DA4060
AES/EBU Delay Compensator
User Guide

The DA4060 AES/EBU Delay Compensator adds user-adjustable delay to two serial AES/EBU audio streams (four audio 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.

Features

Key features of the DA4060 are listed below:

- Four-channel I/O (2 synchronous AES digital audio inputs/outputs) exactly matches audio capabilities of digital VTRs
- More than 2.5 seconds maximum delay. Exact maximum depends on sample rate.
- Easy front-panel selection and display of video format and audio sample rate allow automatic delay calculation in AES frames.
- Timing is derived from AES input
- 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.

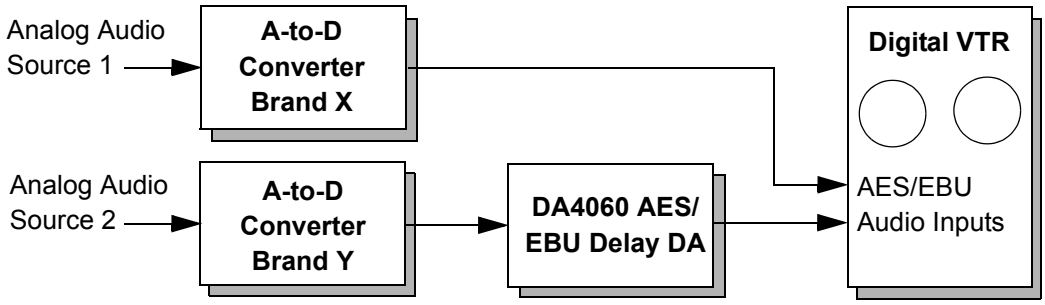
Applications

Typical applications for the DA4060 include the following:

- Compensate for different delay through different audio digital-to-analog converters.
- Compensate for video delay by applying an equal amount of audio delay to maintain lip sync.

These applications are illustrated in Figure 1.

A-to-D Converter Compensation



Compensation to match audio delay to video delay

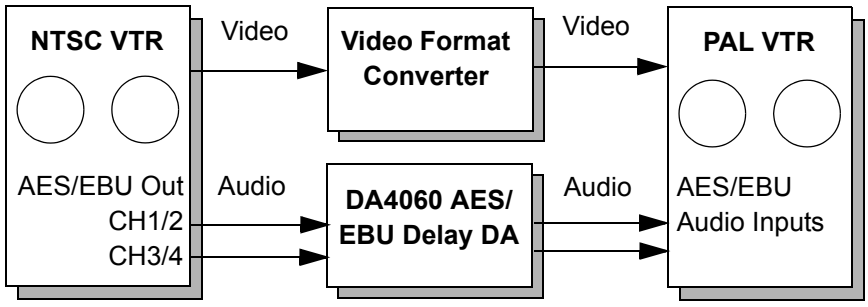


Figure 1. DA4060 Applications

Processing Card Panel Description

Figure 2 illustrates the DA4060 front panel. Front panel LEDs, visible when the 4000 Series frame door is open, are described below.

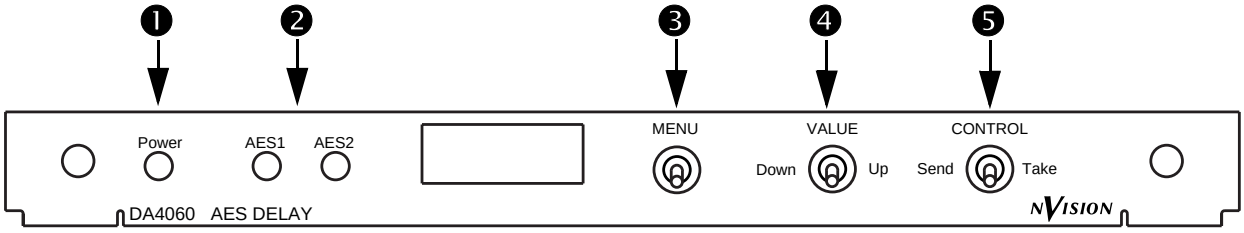


Figure 2. DA4060 AES/EBU Delay Compensator Panel

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 of the current menu selection.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 DA4060 processing card and provides the external connectors for connecting signals to and from the DA4060. Balanced (twisted pair) and unbalanced (coax) versions of the I/O card are available and are chosen at the time the DA4060 is ordered, depending on the requirements of your facility. Figure 3 and the associated table illustrate the balanced and unbalanced DA4060 I/O Card panels and connector functions.

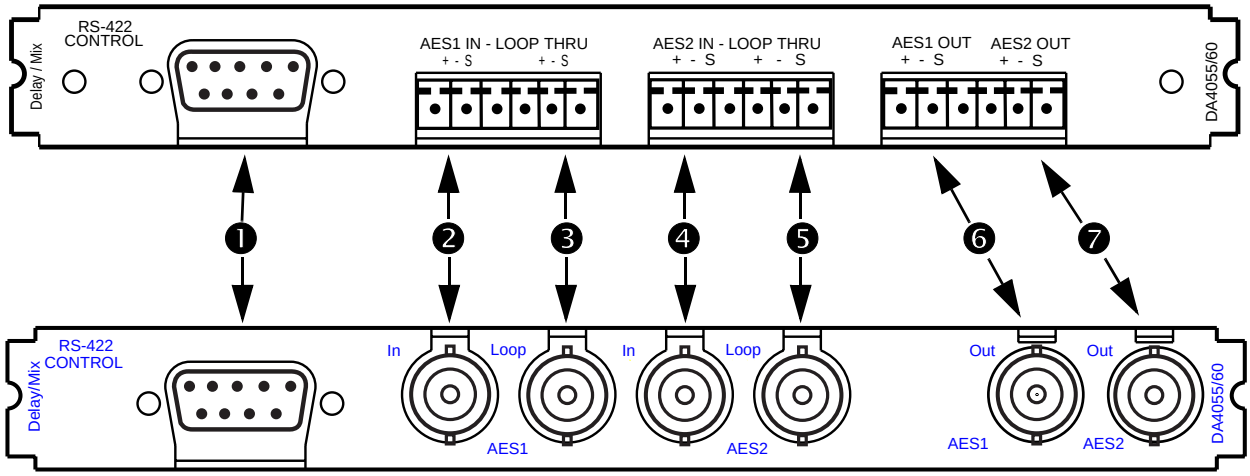


Figure 3. Balanced (top) and Unbalanced (bottom) I/O Card Panels

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 DA4060 module.

Table 1. DA4060 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 or Hi-Z.
2 AES/EBU Unbalanced, Looping	Connector: BNC for coaxial cable Input Impedance: 75Ω or Hi-Z.
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 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 Range	5 AES frames, minimum to 2.62 seconds (78.5/65.5 NTSC/PAL frames) maximum
Delay Resolution	1 AES/EBU frame
Differential Delay	None
Sample Rate(s)	Selectable: 32, 44.056, 44.1, 44.14, 47.952, 48.0, 48.048, or 50 kHz
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 DA4060 AES/EBU Delay Compensator 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 DA4060 requires setting jumpers and a DIP switch as shown in Figure 4.

DIP Switch SW1

DIP switch SW1 sets a number of configuration parameters for the DA4060. 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	UNUSED	UNUSED
2	OFF	OFF enables EEPROM backup. At powerup, the DA4060 reads the last configuration stored in EEPROM and returns to that configuration. ON disables EEPROM backup. At powerup, the DA4060 resets to its power-on default state.
3	UNUSED	UNUSED
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 (8) is set by switch 5 and the LSB (1) is set by switch 8.
5	OFF ON	OFF sets the card address MSB (8) to a binary 0 (zero). ON sets the card address MSB (8) to a binary 1.
6	OFF ON	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.
7	OFF ON	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.
8	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.

Jumpers J1 and J2

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

Pins 1-2 110ΩNo loop-thru, balanced I/O Card
Pins 2-3 75ΩNo loop-thru, unbalanced I/O Card
Pins 3-4 Hi-ZLoop-thru, termination downstream

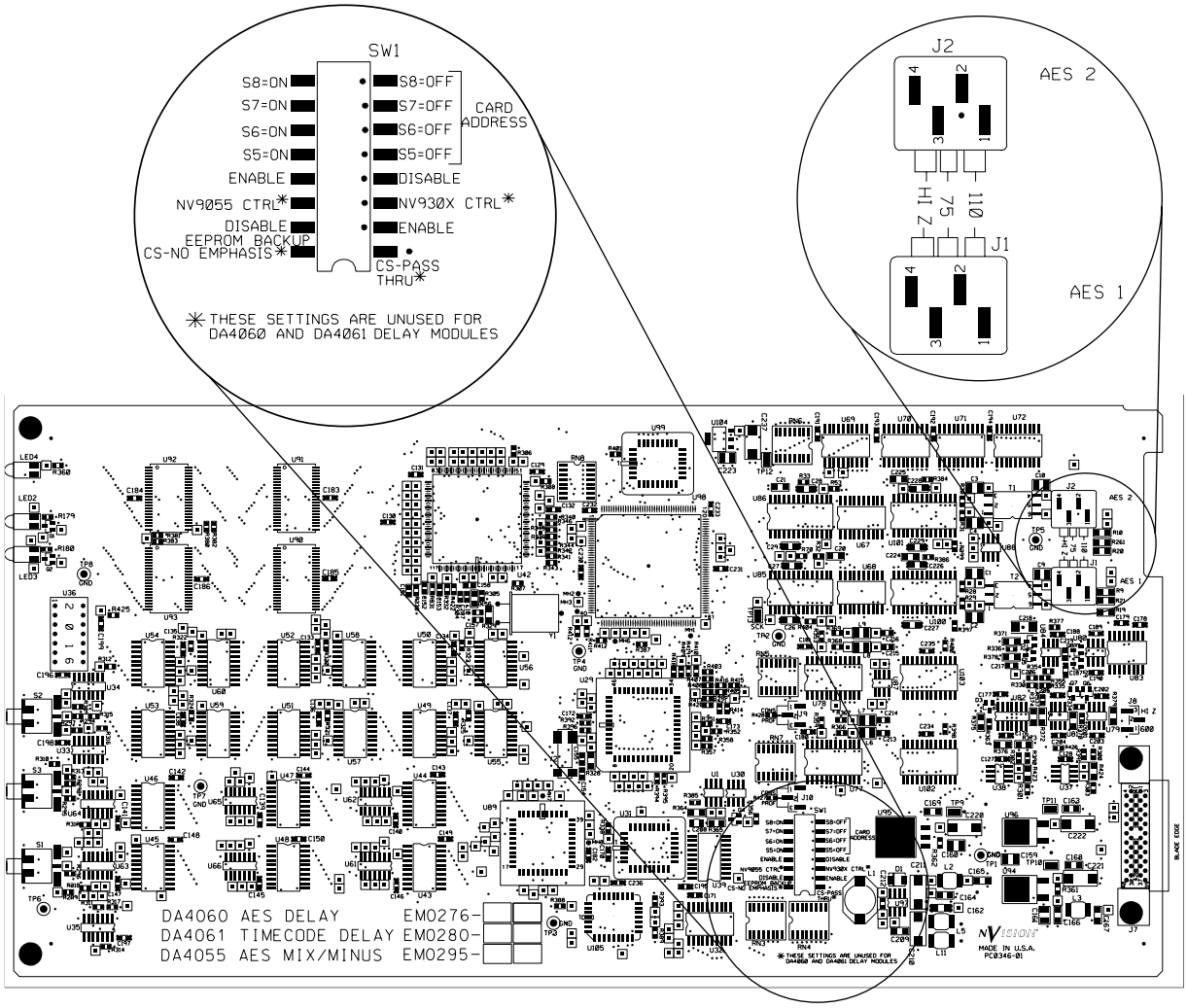


Figure 4. DA4060 Card Switch and Jumper Locations

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.

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.

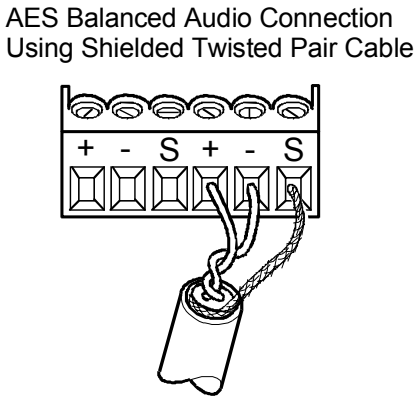


Figure 5. Phoenix Connector Pin Assignments and Wiring

RS-422 Remote Control Connector

For remote control of the DA4060, connect the RS-422 Remote Control connector to an NVISION NV9301 or NV9302 control panel using a standard, straight-through RS-422 serial cable. See Figure 6 for connector pin assignments. The baud rate for the DA4060 and the control panels is fixed at 38.4 kBaud, 8 bits, no parity, 1 stop bit.

Note: The NV9301 and NV9302 panels detect and display the DA4060 as an NV1060 card. This does not affect functionality. All panel controls for the NV1060 will also work in exactly the same way for the DA4060.

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 DA4060 modules in the same or adjacent frames.

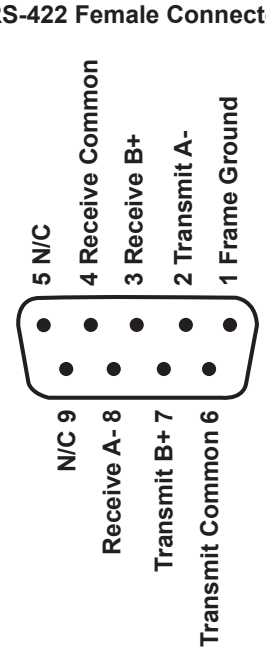


Figure 6. RS-422 Remote Control Connector Pin Assignments

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.

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 as desired, press MENU to move to the next parameter or menu.

Value Switch

The VALUE switch toggles or scrolls through the available values for the current menu or parameter within a menu. Typically, the 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 value you desire is displayed, pressing the MENU button retains the value and moves you to the next menu or parameter.

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.

Delay Calculation

The menu system listed in Table 3 sets the delay using video frames for gross increments and adds AES/EBU frames for fine increments. The formula for calculating the total delay in AES/EBU frames is:

((No. of Video Frames/Frame Rate) * AES Frame Rate) + No. of AES Frames

To arrive at a desired delay setting, follow these steps:

1. Set the number of video frames to the closest value that is lower than the desired delay.
2. Set the number of AES/EBU frames to fine tune the video frame setting to the final value. In most applications, a resolution of one half video frame is sufficient to achieve lip sync.

Example delay settings are presented on the following pages.

Table 3. DA4060 Menu Functions

MENU NO.	FUNCTION	DISPLAY	EXPLANATION
1	Video Format	PAL or NTSC	Sets the video format for PAL or NTSC.
2	Delay in Video Frames	0N1 to 78N5 or 0P5 to 78P5	Sets the amount of audio delay in video frames. The alphabetic character stands for NTSC or PAL and also takes the place of a decimal point. For example, 20N5 equals 20.5 NTSC frames of delay.
3	Sample Rate	 32A0 44A0 44A1 44A2 47A9 48A0 48A1 50A0	Sets the digital audio sample rate: 32.0 kHz 44.056 kHz 44.1 kHz 44.144 kHz 47.952 kHz 48.0 kHz 48.048 kHz 50.0 kHz
4	Delay in Audio Frames	A5 - A999	Sets the number of audio frames of delay. For example, A5 equals five frames of audio delay. The frames of audio delay are added to the frames of video delay to arrive at a total amount of delay applied to the digital audio streams.
5	CH 3/4 Offset	+1 0 -1	Offset delay of Channels 3 and 4 compared to Channels 1 and 2 by zero, plus one, or minus one AES frame.

Operational Examples

The following steps explain how to perform typical delay operations.

Example 1

Set the delay to 7 NTSC frames, the incoming audio sample rate to 48 kHz, and Channels 3/4 in phase with Channels 1/2:

Menu 1 = NTSC

Menu 2 = 7N0

Menu 3 = 48A0

Menu 4 = A0

Menu 5 = D0

The total delay in AES frames is [(7/29.97) * 48000] = 11211 frames.

Example 2

Set the delay to 190 mS using PAL frames, the incoming audio sample rate to 44.1 kHz, and Channels 3/4 to be one frame delayed compared to Channels 1/2:

1. To calculate the gross delay: 190/(1/25) = 4.75 PAL frames. The nearest lower menu value is 4.5 or 4P5.
2. To calculate the additional fine delay, 1/25 * 4.5 PAL frames = 180 mS. This leaves 10 mS to be added: .010 * 44100 = 441 AES frames.

Set the menus as follows:

Menu 1 = PAL

Menu 2 = 4P5

Menu 3 = 44A1

Menu 4 = A441

Menu 5 = D -1

The total delay of Channels 1/2 in AES frames is [(4.5/25) * 44100] + 441 = 8379 frames. Channel 3/4 = 8380 audio frames.

Example 3

Set the delay to 470 AES/EBU frames, the incoming audio sample rate to 48 kHz, and Channels 3/4 in phase with Channels 1/2:

Menu 1 = any setting

Menu 2 = 0?0

Menu 3 = 48A0

Menu 4 = A470

Menu 5 = D0

Example 4

Set the delay to 3.5 NTSC video frames and an additional 20 AES/EBU audio frames, the incoming audio sample rate to 50 kHz, and Channels 3/4 delayed one audio frame more than with Channels 1/2:

Menu 1 = NTSC

Menu 2 = 3N5

Menu 3 = 50A0

Menu 4 = A20

Menu 5 = D -1

The total delay of Channels 1/2 in AES frames is [((3.5/29.97) * 50000)) + 20] = 5859.167 truncated to 5859 frames. Channel 3/4 = 5860 audio frames.

ERROR MESSAGES

The following messages (Table 4) may appear on the DA4060 LED display. Corrective actions are indicated in the explanations.

Table 4. DA4060 Error Messages

DISPLAY MESSAGE	EXPLANATION
AD01	The DA4060 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 DA4060 card. This is an informational message rather than an error indication.
EEPROM READ ERROR	The DA4060 has been powered on with the EEPROM backup and a value is out of range. The DA4060 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 DA4060 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. Use the MENU or VALUE switch to clear the error.
PARITY ERR CH3/4	A parity error has been detected in the channel 3/4 data stream. Audio processing is not interrupted. Use the MENU or VALUE switch to clear the error.
ERROR XXXXH Example: 0010 Hex equals 16 Decimal equals 10000 binary. The one at bit 4 in the binary number indicates Ch 3/4 memory test error.	ERROR message followed by a 4-character Hexadecimal number indicates a problem associated with the SRAM that provides audio delay. Call NVISION Technical Support if this error message appears. To decode the hex number, convert it to binary. The problem is encoded in the bits as follows: Bit 0: Memory size error Bit 1: Ch1/2 and Ch3/4 SRAM sizes differ Bit 2: Reserved for future use Bit 3: Ch1/2 memory test error Bit 4: Ch 3/4 memory test error Bit 5: Memory cleared correctly Bit 6: Reserved for future use Bit 7: Reserved for future use

THEORY OF OPERATION

Please refer to Figure 7 as you read this portion of the manual. The DA4060 Delay DA receives the two AES input streams from the rear connectors via the backplane. The signals are transformer-coupled to AES Receivers U85 and U86, 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 via a FIFO (First In First Out) register.

Two SIPOs (Serial In Parallel Out) ICs convert the data streams from serial to parallel. The audio input channels are then clocked into SRAM memory where they are delayed under the control of Microprocessor U29 and Digital Signal Processor (DSP) U42. The amount of delay applied corresponds to the amount of delay specified by the user via the front panel controls or the remote control panel.

Following the delay stage the processed audio channels pass through a Parallel In Serial Out (PISO) stage that converts them 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 driven to the outputs on the I/O card via the backplane.

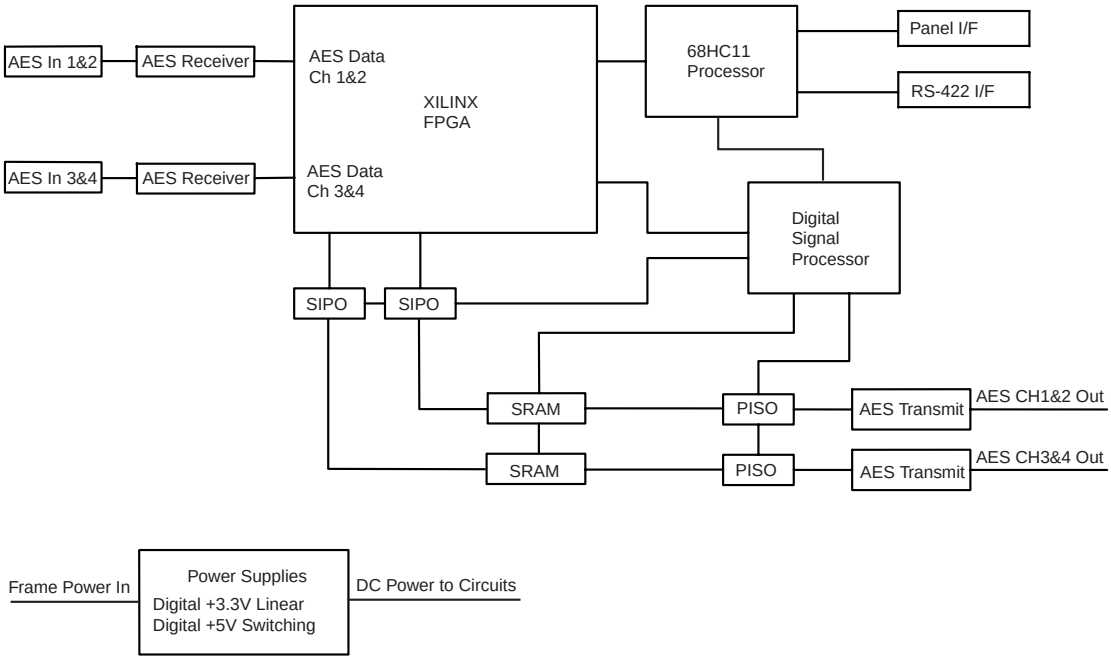


Figure 7. DA4060 Simplified Block Diagram

TROUBLESHOOTING & MAINTENANCE

The module requires no routine maintenance. Table 5 lists common problems and their solutions in approximately the most likely order of occurrence. For technical assistance, call 1-530-265-1000 or send email to *nvsupport@nvision1.com*.

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 DA4060 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 DA4060 will not function. - Check all cables and connections. Damaged or poor quality cable or cables runs that are too long can affect audio quality. - 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 6 for details.)
Signal not locked to video	- Check delay calculations. Incorrect delay may cause loss of lock.
Error message relating to SRAM that cannot be resolved.	Call NVISION Technical Support
Remote Control not working or intermittent.	- Check the serial cable between the DA4060 and the controlling device for continuity on all pins. - Reset both the DA4060 and the controller. To reset the DA4060 pull the board out and reinsert it. - Check baud rate and other communication settings at both ends of the cable. For DA4060 settings, see “DIP Switch SW1” on page 6.

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