

# **Model 545DC Intercom Interface**

## **User Guide**

Issue 1, June 2022

This User Guide is applicable for serial numbers M545DC-00151 and later with Application Firmware 1.00 and later and STcontroller application version 3.08.00 and later.

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## Revision History

### Issue 1, June 2022:

- Initial release.

## Introduction

The Model 545DC Intercom Interface allows two single-channel analog party-line (PL) intercom circuits and associated user devices to be incorporated into Dante® audio-over-Ethernet applications. Single-channel analog party-line (PL) intercom systems are commonly used in theater, entertainment, and education applications where a simple, reliable, low-cost, and easy-to-use solution is desired. Dante has become a major method of interconnecting audio signals and various devices using standard Ethernet networks. The Model 545DC directly supports both analog party-line (PL) and Dante, providing excellent performance in both domains. Single-channel analog party-line (PL) products from Clear-Com® are directly compatible with the Model 545DC. The Dante audio-over-Ethernet media networking technology is used to transport the send and receive audio channels associated with the two single-channel party-line (PL) circuits. The Model 545DC's two hybrid circuits with automatic nulling action provide good separation of send and receive audio with high return loss and excellent audio quality. (These hybrid circuits are sometimes referred to as 2-wire to 4-wire converters.) The Model 545DC's digital audio signals are compatible with all equipment that utilizes Dante technology. An Ethernet connection is all that's required to make the Model 545DC part of a sophisticated, networked audio system.

The Model 545DC can interconnect with Dante-supported devices such as matrix intercom systems, digital audio processors, and audio consoles. The unit is directly compatible with RTS ADAM® and ODIN® intercom systems that support OMNEO® network technology. Alternately, two Model 545DC units can be interconnected by way of an associated Ethernet network. The Model 545DC can also become part of a party-line (PL) intercom system when used in conjunction with devices such as the Models 5421 and 5422A Dante Intercom Audio Engine units from Studio Technologies. In this way, analog party-line (PL) intercom circuits can become part of a high-performance digital party-line (PL) intercom deployment.

The Model 545DC can be powered by Power-over-Ethernet (PoE) or an external source of 12 volts DC. The unit can provide two party-line (PL) power sources and analog impedance termination networks, allowing direct connection of user belt packs such as the Clear-Com RS-501 and RS-701 devices. A Model 545DC can also connect to one or two existing powered and terminated single-channel analog party-line (PL) intercom circuits. The unit provides four audio level meters that help to confirm system performance during setup and operation. Support for transporting industry-standard call light signals between two Model 545DC units, as well as between a Model 545DC and other compatible units, is also provided.



**Figure 1. Model 545DC Intercom Interface front and back views**

The STcontroller software application can be used to real-time monitor and control several Model 545DC operating parameters. In addition, two configuration settings are performed using the application. Versions of STcontroller are available that are compatible with the Windows® and macOS® operating systems. They are available, free of charge, from the Studio Technologies' website.

Standard connectors are used for Model 545DC party-line (PL) intercom, Ethernet, and DC power interconnections. Set up and configuration of the Model 545DC is simple. A Neutrik® etherCON RJ45 jack is used to interconnect with a standard twisted-pair Ethernet port associated with a local-area network (LAN). This connection can provide both PoE power and bidirectional digital audio. LEDs provide status indications of the Ethernet and Dante connections.

The unit's lightweight aluminum enclosure is intended for desk or tabletop use. Optional mounting kits allow one or two Model 545DC units to be mounted in one space (1U) of a standard 19-inch rack enclosure.

## Applications

There are three main ways the Model 545DC can be used in applications: connecting analog party-line (PL) intercom circuits into Dante-based intercom applications, adding party-line (PL) intercom support for matrix intercom systems, and linking two stand-alone analog party-line intercom circuits. The Model 545DC's Dante transmitter (output) and receiver (input) channels can be connected to Dante-based digital PL intercom circuits. These circuits would typically be created using devices such as the Studio Technologies' Models 5421 or 5422A Dante Intercom Audio Engines. This would allow legacy analog party-line intercom equipment to become part of contemporary digital intercom applications. The resultant audio quality for both the analog and Dante-base PL should be excellent.

Ports on matrix intercom systems that support Dante, such as the RTS ADAM and ODIN with OMNEO, can be routed to the Model 545DC's Dante transmitter (output) and receiver (input) channels. The Model 545DC's circuitry will then convert these signals into two single-channel analog party-line intercom circuits. In this way, adding analog party-line support will be a simple task. The Model 545DC can also be

used with matrix intercom systems that don't support Dante. An external analog-to-Dante interface can be used to convert "4-wire" analog intercom resources to Dante channels. For example, the Model 544D Audio Interface from Studio Technologies is well suited to function with matrix intercom systems. Once in the Dante digital domain, these audio channels can be interconnected with the Model 545DC's Dante receiver (input) and transmitter (output) channels.

Separate single-channel analog party-line (PL) intercom circuits can easily be interconnected using two Model 545DC Interfaces. On each end, a Model 545DC is connected to one or two PL circuits as well as to the Dante network. The Dante Controller software application is used to route (subscribe) the audio channels between the two Model 545DC units. (The physical distance between units will only be limited by the deployment of the LAN's subnet.) That's it — nothing else is required to achieve excellent performance.

The Model 545DC can also be used to "bridge" (interconnect) one or two single-channel party-line intercom circuits with a 2-channel party-line intercom circuit. This involves using a Model 545DC to support the single-channel circuits and a Studio Technologies' Model 545DR Intercom Interface to support the 2-channel party-line intercom circuit. The Model 545DR is a "cousin" of the Model 545DC and supports one 2-channel party-line intercom circuit rather than two single-channel circuits. This 2-channel circuits, typically supported by equipment from RTS, are commonly used in broadcast applications.

## Party-Line Interface

As previously discussed, the Model 545DC's two party-line intercom interfaces are optimized for connection with two single-channel party-line intercom circuits or groups of single-channel user devices. (While the Model 545DC will also function in a limited manner with 2-channel RTS TW circuits, the Model 545DR Intercom Interface is the much-preferred choice.) A party-line active detection function ensures that should a user beltpack or active party-line intercom circuit not be connected the Model 545DC'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 545DC's two party-line interfaces is their ability to supply power and a 200 ohms AC termination to "create" two independent intercom circuits. Each 28 volts DC output can power a moderate number of devices such as user belt-packs. With up to 150 milliamperes (mA) of current available, a typical entertainment application could connect up to three RS-501 or five RS-701 belt-packs to each of the Model 545DC's two interfaces. In many applications, this can eliminate the need for an external intercom power supply, 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 545DC 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 transmitter (output) and receiver (input) channels on associated Dante-enabled devices can be routed (subscribed) to the Model 545DC using the Dante Controller application. This makes it simple to select the way in which a Model 545DC fits into a specific application.

## **Analog Hybrids with Auto Nulling**

Two circuits, referred to as "hybrids," interface the Dante transmitter (output) and receiver (input) channels with the two party-line 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 545DC'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 545DC'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 545DC's auto null buttons is pressed, or the STcontroller application is used, digital circuitry adjusts the associated hybrid to achieve its maximum return-loss in under 15 seconds. While the nulling process is automatic, it only takes place upon user request. The resulting null parameters are stored in non-volatile memory.

## **Pro Audio Quality**

The Model 545DC'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 head-room. Using 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 545DC 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. 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 Model 545DC unit.

## **Status Display**

LED indicators are provided on the Model 545DC's front panel, offering a status indication of the party-line power sources, party-line activity, and auto null functions. Two other LEDs offer a direct indication of what source or sources of power are connected to the Model 545DC. The STcontroller application also provides a real-time "virtual" status display of the unit's PL power sources, PL activity, and auto null functions.

## **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 545DC can detect such call light activity, converting it to a 20 kHz audio tone which is then transported over the Dante

audio path. A Model 545DC unit at the “far end” will detect the “call” audio tone and regenerate it as a DC voltage on the party-line intercom audio path. This allows full “end-to-end” call light support between two Model 545DC units. It also allows a Model 545DC to send and receive call light status with an interconnected Model 545DR Intercom Interface. The Model 545DR is typically used with the RTS TW-series of two-channel party-line user beltpacks, including the popular BP-325.

## **Ethernet Data, PoE, and DC Power Source**

The Model 545DC connects to a local area data network (LAN) using a standard 100 Mb/s twisted-pair Ethernet interface. The physical interconnection is made by way of a Neutrik etherCON RJ45 jack. While compatible with standard RJ45 plugs, an etherCON jack allows a ruggedized and locking interconnection for harsh or high-reliability environments. The Model 545DC’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 545DC’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 545DC 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 545DC uses standard connectors to allow fast and convenient interconnections. An Ethernet signal is connected using a Neutrik etherCON RJ45 jack. If Power-over-Ethernet (PoE) is available operation will commence immediately. An external 12 volts DC power source can also be connected by way of a 4-pin female XLR connector. Party-line intercom connections are made using two 3-pin male XLR connectors. The Model 545DC 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-mounting option kits are available that allow one or two Model 545DC units to be mounted in one space (1U) of a standard 19-inch rack enclosure.

## **Future Capabilities and Firmware Updating**

The Model 545DC was designed so that its capabilities and performance can easily be enhanced in the future. A USB receptacle, located on the Model 545DC’s back panel, allows the application firmware (embedded software) to be updated using a USB flash drive. To implement its Dante interface the Model 545DC uses the UltimoX2™ integrated circuit from Audinate. The firmware in this integrated circuit can be updated via the Ethernet connection helping to ensure that its capabilities remain up to date.

## **Getting Started**

In this section, a location will be selected for the Model 545DC. If desired, an optional installation kit will be used to mount the unit into a panel cutout, wall surface, or equipment rack. Signal interconnections will be made using the unit’s back-panel connectors. Connections to one or two existing party-line intercom circuits or one or more party-line user devices will be made using the 3-pin XLR connectors. An Ethernet data connection, typically which includes Power-over-Ethernet (PoE) capability, will be made using a standard RJ45 patch cable. A 4-pin XLR connector allows connection of a 12 volts DC power source.

## **What’s Included**

Included in the shipping carton are a Model 545DC Intercom Interface and instructions on how to obtain an electronic copy of this guide. An optional installation kit allows a Model 545DC to be mounted in a rectangular opening in a tabletop or attached to a flat surface. If one or two Model 545DC units are going to be mounted in a 19-inch equipment rack then having another of the optional rack-mount installation kits is required. If an installation kit was purchased it would typically have been shipped in a separate carton. As a device that can be powered by Power-over-Ethernet (PoE) or an external source of 12 volts DC, no power



source is included. (A compatible power supply, the Studio Technologies' PS-DC-02, is available as an option.)

## Locating the Model 545DC

Where to locate a Model 545DC will depend on being able to access the associated party-line circuits or wiring provided for the desired user devices. In addition, the unit must be located such that connection to the designated Ethernet signal is also possible. The Model 545DC is shipped as a self-contained "throw-down" unit suitable for portable use or placement in a semi-permanent location. Installed on the bottom of the chassis are screw-affixed "bump on" protectors (also known as rubber "feet"). These are useful if the unit is going to be placed on a surface where scratching of either the Model 545DC's enclosure or the surface material could take place. However, if applicable the "feet" can be removed when installation in a panel cutout, wall mount, or rack enclosure is going to be performed.

Once the unit's physical location has been established it's assumed that the twisted-pair Ethernet cabling will be within 100-meters (325-feet) of the Ethernet port on an associated network switch. If this is not the case, then the overall length limit can be overcome by using a fiber-optic interconnection between the Model 545DC's-related-Ethernet switch and another Ethernet switch that's part of the application's local-area-network (LAN). With a fiber interconnect there's no reason why a Dante-supported LAN can't be distributed over many miles or kilometers.

## Mounting Options

### Panel Cutout or Surface Mounting One Model 545DC Unit

Installation kit RMBK-10 allows one Model 545DC to be mounted in a panel cutout or onto a flat surface. The kit contains two standard-length brackets and four 6-32 thread-pitch Phillips-head machine screws. Refer to Appendix B for a visual explanation.

Get ready to install the kit by first removing the four machine screws and associated "bump on" protectors from the bottom of the Model 545DC's chassis. They are removed using a #1 Phillips screwdriver. Store the four machine screws and four "bump on" protectors for possible later use.

To prepare the unit to mount in a cutout or other opening in a panel, use a #2 Phillips screwdriver and two 6-32 machine screws to attach one of the standard-length brackets onto the left side (when viewed from the front) of the Model 545DC's enclosure. Orient the standard-length bracket such that its front is parallel to the Model 545DC's front panel. The screws will mate with the threaded fasteners that can be seen on the side of the Model 545DC's enclosure, near the front of the unit. Using two additional 6-32 machine screws, attach the other standard-length bracket onto the right side of the Model 545DC's enclosure.

Once the two standard-length brackets have been installed the Model 545DC will be ready to be mounted into an opening. Secure the unit into the top left and right edges of the opening using two mounting screws per side.

To prepare the unit to be mounted onto a flat surface simply requires the standard-length brackets be attached to the Model 545DC at 90 degrees from how they are mounted for use in a panel cutout. Use a #2 Phillips screwdriver and two 6-32 machine screws to attach one of the standard-length brackets onto the left side (when viewed from the front) of the enclosure. Orient the bracket such that its front is parallel with the top surface of the Model 545DC's enclosure. The screws will mate with the threaded fasteners that can be seen on the side of the Model 545DC's enclosure, near the front of the unit. Following the same orientation, use two additional 6-32 machine screws to attach the other standard-length bracket onto the right side of the Model 545DC's enclosure.

Once the two standard-length brackets have been installed the Model 545DC will be ready to be mounted onto a flat surface. Secure the unit to the surface using two mounting screws per side.

### Left- or Right-Side Rack Mounting One Model 545DC Unit

Installation kit RMBK-11 allows one Model 545DC to be mounted in the left or right side of one space (1U) of a standard 19-inch rack enclosure. The kit contains one standard-length bracket, one long-length bracket, and four 6-32 thread-pitch Phillips-head machine screws. Refer to Appendix C for a visual explanation.

Get ready to install the kit by removing the four machine screws and associated “bump on” protectors from the bottom of the Model 545DC’s chassis. They are removed using a #1 Phillips screwdriver. Store the four machine screws and four “bump on” protectors for possible later use.

To prepare the unit to mount in the left side of a rack enclosure, use a #2 Phillips screwdriver and two 6-32 machine screws to attach the standard-length bracket onto the left side (when viewed from the front) of the enclosure. The screws will mate with the threaded fasteners that can be seen on the side of the Model 545DC’s enclosure, near the front of the unit. Using two additional 6-32 machine screws, attach the long-length bracket onto the right side of the Model 545DC’s enclosure.

To prepare the unit to mount in the right side of a rack enclosure, use a #2 Phillips screwdriver and two 6-32 machine screws to attach the long-length bracket onto the left side of the enclosure. Using two additional 6-32 machine screws, attach the standard-length bracket onto the right side of the Model 545DC’s enclosure.

Once the standard-length and long-length brackets have been installed the Model 545DC will be ready to 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 unit into the equipment rack using two mounting screws per side.

### **Rack-Mounting Two Model 545DC Units**

Installation kit RMBK-12 is used to allow two Model 545DC units to be mounted in one space (1U) of a standard 19-inch equipment rack. The kit can also be used to mount one Model 545DC and one other Studio Technologies product that is compatible with the RMBK-12, such as the Model 545DR Intercom Interface or the Model 5421 Dante Intercom Audio Engine. The RMBK-12 installation kit contains two standard-length brackets, two joiner plates, eight 6-32 thread-pitch Phillips-head machine screws, and two 2-56 thread-pitch Torx™ T7 thread-forming machine screws. Refer to Appendix D for a visual explanation.

Get ready to install the kit by removing the four machine screws and associated “bump on” protectors from the bottom of each chassis. They are removed using a #1 Phillips screwdriver. Store the eight

machine screws and eight “bump on” protectors for possible later use.

With assistance from a #2 Phillips screwdriver, use two of the 6-32 machine screws to attach one of the standard-length brackets onto the left side (when viewed from the front) of one of the Model 545DC units. The screws will mate with the threaded fasteners that can be seen on the side of the Model 545DC’s enclosure, near the front of the unit. Using two more of the 6-32 machine screws, attach one of the joiner plates onto the right side of that same Model 545DC unit.

Again using two of the 6-32 machine screws, attach the second standard-length bracket onto the right side of the second Model 545DC or another compatible unit. Using the final two 6-32 machine screws, attach the second joiner plate onto the left side of the second Model 545DC or other compatible unit with an orientation of 180 degrees from the way in which the first plate was installed.

To complete the assembly, “join” the units together by sliding each joiner plate through the other. The grooves in each joiner plate will carefully align with each other and form a relatively tight bond. Line up the two units so that the front panels form a common plane. With the aid of a Torx T7 screwdriver, use the two 2-56 Torx machine screws to secure the two joiner plates together. The screws should fit snugly into the small openings formed by the mating of the two joiner plates.

The 2-unit assembly is now ready to 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 assembly into the equipment rack using two mounting screws per side.

### **Center Rack Mounting One Model 545DC Unit**

Installation kit RMBK-13 allows one Model 545DC to be mounted in the center of one space (1U) of a standard 19-inch rack enclosure. The kit contains two medium-length brackets and four 6-32 thread-pitch Phillips-head machine screws. Refer to Appendix E for a visual explanation.

Get ready to install the kit by removing the four machine screws and associated “bump on” protectors from the bottom of the Model 545DC’s chassis. They

are removed using a #1 Phillips screwdriver. Store the four machine screws and four “bump on” protectors for possible later use.

To prepare the unit to mount in the center of a rack enclosure, use a #2 Phillips screwdriver and two 6-32 machine screws to attach one of the medium-length brackets onto the left side (when viewed from the front) of the enclosure. The screws will mate with the threaded fasteners that can be seen on the side of the Model 545DC’s enclosure, near the front of the unit. Using two additional 6-32 machine screws, attach the other medium-length bracket onto the right side of the Model 545DC’s enclosure.

Once the two medium-length brackets have been installed the Model 545DC will be ready to 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 unit into the equipment rack using two mounting screws per side.

### **Ethernet Connection with PoE**

An Ethernet connection that supports 100BASE-TX (100 Mb/s over twisted-pair) is required for Model 545DC operation. A 10BASE-T connection is not sufficient; 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 also provide operating power for the Model 545DC. To support a PoE Ethernet switch (PSE) that includes power management capability the Model 545DC will enumerate itself as a PoE class 3 device.

A 100BASE-TX Ethernet connection is made by way of a Neutrik etherCON RJ45 jack that is located on the back panel of the Model 545DC. This allows connection by way of a cable-mounted etherCON plug or a standard RJ45 plug. A crossover cable will never be required as the Model 545DC’s Ethernet interface supports auto MDI/MDI-X. Per the Ethernet standard, the Ethernet Switch-to-Ethernet Device length limitation for twisted-pair cabling is 100-meters (325-feet).

### **External 12 Volt DC Input**

An external source of 12 volts DC can be connected to the Model 545DC by way of a 4-pin male XLR connector which is located on the unit’s back panel. While the stated requirement for the external source is nominally 12 volts DC, correct operation will take

place over a 10 to 18 volts DC range. The Model 545DC requires a maximum current of 1.0 amperes for correct operation. The DC source should be terminated on a 4-pin female XLR connector with pin 1 negative (–) and pin 4 positive (+); pins 2 and 3 should remain unterminated. Purchased as an option, the PS-DC-02 power supply, available from Studio Technologies, is directly compatible. Its AC mains input allows connection to 100-240 volts, 50/60 Hz and has a 12 volts DC, 1.5 amperes maximum output that is terminated on a 4-pin female connector.

As previously discussed, an Ethernet connection that provides Power-over-Ethernet (PoE) capability can serve as the Model 545DC’s power source. Alternately, an external 12 volts DC source can be connected. For redundancy, both PoE and an external 12 volts DC source can be connected at the same time. If both PoE and an external 12 volts DC source are connected, power will be drawn only from the PoE supply. If the PoE source becomes inoperative the 12 volts DC source will provide the Model 545DC’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 545DC’s two single-channel party-line intercom interfaces are designed to independently function in two distinct ways. They can be connected to independent “powered” single-channel party-line intercom circuits. Alternately, they can be connected directly to party-line intercom user devices. A single-channel party-line intercom circuit, often associated with equipment from Clear-Com, will have DC power and one audio channel on a 3-pin XLR connector. These connectors will be wired such that common is on pin 1, 28 to 32 volts DC is on pin 2, and talk audio is present on pin 3. A single-channel party-line intercom circuit will also typically include an impedance-generating network that provides a 200 ohms audio (AC) load from pin 3 to pin 1. (And in some cases, a DC “call” signal may, when applicable, also be present on pin 3.) When the Model 545DC’s party-line interface is connected to an existing intercom circuit it will act, from an audio standpoint, similar to that of a standard party-line intercom user device. The Model 545DC’s interface won’t draw (use) any DC power from pin 2 although it is capable of applying DC “call” voltage on pin 3.

The Model 545DC's two party-line interfaces can also serve to create two "mini" intercom circuits. They each provide an intercom power source along with a 200 ohms impedance generator, allowing a limited number of single-channel intercom user devices to be directly connected. Each of the Model 545DC's intercom interfaces can provide 28 volts DC on pin 2 with a maximum current of 150 mA. While relatively modest, this 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 a Model 545DC intercom circuit can directly support up to three of them. Applications that utilize the newer and more energy efficient Clear-Com RS-701 should allow up to five to be connected and powered by each Model 545DC intercom circuit. Wiring from the Model 545DC intercom interface's 3-pin male XLR connectors to user devices require 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, the Model 545DC is designed to directly support two single-channel party-line intercom circuits and groups of user devices. It's also possible that applications that involve a 2-channel party-line intercom circuit and user devices (typically associated with the RTS TW-series of products) can be supported. These circuits and devices typically utilize a common connection on pin 1, 28 to 32 volts DC and channel 1 audio on pin 2, and channel 2 audio on pin 3. When a 2-channel circuit or device is connected to a Model 545DC, only the device's channel 2 will be active; the device's channel 1 will not be active. A better means to support these 2-channel circuits and devices is to use the Studio Technologies' Model 545DR Intercom Interface. This unit, the "cousin" of the Model 545DC, is optimized for 2-channel party-line intercom applications. Rather than providing two single-channel interfaces the Model 545DR provides one 2-channel interface. Detailed information about the Model 545DR is available on the Studio Technologies' website.

## **Dante Configuration**

To integrate the Model 545DC into an application requires that a number of Dante-related parameters be configured. These configuration settings will be stored in non-volatile memory within the Model 545DC's Dante interface circuitry. Configuration will typically be done using the Dante Controller software application which is available for download free of charge at [audinate.com](http://audinate.com). Versions of Dante Controller are available to support the Windows and macOS personal computer operating systems. The Model 545DC uses the UltimoX2 2-input/2-output integrated circuit to implement its Dante interface. The Model 545DC's Dante interface is compatible with the Dante Domain Manager (DDM) software application.

### **Audio Routing**

Two Dante transmitter (output) channels on associated equipment should be routed (subscribed) to the Model 545DC's two Dante receiver (input) channels. The Model 545DC's two Dante transmitter (output) channels should be routed (subscribed) to two Dante receiver (input) channels on associated equipment. This achieves audio interconnection of the Model 545DC's two party-line intercom channels with the Dante network and associated Dante device or devices.

Within Dante Controller a "subscription" is the term used for routing a transmitter channel or flow (a group of up to four output channels) to a receiver channel or flow (a group of up to four input channels). The number of transmitter flows associated with an UltimoX2 integrated circuit is limited to two. These can either be unicast, multicast, or a combination of the two. If the Model 545DC's transmitter (output) channels need to be routed using more than two flows it's possible that an intermediary device, such as the Studio Technologies' Model 5422A Dante Intercom Audio Engine, can be used to "repeat" the signals.

Model 545DC units will typically be used in one of two common configurations: "point-to-point" or in association with other Dante-enabled equipment. The first configuration will utilize two Model 545DC units that "work" together to link two physical locations. At each location there will either be an existing party-line intercom circuit or a set of user intercom devices (such as beltpacks). The two Model 545DC units will

operate “point-to-point,” interconnecting by way of the associated Ethernet network. To implement this application is very simple. The From Party-Line Channel A channel on each unit would be routed (subscribed) to the To Party-Line Channel A channel on the other unit. And the From Party-Line Channel B channel on each unit would be routed (subscribed) to the To Party-Line Channel B channel on the other unit.

The other typical application will have one Model 545DC connected to an existing party-line intercom circuit or a set of user devices. Then the unit’s Dante audio channels would be routed (subscribed) to the Dante transmitter (output) and receiver (input) channels on associated Dante-enabled equipment. An example of this equipment could be the RTS ADAM matrix intercom system that provides Dante interconnection capability using its OMNEO interface card. The audio channels on the Model 545DC would be routed (subscribed) 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 (subscribed) to and from a Model 545DC.

## Device and Channel Names

The Model 545DC has a default Dante device name of **ST-545DC-** followed by a unique suffix. (A technical reason prevents the default name to be the preferred ST-M545DC- (an “M” included). But that can be added by the user.) The suffix identifies the specific Model 545DC that is being configured. The suffix’s actual alpha and/or numeric characters relate to the MAC address of the unit’s UltimoX2 integrated circuit. The unit’s two Dante transmitter (output) channels have default names of **From Ch A** and **From Ch B**. The unit’s two Dante receiver (input) channels have default names of **To PL Ch A** and **To PL Ch B**. Using Dante Controller, the default device and channel names can be revised as appropriate for the specific application.

## Device Configuration

The Model 545DC only supports an audio sample rate of 48 kHz with no pull-up/pull-down values available. The audio encoding is fixed for PCM 24. Device Latency and Clocking can be adjusted if required but the default value is typically correct.

## Network Configuration – IP Address

By default, the Model 545DC’s Dante IP address and related network parameters will be determined automatically using DHCP or, if not available, the link-local network protocol. If desired, Dante Controller allows the IP address and related network parameters to be manually set to a fixed (static) configuration. While this is a more-involved process than simply letting DHCP or link-local “do their thing,” if fixed addressing is necessary then this capability is available. In this case, it’s highly recommended that a unit be physically marked, e.g., directly using a permanent marker or “console tape,” with its specific static IP address. If knowledge of a Model 545DC’s IP address has been misplaced there is no reset button or other method to easily restore the unit to a default IP setting.

## AES67 Configuration – AES67 Mode

The Model 545DC can be configured for AES67 operation. This requires the AES67 Mode to be set for Enabled. By default, AES67 mode is set for Disabled. Note that in the AES67 mode the Dante transmitter (output) channels will function in multicast; unicast is not supported.

## Model 545DC Clocking Source

While technically the Model 545DC can serve as a Leader clock for a Dante network (as can all Dante-enabled devices) in virtually all cases the unit will be configured to receive “sync” from another device. As such, the check box for Preferred Leader associated with the Model 545DC would not want to be enabled.

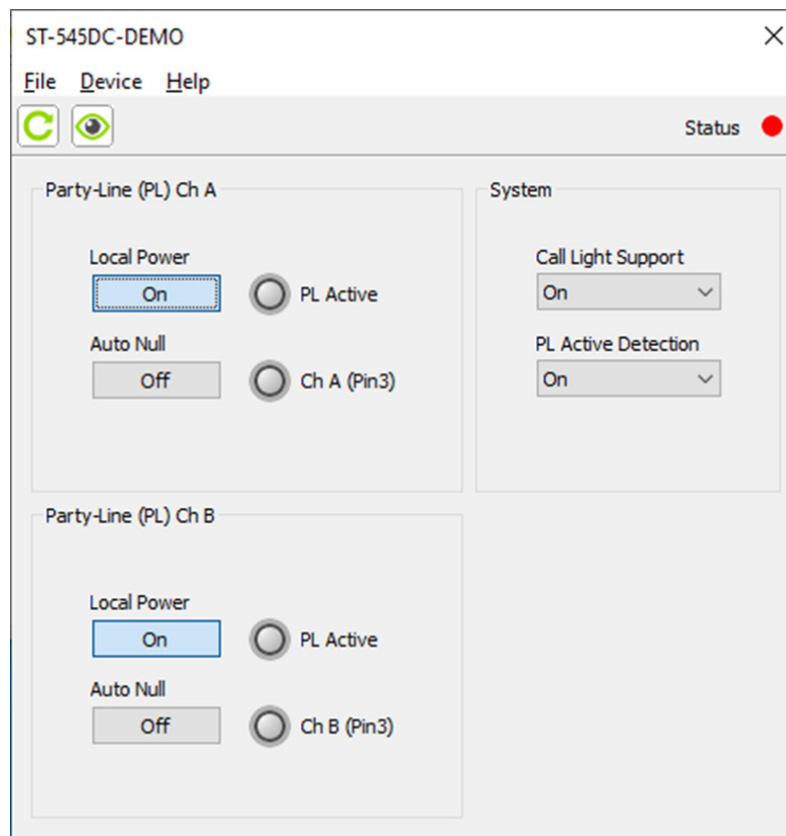
## Model 545DC Configuration

The STcontroller software application is used to configure two Model 545DC functions, call light support, and PL active detection. (STcontroller also allows real-time display and control of other Model 545DC functions. These functions will be detailed in the Operation section.) No DIP switch settings or other local actions are used to configure the unit. This makes it imperative that STcontroller be available for convenient use on a personal computer that's connected to the related LAN.

### Installing STcontroller

STcontroller is available free of charge on the Studio Technologies' website ([studio-tech.com](http://studio-tech.com)). Versions are available that are compatible with personal computers running selected versions of the Windows and macOS operating systems. If required, download and install STcontroller onto a designated personal computer. This personal computer must be on the same local area network (LAN) and subnet as the one or more Model 545DC units that are to be configured. Immediately after starting STcontroller the application will locate all the Studio Technologies' devices that it can control. The Model 545DC units that can be configured will appear in the device list. Use the Identify command to allow easy recognition of a specific Model 545DC unit. Double-clicking on a device name will cause the associated configuration menu to appear. Review the current configuration and make any changes that are desired.

Configuration changes made using STcontroller will be immediately reflected in the unit's operation; no Model 545DC reboot is required. As an indication that a configuration change has been made the two LEDs associated with input power, labeled DC and PoE, on the Model 545DC's front panel will flash in a distinctive pattern.



## System – Call Light Support

Choices are *Off* and *On*.

In STcontroller, the Call Light Support configuration function allows the call light support function to be enabled or disabled as desired. When the function is *On*, the call light support function is enabled. When the Call Light Support configuration is selected for *Off* the function is disabled. For most applications the call light support function should remain enabled. Only special circumstances would merit disabling the function.

## System – PL Active Detection

Choices are *Off* and *On*.

The Model 545DC's current detection function for a party-line interface will be active when both the local power source has been enabled and the PL Active Detection configuration has been selected for *On*. When these two parameters are selected a minimum current of 5 mA (nominal) must be drawn from pin 2 of a PL interface for the Model 545DC to recognize a "PL active" condition. When this minimum current condition is met the LED labeled Active for that specific channel will light green, the PL Active status icon on the STcontroller's menu page will show green, and the Dante transmitter (output) audio path will be active. Having the PL Active Detection function enabled is appropriate for most applications, helping to maintain the most stable audio performance. Only when sufficient current is drawn from pin 2 of an interface will audio from that PL channel be sent out the Dante transmitter (output) channel.

When the PL Active Detection configuration is selected to *Off* (disabled), no minimum current draw is required on pin 2 of the either of the PL interfaces for their Active LEDs to be lit, the STcontroller graphics icons to display green, and the Dante transmitter (output) channels to be active. However, only in special situations would it be appropriate for the PL Active Detection configuration be selected for *Off*.

An example where *Off* would be appropriate would be the case where a Model 545DC is being used with a hypothetical device that has a single-channel party-line interface that doesn't draw DC power. This unit might expect to be connected to an intercom circuit

using a 3-pin XLR connector with common on pin 1, DC power on pin 2, and audio pin 3. The Model 545DC can provide a compatible PL circuit when its local power source is enabled. But a problem can arise as this unit might not draw current from pin 2 of the Model 545DC's PL intercom circuit. It may not function in the same manner as would a typical PL intercom beltpack or user device. It wouldn't use power from the PL connection, instead using its internal power source for operation. In this case, the Model 545DC's party-line interface would not supply current, the Active LED would not light, the active icon in STcontroller would not turn green, and the Dante transmitter (output) audio path would not be enabled. Users of the device would receive Model 545DC Dante receiver (input) audio but would not send audio out the Dante transmitter (output) channel. Using STcontroller to turn off the PL Active Detection function would resolve this issue. Even though no DC current would be supplied by the Model 545DC's PL interface, the Dante transmitter (output) channel would be enabled and successful PL interface operation could take place.

When a Model 545DC party-line intercom circuit has been set to not provide local power the PL Active Detection function works in a slightly different way. Only if a DC voltage of approximately 18 or greater is present on pin 2 of the PL interface will the Model 545DC recognize that a valid PL interconnection has been made. In this case, the channel's Active LED on the front panel will light green, the virtual button in STcontroller will light green, and the Dante transmitter (output) audio channel for that interface will be active. When the PL Active Detection function is disabled, monitoring of DC voltage on pin 2 of the Model 545DC's PL interfaces will not take place. In this situation, the Active LEDs on the Model 545DC's front panel will always be lit, the virtual indicators in STcontroller would be lit, and the Dante transmitter (output) audio channels will be active. The practical application of this specific configuration has not been determined, but it's ready should the need arise!

## Operation

At this point, the Model 545DC should be ready for use. The party-line intercom and Ethernet connections should have been made. Depending on the application, an external source of 12 volts DC power may also have been made. (A 12 volts DC power source is not included with the Model 545DC. One can be purchased as an option.) The Dante receiver (input) and transmitter (output) channels should have been routed (subscribed) using the Dante Controller software application. Normal operation of the Model 545DC can now begin.

On the front panel, multiple LEDs provide an indication of the unit's operating status. In addition, two pushbutton switches are provided to select the on/off status of the local power mode functions as well as activating the auto null functions. The STcontroller software application can be used to observe the status of some of the unit's operating conditions. Virtual pushbutton switches associated with STcontroller also allow control of the on/off status of the local power modes in addition to initiating the auto null functions.

## Initial Operation

The Model 545DC will begin its initial functioning a few seconds after its power source is connected. As previously discussed, the unit's power 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 12 volts DC source.

Upon Model 545DC power up many of the status and meter LEDs on the front and back panels will activate in test sequences. On the back panel, the LED associated with the USB receptacle, labeled Firmware Update, will light green for a few seconds. Soon after that the Dante SYS and Dante SYNC LEDs will light red. After a few seconds they will begin indicating the operating status of the Dante interface, turning green as valid conditions are established. The Ethernet LINK/ACT LED, also located on the back panel, will begin to flash green in response to data flowing into and out of the Ethernet interface.

On the front panel, the input power, auto null, party-line intercom circuit status, and level meter LEDs will light in a rapid test sequence. The Model 545DC

will now begin normal operation. The exact manner in which the LINK/ACT, SYS, and SYNC LEDs (all located on the back panel below the etherCON RJ45 jack) 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. On the front panel, the user is presented with two pushbutton switches, two input power status LEDs, four party-line intercom circuit status LEDs, two auto null LEDs, and four 5-segment LED level meters. These resources are simple to understand and control, as will be described in the following paragraphs.

## Ethernet and Dante Status LEDs

Three status LEDs are located below the etherCON RJ45 jack on the Model 545DC'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 in response to data activity. The SYS and SYNC LEDs display the operating status of the Dante interface and associated network. The SYS LED will light red upon Model 545DC 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 545DC is not synchronized with a Dante network. It will light solid green when the Model 545DC is synchronized with a Dante network and an external clock source (timing reference) is being received. It will slowly flash green when this specific Model 545DC unit is part of a Dante network and is serving as the Leader clock. (It's important to note that typical applications will not have a Model 545DC unit serving as a Dante Leader clock.)

## How to Identify a Specific Model 545DC

Both the Dante Controller and STcontroller software applications offer identify commands that can be used to help locate a specific Model 545DC. When an identify command is selected for a specific Model 545DC unit its meter LEDs will light in a unique pattern. In addition, the SYS and SYNC LEDs, located directly below the etherCON jack on the back panel, will slowly flash green. After a few seconds, the LED identification patterns will cease and normal Model 545DC level meter and Dante status LED operation will again take place.



## Level Meters

The Model 545DC 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 circuits.

### General

The meters are organized into two groups with each group representing one channel of audio being sent to a party-line circuit and one channel of audio being returned by a party-line circuit. The meters are calibrated to reflect the level in dB relative to the reference (nominal) level of the party-line intercom circuit. The Model 545DC's nominal party-line level was selected to be  $-14$  dBu, matching that utilized by typical single-channel party-line intercom circuits. (Note that very early single-channel Clear-Com systems had a nominal level of  $-20$  dBu but that's no longer true for contemporary units.)

Each level meter contains four green LEDs and one yellow LED. The four green LEDs indicate party-line intercom channel signal levels that are 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. Audio signals that cause the yellow LEDs to light don't necessarily indicate an excessive level condition, but do provide a warning that 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 a yellow LED to flash. A yellow LED that lights fully during normal operation will indicate an excessive signal level configuration and/or a configuration problem with associated Dante-enabled equipment.

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 party-line intercom channel A. This would be a very appropriate signal level and should provide excellent operation. (Also note that a  $-14$  dBu signal that is being sent to party-line intercom channel A would indicate that a  $-20$  dBFS digital audio signal is present on Dante receiver (input) channel A. This is

due to Studio Technologies' selecting  $-20$  dBFS as the reference (nominal) level for Dante audio channels.)

### Non-Optimal Signal Levels

If one or more of 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 receiver (input) and/or Dante transmitter (output) channels. (It would be almost impossible for this situation to occur if two Model 545DC units are 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/Telex/Bosch ADAM system has a published nominal audio level of  $+8$  dBu, but it's not clear how this translates into a digital audio level on an associated Dante or OMNEO channel. (OMNEO is the term that RTS uses to refer to their Dante ports.) Using its AZedit configuration software it's possible to set the nominal level of intercom key panels or ports to something different than  $+8$  dBu. The best solution in this case might be to adjust the associated OMNEO (Dante-compatible) ports to achieve nominal audio levels of  $-20$  dBFS on the associated Dante transmitter (output) and receiver (input) channels. Providing compatible digital audio reference levels would lead to the best performance of the Model 545DC and associated party-line user devices.

### Audio Levels and Party-Line Termination

The two From meters display the audio signal levels coming from the two channels associated with the Model 545DC's party-line intercom channels A and B. These analog signals are converted to digital and then output on Dante transmitter (output) channels. For a party-line intercom circuit associated with a Model 545DC 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 one audio termination per intercom channel. This termination, 200 ohms nominally, is almost always made at the intercom power supply source. (An intercom power supply unit typically provides both DC power and an intercom termination network.)

An issue may arise if the audio signal coming from the connected party-line intercom circuit or user devices isn't at a sufficient level such that normal meter display levels can be reached. It's possible that another device, such as a second intercom power supply on the same party-line intercom circuit, can cause a "double-termination" condition. This would result in a party-line intercom channel impedance of approximately 100 ohms (two sources, each 200 ohms, connected in parallel) which would cause a major issue. The most evident problem would be that the intercom channel's nominal audio levels would attenuate (drop) by about 6 dB (half the audio voltage). In addition, auto null circuits, such as provided by the Model 545DC, will not be able to obtain good separation (nulling) performance. Removing the unwanted second termination (the second impedance of 200 ohms) is the only effective means of eliminating the problems.

In most cases, a double-termination issue will be simple to solve. As an example, it's possible that one of the Model 545DC's local power sources, which provide both DC power and 200 ohms termination, has been accidentally enabled when the Model 545DC is connected to an externally powered and terminated party-line circuit. This would be incorrect, leading to a "double-termination" condition. Turning off the Model 545DC's local power source by pressing and holding the appropriate auto null button or using the STcontroller software application is all that is required.

Some intercom power supply units allow selection of the termination impedance to be 200 or 400 ohms. This capability is often incorporated into a 3-position switch that also allows no termination impedance to be applied. Ensure that the selected switch setting, as well as the settings and deployment of other connected equipment, results in an intercom circuit impedance of 200 nominal for each of the two single-channel circuits.

## Power Status LEDs

Two green LEDs are located on the left side of 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 both LEDs will light, however only

the PoE source will be providing the Model 545DC's operating power.

## Party-Line Operating Mode Selection

As discussed previously, each of the unit's two single-channel party-line circuits provides two operating modes. One mode is used when the Model 545DC is required to create a party-line intercom circuit, providing 28 volts DC and a 200 ohms termination impedance network. In this mode, user devices such as belt packs can be directly supported. The associated Local Power status LED will light green when this mode is selected. A virtual (software-based-graphics) button that's part of the STcontroller application will show the text On to indicate that local power has been enabled. The second mode allows the Model 545DC to be connected to a single-channel party-line intercom circuit that provides both DC power and 200 ohms terminating impedance. In this mode, the unit will perform in the same manner as a user device and the Local Power status LED will not be lit. In this mode, the text Off will be shown in the STcontroller's virtual pushbutton switch.

To change a party-line interface's operating mode is simple, only requiring the associated auto null pushbutton switch to be pressed and held for a minimum of two seconds. This will cause the Model 545DC's operating mode to change ("toggle") from one mode to the other. As the mode changes, the associated Local Power status LED and STcontroller application will display accordingly. Once the mode has changed the pushbutton switch can then be released. The operating mode can also be selected using the virtual pushbutton switch in the STcontroller software application. The selected operating mode will be stored in non-volatile memory, ensuring that it will restore to that value after a power-down/power-up cycle.

## Local Power Mode Operation

When the Model 545DC's local power mode is enabled for an intercom circuit, the unit will provide DC power and a 200 ohms termination impedance to create a "standard" single-channel party-line intercom circuit. The party-line interface will supply 28 volts DC on pin 2 of the 3-pin XLR connectors with a maximum current draw of 150 mA available. This current is sufficient to power various intercom user devices such as small user stations and belt packs. A common

broadcast application may use Clear-Com RS-501 or RS-701 belt packs. 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 consumes a maximum of 50 mA of current. According to this figure, up to three of these units can be connected to a Model 545DC. The newer RS-701 has a quiescent current 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.

When the local power mode has been enabled, the associated Active status LED will light green when a minimal amount of current is flowing from the Model 545DC's party-line circuit to the connected user device or devices. This will also cause the associated virtual LED named PL Active in the STcontroller application to light green. This current, 5 mA nominal, provides a party-line power source-active signal to the Model 545DC's firmware indicating that normal operation is taking place. The firmware, in turn, will cause the Active status LED to light, the STcontroller application to light its virtual LED, and the Dante transmitter (output) audio channel to be in its active (unmuted) state. (By muting the Dante transmitter (output) channel when the intercom circuit is not active unwanted audio signals will be prevented from passing to the outside world when no party-line device is connected.)

Note that a setting in the STcontroller application can disable the requirement that a current draw of 5 mA (nominal) or greater on pin 2 of a party-line XLR connector is required for the Active status LED to light, the virtual LED in the STcontroller application to light green, and the transmitter (output) audio path to be active. This function is called PL Active Detection and disabling it can be appropriate for special applications. Refer to the Model 545DC Configuration section for details regarding this function and how it may be utilized.

The Model 545DC's two party-line intercom power supply circuits operate under firmware control. This allows detection of fault conditions and protects the unit's circuitry. Upon initially enabling a party-line intercom power supply no monitoring of the intercom power output takes place for three seconds. This

allows a Model 545DC intercom power supply circuit and connected intercom user device or devices to stabilize. The associated Local Power status LED will be lit solid and the virtual pushbutton switch in the STcontroller application will show the text On. The Active status LED, which responds to the status of the DC voltage on pin 2 of the party-line interface's 3-pin XLR connector, will light to indicate that the output is active. The PL Active virtual LED in STcontroller will light green. After this initial delay, monitoring becomes active. A fault condition is detected if the voltage on pin 2 falls below 24 for a continuous 1-second interval. The firmware responds to this condition by momentarily turning off the DC power source to pin 2. It will also, as a warning, flash the associated Active status LED and flash the virtual LED in STcontroller. After a 5-second "cool-down" interval the DC output will return to the same condition as upon initial power up; power is again applied to pin 2, the Active status LED will light, the virtual PL Active LED will light green, and monitoring won't begin for another three seconds. A full short-circuit condition applied to a party-line power supply circuit will result in a continuous cycle of four seconds on (three seconds for startup and one second for detection) and then five seconds off.

### **External Party-Line Circuit Operation**

When a Local Power status LED on the front panel is not lit and the virtual pushbutton switch in STcontroller is labeled Off the associated Model 545DC's party-line interface does not provide DC power on XLR pin 2 nor provides 200 ohms terminating impedance on XLR pin 3. In this mode, the Model 545DC is intended to be connected to an externally powered party-line circuit. This party-line circuit must provide the DC power and termination impedance required to create the party-line intercom circuit. In this mode, the Model 545DC simply serves in the same fashion as that of another connected single-channel user device. (In effect, the Model 545DC would have the technical characteristics of a non-powered user device.) When connected to a powered party-line circuit the Model 545DC's Active status LED will light when approximately 18 volts DC or greater is present on pin 2 of the associated XLR connector. In addition, the STcontroller's PL Active virtual LED will light green. When this condition is detected, the associated Dante transmitter (output) channel is placed in its active (non-muted) state. Otherwise, it is off (muted) to maintain stable Model 545DC performance.

As previously described, a setting in the STcontroller application can disable the requirement that 18 volts DC or greater be present on pin 2 of the party-line XLR connector for the Active status LED to light, the PL Active virtual LED to light green, and the transmitter (output) audio path to be active. This function is called the PL Active Detection function and disabling it can be appropriate for special applications. Refer to the Model 545DC Configuration section for details regarding this function and how it may be utilized.

### **Auto Null**

The Model 545DC contains circuitry to automatically null the hybrid network associated with each party-line interface. This procedure separates the audio signals as they are sent to and received from the audio channels associated with the two party-line intercom circuits. Two pushbutton switches, located on the front panel, are provided to activate the auto null functions, one for each channel. Virtual (“soft”) buttons in the STcontroller software application also allow activation of the auto null functions. Two status LEDs, located on the unit’s front panel, and two virtual (software-graphics-based) LEDs provided in STcontroller provide an indication of the operation of the auto null circuits.

To initiate auto null for a circuit first requires that the associated Active status LED be lit. When the operating mode is set for local power the Active status LED will light when the required minimum amount of current is flowing from the internal power supply. Alternately, when the Local Power LED is not lit the Active status LED must be lit, indicating that sufficient DC voltage is present on pin 2 of the connected party-line circuit. Once the Active status LED is lit, initiating the auto null function only requires pressing and releasing (“tapping”) the front-panel auto null button. Alternately, the virtual button in the STcontroller application can be used to initiate auto null. The auto null process takes approximately 10 seconds to complete. LEDs on the unit’s front panel provide a visual indication of the auto null process, flashing orange when the auto null process is active. Virtual LEDs in the STcontroller application provide the same function. They are labeled Ch A (Pin 3) and Ch B (Pin 3) to directly indicate which auto null function is active.

If the auto null button is pressed, either on the front panel or in STcontroller, when the associated Active status LED is not lit the auto null process will not start. The auto null LED will quickly flash orange four times to indicate this condition.

Normally, the nulling process is performed at the time of initial Model 545DC configuration but there’s no reason why it can’t be initiated any time one desires. The only time that auto null must be performed is if conditions have changed with the party-line user devices and wiring connected to a Model 545DC’s party-line connector. Even a small change to a party-line intercom circuit, such as adding or removing a section of cable, may be enough to warrant that the auto null process be performed.

An auto null sequence begins with the muting of the Dante receiver (input) and Dante transmitter (output) audio signal paths. If the Model 545DC is providing power on the party-line interface, this is followed by a short disconnection (break) in the 28 volts DC that is sent to pin 2. This will turn off microphones on those connected user devices that are compatible with the Clear-Com “mic kill” protocol. The actual auto nulling process is performed next. A series of tones will be sent to the party-line interface. Other Model 545DC 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 the Model 545DC’s non-volatile memory. Once the process is complete, the Dante receiver (input) and Dante transmitter (output) audio paths are again activated.

If possible, prior to performing an auto null it’s polite to warn all personnel who are actively using the 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 might be a good time to ask them to mute any active microphones. While the automatic “mic kill” signal will be compatible with 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.

## Call Light Support

The Model 545DC provides a call light support function, allowing a DC voltage associated with the call light function on Model 545DC-connected user devices to work together in Dante-interconnected applications. The function also allows a Model 545DC to interconnect with a Model 545DR Intercom Interface unit and support inter-unit call light activity. This enables call-light compatibility between single-channel DC-enabled call lights and 2-channel high-frequency tone activated call lights. No operator action is required for the call light support functions to perform their tasks.

The call light support function is actually quite interesting. Implemented in software, it allows a DC voltage detected on pin 3 of a party-line interface to cause a digitally generated 20 kHz sine wave signal to be output on the associated Dante transmitter (output) channel. A high-frequency signal (nominally 20 kHz) received on a Dante receiver (input) channel will result in the Model 545DC's circuitry outputting a DC voltage on pin 3 of the associated party-line interface. Digitally implemented low-pass (LP) filters prevent the high-frequency tones from passing through to the audio circuitry.

A selection in the STcontroller application allows disabling of call light support. Technically, this instructs the unit's application firmware (embedded software) to not generate a 20 kHz tone when DC is detected on pin 3. It also prevents a DC voltage from being sent to pin 3 when a high-frequency "call" tone is received. The filtering of the high-frequency signal (using low-pass filters) will always stay active. Disabling call light support would be appropriate only in very specialized applications.

## USB Interface

A USB type A receptacle and an associated status LED, labeled Firmware Update, are located on the Model 545DC's back panel. This USB host interface is used only for updating the unit's application firmware; no audio data of any kind will pass through it. For details on the update process please refer to the Technical Notes section.

## 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 545DC 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 volts DC or greater is needed to indicate that the call function is active. The Model 545DC can also generate a call signal by applying a DC voltage to audio path. The DC signal, approximately 16 volts, is ramped up and down to minimize the addition of clicks or pops to the audio signal.

While the Model 545DC can detect and generate a call signal, it's not possible to directly send and receive these DC signals over a Dante interconnection as it's really only intended for audio transport. The Model 545DC 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. 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 545DC's Dante connection shouldn't be a problem as a typical professional broadcast digital audio path that uses a 48 kHz sample rate can easily transport a 20 kHz signal.

When the Model 545DC detects DC on one of the audio paths (pin 3 of either of the back-panel party-line interface connectors) 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 545DC'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 function takes place automatically with no configuration required. This method is very useful for a number of reasons. It allows two Model 545DC 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 545DC (supporting two single-channel Clear-Com party-line circuits) and a Model 545DR (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 545DC'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 kHz call signal from each party-line audio path.

## Common Ground

The Model 545DC 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 545DC'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 545DC'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.

## IP Address Assignment

By default, the Model 545DC's Dante-associated Ethernet interface will attempt to automatically obtain an IP address and associated settings using DHCP (Dynamic Host Configuration Protocol). If a DHCP server is not detected an IP address will automatically 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 randomly assign a unique 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, in most cases, correctly acquire IP addresses and be able to communicate with each other.

An exception does arise when trying to directly interconnect two Dante-enabled devices that use Ultimo integrated circuits to implement Dante. The Model 545DC uses an UltimoX2 "chip" and, as such, a direct one-to-one interconnection between it and another Ultimo-based product would typically not be supported. An Ethernet switch linking these units would be required to successfully interconnect the two Ultimo-based devices. The technical reason that a switch is required relates to the need for a slight latency (delay) in the data flow; an Ethernet switch will provide this. This wouldn't typically prove to be an issue as the Model 545DC uses Power-over-Ethernet (PoE) to provide its operating power. As such, in most cases a PoE-enabled Ethernet switch would be utilized to support Model 545DC units.

Using the Dante Controller software application, the Model 545DC's IP address and related network parameters can be set for a manual (fixed or static) configuration. While this is a more involved process than simply letting DHCP or link-local "do their thing," if fixed addressing is necessary then this capability is available. In this case, it's highly recommended that every unit be physically marked, e.g., directly using a permanent marker or "console tape," with its specific static IP address. If knowledge of a Model 545DC's IP address has been misplaced there is no reset button or other method to easily 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 small PoE-enabled Ethernet switch connecting a personal computer to the Model 545DC. Then by using the appropriate ARP command the required "clues" can be obtained.

## Optimizing Network Performance

For best Dante audio-over-Ethernet performance a network that supports VoIP QoS capability is recommended. In applications that utilize multicast Ethernet traffic enabling IGMP snooping can be valuable. (In this case, ensure that support for PTP timing messages is still available.) These protocols can 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 ([audinate.com](http://audinate.com)) for details on optimizing networks for Dante applications.

## Application Firmware Version Display

A selection in the STcontroller software application allows the Model 545DC's application firmware version to be identified. This can be useful when working with factory personnel on application support and troubleshooting. To identify the firmware version, begin by connecting the Model 545DC unit to the network (via Ethernet with PoE) and wait until the unit starts to function. Then, after starting STcontroller, review the list of identified devices and select the specific Model 545DC for which you want to determine its application firmware version. Then select **Version and Information** under the **Device** tab. A page will then display that will provide lots of useful information. This includes the application firmware version and well as details on the Dante interface firmware.

## Application Firmware Update Procedure

It's possible that updated versions of the application firmware (embedded software) that is utilized by the

Model 545DC'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 load a revised file into its MCU's non-volatile memory by way of a USB interface. The Model 545DC implements a USB host function that directly supports connection of a USB flash drive. The Model 545DC's MCU updates its application firmware using a file named **M545DCvXrXX.stm** where the Xs are decimal digits that represent the actual firmware version number.

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. The USB interface in the Model 545DC is compatible with USB 2.0-, USB 3.0-, and USB 3.1-compliant flash drives. Save the new application firmware file in the root directory of the flash drive with a name of **M545DCvXrXX.stm** where the XrXX is the actual version number. Studio Technologies will supply the application firmware file inside of a .zip archive file. The name of the zip file will reflect the application file's version number and will contain two files. One file will be the actual application file and the other a readme (.txt) text file. It's recommended that the readme (.txt) file be reviewed as it will contain details about the associated application firmware. The application firmware file inside of the zip file will adhere to the required naming convention.

Once the USB flash drive is inserted into the USB host interface, by way of a USB type A receptacle that is located on the Model 545DC's back panel, the unit must be powered off and again powered on. At this point, the file from the USB flash drive will automatically load. The precise steps required will be highlighted in the next paragraphs.

To install the application firmware file, follow these steps:

1. Disconnect power from the Model 545DC. This may entail either removing the PoE Ethernet connection that is made to the RJ45 jack on the back panel. Alternately, it may involve removing a source of 12 volts DC that is connected to the 4-pin XLR connector, also location on the back panel.

2. Insert the prepared USB flash drive into the USB receptacle on the back panel of the unit.
3. Apply power to the Model 545DC either by connecting a PoE Ethernet signal or a source of 12 volts DC.
4. After a few seconds the Model 545DC will run a “boot loader” program that will automatically load the new application firmware file (**M545DCvXrXX.stm**). This loading process will take only a few seconds. During this time period the green LED that’s located adjacent to the USB receptacle will flash slowly. Once the entire loading process is over, taking approximately 10 seconds, the Model 545DC will restart using the newly loaded application firmware.
5. At this time, the Model 545DC is functioning with the newly loaded application firmware and the USB flash drive can be removed. But to be conservative, remove the PoE Ethernet connection or 12 volts DC power source first and then remove the USB flash drive. Re-connect the PoE Ethernet connection or the 12 volts DC power source to restart the unit.
6. Using STcontroller, confirm that the desired application firmware version has been correctly loaded.

Note that upon power being applied to the Model 545DC if a connected USB flash drive doesn’t have the correct file (**M545DCvXrXX.stm**) in its root folder no harm will occur. Upon power up the green LED, located adjacent to the USB receptacle on the back panel, 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, the Model 545DC implements its Dante connectivity using the UltimoX2 integrated circuit from Audinate. The STcontroller or Dante Controller software applications can be used to determine the version of the firmware (embedded software) that resides in this integrated circuit. The firmware (embedded software) residing in the UltimoX2 can be updated by way of the Model 545DC’s Ethernet port. Performing the update process is easily accomplished using an automated method called Dante Updater that’s included as part of the Dante Controller application. This application is available,

free of charge, from the Audinate website (audinate.com). The latest Model 545DC firmware file, with a name in the form of **M545DCvXrXrX.dnt**, is available on the Studio Technologies’ website as well as being part of Audinate’s product library database. The latter allows the Dante Updater software application that is included with Dante Controller to automatically query and, if required, update the Model 545DC’s Dante interface.

## Restoring Factory Defaults

A command in the STcontroller software application allows the Model 545DC’s defaults to be reset to the factory values. From STcontroller select the Model 545DC for which you want to restore its defaults. Select the **Device** tab and then the **Factory Defaults** selection. Then click on the **OK** box. Refer to Appendix A for a list of the Model 545DC’s factory defaults.



## Specifications

### Power Sources:

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

**External:** 10 to 18 volts DC, 1.0 A max at 12 volts DC

### Network Audio Technology:

**Type:** Dante audio-over-Ethernet

**AES67-2018 Support:** yes, selectable on/off

**Dante Domain Manager (DDM) Support:** yes

**Bit Depth:** up to 24

**Sample Rate:** 48 kHz

**Dante Transmitter (Output) Channels:** 2

**Dante Receiver (Input) Channels:** 2

**Dante Audio Flows:** 4; 2 transmitter, 2 receiver

**Analog to Digital Equivalence:** a -10 dBu analog signal on a party-line interface channel results in a Dante digital output level of -20 dBFS and vice-versa

### Network Interface:

**Type:** 100BASE-TX, Fast Ethernet per IEEE 802.3u (10BASE-T and 1000BASE-T (GigE) not supported)

**Power-over-Ethernet (PoE):** Per IEEE 802.3af

**Data Rate:** 100 Mb/s (10 Mb/s and 1000 Mb/s 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):** <0.15%, measured at 1 kHz, Dante input to PL interface pin 2 (0.01% pin 3)

**Signal-to-Noise Ratio:** >65 dB, A-weighted, measured at 1 kHz, Dante input to PL interface pin 2 (73 dB, PL interface pin 3)

### Party-Line (PL) Intercom Interfaces: 2

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

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

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

**Impedance, XLR Pin 3 – Local PL Power Not**

**Enabled:** >10 k ohms

**Impedance, XLR Pin 3 – Local PL Power Enabled:** 200 ohms

**Analog Audio Level, XLR Pin 3:** -14 dBu, nominal, +7 dBu maximum

**Call Light Signal Support, XLR Pin 3:** DC voltage on pin 3; detects at >= 5.5 volts DC nominal; generates at 16 volts DC nominal

**Mic Kill Signal Support, XLR Pin 2 – Local Power Enabled:** momentary break in DC voltage

### 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 non-volatile 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 jack

**External DC:** 4-pin male XLR

**USB:** type A receptacle (used only for updating application firmware)

**Configuration:** requires Studio Technologies' STcontroller software application

**Software Updating:** USB flash drive used for updating application firmware; Dante Updater application used for updating Dante interface firmware

### 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:** 0 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

**DC Power Supply Option:** Studio Technologies' PS-DC-02 (100-240 V, 50/60 Hz, input; 12 volts DC, 1.5 A, output), purchased separately

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

## **Appendix A–STcontroller Default Configuration Values**

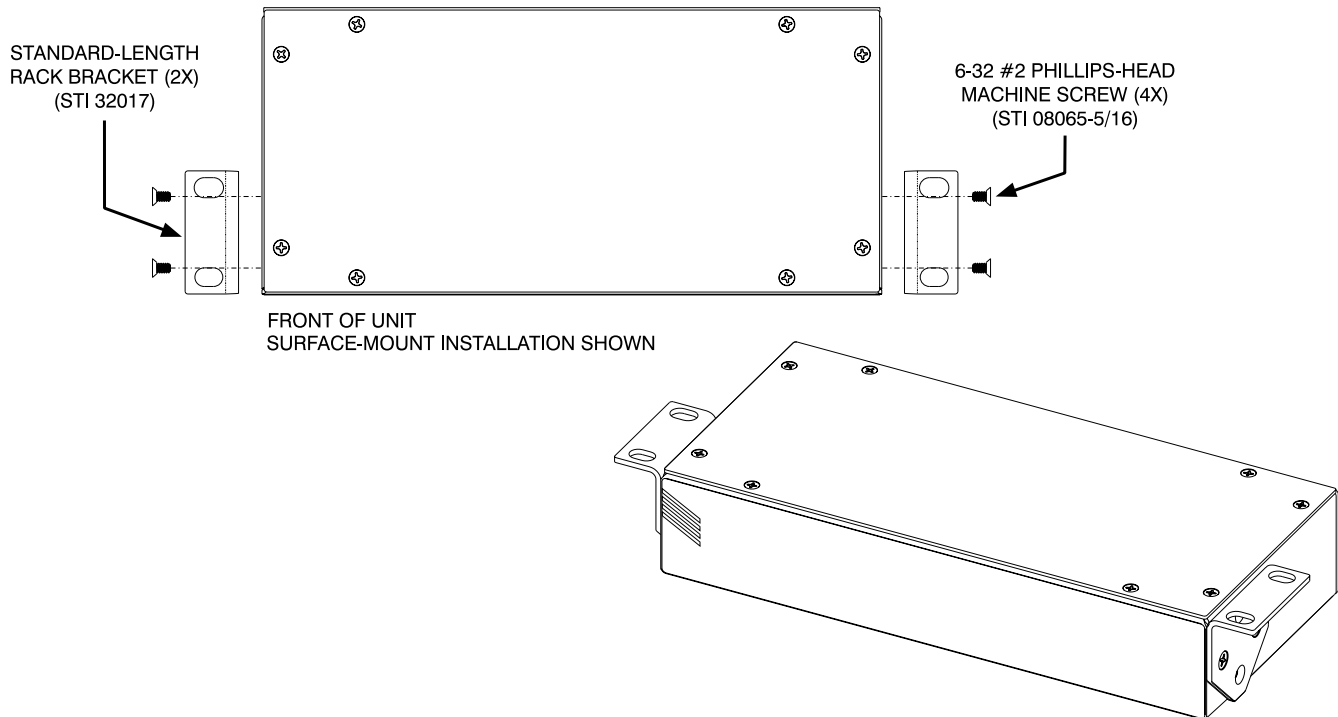
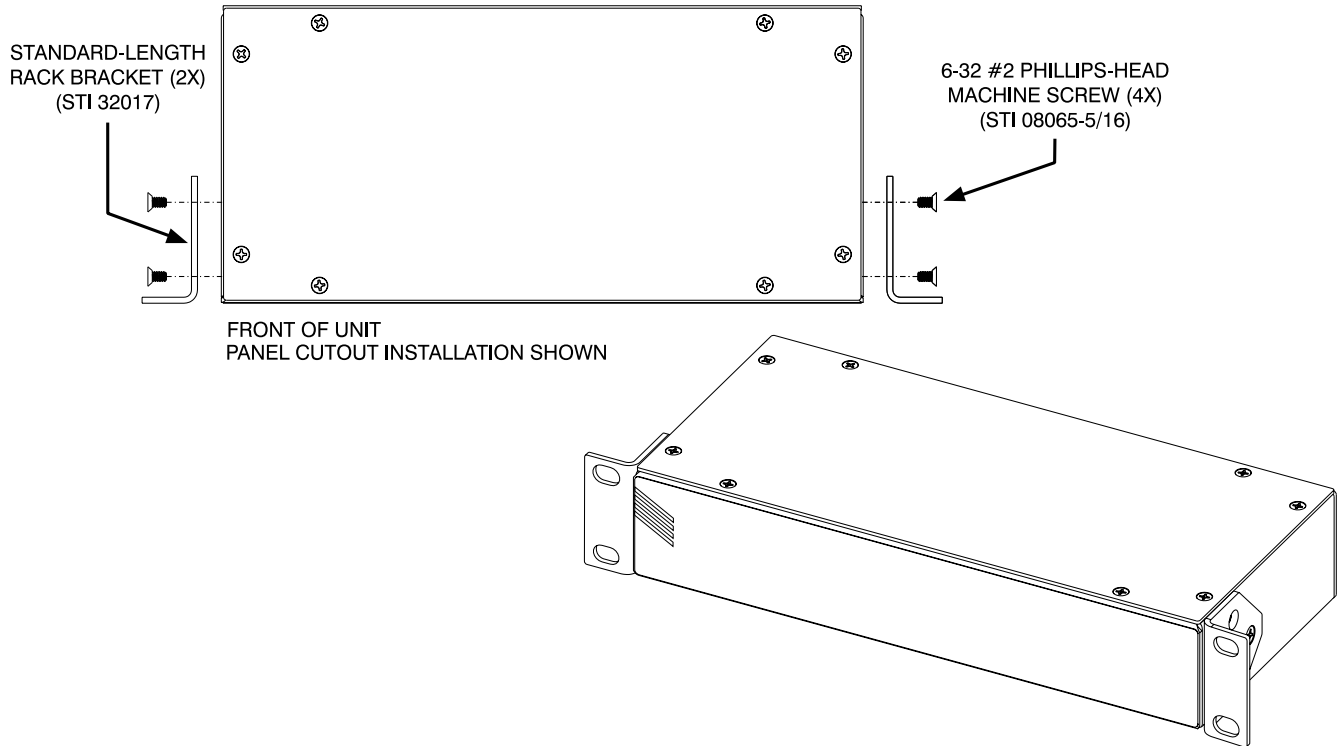
System – Call Light Support: On

System – PL Active Detection: On

**Model 545DC**  
INTERCOM INTERFACE

**Appendix B—Graphical Description of the Installation Kit for  
Panel Cutout or Surface-Mounting Use (Order Code: *RMBK-10*)**

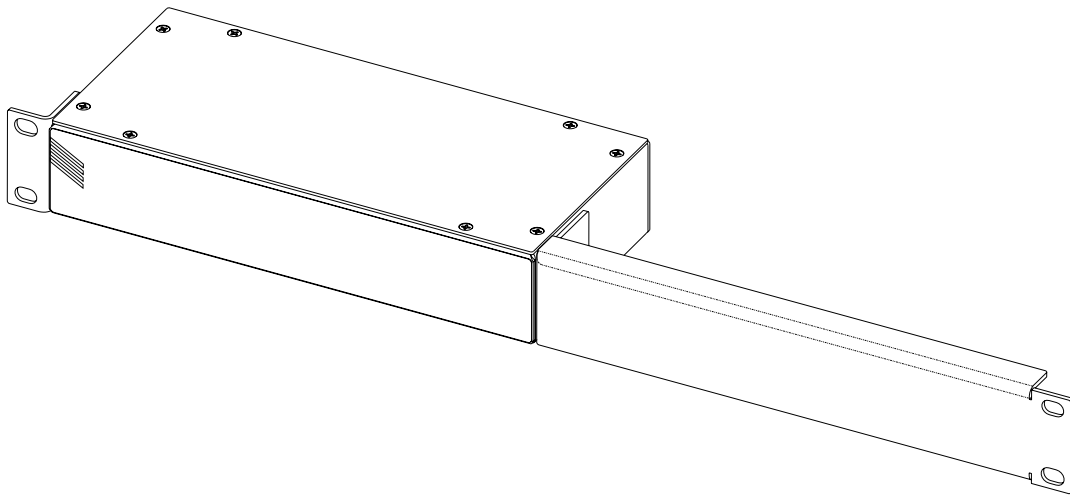
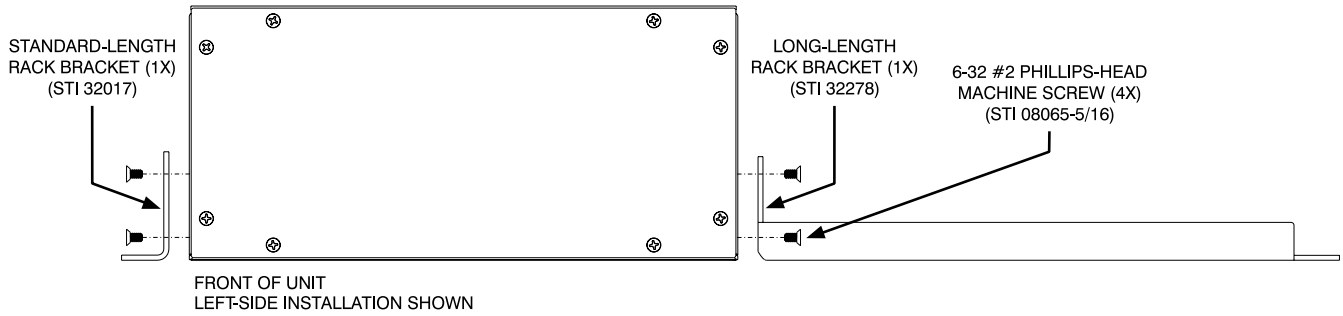
This installation kit is used for mounting one Model 545DC unit into a panel cutout or flat surface.



**Model 545DC**  
INTERCOM INTERFACE

**Appendix C—Graphical Description of Left- or Right-Side Rack-Mount Installation Kit for One “1/2-Rack” Unit (Order Code: *RMBK-11*)**

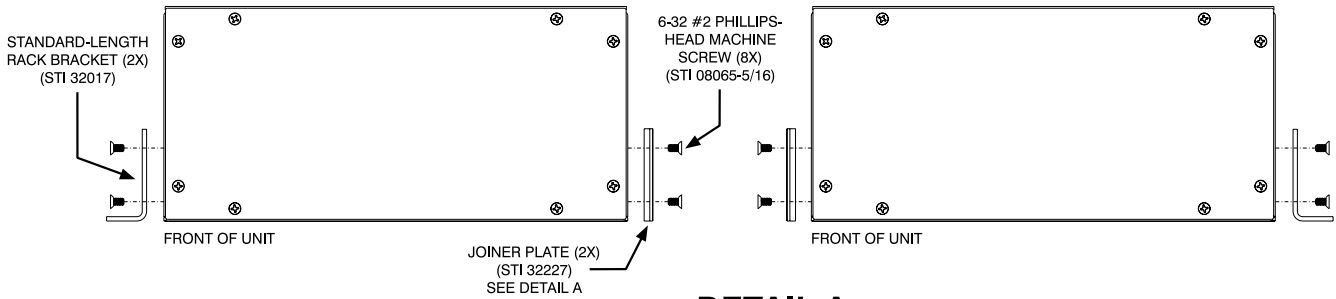
This installation kit is used for mounting one Model 545DC unit into one space (1U) of a 19-inch equipment rack. Unit will be located on the left- or right-side of the 1U opening.



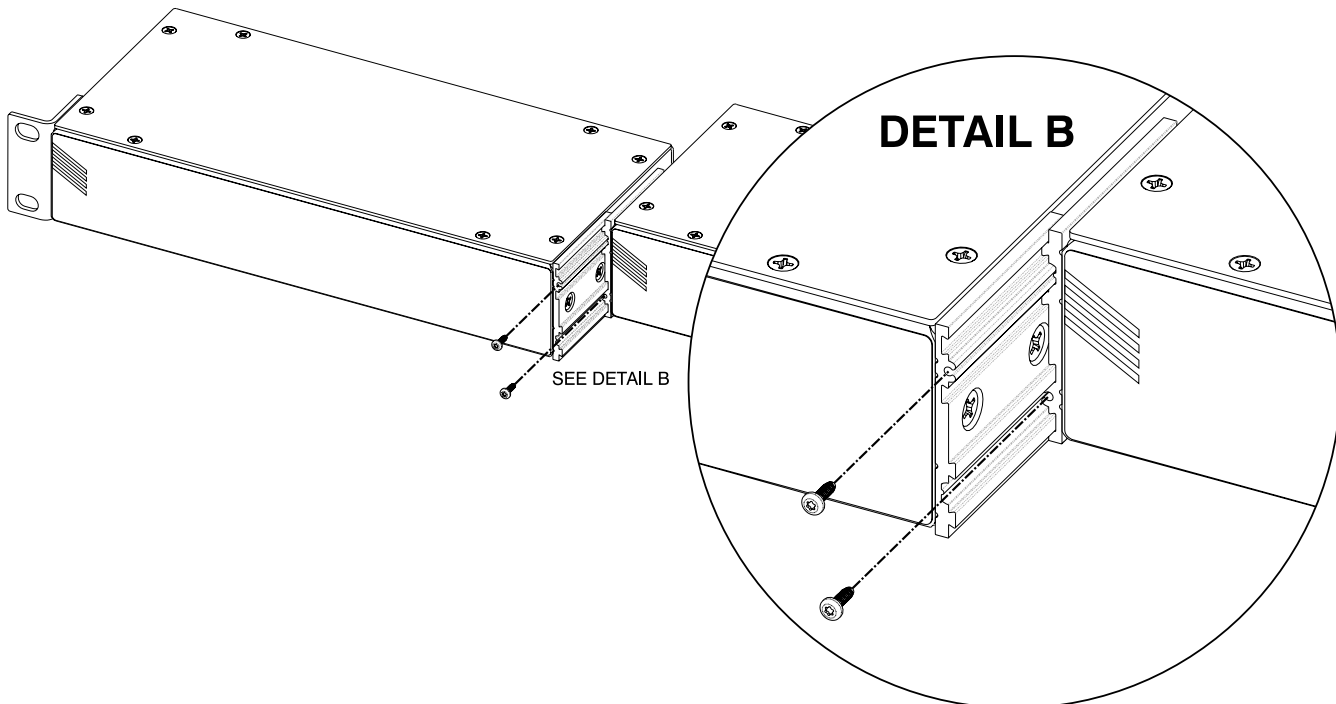
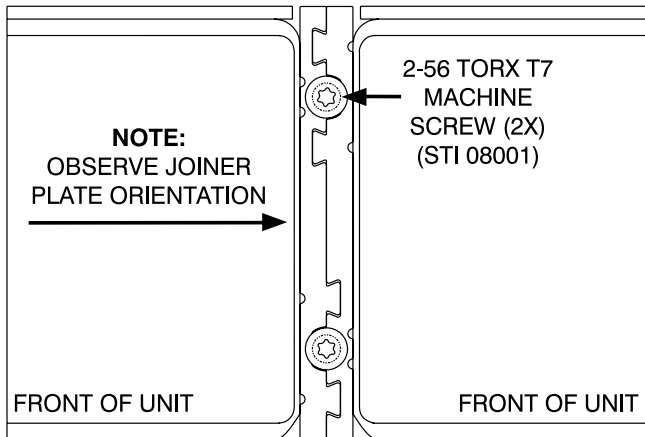
**Model 545DC**  
INTERCOM INTERFACE

**Appendix D—Graphical Description of Rack-Mount Installation Kit for Two “1/2-Rack” Units** (Order Code: *RMBK-12*)

This installation kit can be used to mount two Model 545DC units or one Model 545DC unit and another product that is compatible with the RMBK-12 (such as the Studio Technologies’ Model 5421 Dante Intercom Audio Engine) into one space (1U) of a 19-inch equipment rack.



**DETAIL A**



**Model 545DC**  
INTERCOM INTERFACE

**Appendix E—Graphical Description of Center Rack-Mount Installation Kit for One “1/2-Rack” Unit** (*Order Code: RMBK-13*)

This installation kit is used for mounting one Model 545DC unit into one space (1U) of a 19-inch equipment rack. Unit will be located in the center of the 1U opening.

