Model 45DC

Dante™ to Dual Party-Line Intercom Interface

User Guide

Issue 3, March 2016

This User Guide is applicable for serial numbers
M45DC-00151 and later with application firmware 3.1 and later
and Dante firmware 1.2 (Ultimo 2.2.2.5) and later

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Revision History

Issue 3, March 2016:

1. Documents new configuration that allows the party-line active detection function to be disabled (added to application firmware version 3.1).

Issue 2, August 2015:

1. Documents enhanced unit identification feature (added to application firmware version 2.5).
2. Adds improvements to IP address configuration assignment explanation.

Issue 1, January 2015:

1. Initial release.

Introduction

The Model 45DC Dante™ to Dual Party-Line Intercom Interface is designed for applications that utilize single-channel analog party-line (PL) intercom technology. The unit provides two independent single-channel interfaces that each support one party-line audio channel. Single-channel party-line intercom systems are commonly used in theater, entertainment, and education applications where a simple, reliable, low-cost, and easy to use solution is desired. Analog party-line products from Clear-Com® and ASL are directly compatible with the Model 45DC. The Dante Audio-over-Ethernet media networking technology is used to transport the send and receive audio channels associated with each of the two party-line circuits. Two hybrid circuits with automatic nulling provide excellent audio quality and high return-loss. (These hybrid circuits are sometimes referred to as 2-wire to 4-wire converters.) The Model 45DC is directly compatible with the latest broadcast and audio equipment that uses Dante technology. An Ethernet connection is all that's required to make the Model 45DC part of a sophisticated, networked audio system.

A Model 45DC can interconnect with devices such as matrix intercom systems, DSP processors, and audio consoles. The Model 45DC is directly compatible with the RTS ADAM® OMNEO® matrix intercom network. Alternately, two Model 45DC units can interconnect by way of the associated Ethernet network. The Model 45DC can be powered by Power-over-Ethernet (PoE) or an external source of 12 volts DC. Two party-line power sources with impedance termination networks can be supplied by the Model 45DC, allowing connection of two sets of user beltpacks such as the Clear-Com RS-501 and RS-701. A Model 45DC

Figure 1. Model 45DC standard "throw-down" front view

Figure 2. Model 45DC back view

can also connect with one or two existing powered and terminated intercom circuits. Audio level meters provide confirmation of system performance during setup and operation. Support for transporting call light signals between Model 45DC units is also provided.

Standard connectors are used for party-line intercom, Ethernet, and DC power interconnections. The Model 45DC's enclosure has a "1/2-rack" 1U form factor and weighs less than two pounds, making it well suited for use in portable applications. Alternately, using one of the optional rack-mount front panels, one or two Model 45DC units can be mounted in a single space (1U) of a standard 19-inch rack enclosure.

Applications

There are two main ways that the Model 45DC can be used in applications. The first is to add party-line intercom support for matrix intercom systems. The second is to link two stand-alone party-line intercom systems. Ports on matrix intercom systems that support Dante, such as the RTS ADAM with OMNEO, can be routed to the Model 45DC's Dante receiver (input) and transmitter (output) channels. The Model 45DC's circuitry will then convert these signals into two single-channel party-line intercom circuits. In this way adding party-line support to RTS + OMNEO is a simple task. The Model 45DC can also be used with matrix intercom systems that don't support Dante. An external analog-to-Dante interface can be used to convert analog intercom ports to Dante channels. For example, the Model 44D Interface from Studio Technologies is specifically designed to work with matrix intercom systems. Once in the digital domain, these Dante channels can be interconnected with the Model 45DC's audio input and output channels.

Two separate sets of party-line intercom circuits can easily be interconnected using two Model 45DC Interfaces. At each end a Model 45DC is connected to one or two party-line circuits as well as the Dante network. The Dante Controller application will then be used to route the audio channels between the two units. That's it — nothing else is required to achieve excellent performance.

The Model 45DC can also be used to "bridge" two single-channel party-line intercom circuits with one 2-channel party-line intercom circuit. This involves using a Model 45DC for the two single-channel circuits and one of the Studio Technologies Model 45DR Intercom Interface units for the 2-channel circuit. The Model 45DR is the "cousin" of the Model 45DC and supports one 2-channel party-line intercom circuit rather than two single-channel circuits. These 2-channel circuits, typically supported by equipment from RTS, are commonly used in broadcast applications.

Party-Line Interfaces

The Model 45DC's two party-line intercom interfaces are optimized for connection with two single-channel party-line circuits and user devices such as those associated with equipment from Clear-Com. (While the Model 45DC will function in a limited manner with a 2-channel RTS TW circuit, the Model 45DR Intercom Interface is the much-preferred choice.) Each interface has a party-line active detection function to ensure that should a beltpack or active party-line circuit not be connected the Model 45DC's interface circuitry will

remain stable. This unique feature makes certain that objectionable audio signals, including oscillations and "squeals," won't be sent to other Dante-enabled devices.

A significant capability of the Model 45DC's two party-line intercom interfaces is their ability to supply DC power and 200 ohm AC terminations to "create" two independent intercom circuits. The 28 volt DC output can power user devices such as beltpacks. With up to 150 milliamperes (mA) of current available, a typical entertainment application could connect up to three RS-501 or five RS-701 beltpacks to each of the Model 45DC's two interfaces. In many applications this can eliminate the need for an external intercom power supply, thereby reducing total system cost, weight, and required mounting space. The power supply outputs are monitored for over-current and short-circuit conditions. Under firmware (embedded software) control the outputs will automatically cycle off and on to help prevent damage to the circuitry and connected equipment.

Dante Audio-over-Ethernet

Audio data is sent to and from the Model 45DC using the Dante Audio-over-Ethernet media networking technology. Audio signals with a sample rate of 48 kHz and a bit depth of up to 24 are supported. Audio receiver (input) and transmitter (output) channels on associated Dante-enabled devices can be assigned to the Model 45DC using the Dante Controller software application. This makes selecting the way in which a Model 45DC fits into a specific application a simple matter.

Analog Hybrids with Auto Nulling

Two circuits referred to as "hybrids" interface the Dante input and output channels with the two party-line interface channels. The hybrids provide low noise and distortion, good frequency response, and high return-loss ("nulling"), even when presented with a wide range of party-line conditions. Unlike telephone-line ("POTS") oriented DSP-based hybrid circuits, the Model 45DC's analog circuitry maintains extended frequency response. With a passband 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 a party-line circuit.

The Model 45DC's sophisticated hybrid auto nulling function uses a combination of digital and analog circuitry under microprocessor control to achieve significant trans-hybrid loss. This return-loss "null" is achieved by making a series of firmware-directed adjustments to account for the resistive, inductive, and capacitive conditions that are present on the connected party-line cabling and user devices. Whenever one of the Model 45DC's auto null buttons is pressed digital circuitry adjusts the associated hybrid to achieve its maximum return-loss in less than 15 seconds. While the nulling process is automatic, it only takes place upon user request. The resulting null parameters are stored in nonvolatile memory.

Pro Audio Quality

The Model 45DC'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 of the audio channels 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 hybrid circuits to create substantial “nulls.”

Audio Meters

The Model 45DC contains two sets of 5-segment LED level meters. Each set of two meters displays the level of the signals being sent to and received from a party-line interface channel. At the time of installation and setup the meters are invaluable in helping to confirm correct operation. During normal operation the meters offer rapid confirmation of audio signals flowing in to and out of the unit. Additional LED indicators are also provided on the front panel, offering a status indication of the party-line DC power sources, party-line activity status, and the auto null functions. Two other LEDs offer a direct indication of which source is powering the Model 45DC.

Call Light Support

Typical single-channel party-line intercom circuits provide a call light function by way of a DC voltage applied to the audio path. The Model 45DC can detect call light activity, convert it to a 20 kHz audio tone, and transport the tone over the Dante audio path. A Model 45DC unit at the “far end” will detect the tone and re-generate the call signal as a DC voltage on the audio path. This allows full “end-to-end” call light support between two or more Model 45DC units. It also allows a Model 45DC to send and receive call light status with an interconnected Model 45DR Dante to 2-Channel Party-Line Intercom Interface. The Model 45DR is typically used with the RTS TW-series of party-line user beltpacks including the popular BP-325.

Ethernet Data, PoE, and DC Power Source

The Model 45DC connects to a data network using a standard 100 Mb/s twisted-pair Ethernet interface. The physical interconnection is made by way of a Neutrik® etherCON RJ45 connector. While compatible with standard RJ45 plugs, etherCON allows a ruggedized, locking interconnection for harsh or high-reliability environments. The Model 45DC’s operating power can be provided by way of the Ethernet interface using the Power-over-Ethernet (PoE) standard. This allows fast and efficient interconnection with the associated data network. To support PoE power management, the Model 45DC’s PoE interface reports to the power sourcing equipment (PSE) that it is a class 3 (mid power) device. The unit can also be powered using an external source of 12 volts DC.

For redundancy, both power sources can be connected simultaneously. An internal switch-mode power supply ensures that all Model 45DC features, including party-line intercom circuit power, are available when the unit is powered by either source. Four LEDs on the back panel display the status of the network connection, Dante interface, and PoE power source.

Simple Installation

The Model 45DC uses standard connectors to allow fast and convenient interconnections. An Ethernet signal is connected

using a Neutrik etherCON RJ45. If Power-over-Ethernet (PoE) is available operation will commence immediately. An external 12 volt DC power source can also be connected by way of a 4-pin XLR. Party-line intercom connections are made using two 3-pin male XLR connectors. The Model 45DC is housed in a rugged yet lightweight aluminum enclosure that is designed to be "field tough." It can be used as a standalone portable unit, supporting what's known in the broadcast world as "throw-down" applications. Rack-mount options are also available allowing one or two units to be mounted in one space (1U) of a standard 19-inch rack enclosure.

Future Capabilities and Firmware Updating

The Model 45DC was designed so that its capabilities can be enhanced in the future. A USB connector, located on the Model 45DC's back panel, allows the application firmware (embedded software) to be updated using a USB flash drive. To implement the Dante interface the Model 45DC uses Audinate's Ultimo™ integrated circuit. The firmware in this integrated circuit can be updated via the Ethernet connection, helping to ensure that its capabilities remain up to date.

Installation

In this section signal interconnections will be made using the connectors located on the back panel of the Model 45DC. Connections to one or more party-line user devices or one or two existing party-line intercom circuits will be made using the 3-pin XLR connectors. An Ethernet data connection will be made using either a standard RJ45 patch cable or an etherCON protected RJ45 plug. A 4-pin XLR connector allows the connection of an external source of 12 volts DC.

System Components

Included in the shipping carton are the Model 45DC Intercom Interface and a user guide. If a rack-mount front panel is going to be used as part of the installation it will typically be shipped in a separate carton. If the installation or specific application requires an external source of 12 volts DC it needs to be provided separately. An applicable power supply, the Studio Technologies PS-DC-02, is available as an option.

Locating the Model 45DC

The location of the Model 45DC will depend on the length of the cable runs needed to link the unit with the associated party-line intercom devices. This type of circuit carries unbalanced audio which can be susceptible to interference and cross-talk issues. And since party-line intercom circuits typically carry DC power a voltage drop due to resistive loss can become an issue. In general, minimizing the length of the party-line intercom cables will help ensure more reliable and consistent intercom system performance. Of equal importance is the 100-meter (325-foot) Ethernet cable limitation. A final location criterion is to ensure that access to the Model 45DC's front panel is available. An optimal location will allow convenient use of the auto null pushbutton and easy observation of the status and level meters LEDs.

Protecting the Enclosure

The Model 45DC is shipped as a self-contained unit suitable for portable use

or placement in a semi-permanent location. Installed on the bottom of the chassis are screw-on “bump on” protectors (also known as “rubber feet”). These are useful if the unit is going to be placed on surfaces where scratching of either the Model 45DC or the surface material could take place. The “feet” can be removed, without the use of a tool, when rack- or custom-mounting the unit.

Rack Mounting the Model 45DC

For permanent or mobile applications it might be desirable to mount one or two Model 45DC units into one space (1U) of a 19-inch rack enclosure. Two rack-mount front panels, purchased separately, are available from Studio Technologies. The following provides details on how to install and use the panels.

To attach a Model 45DC unit to the single-unit rack-mount panel, begin the process by using a 5/64-inch hex wrench to remove the four 6-32 button-head machine screws that hold the standard front panel to the chassis. Note that the screws might be quite tightly affixed. Ensure that a good-quality hex wrench is used and press and hold it firmly while turning counterclockwise. Unless this recommendation is followed the wrench can “cam out” and the head could be “stripped.”

Using the screws that were just removed, attach the rack-adapter front panel to the Model 45DC’s chassis. To prevent damage care is required when aligning the front panel with the LEDs and auto null push-button switch that protrude through both the Model 45DC’s chassis and front panel. Tighten the four screws only after a careful inspection ensures that the switch and all 28 of the LEDs protrude through the front panel without interference. To allow vertical clearance in the associated rack, remove the four “bump on” protectors from the bottom of the chassis. They are removed by using the fingers to rotate them counter-clockwise; no tool is required. Carefully protect and store the standard front panel, along with the “bump on” protectors, for possible later use.

Mounting a Model 45DC to a dual-unit rack-mount panel follows the same procedure but will apply to two units. Store both of the removed standard front panels and the eight “bump on” protectors for possible later use. Note that on the rack-panels graphics the unit on the left is designated as A while the unit on the right is designated as B. This is provided so that each can be easily identified during installation, troubleshooting, and operation.

Once the desired one or two Model 45DC units have been installed in a rack-mount front panel, the assembly can be mounted into the designated equipment rack. One space (“1U” or 1.75 vertical inches) in a standard 19-inch equipment rack is required. Secure the front panel into the equipment rack using two mounting screws per side.

Ethernet Connection

An Ethernet connection that supports 100BASE-TX (100 Mb/s over twisted-pair) is required for the Model 45DC’s Dante Audio-over-Ethernet connectivity. A 10BASE-T connection is not sufficient for Model 45DC operation. A 1000BASE-T (“GigE”) connection is not supported unless it can automatically “fall back” to 100BASE-TX operation. An Ethernet connection that supports Power-over-Ethernet

(PoE) is preferred as it will provide operating power for the Model 45DC. To support PoE switch (PSE) power management the Model 45DC will enumerate itself as a PoE class 3 device. If PoE is not available an external 12 volt DC power source can be connected. This will be discussed in the next section of this guide.

The 100BASE-TX Ethernet connection is made by way of a Neutrik etherCON protected RJ45 connector that is located on the back panel of the Model 45DC. This allows connection by way of a cable-mounted etherCON plug or a standard RJ45 plug. The Model 45DC's Ethernet interface supports auto MDI/MDI-X so that most cabling implementations will be directly supported.

External 12 Volt DC Input

An external source of 12 volts DC can be connected to the Model 45DC by way of a 4-pin male XLR connector which is located on the back panel. While the requirement for the external source is to be nominally 12 volts, correct operation will take place over a 10 to 18 volt range. The Model 45DC requires 1.0 amperes maximum for correct operation. The DC source should be terminated to a 4-pin female XLR connector with pin 1 negative (–) and pin 4 positive (+). Purchased as an option, the PS-DC-02 power supply is available from Studio Technologies. Its AC mains input allows connection to 100-240 volts, 50/60 Hz and its 12 volt DC, 1.5 amperes maximum output is terminated on a 4-pin female connector.

As previously discussed in this guide, an Ethernet connection that provides Power-over-Ethernet (PoE) can serve as the Model 45DC's power source. Alternately, an external 12 volt DC source can be connected. For redundancy, both PoE and the external 12 volt DC source can be connected at the same time. If both PoE and an external 12 volt DC source are connected, power will be drawn only from the PoE supply. If the PoE source becomes inoperative the 12 volt DC source will provide the Model 45DC's power with no interruption in operation. (Of course, if both PoE and Ethernet data support are lost that is a very different situation!)

Party-Line Intercom Connections

The Model 45DC's party-line intercom interface is designed to function in two distinct ways. It can be connected to one or two "powered" broadcast-standard 2-channel party-line intercom circuits or directly to one or two sets of party-line intercom user devices. A single-channel party-line intercom circuit, such as frequently associated with equipment from Clear-Com, has DC power and one audio channel on a 3-pin XLR connector. The connector is wired such that common is on pin 1, 22 to 30 volts DC is on pin 2, and audio is on pin 3. An impedance-generating network provides a 200 ohm audio load from pin 3 to pin 1. When the Model 45DC's party-line interfaces are connected to existing intercom circuits they act, from an audio standpoint, as standard user devices. They don't draw (nor supply) any DC power.

The Model 45DC's two party-line interfaces can serve to create two "mini" intercom circuits. They each provide a 28 volt DC intercom power source and a 200 ohm impedance generator, allowing a limited number of single-channel intercom user devices to be directly connected. The Model 45DC's two internal 28 volt DC power

sources each have a maximum current of 150 mA. This modest amount of power can be very useful but requires that the type and number of connected user devices be selected appropriately. Many entertainment applications use the legacy Clear-Com RS-501 beltpack and each Model 45DC intercom circuit can directly support up to three of them. With the newer and more energy efficient Clear-Com RS-701 it should be possible to connect up to five of them. Wiring from the Model 45DC intercom interface's 3-pin male XLR connectors to the user devices requires that a 1-to-1, 2-to-2, 3-to-3 wiring scheme on the mating 3-pin XLR connectors be maintained.

Compatibility with 2-Channel Intercom Systems

As previously discussed in this guide, the Model 45DC is designed to support single-channel party-line intercom circuits and user devices. It's possible that applications that involve 2-channel party-line intercom circuits and user devices (typically associated with the RTS TW-series of products) can also be supported. These circuits and devices typically utilize common on pin 1, 28 to 32 volts DC and channel 1 audio on pin 2, and channel 2 audio on pin 3. When connected to a Model 45DC only channel 2 will be active; channel 1 would not be utilized. A better means to support these 2-channel circuits and devices is to use the Studio Technologies Model 45DR Interface. This unit, the "cousin" of the Model 45DC, is optimized for 2-channel party-line intercom applications. Rather than providing two single-channel interfaces the Model 45DR provides one 2-channel interface. Detailed information about the Model 45DR is available on the Studio Technologies website (www.studio-tech.com).

Configuration

Back-Panel DIP Switches

A 4-position DIP switch assembly, labeled Configuration, is located on the Model 45DC's back panel. Switch SW1 allows the Model 45DC's call light support function to be disabled. Switch SW2 allows the party-line active detection function to be disabled. Switches SW3-4 are not currently utilized and have no impact on Model 45DC operation.

Call Light Support

Switch SW1 allows the call light support function to be disabled. When switch SW1 is in its off (down) position the call light support function is enabled. When SW1 is in its on (up) position the function is disabled. For most applications the call light support function should remain enabled. Only special circumstances would merit disabling the function. Note that the call light function between user devices connected to the same Model 45DC interface will always be active. Disabling the Model 45DC's call light support function only impacts the call function that's sent and received by way of the Dante audio connections.

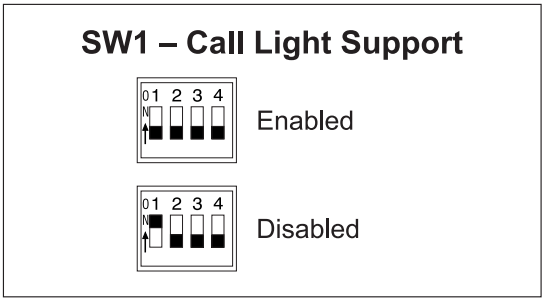

Figure 3. Call light support configuration switch

Party-Line Active Detection Function

When local power has been selected for a Model 45DC party-line interface and switch SW2 is in its off (down) position a minimum of approximately 5 mA of current must be drawn from that interface for an "active" condition to be recognized. When this condition is met the associated active LED on the front panel will light and the Dante output audio path will be active. This default setting is appropriate for most applications and helps to maintain the most stable audio performance.

Switch SW2 allows the party-line active detection function to be disabled. When SW2 is in its on (up) position no minimum party-line current draw is required for the active LED to be lit and an output audio path to be active. Only in special situations would the function need to be disabled. One example is the case where a Model 45DC is being used with a Telex® BTR-700 Wireless Intercom System. The BTR-700 is designed to directly interface with a party-line intercom circuit. This circuit would typically have DC power and one audio channel that has a terminating impedance of nominally 200 ohms. The Model 45DC can provide two such circuits when the local power functions are enabled. But a problem arises as the BTR-700 does not draw current from the connected intercom circuit. It doesn't function in the same manner as would a typical beltpack, instead using an external source of power for operation. So in this case the Model 45DC's party-line interface would not supply current, the active LED would not light, and the output audio path would not be enabled. Users of the BTR-700 would be able to hear Model 45DC input audio but not send audio out the Dante interface. Disabling the party-line active detection function by placing SW2 to its on (up) position would resolve this issue. Even though no DC current would be supplied by the Model 45DC successful operation would take place.

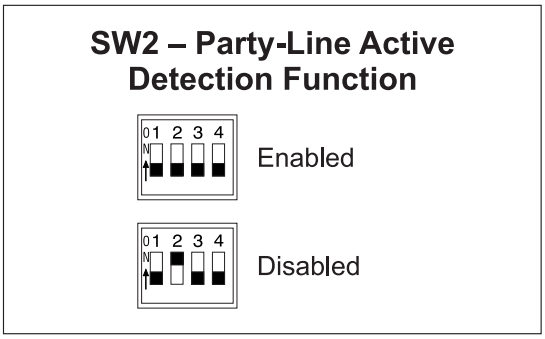

Figure 4. Party-line active detection function configuration switch

When the Model 45DC has been set to not provide local power the party-line active detection function works in a slightly different way. Only if a DC voltage of approximately 18 or greater is present on pin 2 will the party-line interface recognize that a valid interconnection is present. In this case the active LED will light and the Dante output audio path will be active. When SW2 is in its on (up) position the party-line active detection function will be disabled and monitoring of DC voltage on pin 2 will not take place. In this situation the active LED will always be lit and the output audio path will be active. As of the writing of this guide the practical application of this specific configuration has not been determined. But it's ready should the need arise!

Dante Configuration

To integrate the Model 45DC into an application a number of Dante-related parameters can be configured. At a minimum, the

audio receiver (input) and audio transmitter (output) channels must be routed. The configuration settings will be stored in non-volatile memory within the Model 45DC's circuitry. The Model 45DC uses the Ultimo 2-input/2-output integrated circuit to implement the Dante architecture. This dictates which parameters can be configured and what choices are available.

The audio receiver (input) and transmitter (output) channels associated with the Model 45DC's Dante interface must be assigned to desired sources and destinations. This will typically be done with the Dante Controller software application which is available for download free of charge at www.audinate.com. Versions are available to support Windows® and OS X® operating systems. Within Dante Controller a "subscription" is the term used for routing a transmitter flow (a group of output channels) to a receiver flow (a group of input channels). Note that as of the writing of this guide the Ultimo integrated circuit limits the number of Dante flows to two in each direction (two transmitter and two receiver). These can either be unicast, multicast, or a combination of the two.

The Model 45DC has a default Dante device name of **ST-M45DC** followed by a unique suffix. The suffix identifies the specific Model 45DC that is being configured; it relates to the MAC address of the unit's Ultimo integrated circuit. The Model 45DC provides two Dante transmitter (output) channels with the default names of **From PL Ch1** and **From PL Ch2**. The Model 45DC has two Dante receiver (input) channels with default names of **To PL Ch1** and **To PL Ch2**. Using Dante Controller these names can be revised as appropriate for the specific application.

The Model 45DC only supports an audio sample rate of 48 kHz but does have the ability to select a pull-up/pull-down value. This value can be selected using the Dante Controller application. The Model 45DC can serve as the clock master for a Dante network but in most cases that would not be optimal.

Model 45DC units will typically be used in either of two configurations: "point-to-point" or in association with other Dante-enabled equipment. The first configuration finds two units working together to "link" two physical locations. At each location there will either be one or two existing party-line intercom circuits or one or two sets of user devices. The two Model 45DC units will be operating "point-to-point," interconnected by way of the associated Ethernet network. For this application the audio routing would be very simple. **To PL Ch1** on each unit would be routed to **From PL Ch1** on the other unit. And **To PL Ch2** on each unit would be routed to **From PL Ch2** on the other unit.

The other typical applications will have one Model 45DC connected to one or two existing party-line intercom circuits or supporting one or two sets of user devices. The unit's audio channels would be routed to input and output audio channels on associated Dante-enabled equipment. For example, the RTS ADAM matrix intercom system provides Dante interconnection capability using its OMNEO interface card. The audio channels on the Model 45DC would be routed to and from audio channels on the OMNEO card. Other equipment that supports Dante, such as audio consoles or audio interfaces (Dante-to-MADI, Dante-to-SDI, etc.), can have their audio channels routed to and from a Model 45DC.

Operation

At this point the Model 45DC should have its party-line and Ethernet connections made. Depending on the application an external 12 volt DC power connection may have also been made. The Dante receiver (input) and transmitter (output) channels should have been routed using the Dante Controller software application. Normal operation of the Model 45DC can now begin.

Initial Operation

The Model 45DC will begin functioning a few seconds after its power source is connected. As previously discussed, the power source can be provided by Power-over-Ethernet (PoE) or an external source of 12 volts DC. If both are connected the PoE source will power the unit. Should PoE subsequently no longer be available, operation will continue using the external source.

Upon Model 45DC power up many of the status and meter LEDs will activate in test sequences. The PoE and USB LEDs, located on the back panel, will light one after another. On the front panel the input power, channel status and level meters LEDs will light in a sequence. Once the test sequences have completed two columns of front-panel level meter LEDs will momentarily display the version number of the unit's application firmware. Details on how to "read" the version number is provided in the Technical Notes section of this guide.

The Model 45DC will now begin normal operation. The way in which the LINK/ACT, SYS, SYNC, and PoE LEDs (all located on the back panel below the etherCON connector) light will depend on characteristics related to the connected Ethernet signal and the configuration of the unit's Dante interface. Details will be covered in the next paragraph. The user is presented on the front panel with two pushbutton switch, two input power status LEDs, six channel status LEDs, and four 5-segment LED level meters. These resources are simple to operate and understand, as will be described in later paragraphs.

Ethernet, PoE, and Dante Status LEDs

Four status LEDs are located below the etherCON connector on the Model 45DC's back panel. The LINK/ACT LED will light green whenever an active connection to a 100 Mb/s Ethernet network has been established. It will flash on and off in response to data packet activity. The PoE LED will light green whenever Power-over-Ethernet (PoE) associated with the connected Ethernet signal is providing operating power for the Model 45DC. The SYS and SYNC LEDs display the operating status of the Dante interface and associated network. The SYS LED will light red upon Model 45DC power up to indicate that the Dante interface is not ready. After a short interval it will light green to indicate that it is ready to pass data with another Dante device. The SYNC LED will light red when the Model 45DC is not synchronized with a Dante network. It will light solid green when the Model 45DC is synchronized with a Dante network and an external clock source (timing reference) is being received. It will slowly light on and off green when the Model 45DC is part of a Dante network and is serving as a clock master.

How to Identify a Specific Model 45DC

The Dante Controller software application offers an identify command that can be used to help locate a specific Model 45DC. When identify is selected for a specific unit its meter LEDs will light in a unique pattern. In addition, the SYS and SYNC LEDs, located directly below the etherCON connector on the back panel, will slowly flash green. After a few seconds the LED identification patterns will cease and normal Model 45DC level meter and Dante status LED operation will again take place.

Level Meters

The Model 45DC contains four 5-segment LED level meters. These meters are provided as a support aid during installation, configuration, operation, and troubleshooting. The meters represent the strength of the audio signals going to and coming from the two party-line intercom interfaces.

General

Each interface has two meters associated with it, one represents audio being sent to the party-line circuit and the other representing audio coming from the party-line circuit. The meters are calibrated to reflect the level in dB relative to the reference (nominal) level of the party-line circuit. In the case of the Model 45DC the nominal level of the party-line was selected to be –14 dBu since that matches that of the typical single-channel party-line circuit. (Very early single-channel Clear-Com systems had a nominal level of –20 dBu but that's no longer true for contemporary units.)

As an example of how the meters function let's review the situation where the channel A TO meter has its bottom three LEDs (–18, –12, and –6) lit solid and its 0 LED just barely lighting. This would indicate that a signal with an approximate level of –14 dBu is being sent to the associated party-line intercom circuit. (Also note that this –14 dBu signal on the party-line intercom circuit will translate to a –20 dBFS digital audio signal on the Dante interface. This is due to Studio Technologies selecting –20 dBFS as the reference (nominal) level for Dante.)

Each level meter contains four green LEDs and one yellow LED. The four green LEDs indicate party-line circuit signal levels at or below –14 dBu. The top LED is yellow and indicates a signal that is 6 dB or greater than the –14 dBu 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 stage reducing the signal level may be prudent. Typical operation with normal signal levels should find the meters lighting near their 0 point. Signal peaks may cause the yellow LEDs to flash. But a yellow LED that lights fully during normal operation will typically indicate excessive signal level and/or a configuration problem with associated Dante-enabled equipment.

Non-Optimal Signal Levels

If the meters consistently display levels that are lower or higher than the 0 (reference) point it's possible that a configuration issue exists. This would typically be related to incorrect settings on the equipment connected to the associated Dante input and output channels. (This situation is almost impossible to occur if two Model 45DC units were configured "point-to-point" as no Dante digital audio level adjustment is provided.) 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 it's not clear how this translates into a digital audio level on an associated Dante channel. Using its configuration software it's most likely possible to set the nominal level of intercom key panels or ports to something different than +8 dBu. The best solution in this case would be to adjust the associated OMNEO (Dante-compatible) port such that it results in a nominal level of –20 dBFS on the associated Dante channels. This should lead to the best performance of the Model 45DC and associated party-line user devices.

Audio Levels and Party-Line Termination

The FROM meters display the level of signals that come from the party-line circuit. These signals are then sent as digital audio to the associated Dante output channels. An issue may arise if the signals coming from the connected party-line circuit or user devices aren't at a sufficient level so that a normal meter display level can be reached. For a party-line circuit to function correctly the impedance (resistance to AC signals such as audio) must be approximately 200 ohms. Typically to achieve this depends on a single piece of equipment providing a single audio termination. This termination, 200 ohms nominally, 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 party-line circuit, will cause a "double-termination" condition. This will result in a 100 ohm party-line circuit impedance and an audio level drop of about 6 dB. Removing the unwanted termination is the only valid means of correcting the problem. In most cases this will be simple to solve. It's easily possible for the Model 45DC's local power source, which also provides 200 ohm termination networks for the audio channel, to be enabled when the Model 45DC is connected to an externally-powered party-line circuit. This would be incorrect, leading to the "double-termination" condition. Turning off the Model 45DC's local power source by pressing and holding the auto null button is all that is required.

Power Status LEDs

Two green LEDs are located on the front panel and are associated with operating power. The PoE LED indicator will light whenever an Ethernet connection with Power-over-Ethernet (PoE) capability is connected. The DC power LED will light whenever an external DC voltage has been applied. The acceptable range is 10 to 18 volts DC. If both power sources are present the PoE source will provide the Model 45DC's operating power.

Party-Line Operating Mode Selection

As discussed previously in this guide, the Model 45DC provides two main operating modes. One mode is used when a Model 45DC channel is required to create a party-line circuit, providing 28 volts DC and a 200 ohm termination impedance. In this mode user devices such as beltpacks can be directly supported. When this mode is selected the local power status LED will be lit. The second mode allows the Model 45DC to be connected to an existing powered party-line intercom circuit. In this mode the local power status LED will not be lit. To select the desired operating

mode is simple, only requiring the audio null pushbutton switch of the desired interface channel to be pressed and held for two seconds. The mode will change and the local power LED will display accordingly. The button can then be released. The selected operating mode for each interface channel will be stored in nonvolatile memory so that they will restore after a power-down/power-up cycle.

Local Power Mode Operation

When a channel's local power LED is lit the Model 45DC provides party-line power and a 200 ohm termination impedances to create a single-channel party-line circuit. The party-line interface supplies 28 volts DC on pin 2 of the 3-pin XLR connectors. A maximum current draw of 150 mA per interface is available. This current is sufficient to power intercom user devices such as beltpacks. A common entertainment or corporate application might use Clear-Com RS-501 or RS-701 beltpacks. Select the connected devices so that their total maximum current doesn't exceed 150 mA. 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 ubiquitous RS-501 will consume a maximum of 50 mA of current. According to this figure up to three of these units can be connected to a Model 45DC. A newer version, the RS-701 has a quiescent current draw of 12 mA and an approximate maximum of 23 mA. From this information one could estimate that up to five of these units can easily be supported.

The active LED will light when a minimal amount of current is flowing from the Model 45DC intercom interface to the connected user device or devices. This current, approximately 5 mA, provides a "circuit-active" signal to the Model 45DC's firmware, indicating that normal operation is taking place. This helps to prevent unwanted audio signals from passing to the Dante audio channels when no party-line devices are connected.

The Model 45DC's two party-line intercom power supply circuits operate independently under firmware control. This allows detection of fault conditions and protection of the Model 45DC's circuitry. Upon initial Model 45DC party-line intercom power up no monitoring of the intercom power outputs takes place for three seconds. This allows the Model 45DC's circuitry and the connected intercom user devices to stabilize. The active LEDs, which monitor the DC voltage on pin 2 of the 3-pin XLR connectors associated with the intercom channels, will light to indicate that an output is active. After this initial delay period monitoring becomes active. A fault condition is detected if the voltage on pin 2 falls below 24 for a continuous 1-second interval. The hardware and firmware responds to this condition by turning off the associated power source to pin 2 and flashing the active 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 pin 2, the active LED will light, and monitoring won't begin for another three seconds. A full short-circuit condition applied to either of the Model 45DC's party-line circuits will result in a continuous cycle of four seconds on (three seconds for start up and one second for detection) and five seconds off on that specific circuit.

External Party-Line Circuit Operation

When an interface channel's local power LED is not lit that interface is intended to be connected to an external party-line circuit. The external circuit must provide power and termination impedances to "create" the party-line, with the Model 45DC simply serving as a user device. When connected to an external party-line circuit the active LED associated with that interface channel will light when the voltage on pin 2 is equal to or greater than approximately 18. If this condition is present then normal Model 45DC operation will be able to take place.

Auto Null

The Model 45DC contains circuitry to automatically null the hybrid networks associated with the two party-line interfaces. This procedure minimizes the mixing of the audio signals being received by and sent to each party-line interface circuit. Normally the nulling processes are performed at the time of initial Model 45DC configuration but there's no reason why either or both can't be initiated any time one desires. The only time that an auto null must be performed is if conditions have changed with the party-line user devices and wiring connected to a Model 45DC's party-line connector. Even a small change to a party-line intercom circuit, such as adding or removing a section of cable, is often enough to require that the auto null process be performed.

Two pushbutton switches are provided to activate the auto null process for each interface. To initiate auto null first requires that an interface's active LED be lit. When an interface's operating mode is set for local power the active LED will light when current is flowing from the internal power supply. When the local power LED is not lit the active LED must be lit, indicating that sufficient DC voltage is present on pin 2 of the connected party-line circuit. Once the active LED is lit initiating an auto null function only requires pressing and releasing ("tapping") the appropriate auto null button. An LED provides a visual indication of the status of the auto null process, flashing when the auto null process is active. If the auto null button is pressed when its associated active LED is not lit the auto null process will not start. The auto null LED will quickly flash on and off a few times to indicate this condition. Only one auto null process can be active at any one time. Nothing will happen if either auto null button is pressed when the auto null process is active for an interface. (An interface's mode can be changed when the auto null is active on the other interface.)

An auto null sequence begins in this manner: If local power is being provided to the party-line interface by the Model 45DC it will momentarily turn off and then turn on again. This will act as a "mic kill" signal, ensuring that microphones associated with the connected user devices will be placed in their off state. Then the audio input and output signal paths associated with the Dante input and output channels will mute. Next a series of tones will be sent to the party-line interface's audio path. Other Model 45DC circuitry, under firmware control, will rapidly perform adjustments to achieve the best null possible. After the adjustments have been made the results are stored in nonvolatile memory. Once the process is complete the Dante audio input and output paths are again activated.

If possible, prior to performing an auto null it's polite to warn all personnel who

are actively using connected party-line intercom devices. The tones sent to the party-line 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's a good idea to ask them to mute any active microphones. Muting the microphones can be significant as obtaining a "deep" null requires that no extraneous signals be present on the intercom circuit. As previously discussed, if the Model 45DC is supplying local intercom power the microphones will automatically be muted. But for applications that connect to an existing party-line intercom circuit the user's must manually mute the microphones.

The Model 45DC provides a call light support function, allowing call light signals associated with user devices on two Model 45DC interfaces to work together. The function also allows a Model 45DC interconnected with a Model 45DR Dante to 2-Channel Party-Line Intercom Interface to have common call light activity. No operator action is required for the call light support function to perform its task. However, placing DIP switch SW1, located on the back panel, to its on (up) position will disable the function.

USB Interface

A USB type A connector and associated status LED is located on the back panel of the Model 45DC. This data interface is used only for updating the unit's application firmware. No audio data of any kind will pass through it. For details please refer to the Technical Notes section of this guide.

Technical Notes

Call Light Support

A "call" or "call light" indication on a Clear-Com party-line intercom circuit is transmitted by way of a DC voltage that is applied to the audio path, which is typically pin 3 of the interconnecting cable. This DC voltage is summed (added) to any audio that is present. The Model 45DC detects when a call light signal is active by monitoring the audio path for the presence of a DC voltage. A signal of approximately 5 Vdc or greater is needed to indicate that the call function is active. The Model 45DC can also generate a call signal by applying a DC voltage to audio path. The DC, approximately 16 V, is ramped up and down to minimize the addition of clicks or pops to the audio signal.

While the Model 45DC can detect and generate a call signal, it's not possible to directly send and receive these DC signals over a Dante interconnection that's intended only for audio transport. The Model 45DC works around this issue by converting the DC call light signaling to one that's based on a 20 kHz audio tone. An astute user will recognize this as the call method used by the TW-series from RTS; instead of signaling via DC in the audio path a 20 kHz signal is used. In the "telco" world this would be referred to as in-band signaling, not dissimilar to the touch-tone dialing method that's used on analog telephone lines. But unlike touch-tone signals, a 20 kHz signal has the advantage of being above the hearing range of most humans. This allows normal intercom audio and a 20 kHz call signal to be active simultaneously. And transporting this combined talk/call signal over the Model

45DC's Dante connection shouldn't be a problem as a digital audio path that has a 48 kHz sample rate can easily transport a 20 kHz signal.

When the Model 45DC detects DC on the audio path (pin 3 of the back-panel interface connector) it will digitally generate a 20 kHz tone and mix (sum) it with any audio signals present on the associated Dante transmitter (output) channel. Detection circuits in the Model 45DC's Dante receiver (input) audio paths continually monitor for the presence of a 20 kHz tone. If this signal is detected (in the digital domain) it will cause a DC voltage to be applied to the audio path of the associated party-line interface circuit. When the 20 kHz signal is no longer present the DC voltage will be removed. The 20 kHz-to-DC translation takes place automatically with no configuration required. This method is very useful for a number of reasons. It allows two Model 45DC units that are interconnected in a point-to-point manner to transport both audio and call signals between them. It will also allow the support of call signals between a Model 45DC (supporting two single-channel Clear-Com party-line circuits) and a Model 45DR (supporting a 2-channel RTS party-line circuit). And finally it will allow equipment that's capable of transporting 20 kHz call signals associated with RTS party-line circuits, such as RTS ADAM OMNEO ports, to send and receive DC-based call signals associated with single-channel Clear-Com party-line devices.

Note that digital filters in the Model 45DC's firmware prevent essentially all information above 10 kHz from being sent to the party-line audio channels. This helps to ensure that the hybrid circuits provide a "deep" null as was as keeping the 20 Hz call signal from each party-line audio path.

Common Ground

The Model 45DC provides two independent single-channel party-line intercom interfaces. These interfaces can be connected to two sets of user devices, two existing party-line intercom circuits, two channels from an external party-line intercom power supply, or any combination thereof. An important thing to remember is that the power source and audio channel connections associated with the Model 45DC's two single-channel party-line interface channels share a common ground. This is as expected but does provide one application limitation. The two interfaces are not intended to interconnect (bridge) two intercom circuits that are isolated from each other. If this is done through the linking of the pin 1 connections on the Model 45DC's two 3-pin XLR connectors one can expect hum, noise, or other audio artifacts to be created. This would be the result of the potential difference that would typically be found on two separate party-line intercom circuits. If this linking with isolation function is required a product such as the Clear-Com TW-12C would be necessary.

3-Position Header

An internal 3-position header connector allows support for an alternate cover. The cover, purchased as an option, has an Anton-Bauer QR-Gold battery bracket that is electrically wired in parallel with the 4-pin XLR DC input connector. The header, located on the Model 45DC's printed circuit board, is Molex® part number 22-23-2031. It mates with Molex housing number 22-01-3037. To make the

interconnection, separate crimp terminals are attached to three loose wires and then "snapped" into the housing. Molex part number 08-50-0114 specifies crimp terminals that are appropriate for 22 to 30 gauge wires. These terminals are available worldwide from sources such as Digi-Key (www.digikey.com).

IP Address Assignment

By default the Model 45DC's Ethernet interface will attempt to obtain an IP address and associated settings using DHCP (Dynamic Host Configuration Protocol). If a DHCP server is not detected an IP address will be assigned using the link-local protocol. This protocol is known in the Microsoft® world as Automatic Private IP Addressing (APIPA). It is also sometimes referred to as auto-IP (PIPPA). Link-local will assign an IP address in the IPv4 range of 169.254.0.1 to 169.254.255.254. In this way multiple Dante-enabled devices can be connected together and automatically function, whether or not a DHCP server is active on the LAN. Even two Dante-enabled devices that are directly interconnected using an RJ45 patch cord will correctly acquire IP addresses and be able to communicate and transport audio.

Using the Dante Controller software application the Model 45DC's IP address and related network parameters can be set for a fixed ("static") configuration. While this is more involved than letting DHCP or link-local "do their thing," if fixed addressing is necessary then that capability is available. But in this case it's highly recommended that each unit be physically marked, e.g., directly using a permanent marker or "console tape," with its specific IP address. If knowledge of a Model 45DC's IP address has been misplaced there is no reset button or other method to restore the unit to a default IP setting.

In the unfortunate event that a device's IP address is "lost," the Address Resolution Protocol (ARP) networking command can be used to "probe" devices on a network for this information. For example, in Windows OS the **arp –a** command can be used to display a list of LAN information that includes MAC addresses and corresponding IP addresses. The simplest means of identifying an unknown IP address is to create a "mini" LAN with a personal computer connected directly to the Model 45DC. Then by using the appropriate ARP command the required "clues" can be obtained.

For best Dante audio-over-Ethernet performance a network that supports VoIP QoS capability is recommended. This can typically be implemented on virtually all contemporary managed Ethernet switches. There are even specialized switches that are optimized for entertainment-associated applications. Refer to the Audinate website (www.audinate.com) for details on optimizing networks for Dante applications.

Application Firmware Version Display

As part of the Model 45DC's power-up sequence the unit's application firmware version number is displayed. This is useful when working with factory personnel on application support and troubleshooting situations. The five To meter LEDs associated with interface B are used to display the major release number with a range of 1 through 5. The five From meter LEDs associated with interface B are used to display the release sub-number which

ranges from 1 through 5. Refer to Figure 5 for a detailed view of the LEDs and the corresponding application firmware version numbering scheme. The Model 45DC's initial application firmware release is version 2.2 which is represented by the second from the bottom LED of each column being lit.

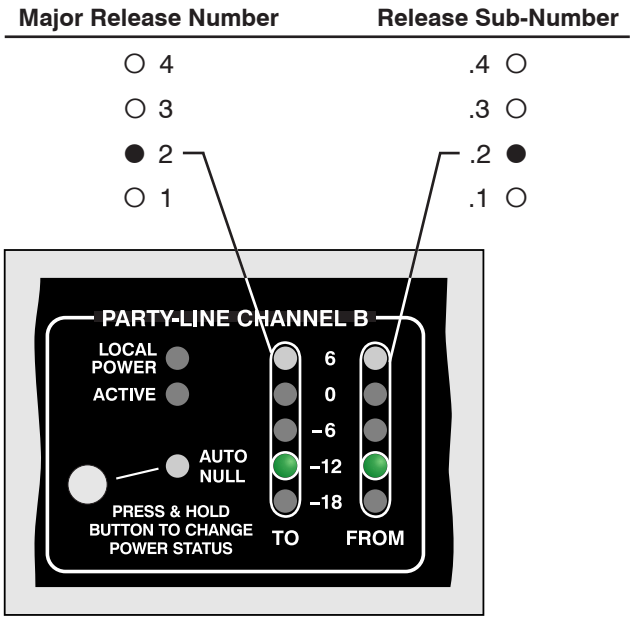

Figure 5. Detail of front panel showing the status LEDs that display the application firmware version. In this example, the application firmware version is 2.2.

Application Firmware Update Procedure

It's possible that updated versions of the application firmware (embedded software) that runs the Model 45DC's microcontroller (MCU) integrated circuit will be released to add features or correct issues. Refer to the Studio Technologies' website for the latest application firmware file. The unit has the ability to automatically load revised files into the MCU's nonvolatile memory by way of its USB interface. The Model 45DC implements a USB host function that directly supports connection of a USB flash drive. The Model 45DC's MCU updates using a file named **m45DC.bin**.

The update process begins by preparing a USB flash drive. The flash drive doesn't have to be empty (blank) but must be in the personal-computer-standard FAT32 format. Save the new firmware file in the root directory with a name of **m45DC.bin**. Studio Technologies will supply the application firmware file inside a .zip archive file. While the firmware file inside of the zip file will adhere to the naming convention required by the Model 45DC, the name of the zip file itself will include the file's version number. For example, a file named **m45DCv2r2MCU.zip** would indicate that version 2.2 of the application firmware (**m45DC.bin**) is contained within this zip file. Two of the LED meters should be used to confirm that the correct application firmware version has been successfully installed.

To install the application firmware file follow these steps:

1. Remove power from the Model 45DC. This will entail removing the Ethernet connection if it is providing PoE power and/or removing the external source of 12 volts DC if that is being used.

2. Ensure that nothing is present in the USB port. Then again apply power to the unit and "read" the currently loaded application firmware version during the power-up sequence using the interface B level meters. (Refer to the Application Firmware Version Display paragraph earlier in this section.) Note this for later reference.

3. Remove power from the Model 45DC.
4. Insert the prepared USB flash drive into the Model 45DC's USB port, located on the back panel of the unit.
5. Apply power to the Model 45DC. Power can be provided by Power-over-Ethernet (PoE) associated with a connected Ethernet signal or can be from an external 12 volt DC source.
6. The Model 45DC will run a "boot loader" program that will immediately load the new application firmware file (**m45DC.bin**). This process takes only a few seconds. During this time period the LED located below the USB connector will flash slowly on and off green. Once the entire loading process is over, taking approximately 10 seconds, the Model 45DC will restart using the newly-loaded application firmware.
7. At this time the Model 45DC is functioning with the newly-loaded application firmware and the USB flash drive can be removed. But to be conservative, remove power first and then remove the USB flash drive.
8. Apply power to the Model 45DC and "read" the application firmware version number by observing the channel B level meters. Ensure that this is the desired version and that it's different from that noted in step 2.

Note that upon power being applied to the Model 45DC if the USB flash drive doesn't have the correct file (**m45DC.bin**) in the root folder no harm will occur. Upon power up the USB LED will flash on and off rapidly for a few seconds to indicate this condition and then normal operation using the unit's existing application firmware will begin.

Ultimo Firmware Update

As previously discussed in this guide, the Model 45DC implements Dante connectivity using the Ultimo integrated circuit from Audinate. This 2-input/2-output device can be updated by way of the Model 45DC's Ethernet connection. The latest Dante firmware file is available on the Studio Technologies website. The Dante Firmware Update Manager application is used to install the firmware. This program is also available for download on the Studio Technologies website.

Specifications

Power Sources:

Power-over-Ethernet (PoE): class 3 (mid power) per IEEE 802.3af

External: 10 to 18 volts DC, 1.0 amp max @ 12 volts DC

Network Audio Technology:

Type: Dante Audio-over-Ethernet

Bit Depth: up to 24

Sample Rate: 48 kHz

Number of Receiver (Input) Channels: 2

Number of Transmitter (Output) Channels: 2

Dante Audio Flows: 4; 2 receiver, 2 transmitter

Analog to Digital Equivalence: a +4 dBu input with 0 dB gain selected results in a Dante digital output level of –20 dBFS

Network Interface:

Type: twisted-pair Ethernet, Power-over-Ethernet (PoE) supported

Data Rate: 100 Mb/s (10 Mb/s Ethernet not supported)

General Audio:

Frequency Response (PL to Dante): –0.3 dB @ 100 Hz (–4.8 dB @ 20 Hz), –2 dB @ 8 kHz (–2.6 dB @ 10 kHz)

Frequency Response (Dante to PL): –3.3 dB @ 100 Hz (–19 dB @ 20 Hz), –3.9 dB @ 8 kHz (–5.8 dB @ 10 kHz)

Distortion (THD+N): <0.01%, measured at 1 kHz, Dante input to PL interface pin 3

Signal-to-Noise Ratio: >73 dB, A-weighted, measured at 1 kHz, Dante input to PL interface pin 3

Party-Line (PL) Intercom Interface: 2

Type: single-channel PL (pin 1 common; pin 2 DC; pin 3 unbalanced analog audio)

Compatibility: single-channel PL intercom systems such as those offered by Clear-Com® and ASL

Power Source, Pin 2: 28 volts DC, 150 mA maximum

Impedance, pin 3 – Local Power Not Enabled: >10 k ohms

Impedance, pin 3 – Local Power Enabled: 200 ohms

Analog Audio Level: –14 dBu, nominal, +7 dBu maximum

Call Light Signal Support: DC voltage on pin 3; detect @ ≥5 Vdc nominal; generate @ 16 Vdc nominal

Mic Kill Signal Support – Local Power Enabled: momentary break in DC voltage on pin 2

Party-Line (PL) Hybrids: 2

Topology: 3-section analog circuitry compensates for resistive, inductive, and capacitive loads

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

Nulling Line Impedance Range: 120 to 350 ohms

Nulling Cable Length Range: 0 to 3500 feet

Trans-Hybrid Loss: >55 dB, typical at 800 Hz

Meters: 4

Function: displays level of audio input and output channels

Type: 5-segment LED, modified VU ballistics

Connectors:

Party-Line (PL) Intercom: two 3-pin male XLR

Ethernet: Neutrik etherCON RJ45

External DC: 4-pin male XLR

USB: type A receptacle

Dimensions – Overall:

8.7 inches wide (22.1 cm)
1.72 inches high (4.4 cm)
8.3 inches deep (21.1 cm)

Mounting Options: single- or dual-unit rack-mount front panels; uses one space (1U) in a standard 19-inch rack

Weight: 1.7 pounds (0.77 kg); rack-mount front panels add 0.2 pounds (0.09 kg)

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