

swissbit®

Product Data Sheet

Industrial USB Flash Drive

U-50n Series
USB 3.1 SuperSpeed, MLC

Commercial and Industrial
Temperature Grade

Date: July 29, 2021
Revision: 1.02

durabit™
“the better MLC”



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U-50n Series – Industrial USB Flash Drive

8 GBytes up to 64 GBytes

1. Product Summary

- **Capacities:** 8 GBytes, 16 GBytes, 32 GBytes, 64 GBytes
- **Form Factor:** USB 3.1 solid state flash drive with USB Type-A connector (24.0 mm x 12.1 mm x 4.5 mm)
- **Compliance:** USB 3.1 Gen 1 SuperSpeed specification compatible (backward compliance with USB 2.0/1.1)
- **Performance:**
 - Read Performance: Sequential Read up to 156 MBytes/s, Random Read IOPS up to 2,850
 - Write Performance: Sequential Write up to 64 MBytes/s, Random Write IOPS up to 1,800
- **Operating Temperature Range¹:**
 - Commercial: 0 °C to 70 °C
 - Industrial: -40 °C to 85 °C
- **Storage Temperature Range:** -40 °C to 85 °C
- **Operating Voltage:** 5.0 V ± 10%
- **Data Retention:** 10 Years @ Life Begin; 1 Year @ Life End
- **Endurance in TeraBytes Written (TBW) @ Max Capacity:** 198 (seq. write 128KB); 6 (random write 4KB)
- **Shock/Vibration:** 1,500 *g* / 50 *g*
- **High-Performance 32-Bit Processor with Integrated, Parallel Flash Interface Engines:**
 - Multi-Level Cell (MLC) NAND Flash
 - Hardware BCH Code ECC (up to 40bit correction per 1024 Bytes)
- **High Reliability:**
 - Mean Time Between Failure (MTBF): > 3,000,000 hours @ 25°C
 - Data Reliability: < 1 non-recoverable error per 10¹⁶ bits read

¹ Adequate airflow is required to ensure the temperature, as reported in the S.M.A.R.T. data, does not exceed 115°C (industrial temperature drive) and 100°C (commercial temperature drive) respectively.

2. Product Features

- Page based Flash management with **durabit™** technology for increased endurance & random performance
- Optimized FW algorithms especially for high read access and long data retention applications
 - Proven power fail management for highest reliability
 - Near Miss ECC technology
Minimize the risk of uncorrectable bit failure over the product life time. Each read command analyzes the ECC margin level and refreshes data if necessary.
 - Read Disturb Management
The read commands are monitored and the content is refreshed when critical levels have occurred.
 - Wear Leveling technology
Equal wear leveling of static and dynamic data. The wear leveling assures that dynamic data as well as static data is balanced evenly across the memory. This guarantees the maximum write endurance of the device.
 - Data Care Management
The interruptible background process controls the user data for read disturb effects or high temperature related retention degradation and refreshes data if necessary.
- Detailed S.M.A.R.T. support and extended vendor information
- LED for operation indication
- In-field firmware update
- 30 µinch gold-plated USB 3.0 Type-A connector contacts
- Swissbit Life Time Monitoring (SBLTM) tool and SDK for SBLTM (on request)
- Customized options like removable or fixed drive configuration, customer specified strings and IDs, FAT16, FAT32 or customer file system, preload service or customized logo on request



3. Ordering Information

Table 1: Standard Product List

| Capacity | Temperature | |
|-----------|------------------------------|------------------------------|
| | Commercial | Industrial |
| | Part Number | Part Number |
| 8 GBytes | SFU3008GCxAE2T0-C-GE-1y1-STD | SFU3008GCxAE2T0-I-GE-1y1-STD |
| 16 GBytes | SFU3016GCxAE1T0-C-GE-1y1-STD | SFU3016GCxAE1T0-I-GE-1y1-STD |
| 32 GBytes | SFU3032GCxAE2T0-C-GE-1y1-STD | SFU3032GCxAE2T0-I-GE-1y1-STD |
| 64 GBytes | SFU3064GCxAE2T0-C-LF-1y1-STD | SFU3064GCxAE2T0-I-LF-1y1-STD |

x = product generation and y = firmware revision

Table 2: Available Part Numbers

| Capacity | Temperature | |
|-----------|------------------------------|------------------------------|
| | Commercial | Industrial |
| | Part Number | Part Number |
| 8 GBytes | SFU3008GC1AE2T0-C-GE-1A1-STD | SFU3008GC1AE2T0-I-GE-1A1-STD |
| 16 GBytes | SFU3016GC2AE1T0-C-GE-1A1-STD | SFU3016GC2AE1T0-I-GE-1A1-STD |
| 32 GBytes | SFU3032GC2AE2T0-C-GE-1A1-STD | SFU3032GC2AE2T0-I-GE-1A1-STD |
| 64 GBytes | SFU3064GC2AE2T0-C-LF-1A1-STD | SFU3064GC2AE2T0-I-LF-1A1-STD |

4. Product Description

The Swissbit U-50n USB 3.1 USB flash drive provides a robust, high performance, and reliable storage product with industry compatible interface and small form factor. The U-50n MLC technology both enables high NAND flash operation and excellent endurance. The use of page based Flash management and a global wear leveling extends the endurance to unprecedented values for USB products.

The U-50n product allows easy operation with USB3 or USB2 Type-A sockets.

For outdoor use or in poorly ventilated systems the U-50n is available in industrial temperature grade from -40°C to +85°C. Each individual industrial temperature grade drive is tested at these corners to verify the temperature resistance.

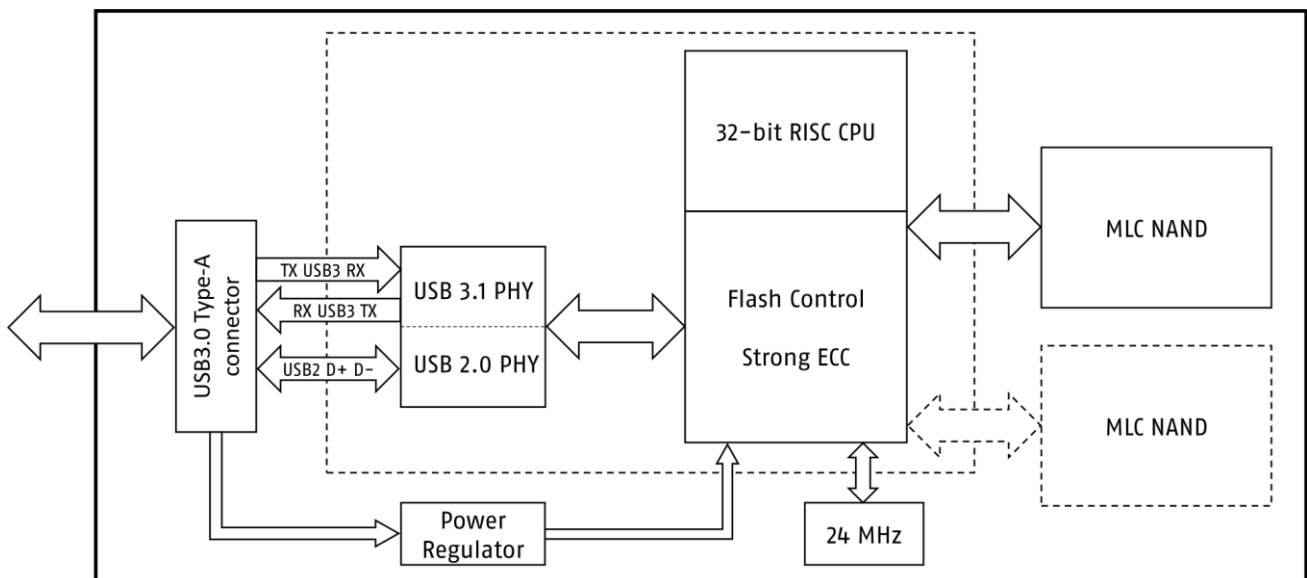
The U-50n firmware includes data care management features which refresh storage areas that are not or only infrequently read. At high temperature storage these areas are prone to retention loss. The firmware monitors the state of the NAND blocks and refreshes those that show a high level of degradation, thus preventing uncorrectable errors. This is an important feature for USB flash drives that are used as read only boot media.

The U-50n uses a high performance 32bit RISC USB controller to address different numbers of NAND dies. The U-50n 8, 32 and 64GB drives use two flash channels for best performance.

The U-50n operates at 5V nominal with ±10% tolerance.

It supports USB 3.1 Gen 1 SuperSpeed and is fully backwards compatible to USB 2.0/1.1 High/Full Speed.

Figure 1: U-50n Functional Block Diagram



4.1 Performance Specifications

The U-50n read/write sequential and random I/O performance benchmarks are detailed in the following Table 3.

Table 3: SuperSpeed Read/Write Performance²

| Capacity | Sequential Read (MBPS) | Sequential Write (MBPS) | Random Read 4k (IOPS) | Random Write 4k (IOPS) |
|-----------|------------------------|-------------------------|-----------------------|------------------------|
| 8 GBytes | 117 | 29 | 2,850 | 900 |
| 16 GBytes | 98 | 21 | 2,850 | 1,800 |
| 32 GBytes | 140 | 40 | 2,850 | 800 |
| 64 GBytes | 156 | 64 | 2,850 | 800 |

Table 4: High-Speed Read/Write Performance³

| Capacity | Sequential Read (MBPS) | Sequential Write (MBPS) | Random Read 4k (IOPS) | Random Write 4k (IOPS) |
|-----------|------------------------|-------------------------|-----------------------|------------------------|
| 8 GBytes | 41 | 23 | 2,250 | 800 |
| 16 GBytes | 41 | 21 | 1,750 | 1,400 |
| 32 GBytes | 41 | 21 | 1,850 | 750 |
| 64 GBytes | 41 | 21 | 2,150 | 750 |

4.2 Current Consumption

The drive-level current consumption as a function of operating mode is shown in the following Table 5.

Table 5: Typical Current Consumption for max transfer speed at 5V⁴

| Drive Capacity | Sequential Read | Sequential Write | Random Read 4k | Random Write 4k | Idle | Unit |
|----------------|-----------------|------------------|----------------|-----------------|------|------|
| 8 GBytes | 145 | 136 | 108 | 114 | 88 | mA |
| 16 GBytes | 103 | 98 | 81 | 86 | 65 | |
| 32 GBytes | 115 | 112 | 76 | 83 | 65 | |
| 64 GBytes | 117 | 146 | 79 | 85 | 65 | |

² The values are measured using CrystalDiskMark 5.5.0 x64 (CDM) in SuperSpeed mode (Seq Q1T1 and 4KiB Q32T1). Performance depends on flash type and number, file/cluster size, and burst speed.

³ The values are measured using CrystalDiskMark 6.0.0 x64 (CDM) in SuperSpeed mode (Seq Q1T1 and 4KiB Q32T1). Performance depends on flash type and number, file/cluster size, and burst speed.

⁴ All values are the typical recorded at 25 °C, with 5V supply voltage at fastest CrystalDiskMark 5.5.0 x64 (CDM) in SuperSpeed mode.

4.3 Environmental Specifications

4.3.1 Recommended Operating Conditions

The recommended operating conditions for the U-50n USB flash drives are provided in the following Table 6.

Table 6: Recommended Operating Conditions⁵

| Parameter | Value |
|--------------------------------------|-----------------|
| Commercial Operating Temperature | 0 °C to 70 °C |
| Industrial Operating Temperature | -40 °C to 85 °C |
| Power Supply V _{CC} Voltage | 5.0 V ± 10% |

4.3.2 Recommended Storage Conditions

The recommended storage conditions are listed in the following Table 7.

Table 7: Recommended Storage Conditions

| Parameter | Value |
|--------------------------------|------------------------------|
| Commercial Storage Temperature | -40 °C to 85 °C ⁶ |
| Industrial Storage Temperature | -40 °C to 85 °C ⁶ |

4.3.3 Shock, Vibration and Humidity

The maximum shock, vibration and humidity test conditions are listed in the following Table 8.

Table 8: Shock, Vibration and Humidity

| Parameter | Value |
|---------------------------|---|
| Shock | 1,500 g, 0.5 ms pulse duration, half-sine wave (IEC 60068-2-27, JESD22-B110) |
| Vibration | 50 g, 10Hz – 2000Hz, 3 axes (IEC 60068-2-6, MIL-STD-883 H M2007.3) |
| Humidity (Non-Condensing) | 85% RH 85 °C, 1000 hrs, max. supply voltage (JESD22-A101) |

⁵ Adequate airflow is required to ensure the temperature, as reported in the S.M.A.R.T. data, does not exceed 115°C (industrial temperature drive) and 100°C (commercial temperature drive) respectively.

⁶ The retention at high temperature is reduced. Swissbit can provide more data and support on request.

4.4 Regulatory Compliance

The U-50n devices comply with the standards listed in the following Table 9.

Table 9: Regulatory Compliance

| Abbreviation | Regulation/ Standard |
|--------------|---|
| EMC | (EU) 2014/30 (FCC) 47 CFR Part 15 |
| RoHS | (EU) 2011/65/EU with 2015/863 and 2017/2102 |
| REACH | (EU) 1907/2006 and 207/2011 |
| WEEE | (EU) 2012/19 |

4.5 Mechanical Specifications

The U-50n uses a USB Type-A connector fully integrated into the metal housing. Physical dimensions and tolerances are detailed in the following Table 10. Figure 3 on page 13 illustrates the U-50n dimensions.

Table 10: Measured Physical Dimensions

| Physical Dimensions | | Unit |
|-----------------------|------------|------|
| Length | 24.00±0.2 | mm |
| Width | 12.10±0.10 | |
| Thickness (Max) | 4.50±0.10 | |
| Weight (Max Capacity) | 3.5 | g |

4.6 Reliability and Endurance

The Mean Time Between Failure (MTBF) is specified to exceed the value listed in the following Table 11. Data reliability with effective error tolerance and data retention at the beginning and end of life is also provided.

Table 11: Reliability

| Parameter | Value |
|-----------------------------|--|
| MTBF (at 25 °C) | > 3,000,000 hours |
| Data Reliability | < 1 Non-Recoverable Error per 10 ¹⁶ Bits Read |
| Data Retention (up to 40°C) | 10 Years at Start (JESD47), 1 Year at EOL |

Endurance represented as TeraBytes Written (TBW) is provided in the following Table 12.

Table 12: Endurance⁷

| Drive Capacity | TeraBytes Written (TBW) @ Seq. Write 128kB Operation ⁸ | TeraBytes Written (TBW) @ Random Write 128kB Operation ⁸ | TeraBytes Written (TBW) @ Random Write 4kB Operation ⁸ |
|----------------|--|--|--|
| 8 GBytes | 25.7 | 3.1 | 1.0 |
| 16 GBytes | 51.1 | 6.8 | 2.3 |
| 32 GBytes | 102.1 | 11.8 | 3.3 |
| 64 GBytes | 198.2 | 18.6 | 6.0 |

4.7 Drive Geometry Specification

Table 13: Drive Geometry

| Raw Capacity | Total LBA | User Addressable Bytes |
|--------------|-------------|------------------------|
| | Decimal | (Unformatted) |
| 8 GBytes | 15,663,104 | 8,019,509,248 |
| 16 GBytes | 31,326,208 | 16,039,018,496 |
| 32 GBytes | 62,533,296 | 32,017,047,552 |
| 64 GBytes | 125,045,424 | 64,023,257,088 |

⁷ The Endurance values depend strongly on the use case, the preconditioning, the operation sequence, use of trim commands and usage level of the flash drive. The given values are for orientation only.

⁸ Sequential write 128kB simulates a continuous stream recording on a drive which has been preconditioned with a sequential write of the complete drive, Random Write 128KB or 4KB represent data logging applications with large or small block sizes.

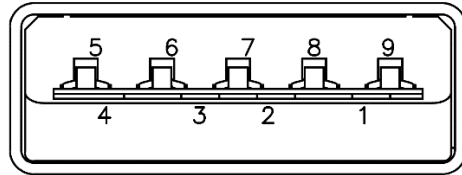
5. Electrical Interface

- USB3 Type-A connector, 9pin
- USB 3.1 Gen1 SuperSpeed interface, USB2.0 high-speed and 1.1 full-speed compatible

Table 14: Electrical pinout from device and host view.

| Pin | Signal device view | Signal host view | Description host view |
|--------|--------------------|------------------|-----------------------|
| 1 | V_Bus | V_Bus | Operating voltage |
| 2 | D- | D- | Data signal pair |
| 3 | D+ | D+ | Data signal pair |
| 4 | GND | GND | Power Ground |
| 5 | SSTX- | SSRX- | Host receive - |
| 6 | SSTX+ | SSRX+ | Host receive + |
| 7 | GND | GND | Signal Ground |
| 8 | SSRX- | SSTX- | Host transmit - |
| 9 | SSRX+ | SSTX+ | Host transmit + |
| Shield | | | Connector shield |

Figure 2: USB3 Type-A connector pinout



6. Electrical Specification

Table 15: Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|----------------------------------|--------|------|-----|------|
| Power Supply Voltage | V_Bus | -0.5 | 6.0 | V |
| Voltage at D+ and D- | V_Data | -0.5 | 5.0 | |
| Voltage at USB3 pins | V_Data | -0.5 | 1.8 | |
| Commercial Operating Temperature | T_A | 0 | 70 | °C |
| Industrial Operating Temperature | | -40 | 85 | |

Table 16: DC characteristics for SuperSpeed operation (T=25°C, V_Bus=5V)

| Parameter | Symbol | Density | Min | Typ | Max | Unit |
|-----------------|--------|------------|-----|-----------------|------|------|
| Supply Voltage | V_Bus | all | 4.5 | 5.0 | 5.50 | V |
| Write current | I_WR | 8GB | | 136 | 150 | mA |
| | | 16GB | | 98 | 120 | |
| | | 32GB | | 112 | 130 | |
| | | 64GB | | 146 | 160 | |
| Read current | I_RD | 8GB | | 145 | 160 | |
| | | 16GB | | 103 | 120 | |
| | | 32GB | | 115 | 130 | |
| | | 64GB | | 117 | 130 | |
| Idle current | I_IDL | 8GB | | 88 ⁹ | 95 | |
| | | 16/32/64GB | | 65 ⁹ | 80 | |
| Suspend current | I_CCS | all | | 1.8 | 2.5 | |

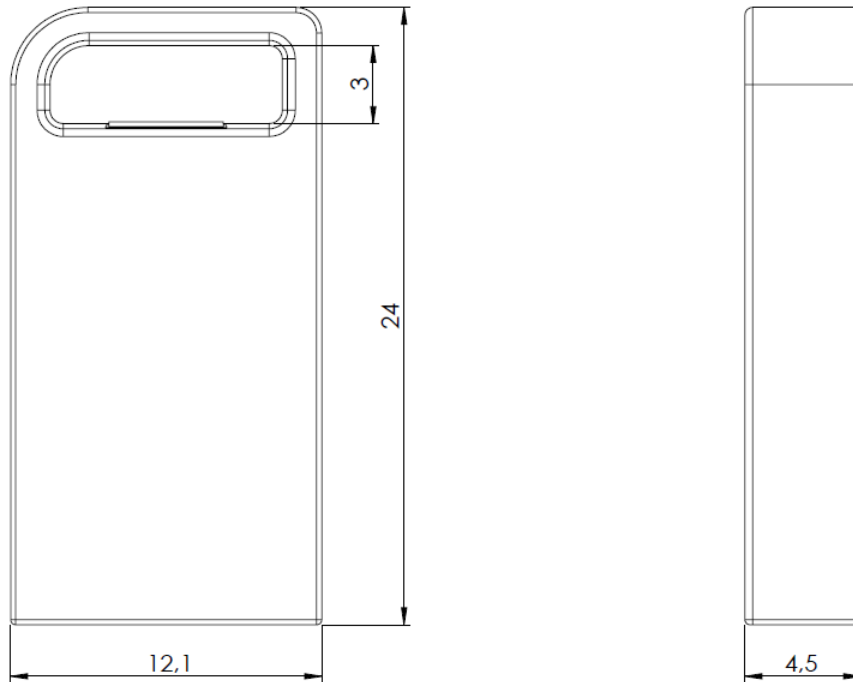
Table 17: DC characteristics for High-Speed operation (T=25°C, V_Bus=5V)

| Parameter | Symbol | Density | Min | Typ | Max | Unit |
|--------------------------------|----------|------------|------|-----------------|------|------|
| Supply Voltage | V_Bus | all | 4.5 | 5.0 | 5.50 | V |
| Write current | I_WR | 8GB | | 81 | 100 | mA |
| | | 16GB | | 66 | 70 | |
| | | 32GB | | 63 | 70 | |
| | | 64GB | | 70 | 80 | |
| Read current | I_RD | 8GB | | 79 | 100 | |
| | | 16GB | | 64 | 70 | |
| | | 32GB | | 62 | 70 | |
| | | 64GB | | 63 | 70 | |
| Idle current | I_IDL | 8GB | | 44 ⁹ | 50 | |
| | | 16/32/64GB | | 32 ⁹ | 40 | |
| Suspend current | I_CCS | all | | 1.8 | 2.5 | |
| High Speed Idle Level | V_HSOI | all | -10 | | 10 | mV |
| High Speed Data Signaling LOW | V_HSOL | all | -10 | | 10 | |
| High Speed Data Signaling HIGH | V_HSOH | all | 360 | | 440 | |
| Chirp J Level (differential) | V_CHIRPJ | all | 360 | | 440 | |
| Chirp K Level (differential) | V_CHIRPK | all | -440 | | -360 | |

⁹ Typically 5 minutes after power on the device performs a background data care management, that needs up to 180mA

7. Package Mechanical

Figure 3: Mechanical Dimensions in mm for U-50n



All dimensions are in millimeters, tolerances as listed in Table 10 on page 9.

8. ATA Pass-Through commands (Identify Device and S.M.A.R.T.)

8.1 ATA Pass-Through commands

Additional to the standard SCSI commands the device also supports the ATA Pass-Through commands.

Table 18: ATA PASS-TRHOUGH(x) commands

| SCSI command | OpCode | Description |
|----------------------|--------|--|
| ATA PASS-THROUGH(12) | A1h | Write and read ATA registers to send commands and read information |
| ATA PASS-THROUGH(16) | 85h | |

<http://www.t10.org/ftp/t10/document.04/04-262r8.pdf>

Table 19: ATA register addressing

| Offset address | Input | Output | Type | Identify device | e.g. SMART commands |
|----------------|--------------|--------|------|-----------------|---------------------|
| 0 | Data | | Word | | |
| 1 | Feature | Error | Byte | xx | yyh* |
| 2 | Sector count | | Byte | xx | 01h |
| 3 | LBA_Low | | Byte | xx | xx |
| 4 | LBA_Mid | | Byte | xx | 4Fh |
| 5 | LBA_High | | Byte | xx | C2h |
| 6 | Drive/head | | Byte | Eoh | Eoh |
| 7 | Command | Status | Byte | ECh | Boh |

* see below

8.2 Identify Device

The Identify Device returns a identify sector compatible to ATA and SATA devices. Here an example of the interpretation of this sector.

Table 20: Identify Device Information

| Word(s) | Default Value | | Total Bytes | Data Field Type Information |
|---------|---------------------------|-----|-------------|---|
| 0 | 0040h | | 2 | Standard Configuration Fixed (optional 848Ah for removable) |
| ... | ... | ... | ... | ... |
| 10-19 | aaaa* | | 20 | Serial number in ASCII (right-justified) |
| ... | ... | ... | ... | ... |
| 23-26 | XXXX* | | 8 | Firmware revision in ASCII (big-endian byte order in Word) |
| 27-46 | XXXX* | | 40 | Model number in ASCII (right-justified) |
| ... | ... | ... | ... | ... |
| 60-61 | XXXXh | | 4 | Total number of sectors addressable in LBA mode |
| ... | ... | ... | ... | ... |
| 82 | 0101h 7701h* 4063h* | | 2 | Command set: SMART feature set, service interrupt |
| ... | ... | ... | ... | ... |
| 85 | 000Xh 0701h* 4063h* | | 2 | Command set enabled: SMART feature set enabled/disabled |
| ... | ... | ... | ... | ... |
| 255 | XXA5h | | 2 | Integrity Word |

* Values depend on device configuration.

8.3 S.M.A.R.T. commands

The intent of the SMART command feature set is to protect user data and minimize the likelihood of unscheduled system downtime that may be caused by predictable degradation and/or fault of the device. By monitoring and storing critical performance and calibration parameters, SMART feature set devices attempt to predict the likelihood of a near-term degradation or fault condition. Providing the host system the knowledge of a negative reliability condition allows the host system to warn the user of the impending risk of a data loss and advise the user of the appropriate action.

All S.M.A.R.T. commands have the command code Boh. The different commands are selected by the Feature register.

Table 21: S.M.A.R.T. Features Supported

| Operation | Feature | Sect Count | LBA low | LBA mid | LBA high | DRV head | Command |
|--------------------------------------|---------|------------|---------|---------|----------|----------|---------|
| S.M.A.R.T. Read Data | D0h | 01h | xx | 4Fh | C2h | E0h | Boh |
| S.M.A.R.T. Read Attribute Thresholds | D1h | 01h | xx | 4Fh | C2h | E0h | Boh |
| S.M.A.R.T. Enable Operations | D8h | xx | xx | 4Fh | C2h | E0h | Boh |
| S.M.A.R.T. Disable Operations | D9h | xx | xx | 4Fh | C2h | E0h | Boh |
| S.M.A.R.T. Return Status | DAh | xx | xx | 4Fh | C2h | E0h | Boh |

All commands are aborted, if the LBA signature is invalid.

8.3.1 S.M.A.R.T. Read Data (Doh)

When the drive receives the S.M.A.R.T. Read Data subcommand, it returns one sector (512 bytes) of data. See the following table for the data structure of this sector.

Table 22: S.M.A.R.T. Data Structure

| Byte(s) | Value | Description |
|---------|-------|---|
| 0-1 | 0010h | S.M.A.R.T. structure version |
| 2-361 | XXh | Attribute entries 1 to 30 (see Table 23) |
| 362 | 00h | Off-line data collection status (no off-line data collection started) |
| 363 | 00h | Self-test execution status byte (self-test completed) |
| 364-365 | 0000h | Total time, in seconds, to complete off-line data collection |
| 366 | 00h | Vendor specific |
| 367 | 00h | Off-line data collection capability (no off-line data collection) |
| 368-369 | 0003h | S.M.A.R.T. capabilities |
| 370 | 00h | No Error logging capability |
| 371 | 00h | Vendor specific |
| 372 | 00h | Short self-test routine recommended polling time, in minutes |
| 373 | 00h | Extended self-test routine recommended polling time, in minutes |
| 374-385 | 00h | Reserved |
| 386-387 | 0004h | SMART Version |
| 388-510 | XXh | Vendor specific |
| 511 | XXh | Data structure checksum |

8.3.2 S.M.A.R.T. Attribute Entry Structure

Each attribute entry (Bytes 2–361) consists of 12 bytes. See the following table for the data structure of each entry.

Table 23: Attribute Entry

| Offset Byte(s) | Value | Description |
|----------------|-------|--|
| 0 | XXh | Attribute ID (see Table 24) |
| 1–2 | XXXXh | Flags (little-endian) Bit0: Advisory (0) or Prefailure (1) Bit1: Not used (0) or updated during normal operation (1) |
| 3 | XXh | Current value as a percentage 64h = 100% |
| 4 | XXh | Worst value as a percentage 64h = 100% |
| 5–10 | XXXXh | Raw value (little-endian) |
| 11 | 00h | Reserved |

8.3.3 S.M.A.R.T. Attributes

The drives support the S.M.A.R.T. attributes listed in the following table.

The Threshold values can be read out with the S.M.A.R.T. Read Attribute Thresholds command (D1h)

The first attributes (196, 213, 229) are “Pre-Fail” type, while all other are Advisory (Old Age).

Table 24: S.M.A.R.T. Attributes

| ID dec | ID hex | Value | Worst | Thres-hold | Attribute | Description | RAW values Offset 5–10 |
|--------|--------|-------|-------|------------|---------------------------------|---|---|
| 196 | C4h | X% | X% | 25 | Spare Block Count | Number of total available NAND spare blocks | Initial (offset 5–7) and current (offset 8–10) number of spare blocks |
| 213 | D5h | X% | X% | 25 | Spare Block Count worst channel | Spare block count for the NAND with the lowest number of remaining spare blocks | Initial (offset 5–7) and current (offset 8–10) number of spare blocks of the channel with the lowest current number of spare blocks |
| 229 | E5h | X% | X% | 2 | Total Erase Count | Estimated number of total NAND block erases | Estimated number of total NAND block erases |
| 203 | CBh | 100 | 100 | 0 | Total ECC Errors | All recorded ECC errors | Total number of ECC errors (correctable and uncorrectable) (offset 5–8) |
| 204 | CCh | 100 | 100 | 0 | Correctable ECC Errors | Total recorded ECC errors that were corrected during the life of the drive | Total number of correctable ECC errors (offset 5–8) |
| 199 | C7h | 100 | 100 | 0 | UDMA CRC Errors | Dummy attribute, included for legacy reasons | This value is fixed at 0. |
| 232 | E8h | 100 | 100 | 0 | Total Number of Reads | Total number of NAND READ commands | Total number of NAND READ commands |
| 12 | 0Ch | 100 | 100 | 0 | Power-On Count | Count of power-on events | Number of power cycles (offset 5–8) |
| 241 | F1h | 100 | 100 | 0 | Total LBAs Written | Total amount of data written to the drive | Total number of LBAs written to the disk, divided by 65536 |
| 242 | F2h | 100 | 100 | 0 | Total LBAs Read | Total amount of data read from the drive | Total number of LBAs read from the disk, divided by 65536 |
| 214 | D6h | 100 | 100 | 0 | Management Block status | Total number of times the management block has been updated | Management block write count (offset 5–8) |
| 215 | D7h | X% | X% | 0 | Trim Status | Amount of device content that is currently in the trimmed state | This value is fixed at 0. |

| ID dec | ID hex | Value | Worst | Thres-hold | Attribute | Description | RAW values Offset 5-10 |
|--------|--------|-------|--------|------------|--------------------|------------------------------------|--|
| 194 | C2h | X°C | Max °C | 0 | Temperature Status | Device temperature in Celsius (°C) | Current (offset 5) / Min (offset 6) / Max temperature (offset 7) |

8.3.4 S.M.A.R.T. Read Attribute Thresholds (D1h)

When the drive receives the S.M.A.R.T. Read Attribute Thresholds subcommand, it returns one sector (512 bytes) of data similar as S.M.A.R.T. Read data sector, but with the threshold value in offset 1 of each attribute (see Table 24).

8.3.5 S.M.A.R.T. Enable Operations (D8h)

This command enables access to the S.M.A.R.T. capabilities of the drive. The state of SMART (enabled or disabled) is preserved across power cycles.

8.3.6 S.M.A.R.T. Disable Operations (D9h)

This command disables access to the S.M.A.R.T. capabilities of the drive. The state of SMART (enabled or disabled) is preserved across power cycles.

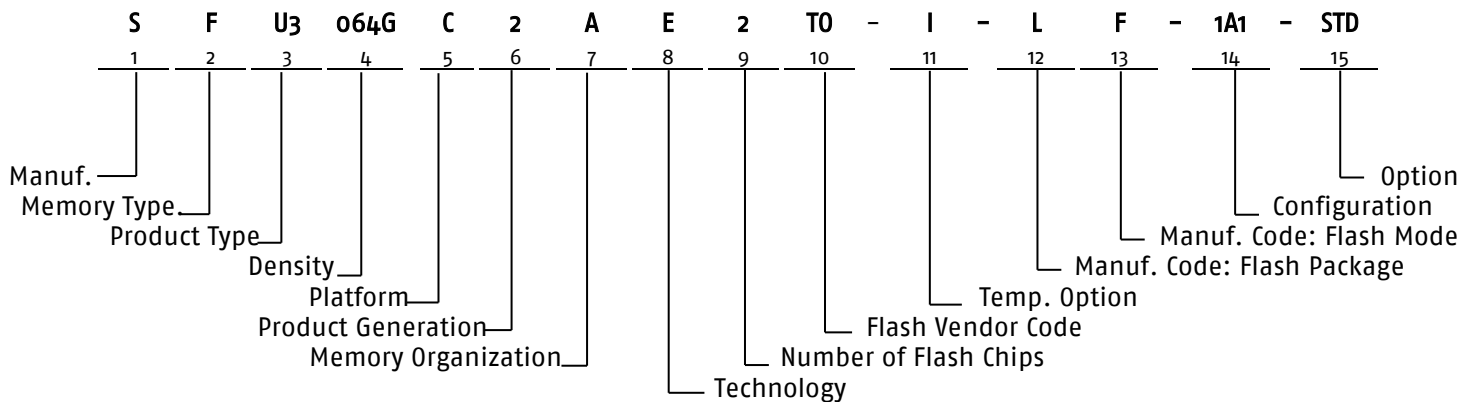
8.3.7 S.M.A.R.T. Return Status (DAh)

Table 25: S.M.A.R.T. Return Status

| Operation | Feature | Sect Count | LBA low | LBA mid | LBA high | DRV head | Com-mand |
|------------------------------------|---------|------------|---------|---------|----------|----------|----------|
| Command S.M.A.R.T. Return Status | DAh | xx | xx | 4Fh | C2h | Eoh | Boh |
| Response | | | | | | | |
| S.M.A.R.T. Return Status OK | xx | xx | xx | 4Fh | C2h | xx | xx |
| S.M.A.R.T. Return Status Pre-FAIL* | xx | xx | xx | F4h | 2Ch | xx | xx |

* If a threshold exceeded condition exists for either the Spare Block Count Worst Channel attribute or the Erase Count attribute, the device will set the Cylinder Low register to F4h and the Cylinder High register to 2Ch. In this case the drive should be replaced soon.

9. Part Number Decoder



9.1 Manufacturer

| | |
|---------------|---|
| Swissbit code | S |
|---------------|---|

9.2 Memory Type

| | |
|-------|---|
| Flash | F |
|-------|---|

9.3 Product Type

| | |
|---------------------|----|
| USB 3.1 Flash Drive | U3 |
|---------------------|----|

9.4 Density

| | |
|-----------|------|
| 8 GBytes | 008G |
| 16 GBytes | 016G |
| 32 GBytes | 032G |
| 64 GBytes | 064G |

9.5 Platform

| | |
|---------------|---|
| USB COB Inlay | C |
|---------------|---|

9.6 Product Generation

| | |
|-------------------|---|
| First generation | 1 |
| Second generation | 2 |

9.7 Memory Organization

| | |
|----|---|
| x8 | A |
|----|---|

9.8 Technology

| | |
|--------------------|---|
| U-5xx platform UFD | E |
|--------------------|---|

9.9 Number of Flash Chips

| | |
|---------|---|
| 1 Flash | 1 |
| 2 Flash | 2 |
| 4 Flash | 4 |

9.10 Flash Code

| | |
|------------------|----|
| Toshiba / Kioxia | TO |
|------------------|----|

9.11 Temperature Option

| | |
|---|---|
| Industrial Temperature Range: -40 °C to 85 °C | I |
| Standard Temperature Range: 0 °C to 70 °C | C |

9.12 Die Classification

| | |
|-------------------------------|---|
| MLC MONO (single die package) | G |
| MLC DDP (dual die package) | L |
| MLC QDP (quad die package) | H |

9.13 Pin Mode

| | |
|----------------------------|---|
| Single nCE and Single R/nB | E |
| Dual nCE and Dual R/nB | F |
| Quad nCE and Quad R/nB | G |

9.14 Configuration XYZ

X = Configuration

| | |
|---------------|---|
| Configuration | X |
| Removable | 1 |

Y = Firmware Revision

| | |
|---------------------|---|
| FW Revision | Y |
| durabit™ Revision 1 | A |

Z = Optional setting

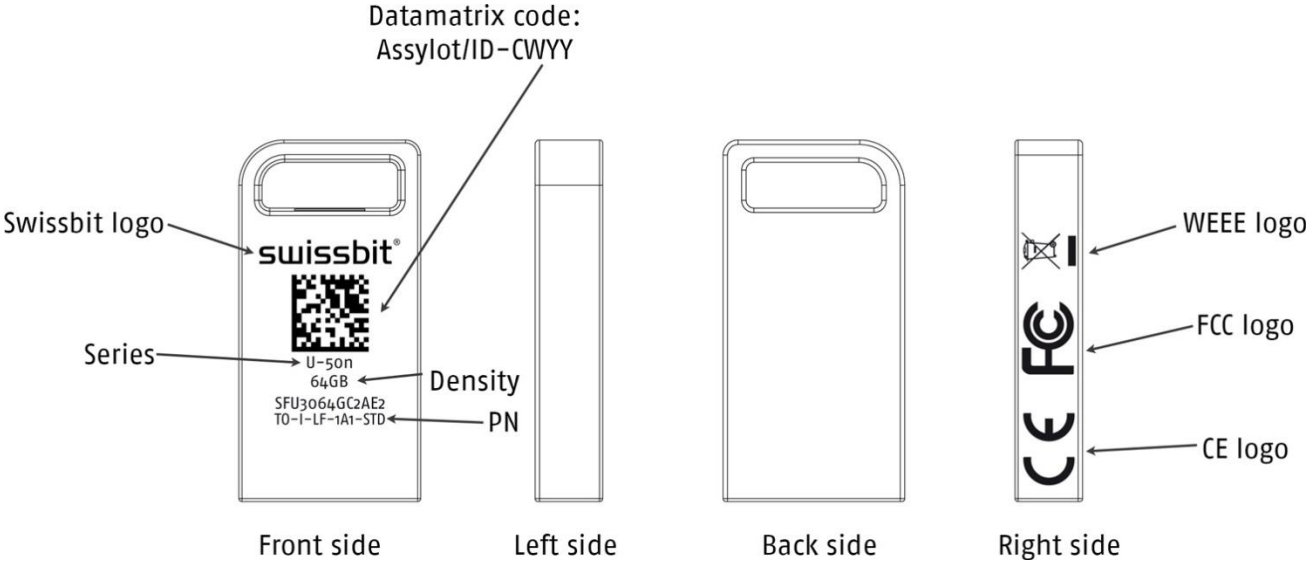
| | |
|-------------------|---|
| Optional Setting | Z |
| Default (MLC) | 1 |
| pSLC (pseudo SLC) | P |

9.15 Option

| | |
|---------------------|-----|
| Swissbit / Standard | STD |
| Customized version | XXX |

10. Marking Specification

Figure 4: U-50n product marking



11.Revision History

Table 26: Document Revision History

| Date | Revision | Description | Revision Details |
|-------------|----------|---|--------------------|
| 11-Feb-2019 | 00 | Initial preliminary release. | Doc. req. no. 2751 |
| 29-Mar-2019 | 1.00 | Initial release. | Doc. req. no. 2851 |
| 26-Jun-2020 | 1.01 | Added new product variant P/Ns for 16GB-64GB and related characterization data; minor changes; updated part number decoder. | Doc. req. no. 3885 |
| 29-Jul-2021 | 1.02 | Capacity values in Table 4 corrected. | Doc. req. no. 4375 |

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