HYBRID BP GEN5/SAS4
USER'S MANUAL

P/N : 2RAKVI015800

Model：2U08-HYBRID BP-GEN5 MODULE

Version: V1.0

Revision History

Version	Changes	Date
V1.0	Official Release	2024/08/27

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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 8 disks in the system. The hybrid backplane is a 2U in height designed supporting state-of-the-art SAS4 24Gbps 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, the 2 pcs of SFF-8654 SlimSAS connectors can support up to 8 SAS/SATA disks. 8 of the disk slots are the so called Hybrid ports that can support U.2/U.3 NVMe SSD via MCIO 4i connectors. Please note that the hybrid ports can support either SAS/SATA disk or U.2/U.3 NVMe SSD at a time.

On backplane offer VRM with 2*4-Pin 12V (32A) DC input provide up to 5V (24A) on board to satisfy the power needs of fully loaded for disk drives.

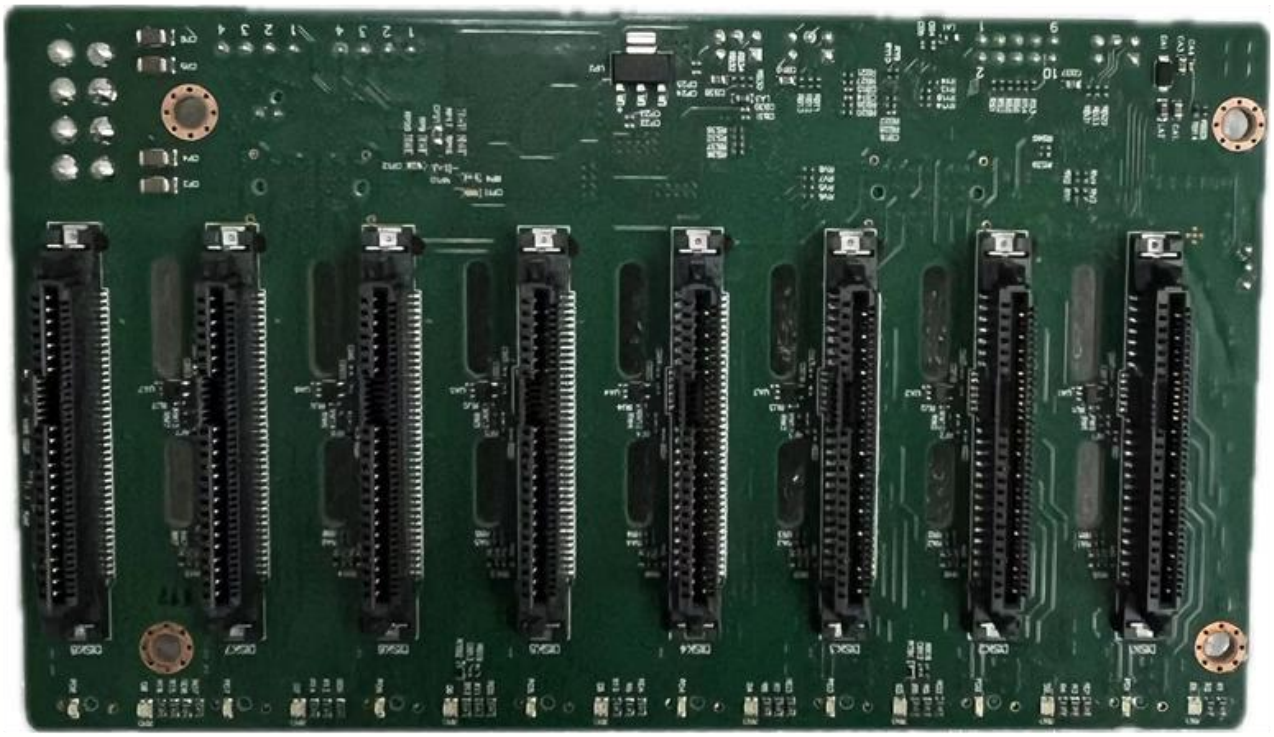
The backplane implemented with smart fan control feature to support wide variety of fan modules by auto-calibrating the installed fan modules at system boot. This feature provides an efficient way to control the thermal heat exhaustion by sensing the temperature on the backplane. The fan module speeds 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. 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. It also supports UBM(Universal Backplane Management) for NVME disks activity and status indication through MCIO connections.

Physical Outlook

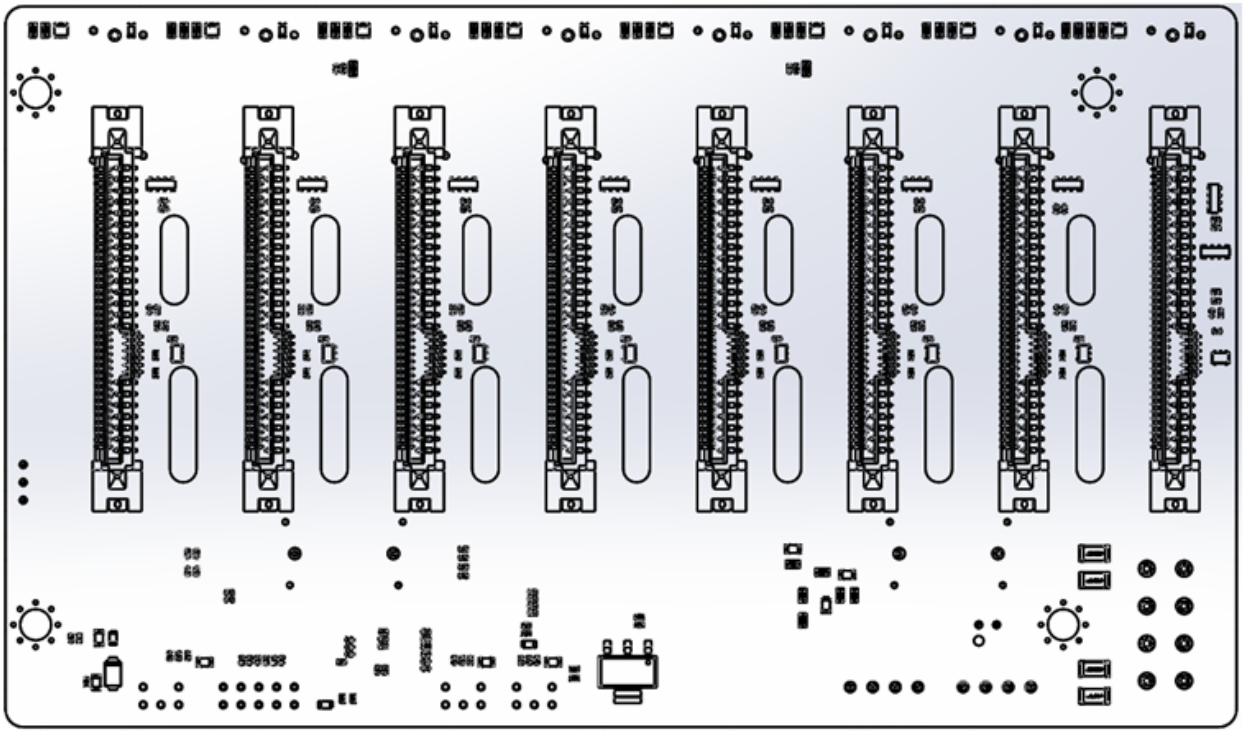
TOP-VIEW



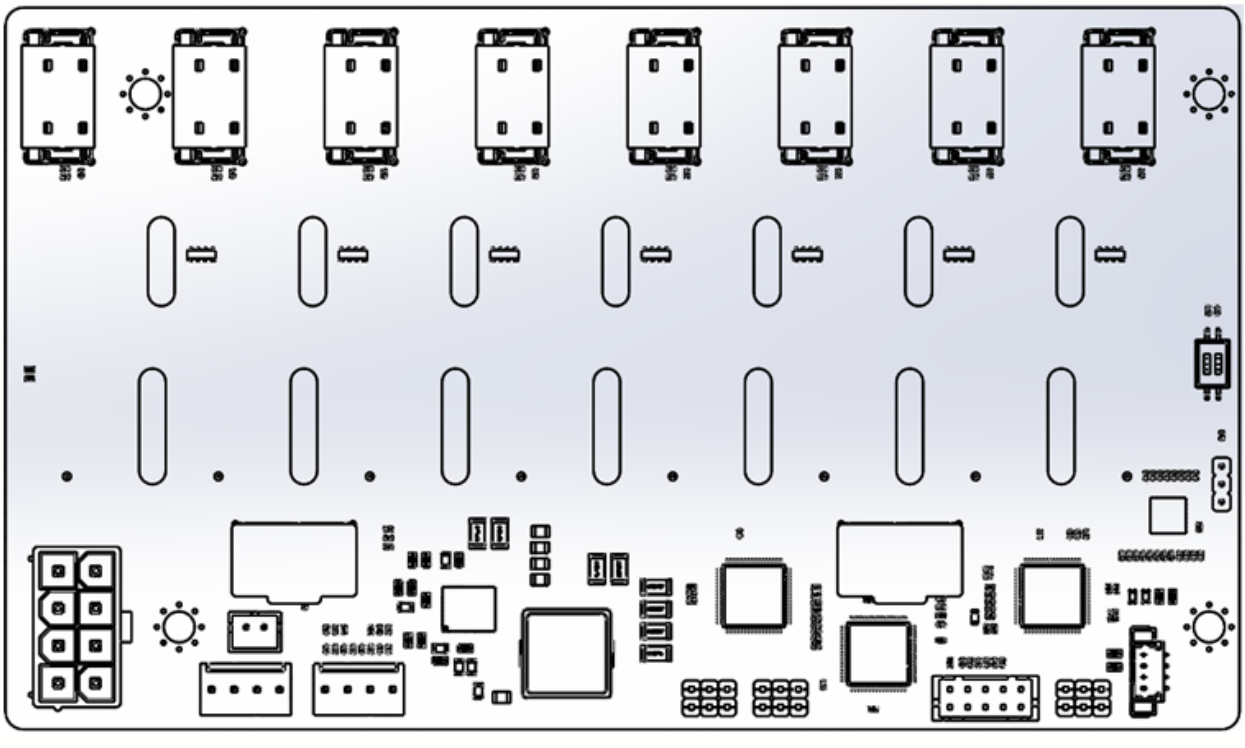
BOTTOM-SIEW

Diagram

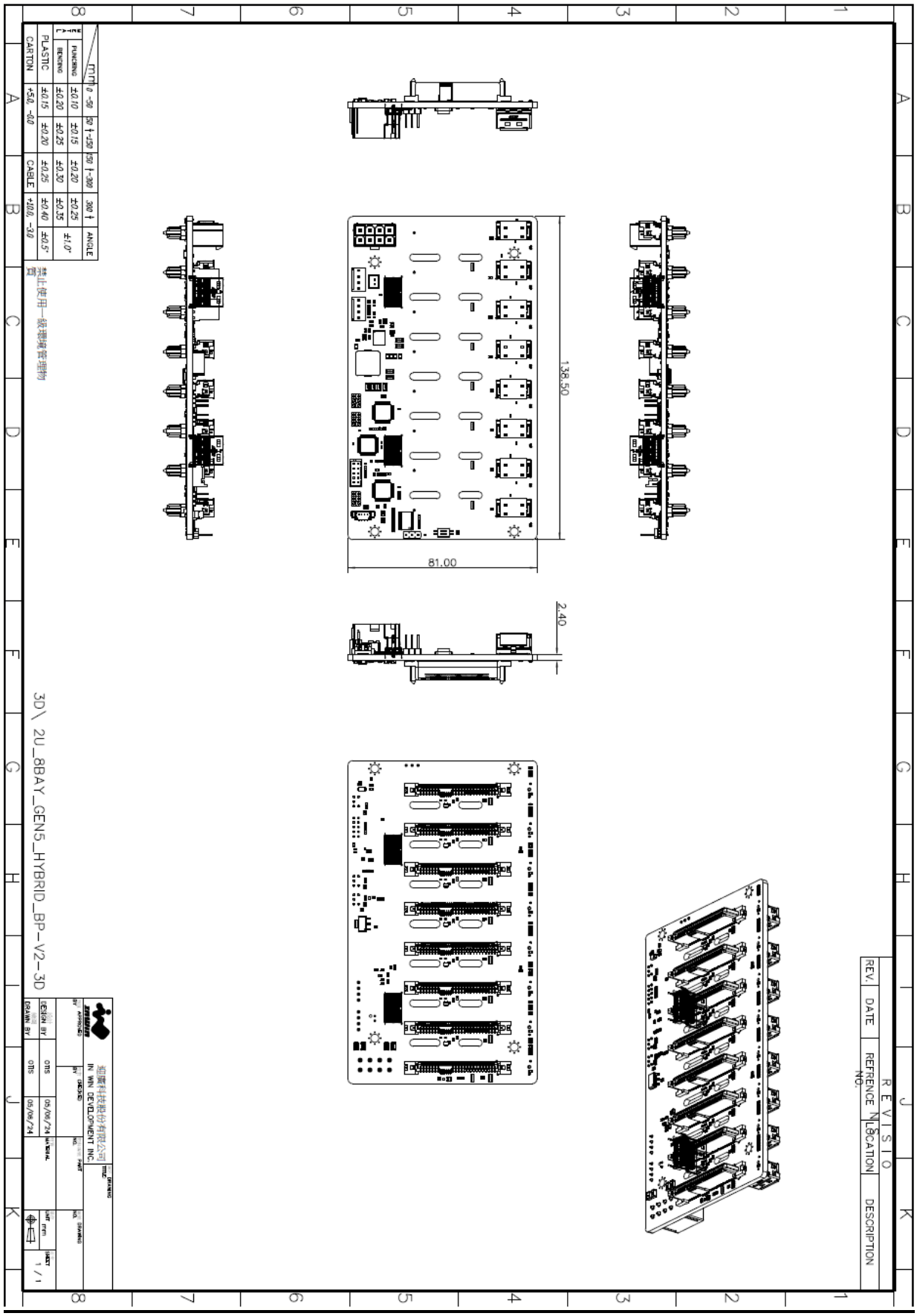
TOP-SIDE



BOTTOM-SIDE



Mechanical


138.50
81.00
2.40
REVISION
REV.
DATE
REFRENCE NO.
LOCATION
DESCRIPTION
3D\ 2U_8BAY_GEN5_HYBRID_BP-V2-3D

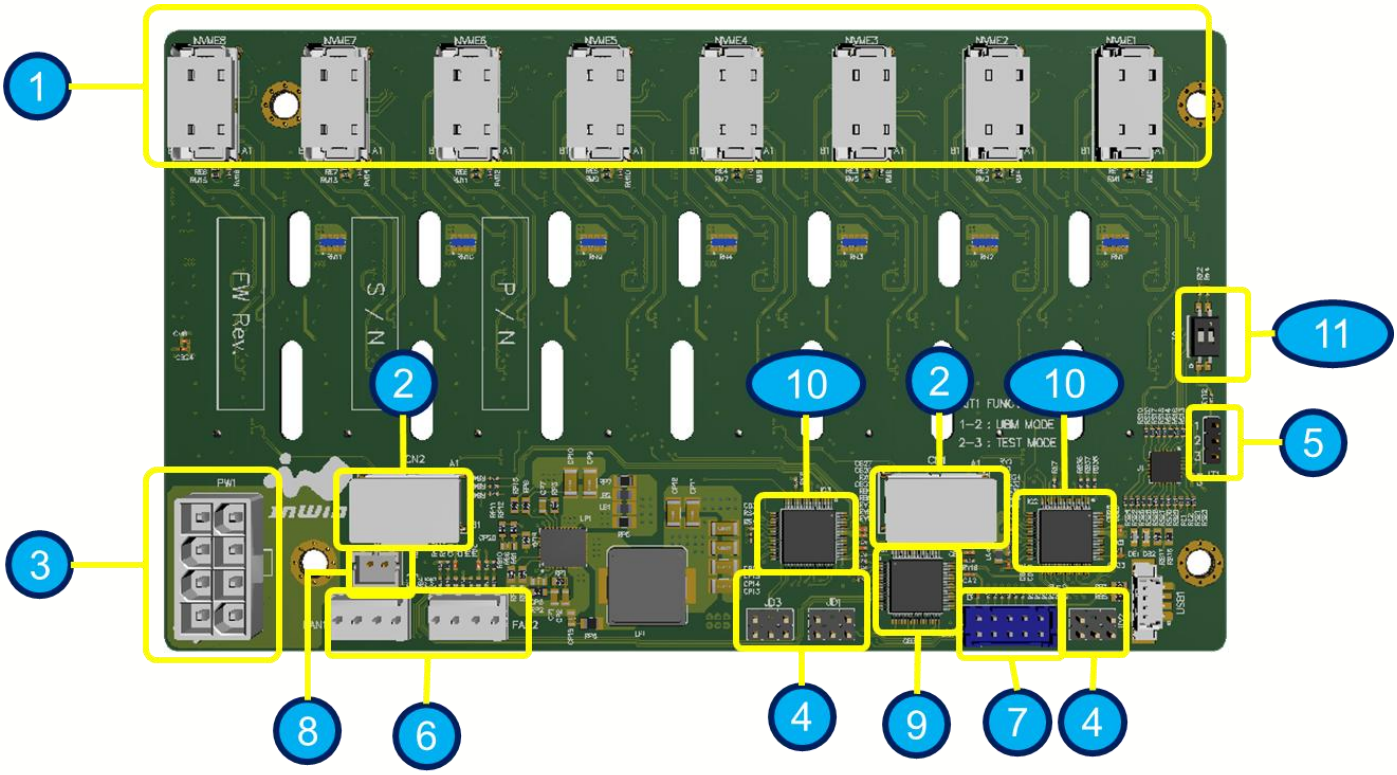
Hardware Specification

HOST Interface ： SlimSAS 4i (SFF-8654)/MCIO 4i

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

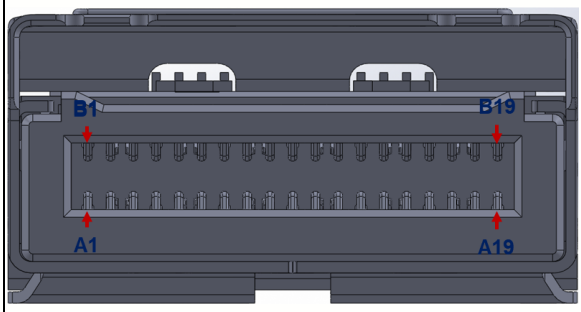
- Indicator ：
  - Power LED (PD1~PD8) : Blue –(When HDD is resent)
  - Dual color(Green/Red) LED D1~D8 for Hard Disk Drive Status (Activity/Fail/Locate)
  - Activity LED: Green (When HDD is Access)
  - Fail/Locate LED: Red (When HDD Fail or Locate)
- Environment Control:
  - PWM FAN Connector (FAN1~FAN2) for Cooling system.
  - Temperature Sensor (RTB1/RTB2) Monitor HDD Bay inside temperature.
- High Speed Connector
  - SlimSAS 4i (SFF-8654) Connector *2 (CN1/CN2)
    - One SlimSAS 4i connector can support up to 4 SAS4 disk bays. All the connectors are directly wired to the 68-pin disk connectors (S1~S7).
      - CN1 directly wired to DISK1~DISK4.
      - CN2 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：
  - P4.2mm 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



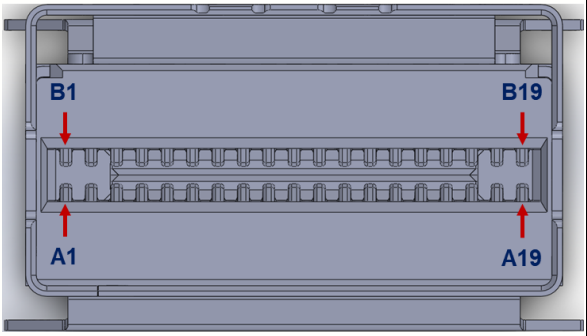
No	Description	No	Description
1	Host facing interface : NVME1~NVME8	7	BMC_SMBUS Connector : JM1
2	Host facing interface (SAS3) : CN1/CN2	8	M/S Communication Connector : JB1
3	Main Power Connector ： PW1	9	Micro-controller-Master : IC1
4	Firmware Programming Header ： JD1~JD4	10	Micro-controller-Slave1~2 : IC2~IC3
5	Multi-Function Selection : JT1	11	BP_NO.Selection SW : S1
6	FAN Connector : FAN1~FAN2		

Connector Pin Definitions.

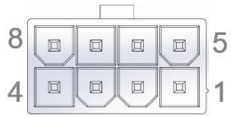


NVME1~NVME12			
Signal Name	Pin No.	Signal Name	Pin No.
PET0_[p/n]	B2/B3	PER0_[p/n]	A2/A3
PET1_[p/n]	B5/B6	PER1_[p/n]	A5/A6
PET2_[p/n]	B14/B15	PER2_[p/n]	A14/A15
PET3_[p/n]	B17/B18	PER3_[p/n]	B17/B18
GND : B1/B4/B7/B13/B16/B19/A1/A4/A7/A13/A16/A19			
Signal Name	Pin No.	Signal Name	Pin No.
BP_Type/Wake#	B8/B9	PERST#	A11
RefClk[p/n]	B11/B12	SMB_CLK/DAT	A8/A9
Sideband_GND : A10/B10			

SFF-8654 SlimSAS 4i Connector

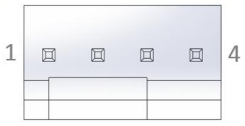


CN1/CN2/CN3			
Signal Name	Pin No.	Signal Name	Pin No.
SAS_TX0_[p/n]	B2/B3	SAS_RX0_[p/n]	A2/A3
SAS_TX1_[p/n]	B5/B6	SAS_RX1_[p/n]	A5/A6
SAS_TX2_[p/n]	B14/B15	SAS_RX2_[p/n]	A14/A15
SAS_TX3_[p/n]	B17/B18	SAS_RX3_[p/n]	B17/B18
SAS_GND	A1/A4/A7/A10/A13/A16/A19		
SAS_GND	B1/B4/B7/B10/B13/B16/B19		
Sideband Definition :			
S0_SClock: A8, S1_SLoad: A9, S4_DataOut: B12,			
S5_DataIn: B12 ,S6/S7 Reserved: A12/B8,			
S2_GND: A11, S3_GND: B9,			

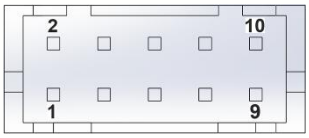
PW1	Power 2*4-Pin Connector	
	PIN #	Definition
	1~4	Ground
	5~8	+12V

JD1~JD4	Firmware Programming Header			
	PIN #	Definition	PIN No#	Definition
	1	VCC	2	ICE_CLK
	3	#Key	4	ICE_DATA
	5	Ground	6	ICE_RST

JT1	Multi-Function Header	
	PIN #	Definition
	1	UBM MODE
	2	MODE_SEL
	3	TSET_MODE
JT1 Function Description: Pin#1-Pin#2 Short for UBM Mode. Pin#2-Pin#3 Short for TEST Mode Floating : VPP/SHP Mode		

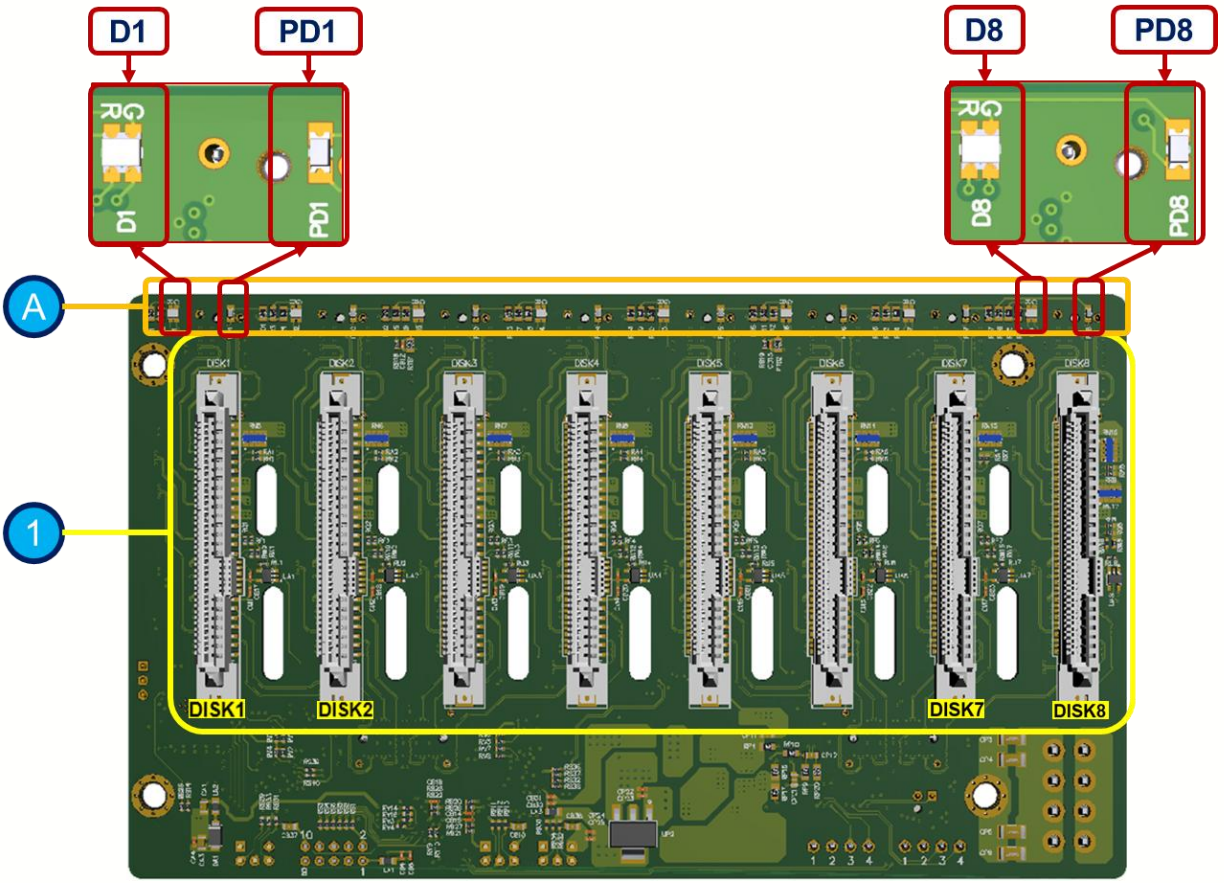
FAN1~FAN2	FAN 4-Pin Connector	
	PIN #	Definition
	1	Ground
	2	+12V
	3	Tachometer
	4	PWM Output

JM1	M/S Communication Connector	
	PIN #	Definition
	1	EXT_SYNC1
	2	EXT_SYNC2

JM1	BMC_SMBUS Connector			
	PIN #	Definition	PIN #	Definition
	1	VCC	2	VCC
	3	Clock1	4	Clock2
	5	Data1	6	Data2
	7	Alert1	8	Alert2
	9	Ground	1	Ground

S1 M/S Selection	Function Description	S1 M/S Selection	Function Description
	11 : BP_MASTER		10 : BP_slave2
	01 : BP_slave1		00 : BP_slave3

Device Connector & LED Indicators.

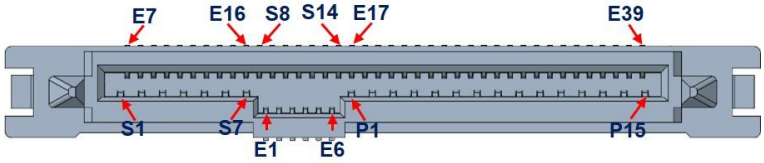


No	Location	Description
1	DISK1~DISK8	NVMe SSD or SATA/SAS Disk #1~#8

No	Location	Description	Location	Description
A	PD1~PD8	DISK1~DISK8 Power LED	D1~D8	DISK1~DISK8 Activity/Failure LED

DISK1~DISK8

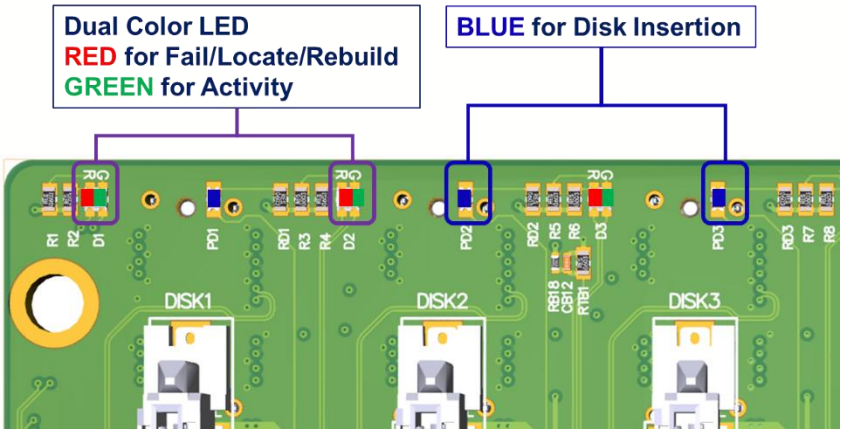
SFF-8639 (U.2) Connector



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

LED Behavior

Disk Bay LED



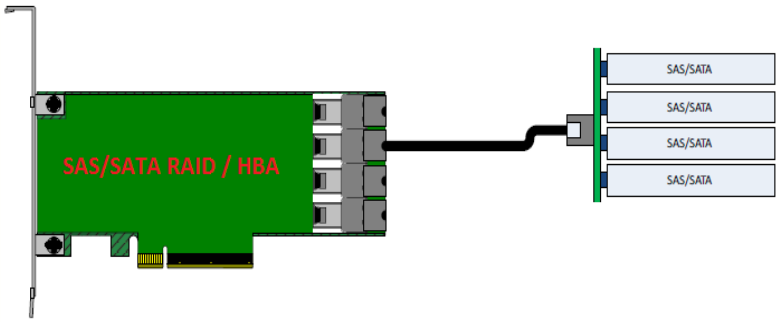
Blue LED:
Disk Insertion Indicator –
Turned on whenever disk drive is properly installed.

Green LED:
Activity indicator –
Stay off when idle and blinking (~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.

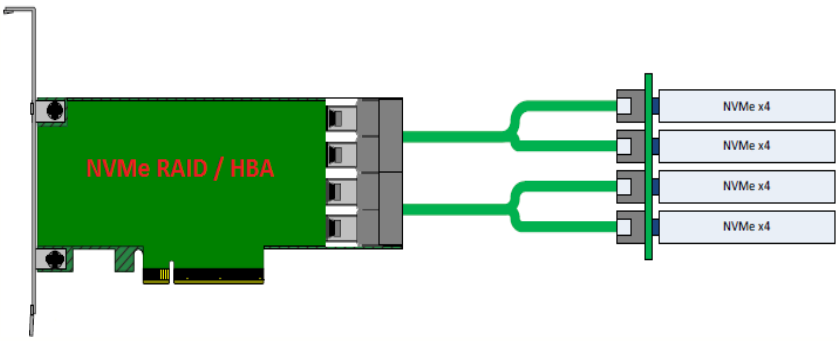
There are 2 parts of LED Management on the backplane. One is for SAS and another is for NVMe. Please note that the disk slots can only accommodate SAS/SATA or NVMe disk at a time since they share the same disk connector.

For SAS application, The LEDs behave by following SGPIO signal coming through sideband bus inside the SFF-8654(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.



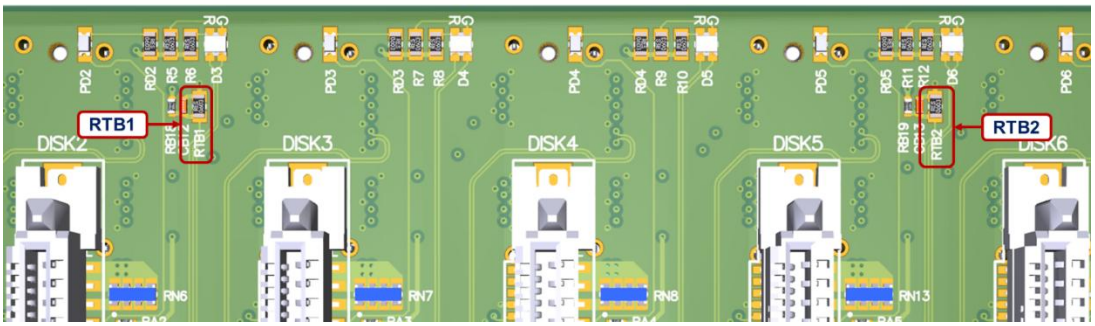
For NVMe application, The LEDs behave according to the VPP over I2C signals from NVMe host controllers through sideband bus of MCIO8i to MCIO4i *2 cables. Whenever the NVMe host controller support VPP over I2C, the RED LEDs behave Locate, Fail and Rebuild signals following VPP signals on the I2C bus. 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 (MCIO4i) 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.

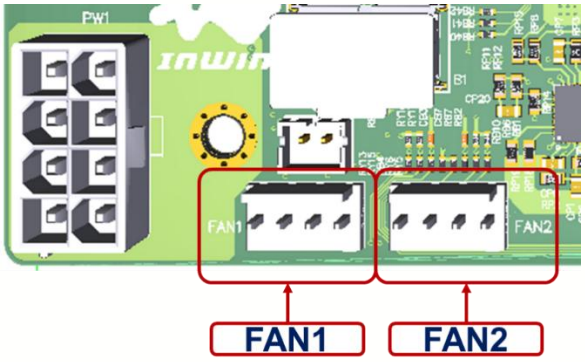


Smart Fan Control

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) 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

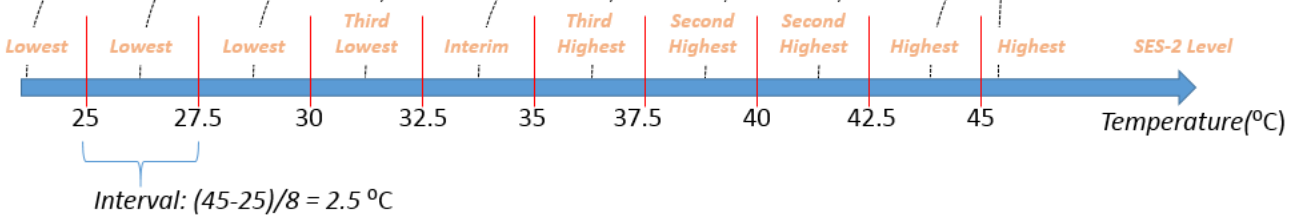
PWM Level Table

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



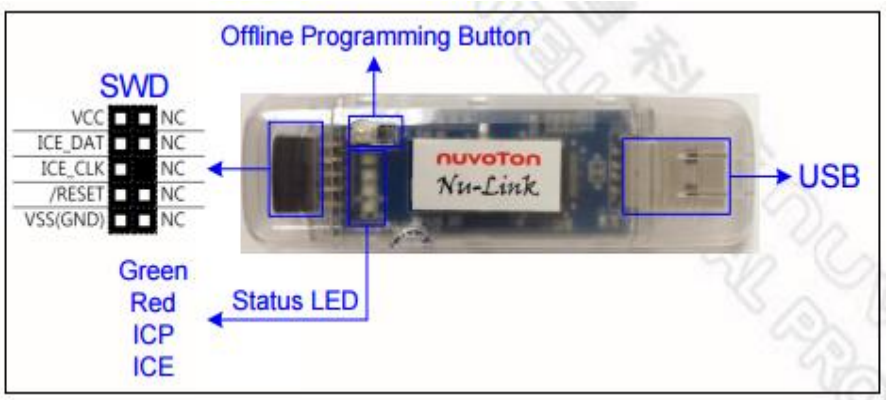
Interval: (45-25)/8 = 2.5 °C

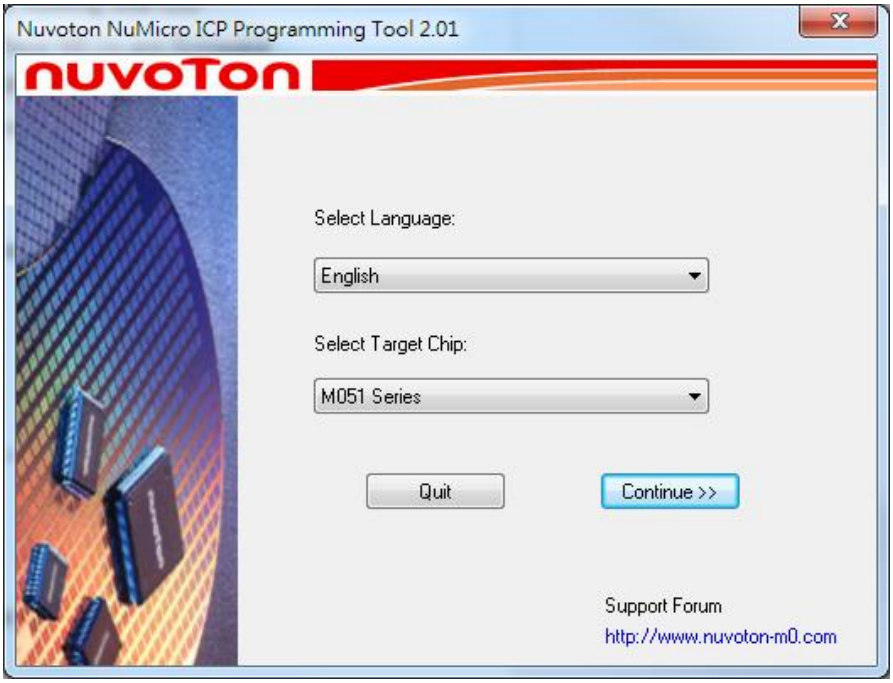
Firmware Upgrade

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.

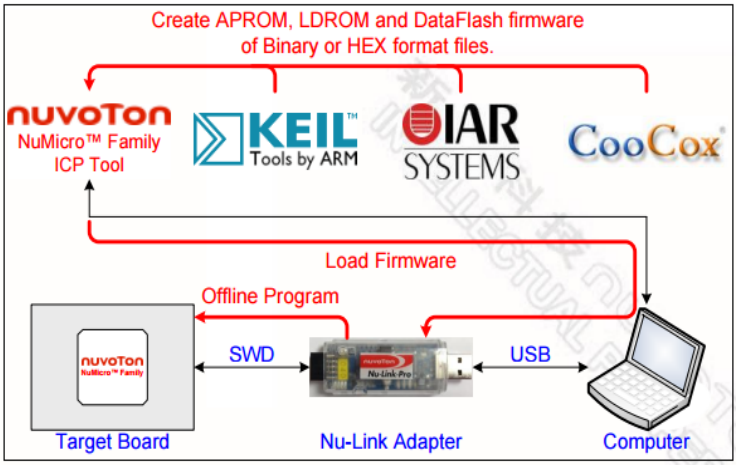
How to upgrade firmware?

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

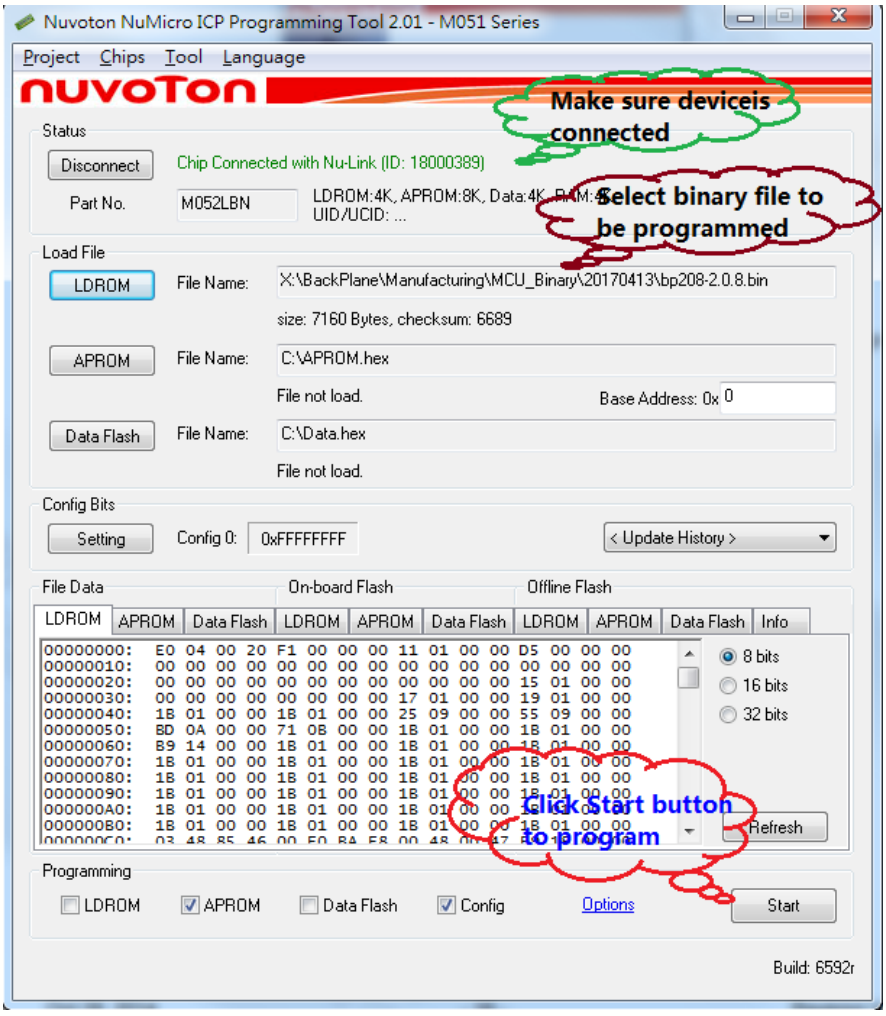




2. Connect Nu-Link USB end to a host and the SWD end to Backplane ICE connector for each MCU.



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.