

# *StudioComm* for Surround

## Model 78 Central Controller and Model 79 Control Console

### User Guide

Issue 5, January 2004

This User Guide is applicable for systems consisting of:  
Model 78: serial number M78-00151 and later;  
Model 79: M79-00151 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 78 Central Controller and the Model 79 Control Console.

## StudioComm for Surround

Once exclusively the domain of major motion picture studios and large production facilities, the recording, mixing, editing, and distribution of multichannel “surround” audio material has become much more prevalent. To handle these tasks, the ability to effectively monitor multichannel sources has become imperative for more and more facilities. Studio Technologies has addressed this need with the StudioComm for Surround Model 78 Central Controller and Model 79 Control Console. The system is perfect for 8-channel “7.1” applications, including adding 7.1 monitoring capability to disk-based recording systems. It’s also ideal for upgrading a post-production, mastering, or broadcast facility to support multichannel monitoring. The StudioComm for Surround Model 78 and Model 79 combination is THX® pm3 approved.

The system’s core design goals were audio quality and ease of use. Designed to support the most sophisticated audio requirements, the signal path was optimized for sonic quality. The operator features and controls were carefully selected to enhance usability and minimize the learning curve. For the first time, advanced multichannel monitoring features such as source selection, level control, downmix, and bass management are available in a compact, sonically excellent, and cost-effective system.

A StudioComm for Surround system starts with the Model 79 Control Console, a compact, comfortable “command center,” that is designed to reside at the operator’s location. Using a single 9-pin cable, the Model 79 connects to the Model 78 Central Controller. The Model 78 occupies just one rack space and allows connection of two 8-channel inputs and an 8-channel monitor output. With the StudioComm for Surround system any audio console, disk-based recording system, or broadcast facility can have a complete 7.1 multichannel monitor system.

## Model 78 Central Controller

The Model 78 Central Controller is a single rack-space unit that contains analog, digital, and power supply electronics. Two 8-channel analog sources can be connected. In many applications the first input, Surround A, will be connected to a multichannel output on an audio console or digital audio workstation. The second input, Surround B, will be connected to a playback device, such as a multitrack tape recorder or disk storage system. For film or video post applications Surround A would be considered the direct source, while Surround B would be considered the playback source. For flexibility, the inputs are compatible with balanced or unbalanced signals having a nominal level range of –12 dBV to +6 dBu. Fifteen-turn trim potentiometers are used to precisely calibrate the input signals.

A sophisticated bass management function is integral to the Model 78’s design. The overall goal of bass management is very simple: ensure that the entire audio bandwidth of all channels can be accurately monitored. Many loudspeaker systems have inherent low-frequency limitations,

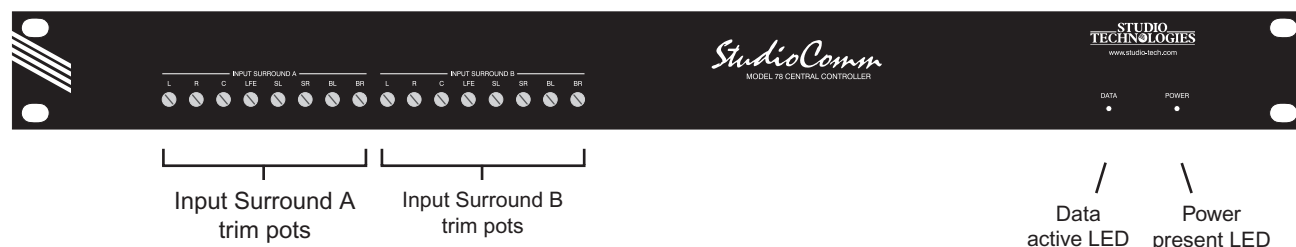
preventing a true picture of the source material from being presented. To overcome this, the low-frequency energy from the seven main channels can be separated and then routed to the subwoofer loudspeaker. From the factory a general-purpose bass management configuration is implemented. In most cases this will provide highly effective monitoring. To support specialized applications a technician can revise many of the bass management parameters, including disabling bass management entirely.

The Model 78 provides an 8-channel monitor output to connect to the loudspeaker system. The outputs are electronically balanced and designed for connection to audio power amplifiers or amplified loudspeakers. Protection circuitry provides power-up and power-down protection. Note that while each of the two surround inputs has an LFE channel associated with it, the monitor output designates a subwoofer, rather than an LFE, output. This terminology was carefully selected to highlight the fact that the output

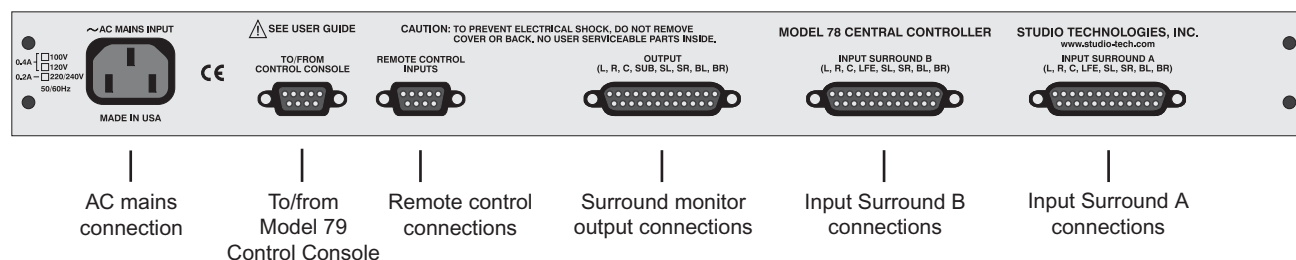
channel designated for connection to the subwoofer loudspeaker may have more than just LFE content. The bass management function redirects low-frequency energy from the main channels, combining it with the LFE content before routing to the subwoofer output.

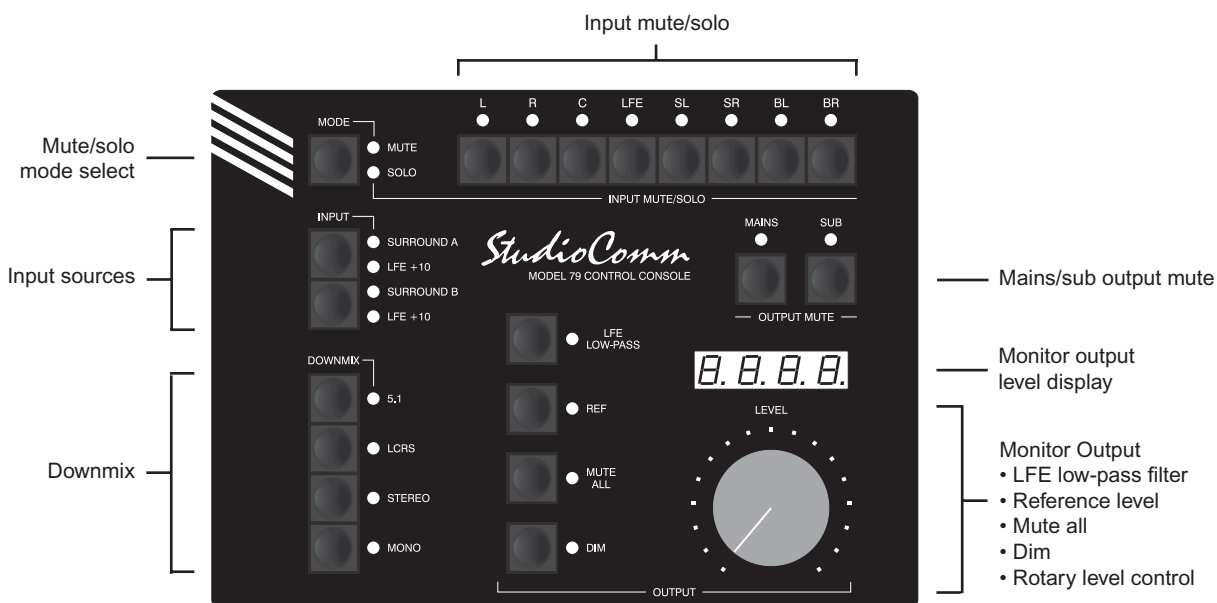
Audio input and output connections are made using three 25-pin D-subminiature connectors. The Model 78's audio path features analog switches for input source selection and digitally controlled analog gain circuits for monitor level control. One 9-pin D-subminiature connector is used to connect the Model 78 to the Model 79 Control Console. A second 9-pin "D-sub" connector is used to interface remote control signals with the Model 78. An 8-bit microcontroller provides the logic "horsepower" for the Model 78. AC mains power is connected directly to the Model 78, which is factory selected for 100, 120, or 220/240 V operation. The internal power supply utilizes two toroidal mains transformers for quiet audio operation.

**Figure 1. Model 78 Central Controller Front Panel**



**Figure 2. Model 78 Central Controller Back Panel**





**Figure 3. Model 79 Control Console Front Panel**

## Model 79 Control Console

The Model 79 Control Console is a compact self-contained unit designed to be located at the operator's position. It allows fingertip control of all monitoring parameters. Numerous LED indicators provide complete status information. A 4-digit numeric display indicates the monitor output level in real time. A major strength of the Model 79 is its ability to configure, under software control, a number of operating parameters. For example, during the installation and calibration process, the relative levels of the monitor output channels can be adjusted. This helps to ensure that maximum performance from the loudspeaker system can easily be obtained. All configuration parameters are stored in nonvolatile memory.

The Model 79 provides two buttons and associated LEDs for selection of the surround source to be monitored. While in most cases only one input source will be monitored at

a time, both inputs can be selected for simultaneous monitoring. This feature can be useful for creating a rough mix from the two sources. It is also a fast, effective means of making a "seat-of-the-pants" check on the phase relationship between synchronized signals. For compatibility with some cinema formats, two buttons and associated LEDs allow +10 dB of gain to be added to each input's LFE channel.

Four downmix modes allow the selected source to be checked for compatibility among different formats. The downmix modes, 5.1, LCRS, Stereo, and Mono, were implemented primarily for use in sound-for-picture applications. As such, from the factory the downmix coefficients were selected to be effective in these environments. However, a technician can easily change each downmix mode to meet the specific needs of a facility or audio format.

An LFE low-pass filter function is provided as a means of checking the audio content in the selected input's LFE channel. The operator can enable and disable the function as required, helping to ensure that the proper signals are being mixed to the LFE channel. Having the correct mix content is critical as the LFE channel is often band-restricted during distribution.

The monitor output level can be controlled by way of a large, easy-to-use rotary control. The "curve" or "taper" of the level control can be configured to match an operator's preference. The choices available are true logarithmic and modified logarithmic. The level control auto mute-all function allows the monitor output channels to automatically mute whenever the rotary level control is in its fully counterclockwise (minimum) position. This is useful in applications such as broadcast. By using the reference level function, the monitor output level can be set to a preconfigured value. This is provided for applications that require a specific monitor level to be quickly selected. The reference level is easily configured by taking an electronic "snapshot" of the position of the rotary level control. For operator confirmation, the 4-digit LED readout displays the level of the monitor output.

For operator convenience, the dim function allows the monitor output level to be reduced by a fixed dB amount. The mute-all function allows one button to simultaneously mute all eight monitor output channels. The input mute/solo section provides individual input channel control. One push-button switch sets the operating mode for either mute or solo. In the mute mode, individual input channels can be muted as required. In the solo mode, one channel can be monitored while the others are automatically muted. Depend-

ing on the configuration, multiple channels can be simultaneously selected for "soloing." The flexibility of having both input mute and input solo available allows an operator to quickly select the most comfortable and productive operating mode.

Two output mute functions are also provided. One button allows the seven main output channels to be directly muted. A second button allows the subwoofer monitor output channel to be muted. The output mute function, along with the input mute/solo function, allows an operator complete flexibility when checking an input source and its path to the loudspeaker system. These mute and solo resources are crucial in a multichannel environment, especially when signals are passing through a bass management system.

The Model 79 Control Console connects to, and is powered by, the Model 78 Central Controller. The Model 79 generates MIDI system-exclusive messages to control the Model 78. Remote-control signals connected to the Model 78 Central Controller are routed to the Model 79 via pins in the interconnecting cable.

### **Remote Control Capability**

For flexibility, the StudioComm for Surround system is designed to easily integrate with recording consoles, studio communications systems, and film motion-control electronics. Three remote-control input functions are provided: mute all, dim, and input source override. By providing access to the StudioComm's mute all and dim functions, talkback or slate activity from an audio console or other communications system can control the monitor output level. The input source override function is provided expressly for film post applications, allowing automatic switching of the StudioComm's

input source whenever the mode of a recording system changes between playback and record. This function, often referred to as PEC/direct switching, allows accurate monitoring during dialog replacement or other overdub sessions.

### **Channel Assignment and Routing**

The Model 78/Model 79 combination is expressly designed to support 8-channel 7.1 monitoring, with the input channels designated as left, right, center, LFE, surround left, surround right, back left, and back right. While it is anticipated that this channel arrangement will be quite common, the channels can obviously be used in alternative arrangements. Using the system with 5.1 sources is perfectly acceptable.

While the StudioComm for Surround system for multichannel monitoring will do many wonderful things, it is not designed to selectively route input signals to different output channels. The input-channel-to-output-channel relationship is maintained. A signal that arrives on the SL channel of the Surround B input will, when selected, output only on the SL channel of the monitor output. Any rerouting of the input signals must be done prior to their connection to the StudioComm for Surround system. This should not be a drawback in most facilities, but it is important to highlight this fact.

## **Installation**

In this section you will be installing the Model 78 Central Controller in an equipment rack. Audio input and monitor output connections will be made. A location will be selected for the Model 79 Control Console and it will be connected to the Model 78. If required, external equipment will be interfaced to the remote control inputs. AC mains power will be connected to the Model 78.

## **System Components**

The shipping carton contains one each of the following: Model 78 Central Controller, Model 79 Control Console, 20-foot (6.1 m) 9-pin D-sub interconnecting cable, and user guide. Units destined for North America also include an AC mains cord. Your dealer or distributor should provide an AC mains cord for non-North American destinations.

### **Mounting the Model 78**

The Model 78 Central Controller requires one space in a standard 19-inch (48.3 cm) equipment rack. Select a location that is convenient to both the analog audio signals and the Model 79 Control Console. A 20-foot (6.1 m) cable is supplied to connect the Model 78 to the Model 79. You can supply your own interconnecting cable, however 50 feet (15.3 m) is the recommended maximum length. Secure the Model 78 into the equipment rack using two mounting screws per side.

### **Audio Connections**

Audio signal connections are made by way of three 25-pin D-sub connectors, located on the Model 78's back panel. Three cable harnesses, each with a 25-pin D-sub plug (male) on one end and the desired connectors on the other end, are necessary. These cable harnesses are not normally supplied by Studio Technologies. Note that our friends in some locations may use the term "loom" instead of harness.

The wiring scheme used by the D-sub connectors complies with the one made familiar by TASCAM® with their DA-88® product. Wiring harnesses prepared for connecting to the surround inputs are identical to DA-88-style input harnesses. A wiring harness

prepared for the monitor outputs is identical to that of a DA-88-style output harness. Please refer to Figures 4 and 5 for the exact connection details. Note that unlike a DA-88-style harness, the Model 78's D-sub connectors use 4-40 threads. This complies with the original design standard for D-subminiature connectors.

Unless there's a special need, it may be cost and time effective for you to purchase commercially made cable harnesses. Let the large market for DA-88-style cabling help you painlessly install your system!

## Surround Inputs

The connectors labeled Input Surround A and Input Surround B are used to interface with the 16 input circuits. Please refer to Figure 4 for details on the exact "pin out" of the D-sub connectors. Each input circuit is electronically balanced. They are intended for connection to balanced or unbalanced sources with nominal signal levels of -12 dBV to +6 dBu. A 15-turn trim potentiometer is associated with each input, allowing the input sensitivity to be adjusted to match the source's level. The configuration section of this guide provides details on using the trim pots.

Balanced sources should be wired so that signal high is connected to +, signal low to -, and shield to the shield connection. With an unbalanced source, connect signal high to the + connection, and shield to both the - and the shield connections. If connecting to an unbalanced source in this manner results in hum or noise, try connecting signal high to +, and shield to -; leave the shield connection unterminated.

It is highly recommended that at least one of the surround inputs be wired by way

Connections	Signal High (+)	Signal Low (-)	Shield
L	24	12	25
R	10	23	11
C	21	9	22
LFE	7	20	8
SL	18	6	19
SR	4	17	5
BL	15	3	16
BR	1	14	2

Notes: 1) Connector type on Model 78 is 25-pin D-subminiature female. Installer must provide plug (male). Connector uses 4-40 threaded inserts for locking with mating plug.

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

**Figure 4. Connections for Inputs Surround A and Surround B**

Connections	Signal High (+)	Signal Low (-)	Shield
L	24	12	25
R	10	23	11
C	21	9	22
LFE	7	20	8
SL	18	6	19
SR	4	17	5
BL	15	3	16
BR	1	14	2

Notes: 1) Connector type on Model 78 is 25-pin D-subminiature female. Installer must provide plug (male). Connector uses 4-40 threaded inserts for locking with mating plug.

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

**Figure 5. Connections for Monitor Output**

of an audio patch bay. This will allow the channels associated with that input source to be easily rerouted. While signals generated within a facility will normally follow a specific format, such as L, R, C, LFE, SL, SR, BL, and BR, it is possible that media provided by an outside facility will follow a different one.

## Monitor Output

The connector labeled output provides access to the 8-channel monitor output. Please refer to Figure 5 for details on the exact “pin out” of the D-sub connector.

The monitor output channels are intended for connection to audio amplifiers associated with monitor loudspeakers, or to the inputs of loudspeakers that contain integrated amplifiers. The monitor outputs are electronically balanced and capable of driving balanced or unbalanced loads of 600 ohms or greater. While balanced operation is preferred, unbalanced operation does not pose a problem. To connect to an unbalanced load connect the + terminal as signal high, and both the – and shield as the signal low/shield. For optimal unbalanced operation, it is important to connect both – and shield together directly on the D-sub plug, not at the other end of the harness.

Note that while the Model 78’s electronically balanced output circuits are capable of driving loads of 600 ohms or greater, the output level will drop slightly as the load impedance approaches 600 ohms. A 0.5 dB difference in output level can be expected as the load impedance changes from 10 k ohms to 600 ohms.

## Remote Control Inputs

Support is provided for three remote control input functions: mute all, dim, and input select. The inputs use logic gates, “pulled up” to +5 V by way of resistors, which are active when brought to the 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.

The connector labeled Remote Control Inputs on the back panel of the Model 78 is used to interface with the remote control inputs. Refer to Figure 6 for exact connection details. Note that pin 1 (Shield) and pin 9 (Remote Control Common) are electrically identical. In addition to connecting to system common, they connect to the Model 78’s chassis and mains earth connection. For convenience, the shield of the interconnecting cable should be connected to pin 1 (Shield), while the return signals of the remote control sources should connect to pin 9 (Remote Control Common).

Note that although the remote control connections are physically made to the D-sub on the Model 78’s back panel, the remote control input circuitry is actually located in the Model 79 Control Console. Conductors in the cable linking the Model 78 to the Model 79 route the remote control signals to the actual input circuitry.

Pin	Signal
1	Shield
5	Remote Mute All
6	Remote Dim
7	Remote Input Select
9	Remote Control Common

Notes: 1) Connector type on Model 78 is 9-pin D-subminiature female. Installer must provide plug (male). Connector uses 4-40 threaded inserts for locking with mating plug.

**Figure 6. Connector Pin Out for Remote Control Inputs**

## Connecting the Model 78 to the Model 79

A cable with 9-pin D-sub plugs (males) on each end is used to interconnect the Model 78 Central Controller with the Model 79 Control Console. A 20-foot (6.1-meter) cable is provided with each system. The connector labeled To/From Control Console on the back panel of the Model 78 is used to connect to the Model 79.

Should a cable of different length be required, it should be wired in a one-to-one fashion for all 9 pins. Pin 1 carries signal common, and must be connected at both ends. A shield connection for the cable should be connected to pin 1 on the Model 78's end. For best performance the cable generally should not exceed 50 feet (15.3 meter) in length. The reality is that a cable much longer in length should work correctly, as long as an excellent-quality cable is utilized. We define "excellent" as extensive shielding along with very low capacitance. The low cable capacitance is important as it limits the amount of data-signal waveform distortion. As far as an actual maximum length, just test and see how far away you can go—if it works, it works!

## AC Mains Power

The Model 78 is internally configured to operate from either nominal 100, 120, or 220/240 V, 50/60 Hz. Units shipped to North America are factory selected for 120 V operation. Units bound for Japan are generally selected for 100 V, while our friends "down under" and in Europe receive units set for 220/240 V. Before connecting the Model 78 to AC mains power, check that it is configured to match the local mains voltage. Look on the back panel (adjacent to the power entry connector) for the factory-configured voltage. Note that an incorrect configuration could prevent operation, or cause damage to the unit. Should it be necessary to change the unit's operating voltage it must be performed only at the factory, or by a factory-authorized service technician.

The Model 78 uses an IEC-standard connector to mate with the AC mains cord. The wire colors in the AC mains cord should conform to the internationally recognized CEE color code and must be wired accordingly:

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

**Safety Warning:** The Model 78 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 AC mains power is applied, the Model 78's power present LED will light. The Model 79 will go through a power-up sequence, lighting each LED in secession. The Model 79's software revision level will also display momentarily. The data active LED on the Model 78 will briefly light upon completion of the Model 79's power-up sequence.

## Configuration

After the physical installation has been completed, several configuration issues must be addressed. On the Model 78 the surround inputs must be calibrated using the trim potentiometers. The operating parameters of the system should be set using the Model 79 Control Console's configuration mode. Using the Model 79's calibration mode, output channel level offsets can be configured if desired.

### Input Level Calibration

Sixteen 15-turn trim potentiometers are located on the front panel of the Model 78 Central Controller. Taking time to carefully adjust the trim pots will ensure that accurate monitoring can take place. Each trim pot allows input signals with a nominal level of  $-12$  dBV to  $+6$  dBu to be utilized. With care, it's easy to calibrate the surround inputs to within one-quarter of a dB of the desired value.

The monitor outputs are used as the measuring point when adjusting the trim pots. A laboratory-grade audio level meter, or equivalent, is required for accurate calibration. In addition, the audio sources connected to the inputs must be able to generate continuous audio signals at their nominal operating level.

### Procedure

This procedure will calibrate the surround input channels. The trim pots will be adjusted in groups corresponding to their associated input source.

1. Begin by turning the audio amplifiers or amplified speakers to their off state. This will protect the loudspeakers and the operator's ears from possible damage.
2. Rotate the level control on the Model 79 to the fully clockwise (maximum) position.
3. Using the Model 79 Control console, select Surround A as the input source.
4. On the Model 78, connect the audio level meter to the left channel of the monitor output.
5. Confirm that the audio source's left channel is generating a steady signal at precisely its reference level.
6. Observing the level meter, adjust trim L for Surround A to give the desired level at monitor output L. This level may be  $+4$  dBu,  $+14$  dBu, or some other value depending on the configuration of the output level range.
7. Disconnect the level meter from the left channel of the monitor output.
8. Repeat steps 4-7 for the other seven channels of Surround A.
9. Repeat steps 3-8 for the channels associated with Surround B.
10. Rotate the level control on the Model 79 to the fully counterclockwise (minimum) position.

11. After ensuring that the Model 79's level control is set to minimum, return AC mains power to the power amps or amplified speakers.

## Model 79 Operating Parameters

Many StudioComm functions can be configured to meet the exact needs of your installation. Here's an overview of what you can configure:

- Input channels active
- Solo mode
- Power-up mute all
- Level control response
- Level control auto mute all
- Output level offset
- Output level range
- Reference level
- Dim level
- Downmix modes
- Remote control inputs

The Model 79 configuration diagrams, located at the end of this section, give details on how each parameter is set. 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 the Model 79 Control Console, adjacent to the 9-pin D-sub connector. Pressing and holding this button for two seconds places the Model 79 into the configuration mode. In the configuration mode the Model 79's array of buttons and LEDs no longer perform

their normal functions, but instead allow you to observe and change many of the operating parameters. The mute/solo mode LEDs light alternately to indicate that the configuration mode is active.

To leave the configuration mode and return the Model 79 to normal operation, once again press and hold the configure button for two seconds. Note that configuration changes are stored 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 the Model 79 into a "rats nest" of music scores or track sheets!

There is no problem frequently "tweaking" the Model 79'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.

### Input Channels Active

The configuration parameter for the number of channels active for each input is provided for those cases where a source has less than eight channels. Let's look at an example. Surround A is connected to an 8-channel source, so its default configuration is fine. But the source for Surround B is different, having only six channels: left, right, center, LFE, surround left, and surround right. This makes it not so "cool" for the operator to select Surround B for monitoring, as the unconnected back left and back right input channels will get

routed to their respective monitor outputs. Will the unused input channels pick up significant noise or hum? Unlikely, but why take a chance at having a problem. Simply use the input channels active configuration to disable the two unused channels. Now when Surround B is selected, only the relevant channels are selected for monitoring.

Note that when a channel associated with an input is disabled, the input routing circuitry, under software control, no longer selects it, but the corresponding monitor output channel does not mute. With our example, when selecting Surround B, our mythical 5.1 source, all monitor output channels will remain active, but the input routing circuitry won't select the BL and BR inputs. While to some people this might seem confusing and possibly a design fault, it was implemented this way because the StudioComm system allows both inputs to be simultaneously selected for monitoring; a 7.1 source might be selected at the same time as a 5.1 source. Muting the outputs simply would not do!

A special mode has been included to allow an input to be disabled from being accessed by the operator. This might be useful, for example, when Surround B is not connected to a source, and has no valid reason to be selected. This might also be useful when connecting a special source, such as a house "tie line" or router output, that shouldn't normally be accessible. To disable an input is simple, just disable all eight channels associated with it. To confirm that an input has been disabled, all LEDs associated with that input will flash on and off. Once the Model 79 is returned to the normal operating mode, the disabled input cannot be selected.

### **Solo Mode**

Solo operation can be configured to satisfy operator preference. The additive solo mode matches the functionality found in many recording consoles. In this mode, multiple channels can be simultaneously "soloed," allowing those channels to be monitored at the same time. Other operators may prefer the exclusive solo mode. When this mode is selected, only one channel can be selected for solo at a time. The additive solo mode is the default setting.

### **Power-up Mute All**

By default, upon application of AC mains power the monitor outputs remain muted after the system's power-up sequence has been performed. Then an operator must manually press the mute all button to enable the monitor outputs. There may be cases where it's desirable to have the monitor output channels return to their respective states as left at the time of the previous loss of AC mains power. This would allow normal operation to automatically resume.

### **Level Control Response**

As expected, the level control on the Model 79 Control Console is used to adjust the output level of the monitor output channels. The amount of rotation required to reach a specific level can be selected. This can be described as allowing the "curve" or "taper" of the level control to be configured. Two choices are available: true logarithmic and modified logarithmic. In the true logarithmic mode the level control provides a precise logarithmic performance over its entire rotation, e.g., the output level is half of its maximum when the control is set at its midpoint, i.e., 50% of its "travel." In the

true log mode, normal listening may require the level control to be set to approximately the 2-o'clock position. Other users may be more comfortable with the response given by the modified logarithmic mode. This provides a much greater output level during the first 50% of the level control's travel. When configured for the modified log mode, normal listening may require the level control to be set to the 11- or 12-o'clock position. The modified log mode more closely matches the monitor level control performance found in many audio consoles. As such it is selected as the default mode.

It's important to note that changing the level control response configuration will impact the reference level. Changing from modified log to true log, or vice-versa, will change the reference level. Technically, the mathematical value stored as the reference level does not change, but the resulting loudness that is heard by the operator will change. Be warned! Changing the level control response may require the reference level to be re-calibrated.

### **Level Control Auto Mute All**

The level control auto mute all function automatically mutes the monitor output channels whenever the rotary level control is in its fully counterclockwise position. In some applications it may be desirable to disable this function. When disabled, the rotary level control adjusts the monitor output level over the configured level range; no automatic muting takes place.

### **Output Level Offset**

To provide assistance during room calibration, the relative output levels on seven of the eight output channels can be adjusted. The exact calibration procedure

is covered later in this document. A configuration parameter selects whether the output level offset function is set for view only, or view and change. The view only mode allows users to view the level offset settings, but serves as a "lock out," preventing a calibrated system from accidentally being changed. Unless the level offsets are actively being adjusted to their desired values, it is recommended that the view only mode be selected.

### **Output Level Range**

To meet the needs of different applications the output level range can be selected. In mode 1 the input-to-output level has a minimum gain of  $-70$  dB and a maximum gain of unity (0 dB). When the rotary control is set to its fully counterclockwise position,  $-70.0$  will display on the readout. Set to its fully clockwise position,  $0.0$  will display. In mode 2 the input-to-output level has a minimum gain of  $-80$  dB and a maximum gain of  $-10$  dB. The display will read over a range of  $-80.0$  to  $-10.0$ .

### **Reference Level**

For audio-with-picture applications it's critical that mixing be done in reference to a known monitor loudspeaker level. This is often referred to as mixing to "85 dB" on the monitors. The Model 79 Control Console allows a precise monitor output level to be stored, and then enabled by pressing the button labeled REF. Setting the reference level is very simple:

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 reference and dim functions are not active.

3. Use the Model 79 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 79's rotary level control until the desired reference output level has been reached.
5. Being careful not to touch the position of the rotary level control, enter the configuration mode by pressing and holding the configuration button located on the Model 79's back panel.
6. Once the configuration mode has been entered, the monitor outputs will mute. Press and hold the reference button until its associated LED lights. This will take approximately 5 seconds. The LED will light to indicate that a "snapshot" of the new reference level has been taken. The level display will show the exact reference level that is being stored.
7. To store the new reference level in memory, exit the configuration mode by again pressing and holding the configure button.

This level is now permanently stored as the reference level. Only by repeating the procedure can the value be changed.

Once the configuration mode has been exited, the monitor output channels will again become active. Confirm that the correct level has been stored by pressing the reference button. The SPL meter should again display the desired level. If not, repeat the calibration procedure.

You might wonder why you have to press and hold the reference button for 5 seconds before the selected value is stored.

This is provided specifically so that some turkey won't accidentally change the reference level while they are playing around in the configuration mode! Only if you know the "secret" will you be able to store a new value.

### **Dim Level**

The dim function is used to reduce the monitor output level by a preset amount. The reduction is in dB relative to the monitor output's current level. There are four dim level values available: 10, 15, 20, and 25 dB.

### **Downmix Stereo Mode**

There are two modes available for the downmix stereo mode. The difference between the two modes relates to how the sum of the SL, SR, BL, and BR channels are routed to the L output channel. In mode 1 the sum of the signals are inverted and then routed to the L output. In mode 2 the sum of the signals are directly routed to the L output. Mode 1 is default and is recommended for THX® monitoring applications. Mode 2 may be more appropriate for general audio monitoring applications. For details on the downmix stereo modes please refer to the Technical Notes section of this guide.

### **Downmix Mono Mode**

There are two modes available for the downmix mono mode. In mode 1 the L, R, and C channels are summed and routed to the C output channel. In mode 2 in addition to the L, R, and C channels, the sum of the SL, SR, BL, and BR channels are routed to the C output. Mode 1 is default and is recommended for THX® monitoring applications. It may also be appropriate for some audio-with-picture applications. Mode 2 may be useful for general audio monitoring applications. Refer to the Technical Notes section

of this guide for details on the downmix mono modes.

### **Remote Mute All**

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

### **Remote Dim**

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

### **Remote Input Select**

The remote input select function requires configuring two parameters: mode and input to be selected. The mode can be selected from three choices: disabled, exclusive, and non-exclusive. As expected, when configured for disabled, the function can't be activated. When configured for exclusive, whenever the function is activated only the specified input will be active. When configured for non-exclusive, whenever the function is activated the specified input will be added (summed) with the other input, if it is already active.

### **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!

## **Output Channel Level Offset**

To provide assistance during room calibration, the relative output levels of seven of the eight output channels can be adjusted over a limited range. The L, R, Sub, SL, SR, BL, and BR channels can be adjusted in 0.5 dB steps over a  $\pm 6$  dB range. The center (C) output channel is used as a reference and cannot be adjusted.


Begin the level offset calibration procedure by entering the offset level calibration mode. Starting from the normal operating mode, press and hold both the mains mute and sub mute buttons. After five seconds the system will enter the level offset calibration mode. This is indicated by the solo mode LED flashing on and off. In this mode the input mute/solo channel buttons are used to display the current level offset values and, if the system is configured for view and change, will allow the displayed value to be changed. The displayed value represents the dB level difference as compared to the center output channel. The range is  $-6.0$  to  $6.0$  in 0.5 dB steps. All other system functions will operate normally. The monitor output will be active, allowing real-time adjustment of the level offset. Changing an offset level will directly impact the monitor output level for that channel.

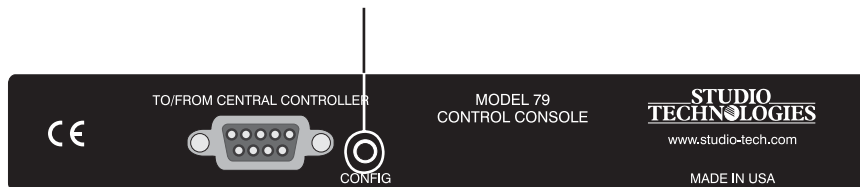
If the Model 79's configuration has been selected for view only, pressing a channel button during the calibration mode will only display the level offset value. No changes can be made. If the configuration is set for view and change, the mains mute and sub mute buttons can be used to adjust the level offset. The buttons are active only when a channel button is pressed. The mains mute button will reduce the output level in 0.5 dB steps. The sub mute button will increase the output level in 0.5 dB steps.

Note that pressing the button associated with the center channel will always display a level offset value of 0.0. This value is fixed and cannot be changed. This is due to the fact that the center channel serves as the system reference.

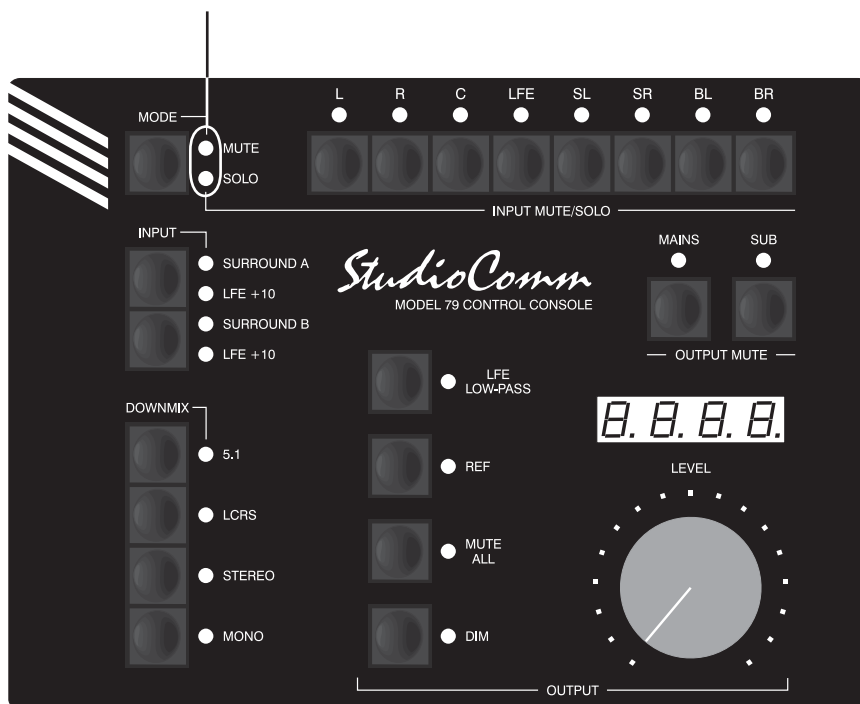
Once the level offset calibration process has been completed, exit the calibration mode by pressing and holding the mains mute and sub mute buttons for five seconds. To prevent the level offset values from being accidentally changed, the main Model 79 configuration mode should be entered and the view only mode selected.

## Model 79 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.



## Model 79 Configuration—Input Channels Active



Press and hold an input button (one at a time) to display and select which channels associated with that input are active.

When an input button is pressed, these LEDs display which input channels are active for that input. A lit LED indicates that the channel is active. Use the buttons to change the configuration.



**Default:** For both inputs, all eight channels (L, R, C, LFE, SL, SR, BL, BR) are active.

**Note:** A special input disable function is available. By disabling all channels associated with a specific input, that input will no longer be available during normal operation. While in the configuration mode, all LEDs associated with an input will flash to indicate that the input has been disabled. This function is useful if an input is not going to have a source associated with it. Then during normal operation this input cannot be selected, minimizing any confusion caused by selecting an invalid input source.

## Model 79 Configuration—Solo Mode, Power-Up Mute All, Level Control Response, Output Level Offset, Level Control Auto Mute All, and Output Level Range Mode

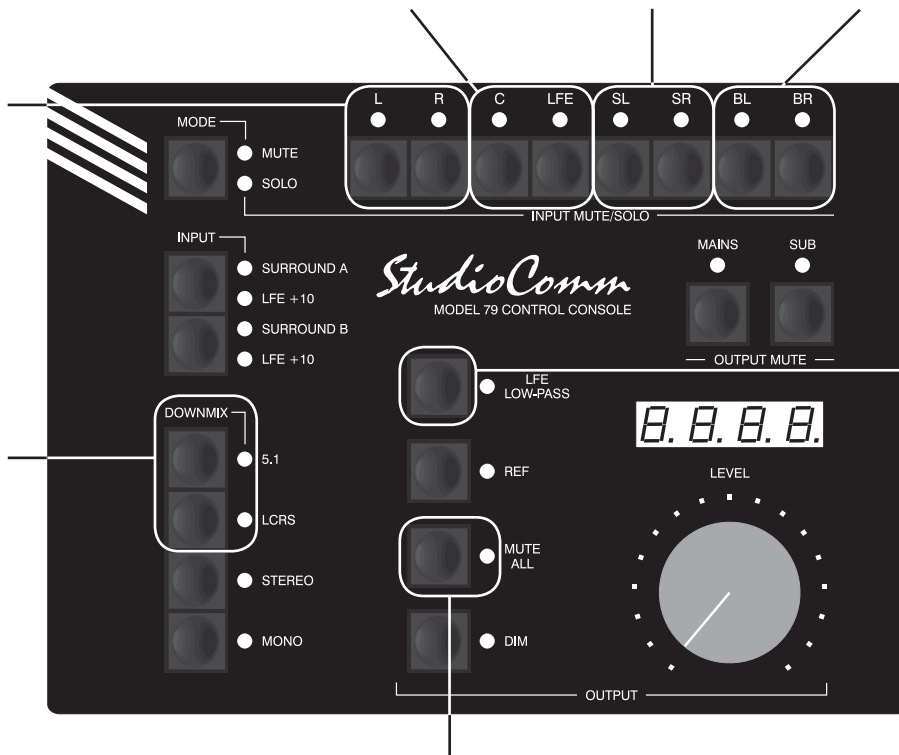
When the LFE Low-Pass button is pressed, these LEDs display the status of the power-up mute all function. When LED C is lit the state of mute all is saved at power down and followed upon power up; when LED LFE is lit the system is always in mute all upon power up. Use the buttons to change the configuration.

When the LFE Low-Pass button is pressed, these LEDs display the status of the level control response mode. When LED SL is lit the level control provides a true logarithmic response. When LED SR is lit the level control provides a modified logarithmic response. Use the buttons to change the configuration.

When the LFE Low-Pass button is pressed, these LEDs display the status of the output level offset function. When LED BL is lit the output level offset can be viewed but not changed. When LED BR is lit the output level offset can be viewed and changed. Use the buttons to change the configuration.

When the LFE Low-Pass button is pressed, these LEDs display the status of the solo mode. When LED L is lit additive solo mode is enabled; when LED R is lit exclusive solo mode is enabled. Use the buttons to change the configuration.

When the LFE Low-Pass button is pressed, these LEDs display the status of the output level range mode: LED 5.1 lit means mode 1, -70 to 0 dB; LED LCRS lit means mode 2, -80 to -10 dB. Use the buttons to select the mode.



Press and hold the LFE Low-Pass button to display the status of the solo mode, power-up mute all function, level control response mode, output level offset, level control auto mute all function, and output level range mode.

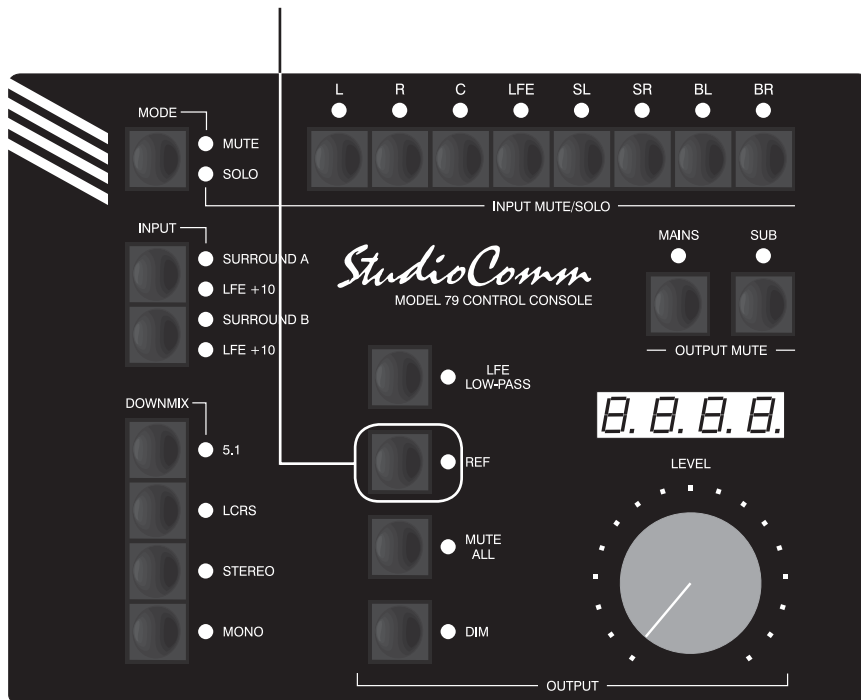
When the LFE Low-Pass button is pressed, this LED displays the status of the level control auto mute all function. When the LED is lit the function is enabled. Use the button to change the configuration.

**Default:** Additive solo mode enabled.  
 Upon power up, mute all function enabled.  
 Level control provides modified logarithmic response.  
 Output level offset view only.  
 Level control auto mute all function enabled.  
 Output level range mode 1, -70 to 0 dB.

## Model 79 Configuration—Reference Level



Press and hold the Ref button for 5 seconds to take a “snapshot” of the level control’s present setting. The Ref LED will light when the “snapshot” has been taken. The 4-digit display will indicate the Ref level that will be stored.



**Default:** Fully attenuated (minimum) monitor output level.

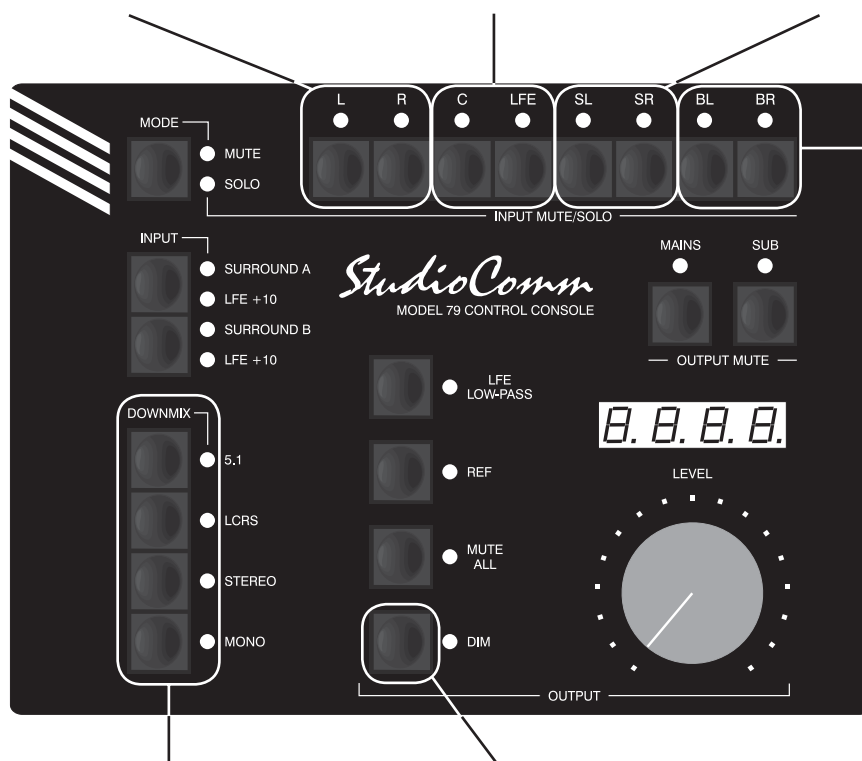
**Note:** The 5-second delay is a safety feature, ensuring that the reference level will not be accidentally changed. To permanently store the new value, you must still exit the configuration mode.

## Model 79 Configuration—Dim Level, Remote Mute All, Remote Dim, Downmix Stereo Mode, and Downmix Mono Mode

These LEDs display the configuration of remote mute all. LED L lit means that remote mute all is disabled; LED R lit means enabled. Use the buttons to change the configuration.

These LEDs display the configuration of remote dim. LED C lit means that remote dim is disabled; LED LFE lit means enabled. Use the buttons to change the configuration.

These LEDs display the status of the downmix stereo function. LED SL lit means mode 1; LED SR lit means mode 2. Use the buttons to change the configuration.



These LEDs display the status of the downmix mono function. LED BL lit means mode 1; LED BR lit means mode 2. Use the buttons to change the configuration.

When the Dim button is pressed, these LEDs display the selected dim level:

LED 5.1 lit means 25 dB dim;  
LED LCRS lit means 20 dB dim;  
LED Stereo lit means 15 dB dim;  
LED Mono lit means 10 dB dim.

Use the buttons to select the dim level.

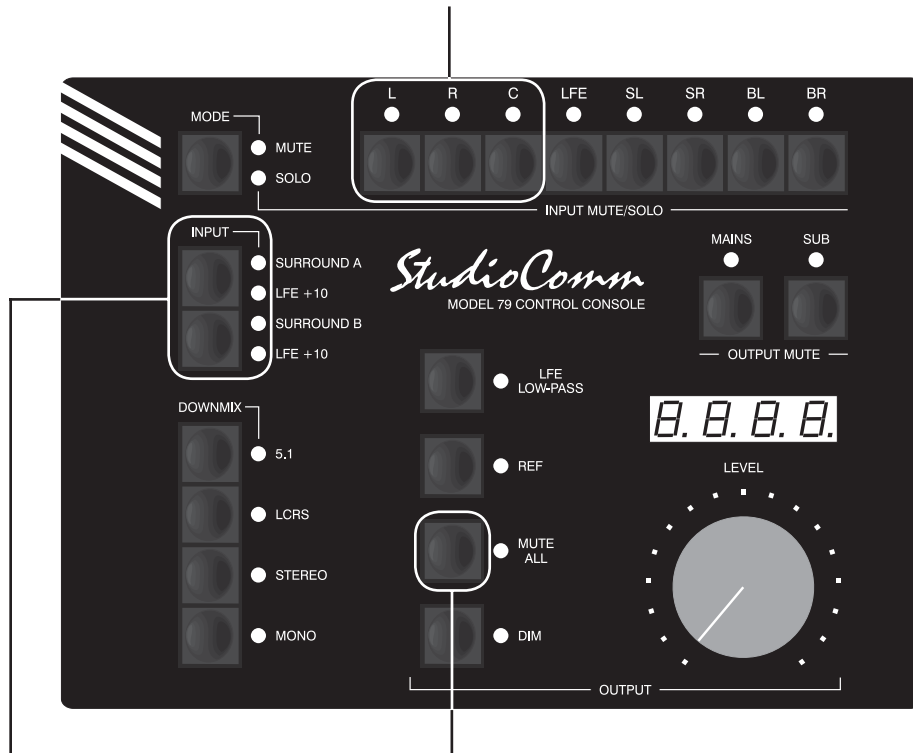


Press and hold the Dim button to display and select the dim level, remote mute all, remote dim input, downmix stereo mode, and downmix mono mode configurations.

**Default:** 20 dB dim level.  
Remote mute all disabled.  
Remote dim disabled.  
Downmix stereo set to mode 1.  
Downmix mono set to mode 1.

## Model 79 Configuration—Remote Input Select

These LEDs display the mode of the remote input select function. LED L lit means that the function is disabled. LED R lit means the function provides exclusive input select. LED C lit means that the function provides non-exclusive input select. Use the buttons to change the configuration.



When the Mute All button is pressed, these LEDs display the input associated with the remote input select function:

LED Surround A lit means Surround A;  
LED Surround B lit means Surround B.

Use the buttons to select the input.



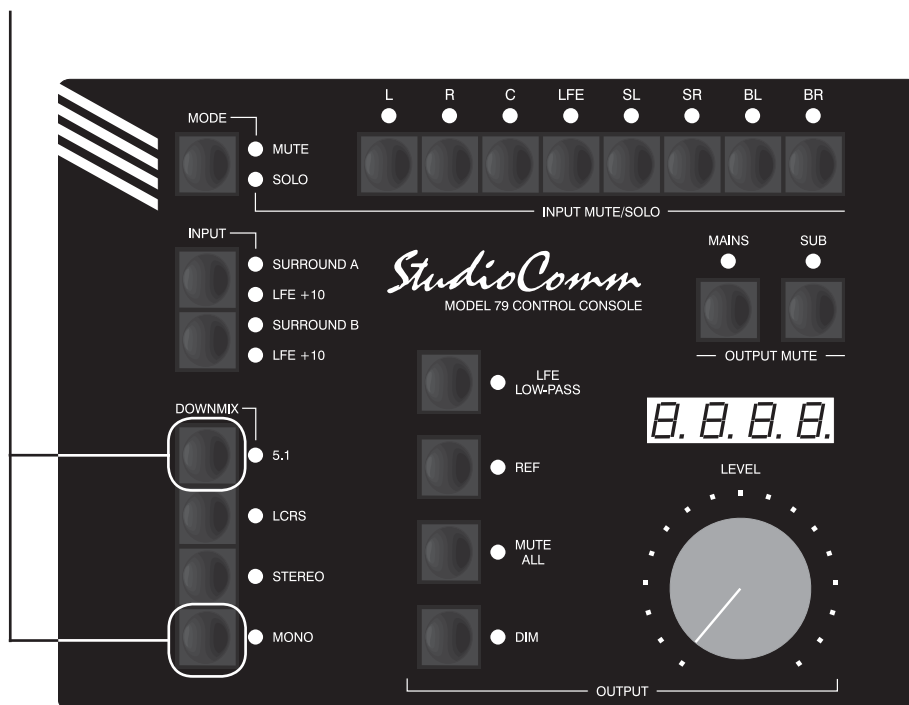
Press and hold the Mute All button to display and configure remote input select function.

**Default:** Remote input select function disabled.  
Surround A associated with remote input select function.

## Model 79 Configuration—Restore Factory Defaults



Press and hold both the 5.1 and Mono buttons for 5 seconds to restore Model 79 factory defaults. Once defaults have been restored, the LEDs will light. After the buttons are released, configuration mode will be exited and normal operation will resume.



**Factory Defaults:** All channels associated with both inputs are active.  
 Additive solo mode enabled.  
 Upon power up, mute all function enabled.  
 Level control operates modified logarithmic.  
 Output level offset view only.  
 Level control auto mute all function enabled.  
 Output level range mode 1, -70 to 0 dB.  
 Reference level is set for fully attenuated (minimum) monitor output level.  
 20 dB dim level.  
 Remote mute all disabled.  
 Remote dim disabled.  
 Downmix stereo set to mode 1.  
 Downmix mono set to mode 1.  
 Remote input select function disabled.  
 Surround A associated with remote input select function.  
 Output level offset 0 dB for all channels.

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

## Operation

Now that you've installed and configured the system, you're ready to go. You should find operation very easy.

### Model 78 Central Controller

The Model 78's front panel contains two LEDs. The power LED should be lit whenever AC mains power is connected. The data LED will light whenever a MIDI system-exclusive message is received from the Model 79.

### Model 79 Control Console

StudioComm operation is controlled using the Model 79 Control Console and, if connected, the remote control inputs. To make things easy to describe, we've divided the StudioComm functions into six main groups: input source and LFE +10 selection, downmix, monitor output general functions, input mute/solo, output mute, and remote controls.

### Input Source and LFE +10 Selection

Input source selection is simple. To select an input source for routing to the monitor output, press one of the two input source buttons. The corresponding LED will light to let you know that the input has been selected. The LFE +10 LED associated with that source will light if that input has been selected to have +10 dB gain added to its LFE channel. You can select both input sources simultaneously. The two inputs will be summed (combined). Start by pressing and holding one of the input source buttons. While that button is pressed, add the second input by momentarily pressing the button associated with that input.

A special configuration mode allows an input to be disabled. This would be appropriate if an input is not connected to an audio source. If you press an input source button and the previously selected input source does not change, the newly selected input has been disabled.

To allow accurate monitoring of some cinema formats, 10 dB of gain can be added to the LFE input channel associated with each of the sources. For flexibility, the inputs can be independently selected to add 10 dB or remain at unity gain. To add 10 dB of gain to the LFE input associated with Surround A, simply press and hold the Surround A button for two seconds. To return to unity gain, simply press and hold the button again for two seconds. The LFE +10 indicator will display the status of the LFE gain function. Use the Surround B button to select unity or 10 dB operation for input surround B.

### Downmix

The four downmix modes allow an operator to perform "real world" compatibility checks. In this way a 7.1 surround input source can be "folded" down to 5.1, LCRS, stereo, and mono. How these modes affect the audio signals will greatly depend on how the Model 79 was configured at the time of installation. Being aware of the selected configuration will allow the downmix modes to serve a more useful role. For technical details on the downmix modes please refer to the Technical Notes section of this guide.

Using the downmix modes simply requires pressing one of the downmix buttons. The downmix buttons are always set to "latch" the function on and off. The associated

LED lights when a downmix mode is enabled. Normal surround operation takes place whenever none of the four downmix LED indicators are lit.

## Monitor Output General Functions

Four buttons and one rotary control are associated with the monitor output functions. The buttons control operation of LFE Low-Pass Filter, reference level, mute all, and dim. The rotary level control is used to manually set the monitor output level.

### LFE Low-Pass Filter

The LFE input low-pass filter function is provided to emulate the processing done by some formats to the LFE channel. Unlike the main channels, an LFE channel is often bandwidth restricted to save digital “bits.” It’s important that an audio “mix” maintain its integrity when such LFE bandwidth restrictions are in place. Technically, when enabled the LFE signal is routed through a series of analog filters which provide a 48 dB/octave slope with a –6 dB frequency of 120 Hz.

To enable the LFE low-pass filter function simply press the LFE Low-Pass button. The associated LED indicator will light when the filter is active in the LFE audio path.

Philosophy dictates how the filter function should be used. The function can be used as a final “double check” to ensure that material will maintain overall integrity when digitally processed. Enabling the filter during a final listening session should find the spectral content remaining constant. If the mix is impacted, content has been incorrectly routed to the LFE channel!

It’s also acceptable to leave the filter enabled at all times. This will ensure that an audio mix will “hold up” when processed. However, this may mask content remaining in the LFE channel which, although it won’t be present after processing, may be confusing to mastering engineers or other personnel who monitor the original source material.

### Reference Level

The reference level button, labeled REF, sets the monitor output level to a preset value. A technician, using a sound-pressure-level (SPL) meter, at the time of system installation normally sets this level. The LED associated with the reference level function lights whenever the function is active. Whenever the reference level mode is active the rotary level control is disabled. The 4-digit display will indicate the reference output level.

The reference LED also serves as a calibration aid. If the reference level mode is not active, and the rotary level control is set at precisely the same level as that stored for the reference value, the reference LED will flash. Due to the method that the software reads the position of the rotary level control, it’s possible that the control can’t always be set to match the exact reference value.

### Mute All

The mute all function is highly complicated to operate—not! Pressing the mute all button causes all eight monitor output channels to mute. The 4-digit display will always indicate a mute condition by showing four horizontal dashes. The mute all button is always set to “latch” the function on and off. The LED associated with mute all 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.

Unless changed from that selected for the default configuration, the mute all function will be active whenever the system begins operation after mains power has been applied. In this case, pressing the mute all button is required to enable audio on the monitor output channels.

### **Dim**

The dim function is quite self-explanatory. Press the dim button to enable the dim mode, which reduces the monitor output level by a preset amount. As expected, the 4-digit display will indicate the now-dimmed monitor output level. The dim button is always set to “latch” the function on and off. Dim activity applies no matter whether the monitor output level is being set by the rotary control or the reference button. The dim level can be configured for 10, 15, 20, or 25 dB, so one of those values will apply when dim is active. The LED associated with the dim button will light whenever dim is active. Note that if dim is enabled via the remote dim function, the dim LED will flash.

What’s not so self-explanatory is the auto-dim-off function. Whenever dim is enabled due to the dim button being pressed, and reference mode is not active, changing the rotary level control will automatically turn off dim. The auto dim off function is a unique attempt at protecting the aural health of audio engineers. No longer will there be a heart-stopping blast of audio whenever 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 used an audio console and experienced this

in person—trust us, this situation does happen! Auto dim off is a wonderful “real-world” feature.

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 monitor output level. It is active any time the reference level function is not active. When the rotary level control is set to give the same output level as the preset reference level, the reference LED will flash. The 4-digit display will always indicate the current level of the monitor output channels.

By default, when the rotary level control is set to its fully counterclockwise position, the monitor output channels automatically mute. This feature is provided for those users accustomed to having a completely quiet output when the level control is set to its minimum position. A Model 79 configuration parameter allows the level control’s automatic mute all function to be disabled. When disabled, the rotary level control simply adjusts the monitor output level over its entire 70 dB range. When the control is in its fully counterclockwise position, low level audio signals will be present on the monitor outputs. This level control operating mode may be preferable for those users who do not like the abrupt level change when the automatic mute all function activates. When the automatic mute all function is disabled, the mute all button can be used to achieve a full monitor output mute.

## **Input Mute/Solo**

The input mute/solo function allows channels associated with the surround input channels to be muted, or be selected for individual “solo” monitoring. It’s very important to understand that the input mute/solo function directly impacts the input channels, but not necessarily only the directly associated output channels. The reason is bass management. The bass management function will redirect low-frequency energy to the monitor output’s subwoofer channel. So for example, a full-range signal coming into the system on the left channel of surround A will have content coming out of both the left and subwoofer monitor output channels. Using the input mute/solo function to mute the left channel will cause the content in both the left and subwoofer monitor output channels to mute.

Associated with the input mute/solo function are nine buttons and ten LED indicators. They work together to provide excellent operating flexibility. The mute/solo mode button allows the operator to select between the mute and solo modes. Going from mute mode to solo mode, or vice-versa, clears all active mutes or solos. Pressing the mode switch twice is a legitimate means of quickly clearing all muted or soloed channels.

In the mute mode, multiple input channels can be muted simultaneously. A channel that is muted has its associated LED lit. The solo mode can operate in one of two ways: additive or exclusive. How solo operates depends on the configuration as set in the Model 79 Control Console. In additive solo mode, multiple input channels can be soloed simultaneously. A channel that is soloed has its associated LED indicator flash on and off, while the LEDs on the non-soloed channels are not lit.

As expected, in the exclusive solo mode pressing a channel button will cause that channel to be soloed. But, in addition, any other channel or channels being soloed will go back to their normal, non-solo condition. Thus the exclusive solo mode allows rapid “soloing” of individual channels. Should more than one channel need to be simultaneously soloed, simply push and hold a channel button, then add the extra channels by momentarily pressing their buttons.

## **Output Mute**

The two buttons associated with the output mute function provide a means of directly muting the monitor output channels. These serve as an aid in observing the performance of the loudspeaker system. The output mute function organizes the monitor output channels into two groups: mains and sub. The mains group consists of the seven main output channels, L, R, C, SL, SR, BL, and BR. The sub group consists of only the subwoofer output channel. Two buttons and associated LED indicators are used to control the output mute function. Both buttons function in a push on/push off manner.

It may be confusing at first to imagine why the output mute buttons are important. The reason, like the input mute/solo function, is bass management. The input mute/solo function allows observation of the channels associated with the surround inputs. But soloing a single channel, such as the left input of surround A, may result in audio content coming out of the system and being reproduced by the left and subwoofer loudspeakers. By maintaining the left channel in the input solo mode, an operator can use the output mute function to independently mute the left and subwoofer output channels as desired.

## Remote Controls

Three remote control signals can be connected to the system and configured for the desired operating characteristics: mute all, dim, and input select. When remote mute all is activated the LED on the Model 79 associated with mute all 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 Remote Dim is activated the LED on the Model 79 associated with the dim function will flash. If dim was already active when remote dim is activated, the LED will change from being steadily lit to flashing.

When remote input select is activated, the LED on the Model 79 associated with the selected input will flash. If the function is set for exclusive, the other input LED will not be lit. If the function is set for non-exclusive, the LED associated with remote input select will flash, while the LED associated with any other active input will remain steadily lit.

## Technical Notes

### Bass Management Review and Configuration

While easy to install and use as configured at the factory, the Model 78 does provide a number of bass management parameters that can be used to “tune” an installation for optimum bass management performance. The default settings were selected to provide appropriate performance for many installations. But don’t be lulled into complacency by the fact that “out of the

box” the Model 78 may seemingly perform well in an application. It’s critical to review how the Model 78 functions within the scope of the entire monitoring system. A system will only meet its potential when all of the components work together to achieve a common goal.

**Warning:** mains power must be disconnected prior to performing any changes to the bass management parameters. Only a competent technician must perform this procedure!

## Basic Configuration

In this section the configuration of the main input’s high- and low-pass filters will be reviewed. Changes will be made if necessary to meet the needs of the monitor system. The bass management signals being routed to the subwoofer output will be reviewed. Again, changes will be made if required.

### Main Inputs High-Pass Filters

Each of the seven main input channels (L, R, C, SL, SR, BL, and BR) includes an independent high-pass filter section. These filter sections remove the audio-frequency content that is to be routed, by way of the low-pass filters, to the subwoofer output. The filter sections are implemented by means of operational amplifier high-pass filter circuits. The filter circuits have a slope of 12 dB/octave and are factory selected to have their –3 dB point at nominally 80 Hz. For flexibility, two jumper positions allow each filter to be inserted into, or removed from, the signal path. The two jumper positions are designated as 12 dB/octave and flat.

From the factory the 12 dB/octave jumper positions are selected, placing the high-pass filters into the signal paths. This choice is appropriate for many applications. One example is where the loudspeakers connected to the main output channels do not include any high pass filtering. Alternately, using the 12 dB/octave high pass filters would be appropriate when the loudspeakers do include 12 dB/octave filters and an overall 24 dB/octave response is desired. Many smaller amplified loudspeakers include such internal high-pass filters.

The flat position is provided for other situations. An example would be where the loudspeakers associated with the main channels already implement the desired low-frequency response curve. This could be due to the loudspeakers containing integral high-pass filters, or to the fact that the speaker's inherent low-frequency response naturally provides the desired frequency response. To review: In the flat position the full bandwidth of the signals entering the main inputs (L, R, C, SL, SR, BL, and BR) route directly to their respective output circuitry. No high-pass filtering is performed.

The key to correctly selecting either the 12 dB/octave or the flat setting is to first understand the needs of the entire monitoring system. It's important to maintain a smooth transition (crossover) between the main channel loudspeakers and the bass management audio signals being reproduced by the subwoofer. Only by studying the entire monitoring configuration can the correct selection be made. Personal taste and philosophy play a major role in decisions like these. Don't minimize the impact that a little planning can have on a loudspeaker system's performance.

## **Main Input Low-Pass Filters**

Each of the seven main input channels (L, R, C, SL, SR, BL and BR) includes an independent low-pass filter section. These filters separate the audio frequency content that will be routed to the second stage of low-pass filter and, if desired, directly to the subwoofer output. Each of the seven filter sections is implemented using an operational amplifier low-pass filter circuit. Each filter has a slope of 12 dB/octave and is factory selected to have its -3 dB point at nominally 80 Hz. One jumper position is provided to allow the output each filter to be routed to the second stage filter and subwoofer output. If bass management is not desired for certain input channels the appropriate jumpers can be removed.

## **Second Stage Low-Pass Filter and Subwoofer Routing**

The outputs of the low-pass filters associated with the seven main input channels are combined (summed), then routed to a second low-pass filter section as well as to a set of jumper positions. The three jumper positions allow the summed bass management signals to be routed as desired. In the 12 dB/octave position the combined signal from the main input low-pass filters are directly routed to the subwoofer output. In the 24 dB/octave jumper position the summed signals are routed through the second stage low-pass filter, and then routed to the subwoofer output. The third jumper position, labeled disable, prevents the summed bass management signals from being routed to the subwoofer output. Selecting the disable position would be appropriate in cases where the main channel loudspeakers have full-range capability. Note that in this case the seven main input channel high-pass filters should be set for flat.

## Bass Management— Advanced Configuration

In this section the configuration of the main input channel's high- and low-pass filter frequencies will be reviewed. In addition, the secondary low-pass filter frequency will be discussed. Changes to the filters can be made if necessary to meet the needs of the loudspeaker system.

### Main Input High-Pass Filters

As previously discussed, each of the seven main input channels (L, R, C, SL, SR, BL, and BR) has an independent high-pass filter section associated with it. Each filter section is created using a 2<sup>nd</sup>-order Sallen-Key circuit. Components were selected at the factory so that the filter section's output has a -3 dB point of nominally 80 Hz. (To be more precise, the math calculations work out to be 83 Hz.) For some applications it may be optimal to adjust this frequency. The Model 78 makes this a simple task with no soldering or complicated procedure required. Note that each of the seven high-pass filter sections can be independently configured. This is provided to meet "real world" monitoring environments. For example, it's quite reasonable that the L, C, and R channels utilize one high-pass filter frequency, while the SL, SR, BL, and BR channels use another.

The frequency of each filter section is configured by means of three resistors, each identical in value. A 6-position socket, located on the printed circuit board, is used to hold the resistors. As shipped from the factory, a 27 k (27,000) ohm 6-pin single-inline-package (SIP) resistor is used to configure the filters for nominally 80 Hz. To revise the frequency this can be replaced with a 6-pin SIP resistor, or three ¼-watt, 1%-tolerance resistors. Note that the SIP

resistor used in this application must be an isolated-terminal-type, providing three independent resistors in one assembly. As SIP resistors typically have a tolerance of 2%, using individual 1%-tolerance, rather than 5%-tolerance, resistors is recommended.

A simple formula is used determine the resistance required for a specific filter frequency:  $R = 2,251,000 \div F$ , where R is resistance in ohms and F is frequency in hertz. Figure 7 lists several frequencies that are provided by standard SIP resistors. Using ¼-watt, 1%-tolerance resistors will allow many other frequencies to be implemented.

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150 Hz: 15 k	68 Hz: 33 k
125 Hz: 18 k	58 Hz: 39 k
113 Hz: 20 k	48 Hz: 47 k
102 Hz: 22 k	40 Hz: 56 k
83 Hz: 27 k	33 Hz: 68 k

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**Figure 7. High-Pass Filters, Frequency versus SIP Resistor Value**

Once the new SIP or 1%-tolerance resistors have been procured, they should be double-checked. Use an ohmmeter to confirm that the resistance values are correct. If SIP resistors are being used, check to ensure that they are isolated-terminal-type. These simple checks should take only a short time and will insure that a change to the filters will achieve the desired audio performance.

The process required to actually change the components is simple, although a competent technician must perform the steps. Following the previously discussed safety procedures, mains power must be disconnected and the Model 78's cover removed. The factory-installed 27 k SIP resistors must be carefully removed by using a pair of needle-nosed pliers. The SIP resistors

should be lifted straight up out of their sockets. If SIP resistors are to be used to achieve the revised frequency, they can be directly inserted into the sockets. Pin 1 of the SIP resistors should correspond with pin 1 of the sockets. Pin 1 is clearly marked by means of a white dot on the printed circuit board.

If three 1%-tolerance resistors are to be used they must first be prepared for insertion. To begin, one lead of each of the resistors must be folded over (carefully bent 180 degrees) so that it becomes parallel with the other. Then both leads must be trimmed (cut) so that they extend out from the body of the resistor by about ¼ inch (6 mm). Once this has been completed the resistors can be inserted into the sockets, with three going into each. The first resistor is inserted into socket pins 1 and 2, the second into pins 3 and 4, and the third into pins 5 and 6. After the resistors are inserted, ensure that they are positioned so that they stand straight up, safely away from other components.

### Main Input Low-Pass Filters

Each of the seven main input channels (L, R, C, SL, SR, BL, and BR) also has individual low-pass filter sections associated with them. Components were selected at the factory so that the filter section's output has a -3 dB point of nominally 80 Hz. (The actual calculations work out to be 82 Hz.) As with the high-pass filter sections, each of the seven low-pass filters can be configured independently. As the previous example noted, it's quite reasonable that the L, C, and R channels utilize one frequency while the other channels use another. It's also reasonable that each input channel's low-pass frequency be configured differently from its associated

high-pass filter frequency. Using asymmetrical filter settings can be very effective in achieving the desired loudspeaker system performance.

The frequency of each low-pass filter section is configured by means of two ¼-watt, 1%-tolerance resistors, each identical in value. One 6-pin socket, located on the printed circuit board, is used to hold the resistors. From the factory, two 13.7 k (13,700) ohm resistors are used to configure the filters for nominally 80 Hz. To revise the frequency, these can be replaced with two other resistors, or a 6-pin isolated SIP resistor.

A simple formula is used determine the resistance required for a specific filter frequency:  $R = 1,125,400 \div F$ , where R is resistance in ohms and F is frequency in hertz. Figure 8 lists several frequencies that are created using 1%-tolerance and SIP resistors. As may be evident, the frequencies were selected to roughly match the high-pass filter frequencies shown in Figure 7.

The process required to actually change the resistors is basically the same as with the high-pass filter sections. The two factory-installed 13.7 k resistors should be carefully removed by using a pair of needle-nose pliers. If two individual resistors are to be used, they must be prepared for insertion. The first resistor is inserted into socket pins 1 and 2, the second into pins 3 and 4. After the resistors are inserted, ensure that they are positioned so that they stand straight up, safely away from other components.

---

150 Hz:	7.50 k	68 Hz:	16.5 k
124 Hz:	9.09 k	57 Hz:	19.6 k
113 Hz:	10.0 k	48 Hz:	23.7 k
102 Hz:	11.0 k	40 Hz:	28.0 k
82 Hz:	13.7 k	33 Hz:	34.0 k

---

**Figure 8. Low-Pass Filters, Frequency versus 1%-Tolerance Resistor Value**

## Second Stage Low-Pass Filter

After the outputs of the individual low-pass filters associated with the seven main input channels (L, R, C, SL, SR, BL, and BR) are combined (summed), the result is routed to a second low-pass filter section. Its  $-3$  dB point is also nominally 80 Hz. The frequency of this filter can be adjusted using the same formula and techniques covered for the low-pass filters associated with the main input channels. Note that changing this frequency would impact the low-pass characteristic of all the main input channels whose signals have been selected bass management. Careful planning is critical to reaching the desired loudspeaker system performance. Be especially cautious should the main input channel's low-pass filters be configured for more than one  $-3$  dB frequency. In this case it may be better to configure the system to not use the second stage low-pass filter.

## LFE Input Low-Pass Filter

A low-pass filter is associated with the LFE input channel. This 48 dB/octave filter can be inserted into the LFE signal path to simulate the bandwidth restrictions applied by some digital audio distribution formats. The low-pass filter section is made up of four 2<sup>nd</sup>-order Sallen-Key circuits that are cascaded, i.e. connected in series. Components were selected at the factory so that the filter section's output has its  $-6$  dB point at nominally 120 Hz. For some applications it may be desirable to revise the filter's cutoff frequency. For example, it's possible that the  $-6$  dB point may need to be configured for 80 Hz to match a future LFE encoding parameter.

As received from the factory two 8-pin SIP resistor packages are used to implement the 120 Hz frequency. Two 8-pin sockets,

located on the printed circuit board, are used to hold the resistors. To achieve the 120 Hz frequency requires two SIP different resistance values. An 8-pin 6.8 k SIP is "shared" by the first two filters, while an 8.2 k SIP is used by the third and fourth. For simplicity, eight  $\frac{1}{4}$ -watt, 1%-tolerance resistors of identical value should be used to implement any revised frequency.

The formula used to determine the resistance required for a specific filter frequency is:  $R = 900,000 \div F$ , where R is resistance in ohms and F is frequency in hertz. As an example, to revise the low-pass filter for 80 Hz eight 11.3 k (11,300) ohm resistors should be used.

The process required to actually change the resistors is basically the same as with the main channel's high- and low-pass sections. The two factory-installed SIP package resistors should be carefully removed by using a pair of needle-nosed pliers. The eight individual 1%-tolerance resistors must be prepared for insertion. The first resistor is inserted into socket pins 1 and 2, the second into pins 3 and 4, etc. After all the resistors are inserted, ensure that they are positioned so that they stand straight up, safely away from other components.

## Monitor Output Audio Path Anomaly

To control the monitor output level, the Model 78 uses four digitally controlled stereo level control integrated circuits. These chips, PGA2310 from Burr-Brown/Texas Instruments, have many nice performance characteristics. They exhibit a wide dynamic range, low noise, and zero-crossing switching. Unfortunately, they do exhibit one minor issue that is worth mentioning. When changing the output level between  $-31.5$  and  $-32.0$  dB, or vice versa, it's

possible for a slight “tick” to be heard in the monitor output channels. This is due to the ‘2310 changing gain circuitry at this point in its 127.5 dB level range. This audio anomaly should pose absolutely no problem during operation. Virtually any audio signal present will mask this slight imperfection. Other than this small issue, the sonic quality of the ‘2310 is excellent—otherwise it would not have been selected for the Model 78!

## Downmix Formulas

The following provides a summary of the action performed when the downmix modes are active. Signals at unity gain unless noted. 0.707 = -3 dB; -0.707 = -3 dB with polarity reverse; 1.414 = +3 dB.

Downmix 5.1 (7.1 to 5.1)

SL = SL + BL

SR = SR + BR

BL and BR mute

Downmix LCRS (7.1 to LCRS)

SL = 0.707(SL + SR + BL + BR)

SR = 0.707(SL + SR + BL + BR)

BL, BR, and LFE mute

Downmix Stereo (7.1 to Stereo)

Configured for Mode 1

L = L + 0.707C + -0.707(SL + SR + BL + BR)

R = R + 0.707C + 0.707(SL + SR + BL + BR)

C, SL, SR, BL, BR, and LFE mute

Configured for Mode 2

L = L + 0.707C + 0.707(SL + SR + BL + BR)

R = R + 0.707C + 0.707(SL + SR + BL + BR)

C, SL, SR, BL, BR, and LFE mute

Downmix Mono (7.1 to Mono)

Configured for Mode 1

C = L + R + 1.414C

L, R, SL, SR, BL, BR, and LFE mute

Configured for Mode 2

C = L + R + 1.414C + 0.707(SL + SR + BL + BR)

L, R, SL, SR, BL, BR, and LFE mute

## Definition of Level—dBu and dBV

Whenever possible, Studio Technologies has opted to use the dBu designation as it seems to be quite rational. Using dBm was fine when all audio line outputs were terminated with 600 ohm loads. In this way it was easy to say that 0 dBm is 1 milliwatt dissipated in the known load (i.e., 0 dBm across 600 ohms will measure 0.775 V). In contemporary situations an output is rarely terminated with 600 ohms; generally 10 k ohms or higher. The dBu designation is better because it refers to dB referenced to 0.775 V, with no reference to load impedance. This takes into account today’s audio scene where signals have a low source impedance, and a high input impedance. The dBu designation is becoming the standard for the professional audio industry.

The Model 78 is designed to interface with audio signals that have nominal signal levels of -12 dBV to +6 dBu. You might wonder why “dBV” came into the picture. Most people don’t realize that equipment that utilizes “-10” levels usually mean -10 dBV—substantially different from -10 dBu (-10 dBV = -7.78 dBu). The dBV designation is simply a different way of measuring signal level and is often used when dealing with portable or consumer

audio equipment. The dBV designation refers to dB referenced to 1.0 V, rather than dBu which refers to 0.775 V.

## “Hot” Disconnection of the Model 79 Control Console

Should you need to relocate the Model 79 while your StudioComm system is operating, there is no reason why you can't disconnect the cable, move the unit, and then connect it again. If the Model 79 is disconnected while it is operating, the current operating parameters are saved in non-volatile memory and the Model 78 Central Controller will continue to operate as before the connection was broken. No clicks, pops, or other noises will occur when the Model 79 is again connected. The Model 79 will go through its standard power-up sequence, send a message to reset power-up defaults, then send the operating parameters as stored in its memory.

## Monitor Output Transient Protection

The Model 78 Central Controller contains a power up/power down transient protection feature. This limits the chance of damage to the monitor loudspeakers during the time when AC mains voltage is connected, disconnected, or has changed significantly from nominal. A combination of hardware and software is used to monitor one of the power supply “rails.” Until the AC mains input exceeds approximately 69% of its nominal voltage, electromechanical relays maintain a short circuit condition on the monitor outputs. After a short delay the relays are allowed to function normally. Whenever the AC mains input drops below approximately 67% of its nominal voltage, the relays immediately go to their mute

state. During testing it was found that upon power up the monitor outputs remained very quiet; during power down a moderate “tick” was the worst that was heard.

## Model 78 to Model 79 Connections

Figure 9 gives a detailed view of the signals that connect between the Model 78 Central Controller and the Model 79 Control Console. The Model 78 provides +15 Vdc power for the Model 79. The Model 79 generates MIDI system-exclusive messages and sends them to the Model 78. From the outside world, the remote control input sources connect to the Model 78. They then route, via the interface cable, from the Model 78 to the actual input circuitry, located in the Model 79.

---

Pin	Signal	Direction
1	Power Supply Common	78 to/from 79
2	+15 Vdc	78 to 79
3	Data (MIDI System-Exclusive)	79 to 78
4	Data Common	79 to/from 78
5	Remote Mute All	78 to 79 (Note 2)
6	Remote Dim	78 to 79 (Note 2)
7	Remote Input Select	78 to 79 (Note 2)
9	Remote Control Common	78 to/from 79

Notes: 1) Connector types on Model 78 and Model 79 are 9-pin D-subminiature female. Connectors use 4-40 threaded inserts for locking with mating plug.

2) Remote control sources connect to D-sub on Model 78, then passively route to Model 79 via 78/79 interface D-sub.

---

**Figure 9. Connections between Model 78 and Model 79**

# Specifications

## Model 78 Central Controller

### General Audio:

**Frequency Response:** 20 Hz-20 kHz  $\pm 0.2$  dB (down 0.5 dB @ 80 kHz), monitor outputs

**Distortion (THD+N):** 0.004%, measured at 1 kHz, +4 dBu, monitor outputs

**S/N Ratio:** 90 dB, ref +4 dBu out, 20 Hz-20 kHz, monitor outputs

**Crosstalk:** 80 dB, typical, ref +4 dBu in, 20 Hz-20 kHz, monitor outputs

**Audio Inputs:** 16, organized as two 8-channel "7.1" inputs

**Type:** electronically balanced, compatible with balanced or unbalanced sources

**Impedance:** 24 k ohms

**Nominal Level:**  $-12$  dBV to +6 dBu, adjustable

**Level Calibration:** 15-turn trim potentiometers

**Monitor Outputs:** 1, 8-channel "7.1"

**Type:** electronically balanced, compatible with balanced or unbalanced loads

**Maximum Level:** +27 dBu into 10 k ohms, +26 dBu into 600 ohms

### Bass Management—General:

Provides 12 dB/octave high-pass filtering for main input channels (L, R, C, SL, SR, BL, BR). Factory configured for  $-3$  dB @ 80 Hz, nominal.

Provides 12 or 24 dB/octave low-pass filtering for main input channels. Factory configured for  $-3$  dB @ 80 Hz, nominal, 24 dB/octave.

Bass management can be field disabled.

### Main Input Channel High-Pass Filters: 7

**Type:** 2<sup>nd</sup> order Sallen-Key; factory configured for 12 dB/octave; field configurable for flat or 12 dB/octave response

**Response:**  $-3$  dB @ 80 Hz, nominal, 12 dB/octave; field configurable

### Main Input Channel Low-Pass Filters: 7

**Type:** 2<sup>nd</sup> order Sallen-Key; 12 dB/octave; field configurable for disabled or 12 dB/octave response

**Response:**  $-3$  dB @ 80 Hz, nominal, 12 dB/octave; field configurable

### Secondary Input Channel Low-Pass Filter:

**Type:** 2<sup>nd</sup> order Sallen-Key; 12 dB/octave

**Response:**  $-3$  dB @ 80 Hz, nominal, 12 dB/octave; field configurable

### LFE Input Channel to Subwoofer Output:

**Overall Gain:** 0 or +10 dB, nominal, switch selectable

### LFE Input Channel Low-Pass Filter:

**Type:** four cascaded 2<sup>nd</sup> order Sallen-Key sections; 48 dB/octave (8th order)

**Response:**  $-6$  dB @ 120 Hz, nominal, field configurable

**Operation:** switch selectable, on/off

### Connectors:

**Audio:** 3, 25-pin D-subminiature female

**Control:** 2, 9-pin D-subminiature female

**AC Mains:** 3-blade IEC-type

### Remote Control Inputs: 3

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

**AC Mains Requirement:** 100, 120, or 220/240 V,  $\pm 10\%$ , factory configured, 50/60 Hz, 30 VA

### Dimensions (Overall):

19.00 inches wide (48.3 cm)

1.72 inches high (4.4 cm)

9.58 inches deep (24.3 cm)

**Mounting:** one space in a standard 19-inch rack

**Weight:** 9.5 pounds (4.3 kg)

## Model 79 Control Console

**Application:** supports Model 78 Central Controller

**Power:** provided by Model 78 Central Controller

**Output Data:** generates MIDI system-exclusive messages

**Connector:** 1, 9-pin D-subminiature female

**Dimensions (Overall):**

7.2 inches wide (18.3 cm)

2.2 inches high (5.6 cm)

5.4 inches deep (13.7 cm)

**Weight:** 1.9 pounds (0.9 kg)



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## Appendix A

### Controlling the Model 78

The Model 78 Central Controller uses MIDI system-exclusive messages to control all functions. The Model 79 Control Console is programmed to generate a subset of what the Model 78 is capable of doing. By using standard MIDI messages, the Model 78 can be used for a wide range of special applications. Any device that can be programmed to send system-exclusive MIDI messages can be used to control the Model 78.

#### General Notes:

All MIDI messages to be acted upon are system-exclusive type (F0H). No channel mode, system common, or system real time messages are utilized.

Studio Technologies, Inc. manufacturer's ID number is 00H 00H 56H.

The Model 78's product device ID number is 06H.

### Function: Reset to Power Up Default Configuration

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	00H	Function, Reset to Power Up Default Configuration
7	F7H	EOX, End of System-Exclusive Message

**Notes:** Action taken after message is received:

Set all channels on both inputs to off

Set output relays to off

Set output level to minimum (all 0s which is mute)

Set downmix to off

Set LFE +10 dB mode on both inputs to off

Set LFE low-pass filter to off (flat), low-pass filter not enabled

### Function: Input Source, Associated Channels, and LFE +10 dB

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	01H	Function, Input Source and Associated Channels
7	0nH	Input Source, range 1-2: 1=Input A 2=Input B
8	nnH	Input Channel Status Bit Map (sum values from all seven channels): Channel L: off=00; on=01 Channel R: off=00; on=02 Channel C: off=00; on=04 Channel LFE: off=00; on=08 Channel SL: off=00; on=10 Channel SR: off=00; on=20 Channel BL: off=00; on=40
9	0nH	Input Channel Status Channel BR: off=0; on=1
10	0nH	LFE +10 dB, Range 0-1: 0=LFE +10 dB Off 1=LFE +10 dB On
11	F7H	EOX, End of System-Exclusive Message

### Function: Output Channel Relay Status

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	02H	Function, Output Channel Relay Status
7	nnH	Output Channel Relay Status Bit Map (sum values from all seven channels): Channel L: off=00; on=01 Channel R: off=00; on=02 Channel C: off=00; on=04 Channel SUB: off=00; on=08 Channel SL: off=00; on=10 Channel SR: off=00; on=20 Channel BL: off=00; on=40
8	0nH	Output Channel Relay Status Channel BR: off=0; on=1
9	F7H	EOX, End of System-Exclusive Message

## Function: Output Level

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	03H	Function, Output Level
7	nnH	Channel L, Output Level, MSB, range 00-7F
8	0nH	Channel L, Output Level, LSB, range 0-1
9	nnH	Channel R, Output Level, MSB, range 00-7F
10	0nH	Channel R, Output Level, LSB, range 0-1
11	nnH	Channel C, Output Level, MSB, range 00-7F
12	0nH	Channel C, Output Level, LSB, range 0-1
13	nnH	Channel SUB, Output Level, MSB, range 00-7F
14	0nH	Channel SUB, Output Level, LSB, range 0-1
15	nnH	Channel SL, Output Level, MSB, range 00-7F
16	0nH	Channel SL, Output Level, LSB, range 0-1
17	nnH	Channel SR, Output Level, MSB, range 00-7F
18	0nH	Channel SR, Output Level, LSB, range 0-1
19	nnH	Channel BL, Output Level, MSB, range 00-7F
20	0nH	Channel BL, Output Level, LSB, range 0-1
21	nnH	Channel BR, Output Level, MSB, range 00-7F
22	0nH	Channel BR, Output Level, LSB, range 0-1
23	F7H	EOX, End of System-Exclusive Message

**Notes:** Output level is 8-bit precision, spread over two MIDI bytes: 00H 00H lowest; 7FH 01H highest.

Control Console sends new values each time output level is changed.

Dim function is performed by control console and is sent using output level command.

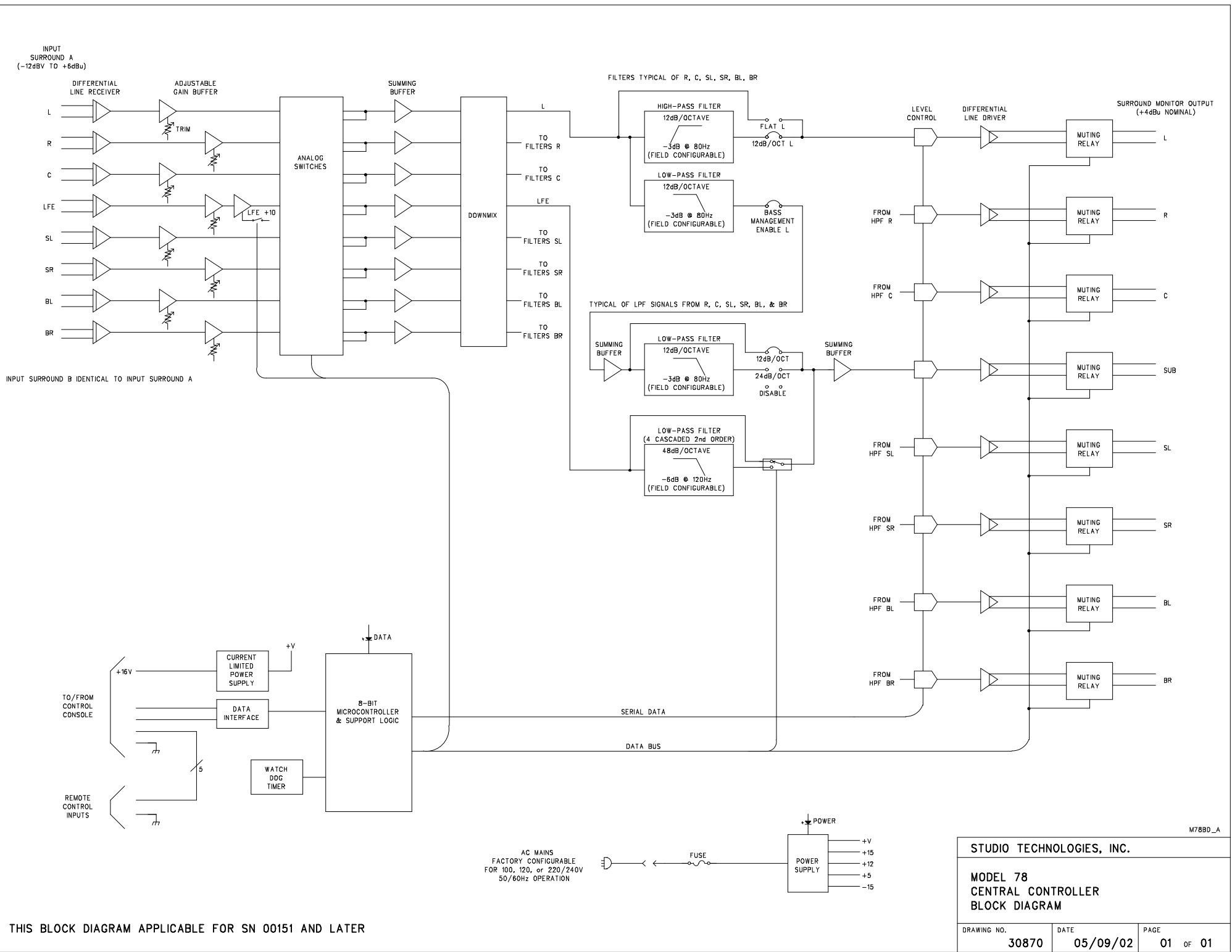
### Function: Downmix Mode

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	04H	Function, Downmix Mode
7	0nH	Downmix Mode, Range 0-6: 0=Downmix Off (Normal Operation) 1=Downmix 5.1 On 2=Downmix LCRS On 3=Downmix Stereo On, Mode 1 4=Downmix Stereo On, Mode 2 5=Downmix Mono On, Mode 1 6=Downmix Mono On, Mode 2
8	F7H	EOX, End of System-Exclusive Message

**Function: LFE Low-Pass Filter**

Byte	Value	Description
1	F0H	System-Exclusive Message
2	00H	1 <sup>st</sup> Byte of Studio Tech ID
3	00H	2 <sup>nd</sup> Byte of Studio Tech ID
4	56H	3 <sup>rd</sup> Byte of Studio Tech ID
5	06H	Product ID (Model 78)
6	05H	Function, LFE Low-Pass Filter
7	0nH	LFE Low-Pass Filter, Range 0-1: 0=Flat (low-pass filter not enabled) 1=Low-pass filter enabled
8	F7H	EOX, End of System-Exclusive Message

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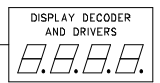
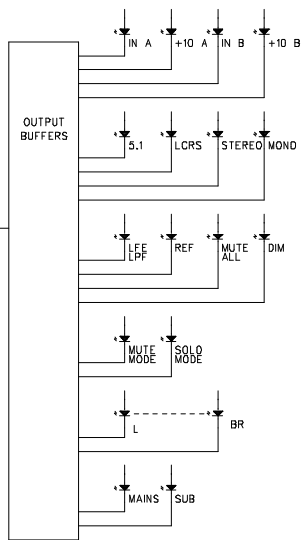
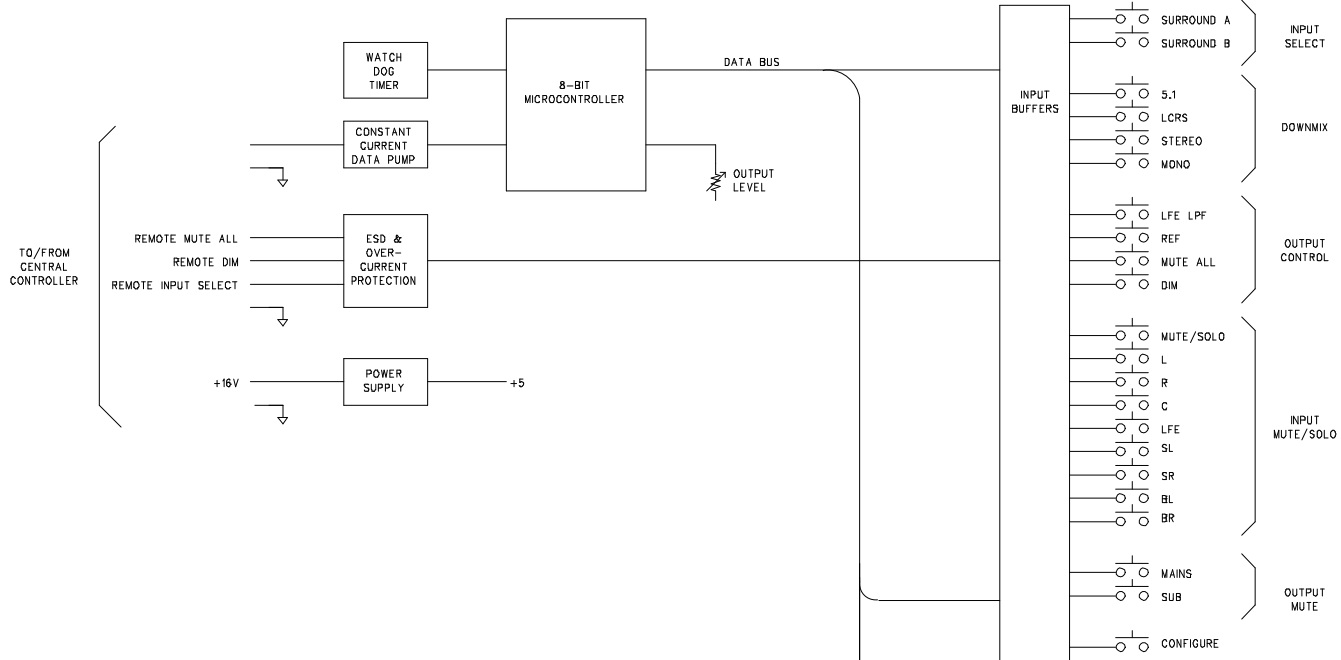
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