

## Features

- **Industry Standard PCIe Host Interface**
    - PCIe 3.0x4
    - Compatible with NVM Express (NVMe) 1.2
    - Supports UEFI boot, Expansion ROM
    - 512B/4KB sector support
    - Hot plug/removal capable
  - **Performance<sup>1</sup>**
    - Sequential Read: up to 2500MB/s
    - Sequential Write: up to 1900MB/s
    - Random Read (4KB): up to 500K IOPS
    - Random Write (4KB): up to 28K IOPS
  - **Latency<sup>2</sup>**
    - Sequential Read/Write: 60µs/20µs (typical)
    - Random Read/Write: 150µs/40µs (typical)
  - **Performance Consistency**
    - Read/Write: up to 95%/95% (99.9%)
    - Consistent latency and IOPS performance
    - Excellent sustained performance across industrial temperature range
    - On-board DRAM for enhanced performance
  - **Quality of Service (QoS)**
    - Read/Write: 300µs/800µs (99.0%)
    - Read/Write: 300µs/1000µs (99.99%)
  - **Power**
    - 12V single power supply
    - Active mode: 7W (typical)<sup>3</sup>
  - **Operating System Compatibility**
    - CentOS 6.5/7.0/7.4/7.5 64-bit
    - RHEL 6.5/7.0/7.4/7.5 64-bit
    - MS Windows Server 2008R2/2012/2016 64-bit
    - VMware ESXi 6.0/6.5/7.0
    - NeoKylin
    - Deepin OS
  - **Capacity**
    - 1.92TB, 3.84TB, 7.68TB (formatted)
  - **Industrial 3D TLC NAND flash**
  - **Reliability**
    - Mean Time Between Failures (MTBF): 2 million hours<sup>4</sup>
    - Static and dynamic wear leveling
    - On-Chip Adaptive RAID protects data from block or die failure and provides reliable failover
    - Unrecoverable Bit Error Rate (UBER): < 1 sector per 10<sup>27</sup> bits read, enhanced by RAID
    - End-To-End Data Path Protection (local CRC) ensures high data integrity
    - Read-only mode support when there is not enough reserved drive space
    - Self-monitoring, analysis and reporting technology (SMART) and Dataset Management command set
  - **Enhanced Power Loss Data Protection**
    - On-board power loss protection (PLP) circuitry
  - **Data Security**
    - Hardware-based AES-256 encryption
    - Secure erase / Crypto erase support
  - **Endurance<sup>5</sup>**
    - 1.92TB: 6,900 TBW / 3.84TB: 13,800 TBW / 7.68TB: 27,600 TBW
  - **Temperature Range**
    - Operation: -40°C to +85°C
    - Storage: -40°C to +85°C
  - **2.5-inch Form Factor**
    - 100.45mm x 69.85mm x 9.50mm
  - **CE and FCC Certifications**
  - **All Devices are RoHS Compliant**
1. Performance values may differ based on system configuration, workload and SSD capacity
  2. Average latency values (iodepth=1, jobs=1)
  3. Active average power measured during sequential read operations for the 1.92TB SSD
  4. Calculated based on the Telcordia SR-322 standard for the reliability prediction of electronic equipment
  5. TBW = TeraBytes Written

## Product Description

The industrial temperature G7200 enterprise NVMe U.2 PX Series (referred to as “U.2 Industrial Enterprise SSD” in this datasheet) are high-performance, high-reliability solid state drives, built with NAND flash memory, DRAM and an advanced NVMe PCIe controller in a standard 2.5-inch form factor housing.

Greenliant’s advanced NVMe PCIe SSD controller with intelligent NAND management firmware communicates with the host through the standard NVMe protocol. The firmware effectively optimizes the use of NAND flash memory’s program/erase (P/E) cycles, improves endurance, enhances data security

and minimizes write amplification, extending the lifespan of aging NAND and achieving the longest device lifetime possible.

Greenliant’s On-Chip Adaptive RAID technology helps seamless data recovery when NAND page, block, or die failure is encountered. Greenliant’s NAND management technology combines robust 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. U.2 Industrial Enterprise SSDs are ideal for high-reliability datacenter, industrial, video, networking, transportation and aerospace applications.

## **1.0 GENERAL DESCRIPTION**

Each U.2 Industrial Enterprise SSD integrates an NVMe PCIe SSD controller with NAND flash multi-chip packages, DRAM, on-chip adaptive RAID, PCIe 4-lane signal port and hardware-based power loss protection circuitry in a standard 2.5-inch form factor housing.

### **1.1 U.2 Industrial Enterprise SSD**

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

#### **1.1.1 Industrial Enterprise SSD Controller**

The U.2 Industrial Enterprise SSD's controller is an advanced ASIC which has been built for high-capacity drives with sustained high performance and consistent, low latency operations.

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

U.2 Industrial Enterprise SSD uses internal DMA allowing instant data transfer from/to buffer to/from flash media.

#### **1.1.3 Power Management Unit (PMU)**

The PMU controls the power consumption and power on/off work flow of U.2 Industrial Enterprise SSD. The Flash File System handles inadvertent power interrupts and has auto-recovery capability to ensure U.2 Industrial Enterprise SSD's user data integrity. For regular power management, the host should set the Shutdown Notification (CC.SHN) field to 01b to indicate a normal shutdown operation and wait for the drive to indicate that shutdown processing has been completed by updating the Shutdown Status (CSTS.SHST) field to 10b before powering down the drive.

#### **1.1.4 Embedded Flash File System**

The embedded flash file system is an integral part of U.2 Industrial Enterprise SSD. It is integrated in the controller's firmware that performs the following tasks:

1. Manages and optimizes the data access of flash media
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 On-Chip Adaptive RAID**

By default, U.2 Industrial Enterprise SSD uses 15+1 RAID. When an uncorrectable read error occurs in one NAND die, the SSD will quickly reconstruct the affected data from the data on the other 15 NAND die

in the same RAID group. This RAID group will be seamlessly reconfigured to ensure continuous data loss protection, without affecting the user capacity.

#### **1.1.6 Power Interrupt Data Protection**

Power Interrupt Data Protection is a mechanism to help prevent data corruption during unexpected power failure events. Enhanced data integrity is supported by the on-board power loss protection (PLP) circuitry with power hold-up capacitors and the SSD controller's advanced firmware. The controller also proactively optimizes the amount and stay time of the "in-flight" data residing in the cache.

#### **1.1.7 Error Correction Code (ECC)**

U.2 Industrial Enterprise SSD uses advanced ECC technology to detect and correct errors, ensuring data integrity and extending the SSD lifespan.

#### **1.1.8 Multi-tasking Interface**

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

### **1.2 Intelligent NAND Management**

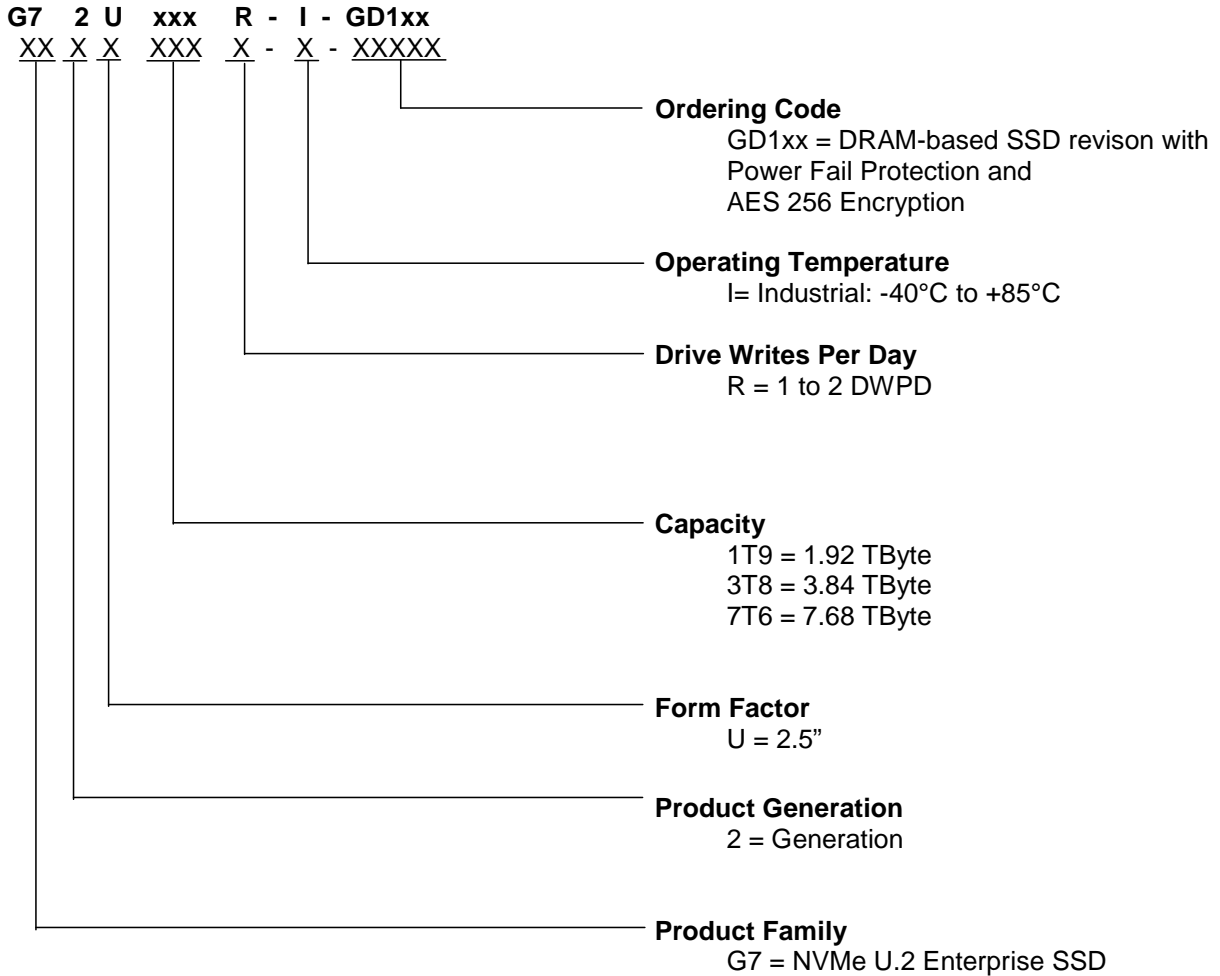
U.2 Industrial Enterprise SSD's NVMe PCIe controller uses advanced wear-leveling algorithms to substantially increase the longevity of NAND flash media. Wear caused by data writes is evenly distributed in all or select blocks in the device that prevents "hot spots" in locations that are programmed and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

### **1.3 Advanced Data Security**

Advanced data security measures include end-to-end data path protection and secure erase support (Format NVM command). The User Data Erase is an effective method to quickly wipe all user content. The Cryptographic Erase (crypto erase) is used to reset the encryption key with which the user data in the NVM subsystem was previously encrypted. U.2 Industrial Enterprise SSD supports industry standard AES-256 encryption to protect sensitive user data.

## 2.0 APPENDIX

### 2.1 Product Ordering Information



**Table 2-1: U.2 Industrial Enterprise SSD Product Valid Ordering Numbers**

Capacity	Operating Temperature	Part Number	Form Factor
1.92 TB	Industrial (-40°C to 85°C)	G72U1T9R-I-GD113	2.5-inch
3.84 TB	Industrial (-40°C to 85°C)	G72U3T8R-I-GD113	2.5-inch
7.68 TB	Industrial (-40°C to 85°C)	G72U7T6R-I-GD113	2.5-inch

## 2.2 Mechanical Diagrams

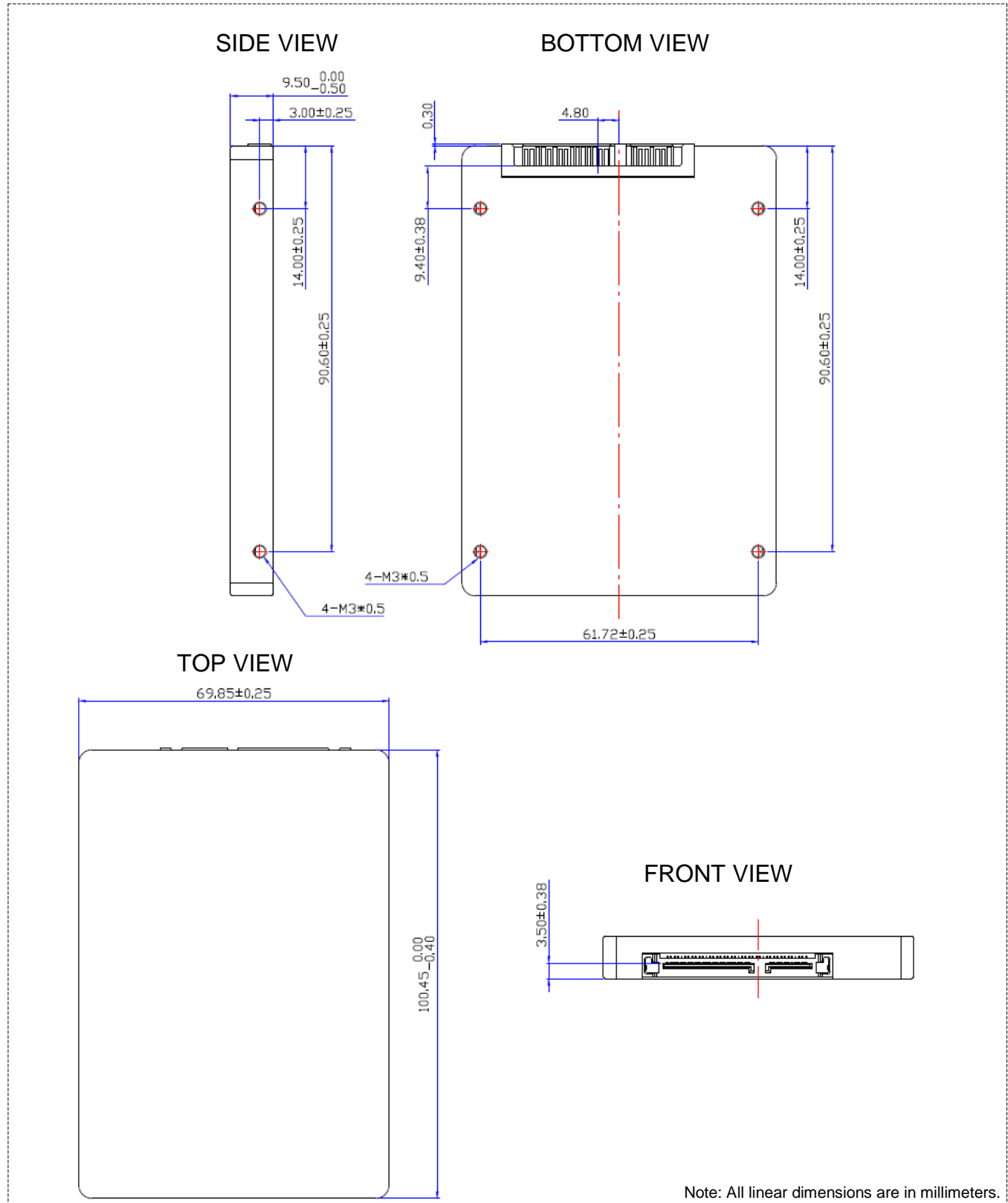


Figure 2-1: U.2 Industrial Enterprise SSD Dimensions

### 2.3 Revision History

Revision	Description	Date
01.000	Initial release	October 08, 2021

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