White Paper

InnoRobust® SSD Series Data Security(QEraser/Destroy SEraser Write Protect)

Introduction

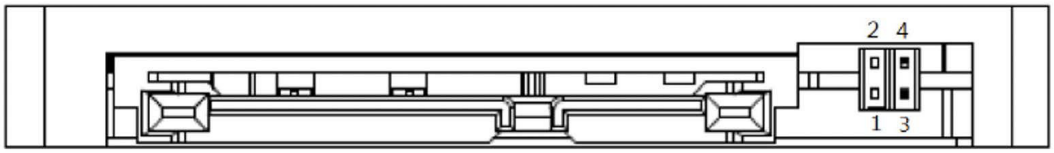
InnoRobust® SATAIII SSD Data Security Functions

InnoRobust SATAIII SSD has several security functions which can be triggered by shorting different pin configurations.

Quick Erase

QEraser

QEraser is designed for emergency data erase in a few seconds. QEraser can be triggered by shorting QEraser Pins (Pin settings may be different by different product series) with an external jumper or by sending an ATA Command. All Data Blocks on the Flash chip will be erased by sending the Flash Erase Command.



Graph 1: InnoRobust SATAIII SSD Data Security QEraser/Destroy Pin Setting

Destroy

Innodisk's Destroy function implements an ultimate data erase of the SSD. Once Destroy is triggered, all user data and SSD information, including SSD firmware, will be erased and UNRECOVERABLE. Destroy is optional and available for customization.

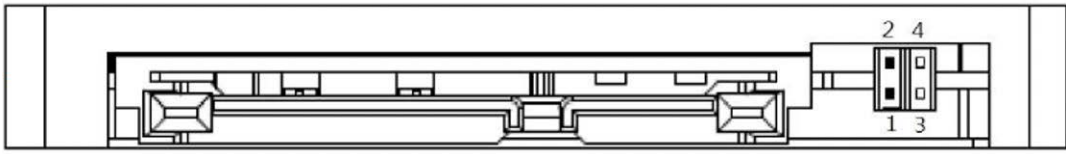
Attention: Once QEraser/Destroy is triggered, the jumper must be removed from QEraser/Destroy pins immediately, otherwise erase command will execute continually.

Security Erase

SEraser

The Security Erase function is designed for emergency data erasure to comply with military standards. The erase function can be triggered by shorting the Security Erase Pin (SE) or by sending an ATA Command. All Data Blocks on the Flash chip will be erased by sending the Flash Erase Command. The SE Pin can be one of the following military Security Erase standards: AFFSI 5020, DoD 5220.22-M, USA Navy NAVSO P-5239-26, NSA Manual 130-2, USA-Army 380-19, NISPOMSUP Chap 8, Sect. 8-501, NSA Manual 9-12 and IRIG106. Word 159 of the Identify Table shows the SE pin's functions. The Identify Table can be read by sending the ECh ATA command.

Attention: Once SEraser is triggered, the jumper must be removed from SEraser pins immediately, otherwise the erase command will execute continually.



Graph 2: InnoRobust SATAIII SSD Data Security SEraser Pin Setting

154	Secure Function Support 7-15 Reserved 6 1= Secure Erase ATA Vendor Command Supported 5 Reserved 4 1=Quick Erase ATA Vendor Command Supported 3 1=Destroy ATA Vendor Command Supported 2 1=Jumper Secure Erase Supported 1 1=Jumper Write Protect Supported 0 1=Jumper Quick Erase Supported	O X O X X X X X
155	Secure Function Status(Enable/Disable) 2-15 1 Reserved 1 1= Write Protect Enabled 0 Reserved	o x
156-158	Vendor Specific	
159	8~15 Function of Jumper “QE” 0x20: Destroy 0x21 or Others: Quick Erase 0~7 Secure Erase Function of Jumper “SE” 0x22: AFFSI 5020 0x23: DoD 5220.22-M 0x24: USA Navy NAVSO P-5239-26 0x25: NSA Manual 130-2 0x26: USA-Army 380-19 0x27: NISPOMSUP Chap 8, Sect. 8-501 0x28: NSA Manual 9-12 0x29: IRIG106	XXXXh

Graph 3: Identify Information

AFFSI 5020

This function is compiled with the AFFSI 5020 specification. Step:
1 Formats the drive with all zeros.
2 Erases all data completely.
3 Writes a random character to the entire disk and verifies the write.

DoD 5220.22-M

This function is compiled with the DoD 5220.22-M specification. Step:
Overwrite Pass 1: The entire disk is filled with binary zeroes.
Overwrite Pass 2: The entire disk is overwritten with binary ones.
Overwrite Pass 3: The entire disk is filled with a random bit pattern.
Then verify the overwrites.

USA Navy NAVSO P-5239-26

This function is compiled with the USA Navy NAVSO P-5239-26 specification. Step:
1 The whole disk is erased using Flash Erase Command.
2 The whole disk is filled with random data.
3 The whole disk is erased using Flash Erase Command.

NSA Manual 130-2

This function is compiled with the NSA Manual 130-2 specification. Step:
1 The whole disk is erased using Flash Erase Command.
2 The whole disk is filled with random data and verifies the write.
3 The whole disk is filled with random data again.
4 The whole disk is erased using Flash Erase Command.
5 The whole disk is filled with fixed character pattern 0x55.

2.1.5 USA-Army 380-19

This function is compiled with the USA-Army 380-19 specification. Step:
1 The whole disk is erased using Flash Erase Command.
2 The whole disk is filled with random data.
3 The whole disk is filled with fixed character pattern 0x55.
4 The whole disk is filled with fixed character pattern 0xAA.

2.1.6 NISPOMSUP Chap 8, Sect. 8-501

This function is compiled with the NISPOMSUP Chap 8, Sect. 8-501 specification. Step:
1. The whole disk is filled with fixed character pattern 0x55.
2. The whole disk is filled with fixed character pattern 0xAA.
3. The whole disk is filled with random data.

2.1.7 NSA Manual 9-12

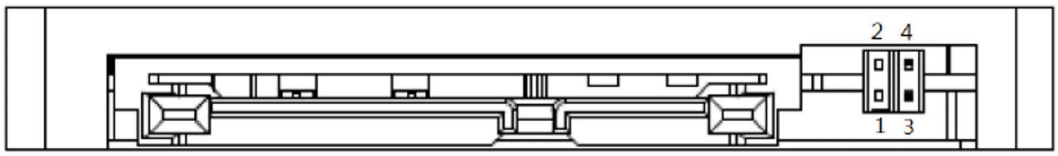
This function is compiled with the NSA Manual 9-12 specification. Step:
1. The whole disk is erased using Flash Erase Command.
2. The whole disk is filled with unclassified pattern.
3. Verify the overwrite procedure by randomly rereading the overwritten information.

IRIG106

This function is compiled with the IRIG106 specification. Step:
1. The whole disk is erased using Flash Erase Command.
2. The whole disk is filled with pattern 0x55, and read back to verify.
3. The whole disk is erased using Flash Erase Command.
4. The whole disk is filled with pattern 0xAA, and read back to verify.
5. The whole disk is erased using Flash Erase Command.
6. Write 0x00 to all bad blocks. If there is any bit still 1,
   the page is re-written 0 again. This procedure is repeated up to 16 times.
7. Erase all bad blocks and check to determine. If any zeros are found,
   erase this block again. This procedure is repeated up to 16 times.
8. Write “SecureErase” string to all blocks.

Write Protect

This command enable SSD into write protect mode, which is read-only. The SSD under write protect will overpass any write command.



Graph 4: InnoRobust SATA III SSD Data Security Write Protect Pin Setting

When Write Protect pins are shorted, the Write Protect function is enabled, and an ATA write command is aborted. This prevents the disk from modification and deletion. Write-protected data in the disk is read only; data cannot be written, edited, appended or deleted.

InnoRobust SATAIII SSD has a real-time detect function. It detects Write Protect pins every 1ms. Once Write Protect pins are shorted, an ATA write command is aborted and Write Protect function is enabled. The Write Protect function is disabled when the jumper is removed from Write Protect pins.

The Write Protect function can coexist with SEraser and QEraser functions.

Erase Time

2.5” SATA SSD 3SE2-P Erase Time

Command	Item	8GB	16GB	32GB	64GB	128GB	256GB	512GB
20h	Destroy	7	9	10	14	16	30	10
21h	Quick Erase	7	9	10	15	15	29	10
22h	AFFSI 5020	77	134	156	198	365	807	1468
23h	DoD 5220.22-M	81	140	160	202	373	815	1488
24h	USA Navy NAVSO P-5239-26	86	145	168	211	383	840	1488
25h	NSA Manual 130-2	228	402	462	586	1088	2403	4415
26h	USA-Army 380-19	221	393	454	577	1077	2370	4423
27h	NISPOMSUP Chap 8, Sect. 8-501	215	384	444	564	1064	2343	4430
28h	NSA Manual 9-12	89	161	183	225	392	835	1495
29h	IRIG106	257	459	523	647	1151	2481	4460

Unit: Sec.

2.5” SATA SSD 3MR2-P Erase Time

Command	Item	8GB	16GB	32GB	64GB	128GB	256GB	512GB	1TB	2TB
20h	Destroy	6	10	11	6	7	14	17	34	35
21h	Quick Erase	5	10	11	6	7	13	17	34	34
22h	AFFSI 5020	273	661	697	671	442	959	1486	2960	3375
23h	DoD 5220.22-M	274	661	697	671	450	974	1512	3007	3417
24h	USA Navy NAVSO P-5239-26	279	671	707	377	449	972	1503	2991	3409
25h	NSA Manual 130-2	815	1972	2080	1107	1327	2878	4467	8888	10132
26h	USA-Army 380-19	811	1966	2069	1102	1330	2885	4473	8910	10132
27h	NISPOMSUP Chap 8, Sect. 8-501	805	1952	2058	1096	1330	2882	4469	8900	10131
28h	NSA Manual 9-12	277	689	713	372	444	16m1s	1489	2964	3379
29h	IRIG106	828	2038	2123	1116	1329	2881	4465	8894	10133

Unit: Sec.

2.5" SATA SSD 3TR6-P Erase Time

Command	Item	32GB	64GB	128GB	256GB	512GB
20h	Destroy	3.46	3.51	3.51	7.08	8.95
21h	Quick Erase	6.31	6.31	6.97	13.35	25.38
22h	AFI 5020	1517.63	1531.75	1577.91	3159.01	3866.18
23h	DOD 5220.22-M	381.92	390.93	431.48	864.17	1643.18
24h	USA Navy NAVO P-5239-26	1524.56	1539.01	1587.85	3176.26	3892.69
25h	NSA Manual 130-2	3409.06	3444.83	3571.64	7152.80	9353.35
26h	USA-Army 380-19	2265.10	2295.43	2415.38	4836.75	7103.84
27h	NIPOMUP Chap 8, sect. 8-501	2259.94	2285.82	2405.76	4814.67	7081.15
28h	NSA Manual 9-12	385.49	397.96	447.25	876.04	1716.81
29h	IRIG106	1271.97	1428.51	3320.65	3624.78	8553.90

Unit: Sec.

InnoRobust Security Functions Overview

Features	Standard	Description
QEraser	Quick Erase	Erase user data/ MBR/ FAT table
SEraser	DoD 5220.22-M	Erase, overwrite with a single character, and then erase again.
	USA-AF AFSSI 5020	Erase, and overwrite with random data.
	USA Navy NAVSO P-5239-26	Erase, overwrite with random data, and then erase again.
	NSA Manual 130-2	Erase, overwrite with random data twice, and then erase and overwrite with one character.
	USA-Army 380-19	Erase and overwrite with random data, erase and overwrite with one character, and then erase and overwrite with complement of the character.
	NISPOMSUP Chap 8, Sect. 8-501	Overwrite all locations with one character, its complement, and then random data.
	NSA Manual 9-12	Erase, and overwrite with random data.
	IRIG 106	Erase, overwrite with one character, erase and overwrite with one character and the erase. Write one character to all bad blocks and erase till it's erased all.
Destroy	Innodisk Destroy	Ultra speed erase user data/ MBR/ FAT table/ Firmware.
Write Protect	Hardware or Software Write Protect	Once the SSD is triggered write protect, the SSD's status will be read only.

Appendix

QEraser Command: 82h

- Protocol: No Data

-Inputs

Register	7	6	5	4	3	2	1	0
Features	21h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table1: Execute Quick Erase command for inputs information

- Normal Outputs

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

Table2: Quick Erase command for normal output information

Device register
- DEV shall specify the selected device

Status register
- BSY will be cleared to zero indicating command completion
- DRDY will be set to one
- DF (Device Fault) will be cleared to zero
- DRQ will be cleared to zero
- ERR will be cleared to zero

SEraser Command
1. AFFSI 5020 Command Code: 82h

- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	22h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 3: Execute AFFSI 5020 command for inputs information

- Normal Outputs

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

Table 4: AFFSI 5020 command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one.
•DF (Device Fault) will be cleared to zero.
•DRQ will be cleared to zero
•ERR will be cleared to zero.

2. DoD 5220.22-M: 82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	23h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 5: Execute DoD 5220.22-M command for inputs information

- Normal Outputs

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

Table 6: DoD 5220.22-M command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one
•DF (Device Fault) will be cleared to zero
•DRQ will be cleared to zero
•ERR will be cleared to zero

3. USA Navy NAVSO P-5239-26: 82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	24h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 7: Execute USA Navy NAVSO P-5239-26 command for inputs information

- Normal Outputs

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

Table 8: USA Navy NAVSO P-5239-26 command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one
•DF (Device Fault) will be cleared to zero
•DRQ will be cleared to zero
•ERR will be cleared to zero

4. NSA Manual 130-2: 82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	25h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 9: Execute NSA Manual 130-2 command for inputs information

- Normal Outputs

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

Table 10: NSA Manual 130-2 command for normal output information

Device register
- DEV shall specify the selected device

Status register
- BSY will be cleared to zero indicating command completion
- DRDY will be set to one.
- DF (Device Fault) will be cleared to zero.
- DRQ will be cleared to zero
- ERR will be cleared to zero

5. USA-Army 380-19:82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	26h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 11: Execute USA Army 380-19 command for inputs information

- Normal Outputs

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

Table 11: Execute USA Army 380-19 command for normal output information

Device register
- DEV shall specify the selected device

Status register
- BSY will be cleared to zero indicating command completion
- DRDY will be set to one.
- DF (Device Fault) will be cleared to zero.
- DRQ will be cleared to zero.
- ERR will be cleared to zero.

6. NISPOMSUP Chap 8, Sect. 8-501:82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	27h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 12: Execute NISPOMSUP Chap 8, Sect. 8-501 command for inputs information

- Normal Outputs

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

Table 13: NISPOMSUP Chap 8, Sect. 8-501 command for normal output information

Device register
- DEV shall specify the selected device

Status register
- BSY will be cleared to zero indicating command completion
- DRDY will be set to one.
- DF (Device Fault) will be cleared to zero.
- DRQ will be cleared to zero.
- ERR will be cleared to zero.

7. NSA Manual 9-12:82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	28h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 14: Execute NSA Manual 9-12 command for inputs 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

Table 15: NSA Manual 9-12 command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one.
•DF (Device Fault) will be cleared to zero.
•DRQ will be cleared to zero
•ERR will be cleared to zero

8. IRIG106:82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	29h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 16: Execute IRIG106 command for inputs information

- Normal Outputs

Register	7	6	5	4	3	2	1	0
Error	Na							
Sector Count	Secure Erase Failure Block Number							
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

Table 17: IRIG106 command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one.
•DF (Device Fault) will be cleared to zero.
•DRQ will be cleared to zero
•ERR will be cleared to zero
•Sector Count: The number of Erase Failure Block.

Write Protect Command: 82h
1. Enable Write Protect
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	17h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 18: Execute Enable Write Protect command for inputs information

- Normal Outputs

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

Table 19: Enable Write Protect command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one
•DF (Device Fault) will be cleared to zero
•DRQ will be cleared to zero
•ERR will be cleared to zero

2. Disable Write Protect
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	18h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 20: Execute Disable Write Protect command for inputs information

Normal Outputs

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

Table 21: Disable Write Protect command for normal output information

Device register
•DEV shall specify the selected device

Status register
•BSY will be cleared to zero indicating command completion
•DRDY will be set to one
•DF (Device Fault) will be cleared to zero
•DRQ will be cleared to zero
•ERR will be cleared to zero

Destroy Command: 82h
- Protocol: No Data
- Inputs

Register	7	6	5	4	3	2	1	0
Features	20h							
Sector Count	41h							
LBA Low	Na							
LBA Mid	Na							
LBA High	Na							
Device	1	1	1	0	Na			
Command	82h							

Table 20: Execute Destroy command for inputs information

Normal Outputs

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

Table 21: Destroy command for normal output information

Device register

- DEV shall specify the selected device

Status register

- BSY will be cleared to zero indicating command completion
- DRDY will be set to one
- DF (Device Fault) will be cleared to zero
- DRQ will be cleared to zero
- ERR will be cleared to zero

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