



November 2011

Product Specification

Industrial 1.8" SLC Micro SATA II SSD

-HERMES Series-

Doc-No: 100-SP8SFJA-01V4



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Revision History

Revision	Description	Date
01V1	Initial release	2009/6/24
01V2	General revised	2010/3/03
01V3	Capacity 64GB information removed	2011/1/18
01V4	Power requirement revised – supports +5V \pm 10% only	2011/11/29

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1. Introduction

APRO 1.8" SLC Micro SATA II SSD – HERMES Series provide high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA 2.6 (SATA) standard as well as ATA protocol is able to work as a booting disk or data storages without any additional drives.

APRO 1.8" SLC Micro SATA II SSD – HERMES Series support SATA Gen-II (3.0 GB/s) with high performance. The main used flash memories are Samsung SLC-NAND type flash memory chips. The available disk capacities are 8GB, 16GB and 32GB. The operating temperature grade is optional for commercial level 0°C ~ 70°C and wide temperature level -40°C ~ +85°C. The data transfer performance by sustained read is up to 176.8 MB/sec (Max.), and sustained write is up to 139.3 MB/sec (Max.).

The APRO 1.8" SLC Micro SATA II SSD products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the 1.8" SLC Micro SATA II SSD to read or write blocks of memory. Each sector is protected by a powerful 8 bits Error Correcting Code (ECC). APRO 1.8" SLC Micro SATA II SSD HERMES Series intelligent controller 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 1.8" Micro SATA II SSD controller.

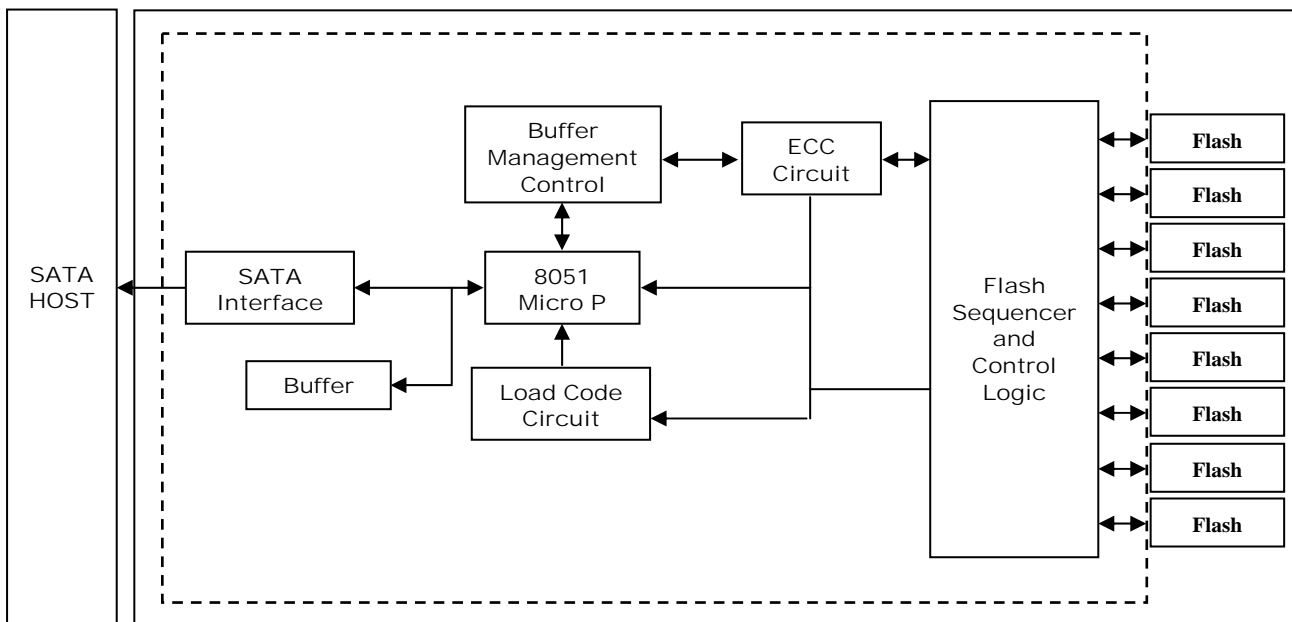


Figure 1: APRO 1.8" SLC Micro SATA II SSD – HERMES Series controller block diagram

1.1. Scope

This document describes the features and specifications and installation guide of APRO 1.8" SLC Micro SATA II SSD – HERMES Series. In the appendix, there provides order information for the most convenient reference.

1.2. System Features

- SLC-NAND type flash technology
- 1.8" form-factor (shorter than PCMCIA Type II form-factor)
- Micro SATA 7 pins (data) + 9 pins (power connector) host Interface
- SATA 1.0a and SATA 2.6 specification compliance
- ATA/ATAPI-7 compliant
- SMART (Self-Monitoring, Analysis and Reporting Technology) function supported.
- Non-volatile memory and no moving parts
- Capacity from 8GB up to 32GB
- Performance up to 176.8 MB/sec
- Automatic 8 bits error correction (ECC) and retry capabilities
- +5 V \pm 10% operation
- MTBF > 3,000,000 hours.
- Endurance cycles greater than 2,000,000 cycles
- Shock : 1,500G, compliance to MIL-STD-810F
- Vibration : 15G, compliance to MIL-STD-810F
- Critical environment is working well
- Very high performance, very low power consumption
- Low weight, Noiseless

1.3. Flash Management Technology - Static Wear Leveling

In order to gain the best management for flash memory, APRO 1.8" SLC Micro SATA II SSD – HERMES 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.

1.4. ECC Technology

Please refer to Figure 2. Figure 2 is a diagram illustrating an allocation method of a spare area in each page of a NAND flash memory, wherein the specific ECC algorithm utilizes a Bose, Chaudhuri and Hocquengham (BCH) ECC algorithm. When a BCH 8 ECC algorithm encodes the data in the NAND flash memory, the parity code generated in the encoding process may occupy 13 bytes of the spare area in each page. When a BCH 15 ECC algorithm encodes the data in the NAND flash memory, the parity code generated in the encoding process may occupy 25 bytes of the spare in each page.

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When a BCH 8 algorithm decodes the data in the NAND flash memory, the data can be decoded correctly if the error bit happened in one sector (512 Bytes) is 8. When a BCH 15 algorithm decodes the data in the NAND flash memory, the data can be decoded correctly if the error bit happened in one sector is 15.

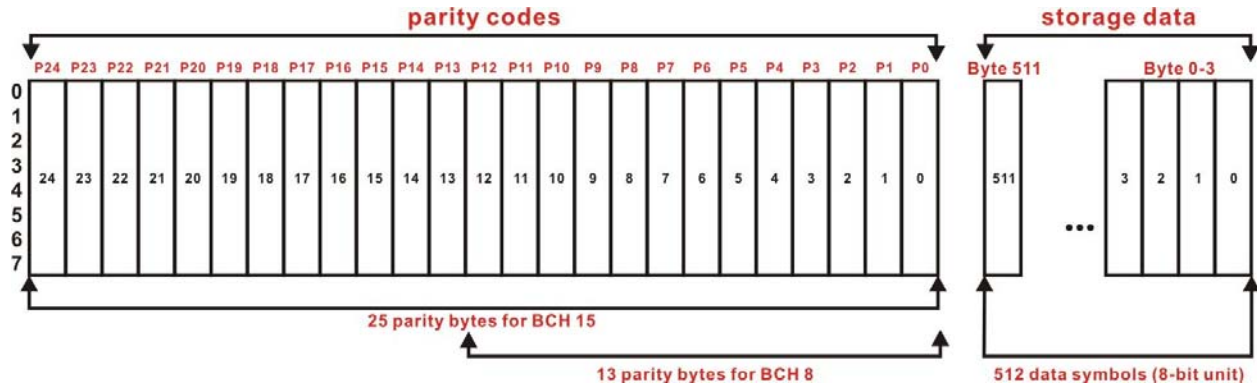


Figure 2: Allocation for ECC Algorithm BCH in NAND Flash

1.5. Conformal Coating

Conformal coating is a protective, dielectric coating designed to conform to the surface of an assembled printed circuit board. Commonly used conformal coatings include silicone, acrylic, urethane and epoxy. APRO applies only silicone on APRO storages products upon requested especially by customers. The type of silicone coating features good thermal shock resistance due to flexibility. It is also easy to apply and repair.

Conformal coating offers protection of circuitry from moisture, fungus, dust and corrosion caused by extreme environments. It also prevents damage from those Flash storages handling during construction, installation and use, and reduces mechanical stress on components and protects from thermal shock. The greatest advantage of conformal coating is to allow greater component density due to increased dielectric strength between conductors.

APRO apply MIL-I-46058C silicon conformal coating.

1.6. Bad Block Management

Bad blocks of NAND flash may accumulate up to 2% of entire number of blocks during its manufacturing process and during the flash operational usage.

A system must be able to recognize bad block(s) based on the original bad block information and create a bad block table to keep track of blocks that fail during use. The first block of NAND Flash (block 0) is guaranteed to be good. The bad block information is stored in the reservoir area that is located in the highest address region of the NAND flash. Once the bad blocks have been located, and the bad blocks be no longer accessed.

To locate the bad blocks on a brand new device, read out each block. Any block that is not all FFFFh in 1st sector of 1st or 2nd page in a spare area is a bad block. Although random bit errors may occur during use, this does not necessarily mean that a block is bad. Generally, a block should be marked as bad only when there is a problem or erase failure. This

can be determined by doing a status read after erase/program operation. The flash memory is initialized by formatting the flash memory into a reserved area and user area.

In order to detect the initial bad blocks to handle run time bad blocks, APRO HERMES Series' SSD provides the Bad Block Management scheme. It remaps a bad block to one of the reserved blocks so that the data contained in one bad block is not lost and new data writes on a bad block is avoided.

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

APRO 1.8" Micro SATA SSD HERMES Series		Commercial Grade	Industrial Grade
		SP8SFxxxG-JACSC	WP8SFxxxG-JAISI
Temperature	Operating:	0°C ~ +70°C	-40°C ~ +85°C
	Non-operating:	-20°C ~ +80°C	-50°C ~ +95°C
Humidity	Operating & Non-operating:	10% ~ 95% non-condensing	
Vibration	Operating & Non-operating:	15G, compliance to MIL-STD-810F	
Shock	Operating & Non-operating:	1,500G, compliance to MIL-STD-810F	
Altitude	Operating & Non-operating:	70,000 feet	

2.2. System Power Requirements

Table 2: Power Requirement

APRO 1.8" Micro SATA SSD HERMES Series		Standard Grade	Industrial Grade
		SP8SFxxxG-JACSC	WP8SFxxxG-JAISI
DC Input Voltage (VCC) 100mV max. ripple(p-p)		5V±10%	
+5V Current (Maximum average value)	Reading Mode :	350mA (max.)	
	Writing Mode :	500mA (max.)	
	Idle Mode :	150mA (max.)	

2.3. System Performance

Table 3: System Performances

Data Transfer Mode supporting		Serial ATA Gen-II (3.0Gb/s = 380MB/s)		
Average Access Time		0.1 ms (estimated)		
Maximum Performance	Capacity	8GB	16GB	32GB
	Sequential Read (MB/s)	175.5MB/s	175.3MB/s	176.8MB/s
	Sequential Write(MB/s)	137.8MB/s	138.3MB/s	139.3MB/s
The number of Flash IC		4pcs	4pcs	8pcs

Note:

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

(2). Testing of the 1.8"Micro SATA II SSD maximum performance was performed under the following platform:

- Computer with AMD 3.0GHz processor
- Windows XP Professional operating system

2.4. System Reliability

Table 4: System Reliability

MTBF	>3,000,000 hours
Wear-leveling Algorithms	Static Wear-leveling
Bad Blocks Management	Supportive
ECC Technology	8 bits per 512 bytes in an ECC block
Endurance	<ul style="list-style-type: none"> ● Un-limited Read Cycles ● Greater than 2,000,000 cycles Logically contributed by static wear-leveling and advanced bad sector management
Data Retention	10 years

2.5. Physical Specifications

Refer to Table 5 and see Figure 3 for **APRO 1.8" SLC Micro SATA II SSD – HERMES Series** physical dimensions

Table 5: Physical Specifications of 1.8" SLC Micro SATA II SSD-HERMES Series

Length:	78.5 ± 0.30mm / 3.09 in
Width:	54 ± 0.20mm / 2.13 in
Thickness:	5 ± 0.15mm / 0.20 in
Weight:	25g ± 5g / 0.88oz

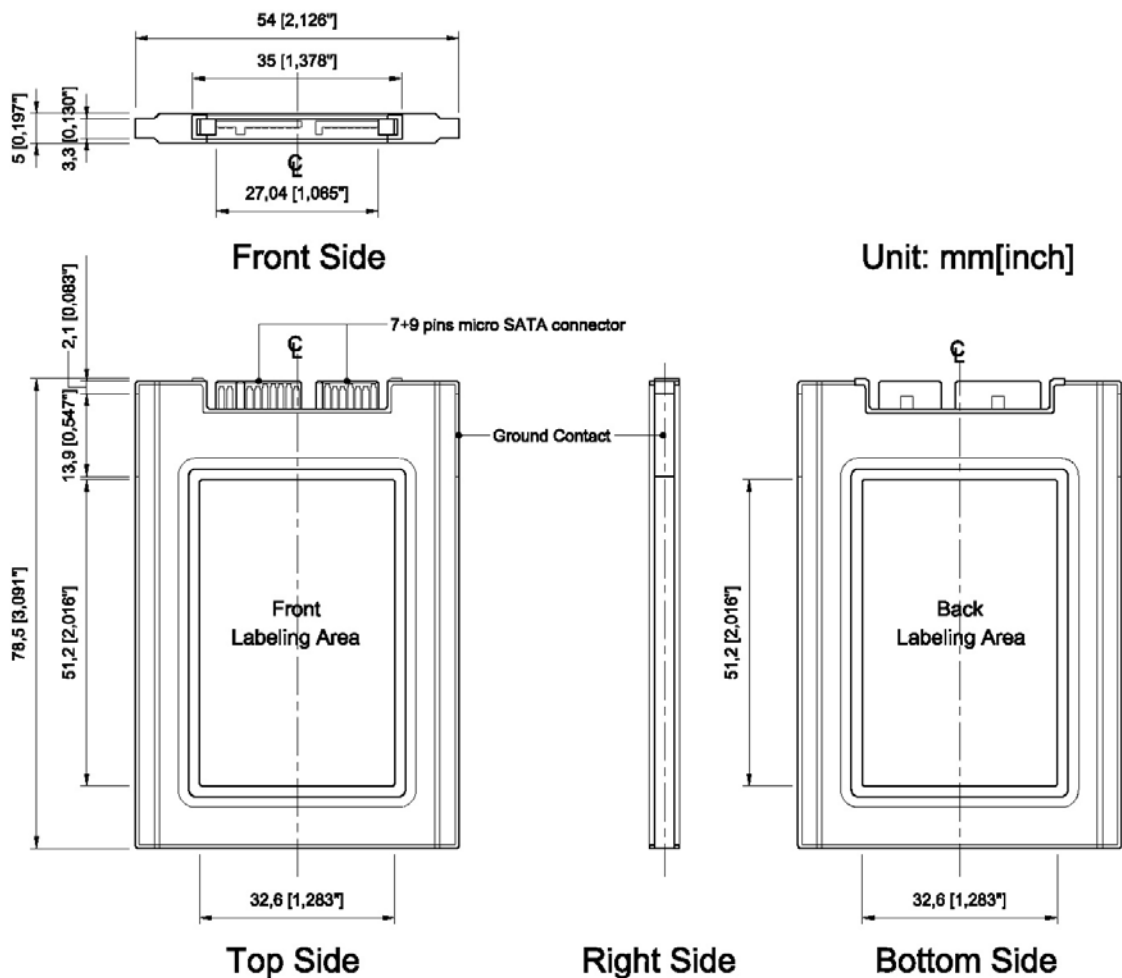


Figure 3: APRO 1.8" SLC Micro SATA II SSD – HERMES Series Dimension

2.6. Capacity Specifications

APRO 1.8" SLC Micro SATA II SSD – HERMES Series are built-in mainly Samsung SLC -NAND Type Flash memory chips. The Table 6 shows the equivalent 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
8GB	K9WAG08U1M (16Gb) or equal * 4
16GB	K9WBG08U1M (32Gb) or equal * 4
32GB	K9WBG08U1M (32Gb) or equal * 8

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

Table 7: Device Parameters

Unformatted Capacity	Cylinder	Head	Sector	LBA
8GB	15,498	16	63	15,621,984
16GB	31,028	16	63	31,276,224
32GB	62,090	16	63	62,586,720

2.7. Pin Assignments

Refer to Table 8 and see Figure 4 for APRO 1.8" SLC Micro SATA II SSD – HERMES Series pin assignments. There are total of 7 pins in the signal segment and 9 pins in the power segment. The pin assignments are listed in below table 8.

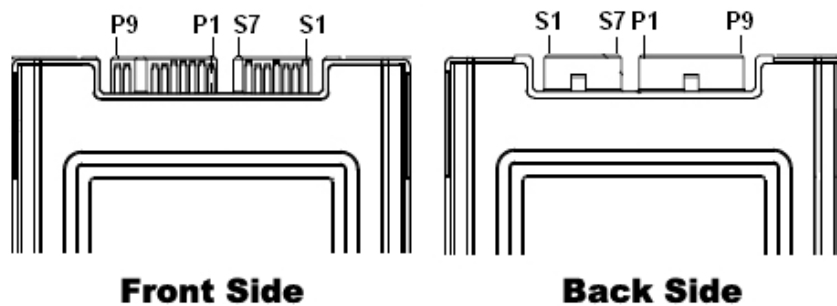


Figure 4: SATA 7-pin (data) + 9-pin (power)

Table 8 - APRO 1.8" SLC Micro SATA II SSD – HERMES Series
SATA 7pins (data) + 9 pins (power) Pin Assignments

Name	Type	Description		
S1	GND			
S2	A+	Differential Signal Pair A		
S3	A-			
S4	GND			
S5	B-	Differential Signal Pair B		
S6	B+			
S7	GND			
Key and Spacing separate signal and power segments		Cable Usage		Backplane
P1	NA	NA	2 nd Mate	3 rd Mate
P2	NA	NA	1 st Mate	2 nd Mate
P3	GND		1 st Mate	1 st Mate
P4	GND		1 st Mate	1 st Mate
P5	V5	5V Power, Pre-charge	1 st Mate	2 nd Mate
P6	V5	5V power	2 nd Mate	3 rd Mate
P7	R	Reserved	2 nd Mate	3 rd Mate
KEY	KEY	KEY	NC	NC
P8	Optional	Vendor Specific	2 nd Mate	3 rd Mate
P9	Optional	Vendor Specific	2 nd Mate	3 rd Mate

NOTE:

1. Although the mate order is shown, hot plugging is not supported when using the cable connector receptacle.
2. All mate sequences assume zero angular offset between connectors.
3. The signal segment and power segment may be separate.
4. The 5V supply voltage pins included to meet future requirements and may optionally be provided on the power segment receptacle. Future revisions of this specification may require 5V supply voltage be provided.
5. The corresponding pin to be mated with pin P7 in the power Internal Micro receptacle connector shall voltage be provided.
6. No connect on the host side.

3. Electrical Specification

3.1. Device Electrical Characteristics

Table 9 - Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Max	Unit
Analog power supply	AV _{DDH}		-0.5	6	V
Digital I/O power supply	DV _{DD}		-0.5	6	V
Digital I/O input voltage	V _{I(D)}		-0.4	DV _{DD} +0.4	V
Storage temperature	T _{STORAGE}		-55	140	°C

Table 10 - Recommended Power Supply Operation Conditions

Parameter	Symbol	Condition	Min	Typical	Max	Unit
DC Power Supply	V _{DD}		-0.3		+5.5	V
Input voltage	V _{IN}		-0.3		+5.5	V
Output voltage	V _{OUT}		-0.3		+3.8	V
Operating Temperature	T _A	Standard	0		+70	°C
		Industrial	-40		+85	°C
Storage Temperature	T _{ST}	Standard	-20		+80	°C
		Industrial	-55		+95	°C

4. ATA Command Register

4.1. ATA Commands

The commands supported ATA/ATAPI-7 commands; certain obsolesced commands are also supported. The supported commands are listed in Table 11.

Table 11 - ATA Commands Supported

Command Name	Code	PARAMETERS USED					
		SC	SN	CY	DR	HD	FT
CHECK POWER MODE	E5h	-	-	-	O	-	-
IDENTIFY DEVICE	ECh	-	-	-	O	-	-
IDLE	E3h	O	-	-	O	-	-
IDLE IMMEDIATE	E1h	-	-	-	O	-	-
SMART	B0h	-	-	O	O	-	O
READ MULTIPLE	C4h	O	O	O	O	O	-
READ SECTOR(S)	20h or 21h	O	O	O	O	O	-
READ VERIFY SECTOR(S)	40h or 41h	O	O	O	O	O	-
READ DMA	C8h or C9h	O	O	O	O	O	-
SET FEATURES	EFh	O	-	-	O	-	O
SET MULTIPLE MODE	C6h	O	-	-	O	-	-
SLEEP	E6h	-	-	-	O	-	-
FLUSH CACHE	E7h	-	-	-	O	O	-
STANDBY	E2h	-	-	-	O	-	-
STANDBY IMMEDIATE	E0h	-	-	-	O	-	-
WRITE MULTIPLE	C5h	O	O	O	O	O	-
WRITE SECTOR(S)	30h or 31h	O	O	O	O	O	-
WRITE DMA	CAh or CBh	O	O	O	O	O	-
EXECUTE DIAGNOSTICS	90h	-	-	-	O	-	-
INITIALIZE DEVICE PARAMETERS	91h	O	-	-	O	O	-
SEEK	7xh	-	-	O	O	O	-
RECALIBRATE	10h	-	-	-	O	-	-
SECURITY DISABLE PASSWORD	F6h	-	-	-	O	-	-
SECURITY ERASE PREPARE	F3h	-	-	-	O	-	-
SECURITY ERASE UNIT	F4h	-	-	-	O	-	-
SECURITY FREEZE LOCK	F5h	-	-	-	O	-	-
SECURITY SET PASSWORD	F1h	-	-	-	O	-	-
SECURITY UNLOCK	F2h	-	-	-	O	-	-

Note:

O = Valid, - = Don't care

SC = Sector Count Register

SN = Sector Number Register

CY = Cylinder Low/High Register

DR = DEVICE SELECT Bit (DEVICE/HEAD Register Bit 4)

HD = HEAD SELECT Bit (DEVICE/HEAD Register Bit 3-0)

FT = Features Register

4.2. ATA Command Specification

Check Power Mode (E5h)

The host can use this command to determine the current power management mode.

Execute Diagnostics (90h)

This command performs the internal diagnostic tests implemented by the drive. See ERROR register for diagnostic codes.

Flush Cash (E7h)

This command is used by the host to request the device to flush de write cache. If there is data in the the write cache, the data shall be written to the media. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

Identify Device (ECh)

This commands read out 512Bytes of drive parameter information. Parameter Information consists of the arrangement and value as shown in the following table. This command enables the host to receive the Identify Drive Information from the device.

4.3. Identify Device Information Default Value

Table 12 - Identify Device Information Table

Word	Value	Description
0	0040h	General Configuration Bit 15: 0=ATA device Bit 14:8: Retired Bit 7:6: Obsolete Bit 5:3: Retired Bit 2: Response incomplete Bit 1: Retired Bit 0 reserved
1	XXXXh	Number of logical cylinders
2	37C8h	Specific configuration
3	16	Number of logical heads
4-5	0000h	Retired
6	63	Number of logical sectors per logical track
7-9	0000h	Retired
10-19	20 ASCII characters	Serial number (ATA String)
20-21	0000h	Retired
22	003Fh	Obsolete
23-26	8 ASCII characters	Firmware revision(ATA String)
27-46	40 ASCII characters	Model number(ATA String)
47	8001h	15-8: 80 7-0: 00h Reserved 01h-FFh: Maximum number of sectors that shall be transferred per DRQ data block on READ/WRITE Multiple commands

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Word	Value	Description
48	4000h	Trusted Computing feature set options 15 shall be cleared to zero 14 shall be set to one 13:1 Reserved for the Trusted Computing Group 0 0 = Trusted Computing feature set is not supported
49	2F00h	Capabilities 15-14: Reserved for the IDENTIFY PACKET DEVICE command. 13: 1=Standby timer values as specified in this standard are supported 0: Standby timer values shall be managed by the device 12: Reserved for the IDENTIFY PACKET DEVICE command 11: 1=IORDY supported 0=IORDY may be disabled 10 1=IORDY may be disabled 9 1=LBA supported 8 1=DMA supported. 7-0 Retired
50	4000h	Capabilities 15: Shall be cleared to zero 14: Shall be set to one 13:2 Reserved 1 Obsolete 0 0
51	0280h	Obsolete
52	0000h	Obsolete
53	0007h	15 Free-fall control Sensitivity 00h: Vendor's recommended setting 7: 3 Reserved 2: 1=the fields reported in word 88 are valid 1: 1=the fields reported in words (70:64) are valid 0: Obsolete
54	XXXXh	Number of current logical cylinders
55	XXXXh	Number of current logical heads
56	XXXXh	Number of current logical sectors per logical track
57-58	XXXXh	Current capacity in sectors
59	0001h	15:9 Reserved 8 0:Multiple sector setting is invalid 7:0 Current setting for number of logical sectors that shall be transferred per DRQ data block on READ/WRITE Multi commands
60-61	XXXXXXXXh	Total number of user address sectors(DWord)
62	0000h	Obsolete
63	0007h	Multi-word DMA transfer(Not support)
64	0003h	15-8 Reserved 7-0 PIO modes supported
65	0078h	Minimum Multiword DMA transfer cycle time per word 15-0 Cycle time in nanoseconds
66	0078h	Manufacturer's recommended Multiword DMA transfer cycle time per word 15-0 Cycle time in nanoseconds
67	0078h	Minimum PIO transfer cycle time without flow control 15-0 Cycle time in nanoseconds
68	0078h	Minimum PIO transfer cycle time with IORDY flow control 15-0 Cycle time in nanoseconds
69-74	0000h	Reserved
75	0000h	No DMA QUEUED command supports

Word	Value	Description
76	0606h	Serial ATA Capabilities
		15:11 Reserved for Serial ATA 10 1= Supports Phy Event Counters 9 1= Supports receipt of host initiated power management Requests 8 0= No Support native Command Queuing 7:3 Reserved for future SATA signaling speed grades 2 1=Supports SATA Gen2 Signaling Speed (3.0Gb/s) 1 1=Support SATA Gen1 Signaling Speed (1.5Gb/s) 0 Shall be cleared to zero
77	0000h	Reserved for Serial ATA
78	0000h	Serial ATA features supported
		15:7 Reserved for Serial ATA 6 0=Device not supports Software Settings Preservation 5 Reserved for Serial ATA 4 0= Device not supports in-order data delivery 3 0= Device not supports initiating power management 2 0= Device not supports DMA Setup auto-activation 1 0= Device not supports non-zero buffer offsets 0 Shall be cleared to zero
79	0000h	Serial ATA feature enabled
		15:7 Reserved for Serial ATA 6 0=Software Settings Preservation not enabled 5 0=Reserved for Serial ATA 4 0= In-order data delivery not enabled 3 0= Device initiated power management not enabled 2 0= DMA setup auto-activation not enabled 1 0= Non-zero buffer offsets not enabled 0 Shall be cleared to zero
80-81	01FE 0021h	ATA Version support (ATA8-ACS)
82	0069h	Command and feature sets supported
		15 0 = Obsolete 14 0 = NOP Command not supported 13 0 = READ BUFFER Command not supported 12 0 = WRITE BUFFER Command not supported 11 0 = Obsolete 10 0 = Host Protected Area Feature Set not supported 9 0 = DEVICE RESET Command not supported 8 0 = SERVICE Interrupt not supported 7 0 = RELEASE Interrupt not supported 6 1 = Look-ahead supported 5 1 = Write Cache supported 4 0 = indicate that the PACKET feature set is not supported 3 1 = mandatory Power Management Feature Set supported 2 0 = Obsolete 1 0 = Security Mode Feature Set not supported 0 1 = SMART Feature Set supported

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Word	Value	Description
83	5000h	<p>Command and feature sets supported</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 0 = FLUSH CACHE EXT Command not supported</p> <p>12 1 = mandatory FLUSH CACHE Command supported</p> <p>11 0 = Device Configuration Overlay feature set not supported</p> <p>10 0 = 48-Bit Address feature set not supported</p> <p>9 0 = Automatic Acoustic Management feature set not supported</p> <p>8 0 = SET MAX security extension not supported</p> <p>7 0 = See Address Offset Reserved Area Boot, INCITS TR27:2001</p> <p>6 0 = SET FEATURES subcommand not required to spin-up after power-up</p> <p>5 0 = Power-Up in Standby feature set supported</p> <p>4 0 = Removable Media Status Notification feature set not supported</p> <p>3 0 = Advanced Power Management feature set not supported</p> <p>2 0 = CFA feature set not supported</p> <p>1 0 = READ/WRITE DMA QUEUED not supported</p> <p>0 1 = DOWNLOAD MICROCODE Command supported</p>
84	4000h	<p>Command Set/Feature Supported Extension</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13-6 Reserved</p> <p>5 0 = General Purpose Logging feature set not supported</p> <p>4 Reserved</p> <p>3 0 = Media Card Pass Through Command feature set not supported</p> <p>2 0 = Media Serial Number not supported</p> <p>1 0 = SMART self-test not supported</p> <p>0 1 = SMART Error Logging not supported</p>
85	0008	<p>Command and feature sets supported or enabled</p> <p>15 0 = Obsolete</p> <p>14 0 = NOP Command not enabled</p> <p>13 0 = READ BUFFER Command not enabled</p> <p>12 0 = WRITE BUFFER Command not enabled</p> <p>11 Obsolete</p> <p>10 0 = Host Protected Area feature set not enabled</p> <p>9 0 = DEVICE RESET Command not enabled</p> <p>8 0 = SERVICE Interrupt not enabled</p> <p>7 0 = RELEASE Interrupt not enabled</p> <p>6 0 = Look-ahead not enabled</p> <p>5 0 = Write Cache not enabled</p> <p>4 Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.</p> <p>3 1 = Power Management Feature Set enabled</p> <p>2 0 = Removable Media feature set not enabled</p> <p>1 0 = Security Mode Feature Set not enabled</p> <p>0 0 = SMART Feature Set not enabled</p>

Word	Value	Description
86	5000h	<p>Command set/feature enabled</p> <p>15-14 0 = Reserved</p> <p>13 0 = FLUSH CACHE EXT Command not supported</p> <p>12 1 = FLUSH CACHE Command supported</p> <p>11 0 = Device Configuration Overlay not supported</p> <p>10 0 = 48-Bit Address features set not supported</p> <p>9 0 = Automatic Acoustic Management feature set not enabled</p> <p>8 0 = SET MAX security extension not enabled by SET MAX SETPASSWORD</p> <p>7 0 = Reserved</p> <p>6 0 = SET FEATURES subcommand required to spin-up after power-up not enabled</p> <p>5 0 = Power-Up in Standby feature set not enabled</p> <p>4 0 = Obsolete</p> <p>3 1 = Advanced Power Management feature set enabled</p> <p>2 0 = CFA feature set not supported</p> <p>1 0 = READ/WRITE DMA QUEUED Command not supported</p> <p>0 1 = DOWNLOAD MICROCODE Command supported</p>
87	4000h	<p>Command and feature sets supported or enabled</p> <p>15 Shall be cleared to zero</p> <p>14 Shall be set to one</p> <p>13 1 = IDLE IMMEDIATE with UNLOAD FEATURE supported</p> <p>12 0 = Reserved for Technical Report, INCITS TR-37-2004</p> <p>11 0 = Reserved for Technical Report, INCITS TR-37-2004</p> <p>10:9 0 = Obsolete</p> <p>8 0 = 64-Bit World Wide Name not supported</p> <p>7 0 = WRITE DMA QUEUED FUA EXT Command not supported</p> <p>6 0 = WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands not supported</p> <p>5 0 = General Purpose Logging feature set not supported</p> <p>4 0 = Obsolete</p> <p>3 0 = Media Card Pass Through Command feature set not supported</p> <p>2 0 = Media Serial Number is not valid</p> <p>1 0 = SMART Self-Test not supported</p> <p>0 0 = SMART Error-Logging not supported</p>
88	X03Fh	<p>Ultra DMA modes</p> <p>15 Reserved</p> <p>14 0 = Ultra DMA mode 6 is not supported</p> <p>13 1 = Ultra DMA mode 5 is selected 0 = Ultra DMA mode 5 is not selected</p> <p>12 1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected</p> <p>11 1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected</p> <p>10 1 = Ultra DMA mode 2 is selected 0 = Ultra DMA mode 2 is not selected</p> <p>9 1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected</p> <p>8 1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected</p> <p>7 Reserved</p> <p>6 0 = Ultra DMA mode 6 is not supported</p> <p>5 1 = Ultra DMA mode 5 and below are supported</p> <p>4 1 = Ultra DMA mode 4 and below are supported</p> <p>3 1 = Ultra DMA mode 3 and below are supported</p> <p>2 1 = Ultra DMA mode 2 and below are supported</p> <p>1 1 = Ultra DMA mode 1 and below are supported</p> <p>0 1 = Ultra DMA mode 0 is supported</p>
89	0000h	Time required for Normal Erase mode SECURITY ERASE UNIT command
90	0000h	Time required for Enhanced erase mode SECURITY ERASE UNIT command
91	0000h	Current advanced power management level value
92	0000h	Master Password Identifier

Word	Value	Description
93	XXXXh	Hardware reset result
94	80FEh	Current automatic acoustic management value
		15:8 Vendor's recommended acoustic management value. 7:0 Current automatic acoustic management value.
95-126	0000h	Reserved
127	0000h	Obsolete
128	0000h	Security Status
		15:9 Reserved
		8 Security level 0 = high, 1 = Maximum
		7:6 Reserved
		5 1= Enhanced security erase supported
		4 1= Security count expired 3 0= Security frozen.
		2 0 = Security not locked
		1 0= Security not enabled 0 0= Security not supported
129-159	0000h	Vendor specific
160	0000h	CFA power mode 1(Not support)
161-175	0000h	Reserved
176-205	0000h	Current media serial number
206-254	0000h	Reserved
255	XXXXh	Integrity word
		15:8 Check Sum 7:0 Signature
Key: F/V = Fixed/ variable content F= the content of the word is fixed and does not change. For removable media devices, these values may change when media is removed or changed. V= the content of the word is variable and may change depending on the state of the device or the command by the device. X= the content of the word may be fixed or variable.		

Idle (E3h)

This command causes the device to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power mode is disabled.

Idle Immediate (E1h)

This command causes the devices to set BSY, enter the Idle (Read) mode, clear BSY and generate an interrupt.

Initialize Device Parameters (91h)

This command enables the host to set the number of sectors per track and the number of tracks per heads.

Read Buffer (E4h)

The Read Buffer command enables the host to read a 512-byte block of data.

Read DMA (C8h)

Read data from sectors during Ultra DMA and Multiword DMA transfer. Use the Set Features command to specify the mode value. A sector count of zero requests 256 sectors.

Read DMA Ext (25h)

48-bit feature set mandatory command. Read data from sectors during Ultra DMA and Multiword DMA transfer. Use the Set Features command to specify the mode value. A sector count of zero requests 65536 sectors.

Read FPDMA Queued (60h)

NCQ feature set mandatory 48-bit command. This command requests that data to be transferred from the device to the host.

Read Log Ext (2Fh)

General purpose logging feature set mandatory 48-bit command. This command requests that data to be transferred from the device to the host.

Log Address	Log Name	Feature	R/W	Access
00h	Log directory	N/A	RO	GPL
10h	NCQ Command Error	NCQ	RO	GPL

Read Multiple (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 command.

Read Multiple Ext (29h)

48-bit feature set mandatory command. 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 command.

Read Sector(s) (20h/21h)

This command reads 1 to 256 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector count of 0 requests 256 sectors. The transfer beings specified in the Sector Number register.

Read Sector(s) Ext (24h)

48-bit feature set mandatory command. This command reads 1 to 65536 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector count of zero requests 65536 sectors. The transfer beings specified in the Sector Number register.

Read Verity Sector(s) (40h/41h)

This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

Read Verify Sector(s) Ext (42h)

48-bit feature set mandatory command. This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

Recalibrate (10h)

The current drive performs no processing if it receives this command. It is supported for backward compatibility with previous devices.

Security Disable Password (F6h)

Disables any previously set user password and cancels the lock. The host transfers 512 bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

Security Erase Prepare (F3h)

This command shall be issued immediately before the Security Erase Unit command to enable erasing and unlocking. This command prevents accidental loss of data on the drive.

Security Erase Unit (F4h)

The host uses this command to transfer 512bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive deletes user data, disables the user password, and cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

Security Freeze Lock (F5h)

Causes the drive to enter Frozen mode. Once this command has been executed, the following commands to update a lock result in the Aborted Command error:

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT

The drive exits from Frozen mode upon a power-off or hard reset. If the SECURITY FREEZE LOCK command is issued when the drive is placed in Frozen mode, the drive executes the command, staying in Frozen mode.

Security Set Password (F1h)

This command set user password or master password. The host outputs sector data with PIO data-out protocol to indicate the information defined in the following table.

Security Unlock (F2h)

The command disables LOCKED MODE of the device. This command transfers 512 bytes of data from the host with PIO data-out protocol. The following table defines the content of this information.

Seek (7xh)

This command is effectively a NOP command to the device although it does perform a range check.

Set Features (EFh)

This command set parameter to Features register and set driver's operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

Feature registers Value and settable operating mode

Value	Function
02h	Enable write cache
03h	Set transfer mode based on value in Sector Count register
55h	Disable read look-ahead feature
82h	Disable write cache
AAh	Enable read look-ahead feature

Set Multiple Mode (C6h)

This command enables the device to perform READ MULTIPLE and WRITE MULTIPLE operations and establishes the block count for these commands.

Sleep (E6h)

This command causes the device to set BSY, enter the Sleep mode, clear BSY and generate in interrupt.

Smart Function Set (B0h)

Performs different processing required for predicting device failures, according to the subcommand specified in the Features register. If the Features register contains an unsupported value, the Aborted Command error is returned. If the SMART function is disabled, any subcommand other than SMART ENABLE OPERATIONS results in the Aborted Command error.

Code	Smart Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D3h	SAVE ATTRIBUTE VALUES
D4h	EXECUTE OFF-LINE IMMEDIATE*
D5h	Reserved
D6h	Reserved
D8h	ENABLE OPERATIONS
D9h	DISABLE OPERATIONS
DAh	RETURN STATUS
DBh	ENABLE/DISABLE AUTO OFF-LINE*

4.4. S.M.A.R.T. Function (Self-Monitoring, Analysis, and Reporting Technology)

To perform different processing requires predicting device failures, according to the subcommand specified in the Features register.

If the Features register contains an unsupported value, the Aborted Command error is returned. If the SMART function is disabled, any subcommand other than SMART ENABLE OPERATIONS results in the Aborted Command error.

4.4.1. S.M.A.R.T. Read Data

Table 13: SMART Feature registers values

Value	Command
D0h	SMATR Read Data
D8h	SMART ENABLE OPERATIONS
D9h	SMART DISABLE OPERATIONS

Table 14: SMART command for inputs information

Register	7	6	5	4	3	2	1	0
Features	D0h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Command	B0h							

Device register-

DEV shall specify the selected device.

Table 15: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device Register-

DEV shall indicate the selected device.

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one. SMART enabled.

DF (Device Fault) will be cleared to zero.

DRQ shall be cleared to zero.

ERR shall be cleared to zero.

Table 16: ID of SMART data structure

ID(Hex)	Description
E9	ECC Fail Record
EA	Average Erase Count, Max Erase Count
EB	Good Block Count, System Block Count

ID: E9h

Table 17: Smart command for ECC fail record information

Byte	Function	Description
0	ECC fail number	When failure bit is bigger than “ECC Fail number”, this block will be marked as Bad Block.
1	Row address 3	Flash Block Address
2	Row address 2	Flash Block Address
3	Row address 1	Flash Block Address
4	Channel number of last ECC fail	NA
5	Bank number of last ECC fail	NA
6	Reserved	NA
7	Reserved	NA

ID: EAh

Table 18: Smart command for average/max erase count information

Byte	Function	Description
0	Average Erase Count (High Byte)	Average erase count of all blocks.
1	Average Erase Count	
2	Average Erase Count (Low Byte)	
3	Max Erase Count (High Byte)	Indicate a block which’s erase count is the largest.
4	Max Erase Count	
5	Max Erase Count (Low Byte)	
6	Reserved	NA
7	Reserved	NA

When the Maximum erase count is 255 bigger than average erase count, the wear-leveling will be executed.

ID: EBh

Table 19: Smart command for good/system block count information

Byte	Function	Description
0	Good Block Count (High Byte)	Total used blocks of SSD
1	Good Block Count	
2	Good Block Count (Low Byte)	

Byte	Function	Description
3	System(Free) Block Count (High Byte)	Free block of SSD. Free block has to be bigger than 20. When the free block count is less than 20, the SSD will be locked.
4	System(Free) Block Count (Low Byte)	
5	Reserved	NA
6	Reserved	NA
7	Reserved	NA

4.4.2. S.M.A.R.T. ENABLE OPERATIONS

Table 20: SMART Enable command for inputs information

Register	7	6	5	4	3	2	1	0
Features	D8h							
Sector Count	Na							
LBA Low	Na							
LBA Mid	4Fh							
LBA High	C2h							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Command	B0h							

Device register-

DEV shall specify the selected device.

Table 21: SMART command for normal outputs information

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Na							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	Obs	Na	obs	DEV	Na	Na	Na	Na
Status	BSY	DRDY	DF	Na	DRQ	Na	Na	ERR

Device Register-

DEV shall indicate the selected device.

Status register-

BSY will be cleared to zero indicating command completion.

DRDY will be set to one.

This command enables access to all SMART capabilities within device.

DF (Device Fault) will be cleared to zero.


DRQ shall be cleared to zero.

ERR shall be cleared to zero.

Appendix A. Ordering Information

Operating temperature supports Standard grade 0°C ~ 70°C and Industrial grade -40°C ~ +85°C

Part number list - Industrial 1.8" micro SATA II SLC SSD

Product Picture	Capacity	0°C ~ 70°C	-40°C ~ +85°C
	8GB	SP8SF008G-JACSC	WP8SF008G-JAISI
	16GB	SP8SF016G-JACSC	WP8SF016G-JAISI
	32GB	SP8SF032G-JACSC	WP8SF032G-JAISI

Part number decoder

X1 X2 X3 X4 X5 X6 X7 X8 X9 — X11 X12 X13 X14 X15 / Y

Example

S P 8 S F 0 3 2 G — J A C S 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 frame kit

P : Plastic frame kit

X3 X4 X5 ⇨ Product category

8SF : 1.8" micro SATA II SSD

X6 X7 X8 X9 ⇨ Capacity

008G : 8GB

016G : 16GB

032G : 32GB

X11 ⇨ Controller

J : JMicron (HERMES Series)

X12 ⇨ Controller version

A,B,C.....

X13 ⇨ Controller grade

C : Commercial grade

I : Industrial grade

X14 ⇨ Flash IC

S : Samsung SLC-NAND flash IC

X15 ⇨ Flash IC grade

C : Commercial grade

I : Industrial grade

Y ⇨ Reserved for specific requirement

Y : Reserved for special request

Appendix B. Limited Warranty

APRO warrants your 1.8" micro SATA II SSD 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.

Warranty period:

- SP8SF0XXG-JACSC 3 years
- WP8SF0XXG-JAISI 5 years



The warranty period is able to extend. Please contact APRO or your APRO distributor for more information.