

Revision History

Rev	Date	Details
A	October 14, 2008	New release of Short and Legacy eUSB Spec with SM325AC controller
B	December 14, 2009	Update to Geometry Table

SMART eUSB Drive

1.0 General Description

1.1 Overview

The SMART INDUSTRIAL GRADE eUSB Drive is a robust “SLC” flash based hard drive designed for use as the main boot and storage device for embedded systems. The small form factor, low power consumption and fast access time are important advantages a SMART eUSB Drive has over traditional hard drives. The drive uses a USB 2.0 High Speed serial link providing a simple two wire signaling interface to the host.

The SMART eUSB Drive is available in sizes up to 16GB, Commercial or Industrial temperature, and 5V or 3.3V power. The drive is capable of sustained read speeds up to 35MB/s and write speeds up to 24MB/s. The time to access a random location is typically less than 1 ms for the drive.

1.2 Features

- Universal Serial Bus 2.0 (Hi-Speed USB) compatible
- 2 wire small form factor USB interface to host
- Industry standard header, or low profile stacking header for connecting to the host
- Read Speed up to 35 MB/s and write Speed up to 24 MB/s
- Capacity range from 256GB to 16GB
- BCH Error Correction Code - corrects up to 8 bit errors per 512 byte sector
- Low power Dissipation- less than .45W active (.68W for 5V version) and less than 1mW standby
- Dynamic and Static Wear Leveling
- Commercial Temp range 0° C to 70°
- Industrial Temp range -40° C to 85°
- Firmware upgradeable via USB bus
- Support USB Mass Storage Class requirements for Bootability
- Remote Write Protect and drive Reset Control options available
- Life Monitoring (Vendor Commands)
- Descriptors programmed into 256 Bytes of Attribute Memory

1.3 Ordering Information

SMART Legacy Standard Connector (.385in high)									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED52L256G1	5	Legacy	256MB	1Gb	2	31	12	.4	80
SG9ED52L512G2	5	Legacy	512MB	2Gb	2	31	17	.4	90
SG9ED52L1GG4	5	Legacy	1GB	4Gb	2	30	17	.5	100
SG9ED52L2GGD	5	Legacy	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED52L2GG9	5	Legacy	2GB	8Gb	2	33	17	.6	100
SG9ED52L4GGC	5	Legacy	4GB	16Gb, 4K	2	32	17	.6	110
SG9ED52L4GGA	5	Legacy	4GB	16Gb	2	32	24	.6	110
SG9ED52L8GGB	5	Legacy	8GB	32Gb, 4K	2	35	15	.6	110
SG9ED52L16GGB	5	Legacy	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110
SMART Legacy Low Profile Connector (.290in high)									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED52U256G1	5	Legacy Low Profile	256MB	1Gb	2	31	12	.4	80
SG9ED52U512G2	5	Legacy Low Profile	512MB	2Gb	2	31	17	.4	90
SG9ED52U1GG4	5	Legacy Low Profile	1GB	4Gb	2	30	17	.5	100
SG9ED52U2GGD	5	Legacy Low Profile	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED52U2GG9	5	Legacy Low Profile	2GB	8Gb	2	33	17	.6	100
SG9ED52U4GGA	5	Legacy Low Profile	4GB	16Gb	2	32	24	.6	110
SG9ED52U4GGC	5	Legacy Low Profile	4GB	16Gb, 4K	2	32	17	.6	110
SG9ED52U8GGB	5	Legacy Low Profile	8GB	32Gb, 4K	2	35	15	.6	110
SG9ED52U16GGB	5	Legacy Low Profile	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110

1.3 Ordering Information Continued

SMART Legacy 2mm Connector (.144in high)									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED52M256G1	5	Legacy 2mm	256MB	1Gb	2	31	12	.4	80
SG9ED52M512G2	5	Legacy 2mm	512MB	2Gb	2	31	17	.4	90
SG9ED52M1GG4	5	Legacy 2mm	1GB	4Gb	2	30	17	.5	100
SG9ED52M2GGD	5	Legacy 2mm	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED52M2GG9	5	Legacy 2mm	2GB	8Gb	2	33	17	.6	100
SG9ED52M4GGC	5	Legacy 2mm	4GB	16Gb, 4K	2	32	17	.6	110
SG9ED52M4GGA	5	Legacy 2mm	4GB	16Gb	2	32	24	.6	110
SG9ED52M8GGB	5	Legacy 2mm	8GB	32Gb, 4K	2	35	15	.6	110
SG9ED52M16GGB	5	Legacy 2mm	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110

1.3 Ordering Information Continued

SMART Stacking Top 9-Pin Locking Connector									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED32T256G1	3.3	Stacking-Top	256MB	1Gb	2	31	12	.4	80
SG9ED32T512G2	3.3	Stacking-Top	512MB	2Gb	2	31	17	.4	90
SG9ED32T1GG4	3.3	Stacking-Top	1GB	4Gb	2	30	17	.5	100
SG9ED32T2GGD	3.3	Stacking-Top	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED32T2GG9	3.3	Stacking-Top	2GB	8Gb	2	33	17	.6	100
SG9ED32T4GGC	3.3	Stacking-Top	4GB	16Gb, 4K	2	32	17	.6	110
SG9ED32T4GGA	3.3	Stacking-Top	4GB	16Gb	2	32	24	.6	110
SG9ED32T8GGB	3.3	Stacking-Top	8GB	32Gb, 4K	2	35	15	.6	110
SG9ED32T16GGB	3.3	Stacking-Top	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110
SMART Stacking Bottom 9-pin Locking Connector									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED32B256G1	3.3	Stacking-Bot	256MB	1Gb	2	31	12	.4	80
SG9ED32B512G2	3.3	Stacking-Bot	512MB	2Gb	2	31	17	.4	90
SG9ED32B1GG4	3.3	Stacking-Bot	1GB	4Gb	2	30	17	.5	100
SG9ED32B2GGD	3.3	Stacking-Bot	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED32B2GG9	3.3	Stacking-Bot	2GB	8Gb	2	33	17	.6	100
SG9ED32B4GGC	3.3	Stacking-Bot	4GB	16Gb, 4K	2	32	17	.6	110
SG9ED32B4GGA	3.3	Stacking-Bot	4GB	16Gb	2	32	24	.6	110
SG9ED32B8GGB	3.3	Stacking-Bot	8GB	32Gb, 4K	2	33	15	.6	110
SG9ED32B16GGB	3.3	Stacking-Bot	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110

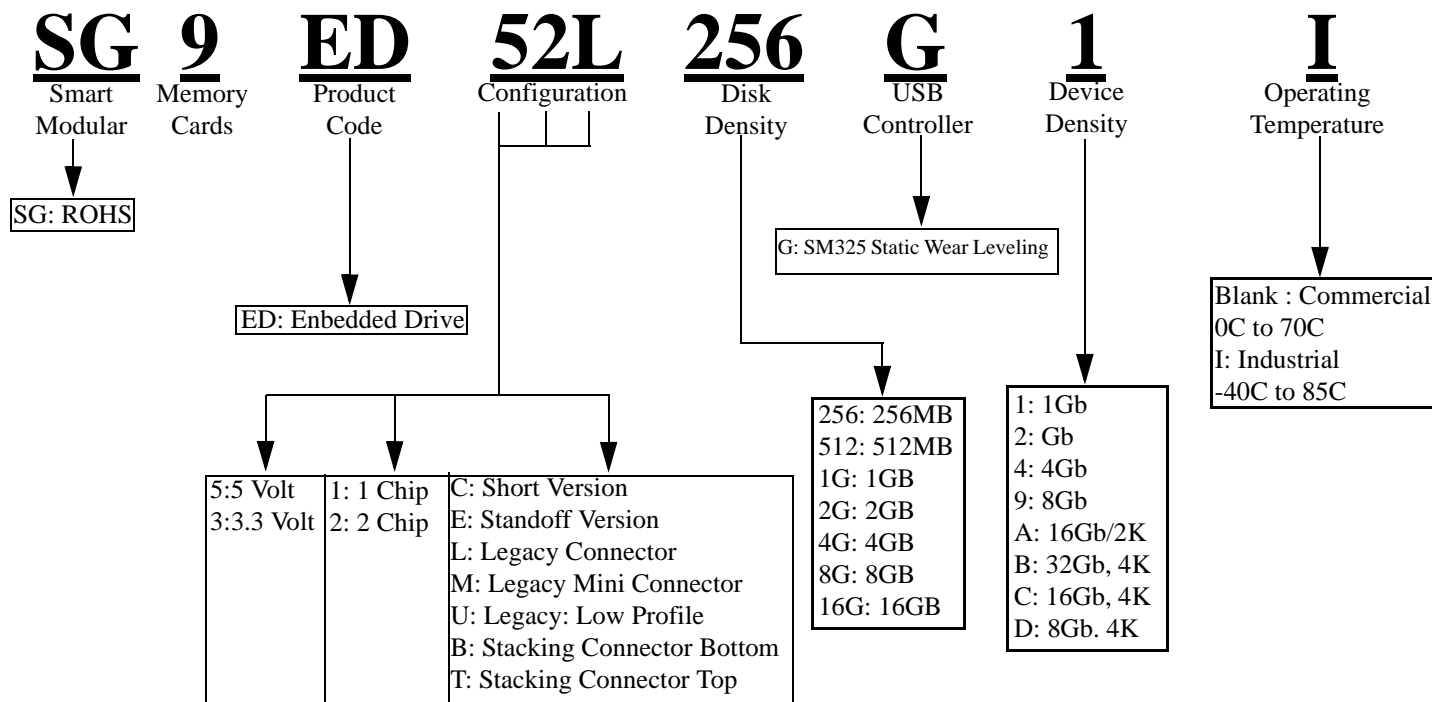
1.3 Ordering Information Continued

SMART Short eUSB With Standoff Connector									
Part Number	Supply Voltage	Connector	Physical Capacity	Chip Density	Chip Quantity	Read Speed (MB/s)	Write Speed (MB/s)	Random Access Time	Typ. Write Current
SG9ED31E256G1	3.3	Standoff eUSB	256MB	1Gb	2	31	12	.4	80
SG9ED31E512G4	3.3	Standoff eUSB	512MB	4Gb	1	18	10	.6	90
SG9ED32E512G2	3.3	Standoff eUSB	512MB	2Gb	2	31	17	.4	90
SG9ED32E1GG4	3.3	Standoff eUSB	1GB	4Gb	2	30	17	.5	100
SG9ED32E2GGD	3.3	Standoff eUSB	2GB	8Gb, 4K	2	33	17	.5	100
SG9ED32E2GG9	3.3	Standoff eUSB	2GB	8Gb	2	33	17	.6	100
SG9ED32E4GGC	3.3	Standoff eUSB	4GB	16Gb, 4K	2	35	15	.6	110
SG9ED32E4GGA	3.3	Standoff eUSB	4GB	16Gb	2	32	24	.6	110
SG9ED32E8GGB	3.3	Standoff eUSB	8GB	32Gb	2	32	15	.6	110
SG9ED32E16GGB	3.3	Standoff eUSB	16GB	32Gb, 4K Stacked	2	28.6	15	.8	110

1.3.1 Part Number Geometry

Page Size	Part Number	Drive Capacity	Unformatted Capacity	Cylinders	Heads	Sectors Track	Maximum LBA
2K/PG Flash	SG9EDxxx256G1	256MB	256,900,608	978	16	32	5017759
	SG9EDxxx512G2	512MB	513,801,728	995	16	63	1003519
	SG9EDxxx1GG4	1GB	1,027,603,968	1991	16	63	2007039
	SG9EDxxx2GG9	2GB	2,055,208,448	4072	16	63	4014079
	SG9EDxxx4GGA	4GB	4,110,417,408	7964	16	63	8028159
4K/PG Flash	SG9EDxxx2GGD	2GB	2,013,265,408	3900	16	63	3932159
	SG9EDxxx4GGC	4GB	4,026,531,328	7801	16	63	7864319
	SG9EDxxx8GGB	8GB	8,052,129,792	15602	16	63	15728639
	SG9EDxxx16GGB	16GB	16,104,259,584	16383*	16	63	31457279

*CHS Not reported at this capacity

Part Number Decoder


1.4 Device Operational Characteristics

1.4.1 Transfer Rates .

2 Chip Solution

- Write Data Transfer Rate 24MB/s (2kp 4GB drive)
- Read Data Transfer Rate 35MB/s (2kp 4GB drive)
- Host Interface Speed 60MB/s

(Refer to chart on page 3 for performance of other capacities)

1.4.2 Reliability

- MTBF >6,000,000 Hours
- Write/Erase >2M Cycles

1.4.3 Power Requirements

(All listed values are typical based on highest power drive configuration . Refer to chart on page 3 for active current requirements of other capacities)

2 Chip Solution

- VCC 5.0V±5%; 3.3V±10%
- Idle Current 50mA
- Write Current 130mA
- Standby Current 2mA

1.4.4 Environmental Characteristics

- Operating temperature 0°C to +70°C (Commercial)
-40°C to +85°C (Industrial)
- Storage temperature -55°C to +150°C
- Humidity 70% to 85%
- Shock 80G max
- Vibration 1.12 grms (3 to 500 Hz)
- Altitude 3000 m

1.4 Device Operational Characteristics Continued

1.4.5 Physical Dimensions

	<u>Legacy Connector</u>	<u>Stacking Connector</u>	<u>Legacy 2mm</u>
• Length PCB	1.36 in. (34.54mm)	1.65 in. (41.91mm)	1.45 in. (36.9mm)
• Width PCB	0.99 in. (25.15mm)	.906 in. (23.00mm)	1.05 in. (26.6mm)
• Mounted Height	0.591 in (15.02mm) <i>(Standard)</i> 0.381 in (9.68mm) <i>(Low Profile)</i>	0.277in. (7.04mm) <i>(Single)</i> 0.468in. (11.8mm) <i>(Double)</i>	0.24in (6.0mm)

1.4.6 Physical Dimensions Short eUSB

	<u>Short eUSB W/Standoff</u>
• Length	1.496 in. (38mm)
• Width	0.906 in. (23mm)
• Mounted Height	0.211in. (5.39mm)

1.5 MTBF Information

SMART Modular Reliability Modeling

Product reliability is based upon several key factors. Every semiconductor component manufacturer publishes a “reliability report” associated with each component. There are several means of reporting and representing these reliability statistics within the industry standard formats. The two major formats of “product reliability” are the abbreviated terms of **MTBF** (Mean Time Between Failure, in hours) and the **FIT Rate** (Failures Per Billion hours). These two terms of reliability factors are the most commonly used within the Electronics Semiconductor Industry.

Reliability Models are based upon internal components specific to each product and will vary widely based upon the internal components technology family, and internal operating conditions for a given application. Reliability Modeling will extrapolate approximate product life-span calculations by utilizing known reliability factors from each component manufacturer, over a given temperature range and operating parameters.

There are several industry standard software packages available for product reliability modeling. Smart Modular utilizes Item Software’s reliability model, the **RDF2000 UTE C 80-810 Telecom Standard**. Smart Modular Technology has derived the following reliability statistics based upon numerous specifics related to and including; internal component packaging, pin configurations, component density, and internal component substrate architecture.

Product reliability modeling for Smart Modular Technology is based upon continual usage of the product, within accepted normal operating parameters. Compromise of the published normal operating parameters will adversely effect the product life-span reliability model. For a more detailed breakdown analysis, contact Smart Modular Customer Support.

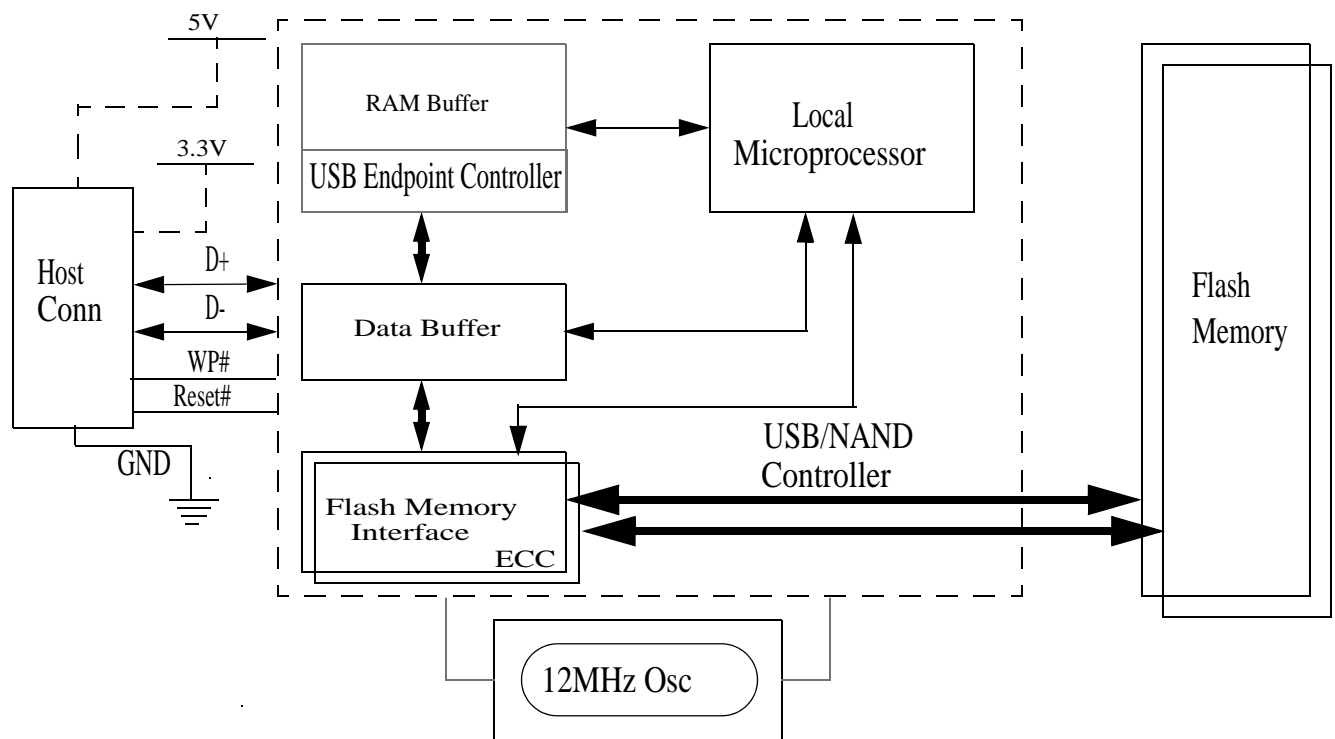
E-USB 2GB @25°C

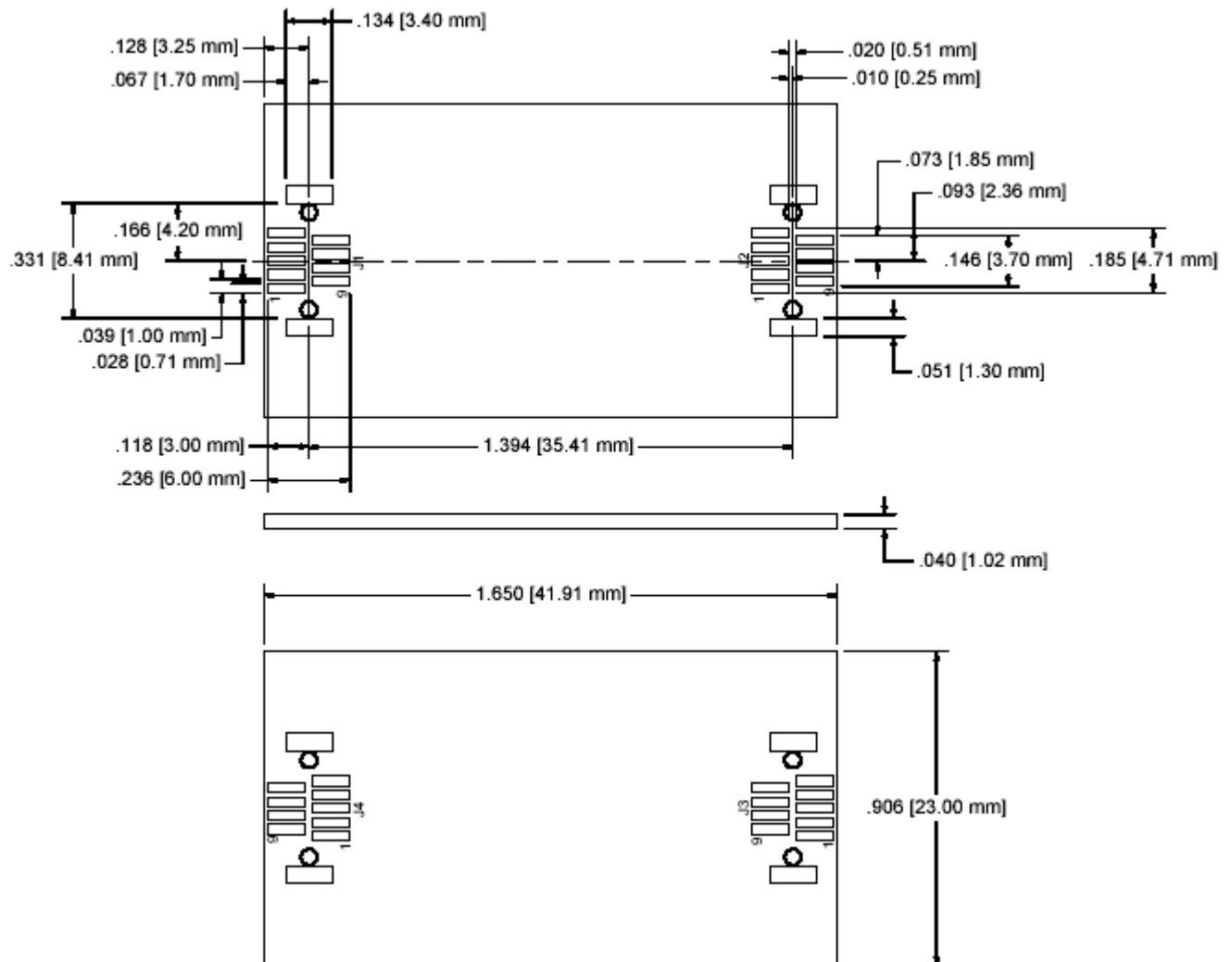
FPBH (Failures Per Billion Hours)	MTBF (Hours)
112	8,863,894

2.0 General Description

The Smart eUSB Drive contains a USB/NAND controller and one or two flash memory devices. The controller interfaces with a host system allowing data to be written and read from the flash memory device.

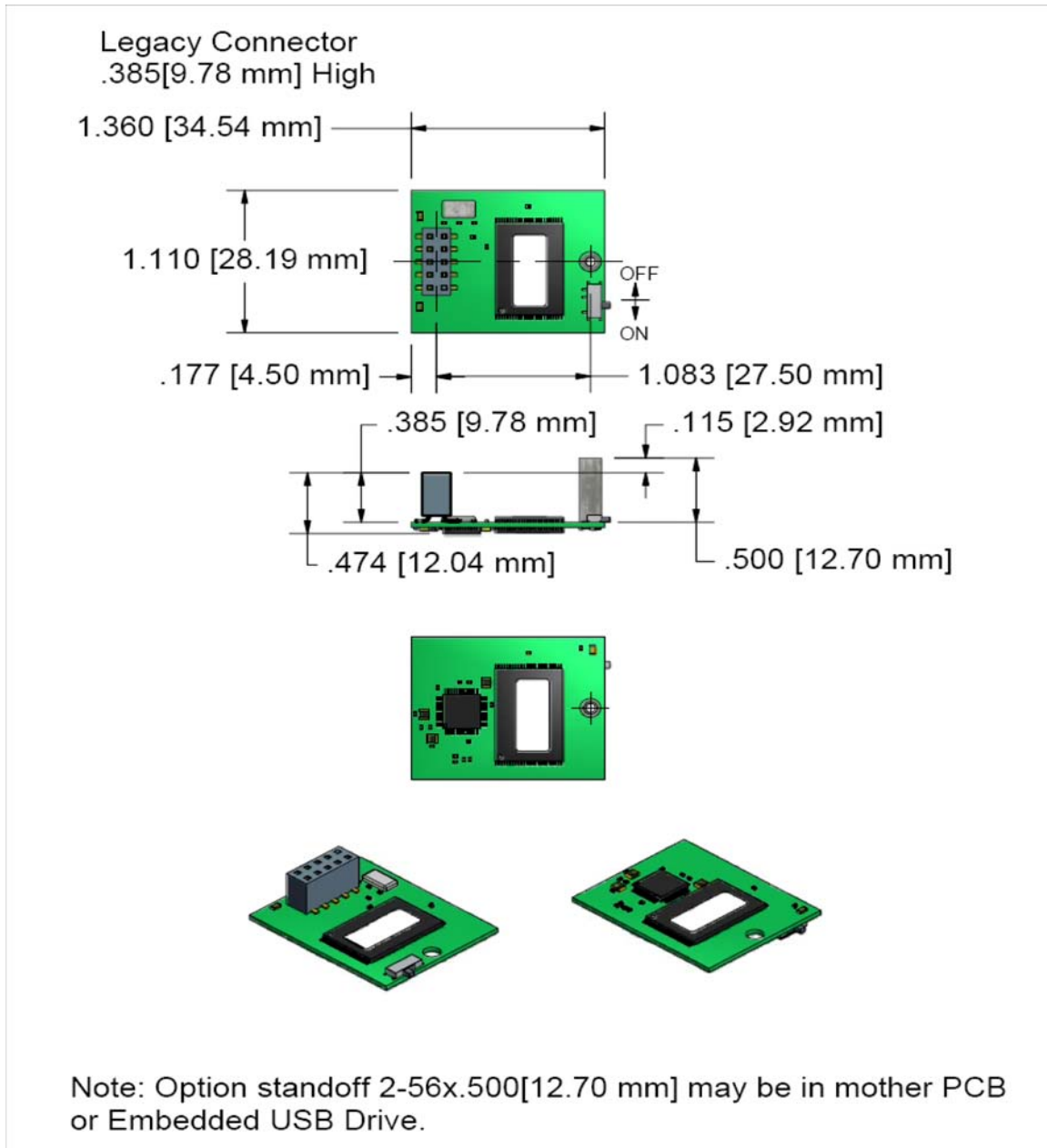
2.1 Functional Block Diagram



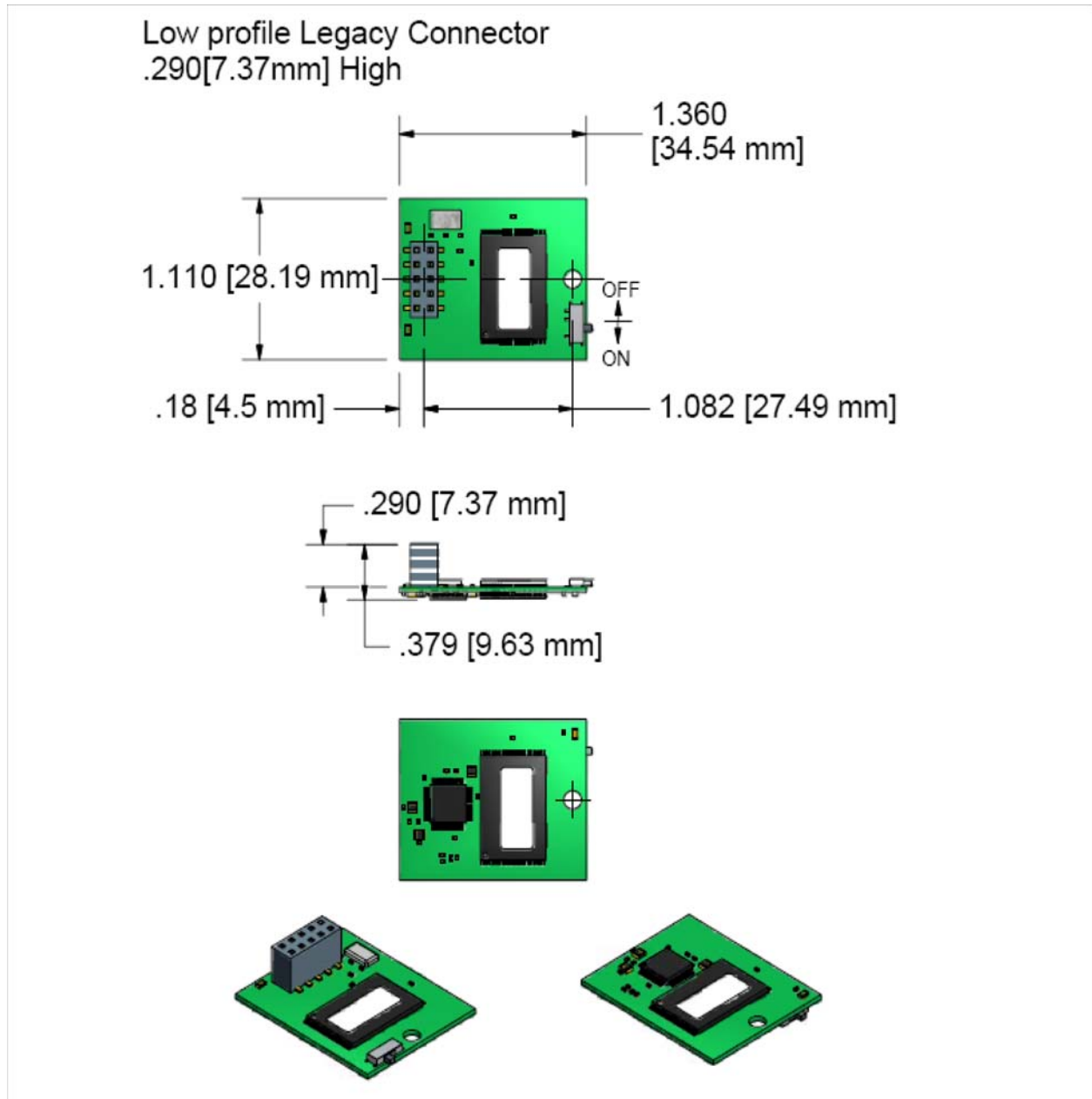
2.2.2 Board Dimensions- Stacking Connector


2.2.3 Horizontal Mounting

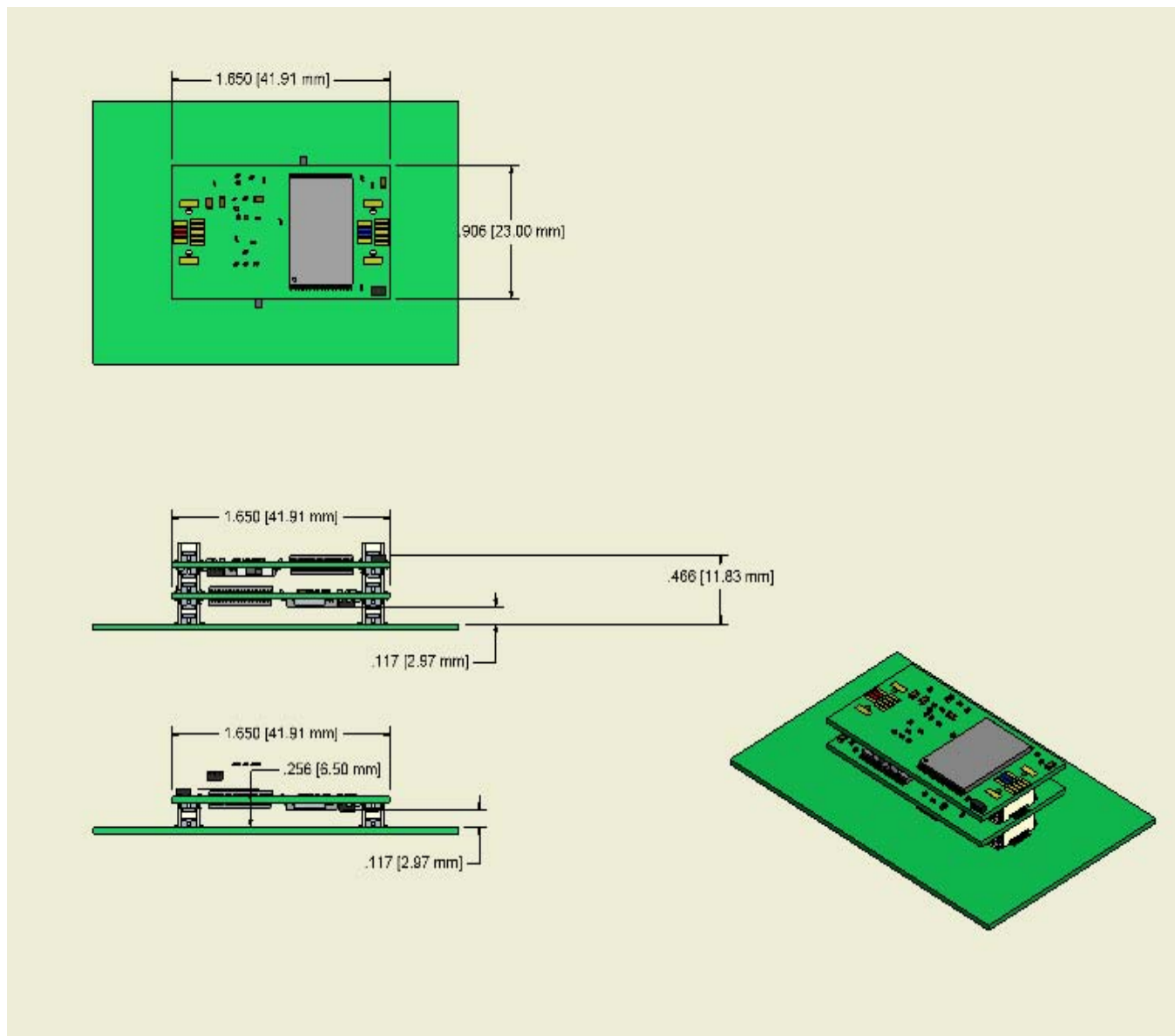
Legacy Connector:



Low Profile Legacy connector:

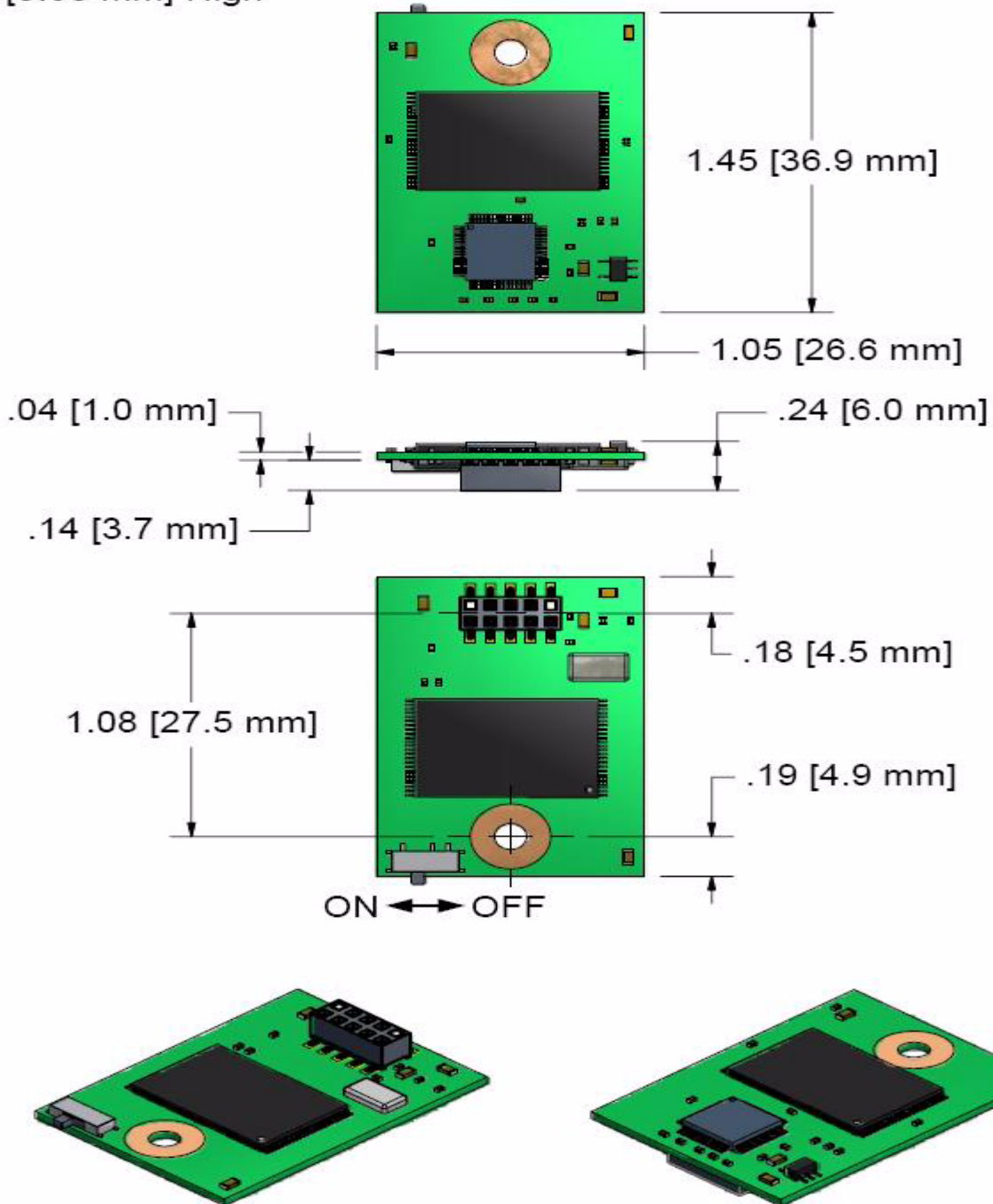


Stacking Connector:



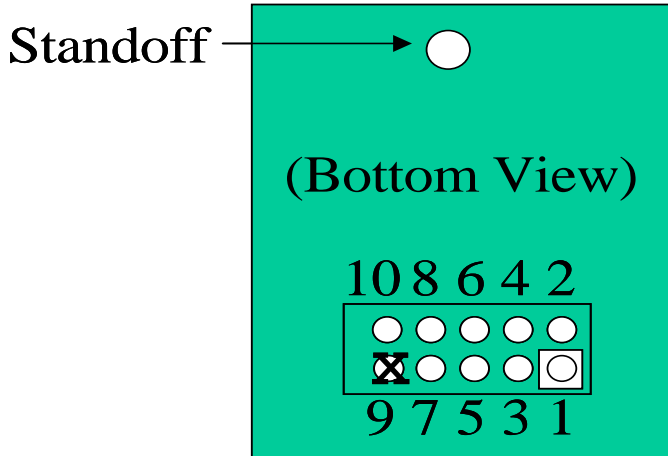
2mm Low Profile Legacy connector:

.145[3.68 mm] High



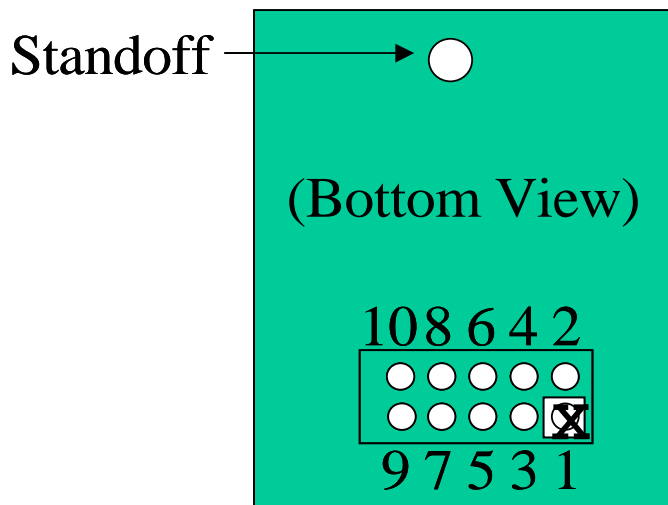
2.2.4 Connector Pinout

Legacy Connector, 5V:

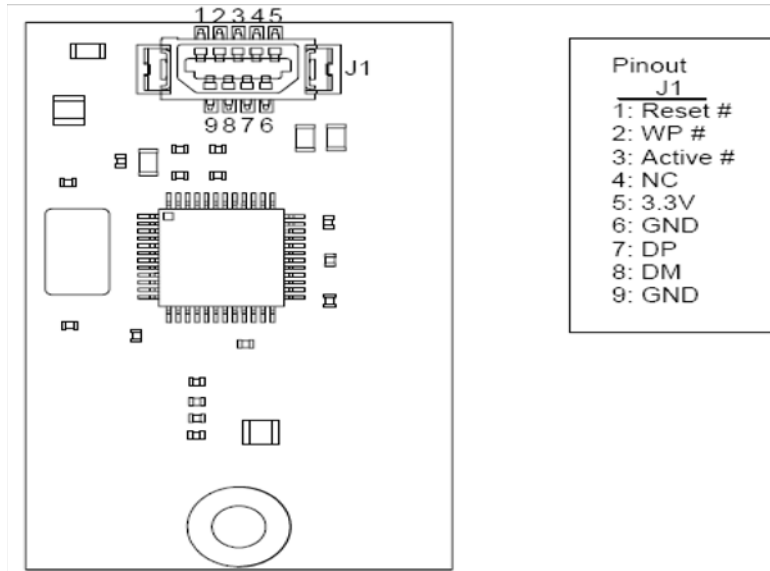
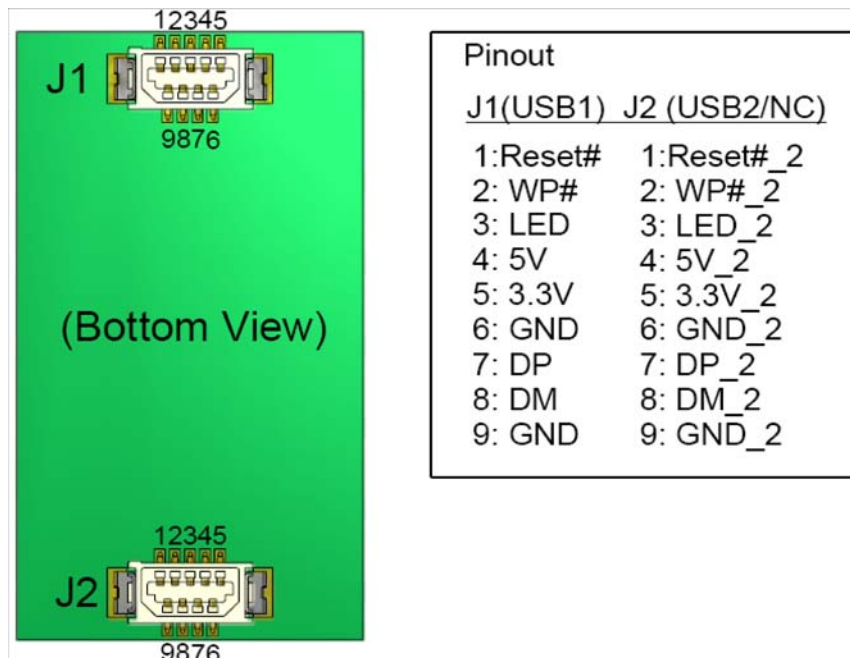


- 1 : + 5 V
- 2 : N o C o n n e c t
- 3 : D a t a -
- 4 : N o C o n n e c t
- 5 : D a t a +
- 6 : N o C o n n e c t
- 7 : G N D
- 8 : N o C o n n e c t
- 9 : K e y
- 10 : N o C o n n e c t

Legacy Connector, 3.3V:



- 1 : K e y
- 2 : N o C o n n e c t
- 3 : D a t a -
- 4 : N o C o n n e c t
- 5 : D a t a +
- 6 : N o C o n n e c t
- 7 : G N D
- 8 : N o C o n n e c t
- 9 : + 3 . 3 V
- 10 : N o C o n n e c t

Standoff Connector:

Stacking Connector:


2.2.5 Host Connector and Pinout

Legacy Connector

The embedded USB drive uses a .1" pitch 2x5 pin header that is keyed to the voltage of the board. The 3.3V board will have position 1 blocked and the 5V board will have position 9 blocked. The connector on the host must be keyed correctly to avoid damage to the board. The header on the host may be any .1" pitch 2x5 header with .025sqin posts with the appropriate position removed for keying. For example a **Samtec P/N TSW-105-23-F-D-009** is the appropriate part number to for the 5V board. **P/N TSW-105-1-23-F-D-001** is the appropriate part number for the 3.3V board.

For the Legacy Short Connector, the header on the host should be TMM-105-S-D-009

Standoff

The Legacy Connector Drive uses a standoff that can be screwed or locked onto the host board. The mounting hole on the host board should be 0.125 inches in diameter to accommodate a screw or locking pins and should be spaced as indicated on the diagram in section 2.2.1. The low profile versions do not come with a standoff.

Stacking Connector

The SMART eUSB Drive with the stacking connectors is designed for applications where low mounted height is important or where a second drive is needed. The stacking drive comes in two configurations: Top or Bottom. If only a single drive will be used on a system, use the Top configuration. In this configuration, J1 is used to connect the power and USB signals between the host and the drive. J2 is used only for board support in this configuration and will not use any signals on this connector.

If board stacking is to be used, a Bottom drive and a Top drive can be used together. Each will have its own independent USB bus and appear as a separate drive. The Bottom drive is the same as the top drive, except that it has additional headers mounted on top of it to connect with a second drive. On the Bottom drive, J2 and J3 are used to pass the second USB bus up to the Top board. J4 is a dummy header used for supporting the Top board and does not contain any signals.

The Stacking Connector drives contains two Hirose DF9, 9Pin, 1mm pitch, friction locking, SMT receptacles for connecting to the host. The part number for this part from Hirose is:

DF9B-9S-1V

The mating part for use on the host may be any of the following Hirose Part numbers:

DF9-9P-1V (with metal fitting, with boss)

DF9B-9P-1V (with metal fitting, without boss)

DF9A-9P-1V (without metal fitting, with boss)

DF9C-9P-1V (without metal fitting, without boss)

Both 5V and 3.3V are shown on the connector but only one is necessary. If the 3.3V drive is being used only 3.3V needs to be connected on the host. If the 5V drive is being used only 5V needs to be connected on the host. To be able to use either drive connect both power lines on the host.

Two optional signals are brought out to pins 1 and 2 of the connector. If these signals are not used by the host, these pins must be left unconnected.

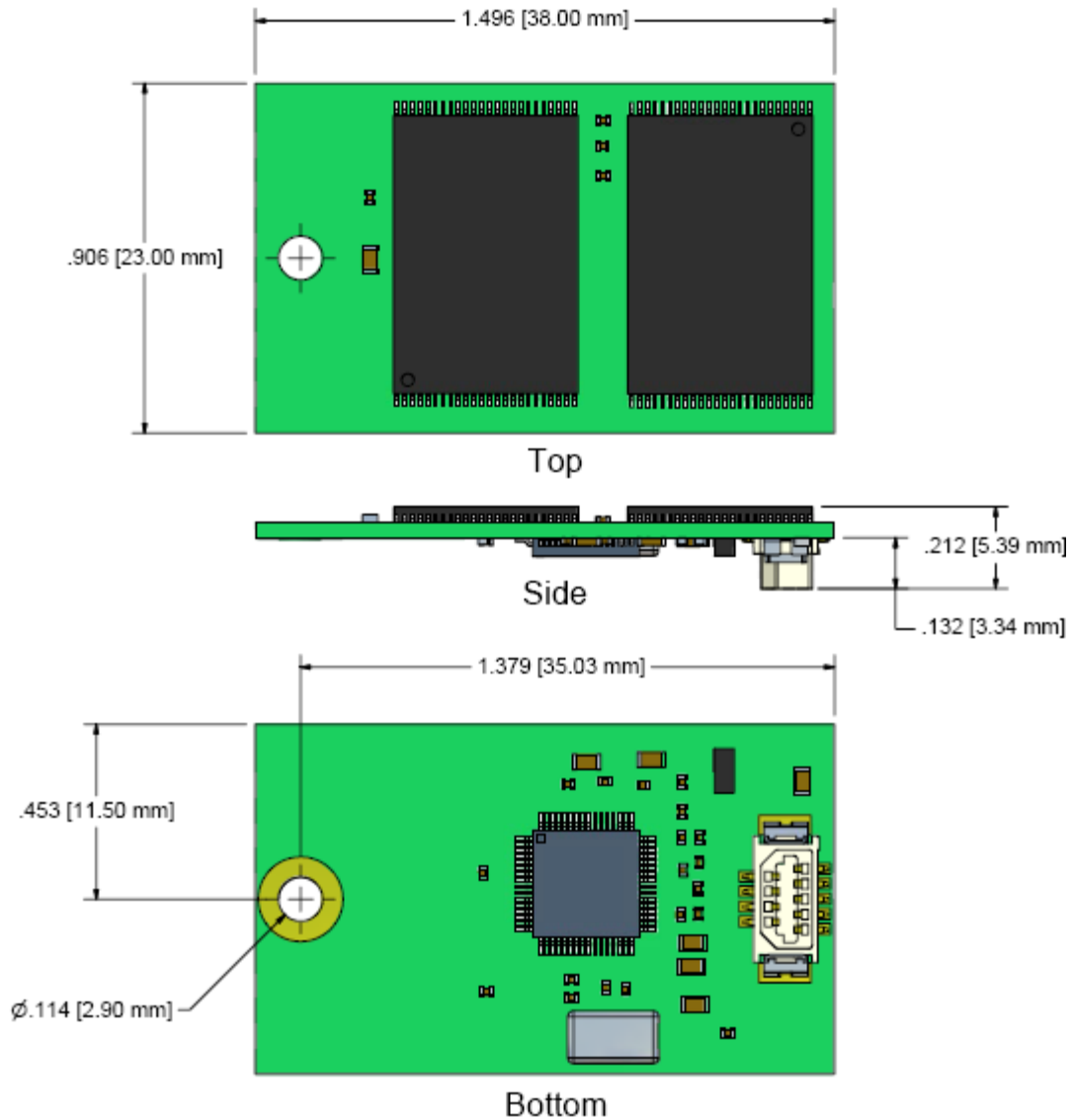
Pin 1, Reset#, may be used by the host to apply a hardware reset to the drive. This reset signal is a 3.3V active low signal. The host may pull this signal low to force a reset to the drive controller. At all other times (including during power up) the host must present a high impedance to this signal. Reset# is pulled up to 3.3V on the drive

Pin 2, WP#, may be used by the host to write protect the drive. This signal is a 3.3V active low signal that is shared between the host and the switch (if present) on the USB drive. The host may pull this signal low to write protect the drive. At all other times the host must present a high impedance to this signal. WP# is pulled up to 3.3V on the drive. The switch and this pin are logically OR'd- if either are set, the drive will be write protected.

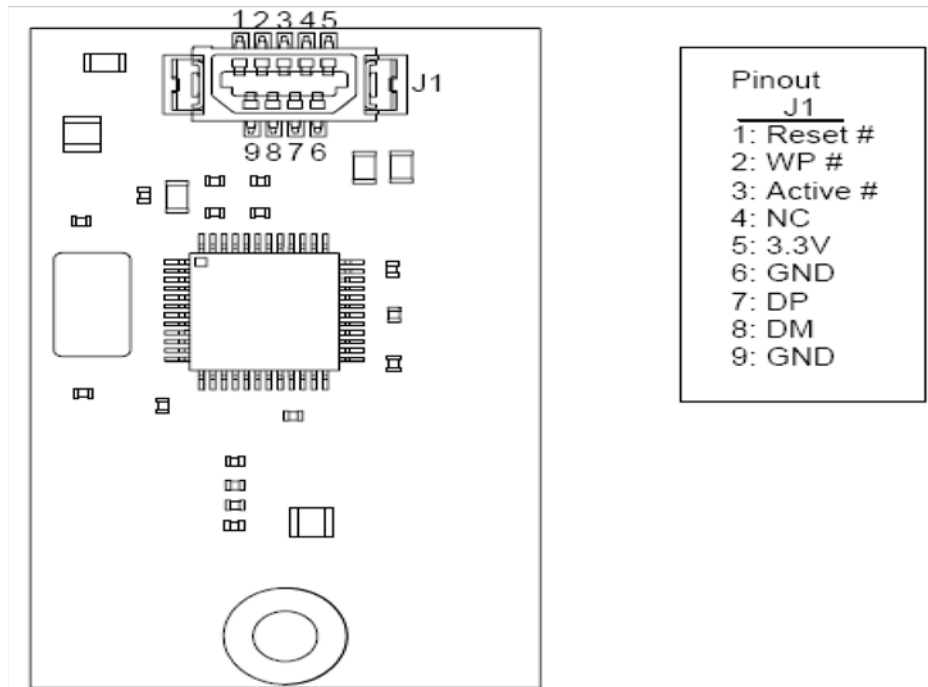
Stacking Connector cont.

Pin 3, LED, is a 3.3V status signal that indicates when the drive is busy. This signal may be used to drive a low current LED or other logic on the host to indicate drive status to the user or system. This signal is active low ? has a 4mA drive strenght

2.3.4 Horizontal Mounting - Short eUSB Drive W/Standoff



2.3.5 Connector Pinout - Short eUSB Drive Connector



2.3.6 Host Connector and Pinout

The short eUSB Drive is designed for applications where low mounted height and a small footprint is needed. The same connector is used on this drive as on the stacking version of the EUSB. J1 is used to bring the USB and control signals to the drive and J2 is a dummy connector used for mechanical support.

The Short EUSB drive contains two Hirose DF9, 9Pin, 1mm pitch, friction locking, SMT receptacles for connecting to the host. The part number for this part from Hirose is:

DF9-9S-1V (61)

The mating part for use on the host may be any of the following Hirose Part numbers:

DF9-9P-1V (with metal fitting, with boss) (61)

DF9B-9P-1V (with metal fitting, without boss) (61)

Both 5V and 3.3V are shown on the connector but only one is necessary. If the 3.3V drive is being used only 3.3V needs to be connected on the host. If the 5V drive is being used only 5V needs to be connected on the host. To be able to use either drive connect both power lines on the host.

Three optional signals are brought out to pins 1, 2 and 3 of the connector. If these signals are not used by the host, these pins must be left unconnected.

Pin 1, Reset#, may be used by the host to apply a hardware reset to the drive. This reset signal is a 3.3V active low signal. The host may pull this signal low to force a reset to the drive controller. At all other times (including during power up) the host must present a high impedance to this signal. Reset# is pulled up to 3.3V on the drive

Pin 2, WP#, may be used by the host to write protect the drive. This signal is a 3.3V active low signal that is shared between the host and the switch (if present) on the USB drive. The host may pull this signal low to write protect the drive. At all other times the host must present a high impedance to this signal. WP# is pulled up to 3.3V on the drive. The switch and this pin are logically OR'd- if either are set, the drive will be write protected

Pin 3, Activity#, is a 3.3V status signal that indicates when the drive is busy. This signal may be used to drive a low current LED or other logic on the host to indicate drive status to the user or system. This signal is active low and has a 4mA drive strength.

3.0 Electrical Interface

3.1. Electrical Description

This interface standard is electrically compatible with the USB 2.0 specification. Bus Timing and Electrical Characteristics are described in the Universal Serial Bus Specification Revision 2.0 Section 7.3.2

3.2 Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
5V	Supply Voltage	-0.3 min to 6.0 max	V
3.3V	Supply Voltage	-0.3 min to 4.0 max	V
V _{IN}	Input Voltage	GND - 0.5 to V _{CC} + 0.5	V
I _{IN} *	DC Input Current	TBD	mA
T _{STG}	Storage Temperature	-25 to 75 (Commercial) -40 to 85 (Industrial)	°C

*Total current from all supplies

3.3 Recommended Operating Conditions

Symbol	Parameter		Ratings	Unit
5V*	Supply Voltage	5.0V	4.75 to 5.25	V
3.3V**	Supply Voltage	3.3V	3.0 to 3.6	V
T _A	Operating Temperature	Commercial Industrial	0 to 70 -40 to 85	°C

*This supply is not used on the 3V only drive.

**This supply is not used on the 5V only drive.

3.4 Electrical Characteristics

Parameters	Configuration	Min	Typ	Max	Unit
Read Current	1 Chip	55	71	90	mA
	2 Chips	55	71	120	mA
Write Current	1 Chip	75	95	90	mA
	2 Chips	85	105	150	mA
Idle Current	All	50	65	75	mA
Suspend Current	All	230	300	500	uA

DC Characteristics (Ta = 0 to +70 °C, Vcc = 3.3V, unless otherwise specified)

4.0 RBC Command Description for USB Bulk-Only Transport

This section documents the Host Interface Commands supported by the USB Memory Controller. The standard class interface specification is currently implemented. SMART Modular's device does not support Interrupt or Isynchronous transport protocol. For the purpose of data integrity only Bulk and Control Transport modes are implemented.

4.1.0 Conventions

For the purpose of this addendum the following naming conventions are used:

- Smart *Modular's Device* - SMART Modular's Embedded USB Drive
- 1Fh - Hexadecimal numbers are followed by an "h"
- 011b- Binary numbers are followed by a "b"
- bRequest - words in *italics* indicate terms defined by USB or by this specification

4.1.1 Definitions

- *Bulk Only Interface* - Communication method used for data storage needing good data integrity. This interface uses bulk endpoints.
- Command block Wrapper (CBW) - A packet containing a command block and associated information.
- Command Status Wrapper (CSW) - A packet containing the status of a command block.
- Configuration Descriptor - A string of data that describes the functionality and operation of the device.
- Data-In - Indicates a transfer of data IN from the device to the host.
- Data-Out - Indicates a transfer of data OUT from the host to the device.
- Device Descriptor - is a string of data that describes a USB device. Examples of data within this descriptor are: Class, Subclass, Product ID, and Version.
- Device Request - Low level communication from the host for querying the device using the control pipe.
- Endpoint - A uniquely addressable portion of a USB device that is the source or sink of information in a communication flow between the host and device.
- Interface Descriptor - Binds a driver to a USB software interface. USB devices may have one or multiple software interfaces. A PC views a USB device as a collection of software interfaces.
- Processed - Data received and controlled internally by the device to the point that the host need no longer be concerned about it.
- Relevant - The amount of the data sent to the host by the device that is significant.
- Reset Recovery - An error recovery procedure by which the host prepares the device for further CBWs. This is done below RBC level through a special low level control packet
- Thin Diagonal - Cases where the host and device are in complete agreement about the data transfer.
- SPC-2 - SCSI Primary Command-2
- RBC - Reduced Block Command

5.0 Related Documents

- *USB Mass Storage Overview Version 1.1*, available at http://www.usb.org/developers/data/devclass/usbmassover_11.pdf
- *USB Mass Storage Bulk-Only Version 1.0* available at http://www.usb.org/developers/data/devclass/usbmassbulk_10.pdf
- *Reduced Block Commands (RBC)*, T10/1240-D, available at <http://www.t10.org/drafts.htm>
- *Universal Serial Bus Specification Version 1.1*, available at <http://www.usb.org/developers/data/usb-spec.zip>
- *Universal Serial Bus Specification version 2.0*, available at http://www.usb.org/developers/data/usb_20.zip

*Note: Please do not confuse the command or transport document versions with the USB specification
SMART Modular's device is USB 2.0 compliant*

6.0 Standard Descriptor

SMART Modular's device supports the following standard USB descriptors:

- *Device Descriptor* - SMART Modular's device has one device descriptor.
- *Configuration* - SMART Modular's device has one default configuration descriptor, which supports the Bulk-Only Data Interface.
- *Interface* - SMART Modular's device supports the Bulk-Only Data Interface.
- *Endpoint* - SMART Modular's device supports the following endpoints: (a) Control (b) Bulk-In endpoint (c) Bulk-Out endpoint. The host shall use the first reported Bulk-In and Bulk-Out endpoints for the selected interface.
- *String* - SMART Modular's device provides the string field that has Vendor Name, product ID as well as containing a unique serial number

6.1- Device Descriptor

SMART Modular's device has one device descriptor. The device shall specify the device class and subclass codes in the interface descriptor, and not in the device descriptor.

Table 6.1- Device Descriptor

Offset	Field	Size	Value	Description
0	<i>bLenght</i>	Byte	12h	Size of this descriptor in bytes.
1	<i>bDescriptorType</i>	Byte	01h	DEVICE descriptor type.
2	<i>bcdUSB</i>	Word	0200h	USB Specification Release Number in Binary Coded Decimal
4	<i>bDeviceClass</i>	Byte	00h	Class is specified in the interface descriptor.
5	<i>bDeviceSubClass</i>	Byte	00h	Subclass is specified in the interface descriptor.
6	<i>bDeviceProtocol</i>	Byte	00h	00h Protocol is specified in the interface descriptor.
7	<i>bMaxPacketSize0</i>	Byte	40h	Maximum packet size for end point zero. (only 8, 16, 32, or 64 are valid (08h, 10h, 20h, 40h))
8	<i>idVendor</i>	Word	0E39h	Vendor ID (assigned by the USB-IF).
10	<i>idProduct</i>	Word	2B00h	Product ID (assigned by the manufacturer)
12	<i>bcdDevice</i>	Word	Varies	Device release number in binary-code decimal
14	<i>iManufactures</i>	Byte	01h	Index of string descriptor describing the manufacturer.
15	<i>iProduct</i>	Byte	02h	Index of string descriptor describing this product
16	<i>iSerial Number</i>	Byte	03h	Index of string descriptor describing the device's serial number
17	<i>bNumConfiguration</i>	Byte	01h	Number of possible configurations

6.2 Configuration Descriptor

SMART Modular's Embedded USB Drive device has one default configuration descriptor, which supports the Bulk-Only Data Interface. The configuration descriptor describes information about a specific device configuration. The descriptor contains a *bConfiguration Value* field with a value that, when used as a parameter to the *setConfiguration()* request, causes the device to assume the described.

Table 6.2 Configuration Descriptor

Offset	Field	Size	Value	Description
0	<i>bLength</i>	Byte	09h	Size of this descriptor in bytes.
1	<i>bDescriptorType</i>	Byte	02h	Configuration Descriptor type.
2	<i>wTotalLength</i>	Word	0020h	Total length of data returned for this configuration, Includes combined length of all descriptors (configuration, interface, endpoint, and class-or vendor-specific) returned for this configuration.
4	<i>bNumInterfaces</i>	Byte	01h	Number of interfaces supported by this configuration. The device shall support at least the Bulk-Only Data Interface.
5	<i>bConfigurationValue</i>	Byte	01h	Value to use as an argument to the <i>SetConfiguration()</i> request to select this configuration.
6	<i>iConfiguration</i>	Byte	00h	Index of string descriptor describing this configuration
7	<i>bmAttributes</i>	Byte	80h	Configuration characteristics: Bit Description 7 Reserved (set to one) 6 Self-powered 5 Remote 4.0 Reserved (reset to zero) Bit 7 is reserved and must be set to one for historical reasons. For a full description of this <i>bmAttributes</i> bit-map, see the USB 2.0 Specification.
8	<i>maxPower</i>	Byte	32h	Maximum power consumption of the USB device from the bus in this specific configuration when the device is fully operational. Expressed in 2mA units (i.e.50=100mA).

6.3 Interface Description

SMART Modular's device supports the Bulk-Only Data Interface. This descriptor describes a specific interface within a configuration. A configuration provides one or more interfaces, each with zero or more endpoint descriptors describing a unique set of endpoints within the configuration.

Table 6.3 -Bulk-Only Data Interface Descriptor

Offset	Field	Size	Value	Description
0	<i>bLength</i>	Byte	09h	Size of this descriptor in bytes.
1	<i>bDescriptorType</i>	Byte	04h	INTERFACE Descriptor type.
2	<i>bInterfaceNuber</i>	Byte	00h	Number of interface. Zero-based value identifying the index in the array of concurrent interfaces supported by this configuration.
3	<i>bAlternateSetting</i>	Byte	00h	Value used to select alternate setting for the interface identified in the prior field.
4	<i>bNumEndpoints</i>	Byte	02h	Number of endpoints used by this interface (excluding endpoint zero)
5	<i>bInterfaceClass</i>	Byte	08h	MASS STORAGE Class
6	<i>bInterfaceSubClass</i>	Byte	06h	Subclass code (assigned by the USB-IF). Indicates which industry standard command block definition to use. Does not specify a type of storage such as a floppy disk or CD-ROM drive. (06h means USB Flash Disc is using SCSI transparent Command set as of USB Mass Storage Overview Specification)
7	<i>bInterfaced Protocol</i>	Byte	50h	BULK-ONLY TRANSPORT. (See USB Mass Storage Overview Specification)
8	<i>iInterface</i>		00h	Index to string descriptor describing this interface

6.4 Endpoints Descriptors

Smart Modular's device supports three endpoints: Control, Bulk-In and Bulk-Out. 0 (zero) is the default Control endpoint and does not require a descriptor.

6.4.1 Bulk-In Endpoint

Table 6.4.1 - Bulk-In Endpoint Descriptor

Offset	Field	Size	Value	Description								
0	<i>bLength</i>	Byte	07h	Size of this descriptor in bytes.								
1	<i>bDescriptorType</i>	Byte	05h	ENDPOINTS Descriptor type.								
2	<i>bEndpointAddress</i>	Byte	81h	The address of this endpoint on the USB device. The address is encoded as follows. <table border="0" style="margin-left: 20px;"> <tr> <td style="padding-right: 20px;">Bit</td> <td>Description</td> </tr> <tr> <td>3..0</td> <td>The endpoint number</td> </tr> <tr> <td>6..4</td> <td>Reversed. set to 0</td> </tr> <tr> <td>7</td> <td>1 = In</td> </tr> </table>	Bit	Description	3..0	The endpoint number	6..4	Reversed. set to 0	7	1 = In
Bit	Description											
3..0	The endpoint number											
6..4	Reversed. set to 0											
7	1 = In											
3	<i>bAttributes</i>	Byte	02h	This is a Bulk endpoints.								
4	<i>wMaxPacketSize</i>	Word	0200h	Maximum packet size.								
6	<i>bInterval</i>	Byte	FFh	Does not apply to Bulk endpoints								

6.4.2 Bulk-Out endpoint

The Bulk-Out Endpoint is used to transfer command and data from host to device.

Table 6.4.2 - Bulk-Out Endpoint Descriptor

Offset	Field	Size	Value	Description								
0	<i>bLength</i>	Byte	07h	Size of this descriptor in bytes.								
1	<i>bDescriptorType</i>	Byte	05h	ENDPOINTS Descriptor type.								
2	<i>bEndpointAddress</i>	Byte	02h	The address of this endpoint on the USB device. The address is encoded as follows. <table border="0" style="margin-left: 20px;"> <tr> <td style="padding-right: 20px;">Bit</td> <td>Description</td> </tr> <tr> <td>3..0</td> <td>The endpoint number</td> </tr> <tr> <td>6..4</td> <td>Reversed. set to 0</td> </tr> <tr> <td>7</td> <td>0 = Out</td> </tr> </table>	Bit	Description	3..0	The endpoint number	6..4	Reversed. set to 0	7	0 = Out
Bit	Description											
3..0	The endpoint number											
6..4	Reversed. set to 0											
7	0 = Out											
3	<i>bAttributes</i>	Byte	02h	This is a Bulk endpoints.								
4	<i>wMaxPacketSize</i>	Word	0200h	Maximum packet size.								
6	<i>bInterval</i>	Byte	FFh	Does not apply to Bulk endpoints								

7.0 Reduce Block Command (RBC) Descriptors

The Reduced Block Commands are a simplified set of the SCSI Primary Commands - 2 (SPC-2) used for block devices. The SPC-2 specification contains the second-generation definition of the basic commands for all SCSI devices.

7.0 Reduce Block Command (RBC) Descriptors

Command	OpCode	Command Support	Supported by SMART Modular's device	Reference
FORMAT UNIT	04h	O	NO *	RBC
INQUIRY	12h	M	Yes	SPC-2
MODE SELECT (6)	15h	M	Yes	SPC-2
MODE SENSE (6)	1Ah	M	Yes	SPC-2
PERSISTENT RESERVE IN	5Eh	O	No *	SPC-2
PERSISTENT RESERVE OUT	5Eh	O	No *	SPC-2
PREVENT.ALLOW MEDIUM REMOVAL	1Eh	M	Yes	RBC
READ (10)	28h	M	Yes	RBC
READ CAPACITY	25h	M	Yes	SPC-2
RELEASE (6)	17h	O	No *	SPC-2
REQUEST SENSE	03h	O	Yes	SPC-2
RESERVE (6)	16h	O	No *	RBC
START STOP UNIT	1Bh	M	Yes	RBC
SYNCHRONIZE CACHE	35h	O	No *	SPC-2
TEST UNIT READY	00h	M	Yes	RBC
VERIFY (10)	2Fh	M	Yes	RBC
WRITE (10)	2Ah	M	Yes	SPC-2
WRITE BUFFER	3Bh	O	Yes	SPC-2
MODE SENSE	5Ah	B	Yes	USB-Boot

Notes:

- Command Support Key: M = support is mandatory; N/A = not applicable, O = support is optional, B = support if for Bootability
- The CONTROL byte (the last byte of CDB) shall be set to zero
- *When the host issue command that it is not supported by SMART Modular's device, the device returns "STALL" and waits for the host to send a "Clear Feature" command to reset.