StudioComm
for Surround

# Model 76DA Central Controller and Model 77 Control Console

## User Guide

**Issue 9, May 2014**

**This User Guide is applicable for systems consisting of:**
**Model 76DA: serial number M76DA-01151 and later**
**with software version 4.20 and higher and FPGA version 4.12 and higher;**
**Model 77: serial number M77-00151 and later with software version 4.20 and higher**

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# Introduction

## What This User Guide Covers

This User Guide is designed to assist you when installing and using the Model 76DA Central Controller and one or more associated Model 77 or Model 71 Control Consoles.

## Overview

As creating and distributing multi-channel surround (5.1) and stereo audio material has become a day-to-day reality, the ability to simply and effectively monitor these sources is imperative for recording, post-production, and broadcast facilities. And with audio-with-picture applications becoming so prevalent, additional monitoring challenges have arisen. Studio Technologies has addressed these needs with the StudioComm for Surround Model 76DA Central Controller and the Model 77 and Model 71 Control Consoles. With digital audio inputs, digital and analog monitor outputs, support for multiple user control surfaces, and an extensive set of operating resources it's a simple task to integrate a monitoring system into virtually any facility. The carefully selected group of features, including surround and stereo inputs, configurable input-signal time delay, multiple pre- and post-fader outputs, configurable downmix and mute/solo functions, and bass management, along with a multi-format sync input, make the system powerful yet simple to operate. And by using the best of contemporary technology, as well as following rigorous design practices, the system's audio quality is excellent.

A StudioComm for Surround system starts with the Model 77 Control Console. It's the system's "command center" and is designed to reside at an operator's location, allowing fingertip selection of all monitoring functions. Numerous LED indicators provide complete status information. A 4-digit numeric display indicates the post-fader monitor output level in real time. A major strength of the Model 77 is its ability to configure, under software control, many important operating parameters. Intended for secondary monitoring locations, the Model 71 Control Console is a compact user control surface. It provides three of the most basic functions: a rotary level control, dim on/off button, and reference level on/off button.

While many installations will use only one Model 77 Control Console, up to three additional Model 77 or Model 71 Control Consoles can also be connected. This provides multiple users with full control over a facility's monitor system. And to make installation simple, the Model 76DA provides power for all connected Model 77 or Model 71 units.

The core of this StudioComm for Surround system is the Model 76DA Central Controller. The one-rack-space unit contains circuitry that supports digital audio inputs, digital and analog monitor outputs, processing, and the user interface. The Model 76DA provides two surround (5.1) and three stereo digital audio inputs. These unbalanced digital inputs are AES3/SMPTE 276M-compliant; sources of this type are ubiquitous in most post-production and broadcast environments. The inputs allow a sample rate of up to 192 kHz and a bit depth of up to 24 to be directly supported. Circuitry associated with one of the stereo inputs provides sample rate conversion (SRC) capability, allowing a wide range of digital audio sources to be monitored. Up to 340 milliseconds of input

delay can be selected to compensate for processing delays in an associated video path. For flexibility, two delay values can be configured, allowing real-time selection as desired. A number of different signals can serve as the Model 76DA's digital audio timing reference. For synchronization with a master timing reference a dedicated source of word clock, DARS (AES11), bi-level video, or tri-level video can be connected. Alternately, the L/R connection of the actively selected surround or stereo input source can serve as the timing reference.

A range of digital and analog surround (5.1) and stereo digital monitor outputs are provided. The post-fader surround and stereo digital and analog monitor outputs are intended for connection to monitor loudspeaker systems. The pre-fader surround digital monitor output can be used with metering systems that require signals that aren't impacted by level control or other monitoring functions. The stereo input C direct digital monitor output allows an installation to directly access the SRC capabilities.

For installation flexibility the digital monitor outputs can be configured for compatibility with equipment that requires balanced or unbalanced AES3 digital audio signals. When selected for balanced AES3 compatibility the output impedance is 110 ohms with a signal level of 5 volts peak-to-peak (Vpp). For unbalanced AES3 operation the impedance is 75 ohms and the level is 1 Vpp.

A sophisticated bass management function is integral to the Model 76DA's design and can be enabled if desired. It can apply to both the surround and stereo digital and analog post-fader monitor output channels. Note however that the bass management function is only supported at sample rates of 44.1, 48, 88.2, and 96 kHz. The overall goal of bass management is very simple: ensure that the entire audio bandwidth of all channels can be accurately monitored. Many loudspeaker systems have inherent low-frequency limitations, preventing a true picture of the source material from being presented. To overcome this, the low-

**Figure 1. Model 76DA Central Controller Front Panel**

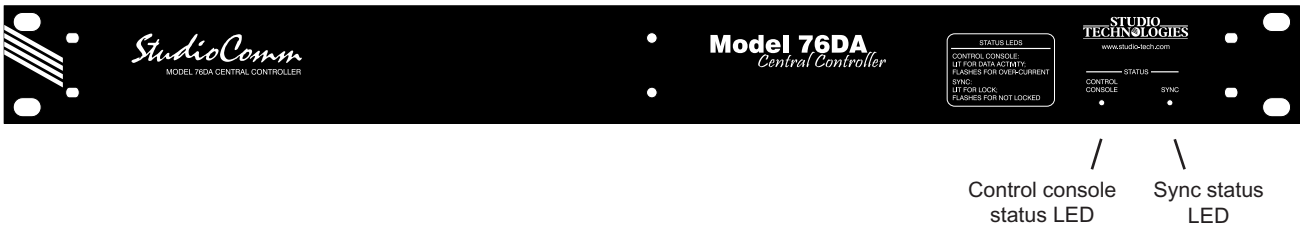
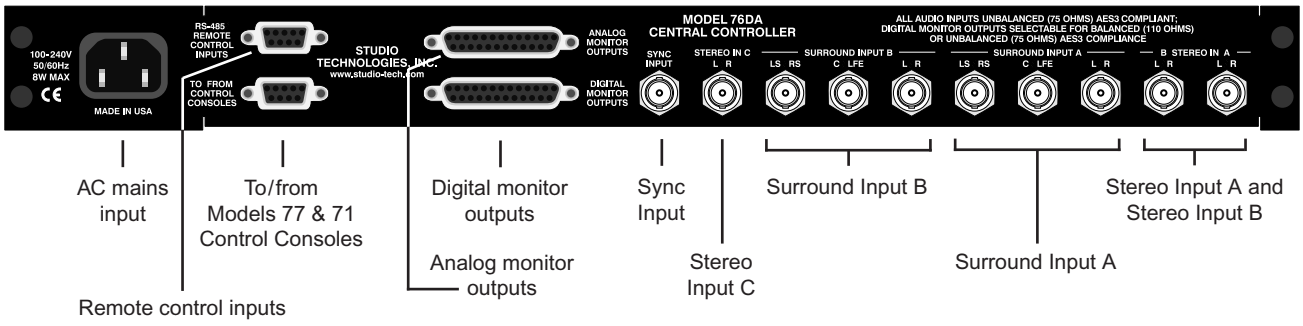



**Figure 2. Model 76DA Central Controller Back Panel**



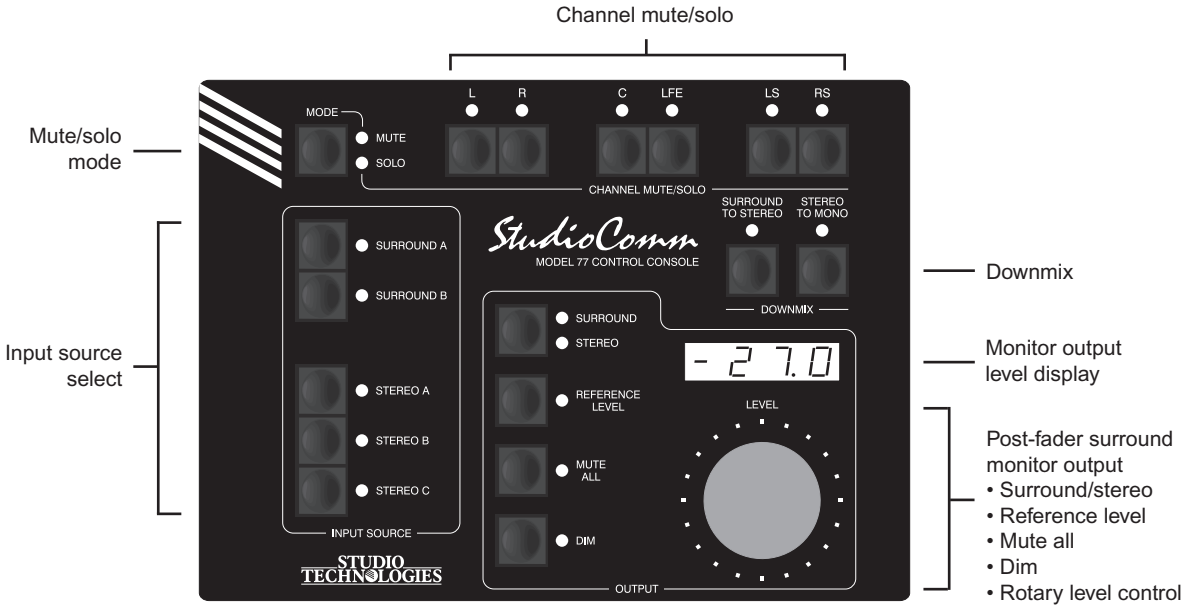



**Figure 3. Model 77 Control Console Front Panel**

frequency energy from the five surround and two stereo channels can be separated and then routed to the subwoofer loudspeaker. Several of the bass management functions can be configured to match the requirements of specific installations.

Great care was taken in designing the system's architecture, ensuring that the character of the audio input signals is preserved. All audio processing, including bass management, is performed in 32 bits using a high-speed field-programmable gate array (FPGA) integrated circuit.

The Model 76DA occupies one space (1U) in a standard 19-inch rack. Digital audio sources are interfaced with the Model 76DA using nine BNC connectors. A tenth BNC connector is used by the sync source. Digital and analog monitor output signal connections are made using two 25-pin female D-subminiature connectors. One 9-pin female D-subminiature connector is used to connect the Model 76DA with up to four Model 77 or Model 71 Control Consoles. A second 9-pin female "D-sub" connector is used to interface with remote control signals. AC mains power is connected directly to the Model 76DA, with an acceptable range of 100 to 230 volts, 50/60 Hz.

## Additional Details

The Model 77 provides five buttons and associated LEDs for selection of the surround and stereo input sources to be monitored. While in most cases only one input source will be monitored at a time, stereo input C can be selected for simultaneous monitoring with one of the two surround or other two stereo inputs. This allows the two selected inputs to be combined ("summed").

It's interesting to note that while each of the two surround inputs has an LFE channel associated with it, the ".1" post-fader digital and analog surround monitor outputs are designated as SUB (subwoofer), rather than LFE. This terminology was carefully selected to highlight the fact that this output channel may include more than just LFE content. The bass management function, if enabled,

will redirect low-frequency energy from the main input channels, combing it with the LFE content before routing the sum to the digital and analog subwoofer outputs.

The post-fader surround and stereo digital and analog monitor output levels can be controlled by way of a large, easy-to-use rotary control. The control, actually a digital encoder, allows level selection in precise 0.5-dB steps. The auto mute all function causes the post-fader surround and stereo monitor output channels to automatically mute whenever the output level control reaches maximum attenuation. Using the reference level function, the post-fader surround and stereo monitor output levels can be set to a pre-configured value. This is provided for audio-with-picture applications that require a specific monitor output level. The reference level is easily configured by taking an electronic "snapshot" of the desired monitor output level. For operator confirmation a 4-digit LED readout can display the level of the post-fader surround and stereo monitor output channels. To match the needs of a facility, it can be configured to display either the attenuation level or the sound pressure level (SPL).

The dim function allows the post-fader surround and stereo digital and analog monitor output levels to be reduced by a fixed dB amount. The dim level is configured from among four available values. A mute all function allows the post-fader surround and stereo monitor output channels to be simultaneously muted. The channel mute/solo section provides post-fader surround and stereo channel monitoring control, allowing a single channel to be muted or monitored. Multiple channels can also be simultaneously selected for muting or "soloing."

A special solo mode is also provided, called channel pop solo, which offers a unique aid in monitoring audio material. Channel pop solo allows the level of a single post-fader digital and analog monitor output channel to be raised while the level of the other channels is reduced. This helps to emphasize the content on one channel without fully muting the others. Broadcast applications can benefit from the channel pop solo mode by allowing, for example, the center channel to be highlighted while still maintaining some level on the other channels. The amount of level increase—the "pop"—as well as the amount of attenuation can be configured to meet the needs of specific applications or users.

Two functions allow the input sources to be checked for level or phase inconsistencies. The surround to stereo downmix function is used to create a stereo signal from the selected surround (5.1) source. Key operating parameters in the surround to stereo downmix function can be configured to meet the requirements of an application. This can be especially useful when support for specific international broadcast standards is required. The stereo to mono downmix function allows audio on the left and right channels to be added (summed) and monitored on the center output channel. The two downmix functions can be simultaneously enabled, allowing a surround source to be checked for mono compatibility. The downmix functions always impact the post-fader surround and stereo monitor outputs. A configuration setting allows the pre-fader surround monitor output to be selected for pre- or post-downmix operation.

For flexibility, the StudioComm for Surround system is designed to easily integrate with equipment such as production

intercom systems, on-air or recording tally signals, and audio consoles. Two remote-control inputs provide access to the mute all and dim functions. By providing access to these functions, talkback or slate activity from an audio console or other communications system can control the level of the post-fader surround and stereo monitor outputs.

# Installation

In this section you will be installing the Model 76DA Central Controller in an equipment rack. Connections to the digital audio inputs, digital monitor outputs, and analog monitor outputs will be made. A dedicated digital audio timing reference signal can be connected to the sync input. If desired, external equipment will be interfaced to the remote control inputs. A location will be selected for the first Model 77 Control Console and it will be connected to the Model 76DA. AC mains power will be connected to the Model 76DA. For advanced applications up to three additional Model 77 or Model 71 Control Console units can be connected to the Model 76DA.

## System Components

The main shipping carton contains one each of the following: Model 76DA Central Controller, Model 77 Control Console, 9-pin D-sub interconnecting cable, and user guide. Also included in the shipping carton is a North-American-standard AC mains cord. Your dealer or distributor should provide an AC mains cord appropriate for destinations outside of North America. Any additional Model 77 or Model 71 Control Consoles will be shipped in separate cartons.

## Mounting the Model 76DA

The Model 76DA Central Controller requires one space (1U) in a standard 19-inch (48.3 cm) equipment rack. Secure the Model 76DA into the equipment rack using two mounting screws per side. Select a location that is convenient for making connections to the audio signals as well as interfacing with the first (or only) Model 77 Control Console. A cable is supplied to connect the Model 76DA to the Model 77. If the needs of a specific installation dictate, an alternate-length interconnecting cable can be fabricated and used.

## Audio Connections

Audio connections are made by way of nine BNC jacks and two 25-pin female D-subminiature connector. All the connectors are located on the Model 76DA's back panel. Refer to Figure 2 for a detailed view of these jacks and the connector.

## Audio Inputs

Two surround (5.1) and three stereo digital audio sources can be connected. All sources can be monitored using the pre- and post-fader surround and post-fader stereo monitor output channels. A one-to-one relationship is maintained between the input and output channels, i.e., left input to left monitor output, right input to right monitor output, center input to center monitor output, etc. (Of course this won't be true in the case where the user has enabled one or both of the downmix functions.) Stereo input C is also routed to the stereo input C direct monitor output.

The audio inputs support digital audio signals with a sampling rate of up to 192 kHz and a word length (depth) of up to 24 bits. It's best if the connected signal sources

maintain a common sample rate and timing reference. Having all signals "locked" together helps to ensure proper handling by the Model 76DA's all-digital signal control path.

There is, however, an exception worth noting. Circuitry associated with stereo input C has sample rate conversion (SRC) capability, allowing virtually any digital audio signal to be connected. A signal connected to stereo input C can have an independent sample rate and timing reference and still be monitored correctly. Refer to the Technical Notes section of this guide for a detailed review of the SRC capability.

Nine BNC jacks on the Model 76DA's back panel are used to interface with the 18 channels associated with the digital audio signal sources; each BNC connector carries two audio channels. The digital audio inputs are intended for connection with unbalanced digital audio sources that are compatible with the AES3 standard. In broadcast or post-production environments these signals may also be referred to as following the SMPTE 276M standard. This signal type has a nominal impedance of 75 ohms with a nominal signal level of 1 Vpp. As expected, these digital audio sources should be provided in the form of coaxial cables with BNC plugs attached.

Balanced AES3 digital audio signals can also be used with the Model 76DA's inputs if external coupling transformers ("baluns") are utilized. These impedance-matching (110 ohms to 75 ohms) and level-attenuating transformer assemblies typically provide a 3-pin female XLR connector on their input and a female BNC connector on their output.

## Digital Monitor Outputs

The 25-pin female D-subminiature connector labeled Digital Monitor Outputs provides access to the Model 76DA's 16 channels of digital audio monitor output: pre-fader surround, post-fader surround, post-fader stereo, and stereo input C direct. The pre-fader surround digital monitor output channels are intended for connection to metering or monitoring equipment that requires uninterrupted full-level signals.

The post-fader surround digital monitor output channels are intended to connect to a 5.1 loudspeaker system. The post-fader stereo digital monitor output is provided to support a separate set of stereo monitor loudspeakers.

The stereo input C direct digital monitor output is essentially a unity gain copy of the signal connected to stereo input C. However, the signal does pass through the sample rate conversion (SRC) and input delay circuitry. The impact made by these functions will depend on the specific input signal and the Model 76DA's configuration settings.

For flexibility the digital monitor outputs are transformer-coupled and can be configured to act as balanced or unbalanced AES3 digital audio sources. The digital monitor outputs are configured in two groups with separate choices available for the pre-fader surround/stereo input C direct group and post-fader surround/post-fader stereo group. When a group is set for balanced AES3 operation the signals have a nominal impedance of 110 ohms and a nominal level of 5 Vpp. Signals of this type are normally interconnected using shielded twisted-pair cable terminated with 3-pin

XLR connectors. When a group is configured for unbalanced AES3 operation the signals have a nominal impedance of 75 ohms and a nominal level of 1 Vpp. These signals are typically interconnected using coaxial cable terminated with BNC connectors. For details on how a Model 77 Control Console is used to select the digital monitor output types refer to the Configuration section of this user guide.

A cable assembly with a 25-pin male D-sub connector (DB-25M) on one end and the desired connectors on the other end will be used for connecting to the digital monitor outputs. The D-subminiature connector follows the TASCAM® wiring convention, organizing the 25 pins into eight groups of three pins each; one pin remains unused. Each set of three pins provides an independent interface. In the analog world this would allow eight audio signals to be transported. But with AES3 digital audio signals this allows support for 16 audio channels; eight interfaces each supplying two audio channels.

A wiring assembly prepared for the Model 76DA's digital monitor outputs, when configured for balanced AES3 (110 ohms/ 5 Vpp), would be identical to that of a DA-88-style output assembly. An assembly of this type would have a 25-pin male D-subminiature connector (DB-25M) on one end and eight 3-pin male XLR connectors on the other. A wiring assembly prepared for the Model 76DA's digital monitor outputs, when set for unbalanced AES3 (75 ohms/1 Vpp), would typically have eight BNC plugs attached.

For compatibility with balanced AES3 digital audio signals connect the D-sub's + terminal as signal high and the – terminal as signal low. In most applications a 3-pin male XLR connector will be used. In this case the + terminal would go to pin 2 of the XLR, the – terminal to XLR pin 3, and the shield terminal to XLR pin 1.

For compatibility with unbalanced AES3 digital audio signals connect the D-sub's + terminal as signal high, and both the – and shield terminals as the signal low/ shield. When terminating to a BNC plug the D-sub's + terminal should connect to the center pin; the – and the shield connections should go to the "body" of the BNC plug. To clarify, for optimal operation it is best to connect both the – and shield connectors together directly on the D-sub plug, rather than at the BNC end of the interface assembly. Note that the output circuitry is transformer-coupled so it is possible to just connect to the + and – terminals and still experience correct operation. This would leave the shield connection unterminated.

Refer to Figure 4 or Appendix A for the exact connection details. Note that unlike a DA-88-style assembly, the two threaded fasteners associated with the Model 76DA's D-sub connectors use 4-40 threads. This complies with the original design standard for D-subminiature connectors.

### Pre-Fader Surround Digital Monitor Output

The pre-fader surround digital monitor output channels are intended to connect to metering, measurement, or other signal monitoring equipment that requires uninterrupted, full-level digital audio signal sources.

### Stereo Input C Direct Digital Monitor Output

The stereo input C direct digital monitor output is intended for use in site-specific applications. It provides an uninterrupted,

| Connections | TASCAM® Channel | Signal High (+) | Signal Low (–) | Shield |
|---|---|---|---|---|
| Pre-Fader L/R | 1 | 24 | 12 | 25 |
| Pre-Fader C/SUB | 2 | 10 | 23 | 11 |
| Pre-Fader LS/RS | 3 | 21 | 9 | 22 |
| Stereo Input C Direct | 4 | 7 | 20 | 8 |
| Post-Fader L/R | 5 | 18 | 6 | 19 |
| Post-Fader C/SUB | 6 | 4 | 17 | 5 |
| Post-Fader LS/RS | 7 | 15 | 3 | 16 |
| Post-Fader Stereo | 8 | 1 | 14 | 2 |

**Notes:** 1) All signals transformer-coupled digital audio; selectable for balanced or unbalanced AES3 compatibility.

2) Connector type on Model 76DA is 25-pin female D-subminiature (DB-25F). Installer must provide male (DB-25M). Connector uses 4-40 threaded inserts for locking with mating plug.

3) Wiring scheme follows TASCAM DA-88 convention. Standard DA-88-type wiring harnesses are directly compatible, with the possible exception of 4-40 screw threads being required.

**Figure 4. Connections for Digital Monitor Outputs**

full-level digital audio signal source that is post-SRC and input delay in the signal chain.

### Post-Fader Surround Digital Monitor Output

The post-fader surround digital monitor output channels are designed for connection to digital inputs on audio amplifiers associated with monitor loudspeakers. Alternately, they could be connected to the inputs of loudspeakers that contain integrated amplifiers with digital audio input capability.

### Post-Fader Stereo Digital Monitor Output

The post-fader stereo digital monitor output channels are intended to support a stereo loudspeaker system, either by connecting to the digital input of an amplifier associated with a set of loudspeakers or directly to a set of amplified speakers that provide digital inputs.

## Analog Monitor Outputs

The connector labeled Analog Monitor Outputs provides access to the Model 76DA's 6-channel (5.1) surround and 2-channel stereo analog monitor outputs. The surround analog monitor output channels are intended to connect to analog inputs associated with the surround loudspeaker system incorporated in a facility. The stereo analog monitor output allows support for a secondary set of stereo monitor loudspeakers.

The analog monitor output channels are designed for connection to audio amplifiers associated with monitor loudspeakers or to the inputs of loudspeakers that contain integrated amplifiers. The analog monitor outputs are electronically balanced and will perform optimally when driving loads of 2000 (2 k) ohms or greater. In most applications 3-pin male XLR connectors will be used to interface with the inputs on the associated amplifiers or amplified speakers. In this case the + terminal would go to pin 2 of the XLR, the – terminal to XLR pin 3, and the shield terminal to XLR pin 1.

Balanced operation of the analog monitor outputs is the preferred connection method but unbalanced operation does not pose a problem. To connect to an unbalanced load connect the + terminal as signal high, and only the Model 76DA's shield terminal as the signal low/shield. Leave the – terminal unconnected. For correct unbalanced operation, it is important not to connect – and shield together.

The wiring scheme used by the D-subminiature connector complies with that made popular by TASCAM with their DA-88 product. A wiring assembly prepared for the Model 76DA's analog monitor outputs

is identical to that of a DA-88-style output assembly. Please refer to Figure 5 for the exact connection details. Again note that unlike a DA-88-style assembly, the Model 76DA's D-sub connectors use 4-40 threads.

| Connections | Signal High (+) | Signal Low (–) | Shield |
|---|---|---|---|
| Surround L | 24 | 12 | 25 |
| Surround R | 10 | 23 | 11 |
| Surround C | 21 | 9 | 22 |
| Surround SUB | 7 | 20 | 8 |
| Surround LS | 18 | 6 | 19 |
| Surround RS | 4 | 17 | 5 |
| Stereo L | 15 | 3 | 16 |
| Stereo R | 1 | 14 | 2 |

**Notes:** 1) Connector type on Model 76DA is 25-pin female D-subminiature (DB-25F). Installer must provide male (DB-25M). Connector uses 4-40 threaded inserts for locking with mating plug.

2) Wiring scheme follows TASCAM DA-88 convention. Standard DA-88-type wiring harnesses are directly compatible, with the exception of 4-40 screw threads being required.

**Figure 5. Connections for Analog Monitor Outputs**

## Sync Input

The Model 76DA requires a timing reference (sync) signal so that the digital audio input and digital monitor output signals will be handled correctly. A configuration setting allows the source of sync to be the L/R input of the currently selected surround or stereo digital audio input. While this is acceptable, audio artifacts (clicks or noise) can occur when switching between inputs. A better method is to connect a dedicated timing reference signal to the Model 76DA's sync input connector. The connected sync signal must maintain a stable relationship between itself and the digital audio inputs. The actual sync source can be in one of several formats: word clock, DARS (AES11), bi-level video, or tri-level video.

An overview of the various compatible timing reference signals might prove worthwhile. Word clock is a digital signal that is locked in phase and frequency to the sample rate of the associated digital audio sources. DARS (digital audio reference source) is a timing signal compliant with the AES11 standard. It's sometimes referred to as "AES3-black." Technically it is similar to an AES3 signal but is generated specifically as a timing reference signal. Bi-level video sync signals were originally provided to support NTSC and PAL broadcast applications, although they continue to be used by contemporary equipment. Tri-level sync signals were primarily associated with facilities that supported high-definition (HD) video equipment, however the importance of this type of sync seems to be waning. Both bi-level and tri-level signals can be found at numerous rate combinations, configured to allow for compatibility with the various video formats.

With the wide range of allowable sync sources proper Model 76DA operation should be easy to obtain. Extensive testing has been done using many different sync source types and rates. Interested users can refer to Appendix B of this user guide for details.

The external sync reference source is connected to the sync input BNC connector located on the Model 76DA's back panel. For flexibility this input can be configured to be high-impedance ("floating") or terminated with an impedance of 75 ohms. A sync source that is dedicated for use by the Model 76DA's sync input will typically have input termination enabled. If the sync

signal connected to the Model 76DA is being connected ("multed") to other inputs it may be desirable for the termination to be disabled. A general "rule of thumb" is that termination should be applied only at the location of the last physical device using a sync signal.

## Remote Control Inputs

Support is provided for two remote control input functions: remote mute all and remote dim. These functions only impact the post-fader surround and stereo digital and analog monitor outputs. The Model 76DA's inputs use logic gates, "pulled up" to 5 volts DC by way of resistors, which are active whenever they are brought to their logic low state. Inputs of this type are commonly referred to as GPI inputs. While the input circuitry is protected from over-current and static discharge (ESD), care should be taken to prevent nasty signals from reaching them. The inputs are active only when held in the low state; they can't be configured to change state ("latch") in response to a logic pulse.

A 9-pin female D-subminiature connector is used for the remote control inputs. Refer to Figure 6 or Appendix A for the exact connection details. Note that pin 4 (remote common) connects to the Model 76DA's internal circuit common connection as well as to the Model 76DA's chassis and mains earth connections. Figure 6 also shows two spare remote control inputs (pins 8 and 9). These are provided for future applications and should remain unconnected. This connector also allows access to an RS-485 data interface. This interface is not supported in the Model 76DA and, as such, pins 7 and 2 should remain unterminated.

| Signal | Pin | Direction |
|---|---|---|
| Data + (RS-485/RS-422) | 7 | Not used |
| Data – (RS-485/RS-422) | 2 | Not used |
| Data Shield | 1 | Shield |
| Remote Mute All | 5 | Input |
| Remote Dim | 6 | Input |
| Remote Spare 1 | 8 | Input |
| Remote Spare 2 | 9 | Input |
| Remote Common | 4 | Common |

**Note:** Connector type on Model 76DA is 9-pin female D-subminiature (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

**Figure 6. Connections for Remote Control Inputs**

## Connecting the Model 76DA to the Model 77

A 9-pin female D-subminiature connector, labeled To/From Control Consoles, is provided on the back panel of the Model 76DA Central Controller. This is used to interface the unit with Model 77 Control Consoles. Refer to Figure 7 or Appendix A for details. A 9-pin female D-sub connector, labeled To/From Central Controller, is provided on the back panel of each Model 77 Control Console. A cable with 9-pin male D-sub (DE-9M) connectors on each end is used to interconnect the Model 76DA with the Model 77 units. A cable is included in the shipping carton. The cable implements all nine connector pins in a one-to-one manner.

Should an interconnecting cable of a different length be required there's no problem for one to be fabricated and used. While it can be wired in a one-to-one fashion supporting all nine pins, only four connections are required: pin 1 (data +), pin 6 (data –), pin 4 (DC +), and pin 9 (DC –). The Model 76DA's connector pin-out scheme was de-

| Signal | Pin | Direction |
|---|---|---|
| Data + (RS-485) | 1 | To/From Models 77/71 |
| Data – (RS-485) | 6 | To/From Models 77/71 |
| Data Shield | 2 | To/From Models 77/71 |
| DC + (12 V) | 4 | To Models 77/71 |
| DC – (12 V Return) | 9 | To Models 77/71 |
| DC Power Shield | 5 | To/From Models 77/71 |

**Note:** Connector type on Model 76DA is 9-pin female D-subminiature (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

**Figure 7. Connections between Model 76DA and Model 77 and Model 71**

signed to allow creation of an interconnecting cable which uses commonly available 2-pair audio cable. This cable, consisting of two twisted pairs each with an individual shield, is typically sleek, flexible, and available in many colors. One pair and shield can be used for the data connections while the other pair and shield can be used for the DC connections. This implementation has the advantages of providing a shield for the data path and a more robust common connection (two conductors including the shield) for the DC power circuit.

A few simple calculations are required to determine the maximum cable length when connecting a Model 76DA to a Model 77. The differential transmission scheme used by the system's RS-485 interface makes an interconnection in excess of 1000 feet (>300 meters) easily possible. The limiting factor is typically the ability of the wiring to pass the DC power supplied by the Model 76DA to a Model 77. The Model 76DA supplies 12 volts DC with a maximum current of 500 milliamperes.

The Model 77 requires a minimum of 9 volts DC, 100 milliamperes, for correct operation. (The voltage must be measured directly at the Model 77's 9-pin connector.) So the maximum interconnecting cable length is directly related to the resistive voltage losses associated with the two DC-carrying conductors. As the Model 76DA supplies 12 volts and the Model 77 requires 9 volts minimum, this directly leads to a 3 volt DC maximum drop due to the interconnecting cable. Using Ohm's law it's quite easy to determine whether the selected cable will support the desired interconnection length. Calculate the voltage drop by multiplying the total resistance (in ohms) of the proposed cable by 0.1 (the Model 77's required current in amperes). Remember to include the resistance in both the DC + and DC – wires when calculating the voltage drop. If it's greater than 3 volts your cable is too long or the wire gauge is too small.

## Additional Control Consoles

Some installations may benefit from the Model 76DA's ability to be controlled by additional control consoles. At least one Model 77 Control Console must be connected to the Model 76DA Central Controller. After this requirement has been met up to three additional Model 77 or Model 71 Control Consoles can also be connected and to powered by the Model 76DA.

When connecting multiple control consoles to a Model 76DA all nine pins of each interconnecting cable can be connected in parallel ("multed"). Using this arrangement the data and 12 volts DC power signals between all the units will be multed. A custom cable implementation requires just four pins to be connected: pin 1 (data +), pin 6 (data –), pin 4 (DC +), and pin 9 (DC –).

To make installation simple, a "bus" cable assembly can be created using a short length of ribbon cable with one male and multiple 9-pin female D-subminiature insulation-displacement connectors attached.

Then standard 9-pin cables can link the control consoles with the connectors on the bus cable.

Refer to the previous paragraphs of this user guide where the issues involving Model 76DA to Model 77 cable length are discussed. Note the required current for a Model 77 is 100 milliamperes while a Model 71 requires only 35 milliamperes. It's important to review this information prior to creating the interconnection scheme to be used for installing multiple Model 77 units.

## AC Mains Power

The Model 76DA operates directly from AC mains power of 100 to 230 volts, 50/60 Hz. Being a "universal input" device, there are no switches to set or jumpers to install to match a location's mains voltage. The unit uses a 3-pin IEC 320 C14-type inlet connector to mate with a detachable mains cord. All units are supplied with a mains cord that has a North-American-standard plug (NEMA 5-15L) on one end and an IEC 320 C13 socket on the other. Units bound for other destinations require that the appropriate cord be used. The wire colors in the mains cord must conform to the internationally recognized color code and should be terminated accordingly:

| Connection | Wire Color |
|---|---|
| Neutral (N) | Light Blue |
| Line (L) | Brown |
| Protective Earth (E) | Green/Yellow |

**Safety Warning:** The Model 76DA does not contain an AC mains disconnect switch; the AC mains cord plug serves as the disconnection device. Safety considerations require that the plug and associated outlet be easily accessible to allow rapid disconnection of AC mains power should it prove necessary.

As soon as mains power is applied the Model 76DA will perform a power-up sequence. The two LEDs on the right side of the front panel will individually light in a rapid right-to-left test sequence. Then the LEDs will flash in cadence while the firmware loads into the Model 76DA's main logic device. After just a few seconds initial system operation will commence and the two LEDs will perform their intended functions. Once operating data is being interchanged with the one or more connected Model 77 or Model 71 Control Consoles the control console status LED will also light. The sync status LED will light if a valid sync source has been recognized. The sync status LED will flash if a valid sync source is not recognized.

Also upon application of mains power, all connected Model 77 units will go through a power-up sequence, lighting each of its LEDs in succession. Using its 4-digit display, each Model 77 will then momentarily display its address, its software version, and the main and logic device software versions of the associated Model 76DA.

All connected Model 71 units will also go through a power-up sequence after mains power is applied to the Model 76DA. Each of the Model 71's three LEDs will light momentarily. After these LEDs have been lit, the device address will be shown briefly

using the dim and reference level LEDs, as shown in Figure 8 in the Configuration section. When this is complete the Model 71 will begin normal operation and its status LED will light if communication is established with the Model 76DA. If the Model 71's status LED does not light check to see if there is a device address conflict among all connected control consoles and that all cables are connected properly.

Should an error be detected during the start-up process the two LEDs on the Model 76DA's front panel will continue to flash in cadence indefinitely. On the Model 77 units a diagnostic code may be displayed. Refer to the Technical Notes section of this user guide for details.

Only after the Model 76DA and all connected Model 77 and Model 71 units have correctly powered up will full system operation begin. It's possible that audio signals will first be present on the digital monitor outputs. The analog monitor outputs will only become active after a protection interval has elapsed. These outputs are muted using electro-mechanical relays that operate under software control.

# Configuration

After the physical installation has been completed it's important that the system's configuration options be carefully reviewed. In most cases one or more of the operating parameters will need to be revised to meet the needs of the specific installation. Many of the configuration parameters will impact the signal flow in to and out of the Model 76DA Central Controller. Other parameters affect how the one or more Model 77 Control Consoles will display status conditions and respond to user commands. Most of the configuration choices will be made using a Model 77 Control Console. However, two configuration choices are available for each of the connected Model 71 Control Consoles.

## Configurable Parameters

Many StudioComm functions can be configured to meet the exact needs of an installation. A Model 77 Control Console is used to display and select the desired system configuration. Here's an overview of what can be configured:

- Model 77 Device Address (must be unique for each unit!)
- Stereo Input C Sample Rate Converter
- Post-Fader Stereo Digital and Analog Monitor Output
- Bass Management
- Mute/Solo Bass Management Mode
- Sync Source
- Sync Input Termination
- Audio-Synced-to-Video Sample Rate
- Digital Monitor Output Types
- Reference Level
- Overall Display Mode
- Reference Level in dB SPL
- Auto Reference Level Off
- Dim Level
- Remote Inputs
- Surround to Stereo Downmix Levels
- Pre-Fader Surround Digital Monitor Output Mode
- Channel Pop Solo Mode Offset Levels
- Input Delay A and B
- Post-Fader Digital and Analog Monitor Output Channel Level Offsets

The configuration diagrams, located later in this section, give details on setting each parameter. An overview of each configurable parameter is provided in the following paragraphs.

## Entering and Exiting the Configuration Mode

A small button is located on the back of each Model 77 Control Console, adjacent to its 9-pin female D-sub connector. On any connected Model 77 pressing and holding this button for two seconds places both this specific unit and the Model 76DA into their configuration modes. Other connected Model 77 and Model 71 units will enter a standby mode. When the Model 76DA enters its configuration mode it will immediately mute the monitor outputs as a speaker protection measure. When a Model 77 enters the configuration mode its array of buttons and LEDs no longer perform their normal functions, instead they are used to display the operating parameters and reflect configuration changes as they are made.

As a user aid, a Model 77 that has entered the configuration mode will have its mute and solo LEDs (associated with the channel mute/solo section) light in an alternating manner. Other connected Model 77 units will indicate that they have entered the standby mode by simultaneously flashing their mute and solo LEDs.

To leave the configuration mode and return the system to normal operation requires one last action to be made on the Model 77 unit that's in its configuration mode; press and hold its configure the button for two seconds. Note that configuration changes are stored in nonvolatile memory only after the configuration mode has been exited.

Our apologies to those of you who find the configuration button a pain to use, but it's supposed to be that way! Seriously, the top of the button is slightly recessed from the back panel, making it harder to accidentally activate. We didn't want normal operation to cease because someone pushed a Model 77 into a "rats nest" of schedules, memos from management, and empty coffee cups! But a firm press with the fleshy part of an index finger should do the trick.

There is no problem frequently "tweaking" the system's operating parameters to achieve the desired performance. The configuration data is stored in nonvolatile memory, which is rated for thousands of read and write cycles and a retention time in tens of years. Note that memory integrated circuits are located in the Model 76DA Central Controller as well as the Model 77 and Model 71 Control Consoles. The individual device address is stored in each Model 77. The device address and button configuration parameters are stored in the Model 71. All other configuration parameters are stored in the Model 76DA.

## Model 77 Device Address

A unique device address must be assigned to each Model 77 that is connected to a Model 76DA. The choices are A1, A2, A3, or A4, with the default address being A1. As most installations will find only one Model 77 utilized, its default setting is appropriate. For installations that use a second, third, or fourth Model 77 each unit must be configured with a unique device address. Problems will occur if more than one unit has the same address! It's important to highlight the fact that the device address is the only setting that must be done on each individual Model 77 unit. All other settings can be made on any one of the connected

Model 77 units. Be sure that any selected address does not conflict with addresses to be assigned to Model 71 units.

## Stereo Input C Sample Rate Converter

Circuitry associated with stereo input C can provide sample rate conversion (SRC) for digital audio signals connected to that input. The acceptable input range for sample rate conversion is very wide, but is dependent upon the output sample rate. With an output sample rate of 48 kHz any signal with a sample rate over a range of 8 to 216 kHz can be properly monitored by the system. This capability can be especially useful with signals that are not synchronized with respect to the others connected to the Model 76DA, even if the sample rate is identical. The only compromise is that the SRC process adds a fixed input-to-output (group) delay of approximately 1 millisecond, a value that shouldn't impact most installations. As such, it's recommended that the sample rate converter remain enabled. However there might be special cases where this resource isn't desired and it can be disabled.

## Post-Fader Stereo Digital and Analog Monitor Outputs

In addition to the post-fader surround digital and analog monitor outputs, separate post-fader stereo digital and analog monitor outputs are also provided. By default the stereo outputs can be enabled by an operator. In applications where stereo monitor loudspeakers are not connected to either of the post-fader stereo monitor outputs, the outputs can be disabled. This can minimize confusion, preventing an operator from attempting to select the post-fader stereo digital and analog monitor outputs.

## Bass Management

The Model 76DA incorporates flexible and sonically excellent bass management capabilities which can impact both the digital and analog post-fader monitor outputs. It is, however, limited to functioning only at sample rates of 44.1, 48, 88.2, and 96 kHz. Five configuration parameters are used to enable or disable bass management as well as to select the characteristics of the associated audio filters. While the settings are simple to make, great care must be taken in first reviewing the entire monitor system. Only after a full understanding of the performance of the associated surround and, if present, stereo loudspeaker systems are determined can a plan for bass management be established.

Bass management can be enabled so that the function is active when the surround post-fader monitor outputs are enabled. It can also be independently enabled so that it can be active when the stereo post-fader monitor outputs are enabled. By default bass management for both outputs is disabled. The crossover point of the bass management filters can be selected from among four choices: 40, 50, 60, or 80 Hz. The slope of the low-pass and high-pass filters associated with bass management can be independently selected. The choices are 12 dB/octave or 24 dB/octave with the latter being the default.

## Mute/Solo Bass Management Mode

The Model 76DA's mute/solo function can be configured for how it performs in applications where bass management has been enabled. This is a somewhat-esoteric topic but can be important in certain situations. The default setting for the mute/solo bass

management mode is for pre-bass management. This means that if a channel has been selected for, as an example, soloing then the bass management filters will send any applicable low-frequency content to the post-fader digital and analog subwoofer outputs. So in this case the solo function is really an “input channel” solo since the actual acoustical energy associated with that channel will be reproduced by both the main channel and subwoofer loudspeakers. So while one is “soloing” a channel (or set of channels) two or more loudspeakers may be reproducing the signals.

The mute/solos bass management mode can also be set for post-bass management. When this mode is enabled a channel selected for soloing will cause only its associated post-fader digital and analog monitor output channels to remain active. So if, for example, one of the main surround input channels (one of the “5.” channels) is selected for soloing then all post-fader output channels except that one will mute. The bass management filters will remain enabled, thus sending only the high-passed audio energy from the soloed input channel to the soloed output channel. Only if the LFE channel has been selected for soloing will the subwoofer output remain active. Typically the only reason why the post-bass management mode would be selected is when troubleshooting issues with the loudspeaker system.

## Sync Source

The Model 76DA requires that the designated external timing reference (sync) be defined. Three of the choices—word clock, DARS, and video—are associated with a signal that is connected to the sync input BNC connector. The fourth choice allows the L/R input of the currently selected surround or stereo digital audio input to serve as the system’s sync source.

## Sync Input Termination

The sync input circuitry can be configured to terminate the signal connected to the back-panel sync input BNC connector. When termination is selected a 75 ohm load is applied to the signal. When the sync input is not terminated the input impedance is very high, essentially applying no load to the source. If the sync source is connected only to the Model 76DA then enabling termination is typically appropriate. However, if the sync source is being “shared” by multiple inputs then care must be taken so that the signal is only terminated by one device.

## Audio-Synced-to-Video Sample Rate

If a video sync signal is being used as the Model 76DA’s timing reference the sample rate of the connected digital audio signals must be specified. In most cases the default value of 48 kHz will be appropriate, but rates from 32 to 192 kHz are available.

## Pre-Fader Surround/Stereo Input C Direct Digital Monitor Output Type

To meet the needs of specific installations the nominal impedance and level characteristic of the pre-fader surround and stereo input C direct digital monitor outputs can be selected. They are selected as a group; configuration of individual digital outputs is not provided. If the digital output signals are going to be connected to balanced AES3 inputs then the setting that provides a source impedance of 110 ohms and a nominal 5 Vpp output level would be

appropriate. If the digital output signals are going to be connected to unbalanced AES3 inputs then the setting that provides a 75 ohm source impedance and a nominal output level of 1 Vpp would be correct.

## Post-Fader Surround/Stereo Digital Monitor Output Type

The source impedance and output level of the post-fader surround and stereo digital monitor outputs, as a group, can be configured. The information previously provided concerning configuring the pre-fader surround/stereo input C direct digital monitor output type also applies to these outputs.

## Reference Level

For audio-with-picture applications it's often beneficial for monitoring to be done in reference to a known loudspeaker level. This is often referred to as "mixing to 85 dB" on the monitors. The StudioComm for Surround system allows a precise post-fader surround digital and analog monitor output level to be stored, and then enabled by pressing the Model 77 button labeled Reference Level. Setting the reference level is very simple but care is required:

1. Set up a precision sound pressure level (SPL) measuring device at the desired listening location.
2. Place the StudioComm system in the normal operating mode, not the configuration mode. Be certain that the dim, mute all, reference level, and downmix functions are not active. The remote mute all and remote dim functions must also not be active.
3. Use the Model 77 Control Console to select the input source that contains the desired reference signal source, e.g., pink noise.
4. Observing the SPL meter, adjust the Model 77's rotary level control until the desired loudspeaker system reference level has been reached.
5. Being careful not to disturb the position of the rotary level control, enter the configuration mode by pressing and holding the configuration button located on the Model 77's back panel.
6. Once the configuration mode has been entered, all the monitor outputs (digital and analog) will mute. Press and hold the reference level button; its associated LED will begin to flash. After five seconds the LED will light steadily to indicate that a "snapshot" of the new reference level has been taken. The Model 77's numeric display will then show the value of the new reference level. The value shown will always be a negative number as it's always a value less than the maximum output level. The reference level button can now be released.
7. To complete the process the configuration mode must be exited. This is performed by again pressing and holding the configuration button for two seconds. The new reference level is now stored in the Model 76DA's nonvolatile memory. Only by repeating the entire procedure can the value be changed.

Once the configuration mode has been exited, the digital and analog monitor outputs will again become active. Confirm that the correct level has been stored by

pressing the reference level button. The SPL meter should display the desired level. If not, repeat the calibration procedure to achieve the desired goal.

You might wonder why you have to press and hold the reference level button for five seconds before the selected value is recognized. This is provided specifically so that unauthorized users won't accidentally change the reference level while they experiment with the configuration mode. Only if you know the "secret" will you be able to store a new value.

## Overall Display Mode

The Model 77's 4-digit numeric display can be configured to display the post-fader surround and stereo digital and analog monitor output levels in either an attenuation mode or an SPL mode. In the attenuation mode the output level is shown as a reduction in level, in dB, relative to the maximum output level. When the rotary control is used to set the output level to its maximum the display will show 0.0. As the rotary control is turned in the counterclockwise direction the display will show negative values, reaching –70.0 before the full mute function automatically mutes the outputs.

In the SPL mode the display can be configured to allow the output level to be presented to users in terms of the actual sound pressure level (SPL). It is used in conjunction with the reference level in dB SPL configuration and the stored reference level. The SPL mode allows a user to see a visual representation of the SPL level that is present in the listening environment. While it takes a little more care to correctly implement the SPL display mode, it can offer an enhanced experience for StudioComm users.

## Reference Level in dB SPL

The reference level in dB SPL configuration allows a specific SPL value to be associated with the stored reference level value. In this way whenever the post-fader surround or stereo digital and analog monitor outputs are at their reference level, either through activating the reference level function or manually adjusting the rotary level control, the Model 77's display will show the configured SPL level. Whenever the monitor output is not at the reference value the display will show the current value, in dB, relative to the reference level. The reference level in dB SPL can be configured over a range of 70.0 to 100.0 dB in 1.0-dB steps. In many applications selecting a value of 85 would be appropriate, reflecting the widely used audio-for-picture 85 dB monitoring reference level. (Typically this 85 dB is really 85 dBC, indicating that a C-weighting filter has been applied to the measurement.) Other common reference SPL values, such as 82 dB and 87 dB, are well within the allowable range.

## Auto Reference Level Off

When auto reference level off is enabled, the function automatically turns the reference level function off if a change is made to the rotary level control while the reference level function is active.

## Dim Level

The dim function is used to reduce the post-fader surround and stereo digital and analog monitor output levels by a preset amount. The reduction is in dB relative to the post-fader surround and stereo monitor outputs' current level. There are four dim level values available: –10.0, –15.0, –20.0, and –25.0 dB.

## Remote Mute All

Two configuration choices are associated with the remote mute all function: disabled and enabled. To utilize the remote mute all function simply requires you to select the enabled setting.

## Remote Dim

Two configuration choices are associated with the remote dim function: disabled and enabled. To utilize the remote dim function simply configure it for enabled.

## Input Delay

A time delay can be added to the input signals, allowing compensation for delays that may be present on associated video signals. The time delay applies to all input signals and cannot be applied selectively. A configured delay time is referenced to a sample rate of 48 kHz. In the case of input signals with a sample rate of 48 kHz the delay range is 0 to 340 milliseconds in 1-millisecond steps. For other sample rates the time must be linearly scaled. For example, for a sample rate of 96 kHz the actual time range is 0 to 170 milliseconds. In this case selecting a delay of 120 on the Model 77 will result in an actual time delay of 60 milliseconds. For 192 kHz sampling the time range is 0 to 85 milliseconds. Selecting a delay of 240 will result in a time delay of 60 milliseconds.

For operating flexibility two different input delay values can be selected and stored during the configuration process. These can then be enabled as required by the operator during normal system operation. The default value for both Delay A and Delay B is 0 milliseconds. Typical applications would require only one input delay to be configured. But in other cases two different, both non-zero, input delay values will be selected. This could be appropriate in applications where multiple video display systems are being used in the same control room or monitoring facility. Each video display may exhibit its own processing latency and audio would need to be "lined up" accordingly. During normal StudioComm operation an operator can select the appropriate input delay for the display system currently being utilized.

## Surround to Stereo Downmix Levels

The surround to stereo downmix function is a useful tool for checking the compatibility of surround (5.1) input signals with stereo and monaural playback environments. The exact technical formula for how the Model 76DA handles the surround to stereo downmix function can be selected by way of four configurable parameters. The default settings create a good general-purpose function that's effectively used by numerous users of Studio Technologies' StudioComm for Surround products. But there are application-specific situations where modifying one or more of the parameters will be appropriate. This can be in response to a personal choice in monitoring methods or, more frequently, to meet the requirements of international broadcast standards.

When the surround to stereo downmix function is active the path from the left (L) channel input to the left post-fader output channel and the right (R) channel input to the right post-fader output channel is maintained. A configuration choice allows the level of the L and R inputs routed to the L and R outputs to be selected. By default, when the surround to stereo downmix function is active the level of the L and R inputs

remain at unity, with no gain or loss applied. An alternate setting allows the level of L and R input channels to be reduced (attenuated) by 3 dB. (The available changes in signal level can also be notated as 0 dB or –3 dB.)

When the surround to stereo downmix function is active the left surround (LS) input is routed to the left (L) post-fader monitor output; the right surround (RS) input is routed to the right (R) post-fader monitor output. By default the level of the LS and RS signals routed to L and R will be reduced (attenuated) by 3 dB. An alternate setting allows the levels to be reduced by 6 dB. (These settings can also be notated as –3 dB and –6 dB.)

When the surround to stereo downmix function is active the center (C) input is routed to both the left (L) and right (R) post-fader monitor outputs. By default the level of the C signal routed to L and R will be reduced (attenuated) by 6 dB. An alternate setting allows the attenuation level to be 3 dB. (These levels can also be notated as –3 dB and –6 dB.)

By default, when the surround to stereo downmix function is active the LFE channel associated with a surround input is fully attenuated (muted). This removes LFE content from the “downmixed” signal. In most applications this is appropriate. However, for special situations a configuration mode allows the LFE channel to be reduced by 6 dB and routed to both the left (L) and right (R) post-fader monitor outputs.

A last word on configuring the surround to stereo downmix function: no matter what choices are made when the function is active the center (C), left surround (LS), right surround (RS), and subwoofer (SUB) post-fader monitor outputs will fully mute.

## Pre-Fader Surround Digital Monitor Output Mode

The pre-fader surround digital monitor output can be configured as to its place in the Model 76DA’s signal flow. The choices are pre- or post-downmix. In the pre-downmix mode the digital monitor output channels will not be impacted by the state of the downmix functions. This setting would be appropriate if the pre-fader surround digital monitor outputs were being routed to a storage system, routed to another facility, etc. In this case the action of an operator enabling or disabling the downmix functions won’t impact the pre-fader surround digital monitor output signals. If the post-downmix mode is selected the pre-fader surround digital monitor outputs will reflect the actions of the downmix functions. This choice would be correct if, for example, level meters were connected to the pre-fader surround digital monitor outputs. In this scenario an operator would want to visually observe the actions that the downmix functions impart on the signals.

## Channel Pop Solo Mode Offset Levels

Two parameters can be configured that determine how the channel pop solo function will impact the output levels of the post-fader digital and analog monitor outputs. The up offset level sets the amount of increase (gain) that a channel will experience when it is soloed in the channel pop solo mode. The down offset level sets the amount of decrease (attenuation) that the non-soloed channels will experience when a channel is active in the channel pop solo mode.

## Post-Fader Digital and Analog Monitor Output Level Offsets

To provide assistance during room calibration, the relative output levels of the post-fader surround and stereo digital and analog monitor output channels can be adjusted over a limited range. The eight channels can be adjusted in 0.5-dB steps over a ±12-dB range. During configuration the displayed value represents the dB level difference as compared to the nominal output level. In most cases one surround and one stereo channel should serve as the overall reference level and not be changed. This is typically the center channel for surround and the left channel for stereo. The configured output level offset values apply to both the digital and analog surround stereo monitor outputs. It is not possible to configure a specific channel's digital and analog monitor output level offsets to independent values.

This feature is provided primarily for use when the post-fader monitor output channels are connected to loudspeaker systems that don't offer a means of "trimming" the input sensitivity of individual channels. Without this capability, minor adjustments to the output level of specific loudspeakers to account for room acoustics wouldn't be possible.

It's also possible to use the StudioComm's output level offset capability to adjust the overall post-fader monitor output levels to allow matching to the input sensitivity of loudspeaker systems. In this case all the channels (six for surround, two for stereo) would be configured to have the same output level offset setting. For example, the six surround channels could all be configured to have a –3.5 dB output level offset. However, great care must be taken when configuring a system in this manner. The dynamic range or noise floor of the audio signals will be impacted and extreme settings could lead to poor monitor system performance.

## Restore Factory Defaults

The restore factory defaults function is provided primarily for factory use. In this way a system can be shipped with the default settings selected. While you are welcome to use this function, be careful so that your configuration efforts aren't wasted. Specifically, be aware that the reference level is reset to minimum level. All the other parameters are fairly easy to set up, but resetting the reference level would require getting out an SPL meter and a calibrated signal source. This is a hassle you may not need!

## Model 71 Control Console Configuration

Two configuration choices are available on each Model 71. One is its device address, the other is the button disable mode. A small button is located on the back of each Model 71 Control Console, adjacent to the 9-pin female D-sub connector. Pressing and holding this button for two seconds places this specific unit in its configuration mode; normal operation of the Model 76DA and other connected Model 71 and Model 77 units will continue. When a Model 71 enters its configuration mode its three LEDs will no longer perform their usual functions. Instead the status LED will blink to indicate that configuration mode is active. Refer to Figure 8 for details.

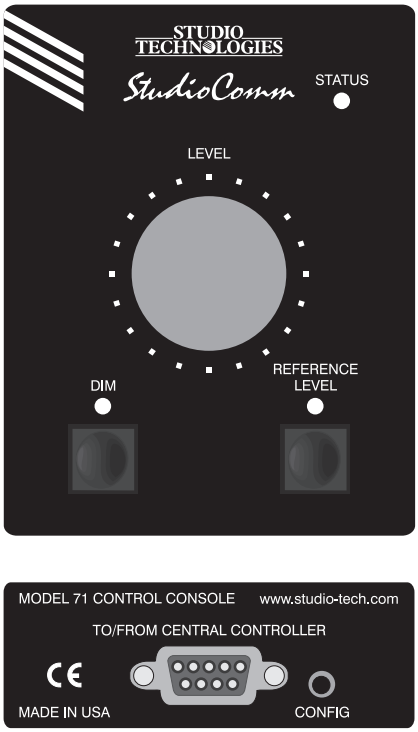



**Figure 8. Model 71 Control Console Front and Back Panels**

## Device Address

The dim and reference level LEDs will display the Model 71's current device address. The rotary level control is used to select the desired device address; the LEDs will respond accordingly. The device address must be selected so as not to conflict with the device address of any other connected Model 71 or Model 77 Control Console. The choices are A1, A2, A3, and A4. All Model 71 units have a default device address of A4; Model 77's units have a default device address of A1. This ensures that, in most cases, no change will have to be made. Refer to Figure 9 for details.

| Address | Dim LED | Reference Level LED |
|---|---|---|
| A1 | OFF | OFF |
| A2 | OFF | ON |
| A3 | ON | OFF |
| A4 | ON | ON |

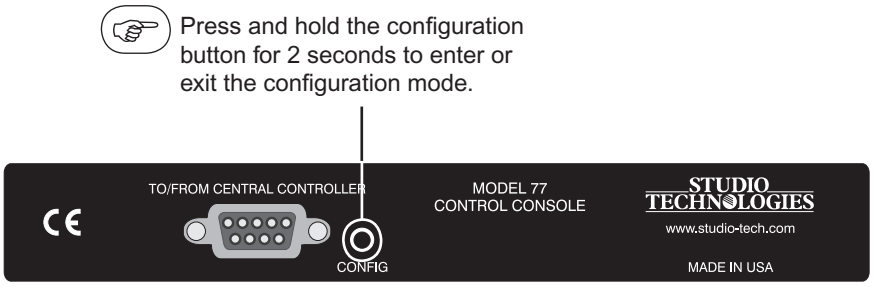
**Figure 9. Model 71 Device Address Chart**

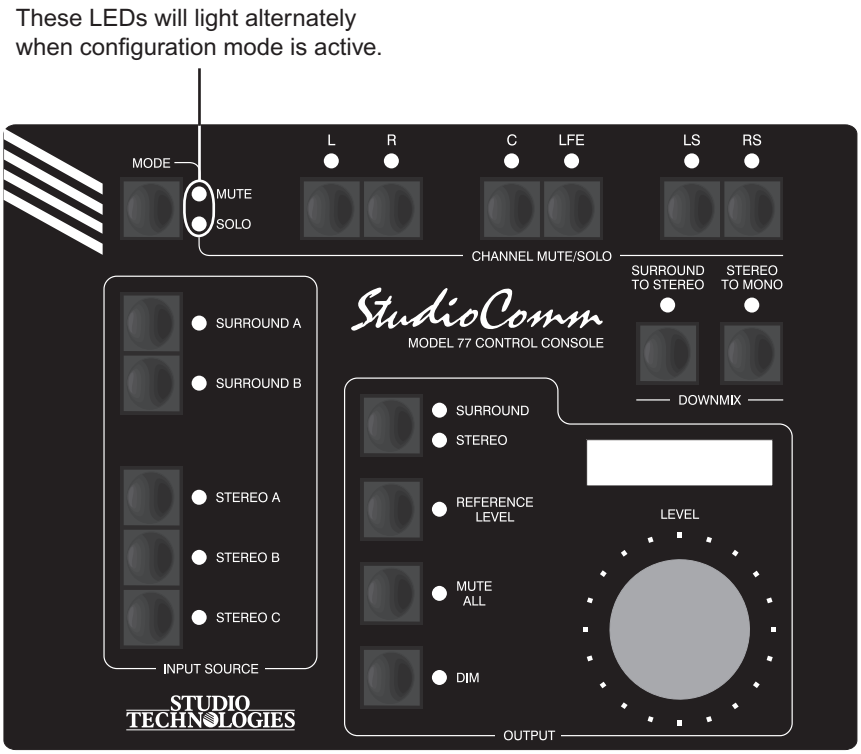
## Button Disable

To disable the Model 71's buttons, simultaneously press and hold both the dim and reference buttons for two seconds. When the disable request has been recognized the LEDs above both buttons will flash rapidly. Release the buttons and they will no longer enable or disable their normal functions. To return the buttons to normal operation simultaneously press and hold both buttons for two seconds at which time the two LEDs will flash rapidly.

To leave the configuration mode and return a Model 71 to normal operation requires one last action: again press and hold its configuration button for two seconds. The selected configuration parameters will be stored in a nonvolatile memory device that is located inside this specific Model 71.

# Configuration—Entering and Exiting Configuration Mode

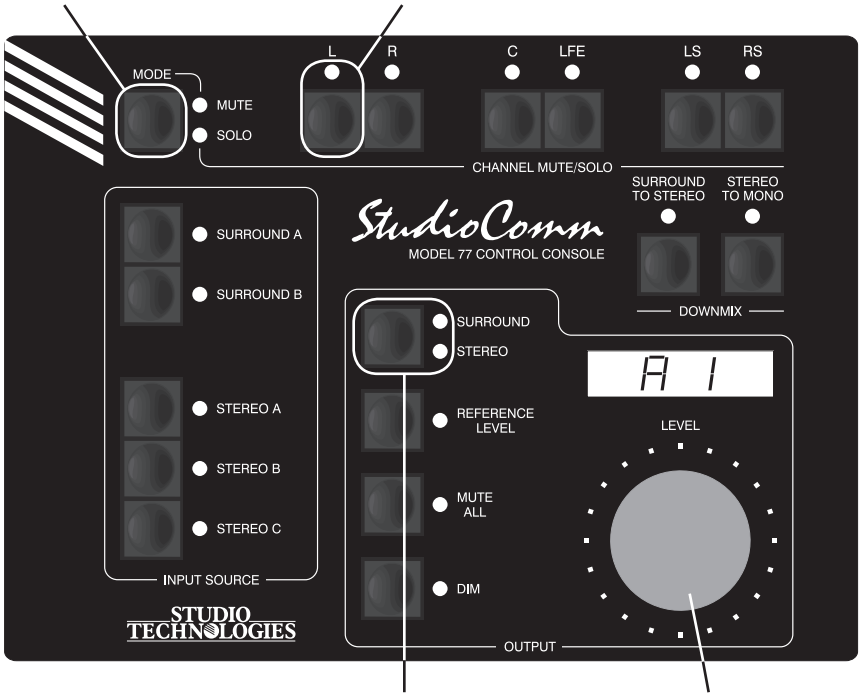


# Configuration—Model 77 Device Address, Stereo Input C Sample Rate Converter, and Post-Fader Stereo Digital and Analog Monitor Output

Press and hold the Mute/Solo button to display and configure the Model 77's device address, stereo input C sample rate converter, and post-fader stereo digital and analog monitor output.

This LED displays the configuration of the **stereo input C sample rate converter** (SRC). LED not lit means SRC is disabled; LED lit means SRC enabled. Use the button to change the configuration.




These LEDs display the status of the **post-fader stereo digital and analog monitor output** function. When LED Surround is lit the function cannot be enabled. When LED Stereo is lit the function can be enabled. Use the button to change the configuration.

Use the Level control to change this specific **Model 77's device address**. Address can be either A1, A2, A3, or A4. See Note below.

**Default:** Device address A1.
Stereo input C sample rate converter enabled.
Post-fader stereo digital and analog monitor output can be enabled.

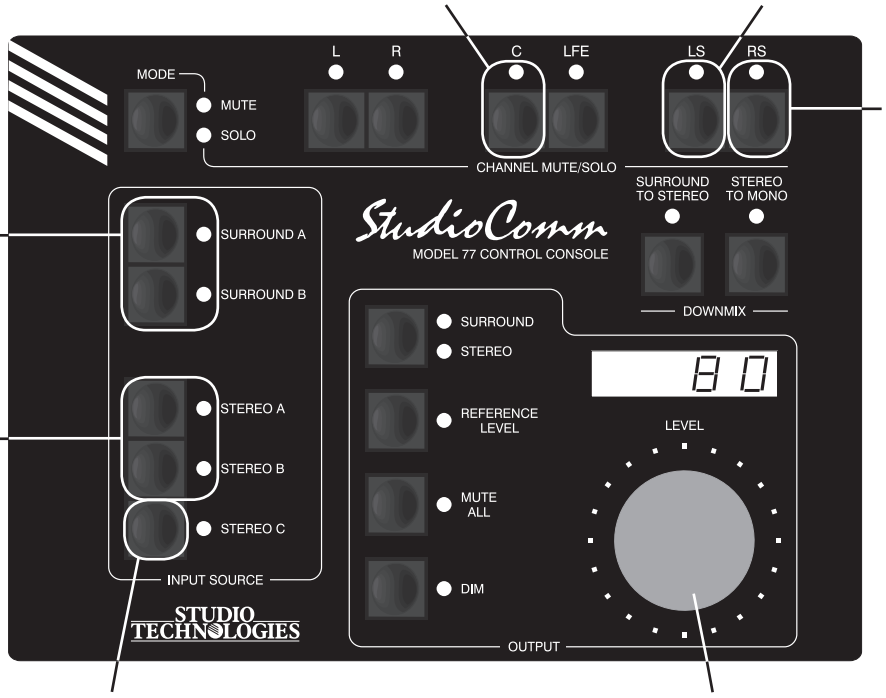
**Note:** The Model 77's device address is the only parameter stored in the Model 77. All other parameters are stored in the Model 76DA.

# Configuration—Bass Management and Mute/Solo Bass Management Mode

This LED displays the configuration of the **surround output bass management**. LED lit means surround output bass management enabled; LED not lit means surround output bass management disabled. Use the button to change the configuration. See Note below.

This LED displays the configuration of the **stereo output bass management**. LED lit means stereo output bass management enabled; LED not lit means stereo output bass management disabled. Use the button to change the configuration. See Note below.

Use these buttons to select **bass management low-pass filter slope**. LED Surround A lit means 24 dB/octave; LED Surround B lit means 12 dB/octave.




This LED displays the configuration of the **mute/solo bass management mode**. LED lit means mute/solo functions occur post-bass management; LED not lit means mute/solo functions occur pre-bass management. Use the button to change the configuration.

Use these buttons to select **bass management high-pass filter slope**. LED Stereo A lit means 24 dB/octave; LED Stereo B lit means 12 dB/octave.

Press and hold the Stereo C button to display and configure the bass management and mute/solo bass management mode settings.

Use the Level control to select the **bass management crossover frequency**. Choices are 40, 50, 60, or 80 Hz.

**Default:** Surround output bass management disabled.
Stereo output bass management disabled.
Bass management low-pass filter slope 24 dB/octave.
Bass management high-pass filter slope 24 dB/octave.
Bass management crossover frequency 80 Hz.
Mute/solo pre-bass management mode.

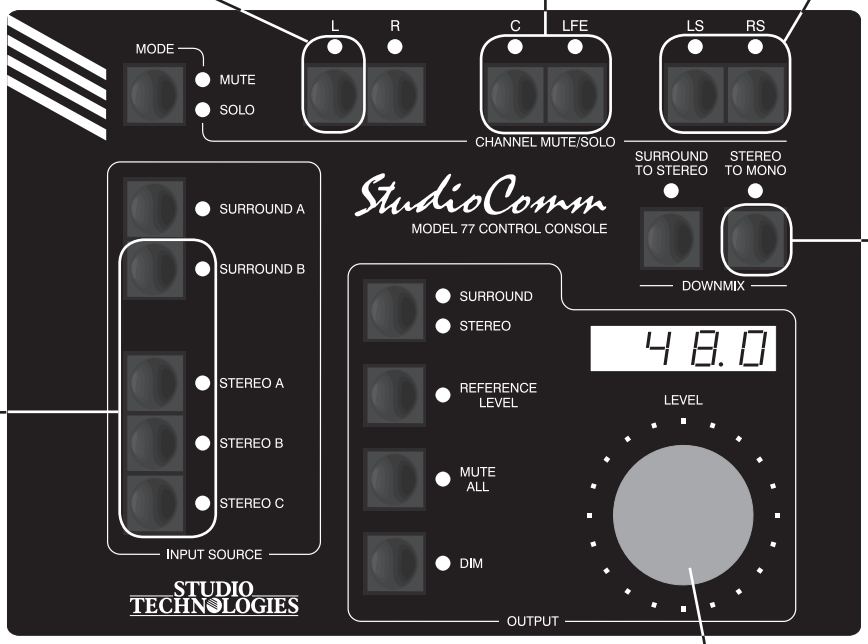
**Note:** Bass management capability only available at sample rates of 44.1, 48, 88.2, and 96 kHz.

# Configuration—Sync Source, Sync Input Termination, Audio-Synced-to-Video Sample Rate, and Digital Monitor Output Types

This LED displays the configuration of the **sync input termination**. LED not lit means sync input is not terminated; LED lit means terminated with 75 ohms. Use the button to change the configuration.

Use the Channel Solo C and LFE buttons to select the **pre-fader surround/stereo input C direct digital monitor output type**. Use the buttons to change the configuration. C LED lit means unbalanced AES3 (75 ohms/1 Vpp); LFE LED lit means balanced AES3 (110 ohms/5 Vpp).

Use the Channel Solo LS and RS buttons to select the **post-fader surround/stereo digital monitor output type**. Use the buttons to change the configuration. LS LED lit means unbalanced AES3 (75 ohms/1 Vpp); RS LED lit means balanced AES3 (110 ohms/5 Vpp).




Use these buttons to select the **sync source**.
LED Surround B lit means sync input, video;
LED Stereo A lit means sync input, DARS;
LED Stereo B lit means sync input, word clock;
LED Stereo C lit means L/R of currently selected input.

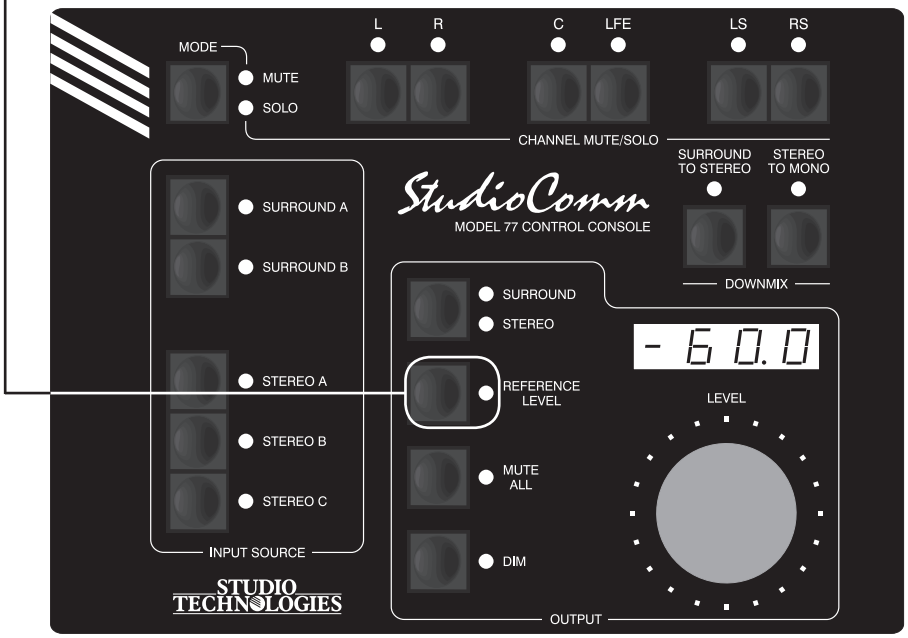
Press and hold the Stereo to Mono button to display and select the sync source, sync input termination, audio-synced-to-video-sample rate, and digital monitor output types.

Use the level control to adjust the **audio-synced-to-video sample rate**. Available sample rates are 32, 44.1, 48, 88.2, 96, 176.4, and 192 kHz.

**Default:** Sync source is L/R of currently selected input.
Sync input terminated.
Audio-synced-to-video sample rate 48 kHz.
Pre-fader surround/stereo input C direct digital monitor output type balanced AES3 (110 ohms/5 Vpp).
Post-fader surround/stereo digital monitor output type balanced AES3 (110 ohms/5 Vpp).

# Configuration—Reference Level

Press and hold the Reference Level button for 5 seconds to take a “snapshot” of the level control’s setting at the time configuration mode was entered. The Reference Level LED will flash when the button is initially pressed and then light steadily when the “snapshot” has been taken. See Note below.



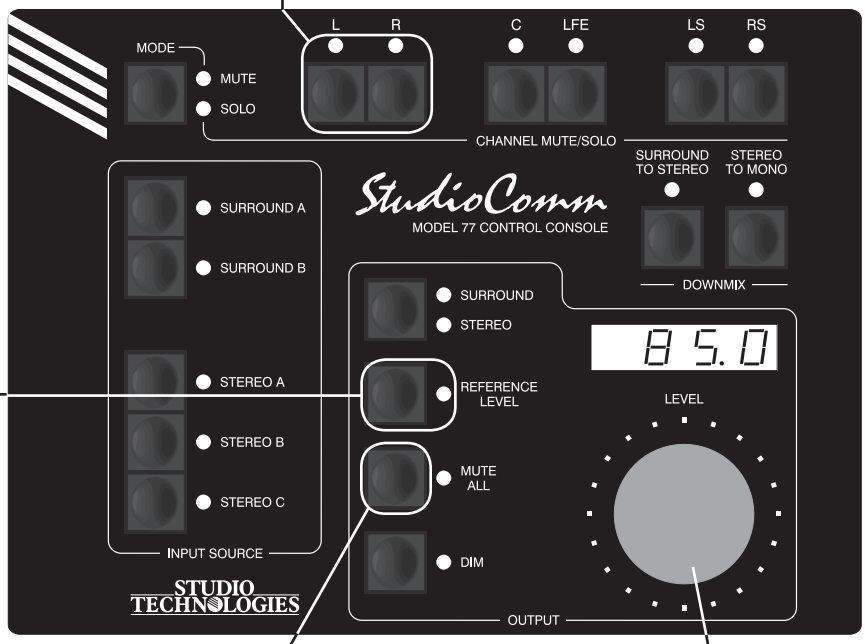

**Default:** Reference level set for –60.0 dB post-fader monitor output level.

**Note:** The 5-second button-press delay is a safety feature ensuring that the reference level will not be accidently changed. To permanently store the new value, you must still exit the configuration mode.

# Configuration—Overall Display Mode, Reference Level in dB SPL, and Auto Reference Level Off

When the Mute All button is pressed, use the Channel Mute/Solo L and R buttons to select the **overall display mode**. LED L lit means attenuation mode is selected; LED R lit means SPL mode is selected. Use the buttons to change the configuration.

When the Mute All button is pressed, use the Reference Level button to enable or disable **auto reference level off**. When the Reference Level LED is lit auto reference level off is enabled.




Press and hold the Mute All button to display and set the overall display mode, the reference level in dB SPL, and auto reference level off.

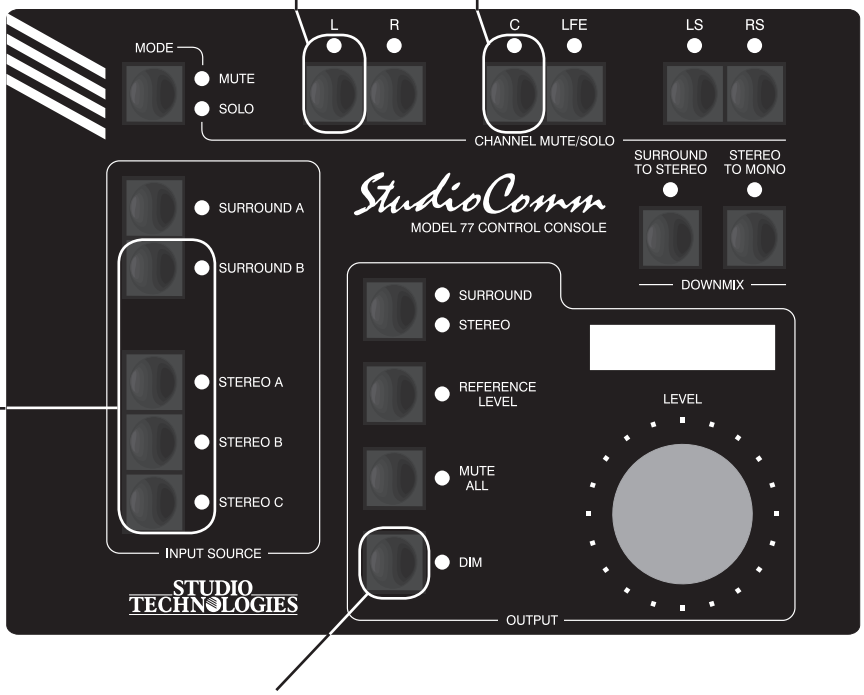
When the Mute All button is pressed, use the Level control to adjust the **reference level in dB SPL**.

**Default:** Attenuation display mode selected.
85.0 dB SPL reference level.
Auto ref level off disabled.

# Configuration—Dim Level, Remote Mute All, and Remote Dim

This LED displays the configuration of **remote mute all**. LED not lit means remote mute all is disabled; LED lit means enabled. Use the button to change the configuration.

This LED displays the configuration of **remote dim**. LED not lit means remote dim is disabled; LED lit means enabled. Use the button to change the configuration.




Use these buttons to select **dim level**. LED Surround B lit means –10 dB; LED Stereo A lit means –15 dB; LED Stereo B lit means –20 dB; LED Stereo C lit means –25 dB.

Press and hold the Dim button to display and select the dim level, remote mute all, and remote dim.

**Default:** –20 dB dim level.
Remote mute all enabled.
Remote dim enabled.

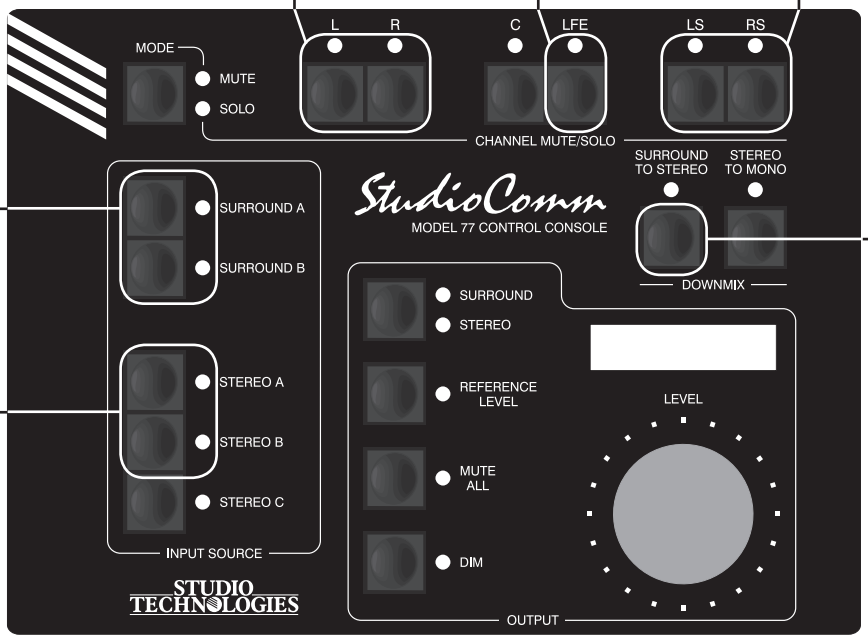
# Configuration—Surround to Stereo Downmix Levels and Pre-Fader Surround Digital Monitor Output Mode

These LEDs display the configuration of the **pre-fader surround digital monitor output mode**. LED L lit means output channels are pre-downmix; LED R lit means output channels are post-downmix. Use the buttons to change the configuration.

Use this button to select the level change for the LFE channel when the **surround to stereo downmix function** is active. LED not lit means full attenuation; LED lit means –6 dB.

Use these buttons to select the level change for the center channel when the **surround to stereo downmix function** is active. LED LS lit means –3 dB; LED RS lit means –6 dB.

Use these buttons to select the level change for the left and right channels when the **surround to stereo downmix function** is active. LED Surround A lit means 0 dB; LED Surround B lit means –3 dB.




Use these buttons to select the level change for the left surround and right surround channels when the **surround to stereo downmix function** is active. LED Stereo A lit means –3 dB; LED Stereo B lit means –6 dB.

Press and hold the Surround to Stereo button to display and confirm the surround to stereo downmix levels and pre-fader surround digital monitor output mode.

**Default:** L and R channel level change 0 dB when surround to stereo downmix function active.
LS and RS channel level change –3 dB when surround to stereo downmix function active.
C channel level change –6 dB when surround to stereo downmix function active.
LFE level change full attenuation when surround to stereo downmix function active.
Pre-fader surround digital monitor outputs pre-downmix.

# Configuration—Channel Pop Solo Mode Offset Levels

Press and hold the Surround A button to display and select the channel pop solo up offset level.

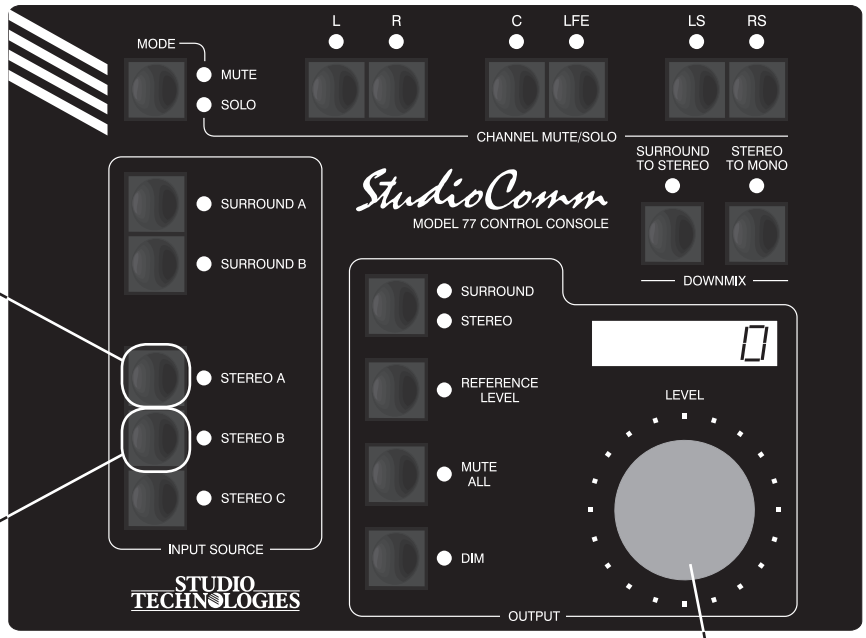
Press and hold the Surround B button to display and select the channel pop solo down offset level.


When the Surround A button is pressed, use the level control to adjust the **channel pop solo up offset level**. The range is 0.0 to 12.0 in 0.5-dB steps.

When the Surround B button is pressed, use the level control to adjust the **channel pop solo down offset level**. The range is –0.0 to –12.0 in 0.5-dB steps and full mute. Full mute is selected by adjusting the level control past –12.0, at which point the display will show – – – –.

**Default:** 6.0 dB channel pop solo up offset level.
–6.0 dB channel pop solo down offset level.

# Configuration—Input Delay Settings



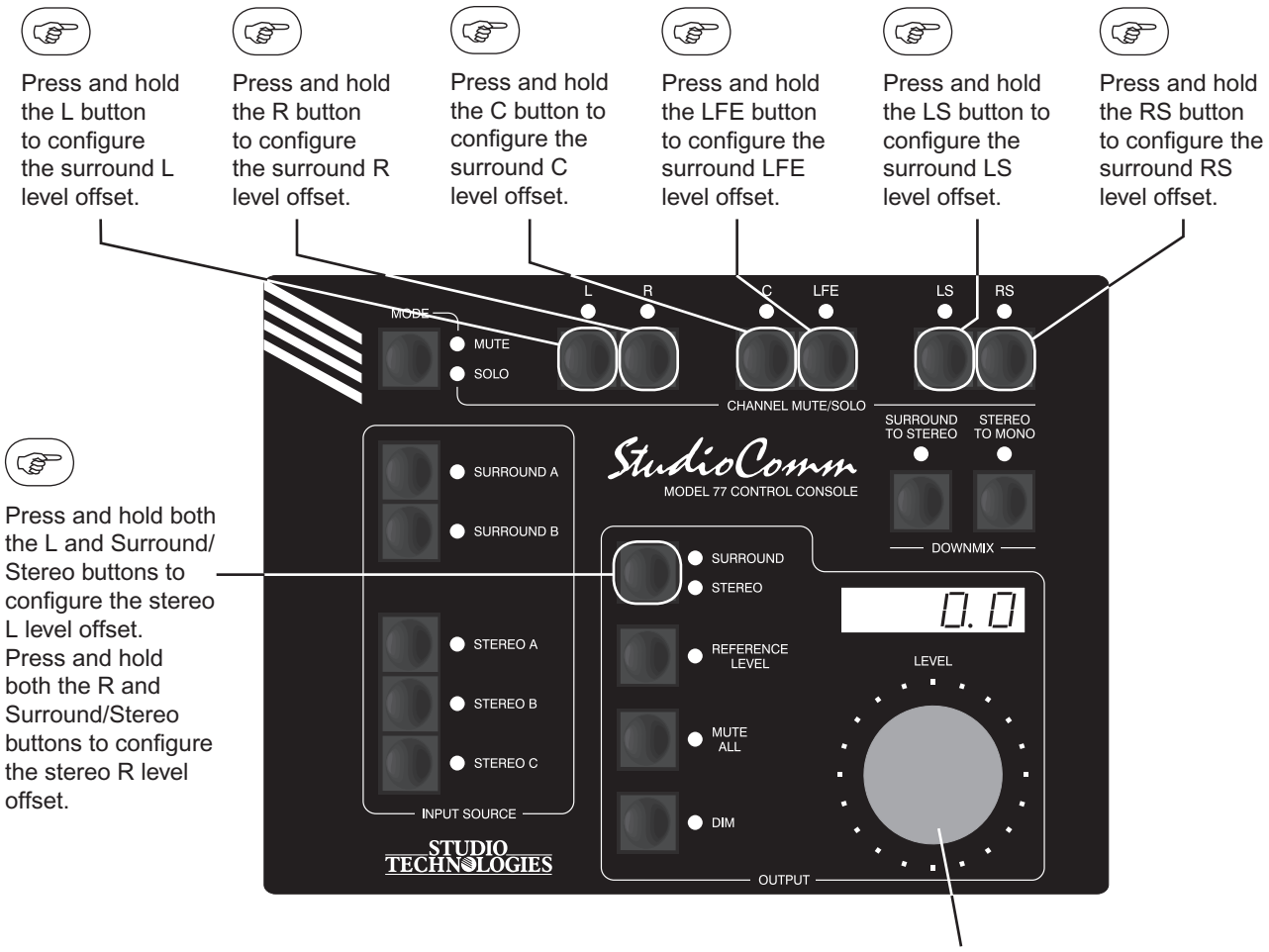

Press and hold the Stereo A button to display and select input delay A.

Press and hold the Stereo B button to display and select input delay B.

Use the level control to adjust the **input delay**. Range is from 0 to 340. The display shows delay in milliseconds at 48 kHz sampling rate. The value is scaled up or down for other sample rates.

**Default:** Input delay 0 ms for both A and B.

# Configuration—Post-Fader Digital and Analog Monitor Output Level Offsets

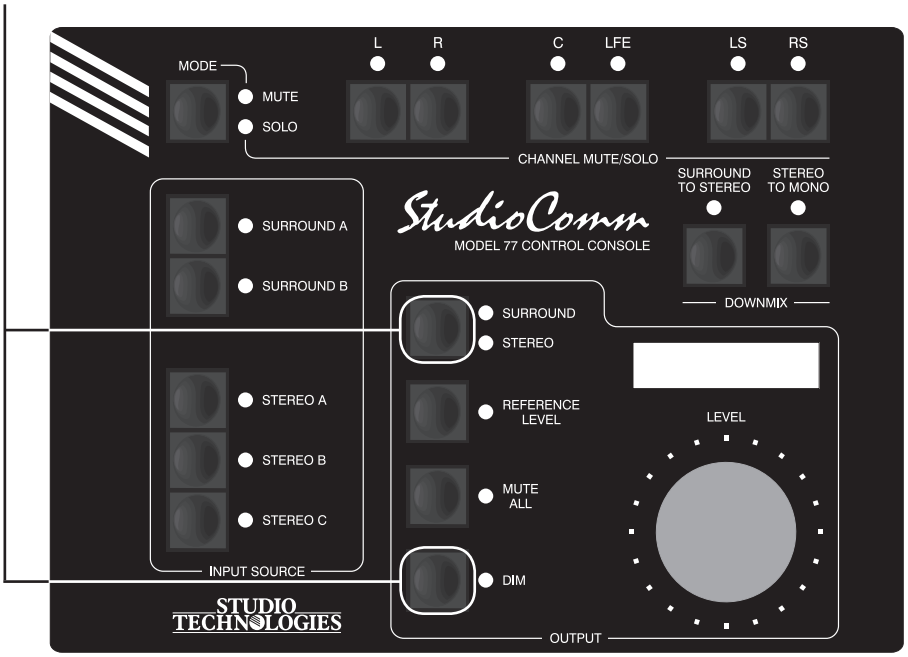



Use the level control to adjust the **post-fader digital and analog monitor output level offsets**. The range is –12.0 to 12.0 in 0.5-dB steps.

**Default:** 0.0 dB post-fader surround monitor output level offsets.
0.0 dB post-fader stereo monitor output level offsets.

# Configuration—Restore Factory Defaults

Press and hold both the Surround/Stereo and Dim buttons for 5 seconds to restore Model 77 factory defaults. Once defaults have been restored, the associated LEDs will light. After the buttons are released, configuration mode will be exited and normal operation will resume. See Note below.




**Factory Defaults:**
Device address A1.
Stereo input C sample rate converter enabled.
Post-fader stereo digital and analog monitor outputs can be enabled.
Surround output bass management disabled.
Stereo output bass management disabled.
Bass management low-pass filter slope 24 dB/octave.
Bass management high-pass filter slope 24 dB/octave.
Bass management crossover frequency 80 Hz.
Mute/solo pre-bass management mode.
Sync source is L/R of currently selected input.
Sync input terminated.
Audio-synced-to-video sample rate 48 kHz.
Pre-fader surround/stereo input C direct digital monitor output type balanced AES3 (110 ohms/5 Vpp).
Post-fader surround/stereo digital monitor output type balanced AES3 (110 ohms/5 Vpp).
Reference level set for –60.0 dB post-fader monitor output level.
Attenuation display mode selected.
85.0 dB SPL reference level.
Auto reference level off disabled.
–20 dB dim level.
Remote mute all enabled.
Remote dim enabled.
L and R channel level change 0 dB when surround to stereo downmix function active.
LS and RS channel level change –3 dB when surround to stereo downmix function active.
C channel level change –6 dB when surround to stereo downmix function active.
LFE level change full attenuation when surround to stereo downmix function active.
Pre-fader surround digital monitor outputs pre-downmix.
6.0 dB channel pop solo up offset level.
–6.0 dB channel pop solo down offset level.
Input delay 0 ms for both A and B.
0.0 dB post-fader surround monitor output level offsets.
0.0 dB post-fader stereo monitor output level offsets.

**Warning:** Each Model 77 unit must have a unique address. Restoring factory defaults will reset only this specific Model 77 to device address A1. If another connected unit is already configured for address A1, normal system operation will stop.

**Note:** The 5-second button-press delay is a safety feature ensuring that the factory defaults will not be accidently restored.

# Operation

Now that you've installed and configured the system, you're ready to go. You should find operation very easy. However, taking time to study this section of the guide may prove valuable.

Upon power up the system will return to the last operating condition, including the selected source, downmix modes, etc. As a precaution, however, the post-fader surround and stereo digital and analog monitor output levels will always return to their minimum value. The rotary level control or the reference level button must then be used to return the system to the desired monitor output level.

## Model 76DA Central Controller

The Model 76DA's front panel contains two LEDs. The control console status LED will light whenever the Model 76DA is communicating with the one or more connected Model 77 or Model 71 units. A flashing control console status LED will indicate that the DC power output supporting the control consoles is in a short circuit or over-current condition. The control console status LED will not light when a Model 77 is in the configuration mode or when the Model 77 is going through its power-up sequence.

The sync status LED will light whenever a valid timing reference signal is being received by the Model 76DA. A flashing sync status LED indicates that a valid sync signal is not being received.

## Control Consoles

StudioComm for Surround operation is controlled using the up to four Model 77 or Model 71 Control Consoles that have been connected. Two system functions can also be controlled by means of the remote control inputs.

## Model 77 Control Console

To make things easy to describe, the Model 77's operator functions are divided into six main groups: input source selection, downmix, monitor output general functions, channel mute/solo, display and display mode, and remote control inputs.

Any change made to any one Model 77 unit will be reflected in the LEDs and displays on all the connected units. Note that all control consoles function simultaneously—there is no priority of one unit over the others.

## Input Source Selection

To select an input source press one of the five input source buttons. The corresponding LED will light to indicate that the input has been selected. Typically, only one source will be selected for monitoring at any one time. However, input stereo C can be selected by itself, or mixed (summed) with one of the other four inputs. To accomplish this is easy: simply press and hold input stereo C then press the button associated with the other desired input source. The two corresponding LEDs will light. Alternately, press and hold the first desired input (other than input stereo C) and then press the input stereo C button.

It's possible (although unlikely) that selecting an input will result in the mute all function being enabled and an **Err3** message being displayed. This would indicate a conflict between the sample rate of the selected input source and the bass management function. (Operation of the bass

management function requires the source to have a sample rate of 44.1, 48, 88.2, or 96 kHz.) Selecting a source with a sample rate of 44.1, 48, 88.2, or 96 kHz will resolve the issue and normal operation will resume. Refer to the Technical Notes section of this guide for additional details.

## Downmix

Two downmix functions allow users to perform "real-world" audio format compatibility checks. One function allows a surround (5.1) signal to be "folded down" (mixed) to stereo. The other allows a stereo signal to be converted to mono. Using the downmix functions simply requires pressing the desired button. The buttons are set to always "latch" the functions on and off. An LED is located adjacent to each button and lights whenever its respective function is active. The downmix functions always impact the post-fader surround and stereo digital and analog monitor outputs. And, depending on the selected configuration, they may also impact the pre-fader surround digital monitor output.

A specific downmix function can only be enabled when it is applicable for the currently selected input source. This means that the surround to stereo downmix function can only be enabled when surround input A or B is selected.

The Model 77 associates the state of the downmix functions with the currently selected input. For example, if surround input A is the selected input source and the surround to stereo downmix function is enabled, this condition will be "remembered" when switching to one of the stereo input sources. Upon returning to surround input A, the surround to stereo downmix function will again become active.

## Surround to Stereo

When the surround to stereo downmix function is enabled the LS, RS, and C channels associated with a surround source are combined ("folded down") with the L and R signals to create a 2-channel stereo (left and right) signal. And, depending on the system's configuration, the LFE channel may also be combined with the L and R signals. The resulting stereo signal, sometimes known as LtRt, is routed to the L and R post-fader surround digital and analog monitor output channels. Also, whenever the surround to stereo downmix function is enabled the C, LS, RS, and SUB digital and analog monitor output channels are muted. By utilizing this downmix function phase relationships and inter-channel level issues can be quickly observed.

## Stereo to Mono

The stereo to mono downmix function combines the L and R audio channels to create a single-channel monaural signal. This signal is sent out the C surround digital and analog monitor output channels while the L, R, LS, RS, and SUB digital and analog monitor output channels are muted.

When a surround source has been selected for monitoring, the surround to stereo downmix function will automatically enable whenever the stereo to mono downmix function is enabled. This ensures that an operator will hear a mono signal created by folding down all channels associated with the selected surround input.

## Monitor Output General Functions

Four buttons and one rotary control are associated with the post-fader digital and analog surround and stereo monitor output functions. The buttons control operation of the surround and stereo outputs, reference level, mute all, and dim functions. The rotary level control is used to manually set the post-fader surround and stereo digital and analog monitor output levels. These buttons and the rotary control do not impact the pre-fader surround and stereo input C direct digital monitor outputs.

### Surround and Stereo Digital and Analog Outputs

The surround/stereo function allows selection between two different loudspeaker systems. When the surround output is selected the six post-fader surround channels associated with both the digital and analog monitor outputs are active. The channels associated with the post-fader digital and analog stereo monitor outputs are muted. When the stereo output is selected the left (L) and right (R) channels associated with both the post-fader digital and analog stereo monitor outputs become active; the six channels associated with the post-fader surround digital and analog monitor outputs mute.

Remember that the Model 77 Control Console can be configured to disable the surround/stereo button. If the button is pressed and the post-fader stereo monitor outputs are not selected, this must be the case!

### Display Current Sample Rate

The surround/stereo monitor output select button is also used to display the system's current sample rate value. Pressing and holding the surround/stereo button will cause the current sample rate value to be displayed: **32.0**, **44.1**, **48.0**, **88.2**, **96.0**, **176.4**, or **192.0**. This can be useful during troubleshooting or just for general interest. Once the button is released normal display operation will resume.

### Reference Level

The reference level button sets the post-fader surround and stereo digital and analog monitor output levels to a preset value. Technical personnel, using a sound-pressure-level (SPL) meter and precision signal source, should have set this level to meet the requirements of the specific monitoring environment. The LED associated with the reference level button will light whenever the function is active. The 4-digit display will indicate the reference output level. Note that the system's default reference level is –60.0 dB so "out of the box" the Model 77 will display **–60.0** when reference level mode is enabled.

How the rotary level control functions whenever the reference level mode is active depends on a configuration setting. If the auto reference level off function is disabled turning the rotary level control will have no impact on the reference level function; it will remain active. If the auto reference level off function has been enabled turning the rotary level control will cause the reference level function to automatically turn off.

The LED associated with the reference level button can also serve as a calibration aid. If the reference level mode is not active, whenever the post-fader surround or stereo digital and analog monitor output levels are precisely the same as that stored for the reference value the reference level LED will flash. This exact level can be reached through the use of the rotary level control,

either by itself or through the setting of the rotary level control in conjunction with the dim function. Whatever path the post-fader surround and stereo monitor outputs take to reach the reference level value, it will cause the reference level LED to flash!

### Mute All

Pressing the mute all button causes the output channels associated with the post-fader surround and stereo monitor outputs to mute. The 4-digit display indicates the mute condition by showing four dashes (– – – –). The mute all button is always set to "latch" the function on and off. The LED associated with the mute all button will light whenever mute all is active. Note that if mute all is enabled via the remote mute all function, the mute all LED will flash.

### Dim

The dim function is provided for user convenience, allowing the post-fader surround and stereo digital and analog monitor output levels to be reduced by a fixed amount. The Model 77's configuration mode allows the dim level to be selected from among four choices: –10.0, –15.0, –20.0, or –25.0 dB. Pressing the dim button will enable the function. The dim button is always set to "latch" the function on and off. The 4-digit display, when selected for output level mode, will indicate the revised post-fader monitor output level. If the requested "dimmed" output level is equal to or less than –96.0 dB, the monitor outputs will go into full mute and the display will show four dashes (– – – –). When dim is active the post-fader monitor output level reduction will apply no matter whether the level is being set by the rotary level control or by the reference level button. The LED associated with the dim button will light whenever dim is active. If dim mode is enabled via the remote dim function the dim LED will flash.

It's worth using a few sentences to discuss the auto dim off function. Whenever dim is enabled due to the dim button being pressed, and the rotary level control is active (reference level mode is not active), changing the setting of the rotary level control will automatically turn off dim. The auto dim off function is a unique attempt at protecting the aural health of users. No longer will there be a heart-stopping blast of audio when the dim button is pressed, supposedly to enable dim, but actually turning dim off because it was already enabled. It's hard to explain unless you've experienced this in person—trust us, this situation can and does happen!

Note that the auto dim off function is not active whenever dim is enabled due to the remote dim function being active. This allows remote control equipment, such as a talkback system, to reliably dim the monitor outputs.

### Rotary Level Control

The rotary level control is used to manually adjust the post-fader surround and stereo monitor output levels. The level control provides the ability to adjust the post-fader surround and stereo digital and analog monitor output levels over a 70-dB range. Technically the rotary level control is a 24-step-per-revolution mechanical encoder. The amount of level change in dB per step ("click") will depend on how quickly the control is turned. When rotated slowly, each step represents a 0.5-dB change in level. In this case, to traverse the entire level range would require rotating the control more than five full turns. But the Model 77's software detects when the control is rotated more quickly and increases the amount of level

change in dB per step. A little experimentation will allow the user to acquire a good "feel" for how best to use the control.

The reference level LED will flash when the rotary level control sets the post-fader monitor output level to be the same as the stored reference level. Whenever the rotary level control attempts to set the output level for less than –70.0 dB, the post-fader surround and stereo monitor output channels will automatically mute. As previously discussed, the 4-digit display indicates the mute condition by showing four dashes (– – – –).

If the mute all function is active the rotary level control won't have an impact on the post-fader surround and stereo output levels. It's also not active whenever the reference level function is active, except if the auto reference level off function has been enabled.

## Channel Mute/Solo

The channel mute/solo functions allow specific channels to be selected for individual or group mute or "solo" monitoring. The functions impact the post-fader surround and stereo monitor outputs, taking place electrically "after" the input source selection, input delay, downmix, and level control functions. The relationship between the mute/solo function and the bass management resources will depend on how the system has been configured.

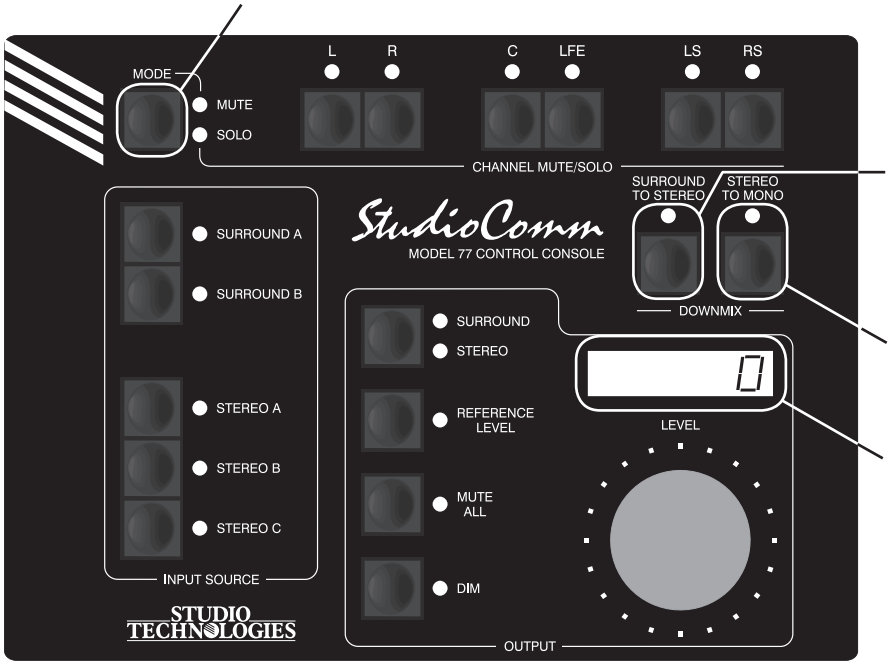
The mute/solo mode button and the six channel mute/solo buttons, along with associated LEDs, work together to provide excellent operating flexibility. The channel mute/solo mode button allows the operator to select between the mute and solo functions. Going from mute mode to solo mode, or vice-versa, clears all active mutes or solos. Pressing the mode button twice is a legitimate means of quickly clearing muted or soloed channels. To mute or solo a channel simply requires pressing one of the channel mute/solo buttons. The buttons function in a press-to-enable/press-to-disable "latching" mode. Multiple channels can be muted or soloed at the same time. The LED associated with any muted or soloed channels is used to indicate that the function is active.

In most cases the mute/solo function will be configured to act in a pre-bass management signal flow, creating an "input" mute/solo function. In this case soloing one channel when bass management is enabled will result in audio content being reproduced in both the soloed channel as well as the subwoofer post-fader monitor output channels. Should the function be configured for post-bass management mode soloing a channel will result in only that specific monitor output channel reproducing the audio content.

### Selecting the Solo Mode

As previously discussed in this user guide, solo operation can be selected between normal and channel pop. When the normal solo mode has been enabled the solo LED will light steadily. When the channel pop solo mode is enabled the solo LED will flash. It's easy to change from normal to pop solo, and vice-versa. Simply press and hold the mode button and use the surround to stereo button to select the desired solo mode. The LED associated with the surround to stereo button displays the active mode. Refer to Figure 10 for details. The selected mode will be stored in non-volatile memory so a power down/power up cycle will not change the selection.

During normal operation, press and hold the Mute/Solo button to view and change the solo mode and input delay settings.




This LED displays the current setting of the **solo mode**. LED not lit means normal; LED lit means channel pop. Press the button to change the mode.

This LED displays the current setting of the **input delay**. LED not lit means input delay A is selected; LED lit means input delay B is selected. Press the button to change the setting.

The display shows the currently selected **input delay** in milliseconds.

**Figure 10. Solo mode and input delay settings**

## Input Delay

Two input delay settings, A and B, can be selected and saved during system configuration. These are provided for aligning the audio input signals with latencies associated with video processing and display systems. During normal operation of the StudioComm system the active input delay, A or B, can be selected. The channel mute/solo button, stereo to mono button, and 4-digit display are used to display and select the input delay. When the mute/solo button is pressed and held the LED associated with the stereo to mono button indicates whether input delay A or input delay B is active. The 4-digit display will show the active delay time in milliseconds. While pressing and holding the mute/solo button the stereo to mono button can be pressed to change the selected input delay. Refer to Figure 10 for details. The selected input delay will be stored in non-volatile memory so a power down/power up cycle will not change the selection.

## Display and Display Mode

The Model 77's 4-digit LED display shows the post-fader surround and stereo digital and analog monitor output levels as either the amount of attenuation or the sound pressure level (SPL). Both will indicate level in dB. What the digits actually represent will depend upon how the Model 77 has been configured.

### Display in dB of Attenuation

If configured for the attenuation mode the display will show the post-fader monitor output level as an attenuation value in reference to the maximum output. This is in the form of 0.5-dB steps less than the maximum of 0.0 dB. So a display of –40.5 would indicate that the surround or stereo

monitor output is set to be 40.5 dB below the maximum level. As the rotary level control is moved counterclockwise the output level will go down and the indicated value will get more negative.

### Display in dB SPL

If the Model 77 is configured to display the post-fader digital and analog monitor output level in dB SPL, the 4-digit display will always show the output level in positive numbers. These numbers are intended to represent the sound pressure level in dB SPL, a figure that should directly relate to the actual sound pressure level that the surround or stereo loudspeaker system is presenting to users. (Typically, the level value would actually be in dBC, the C-weighted sound pressure level.) When the reference level button is enabled, or the rotary level control is set so that the reference level has been reached, the display will typically show something in the range of 82 to 87 dB. Assuming that the monitoring environment has been correctly calibrated, this would indicate that an average listening level of 85 dB, for example, had been achieved.

### Channel Pop Solo Display

As has been previously discussed, the channel pop solo mode offers a unique way of sonically highlighting an individual channel. A channel selected for soloing in this mode will have its level increased while the other non-soloed channels will be reduced in level. To highlight this condition the letters **POP** will appear in the 4-digit display whenever a channel is actively being soloed in the channel pop solo mode. This ensures that a user will understand that the post-fader monitor outputs no longer represent the true inter-channel level relationships.

## Remote Control Inputs

As previously discussed in the Installation section of this user guide, two remote control signals can be connected to the Model 76DA and then configured for operation. The functions are remote mute all and remote dim. When an external signal activates remote mute all the LED on the Model 77 associated with the mute all button will flash. If mute all was already active when the remote mute all function is activated, the LED will change from being steadily lit to flashing.

When an external signal activates remote dim the LED on the Model 77 associated with the dim button will flash. If dim was already active when remote dim is activated, the LED will change from being steadily lit to flashing.

## Model 71 Control Console

The Model 71 Control Console provides a rotary level control and a limited number of pushbutton switches and LEDs for control and status display. The rotary level control allows adjustment of the post-fader surround and stereo monitor output levels. Two buttons, along with associated LEDs, provide access to the dim and reference level functions. A status LED lights steadily whenever normal Model 71 operation is taking place.

Any changes made using the Model 71's rotary level control and buttons will be reflected in the appropriate LEDs and displays on all the connected Model 77 and Model 71 units. And, as expected, changes made using a Model 77 will be reflected in the Model 71's LEDs.

In some applications it may be desirable to disable operation of a Model 71's dim and reference buttons. An example could be

where non-technical personnel are allowed only to use the rotary level control. A configuration parameter, previously described in the Model 71 Control Console Configuration section, allows button operation to be disabled.

### Rotary Level Control

The rotary level control is used to manually adjust the post-fader surround and stereo monitor output levels. Its operating characteristics are identical to those of the Model 77 Control Console, discussed earlier in this section.

### Dim

The dim function allows the post-fader surround and stereo monitor output levels to be reduced by a fixed amount. Its operating characteristics are identical to those of the Model 77 Control Console, discussed earlier in this section.

An indication is provided should the dim button be pressed when button operation has been disabled. Its associated LED will flash briefly but no operating change will occur. The LED will continue to display the status of the dim function as selected by other Model 77 and Model 71 units.

### Reference Level

The reference level button sets the post-fader surround and stereo monitor output levels to their preset values. The operating characteristics are identical to those of the Model 77 Control Console, discussed earlier in this section.

An indication is provided should the reference button be pressed when button operation has been disabled. The associated LED will flash briefly but no operating change will occur. The LED will continue to display the status of the reference level function as selected by other Model 77 and Model 71 units.

# Technical Notes

## Loss of Sync

The Model 76DA relies on an external timing reference (sync) source for proper operation. This can be in the form of an AES3, word clock, DARS (AES11), bi-level video, or tri-level video reference signal. In most cases the sync signal will be connected to the sync input BNC connector located on the Model 76DA's back panel. Alternately, a configuration choice allows the L/R input of the AES3 source currently selected for monitoring to also serve as the system's timing reference. Whenever a valid sync signal has been connected to the Model 76DA the sync status LED, located on the unit's front panel, will light. The sample rate of the monitor output channels will reflect the rate of the sync input and, if a video sync source is utilized, the configured rate.

If a valid sync signal is not present several visual indications are provided. On the Model 76DA the sync status LED will flash. On all connected Model 77 Control Consoles the 4-digit LED display will cease normal operation, instead alternating between the words no and sync. When a valid sync signal is again connected the Model 76DA's sync status LED will light steadily. On the Model 77 units the word sync will momentarily be displayed followed by a brief display of the monitor output sample rate. The sample rate will display as **32.0**, **44.1**, **48.0**, **88.2**, **96.0**, **176.4**, or **192.0**, reflecting the impact of the sync source rate and the Model 76DA's configuration.

If during normal operation the sync source changes from one valid rate to another a visual indication is provided. On the Model 77 units the new sample rate—**32.0**, **44.1**, **48.0**, **88.2**, **96.0**, **176.4**, or **192.0**—will momentarily be displayed.

Any time that a valid sync signal is not connected to the Model 76DA the monitor outputs will automatically revert to an internally generated sample rate of 48 kHz with no digital audio content present. This audio "black" signal will allow most connected equipment to continue to function correctly, of course with no meaningful audio signal present. As soon as a valid sync signal is again connected to the Model 76DA the monitor outputs will automatically switch to their correct sample rate and audio signals will again be present.

## Power Down

Great care was taken in the Model 76DA's design to minimize the chance that clicks, pops, or other objectionable audio signals will be present on the post-fader digital and analog monitor outputs. A power-down circuit supplies the main microcontroller integrated circuit with an indication that a power loss is imminent. When this condition is detected the digital monitor outputs will switch to silence (digital audio "black") in preparation for a complete loss of signal. Electromechanical relays associated with the analog monitor outputs will change to their mute state to minimize the chance of signal transients reaching the connected loudspeaker inputs.

## Power-Up Messages

Upon mains power being applied to the Model 76DA all connected Model 77 units will go through a power-up sequence. The sequence starts by each of the individual LEDs lighting in a "walk-through" sequence. Then the 4-digit display tests all its LED segments. Finally, a set of messages provide details on the specific Model 77 and connected Model 76DA software versions:

1. Displays **77**
2. Displays Model 77's software version
3. Displays Model 77's unit address (**A1**, **A2**, **A3**, or **A4**)
4. Displays **76DA**
5. Displays Model 76DA's main software version
6. Displays **FPgA**
7. Displays Model 76DA's logic device (FPGA) software version

After a successful system power-up sequence normal operation will then commence.

## Error Codes Err1 and Err2

Should a problem be encountered during power up one of two error codes may show on the Model 77's 4-digit display. If **Err1** displays it indicates that communication is not taking place with the Model 76DA. The most likely cause would be incorrect wiring of the data pair linking the two units. **Err2** indicates that the Model 76DA is having problems with its internal logic device. (A high-speed field-programmable gate array (FPGA) serves as the digital "heart" of the Model 76DA and without it no audio activity can occur.) The only way to remedy this condition is to first try removing and reconnecting mains power. (And that's a long-shot as to whether it would accomplish anything.) If the error code continues to be displayed the Model 76DA must be returned

to the factory for service. Note that for the vast majority of StudioComm systems neither of these error codes, especially Err2, will ever appear.

## Error Code Err3

As previously discussed in this guide, the bass management function only supports input signals whose sample rate is 44.1, 48, 88.2, or 96 kHz. If during normal operation this condition is not met, it's possible that **Err3** will display and the mute all function will be automatically enabled. This will occur if the bass management function is configured to be enabled for either or both the surround and stereo post-fader monitor outputs and an input with a non-compatible sample rate has been selected. In this scenario, selecting a different input with a sample rate of 44.1, 48, 88.2, or 96 kHz will return the system to normal operation.

## Sample Rate Conversion (SRC)

Circuitry associated with stereo input C can provide sample rate conversion (SRC) capability. A digital audio signal connected to that input can have its sample rate and timing re-synchronized to match the Model 76DA's internal timing. While it would be nice to proclaim that the engineers at Studio Technologies came up with a unique and exotic circuit to perform this function it's really not the case. Several semiconductor companies provide "single-chip" SRC solutions and an excellent one from AKM was selected for the Model 76DA. The technical capabilities of the Model 76DA's SRC function is stated in this way: the sample rate of an input signal can range from 1/6 to six times the Model 76DA's output sample rate, with the additional restriction that it must be no less than 8 kHz and no more than 216 kHz. The Model 76DA's output sample rate is determined by the selected timing reference (sync) signal and, if required, a configured value. If a word clock, DARS (AES11), or AES3 signal is the designated sync source its rate will be the Model 76DA's output sample rate. If a video sync signal is connected, the Model 76DA's sample rate is selected as part of the configuration process.

So in practice what can the SRC function accomplish? If the output sample rate is 48 kHz then a signal connected to stereo input C can have a sample rate from 8 to 216 kHz. Or, as another example, if the Model 76DA's output sample rate is 96 kHz a signal connected to stereo input C can have its sample rate range from 16 to 216 kHz.

As useful as allowing one disparate sample rate to be converted to another, it may be the ability of the Model 76DA's SRC function to re-synchronize a signal that proves most valuable. For example, in typical post-production and broadcast applications all signals will have a sample rate of 48 kHz. A Model 76DA and all of its normally connected input signals will be "locked" to the main timing reference signal that supports the 48 kHz sampling rate. But, as an example, a signal associated with a portable device, while at a 48 kHz sampling rate, may not be synchronized ("genlocked") to the "house" reference. Connecting this signal to stereo input C will cause the SRC function to "lock" it to the Model 76DA's rate, thus allowing it to be monitored over a loudspeaker system. In addition, the stereo input C direct monitor

output can be connected to other devices that find need for the now-synchronized signal. In some cases it may be useful to connect the stereo input C direct monitor output to the input of a signal router, allowing an entire facility to access the signal.

## Model 76DA to Control Console Connections

Figure 7 gives a detailed description of the signals that connect the Model 76DA Central Controller to the one or more Model 77 or Model 71 Control Consoles. The Model 76DA provides 12 volts DC for use by the control console's circuitry. The DC output is current-limited to minimize the chance that a short-circuit condition will damage the Model 76DA's circuitry. An asynchronous, bi-directional data interface links the connected units. The RS-485 hardware connection scheme operates at a rate of 115.2 kbit/s and uses an 8-N-1 data format. The Model 76DA communicates with each Model 77 and Model 71 unit 20 times per second, receiving button and rotary level control information and sending LED and 4-digit display status data.

## "Hot" Disconnection of Control Consoles

There's no problem relocating one or more Model 77 or Model 71 Control Consoles while the StudioComm system is operating. You can disconnect the 9-pin interconnecting cable, move the unit (or units), and then reconnect without issue. Upon disconnection of all control consoles the Model 76DA Central Controller will mute the internal digital audio channels as well as saving the current operating parameters. No clicks, pops, or other noises will occur when the Model 77 or Model 71 units are again connected. The control consoles will go through their standard power-up sequence and then normal operation will resume.

## Channel Status, User, and Validity Bits

The non-audio bits that are part of the AES3 digital audio monitor output channel data are actively controlled by the Model 76DA's software. The Channel Status bits use the Professional Use of Channel Status block. They indicate a word length of 24 and the current sample rate. The correct CRC is also calculated and inserted. The User bits are always set to 0. When a valid timing reference (sync) source is recognized by the system the Validity bits will be set to 1.

The Model 76DA's hardware is capable of routing the C/U/V bit information from any of the L/R inputs, as well as the sync input, to the main logic device (FPGA) and then on to the digital audio transmitter (DIT) integrated circuits. This is provided for future use and is not active at this time.

# Specifications

## Model 76DA Central Controller

**General Audio:**
**Supported Sample Rates:** 32, 44.1, 48, 88.2, 96, 176.4, and 192 kHz

**Word Length:** 24 bits maximum

**Internal Processing:** 32 bits

**Input-to-Output Latency:** two samples (e.g., 0.042 milliseconds @ 48 kHz sample rate)

**Digital Audio Inputs:** 5 (18 audio channels)
**Configuration:** two surround (5.1) and three stereo

**Type:** unbalanced AES3/SMPTE 276M (75 ohms/ 1 Vpp)

**Connectors:** BNC (per IEC 60169-8 Amendment 2)

**Sample Rate Conversion (SRC):**
**Application:** available on Stereo Input C

**Input Sample Rate Range:** 8 to 216 kHz, limited to 1/6 to 6 times the output sample rate

**Latency:** 1 millisecond, nominal

**Sync Source:** configured to follow L/R of currently selected input or signal connected to sync input

**Sync Input:**
**Compatible Sources:** word clock, DARS (AES11), bi-level video, tri-level video

**Jitter:** 4 ns pp maximum

**Connector:** BNC (per IEC 60169-8 Amendment 2)

**Termination:** 75 ohms, selectable on/off

**Digital Monitor Outputs:** 16 (eight pairs)
**Configuration:** organized as two surround (5.1) and two stereo

**Dynamic Range:** >135 dB

**Type:** balanced AES3 (110 ohms/5 Vpp) or unbalanced AES3/SMPTE 276M (75 ohms/1 Vpp), selectable

**Connector:** 25-pin female D-subminiature (DB-25F)

**Analog Monitor Outputs:** 8
**Configuration:** organized as one surround (5.1) and one stereo (2-channel)

**Type:** electronically balanced, source impedance 200 ohms

**Nominal Level:** +4.0 dBu @ –20 dBFS input source and level control at maximum setting

**Maximum Level:** +24 dBu into 2000 (2 k) ohms or greater

**Frequency Response, Digital Inputs to Analog Monitor Outputs:** 10 Hz-20 kHz +0.0/–0.3 dB @ 48 kHz sample rate; –3 dB @ 64 kHz

**Distortion (THD+N):** 0.004%, ref 1 kHz, +4 dBu output

**S/N Ratio:** 89 dB, ref +4 dBu output

**Dynamic Range:** greater than 109 dB

**Crosstalk:** –98 dB at 1 kHz; –97 dB at 16 kHz, ref –1 dBFS input

**Connector:** 25-pin female D-subminiature (DB-25F)

**Configurable Input Delay:** 0 to 340 milliseconds @ 48 kHz sample rate (scales up or down depending on actual sample rate)

**Post-Fader Monitor Output Level Offsets:**
each surround and stereo channel independently adjustable in 0.5-dB steps over a ±12-dB range. (Digital and analog outputs associated with a specific channel share the same setting.)

**Bass Management:**
**Supported Sample Rates:** 44.1, 48, 88.2, and 96 kHz only

**Crossover Frequency and Type:** –6 dB @ 40, 50, 60, or 80 Hz, symmetrical for low-pass and high-pass filters, maximally flat

**Filter Slope:** 12 or 24 dB/octave

**Overall Operation:** independent on/off selectable for surround and stereo post-fader monitor outputs

**Downmix:**
**Functions:** surround to stereo, stereo to mono

**Surround to Stereo:**
L @ 0 or –3 dB;
R @ 0 or –3 dB;
C @ –3 or –6 dB summed with L and R;
LFE @ full attenuation or –6 dB summed with L and R;
LS @ –3 or –6 dB summed with L;
RS @ –3 or –6 dB summed with R;
C, SUB, LS, and RS monitor outputs mute

**Stereo to Mono:**
L @ –3 dB summed with R @ –3 dB to C;
L, R, LS, RS, and SUB monitor outputs mute
For a surround input this results in the C output being the sum of L @ –3 or –6 dB, R @ –3 or –6 dB; C @ –3 or –6 dB, LFE @ full attenuation or –6 dB; LS @ –6 or –9 dB, and RS @ –6 or –9 dB.

**Control Console Interface:**
**Type:** RS-485, 115.2 kbit/s, 8-1-N

**Polling Interval:** 50 milliseconds

**Power:** 12 volts DC, 500 milliamperes maximum

**Connector:** 9-pin female D-subminiature (DE-9F)

**Remote Control Inputs:** 2
**Functions:** remote mute all, remote dim

**Type:** 5 Vdc logic, activates on closure to system common

**Connector:** 9-pin female D-subminiature (DE-9F)

**AC Mains:**
**Requirement:** 100 to 230 V, +10/–15%, 50/60 Hz, 15 W maximum

**Connector:** 3-blade, IEC 320 C14-compatible (mates with IEC 320 C13)

**Dimensions:**
19.00 inches wide (48.3 cm)
1.72 inches high (4.4 cm)
7.00 inches deep (17.8 cm)

**Mounting:** one space (1U) in a standard 19-inch rack

**Weight:** 3.6 pounds (1.6 kg)

## Model 77 Control Console

**Application:** up to four Model 77 Control Consoles can be connected to a Model 76DA Central Controller

**Power:** 12 volts DC nominal (9 volts DC minimum), maximum current 100 milliamperes, provided by Model 76DA Central Controller

**Control Data:**
**Type:** RS-485

**Data Rate/Format:** 115.2 kbit/s, 8-N-1

**Connector:** 9-pin female D-subminiature (DE-9F)

**Dimensions (Overall):**
7.20 inches wide (18.3 cm)
2.20 inches high (5.6 cm)
5.40 inches deep (13.7 cm)

**Weight:** 1.7 pounds (0.8 kg)

## Model 71 Control Console

**Application:** up to three Model 71 Control Consoles can be connected to a Model 76DA Central Controller

**Power:** 12 volts DC nominal (9 volts DC minimum), maximum current 35 milliamperes, provided by Model 76DA Central Controller

**Control Data:**
**Type:** RS-485

**Data Rate/Format:** 115.2 kbit/s, 8-N-1

**Connector:** 9-pin female D-subminiature (DE-9F)

**Dimensions (Overall):**
3.20 inches wide (8.1 cm)
2.20 inches high (5.6 cm)
4.10 inches deep (10.4 cm)

**Weight:** 0.8 pounds (0.4 kg)

Specifications and information contained in this User Guide subject to change without notice.

# Appendix A—Connection Pin-Out Charts

| Connections | TASCAM® Channel | Signal High (+) | Signal Low (–) | Shield |
|---|---|---|---|---|
| Pre-Fader L/R | 1 | 24 | 12 | 25 |
| Pre-Fader C/SUB | 2 | 10 | 23 | 11 |
| Pre-Fader LS/RS | 3 | 21 | 9 | 22 |
| Stereo Input C Direct | 4 | 7 | 20 | 8 |
| Post-Fader L/R | 5 | 18 | 6 | 19 |
| Post-Fader C/SUB | 6 | 4 | 17 | 5 |
| Post-Fader LS/RS | 7 | 15 | 3 | 16 |
| Post-Fader Stereo | 8 | 1 | 14 | 2 |

**Notes:** 1) All signals transformer-coupled digital audio; selectable for balanced or unbalanced AES3 compatibility.

2) Connector type on Model 76DA is 25-pin D-subminiature female (DB-25F). Installer must provide male (DB-25M). Connector uses 4-40 threaded inserts for locking with mating plug.

3) Wiring scheme follows TASCAM DA-88 convention. Standard DA-88-type wiring harnesses are directly compatible, with the possible exception of 4-40 screw threads being required.

## Connections for Digital Monitor Outputs

| Signal | Pin | Direction |
|---|---|---|
| Data + (RS-485/RS-422) | 7 | Not used |
| Data – (RS-485/RS-422) | 2 | Not used |
| Data Shield | 1 | Shield |
| Remote Mute All | 5 | Input |
| Remote Dim | 6 | Input |
| Remote Spare 1 | 8 | Input |
| Remote Spare 2 | 9 | Input |
| Remote Input Common | 4 | Common |

**Note:** Connector type on Model 76DA is 9-pin D-subminiature female (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

## Connections for Remote Control Inputs

| Connections | Signal High (+) | Signal Low (–) | Shield |
|---|---|---|---|
| Surround L | 24 | 12 | 25 |
| Surround R | 10 | 23 | 11 |
| Surround C | 21 | 9 | 22 |
| Surround SUB | 7 | 20 | 8 |
| Surround LS | 18 | 6 | 19 |
| Surround RS | 4 | 17 | 5 |
| Stereo L | 15 | 3 | 16 |
| Stereo R | 1 | 14 | 2 |

**Notes:** 1) Connector type on Model 76DA is 25-pin D-subminiature female (DB-25F). Installer must provide male (DB-25M). Connector uses 4-40 threaded inserts for locking with mating plug.

2) Wiring scheme follows TASCAM DA-88 convention. Standard DA-88-type wiring harnesses are directly compatible, with the exception of 4-40 screw threads being required.

## Connections for Analog Monitor Outputs

| Signal | Pin | Direction |
|---|---|---|
| Data + (RS-485) | 1 | To/From Models 77/71 |
| Data – (RS-485) | 6 | To/From Models 77/71 |
| Data Shield | 2 | To/From Models 77/71 |
| DC + (12 V) | 4 | To Models 77/71 |
| DC – (12 V Return) | 9 | To Models 77/71 |
| DC Power Shield | 5 | To/From Models 77/71 |

**Note:** Connector type on Model 76DA is 9-pin D-subminiature female (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

## Connections between Model 76DA and Model 77 and Model 71

# Appendix B—Sync Input Sources

The Model 76DA's sync input has been tested and confirmed for correct operation with the following sync signals:

**Word Clock:** Square wave signal with rate of 32, 44.1, 48, 88.2, 96, 176.4, or 192 kHz.

**DARS (AES11) or AES3:** Signal with sample rate of 32, 44.1, 48, 88.2, 96, 176.4, or 192 kHz.

**Bi-Level and Tri-Level Video:** See table below.

| Video Format |
|---|
| NTSC ("Black Burst") |
| PAL ("Black Burst") |
| 525i/59.94 Hz |
| 525p/59.94 Hz |
| 625i/50 Hz |
| 625p/50 Hz |
| 720p/23.98 Hz |
| 720p/24 Hz |
| 720p/25 Hz |
| 720p/29.97 Hz |
| 720p/30 Hz |
| 720p/50 Hz |
| 720p/59.94 Hz |
| 720p/60 Hz |

| Video Format, continued |
|---|
| 1035i/59.98 Hz |
| 1035i/60 Hz |
| 1080i/50 Hz |
| 1080i/59.94 Hz |
| 1080i/60 Hz |
| 1080p/23.98 Hz |
| 1080p/24 Hz |
| 1080p/25 Hz |
| 1080p/29.97 Hz |
| 1080p/30 Hz |
| 1080psf/24 Hz |
| 1080psf/23.98 Hz |
| |
| |