十个 USB 光驱要响应的命令

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USBMassbulk_10.pdf

一.GetMaxLun

3.2 Get Max LUN *(class-specific request)*

The device *may* implement several logical units that share common device characteristics. The host uses *bCBWLUN* (see 5.1 Command Block Wrapper (CBW)) to designate which logical unit of the device is the destination of the CBW. The Get Max LUN device request is used to determine the number of logical units supported by the device. Logical Unit Numbers on the device shall be numbered contiguously starting from LUN 0 to a maximum LUN of 15 (Fh).

To issue a Get Max LUN device request, the host shall issue a device request on the default pipe of:

- *bmRequestType*: Class, Interface, device to host
- *bRequest* field set to 254 (FEh)
- *wValue* field set to 0
- *wIndex* field set to the interface number
- *wLength* field set to 1

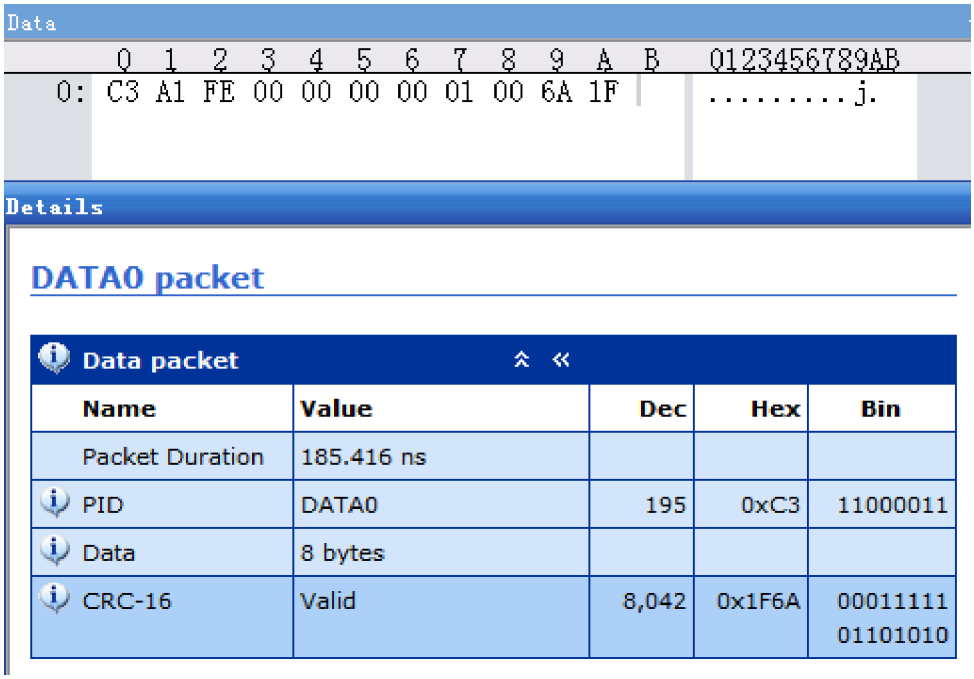
Table 3.2 –Get Max LUN

bmRequestType	*bRequest*	*wValue*	*wIndex*	*wLength*	Data
10100001b	11111110b	0000h	Interface	0001h	1 byte

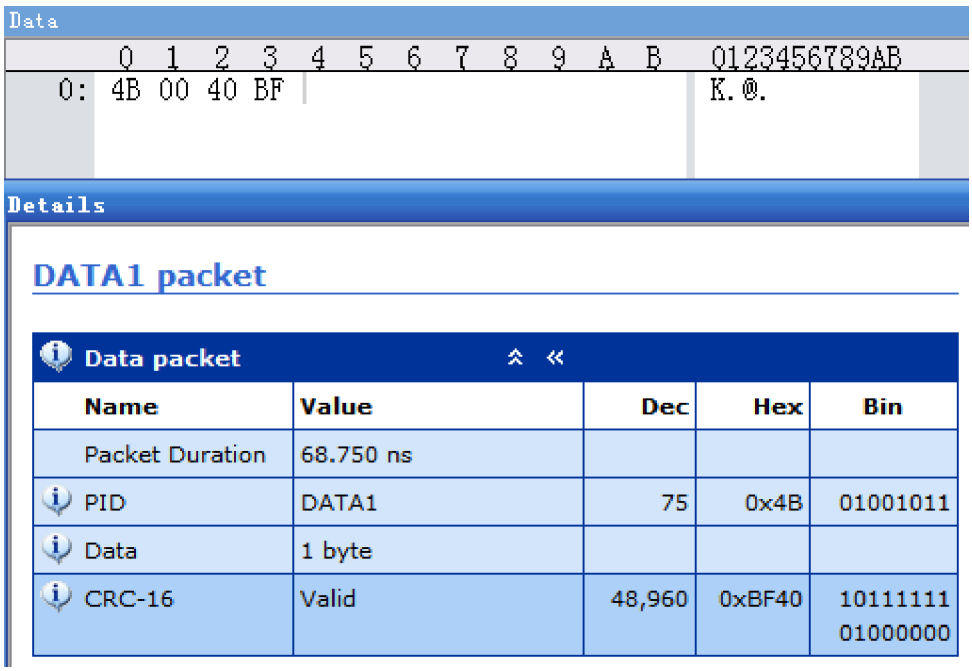
The device shall return one byte of data that contains the maximum LUN supported by the device. For example, if the device supports four LUNs then the LUNs would be numbered from 0 to 3 and the return value would be 3. If no LUN is associated with the device, the value returned shall be 0. The host shall not send a command block wrapper (CBW) to a non-existing LUN.

Devices that do not support multiple LUNs *may* STALL this command.

Host To Device



Device To Host 虽然没有具体的 spec 但是我们能确定 00 就是返回的 Lun 数量



二. Inquiry

USBMass-ufi10.pdf

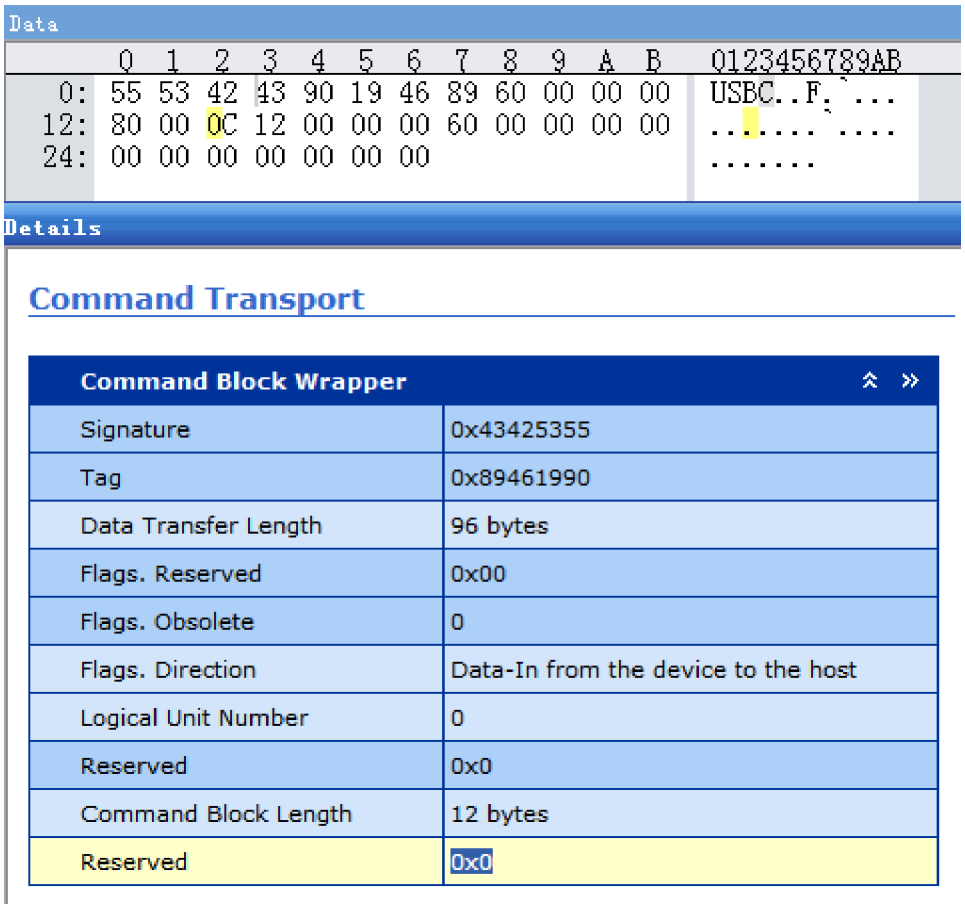
4.2 INQUIRY Command: 12h

The INQUIRY command requests that information regarding parameters of the UFI device itself be sent to the host. It is used by a driver on the host to ask the configuration of the UFI device, typically after power-on or hardware reset.

Table 9 - INQUIRY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved				EVPD (0)
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

前面是一个 CBW



下面才是真正的 INQUIRY 命令

Command				
Name	**Value**	**Dec**	**Hex**	**Bin**
Operation Code	INQUIRY	18	0x12	00010010
EVPD	No	0	0x0	0
Reserved	0x0	0	0x0	0000
Logical Unit Number	0	0	0x0	000
Page Code	Supported vital product data pages	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Allocation Length	96 bytes	96	0x60	01100000
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	10 bytes			

返回值如下：

Data

	0	1	2	3	4	5	6	7	8	9	A	B	0123456789AB
0:	05	80	00	32	5B	00	00	00	4C	49	54	45	...2[...LITE
12:	2D	4F	4E	20	4C	54	52	2D	35	32	33	32	-ON LTR-5232
24:	37	53	20	20	20	20	20	20	51	53	35	38	7S QS58
36:	20	4D	61	72	32	36	20	2C	32	30	30	34	Mar26 ,2004
48:	00	00	00	00	00	00	00	00	00	00	00	00	.....
60:	00	00	00	00	00	00	00	00	00	00	00	00	.....
72:	00	00	00	00	00	00	00	00	00	00	00	00	.....
84:	00	00	00	00	00	00	00	00	00	00	00	00	.....
96:													

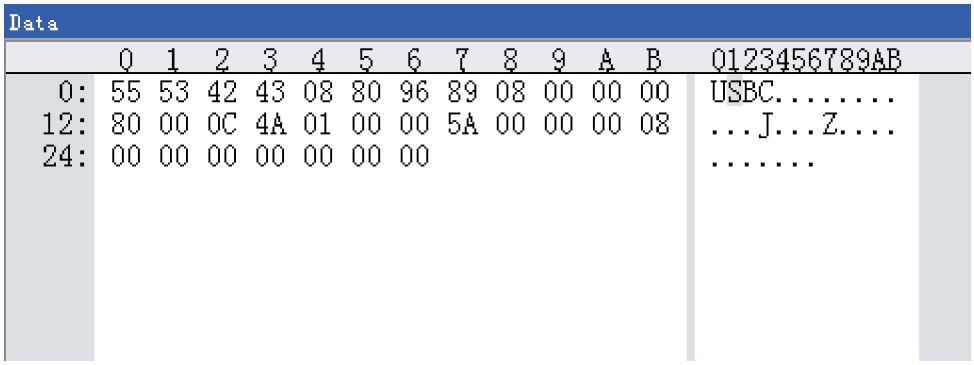
Details

Data				
Name	**Value**	**Dec**	**Hex**	**Bin**
Device Type	CD/DVD device	5	0x05	00101
Removable Media	Yes	1	0x1	1
ANSI Version	0	0	0x0	000
ECMA Version	0	0	0x0	000
ISO Version	0	0	0x0	00
Response Data Format	As specified in SCSI-2	2	0x2	0010
Additional Length	91 bytes	91	0x5B	01011011
Vendor Information	"LITE-ON "			
Product Identification	"LTR-52327S "			
Product Revision	"QS58"			
Vendor Specific		-	-	-
Version Descriptor 1	0x0000	0	0x0000	00000000 00000000
Version Descriptor 2	0x0000	0	0x0000	00000000 00000000
Version Descriptor 3	0x0000	0	0x0000	00000000 00000000
Version Descriptor 4	0x0000	0	0x0000	00000000 00000000
Version Descriptor 5	0x0000	0	0x0000	00000000 00000000
Version Descriptor 6	0x0000	0	0x0000	00000000 00000000
Version Descriptor 7	0x0000	0	0x0000	00000000 00000000
Version Descriptor 8	0x0000	0	0x0000	00000000 00000000

Details | Search | Export | Summary

三.Get Event Status Notification 命令

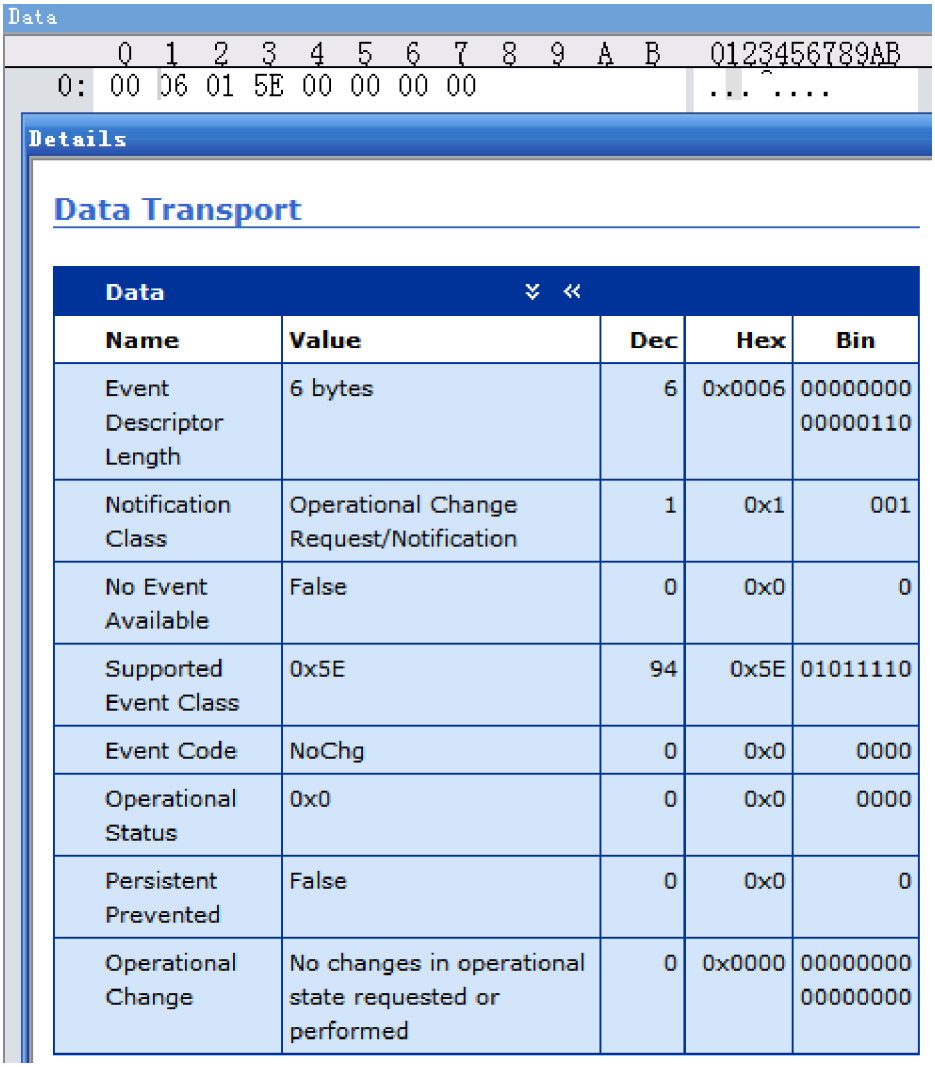
命令数据：



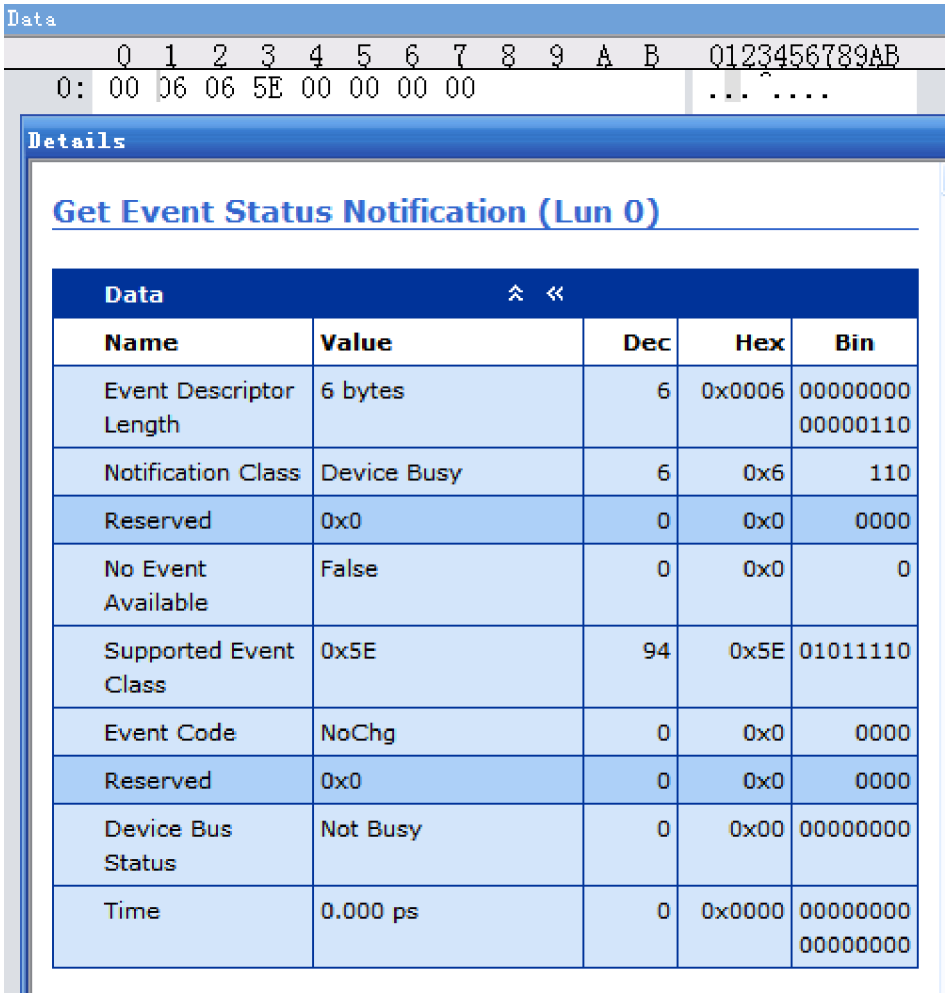
4A 表示 Get Event Status Nofification

Operation Code	GET EVENT STATUS NOTIFICATION	74	0x4A	01001010
Polled	True	1	0x1	1
Reserved	0x00	0	0x00	0000000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Notification Class Request. Reserved	0x0	0	0x0	0
Notification Class Request. Operational Change	True	1	0x1	1
Notification Class Request. Power Management	False	0	0x0	0
Notification Class Request. External Request	True	1	0x1	1
Notification Class Request. Media	True	1	0x1	1
Notification Class Request. Multi-Host	False	0	0x0	0
Notification Class Request. Device Busy	True	1	0x1	1
Notification Class Request. Reserved	0x0	0	0x0	0
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Allocation Length	8 bytes	8	0x0008	00000000 00001000
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	6 bytes			

返回数据如下：

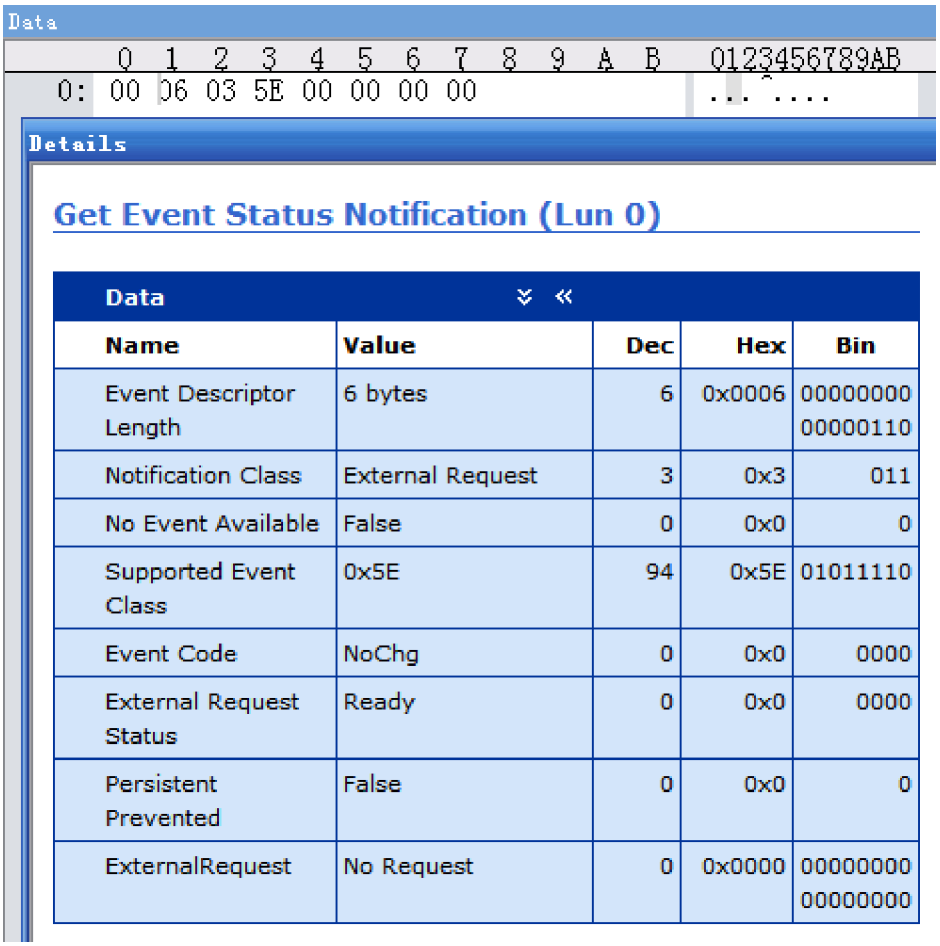

Data
0 1 2 3 4 5 6 7 8 9 A B 0123456789AB
0: 00 06 01 5E 00 00 00 00 ... .
Details
Data Transport
Data
Name
Value
Dec
Hex
Bin
Event Descriptor Length
6 bytes
6
0x0006
00000000 00000110
Notification Class
Operational Change Request/Notification
1
0x1
001
No Event Available
False
0
0x0
0
Supported Event Class
0x5E
94
0x5E
01011110
Event Code
NoChg
0
0x0
0000
Operational Status
0x0
0
0x0
0000
Persistent Prevented
False
0
0x0
0
Operational Change
No changes in operational state requested or performed
0
0x0000
00000000 00000000

还可能的回复



Get Event Status Notification (Lun 0)

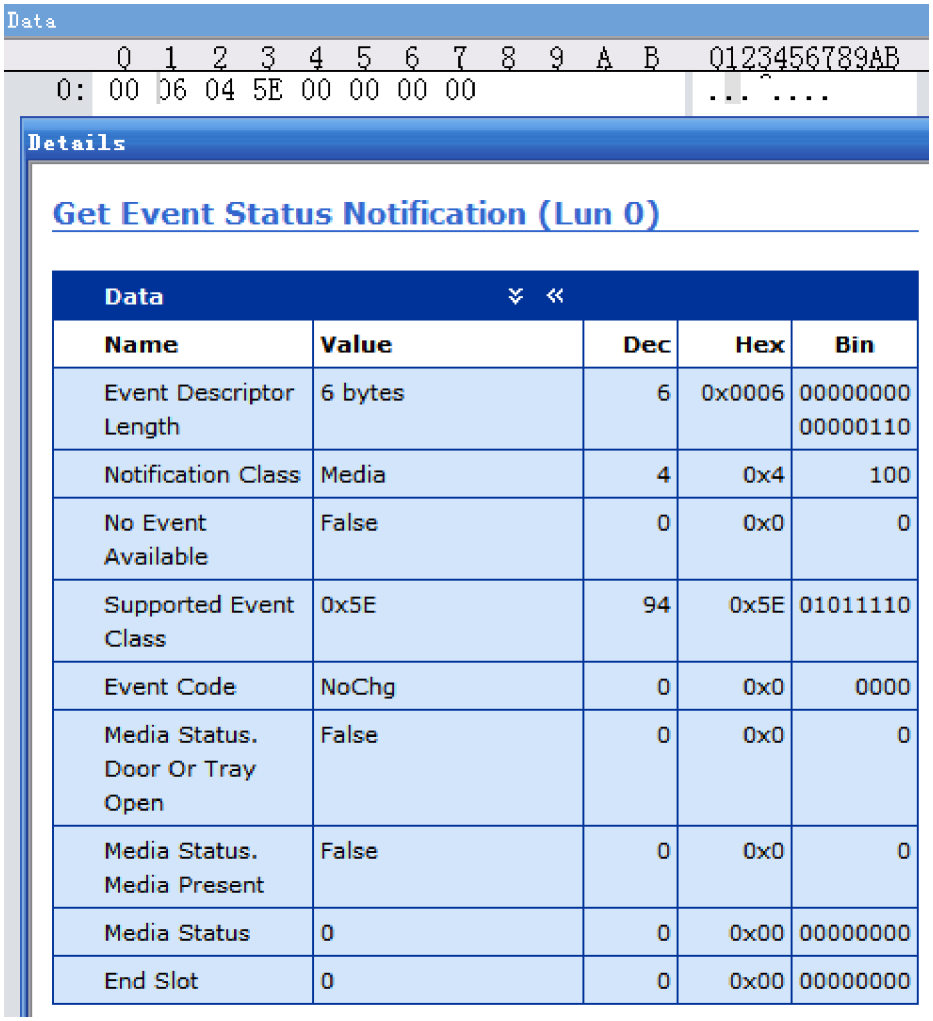
Data				
Name	**Value**	**Dec**	**Hex**	**Bin**
Event Descriptor Length	6 bytes	6	0x0006	00000000 00000110
Notification Class	Device Busy	6	0x6	110
Reserved	0x0	0	0x0	0000
No Event Available	False	0	0x0	0
Supported Event Class	0x5E	94	0x5E	01011110
Event Code	NoChg	0	0x0	0000
Reserved	0x0	0	0x0	0000
Device Bus Status	Not Busy	0	0x00	00000000
Time	0.000 ps	0	0x0000	00000000 00000000



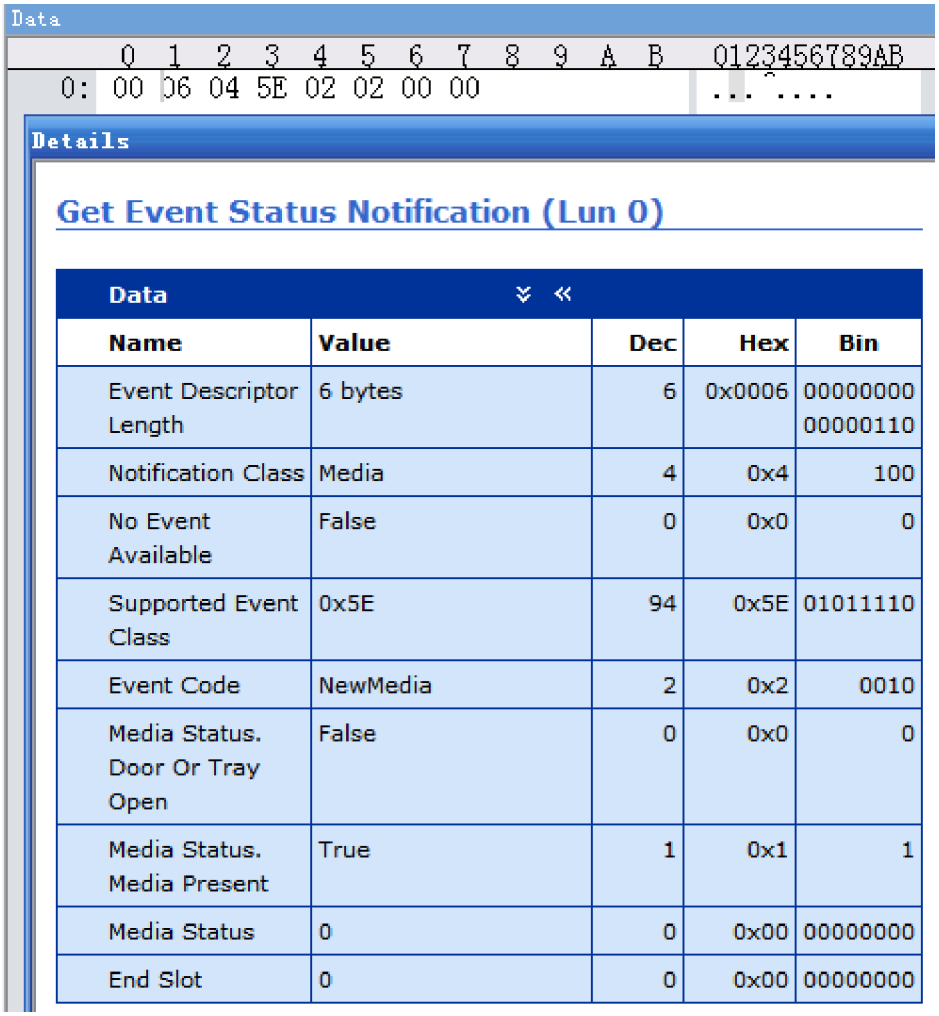
Get Event Status Notification (Lun 0)

Data

Name	Value	Dec	Hex	Bin
Event Descriptor Length	6 bytes	6	0x0006	00000000 00000110
Notification Class	External Request	3	0x3	011
No Event Available	False	0	0x0	0
Supported Event Class	0x5E	94	0x5E	01011110
Event Code	NoChg	0	0x0	0000
External Request Status	Ready	0	0x0	0000
Persistent Prevented	False	0	0x0	0
ExternalRequest	No Request	0	0x0000	00000000 00000000



下面这个非常重要，表示插入光盘



四.Test Unit Ready 命令

USBMass-ufi10.PDF

4.16 TEST UNIT READY Command: 00h

The TEST UNIT READY command provides a means to check if the UFI device is ready. This is not a request for a self-test. If the UFI device would accept an appropriate medium-access command without returning CHECK CONDITION status, this command shall return a GOOD status. If the UFI device cannot become operational or is in a state such that a host action is required to make the UFI device ready, the UFI device shall return CHECK CONDITION status with a sense key of NOT READY.

Table 45 - TEST UNIT READY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

The UFI device may fail a TEST UNIT READY command with a sense key of NOT READY and an Additional Sense Code of LOGICAL DRIVE NOT READY – INITIALIZATION REQUIRED. After clearing the error, the host should try issuing a START command block.

具体命令格式

Data

```
      0  1  2  3  4  5  6  7  8  9  A  B   0123456789AB
 0:  55 53 42 43 28 CE E2 88 00 00 00 00   USBC(.......
12:  00 00 0C 00 00 00 00 00 00 00 00 00   ............
24:  00 00 00 00 00 00 00                 .......
```

Bookmarks | Devices | Setup | Data | Search | Export

Details

Command Transport

Command Block Wrapper

Name	Value	Dec	Hex	Bin
Data Transfer Length	0 bytes	0	0x00000000	00000000 00000000 00000000 00000000
Flags. Direction	Data-Out from host to the device	0	0x0	0
Logical Unit Number	0	0	0x0	0000
Command Block Length	12 bytes	12	0x0C	01100

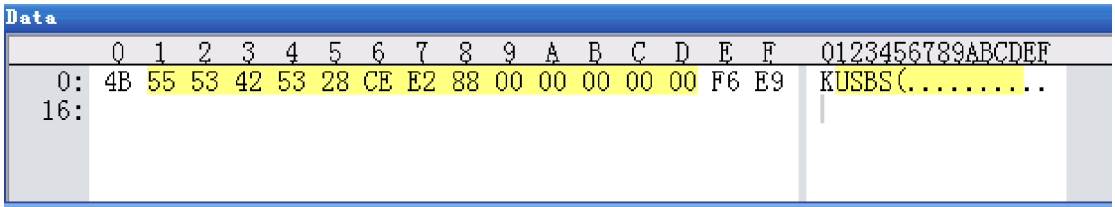
Details

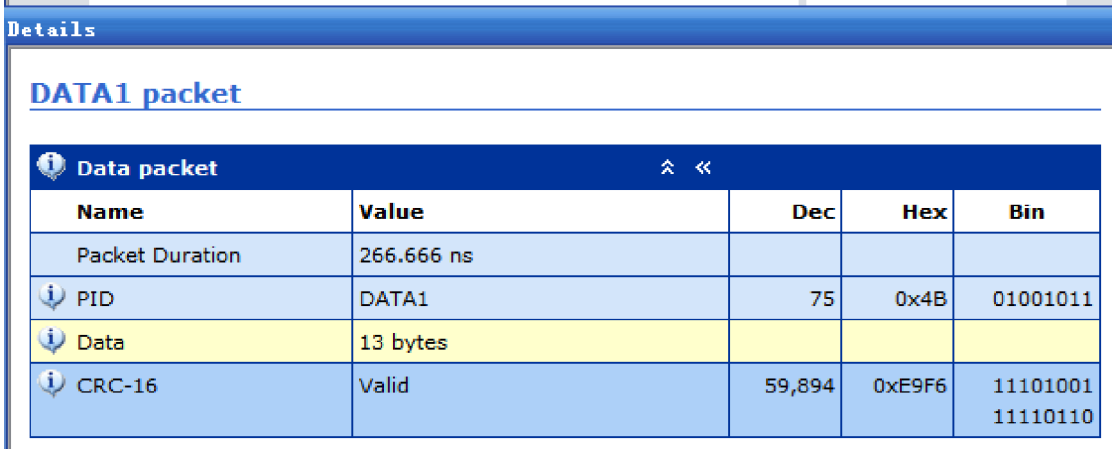
Command Block Length	12 bytes	12	0x0C	01100

Command

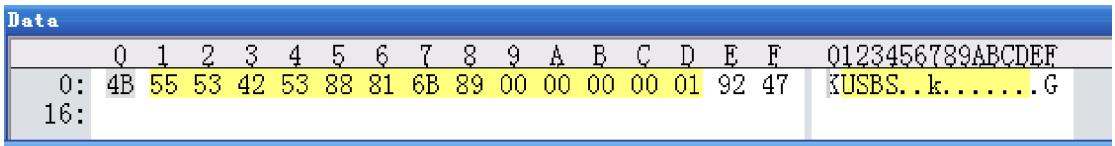
Name	Value	Dec	Hex	Bin
Operation Code	TEST UNIT READY	0	0x00	00000000
Reserved	0x00	0	0x00	00000
Logical Unit Number	0	0	0x0	000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	10 bytes			

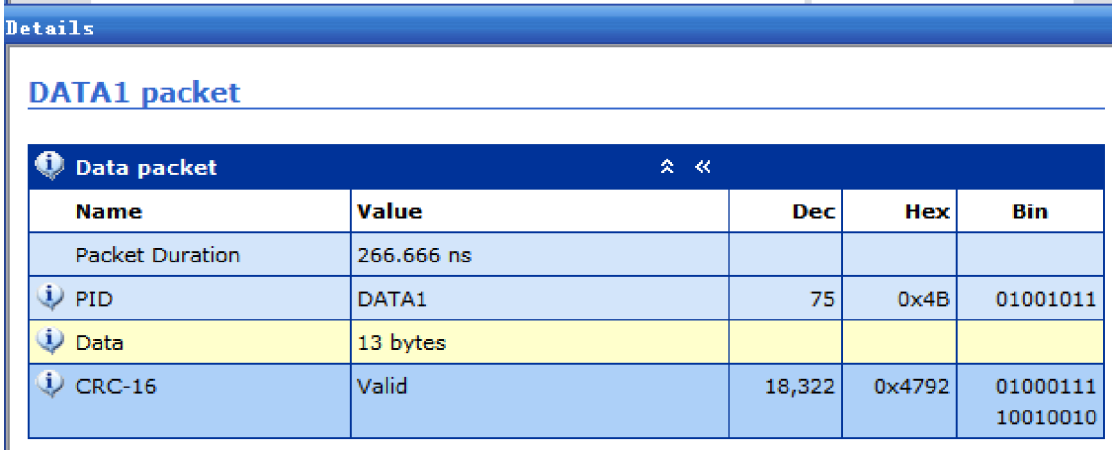
Ready 的应答





另外一个例子中，出错的情况：





五.Request Sense 命令

资料 INF-8070.pdf <<ATAPI Removable Rewritable Specification>>

REQUEST SENSE Command

The REQUEST SENSE command instructs the ATAPI Block Device to transfer sense data to the host computer.

Table 50 - REQUEST SENSE Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

具体的例子：

Data

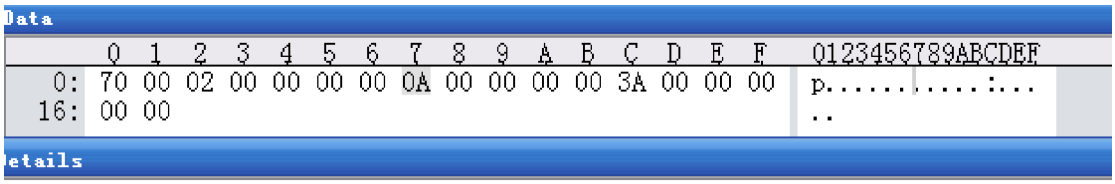
```
     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
 0: 55 53 42 43 88 81 6B 89 12 00 00 00 80 00 0C 03   USBC..k.........
16: 00 00 00 12 00 00 00 00 00 00 00 00 00 00 00 00   ................
```

Details

Command Block Wrapper	
Data Transfer Length	18 bytes
Flags. Direction	Data-In from the device to the host
Logical Unit Number	0
Command Block Length	12 bytes

Command				
Name	**Value**	**Dec**	**Hex**	**Bin**
Operation Code	REQUEST SENSE	3	0x03	00000011
Reserved	0x00	0	0x00	00000
Logical Unit Number	0	0	0x0	000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Allocation Length	18 bytes	18	0x12	00010010
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	10 bytes			

返回值：



Data Transport

Data				
Name	**Value**	**Dec**	**Hex**	**Bin**
Error Code	Current errors	112	0x70	1110000
Valid	No	0	0x0	0
Reserved	0x00	0	0x00	00000000
Sense Key	Not Ready	2	0x2	0010
Reserved	0x0	0	0x0	0000
Information	0x00000000	0	0x00000000	00000000 00000000 00000000 00000000
Additional Sense Length	10 bytes	10	0x0A	00001010
Reserved	0x00000000	0	0x00000000	00000000 00000000 00000000 00000000
Additional Sense Code	Medium Not Present	14,848	0x3A00	00111010 00000000
Reserved	0x00000000	0	0x00000000	00000000 00000000 00000000 00000000

关于 Sense Key 的值

Table 53 - Sense Key Descriptions

Sense Key	Description
0h	NO SENSE. Indicates that there is no specific sense key information to be reported. This would be the case for a successful command.
1h	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the ATAPI Block Device. Details may be determinable by examining the additional sense bytes and the Information field. When multiple recovered errors occur during one command, the choice of which error to report is device specific.
2h	NOT READY. Indicates that the ATAPI Block Device cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR. Indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the ATAPI Block Device is unable to distinguish between a flaw in the medium and a specific hardware failure (sense key 4h).
4h	HARDWARE ERROR. Indicates that the ATAPI Block Device detected a non-recoverable hardware failure while performing the command or during a self-test.
5h	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the Command Packet or in the additional parameters supplied as data for some commands. If the ATAPI Block Device detects an invalid parameter in the Command Packet, then it ***shall*** terminate the command without altering the medium. If the ATAPI Block Device detects an invalid parameter in the additional parameters supplied as data, then the ATAPI Block Device may have already altered the medium.
6h	UNIT ATTENTION. Indicates that the removable medium may have been changed or the ATAPI Block Device has been reset.
7h	DATA PROTECT. Indicates that a command that writes the medium was attempted on a block that is protected from this operation. The write operation was not performed.
8h	BLANK CHECK. Indicates that a write-once device or a sequential-access device encountered blank medium or format-defined end-of-data indication while reading or a write-once device encountered a non-blank medium while writing.
9h	Vendor Specific. This sense key is available for reporting vendor specific conditions.
Ah	Reserved
Bh	ABORTED COMMAND. Indicates that the ATAPI Block Device has aborted the command. The host may be able to recover by trying the command again.
Ch	Reserved
Dh	VOLUME OVERFLOW. Indicates that a buffered peripheral device has reached the end-of-partition and data may remain in the buffer that has not been written to the medium.
Eh	MISCOMPARE. Indicates that the source data did not match the data read from the medium.
Fh	Reserved

六. Read TOC/PMA/ATIP

USB_MSC_Boot1[1].0.pdf << Universal Serial Bus Mass Storage Specification For Bootability >>

5.1 READ TOC

The READ TOC command is used by the Host Computer to identify a multi-session CD.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (43h)							
1	Reserved						MSF	Reserved
2	Reserved				Format-A			
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	MSB Allocation Length							
8								LSB
9	Format-B		Reserved					
10	PAD							
11								

Table 14 READ TOC command

To identify the multi-session CD TOC, the Host Computer shall issue the following READ TOC command.

The Format-A field in byte 2 of the CBD shall be set to zero and the Format-B field, bits 7-6 of byte 9, shall be set to 01b. These values indicate "Multi-session mode". All other values are reserved for definition in MMC.

The MSF bit shall be set to 0 to indicate that the return CD address values are specified in LBA format, not minute second frame.

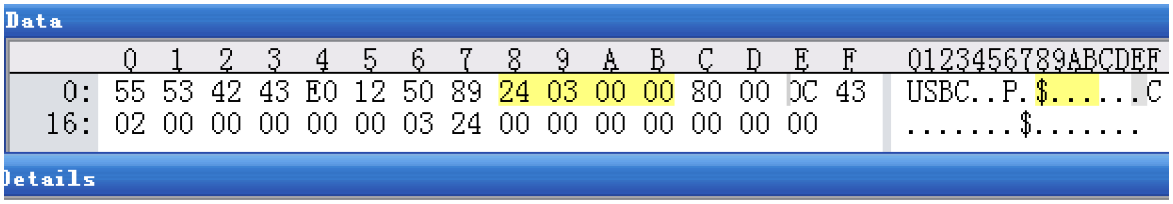
The Allocation Length shall be set to 0Ch (12); all other values are reserved.

返回值部分和具体实验结果有差异

Bit / Byte	7	6	5	4	3	2	1	0
0	MSB TOC Data Length (0Ah)							
1								LSB
2	First Complete Session Number							
3	Last Complete Session Number							
	TOC Track Descriptor							
0	Reserved							
1	Reserved							
2	First Track Number in Last Complete Session							
3	Reserved							
4	MSB							
5	Logical Block Address of First Track in Last Session							
6								
7								LSB

Table 15 READ TOC data

发送命令的实例：



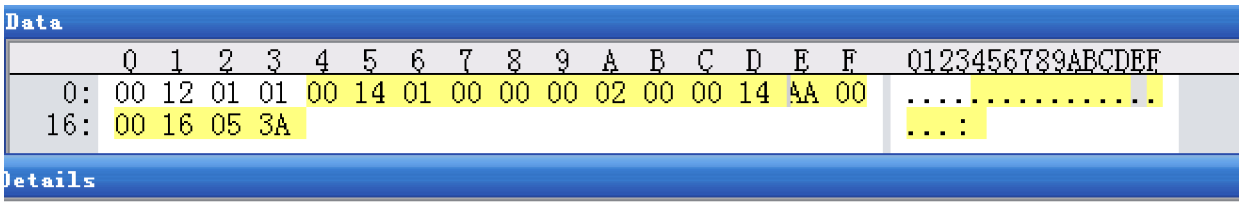
Command Transport

Command Block Wrapper	
Data Transfer Length	804 bytes
Flags. Direction	Data-In from the device to the host
Logical Unit Number	0
Command Block Length	12 bytes

Command

Name	Value	Dec	Hex	Bin
Operation Code	READ TOC/PMA/ATIP	67	0x43	01000011
Reserved	0x0	0	0x0	0
MCF	True	1	0x1	1
Reserved	0x00	0	0x00	000000
Format	0000	0	0x0	0000
Reserved	0x0	0	0x0	0000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Track Session Number	0	0	0x00	00000000
Allocation Length	804 bytes	804	0x0324	00000011 00100100
Control	0x00	0	0x00	000000
SFF8020 Format	False	0	0x0	00
Padding	6 bytes			

返回值部分



Data Transport

Data				
Name	**Value**	**Dec**	**Hex**	**Bin**
Data Length	18 bytes	18	0x0012	00000000 00010010
First Track/Session/Reserved Field	1	1	0x01	00000001
Last Track/Session/Reserved Field	1	1	0x01	00000001
Parameter List Descriptor Data	See Data pane	-	-	-

其中的后面 See Data pane 含义不清楚

七.Read Capacity 命令

USBMass-ufi10.pdf << USB Mass Storage Class – UFI Command Specification >>

命令格式：

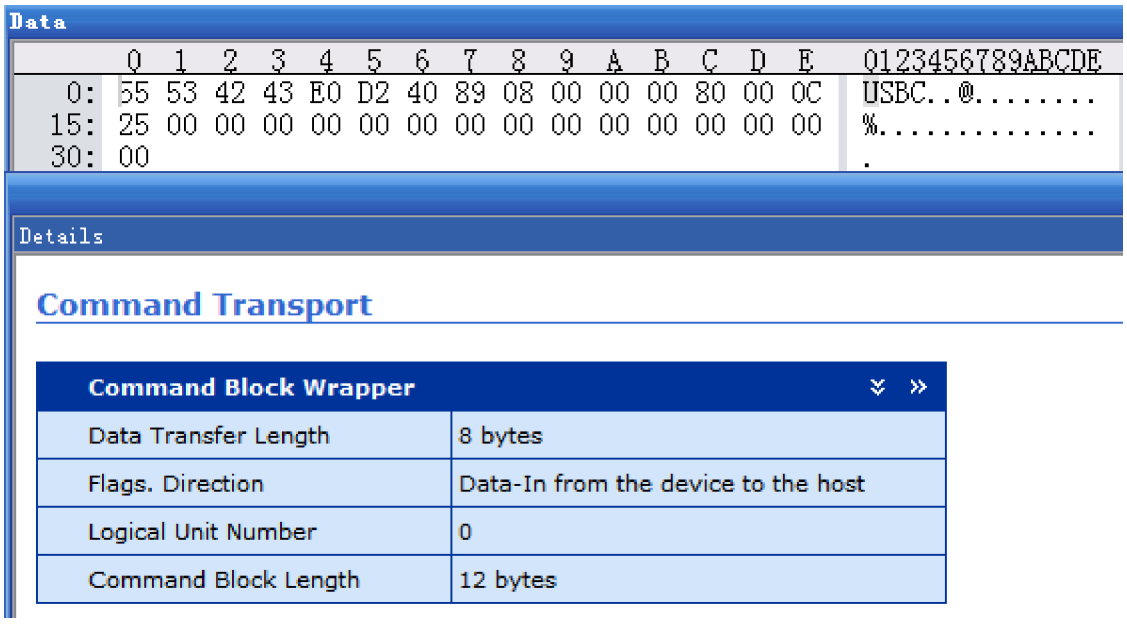
Table 27 - READ CAPACITY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (25h)							
1	Logical Unit Number			Reserved				RelAdr
2	(MSB)							
3	Logical Block Address							
4								
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							PMI
9	Reserved							
10	Reserved							
11	Reserved							

返回值格式：

Table 28 - READ CAPACITY Data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				Last Logical Block Address				
2								
3								(LSB)
4	(MSB)							
5				Block Length In Bytes				
6								
7								(LSB)



Command				
Name	**Value**	**Dec**	**Hex**	**Bin**
Operation Code	READ CAPACITY	37	0x25	00100101
Relative Addressing	No	0	0x0	0
Reserved	0x0	0	0x0	0000
Logical Unit Number	0	0	0x0	000
Logical Block Address	0	0	0x00000000	00000000 00000000 00000000 00000000
Reserved	0x00	0	0x00	00000000
Reserved	0x00	0	0x00	00000000
Partial Medium Indicator	0	0	0x0	0
Reserved	0x00	0	0x00	0000000
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	6 bytes			

返回值，直接告诉是 2048

Data

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	0123456789ABCDE
0:	00	01	83	D2	00	00	08	00								.....

Details

Data Transport

Data				
Name	**Value**	**Dec**	**Hex**	**Bin**
Last Logical Block Address	99,282	99,282	0x000183D2	00000000 00000001 10000011 11010010
Block Length	2.00 kB (2,048 bytes)	2,048	0x00000800	00000000 00000000 00001000 00000000

八.Read（10）

Usbmass-ufi10.pdf <<USB Mass Storage Class – UFI Command Specification>>

命令格式：

4.7 READ(10) Command: 28h

The READ(10) command requests that the UFI device transfer data to the host. The most recent dat
written in the addressed logical block shall be returned.

See section 4.8 "READ(12) Command: A8h" on page 31 for a definition of the operation of this co

Table 25 - READ(10) Command

Bit / Byte	7	6	5	4	3	2	1
0	Operation Code (28h)						
1	Logical Unit Number			DPO	FUA	Reserved	
2	(MSB)						
3	Logical Block Address						
4							
5							
6	Reserved						
7	Transfer Length (MSB)						
8	Transfer Length (LSB)						
9	Reserved						
10	Reserved						
11	Reserved						

具体例子：

Data

```
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E   0123456789ABCDE
 0:  55 53 42 43 E0 E3 34 89 00 10 00 00 80 00 0C  USBC..4.....
15:  28 00 00 00 00 00 00 00 02 00 00 00 00 00 00  (..............
30:  00                                           .
```

Details

Command Transport

Command Block Wrapper

Name	Value	Dec	Hex	Bin
Signature	0x43425355	1,128,420,181	0x43425355	01000011 01000010 01010011 01010101
Tag	0x8934E3E0	2,301,944,800	0x8934E3E0	10001001 00110100 11100011 11100000
Data Transfer Length	4.00 kB (4,096 bytes)	4,096	0x00001000	00000000 00000000 00010000 00000000
Flags. Reserved	0x00	0	0x00	000000
Flags. Obsolete	0	0	0x0	0
Flags. Direction	Data-In from the device to the host	1	0x1	1
Logical Unit Number	0	0	0x0	0000
Reserved	0x0	0	0x0	0000
Command Block Length	12 bytes	12	0x0C	01100
Reserved	0x0	0	0x0	000

Command				
Name	**Value**	**Dec**	**Hex**	**Bin**
Operation Code	READ(10)	40	0x28	00101000
Relative Addressing	No	0	0x0	0
Reserved	0x0	0	0x0	00
Force Unit Access	No	0	0x0	0
Disable Page Out	No	0	0x0	0
Logical Unit Number	0	0	0x0	000
Logical Block Address	0	0	0x00000000	00000000 00000000 00000000 00000000
Reserved	0x00	0	0x00	00000000
Transfer Length	2 blocks	2	0x0002	00000000 00000010
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	6 bytes			

另外的例子：LBA17

Data

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	0123456789ABCDE
0:	55	53	42	43	E0	E3	34	89	00	08	00	00	80	00	0C	USBC..4.....
15:	28	00	00	00	00	11	00	00	01	00	00	00	00	00	00	(.....
30:	00															.

Command				
Name	**Value**	**Dec**	**Hex**	**Bin**
Operation Code	READ(10)	40	0x28	00101000
Relative Addressing	No	0	0x0	0
Reserved	0x0	0	0x0	00
Force Unit Access	No	0	0x0	0
Disable Page Out	No	0	0x0	0
Logical Unit Number	0	0	0x0	000
Logical Block Address	17	17	0x00000011	00000000 00000000 00000000 00010001
Reserved	0x00	0	0x00	00000000
Transfer Length	1 block	1	0x0001	00000000 00000001
Control. Link	0	0	0x0	0
Control. Flag	0	0	0x0	0
Control. Reserved	0x0	0	0x0	0000
Control. Vendor-Specific	0x0	0	0x0	00
Padding	6 bytes			

返回值就是赤裸的数据