

# **Model 47** *Interface*

## **User Guide**

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This User Guide is applicable for serial numbers:

M47-00151 and later

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# **Model 47**

*Interface*

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# Introduction

The Model 47 is designed to interface 2-wire full-duplex party-line intercom circuits with 4-wire audio circuits associated with matrix intercom systems. Other specialized audio system interfacing applications can also be supported. The Model 47 provides two independent full-featured 2-channel interfaces. Each interface contains two hybrid circuits which include automatic nulling capability. The analog circuitry, under software control, provides excellent audio quality and high return-loss. The interfaces are compatible with powered and unpowered 2-wire party-line circuits. They are capable of supplying DC power to devices such as user belt packs and user stations. Independent power sources are provided for both channels (pins 2 and 3) of each interface, allowing direct support for broadcast source assignment panel (SAP) applications. Configuration settings allow the 2-wire and 4-wire interface circuitry to be compatible with a range of nominal signal levels. Audio level meters provide user confirmation of system performance during setup and operation. Applications for the Model

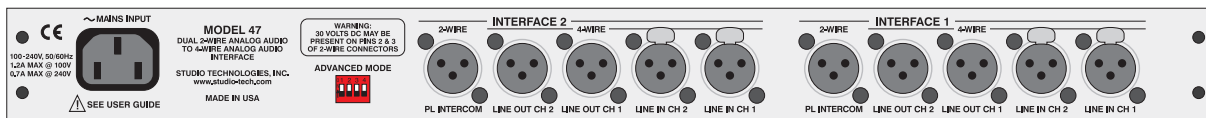
47 include mobile and fixed television facilities, theme park and theater installations, and industrial testing environments. Standard audio connectors are used for all input and output signals. The Model 47 mounts in one space (1U) of a standard 19-inch rack enclosure and requires 100-240 volts, 50/60 Hz for operation.

## 2-Wire Interfaces

The Model 47's 2-wire interfaces are optimized for direct connection with dual-channel party-line (PL) intercom circuits. In addition, single-channel party-line intercom circuits can also be connected. Many broadcast applications use the dual-channel TW-series from RTS®, including their popular BP325 belt pack. Other industry-standard single- and dual-channel PL intercom systems, including those from Clear-Com®, are also directly compatible. To provide optimal signal matching and interface performance the nominal level of the Model 47's 2-wire interfaces can be selected. Using DIP switches, accessible on the front panel, the nominal levels can be selected to be either -10 or -14 dBu, settings that should allow compatibility with virtually all party-line systems.



**Model 47 Front Panel**



**Model 47 Back Panel**

The Model 47's 2-wire interfaces can correctly function with powered ("wet") or unpowered ("dry") intercom circuits. Powered circuits have a DC voltage present, typically provided by power supplies such as the RTS PS20. This DC power, normally 30-32 volts, provides energy for connected devices such as user stations or belt packs. In this type of application the Model 47 is configured to operate in its external 2-wire power source mode. In this mode the Model 47's circuitry maintains the required high-impedance load and, as in all cases, draws no power from the party-line circuit. An auto-terminate function ensures that should a "wet" circuit not be connected, the Model 47's interface circuitry will remain stable. This unique feature makes certain that objectionable audio signals, including oscillations and "squeals," will infrequently be sent to the connected 4-wire device.

A significant capability of the Model 47's 2-wire interfaces is their ability to supply DC power and 200 ohm AC termination to both channels (pins 2 and 3) of the connected intercom circuits. Referred to as the Model 47's internal 2-wire power source mode, the 30 volt outputs can power devices such as user stations and belt packs. With independent power sources provided for both pins 2 and 3 of each interface, applications that include flexible party-line intercom channel routing will be directly supported. As such, in applications that include both source assignment panel (SAP) and Model 47 units the need for external intercom power supplies can be eliminated. Besides reducing total system cost, this capability may also lower system weight, reduce required mounting space, and decrease the mains energy requirements.

With the Model 47's 2-wire interfaces able to supply up to 300 milliamperes of current on each channel, a typical broadcast application that uses four sets of three BP325 belt packs can easily be supported. And the sophisticated 30 volt DC intercom power sources ensure that applications that require long intercom cable runs will function correctly. The circuitry's output regulation is such that little change in the output voltage will occur over its entire rated output current. Also, the unique design of the power supply circuitry virtually eliminates the noise and "hiss" associated with typical intercom power supply performance. Under software control each of the four DC power sources is monitored for over-current and short-circuit conditions. This allows protective shut-down of individual DC outputs, as well as providing an alert by way of a visual indicator.

### **Analog Hybrids with Auto Nulling**

A key reason that the Model 47's interfaces achieve excellent audio performance is the design of the 2-wire-to-4-wire hybrid circuits. They provide low noise and distortion, good frequency response, and high return-loss ("nulling"), even when presented with a wide range of 2-wire conditions. Unlike telephone-line ("POTS") oriented DSP-based hybrid circuits, the Model 47's analog circuitry provides extended frequency response. With a pass band of 100 Hz on the low-end and 8 kHz on the high-end, natural-sounding voice signals can be sent to, and received from, the 2-wire party-line circuits.

A hybrid's ability to isolate the transmit signal from the receive signal in the 2-wire-to-4-wire interface is critical. The quality of

this isolation, technically known as return-loss or trans-hybrid loss, is measured in dB. A high value is important, especially in applications where multiple 2-wire-to-4-wire interfaces are used together. Remote sports broadcast applications are especially sensitive to this requirement. The Model 47's sophisticated auto nulling function uses analog circuitry under microprocessor control to achieve significant trans-hybrid loss. This return-loss "null" is achieved by making a series of adjustments to account for the resistive, inductive, and capacitive conditions that are present on the connected 2-wire party-line circuit. A party-line's condition is the sum of the impact made by the type and quantity of cable, the connected user devices, and the intercom power source.

Whenever a user presses one of the Model 47's "auto null" buttons digital circuitry adjusts the analog hybrids to rapidly achieve their maximum return-loss. The nulling process takes less than ten seconds for each channel of an interface. However, it's important to note that while the nulling process is automatic, it only takes place upon user request. This can lead to more stable and consistent audio performance when a hybrid is exposed to the varying 2-wire conditions often found in broadcast applications. The parameters obtained during the nulling process are stored in non-volatile memory; mains power interruptions won't require the auto nulling function to again be performed.

A sine-wave audio tone is generated for use during the auto nulling process. The frequency is software-controlled to maximize the ability of the hybrid circuits to reach a "deep" null. In addition, at the beginning of each auto null sequence a

short period of 24 kHz tone is sent to the associated 2-wire party-line interface. This serves as a microphone disable ("mic kill") signal for user devices such as the RTS BP325. By automatically disabling "open" microphones the auto nulling process can achieve better performance.

## 4-Wire Interfaces

Associated with the 4-wire portion of the Model 47's interfaces are analog line-level inputs and outputs. These are intended to interconnect with a variety of 4-wire devices, including matrix intercom systems, audio-over-fiber transmission systems, and other specialized audio equipment. The input and output circuitry is transformer-coupled to minimize the chance of hum, noise, or ground "loop" issues. A key characteristic of the Model 47's design is the ability to select the 4-wire input and output nominal levels. This helps to ensure compatibility with virtually all audio equipment. Front-panel-accessible DIP switches allow the nominal levels to be configured from among four choices: 0, +4, +6, or +8 dBu. The 0 dBu setting was specifically provided for compatibility with Clear-Com matrix intercom systems. The +4 dBu setting allows "standard" audio signals to be directly connected. Digital matrix intercom systems from Riedel® can be effectively connected using the +6 dBu setting. And the +8 dBu setting allows proper level matching with the popular ADAM® series of matrix intercom systems from RTS. This setting also applies to the related RVON-I/O VoIP product.

The Model 47 contains eight 5-segment LED level meters. Four of the meters are provided for each interface, with two displaying the level of the signal being

received from the 4-wire source and two displaying the level being sent to the 4-wire output. During installation and setup the meters are invaluable in helping to confirm that the nominal level DIP switch settings have been properly made. During normal operation the meters offer rapid confirmation of audio signal flow in and out of the unit. Additional LED status indicators are also provided, offering a clear view of the 2-wire DC power and auto null functions.

## Pro Audio Quality

The Model 47's audio circuitry was designed in the spirit of professional audio equipment, rather than that found in typical party-line intercom gear. High-performance components are used throughout, providing low-distortion, low-noise, and high headroom. Using passive and active filters, the frequency response is limited to approximately 100 Hz to 8 kHz. This range was selected to provide excellent performance for human speech, while maximizing the ability of the hybrids to create substantial "nulls." When the Model 47's internal DC power sources are selected to provide 2-wire party-line intercom power, enhanced audio performance can also be expected. The quality of the DC power sources is excellent, with very little noise, hum, or "hiss" being added to the 2-wire connections.

Attention to detail is a hallmark of the Model 47's design. For example, during the brief auto nulling process an interface channel's 4-wire input and output signal is muted, preventing unwanted audio from reaching the connected equipment. Associated with the 2-wire interfaces is circuitry that, under software control, applies 200 ohm terminating impedances to the 2-wire

party-line circuits. This, along with other circuitry that monitors DC voltages present on the 2-wire circuits, ensures that audio instability associated with unterminated circuits will rarely occur. As previously mentioned the Model 47's 2-wire DC power sources offer a unique level of performance. Their ability to deliver power while maintaining audio quality is simply unmatched.

## Special Applications

While the Model 47 is designed to directly integrate into typical applications, it's ready to support the "one-in-a-million" situations too. To accomplish this DIP switches, accessible on the back panel, allow some of the automatic features to be disabled. For example, one DIP switch allows the auto-terminate feature to be disabled. While this feature can help maintain audio quality, advanced users might need to disable it. This would allow full control over the Model 47's four hybrid circuits, enabling them to be used completely independently. A second DIP switch changes the way in which the front-panel auto null pushbutton switches operate. Normally pressing one of the buttons begins the process of auto nulling both channels associated with an interface. The alternate switch mode allows each auto null sequence to be activated independently. One tap of the auto null button will begin the auto null process for interface one. Two taps of the button will begin the auto null process for channel two. For installer-selected applications, three opto-coupled inputs allow selected Model 47 features to be remotely controlled. These features include remote auto nulling for each interface and remote "mic kill" activation.

## Simple Installation

The Model 47 uses standard 3-pin XLR connectors to allow convenient interconnection in most broadcast and general audio environments. For flexibility, access to the 2-wire party-line intercom interfaces can be made using the connectors provided on both the front and back panels. In permanent installations the back-panel connectors will typically be utilized. In other settings, such as field television production, front-panel access allows intercom belt packs to be rapidly connected, without requiring access to the inside of a rack enclosure or necessitating the use of a secondary input/output (I/O) panel.

The Model 47 is housed in a rugged steel enclosure that is designed to be “road tough.” It mounts in one space (1U) of a standard 19-inch rack enclosure. The mains input source can range from 100 to 240 volts, 50/60 Hz allowing direct operation virtually anywhere in the world. A switch-mode power supply, contained within the Model 47’s enclosure, provides conversion of the mains input power into the DC voltage required by the party-line power supply circuits. Also contained within the unit is a DC-to-DC converter that creates the voltages required by the analog and digital circuitry. These efficient power supplies help to ensure cool, reliable operation in a variety of settings.

## Design Philosophy

While the “bits and pieces” that make up the Model 47 have been described in conventional terms, the real strength of the unit rests in how it integrates and performs in the “real world.” Before beginning the Model 47’s design process, conversations with industry experts quickly made

it apparent that installing and configuring existing 2-wire-to-4-wire interface units was invariably a time-consuming, aggravating process that required the talent of an expert to achieve reasonable results. And even under those constraints the resulting audio performance was often mediocre. Any new design had to look at the application in a different way. This led to the over-riding Model 47 design goal: create a “new breed of cat,” fundamentally changing how broadcast 2-wire-to-4-wire interface equipment fit into actual applications.

An important first step was to eliminate the requirement that a senior technician, along with a screwdriver, be present during every installation. (It was universally acknowledged that their time can be better spent elsewhere!) The need to adjust trim potentiometers, fabricate special cabling and connector straps, use nulling ear-pieces, etc. had to be eliminated. For example, in virtually all instances, input and output levels fall within just a few dB of their nominal values and, as such, could be supported with a limited number of configurable choices. In addition, it was acknowledged that in this application analog audio circuitry was capable of providing excellent audio performance, but that the required manual nulling process was operationally taxing. By adding digital control to the analog circuitry, automatic nulling could be performed—the best of both worlds!

The next step was to identify resources that would improve the installation process and make operation more reliable. This led to the inclusion of multiple LED level meters, allowing continuous monitoring of the input and output signals. It also turned out that in many applications only a small number of user devices, such as belt packs, are

typically connected to 2-wire party-line intercom circuits. But power on both pins 2 and 3 of each interface was necessary for compatibility with SAP panel applications. By adding two DC power sources to each of the Model 47's 2-wire interfaces, the need for external intercom power supplies could often be eliminated.

The final step was to create a physical package that would provide significant resources in a form that allowed simple and reliable integration with other equipment. This was accomplished by including two 2-channel interfaces in a 1U enclosure. Using standard 3-pin XLR audio connectors would enable rapid installation and troubleshooting. And by making the Model 47 "universally" powered, installation in any locale could be directly supported.

## Installation

In this section you will be installing and interconnecting the Model 47. The one-rack-space unit will be mounted in an equipment rack. Audio input, audio output, and party-line intercom connections will be made by way of 3-pin XLR connectors. AC mains power will be connected by means of a detachable cord set that is compatible with the Model 47's 3-pin IEC 320 C14 inlet connector.

## System Components

The shipping carton contains the Model 47 Interface, user guide, and AC mains cord suitable for use in North America and Japan. Your dealer or distributor should provide an AC mains cord appropriate for use in other locations.

## Locating the Model 47

The Model 47's mounting location will dictate the length of the cable runs needed to link the unit with the connected devices. This is really only a factor in relation to the 2-wire party-line intercom circuits. These circuits carry unbalanced audio which can be susceptible to interference and cross-talk issues. Intercom circuits also carry DC power which may make resistive losses come into the picture. In general, shorter intercom cable lengths will assure more reliable and consistent system performance. Another location criterion is access to the Model 47's front panel. An optimal location will allow convenient use of the auto null pushbuttons and easy observation of the status and level meter LEDs.

## Mounting the Model 47

Once a mounting location has been selected installation can begin. The Model 47 requires one space (1.75 vertical inches) in a standard 19-inch (48.3 cm) equipment rack. Secure the unit into the equipment rack using two mounting screws per side.

## 4-Wire Audio Inputs and Outputs

Two audio line input and two audio line output signals are associated with the 4-wire section of each of the Model 47's two interface circuits. Connections are made using standard 3-pin male and female XLR connectors. Refer to Appendices A, B, and C for details on interconnecting with RTS, Riedel, and Clear-Com matrix intercom systems.

### 4-Wire Line Inputs

As previously mentioned, each of the Model 47's two interfaces allows two analog line-level audio sources to be connected. The source for these signals will typically be ports on a matrix intercom system. It's also possible that the signals will come from other devices, such as a fiber-optic-based audio transmission system. The 4-wire input circuitry is balanced, capacitor coupled, transformer isolated, and has an impedance of 13 k ohms. The line inputs are compatible with signals that have a nominal level of 0, +4, +6, or +8 dBu. Configuration DIP switches, located on the Model 47's front panel, allow the circuitry to be adjusted to match the connected nominal level. The DIP switches work in tandem to control both the line input and line output nominal levels.

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. Refer to Figure 1 for a detailed view. Note that pin 1 of these connectors is internally connected to the Model 47's earth/chassis ground point.

Prepare the mating connectors (males) so that pin 2 is signal high (+ or hot), pin 3 is low (– or cold), 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; “floating” pin 1 will remove a potential ground current path from the Model 47's earth/chassis ground point through the shield of a cable. Also, if a hum or noise issue does arise be certain to confirm that, unless absolutely necessary, the mating connector's “shell” isn't connected to the cable's shield or pin 1. The termination of this “fourth” pin of a

3-pin XLR connector is often the cause of seemingly inexplicable noise issues.

With an unbalanced source connect pin 2 to signal high (+ or hot) and both pins 1 and 3 to shield. If connecting an unbalanced source in this manner results in hum or noise, connect pin 2 to high (+ or hot) and pin 3 to shield; leave pin 1 unterminated.

### 4-Wire Line Outputs

Each of the Model 47's two interfaces provides two analog line-level audio outputs. These outputs are intended to be connected to inputs on the devices associated with the 4-wire audio signals. The outputs are capacitor coupled, transformer balanced with a nominal level of 0, +4, +6, or +8 dBu. As previously mentioned, the 4-wire nominal level configuration DIP switches, located on the Model 47's front panel, control the level of both the line outputs and the line inputs. The 4-wire line outputs are capable of driving inputs that have impedances as low as 600 ohms, however connecting to loads of 2 k ohms or greater is preferred. The line outputs are connected by way of 3-pin male XLR connectors which are located on the Model 47's back panel. Refer to Figure 1 for a detailed view.

The mating connectors (females) should be prepared so that signal high (+ or hot) is expected on pin 2. Signal low (– or cold) should be expected on pin 3. A cable's shield can be connected to pin 1. However, in order to minimize the chance that ground-interaction problems will arise, pin 1 on each of the line output connectors is isolated from all Model 47 circuitry and ground points. “Floating” pin 1 virtually eliminates the chance that a “ground loop” problem will occur.

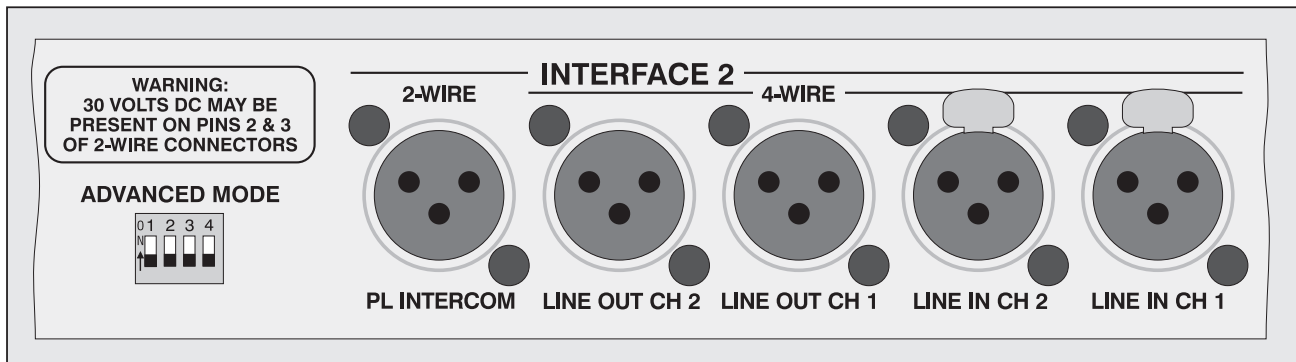


Figure 1. Detail of back panel showing line inputs and outputs

## 2-Wire Party-Line Intercom Connections

The Model 47's 2-wire party-line (PL) intercom interfaces can be directly connected with standard single- and dual-channel party-line intercom devices. But to take advantage of the power that's provided on both pins 2 and 3 of the PL circuits, the interfaces will typically be routed by way of a source assignment panel (SAP).

The Model 47 can provide the DC power required by connected intercom user devices. The internal 30 volt DC intercom power sources are limited to 300 milliamperes of current. This moderate amount of power requires that the type and number of connected user devices be selected appropriately. Each of the two 2-channel PL interfaces is also compatible with intercom circuits that have their own DC power sources.

For convenience, the 2-wire PL intercom circuits can be connected to the Model 47 by way of four 3-pin male XLR connectors; two are located on the back panel and two on the front. They are organized in groups of two connectors per interface—one on the back and one on the front. They are

wired in parallel ("malted") and provide access to the identical signals.

## Source Assignment Panel (SAP) Applications

When used in conjunction with a broadcast SAP installation the Model 47 should be considered as having four independent 2-wire interfaces. Each interface should be interconnected to the SAP such that common is on pin 1, DC with channel 1 audio is on pin 2, and DC with channel 2 audio is on pin 3. Typically the 2-wire PL XLR connectors that are located on the Model 47's back panel should be used. This will provide the most organized wiring implementation. In addition, the front-panel 2-wire PL XLR connectors will remain available for emergency and troubleshooting access.

## Dual-Channel Intercom Systems

If direct compatibility with RTS TW systems is desired the mating connectors (females) 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. This wiring scheme is correct whether the connected devices are to be powered by an external source or by means of the Model 47's internal power sources.

## Single-Channel Intercom Systems

There are two ways of connecting to the Model 47's 2-wire PL intercom connectors when compatibility with Clear-Com single-channel intercom devices is desired. The most direct method is to prepare the female XLR mating connector so that common is on pin 1, power is on pin 2, and audio is connected on pin 3. With this connection scenario only audio channel two, associated with pin 3 of the Model 47's 2-wire PL intercom interface connectors will be utilized. Pin 2, the Model 47's audio channel 1, will only be used for connecting DC power to the connected devices.

In some single-channel PL intercom system applications it may be desirable to take full advantage of the two channels associated with each Model 47 interface. In these applications one might want to view the Model 47 as providing four 2-wire-to-4-wire interface circuits. The Model 47 can certainly be used in this fashion, but adapter cables will have to be prepared. Refer to Figure 2 for details.

These adapters will "split" the Model 47's 2-wire PL intercom connectors into two 3-pin male XLR connectors, one for each audio channel. Pin 1 of the female 3-pin XLR intended to mate with the Model 47 will connect to pin 1 of both 3-pin male XLR connectors. Pin 2 of the female XLR will go to pin 3 of the male XLR designated

as channel 1. Pin 3 of the female XLR will go to pin 3 of the male XLR designated as channel 2.

Using two adapter cables the Model 47 can be directly interconnected with four Clear-Com intercom circuits. However, power for the connected devices must be provided by external power sources. The Model 47's ability to supply intercom power will not be utilized.

**Note:** It's critical that the correct configuration settings be made when using the Model 47's interfaces to support four independent intercom circuits. Specifically, the 2-wire power source configuration DIP switches must be set for external. In addition the auto terminate DIP switch must be placed in its on (up) position. Refer to the Configuration and Advanced Configuration sections of this user guide for details.

## Remote Control Inputs

The Model 47 allows connection of three externally provided DC signals. These signals can provide remote control operation of three functions: auto nulling for interface 1, auto nulling for interface 2, and a special "mic kill" function. Remote control of the auto nulling functions provides a resource identical to that of the front-panel pushbutton switches. The exact manner in which the buttons and the remote control inputs operate depends on the setting of the auto null button configuration DIP switch. The "mic kill" function is unique, only being available using the remote control input. It causes a 500 millisecond "burst" of 24 kHz signal to be sent sequentially to both of the 2-wire partly-line interface channels associated with each of the Model 47's two interfaces. To clarify, a "mic kill" signal is sent to a total of four

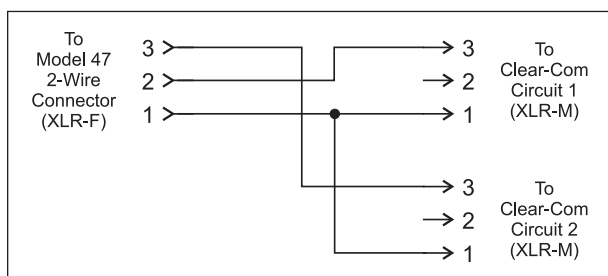


Figure 2. Adapter cable wiring diagram

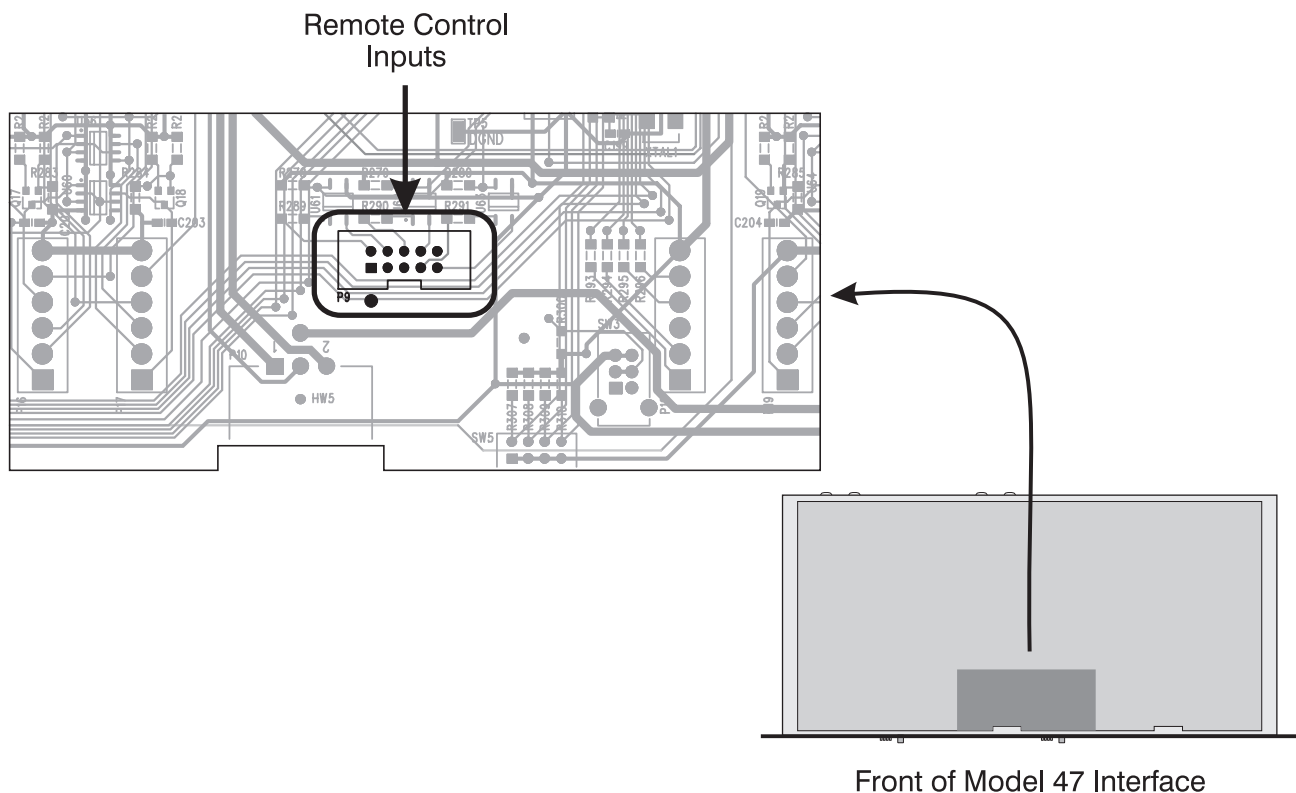
## Model 47 Interface

intercom channels whenever the function is activated. Independent control of sending “mic kill” signals to interface 1 or interface 2 is not supported. User intercom devices compatible with this 24 kHz “mic kill” signal include RTS TW-series belt packs such as the BP325.

The opto-coupled remote control inputs are designed for direct connection with 3.3 and 5 volt DC logic signals. An internal 475 ohm resistor, in series with each opto-coupler’s photodiode, acts to limit the current flow. Signals of up to 32 volts DC can be safely connected as long as the current is limited to 20 milliamperes maximum. If necessary, an external resistor can serve to limit the current. For example, with a 12 volt DC signal using a 560 ohm, ¼-watt resistor in series with the connection would be appropriate. With a 24 volt

DC control signal a series resistor of 1.8 k (1800) ohms is recommended. No matter the source voltage, for correct operation a minimum current of 2 milliamperes is recommended.

Access to the remote control inputs is provided by means of a 10-pin male “header” connector which is located on the Model 47’s circuit board. Refer to Figure 3 for a view of the connector’s location. The “keyed” and “shrouded” header follows a common industry-standard specification: two rows of five pins each with 0.1 inch between rows and pins. The mating connector is intended to be an insulation-displacement (IDC) socket connector such as the Tyco 1658620-1. The connector would be “crimp” terminated onto a piece of 10-conductor flat ribbon cable. This ribbon cable can safely exit the Model 47



**Figure 3. Location of 10-Pin male header connector on the Model 47 printed circuit board**

by laying flat between the chassis and the cover. The ribbon cable can then “fan out” to loose wires or, better yet, be terminated onto another connector such as a 9-pin D-subminiature type.

A competent technician can easily fabricate an appropriate remote control input interconnect wiring assembly. Starting with a partially pre-made assembly from Digi-Key (part number A1AXH-1036G-ND) makes the task even easier.

It’s important to ensure that the source of the remote control signals can meet the Model 47’s logic state and timing requirements. The Model 47 recognizes an idle remote control input as one that has no current flowing through it. An active remote control input is one that has current flowing through it for a minimum of 30 milliseconds. A special case arises when the auto null button operating mode has been set to independent. This requires one front-panel button tap to auto null channel 1 and two button taps to auto null channel 2. The remote control equivalent for one tap is current flowing for a minimum of 30 milliseconds. The equivalent for two taps is current that flows for 30 milliseconds, then a minimum no-current period of 30 milliseconds, followed by current flow for a minimum of 30 milliseconds. The second period of current flow must come within one second of the start of the first.

Once the interconnect method and the source of the control signals have been selected, refer to Figure 4 for connection details. Ensure that the connected signals follow the specified polarity or damage to the opto-coupled inputs may occur.

Function	10-Pin Header (P9)	9-Pin D-Sub Interface Cable
Remote Auto Null Interface 1 +	7	4
Remote Auto Null Interface 1 –	9	5
Remote Auto Null Interface 2 +	2	6
Remote Auto Null Interface 1 –	4	7
Remote “Mic Kill” +	6	8
Remote “Mic Kill” –	8	9

**Figure 4. Remote control input pin-out chart**

It’s important that a competent technician be available to perform the actual remote control input connection process. As expected, mating the interconnecting cable assembly with the Model 47’s 10-pin “header” requires removing the unit’s cover. As such, this must be done only after confirming that all sources of mains power have been disconnected from the unit.

## AC Mains Power

The Model 47 operates directly from AC mains power of 100 to 240 V, 50/60 Hz. As a “universal mains input” device, there are no switches to set or jumpers to install. A 3-pin IEC 320 C14 inlet connector on the Model 47 mates with a detachable mains cord set. For units shipped to North America and Japan a cord is supplied that has a North-American (NEMA 5-15L) standard plug on one end and an IEC 320 C13 connector on the other. Units bound for other destinations require that the appropriate cord set be obtained. The wire colors in the mains cord should conform to the internationally recognized color code and should be terminated according to the following chart:

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

**Safety Warning:** The Model 47 does not contain an AC mains disconnect switch. As such, the AC mains cord plug serves as the disconnection device. Safety considerations require that the plug and associated inlet be easily accessible to allow rapid disconnection of AC mains power should it prove necessary.

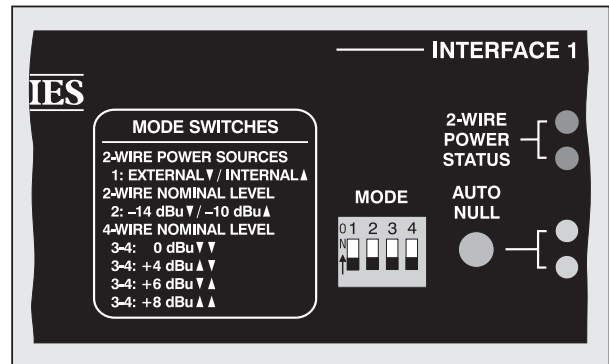
As soon as AC mains power is applied the Model 47 will begin its power-up sequence. As a “boot up” indication the power LED and each of the status LEDs will momentarily light. After the sequence has completed the power LED will again light and remain lit. The unit is now fully functional.

## Configuration

For the Model 47 to support the needs of specific applications a number of operating parameters must be configured. These include the 2-wire party-line power source, the nominal 2-wire level, and the nominal 4-wire level. Three 4-position DIP switch assemblies are used to establish the desired configuration. One DIP switch assembly is associated with interface 1, a second is associated with interface 2, and a third is associated with advanced operating features that apply to both interfaces.

### Configuration – Interface 1 and Interface 2

The DIP switch assemblies associated with interfaces 1 and 2 are accessible on the Model 47’s front panel. They provide identical capability for their respective interfaces. Refer to Figure 5 for a detailed



**Figure 5. Detail of front panel showing four DIP switches**

view. In this section the four DIP switches associated with interface 1 will be covered in detail. This information applies to interface 2 as well. The four DIP switches allow selection of the 2-wire party-line power sources, the nominal level for the 2-wire party-line channels, and the nominal level of the 4-wire inputs and outputs.

#### 2-Wire Party-Line Power Source

DIP switch 1 is used to select whether or not the Model 47 provides DC power to pins 2 and 3 of connectors associated with the 2-wire party-line intercom channels. Two 3-pin male XLR connectors, one located on the Model 47’s front panel and one on the back panel, are used to interconnect the Model 47 with the intercom user devices or a SAP. When DIP switch 1 is in its off (down) position the Model 47 will not provide DC power. This DIP switch setting is appropriate when an external intercom power supply is providing power to the intercom circuit. In addition to power, it’s expected that the external power supply will also provide the required 200 ohm terminating impedance to both pins 2 and 3.

When DIP switch 1 is in its on (up) position the Model 47 provides independent 30 volt, 300 milliamperes maximum sources of DC

power to pins 2 and 3 of the 2-wire PL intercom connectors. The Model 47 will also provide 200 ohm terminating impedances for both pins 2 and 3 of the party-line connectors. The DC power and termination capabilities allow direct powering of dual-channel intercom belt packs, such as the RTS BP325. In addition, listen-only belt packs, such as the Model 34 from Studio Technologies, Inc. can be directly connected. There's also no problem connecting single-channel intercom belt packs or user stations.

### **2-Wire Nominal Audio Level**

DIP switch 2 allows adjustment of the nominal audio level for the two 2-wire party-line channels associated with interface 1. When the DIP switch is in its off (down) position the nominal level is -14 dBu. This level is compatible with intercom belt packs from manufacturers such as Clear-Com. When the DIP switch is in its on (up) position the nominal level is -10 dBu. This setting is appropriate when belt packs from RTS, such as the BP325, or listen-only talent amplifier units from Studio Technologies, Inc. are connected. For best Model 47 performance it's important that the 2-wire nominal level selection be made correctly.

### **4-Wire Nominal Audio Level**

DIP switches 3 and 4 are used to configure the nominal level of the input and output circuitry associated with interface 1's two 4-wire input and output connections. Four level settings are available: 0, +4, +6, and +8 dBu. Prior to setting these DIP switches it's important to determine the nominal audio level of the equipment connected to the Model 47's 4-wire input and outputs. This may take a little investigation

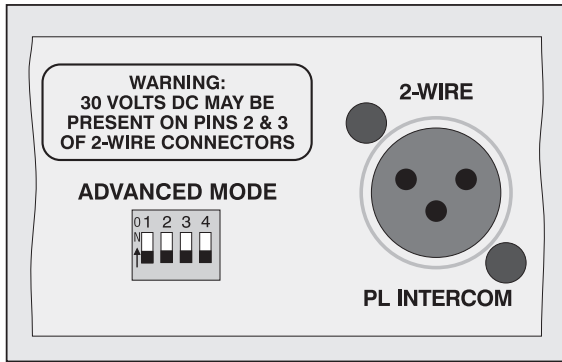
but is important for obtaining the best possible Model 47 performance.

The 0 dBu setting is provided specifically for use when a Model 47 is interconnected with a Clear-Com matrix intercom system. The +4 dBu setting is appropriate when standard audio lines with "+4" nominal levels are interconnected. The +6 dBu setting can be appropriate when interconnecting with equipment manufactured in Europe, such as the digital matrix intercom systems from Riedel. The +8 dBu setting is provided specifically when interconnecting the Model 47 with audio signals associated with an RTS ADAM-series of matrix intercom system. This includes the related RVON-I/O unit.

When DIP switches 3 and 4 are in their off (down) position the nominal level is set for 0 dBu. When DIP switch 3 is on (up) and DIP switch 4 is off (down) the nominal level is +4 dBu. When switch 3 is off (down) and switch 4 is on (up) the nominal level is +6 dBu. When both switches 3 and 4 are in their on (up) position the nominal level is configured for +8 dBu.

## **Advanced Configuration**

Four DIP switches are provided on the Model 47's back panel. They allow the two interfaces to be configured for several advanced operating modes. Refer to Figure 6 for a detailed view of these DIP switches. The available configurations include auto terminate, auto null button, logic refresh, and factory test.



**Figure 6. Detail of back panel showing the Advanced Mode DIP switches**

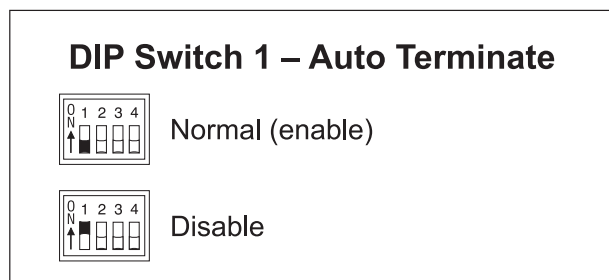
## Auto Terminate

The auto terminate function is designed to ensure that each 2-wire-to-4-wire interface circuit remains stable under most operating conditions. Specifically, 200 ohm impedances are automatically applied to both pins 2 and 3 of a Model 47 2-wire party-line interface when that interface is configured for external power and no external source of intercom power is detected on pins 2 or 3. This function is directly compatible with RTS TW-series intercom applications in which the three conductors of a cable support both DC power and two channels of audio. It's also compatible in situations where all three conductors of a Clear-Com single-channel intercom circuit are connected to the Model 47. In this latter case only one of the Model 47's audio channels will be used.

There may be situations where it's necessary for the two channels associated with each Model 47 interface be used with separate 2-wire party-line circuits. An example of this might be where two "loops" of single-channel belt packs, such as units from Clear-Com, need to be connected. Adapter cables as shown in Figure 2

would be used. In this case the intercom circuit's DC power will not be connected to the Model 47, but only to the user devices. In this scenario, a DC voltage won't be present on pins 2 or 3. Another example of this might be where adapter boxes with DC blocking are used to interconnect intercom circuits with the Model 47. In both these cases a DC voltage won't be present on either pins 2 or 3 and the Model 47 will automatically apply 200 ohm terminations. In both these cases the termination will be in error and will result in incorrect audio levels due a double-termination condition.

To prevent this problem the auto terminate function can be disabled. Referring to Figure 7, when DIP switch 1 is in its off (down) position the auto terminate function is active. When DIP switch 1 is in its on (up) position the auto terminate function is disabled. Repeating for clarity, the auto terminate function applies to both interfaces 1 and 2. With the auto terminate function disabled the two interfaces, when set for external power, will operate normally with the exception that pins 2 and 3 will never be terminated by the Model 47's circuitry.



**Figure 7. DIP Switch 1—Auto Terminate**

The auto terminate function should be disabled only when absolutely necessary; it's possible that a significant downside could be experienced. With auto terminate disabled it's important that properly terminated 2-wire party-line intercom circuits be connected to pins 2 or 3 on the Model 47's 2-wire PL connectors. If they are not connected, it's likely that audio oscillations, noise, and distortion will be generated in the Model 47's 2-wire-to-4-wire converter circuitry. These audio artifacts will not cause any damage, but will be sent out the 4-wire line output connectors. Users of the 4-wire equipment may be less than pleased with what they hear!

## Auto Null Button

One pushbutton switch is associated with each of the Model 47's two interface circuits. An advanced configuration parameter allows selection of the button's operation. The choices are dual auto null and independent auto null. When dual auto null is selected a single tap (press and release) of one of the two front-panel pushbutton switches initiates a routine that begins with channel 1's auto null sequence taking place followed immediately by channel 2's auto null sequence being performed. Note that the configuration selected for auto null button operation will also apply to the remote auto null inputs.

Independent auto null allows the auto null function to be initiated for each channel as desired. A single tap will start the auto null routine for channel 1. Two taps will start the routine for channel 2.

Referring to Figure 8, when DIP switch 2 is in its off (down) position dual auto null is selected. This is provided specifically for cases where the Model 47's 2-wire party-

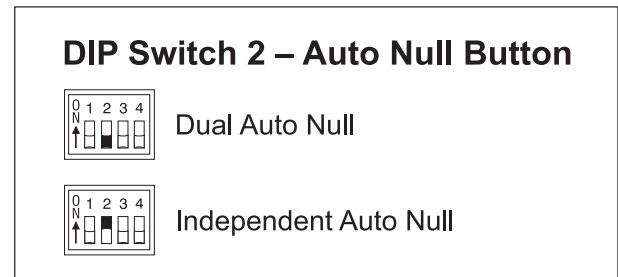


Figure 8. DIP Switch 2—Auto Null Button

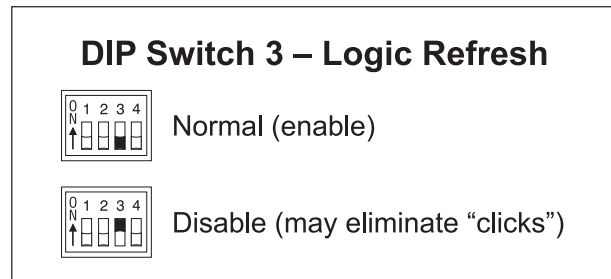
line interfaces will be used with dual-channel intercom user devices. As an example: the RTS TW-series provides two independent audio channels, as well as power, over a single 3-conductor cable. In a case such as this it's useful for both of the hybrid circuits associated with an interface to be auto nulled at approximately the same time. Dual auto null allows a single tap of the button to initiate nulling of both hybrid circuits.

When DIP switch 2 is in its on (up) position independent auto null is selected. This would be appropriate for applications in which the two audio paths associated with each interface are used with independent party-line intercom circuits. This situation might arise when two Clear-Com single-channel intercom circuits are connected to one of the Model 47's dual-channel interfaces. The hybrid circuit associated with each channel can be auto nulled as desired. Another example would be in an RTS TW-series application that uses source assignment panels. These SAP panels would be used to route multiple intercom channels to various sets of user devices as desired. In this case, the two channels associated with each Model 47 interface will often end up not routed to the same user device; independent auto nulling is certainly desired.

## Logic Refresh

While testing the Model 46, “cousin” to the Model 47, it was found that in cases of extreme ESD (electro-static-discharge or “static”) an integrated circuit in the audio signal path could “latch up.” This would result in the audio signal no longer passing through this component and on to the 4-wire audio output. Whenever this situation arose the component was not damaged, but restoring the flow of audio required either a power-down/power-up sequence, an auto null operation, or a change to one of the level configuration DIP switches to take place. While it is very unlikely that this type of ESD event would occur during normal field operation it is of concern for critical applications. Since the Model 47’s circuitry is very similar, to minimize the chance that its audio path could experience this problem a “refresh” routine was included in the operating software (“firmware”). To ensure that the ESD-sensitive component always remains functioning correctly the software re-sends its operating instructions four times each second. With this implementation the worst case scenario would result in an audio loss of 250 milliseconds or less in the event of an extreme ESD “hit” being experienced.

But nothing comes without a price and in this case the logic refresh routine adds a very slight audio click to the 4-wire output and 2-wire party-line signals. During typical applications these refresh clicks will not be noticeable. But there may be situations where any added audio artifact may simply not be acceptable. To address this possible, but highly unlikely, case back-panel DIP switch 3 can be used to disable the refresh routine. Referring to Figure 9,

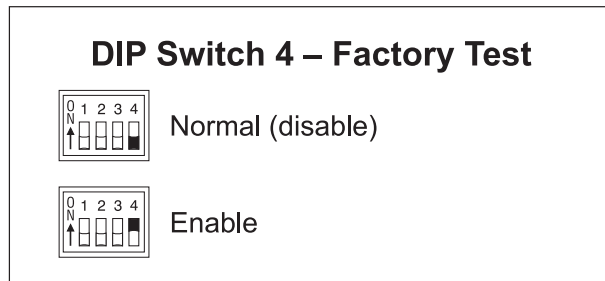


**Figure 9. DIP Switch 3—Logic Refresh**

when DIP switch 3 is in its off (down) position the Model 47 operates in its standard fashion. When DIP switch 3 is in its on (up) position the logic refresh routine is disabled. The Model 47 will continue to function normally with the exception that the 4-times-per-second logic refresh routine will not occur. Goodbye click but hello to the possibility that an ESD-induced audio path problem could occur. A good “rule of thumb” is that if a Model 47 is mounted in an equipment rack with a known-good ground connection, disabling logic refresh shouldn’t pose any risk to reliable operation. But if a unit is mounted in a portable rack, or used loose as a single device, logic refresh should always remain enabled. The reasoning is quite simple: the latter condition is much more likely to allow an ESD “hit” to dissipate into the Model 47’s enclosure, while a substantial rack enclosure will offer a low-impedance path for ESD energy to dissipate into.

## Factory Test

Back-panel DIP switch 4 is used to select between normal mode and factory test mode. Referring to Figure 10, when DIP switch 4 is in its off (down) position the Model 47 operates in its standard fashion. When DIP switch 4 is in its on (up) position the factory test mode is selected. As expected, when the Model 47 is deployed



**Figure 10. DIP Switch 4—Factory Test**

in the field DIP switch 4 should remain in its off (down) position. No damage to the Model 47 or connected equipment will occur when factory test mode is active.

## Operation

Technician intervention is typically not required during normal Model 47 operation. The unit is designed for continuous operation with no routine maintenance necessary. Activating the auto null functions may be warranted should connected user devices or wiring associated with the 2-wire party-line intercom be changed. Upon power-up the Model 47 will go through a short initialization sequence before normal operation will begin. The power and status LEDs will each light sequentially and, upon completion, the power LED will light steadily. The settings for the four hybrid circuits are stored in non-volatile memory and will be recalled during the power-up process.

## Level Meters

The Model 47 contains eight 5-segment LED level meters. These meters are provided as a support aid during installation, configuration, operation, and troubleshooting. The meters represent the signals coming in from, and going out to, the 4-wire connections. The meters are organized in four groups each representing one input and

one output. They are calibrated to reflect the level in dB relative to the configured nominal operating level. This is similar to the way in which now-legacy VU meters functioned. As an example let's take the situation where the nominal operating level of an interface is configured for +4 dBu and an output ("to 4-wire") LED labeled "0 dB" is lit. (For this example, the level on the 2-wire PL circuit is just large enough to light the "0" LED.) This indicates that a signal with an approximate level of +4 dBu is present on the associated 4-wire output connector. Another example would be a Model 47 interface configured for +8 dBu operation and a -12 dB LED is lit. This indicates that a signal with audio level of -4 dBu is present on its associated output.

Each level meter contains four green LEDs and one yellow LED. The four green LEDs indicate signal levels at or below the configured nominal level. The top LED is yellow in color and indicates a signal that is 6 dB or greater than the nominal level. An audio signal that causes the yellow LED to light doesn't necessarily indicate an excessive level condition, but it does provide a warning that at some point reducing the signal level may be prudent. Normal operation with normal signal levels should find the meters lighting near their 0-dB point. Signal peaks may cause the yellow LEDs to flash. But a yellow LED that lights fully during normal operation will typically indicate a signal level or configuration problem.

If the "from 4-wire" meters display consistency lower or higher levels than their 0-dB points it's possible that a configuration issue exists. One potential problem is incorrectly set 4-wire nominal audio level DIP switches for one or both of the Model

47's interfaces. If the nominal level is set too low then sufficient audio headroom might not be available. It can also result in excessively high audio signals being sent to 2-wire party-line circuits. Setting the nominal level for too high a value will reduce the signal-to-noise performance. And, as expected, it may also result in audio signals being sent to the 2-wire circuits at too low a level. Begin a review by confirming that the two 4-wire level DIP switches associated with each interface are set as required.

If the Model 47's 4-wire nominal levels are set correctly but the meters still reflect sub-optimal levels, the issue may be related to incorrect settings on the equipment connected to the 4-wire inputs and outputs. It's possible that although a connected 4-wire device's nominal level matches the Model 47's level setting, its actual nominal level may be significantly different. With a digital matrix intercom system this problem could be due to an incorrect configuration having been made to a specific channel or port. For example, the RTS ADAM system has a published nominal level of +8 dBu, but using its configuration software it's possible to set panels or ports to a level different than nominal. The best solution in this case is to adjust the intercom system so that its levels comply with its own published nominal value. This should, at least in theory, lead to the best system performance, including correct interfacing with the Model 47. But often it's impossible to "clean up" the levels of an existing system. In this case it may be necessary to revise the Model 47's 4-wire nominal level settings to match the reality of the connected signals.

The "to 4-wire" meters display the level of signals that come from the 2-wire party-line circuits and go out the 4-wire interfaces. An issue may arise if the signals coming from the connected party-line user devices aren't at a sufficient level so that a normal meter display can be reached. This could be the result of an incorrectly configured 2-wire nominal audio level. Confirm that the DIP switch associated with each interface is set to match the nominal level of the connected devices. RTS user devices have a nominal level of -10 dBu; Clear-Com devices typically have a -14 dBu nominal level.

It's also possible that an error is present on the 2-wire party-line circuit. Signal levels associated with 2-wire party-line circuits depend on a single termination being present. This termination, typically 200 ohms, is almost always made at the power supply source. But it's possible that another device, such as a second active power supply on the same circuit, will cause a "double-termination" condition. This leads to a nominal 100 ohm line impedance which will result in a level drop of at least 6 dB. Removing the unwanted termination is really the only valid means of correcting the problem.

## **Connecting Party-Line Devices**

The Model 47's two dual-channel interface circuits allow two sets of user devices to be connected. Depending on the setting of the configuration DIP switches, either an external intercom power source or the Model 47's internal 2-wire power sources have been designated for supporting the connected user devices.

## External Power Source

When set for an external 2-wire power source, the Model 47 will not provide power on pins 2 and 3 of the 2-wire connectors, nor will the Model 47 use any power from a connected intercom circuit. As expected, audio signals will be sent from, and received by, each interface's two audio circuits. In this mode of operation the Model 47 acts as a typical user station on the connected intercom circuit, albeit without drawing any power.

As a connection confirmation, hardware and software in the Model 47 monitors pins 2 and 3 of the 2-wire PL intercom connectors for the presence of DC voltage. A level greater than approximately 18 volts DC on pin 2 will cause the pin 2 status LED to light. A level greater than 18 volts DC on pin 3 will cause the pin 3 status LED to light.

The author is aware that user intercom devices almost always draw power from pin 2 rather than pin 3. However, in many broadcast applications power is provided on all intercom paths so that flexible channel assignments can be made. In the external 2-wire power mode the Model 47 is simply an observer; whether intercom power is present on pin 2, pin 3, or both pins 2 and 3 is not significant.

So that the Model 47's 2-wire-to-4-wire interface circuits remain stable and don't generate audio artifacts, an auto terminate feature is implemented. This maintains a 200 ohm termination on both pins 2 and 3 so long as neither of the 2-wire power status LEDs are lit. To clarify, if either, or both, LEDs are lit then both terminations are removed. It was felt that this method would provide a fairly accurate indication that an active intercom circuit is connected. In this

case the 200 ohm termination is expected to be provided elsewhere, typically as part of the external power supply, and the Model 47's termination is "lifted."

## Internal Power Sources

When an interface's front-panel DIP switch is set for internal 2-wire power sources the Model 47 supplies 30 volt DC on pins 2 and 3 of the output connector. A maximum current draw of 300 milliamperes is available on each pin. This current is sufficient to power various intercom user devices such as small user stations and belt packs. A common broadcast application would be to use RTS BP325 belt packs. Select the connected devices so that their total current doesn't exceed 300 milliamperes. That's not always the easiest figure to calculate but a web search will generally find specifications for all commonly used devices. For example, a search finds that the original version of the BP325 consumes a maximum of 85 milliamperes of current. According to this figure up to three of these units can be connected to each Model 47 interface. Newer versions of the BP325 (production date of 1992 and later) use surface mount component technology and have a lower maximum current draw of 65 milliamperes. Four of these "modern" BP325 units can easily be supported.

The Model 47's intercom power supply circuits operate under software control. This allows detection of fault conditions and protection of both the Model 47's circuitry and connected intercom user devices. Upon initial Model 47 power-up no monitoring of the intercom power sources takes place for a period of three seconds. This allows the Model 47's circuitry and the connected intercom user

devices to stabilize. The LEDs associated with pins 2 and 3 will light to indicate that the outputs are active. After this initial 3-second period monitoring becomes active. A fault condition is detected if the power on a pin falls below 24 volts for a continuous 1-second interval. The hardware and software responds to this condition by turning off the power source on that specific pin and flashing its associated LED as a warning. After a 5-second “cool down” interval the output returns to the same condition as upon initial power-up: power is again applied to the pin, the pin status LED will light, and monitoring won’t begin for another three seconds. A full short-circuit condition applied to the Model 47’s 2-wire connectors will result in a continuous cycle of four seconds on (three seconds for start up and one second for detection) and five seconds off.

## Auto Null

Each of the Model 47’s dual-channel interfaces has circuitry to automatically null the two 2-wire-to-4-wire interfaces. Normally this process is performed at the time of initial Model 47 configuration but there’s no reason why auto nulling can’t be initiated anytime one desires. The only time that auto null must be performed is if conditions have changed vis-à-vis the intercom user devices and wiring connected to a Model 47 2-wire PL interface connector. Even a slight change to an intercom circuit, such as adding or removing a section of cable, is sufficient to require that the auto null process be performed.

Two buttons, one associated with each interface, are provided to activate the auto null process. Refer to Figure 11 for a detailed view. To initiate auto null simply requires tapping (pressing and

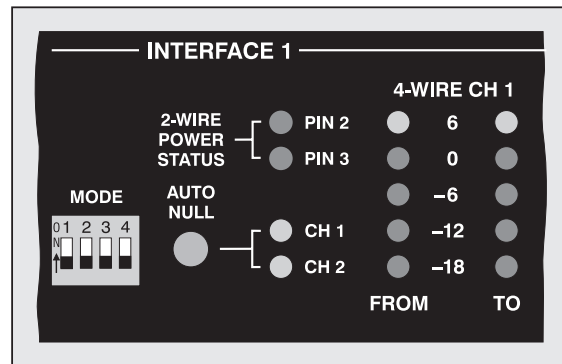


Figure 11. Detail of front panel showing auto null section

releasing) a button. The process begins by nulling channel 1 of an interface and, when completed, moves on to channel 2. Two LEDs provide a visual indication of the auto null process, flashing when the auto null process for its respective channel is active.

An actual auto null sequence starts by muting the 4-wire input and output signal paths associated with the specific channel to be nulled. Then a short period of 24 kHz signal is sent out the 2-wire PL intercom interface channel. This will turn off microphones on those connected user devices that are compatible with the RTS TW-series “mic kill” protocol. The actual auto nulling process will next be performed. A series of tones will be sent out the 2-wire interface. Other Model 47 circuitry, under software control, will rapidly perform adjustments to achieve the best null possible. After the adjustments are made the results are stored in non-volatile memory. Once the process has completed the 4-wire input and output paths are again activated.

Advanced configuration DIP switch 2, located on the back panel, allows an independent auto null button mode to be

selected. If DIP switch 2 is in its on (up) position, the front-panel pushbuttons will function in quite a different manner. In the independent mode, a single tap to a button will cause channel 1 to auto null. Two taps will cause channel 2 to auto null. By observing the operation of the two auto null status LEDs it will become readily apparent which of the button modes has been selected.

If possible, prior to performing an auto null it's polite to warn all personnel who are actively using the connected intercom devices. The tones sent to the 2-wire intercom circuit during the nulling process are not excessively loud or obnoxious, but most users might want to remove their headsets during the process. In addition to warning users, it might be a good time to ask them to mute any active microphones. While the automatic "mic kill" signal will apply to many user devices it may not apply to all. Muting microphones is significant as obtaining a "deep" null requires that no extraneous signals be present on the intercom circuit.

## Advanced Operation

The Model 47 allows several of the operating parameters to be configured to meet the needs of specific applications. The following paragraphs provide details about the auto terminate and factory test modes.

### Auto Terminate

As previously discussed in this user guide, the auto terminate function can come into play when a 2-wire interface is configured for external power. Using a combination

of hardware and software, pins 2 and 3 of each 2-wire PL intercom connector are monitored for the presence of DC voltage. If a level of greater than approximately 18 volts DC is not detected on either pin, 200 ohm terminating networks are applied to those same pins. This ensures that the Model 47's hybrid circuitry remains stable, preventing objectionable audio signals from being sent to the 4-wire output connectors. One caveat does apply: there may be a few seconds of severe noise whenever an interface moves from a DC present condition to a DC not present condition. But other than that period the audio paths will remain "clean."

As a visual aid, LEDs on the front panel will display the DC power status of pins 2 and 3. But when auto terminate disable mode is active the LEDs will no longer indicate the intercom circuit's termination status.

For special externally powered 2-wire applications the auto terminate function can be disabled. This primarily will come into play when "splitting" the Model 47's resources into four separate single-channel interfaces. Moving advanced configuration DIP switch 1, located on the Model 47's back panel, to its on (up) position disables the auto terminate function. To someone observing only the Model 47's front panel this change would not be readily apparent. The front-panel LEDs will continue to display the DC power status of pins 2 and 3. But whether or not either or both LEDs are lit, the Model 47 will never apply 200 ohm terminations to pins 2 or 3. For the hybrid circuits to remain stable termination impedances must be provided by the connected circuits. If these are not present one should expect the hybrid

circuits to generate a very impolite noise. This condition, caused by the 2-wire output circuitry being in an “unloaded” state, will not damage the Model 47’s circuitry. But errors in cable “patching,” a disconnected cable, or other real-world issues can lead listeners of the Model 47’s 4-wire outputs from being presented with a rude surprise!

In conclusion, it’s important that technical personnel working with the Model 47 be informed when the auto termination function has been disabled. They will then be aware of the potential noise issues and be ready to make corrections should a problem arise.

## Factory Test

Back-panel DIP switch 4 allows a factory test mode to be enabled. During normal operation DIP switch 4 should remain in its off (down) position. When DIP switch 4 is in its on (up) position factory mode is active (enabled). Enabling this mode will result in the following operating condition: during an auto null sequence the associated 4-wire output channel will remain active. This will allow the tones associated with the nulling process to be present on the 4-wire output. While not appropriate during actual Model 47 use, it is interesting to “hear” the nulling process take place. But unless directed by factory personnel DIP switch 4 should remain in its off (down) position.

# Technical Notes

## Software Version Display

A special Model 47 power-up sequence allows the unit’s software version number

to be displayed. This is useful when working with factory personnel on application support and troubleshooting situations. The four status LEDs associated with interface 1 are used to display the major release number with a range of 1 through 4. The four status LEDs associated with interface 2 are used to display the release sub-number which again ranges from 1 through 4. Refer to Figure 12 for a detailed view of the status LEDs and the corresponding software version numbering scheme. The Model 47’s initial software release is version 1.1 which is represented by the bottom LEDs of each status column being lit.

To display the Model 47’s software version is very simple. From the powered-down state, press and hold the auto null button associated with interface 1. Apply mains power while continuing to press the button. The normal power-up sequence will not occur but instead one LED will be lit in the column associated with interface 1 and one LED will be lit in the column associated with interface 2. As previously described, these two LEDs represent the unit’s current software version. While the software version number is being displayed the LED level meters will likely display random readings. This is not a problem and can simply be ignored. After the software version number has been “read” the auto null button can be released. At this time the unit will begin its normal power-up sequence.

Note that while it’s easy to determine which software version is loaded into the Model 47 a trip back to the factory is required to update it. The 8-bit micro-controller that provides the unit’s logic “horsepower” also includes internal

# Model 47 Interface

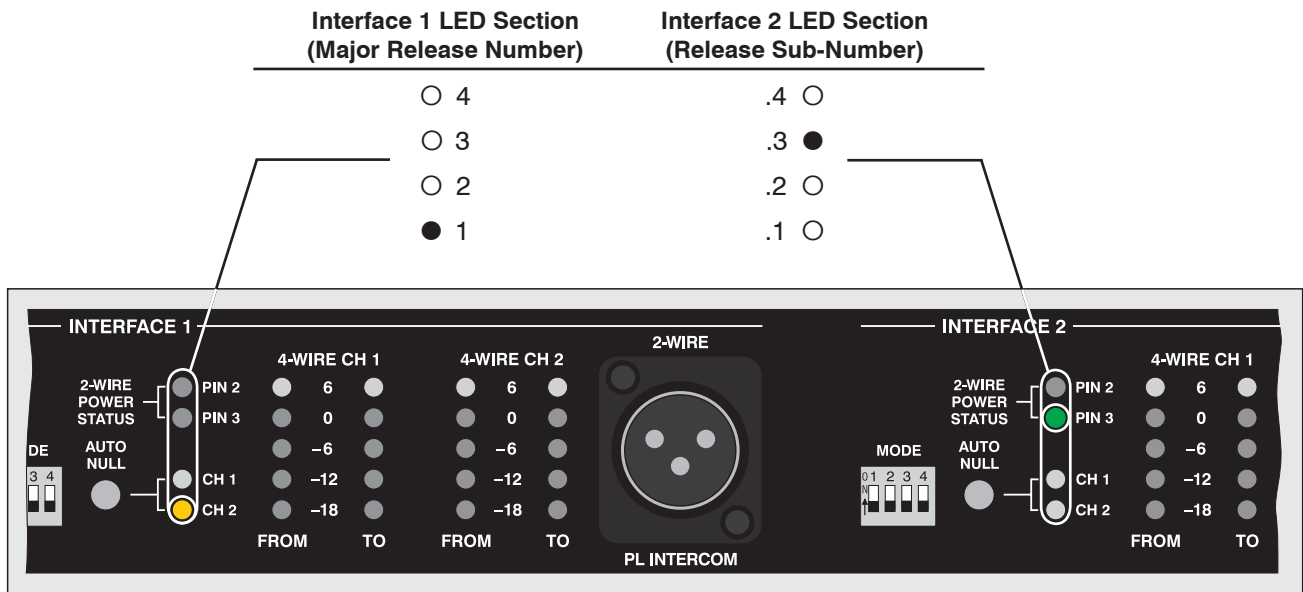


Figure 12. Detail of front panel showing the status LEDs that display the software version. In this example, the software version is 1.3.

FLASH memory. This non-volatile memory is used to store the operating software (“firmware”). Re-programming this memory requires using a specialized programming unit. While not outrageous in price, it still costs in the range of US\$500. The “programmer” uses a ribbon cable and socket to interface with a 6-pin “header” on the Model 47’s printed circuit board. And, as you would guess, once connected, re-programming takes only a matter of seconds. But unfortunately the programmer is not something that would be found in a typical “field shop” or repair facility.

## Not a TW-12B Replacement!

The Model 47 will provide a high level of performance over its range of intended tasks. But it’s not intended to act as a “universal” 2-wire-to-2-wire interface such as is provided by the venerable Clear-Com TW-12B. The Model 47’s 2-wire interfaces are not isolated from each other; they share the Model 47’s internal power supply’s

common connection. (The power supply’s common point is DC isolated from chassis and earth ground.) Specifically, pin 1 on the XLR connector associated with interface 1’s 2-wire party-line interface is electrically connected to the pin 1 connection on interface 2. This is due to the fact that both 2-wire party-line interfaces are capable of supplying DC power to connected devices. They also use the resources of a single set of logic circuitry. And as such they each require access to the Model 47’s common power supply circuitry. There’s no doubt that a Model 47 could be used to create a 2-wire-to-2-wire party line “bridge” by cross-linking the 4-wire inputs and outputs using standard XLR audio cables. But it’s likely that a significant “ground loop” would be created through pin 1 of each of the Model 47’s 2-wire interfaces. While it’s possible to use a set of special isolation transformers to eliminate the ground loop, that’s best left to the brave of heart!

## Model 72 Interface

And now for a shameless “product plug.” Studio Technologies, Inc. manufactures a nifty product called the Model 72 Level Meter/Interface. A compact, standalone unit, it can prove very useful when setting up, maintaining, and troubleshooting intercom circuits. It will give a direct indication of signal levels at any point in a single- or dual-channel intercom circuit. Check it out!

# Specifications

### **General Audio:**

Frequency Response:  $\pm 2$  dB 100 Hz to 8 kHz

Distortion (THD+N):  $< 0.5\%$ , measured at 1 kHz, 4-wire input to 2-wire interface pin 2

Signal-to-Noise Ratio:  $> 55$  dB, measured at 1 kHz, 4-wire input to 2-wire interface pin 2

### **Connectors:**

Inputs from 4-Wire: 3-pin female XLR

Outputs to 4-Wire: 3-pin male XLR

2-Wire Party-Line Intercom: 3-pin male XLR

Remote Control: 10-pin header, requires user-provided 10-pin ribbon connector assembly

AC Mains: 3-blade, IEC 320 C14 (mates with IEC 320 C13)

### **2-Wire Party-Line Intercom Interfaces: 2**

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

Compatibility: single- and dual-channel intercom systems such as from RTS® and Clear-Com®

Impedance, External Power Mode:  $> 10$  k ohms

Impedance, Internal Power Mode: 200 ohms

Nominal Level:  $-10$  or  $-14$  dBu, selectable

“Mic Kill” Signal: square wave, 24 kHz,  $\pm 1\%$

### **2-Wire Party-Line Power Sources: 4, 2 per interface**

Rating: 30 volts DC nominal, 300 milliamperes maximum, software monitored and controlled

### **Hybrids: 4, 2 per interface**

Topology: 3-section analog circuitry compensates for resistive, inductive, and capacitive 2-wire party-line loads

Nulling Method: automatic upon user initiation, processor implements digital control of analog circuitry; null settings stored in non-volatile memory

Nulling Line Impedance Range: 120-350 ohms

Nulling Cable Length Range: 0-3500 feet, typical

Trans-Hybrid Loss:  $> 40$  dB, typical at 800 Hz

### **4-Wire Inputs: 4, 2 per interface**

Type: transformer-coupled, capacitor isolated

Impedance: 13 k ohms

Nominal Level: 0, +4, +6, or +8 dBu, selectable in tandem with nominal output level

Maximum Level: +22 dBu

### **4-Wire Outputs: 4, 2 per interface**

Type: transformer-coupled, capacitor isolated

Impedance: 50 ohms nominal

Nominal Level: 0, +4, +6, or +8 dBu, selectable in tandem with nominal input level

Maximum Level: +20 dBu into 2 k ohms

### **Meters: 8**

Function: displays level of 4-wire inputs and outputs

Type: 5-segment LED, modified VU ballistics

### **Remote Control Inputs: 3**

Type: optically coupled

Input: 3-32 volts DC; 2 milliamperes minimum for operation, 20 milliamperes maximum

Functions: auto null interface 1, auto null interface 2, and “mic kill”

**AC Mains Requirement:** 100-240 volts ( $-15/+10\%$ ), 50/60 Hz, 1.2 amperes maximum @ 100 volts, 0.7 amperes maximum @ 240 volts

### **Dimensions (Overall):**

19.0 inches wide (48.3 cm)

1.72 inches high (4.4 cm)

10.3 inches deep (26.2 cm)

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

**Weight:** 8.6 pounds (3.9 kg)

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









