

MLC

2.5" Rugged Metal PAPA SSD

HERCULES-Q Series



Document No. : 100-XR2IF-MQTMB

Version No. : 02V0

Date : June, 2019

ISO 9001 : 2015 CERTIFIED



Product Features

- **Flash IC**
 - TOSHIBA NAND Flash IC.
 - Multi-Level Cell (MLC) management
- **Compatibility**
 - ATA/ATAPI-8 standard compatible in True-IDE mode.
- **Additional Capabilities**
 - S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) feature set support.
 - Supports the following data transfer rate:
 - PIO mode 0, 1, 2, 3, 4
 - DMA mode 0, 1, 2
 - Ultra DMA mode 0, 1, 2, 3, 4, 5, 6.
 - Customize C.H.S./Total LBAs capacity.
 - Support bad Block Management.
 - Support Power Loss Data Protection by low voltage detector.
 - Support both Global Wear Leveling Wear Leveling.
- **Mechanical**
 - Standard 44-Pin PATA (IDE) male connector
 - Dimension: 100.0mm x 70.1mm x 8.8mm.
 - Weight: 75.00 g / 2.64 oz.
- **Power Operating Voltage 5.0V(+/-) 5%**
 - Read Mode: 225.7 mA (max.)
 - Write Mode: 295.9 mA (max.)
 - Standby Mode: 4.8 mA (max.)
- **Performance (Maximum value) *1**
 - Sequential Read: 103.1 MB/sec. (max.)
 - Sequential Write: 100.2 MB/sec. (max.)
- **Capacity**
 - 16GB, 32GB, 64GB, 128GB, 256GB and 512GB.
- **Reliability**
 - **TBW:** Up to 150 TBW at 512GB Capacity. (Client workload by JESD-219A)
 - **ECC:** Automatic 72 bits per 1024 bytes error correction (ECC) and retry capabilities.
 - **Temperature:** (Operating)
 - Standard Grade: 0°C ~ +70°C
 - Wide Temp. Grade: -40°C ~ +85°C
 - **Vibration:** 70 Hz to 2K Hz, 15G, 3 axes.
 - **Shock:** 0.5ms, 1500 G, 3 axes
 - **Erase counts:** 3K
- **Certifications and Declarations**
 - **Certifications:** CE & FCC
 - **Declarations:** RoHS & REACH
- **Remarks:**
 - Sequential performance is based on CrystalDiskMark

Order Information

I. Part Number List

◆ APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series

Product Picture	Grade	Standard grade (0°C ~ 70°C)	Wide Temp. Grade (-40°C ~ +85°C)
	16GB	SR2IF016G-MQCTMB-U	WR2IF016G-MQCTMB-UC
	32GB	SR2IF032G-MQCTMB-U	WR2IF032G-MQCTMB-UC
	64GB	SR2IF064G-MQCTMB-U	WR2IF064G-MQCTMB-UC
	128GB	SR2IF128G-MQCTMB-U	WR2IF128G-MQCTMB-UC
	256GB	SR2IF256G-MQCTMB-U	WR2IF256G-MQCTMB-UC
	512GB	SR2IF512G-MQCTMB-U	WR2IF512G-MQCTMB-UC

II. Part Number Decoder:

X1 X2 X3 X4 X5 X6 X7 X8 X9—X11 X12 X13 X14 X15 X16—X18 X19 X20

X1 : Grade

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

W: Wide Temp Grade- operating temp. -40° C ~ +85 ° C

X2 : The material of case

R : Rugged Metal

X3 X4 X5 : Product category

2IF : 2.5" PATA SSD

X6 X7 X8 X9 : Capacity

016G: 16GB 128G: 128GB

032G: 32GB 256G: 256GB

064G: 64GB 512G: 512GB

X11 : Controller

M : HERCULES Series

X12 : Controller version

A, B, C.....

X13 : Controller Grade

C : Commercial grade

X14 : Flash IC

T : Toshiba NAND Flash IC

X15 : Flash IC grade / Type

M : MLC-NAND Flash IC

X16 : MLC Technology

B : Toshiba 15nm MLC

X18 : Data transfer rate and disk type

U: defaulted as UDMA-6 mode / Fixed disk type

X19 X20 : Reserved for specific requirement

C : Conformal-coating (optional)

Revision History

Revision	Description	Date
1.0	Initial release	2016/6/28
1.1	Updated Version	2018/11/28
2.0	Updated Document form	2019/06/11

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1. Introduction

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series provides high capacity flash memory Solid State Drive (SSD) that electrically complies with ATA/ATAPI-8 standard. APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series support UDMA-6 with high performance. The main used flash memories are 15nm MLC-NAND type flash memory chips. The available disk capacities are 16GB, 32GB, 64GB, 128GB, 256GB and 512GB

The operating temperature grade is optional for Standard grade 0°C ~ 70°C and wide temp grade -40°C ~ +85°C. The data transfer performance by sequential read is up to 103.1 MB/sec, and sequential write is up to 100.2 MB/sec.

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series products provide a high level interface to the host computer. This interface allows a host computer to issue commands to the Rugged Metal 2.5" PATA MLC SSD to read or write blocks of memory. Each sector is protected by a powerful 72 bits per 1024 bytes error correction (ECC).

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q 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 APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series.

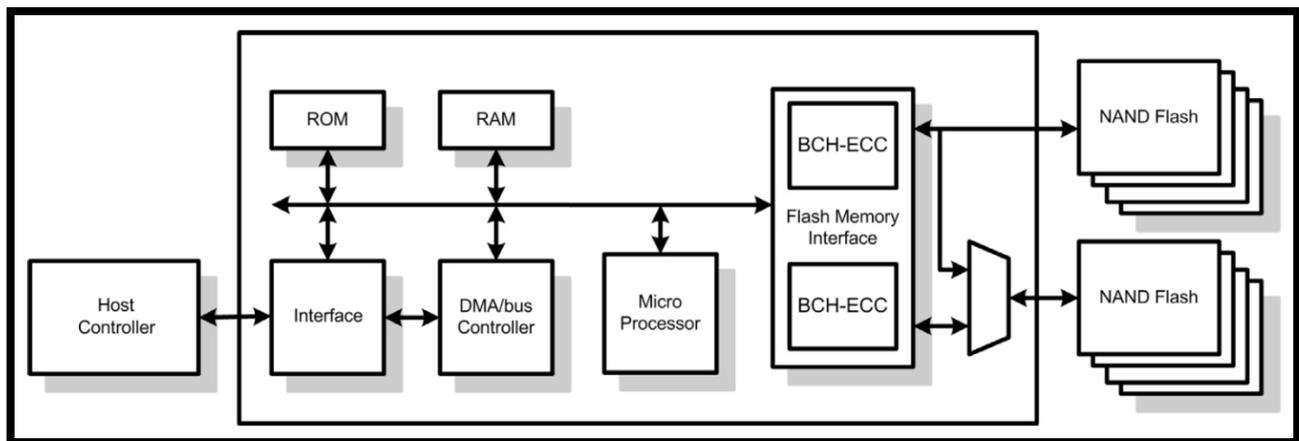


Figure 1: APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series block diagram

1.1. Scope

This document describes features, specifications and installation guide of APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series. The appendix provides order information, warranty policy, RMA/DOA procedure for the most convenient reference.

1.2. Flash Management Technology - Global Wear Leveling

In order to gain the best management for flash memory, APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series applies Global 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. The objective of global wear leveling is to prevent any frequently updated data from staying at the static area so that wear leveling could be evenly applied to all blocks. Static areas contain any data that does not change, and are ignored by dynamic wear leveling. Such static data may include operating system files, table look-ups, executable files, and etc. Global wear leveling frequently replaces blocks in this area with block in the hot area, and thus each block in all areas has the same probability to be used.

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 data, it moves that data to a more heavily used location before it moves the newly written data. Wear leveling maximizes effective endurance Flash array compared to no wear leveling products.

1.3. Bad Block Management

➤ Early Bad Block

The fault block generated during the manufacturing process of NAND Flash is called Early Bad Block.

➤ Later Bad Block

In the process of use, as the number of operations of writing and erasing increases, a fault block is gradually generated, which is called a Later Bad Block.

Bad block management is a management mechanism for a bad block to be detected by the control IC and mark bad blocks in the NAND Flash and improve the reliability of data access. The bad block management mechanism of the control IC will establish a **Bad Block Table** when the NAND Flash is started for the first time, and will also record the errors found in the process of use in the bad block table, and data is ported to new valid blocks to avoid data loss.

In order to detect the initial bad blocks to handle run time bad blocks, APRO MLC Rugged Metal 2.5" PATA SSD HERCULES-Q Series 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.

1.4. Power-Loss Data Protection by Low Voltage Detector

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series has built-in Low Voltage Detector; it becomes active when detecting voltage threshold near 50% of the power it should receive from host. In this scenario, storage will take precedence for the data that host has already completed its command to write into flash at the same time whenever low voltage is detected.

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series utilizes host and device-initiated power fail protection mechanisms to guarantee data integrity. When encountering sudden power interruption, device will check the last programmed page for any uncorrectable error, if errors were found, all data written prior of the error will be moved to a new block while old block will be erased and corrected during the next power on.

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 MLC 2.5" Rugged Metal PATA SSD		Standard Grade	Wide Temp. Grade
HERCULES-Q Series		SR21FxxxG-MQCTMB-U	WR21FxxxG-MQCTMB-UC
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:	70 Hz to 2K Hz, 15G, 3 axes	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes	

2.2. System Power Requirements

Table 2: Power Requirement

APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series		
DC Input Voltage (VCC)		+5V ± 5%
Maximum average value	Reading Mode :	225.7 mA (max.)
	Writing Mode :	295.9 mA (max.)
	Idle Mode :	4.8 mA (max.)

2.3. System Performance

Table 3: System Performances

Data Transfer Mode supporting	PIO 0~4, MWDMA 0~2, UDMA 0~6 supported						
Average Access Time	0.5 ms (estimated)						
Maximum Performance	Capacity	16GB	32GB	64GB	128GB	256GB	512GB
	Sequential Read (MB/s)	106.2	104.2	104.3	102.4	103.1	103.3
	Sequential Write(MB/s)	50.6	50.8	79.3	87.9	100.2	98.4

Note:

- All values quoted are typically at 25°C and nominal supply voltage.
- The performance is obtained from CrystalDiskMark Test

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms	Global wear-leveling algorithms
Bad Blocks Management	Supported
ECC Technology	72 bits per 1024 bytes
Erase counts	NAND MLC Flash Cell Level : 3K P/E Cycles
TBW (Tera Bytes Written)	
Capacity	TBW(TB)
16GB	4.68
32GB	9.37
64GB	18.75
128GB	37.5
256GB	75.0
512GB	150.0

Note:

- Client workload by JESD-219A
- Lifespan is calculated by device written per day.

2.5. Physical Specifications

Refer to Table 5 and see Figure 3 for APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series physical specifications and dimensions.

Table 5: Physical Specifications

Length:	100.0 mm
Width:	70.10 mm
Thickness:	8.80 mm
Weight:	75.00 g / 2.64 oz.

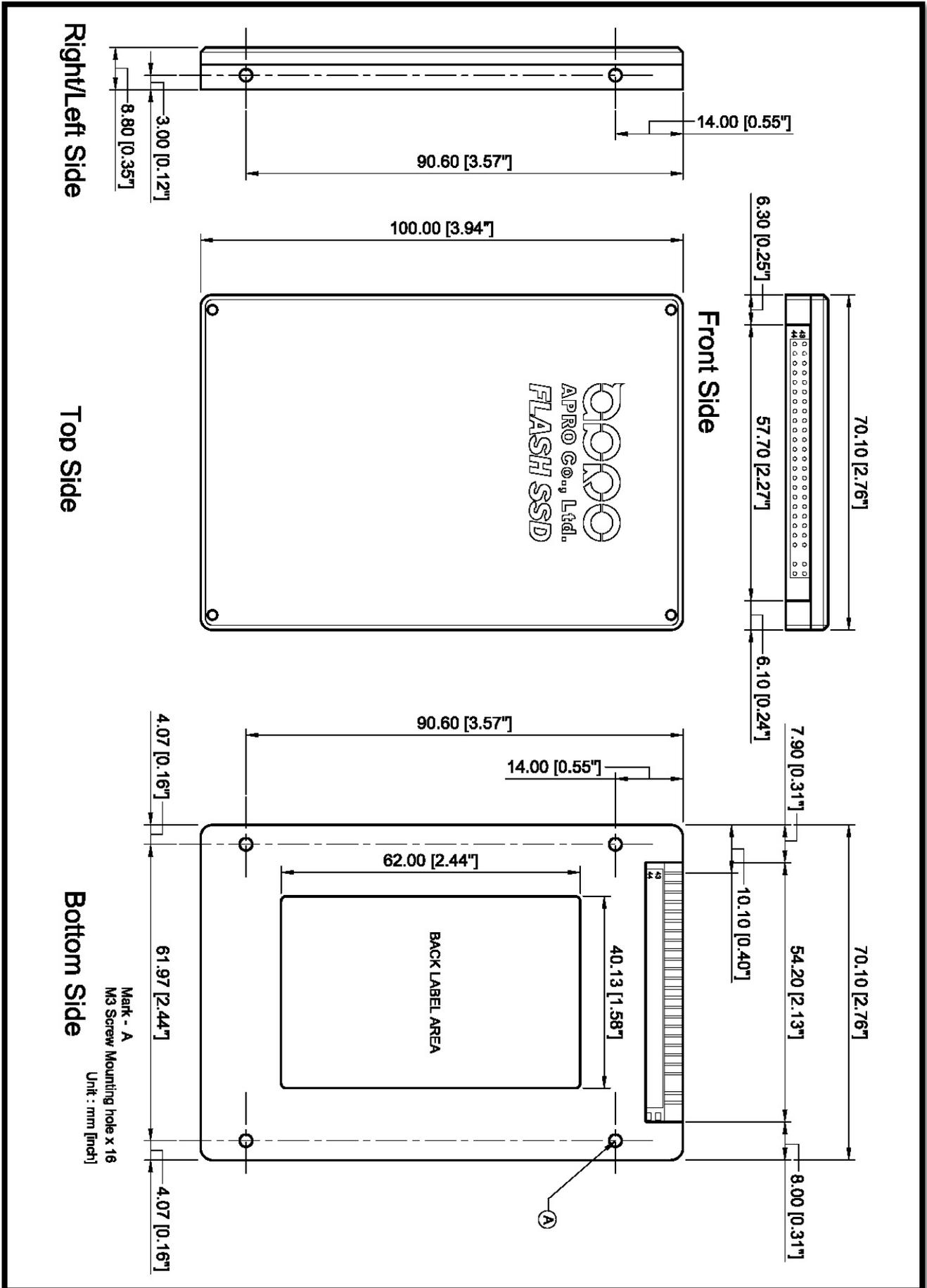


Figure 2: APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series Dimension

2.6. 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 storage 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 uses MIL-I-46058C silicon conformal coating

2.7. Device Parameter

The table 6 shows the specific capacity for the various models and the default number of heads, sectors/track and cylinders.

Table 6: Device Parameter

Unformatted Capacity	Cylinder	Head	Sector	LBA Total Sectors
16GB	16,383	15	63	30,932,992
32GB	16,383	16	63	61,865,984
64GB	16,383	15	63	123,731,968
128GB	16,383	15	63	247,463,936
256GB	16,383	15	63	494,927,872
512GB	16,383	15	63	989,855,744

3. Interface Description

3.1. 2.5" PATA SSD interface

Pin 1 ~ pin 44 are for IDE interface. Pin A ~ pin D is for Master/Slave selection via physical jumpers.

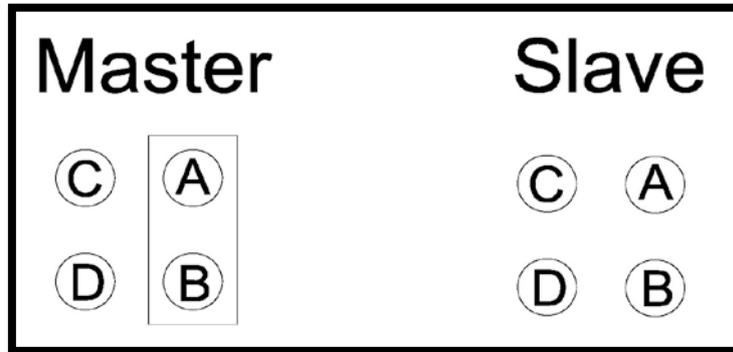


Figure 3 : The connectors of 2.5" PATA MLC SSD

3.2. Pin Assignments

Signals whose source is the host is designated as inputs while signals that APRO MLC 2.5" Rugged Metal PATA SSD HERCULES-Q Series sources are outputs.

The pin assignments are listed in below table 7.

Table 7 - Pin Assignments

Pin	Name	Descriptions	Pin	Name	Descriptions
01	-RESET	Drive Reset	02	GND	Ground
03	DD7	Drive data bus bit 7	04	DD8	Drive data bus bit 8
05	DD6	Drive data bus bit 6	06	DD9	Drive data bus bit 9
07	DD5	Drive data bus bit 5	08	DD10	Drive data bus bit 10
09	DD4	Drive data bus bit 4	10	DD11	Drive data bus bit 11
11	DD3	Drive data bus bit 3	12	DD12	Drive data bus bit 12
13	DD2	Drive data bus bit 2	14	DD13	Drive data bus bit 13
15	DD1	Drive data bus bit 1	16	DD14	Drive data bus bit 14
17	DD0	Drive data bus bit 0	18	DD15	Drive data bus bit 15
19	GND	Ground	20	KEY	No pin
21	DMARQ	DMA request	22	GND	Ground
23	-DIOW:STOP	Drive I/O Write	24	GND	Ground
25	DIOR-	Drive I/O Read	26	GND	Ground
27	IORDY	I/O channel ready	28	CSEL	Cable select
29	-DMACK	DMA acknowledge	30	GND	Ground
31	INTRO	Drive interrupt	32	IOIS16	Drive 16 bit I/O
33	DA1	Drive address bus bit 1	34	-PDIAG: -CBLID	Passed diagnostics
35	DA0	Drive address bus bit 0	36	DA2	Drive address bus bit 2
37	-CS0	Chip select 0	38	CS1	Chip select 1
39	-DASP	Drive active slave present	40	GND	Ground
41	VCC	+5V supply	42	VCC	+5V supply
43	GND	Ground	44	NC	Reserved for future definition

Appendix A: Limited Warranty

APRO warrants your MLC 2.5" Rugged Metal PATA SSD HERCULES-Q 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.

WARRANTY PERIOD:

- **MLC (Standard grade / Wide temp. grade) 2 years / Within 3K Erasing Counts**

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