

# **Model 391**

## **Dante Alerting Unit**

### **User Guide**

Issue 5, February 2026

This User Guide is applicable for serial numbers:

M391-00151 and later with  
Application Firmware (.stm) version 2.3 and later  
STController version 4.05.01 (Windows) and later and  
STController version 4.05.01 (MacOS) and later

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## Revision History

### **Issue 5, February 2026:**

- Documents addition of Minimum On Time configuration for Audible Alert.

### **Issue 4, December 2022:**

- Added STcontroller screenshot.

### **Issue 3, December 2021:**

- Documents addition of UDP command support.

### **Issue 2, December 2018:**

- Documents new feature which allows simultaneous call detection on channels 1 and 2.
- Documents expanded frequency detection range for call signals. (Was 20 kHz, now 18-23 kHz nominal.)

### **Issue 1, May 2018:**

- Initial release.

## Introduction

The Model 391 Dante® Alerting Unit builds on the limited capabilities of the “beacon” or “strobe” devices that are ubiquitous with analog party-line (PL) intercom systems and adds a broad range of new and enhanced features. The Model 391 responds to audio “call” signals that are present in the unit’s Dante audio input channels. With an 18-23 kHz detection range, it will detect tone call signals that are commonly utilized in both legacy analog and modern digital PL intercom circuits. It can also respond to UDP commands supplied via Ethernet.

Upon detecting a tone call signal the Model 391 can provide a visual indicator, enable an audio sounder output, and even activate an analog line output. Each of the Model 391’s alerting resources can be individually optimized to meet the unique requirements of many applications. The STcontroller personal computer application is used to select from a wide range of operating choices. The compact, portable unit is compatible with Dante audio-over-Ethernet installations and requires only an Ethernet connection with Power-over-Ethernet (PoE) capabilities for operation. Typically, applications will find the Model 391 applicable for use in theater, sports, and broadcast facilities.

The Model 391 is directly compatible with the call signals generated by the popular Studio Technologies’ Dante-enabled beltpacks and intercom stations. These Dante-connected user devices generate 20 kHz tones whenever their call button is pressed. Model 391 applications can also employ the Studio Technologies’ Model 545DC or Model 545DR Intercom Interface units to provide compatibility with

legacy analog PL intercom systems. The Model 545DC is compatible with Clear-Com® PL circuits that use a DC voltage to indicate call activity. The Model 545DR supports the TW-series PL intercom circuits from RTS® which directly use 20 kHz tones for call activity. Both interfaces will convert the associated analog PL circuit’s audio and call signals to Dante digital audio. Once in the Dante “world” the call signals and user audio is compatible with the Model 391 Dante Alerting Unit as well as user beltpacks such as the Model 370A, Model 371A, and Model 374A. In addition, the Models 348 and 5304 Intercom Stations can send and receive compatible call signals.

## Applications

The most-typical application for the Model 391 is to alert users that a call signal on an intercom channel is active. Some technicians and engineers associated with theater, entertainment, and corporate events won’t always stay “on headset” and may need to be alerted when their presence on the production’s intercom system is needed. As an example, a front-of-house audio mixer could find value by placing a Model 391 unit on their audio console or associated equipment rack. They would then be able to quickly respond to an intercom call request while not having to continuously wear a headset that would interfere with their normal work.

The Model 391 can also be used as a general-purpose status indicator for various live-event applications. Instead of responding to intercom call signals, the STcontroller application can be used to select the real-time action of the visual indicator, audio sounder, and line output. For example, a Model 391 placed in



**Figure 1. Model 391 Dante Alerting Unit front and back views**

a theater's "green room" could provide a visual "quiet on the set" indication.

This might be useful to provide an on-air or program audio feed to inputs on various pieces of audio equipment. The line output can also be configured to be active only when a call signal is present. This could serve as a paging output or allow an audio call function to be implemented.

In addition to responding to intercom beltpack call requests, the Model 391 can also be used in many other applications. These include allowing one of the contact closure inputs on a Studio Technologies' Model 544D Interface to trigger the alerting functions on a Model 391. Being Dante networked audio devices, the units will function together as long as they are located on same network, whether the devices are in the same room or on the opposite sides of a university campus. The Model 391's analog line output offers a unique resource. It can be configured as an always-active output that follows one of the audio inputs associated with the Model 391. Additionally, signals generated by other products, such as the Studio Technologies' Models 214A and 215A Announcer's Consoles, will allow the Model 391 to serve as a broadcast "on-air" indicator.

## Features

For visual alerting the Model 391 incorporates a trapezoidal-prism-shaped polycarbonate lens with multiple red/green/blue (RGB) LEDs. The unit is typically placed on an audio console, lighting board, or on top of an equipment rack. The visual indicator provides a highly visible 360-degree viewing field. Configuration choices allow selection of the exact color, intensity, and lighting cadence. Another selection determines what action will cause the LEDs to activate. It can respond to a call signal or can remain enabled as a status indication. This allows the Model 391 to be used in a variety of alerting applications, ranging from a request to join an intercom conversation to providing a "rehearsal in progress" or "closed set" indication.

A configuration choice allows call signals to be simultaneously detected on audio input channels 1 and 2. Unique colors will be displayed in response to a call signal on channel 1 versus a call signal on channel 2.

The Model 391 includes an audio sounder whose output will "cut through" ambient audio to gain the attention of nearby personnel. The character of the sounder was selected to be effective at gaining attention rather than being pleasant. The overall level range of the sounder can be configured while the precise value can be set by the user by way of a rotary potentiometer. The action of the sounder can be configured from among multiple choices, including continuous, beep, and pulse. A delay can also be selected so that the visual indicator can activate first while the sounder will enable only after the selected period of time has elapsed. This could help prevent users from being annoyed by the sounder if they are able to quickly respond to the visual alert.

A unique Model 391 feature is the line output. Interfaced using a standard 3-pin XLR audio connector, the balanced analog line-level output signal is compatible with inputs on devices such as audio consoles and amplified speakers. A configuration choice allows the on/off status of the line output to be selected. One choice designates that the line output be active only when a call signal is received. This allows voice signals to be provided to users simultaneously with visual and sounder activation. The line output can also be configured to be continuously active, acting as a general-purpose analog output signal from either of the two Dante input channels.

The Model 391 provides two operating modes, each with a fully independent operating configuration. A pushbutton switch and two associated LED indicators on the Model 391's front panel allows observation and selection of the desired operating mode. By allowing two independent configurations the Model 391 can offer two unique sets of application-specific alerting conditions. As an example, Mode 1 might be considered a "rehearsal" mode where both a bright visual indicator and a loud sounder output are desired whenever a call signal is received. Mode 2 could be configured as a "performance" mode and enabled whenever an event is actively taking place. The configuration for this mode might have the audio sounder disabled and the intensity, color, and action of the visual indicator selected to be unobtrusive.

## Dante Audio-over-Ethernet

Audio and related data is sent to the Model 391 using the Dante audio-over-Ethernet media networking

technology. As a Dante-compliant device, the Model 391's two input (Dante receiver) audio channels can be assigned (routed) from source devices using the Dante Controller software application. The Model 391 is compatible with Dante digital audio sources that have a sampling rate of 48 kHz and a bit depth of up to 24. Two bi-color LEDs provide an indication of the Dante connection status.

## Ethernet Data and PoE

The Model 391 connects to an Ethernet data network using a standard 100 Mb/s twisted-pair Ethernet interface. The physical interconnection is made by way of a Neutrik® etherCON® RJ45 connector. While compatible with standard RJ45 plugs, etherCON allows a ruggedized and locking interconnection for harsh or high-reliability environments. An LED displays the status of the network connection.

The Model 391's operating power is provided by way of the Ethernet interface using the 802.3af Power-over-Ethernet (PoE) standard. This allows fast and efficient interconnection with an associated data network. To support PoE power management, the Model 391's PoE interface reports to the power sourcing equipment (PSE) that it's a class 1 (very low power) device. If a PoE-enabled Ethernet port can't be provided by the associated Ethernet switch a low-cost PoE midspan power injector can be utilized.

## Setup, Configuration, and Operation

Setup, configuration, and operation of the Model 391 is simple. An etherCON RJ45 jack is used to interconnect the network interface with a standard twisted-pair Ethernet cable associated with a port on a PoE-enabled network switch. This connection provides both network data and power. A 3-conductor XLR connector provides access to the analog, electronically balanced line output. The Dante Controller personal computer application is used to route ("subscribe") one or two audio sources to the Model 391's inputs.

All Model 391 features are configured using the STcontroller personal computer software application. An extensive set of parameters allows the unit's operation to be tailored to meet the needs of many applications. STcontroller, compatible with version 7 and later of the Windows® operating system, is a fast and simple means of confirming and revising the unit's operating parameters.

A pushbutton switch is used to select the operating mode. A rotary potentiometer ("pot") makes it easy for the user to set the level of the audio sounder. Three status LEDs provide a clear indication of the unit's operating mode and alerting status. The Model 391's compact enclosure is made from steel, whose mass helps to keep it stable at whatever location it is deployed.

## Future Capabilities and Firmware Updating

The Model 391 was designed so that its capabilities and performance can be enhanced in the future. A USB connector, located on the unit's main circuit board (underneath the unit's cover), allows the application firmware (embedded software) to be updated using a USB flash drive.

To implement the Dante interface the Model 391 uses Audinate's Ultimo™ integrated circuit. The firmware in this integrated circuit can be updated via the Ethernet connection, helping to ensure that its capabilities remain up to date.

## Getting Started

### What's Included

Included in the shipping carton are a Model 391 Dante Alerting Unit and a printed copy of this guide. As a device that is Power-over-Ethernet (PoE) powered, no external power source is provided. In most applications an Ethernet switch with PoE capability will be utilized. If that's not available a PoE midspan power injector can be used.

## Connections

Signal interconnections will be made using the two connectors located on the back of the Model 391's enclosure. An Ethernet data connection with Power-over-Ethernet (PoE) capability will be made using either a standard RJ45 patch cable or an etherCON protected RJ45 plug. If desired, the Model 391's analog line-level output may be interfaced with other equipment using a cable terminated with a standard 3-pin female XLR connector.

### Ethernet Connection with PoE

A 100BASE-TX Ethernet connection that supports Power-over-Ethernet (PoE) is required for Model 391 operation. This one connection will provide both the

Ethernet data interface and power for the Model 391's circuitry. A 10BASE-T connection is not sufficient and a 1000BASE-T (GigE) connection is not supported unless it can automatically "fall back" to 100BASE-TX operation. The Model 391 supports Ethernet switch power management, enumerating itself as a PoE class 1 device.

The Ethernet connection is made by way of a Neutrik etherCON protected RJ45 connector that is located on the back of the Model 391's enclosure. This allows connection by way of a cable-mounted etherCON connector or a standard RJ45 plug. The Model 391's Ethernet interface supports auto MDI/MDI-X so that a "cross-over" or "reversing" cable will never be required.

### **Ethernet Connection without PoE**

As previously discussed, the Model 391 was designed such that the Ethernet connection will provide both data and Power-over-Ethernet (PoE) power. There may be situations where the associated Ethernet switch does not provide PoE power. In such cases, an external PoE midspan power injector can be used. If the selected midspan power injector is 802.3af-compatible, it should function correctly. Midspan units are available from a variety of sources, including many online retailers.

### **Line Output**

A cable-mounted 3-pin female XLR connector is used to interface with the Model 391's line-level analog output. The electronically balanced output has a nominal level of 0 dBu with significant headroom. It allows connection to a variety of amplified speakers, audio consoles, wired or wireless IFB systems, etc.

## **Dante Configuration**

For call signaling tones and audio signals to pass to the Model 391, several Dante-related parameters must be configured. These configuration settings will be stored in non-volatile memory within the Model 391's circuitry. Configuration will typically be done with the Dante Controller software application which is available for download free of charge at [audinate.com](http://audinate.com). Versions of Dante Controller are available to support Windows and OS X® operating systems. The Model 391 uses the Ultimo integrated circuit to implement the Dante architecture. The Model 391 can also be configured to meet the requirements of

the AES67 standard. This requires a setting to be enabled within the Device Info section of the Dante Controller application.

Audio from one or two Dante transmitter (Tx) channels can be routed to the Model 391's two Dante receiver (Rx) channels. (The Model 391 does not have any Dante transmitter (output) channels.) The transmitter channel(s) on associated equipment are used to supply the Model 391 with the call signaling tones and, if applicable, the audio signals to be sent to the unit's line output. Some applications will need only one audio source to be routed to the Model 391 while others may utilize both.

The Model 391 supports an audio sample rate of 48 kHz with no pull-up/pull-down values available. While technically the Model 391 can serve as a Leader Clock for a Dante network (as can all Dante-enabled devices), in virtually all cases the unit will be configured to receive "sync" from another device.

The Model 391 has a default Dante device name of **ST-M391** along with a unique suffix. The suffix identifies the specific Model 391 that is being configured. The suffix's actual alpha and/or numeric characters relate to the MAC address of the unit's Ultimo integrated circuit. The two Dante receiver (Rx) audio input channels have default names of **Ch1** and **Ch2**. Using Dante Controller the default device name and channel labels can be revised as appropriate for the specific application.

## **Model 391 Configuration**

The STController software application is used to configure the way in which the Model 391 functions. No DIP switch settings or other local actions are used to configure the unit. This makes it imperative that STController be available for convenient use in a personal computer that's connected to the related LAN.

STController is available, free of charge, on the Studio Technologies' website ([studio-tech.com/stcontroller](http://studio-tech.com/stcontroller)). Versions compatible with personal computers running Windows and Mac operating systems are available. If required, download and install STController onto a designated personal computer. This personal computer must be on the same local area network (LAN) and subnet as the Model 391 unit or units that are to be configured.

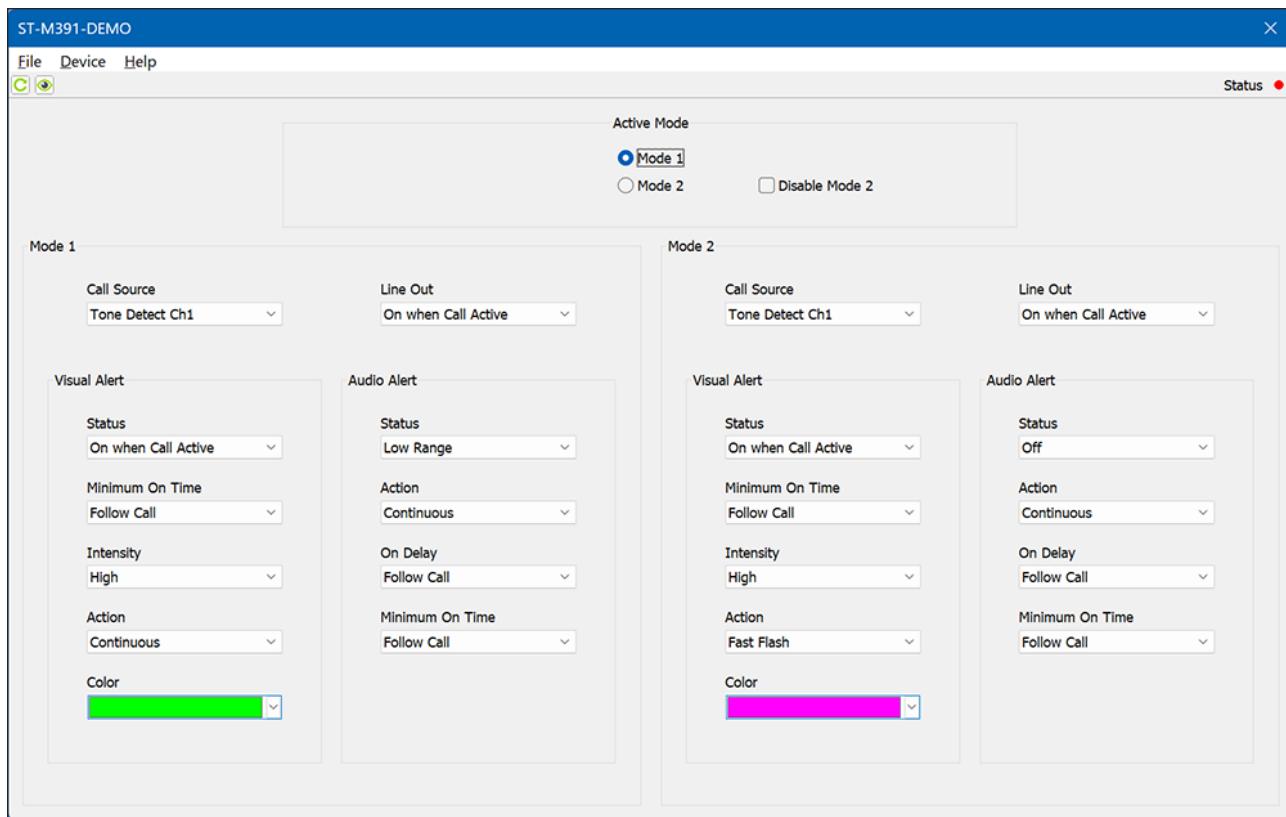
STcontroller allows observation and selection of whether Mode 1 or Mode 2 is active. Another selection allows access to Mode 2 to be disabled. In addition, the following operating parameters can be independently configured for Mode 1 and Mode 2:

- Call Source
- Line Out
- Visual Alert Status, Minimum On Time, Intensity, Action, and Color
- Audio Alert Status, Action, On Delay, and Minimum On Time

Operating mode and configuration changes will immediately be reflected in the unit's operation. No Model 391 "reboot" or other action is required. Each time a configuration change is made the Model 391's visual indicator will momentarily flash yellow to indicate that a command from STcontroller has been received.

## Using STcontroller

Immediately after starting STcontroller the application will locate the devices that it can control. The Model 391 unit or units will appear in the device list. Use the Identify command to allow easy recognition of a specific Model 391 unit. Upon receiving an identify command a Model 391 will momentarily flash its visual indicator with a green color. Double-clicking on a device name will cause the associated configuration menu to appear. Review the current configuration and make changes as required.



## Active Mode

Choices are: *Mode 1* and *Mode 2*; also can disable access to Mode 2.

The Active Mode section of the Model 391 configuration screen within STcontroller will display the mode that is currently active. The choices are Mode 1 and Mode 2 with *Mode 1* as the default. The active mode can be changed by clicking on the desired radio button. If the pushbutton on the Model 391's front panel is used to change the active mode (press and momentarily hold the button to make a change) the status will be updated on the STcontroller screen.

There may be applications where only one active mode is desired. In this case, simply enable the check box for Disable Mode 2. When selected, this will force

the unit to operate in Mode 1 only. The configuration settings for Mode 2 will not be disturbed, remaining for future use if desired. These settings can be changed as designated although they won't be utilized.

## Call Source

Choices are: *Tone Detect Ch1*, *Tone Detect Ch2*, *Tone Detect Ch1 & Ch2*, and *UDP Commands*.

Three of the call source choices use tone signals (18-23 kHz audio signals contained within an audio channel) to activate the call functions. The fourth choice, UDP commands, allows data presented to the Model 391 unit via the Ethernet connection to activate the call functions. (The call functions, depending on the configuration, can consist of the visual indicator, audio sounder, and line output.)

*Tone Detect Ch1* allows a high-frequency tone present on Dante receiver (input) channel 1 to serve as the call source. *Tone Detect Ch2* allows a tone present on Dante receiver (input) channel 2 to serve as the call source. Selecting *Tone Detect Ch1 & Ch2* enables tones on either or both Dante receiver (input) channels to be recognized as a call source. This configuration setting is effectively a logical OR function. Selecting *UDP Commands* allows packets contained within the Ethernet data connection to serve as the call source. Refer to Appendix B for details on the UDP packet structure.

## Line Out

Choices are: *Off*, *On When Call Active*, *Always On–Ch 1*, and *Always On–Ch 2*.

This setting allows the operation of the line-level analog output to be configured. If *On When Call Active* is selected, audio from the designed Call Source Dante receiver channel will be present on the line output whenever a call is detected. If the call function is not active then no audio will be present on the line output. If either of the *Always On* choices is selected, any audio present on the specified Dante receiver channel will be sent to the line output. These two always-on configuration choices allow the line output to serve as a general-purpose Dante-to-analog output converter. The default configuration for both Mode 1 and Mode 2 is *On When Call Active*.

## Visual Alert

To provide a visual indication that a call signal is active a set of five red/green/blue (RGB) LEDs can project a full range of colors into a futuristic polycarbonate lens assembly. Five configuration parameters allow the action of the visual indicator assembly to be optimized for the desired applications.

## Status

Choices are: *Off*, *On When Call Active*, and *Always On*.

The Status configuration allows the overall operation of the visual indicator to be selected. When selected for *Off*, the visual indicator will never light. When selected for *On When Call Active*, the visual indicator will be enabled whenever a call signal is received. When selected for *Always On*, the visual indicator will always be active. The default configuration for both Mode 1 and Mode 2 is *On When Call Active*. Note that

the exact action of the visual indicator when it's active will follow the Intensity, Action, and Color configuration parameters, described next.

The *Always On* configuration can be useful for a number of purposes. One example is to make it easier to observe the action of the visual indicator as its intensity, action, and color configurations are selected. “Forcing” the visual indicator to be active simulates what will occur when a call signal is active. This configuration choice also allows the visual indicator to serve as a general-purpose, local, or remotely controlled indicator or “beacon.” Informing users about a “closed set” or “rehearsal in progress” situation could be easily accomplished.

## Minimum On Time

Choices are: *Follow Call*, *2 Seconds*, *4 Seconds*, and *6 Seconds*.

The Minimum On Time configuration can be useful in situations where it's important for users to be aware that a call signal has been received. In the *Follow Call* configuration the on/off status of the visual indicator will directly respond to an incoming call signal. So, as an example, a very short (e.g., less than one second) call signal will result in a very short “burst” of light from the visual indicator. The *Follow Call* setting is the default for both Mode 1 and Mode 2. It might be the correct setting for some applications, but may allow situations where users can be unaware that call activity took place.

The configuration choices for 2, 4, or 6 seconds ensures that the visual indicator will light for a “reasonable” amount of time. Selecting one of these values will ensure that the visual indicator will activate for a minimum period of time. As an example, if set for 4 seconds and a call signal is received for 3 seconds, the visual indicator will stay active for an extra 1 second. (It would stay enabled for 4 seconds.) Should, in this same example, the call signal remain active for 5 seconds the visual indicator will immediately turn off at the end of the 5 seconds. (The 5-second call signal would exceed the 4-second minimum on time.)

Technically, the three minimum time choices could be considered to provide non-retiggerable one-shot actions. This is effectively a logical “OR” function with the call signal and either a 2-, 4-, or 6-second timer serving as the inputs. The call signal also serves as

the timer start trigger. (But ignore this description if you're a) not an engineer and/or b) don't appreciate this kind of obscure technical stuff!)

### Intensity

Choices are: *Low*, *Medium*, and *High*.

The brightness (amount of lumens) emitted by the visual indicator can be selected using the Intensity configuration. Select the value that's appropriate for the application. The default intensity value for both Mode 1 and Mode 2 is *High*.

### Action

Choices are: *Continuous*, *Slow Flash*, *Fast Flash*, and *Pulse*.

The four Action choices allow the character of the visual indicator to be selected. Select the configuration that best fits the application. When selected for *Continuous*, the visual indicators will light steadily whenever it is enabled. (Remember, depending on the configuration of the Status configuration, it can be enabled whenever a call signal is present or could be active all the time.) When selected to *Slow Flash*, the visual indicator will alternate between on and off two times per second. In *Fast Flash* the visual indicator will alternate between on and off a little more than four times per second. In the *Pulse* configuration the visual indicator will light twice followed by a short pause, repeating a little more once per second. The Pulse setting can be effective in gaining a viewer's attention. The default configuration is *Continuous* for Mode 1 and *Fast Flash* for Mode 2.

### Color

Choices are: standard colors and Operating System Color Picker.

The Color configuration allows the color of the visual indicator's red/green/blue (RGB) LEDs to be selected. There are several standard colors to choose from. Should none of these meet the application's needs using the color palette can provide many more choices. Note that selecting black will result in the visual indicator producing a dark gray color. This seemed to be more reasonable than trying to generate black which is the absence of light! The default color for Mode 1 is green while the default for Mode 2 is purple. These two colors were selected just to highlight the possibilities that the flexible configuration choices allow.

A unique color configuration situation arises if the Call Source has been selected to be Channel 1 & 2. In this case, a call signal (18-23 kHz tone) present on either audio input channel will activate the configured call functions. But to keep the underlying firmware and user interface reasonably simple only one color configuration choice is provided. If a call signal is detected on channel 1 the visual alert will light in the color that has been configured. If a call signal is detected on channel 2 the visual alert will light in a color that's mathematically complementary to the configured color. This ensures that two unique colors will always display in response to call signals on the two input channels. Experimenting with various color selections will allow the "color pairs" to be observed and a desired choice to be made.

### Audio Alert

Four configuration choices allow the character of the audio sounder to be selected.

### Status

Choices are: *Off*, *Low Range*, and *High Range*.

The Status choices allow selection of the overall operation and output level of the audio sounder. The *Off* choice should be selected if the audio sounder should never activate. A rotary control on the front panel of the Model 391 allows the user to select the desired output level. Two configuration choices allow the level adjustment range of the audio sounder to be selected. This helps the user select a final level that best meets the needs of an application while not exceeding what is considered reasonable. In most applications it's expected that the *Low Range* will be appropriate. When the audio sounder has to "cut through" other audio content the *High Range* can be useful. But at its maximum level the audio sounder can be quite annoying and should be selected with care! The default configuration for Mode 1 is *Low Range* while the default for Mode 2 is *Off*.

### Action

Choices are: *Continuous*, *Slow Beep*, *Fast Beep*, and *Pulse*.

Four Action choices allow the character of the audio sounder to be selected. Select the configuration that best fits the application. When selected for *Continuous*, the audio sounder will be constant

whenever it is active. When selected for *Slow Beep*, the audio sounder will alternate between on and off twice per second. The *Fast Beep* pattern will cause the audio sounder to alternate between on and off a little more than four times per second. The *Pulse* configuration will cause the audio sounder to be active for two short intervals followed by a pause. This will continuously repeat a little more than once per second. The default configuration for both Mode 1 and Mode 2 is *Continuous*.

### On Delay

Choices are: *Follow Call*, *2 Seconds*, *4 Seconds*, and *6 Seconds*.

This configuration choice was included as a user convenience feature, helping to prevent the audio sounder from activating unless it's absolutely necessary. The *Follow Call* choice configures the audio sounder to function as one might expect; whenever a call signal is detected the audio sounder will become active. It is the default setting for both Mode 1 and Mode 2 so that "out of the box" operation will be readily understood. The other choices, delays of two, four, and six seconds, are quite unique. They support situations where an operator is in close proximity to the Model 391 and can respond quickly to a visual call indication without needing the prompting of the audio sounder. Selecting a delay value will allow that person to respond to a call request without always being annoyed by the audio alerting function. Only if the call request exceeds the delay time of 2, 4, or 6 seconds will the audio sounder become active. The concept of this configuration choice is that as soon as personnel responds to a call request it's expected that the person initiating the call function will stop the request. The visual indicator is designated as the primary alerting method with the audio sounder only activating if the specified time interval has passed.

### Minimum On Time

Choices are: *Follow Call*, *2 Seconds*, *4 Seconds*, and *6 Seconds*.

The Minimum On Time configuration can be useful in situations where it's important for users to be aware that a call signal has been received. In the *Follow Call* configuration the on/off status of the visual indicator will directly respond to an incoming call signal. So, as an example, a very short (e.g., less than one

second) call signal will result in a very short "burst" of light from the visual indicator. The *Follow Call* setting is the default for both Mode 1 and Mode 2. It might be the correct setting for some applications, but may allow situations where users can be unaware that call activity took place.

The configuration choices for 2, 4, or 6 seconds ensures that the visual indicator will light for a "reasonable" amount of time. Selecting one of these values will ensure that the visual indicator will activate for a minimum period of time. As an example, if set for 4 seconds and a call signal is received for 3 seconds, the visual indicator will stay active for an extra 1 second. (It would stay enabled for 4 seconds.) Should, in this same example, the call signal remain active for 5 seconds the visual indicator will immediately turn off at the end of the 5 seconds. (The 5-second call signal would exceed the 4-second minimum on time.)

Technically, the three minimum time choices could be considered to provide non-retriggerable one-shot actions. This is effectively a logical "OR" function with the call signal and either a 2-, 4-, or 6-second timer serving as the inputs. The call signal also serves as the timer start trigger. (But ignore this description if you're a) not an engineer and/or b) don't appreciate this kind of obscure technical stuff!)

## Operation

At this point all connections and configuration steps should have been completed and everything should be ready for Model 391 operation to commence. An Ethernet connection with Power-over-Ethernet (PoE) capability should have been made. Alternately, a mid-span power injector, in "series" with the Ethernet connection, should have been put into place. If desired, a connection to the line output should have been made.

The Model 391 should have been placed in the desired physical location. Using the Studio Technologies' STController software application the unit's configuration should have been set to meet the needs of the specific application. The Model 391's Dante configuration settings should have been selected using the Dante Controller software application. In this way, either or both of the unit's two audio input channels (Dante receiver channels) should have been routed, by way of Dante "subscriptions," to the transmitter channels on associated Dante-enabled equipment.

## Initial Operation

The Model 391 will start to function as soon as a Power-over-Ethernet (PoE) power source is connected. However, it may take 20 to 30 seconds for full operation to commence. Upon initial power up the three status LEDs, located on the back panel below the RJ45 jack, will begin to light as network and Dante connections are established. The visual indicator, located on top of the Model 391's enclosure, will light, starting with red then changing to green and then to blue, "cycling" through the colors before going dark. The three green LEDs on the front panel will light in a sequence to display that they are functioning correctly.

## How to Identify a Specific Model 391

Functions within the Dante Controller and STcontroller software applications allow a specific Model 391 unit to be identified. Each application provides an "eyeball" icon that when clicked will activate the Identify function. When *Identify* is selected, it will send a command to a specific Model 391 unit. On that unit the visual indicator will flash green in a pattern four times. In addition, the SYS and SYNC status LEDs, located directly below the etherCON RJ45 connector on the back panel, will slowly flash green. After a few seconds the LED identification pattern will cease and normal Model 391 LED operation will resume.

## Ethernet and Dante Status LEDs

Three status LEDs are located below the etherCON RJ45 connector on the Model 391's back panel. The LINK/ACT LED will light green whenever an active connection to a 100 Mb/s Ethernet network has been established. It will then flash in response to all Ethernet data packet activity. The SYS and SYNC LEDs display the operating status of the Dante interface and its associated network activity. The SYS LED will light red upon Model 391 power up to indicate that the Dante interface is not ready. After a short interval it will light green to indicate that it is ready to pass data with another Dante device. The SYNC LED will light red when the Model 391 is not synchronized with a Dante network. It will light solid green when the Model 391 is synchronized with a Dante network and an external clock source (timing reference) is being received. It will slowly flash green when this specific Model 391 is part of a Dante network and is serving as the Leader Clock. It is possible that up

to 30 seconds may be required for the SYNC LED to reach its final state.

## Operating Modes 1 and 2

The Model 391 can be configured to operate in two unique operating modes, named Mode 1 and Mode 2. The configuration of the operating modes should have previously been selected using the STcontroller software application. The operating mode that the Model 391 is actively following can be selected either using the pushbutton switch located on the front panel or a command made within STcontroller. Two green LED indicators, located adjacent to the pushbutton switch, are used to display the active operating mode. To change the operating mode simply requires the pushbutton switch to be pressed and momentarily held; a quick "tap" of the button will not change the operating mode. This feature helps to ensure that a random press of the pushbutton switch will not change the operating mode.

A configuration choice within STcontroller allows disabling access to operating Mode 2. If this feature is enabled and the pushbutton switch is pressed and held, the Mode 1 LED will remain lit while the Mode 2 LED will quickly flash four times to indicate that access to it has been disabled.

## Visual Alert

As expected, the action of the Visual Alert section will follow the configuration choices made for the operating mode that has been selected. There are many different operating choices, such as color, intensity, and on/off action, that should work together to provide optimal performance in many different applications. What's presented to the user will be just a subset of all the choices that are available.

A unique set of visual alert actions will occur if the Call Source has been selected to be Channel 1 & 2. If a call signal is detected on audio input channel 1 the visual alert will light with the configured color choice. If a call signal is detected on audio input channel 2 the visual alert will light with a color that's different from the configured color. (That color will be determined by a fixed math formula.) If call signals are simultaneously detected on both audio input channels 1 and 2, the configured color will be displayed. This effectively makes a call signal on input channel 1 have priority over a call signal on input channel 2.

## Audio Alert

The Audio Alert section consists of three items on the front panel. A small rectangular hole is used by the audio sounder as the exit point for the alert audio. A green LED displays the status of the audio alert function. And a rotary “trim” potentiometer (pot) is provided for the user to adjust the level of the audio sounder. The status LED provides a number of indications which are important to understand. The LED will not be lit if the active operating mode is configured such that the status of the audio alert is turned off. Should a call signal be received by the Model 391 the LED will remain off; adjusting the trim pot will not result in any operating change.

If the status is configured for Low Range or High Range, the user can use the trim pot to adjust the output level of the audio sounder. If the trim pot is not set to its fully counterclockwise position, the status LED will be lit steadily. This indicates that the audio sounder is “ready” to be activated by a call signal. If the status of the audio alert function is configured for Low Range or High Range and the trim pot is set to its fully counterclockwise position, the status LED will flash. This condition is provided to inform the user that although the configuration is selected, for the audio sounder to be active the trim pot is set such that no audio will be generated. Setting the trim pot to its fully counterclockwise position is certainly a valid means of turning off the audio sounder and the flashing LED will highlight this condition. If the audio alert status LED is either lit or flashing, it will change to a fast-flash cadence whenever a call signal is received. This helps to identify when the audio alert function is receiving a call signal request and, depending on the setting of the trim pot, the sounder may be generating an audio output.

## Line Output

What is present on the line output connection will depend on the configuration settings associated with the active Model 391 operating mode. Some applications will have no audio present on the line output. Other configurations will have audio from Dante receiver channel 1 or channel 2 present at all times on the line output. In other cases, audio will be present on the line output only when a call signal is being received.

## Technical Notes

### IP Address Assignment

By default the Model 391’s Ethernet interface will attempt to automatically obtain an IP address and associated settings using DHCP (Dynamic Host Configuration Protocol). If a DHCP server is not detected an IP address will automatically be assigned using the link-local protocol. This protocol is known in the Microsoft® world as Automatic Private IP Addressing (APIPA). It is also sometimes referred to as auto-IP (PIPPA). Link-local will randomly assign a unique IP address in the IPv4 range of 169.254.1.0 to 169.254.254.255. In this way, multiple Dante-enabled devices can be connected together and automatically function, whether or not a DHCP server is active on the LAN.

An exception does arise when trying to directly interconnect two Dante-enabled devices that use Ultimo integrated circuits to implement Dante. The Model 391 uses Ultimo and, as such, a direct one-to-one interconnection to another Ultimo-based product is not supported. An Ethernet switch linking the two units is required to successfully interconnect two Ultimo-based devices. The technical reason that a switch is required relates to the need for a slight latency (delay) in the data flow; an Ethernet switch will provide this.

As previously discussed, the Model 391’s Dante IP address and related network parameters can be manually set for a fixed (static) configuration using the Dante Controller software application. In the unfortunate event that a specific Model 391’s IP address is “lost,” there are several techniques that may prove useful. It is possible that the Address Resolution Protocol (ARP) networking command can be used to “probe” devices on a network for this information. For example, in Windows OS the **arp -a** command can be used to display a list of LAN information that includes MAC addresses and corresponding IP addresses. (Within this list should be the Model 391’s statically assigned Dante IP address.) This method is most effective with a LAN that uses unmanaged Ethernet switches. Contemporary LANs that utilize managed switches may limit the ARP command’s effectiveness.

In general, the simplest means of identifying an unknown IP address is to create a “mini” LAN with an unmanaged PoE-enabled Ethernet switch. Then

by using the appropriate ARP command the required “clues” can be obtained.

## Optimizing Network Performance

For best Dante audio-over-Ethernet performance a network that supports VoIP QoS (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. Refer to the Audinate website ([audinate.com](http://audinate.com)) for details on optimizing networks for Dante applications.

## Application Firmware Version Display

There are two ways in which the version number of the Model 391's application firmware (embedded software) can be identified. One requires only the Model 391 unit and involves a button-press sequence performed upon power up. The other method utilizes the Model 391 and the STcontroller software application. Either method may prove to be useful when working with factory personnel on application support and troubleshooting.

As part of the Model 391's power-up sequence the unit's application firmware can be directly displayed. Before connecting the PoE-enabled Ethernet cable, press and hold the operating mode button. Then connect the Ethernet cable. Upon application of PoE power the Model 391 will first go through its normal power-up sequence and then will display the firmware version. The visual indicator on the top of the unit will first “flash” green in color to display the major version number and then “flash” yellow to display the minor version number. After this is completed the visual indicator will remain off until the operating mode button is released. Once the operating mode button is released normal operation will take place. As an example of what would be a typical firmware display, if the visual indicator “flashes” once green and then “flashes” twice yellow it would indicate that application firmware version 1.2 is present in the Model 391.

A selection in the STcontroller software application allows the Model 391's application firmware version to be identified. Connect the Model 391 unit to the network and let it connect and start to function. Then,

after starting STcontroller, review the list of identified devices and select the specific Model 391 for which you want to determine its application firmware version. Then select **Version** under the **Device** tab. A page will then display the version number of the application firmware as well as additional details including the version number of the Dante interface firmware.

## Application Firmware Update Procedure

It is possible that updated versions of the application firmware (embedded software) that is utilized by the Model 391's processor (microcontroller or MCU) integrated circuit will be released to add features or correct issues. Refer to the Studio Technologies' website for the latest application firmware file. The unit has the ability to load a revised file into the MCU's non-volatile memory by way of a USB interface. The Model 391 implements a USB host function that directly supports connection of a USB 2.0-compliant flash drive. The Model 391's MCU updates its firmware using a file named **m391.bin**.

The update process begins by preparing a USB flash drive. The flash drive doesn't have to be empty (blank) but must be in the personal-computer-standard FAT32 format. Save the new firmware file in the root directory with a name of **m391.bin**. Studio Technologies will supply the application firmware file inside a .zip archive file. While the firmware file inside of the zip file will adhere to the naming convention required by the Model 391, the name of the zip file itself will include the file's version number. For example, a file named **m391v1r2MCU.zip** would indicate that version 1.2 of the application firmware (**m391.bin**) is contained within this zip file.

Once the USB flash drive is inserted into the USB interface, located on the main circuit board under the cover, the unit must be powered off and again powered on. At this point the file will automatically load. The precise steps required will be highlighted in the next paragraphs of this guide. After the firmware update process has been performed it's recommended that confirmation be done to ensure that the desired application firmware version has been correctly stored. The version number can be identified using either of two simple methods. Both were described in detail in previous paragraphs.

To install an application firmware file follow these steps:

1. Disconnect power from the Model 391. This will entail removing the Ethernet connection that is providing PoE power.
2. Remove the cover from the Model 391. Use a 5/64-inch hex driver to remove four hex-head machine screws and associated lock washers, two on each side of the cover. Be certain to save the screws and lock washers so that re-assembly will be fast and painless. Then carefully slide the cover forward and, once it is cleared away from the operating mode pushbutton switch and rotary level control, rotate it 90 degrees to the left (pushbutton) side. Be very careful not to kink, damage, or disconnect the miniature ribbon interconnecting cable.
3. Locate the USB connector on the main circuit board. It is at the front of the unit, between the left side of the enclosure and the pushbutton switch. Insert the prepared USB flash drive into the connector.
4. Apply power to the Model 391 by connecting to a Power-over-Ethernet (PoE) Ethernet source.
5. After a few seconds the Model 391 will run a “boot loader” program that will automatically load the new application firmware file (**m391.bin**) into internal memory. During this time period an LED, located adjacent to the USB connector, will slowly flash green. Once the loading process is over, taking approximately 10 seconds, the Model 391 will restart using the newly loaded application firmware.
6. At this time the Model 391 is functioning with the newly loaded application firmware and the USB flash drive can be removed. But to be conservative, remove PoE power first and then remove the USB flash drive.
7. Confirm that the desired firmware version has been correctly loaded. This can be done by pressing and holding the operating mode button, applying power to the Model 391, and then “reading” the application firmware version number by observing the visual indicator. Alternately, the STController application can be used to identify the application firmware version number. Whatever method you use, ensure that the desired version is present.

8. Once the update process has been completed reverse the steps and re-attached the cover using the four previously removed machine screws and lock washers. Ensure that each end of the miniature ribbon cable remains fully mated with its associated connectors.

Note that if a connected USB flash drive doesn’t have the correct file (**m391.bin**) in its root folder no harm will occur if power is applied to the Model 391. Upon power up the green LED will flash on and off rapidly to indicate this condition and then normal operation using the unit’s existing application firmware will begin.

## **Ultimo Firmware Update**

As previously discussed, the Model 391 implements Dante connectivity using the 2-input/2-output Ultimo integrated circuit from Audinate. The Dante Controller software application can be used to determine the version of the firmware (embedded software) that resides in the Ultimo “chip.” The STController software application can also be used to identify the firmware version. (Use the Version selection under the Device tab.) The Dante firmware can be updated by way of the Model 391’s Ethernet connection. The latest Dante firmware file is available on the Studio Technologies website. The Dante Firmware Update Manager (FUM) application can be used to install the firmware. This program is also available for download on the Studio Technologies website. It is anticipated that a more automated method of updating Dante firmware will become available. If this comes to fruition then it might offer a much simplified method of keeping the firmware current.

## **Restoring Factory Defaults**

A command in the STController software application allows the Model 391’s configuration settings to be reset to the factory default values. From STController select the specific Model 391 that you wish to restore to the factory default values. Select the **Device** tab and then select the **Factory Defaults** feature. Then click on the **OK** box. For a list of default values refer to Appendix A.

## Specifications

### Power Source:

**Power-over-Ethernet (PoE):** class 1 (very low power,  $\leq 3.84$  watts) per IEEE® 802.3af

### Network Audio Technology:

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

**AES67-2013 Support:** yes

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

**Bit Depth:** up to 24

**Sample Rate:** 48 kHz

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

**Dante Receiver (Input) Nominal Level:**  $-20$  dBFS

### Network Interface:

**Type:** 100BASE-TX, twisted-pair Ethernet, Power-over-Ethernet (PoE) supported

**Data Rate:** 100 Mb/s (10 Mb/s and 1000 Mb/s GigE Ethernet not supported)

### Call Activation – In-Band Tone:

**Source:** receiver channel 1, receiver channel 2, receiver channel 1 and 2, selectable

**Tone Characteristics:** 18-23 kHz, nominal

**Minimum Level:**  $-25$  dBFS, nominal

**Detect Time:** 10 milliseconds, minimum

### Call Activation – UDP Commands:

**Source:** Ethernet interface

### Visual Alert:

**Type:** qty 5, red/green/blue (RGB) LEDs

**Color:** adjustable (choices include standard colors and operating system color picker)

**Intensity:** adjustable

**Action:** adjustable

### Audio Alert:

**Type:** electromagnetic sounder

**Action:** adjustable

**Frequency:** 2.7 kHz, nominal, square wave

**Level:** adjustable, 2 level ranges

**Maximum Level:** 85 dB SPL @ 3.9 inches (10 cm)

**Action:** adjustable

### Line Output:

**Type:** analog, electronically balanced, capacitor coupled, intended to drive balanced or unbalanced loads of 2 k ohms or greater

**Source Impedance:** 200 ohms

**Nominal Level:** 0 dBu, reference  $-20$  dBFS

**Maximum Level:**  $+20$  dBu, 0 dBFS input, measured at 1 kHz

**Dynamic Range:**  $>106$  dB, A-weighted

**Distortion (THDS+N):** 0.0011% ( $-99$  dB), measured at  $-1$  dBFS, 22 kHz bandwidth

**Frequency Response:**  $+0/-1.5$  dB, 20 Hz to 20 kHz

**Configuration:** requires Studio Technologies' STcontroller personal computer application, version 1.07.00 and later (versions compatible with personal computers running Windows and Mac operating systems are available)

### Connectors:

**Line Output:** 3-pin male XLR

**Ethernet:** Neutrik etherCON RJ45

**USB:** type A receptacle (located inside Model 391's enclosure and used only for updating firmware)

### Dimensions (Overall):

3.4 inches wide (8.6 cm)

3.5 inches high (8.9 cm)

5.1 inches deep (13.0 cm)

**Mounting Options:** intended for tabletop applications; optional MBK-02 Mounting Bracket Kit allows Model 391 to be permanently mounted

**Weight:** 1.0 pound (0.46 kg)

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

## Appendix A – STcontroller Default Configuration Values

**Active Mode:** Mode 1

**Disable Mode 2:** Box not checked

### **Mode 1:**

Call Source: Tone Detect Ch1  
Line Out: On When Call Active  
Visual Alert – Status: On When Call Active  
Visual Alert – Minimum On Time: Follow Call  
Visual Alert – Intensity: High  
Visual Alert – Action: Continuous  
Visual Alert – Color: Green  
Audio Alert – Status: Low Range  
Audio Alert – Action: Continuous  
Audio Alert – On Delay: Follow Call  
Audio Alert – Minimum On Time: Follow Call

### **Mode 2:**

Call Source: Tone Detect Ch1  
Line Out: On When Call Active  
Visual Alert – Status: On When Call Active  
Visual Alert – Minimum On Time: Follow Call  
Visual Alert – Intensity: High  
Visual Alert – Action: Fast Flash  
Visual Alert – Color: Purple  
Audio Alert – Status: Off  
Audio Alert – Action: Continuous  
Audio Alert – On Delay: Follow Call  
Audio Alert – Minimum On Time: Follow Call

## Appendix B – UDP Packet Structure

Supported in Application Firmware version 2.1 and later.

**Table 4. Model 391 Remote Settings**

Setting ID	Setting Name	Setting Values
0x19	Alerting State	0x00 - Off 0x01 - On

Command Structure (without UDP header):

```
<start> <cmd_system> <settings_len> <setting_id> <setting_val>
[<setting_id>, <setting_val>...] <crc8>
```

In this case, the command structure for setting On State enabled is:

```
0x5A 0x09 0x02 0x19 0x00 0xC5
```