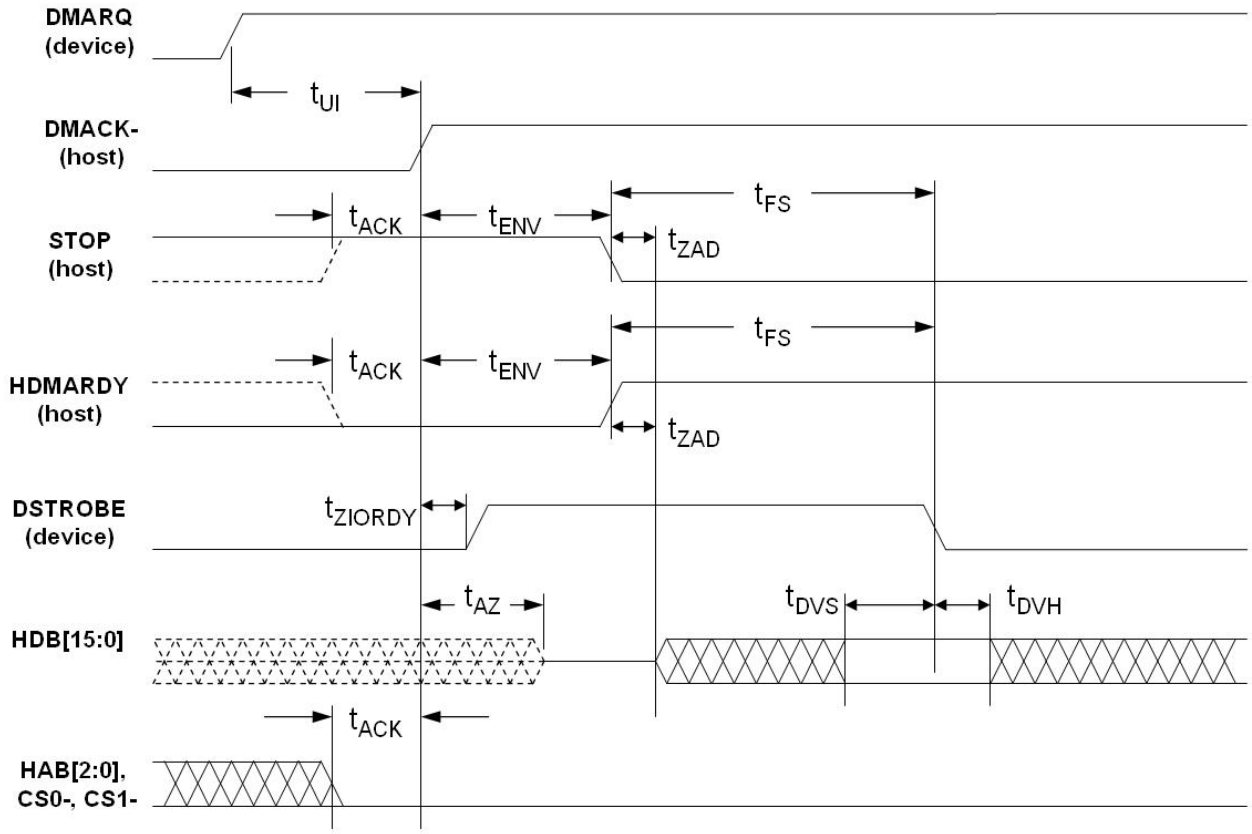

Figure 14: Ultra DMA Mode Data-out Burst Initiation Timing Diagram

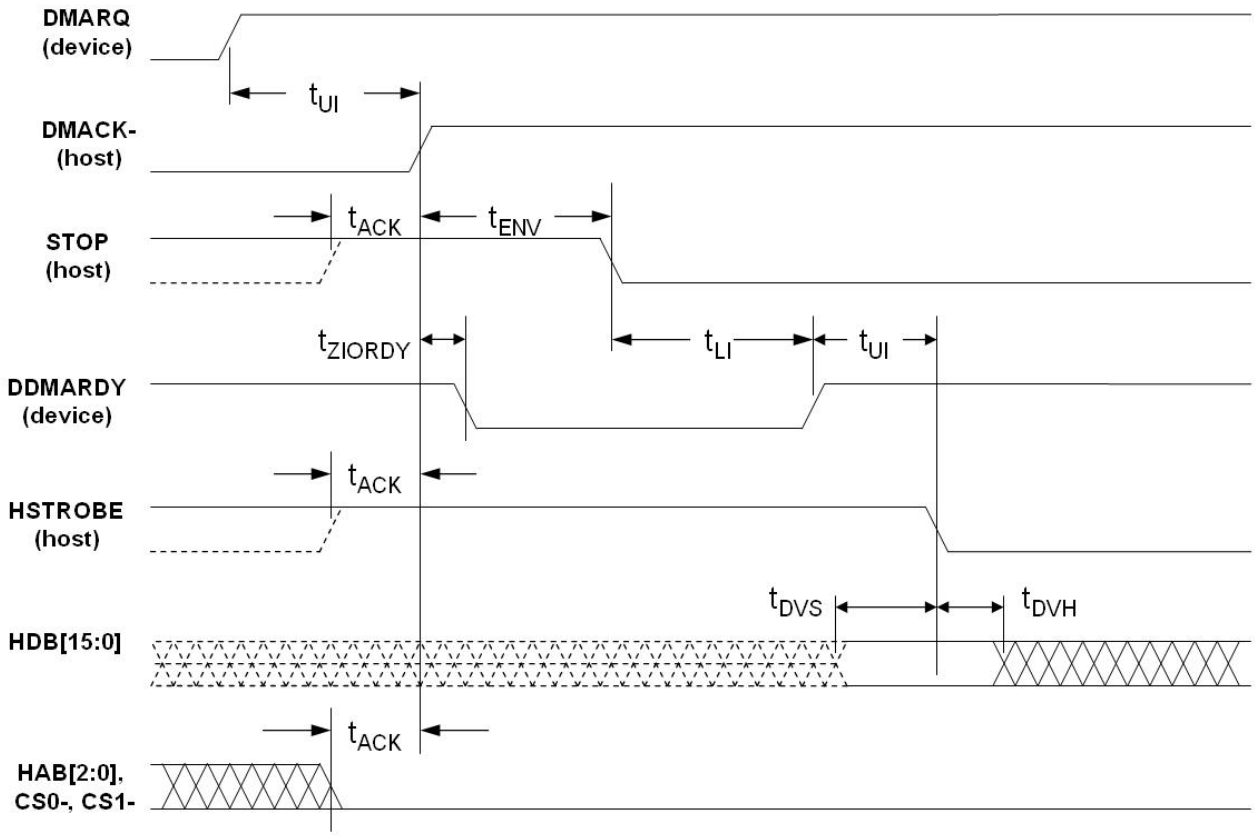

Figure 15: Sustained Ultra DMA Mode Data-in Burst Timing Diagram

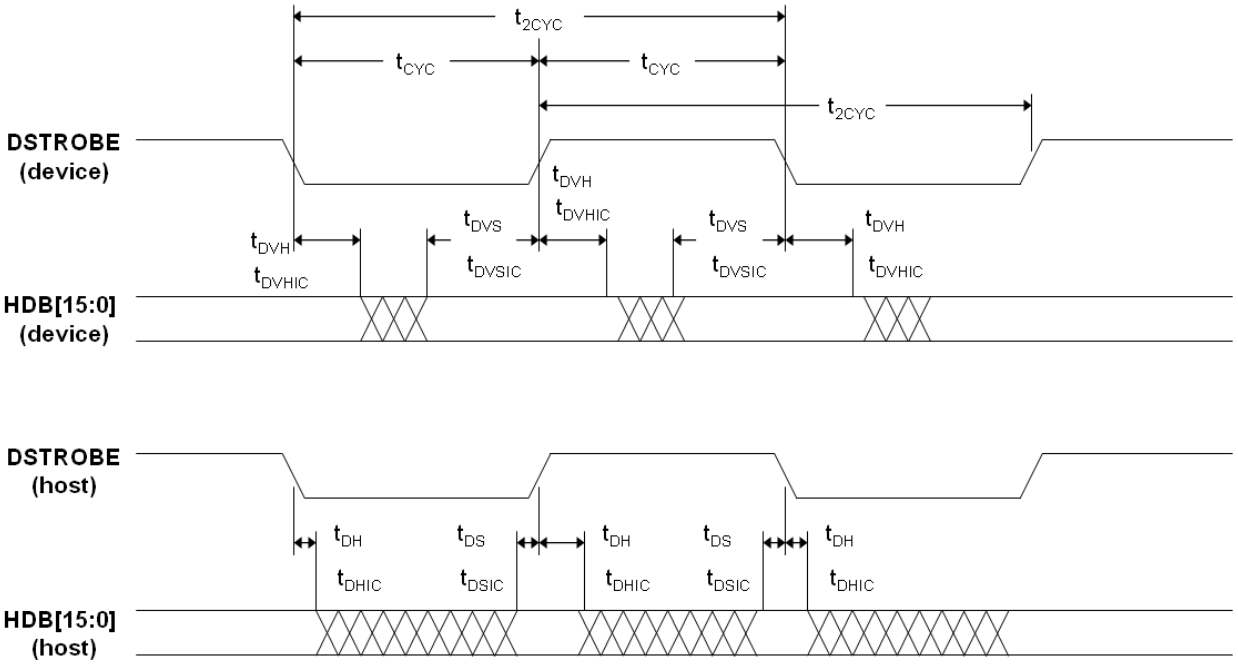

Figure 25: Sustained Ultra DMA Mode Data-out Burst Timing Diagram

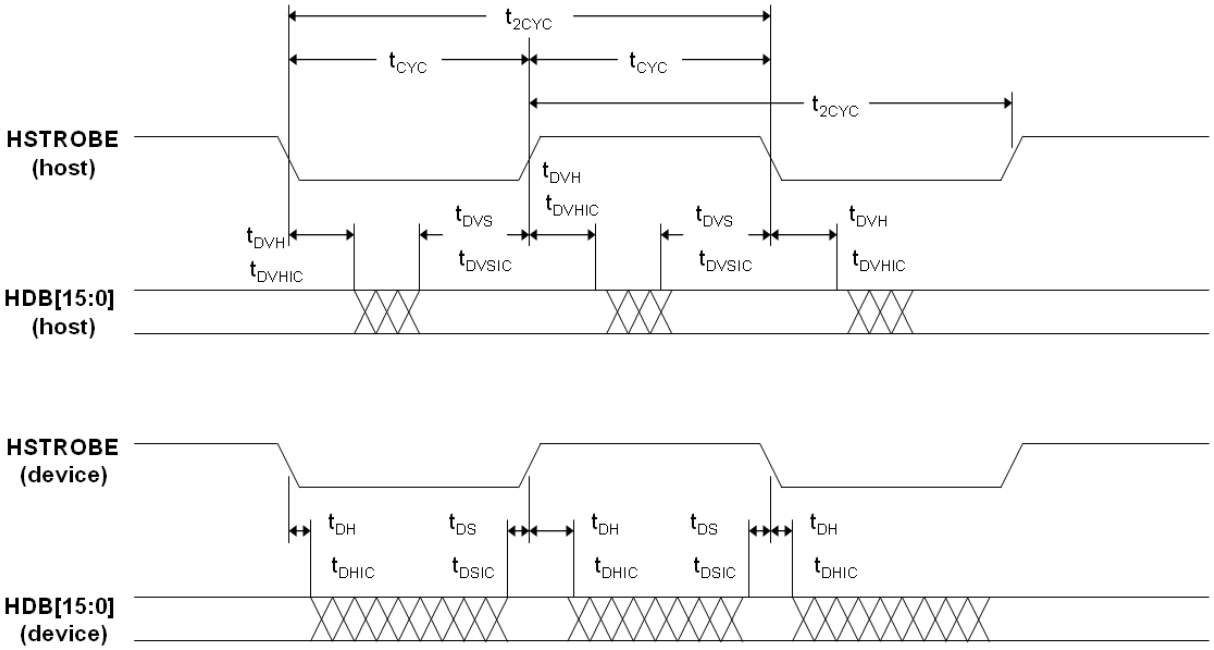

Table 16: Timing Diagram, Ultra DMA Mode 0-4

Ultra DMA timing parameters		Mode 0		Mode 1		Mode 2		Mode 3		Mode 4	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
t_{2CYC}	Typical sustained average two cycle time	240	-	160	-	120	-	90	-	60	-
t_{CYC}	Cycle time allowing for asymmetry and clock variations (from STROBE edge to STROBE edge)	112	-	73	-	54	-	39	-	25	-
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	-	115	-	86	-	57	-
t_{DS}	Data setup time (at recipient)	15	-	10	-	7	-	7	-	5	-
t_{DH}	Data hold time (at recipient)	5	-	5	-	5	-	5	-	5	-
t_{DVS}	Data valid setup time at sender (from data bus being valid until STROBE edge)	70	-	48	-	31	-	20	-	6.7	-
t_{DVH}	Data valid hold time at sender (from STROBE edge until data may become invalid)	6.2	-	6.2	-	6.2	-	6.2	-	6.2	-
t_{FS}	First STROBE time (for device to first negate DSTROBE from STOP during a data in burst)	-	230	-	200	-	170	-	130	-	120
Ultra DMA timing parameters		**Mode 0**		**Mode 1**		**Mode 2**		**Mode 3**		**Mode 4**	
		Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
t_{LI}	Limited interlock time	0	150	0	150	0	150	0	100	0	100
t_{MLI}	Interlock time with minimum	20	-	20	-	20	-	20	-	20	-
t_{UI}	Unlimited interlock time	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
t_{ZAH}	Minimum delay time required for output drivers to assert or negate (from released state)	20	-	20	-	20	-	20	-	20	-
t_{ZAD}		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	70	20	55	20	55
t_{RFS}	Ready-to-final-STROBE time (no STROBE edges shall be sent this long after negation of DMARDY-)	-	75	-	70	-	60	-	60	-	60
t_{RP}	Ready-to-pause time (time that recipient shall wait to initiate pause after negating DMARDY-)	160	-	125	-	100	-	100	-	100	-
t_{IORDYZ}	Pull-up time before allowing IORDY to be released	-	20	-	20	-	20	-	20	-	20
t_{ZIORDY}	Minimum time device shall wait before driving IORDY	0	-	0	-	0	-	0	-	0	-
t_{ACK}	Setup and hold times for DMACK- (before assertion or negation)	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	-	20	-	20	-

4. Command Descriptions

4.1. *Command Set*

The following table summarizes the command defined in ATAPI-6 specification and lists the commands supported by the controller.

Table 17: IDE Commands

Command Name	Command Code
Check Power Mode	98H or E5H
Execute Device Diagnostic	90H
Erase Sector	C0H
Format Track	50H
Identify Device	ECH
Idle	97H or E3H
Idle immediate	95H or E1H
Initialize Device Parameters	91H
NOP	00H
Read Buffer	E4H
Read Long Sector	22H or 23H
Read Multiple	C4H

Read Sector	20H or 21H
Read Verify Sector	40H or 41H
Recalibrate	1XH
Seek	7XH
Set Features	EFH
Set Multiple Mode	C6H
Set Sleep Mode	99H or E6H
Standby	96H or E2H
Standby Immediate	94H or E0H
Write Buffer	E8H
Write Long Sector	32H or 33 H
Write Multiple	C5H
Write Sector	30H or 31H
Write Verify	3CH

5. Installation Procedure

5.1. *Before unpacking*

Before unpacking or handling a drive, take all proper electrostatic discharge (ESD) precautions, including personal and equipment grounding. Before you start to install the 40/44-pin Vertical MIF Hermit Series into your system – please check the following.

- If the shipping package appears to be damaged or water stained, notify your dealer.
- Remove the disk from its shipping enclosure and inspect it for any damage that may have occurred during shipment. If any damage is observed, notify your dealer.
- Record the disk serial number and shipment date.
- Retain the original shipping enclosure and all packing material for re-shipment.

5.2. *ESD Precautions*

You can prolong the life of your MIF as well as increase its reliability and prevent unnecessary damage by following the instructions listed below. Failure to follow any of these instructions may void your warranty.

(1) Always take all proper electrostatic discharge (ESD) precautions, including personnel and equipment grounding.

(2) Always operate the Flash disk within the environmental specifications.

(3) Always use a grounded wrist strap when handling the Flash disk. Drives that are not installed in the system are sensitive to ESD damage.

5.3. *Configuration of MIF*

(1) Select Master or Slave by Switch
(2) Find the pin-1 of both MIF and the IDE interface on motherboard, the fool-proof device on MIF can also help to connect the IDE connector correctly.

5.4. *MIF Insertion and Removing*

5.4.1. MIF Insertion

The connector of V-type MIF is very tight when plugging in, and it insures the MIF connection to motherboard properly. However, you have to be very careful to insert the MIF, especially V-type MIF, in right behavior. Blows are the important points for your attention to insert the MIF.

(1) Check the MIF housing to see if there are any damaged or loose parts and then check the female connector carefully if they are intact.

(2) Before inserting the MIF, please check each IDE pins on motherboard are perfect and straight.

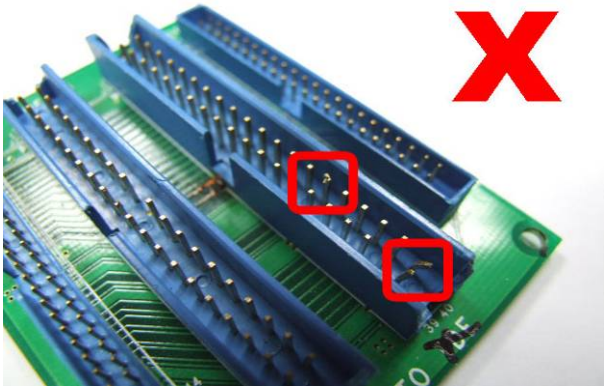

Figure 16 - Defective IDE male Pins on Motherboard

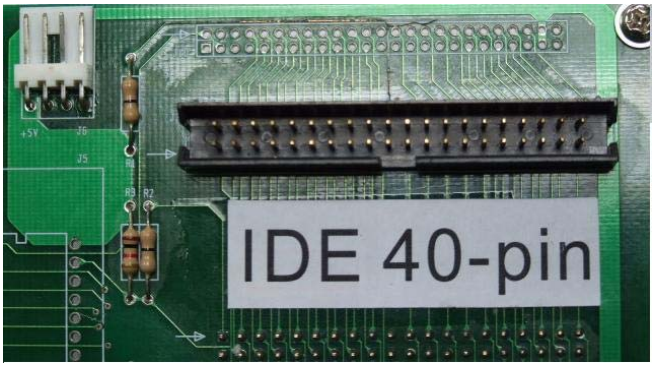

Figure 17 - Intact IDE male pins on Motherboard

(3) Any rude or wrong insertion will damage the both connectors of MIF and motherboard.

Figure 18 – Wrong Insertions

(4) When plugging in, make sure pin-1 of MIF matches to pin 1 of IDE socket on motherboard. The two ends of connectors must be vertically aligned. Press it down gently and swing slightly a few times. If insertion is not smooth, DO NOT ATTEMPT TO INSERT FORCEFULLY.

5.4.2. MIF Removing

(1) Make sure the power is off before removing.
(2) As they are firmly attached, you can swing gently a few times to remove. DO NOT PULL IT OFF FORECE.

5.5. *IDE Device Setup / Auto-Detection*

Most BIOSes have an entry in the Standard Setup menu for each of the four IDE/ATA devices supported in a system (primary master, primary slave, secondary master, and secondary slave). For each one, you can enter a value for each setting in this section (type, size, cylinders, etc.).

Virtually all BIOSes now come with IDE device Auto-Detection. This comes in two forms:

- **Dynamic IDE Auto-Detection:** This is the fully automatic mode. You set one or more of the IDE devices (primary master, primary slave, etc.) on "Auto" and the BIOS will automatically re-detect and set the correct options for the drive each time you boot the PC. The BIOS will usually display on the screen what device it finds each time it auto-detects. For most people, this is the best way to go; it ensures that your BIOS always has the correct information about your hardware, and it removes any possibility of you installing a new drive but forgetting to set up the CMOS properly, or of changing a parameter by mistake in the setup program. Not all BIOSes offer this setting but most newer ones do.

- **Manual IDE Auto-Detection:** This type of Auto-Detection is run from the BIOS setup program. You select Auto-Detection, and the BIOS will scan the IDE channels, and set the IDE parameters based on the devices it finds. When you save the BIOS settings, they are recorded permanently. The disadvantage of this is that if you change devices, you must return to the BIOS to re-auto-detect the new devices (unlike the dynamic Auto-Detection scheme, which does a fresh Auto-Detection each time you boot the PC). Virtually every BIOS created in the last 8 to 10 years offers manual Auto-Detection.

When you use dynamic Auto-Detection, the BIOS will normally "lock" the individual device settings that are being automatically set by the BIOS at boot time. Most systems that provide manual Auto-Detection will *not* lock the individual settings; they auto-detect, set the settings, and then let you change them if you want to. In most cases of course, you will not want to change what the BIOS detects.

Most BIOSes that allow dynamic Auto-Detection also allow manual Auto-Detection; the choice is yours. Using some sort of Auto-Detection for IDE/ATA devices is *strongly* recommended. It is the best way to reduce the chances of disk errors due to incorrect BIOS settings. It also provides immediate feedback of problems; if you can't auto-detect a drive from the BIOS, you know you have a problem even before you try to boot up.

5.6. *Partition & Format*

Before you install your operating system, you must first create a primary partition on the MIF on the system, and then format a file system on that partition. The Fdisk tool is an MS-DOS-based tool that you can use to prepare (partition) the MIF. You can use the Fdisk tool to create, change, delete, or display current partitions on the MIF, and then each allocated space on the MIF (primary partition, extended partition, or logical drive) is assigned a drive letter. Disk 1 may contain one extended partition, and a second MIF may contain a primary or extended partition. An extended partition may contain one or more logical MS-DOS drives.

After you use the Fdisk tool to partition MIF, use the Format tool to format those partitions with a file system. The file system File Allocation Table (FAT) allows the MIF to accept, store, and retrieve data. Windows 95 OEM Service Release 2 (OSR2), Windows 98, Windows 98 Second Edition, Windows Millennium Edition (Me), and Windows 2000 support the FAT16 and FAT32 file systems. When you run the Fdisk tool on a MIF that is larger than 512 megabytes (MB), you are prompted to choose one of the following file systems:

FAT16: This file system has a maximum of 2 gigabytes (GB) for each allocated space or drive letter. For example, if you use the FAT16 file system and have a 6-GB MIF, you can have three drive letters (C, D, and E), each with 2 GB of allocated space.

FAT32: This file system supports drives that are up to 2 terabytes in size and stores files on smaller sections of the MIF than the FAT16 file system does. This results in more free space on the MIF. The MIF file system does not support drives that are smaller than 512 MB.

When you run the **fdisk** and **format** commands, the Master Boot Record (MBR) and file allocation tables are created. The MBR and file allocation tables store the necessary disk geometry that allows MIF to accept, store, and retrieve data.

Ordering Information

X1 X2 X3 X4 X5 X6 X7 X8 X9 — X11 X12 X13 X14 X15 — Y1 Y2 Z1 / C

X1 : Grade

S : Standard Grade – operating temp. 0° C ~ 70 ° C

W : Industrial Grade – operating temp. -40° C ~ 85 ° C

X2 : The material of case

B : Bare (without case)

P : Plastic case

X3 X4 X5 : Product category

MIF : micro IDE Flash (module)

X6 X7 X8 X9 : Capacity

128M:	128MB
256M:	256MB
512M:	512MB
001G:	1GB
002G:	2GB
004G:	4GB
008G:	8GB

X11 : Controller

H : Hyperstone (Hermit Series)

X12 : Controller version

A, B, C…..

X13 : Controller grade

C : Commercial grade

I : Industrial grade

X14 : Flash IC

S : Samsung Flash IC

X15 : Flash IC grade / Type

C : Commercial grade

I : Industrial grade

Y1 Y2 : MIF orient only

0V : 40-pin IDE Vertical MIF

0R : 40-pin IDE Right-oriented MIF

0L : 40-pin IDE Left-oriented MIF

4V : 44-pin IDE Vertical MIF

4R : 44-pin IDE Right-oriented MIF

4L : 44-pin IDE Left-oriented MIF

Z1 : Data transfer rate

IDE interface is always Fixed Disk Mode

P : PIO-4 mode

U : UDMA-4 mode

A : Auto PIO or UDMA mode

C : Reserved for specific requirement

C : Conformal-coating

Appendix A. Limited Warranty

APRO warrants your Industrial 40/44-pin micro IDE Flash (MIF) Disk Hermit Series against defects in material and workmanship for the life of the drive. The warranty is void in the case of misuse, accident, alteration, improper installation, misapplication or the result of unauthorized service or repair. The implied warranties of merchantability and fitness for a particular purpose, and all other warranties, expressed or implied, except as set forth in this warranty, shall not apply to the products delivered. In no event shall APRO be liable for any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, this product.

BEFORE RETURNING PRODUCT, A RETURN MATERIAL AUTHORIZATION (RMA) MUST BE OBTAINED FROM APRO.

Product shall be returned to APRO with shipping prepaid. If the product fails to conform based on customers' purchasing orders, APRO will reimburse customers for the transportation charges incurred.

After Service

1. Policy

In order to return any item for repair, an RMA (Return Merchandise Authorization) number must be assigned by APRO. Customers need to provide the following information, before an RMA will be issued:

- **Product model**
- **Quantity**
- **Lot number**
- **Defect description**
- **Customer name**
- **Contact person**
- **Email address or telephone number**
- **Shipping address**

In order to receive an RMA number, please contact our customer service department via fax or email:

- **Fax the RMA Request Form to 886-2-2929 0389. The RMA Request From can be downloaded from http://www.apro-tw.com/support/rmaform.htm)**

- **Email to rma@apro-tw.com.tw**

The description of the defect needs to be clear and complete in order for APRO to address the problem according to customer expectations. Without a clear description, APRO can only provide a basic test of the returned products.

1.1. Warranty period

- SxMIFxxxx-HACSC- Series 3 year
- WxMIFxxxx-HBISI- Series 5 years

1.2. Service charge under warranty period

For a warranty repair, there is no charge.

Remark:
The warranty does not cover product damage due to improper operation or force of nature such as fire or flood.

1.3. Service charge for out of warranty period

Out of warranty repair charges are dependent on component cost and labor time. APRO will issue an estimate after diagnosing the problem.

1.4. End of Life service

APRO cannot guarantee repair of any products beyond one year of End-of-Life due to limited availability of replacement components. If repair components are not available, APRO will suggest equivalent products for purchase and offer special pricing.

1.5. Shipping Charges

The customer is responsible for packaging the product such that no additional damage occurs during normal shipping and handling. Any freight-collect shipments without notice in advance will be refused.

For warranty repairs, the customer is responsible for the cost of shipping the product back to APRO. APRO will pay for shipping back to the customer.

For DOA warranty replacements, APRO will pay shipping charges for return and replacement. APRO reserves the right to use the most economical shipping method available.

2. Procedure

The definition of defective products fall into three categories as described below:

- DOA (Defect on Arrival): Defect occurs within 30 days of purchase.
- RMA in warranty period
- RMA out of the warranty period

The above terms are determined by the purchase date on the invoice up to the time to product is returned to APRO. APRO's repair service procedure is as follows:

2.1. Request an RMA Number from APRO:

(1) Fill out an "RMA Request From" and send it by fax to +886-2-2929 0307 or e-mail to rma@APRO-tw.com

(2) APRO's RMA engineer will check that the "RAM Request From" has been completed with precise information. Then the customer will receive a RMA number.
If you need a replacement rather than wait for the returned defective product to be repaired, this requirement must be noted in your "RMA Request From".

2.2. Package and Delivery to APRO

(1) Returned products have to be packed properly to avoid damage during the transportation.

(2) DOA products: DOA products qualify for complete replacement and have to be returned with all accessories included in the original purchase.

(3) Please indicate your unique RMA umber on the top outside of the package.

(4) To speed up the RMA/DOA procedure, please notify us by e-mail (rma@APRO -tw.com) with information that includes the shipping date, the name of carrier and the tracking number of the package.

2.3. Product Check On Arrival

(1) APRO's RMA engineer will check your product within 8 hours since arrival.

(2) If the product arrives undamaged and conforms to the conditions described on the "RMA Request Form", it will be for repairing.

(3) If the product is damaged or there is some inconsistency with the "RMA Request Form" description, APRO will contact and confirm the status with the customer before proceeding.

2.4. Repair

(1) The RMA engineer will repair the defect as described by the customer. The products will also be tested to ensure it is in proper working order.

(2) If no additional problems are detected, APRO will notify the customer.

(3) If the customer does not reply us within 48 hours, and no failure occurs during testing, the product will be processed as NTF. (No testing failure).

2.5. Charge

The customer will be charged for repairs under below conditions:

- RMA is out of the warranty period
- RMA or DOA terms apply, but it is determined by APRO's RMA engineer that the defect was caused by abuse, misuse or unauthorized repair.

2.6. Package and Delivery to the customer

(1) We will properly pack the repaired product along with a RMA report.

(2) The RMA number and quantity will be clearly marked on the package.

(3) The customer will receive an e-mail notification of the product RMA number and shipping advice.