

# **GEN5-SAS4 BP USER'S MANUAL**

**P/N : 2RAKVI018100**

**Model : RS108-09 GEN5-SAS4 BP**

Version: V1.0

## Revision History

| Version | Changes          | Date       |
|---------|------------------|------------|
| V1.0    | Official Release | 2024/04/20 |
|         |                  |            |
|         |                  |            |
|         |                  |            |

## ● **TABLE OF CONTENTS**

|                                                     |           |
|-----------------------------------------------------|-----------|
| ● <b>Overview.....</b>                              | <b>4</b>  |
| Physical Outlook.....                               | 5         |
| Diagram.....                                        | 5         |
| Mechanical .....                                    | 6         |
| ● <b>Hardware Specification .....</b>               | <b>7</b>  |
| ● <b>Host and Function Connector Location .....</b> | <b>8</b>  |
| Connector Pin Definitions. ....                     | 8         |
| Device Connector & LED Indicators. ....             | 9         |
| ● <b>LED Behavior .....</b>                         | <b>10</b> |
| Disk Bay LED .....                                  | 10        |
| ● <b>Smart Fan Control.....</b>                     | <b>13</b> |
| ● <b>Firmware Upgrade .....</b>                     | <b>15</b> |

## **Overview**

This high-performance, economical backplane is the suitable solution for users whose MB or RAID/HBA provide sufficient SAS host ports to accommodate 8 disks in the system.

This 1U hybrid backplane is designed to support state-of-the-art SAS4 24Gbps HDD/SSD and is backward compatible with SAS3 12Gbps, SAS 6Gbps, SATA 6Gps and SATA 3Gps HDD/SSD. The backplane supports up to 8 pcs of NVMe SSD GEN5 through MCIO-4i (Mini Cool Edge IO) interfaces. The MCIO-4i connector could connect to a compatible MB, NVMe HBA/RAID or PCIe Retimer Card.

MCIO-4i connectors. Please notices that the hybrid port can only support either SAS/SATA disks or U.2/U.3 NVMe SSDs at any given time.

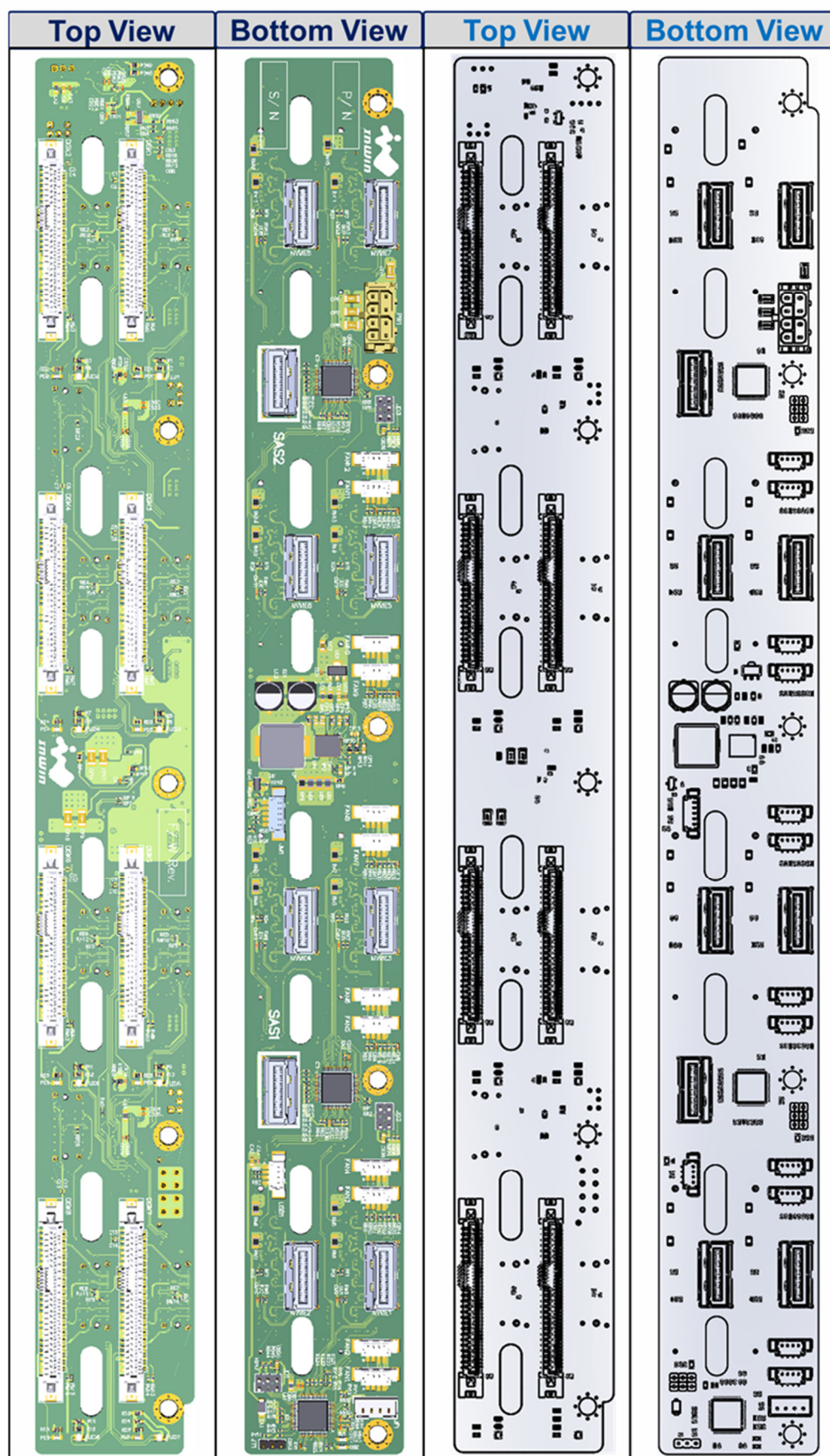
The on-board voltage regulator module (VRM) offers 2\*4-Pin 12V (32A) DC input and provide up to 5V (24A) output to satisfy the power requirements of fully loaded disk drives.

The backplane is implemented with a smart fan control feature to support wide variety of fan modules by auto-calibrating the installed fan modules during system boot. This feature provides an efficient way to control the thermal heat exhaustion by sensing the temperature on the backplane. The fan speeds automatically enhance and reduce upon the enclosure's temperature rises and falls. Furthermore, the backplane reserves a connector to accept Fan PWM from motherboard, allowing it to leverage the motherboard's speed request and operate according to the higher RPM number between the MB and backplane.

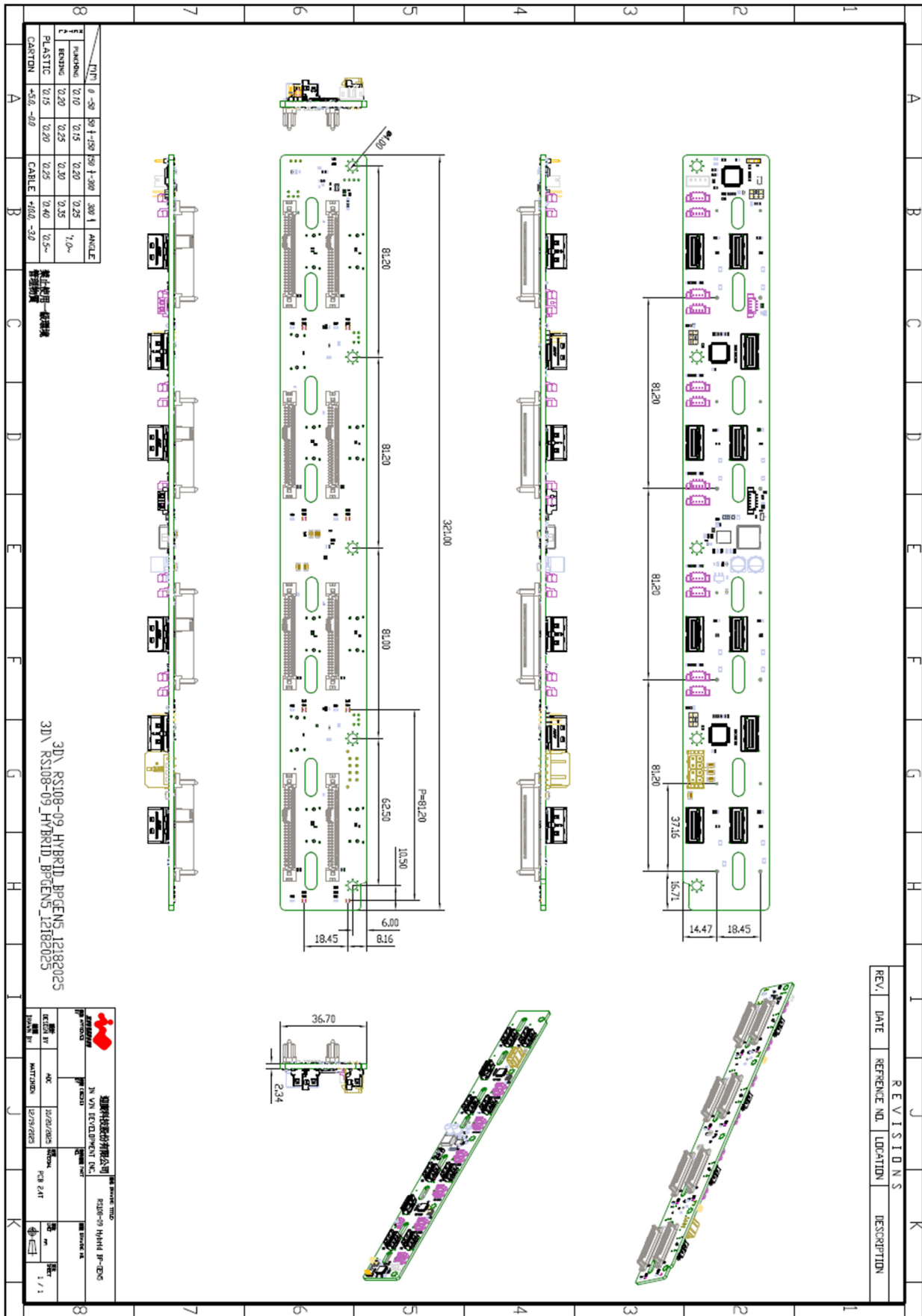
In addition to the smart fan control feature, a system alarming feature is also implemented, it alerts users to fan module failure and/or system overheat by illuminating an LED indicator. Users are thus immediately informed and can take the necessary corresponding actions to resolve the issue based on the failure type.

For disk bays management, the backplane supports SGPIO protocol for SAS/SATA disk activity and status indication through MCIO\_4i (SAS1/SAS2) connections on the board. It also supports for NVMe disks activity and status indication through MCIO\_4i (NVME1~NVME8) connections.

## Physical Outlook & Diagram



# Mechanical



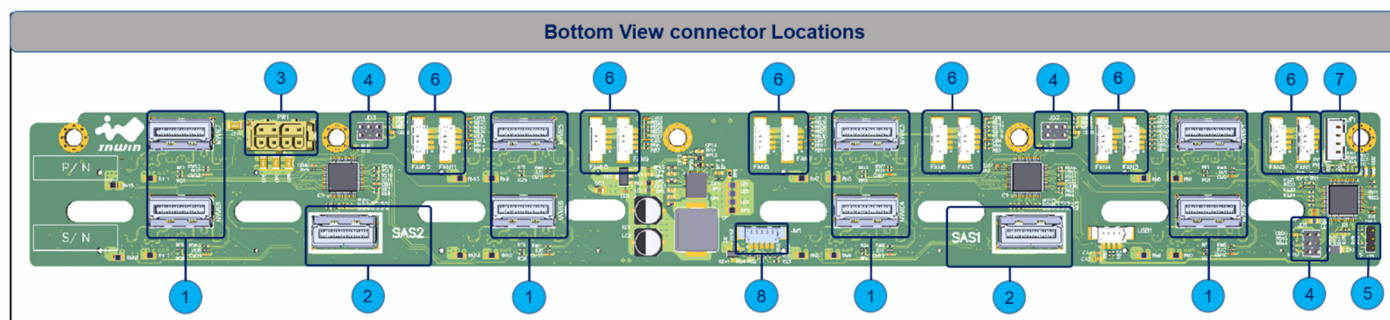
## **Hardware Specification**

HOST Interface : MCIO\_4i (SAS/SATA) & MCIO\_4i (NVME)

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

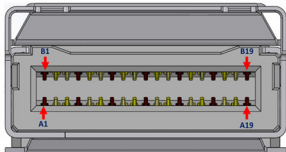
- Indicator :
  - Power LED (PD1~PD8) : Blue –(When Drive is present)
  - Dual color(Green/Red) LED D1~D8 for Drive Status (Activity/Fail/Locate)
  - Activity LED: Green (When Drive is Access)
  - Fail/Locate LED: Red (When Drive Fail or Locate)
- Environment Control:
  - PWM FAN Connector (FAN1~FAN12) for Cooling system.
  - Temperature Sensor (RTB1/RTB2) Monitor Drive Bay inside temperature.
- High Speed Connector
  - MCIO\_4i Connector \*2 (SAS1/SAS2)
    - ◆ One MCIO\_4i connector can support up to 4 SAS4 disk bays. All the connectors are directly wired to the 68-pin disk connectors (S1~S7).
      - SAS1 directly wired to DISK1~DISK4.
      - SAS2 directly wired to DISK5~DISK8.
  - MCIO-4i Connector \*8 (NVME1~NVME8)
    - ◆ All the MCIO\_4i connectors (NVME1~NVME8) are directly wired to the SFF-8639 68-pin connectors (DISK1~DISK8).
  - SFF-8639 68Pin Connector \*8 (DISK1~DISK8) for SATA/SAS4 Disk or NVMe SSD.
- Power Connector/Signal Control Header:
  - P3.0mm 2\*4Pin Power Connector\*1 (PW1 [+12V]).
  - JM1 SMBUS Connector for external BMC SMBUS control function.
  - JT1 Headers for UBM MODE & Test Mode Selection.
  - JD1/JD2/JD3 Header for Programming MCU Firmware.

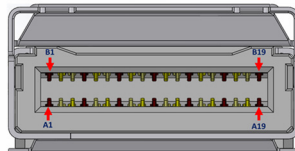
## Host and Function Connector Location

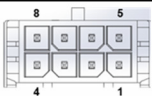


| No | Description                              | No | Description                    |
|----|------------------------------------------|----|--------------------------------|
| 1  | Host facing interface : NVME1~NVME8      | 5  | Multi-Function Selection : JT1 |
| 2  | Host facing interface (SAS4) : SAS1/SAS2 | 6  | FAN Connector : FAN1~FAN12     |
| 3  | Main Power Connector : PW1               | 7  | Fan Speed Controller : JF1     |
| 4  | Firmware Programming Header : JD1~JD3    | 8  | BMC_SMBUS Connector: JM1       |

### Connector Pin Definitions.

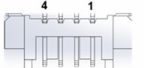
| NVME1~NVME8                                                                        |                          |             |         |
|------------------------------------------------------------------------------------|--------------------------|-------------|---------|
|  |                          |             |         |
| Signal Name                                                                        | Pin No.                  | Signal Name | Pin No. |
| PET0_[p/n]                                                                         | B2/B3                    | PET1_[p/n]  | B5/B6   |
| PER0_[p/n]                                                                         | A2/A3                    | PER1_[p/n]  | A5/A6   |
| PET2_[p/n]                                                                         | B14/B15                  | PET3_[p/n]  | B17/B18 |
| PER2_[p/n]                                                                         | A14/A15                  | PER3_[p/n]  | B17/B18 |
| GND                                                                                | A1/A4/A7/A10/A13/A16/A19 |             |         |
| GND                                                                                | B1/B4/B7/B10/B13/B16/B19 |             |         |
| Sideband Definition :                                                              |                          |             |         |
| BT_TYPE                                                                            | B8                       | CWAKE#      | B9      |
| SMB_CLK/DAT                                                                        | A8/A9                    | PERST#      | A11     |
| RefClk[p/n]                                                                        | B11/B12                  | CPRSNT#     | A12     |

| SAS1/SAS2                                                                           |                          |               |         |
|-------------------------------------------------------------------------------------|--------------------------|---------------|---------|
|  |                          |               |         |
| Signal Name                                                                         | Pin No.                  | Signal Name   | Pin No. |
| SAS_TX0_[p/n]                                                                       | B2/B3                    | SAS_RX0_[p/n] | A2/A3   |
| SAS_TX1_[p/n]                                                                       | B5/B6                    | SAS_RX1_[p/n] | A5/A6   |
| SAS_TX2_[p/n]                                                                       | B14/B15                  | SAS_RX2_[p/n] | A14/A15 |
| SAS_TX3_[p/n]                                                                       | B17/B18                  | SAS_RX3_[p/n] | B17/B18 |
| SAS_GND                                                                             | A1/A4/A7/A10/A13/A16/A19 |               |         |
| SAS_GND                                                                             | B1/B4/B7/B10/B13/B16/B19 |               |         |
| Sideband Definition :                                                               |                          |               |         |
| S0_SClock: B8, S1_SLoad: B9, S4_DataOut: A9,                                        |                          |               |         |
| S5_DataIn: B12 ,S6/S7 Reserved: A12/B8,                                             |                          |               |         |
| S2_GND: A11, S3_GND: B9,                                                            |                          |               |         |

| PW1                                                                                 |  | Power Connector |            |
|-------------------------------------------------------------------------------------|--|-----------------|------------|
|  |  | PIN #           | Definition |
|                                                                                     |  | 1-2/5-6         | Ground     |
|                                                                                     |  | 3-4/7-8         | +12V       |

| JD1~JD3                                                                             |  | Firmware Programming Connector |            |       |            |
|-------------------------------------------------------------------------------------|--|--------------------------------|------------|-------|------------|
|  |  | PIN #                          | Definition | PIN # | Definition |
|                                                                                     |  | 2                              | ICE_CLK    | 1     | VCC        |
|                                                                                     |  | 4                              | ICE_DATA   | 3     | #Key       |
|                                                                                     |  | 6                              | ICE_RST    | 5     | Ground     |

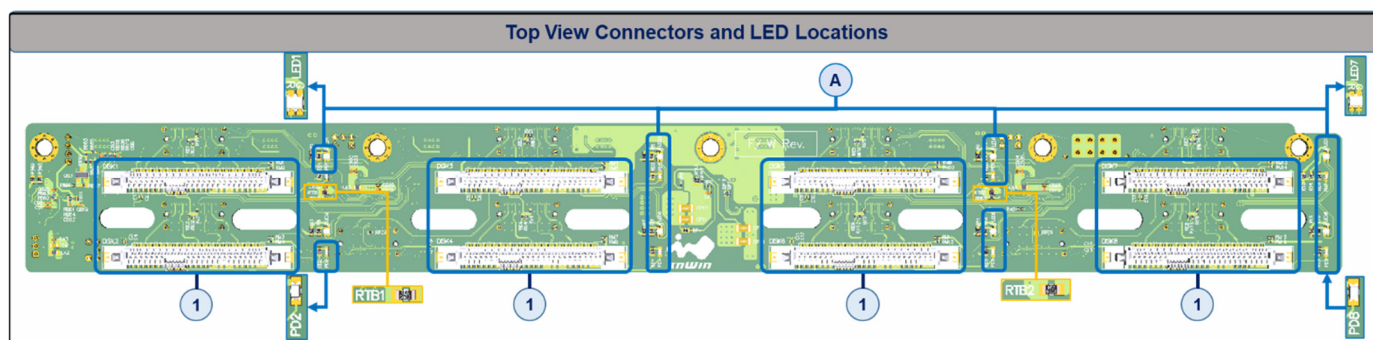
| JT1                                                                                                                           | Multi-Function Header |            |
|-------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|
|                                              | PIN #                 | Definition |
|                                                                                                                               | 1                     | UBM MODE   |
|                                                                                                                               | 2                     | MODE_SEL   |
|                                                                                                                               | 3                     | TEST_MODE  |
| <b>JT1 Function Description:</b><br>Pin#1-Pin#2 Short for UBM Mode.<br>Pin#2-Pin#3 Short for TEST Mode<br>Floating : RESERVED |                       |            |

| FAN1                                                                              | FAN 4-Pin Connector |            |
|-----------------------------------------------------------------------------------|---------------------|------------|
|  | PIN #               | Definition |
|                                                                                   | 1                   | PWM Output |
|                                                                                   | 2                   | Tachometer |
|                                                                                   | 3                   | +12V       |
|                                                                                   | 4                   | Ground     |

| JF1                                                                               | MB_FSC Connector |            |
|-----------------------------------------------------------------------------------|------------------|------------|
|  | PIN #            | Definition |
|                                                                                   | 1                | +12V       |
|                                                                                   | 2                | MB_PWM_IN  |
|                                                                                   | 3                | TACH_TO_MB |
|                                                                                   | 4                | Ground     |

| JM1                                                                               | BMC_SMBUS Connector |            |
|-----------------------------------------------------------------------------------|---------------------|------------|
|  | PIN #               | Definition |
|                                                                                   | 1                   | ALERT      |
|                                                                                   | 2                   | VCC        |
|                                                                                   | 3                   | SMB_CLK    |
|                                                                                   | 4                   | GND        |
|                                                                                   | 5                   | SMB_DAT    |

## Device Connector & LED Indicators.

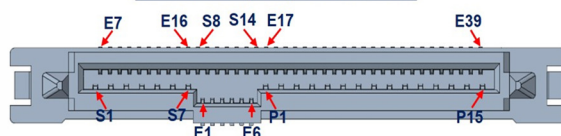


| No | Location    | Description                     |
|----|-------------|---------------------------------|
| 1  | DISK1~DISK8 | NVMe SSD or SATA/SAS Disk #1~#8 |

| No | Location | Description           | Location  | Description                      |
|----|----------|-----------------------|-----------|----------------------------------|
| A  | PD1~PD8  | DISK1~DISK8 Power LED | LED1~LED8 | DISK1~DISK8 Activity/Failure LED |

## DISK1~DISK8

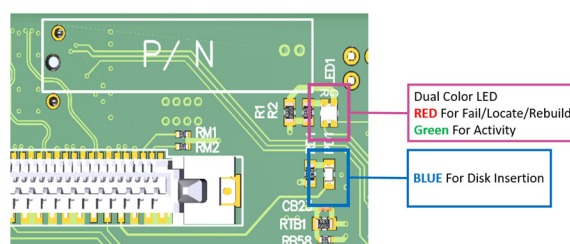
### SFF-8639 (U.2) Connector



| 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                            | PWRDIS#     | P3      | IFDET#1/2    | P4/E6   |
| +5V&Charge   | P7~P9                                  | 12V&Charge  | P13~P15                       | PRSENT      | P10     | READ_LED     | P11     |

## 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 (2 Hz) whenever disk drive is being accessed.

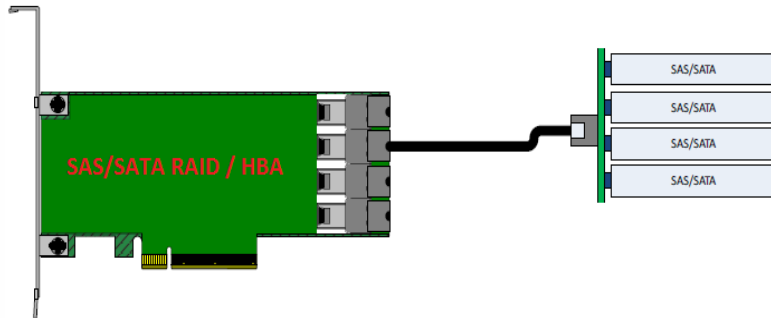
RED LED:

Fail and Locate indicator –

Turned steady on when disk failure occurs. Blinking (0.5 Hz) when locating Disk, Blinking (1 Hz) when RAID rebuild and consistent check.

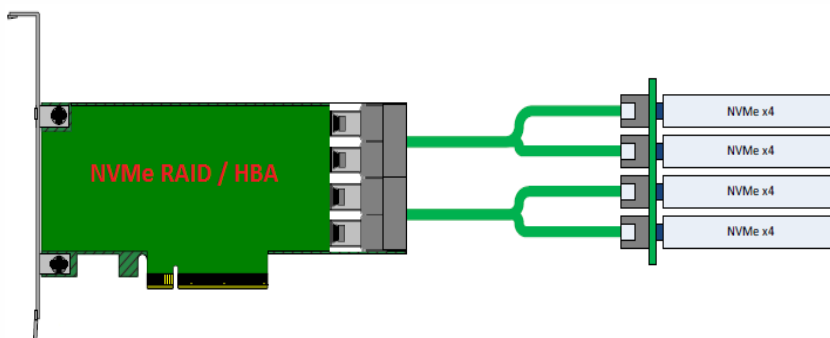
There are 2 parts of LED Management on the backplane. One is for SAS and another is for NVMe. Please note that the disk slots can only accommodate SAS/SATA or NVMe disk at any given time since they share the same disk connector.

For SAS applications, The LEDs behave by following SGPIO signal coming through sideband bus inside the MCIO cables. 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 (READ\_LED) of the disk connectors.



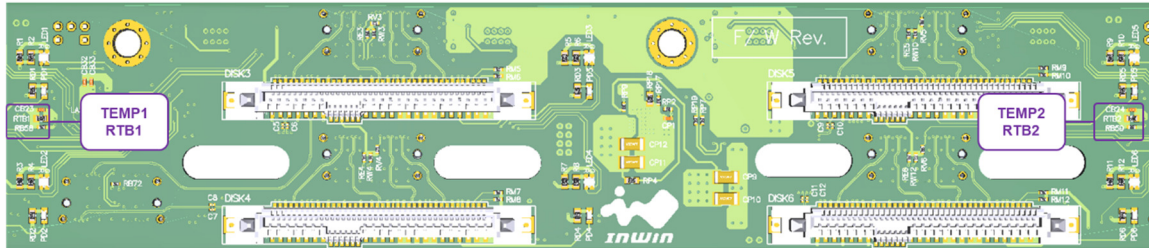
For NVMe application, The LEDs behave according to the VPP over I2C signals from NVMe host controllers through sideband bus of MCIO-8i to MCIO-4i \*2 cables. Whenever the NVMe host controller support VPP over I2C, the RED LEDs behave Locate, Fail and Rebuild signals following VPP signals on the I2C bus. 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 (MCIO-4i) to manage its corresponding and the following NVMe disks. For example, NVMe1 and NVMe2 LED management signal is derived from sideband I2C bus of the NVMe1 connector, NVMe3 and NVMe4 LED management signal is derived from NVMe3 sideband I2C bus of the connector and ...etc.



## Smart Fan Control

IN-WIN's Backplane implement Smart Fan Control feature by automatically detecting the presence of the Fan Modules and intelligently controlling the Fan RPM according to the system temperature detected by two thermal sensors (RTB1/RTB2) on the backplane.



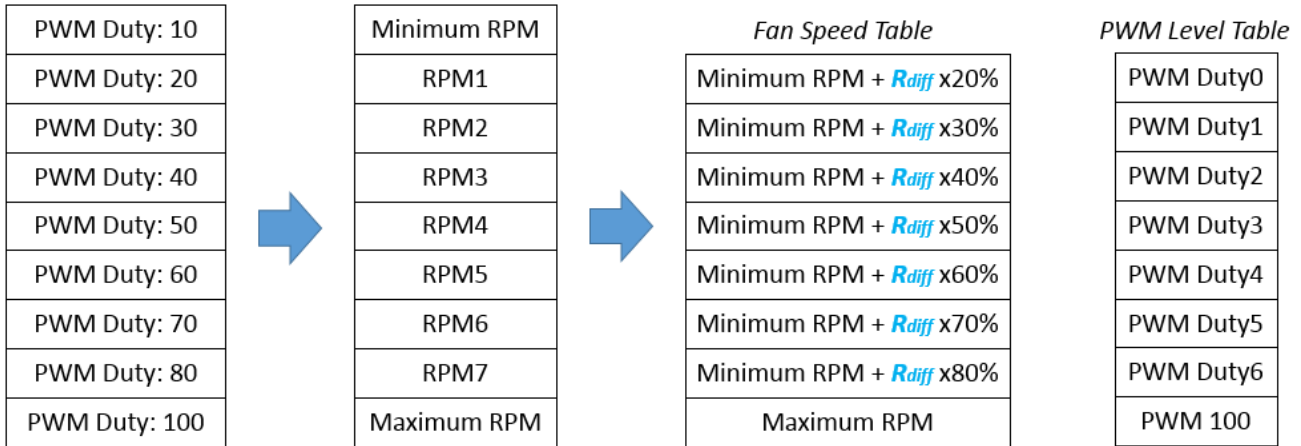
Thanks to Smart Fan Control feature, the Fan connectors (FAN1~FAN12) on backplane support a wide variety of PWM driven Fan modules used in the enclosure.

How it works?

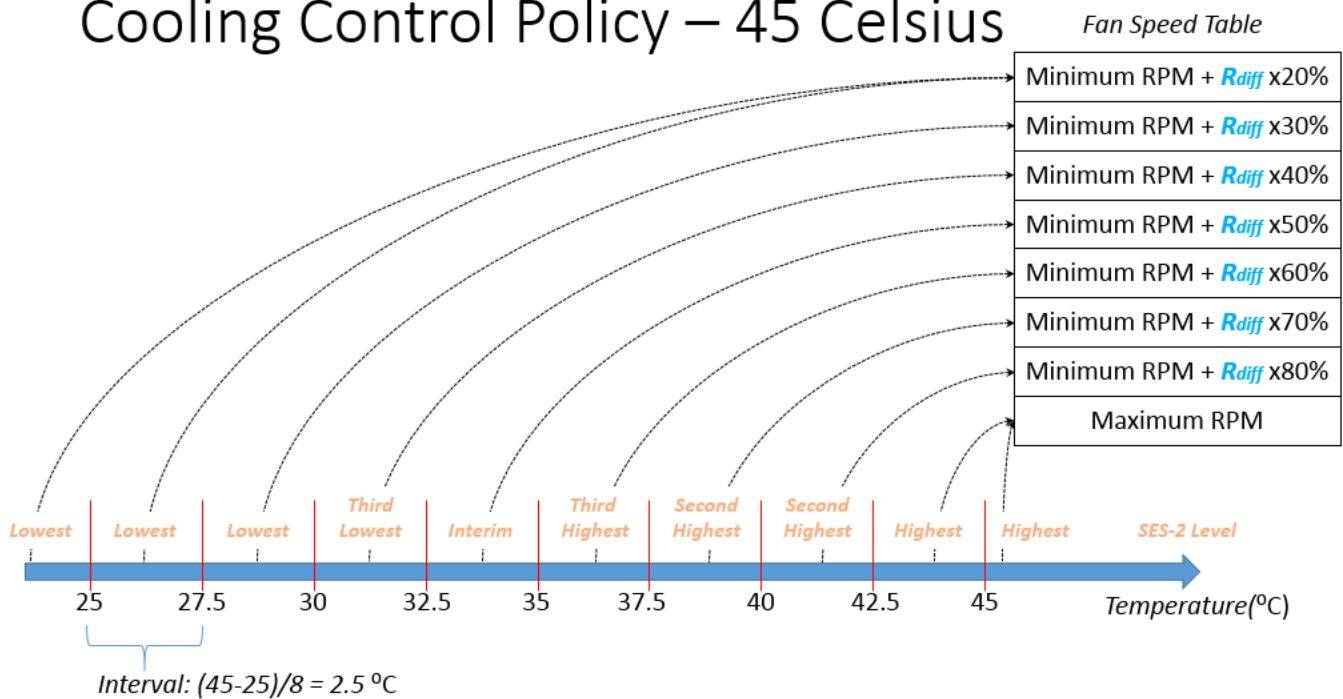
1. Fan module auto-calibration is triggered upon every system boot. The thermal profile would then be recorded and used until next reboot.
2. Backplane starts fan calibration and calculates the corresponding PWM duty cycle for each level. There are totally 8 speed levels to be sensed and used until next system boot.
3. The 8 fan speed levels are mapped to the temperature readings detected by thermistor spreading from 25 to 45°C in 3.75°C steps.
4. In normal operation, when the system temperature changes to next level, the fan module would change speed accordingly. 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 selecting whichever is higher as the output PWM to the fan modules.

# Fan Speed Measurement

$$R_{diff} = \text{Maximum RPM} - \text{Minimum RPM}$$



## Cooling Control Policy – 45 Celsius



## Firmware Upgrade

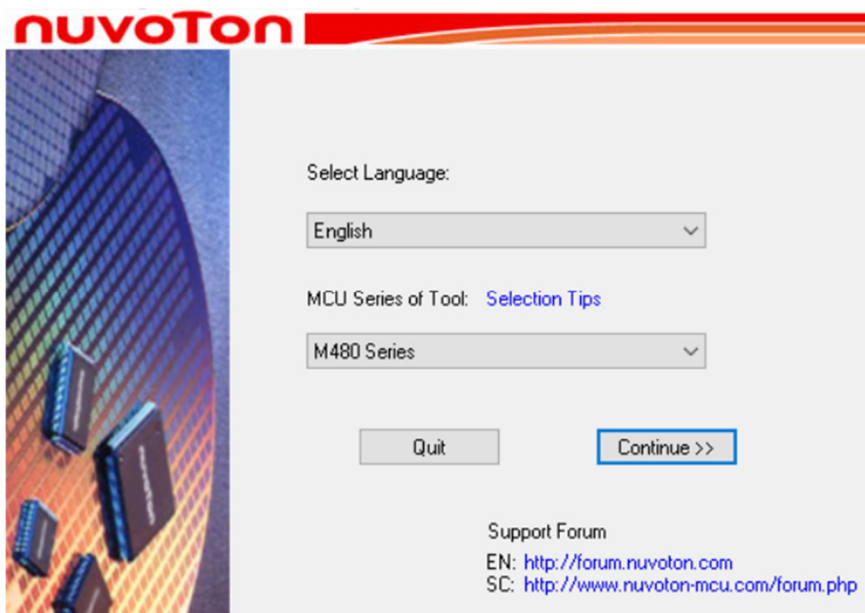
The passive backplanes are equipped with Nuvoton M482 series MCUs for managing disk LED indication, Fan speed control and system fail alarm. These MCUs are pre-programmed in manufacturing. In most cases, the MCUs are not required to reprogram unless there is issue needed to fix.

How to upgrade firmware?

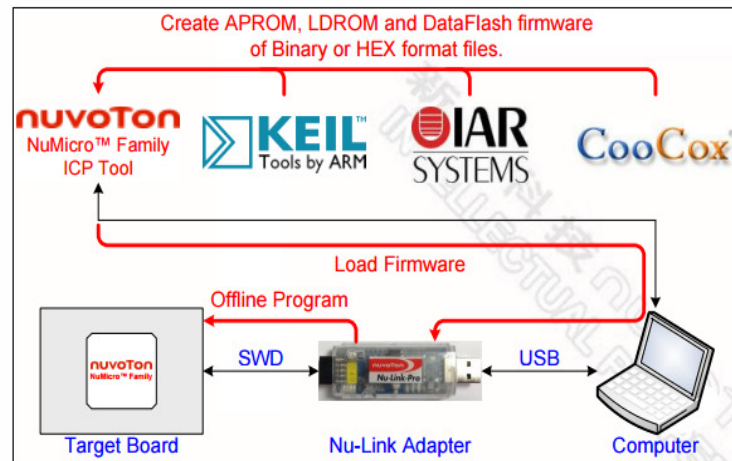
1. You will need a Nuvoton ARM Cortex-M0 programming tool. Nu-Me or Nu-Link and must install Nuvoton ICP Programming tool software.



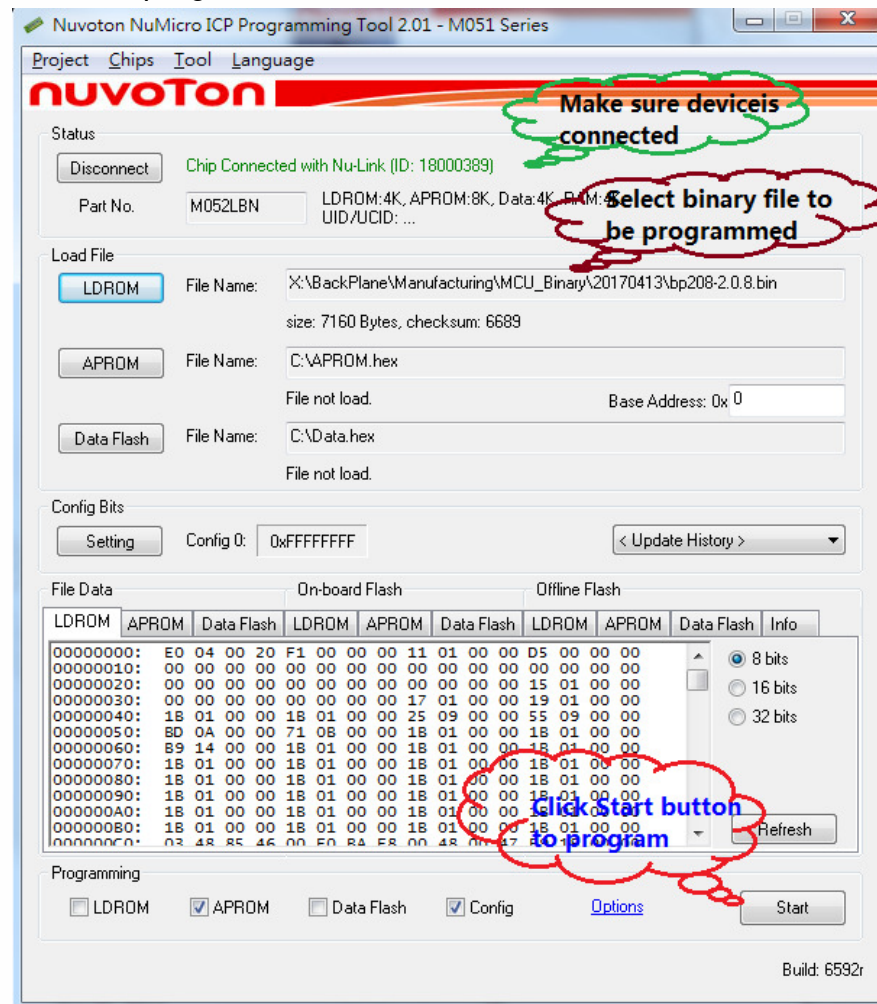
Nuvoton NuMicro ICP Programming Tool 3.09



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



3. Make sure device is connected and select the binary file to be 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](http://www.nuvoton.com/resource-files/NuLink_Adapter_User_Manual_EN_V1.01.pdf) for more details.