

Audio/Serial Option User's Guide

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Introduction

This guide documents the Silicon Graphics® Audio/Serial Option:

- Chapter 1, “Overview and Theory of Operation” lists the basic capabilities of the Audio/Serial Option and provides block diagrams of the board functions.
- Chapter 2, “Using the Serial Ports” describes how to connect devices to the serial ports, supported baud rates, device file names for the serial ports, and how to switch the serial ports between RS-232 and RS-422 protocols.
- Chapter 3, “Using Audio” documents how to connect devices to the audio jacks, how to adjust the input and output audio levels, and how to use the line-level inputs and outputs in two-channel and four-channel modes.
- Appendix A, “Connector Pinouts” provides detailed specifications for the Audio/Serial Option, and documents the board’s connectors and the signals present on each pin.

This document is designed to give you an overview of using both the serial ports and the audio capabilities of the Audio/Serial Option. The audio features and standard serial features of the Audio/Serial Option are documented in a variety of existing guides and reference pages. The next section, “Additional Documentation and Information” provides a list of those sources.

Additional Documentation and Information

In addition to the *Audio/Serial Option User's Guide*, additional information is available from several different sources.

See the *Audio/Serial Option Release Notes* for up-to-the-minute information on the product. Release notes are provided online, and can be viewed using the following commands:

- | | |
|------------------|--|
| <i>relnotes</i> | A text-based release notes viewer, available by typing relnotes at a shell prompt. |
| <i>grelnotes</i> | A graphical release notes viewer, which is available from the Help menu of the Toolchest, or by typing grelnotes at a shell prompt. |

Serial Documentation

For more information about using and configuring serial ports, see the *Personal System Administration Guide*, the *IRIX Advanced Site and Server Administrator's Guide*, and the *serial(7)* reference page.

Note: One section of the *Personal System Administration Guide* does not apply to the Audio/Serial Option. The section "Setting Up Peripheral Connections" describes the Port Tool, which does not work with the Audio/Serial Option.

For information on writing STREAMS based applications for the Audio/Serial Option, see *asoser(7)* and *streamio(7)*. For information on writing memory-mapped (non STREAMS) applications, see *asoserns(7)* and the file */usr/include/sys/asoser.h*.

Audio Documentation

For an overview of the various audio commands, including available online reference pages, see *audio(1)*.

See the *Media Control Panels User's Guide* and the *Media Tools User's Guide* for more information about using audio tools, including making and playing back recordings and editing sound files.

For information on developing audio applications, see the *IRIS[®] Digital Media Programming Guide* and the *Apple[®] Audio Interchange File Format – AIFF-C Specification*, which are available from Silicon Graphics in the IRIS Digital Media documentation kit.

Chapter 1

Overview and Theory of Operation

This chapter provides an overview of the Audio/Serial Option, including block diagrams of the serial and audio portions of the mezzanine card.

Overview and Theory of Operation

This Chapter provides an overview of the Audio/Serial Option, describing the various connectors and basic functions.

Description

The Audio/Serial Option provides the following capabilities:

- Audio Library-compatible audio input and output.
- Audio capabilities that are functionally equivalent to those provided on the Indigo² and Indy, including dedicated line-level in and out, serial digital audio in and out, headphone output, and microphone input.
- Line-level audio input and output in either two-channel mode or four-channel mode.
- Six serial ports, switchable through software between RS-422 and RS-232.
- Serial port speeds of up to 38400 baud using standard utilities (such as *getty* and *cu*) and up to 115,200 baud through user-developed applications. User-developed applications can use either STREAMS or, for lower latency, memory-mapped I/O.

Caution: Although the Audio/Serial Option serial ports can function at speeds beyond 115,200 baud, such higher rates are not supported. Operating beyond 115,200 baud can result in loss of serial characters and overall degraded performance.

Block Diagram of the Audio/Serial Option

Figure 1-1 is a block diagram of the Audio/Serial Option board, showing the serial subsystem and its relation to the audio subsystem.

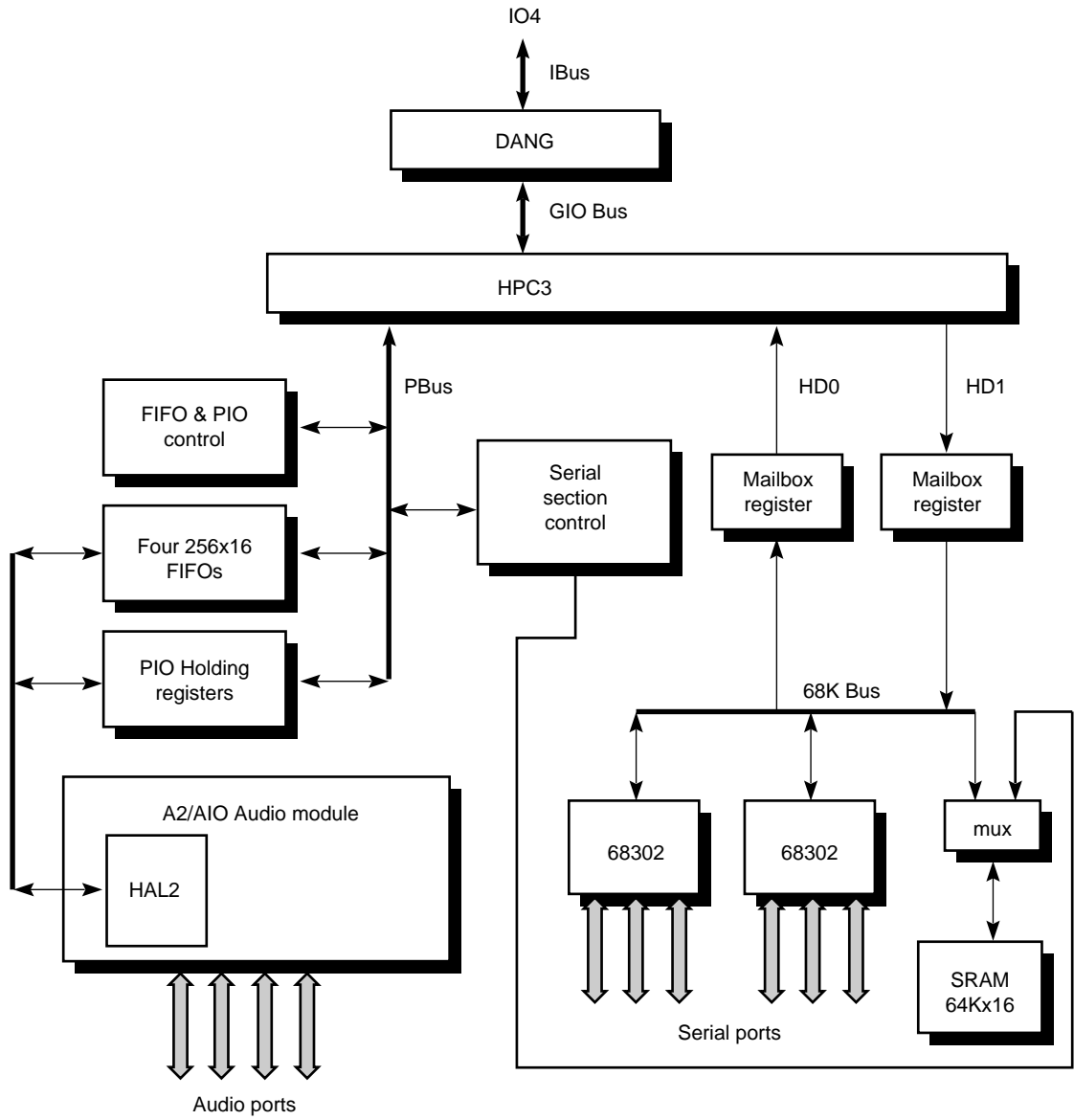


Figure 1-1 Block Diagram of the Audio/Serial Option

Serial Subsystem

The serial subsystem provides six DB-9 female serial connectors, each of which are selectable in software between RS-232 and RS-422 modes. Figure 1-2 shows how the ports are arranged on the connector plate.

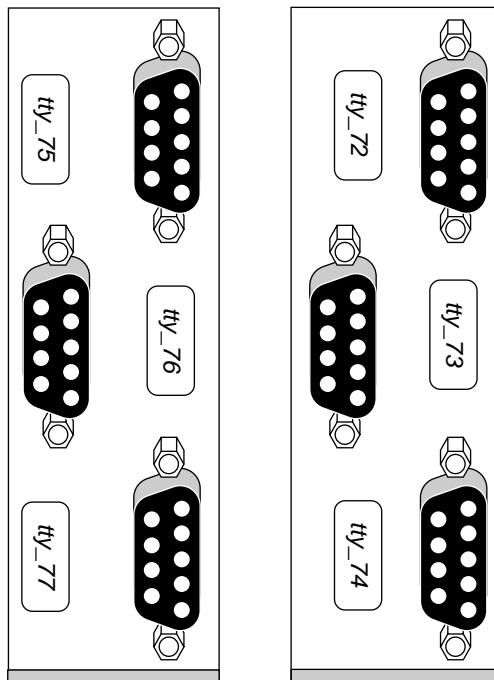


Figure 1-2 Layout of the Serial Connectors

For a description of the pin-outs of the serial connectors, see Appendix A, “Connector Pinouts.”

Note: In RS-422 mode, the pin-outs of the Audio/Serial Option ports do not match those of the built-in RS-422 connector on CHALLENGE™ and Onyx™ deskside and rackmount systems. See “Differences Between Existing Challenge and Onyx Serial Ports” on page 23.

Table 1-1 shows how the ports correspond to *tty* device files.

Table 1-1 Correspondence of Serial Ports to Device File Names

| RS-232 Device File | RS-422 Device File | Memory-Mapped Device File |
|---------------------------|---------------------------|----------------------------------|
| <i>/dev/tty[dfm]72</i> | <i>/dev/tty4[dfm]72</i> | <i>/dev/aso_mmap/tty72</i> |
| <i>/dev/tty[dfm]73</i> | <i>/dev/tty4[dfm]73</i> | <i>/dev/aso_mmap/tty73</i> |
| <i>/dev/tty[dfm]74</i> | <i>/dev/tty4[dfm]74</i> | <i>/dev/aso_mmap/tty74</i> |
| <i>/dev/tty[dfm]75</i> | <i>/dev/tty4[dfm]75</i> | <i>/dev/aso_mmap/tty75</i> |
| <i>/dev/tty[dfm]76</i> | <i>/dev/tty4[dfm]76</i> | <i>/dev/aso_mmap/tty76</i> |
| <i>/dev/tty[dfm]77</i> | <i>/dev/tty4[dfm]77</i> | <i>/dev/aso_mmap/tty77</i> |

Audio Subsystem

The audio subsystem provides the following inputs and outputs:

- Headphone output (stereo)
- Microphone input (mono or stereo)
- Line-level input
- Line-level output
- Serial digital input/output

For detailed electrical specifications, impedances, and output levels, see “Audio Specifications” in Chapter 3.

All the audio jacks accept 3.5-mm stereo plugs, which can use mono plugs where appropriate. Figure 1-3 shows the layout of the audio connectors.

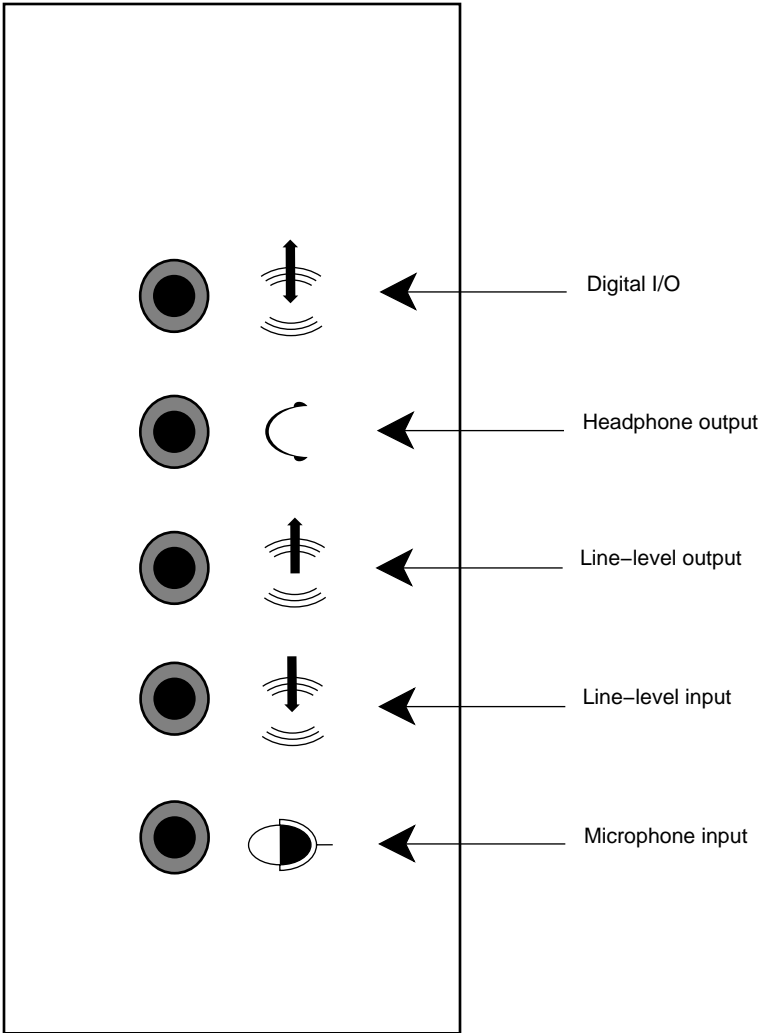


Figure 1-3 Audio Connectors

Block Diagram and Features

The heart of the Audio/Serial Option audio subsystem is the HAL2, a high-density ASIC on the audio module that performs the basic I/O functions. Figure 1-4 is a block diagram of the audio subsystem.

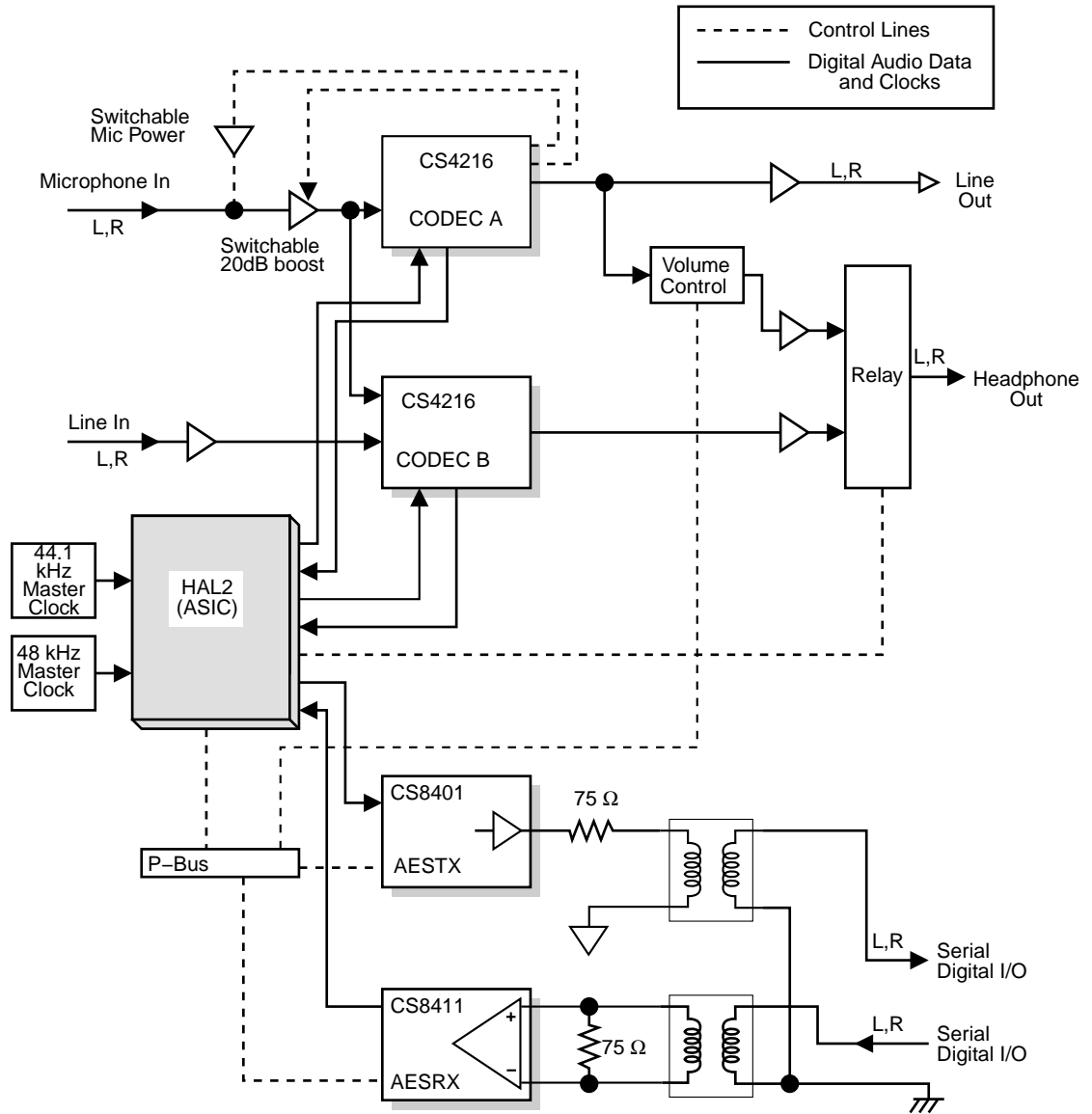


Figure 1-4 Block Diagram of the Audio Subsystem

The audio module provides the following features:

- Stereo line-level analog audio input and output.
- Stereo headphone output.
- Microphone input that supports stereo and mono microphones.
- Serial digital audio input and output, supporting up to 24 bits per sample.
- Industry-standard sampling rates of 8, 11.025, 22.5, 16, 32, 44.1, and 48 kHz, and others.
- Microphone input with DC power.
- Simultaneous input and output.
- Independent input and output sampling rates.
- Output rate can be synchronized to the serial digital audio input rate.
- Silicon Graphics Audio Library (AL) application programming interface (API).
- Low-latency operation.
- Four-channel mode supports four-analog-channel input and four-analog-channel output, simultaneously.
- Analog audio input may be synchronized to serial digital audio input rate.
- Sampling time base is generated by Bresenham's algorithm, allowing near-continuous choice of sample rates.

HAL2 ASIC

The audio module is built around a central controller chip, the HAL2 ASIC, two audio CODEC chips, an AES transmitter chip, an AES receiver chip, a microphone input circuit, a headphone amplifier circuit, and a four-channel mode switching relay.

The HAL2 chip is a 1-micron, 28K-gate, CMOS gate array that contains the data path and control logic to interface the P-bus and the audio devices on the module. The major functional blocks connected to the HAL2 are the two CS4216 CODECs, the CS8401 AES3 transmitter, the CS8411 AES3 receiver, the headphone gain circuit, the microphone input circuit, and the four-channel mode switching relay.

Notable features of the HAL2 design:

- Three independent clock sources:
 - AES out
 - analog in
 - analog out
- Each of the clock generators can select from three different time bases:
 - 44.1 kHz master clock
 - 48 kHz master clock
 - AES3 external clock (through the serial digital jack)
- The clock generators scale the input clocks by rational fractions.
- Each audio device has its own DMA channel and clock generator.
- The audio devices attach with conventional three-wire serial interfaces.
- In four-channel mode, each four-channel DMA data stream consists of interleaved, synchronized audio data.

CODECs

The audio module uses a pair of Crystal Semiconductor CS4216 stereo audio coder/decoders (CODECs). These chips are monolithic CMOS mixed-signal devices. Both of the Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC) are 64x-oversampling delta-sigma 16-bit converters. They also contain on-chip reconstruction and anti-aliasing filters, programmable input gain, and programmable input source switching. The filter responses track the sampling rate, a significant advantage over the older fixed-response, low-pass, analog filter designs.

In the normal mode of operation, the CODEC A DAC is used for analog output and the CODEC B ADC is used for analog input. The CODECs can use independent sample-rate clock generators from the HAL2 so that the analog input sample rate and the analog output sample rate may be selected independently. The analog input (to CODEC B) is selectable from either the line or microphone inputs under software control. The analog output signal (from CODEC A) is routed both to line-out and to the stereo headphone circuit.

The audio system provides an enhanced mode of operation that extends from two to four the number of simultaneously active analog input channels. The graphical audio control panel utility, *apanel*, can switch the audio system between two-channel mode and enhanced, four-channel mode. This can also be done programmatically by applications.

In enhanced, four-channel mode, both CODECs are synchronized to the same sample rate and are used simultaneously for input (ADC) and output (DAC). CODEC B's input (ADC) comes from the microphone input, while CODEC A's input (ADC) comes from the line input. CODEC A's output continues to be routed to the line output, but CODEC B's output is routed at line-levels to the headphone jack.

Powered (Headphone) Output

The audio module provides a 3.5-mm stereo phone jack for a set of headphones. See "Audio Specifications" in Chapter 3 for output power ratings and other characteristics, and Appendix A, "Connector Pinouts," for the tip-ring-sleeve connections.

In four-channel mode, the headphone output is switched to line-level output.

Microphone Input

The microphone input is a 3.5-mm stereo phone jack that accepts mono or stereo signals. See "Audio Specifications" in Chapter 3 for information on input sensitivity and other characteristics, and Appendix A, "Connector Pinouts," for a description of the tip-ring-sleeve connections.

In four-channel mode, the microphone input can be used either for microphone-level signals or switched to line-level input.

Chapter 2

Using the Serial Ports

This chapter explains how to use the serial ports and discusses various issues pertaining to their use and programming.

Using the Serial Ports

This Chapter describes how to use the serial capabilities of the serial/audio mezzanine card. For information on writing applications, see “Additional Documentation and Information” on page x.

Required Software

In order to use the serial ports, the Audio/Serial Option requires the *aso.sw* subsystem, which provides:

- the STREAMS based ASO driver (*/var/sysgen/boot/asoser.o*), which lets you use the serial ports on the Audio/Serial Option with STREAMS based utilities at up to 115,200 baud (depending upon the utility)
- the memory-mapped ASO driver (*/var/sysgen/boot/asoserns.o*), which allows custom applications to use a low-latency, memory-mapped interface to the ASO serial ports

Attaching Serial Devices

All of the serial ports provided by the Audio/Serial Option use DB-9 connectors and can be used as either RS-232 or RS-422 ports. When used as RS-422 ports, pins 1 and 6 are activated for TX_H and RX_H (transmit high and receive high), respectively. See Appendix A, “Connector Pinouts,” for a diagram of the connector pinout of the DB-9 ports.

Caution: The power-up default for all of the Audio/Serial Option serial ports is RS-232 mode. If you have serial devices that would be damaged by pinout voltages in RS-232 mode, be sure to disconnect them before rebooting your Challenge or Onyx system.

Correspondence of Ports and Device Entries

Figure 2-1 shows the layout of the serial ports.

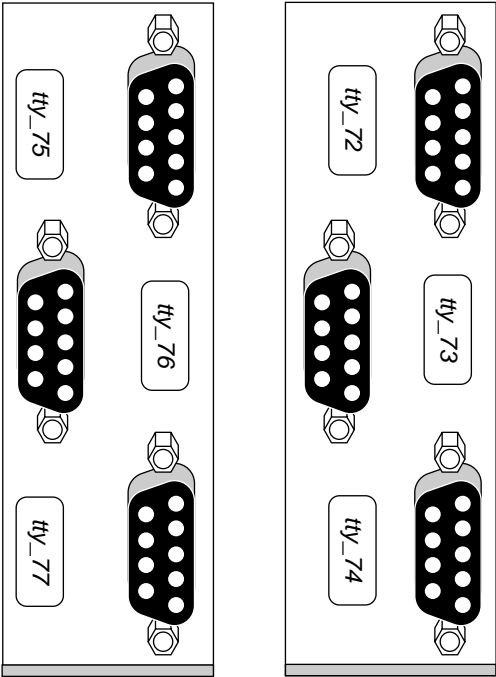


Figure 2-1 Layout of Serial Ports

Pinouts for the ports are described in Appendix A, "Connector Pinouts."

Table 2-1 shows how the ports correspond to IRIX[®] device file entries.

Table 2-1 How the Serial Ports Correspond to IRIX Device Files

| RS-232 Device | RS-422 Device | High-Speed (Memory-Mapped) Device |
|------------------------|-------------------------|--|
| <i>/dev/tty[dfm]72</i> | <i>/dev/tty4[dfm]72</i> | <i>/dev/aso_mmap/tty72</i> |
| <i>/dev/tty[dfm]73</i> | <i>/dev/tty4[dfm]73</i> | <i>/dev/aso_mmap/tty73</i> |
| <i>/dev/tty[dfm]74</i> | <i>/dev/tty4[dfm]74</i> | <i>/dev/aso_mmap/tty74</i> |
| <i>/dev/tty[dfm]75</i> | <i>/dev/tty4[dfm]75</i> | <i>/dev/aso_mmap/tty75</i> |
| <i>/dev/tty[dfm]76</i> | <i>/dev/tty4[dfm]76</i> | <i>/dev/aso_mmap/tty76</i> |
| <i>/dev/tty[dfm]77</i> | <i>/dev/tty4[dfm]77</i> | <i>/dev/aso_mmap/tty77</i> |

Testing A Serial Port

To make sure that a particular serial port is working in RS-232 mode, follow these steps:

1. Obtain an ASCII terminal and the proper cable with which to connect it to one of the Audio/Serial Option serial ports:
 - The ports on both the Audio/Serial Option and the terminal use data terminal equipment (DTE) signals. This means the transmit data pin on an Audio/Serial Option port should be connected to a receive data pin on the terminal, and vice versa. See Appendix A, "Connector Pinouts."
 - The cable needs at least three wires to function properly with a terminal: transmit low (pin 2), receive low (pin 3), and ground (pin 7). (These pin numbers are for the Audio/Serial Option DB-9 connector; the pin numbers on the terminal may vary, depending upon the type of connector it uses.)
2. Connect the ASCII terminal to the serial port you want to test using the serial cable.

3. Turn on the terminal and make sure it is configured in the following way:
 - 9600 baud
 - 8 data bits
 - 1 stop bit
 - no parity

4. Press the **<Enter>** key on the ASCII terminal. You should see a login prompt similar to this:

```
IRIS login:
```

5. If you do not see a login prompt, log in as *root* on the workstation and type some characters directly to the terminal.

6. For example, if you are testing the port **tty_72**, type the following at a shell prompt:

```
cat >> /dev/ttyd72
This is a test
Are these words displayed
on the terminal screen?
```

These sentences should appear on the ASCII terminal. When you are finished typing, press **<Ctrl-D>**.

7. If you do not see a login prompt, and the sentences you typed in the previous step do not appear on the ASCII terminal screen, check the following:
 - Make sure the cable is connected to the correct serial port. Refer to Figure 2-1 for the default layout of serial ports and connectors.
 - Make sure the cable is wired correctly. It should be a three-wire, null-modem serial cable with transmit wired to receive, and ground wired to ground.
 - Verify that the terminal's communication settings are correct. They should be 9600 baud, 8 data bits, 1 stop bit, and no parity.

- Some terminals have more than one port (for example, a data port and an auxiliary port.) Make sure you connect the serial cable to the correct port for the terminal, usually the port labeled **Data** or **Modem**. If your terminal has more than one port, and you are not sure which is correct, refer to your terminal's documentation.

For complete information on using serial ports with modems, terminals, and other devices, see the *IRIX Advanced Site and Server Administrator's Guide*.

Serial Modes and Baud Rates

Table 2-2 shows how you can use any of the six ASO serial ports:

Table 2-2 ASO Serial Port Device Entries and Baud Rates

| Serial Mode | Device Files | Maximum Baud Rate | Driver |
|---|---|----------------------|--|
| RS-232 | <code>/dev/tty[dfm]72</code> through <code>/dev/tty[dfm]77</code> | 115,200 ^a | Silicon Graphics supplied ASO driver <code>/var/sysgen/boot/asoser.o</code> |
| RS-422 | <code>/dev/tty4[dfm]72</code> through <code>/dev/tty4[dfm]77</code> | 115,200 ^a | Silicon Graphics supplied ASO driver <code>/var/sysgen/boot/asoser.o</code> |
| RS-232 or RS-422 via memory-mapped interface ^b | <code>/dev/aso_mmap/tty72</code> through <code>/dev/aso_mmap/tty77</code> | 115,200 ^a | Silicon Graphics supplied ASO driver <code>/var/sysgen/boot/asoserns.o</code> |

a. Standard utilities, such as `getty` and `cu`, may be limited to 38400 baud. Using serial devices via STREAMS at greater than 38400 baud requires custom applications.

b. Software selectable; the default is RS-232.

Caution: When the serial ports on the Audio/Serial Option are used in RS-422 mode, the pin-outs are not the same as the standard RS-422 ports used on Challenge and Onyx deskside and rackmount systems. See "Differences Between Existing Challenge and Onyx Serial Ports" on page 23.

If you access the serial ports through the entries `/dev/tty[dfm]72` through `/dev/tty[dfm]77`, RS-232 signals are automatically enabled on the serial port pins. If you access the ports through the entries `/dev/tty4[dfm]72` through `/dev/tty4[dfm]77`, RS-422 signals are automatically enabled. You can also select between RS-232 and RS-422 modes using STREAMS IOCTL calls. See the *serial(7)*, *streamio(7)*, and *asoser(7)* reference pages, and `/usr/include/sys/asoser.h`.

Memory-mapped applications use `/dev/aso_mmap/tty72` through `/dev/aso_mmap/tty77`. Both RS-232 and RS-422 modes are supported. The default is RS-232. See the *asoserns(7)* reference page.

Standard IRIX serial utilities may not work at baud rates higher than 38400. Custom applications can use baud rates up to the maximum supported by the Audio/Serial Option using either STREAMS or memory-mapping. See “Writing Serial Applications” on page 24 for more information.

Setting Up Serial Ports for Use With IRIX

To use the Audio/Serial Option serial ports with standard utilities, operations, and devices, such as *getty*, *cu*, SLIP, PPP, *uucp*, printers, terminals, and modems, you must manually edit a variety of configuration files. For complete instructions, see the *IRIX Advanced Site and Server Administrator's Guide*. Also, see *serial(7)* and the reference pages for the specific utilities, such as *getty(1M)*.

The *IRIX Advanced Site and Server Administrator's Guide* is available online using the InSight document viewer. It is also available in printed form. Contact your local Silicon Graphics representative for more information on ordering printed manuals.

Note: Do not use the graphical Port Setup tool, available from the Toolchest and System Manager, with the Audio/Serial Option. This is the tool that is documented in “Setting Up Peripheral Connections,” in the *Personal System Administration Guide*. The Port Setup tool does not recognize the serial ports found on the Audio/Serial Option.

Differences Between Existing Challenge and Onyx Serial Ports

In RS-232 mode, the pin-outs of the Audio/Serial Option serial ports are identical to the standard RS-232 ports found on Challenge and Onyx systems. However, the serial ports on the Audio/Serial Option use different pinouts for RS-422 connections. Table 2-3 shows these differences between the ports:

Table 2-3 RS-422 Port Pinout Comparison

| Audio/Serial Option Port Pin Number | Existing CHALLENGE and Onyx Port Pin Number | Meaning |
|-------------------------------------|---|---------------------------|
| 1 | 7 | Transmit high (TX_H) |
| 2 | 2 | Transmit low (TX_L) |
| 3 | 3 | Receive low (RX_L) |
| 4 | 9 | Request to send (RTS) |
| 5 | 5 | Clear to send (CTS) |
| 6 | 8 | Receive high (RX_H) |
| 7 | 6 | Signal ground |
| 8 | 4 | Data carrier detect (DCD) |
| 9 | 1 | Data terminal ready (DTR) |

If necessary, you can use the information in the above table to construct an adapter cable that will allow any RS-422 cables designed for the existing Challenge and Onyx port pinouts to work properly with the Audio/Serial Option ports.

Writing Serial Applications

The Audio/Serial Option provides two methods of accessing serial devices:

- a STREAMS based interface
- a memory-mapped interface

The following guidelines should help application developers decide which method to use.

The STREAMS interface is appropriate if you want to take advantage of the features of STREAMS. These features include portability, carriage-return and newline translation, blocking I/O, and ease of porting existing STREAMS based serial applications.

However, the memory-mapped interface may be appropriate for the following reasons:

- It offers lower latency than STREAMS, making it more appropriate for use with the frame scheduler in real-time applications.
- It offers lower system overhead.
- It provides non-blocking I/O, which may be important for applications that need a smooth flow of data to and from a serial device.

See "Additional Documentation and Information" on page x for information on STREAMS documentation.

Tuning Serial Performance

One way that you can tune serial performance is through the lboot variable *asoser_int_lim*, which is found in the file */var/sysgen/master.d/asoser*. This variable controls the maximum number of interrupts per second generated by the Audio/Serial Option board.

Values of *asoser_int_lim* range from 50 to 1000 interrupts per second. A lower number of interrupts per second causes greater latency for serial I/O. A higher number of interrupts increases interrupt overhead and thus CPU use. The default value of *asoser_int_lim* is 500.

When using the memory-mapped interface, latency is the expected time between the receipt of the “stop” bit trailing a the data byte and the time that data byte becomes is available to the user application. When using the STREAMS driver, latency can be longer because of STREAMS scheduling. If low-latency is important for a particular application, use the non STREAMS (memory-mapped) driver.

Latency can also vary slightly under severe system bus loading or if interrupts are disabled for a long period of time. To help prevent data loss under these conditions, the Audio/Serial Option mezzanine card and firmware are designed to buffer thousands of characters.

The formula in Figure 2-2 describes how the number of interrupts per second (IPS) translates into latency in milliseconds.

$$\frac{1}{\text{IPS}} \times 1000 + 1 = \text{Latency in milliseconds}$$

Figure 2-2 Computing Serial I/O Latency From Serial Interrupts

Thus, an *asoser_int_lim* value of 50 interrupts per second would translate to a latency of 20 milliseconds.

Chapter 3

Using Audio

This chapter describes how to use the audio jacks and the audio control panel. It also contains electrical and performance specifications for the audio subsystem.

Using Audio

This Chapter describes how to use the audio capabilities of the Audio/Serial Option.

Required Software

There are a variety of utilities supplied by Silicon Graphics that let you manipulate the audio ports, work with audio files, bring audio signals into the system, and send audio signals out of the system. These include:

| | |
|--------------------|---|
| <i>apanel</i> | A graphical control panel that manipulates the input signal levels and headphone output level, and switches between two-channel and four-channel audio modes. |
| <i>soundplayer</i> | A graphical tool for playing audio files. |
| <i>soundeditor</i> | A graphical tool for editing mono and stereo audio files. |
| <i>sfinfo</i> | A command-line tool that describes the format of an audio file. |
| <i>sfplay</i> | A command-line tool for playing audio files. |

These and other audio tools are found in the various `dmedia_eoe` and `dmedia_tools` subsystems. For an overview of the various audio tools and the audio hardware, see the *audio(1)* reference page, the *Media Tools User's Guide*, and the *Media Control Panels User's Guide*.

Developing Audio Applications

The Audio Library (AL) programming interface provides an application programming interface for developing audio applications. The Audio Library is provided in the IRIS Development System option. The Audio

Library is documented in the *IRIS Digital Media Programming Guide*. This guide, as well as the *Apple® Audio Interchange File Format – AIFF-C Specification*, are available from Silicon Graphics in the IRIS Digital Media documentation kit. Also, the various audio library calls, for example *AFclosefile(3dm)*, are documented in the digital media reference pages (section 3dm).

Using the Software Audio Control Panel

The graphical utility that controls audio on a Silicon Graphics workstation is the audio control panel, or *apanel*. You can start *apanel* from the Toolchest, by opening the *apanel* desktop icon, or by typing `apanel` at a shell prompt. Many utilities, such as *capture* and *soundeditor*, also provide the ability to start *apanel*. When you start *apanel* from the command line, a variety of options are available. See *apanel(1)*.

Figure 3-1 shows *apanel* in the default, two-channel mode.

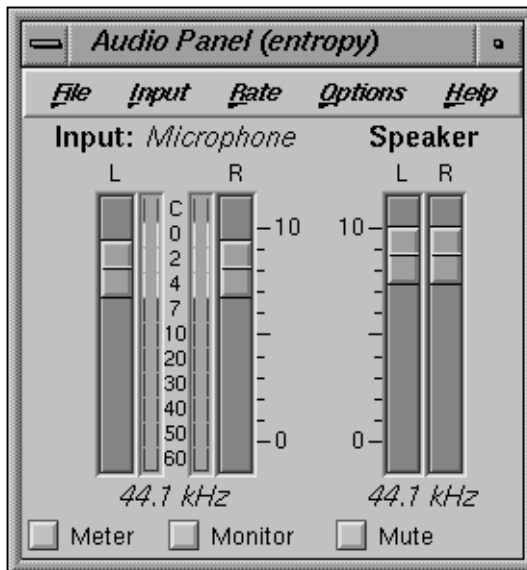


Figure 3-1 The Audio Control Panel (Two-Channel Mode)

The audio control panel shows you the state of the audio hardware and allows you to control input levels, input and output sampling rates, and headphone output. You can also monitor both the signal and signal levels of a given input.

Although the output sliders are labeled “Speaker,” there is no external speaker provided with the Audio/Serial Option. The output sliders control the headphone volume.

Note: The input meters consume some CPU bandwidth and use one of the internal audio ports.

Selecting the Sampling Rate

To select the input or output sampling rates, pull down the Rate menu and select either Input or Output, then choose the appropriate rate. Figure 3-2 shows the Input sampling rate menu.

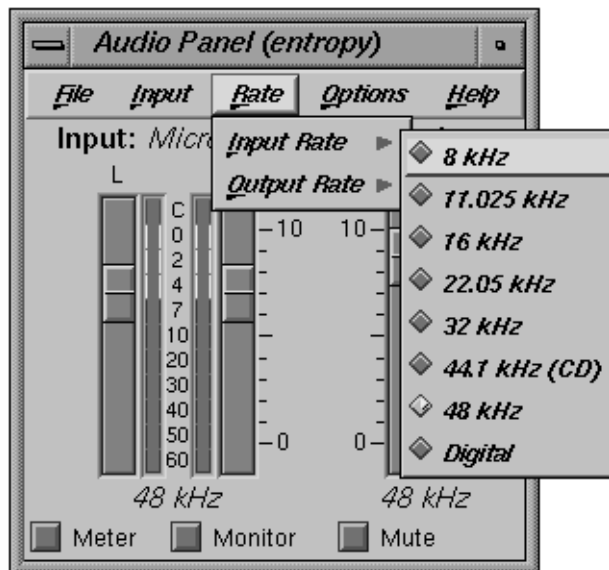


Figure 3-2 Changing the Sampling Rate (Input Shown)

The Output rate sampling menu has the additional option of matching the Input sampling rate regardless of what the Input sampling setting. This is useful because *apanel* is not a sampling rate conversion tool. If the input and output rates do not match, the resulting audio signal is pitch-shifted and distorted.

Sampling-rate conversion is performed by the graphical tool *soundfiler* and by the command-line tool *sfconvert*. See *audio(1)* for an overview of the various tools.

Be aware that audio applications will change the sampling rates as needed and there is no way to “lock” the sampling rate so that this does not happen. Many applications return the sampling rate to the previous setting, but some applications do not.

Using the Sliders for Independent Left and Right Levels

By default, the left and right sliders of both the input and output controls are ganged together. If you want independent control over the sliders, select the Options menu and click on the check box that corresponds to the sliders you want to control. Figure 3-3 shows the Options menu.

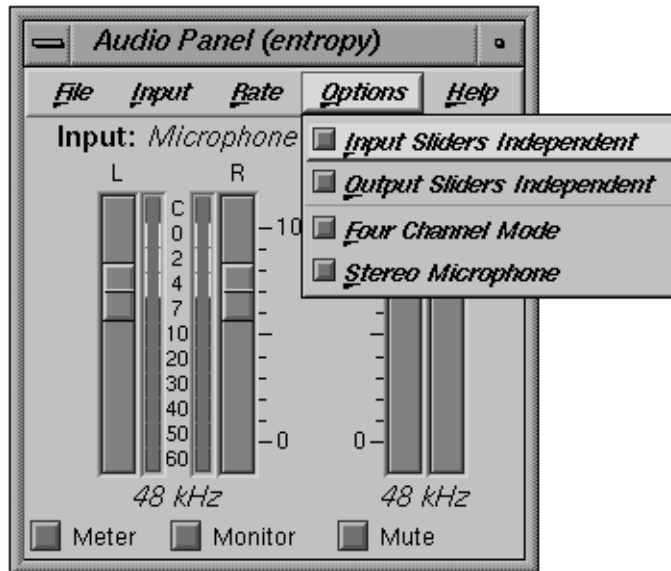


Figure 3-3 The Audio Panel Options Menu

Two-Channel Mode Input and Output

In two-channel mode, you can select from one of the three input channels using the Input pulldown menu. Available input channels are digital I/O, line-level input, and microphone input.

You can switch the microphone input between mono and stereo modes using the Options menu.

To adjust the headphone volume, use the output sliders.

The line-level output, and digital I/O signal levels are not adjustable.

If you want to see the signal level of a sound file that you are playing (for example, using *playafc* or *soundeditor*), switch the input mode to Digital. This causes the meters to display the signal level of the sound file as it plays, provided:

- the output sampling rate is not set to “input rate,”
- the sampling rate of the audio file you are playing is 30 kHz or greater, and
- there is no plug installed in the serial digital audio jack.

Do not turn on monitoring (by checking the Monitor box) while listening to a sound file, as this will cause feedback.

Four-Channel Mode Input and Output

In four-channel mode, the microphone and headphone jacks have different functions than in normal, stereo mode in order to provide four-channel, line-level input and output. Table 3-1 shows the function of each connector in four-channel mode.

Table 3-1 Input and Output Assignments in Four-Channel Mode

| Input Selection | Connector | Function |
|-----------------|-------------------|------------------------|
| Microphone | Digital | N/A |
| | Headphone | Line-level output (L2) |
| | Line-level output | Line-level output (L1) |
| | Line-level input | Line-level input (L1) |
| | Microphone input | Microphone input (L2) |
| Line | Digital | N/A |
| | Headphone | Line-level output (L2) |
| | Line-level output | Line-level output (L1) |
| | Line-level input | Line-level input (L1) |
| | Microphone input | Line-level input (L2) |
| Digital | Digital | Digital In/Out (L1) |
| | Headphone | Line-level output (L2) |
| | Line-level output | Line-level output (L1) |
| | Line-level input | N/A |
| | Microphone input | N/A |

Changing the Audio Panel Input Scale

You can switch the input scale between simple 1 to 10 gradations and decibel calibrations by running `apanel` with either the `-decadescale` or `-dbscale` options. See `apanel(1)` for more information.

Saving and Loading Audio Panel Configurations

You can save and load audio panel configurations through the File menu. Select the Save option to save the current `apanel` configuration in the default filename (`apanel.parameters`) in your home directory. The Save As option prompts for an alternate file name.

To load a configuration, select Open from the File menu.

Audio panel configurations are not automatically loaded when `apanel` starts. You have to specifically open a file that contains audio panel configuration settings.

Attaching Audio Cables

All of the audio connectors accept 3.5-mm stereo phone plugs. The following connectors use stereo (L, R, and ground) connectors:

- Line in
- Line out
- Serial digital audio
- Headphone

The microphone connector accepts either mono or stereo plugs, depending upon the application and how the connector is configured (programmatically or through *apanel*).

For a complete description of the tip, ring, and sleeve connections for all of these jacks, see Appendix A, “Connector Pinouts.”

Connector Size Limitations

The audio connector bodies and strain-relief attachments cannot be longer than about 1.75 inches to 2 inches (4.4 cm to 5 cm). The exact length depends upon where the audio connector housing is installed, which jack you are using, and the flexibility of the audio cable you are attaching. Also, rackmount systems will typically provide greater clearance and desk-side systems for connector housings. See Figure 3-4.

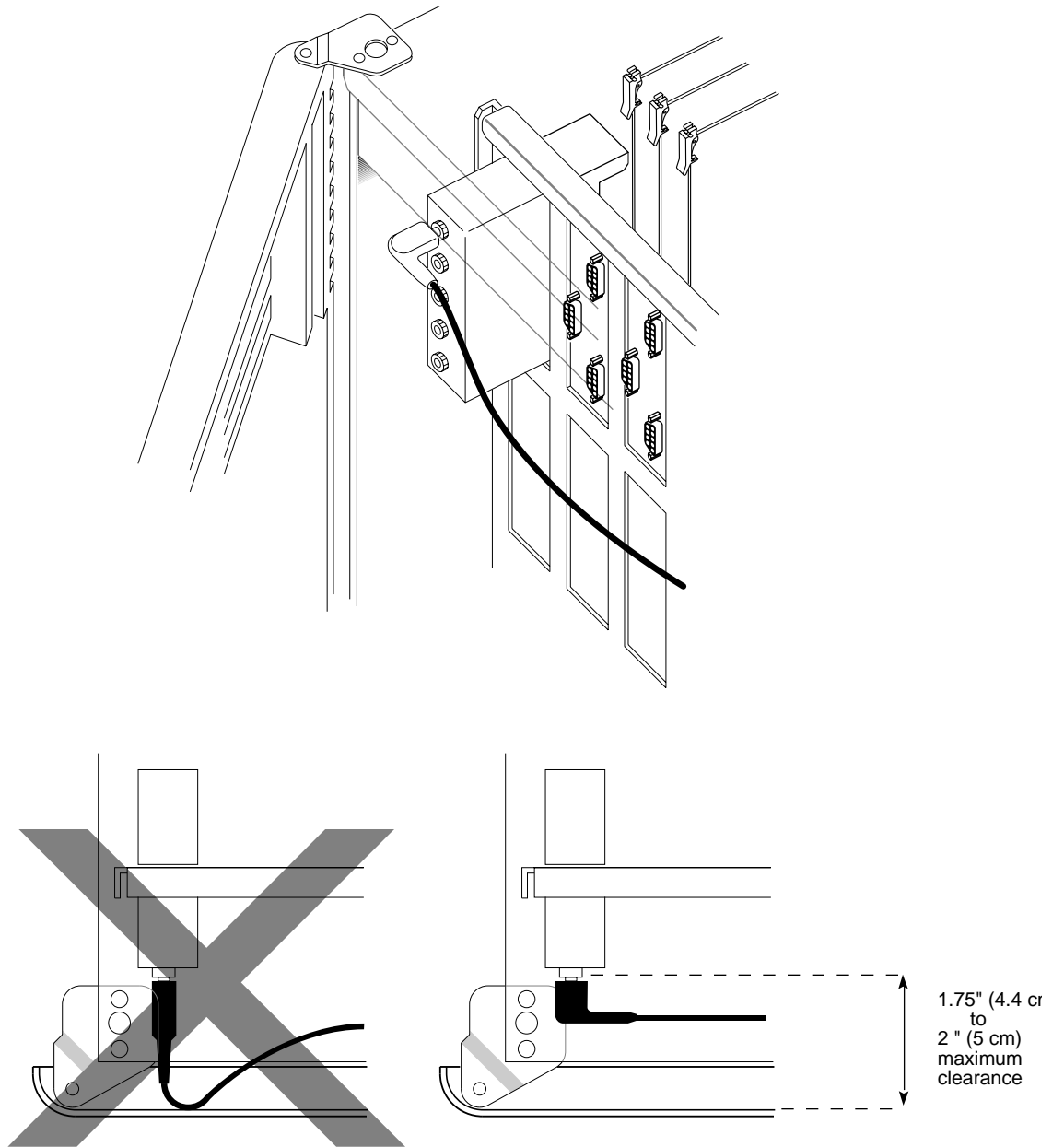


Figure 3-4 Audio Cable Connector-Body Limitations

To avoid damaging the audio cables and connectors, use right-angle audio connectors whenever possible.



Warning: Do not operate a Challenge or Onyx system with the door open or removed. The door channels air for proper flow through the system and protects connectors and back-panel components from accidental damage. If an audio connector does not allow the door to close properly, you should obtain a right-angle connector or other adapter cable to allow you to close the system door.

Digital Transfers

Serial digital transfers can be made for any sampling rate between 30 kHz and 50 kHz. If you want to use other sampling rates, you must use the analog interconnect (line-level).

Audio Techniques

The following are some techniques that are useful for obtaining the best possible signals with the Audio/Serial Option.

Equipment and Connections

Avoid using mono plugs in the stereo connectors, or cables that short some of the signals together. Avoid using cables with built-in attenuation.

Minimizing Input Gain/Maximizing Input Signal

The analog input circuitry for microphone and line-in recording has a software-controlled gain setting. The input circuitry accommodates signal levels of up to 8.4 Vpp (peak-to-peak) at the line-in connector. This is in excess of the levels produced at most modern consumer equipment line-out connectors.

To produce the best possible recordings, turn up the output control as far as possible without exceeding 8.4 Vpp (if the source machine has an output

control). Start with the *apanel* input gain level setting at the “factory preset” level, which corresponds to “8” on the scale. Adjust the input gain level setting so that loudness peaks of the input material lights up almost the entire level meter. You can obtain the best results with a low input gain setting and a signal that registers nearly the entire span of the meter.

Minimizing Output-to-Input Crosstalk

In order to minimize distortion and crosstalk effects between the headphone amplifiers and the more sensitive portions of the analog audio system, reduce the headphone volume level as much as possible during critical analog recording. Changing the headphone volume does not affect the line-out levels.

Avoiding Ground Loops

The analog audio instrumentation circuits in the Audio/Serial Option are very sensitive to the implementation of an analog ground voltage reference. You can achieve the best performance by letting the workstation be the only machine in your system of audio equipment that connects its system electrical ground to the safety grounding conductor.

If this is not possible, you may have to use signal isolation transformers. Note that the serial digital audio ports are already isolated by transformers within the machine, so that ground-reference problems do not typically apply to serial digital audio connections.

Other Cautions and Advice

If your workstation is connected to a monitoring system such as a power amplifier driving speakers or headphones, turn the monitoring system volume down or off before you power the workstation on or off.

Do not wear headphones that are plugged into the workstation during power on or off cycles.

Do not record or monitor from an input connector that has nothing plugged into it.

Never connect a high-power output, such as the speaker output of a power amplifier, to any of the audio connectors on the Audio/Serial Option.

Audio Specifications

This section describes the electrical and performance specifications of the audio subsystem. Unless otherwise stated, all parameters given in the following sections are measured under the conditions shown in Table 3-2:

Table 3-2 Audio Subsystem Specifications Test Conditions

| Specification | Test Condition |
|-------------------------------------|-----------------------------|
| Analog test signal levels | |
| Line-level input | 1 Vrms |
| Microphone input | 0.1 Vrms |
| Analog test signal output impedance | 600 Ω |
| Test output destination impedances | |
| Line-level output | 5 kΩ |
| Headphone output | 150 Ω |
| Sampling rate | 48 kHz |
| Measurement bandwidth | 17 Hz to 22 kHz, unweighted |
| Digital test signal level | 100% of full scale |

Serial Digital Interconnect Standards and Specifications

The Stereo Serial Digital Audio interconnect is a coaxial digital interconnect that makes noiseless audio connections to DAT machines, professional audio equipment, CD players, other workstations, and so forth. It corresponds to the electrical characteristics of AES3-ID-DRAFT, for distribution of digital audio using 75-ohm video cable. The interconnect is transformer coupled to prevent ground loops and provide isolation.

It supports up to 24-bit, 50 kHz sampling. It is based on the following standards:

- CP-340: EIAJ
- AES3-1992: Audio Engineering Society
- AES3-ID-DRAFT: Audio Engineering Society
- IEC958: IEC

The sample rate is encoded in the incoming stream, and the input sample rate may serve as sample clock source for analog in, analog out, and digital out. The digital output is nominally set to consumer-level configuration.

Table 3-3 lists the specifications for the serial digital audio input and output:

Table 3-3 Serial Digital Specifications

| Specification | Value |
|-----------------------|---|
| Input impedance | 75 Ω , transformer coupled |
| Input level | 0.5 Vpp nominal |
| Input sample rates | 30 kHz to 50 kHz |
| Output impedance | 75 Ω , transformer coupled |
| Output level | 0.5 Vpp into 75 Ω load |
| Output sampling rates | 32 kHz, 44.1 kHz, 48 kHz serial input sampling rate and divisors of those rates |
| Resolution | Supports up to 24 bits per sample |

Line-Level Input and Output Specifications

Table 3-4 lists the specifications for the line-level input.

Table 3-4 Line-Level Input Specifications

| Specification | Value |
|-----------------------------------|---|
| Impedance | 20 k Ω , nominal |
| Frequency response | +/- 0.81 dB, 20 Hz to 20 kHz |
| Total harmonic distortion + noise | |
| At 1 kHz | < 0.006%, 20 Hz to 20 kHz |
| Maximum | < 0.007% |
| Residual noise, unweighted | -86 dB |
| Residual noise, A weighted | -88 dB |
| Interchannel isolation | |
| 1 kHz | -82 dB |
| 10 kHz | -72 dB |
| 20 kHz | -67 dB |
| Full-scale amplitude | 0.63 V _{pp} to 8.4 V _{pp} |
| Gain adjustment increment | 1.5 dB |
| Gain range | 0 dB to +25 dB |

Table 3-5 lists the specifications for the line-level output:

Table 3-5 Line-Level Output Specifications

| Specification | Value |
|-----------------------------------|-----------------------------|
| Impedance | 600 Ω , nominal |
| Frequency response | +/- 1.2 dB, 20 Hz to 20 kHz |
| Total harmonic distortion + noise | |
| At 1 kHz | < 0.02%, 20 Hz to 20 kHz |
| Residual noise, unweighted | -81 dB |

Table 3-5 (continued) Line-Level Output Specifications

| Specification | Value |
|----------------------------|---------------------|
| Residual noise, A weighted | −85 dB |
| Interchannel isolation | |
| 1 kHz | −80 dB |
| 10 kHz | −75 dB |
| 20 kHz | −71 dB |
| Full-scale amplitude | 4.7 V _{pp} |

Microphone Input Specifications

Table 3-6 lists the specifications for the microphone input:

Table 3-6 Microphone Input Specifications

| Specification | Value |
|-----------------------------------|---|
| Input impedance | 1.5 k Ω |
| Frequency response | +/− 0.66 dB, 20 Hz to 20 kHz |
| Total harmonic distortion + noise | |
| At 1 kHz | < 0.0053%, 20 Hz to 20 kHz |
| Maximum (at 17.5 kHz) | 0.0067% |
| Residual noise, unweighted | −86 dB |
| Residual noise, A weighted | −89 dB |
| Full-scale amplitude | 0.063 V _{pp} to 0.84 V _{pp} |
| Microphone power supply | +3 VDC, 1 mA maximum |

Headphone Output Specifications

Table 3-7 lists the headphone output specifications:

Table 3-7 Headphone Output Specifications

| Specification | Value |
|-----------------------------------|-----------------------------|
| Headphone output level | |
| Into a 64 Ω load | 36 mW |
| Into a 32 Ω | 57 mW |
| Into a 16 Ω load | 74 mW |
| Impedance | 10 Ω |
| Frequency response | +/- 2.3 dB, 20 Hz to 20 kHz |
| Total harmonic distortion + noise | |
| At 1 kHz | < 0.2%, 20 Hz to 20 kHz |
| Maximum (at 19.3 kHz) | 0.3% |
| Residual noise, unweighted | -88 dB |
| Residual noise, A weighted | -90 dB |
| Interchannel isolation | |
| 1 kHz | -87 dB |
| 10 kHz | -76 dB |
| 20 kHz | -73 dB |

Appendix A

Connector Pinouts

This appendix documents the pin assignments of the external connectors of the Audio/Serial Option.

Connector Pinouts

This Appendix describes the pinouts of the various connectors on the Audio/Serial Option mezzanine card.

Serial Ports

The Audio/Serial Option serial ports are female DB-9 connectors. Figure A-1 shows the pin numbering of the connectors.

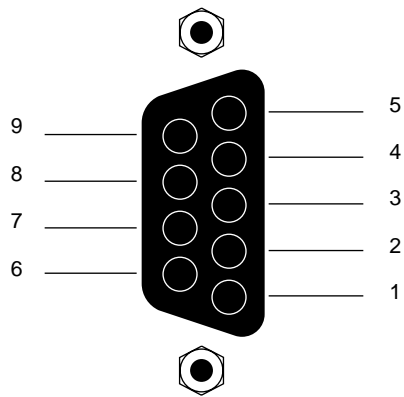


Figure A-1 Serial Port Pin Numbering

Table A-1 describes the pinouts of the DB-9 connectors in both RS-232 and RS-422 modes.

Table A-1 Audio/Serial Option Serial Connector Pinouts

| Pin Number | RS-232 Mode | RS-422 Mode |
|------------|---------------------------|---------------------------|
| 1 | N/C | Transmit high (TX_H) |
| 2 | Transmit low (TX_L) | Transmit low (TX_L) |
| 3 | Receive low (RX_L) | Receive low (RX_L) |
| 4 | Request to send (RTS) | Request to send (RTS) |
| 5 | Clear to send (CTS) | Clear to send (CTS) |
| 6 | N/C | Receive high (RX_H) |
| 7 | Signal ground | Signal ground |
| 8 | Data carrier detect (DCD) | Data carrier detect (DCD) |
| 9 | Data terminal ready (DTR) | Data terminal ready (DTR) |

Audio Connectors

All audio jacks accept 3.5 mm stereo phone plugs. The microphone input can be used with a mono plug for mono input signals. Other inputs can be used with mono plug, which short the ring signal to ground.

Table A-2 lists the tip, ring, and sleeve connections for the various audio connectors.

Table A-2 Audio Connector Tip, Ring, and Sleeve Assignments

| Connector | Tip | Ring | Sleeve |
|-------------------|---------------|----------------|--------|
| Microphone | Input (mono) | N/C (mono) | Ground |
| | Left (stereo) | Right (stereo) | Ground |
| Line-level input | Left | Right | Ground |
| Line-level output | Left | Right | Ground |

Table A-2 (continued) Audio Connector Tip, Ring, and Sleeve Assignments

| Connector | Tip | Ring | Sleeve |
|------------------|------------|-------------|---|
| Headphone | Left | Right | Ground |
| Digital I/O | Output | Input | Ground (for this circuit only; isolated from analog audio ground) |

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