Model 5401A
Dante® Leader Clock

User Guide

Issue Preliminary 2, April 2021

This User Guide is applicable for serial numbers
M5401A-01001 and later with Main MCU firmware 1.02 and later

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Revision History

Issue Preliminary 2, April 2021:

- Minor corrections and clarifications.

Issue Preliminary 1, April 2021:

- Initial preliminary release.

Introduction

The Model 5401A Dante Leader Clock provides precise timing signals for applications that utilize the Dante audio-over-IP media networking technology. The unit implements a high-performance IEEE® 1588 precision time protocol (PTP) server, compatible with the requirements of Dante and capable of simultaneously supporting the timing needs of up to hundreds of Dante-compatible devices. As expected, the Model 5401A provides the PTP v1 (IEEE 1588-2002) compatibility that's required by Dante. In addition, the unit supports PTP v2 (IEEE 1588-2008) for AES67 applications. A word clock output provides a general-purpose timing reference for use by external devices. The Model 5401A also generates eight sine-wave audio tones on Dante transmitter (output) channels which can be useful during audio network installation, maintenance, and operation. A sync input connection allows the Model 5401A's internal oscillator to be synchronized with a variety of timing and reference signals.

The Model 5401A is suitable for use in fixed and mobile broadcast facilities, post-production studios, commercial and educational theater environments, and entertainment applications. Only power and one, two, or three Ethernet network connections are required for full operation. Using Dante's inherent capabilities two Model 5401A units can serve in primary and secondary Leader clock roles for redundant operation.

The unit's three Gigabit Ethernet (GigE) network interfaces can be configured for use in a range of network implementations. For high-performance applications two of the interfaces can support Dante redundancy operation while the third is used for accessing the management webpages. To meet the latest interoperability standard the Model 5401A's Dante implementation supports AES67-2018. The unit also supports the Dante Domain Manager™ (DDM) software application.

An integrated web server allows fast and flexible monitoring and configuration of the unit's networking, clocking, and Dante performance. Front-panel LED indicators, an LCD display, and pushbutton switches provide users with direct access to key operating parameters.

The Model 5401A can be powered by 100-240 V, 50/60 Hz mains or a source of 12 volts DC. Both can be simultaneously connected to provide redundant operation. The lightweight enclosure mounts in one space (1U) of a standard 19-inch rack. Industry-standard connectors are used for Ethernet, DC power, and AC mains interconnections. Updating the Model 5401A's operating software can be easily performed using a standard USB flash drive.

Figure 1. Model 5401A Dante Leader Clock front and back views

Applications

Applications for the Model 5401A include broadcast and post-production facilities, college and university audio networks, arenas, stadiums, and corporate installations — virtually any application where substantial numbers of Dante-compatible devices are utilized. The Model 5401A will serve as a stable and consistent Leader clock for the entire Dante "network." And, as expected, the Model 5401A is compatible with all Dante devices, no matter what their primary function or manufacturer. Applications that utilize devices compatible with AES67 will also benefit from the Model 5401A's resources.

Why a Dedicated Dante Leader Clock?

With Dante ubiquitous in fixed and mobile facilities of all sizes and types, the need arose for a cost-effective, purpose-designed, dedicated Leader clock. While an inherent strength of Dante networking is its carefully implemented use of IEEE 1588 to ensure that all connected devices maintain a common timing reference, the actual performance can vary widely depending on the specific Dante devices in use and the overall number of devices on a network. There are many Dante-compatible devices that can provide adequate basic performance as a Leader clock, but with the Model 5401A networked audio systems get the benefits of a high-performance "Primary Leader" PTP server, along with additional unique capabilities. The unit's feature set, along with the associated internal hardware and software, was designed to provide optimum performance, flexibility, and system integrity.

Timing Sources

The Model 5401A can provide excellent Leader clock performance using its accurate and stable internal oscillator, which is temperature-stabilized and exceeds the capability of standard Dante devices by at least an order of magnitude. While its stand-alone performance is excellent, the Model 5401A can also be "locked" to a variety of external signals for integration into facilities that include a central or main timing reference. Compatible signals include word clock, video reference, and 10 MHz.

Word clock is a square wave signal that is often used as a timing reference in audio-only facilities. Several word clock rates, including 48 and 96 kHz, are compatible with the Model 5401A's sync input. Video reference ("sync") signals are found in most broadcast and post-production facilities. The Model 5401A supports the most-common video format/rate combinations including "black burst," bi- and tri-level HD, and several that are specifically intended for 4K applications. Industrial and commercial facilities often utilize a GPS-disciplined source of 10 MHz as a timing reference. This sine-wave signal is typically compatible with the Model 5401A's sync input.

Word Clock Output

The Model 5401A generates a precise word clock output signal that can be used as a timing reference for related equipment. It's specifically intended for "locking" digital audio devices in applications that use the Model 5401A to provide timing reference signals for the associated Dante equipment. In this way, all devices in an installation will share a common timing reference.

The word clock output rate can be selected to be 44.1, 48, 88.2, or 96 kHz. The underlying timing source for the word clock output is derived from the Model 5401A's main timing source. As previously reviewed, the internal oscillator, if desired, can be

"locked" to an external source. The main timing source is divided and processed by the Model 5401A's logic circuitry to create the highly stable word clock output. This ensures that the word clock output is synchronized with the unit's PTP server functionality.

Audio Reference Signals

The Model 5401A generates eight sine-wave audio reference signals intended for general-purpose use. They are individually configurable in level and frequency. These audio "tones" are available from the Model 5401A by way of Dante transmitter (output) channels and can be connected, using the Dante Controller application, to Dante receiver (input) channels on related equipment. The flexibility of being able to interconnect signals (create Dante "subscriptions") between all Dante devices on a network allows the audio reference tones to be used for a variety of purposes. Configuration choices allow the frequency and level of each sine-wave signal to be optimized for use in specific applications.

Leader Clock Support for Dante Networks

A core part of the technology underlying Dante audio-over-IP networking ensures that all connected devices follow a common timing reference. This is accomplished using the IEEE 1588-2002 precision time protocol (PTP v1). Any connected Dante device can be used as a Leader clock; there is no requirement that a dedicated Leader clock device be utilized to realize adequate functionality. However, the actual performance can vary widely depending on the specific Dante devices available and the overall number of Dante devices on a network.

Many Dante devices utilize the 2- or 4-channel Ultimo™ ULT or UXT integrated circuits to implement Dante connectivity. While Ultimo devices will fully support Dante audio transport, they are not well suited to serve as a Leader clock. Ultimo's PTP performance is limited and does not have the ability to synchronize with an external timing reference. Other Dante devices may use the Brooklyn II module or Broadway integrated circuit to support Dante connectivity. In some cases, these devices can provide good basic performance as a Leader clock.

However, problems and limitations may arise when these devices are called upon to perform "double duty," serving in both a primary function (such as analog-to-Dante interfacing or audio signal processing) as well as acting as a Leader clock. This is understandable as the main purpose of these devices is to serve functions other than acting as a primary synchronization reference. Timing related features, such as allowing connection of a video bi- or tri-level sync signal is rarely, if ever, supported. And PTP performance can degrade when the computing power of a device is intended primarily for handling and manipulating digital audio signals. This can lead to the required PTP resources being in short supply when the number of Dante devices that need timing messages moves into the hundreds. Also, firmware updates, cabling changes, and other maintenance tasks typically associated with a general-purpose Dante device would impact the Leader clock functionality for an entire installation.

The Model 5401A was specifically designed to support a Dante-based audio system's Leader clock requirement. And the unit's generation of audio tones and implementation of the word clock output utilize hardware that is separate from that associated with its PTP functionality. As such, this secondary

functionality will not interfere with PTP operation. Unlike a general-purpose Dante device, once mounted in an equipment rack and the required interconnections are made, the Model 5401A will perform its tasks without risk of interruption due to conflicting resource demands.

Flexible Networking Capability

Using the Dante Controller application program, the Model 5401A's three Ethernet ports can be selected to operate in one of four modes: Switched, Redundant, Switched+Mgmt, and Redundant+Mgmt. This should allow virtually any desired networking implementation to be easily achieved.

In the Switched mode a single Ethernet connection to either of the Model 5401A's two Dante Ethernet ports will provide Dante Leader clock functionality. The remaining Dante Ethernet port will provide Dante network "loop-through" capability and can be used to interface with another piece of Ethernet-connected equipment. The management Ethernet port will be used to access the Model 5401A's monitoring and configuration webpages.

In the Redundant mode two independent Ethernet connections are made to the Model 5401A's two Dante Ethernet ports, enabling Dante's redundant networking capability. Again, the management Ethernet port will be used to access the Model 5401A's monitoring and configuration webpages. Using either of these network modes allows separate network connections to be maintained for Dante audio and management purposes.

In the Switched+Mgmt mode a single Ethernet connection is used for both Dante Leader clock functionality as well as providing access to the Model 5401A's management webpages. The remaining Dante Ethernet port will provide network "loop-through" capability and can be used to interface with another piece of Ethernet-connected equipment.

In the Redundant+Mgmt mode two independent Ethernet connections can be made to the Model 5401A's two Dante Ethernet ports. This will enable Leader clock capability for applications that utilize Dante redundancy. Access to the Model 5401A's management webpages will be made by way of the Ethernet connection made to the Dante primary Ethernet port.

Operating Power

The Model 5401A allows an AC mains source of 100-240 V, 50/60 Hz to be directly connected. It can also be DC powered using a nominal 12 volt source that is connected via a broadcast-standard 4-pin XLR connector. If both AC and DC power sources are connected the unit will be powered by the AC mains supply. Only if the AC mains source fails will appreciable power be drawn from the DC source. This allows a source of DC, typically an external power supply or broadcast-style battery, to serve in a backup capacity. With this arrangement normal operation can continue even if AC mains power is lost.

Future Capabilities

The Model 5401A was designed so that its capabilities can be enhanced in the future. A USB connector, located on the unit's back panel, allows the three firmware files (embedded software) to be updated using a USB flash drive. The Model 5401A's Dante firmware can be updated using one of the unit's Ethernet connections, helping to ensure that the Dante capabilities remain up to date. All software files and configuration parameters are stored in non-volatile memory.

Installation

In this section, the Model 5401A will be mounted in one space (1U) of an equipment rack. One or more Ethernet data connections will be made. An external source of synchronization may be connected. A connection may be made to the word clock output. AC mains and/or DC power will be connected to the Model 5401A.

Up to three Ethernet data connections will be made to the Model 5401A using standard RJ45 patch cables. Using a coaxial cable terminated with a BNC plug, an external source of synchronization may be connected to the sync input. A word clock output is provided on a BNC receptacle and may be utilized by another piece of equipment.

AC mains power can be connected to the Model 5401A by means of a detachable cord that is compatible with the unit's 3-pin IEC 320 C14 inlet connector. Some applications may warrant connection to a source of nominal 12 volts DC which can be made by way of a 4-pin XLR connector. The DC source can be used to power the Model 5401A as well as serving as a backup power source should AC mains be disconnected.

What's Included

The shipping carton contains a Model 5401A Dante Leader Clock and instructions on how to obtain an electronic copy of this guide. Also included in the shipping carton is a North-American-standard AC mains cord. For destinations outside of North America the local reseller or distributor should provide an appropriate AC mains cord.

Mounting the Model 5401A

The Model 5401A Dante Leader Clock requires one space (1U) in a standard 19-inch (48.3 cm) equipment rack. Secure the unit into the designated equipment rack using two mounting screws per side. As the Model 5401A does not contain a fan or other noise-producing source it can be located within a room or other structure where audio monitoring is going to take place. Select a location that is convenient for making connections to the Ethernet interfaces, sync input, word clock output, and AC mains and/or DC power. Twisted-pair (UTC) Ethernet has a 100-meter (325-foot) interconnection cable limitation. But that can be overcome by using a fiber-optic interconnection between the Model 5401A and the Ethernet switch or switches in the one or more associated local-area-networks (LANs).

Ethernet Connections

The Model 5401A provides three Gigabit Ethernet (GigE) ports for flexibility and compatibility with many networking implementations. Two ports are provided for interconnections with one or two local area networks (LAN) associated with Dante audio-over-IP networking schemes. They are labeled as PRI (primary) and SEC (secondary). The third Ethernet port, labeled MGMT, can be used to access the Model 5401A management resources. An internal webserver function supports the Model 5401A's management port's webpages. These webpages are used for configuration, monitoring, and maintenance of Model 5401A operation. Refer to Figure 2 for an overview of the Model 5401A's three Ethernet ports and how they can operate.

Using the Dante Controller application, the three Ethernet ports can be configured to operate in one of four modes:

Dante Controller Network Switch Configuration	Model 5401A Ethernet Port		
	Pri	Sec	Mgmt
Switched	Dante		Management
Redundant	Dante Primary	Dante Secondary	Management
Switched+Mgmt	Dante and Management		Disabled
Redundant+Mgmt	Dante Primary and Management	Dante Secondary	Disabled

Figure 2. Model 5401A Ethernet Port Configuration and Operation

Switched, Redundant, Switched+Mgmt, or Redundant+Mgmt. If configured for either the Switched or Redundant modes the management webpages are accessed by way of the management Ethernet port. When configured for the Switched+Mgmt mode the management webpages are accessed by way of either the primary or secondary Ethernet port. When configured for the Redundant+Mgmt mode the management webpages are accessed using an Ethernet connection made to the primary Ethernet port.

By providing three Ethernet ports and four configuration modes, the Model 5401A allows support for virtually all facilities, including those that utilize separate networks for Dante audio transport and equipment management. In this way, “production” networks that support transport of audio signals by way of a single LAN (Switched mode) or two LANs (Redundant mode) can be separate from an engineering network that is used by technical personnel for configuring and maintaining a facility or “plant.”

Connections to the three Ethernet interfaces are made by way of standard RJ45 receptacles that are located on the back of the Model 5401A’s enclosure. The Ethernet interfaces support auto MDI/MDI-X so that crossover cables are not required. Refer to Appendix A, located at the back of this guide, for examples of how the Model 5401A’s three Ethernet interfaces might be utilized. It’s difficult to conceive of a network environment that the unit wouldn’t be able to effectively support.

Dante Port Connections

At least one 1000BASE-T (GigE) Ethernet connection is required for Model 5401A Dante operation. It should be connected to the primary RJ45 receptacle. A second 1000BASE-T connection can be made to the secondary RJ45 receptacle if Dante redundancy is desired. For this functionality to be active the Model 5401A’s network configuration must be set for the Redundant or Redundant+Mgmt mode within the Dante Controller software application. While technically 100BASE-TX Ethernet can also be used for these Dante connections, it is not optimal. Additionally, it’s important to note that 10BASE-T Ethernet connections are not sufficient.

When configured in Dante Controller for the Switched or Switched+Mgmt modes the Model 5401A’s Dante secondary Ethernet connection can also be used as a “loop through” port such as would be provided by an Ethernet switch. Switched mode is the default setting but using the Dante secondary port in this manner for applications other than troubleshooting or “looping” to access the Model 5401A’s management port is not recommended. It will function reliably but “daisy chaining” Ethernet signals can limit flexibility and present a failure point; it’s

optimal if each Dante Ethernet interface connects directly to a separate port on an Ethernet switch.

Management Port Connection

If required by the needs of an application, the management webpages can be accessed using an Ethernet signal connected with the Model 5401A's management Ethernet port. This requires that the network mode in Dante Controller be configured for Switched or Redundant. It's recommended that a 1000BASE-T (GigE) connection be made but a 100BASE-TX or even a 10BASE-T or connection is sufficient. (GigE will provide the best performance and it's assumed that all contemporary applications will support it.)

Accessing the Model 5401A's management webpages can also be made using the same network connection that's being used for the Dante primary connection. This requires that the network mode in Dante Controller be configured for Switched+Mgmt or Redundant+Mgmt. As previously mentioned, Appendix A provides examples of how these Ethernet connection scenarios can be easily implemented.

Sync Input

An external synchronization source can be connected to the Model 5401A's sync input BNC receptacle. Located on the back panel, this input allows the Model 5401A's internal timing reference to be "locked" to an external reference. Compatible synchronization source signals include word clock, bi-level video, tri-level video, and 10 MHz sine wave. A configuration setting in the Sync Input webpage defines what type of signal is going to be connected. Another setting defines if a termination impedance is applied to the sync input. Refer to the Specifications section of this guide for the characteristics required of acceptable external sync signals.

A connected word clock signal must be a square wave with a rate that matches the Dante sample rate as defined in the Dante Controller application. The rate can be 44.1, 48, 88.2, or 96 kHz. If termination has been enabled for the sync input the applied impedance is 75 ohms.

A source of bi-level or tri-level video can also be connected to the sync input. Circuitry within the Model 5401A will decode many of the common video rates and formats, allowing them to serve as a timing reference. Refer to Appendix B, located at the end of this guide, for a list of compatible rates and formats. If the sync input is configured to have a termination applied it will have an impedance of 75 ohms.

A source of 10 MHz sine wave can also be connected to the Model 5401A's sync input. This type of signal is commonly used as a timing reference in industrial applications. An impedance of 50 ohms will be applied to the sync input if termination has been enabled in the Sync Input webpage.

Word Clock Output

A word clock output signal is provided for use by other devices that want to be "timed" from the Model 5401A. Available by way of a BNC receptacle located on the back panel, the square wave output has a frequency that matches the unit's configured Dante sample rate. Choices are 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz. The exact frequency of the word clock output is based on the timing reference that has been selected for the Model 5401A. If, for example, a 10 MHz signal was connected to the Model 5401A's sync input and selected as the unit's timing reference, then the word clock output would be "locked" to it.

The source impedance of the word clock signal is 75 ohms and its unterminated output

level is 5 volts peak-to-peak (Vpp). When externally terminated with a 75 ohm load the word clock output level will drop to 2.5 Vpp.

Connecting Power

The Model 5401A requires a source of AC mains or nominal 12 volts DC for operation. Either source can be connected with the same result. Both can also be simultaneously connected if a redundant (backup) power scheme is desired.

Connecting AC Mains Power

The Model 5401A can operate directly from AC mains power of 100 to 240 volts, 50/60 Hz, 5 watts maximum. As a “universal mains input” device there are no switches to set or jumpers to install. A 3-pin IEC 320 C14 inlet connector on the back panel mates with a detachable mains cord set.

All units are supplied from the factory with an AC mains cord that has a North-American (NEMA 5-15L) standard plug on one end and an IEC 320 C13 connector on the other end. Units intended for use in other destinations require that an appropriate mains cord be obtained. The wire colors in the mains cord should conform to the internationally recognized color code and be terminated accordingly:

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

Because the Model 5401A does not contain a power on/off switch it will begin operation as soon as AC mains power is connected.

Safety Warning: The Model 5401A does not contain an AC mains disconnect switch. As such, the AC mains cord plug serves as the disconnection device. Safety considerations require that the plug and associated inlet be easily accessible to allow rapid disconnection of AC mains power should it prove necessary.

Connecting DC Power

The Model 5401A can also operate from a source of nominal 12 volts DC. The current required from a 12 volts DC source is 0.5 ampere (500 milliamperes) maximum. A 4-pin male XLR connector, located on the unit’s back panel, is used to connect the source of DC. Prepare a mating connector (female) so that pin 1 is DC– and pin 4 is DC+. Pins 2 and 3 are not used and should remain unconnected. This connector type and pinout have become a broadcast DC power standard and should be familiar to many technical personnel. Because the Model 5401A contains no power on/off switch it will begin operation as soon as a DC power source is connected.

As previously mentioned, both an AC mains source and a DC source can be connected at the same time. If this is the implementation then the AC mains source will always power the Model 5401A with the DC source serving as a “hot standby.” Only if the AC source fails will the unit draw power from the DC source. This will occur automatically with no interruption of Model 5401A operation. In this “standby” mode (when an AC mains source is connected) the Model 5401A draws less than 110 microamperes (uA) from a 12 volt DC input.

Dante Configuration

For audio and timing to correctly pass from the Model 5401A requires that several Dante-related parameters be configured. These configuration settings are stored in non-volatile memory within the Model 5401A's Dante network interface circuitry. Configuration will typically be done with the Dante Controller software application, available for download free of charge at audinate.com. Refer to Appendix C of the list of the Model 5401A's Dante Controller default configuration. Versions of Dante Controller are available to support several operating systems.

The Model 5401A's Dante interface is compatible with the Dante Domain Manager (DDM) software application. Refer to DDM documentation, also available from Audinate, for details on which Model 5401A and related parameters may have to be configured.

Audio Routing

The Model 5401A's eight Dante transmitter (output) channels can be assigned to the desired Dante receiver (input) channels on associated equipment. This will route the eight channels associated with the tone generator function. Within Dante Controller a "subscription" is the term used for routing a transmitter flow (a group of output channels) to a receiver flow (a group of input channels).

The Model 5401A uses the Brooklyn II module to implement its Dante functionality. The number of transmitter flows associated with this module is 32 and, as such, typically no flow limitation will occur. These flows can either be unicast, multicast, or a combination of the two. (Note that in the AES67 mode the Dante transmitter (output) channels will only function in multicast; unicast is not supported.)

Unit and Channel Names

The Model 5401A has a default Dante device name of **ST-5401A-** along with a unique suffix. The suffix identifies the specific Model 5401A that is being configured. The suffix's actual alpha and/or numeric characters relate to the MAC address of the unit's Brooklyn II module. The eight Dante transmitter (output) channels have default names of **Tone 1** through **Tone 8**. Using Dante Controller, the device and channel names can be revised as appropriate for a specific application.

Device Configuration

The Model 5401A supports audio sample rates of 44.1, 48, 88.2, and 96 kHz with no pull-up/down options available. The digital audio data is in the form of 24-bit pulse-code modulation (PCM) samples. Clocking- and latency-related parameters can be adjusted if required in Dante Controller but the default values are typically correct.

Network Configuration – Dante

As has been covered previously in this guide, the Model 5401A allows connection of one, two, or three Ethernet signals using standard RJ45 receptacles which are located on the back panel. In many applications two of the receptacles will be used for Dante audio and the third for connecting to a network designated for device management purposes. It's also possible to access the Model 5401A's management webpages using the Dante primary Ethernet port. The Model 5401A's Dante ports are labeled PRI and SEC indicating that they are typically used for the primary and secondary connections. The third Ethernet port is labeled MGMT, indicating that it is intended for use accessing the management webpages. How these three Ethernet ports function can be selected

in the Network Config – Switch Configuration section of Dante Controller. The choices are Switched, Redundant, Switched+Mgmt, and Redundant+Mgmt.

If Switched is selected then the Model 5401A can establish one Dante audio connection with an Ethernet network. It doesn't matter which RJ45 receptacle is utilized, although for clarity this would typically be the primary receptacle. The secondary RJ45 receptacle can be used to interconnect with another piece of networked equipment. The management Ethernet port will be used to access the management webpages.

If the Model 5401A's Dante network is configured for Switched ensure that only one of the two Dante RJ45 receptacles on the back panel is connected to the LAN associated with the Dante network. If both of the Model 5401A's Dante RJ45 connections are routed to ports on the same LAN this will typically "crash" the network! (Although some of the latest/most-advanced Ethernet switches will automatically detect and prevent such a "network bridging" issue from occurring.)

If Switched+Mgmt is selected the same issues as discussed in the previous two paragraphs would again apply. The only difference is that the management webpages would be accessed using the same Dante Ethernet port that is being used to access the Dante network. The management Ethernet port will be disabled.

If Redundant is selected then Dante's Redundant networking capability will be enabled. In this case, separate Ethernet LAN connections should be made to the Dante primary and Dante secondary RJ45 receptacles. Again, the Model 5401A's separate management Ethernet port will be used to access the management webpages.

If Redundant+Mgmt is selected in Dante Controller then the network connection made to the Dante primary Ethernet port will also be used to access the management webpages. The Model 5401A's separate management port will be disabled.

IP Addresses

When a Model 5401A has been configured for either the Switched or Switched+Mgmt network mode a single Dante IP address will be associated with the network connection that is made to either the Dante primary or the Dante secondary RJ45 receptacle. If the network configuration has been selected for Redundant or Redundant+Mgmt then separate IP addresses and related network parameters will be assigned to the Dante primary and Dante secondary Ethernet ports. No matter what network mode has been selected the Model 5401A will always have a separate management IP address.

Typically, the Model 5401A's Dante IP address or addresses and related network parameters will be determined automatically using DHCP or, if that's not available, the link-local network protocol. If desired, the Dante Controller application allows Dante IP addresses 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.

Note that if the Model 5401A's network configuration has been set for Redundant or Redundant+Mgmt then the Dante primary and Dante secondary IP addresses and related parameters can be independently configured. This allows both Dante interfaces to be configured automatically, both interfaces to be configured manually, or one interface

to be configured automatically and the other to be configured manually.

By default, the Model 5401A's management IP address and related network parameters will be determined automatically using DHCP or link-local. Configuration options, provided using the front-panel display and buttons or the management webpages, allow manual control of the IP address and subnet mask values.

AES67 Configuration – AES67 Mode

Dante Controller allows a Model 5401A to be configured for AES67 operation. This requires the AES67 mode to be set for Enabled. As previously noted in this guide, if AES67 mode is enabled then the Dante transmitter (output) channels will use multicast. The sample rate will be fixed at 48 kHz.

Preferred Clock Source

By the very nature of its intended application, the Model 5401A will serve as the Leader clock for all Dante-enabled devices. The unit has the ability to communicate with the Dante network, selecting itself as the Preferred Leader and causing the Enabled Sync to External function to be enabled. The status of these two parameters can be observed using the Clock Status function in Dante Controller.

Settings accessible using the Model 5401A's management webpages allow extensive changes to the clock configuration. These are provided for troubleshooting use or in the case of special applications. In most cases, the Model 5401A's default settings would be appropriate and should be utilized.

Model 5401A Configuration

Many Model 5401A Dante Leader Clock operating parameters can be configured using the webpages that are provided by way of one of the unit's Ethernet ports. The specific port utilized will depend on the network configuration that is performed using the Dante Controller application. A standard web browser is all that is required to utilize the menu webpages.

Several key network configuration parameters can also be viewed and revised using the Model 5401A's front-panel pushbutton switches and graphics display. Refer to Appendix D for details on which parameters can be revised in this manner.

Management IP Address

It's easy to identify the Model 5401A's active management IP address. With the unit powered and operational, and a network connection made to the appropriate Ethernet port, press the Enter button on the Model 5401A's front panel while screen saver is active. The management IP address will show in the Model 5401A's front-panel display.

How the management Ethernet port obtains its IP address will depend on the Management Addresses configuration setting. The default method is automatic so the Model 5401A's management port will first try to obtain an IP address using DHCP. If that is not successful an IP address will be assigned using the link-local protocol. The Model 5401A might also have been configured to use a manual (fixed or static) IP address. The front-panel display and buttons, as well as a Model 5401A's management webpage, are required to review or make changes to the IP address and related parameters.

Accessing the Management Webpages

To access the Model 5401A's home webpage, type the unit's management IP address into the browser's search bar. (It's possible that some browsers may require the text http:// followed by the IP address.)

Home Menu

Once the Model 5401A menu system has been accessed the Home webpage will appear. It provides three display-only fields along with a link to the Login menu webpage. The three fields are identical to those provided in the Main menu configuration webpage. The Dante sync status field will display the role that the Model 5401A is actively playing as a timing source for the devices connected to the associated network. The current clock source field will display which timing source is actively being utilized by the Model 5401A. The sync input status displays the current operating condition of the external sync input that is located on the back panel of the Model 5401A. Details about these fields are provided in the Main menu paragraphs found later in this section.

Login Menu

From the Home webpage click on the Login tab to access the Login webpage. Entry of a valid user name and password is required to access the additional configuration menus. The Model 5401A's doesn't incorporate a sophisticated security implementation. The user name and password, as well as the underlying software, is intended to keep "honest" people from making unauthorized changes to the configuration of the Model 5401A. It is not intended as a sophisticated, rigorous security system.

Should the applicable user name and/or password be misplaced, refer to the Technical Notes section of this guide for a recovery method.

User Name

Enter the Model 5401A's user name into this field. It is case sensitive. The default user name is **guest**. If both the default user name and the default password are active then the user name will display in this field.

Password

Enter the Model 5401A's password into this field. It is case sensitive. The default password is **guest**. If both the default user name and the default password are active then the password will display in this field.

Log In Button

Click on the Log In button to submit the entered user name and password. If the correct entries have been made the Configuration menu webpage will display. If an incorrect user name and/or password is entered then a login failed message will be displayed.

Main Menu

Once the correct user name and password have been submitted the Main menu webpage will display. This menu will display three key parameters along with providing the ability to select three important operating parameters. In addition, the menu system allows direct access to other menu webpages. Refer to Appendix E for a view of the Main menu.

Dante Sync Status

If the network configuration in Dante Controller for this specific Model 5401A has been selected for Switched or Switched+Mgmt, one field will display and

it will be titled Dante Sync Status. This field will show Primary Leader, Leader, Follower, Error, or Error – Link Down.

If Primary Leader is displayed it indicates that this specific Model 5401A is acting as the Primary Leader clock for the Dante network. If the field shows Leader then this specific Model 5401A is serving as a boundary clock. The unit is obtaining its timing reference by way of the unit's Dante interface which is following the timing provided by the Dante device that is serving as the Primary Leader clock. If Follower is displayed this indicates that this specific Model 5401A is obtaining its timing reference from another Dante device on the network. This would be the current display if this specific Model 5401A was serving as a "hot" standby Dante Leader clock. A display of Error would indicate that this specific Model 5401A is having a permanent or temporary issue with its internal circuitry. There may be occasions where Error would display for a few seconds while Model 5401A circuitry becomes active. If Error – Link Down is displayed this will indicate that a valid Ethernet connection has not been made to an appropriate Model 5401A Ethernet interface RJ45 receptacle.

If the network configuration in Dante Controller for this specific Model 5401A has been selected for Redundant or Redundant+Mgmt two fields will be displayed. One is named Dante Primary Sync Status and the second is named Dante Secondary Sync Status. These fields will independently show the same choices as described above: Primary Leader, Leader, Follower, Error, or Error – Link Down. This is provided for the situation where the Model 5401A is operating in one of the redundant Dante modes (Redundant or Redundant+Mgmt) and the two Ethernet ports associated with Dante will function independently. In this case, their specific sync status configuration can be different and it's useful for them to be independently displayed.

Current Clock Source

This is a display-only field with choices of Internal, Internal (Failover Active), Sync Input, Dante, and Dante (Failover Active).

The text Failover Active will display in red as a warning of an abnormal condition that warrants intervention. (It can also display --- which indicates a major hardware error and would warrant contacting the factory.)

When Internal is displayed it indicates that the Model 5401A's internal temperature-stabilized oscillator is being used as its timing reference. When Internal (Failover Active) is displayed an abnormal condition is occurring. In this case, the Model 5401A has been configured to use an external timing reference but a valid one is not available; it is using its internal temperature-stabilized oscillator as its timing reference. If Sync Input is displayed this indicates that an external timing reference signal is connected to the sync input connector and the Model 5401A is using it as its timing reference. If Dante is displayed this indicates that the Model 5401A is using a timing reference derived from its Dante network interface. This is not an invalid condition but would typically only occur in a troubleshooting situation. If Dante (Failover Active) is displayed an abnormal condition is occurring. In this case, the Model 5401A is using a timing reference derived from its Dante network interface. However, this is only occurring because the configured clock source is not currently available.

Sync Input Status

This is a display-only field with choices of Locked, Unlocked, Standby, and Idle. As a warning of an abnormal condition the text Unlocked will display in the color red.

If Locked is displayed this indicates that the signal connected to the Model 5401A's external sync input is serving as the unit's timing reference. If Unlocked is displayed it indicates that a signal may be connected to the Model 5401A's sync input but is not being recognized as a valid timing reference. This can occur for several reasons. The most common would be due to a configuration mismatch, such as if a video reference is connected while the Model 5401A is configured to support a word clock source. It might also indicate that a non-supported word clock rate or an incompatible video reference is connected. Unlocked could also be displayed if no signal is connected to the sync input or if a connected signal is incorrectly terminated, e.g., no termination applied when one is required or if two terminations ("double termination") were present. If Standby is displayed it indicates that the Model 5401A is able to recognize a timing reference that is connected to the sync input but that the unit is not using that signal as its timing reference. This would apply only if the Model 5401A's clock source was selected for Internal or Dante. Idle will display if the sync input has not been selected as the Model 5401A's clock source and a valid source has not been connected to the sync input.

Clock Source

This is a configurable field with three choices: Internal, Sync Input, or Dante.

This setting determines which timing source is used by the Model 5401A's circuitry as its own "Leader" timing reference. This is the clock source that will be used by the Model 5401A's PTP server circuitry, the "heart" of the Model 5401A's support of related Dante devices. When Internal is selected the Model 5401A's temperature-stabilized, high-performance crystal oscillator is utilized. This will provide excellent timing accuracy and long-term consistent performance. This source is far superior to that provided by other standard Dante devices. This is the correct choice if a high-quality external reference signal is not going to be connected.

When Sync Input is selected the Model 5401A's external sync input connection will be active. Using a BNC receptacle, located on the Model 5401A's back panel, an external source of word clock, video reference, or 10 MHz sine wave can be connected. Circuitry within the Model 5401A will "lock" (synchronize) the internal timing signals to the externally provided reference signal. This is the recommended operating mode if a precision external reference is available. For example, in facilities that have equipment that supports video it's typical to have a high-end Leader timing generator. And in audio facilities a "Leader" source of word clock may be available. In industrial or commercial settings, a GPS receiver may be used to provide a precision source of 10 MHz sine-wave. But be aware that it is possible that an externally available reference signal may not be as "good" as the Model 5401A's internal oscillator. If that is the case then the internal source should be utilized. Other devices in a facility can then "lock" to the Model 5401A's word clock output. (This is available by way of a BNC receptacle located on the Model 5401A's back panel.)

Selecting Dante will instruct the Model 5401A to use the clock signal from its Dante interface circuitry as the timing source for

the PTP server. The Dante interface circuitry will either use its internal crystal oscillator or synchronize to another Dante device on the network. The clock source the Model 5401A's Dante interface uses will depend on a setting in the Dante Controller application. The Model 5401A includes the choice of Dante as a clock source only for troubleshooting or other factory-directed activities. It's not expected that this selection will ever be used during normal Model 5401A operation. By selecting Dante, the excellent timing performance that the internal oscillator can provide or the benefits gained from synchronization with a "house" timing reference would not be utilized.

Failover Source

This is a configurable field with two choices: Internal or Dante.

This configuration choice applies only if the Model 5401A has been configured to use the sync input. It specifies which clock source should be used by the Model 5401A if a valid sync source is not connected to the sync input. If Internal is selected then the precision crystal oscillator will be utilized as the Leader clock source should a valid signal not be connected to the sync input. If Dante is selected then the clock source derived from the Dante interface will be used.

From a performance standpoint it's preferable to select Internal. This ensures that the best clock performance can be obtained should a valid external sync source not be present (sync input status unlocked). However, selecting Dante would allow an interesting alerting feature to become active. In the Dante Controller application, a device such as the Model 5401A that has been selected as the preferred Leader with an external source allowed will have an error condition occur if the Dante interface doesn't detect an external reference being applied. And losing the external reference is what the Model 5401A's circuitry will do should Dante be selected as the failure source. In this way, a Dante network user could be alerted to an issue with the Model 5401A should it lose its very important external sync source.

Getting an error condition reported in Dante Controller is probably not terribly important. The sync LED on the Model 5401A's front panel will also offer a clear indication of a loss of an external sync signal. The LED will typically slowly flash green when the Model 5401A is functioning correctly as the clock Leader for the Dante network. However, should the unit be configured to use an external sync signal and a valid one is not present, the sync LED will flash orange to indicate the loss of lock to the sync input. In addition, the display will provide a text indication of this condition.

Force Preferred Leader

This is a configurable field with two choices: Disabled or Enabled.

This function impacts how the Model 5401A will control a Dante network's selection of which device is going to serve as the Leader clock. As the main reason for the Model 5401A's existence is to serve as a Leader clock, in most cases the unit should serve in that role. By forcing the Model 5401A to be a Preferred Leader clock it helps to ensure optimal Dante network operation. By enabling this configuration, users of the Dante Controller application will not be able to accidentally disable the Model 5401A as a Preferred Leader. One can observe exactly what is meant by the term Force Preferred Leader by unchecking the Model 5401A's Preferred Leader check box in Dante Controller. After a short interval the

box will automatically return to the enabled (checked) state.

How the Model 5401A handles forcing the Dante network to Preferred Leader clock operation and, if applicable, supporting an external clock input is not trivial. Reviewing some of these details can provide valuable insight: If the Model 5401A's clock source is configured for Dante the Model 5401A will always force the Enable Sync to External selection in Dante Controller to be off (unchecked). If the Model 5401A's clock source is configured for Internal or Sync Input then the Model 5401A will always force Enable Sync to External in Dante Controller to be on (checked) as long as the Model 5401A is acting as Primary Leader, Leader, or AES67 Leader.

Submit

A Submit button is located on the bottom of the Main menu webpage. For any changes made to fields on the Main menu webpage to be saved and acted upon the Submit button must be pressed.

Sync Input Menu

The Sync Input menu has parameters that are related to the Model 5401A's external sync input. This allows an external source of timing to be connected to the Model 5401A using the BNC receptacle that is located on the unit's back panel. Refer to Appendix E for a view of the Sync Input menu.

Lock Status

This is a display-only field that can show ---, Unlocked, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, one of the video format/rate combinations, or 10 MHz. It's also possible that it could display Error which would indicate a Model 5401A hardware problem. This would be a rare occurrence and, in this case, contacting the factory would be recommended.

This field reflects the operation of the Model 5401A's sync input circuitry. If Sync Input is not selected on the Main menu then --- will display. If Sync Input is selected on the Main menu then this field will display either Unlocked or a detected rate. Unlocked will display if no signal source is connected or if the connected source doesn't match the selected sync input type. For example, Unlocked will display if Word Clock has been selected as the sync input type but a video sync signal has been connected. The detected rate will be displayed whenever the sync input is locked to the connected signal. If this is a word clock signal then one of the four compatible rates will be displayed. If this is due to a video source being connected then the actual rate/format characteristics will be displayed. The compatible rate/format combinations are listed in Appendix B of this guide. If the sync input is locked due to a 10 MHz signal being recognized then 10 MHz will display.

Unlocked will be displayed, in the text color red, if the sync input has been selected as the clock source but either no signal is connected to the sync input or a non-compatible signal is connected. A non-compatible signal would include a sync input type being selected for Word Clock and then a word clock signal at a different rate than the current Dante sample rate is connected. For example, an incompatible situation would be where the current Dante sample rate is 48 kHz but the connected word clock signal is 96 kHz. Probably the most common non-compatible signal would be a situation where a video reference signal is connected to the sync input but the sync input type was left at the default (Word Clock) rather than being selected for Video.

Locked will be displayed in the lock status field when a signal connected to the Model

5401A's sync input is serving as the Leader timing reference. If the clock source configuration on the Main menu has been selected for External this is the desired condition. If Locked does not display then standard troubleshooting should be performed to remedy the issue. In most cases, the problem will be resolved by ensuring that the sync input type configuration and the actual connected sync source are the same.

Current Dante Sample Rate

This is a display-only field that can show 44.1 kHz, 48 kHz, 88.2 kHz, or 96 kHz. It can also display Error in the unlikely event that there is an issue with the Brooklyn II module that provides the Dante interface.

This field displays the Model 5401A's currently selected sample rate as used by the Model 5401A's Dante transmitter (output) channels. The Dante transmitter (output) channels provide eight unique tone outputs labeled Tone 1 through Tone 8. Changes to the Dante sample rate are made using the Dante Controller software application.

Type

This is a configurable field with three choices: Word Clock, Video, or 10 MHz.

If the Model 5401A's clock source has been selected to Sync Input on the Main menu the type of connected source must be defined to match the application. If Word Clock is selected then a square wave source with a rate of 44.1 kHz, 48 kHz, 88.2 kHz, or 96 kHz needs to be connected. For proper operation the nominal unloaded level of the word clock source must be 5 volts DC peak-to-peak. Also, the connected word clock source must match the displayed current Dante sample rate. This is a bit of a "chicken or the egg" situation since it can be confusing as to who is supposed to control the sample rate and who is supposed to follow the sample rate! The Dante Controller software application should be used to select the desired Model 5401A sample rate. This is the sample rate desired for the eight sine-wave audio channels provided by the tone generator function. In most applications this will be 48 kHz. It's possible that in some audio-only applications 96 kHz will be selected. Once the desired sample rate has been selected and/or confirmed, an external word clock source of the same rate should be connected. If the available external word clock source has a rate different than the current Dante sample rate then a review of the entire application must be performed and a common rate selected.

If Video is selected for the sync input type then a wide range of bi- and tri-level video reference signals can be connected to the sync input BNC receptacle. The Model 5401A's circuitry will automatically decode many of the most common format/rate combinations. These include ubiquitous "black burst" signals as well as signals intended to support 4K video applications. Refer to Appendix B at the end of this guide for a detailed list of compatible video sources.

If a choice of sync sources is available for a specific application it's recommended that a source of word clock be utilized. This is not because a word clock source is inherently better, but is related to the Model 5401A's circuit design. The unit's logic circuitry has to perform the least amount of processing with a word clock input signal as compared to that required to utilize a video reference or 10 MHz signal. All compatible signals will work well but using a source of word clock requires the least software "horsepower."

Termination

This is a configurable field with two choices: Off and On.

If desired, the Model 5401A can apply a terminating impedance to the sync input connection. The need for an input source to be terminated, or not, will depend on the source of the external sync signal. Typically, a source of sync should have one (and only one) termination applied. A timing reference source can generally be shared ("bused") to multiple devices with the only the last connection on the "string" having an appropriate termination.

If the sync input termination is configured for Off then the sync input's impedance will be considered "high Z." If the sync input termination is selected to On and the sync input type is selected for Word Clock or Video the termination impedance will be 75 ohms. If 10 MHz has been selected as the sync input type then a termination impedance of 50 ohms will be applied.

These termination values were selected to meet the technical requirements of industry-standard reference signals. Word clock should be a square wave with a source impedance of 75 ohms. Video is typically a complex analog signal with a source impedance of 75 ohms. And a 10 MHz reference is a sine-wave with a source impedance of 50 ohms. The latter is typically utilized in industrial or instrumentation applications.

Submit

A Submit button is located on the bottom of the Sync Input menu webpage. To save any changes made to fields on the Sync Input webpage requires that the Submit button be pressed. The Model 5401A will immediately incorporate operating changes as soon as the Submit button has been pressed.

Tone Generator Menu

The Model 5401A's tone generator function is capable of creating eight precision sine-waves tones with independent frequency and level configuration. The frequency range is 1 to 22000 hertz (Hz) and the level range is –99 to 0 dBFS. Refer to Appendix E for a view of the Tone Generator menu.

The tone signals have Dante transmitter (output) default names of Tone 1 through Tone 8. It's expected that most applications will only use a few of the tones. But having eight output channels provides flexibility in creating a set of tones with various frequency and level combinations. These can be useful in a range of applications including identifying individual channels in a multi-channel arrangement, e.g., stereo, 5.1, or 7.1.

Frequency (Hz)

These eight fields reflect the Model 5401A's currently selected sine-wave generator frequencies. For each channel enter the desired frequency in full hertz. Don't use a suffix such as k or kHz, nor enter a comma or period to delineate thousands. Entering 1001 would be correct while 1,001 or 1.001 k would not be acceptable.

The default tone frequencies were selected in hundreds of hertz with the first digit matching the channel number: 100, 200, 300, etc. This can be useful when checking a series of channels as this pattern can be easily recognized either by ear or using equipment that can display the frequency in text. Some applications may need the common 1000 or 10000 Hz reference sine-wave tones and there's no problem configuring these if desired.

Level (dBFS)

These eight fields display the level of the Model 5401A's eight sine-wave outputs.

The output level for each of the eight audio generator output channels is independently adjustable over a range of –99 to 0 dBFS. The level is selectable in 1-dBFS steps.

Enter the desired level in full dBFS with a hyphen as the prefix to indicate less than full scale. In applications that comply with the SMPTE® audio standards the typical nominal level will be –20 dBFS which can be thought of as 20 dB less than full scale or digital 0. In EBU applications the typical nominal level will be –18 dBFS. Some applications may benefit from a sine-wave test tone that's 12 dB less than the reference level. This would equate to configuring an output to –34 dBFS (SMPTE) or –32 dBFS (EBU). These would typically be associated with a 1000 Hz tone.

The default tone levels were selected in a pattern that could help identify a specific channel. Channel Tone 1 has a default level of –21 dBFS with the value of 1 being selected to reflect the channel number. Each subsequent channel then reduces its level by 1 dB. So, for example, the second channel, Tone 2, has a level of –22 dBFS. While these level steps may not be readily discernible to human ears most test equipment or metering could easily be used to identify specific channels.

Submit

A Submit button is located at the bottom of the Level (dBFS) column on the Tone Generator menu webpage. To save any changes made to the level or frequency fields requires that the Submit button be pressed. Changes will be made immediately after pressing the Submit button.

Network Menu

Refer to Appendix E for a view of the Network menu.

Dante Interfaces

There are three display-only fields associated with the Dante Interface section of the Network menu webpage.

Primary IP Address

This is a display-only field that shows the IP address associated with the Model 5401A's Dante primary Ethernet interface. It will show either No Ethernet Link or an IP address. The IP address displayed in this field is not the IP address associated with the Model 5401A's internal management web server. The 32-bit IP v4 address is displayed in what's known as dot-decimal notation (4 octets, each separated by a dot).

How the IP address is determined depends on the Model 5401A's network configuration setting as performed using the Dante Controller application. The IP address can be established automatically using a DHCP server or the IPv4 link-local protocol. An IP address assigned to the Dante primary interface by link-local will have a format of 169.254.x.x. The Dante primary IP address can also be set to a manual (static or fixed) IP address using Dante Controller.

If the network configuration is selected in Dante Controller for Switched or Switched+Mgmt then the Dante primary IP address will be associated with a network connection made to either the Dante primary or the Dante secondary RJ45 connections on the Model 5401A's back panel. If the network configuration is selected for Redundant or Redundant+Mgmt then the primary Dante IP address will be associated with the RJ45 connection labeled PRI on the Model 5401A's back panel. Link Down will display if a valid Ethernet connection has not been made with the Dante primary Ethernet interface.

If the Model 5401A's network configuration in Dante Controller is selected for Switched or Switched+Mgmt ensure that only one of the RJ45 connections on the back panel is connected to the LAN associated with the Dante devices. The other RJ45 connection can be used to interconnect with another piece of networked equipment. But having both of the Model 5401A's RJ45 connections routed to ports on the same LAN will typically "crash" the network!

Secondary IP Address

This is a display-only field that shows the IP address associated with the Model 5401A's Dante secondary Ethernet interface. It will show Disabled, Link Down, or an IP address. An IP address will be displayed in dot-decimal notation and will not be the IP address associated with the Model 5401A's internal management web server.

What is displayed and how a displayed IP address is determined by a setting of the Model 5401A's network configuration using the Dante Controller application. If the network configuration is selected for Switched or Switched+Mgmt then a Dante secondary IP address will never be active and Disabled will be displayed.

If the network configuration is selected for Redundant or Redundant+Mgmt then the Dante secondary IP address will be displayed. This is the Ethernet connection that is associated with the RJ45 receptacle labeled SEC on the Model 5401A's back panel. The IP address can be established automatically using a DHCP server or the IPv4 link-local protocol. An IP address assigned to the Model 5401A's Dante secondary interface by link-local will have a format of 172.31.x.x. The secondary IP address can also be set to a manual (static or fixed) number using the Dante Controller application. No Ethernet Link will display if a valid Ethernet connection has not been made with the secondary RJ45 receptacle.

Switch Configuration

This is a display-only field that shows the Model 5401A's network configuration as determined by a setting in the Dante Controller application. The term "Switch" refers to an Ethernet switching and routing integrated circuit that is part of the Model 5401A's hardware. How this integrated circuit is configured determines the how the Model 5401A's three GigE Ethernet ports will function. The field will show Switched, Redundant, Switched+Mgmt, or Redundant+Mgmt. It will also display Error in the unlikely event that an error in the Brooklyn II module has occurred.

Management Interface

There are eight fields that relate only to the Model 5401A's management interface. They don't have any relation to the primary and Dante secondary IP addresses and their associated network parameters. The first four are display-only and the last four allow changes to be made.

MAC Address

This is a display-only field that shows the Model 5401A's MAC (media access control) address for the management interface. This is a unique hardware identification number that is assigned to each specific Model 5401A. (No two Ethernet-connected devices on any piece of equipment, anywhere in the world, should ever share a MAC address.)

Current IP Address

This is a display-only field that shows the IP address associated with the Model 5401A's management interface and associated web server. This address can be

assigned automatically using the DHCP protocol or, if a DHCP server is not available, the IPv4 link-local protocol. It can also be manually assigned with a fixed or static IP address. The current IP address is not associated with the Model 5401A's Dante primary or Dante secondary Ethernet interfaces.

If the network configuration in the Dante Controller application is selected for Switched or Redundant this field will show the IP address that's related to the connection made to the Model 5401A's management RJ45 receptacle. If the Model 5401A's network configuration is selected in Dante Controller for Switched+Mgmt then the current IP address will be associated with a connection made to either the Dante primary or Dante secondary Ethernet interface on the Model 5401A's back panel.

If the network configuration in Dante Controller has been selected for Redundant+Mgmt then the current IP address will be associated with an Ethernet connection made to the Dante primary Ethernet interface on the Model 5401A's back panel.

As previously mentioned, if the Model 5401A's network configuration in Dante Controller is selected for Switched or Switched+Mgmt ensure that only one of the Dante RJ45 receptacles on the back panel is connected to the LAN associated with the Dante devices. The other RJ45 connection can be used to interconnect the same LAN with another piece of networked equipment. But having both of the Model 5401A's RJ45 connections routed to ports on the same LAN will typically "crash" the network!

If the Model 5401A's IP address configuration has been selected for Manual then the current IP address will be the same as that displayed in the manual IP address field. This is because the value configured for the manual IP address is being used by the network interface as its IP address. (This assumes that the manual IP address hasn't changed since the last reboot.)

Current Subnet Mask

This is a display-only field that shows the subnet mask address that is currently active for the Model 5401A's management interface and associated web server. If the current IP address and related network parameters were obtained by way of DHCP then this field will display an IPv4 subnet mask in dot-decimal notation. If the IP configuration mode is selected for Automatic and the current IP address was obtained by way of link-local, then a subnet mask of 255.255.0.0 will be utilized and will be shown in this field.

If the Model 5401A's IP address configuration has been selected for Manual then the current subnet mask value will be the same as that displayed in the manual subnet mask field. This is because the value configured for the manual subnet mask is being used by the network interface as its subnet mask value. (This assumes that the manual subnet mask hasn't changed since the last reboot.)

Current Gateway

This is a display-only field that shows the gateway IP address that is currently active for the Model 5401A's management interface and associated web server. If the current IP address and related network parameters were obtained by way of DHCP then this field will display an IPv4 gateway IP address in dot-decimal notation. If the IP configuration mode is selected for Automatic and the current IP address was obtained by way of link-local, no gateway IP address will be shown in this field. This is because no gateway IP address is associated with link-local.

If the Model 5401A's IP address configuration has been selected for Manual then the current manual gateway value will be the same as that displayed in the manual gateway field. This is because the value configured for the manual gateway is being used by the network interface as its manual gateway value. (This assumes that the manual gateway IP address hasn't changed since the last reboot.)

IP Address Configuration

This is a configurable field with two choices: Automatic and Manual.

The selected configuration impacts how the Model 5401A obtains the IP address that is used for accessing the Model 5401A's management interface and associated web server. This setting has no impact on how the Model 5401A obtains IP addresses for the Dante primary and Dante secondary Ethernet interfaces.

Selecting the Automatic setting causes the Model 5401A to use the DHCP or, if DHCP is not available, the IPv4 link-local protocol to establish the IP address for the Model 5401A's management port. When selected to use Automatic, upon establishing a connection to the configured Model 5401A RJ45 receptacle the DHCP protocol will request an IP address and related parameters. If obtaining an IP address in this manner is not successful then the IPv4 link-local protocol will be used. (If an IP address has the format of 169.254.x.x then it was assigned using IPv4 link-local.) Even if the IP address was established using link-local the DHCP protocol will remain active. In this case, approximately every 30 seconds the Model 5401A's firmware will check for the presence of a DHCP server. If one becomes available then an IP address will be requested and, when obtained, will automatically replace the IP address that was previously established by link-local.

The Manual setting allows the desired IP address and related parameters to be manually entered. This can be useful when a fixed addressing scheme has been established. In this way, a static IP address can be entered along with the other important network parameters.

When selected for Automatic the fields for the manual IP address, subnet mask, and gateway IP address will be "grayed out" (will have a gray background) to indicate that their values cannot be manually changed. In this condition they are display-only. Changing between Automatic and Manual and vice-versa will not impact the values stored in the manual IP address, manual subnet mask, and manual gateway IP address fields.

Note that to minimize the chance of losing access to the management web server, restoring the Model 5401A's default configuration values will not change the currently selected IP address configuration choice.

Manual IP Address

This field shows the stored IP address associated with the management web server when the manual mode has been selected for the IP address configuration. This address has nothing to do with the IP address utilized by the Dante primary and Dante secondary Ethernet interfaces. When IP address configuration is selected for Automatic this field is grayed out and the value cannot be revised. Whenever the IP address configuration is selected for Manual the manual IP address can be modified as desired to meet the requirements of the application. After entering an IP address, using the standard dot-decimal notation, the Submit button at the bottom of the webpage

must be pressed for the changes to be stored. A system reboot is required for the revised manual IP address to be utilized. The Reboot function is available on the system webpage and the front panel. Restoring the Model 5401A to its default values will not change the stored manual IP address.

Manual Subnet Mask

This field shows the stored subnet mask value associated with the management web server when the manual mode has been selected for the IP address configuration. When IP address configuration is selected for Automatic this field is grayed out and the value cannot be revised. When the IP address configuration is selected for Manual this field will not be grayed out and the value can be modified as desired to meet the requirements of the application. After entering a revised subnet mask value, using the standard dot-decimal notation format, the Submit button must be pressed for the change to be stored. A system reboot is required for the revised subnet mask value to be utilized. Restoring the Model 5401A's default values will not change the stored manual subnet mask value.

Manual Gateway

This field shows the stored gateway value associated with the management web server when the manual mode has been selected for the IP address configuration. When IP address configuration is selected for Automatic the manual gateway field is grayed out and the value cannot be revised. When the IP address configuration is selected for Manual this field will not be grayed out and the value can be modified as desired. After entering a revised gateway value, using dot-decimal notation, the Submit button must be pressed for the change to be stored. A system reboot is required for the revised gateway value to be utilized. Restoring the Model 5401A's default values will not change the stored manual gateway value.

Submit

The Submit button is located at the bottom of the Management Interface area of the Network menu webpage. To save any changes made to four fields in the Management Interface requires that the Submit button be pressed. To utilize those changes requires that a Model 5401A reboot to take place. That can occur by using the system Reboot function on the system webpage.

Access Menu

As a security method a user name and password must be entered before the configuration webpages can be accessed. (This is what you did to get this far!) These values can be changed as desired. Refer to Appendix E for a view of the Access menu.

The Model 5401A's access security method is in no way rigorous. The user name and password are sent to and received from the Model 5401A as plain text. They are also stored within the Model 5401A as plain text. There is no security method or encryption associated with these fields. Anyone "snooping" on the LAN that is transporting Model 5401A management data will see all values in plain text. The ability to select user name and password values is intended simply to provide a means of keeping "honest" users from easily changing the configuration of a Model 5401A. If unauthorized access is of concern then it's recommended that the Model 5401A's network configuration be selected for Switched or Redundant. And then an Ethernet connection to the Model 5401A's management RJ45 receptacle should not be present except when access by authorized personnel is desired.

The default user name is **guest** and the default password is **guest**. These are case sensitive. If neither of the default entries are changed then they will display in the User Name and Password entry fields on the Login menu webpage. If the default user name and/or default password is changed then neither the user name nor the password will display upon accessing the Login menu webpage.

Management Log Credentials

User Name

In this field a revised user name can be entered. The user name must be a minimum of five characters, a maximum of 15 characters, and is case sensitive. All 95 of the printable ASCII characters can be used. These include upper and lower alphabetic characters, numbers, and standard punctuation marks.

New Password

In this field a revised password can be entered. The password must be a minimum of five characters, have a maximum of 15 characters, and is case sensitive. All 95 of the printable ASCII characters can be used. These include upper and lower alphabetic characters, numbers, and standard punctuation marks.

Confirm New Password

For a new password to be considered valid, enter it identically into this field.

Submit

The Submit button is located below the field for Confirm New Password. To save changes made to the User Name and/or New Password fields requires that the Submit button be pressed. Changes made will be effective upon the next attempt at logging into the Model 5401A. Restoring the Model 5401A to its default values does not change the stored user name and password.

System Menu

This menu has six display-only fields as well as functions that allow the default settings to be restored and the system to be rebooted (restarted). Refer to Appendix E for a view of the System menu.

One of the display-only fields shows the hardware serial number and the remaining five provide details about the firmware (embedded software) that is being actively utilized by the Model 5401A.

Serial Number

This is a display-only field that shows the Model 5401A's hardware serial number. This number has been assigned at the factory and cannot be changed.

Version Information

The version information section consists of five rows of information that provides details about the five firmware (embedded software) files that are being used by the Model 5401A. These are display only and will include a date if that is specified as part of the firmware release.

Main MCU Firmware

This display-only field shows the version number and associated release date of the Model 5401A's Main MCU firmware. This firmware, with a file name **M5401A.bin**, can be updated using a USB flash drive. Update details are provided in the Technical Notes section of this guide.

Main FPGA Firmware

This display-only field that shows the version number and associated date of the Model 5401A's Main FPGA (field-programmable-gate-array) firmware. This firmware, with a file name of **DSMC.bit**, can be updated using a USB flash drive. Update details

are provided in the Technical Notes section of this guide.

Sync FPGA Firmware

This display-only field shows the version number and associated date of the Model 5401A's synchronization board FPGA (field-programmable-gate-array) firmware. This firmware, with a file name of **CLOK.bit**, can be updated using a USB flash drive. Update details are provided in the Technical Notes section of this guide.

Dante Product

This display-only field shows the product version number and associated date that's stored in and being utilized by the Dante interface. (The Dante interface is implemented using a Brooklyn II module from Audinate.) This version number is assigned by Studio Technologies as an identifier when a file is released that combines specific Model 5401A configuration information along with Dante operating firmware. The firmware for the Model 5401A's Dante interface can be updated by way of an Ethernet connection using the Dante Updater software application that's provided as part of the Dante Controller software application. The Dante product firmware file has a **.dnt** extension.

Dante Firmware

This is a display-only field that shows the version number of the firmware associated with the Dante interface (Brooklyn II module) that the Model 5401A is utilizing for Dante interconnectivity. No date is associated with this file. The displayed version number is assigned by Audinate and can't be changed by Studio Technologies. It is incorporated into the Dante Product (.dnt) file that is released by Studio Technologies' specifically for the Model 5401A. As noted previously, this firmware, part of the Dante product firmware, can be updated by way of an Ethernet connection using the Dante Updater software application.

Restore Default Settings

The Restore Default Settings function allows many of the Model 5401A's default configuration settings to be restored. However, it will not impact the network configuration or user name and password settings. For the defaults to be restored the associated check box must be enabled prior to pressing the Submit button. Be careful when using this function as invoking it after enabling the check box will immediately cause the defaults to be restored. Refer to Appendix F for a list of the default values.

System Reboot

The Reboot function is located on the bottom of the System menu webpage. It allows the Model 5401A to be rebooted (restarted) without having to perform a power cycle. (The function can be considered to invoke a "cold boot.") For a system reboot to take place the check box must be enabled prior to pressing the Reboot button. During normal operation a system reboot will never be required. But after changes are made to any of the unit's management interface network configuration a reboot is required. A system reboot will cause the three Ethernet interfaces to go through a reconnection process, necessary should any of the management network parameters be revised. (These changes can be made by way of the Network menu choices or using the front-panel display and buttons.)

Menu Text and Links

The following provides details on some of the text and links that are presented on the Model 5401A's webpages.

Device Name

In the upper-right corner of each Model 5401A webpage is the Dante device name. This name is unique to each device in a Dante deployment and is used as part of the Dante subscription (channel routing) process. The name can be changed from within the Dante Controller application.

Identify Device Link

In the upper-right corner of each webpage, directly below the device name, is a link called Identify Device. Clicking on it will cause the Dante identify action to commence on the specific Model 5401A. The action will consist of the front-panel display's green backlight flashing five times. This command will help confirm that the web server on the desired Model 5401A is being accessed.

Company Name Link

On the bottom of each webpage is a link with the title Studio Technologies, Inc. Clicking on this link will cause the browser to open the Home webpage of the Studio Technologies website.

Log Out Link

In the upper-right corner of most of the Configuration menu webpages is a link called Log Out. It will cause the Model 5401A's web server to end the session, logging out the user and returning to the Home menu. To again access the configuration webpages requires that the user click on the Login tab and provide a valid user name and password.

Operation

Now that the Model 5401A is installed and configured it's ready for use. The unit is designed for continuous, unattended operation. However, there are a number of nuances in the unit's operation. This may make it worthwhile for personnel to spend some time reviewing this section.

Upon application of AC mains or DC power, the Model 5401A will go through a power-up sequence. The eight bi-color LEDs on the Model 5401A's front panel will first light green, then light red in a confirmation sequence. The unit's graphics display will show the Studio Technologies logo graphics image, followed by a menu page that shows the product name (Model 5401A) and the Dante name. Then the version number of the Main MCU firmware will display. After a few seconds the screen saver mode, detailed later in this section, will begin operation. Upon power being applied the green LED adjacent to the USB connector on the back panel will flash once to indicate that its associated circuitry is performing correctly. Note that upon power being applied to the Model 5401A the LEDs on the back panel associated with the unit's three Ethernet jacks may, or may not, flash. But that activity would just be random in response to the unit's circuitry starting operation.

After the Model 5401A has completed its power-up sequences the unit will begin operation. The eight front-panel LEDs will reflect the real-time status of the unit's major functions. The front-panel display will allow the viewing of over 20 menu pages showing status and configuration conditions. In addition, using the pushbutton switches some of the unit's configuration settings can be revised as required.

The following paragraphs will detail the operation of the front-panel LEDs.

Power LEDs

Two LEDs indicate the presence of incoming AC mains and nominal 12 volts DC power. They are labeled AC and DC and can light green or red. When a source of AC mains power is connected the AC LED will light green. (This is actually in response to 12 volts DC that is being generated by the internally located AC mains input/12 volts DC output power supply.) The LED labeled DC will light green whenever a connected DC source exceeds approximately 10 volts. The DC LED will light red when the DC input is between approximately 9 and 10 volts, indicating a low-voltage condition. Once the DC input is less than approximately 9 volts the DC LED will not light and the Model 5401A will no longer operate from the DC source.

Network LEDs

Three LEDs provide status indications related to the Model 5401A's three Ethernet network interfaces. Two of the LEDs are associated with the Model 5401A's Dante primary and Dante secondary Ethernet ports. They are labeled PRI and SEC. The third LED, labeled MGMT, is associated with the unit's management Ethernet port. The way in which the three Ethernet interfaces and their associated status LEDs function depend on the network configuration as selected using the Dante Controller application. The choices are Switched, Redundant, Switched+Mgmt, and Redundant+Mgmt.

Switched Network Operation

When the Dante interface is configured for Switched operation the PRI LED will light red when no Ethernet connection is present on the Dante primary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The SEC LED will not light when an Ethernet connection is not present on the Dante secondary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

When no Ethernet connection is present on the management Ethernet port the MGMT LED will not light. It will light green whenever a Gigabit or a 100 MB/s Ethernet signal is connected and a link has been established.

Redundant Network Operation

When the Dante interface is configured for Redundant operation the PRI LED will light red when no Ethernet connection is present on the Dante primary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The SEC LED will light red when an Ethernet connection is not present on the Dante secondary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

When no Ethernet connection is present on the management Ethernet port the MGMT LED will not light. It will light green whenever a Gigabit or a 100 MB/s Ethernet signal is connected and a link has been established.

Switched+Mgmt Network Operation

When the Dante interface is configured for Switched+Mgmt operation the PRI LED will light red when no Ethernet connection is present on the Dante primary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The SEC LED will not light when an Ethernet connection is not present on the Dante

secondary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The MGMT LED will never light, no matter whether or not an Ethernet signal has been connected to the management port.

Redundant+Mgmt Network Operation

When the Dante interface is configured for Redundant+Mgmt operation the PRI LED will light red when no Ethernet connection is present on the Dante primary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The SEC LED will light red when an Ethernet connection is not present on the Dante secondary Ethernet port. It will light green whenever a Gigabit or a 100 MB/s Ethernet connection is present and a link has been established.

The MGMT LED will never light, no matter whether or not an Ethernet signal has been connected to the management port.

Dante LEDs

Two LEDs are associated with the Model 5401A's Dante interface. The system LED, labeled SYS, and the synchronization LED, labeled SYNC, will both light red as the Model 5401A's Dante interface starts to function and awaits connection and full operation with one or two local area networks (LANs). (Two networks are utilized only when Dante redundancy is enabled.) The SYS LED will light red to indicate that the Dante interface is not ready to pass data to other devices. It will blink red if there is an issue communicating with the internal Dante Brooklyn II module. It will light green when the Dante interface is operating normally and is ready to pass Dante data.

The SYNC LED will light red to indicate that the Model 5401A's Dante interface has not established timing synchronization. The SYNC LED will slowly flash green if this specific Model 5401A is serving as the Leader clock for the associated Dante network. This will be a normal situation as usually this Model 5401A will be providing the timing reference for all of the other Dante devices. The SYNC LED flashing green can be misconstrued as an error condition, but it is not. The SYNC LED flashing mimics the action that other Dante devices will perform if they are acting as the Leader clock.

The SYNC LED will slowly flash orange if the Model 5401A is serving as the Leader clock for the Dante network and its failover mode is active. This would indicate that the unit was specified to utilize a timing source connected to the sync input but it is not able to do so. (Typically due to a sync source not connected or one with an incompatible format.) If the SYNC LED is lit solid orange then the Model 5401A is not acting as the Leader clock and its failover mode is active. The SYNC LED lighting orange, whether solid or flashing, would typically indicate an error condition that should be resolved.

The SYNC LED will light solid green when the Model 5401A is not acting as the Leader clock. In this case, the unit is using another Dante device on the network to provide its timing reference. This is not a typical situation and might only be happening if an external reference is not connected to the Model 5401A's sync input or while performing system testing.

Note that it's possible that up to 30 or 40 seconds may be required for the SYNC LED to reach its final state after the Model 5401A powers up or performs a reboot (restart). Also, both the SYS and SYNC LEDs will flash red whenever the Model 5401A's

network configuration mode is changing. (This would be performed using the Dante Controller application.) After the revised network configuration has been established the SYS and SYNC LEDs will perform normally.

External Lock LED

An LED, labeled SYNC IN, is associated with the status of the Model 5401A's external synchronization input. If the unit has been configured to not utilize an external synchronization source then the LED will not be lit. The SYNC IN LED will light red if the Model 5401A has been configured to utilize an external source of "sync" but a valid one has not been connected. The LED will light green if a valid source of synchronization has been connected. The LED lighting red will typically indicate an error condition that should be investigated.

RJ45 LED Indicators

On the Model 5401A's back panel there are three RJ45 receptacles that are provided for interfacing with the unit's three Ethernet ports. Two of the ports are typically used for Dante and the third for the management function. The Ethernet ports are labeled Dante PRI, Dante SEC, and MGMT. Associated with each port are two LEDs. One LED is labeled LINK and lights orange when a valid Ethernet connection has been established with that specific port. The other LED is labeled ACT and flashes green to indicate activity, responding to Ethernet data traveling through the specific port.

The Model 5401A's three Ethernet ports, as a group, can be configured, using the Dante Controller application, to operate in one of four network configuration modes: Switched, Redundant, Switched+Mgmt, and Redundant+Mgmt. Details about the four network configuration modes are provided in other sections of this guide. The manner in which the LEDs associated with each RJ45 receptacle will light depends on the network configuration. The following sections detail the operation of the LEDs based on the specific network configuration.

Switched Network Mode

Dante PRI RJ45 LEDs:

LINK (Orange): Off if no Ethernet signal is connected; lit if a valid Ethernet signal is connected and link established.

ACT (Green): Off if no data traffic; flashes to show data traffic.

Dante SEC RJ45 LEDs:

LINK (Orange): Off if no Ethernet signal is connected; lit if a valid Ethernet signal is connected and link established.

ACT (Green): Off if no data traffic; flashes to show data traffic.

MGMT RJ45 LEDs:

LINK (Orange): Off if no Ethernet signal is connected; lit if a valid Ethernet signal is connected and link established.

ACT (Green): Off if no data traffic; flashes to show data traffic.

Redundant Network Mode

Same as Switched.

Switched+Mgmt Network Mode

Dante PRI RJ45 LEDs:

LINK (Orange): Off if no Ethernet signal is connected; lit if a valid Ethernet signal is connected and link established.

ACT (Green): Off if no data traffic; flashes to show data traffic.

Dante SEC RJ45 LEDs:

LINK (Orange): Off if no Ethernet signal is connected; lit if a valid Ethernet signal is connected and link established.

ACT (Green): Off if no data traffic; flashes to show data traffic.

MGMT RJ45 LEDs:

LINK (Orange): Always Off.

ACT (Green): Always Off.

Redundant+Mgmt Network Mode

Same as Switched+Mgmt.

Front-Panel Display Page Descriptions

The following sections provide information about the Model 5401A's front-panel menu pages. Additional details can be found in the Model 5401A Configuration section of this guide. Refer to Appendix D for the menu structure diagram.

Row One:

There are five display pages associated with the top row which we'll refer to as row one. They relate to the timing of the associated Dante network, the Model 5401A's internal timing, and parameters related to the external sync input.

Dante Sync Status

This menu page will display one or two items depending on how the Dante network interface has been configured. If the network configuration in Dante Controller has been selected for Switched or Switched+Mgmt, one field will display on this menu page. It will show Primary Leader, Leader, Follower, Error, or Error – Link Down. If the network configuration in Dante Controller has been selected for Redundant or Redundant+Mgmt two fields will display on this menu page. The first (top) field is named Dante Primary. The second field is named Dante Secondary. These fields will independently show the same choices as described above: Primary Leader, Leader, Follower, Error, or Error – Link Down.

Current Clock Source

This menu page will display which timing source is actively being used by the Model 5401A's circuitry. The possibilities are Internal, Internal (Failover Active), Sync Input, Dante, Dante (Failover Active), and ---. Should the text Failover Active be present it will alternate on and off as a warning of an abnormal condition. This would typically warrant intervention.

Sync Input Type & Status

This display page shows two parameters. The first two (top) lines will show the type of input that has been configured for the Model 5401A's external sync input connection. The possibilities are ---, Unlocked, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, one of the video format/rate combinations, 10 MHz, or Error.

The third and fourth (bottom) lines will show the status of the external sync input as it is used by the Model 5401A as its timing reference. The possibilities are Locked, Unlocked, Standby, and Idle. Should the text Unlocked be present it will flash on and off to indicate a warning condition.

Sync Input Termination

This menu page will display the status of a terminating impedance being applied to the external sync input connector. The two possibilities are Off and On.

Phase Detector Deviation (Factory Use)

The menu page will display two numbers related to how well the Model 5401A's internal

circuitry is “locking” to a signal connected to the external sync input. The information on this page will only be relevant if the factory has been contacted regarding a technical issue.

Row Two:

Row two has five front-panel menu pages that involve the management IP address and related parameters. Two are display only and three allow changes to be made.

Current Management IP Address

This menu page will show the IP address associated with the Model 5401A’s internal management web server. This address can be assigned automatically using the DHCP protocol or, if a DHCP server is not available, using the IPv4 link-local protocol. (An IP address that has the format of 169.254.x.x was assigned using IPv4 link-local.) The management IP address can also be manually assigned with a fixed or static IP address. If no Ethernet connection has been made the text Link Down will be displayed.

If the Model 5401A’s network configuration in the Dante Controller application is selected for Switched or Redundant then this menu page will show the IP address that’s associated with the connection made to the Model 5401A’s management RJ45 jack.

If the Model 5401A’s network configuration in the Dante Controller application is selected for Switched+Mgmt then the IP address that is displayed will be associated with a connection that is made to either the Dante primary or Dante secondary Ethernet interface.

If the network configuration in Dante Controller has been selected for Redundant+Mgmt then the IP address that is displayed will be associated with a connection that is made to the Dante primary Ethernet interface.

Current Management Subnet Mask

This menu page will show the subnet mask setting that is active for the management interface and associated web server. If the IP address and related network parameters were obtained by way of DHCP then this field will display an IPv4 subnet mask in dot-decimal notation. If the IP configuration mode is selected for Automatic and the current IP address was obtained by way of link-local, then 255.255.0.0 will show. It’s also possible that the subnet mask value was manually entered as part of a fixed or static IP address setting.

Management IP Configuration

This menu page allows the display and revision of the method that the Model 5401A will use to obtain a management IP address and related parameters. The choices are Automatic and Manual. The selected configuration impacts how the Model 5401A obtains the IP address that is used for accessing the management web server and associated menu webpages. This setting has no impact on how the Model 5401A obtains IP addresses for the Dante primary and Dante secondary Ethernet interfaces.

An arrow icon will display in the upper-right corner of this menu page. This indicates that the setting can be changed. If the active method is not the desired one, press the enter pushbutton switch located on the front panel. Use the left and right arrow buttons to select the desired method. Then again press the enter button. The entry will be stored. To cause the Model 5401A to use a new setting requires that the unit be rebooted (restarted). This can be performed using another front-panel menu page, a selection in one of the management webpages, or by power cycling the unit.

Selecting the Automatic setting causes the Model 5401A to use DHCP or, if DHCP is not available, the IPv4 link-local protocol to establish the IP address for the management port. Even if the IP address was established using link-local the DHCP protocol will remain active. In this case, approximately every 30 seconds the Model 5401A's firmware will check for the presence of a DHCP server. If one becomes available then an IP address will be requested and, when obtained, will automatically replace the IP address that was previously established by link-local.

The Manual setting allows the desired IP address and related parameters to be manually entered. This can be useful when a fixed or static addressing scheme has been established. In this way, a designated IP address can be entered along with the other necessary network parameters.

Note that to minimize the chance of losing access to the management web server, restoring the Model 5401A's default configuration values will not change the currently selected IP address configuration choice.

Manual Management IP Address

This menu page shows the stored IP address associated with the connection used to access the management web server. (This address has nothing to do with the IP address utilized by the Dante primary and Dante secondary Ethernet interfaces.) It will be utilized only when the manual mode has been selected for the management IP address configuration. When the IP address configuration has been selected for Automatic this field cannot be changed and a lock icon will show in the upper-right corner of the display.

Whenever the IP address configuration is selected for Manual the manual IP address can be modified as desired. This will be indicated by a circle with arrows icon that will show in the upper-right corner of the display. To start the process of changing the manual management IP address press the enter pushbutton switch on the front panel. An icon with a wrench and screwdriver will display to indicate that an edit is in process. Use the left and right arrow pushbutton switches to select which specific digit of the IP address number is to be modified. Press the up and down arrow pushbuttons to select the desired number. The standard dot-decimal notation is used to display and revise the IP address. Once all the desired changes have been made press the enter button to store them.

To cause the Model 5401A to use a new setting requires that the unit be rebooted (restarted). This can be performed using another front-panel menu page, using a function on a management webpage, or by power cycling the unit. Restoring the Model 5401A to its default values will not change the stored manual IP address.

Manual Management Subnet Mask

This menu page shows the stored subnet mask value associated with the connection used to access the management web server. (This value has nothing to do with the subnet mask values utilized by the Dante primary and Dante secondary ports.) It will be utilized only when the manual mode has been selected for the management IP address configuration. When the IP address configuration has been selected for Automatic this field cannot be changed and a lock icon will show in the upper-right corner of the display.

Whenever the IP address configuration is selected for Manual the subnet mask value can be modified as desired. This will be indicated by a circle with arrows icon that will show in the upper-right corner of the display. To start the process of changing the subnet mask value press the enter pushbutton switch on the front panel. An icon with a wrench and screwdriver will display to indicate that an edit is in process. Use the up and down arrow pushbutton switches to select the desired subnet mask number. Once the desired value has been selected press the enter button to store it.

To cause the Model 5401A to use a new subnet mask value requires that the unit be rebooted (restarted). This can be performed using another front-panel menu page, using a function on a management webpage, or by power cycling the unit. Restoring the Model 5401A to its default values will not change the stored subnet mask value.

Row Three:

Row three has a total of six menu pages. Four of the menu pages relate to the Dante primary interface with three of these allowing both display and configuration changes to be made. The fifth menu page allows the configuration of the Ethernet switch integrated circuit to be displayed. A sixth menu page allows the Dante interface to be rebooted (restarted).

Dante Device Name

The Dante device name is shown on this menu page. This name is unique to each device in a Dante deployment and is used as part of the Dante subscription (channel routing) process. The name can be changed from within the Dante Controller application. The text shown on this menu page is same as is shown In the upper-right corner of each Model 5401A management webpage.

Dante Primary IP Configuration

This menu page allows the display and revision of the method that the Model 5401A's Dante interface will use to obtain the Dante primary IP address and related parameters. The choices are Automatic and Manual. This setting has no impact on how the Model 5401A obtains IP addresses for the Dante secondary interface and management interface webpages.

An arrow icon will display in the upper-right corner of this menu page. This indicates that the setting can be changed. If the active method is not the desired one, press the enter pushbutton switch located on the front panel. Use the left and right arrow buttons to select the desired method. Then again press the enter button. The entry will then be stored. To cause the Model 5401A to use a new setting requires that the unit be rebooted (restarted). This can be performed using another front-panel menu page, a selection in one of the management webpages, or by power cycling the unit.

Selecting the Automatic setting causes the Model 5401A's Dante interface to use DHCP or, if DHCP is not available, the IPv4 link-local protocol to establish the IP address used by the Dante primary interface. (An IP address that has the format of 169.254.x.x was assigned using IPv4 link-local.) Even if the IP address was established using link-local the DHCP protocol will remain active. In this case, approximately every 30 seconds the Model 5401A's Dante interface will check for the presence of a DHCP server. If one becomes available then an IP address will be requested and, when obtained, will automatically replace the IP address that was previously established by link-local.

The Manual setting allows the desired Dante primary IP address and related pa-

rameters to be manually entered. This can be useful when a fixed or static addressing scheme has been established. In this way, a designated IP address can be entered along with the other necessary network parameters.

To cause the Model 5401A to use a revised Dante primary IP address configuration method requires that the unit's Dante interface be rebooted (restarted). This can be performed using the reboot Dante front-panel menu page or by rebooting the Model 5401A. This latter action can be accomplished using the reboot system menu page, using a function on one of the management webpages, or by power cycling the Model 5401A.

Note that to minimize the chance of losing access to the Dante network, restoring the Model 5401A's default configuration values will not change the currently selected IP address configuration method.

Dante Primary IP Address

This menu page shows the IP address associated with the Dante primary interface. (This address has nothing to do with the IP addresses utilized by the Dante secondary and management interface ports.) It can be revised only when the manual mode has been selected for the Dante primary IP configuration. When the IP address configuration has been selected for Automatic this field cannot be changed and a lock icon will show in the upper-right corner of the display. If no Ethernet connection has been made the text Link Down will be displayed.

If the network configuration is selected in the Dante Controller application for Switched or Switched+Mgmt then the Dante primary IP address will be associated with a network connection made to either the primary or the secondary RJ45 connections on the Model 5401A's back panel. If the network configuration is selected for Redundant or Redundant+Mgmt then the Dante primary IP address will be associated with the RJ45 connector labeled PRI on the Model 5401A's back panel.

Whenever the IP address configuration is selected for Manual the manual Dante primary IP address can be modified as desired. This will be indicated by a circle with arrows icon that will show in the upper-right corner of the display. To start the process of changing the Dante primary IP address press the enter pushbutton switch on the front panel. An icon with a wrench and screwdriver will display to indicate that an edit is in process. Use the left and right arrow pushbutton switches to select which specific digit of the IP address number is to be modified. Press the up and down arrow pushbuttons to select the desired number. The standard dot-decimal notation is used to display and revise the Dante primary IP address. Once all the desired changes have been made press the enter button to store them.

To cause the Model 5401A to use the new Dante primary IP address setting requires that the unit's Dante interface be rebooted (restarted). This can be performed using the reboot Dante front-panel menu page. Rebooting the entire the Model 5401A can also be utilized to cause a new Dante primary IP address to be used. This can be accomplished using the reboot system menu page, using a function on one of the management webpages, or by power cycling the Model 5401A. Restoring the Model 5401A to its default values will not change a stored Dante primary IP address.

Dante Primary Subnet Mask

This menu page shows the stored subnet mask value associated with the Dante primary interface. (This value has nothing to do with the subnet mask utilized by the Dante secondary or management ports.) It will be utilized only when the manual mode has been selected for the Dante primary IP address configuration. When the IP address configuration has been selected for Automatic this field cannot be changed and a lock icon will show in the upper-right corner of the display.

Whenever the IP address configuration is selected for Manual the subnet mask value can be modified as desired. This will be indicated by a circle with arrows icon that will show in the upper-right corner of the display. To start the process of changing the subnet mask press the enter pushbutton switch on the front panel. An icon with a wrench and screwdriver will display to indicate that an edit is in process. Use the up and down arrow pushbutton switches to select the desired subnet mask number. Once the desired value has been selected press the enter button to store it.

To instruct the Model 5401A to use the new Dante subnet mask value requires that the unit's Dante interface be rebooted (restarted). This can be performed using the reboot Dante front-panel menu page. Rebooting the entire Model 5401A can also be used to cause a new Dante primary subnet mask value to be used. This can be accomplished using the reboot system menu page, using a function on one of the management webpages, or by power cycling the Model 5401A. Restoring the Model 5401A to its default values will not change a stored Dante primary IP address.

Ethernet Switch Configuration

This menu page shows the Model 5401A's network configuration as determined by a setting in the Dante Controller application. The term "switch" refers to an Ethernet switching and routing integrated circuit that is part of the Model 5401A's hardware. How this integrated circuit is configured determines the how the Model 5401A's three Ethernet ports will function. The field will show Switched, Redundant, Switched+Mgmt, or Redundant+Mgmt. It will also display Error in the unlikely event that an error has occurred in the Brooklyn II module that supports the Model 5401A's Dante interface.

Reboot Dante

This menu page allows the Dante interface to be rebooted (restarted). This can be useful to force the Model 5401A's Dante interface to utilize revised Dante primary IP address and related parameter configuration changes. It can also be useful when troubleshooting a Dante network issue. An arrow icon shows in the upper-right corner of the reboot Dante menu. To start the process of rebooting the Dante interface press the enter pushbutton on the unit's front panel. This will lead to a confirmation page being displayed. Use the left and right arrow pushbutton switches to select the desired action. The choices are to cancel or to confirm. Press the enter pushbutton switch to select the highlighted action.

Note that if the Dante interface is rebooted it may take 20 to 60 seconds for the Model 5401A's operation to fully restore. And during this time period the management Ethernet port will also disconnect and then reconnect.

Row Four:

Row four contains six menu pages. Five of the pages provide information about the specific Model 5401A, including its serial number and versions of software that are in use. It also includes a menu page that allows the system to be rebooted (restarted).

Product Name & Serial Number

This menu page shows the name of the product (Model 5401A) and the hardware serial number. The name and serial number, along with three MAC addresses associated with the Ethernet interfaces, are assigned at the factory and cannot be changed.

Main MCU Firmware Version

This menu page shows the version number of the Model 5401A's Main MCU firmware. This firmware can be updated using a USB flash drive. Update details are provided in the Technical Notes section of this guide.

Main FPGA Firmware Version

This menu page shows the version number of the Model 5401A's Main FPGA (field-programmable-gate-array) firmware. This firmware can be updated using a USB flash drive. Update details are provided in the Technical Notes section of this guide.

Sync FPGA Firmware Version

This menu page shows the version number Model 5401A's internal synchronization board FPGA (field-programmable-gate-array) firmware. This firmware can be updated using a USB flash drive. Update details are provided in the Technical Notes section of this guide.

Dante Product Version

This menu page shows the product version number that's stored in and being utilized by the Dante interface. The Model 5401A's Dante interface is implemented using a Brooklyn II module from Audinate. This version number is assigned by Studio Technologies as an identifier when a file is released that combines specific Model 5401A configuration information along with Audinate-developed Dante operating firmware. The firmware for the Model 5401A's Dante interface can be updated by way of an Ethernet connection using the Dante Updater software application that's provided as part of the Dante Controller software application.

Reboot System

This menu page allows the Model 5401A to be rebooted (restarted). This can be useful to force the Model 5401A to utilize all revised management and Dante interface configuration changes. An arrow icon shows in the upper-right corner of the reboot Dante menu. To start the process of rebooting the Model 5401A press the enter pushbutton on the unit's front panel. This will lead to a confirmation page being display. Use the left and right arrow pushbutton switches to select the desired action. The choices are to cancel or to confirm. Press the enter pushbutton switch to select the highlighted action.

Note that if the Dante interface is rebooted it may take 20 to 60 seconds for the Model 5401A's operation to fully restore. During this time period the management Ethernet port will also disconnect and then reconnect.

Screen Saver

To help prevent damage to the Model 5401A's front panel display due to the same image being continually present, a "screen saver" mode will automatically activate two minutes after the last press of a front-panel pushbutton switch. When active, the screen

saver mode will cause a continuous sequence of five menu pages to activate. Each menu page will be present for about three seconds before the next menu page will display.

When the screen saver mode is active pressing the enter pushbutton switch on the front panel will cause it to stop and the current management IP address menu page to immediate display. To cause the screen saver mode to immediately start simultaneously press the left and right arrow pushbutton switches on the front panel.

The five menu pages that will display when the screen saver mode are:

1. The Studio Technologies company logo graphic.
2. The product name (Model 5401A) and the Dante device name (as documented previously).
3. The Dante sync status (as documented previously).
4. The current clock source (as documented previously).
5. The current management IP address (as documented previously).

Technical Notes

PTPv1, PTPv2, and AES67

For clock synchronization “native” Dante utilizes version 1 of the Precision Time Protocol (PTPv1). Technically, the applicable standard is IEEE 1588-2002, which is what the Model 5401A supports for applications that utilize both single and redundant Dante. When operating in the Redundant or Redundant+Mgmt network modes, independent PTPv1 server functionality is supported, one instance provided for the Dante primary Ethernet interface and a second instance provided for the Dante secondary Ethernet interface.

Applications that utilize AES67 require PTP version 2 (PTPv2) as covered under the standard IEEE-1588-2008. (And following details as specified in the SMPTE ST2059-2 profile.) The Model 5401A will provide support for PTPv2 if the AES67 mode has been enabled in the Dante Controller application. This is in addition to PTPv1 support; both can function simultaneously. When AES67 mode has been enabled and Redundant or Redundant+Mgmt mode is selected, then both the Model 5401A’s Dante primary and Dante secondary Ethernet interfaces will provide independent PTPv2 server functionality. (And to highlight, this is in addition to PTPv1 functionality.)

In Dante-related AES67 applications the Model 5401A can provide good PTPv2 functionality. But the Model 5401A can’t serve as a general-purpose PTPv2 grandmaster clock. Limitations in Dante’s AES67 implementation restricts Studio Technologies’ ability to adjust PTPv2 operating parameters, something that some applications may require. Refer to Appendix G, located at the end of this guide, for details on the PTPv2 implementation that the Model 5401A provides.

Dante IP Addresses

If the Model 5401A’s Dante interface has been configured in the Dante Controller application for Switched or Switched+Mgmt operation, by default the Model 5401A’s Dante primary or Dante secondary Ethernet interfaces will attempt to automatically obtain an IP address and associated settings using DHCP (Dynamic Host Configuration Protocol). If a DHCP server is not detected then 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 will connect 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 should correctly acquire IP addresses and be able to communicate with each other. As previously discussed in this guide, using Dante Controller the Model 5401A's Dante Ethernet IP address(es) and related network parameters can also be set for manual (fixed or static) operation.

If the Model 5401A's Dante interface has been configured in Dante Controller for Redundant or Redundant+Mgmt operation then both the Model 5401A's Dante primary and Dante secondary Ethernet interfaces will attempt to automatically obtain IP addresses and associated network settings using DHCP. If DHCP is not available then link-local IP addresses will be assigned. If automatic assignment of IP addresses is not desired each interface can be individually configured using Dante Controller to use a manual (fixed or static) IP address and related network parameters.

The specific IP address assigned to each of the Model 5401A's Dante interfaces can be identified using several methods. The Dante Controller application will directly display the network parameters of the primary and, if utilized, secondary Ethernet interfaces. Another means is to utilize the Model 5401A's network configuration webpage to directly display the IP addresses assigned to the primary and, if utilized, secondary Ethernet ports. The Model 5401A's front-panel menu system can also be selected to display the Dante primary IP address.

Optimizing Dante Network Performance

For best Dante audio-over-IP performance a network that supports VoIP QoS (voice-over-internet-protocol quality of service) capability is recommended. This can typically be implemented on virtually all contemporary managed Ethernet switches. There are even specialized switches that are optimized for entertainment-associated applications. Also, it's recommended that IGMP snooping functionality on Ethernet switch ports associated with Dante devices be disabled. This can be important, allowing Dante-related multicast data traffic, including PTP v1, to be correctly supported. Refer to the Audinate website (audinate.com) for details on how to optimize a network for Dante applications.

Management IP Address and Configuration

It's easy to determine the active IP address being used by the Model 5401A's management Ethernet port. The most direct method is to simply watch the front-panel screens that are active in the "screen saver" mode. This mode will enable automatically two minutes after the last press of any of the front-panel buttons. The front-panel menu system also allows the management IP address to be displayed and, if required, revised. A menu structure diagram is available in Appendix D of this guide. It's also available as a separate document on the Studio Technologies website.

By default, the Model 5401A's management Ethernet interface address configuration is

set for automatic. In this way, it will attempt to automatically obtain an IP address and associated settings using DHCP. If a DHCP server is not detected an IP address will automatically be assigned using the link-local protocol in the IPv4 range of 169.254.0.1 to 169.254.255.254. There are two ways that the management Ethernet IP address and related network parameters can be set to a manual (fixed or static) configuration. The first method uses the front panel display and buttons to allow the management Ethernet network parameters to be viewed and revised as desired. An even easier method might be to use the network configuration webpage that is provided as part of the Model 5401A's management webpages.

Model 5401A Firmware Update Procedure

It's possible that updated versions of the three firmware (embedded software) files that are utilized by the Model 5401A's MCU (microcontroller) and two FPGA (field-programmable-gate-array) integrated circuits will be released to add features or correct issues. Refer to the Studio Technologies' website for the latest firmware files. The Model 5401A has the ability to load applicable firmware files into non-volatile memory by way of a standard USB flash drive. The Model 5401A implements a USB host function and provides access by way of a type A receptacle located on the back panel. The Model 5401A updates its firmware using three files. The Main MCU firmware is named **M5401A.bin**, the Main FPGA firmware is named **DSMC.bit**, and the Sync FPGA firmware is named **CLOK.bit**.

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. One, two, or all three of the firmware files can be automatically loaded at essentially the same time. On the flash drive's root folder, save the desired new firmware files ensuring that the required names are specified. The file name for the Main MCU firmware must be **M5401A.bin**. The file name for the Main FPGA firmware must be **DSMC.bit**. And the file name for the Sync FPGA firmware must be **CLOK.bit**. Be certain to use the eject command to ensure that the file is correctly stored on the USB flash drive. Studio Technologies will supply each firmware file inside a .zip archive file. While the firmware file inside of the zip file will adhere to the naming convention required by the Model 5401A, the name of the zip file itself will include the file's version number. For example, a zip file named **M5401Av1r02MCU.zip** would indicate that version 1.02 of the Main MCU firmware (**M5401A.bin**) is contained within this zip file.

Once the prepared USB flash drive is inserted into the USB receptacle, located on the Model 5401A's back panel, the Model 5401A must be powered off and then powered on again. At this point the file(s) stored on the USB flash drive will automatically load. The precise steps required will be highlighted in the following paragraphs.

To install one, two, or all three of the firmware files follow these steps:

1. Remove power from the Model 5401A. This will entail removing the AC mains power connector or removing the connector associated with the external source of nominal 12 volts DC. (Both must be disconnected if dual powering has been implemented.)

2. Locate the USB receptacle on the Model 5401A's back panel. It is labeled Firmware Update. Directly adjacent to the USB receptacle is a small hole that provides visual access to a green LED indicator.
3. Insert the prepared USB flash drive into the USB receptacle.
4. Apply power to the Model 5401A. Power can be provided by connecting AC mains or a source of nominal 12 volts DC.
5. After a few seconds the Model 5401A will run a "boot loader" program that will automatically load and save the new firmware file(s) that are present on the USB flash drive. The update process can range from approximately 10 seconds to approximately 60 seconds, depending on which of the three files are going to be updated. While files are being loaded the green LED, located adjacent to the USB receptacle, will flash slowly. Once the entire loading process has completed the Model 5401A will reboot (restart) using the newly saved firmware.
6. At this time the Model 5401A is functioning with the newly loaded firmware and the USB flash drive can be removed.
7. It's a good idea to confirm that the desired Model 5401A's Main MCU, Main FPGA, and Sync FPGA firmware versions are loaded and operating as expected. There are two methods for observing the Model 5401A's firmware version numbers. The most direct is to use the front-panel display. Alternately, the System webpage from the management webpages can be utilized.

Note that no harm will occur if power is applied to the Model 5401A that has a USB flash drive connected that doesn't have relevant files in its root folder. Upon power up the green LED, located adjacent to the USB receptacle, will flash on and off rapidly for a few seconds to indicate that a valid file has not been found. After this warning, normal operation using the unit's existing firmware will begin.

Dante Firmware Update

As previously discussed in this guide, the Model 5401A implements Dante connectivity using the Brooklyn II module from Audinate. The Dante Controller software application can be used to determine the version of the firmware (embedded software) that resides in the Brooklyn II module. The System webpage provided by the Model 5401A's management webserver can also be used to identify the firmware version.

The firmware (embedded software) residing in the Brooklyn II module can be updated using the Model 5401A's Dante primary 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 software application. The Dante Controller application is available, free of charge, from the Audinate website (audinate.com).

The latest Model 5401A firmware file, with an extension of .dnt, is available on the Studio Technologies' website as well 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 5401A's Dante interface.

Restoring Model 5401A's Default Configuration Values

A command in the System Information webpage provided by the Model 5401A's management webserver allows most of the

configuration settings to be restored to their default configuration values. This can be useful but must be used with caution. Any customization made to the Model 5401As configuration will be lost. This can be offset in a positive way by returning the Model 5401A to a known configuration, a point that might aid in troubleshooting an issue. Refer to Appendix F for a list of the default values.

Lost User Name and/or Password

As is covered in detail in other sections of this guide, gaining access to the Model 5401A's configuration menu webpages requires entering the correct user name and password. If the default entries, both of which are **guest**, are stored for use then they will display on the Login menu webpage. Pressing the Log In button on that webpage will then access the Main configuration webpage. If either or both the user name and the password have been configured to be something other than **guest** (the default) then nothing will show in the fields associated with the login menu webpage.

If knowledge of the stored user name and/or password is "lost" then the Model 5401A includes a "back door" to allow access. But as a security measure physical access to the unit is required to utilize that access method; there is no means to access the unit via an Ethernet port without knowledge of the user name and password. The exact process of accessing the Model 5401A's configuration webpages without knowledge of the user name and/or password is detailed in Appendix H, located at the end of this guide.

Specifications

Applications:
High-performance Leader clock for Dante audio-over-IP applications. Also supports AES67-2018 applications. In addition, provides audio reference signals (tones) on Dante transmitter (output) channels for general-purpose use and a precision word clock synchronization output.

Precision Time Protocol (PTP) Support: IEEE 1588-2002 Version 1 (v1) for Dante; IEEE 1588-2008 Version 2 (v2) for AES67-2018

Timing Reference:
Source: internal time base, external sync input, or via an existing Dante network, selectable

Internal Time Base:
Type: 24.576 MHz temperature-stabilized crystal oscillator

Initial Accuracy: 1 ppm (parts-per-million)

Long-Term Accuracy: 1 ppm (parts-per-million) per year

Temperature Stability: ±280 ppb (parts-per-billion), 0-50 degrees C

Sync Input:
Compatible Sources: word clock, bi-level video, tri-level video, 10 MHz

Termination: 50 ohms (10 MHz), 75 ohms (word clock or video), or high Z (unterminated), selectable

Word Clock Compatibility: square wave, 5 Vpp nominal unloaded, 44.1, 48, 88.2, or 96 kHz

Video Signal Compatibility: bi- or tri-level, 1 Vpp nominal into 75 ohm load

10 MHz Signal Compatibility: sine wave, 3 Vpp nominal into 50 ohm load

Word Clock Output:
Type: square wave

Rate: 44.1, 48, 88.2, or 96 kHz, selectable

Source Impedance: 75 ohms

Amplitude: 5 Vpp, unterminated; 2.5 Vpp, externally terminated with 75 ohms

Jitter: 0.01 UI (using internal oscillator)

Network Audio Technology:
Type: Dante audio-over-IP

AES67-2018 Support: yes

Dante Domain Manager™ (DDM) Support: yes

Ethernet Interface Configuration: Switched, Redundant, Switched+Mgmt, or Redundant+Mgmt, selectable

Clock Source: follows overall Model 5401A configuration

Sample Rate: 44.1, 48, 88.2, or 96 kHz, selectable

Bit Depth: 24

Number of Dante Transmitter (Output) Channels: 8

Number of Dante Flows: 32 transmitter

Audio Reference Signals:
Type: continuous sine-wave signals on Dante transmitter (output) channels

Number of Channels: 8

Frequency: 1 Hz to 22 kHz, individually configurable in 1-Hz steps

Amplitude: 0 to –99 dBFS, individually configurable in 1-dB steps

Distortion (THD+N): <0.0001% (<–121 dB), measured at 1 kHz, –1 dBFS

Network Interfaces:
Qty: 3, Dante Primary, Dante Secondary, and Management

Type: 1000BASE-T, Gigabit Ethernet (GigE) per IEEE 802.3ab (100 Mb/s supported but not recommended for optimal performance; 10 Mb/s not supported)

Ethernet Connection NIC Status LEDs: one link and one activity for each Ethernet interface

Front-Panel Display: backlit LCD

Front-Panel LEDs: 8, dual-color
Functions: provides indication of condition of incoming AC and DC power, status of three Ethernet interfaces, status of Dante connectivity, and status of sync input

Software Updating: USB flash drive supports updating of Main MCU, Main FPGA, and Sync FPGA firmware (embedded software); Dante interface updated via Ethernet interface

Power Sources:
AC Mains: 100 to 240 V, 50/60 Hz, 5 W maximum

DC: 10 to 18 V, 0.5 A max: 110 uA maximum with 12 volts DC and AC mains present, 190 uA maximum with 18 volts DC and AC mains present

Connectors:

Sync Input, Word Clock Output: BNC receptacle, per IEC 61169-8 Annex A

Ethernet: 3, RJ45 receptacle

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

DC Input: 4-pin male XLR (pin 1 negative, pin 4 positive)

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

Environmental:

Operating Temperature: 0 to 50 degrees C (32 to 122 degrees F)

Storage Temperature: –40 to 70 degrees C (–40 to 158 degrees F)

Humidity: 5 to 95%, non-condensing

Altitude: not characterized

Dimensions (Overall):

19.00 inches wide (48.3 cm)

1.72 inches high (4.4 cm)

7.9 inches deep (20.1 cm)

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

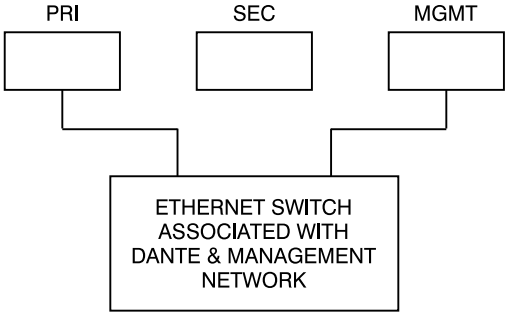
Weight: 3.0 pounds (1.4 kg)

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

Appendix A–Network Configuration Examples

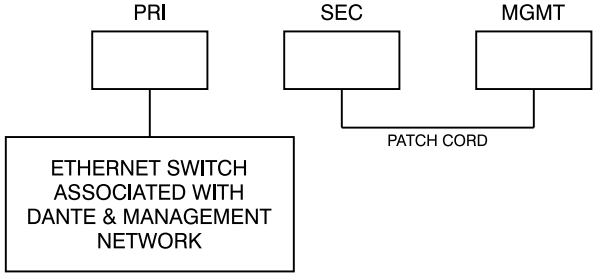
ONE LAN – SWITCHED DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR SWITCHED OPERATION



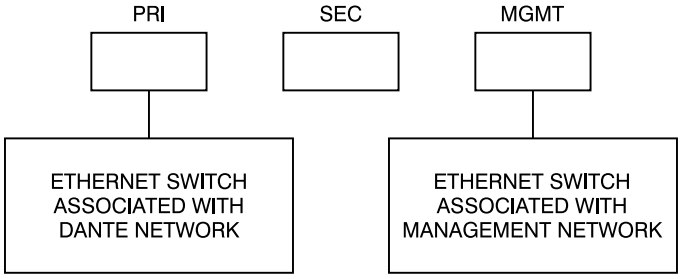
ONE LAN – SWITCHED DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR SWITCHED OPERATION



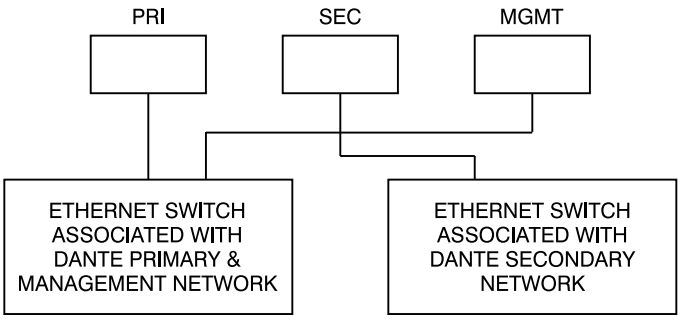
TWO LANs – SWITCHED DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR SWITCHED OPERATION



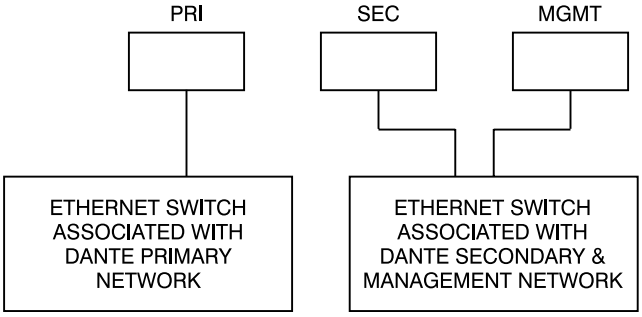
TWO LANs – REDUNDANT DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR REDUNDANT OPERATION



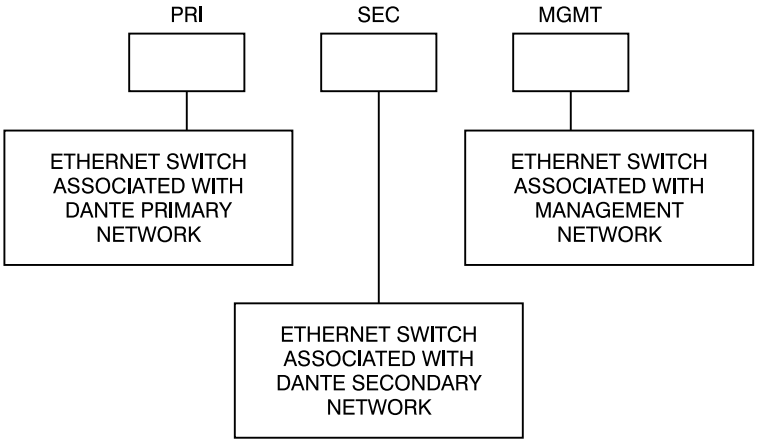
TWO LANs – REDUNDANT DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR REDUNDANT OPERATION



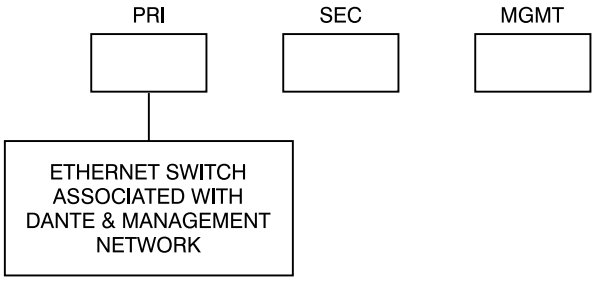
THREE LANs – REDUNDANT DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR REDUNDANT OPERATION



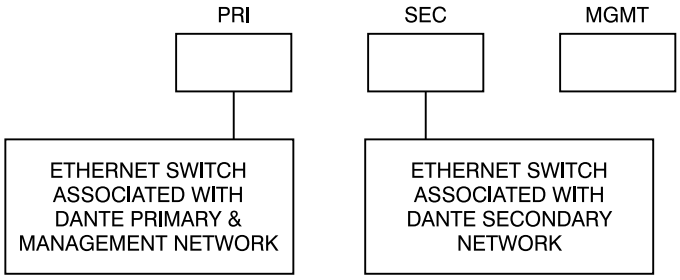
ONE LAN – SWITCHED+MANAGEMENT DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR SWITCHED+MANAGEMENT OPERATION



TWO LANs – REDUNDANT+MANAGEMENT DANTE

MODEL 5401A NETWORK INTERFACE
CONFIGURED FOR REDUNDANT+MANAGEMENT OPERATION



Appendix B–Sync Input Sources

The Model 5401A's sync input has been tested and confirmed for correct operation with the following sync signals:

Word Clock: Square wave signal with rate of 44.1, 48, 88.2, or 96 kHz

10 MHz: Sine wave signal with an amplitude of 1 Vrms, nominal, terminated with 50 ohms

Bi-Level and Tri-Level Video: See table below

Video Format
NTSC ("Black Burst")
PAL ("Black Burst")
720p/50 Hz
720p/59.94 Hz
720p/60 Hz
1080psf/23.98 Hz
1080psf/24 Hz
1080i/50 Hz
1080i/59.94 Hz
1080i/60 Hz
1080p/23.98 Hz
1080p/24 Hz
1080p/25 Hz
1080p/29.97 Hz
1080p/30 Hz
1080p/50 Hz
1080p/59.94 Hz
1080p/60 Hz

Appendix C–Dante Controller Network Default Configuration Values

Dante Interface Default Values:

Device Config, Sample Rate: 48 k

Device Config, Clocking, Unicast Delay Requests: Disabled

Device Config, Device Latency: Latency: 1.0 msec

Network Config, Switch Configuration, Current: Switched

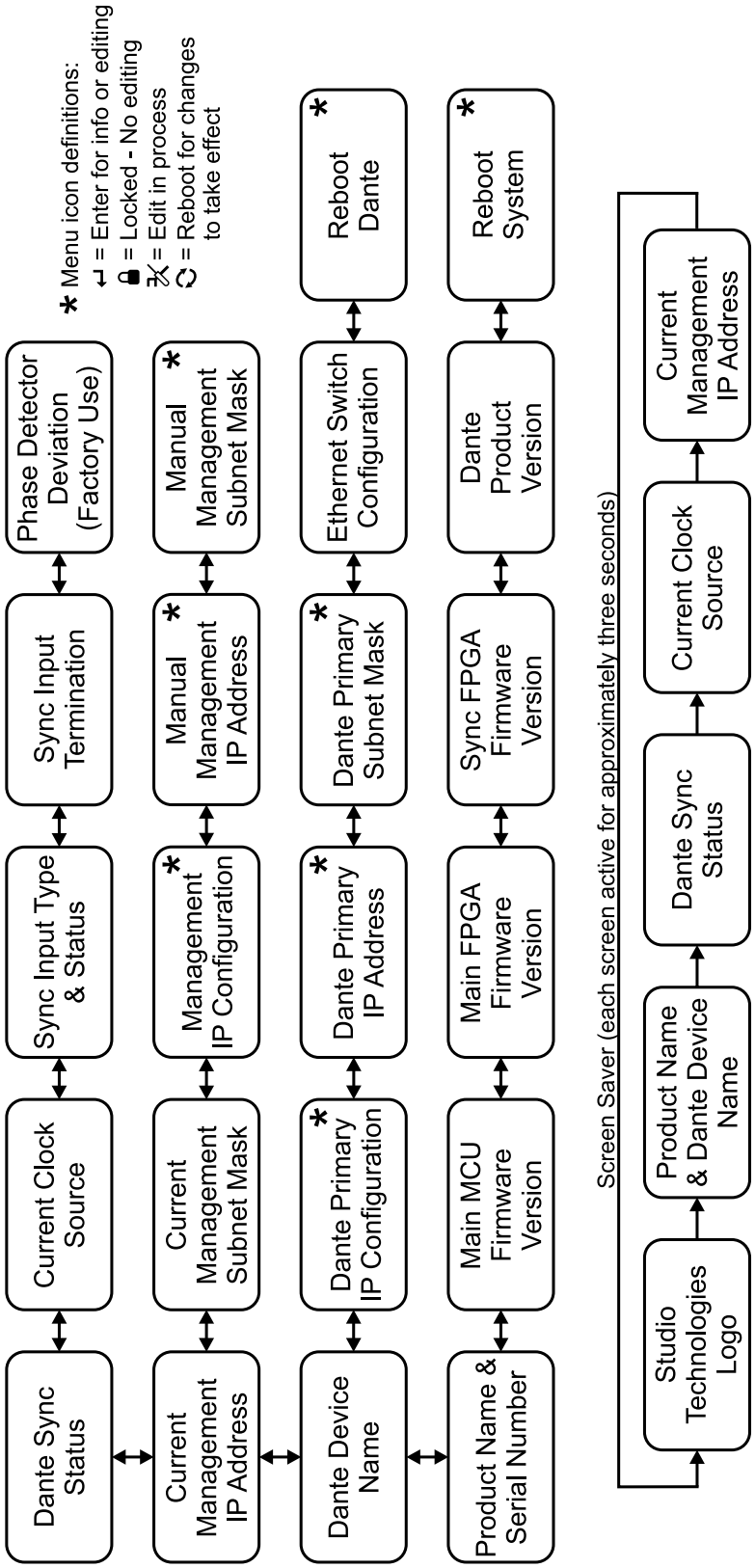
Network Config, Addresses: Obtain an IP Address Automatically (default)

AES67 Config, AES67 Mode, Current: Disabled

Leader Clock, Preferred Leader: Enabled

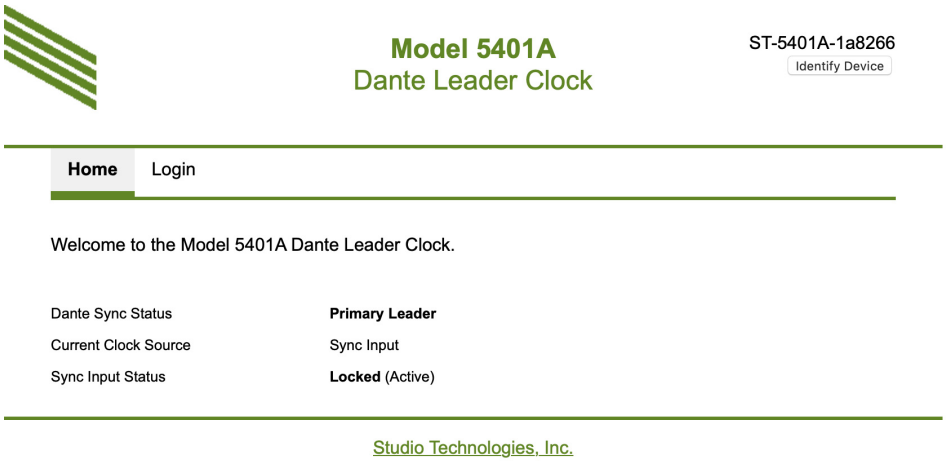
Leader Clock, Enable Sync to External: Enabled

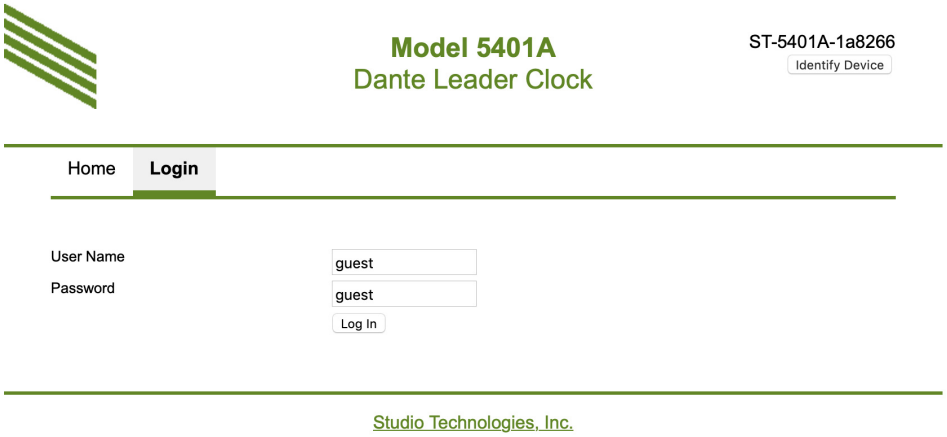
Appendix D–Menu Structure

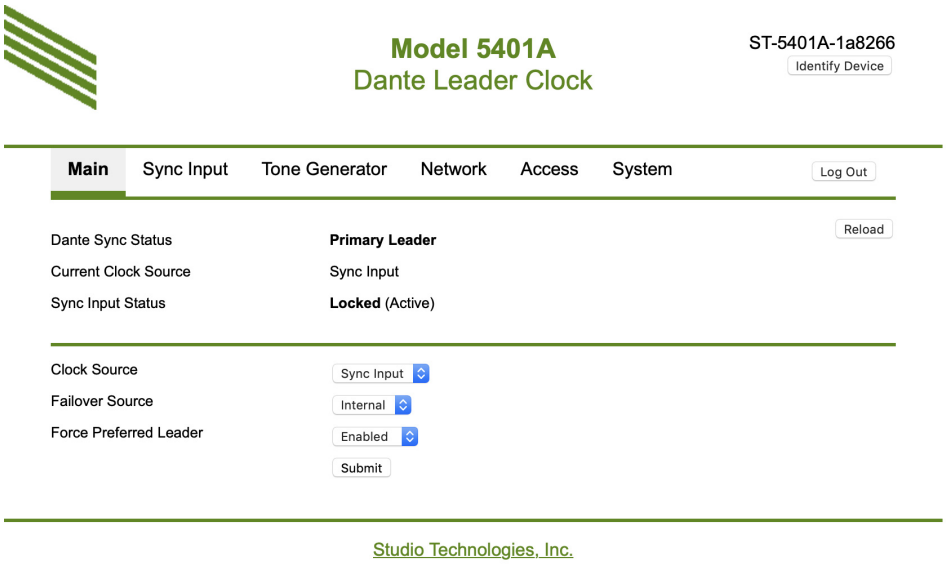


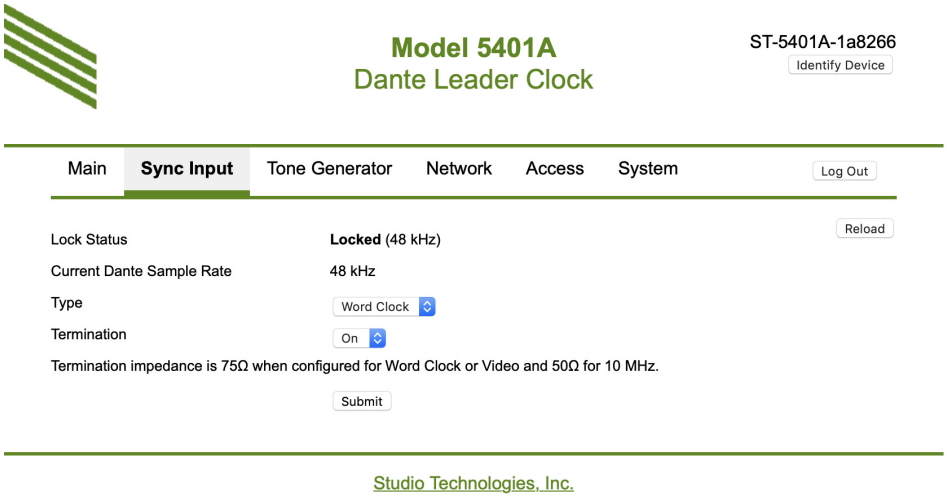
1. Screen saver automatically activates two minutes after last button press.
2. Press left and right buttons simultaneously to immediately enter screen saver mode.
3. Pressing Enter while screen saver is active goes directly to Current Management IP Address page.
4. This reflects operation for Model 5401A Main MCU firmware version 1.02 and later.

Appendix E–Screen Captures






Model 5401A
Dante Leader Clock
ST-5401A-1a8266
Identify Device
Main
Sync Input
Tone Generator
Network
Access
System
Log Out
Reload
Dante Sync Status
Primary Leader
Current Clock Source
Sync Input
Sync Input Status
Locked (Active)
Clock Source
Sync Input
Failover Source
Internal
Force Preferred Leader
Enabled
Submit
Studio Technologies, Inc.


Model 5401A
Dante Leader Clock
ST-5401A-1a8266
Identify Device
Main
Sync Input
Tone Generator
Network
Access
System
Log Out
Reload
Lock Status
Locked (48 kHz)
Current Dante Sample Rate
48 kHz
Type
Word Clock
Termination
On
Termination impedance is 75Ω when configured for Word Clock or Video and 50Ω for 10 MHz.
Submit
Studio Technologies, Inc.

Model 5401A
Dante Leader Clock

ST-5401A-1a8266
Identify Device

Main | Sync Input | **Tone Generator** | Network | Access | System | Log Out

Channel	Frequency (Hz)	Level (dBFS)
Tone 1	100	-21
Tone 2	200	-22
Tone 3	300	-23
Tone 4	400	-24
Tone 5	500	-25
Tone 6	600	-26
Tone 7	700	-27
Tone 8	800	-28

Frequency range is 1 to 22000 Hz. Level range is -99 to 0 dBFS. Submit

Studio Technologies, Inc.

Model 5401A
Dante Leader Clock

ST-5401A-1a8266
Identify Device

Main | Sync Input | Tone Generator | **Network** | Access | System | Log Out

Dante Interfaces

Primary IP Address	192.168.1.245
Secondary IP Address	Disabled
Switch Configuration	Switched

Management Interface

MAC Address	00-04-22-F2-00-02
Current IP Address	192.168.1.236
Current Subnet Mask	255.255.255.0
Current Gateway	192.168.1.1
IP Address Configuration	Automatic
Manual IP Address	192.168.1.54
Manual Subnet Mask	255.255.255.0
Manual Gateway	192.168.1.1

System must be rebooted for changes to take effect. Submit

Studio Technologies, Inc.

Model 5401A
Dante Leader Clock

ST-5401A-1a8266
Identify Device

Main | Sync Input | Tone Generator | Network | **Access** | System | Log Out

Management Login Credentials

User Name	guest
New Password	
Confirm New Password	

Submit

Studio Technologies, Inc.

Model 5401A
Dante Leader Clock

ST-5401A-1a8266
Identify Device

Main | Sync Input | Tone Generator | Network | Access | **System** | Log Out

Serial Number 00002

Version Information	Version	Date
Main MCU Firmware	1.02	10 Feb 2021
Main FPGA Firmware	1.03	06 Jul 2020
Sync FPGA Firmware	1.01	27 Apr 2020
Dante Product	1.0.2	11 Jan 2021
Dante Firmware	4.2.0.28	---

Restore Default Settings ☐

Submit

System Reboot ☐

Reboot

Studio Technologies, Inc.

Appendix F–Model 5401A's Default Configuration Values

Main Menu:
Clock Source: Internal
Failover Source: Dante
Force Preferred Leader: Enabled

Sync Input Menu:
Type: Word Clock
Termination: On

Tone Generator Menu:
Tone 1: Frequency 100 Hz, Level –21 dBFS
Tone 2: Frequency 200 Hz, Level –22 dBFS
Tone 3: Frequency 300 Hz, Level –23 dBFS
Tone 4: Frequency 400 Hz, Level –24 dBFS
Tone 5: Frequency 500 Hz, Level –25 dBFS
Tone 6: Frequency 600 Hz, Level –26 dBFS
Tone 7: Frequency 700 Hz, Level –27 dBFS
Tone 8: Frequency 800 Hz, Level –28 dBFS

Network Menu, Management Interface:
IP Address Configuration: Automatic
Manual IP Address: 192.168.1.26
Manual Subnet Mask: 255.255.255.0
Manual Gateway: 192.168.1.1
(Note: Using the Restore Default Settings command in the System menu does not restore these items to their default configuration values.)

Access Menu, Management Login Credentials:
User Name: guest
Password: guest
(Note: Using the Restore Default Settings command in the System menu does not restore these items to their default configuration values.)

Appendix G–PTP v2 (IEEE-1588-2008) Characteristics

Note: For Model 5401A PTP v2 support to be active AES67 Compatibility check box must be enabled in Dante Controller software application.

Domain: 0

Priority 1: 114

Clock Class: 248

Accuracy: Unknown (0xFE)

Variance: 61536

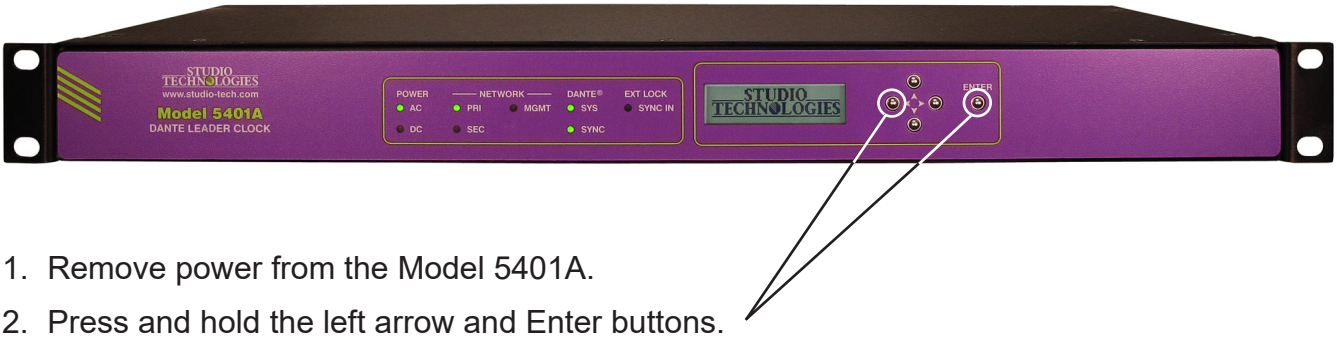
Priority 2: 112

Unique ID: 00:1D:C1:XX:XX:XX

DSCP: EF (46)

Appendix H–Accessing the Unit when the User Name and/or Password is Not Known

Follow this procedure to access the Configuration menu webpages if the user name and/or password is not known.



1. Remove power from the Model 5401A.
2. Press and hold the left arrow and Enter buttons.
3. While continuing to hold the two buttons apply AC Mains or 12 volts DC power.
4. Continue to hold the two buttons and allow the Model 5401A to start. The Status LEDs on the front panel will first light green then light red in their start-up sequence.
5. Once the Status LEDs have completed their start-up sequence release the two buttons.
6. Use a web browser to access the Model 5401A's Configuration menu webpages. The management port's IP address to use is shown in the current management IP address page on the front-panel display. Pressing the Enter button will cause the current management IP address page to immediately show on the front-panel display.
7. From the Home webpage select the Login webpage tab. Leave the User Name and Password fields empty and click the Log In button. This will allow access to the Configuration menu selections. At this point your web browser should display the Model 5401A's Home webpage.
8. Navigate to the Access menu. From this webpage you will be able to view the stored user name. You will not be able to view the previously saved password. Enter and confirm a new password. Henceforth, to access the Model 5401A's Configuration menu will require the use of the stored user name and password.