

An Innodisk White Paper
April 2014

Innodisk iAnalyzer Technology for SSDs

Data Pattern Recorder for SSDs

Revision History	Date	Version	Information
	2014.04	1.0	First Release

Introduction

One limitation of NAND flash memory is the finite number of Program/Erase cycles. The current 2xnm SLC flash on the market is rated between 60,000 to 100,000 Program/Erase cycles and 1xnm MLC flash is rated between 1,500 and 3,000 Program/Erase cycles. Lower grade consumer type MLC and TLC flash is rated at under 1,000 Program/Erase cycles.

An industrial grade SSD uses highly reliable flash components selected for your application. Innodisk has designed a new iAnalyzer function that can record your system's behavior, such as read/write distribution, sequential/random read/write commands, the ratio of file sizes and total amount written to the disk. This information can help our customers understand their software behavior so they can select the best product for their system's lifespan.

How to record system application behavior

iAnalyzer is a new feature that is accessed through Innodisk's iSMART Windows utility. This is a free tool that records the read/write behavior of the disk without the need for a driver or external analyzer. When the iAnalyzer function is triggered, the GUI shows the distribution of read/write of the host's behavior. This information can be used to select a more cost-effective product for your application.

Figure 1: iAnalyzer shown on iSMART

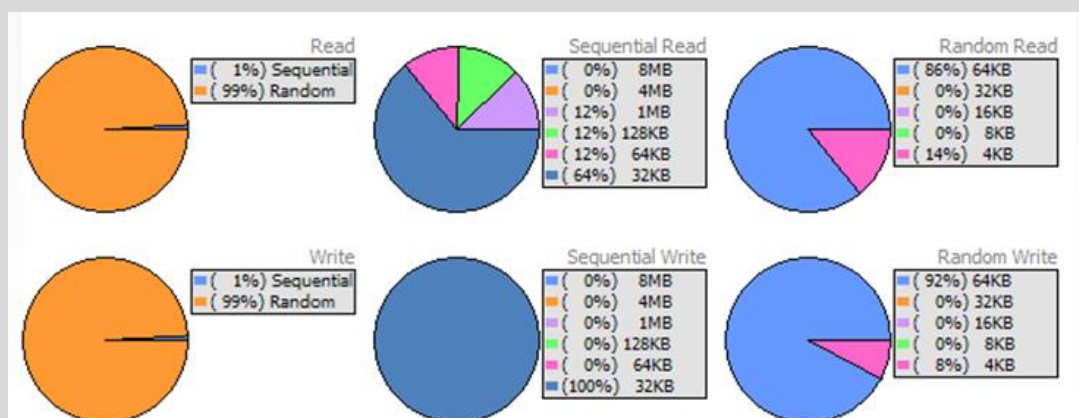
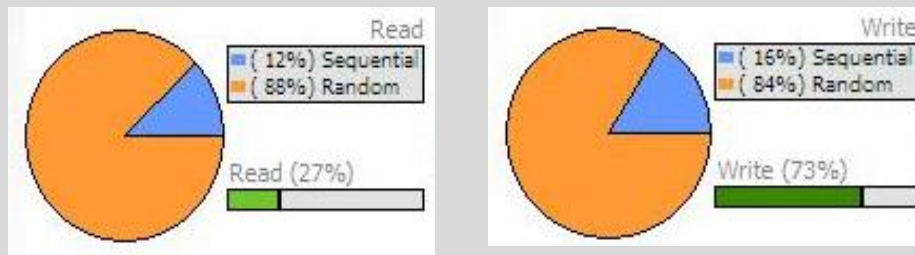


Figure 2: The distribution of read/write

This feature can separately monitor all read/write sector, multiple, DMA, DMA EXT, FPDMA commands. It will then sort all the command file sizes from 4KB up to 8MB. This information that is gathered can provide you more details about your system's behavior. This can also provide Innodisk's firmware team the ability to finely tune our product's firmware to meet the customer's additional requirements. The utility can calculate the total data written sent from the host to report an estimated life expectancy of the drive.

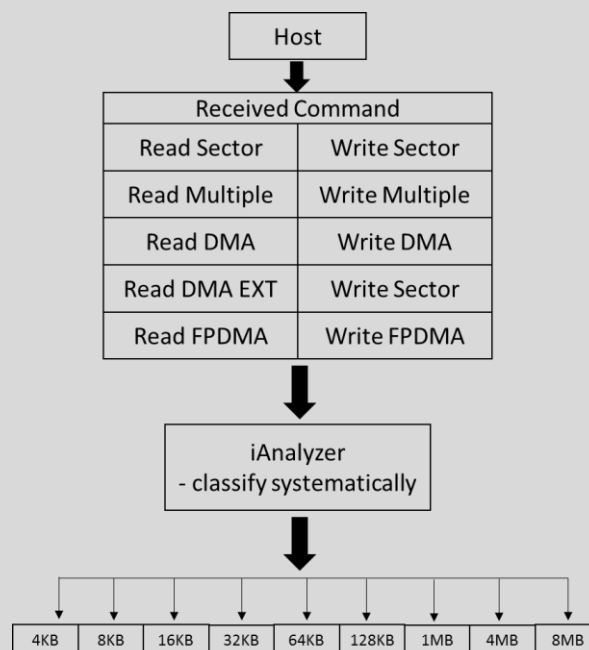
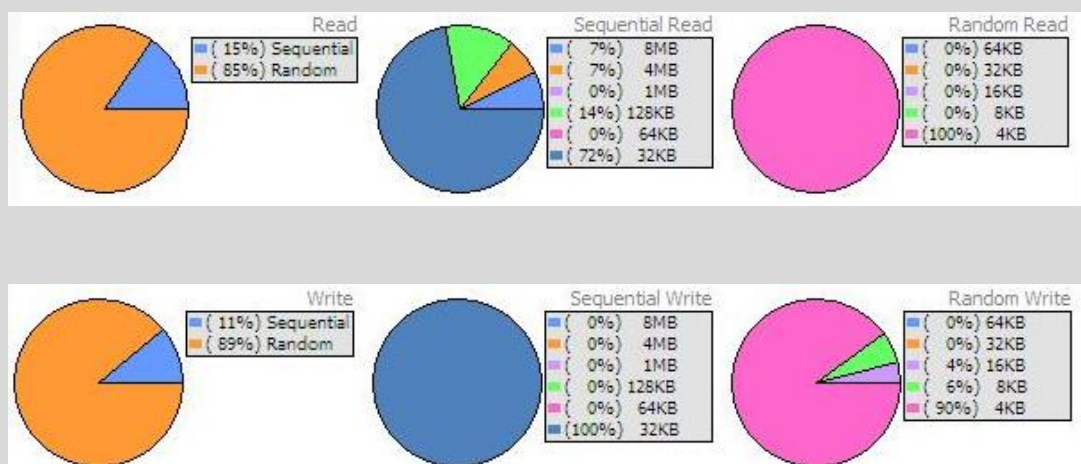
Figure 3: iAnalyzer flow chart

Figure 4: The proportion of sequential/random read and write

Figure 5: The total data written

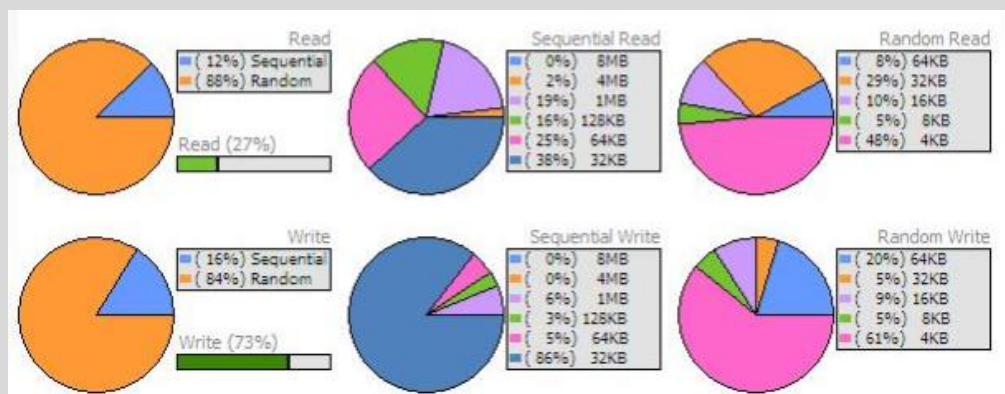
W.Protect Idle PW Saving Security Erase iAnalyzer			
ID	Attribute Name	Item Value	Raw Values
09	Power On Hours	0	000000000000000000000000
0C	Power Cycle Count	2	000000000200000000000000
E1	Host Writes	0.00KB	000000000000000000000000
AA	Later Bad Block	0	0300646400009F0000000000
AD	Erase Count	Max:1 Ave:0	120064640000010000000000
EC	Unstable Power Count	0	020064640000000000000000
EB	Later Bad Block	Lat:0 Rea:0 Wri:0 Era:0	020064000000000000000000
01			000000000000000000000000
02			000000000000000000000000

Application

Innodisk uses our iAnalyzer to monitor the installation of three different operating systems. The real-time collection and analysis of Window XP, Window 7, and Linux Ubnutu are shown below. See Figure 6-8.

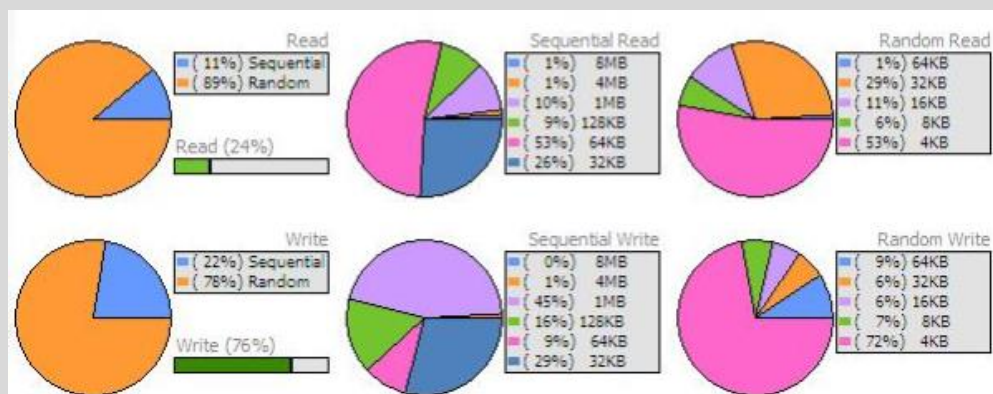
- (1) Window XP- 73% write commands, 27% read commands, and host write is 1.69GB.

Figure 6: iAnalyzer information of Window XP



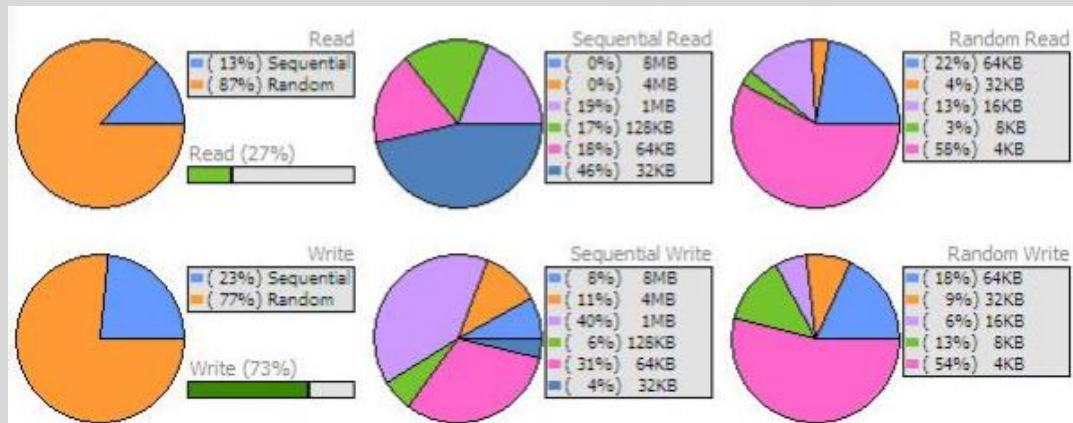
- (2) Window 7- 76% write commands, 24% read commands, and host write is 6.03GB.

Figure 7: iAnalyzer information of Window 7



(3) Linux Ubuntu- 73% write commands, 27% read commands, and host write is 2.82GB.

Figure 8: iAnalyzer information of Linux Ubuntu



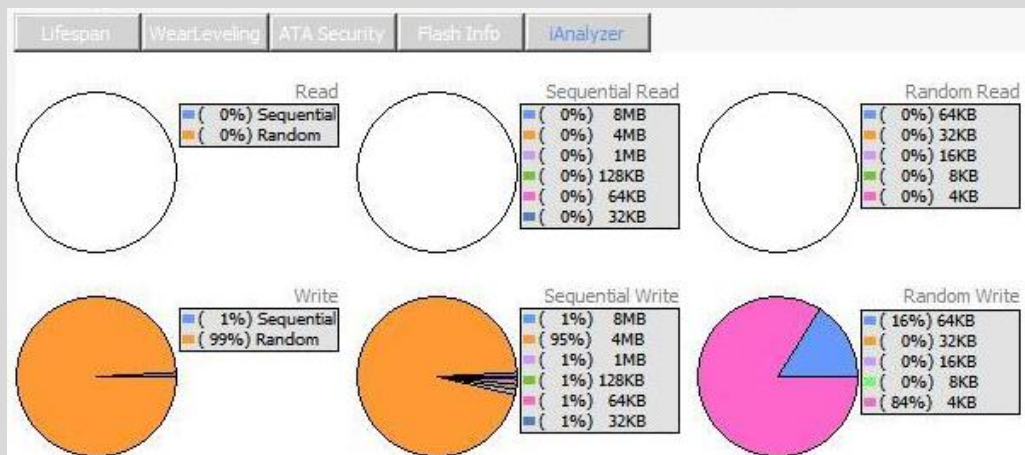
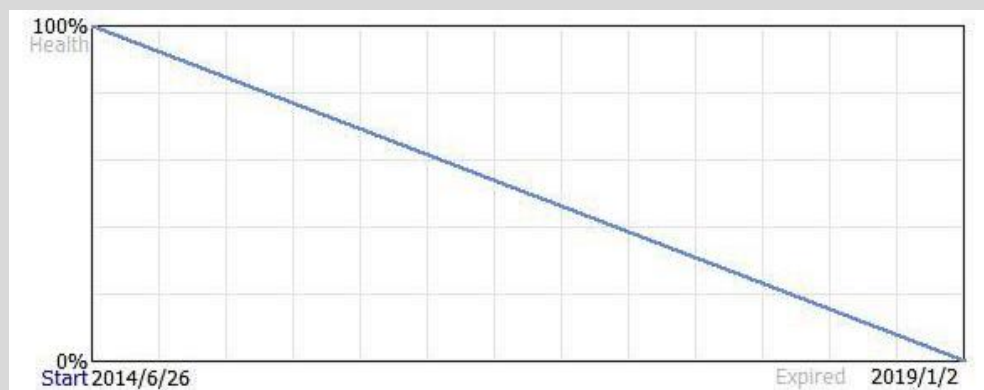
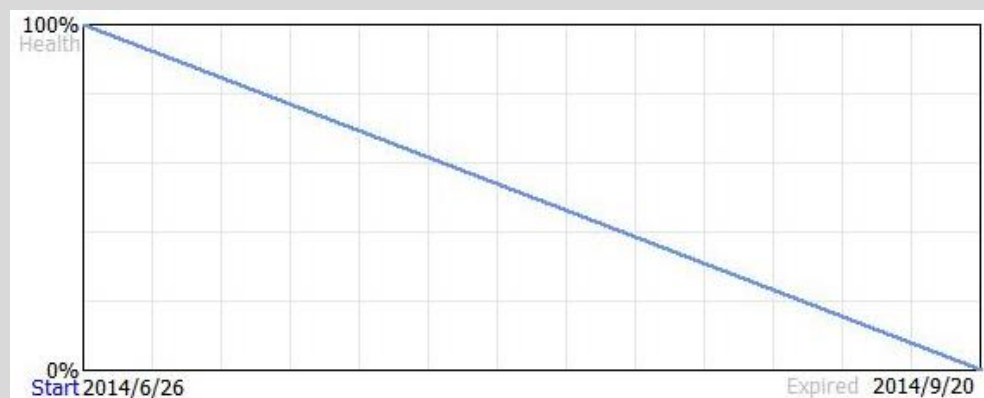
According to iAnalyzer, the major behavior during the installation of these operating systems are 4K random writes with Windows XP at 61%, Windows 7 at 72%, and Linux Ubuntu at 54%. Knowing the application relies on a lot of 4K random writes, the customer can select the correct product that can meet their performance needs.

Sample conditions

Innodisk simulates two different kinds of applications to predict the lifespan by running IOmeter for 24 hours. With this data, the user can easily choose the best product for their specific applications.

1. Condition: frequent small file size writes, such as POS/KIOSK/ATM applications.

We simulated the behavior on two different Innodisk products; 3MG-P and 3ME. Both 3MG-P and 3ME show that this application does over 84% of it's random write in 4K patterns. This is a worst case scenario for the 3ME since our life expectancy calculates this drive to only last another 3 months with this application writing behavior. A better product to select would be the 3MG-P which shows our firmware is tuned for this type of application and the life expectancy is over 4 years.

Figure 9: small file write behavior

Figure 10: The lifespan curve of 3MG-P

Figure 11: The lifespan curve of 3ME


2. Condition: Sequential writes, such as surveillance or machine monitors.

We simulate the behavior on two different Innodisk products; 3SE-P and 3MG-P. Both 3SE-P and 3MG-P show that this application does over 95% in 4MB patterns. The large amount of data written to these drives show that an MLC drive (3MG-P) will not be able to sustain this type of writing pattern for more than one month. The SLC drive (3SE-P) on the otherhand shows that it's more than capable of sustaining this heavy writing pattern to last over 1,000 times the 3MG-P drive.

Figure 12: Sequential write behavior

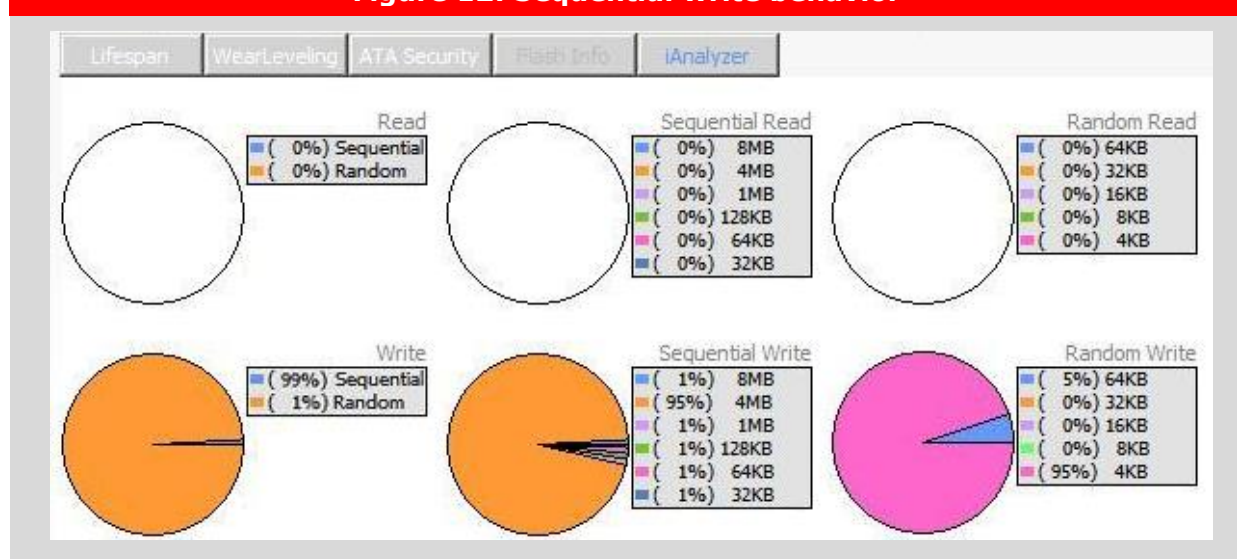


Figure 13: The lifespan curve of 3SE-P

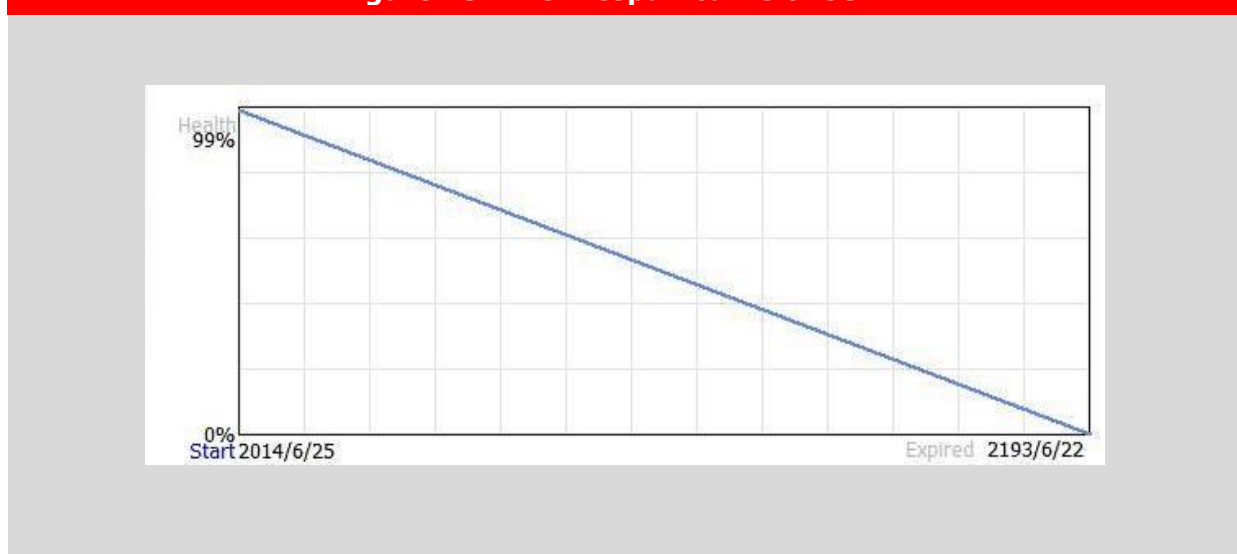
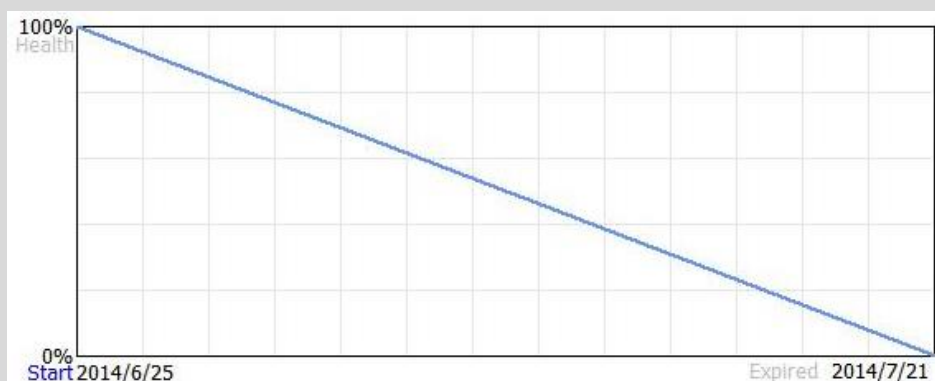


Figure 14: The lifespan curve of 3MG-P

Conclusion

iAnalyzer is a powerful feature for collecting, analyzing and displaying data in Innodisk's iSMART utility. Through the iAnalyzer function, customers can easily capture their application's data behavior. This real-time collection provides in-depth knowledge of the user's application, and aids them in choosing the best solution for their system. Innodisk iAnalyzer is able to work on a wide variety of embedded systems, including industrial, medical, transportation, automation, and gaming industries.

About us

Innodisk is a worldwide leading provider of data storage and memory module solutions for industrial and mission-critical applications. Leveraging in-house engineering and R&D expertise with a keen insight on industry trends, Innodisk's solid-state drive (SSD) technologies provide enhanced, vertically-integrated data storage solutions. Our advanced Flash-based data storage and DRAM memory solutions meet stringent aerospace and defense application requirements, and are also widely used in industrial applications and embedded systems. Innodisk offers customized solutions, from unique form factors to special firmware designs, and our support team of hardware, software and firmware engineers is always ready to tailor the right solution to each customer's needs. Innodisk continually strives to innovate and provide system integrators and end customers with the best service in the industry.

For more information about Innodisk's product line, technologies and applications, please visit www.innodisk.com