

swissbit®

Product Data Sheet

Industrial USB Flash Drive Module

U-400 Series
USB2.0 high speed, SLC

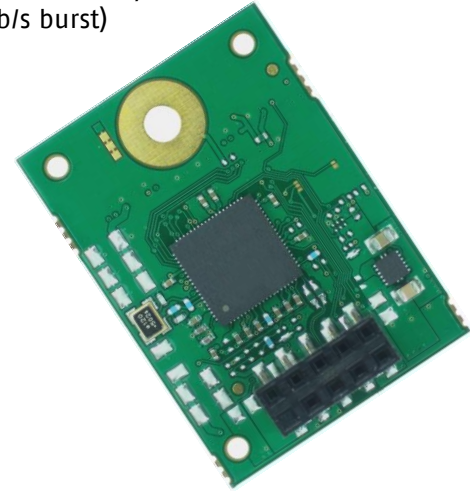


U-400 SERIES (USB2.0, HIGH SPEED, SLC)

INDUSTRIAL USB FLASH DRIVE MODULE (eUSB) – 1 TO 16GBYTE

Main Features

- USB2.0 solid state flash drive for internal 9(10)-pin USB connector terminal
 - Fully compliant with USB specification 2.0/3.0 (High-Speed, 480Mb/s burst)
 - Fully backward compliant with USB 1.1 systems (Full speed, 12Mb/s burst)
 - Dimension of 26.65 x 36.8mm
 - 2.54mm or 2.00mm connector with keyed pin9 (optional different key pins and pinouts)
 - Screw hole not connected (optional grounded)
 - Fix drive (optional removable)
 - LED for operation indication
 - Write protect switch (optional)
 - FAT32 preformatted
 - Diagnostic features with Life Time Monitoring tool support
 - Firmware update in field possible
- High performance 2.0 specification
 - Up to 40 IOPS write and 1700 IOPS read (4KByte transfers)
 - Up to 34MBytes/s sequential write and 36MBytes/s read speed
- Power Supply: (Low-power CMOS technology)
 - 3.1 to 5.5V operating voltage
- Optimized FW algorithms especially for high read access and long data retention applications
 - Patented power-off reliability technology
 - 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 refresh 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. With that the maximum write endurance of the device is guaranteed.
 - Data Care Management
The interruptible background process maintain the user data for Read Disturb effects or Retention degradation due to high temperature effects.
 - UBER <10⁻¹⁷
- High reliability
 - SLC NAND Flash with highest program erase cycles per block
 - Designed with sophisticated firmware architecture for industrial and netcom market especially 24/7 application like networking, base stations, infrastructure systems, POS/POI, medical and general boot medium use case.
 - The product is optimized for highest reliability and power fail safety.
 - Commercial and Industrial Temperature range, 0° up to 70°C and -40° up to 85°C
- Controlled BOM & PCN process
- RoHS, China-RoHS, REACH compatible, WEEE, CE, FCC compliant
- Customized options like registers, removable device, connector options, write protect switch, grounded mounting hole, conformal coating, densities, uploads, label, security controller, ...



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2 Order Information

Density	Part Number	Connector	Temp. Range	Flash Technology
1GB	SFUI1024cgAB1TO-t-MS-2xx-STD	c = J 2.54mm pitch c = K 2.00mm pitch	t = C -0°C to 70°C t = I -40°C to 85°C	SLC NAND Flash
2GB	SFUI2048cgAB2TO-t-MS-2xx-STD			
4GB	SFUI4096cgAB1TO-t-MS-2xx-STD			
8GB	SFUI8192cgAB2TO-t-MS-2xx-STD			
16GB	SFUI016GcgAB1TO-t-QT-2xx-STD			

g = generation; x = options, firmware and custom configuration

2.1 Standard products with 2.54mm (J) connector

Density	Part Number
1GB	SFUI1024J1AB1TO-t-MS-211-STD
2GB	SFUI2048J1AB2TO-t-MS-211-STD
4GB	SFUI4096J1AB1TO-t-MS-211-STD
8GB	SFUI8192J1AB2TO-t-MS-211-STD
16GB	SFUI016GJ1AB1TO-t-QT-211-STD

2.2 Low profile products with 2.00mm (K) connector

Density	Part Number
1GB	SFUI1024K1AB1TO-t-MS-211-STD
2GB	SFUI2048K1AB2TO-t-MS-211-STD
4GB	SFUI4096K1AB1TO-t-MS-211-STD
8GB	SFUI8192K1AB2TO-t-MS-211-STD
16GB	SFUI016GK1AB1TO-t-QT-211-STD

t = temperature grade (C=0°C to 70°C and I=-40°C to +85°C)

2.3 Offered options for custom products

- Removable or fixed drive (standard fix)
- Customer specified strings and IDs
- FAT16, FAT32 format or customer file system, default FAT32
- Preload service
- Temperature range

Please ask our sales for more details and additional features.

3 NAND Flash technologies

SLC, pSLC and MLC flash

- Single-level-cell (SLC) flash, 1 bit (1 level) is stored in each memory cell
- Pseudo Single-level-cell (pSLC) 1 bit (1 level) is stored in an MLC memory cell by special sequences
- Multi-level-cell (MLC) flash, 2 bit (3 level) are stored in each memory cell

Differences

Series	U-400	U-46	U-45	
	SLC	pSLC	MLC	comment
Endurance	up to 100,000	up to 20,000	up to 3,000	Physical write/erase cycles
Write Performance	Superior	Superior	High	pSLC and SLC have improved write performance due to single bit write
Read Performance	Increased	Increased	High	pSLC and SLC have improved read performance due to single bit read
Reliability	highest	high	normal	Degradation of information has higher impact with 4 reference levels
Cost	high	medium	low	MLC can store twice the bits per square mm silicon

4 Capacity specification

Capacity	Sectors	Total addressable capacity (Byte)
1GB	1,960,704	1,003,880,448
2GB	3,921,664	2,007,891,968
4GB	7,843,328	4,015,783,936
8GB	15,663,104	8,019,509,248
16GB	31,719,424	16,240,345,088
32GB	62,533,296	32,017,047,552

5 System performance

Speed	High Speed mode (sequential, typ)	Full Speed mode (sequential, typ)	unit
Burst	480	12	Mbit/s
Read	28 ⁽¹⁾	1.0	MByte/s
Write	19/27 ⁽¹⁾	0.9	

1) Effective speed varies with controller, number and type of flash, host, file size, file system and operating system

System Performance High Speed mode		typ	max	Unit
Burst Data transfer Rate (480Mbit/s)		60		MB/s
Sustained Sequential Read	1...2GB	28 ⁽¹⁾⁽²⁾	34 ⁽¹⁾	
	4GB	28 ⁽¹⁾⁽²⁾	36 ⁽¹⁾	
	8...16GB	25 ⁽¹⁾⁽²⁾	32 ⁽¹⁾	
Sustained Sequential Write	1...2GB	28 ⁽¹⁾⁽²⁾	34 ⁽¹⁾	
	4GB	26 ⁽¹⁾⁽²⁾	31 ⁽¹⁾	
	8...16GB	23 ⁽¹⁾⁽²⁾	28 ⁽¹⁾	
Random Read 4k	1...2GB	1200 ⁽¹⁾⁽²⁾	1400 ⁽¹⁾	IOPS
	4GB	1500 ⁽¹⁾⁽²⁾	1700 ⁽¹⁾	
	8...16GB	1500 ⁽¹⁾⁽²⁾	1700 ⁽¹⁾	
Random Write 4k	1...2GB	33 ⁽¹⁾⁽²⁾	40 ⁽¹⁾	
	4GB	16 ⁽¹⁾⁽²⁾	22 ⁽¹⁾	
	8...16GB	18 ⁽¹⁾⁽²⁾	25 ⁽¹⁾	

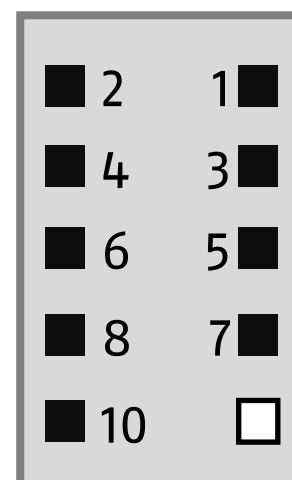
1) Effective speed varies with controller, number and type of flash, host, file size, file system and operating system
2) performance measured with Crystal Disk Mark performance test

6 Interface / Pin out

- USB-connector 10pin (2mm or 2.54mm pitch)
- USB 2.0 high speed interface, USB1.1 full speed compatible
- STD variation

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, Reset in

See also chapter (Standard form factors and hardware)



7 Electrical Specification

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Power Supply Voltage	V _{Bus}	-0.5	6.0	V
Voltage on D+ and D-	V _{Data}	-0.5	3.6	
Commercial Operating Temperature	T _A	0	70	°C
Industrial Operating Temperature		-40	85	

DC characteristics for High-Speed operation (T=25°C, V_{Bus}=5V or 3.3V)

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Supply Voltage (Standard)	V _{Bus}		3.1 ⁽¹⁾	3.3 or 5.00	5.25	V
Write current	I _{WR}	V _{Bus} =5.0V		100	120	mA
Read current	I _{RD}			70	100	
Idle current	I _{IDL}			45	60	
Suspend current	I _{CCS}			0.8	2.5	
High Speed Idle Level	V _{HSOI}	V _{Bus} =5.0V	-10		10	mV
High Speed Data Signaling LOW	V _{HSOL}	V _{Bus} =5.0V	-10		10	
High Speed Data Signaling HIGH	V _{HSOH}	V _{Bus} =5.0V	360		440	
Chirp J Level (differential)	V _{CHIRPJ}	V _{Bus} =5.0V	360		440	
Chirp K Level (differential)	V _{CHIRPK}	V _{Bus} =5.0V	-440		-360	

1) The U-400 devices can be supplied with 5V or with 3.3V.

DC characteristics for Full-Speed operation (T=25°C, V_{Bus}=5V or 3.3V)

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Supply Voltage (5V Type)	V _{Bus}		3.1 ⁽¹⁾	3.3 or 5.00	5.25	V
Write current	I _{WR}	V _{Bus} =5.0V		80	100	mA
Read current	I _{RD}			60	80	
Idle current	I _{IDL}			45	60	
Suspend current	I _{CCS}			0.8	2.5	
Input LOW Voltage	V _{IL}				0.8	V
Input HIGH Voltage	V _{IH}		2			
Output LOW Voltage	V _{OL}	R _L of 1.5kΩ to 3.6V			0.3	
Output HIGH Voltage	V _{OH}	R _L of 15kΩ to GND	2.8		3.6	
Output Signal Crossover Voltage	V _{CRS}		1.3		2.0	

1) The U-400 devices can be supplied with 5V or with 3.3V.

8 Environmental Specification and Reliability

8.1 Recommended operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Commercial Operating Temperature	T_A	0	25	70	°C
Industrial Operating Temperature		-40		85	
Storage Temperature	T_S	-40		100 ⁽¹⁾	

1) Data loss (Retention) is accelerated by high temperature (5 days@100°C is equivalent to 10 years@40°C, i.e. retention acceleration factor is 700)

8.2 Reliability

Parameter	Value
Endurance (SLC NAND Flash)	Up to 100,000 erases per flash block (JESD 218)
Data reliability (UBER)	<10 ⁻¹⁷ bits read
Error correction code (ECC)	correct up to 40-bit errors per 1kB
MTBF / MTF	> 3,000,000 hours
Data retention@40°C (JESD 218)	10 years @ 10% life time / 1 years @ life end
Durability	> 1,500 insertions / removals

8.3 Environmental – Shock, Vibration, and Humidity

Parameter	Value
Shock	1,500G Peak, 0.5m pulse duration, 6 axes (JESD22-B110 / B104)
Vibration	50G Peak, 20-2,000Hz, 0.75mm, 4 cycles per direction (X, Y and Z) (MIL-STD-883H M2007.3)
Humidity	85°C, 85% RH, V _{max} (JESD22-A101)
Free fall / Drop test	1.5m (IEC 60068-2-32)
Temperature Cycles	-40°C/+125°C 1000 cycles (JESD22-A104)
Hazardous gases	SO ₂ /H ₂ S 10 days (IEC 60068-42/43)

9 Compatibility & Compliance

- Configurable as boot-drive
- Standard fix Configuration (mounted as local drive, not as removable drive)
- Operating Systems:
 - Windows CE
 - Windows Server 2003 and 2008
 - Windows 10, 8, 7, Vista, XP, 2000, ME
 - Mac 9.0 and newer
 - Mac 8.6 (with driver) and newer
 - Linux 2.4 and newer
 - All USB mass-storage host systems (guarantee on all USB-IF certified systems)
- CE – EN 55022/55024
- FCC class B for information technology
- USB-IF high speed certified
- RoHS
- UL60950 compliant PCB
- WEEE

10 Applications

- Gaming
- Industrial PCs
- Point-Of-Sale (POS)
- Industrial Automation
- Networking Equipment
- Medical Equipment
- Data Recorders

11 Standard form factors and hardware

- Standard form factor of PCBs 36.8mm x 26.65mm
- Hole for mechanical fixture (optional grounded)
- Shield (connector Pin 10) grounded (optional NC)
- 2 additional holes
- LED for operation indication (optional no LED)
- 2 connector types
 - 2.54mm pitch, 7.5mm long standard
 - 2.00mm pitch, 3.6mm long low profile
- Component heights max. 1.6mm on connector side
max. 1.2mm on flash side

Figure 1: Mechanical Dimensions for 2.54mm connector (standard)

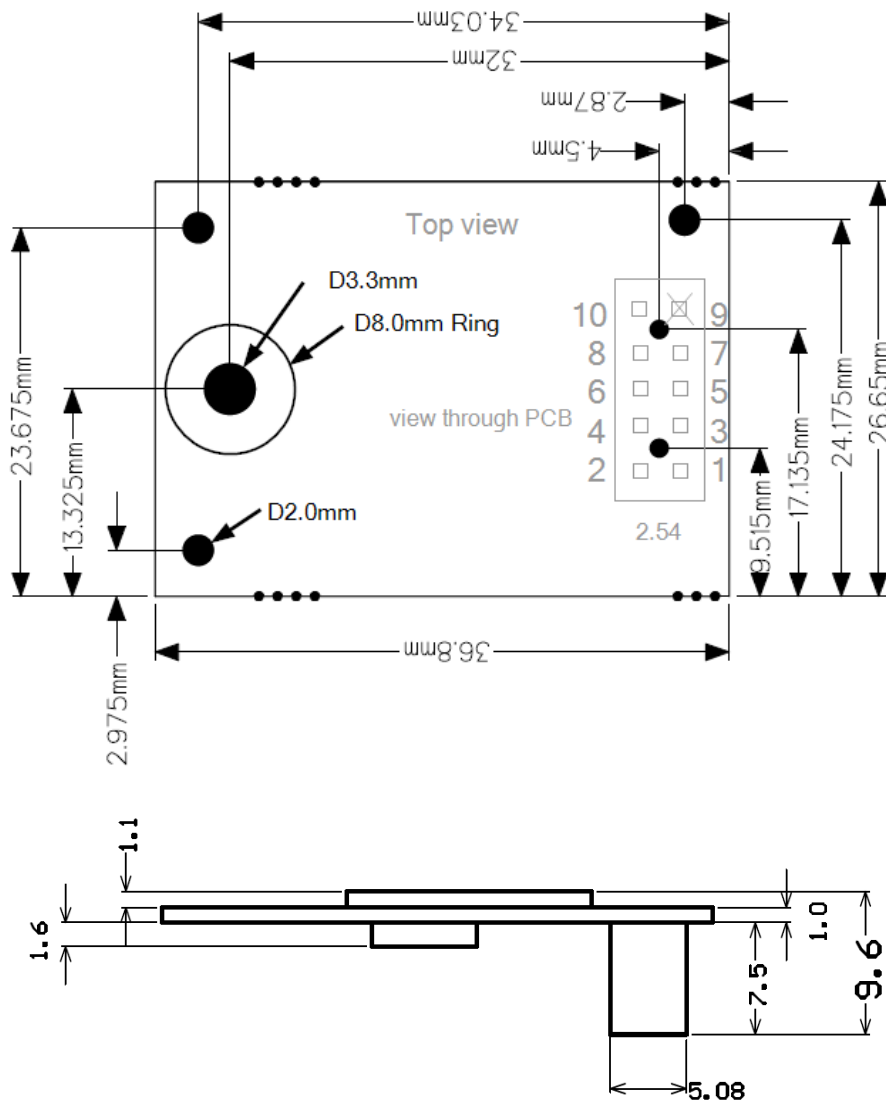
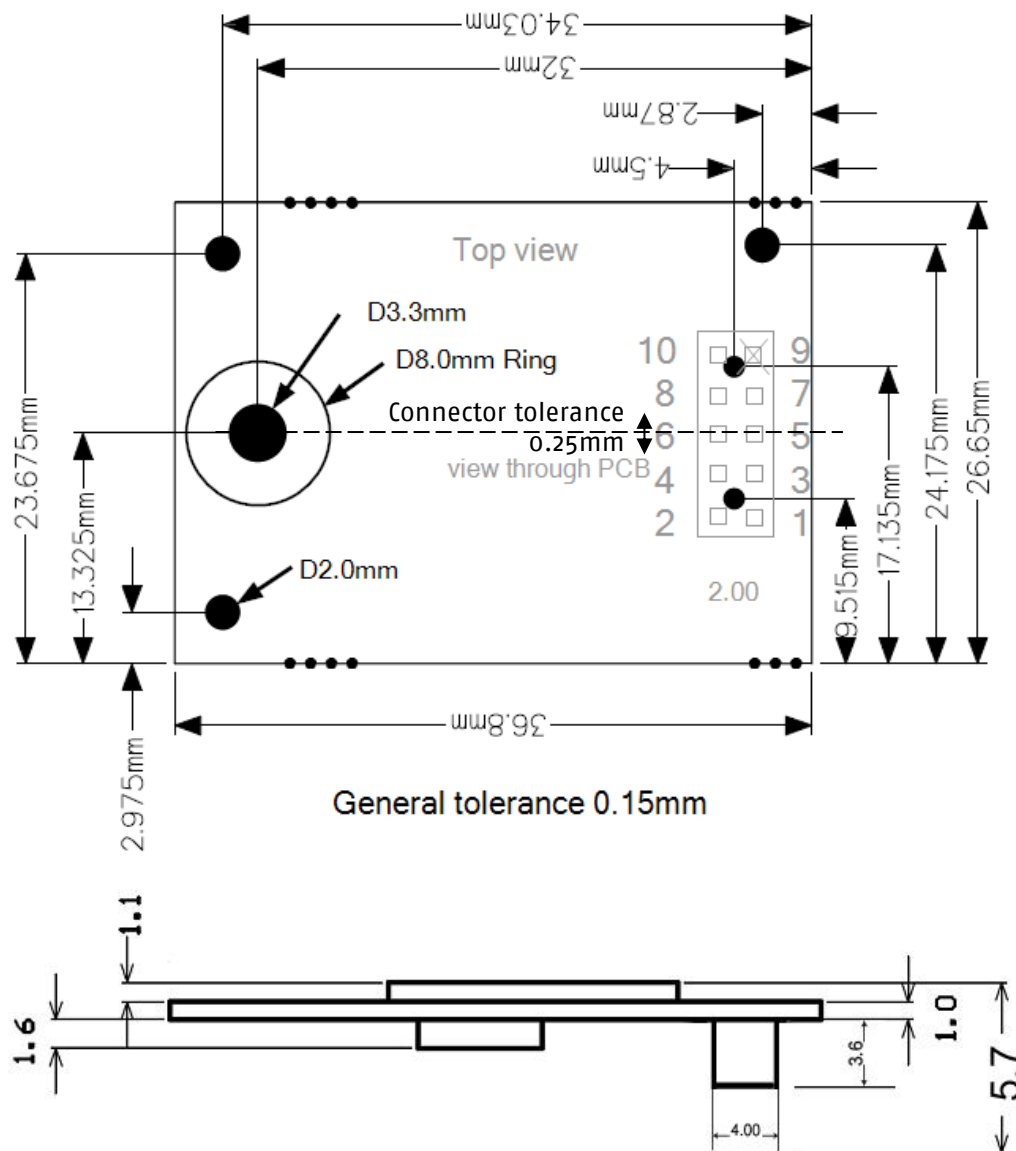


Figure 2: Mechanical Dimensions for 2.00mm connector (low profile)



Variations

Part number	Connector	Pin 9	Pin 10	Hole	LED
SFUIxxxxJgABxxx-t-xx-xfx-STD	2.54 mm	Key pin	Shield	NC	For operational indication
SFUIxxxxKgAB2xx-t-xx-xfx-STD	2.00 mm	Key pin	(NC on request)	(grounded on request)	(no LED on request)

g = hardware generation

t = temperature grade (C=0°C to 70°C and I=-40°C to +85°C)

f = firmware generation per product type

Figure 3: Component region on connector side (general tolerance $\pm 0.5\text{mm}$)

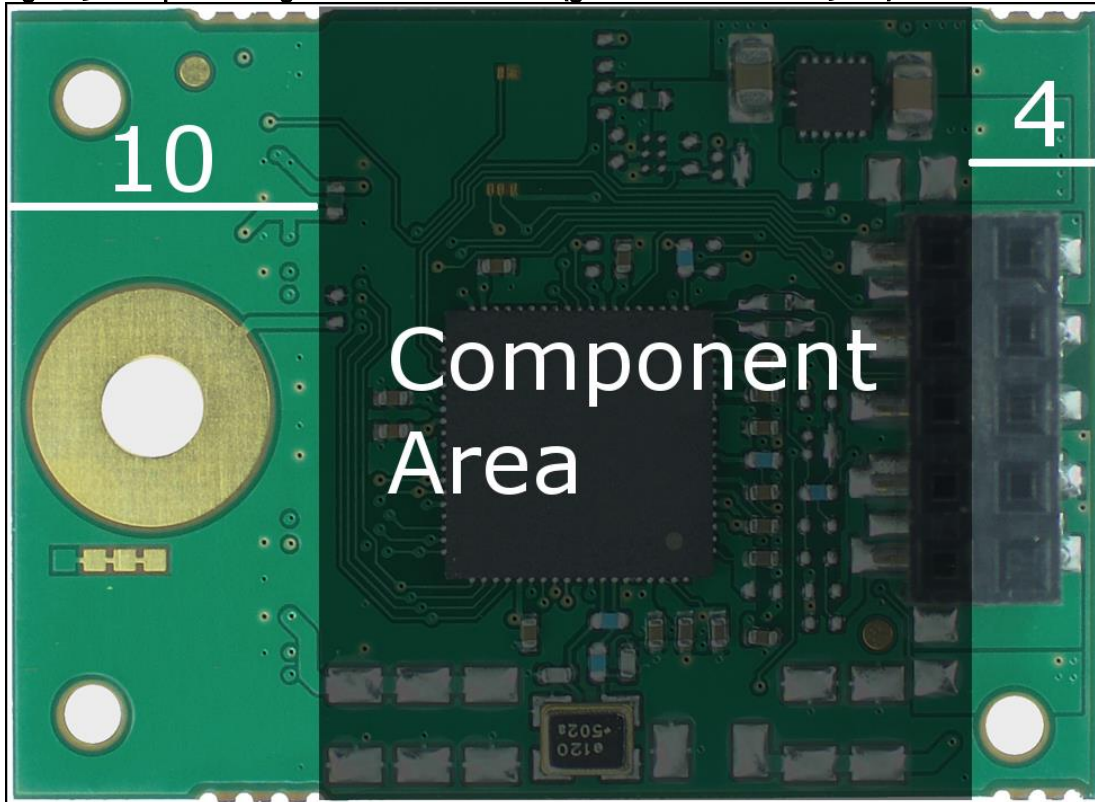
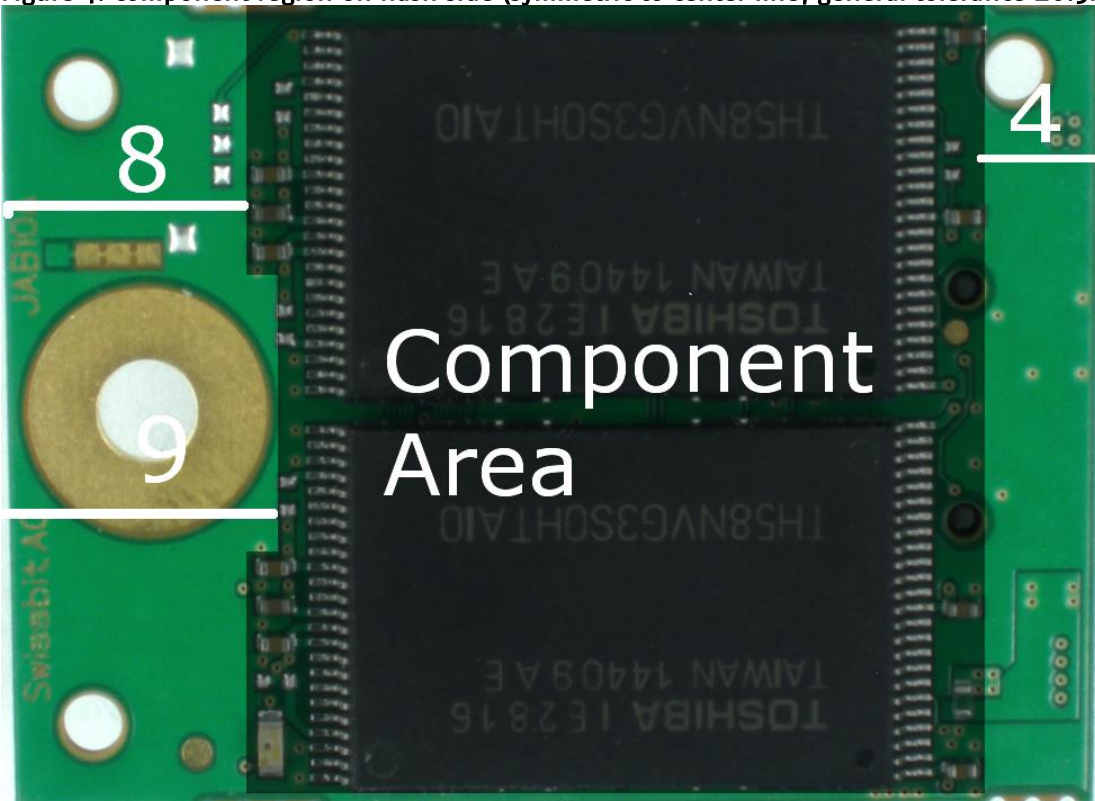


Figure 4: Component region on flash side (symmetric to center line, general tolerance $\pm 0.5\text{mm}$)



12 Best Practices

There are a number of best practices to reach the maximum life time.

12.1 Device Removal & Power Failure

User data can be lost or corrupted if power is interrupted while the UFD is writing data. To avoid data loss, it is necessary to avoid power interruption while the device is busy. This can be made sure by always using the host (e.g. Windows) shutdown mechanisms or by detaching the device in the operating system before unplugging it. Swissbit also offers an Application Note "Design-In Guide" that describes techniques to reduce data loss on power failure, if power failure absolutely can't be avoided.

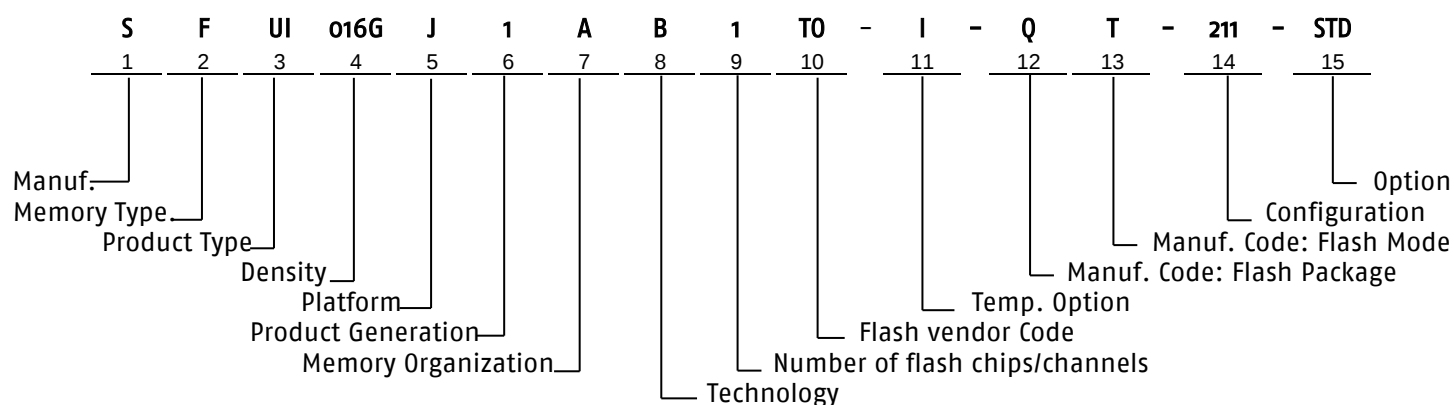
12.2 Lifetime end handling

If the flash reaches its end of life, the number of bad blocks will increase (bad flash blocks will be replaced with spare blocks). There exist different side effects with negative data influence by degraded flash cells. Sometimes bit errors can occur because of effects that are not immediately detected by the flash, e.g. effects like program disturb or read disturb, which means that the bad block recognition does not always prevent data loss. When the number of bit errors in a sector exceeds the ECC correcting capabilities, invalid (uncorrected) data cannot be read from the host. Because of these effects it is strongly recommended to replace devices that are nearing their end of life. One good indicator would be the current spare blocks should not be reducing below 5. It is in the responsibility of the system integrator to account for the flash usage. Swissbit offers support for calculating expected life time if the exact use case is provided (e.g. by providing low level [USB interface] write statistics).

For notes on reducing flash stress, Swissbit offers an Application Note called "Design-In Guide".

Please contact your sales channel for more information or send a mail to sales@swissbit.com.

13 Part Number Decoder



1. Manufacturer

Swissbit	S
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2. Memory Type

Flash	F
-------	---

3. Product Type

U-xxx USB Flash Drive Module (Internal)	UI
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4. Density

1 GB	1024
2 GB	2048
4 GB	4096
8 GB	8192
16 GB	016G

5. Platform

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

6. Product Generation

7. Memory Organization

x8	A
----	---

8. Technology

U-4xx technology	B
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9. Number of Flash chips

1 Flash	1
2 Flash	2

10. Flash Code

Toshiba	T0
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11. Temp. Option

Industrial Temp. Range -40°C to 85°C	I
Standard Temp. Range 0°C to 70°C	C

12. DIE Classification

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

13. PIN Mode

Normal nCE & R/nB	S
Dual nCE & Dual R/nB	T

14. UFD XYZ

X → Setting

Removable Drive	1
Fix Drive	2

Y → Firmware revision per product generation

Block Based Revision 1, 2, 3, ...	1,2,3...
durabit Revision 1, 2, 3, ...	A,B,C...

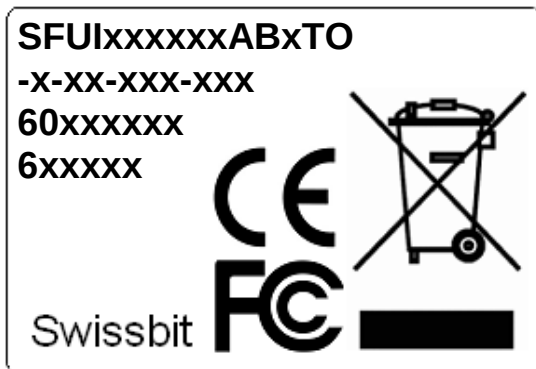
Z → Optional setting

default	1
pSLC (pseudoSLC)	P

15. Option

Swissbit / Standard 5V supply	STD
Customized version	XXX

14 Label



SFUIxxxxxxABxxx
-X-XX-XXX-XXX
60xxxxxx
6xxxxxx

Part Number

Lot Code
Type No.

15 Revision History

Document Revision History

Date	Revision	Description	Revision Detail
05-October-2015	1.00	Initial release	Doc. req. no. 0792
15-February-2016	1.01	2.00mm connector position tolerance added	Doc. req. no. 0963
27-February-2017	1.02	Added capacity specification and NAND flash technologies Update performance values, interface illustration, wording adjustment and removed RoHS, ACPEIP and WEEE decl.	Doc. req. no. 1568

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