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Product Specification
Semi-Metal MLC USB Flash Disk
Generation 3
-HAMMER-D Series-

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Revision History

Rev.	Description	Update
1.0	Initial Released	2011/12/12
1.1	Warranty period : revised from 1 year to 2 years	2012/7/30

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1. Introduction

MUFD - Generation 3 - HAMMER-D Series, is specified as 2.0 High Speed Device, Mass Storage Class; USB-IF (USB Implementers Forum), WHQL (Window Hardware Quality Labs) and EMI tests certified. Also, its random access performance exceed the minimum requirement of Read Boost feature found in Microsoft Vista operating system, in which randomly access blocks of information are saved into MUFD - Generation 3 for boosting up the average performance. They are available in 1GB, 2GB, 4GB, 8GB and 16GB capacities by Samsung MLC Flash IC.

The MUFD - Generation 3 - HAMMER-D Series also offers unique customization for OEM customers by laser markings.

1.1. Scope

This document describes the key features and specifications of MUFD built-in NAND type MLC flash IC – Generation 3 – HAMMER-D Series.

1.2. System Features

- USB 2.0 interface downwards compatible to USB 1.1
- USB 2.0 Mass Storage compliant
- LED indicates the usage status of USB Flash Disk
- Standard grade operating temperature 0°C to 70°C and wide temperature -40°C ~ +85°C with special conformal coating treatment
- Support partition management for Disk Lock and Password Protection
- Supports Ready Boost for Microsoft Vista O.S.
- Capacities from 1GB to 16GB

2. Product Specifications

For all the following specifications, values are defined at ambient temperature and nominal supply voltage unless otherwise stated.

2.1. System Environmental Specifications

Table 1: Environmental Specification

Temperature	Standard grade operating temperature :	0 °C ~ +70 °C
	Standard grade non-operating temperature :	-20°C ~ +85°C
	Wide temperature operating temperature :	-40 °C ~ +85 °C
	Wide temperature non-operating temperature :	-50°C ~ +95°C
Humidity	Operating & Non-operating:	10% ~ 95% non-condensing
Vibration	Operating & Non-operating:	15G peak-to-peak maximum
Shock	Operating & Non-operating:	1,500 G maximum

2.2. System Power Requirements

Table 2: Power Requirement

DC Input Voltage (VCC) 100mV max. ripple(p-p)		5V±10%
+5V Current (Maximum average value)	Idle Mode :	63.5 mA
	Reading Mode :	74.0 mA
	Writing Mode :	88.0 mA

2.3. System Performance

Table 3: System Performances

Performance (KB/sec)	Sequent Speed (MB/Sec.)	
	Read	Write
1GB	15.7	6.9
2GB	18.2	5.1
4GB	18.5	6.2
8GB	20.1	16.2
16GB	19.1	16.7

Note:

(1). All values quoted are typically at 25°C and nominal supply voltage.

(2). The Max. Performance was tested by SiSoftware Sandra /File Benchmark

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms	Dynamic
ECC Technology	8 bits or 15 bits per 512 bytes block
Data Retention	10 years

2.5. Physical Specifications

Refer to Table 5 and see Figure 1 for USB Flash Disk physical specifications and dimensions.

Table 5: Physical Specifications

APRO USB Flash Disk	
Length:	47.30 mm
Width:	17.60 mm
Thickness:	8.40 mm
Weight:	15.0 g

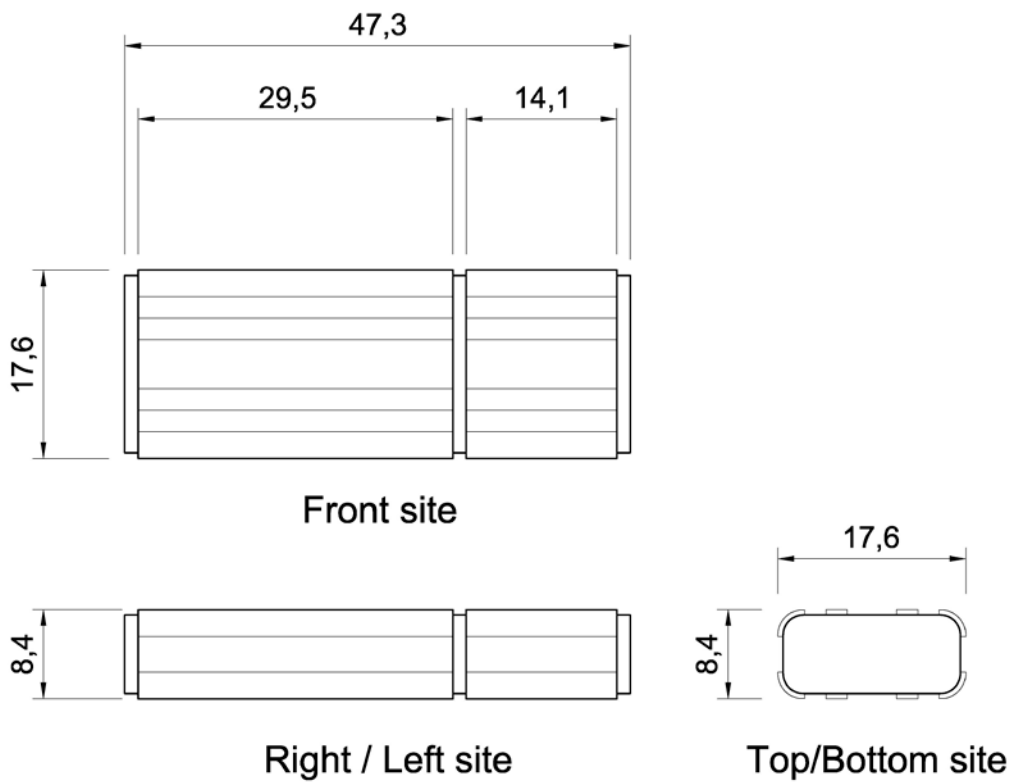


Figure 1: MUFD Generation 3 Dimensions

2.6. Certifications

2.6.1. EMC / Verification No.: EM/2007/90094C

APRO MUFD - Generation 3 - HAMMER-D Series products meet the requirements of the below standards and hence fulfills the requirements of EMC Directive 2004/108/EC requirements.

Table 6: APRO MUFD Electromagnetic Compatibility

Parameter	Standard
Emission	EN55022 : 1998+A1: 2000+A2:2003 Class B
Immunity	EN55024 : 1998+A1: 2001+A2:2003
	IEC61000-4-2: 1995+A1:1998+A2:2000
	IEC61000-4-3: 2002+A1:2002

2.6.2. FCC / Declaration No.: EM/2007/70044C

In the configuration tested the APRO MUFD - Generation 3 - HAMMER-D Series complied with the standards **FCC Part 15: 2006, Subpart B, Class B.**

2.6.3. RoHS

Directive of the European Parliament of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2002/95/EC (RoHS).

3. Interface Description

3.1. Physical Description

The host is connected to the MUFD - Generation 3 - HAMMER-D Series using a Type A female USB connector.

3.2. Pin Assignments

Table 7: Pin Assignments of USB 2.0

Pin Number	Pin Name	Function
Pin 1	Vcc	Power
Pin 2	USB -	The pairs are used to transmit Address, Data and Command.
Pin 3	USB +	
Pin 4	Vss	Ground

4. Electrical Characteristics

4.1. Absolute Maximum Ratings

Table 8: Absolute Maximum Ratings

SYMBOL	PARAMETER	RATING	UNITS
AV _{DD5V}	5V Power Supply	-0.25 to A _{DDH} + 0.25	V
V _{DDH}	Power Supply	-0.3 to V _{DDH} + 0.3	V
V _{IN}	Input Signal Voltage	-0.3 to 3.6	V
V _{OUT}	Output Signal Voltage	-0.3 to V _{DDH} + 0.3	V
T _{STG}	Storage Temperature	-40 to 150	°C
V _{DD3V}	3.3V Power Supply	250	mA
V ₁₈	1.8V Power Supply	250	mA

4.2. Recommended Operating conditions

Table 9: Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
AV _{DD5V}	5V Power Supply	4.00	5.0	5.25	V
V _{DDH}	Power Supply	3.0	3.3	3.6	V
V _{DD}	Digital Supply	1.62	1.8	1.98	V
V _{IN}	Input Signal Voltage	0	3.3	3.6	v
T _{OPR}	Operating Temperature	0		70	°C

4.3. General DC Characteristics

Table 10: General DC Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
I _{IN}	Input current	No pull-up or pull-down	-10	±1	10	μA
I _{OZ}	Tri-state leakage current		-10	±1	10	μA
C _{IN}	Input capacitance	Pad Limit		2.8		ρF
C _{OUT}	Output capacitance	Pad Limit		2.8		ρF
C _{BID}	Bi-directional buffer capacitance	Pad Limit		2.8		ρF

4.4. DC Electrical Characteristics of 3.3V I/O Cells

Table 11: Electrical Characteristics of 3.3V I/O Cells

SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			MIN	TYP	MAX	
V _{DDH}	Power supply	3.3V I/O	3.0	3.3	3.6	V
V _{il}	Input low voltage	LVTTL			0.8	V
V _{ih}	Input high voltage		2.0			V
V _{ol}	Output low voltage	I _{oi} =2~16mA			0.4	V
V _{oh}	Output high voltage	I _{oh} =2~16mA	2.4			V
R _{pu}	Input pull-up resistance	PU=high, PD=low	55	75	110	KΩ
R _{pd}	Input pull-down resistance	PU=high, PD=low	40	75	150	KΩ
I _{in}	Input leakage current	V _{in} = V _{DDH} or 0	-10	±1	10	μA
I _{oz}	Tri-state output leakage current		-10	±1	10	μA

4.5. USB Transceiver Characteristics

Table 12: Electrical characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
VD33	Analog supply Voltage		3.0	3.3	3.6	V
VDDU VDDA	Digital supply Voltage		1.62	1.82	1.98	V
I _{cc}	Operating supply current	High speed operating at 480 MHz			55	mA
I _{cc(susp)}	Suspend supply current	In suspend mode, current with 1.5kΩ pull-up resistor on pin RPU disconnected			120	μA

4.6. Static Characteristic

Table 13: Static characteristic: Digital pin

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Input levels						
V _{IL}	Low-level input voltage				0.8	V
V _{IH}	High-level input voltage		2.0			V
Output levels						
V _{OL}	Low level output voltage				0.2	V
V _{OH}	High-level output voltage		V _{ddh} -0.2			V

VD33=3.0DV~3.6V ; VDDU,VDDA=1.62V~1.98V ; Temp=0°C~70°C

Table 14: Static characteristic: Analog I/O pin (DP / DM)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
USB 2.0 Transceiver (HS)						
Input Levels (differential receiver)						
V_{HSDIFF}	High speed differential input sensitivity	$ V_{I(DP)} - V_{I(DM)} $ measured at the connection as application circuit	300			mV
V_{HSCM}	High speed data signaling common mode voltage range		-50		500	mV
V_{HSSQ}	High speed squelch detection threshold	Squelch detected			100	mV
		No squelch detected	150			mV
V_{HSDSC}	High speed disconnection detection threshold	Disconnection detected	625			mV
		Disconnection not detected			525	mV
Output Levels						
V_{HSOI}	High speed idle level output voltage (differential)		-10		10	mV
V_{HSOL}	High speed low level output voltage (differential)		-10		10	mV
V_{HSOH}	High speed high level voltage (differential)		-360		400	mV
V_{CHRPJ}	Chirp-J output voltage (differential)		700		1100	mV
V_{CHIRPK}	Chirp-K output voltage (differential)		-900		-500	mV
Resistance						
R_{DRV}	Driver output impedance	Equivalent resistance used as internal chip only	3	6	9	Ω
		Overall resistance including external resistor	40.5	45	49.5	
V_{TERM}	Termination voltage for pull-up resistor on pin RPU		3.0		3.6	V
USB 1.1 Transceiver (FS/LS)						
Input Levels (differential receiver)						
V_{DI}	Differential input sensitivity	$ V_{I(DP)} - V_{I(DM)} $	0.2			V
V_{CM}	Differential common mode voltage		0.8		2.5	V
Input Levels (single-ended receivers)						
V_{SE}	Single ended receiver threshold		0.8		2.0	V
Output Levels						
V_{OL}	Low-level output voltage		0		0.3	V
V_{OH}	High-level output voltage		2.8		3.6	V

VD33=3.0DV~3.6V ; VDDU,VDDA=1.62V~1.98V ; Temp=0°C~70°C

4.7. Dynamic Characteristic

Table 15: Dynamic characteristic: Analog I/O pins (DP DM)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Driver Characteristics						
High-Speed Mode						
t _{HSR}	High-speed differential rise time	V _{I(DP)} - V _{I(DM)} measured at the connection as application circuit	500			ps
t _{HSF}	High-speed differential fall time		500			ps
Full-Speed Mode						
t _{FR}	Rise time	CL=5pF ; 10 to 90% of V _{OH} - V _{OL} ;	4		20	ns
t _{FF}	Fall time	CL=5pF ; 90 to 10% of V _{OH} - V _{OL} ;	4		20	ns
t _{FRMA}	Differential rise / fall time matching (t _{FR} / t _{FF})	Excluding the first transition from idle mode	90		110	%
V _{CRS}	Output signal crossover voltage	Excluding the first transition from idle mode	1.3		2.0	V
Low-Speed Mode						
t _{LR}	Rise time	CL=200pF-600pF ; 10 to 90% of V _{OH} - V _{OL} ;	75		300	ns
t _{LF}	Fall time	CL=200pF-600pF ; 90 to 10% of V _{OH} - V _{OL} ;	75		300	ns
t _{LRMA}	D Differential rise / fall time matching (t _{LR} / t _{LF})	Excluding the first transition from idle mode	80		125	%
V _{CRS}	Output signal crossover voltage	Excluding the first transition from idle mode	1.3		2.0	V
V _{OH}	High-level output voltage		2.8		3.6	V

Appendix A. Ordering Information

1. Part Number

MUFD - Generation 3 - HAMMER-D Series USB Flash Disk		
Grade	Standard Grade 0°C ~ 70°C	Wide temperature -40°C ~ 85°C
1GB	SMUFD001G – ADCSM – 3	WMUFD001G – ADCSM – 3C
2GB	SMUFD002G – ADCSM – 3	WMUFD002G – ADCSM – 3C
4GB	SMUFD004G – ADCSM – 3	WMUFD004G – ADCSM – 3C
8GB	SMUFD008G – ADCSM – 3	WMUFD008G – ADCSM – 3C
16GB	SMUFD016G – ADCSM – 3	WMUFD016G – ADCSM – 3C

Remark:

The wide temperature items support operating temperature -40°C ~ 85°C are with special conformal coating treatment on PCBA.

2. Part Number Decoder

X1 X2 X3 X4 X5 X6 X7 X8 X9 – X11 X12 X13 X14 X15 – 3 / C

X1 : Grade

S : Standard Grade – operating temperature 0° C ~ 70 ° C

W : Wide temperature – operating temperature -40° C ~ 85 °C

X2 : The material of case

M : Semi-metal / metal casing

X3 X4 X5 : Product category

UFD : USB 2.0 Flash Disk

X6 X7 X8 X9 : Capacity

001G : 1GB

002G : 2GB

004G : 4GB

008G : 8GB

016G : 16GB

X11 : Controller

A : Alcor (HAMMER Series)

X12 : Controller version

A, B, C, D.....

X13 : Controller Grade

C : Commercial grade

X14 : Flash IC

S : Samsung Flash IC

X15 : Flash IC grade

M : MLC-NAND flash IC

3 : Generation of casing design

3 : Generation 3

C : Reserved for specific requirement

C : Conformal coating

Appendix B. Limited Warranty

APRO warrants your Metal USB Flash Disk against defects in material and workmanship for the life of the drive. The warranty is void in the case of misuse, accident, alteration, improper installation, misapplication or the result of unauthorized service or repair. The implied warranties of merchantability and fitness for a particular purpose, and all other warranties, expressed or implied, except as set forth in this warranty, shall not apply to the products delivered. In no event shall APRO be liable for any lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, this product.

BEFORE RETURNING PRODUCT, A RETURN MATERIAL AUTHORIZATION (RMA) MUST BE OBTAINED FROM APRO.

Product shall be returned to APRO with shipping prepaid. If the product fails to conform based on customers' purchasing orders, APRO will reimburse customers for the transportation charges incurred.

Warranty Period: 2 years for MLC products



The warranty period is able to extend. Please contact with APRO or APRO's distributor for more information.