swissbit®

Product Data Sheet

Industrial
USB Flash Drive Module

U-450 Series
USB 2.0 High-Speed, SLC

Commercial and Industrial
Temperature Grade

Date: January 13, 2021
Revision: 1.01

Made in Germany

Contents

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U-450 Series – Industrial USB Flash Drive Module (eUSB) 1 GByte up to 16 GBytes

1. Product Summary

- **Capacities:** 1 GByte, 2 GBytes, 4 GBytes, 8 GBytes, 16 GBytes
- **Form Factor:**
  - USB 2.0 solid state flash drive for internal 10-pin USB connector terminal (26.65mm x 36.8mm)
  - 2.54mm or 2.00mm connector with keyed pin9
- **Compliance:** USB 2.0 High-Speed specification compatible (backward compliance with USB 1.1)
- **Performance:**
  - Read Performance: Sequential Read up to 36 MBytes/s, Random Read IOPS up to 1,900
  - Write Performance: Sequential Write up to 26 MBytes/s, Random Write IOPS up to 1,400
- **Operating Temperature Range:**
  - Commercial: 0 °C to 70 °C
  - Industrial: -40 °C to 85 °C
- **Storage Temperature Range:** -40 °C to 85 °C
- **Operating Voltage:** 3.3V ±5% or 5V ± 10%
- **Data Retention:** 10 Years @ Life Begin; 1 Year @ Life End
- **Endurance in TeraBytes Written (TBW):**
  - Enterprise Workload: up to 101
- **Shock/Vibration:** 1,500 g / 50 g
- **High-Performance 32-Bit Processor with Integrated, Parallel Flash Interface Engine:**
  - Single-Level Cell (SLC) NAND Flash
  - Hardware BCH Code ECC (up to 60bit correction per 1024 Bytes)
- **High Reliability:**
  - Mean Time Between Failure (MTBF): > 3,000,000 hours @ 25°C
  - Data Reliability: < 1 non-recoverable error per 10^{17} bits read

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 3 of 20

2. Product Features

- Subpage based Flash management 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
- Swissbit Life Time Monitoring (SBLTM) tool and SDK for SBLTM (on request)
- Controlled BOM & PCN process
- Customized options like registers, removable device, connector options, write protect switch, grounded mounting hole, densities, uploads, label, etc.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 4 of 20

3. Ordering Information

Table 1: Standard Product List

| Capacity | Temperature | |
	Commercial	Industrial
	Part Number	Part Number
1 GByte	SFUI1024cxAB1T0-C-MS-2y1-STD	SFUI1024cxAB1T0-I-MS-2y1-STD
2 GBytes	SFUI2048cxAB2T0-C-MS-2y1-STD	SFUI2048cxAB2T0-I-MS-2y1-STD
4 GBytes	SFUI4096cxAB1T0-C-MS-2y1-STD	SFUI4096cxAB1T0-I-MS-2y1-STD
8 GBytes	SFUI008GcxAB2T0-C-MS-2y1-STD	SFUI008GcxAB2T0-I-MS-2y1-STD
16 GBytes	SFUI016GcxAB1T0-C-QT-2y1-STD	SFUI016GcxAB1T0-I-QT-2y1-STD

c = connector, x = product generation, y = firmware revision

Table 2: Available Part Numbers

Industrial Temperature		
Capacity	Part Number	Connector
1 GByte	SFUI1024J2AB1T0-I-MS-2A1-STD	2.54mm pitch
2 GBytes	SFUI2048J2AB2T0-I-MS-2A1-STD	2.54mm pitch
2 GBytes	SFUI2048K2AB2T0-I-MS-2A1-STD	2.00mm pitch
4 GBytes	SFUI4096J2AB1T0-I-MS-2A1-STD	2.54mm pitch
4 GBytes	SFUI4096K2AB1T0-I-MS-2A1-STD	2.00mm pitch
8 GBytes	SFUI008GJ2AB2T0-I-MS-2A1-STD	2.54mm pitch
8 GBytes	SFUI008GK2AB2T0-I-MS-2A1-STD	2.00mm pitch
16 GBytes	SFUI016GJ2AB1T0-I-QT-2A1-STD	2.54mm pitch
16 GBytes	SFUI016GK2AB1T0-I-QT-2A1-STD	2.00mm pitch

Commercial Temperature		
Capacity	Part Number	Connector
1 GByte	SFUI1024J2AB1T0-C-MS-2A1-STD	2.54mm pitch
2 GBytes	SFUI2048J2AB2T0-C-MS-2A1-STD	2.54mm pitch
4 GBytes	SFUI4096J2AB1T0-C-MS-2A1-STD	2.54mm pitch
8 GBytes	SFUI008GJ2AB2T0-C-MS-2A1-STD	2.54mm pitch
16 GBytes	SFUI016GJ2AB1T0-C-QT-2A1-STD	2.54mm pitch

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 5 of 20

4. Product Description

The Swissbit U-450 USB 2.0 embedded USB flash drive provides a robust, high performance, and reliable storage product with industry compatible interface and small form factor. The U-450 SLC 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 10-pin connector makes easy integration into existing or newly designed system boards possible. The U-450 is compatible with standard on-board USB connectors. The embedded USB module serves applications which utilize USB products as acceleration cache for HDDs or as a boot media, for example networking and telecommunication systems.

For outdoor use or in poorly ventilated systems the U-450 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.
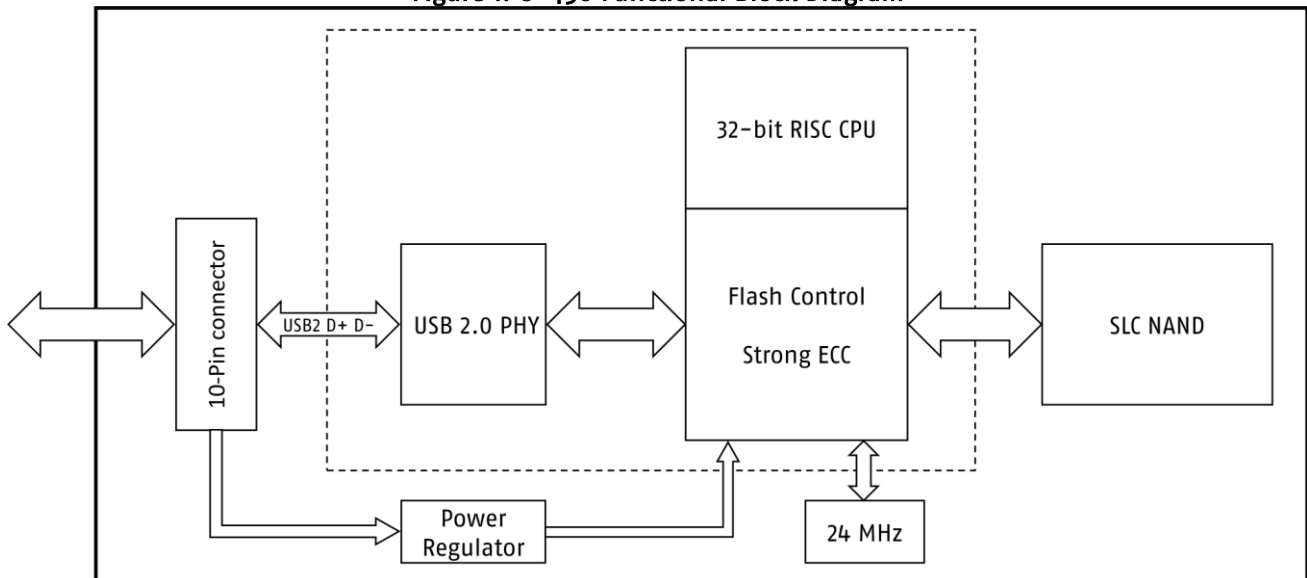
The U-450 firmware includes data care management features which refresh storage areas that are not or only infrequently read. At high temperature operation these areas are prone to retention loss. The firmware monitors the state of the NAND blocks and refreshes those that show a high level of degradation, thus preventing uncorrectable errors. This is an important feature for USB flash drives that are used as read only boot media.

The U-450 consists of a high performance 32bit RISC USB controller, the 10pin connector, power circuitry and different numbers of NAND dies.

The U-450 can flexibly operate at 3.3V ±5% or 5V ± 10%.

It supports USB 2.0 High-Speed and is fully backwards compatible to USB 1.1 Full Speed.

Figure 1: U-450 Functional Block Diagram

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 6 of 20

4.1 Performance Specifications

The U-450 read/write sequential and random CDM performance benchmarks are detailed in the following Table 3.

Table 3: Read/Write Performance in High-Speed mode[1]

Capacity	Sequential Read (MBPS)	Sequential Write (MBPS)	Random Read 4K (IOPS)	Random Write 4K (IOPS)
1 GByte	30	18	1,750	1,400
2 GBytes	30	19	1,550	1,100
4 GBytes	36	26	1,900	1,350
8 GBytes	36	26	1,900	1,400
16 GBytes	36	26	1,900	1,400

4.2 Current Consumption

The drive-level current consumption as a function of operating mode is shown in the following Table 4.

Table 4: Current Consumption[2]

Capacity	Sequential Read	Sequential Write	Random Read 4K	Random Write 4K	Idle	Unit
1 GByte	59	63	44	49	28	
2 GBytes	60	66	43	48	28	
4 GBytes	68	66	49	50	30	mA
8 GBytes	70	68	50	51	30	
16 GBytes	75	72	51	53	30	

4.3 Environmental Specifications

4.3.1 Recommended Operating Conditions

The recommended operating conditions for the U-450 USB flash drives are provided in the following Table 5.

Table 5: Recommended Operating Conditions

Parameter	Value
Commercial Operating Temperature	0 °C to 70 °C
Industrial Operating Temperature	-40 °C to 85 °C
Power Supply V_{CC} Voltage	3.3 V ± 5% or 5.0 V ± 10%

4.3.2 Recommended Storage Conditions

The recommended storage conditions are listed in the following Table 6.

Table 6: Recommended Storage Conditions

Parameter	Value
Commercial Storage Temperature	-40 °C to 85 °C[3]
Industrial Storage Temperature	-40 °C to 85 °C[3]

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[1] The values are measured using CrystalDiskMark 6.0.2 x64 (CDM) with Seq Q32T1 and 4KiB Q8T8. Performance depends on flash type and number, file/cluster size, and burst speed.

[2] All values are the typical recorded at 25 °C, with 5V supply voltage at fastest CrystalDiskMark 6.0.2 x64 (CDM) in High-Speed mode.

[3] The retention at high temperature is reduced. The acceleration factor at 85°C compared with 40°C is 170.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 7 of 20

4.3.3 Shock, Vibration and Humidity

The maximum shock, vibration and humidity test conditions are listed in the following Table 7.

Table 7: 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, 20Hz – 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)

4.4 Regulatory Compliance

The U-450 devices comply with the regulations / standards listed in the following Table 8.

Table 8: 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

Physical dimensions are detailed in the following Table 9. Figure 3 on page 12 illustrates the U-450 dimensions.

Table 9: Measured Physical Dimensions

Physical Dimensions		Unit
Length	36.8±0.15	mm
Width	26.65±0.15	
Thickness (Max)	9.7±0.25 (standard connector) 5.8±0.25 (low profile connector)	
Weight (Max Capacity)	5	g

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Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 8 of 20

4.6 Reliability and Endurance

The Mean Time Between Failure (MTBF) is specified to exceed the value listed in the following Table 10. Data reliability with effective error tolerance and data retention at the beginning and end of life is also provided.

Table 10: Reliability

Parameter	Value
MTBF (at 25 °C)	> 3,000,000 hours
Data Reliability	< 1 Non-Recoverable Error per 10^{17} Bits Read
Data Retention (up to 40°C)	10 Years at Start (JESD47), 1 Year at EOL

Endurance represented as both TeraBytes Written (TBW) and full Drive Writes Per Day (DWPD) is provided in the following Table 11.

Table 11: Endurance[4, 5]

Capacity	Enterprise Workload	
	TBW	DWPD[6]
1 GByte	7.7	4.2
2 GBytes	15	4.2
4 GBytes	31	4.2
8 GBytes	60	4.1
16 GBytes	101	3.4

4.7 Drive Geometry Specification

Table 12: Drive Geometry

Raw Capacity	User Capacity	Total LBA	User Addressable Bytes
		Decimal	(Unformatted)
1 GByte	1 GByte	1,960,704	1,003,880,448
2 GBytes	2 GBytes	3,921,664	2,007,891,968
4 GBytes	4 GBytes	7,843,328	4,015,783,936
8 GBytes	8 GBytes	15,663,104	8,019,509,248
16 GBytes	16 GBytes	31,719,424	16,240,345,088

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[4] Enterprise workload follows the JEDEC JESD219 standard. Enterprise workload values are measured based on 168 hours of runtime. 1 TByte = 10^{12} bytes

[5] The specified TBW is valid if the amount is spread evenly over at least 18 months. Higher average daily data volume reduces the specified TBW. Swissbit recommends to calculate the service life based on target system mission profile.

[6] DWPD values are based on a service life of 5 years

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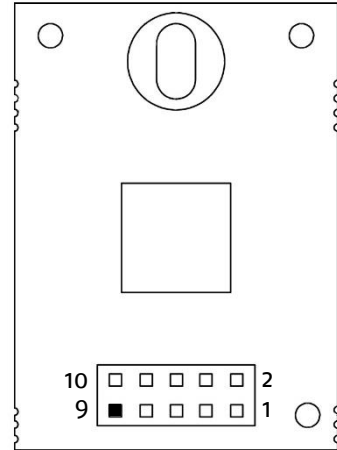Page 9 of 20

5. Electrical Interface

- USB connector 10pin (2mm or 2.54mm pitch)
- USB 2.0 High-Speed interface, USB 1.1 Full Speed compatible
- STD variation

Table 13: Electrical pinout

Pin	Signal	Standard type	Optional on request
1	V_Bus	Operating voltage	
2	NC	Not Connected	V_Bus
3	D-	Data signal pair	
4	NC	Not Connected	
5	D+	Data signal pair	
6	NC	Not Connected	
7	GND	Ground	
8	NC	Not Connected	GND
9	NC	Keyed at connector	not keyed NC or V_Bus
10	Shield	Ground (shield)	NC, LED out

See also chapter 7 Package Mechanical

Figure 2: Module view (connector side)

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 10 of 20

6. Electrical Specification

Table 14: 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	
Commercial Operating Temperature	T_A	0	70	°C
Industrial Operating Temperature		−40	85	

Table 15: DC characteristics for High-Speed operation (T=25°C, V_Bus=5V)

Parameter	Symbol	Density	Min	Typ	Max	Unit
Supply Voltage	V_Bus	all	3.1	3.3 or 5.0	5.50	V
Write current	I_WR	1 GByte		63	75	mA
		2 GBytes		66	75	
		4 GBytes		66	75	
		8 GBytes		68	75	
		16 GBytes		72	75	
Read current	I_RD	1 GByte		59	75	
		2 GBytes		61	75	
		4 GBytes		68	75	
		8 GBytes		70	75	
		16 GBytes		75	75	
Idle current	I_IDL	all		28[7]	40	
Suspend current	I_CCS	all		1.9	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	

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[7] For every 10th power-on cycle, typically 5 minutes after power-on, the device performs background data care management that requires up to 70mA.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 11 of 20

7. Package Mechanical

- Standard form factor of PCBs 36.8mm x 26.65mm
- Oval hole for mechanical fixture (optional grounded)
- 3 additional holes
- LED for operation indication (optional without LED)
- 2 connector types
  - 2.54mm pitch, 7.5mm long   standard
  - 2.00mm pitch, 3.68mm long   low profile
- Component heights   max. 1.2mm on connector side
                         max. 1.4mm on flash side

Figure 3: Mechanical Dimensions for U-450 drive

Dimension	Low profile	Standard profile
A	2,0	2,54
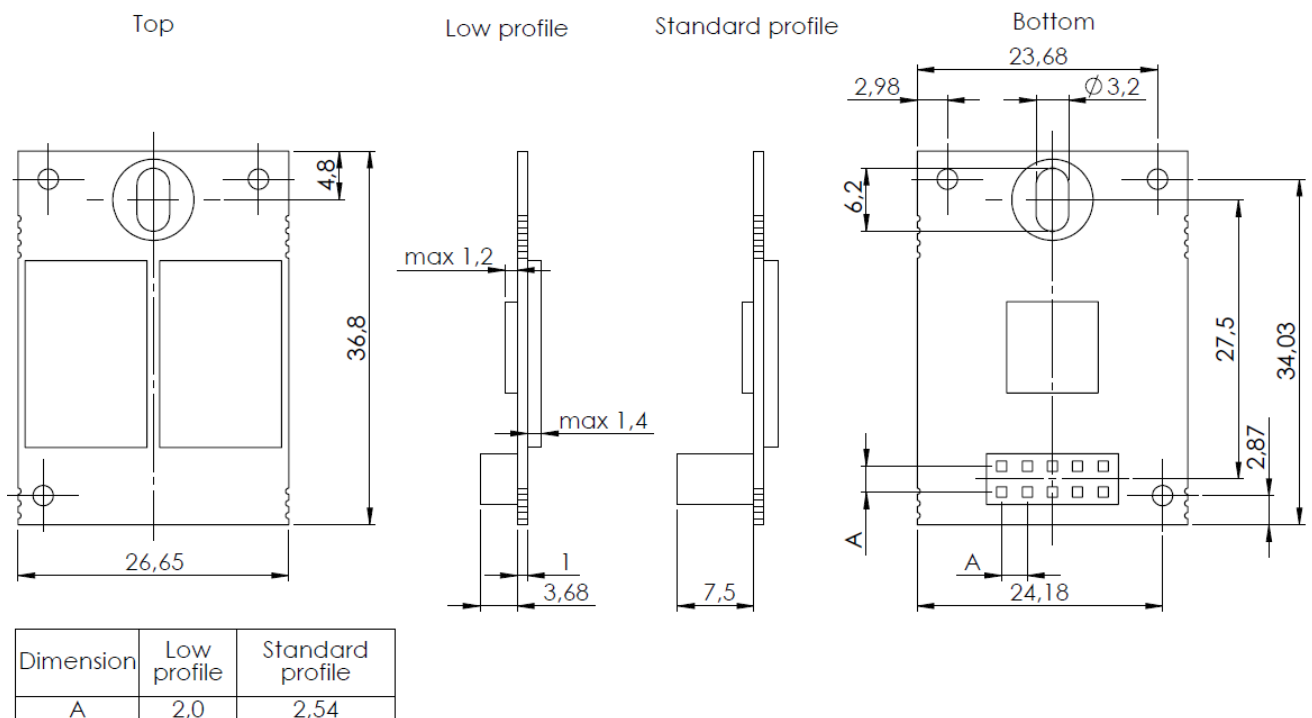
All dimensions are in millimeters, tolerance: ±0.15

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 12 of 20

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 16: 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 17: 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	E0h	E0h
7	Command	Status	Byte	ECh	B0h

* 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 18: 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.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 13 of 20

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 B0h. The different commands are selected by the Feature register.

Table 19: S.M.A.R.T. Features Supported

Operation	Feature	Sect Count	LBA low	LBA mid	LBA high	DRV head	Com- mand
S.M.A.R.T. Read Data	D0h	01h	xx	4Fh	C2h	E0h	B0h
S.M.A.R.T. Read Attribute Thresholds	D1h	01h	xx	4Fh	C2h	E0h	B0h
S.M.A.R.T. Enable Operations	D8h	xx	xx	4Fh	C2h	E0h	B0h
S.M.A.R.T. Disable Operations	D9h	xx	xx	4Fh	C2h	E0h	B0h
S.M.A.R.T. Return Status	DAh	xx	xx	4Fh	C2h	E0h	B0h

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

8.3.1 S.M.A.R.T. Read Data (D0h)

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 20: 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 21)
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

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 14 of 20

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 21: Attribute Entry

Offset Byte(s)	Value	Description
0	XXh	Attribute ID (see Table 22)
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 22: 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.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 15 of 20

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 22).

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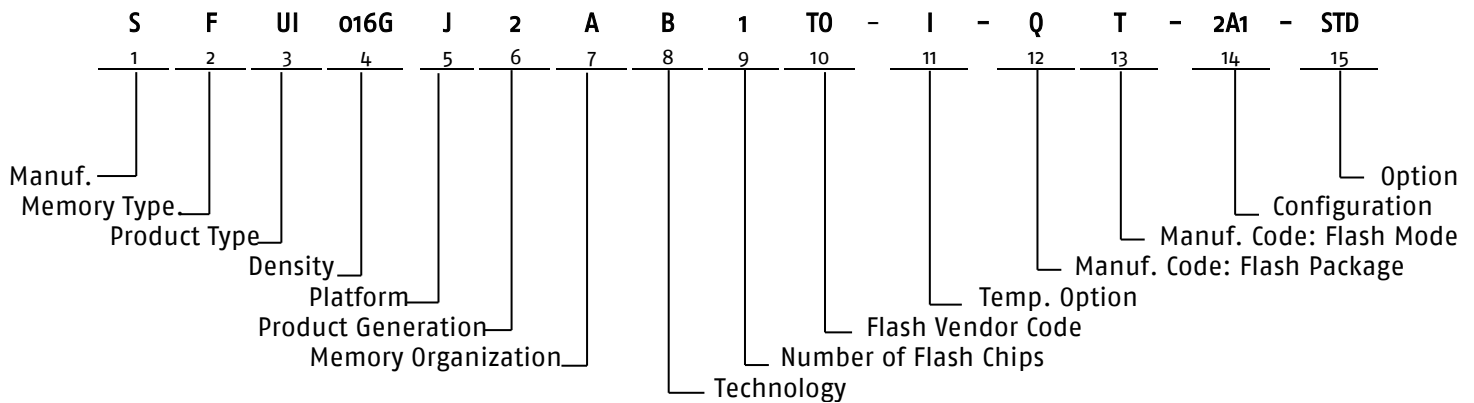
8.3.6 S.M.A.R.T. Disable Operations (D9h)

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 23: 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	E0h	B0h
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.

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 16 of 20

9. Part Number Decoder

```
S    F    UI   016G   J    2    A    B    1    T0   -   I   -   Q    T   -   2A1   -   STD
1    2    3    4      5    6    7    8    9    10       11      12   13      14        15
```

- Manuf. — 1
- Memory Type — 2
- Product Type — 3
- Density — 4
- Platform — 5
- Product Generation — 6
- Memory Organization — 7
- Technology — 8
- Number of Flash Chips — 9
- Flash Vendor Code — 10
- Temp. Option — 11
- Manuf. Code: Flash Package — 12
- Manuf. Code: Flash Mode — 13
- Configuration — 14
- Option — 15

9.1 Manufacturer

Swissbit code	S

9.2 Memory Type

Flash	F

9.3 Product Type

U-xxx USB Flash Drive Module (Internal)	UI

9.4 Density

1 GByte	1024
2 GBytes	2048
4 GBytes	4096
8 GBytes	008G
16 GBytes	016G

9.5 Platform

U-xxx – 2.54mm plug	J
U-xxx – 2.00mm plug	K

9.6 Product Generation

First generation	1
Second generation	2

9.7 Memory Organization

x8	A

9.8 Technology

U-4xx platform UFD	B

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Revision: 1.01
Template: Doc-3581
File: U-450_data_sheet_UI-xxAB_STD_Rev101
Page 17 of 20

9.9 Number of Flash Chips

1 Flash	1
2 Flash	2

9.10 Flash Code

Toshiba / Kioxia	T0

9.11 Temperature Option

Commercial Temperature Range: 0 °C to 70 °C	C
Industrial Temperature Range: –40 °C to 85 °C	I

9.12 Die Classification

SLC MONO (single die package)	M
SLC DDP (dual die package)	D
SLC QDP (quad die package)	Q

9.13 Pin Mode

	TSOP
Single nCE and Single R/nB	S
Dual nCE and Dual R/nB	T

9.14 Configuration XYZ

X = Configuration

Configuration	X
Removable Drive	1
Fixed Drive	2

Y = Firmware Revision

FW Revision	Y
Revision 1	A

Z = Features

Features	Z
Default (SLC or MLC)	1
pSLC (pseudo SLC)	P

9.15 Option

Swissbit / Standard	STD
Customized version	XXX

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Revision: 1.01
Template: Doc–3581
File: U–450_data_sheet_UI–xxAB_STD_Rev101
Page 18 of 20

10. Marking Specification

10.1 Top View

Figure 4: U-450 top view (example)

10.2 Label content

Figure 5: U-450 label details

Swissbit AG   Revision: 1.01
Industriestrasse 4   Confidential   Template: Doc-3581
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Switzerland   industrial@swissbit.com   Page 19 of 20
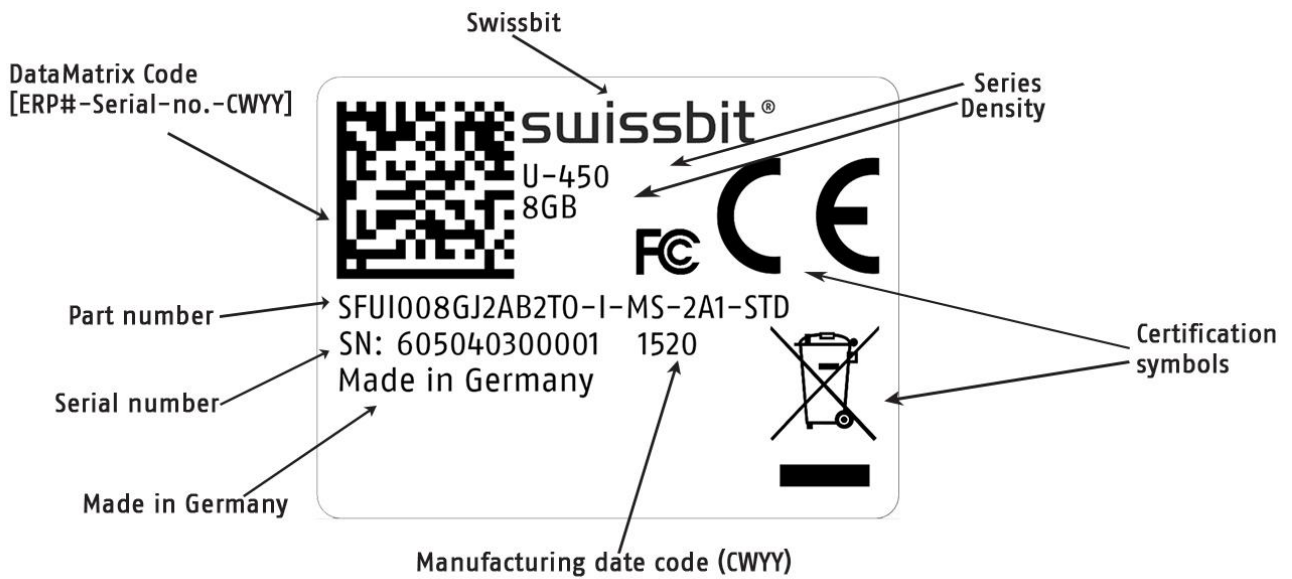
11.Revision History

Table 24: Document Revision History

Date	Revision	Description	Revision Details
15-May-2020	0.90	Preliminary release	Doc. req. no. 3693
31-Aug-2020	1.00	Initial release	Doc. req. no. 4007
13-Jan-2021	1.01	Added 1 GByte product variant, additional commercial temperature partnumbers and updated feature icons	Doc. req. no. 4306

Swissbit AG   Revision: 1.01
Industriestrasse 4   Confidential   Template: Doc-3581
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Switzerland   industrial@swissbit.com   Page 20 of 20

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