

StudioComm for Surround

Model 76D Central Controller and Model 77 Control Console

User Guide

Issue 1, March 2009

**This User Guide is applicable for systems consisting of:
Model 76D: serial number M76D-00151 and later;
Model 77: M77-00151 and later**

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Introduction

What This User Guide Covers

This User Guide is designed to assist you when installing and using the Model 76D 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 (2-channel) 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 an “all-digital” world now upon us, additional monitoring challenges have arisen. Studio Technologies has addressed these needs with the StudioComm for Surround Model 76D Central Controller and the Model 77 and Model 71 Control Consoles. With the all-digital audio inputs and outputs, support for multiple user control surfaces, and 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, multiple pre- and post-fader outputs, downmix and mute/solo functions, 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.

An all-digital 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 level control, dim, and reference level.

While many installations will use only one Model 77 Control Console, up to a total of four Model 77 or Model 71 Control Consoles can be connected to a Model 76D Central Controller. This provides multiple users with full control over a facility's monitor system. Making installation simple, the Model 76D provides power for all connected Model 77 or Model 71 units.

The core of this StudioComm for Surround system is the Model 76D Central Controller. The one-rack-space unit contains all the audio input, output, processing, and support circuitry. The Model 76D provides two surround (5.1) and three stereo audio inputs. These unbalanced digital inputs are AES3id/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 source to be monitored. Up to 340 milliseconds of input delay can be selected to compensate for processing delays in an associated video path. For synchronization with a master timing reference the Model 76D allows direct connection of a word

clock, DARS (AES11), AES3id, bi-level video, or tri-level video signal.

Two surround (5.1) and two stereo monitor outputs are provided. The post-fader surround and stereo monitor outputs are intended for connection to monitor loud-speaker systems. The pre-fader surround 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 monitor output allows an installation to directly access the SRC capabilities.

For installation flexibility the outputs can be configured for compatibility with equipment that requires AES3 ("balanced") or AES3id ("unbalanced") digital audio signals. When selected for AES3 compatibility the output impedance is 110 ohms with a 5 volts peak-to-peak (Vpp) level. For AES3id operation the impedance is 75 ohms and the level is 1 Vpp.

Great care was taken in designing the system's architecture, ensuring that the character of the audio input signals is preserved. All audio processing is performed in 32 bits using a high-speed field-programmable gate array (FPGA) integrated circuit. A dynamic range of greater than 123 dB is provided with less than 1 dB of input-to-output noise added.

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

Figure 1. Model 76D Central Controller Front Panel

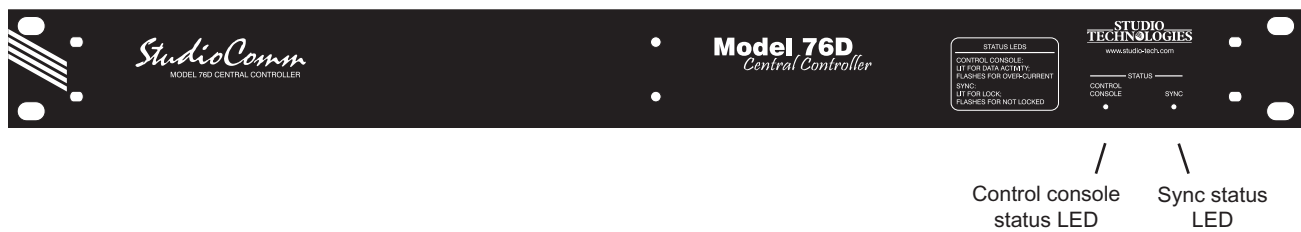
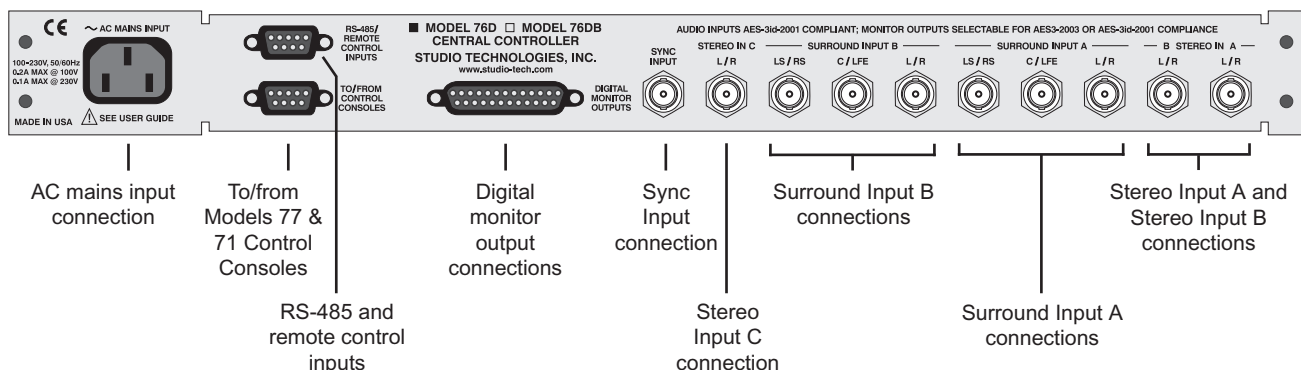


Figure 2. Model 76D Central Controller Back Panel



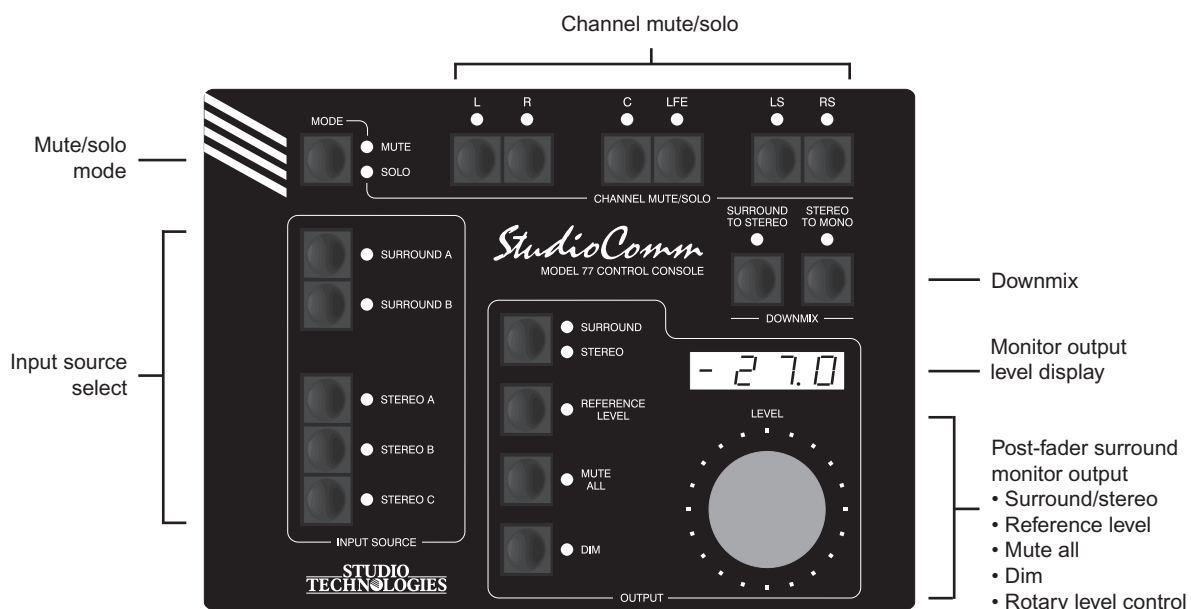


Figure 3. Model 77 Control Console Front Panel

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”).

The post-fader surround and stereo 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 is set to its minimum position. 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 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 all post-fader surround and stereo monitor output channels to be simultaneously muted. The channel mute/solo section provides individual 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 channel to be raised while the level of the other channel 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 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 5.1 to stereo downmix function is used to create a stereo signal from the selected surround (5.1) source. 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 input functions are provided: mute all and dim. 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 76D Central Controller in an equipment rack. Connections to the audio inputs and monitor outputs will be made. 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 76D. AC mains power will be connected to the Model 76D. For advanced applications up to three additional Model 77 or Model 71 Control Console units can be connected to the Model 76D.

System Components

The main shipping carton contains one each of the following: Model 76D 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 76D

The Model 76D Central Controller requires one space in a standard 19-inch (48.3 cm) equipment rack. 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 76D to the Model 77. If the needs of a specific installation dictate, an alternate-length interconnecting cable can be fabricated and used. Secure the Model 76D into the equipment rack using two mounting screws per side.

Audio Connections

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

Audio Inputs

Two surround (5.1) and three stereo (2-channel) 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 channels 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 the 5.1 to stereo downmix function.) Stereo input C is also routed to the stereo input C direct monitor output.

The audio inputs support digital audio signals with sampling rates of up to 192 kHz and a word length (depth) of up to 24 bits. However, all the connected signal sources must maintain a common sample rate and timing reference. Having all signals "locked" together ensures proper handling by the Model 76D's all-digital signal 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. Refer to the Technical Notes section of this guide for a detailed review of the SRC capability. A signal connected to stereo input C can have an independent sample rate and timing reference and still be monitored correctly.

Nine BNC jacks (female) on the Model 76D'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 AES3id 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 76D's inputs if external coupling transformers ("baluns") are utilized. These impedance-matching (110 ohms to 75 ohms) and level-attenuation transformer assemblies typically provide a 3-pin female XLR connector on their input and a female BNC connector on their output.

Monitor Outputs

The 25-pin D-subminiature connector labeled Digital Monitor Outputs provides access to the Model 76D's 16 channels of digital audio: pre-fader surround, post-fader surround, post-fader stereo, and stereo input C direct monitor outputs. The pre-fader surround monitor output channels are intended for connection to metering or monitoring equipment that requires uninterrupted full-level signals. The post-fader surround monitor output channels are intended to connect to the main 5.1 loudspeaker system incorporated in a facility. The post-fader stereo monitor output is provided to support a separate set of stereo monitor loudspeakers. The stereo

input C direct 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 76D's configuration settings.

It's important to reiterate that all the monitor outputs are digital; the Model 76D doesn't provide any analog outputs! This requires that all equipment connected to the Model 76D's monitor outputs provide digital input capability.

For flexibility the monitor outputs are transformer-coupled and can be configured to act as AES3 or AES3id digital audio sources. The monitor outputs are configured as groups with separate choices available for the pre-fader surround/stereo input C direct group and post-fader surround/post-fader stereo monitor output group. When a group is set for AES3 (110 ohms/5 Vpp) the signals are compatible with AES3 interfaces. Signals of this type are normally interconnected using 3-pin XLR connectors. When a group is configured for AES3id (75 ohms/1 Vpp) the source impedance and signal level are compatible with the requirements of AES3id interfacing. These signals are typically interconnected using BNC connectors. For details on how a Model 77 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 D-sub plug (male) 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/AES3id digital audio signals this allows support for 16 audio channels; eight interfaces each consisting of two audio channels.

A wiring assembly prepared for the Model 76D's monitor outputs, when configured for 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 male 25-pin 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 76D's digital monitor outputs, when set for AES3id (75 ohms/1 Vpp), would typically have eight BNC plugs attached.

For compatibility with AES3 balanced digital audio signals connect the D-sub's + terminal as signal high and the – terminal as signal low. In most applications a 3-pin XLR plug (male) will be used. In this case the + signal 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 AES3id unbalanced 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. For optimal operation, it is best to connect both – and shield 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 76D's D-sub connector use 4-40 threads. This complies with the original design standard for D-sub connectors.

Pre-Fader Surround Monitor Output

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

Post-Fader Surround Monitor Output

The post-fader surround monitor output channels are designed for connection to audio amplifiers associated with monitor loudspeakers or to the inputs of loudspeakers that contain integrated amplifiers.

Connections	TASCAM® Channel	Signal High (+)	Signal Low (-)	Shield
Pre-Fader L/R	1	24	12	25
Pre-Fader C/LFE	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/LFE	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 AES3 or AES3id compatibility.

2) Connector type on Model 76D 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 exception of 4-40 screw threads being required.

Post-Fader Stereo Monitor Output

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

Stereo Input C Direct Monitor Output

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

Sync Input

An external timing reference signal must be connected to the Model 76D. This synchronization (“sync”) signal must maintain a stable relationship between itself and the connected digital audio signals. The actual sync source can be in one of several forms: word clock, DARS, AES3id, bi-level video, or tri-level video. The source of the Model 76D's sync reference will, in most cases, be a dedicated sync signal connected to the unit's sync input. Alternately, the AES3id-compatible digital audio source connected to the L/R input of surround A can also serve as the sync reference. A configuration choice, described later in this user guide, is used to select the actual sync source to be utilized. In this section of the user guide details will be provided regarding connection of a dedicated sync signal to the sync input. This is the recommended method and in most cases should be utilized.

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

Figure 4. Connections for Monitor Outputs

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 or AES3id signal but is generated specifically as a timing reference signal. Bi-level video sync signals are typically provided to support NTSC or PAL broadcast applications, although they're also used by some later-generation equipment. Tri-level sync signals are primarily associated with facilities that support high-definition (HD) video equipment. These 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 76D 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 should be connected to the sync input BNC connector located on the Model 76D's back panel. For flexibility the 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 76D's sync input will typically have input termination enabled. If the sync signal connected to the Model 76D 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. Refer to the Configuration section of this guide for details on how to select the desired termination settings.

Remote Control Inputs

Support is provided for two remote control input functions: remote mute all and remote dim. The 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 (ESD) discharge, 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 D-subminiature connector is used for the remote control inputs. Refer to Figure 5 or Appendix A for the exact connection details. Note that pin 4 (remote common) connects to the Model 76D's internal circuit common connection as well as the Model 76D's chassis and mains earth connections. Figure 5 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

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 76D is 9-pin D-subminiature female. Connector uses 4-40 threaded inserts for locking with mating plug.

Figure 5. Connector Pin Out for Remote Control Inputs

access to an RS-485 data interface. This interface is not supported in the Model 76D and, as such, pins 7 and 2 should remain unterminated.

Connecting the Model 76D 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 76D Central Controller. This is used to interface the unit with Model 77 Control Consoles. 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 connectors on each end is used to interconnect the Model 76D 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 76D's connector pin-out scheme was designed 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. Refer to Figure 6 or Appendix A for details.

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 76D is 9-pin D-subminiature female (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

Figure 6. Connections between Model 76D and Model 77 and Model 71

A few simple calculations are required to determine the maximum cable length when connecting a Model 77 to a Model 76D. 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 76D to the Model 77. The Model 76D supplies 12 volt DC with a maximum current of 500 milliamperes.

The Model 77 requires a minimum of 9 volts DC, 100 milliamperes maximum 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 76D 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 maximum required current in amperes). Remember to include

the resistance in both the DC + and DC – wires in the figure for the total resistance. 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 76D's ability to be controlled by additional control consoles. As expected, at least one Model 77 Control Console must be connected to a Model 76D Central Controller. After this requirement has been met up to three additional Model 77 or Model 71 Control Consoles can also be connected and powered by the Model 76D.

When connecting multiple control consoles to a Model 76D all nine pins of each interconnecting cable can be connected in parallel ("multed"). This will electrically mult the data and 12 volt DC power signals between all the units. 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 female 9-pin 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 76D to Model 77 cable length are discussed. Note the maximum 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 76D operates directly from AC mains power of 100 to 230 V, 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 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:

<u>Connection</u>	<u>Wire Color</u>
Neutral (N)	Light Blue
Line (L)	Brown
Protective Earth (E)	Green/Yellow

Safety Warning: The Model 76D does not contain an AC mains disconnect switch. As such, 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 76D 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 76D's main logic device. After just a few seconds normal operation can commence and the LEDs will perform their intended functions. Once

normal operating data is being interchanged with the one or more connected Model 77 or Model 71 Control Consoles the control console status LED will light. The sync status LED will light if a recognized sync source has been connected. 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 software versions of the associated Model 76D. At this point normal system operation can begin.

All connected Model 71 units will also go through a power-up sequence after mains power is applied to the Model 76D. Each of the units' three status LEDs will light momentarily. After the three status LEDs have been lit, the device address will be shown briefly using the dim and reference level LEDs as shown in Figure 8. When this is complete the Model 71 will enter the normal operating mode and its status LED will light if communications are established with the Model 76D. 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 status LEDs on the Model 76D 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.

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 76D 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. One configuration choice is 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. The 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
- Stereo Input C Sample Rate Converter
- Post-Fader Stereo Output
- Sync Type
- Sync Input Termination
- Audio-Synced-to-Video Sample Rate
- Monitor Output Types
- Reference Level
- Overall Display Mode
- Reference Level in dB SPL
- Auto Reference Level Off
- Dim Level

- Remote Inputs
- Input Delay
- LFE Downmix Mode
- Pre-Fader Surround Monitor Output Mode
- Channel Pop Solo Mode Offset Levels

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 the 9-pin D-sub connector. On any connected Model 77 pressing and holding this button for two seconds places both this specific unit and the Model 76D into their configuration modes. Other connected Model 77 and Model 71 units will enter a standby mode. When the Model 76D 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 on the Model 77 unit that's in its configuration mode. Again press and hold configure 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 configure 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 76D Central Controller as well as the Model 77 and Model 71 Control Consoles. Only the individual device address is stored in each Model 77 and Model 71. All other configuration parameters are stored in the Model 76D.

Model 77 Device Address

A unique device address must be assigned to each Model 77 that is connected to a Model 76D. 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) of connected digital audio signals. 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 in respect with the others connected to the Model 76D, 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 Output

In addition to the post-fader surround monitor output, a separate post-fader stereo monitor output is also provided. By default this stereo output can be enabled by an operator. In applications where

stereo monitor loudspeakers are not connected to the post-fader stereo monitor output, the output can be disabled. This can minimize confusion, preventing an operator from attempting to select the post-fader stereo monitor output.

Sync Type

The Model 76D requires that the designated sync (external timing reference) signal 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 an AES3id-compatible digital audio signal connected to the L/R input of surround input A to serve as the 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 76D then enabling termination is typically appropriate. 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 76D'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 Monitor Output Type

To meet the needs of a specific installation the nominal impedance and level characteristic of the pre-fader surround and stereo input C direct monitor outputs can be selected. They are selected as a group; configuration of individual outputs is not provided. If the output signals are going to be connected to balanced AES3 inputs then the setting that provides a source impedance of 110 ohms with a nominal 5 Vpp level would be appropriate. If the output signals are going to be connected to unbalanced AES3id 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 Monitor Output Type

The source impedance and output level of the post-fader surround and stereo monitor outputs, as a group, can be configured. The information previously provided concerning the pre-fader surround and stereo input C direct 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 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 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 configure button for two seconds.

The new reference level is now stored in the Model 76D's nonvolatile memory. Only by repeating the entire procedure can the value be changed.

Once the configuration mode has been exited, the 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 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 moved 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). Used in conjunction with the reference level in dB SPL configuration and the stored reference

level, 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 monitor output is at the 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 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 selected time delay applies to all input signals and cannot be applied selectively. The 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. 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.

LFE Downmix Mode

By default, when the 5.1 to stereo downmix function is active the LFE channel associated with a surround input is 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 part of the downmix signal flow. When the LFE downmix mode is enabled, if surround input A or B is the active input and the 5.1 to stereo downmix function is active, the LFE signal level is reduced in level by 6 dB and added to both the left and right output channels. As expected, even when the LFE downmix mode is active the LFE output channel will still mute when 5.1 to stereo downmix is active.

Pre-Fader Surround Monitor Output Mode

The pre-fader surround monitor output can be configured as to its place in the Model 76D's signal flow. The choices are pre- or post-downmix. In the pre-downmix mode the output channels will not be impacted by the state of the downmix functions. This setting would be appropriate if the pre-fader surround 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 monitor output signals. If the post-downmix mode is selected the pre-fader surround 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 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

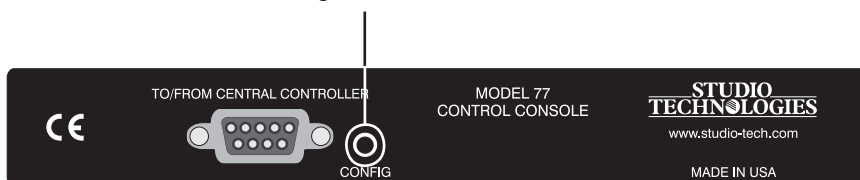
Two parameters can be configured that set how the channel pop solo function will impact audio levels. The up offset level sets the amount of increase (gain) that a channel will experience when it is soloed in the channel pop solo mode. The down offset level sets the amount of decrease (attenuation) that the non-soloed channels will experience when a channel is active in the channel pop solo mode.

Restore Factory Defaults

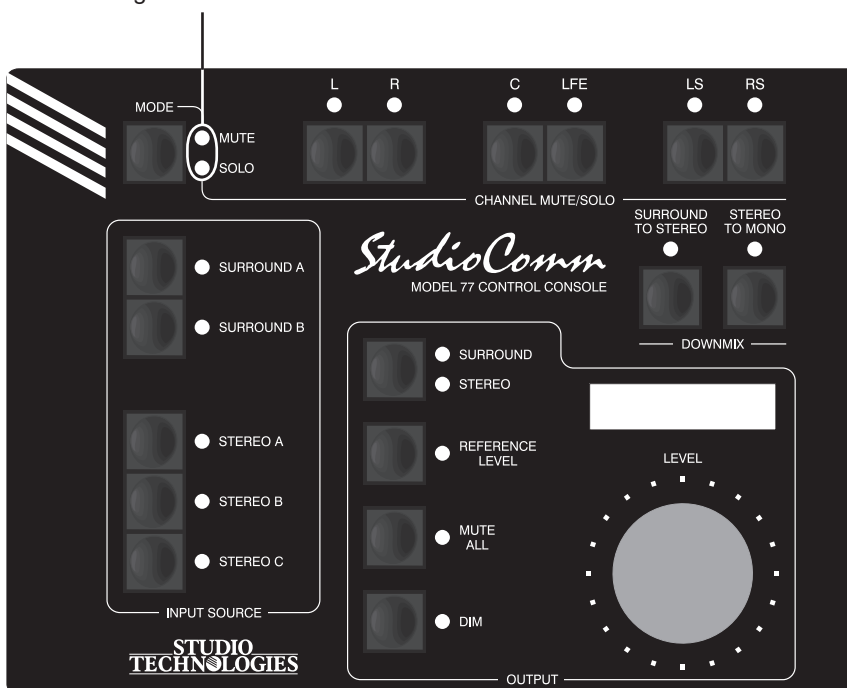
The restore factory defaults function is provided primarily for factory use. In this way a system can be shipped with the default settings selected. While you are welcome to use this function, be careful so that your configuration efforts aren't wasted. Specifically, be aware that the reference level 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!

Configuration—Entering and Exiting Configuration Mode


 Press and hold the configuration button for 2 seconds to enter or exit the configuration mode.



These LEDs will light alternately when configuration mode is active.

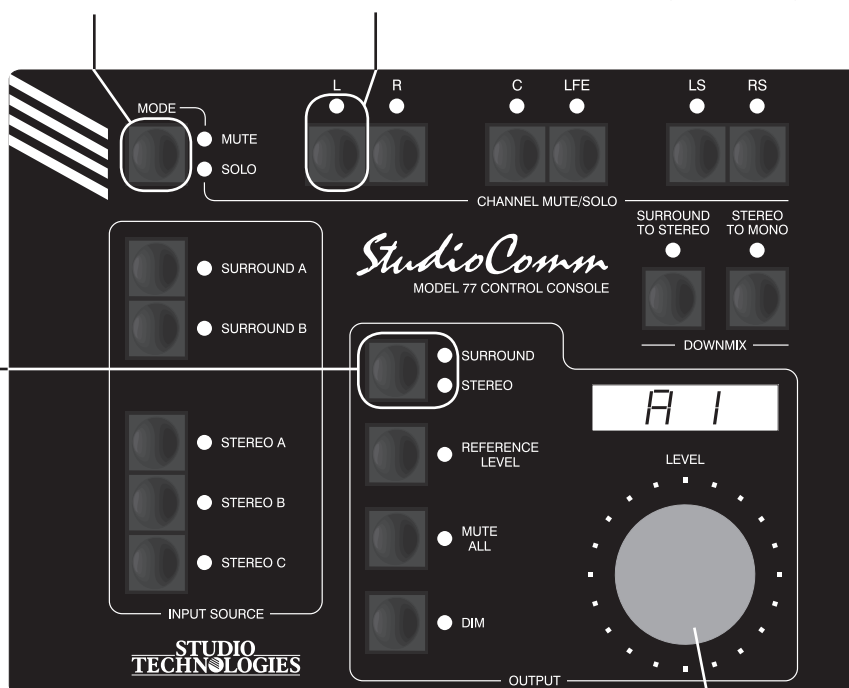


Configuration—Model 77 Device Address, Stereo Input C Sample Rate Converter, and Post-Fader Stereo Output

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

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

When the Mode button is pressed, these LEDs display the status of the **post-fader stereo 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.

Default: Device address A1.
Stereo input C sample rate converter enabled.
Post-fader stereo 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 76D.

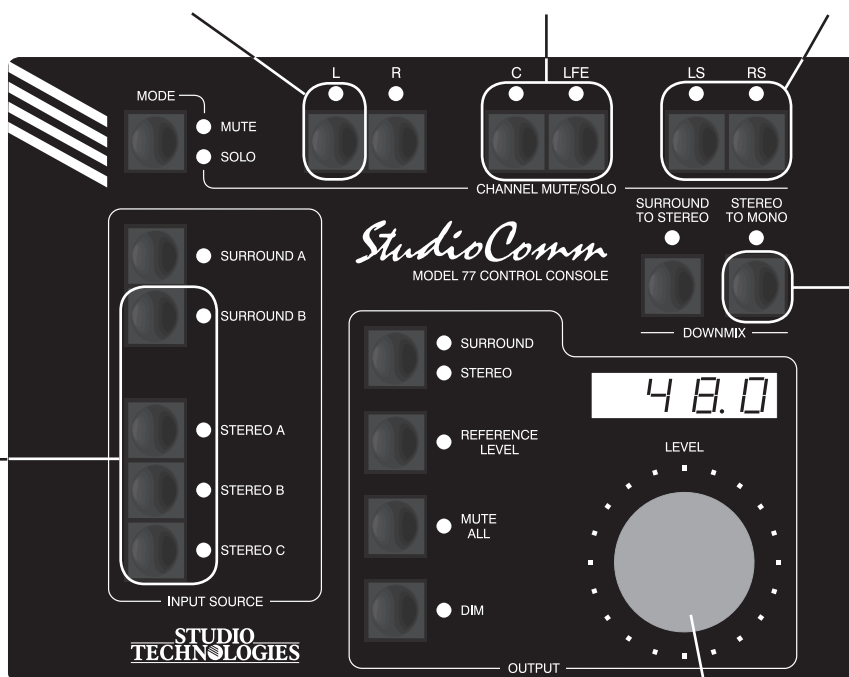
Configuration—Sync Type, Sync Input Termination, Audio-Synced-to-Video Sample Rate, and Monitor Output Types

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 monitor output type**. Use the buttons to change the configuration. C LED lit means AES3id (75 ohms/1 Vpp); LFE LED lit means AES3 (110 ohms/5 Vpp).

Use the Channel Solo LS and RS buttons to select the **post-fader surround/stereo monitor output type**. Use the buttons to change the configuration. LS LED lit means AES3id (75 ohms/1 Vpp); RS LED lit means AES (110 ohms/5 Vpp).

Use these buttons to select **sync type**. LED Surround B lit means video sync; LED Stereo A lit means DARS; LED Stereo B lit means word clock; LED Stereo C lit means sync to surround input A.




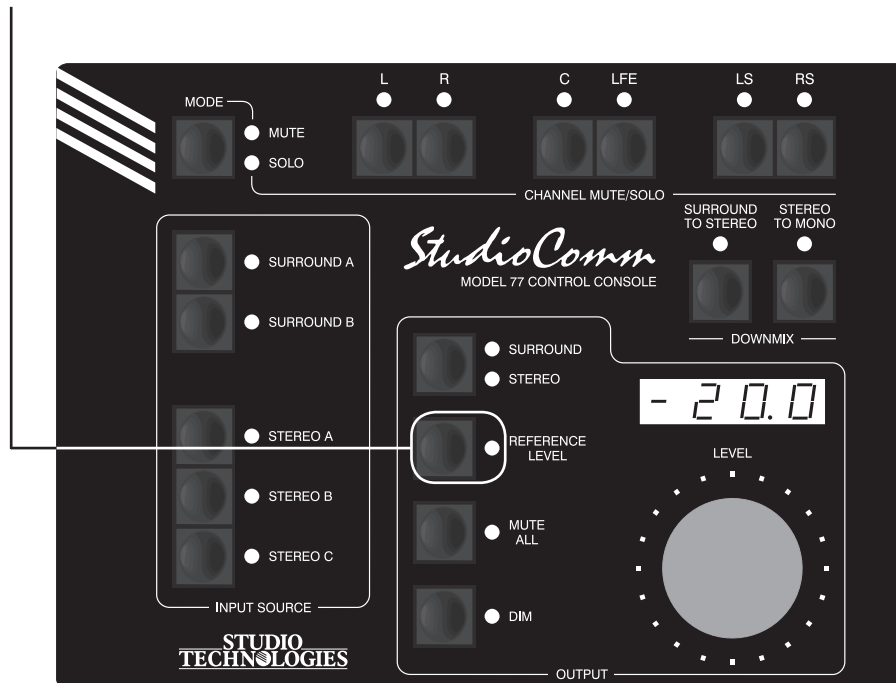
Press and hold the Stereo to Mono button to display and select the sync type, sync input termination, audio-synced-to-video-sample rate, and monitor output types.

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 type video.
 Sync input terminated.
 Audio-synced-to-video sample rate 48 kHz.
 Pre-fader surround/stereo input C direct monitor output type AES3 (110 ohms/5 Vpp).
 Post-fader surround/stereo monitor output type 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.



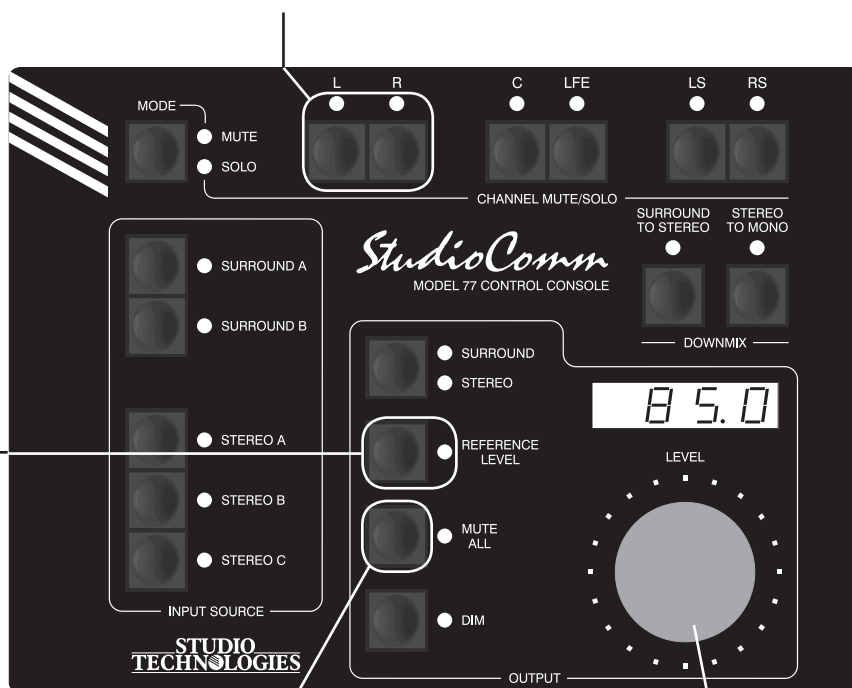
Default: Reference level set for fully attenuated (minimum) post-fader monitor output level.


Note: The 5-second button-press delay is a safety feature ensuring that the reference level will not be accidentally 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**.

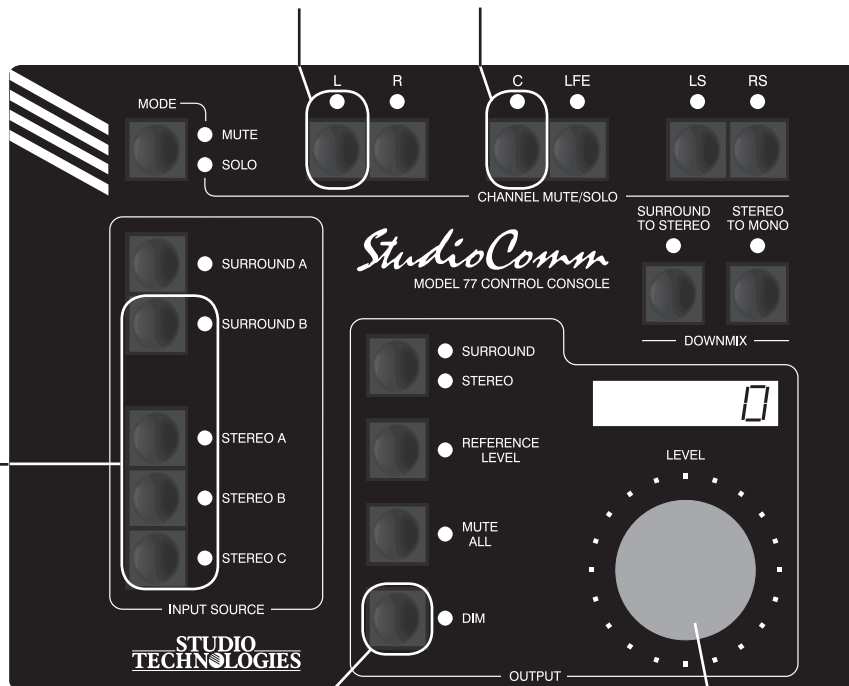
Default: Attenuation display mode selected.
85.0 dB SPL reference level.
Auto ref level off disabled.


Configuration—Dim Level, Remote Mute All, Remote Dim, and Input Delay

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, and input delay.

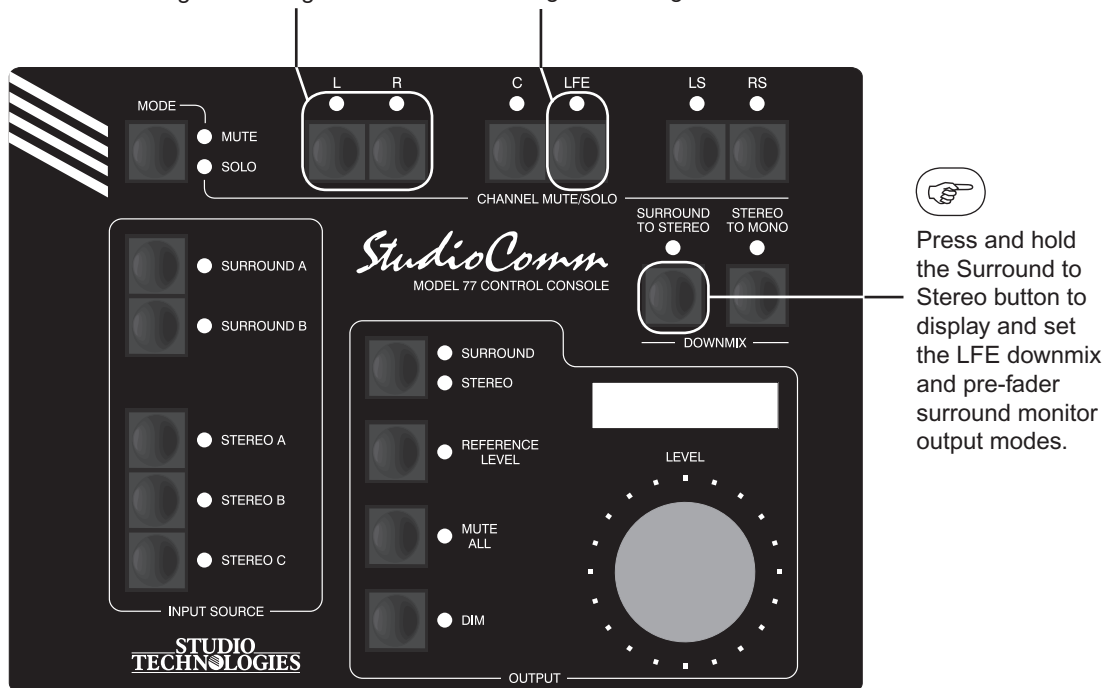
Use the level control to adjust the **input delay**. Range is from 0 to 340. The display shows delay in milliseconds at 48 kHz sampling rate. Scale up or down for other sample rates.

Default: -20 dB dim level.
Remote mute all enabled.
Remote dim enabled.
Input delay 0 ms.

Configuration—LFE Downmix Mode and Pre-Fader Surround Monitor Output Mode

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

This LED displays the configuration of the **LFE downmix mode**. LED not lit means LFE downmix mode is disabled; LED lit means enabled. Use the button to change the configuration.



Default: LFE downmix disabled.
Pre-fader surround 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.

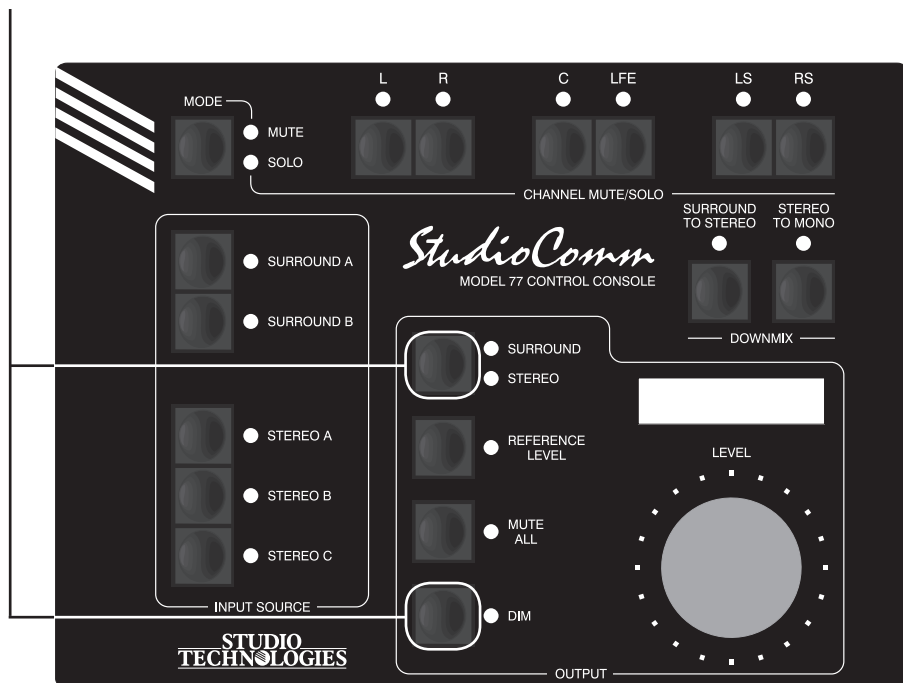
When the Surround B button is pressed, use the level control to adjust the **channel pop solo down offset level**. The range is -0.0 to -12.0 in 0.5 dB steps and full mute. Full mute is selected by adjusting the level control past -12.0, at which point the display will show - - - -.

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

Configuration—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.



Factory Defaults:

Device address A1.
Stereo input C sample rate converter enabled.
Post-fader stereo output can be enabled.
Sync type video.
Sync input terminated.
Audio-synced-to-video sample rate 48 kHz.
Pre-fader surround/stereo input C direct monitor output type AES3 (110 ohms/5 Vpp).
Post-fader surround/stereo monitor output type AES3 (110 ohms/5 Vpp).
Reference level set for fully attenuated (minimum) 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.
Input delay 0 ms.
LFE downmix disabled.
Pre-fader surround monitor outputs pre-downmix.
6.0 dB channel pop solo up offset level.
–6.0 dB channel pop solo down offset level.

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 accidentally restored.

Model 71 Control Console Configuration

The only configuration choice available on a Model 71 is its device address. It 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 while the Model 77's have a default device address of A1. This ensures that, in most cases, no change will have to be made.

A small button is located on the back of each Model 71 Control Console, adjacent to the 9-pin D-sub connector. On any connected Model 71 pressing and holding this button for two seconds places this specific unit in its configuration mode; normal operation of the Model 76D 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. 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. Refer to Figures 7 and 8 for details.

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

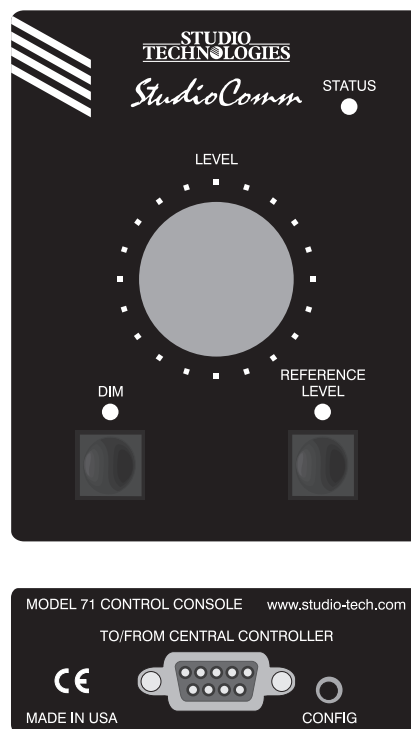


Figure 7. Model 71 Control Console Front and Back Panels

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

Figure 8. Model 71 Device Address Chart

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 all selected sources, downmix modes, etc. As a precaution, however, the post-fader surround and stereo monitor output level will always return to its 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 76D Central Controller

The Model 76D's front panel contains two LEDs. The control console status LED will light whenever the Model 76D is communicating under normal operation with the one or more connected Model 77 or Model 71 units. A flashing control console status LED indicates 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 76D. 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. System functions can also be controlled by means of the metadata and 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 will be reflected in the status LEDs and displays on all the connected units. Note that all control console units 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 selection of two inputs 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.

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 (2-channel). 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 monitor outputs. And, depending on the selected configuration, they may also impact the pre-fader surround monitor output. Please refer to the Specifications section of this guide for a detailed description on how the downmix functions perform their tasks.

A specific downmix function can only be enabled when it is applicable for the currently selected input source. This means that the 5.1 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 5.1 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 5.1 to stereo downmix function will again become active.

5.1 to Surround

When the 5.1 to stereo downmix function is enabled the LS, RS, and C channels associated with a surround signal 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 LoRo, is routed to the L and R surround monitor output channels. The C, LFE, LS, and RS 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 monitor output channel while the L, R, LS, RS, and LFE monitor output channels are muted.

When a surround source has been selected for monitoring, the 5.1 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 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 monitor output levels. These buttons and the rotary control do not impact the pre-fader surround and stereo input C direct monitor outputs.

Surround and Stereo Outputs

The surround/stereo function allows selection between two different loudspeaker systems. When the surround output is selected the six post-fader surround monitor output channels are active. The two channels associated with the post-fader stereo monitor output are muted. When the stereo output is selected the left and right channels associated with the post-fader stereo monitor output become active; the

six channels of the post-fader surround monitor output 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 output is 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 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 full mute so "out of the box" the Model 77 will display four dashes (----) 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 monitor output level is 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 output level takes 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 output 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 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 output 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, as well as the rotary level control being 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 monitor output level 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 changed 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 four 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 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 monitor 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, downmix, and level control functions.

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. It is also used to select which solo mode, normal or channel pop, is active. 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.

The mute/solo button is also used to select the solo mode, the choices being normal or channel pop. Simply press and hold the mute/solo button for a few seconds until the LED associated with the solo mode lights in the desired manner; steady to indicate normal solo mode and flashing for channel pop solo mode. Once the state of the mode has changed as indicated by the LED (steady-to-flashing or vice-versa) the desired solo mode becomes active and the mute/solo button can be released. The selected solo mode will be maintained even after the system is powered down and subsequently powered up.

Display and Display Mode

The Model 77’s 4-digit LED display shows the post-fader surround and stereo monitor

output level 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 Attenuation

If configured for the attenuation mode the display will show the 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 counter-clockwise 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 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 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 76D 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 limited number of pushbutton switches, LEDs, and a rotary level control for operation status display and control. The two buttons, along with associated LEDs, provide access to the dim and reference level functions. A rotary level control allows adjustment of the post-fader surround and

stereo monitor output level. 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 status LEDs and displays on 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.

Rotary Level Control

The rotary level control is used to manually adjust the post-fader surround and stereo monitor output level. 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 level 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.

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.

Technical Notes

Loss of Sync

The Model 76D relies on an external timing reference (sync) source for proper operation. This can be in the form of a word clock, DARS (AES11), AES3id, 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 76D's back panel. A configuration setting also allows the signal connected to the L/R input of surround input A to serve as an AES3id timing reference. Whenever a valid sync signal has been connected to the Model 76D 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 76D 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 76D'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 76D'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 a valid sync signal is not connected to the Model 76D 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 76D 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 76D's design to minimize the chance that clicks, pops, or other objectionable audio signals will be present on the 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 monitor outputs automatically switch to silent audio (audio "black") in preparation of a complete loss of signal.

Power-Up Messages and Error Codes

Upon mains power being applied to the Model 76D 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 76D software versions:

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

After a successful system power-up sequence normal operation will then commence. 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 76D. The most likely cause would be incorrect wiring of the data pair linking the two units. **Err2** indicates that the Model 76D is having problems with its internal logic device. (A high-speed field-programmable gate array (FPGA) serves as the digital "heart" of the Model 76D 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 that would accomplish anything.) If the error code continues to be displayed the Model 76D 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.

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 76D's internal clock. 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 76D. The technical capabilities of the Model 76D'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 76D'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 76D's output sample rate is determined by the external timing reference (sync) signal and, if required, a configured value. If a word clock, DARS (AES11), or AES3id signal is the designated sync source its rate will be the Model 76D's output sample rate. If a video sync signal is connected, the Model 76D'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 76D'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 76D's SRC function to re-synchronize a signal that proves most valuable. For example, in typical post-production and broadcast applications signals will have a sample rate of 48 kHz. A Model 76D and all 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 76D'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 76D to Control Console Connections

Figure 6 gives a detailed description of the signals that connect the Model 76D Central Controller to the one or more Model 77 or Model 71 Control Consoles. The Model 76D provides a +12 volt DC power source 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 76D'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 76D 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 76D Central Controller will mute the monitor output 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/AES3id monitor output channel data are actively controlled by the Model 76D'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 an external timing reference (sync) source is available to the system the Validity bits will be set to 1.

The Model 76D's hardware is capable of routing the C/U/V bit information from surround input A L/R, stereo input C, and 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 76D 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

Dynamic Range: 134 dB

Input-to-Output Latency: one sample (e.g., 0.021 milliseconds @ 48 kHz sample rate)

Digital Audio Inputs: five (18 audio channels)

Configuration: two surround (5.1) and three stereo (2-channel)

Type: AES3id-2001/SMPTE 276M (75 ohms, unbalanced)

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 Input:

Sources: word clock, DARS (AES11), AES3id, 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: four (16 audio channels)

Configuration: organized as two surround (5.1) and two stereo

Type: AES3 (110 ohms/5 Vpp) or AES3id/SMPTE 276M (75 ohms, 1 Vpp), selectable

Connector: 25-pin D-subminiature female

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

Downmix:

Functions: 5.1 to stereo, stereo to mono

5.1 to Stereo: LS @ -3 dB summed with L; RS @ -3 dB summed with R; C @ -6 dB summed with L and R; LFE @ -6 dB summed with L and R (if enabled); C, LFE, LS, and RS monitor outputs mute

Stereo to Mono: L @ -3 dB summed with R @ -3 dB to C; L, R, LS, RS, and LFE monitor outputs mute. (For a surround input this results in the C output being the sum of L @ -3 dB, R @ -3 dB, C @ -3 dB, LFE @ -3 dB (if enabled), LS @ -6 dB, and RS @ -6 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 D-subminiature female

Remote Control Inputs: two

Functions: remote mute all, remote dim

Type: +5 V logic, activates on closure to system common

Connector: 9-pin D-subminiature female

AC Mains:

Requirement: 100 to 230 V, 50/60 Hz, 15 watts maximum

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

Mounting: one space in a standard 19-inch rack

Dimensions:

19.00 inches wide (48.3 cm)

1.72 inches high (4.4 cm)

7.00 inches deep (17.8 cm)

Weight: 6.2 pounds (2.8 kg)

Model 77 Control Console

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

Power: 12 volts DC, maximum current 100 milliamperes, provided by Model 76D Central Controller

Control Data:

Type: RS-485

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

Connector: 9-pin D-subminiature female

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 76D Central Controller

Power: 12 volts DC, maximum current 35 milliamperes, provided by Model 76D Central Controller

Control Data:

Type: RS-485

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

Connector: 9-pin D-subminiature female

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/LFE	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/LFE	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 AES3 or AES3id compatibility.

2) Connector type on Model 76D 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 exception of 4-40 screw threads being required.

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 76D is 9-pin D-subminiature female (DE-9F). Connector uses 4-40 threaded inserts for locking with mating plug.

Connections between Model 76D and Model 77 and Model 71

Connections for 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 76D is 9-pin D-subminiature female. Connector uses 4-40 threaded inserts for locking with mating plug.

Connector Pin Out for Remote Control Inputs

Appendix B—Sync Sources

The Model 76D'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 AES3id: Signal with sample rate of 32, 44.1, 48, 88.2, 96, 176.4, or 192 kHz.

Video: See table below.

Video Format	Video Format
NTSC ("Black Burst")	1035i/59.98 Hz
PAL ("Black Burst")	1035i/60 Hz
525i/59.94 Hz	1080i/50 Hz
525p/59.94 Hz	1080i/59.94 Hz
625i/50 Hz	1080i/60 Hz
625p/50 Hz	1080p/23.98 Hz
720p/23.98 Hz	1080p/24 Hz
720p/24 Hz	1080p/25 Hz
720p/25 Hz	1080p/29.97 Hz
720p/29.97 Hz	1080p/30 Hz
720p/30 Hz	1080psf/24 Hz
720p/50 Hz	1080psf/23.98 Hz
720p/59.94 Hz	
720p/60 Hz	

