UFS Device

153FBGA 11.5x13

64GB UFS2.2

Datasheet

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Revision History

Version	Date	Description
1.0	2024.4	Preliminary release

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1. 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-GEAR3 with 2 lane.

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.

1.2 Product Information

UFS Part ID	Capacity	Size	Package
BWU2A0516B064G	64GB	11.5*13mm	FBGA153

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1.3 Features

- UFS supports UFS2.2 features defined by JEDEC Standard
  - Erase / Discard / Purge / Wipe
  - RPMB and BOOT LUN Partition
  - Power-on/HW/EndPoint/LU Reset
  - Background Operations
  - High Priority LU
  - Reliable Write Operation
  - Task Management operations
  - Power Management operations
  - Write Protect, Secure Write Protect
  - Command Queuing/Cache
  - Field Firmware Update
  - Device Health Descriptor
  - Secure Removal Type
  - HPB
  - Write Booster
- Interface:
  - Supports up to HS-GEAR3 with two lanes
  - Low-speed mode (PWM): LS mode (gear 1,2,3,4)
  - High-speed burst mode: HS mode (gear 1,2,3)
- UFS Layering:
  - MIPI M-PHY specification version v3.0
  - MIPI UniPro specification version v1.61(Deep stall is not supported)
- Operating Voltage Range
  - VCC: 2.7V - 3.6V
  - VCCQ2: 1.7-1.95V
- 8b10b line coding, as defined by MIPI M-PHY
- Temperature
  - Operation Temperature (-25℃ ~ +85℃)
  - Storage Temperature (-40℃ ~ +85℃)
- Reference
  - UFS Specification-JESD220C
  - MIPI UniPro Specification V1.61
  - MIPI M-PHY Specification V3.0

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1.4 PIN Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	NC	NC	NC	NC	NC	VCCQ2	VCCQ2	VDDIQ2	NC	NC	NC	NC	NC	NC
B	NC	GND	NC	NC	NC	VCCQ2	VCCQ2	VCC	VCC	NC	GND	GND	NC	NC
C	GND	GND	GND	NC	NC	VCCQ2	VCCQ2	VCC	VCC	NC	GND	GND	NC	NC
D	DIN1_T	DIN1_C	GND	NC								GND	GND	GND
E	GND	GND	GND		NC	JTMS	JTDI	VCC	JTDO	UR_TX		GND	NC	NC
F	DIN0_T	DIN0_C	GND		NC					OP2		GND	GND	GND
G	GND	GND	GND		JTCK					GND		GND	NC	NC
H	RFE_CLK	RST_N	GND		GND					GND		GND	GND	GND
J	GND	GND	GND		GND					F0_CE3		GND	NC	NC
K	DOUT0_C	DOUT0_T	GND		GND	VCCQ2	VCCQ2	VCC	NC	UR_RX		GND	GND	GND
L	GND	GND	GND									GND	NC	NC
M	DOUT1_C	DOUT1_T	GND	GND	GND	NC	NC	NC	NC	NC	NC	GND	GND	GND
N	NC	GND	GND	GND	GND	NC	NC	VCC	VCC	NC	GND	GND	NC	NC
P	NC	NC	NC	GND	GND	NC	NC	VCC	VCC	NC	GND	GND	NC	NC

Figure1. 153FBGA Ball Assignment (Top View)

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1.5 PIN Description

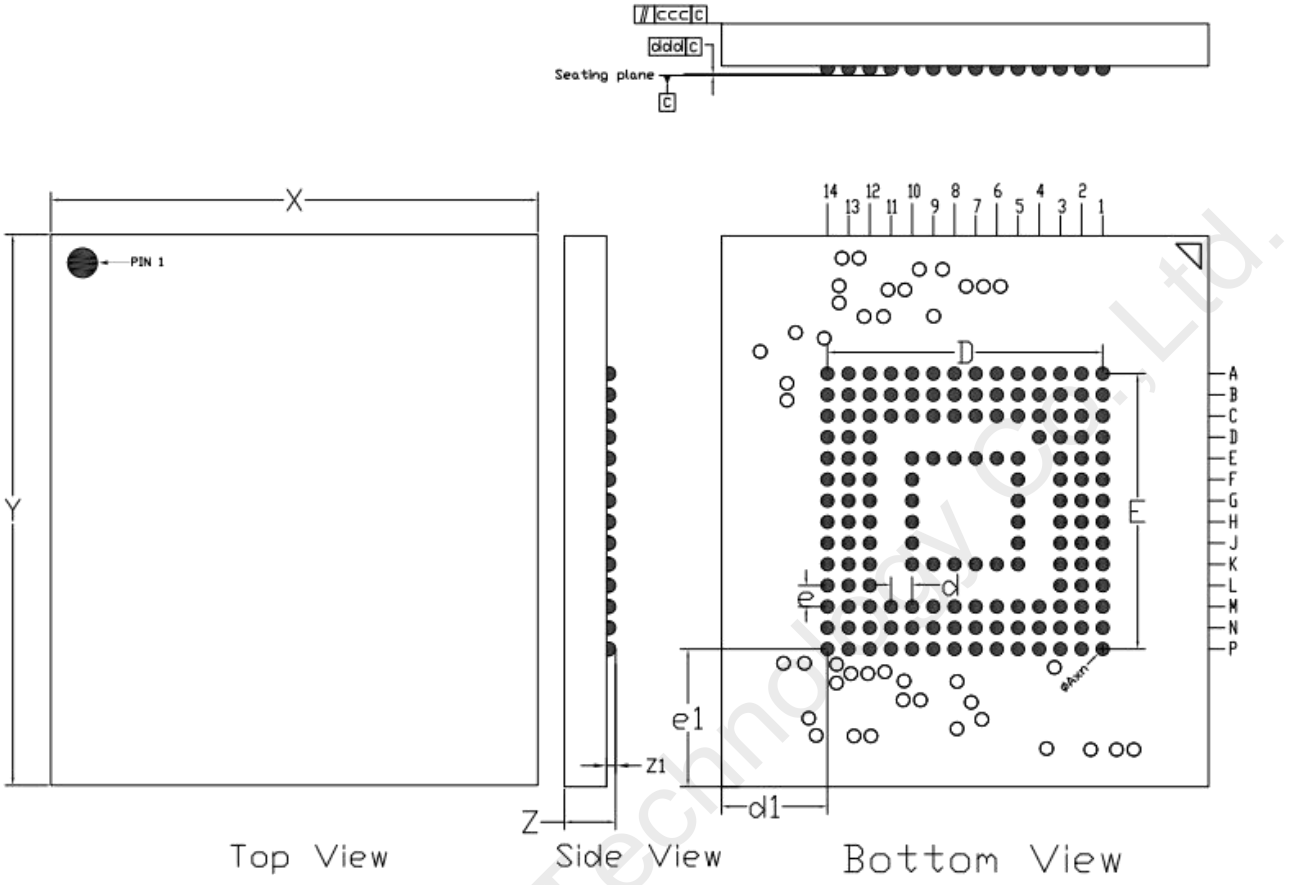
153 FBGA Ball Information

Ball 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
VDDIQ2	Input	Input terminal to provided bypass capacitor for VCCQ2 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
DIN0_t, DIN0_c DIN1_t, DIN1_c	Input	Downstream lane input, Differential input true and complement signal pair.
DOUT0_t, DOUT0_c DOUT1_t, DOUT1_c	Output	Upstream lane output, Differential output true and complement signal pair.
NC	-	Not connected.NC pin can be left floating
JTDI、JTDO JTMS、JTCK	-	JTAG interface signals
UR_TX、UR_RX	-	UART interface signals
OP2	-	Optional pin for internal operation

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1.6 Package Dimension



ITEM	Symble	Unit: mm		
		MIN	NORM	MAX
BODY SIZE	X	11.40	11.50	11.60
	Y	12.90	13.00	13.10
TOTAL THICNESS	Z	0.80	0.90	1.00
STAND OFF	Z1	0.19	0.21	0.23
EDGE BALL (CENTER TO CENTER)	D	6.50		
	E	6.50		
BALL PITCH	d	0.50		
	e	0.50		
BALL COUNT	n	153		
BALL WIDTH (after reflow)	ΦA	0.29	0.32	0.35
BALL TO OUTLINE	d1	2.40	2.50	2.60
	e1	3.15	3.25	3.35
COPLANARITY	ddd			0.08
Mold package warpage	ccc			0.08
JEDEC		MO-276P		

Notice: 1.Ball diameter: 0.3mm(Before reflow)
2."◗"---bumping ball location
3.In the diagram,there are 153 ball locations in all.

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Figure2. 11.5mm x 13mm x 0.9mm Package Dimension

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2. PRODUCT SPECIFICATION

2.1 Mechanical Specification

2.1.1 UFS Device Block Diagram

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

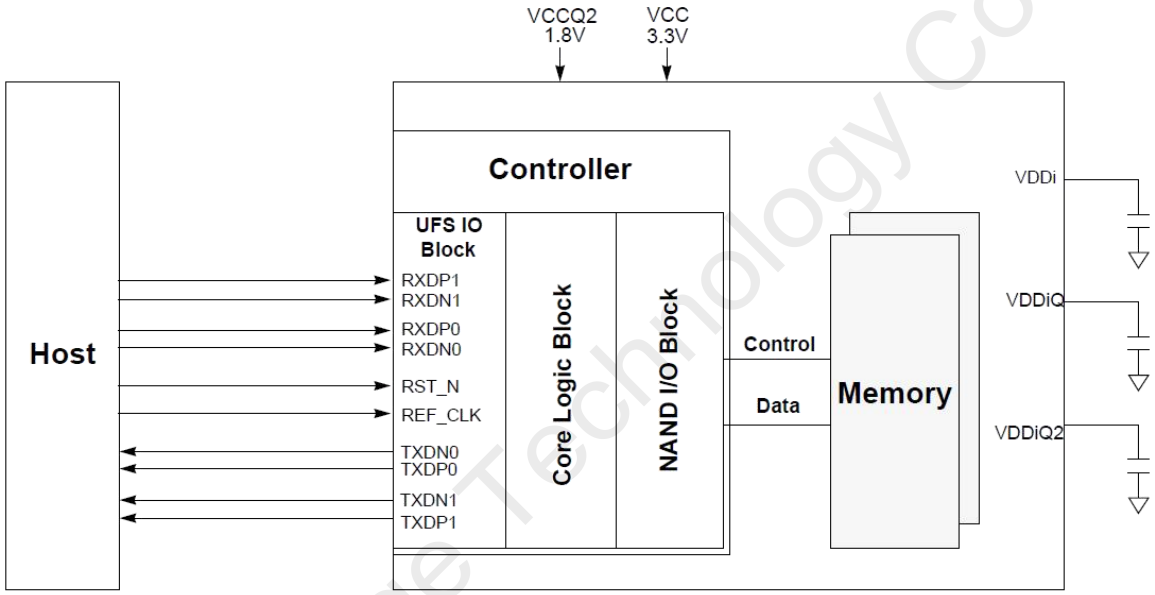


Figure3. UFS Device Block Diagram

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2.2 Operating Conditions

2.2.1 Supply Voltage

Table.1 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.2 Temperature

Condition	Min	Max	Unit
Operation	-25	85	℃
Storage without Operation	-40	85	℃

2.3 Reference Clock

2.3.1 Reference Clock Description

Table.3 Requirement of Reference Clock

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

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Table.4 Reference Clock Support

Frequency	Support	Description
19.2 MHz	Yes	-
26.0 MHz	Yes	Default
38.4 MHz	Yes	-
52.0 MHz	Yes	-

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, Power-down) defined by JEDEC UFS2.2 Specification.The two main power saving modes are described in the following sections. The Sleep mode are defined by JEDEC Standard, and the IDLE2 mode is defined by BIWIN.

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

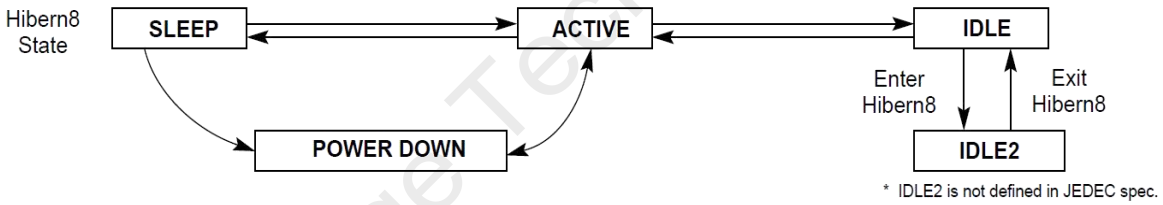


Figure4. Power Mode Diagram

Table.5 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 Chapter 2.4.1
SLEEP	HIBERNATE_STATE	Hibern8	Off	-
POWER DOWN	OFF_STATE	UNPOWERED	Off	-

NOTE :

1) BIWIN specific power mode for saving the IDLE power. Host shall issue 'enter hibern8' for this power mode. Device doesn't have an actual value to represent IDLE2 when host try to read UFS power mode.

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2.4.1 The IDLE2 Mode

This device supports a new power mode to minimize idle power consumption. It is not a UFS2.2 JEDEC standard power mode, but BIWIN specific power mode. If a host does not issue any command during a certain period of time, then the host can issue 'DME_HIBERNATE_ENTER' and the device will automatically enter the IDLE2 mode for the IDLE power saving. It's the same as IDLE mode from the host's 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.6 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.7 Logical Unit Information

Device	User Capacity(%)	TotalRawDeviceCapacity (Hex)
64 GB	93.1[1)]	0x7734000

NOTE :

1)User Capacity may vary depending on Boot LU Size.

Table.8 Default Values for Logical Unit

Logical Unit		Values	Description
Normal User Area	Size	TBD (Host Config)	-
	bUnitIndex	00h	Unit Index
	bMemoryType	Normal Type	Memory Type
Boot1	Size	TBD (Host Config)	Logical Unit Size
	bUnitIndex	TBD (Host Config)	Unit Index
	bBootLunID	TBD (Host Config)	Boot LUN ID
	bMemoryType	TBD (Host Config)	Memory Type
Boot2	Size	TBD (Host Config)	Logical Unit Size
	bUnitIndex	TBD (Host Config)	Unit Index

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Logical Unit		Values	Description
	bBootLunID	TBD (Host Config)	Boot LUN ID
	bMemoryType	TBD (Host Config)	Memory Type
RPMB	Size	16MB(fixed)	Logical Unit Size
	bUnitIndex	C4h	Unit Index
	bMemoryType	RPMB memory type 1	Memory Type

Table.9 Memory Type Support

Memory Type	Mandatory / Optional	Support
Normal Type	M	Yes
System code	O	No
Non-Persistent	O	No
Enhanced type1[1)]	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.

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2.6 Performance

2.6.1 Default LU Performance

Table.10 Default LU performance

Products	HS-Gear3 x 2Lane		Unit*
	Seq.Read	Seq.Write	
64GB	500	410	MB/s

NOTE:

1) Test condition:@25℃, Device level test without file system overhead, Data transfer unit size is 512KByte, Cache on.
2) Performance may vary depending on test conditions and environment.

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3. SUPPORTED FEATURES

3.1 SCSI Command

The following table defines a SCSI command set supported by UFS.

Table.11 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	Yes	-
READ (6)	08h	M	Yes	-
READ (10)	28h	M	Yes	-
READ (16)	88h	O	Yes	-
READ BUFFER	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[2)]	1Dh	M	Yes	-
START STOP UNIT	1Bh	M	Yes	-
SYNCHRONIZE CACHE (10)	35h	M	Yes	-
SYNCHRONIZE CACHE (16)	91h	O	Yes	-
TEST UNIT READY	00h	M	Yes	-
UNMAP	42h	M	Yes	-
VERIFY (10)	2Fh	M	Yes	-
WRITE (6)	0Ah	M	Yes	-

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Command name	Opcode	Mandatory / Optional	Support	Comments
WRITE (10)	2Ah	M	Yes	-
WRITE (16)	8Ah	O	Yes	-
WRITE BUFFER	3Bh	M	Yes	-
M : mandatory, O : optional				

NOTE :

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

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

3.2 Functional Features

Table.12 UFS2.2 Features Supportability

Function		Support	Description
H/W	H/W Reset Pin	Yes	-
Logical Unit / Partitions	LUs	Yes (up to 32)	Chapter 2.5
	Boot LUs	Yes (up to 2)	
	RPMB LUs	Yes (up to 1)	
	LU Priority	Yes	-
	LU Type	Yes	-
	Logical Block Size[1)]	4KB	Chapter 2.5
UFS Security Features	ERASE	Yes	Chapter 3.2.2
	DISCARD	Yes	
	Purge	Yes	
	Wipe Device	Yes	
	Write Protection[2)]	Yes	-
	Secure Write Protection	Yes	-
	RPMB	Yes	Chapter 2.5
	Inter-LU Priority	Yes	-
	Background Operation Mode	Yes	Chapter 3.2.1
	Power Off Notification	Yes	-
	Dynamic Device Capacity	Yes	Protocol support only
	Data Reliability	Yes	-
	Real-Time Clock Information	Yes	Protocol support only

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Function		Support	Description
Host Device Interaction	Context Management	Yes	Protocol support only
	System Data Tag Mechanism	Yes	Protocol support only
	Exception Events Mechanism	Yes	-
	Queue Priority [HPI]	Yes	Chapter 3.2.3
	Out of Order Data Transfer	No	-
	Command Priority	Yes	-
	Device Life Span Mode	No	-
	WriteBooster	Yes	-
	HPB	Yes	-
UFS Cache	Cache	Yes	-
Command Status Response	Illegal Request	Yes	-
	Medium Error	Yes	-
	Hardware Error	Yes	-
	Unit Attention	Yes	-
Vendor Specific Function	FW Update	Yes	-
Reflow	Production State Awareness(PSA)	Yes	-
UFS Feature	Device Health Information	Yes	-

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.

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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 JEDEC UFS2.2 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 BIWIN UFS

Table.13 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[1)]	All device	0	Yes

NOTE :

1) If the FORMAT UNIT command is issued to Device Well-Known logical unit, all enabled logical units except with RPMB LU attempt to be formated. If any logical unit is write protected when the FORMAT UNIT command is issued to Device Well-Known logical unit, the FORMAT UNIT command shall fail and the content of the medium shall not be altered.

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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.14 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.

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 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.

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4. DC PARAMETERS

4.1 Power Consumption

Table.15 Power Consumption

Power	Density	HS Gear3 x 2Lane		Unit
		VCCQ2(1.8V)	VCC(3.3V)	
Active Read	64GB	335	55	mA
Active Write		295	80	mA
Idle2		400	100	uA
Sleep			0[1)]	uA

NOTE :

* Power Measurement conditions: HS-Gear3 x 2 Lane, VCC=3.3V, VCCQ2=1.8V, Not 100% tested, TA=25°C .

* The measurement for max RMS current is measured in 100μs * 500 count (50 ms), Max RMS is the maximum RMS value during Seq. write and Seq. Read .

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

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5. REGISTER VALUES

5.1 Descriptors

5.1.1 Device Descriptor

Table.16 Device Descriptor

IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
00h	Device	00h	1	bLength	59h	No	-
		01h	1	bDescriptorType	00h	No	-
		02h	1	bDevice	00h	No	-
		03h	1	bDeviceClass	00h	No	-
		04h	1	bDeviceSubClass	00h	No	-
		05h	1	bProtocol	00h	No	-
		06h	1	bNumberLU	00h	Yes	-
		07h	1	bNumberWLU	04h	No	-
		08h	1	bBootEnable	00h	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	05h	No	-
		0Fh	1	bInitActiveICCLevel	00h	Yes	-
		10h	2	wSpecVersion	0220h	No	-
		12h	2	wManufactureDate	-	No	TBD, customizable
		14h	1	iManufacturerName	00h	No	-
		15h	1	iProductName	01h	No	-
		16h	1	iSerialNumber	02h	No	-
		17h	1	iOemID	03h	No	-
		18h	2	wManufacturerID	0DABh	No	Manufacturer ID

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IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
		1Ah	1	bUD0BaseOffset	16h	No	-
		1Bh	1	bUDConfigPLength	1Ah	No	-
		1Ch	1	bDeviceRTTCap	02h	No	-
		1Dh	2	wPeriodicRTCUpdate	00h	Yes	-
		1Fh	1	bUFSFeatureSupport	87h	No	-
		20h	1	bFFUTimeout	0Ah	No	-
		21h	1	bQueueDepth	20h	No	-
		22h	2	wDeviceVersion	2752h	No	Device Version This field provides the device version.
		24h	1	bNumSecureWPArea	20h	No	This value specifies the total number of Secure Write Protect Areas supported by the device. The value shall be equal to or greater than bNumberLU and shall not exceed 32 (bNumberLU ≤ bNumSecureWPArea ≤ 32).
		25h	4	dPSAMaxDataSize	-	No	TBD, customizable
		29h	1	bPSAStateTimeout	12h	No	-
		2Ah	1	iProductRevisionLevel	04h	No	-
		2Bh	21	Reserved	00h	No	-
		40h	2	wHPBVersion	200h	No	-
		42h	1	bHPBControl	01h	Yes	-
		4Fh	4	dExtendedUFSFeatureSupport	187h	No	-
		53h	1	bWriteBoosterBufferPreserveUserSpaceEn	00h	Yes	-
		54h	1	bWriteBoosterBufferType	00h	Yes	-
		55h	4	dNumSharedWriteBoosterBufferAllocUnits	00h	Yes	-

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NOTE :

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

5.1.2 Device Health Descriptor

Table.17 Device Health Descriptor

Offset	Size	Name	MDV	User Conf.	Description
00h	1	bLength	25h	No	Size of this descriptor
01h	1	bDescriptorIDN	09h	No	Device Health Descriptor Type Identifier
02h	1	bPreEOLInfo	Device specific	No	Pre End of Life Information This field provides indication about device life time reflected by average reserved blocks. 00h: Not defined 01h: Normal 02h: Warning. Consumed 80% of reserved blocks. 03h: Critical. Consumed 90% of reserved blocks. Others: Reserved
03h	1	bDeviceLifeTimeEstA	Device specific	No	This field provides indication about current averaged program erase cycle of memory relative to its maximum estimated capability. It is calculated by vendor specific method A. 00h: Not defined 01h: 0% - 10% device life time used 02h: 10% - 20% device life time used 03h: 20% - 30% device life time used 04h: 30% - 40% device life time used 05h: 40% - 50% device life time used 06h: 50% - 60% device life time used 07h: 60% - 70% device life time used 08h: 70% - 80% device life time used 09h: 80% - 90% device life time used 0Ah: 90% - 100% device life time used 0Bh: Exceeded its maximum estimated device life time Others: Reserved

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Offset	Size	Name	MDV	User Conf.	Description
04h	1	bDeviceLifeTimeEstB	Device specific	No	This field provides indication about current averaged program erase cycle of memory relative to its maximum estimated capability. It is calculated by vendor specific method B. 00h: Not defined 01h: 0% - 10% device life time used 02h: 10% - 20% device life time used 03h: 20% - 30% device life time used 04h: 30% - 40% device life time used 05h: 40% - 50% device life time used 06h: 50% - 60% device life time used 07h: 60% - 70% device life time used 08h: 70% - 80% device life time used 09h: 80% - 90% device life time used 0Ah: 90% - 100% device life time used 0Bh: Exceeded its maximum estimated device life time Others: Reserved
05h	32	VendorPropInfo	Device specific	No	Reserved for Vendor Proprietary Health Report

5.1.3 Configuration Descriptor

Table.18 Configuration Descriptor(IDN=0x01)(with INDEX = 00h)

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
		Header and Device Descriptor Configuration parameters	00h	1	bLength	E6h	No	-
			01h	1	bDescriptorIDN	01h	No	-
			02h	1	bConfDescContinue	00h	Yes	-
			03h	1	bBootEnable	00h	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
			08h	1	bInitActiveICCLevel	00h	Yes	-
			09h	2	wPeriodicRTCUpdate	00h	Yes	-

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IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
01h	Configuration		0Bh	1	bHPBControl	01h	Yes	-
			10h	1	bWriteBoosterBifferPreserveUserSpaceEn	00h	Yes	-
			11h	1	bWriteBoosterBufferType	00h	Yes	-
			12h	4	dNumSharedWriteBoosterBufferAllocUnits	00h	Yes	-
		Unit Descriptor configurable parameters	00h	1	bLUEnable	00h	Yes	-
			01h	1	bBootLunID	00h	Yes	-
			02h	1	bLUWriteProtect	00h	Yes	-
			03h	1	bMemoryType	00h	Yes	-
			04h	4	dNumAllocUnits	00h	Yes	-
			08h	1	bDataReliability	00h	Yes	-
			09h	1	bLogicalBlockSize	0Ch	Yes	Logical Block Size is 4KByte
			0Ah	1	bProvisioningType	00h	Yes	-
			0Bh	2	wContextCapabilities	00h	Yes	-
			0Dh	3	Reserved	00h	No	-
			10h	2	wLUMaxActiveHPBRegion	00h	Yes	-
			12h	2	wHPBPinnedRegionStartIdx	00h	Yes	
			14h	2	wNumHPBPinnedRegions	00h	Yes	
			16h	4	dLUNumWriteBoosterBufferAllocUnits	00h	Yes	-

Table.19 Configuration Descriptor(IDN=0x01)(with INDEX = 01/02h/03h)

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
01h	Configuration	Configuration Descriptor Header	00h	1	bLength	E6h	No	-
			01h	1	bDescriptorIDN	01h	No	-
			02h	1	bConfDescContinue	00h	Yes	-
			03h	19	Reserved	00h	No	-
			00h	1	bLUEnable	00h	Yes	-
			01h	1	bBootLunID	00h	Yes	-

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IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
		Unit Descriptor configurable parameters	02h	1	bLUWriteProtect	00h	Yes	-
			03h	1	bMemoryType	00h	Yes	-
			04h	4	dNumAllocUnits	00h	Yes	-
			08h	1	bDataReliability	00h	Yes	-
			09h	1	bLogicalBlockSize	0Ch	Yes	Logical Block Size is 4KByte
			0Ah	1	bProvisioningType	00h	Yes	-
			0Bh	2	wContextCapabilities	00h	Yes	-
			0Dh	3	Reserved	00h	No	-
			10h	2	wLUMaxActiveHPBRegion	00h	Yes	-
			12h	2	wHPBPinnedRegionStartIdx	00h	Yes	-
			14h	2	wNumHPBPinnedRegions	00h	Yes	-
			16h	4	dLUNumWriteBoosterBufferAllocUnits	00h	Yes	-

5.1.4 Geometry Descriptor

Table.20 Geometry Descriptor

IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
07h	Geometry	00h	1	bLength	57h	No	-
		01h	1	bDescriptorType	07h	No	-
		02h	1	bMediaTechnology	00h	No	-
		03h	1	Reserved	00h	No	-
		04h	8	qTotalRawDeviceCapacity 64GB	7734000h	No	-
		0Ch	1	bMaxNumberLU	01h	No	-
		0Dh	4	dSegmentSize	2000h	No	-
		11h	1	bAllocationUnitSize	01h	No	-
		12h	1	bMinAddrBlockSize	08h	No	-
		13h	1	bOptimalReadBlockSize	00h	No	-
		14h	1	bOptimalWriteBlockSize	80h	No	-

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IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
		15h	1	bMaxInBufferSize	40h	No	-
		16h	1	bMaxOutBufferSize	40h	No	-
		17h	1	bRPMB_ReadWriteSize	20h	No	-
		18h	1	bDynamicCapacityResourcePolicy	00h	No	-
		19h	1	bDataOrdering	00h	No	-
		1Ah	1	bMaxContexIDNumber	05h	No	-
		1Bh	1	bSysDataTagUnitSize	00h	No	-
		1Ch	1	bSysDataTagResSize	00h	No	-
		1Dh	1	bSupportedSecRTypes	01h	No	-
		1Eh	2	wSupportedMemoryTypes	8009h	No	-
		20h	4	dSystemCodeMaxNAllocU 64GB	00h	No	-
		24h	2	wSystemCodeCapAdjFac	00h	No	-
		26h	4	dNonPersistMaxNAllocU 64GB	00h	No	-
		2Ah	2	wNonPersistCapAdjFac	00h	No	-
		2Ch	4	dEnhanced1MaxNAllocU 64GB	-	No	TBD
		30h	2	wEnhanced1CapAdjFac	0300h	No	-
		32h	4	dEnhanced2MaxNAllocU	00h	No	-
		36h	2	wEnhanced2CapAdjFac	0000h	No	-
		38h	4	dEnhanced3MaxNAllocU	00h	No	-
		3Ch	2	wEnhanced3CapAdjFac	0000h	No	-
		3Eh	4	dEnhanced4MaxNAllocU	00h	No	-
		42h	2	dEnhanced4CapAdjFac	0000h	No	-
		44h	4	dOptimalLogicalBlockSize	00000000h	No	-
		48h	1	Reserved	-	-	-
		4Dh	1	Reserved	-	-	-
		4Fh	4	dWriteBoosterBufferMaxNAllocUnits	600h	No	-
		53h	1	bDeviceMaxWriteBoosterLUs	01h	No	-
		54h	1	bWriteBoosterBufferCapAdjFac	03h	No	-

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IDN	Descriptor	Offset	Size (Byte)	Name	MDV	User Conf.	Description
		55h	1	bSupportedWriteBoosterBufferUserSpaceReductionTypes	01h	No	-
		56h	1	bSupportedWriteBoosterBufferTypes	01h	No	-

NOTE:

The Capacity value will be returned except the Boot A/B, and RPMB LU for the Read Capacity SCSI Command.

5.1.5 Unit Descriptor

Table.21 Unit Descriptor(IDN= 0X02)(INDEX=Unit Index0)

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
02h	Unit	Normal	00h	1	bLength	2Dh	No	-
			01h	1	bDescriptorIDN	02h	No	-
			02h	1	bUnitIndex	00h	No	-
			03h	1	bLUEnable	00h	Yes	-
			04h	1	bBootLunID	00h	Yes	-
			05h	1	bLUWriteProtect	00h	Yes	-
			06h	1	bLUQueueDepth	00h	No	-
			07h	1	bPSASensitive	01h	No	-
			08h	1	bMemoryType	00h	Yes	-
			09h	1	bDataReliability	00h	Yes	-
			0Ah	1	bLogicalBlockSize	0Ch	Yes	-
			0Bh	8	qLogicalBlockCount	00h	Yes	-
			13h	4	dEraseBlockSize	00h	No	-
			17h	1	bProvisioningType	00h	Yes	-
			18h	8	qPhyMemResourceCount	00h	No	-
			20h	2	wContextCapabilities	00h	Yes	-
			22h	1	bLargeUnitGranularity_M1	00h	No	-
			23h	2	wLUMaxActiveHPBRegions	00h	Yes	-
			25h	2	wHPBPinnedRegionStartIdx	00h	Yes	-
			27h	2	wNumHPBPinnedRegions	00h	Yes	-

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IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
			29h	4	dLUNumWriteBoosterBufferAllocUnits	00h	Yes	-

Table.22 Unit Descriptor(IDN= 0X02)(INDEX=0xC4)

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
02h	Unit	RPMB	00h	1	bLength	23h	No	-
			01h	1	bDescriptorIDN	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	bPSASensitive	00h	No	-
			08h	1	bMemoryType	0Fh	No	-
			09h	1	bRPMBRegionEnable	00h	Yes	-
			0Ah	1	bLogicalBlockSize	08h	No	-
			0Bh	8	qLogicalBlockCount	10000h	No	-
			13h	4	dEraseBlockSize	00h	No	-
			17h	1	bProvisioningType	00h	No	-
			18h	8	qPhyMemResourceCount	10000h	No	-
			20h:22h	3	Reserved	00h	N/A	-

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5.1.6 Other Descriptor

Table.23 Other Descriptor

IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
04h	Interconnect		00h	1	bLength	06h	No	-
			01h	1	bDescriptorType	04h	No	-
			02h	2	bcdUniproVersion	160h	No	UniPro 1.6
			04h	2	bcdMphyVersion	300h	No	M-PHY 3.0
05h	String	Manufacturer Name	00h	1	bLength	12h	No	-
			01h	1	bDescriptorType	05h	No	-
			02h	2	UC[0]	0042h	No	"B"
			04h	2	UC[1]	0049h	No	"I"
			06h	2	UC[2]	0057h	No	"W"
			08h	2	UC[3]	0049h	No	"I"
			0Ah	2	UC[4]	004Eh	No	"N"
			0Ch	2	UC[5]	00h	No	-
			0Eh	2	UC[6]	00h	No	-
		Product Name	00h	1	bLength	22h	No	-
			01h	1	bDescriptorType	05h	No	-
			02h	2	UC[0]	0042h	No	"B"
			04h	2	UC[1]	0057h	No	"W"
			06h	2	UC[2]	0055h	No	"U"
			08h	2	UC[3] 64GB	0032h	No	"2"
			0Ah	2	UC[4]	0041h	No	"A"
			0Ch	2	UC[5] 64GB	0030h	No	"0"
			0Eh	2	UC[6]	0035h	No	"5"
			10h	2	UC[7]	0031h	No	"1"
			12h	2	UC[8]	0036h	No	"6"
			14h	2	UC[9]	0042h	No	"B"
			16h	2	UC[10]	0030h	No	"0"

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IDN	Descriptor		Offset	Size (Byte)	Name	MDV	User Conf.	Description
			18h	2	UC[11]	0036h	No	"6"
			1Ah	2	UC[12]	0034h	No	"4"
			1Ch	2	UC[13]	0047h	No	"G"
			1Eh	2	UC[14]	0000h	No	-
		Serial Number	00h	1	bLength	40h	No	-
			01h	1	bDescriptorIDN	05h	No	-
			02h	2	UC[0]	Random value	No	-
			04h	2	UC[1]		No	-
			06h	58	UC[2]-UC[30]		No	-
		OEM ID	00h	1	bLength	40h	No	Size of this descriptor
			01h	1	bDescriptorIDN	05h	No	-
			02h	2	UC[0]	0042h	No	“B”
			04h	2	UC[1]	0049h	No	“I”
			06h	2	UC[2]	0057h	No	“W”
			08h	2	UC[3]	0049h	No	“I”
			0Ah	2	UC[4]	004Eh	No	“N”
			0Ch	2	UC[5]-UC[30]	00h	No	-
08h	Power		00h	1	bLength	62h	No	-
			01h	1	bDescriptorIDN	08h	No	-
			02h	32	wActiveICCLevelsVCC[15:0]	81F4h	No	-
			22h	32	wActiveICCLevelsVCCQ[15:0]	0000h	No	-
			42h	32	wActiveICCLevelsVCCQ2[15:0]	81F4h	No	-
09h	Device Health		00h	1	bLength	25h	No	-
			01h	1	bDescriptorType	09h	No	-
			02h	1	bPreEOLInfo	01h	No	-
			03h	1	bDeviceLifeTimeEstA	01h	No	-
			04h	1	bDeviceLifeTimeEstB	01h	No	-
			05h	32	VendorPropInfo	00h	No	-

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5.2 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	fDeviceLifeSpanModeEn	Read / Volatile	D	00h	-
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	N/A	N/A	-
0Bh	fPermanentlyDisableFwUpdate	Read / Write once	D	00h	-
0Ch	Reserved	N/A	N/A	N/A	-
0Dh	Reserved	N/A	N/A	N/A	-
0Eh	fWriteBoosterEn	Read / Volatile	A/LU/0D	00h	
0Fh	fWriteBoosterBufferFlushEn	Read / Volatile	A/LU/0D	00h	
10h	fWriteBoosterBufferFlushDuringHibernate	Read / Volatile	A/LU/0D	00h	
11h	fHPBReset	Read /Set Only	D	00h	-
12h	fHPBEn	Read/ Persistent	D	00h	-

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5.3 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	00h	-
01h	bMAX_ DATA_SIZE_FOR_HPB _SINGLE_CMD	Read / Read Only	1	D	FFh	-
02h	bCurrentPowerMode	Read only	1	D	11h	-
03h	bActiveICCLevel	Read / Persistent	1	D	00h	-
04h	bOutOfOrderDataEn	Read / Write once	1	D	00h	-
05h	bBackgroundOpStatus	Read only	1	D	00h	-
06h	bPurgeStatus	Read only	1	D	00h	-
07h	bMaxDataInSize1)	Read / Persistent	1	D	40h	-
08h	bMaxDataOutSize2)	Read / Persistent	1	D	40h	-
09h	dDynCapNeeded	Read only	4	A, (LUN), 0	00h	-
0Ah	bRefClkFreq	Read / Persistent	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, (LUN), 15(ID)	00h	-
11h	Obsolete	N/A	Not Defined	N/A	N/A	-
12h	Reserved	N/A	Not Defined	N/A	N/A	-
13h	Reserved	N/A	Not Defined	N/A	N/A	-
14h	bDeviceFFUStatus	Read Only	1	D	00h	-
15h	bPSAState	Read/Persistent	1	D	00h	-
16h	dPSADataSize	Read/Persistent	4	D	00h	-

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IDN	Name	Access Property	Size	Type, #Index, #Selector	MDV	Description
17~1Bh	Reserved	-	-	-	00h	Reserved
1Ch	bWriteBoosterBufferFlushStatus	Read Only	1	A/LU/0 or D	00h	-
1Dh	bAvailableWriteBoosterBufferSize	Read Only	1	A/LU/0 or D	00h	-
1Eh	bWriteBoosterBufferLifeTimeEst	Read Only	1	A/LU/0 or D	00h	-
1Fh	dCurrentWriteBoosterBufferSize	Read Only	4	A/LU/0 or D	00h	-

NOTE :

1) bMaxDataInSize = 32 KByte, not reconfigurable.

2) bMaxDataOutSize = 32 KByte, not reconfigurable.

5.3.1 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.

5.4 Mode Pages

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

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5.4.1 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	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	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	00b	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	01h	No	-
	0Ah	02h	EXTENDED SELF-TEST COMPLETION TIME	0000h	No	-

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5.4.2 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 page

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	No	-
	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	00b	No	-
	07h	1b	TPERE	0b	No	-
	08h	01h	WRITE RETRY COUNT	00h	No	-
	09h	01h	Reserved	00h	No	-
	0Ah	02h	RECOVERY TIME LIMIT	4B0h	No	-

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5.4.3 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	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	0Eh	02h	CACHE SEGMENT SIZE	0000h	No	-
	10h	01h	Reserved	00h	No	-
	11h	03h	Obsolete	0000h	No	-

5.5 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	RESPONSE DATA FORMAT: Type 2
	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	00b	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	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	06h	1b	MULTIP	0b	No	-
	06h	1b	VS	0b	No	-
	06h	1b	ENCSERV	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	"BIWIN"	No	-
	10h	04h	PRODUCT IDENTIFICATION	-	No	TBD, customizable
	20h	04h	PRODUCT REVISION LEVEL	-	No	TBD, customizable
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	0007h	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	-
	09h	01h	Supported VPD Page List[5]	B1h	No	-
	0Ah	01h	Supported VPD Page List[6]	B2h	No	-
	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
Unit Serial Number	01h	01h	PAGE CODE	80h	No	-
	02h	02h	PAGE LENGTH	1Fh	No	-
	04h	01h	PRODUCT SERIAL NUMBER[0]	Device Specific	No	-
	05h	01h	PRODUCT SERIAL NUMBER[1]		No	-
	06h	01h	PRODUCT SERIAL NUMBER[2]		No	-
	07h	01h	PRODUCT SERIAL NUMBER[3]		No	-
	08h	01h	PRODUCT SERIAL NUMBER[4]		No	-
	09h	01h	PRODUCT SERIAL NUMBER[5]		No	-
	0Ah	01h	PRODUCT SERIAL NUMBER[6]		No	-
	0Bh	01h	PRODUCT SERIAL NUMBER[7]		No	-
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	14h	No	-
	N/A	N/A	Designation descriptor[first]	N/A	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	00h	No	-
	07h	01h	DESIGNATOR LENGTH	08h	No	-
	08h	03h	IEEE COMPANY ID	TBD	No	-
	0Bh	05h	VENDOR SPECIFIC EXTENSION IDENTIFIER	TBD	No	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	N/A	N/A	Designation descriptor[second]	N/A	No	-
	10h	4b	CODE SET	0001b	No	-
	10h	4b	PROTOCOL IDENTIFIER	0000b	No	-
	11h	4b	DESIGNATOR TYPE	0110b	No	-
	11h	2b	ASSOCIATION	10b	No	-
	11h	1b	Reserved	0b	No	-
	11h	1b	PIV	0b	No	-
	12h	01h	Reserved	00h	No	-
	13h	01h	DESIGNATOR LENGTH	04h	No	-
	14h	02h	Reserved	0000h	No	-
	16h	02h	LOGICAL UNIT GROUP	0000h	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	14h	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	
	06h	05b	Reserved	00000b	No	-
	06h	01b	MLUS[0]	1b	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	-
	0Ah	05b	Reserved	00000b	No	-
	0Ah	01b	MLUS[1]	1b	No	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	0Bh	01h	Reserved	00h	No	-
	0Ch	06b	POLICY PAGE CODE[2]	08h	No	Caching Mode Page
	0Ch	02b	Reserved	00b	No	-
	0Dh	01h	POLICY SUBPAGE CODE[2]	00h	No	-
	0Eh	02b	MODE PAGE POLICY[2]	00b	No	-
	0Eh	05b	Reserved	00000b	No	-
	0Eh	01b	MLUS[2]	1b	No	-
	0Fh	01h	Reserved	00h	No	-
	10h	06b	POLICY PAGE CODE[3]	3fh	No	All Pages
	10h	02b	Reserved	00b	No	-
	11h	01h	POLICY SUBPAGE CODE[3]	00h	No	-
	12h	02b	MODE PAGE POLICY[3]	00b	No	-
	12h	05b	Reserved	00000b	No	-
	12h	01b	MLUS[3]	1b	No	-
	13h	01h	Reserved	00h	No	-
	14h	06b	POLICY PAGE CODE[4]	3fh	No	All sub Pages
	14h	02b	Reserved	00b	No	-
	15h	01h	POLICY SUBPAGE CODE[4]	ffh	No	-
	16h	02b	MODE PAGE POLICY[4]	00b	No	-
	16h	05b	Reserved	00000b	No	-
	16h	01b	MLUS[4]	1b	No	-
	17h	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	003Ch	No	-
	04h	01h	Reserved	00h	No	-
	05h	01h	MAXIMUM COMPARE AND WRITE LENGTH	00h	No	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	06h	02h	OPTIMAL TRANSFER LENGTH GRANULARITY	01h	No	-
	08h	04h	MAXIMUM TRANSFER LENGTH	00h	No	-
	0Ch	04h	OPTIMAL TRANSFER LENGTH	80h	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	3Fh	No	-
	1Ch	04h	OPTIMAL UNMAP GRANULARITY	1h	No	-
	20h	04h	UNMAP GRANULARITY ALIGNMENT	00h	No	-
	24h	1Bh	Reserved	00h	No	-
Block Device Characteristics	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	B1h	No	-
	02h	02h	PAGE LENGTH	003Ch	No	-
	04h	02h	MEDIUM ROTATION RATE	0001h	No	0001h : Non-rotat- ing medium (e.g., solid state)
	06h	01h	Reserved	00h	No	-
	07h	4b	NOMINAL FORM FACTOR	00h	No	0h : Nominal form factor is not reported 1h : 5.25 inch 2h : 3.5 inch 3h : 2.5 inch 4h : 1.8 inch 5h : Less than 1.8 inch All others : Reserved
	07h	4b	Reserved	00h	No	-

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Mode Page	Offset	Size	Field	MDV	User Conf.	Description
	08h	38h	Reserved	00h	No	-
Logical Block Provisioning	00h	5b	PERIPHERAL DEVICE TYPE	00000b	No	-
	00h	3b	PERIPHERAL QUALIFIER	000b	No	-
	01h	01h	PAGE CODE	B2h	No	-
	02h	02h	PAGE LENGTH	0004h	No	-
	04h	01h	THRESHOLD EXPONENT	16h	No	-
	05h	1b	DP	00h	No	-
	05h	1b	ANC_SUP	00h	No	-
	05h	4b	Reserved	00h	No	-
	05h	1b	LBPWS	00h	No	-
	05h	1b	LBPU	01h	No	-
	06h	3b	PROVISIONING TYPE	00h	No	0 : Thin provision 1 : Full provision
	06h	5b	Reserved	00h	No	-
	07h	01h	Reserved	00h	No	-
	08h	(n-8+1)h	PROVISIONING GROUP DESCRIPTOR	00h	No	-

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6. DESIGN GUIDE FOR PCB LAYOUT

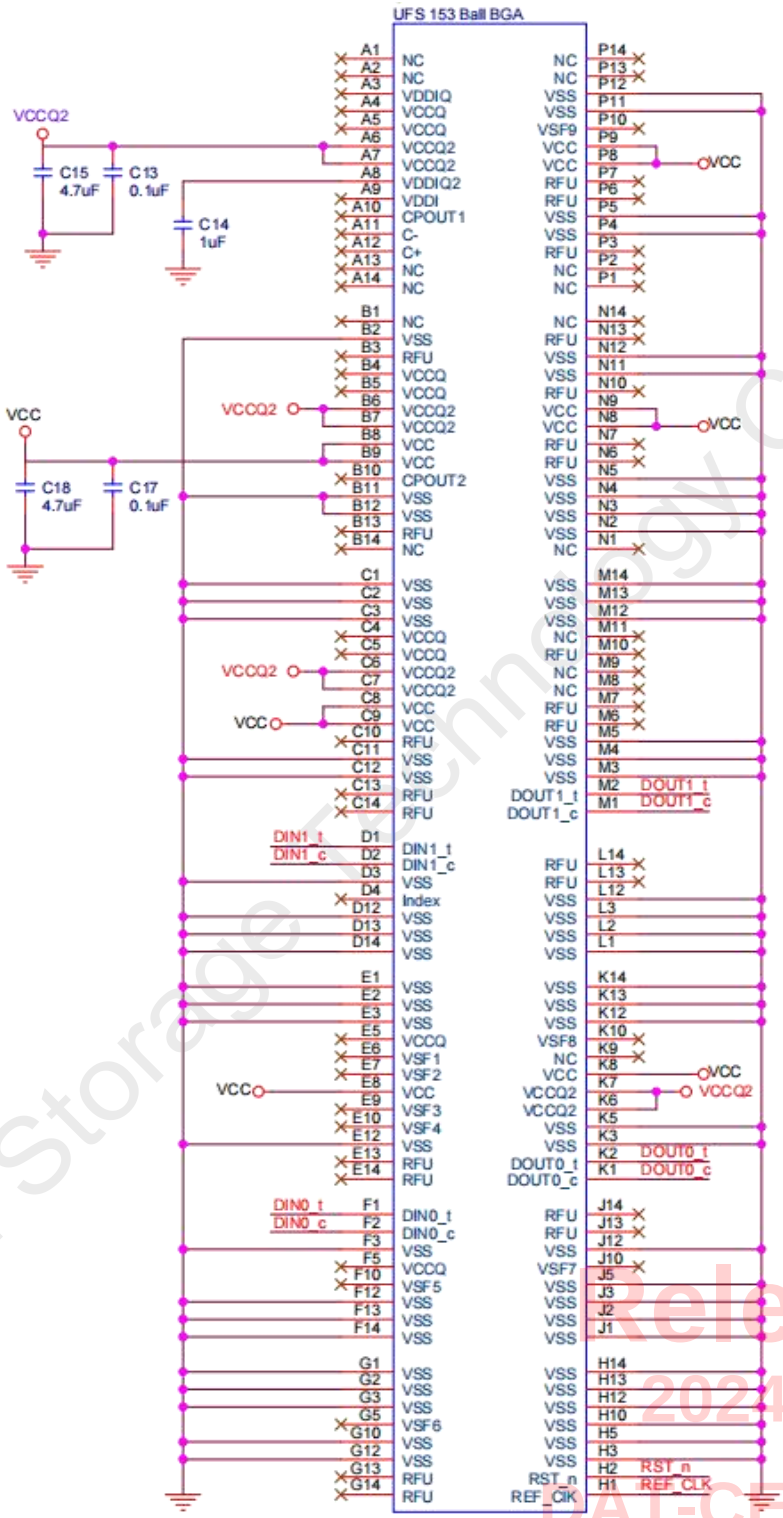


Figure5. schematic diagram of product marking

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7. MARKING

First Row: Simplified BIWIN Logo

Second Row: Product Logo

Third Row: Sales Item P/N

Fourth Row: Lot No.

Fifth Row: Serial Number + Flash Code

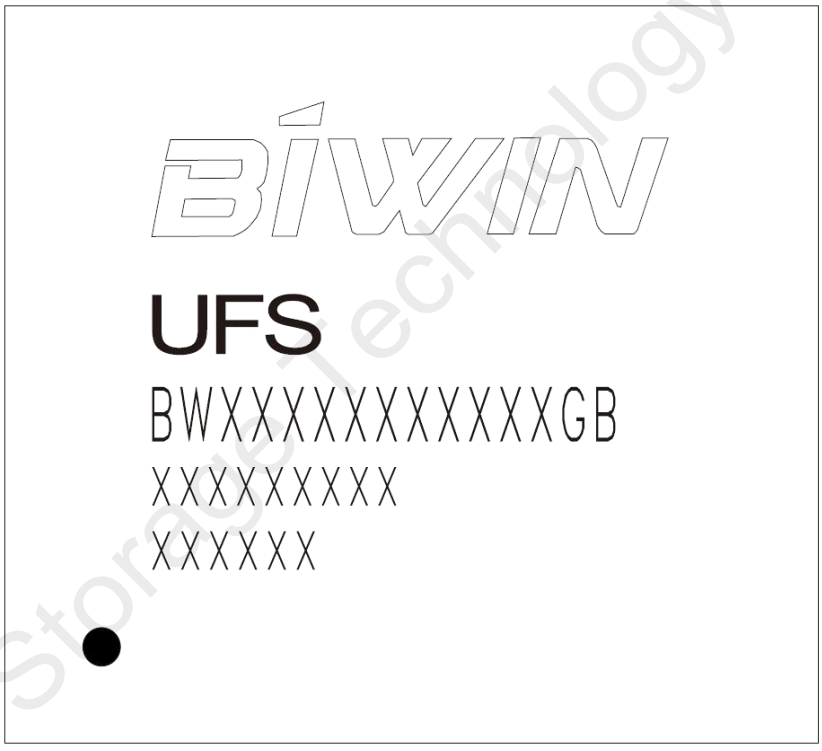


Figure6. schematic diagram of product marking

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