



Model 5401 Dante™ Master Clock

Key Features

- Dedicated master clock for Dante audio-over-Ethernet applications
- High-performance IEEE® 1588 V1 PTP server
- Internal temperature-stabilized frequency reference
- Compatible with external word clock and video sync sources
- Audio tones and channel identification signals
- Dante audio-over-Ethernet technology with AES67 support
- Dual Gigabit Ethernet interfaces allow switched, redundant, and split Dante operation
- Web-based configuration and software updating
- AC mains and 12 volts DC powering
- Lightweight enclosure, single rack-space (1U) mounting

Overview

The Model 5401 Dante Master Clock is intended to provide precise timing signals for applications and related devices that utilize the Dante® audio-over-Ethernet media networking technology. The unit implements a high-performance IEEE 1588 precision time protocol (PTP) server compatible with the requirements of Dante. The Model 5401's dedicated circuitry allows it to simultaneously support the timing needs of literally hundreds of Dante devices. A configuration choice allows the Model 5401's master timing signal to originate within the unit or to "sync" to a variety of externally-provided references. In addition to serving as a timing reference, the Model 5401 generates audio tone and channel identification signals for application-specific use. These digital audio signals are provided on standard Dante transmitter (output) channels.

The Model 5401 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 or two Ethernet network connections are required for full operation. Using Dante's inherent capabilities, two Model 5401 units can serve in primary master clock and secondary master clock roles for seamless, redundant time server operation.

An integral web server allows fast and flexible configuration of the Model 5401's networking, master clock, and audio performance. Front-panel indicators, an LCD display, and pushbutton switches provide personnel with direct access to key operating parameters. Updating of the Model 5401's operating software can be easily performed using the unit's integrated FTP (file-transfer protocol) client. The unit's dual Gigabit Ethernet ("GigE") network interfaces support redundant Dante operation. All program software files and configuration parameters are stored in non-volatile memory. The Model 5401 can be powered by 100-240 V, 50/60 Hz mains or a source of 12 volts DC. The lightweight enclosure mounts in one space (1U) of a standard 19-inch rack.



Model 5401 Front and Rear Views

Master Clock Support for Dante Networks

An inherent strength of Dante audio-over-Ethernet networking is the well-defined and implemented method for ensuring that all connected devices maintain their required timing. This is accomplished by using the industry-standard IEEE 1588 precision time protocol (PTP). Any connected Dante device can be used as a master clock; there is no requirement that a dedicated master clock device be utilized for adequate performance to be realized. However, the actual performance can range widely depending on the specific Dante devices available and the overall number of Dante devices on the network.

Many Dante devices utilize the 2- or 4-channel Ultimo™ integrated circuit to implement Dante connectivity. While Ultimo devices will fully support Dante audio transport they are not well suited to serve as a master clock. Its PTP performance is limited and it does not have the ability to synchronize with an external timing reference. Other Dante devices use the Brooklyn II module to support Dante connectivity. In many cases these devices can provide good basic performance as a master clock, including some that allow connection of an external source of word clock.

Problems and limitations may arise when these devices are called upon to perform “double duty,” serving both a primary function (such as analog-to-Dante interfacing or audio signal processing) and acting as a master clock. This is understandable as the main purpose of these devices is to serve a function other than as a master clock. For example, 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 audio device would impact the master clock functionality for an entire installation.

The Model 5401 is specifically designed to serve a Dante-based audio system’s master clock requirements. The feature set, along with the internal hardware and software, were designed to provide optimum master clock performance. The

unit’s generation of tone and channel identification audio signals is performed in hardware that is separate from that associated with PTP functionality. As such, this secondary functionality will not interfere with PTP operation. Unlike a general-purpose audio device, once mounted in an equipment rack and the required interconnections made, the Model 5401 will perform its tasks without risk of interruption due to conflicting resource demands.

Timing Sources and Sync Output

The Model 5401 can provide excellent master clock performance using its accurate and stable internal oscillator. The oscillator is temperature controlled and exceeds the performance of standard Dante devices by almost an order of magnitude. As such, standalone performance will be very good. However, for integration into a facility that has a master timing reference the Model 5401 can be “locked” to an external signal. A variety of timing signals can be connected including word clock, video sync, and 10 MHz. Word clock is ubiquitous in audio applications and is often a 48 kHz square wave. A video synchronization signal, often referred to as “video black” or “black burst,” is commonly utilized in broadcast, production, and post-production facilities. The Model 5401 supports both bi- and tri-level video synchronization sources. In non-broadcast applications a 10 MHz reference signal, typically associated with a GPS-based master timing system, may be available. A choice on a configuration web page will specify which timing source will be used by the Model 5401. In addition, a menu choice allows the desired termination to be selected.

The Model 5401 can generate a sync output signal that is based on the selected timing reference. The output is a word clock signal with a rate selectable as 44.1, 48, or 96 kHz. The unit’s internal oscillator or an external timing source will be divided and processed by the Model 5401’s logic circuitry to create the highly-stable word clock output signal.

Audio Reference Signals

The Model 5401 will provide a set of audio tones and channel identification signals for general-purpose use. These signals are available on the Model 5401’s Dante transmitter (output) channels and will be connected to Dante receivers (inputs) using the Dante Controller application. The flexibility of the available routes (Dante “subscriptions”) between all Dante

devices on a network allows the reference signals to be used for a variety of purposes. Configuration choices will allow the frequency, level, and composition of the signals to be optimized for specific applications. English-language channel identification signals may prove especially useful when implementing multi-channel audio playback or reinforcement systems.

Applications

Applications for the Model 5401 include fixed and mobile broadcast 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 5401 will serve as a stable and consistent master clock for the entire Dante “network.” And, as expected, the Model 5401 is compatible with all Dante devices, no matter what their primary function or manufacturer.

Overall Networking Capability

Using the Dante Controller application program, the Model 5401’s two Gigabit Ethernet ports can be selected to operate in one of three modes: switched, redundant, or split. In the switched mode a single Ethernet connection can be used for Dante master clock functionality as well as to access the Model 5401’s configuration web pages. The second Model 5401 Ethernet port can be used to interface with another piece of network equipment. In the redundant mode two

independent Ethernet connections can be used to implement Dante’s redundant network capability. Either of the Model 5401’s network ports will provide access to the configuration web pages. In the split mode the Model 5401’s primary Ethernet connection will be used for master clock operation and reference signal audio while the secondary connection will be used to access the configuration web pages.

Operating Power

The Model 5401 allows an AC mains source of 100-240 V, 50/60 Hz to be directly connected. It can also be DC powered using a 10-18 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 a load be placed on 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 5401 allows its firmware (embedded software) to be updated by way of its Ethernet network connection. Multiple versions of firmware are used to support the Dante interface hardware, user configuration menus, and audio generation capabilities. Each can be independently updated as required.

Model 5401 Specifications

Applications:

Serves as a specialized, high-performance IEEE® 1588 Version 1 Precision Time Protocol (PTP) server to support Dante audio-over-Ethernet applications. Also provides audio tone and channel identification test signals for general-purpose Dante use.

Timing Reference:

Source: internal, external, or via Dante network, selectable

Internal Time Base:

Type: 24.576 MHz temperature-stabilized crystal oscillator
Initial Accuracy: 2 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, 75 ohms, or high Z (unterminated), selectable

Sync Output:

Type: word clock, 44.1, 48, or 96 kHz, selectable

Impedance: 75 ohms

Amplitude: 5 Vpp, measured unterminated (no external load)

Network Audio Technology:

Type: Dante audio-over-Ethernet

AES67-2013 Support: selectable enabled/disabled

Ethernet Interface Configuration: switched, redundant, or split

Clock Source: follows overall Model 5401 configuration

Bit Depth: 24

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

Number of Dante transmitter (output) channels: 16

Number of Dante Flows: 32 transmitter (output)

Audio Outputs:

Type: tone and channel reference signals on Dante transmitter (output) channels

Number of channels: 16 maximum, configurable using web interface

Frequency: configurable using web interface

Amplitude: configurable using web interface

Channel References: identification using English-language voice prompts, configurable using web interface

Network Interfaces: 2, Primary and Secondary

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

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

Software Updating: internal FTP client supports updating of main and audio processing (FPGA) software

Front Panel Display: LCD with LED backlighting

Front Panel LEDs: 6, dual-color

Functions: provides indication of condition of incoming AC and DC power, status of Dante connections on Ethernet interfaces, and status of Dante connectivity

Power Sources:

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

DC: 10 to 18 V, 0.5 A max

Connectors:

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

Ethernet: 2, RJ45

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

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

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 subject to change without notice.

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