

UFS Product family

UFS2.0 Specification Compatible

datasheet

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1.0 INTRODUCTION

1.1 General Description

UFS(Universal Flash Storage) is an embedded Flash storage for mobile systems which consists of NAND Flash and Flash controller. UFS has a high speed serial interface which supports up to HS-GEAR2 with 2lane.

UFS basically supports Flash-friendly eMMC features such as partitions for boot and RPMB, security of write protect and Purge, several Flash managements like background operation, power off notification. Also, UFS has SSD-like command queue feature which is based on SCSI architecture model to enhance responsiveness for better user experience.

Samsung UFS is based on industry-leading specifications from MIPI Alliance to support high performance and is optimized with Samsung's cutting edge NAND Flash memory technology.

1.2 Reference Documents

This datasheet is based on the following normative documents. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

- [JEDEC], UFS Specification – JESD220A
- [MIPI-UniPro], MIPI Alliance Specification for Unified Protocol (UniProSM) Version 1.6
- [MIPI-M-PHY], MIPI Alliance Specification for M-PHYSM Specification, Version 3.0
- [MIPI-DDB], MIPI Alliance Specification for Device Descriptor Block, Version
- [SAM], SCSI Architecture Model – 5 (SAM-5), Revision 05, 19 May 2010
- [SPC], T10 Specification : SCSI Primary Commands – 4 (SPC-4), Revision 27, 11 October 2010 Samsung UFS
- [SBC], T10 Specification : SCSI Block Commands – 3 (SBC-3), Revision 24, 05 August 2010

1.3 Product Line-up

[Table 1] Product Line-up

Product	UFS Part ID	NAND Flash Type	User Capacity(%)	Package size	Ball Configuration
16 GB	KLUAG2G1BD-B0B2	64Gb x 2	91.7	11.5mm x 13mm x 1.0mm	153 ball
32 GB	KLUBG4G1BD-B0B1	64Gb x 4	91.0		
64 GB	KLUCG8G1BD-B0B1	64Gb x 8			

1.4 General Features

- UFS supports UFS2.0 features defined by JEDEC Standard
 - Boot Operation Mode, Command Queue, Cache, Reliable Write operation, Background operation, Secure operations, Task Management operation, Power Management operations, support for Boot and RPMB partition
- Full backward compatibility with UFS1.1 specification (HS-Gear2, 1Lane)
- Interface:
 - Support for High Speed Gears : up to HS-GEAR2 2Lane
 - Low-speed mode(PWM) : LS mode(gear 1,2,3,4)
 - High-speed burst mode : HS mode(gear 1,2)
- UFS Layering :
 - MIPI M-PHY specification version v3.0
 - MIPI UniPro specification version v1.6 (Deep stall is not supported)
- Temperature : Operation(-25°C ~ 85°C), Storage without operation (-40°C ~ 85°C)
- Power Supplies for I/O & Core
 - VCCQ2 supply: 1.8V
 - VCC supply: 3.3 V
- 8b10b line coding, as defined by MIPI M-PHY

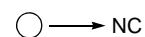
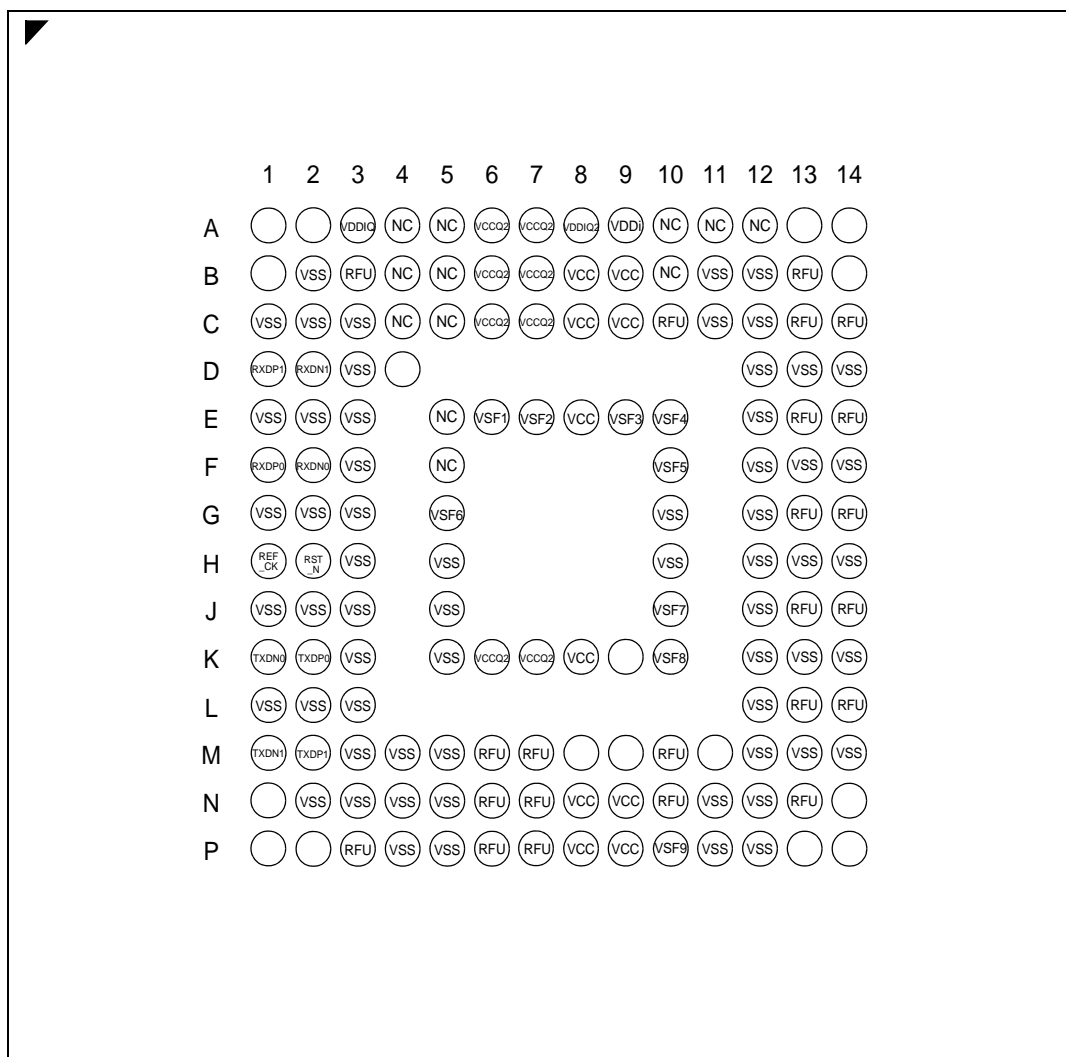
2.0 PRODUCT SPECIFICATION

2.1 Mechanical Specification

2.1.1 UFS Ball Assignment

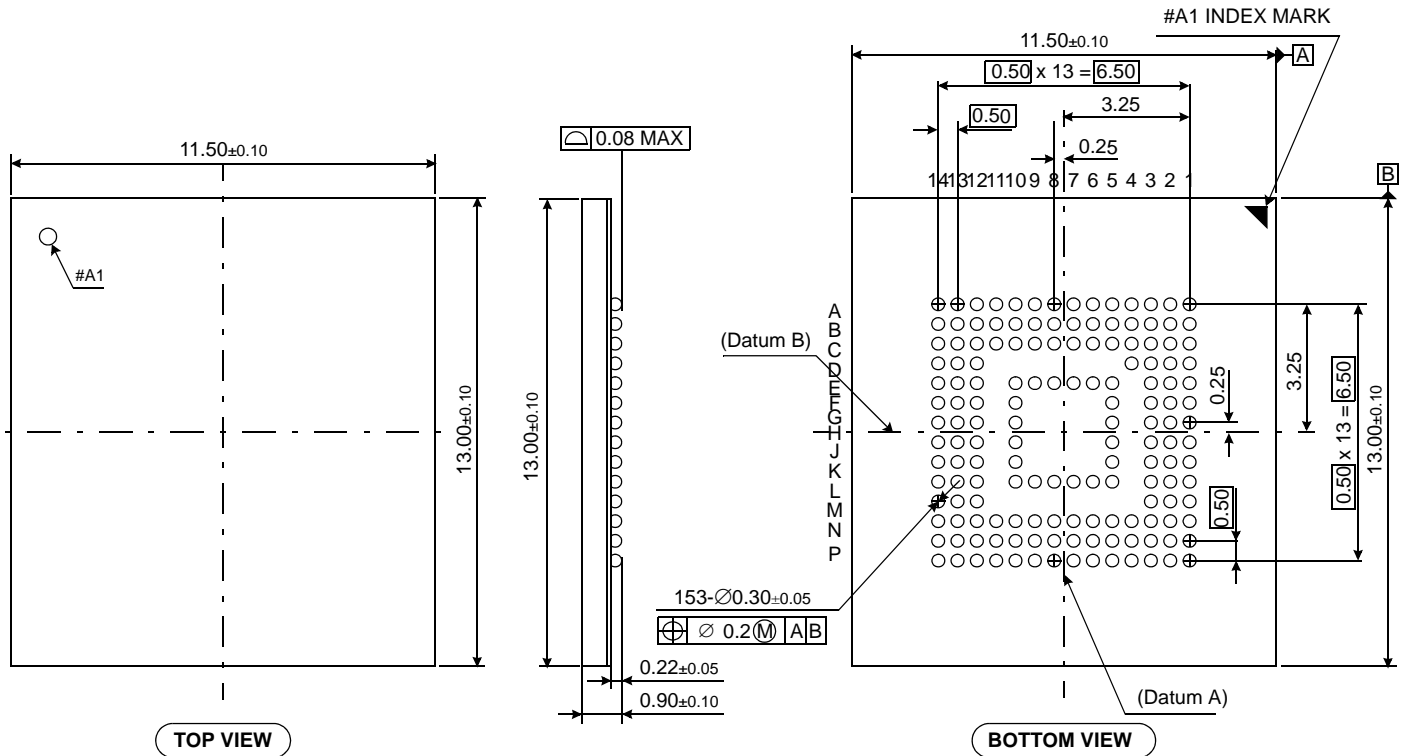
[Table 2] 153 FBGA Ball Information

Name	Type	Description
VCC	Supply	Supply voltage for the memory devices
VCCQ2	Supply	Supply voltage used typically for the PHY interface and the memory controller and any other internal low voltage block
VDDiQ	Input	Input terminal to provided bypass capacitor for VCCQ internal regulator typically related to the memory controller
VDDiQ2	Input	Input terminal to provide bypass capacitor for VCCQ2 internal regulator, typically related to memory IF
VDDi	Input	Input terminal to provide bypass capacitor for VCC internal regulator
VSS	Supply	Ground
RST_n	Input	Input hardware reset signal. This is an active low signal
REF_CLK	Input	Input reference clock. When not active, this signal shall be pull-down or driven low by the host SoC.
RXDP0 / RXDP1	Input	Downstream data lane(1st and 2nd lane) : differential input signals into UFS device from the host
RXDN0 / RXDN1		
TXDP0 / TXDP1	Output	Upstream data lane(1st and 2nd lane) : differential output signals from the UFS device to the host
TXDN0 / TXDN1		
NC	-	Not Connected. NC pins can be connected to ground or left floating
RFU	-	Reserved for Future Use. RFU pins must be left floating.
VSF _n	-	Vendor Specific Function. VSF _n (n=1-9) pins must be left floating. Each vendor is able to use these pins during manufacturing

[Figure 1] 153FBGA Ball Assignment

2.1.1.1 11.5mm x 13mm x 1.0mm Package Dimension

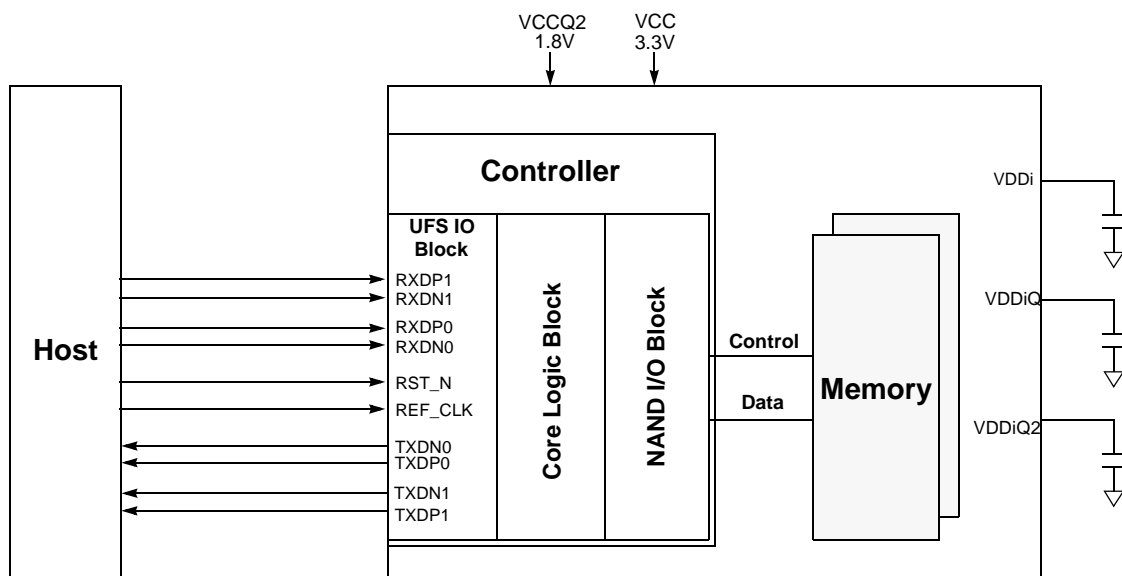


[Figure 2] 11.5mm x 13mm x 1.0mm Package Dimension

2.1.2 UFS Device Block Diagram

As described in Chapter 1.4, UFS requires two power supplies from the host side. Followings are information of the physical connection between the host and the device.

- Requires two power supplies ; 3.3V(VCC) and 1.8V(VCCQ2)
- The value of each capacitance component might be changed depending on different system environment
- For more details, refer to "Board Design Guide for Mobile Set", the application note, provided by Samsung



[Figure 3] UFS Device Block Diagram

2.2 Operating Conditions

2.2.1 Supply Voltage

[Table 3] Supply voltage for operating

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Voltage	VCC	2.7	3.3	3.6	V
Supply Voltage	VCCQ2	1.7	1.8	1.95	V

2.2.2 Temperature

The operating temperature is the UFS case surface temperature on the center of top side of the case

[Table 4] Temperature

Condition	Min	Max	Unit
Operation	-25	85	°C
Storage without Operation	-40	85	°C

2.3 Reference Clock

2.3.1 Reference Clock Description

[Table 5] Requirement of Reference Clock

Mode	Reference Clock On/Off
HS-Gear 1,2	On
PWM-gear 1,2,3,4	On

[Table 6] Reference Clock Support

Frequency	Support	Description
19.2 MHz	Yes	-
26.0 MHz	Yes	Default
38.4 MHz	No	-
52.0 MHz	No	-

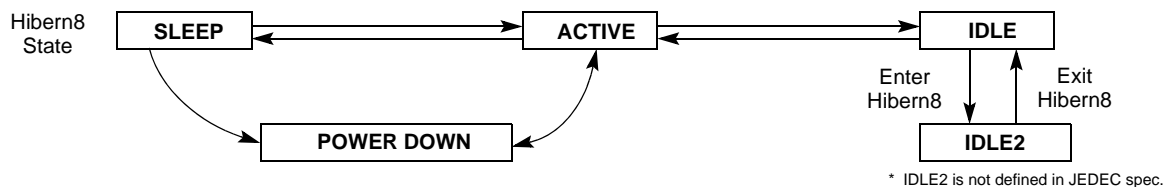
NOTE :

A frequency which is set in fRefClkFreq attribute shall be provided for the operations. If a different frequency were provided, the reference clock would not be recognized for PWM mode and HS mode. bRefClkFreq attribute should be set in PWM mode. After bRefClkFreq attribute is set, device should re-power up.

2.4 Power Mode

UFS device supports multiple power modes controlled by the START_STOP_UNIT command and some attributes. In order to support a variety of operating scenarios, UFS will support four basic power modes(active, Idle, sleep, powerdown) defined by UFS JEDEC specification. The two main power saving modes are described in the following sections. One is the Sleep Mode defined by UFS JEDEC and the other is the IDLE2 Mode defined by Samsung.

The relationship among the different power mode in UFS is shown in the following diagram



[Figure 4] Power Mode Diagram

[Table 7] Power mode and MIPI UniPro and M-PHY power state

UFS power mode	UniPro Power Mode	M-PHY Power Mode	VCC Power	Description
ACTIVE	FAST_STATE	HS-BURST	On	-
IDLE	SLEEP_STATE	STALL	On	-
IDLE2 ¹⁾	HIBERNATE_STATE	Hibern8	On	See the Chapter2.4.1
SLEEP	HIBERNATE_STATE	Hibern8	Off	-
POWER DOWN	OFF_STATE	UNPOWERED	Off	-

NOTE :

1) Samsung specific power mode for saving the IDLE power. Host shall issue 'enter hibern8' for this power mode.

2.4.1 The IDLE2 Mode

This device support a new power mode to minimize idle power consumption. It is not a UFS2.0 JEDEC standard power mode, but Samsung specific power mode. If a host does not issue any command during certain time, then the host can issue 'DME_HIBERNATE_ENTER' and the device automatically enters the IDLE2 mode for the IDLE power saving. It's the same as IDLE mode for host perspective. The following state is always the Active power mode and the receipt of any command will transition the device into Active power mode.

[Table 8] Shows the each layers power mode for IDLE2 mode.

Mode	Entering Condition	State
IDLE2	DME_HIBERNATE_ENTER	UFS : IDLE UniPro : HIBERNATE_STATE M-PHY : HIBERN8

2.5 Logical Unit Information

[Table 9] User Capacity

Device	User Capacity(%)	User Capacity(Bytes)
16 GB	91.7	15,758,000,128
32 GB	91.0	31,268,536,320
64 GB		62,537,072,640

NOTE :

1) The above user capacity is for user space that doesn't include Boot LU1 and Boot LU2.

[Table 10] Default Values for Logical Unit

Logical Unit		Values	Description
Normal User Area	Size	See table 9	Total Density
	bUnitIndex	00h	Unit Index
	bMemoryType	Normal Type	Memory Type
Boot1 ¹⁾	Size	4MB	Logical Unit Size
	bUnitIndex	01h	Unit Index
	bBootLunID	01h : Boot LU A	Boot LUN ID
	bMemoryType	Enhanced memory type 1 ³⁾	Memory Type
Boot2 ¹⁾	Size	4MB	Logical Unit Size
	bUnitIndex	02h	Unit Index
	bBootLunID	02h : Boot LU B	Boot LUN ID
	bMemoryType	Enhanced memory type 1 ³⁾	Memory Type
RPMB ²⁾	Size	4MB	Logical Unit Size
	bUnitIndex	C4h	Unit Index
	bMemoryType	Enhanced memory type 1 ³⁾	Memory Type

NOTE :

1) Need to set Enhanced memory type only

2) The logical unit size of RPMB is defined in the RPMB Unit Descriptor which shall be configured by manufacturers

3) Refer to the Chapter 13.2.2 in UFS 2.0 JEDEC standard

[Table 11] Memory Type Support

Memory Type	Mandatory / Optional	Support
Normal Type	M	Yes
System code ¹⁾	O	Yes
Non-Persistent ¹⁾	O	Yes
Enhanced type1	O	Yes
Enhanced type2	O	No
Enhanced type3	O	No
Enhanced type4	O	No
RPMB	M	Yes

NOTE :

1) Current version UFS Device is able to handle as Normal type

2.6 Performance

2.6.1 Default LU Performance

[Table 12] Default LU performance

Products	HS-Gear2 x 2Lane	
	Seq.Read (MB/s)	Seq.Write (MB/s)
16 GB	310	70
32 GB		100
64 GB		

NOTE :

Test/Estimation condition : Data transfer unit size is 512KByte, file system overhead is not considered, Performance may vary depending on test conditions and environment

3.0 SUPPORTED FEATURES

3.1 SCSI Command

The following table defines a SCSI command set supported by UFS

[Table 13] UFS SCSI Command Supportability

Command name	Opcode	Mandatory / Optional	Support	Comments
FORMAT UNIT ¹⁾	04h	M	YES	-
INQUIRY	12h	M	YES	-
MODE SELECT (10)	55h	M	YES	-
MODE SENSE (10)	5Ah	M	YES	-
PRE-FETCH (10)	34h	M	YES	-
PRE-FETCH (16)	90h	O	NO	Not required under 2TB
READ (6)	08h	M	YES	-
READ (10)	28h	M	YES	-
READ (16)	88h	O	NO	Not required under 2TB
READ BUFFER ²⁾	3Ch	O	YES	-
READ CAPACITY (10)	25h	M	YES	-
READ CAPACITY (16)	9Eh	O	YES	-
REPORT LUNS	A0h	M	YES	-
REQUEST SENSE	03h	M	YES	-
SECURITY PROTOCOL IN	A2h	M	YES	-
SECURITY PROTOCOL OUT	B5h	M	YES	-
SEND DIAGNOSTIC ³⁾	1Dh	M	YES	-
START STOP UNIT	1Bh	M	YES	-
SYNCHRONIZE CACHE (10)	35h	M	YES	-
SYNCHRONIZE CACHE (16)	91h	O	NO	Not required under 2TB
TEST UNIT READY	00h	M	YES	-
UNMAP	42h	M	YES	-
VERIFY (10)	2Fh	M	YES	-
WRITE (6)	0Ah	M	YES	-
WRITE (10)	2Ah	M	YES	-
WRITE (16)	8Ah	O	NO	Not required under 2TB
WRITE BUFFER ⁴⁾	3Bh	O	YES	-

M : mandatory, O : optional

NOTE :

1) Defect List(FMTDATA =1) is not supported

2) Only 01h in the Mode field is supported

3) Only the default SELF TEST(0x00) Mode is supported

4) Only 0Eh in the Mode field is supported

3.2 Functional Features

[Table 14] UFS2.0 Features Supportability

Function		Support	Description
H/W	H/W Reset Pin	Yes	-
Logical Unit / Partitions	LUs	Yes(up to 8)	Chapter2.5
	Boot LUs	Yes(up to 2)	
	RPMB LUs	Yes(up to 1)	
	LU Priority	Yes	-
	LU Type	Yes	-
	Logical Block Size ¹⁾	4KB	Chapter2.5
UFS Security Features	ERASE	Yes	Chapter3.2.2
	DISCARD	Yes	
	Purge	Yes	
	Wipe Device	Yes	
	Write Protection ²⁾	Yes	-
	RPMB	Yes	Chapter2.5
	Security Extension v1.0	Yes	-
Host Device Interaction	Inter-LU Priority	Yes	-
	Background Operation Mode	Yes	Chapter3.2.1
	Power Off Notification	Yes	Chapter3.2.6
	Dynamic Device Capacity	No	-
	Data Reliability	Yes	-
	Real-Time Clock Information	Yes	-
	Context Management	Yes	-
	System Data Tag Mechanism	Yes	-
	Exception Events Mechanism ³⁾	Yes	-
	Queue Priority [HPI]	Yes	Chapter3.2.3
	Out of Order Data Transfer	Yes	-
UFS Cache	Cache	Yes	Chapter3.2.4
Command Status Response	Illegal Request	Yes	-
	Medium Error	Yes	-
	Hardware Error	Yes	-
	Unit Attention	Yes	-
Vendor Specific Function	FW Update	Yes	Chapter3.2.5

NOTE :

1) bLogicalBlockSize= 4 KByte and not reconfigurable

2) Write Protection Should be independently executed for each LU and SWP(Software Write Protect) shall be enabled by using Mode Select

3) Only URGENT_BKOPS is supported

3.2.1 Background Operation Mode

When the command queue is empty and this mode is enabled, the background operation mode grants the device time to perform Flash management tasks such as wear leveling, garbage collection and bad block management. In order to reduce latencies during time critical operations, it is better to execute maintenance operations when the device is not serving the host. For more details, refer to UFS 2.0 JEDEC standard section 13.4.4

3.2.2 Security Features

The way in which data is removed securely from the device is dependent on the type of memory technology. The following table is description of methods that apply to Samsung UFS

[Table 15] Security Features

Features	Target Area	Description	
		Value of deallocated LBA	Erase of Physical Memory
ERASE	Unmapped LBA	0	No
DISCARD	Unmapped LBA	any data	No
PURGE	Unmapped LBA	0	Yes
WIPE Device	All device	0	Yes

3.2.3 Queue Priority

A Logical Unit contains a task queue that will support the processing of one or more tasks which are managed by the Logical Unit. The following table is description of queue types

[Table 16] Command Queue Description

Queue Type	Task Attribute Definition in Flags.ATTR ¹⁾		Support
	Bit 1	Bit 0	
Simple	0	0	Yes
Ordered	0	1	Yes
Head of Queue	1	0	Yes

NOTE :

1) The Flags.ATTR field in COMMAND UPIU contains the task attribute value as defined by the SAM-5 specification

3.2.4 Cache

The cache is a device level cache and volatile storage space in UFS. The cache data is not expected to remain valid over sudden power-off or HW/SW resets

3.2.5 Field Firmware Update

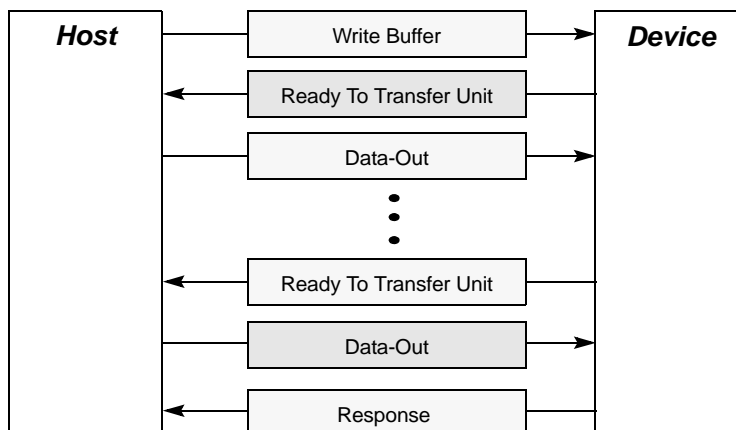
Field Firmware Update shall be implemented by using Write Buffer command which is optional in UFS2.0 JEDEC standards.

[Sequence]

- The Write Buffer command will transfer the necessary data to a temporary storage space in an UFS device.
- 0x0E is default mode , 0x01 is recommended once 0x0E is failed (0x01 is test purpose only)
- If the data transfer is finished, the UFS device will check the validity of the F/W
- If the data authentication is completed, the UFS device will start writing a new F/W to non-volatile storage space
- After the F/W update is successfully completed, the UFS device shall issue Response to the host and Host is expected to perform HW Reset in order to apply to a new F/W update (Device should re-power up to make sure the F/W is updated properly)

NOTE :

In order to check data integrity of a new F/W in non-volatile storage, Read Buffer (0x01) shall be used before power cycle.
After the F/W update is successfully completed, no other commands than Read Buffer shall be issued before power cycle.



[Figure 5] Field Firmware Update Sequence

[Error Handling]

When an error occurs during Field Firmware Update, the error handling shall be implemented by checking the value of Response Status in SCSI CMD. When the F/W update fails, the UFS is expected to remain previous data so that it shall be possible to read stale F/W data from the device. Detail guidelines for each error case are described in the following table.

[Table 17] Error Handling Description

Step	UPIU	Root Cause	Fail Status (SENSE KEY)	Fail Status (ASC & ASCQ)		Error Handling
Entry FFU	Write Buffer	Error about Command	ILLEGAL_REQUEST (0x05)	Not Support Well Known LU	INVALID_COMMAND_OPERATION_CODE(0x2000)	Retry Write Buffer
				Invalid LU	LOGICAL_UNIT_NOT_SUPPORTED (0x2500)	
				Invalid CDB	INVALID_FIELD_IN_CDB(0x2400)	
Write Patch Binary	RTT & Data Out	Error about F/W Image	MISCOMPARE (0x0E)	Invalid Header	MICROCODE_INVALID_HEADER (0x8000)	Retry Write Buffer
				Invalid Confirm	MICROCODE_INVALID_CONFIRM (0x8001)	
				Invalid Binary Contents	MICROCODE_INVALID_CONTENTS (0x8002)	
				Old FW version	MICROCODE_OLD_FW_VERSION (0x8003)	
				No Compatibility	MICROCODE_NOT_COMPATIVLE (0x8008)	
Exit FFU	Response	Error about NAND	MEDIUM_ERROR (0x03)	NAND Write Fail	MICROCODE_WRITE_ERROR (0x8004, 0x8005)	Retry Write Buffer

3.2.6 Power Off Notification

Power Off Notification allows the host to notify the device before the power off so that the device can prepare itself for being powered off and protect the risk of data loss. During this operation, the device requires time to complete any ongoing operations and the host may write meta data in advance that can reduce initialization time in the next power up sequence.

4.0 DC PARAMETERS

4.1 Power Consumption

[Table 18] Power Consumption

Power	Density	NAND Type	VCCQ2(1.8V)	VCC(3.3V)	Unit
Active	16 GB	64Gb MLC x 2	300	130	mA
IDLE2			450	50	uA
Sleep				0 ¹⁾	uA
Active	32 GB	64Gb MLC x 4	300	230	mA
IDLE2			450	70	uA
Sleep				0 ¹⁾	uA
Active	64 GB	64Gb MLC x 8	300	230	mA
IDLE2			450	130	uA
Sleep				0 ¹⁾	uA

NOTE :

* Power Measurement conditions: HS-Gear2 x 2 Lane, VCC=3.3V, VCCQ2=1.8V, Not 100% tested, TA=25°C over a period of 100ms

* The measurement for max RMS current is the average RMS current consumption over a period of 100ms

1) In the Sleep Mode NAND power can be turned off.

5.0 AC PARAMETERS

[Table 19] Time Parameter

Items	Max.	unit
Initialization Time after Power Off Notification	15	ms
Sync Cache	350	ms
Active to Sleep (or Idle2)	1	ms
Sleep to Active	1.1	ms
Enter Hibern8	300	us
Exit Hibern8	600	us
Active (or Sleep) to Power Down	5	ms
Read	100	ms
Write	350	ms
Erase	600	ms
Discard	600	ms
Wipe the device	3	min

NOTE :

Measurement conditions: HS-Gear2 x 2 Lane, VCC=3.3V, VCCQ2=1.8V, Not 100% tested, file system overhead is not considered

6.0 REGISTER VALUES

6.1 Descriptors

6.1.1 Device Descriptor

[Table 20] Device Descriptor

IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
00h	Device	00h	1	bLength	40h	No	-
		01h	1	bDescriptorType	00h	No	-
		02h	1	bDevice	00h	No	-
		03h	1	DeviceClass	00h	No	-
		04h	1	bDeviceSubClass	00h	No	-
		05h	1	bProtocol	00h	No	-
		06h	1	bNumberLU	03h	Yes	-
		07h	1	bNumberWLU	04h	No	-
		08h	1	bBootEnable	01h	Yes	01h = bootable feature enabled
		09h	1	bDescrAccessEn	00h	Yes	-
		0Ah	1	bInitPowerMode	01h	Yes	-
		0Bh	1	bHighPriorityLUN	7Fh	Yes	-
		0Ch	1	bSecureRemovalType ¹⁾	00h	Yes	Secure Removal Type = 00h is only supported
		0Dh	1	bSecurityLU	01h	No	-
		0Eh	1	bBackgroundOpsTermLat	04h	No	-
		0Fh	1	bInitActiveICCLLevel	00h	Yes	-
		10h	2	wSpecVersion	0200h	No	-
		12h	2	wManufactureDate	-	No	-
		14h	1	iManufacturerName	00h	No	-
		15h	1	iProductName	01h	No	-
		16h	1	iSerialNumber	02h	No	-
		17h	1	iOemID	03h	No	-
		18h	2	wManufacturerID	01CEh	No	-
		1Ah	1	bUD0BaseOffset	10h	No	-
		1Bh	1	bUDConfigPLength	10h	No	-
		1Ch	1	bDeviceRTTCap	02h	No	-
		1Dh	2	wPeriodicRTCUpdate	00h	Yes	-
		1Fh	17	Reserved	00h	No	-
		30h	16	Reserved	00h	No	-

NOTE :

1) For configuration, only "00h - information removed by an erase of the physical memory" is supported

6.1.2 Configuration Descriptor

[Table 21] Configuration Descriptor

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
01h	Header and Device Descriptor Configuration parameters		00h	1	bLength	90h	No	-
			01h	1	bDescriptorType	01h	No	-
			02h	1	Reserved	00h	No	-
			03h	1	bBootEnable	01h	Yes	01h = bootable feature enabled
			04h	1	bDescrAccessEn	00h	Yes	-
			05h	1	bInitPowerMode	01h	Yes	-
			06h	1	bHighPriorityLUN	7Fh	Yes	-
			07h	1	bSecureRemovalType	00h	Yes	Secure Removal Type = 00h is only supported
			08h	1	bInitActiveICCLLevel	00h	Yes	-
			09h	2	wPeriodicRTCUpdate	00h	Yes	-
			0Bh	5	Reserved	00h	No	-
	Unit Descriptor configurable parameters		00h	1	bLUEnable	01h	Yes	-
			01h	1	bBootLunID	00h	Yes	-
			02h	1	bLUWriteProtect	00h	Yes	-
			03h	1	bMemoryType	00h	Yes	-
			04h	4	dNumAllocUnits	16GB	TBD	-
						32GB	1D1Fh	
						64GB	3A3Eh	
			08h	1	bDataReliability	00h	Yes	-
			09h	1	bLogicalBlockSize	0Ch	Yes	Logical Block Size is 4KByte
			0Ah	1	bProvisioningType	02h	Yes	-
			0Bh	2	wContextCapabilities	00h	Yes	-
			0Dh	3	Reserved	00h	No	-

6.1.3 Geometry Descriptor

[Table 22] Geometry Descriptor

IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
07h	Geometry	00h	1	bLength	44h	No	-
		01h	1	bDescriptorType	07h	No	-
		02h	1	bMediaTechnology	00h	No	-
		03h	1	Reserved	00h	No	-
		04h	8	qTotalRawDeviceCapacity	16GB	No	-
					32GB		
					64GB		
		0Ch	1	Reserved	00h	No	-
		0Dh	4	dSegmentSize	2000h	No	-
		11h	1	bAllocationUnitSize	01h	No	-
		12h	1	bMinAddrBlockSize	08h	No	-
		13h	1	bOptimalReadBlockSize	08h	No	-
		14h	1	bOptimalWriteBlockSize	08h	No	-
		15h	1	bMaxInBufferSize	08h	No	-
		16h	1	bMaxOutBufferSize	08h	No	-
		17h	1	bRPMB_ReadWriteSize	20h	No	-
		18h	1	Reserved	00h	No	-
		19h	1	bDataOrdering	00h	No	-
		1Ah	1	bMaxContextIDNumber	05h	No	-
		1Bh	1	bSysDataTagUnitSize	00h	No	-
		1Ch	1	bSysDataTagResSize	06h	No	-
		1Dh	1	bSupportedSecRTypes	01h	No	-
		1Eh	2	wSupportedMemoryTypes	800Fh	No	-
		20h	4	dSystemCodeMaxNAllocU	16GB	No	-
					32GB		
					64GB		
		24h	2	wSystemCodeCapAdjFac	0100h	No	-
		26h	4	dNonPersistMaxNAllocU	16GB	No	-
					32GB		
					64GB		
		2Ah	2	wNonPersistCapAdjFac	0100h	No	-
		2Ch	4	dEnhanced1MaxNAllocU	16GB	No	-
					32GB		
					64GB		
		30h	2	wEnhanced1CapAdjFac	0200h	No	-
		32h	4	dEnhanced2MaxNAllocU	00h	No	-
		36h	2	wEnhanced2CapAdjFac	0200h	No	-
		38h	4	dEnhanced3MaxNAllocU	00h	No	-
		3Ch	2	wEnhanced3CapAdjFac	0200h	No	-
		3Eh	4	dEnhanced4MaxNAllocU	00h	No	-
		42h	2	dEnhanced4CapAdjFac	0200h	No	-

6.1.4 Unit Descriptor Configurable Parameter

Unit Descriptor Configurable Parameter for Individual Logical Unit

IDN	Descriptor		Offset	Size (Byte)	Name		MDV	User Conf.	Description
02h	Unit	Normal[0]	00h	1	bLength		23h	No	-
			01h	1	bDescriptorType		02h	No	-
			02h	1	bUnitIndex		00h	No	-
			03h	1	bLUEnable		01h	Yes	-
			04h	1	bBootLunID		00h	Yes	-
			05h	1	bLUWriteProtect		00h	Yes	-
			06h	1	bLUQueueDepth		00h	No	-
			07h	1	Reserved		00h	No	-
			08h	1	bMemoryType		00h	Yes	-
			09h	1	bDataReliability		00h	Yes	-
			0Ah	1	bLogicalBlockSize		0Ch	Yes	-
			0Bh	8	qLogicalBlockCount	16GB	TBD	Yes	-
						32GB	747C00h		
						64GB	E8F800h		
			13h	4	dEraseBlockSize		01h	No	-
			17h	1	bProvisioningType		02h	Yes	-
			18h	8	qPhyMemResourceCount	16GB	TBD	No	-
						32GB	747C00h		
						64GB	E8F800h		
			20h	2	wContextCapabilities		00h	Yes	-
			22h	1	bLargeUnitGranularity_M1		TBD	No	-
		Normal[1]	00h	1	bLength		23h	No	-
			01h	1	bDescriptorType		02h	No	-
			02h	1	bUnitIndex		01h	No	-
			03h	1	bLUEnable		01h	Yes	-
			04h	1	bBootLunID		01h	Yes	-
			05h	1	bLUWriteProtect		00h	Yes	-
			06h	1	bLUQueueDepth		00h	No	-
			07h	1	Reserved		00h	No	-
			08h	1	bMemoryType		03h	Yes	-
			09h	1	bDataReliability		01h	Yes	-
			0Ah	1	bLogicalBlockSize		0Ch	Yes	-
			0Bh	8	qLogicalBlockCount		0400h	Yes	-
			13h	4	dEraseBlockSize		01h	No	-
			17h	1	bProvisioningType		02h	Yes	-
			18h	8	qPhyMemResourceCount		0400h	No	-
			20h	2	wContextCapabilities		00h	Yes	-
			22h	1	bLargeUnitGranularity_M1		TBD	No	-

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
02h	Unit	Normal[2]	00h	1	bLength	23h	No	-
			01h	1	bDescriptorType	02h	No	-
			02h	1	bUnitIndex	02h	No	-
			03h	1	bLUEnable	01h	Yes	-
			04h	1	bBootLunID	02h	Yes	-
			05h	1	bLUWriteProtect	00h	Yes	-
			06h	1	bLUQueueDepth	00h	No	-
			07h	1	Reserved	00h	No	-
			08h	1	bMemoryType	03h	Yes	-
			09h	1	bDataReliability	01h	Yes	-
			0Ah	1	bLogicalBlockSize	0Ch	Yes	-
			0Bh	8	qLogicalBlockCount	0400h	Yes	-
			13h	4	dEraseBlockSize	01h	No	-
			17h	1	bProvisioningType	02h	Yes	-
			18h	8	qPhyMemResourceCount	0400h	No	-
			20h	2	wContextCapabilities	00h	Yes	-
			22h	1	bLargeUnitGranularity_M1	TBD	No	-
		Normal[3]~[7]	00h	1	bLength	23h	No	-
			01h	1	bDescriptorType	02h	No	-
			02h	1	bUnitIndex	03h to 07h	No	-
			03h	1	bLUEnable	00h	Yes	-
			04h	1	bBootLunID	00h	Yes	-
			05h	1	bLUWriteProtect	00h	Yes	-
			06h	1	bLUQueueDepth	00h	No	-
			07h	1	Reserved	00h	No	-
			08h	1	bMemoryType	00h	Yes	-
			09h	1	bDataReliability	00h	Yes	-
			0Ah	1	bLogicalBlockSize	0Ch	Yes	-
			0Bh	8	qLogicalBlockCount	00h	Yes	-
			13h	4	dEraseBlockSize	01h	No	-
			17h	1	bProvisioningType	00h	Yes	-
			18h	8	qPhyMemResourceCount	00h	No	-
			20h	2	wContextCapabilities	00h	Yes	-
			22h	1	bLargeUnitGranularity_M1	TBD	No	-

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
02h	Unit	RPMB	00h	1	bLength	23h	No	
			01h	1	bDescriptorType	02h	No	
			02h	1	bUnitIndex	C4h	No	
			03h	1	bLUEnable	01h	No	
			04h	1	bBootLunID	00h	No	
			05h	1	bLUWriteProtect	00h	No	
			06h	1	bLUQueueDepth	00h	No	
			07h	1	Reserved	00h	No	
			08h	1	bMemoryType	0Fh	No	
			09h	1	Reserved	00h	No	
			0Ah	1	bLogicalBlockSize	08h	No	
			0Bh	8	qLogicalBlockCount	4000h	No	
			13h	4	dEraseBlockSize	00h	No	
			17h	1	bProvisioningType	00h	No	
			18h	8	qPhyMemResourceCount	4000h	No	
			20h	3	Reserved	00h	Yes	

6.1.5 Other Descriptor

[Table 23] Other Descriptor

IDN	Descriptor		Offset	Size (Byte)	Name		MDV	User Conf.	Description
08h	Power		00h	1	bLength		62h	No	-
			01h	1	bDescriptorType		08h	No	-
			02h	32	wActiveICCLevelsVCC(15:0)		N/A	No	-
			22h	32	wActiveICCLevelsVCCQ(15:0)		N/A	No	-
			42h	32	wActiveICCLevelsVCCQ2(15:0)		N/A	No	-
04h	Interconnect		00h	1	bLength		06h	No	-
			01h	1	bDescriptorType		04h	No	-
			02h	2	bcdUniproVersion		0160h	No	UniPro 1.6
			04h	2	bcdMphyVersion		0300h	No	M-PHY 3.0
05h	String	Manufaceoqturer Name	00h	1	bLength		10h	No	-
			01h	1	bDescriptorType		05h	No	-
			02h	2	UC[0]		"S"	No	-
			04h	2	UC[1]		"A"	No	-
			06h	2	UC[2]		"M"	No	-
			08h	2	UC[3]		"S"	No	-
			0Ah	2	UC[4]		"U"	No	-
			0Ch	2	UC[5]		"N"	No	-
			0Eh	2	UC[6]		"G"	No	-
		Product Name	00h	1	bLength		20h	No	-
			01h	1	bDescriptorType		05h	No	-
			02h	2	UC[0]		"K"	No	-
			04h	2	UC[1]		"L"	No	-
			06h	2	UC[2]		"U"	No	-
			08h	2	UC[3]	16GB	"A"	No	-
						32GB	"B"		
						64GB	"C"		
			0Ah	2	UC[4]		"G"	No	-
			0Ch	2	UC[5]	16GB	"2"	No	-
						32GB	"4"		
						64GB	"8"		
			0Eh	2	UC[6]		"G"	No	-
			10h	2	UC[7]		"1"	No	-
			12h	2	UC[8]		"B"	No	-
			14h	2	UC[9]		"D"	No	-
			16h	2	UC[10]		"_"	No	-
			18h	2	UC[11]		"B"	No	-
			1Ah	2	UC[12]		"0"	No	-
			1Ch	2	UC[13]		"B"	No	-

05h	String	Product Name	1Eh	2	UC[14]	16GB	"2"	No	-
						32GB	"1"		
						64GB	"1"		
		Serial Number	00h	1	bLength	1Ah	No	-	-
			01h	1	bDescriptorType	05h	No	-	-
			02h	2	UC[0]	TBD	No	-	-
			04h	2	UC[1]	TBD	No	-	-
			06h	2	UC[2]	TBD	No	-	-
			08h	2	UC[3]	TBD	No	-	-
			0Ah	2	UC[4]	TBD	No	-	-
			0Ch	2	UC[5]	TBD	No	-	-
			0Eh	2	UC[6]	TBD	No	-	-
			10h	2	UC[7]	TBD	No	-	-
			12h	2	UC[8]	TBD	No	-	-
			14h	2	UC[9]	TBD	No	-	-
			16h	2	UC[10]	TBD	No	-	-
			18h	2	UC[11]	TBD	No	-	-
		OEM ID	00h	1	bLength	USER	Yes	Recorded by a user	
			01h	1	bDescriptorType	05h	No	-	-
			02h	2	UC[0] ~ UC[127]	USER	Yes	Recorded by a user	

6.2 Flag

A flag is a single Boolean value that represents a TRUE or FALSE, 0' or 1', ON or OFF type of value. A flag can be cleared or reset, set, toggled or read

[Table 24] Flag

IDN	Name	Access Property	Type, #Index, #Selector	Default	Description
00h	Reserved	N/A	N/A	N/A	-
01h	fDeviceInit	Read / Set only	D	00h	-
02h	fPermanentWPEn	Read / Write once	D	00h	-
03h	fPowerOnWPEn	Read / Power on reset	D	00h	-
04h	fBackgroundOpsEn	Read / Volatile	D	01h	-
05h	Reserved	N/A	N/A	N/A	-
06h	fPurgeEnable	Write only / Volatile	D	00h	-
07h	Reserved	N/A	N/A	N/A	-
08h	fPhyResourceRemoval	Read / Persistent	D	00h	-
09h	fBusyRTC	Read Only	D	00h	-
0Ah	Reserved	N/A	D	00h	-
0Bh	fPermanentlyDisable FwUpdate	Read / Write once	D	00h	-

6.3 Attribute

An attribute is a parameter that represents a specific range of numeric values that can be written or read

[Table 25] Attribute

IDN	Name	Access Property	Size	Type, #Index, #Selector	MDV	Description
00h	bBootLunEn	Read / Persistent	1	D	01h	-
01h	Reserved	N/A	1	N/A	N/A	-
02h	bCurrentPowerMode	Read only	1	D	11h	-
03h	bActiveICCLLevel	Read / Persistent	1	N/A	00h	-
04h	bOutOfOrderDataEn	Read / Write once	1	D	00h	-
05h	bBackgroundOpStatus	Read only	1	D	00h	-
06h	bPurgeStatus	Read only	1	D	00h	-
07h	bMaxDataInSize ¹⁾	Read / Persistent	1	D	08h	-
08h	bMaxDataOutSize ²⁾	Read / Persistent	1	D	08h	-
09h	dDynCapNeeded	Read only	4	A, 8(LUN), 0	00h	-
0Ah	bRefClkFreq	Read / Write once	1	D	01h	-
0Bh	bConfigDescrLock	Read / Write once	1	D	00h	-
0Ch	bMaxNumOfRTT	Read / Persistent	1	D	02h	-
0Dh	wException EventControl	Read / Volatile	2	D	00h	-
0Eh	wExceptionEventStatus	Read only	2	D	00h	-
0Fh	dSecondsPassed	Write Only	4	D	00h	-
10h	wContextConf	Read / Volatile	2	A, 8(LUN), 15(ID)	00h	-
11h	dCorrPrgBlkNum	Read only	4	A, 8(LUN), 0	00h	-
12h	Reserved	N/A	1	N/A	N/A	-

NOTE :

1) bMaxDataInSize = 4KByte, not reconfigurable

2) bMaxDataOutSize = 4KByte, not reconfigurable

6.3.1 MIPI UniPro Related Attributes

In general the UniPro related attributes, values and use of them are defined in the MIPI UniPro Specification. The attributes may be generic for all UniPro applications and thus out of scope of this document.

6.4 Mode Pages

The device supports the following mode pages. This section describes the mode pages used with MODE SELECT command and MODE SENSE command.

6.4.1 Control Mode Page

The Control mode page provides controls over SCSI features that are applicable to all device 4120 types (e.g., task set management and error logging).

[Table 26] Control Mode page

Mode Page	Offset	Size	Field	MDV	User Conf.	Description
Control [0]~[7]	00h	6b	PAGE CODE	0Ah	No	-
	00h	1b	SPF	0b	No	-
	00h	1b	PS	1b	No	-
	01h	01h	PAGE LENGTH	0Ah	No	-
	02h	1b	RLEC	0b	No	-
	02h	1b	GLTSD	0b	No	-
	02h	1b	D_SENSE	0b	No	-
	02h	1b	DPICZ	0b	No	-
	02h	1b	TMF_ONLY	0b	No	-
	02h	3b	TST	0b	No	-
	03h	1b	Obsolete	0b	No	-
	03h	2b	QERR	00b	No	-
	03h	1b	NUAR	0b	No	-
	03h	4b	QUEUE ALGORITHM MODIFIER	0001b	Yes	-
	04h	3b	Obsolete	000b	No	-
	04h	1b	SWP	0b or 1b	Yes	-
	04h	2b	UA_INTLCK_CTRL	00b	No	-
	04h	1b	RAC	0b	No	-
	04h	1b	VS	0b	No	-
	05h	3b	AUTOLOAD MODE	000b	No	-
	05h	1b	Reserved	0b	No	-
	05h	1b	RWWP	0b	No	-
	05h	1b	ATMPE	0b	No	-
	05h	1b	TAS	0b	No	-
	05h	1b	ATO	0b	No	-
	06h	01h	Obsolete	0000h	No	-
	08h	02h	BUSY TIMEOUT PERIOD	03h	Yes	-
	0Ah	02h	EXTENDED SELF-TEST COMPLETION TIME	0000h	No	-

6.4.2 Read-Write Error Recovery Mode Page

The Read-Write Error Recovery mode page specifies the error recovery parameters the device server shall use during any command that performs a read or write operation to the medium

[Table 27] Read-Write Error Recovery Mode pag

Mode Page	Offset	Size	Field	MDV	User Conf.	Description
Read-Write Error Recovery	00h	6b	PAGE CODE	01h	No	-
	00h	1b	SPF	0b	No	-
	00h	1b	PS	1b	No	-
	01h	01h	PAGE LENGTH	0Ah	No	-
	02h	1b	DCR	0b	No	-
	02h	1b	DTE	0b	No	-
	02h	1b	PER	0b	No	-
	02h	1b	EER	0b	No	-
	02h	1b	RC	0b	No	-
	02h	1b	TB	0b	No	-
	02h	1b	ARRE	0b	No	-
	02h	1b	AWRE	1b	No	-
	03h	01h	READ RETRY COUNT	00h(TBD)	Yes	-
	04h	01h	Obsolete	00h	No	-
	05h	01h	Obsolete	00h	No	-
	06h	01h	Obsolete	00h	No	-
	07h	2b	Restricted for MMC-6	00b	No	-
	07h	5b	Reserved	00000b	No	-
	07h	1b	TPERE	0b	No	-
	08h	01h	WRITE RETRY COUNT	00h(TBD)	Yes	-
	09h	01h	Reserved	00h	No	-
	0Ah	02h	RECOVERY TIME LIMIT	50h	Yes	-

6.4.3 Caching Mode Page

The caching mode page defines the parameters that affect the use of the cache. A UFS device shall implement support for following parameters.

[Table 28] Caching Mode Page

Mode Page	Offset	Size	Field	MDV	User Conf.	Description
Caching	00h	6b	PAGE CODE	08h	No	-
	00h	1b	SPF	0b	No	-
	00h	1b	PS	1b	No	-
	01h	01h	PAGE LENGTH	12h	No	-
	02h	1b	RCD	0b	Yes	-
	02h	1b	MF	0b	No	-
	02h	1b	WCE	1b	Yes	-
	02h	1b	SIZE	0b	No	-
	02h	1b	DISC	0b	No	-
	02h	1b	CAP	0b	No	-
	02h	1b	ABPF	0b	No	-
	02h	1b	IC	0b	No	-
	03h	4b	WRITE RETENTION PRIORITY	0000b	No	-
	03h	4b	DEMAND READ RETENTION PRIORITY	0000b	No	-
	04h	02h	DISABLE PRE-FETCH TRANSFER LENGTH	0000h	No	-
	06h	02h	MINIMUM PRE-FETCH	0000h	No	-
	08h	02h	MAXIMUM PRE-FETCH	0000h	No	-
	0Ah	02h	MAXIMUM PRE-FETCH CEILING	0000h	No	-
	0Ch	1b	NV_DIS	0b	No	-
	0Ch	2b	Reserved	00b	No	-
	0Ch	2b	Vendor Specific	00b	No	-
	0Ch	1b	DRA	0b	No	-
	0Ch	1b	LBCSS	0b	No	-
	0Ch	1b	FSW	0b	No	-
	0Dh	01h	NUMBER OF CACHE SEGMENTS	00h	No	-
	0Eh	02h	CACHE SEGMENT SIZE	0000h	No	-
	10h	01h	Reserved	00h	No	-
	11h	03h	Obsolete	000000h	No	-

6.5 Vital Product Data Register Values

[Table 29] Vital Product Data Register Values

Mode Page	Offset	Size	Field	MDV	User Conf.	Description
Standard Inquiry	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	6b	Reserved	0000000b	No	-
	01h	1b	RMB	0b	No	-
	02h	1b	VERSION	06h	No	-
	03h	4b	RESPONSE DATA FORMAT	0010b	No	-
	03h	1b	HISUP	0b	No	-
	03h	1b	NORMACA	0b	No	-
	03h	1b	Obsolete	0b	No	-
	03h	1b	Obsolete	0b	No	-
	04h	01h	ADDITIONAL LENGTH	1Fh	No	-
	05h	1b	PROTECT	0b	No	-
	05h	2b	Reserved	0b	No	-
	05h	1b	3PC	0b	No	-
	05h	2b	TPGS	0b	No	-
	05h	1b	ACC	0b	No	-
	05h	1b	SCCS	0b	No	-
	06h	1b	ADDR16	0b	No	-
	06h	1b	Obsolete	0b	No	-
	06h	1b	Obsolete	0b	No	-
	06h	1b	Obsolete	0b	No	-
	06h	1b	MULTIP	0b	No	-
	06h	1b	VS	0b	No	-
	06h	1b	ENC SERV	0b	No	-
	06h	1b	Obsolete	0b	No	-
	07h	1b	VS	0b	No	-
	07h	1b	CMDQUE	1b	No	-
	07h	1b	Obsolete	0b	No	-
	07h	1b	Obsolete	0b	No	-
	07h	1b	SYNC	0b	No	-
	07h	1b	WBUS16	0b	No	-
	07h	1b	Obsolete	0b	No	-
	07h	1b	Obsolete	0b	No	-
	08h	04h	VENDOR IDENTIFICATION	"SAMSUNG\0"	No	-
	10h	04h	PRODUCT IDENTIFICATION	16GB	"KLUAG2G1BD-B0B2\0"	
				32GB	"KLUBG4G1BD-B0B1\0"	No
				64GB	"KLUCG8G1BD-B0B1\0"	
	20h	04h	PRODUCT REVISION LEVEL	"0000" ~ "9999"	No	-

Supported VPD Pages	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	00h	No	-
	02h	02h	PAGE LENGTH	05h	No	-
	04h	01h	Supported VPD Page List[0]	00h	No	-
	05h	01h	Supported VPD Page List[1]	80h	No	-
	06h	01h	Supported VPD Page List[2]	83h	No	-
	07h	01h	Supported VPD Page List[3]	87h	No	-
	08h	01h	Supported VPD Page List[4]	B0h	No	-
Unit Serial Number	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	80h	No	-
	02h	02h	PAGE LENGTH	08h	No	-
	04h	01h	PRODUCT SERIAL NUMBER[0]	"F"	No	TBD
	05h	01h	PRODUCT SERIAL NUMBER[1]	"D"	No	TBD
	06h	01h	PRODUCT SERIAL NUMBER[2]	"1"	No	TBD
	07h	01h	PRODUCT SERIAL NUMBER[3]	"0"	No	TBD
	08h	01h	PRODUCT SERIAL NUMBER[4]	"0"	No	TBD
	09h	01h	PRODUCT SERIAL NUMBER[5]	"0"	No	TBD
	0Ah	01h	PRODUCT SERIAL NUMBER[6]	"0"	No	TBD
	0Bh	01h	PRODUCT SERIAL NUMBER[7]	"\0"	No	TBD
Device Identification	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	83h	No	-
	02h	02h	PAGE LENGTH	0Ch	No	-
	04h	4b	CODE SET	0010b	No	-
	04h	4b	PROTOCOL IDENTIFIER	0000b	No	-
	05h	4b	DESIGNATOR TYPE	0010b	No	-
	05h	2b	ASSOCIATION	00b	No	-
	05h	1b	Reserved	0b	No	-
	05h	1b	PIV	0b	No	-
	06h	01h	Reserved	0b	No	-
	07h	01h	DESIGNATOR LENGTH	08h	No	-
	08h	01h	DESIGNATOR[0]	"S"	No	-
	09h	01h	DESIGNATOR[1]	"A"	No	-
	0Ah	01h	DESIGNATOR[2]	"M"	No	-
	0Bh	01h	DESIGNATOR[3]	"S"	No	-
	0Ch	01h	DESIGNATOR[4]	"U"	No	-
	0Dh	01h	DESIGNATOR[5]	"N"	No	-
	0Eh	01h	DESIGNATOR[6]	"G"	No	-
	0Fh	01h	DESIGNATOR[7]	"\0"	No	-

Mode Page Policy	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	87h	No	-
	02h	02h	PAGE LENGTH	0Ch	No	-
	04h	06b	POLICY PAGE CODE[0]	0Ah	No	Control Mode Page
	04h	02b	Reserved	00b	No	-
	05h	01h	POLICY SUBPAGE CODE[0]	00h	No	-
	06h	02b	MODE PAGE POLICY[0]	00b	No	Per target port (01h)
	06h	05b	Reserved	00000b	No	-
	06h	01b	MLUS[0]	0b	No	-
	07h	01h	Reserved	00h	No	-
	08h	06b	POLICY PAGE CODE[1]	01h	No	R/W Error Recovery Mode Page
	08h	02b	Reserved	00b	No	-
	09h	01h	POLICY SUBPAGE CODE[1]	00h	No	-
	0Ah	02b	MODE PAGE POLICY[1]	00b	No	Per I_T nexus (03h)
	0Ah	05b	Reserved	00000b	No	-
	0Ah	01b	MLUS[1]	1b	No	-
	0Bh	01h	Reserved	00h	No	-
	0Ch	06b	POLICY PAGE CODE[2]	08h	No	Caching Mode Page (08h)
	0Ch	02b	Reserved	00b	No	-
	0Dh	01h	POLICY SUBPAGE CODE[2]	00h	No	-
	0Eh	02b	MODE PAGE POLICY[2]	00b	No	Per I_T nexus (03h)
	0Eh	05b	Reserved	00000b	No	-
	0Eh	01b	MLUS[2]	1b	No	-
	0Fh	01h	Reserved	00h	No	-
Block Limits	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	B0h	No	-
	02h	02h	PAGE LENGTH	3Ch	No	-
	04h	01h	Reserved	00h	No	-
	05h	01h	MAXIMUM COMPARE AND WRITE LENGTH	00h	No	-
	06h	02h	OPTIMAL TRANSFER LENGTH GRANULARITY	02h	No	-
	08h	04h	MAXIMUM TRANSFER LENGTH	FFFFh	No	-
	0Ch	04h	OPTIMAL TRANSFER LENGTH	02h	No	-
	10h	04h	MAXIMUM PREFETCH XDREAD XDWRITE TRANSFER LENGTH	00h	No	-
	14h	04h	MAXIMUM UNMAP LBA COUNT	FFFFFFFFh	No	-
	18h	04h	MAXIMUM UNMAP BLOCK DESCRIPTOR COUNT	FFh	No	-
	1Ch	04h	OPTIMAL UNMAP GRANULARITY	2000h	No	-
	20h	04h	UNMAP GRANULARITY ALIGNMENT	00h	No	-
	24h	1Bh	Reserved	00h	No	-

7.0 APPENDIX

7.1 Design Guide for PCB Layout

Please refer to the "Board Design Guide for Mobile Set", the application note, provided by Samsung for the details.