2.5" PATA-SSD Datasheet

CONTENTS

Revision History

Rev.	Date	History
0.1	2009/3/25	1. 1st draft
0.2	2009/3/30	1. Modify description
0.3	2009/4/16	1. Increase testing information
0.4	2009/6/25	1. Increase extended temperature product line
0.5	2009/7/14	1. Fixed the data transfer mode information.
0.6	2009/7/29	1. Define form template

1. Overview

Advantech SQFlash 2.5" PATA-SSD (Solid State Drive) is a non-volatile, solid state data storage system. Due to rapid reduction of flash media, Solid State Drive becomes more and more popular storage media to replace conventional Hard Disk Drive. Free of any mechanical components, 2.5" PATA-SSD provides more robust and cost effective storage solution for embedded application. Offering standard ATA interface, which is fully compatible with traditional HDD, 2.5" PATA-SSD offers the designer an easy solution to implement in PC-based systems.

Advantech SQFlash 2.5" PATA-SSD is one of the most popular cards today based on its high performance, good reliability and wide compatibility.

2. Features

- **Standard 2.5" PATA Form Factor**
- **Operating Voltage：3.3V、5.0V**
- **Standard ATA/IDE Bus Interface**
  - 512 Bytes/Sector
  - ATA command set compatible
  - Selectable Master/Slave Setting
- **Capacities**
  - SLC type：4GB，8GB，16GB，32GB，64GB
  - MLC type：8GB，16GB，32GB，64GB，128GB
- **Data Transfer mode**
  - Support Data Transfer up to PIO mode 4
  - Support Data Transfer up to Multiword DMA mode 2
  - Support Data Transfer up to Ultra DMA mode 4
- **Performance**
  - SLC type
    - Sustain Read Speed up to 65 MB/s
    - Sustain Write Speed up to 55 MB/s
  - MLC type
    - Sustain Read Speed up to 63 MB/s
    - Sustain Write Speed up to 28 MB/s
- **Temperature Ranges**
  - Commercial Temperature
    - 0℃ to 70℃ for operating
    - -25℃ to 85℃ for storage
  - Extended Temperature
    - -40℃ to 85℃ for operating
    - -55℃ to 125℃ for storage
- **Mechanical Specification**
  - Shock：2,500G / 0.5ms
  - Vibration：20G / 80~2,000Hz
- **Humidty**
  - Operating Humidity：5% ~ 95%
  - Non-Operating Humidity：5% ~ 95%
- **Flash Endurance**
  - SLC type：100,000 Program/Erase Cycle
  - MLC type：5,000 Program/Erase Cycle
- **MTBF**
  - 2,000,000 hours

- **Data Retention**
  - 10 years
- **Intelligent ATA/IDE Module**
  - Built-in Embedded Flash File System
  - Implements dynamic wear-leveling algorithms and static wear-leveling algorithms to increase endurance of flash media
  - This algorithm can correct up to 12 random bits per 512bytes area.
- **Acquired RoHS、CE、FCC Certificate**
- **Dimension：100mm x 69.85mm x 7.2 mm**

3. General Description

■ Advanced NAND Flash Controller

Advantech SQFlash 2.5" PATA-SSD includes Bad Block Management Algorithm, Wear Leveling Algorithm and Error Detection / Correction Code (EDC/ECC) Algorithm.

■ Bad Block Management

Bad blocks are blocks that contain one or more invalid bits of which the reliability is not guaranteed. Bad blocks may be representing when flash is shipped and may developed during life time of the device.

Advantech SQFlash 2.5" PATA-SSD implement an efficient bad block management algorithm to detect the factory produced bad blocks and manages any bad blocks that may develop over the life time of the device. This process is completely transparent to the user, user will not aware of the existence of the bad blocks during operation.

■ Wear Leveling

NAND Type flash have individually erasable blocks, each of which can be put through a finite number of erase cycles before becoming unreliable. It means after certain cycles for any given block, errors can be occurred in a much higher rate compared with typical situation. Unfortunately, in the most of cases, the flash media will not been used evenly. For certain area, like file system, the data gets updated much frequently than other area. Flash media will rapidly wear out in place without any rotation.

Wear leveling attempts to work around these limitations by arranging data so that erasures and re-writes are distributed evenly across the full medium. In this way, no single sector prematurely fails due to a high concentration of program/erase cycles.

Advantech SQFlash 2.5" PATA-SSD provides advanced wear leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. By implement both dynamic and static wear leveling algorithms, the life expectancy of the flash media can be improved significantly.

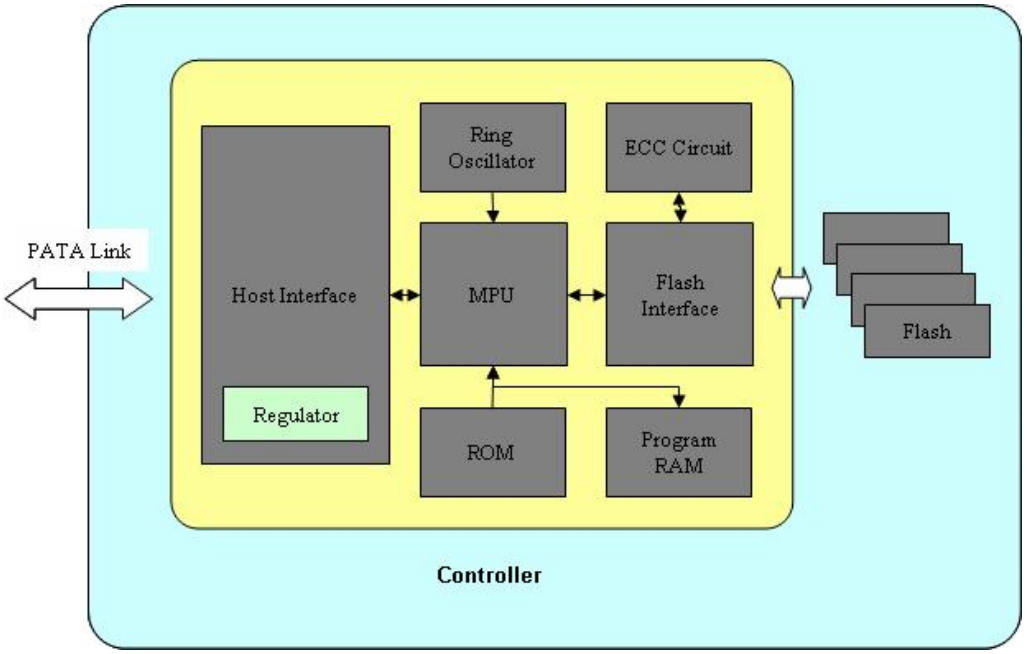
■ Error Detection / Correction

Advantech SQFlash 2.5" PATA-SSD utilizes BCH ECC Algorithm which offers one of the most powerful ECC algorithms in the industry. This algorithm can correct up to 12 random bits per 512bytes area.

■ Sophisticate Product Management Systems

Since industrial application require much more reliable devices compare with consumer product, a more sophisticated product management system become necessary for industrial customer requirement. The key to providing reliable devices is product traceability and failure analysis system. By implement such systems end customer can expect much more reliable product.

■ Block Diagram



■ LBA、Cylinders、Heads、Sectors value

Density	LBA (K bytes)	Cylinders	Heads	Sectors
4 GB	7,880,544	7,818	16	63
8 GB	15,072,624	14,953	16	63
16 GB	30,146,256	16,383	16	63
32 GB	61,078,752	16,383	16	63
64 GB	122,158,512	16,383	16	63
128 GB	249,822,720	16,383	16	63

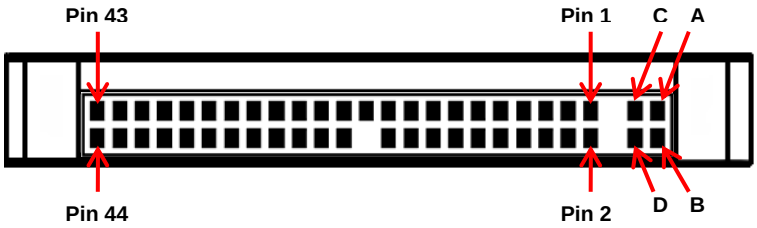
4. Pin Assignment and Description

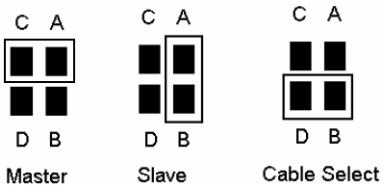
4.1 2.5" PATA-SSD Interface Pin Assignments

Pin #	Signal Name	Pin Type	Pin #	Signal Name	Pin Type
1	-RESET	I	2	GND	-
3	DD7	I/O	4	DD8	I/O
5	DD6	I/O	6	DD9	I/O
7	DD5	I/O	8	DD10	I/O
9	DD4	I/O	10	DD11	I/O
11	DD3	I/O	12	DD12	I/O
13	DD2	I/O	14	DD13	I/O
15	DD1	I/O	16	DD14	I/O
17	DD0	I/O	18	DD15	I/O
19	GND	-	20	KEY_PIN(OPEN)	
21	DMARQ	O	22	GND	-
23	-DIOW:STOP	I	24	GND	-
25	-DIOR:-HDMARDY:HSTOBE	O	26	GND	-
27	IORDY:DDMARDY:DSTROBE		28	CSEL	I
29	-DMACK	I	30	GND	-
31	INTRQ	O	32	IOIS16	O
33	DA1	I	34	-PDIAG:-CBLID	I/O
35	DA0	I	36	DA2	I
37	-CS0	I	38	-CS1	I
39	-DASP	I/O	40	GND	-
41	VCC	P	42	VCC	P
43	GND	-	44	NC	

***Note：**

"I"：An input from the host system to the device.
"O"：An output from the device to the host system.
"I/O"：An input/output (bi-direction) common.
"P"：Power supply.





4.2 2.5" PATA-SSD Pin Descriptions

Pin #	Signal Name	Pin Type	Description
1	**-RESET**	I	Hardware reset signal from the host
17, 15, 13, 11, 9, 7, 5, 3, 4, 6, 8, 10, 12, 14, 16, 18	**DD0~DD15** (Device Data)	I/O	16-bit bi-direction Data Bus. DD (7:0) are used for 8-bit register transfers.
21	**DMARQ** (DMA Request)	O	For DMA data transfers. Device will assert DMARQ when the device is ready to transfer data to or from the host.
23	**-DIOW** (I/O Write)	I	This is the strobe signal used by the host to write to the device register or Data port
	STOP (Stop UDMA Burst)		The host assert this signal during an UDMA burst to stop the DMA burst
25	**IORDY** (I/O channel ready)	O	This signal is used to temporarily stop the host register access (read or write) when the device is not ready to respond to a data transfer request.
	DDMARDY (UDMA ready)		The device will assert this signal to indicate that the device is ready to receive UDMA data-out burst.
	DSTROBE (UDMA data strobe)		When UDMA mode DMA Read is active, this signal is the data-in strobe generated by the device.
28	**CSEL** (Cable select)	I	This pin is used to configure this device as Device 0 or Device 1.
29	**-DMACK** (DMA acknowledge)	I	This signal is used by the host in respond to DMARQ to initiate DMA transfer.
31	**INTRQ** (Interrupt)	O	When this device is selected, this signal is the active high Interrupt Request to the host
32	**IOIS16**	O	During PIO transfer mode0, 1 or 2, this pin indicates to the host the 16-bit data port has been addressed and the device is prepared to send or receive a 16-bit data word. When transferring in DMA mode, the host must use a 16-bit DMA channel and this signal will not be asserted.
35, 33, 36	**DA0~DA2** (Device Address)	I	This is 3-bit binary coded Address Bus.
34	**-PDIAG** (Passed diagnostics)	I/O	This signal will be asserted by Device 1 to indicate to Device 0 that Device 1 has completed diagnostics,
	-CBLID (Cable assembly type identify)		
37, 38	**-CS0, -CS1** (Chip select)	I	These signals are used to select the Command Block and Control Block registers. When –DMACK is asserted, -Cs0 and –Cs1 shall be negated and transfers shall be 16-bit wide.
39	**-DASP** (Device active, Device 1 present)	I/O	During the reset protocol, -DASP shall be asserted by Device 1 to indicate that the device is present.
41, 42	**VCC**	P	Power supply
2, 19, 22, 24, 26, 30, 40, 43	**GND**	--	Ground.

5. Identify Drive Information

The Identity Drive Command enables Host to receive parameter information from the device. The parameter words in the buffer have the arrangement and meanings defined in below table. All reserve bits or words are zero

Word Address	Default Value	Total Bytes	Data Field Type Information
0	044Ah	2	General configuration – bit significant for Non-removable device
1	xxxxh	2	Default number of cylinders
2	0000h	2	Reserved
3	xxxxh	2	Default number of heads
4	7E00h	2	Retired
5	0200h	2	Retired
6	xxxxh	2	Default number of sectors per track
7 - 8	xxxxh	4	Number of sectors per device
9	0000h	2	Retired
10 - 19	xxxxh	20	Serial Number in ASCII
20	0002h	2	Retired
21	0002h	2	Retired
22	0004h	2	Number of ECC Bytes passed on Read/Write Long Commands
23 - 26	aaaah	8	Firmware revision in ASCII
27 - 46	xxxxh	40	Model number in ASCII
47	8001h	2	Maximum number of sector that shall be transferred on Read/Write Multiple commands
48	0000h	2	Reserved
49	2B00h	2	Capabilities-LBA/DMA Supported
50	4000h	2	Reserved
51	0200h	2	PIO data transfer cycle timing mode 2
52	0000h	2	Retired
53	0007h	2	Word 54 - 58, 64 - 70 and 88 are valid
54	xxxxh	2	Current numbers of cylinders
55	xxxxh	2	Current numbers of heads
56	xxxxh	2	Current sectors per track
57 - 58	xxxxh	4	Current capacity in sectors (LBAs)(Word 57= LSW, Word 58= MSW)
59	0101h	2	Multiple sector setting is valid
60 - 61	xxxxh	4	Total number of sectors addressable in LBA Mode
62	0000h	2	Retired
63	0007h	2	Multiword DMA mode 2 and below are supported
64	0003h	2	Advance PIO transfer modes supported
65	0078h	2	Minimum Multiword DMA transfer cycle time 120nsec
66	0078h	2	Manufacturer's recommended Multiword DMA transfer cycle time 120nsec
67	0078h	2	Minimum PIO transfer cycle time without flow control 120nsec
68	0078h	2	Minimum PIO transfer cycle time with IORDY flow control 120 nsec
69 - 79	0000h	26	Reserved
80	0030h		Major version number
81	0000h		Reserved
82	7009h	2	Supports Security Mode feature set
83	5004h	2	Reserved

Word Address	Default Value	Total Bytes	Data Field Type Information
84	4000h		
85	7009h		Feature Setting
86	1004h		Feature Setting
87	4000h		Feature Setting
88	203Fh	2	Ultra DMA mode 5 and below are supported, UDMA mode5 select
89 - 92	0000h	8	Reserved
93	xxxxh		
94 - 128	0000h	2	Enhanced security erase supported
129 - 159	0000h	62	Reserved vendor unique bytes
160 - 255	0000h	192	Reserved

***Note：**

"a"： Vender Specific Configuration

"n"： Host Selectable Configuration

6. Power Management

2.5" PATA-SSD provides automatic power saving mode. There are four modes on this system.

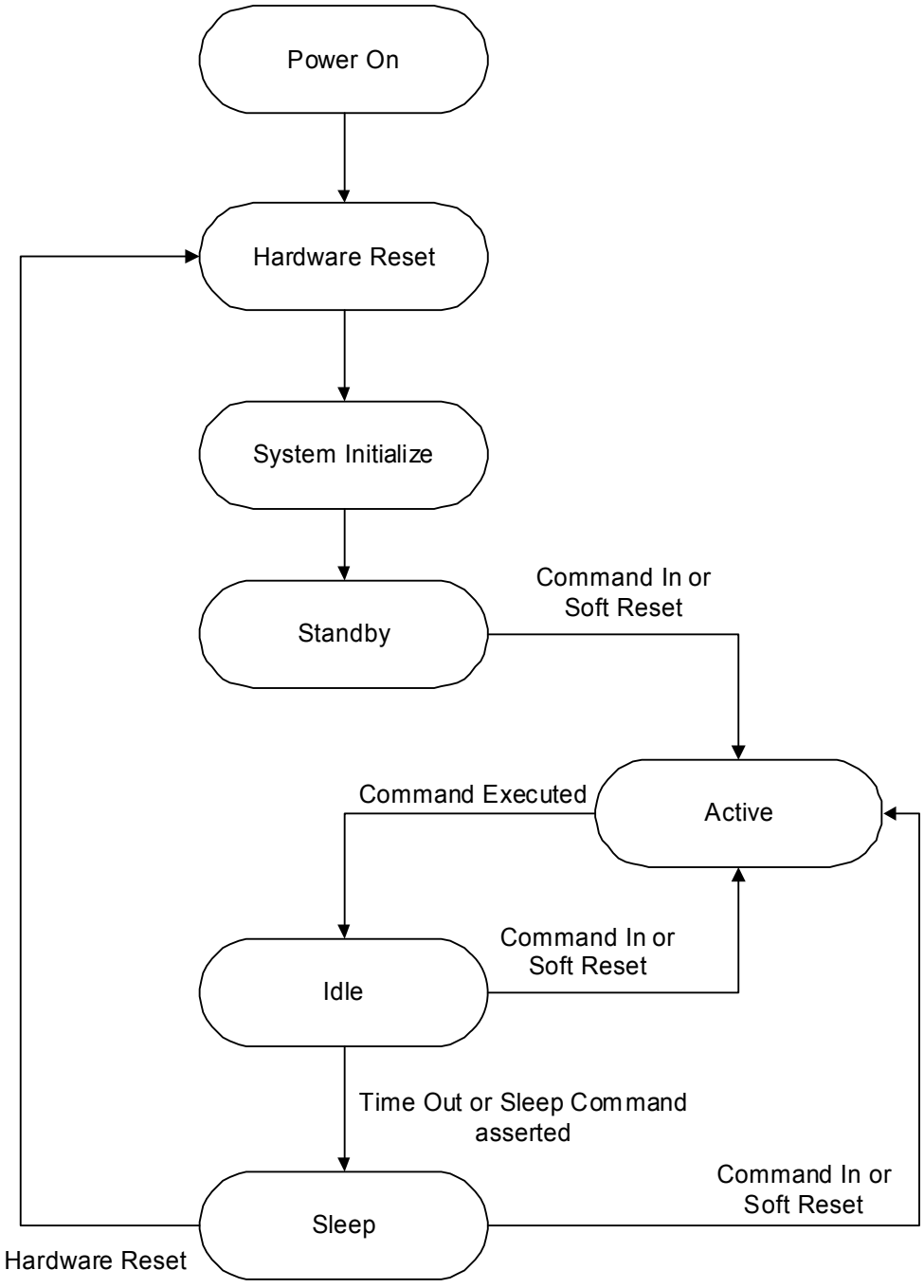
Standby Mode: When 2.5" PATA-SSD finishes the initialization routine after power reset, it goes into Standby Mode and wait for Command In or Soft Reset.

Active Mode: If 2.5" PATA-SSD received any Command In or Soft Reset, it goes into Active Mode. In Active Mode, it is capable to execute any ATA commands. The power consumption is the greatest in this mode.

Idle Mode: After 2.5" PATA-SSD executed any ATA Commands or Soft Reset, it goes into Idle Mode. Power consumption is reduced from Active Mode.

Sleep Mode: The 2.5" PATA-SSD will enter Sleep Mode if there is no Command In or Soft Reset from the host. 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.

6.1 Power Saving Flow



7. ATA Command Set

[Command Set List]

No.	Command set	Code	FR	SC	SN	CY	DR	HD	LBA
1	CHECK POWER MODE	98h,E5h	N	N	N	N	Y	N	N
2	EXECUTE DEVICE DIAGNOSTIC	90h	N	N	N	N	N	N	N
3	IDENTIFY DEVICE	Ech	N	N	N	N	Y	N	N
4	IDLE	97h,E3h	N	Y	N	N	Y	N	N
5	IDLE IMMEDIATE	95h,E1h	N	N	N	N	Y	N	N
6	INITIALIZE DEVICE PARAMETERS	91h	N	Y	N	N	Y	Y	N
7	NOP	00h	N	N	N	N	Y	N	N
8	READ BUFFER	E4h	N	N	N	N	Y	N	N
9	READ DMA	C8h,C9h	N	Y	Y	Y	Y	Y	Y
10	READ MULTIPLE	C4h	N	Y	Y	Y	Y	Y	Y
11	READ NATIVE MAX ADDRESS	F8h	N	N	N	N	Y	N	Y
12	READ LONG SECTOR	22h,23h	N	N	Y	Y	Y	Y	Y
13	READ SECTOR(S)	20h,21h	N	Y	Y	Y	Y	Y	Y
14	READ VERIFY SECTOR(S)	40h,41h	N	Y	Y	Y	Y	Y	Y
15	RECALIBRATE	1Xh	N	N	N	N	Y	N	N
16	SECURITY DISABLE PASSWORD	F6h	N	N	N	N	Y	N	N
17	SECURITY ERASE PREPARE	F3h	N	N	N	N	Y	N	N
18	SECURITY ERASE UNIT	F4h	N	N	N	N	Y	N	N
19	SECURITY FREEZE LOCK	F5h	N	N	N	N	Y	N	N
20	SECURITY SET PASSWORD	F1h	N	N	N	N	Y	N	N
21	SECURITY UNLOCK	F2h	N	N	N	N	Y	N	N
22	SEEK	7Xh	N	N	Y	Y	Y	Y	Y
23	SET FEATURE	EFh	Y	Y	Y	Y	Y	Y	N
24	SET MULTIPLE	C6h	N	Y	N	N	Y	N	N
25	SLEEP	99h,E6h	N	N	N	N	Y	N	N
26	SMART ENABLE/DISABLE AUTO SAVE	B0h	D2h	Y	N	Y	Y	N	N
27	SMART ENABLE OPERATION	B0h	D8h	N	N	Y	Y	N	N
28	SMART DISABLE OPERATION	B0h	D9h	N	N	Y	Y	N	N
29	SMART RETURN STATUS	B0h	DAh	N	N	Y	Y	N	N
30	STANDBY	96h,E2h	N	N	N	N	Y	N	N
31	STANDBY IMMEDIATE	94h,E0h	N	N	N	N	Y	N	N
32	WRITE BUFFER	E8h	N	N	N	N	Y	N	N
33	Write DMA	CAh,CBh	N	Y	Y	Y	Y	Y	Y
34	Write Multiple	C5h	N	Y	Y	Y	Y	Y	Y
35	Write Long Sector	32h,33h	N	N	Y	Y	Y	Y	Y
36	Write Sector(s)	30h,31h	N	Y	Y	Y	Y	Y	Y
37	Write Verify	3Ch	N	Y	Y	Y	Y	Y	Y

Note : FR: Feature Register
SC: Sector Count registers
SN: Sector Number register
CY: Cylinder Low/High register
DR: Device bit of Device/Head register
HD: Head No. (3 to 0) of Device/Head register
NH: No. of Heads
LBA: Logical Block Address
Y: Setup
N: Not setup

[Command Set Descriptions]

1. CHECK POWER MODE (code: E5h);
This command checks the power mode.

2. EXECUTE DEVICE DIAGNOSTIC (code: 90h);
This command performs the internal diagnostic tests implemented by the module.

3. IDENTIFY DEVICE (code: ECh);
The IDENTIFY DEVICE command enables the host to receive parameter information from the module.

4. IDLE (code: 97h or E3h);
This command allows the host to place the module in the Idle mode and also set the Standby timer. H_INTRQ_P may be asserted even through the module may not have fully transitioned to Idle mode. If the Sector Count register is non-"0", then the Standby timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby timer. If the Sector Count register is "0" then the Standby timer is disabled.

5. IDLE IMMEDIATE (code: 95h or E1h);
This command causes the module to set BSY, enter the Idle (Read) mode, clear BSY and generate an interrupt.

6. INITIALIZE DEVICE PARAMETERS (code: 91h);
This command enables the host to set the number of sectors per track and the number of heads per cylinder.

7. NOP (code: 00h);
If this command is issued, the module respond with command aborted.

8. READ BUFFER (code: E4h);
This command enables the host to read the current contents of the module's sector buffer.

9. READ DMA (code: C8h,C9h);
This command reads from "1" to "256" sectors as specified in the Sector Count register using the DMA data transfer protocol. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

10. READ MULTIPLE (code: C4h);
This command performs similarly to the READ SECTORS command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple commands.

11. READ NATIVE MAX ADDRESS (code: F8h);
This command returns the native maximum address.

12. READ LONG SECTOR (code: 22h, 23h);
This command is provided for compatibility purposes and nearly performs "1" sector READ SECTOR command except that it transfers the data and 4 bytes appended to the sector. These appended 4 bytes are all 0 data.

13. READ SECTOR(S) (code: 20h or 21h);
This command reads from "1" to "256" sectors as specified in the Sector Count register. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

14. READ VERIFY SECTOR(S) (code: 40h or 41h);
This command is identical to the READ SECTORS command, except that DRQ is never set and no data is transferred to the host.

15. RECALIBRATE (code: 1Xh);
This command return value is select address mode by the host request.

16. SECURITY DISABLE PASSWORD (code: F6h);
This command transfers 512Bytes of data from the host. Table Security Password defines the content of this information.

17. SECURITY ERASE PREPARE (code: F3h);
This command shall be issued immediately before the SECURITY ERASE UNIT command to enable device erasing and unlock. This command prevents accidental erase of the device.

18. SECURITY ERASE UNIT (code: F4h);
This command requests transfer of a single sector of data as form of table SECURITY ERASE UNIT password from the host.
If the password is not match, this command will be reject, the Security Erase Prepare command should be completed immediately prior the Security Erase Unit command.
If Normal Erase mode, the all user data area will be written binary 0, if Enhanced Erase mode, the predetermined data pattern will written to the user data area.

19. SECURITY FREEZE LOCK (code: F5h);
This command sets the device to Frozen mode. After command completion, all other commands that update device lock mode shall be command aborted. Frozen mode shall be disabled by power-off or hardware reset.

20. SECURITY SET PASSWORD (code: F1h);
This command requests a transfer of a single sector of data from the host.

21. SECURITY UNLOCK (code: F2h);
This command requests transfer of a single sector of data from the host.

22. SEEK (code: 7Xh);
This command performs a range check.

23. SET FEATURE (code: EFh);
This command is used by the host to establish parameters that affect the execution of certain device features.

24. SET MULTIPLE MODE (code: C6h);
This command enables the module to perform READ and Write Multiple operations and establishes the block count for these commands.

25. SLEEP (code: 99h or E6h);
This command causes the module to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

26. SMART ENABLE/DISABLE AUTO SAVE (code: B0h);
This command enables and disables the optional attribute auto save feature of the module.

27. SMART ENABLE OPEARIONS (code: B0h);
This command enables access to all SMART capabilities within the module.

28. SMART DISABLE OPEMTIONS (code: B0h);
This command disables all SMART capabilities within the module.

29. SMART RETURN STATUS (code: B0h);
This command causes the module return the reliability status of the module to the host.

30. STANDBY (code: 96h or E2h);
This command causes the module to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

31. STANDBY IMMEDIATE (code: 94h or E0h);
This command causes the module to set BSY, enter the Sleep mode (which corresponds to the ATA Standby Mode), clear BSY and return the interrupt immediately.

32. WRITE BUFFER (code: E8h);
This command enables the host to overwrite contents of the module's sector buffer with any data pattern desired.

33. WRITR DMA (code: CAh or CBh);
This command writes from "1" to "256" sectors as specified in the Sector Count register using the DMA data transfer protocol. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

34. WRITE MULTIPLE (code: C5h);
This command is similar to the WRITE SECTORS command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

35. WRITE LONG SECTOR (code: 32h or 33h);
This command is provided for compatibility purposes and nearly performs "1" sector WRITE SECTOR command except that it transfers the data and 4 bytes appended to the sector. These appended 4 bytes are not written on the flash memories.

36. WRITE SECTOR(S) (code: 30h or 31h);
This command writes from "1" to "256" sectors as specified in the Sector Count register. A sector count of "0" requests "256" sectors transfer. The transfer begins at the sector specified in the Sector Number register.

37. WRITE VERIFY (code: 3Ch);
This command is similar to the WRITE SECTOR(S) command, except that each sector is verified before the command is completed.

8. System Power Consumption

(Ta = 0 to 70℃)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Iccr	Read current	5V	-	130	-	mA
Iccw	Write current	5V	-	140	-	mA
Ipd	Power down current	5V	-	0.2	0.4	mA
Iccr	Read current	3.3V	-	200	-	mA
Iccw	Write current	3.3V	-	210	-	mA
Ipd	Power down current	3.3V	-	0.3	-	mA

9. Electrical Specifications

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit	Remark
V_{DD}-V_{SS}	DC Power Supply	-0.3	+5.5	V	
V_{IN}	Input Voltage	V_{SS}-0.3	V_{DD}+0.3	V	
Ta	Operating Temperature	0	+70	℃	Commercial version
Tst	Storage Temperature	-25	+85	℃	Commercial version
Ta	Operating Temperature	-40	+85	℃	Extended version
Tst	Storage Temperature	-55	+125	℃	Extended version

Symbol	Parameter	Min	Typ	Max	Unit	Remark
V_{DD}	V_{DD} Voltage	3.0	3.3	3.6	V	
		4.5	5.0	5.5	V	

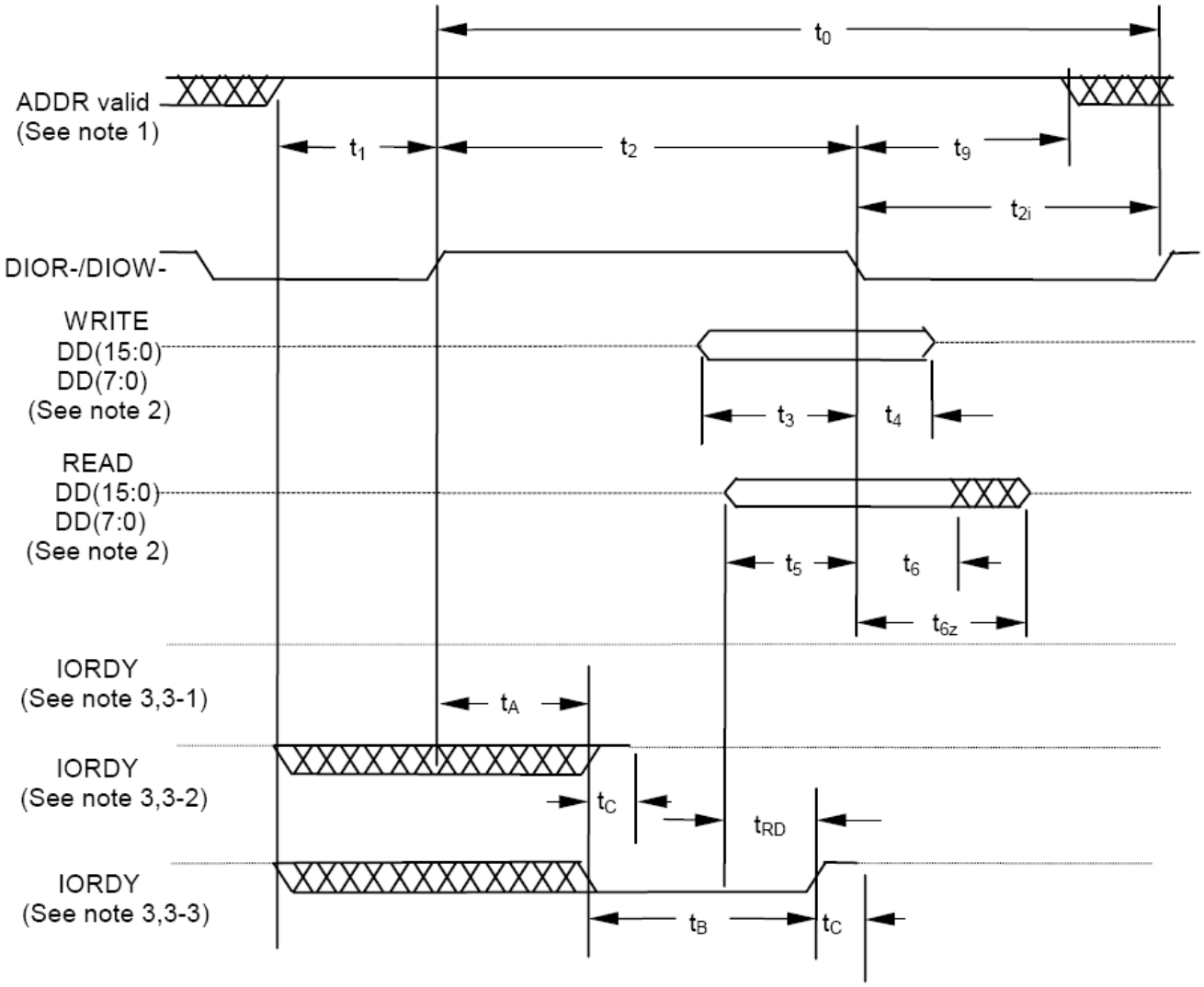
10. DC Characters

DC characteristics of 5.0V I/O Cells (Host Interface)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vol	Output Low Voltage	|Iol| = 4 ~ 32 mA	-	-	0.4	V
Voh	Output High Voltage	|Ioh| =4 ~ 32 mA	2.8	-	-	V
Vil	Input Low Voltage	TTL (5V)	-	-	0.85	V
Vih	Input High Voltage		1.25	-	-	V
Vil	Input Low Voltage	TTL (3.3V)	-	-	1.05	V
Vih	Input High Voltage		1.75	-	-	V
Iin	Input Leakage Current	No pull-up or pull-down	-10	±1	10	µA
Ioz	Tri-state Output Leakage Current		-10	±1	10	µA

11. AC Characters

11.1 PIO Data Transfer



NOTES –

1 Device address consists of signals CS0-, CS1- and DA(2:0)

2 Data consists of DD(15:0) for all devices except devices implementing the CFA feature set when 8-bit transfers is enabled. In that case, data consists of DD(7:0).

3 The negation of IORDY by the device is used to extend the PIO cycle. The determination of whether the cycle is to be extended is made by the host after t_A from the assertion of DIOR- or DIOW-. The assertion and negation of IORDY are described in the following three cases:

- 3-1 Device never negates IORDY, devices keeps IORDY released: no wait is generated.
- 3-2 Device negates IORDY before t_A, but causes IORDY to be asserted before t_A. IORDY is released prior to negation and may be asserted for no more than 5 ns before release: no wait generated.
- 3-3 Device negates IORDY before t_A. IORDY is released prior to negation and may be asserted for no more than 5 ns before release: wait generated. The cycle completes after IORDY is reasserted. For cycles where a wait is generated and DIOR- is asserted, the device shall place read data on DD(7:0) for t_{RD} before asserting IORDY.

4 DMACK- shall be negated during a PIO data transfer.

PIO timing parameters			Mode 0 ns	Mode 1 ns	Mode 2 ns	Mode 3 ns	Mode 4 ns	Note
t_0	Cycle time	(min)	600	383	240	180	120	1,4
t_1	Address valid to DIOR-/DIOW- setup	(min)	70	50	30	30	25	
t_2	DIOR-/DIOW-	(min)	165	125	100	80	70	1
t_{2i}	DIOR-/DIOW- recovery time	(min)	-	-	-	70	25	1
t_3	DIOW- data setup	(min)	60	45	30	30	20	
t_4	DIOW- data hold	(min)	30	20	15	10	10	
t_5	DIOR- data setup	(min)	50	35	20	20	20	
t_6	DIOR- data hold	(min)	5	5	5	5	5	
t_{6Z}	DIOR- data tristate	(max)	30	30	30	30	30	2
t_9	DIOR-/DIOW- to address valid hold	(min)	20	15	10	10	10	
t_{RD}	Read Data Valid to IORDY active (if IORDY initially low after t_A)	(min)	0	0	0	0	0	
t_A	IORDY Setup time		35	35	35	35	35	3
t_B	IORDY Pulse Width	(max)	1250	1250	1250	1250	1250	
t_C	IORDY assertion to release	(max)	5	5	5	5	5	

NOTES –

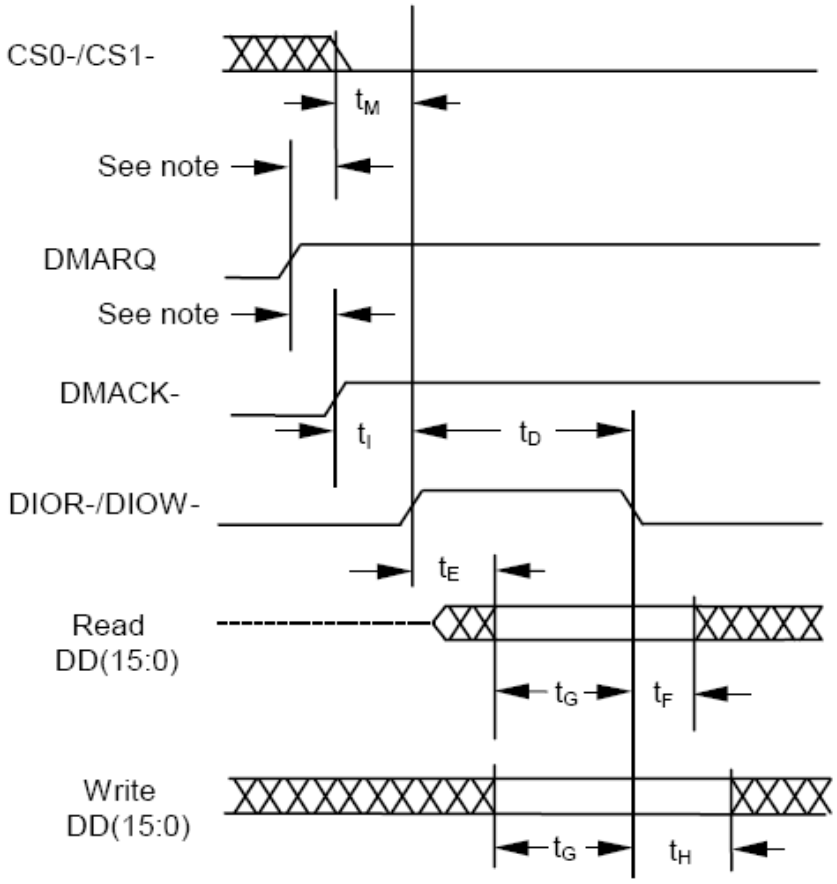
1 t_0 is the minimum total cycle time, t_2 is the minimum DIOR-/DIOW- assertion time, and t_{2i} is the minimum DIOR-/DIOW- negation time. A host implementation shall lengthen t_2 and/or t_{2i} to ensure that t_0 is equal to or greater than the value reported in the devices IDENTIFY DEVICE data. A device implementation shall support any legal host implementation.

2 This parameter specifies the time from the negation edge of DIOR- to the time that the data bus is released by the device.

3 The delay from the activation of DIOR- or DIOW- until the state of IORDY is first sampled. If IORDY is inactive then the host shall wait until IORDY is active before the PIO cycle is completed. If the device is not driving IORDY negated at the t_A after the activation of DIOR- or DIOW-, then t_5 shall be met and t_{RD} is not applicable. If the device is driving IORDY negated at the time t_A after the activation of DIOR- or DIOW-, then t_{RD} shall be met and t_5 is not applicable.

4 Mode may be selected at the highest mode for the device if CS(1:0) and AD(2:0) do not change between read or write cycles or selected at the highest mode supported by the slowest device if CS(1:0) or AD(2:0) do change between read or write cycles.

11.2 Multi Word DMA

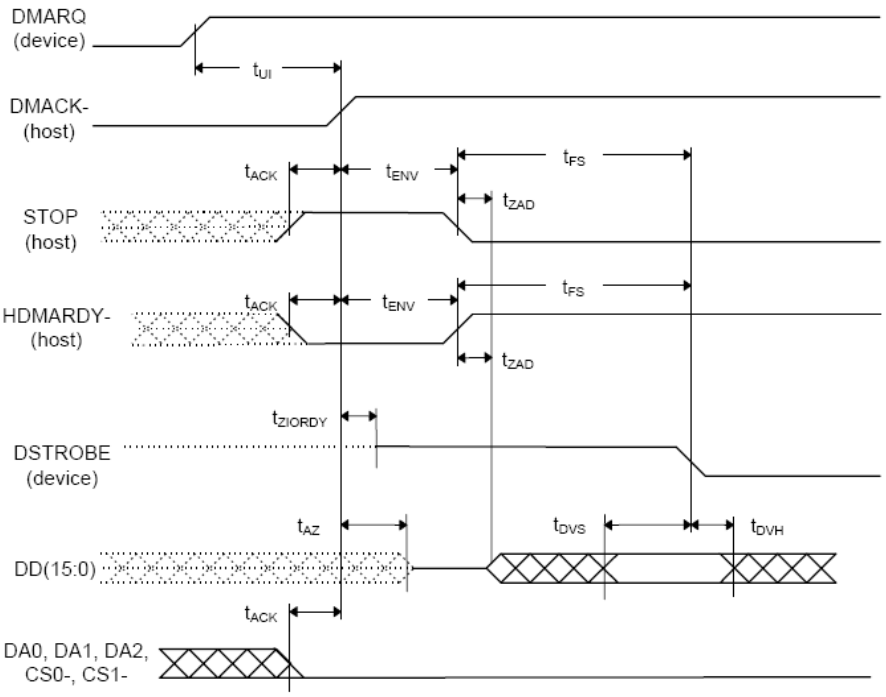


NOTE – The host shall not assert DMACK- or negate both CS0 and CS1 until the assertion of DMARQ is detected. The maximum time from the assertion of DMARQ to the assertion of DMACK- or the negation of both CS0 and CS1 is not defined.

Multiword DMA timing parameters		Mode 0 (ns)	Mode 1 (ns)	Mode2 (ns)	Note
t_0	Cycle time (min)	480	150	120	See note
t_D	DIOR-/DIOW- asserted pulse width (min)	215	80	70	See note
t_E	DIOR- data access (max)	150	60	50	
t_F	DIOR- data hold (min)	5	5	5	
t_G	DIOR-/DIOW- data setup (min)	100	30	20	
t_H	DIOW- data hold (min)	20	15	10	
t_I	DMACK to DIOR-/DIOW- setup (min)	0	0	0	
t_J	DIOR-/DIOW- to DMACK hold (min)	20	5	5	
t_{KR}	DIOR- negated pulse width (min)	50	50	25	See note
t_{KW}	DIOW- negated pulse width (min)	215	50	25	See note
t_{LR}	DIOR- to DMACK delay (max)	120	40	35	
t_{LW}	DIOW- to DMACK delay (max)	40	40	35	
t_M	CS(1:0) valid to DIOR-/DIOW- (min)	50	30	25	
t_N	CS(1:0) hold (min)	15	10	10	
t_Z	DMACK- to read data released (max)	20	25	25	
Notes- t_0 is the minimum total cycle. t_D is the minimum DIOR-/DIOW- assertion time, and t_K(t_{KR} or t_{KW}, as appropriate) is the minimum DIOR-/DIOW- negation time. A host shall lengthen t_D and/or t_K to ensure that t_0 is equal to the value reported in the devices IDENTIFY DEVICE data.					

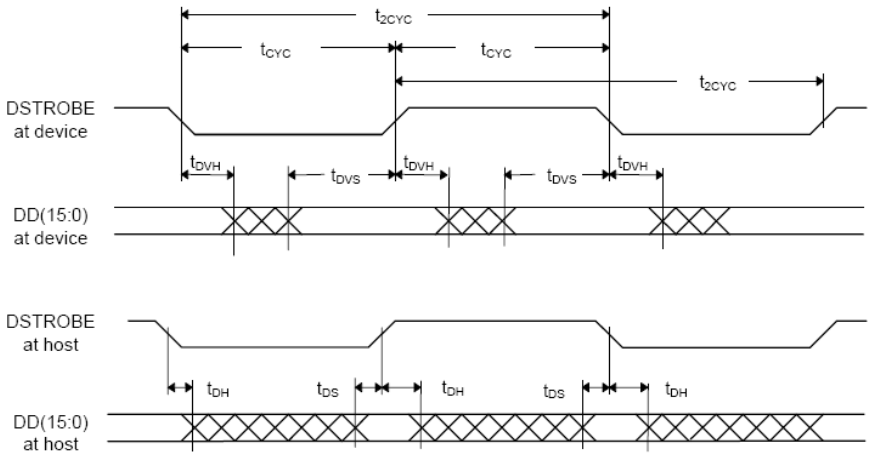
11.3 Ultra DMA

[Initiating an Ultra DMA data-in burst]



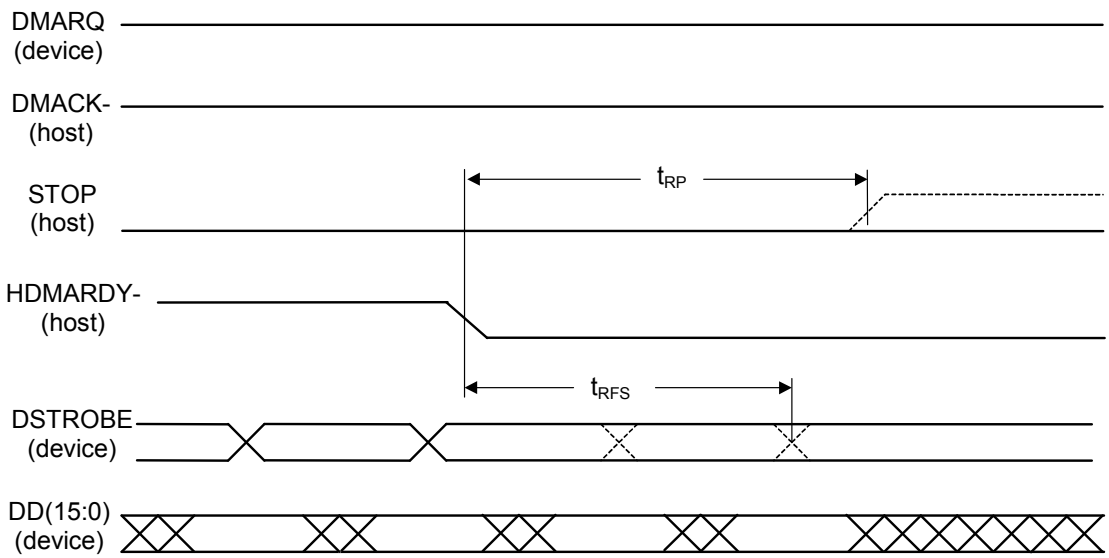
NOTES –
1 See 9.13.1 Initiating an Ultra DMA data-in burst.
2 The definitions for the DIOW-:STOP, DIOR-:HDMARDY-:HSTROBE and IORDY:DDMARDY-:DSTROBE signal lines are not in effect until DMARQ and DMACK are asserted.

[Sustained Ultra DMA data-in burst]

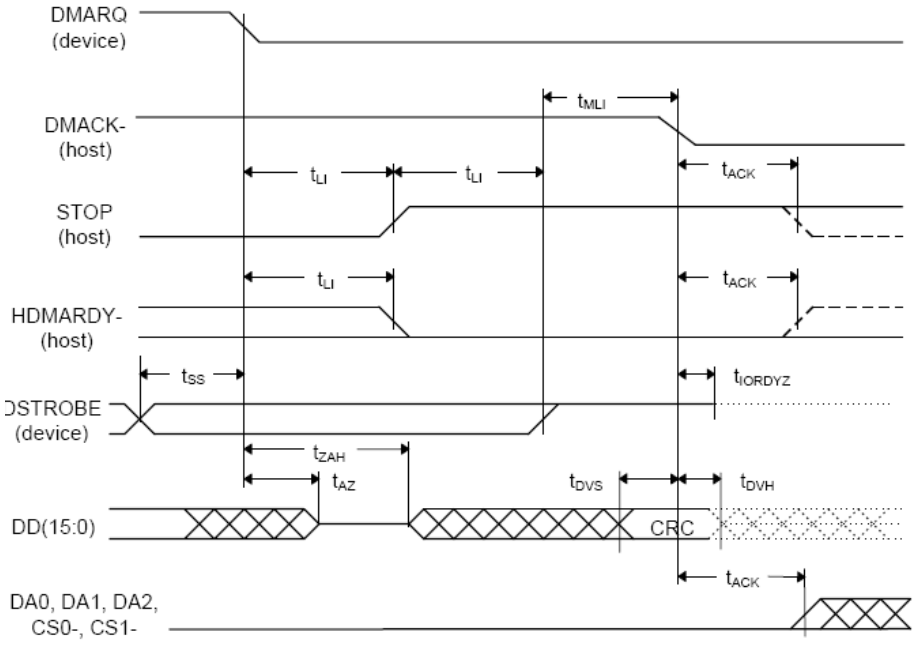


NOTES –
1 See 9.13.2 The data-in transfer.
2 DD(15:0) and DSTROBE signals are shown at both the host and the device to emphasize that cable settling time as well as cable propagation delay shall not allow the data signals to be considered stable at the host until some time after they are driven by the device.

[Host pausing an Ultra DMA data-in burst]

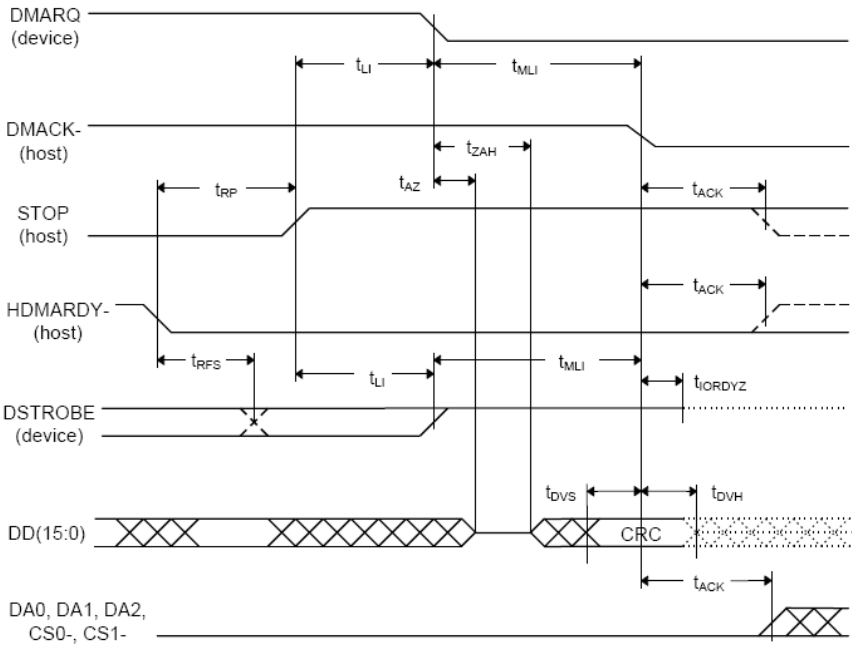


[Device terminating an Ultra DMA data-in burst]



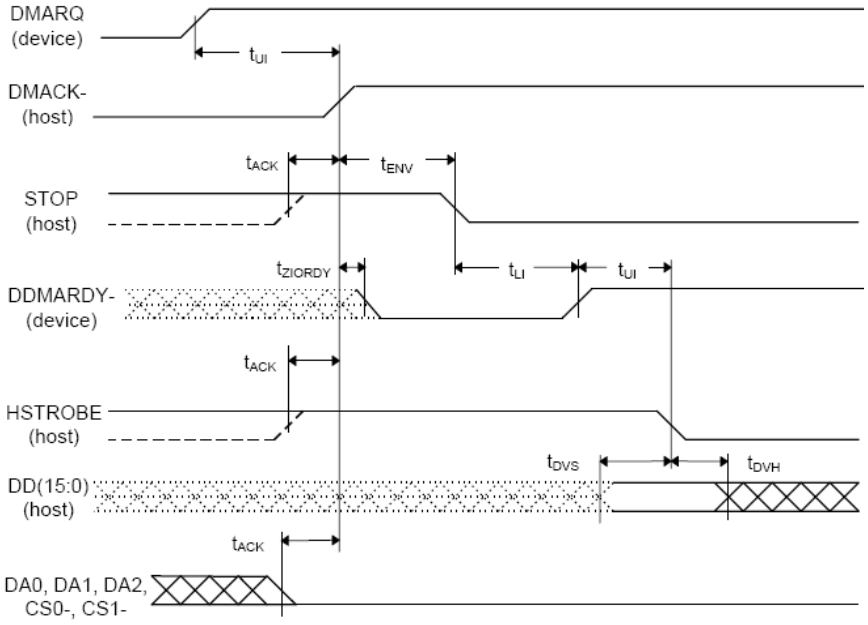
NOTES –
1 See 9.13.4.1 Device terminating an Ultra DMA data-in burst.
2 The definitions for the DIOW-:STOP, DIOR-:HDMARDY-:HSTROBE and IORDY:DDMARDY-:DSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

[Host terminating an Ultra DMA data-in burst]



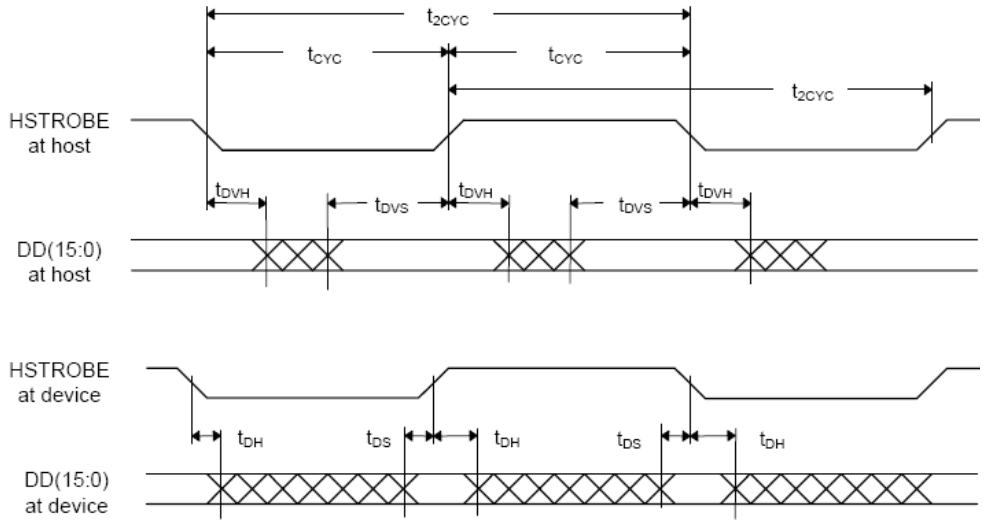
NOTES –
1 See 9.13.4.2 Host pausing an Ultra DMA data-in burst.
2 The definitions for the DIOW-:STOP, DIOR-:HDMARDY-:HSTROBE and IORDY:DDMARDY-:DSTROBE signal lines are no longer in effect after DMARQ and DMACK are negated.

[Initiating an Ultra DMA data-out burst]



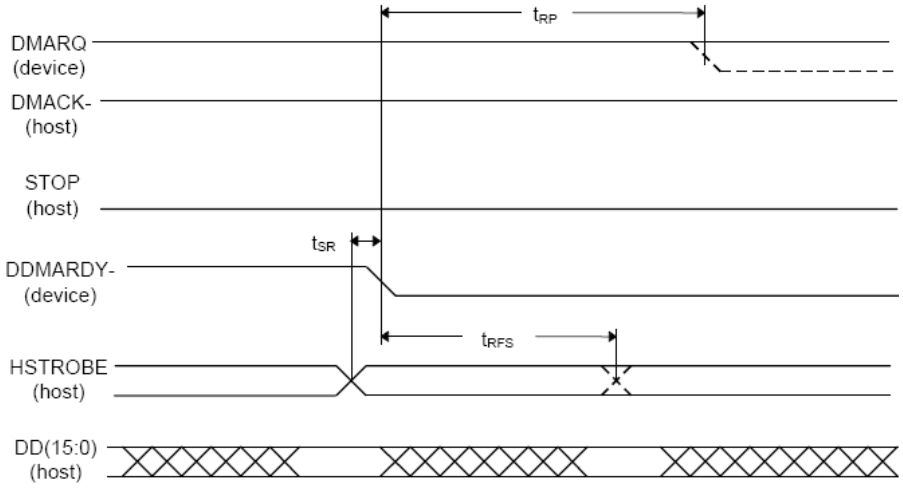
NOTES –
1 See 9.14.1 Initiating an Ultra DMA data-out burst.
2 The definitions for the DIOW-:STOP, IORDY:DDMARDY-:DSTROBE and DIOR-:HDMARDY-:HSTROBE signal lines are not in effect until DMARQ and DMACK are asserted.

[Sustained Ultra DMA data-out burst]



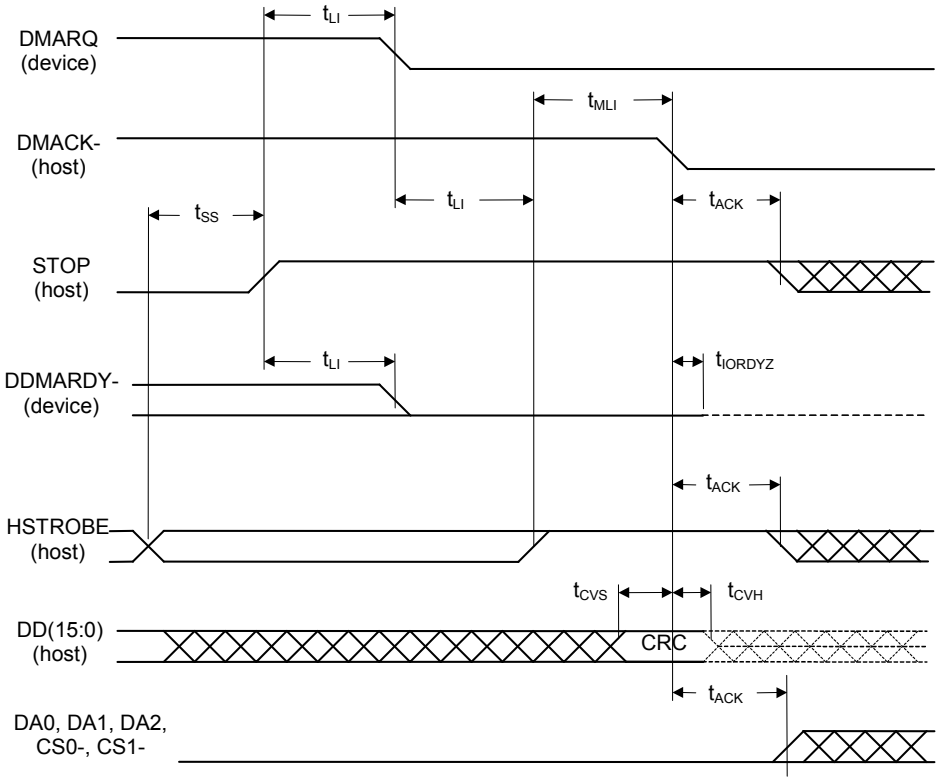
NOTES –
1 See 9.14.2 The data out-transfer.
2 DD(15:0) and HSTROBE signals are shown at both the device and the host to emphasize that cable settling time as well as cable propagation delay shall not allow the data signals to be considered stable at the device until some time after they are driven by the host.

[Device pausing an Ultra DMA data-out burst]

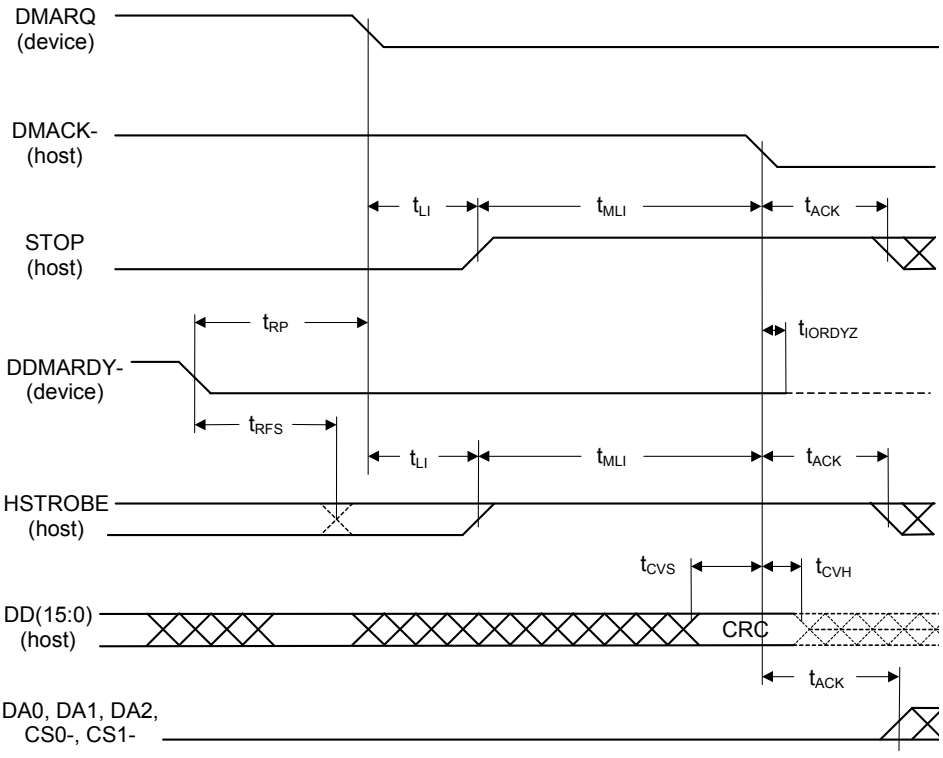


NOTES –
1 See 9.14.3.2 Device pausing an Ultra DMA data-out burst.
2 The device may negate DMARQ to request termination of the Ultra DMA burst no sooner than t_{RP} after DDMARDY- is negated.
3 If the t_{SR} timing is not statisfied, the device may receive zero, one, or two more data words from the host.

[Host terminating an Ultra DMA data-out burst]



[Device terminating an Ultra DMA data-out burst]



[Ultra DMA data burst timing requirements]

Name	Mode 0 (ns)		Mode 1 (ns)		Mode 2 (ns)		Mode 3 (ns)		Mode 4 (ins)		Mode 5 (ns)		Measurement location
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{2CYCTYP}$	240		160		120		90		60		40		Sender
t_{CYC}	112		73		54		39		25		16.8		Note 3
t_{2CYC}	230		153		115		86		57		38		Sender
t_{DS}	15.0		10.0		7.0		7.0		5.0		4.0		Recipient
t_{DH}	5.0		5.0		5.0		5.0		5.0		4.6		Recipient
t_{DVS}	70.0		48.0		31.0		20.0		6.7		4.8		Sender
t_{DVH}	6.2		6.2		6.2		6.2		6.2		4.8		Sender
t_{CS}	15.0		10.0		7.0		7.0		5.0		5.0		Device
t_{CH}	5.0		5.0		5.0		5.0		5.0		5.0		Device
t_{CVS}	70.0		48.0		31.0		20.0		6.7		10.0		Host
t_{CVH}	6.2		6.2		6.2		6.2		6.2		10.0		Host
t_{ZFS}	0		0		0		0		0		35		Device
t_{DZFS}	70.0		48.0		31.0		20.0		6.7		25		Sender
t_{FS}		230		200		170		130		120		90	Device
t_{LI}	0	150	0	150	0	150	0	100	0	100	0	75	Note 4
t_{MLI}	20		20		20		20		20		20		Host
t_{UI}	0		0		0		0		0		0		Host
t_{AZ}		10		10		10		10		10		10	Note 5
t_{ZAH}	20		20		20		20		20		20		Host
t_{ZAD}	0		0		0		0		0		0		Device
t_{ENV}	20	70	20	70	20	70	20	55	20	55	20	50	Host
t_{RFS}		75		70		60		60		60		50	Sender
t_{RP}	160		125		100		100		100		85		Recipient
t_{IORDYZ}		20		20		20		20		20		20	Device
t_{ZIORDY}	0		0		0		0		0		0		Device
t_{ACK}	20		20		20		20		20		20		Host
t_{SS}	50		50		50		50		50		50		Sender

NOTES –
1 All timing measurement switching points (low to high and high to low) shall be taken at 1.5 V.
2 All signal transitions for a timing parameter shall be measured at the connector specified in the measurement location column. For example, in the case of t_{RFS}, both STROBE and DMARDY- transitions are measured at the sender connector.
3 The parameter t_{CYC} shall be measured at the recipient's connector farthest from the sender.
4 The parameter t_{LI} shall be measured at the connector of the sender or recipient that is responding to an incoming transition from the recipient or sender respectively. Both the incoming signal and the outgoing response shall be measured at the same connector.
5 The parameter t_{AZ} shall be measured at the connector of the sender or recipient that is driving the bus but must release the bus the allow for a bus turnaround.

[Ultra DMA data burst timing descriptions]

Name	Comment
$t_{2CYCTYP}$	Typical sustained average two cycle time
t_{CYC}	Cycle time allowing for asymmetry and clock variations (from STROBE edge to STROBE edge)
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)
t_{DS}	Data setup time at recipient (from data valid until STROBE edge) (See note 2,5)
t_{DH}	Data hold time at recipient (from STROBE edge until data may become invalid) (See note 2,5)
t_{DVS}	Data valid setup time at sender (from data valid until STROBE edge) (See note 3)
t_{DVH}	Data valid hold time at sender (from STROBE edge until data may become invalid) (See note 3)
t_{CS}	CRC word setup time at device (See note 2)
t_{CH}	CRC word hold time device (See note 2)
t_{CVS}	CRC word valid setup time at host (from CRC valid until DMACK- negation) (See note 3)
t_{CVH}	CRC word valid hold time at sender (from DMACK- negation until CRC may become invalid) (See note 3)
t_{ZFS}	Time from STROBE output released-to-driving until the first transition of critical timing.
t_{DZFS}	Time from data output released-to-driving until the first transition of critical timing.
t_{FS}	First STROBE time (for device to first negate DSTROBE from STOP during a data in burst)
t_{LI}	Limited interlock time (See note 1)
t_{MLI}	Interlock time with minimum (See note 1)
t_{UI}	Unlimited interlock time (See note 1)
t_{AZ}	Maximum time allowed for output drivers to release (from asserted or negated)
t_{ZAH}	Minimum delay time required for output
t_{ZAD}	drivers to assert or negate (from released)
t_{ENV}	Envelope time (from DMACK- to STOP and HDMARDY- during data in burst initiation and from DMACK to STOP during data out burst initiation)
t_{RFS}	Ready-to-final-STROBE time (no STROBE edges shall be sent this long after negation of DMARDY-)
t_{RP}	Ready-to-pause time (that recipient shall wait to pause after negating DMARDY-)
t_{IORDYZ}	Maximum time before releasing IORDY
t_{ZIORDY}	Minimum time before driving IORDY (See note 4)
t_{ACK}	Setup and hold times for DMACK- (before assertion or negation)
t_{SS}	Time from STROBE edge to negation of DMARQ or assertion of STOP (when sender terminates a burst)

NOTES –

1 The parameters t_{UI}, t_{MLI}, and t_{LI} indicate sender-to-recipient or recipient-to-sender interlocks, i.e., one agent (either sender or recipient) is waiting for the other agent to respond with a signal before proceeding. t_{UI} is an unlimited interlock that has no maximum time value. t_{MLI} is a limited time-out that has a defined minimum. t_{LI} is a limited time-out that has a defined maximum.

2 80-conductor cabling shall be required in order to meet setup (t_{DS}, t_{CS}) and hold (t_{DH}, t_{CH}) times in modes greater than 2.

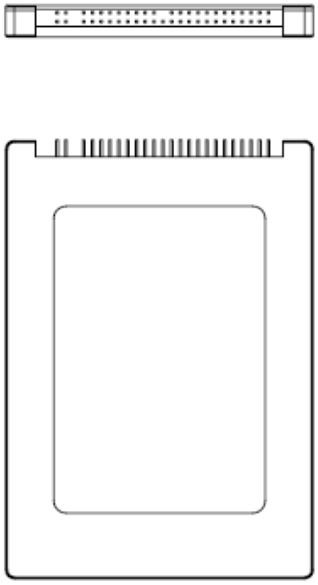
3 Timing for t_{DVS}, t_{DVH}, t_{CVS} and t_{CVH} shall be met for lumped capacitive loads of 15 and 40 pf at the connector where the Data and STROBE signals have the same capacitive load value. Due to reflections on the cable, these timing measurements are not valid in a normally functioning system.

4 For all modes the parameter t_{ZIORDY} may be greater than t_{ENV} due to the fact that the host has a pull-up on IORDY- giving it a known state when released.

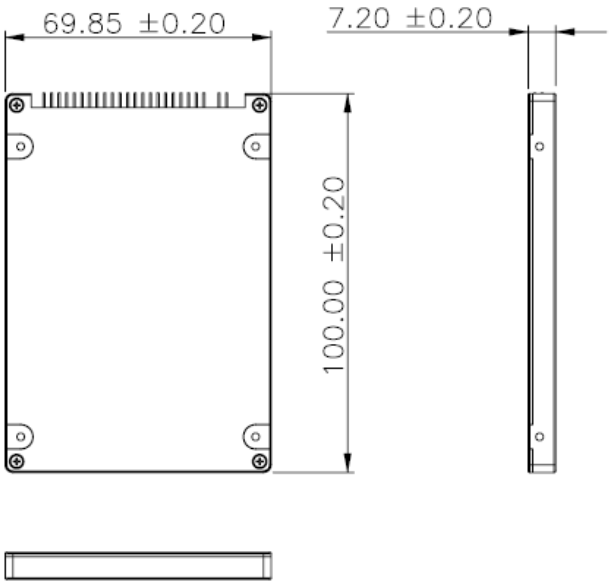
5 The parameters t_{DS}, t_{DH} for mode 5 are defined for a recipient at the end of the cable only in a configuration with a single device located at the end of the cable. This could result in the minimum values for t_{DS} and t_{DH} for mode 5 at the middle connector being 3.0 and 3.9 ns respectively.

12. Physical Dimension

2.5" PATA SSD (Unit: mm)



(Top View)



(Bottom View)

Appendix: Part Number Table

Product	Advantech PN	Manufacture PN
Advantech SQFlash 2.5" PATA SSD 4G SLC, DMA (0~70°C)	SQF-P25S4-4G-CTE	PSB004GTSC0-P70
Advantech SQFlash 2.5" PATA SSD 8G SLC, DMA (0~70°C)	SQF-P25S4-8G-CTE	PSB008GTSC0-P70
Advantech SQFlash 2.5" PATA SSD 16G SLC, DMA (0~70°C)	SQF-P25S4-16G-CTE	PSB016GTSC0-P70
Advantech SQFlash 2.5" PATA SSD 32G SLC, DMA (0~70°C)	SQF-P25S4-32G-CTE	PSB032GTSC0-P70
Advantech SQFlash 2.5" PATA SSD 64G SLC, DMA (0~70°C)	SQF-P25S4-64G-CTE	PSB064GTSC0-P70
Advantech SQFlash 2.5" PATA SSD 4G SLC, DMA (-40~85°C)	SQF-P25S4-4G-ETE	PSB004GTSE0-P70
Advantech SQFlash 2.5" PATA SSD 8G SLC, DMA (-40~85°C)	SQF-P25S4-8G-ETE	PSB008GTSE0-P70
Advantech SQFlash 2.5" PATA SSD 16G SLC, DMA (-40~85°C)	SQF-P25S4-16G-ETE	PSB016GTSE0-P70
Advantech SQFlash 2.5" PATA SSD 32G SLC, DMA (-40~85°C)	SQF-P25S4-32G-ETE	PSB032GTSE0-P70
Advantech SQFlash 2.5" PATA SSD 64G SLC, DMA (-40~85°C)	SQF-P25S4-64G-ETE	PSB064GTSE0-P70
Advantech SQFlash 2.5" PATA SSD 8G MLC, DMA (0~70°C)	SQF-P25M4-8G-CTE	PSB008GTMC0-P70
Advantech SQFlash 2.5" PATA SSD 16G MLC, DMA (0~70°C)	SQF-P25M4-16G-CTE	PSB016GTMC0-P70
Advantech SQFlash 2.5" PATA SSD 32G MLC, DMA (0~70°C)	SQF-P25M4-32G-CTE	PSB032GTMC0-P70
Advantech SQFlash 2.5" PATA SSD 64G MLC, DMA (0~70°C)	SQF-P25M4-64G-CTE	PSB064GTMC0-P70
Advantech SQFlash 2.5" PATA SSD 128G MLC, DMA (0~70°C)	SQF-P25M4-128G-CTE	PSB128GTMC0-P70
Advantech SQFlash 2.5" PATA SSD 8G MLC, DMA (-40~85°C)	SQF-P25M4-8G-ETE	PSB008GTME0-P70
Advantech SQFlash 2.5" PATA SSD 16G MLC, DMA (-40~85°C)	SQF-P25M4-16G-ETE	PSB016GTME0-P70
Advantech SQFlash 2.5" PATA SSD 32G MLC, DMA (-40~85°C)	SQF-P25M4-32G-ETE	PSB032GTME0-P70
Advantech SQFlash 2.5" PATA SSD 64G MLC, DMA (-40~85°C)	SQF-P25M4-64G-ETE	PSB064GTME0-P70
Advantech SQFlash 2.5" PATA SSD 128G MLC, DMA (-40~85°C)	SQF-P25M4-128G-ETE	PSB128GTME0-P70