



*JUN 2013*

# Product Specification

**Industrial Rugged Metal USB Flash Disk**

**RUFD - Generation 4SB**

**- HAMMER-D Series -**

Doc-No: 100-xRUFD-ADS4SB-01V1



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*Revision History*

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## **1. Introduction**

RUFD - Generation 4SB – HAMMER-D Series, is specified as 2.0 High Speed Device, Mass Storage Class; USB-IF (USB Implementers Forum), WHQL (Window Hardware Quality Labs), EMI and IP-54/ IP-68 waterproof tests certified. In addition to being as a removable storage device, RUFD - Generation 4SB can also be configured as a bootable disk for system recovery. 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 RUFD - Generation 4SB for boosting up the average performance. They are available in 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, and 8GB capacities by Samsung SLC Flash IC.

The RUFD - Generation 4SB - 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 S/WRUFD – Generation 4SB – HAMMER-D Series.

### **1.2. System Features**

- Full metal enclosure design to endure various rough environments
- IP-54 & IP-68 Waterproof metal casing design with Screw Thread to Fix Cap
- USB 2.0 interface downwards compatible to USB 1.1
- USB 2.0 Mass Storage compliant
- Standard grade operating temperature 0°C to 70°C
- Support partition management for Disk Lock and Password Protection
- Supports Ready Boost for Microsoft Vista O.S.
- Capacities from 128MB to 8GB

## 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 ~ +80°C
	Industrial grade operating temperature :	-40 °C ~ +85 °C
	Industrial grade 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 :	68.3 mA
	Reading Mode :	78.2 mA
	Writing Mode :	80.5 mA

### 2.3. System Performance

**Table 3: System Performances**

Performance (KB/sec)	Sequent Speed (MB/Sec.)	
	Read	Write
128MB	16.4	6.4
256MB	16.4	6.4
512MB	17.7	9.3
1GB	17.6	5.7
2GB	18.1	14.8
4GB	20.1	20.0
8GB	15.6	15.0

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**

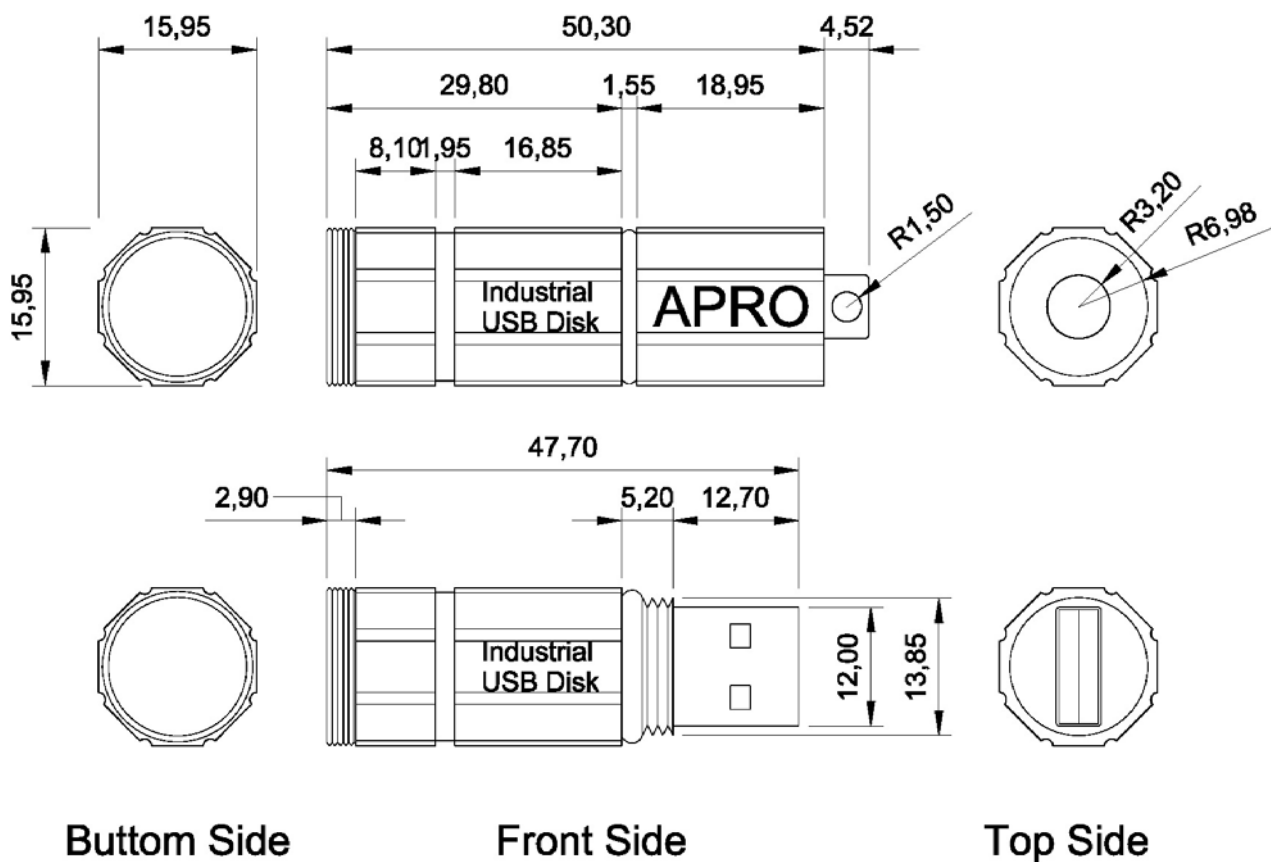
<b>MTBF</b>	>1,000,000 hours
<b>Wear-leveling Algorithms</b>	Dynamic
<b>Endurance</b>	Greater than 2,000,000 cycles Logically contributed by Wear-leveling and advanced bad sector management
<b>Data Retention</b>	10 years

**2.5. Physical Specifications**

Refer to Table 5 and see Figure 3 for USB Flash Disk physical specifications and dimensions.

**Table 5: Physical Specifications**

APRO Industrial USB Flash Disk	
<b>Length:</b>	54.80 mm
<b>Width:</b>	15.80 mm
<b>Thickness:</b>	15.80 mm
<b>Weight:</b>	25 g / 0.88 oz



**Figure 3: Generation 4SB Dimensions**

## 2.6. Certifications

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

APRO RUFD - Generation 4SB - HAMMER-D Series products meet the requirements of the below standards and hence fulfills the requirements of EMC Directive 2004/108/EC requirements.

**Table 7: APRO SRUFD 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 RUFD - Generation 4SB - HAMMER-D Series complied with the standards **FCC Part 15: 2006, Subpart B, Class B.**

### 2.6.3. SGS Waterproof test

Special metal casing design for waterproof and passed IP-54 & IP-68 test by SGS.

### 2.6.4. 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 RUFD - Generation 4SB - HAMMER-D Series using a Type a female USB connector.

#### 3.2. Pin Assignments

**Table 8: 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 9: Absolute Maximum Ratings**

SYMBOL	PARAMETER	RATING	UNITS
V <sub>DDH</sub>	Power Supply	-0.3 to V <sub>DDH</sub> + 0.3	V
V <sub>IN</sub>	Input Signal Voltage	-0.3 to 3.6	V
V <sub>OUT</sub>	Output Signal Voltage	-0.3 to V <sub>DDH</sub> + 0.3	V
T <sub>STG</sub>	Storage Temperature	-40 to 150	°C

#### 4.2. Recommended Operating conditions

**Table 10: Recommended Operating Conditions**

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS
A <sub>DD</sub>	5V Power Supply	4.75	5.0	5.0	V
V <sub>DDH</sub>	Power Supply	3.0	3.3	3.6	V
V <sub>DD</sub>	Digital Supply	1.62	1.8	1.98	V
V <sub>IN</sub>	Input Signal Voltage	0	3.3	3.6	v
T <sub>OPR</sub>	Operating Temperature	0		70	°C

#### 4.3. General DC Characteristics

**Table 11: General DC Characteristics**

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
I <sub>IN</sub>	Input current	No pull-up or pull-down	-10	±1	10	μA
I <sub>OZ</sub>	Tri-state leakage current		-10	±1	10	μA

$C_{IN}$	Input capacitance	Pad Limit		2.8		$\rho F$
$C_{OUT}$	Output capacitance	Pad Limit		2.8		$\rho F$
$C_{BID}$	Bi-directional buffer capacitance	Pad Limit		2.8		$\rho F$

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

**Table 12: 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\sim 16mA$			0.4	V
$V_{oh}$	Output high voltage	$ I_{oh}  = 2\sim 16mA$	2.4			V
$R_{pu}$	Input pull-up resistance	PU=high, PD=low	55	75	110	K $\Omega$
$R_{pd}$	Input pull-down resistance	PU=high, PD=low	40	75	150	K $\Omega$
$I_{in}$	Input leakage current	$V_{in} = V_{DDH}$ or 0	-10	$\pm 1$	10	$\mu A$
$I_{oz}$	Tri-state output leakage current		-10	$\pm 1$	10	$\mu A$

#### 4.5. USB Transceiver Characteristics

**Table 13: 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 1.5k $\Omega$ pull-up resistor on pin RPU disconnected			120	$\mu A$

#### 4.6. Static Characteristic

**Table 14: 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		Vddh-0.2			V

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

**Table 15: Static characteristic: Analog I/O pin ( DP / DM )**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>USB 2.0 Transceiver ( HS )</b>						
<b>Input Levels ( differential receiver )</b>						
$V_{HSDIFF}$	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
<b>Output Levels</b>						
$V_{HSOI}$	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
<b>Resistance</b>						
$R_{DRV}$	Driver output impedance	Equivalent resistance used as internal chip only	3	6	9	$\Omega$
		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
<b>USB 1.1 Transceiver ( FS/LS )</b>						
<b>Input Levels ( differential receiver )</b>						
$V_{DI}$	Differential input sensitivity	$ V_{I(DP)} - V_{I(DM)} $	0.2			V
$V_{CM}$	Differential common mode voltage		0.8		2.5	V
<b>Input Levels (single-ended receivers)</b>						

$V_{SE}$	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

$V_{D33}=3.0\text{DV}\sim 3.6\text{V}$  ;  $V_{DDU},V_{DDA}=1.62\text{V}\sim 1.98\text{V}$  ;  $\text{Temp}=0^{\circ}\text{C}\sim 70^{\circ}\text{C}$

#### 4.7. Dynamic Characteristic

**Table 16: Dynamic characteristic: Analog I/O pins ( DP DM )**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Driver Characteristics</b>						
<b>High-Speed Mode</b>						
$t_{HSR}$	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
<b>Full-Speed Mode</b>						
$t_{FR}$	Rise time	$CL=5\text{pF}$ ; 10 to 90% of $ V_{OH} - V_{OL} $ ;	4		20	ns
$t_{FF}$	Fall time	$CL=5\text{pF}$ ; 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
<b>Low-Speed Mode</b>						
$t_{LR}$	Rise time	$CL=200\text{pF}\sim 600\text{pF}$ ; 10 to 90% of $ V_{OH} - V_{OL} $ ;	75		300	ns
$t_{LF}$	Fall time	$CL=200\text{pF}\sim 600\text{pF}$ ; 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

RUFD - Generation 4SB - HAMMER-D Series Industrial USB Flash Disk		
Grade	Standard Grade 0°C ~ 70°C	Industrial Grade -40°C ~ 85°C
128MB	SRUFD128M – ADCSC – 4SB(/C)	WRUFD128M – ADISI – 4SB(/C)
256MB	SRUFD256M – ADCSC – 4SB(/C)	WRUFD256M – ADISI – 4SB(/C)
512MB	SRUFD512M – ADCSC – 4SB(/C)	WRUFD512M – ADISI – 4SB(/C)
1GB	SRUFD001G – ADCSC – 4SB(/C)	WRUFD001G – ADISI – 4SB(/C)
2GB	SRUFD002G – ADCSC – 4SB(/C)	WRUFD002G – ADISI – 4SB(/C)
4GB	SRUFD004G – ADCSC – 4SB(/C)	WRUFD004G – ADISI – 4SB(/C)
8GB	SRUFD008G – ADCSC – 4SB(/C)	WRUFD008G – ADISI – 4SB(/C)

### 2. Part Number Decoder

**X1 X2 X3 X4 X5 X6 X7 X8 X9** – **X11 X12 X13 X14 X15** – **Z1 Z2 Z3** / **C**

**X1** : Grade

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

**W** : Industrial Grade – operating temperature -40° C ~ +85 °C

**X2** : The material of case

**R** : Rugged Metal case

**X3 X4 X5** : Product category

**UFD** : USB 2.0 Flash Disk

**X6 X7 X8 X9** : Capacity

**128M**: 128MB

**256M**: 256MB

**512M**: 512MB

**001G**: 1GB

**002G**: 2GB

**004G**: 4GB

**008G**: 8GB

**X11** : Controller

**A** : Alcor (HAMMER-D Series)

**X12** : Controller version

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

**X13** : Controller Grade

**C** : Commercial grade

**I** : Industrial grade

**X14** : Flash IC

**S** : Samsung SLC-NAND Flash IC

**X15** : Flash IC grade / Type

**C** : Commercial grade

**I** : Industrial grade

**Z1** : Generation of housing design

**4** : Generation 4SB

**Z2** : Special design

**S** : Screw Thread

**Z3** : The color of the USB casing

**B** : Black

**C** : Reserved for specific requirement

**C** : Option for Conformal-coating on PCBA

## **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:**

- SRUFDxxxx-ADCSC-4SB                      **3 years**
- WRUFDxxxx-ADISI-4SB                      **5 years**



**The warranty period is able to extend. Please contact APRO and/or Your APRO distributors for more information.**