A33606-AIC-02 User's Guide

Installation and Operation of the Astek SAS/SATA X36 Expander

Document Number: 90-000156

Document Status: Rev. A

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Introduction

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This document describes the use of the Astek A33606-AIC-02 SAS/SATA X36 Expander.

The A33606-AIC-02 is a 36 port Expander compatible with the Second Generation SAS-2 protocol standard and with SAS-2 compliant Hard Disk Drives, CDROM Drives and similar devices.

This document remains the official reference source for all revisions/releases of this product until rescinded by an update.

To receive product literature, visit us at http://www.astekcorp.com.

Astek Corporation reserves the right to make changes to the A33606-AIC-02 at any time without notice.

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Related Publications

LSISAS2X36 Product Brief (pdf)

Serial Attached SCSI - 2 (SAS-2) draft standard (pdf)

Preface
This document is the primary reference and user's guide for the Astek A33606-AIC-02 SAS/SATA X36 Expander.

Audience
This document assumes the user has familiarity with Serial Attached SCSI (SAS) and Serial AT Attachment (SATA) specifications, equipment and applications.

Organization
This document has the following sections**:**

> Introduction – Covering general Astek product, documentation and legal information.

> Main – Covering specific information relating to this product, its specifications, functional design, installation, normal uses and special applications.

> Appendices – Covering diagnostic information specific to this product, general information regarding assistance with Astek products and information specific to this document.

Naming Convention
This document uses the following naming convention:

Name/Phrase	Definition
SAS	Serial Attached SCSI
SCSI	Small Computer System Interface
SATA	Serial AT Attachment
HBA	Host Bus Adapter
Expander	A33606-AIC-02 SAS/SATA X36 Expander
Expander IC	LSISAS2X36
Initiator	HBA or any device originating device service requests
Target	Any device responding to device service requests
PHY	Physical Layer

Additionally, the Service Delivery Subsystem refer to the cables, backplane and expanders that comprise the physical SAS/SATA communication link.

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Main

Product Specifications

Astek A33606-AIC-02 SAS/SATA X36 Expander Design Verification

- Compliance with SAS-2 Protocol Standards via the LSI Logic LSISAS2X36 IC

- Astek A33606-AIC-02 Design Verification

- Compliance was verified via a rigorous Astek test protocol.

Astek A33606-AIC-02 Operating Environment

- Power Supply   5.0 V ± 5% 1.65 A min

- Power Connector: Standard 4 pin PC-AT

- Ambient Operating Temperature: 0 to 55 C heatsink, air flow recommended

- Storage Temperature: -40 to +85 C

Astek A33606-AIC-02 Mechanical Characteristics

- Dimensions: 3" x 7.5" x 0.9"   without heatsink

- Mounting: Four corner mounting holes

- SAS Connectors:

    Nine Mini-SAS (SFF-8087) connectors

    Right angle orientation with Universal keying

    Four SAS Lanes per connector (One 4 lane connector => One SAS Quad)

    Standard mini-SAS signal pinout

Astek A33606-AIC-02 Shipment Description

The following items are supplied directly by Astek Corporation as part of the A33606-AIC-02.

- Item A33606-AIC-02   The SAS/SATA X36 Expander

- Item 90-000156   The A33606-AIC-02 User's Guide, this document

The A33606-AIC-02 consists of a mezzanine board mounted above a Carrier board. The mezzanine board contains the LSI Expander IC. The Carrier board distributes the signals from the Expander IC to the mini-SAS connectors. The User must purchase Mini-SAS cables separately.

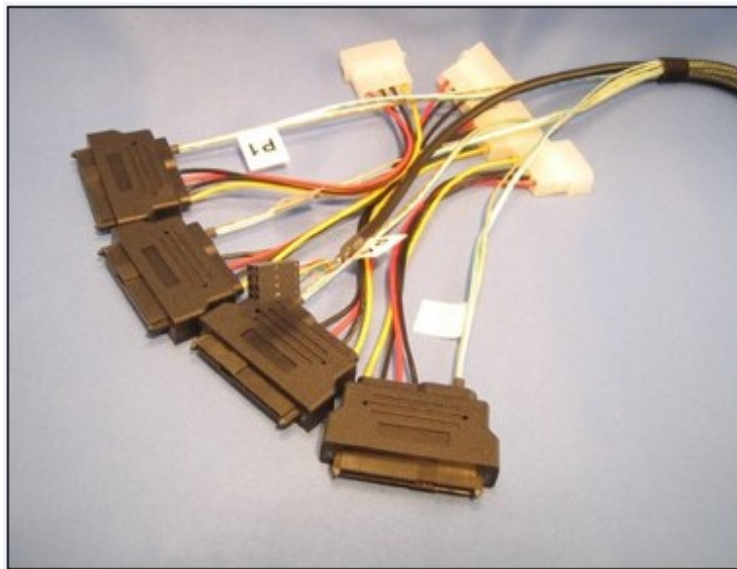The A33606-AIC-02 assembly is illustrated below.

Figure 1   The A33606-AIC-02 Assembly

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Mini-SAS Connectors

Up to nine mini-SAS cables can be connected to the A33606-AIC-02; Astek does not supply these.

The mini-SAS cable part number is SFF-8087/SFF-8482. As illustrated below, four connectors (top frame) are available at one end of each cable to connect as many as four drives for each mini-SAS connector (bottom frame) that attaches to the A33606-AIC-02.

Figure 2   SFF-8087 / SFF-8482 Mini-SAS Cable

Functional Description

The A33606-AIC-02 provides easy access to the full functionality of the LSISAS2X36 Expander IC.

This enables the User to access and control up to 35 SAS/SATA Targets with one Host SAS lane.

Multiple A33606-AIC-02 Expanders can also be connected in Cascade for even greater versatility.

The User can then manage a large, complex Storage Network using an SAS Domain that best suits the needs of the application and the limitations of the available equipment.

Carrier Board Block Diagram

The Carrier board is the foundation of the A33606-AIC-02 to which all mini-SAS cables connect and which also has the mounting holes for Host installation.

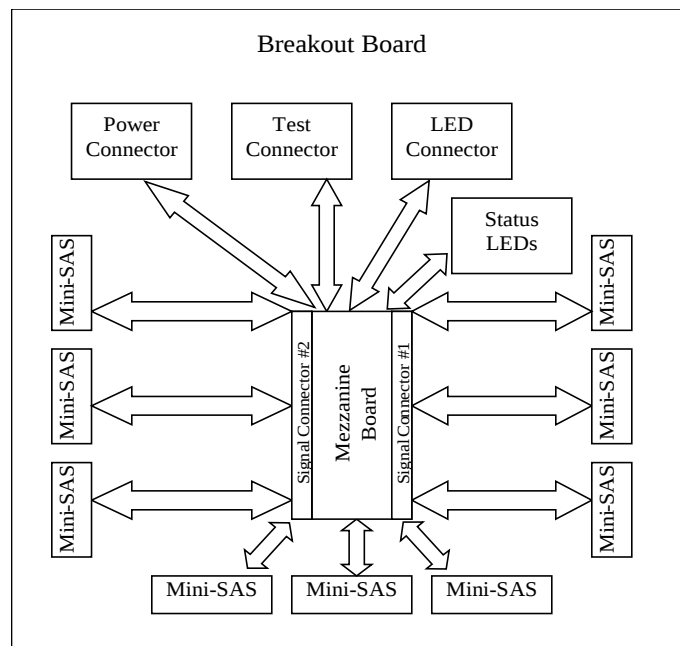The functional block diagram of the Carrier is shown below.

Figure 3   Carrier Board Block Diagram

The Carrier board expands the mezzanine board signals into nine mini-SAS internal connectors. The Carrier board also provides test and programming capability for the mezzanine board.

Mezzanine Board Block Diagram

The mezzanine board mounts on top of the Carrier board and contains the LSISAS2X36 IC.

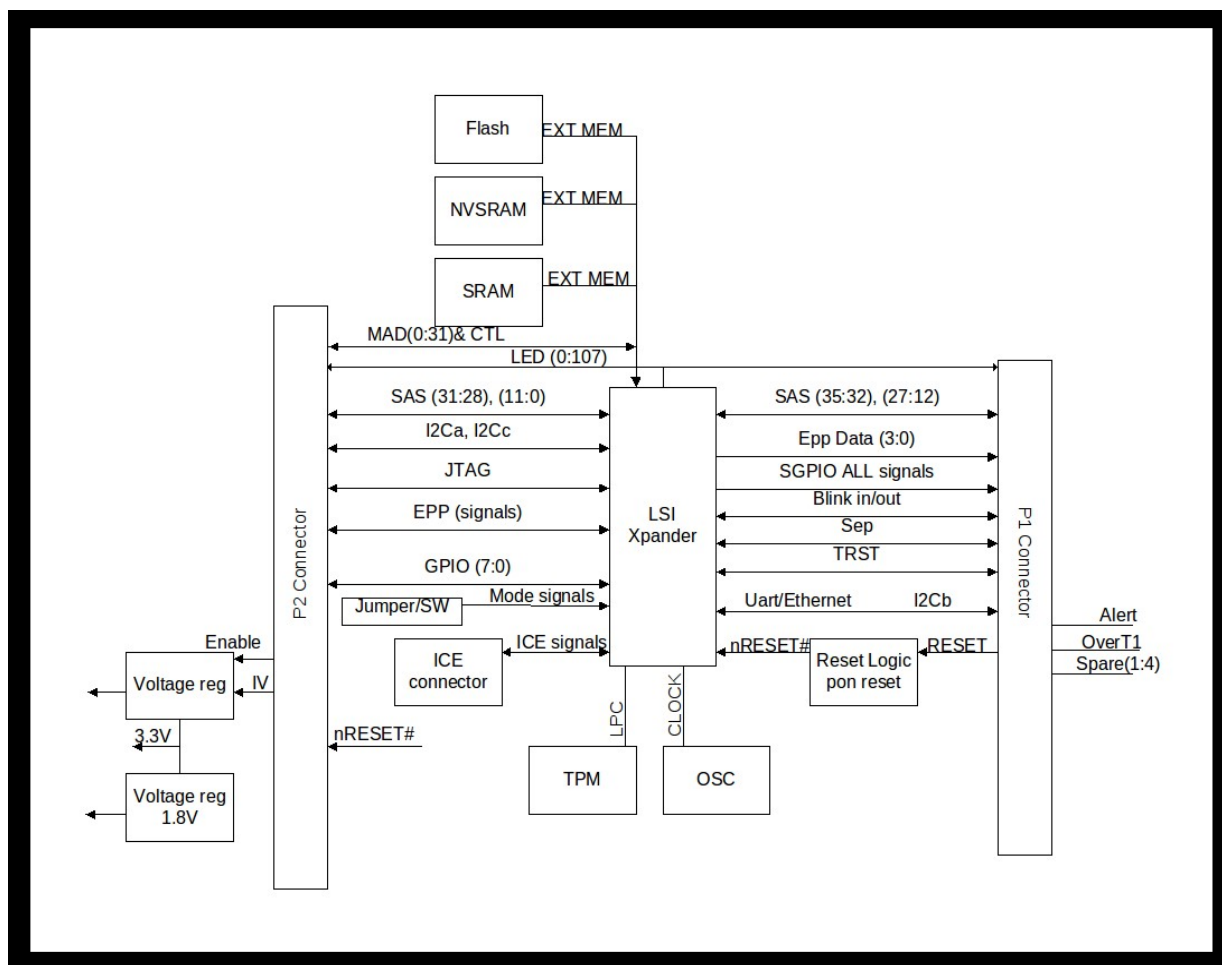The functional block diagram of the mezzanine board is shown below.

Figure 4   Mezzanine Board Block Diagram

The mezzanine board is mounted on the Carrier board through low-profile, high-speed signal connectors. The LSI Expander IC provides 36 lanes of SAS connectivity. The mezzanine board includes on board Memory for configuration and program storage for the Expander IC. The board generates all required operating voltages from a 5V or 12V supply.

The mezzanine board is preprogrammed by Astek as part of the standard build.

Installation

The User should be aware that the Host System and the A33606-AIC-02 will be exposed during installation and both are susceptible to ESD damage. Compliance with IEC 61340-5-1 & 2 or its equivalent is recommended and assumed.

CAUTION
Ignoring ESD prevention guidelines can damage the Host and/or the A33606-AIC-02.

Astek assumes no responsibility for Host System damage that may occur in the course of using the A33606-AIC-02. Refer to the A3360-AIC-12 warranty for more information.

Mechanical Preparation

Identify a suitable location within the Host System that fits the size and shape of the A33606-AIC-02 and provides good airflow to the Expander IC.

Orientation – Access and Cooling Considerations

The A33606-AIC-02 is intended to be installed into a chassis using M3 hardware and standoffs. Use spacers or standoffs to provide clearance between the A33606-AIC-02 and the Host System to allow access to connectors on the A33606-AIC-02 Carrier board. The A33606-AIC-02 may be installed in any orientation as long it provides access to connectors and adequate cooling of the Expander IC.

Visibility of the Indicator LEDs (D1 through D4) may be critical during Performance Verification and if any troubleshooting is required. Ensure that all those LEDs will be visible when installation is complete. See Mezzanine Board Diagnostic LEDs illustration.

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The figure below shows the size and location of the mounting holes on the A33606-AIC-02; the User must provide mounting holes and adequate clearance at the chosen mount location in the Host System.
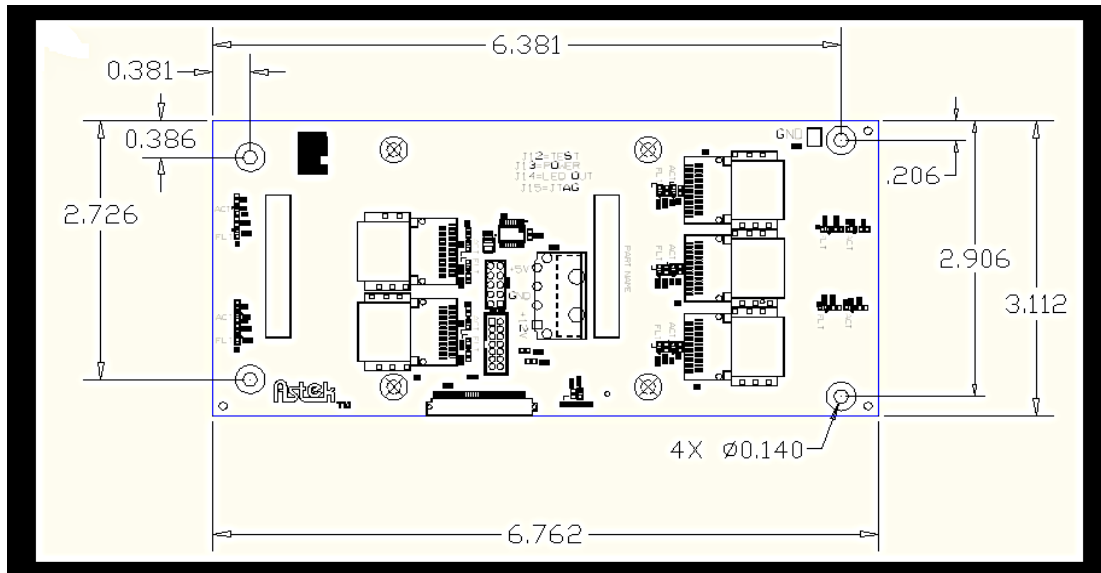

Figure 5   A33606-AIC-02 Mounting Holes

CAUTION
Failure to provide proper cooling to the LSI Expander IC will damage it or degrade its performance. A suitable heat sink should be attached to the Expander IC or the A33606-AIC-02 should be mounted so that the LSI Expander IC is in direct thermal contact with the Host chassis. See the next page for more details.

Orientation for Best Air Flow

The A33606-AIC-02 can be installed for best air flow across the Expander IC and effective cooling. However, this restricts access and visibility of LEDs and connectors on the Mezzanine Board Side.

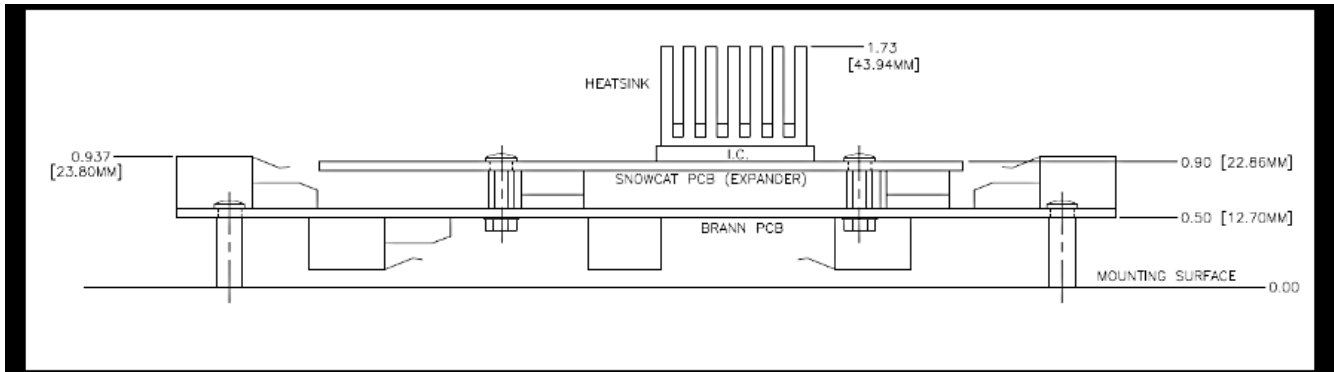For best air flow cooling, install the A33606-AIC-02 as shown below.

Figure 6-A   Mounting for Best Air Flow to Expander IC

Orientation for Best Access and Visibility

The A33606-AIC-02 can also be installed for LED visibility and connector access on the Mezzanine Board side, relying on direct contact with a good thermal conductor to cool the Expander IC.

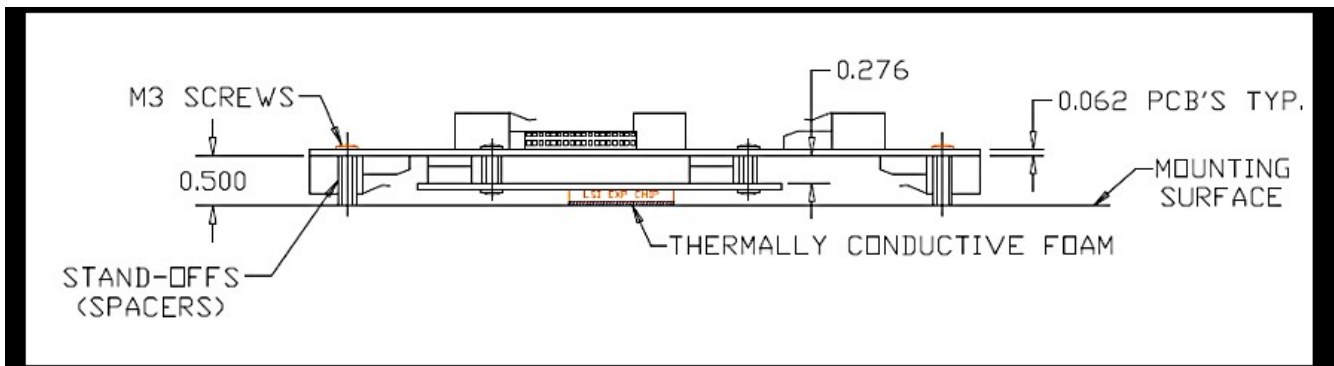To do this, remove the Expander IC heatsik and install the A33606-AIC-02 as shown below.

Figure 6-B   Mounting for Best Connector Access and LED Visibility

Prepare the Host System

1. Ground yourself to prevent ESD damage to the equipment .

2. Drill four 0.140 in. holes in the Host System to mate with the mounting holes.

3. Secure four 0.5in threaded spacers to the Host on which to mount the A33606-AIC-02.

Install the A33606-AIC-02

1. Ground yourself to prevent ESD damage to the equipment .

2. Remove the A33606-AIC-02 from the package and verify it is not damaged.

3. Install the A33606-AIC-02 in the Host System with appropriate mounting screws.

4. Make any other changes needed to the Host System.

Connect Power

Connect a standard 4 pin PC-AT connector from the System power supply to the Power Connector on the Carrier Board. The location of the J13 Power Connector is illustrated below.
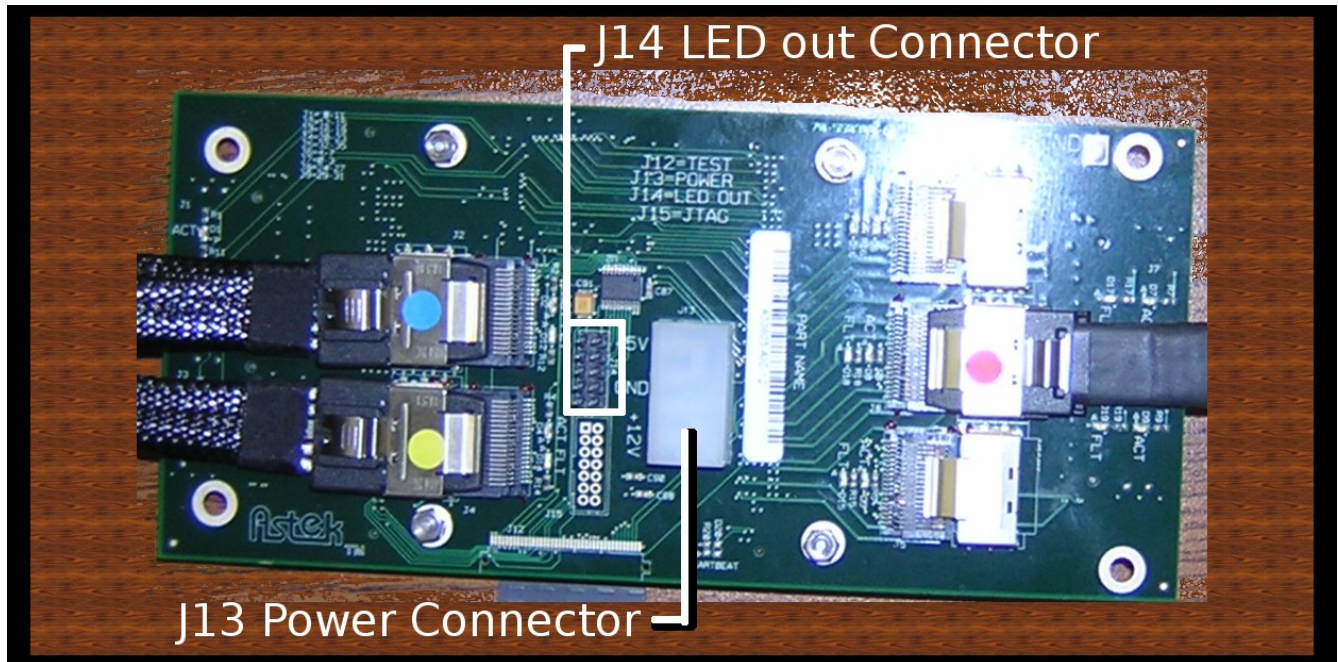

Figure 7   **Power Connector Locations**

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Drivers and Software

No special drivers are needed to utilize the A33606-AIC-02 device. Drivers for the Host Bus Adapter should provide all necessary support for use of an A33606-AIC-02 in a system.

Normal Operations

Once the A33606-AIC-02 is installed, performance can be verified by connecting it to a Host through any one of the nine Mini-SAS connectors. This gives the Host four SAS Lanes that can access Targets. Each of the remaining eight Mini-SAS connectors can then be connected to four known good Targets to verify the performance of the 32 Target lanes. Alternatively, a single known good Target or a known good System comprising 32 known good Targets can also be employed. The objective in any case is to verify that all 36 SAS lanes are functioning properly.

Before Power UP: Location of SAS Port ACT / FLT LEDs

Each of the nine SAS Quads has two LEDs located beside the corresponding Mini-SAS connector but all the LEDs are loaded on the same side of the Carrier board. The Mezzanine board is mounted on the other side.

One LED is labeled FLT (Fault); the other LED is labeled ACT (Activity). The function of these LEDs is described on the next page.
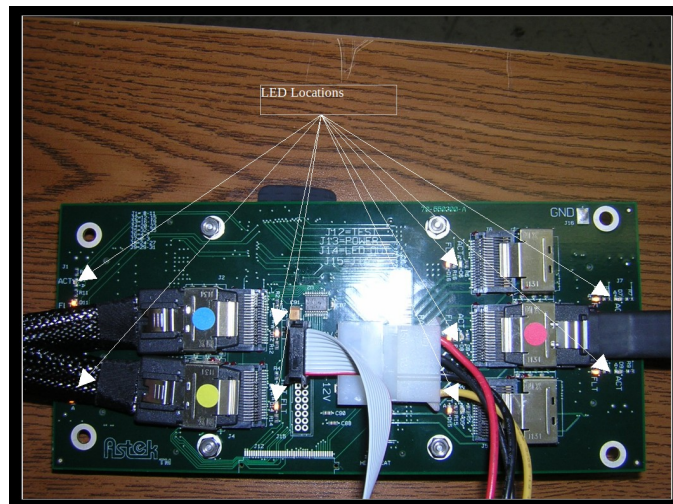
The figure below shows the location of these LEDs.

Figure 8   Indicator LEDs (ACT and FLT)

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Power Up the System: Verify SAS Port ACT / FLT LED Function

On Power Up, all the ACT / FLT LEDs on the A33606-AIC-02 will blink for 1-2 seconds during initialization. Once initialization is done, the ACT / FLT LEDs will function as described below.

When an Initiator (Host / HBA) or Target Quad (e. g. any SAS/SATA storage drive) is connected to the A33606-AIC-02, the amber FLT LEDs should turn OFF. Note: all 4 lanes associated with a connector must establish a connection to a device before the fault LED will turn off.

Once connections have been established, the green ACT LEDs will flash ON/OFF if there is activity on any lane of the Quad port. If large transfers are occurring across the SAS bus, the green LEDs may not visibly flash but instead appear to stay ON for long periods of time.

Verify that the ACT and FLT (Activity and Fault) LED signals function properly for each of the nine SAS Quads (each Mini-SAS connector). Note that all nine pairs of ACT / FLT LEDs, one for each Mini-SAS connector, are visible on the Carrier Board on the side opposite the Mezzanine Board.

If the A33606-AIC-02 was mounted for optimum air flow to the Mezzanine Board, the board will have to be tested in the unmounted position to gain visual access to the ACT / FLT LEDs.

The table below illustrates the test results that would be recorded for a good A33606-AIC-02.

Single A33606-AIC-02 and Cascaded Topologies

Nine Mini-SAS connectors, J1 through J9 provide SAS/SATA connectivity to the A33606-AIC-02.

Each connector conforms to the SFF-8087 Mini-SAS connector specification.

Preferred Initiator ports for Host/HBA connections are J1, J2, and/or J6; J2 is the Upstream Port.

Preferred Target ports for drive connections are J3, J4, J5, J7, J8, and/or J9.

The A33606-AIC-02 can be used alone or in multiples in cascade as shown below.
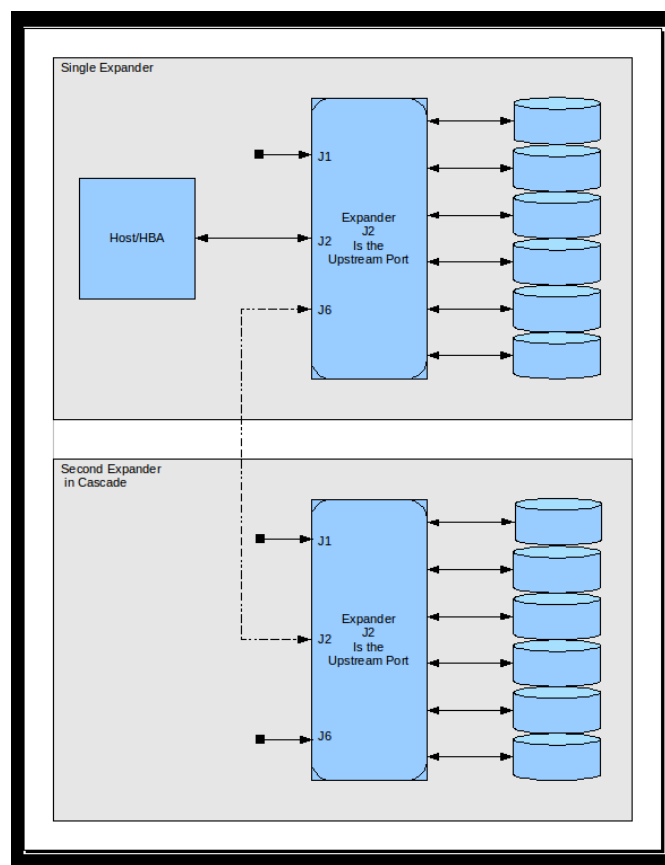

Figure 10   Normal A33606-AIC-02 Topologies

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Special Operations

Many topologies using advanced A33606-AIC-02 features are possible; a few are described below. Most of these features require custom configuration of the A33606-AIC-02. Please contact Astek Corporation for additional information regarding these features.

SCSI Enclosure Services (SES) Protocol Support

The A33606-AIC-02 ships with generic SES support and functionality to illustrate the usefulness of the feature. The default configuration supports the following items.

> Generic Page 1 indicating part number, Astek,
> Temperature Sensor indicating ambient temperature and Expander IC temperature.
> Target mapping associated with 6 of the Mini-SAS connectors.

Additional SES configurations are possible that include but are not limited to:

> Advanced LED control
> Voltage monitoring
> Fan control/monitor
> Alarms and indicators

SES Target Mapping

The table below is the generic SES Target Mapping.

Port J1, J2 and J6 do not have any drive mapping as they are reserved for Initiator connections.

Port / Connector	Connection Map
J3	Target Devices (Drives) 20-23
J4	Target Devices (Drives) 16-19
J5	Target Devices (Drives) 12-15
J7	Target Devices (Drives) 00-03
J8	Target Devices (Drives) 04-07
J9	Target Devices (Drives) 08-11

Generic Connection Map for SES Protocol

Zoning

The A33606-AIC-02 supports SAS-2 zoning. Zoning allows multiple HBAs to share/access storage devices on the same SAS domain. This blocks initiators from access to other initiator's devices. Zoning is not intended for systems with a single Server/Host.
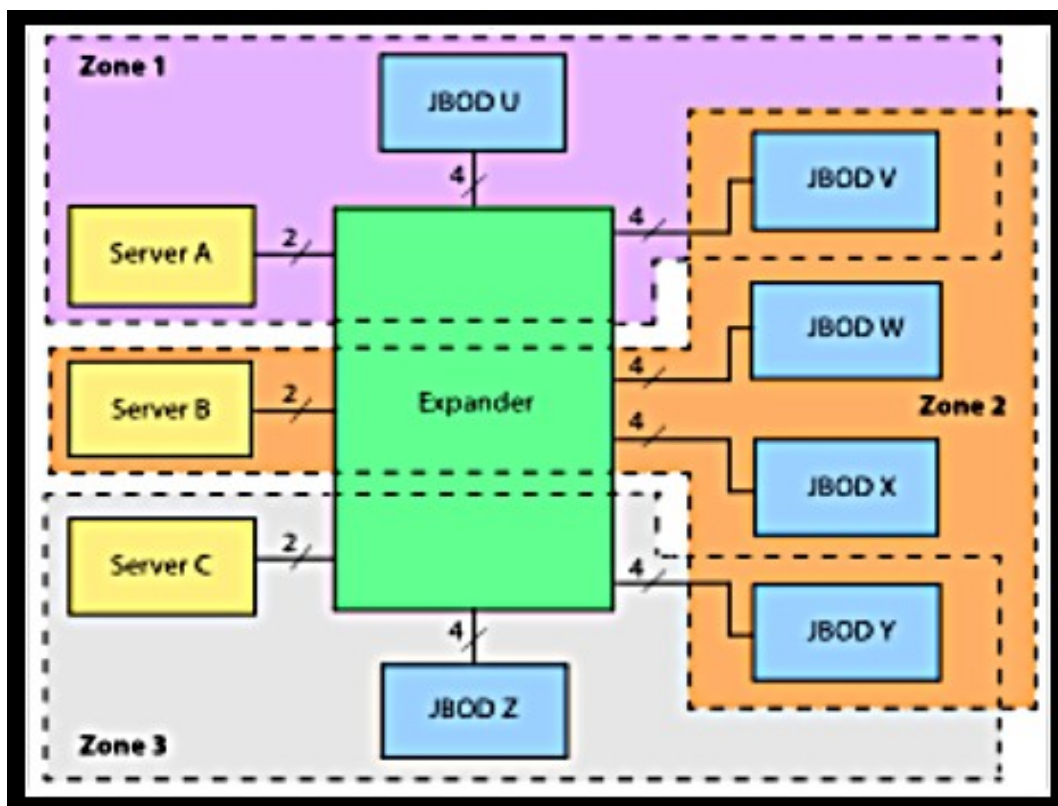
The concept of Zoning is illustrated below.

Figure 11 Example of Zoning

Serial General Purpose I/O (SGPIO)

The A33606-AIC-02 supports SGPIO and the unit can be configured to output SGPIO signals onto a header on the board. SGPIO is commonly used to create an LED panel at the front or rear of a JBOD (Just a Bunch of Disks). This LED panel typically displays the ACT / FLT status for each Quad connector on the A33606-AIC-02. If this feature is desired, please contact Astek for details on how to enable this feature.

The SGPIO is accessed via J14 on the A33606-AIC-02 (see Power Connector Locations). J14 is labeled "LED OUT" on the Carrier board. The table below shows the pinout for J14. The pins are active-low, intended to illuminate remote LEDs provided by the User.

Description	Left Pin	Right Pin	Description
5 V	1	2	5 V
Activity on any lane	3	4	Fault on any lane
Activity on lanes 0-11	5	6	Fault on lanes 0-11
Activity on lanes 12-23	7	8	Fault on lanes 12-23
Activity on lanes 24-35	9	10	Fault on lanes 24-35

J14 LED out Connector Pinout

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Troubleshooting

The A33606-AIC-02 can be operated in a dismount condition if adequate airflow is provided, this can make troubleshooting easier.

Diagnostics

If the A33606-AIC-02 does not work as expected, the following check list may be helpful.

1. **Check the mezzanine board Power LEDs, shown below**
   Power LEDs should all be ON (3.3 V bright, others dim but ON)

2. **Check the mezzanine board Heart Beat LED shown below.**
   HB should blink with a regular beat @ ~ 1 beat/second.

3. **Check the Carrier board ACT and FLT LEDs at each mini-SAS.**
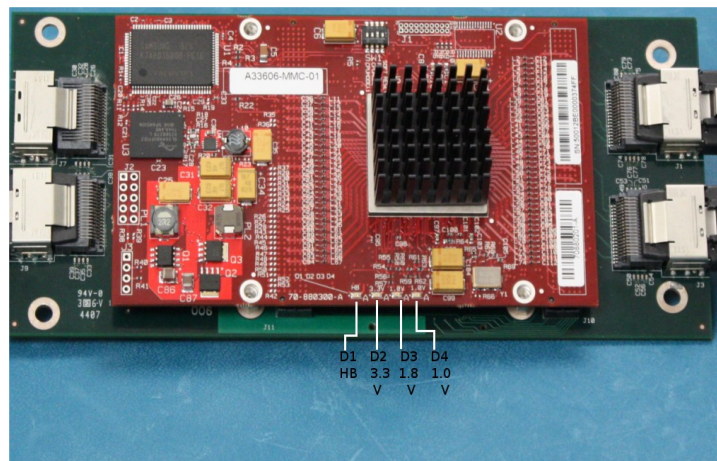   ACT should flash with activity and FLT should be OFF.

Figure 12   Mezzanine Board Diagnostic LEDs

Customer Service

Contact your Product Manager or email support@astekcorp.com.

Revision History

Revision	Date	Changes
A	09/17/09	Initial Release