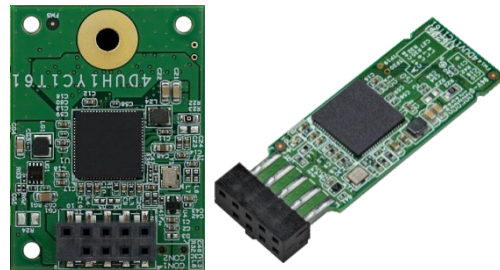


SLC / MLC

Industrial Micro USB Module

HERMIT-G Series

(USB 2.0)



Document No. : 100-xBMUM-HGTSM

Version No. : 01V0

Date : October, 2022

ISO 9001 : 2015 CERTIFIED



Product Features

■ Flash IC

- KIOXIA NAND Flash IC.
- Support SLC and 15nm-MLC Flash IC.

■ Compatibility

- Complete USB specification ver.2.0 and backward compatible ver.1.1
- High Speed and Full Speed transfer support.
- USB mass storage device class (MSC)
- USB Attached SCSI (UASP) support

■ Additional Capabilities

- S.M.A.R.T.*¹ (Self-Monitoring, Analysis and Reporting Technology) feature set support.
- Support Static wear-leveling algorithm.
- Support Bad Blocks Management.
- SLC solution support **VS/HS/HL** form-factor.
- MLC solution support **HS/HL** form-factor.

■ Mechanical

- USB 2.0 female 10-pin @ 2 rows connector.
VS: Vertical Std./2.54mm pin pitch connector.
HS: Horizontal Std./2.54mm pin pitch connector.
HL: Horizontal Low-profile/2.00mm pin pitch connector
- **Dimension:**
Vertical Type: 42.0 mm x 26.7 mm
Horizontal Type: 37.0 mm x 26.7 mm
- **Weight:** 10.0 g / 0.35 oz.

■ Capacity

SLC:

- 512MB, 1GB, 2GB, 4GB, 8GB, 16GB.

MLC:

- 8GB, 16GB, 32GB, 64G, 128GB.

■ Power Operating Voltage 5V(+/-) 10%

SLC:

- Read Mode: 0.54W (16GB.)
- Write Mode: 0.50W (16GB.)
- Idle Mode: 0.28W (16GB.)

MLC:

- Read Mode: 0.39W (128GB.)
- Write Mode: 0.45W (128GB.)
- Idle Mode: 0.22W (128GB.)

■ Performance (Maximum value) ²

SLC:

- Sequential Read: 30.0 MB/sec. (max.)
- Sequential Write: 30.0 MB/sec. (max.)

MLC:

- Sequential Read: 40.0 MB/sec. (max.)
- Sequential Write: 25.0 MB/sec. (max.)

■ Reliability

- **TBW:** (Sequential Write)
SLC: Up to 864.0 TBW at 16GB Capacity.
MLC: Up to 345.6 TBW at 128GB Capacity.
- **MTBF:** > 3,000,000 hours.
- **ECC:** up to 96 bits error correction in 1K Byte data
- **Temperature:** (Operating)
Standard Grade: 0°C ~ +70°C
Industrial. Grade: -40°C ~ +85°C
- **Vibration:** 70Hz ~ 2K Hz, 15G / 3 axis.
- **Shock:** 0.5ms, 1500 G, 3 axis.

■ Certifications and Declarations

- **Certifications:** CE & FCC
- **Declarations:** RoHS & REACH


Remarks:

1. Support official S.M.A.R.T. Utility.
2. Performance are based on CrystalDiskMark 6.0.2


Order Information

I. Part Number List


◆ APRO Micro USB Flash Module Vertical Standard – HERMIT-G Series

Product Picture	Grade		Std. grade (0°C ~ 70°C)	Ind. Grade (-40°C ~ +85°C)
		SLC	512MB	SBMUM512M-HGCTC-VS
1GB			SBMUM001G-HGCTC-VS	WBMUM001G-HGITI-VS
2GB			SBMUM002G-HGCTC-VS	WBMUM002G-HGITI-VS
4GB			SBMUM004G-HGCTC-VS	WBMUM004G-HGITI-VS
8GB			SBMUM008G-HGCTC-VS	WBMUM008G-HGITI-VS
16GB			SBMUM016G-HGCTC-VS	WBMUM016G-HGITI-VS

◆ APRO Micro USB Flash Module Horizontal Standard – HERMIT-G Series

Product Picture	Grade		Std. grade (0°C ~ 70°C)	Wide Temp. Grade (-40°C ~ +85°C)
	 2.54mm pin pitch connector.	SLC	512MB	SBMUM512M-HGCTC-HS
1GB			SBMUM001G-HGCTC-HS	WBMUM001G-HGITI-HS
2GB			SBMUM002G-HGCTC-HS	WBMUM002G-HGITI-HS
4GB			SBMUM004G-HGCTC-HS	WBMUM004G-HGITI-HS
8GB			SBMUM008G-HGCTC-HS	WBMUM008G-HGITI-HS
16GB			SBMUM016G-HGCTC-HS	WBMUM016G-HGITI-HS
MLC		8GB	SBMUM008G-HGCTM-HS	WBMUM008G-HGCTM-HSC
		16GB	SBMUM016G-HGCTM-HS	WBMUM016G-HGCTM-HSC
		32GB	SBMUM032G-HGCTM-HS	WBMUM032G-HGCTM-HSC
		64GB	SBMUM064G-HGCTM-HS	WBMUM064G-HGCTM-HSC
		128GB	SBMUM128G-HGCTM-HS	WBMUM128G-HGCTM-HSC

◆ APRO Micro USB Flash Module Horizontal Low Profile – HERMIT-G Series

Product Picture	Grade		Std. grade (0°C ~ 70°C)	Wide Temp. Grade (-40°C ~ +85°C)
	 2.00mm pin pitch connector.	SLC	512MB	SBMUM512M-HGCTC-HL
1GB			SBMUM001G-HGCTC-HL	WBMUM001G-HGITI-HL
2GB			SBMUM002G-HGCTC-HL	WBMUM002G-HGITI-HL
4GB			SBMUM004G-HGCTC-HL	WBMUM004G-HGITI-HL
8GB			SBMUM008G-HGCTC-HL	WBMUM008G-HGITI-HL
16GB			SBMUM016G-HGCTC-HL	WBMUM016G-HGITI-HL
MLC		8GB	SBMUM008G-HGCTM-HL	WBMUM008G-HGCTM-HLC
		16GB	SBMUM016G-HGCTM-HL	WBMUM016G-HGCTM-HLC
		32GB	SBMUM032G-HGCTM-HL	WBMUM032G-HGCTM-HLC
		64GB	SBMUM064G-HGCTM-HL	WBMUM064G-HGCTM-HLC
		128GB	SBMUM128G-HGCTM-HL	WBMUM128G-HGCTM-HLC

II. Part Number Decoder:

X1 X2 X3 X4 X5 X6 X7 X8 X9 — **X11 X12 X13 X14 X15** — **X17 X18 X19**

X1 : Grade

S: Standard Grade – operating temp. 0° C ~ 70 ° C

W: Ind./Wide Temp. Grade- operating temp. -40° C ~ +85 ° C

X2 : The material of case

B : Bare

X3 X4 X5 : Product category

MUM : Micro USB 2.0 Flash Module

X6 X7 X8 X9 : Capacity

512M: 512MB **016G:** 16GB

001G: 1GB **032G:** 32GB

002G: 2GB **064G:** 64GB

004G: 4GB **128G:** 128GB

008G: 8GB

X11 : Controller

H: HERMIT Series

X12 : Controller version

A, B, C.....

X13 : Controller Grade

C : Commercial grade

I : Industrial grade

X14 : Flash IC

T : KIOXIA NAND Flash IC

X15 : Flash IC grade / Type

C : Commercial grade

I : Industrial grade

M : MLC Flash CI.

X17 X18 : Form Factor – MUM only

VS : Vertical type Standard form factor

HS : Horizontal type Standard form factor

HL : Horizontal type Low Profile form factor

X19 : Reserved for specific requirement

C : Conformal-coating (optional)

Revision History

Revision	Description	Date
1.0	Initial release	2022/10/25

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1. Introduction

APRO Micro USB Module (MUM) HERMIT-G Series, is specified as 2.0 High Speed Device, Mass Storage Class; USB-IF (USB Implementers Forum), WHQL (Window Hardware Quality Labs). In addition to being as a removable storage device, APRO SLC MUM HERMIT-G Series can also be configured as a bootable disk for system recovery. Also, its random access performance exceed the minimum requirement of Windows / Linux / VxWorks / QNX Embedded operating system, in which randomly access blocks of information are saved into MUM for boosting up the average performance. SLC solution are available in 512MB, 1GB, 2GB, 4GB, 8GB, 16GB capacities and the MLC solution are available in 8GB, 16GB, 32GB, 64GB and 128GB by KIOXIA NAND Flash IC.

The operating temperature grade is optional for standard grade 0°C ~ 70°C and industrial grade -40°C ~ +85°C.

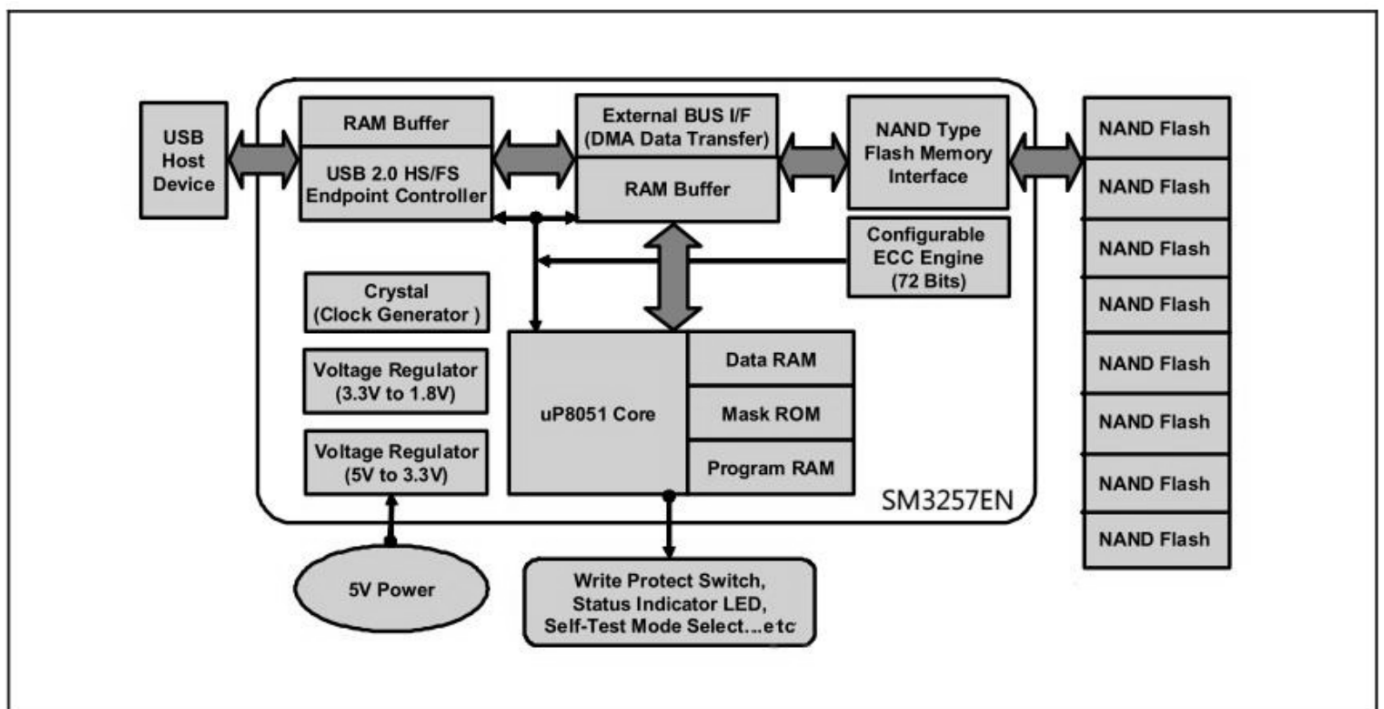


Figure 1: APRO Micro USB Module (MUM) HERMIT-G Series block diagram

1.1. Scope

This document describes the key features and specifications of APRO MUM HERMIT-G Series.

1.2. Flash Management Technology – Static Leveling

Flash memory can be erased within a limited number of times. This number is called the erase cycle limit or write endurance limit and is defined by the flash array vendor. The erase cycle limit applies to each individual erase block in the flash device.

APRO Micro USB Module (MUM) HERMIT-G Series uses a **static wear-leveling** algorithm to ensure that consecutive writes of a specific sector are not written physically to the same page/block in the flash. This spreads flash media usage evenly across all pages, thereby extending flash lifetime.

1.3. Bad Block Management

➤ Early Bad Block

The fault block generated during the manufacturing process of NAND Flash is called Early Bad Block.

➤ Later Bad Block

In the process of use, as the number of operations of writing and erasing increases, a fault block is gradually generated, which is called a Later Bad Block.

Bad block management is a management mechanism for a bad block to be detected by the control IC and mark bad blocks in the NAND Flash and improve the reliability of data access. The bad block management mechanism of the control IC will establish a **Bad Block Table** when the NAND Flash is started for the first time, and will also record the errors found in the process of use in the bad block table, and data is ported to new valid blocks to avoid data loss.

In order to detect the initial bad blocks to handle run time bad blocks, APRO Micro USB Module (MUM) HERMIT-G Series provides the **Bad Block Management** scheme. It remaps a bad block to one of the reserved blocks so that the data contained in one bad block is not lost and new data writes on a bad block is avoided.

1.4. Error Detection and Correction

Highly sophisticated Error Correction Code algorithms are implemented. The ECC unit consists of the Parity Unit (parity-byte generation) and the Syndrome Unit (syndrome-byte computation). This unit implements an algorithm that can correct 96 bits per 1024 bytes in an ECC block. Code-byte generation during write operations, as well as error detection during read operation, is implemented on the fly without any speed penalties.

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

APRO Micro USB Module (MUM) HERMIT-G Series		Standard Grade	Ind./Wide Temp. Grade
Temperature	Operating:	0°C ~ +70°C	-40°C ~ +85°C
	Non-operating:	-20°C ~ +80°C	-50°C ~ +95°C
Humidity	Operating & Non-operating:	85 °C / 95% RH Non-Operating	
Vibration	Frequency/Displacement:	20Hz ~ 70 Hz, 1.52mm / 3 axes.	
	Frequency/Acceleration:	70Hz ~ 2K Hz, 15G / 3 axes.	
Shock	Operating & Non-operating:	0.5ms, 1500 G, 3 axes	
Electrostatic Discharge (ESD)	Temperature:	24°C	
	Relative Humidity:	49% (RH)	
	+/-4KV:	Device functions are affected, but EUT will be back to its normal or operational state automatically.	

2.2. System Power Requirements

Table 2: Power Requirement

APRO Micro USB Module (MUM) HERMIT-G Series			
DC Input Voltage (VCC)			5V±10%
Maximum average value	SLC	Reading Mode :	0.54W (16GB.)
		Writing Mode :	0.50W (16GB.)
		Idle Mode :	0.28W (16GB.)
	MLC	Reading Mode :	0.39W (128GB.)
		Writing Mode :	0.45W (128GB.)
		Idle Mode :	0.22W (128GB.)

2.3. System Performance

Table 3: System Performances

Data Transfer Mode supporting		USB 2.0					
SLC Performance (MB/s)	Capacity	512MB	1GB	2GB	4GB	8GB	16GB
	Seq. Read	30.0	30.0	30.0	30.0	30.0	30.0
	Seq. Write	15.0	15.0	20.0	25.0	30.0	30.0
MLC Performance (MB/s)	Capacity	8GB	16GB	32GB	64GB	128GB	
	Seq. Read	35.0	35.0	40.0	40.0	40.0	
	Seq. Write	20.0	20.0	25.0	25.0	25.0	

Note: Performance results are based on CrystalDiskMark 6.0.2 with typical tolerances for range from 1% to 10%.

2.4. System Reliability

Table 4: System Reliability

Wear-leveling Algorithms		Static Wear Leveling algorithms	
Bad Block Management		Supportive	
ECC Technology		96 bits per 1K bytes	
Erase counts		NAND SLC Flash Level : 3K P/E Cycles	
Endurance		TBW (Tera Bytes Written) Sequential Write	
Flash Type.		SLC	MLC
Capacity	512MB	27.0	N/A
	1GB	54.0	N/A
	2GB	108.0	N/A
	4GB	216.0	N/A
	8GB	432.0	21.6
	16GB	864.0	43.2
	32GB	N/A	86.4
	64GB	N/A	172.8
	128GB	N/A	345.6

Note:

- Client workload by Sequential Write.
- The endurance of disk could be varying based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

2.5. Physical Specifications

Refer to Table 5 and see Figure 2 for APRO Micro USB Module (MUM) HERMIT-G Series physical specifications and dimensions.

Table 5: Physical Specifications

Form factor:	HS & HL Type (+/- 0.30mm)	VS Type (+/- 0.15mm)
Length:	36.9 mm	41.5 mm
Width:	26.6 mm	14.0 mm
Weight:	10 g / 0.35 oz	

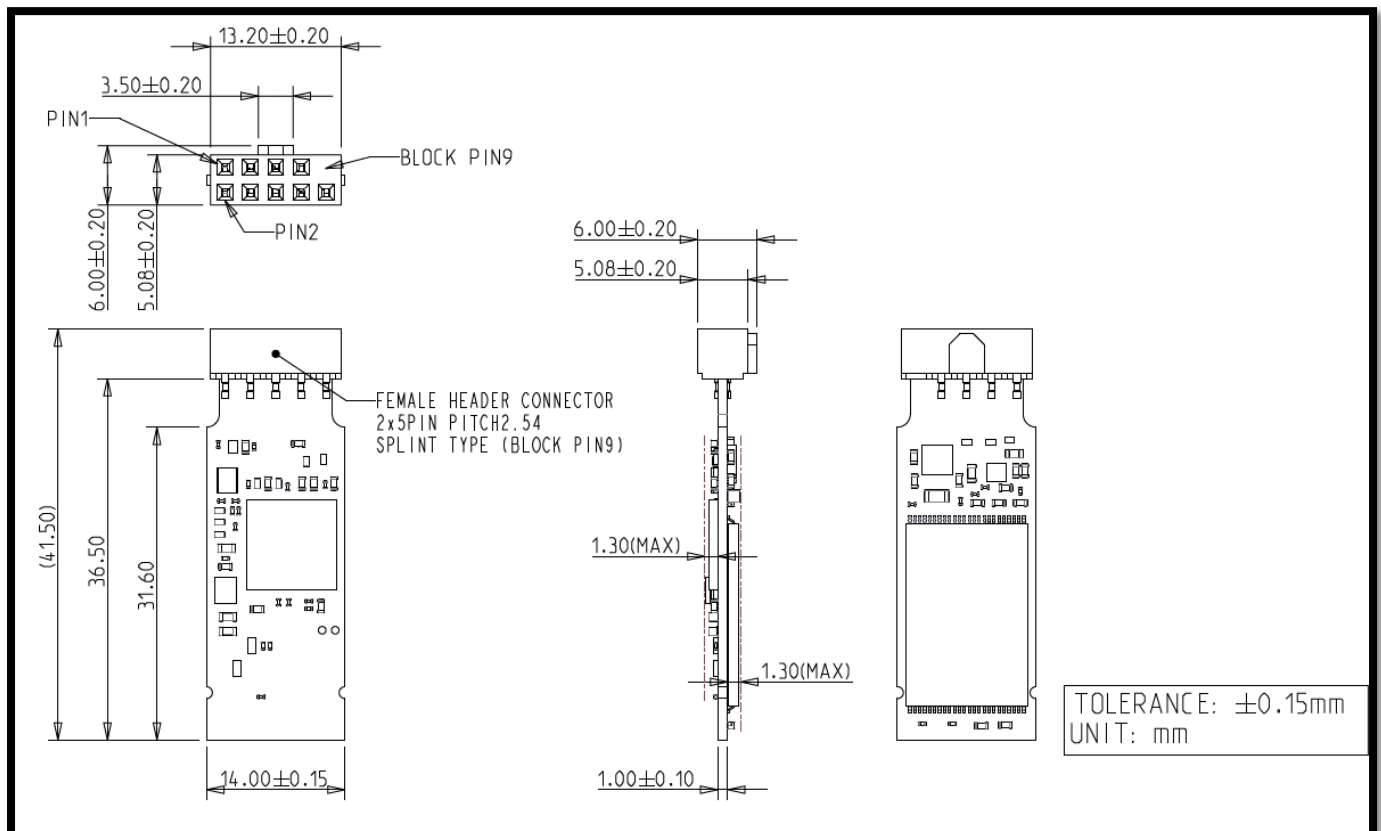


Figure 2: APRO Micro USB Module (MUM) HERMIT-G Series Vertical Type Dimension

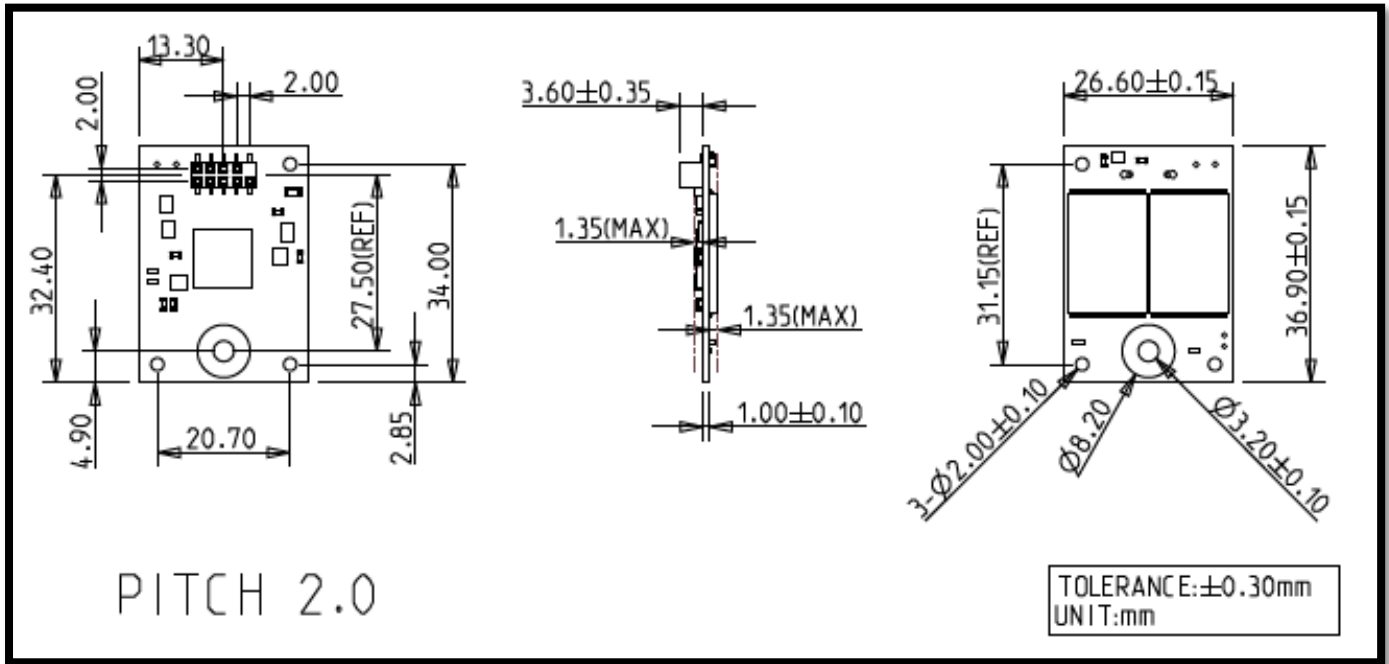


Figure 3: APRO Micro USB Module (MUM) HERMIT-G Series Horizontal Low-profile Type Dimension

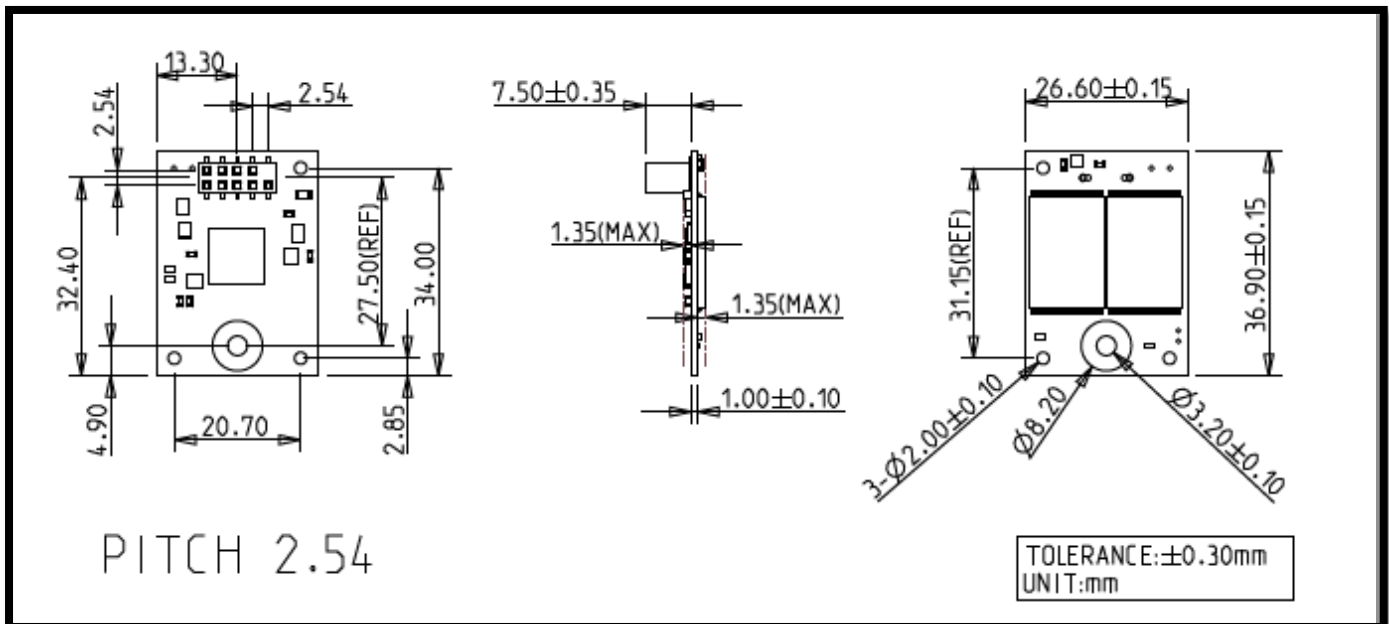


Figure 4: APRO Micro USB Module (MUM) HERMIT-G Series Vertical Standard Type Dimension

2.6. Conformal coating

Conformal coating is a protective, dielectric coating designed to conform to the surface of an assembled printed circuit board. Commonly used conformal coatings include silicone, acrylic, urethane and epoxy. APRO applies only silicone on APRO storage products upon requested especially by customers. The type of silicone coating features good thermal shock resistance due to flexibility. It is also easy to apply and repair.

Conformal coating offers protection of circuitry from moisture, fungus, dust and corrosion caused by extreme environments. It also prevents damage from those Flash storages handling during construction, installation and use, and reduces mechanical stress on components and protects from thermal shock. The greatest advantage of conformal coating is to allow greater component density due to increased dielectric strength between conductors.

APRO uses MIL-I-46058C silicon conformal coating

3. Interface Description

3.1. USB2.0 male connector from host motherboard.

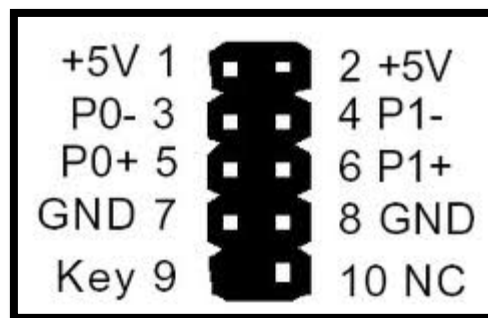


Figure 5: USB 10 pins Host male connector

3.2. Pin Assignments

There are total of 9 pins in the signal segment. The pin assignments are listed in below table 6.

Table 6 - Pin Assignments

Horizontal Type			
Pin Number	Signal	Pin Number	Signal
Pin 1	+5VDC	Pin 2	NC
Pin 3	USB -	Pin 4	NC
Pin 5	USB +	Pin 6	NC
Pin 7	GND	Pin 8	NC
Pin 9	NC (Blocked)	Pin 10	NC

Appendix A: Limited Warranty

APRO warrants your Micro USB Module (MUM) HERMIT-G Series 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:

- **SLC STD. Grade** 3 years / Within 60K Erasing Counts
- **SLC IND. Grade** 5 years / Within 60K Erasing Counts
- **MLC (Standard grade / Wide temp. grade)** 2 years / Within 3K Erasing Counts

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