SK-SERIES SAS4-GEN5 BACKPLANE

USER'S MANUAL

P/N : 2RAKVI017800

Model：SK35-09 5BAY SAS4-GEN5 BP MODULE

Version : V1.0

Revision History

Version	Changes	Date
V1.0	Official Release	2025/05/02

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Overview

The backplane is a high-performance economical solution for users who has sufficient SAS host ports on MB or RAID/HBA to accommodate 4 disks in the system. The hybrid backplane is supporting state-of-the-art SAS4 22.5Gbps HDD/SSD and backward compatible with SAS3 12Gbps, SAS 6Gbps, SATA 6Gps and SATA 3Gps HDD/SSD. The backplane supports 8 pcs of NVMe SSD up to GEN5 through MCIO 4i (Mini Cool Edge IO) interfaces. The MCIO 4i connector could connect to MB, NVMe HBA/RAID or PCIe Retimer Card that supports it.

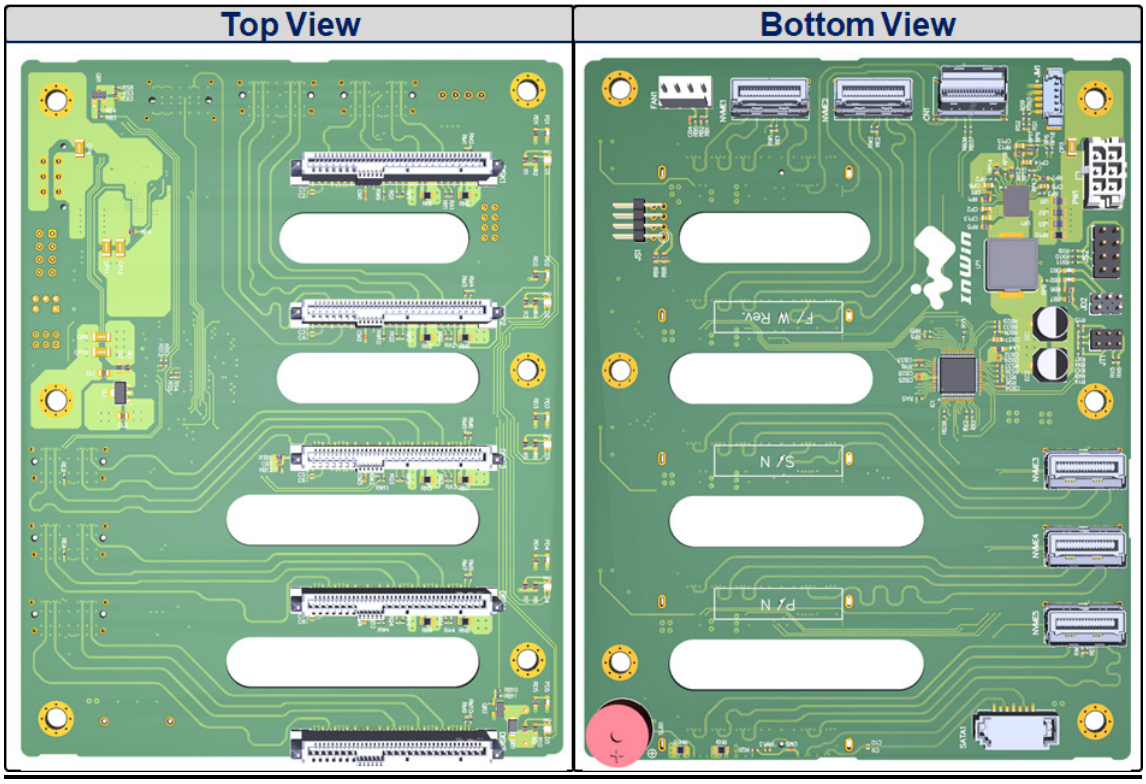
Basically, A 7-pin SATA connector and MCIO_4i share a U.2 connector(Disk#5) to support either 6Gps SATA drive or GNE5 NVMe SSD. One single SFF-8654_4i SlimSAS_4i connector can support up to 4 disk bays, says Disk#1 to Disk#4. is so called Hybrid that further supports NVMe SSD via MCIO_4i connector.

On backplane offer VRM with P3.0-2*3Pin 12V (15A) DC input provide up to 5V (15A) on board to satisfy the power needs of fully loaded for disk drives.

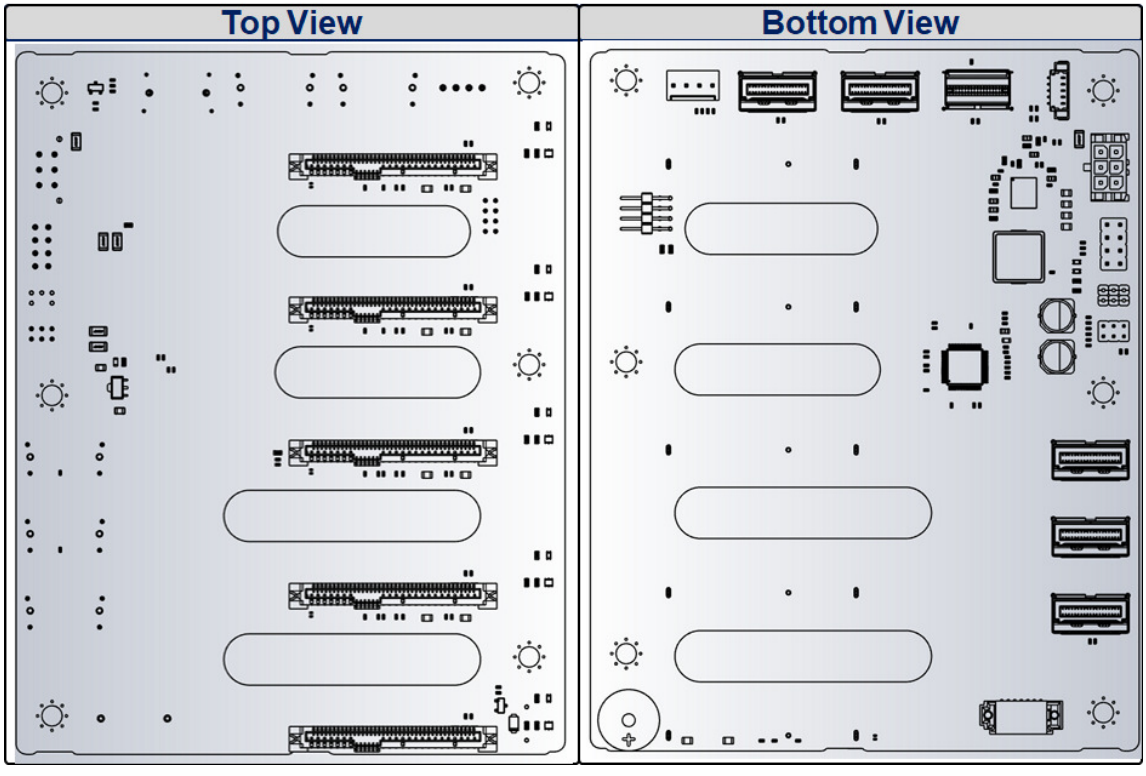
Along with the smart fan control feature, a system alarming feature is also implemented to alert users in case Fan module failure and/or system overheat occurs by illuminating the LED indicator. Users can then inform of issue and take corresponding actions to resolve the issue according to the failure type.

For disk bays management, the backplane supports SGPIO protocol for SAS/SATA disks activity and status indication through SlimSAS connections on the board.

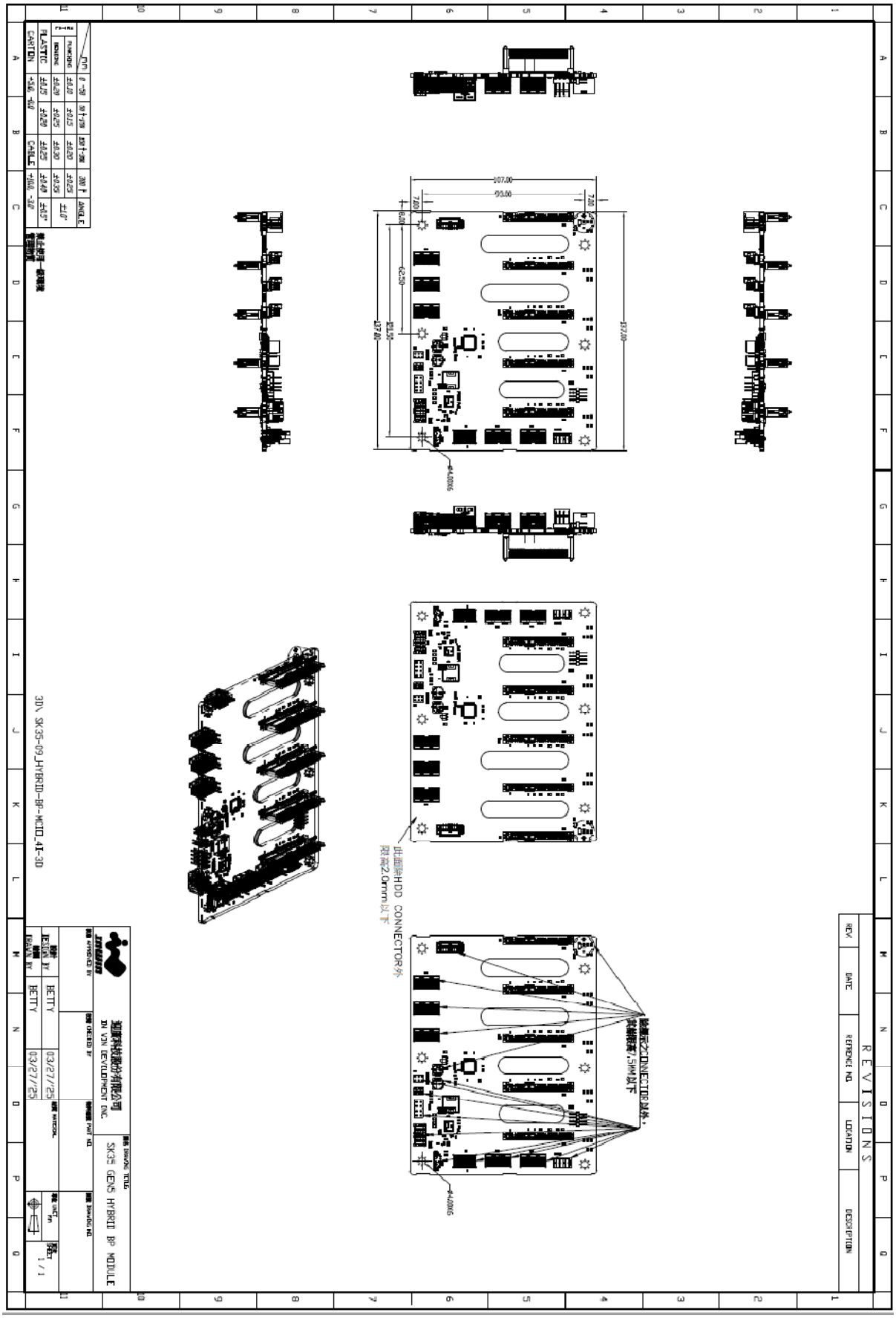
Physical Outlook



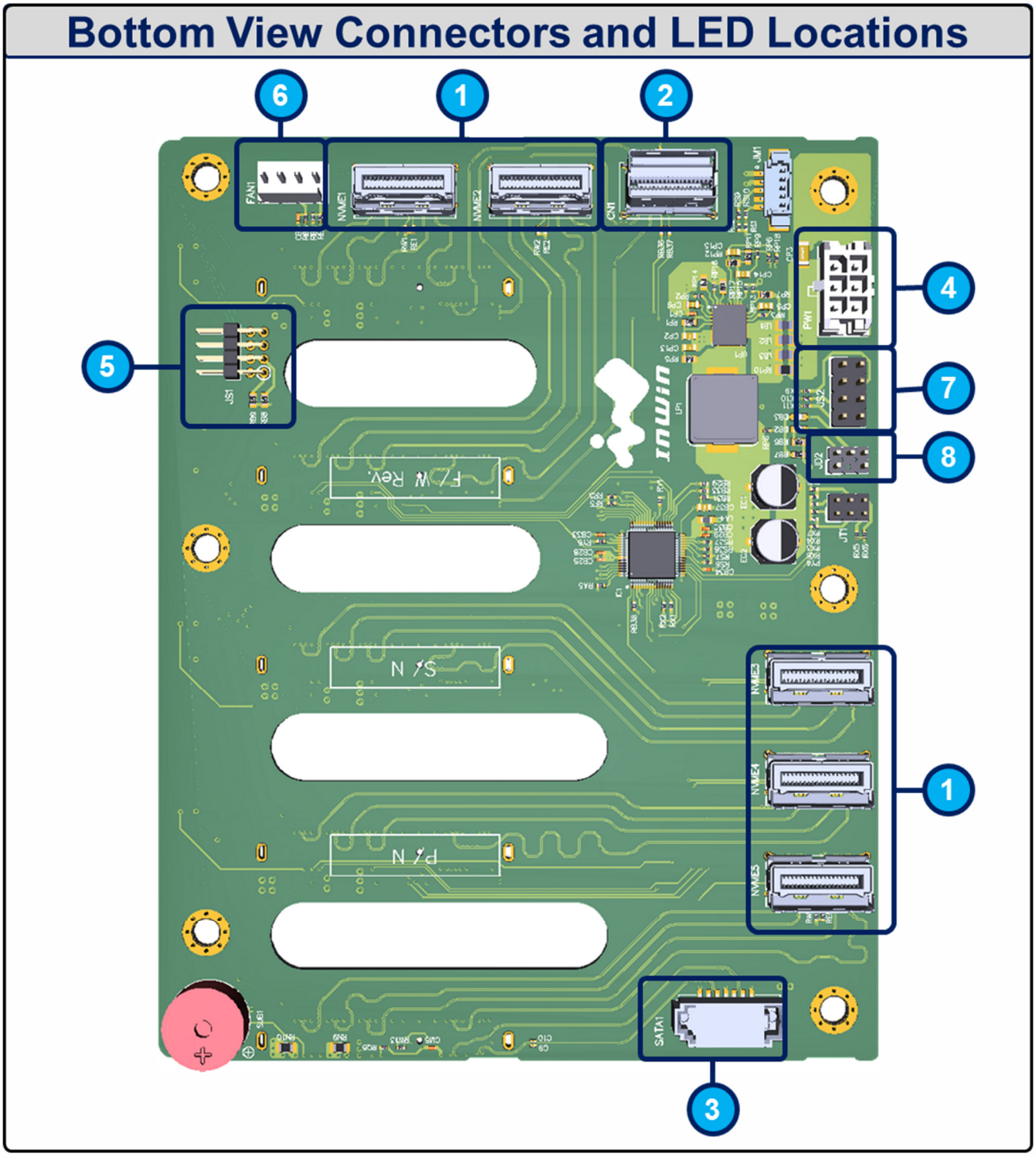
Diagram



Mechanical

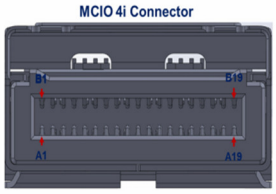

REVISIONS
REV
DATE
REFERENCE NO.
LOCATION
DESCRIPTION
SK3S GEN5 HYBRID BP MODULE
BETTY
03/27/25
3D\ SK3S-09_HYBRID-BP-MCIO_4I-3D

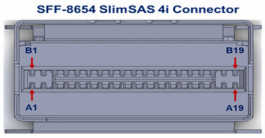
Connector Locations and LED Indicators

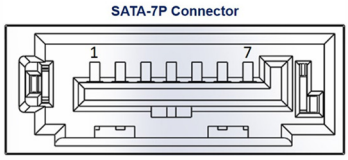


No	Description	No	Description
1	Host facing interface : NVME1 ~ NVME5	5	LED & Mute_SW Header : JS1
2	Host facing interface (SAS4) : CN1	6	FAN Connector : FAN1
3	Host facing interface (SATA) : SATA1	7	SGPIO Header : JS2
4	Main Power Connector ： PW1	8	Firmware Programming Header ： JD2

Bottom Connector and Pin Definitions

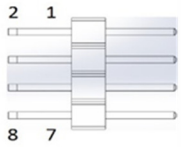
NVME1~NVME5							
							
Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.
PET0_[p/n]	B2/B3	PET1_[p/n]	B5/B6	PET2_[p/n]	B14/B15	PET3_[p/n]	B17/B18
PER0_[p/n]	A2/A3	PER1_[p/n]	A5/A6	PER2_[p/n]	A14/A15	PER3_[p/n]	A17/A18
GROUND	B1/B4/B7/B13/B16/B19/A1/A4/A7/A13/A16/A19						
Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.
BP_Type/Wake#	B8	WAKE#	B9	RefClk[p]	B11	RefClk[n]	B12
SMB_CLK	A8	SMB_DATA	A9	PERST#	A11	SB_GNDA	A10/B10

CN1			
			
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,			

SATA1			
			
Signal Name	Pin No.	Signal Name	Pin No.
SAS_RX0_[p/n]	P2/P3	SAS_TX0_[p/n]	P4/P5
SAS_GND	P1/P4/P7		

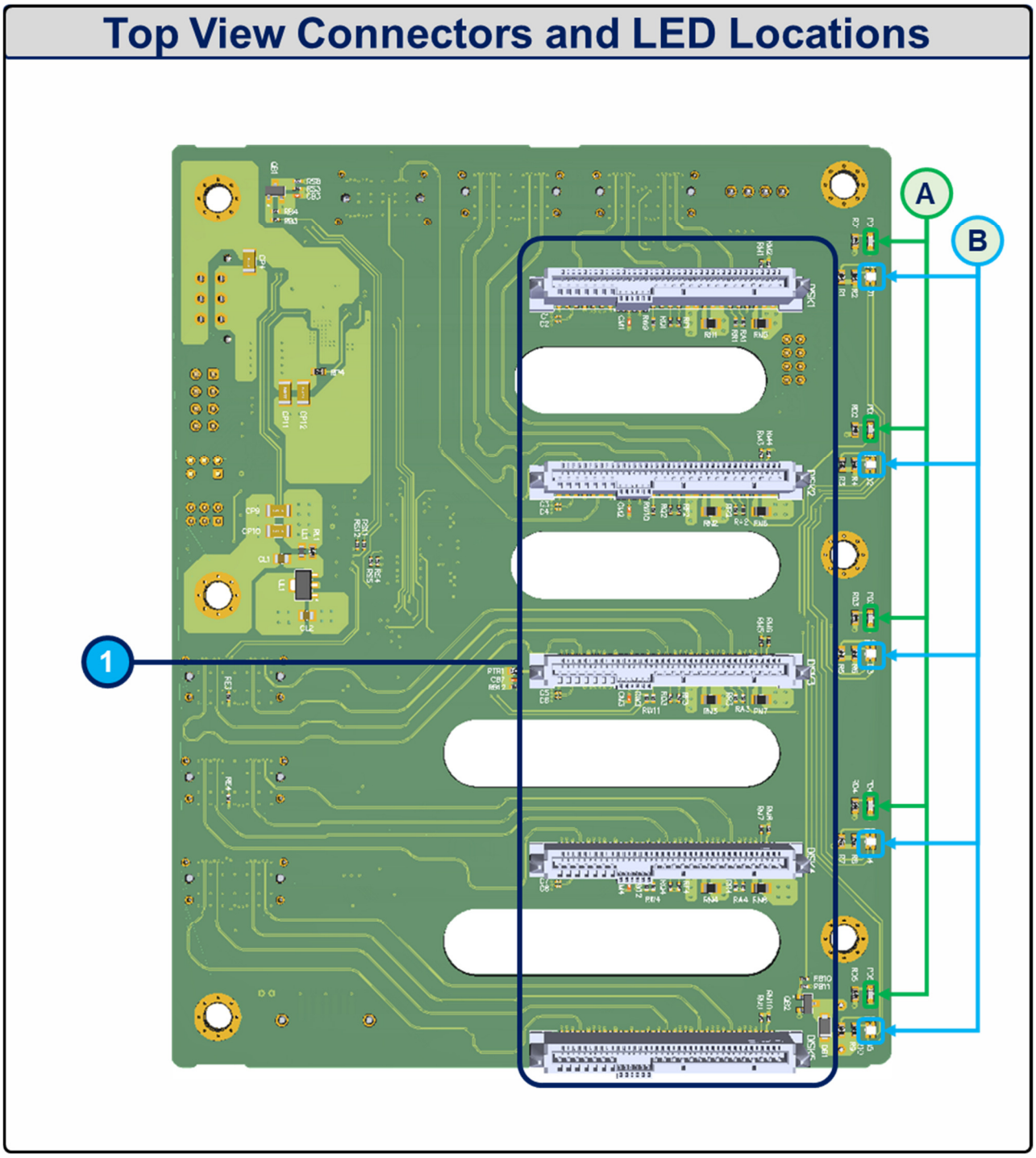
PW1	Power Connector	
	PIN #	Definition
	1~3	Ground
	4~6	+12V

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

JS1	LED & Mute SW 8Pin-Key#8 Connector			
	PIN #	Definition	PIN No#	Definition
	2	FAN Fail LED -	1	FAN Fail LED +
	4	TEMP_Fail LED -	3	TEMP_Fail LED +
	6	Mute_SW -	5	Mute_SW +
	8	#Key	7	NC

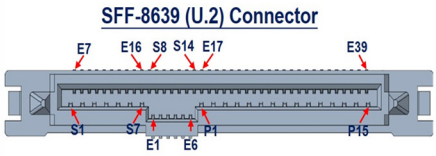
JD1	Firmware Programming Connector			
	PIN #	Definition	PIN #	Definition
	2	ICE_CLK	1	VCC
	4	ICE_DATA	3	#Key
	6	ICE_RST	5	Ground

Top Connectors and LED Indicators



No.	Location	SAS/U.2 Drive Number
1	DISK1~DISK5	SATA/SAS Disk or NVMe SSD

No.	Location	Hard Drive Power/Activity/Failure/Locate LEDs
A	PD1~PD5	DISK1~DISK5 Power LED
B	D1~D5	DISK1~DISK5 Activity/Failure/Locate LED

DISK01~DISK05 (NVME1~NVME5)							
							
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/E			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

Hardware Specification

HOST Facing Interface ： SFF-8654 SlimSAS 4i /MCIO_4i

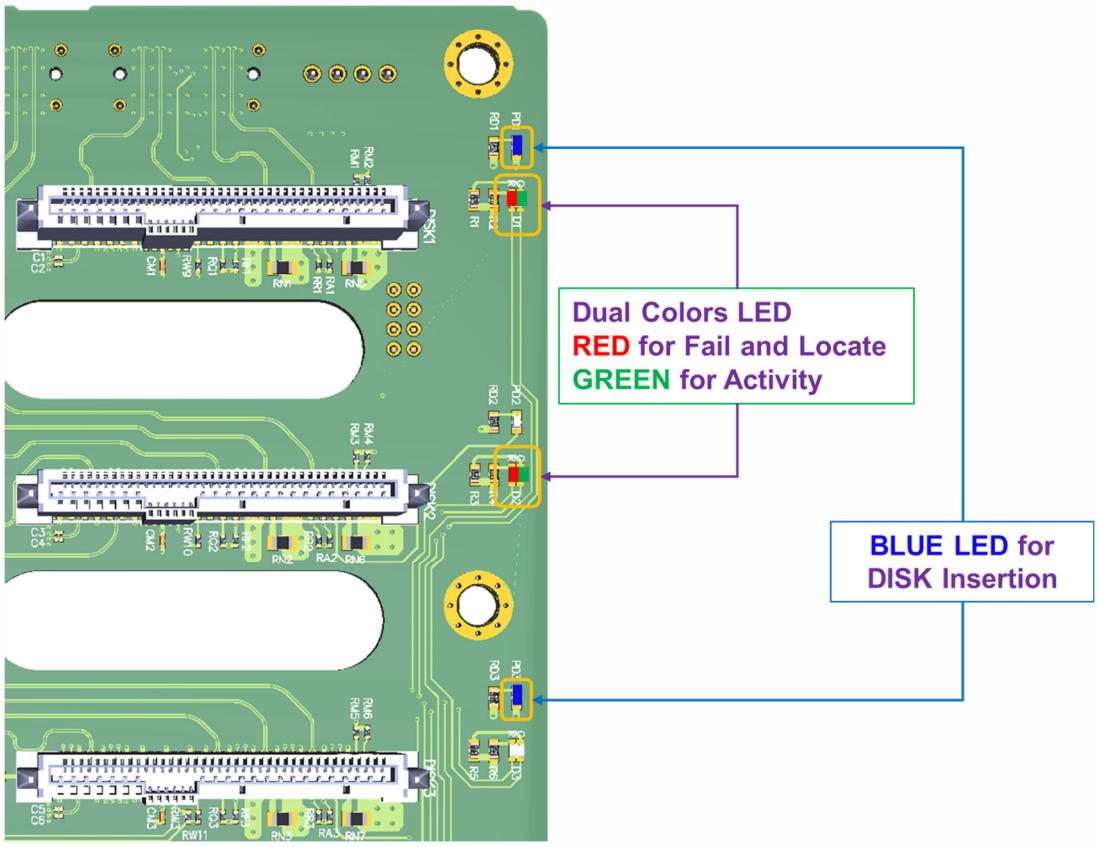
DEVICE Facing Interface ： SFF-8639 U.2-SATA/SAS/NVMe SSD

Indicator ：

- Indicator ：
  - Power LED PD1~PD5: Steady Blue –(When HDD is resent)
  - Dual color (Green/Red) LED D1~D5 for Hard Disk Drive Status (Activity/Failure/Locate)
    - Activity LED: Blinking Green (When HDD is Access)
    - Locate LED: Blinking Red (When HDD Fail or Locate)
    - Fail LED: Steady Red (When HDD Fail or Locate)
- Environment Control :
  - PWM FAN Connector (FAN1) for Cooling system.
  - Temperature Sensor (RTB1) Monitor HDD bay inside temperature.
  - Buzzer (SUB1) for Over-temperature and FAN fail alerting.
- Connector
  - SFF-8654 SlimSAS 4i 38pin Connector (CN1) for Host Facing Interface (SAS4)
  - SATA-7PIN Connector *1 (SATA1) for Host Facing Interface (SATA)
  - MCIO 4i 38Pin (NVME1~NVME5 for Host Facing Interface (NVMe)
  - SFF-8639 U.2 68PIN Connector (DISK1~DISK5 for SATA/SAS4Disk or NVMe SSD).
  - 6Pin Main Power Connector*1(PW1)
- JS1 connector for LED/Mute SW cable connection from Front Panel to Backplane.
- JS2 connector for SGPIO Cable connection from Mother Board to Backplane.
- JD1 MCU Programming Header for Programming MCU Firmware

LED Behavior

Disk Bay LED



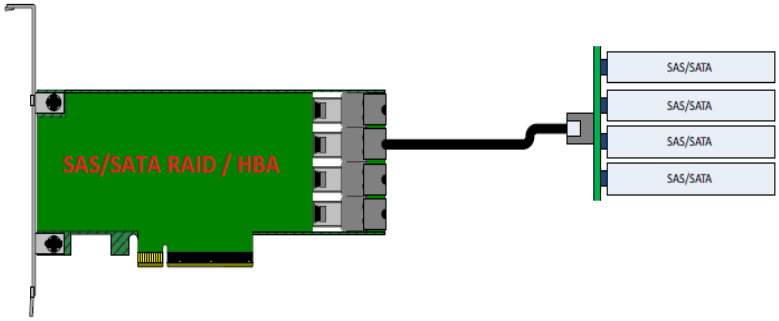
Blue LED:
Disk Insertion Indicator –
Turned on whenever disk drive is properly installed.

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.

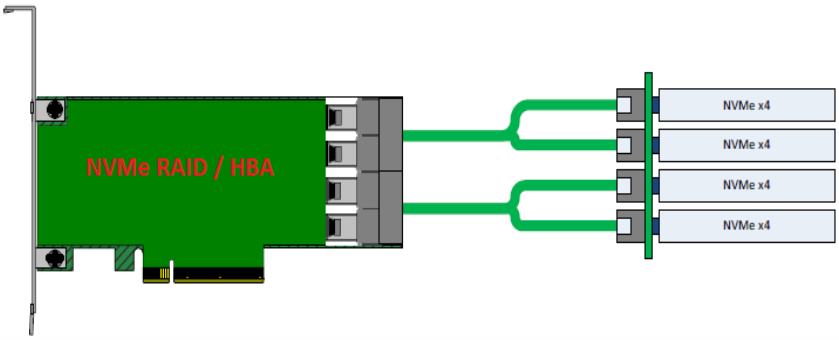
There are 2 parts of LED Management on the backplane. One is for SAS and another is for NVMe. Please note that the disk slots can only accommodate SAS/SATA or NVMe disk at a time since they share the same disk connector.

For SAS application, The LEDs behave by following SGPIO signal coming through sideband bus inside the SLIMSAS 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.



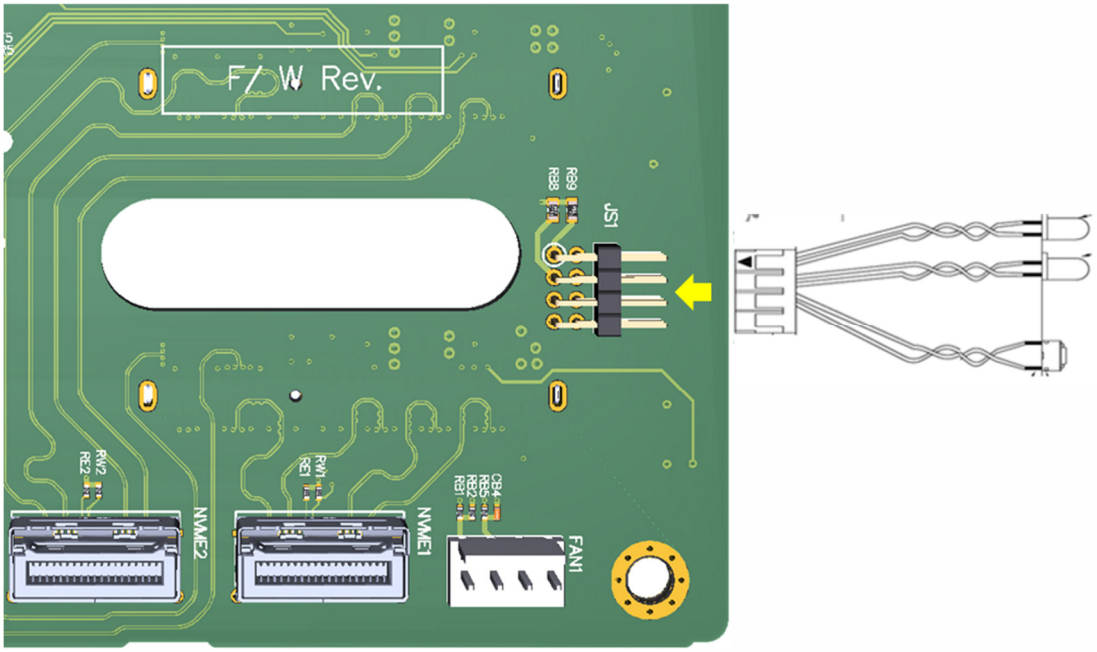
For NVMe application, The LEDs behave according to the VPP over I2C signals from NVMe host controllers through sideband bus of Oculink or SlimSAS cables. Whenever the NVMe host controller support VPP over I2C, the RED LEDs behave Locate, Fail and Rebuild signals following VPP signals on the I2C bus.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



System Alarm LED

There are two FAIL LED design on the Backplane to indicate Fan Fail and Over-Temperature. Lead 2.0mm 8-pin header JS1 to front panel for indicating system fault.



Fan Fail:
When any fan module RPM is lower than 75% of the expected speed the Fan Fail is triggered and the Fail LED blinks in 0.5Hz rate. Goes off when the issue is resolved or disappeared.

Overheat:
When the system temperature at the backplane area is going beyond 45℃ the Temp Fail triggered and Fail LED blinks in 2Hz rate. Goes off when temperature is going under 45℃.

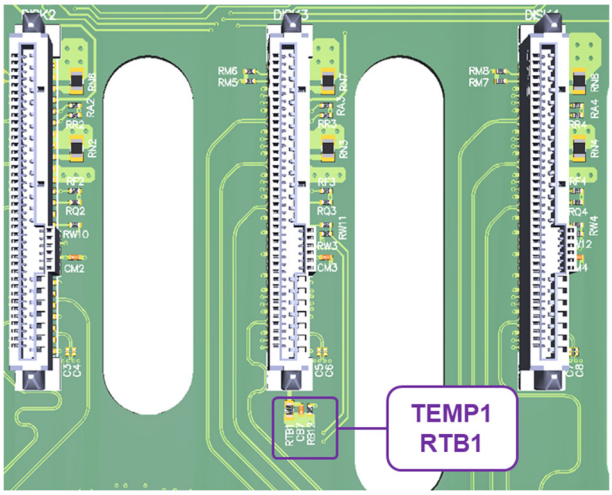
Overheat & Fan Fail:
Fail LED stays steady on when both events triggered at the same time.

Note:

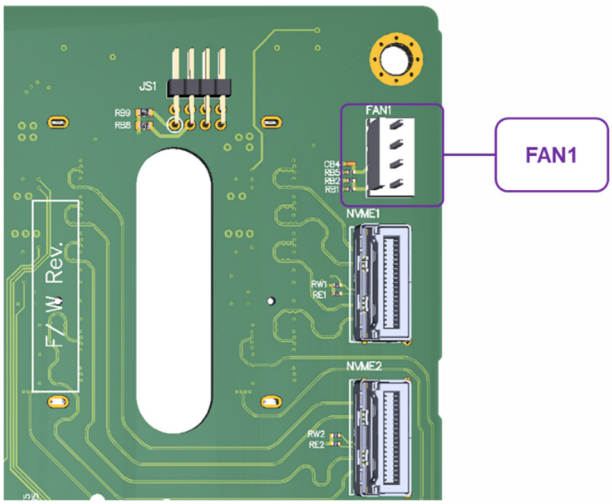
- When the system alarm is triggered, the Buzzer beeps along with it and stops beeping when alarm is disappeared.
- 1 short beep(B—B—B) stands for Fan Fails
- 2 short beeps(BB—BB—BB) stand for Over-Temperature
- Press Mute Button to disable buzzer beeping and will be retriggered when either failure occurs again.

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 a thermal sensor (RTB1) on the backplane.



Thanks to Smart Fan Control feature the Fan connector (FAN1) 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

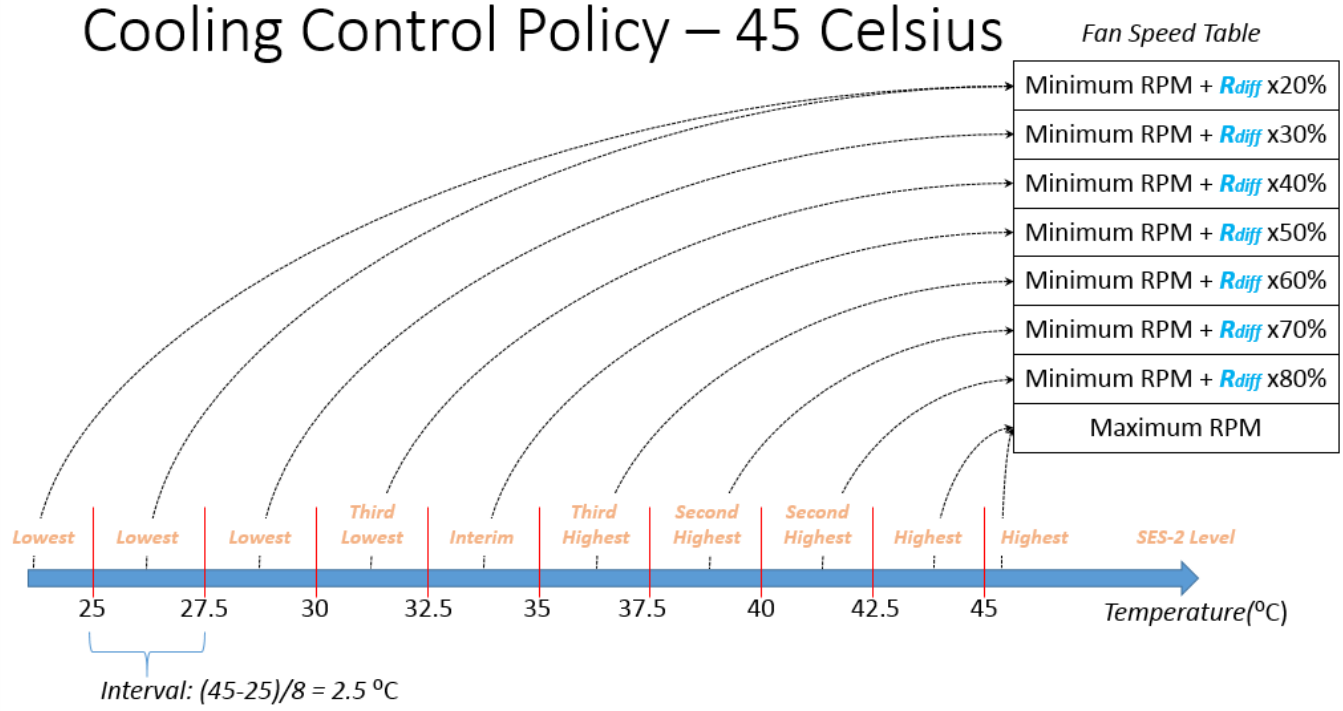
Fan Speed Table

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

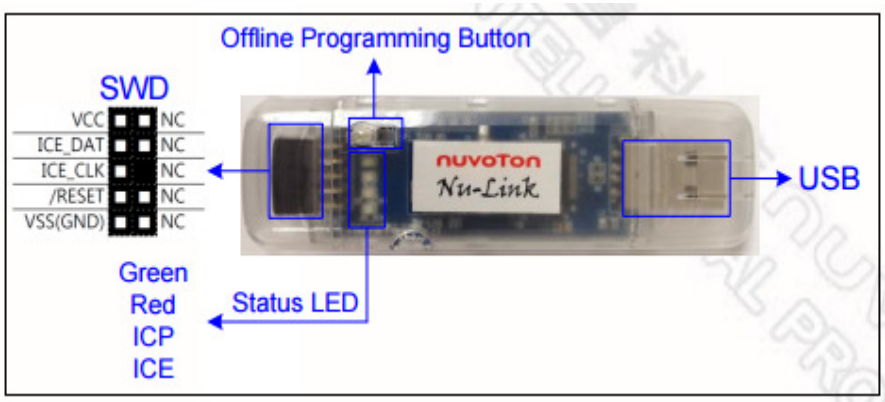


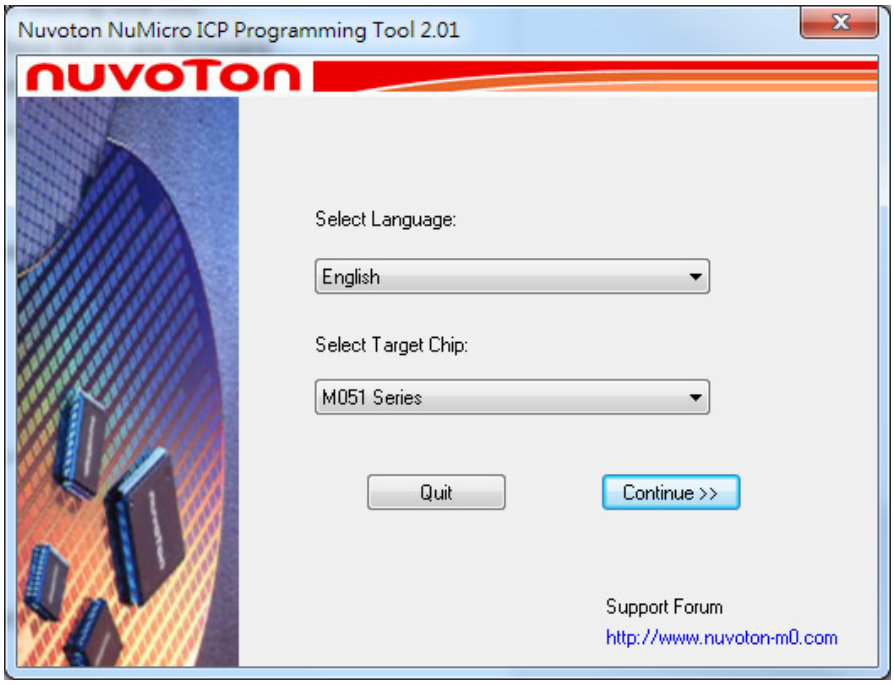
Firmware Upgrade

The passive backplanes are planted Nuvoton M482 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.

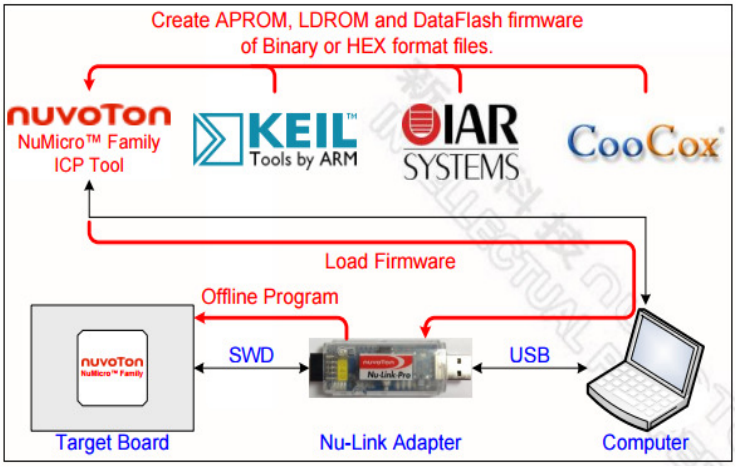
How to upgrade firmware?

1. Require Nuvoton ARM Cortex-M4 programming tool. Nu-Me or Nu-Link and install Nuvoton ICP Programming tool software.

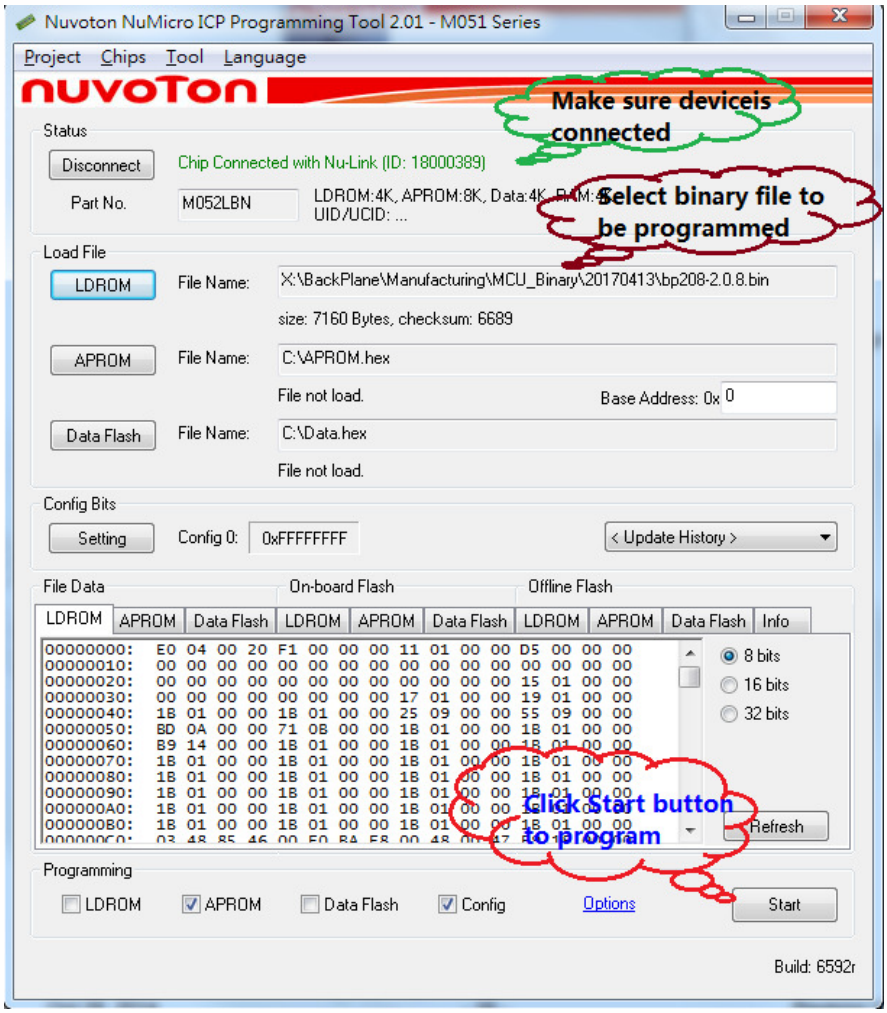




2. Connect Nu-Link USB end to a host and the SWD end to Backplane ICE connector for each MCU.



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.