HYBRID_NVME*4 GEN4 BP
USER'S MANUAL

P/N : 2RAKVI011401

Model：RS112-08 HYBRID-NVME*4 GEN4 BP MODULE

Version : V1.0

Revision History

Version	Changes	Date
V1.0	Official Release	2022/07/05

TABLE OF CONTENTS

Overview

The backplane is a high performance economical solution for users who has sufficient SAS host ports on MB or RAID/HBA to accommodate 12 disks in the system. The hybrid backplane is a 1U in height designed supporting state-of-the-art SAS3 12Gbps HDD/SSD and backward compatible with SAS 6Gbps, SATA 6Gps and SATA 3Gps HDD/SSD. The backplane supports 4 pcs of NVMe SSD up to GEN4 through SlimSAS 8i interfaces. The SlimSAS 8i connector could connect to NVMe HBA/RAID or PCIe Retimer Card that supports it.

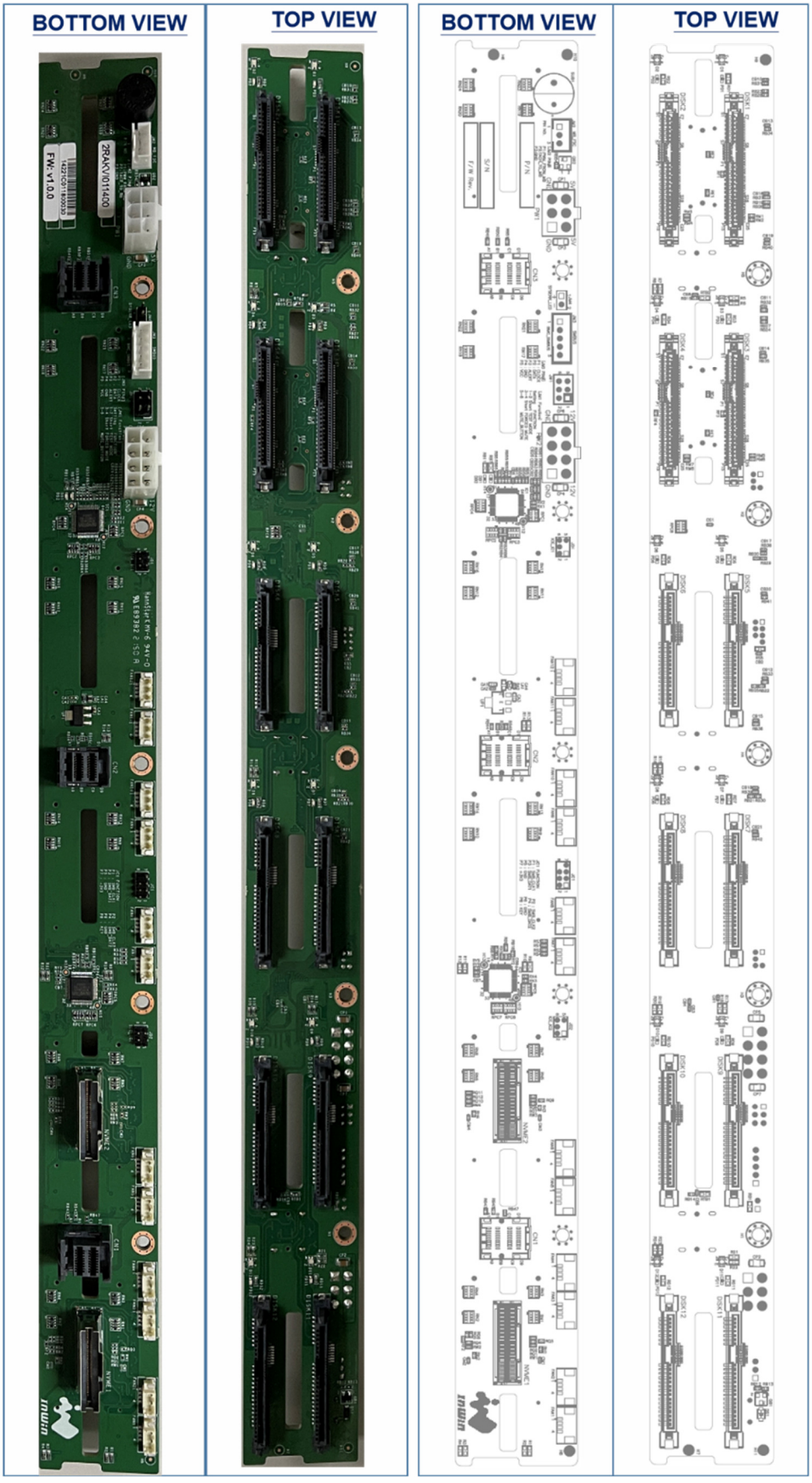
Basically, the 3 pcs of SFF-8643 MiniSAS HD connectors can support up to 12 SAS/SATA disks. 4 of the disk slots are the so called Hybrid ports that can support U.2/U.3 NVMe SSD via SlimSAS 8i connectors. Please note that the hybrid ports can either support SAS/SATA disk or U.2/U.3 NVMe SSD at a time.

One piece of 2*3-Pin 5V and one piece of 2*4-Pin 12V power receptacles support up to 5V(24A)/12V(32A) current to satisfy the power needs of fully loaded disk drives.

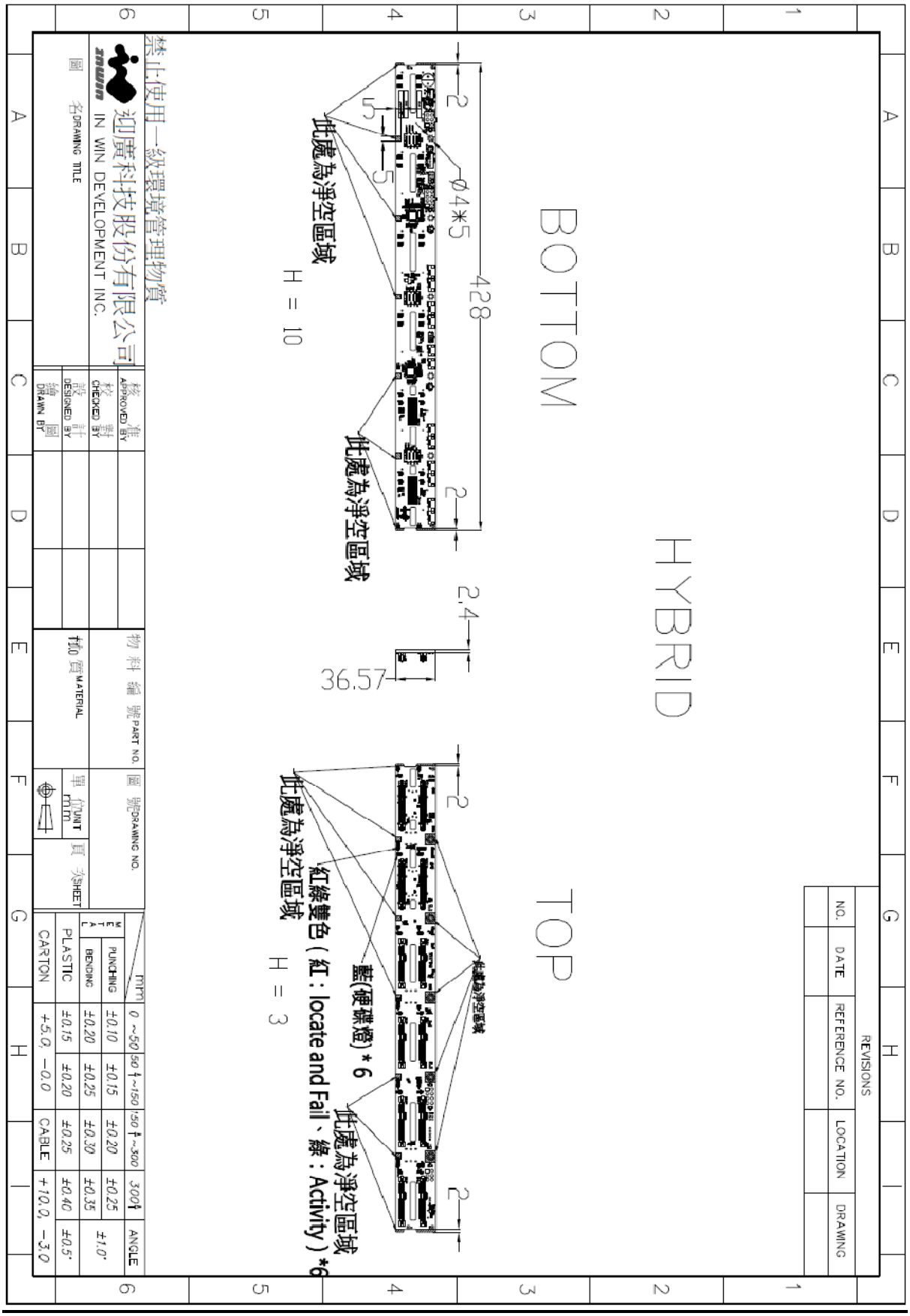
The backplane is implemented with smart fan control feature to support wide variety of fan modules by auto-calibrating the installed fan modules at system boot. This feature provides an efficient way to the thermal solution by sensing the temperature in the enclosure. The fan modules speed up and down upon the temperature rises and falls in the enclosure.
Further, the backplane reserves a connector for adapting Fan PWM from motherboard so backplane can leverage PWM request from motherboard and behave according to the higher RPM number between MB and backplane.

Along with the smart fan control feature, a system alarming feature is also implemented to alert users in case Fan module failure and/or system overheat occurs by illuminating the LED indicator and sounding the buzzer at the same time. Users can then detect issue and take corresponding actions to resolve the issue according to the failure type. As soon the issue disappears or resolved the alarm stops.

Physical Outlook & Diagram

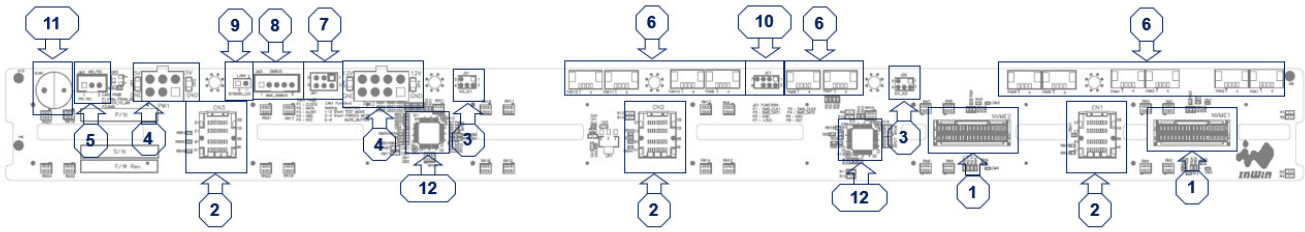


Mechanical


BOTTOM
HYBRID
TOP
Ø4*5
428
2.4
36.57
此處為淨空區域
H = 10
此處為淨空區域
此處為淨空區域
H = 3
藍(硬碟燈) * 6
紅綠雙色 (紅 : locate and Fail、綠 : Activity) *6
REVISIONS
NO.
DATE
REFERENCE NO.
LOCATION
DRAWING
禁止使用一級環境管理物質
迎廣科技股份有限公司
IN WIN DEVELOPMENT INC.
圖名 DRAWING TITLE
APPROVED BY 核准
CHECKED BY 校對
DESIGNED BY 設計
DRAWN BY 繪圖
物料編號 PART NO.
圖號 DRAWING NO.
材質 MATERIAL
單位 UNIT mm
頁次 SHEET
PUNCHING
BENDING
PLASTIC
CARTON
CABLE
ANGLE

Connector Locations and LED Indicators

Bottom View connector Locations

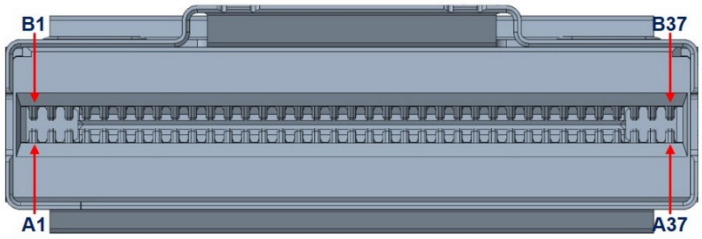


No	Description	No	Description
1	Host facing interface : NVME1~NVME2	7	Multi-Function Header : JM1
2	Host facing interface (SAS3) : CN1/CN2/CN3	8	BMC_SMBUS Connector : JM3
3	Firmware Programming Header ： JD1/JD2	9	System_Fail_LED Header : JM4
4	Main Power Connector ： PW1/PW2	10	VPP Over I2C Header : JC1
5	M/B Fan Speed Control : JM2	11	Buzzer: SUB1
6	FAN Connector : FAN1~FAN12	12	M058SSAN Micro-controller : IC1/IC2

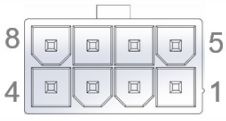
Connector Pin Definitions.

NVME1~NVME2

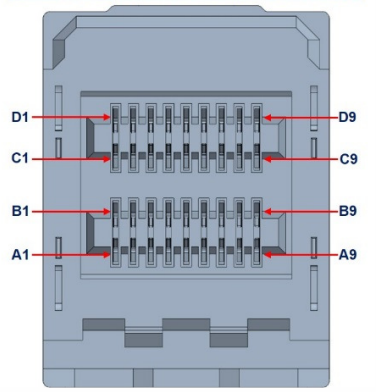
SFF-8654 (SlimSAS 8x) Connector



Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.
PET0_[p/n]	B2/B3	PET1_[p/n]	B5/B6	PET2_[p/n]	B14/B15	PET3_[p/n]	B17/B18
PER0_[p/n]	A2/A3	PER1_[p/n]	A5/A6	PER2_[p/n]	A14/A15	PER3_[p/n]	B17/B18
PET4_[p/n]	B20/B21	PET5_[p/n]	B23/B24	PET6_[p/n]	B32/B33	PET7_[p/n]	B35/B36
PER4_[p/n]	A20/A21	PER5_[p/n]	A23/A24	PER6_[p/n]	A32/A33	PER7_[p/n]	A35/A36
PCEI_GND	B1/B4/B7/B13/B16/B19/B22/B25/B31/B34/B37/A1/A4/A7/A13/A16/A19/A22/A25/A31/A34/A37						
BT_TYPE_A/B	B8/B26	CWAKE#_A/B	B9/B27	RefClk[p/n]_A	B11/B12	RefClk[p/n]_B	B29/B30
SMB_CLK_A	A8	SMB_DAT_A	A9	PERST#_A/B	A11/A29	SB_GNDA	A10/A28
SMBCLK_B	A26	SMBDAT_B	A27	CPRSNT#_A/B	A12/A30	SB_GNDB	B10/B28

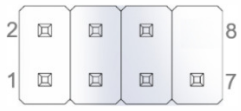
PW1	Power 2*3-Pin Connector		PW2	Power 2*4-Pin Connector	
	PIN #	Definition		PIN #	Definition
	1~3	+5V		1~4	Ground
	4~6	Ground		5~8	+12V

SFF-8643 (MiniSAS HD) Connector



CN1/CN2/CN3			
Signal Name	Pin No.	Signal Name	Pin No.
SAS_TX0_[p/n]	D4/D5	SAS_RX0_[p/n]	B4/B5
SAS_TX1_[p/n]	C4/C5	SAS_RX1_[p/n]	A4/A5
SAS_TX2_[p/n]	D7/D8	SAS_RX2_[p/n]	B7/B8
SAS_TX3_[p/n]	C7/C8	SAS_RX3_[p/n]	A7/A8
SAS_GND	D3/D6/D9	SAS_GND	B3/B6/B9
SAS_GND	C3/C6/C9	SAS_GND	A3/A6/A9
Sideband Definition :			
S0_SClock: A1, S1_SLoad: B1, S4_DataOut: C2,			
S5_DataIn: D2,S6/S7 Reserved: A2/D1,			
S2_GND: C1, S3_GND: B2,			

JC1



VPP over I2C Signal Header			
PIN #	Definition	PIN No#	Definition
1	SMB_CLK1	2	SMB_CLK2
3	SMB_DAT1	4	SMB_DAT2
5	Ground	6	Ground
7	VCC	8	#Key

JD1~JD2

Firmware Programming Header			
PIN #	Definition	PIN No#	Definition
1	VCC	2	ICE_CLK
3	#Key	4	ICE_DATA
5	Ground	6	ICE_RST

JM1

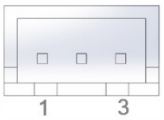
Multi-Function Header			
PIN #	Definition	PIN No#	Definition
1	TEST_P+	2	TEST_P-
3	BUZ_EN+	4	BUZ_EN-
5	MUTE_SW+	6	MUTE_SW-

JB3 Function Description:
Pin#1-Pin#2 Short for Test Mode.
Pin#3-Pin#4 Short for Forced Mute.
Pin#5-Pin#6 for External Mute Switch.

JM4

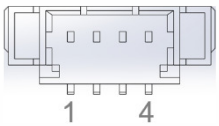
System_Fail_LED Header	
PIN #	Definition
+	LED +
-	LED -

JM2



M/B FSC 3-Pin Connector	
PIN #	Definition
1	PWM_FROM_MB
2	TACH_TO_MB
3	Ground

FAN1~FAN12

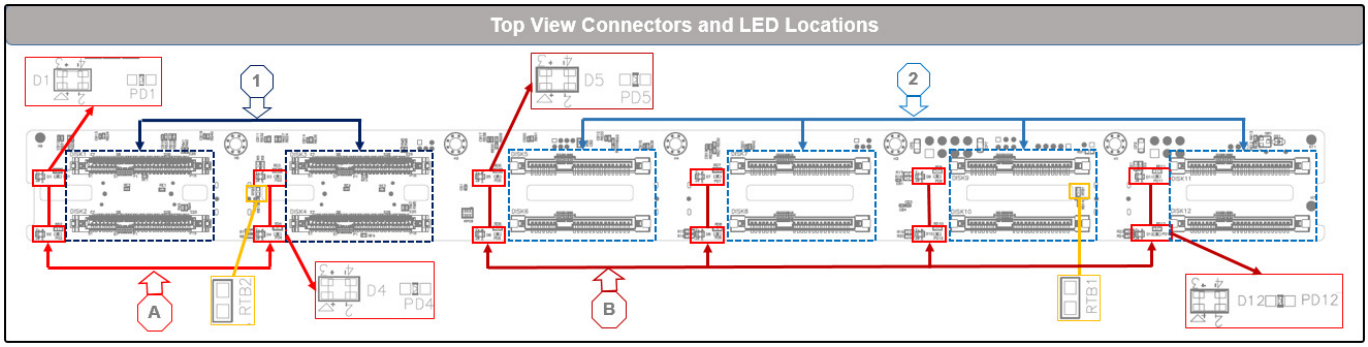


PWM FAN Connector	
PIN #	Definition
1	Tachometer
2	PWM Output
3	+12V
4	Ground

JM3

BMC_SMBUS Connector	
PIN #	Definition
1	Clock
2	Data
3	Alert
4	Ground
5	VCC

Connector/ LED Indicators.

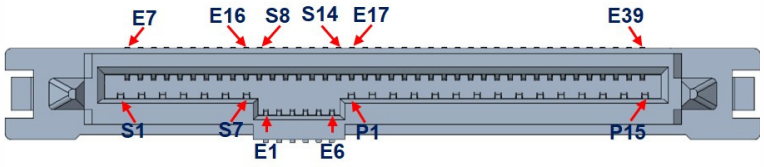


No	Location	Description
1	DISK1~DISK4	NVMe SSD or SATA/SAS Disk #1~#4
2	DISK5~DISK12	SATA/SAS Disk #5~#12

No	Location	Description	Location	Description
A	PD1~PD4	DISK1~DISK4 Power LED	D1~D4	DISK1~DISK4 Activity/Failure LED
B	PD5~PD12	DISK5~DISK12 Power LED	D5~D12	DISK5~DISK12 Activity/Failure LED

DISK1~DISK4

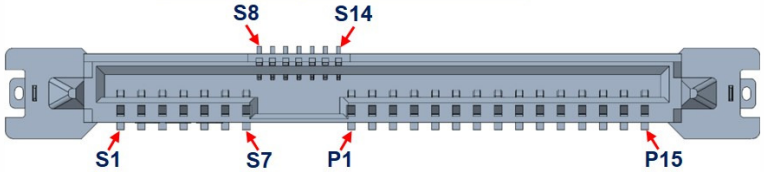
SFF-8639 (U.2) Connector



Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.
SAS0Tx[p/n]	S2/S3	SAS0Rx[p/n]	S5/S6	SAS1Tx[p/n]	S9/S10	SAS1Rx[p/n]	S12/S13
PET0_[p/n]	E10/E11	PET1_[p/n]	S17/S18	PET2_[p/n]	S23/S24	PET3_[p/n]	E17/E18
PER0_[p/n]	E13/E14	PER1_[p/n]	S20/S21	PER2_[p/n]	S26/S27	PER3_[p/n]	E20/E21
PCEI_GND	E9/E12/E15/S16/S19/S22/S25/S28/E19/E22			SAS_GND	S1/S4/S7/S8/S11/S14/P5/P6/P12		
RefClk1[p/n]	E1/E2	3.3V_AUX	E3	EPERST#1/2	E4/E5	RefClk0[p/n]	E7/E8
HPT0/HPT1	E16/S15	SMB_Clock	E23	SMB_Data	E24	DualPortEn	E25
WAKE#	P1	SPCIE_RST	P2	CLK_REQ#	P3	IFDET#1/2	P4/E6
+5V&Charge	P7~P9	12V&Charge	P13~P15	PRSNT	P10	READ_LED	P11

DISK5~DISK12

SFF-8680 (SAS) Connector



Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.
SAS0Tx[p/n]	S2/S3	SAS0Rx[p/n]	S5/S6	SAS1Tx[p/n]	S9/S10	SAS1Rx[p/n]	S12/S13
SAS_GND	S1/S4/S7/S8/S11/S14			Power_GND	P4/P5/P6/P10/P12		
+3.3V&Charge	P1~P3	+5V&Charge	P7~P9	12V&Charge	P13~P15	READ_LED	P11

Hardware Specification

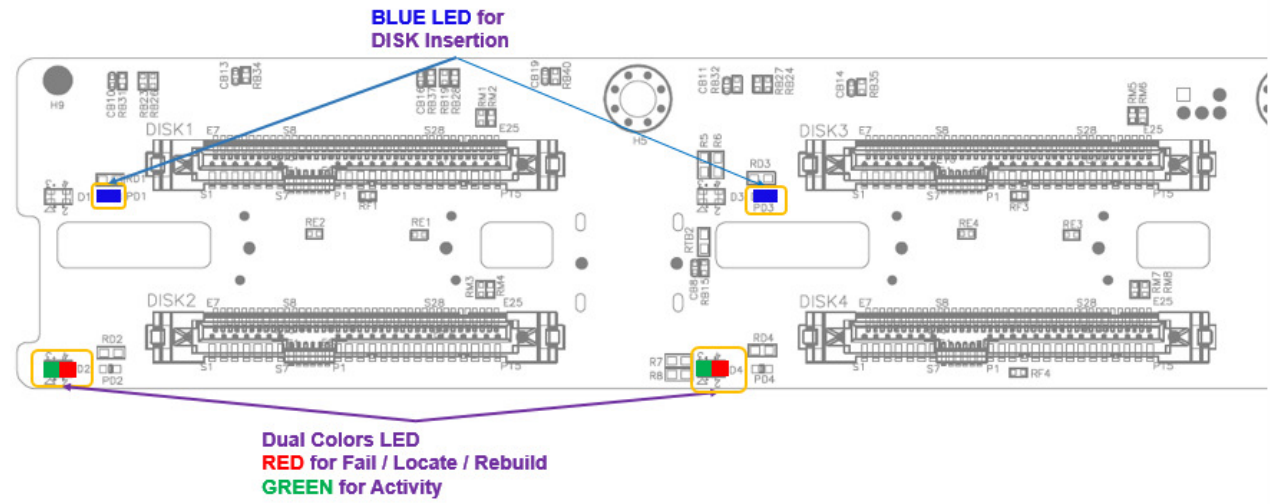
HOST Interface ： MiniSAS HD(SFF-8643)/SlimSAS 8i (SFF-8654)

Hard Disk (SSD) Interface ： SAS29Pin (SFF-8680)/U.2 (SFF-8639)

- Indicator ：
  - Power LED (PD1~PD12) : Blue –(When HDD is resent)
  - Dual color(Green/Red) LED D1~D12 for Hard Disk Drive Status (Activity/Fail/Locate)
  - Activity LED: Green (When HDD is Access)
  - Fail/Locate LED : Red (When HDD Fail or Locate)
- Environment Control :
  - PWM FAN Connector (FAN1~FAN12) for Cooling system.
  - Temperature Sensor (RTB1/RTB2) Monitor HDD bay inside temperature.
  - Buzzer (SUB1) for Over-temperature and FAN fail alerting.
- High Speed Connector
  - SFF-8643 MiniSAS HD Connector *3 (CN1/CN2/CN3)
    - One MiniSAS HD connector can support up to 4 SAS3 disk bays. All the connectors are directly wired to the 29-pin disk connectors.
      - CN1 directly wired to DISK1~DISK4.
      - CN2 directly wired to DISK5~DISK8.
      - CN3 directly wired to DISK9~DISK12.
  - SFF-8680 SAS29Pin Connector *8 (DISK5~DISK12) for SATA/SAS3 Disk.
  - SlimSAS 8i (SFF-8654) Connector *2 (NVME1~NVME4)
    - One SlimSAS 8i connector can support up to 2 NVMe SSD bays. All the connectors are directly wired to the SFF-8639 68-pin connectors.
      - NVME1 directly wired to DISK1~DISK2.
      - NVME2 directly wired to DISK3~DISK4.
  - SFF-8639 68Pin Connector *4 (DISK1~DISK4) for SATA/SAS3 Disk or NVMe SSD.
- Power Connector/Signal Control Header：
  - JM1 Header for Test_Mode/Buzzer Alarm Enable/Disable selection and Mute_SW.
  - JM2 connector for Fan speed control connected between Motherboard and backplane.
  - JM3 SMBUS Connector for external BMC SMBUS control function.
  - SYS_ERR_LED (JM4) Turn on when system Fan fails or system over temperature.
  - JC1 Headers for VPP over I2C connection.
  - JD1/JD2 Header for Programming MCU Firmware.

LED Behavior

Disk Bay LED



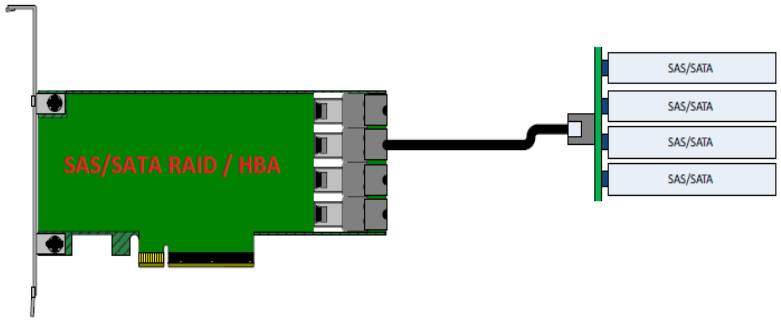
Blue LED:
Disk Insertion Indicator –
Turned on whenever disk drive is properly installed.

Green LED:
Activity indicator –
Stay off when idle and blinking (~8 Hz) whenever disk drive is being accessed.

RED LED:
Fail and Locate indicator –
Turned steady on when disk failure occurs. Blinking (1 Hz) when locating Disk, RAID rebuild and RAID consistent check.

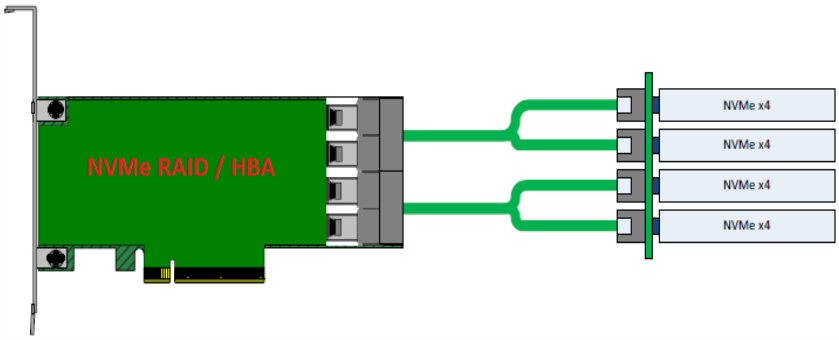
There are 2 parts of LED Management on the backplane. One is for SAS and another is for NVMe. Please note that the disk slots can only accommodate SAS/SATA or NVMe disk at a time since they share the same disk connector.

For SAS application, The LEDs behave by following SGPIO signal coming through sideband bus inside the SFF-8643 cables. Please refer to Section 2 for SGPIO settings. When SGPIO Jumper setting is enabled the LEDs behave according to the SGPIO signals. When SGPIO is disabled, the RED LEDs (for Locate and Fail) do not behave while the GREEN LEDs (for Activity) behave according to the signal from P11 (READY LED) of the disk connectors.



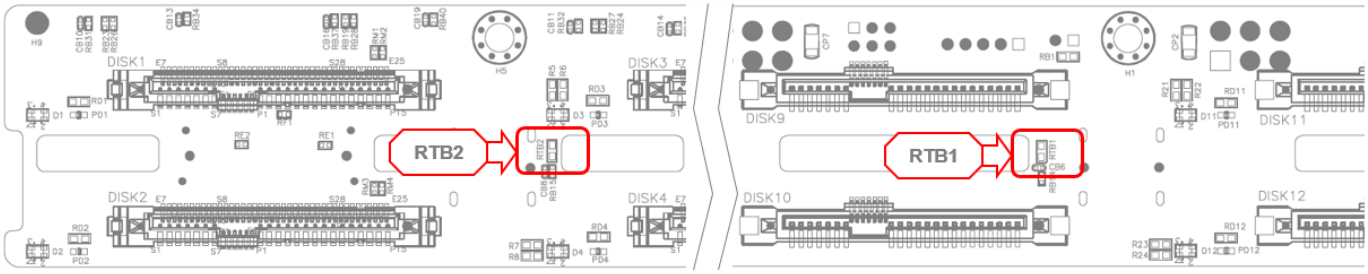
For NVMe application, The LEDs behave according to the VPP over I2C signals from NVMe host controllers through sideband bus of Oculink or SlimSAS cables. Whenever the NVMe host controller support VPP over I2C, the RED LEDs behave Locate, Fail and Rebuild signals following VPP signals on the I2C bus. The Green LEDs (for Activity) behave according to the signal from P11 (Activity) of the disk connectors.

Examples of NVMe connections to Broadcom RAID/HBA controller. Each pair of VPP over I2C signal supports 2 pieces of NVMe disks LED management. The I2C bus is leaded to odd-number NVMe connector (Oculink or SlimSAS) to manage its corresponding and the following NVMe disks. For example, NVMe1 and NVMe2 LED management signal is form NVMe1 connector's sideband I2C bus, NVMe3 and NVMe4 LED management signal is from NVMe3 connector's sideband I2C bus and …etc.

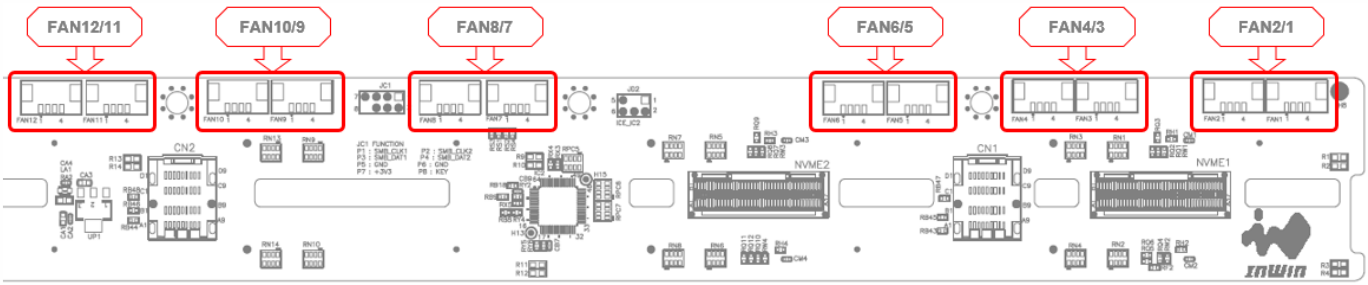


Smart Fan Control

IN WIN's Backplane is implemented Smart Fan Control feature by automatically detecting the existences of the Fan Modules and intelligently control the Fan RPM per the system temperature being detected by two thermal sensors (RTB1/RTB2) on the backplane.



Thanks to Smart Fan Control feature the Fan connectors (FAN1/FAN2/FAN3/FAN4) on backplane support wide variety of PWM driven Fan modules being used in the enclosure.



How it works?

1. Fan module auto-calibration triggered in every system boot. The thermal profile would then be recorded and used until next reboot.
2. Backplane starts fan calibration and calculates the corresponding PWM duty cycle for each level. There are totally 8 speed levels to be sensed and used until next system boot.
3. The 8 levels of fan speed are mapped to the temperature readings detected by thermistor spreading from 25 to 45 ℃ in 3.75 degree C step.
4. In normal operation, when the system temperature changes to next level, the fan module would change speed accordingly. And, the Fan failure alarm would be triggered when the RPM of the Fan module is dropped lower than 75% of its expected speed.
5. The fan module calibration and thermal profile are as below.
6. When an external PWM source joins, the output PWM duty is determined by comparing the internal calculated PWM and external PWM and then select whichever is higher as the output PWM to the fan modules.

Fan Speed Measurement

R_{diff} = Maximum RPM – Minimum RPM

PWM Duty: 10
PWM Duty: 20
PWM Duty: 30
PWM Duty: 40
PWM Duty: 50
PWM Duty: 60
PWM Duty: 70
PWM Duty: 80
PWM Duty: 100

Minimum RPM
RPM1
RPM2
RPM3
RPM4
RPM5
RPM6
RPM7
Maximum RPM

Fan Speed Table

Minimum RPM + R_{diff} x20%
Minimum RPM + R_{diff} x30%
Minimum RPM + R_{diff} x40%
Minimum RPM + R_{diff} x50%
Minimum RPM + R_{diff} x60%
Minimum RPM + R_{diff} x70%
Minimum RPM + R_{diff} x80%
Maximum RPM

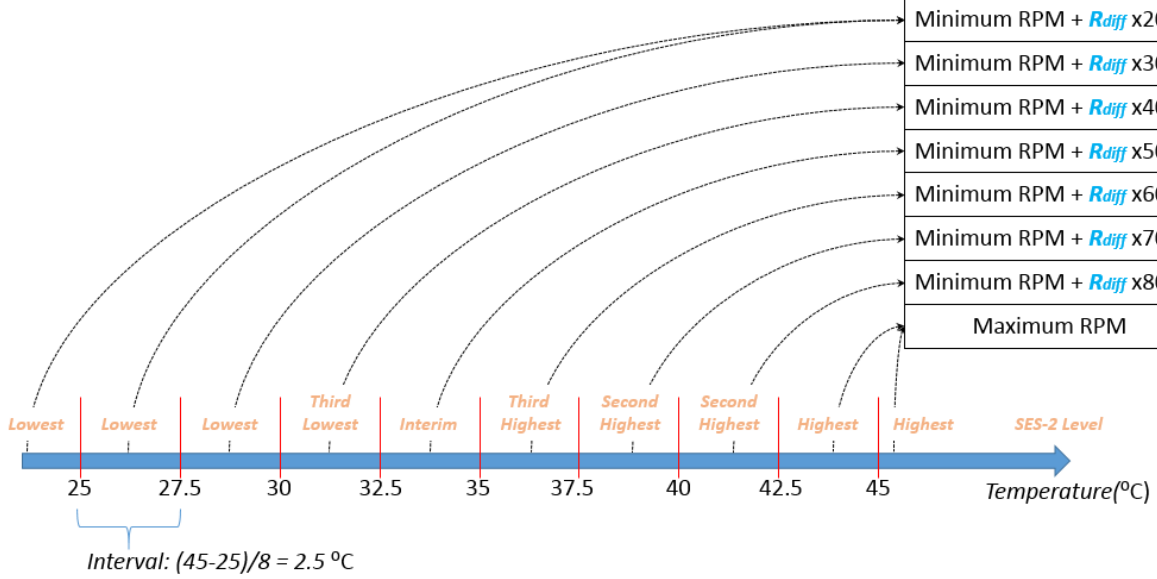
PWM Level Table

PWM Duty0
PWM Duty1
PWM Duty2
PWM Duty3
PWM Duty4
PWM Duty5
PWM Duty6
PWM 100

Cooling Control Policy – 45 Celsius

Fan Speed Table

Minimum RPM + R_{diff} x20%
Minimum RPM + R_{diff} x30%
Minimum RPM + R_{diff} x40%
Minimum RPM + R_{diff} x50%
Minimum RPM + R_{diff} x60%
Minimum RPM + R_{diff} x70%
Minimum RPM + R_{diff} x80%
Maximum RPM

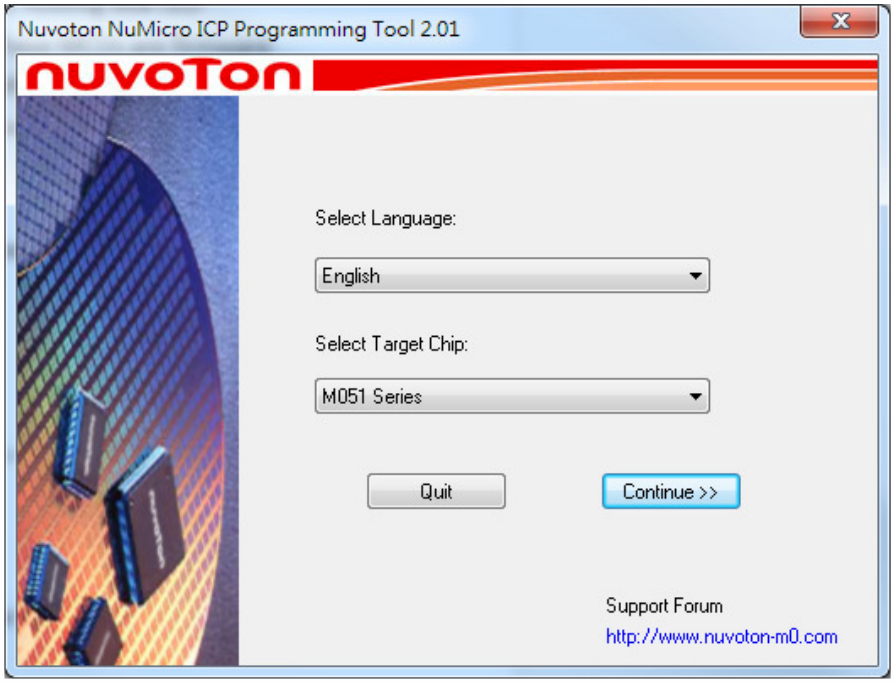


Firmware Upgrade

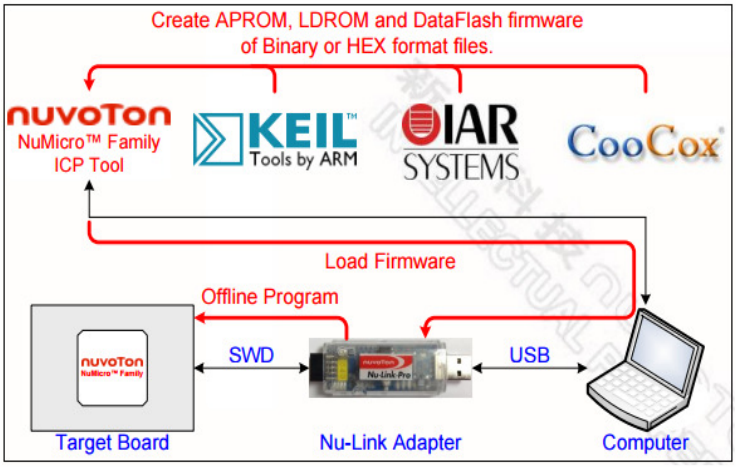
The passive backplanes are planted Nuvoton M058 series MCUs for hosting disk LED indication, Fan speed control and system fail alarm. These MCUs are preprogrammed in manufacturing. In most cases, the MCUs are not required to reprogram unless there is issue needed to fix.

How to upgrade firmware?

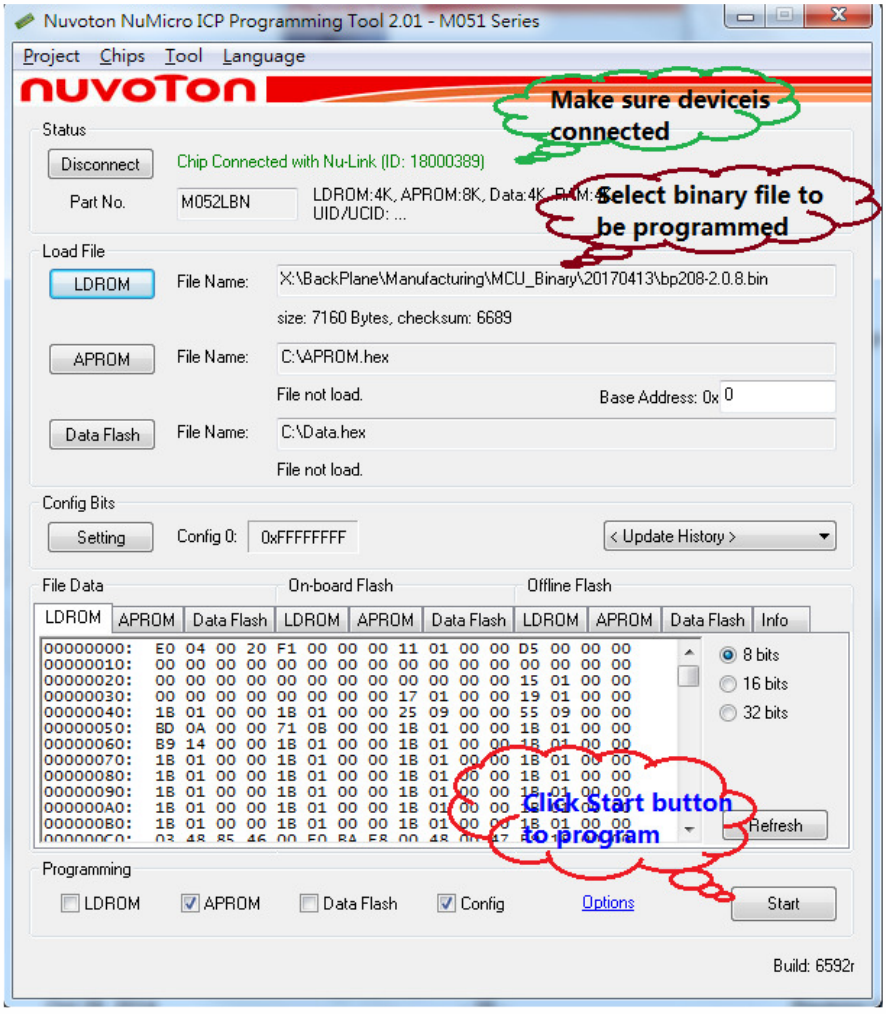
1. Require Nuvoton ARM Cortex-M0 programming tool. Nu-Me or Nu-Link and install Nuvoton ICP Programming tool software.



2. Connect Nu-Link USB end to a host and the SWD end to Backplane ICE connector for each MCU.



3. Make sure device is connected and select the binary file being programmed and then click on Start button to program firmware.



4. Please refer to http://www.nuvoton.com/resource-files/NuLink_Adapter_User_Manual_EN_V1.01.pdf for more details.