Model 5414
Mic/Line Input & Line Output Dante™ Interface

User Guide

Issue 2, August 2017

This User Guide is applicable for serial numbers
M5414-00151 and later with application firmware 05 and later
and Dante firmware 2.1 (Ultimo 3.10.4.1) and later

www.studio-tech.com

50600-0817, Issue 2

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Revision History

Issue 2, August 2017:

1. Documents that the unit now supports the STcontroller software application.

Issue 1, October 2016:

1. Initial release.

Introduction

The Model 5414 Mic/Line Input & Line Output Interface provides a simple yet high-performance means of interfacing analog signals with applications that utilize Dante™ audio-over-Ethernet media networking technology. Four microphone or level-level sources can be connected to the unit and then, after conversion to digital, output by way of a Dante interface. Four signals arriving by way of Dante can be converted to analog and then output as balanced line-level signals. A monitor section allows the input and output signals to be selectively observed using meters and a headphone output.

The Model 5414 is a fully professional product that offers the audio quality, features, and reliability required by 24-hour on-air and commercial applications. The four mic/line audio inputs use standard 3-pin female XLR connectors for easy interfacing with balanced and unbalanced sources. The input circuitry features adjustable gain, P48 phantom power, and high-pass filter functions. Configuration of the inputs can be made locally by using pushbutton switches or remotely using the STcontroller application. The input audio signals are converted to 24-bit digital and then transported via the Dante interface. Four digital audio signals can be routed to the Model 5414 via the Dante interface and are then converted to analog.

Four 3-pin male XLR connectors on the unit's back panel provide access to the balanced line-level outputs. The monitor section provides the user with the ability to select any input or output signal, or signal pair, and then monitor them using LEDs meters and a 2-channel (stereo) headphone output.

An Ethernet connection is all that's required to make the Model 5414 part of a sophisticated networked audio system. Dante audio-over-Ethernet has found wide acceptance as an audio "backbone" due to its ease of use, interoperability, excellent audio quality, and wide adoption by a large number of equipment manufacturers. The Model 5414 can serve as an "edge" device for a Dante network implementation, providing high-performance input, output, and monitor resources for applications that need a limited number of channels. It can also serve as a general-purpose "tool" to help expand Dante capabilities to facilities and applications that were initially implemented to support signals in the analog domain.

Figure 1. Model 5414 Mic/Line Input & Line Output Dante Interface front and back views

The Model 5414 is "universal" mains powered, requiring 100 to 240 volts, 50/60 Hz for operation. Standard connectors are used for the audio input and output, Ethernet, and AC mains interconnections. The unit's enclosure mounts in one space (1U) of a standard 19-inch rack enclosure and weighs less than four pounds (2 Kg).

Dante Audio-over-Ethernet

Digital audio data associated with the Model 5414 is interfaced with a local area network (LAN) using Dante audio-over-Ethernet media networking technology. Status LEDs provide a real-time indication of Dante and LAN performance. A major benefit of using Dante is its ability to use any standard Ethernet network implementation, including switches, to directly transport professional audio signals. The Model 5414 supports digital audio signals with a sampling rate of 48 kHz and a bit depth of up to 24. This sampling rate was selected for optimal support of broadcast, production, industrial, and commercial applications.

The signals associated with the four mic/line input channels are converted to digital and then routed to transmitter (output) channels on the Dante interface. Four transmitter (output) channels from an associated Dante-enabled device can be assigned to the Model 5414's receiver (input) channels using the Dante Controller application. These input signals are converted into analog and then sent to the line output circuitry.

Applications

The Model 5414 is a general-purpose mic/line input, line output, and monitoring device intended for a variety of audio and audio-for-picture applications that utilize Dante. It's suitable for use in demanding on-air broadcast and live-event applications that require both excellent audio performance and reliable operation. The rack-mounted unit is appropriate for installation in fixed locations, serving the needs of systems associated with stadium, worship, education, commercial, and government facilities. Its lightweight enclosure also makes it suitable for mobile and field uses.

The Model 5414 features an optimized set of controls and indicators that makes it simple and intuitive to use. With the unit's metering and monitoring resources it's easy for operators to obtain optimal performance. And by providing standard connectors for all inputs and outputs, along with direct AC mains powering, setup can be completed in just a few minutes.

Mic/Line Inputs

The Model 5414 provides four analog inputs that are compatible with microphone and line-level signals. The mic/line input circuitry allows the level of the connected sources to be boosted as required, converted to digital, and then output to an Ethernet network by way of Dante. Each mic/line input can be individually configured to meet the requirements posed by a wide range of sources. The configuration choices can be made either locally or by way of the STcontroller remote control software application. The preamplifier gain of each channel can be selected from among 20 values: 0 dB (line), 10 dB, and 19 through 70 dB in 3-dB steps. A source of P48 phantom power can be enabled to power condenser microphones. In addition, a high-pass filter (HPF) function can be

enabled as required to reduce the presence of unwanted low-frequency content typically associated with hum, rumble, or wind noise.

Compatible signal sources include dynamic, ribbon, and phantom-powered condenser (capacitor) microphones. The extended gain range, up to 70 dB, allows microphones with low-sensitivity to perform correctly. The preamplifier gain settings of 0 dB and 10 dB were specifically included to support connection of balanced and unbalanced line-level signals that are commonly provided by professional and semi-professional audio equipment. Typical nominal levels for these sources would be +4 dBu and –10 dBV, respectively. Devices providing these analog signal sources could include audio consoles, wireless microphone receivers, and broadcast playback equipment.

An 8-segment LED meter is associated with each of the four mic/line input channels. The meters are calibrated in dBFS which can assist users in optimizing the preamplifier gain settings so as to provide the best possible conversion from the analog to the digital domain. LEDs display the on/off status of the P48 phantom power and high-pass filter (HPF) functions. For front-panel space efficiency the four mic/line input channels share a common configuration section which includes a 2-digit LED display and four pushbutton switches. The LED display allows the selected preamplifier gain of the mic/line input channels to be observed. The buttons allow rapid local selection of the preamplifier gain as well as controlling the on/off status of the P48 phantom power and high-pass filter (HPF) functions.

The mic/line inputs are electronically balanced (differential), capacitor-coupled, and ESD (static) protected for reliable operation in a variety of demanding applications. Extensive filtering minimizes the chance that radio frequency (RF) energy will cause interference. The inputs are protected from damage should a moderate DC voltage be accidentally connected. The sum of these characteristics makes the mic/line inputs suitable for use in studio and mobile facilities as well as field-deployed environments.

The four 3-pin female XLR connectors associated with the Model 5414's mic/line inputs were specifically located on the front panel. This can eliminate the need for an external I/O or "patch" panel, allowing signal sources and their associated interconnecting cables to be rapidly connected as required. Rather than being "buried" in the back of a rack enclosure the Model 5414 provides convenient access to the mic/line input connectors and their associated configuration buttons, indicators, and displays.

The audio performance of the Model 5414's mic/line inputs is very good. Low-noise, wide dynamic-range preamplifier circuits ensure that input audio quality is preserved. The P48 phantom power source is extremely low noise, allowing optimal microphone operation and imparting little signal degradation. The outputs of the preamplifiers are routed to high-performance analog-to-digital conversion (ADC) sections that support a sampling rate of 48 kHz and a bit depth of 24. A precision voltage-reference integrated circuit helps the ADC circuitry perform highly accurate signal conversion. The audio signals, now in the digital domain, are connected to the Dante interface section where they are packetized and prepared for transport over Ethernet.

Line Outputs

The Model 5414 provides four general-purpose analog line-level output channels. Four receiver (input) channels associated with the unit's Dante interface serve as the audio sources. The Dante Controller application software is used to select the sources which are provided by transmitter (output) channels on associated equipment. The Model 5414's line output channels have a maximum output level of +24 dBu. This allows compatibility in SMPTE®-compliant applications where digital audio signals with a nominal level of –20 dBFS will translate to signals in the analog domain having a nominal level of +4 dBu. The line outputs are electronically balanced, capacitor-coupled, and ESD (static) protected. High-quality components, including the important digital-to-analog converters, are used to provide low-distortion, low-noise, and sonically-excellent performance. Robust circuitry provides protection from damage should a moderate DC voltage be accidentally connected, something especially useful in broadcast applications. The line outputs are compatible with virtually all balanced and unbalanced loads with an impedance of 2 k ohms or greater.

Input and Output Monitoring

A flexible yet easy-to-use monitor section offers the ability to listen to and visually observe the level of the audio signals that are associated with the four mic/line input channels and the four line output channels. A mode configuration choice allows monitoring of either a single audio channel or a pair of audio channels. This can be valuable when monitoring monaural or stereo (dual-channel) signals. A 2-channel analog output supports the connection of a pair of stereo headphones. For application flexibility the headphone output can also be interfaced with inputs on amplified loudspeakers or a power amplifier associated with monitor loudspeakers. A rotary control allows the level of the headphone output to be adjusted.

For convenience, two ¼-inch 3-conductor (stereo) phone jacks, one located on the front panel and one on the back panel, are provided. The same 2-channel signal is routed to both the front and the back headphone output jacks. However, whenever the front jack is utilized the jack on the back panel will automatically mute. This mute function can be useful when the jack on the back panel is being used to interface with inputs on loudspeaker systems. Automatic muting of the loudspeakers will occur whenever a pair of headphones is plugged into the jack on the front panel, a feature especially important for on-air applications.

Two 8-segment LED meters display the level of the signal or signals that are selected for monitoring. The meters are calibrated relative to the digital domain (dBFS), directly reflecting the signal level in the Dante transmitter (output) and receiver (input) paths.

Simple Installation

The Model 5414 uses standard connectors to allow fast and convenient interconnections. 3-conductor male and female XLR connectors and 3-conductor ¼-inch jacks are used to interface with the analog input, analog output, and headphone output audio signals. The unit connects to a local area network (LAN) 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 and patch cables, etherCON allows a ruggedized

and locking interconnection method that's suitable for harsh or high-reliability environments. Three LEDs on the back panel display the status of the network connection and Dante interface. The Model 5414 requires 100-240 volts, 50/60 Hz mains power for operation which is connected by way of a standard detachable mains power cord. The light-weight aluminum enclosure mounts in one space (1U) of a standard 19-inch rack enclosure.

Future Capabilities and Firmware Updating

The Model 5414 was designed so that its capabilities can be enhanced in the future. A USB connector, located on the unit's back panel, allows the application firmware (embedded software) to be updated using a USB flash drive. (Refer to Figure 2 for a detailed view.)

The Model 5414 uses Audinate's Ultimo™ integrated circuit to implement Dante. The firmware in this integrated circuit can be updated via the unit's Ethernet connection, helping to ensure that its capabilities remain up to date.

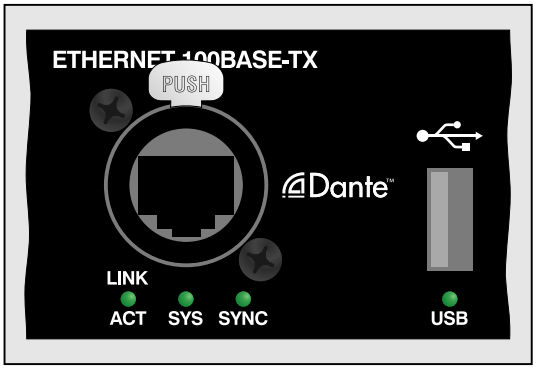

Figure 2. Detail of back panel, right side shows USB connector and USB status LED

Installation

In this section the Model 5414 will be installed and signals interconnected. The one-rack-space (1U) unit will be mounted in an equipment rack. An Ethernet data connection will be made using either a standard RJ45 patch cable or an etherCON protected RJ45 plug. Audio input and output connections will be made using 3-pin XLR connectors and ¼-inch 3-conductor jacks. AC mains power will be connected by means of a detachable cord set that is compatible with the unit's 3-pin IEC 320 C14 inlet connector.

System Components

The shipping carton contains a Model 5414 Mic/Line Input & Line Output Interface, user guide, and AC mains cord suitable for use in North America and Japan. When installation will take place in other locations your dealer or distributor should provide a suitable AC mains cord.

Locating the Unit

The selected Model 5414 mounting location will primarily depend on the unit being within the 100-meter (325-foot) twisted pair Ethernet cable limitation. But that can be overcome by using a fiber-optic interconnection between the Model 5414-related Ethernet switch and the other Ethernet switches in the local-area-network (LAN). Also, as a device that contains high-gain audio stages, hum and noise pickup is possible by way of the chassis and associated cabling. Locating the unit away from devices that radiate strong AC fields is recommended.

Mounting

Once a mounting location has been selected installation can begin. The Model 5414 requires one space (1.75 vertical inches or 1U) in a standard 19-inch (48.3 cm) equipment rack. Secure the unit into the equipment rack using four mounting screws, two per side.

Ethernet Connection

An Ethernet connection that supports 100BASE-TX (100 Mb/s over twisted-pair) is required for the Model 5414's Dante audio-over-Ethernet connectivity. A 10BASE-T connection is not sufficient for Model 5414 operation. A 1000BASE-T ("GigE") connection is not supported unless it can automatically "fall back" to 100BASE-TX operation.

The 100BASE-TX Ethernet connection is made by way of a Neutrik etherCON protected RJ45 connector that is located on the back panel of the Model 5414. (Refer to Figure 3 for a detailed view.) This allows connection by way of a cable-mounted etherCON plug or a standard RJ45 plug. The Model 5414's Ethernet interface supports auto MDI/MDI-X and, as such, eliminates the need to use a crossover or "reversing" cable.

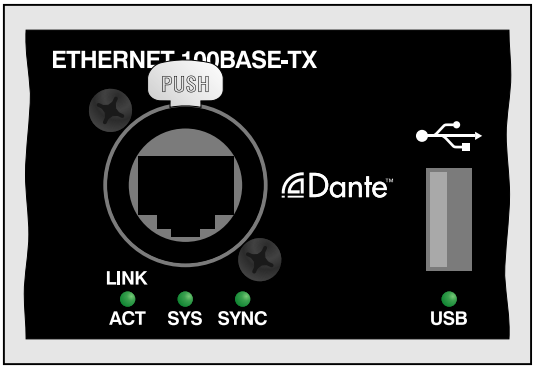

Figure 3. Detail of back panel, left side shows Ethernet connector, Ethernet status LED, and Dante status LEDs

Mic/Line Inputs

The Model 5414 provides four inputs that are intended for connection to microphone or line-level analog audio signal sources. It's expected that in most applications the connections to the mic/line inputs will be on a temporary basis, varying "day-to-day" as the applications change. As such, permanent wiring to the four mic/line inputs is not expected to be made. The 3-pin female XLR connectors, located on the Model 5414's front panel, do not include the traditional latches that would "lock" the mating connectors to them. This was specifically implemented as a feature, allowing mating connectors to automatically release in the presence of significant force. This makes changing input source cables easy and minimizes the chance of damage to the connectors on the Model 5414 or the mating connector should a cable be accidentally grabbed, pulled, or snagged.

Prepare 3-pin male XLR mating connectors such that pin 2 carries signal high (+), pin 3 carries signal low (–), and pin 1 is common/shield. It's also highly probably that unbalanced sources will interface correctly with the mic/line inputs. With an unbalanced source begin by connecting signal high (+) to pin 2 and signal low/shield (–) to both pins 1 and 3. If this provides a "clean" signal interconnection then all is well. However, if this results in hum or noise on the mic/line input, try connecting signal high (+) to pin 2 and signal low/shield (–) only to pin 3; leave pin 1 unconnected ("floating").

Line Outputs

The Model 5414 provides four line outputs. These analog outputs are designed for general-purpose use which could include

connecting to analog inputs on devices such as audio consoles, transmitters associated with wireless in-ear monitors, matrix intercom systems, or amplified speakers. The circuitry associated with the line outputs is analog, capacitor-coupled, and has a source impedance of 200 ohms. They will perform optimally when driving loads of 2 k (2000) ohms or greater. The signal level on the line outputs will be +4 dBu when an associated Dante receiver input level is –20 dBFS. The line output circuitry is capable of a maximum signal level of +24 dBu. This 20 dB of audio "headroom" means that +24 dBu will be present a line output when the corresponding Dante receiver input level is 0 dBFS.

No special precautions are necessary when using the line outputs in settings where a variety of signals may be present. The circuitry is protected from damage in cases such as the accidental connection to a powered analog party-line (PL) intercom circuit or to a microphone signal with P48 phantom power present.

Four 3-pin male XLR connectors, located on the Model 5414's back panel, are provided for interfacing the line outputs with associated equipment. Prepare 3-pin female XLR mating connectors such that pin 2 is signal high (+), pin 3 is signal low (–), and pin 1 is common/shield. To connect to an unbalanced load use pin 2 as signal high (+) and pin 1 as low/shield; do not connect anything to pin 3. Do not connect (short) pins 3 to pins 1 on the mating connectors as this will stress the output circuitry.

Headphone Output

The Model 5414 provides one 2-channel (stereo) headphone output that is routed to two jacks, one located on the front panel and the other on the back panel. (Refer to Figure 4 for a detailed view of the back-panel jack.)

The audio sources for the headphone output circuitry are selected using the Model 5414's monitor section. A rotary control, also located on the front panel, adjusts the level of the 2-channel signal that's sent to both output jacks. The jacks are standard ¼-inch 3-conductor (stereo) tip-ring-sleeve type. As would be expected, each headphone output jack has the left channel on its tip lead, the right channel on its ring lead, and common for both channels on its sleeve lead.

The same signals are routed to both headphone output jacks but they function differently. The jack on the back panel will only be active when nothing is plugged into the jack on the front panel. This is provided as an automatic disconnect function should the headphone output jack on the back panel be routed to inputs on an audio power amplifier or powered speakers. In this way plugging a pair of headphones into the jack on the front panel will cause a break in the signal being sent to the jack on the back panel. This will result in connected speakers going silent, effectively "muting" them.

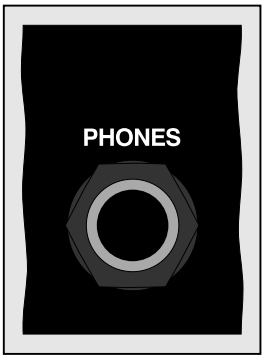

Figure 4. Detail of back panel showing 2-channel (stereo) headphone output jack

To clarify what happens technically, when a plug is inserted into the jack on the front panel the tip and ring paths (the “normals”) going from the front jack to the jack on the back panel are disconnected (“lifted”). When in this condition the tip and ring connections on the back panel jack and anything connected to them will “float” without a signal path. They will not short to each other or to the sleeve (common) connection.

As mentioned in the previous paragraph, the headphone output is suitable not just for connection to a pair of stereo headphones. The audio quality is excellent and there’s no reason why it can’t be used as an unbalanced line-level stereo output. It’s recommended for applications of this type that loads of 2 k ohms or greater be connected. Prepare an interface cable such that the tip lead of the mating 3-conductor ¼-inch phone plug serves as signal high (+) for the left channel, the ring lead of the plug serves as the signal high (+) for the right channel, and the sleeve lead of the plug serving as signal low (–) for both the left and right channels.

Connecting AC Mains Power

The Model 5414 operates directly from AC mains power of 100 to 240 volts, 50/60 Hz, 15 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. (Refer to Figure 5 for a detailed view.)

All units are supplied 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.

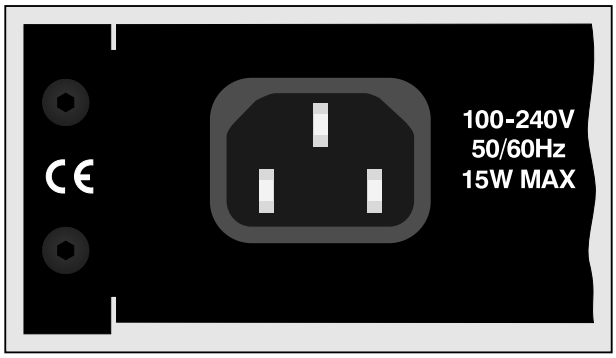

Figure 5. Detail of back panel showing AC mains power connector

Units bound for other destinations require that the appropriate cord set 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 5414 does not contain a power on/off switch it will begin operation as soon as AC mains power is connected.

Safety Warning: The Model 5414 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.

Configuration

Dante Configuration

To integrate the Model 5414 into the desired application several Dante-related parameters must be configured. At a minimum, subscriptions (routes) must be established with the four Dante transmitter (output) channels and to the four Dante receiver (input) channels. The Dante configuration settings will be stored in non-volatile memory within the Model 5414's circuitry. As such, power-down and power-up activities will not impact the unit's settings. The Model 5414 uses the Ultimo 4-input/4-output integrated circuit to implement the Dante architecture.

The four Dante transmitter channels associated with the Model 5414's Dante interface must be assigned to the desired Dante receiver channels on other devices. The Model 5414's four receiver channels must be assigned to the desired transmitter channels on associated Dante devices. This will typically be done with the Dante Controller software application which is available for download free of charge at www.audinate.com. Versions are available to support Windows® and OS X® operating systems. Within Dante Controller a "subscription" is the term used for routing a transmitter flow (a group of output channels) to a receiver flow (a group of input channels). Note that as of the writing of this guide the Ultimo integrated circuit used in the Model 5414 limits the number of Dante flows to four — two transmitter and two receiver. Each can be independently selected for unicast or multicast.

The Model 5414 has a default Dante device name of **ST-M5414** followed by a unique suffix. The suffix identifies the specific Model 5414 that is being configured. The suffix's actual alpha and numeric characters relate to the MAC address of the Ultimo integrated circuit that's present in the specific Model 5414. The four Dante transmitter (output) channels have the default names of **Ch1**, **Ch2**, **Ch3**, and **Ch4**. The four Dante receiver (input) channels have default names of **Ch1**, **Ch2**, **Ch3**, and **Ch4**. Using Dante Controller these names can be revised as appropriate for the specific application.

The Model 5414 supports an audio sampling rate of 48 kHz along with several pull-up/pull-down values. The desired configuration can be made using the Dante Controller software application. The Model 5414 can serve as the clock master for a Dante network but in most cases that would not be optimal.

Operation

At this point the Model 5414 should have its Ethernet, mic/line input, line output, headphone output, and AC mains connections implemented as desired for the application. The four Dante transmitter (output) channels and four Dante receiver (input) channels should have been routed using the Dante Controller software application. Normal operation of the Model 5414 can now begin. The unit is designed for continuous operation with no regular maintenance required.

Initial Operation

The Model 5414 will begin its power-up process as soon as AC mains power is connected. As an integrity check all the meter LEDs, status LEDs, and 2-digit LED display digits located on the front panel will light in a test sequence. This will take approximately five seconds and will be followed by the

application firmware's (embedded software) version number being displayed on the 2-digit LED display for about one second. At this point preliminary operation will begin. Full Model 5414 operation will depend on the establishment of Dante connectivity by way of the Ethernet connection.

Upon power down all Model 5414 operating parameters are saved in non-volatile memory. In this way all settings, such as mic/line preamplifier gain and P48 phantom power on/off status, will be restored upon the next power-up cycle.

Also upon Model 5414 power up the status LEDs on the back panel will light in various manners. The status LED located below the USB connector will flash once to indicate that it is functioning. The two Dante and one network status LEDs, located below the etherCON RJ45 connector on the back panel, will light in seemingly random ways as Ethernet and Dante network performance begins. Please refer to the next section of this guide for details on what these LEDs indicate.

Note that during the first few seconds after power up a few mechanical clicks may be heard emanating from within the Model 5414's enclosure. This is normal and is a function of the mic/line input attenuator circuitry's latching relays being set to their correct status.

User Displays and Controls

The user is now presented on the front panel with eight LED level meters, twenty status LEDs, and ten pushbutton switches; on the back panel are four status LEDs. These resources are simple to understand and use and should prove to be useful in obtaining the desired performance.

Ethernet and Dante Status LEDs

As previously mentioned, three status LEDs are located below the etherCON RJ45 connector on the Model 5414's back panel. The LINK/ACT LED will light green whenever an active data connection to a 100 Mb/s Ethernet network has been established. It will flash on and off in response to data packet activity. The SYS and SYNC LEDs display the operating status of the Dante interface and associated audio-over-Ethernet network. The SYS LED will light red upon Model 5414 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 audio data with another Dante device. (It doesn't indicate that data is passing but simply that data could be passing!) The SYNC LED will light red when the Model 5414 is not synchronized with a Dante network. It will light solid green when the Model 5414 is synchronized with a Dante network and an external clock source (timing reference) is being received. It will slowly flash green if this specific Model 5414 is serving as the clock master for the Dante network. (It's not expected that a Model 5414 will serve as a clock master but technically it is capable of doing that.)

How to Identify a Specific Model 5414

The Dante Controller software application offers an identify command that can be used to help locate a specific Model 5414. When identify is selected for a specific unit that unit's six audio level meters will light in a unique pattern. This aggressive display will make the unit readily identifiable. In addition, the SYS and SYNC LEDs, located directly below the etherCON connector on

the back panel, will slowly flash green. After a few seconds the LED identification patterns will cease and normal Model 5414 level meter and Dante status LED operation will again take place. Audio performance will not be impacted by the use of the identify command. As such it's perfectly acceptable to use the identify command any time it would be useful.

Mic/Line Inputs

The Model 5414's four mic/line inputs are intended for connection to virtually any microphone or line-level source. The input circuitry is electronically balanced (differential), capacitor coupled, and protected from damage should a moderate DC voltage be accidentally connected. For example, no damage will occur if a powered analog party-line (PL) intercom circuit be accidentally connected. (A PL circuit would typically have approximately 30 volts DC present.) The 3-pin female XLR connectors used for the mic/line inputs were specifically located on the front panel so that they can be readily accessed. (Refer to Figure 6 for details.) This makes changing sources and associated cabling fast and simple. Allowing "on the fly" set up and use was a main goal. The XLR connectors are "latch-less" and rely on friction instead of a mechanical lock to provide a positive retention force.

Each of the four mic/line input channels can be individually configured for preamplifier gain, P48 phantom power, and high-pass filter (HPF). (Refer to Figure 7.) This can be done locally using a common set of pushbutton switches. Alternately, the STcontroller software application can be used to view and change the gain of the preamplifier, P48 phantom power on/off status, and high-pass filter (HPF) on/off status.

An 8-segment LED meter is associated with each of the four mic/line inputs. These provide a real-time view of the signals as they are presented in the digital domain to the four Dante transmitter (output) channels. The meters display in dBFS which is the number of dB relative to the maximum

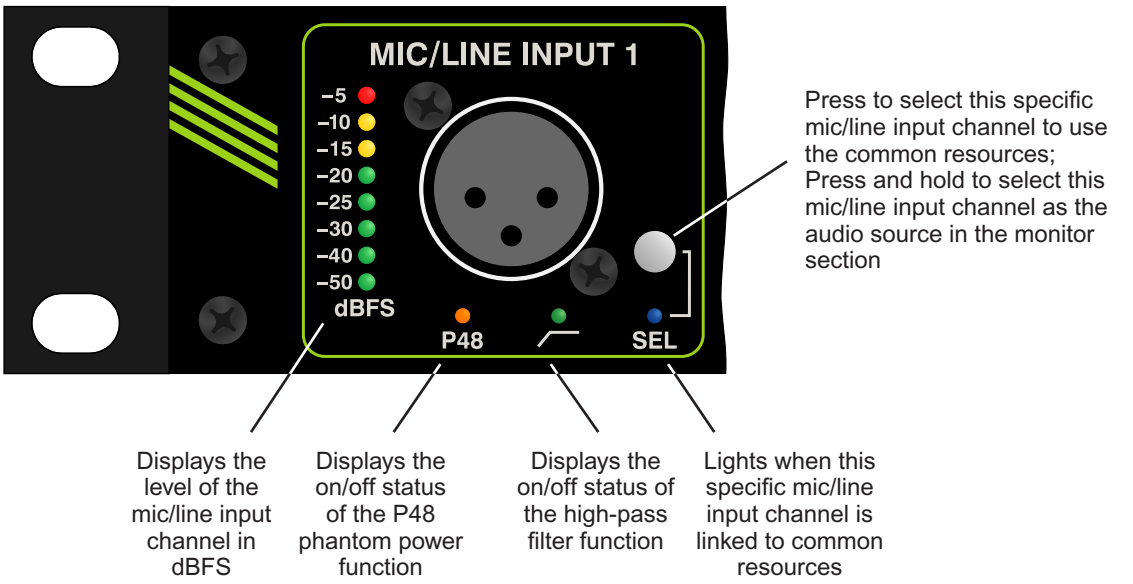

Figure 6. Detail of front panel showing one mic/line input channel (typical of four)

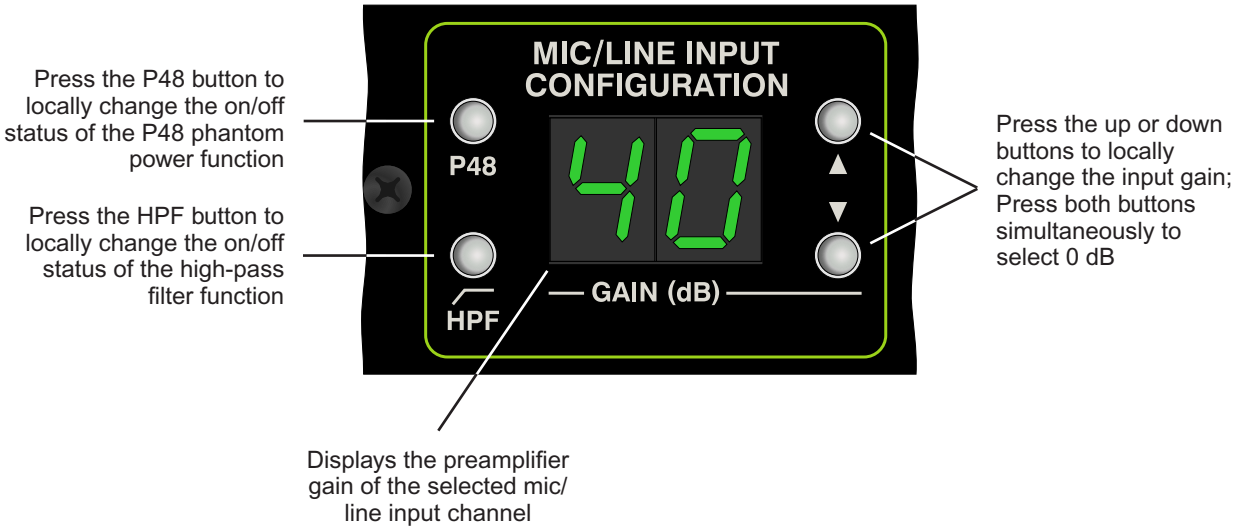

Figure 7. Detail of front panel showing common resources shared by mic/line inputs

level; digital maximum (full scale) is 0 dBFS. Associated with each input channel is an orange LED that displays the on or off status of the P48 phantom power function and a green LED that displays the on or off status of the HPF function.

The Model 5414 provides a common set of resources to display and locally select preamplifier gain as well as selecting the on/off status of the P48 phantom power and HPF functions. The common resources consist of a 2-digit LED display to indicate the selected preamplifier gain, two pushbutton switches to raise or lower the preamplifier gain, a pushbutton switch to select the on or off status of P48 phantom power, and a pushbutton switch to select the on or off status of the HPF function.

Channel Select Button

Each mic/line input channel has a pushbutton switch, labeled SEL, that's used for "assigning" the common resources to that specific input channel. Simply tap (momentarily press) a channel's select button and the common resources are assigned to that channel. A blue LED, located on the front panel directly below each channel select switch, will light to show which mic/line input channel is linked to the common resources. As expected, only one blue SEL LED can be lit at any one time.

The mic/line input select buttons are also used to activate a monitor input channel select function. If a select button is pressed and held for two seconds the monitor section will automatically select that channel as a monitor source. If the monitor section is in the single-channel mode then the mic/line input channel whose select button is pressed and held will have its audio signal as the only monitor source. If the monitor section is in the dual-channel mode then the mic/line input channel whose select button is pressed and held will have its audio signal become one of the two audio sources that are selected. This "hidden" feature can be very useful when configuring a mic/line input channel and a quick check of the associated audio signal is desired.

Preamplifier Gain

As soon as the common resources have been linked to an input channel the 2-digit LED display will indicate that input's pre-amplifier gain setting. Use the up and down buttons in the common resources to locally increase or decrease the preamplifier gain to the desired setting. Simultaneously pressing both the up and down buttons will immediately change the preamplifier gain to 0 dB. This is another "hidden" feature that allows an input to be rapidly returned to a known preamplifier gain setting. There are 20 preamplifier gain choices that range from 0 dB to 70 dB: 0 dB (line), 10 dB, and 19 through 70 dB in 3-dB steps. When changing from the 0 dB to the 10 dB setting, or vice-versa, a user may observe a slight mechanical click coming from inside the Model 5414's enclosure. This is normal, a result of a state change being made to an electromechanical relay that is used by an input attenuator ("pad") associated with the preamplifier circuitry.

The 0 dB preamplifier gain setting is appropriate when a source with a nominal level in the range of +4 dBu has been connected. The 10 dB preamplifier gain setting might be correct when a "semi-pro" signal source, such as from a personal audio device. e.g., tablet computer or portable phone, has been connected. It would be typical for a handheld or headset-associated dynamic microphone that is used in a close-talk environment to need 40 or 43 dB of gain. As a general rule, one should set a channel's preamplifier gain such that the green LEDs on its associated level meter will light whenever a signal is active while its yellow LEDs should rarely light and its red LED should never light.

P48 Phantom Power

To locally change the on or off status ("toggle") the P48 phantom power function requires simply tapping the P48 button. The selected mic/line input channel's orange LED will reflect the revised on or off condition. By design, if P48 phantom power has been enabled it will apply no matter what preamplifier gain has been selected. This includes the 0 dB and 10 dB gain settings which are not normally associated with microphone sources.

High-Pass Filter (HPF)

To locally change the on or off status of the HPF function tap the HPF button. This will "toggle" the status between on and off or vice-versa. The selected mic/line input channel's green LED will change state to reflect the HPF function's current on or off status. The status of the HPF filter function is not impacted by the P48 phantom power status and selected preamplifier gain. To understand exactly how the HPF function impacts a mic/line input signal refer to the Specifications section of this guide.

Remote Configuration of Gain, P48, and HPF

Using the STcontroller application allows personal computer users to view and adjust the Model 5414's preamplifier gain, P48 phantom power on/off status, and high-pass filter (HPF) on/off status. The application is available for download on the Studio Technologies website (www.studio-tech.com). Its initial release is compatible with the Windows® operating system. Changes made using the application will be displayed in real-time on the Model 5414's 2-digit display. Changes made to the preamplifier gain, P48 phantom power on/off status, and

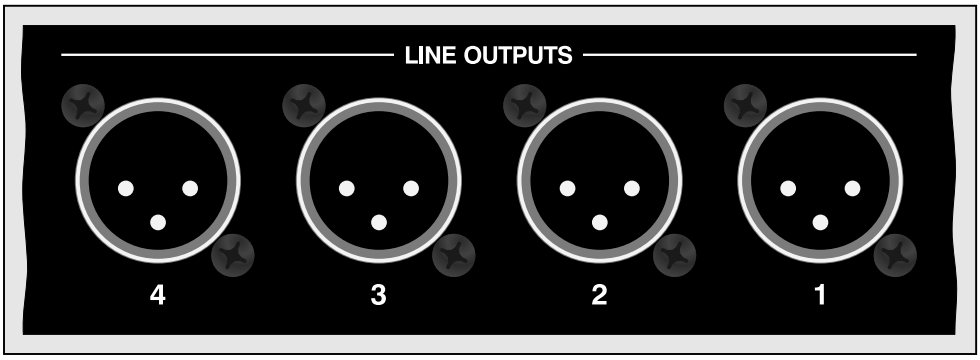

Figure 8. Detail of back panel showing line output connectors

HPF on/off status using the Model 5414's local pushbutton switches will be displayed in STcontroller.

Line Outputs

On the Model 5414's back panel are four 3-pin male XLR connectors that provide access to the line outputs. (Refer to Figure 8 for a detailed view.) For these analog line-level outputs to be active only requires using the Dante Controller software application to establish the subscriptions (routes) that link the desired Dante audio sources (transmitters) with the Model 5414's Dante receiver (input) channels. Typically the nominal level of the line outputs will be +4 dBu, assuming that the associated Dante source channels observe a –20 dBFS nominal level. Within the Model 5414 there are no level controls, channel mutes, or other functions that impact the line outputs. A Dante source signal with a level of 0 dBFS will always result in a signal on the corresponding analog output that has a level of +24 dBu. The four signals associated with the line outputs can be visually and aurally observed using the monitor section. Details on the monitor section are provided in the next paragraphs of this guide.

Input and Output Monitoring

The monitor section provides users with the ability to listen to and visually observe the level of the audio signals that are associated with the four mic/line input channels and the four line output channels. (Refer to Figure 9 for details.)

A mode selection allows either a single audio channel or a pair of audio channels to be monitored. A 2-channel (stereo) analog output supports the connection of a pair of stereo headphones. Alternately, the headphone output can be connected to inputs on amplified speakers or an audio power amplifier. A rotary control allows the level of the headphone output to be adjusted.

For convenience, two ¼-inch 3-conductor (stereo) phone jacks, one located on the front panel and one on the back panel, are provided. The same signal is routed to both the front and the back headphone output jacks; however whenever the front jack is utilized the jack on the back panel will automatically mute. Technically this is accomplished by the "normal" connections (two switched electrical contacts) that are part of the headphone jack on the front panel being electrically routed to the back panel's ¼-inch jack. This creates the muting function, making the jack on the back panel active only when the

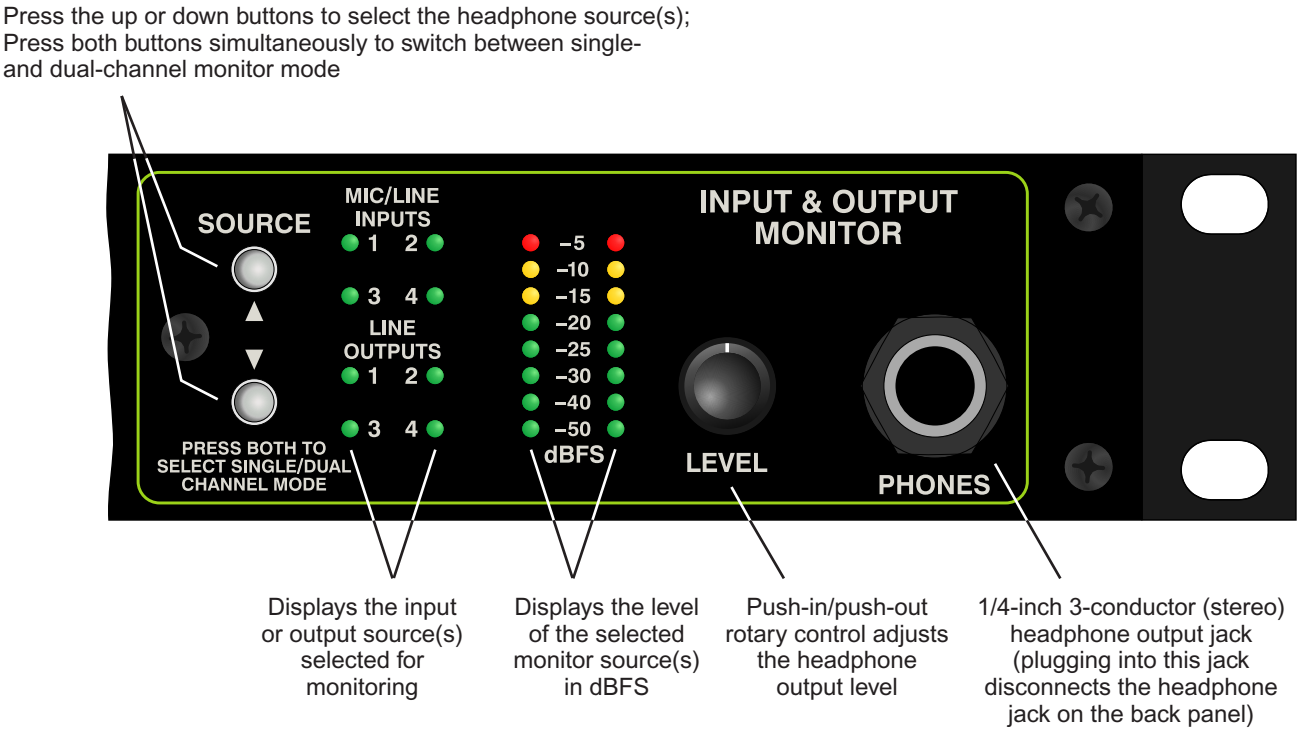

Figure 9. Detail of front panel showing input and output monitor section

jack on the front panel is not being used. This function is especially useful when the jack on the back panel is being used to interface with loudspeaker systems. Plugging headphones into the jack on the front panel will silence the loudspeakers which could be appropriate for on-air applications.

Two 8-segment LED meters display the level of the signal or signals selected for monitoring. The meters display the level of the selected signal(s) as they are present in the digital domain. They are calibrated in dBFS. The meter's yellow LEDs will light when signal levels are in the range that's typically considered to be headroom. This could be thought of as the area above the typical Dante nominal level of –20 dBFS. Any time a red LED lights is a cause for concern. This would indicate that there is little or no headroom left and signal "clipping" may be taking place.

As previously mentioned, a rotary control ("pot") allows adjustment of the headphone output level. The pot is a "push-in/push-out" type which allows its associated knob to be in its "out" position when adjusting the level and placed in its "in" position when protection from an unwanted change is desired. Note that audio signals do not pass directly through the level control. The position of the pot is recognized by the Model 5414's processor which in turn adjusts the level of the signal or signals within the digital domain. Users should find the headphone output audio quality to be excellent, with high maximum output level and low distortion. This allows high signal levels to be present on the connected headphones or related devices. Care must be taken so as not to cause hearing damage.

The monitor section can be selected to function in either a single-channel or a dual-channel mode. In the single-channel mode each input channel and each output channel can be individually monitored. In this way any one of the eight total sources can be monitored. Pressing the up or down buttons will move between individual channels. In the dual-channel mode four pairs of channels can be selected for monitoring. These pairs consist of mic/line inputs 1 and 2, mic/line inputs 3 and 4, line outputs 1 and 2, and line outputs 3 and 4. Simultaneously pressing both the up and down buttons in the monitor section will alternate ("toggle") between the single-channel and dual-channel monitor modes.

When using the up and down buttons to change the source(s) to be monitored a slight delay will be present before the new audio source(s) become active. This is a software function that allows a user to "hop over" inputs that are actually not intended to be selected. An example would be if in the single-channel mode the down button was pressed repeatedly to change the source being monitored from line output 1 to line output 4. The Model 5414's software would ignore the fact that line output 2 and line output 3 were momentary selected as the source was changed from 1 to 4. This prevents momentary "bursts" of audio from monitor sources that were not actually desired.

When in the single-channel mode the level of the selected source will be displayed on the left level meter. The source will be routed to both the left and right channels of the headphone output, providing a dual-channel mono headphone listening experience. When in the dual-channel monitor mode the level of source selected for the left channel will display on the left meter and be routed to the left channel of the headphone output. The level of the selected right channel source will be displayed on the right meter and the signal will be routed to the right channel of the headphone output. The rotary control will impact the level of both headphone output channels.

As discussed previously in this guide, pressing and holding the select button on a mic/line input channel will cause the monitor section to select that input channel as its source. If the single-channel monitor mode is active then, as expected, pressing a select button will cause audio from that specific mic/line input channel to be the monitor source. But things are a bit different when the monitor section has the dual-channel mode selected. In this case pressing and holding the select button on either mic/line input 1 or 2 will cause inputs 1 and 2 to be selected as the pair of channels to be monitored. And pressing and holding the select button on either mic/line input 3 or 4 will cause inputs 3 and 4 to be selected as the source pair.

Technical Notes

IP Address Assignment

By default the Model 5414'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 assign an IP address in the IPv4 range

of 169.254.0.1 to 169.254.255.254. In this way multiple Dante-enabled devices can be connected together and automatically function, whether or not a DHCP server is active on the LAN. Even two Dante-enabled devices that are directly interconnected using an RJ45 patch cord will, in most cases, correctly acquire IP addresses and be able to communicate and transport audio. An exception does arise when trying to directly interconnect two Dante-enabled devices that use the Ultimo Dante implementation, such as two Model 5414 units. An Ethernet switch is required to provide the Ethernet ports to correctly interconnect two Ultimo-based devices directly with each other. (The technical reason relates to the need for the slight latency provided by an Ethernet switch.)

Using the Dante Controller software application the Model 5414's IP address and related network parameters can be set for 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 that capability is available. But in this case it's highly recommended that each unit be physically marked, e.g., directly labeled using a permanent marker or "console tape," with its specific IP address. If knowledge of a Model 5414's IP address has been misplaced there is no reset button or other method to easily restore the unit to a default IP setting.

In the unfortunate event that a device's IP address is "lost," the Address Resolution Protocol (ARP) networking command can be used to "probe" devices on a network for this information. For example, in Windows OS the **arp –a** command can be used to display a list of LAN information that includes MAC addresses and corresponding IP addresses. The simplest means of identifying an unknown IP address is to create a "mini" LAN with a personal computer connected directly to the Model 5414. Then by using the appropriate ARP command the required "clues" can be obtained.

Optimizing Network Performance

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

Application Firmware Version Display

As part of the Model 5414's power-up sequence the 2-digit LED display, located on the front panel, will indicate the unit's application firmware version number. The range of the release numbers is 00 through 99.

Application Firmware Update Procedure

It's possible that updated versions of the application firmware (embedded software) that runs the Model 5414's microcontroller (MCU or processor) integrated circuit will be released to add features or correct issues. Refer to the Studio Technologies' website for the latest application firmware file. The unit has the ability to automatically load revised files into the MCU's non-volatile memory by way of its USB interface. The Model 5414 implements a USB host function that directly

supports connection of a USB flash drive. The Model 5414's MCU updates using a file named **M5414.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. The new firmware file will be saved in the root directory with a name of **M5414.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 5414, the name of the zip file itself will include the file's version number. For example, a file named **M5414v02MCU.zip** would indicate that version 02 of the application firmware (**M5414.bin**) is contained within this zip file. Once the desired **M5414.bin** file has been stored in the root directory the flash drive will be ready for use.

To install the application firmware file follow these steps:

1. Remove power from the Model 5414. This will require removing the IEC C13 connector associated with the AC mains cord.
2. Insert the prepared USB flash drive into the USB connector that is accessible on the back panel.
3. Apply AC mains power to the Model 5414.
4. The Model 5414 will run a "boot loader" program that will immediately load the new application firmware file (**M5414.bin**). This process will take only a few seconds. During this time period the LED located below the USB connector will flash slowly on and off green. Once the entire loading process is over, taking approximately 10 seconds, the Model 5414 will restart using the newly-loaded application firmware.
5. At this time the Model 5414 is functioning with the newly-loaded application firmware and the USB flash drive can be removed. But to be conservative, remove AC mains power first and then remove the USB flash drive.
6. Apply AC mains power to the Model 5414 and "read" the application firmware version number by observing the 2-digit LED display on the front panel. Ensure that this is the desired version.

Note that upon power being applied to the Model 5414 if the USB flash drive doesn't have the correct file (**M5414.bin**) in the root folder no harm will occur. Upon power up the green LED located below the USB connector will flash on and off rapidly for a few seconds to indicate that a valid file was not found and then normal operation using the unit's existing application firmware will begin.

Ultimo Firmware Update

As previously discussed in this guide, the Model 5414 implements Dante connectivity using the Ultimo integrated circuit from Audinate. The Dante Controller software application can be used to determine the version of the firmware (embedded software) residing in the Ultimo "chip." This firmware can be updated by way of the Model 5414's Ethernet connection. The latest Dante firmware file is available on the Studio Technologies website (www.studio-tech.com). The Dante Firmware Update Manager application is used to install the firmware. This program is also available for download on the Studio Technologies website.

Specifications

Network Audio Technology:

Type: Dante audio-over-Ethernet

Bit Depth: up to 24

Sample Rates: 48 kHz

Number of Transmitter (Output) Channels: 4

Number of Receiver (Input) Channels: 4

Dante Audio Flows: 4; 2 transmitter, 2 receiver

Network Interface:

Type: twisted-pair Ethernet

Data Rate: 100 Mb/s (10 Mb/s not supported; 1000 Mb/s "GigE" Ethernet not supported unless falls back to 100 Mb/s)

Mic/Line Inputs: 4

Compatibility: dynamic, ribbon, or phantom-powered mics; line-level sources

Type: analog, electronically balanced, capacitor coupled

Impedance: 4 k ohms, nominal

Gain: 0 dB (line), 10 dB, 19-70 dB in 3-dB steps (total 20 choices)

Maximum Level: +24 dBu, 0 dB gain selected (results in Dante output level of 0 dBFS)

EIN: –123 dBu, 22 kHz bandwidth, 70 dB gain, 150 ohm source resistance

Dynamic Range: >116 dB, 0 dB gain, A-weighted

Distortion (THD+N): <0.001% (–101 dB) at –1 dBFS, 40 dB gain, 22 kHz bandwidth

Frequency Response: +0.0/–0.5 dB, 22 Hz to 22 kHz, HPF off

High-Pass Filter (HPF): –6 dB at 75 Hz, 18 dB per octave, on/off selectable per channel

Phantom Power: P48 per IEC 61938:2013 standard, +46 volts DC nominal, on/off selectable per channel

Meters: 4, one 8-segment LED per input

Status LEDs: 3, P48, HPF, input channel selected

Remote Configuration Capability: preamplifier gain, P48 phantom power on/off status, and high-pass filter (HPF) on/off status (uses STcontroller application)

Line Outputs: 4

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: +4 dBu, reference –20 dBFS

Maximum Level: +24 dBu with 0 dBFS on Dante input

Dynamic Range: >119 dB, A-weighted

Distortion (THD+N): 0.0012% (–99 dB), measured at –1 dBFS, 22 kHz bandwidth

Frequency Response: ±0.1 dB, 20 Hz to 20 kHz

Audio Monitor:

Source: mic/line inputs or line outputs, selectable as monaural or stereo

Meters: 2, 8-segment LED

Headphone Output:

Type: stereo (dual-channel), when jack on front panel is used jack on back panel automatically disconnects

Compatibility: intended for connection to stereo headphones with nominal impedance of 100 ohms or greater

Maximum Output Voltage: 4.9 volts RMS, 1 kHz, 150 ohm load

Frequency Response: +0/–1.4 dB, 20 Hz to 20 kHz

Distortion (THD+N): 0.005%

Dynamic Range: >100 dB

Connectors:

Mic/Line Inputs: 3-pin female XLR

Line Outputs: 3-pin male XLR

Ethernet: Neutrik etherCON RJ45

Headphone Outputs: 3-conductor ¼-inch jack

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

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

Power Source:

AC Mains: 100 to 240 volts, +10/–15%, 50/60 Hz, 15 watt maximum

Dimensions – Overall:

19.0 inches wide (48.3 cm)
1.72 inches high (4.4 cm)
8.4 inches deep (21.3 cm)

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

Weight: 3.5 pounds (1.6 kg)

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