

SAS3 12Gbps BP with Expander User Manual

Cobra Series

02M and 07 Series

Supported Devices

Part Number	Description
2RAKVI000800	IW-RS212-02M SAS3 EXP BACK PLANE MODULE
2RAKVI000900	IW-RS316-02M SAS3 EXP BACK PLANE MODULE
2RAKVI000700	IW-RS424-02M SAS3 EXP BACK PLANE MODULE
2RAKVI002300	IW-RS212-07 12BAY BP-EXP OCULINK MODULE
2RAKVI002400	IW-RS212-07 12BAY BP-EXP SLIMSAS MODULE
2RAKVI004000	IW-RS316-07 HYBRID OCULINK*8 BP
2RAKVI004100	IW-RS316-07 HYBRID SLIMSAS*8 BP
2RAKVI004200	IW-RS424-07 HYBRID OCULINK*8 BP
2RAKVI004300	IW-RS424-07 HYBRID SLIMSAS*8 BP

Version: 0.9

History

Version	Changes	Date
0.1	First draft	2017/2/16
0.2	Added Firmware Upgrade Procedures	2017/2/18
0.3	Added supported parts and wide-port operation mode for IW-RS212-02M	2017/2/20
0.4	Modify Fan Control contents	2017/2/21
0.5	Wording modification and Fan control behavior change.	2017/4/12
0.6	Added firmware upgrade through in band connection.	2017/6/5
0.7	Remove fan control manual learning description to prevent misuse.	2017/8/1
0.8	Added supported device 2RAKVI002300 and 2RAKVI002400	2018/8/27
0.9	Added support devices 2RAKVI004000, 2RAKVI004100, 2RAKVI004200, 2RAKVI004200	2019/6/18

Table Of Contents

1	Overview.....	4
2	Jumper Settings	7
3	Connectors	8
3.1	29-pin SAS HDD connector.....	8
3.2	SFF-8639(U.2) Disk Connector	9
3.3	SFF-8643 Mini-SAS connector:.....	10
3.4	Oculink and SlimSAS Connector	11
3.5	Power Receptacle	12
4	LED and Buzzer Behavior	14
4.1	Disk Bay LED	14
4.2	System Alarm LED	17
4.3	System ID LED	18
5.	Smart Fan Control.....	19
6.	Firmware Upgrade.....	22
6.1	Out-Of-Band through serial console	23
6.2	In Band through SES Command	26
7.	Management	28

1 Overview

InWin's 12G SAS3 Backplanes equipped with LSI 3x36R Expander provide an industry leading high performance and high stability of data transfer for storage server solution.

The backplanes support state-of-the art SAS3 12Gbps HDD/SSD and also backward compatible with SAS 6Gbps, SATA 6Gps and SATA 3Gps HDD/SSD.

There are 2 or 3 miniSAS wide ports on each backplane. 1 or 2 of them are defined as host ports for connecting to RAID/HBA cards and the other is defined as the cascade port for connecting to another backplane and/or storage enclosure (JBOD) by extending it to the rear panel of the chassis through a SFF-8643 to SFF8644 cable.

6 to 10 pieces of 4-Pin 12v/5v power receptacles support up to 50A current to satisfy the power needs of fully loaded HDDs (12 to 24 HDDs depends on backplane model).

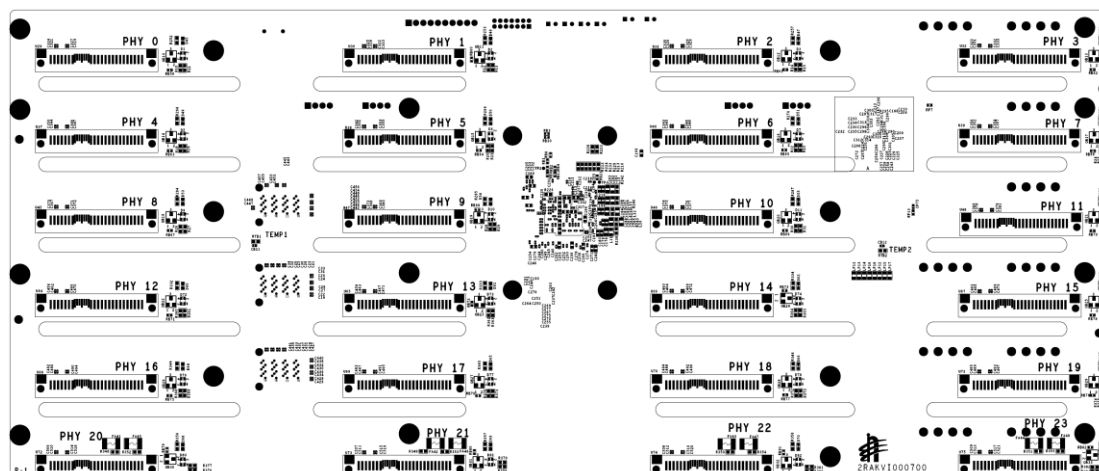
The backplane is implemented with smart fan control feature to support wide variety of fan modules by auto-calibrating the installed modules at system booting up. This feature provides an efficient way to control the thermal heat exhaustion by sensing the heat in the enclosure.

Along with the smart fan control feature, a system alarming feature is also implemented to alert users in case Fan module failure and system overheat occurs by illuminating the LED indicator and sounding the alarm.

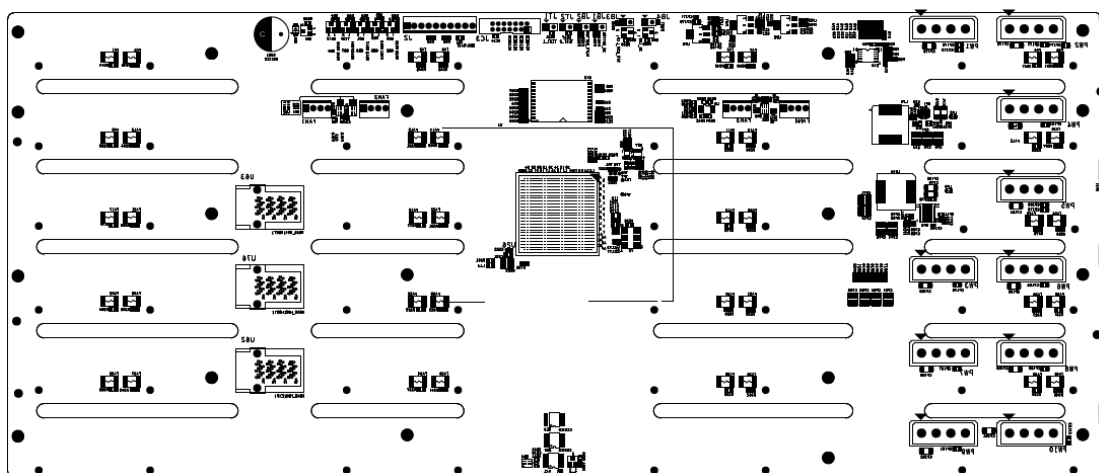
Below the views of the backplane.

IW-RS424-02M

Top view

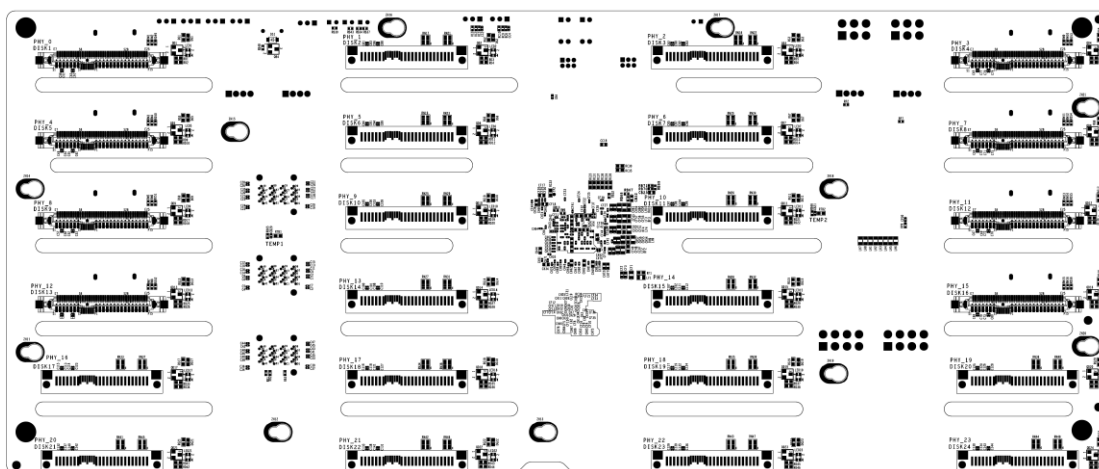


Bottom view

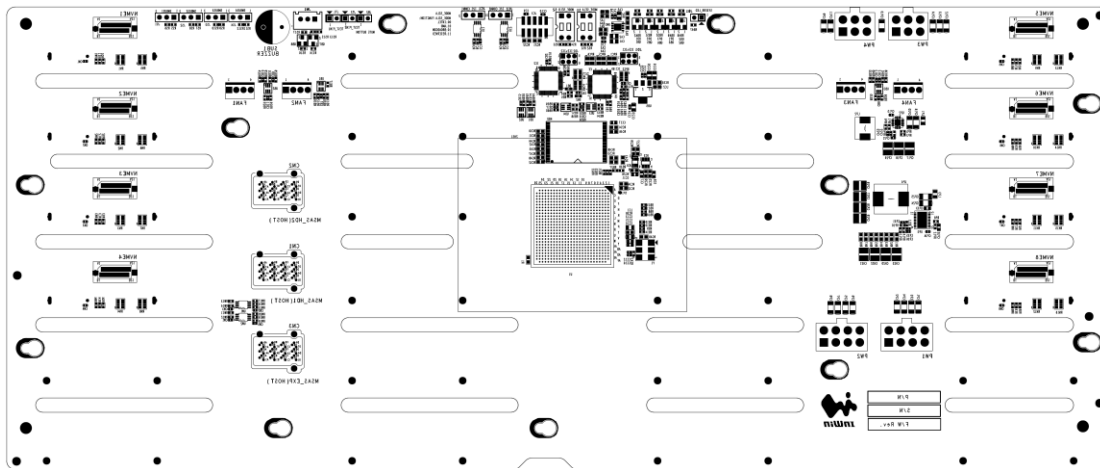


IW-RS424-07

Top View



Bottom View

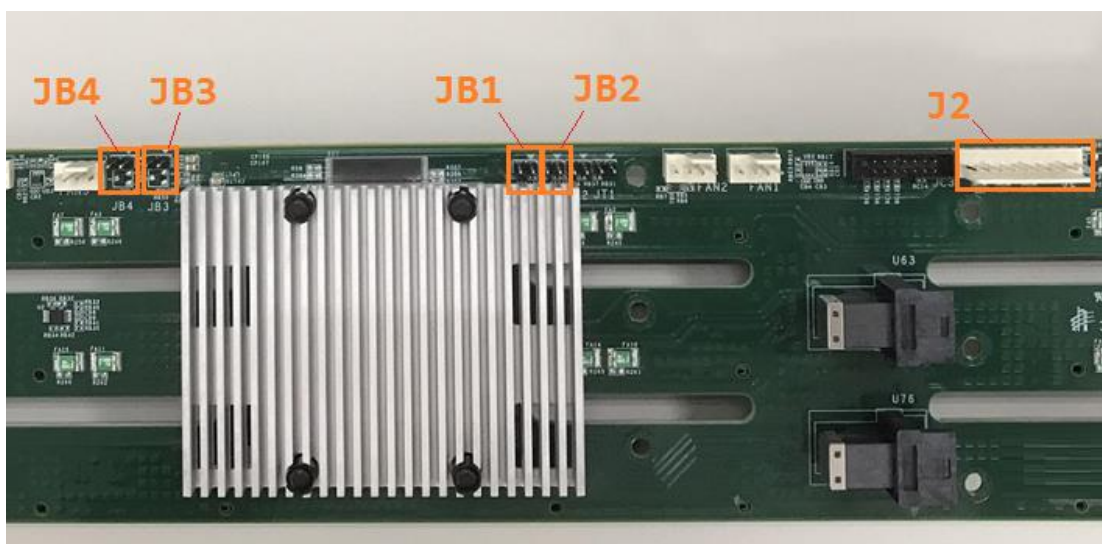


2 Jumper Settings

System indicators and buttons designed for chassis by connecting 2-wire cable from the front panel (if existed) to the jumpers on the backplane accordingly to facilitate the alarm system.

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

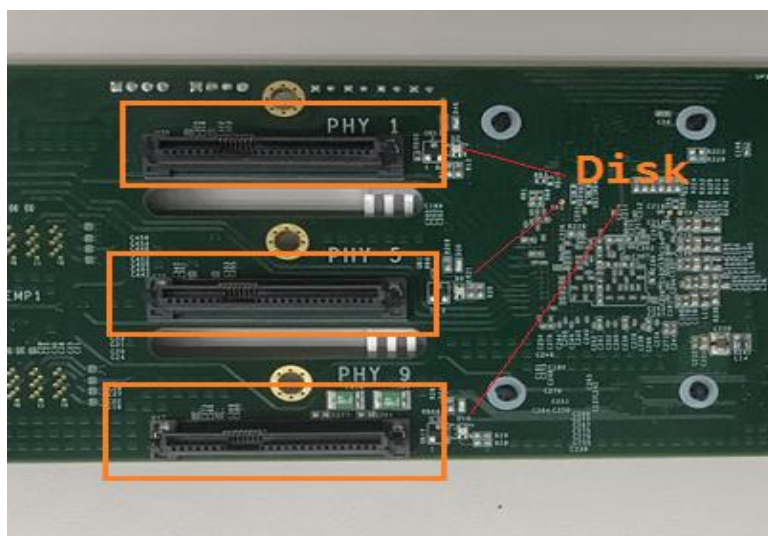
Jumper Name	Print	Function
JB1	ID_BUTTON	To Turn on/off ID Indicator by toggling it
JB2	MUTE_BUTTON	To mute the warning beeping
JB3	SYS_ERR_LED	Turn on when system Fan fails or system over temperature
JB4	ID_LED	Turn on/off according to ID button toggling
J2	DBG/UART	Use for firmware upgrade and debugging purpose
JC1	DBG/UART	Use for firmware upgrade and debugging purpose (For IW-RS212-07)
JD1	MCU Prg Header	For programming onboard MCU FW
JM1/JM4	MB Fan	For connecting to MB 4-pin fan connector
S1	LED Mode Sel	For selecting NVMe LED Management mode



3 Connectors

3.1 29-pin SAS HDD connector

There are totally 8 to 24 pcs of 29-pin SAS HDD/SSD connectors to accommodate 8 to 24 SAS HDD/SSDs for the enclosure.

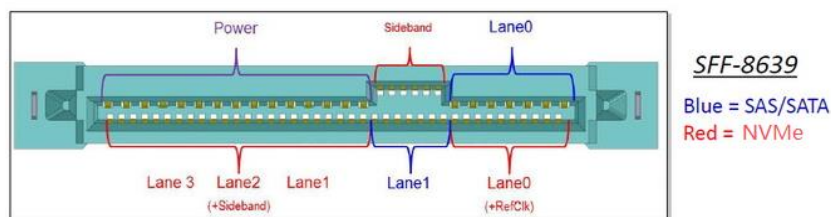


3.2 SFF-8639(U.2) Disk Connector

There are totally 4 pieces of SFF-8639 connectors to accommodate 4 SAS/SATA/NVMe SSDs. Please note that only xxx-07 equipped with SFF-8639 connectors for adapting SAS/SATA and NVMe hybrid design on specific disk slots. The so-called 'hybrid' meaning the disk slots support either SATA, SAS or NVMe disk at a time.

Below graphic demonstrates the pin definition of SFF-8639 connector.

- SFF-8639 includes 6 lanes, only 4 lanes are used at one time
 - PCIe: 4 red lanes on CPU PCIe lanes
 - SATA & SAS: 2 blue lanes on HBA/RAID controller or chipset
- Compatible with existing SATA and SAS devices

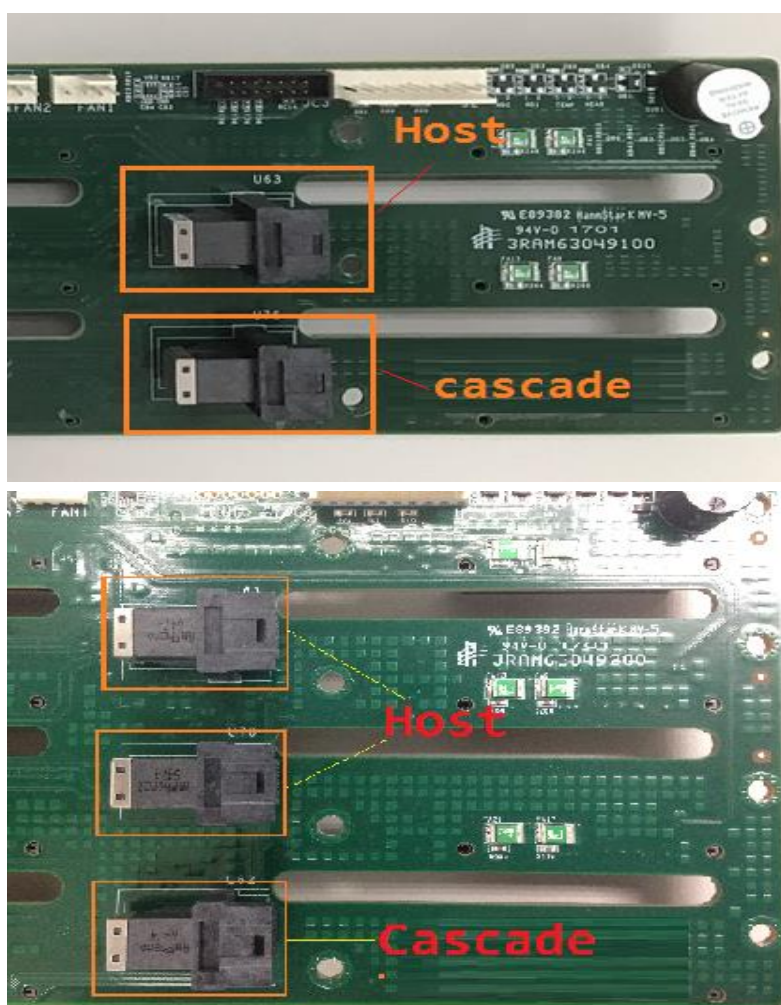


3.3 SFF-8643 Mini-SAS connector:

The backplane is equipped with 2 to 3 pieces of SFF-8643 female mini-SAS connectors. 1 or 2 are for connecting to host (RAID card/ HBA card) and the other for connecting to extra enclosure (JBOD) via the cascade port.

The upper ones – For host (RAID Card or HBA)

The lower one – For cascading to extra enclosure or backplane if applicable.



3.4 Oculink and SlimSAS Connector

Oculinkx4 and SlimSASx4 connectors are for connecting backplane to NVMe host controllers such as RAID/HBA card for setting up NVMe SSD access in the enclosure. Please note that only IW-RS212-07 backplanes are equipped with Oculinkx4 or SlimSASx4 connectors on specific ports. And, each Oculinkx4 or SlimSASx4 link supports a PCIe x4 NVMe SSD connection.

The mapping of the connectors are as below.

For IW-RS212-07 BP (Supports 4 * x4 NVMe)

NVMe1 → SSD1

NVMe2 → SSD4

NVMe3 → SSD5

NVMe4 → SSD8

For IW-RS316-07 and IW-RS424-07 (Support 8* x4 NVMe)

NVMe1 → SSD1

NVMe2 → SSD5

NVMe3 → SSD9

NVMe4 → SSD13

NVMe5 → SSD4

NVMe6 → SSD8

NVMe7 → SSD12

NVMe8 → SSD16

The look of Oculinkx4 and SlimSASx4 connector



Oculink



SlimSAS

3.5 Power Receptacle

6 to 10 pieces of 4-pin power receptacles (For -02M BP) to support most up to 50A (600W) power for providing stable power source for expander and disks.

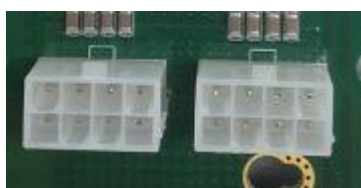
Users can then decide the number of power connector to connect according to the disk type being installed.

Bottom view located on the left



2 pieces of 2x3 (for 5v DC) and 2 pieces of 2x4 (for 12v DC) power receptacles (For -07 BP) to support most up to 48A and 64A current per each for providing stable power source for expander and disks.

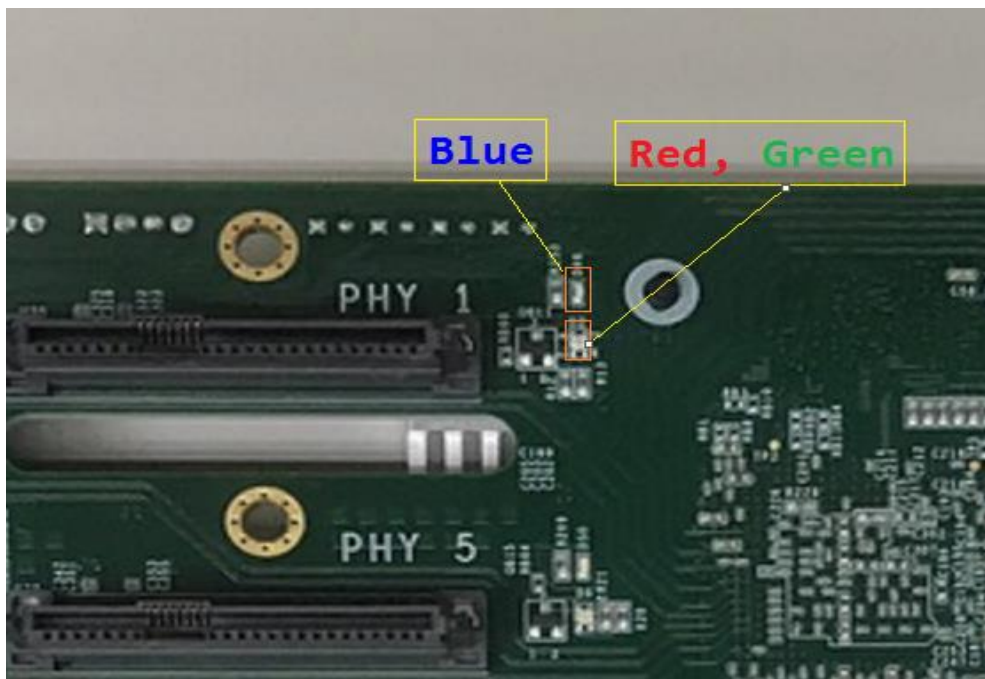
Note that the power receptacle number varies across backplanes supporting different number of disk slots.



4 LED and Buzzer Behavior

4.1 Disk Bay LED

3 LEDs for each bay to indicate HDD status and behaviors by illuminating in different color and format.



Blue LED:

Power Indicator. Turned on whenever disk drive is properly installed.

Green LED:

Activity indicator. Stay off when idle and blinking whenever disk drive is accessing.

RED LED:

Fail and Locate indicator. Turned on when disk failure occurs. Blinking when locate HDD, RAID rebuild and RAID consistent check.

Basically, The LEDs behave following the SES control signal from RAID card when working in SAS/SATA mode. Below is the design SPEC of the Disk indicators.

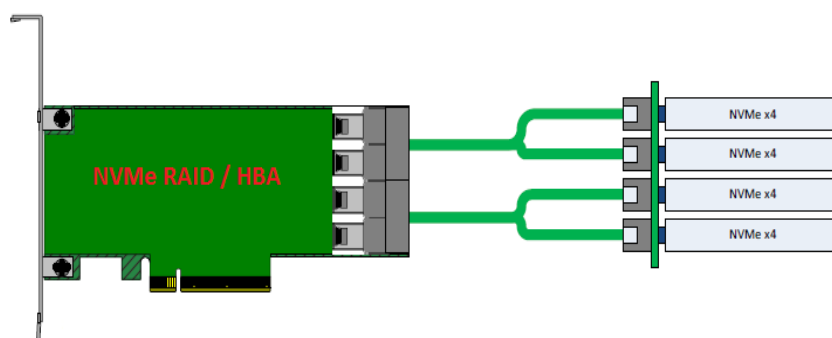
SES Status	Status Description	Red LED (Error)	Green LED (Activity)	Priority (Hex)	SES Control
Power-On State (before SES client intervening)					
Forced Condition					
Cleared	Empty slot or disk unplugged	Off	Off	10	N/A (SEP internal)
Condition Cleared	Disk loaded or inserting	Off	ActFlash	12	N/A (SEP internal)
Informative					
OK		Off	ActFlash	11	RQST OK
Device Off	Power down phy or bay	Off	Off	10	RQST DEVICE OFF
Reserved Device Hot Spare Do Not Remove	Usually for RAID members	Off	ActFlash	0E	RQST RSVD DEVICE RQST HOT SPARE DO NOT REMOVE
Activity					
Consistence Check (Cons Chk)	Check RAID consistence	Blink_1	ActFlash	03	RQST CONS CHECK
Rebuild/Remap (disk array)	Spare disk summoned for critical RAID rebuild	Blink_1	ActFlash	03	RQST REBUILD/REMAP
Active (Activity)		Off	ActFlash	10	RQST ACTIVITY
Warning & Error					
In Critical Array	Members in degraded RAID	Off	ActFlash	06	RQST IN CRIT ARRAY
In Failed Array	Members in broken RAID	On	ActFlash	07	RQST IN FAILED ARRAY
Rebuild/Remap Aborted (R/R Abort)	Spare disk summoned for RAID rebuild yet aborted	On	ActFlash	05	RQST R/R ABORT
Fault		On	ActFlash	04	RQST FAULT
Missing		On	ActFlash	04	RQST MISSING
Predict Failing (Fault Sensed)	Dying disk detected by enclosure	On	ActFlash	05	COMMON CONTROL PRDFAIL
Identify & Prompt					
Identify/Locate		Slow_Blink_1	ActFlash	00	RQST IDENT
Ready to Insert		Off	ActFlash	0B	RQST INSERT
Ready to Remove (RMV)	Disk spun down	Off	ActFlash		RQST REMOVE

				0C	
Note: ● Blink_1 : 50% On and then Off in a one second circle ● Slow_Blink_1 : 50% On and then Off in a 2 seconds circle ● ActFlash : Stay off while idle and fast flash upon I/O load					

Whenever working in NVMe mode, The RED LEDs behave following the VPP(Virtual Pin Port) over I2C Spec to illuminate. Only Fault, Locate and Rebuild are supported in the SPEC.

Please note that the SPEC might varies with host controller from different vendor.

The current FW design is only validated with Broadcom Tri-Mode HBA. Working with other vendors HBA might need FW implementation to support. 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 system error LEDs designed on the Backplane to indicate system Error including system Fan Fail and Over-Temperature.



System Fail Indicator:

JB3 is the jumper for system Fail Indicator. The System Fail indicator on the front panel connect to this jumper to indicate system fan fails or system overheat when it occurs.

Fan Fail:

When the Fan RPM is lower than 50% of the expected speed the indicator goes ON. And it would go off when the issue is resolved or not existed.

Overheat:

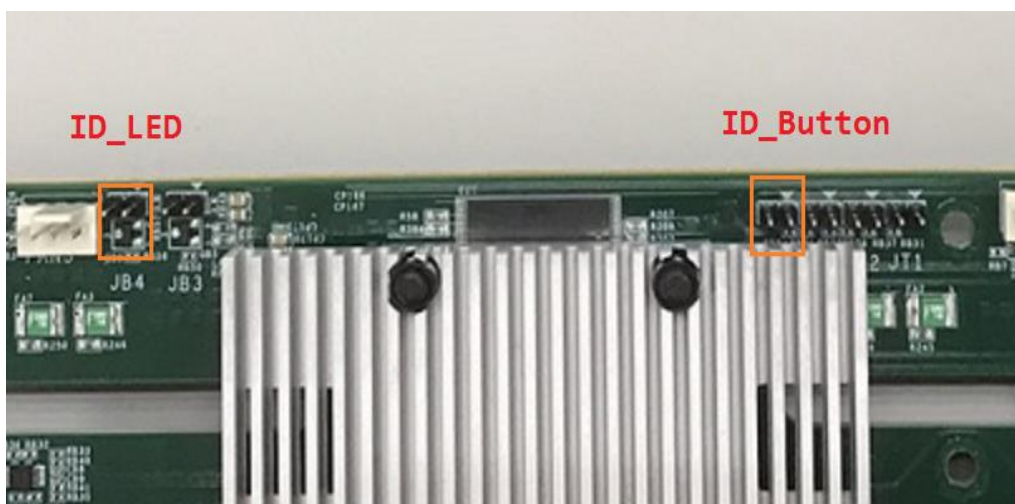
When the system temperature at the backplane area is going beyond 45°C the System Fail LED is turned ON. And would be turned off when temperature is going under 44°C

Note:

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

4.3 System ID LED

ID LED is designed to locate enclosure when required. The system ID LED illuminates when a momentary ID Button is pressed and goes off when pressing it again.

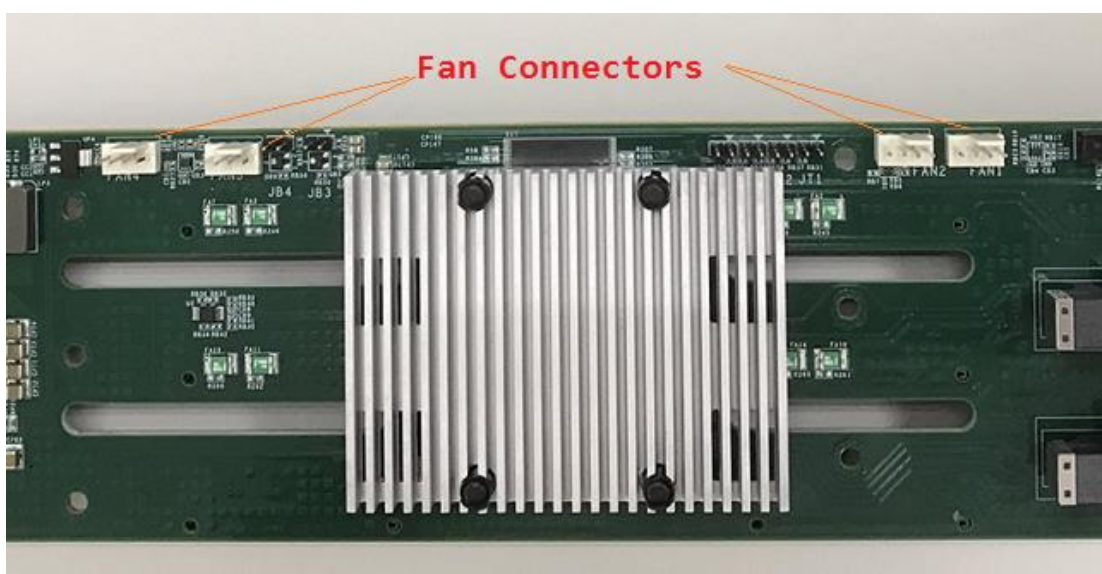


5. Smart Fan Control

InWin'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 sensed by 2 thermal sensors on backplane.



Thanks to Smart Fan Control feature the 4 Fan connectors on backplane support wide variety of PWM driven Fan modules being used in the enclosure.



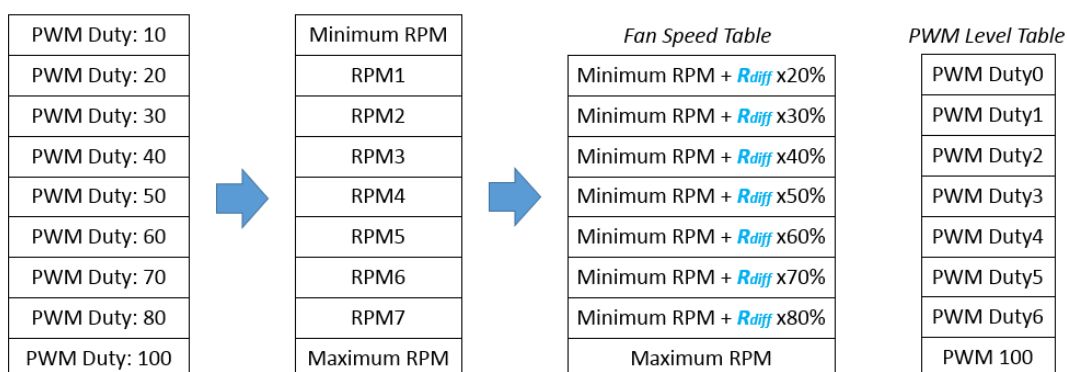
For 07 series BP, an extra connector JM1 or JM2 is designed to join the arbitration of the Fan speed control. When there is a customized cable connected between BP and MB, the MB's PWM would be recognized by BP to determine what PWM duty the controller chip output to fan modules. The basic idea is outputting the higher PWM by comparing the value the controller calculated based on the temperature detected and the one from MB.

How it works?

1. Fan module auto-calibration would launch in every system boot. The 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 calculated and recorded.
3. The 8 levels of fan speed are mapped to the temperature readings sensing by thermistor spreading from 25 to 45 °C in 3.75 degree C step.
4. In normal operation, when the system Temperature changed, 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 control profile are as below.

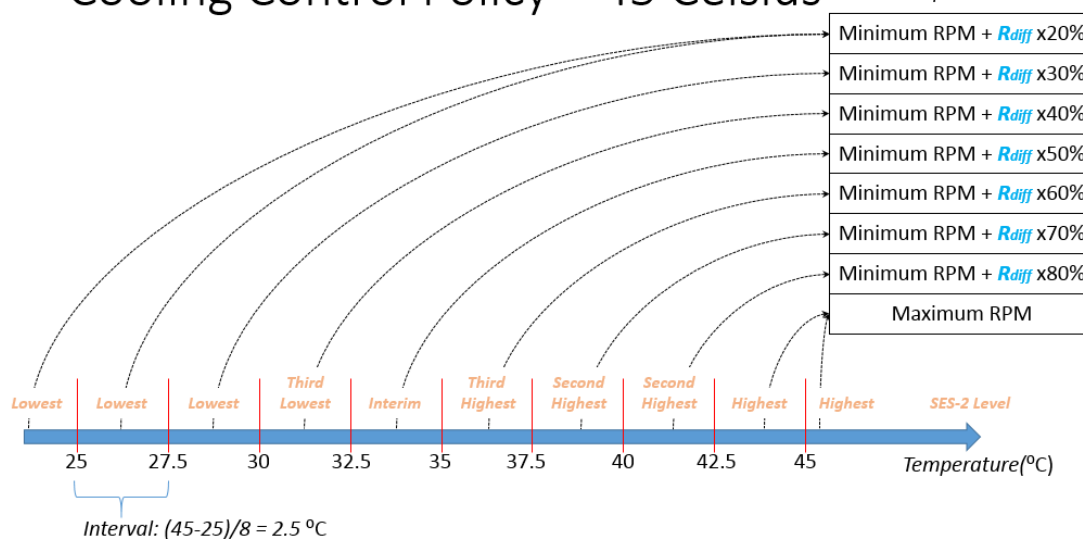
Fan Speed Measurement

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



Cooling Control Policy – 45 Celsius

Fan Speed Table



6. Firmware Upgrade

The SAS3 backplane equipped with firmware upgrade feature through serial console in case it is required. There are 2 firmware to be upgraded. One is Expander system firmware and another is system configuration data. They are not necessarily to be upgraded at the same time. Either one can be upgraded independently when required.

How to upgrade firmware?

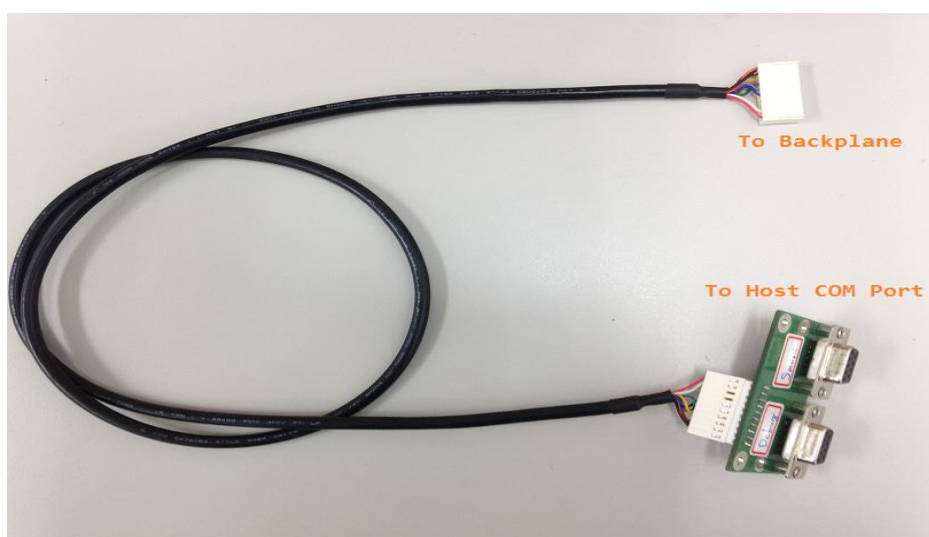
1. Out-Of-Band through serial console
2. In Band through SCSI Command

6.1 Out-Of-Band through serial console

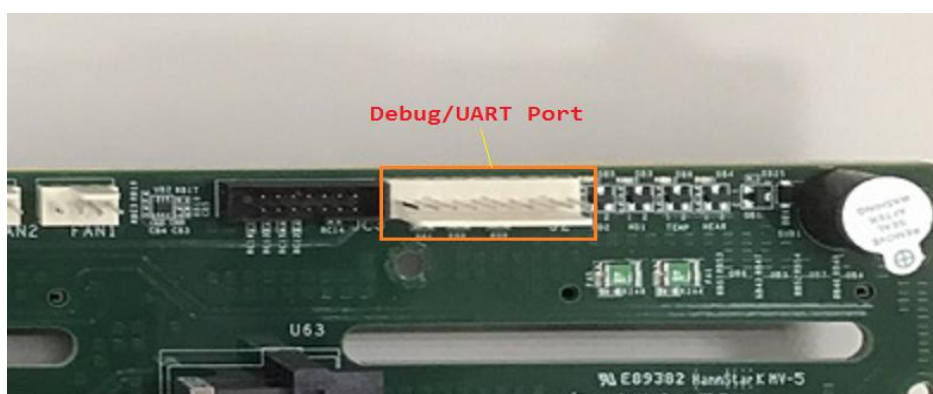
InWin's SAS-3 12Gps Backplane implements a serial UART port allowing users to conduct firmware upgrade through it.

1. Require a proprietary serial cable InWin made.

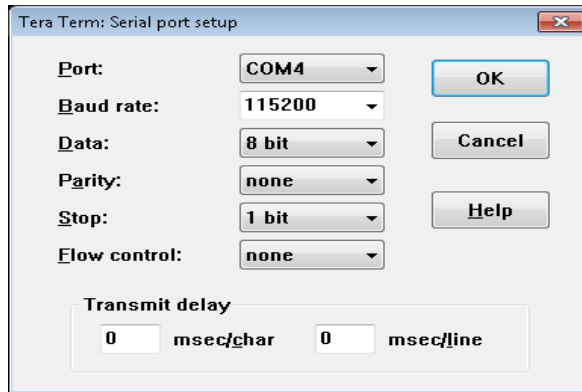
Please note that the connector to Backplane varies depends on the backplane. The 07 series backplane UART port is redesigned with smaller form factor.



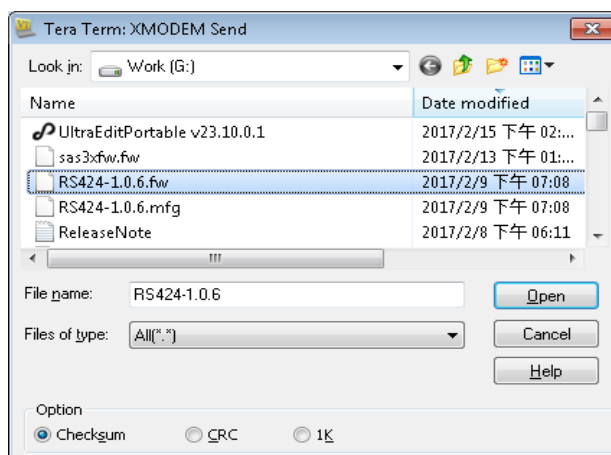
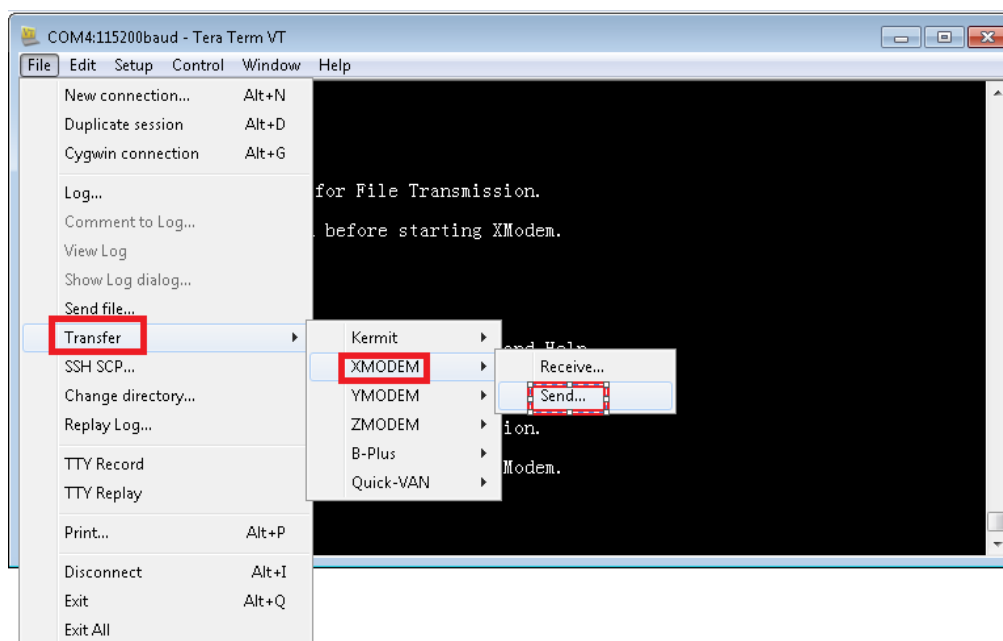
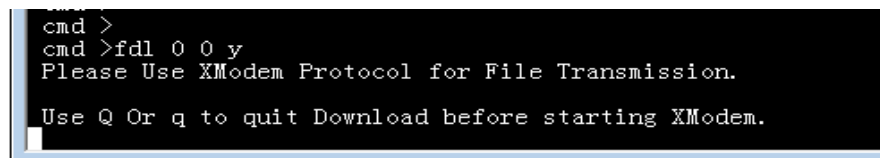
2. Require a host with a serial COM port.
3. Connect serial cable between Backplane and host.



4. Configure serial port setting as 115200, N, 8, 1.

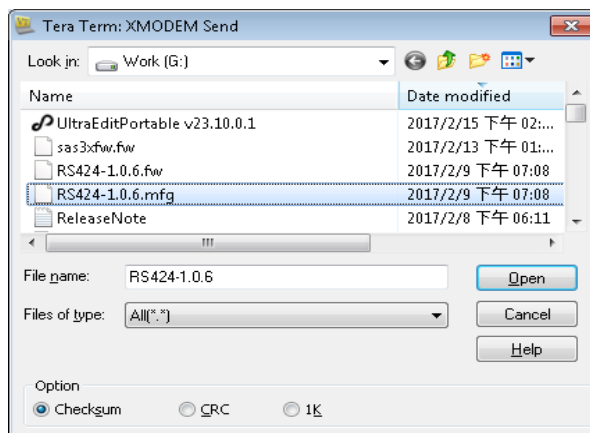
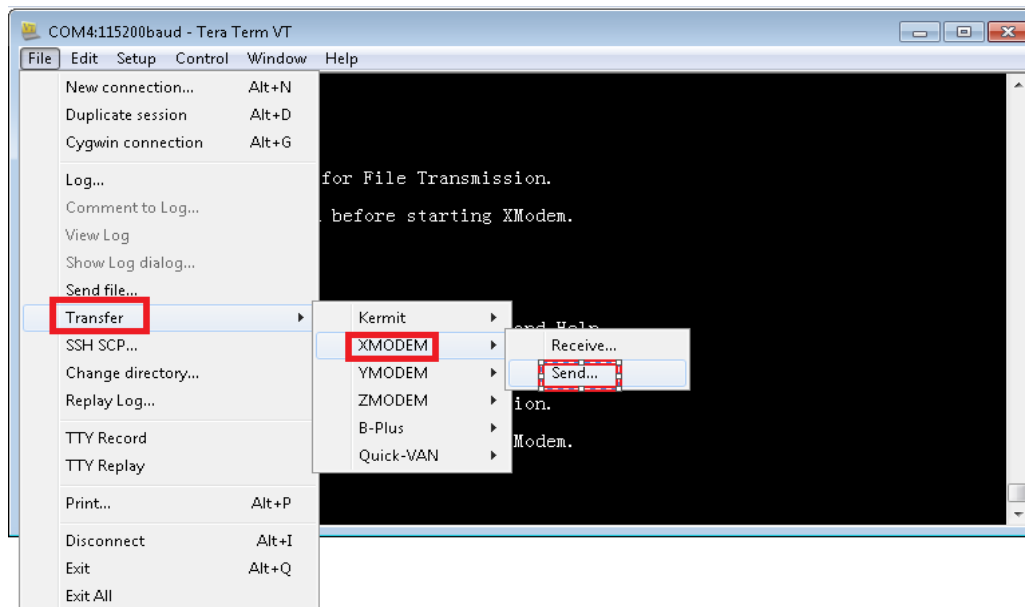


5. Command “fdl 0 0 y” for system firmware upgrade in serial console. Sending system firmware through Xmodem.



6. Command “fdl 1 0 y” in serial console for system configuration data upgrade.
Sending system firmware through Xmodem.

```
cmd >
cmd >fdl 1 0 y
Please Use XModem Protocol for File Transmission.
Use Q Or q to quit Download before starting XModem.
```



7. Reset system by typing “reset” command in serial console or power cycle to make new firmware take effect.

6.2 In Band through SES Command

An option way to program firmware out of UART console is to leverage sg utilities going through In Band connection. No extra serial cable required.

1. Download sg utility. (For either Windows or Linux)
 - i. http://sg.danny.cz/sg/p/sg3_utils-1.42_mw64exe.zip
 - ii. http://sg.danny.cz/sg/p/sg3_utils-1.42.tgz
2. Install sg utility onto server which is with HBA/RAID card installed.
3. Connect backplane to the installed HBA/RAID card.
4. Issue command to check connected backplane.
 - i. “sg_scan -s” to list SCSI devices in the system.

```
C:\Users\Administrator\Downloads\sg3_utils-1.42>sg_scan -s
PD0      [C]      WDC WD50  00AAKX-001CA      15.0      W -DCWYAFU307288

SCSI0:0,0,0   claimed=1 pdt=0h      WDC WD50  00AAKX-001CA      15.0
SCSI1:1,112,0 claimed=0 pdt=dh      IN-WIN   RS-316      0009
SCSI1:2,36,0  claimed=0 pdt=dh      IN-WIN   RS-212      0009
```

5. Issue command to conduct firmware upgrade.

- i. sg_ses_microcode usage

```
C:\Users\Administrator\Downloads\sg3_utils-1.42>sg_ses_microcode -h
Usage: sg_ses_microcode [--bpw=CS] [--help] [--id=ID] [--in=FILE]
                        [--length=LEN] [--mode=MO] [--non]
                        [--offset=OFF] [--skip=SKIP] [--subenc=SEID]
                        [--tlength=TLEN] [--verbose] [--version]
                        DEVICE

where:
  --bpw=CS|-b CS      CS is chunk size: bytes per send diagnostic
                        command (def: 0 -> as many as possible)
  --help|-h          print out usage message then exit
  --id=ID|-i ID      buffer identifier (0 (default) to 255)
  --in=FILE|-I FILE  read from FILE ('-I -' read from stdin)
  --length=LEN|-l LEN length in bytes to send; may be deduced from
                        FILE
  --mode=MO|-m MO    download microcode mode, MO is number or
                        acronym (def: 0 -> 'dmc_status')
  --non|-N          non-standard: bypass all receive diagnostic
                        results commands except after check condition
  --offset=OFF|-o OFF buffer offset (unit: bytes, def: 0);
                        ignored if --bpw=CS given
  --skip=SKIP|-s SKIP bytes in file FILE to skip before reading
  --subenc=SEID|-S SEID subenclosure identifier (def: 0 (primary))
  --tlength=TLEN|-t TLEN total length of firmware in bytes
                        (def: 0). Only needed if TLEN>LEN
  --verbose|-v      increase verbosity
  --version|-V      print version string and exit

Does one or more SCSI SEND DIAGNOSTIC followed by RECEIVE DIAGNOSTIC
RESULTS command sequences in order to download microcode. Use '-m xxx'
to list available modes. With only DEVICE given, the Download Microcode
Status dpage is output.
```

- ii. For MFG file upgrade use below the command

```
sg_ses_microcode.exe -b 4k -m 7 -i 1 -l RS424-1.0.8.mfg SCSI1:1,112,0
```

iii. For Firmware upgrade use below the command

```
sg_ses_microcode.exe -b 4k -m 7 -i 0 -l RS424-1.0.8.fw SCSI1:1,112,0
```

6. Power cycle backplane to make new firmware take effect.

7. Management

To manage backplane, users can connect a serial console cable to backplane or expander UART through RS232 COM port on system host. Refer to Section 6.1 for the details of the serial console cable and the console terminal setting.

There are some useful commands for users to check expander status, conduct firmware update and debug issue when required.

Useful Console Commands

Function	Command
help	To list the usage of the CLI commands
Show/Set the current	date [set <newdate(*)>]
Reset the expander	reset [watchdog]
Display phy info.	phyinfox [-i [(1 .. NumBpc)] -s -i : show phy info of BPC expander -s : show SES Array Device info of CSE BRC (bridge console only)
Configuration update	fdl 1 0 y Download and Update MFG configuration. (feed it with 'MFG image file')
Firmware Update	Fdl 0 0 y Download and update firmware
Display info for all phys	phyinfo [help edfb power cable] [up <PhyNum(D)>] - no arguments displays default output - 'help' displays detailed help information - 'edfb' subcommand displays EDFB info - 'power' subcommand displays power mgmt info - 'up' filters to display connected phys only - 'cable' subcommand displays cable mgmt info - <PhyNum> is a valid phy index and filters the output to display info about that phy
Display or reset all phy counters	counters [config event reset] - no arguments displays phy error counters and generic broadcast counters

	- 'config' subcommand displays phy event configuration - 'event' subcommand displays phy event counters - 'reset' subcommand resets all phy counters
Display expander SAS address	sasaddr [-d] ('-d': also show virtual ports address)
Show POST info	showpost
Show MFG revision	showmfg
Show firmware revision	rev