Model 240

Producer's Console

User Guide

Issue 2, June 2016

This User Guide is applicable for serial numbers:
M240-00151 and later with application firmware 2.1 and higher

www.studio-tech.com

50353-0616, Issue 2

This page intentionally left blank.

Table of Contents

Revision History

Issue 2, June 2016:

1. Documents firmware identification feature (added to application firmware version 2.1).

Issue 1, August 2013:

1. Initial release.

Introduction

What This User Guide Covers

This User Guide is designed to assist you when installing, configuring, and using Model 240 Producer's Consoles with serial numbers of 00151 and later. Additional background technical information is also provided. A product block diagram is included at the end of this guide.

System Overview

The Model 240 Producer's Console is designed for producers, directors, or those who need to efficiently communicate with on-air broadcast personnel and related production crew. The unit provides the resources of a 4-channel talent cueing ("IFB") central controller combined with a 2-channel party-line (PL) intercom user station. Incorporating numerous configurable features and extensive upgrade flexibility, the Model 240 can meet the exacting demands of this important and highly specialized field. Compatible with broadcast and production audio and intercom system environments, the tabletop unit is well suited for applications including sports and entertainment television programming, radio and TV news, and corporate events. While the Model 240 is sophisticated on the inside, users are presented with a simple-to-use, great sounding "tool" to help them do their job better.

Four pushbutton switches control the routing of microphone audio to the four main outputs and, if selected, the 2-channel PL intercom interface. Each button can be configured for push-to-talk or alternate-action operation. A status LED is located above each button and provides a clear indication of talk status. Two line inputs allow a variety of audio sources to be connected. They can be used as program audio for the four main outputs or routed to the 2-channel headphone output.

Figure 1. Model 240 front panel

Figure 2. Model 240 back panel

System Features

Headset for Microphone and Phones

A 5-pin XLR connector is provided for connection of a broadcast-style headset. The selected headset should contain a dynamic microphone and a single or dual earpiece. While not directly intended for on-air applications, the microphone preamplifier is excellent, providing low-noise, low-distortion, and high headroom performance. For optimal sound quality the gain of the mic preamp can be configured from among five choices. A sophisticated audio compressor circuit follows the microphone preamplifier to minimize the chance of signal overload. The headphone output features low-noise circuitry with plenty of all-important headroom. Many parameters associated with the headphone output can be configured to meet user requirements.

Main Outputs

Four main outputs are provided which can be independently configured to meet the specific needs of broadcast and production applications. They can be, at their most basic, considered talkback channels that, under pushbutton control, contain the signal from the connected headset's microphone. When an additional audio source is selected for use by a main output a composite program/interrupt talent cueing signal is created. Each main output provides a line-level signal that's transformer and capacitor coupled for superior compatibility and reliability. Resistors in series with the output signals allow passive mixing of multiple main output channels. And not to be ignored is the audio quality: clean, quiet, and "click free."

Intercom Interface

The intercom interface is compatible with single- and dual-channel party-line (PL) intercom circuits commonly found in broadcast, production, and industrial applications. Direct connections with PL circuits associated with RTS™ TW and Clear-Com® intercom systems is assured. The Model 240 can be configured to serve in a listen-only mode where PL intercom receive audio is routed to the headphone output. Main outputs 3 and 4 can also be independently selected to send talk audio to the intercom circuit. The latter makes the Model 240 function as a full 2-channel intercom user station. The intercom circuit can also provide the power required by the Model 240.

Line-Level Audio Inputs

Two line-level audio inputs allow the connection of a variety of cue signals. The inputs are capacitor and transformer coupled, ensuring consistent and reliable interfacing with almost any audio source found in the field. Two trim potentiometers allow adjustment of the input signal level. The two line inputs can be configured for use with the four main outputs as well as with the headphone output. The four main outputs can be independently configured to use this "program" audio to create talent cue signals. While line input 1 is always assigned to main outputs 1 and 3, the choice of line input 1 or line input 2 is independently assignable to main outputs 2 and 4. Each main output can then be configured for how it uses its associated program audio source. They can be set to have no program audio, continuous program audio that combines with talk audio, program audio that's fully muted when talk is active, or program audio that's "dimmed" (attenuated by 15 dB) when talk is active. In this way four independent "dry" (non-powered) talent cue (IFB) channels can be easily created.

Headphone Output

A 2-channel (stereo) headphone output is provided for monitoring program or intercom audio signals. Physically the headphone output connections are part of the 5-pin XLR headset connector located on the Model 240's back panel. Each headphone output channel can be independently configured to monitor the two line-level inputs or the two intercom interface channels. Two rotary controls allow the user to independently adjust the level of the left and right headphones output channels. A configuration setting allows the headphone output to be placed in monaural mode, mixing the signals selected for the left and right channels. This can be useful when single earpiece ("single-muff") headsets or in-ear transducers are used. A sidetone function is also available, allowing audio from the microphone input to be routed to the left and/or right headphone channels. A separate rotary control is provided for the user to adjust the sidetone level.

Provision has also been made to allow two additional line-level audio sources to be connected and routed to the headphone output channels. Using optional line input cards mounted in the back panel openings of the Model 240, functions such as announcer/commentator pre-fader listen can be implemented.

There may be applications where connecting monitor loudspeakers, rather than a headset or headphones, would be beneficial. This can be easily implemented by installing one or two optional line output cards. A configuration feature allows the headphone output level to be reduced ("dimmed") whenever a talk function is active. This will minimize the chance that acoustical interference and possible feedback will take place between the loudspeakers and the connected microphone.

Relay Contacts

Five normally open (not shorted) solid-state relay contacts are provided as "tally" signals for application-specific use. Four of the contacts are associated with the four talk functions, closing (shorting) whenever a pushbutton switch and associated main output function is active. They can prove useful in applications such as enabling a call light or activating a wireless transmitter. The fifth contact offers a special function, closing (shorting) whenever any of the

talk functions are active. This is specifically provided as a "trigger" to mute loudspeaker systems that are located in the same physical area as the Model 240.

Signal Flow

This document can only highlight some of the Model 240's capabilities. For a detailed view of the unit's signal flow it's recommended that the block diagram, located at the end of this guide, be reviewed.

Rugged, Flexible, Reliable

The Model 240 uses a rugged desktop enclosure with a removable security plate on the bottom that provides access to the many configuration switches and trim pots. (The unit does not have to be disassembled to be configured!) Laser-engraved on the plate is a complete set of configuration information so that field setup can be fast and accurate. Four openings in back of the Model 240's enclosure allow installation of a variety of option modules. These allow a range of additional features and resources to be easily added for a myriad of potential applications. Numerous 3-pin header connectors are provided on the Model 240's printed circuit board assembly. These provide access to all audio inputs and outputs, along with many special input and output signals. These include four contact inputs associated with the four pushbutton switches. A competent technician can use them to create a highly-customized feature set for meeting the exact needs of specific applications.

The four pushbutton switches associated with the talk functions use gold-plated contacts for reliable long-term operation and include backlighting using white LEDs. A data link allows two Model 240 units to be interconnected as an integrated 2-location system. The status of the talk channels is communicated via the data link; combining of the main output audio signals is done passively. The Model 240 can be powered by an external source of 24 volts DC. Alternately, a connected party-line intercom circuit can provide the required power.

Installation and Setup

In this section interconnections will be made using the input and output connectors located on the Model 240's back panel. The main outputs, line inputs, and party-line (PL) intercom signals are interfaced by way of 3-pin XLR connectors. A headset is connected using a 5-pin XLR connector. A 2.1 x 5.5 mm coaxial jack allows connection of an external 24 volt DC power source.

System Components

The following is included in the shipping carton: Model 240 Producer's Console, Model 240 User Guide, button label sheet, and 24 volt DC power supply.

Headset Connection

The Model 240 is compatible with headsets that have a dynamic microphone and single- or dual-earpieces. These are commonly referred to as single- or dual-muff headsets. The microphone portion of compatible broadcast-quality headsets will typically have a source impedance of 200-300 ohms. The impedance of the earpieces can range more widely. Connecting devices with earpiece impedance of 100 ohms or greater is preferred. Some common devices have an earpiece impedance of 50 ohms and while not optimal they should also function correctly.

The quality of the Model 240's microphone preamplifier and associated circuitry is such that special applications may benefit from using "high-end" headsets. If selected appropriately, models from manufacturers such as AKG, beyerdynamic, or Audio Technica will perform very well.

Headset interconnection is made by way of a 5-pin female XLR connector which is located on the Model 240's back panel. The mating connector (male) should be wired following the details provided in Figure 3.

Pin Number	Function
1	Mic low (–)
2	Mic high (+)
3	Mic Shield/Headphone Output Common
4	Headphone Output Left Channel
5	Headphone Output Right Channel

Figure 3. Headset connections (5-pin male XLR)

It's recommended that a headset with a balanced microphone be used. But it's also possible that a headset that incorporates an unbalanced microphone could work correctly. In the latter case wire the mating connector (male) with pin 2 as signal high (+) and pin 1 as signal common/shield.

A potential crosstalk issue comes from the fact that pin 3 of the 5-pin XLR serves as both the microphone connection's shield and the common lead for the left and right headphone output. This allows headphone audio current that's flowing through the common lead to induce signal into the microphone input. While the microphone input circuity's common-mode rejection capability will limit the impact, the current can reach a "critical" amount causing induced noise. Typically this won't happen during normal operation but it's possible. But whit a common path nothing can be done to guarantee that this condition will never occur. Installing separate microphone input and headphone output connectors in the spare connector openings in the Model 240's back panel can go a long way toward minimizing this issue. The Technical Notes section of the guide offers additional details on this subject.

When an appropriate interface cable is fabricated the microphone input portion of the headset connector is also compatible with line-level audio sources. This allows the output of an intercom user station, wireless microphone receiver, or audio console to be directly connected. When the microphone preamplifier gain configuration DIP switches are set for 0 dB (no gain) the nominal level of a connected line-level source should be approximately –2 dBu.

Wiring options would also allow connection of a separate microphone and pair of headphones. This can be accomplished by creating an external "break out" cable that wires a 5-pin male XLR to separate 3-pin female XLR and 3-conductor ¼-inch phone jacks.

The Model 240 does not provide microphone "phantom" power. This is not due to a technical limitation or oversight but rather reflects a design decision; the intended applications won't typically require phantom. The Model 240 is also not compatible with headsets that include an unbalanced "electret"-type microphone that requires a source of low-voltage DC for operation. These microphones, sometimes found in low-cost headset models, are not generally suitable for professional applications.

Main Outputs

The four main outputs are intended to be connected to listen-only beltpacks, inputs on wireless monitor transmitters, audio-to-

powered-IFB interfaces, or other locations where cue signals are required. The outputs are transformer balanced with a nominal level of 0 dBu. To enhance talk audio quality, a compressor circuit controls the dynamic range of the signal coming from the Model 240's microphone preamplifier.

For protection against accidental connection to cables that have DC power present, the main outputs are, in addition to being transformer-isolated, capacitor coupled. Also in series with the main output leads are 300 ohm resistors, making the effective output impedance approximately 600 ohms. These resistors create a passive summing network, allowing main outputs on multiple Model 240 units to be connected ("bridged") together.

The main outputs are connected by way of four 3-pin male XLR connectors which are located on the Model 240's back panel. Prepare the mating connectors (females) so that pin 2 is signal high (+) and pin 3 is signal low (–). Each cable's shield can be connected to pin 1. But in order to minimize the chance that ground-interaction problems will arise, pin 1 on each of the main output connectors is isolated from the Model 240's chassis and circuitry. By making pin 1 "float," the chance of often-feared "ground loop" problems should be minimized. Note that the metal shell of the mating connector must also be "floating."

The main outputs are intended to drive the lengthy cable runs that are often part of broadcast and production audio applications. While the output circuitry is not intended to be "on-air" quality, overall audio performance should be very good. Devices connected to the main outputs can range from amplified loudspeakers, analog inputs on intercom systems, inputs on in-ear monitor system transmitters, and input channels associated with audio consoles.

As previously mentioned, the main outputs on multiple Model 240 units can be directly connected together. Using a simple "Y" or "W" cable, this passive summing (adding together or "bridging") of signals allows one audio cable to serve as a composite output path. A side effect from using this passive summing technique is that signal attenuation will occur. The audio quality won't suffer, but an audio "pad" is created. If two main outputs are connected together, a signal attenuation of 6 dB can be expected. Connecting three main outputs together will result in 9.5 dB of attenuation. And four main outputs "multed" together will lead to 12 dB of attenuation. In most cases this attenuation won't pose a problem. Typically a device that receives the signal, such as an amplified loudspeaker, will have an adjustable input sensitivity so this attenuation won't prove to be a problem.

Line Inputs

The Model 240 allows two line-level audio sources to be connected. These sources can be individually routed to the four main outputs as well as the headphone output channels. The inputs are balanced, transformer-coupled with a nominal impedance of 10 k ohms. Capacitors, in series with the transformer's input leads, prevent a DC voltage present on the source from impacting performance. The line inputs are compatible with signals that have a nominal level of –10 to +6 dBu. Two trim potentiometers, located on the bottom of the Model 240's enclosure, allow signals over this wide nominal level range to be effectively utilized.

Audio sources are connected to the line inputs by way of 3-pin female XLR connectors which are located on the unit's back panel. Prepare the mating connectors (males) so that pin 2 is signal high (+), pin 3 is low (–), and pin 1 is shield. If connecting a source in this manner results in hum or noise, it's possible that removing the shield connection from pin 1 can eliminate the issue. With an unbalanced source connect pin 2 to signal high (+) and both pins 1 and 3 to shield. If connecting an unbalanced source in this manner results in hum or noise, try connecting pin 2 to high (+) and pin 3 to shield; leave pin 1 unterminated.

Intercom Interface

The Model 240's intercom interface is designed to directly connect with standard single- and dual-channel party-line (PL) intercom circuits. The one or two audio signals provided by the intercom circuit can serve as audio sources for the headphone outputs. Each signal can be individually assigned to the left channel, the right channel, or both the left and right channels. The Model 240 can also be configured to send main output channel 3 and channel 4 audio to the intercom channels. In addition, the intercom circuit can provide the DC power required to operate the Model 240's circuitry.

An intercom circuit is connected to the Model 240 by way of a 3-pin female XLR connector which is located on the back panel. The mating connector (male) should be wired so that common is on pin 1, DC with channel 1 audio is on pin 2, and channel 2 audio is on pin 3. With single-channel intercom circuits common is on pin 1, DC power is on pin 2, and audio is connected to pin 3.

The Model 240's intercom interface is directly compatible with broadcast and production party-line intercom circuits associated with systems from manufacturers such as RTS and Clear-Com. Intercom circuits associated with other similar systems should be equally compatible. RTS TW-series systems are normally interfaced using 3-pin XLR connectors. These connectors are wired with common on pin 1, DC power and channel 1 audio on pin 2, and channel 2 audio on pin 3. Most Clear-Com party-line systems are single-channel with common on pin 1, DC power on pin 2, and audio on pin 3.

The DC power supplied by the connected intercom circuit is generally sufficient to operate the Model 240's circuitry. The acceptable input range is 24 to 32 volts, with a required current of 150 milliamperes. Note that the specified input voltage is given when measured directly at the Model 240's intercom input connector (with the connector terminated on the Model 240) and not at the source of the intercom circuit's power.

Multi-Unit Interconnection

Two Model 240 units can be interconnected so as to function together. Audio signals on multiple main output channels are combined passively; there is no internal digital or analog busing created. (This is "old school" but works well!) Interconnecting cables would be prepared so that the pins on two 3-pin female XLR connectors would be connected 1-to-1, 2-to-2, and 3-to-3 and the combination routed to the input on the destination device. The Model 240's main output circuitry is designed to be passively combined so there is no risk of damage by doing this. The audio level on both units will drop approximately 6 dB due to the passive combining.

Line inputs that are going to be assigned as main output sources should be connected only on the Model 240 being designated as the primary unit. Otherwise signals will "clash" on the combined main audio outputs. An intercom circuit would have to be connected to both Model 240 units, and configured identically, for correct operation to take place.

An RS-485 data bus links the microcontroller integrated circuits on the two units and conveys button status information. Only one pair of wires for the data bus is required. An installer-provided connector is necessary. Please refer to the Technical Notes section of this guide for connection details.

External Power Input

An external source of 24 volt DC power can be connected to the Model 240 by way of a 2.1 x 5.5 mm coaxial power jack which is located on the back panel of the unit. The center pin of the jack is the positive (+) connection. While the requirement for the external source is nominally 24 volts, correct operation will take place over a 20 to 30 volt range. The Model 240 requires 125 milliamperes at 24 volts DC for correct operation. Included with each Model 240 is a 24 volt DC external power supply. The power supply's DC output cable has been terminated with a Switchcraft® S760K coaxial power plug. This "locking" type of plug correctly mates with the Model 240's 24 Vdc input jack. The locking feature is important, allowing the external power source to be securely attached to the Model 240.

As previously discussed in this guide, an intercom circuit connected to the Model 240 can serve as the unit's power source. For redundancy, the intercom circuit and the external 24 volt DC source can be connected at the same time. If one of them becomes inoperative the remaining source will provide power for the Model 240.

The Model 240's circuitry establishes the priority in which the unit draws its operating power. If an external source of 24 volt DC power is connected, it will always serve as the primary source. This minimizes the impact that the unit's power draw could have on a connected intercom circuit. If no external source of 24 volt DC is connected then power will be drawn from the intercom circuit.

Pushbutton Labeling

The four pushbutton switches used in the Model 240 were selected for several reasons. Foremost was the fact that they are highly reliable, using gold-plated contacts for long life in less-than-ideal environments. A second reason was that applying customized labels to the button caps would be very simple. Labels, text printed on clear material, can be placed under the clear lens that is part of the button cap. And with the integrated white LED backlighting the label text will be highly legible.

From the factory the four lenses in the button caps are not directly labeled. This is because there are simply too many possible uses for the Model 240 to allow "default" labels to be meaningful. Text on the graphics label on the Model 240's front panel does provide a simple indication of the button positions, showing 1, 2, 3, and 4. But it's expected that some applications may benefit from more-specific labels being added to the button caps.

As a "head start" for some applications, a clear sheet with a number of commonly used button designations printed on it is included in the shipping carton. These were created at the factory using a standard

personal computer graphics program and laser printed onto 3M CG3300 (or equivalent) transparency film. The desired button labels can be cut out with a pair of scissors or an X-ACTO® knife following the printed guide lines that indicate the required size.

The clear lens on top of each button cap can be removed with a fingernail or small screwdriver. Be certain not to scratch the button cap or lens if a screwdriver or other small tool is used. The clear label should then be set in place. To complete the task snap the lens back into the top of the button caps using finger-pressure only. No tool is required to replace them.

If you need to make your own button labels the process is quite simple. Use a personal computer to create the desired text. The finished label size should be 0.625-inches (15.8 mm) square. The completed artwork can then be printed on transparency film sheets using a laser or inkjet printer. These sheets are available from most office supply sources. A pair of scissors or an X-ACTO knife will complete the task.

Configuration

For the Model 240 to support the needs of specific applications a number of operating parameters may be configured. These include microphone preamplifier gain, program audio routing, headphone source selection, and various operating modes. Three 8-position and one 12-position DIP-switch assemblies are used to establish the desired configuration. These switch assemblies are referred to as SW1 through SW4, with individual switches designated as SW1-1, SW1-2, etc. The switch assemblies are accessed through openings in the bottom of the Model 240's enclosure. The enclosure does not have to be disassembled to access the switches.

To prevent unauthorized personnel from changing the configuration settings, a security plate is attached to the bottom of the Model 240's enclosure. For convenience, text and graphics on the security plate provide a summary of the configurable parameters and related information. Refer to Appendix A at the end of this guide for a representative view. The security plate is held in place by means of four rubber bumpers ("feet") that have built-in screws. Using your fingers, remove the four bumpers so that the plate can be removed. Refer to Figure 4 for a detailed view of the configuration switch assemblies.

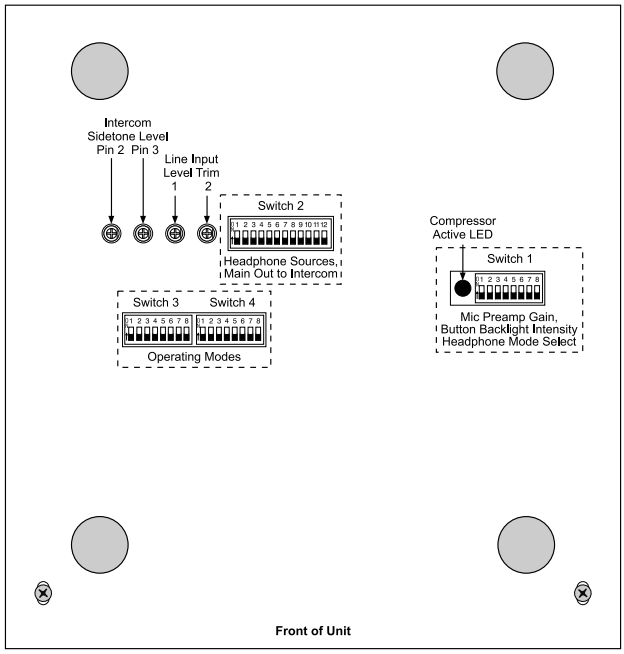


Figure 4. Bottom view of Model 240 showing configuration switches, trim pots, and compressor active LED

Microphone Preamplifier Gain

Five switches, SW1-1 through SW1-5, are used to select the gain of the microphone preamplifier. The choices are 35, 40, 45, 50, and 55 dB. Only one switch should be enabled at a time. There's no problem changing the gain setting while the unit is operating. Audio clicks or pops might occur during gain transitions, but this shouldn't be a major issue as long as any associated monitor loudspeakers are temporarily attenuated or muted.

Selecting the correct amount of gain for an application might require some experimentation. The goal is to bring the microphone's signal up to the nominal line level, which is 0 dBu, on the Model 240's main outputs. Operating at this signal level will help to ensure the delivery of "clean" audio to the connected devices. The output of the Model 240's microphone preamplifier is used, by way of the compressor circuit, by the four main output functions. So creating a nice "hot" signal will help maintain audio quality, specifically the signal-to-noise ratio, when driving lengthy cable runs. It will also ensure that, if selected, audio from a line input (assigned as a program source) or talk audio routed to the intercom interface will be at the optimal level.

Unfortunately, there's no "perfect" gain setting that this guide can recommend. The two issues that impact gain selection are output sensitivity of the connected microphone and the amount of acoustical output from the microphone's user. With some headset microphones, such as the one associated with the beyerdynamic DT109, selecting an initial gain setting of 45 dB is appropriate. Users who speak loudly might need to have the gain reduced to the 40 or 35 dB setting. Users with quiet voices might need to select 50 or 55 dB of gain.

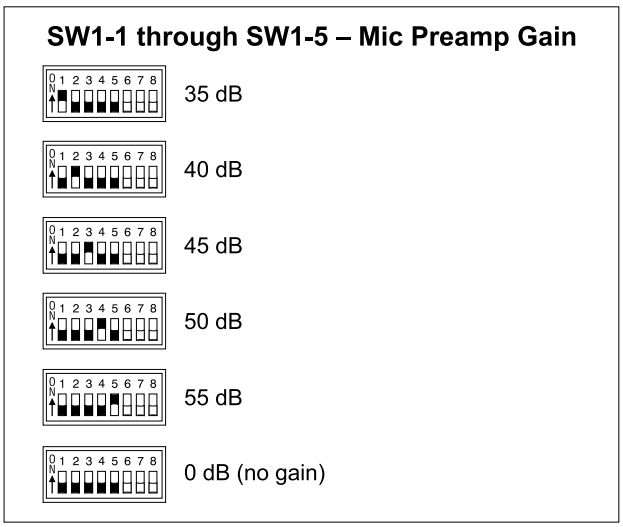


Figure 5. Microphone preamplifier gain settings

An LED indicator is provided as an aid in optimally setting the gain of the microphone preamplifier. Red in color, this LED is located adjacent to switch assembly SW1. It is visible by observing the bottom of the Model 240's enclosure when the security plate has been removed. Technically, this red LED lights whenever the compressor circuitry is actively controlling the dynamic range of the signal coming from the microphone preamplifier. The threshold is set to be 2 dB above the Model 240's nominal internal operating level. So a good "rule of thumb" is to adjust the gain of the microphone preamplifier so that the compressor active LED lights ("flashes") when the connected headset's microphone is sending signal peaks. During normal operation the LED should never remain fully lit when typical audio signals are present on the connected headset's microphone.

Note that if no gain switch is set to its active (on) position the preamplifier will operate at unity (0 dB) gain. This is provided for compatibility when line-level signals need to be connected to the microphone input. But when a microphone is serving as the input source the 0 dB setting would never

be appropriate. The issue is that with no gain added to the microphone input signal, the relative noise floor on the main outputs would be much too high. And the relative level of the talk signal versus a program or intercom input signal would be completely mismatched.

Headphone Source Selection

The first ten switches associated with switch assembly SW2 are used to configure the sources that are routed to the headphone output. Five headphone sources are available: line input 1, line input 2, intercom pin 2, intercom pin 3, and sidetone. Each of these sources can be independently assigned to the left, right, or both the left and right channels of the stereo headphone output.

As previously noted, two line-level input sources are interfaced using two connectors located on the back panel. Associated with line inputs 1 and 2 are level trim potentiometers. They are provided so that audio sources with a wide range of nominal levels can be effectively used as cue sources. Please refer to the Advanced Operation section of this guide for details on using the trim pots.

Audio associated with the two channels of party-line intercom, referred to as pin 2 and pin 3, is provided by way of the intercom interface whose connector is also located on the back panel. With broadcast-standard RTS TW party-line intercom systems pin 2 is audio channel 1; pin 3 is audio channel 2. With the ubiquitous Clear-Com single-channel party-line systems pin 2 contains only DC power and no audio; pin 3 provides the one (and only) audio channel. Two trim pots are associated with the intercom channels. They allow adjustment of the intercom sidetone (null) level of the

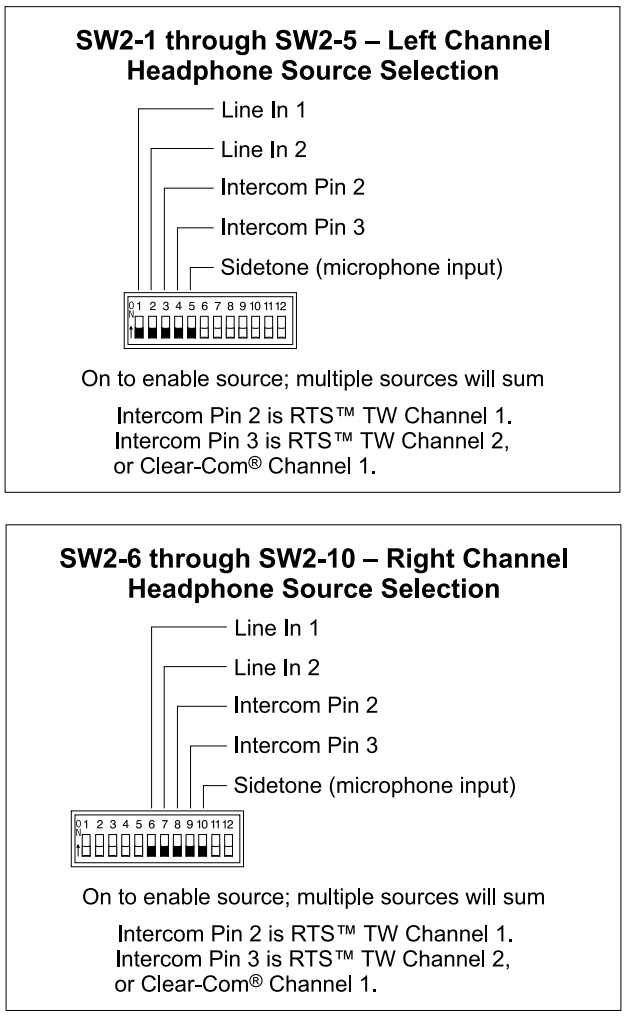


Figure 6. Left and right channel headphone source selection settings

actual intercom interface circuitry. This impacts the amount of main output (talk and, if selected, program) audio signal that is returned to the headphone output when intercom audio is selected for monitoring by the headphone output and either or both of the main output-to-intercom functions are active.

The switches designated for the sidetone audio source select audio that comes from the output of the compressor circuit associated with the microphone preamplifier. This allows a producer or other Model 240 user to hear themselves and thus receive

a confidence signal of what is being sent to the main outputs and possibly the intercom channels.

As previously discussed, each of the five available audio sources can be assigned to the headphone output's left channel, right channel, or both the left and right channels. There is no problem selecting multiple sources for routing to a headphone output channel. The sources will sum (add together) with no loss of level or fidelity. The Model 240's circuitry allows any combination of source assignments to be made. For example, consider the situation where a single-channel intercom circuit, with audio present only on pin 3, is connected. In this case it may be desirable to assign this intercom audio source to both the left and right headphone channels. This would entail setting switches SW2-4 and SW2-9 to their on positions. All other switches would remain in their off positions.

A more complex application might have a broadcast-type 2-channel PL intercom circuit connected to the intercom interface and a line-level audio signal from a golf event "spotter" connected to line input 1. In a case such as this, it would be typical for intercom pin 2 (PL channel 1) to be assigned to the headphone's left channel, intercom pin 3 (PL channel 2) assigned to the right channel, and line input 1 also assigned to the right channel. This would allow both PL audio channels along with "spotter" audio to be heard in the headphone output. To achieve this would require that three switches, SW2-3, SW2-6, and SW2-9, be placed in their on position.

Special applications may benefit from using the Model 240 in a 3-channel monaural headphone output mixer mode. This is accomplished by first configuring the headphone output to monaural. (Details on how to accomplish this are described in the next section of this guide.) Next the cue sources are selected. The source whose level is to be adjusted by the rotary control on the far left side of the front panel is assigned to the left channel. Then the cue source whose level is to be adjusted by the center control is assigned to the right channel. Finally sidetone can be assigned to either of the channels. (If it's assigned to both there won't be an issue except that the level will increase by 6 dB.) During operation the user will then be able to create their desired cue mix using the three front-panel controls.

There may also be cases where a monaural "single-muff" headset will be connected to the Model 240's headphone output. In this case the desired source(s) should be routed only to the left channel.

Headphone Normal/Dim

Switch SW1-7 configures whether the level of the headphone output will dim (attenuate by 20 dB) when one of the talk functions is active.

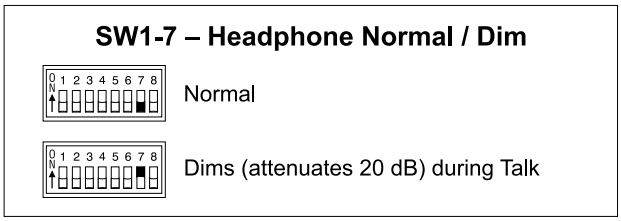


Figure 7. Headphone normal/dim settings

Two modes are available:

Normal: In this mode the headphone output level will not change when a talk function is active.

Dim: In this mode the headphone output level will be reduced ("dimmed") by 20 dB whenever any talk function is active.

Headphone Stereo/Mono

Switch SW1-8 allows a monaural headphone output to be created. This is accomplished by summing (adding) the selected left- and right-channel audio sources. When SW1-8 is enabled, the signals are sent to both the left- and right-channel headphone output driver circuits. The outputs of these circuits connect, by way of 100 ohm series protection resistors, to the headphone output pins of the headset connector.

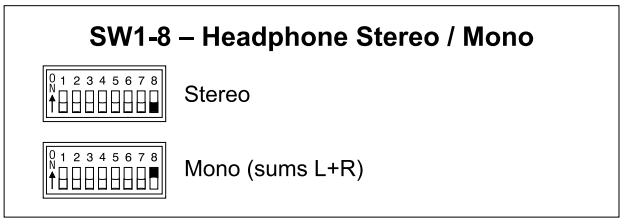


Figure 8. Headphone stereo/mono settings

The headphone stereo/mono feature was specifically included so that a 3-channel monaural headphone mixer mode can be created. By enabling headphone mono, the three front-panel user level controls ("pots") can be used to create the desired "mix" of signals being sent to the headphone outputs. Many applications may benefit from this capability. The desired headphone sources must be carefully assigned to take advantage of the monaural feature. The first source should be assigned, using the DIP switches, to the left channel. Its output level will be adjusted by the control on the far left. The second source should be assigned to the right channel. Its output level will be adjusted by the center control. A third cue signal, sidetone, can also be enabled. The sidetone level control, located on the far right, will be used to adjust its level.

There is one limitation related to the headphone output mono feature. It's the fact that the output will be 2-channel monaural. Whatever signal is present on the headphone output's left channel will also be present on the right channel. A stereo headphone mix can't be created. But in most cases this limitation won't overshadow the benefit of being able to create a mix. For signal-flow clarification please review the block diagram located at the end of this guide.

Main Output to Intercom Functions

The last two switches in switch assembly SW2, SW2-11 and SW2-12, are used to configure the routing of audio associated with the main outputs. SW2-11, when enabled, routes audio associated with main output 3 to intercom interface pin 2. SW2-12 allows audio associated with main output 4 to be routed intercom interface pin 3.

Main Output 3 to Intercom Pin 2 Function Mode

Switch SW2-11 configures whether the audio signal associated with main output 3 will be routed to pin 2 of the intercom interface.

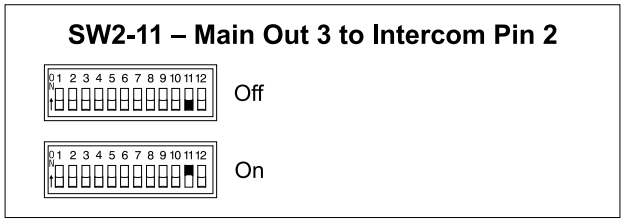


Figure 9. Main output 3 to intercom pin 2 settings

Two modes are available:

- Off: In this mode audio will not be routed to pin 2 of the intercom interface.
- On: In this mode audio associated with main output 3 will be routed to pin 2 of the intercom interface. (Note that pin 2 is channel 1 of an RTS TW intercom system. For typical single-channel Clear-Com party-line intercom systems pin 2 is not associated with an audio channel.)

Main Output 4 to Intercom Pin 3 Function Mode

Switch SW2-12 configures whether the audio signal associated with main output 4 will be routed to pin 3 of the intercom interface.

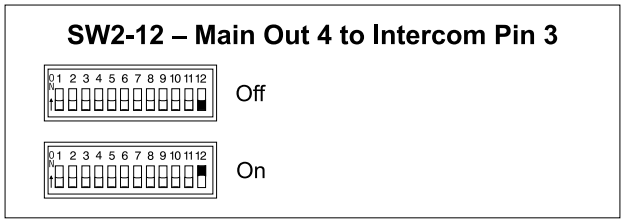


Figure 10. Main output 4 to intercom pin 3 settings

Two modes are available:

- Off: In this mode audio will not be routed to pin 3 of the intercom interface.
- On: In this mode audio associated with main output 4 will be routed to pin 3 of the intercom interface. (Pin 3 is channel 2 of an RTS TW intercom system. For a single-channel Clear-Com intercom system pin 3 is channel 1.)

Operating Modes

The sixteen switches associated with switch assemblies SW3 and SW4 are used to configure the Model 240's operating modes. Technically, these switches communicate with the microcontroller integrated circuit and then on to the firmware (embedded software) that gives the Model 240 its "smarts." The firmware has been carefully designed to provide a number of different ways in which the unit can function. It's important to carefully review the available selections and choose the ones that best meet the needs of a specific application. Note that switches can be changed even while the Model 240 is powered up and operating. The unit's operating characteristics will change in "real-time" in response to configuration changes.

Button Modes

Switches SW3-1 through SW3-4 configure how each of the four talk buttons function.

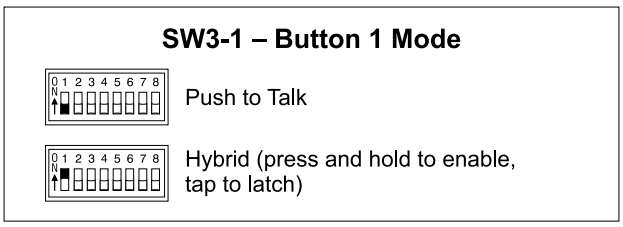


Figure 11. Button 1 mode settings (settings same for button 2-4 modes)

Two modes are available for each button:

- Push to Talk: In this mode the talk function associated with a button is normally off. The associated talk function becomes active whenever the button is pressed and held.
- Hybrid: This mode is a combination of push to talk and alternate action. If the button is pressed and held, the associated talk function will become active until the button is released. If the button is momentarily "tapped" the function's state will change; off-to-on or on-to-off. When set to the hybrid mode upon Model 240 power up the associated talk function will be in its off state.

Intercom Listen Mode

Switch SW3-5 configures the way the intercom listen mode functions.

Figure 12. Intercom listen mode settings

Two modes are available:

- Auto: In this mode the ability to listen to one or both pins of a connected intercom circuit will only be active when the intercom interface circuit detects DC voltage on pin 2. This mode minimizes the chance that objectionable audio content (i.e., "howls" or "squeals") will be routed to the headphones when an intercom circuit is not connected.
- Always On: In this mode audio from the intercom interface will be routed to the headphone output (if selected) whether or not DC voltage is present on pin 2 of the intercom interface. This mode allows two channels of non-powered ("dry") intercom to be connected and routed to the headphone output. This mode would be appropriate if, for example, two independent channels associated with two Clear-Com intercom circuits were connected.

Multi-Unit Mode

Switch SW3-6 configures the way the Model 240's multi-unit mode functions. It is applicable only when two Model 240 units are interconnected using the local data bus and audio from the main outputs are passively combined.

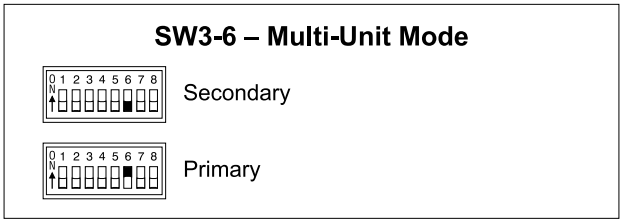


Figure 13. Multi-unit mode settings

Two modes are available:

- Secondary: In this mode the Model 240 being configured will serve as the secondary unit in a 2-unit application. Select this mode if multi-unit operation is not implemented.
- Primary: In this mode the Model 240 being configured will serve as the primary unit in a 2-unit application.

Main Output 2 and Main Output 4 Program Audio Sources

Switches SW3-7 and SW3-8 select the program audio sources for main output 2 and main output 4. The choices are line input 1 and line input 2. (Note that line input 1 is always the program audio source for main output 1 and main output 3.)

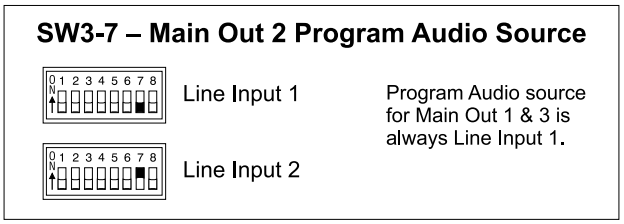


Figure 14. Main output 2 program audio source settings (settings same for main output 4 program audio source)

Program Audio to Main Outputs 1-4

Switches SW4-1 through SW4-8 select how program audio is routed to the four main outputs. Each main output can be configured independently.

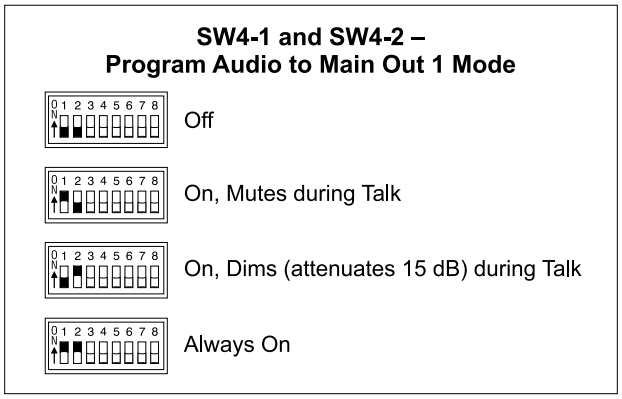


Figure 15. Program audio to main output 1 mode settings (settings same for program audio to main output 2-4 modes)

Four choices are available for each main output:

- Off: No program audio is routed to the associated main output.
- On, Mutes during Talk: Program audio is routed to the associated main output but mutes (fully attenuates) whenever talk audio is actively being sent to that main output.
- On, Dims (attenuates 15 dB) during Talk: Program audio is routed to the associated main output but reduces in level ("dims", i.e., attenuates by 15 dB) whenever talk audio is actively being sent to that main output.
- Always On: Program audio is routed to the associated main output and remains at full level, whether or not talk audio is actively being sent to that main output.

Button Backlight Intensity

Switch SW1-6 selects the intensity of the white LEDs that provide backlighting for the four pushbutton switches. Two choices are available: low and high. Low is appropriate when the Model 240 is going to be used in an environment where the ambient light level is low. High would be appropriate where other light sources in the physical area may make the buttons more difficult to identify. High may also be useful when identification markings have been inserted under the clear lens caps.

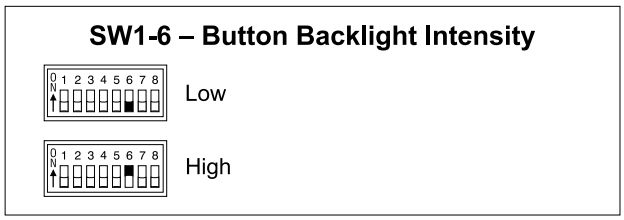


Figure 16. Button backlight intensity settings

Conclusion

Once the switches have been set to the desired Model 240's operating configurations, it may be time to reattach the security plate. The exception is if the trim pots associated with the line inputs and intercom sidetone (null) need to be adjusted. Details are provided later in this guide. The plate attaches using the four rubber bumpers. They should be hand-tightened only; no tools are to be used.

Operation

At this point the desired input, output, and power connections should have been made. The buttons may have had labels installed. After carefully reviewing the needs of the specific application, the configuration switches should have been set. Normal operation of the Model 240 can now begin. The unit will begin functioning as soon as a power source is connected. As previously discussed, power for the Model 240 can be provided by an external source of 24 volt DC or a connected party-line intercom circuit. It's important to highlight the fact that the Model 240 is an active device. Audio signals will not be present on the main outputs, headphone output, or intercom interface unless a power source has been connected.

Upon Model 240 power up the unit's firmware will "boot" (start up) and the eight LEDs (four white LEDs that provide back lighting for the four pushbuttons and four green status LEDs associated with the main output functions) will light in a sequence.

Once the initial power-up sequence has completed the four pushbutton switches will momentarily light to display the version number of the unit's application firmware. Details on how to "read" the version number

are provided in the Technical Notes section of this guide. The unit will then begin normal operation. The user is now presented with four buttons and associated LEDs and three rotary controls. These are simple to operate and understand, as will be described in the following paragraphs.

Pushbutton Switches and Status LEDs

Four pushbutton switches are used to control the main output functions. The way each switch operates depends on the selected configuration. An LED indicator, green in color, is located directly above each pushbutton. They will light whenever its associated main output function is active.

There are two other cases where the status LEDs could change state even if the pushbutton switches are not actuated. The first case is if contact closures have been connected to the Model 240's remote control inputs. In this way the main output functions can be controlled by an external source and the LEDs will respond accordingly.

The second case is if two Model 240 units are being used in the multi-unit mode. Intercommunicating using the RS-485 data link, the status of one unit will cause both units to respond. If the pushbutton on one unit is activated its associated status LED will continually light while the status LED on the other Model 240 will light in an on-and-off cadence. This provides a distinctive indication of the current operating condition but doesn't restrict its associated pushbutton from being pressed. (This doesn't "lock out" or prevent the buttons associated with the same main output channel from being activated at the same time.) If the buttons on both Model 240 units are simultaneously pressed their associated LEDs will continually light.

Note that the cap of each pushbutton switch is back lit using a white LED. The LEDs will light whenever the Model 240 is operating. They do not change intensity or provide a status indication in response to the unit's operation. The backlight level can be configured from among two choices, low or high.

Button Modes

Each of the four pushbutton switches can be independently configured to function from either of two operating modes:

- Push to talk: If this mode is selected the function associated with the pushbutton is normally off. The function will become active whenever the button is pressed and held.
- Hybrid: This mode is a combination of push to talk and alternate action. If the button is pressed and held, the function associated with it will become active until the button is released. If the button is momentarily "tapped" the function will change state. Upon Model 240 power up the function will be in its off state.

Headphone Output Level Controls

Three rotary controls ("pots") are located on the Model 240's front panel and are associated with the headphone output section of the headset connector. How they function depends on the setting of two configuration parameters. The first configuration choice allows the headphone output to be set for stereo or monaural. The other configuration choice (actually two configuration switches) allows sidetone audio to be sent to either or both of the headphone channels. When set for stereo the control on the far left is used to adjust the level of the headphone output's left channel. The

control in the center is used to adjust the level of the right channel. If sidetone has been enabled the control located on the right adjusts the level of the sidetone audio signal. Turning any of the controls to their fully counterclockwise position will cause its respective output to fully mute.

The headphone monaural mode is specifically provided so that a flexible headphone mix can be easily created. If mono has been enabled, the three front-panel level controls are used as a phones source mixer. A signal assigned to the left channel can have its level adjusted using the control on the far left. A signal assigned to the right channel will have its level adjusted using the control in the center. If sidetone is enabled, the control on the far right will adjust the amount of signal associated with the microphone input to be sent to the headphone output.

Notes on Sidetone Operation

As previously covered in this guide, the sidetone function can be enabled. Sidetone is defined as the user's own voice signal being returned to them as a headphone source. This helps the user be more effective as they can be aware of what they are saying into the microphone. Depending on how it was configured, sidetone audio will be sent to the left headphone output, the right headphone output, or both the left and right headphone outputs. When the sidetone level control is in its fully counterclockwise position the sidetone signal will always be fully muted.

Astute readers will realize that sidetone audio can also be provided from the intercom cue sources during Model 240 talk to intercom activity. This "passive" sidetone is created in the intercom interface's analog talk/listen hybrid sidetone (null) circuit. Trim pots allow the intercom sidetone level to be adjusted over a limited range. To get maximum performance when either or both intercom channels are used as a cue source one simple calibration process may need to be performed. This involves adjusting the sidetone (null) trim pots to their fully counterclockwise positions, providing minimum sidetone level. This will reduce the level "build up" that would occur when both the main and the intercom sidetone audio signals are sent to the headphone output. The goal is for the sidetone level to remain as constant as possible, no matter what function — talk-to-main output or talk-to-main-output-and-intercom — is active.

The Model 240's level controls have a mechanical step (detent) that is located at the halfway (50%) position of their rotation range. This is intended to serve as an aid to Model 240 users. In an ideal installation, setting the far left and center controls to their detent position will result in a comfortable headphone output level. The user, in response to a changing operating environment, can then move the controls to get more or less level as desired. The detent position will always remain as a useful reference point. To achieve this condition the audio level on the connected line inputs may have to be calibrated as required. This is somewhat counter to the usual mentality of just providing the user with whatever level comes up by default. Spending a few extra minutes "trimming" the audio levels can result in much happier and more productive personnel. As previously mentioned, a level trim potentiometer is associated with each line input. If either or both of the line inputs is assigned to the headphone output these trim pots may be helpful in achieving the desired adjustment range of the two front-panel level controls. Refer to the Advanced Operation section of this guide for details.

Headphone Output Level

Typically the headphone output level will not be impacted by talk function activity. But a configurable option allows the headphone output level to be reduced in level ("dimmed") by 20 dB whenever a talk function is active. This is included for applications where connecting monitor loudspeakers, rather than a headset or headphones, is desired. If the headphone output level is not functioning as designed it's possible that the setting of the headphone normal/dim configuration DIP switch may need to be revised.

Advanced Operation

Adjusting the Line Input Trim Pots

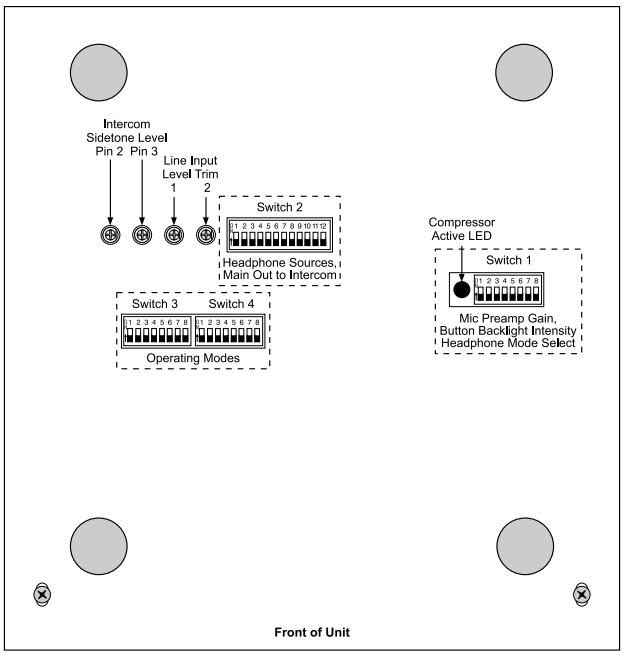
As has been previously mentioned, associated with the two line inputs are trim pots that allow the input levels to be adjusted. The two trim pots are accessible by way of round openings in the bottom of the Model 240's enclosure. By adjusting these trim pots, signals with a nominal level of –10 to +6 dBu can be effectively used as main output program and headphone sources. Unfortunately, there are no definitive rules regarding how best to adjust the trim pots, but some suggestions may prove to be valuable. Depending on how the line inputs are utilized, the trim pots can be used to either adjust the absolute level of each line input signal, or to adjust the relative level of the signals when compared to other sources. The following examples may provide some clarification.

Let's begin with an application that has a stereo cue source connected to the line inputs. The cue source selection switches are configured to create a stereo headphone output with line input 1 assigned to the left channel and line input 2 assigned to the right channel. Begin the trim pot adjustment process by moving the user level controls (located on the front panel) to their detent (50% of rotation) positions. Then, with the stereo cue source providing signal at its normal level, adjust the trim pots to provide a comfortable level to the connected headphones. The user can now, in response to changing conditions, adjust the front-panel level controls as desired. Returning the controls to their detent positions will always provide the "reference" level to the headphone output.

A second example has a source of audio connected to line input 1. This audio is assigned as program audio for one or more of the main outputs. The input trim pot associated with line input 1 can be used to adjust the relative level of the program audio source as compared to the talk level from the connected headset. The trim pot allows the desired "mix" to be created, providing the user with an effective signal with the desired ratio of talk audio to program audio.

Intercom Interface Sidetone Adjustment

Associated with the main output-to-intercom functions are sidetone trim potentiometers that are used to adjust the level of talk and program signal that is returned to the headphone output by way of the intercom interface circuitry. These two trim pots are part of the analog hybrid circuit that separates (nulls) audio from a main output channel being sent to the intercom interface from audio being received from the intercom interface. If audio from either or both of the intercom channels is to be used as a headphone source, and either



Intercom Pin 2 is RTS™ TW Channel 1.
Intercom Pin 3 is RTS™ TW Channel 2,
or Clear-Com® Channel 1.

Figure 17. Bottom view showing line input and intercom sidetone trim pots

or both of the main output-to-intercom functions has been configured, the sidetone trim pots may need to be adjusted.

One trim pot is associated with the sidetone level for each channel of the intercom interface. Both are accessible on the bottom of the Model 240's enclosure, adjacent to the trim pots associated with the line-level inputs. Adjusting them is very simple, requiring only a pair of ears and a screwdriver.

With the Model 240 configured as previously described, activate one of the main output-to-intercom functions. When the talk button associated with the configured channel is activated audio from the connected headset microphone may be heard in the configured headphone output channel(s). Adjust the trim pot associated with the active intercom channel so that the desired sidetone level, relative to the intercom receive level, is achieved. The adjustment range is approximately 18 dB, with the sidetone level increasing as the trim pot is rotated in its clockwise direction. Now change to the other intercom channel and adjust its sidetone trim pot as desired.

Using the Model 240's main sidetone function, talk audio can be routed to the headphone outputs by means of active circuitry. If this is enabled be certain to place the two intercom sidetone trim pots to their fully counterclockwise positions. This will minimize the increase in sidetone level that will occur when both the main sidetone and the sidetone associated with main output-to-intercom functions are active.

Technical Notes

Multi-Unit Data Bus Interconnection

To interconnect the data bus signals on two Model 240 units requires just one pair of interconnecting wires. This provides a serial data path, technically an RS-485 data circuit with the specific characteristics of 115.2 kbps, 8-1-N. If shielded cable is to be utilized the shield connection should only be terminated at one end. If it's terminated at both ends a connection between the common points in both Model 240 units will be established which can lead to audio noise issues, especially when intercom circuits are also being connected.

The data bus is accessible by way of a 3-pin "header" located on the Model 240's circuit board. The installer must provide the desired connector and mount it in one of the four spare connector locations on the back panel. The type of connector can range from a 3- or 4-pin XLR to one pair on an RJ-45, such as provided by an EtherCon® connector. A simple means of

providing access to the data bus is to use the Studio Technologies EtherCon Connector Card Kit (part number 31207). It's very simple to install and includes a pre-terminated interconnecting cable. A standard Ethernet patch cable would then be used to interconnect the two Model 240 units. Refer to Appendix B at the end of this guide for connection details.

As noted in the Configuration section of this guide, each Model 240 is designated as either secondary or primary. It's important that its companion unit has the opposite setting. Once the data path has been established and power is applied to both units, mutli-unit operation will automatically take place.

Grounding and Shielding

As previously discussed in this guide, the pin 1 connections on the four 3-pin male XLR connectors associated with the main outputs are "floating," i.e., not connected to anything within the Model 240's enclosure. Some audio experts might take offense to this, complaining that this should have been left to the user or installer to be connected or disconnected as desired. However, repeated field testing of predecessor products found that floating pin 1 on these outputs was often an important part of maintaining quiet audio. From Fenway Park in Boston, to the Orange Bowl in Miami, and then northwest to Husker Stadium on the Nebraska Plains, lifting pin 1 always did the trick.

A simple solution is available if an application does require that a ground be available on the main outputs' interconnecting cables. All Model 240 XLR connectors have a ground connection that is made to the interfacing connector's metal "shell." And most XLR connectors have a pin or connection point available to access its metal shell. By connecting the cable shield to the mating connector's shell terminal, the common connection typically found on audio interconnections is created.

Intercom Channel Crosstalk

By the very nature of its design, a 2-channel party-line intercom circuit is prone to exhibit crosstalk. This occurs because the audio paths are unbalanced ("single-ended") and are typically transported on a single shielded twisted-pair audio cable. The primary causes of the crosstalk are the common signal return wire and the capacitance between the wires in the cable pair. The greater the capacitance, due to cable type and length, the more crosstalk there will be. It's not surprising to find in sports broadcasting venues that audio from one channel can be heard "bleeding" into the other channel. Does this generally create a problem? No. But it can be a bit unnerving.

There are several ways of reducing intercom channel crosstalk. Probably the easiest way is to use cable pairs that are not twisted. Twisted pairs are great for differential (balanced) signals, but not so great for unbalanced transmission. This is generally because the more twists in a pair the greater the effective cable capacitance. In a stadium or arena setting, choosing standard "telco" pairs may actually work better than "high-performance" audio or data cable!

Another option is to use two cable pairs for each intercom circuit. If the pairs are not shielded the wiring is simple. Common would be connected to one side of each pair, and then signal from each channel would connect to the other side of the pairs. If the pairs also contain shields the wiring could be done somewhat differently. One option is to connect common to both cable shields, intercom channel 1 (DC with audio) to one full

pair, and intercom channel 2 to the second full pair. A better option might be to have common connect to both shields and one side of the pair that serves channel 2.

Intercom Audio Levels

The Model 240 was designed to function well with intercom circuits associated with standard broadcast and production party-line ("PL") intercom systems. These systems provide DC power and one or two channels of audio over standard 3-conductor cables that terminate with 3-pin XLR connectors. Establishing the correct "listen" and "talk" levels is critical in achieving good audio performance. In North America the two most common intercom systems are those from RTS and Clear-Com. From tests performed in Studio Technologies' lab, the nominal RTS TW-series audio level is approximately –10 dBu. The dynamic range control provided by user beltpacks such as the BP325 was very good, limiting the maximum level to at most 10 dB above the nominal. The nominal audio level associated with a Clear-Com system was harder to characterize. It appeared to be a few dB less than –10 dBu, but the dynamic range was much larger. Level peaks of 10 to 20 dB over nominal were easy to produce.

This objective data led to the following Model 240 design decision: When audio signals from intercom pins 2 and 3 are used as headphone sources level sensitivity selection switches or trim pots were not required. The level range available on the Model 240's front-panel controls proved to be sufficient for the user to be able to establish the desired listening level.

When main output audio (program and talk) was routed to the intercom circuit a single audio level proved to work well with both RTS and Clear-Com systems. This was mainly possible due to the excellent dynamic-range-control provided by the compressor circuit. Its threshold (2 dB above the Model 240's nominal output level) and compression ratio (5:1) resulted in excellent audio. So in the end, no level or compatibility switches of any kind were required to achieve the desired "listen" and "talk" performance.

The preceding paragraphs may elicit howls of protests from a host of engineers and intercom system experts. But for years we've heard differing reports as to the actual nominal audio levels for RTS and Clear-Com systems. The "in-the-know cats" agreed that RTS TW intercom was –10 dBu, a value that we confirmed in our tests. But the nominal level for Clear-Com was variously reported as –20, –15, –12, –10, and "you know, the Clear-Com level!" It's most likely that early Clear-Com systems did use a nominal level of approximately –20 dB. But after making controlled tests, the contemporary Clear-Com equipment seemed to be much closer to –10 dBu. And with the limited dynamic-range control that we experienced, the actual level during operation may vary widely. That's why intercom interface sensitivity, compatibility switches, or rotary controls were not included in the Model 240.

In conclusion, the engineers at Studio Technologies are always open to learning more. Additional information from the field concerning such topics as intercom system levels, impedance matching, and DC power sourcing would be welcomed. Stopping by our offices for an in-person chat would be also great. Bringing along a bit of road "swag" would be appreciated. Just park the production trailers in the alley behind our warehouse—plenty of power is available!

Connecting an IFB Circuit

A broadcast-standard powered ("wet" or DC with audio) IFB circuit can be directly connected to the Model 240's intercom interface. Originated by sources such as the RTS 4000-series IFB system or IFB interface devices from Studio Technologies, the connected IFB circuit can provide two channels of cue audio as well as DC power to operate the Model 240. No Model 240 main output audio can be effectively sent to the IFB circuit due to its one-way nature. (Technically, a powered IFB circuit has a low-source-impedance and a high-input-impedance circuit arrangement.)

The power supplied by an IFB circuit, normally in the range of 28 to 32 volts DC, is usually sufficient to operate the Model 240's circuitry. The acceptable input range is 24 to 32 volts, with a required current of 150 milliamperes. Note that the specified input voltage is given when measured directly at the Model 240's intercom interface connector, not at the source of the IFB circuit.

In North American field and in-studio broadcast applications it is possible to find RTS 4000-series IFB equipment being used to provide the IFB circuits. The Model 240 can be directly connected to, and function correctly with, one of these circuits. For reliable operation, especially when using lengthy cable runs, it's strongly recommended that no other device be connected to a 4000-series IFB circuit that is specified for connection to a Model 240. This requirement is due to the current-limited DC source that is supplied by the 4010 IFB Controller.

Symptoms of Insufficient Power

A core part of the Model 240's internal circuitry is a switch-mode power supply that produces +12 volts, +5 volts, and –12 volts. This power supply circuit works very well as long as it is "fed" with sufficient input voltage and current. "Sufficient" is defined as a minimum of 24 volts on the intercom interface and 20 volts on the external 24 volt DC input. The necessary current, 150 milliamperes for the intercom circuit and 125 milliamperes for the external source, must be supplied over their respective voltage ranges.

It's worth discussing what will happen if either of these power sources fall below their specified minimum. Typically, if the Model 240 is being powered by an external 24 volt nominal power source, normal operation will continue until the input falls to the 18-20 volt range. As the input voltage drops below this range the Model 240's internal power supply will have reduced stability, operating in this manner until its low-voltage shutdown circuit halts operation. Note that as the input voltage moves down from 24 volts the input current will rise proportionately to make up for the loss of power.

Using the intercom circuit to provide Model 240 power shouldn't prove to be a problem. Power supplies associated with broadcast and production intercom systems are designed to support multiple beltpack and related devices. In the "big scheme of things," connecting a Model 240 shouldn't add a significant load.

Travel Case

For portable applications it may be desirable to store and transport each Model 240 in a protective case. After much travel with prototype units, Studio Technologies personnel learned to appreciate the Pelican Model 1450 case. Purchased with the foam interior option, it does an excellent job of holding one Model 240, its associated 24 volt DC power supply, and documentation. Some

applications may benefit from selecting a larger case that would also hold a related headset, cables, etc. A larger case could also be selected that would hold multiple Model 240 units. Pelican sells their products through a dealer network, many of which can be located via a web search.

Spare Connector Locations

Four spare connector locations are provided on the Model 240's back panel. From the factory they contain blank plates that can be readily removed and replaced with a variety of XLR or similar-sized connectors. These spare connector locations are included so that a Model 240 can be customized to meet the many specific needs that arise in broadcast and related audio applications. Expected uses for these locations include adding a 6- or 7-pin XLR connector to allow connection of an "on-air"-type broadcast headset. (These typically do not use a 5-pin XLR connector.) Other uses include creating "loop through" or "mult" functions associated with the main output, line input, or intercom interface connections.

The spare connector locations are compatible with the Neutrik DL-series of connectors. For flexibility, versions of XLR connectors are available that provide from three to seven contacts. For example, a compatible 3-pin female connector would be Neutrik part number NC3FD-L-1. To support some headsets the NC6FDS-L-1 is often used. This is a 6-pin female connector with the unique Switchcraft 6-pin arrangement. The hardware that secures the blank plates to the Model 240's back panel is also intended to secure the replacement connectors. Many other types of connectors are also available that are DL-cutout compatible. These include 1/4-inch jacks, 8-position ("RJ-45") modular jacks, and 3-pin screw terminal strips.

The Model 240's enclosure must be disassembled prior to installing connectors in the spare locations. Four hex-head machine screws, two on the bottom front of the enclosure and two on the back panel, must be removed. A 5/64-inch hex driver is required. The cover can then be carefully separated from the chassis, remaining attached by means of a flexible cable assembly. This "flex-cable" assembly links the main printed circuit board assembly with the board assembly that contains the pushbuttons and LED indicators. Ensure that the flex cable is not damaged while the Model 240 is being customized. For easier access, the pushbutton/LED board assembly can also be removed.

If connectors are installed in the Model 240's spare connector locations adding labels to those connectors can be helpful. For a great look it is recommended that Brother® P-Touch ¼-inch (6 mm) labels be created. Tape material that prints white text on a black background works out well for the Model 240. The Brother label cassette number TX-3151, white on black, is appropriate for use with many of their printers.

Circuit Board "Header" Connectors

In addition to the four spare connector locations on the Model 240's back panel, provision has been made to allow easy interconnection with the Model 240's printed-circuit-board-mounted input and output connectors. This was accomplished by including numerous 3-position male "header" connectors on the Model 240's circuit board. These headers, on 0.1-inch centers, are wired in parallel with the Model 240's connectors. This "no solder" solution makes customizing a Model 240 a simple process. The headers, located on

the Model 240's printed circuit board, are Molex® part number 22-23-2031. They mate with Molex housing number 22-01-3037. To make the interconnection, separate crimp terminals are attached to loose wires and then "snapped" into the housing. Molex part number 08-50-0114 specifies crimp terminals that are appropriate for wires of 22 to 30 gauge. These parts are available worldwide from sources such as Digi-Key, website www.digikey.com.

To make the process of connecting to the Model 240's headers a simple task an interface cable kit, part number 31087, is available from Studio Technologies. Each kit includes five cable assemblies and a length of heat-shrinkable tubing. Each cable assembly consists of a mating connector with three color-coded wires attached. These wires, approximately 12 inches in length, allow convenient soldering to a connector slated to be installed in a spare location on the Model 240's back panel. For reference, the wire color for pin 1 is gray, pin 2 is yellow, and pin 3 is blue.

The heat-shrinkable tubing is provided so that the connector solder cups can be insulated from each other. It will also provide some strain relief to the solder joints. Be certain to slip the desired length of tubing over the wire prior to soldering a connection! (If this writer had a dollar for every time he forgot to put tubing on a wire (or slip on a connector shell) before making a solder connection…)

The 3-position headers on the Model 240's main circuit board assembly are located close to their related input or output connectors. For details please refer to Appendix B at the end of this guide.

Remote Switch Input Connections

Provision has been made on the Model 240's printed circuit board assembly to allow external switches or contact closures to control the talk-to-main output functions. Two 3-position headers provide access to the circuitry associated with these functions. Electrically the contact inputs are in parallel (connected directly together) with the normally open (not shorted) contacts on the four front-panel pushbutton switches. Each switch input circuit is "active low," with a 10 k ohm resistor connected to +5 volts acting as a pull up. A combination of resistors and capacitors provide ESD protection, isolating the contact from the unit's microcontroller integrated circuit. Refer to Appendix B at the end of this guide for connection details.

Relay Contacts

The Model 240 provides five normally open (not shorted) relay contacts for use in specialized applications. A relay contact is associated with each of the four main output functions. Whenever a talk function is active its associated relay contact will close (short). The fifth relay closes (shorts) whenever any of the talk-to-main output functions are active. No matter whether one, two, or all the talk functions are active the relay will close (short). This "any talk" contact can be considered to be responding to the talk functions as a logical "OR" function. The five relays operate under software control and are always active, whether or not connections are made to them.

Some "head scratching" or "brainstorming" should lead to a number of interesting ways to take advantage of the relay contacts. Applications could include keying wireless transmitters, activating "on air" lights, and

muting loudspeakers systems. To utilize any of the relay contacts does require the talents of a qualified technician. This is because the Model 240's enclosure must be disassembled and the desired wiring scheme implemented. For detailed information on interfacing with the relay contacts refer to Appendix B at the end of this guide.

Optional Connector and Special Function Modules

A variety of special function and interface options can be easily implemented using the option modules available from Studio Technologies. These include pre-fabricated 6- and 7-pin headset connector assemblies, RJ-45 interface kits, and line input and line output modules. They install in the spare connector locations in the Model 240's back panel. Please refer to the Studio Technologies website for details on what options are available.

Auxiliary Headphone Line Inputs

Provision has been made to allow two additional line-level input sources to be connected and used exclusively as headphone signal sources. These are intended to support applications where sources separate from those connected to the Model 240's two line input functions are required. An example application would be where a producer needs to monitor a talent's microphone signal pre-fader ("talent pre-fade listen") while the talent's headphones receive, via the normal line inputs and main outputs, a mix or mix-minus "feed."

Adding the two auxiliary headphone line inputs requires installation of two optional line input modules from Studio Technologies (part number 31084). Line input module kits provide a small circuit board and required jumper cable assembly that a technician can easily install. The circuit board is installed in a spare connector location on the Model 240's back panel. The jumper cable connects the line input circuit board to a 3-pin "header" on the Model 240's circuit board assembly. Each line input module routes a connected source to its respective left or right channel of the headphone output circuit. These signals will sum (combine) with any other sources that are routed to the headphone outputs by way of the source configuration switches. The auxiliary headphone line inputs are transformer-balanced, capacitor coupled, and have a nominal signal level of + 4 dBu.

Compressor Circuit

In this section some general information about the Model 240's compressor circuit will be provided. As previously discussed, the output of the microphone preamplifier circuit is connected to a studio-quality compressor circuit. The output of the compressor is used by the talk-to-main outputs. The gain element in the compressor circuit is a laser-trimmed voltage-controlled-amplifier integrated circuit. It provides accurate, low-noise, low-distortion performance. The threshold of the compressor circuit is 2 dB above the Model 240's nominal main output of 0 dBu. A 5:1 compression ratio is implemented and, like the threshold level, is not field adjustable. The threshold and ratio settings were selected so that excellent talk audio would be provided. By controlling the dynamic range, intelligibility can be improved and overloading of connected devices can be avoided. An LED indicator lights whenever the compressor's threshold has been reached and the circuit is actively controlling the dynamic range. This LED is provided as an aid when setting the gain of the microphone preamplifier.

Line-Level Headphone Outputs

There are applications where connecting the Model 240's stereo headphone output to inputs of powered loudspeakers, rather than a headset or headphones, would be optimal. A competent technician can easily add one or two line-level outputs that would be associated with the headphone output circuitry. This would be accomplished by installing one or two of the optional Line Output Card Kits, Studio Technologies' part number 31086, into spare connector locations on the Model 240's back panel. The only issue that requires careful attention is the interconnect wiring between the main circuit board's 3-pin header connector associated with the headphone output and the one or two line output modules being installed. The interface cables, one supplied with each line output kit, will have to be slightly modified for implementing the proper interconnections. Pin 1 (common) on the headphone output header would be connected to pin 1 on both connectors that attach to the input headers on the line output modules. Pin 2 (left channel) of the headphone output header would be connected to pin 2 of the first line output module. (The first module would supply a line-level output associated with the left channel of the headphone output.) Pin 3 (right channel) of the headphone output header would be connected to pin 2 of the second line output module. (The second module would supply a line-level output associated with the right channel of the headphone output.)

The output of each line output module is transformer-balanced and capacitor-coupled. Each has 300 ohm resistors in series with both their + (pin 2) and – (pin 3) connections on the 3-pin male XLR output connector. This provides both protection against damage from external signals as well as the ability to be passively summed (combined). The line-level output signals associated with the Model 240's headphone output can be directly connected to the inputs on amplified speakers or audio power amplifiers.

Prepare the mating connectors (females) so that pin 2 is signal high (+) and pin 3 is signal low (–). Each cable's shield can be connected to pin 1. But in order to minimize the chance that ground-interaction problems will arise, pin 1 on the connector is isolated from the Model 240's chassis and circuitry. By making pin 1 "float," the chance of often-feared "ground loop" problems should be minimized. Note that the metal shell of the mating connector must also be "floating."

Application Firmware Version Display

As part of the Model 240's power-up sequence the unit's application firmware (embedded software) version number is displayed. This is useful when working with factory personnel on support and operation issues. The four pushbutton switches on the front panel will light to display the major and minor release numbers with a range for each of 1 through 4. Following the initial sequential lighting of each pushbutton switch, one of the four buttons will light briefly to indicate the major release number. This will be followed by a short pause when no buttons will be lit. Then one of the four buttons will light briefly to indicate the minor version number. Once this has completed normal Model 240 operation will commence. When describing the displayed firmware number the format is major number, then a period as a separator, and then the minor number. For example, 2.1 which indicates a major version of 2 and a minor version of 1.

Specifications

General Audio:

Frequency Response: 20 Hz-20 kHz, +0/–1 dB, mic in/main out

Distortion (THD+N): <0.04%, measured at 1 kHz, mic in/main out

S/N Ratio: 87 dB, referenced to –42 dBu mic in/0 dBu main out

Dynamic Range (A-weighted): 113 dB, line in/main out

Microphone Input/Preamplifier:

Type: electronically balanced

Input Impedance: 2 k ohms

CMRR: 83 dB @ 60 Hz, 76 dB @ 20 kHz, 40 dB gain

Gain Range: 35 to 55 dB, adjustable in 5-dB steps

Compatibility: balanced and unbalanced dynamic microphones

Compressor (Microphone Input):

Threshold: 2 dB above nominal level

Attack/Release Time: 2 mSec/100 mSec

Slope: 5:1

Status LED: compressor active

Line Inputs: 2

Type: balanced, transformer-coupled with series capacitors

Impedance: 10 k ohms

Nominal Level: –10 to +6 dBu, adjustable

Main Outputs: 4

Type: transformer-coupled with series capacitors and isolation resistors

Impedance: 600 ohms

Nominal Level: 0 dBu

Maximum Level: +20 dBu, line in/main out

Aux Headphone Line Inputs: 2

Implementation: requires one or two optional line input cards (Studio Technologies part number 31084) to be installed into back panel

Type: balanced, transformer-coupled

Impedance: 10 k ohms, nominal

Nominal Level: +4 dBu

Headphone Output: 1, stereo

Compatibility: intended for connection to mono or stereo headsets or earpieces with nominal impedance of 100 ohms or greater

Type: voltage driver

Maximum Output Voltage: 12 Vpp, 150 ohm load

Intercom Interface:

Type: 2-channel, unbalanced (pin 1 common; pin 2 DC with channel 1 audio; pin 3 channel 2 audio)

Compatibility: single- and dual-channel party-line (PL) intercom systems such as from RTS™ and Clear-Com®

Impedance: 10 k ohms

Nominal Receive Level: –10 dBu

Nominal Talk Level: –10 dBu

Sidetone (Null): 0 to –18 dB, adjustable

Relay Contacts: 5

Functions: one each follows status of main output 1-4 and one provides status of any main output active

Contacts: form A (normally open, not shorted)

Rating: 100 mA, 60 volts AC/DC, maximum

Contact Resistance: 16 ohms, maximum

Access: requires user-implemented connector scheme

Remote Switch Inputs: 4

Functions: mimics the action of the four pushbutton functions

Type: active low, 0.5 mA maximum, inputs pull up to 5 volts DC

Multi-Unit Support: Two units can be interconnected via an RS-485 data bus. Audio summing is performed passively using external wiring.

Power Sources:

Intercom Interface: 24-32 Vdc, 150 mA

External: 20-30 Vdc, 125 mA @ 24 Vdc. Each unit shipped with a universal input/24 Vdc output power supply.

Connectors:

Line Inputs, Intercom Interface: 3-pin female XLR

Main Outputs: 3-pin male XLR

Headset (mic/phones): 5-pin female XLR

24 Vdc Power In: 2.1 x 5.5 mm coaxial power jack with locking bushing, compatible with Switchcraft S760K plug

Spare Connector Locations: 4

For use by Studio Technologies' wide range of option modules. Also allows up to four Neutrik NC*D-L-1 connectors to be installed (*=3F, 3M, etc.).

Dimensions (Overall):

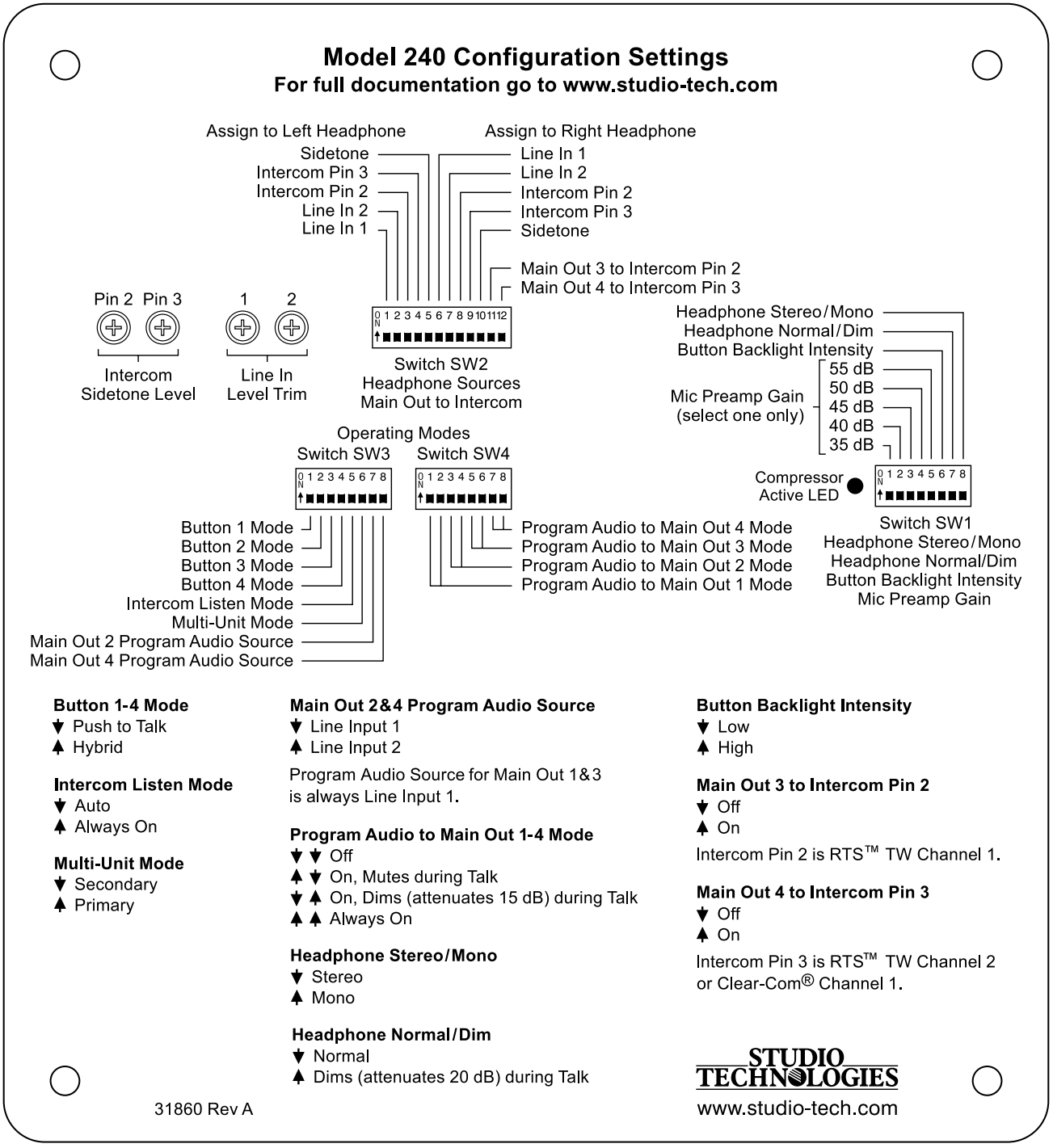
8.1 inches wide (20.6 cm)
3.3 inches high (8.4 cm)
8.5 inches deep (22.4 cm)

Weight: 4.5 pounds (2.1 kg)

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

Appendix A

Attached to the bottom of the unit is a security plate with text that provides a summary of the configurable parameters and related information.



Appendix B

The following list provides details on the 3-pin header connectors located on the Model 240's printed circuit board. Shown are both reference numbers and associated functions.

P5: Headphone Output
Pin 1 common
Pin 2 tip (left)
Pin 3 ring (right)
These pins are electrically in parallel with pins 3, 4, and 5 respectively of the back panel 5-pin XLR headset connector.

P6: Microphone Input
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
These pins are electrically in parallel with pins 3, 2, and 1 respectively of the back-panel 5-pin XLR headset connector.

P7: Main Output 1
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
Pins 2 and 3 are electrically in parallel with pins 2 and 3 respectively of the back-panel 3-pin XLR main out 1 connector.
Careful! The back-panel main out 1 XLR has pin 1 floating.

P8: Main Output 2
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
Pins 2 and 3 are electrically in parallel with pins 2 and 3 respectively of the back-panel 3-pin XLR main out 2 connector.
Careful! The back-panel main out 2 XLR has pin 1 floating.

P9: Main Output 3
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
Pins 2 and 3 are electrically in parallel with pins 2 and 3 respectively of the back-panel 3-pin XLR main out 3 connector.
Careful! The back-panel main out 3 XLR has pin 1 floating.

P10: Main Output 4
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
Pins 2 and 3 are electrically in parallel with pins 2 and 3 respectively of the back panel 3-pin XLR main out 4 connector.
Careful! The back panel main out 4 XLR has pin 1 floating.

P11: Aux Headphone Line Input 1 Left
Pin 1 common
Pin 2 high (+)
Pin 3 not used

P12: Aux Headphone Line Input 2 Right
Pin 1 common
Pin 2 high (+)
Pin 3 not used

P13: Line Input 1
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
These pins are electrically in parallel with pins 1, 2, and 3 respectively of back-panel 3-pin XLR line input 1 connector.

P14: Line Input 2
Pin 1 common
Pin 2 high (+)
Pin 3 low (–)
These pins are electrically in parallel with pins 1, 2, and 3 respectively of back-panel 3-pin XLR line input 2 connector.

P15: Intercom Interface
Pin 1 common
Pin 2 DC with channel 1 audio
Pin 3 channel 2 audio
Follows pins 1, 2, and 3 respectively of back-panel 3-pin XLR intercom connector.

P17: 24 Volt DC Input
Pin 1 common
Pin 2 +24 volts
Pin 3 not used
Header P16 is used by the back-panel 24 Vdc input jack assembly and is electrically in parallel with pins 1 and 2 respectively of P17. (Back-panel 24 Vdc input jack (2.1 x 5.5 mm coaxial) has + on the center pin.)

P19: Multi-Unit Data Interface
Pin 1 common
Pin 2 Data +
Pin 3 Data –

P21: Internal Power Supply Rails
Pin 1 common
Pin 2 + 12 Vdc
Pin 3 –12 Vdc

P22: Relay Contact Main Out 1
Pin 1 common
Pin 2 normally open
Pin 3 normally open
Note: Pins 2 and 3 close (short) when contact is active.

P23: Relay Contact Main Out 2
Pin 1 common
Pin 2 normally open
Pin 3 normally open
Note: Pins 2 and 3 close (short) when contact is active.

P24: Relay Contact Main Out 3
Pin 1 common
Pin 2 normally open
Pin 3 normally open
Note: Pins 2 and 3 close (short) when contact is active.

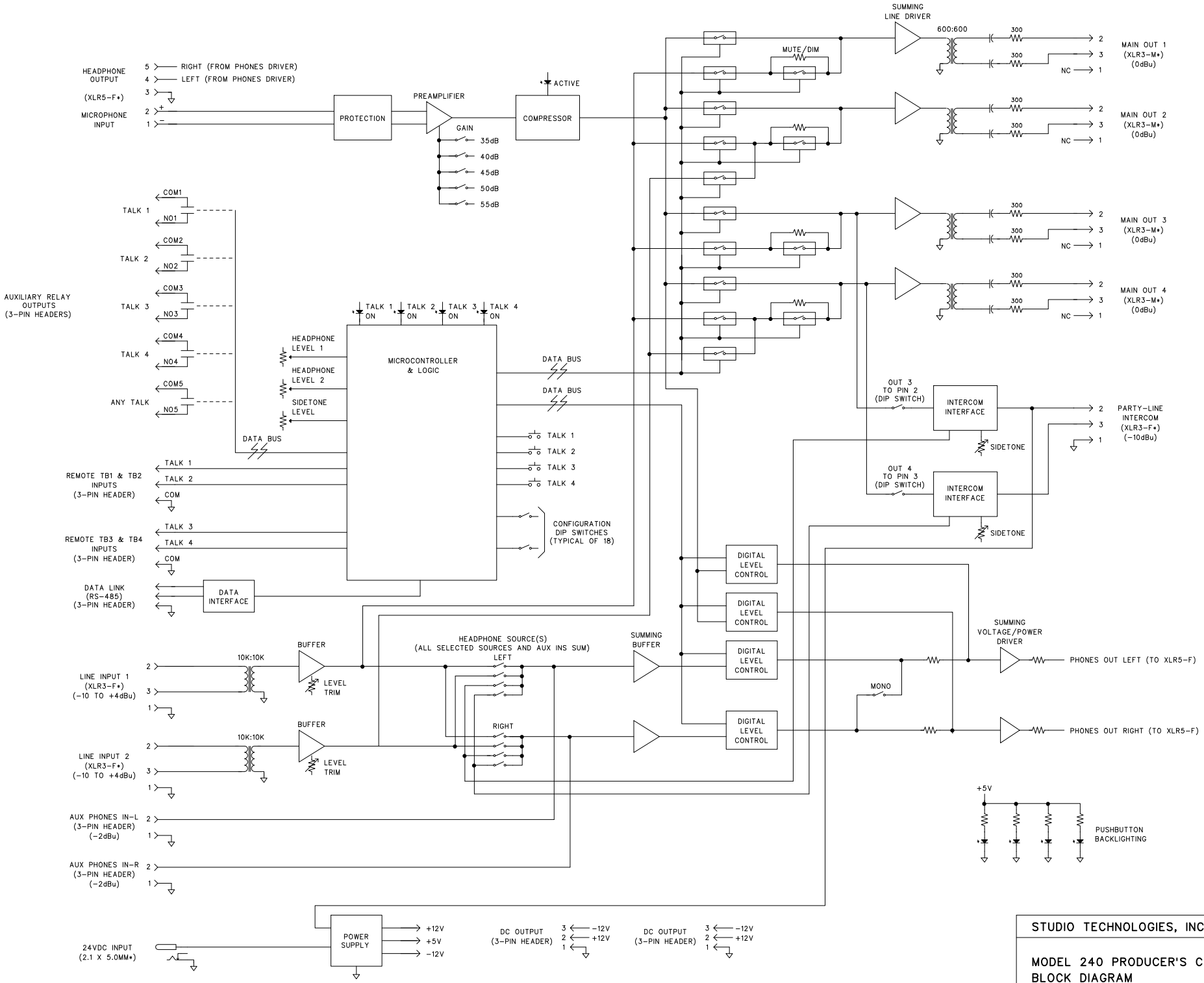
P25: Relay Contact Main Out 4
Pin 1 common
Pin 2 normally open
Pin 3 normally open
Note: Pins 2 and 3 close (short) when contact is active.

P26: Relay Contact "Any Main Out"
Pin 1 common
Pin 2 normally open
Pin 3 normally open
Note: Pins 2 and 3 close (short) when contact is active.

P27: Internal Power Supply Rails
Pin 1 common
Pin 2 + 12 Vdc
Pin 3 –12 Vdc

P28: Remote Switch Inputs
Pin 1 common
Pin 2 main output button 1
Pin 3 main output button 2

P29: Remote Switch Inputs
Pin 1 common
Pin 2 main output button 3
Pin 3 main output button 4



STUDIO TECHNOLOGIES, INC.

MODEL 240 PRODUCER'S CONSOLE
BLOCK DIAGRAM

DRAWING NO.	DATE	PAGE
31854	05/02/13	01 OF 01

FOR SERIAL NUMBER 00151 AND LATER

* ALSO HAS 3-PIN HEADER(S) IN PARALLEL ON PRINTED CIRCUIT BOARD