

## Features

- **Industry Standard PCIe Host Interface**
  - PCIe Gen3x4
  - PCI Express Base Revision 3.1 compliant
  - NVMe 1.4c compliant
- **Performance**
  - Sequential data read: Up to 2,390 MB/s
  - Sequential data write: Up to 1,780 MB/s (measured using 128KB transfer size)
- **Power Management**
  - 3.3V single power supply
  - Autonomous power state transition (APST)
  - Active state power management (ASPM)
  - Supports L1.2
- **Power Consumption**
  - Active mode (typical):
    - 640GB: 2,900 mW
    - 320GB: 2,700 mW
    - 160GB: 2,620 mW
    - 80GB: 2,500 mW
    - 40GB: 1,800 mW
  - Slumber mode (typical): 60 mW
  - Sleep mode (typical): 4.2 mW
- **Data Protection**
  - End-to-end data path protection
  - AES-256 encryption engine
  - Hardware Crypto Erase (HCE)
  - Secure erase / Data sanitization
  - Host Controlled Thermal Management (HCMT)
  - Thermal throttling
  - Write protection
- **Power Loss Notification**
- **Supports up to 4 Namespaces**
- **Boot Partition**
- **Reply Protected Memory Block (RPMB)**
- **Host Memory Buffer (HMB)**
- **Volatile Write Cache (VWC)**
- **Field Firmware Update (FFU)**
- **Supports SMART and TRIM Commands**
- **Command Queuing**
  - 1 Admin queue and 8 IO queues supporting up to 128 commands per queue
- **Dynamic and Static Wear-Leveling**
- **Bad Block Management**
- **Built-in ECC**
  - Uses advanced LDPC bit error detection and correction optimized for 3D NAND
- **NAND Configuration**
  - 1 bit per cell (SLC)
  - Designed with Greenliant's advanced EnduroSLC™ Technology
- **High Endurance**
  - GLS88ASxxxG1  
P/E cycles: 75K, TBW: Up to 25,800
  - GLS88ASxxxG8  
P/E cycles: 150K, TBW: Up to 51,600
- **Operating Temperature Range**
  - Industrial: -40°C to 95°C (Tc)
- **M.2 2280 Form Factor**
  - 22mm x 80mm x 2.38mm (max)
  - Single-sided (SS), M key
- **All Devices are RoHS Compliant**

- Notes:
1. User capacity: 1GB = 1 billion bytes
  2. PCIe = Peripheral Component Interconnect Express
  3. NVMe = Non-Volatile Memory Express
  4. P/E cycles = NAND Program/Erase cycles
  5. TBW = TeraBytes Written
  6. Tc = Case surface temperature

## Product Description

The GLS88AS040G1 / 040G8 / 080G1 / 080G8 / 160G1 / 160G8 / 320G1 / 320G8 / 640G1 / 640G8 Industrial Grade NVMe M.2 2280 ArmourDrive™ EX Series (referred to as “M.2 ArmourDrive” in this datasheet) are high-performance, high-reliability solid state drives (SSDs). They combine 40, 80, 160, 320 or 640 GBytes of NAND flash memory with an advanced NVMe PCIe controller on a printed circuit board (PCB).

The NVMe PCIe SSD controller with built-in advanced NAND management firmware communicates with the host through the standard PCIe interface. It does not require any additional or proprietary software such as the Flash File System (FFS) or Memory Technology

Driver (MTD). The firmware effectively optimizes the use of NAND flash memory's program/erase (P/E) cycles and minimizes write amplification.

M.2 ArmourDrive's advanced NAND management technology improves endurance, enhances data security and helps prevent data corruption during unexpected power failure events. This innovative technology combines robust NAND controller hardware error correction capabilities with advanced wear-leveling algorithms and bad block management to improve data reliability and significantly extend the life of the product. M.2 ArmourDrive is ideal for high-reliability industrial and networking systems which need low latency and fast performance.

## 1.0 GENERAL DESCRIPTION

Each M.2 ArmourDrive module integrates an NVMe PCIe SSD controller with one or two NAND flash multi-chip packages. Refer to Figure 2-1 for the M.2 ArmourDrive block diagram.

### 1.1 Optimized M.2 ArmourDrive

The heart of M.2 ArmourDrive is the NVMe PCIe SSD controller, which translates standard PCIe signals into flash media data and control signals. The following components contribute to M.2 ArmourDrive's operation.

#### 1.1.1 Microcontroller Unit (MCU)

The MCU translates PCIe / NVMe commands into data and control signals required for flash media operation.

#### 1.1.2 Internal Direct Memory Access (DMA)

M.2 ArmourDrive uses internal DMA allowing instant data transfer from/to buffer to/from flash media. This implementation eliminates microcontroller overhead associated with the traditional, firmware-based approach, thereby increasing the data transfer rate.

#### 1.1.3 Power Management Unit (PMU)

The PMU controls the power consumption of M.2 ArmourDrive. The PMU dramatically reduces the power consumption of M.2 ArmourDrive by putting the part of the circuitry that is not in operation into sleep mode.

The Flash File System handles inadvertent power interrupts and has auto-recovery capability to ensure M.2 ArmourDrive firmware integrity.

#### 1.1.4 Embedded Flash File System

The embedded flash file system is an integral part of M.2 ArmourDrive. It contains MCU firmware that performs the following tasks:

1. Translates host side signals into flash media writes and reads
2. Provides flash media wear leveling to spread the flash writes across all memory address space to increase the longevity of flash media
3. Keeps track of data file structures

#### 1.1.5 Power Interrupt Data Protection

Power Interrupt Data Protection is a mechanism to prevent data corruption during unexpected power failure events. Enhanced data integrity is supported by the controller's advanced firmware during abnormal power loss. The controller proactively optimizes the amount and stay time of the "in-flight" data residing in the cache. To ensure there is no data loss risk caused by power cycling, the controller sends an

acknowledgement to the host only when the incoming data is fully committed to the NAND flash.

#### 1.1.6 Error Checking and Correction (ECC)

The ECC technology uses advanced LDPC algorithms to detect and correct errors, ensuring data integrity and extending the SSD lifespan.

#### 1.1.7 Multi-tasking Interface

The multi-tasking interface enables concurrent Read, Program and Erase operations to multiple NAND flash media.

## 1.2 EnduroSLC™ Technology

EnduroSLC™ is a proprietary 3D NAND management technology developed by Greenliant for high reliability applications requiring ultra-high endurance and superior data retention. Using 1-bit-per-cell (SLC) NAND configuration, EnduroSLC enabled SSDs are ideal for write-intensive applications used in extreme temperature, high stress environments. EnduroSLC enabled solid state drives offer a high reliability flash storage solution with ultra-high write endurance that exceeds capabilities of legacy, planar SLC NAND based products.

## 1.3 Advanced NAND Management

M.2 ArmourDrive's controller uses advanced wear-leveling algorithms to substantially increase the longevity of NAND flash media. Wear caused by data writes is evenly distributed in all or select blocks in the device that prevents "hot spots" in locations that are programmed and erased extensively. This effective wear-leveling technique results in optimized device endurance, enhanced data retention and higher reliability required by long-life applications.

## 1.4 Advanced Data Security

Advanced data security measures include end-to-end data path protection, data sanitization (Secure Erase) support and Hardware cryptographic erase. Secure Erase is an effective method to quickly wipe all data from a PCIe-based SSD using the NVMe protocol (Format NVM). M.2 ArmourDrive's controller supports industrial standard AES-256 encryption to protect sensitive user data. Hardware cryptographic erase resets the cryptographic keys of the M.2 ArmourDrive SSD, making all encrypted user data useless.

## 2.0 FUNCTIONAL BLOCKS

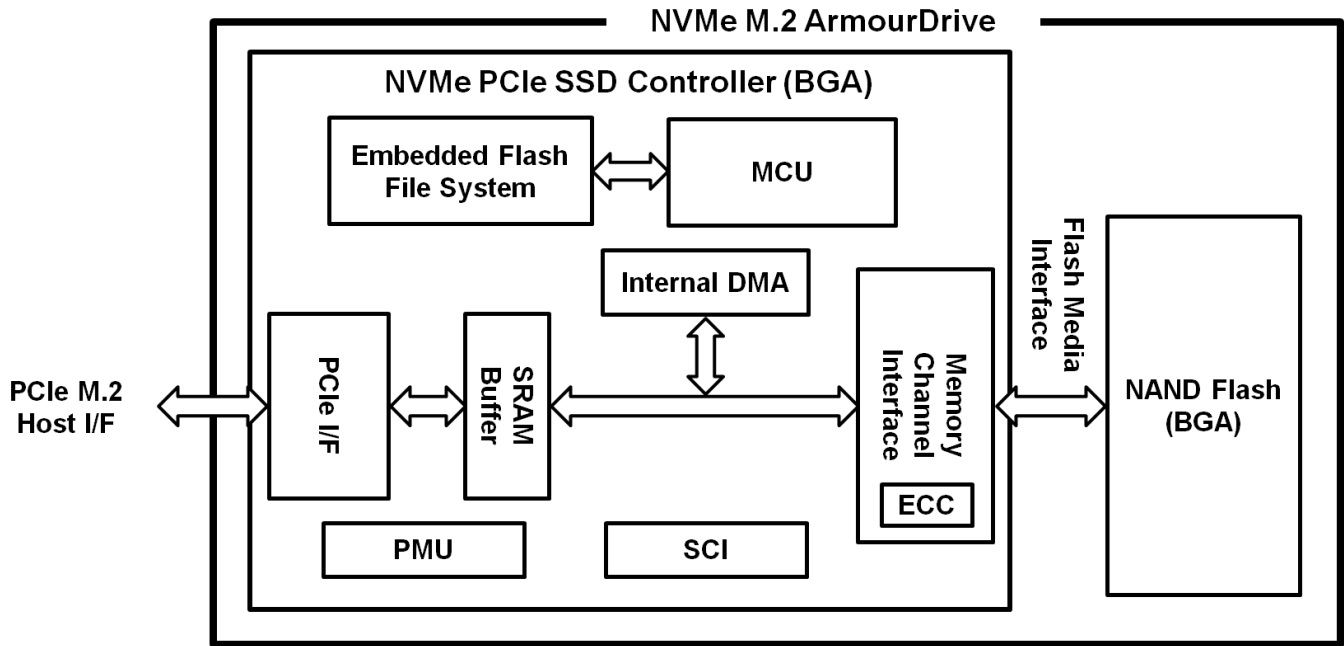
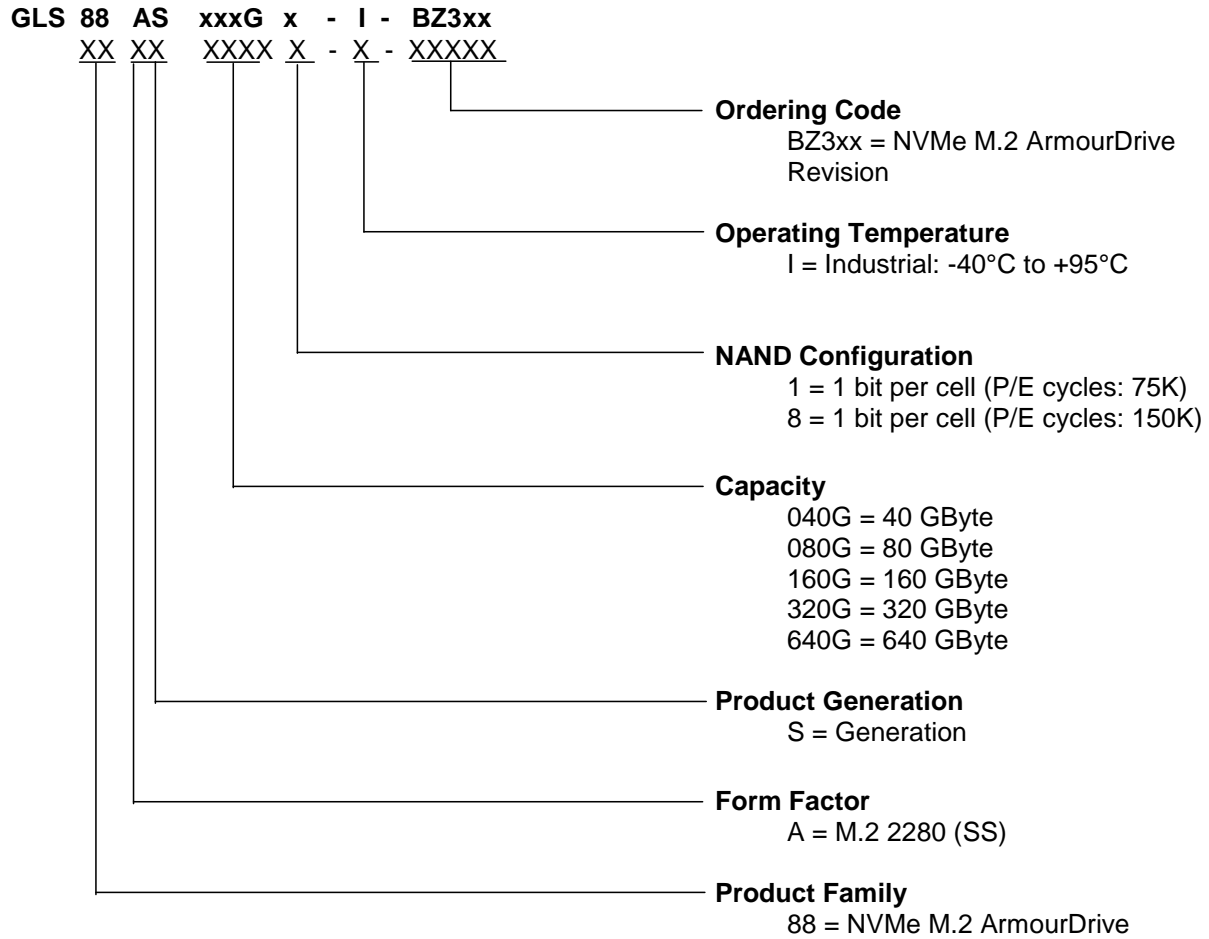


Figure 2-1: M.2 ArmourDrive Block Diagram

### 3.0 APPENDIX

#### 3.1 Product Ordering Information



**Valid Combinations**

Valid product combinations are those that are in the mass production or will be in the mass production. Consult your Greenliant sales representative to confirm availability of the valid combinations and to determine availability of new product combinations.

**Table 3-1: M.2 ArmourDrive Product Valid Ordering Numbers**

Capacity	Operating Temperature	Part Number	Form Factor
40GB	Industrial (Tc = -40°C to 95°C)	GLS88AS040G1-I-BZ308	2280 (SS), M key
40GB	Industrial (Tc = -40°C to 95°C)	GLS88AS040G8-I-BZ309	2280 (SS), M key
80GB	Industrial (Tc = -40°C to 95°C)	GLS88AS080G1-I-BZ308	2280 (SS), M key
80GB	Industrial (Tc = -40°C to 95°C)	GLS88AS080G8-I-BZ309	2280 (SS), M key
160GB	Industrial (Tc = -40°C to 95°C)	GLS88AS160G1-I-BZ308	2280 (SS), M key
160GB	Industrial (Tc = -40°C to 95°C)	GLS88AS160G8-I-BZ309	2280 (SS), M key
320GB	Industrial (Tc = -40°C to 95°C)	GLS88AS320G1-I-BZ308	2280 (SS), M key
320GB	Industrial (Tc = -40°C to 95°C)	GLS88AS320G8-I-BZ309	2280 (SS), M key
640GB	Industrial (Tc = -40°C to 95°C)	GLS88AS640G1-I-BZ308	2280 (SS), M key
640GB	Industrial (Tc = -40°C to 95°C)	GLS88AS640G8-I-BZ309	2280 (SS), M key

### 3.2 Board Diagrams

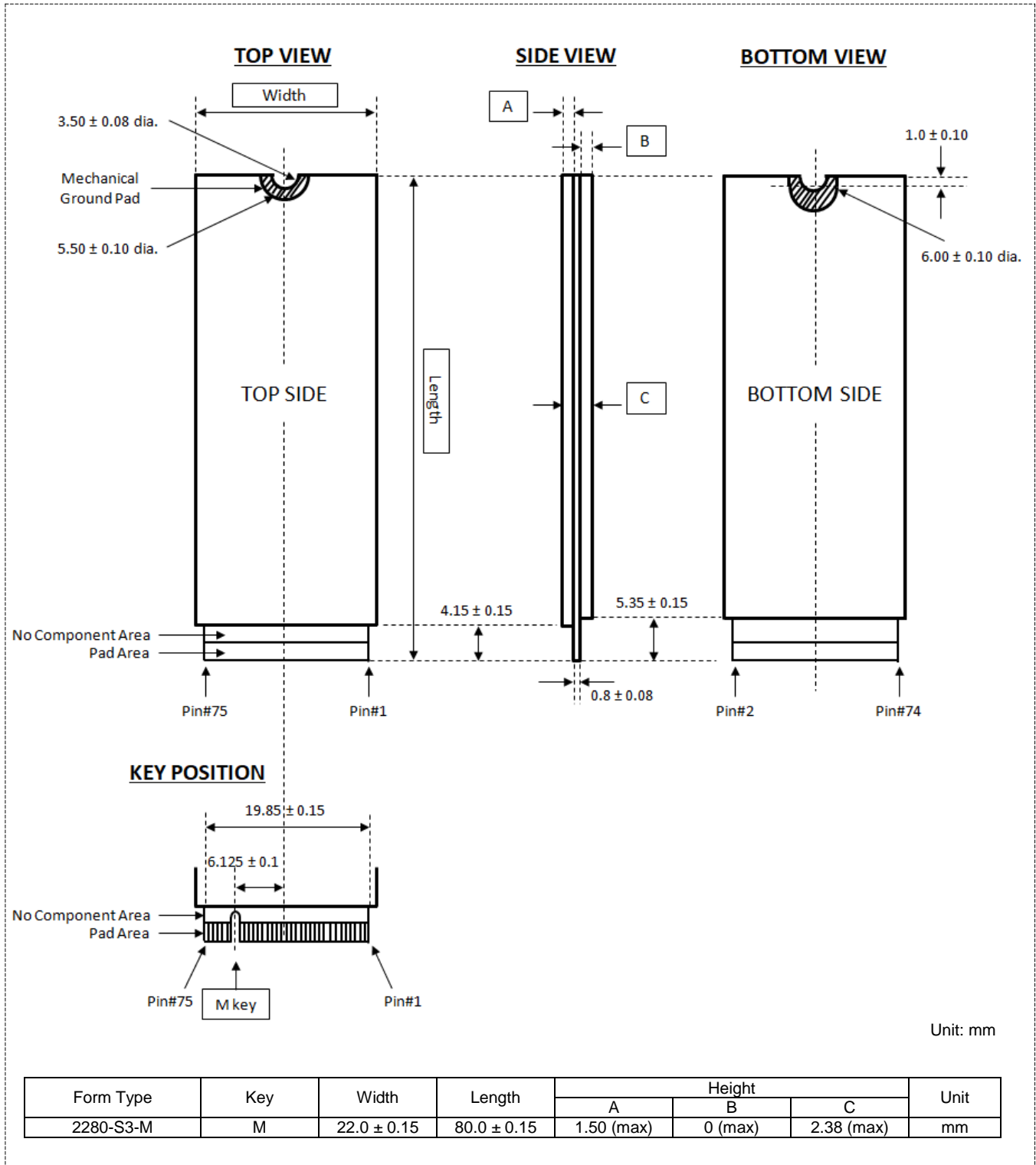


Figure 3-1: NVMe M.2 2280 ArmourDrive Dimensions

## Revision History

Number	Description	Date
00.100	Initial Release as Advance Factsheet	July 12, 2024

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Specifications are subject to change without notice. Memory sizes denote raw storage capacity; actual usable capacity may be less.

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