

EDGE Part Number

480GB: PE236700



Features:

- Ultra-efficient Block Management & Wear Leveling
- Advanced Read Disturb Management
- Intelligent “Recycling” for advanced free space management
- RoHS-compliant package
- TRIM Command Support
- Temperature Management
- No External DRAM
- SATA 3.0 Compliant,
 - SATA 6.0Gb/s with 3Gb/s and 1.5Gb/s support
- ATA modes supported
 - PIO modes 3 and 4
 - Multiword DMA modes 0, 1, 2
 - Ultra DMA modes 0, 1, 2, 3, 4, 5, 6
- Industry-standard, 512-byte sector size support
- Native command queuing support with 32 command slot support
- ATA8-ACS2 command set support
- Secure erase (data page) command set
- S.M.A.R.T. (Self-monitoring, analysis, and reporting technology) command set
- Capacity: 480GB¹
- Performance (lifetime)²
 - Sequential READ: up to 535MB/s @128K
 - Sequential WRITE: up to 425MB/s @128K
 - Random READ: up to 60K IOPs @4K
 - Random WRITE: up to 30K IOPs @4K
- Endurance: Total bytes written (TBW)
 - Up to 2.8 PB
- Asynchronous Flash

- Security
 - 128/256-bit AES compliant Data Encryption
 - User Selectable Password prior to boot
 - User Selectable Password runtime
 - Secure Erase (Factory Reset - ATA)
- Reliability
 - MTBF(PoH): 2 million device hours³
 - Up to 24 9-bit Symbols Correction per 512 9-bit Symbol
 - Static and dynamic wear leveling
 - Field-upgradable firmware
 - Non-recoverable Read Errors: (Less than 1 sector per bits read) 10^{^16}
 - Power consumption (typical): 2W (active) / 0.7W (idle)
- Mechanical/Electrical
 - Standard SATA connector
 - 3.3V power (±10%)
 - MO-300 drive: 50.8mm x 29.85 mm
 - 4.8 mm thickness
 - Weight: 0.01lbs
- Environmental
 - Operating temperature: 0°C to 70°C
 - Humidity (operating): 5% to 95% RH
 - Shock and vibrate
 - 1500G/0.5ms
 - 2–500Hz at 3.1G

Notes:

1. 1GB = 1 billion bytes (1000⁴)
2. Typical I/O performance numbers as measured using Iometer with a queue depth of 32 and write cache enabled.
3. The product shall achieve a mean time between failures (MTBF) of 2.0 million hours, which are based on population statistics that are not relevant to individual units.

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Patents pending.

Document No. xx-xxxx-xx Mar-2012 Printed in U.S.A.

Revision History

Nov 2012 Preliminary Rev 0.1 – initial release

Ordering Information

Table 1 lists the ordering part number for EDGE Boost Pro mSATA SSDs:

Table 1 Ordering Information

User Capacity (1000 ⁴)	MLC (Async)
480	PE236700

Package Dimensions

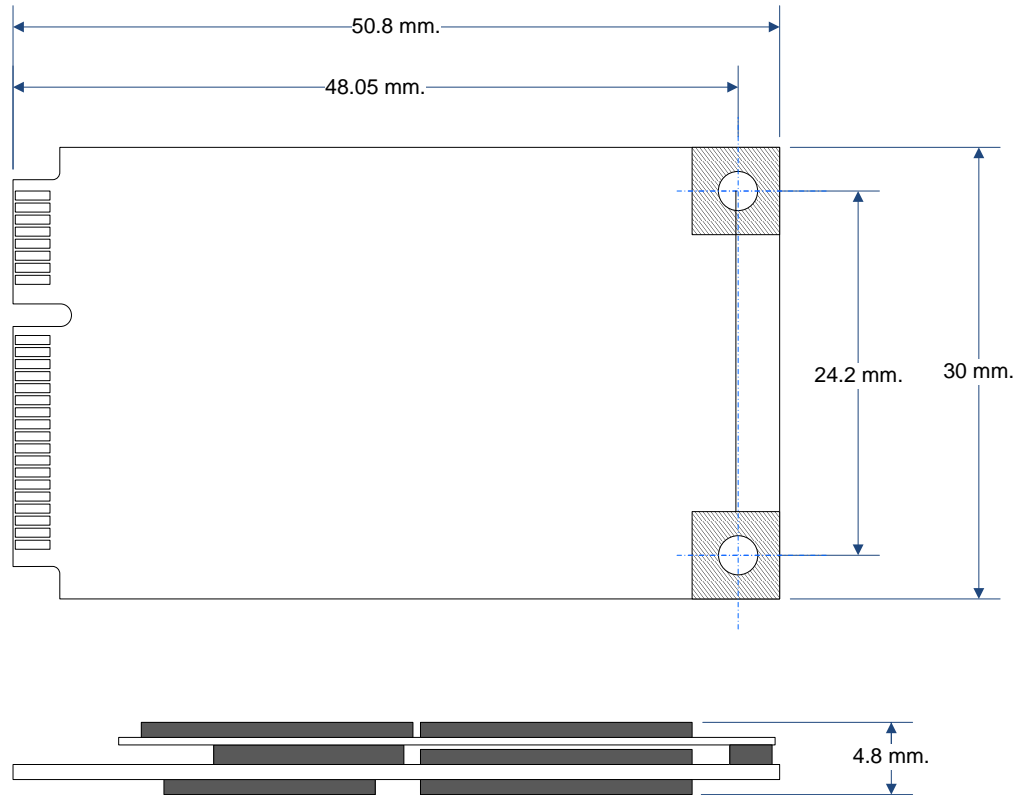


Figure 1 EDGE 2.5" SSD Enclosure

General Description

EDGE Memory Solid State Drives (SSD) is designed to bring enterprise class storage to Ultrabook and mobile PC users. With the shift from Hard Disk Drives (HDD) to SSDs, the EDGE Boost Pro mSATA is an excellent upgrade choice. This is a drop-in replacement for lower capacity and poor performing SSDs. It delivers superior reliability, durability, performance and power efficiency - keeping Ultrabooks working reliably in the toughest of conditions.

The Boost Pro mSATA conforms to the industry standard MO-300 form-factor, the SSD integrates easily in existing storage infrastructures. EDGE SSDs provide high bandwidth and IOPS while efficiently managing write amplification. Employing SSD technology in a system enables faster boot times, quicker application load times, lower power consumption, and enhanced reliability.

Architecture

EDGE’s solid state drive (SSD) employs a single-chip controller with a SATA interface on the system side and up to 8-channels of NAND Flash internally.

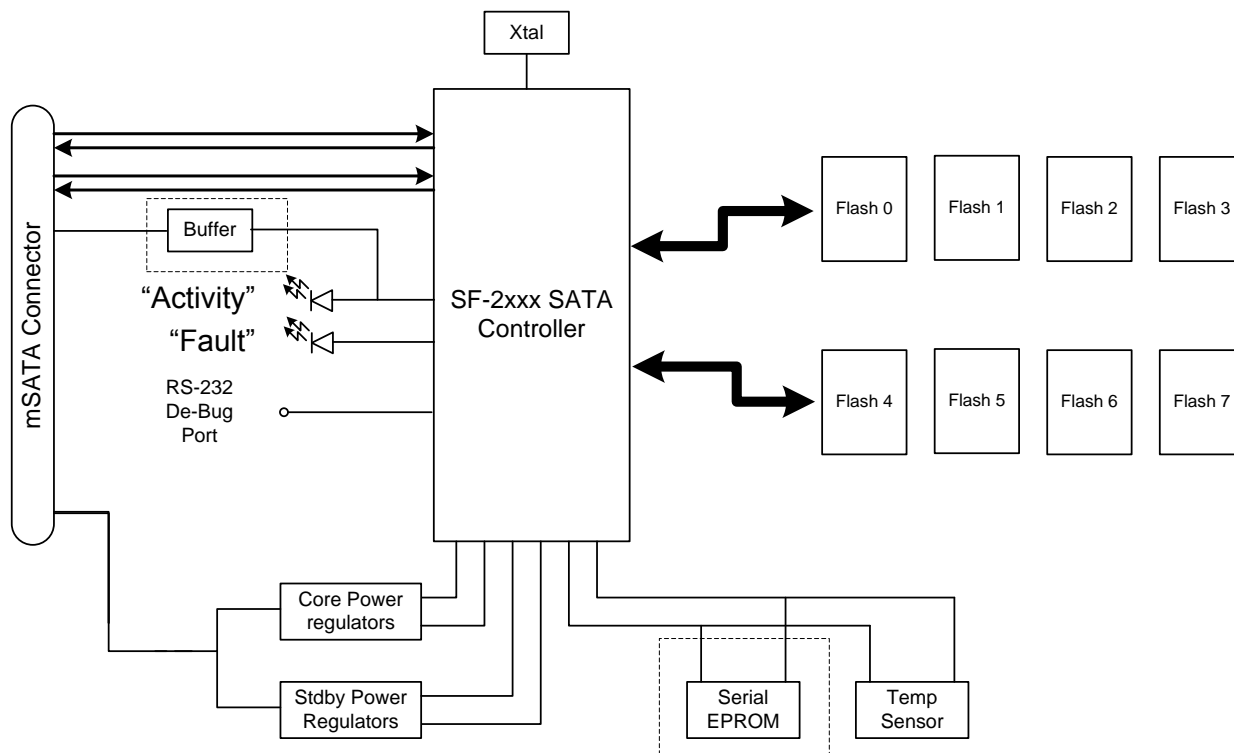


Figure 2 – SATA Connections

Logical Block Address Configuration

The drive is set to report the number of logical block addresses (LBA) that will ensure sufficient storage space for the specified density. Standard LBA settings, based on the IDEMA standard (LBA1-02), are shown below.

Capacity

The capacity is reported as a decimal count of Bytes. The capacity is determined using the industry standard method as defined by the International Drive Equipment Manufacturers Association (IDEMA).

Drive capacity is calculated with the following equation:

$$\text{SSD Capacity in Gbytes} = (\text{UserAddressableLBAcount} - 21168) / 1953504$$

Equation 1 IDEMA user capacity calculation

Table 2 EDGE Drive Configurations

User Capacity	Provisioning	Async MLC	LBA	Comments
480	7%	PE236700	937,703,088	

Performance

The performance for compressible data as reported by the ATTO Benchmark with a queue depth of 10 is shown in Table 3 for Async.

Table 3 Compressible Data Performance – Async Flash

User Capacity (1000 ⁴)	Sequential		Random		Access
	Read (MB/s)	Write (MB/s)	Read (IOPS)	Write (IOPS)	
480	>535	>425	>60K	>30K	<100 μsec

Table 4 Nominal Dimensions and Weights

Signal Name	Type	Description
Height	4.8	mm
Width	30	mm
Length	50.8	mm
Unit weight	20	g

Interface Connectors

The EDGE SSD uses the industry standard PCIe mini Card connector as defined by SATA-IO. The pin-out of the connector is shown in Table 5.

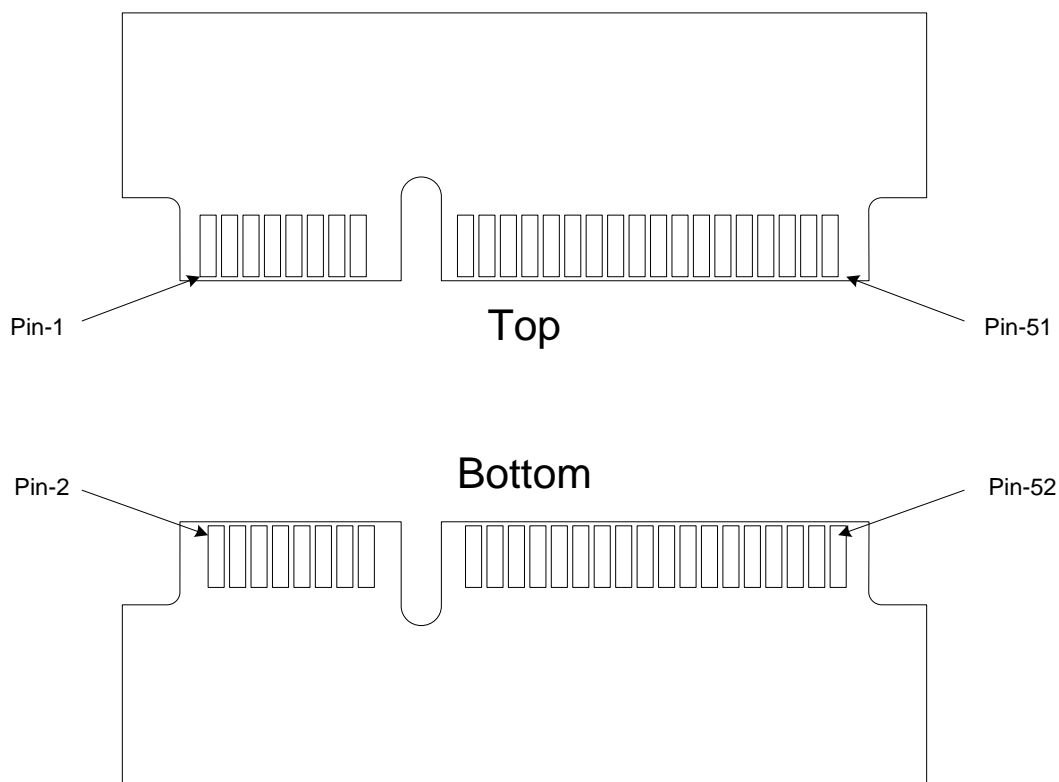


Figure 3 – mSATA Connections

Table 5 mSATA pin assignments

Pin	Signal	Use	Pin	Signal	Use
1	Reserved	-	2	3.3V	PWR
3	Reserved	-	4	GND	GND
5	Reserved	-	6	1.5V	NC
7	Reserved	-	8	Reserved	-
9	GND	GND	10	Reserved	-
11	Reserved	-	12	Reserved	-
13	Reserved	-	14	Reserved	-
15	GND	GND	16	Reserved	-
17	Reserved	-	18	GND	GND
19	Reserved	-	20	Reserved	-
21	GND	GND	22	Reserved	-
23	A+	TXP	24	3.3V	PWR
25	A-	TXN	26	GND	GND
27	GND	GND	28	1.5V	NC
29	GND	GND	30	SMB-SCL	NC
31	B-	RNX	32	SMB-SDA	NC
33	B+	RXP	34	GND	GND
35	GND	GND	36	Reserved	-
37	GND	GND	38	Reserved	-
39	3.3V	PWR	40	GND	GND
41	3.3V	PWR	42	Reserved	-

43	Select	NC (mSATA Select)	44	Reserved	-
45	Vendor	RS232-TX	46	Reserved	-
47	Vendor	RS232-RX	48	1.5V	NC
49	DAS	DAS	50	GND	GND
51	Presence	GND	52	3.3V	PWR

Commands

Table 6 Supported ATA Command Set

Command Name	Command Code (hex)	Description
CHECK POWER MODE	0x98	
CHECK POWER MODE	0xE5	
DEVICE CONFIGURATION	0xB1	
FLUSH CACHE	0xE7	
FLUSH CACHE EXT	0xEA	
IDLE	0xE3	
IDLE	0x97	
IDLE IMMEDIATE	0x95	
IDLE IMMEDIATE	0xE1	
NOP	0x00	
READ BUFFER	0xe4	
READ BUFFER DMA	0xe9	
READ DMA	0xc8	
READ DMA EXT	0x25	
READ DMA (without retries)	0xc9	
READ FPDMA QUEUED	0x60	
READ LOG DMA EXT	0x47	
READ LOG EXT	0x2F	
READ MULTIPLE	0xc4	
READ MULTIPLE EXT	0x29	
READ NATIVE MAX ADDRESS	0xF8	
READ NATIVE MAX ADDRESS EXT	0x27	
READ SECTORS	0x20	
READ SECTORS EXT	0x24	
READ SECTORS (without retry)	0x21	
READ VERIFY SECTORS	0x40	
READ VERIFY SECTORS EXT	0x42	
READ VERIFY SECTORS (without retry)	0x41	
RECALIBRATE	0x10	
REQUEST SENSE DATA EXT	0x0B	
SECURITY DISABLE PASSWORD	0xF6	
SECURITY ERASE PREPARE	0xF3	
SECURITY ERASE UNIT	0xF4	
SECURITY FREEZE LOCK	0xF5	
SECURITY SET PASSWORD	0xF1	
SECURITY UNLOCK	0xF2	
SEEK	0x70	
SET FEATURES	0xEF	
SET MAX ADDRESS	0xF9	
SET MULTIPLE MODE	0xC6	
SET NATIVE MAX ADDRESS EXT	0x37	
SLEEP	0x99	
SLEEP	0xE6	
SMART	0xB0	

STANDBY	0xE2	
STANDBY	0x96	
STANDBY IMMEDIATE	0x94	
STANDBY IMMEDIATE	0xE0	
WRITE BUFFER	0xE8	
WRITE BUFFER DMA	0xEB	
WRITE DMA	0xCA	
WRITE DMA EXT	0x35	
WRITE DMA FUA EXT	0x3D	
WRITE DMA (without retries)	0xCB	
WRITE FPDMA QUEUED	0x61	
WRITE LOG DMA EXT	0x57	
WRITE LOG EXT	0x3F	
WRITE MULTIPLE	0xC5	
WRITE MULTIPLE EXT	0x39	
WRITE MULTIPLE FUA EXT	0xCE	
WRITE SECTORS	0x60	
WRITE SECTORS EXT	0x34	
WRITE SECTORS (without retry)	0x31	

Smart Attributes

Table 7 S.M.A.R.T Attributes

Reliability Tracking		Mobile	Comments
1 (01)	Raw Read Error Rate	X	
5 (05)	Retired Block Count	X	
13 (0D)	Soft Read Error Rate		Enterprise Only
171/181	Program Fail Count	X	
172/182	Erase Fail Count	X	
184 (B8)	IOEDC Errors		Enterprise Only
187 (BB)	Reported Uncorrectable Errors	X	
195 (C3)	ECC On-the-fly Count	X	
196 (C4)	Reallocation Event Count	X	
198 (C6)	Uncorrectable Sector Count		Enterprise Only
199(C7)	SATA R-Errors Error Count		Enterprise Only
201 (C9)	Uncorrectable Soft Read Error Rate	X	
204 (CC)	Soft ECC Correction Rate (RAISE)	X	
Usage Statistics			
9 (09)	Power On Hours	X	
12 (0C)	Device Power Cycle Count	X	
100 (64)	Gigabytes Erased		Enterprise Only
241 (F1)	Lifetime Writes from Host	X	
242 (F2)	Lifetime Reads from Host	X	
Life Remaining			
170 (AA)	Reserved Block Count		Enterprise Only
231 (E7)	SSD Life Left	X	
232 (E8)	Available Reserved Space		
Power Loss			
174 (AE)	Unexpected Power Loss	X	
235 (EB)	Supercap Monitoring		Enterprise Only
Wear Leveling			
177 (B1)	Wear Range Delta	X	
Temperature			
194 (C2)	Temperature	X	

Warranty Life Throttling			
260 (E6)	Life Curve Status		Enterprise Only
Other			
233 (E9)	Internal Reserved	X	
234 (EA)	Internal Reserved	X	

Reliability

EDGE SSDs incorporate advanced technology for defect and error management. The Controller uses various combinations of redundant storage elements, hardware-based error correction algorithms and firmware-based static and dynamic wear-leveling algorithms.

Over the life of the SSD, uncorrectable errors may occur. An uncorrectable error is defined as data that is reported as successfully programmed to the SSD but when it is read out of the SSD, the data differs from what was programmed.

Table 8 Uncorrectable Bit Error Rate

Uncorrectable Bit Error Rate	Operation
<1 sector per 10 ¹⁶ bits read	Read

The product life is at least 5 years or 43,800 power-on hours, whichever comes earlier under the following conditions:

- Power-on hours = 8,760 per year
- Operating time = 100% of power-on hours
- Active/Idle duty cycle = 90% of the time
- Environmental = temperature, altitude, humidity and voltage within operating ranges
- The drive should be protected from electrostatic discharge (ESD)
- The product life does not represent any warranty or warranty period. Applicable warranty and warranty period are covered by the purchasing agreement.
- Note: Product life is defined as time in service at systems conditions while maintaining compliance to the MTTF specification for the device.

Mean Time Between Failures

Mean time between failures (MTBFs) for the SSD can be predicted based on the component reliability data using the methods referenced in the Telcordia SR-332 reliability prediction procedures for electronic equipment.

Table 9 Drive MTBFs

Density	MTBF (Operating Hours) ¹	
480	2 million	

Note: 1. A mean time between failure (MTBF) is based on population statistics that are not relevant to individual units.

Preventive Maintenance

Not Applicable. No preventative maintenance is required.

Unauthorized maintenance to the SSD will void the warranty.

Endurance

The endurance of a drive is expressed as the total bytes written (TBW). The TBW is a function of the capacity of the drive, the PE cycles of the flash devices used, the Write Amplification (WA) of the controller and the efficiency of the wear leveling algorithm.

There is a generic calculation that has been standardized by JEDEC. The industry standard equation is given in Equation 2.

$$TBW = (\text{Flash Capacity}(\text{user}) * PE \text{ Cycles}) / (2 * WA)$$

Where:

Flash capacity (user): Industry Standard uses the user capacity of the drive in Decimal Bytes.

PE cycles: Max # of PE cycles for Flash devices

WA: Write Amplification

Efficiency: ratio of the best case to worst case wear leveling block. Industry standard assumes the worst case is 2X the best case

Equation 2 JEDEC STD / IDEMA Total Bytes Written Calculation

The calculation for TBW of the EDGE drive is shown below. This calculation takes advantages of the benefits of the Controller used in the EDGE SSDs and yields significantly better results than the generic equation.

$$TBW = (\text{Flash Capacity}(\text{raw}) * PE \text{ Cycles}) / (1.2 * WA)$$

Where:

Flash Capacity (raw): Binary capacity of the raw flash expressed as a decimal #.

PE cycles: Max # of PE cycles for Flash devices

WA: Write Amplification

Efficiency: The Controller in the EDGE Drives achieves a ratio 1.2Xworst case to best case block wear leveling.

Equation 3 EDGE Total Bytes Written Calculation

Table 10 gives the life expectancy of the drive in Total Bytes Written (TBW) for the best case WA for the controller used in EDGE drives for a typical and a worst case WA. Actual WA for a particular application can be determined using the S.M.A.R.T. attributes.

Table 30 Drive Endurance – Total Bytes Written (TB)

User Capacity	Provisioning	Raw Flash	Standard MLC based part numbers	Write Life w/MLC		Comments
				WA=.5 (TB)	WA=6 (TB)	
480	7%	512	PE236700	2814	234.5	

Electrical Characteristics

Table 11 SATA Typical Power Consumption

Density	Idle	Idle w/DIPM	Sequential Write/Read	Random Write/Read		Unit
480			4	4		W

Table 42 Absolute Maximum Ratings

Condition	Symbol	Min	Max	Unit
Voltage Input	V _s	3.0	5.5	V
Operating Temperature	T _A	0	70	C
Non-operating Temperature		-40	85	C
Relative Humidity		5	95	%

Table 513 Shock and Vibration

Condition	Specification
Operating shock	1500 G / 0.5ms
Operating Vibration	2-500 Hz at 3.1G

Compliance

EDGE SSDs comply with the following:

- RoHS “green”
- CE (Europe): EN55022, 2006 Class B and EN55024, 1998 + A1: 2001 + A2:2003
- FCC: CFR Title 47, Part 15, ICES-003, all Class B
- BSMI (Taiwan): approval to CNS 13438 (testing in progress)
- C-TICK (Australia, New Zealand): approval to AS/NZS CISPR22 (testing in progress)
- TUV (Germany): approval to IEC60950/EN60950 (testing in progress)
- VCCI (testing in progress)

References

- Serial ATA: High-speed serialized AT attachment, Serial ATA working group, available at www.sata-io.org
- Small Form Factor Specification SFF-8201, SFF-8223
- Electronic Industries Association Standard, EIA-720
- Serial ATA: High-speed serialized AT attachment, Serial ATA working group
- SFF documents
- EIA-720 document
- NCITS T13 Project 1697D AT Attachment - 8 ATA Serial Transport (ATA8-AST)
- NCITS 1699D AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS)
- NCITS 1510D Host Adapter Standards (ATA Adapter)
- For more details about Serial ATA technology, the reader is referred to the following industry specifications:
- Serial ATA 2.5 specifications (The Sil5723 is fully compliant.)
- Serial ATA / High Speed AT Attachment specification, Revision 1.0a
- Serial ATA II: Extensions to Serial ATA 1.0a, Revision 1.2
- Serial ATA II: Port Multiplier, Revision 1.1 and Revision 1.2 Release Candidate
- Serial ATA II: Electrical Specification, Revision 1.0
- Serial ATA II: Cables and Connectors, Volumes 1 and

EDGE Memory Limited Warranty Terms and Conditions

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A period of 5 years from purchase date

-OR-

Maximum Total Bytes Written (TBW) to flash by capacity using the JEDEC standardized formula as shown below:

$$\text{TBW} = \frac{(\text{P/E Cycles}) * (\text{Raw Capacity})}{2 * (\text{Write Amplification})}$$

This warranty is in effect beginning from the date of purchase and must be verified with an original invoice or purchase order number to establish purchase date and original purchaser. This warranty extends only to the original purchaser and is non-transferable, except where prohibited by law, to anyone who subsequently purchases the product from the original purchaser. All warranty returns must be received on or before the warranty expiration date.

If the Product, which is the subject of this Limited Warranty, fails to conform to the above warranty during the warranty period, EDGE, at its option and sole discretion, will repair or replace the Product with another product (where the replacement product is an equivalent product at the time a claim for warranty service is made to EDGE under this Limited Warranty). Credit will only be issued if a "like" replacement is not available. The credit price will be the lower of the purchase price or the current market value at the time a claim for warranty service is made to EDGE under this Limited Warranty.

The customer is responsible for return freight and product packaging; EDGE Memory is responsible for freight charges in the shipment of RMA product to the customer and appropriate product packaging. The Limited Warranty will extend to Product which is repaired or replaced for the balance of the applicable period of the original warranty or thirty (30) days from the date of return shipment from EDGE of a repaired or replacement Product, whichever period is longer. This warranty does not extend to any product not purchased from EDGE Memory nor to any product that has been damaged or rendered nonconforming:

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- By the use of parts not manufactured or sold by EDGE Memory.
- By the modification of the product.
- As a result of service by anyone other than EDGE Memory.
- Use in applications not conforming to the environmental or operating specifications for the product.
- Shipping damage due to inadequate packaging by the customer in sending product for repair or upgrade.
- Customer induced damage, whether accidental or deliberate, due to unusual physical, electrical, or electromagnetic stress including, but not limited to, electrical surges and/or power failures.

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EDGE Memory
3799 Arapaho Rd
Addison, TX 75001
Tel: 972.239.3410
Fax: 972.239.4214
info@EDGEmemory.com
www.EDGEmemory.com