

swissbit®

Product data sheet

Industrial USB Flash Drive

unitedCONTRAST II USB2.0 high speed

BU: Flash Products

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USB Flash Drive unitedCONTRAST II

512MByte to 16GByte

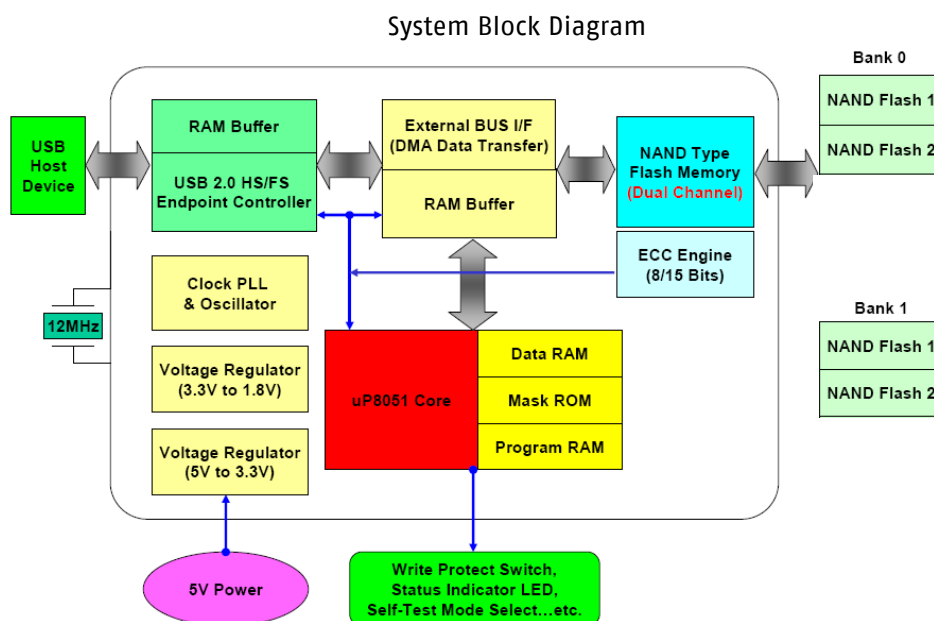
USB Flash Drive (UFD) provides non-volatile, solid-state storage in different design options, making it perfectly suited for OEM and industrial market. Swissbit uses high end USB 2.0 flash memory controller, providing high data reliability and endurance. The built-in BCH-ECC engine can correct up to 8 random bit errors per sector, while sophisticated wear leveling algorithms guarantee highest endurance.

USB Flash Drive is available with a standard USB 2.0 certified Type A connector. High performance, high reliability and industrial requirements make the USB Flash Drive the product of choice in OEM and industrial markets, such as embedded computing, networking equipment and industrial PCs.

Swissbit offers value-added services to OEM customers, such as customized form factors and test solutions, custom firmware, controlled Bill of Materials (BOM), customer-specific marking and inlays.

1 Feature summary

- Custom-designed, highly-integrated USB-Drive flash memory controller
 - Fully compliant with USB-Specification 2.0 (High-Speed, 480Mb/s burst)
 - Fully compliant with USB-Specification 1.1 (Full speed, 12Mb/s burst)
- High reliability
 - MTBF > 3,000,000 hours (SLC flash)
 - Error correction code (ECC)
 - Wear leveling
 - Data reliability: < 1 non-recoverable error per 10^{14} bits read (SLC Flash)
- Commercial and industrial temperature grade
- Plug&Play
- Bootable
- Removeable Drive
- LED indicator
- FAT32 format
- Unique serial number
- USB-IF high speed certified
- CE / FCC
- RoHS compliant
- WEEE



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3 Order Information

3.1 Standard products for Industrial and Commercial temperature range

Density	Part Number
512MB	SFU20512EgBP2xx-t-xx-1f1-STD
1GB	SFU21024EgBP2xx-t-xx-1f1-STD
2GB	SFU22048EgBP2xx-t-xx-1f1-STD
4GB	SFU24096EgBP2xx-t-xx-1f1-STD
8GB	SFU28192EgBP2xx-t-xx-1f1-STD
16GB	SFU216GBEgBP2xx-t-xx-1f1-STD

g = hardware generation

t = temperature range (C=0°C to 70°C, I=-40°C to +85°C)

f = firmware generation per product generation

Table 1: Product list for standard products

3.2 Offered options

- Customized logo
- Removable or fixed drive
- Customer specified strings and IDs
- FAT16, FAT32 format or customer file system, default FAT32
- Preload service
- CD partition
- Auto run option
- Other software tools for synchronization password detection on request
- Dongle functionality
- Secured area (password protected, API available)
- SDK for developers
- Industrial and Commercial Temperature range

Please ask our sales for more details and additional features.

4 System performance

Speed	High Speed mode (max)	Full Speed mode (max)	unit
Burst	480	12	Mbit/s
Read	32 ¹⁾	1.0	MByte/s
Write	23 ¹⁾	0.9	

¹⁾ measured speed in Chapter 11

Effective speed varies with controller, number and type of flash, host, file size, file system and operating system
The USB drive could be busy for max. 320ms during operation due to internal data organization.

5 Interface

- USB-A connector
- USB 2.0 high speed interface, USB1.1 compatible
- USB-IF high speed certified

Pin	Signal	Comment
1	V_Bus	Operating voltage
2	D-	Data signal pair
3	D+	
4	Gnd	Ground
Shield	Shield	should be connected with host shield

6 NAND Flash technologies

SLC and MLC flash

- Single-level-cell (SLC) flash, 1 bit (1 level) is stored in each memory cell
- Multi-level-cell (MLC) flash, 2 bit (3 level) are stored in each memory cell

Differences

	SLC	MLC ¹⁾	comment
Endurance	~100,000	~5,000	physical write/erase cycles
Write Performance	fast write	slow write	MLC write is more time consuming because of 4 states
Read Performance	fast read	fast read	MLC and SLC technology is similar in the read performance
Reliability	high	normal	errors are more likely, because the 4 states
Price	expensive	cheap	the same density can be stored in less silicon

¹⁾ Not recommended for OEM market or industrial applications

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 Full-Speed operation (T=25°C, V_Bus=5V)

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Supply Voltage	V_Bus		4.75	5.00	5.25	V
Operating current	I_CC	V_Bus=5.0V	60		90	mA
Suspend current	I_CCS		350		500	µA
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	

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

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
Supply Voltage	V _{Bus}		4.75	5.00	5.25	V
Operating current	I _{CC}	V _{Bus} =5.0V	80		120	mA
Suspend current	I _{CCS}		350		500	µA
High Speed Idle Level	V _{HSOI}		-10		10	mV
High Speed Data Signaling LOW	V _{HSOL}		-10		10	
High Speed Data Signaling HIGH	V _{HSOH}		360		440	
Chirp J Level (differential)	V _{CHIRPJ}		360		440	
Chirp K Level (differential)	V _{CHIRPK}		-440		-360	

- Low-power CMOS technology
- Suspend mode 500µA (max)
- Operation mode 120mA (max)
- Operation Voltage 5V (± 5%)
- Hot swappable

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	-50		100	

8.2 Reliability

Parameter	Value
Endurance (SLC NAND Flash)	2'000'000 cycles ¹⁾
Data reliability	1 in 10 ¹⁴ bits, read
Error correction code (ECC)	correct up to 8 random bit errors per sector
MTBF / MTTF	> 3,000,000 hours
Data retention	10 years @ 10% life time / 1 years @ life end
Durability	> 1500 insertions / removals

¹⁾ 100'000 program/erase cycles NAND Flash cell endurance / average file size written = 5% of device capacity (50MB for 1GB device)/no static data

8.3 Shock, Vibration, and Humidity

Parameter	Value
Shock	1500G Peak, 0.5m pulse duration, 5 pulses, 6 axes (JESD22-B110)
Vibration	20G Peak, 20-2000 Hz, 4 cycles per direction (X, Y and Z) (JESD22-B103)
Humidity	85°C, 85% RH, V _{max} for 500 hrs (JESD22-A101)

9 Compatibility & Compliance

- Configurable as boot-drive
- Operating Systems:
 - Windows 7
 - Windows Vista
 - WinXP, 2000, ME
 - Win98 SE (driver available)
 - Mac 9.0 and newer
 - Mac 8.6 (with driver) and newer
 - Linux 2.4 and newer
 - Windows CE
 - 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 Performance reference

11.1 Test Equipment

Mainboard:	ASUS P5LD2	CPU:	Intel Core 2 4400 @2.0GHz
OS:	Win XP Prof. V.2002 SP3	Testsoftware:	Swissbit FlashTest 1.2.1/1.3.0 / Script „Performance“
Firmware:	Depends on generation	Prod.Tool:	SPT 1.0.22/23 SDK: 1.0.24
Filesystem:	Low level		

11.2 Performance results

The effective speed depends on Controller, Number and type of flash, File system and file size, Test tool & OS.

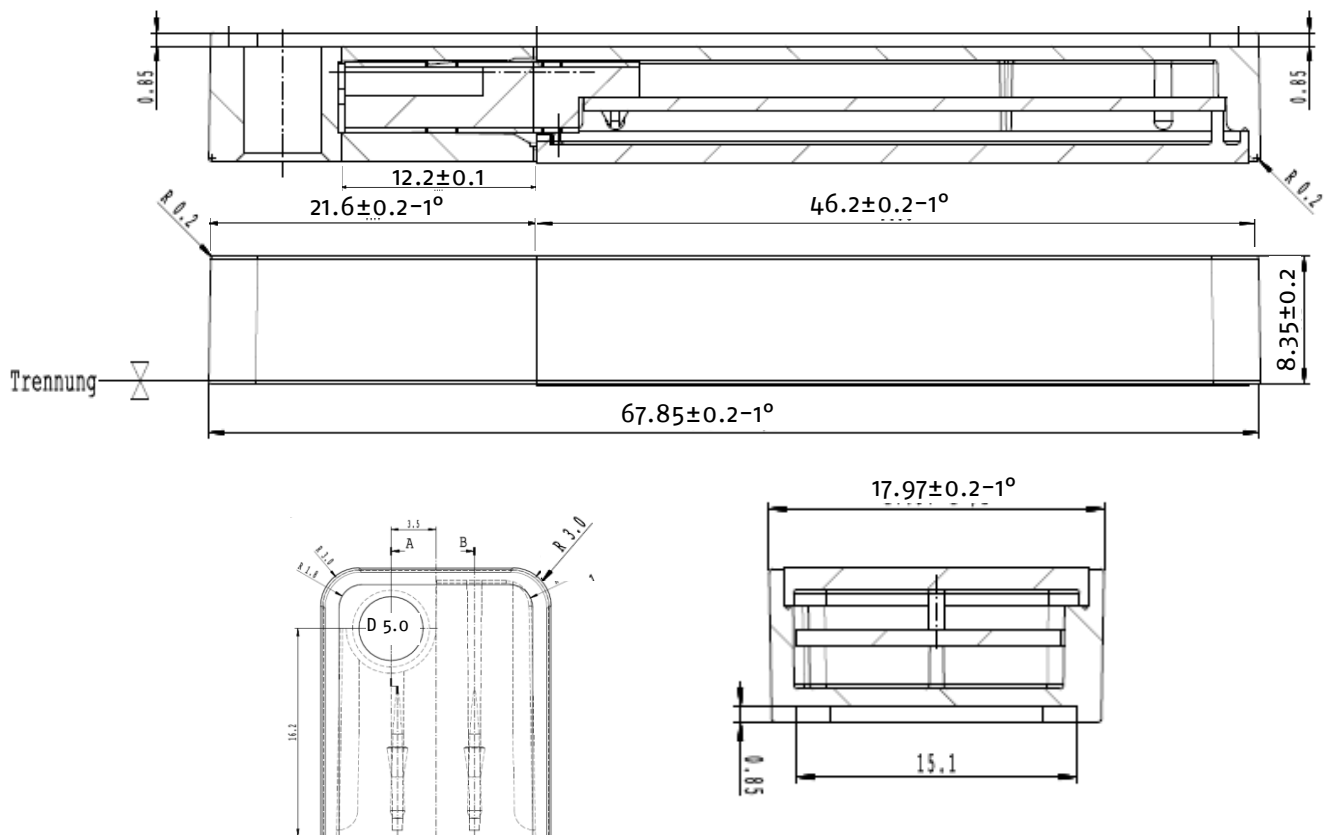
	Random Read [kByte/sec]		Random Write [kByte/sec]	
	8 sector - 4kByte	128 sector - 64kByte	8 sector - 4kByte	128 sector - 64kByte
SFU*0512E*BP2TO-t-MS*	~6700	~25800	~120	~2000
SFU*1024E*BP2TO-t-MS*	~5800	~24800	~100	~1600
SFU*2048E*BP2TO-t-MS*	~5800	~26500	~75	~1200
SFU*4096E*BP2TO-t-DT*	~5800	~26000	~75	~1150
SFU*8192E*BP2TO-t-QT*	~5400	~25900	~75	~1150
SFU*16GBE*BP2MT-t-QT*	~5100	~26000	~22	~390

	Sequential Read [kByte/sec]		Sequential Write [kByte/sec]	
	8 sector - 4kByte	128 sector - 64kByte	8 sector - 4kByte	128 sector - 64kByte
SFU*0512E*BP2TO-t-MS*	~8700	~26800	~6200	~9800
SFU*1024E*BP2TO-t-MS*	~7800	~26200	~6500	~8100
SFU*2048E*BP2TO-t-MS*	~8100	~28500	~4600	~11800
SFU*4096E*BP2TO-t-DT*	~8100	~28700	~4600	~20800
SFU*8192E*BP2TO-t-QT*	~8000	~28900	~4600	~20800
SFU*16GBE*BP2MT-t-QT*	~6600	~27000	~2900	~22000

12 Design & Housing



general tolerance $\pm 0.2\text{mm}$



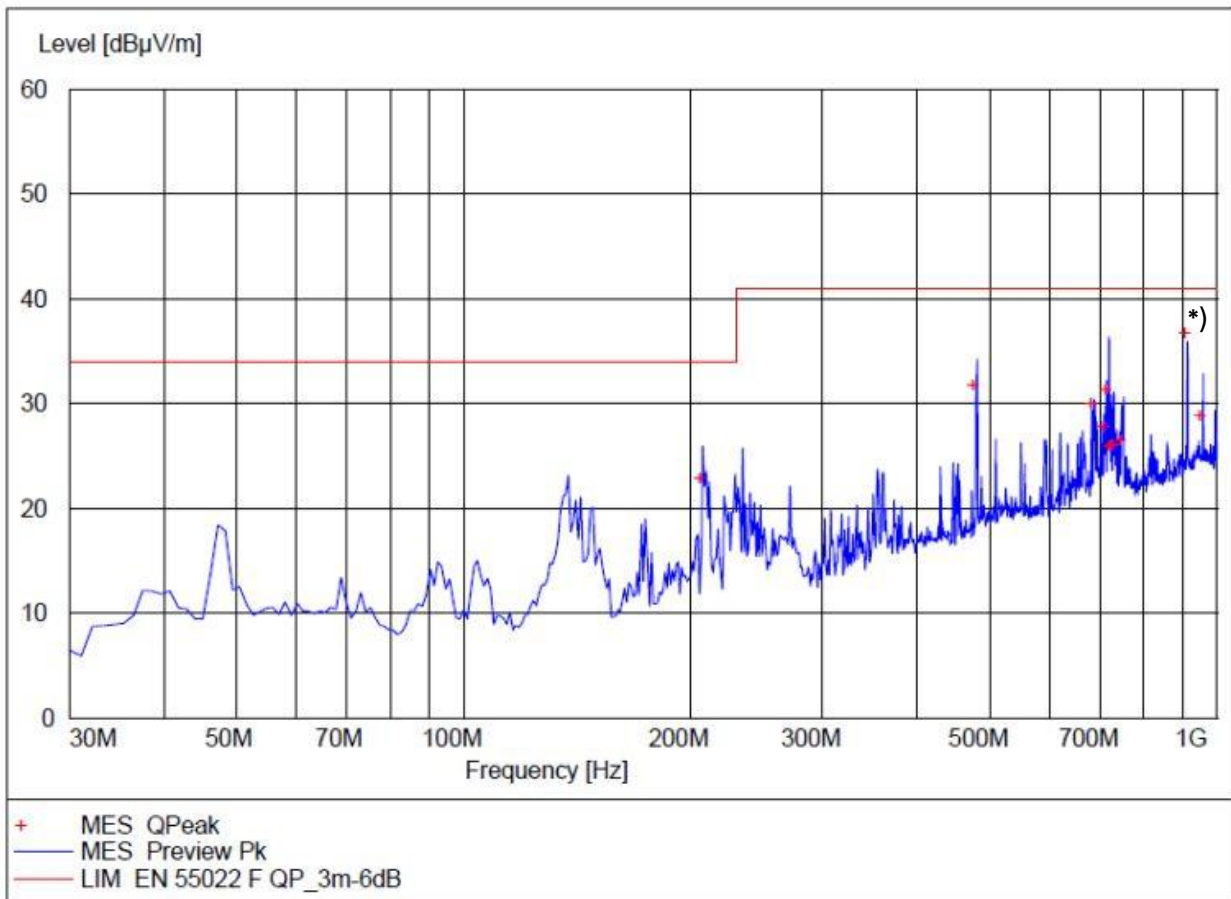
13 EMI Test results in 3m Chamber TBD

according to EN 55022 class B

EUT: UNCO 3252 modified w/o L6 + 100nF
 Manufacturer: Swissbit
 Operating Condition: EMC.exe FDD test
 Test Site: Fujitsu Technology Solutions Augsburg (3m CDC)
 Operator: F. Maerkl
 Configuration: Celsius R550, only stick connected
 Comment: on front usb port
 Start of Test: 10.12.2009 / 08:24:47

SCAN TABLE: "scan"

Short Description:			"BILOG" Antenna			
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
10.0 MHz	30.0 MHz	5.0 kHz	MaxPeak	50.0 ms	10 kHz	CBL 6140
30.0 MHz	1.0 GHz	30.0 kHz	MaxPeak	50.0 ms	120 kHz	CBL 6140



*) 920MHz signal from the Host-System, not from the USB-Stick

Combined measurement with CFAST cards

Test Result 1-6GHz

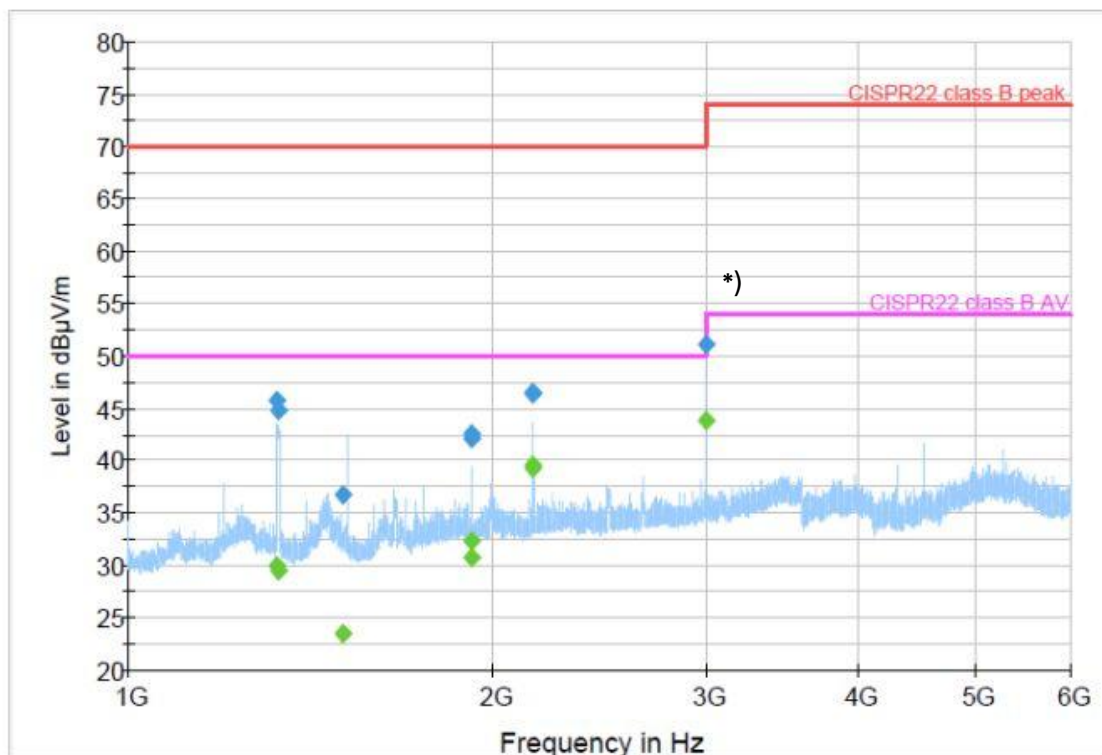
Common Information

Test Description:	Radiated Emission test
Operating Conditions:	EMC.exe, Fdd-,disk-test
Operator Name:	F.Märkl
Test configuration:	Celsius R550, ms,kb, mon, hdd

EUT Information

Description:	
Category:	Flash Memorymedia
Product:	Memorystick, CF cards
Model:	DUT2,3,4 Unco3252, CFAST w. w/o. case internal and sata CR)
Detail:	UnCo 3252 with usb cable (0,8m)
Manufacturer:	Swissbit AG
Date:	05.11.2009

CISPR22 1-6GHz ESU classB



*) 3GHz signal from SATA interface, but not from USB-Stick

13.1 ESD Test results

2.1 Test set-up: basic system configuration					
Test level voltage (kV)	Air discharge	Contact discharge			Comments
		Direct	Indirect		
			vertical	horizontal	
1					
2					
4	A	A	A	A	
5		A	A	A	
6	A	-	-	-	
8	A	-	-	-	
9	A	-	-	-	

Tested with workstation FTS Celsius R550
 UnCo 3252 2GB
 UnCo 3252 was modified. Reset Pin (C21) is with 100nF assembled.
 Bead L6 was removed

Test specification to EN 55024: 1998

Contact discharge to connector and indirect (tested with and without cable at a PC)

Testlevel to EN 61000-4-2: 1995: 4kV

Upto ±5kV tested Criteria A no influence

Air discharge to non conductive surfaces

Testlevel to EN 61000-4-2: 1995: 8kV

Upto ±9kV tested Criteria A no influence, discharge is not possible due to isolation

14 RoHS and WEEE update from Swissbit

Dear Valued Customer,

We at Swissbit place great value on the environment and thus pay close attention to the diverse aspects of manufacturing environmentally and health friendly products. The European Parliament and the Council of the European Union have published two Directives defining a European standard for environmental protection. This states that CompactFlash Cards must comply with both Directives in order for them to be sold on the European market:

- **RoHS** – Restriction of Hazardous Substances
- **WEEE** – Waste Electrical and Electronic Equipment

Swissbit would like to take this opportunity to inform our customers about the measures we have implemented to adapt all our products to the European norms.

What is the WEEE Directive (2012/19/EC)?

The Directive covers the following points:

- Prevention of WEEE
- Recovery, recycling and other measures leading to a minimization of wastage of electronic and electrical equipment
- Improvement in the quality of environmental performance of all operators involved in the EEE life cycle, as well as measures to incorporate those involved at the EEE waste disposal points

What are the key elements?

The WEEE Directive covers the following responsibilities on the part of producers:

Producers must draft a disposal or recovery scheme to dispose of EEE correctly.
Producers must be registered as producers in the country in which they distribute the goods.
They must also supply and publish information about the EEE categories.
Producers are obliged to finance the collection, treatment and disposal of WEEE.

Inclusion of WEEE logos on devices

In reference to the Directive, the WEEE logo must be printed directly on all devices that have sufficient space.
«In exceptional cases where this is necessary because of the size of the product, the symbol of the WEEE Directive shall be printed on the packaging, on the instructions of use and on the warranty»
(WEEE Directive 2012/19/EC)

When does the WEEE Directive take effect?

The Directive came into effect internationally on July 04, 2012.

What is RoHS (2011/65/EU)?

The goals of the Directive are to:

- Place less of a burden on human health and to protect the environment by restricting the use of hazardous substances in new electrical and electronic devices
- To support the WEEE Directive (see above)

RoHS enforces the restriction of the following 6 hazardous substances in electronic and electrical devices:

- Lead (Pb) – no more than 0.1% by weight in homogeneous materials
- Mercury (Hg) – no more than 0.1% by weight in homogeneous materials
- Cadmium (Cd) – no more than 0.01% by weight in homogeneous materials
- Chromium (Cr6+) – no more than 0.1% by weight in homogeneous materials
- PBB, PBDE – no more than 0.1% by weight in homogeneous materials

Swissbit is obliged to minimize the hazardous substances in the products.

According to part of the Directive, manufacturers are obliged to make a self-declaration for all devices with RoHS. Swissbit carried out intensive tests to comply with the self-declaration. We have also already taken steps to have the analyses of the individual components guaranteed by third-party companies.

Swissbit carried out the following steps during the year with the goal of offering our customers products that are fully compliant with the RoHS Directive.

- **Preparing all far-reaching directives, logistical enhancements and alternatives regarding the full understanding and introduction of the RoHS Directive's standards**
- **Checking the components and raw materials:**
 - Replacing non-RoHS-compliant components and raw materials in the supply chain
 - Cooperating closely with suppliers regarding the certification of all components and raw materials used by Swissbit
- **Modifying the manufacturing processes and procedures**
 - Successfully adapting and optimizing the new management-free integration process in the supply chain
 - Updating existing production procedures and introducing the new procedures to support the integration process and the sorting of materials
- **Carrying out the quality process**
 - Performing detailed function and safety tests to ensure the continuous high quality of the Swissbit product line

When does the RoHS Directive take effect?

As of June 08, 2011 only new electrical and electronic devices with approved quantities of RoHS will be put on the market.

When will Swissbit be offering RoHS-approved products?

Swissbit's RoHS-approved products are available now. Please contact your Swissbit contact person to find out more about exchanging your existing products for RoHS-compliant devices.

For your attention

We understand that packaging and accessories are not EEE material and are therefore not subject to the WEEE or RoHS Directives.

Contact details:

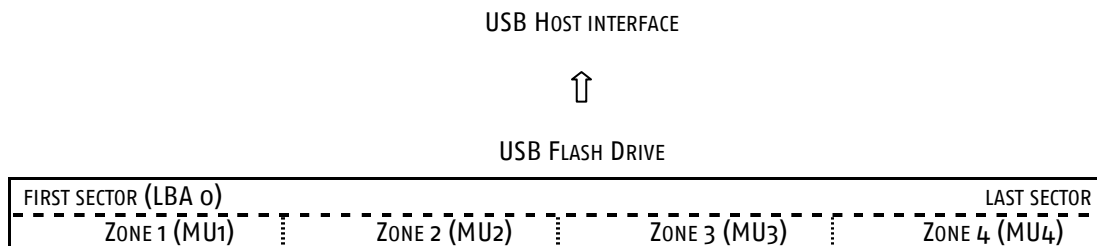
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15 Best Practices

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

15.1 Wear Leveling and Spare Block Management

The device uses zone based flash management (zones also called as management units). This means that the user accessible data range (LBA area) is evenly divided into multiple zones, which are all managed separately for both, wear leveling (dynamic and static) and for spare & bad block management.



*MU=Management Unit

The number of zones is depending on the device capacity and can be read out using the Swissbit Life Time Monitoring tool. The tool will show the number of available spare blocks per management unit (zone). The devices need a minimum number of 2 spare blocks per unit to work with. If the first unit reaches this value, the device will be write-protected by the firmware.

To get optimal life time, write accesses must be evenly distributed over all zones. This can, for example, be achieved by using multiple partitions and by then distributing the data between the partitions.

Spare block status: **PASS**  100%

Spare block table:

	Initial	Current
Unit 1	13	13
Unit 2	14	14
Total	27	27

Minimum Spare / Unit: 2

15.1 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.

15.2 Lifetime end handling

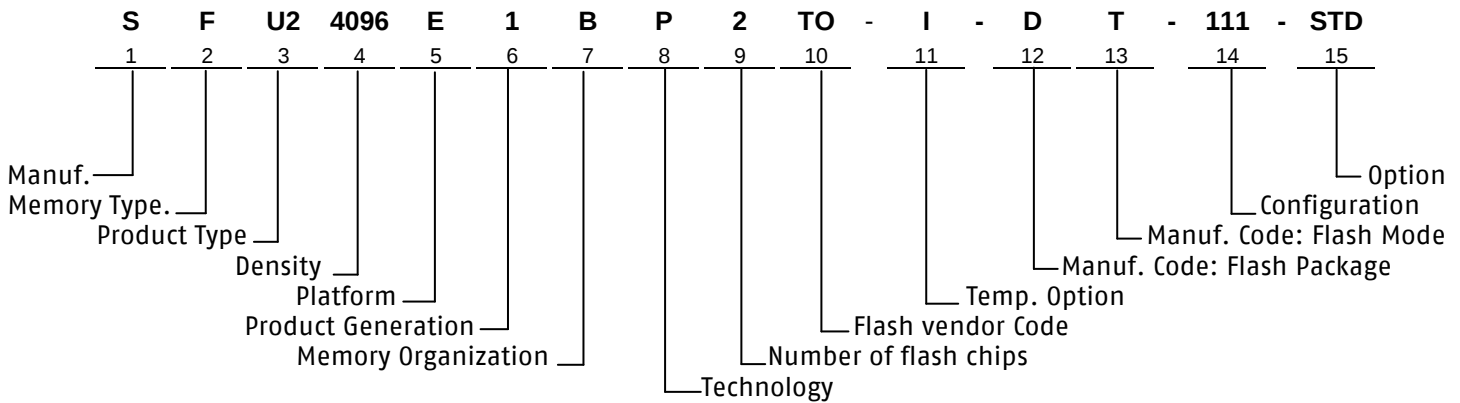
If the flash reaches its end of life, the number of bad blocks will increase (bad flash blocks will be replaced with spare blocks). There exist different side effects with negative data influence by degraded flash cells. Sometimes bit errors can occur because of effects that are not immediately detected 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 can be reported back to 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 per unit should not be reducing below 5. It is in the responsibility of the system integrator to account for the flash usage per zone. 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.

16 Part Number Decoder



16.1 Manufacturer

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

16.2 Memory Type

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

16.3 Product Type

USB Flash Drive 2.0	U2
---------------------	----

16.4 Density

512 MB	0512
1 GB	1024
2 GB	2048
4 GB	4096
8 GB	8192
16 GB	16GB

16.5 Platform

unitedCONTRAST	E
----------------	---

16.6 Product Generation

16.7 Memory Organization

x8	B
----	---

16.8 Technology

unitedCONTRAST II	P
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16.9 Number of Flash Chip / channels

1 Flash	1
2 Flash	2

16.10 Flash Code

SAMSUNG	SA
TOSHIBA	TO
Micron	MT

16.11 Temp. Option

Industrial Temp. Range -40°C to 85°C	I
Industrial Temp. Range -25°C to 85°C	E
Standard Temp. Range 0°C to 70°C	C

16.12 DIE Classification

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

16.13 PIN Mode

Normal nCE & R/nB	o/S
Dual nCE & Dual R/nB	1/T

16.14 UFD XYZ

X → Setting

Removable	1
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Y → Firmware revision per product generation

Revision 1	1
Revision 2	2
Revision 3	3

Z → Optional setting

default	1
---------	---

16.15 Option

Swissbit / Standard	STD
Customized	XXX

17 Revision History

Date	Revision	Revision Details
11-January-2010	1.00	First release
28-October-2010	1.10	General part numbers update, speed values for Toshiba flash
18-June-2012	1.20	Add 16GB UFD, add best practices
29-August-2012	1.21	16GB Performance adapted (better data reliability)
18-December-2012	1.30	New CE Declaration
07-April-2014	1.40	Corrected performance values and added 512MB data, added FW rev. 3 for 16GB and removed CE declaration

Table 2: Document Revision History

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