

2.5" SATA SSD

3MG2-P Series

Customer: _____
Customer
Part
Number: _____
Innodisk
Part
Number: _____
Innodisk
Model Name: _____
Date: _____

Innodisk Approver	Customer Approver

**Total Solution For
Industrial Flash Storage**

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REVISION HISTORY

Revision	Description	Date
Preliminary	First Released	July, 2014
Rev 1.0	Add 1TB LBA Update ME drawing Update Performance	August, 2014
Rev 1.1	Add CE/FCC	August, 2014

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1. Product Overview

1.1 Introduction of Innodisk 2.5" SATA SSD 3MG2-P

Innodisk 2.5" SATA SSD 3MG2-P products provide high capacity flash memory Solid State Drive (SSD) that electrically complies with Serial ATA (SATA) standard. It supports SATA III standard (6.0GHz) with high performance. Innodisk 2.5" SATA SSD 3MG2-P is designed for industrial field, and supports several standard features, including TRIM, NCQ, and S.M.A.R.T. The SSD have good performance, no latency time and small seek time. It effectively reduces the booting time of operation system and the power consumption is less than hard disk drive (HDD).

1.2 Product View and Models

Innodisk 2.5" SATA SSD 3MG2-P is available in follow capacities:

- | | |
|---------------------------|----------------------------|
| 2.5" SATA SSD 3MG2-P 8GB | 2.5" SATA SSD 3MG2-P 128GB |
| 2.5" SATA SSD 3MG2-P 16GB | 2.5" SATA SSD 3MG2-P 256GB |
| 2.5" SATA SSD 3MG2-P 32GB | 2.5" SATA SSD 3MG2-P 512GB |
| 2.5" SATA SSD 3MG2-P 64GB | 2.5" SATA SSD 3MG2-P 1TB |



Figure 1: Innodisk 2.5" SATA SSD 3MG2-P

1.3 SATA Interface

Innodisk 2.5" SATA SSD 3MG2-P supports SATA III interface, and compliant with SATA I and SATA II. SATA III interface can work with Serial Attached SCSI (SAS) host system, which is used in server computer. Innodisk 2.5" SATA SSD 3MG2-P is compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps /3.0Gbps/6.0Gbps data rate). SATA connector uses a 7-pin signal segment and a 15-pin power segment.

1.4 2.5-inch Form Factor

The Industry-standard 2.5-inch form factor design with metal material case is easy for installation, which has a compact design 69.85mm (W) x100.10mm (L) x 7mm (H).

2. Product Specifications

2.1 Capacity and Device Parameters

2.5" SATA SSD 3MG2-P device parameters are shown in Table 1.

Table 1: Device parameters

Capacity	LBA	Cylinders	Heads	Sectors	User Capacity(MB)
8GB	15649200	15525	16	63	7641
16GB	31277232	16383	16	63	15272
32GB	60579792	16383	16	63	29580
64GB	121138416	16383	16	63	59150
128GB	242255664	16383	16	63	118289
256GB	484490160	16383	16	63	236567
512GB	968959152	16383	16	63	473124
1TB	1937897136	16383	16	63	946238

2.2 Performance

Burst Transfer Rate: 6.0Gbps

Table 2: Performance

Capacity	8GB	16GB	32GB	64GB	128GB	256GB	512GB	1TB
Sequential* Read (max.)	140 MB/s	290 MB/s	530 MB/s	520 MB/s	520 MB/s	520 MB/s	520 MB/s	520 MB/s
Sequential* Write (max.)	21 MB/s	43 MB/s	87 MB/s	170 MB/s	350 MB/s	450 MB/s	450 MB/s	450 MB/s
4KB Random** Read (QD32)	17,000 IOPS	31,000 IOPS	51,000 IOPS	70,000 IOPS	70,000 IOPS	70,000 IOPS	70,000 IOPS	70,000 IOPS
4KB Random** Write (QD32)	2,400 IOPS	2,500 IOPS	6,900 IOPS	13,000 IOPS	25,000 IOPS	25,000 IOPS	25,000 IOPS	25,000 IOPS

Note: * Sequential performance based on CrystalDiskMark 3.01 with file size 1000MB

** Random performance based on Iometer with Queue Depth 32

2.3 Electrical Specifications

2.3.1 Power Requirement

Table 3: Innodisk 2.5" SATA SSD 3MG2-P Power Requirement

Item	Symbol	Rating	Unit
Input voltage	V _{IN}	+5 DC +- 5%	V

2.3.2 Power Consumption

Table 4: Power Consumption

Mode	Power Consumption
Read	630 mA (max.)
Write	1.2 A (max.)
Idle	77 mA (max.)
DEVSLP Mode	3mW (min.)
Slumber Mode	30mW (min.)

* Target: 2.5" SATA SSD 3MG2-P 256GB

2.4 Environmental Specifications

2.4.1 Temperature Ranges

Table 5: Temperature range for 2.5" SATA SSD 3MG2-P

Temperature	Range
Operating	Standard Grade: 0°C to +70°C
	Industrial Grade: -40°C to +85°C
Storage	-55°C to +95°C

2.4.2 Humidity

Relative Humidity: 10-95%, non-condensing

2.4.3 Shock and Vibration

Table 6: Shock/Vibration Testing for 2.5" SATA SSD 3MG2-P

Reliability	Test Conditions	Reference Standards
Vibration	7 Hz to 2K Hz, 20G, 3 axes	IEC 68-2-6
Mechanical Shock	Duration: 0.5ms, 1500 G, 3 axes	IEC 68-2-27

2.4.4 Mean Time between Failures (MTBF)

Table 7 summarizes the MTBF prediction results for various 2.5" SATA SSD 3MG2-P configurations. The analysis was performed using a RAM Commander™ failure rate prediction.

- **Failure Rate:** The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated condition.
- **Mean Time between Failures (MTBF):** A basic measure of reliability for repairable items: The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

Table 7: 2.5" SATA SSD 3MG2-P MTBF

Product	Condition	MTBF (Hours)
Innodisk 2.5" SATA SSD 3MG2-P	Telcordia SR-332 GB, 25°C	>3,000,000

2.5 CE and FCC Compatibility

2.5" SATA SSD 3MG2-P conforms to CE and FCC requirements.

2.6 RoHS Compliance

2.5" SATA SSD 3MG2-P is fully compliant with RoHS directive.

2.7 Reliability

Parameter	Value
Read Cycles	Unlimited Read Cycles
Wear-Leveling Algorithm	Support
Bad Blocks Management	Support
Error Correct Code	Support
iData Guard	Support
Thermal Sensor	Support
Flash endurance	3,000 P/E cycles
TBW* (Total Bytes Written)	
8GB	7.79
16GB	15.58
32GB	31.16
64GB	62.33
128GB	124.67
256GB	249.35
512GB	TBD
1TB	TBD
* Total bytes written is based on JEDEC 218 (Solid-State Drive Requirements and Endurance Test Method)	
** Lifespan is calculated by device written per day	

2.8 Transfer Mode

2.5" SATA SSD 3MG2-P support following transfer mode:

Serial ATA III 6.0Gbps

Serial ATA II 3.0Gbps

Serial ATA I 1.5Gbps

2.9 Pin Assignment

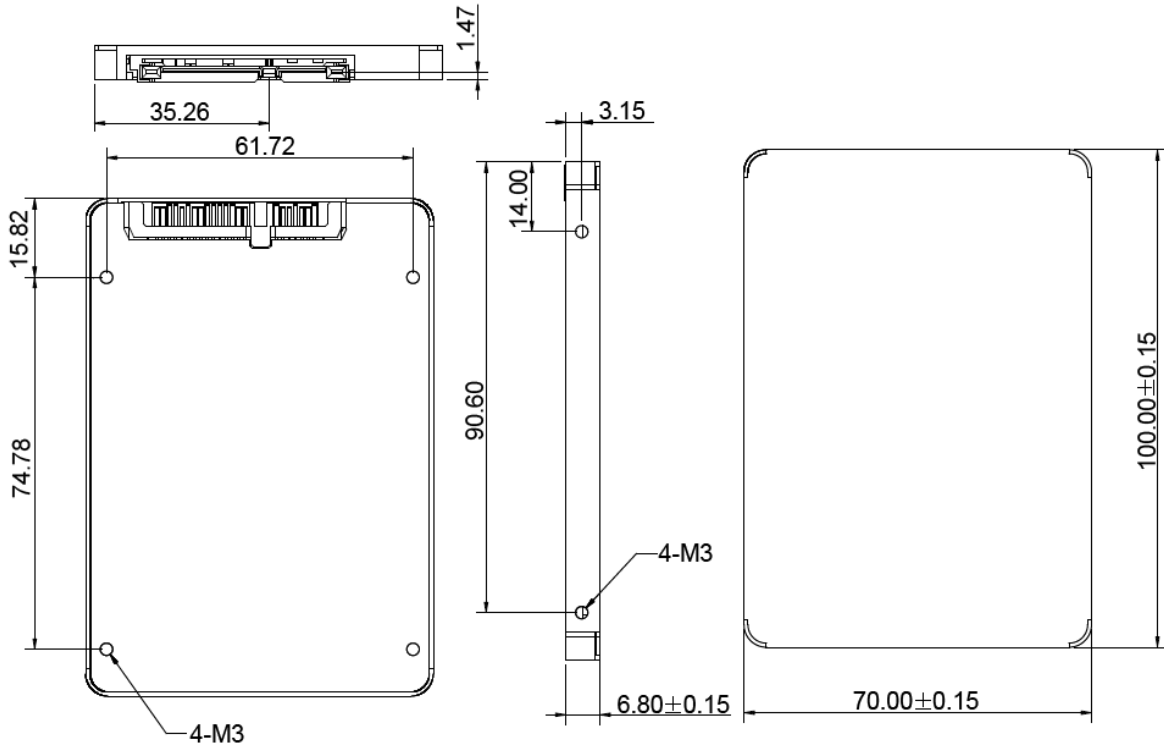
Innodisk 2.5" SATA SSD 3MG2-P uses a standard SATA pin-out. See Table 8 for 2.5" SATA SSD 3MG2-P pin assignment.

Table 8: Innodisk 2.5" SATA SSD 3MG2-P Pin Assignment

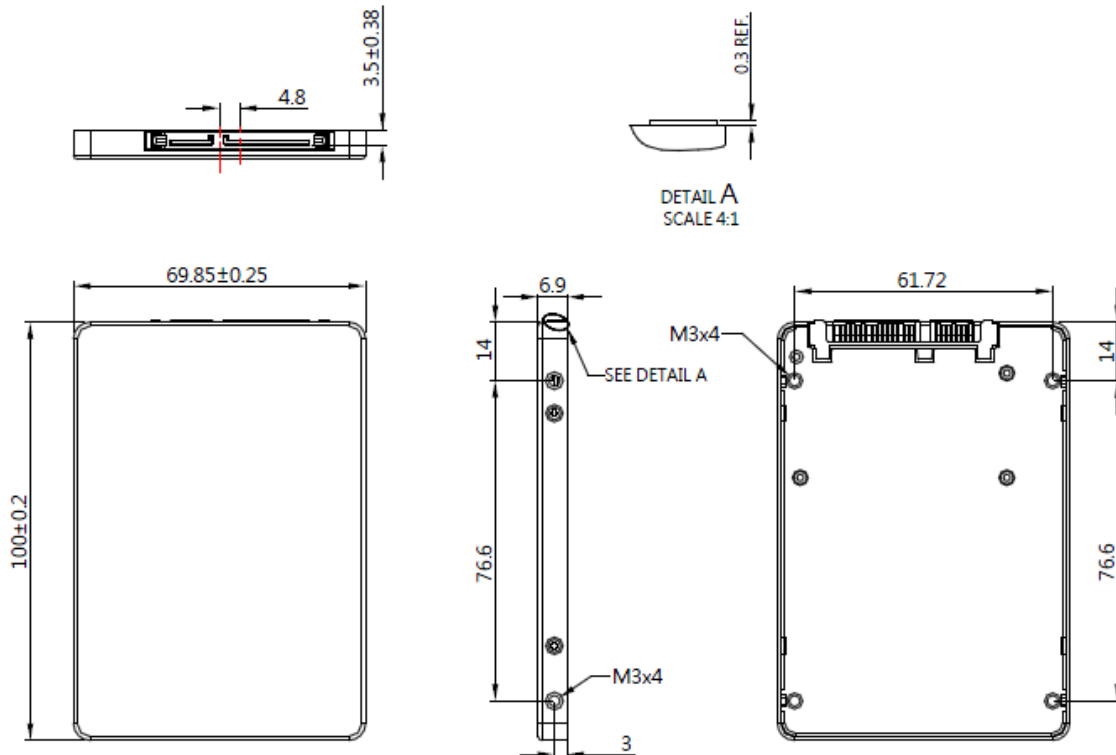
Name	Type	Description
S1	GND	NA
S2	A+	Differential Signal Pair A
S3	A-	
S4	GND	NA
S5	B-	Differential Signal Pair B
S6	B+	
S7	GND	NA
Key and Spacing separate signal and power segments		
P1	NC	NA
P2	NC	NA
P3	NC	NA
P4	GND	NA
P5	GND	NA
P6	GND	NA
P7	V5	5V Power, Pre-Charge
P8	V5	5V Power
P9	V5	5V Power
P10	GND	NA
P11	DAS/DSS	Device Activity Signal / Disable Staggered
P12	GND	NA
P13	NC	NA
P14	NC	NA
P15	NC	NA

2.10 Mechanical Dimensions

* DGS25-XXXD81SX1XC



* DGS25-XXXD81SX3XC



2.11 Assembly Weight

An Innodisk 2.5" SATA SSD 3MG2-P within MLC flash ICs, 16GB's weight is 100 grams approx. The total weight of SSD will be less than 135 grams.

2.12 Seek Time

Innodisk 2.5" SATA SSD 3MG2-P is not a magnetic rotating design. There is no seek or rotational latency required.

2.13 Hot Plug

The SSD support hot plug function and can be removed or plugged-in during operation. User has to avoid hot plugging the SSD which is configured as boot device and installed operation system.

Surprise hot plug : The insertion of a SATA device into a backplane (combine signal and power) that has power present. The device powers up and initiates an OOB sequence.

Surprise hot removal: The removal of a SATA device from a powered backplane, without first being placed in a quiescent state.

2.14 NAND Flash Memory

Innodisk 2.5" SATA SSD 3MG2-P uses Multi Level Cell (MLC) NAND flash memory, which is non-volatility, high reliability and high speed memory storage.

3. Theory of Operation

3.1 Overview

Figure 2 shows the operation of Innodisk 2.5" SATA SSD 3MG2-P from the system level, including the major hardware blocks.

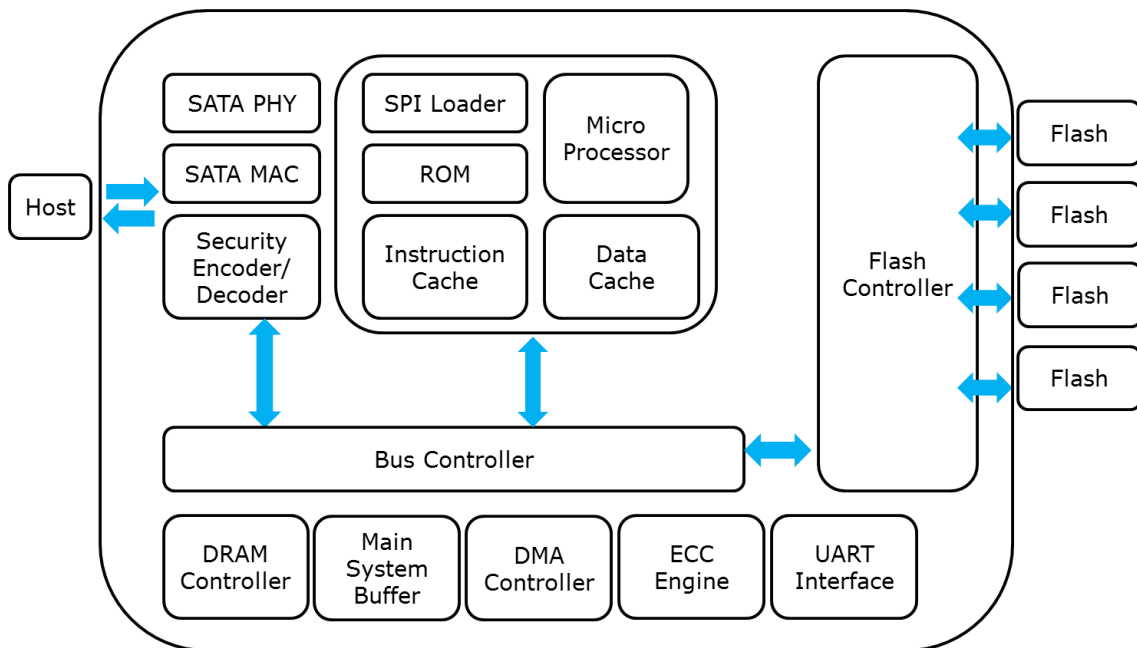


Figure 2: Innodisk FiD 2.5" SATA SSD 3MG2-P Block Diagram

Innodisk 2.5" SATA SSD 3MG2-P integrates a SATA III controller and NAND flash memories. Communication with the host occurs through the host interface, using the standard ATA protocol. Communication with the flash device(s) occurs through the flash interface.

* iCell is optional feature with different part number.

3.2 SATA III Controller

Innodisk 2.5" SATA SSD 3MG2-P is designed with ID 201, a SATA III 6.0Gbps (Gen. 3) controller, which supports external DDR3 DRAM. The Serial ATA physical, link and transport layers are compliant with Serial ATA Gen 1, Gen 2 and Gen 3 specification (Gen 3 supports 1.5Gbps/3.0Gbps/6.0Gbps data rate). The controller has 4 channels for flash interface.

3.3 Error Detection and Correction

Highly sophisticated Error Correction Code algorithms are implemented. The ECC unit consists of the Parity Unit (parity-byte generation) and the Syndrome Unit (syndrome-byte computation). This unit implements an algorithm that can correct 66 bits per 1024 bytes in an ECC block. Code-byte generation during write operations, as well as error detection during read operation, is implemented on the fly without any speed penalties.

3.4 Wear-Leveling

Flash memory can be erased within a limited number of times. This number is called the **erase cycle limit** or **write endurance limit** and is defined by the flash array vendor. The erase cycle limit applies to each individual erase block in the flash device.

Innodisk 2.5" SATA SSD 3MG2-P uses a static wear-leveling algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page/block in the flash. This spreads flash media usage evenly across all pages, thereby extending flash lifetime.

3.5 Bad Blocks Management

Bad Blocks are blocks that contain one or more invalid bits whose reliability are not guaranteed. The Bad Blocks may be presented while the SSD is shipped, or may develop during the life time of the SSD. When the Bad Blocks is detected, it will be flagged, and not be used anymore. The SSD implement Bad Blocks management, Bad Blocks replacement, Error Correct Code to avoid data error occurred. The functions will be enabled automatically to transfer data from Bad Blocks to spare blocks, and correct error bit.

3.6 iData Guard

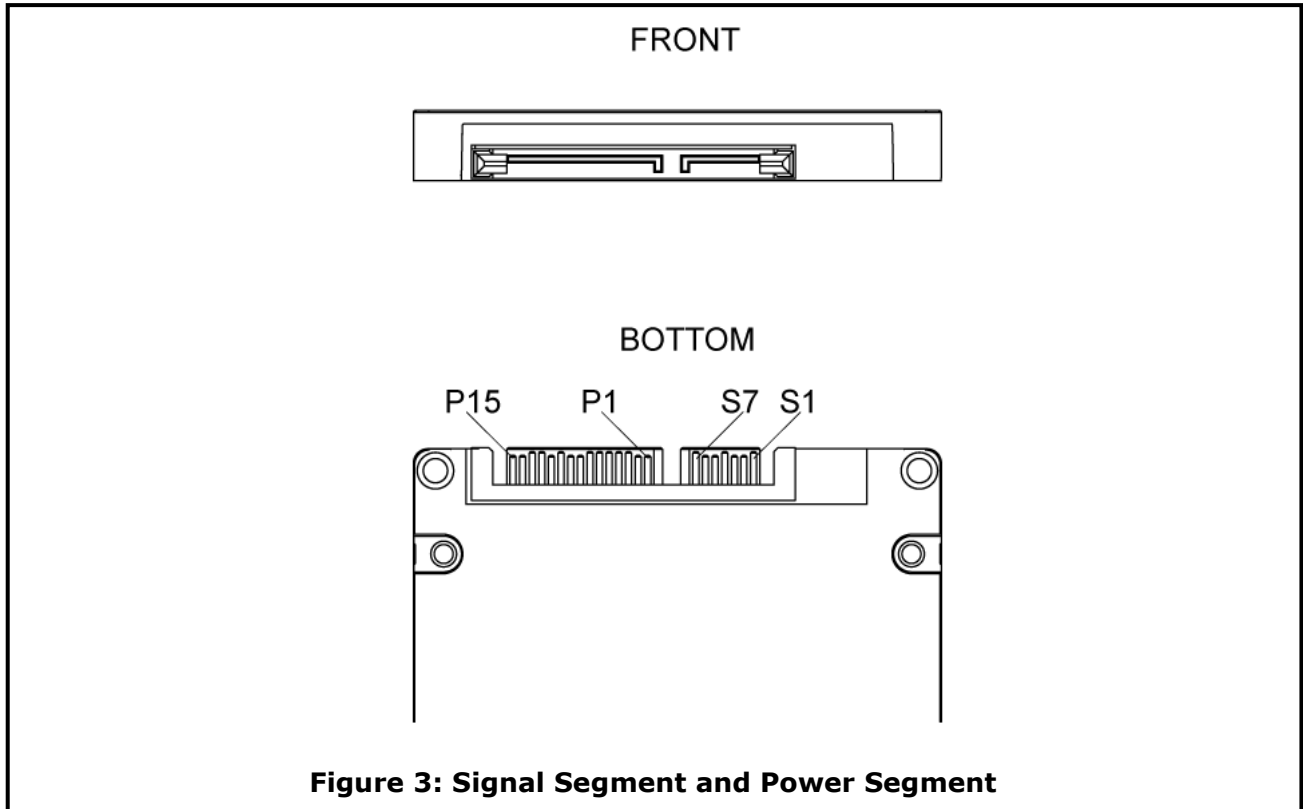
Innodisk's iData Guard is a comprehensive data protection mechanism that functions before and after a sudden power outage to SSD. Low-power detection terminates data writing before an abnormal power-off, while table-remapping after power-on deletes corrupt data and maintains data integrity. Innodisk's iData Guard provides effective power cycling management, preventing data stored in flash from degrading with use.

3.7 Garbage Collection/TRIM

Garbage collection and TRIM technology is used to maintain data consistency and perform continual data cleansing on SSDs. It runs as a background process, freeing up valuable controller resources while sorting good data into available blocks, and deleting bad blocks. It also significantly reduces write operations to the drive, thereby increasing the SSD's speed and lifespan.

4. Installation Requirements

4.1 2.5" SATA SSD 3MG2-P Pin Directions



4.2 Electrical Connections for 2.5" SATA SSD 3MG2-P

A Serial ATA device may be either directly connected to a host or connected to a host through a cable. For connection via cable, the cable should be no longer than 1 meter. The SATA interface has a separate connector for the power supply. Please refer to the pin description for further details.

4.3 Form Factor

Please prepare following things:

- Screw driver.
- Four M3 screws.
- SATA single cable (7-pin, Maximum length 1 meter).
- SATA power cable (15-pin).

Please turn off your computer, and open your computer's case. Find one of available 2.5-inch slot, and plug the SSD in. To use the screws fix the SSD. Plug in the SATA single cable, and power cable. Please boot the installation Operation System from CD-ROM, and install Operation System into SSD.

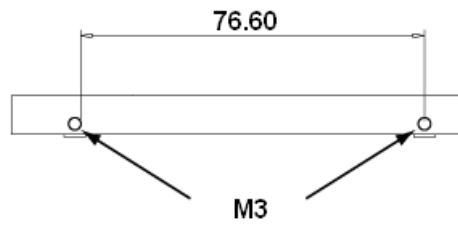


Figure 4: 2.5" SATA SSD 3MG2-P Mechanical Screw Hole

4.4 Device Drive

No additional device drives are required. Innodisk 2.5" SATA SSD 3MG2-P can be configured as a boot device.

5. Part Number Rule

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	D	G	S	2	5	-	3	2	G	D	8	1	S	C	1	Q	C	-	X	X
Description	Disk	2.5" SATA SSD 3MG2-P					Capacity			Category			Flash mode	Operation Temp.	Internal Control	CH.	Flash	-	Customized Code	
Definition																				
Code 1st (Disk)												Code 13th (Firmware version)								
D : Disk												S: Synchronous Flash								
Code 2nd ~ 5th (Form Factor)												Code 14th (Operation Temperature)								
GS25: 2.5" SATA SSD 3MG2-P (EverGreen Series)												C: Standard Grade (0°C ~ +70°C)								
Code 7th ~9th (Capacity)												Code 15th (Internal control)								
08G: 8GB												Code 16th (Channel of data transfer)								
16G: 16GB												S: Single Channel								
32G: 32GB												D: Dual Channels								
64G: 64GB												Q: Quad Channels								
A28: 128GB												Code 17th (Flash Type)								
B56: 256GB												C: Toshiba MLC								
C12:512GB																				
01T: 1TB																				
Code 10th ~12th (Series)												Code 19th ~20th (Customized code)								
D81: 2.5" SATA SSD 3MG2-P																				

Appendix

ISL International Standards Laboratory Laboratory http://www.isl.com.tw

Certificate

Issue Date: August 19, 2014
Ref. Report No. ISL-14LE346CE

Product Name : 2.5" SATA SSD 3MG2-P
Model(s) : D@S25-KCKXD81*#%#&
Brand : Innodisk
Responsible Party : Innodisk Corporation
Address : 5F.No.237, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)

We, International Standards Laboratory, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in European Council Directive- EMC Directive 2004/108/EC. The device was passed the test performed according to :



Standards:

- EN 55022: 2010+AC2011 and CISPR 22: 2008 (modified)
- EN 61000-3-2: 2006+A1:2009 +A2:2009 and IEC 61000-3-2: 2005+A1:2008 +A2:2009
- EN 61000-3-3: 2013 and IEC 61000-3-3: 2013
- EN 55024: 2010 and CISPR 24: 2010
- EN 61000-4-2: 2009 and IEC 61000-4-2: 2008
- EN 61000-4-3: 2006+A1: 2008 +A2: 2010 and IEC 61000-4-3:2006+A1: 2007+A2: 2010
- EN 61000-4-4: 2004 +A1:2010 and IEC 61000-4-4: 2004 +A1:2010

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

International Standards Laboratory

Jim Chu
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Certificate

Issue Date: August 19, 2014
Ref. Report No. ISL-14LE346FB

Product Name : 2.5" SATA SSD 3MG2-P
Model(s) : D@S25-KXKD81*#%*&
Brand : Innodisk
Applicant : Innodisk Corporation
Address : 5F.No.237, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221,
Taiwan (R.O.C.)

We, International Standards Laboratory, hereby certify that:

The device bearing the trade name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified. (refer to Test Report if any modifications were made for compliance).



Standards:

FCC CFR, Title 47 Part 15 Subpart B: 2012- Section 15.107 and 15.109
ANSI C63.4-2009
Industry Canada Interference-Causing Equipment Standard ICES-003 Issue 5: 2012

Class B

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

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