Technical Note

Micron UFS Memory Health Report for Mobile Devices

Introduction

This technical note describes how to obtain the health report information for Micron's UFS devices specified below. The health report information is accessed via proprietary vendor-unique (VU) commands issued through the SCSI interface of the UFS device.

Because UFS devices are Managed NAND components, and NAND cells are stressed by the continuous use of UFS devices, it is important to understand how usage affects the device and the device data. The health report is a resource that allows customers to monitor a device's media usage and the length of time that the device can be cycled.

Scope

The following Micron UFS devices are compatible with this method of retrieving the health report information.

Table 1: Micron UFS Device Listing

Part Number	Density	Package	Package Code
MTFC64GAOAMEA-WT	64GB	153-ball WFBGA 11.5mm x 13.0mm x 0.8mm	EA
MTFC128GAOAMEA-WT	128GB		
MTFC256GAOAMAM-WT	256GB	153-ball WFBGA 11.5mm x 13.0mm x 1.0mm	AM

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Obtaining Health Report Data

Obtaining the report data requires using the SCSI commands WRITE BUFFER and READ BUFFER with opcodes 0x3B and 0x3C, respectively. The command details are given below, but in short, a VU command request is issued to the device via the WRITE BUFFER command. A READ BUFFER command is then used to retrieve the 512B data burst reply, which contains the health report data.

Table 1 shows the format for the WRITE BUFFER command. The READ BUFFER command will follow a similar format. Note the new 0x3C opcode (Byte 0), and that in both the WRITE and READ commands the VU operation must use the reserved bits of Byte 1.

Command Sequence

1. Command descriptor block (CDB) for WRITE BUFFER:3B E1 00 00 00 00 00 00 2C 00VU Parameter List Data (0x2C == 44B)

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
FE	40	00	10	01	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

2. CDB for READ BUFFER: 3C C1 00 00 00 00 00 02 00 00

Table 2: WRITE BUFFER Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (3Bh)							
1	Reserved			Mode				
2	Buffer ID							
3	(MSB)	Buffer offset						
5								(LSB)
6	(MSB)	Parameter list length						
8								(LSB)
9	Control							

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Table 3: Health Report: Initial Values

Name	Hex	Decimal	Comments
Factory bad block count	–	–	Varies by each unit, NAND dependent
Run-time bad block count	0x0	0	
Spare block count	–	–	Varies by each unit, NAND dependent
Reserved block count for SLC	0x1	1	
Reserved block count for TLC	0x2	2	
Exhausted life for SLC	0x1	1	
Exhausted life for TLC	0x1	1	
Metadata corruption	0x0	0	
Write amplification factor	0x64	100	Default to 1.00
Minimum block erase for TLC	0x0	0	
Maximum block erase for TLC	0x0	0	Customer may see 1 on the fresh part
Average block erase for TLC	0x0	0	
Minimum block erase for SLC	0x0	0	
Maximum block erase for SLC	0x0	0	Customer may see 1 on the fresh part
Average block erase for SLC	0x0	0	
Initialization count (success)	0x0	0	
Initialization count (failure)	≤0x4	≤4	Artifact of the manufacturing process
Read reclaim count for SLC	0x0	0	
Read reclaim count for TLC	0x0	0	
Read data size (unit: 100MB)	0x0	0	
Written data size (unit: 100MB)	0x0	0	
SPOR write fail count	0x0	0	
SPOR recovery count	≤0x4	≤4	Artifact of the manufacturing process
VDET count	0x0	0	
UECC count	0x0	0	This count includes UECC's from the host read, GC, and in some cases power loss.
Read retry count	0x0	0	

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Understanding Health Report Data

512B of data will be acquired by the READ BUFFER command (0x200B). The data should look similar to what is shown below.

00	00	06	00	00	00	11	00	01	00	11	01	01	00	00	01	4a
10	00	00	00	05	00	00	00	30	00	00	00	1f	00	00	00	00
20	00	00	00	05	00	00	00	28	00	00	00	0a	00	00	00	00
30	00	00	00	06	00	00	00	0c	00	00	00	00	00	00	00	00
40	00	00	00	37	00	00	31	a1	00	00	00	00	00	00	00	0c
50	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
…																
1f0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

Use the byte decode from Table 2 to evaluate the data.

Table 4: Health Report Decode

HR Output (offset bytes)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
000	Factory bad block count		Run-time bad block count		Spare block count		Reserved block count for SLC		Reserved block count for TLC		Exhausted life for:		Meta data corruption		Write amplification factor	
											SLC	TLC				
010	Minimum block erase for TLC				Maximum block erase for TLC				Average block erase for TLC				Reserved			
020	Minimum block erase for SLC				Maximum block erase for SLC				Average block erase for SLC				Reserved			
030	Initialization count (success)				Initialization count (failure)				Read reclaim count for SLC				Read reclaim count for TLC			
040	Read data size (unit: 100MB)				Written data size (unit: 100MB)				SPOR write fail count				SPOR recovery count			
050	VDET count				UECC count				Read retry count				Reserved			
060	Reserved				Reserved				Reserved				Reserved			
070	…				…				…				…			
…	Reserved				Reserved				Reserved				Reserved			
…	Reserved				Reserved				Reserved				Reserved			

Note: 1. Block counts are given in virtual blocks, not in discrete NAND blocks.

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Table 5: Health Byte Report Details

Byte	Description
0x0A	Current output value is coupled with 00B and based on TLC blocks
TLC exhausted life	(Dynamic SLC EC/2 + TLC EC)/1500
0x0B	Current output value is coupled with 00A and based on TLC blocks
TLC exhausted life	Dynamic SLC EC/2 + TLC EC)/1500
0x10 - 0x13	Because of Architecture of Device, this value represents the min block erase count for all user blocks currently being used as TLC
0x14 - 0x17	Because of Architecture of Device, this value represents the min block erase count for all user blocks currently being used as TLC
0x18 - 0x1B	Because of Architecture of Device, this value represents the min block erase count for all user blocks currently being used as TLC
0x20 - 0x23	Because of Architecture of Device, this value represents the max block erase count for all user blocks currently being used as SLC
0x24 - 0x27	Because of Architecture of Device, this value represents the max block erase count for all user blocks currently being used as SLC
0x28 - 0x2B	Because of Architecture of Device, this value represents the max block erase count for all user blocks currently being used as SLC
0x38 - 0x3B	Because of Architecture of Device, this value represents the max block erase count for all user blocks currently being used as SLC
0x3C - 0x3F	Because of Architecture of Device, this value represents the min block erase count for all user blocks currently being used as TLC

Note: 1. Write amplification should be decimalized then divided by 100; that is, 0x14A > 330/100 ≥ 3.30.

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Revision History

Rev. C – 05/19

- Added the "Health Report: Initial Values" table

Rev. B – 12/17

- Added in additional health decode bye description

Rev. A – 11/17

- Initial release

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