Model 545AR Intercom Interface

Key Features

- Dual analog hybrids with auto null capability
- Integrated party-line (PL) intercom power source
- Transformer-coupled 4-wire inputs and outputs
- Input and output level metering
- Excellent audio quality
- Standard audio and power connectors
- 12 volts DC powering
- Table-top, portable, or optional rack-mount use

Overview

The Model 545AR is designed to interface 2-wire full-duplex party-line (PL) intercom circuits with 4-wire audio circuits associated with analog audio equipment. These devices include audio consoles, matrix intercom systems, wireless intercom systems, fiber-optic transport units, and Internet streaming units. Applications for the Model 545AR include television sports and live-event broadcasting, theme park and theater installations, corporate AV, and industrial testing environments. The unit provides one full-featured 2-channel 2-wire-to-4-wire interface. The interface features hybrid circuitry that includes automatic "nulling" capability. The analog hybrids, under software control, provide excellent audio quality and high return-loss.

The Model 545AR is powered by an external source of 12 volts DC. The circuitry is designed so that full isolation from the connected party-line circuit is maintained. The unit can be directly connected to a party-line circuit which provide DC power and audio terminations. For maximum flexibility, the unit is also capable of supplying 28 volts DC power with 200 ohm intercom audio terminations, thus creating a 2-channel 2-wire party-line intercom circuit. This allows direct support for devices such as intercom beltpacks and user interfaces.

Audio level meters provide user confirmation of system performance during setup and operation. Standard audio connectors are used for interfacing audio input, audio output, party-line intercom, and DC power signals. The unit's lightweight aluminum enclosure is intended for desk or tabletop use. The compact "1/2-rack" form factor meets the needs of broadcast "throw-down" applications. Optional mounting kits allow one or two Model 545AR units to be mounted in one space (1U) of a standard 19-inch rack enclosure.

Model 545AR Intercom Interface front and back views

2-Wire Party-Line Interface

The Model 545AR's 2-channel 2-wire party-line interface is optimized for direct connection with a dual-channel party-line intercom circuit. The unit's 2-wire interface is configured for a –10 dBu nominal level, matching that of the popular RTS® TW-series of analog party-line intercom products.

The Model 545AR's 2-wire party-line interface can be directly connected to a powered 2-channel party-line intercom circuit. This type of party-line circuit has power present, normally 28-32 volts DC, which provides energy for connected devices such as analog beltpacks and smaller user stations. In this scenario, the Model 545AR's circuitry will appear as a standard analog user device, maintaining a high-impedance load on the two audio channels and drawing no DC power.

Alternately, the Model 545AR's 2-wire party-line interface has the ability to create a fully functioning 2-channel 2-wire party-line intercom circuit, supplying the required DC power and 200 ohms AC terminations. Referred to as the Model 545AR's local power mode, it provides a 28 volts DC, 300 milliampere maximum output which can power devices such as user beltpacks. In many applications, this will eliminate the need for an external intercom power supply. Besides reducing total system cost, this feature can also lower system weight, reduce the required mounting space, and decrease the mains energy requirement.

With the 2-wire interface's ability to supply up to 300 milliamperes of current a typical broadcast application which uses up to four of the RTS BP-325 beltpacks can easily be supported. The circuitry's output regulation is such that little change in the 28 volts output voltage will occur over its entire rated output current. The local power source is an industry-standard 28 volts DC, helping to ensure that applications requiring long intercom cable runs will function correctly. Also, the design of the power supply circuitry helps to minimize the noise and "hiss" often associated with intercom power supplies. Under software control the local DC power supply's output is monitored for over-current and short-circuit conditions. This allows protection shutdown of the output, as well as providing an alert by way of a visual indicator.

An auto-terminate function ensures that should a party-line circuit not be connected, the Model 545AR's interface circuitry will remain stable. This unique feature makes certain that objectionable audio signals, such as oscillations and "squeals," will rarely be sent to the connected 4-wire device. To support special applications, this function can be disabled with a button-press sequence.

Analog Hybrids with Auto Nulling

A key reason that the Model 545AR achieves excellent audio performance is the design of its 2-wire-to-4-wire hybrid circuits. Each of the two independent circuits provides low noise and distortion, good frequency response, and high return-loss (separation of send and receive audio or "nulling"), even when presented with a wide range of 2-wire party-line conditions. Unlike telephone-line ("POTS") oriented DSP-based hybrid circuits, the Model 545AR'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 party-line circuit.

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 545AR'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 set of adjustments to account for the resistive, inductive, and capacitive conditions that are present on the connected 2-wire party-line circuit. The party-line's conditions are 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 the Model 545AR's auto null pushbutton switch, digital circuitry adjusts the analog hybrids to achieve their maximum return-loss. The nulling process takes less than 15 seconds for both interface channels. It's important to highlight that while the nulling process is automatic, it only takes place upon user request.

The parameters obtained during the nulling process are stored in non-volatile memory; power interruptions won't require the auto nulling function to be performed again.

The Model 545AR generates a sine wave audio tone for use during the auto nulling process. The signal's 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 nulling sequence, a short period of 24 kHz tone is sent to the associated channel of the 2-wire party-line interface. This serves as a microphone disable ("mic kill") signal for user devices such as the RTS BP-325 user belt-pack. By automatically disabling "open" microphones the auto nulling process can achieve a better result.

4-Wire Interfaces

Associated with the 4-wire portion of the Model 545AR's dual-channel interface are analog line-level inputs and outputs. These are intended to interconnect with a variety of 4-wire devices, including matrix intercom systems, audio consoles, audio-over-fiber transmission systems, and specialized audio equipment. The 4-wire input and output circuitry is transformer-coupled to minimize the chance of hum, noise, or ground "loop" issues. The nominal input and output levels are +4 dBu, helping to ensure compatibility with professional audio equipment. Some digital matrix intercom systems use other nominal levels but with their configuration flexibility they can be easily adjusted to match the Model 545AR. For example, the Riedel Artist® system has a nominal level of +6 dBu so an adjustment of only 2 dB is required. The RTS ADAM™ series of matrix intercom systems have a nominal level of +8 dBu. This level also applies to their RVON-I/O VoIP products. As such, reducing their nominal input and output levels by 4 dB will ensure optimal compatibility.

The Model 545AR contains four 5-segment LED level meters with two displaying the level of the signals being received on the 4-wire inputs and two displaying the level being sent out the 4-wire outputs. During installation and setup, the meters can be invaluable in helping to confirm that proper operation is taking place. The meters are also useful during normal operation, allowing confirmation of audio signal flow into and out of the Model 545AR.

Pro Audio Quality

The Model 545AR'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 nominally 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 545AR's local (internal) power source is selected to provide 2-wire party-line intercom power, enhanced audio performance can also be expected. The quality of the local DC supply circuit is very good, with very little noise, hum, or "hiss" being added to the 2-wire connection. In addition, the impedance characteristics of the interface's DC powered ("wet") channel was tailored to be essentially identical to that of the un-powered ("dry") channel. This unique situation allows the automatic nulling circuitry to provide excellent, consistent results for both the powered and un-powered channel.

Attention to detail is a hallmark of the Model 545AR's design. For example, during the brief auto nulling process the interface channel's 4-wire output signals are normally muted, preventing unwanted audio from reaching the connected equipment. Associated with the 2-wire party-line interface is circuitry that, under software control, applies 200 ohm terminating impedances to the 2-wire party-line circuit. This, along with other circuitry that monitors DC voltages present on pin 2, ensures that audio instability associated with unterminated circuits will rarely occur.

Simple Installation

The Model 545AR uses standard 3-pin XLR connectors to allow convenient 2-wire party-line and 4-wire interconnection in broadcast and general-audio environments. For flexibility, access to the 2-wire party-line intercom interface can be made using either a male or female XLR connector on the back panel or a male XLR connector on the front panel.

The Model 545AR is powered by an external source of 12 volts DC. A compact, lightweight 12 volts DC output power source is supplied with each unit. The power supply's

universal mains input capability (100-240 volts, 50/60 Hz) allows operation virtually anywhere in the world. The power supply's DC output is terminated on a 4-pin female XLR connector, allowing direct connection to the Model 545AR's DC power input receptacle.

Four LED meters make it simple to confirm operation of the connected 4-wire inputs, 4-wire outputs, and 2-wire party-line circuit. Additional LED status indicators are also provided, offering a clear view of the 2-wire DC power source, auto null functions, and input operating power.

The Model 545AR is housed in a rugged, lightweight aluminum enclosure that is designed to be "road tough." The "1/2-rack" unit is ready for portable or stand-alone "thrown-down" applications. Optional mounting kits are available, allowing one or two units to be mounted in one space (1U) of a standard 19-inch rack enclosure, wall-mounted, or installed in a panel cutout.

Design Philosophy

While the "bits and pieces" that make up the Model 545AR have been described in conventional terms, the real strength of the unit rests in the way it integrates and performs in the "real world." Studio Technologies learned from conversations with industry experts that installing and configuring 2-wire-to-4-wire interface equipment has traditionally been a time-consuming, aggravating process, requiring the efforts of an expert to achieve reasonable results. Even under those constraints, the resulting audio performance was often mediocre. This "history lesson" made it clear that any new design had to start with a unique set of requirements. This led to an overriding design goal: create a "new breed of cat," fundamentally changing how broadcast 2-wire-to-4-wire interface equipment fits 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 earpieces, 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 one industry-standard nominal audio level. 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 use of standard 3-pin XLR audio connectors, enabling rapid installation and troubleshooting in any locale. The inclusion of LED level meters allowed continuous monitoring of the input and output signals. Additional status LEDs were also deemed to be valuable.

In many applications, a small number of user devices, such as beltpacks, would be connected to a 2-wire party-line circuit. To address this need, the Model 545AR incorporates a local DC power source associated with the 2-wire interface, often eliminating the need for an external intercom power supply to be utilized.

The final step was to create a physical package that would provide significant resources in a format that allowed simple and reliable integration with other equipment. This was accomplished by specifying a convenient "1/2-rack" form factor which would be excellent for "thrown-down" use. By creating mounting kits, it would be possible to allow flexible installation opportunities, including being able to mount one or two Model 545AR units in one space of a 19-inch rack

Model 545AR Specifications

Power Requirement:
10 to 16 volts DC, 1.2 A max at 12 volts DC, Studio Technologies' PS-DC-02 (100-240 V, 50/60 Hz, input; 12 volts DC, 1.5 A, output) included with each unit

General Audio:
Frequency Response: –0.3 dB @ 100 Hz (–4.8 dB @ 20 Hz), –2 dB @ 8 kHz (–2.6 dB @ 10 kHz)
Distortion (THD+N) – 4-Wire Input to PL Interface Pin 2: <0.15%, measured at 1 kHz
Distortion (THD+N) – 4-Wire Input to PL Interface Pin 3: <0.15%, measured at 1 kHz
Signal-to-Noise Ratio – 4-Wire Input to PL Interface Pin 2: >65 dB, A-weighted, measured at 1 kHz
Signal-to-Noise Ratio – 4-Wire Input to PL Interface Pin 3: >73 dB, A-weighted, measured at 1 kHz

Party-Line (PL) Intercom Interface:
Type: 2-channel analog PL, unbalanced (pin 1 common; pin 2 DC with channel 1 audio; pin 3 channel 2 audio)
Compatibility: 2-channel PL intercom systems such as those offered by RTS®
Power Source: 28 volts DC, 300 mA maximum, on XLR pin 2
Impedance – Local PL Power Not Enabled: >10 k ohms
Impedance – Local PL Power Enabled: 200 ohms
Analog Audio Level Pin 2: –10 dBu, nominal, +3 dBu maximum
Analog Audio Level Pin 3: –10 dBu, nominal, +7 dBu maximum
Mic Kill Signal Support: 24 kHz, ±1%, square-wave

Party-Line (PL) Hybrids: 2
Topology: 3-section analog circuitry compensates for resistive, inductive, and capacitive PL loads
Nulling Method: automatic upon user initiation, processor implements digital control of analog circuitry; settings stored in non-volatile memory
Nulling Line Impedance Range: 120 to 350 ohms
Nulling Cable Length Range: 0 to 3500 feet, typical
Trans-Hybrid Loss – PL Interface Pin 2: >50 dB, typical at 800 Hz
Trans-Hybrid Loss – PL Interface Pin 3: >55 dB, typical at 800 Hz

4-Wire Inputs: 2
Type: transformer-coupled, capacitor isolated
Impedance: 13 k ohms
Nominal Level: +4 dBu
Maximum Level: +22 dBu

4-Wire Outputs: 2
Type: transformer-coupled, capacitor isolated
Impedance: 50 ohms nominal
Nominal Level: +4 dBu
Maximum Level: +20 dBu into 2 k ohms

Meters: 4
Function: displays level of 4-wire audio input and output channels
Type: 5-segment LED, modified VU ballistics

Connectors:
Party-Line (PL or 2-Wire) Interface: 1, 3-pin male XLR and 1, 3-pin female XLR
4-Wire (Line) Inputs: 2, 3-pin female XLR
4-Wire (Line) Outputs: 2, 3-pin male XLR
Power (DC) Input: 4-pin male XLR

Environmental:
Operating Temperature: 0 to 50 degrees C (32 to 122 degrees F)
Storage Temperature: –40 to 70 degrees C (–40 to 158 degrees F)
Humidity: 5 to 95%, non-condensing
Altitude: not characterized

Dimensions – Overall:
8.70 inches wide (22.1 cm)
1.72 inches high (4.4 cm)
8.30 inches deep (21.1 cm)

Weight: 1.7 pounds (0.77 kg); rack-mounting installation kits add approximately 0.2 pounds (0.09 kg)

Deployment: intended for tabletop applications. Four optional mounting kits are also available:

- RMBK-10 allows one unit to be mounted in a panel cutout or on a flat surface
- RMBK-11 allows one unit to be mounted in the left- or right-side of one space (1U) of a standard 19-inch rack
- RMBK-12 allows two units to be mounted in one space (1U) of a standard 19-inch rack
- RMBK-13 allows one unit to be mounted in the center of one space (1U) of a standard 19-inch rack

Specifications subject to change without notice.

Studio Technologies, Inc.
Skokie, Illinois USA

studio-tech.com