

## InWin 07 Series

### Purley Platform

## Passive SAS/SATA Backplane User Manual

### Supported Devices

| Part Number  | Description                                     |
|--------------|-------------------------------------------------|
| 3RAMVI007000 | IW-RS104-07 PASSIVE BACKPLANE MODULE (SAS Only) |
| 2RAKVI001900 | IW-RS104-07 HYBRID-OCULINK 4BAY BP              |
| 2RAKVI002000 | IW-RS104-07 HYBRID-SLIMSAS 4BAY BP              |
| 2RAKVI002100 | IW-RS110-07 HYBRID-OCULINK 12BAY BP             |
| 2RAKVI002200 | IW-RS110-07 HYBRID-SLIMSAS 12BAY BP             |

Version: 0.3

## History

| Version | Changes                                   | Date      |
|---------|-------------------------------------------|-----------|
| 0.1     | First draft                               | 2018/1/16 |
| 0.2     | Change description according to HW change | 2018/8/15 |
| 0.3     | Added detailed LED Management Description | 2018/8/20 |

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# 1 Overview

InWin backplanes (without Expander) are high performance and cost effective solution for supporting Intel Purley platform by adding NVMe support.

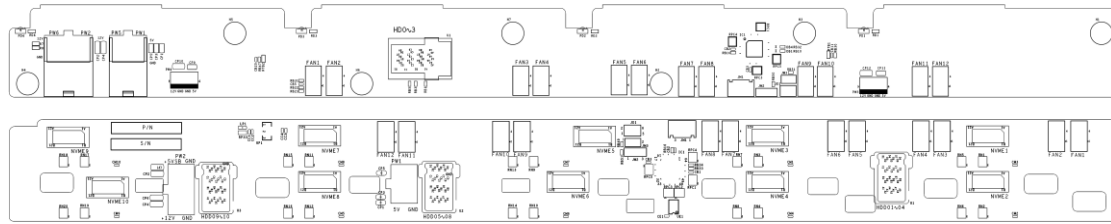
The passive backplanes support state-of-the art SAS3 12Gbps HDD/SSD and also backward compatible with SAS 6Gbps, SATA 6Gps and SATA 3Gps HDD/SSD. Some of the backplanes support NVMe SSD through either OcuLink x4 or SlimSAS x4 connectors.

Basically, one single SFF-8643 miniSAS connector can support up to 4 disk bays. Some SKUs of backplane has 4 \* OcuLink/SlimSAS connectors and 4 \* U.2 connectors to accommodate 4 \* 2.5" NVMe SSDs per each backplane.

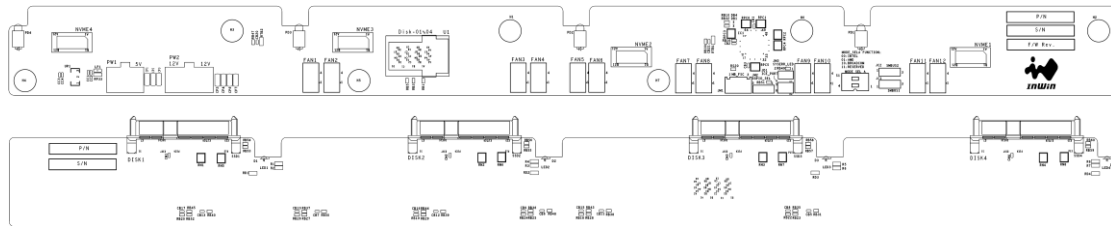
There are 12 pcs Fan connectors on backplane to support up to 12 pcs of Fan modules as enclosure cooling system. It is implemented with smart fan control feature to support wide variety of fan modules by auto-calibrating the installed fan modules at system boot. This feature provides an efficient way to 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 and beeping the buzzer at the same time. Users can then informed of issue and take corresponding actions to resolve the issue according to the failure type. As soon as the issue disappears the alarm stops.

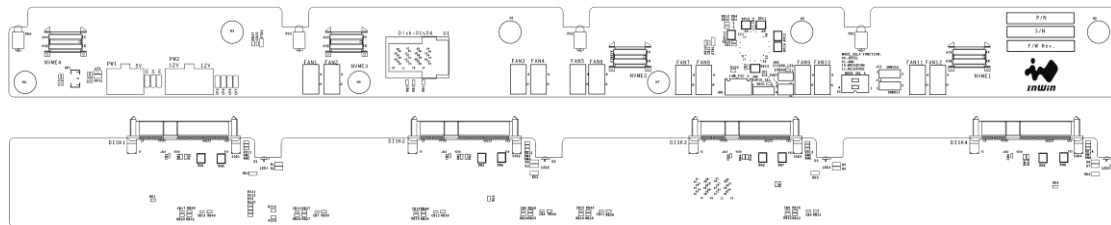
### IW-RS104-07 SAS Only BP



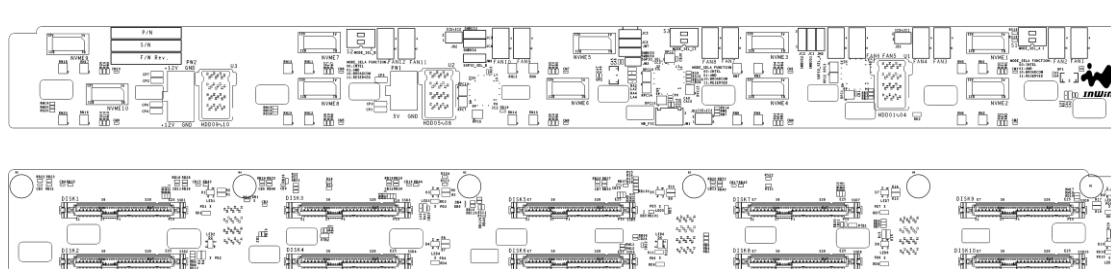
### IW-RS104-07 SAS/NVMe Hybrid BP (Oculink)



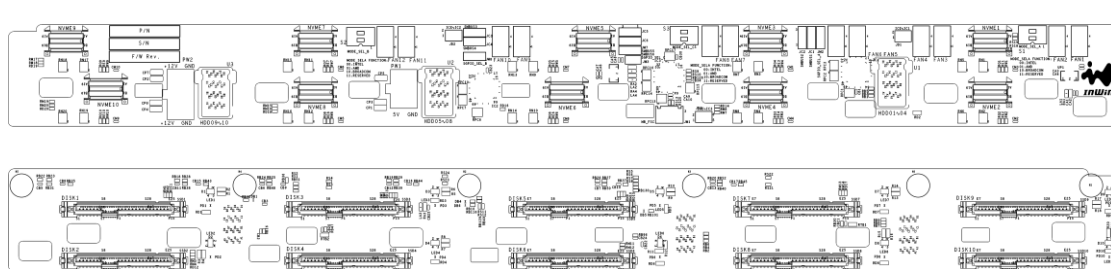
### IW-RS104-07 SAS/NVMe Hybrid BP (SlimSAS)



### IW-RS110-07 SAS/NVMe Hybrid BP (Oculink)



### IW-RS110-07 SAS/NVMe Hybrid BP (SlimSAS)



## 2 Jumper Settings

Jumpers on backplane are for function configuration setting or failure indication purpose.

The definitions of the Jumpers on the backplane are as below.

| Jumper Name | Function               |          | Details                                                                                                                                                                                                                                                                                                            | Model                      |
|-------------|------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| JD1         | MCU Programming Header |          | For Programming MCU Firmware                                                                                                                                                                                                                                                                                       | IW-RS104-07<br>IW-RS110-07 |
| JM3         | Setting                | Function | <p>FAN FAIL:<br/>LED blinks in 0.5Hz(1s on and 1s off) when the fan module speed is going down below 75% of its expected RPM</p> <p>OVER-TEMP:<br/>LED blinks in 2Hz(0.25s on and 0.25s off) when the temperature on backplane is <math>\geq 45^{\circ}\text{C}</math></p> <p>Both Failures:<br/>LED steady ON</p> | IW-RS104-07<br>IW-RS110-07 |
| JM2         | Setting                | Function | <p>Enable:<br/>Disk RED LEDs behave following SGPIO signal from RAID/HBA.</p> <p>Disabled:<br/>Disk RED LEDs does not function.</p> <p>Note:<br/>SGPIO setting is for SAS only.</p>                                                                                                                                | IW-RS104-07<br>IW-RS110-07 |

|                |                                                                               |            |                                                                                                                                                                    |                            |
|----------------|-------------------------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| JM1            | Pin                                                                           | Function   | JM1 allows external PWM source input to backplane.                                                                                                                 | IW-RS104-07                |
|                | 1                                                                             | PWM input  |                                                                                                                                                                    | IW-RS110-07                |
|                | 2                                                                             | RPM output | Smart Fan Control module generates higher PWM value to fan modules by detecting the external PWM and comparing with the calculated PWM level.                      |                            |
|                | 3                                                                             | GND        | This feature enables a way for backplane to collaborate with Motherboard conducting best thermal solution when Fan modules are connected to backplane.             |                            |
| FAN1 ~ FAN12   | For connecting to Fan Modules.<br>The backplane supports up to 12 Fan modules |            | Fan modules connected to backplane are controlled by onboard MCU. Smart Fan Control feature is implemented to provide efficient Fan control.                       | IW-RS104-07<br>IW-RS110-07 |
| NVME1 ~ NVME10 | NVMe interfaces for connecting to NVMe HBA.                                   |            | 2 types of NVMe interfaces to opt for accommodating the system need.<br><br>x4 Oculink or x4 SlimSAS can be selected. Each NVMe interface support one x4 NVMe SSD. | IW-RS110-07                |

## 3 Connectors

### 3.1 Disk Slot Connector

The Backplane is equipped with numbers of disk connectors (SFF-8482/SFF-8639(aka U.2)) supporting SATA 3G, 6G, SAS 6G and 12G HDD/SSD for pure SAS SKU. And, further supporting NVMe for SAS/NVMe Hybrid SKU.

Different model equipped with different type and different number of disk slot connectors according to design and application. Please refer to below tables.

| Model                | Disk Slot | Backplane Type  | Supported Disk             |
|----------------------|-----------|-----------------|----------------------------|
| IW-RS104-07 / SAS    | 4         | Horizontal Type | SATA, SAS (SFF-8482)       |
| IW-RS104-07 / Hybrid | 4         | Horizontal Type | SATA, SAS, NVMe (SFF-8639) |
| IW-RS110-07 / Hyhrid | 10        | Vertical Type   | SATA, SAS, NVMe (SFF-8639) |

| Name              | Function                                 | Details                                                                                                                                                                                                                                                                                                                                                  |                                    |
|-------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Disk1 ~<br>Disk10 | Connecting SATA/SAS HDD/SSD or NVMe SSD. | <p>For IW-RS104-07:<br/>SAS only SKU -<br/>4 * SFF-8482 connectors to support up to 4 SATA/SAS HDD/SSD.</p> <p>Hybrid SKU -<br/>4 * SFF-8639 connectors to support up to 4 SATA/SAS HDD/SSD or NVMe SSD.</p> <p>For IW-RS110-07:<br/>10 * U.2(SFF-8639) connectors to support SATA/SAS/NVMe disks.</p> <p>SATA/SAS is routed to SFF-8643 miniSAS-HD.</p> | <p>IW-RS104-07<br/>IW-RS110-07</p> |

|                   |                                                             |                                                                                                                                                                    |                            |
|-------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
|                   |                                                             | NVMe is routed to Oculink/SlimSAS connector.                                                                                                                       |                            |
| NVME1 ~<br>NVME10 | NVMe interfaces for connecting to NVMe HBA/RAID Controller. | 2 types of NVMe interfaces to choose for accommodating the system need.<br><br>x4 Oculink or x4 SlimSAS can be selected. Each NVMe interface support one NVMe SSD. | IW-RS104-07<br>IW-RS110-07 |
|                   |                                                             |                                                                                                                                                                    |                            |

### 3.2 SFF-8643 Mini-SAS connector:

Different model of backplane is equipped with different number of miniSAS connector. All the backplanes support data access speed up to 12Gbps SAS3.

All the miniSAS connectors are directly wired to the disk slot connectors. Each miniSAS connector supports up to 4 disks

| Model       | Number of miniSAS HD | Note                                             |
|-------------|----------------------|--------------------------------------------------|
| IW-RS104-07 | 1                    |                                                  |
| IW-RS110-07 | 3                    | 3 <sup>rd</sup> miniSAS HD support 2 disks only. |

### 3.3 Power Receptacle

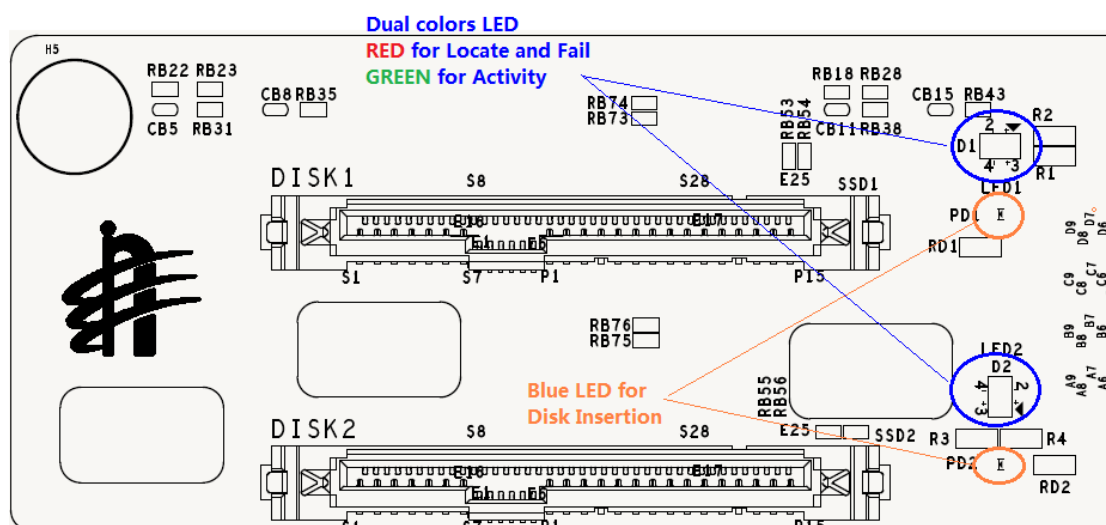
2 power connector implementation. One for 5Vdc and another for 12Vdc

| Model       | Number of Power connector | Note                          |
|-------------|---------------------------|-------------------------------|
| IW-RS104-07 | 2                         | 2*4 for 12Vdc<br>2*3 for 5Vdc |
| IW-RS110-07 | 2                         | 2*4 for 12Vdc<br>2*3 for 5Vdc |

## 4 LED Behavior

### 4.1 Disk Bay LED

There are 3 colors of LEDs for each bay to indicate HDD status by illuminating in different color and format.



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.

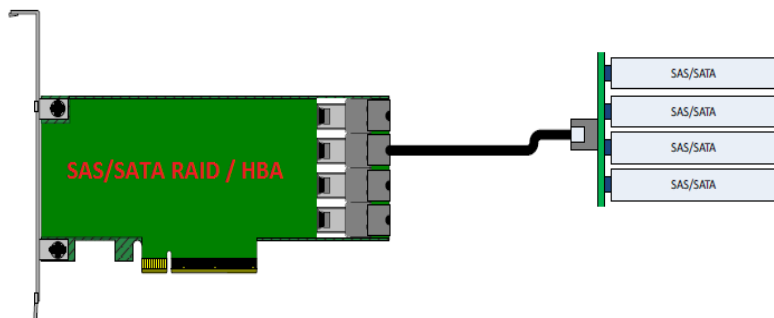
RED LED:

Fail and Locate indicator –

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

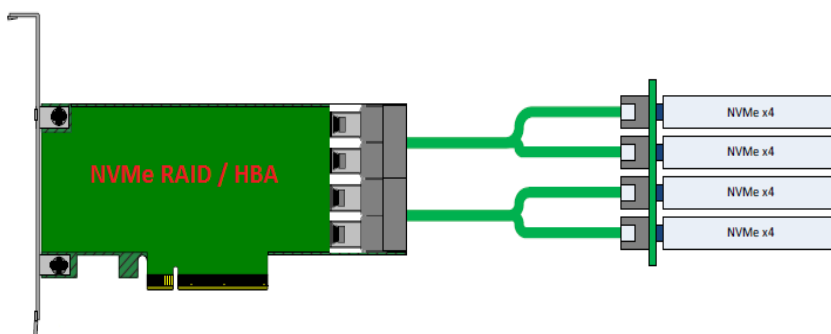
There are 2 parts of LED Management on the backplane. One is for SAS and another is for NVMe. Please note that the disk slots can only accommodate SAS/SATA or NVMe disk at a time since they share the same disk connector.

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.



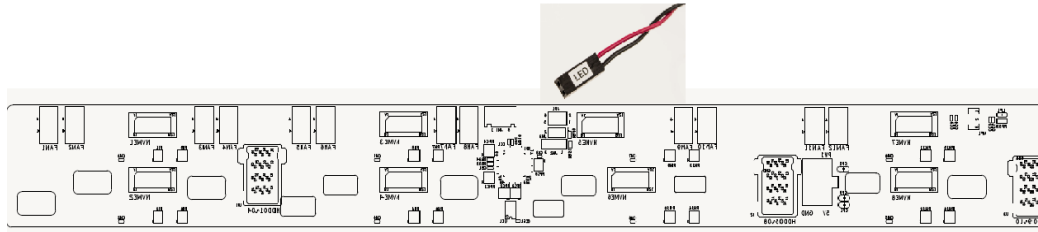
For NVMe application, The LEDs behave according to the VPP over I2C signals from NVMe host controllers through sideband bus of Oculink or SlimSAS cables. Whenever the NVMe host controller support VPP over I2C, the RED LEDs behave Locate, Fail and Rebuild signals following VPP signals on the I2C bus.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



## 4.2 System Alarm LED

There is a FAIL LED design on the Backplane to indicate Fan Fail and Over-Temperature. Lead 2.5mm 2-pin jumper JM3 (1/+, 2/-) 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:

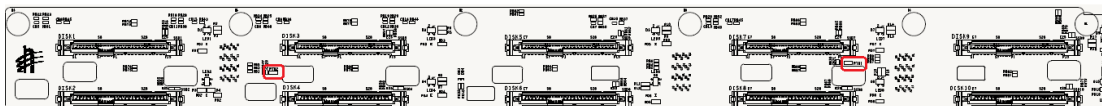
When the system temperature at the backplane area is going beyond 45°C the Temp Fail triggered and Fail LED blinks in 2Hz rate. Goes off when temperature is going under 45°C.

### Overheat & Fan Fail:

Fail LED stays steady on when both events triggered at the same time.

## 5. Smart Fan Control

InWin's Backplane is designed with 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 2 thermal sensors on the backplane.

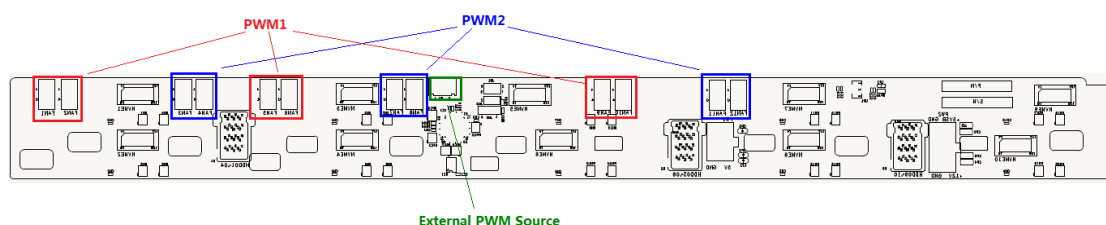


Two PWM sources onboard to control 12 fan modules. An external PWM source (From Motherboard) as a reference input for determining the output PWM duty cycle when it is connected.

PWM source of Fan modules are list as below. There are 2 PWM sources from MCU.

PWM1: Fan1, 2, 5, 6, 9, 10

PWM2: Fan3, 4, 7, 8, 11, 12

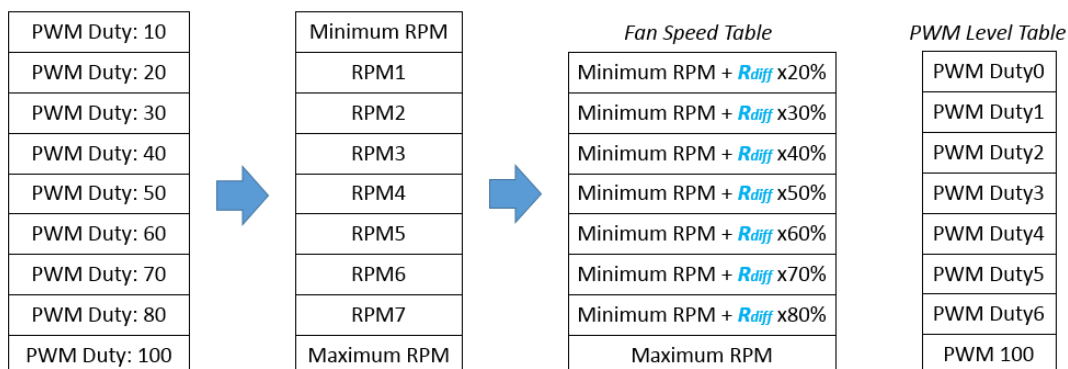


How it works?

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 °C 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.

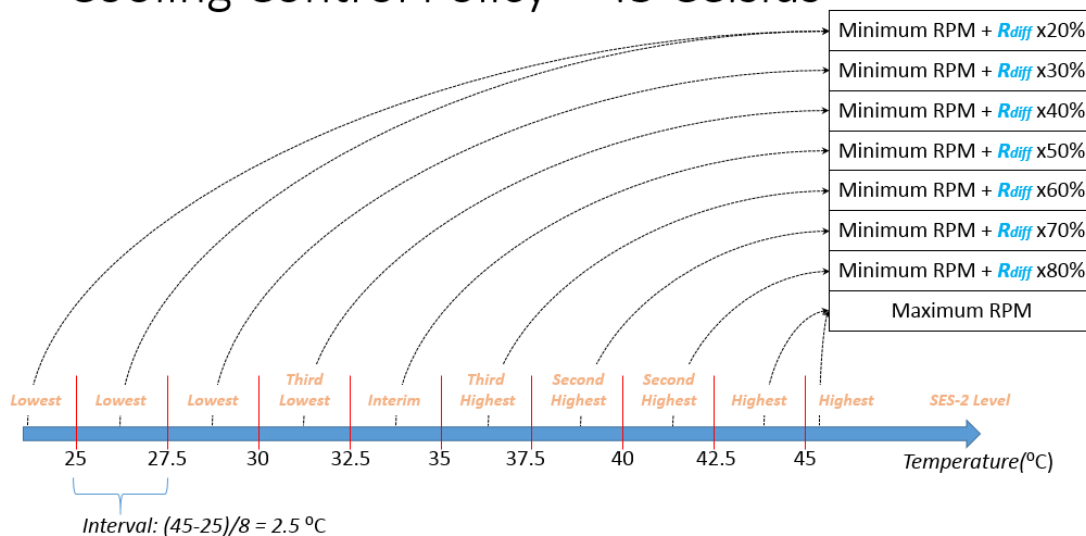
## Fan Speed Measurement

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



# Cooling Control Policy – 45 Celsius

Fan Speed Table

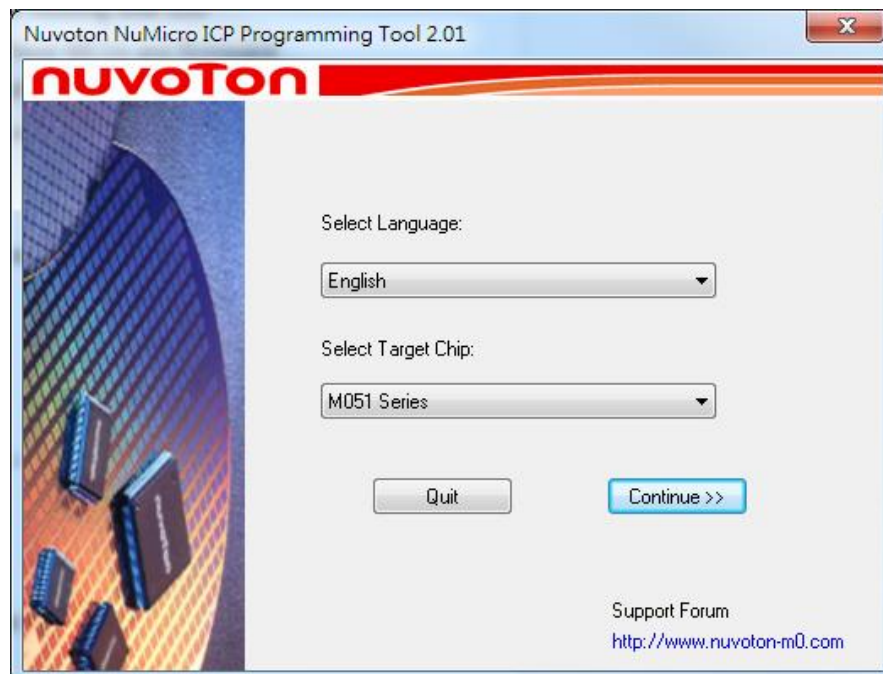


## 6. Firmware Upgrade

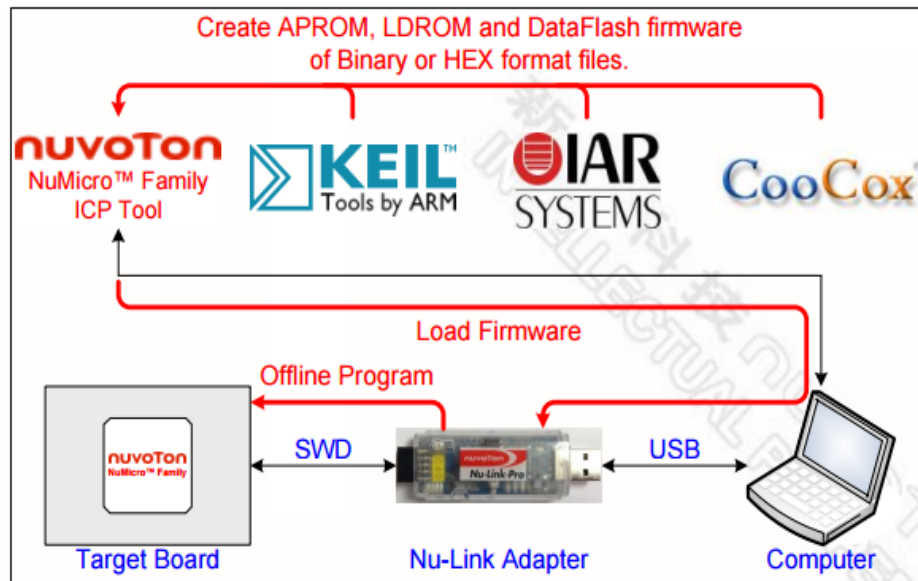
The passive backplanes are planted Nuvoton M058 series MCUs for hosting disk LED indication, Fan speed control and system fail alarm. These MCUs are preprogrammed in manufacturing. In most cases, the MCUs are not required to reprogram unless there is issue needed to fix.

How to upgrade firmware?

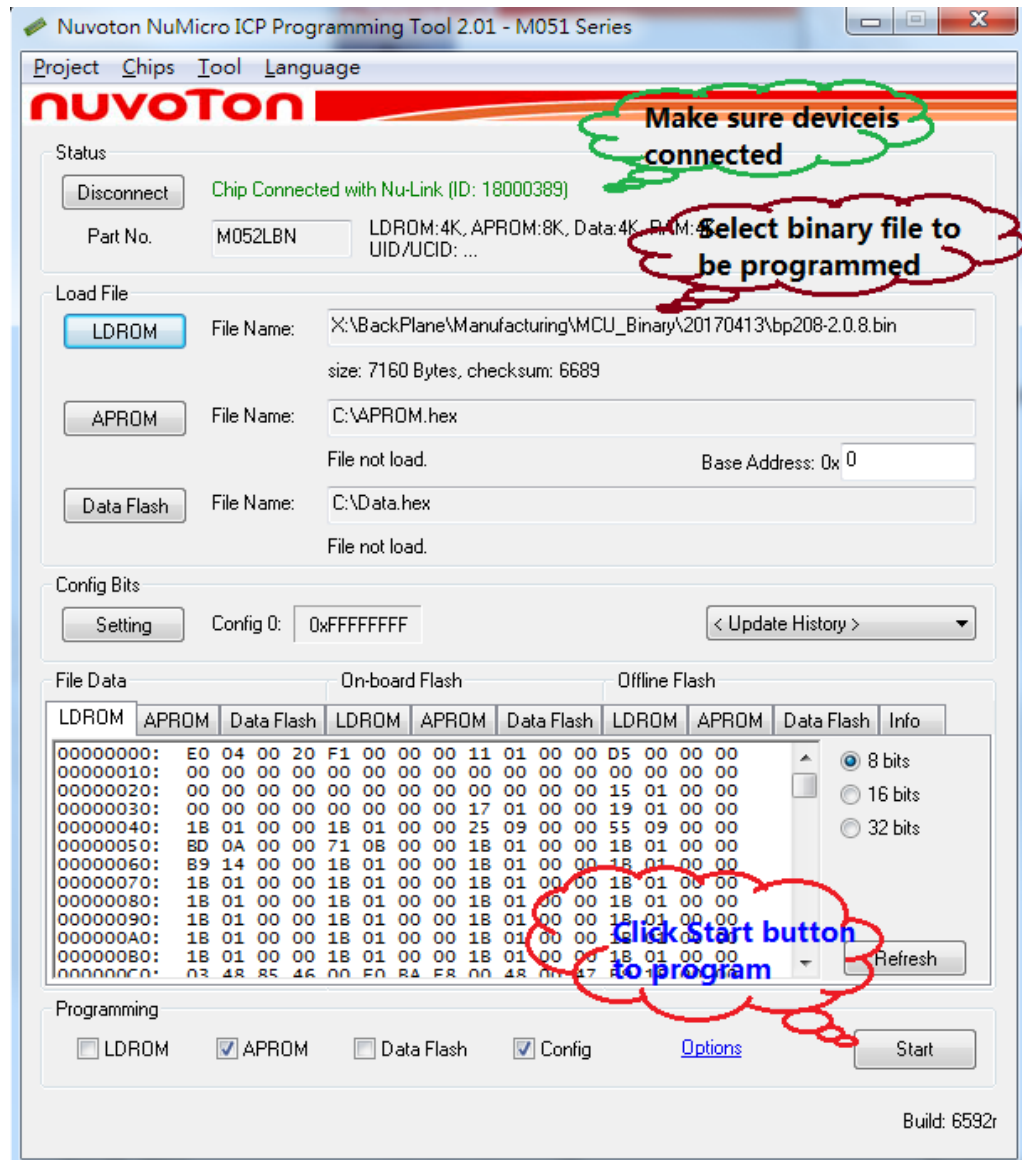
1. Require Nuvoton ARM Cortex-M0 programming tool. Nu-Me or Nu-Link and install Nuvoton ICP Programming tool software.



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](http://www.nuvoton.com/resource-files/NuLink_Adapter_User_Manual_EN_V1.01.pdf) for more details.