DA4055
4-Channel Mix/Minus with Router
User Guide

INTRODUCTION

The DA4055 module is one of the variety of processing and distribution modules available for installation into the 4000 Series Processing Equipment frame. This module provides a two-input, two output AES/EBU digital audio mixer with signal gain, phase inversion, and output channel mix and fade.

Features

Key features of the DA 4055 are listed below:

- Four-channel I/O (2 synchronous AES digital audio inputs/outputs) exactly matches audio capabilities of digital VTRs
- Four independent layers of 4 x 1 AES audio mixing.
- Synchronous 4 x 4 AES3 Sub-Frame Routing for glitch-free mixing.
- Performs overs, stereo or quad mix downs, and on-air breakaways.
- 24-bit audio processing for full fidelity of source material. Flexible sample rate of 28 kHz to 50 kHz.
- Two audio connector options: BNC for single-ended coaxial cable or Phoenix screw type terminal blocks for balanced twisted pair wiring.
- Front panel control or remote control using NVISION control panels or other control systems via RS-422 9-pin D connector.

Available Mixing and Routing Operations

Available mixing and routing operations include the following:

- Invert the phase of any input and route to any output
- Mono output—pass any channel straight through or swap any channel with any other channel at the output.
- Stereo mix—mix any two inputs and route to any output.
- Stereo mix with attenuation—mix any two inputs with attenuation and route to any output.
- Three way mix—mix any three inputs and route to any output.
- Special quad mix—mix Channels 1 and 2 with attenuation and Channels 3 and 4 without attenuation and route to any output.

Applications

The DA4055 has many applications, especially anyplace where audio mixing is required but the size and expense of a full-blown audio mixing system is not justified. Typical applications include the following:

- Dubbing—The DA4055 is an ideal interface between source (playback) and destination (record) DVTRs used for dubbing or editing. It saves tying up an expensive mixing console for production applications and studio mix-downs.
- Signal Processing—You can use DA4055s at the inputs of a digital mixer to expand the number of inputs and provide mixing flexibility.
- Distributed Mixing Capability—Up to 16 DA4055s can be controlled by a 9055 control panel, or multiple control panels. These mixers can be distributed among multiple studios to provide limited digital audio mixing capacity at each point where it is needed.

Functional Diagram

Figure 1 provides a visual representation of the functionality the DA4055 provides. Two synchronous AES/EBU digital audio inputs enter the module where they are phase-aligned and decoded into four separate channels of audio. Each channel is adjusted for the desired input gain and polarity inversion. An input mixer stage combines the signals and applies the selected amount of output gain. The four mixed audio outputs pass through an output fader before entering a reformatter which converts the four channels back into two AES/EBU digital audio output streams.

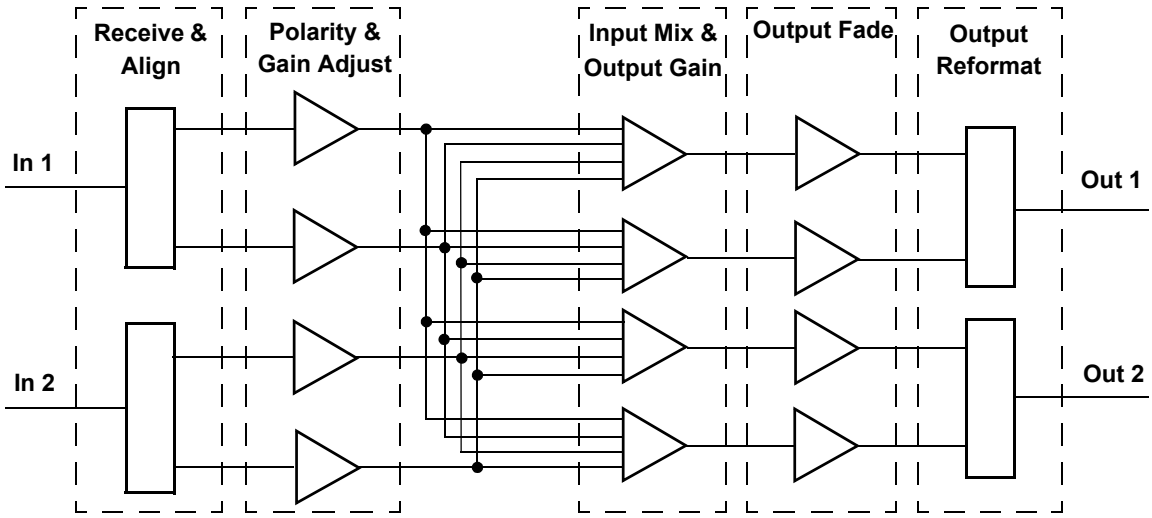

Figure 1. DA4055 Functional Block Diagram

Module Overview

The DA4055 module provides mixing and routing of four AES audio input channels to four audio output channels. It consists of two cards: a Processing Card that installs into a slot in the front of the 4000 frame and an I/O Card that installs in the back of the frame behind the Processing Card.

Processing Card Panel Description

Figure 2 shows the DA4055 front panel. Front panel LEDs, visible when the 4000 Series frame door is open, are described below.

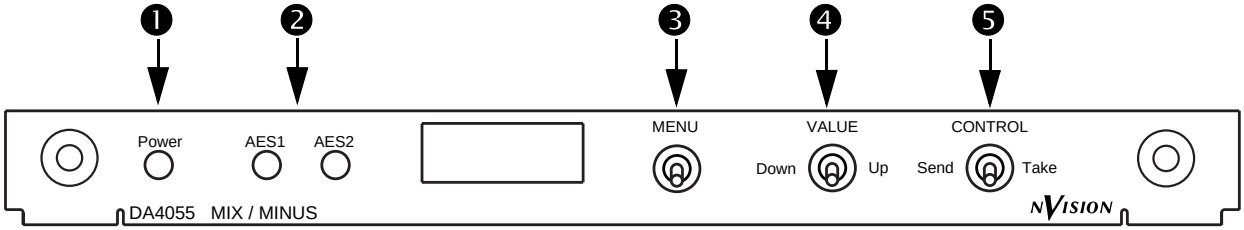

Figure 2. DA4055 Front Panel

1. This green Power LED is normally On to indicate that the module is receiving power from the NV4001 or NV4002 frame power supply through the motherboard. An on-board power supply regulator provides the +5VDC required by the module's circuits.

2. The green AES LEDs are normally On to indicate that the module is receiving the AES signals.

3. The MENU switch moves the menus in the display forward when you push the switch to the right and backward when you push it to the left. The menus are described in the following table.

4. The VALUE switch changes the value or selection of the current menu.When you push the switch left, the value decreases, and when you push the switch right, the value increases.

5. The CONTROL switch loads the new parameters that you set using the other two switches and restarts the output. Press the switch left or right to send the new parameters to memory and enable them to take effect.

I/O Card Panel Description

The I/O Card plugs into the back of the frame behind the DA4055 processing card and provides the external connectors for connecting signals to and from the DA4055. Balanced (twisted pair) and unbalanced (coax) versions of the I/O card are available and are chosen at the time the DA4055 is ordered, depending on the requirements of your facility. Figure 3 and the associated table illustrate the balanced and unbalanced DA4055 I/O Card panels and connector functions.

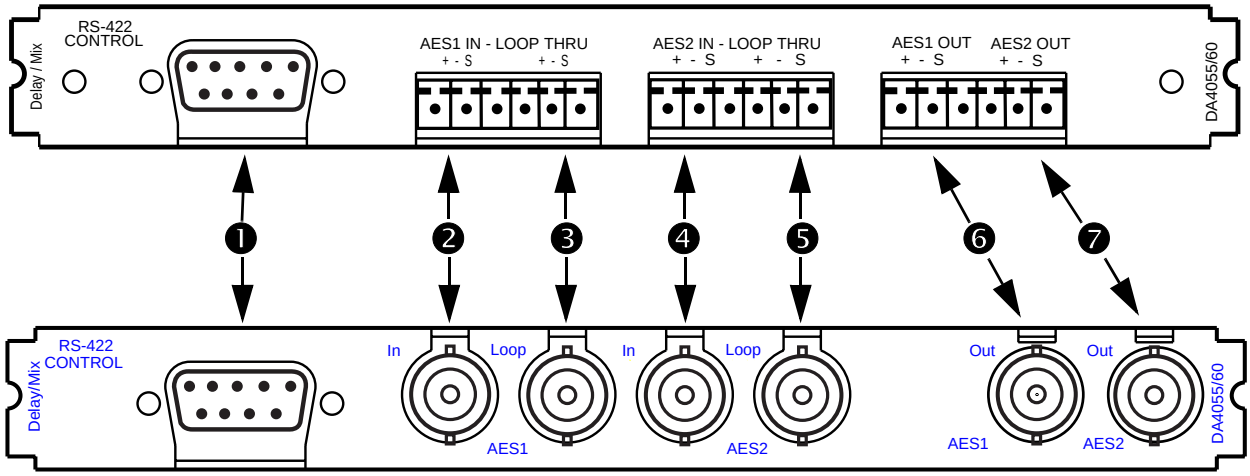

Figure 3. Balanced (top) and Unbalanced (bottom) I/O Card Panels

1. RS-422 Control 9-pin D connector. Connect to external controller, if desired.
2. AES 1 IN digital audio input. Connect a source of AES audio.
3. AES 1 LOOP-THRU. Connect to downstream equipment that will also use the AES 1 audio input.
4. AES 2 IN digital audio input. Connect a source of AES audio.
5. AES 2 LOOP-THRU. Connect to downstream equipment that will also use the AES 1 audio input.
6. AES 1 OUT digital audio output. Connect to equipment that will use audio output channels 1 and 2.
7. AES 2 OUT digital audio output. Connect to equipment that will use audio output channels 3 and 4.

Specifications

Table 1 lists specifications for the DA4055 module.

Table 1. DA4055 Product Specifications

TYPE	PARAMETER
Digital Audio Inputs	Signal Requirements: Both inputs must be synchronous (locked to the same sample rate reference). Phase may be random.
2 AES/EBU Balanced, Looping OR	Connector: Phoenix, pluggable screw-type terminals for twisted pair cable Input Impedance: 110Ω
2 AES/EBU Unbalanced, Looping	Connector: BNC for coaxial cable Input Impedance: 75Ω
Digital Audio Outputs	Outputs are synchronous and phase-aligned.
2 AES/EBU audio, balanced OR	Connector: Phoenix, pluggable screw-type terminals for twisted pair cable Output Impedance: 110Ω
2 AES/EBU audio, unbalanced	Connector: BNC for coaxial cable Output Impedance: 75Ω
Remote Control	
1 RS-422 ANSI/SMPTE 207M	Connector: 9-pin D Female Interface: RS-422, bidirectional, twisted pair, asynchronous, NVSP serial protocol Baud Rate: DIP switch selectable, 115.2 kbaud for NV9055 panel, 38.4 kbaud for NV9301/NV9302 panels. Uses 8 data bits, no parity, 1 stop bit, LSB sent first. Controlling Sense: Controlled Device
Performance	
Delay	5 AES frames
Differential Delay	None
Sample Rate	28 kHz to 54 kHz, continuous and tracking
Digital Resolution	24 bit inputs and outputs, 56 bit accumulator, 24 bit coefficient
General	
Power	3 Watts, ±15VDC input from 4000 Series frame, +5 VDC on-board.
Size	Processing Card: 0.563” (14.3mm) H x 6.125” (155.6mm) W x 12.375” (314.3mm) D. I/O Card: 0.563” (14.3mm) H x 6.125” (155.6mm) W x 2.938” (76.6mm) D.
Weight	1.25 lbs (0.6kg) max.

CONFIGURATION

Use the information that follows to configure your DA4055 when you receive the module (either separately or as part of your 4000 Series Processing Equipment frame) or if you are changing your use of the module. Configuring the DA4055 requires setting a jumper and a DIP switch as shown in Figure 4.

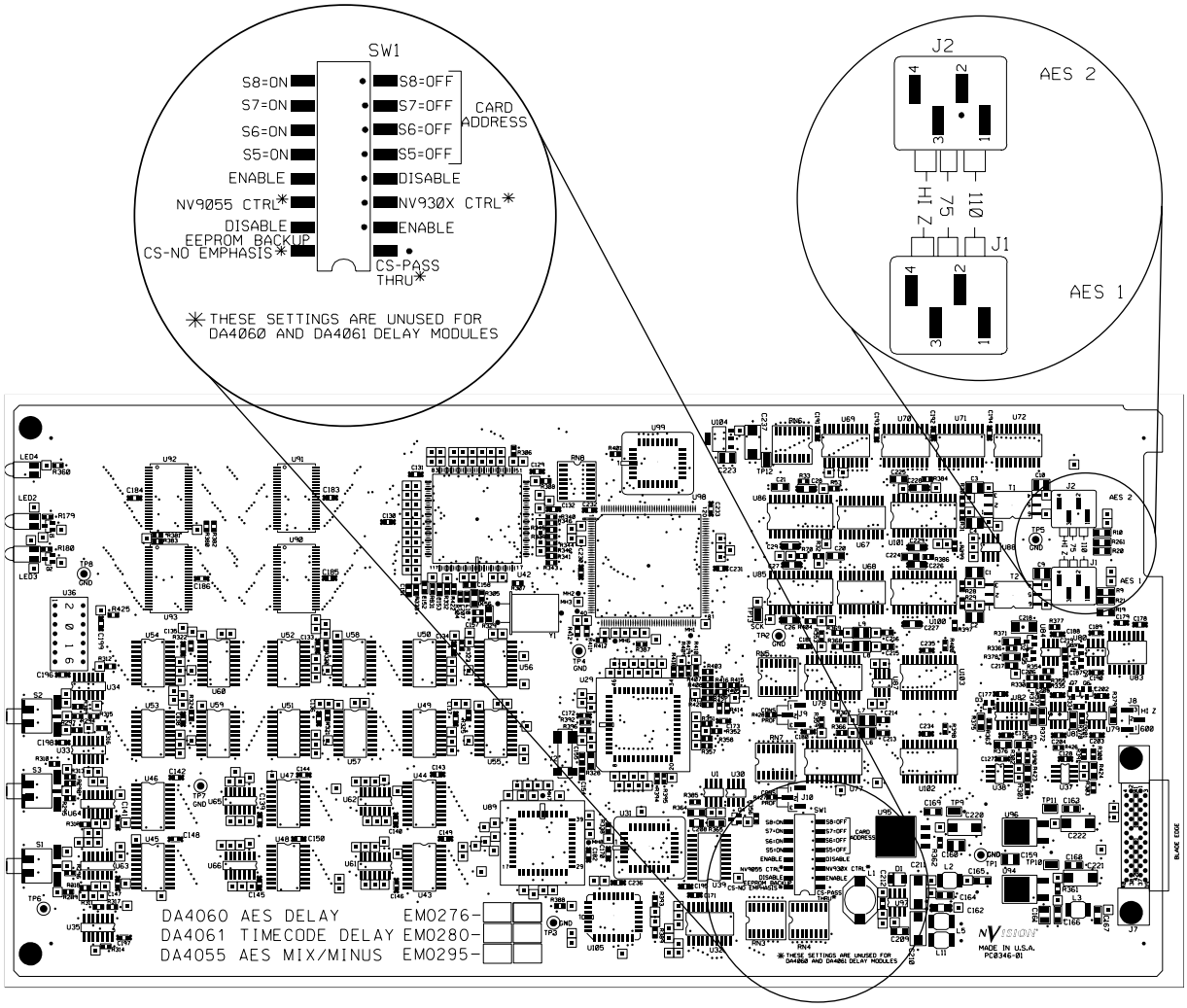

Figure 4. DA4055 Processing Card Jumpers and Adjustments

Jumpers J1 and J2

Use jumpers J1 and J2 to set the termination of inputs AES 1 and AES 2 as follows:

Pins 1-2	110Ω	No loop-thru, Balanced I/O Card
Pins 2-3	75Ω	No loop-thru, Unbalanced I/O Card
Pins 3-4	Hi-Z	Loop-thru, termination downstream

DIP Switch SW1

DIP switch SW1 sets a number of configuration parameters for the DA4055. Each of eight switches on SW1 can be separately set. When a switch is pushed toward the board front panel, it is ON; when it is pushed toward the rear edge connector, it is OFF. See Table 2 for settings.

Table 2. DIP Switch SW1 Settings

SWITCH	SETTING	FUNCTION
1	OFF ON	OFF sets emphasis bits in Channel Status data to the highest emphasis bit setting found in the inputs. ON forces emphasis bits in the Channel Status data to 100 (no emphasis) if all emphasis bits in an output are 000.
2	OFF	OFF enables EEPROM backup. At powerup, the DA4055 reads the last configuration stored in EEPROM and returns to that configuration. ON disables EEPROM backup. At powerup, the DA4055 resets to its power-on default state where each input passes directly to the corresponding output (1 to 1, 2 to 2, and so on) with no mixing or gain changes.
3	OFF ON	OFF sets RS-422 baud rate to 115.2 kbaud (NV9055 panel). ON sets RS-422 baud rate to 38.4 kbaud (NV9301/9302 panels).
4	OFF ON	OFF sets the module address according to the front panel config settings. ON sets the module address according to DIP switch SW1, switches 5-8. These four switches set a 4-bit binary card address between 0 and 15. The MSB is set by switch 8 and the LSB is set by switch 5.
5	OFF ON	OFF sets the card address LSB (1) to a binary 0 (zero). ON sets the card address LSB (1) to a binary 1.
6		OFF sets the card address LSB + 1 (2) to a binary 0 (zero). ON sets the card address LSB +1 (2) to a binary 1.
7		OFF sets the card address LSB + 2 (4) to a binary 0 (zero). ON sets the card address LSB +2 (4) to a binary 1.
8		OFF sets the card address MSB (8) to a binary 0 (zero). ON sets the card address MSB (8) to a binary 1.

INSTALLATION

The module can be installed (by qualified personnel only) with frame power on. Installation entails inserting the processing module into an available front slot of the 4000 frame and inserting the I/O module in the rear slot directly behind the processing module. For module installation procedures, please see “Section 2: Installation” of the 4000 System Manual.

Cabling

Make cable connections to the I/O panel using the connector information in Figure 3, which shows the I/O panel and explains the function of each connector. Information about connector wiring is given below.

Balanced I/O Connectors (Phoenix)

Figure 5 shows how to connect audio I/O to the terminal block connectors. Connect the conductors to the + and - screw terminals and the shield to the S screw terminal. Then plug the connector into the connector block on the back of the I/O card.

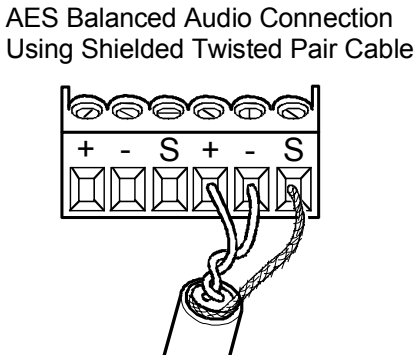

Figure 5. Phoenix Connector Pin Assignments and Wiring

RS-422 Remote Control Connector

For remote control of the DA4055, connect the RS-422 Remote Control connector to an NVISION NV9055, NV9301, or NV9302 control panel using a standard, straight-through RS-422 serial cable. See Figure 6 for connector pin assignments.

Note: The NV9055, NV9301, and NV9302 panels detect and display the DA4055 as an NV1055 card. This does not affect functionality. All panel controls for the NV1055 work in exactly the same way for the DA4055.

Panels made by other manufacturers may also be used if they follow the NVSP protocol; be sure to verify the connector pin-out of the OEM panel and wire your serial cable accordingly.

If you want to connect multiple modules to a single control panel, you can use ribbon cable and IDC connectors to fabricate a single looping cable to connect the cards together in a daisy chain. The cable length that the cards will tolerate may be limited and prone to interference. Keep the cable as short as possible by locating the 4055 modules in the same or adjacent frames.

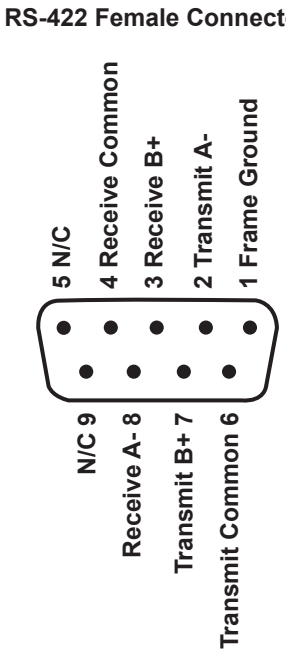

Figure 6. RS-422 Remote Control Connector Pin Assignments

OPERATION

The following pages explain operation of the three front panel switches and the 4-character LED display. The display shows various codes corresponding to menus and selections within the menus. The three switches control those selections. Note that the functionality available at the front panel is limited. To use the full functionality of the DA4055, you should use an NV9055, NV9301, or NV9302 panel to control the module.

Menu Switch

The MENU switch causes the display to scroll forward or backward through the menus. Pushing the switch to the left scrolls backwards, and pushing it to the right scrolls forward. When the desired menu is displayed, use the VALUE switch to change the values associated with the current menu. When the values are set, press MENU to move to another menu.

Value Switch

The VALUE switch toggles or scrolls through the available values for the current menu or parameter within a menu. Typically, the menu or parameter currently available for changing blinks. Pushing the switch to the left scrolls Down through the values, and pushing it to the right scrolls Up, as indicated on the front panel silkscreen. When the desired value is displayed, press the MENU button to move to the next character or menu.

Control Switch

Pressing the CONTROL switch left or right (both directions have the same effect) within 30 seconds of the last value change commits the new configuration to memory. After a brief initialization, the module reconfigures itself to the new settings and becomes available for use.

Note: If you do not press CONTROL within 30 seconds of the last parameter change, your changes will be lost and you must reenter them.

LED Display

The LED display shows a variety of menus and blinks to show the current value that may be set in the menu. The following table lists the available functions as they appear in the display.

Table 3. DA4055 Menu Functions

FUNCTION	DISPLAY	EXPLANATION
Module Address	ADnn EAnn	Displays the 4-digit binary address (0-15) of the DA4055 card used by control panels/systems. **AD** indicates the card's EEPROM is set by SW1-2 to power up using default settings. **EA** indicates the card's EEPROM is set by SW1-2 to power up using last remembered settings. **nn** represents the address number: 01, 02, ...15
Input Phase Inversion	**IP1+** or **IP1-** **IP2+** or **IP2-** **IP3+** or **IP3-** **IP4+** or **IP4-**	Sets each input for inverted or normal phase. **IP** stands for Input Phase. **Numbers** indicate the input number. + (plus) = normal phase - (minus) = inverted phase
Monaural Output	1M1, 1M2, 1M3, 1M4 2M1, 2M2, 2M3, 2M4 3M1, 3M2, 3M3, 3M4 4M1, 4M2, 4M3, 4M4	Selects an output to which a monaural input will be routed with unity gain. **First digit** specifies the output channel. **M** specifies monaural. **Last digit** specifies the input channel.
Stereo Mix with Attenuation	1S12, 1S13, 1S14, 1S21, 1S23, 1S24, 1S31, 1S32, 1S34, 1S41, 1S42, 1S43. 2S12, 2S13, 2S14, 2S21... 3S12, 3S13, 3S14, 3S21... 4S12, 4S13, 4S14, 4S21...	Selects an output to which a stereo mix of two inputs will be routed with 50% attenuation of each input. **First digit** specifies the output channel. **S** specifies stereo. **Third digit** specifies an input channel or silence (-). **Fourth digit** specifies an input channel or silence (-).
Stereo Mix with No Attenuation	1SNA, 2SNA, 3SNA, 4SNA	Selects an output channel to which a stereo mix of two fixed inputs will be routed with no attenuation. **First digit** represents the output channel. **SNA** represents Stereo No Attenuation. **Outputs 1 and 2** pass Inputs 1 and 2. **Outputs 3 and 4** pass Inputs 3 and 4.
Three-Way Mix with No Attenuation	1TWM, 2TWM, 3TWM, 4TWM	Selects an output channel to which a stereo mix of three fixed inputs will be routed with no attenuation. **First digit** specifies the output channel. **TWM** specifies Three-Way Mix. **Output** passes Inputs 1, 2, and 3.
Special Quad Mix	1SPQ, 2SPQ, 3SPQ, 4SPQ	Selects an output channel to which a stereo mix of all four input channels will be routed. **First digit** specifies the output channel. **SPQ** specifies Special Quad Mix. **Output** passes Inputs 1 and 2 with 50% attenuation and Inputs 3 and 4 with no attenuation (100%).

Operational Procedures

The following steps explain how to perform typical operations.

Initial Testing

The first operation to perform is to set up all inputs to go straight through to the outputs so you can verify that the system is passing signals correctly:

1. Remove the DA4055 Processing Card and set DIP switch SW1-2 ON so that the system powers up in its default state, which passes each input to its corresponding output.
2. When you reinsert the card, it will power up in the default state. With known good signals applied to the inputs, check that the same signals appear at the corresponding outputs.
3. When finished testing, set SW1-2 to the desired normal operating mode: ON to boot up in the default state, or OFF to boot up using the last remembered configuration. OFF is recommended.

Setting Input Phase

1. If the module has just been rebooted, the card address currently appears in the display. Press the MENU button once to the right to show the Input 1 phase: IP1+ or IP1-.
2. Push the VALUE button left or right to change the phase sign from + to - or vice versa. The + (plus) indicates normal phase, and a - (minus) indicates inverted phase.
3. Press the MENU button to the right again to display the phase of Input 2 and set the VALUE of that input. Repeat for all four inputs.
4. When finished, press the CONTROL button in either direction to save the changed configuration.

Setting the Mix Configuration for Output 1

1. The output channel mixer menu for input channel 1 appears after the input phase menus. Press the MENU button once to the right to display output 1.
2. If necessary, press the MENU button to the right until the second digit in the display blinks, allowing you to set the mix type.
3. Press the VALUE button to the right to scroll through the values available for the second digit: M = monaural, S = stereo, SNA = stereo without attenuation, TWM = three-way mix, or SPQ = special quad mix.
4. If you selected M or S, press MENU again to move to the third digit of the display. Then press VALUE again to move through and select the available values. For SNA, TWM, and SPQ, there are no additional values. For M (mono) or S (stereo) you can select the input number for one of the inputs in the mix, or select a - (minus) for silence.
5. If you selected stereo mode (S), press MENU one more time. Press VALUE to scroll through the available numbers specifying the second input in the stereo mix. The second input must be different from the first or an error message will appear.

6. This completes the setup for Output 1. To go to Output 2, press MENU again. A 2 should appear in the first digit of the display. Configure Output 2 the same way you did Output 1. Repeat for all four outputs.
7. When you are finished configuring the outputs, press CONTROL in either direction within 30 seconds of the last value change to store the configuration in memory and reinitialize the module. After reinitialization, the module is ready to use with the new configuration.

Error Messages

The following messages (Table 4) may appear in the DA4055 LED display. Corrective actions are indicated in the explanations.

Table 4. DA4055 Error Messages

DISPLAY MESSAGE	EXPLANATION
AD01	The DA4055 has been powered on with the EEPROM backup enabled. See DIP Switch definition for switch SW1-2. The number following the AD is the current address of the DA4055 card.
EEPROM READ ERROR	The DA4055 has been powered on with the EEPROM backup and a value is out of range. The DA4055 is reset to default values and will run normally. This can occur if a board is initially powered on with DIP switch SW1-2 OFF when valid data has not been previously stored in the EEPROM.
CH1/2 NO INPUT	There is no valid input data on the channel 1/2 input. The DA4055 locks to the channel 1/2 input. If there is no data present then no data is processed on channels 1/2 or 3/4.
CH3/4 NO INPUT	There is no valid input data on the channel 3/4 input. This is usually seen when there is valid data on channels 1/2 and data on channels 3/4 has disappeared.
CH1/2 BIPHASE ERR	A bi-phase coding error has been found in the channel 1/2 data stream. This message sometimes appears when a cable is unplugged and a bi-phase error is detected before the input lock is lost. If lock is lost, audio processing stops.
CH3/4 BIPHASE ERR	A bi-phase coding error has been found in the channel 3/4 data stream. This message sometimes appears when a cable is unplugged and a bi-phase error is detected before the input lock is lost.
PARITY ERR CH1/2	A parity error has been detected in the channel 1/2 data stream. Audio processing is not interrupted.
PARITY ERR CH3/4	A parity error has been detected in the channel 3/4 data stream. Audio processing is not interrupted.
AD MIX	Trying to mix a channel with itself causes this error. Select two different channels for the mix.

THEORY OF OPERATION

Please refer to Figure 7. The DA 4055 Audio Mix/Minus card receives the two AES input streams from the rear connectors via the backplane. The signals are transformer-coupled to AES Receivers U100 and U101, which extract timing and Channel Status data from the serial input stream. Channel Status Bit information is fed to U29, the 68HC11 processor which provides control of the front panel switch and display interface, the RS-422 remote control interface, and the audio output processing circuits.

Input channel data and timing signals are processed by U98, the XILINX field programmable gate array (FPGA), to provide timing and control of the input processing circuitry. Timing and phase alignment are derived from the Input 1 data stream, which must be present for the module to work properly. Input 2 must be synchronous with Input 1 but need not be exactly phase-aligned with it. The FPGA detects the timing difference between the two inputs, and brings them into phase alignment by adding delay as required.

Two SIPOs (Serial In Parallel Out) ICs convert the data streams from serial to parallel and separate the two audio channels out of each audio data stream. The audio input channels are then applied to U42, the DSP56002 Digital Signal Processor, where mixing, gain adjustments, phase inversion, and fades occur based on the configuration set by the user and stored by the microprocessor.

Following the mixing stage the processed audio channels pass through a Parallel In Serial Out (PISO) stage that converts them back to serial audio streams. Serial transmitters U77 and U78 add appropriate clocks from the FPGA and CS data from the microprocessor to produce standard AES audio signals. These signals are then driven to the outputs on the I/O card via the backplane.

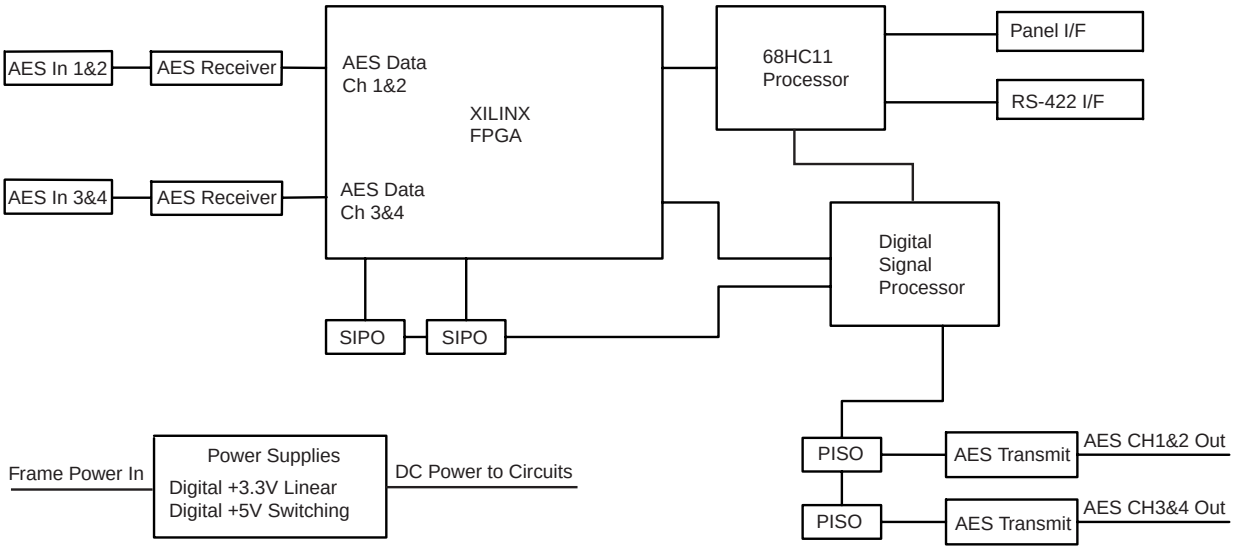

Figure 7. DA 4055 Simplified Block Diagram

TROUBLESHOOTING & MAINTENANCE

The module requires no routine maintenance. If it does not appear to operate correctly, first reseat the module in the frame to ensure good internal connections and then check that the Power indicator on the front of the module is lit. If the signal exhibits problems, check signal sources, cables, terminations, and switch/jumper settings, if any. For technical assistance, call 1-530-265-1000 or send email to *nvsupport@nvision1.com*.

Table 5 lists common problems and their solutions in likely order of occurrence.

Table 5. Troubleshooting Checklist

SYMPTOM	POSSIBLE CAUSES AND SOLUTIONS
Module not functioning at all.	- Check the Power LED on the front panel. If it is not lit, make sure the module is properly seated in the frame. If it is lit, replace the DA4055 with a known good board. - Check the frame to be sure the AC line cord is plugged in. - Check the test points on the front of the frame Power Supply(s) for correct DC voltages as explained in the Maintenance section of the main 4000 manual. Replace the Power Supply if any voltages are incorrect.
Weak, distorted, or missing output signal.	- Check the AES audio sources. If Input 1 is missing or out of sync with Input 2, the DA4055 will not function. - Check all cables and connections. - Check for proper termination. - Check each signal path. To do this reset the board to its default configuration, which routes each input directly to the corresponding output. (The default configuration is enabled by setting DIP swithch SW1-2 ON. See “DIP Switch SW1” on page 7 for details.)
Remote Control not working or intermittent.	- Check the serial cable between the DA4055 and the controlling device for continuity on all pins. - Reset both the DA4055 and the controller. To reset the DA4055 pull the board out and reinsert it. - Check baud rate and other communication settings at both ends of the cable. For DA4055 settings, see “DIP Switch SW1” on page 7.

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