



# **Proposal for USB Solid State Drive Mode Sense specification**

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## **Background:**

USB Solid State (flash) drives were designed to be plug compatible with USB Hard disk drives. They respond with a peripheral type of 00h (Direct Access Device) to the Inquiry command.

The USB Solid State (flash) drives may or may not supply Hard disk or Flexible disk mode pages – consistent response to Mode Sense seems to be immaterial to function in the Windows XP environment (there are some issues in the Macintosh environment).

There are several Solid State drive parameters that can be useful to the host, and therefore we propose that a Mode Sense page be defined for Direct Access Devices that are implemented using Solid State Media.

The T10 Working Draft (T10/1417-D) Table 102 specifies the Mode page codes for direct-access devices. The page code to be used for the Solid State drive parameters should be determined so that there is no conflict with the previously defined page codes. The page code will then be used for the Solid State Media information suggested below. Only Solid State Media would return valid data when this page code is requested.

So, if the Peripheral Device Type is 00h (SBC Direct-Access device) and the device is implemented using Solid State Media, then the mode sense page will be specified as follows:

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS	Reserved	Page Code (TBD)					
1	Page length in bytes (1Eh)							
2	Solid State Media Subtype				Solid State Media Type			
3	WC	WT	Form Factor					
4	Page Size (x 512 bytes)							
5	Block Size (pages per block)							
6-7	Total Number of Blocks on Solid State Media							
8-12	Solid State Media Manufacturers Device ID (5 bytes)							
13	Sustained Sequential Write Performance							
14	Sustained Sequential Read Performance							
15	Random Read Access Time				Random Write Access Time			
16	Minimum Program/Erase Cycles per block							
17	Maximum partial writes in page							
18	Storage Capacity Status				Media Health Status			
19	ECC Correction Capability				ECC Detection Span			
20	Solid State Data Bus Width				Solid State Data Channels			
21	Reserved				PS	BB	MVOL	
22-31	Reserved							

**BYTE 0:**      Bits 0-5      Page Code (TBD)  
                   Bit 6        Reserved  
                   Bit 7        PS – Parameters Savable bit. A PS bit set to one indicates that the device is capable of saving the mode page in a non-volatile vendor-specific location.

**BYTE 1:**      Bits 0-7      Page Length (1Eh)

**BYTE 2:**      Low Nibble; Solid State Media Type is defined as follows:

0h    -    Not Specified  
 1h    -    ROM (Read Only)

2h	-	OTP (One Time Programmable)
3h	-	NOR
4h	-	NAND
5h	-	AND
6h	-	AG-AND
7h	-	NROM/Mirrorbit
8h-Fh	-	Reserved

BYTE 2: High Nibble; Solid State Media Subtype is defined as follows:

0h	-	Not Specified
1h	-	One Bit Per Cell
2h	-	Two Bits Per Cell
3h	-	Three Bits Per Cell
4h	-	Four Bits Per Cell
5h-Fh	-	Reserved

BYTE 3: Device Form Factor (If this device is a USB card reader, then the type of card inserted into the reader slot is specified here).

00h	-	USB (not a card reader)
01h	-	PC-CARD
02h	-	Compact Flash
03h	-	Smart Media
04h	-	Miniature Card
05h	-	Memory Stick
06h	-	SD
07h	-	MMC
08h	-	xD

09h-03Fh - Reserved

Bit 6	-	WT – Device supports Write Through Cache (FUA)
Bit 7	-	WC – Device implements a Write Cache (Additional Cache parameters are in mode sense page 6 or 8)

BYTE 4: The Page Size is specified as the number of 512 byte sectors in a page.  
For Byte Addressable Solid State Media this parameter is reserved.

BYTE 5: The Block size parameter is the number of pages in each erase block.



BYTE 6-7: The Total Number of Blocks on Solid State Media parameter specifies the blocks on each Solid State Media component on the device.

BYTE 8-12: The Solid State Media Manufacturers Device ID parameters contain the bytes supplied from the Solid State Media device.

0h - Not Specified.

BYTE 13: Sustained Sequential Write Performance

0h	-	No Speed rating
1h	-	1MB/s
2h	-	3MB/s
3h	-	6MB/s
4h	-	9MB/s
5h	-	12MB/s
6h	-	15MB/s
7h	-	18MB/s
8h	-	21MB/s
9h	-	27MB/s
Ah	-	33MB/s
Bh	-	39MB/s
Ch	-	45MB/s
Dh	-	51MB/s
Eh	-	57MB/s
Fh	-	60MB/s

10h-FFh – Reserved

BYTE 14: Sustained Sequential Read Performance

0h	-	No Speed rating
1h	-	1MB/s
2h	-	3MB/s
3h	-	6MB/s
4h	-	9MB/s
5h	-	12MB/s
6h	-	15MB/s
7h	-	18MB/s
8h	-	21MB/s
9h	-	27MB/s
Ah	-	33MB/s

Bh	-	39MB/s
Ch	-	45MB/s
Dh	-	51MB/s
Eh	-	57MB/s
Fh	-	60MB/s
10h-FFh	-	Reserved

BYTE 15: Low Nibble; Random Write Access Time to a sector (512 Bytes). The device will specify the maximum random write access time as follows.

0h	-	Not Specified
1h	-	1000 ms
2h	-	100 ms
3h	-	10 ms
4h	-	1 ms
5h	-	100 us
6h	-	10 us
7h	-	1 us
8h	-	100 ns
9h	-	10 ns
Ah	-	1 ns
Bh-Fh	-	Reserved

High Nibble; Random Read Access Time to a sector (512 Bytes). The device will specify the maximum random write access time as follows.

0h	-	Not Specified
1h	-	1000 ms
2h	-	100 ms
3h	-	10 ms
4h	-	1 ms
5h	-	100 us
6h	-	10 us
7h	-	1 us
8h	-	100 ns
9h	-	10 ns
Ah	-	1 ns
Bh-Fh	-	Reserved

**BYTE 16:** Minimum Program/Erase Cycles per block.  
The device will specify the Minimum number of Program/Erase Cycles per block as follows:

0h	-	Not Specified
1h	-	No erase (OTP or "WORM")
2h	-	100
3h	-	1,000
4h	-	10,000
5h	-	100,000
6h	-	1,000,000
7h	-	2,000,000
8h	-	4,000,000
9h	-	8,000,000
Ah	-	16,000,000
Bh-FFh	-	Reserved

**BYTE 17:** Maximum partial writes per page.  
Some Solid State Media (eg. Flash) allows for a limited number of partial writes in a page before the page has to be erased in order to continue writing to it. This byte specifies the maximum number of partial writes allowed.

0h	-	Not Specified
1h	-	Write Once Only
2h – FEh	1d - 254d	Partial writes allowed
FFh	-	Unlimited Partial writes allowed

**BYTE 18:** Low Nibble; Media Health Status: The device will report how many spare blocks remain as a percentage of the spare blocks reserved during manufacturing as follows;

0d	-	Not Specified
1d – 100d		Percent of spare blocks remaining.
101d - 126d		Reserved
127d	-	No Spare blocks left

**BYTE 18:** High Nibble; Storage Capacity Status: The device will report how many blocks remain as a percentage of the original formatted capacity of the device.



Note that this field may be updated by the device or the host, depending on the device capabilities. If the device cannot determine capacity remaining, then this field will be changeable using the Mode Select command. The device can then use this value to present the capacity remaining to the user on the device itself.

- 0d - Not Specified
- 1d –100d Percent capacity remaining.
- 101d - 126d Reserved
- 127d - Device full

BYTE 19: Low Nibble; The ECC Detection span specifies the number of bits in error that the ECC code can detect.

BYTE 19: High Nibble; The ECC Correction capability specifies the number of bits that the ECC code is capable of correcting.

BYTE 20: Low Nibble; The number of Solid State Data Channels are specified as n for values of 1 to 15

- 0h - Not Specified
- 1h-Fh - Number of channels (1d-32d)

BYTE 20: High Nibble; The Solid State Data Bus Width is specified as  $2^n$  Where n is 0 – 6 for a bus width of 1 – 64 bits

- 0h - 1
- 1h - 2
- 2h - 4
- 3h - 8
- 4h - 16
- 5h - 32
- 6h - 64
- 7h-Fh - Reserved

BYTE 21: Bits 0,1 MVOL – Medium Volatility Characteristics as follows:  
00b Not Specified  
01b Not Changeable (ROM)  
10b Volatile – (RAM)  
11b Erasable (Flash)



- Bit 2 if set, BB – Battery Backup supplied, conforms to 03-388r3 SPC-3, SBc-2 Nonvolatile Caches
- Bit 3 if set, PS – Conforms to 03-388r3 specification for Power Supply information
  
- Bits 4-7 Reserved

BYTE 22-31: Reserved.





## **Change Log:**

1. Changed "Flash" To "Solid State" and "Solid State Media" since it is clear that devices can be implemented using semiconductor components other than flash.
2. Changed Page code to 09h so we can refer to page 06 (RBC) for caching parameters
3. Moved Data Bus and Channels byte, added Form Factor
4. Added PS bit (Parameters Savable)
5. Added WT bit (Write Through Cache)
6. Added WC bit (Write Cache supported)
7. Added Medium Volatility Specification
8. Added Battery Backup (BB) and Power Supply (PS) Bits
9. Added explanation about previous usage of Page 09h.
10. Added Storage Capacity Status.
11. Added AG-AND device type.
12. Modified for T10 document publication.