

LT-MADI

User Manual

Please Note: The LT-MADI requires your Aurora converter to have Firmware Version 24 or later. Any Aurora shipped from Lynx Studio Technology prior to September 9th, 2009 will have previous firmware installed in it.

For information about updating the Aurora's firmware to a compatible revision, see Section 3.3 Operation Requirements.

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LT-MADI

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1 Introduction

Thank you for purchasing the LT-MADI™! We are proud to provide you with a reliable, professional-quality product for your digital audio requirements.

This manual provides basic information to help you get started. Additional information is available via our web site and email support. Please refer to Section 12, Support, at the end of this manual for support contact information.

The LT-MADI is a 64-channel LSlot interface that is designed to allow the Aurora professional audio AD/DA converters to be used with MADI (Multichannel Audio Digital Interface) compatible mixers, multi-track recorders and other audio devices. The LT-MADI features coaxial and optical connections, allows synchronization to MADI input streams, and allows daisy-chaining of LT-MADI equipped Auroras. Each LT-MADI card can be configured for 56 or 64 channel operation. Connections up to 100 meters with coaxial cable and 2000 meters with fiber optic cable are supported.

2 Features

- Two BNC/Coaxial and Two SC-Type Optical connectors per card.
- Each LT-MADI card is capable of up to 64-channels of I/O at sample rates up to 48kHz, 32-channels at 88.2/96kHz, and 16-channels at 176.4/192kHz.
- An Aurora 16 can be configured for 32-channel or 16-channel operation. In 32-channel mode, all Analog AND AES/EBU channels can be routed to and from MADI I/O. In 16-channel mode, Analog OR AES/EBU channels can be routed to and from MADI I/O. An Aurora 8 will only operate in 16-channel mode, using 8 analog and 8 AES/EBU channels.
- Up to four Auroras can be daisy-chained together for a maximum of 64 channels of I/O.
- Lynx proprietary SynchroLock™ technology can be used to reduce jitter when Aurora is a clock slave or to provide stable, low jitter clock to downstream devices. This is especially important and highly recommended for MADI clocking due to its inherent high jitter level.
- Supports MADI 64-channel operation as well as legacy 56-channel operation.
- Routing and configuration options available via Aurora Remote Control software application.
- Supports Cable lengths up to 100 meters with coaxial, and up to 2000 meters with fiber optic cable.
- Programmable firmware onboard allows field updates to expand device utility and features.
- Automatic Delay Compensation insures sample accuracy with multiple, daisy-chained Auroras.
- Easily installed into Aurora.

3 Before You Begin

We recommend that you read through the manual to acquire an overview of the installation procedure and use of the LT-MADI. This manual will presume a working knowledge of the Aurora converter. For additional information, please refer to the Aurora owner's manual.

3.1 Contents

Verify that you received the following in the LT-MADI shipping carton:

- LT-MADI card in cushioned antistatic bag
- Warranty Registration Card
- Lynx Installation CD
- 1/2" Standoff Post

3.2 Optional Equipment

75-ohm Coaxial Cable with BNC connectors or Fiber optic cable for connection to MADI devices.

3.3 Operation Requirements

The LT-MADI requires your Aurora converter to have Firmware Version 24 or above. This should be verified prior to installing and configuring the LT-MADI card. To determine what firmware revision your Aurora has, press the TRIM and POWER buttons at the same time with the power to the Aurora off. If the LED flashes over the numbers 2 & 4 or above (i.e. 2 & 5, 3 & 1, etc.), then your unit is compatible with the LT-MADI. If pressing Power and Trim does not cause any LEDs to flash, or causes a single number to flash, then your unit needs to be updated.

The Aurora firmware can be updated by a Windows PC or OSX Macintosh with a Lynx AES16 PCI audio interface installed, or via MIDI (note: firmware revision 13 or above is required for MIDI programming). The Aurora firmware updater program is available for download from the Lynx website at Support > Downloads. If your unit requires an AES16 to update because it has firmware revision 12 or earlier, and you do not have access to one, there are two options for customers within the USA and Canada:

- Option 1: Send the Aurora and LT-MADI to Lynx Studio Technology in California. We will update the Aurora, install the LT-MADI and do a full diagnostic test within one day of receipt. It will be return shipped via 2-Day Air.
 - Option 2: Lynx Studio Technology will loan you an AES16 for updating the firmware in your Aurora. For more information on the procedure and any questions, contact support@lynxstudio.com or call 714-545-4700 extension 206.
- If you are outside of the USA or Canada, please contact your local distributor for additional firmware update options.

4 Nomenclature used in this manual

The following typographic conventions are used in this manual:

- ALL UPPER CASE TEXT refers to a specific parameter selection control (i.e. SYNC SOURCE) or a cable connection.
- Text in quotation marks indicates a parameter selection value or menu option (i.e. “EXT”).
- Phrases, such as: Click Setups Mixer > About Aurora Remote..., use the greater than symbol (“>”) to indicate multiple menu options or mouse selections within a software control context.

5 Warranty Registration

We are committed to providing you with the best service possible. To help us serve you better, please be sure to register your LT-MADI using one of the following methods:

- Fill out and mail the Warranty Registration Card included with your LT-MADI.
- Register on the web at:
https://www.lynxstudio.com/support_register.asp

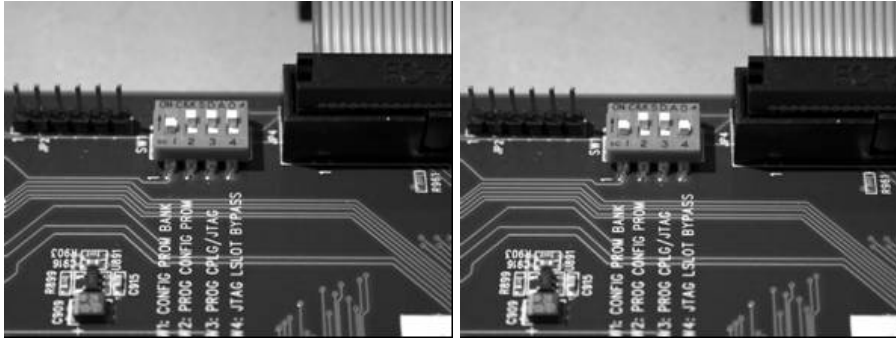
Once you are registered you will automatically receive notifications of new products and upgrades.

5.1 Locating the Serial Number of Your LT-MADI

To register your LT-MADI, you must supply its serial number. The serial number is located on a label attached to the back (solder-side) of the LT-MADI board, and also on the shipping carton.

6 Installation Procedure

1. Remove the AC power cord and take the top off of the Aurora 16 or Aurora 8. There are seven large screws plus one small screw near the center of the front faceplate.
2. Before installing the LT-MADI card, slide switch 4 (labeled W4 on PCB) of SW1 to the OFF position (towards back panel)

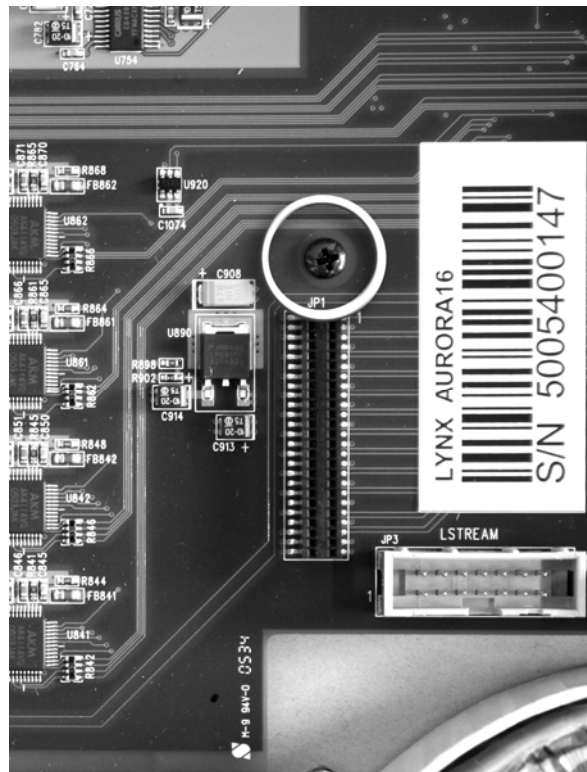


If you are updating an older Aurora that has jumper pins at JP6, instead of the W4 switches, please call Lynx Technical Support for instructions.

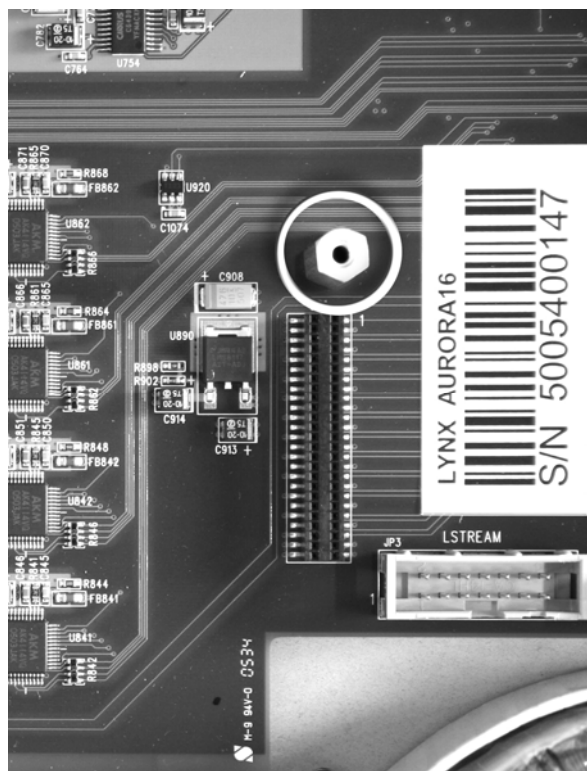
3. Remove the LSlot Expansion Port cover above the AES I/O Ports by removing the two mounting screws. Set these two screws aside, as they will be used to secure the LT-MADI after installation.



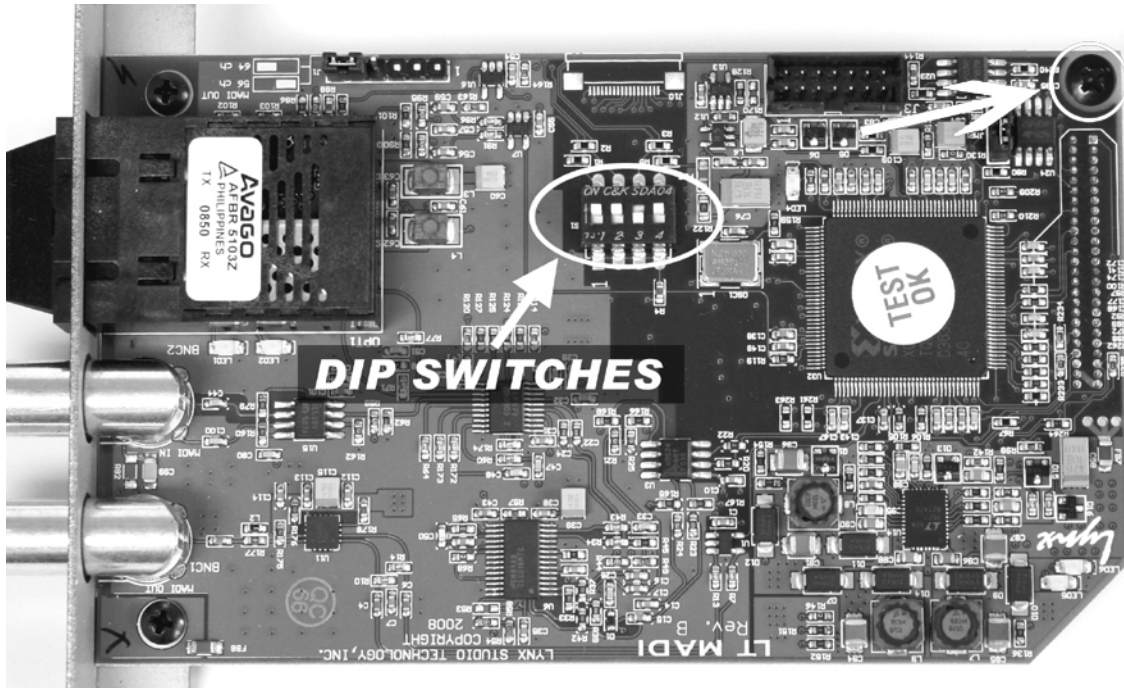
4. Remove the screw from the Aurora circuit board that is adjacent to the JP1 connector and the white serial number/barcode label. Set the screw aside for reuse.



5. Install the standoff post (included with the LT-MADI) in this same hole.



6. Grounding yourself to the earth ground, remove the LT-MADI from its protective static bag.
7. Set the appropriate dip switches on the LT-MADI. These settings are specific to the context of use, so it is strongly encouraged to read the associated sections of the manual before determining which settings are correct. The following settings are configured from the Dip Switches on the LT-MADI card:



Device Order: These switches establish whether the Aurora is to be used as the only device in the MADI system, or within a multiple Aurora configuration. See Section 7.4.1 Unit ID Switch for a detailed explanation.

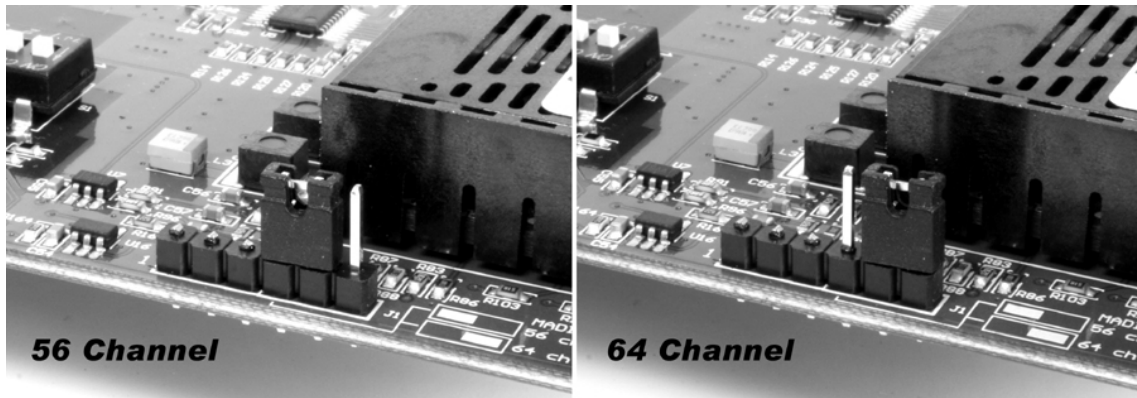
Note that when the Aurora is the only MADI device connected, switch SW3 should be OFF and switches SW1 and SW 2 should be ON (this is the default state for a new LT-MADI card). When multiple Auroras are used, each needs a unique device ID to be correctly integrated, and SW3 should be ON. The table below will describe the pertinent switch settings for single unit mode and any of the four device IDs:

SW1	SW2	SW3	UNIT_ID	SWITCH
ON	ON	OFF	Single Aurora	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>
ON	ON	ON	Device 0	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>
OFF	ON	ON	Device 1	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>
ON	OFF	ON	Device 2	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>
OFF	OFF	ON	Device 3	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>

16-channel mode: This is applicable to an Aurora 16 that is configured for 16-channel mode. It is not applicable for an Aurora 8 or an Aurora 16 in 32-channel mode. For an explanation of 16 and 32-channel mode, see Section 9.1.1 MADI Output Routing. The SW4 determines whether the Aurora's ANALOG or DIGITAL Inputs will route to the 16-channel MADI stream. For more information, see Section 9.1.1.2 Aurora 16 in 16-channel mode.

SW4	Selection when in 16-channel mode	SWITCH
OFF	DIGITAL INPUT	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>
ON	ANALOG INPUT	<p>Back of Aurora</p> <p>ON C&K SDA04</p> <p>1 2 3 4</p>

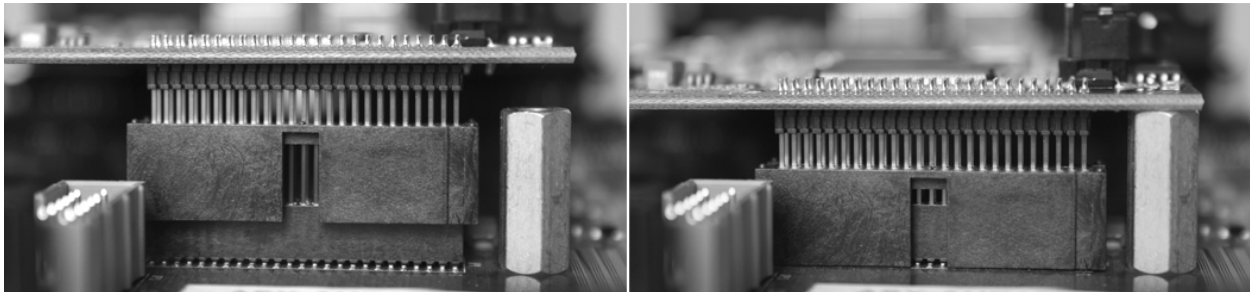
- Set the JP2 jumper for the MADI 56 or 64 channel modes. MADI devices can utilize 56 channel operation or 64 channel operation. The LT-MADI inputs auto-detect the appropriate mode, but the outputs must be configured to work correctly with MADI devices receiving streams from the LT-MADI outputs. It is crucial to consult the documentation for your MADI equipment to determine which mode is appropriate. See [MADI 56/64 Channel Modes](#). 64 channel mode is the LT-MADI default state.



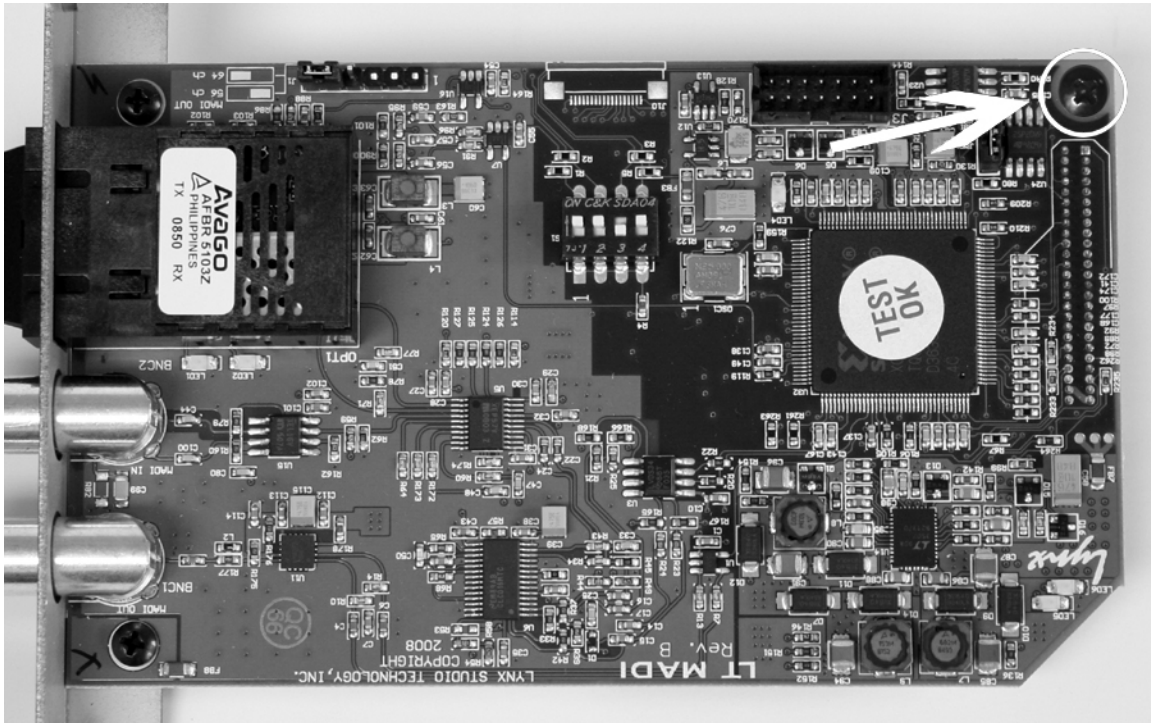
- Attach the multi-pin connector on the back edge of the LT-MADI to the LSLOT connector (JP1) on the Aurora mainboard. The LT-MADI LSLOT connector has a protective sheath to insure that the pins line up correctly with the Aurora LSLOT receptacle. When the LT-MADI connector pins appear to be lined up correctly with the Aurora LSLOT connector press gently until the connector snaps into place. In some cases, the board may need to be gently flexed for the LSLOT connector pins to line up correctly with JP1 on the Aurora mainboard.



Use caution to insure that the pins line up as shown. Incorrect installation could damage the unit.

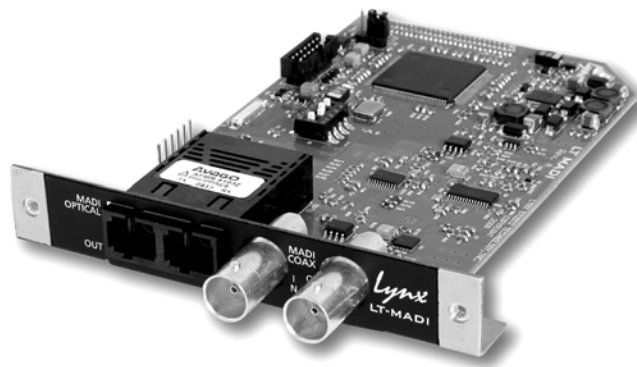


- Secure LT-MADI with three screws; one on the standoff and two from the back panel of Aurora. Keep screws loose until LT-MADI is properly aligned, then tighten snugly, but do not overtighten.



- Reinstall the Aurora lid using the eight screws that had been removed. Do not over tighten the small screw near the center of the front faceplate as it is easily damaged.
- Plug in and power up the Aurora using the front panel standby switch. You can see the LT-MADI from the slits in the Aurora lid. If LED6 on the LT-MADI lights up green, then the installation was successful. If LED6 does not light, unplug the Aurora and re-mount the LT-MADI, making sure that it is securely attached. Then plug in and power up again. If LED6 still does not light, contact Lynx Customer Support (714-545-4700 extension 206).

7 External Connections



MADI (Multichannel Audio Digital Interface), also known as AES10, is an AES approved digital audio standard. Originally conceived for use with Digital Consoles, MADI has since expanded into other audio contexts where high channel count audio transfers are required, such as broadcast, installations, live sound, video post-production, etc. MADI is distinct from other common digital audio standards by the number of channels supported per cable connection. Where other popular standards (AES/EBU, ADAT Lightpipe, TDIF) carry up to 8 channels per connection, MADI is capable of carrying up to 64-channels per connection.

MADI is a point-to-point interface, with separate cable connections carrying input and output signals. There are some variations in how MADI is implemented that are important to consider when configuring your system. These options, as they apply to the LT-MADI card, are explored below.

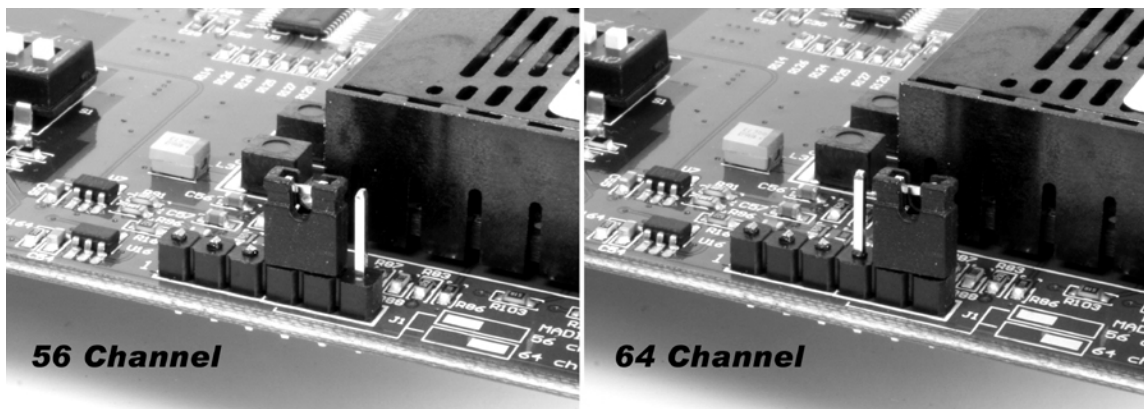
7.1 MADI 56/64 Channel Modes

Originally, the MADI standard defined a maximum of 56-channels per connection at 100 Mbit/s. In 2001, the specification was expanded to support 64-channel operation at 125 Mbit/s. 64-channel operation was conceived for cases where an exact sampling frequency was to be provided, as is typical with modern digital equipment.

MADI operates as a stream of 64 channels, with connected devices occupying a particular number of channels in that stream. For instance, when operating in 64-channel mode up to four 16-channel devices can be plugged into this stream, as long as their device IDs are unique.

The LT-MADI card supports 56 and 64-channel operation. Consult the operation manual for the hardware that you will be connecting to the LT-MADI to determine if it supports 64 or 56 channel operation.

Incoming MADI streams are analyzed for 56 or 64 channel operation and the LT-MADI receiver is automatically adjusted. For output streams, the card needs to be configured for 56-channel or 64-channel mode by setting the jumper on J1. See illustration below:



64-channel mode is the default. If this is a new installation and your connected hardware supports 64-channel mode, then no changes are required.

Maximum channel count is also dependent on the operating sample rate. In 56-channel mode, the LT-MADI is capable of 56 channels at 44.1kHz or 48kHz sample rates, 28 channels at 88.2 or 96kHz and 14 channels at 176.4 or 192kHz. In 64-channel mode, the LT-MADI is capable of 64 channels at 44.1kHz or 48kHz sample rates, 32 channels at 88.2 or 96kHz and 16 channels at 176.4 or 192kHz. Also consider that the maximum number of channels that can be achieved from a single Aurora 16 is 32. Greater than 32-channels is possible only in a system with multiple Auroras.

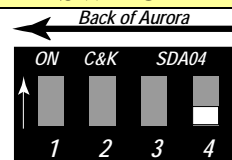
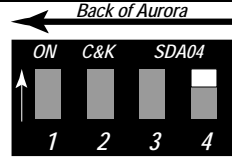
7.2 LT-MADI 16/32-channel modes

When used with some LSLOT expansion cards like the LT-MADI, an Aurora 16 can be configured to operate as a 16-channel or a 32-channel device, depending on your ultimate I/O needs. 16-channel mode is ideal for streaming audio via MADI to the Auroras Analog I/O OR AES I/O, but not both. In contrast, 32-channel mode provides access to all AES/EBU and ANALOG channels on the Aurora, simultaneously and independently.

7.2.1 16-channel mode

In 16-channel mode, the LT-MADI extracts 16 audio channels from the incoming MADI stream and sends them to the Analog and AES outputs simultaneously. The signals are mirrored so that signals delivered to Analog Output 1 would also be sent to AES Output 1.

For the outgoing MADI Stream, the LT-MADI card can be set to route audio from the Analog inputs OR the AES inputs, but not both at the same time. Selecting Digital Inputs or Analog Inputs is done with SW4 switch on the LT-MADI card. See below:

SW4	Selection when in 16-channel mode	SWITCH
OFF	DIGITAL INPUT	
ON	ANALOG INPUT	

The Analog/Digital selection is global. You cannot, for instance, send 8 channels from the Analog inputs and 8 channels from the AES inputs to the MADI outputs.

Note: this switch is only applicable for an Aurora 16 set to 16-channel mode, and is not pertinent for use with an Aurora 8 or an Aurora 16 set to 32-channel mode.

7.2.2 32-channel mode

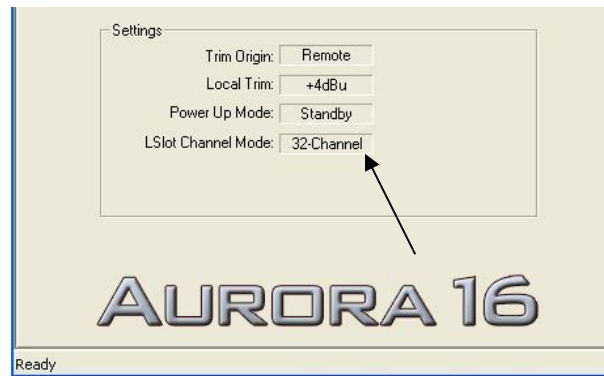
In 32 channel mode and device ID 0, the LT-MADI is capable of routing 32 audio channels from the incoming MADI stream and sending channels 1-16 to the Aurora Analog outputs, and channels 17-32 to the AES outputs. Similarly, the signals from the Analog Inputs can be routed to MADI Outputs 1-16, and signals from the AES Inputs can be routed to MADI outputs 17-32 (note that if the LT-MADI has device ID 1, then the corresponding MADI channels will be 33-48 and 49-64).

As an example, a signal sent to MADI input channel 3 will be delivered to Aurora analog output 3, whereas a signal sent to MADI input channel 18 will be delivered to AES Output 2 (sometimes labeled 1R). See Section 9: [Routing and Channel Mapping](#) for more information.

7.2.3 Switching and verifying mode

Switching between 16-channel and 32-channel mode is done by holding down the TO ANALOG OUT button on the Aurora front panel for one-half second. All of the Aurora LEDs will flash to confirm the switch has occurred. There are two ways to confirm that a unit is in 16-channel or 32-channel mode:

1. Run the Aurora Remote Control software via MIDI. The Aurora Remote Control software is available for OSX or Windows computers, and is on the Lynx Installation disk, or it can be downloaded from www.lynxstudio.com > Support > Downloads. On the Analog I/O page, the LSlot CHANNEL MODE label will display either “32-channel” or “16-channel”.



For more information about the Aurora Remote Control software, see [Aurora Remote Control Software](#).

2. The Aurora channel state can be determined by putting the Aurora into “demo mode”. This is done by pressing down the TRIM and POWER buttons at the same time with the power to the Aurora off. This will cause the Aurora LEDs to flash sequentially from left to right. In addition to this, if the three LEDs around the TO ANALOG OUT button flash together repeatedly, then the Aurora is in 32-channel mode. If they do not, then it is in 16-channel mode.

7.2.4 What about an Aurora 8?

There is no equivalent mode option for an Aurora 8. An Aurora 8 will always operate in 16 channel mode, where the analog and digital inputs and outputs are independent.

With an Aurora 8, the LT-MADI extracts 16 audio channels from the MADI inputs and routes channels 1-8 to the Analog Outputs, and channels 9-16 to the AES outputs. Similarly, the signals from the Analog inputs are routed to MADI outputs 1-8, signals from the AES Inputs are routed to MADI outputs 9-16.

7.3 Connector Types

MADI is typically carried on one of two connector and cable types, and both are supported by the LT-MADI card. The older, original method is coaxial cable with BNC connectors. The LT-MADI requires 75 Ohm coaxial cable. Cables of this sort are inexpensive and easily procurable.

The alternative, more typical with newer MADI devices, uses SC-Type Optical connections with network fiber optic cables. There are a number of benefits to this connection type including markedly less jitter on the digital signal. One of the biggest differences between the two connection types is maximum cable length. Cable runs of up to 2000 meters are possible with the fiber optic connection, whereas coaxial has a maximum cable length of 100 meters.

Two types of glass fiber optic cables can be used:

- Cables with an internal diameter of 50 μm and an external diameter of 125 μm are typically orange and referred to as 50/125 Network Cables.
- Cables with an internal diameter of 62.5 μm and an external diameter of 125 μm are typically blue and referred to as 62.5/125 Network Cables.

Signals passing to the LT-MADI outputs are mirrored to both the coaxial and fiber optic ports. Potentially, both can be connected at the same time in cases where it is useful to have duplicate streams sent to different devices for recording or monitoring.

For MADI input signals, the hardware supports only using either the optical or coaxial ports, but not both simultaneously. The MADI receiver auto-detects which connection has a valid MADI signal, and selects that as the default input port. If both connections contain a valid MADI signal, then priority is given to the fiber optic port.

Tips: LED1 being ON indicates that there is a valid MADI signal on an input port, otherwise, if the incoming MADI signal is invalid, LED1 will blink. LED2 being ON indicates that both MADI output ports are enabled and are passing MADI data.

7.4 Configuring Multiple Auroras

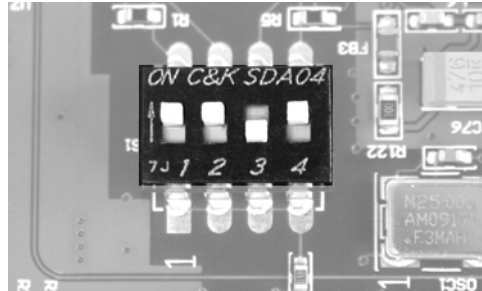
The LT-MADI was designed so that up to four Auroras could be daisy-chained through a single MADI connection. This allows great flexibility in creating a high-channel count system that is simple to manage and use. Any combination of Aurora 16s and/or Aurora 8s can be combined to a channel maximum of 64-channels.

As described earlier, each MADI connection carries up to 64 channels divided into 16-channel clusters. Aurora I/Os occupy these clusters based on several factors:

- Aurora Type (8 or 16)
- Channel Mode (16 or 32 – Pertinent to Aurora 16 only, see Section 7.2.)
- Sample Rate (1X – 44.1/48kHz, 2X – 88.2/96kHz, or 4X – 176.4/192kHz)
- Unit ID settings (LT-MADI Switches SW1 – SW2)

With this number of influential factors, there are a significant number of possible combinations. A key element to multi-Aurora configurations is correctly setting the Unit ID switch on each LT-MADI card.

7.4.1 Unit ID Switch



When multiple Auroras are daisy chained via MADI, it is essential that they each occupy unique positions in the MADI stream. MADI is a serial medium, so devices in a MADI daisy chain will be mounted in a sequential fashion. The Unit ID switch on each LT-MADI card determines the order in which devices are integrated into the MADI stream.

The Unit ID is determined by the position of the SW1 and SW2 switch on the LT-MADI card. It is possible to set this switch after the card is installed, although there should be no AC power to the Aurora when this modification is made.

The unit ID should also correspond to the physical position of each unit in the daisy-chain. For instance, the output of Unit 0 should connect to the input of Unit 1. The output of Unit 1 should connect to the input of Unit 2, etc. For a system that is used in different settings, it is important to make note of the device IDs for each Aurora so that they are not connected in the wrong order.

Switch 3 toggles the delay compensation on or off. Delay Compensation should be ON whenever more than one Aurora is used in a MADI daisy-chain (see section 7.4.2), and OFF whenever a single Aurora is used. The table below will describe the pertinent switch settings:

SW1	SW2	SW3	UNIT_ID	SWITCH
ON	ON	OFF	Single Aurora	
ON	ON	ON	Device 0	
OFF	ON	ON	Device 1	

ON	OFF	ON	Device 2	
OFF	OFF	ON	Device 3	

The factory default state of these Switches is for Single Aurora operation.

7.4.2 Delay Compensation

Each device in a MADI chain operates a number of samples behind or ahead of the previous device, due to latencies intrinsic to the transportation of MADI data through the daisy-chain. Normally, the result of this disparity would be that streams from multi-unit systems would NOT be sample aligned. The LT-MADI has a mechanism to correct for this disparity. Internal delay compensation for each unit insures that analog signals are sample aligned, even with four units connected. The amount of delay compensation that is applied is determined by the Unit ID on the LT-MADI card. For that reason, it is important that the Auroras are daisy chained consistent with the Unit ID position (i.e. Device 0 into Device 1 into Device 2 etc.). Delay Compensation, as stated previously, is turned ON with the SW3 switch and should always be ON for multi-Aurora systems.

The delay compensation affects all Analog and AES/EBU inputs and outputs, at all sample rates.

7.4.3 Unit Bypass

When all MADI channels are being deployed by Auroras on a chain, additional Auroras are put in bypass mode (MADI in and out are bypassed). Bypass is relative to the sample rate. If, for instance, 4 Auroras in 16-channel mode are chained together at 44.1/48 kHz sample rates, I/O from all 4 units will be utilized. At an 88.2/96 kHz sample rate, only the first two units in the chain will be utilized and the last two put into Bypass mode. This is because at the 2X sample rates MADI supports a maximum of 32-channels. LED5 being turned ON (green) indicates that the LT-MADI card is in bypass mode.

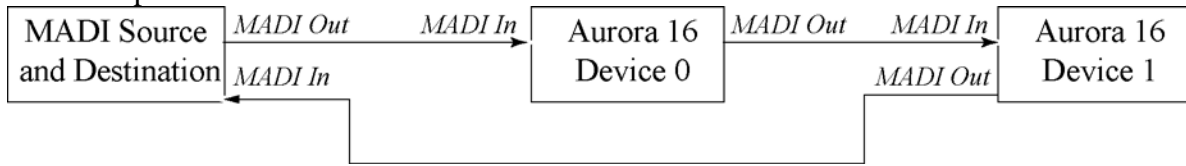
Section 7.4.5 details several common multi-Aurora scenarios and which units are in bypass mode at different sample rates.

7.4.4 Daisy-Chaining Units

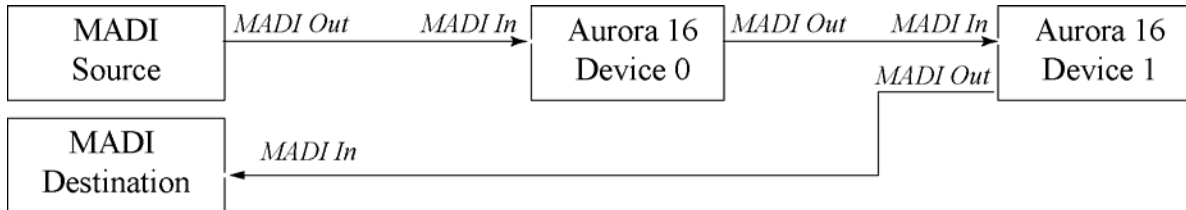
In MADI systems where signal flow is ingoing and outgoing, connected devices typically form a loop. In systems where audio only travels either upstream or downstream (ie. either recording or playback, but not both), then creating a complete daisy-chained loop is not necessary.

The graphics below detail some common scenarios to use as a configuration guide.

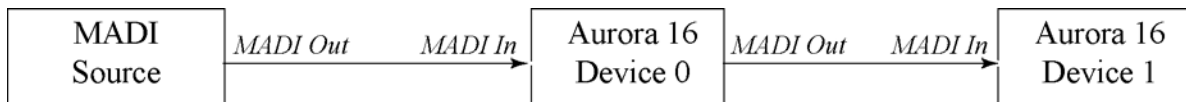
In a system where there is a MADI device that is both the signal source and final destination, connected devices form a loop with outputs connected to inputs through each device in the chain. The example below shows two Aurora 16s connected to a MADI source/destination:



In the case of a system when the MADI source and destination are different devices, the configuration would look like this:



Alternatively, it is possible to have the MADI stream only move in one direction. In this case it is not necessary for the MADI stream to form a complete loop. The example below details a MADI system used for playback only:



Since signals are mirrored to the Optical and Coaxial outputs simultaneously on the LT-MADI, it is possible to mix coaxial and optical connections types in a single MADI daisy chain. However, keep in mind that the optical port will be prioritized as the input connection, so generally you would not want to have both optical and coaxial *input* connections made to the same Aurora.

7.4.5 Possible Combinations

Since there are a variety of factors that impact the channel count and I/O types in a multi Aurora system, this section will help you identify what hardware and settings are necessary to achieve several common configurations.

7.4.5.1 32-channels of Analog I/O, No AES

For this configuration you will need two Aurora 16s. The first Aurora in the chain should be configured as Device 0 and the second as Device 1. Only the Analog I/O on the Aurora will be connected to signal sources and destinations.

	16/32 channel mode	SWITCH	Active Channels 44.1/48kHz	Active Channels 88.2/96kHz	Active Channels 176.4/192kHz
Aurora 16 - Device 0	16-Channel Mode		Analog 1-16	Analog 1-16	Analog 1-16
Aurora 16 - Device 1	16-Channel Mode		Analog 1-16	Analog 1-16	ByPass

7.4.5.2 64 Channels of Analog I/O, No AES

For this configuration you will need four Aurora 16s. They should be configured, in order, as Devices 0 – 3. Only the Analog I/O on the Aurora will be connected to signal sources and destinations.

	16/32 channel mode	SWITCH	Active Channels 44.1/48kHz	Active Channels 88.2/96kHz	Active Channels 176.4/192kHz
Aurora 16 - Device 0	16-Channel Mode		Analog 1-16	Analog 1-16	Analog 1-16
Aurora 16 - Device 1	16-Channel Mode		Analog 1-16	Analog 1-16	ByPass
Aurora 16 - Device 2	16-Channel Mode		Analog 1-16	ByPass	ByPass
Aurora 16 - Device 3	16-Channel Mode		Analog 1-16	ByPass	ByPass

7.4.5.3 32 Channels of Analog I/O AND 32 Channels of Digital I/O

For this configuration you will need two Aurora 16s. They should be configured, in order, as Devices 0 – 1. All Analog I/O and AES/EBU on both Auroras will be connected to signal sources and destinations.

	16/32 channel mode	SWITCH	Active Channels 44.1/48kHz	Active Channels 88.2/96kHz	Active Channels 176.4/192kHz
Aurora 16 - Device 0	32-Channel Mode		Analog 1-16, AES 1-16	Analog 1-16, AES 1-16	Analog 1-16
Aurora 16 - Device 1	32-Channel Mode		Analog 1-16, AES 1-16	ByPass	ByPass

7.4.5.4 16 Channels of AES I/O, No Analog

For this configuration you will need one Aurora 16 that should be configured as a single unit. Only the Digital I/O on the Aurora will be connected to signal sources and destinations.

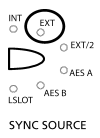
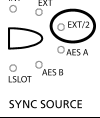
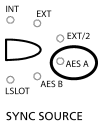
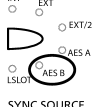
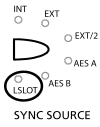
	16/32 channel mode	switch	Active Channels 44.1/48kHz	Active Channels 88.2/96kHz	Active Channels 176.4/192kHz
Aurora 16 – Single Unit	16-Channel Mode		AES 1-16	AES 1-16	AES 1-16

8 Clock Settings

In any audio system with more than one digital device, it is ideal for one master clock to provide synchronization to all connected devices. There are several options for configuring the Aurora to send or receive a clock signal within a MADI environment.

MADI equipment and other digital devices can slave to the sample clock generated by the Aurora, or the Aurora can be configured to receive clock from other digital devices. It is also possible to have a dedicated clock source that provides clock to both the Aurora and every other digitally connected device. In fact, if more than two digital I/O devices will be integrated into your system, we strongly recommend using some form of clock distribution to insure proper clock synchronization.

The table below details SYNC SOURCE choices for the Aurora as pertinent to use within a MADI-based system. Please see section 2.4 of the Aurora manual for general information about available clock settings and clocking considerations with the Aurora.

 <p>INT EXT EXT/2 AES A AES B LSLOT SYNC SOURCE</p>	<p>EXT - External</p> <p>Clock signals from Aurora WORD CLOCK input. In general, WORD CLOCK is the preferred means to clock devices (including multiple Auroras) in a MADI system. Auroras can be daisy-chained via wordclock, or recipients of wordclock distribution. In a simple system (i.e. one Aurora and a MADI source/destination), it is still ideal to use Word Clock sync between the Aurora and the other MADI device(s) as a means to reduce jitter system-wide.</p>
 <p>INT EXT EXT/2 AES A AES B LSLOT SYNC SOURCE</p>	<p>EXT/2 - External Divided by 2</p> <p>Used if the word clock is half the rate of the desired sample rate, which would be more typical in legacy systems.</p>
 <p>INT EXT EXT/2 AES A AES B LSLOT SYNC SOURCE</p>	<p>AES A – Port A Digital Input</p> <p>Word Clock recovered from the Port A digital input (or AES channels 1-4 on an Aurora 8). In a MADI-based system this would be an unusual Sync Source. It could be a solution when the Aurora is used with a MADI device that does not have wordclock sync options but does have AES/EBU ports, in order to avoid some of the issues with clocking via MADI connections.</p>
 <p>INT EXT EXT/2 AES A AES B LSLOT SYNC SOURCE</p>	<p>AES B – Port B Digital Input</p> <p>Word Clock recovered from the Port B digital input, like above. On an Aurora 8, this would be signals from AES inputs 5-8.</p>
 <p>INT EXT EXT/2 AES A AES B LSLOT SYNC SOURCE</p>	<p>LSLOT</p> <p>Sample clock derived from the incoming MADI signal.</p> <p><i>There are some specific issues to be aware of when clocking via MADI:</i></p> <p>Clock signals derived from a MADI stream contain high-levels of jitter because the clock rate for MADI I/O is asynchronous with the sample rate.</p> <p>Thankfully, the Aurora was designed with Lynx’s SynchroLock technology specifically to correct for jitter in incoming signals. It is capable of jitter reduction up to 3000:1. Considering the poor jitter performance with the MADI protocol, we strongly recommend leaving SynchroLock ON when clocking via LSLOT.</p> <p>Additionally, MADI devices can only detect the base (1x) rate of the incoming MADI stream. Therefore it is necessary to manually set the Aurora to the desired Sample Rate when using LSLOT as the SYNC SOURCE at sample rates > 48kHz (ie. 2x, 4x rates). For instance, if the incoming MADI signal is operating at 88.2kHz, the Aurora will default to a sample rate of 44.1kHz. Click the SAMPLE RATE button on the Aurora front panel to toggle between 2x, 4x, 1x sample rates and set the Aurora to 88.2kHz for proper clock operation.</p>

9 Routing and Channel Mapping

Sending audio signals into and out of the LT-MADI is straightforward. Routing can be initiated globally from the Aurora front panel or on a per-channel basis by using the Aurora Remote Control software.

9.1 Routing Logic

The LT-MADI card implements a routing scheme whereby signals sent to Analog or Digital *inputs* on the Aurora get automatically routed to appropriate MADI *Outputs*. Signals going into MADI *Inputs* however can be routed to the AES, Analog or MADI *Outputs*.

The selections of 16/32 channel mode, and the Analog/Digital switch for 16-channel mode are pertinent to the routing behavior, so it is important to be clear on the state of the Aurora in this regard to understand the results.

9.1.1 MADI Output Routing

MADI Output routing is hard wired and cannot be altered by the user. The state of the TO ANALOG OUT and TO DIGITAL OUT buttons on the Aurora front panel have no impact on the MADI Output routing scheme. Signals sent to an Aurora input (analog and/or digital) get routed directly to a MADI output. The block of MADI output channels that will be affected depends on the LT-MADI's device ID, whether the Aurora is operating in 16 or 32 channel mode (for an Aurora 16 only), and the operating sample rate.

9.1.1.1 Aurora16 in 32-channel mode

In 32-channel mode, all 16 Analog AND all 16 AES/EBU Inputs send audio streams to the MADI outputs. Analog Inputs 1-16 are routed directly to MADI outputs 1-16, and Aurora Digital Inputs 1-16 are routed directly to MADI Outputs 17-32. It is important to consider the active sample rate as this has pertinence to the number of actual MADI channels available. See the reference charts in section 7.4.5: [Possible Combinations](#)

9.1.1.2 Aurora 16 in 16-channel mode

In 16-channel mode, the Aurora 16 will pass up to 16 channels of audio to the MADI outputs. If the LT-MADI card is set to "ANALOG", then signals sent to the 16 Analog inputs will be routed to the MADI outputs, and signals sent to the Aurora's Digital inputs will not. Conversely, if the LT-MADI card is set to "DIGITAL", then signals sent to the 16 Digital inputs will be routed to the MADI outputs, and signals sent to the Analog inputs will not.

9.1.1.3 Aurora 8

An Aurora 8 will always be a 16-channel device when used with the LT-MADI. All 8 Analog AND all 8 AES/EBU Inputs send audio streams to the MADI outputs. Analog Inputs 1-8 are routed to MADI Outputs 1-8, and Digital Inputs 1-8 are routed to MADI Outputs 9-16.

9.1.2 Input Routing

Signals from MADI inputs can be routed to Aurora Analog and/or AES/EBU Outputs. The Aurora will need to be configured for this routing scheme and will not operate this way in its default state. Input routing can be set globally from the Aurora Remote Control software or from the Aurora front panel.

Additionally, input routing can also be initiated by the user on a per-channel basis with the Aurora Remote Control software.

9.1.2.1 Global Routing

Global routing is achieved from the Aurora Remote Control software or from the Aurora front panel. From the front panel, the buttons labeled TO ANALOG OUT and TO DIGITAL OUT are where appropriate routing would be established. Since the LT-MADI is an LSLOT device, Choosing “LSLOT In” as the Source for TO ANALOG OUT would route signals from MADI inputs to the Aurora’s Analog outputs. Choosing “LSLOT In” as the Source for TO DIGITAL OUT would route signals from MADI inputs to the Aurora’s AES/EBU DIGITAL outputs.

This setting will be affected by the 16/32-channel mode states for an Aurora 16. In 32-channel mode, MADI inputs 1-16 will route to Analog outputs 1-16. MADI inputs 17-32 would route to Aurora Digital outputs 1-16.

In 16-channel mode, if the LT-MADI card is set to “ANALOG”, then signals sent to the 16 MADI inputs will be routed to the Aurora’s Analog outputs, and signals sent to the Aurora’s Digital inputs will not. Conversely, if the LT-MADI card is set to “DIGITAL”, then signals sent to the 16 Digital inputs will be routed to the MADI outputs, and signals sent to the Analog inputs will not.

With an Aurora 8, MADI inputs 1-8 will be sent to the Aurora’s Analog outputs, and MADI inputs 9-16 will be sent to the Aurora’s Digital outputs.

The following chart will detail global LT-MADI Input routing with the various configurations of an Aurora 8 or Aurora 16

Unit	16/32 channel mode	Digital or Analog mode	MADI Inputs 1-8 Route to	MADI Inputs 9-16 Route to	MADI Inputs 17-24 Route to	MADI Inputs 25-32 Route to
Aurora 16	32-Channel Mode	N/A	Analog Out 1-8	Analog Out 9-16	Digital Out 1-8	Digital Out 9-16
Aurora 16	16-Channel Mode	SW4 switch = Analog	Analog Out 1-8	Analog Out 9-16	N/A	N/A
Aurora 16	16-Channel Mode	SW4 switch = Digital	Digital Out 1-8	Digital Out 9-16	N/A	N/A
Aurora 8	N/A	N/A	Analog Out 1-8	Digital Out 1-8	N/A	N/A

9.1.2.2 Per Channel Routing

In addition to global routing, an LT-MADI equipped Aurora is capable of routing MADI streams to Aurora Analog and Digital outputs on a per-channel basis. MADI streams can also be duplicated across multiple Aurora outputs. For instance, MADI input 1 and 2 can be routed to Analog outputs 7 and 8, while MADI inputs 3 and 4 can be routed to Analog outputs 5 and 6 AND Digital out 1 and 2 at the same time.

Per-channel routing can only be initiated from the Aurora Remote Control software. The Aurora Remote Control (ARC) application allows control of Aurora parameters from a convenient software interface. It also provides accurate real-time metering for the Analog and Digital inputs and outputs.

The ARC software can operate on an OSX or Windows PC computer via a Lynx AES16 audio interface or MIDI. The software is available on the Lynx Installation CD, or can be downloaded from www.lynxstudio.com > Support > Downloads.

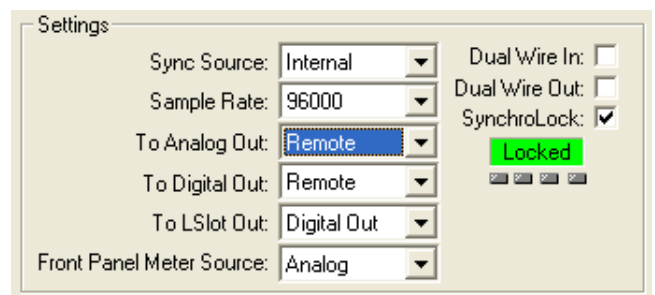
9.1.2.2.1 Aurora Remote Control Software

The Aurora Remote Control (ARC) application allows control of Aurora parameters from a convenient software interface. It also provides accurate real-time metering for the Analog and Digital inputs and outputs.

After installation, the ARC can be run from the “Lynx Studio Technology” program group on a Windows machine, or from “Applications” on an OSX installation.

The Aurora Remote Control Application allows the user to control output levels, route inputs to outputs, change parameters, and view accurate meters for inputs and outputs on a connected Aurora. Most parameter changes will be reflected both on the Aurora front panel and within the software application.

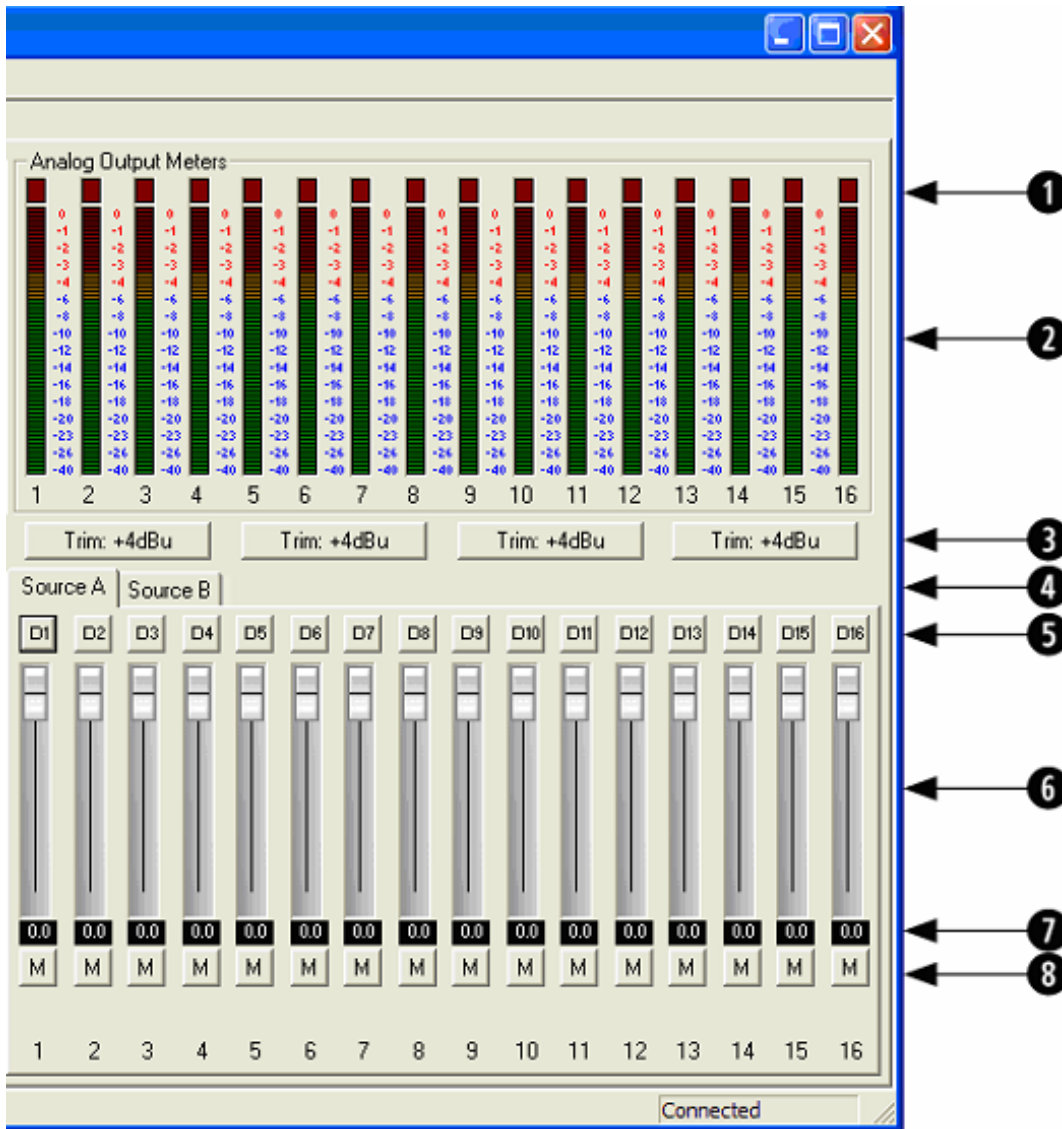
Global routing can be set identically from the Aurora front panel or from the ARC application. The selections available for TO ANALOG OUT and TO DIGITAL OUT are “ANALOG IN”, “AES IN” and “LSLOT IN”. Additionally these buttons can be set to “Remote” mode by pressing the appropriate button until the LEDs for all three choices are illuminated or by selecting “Remote” as the source from within the ARC Digital I/O and Settings page.



In “Remote” routing mode, the Volume faders in the ARC become active, and audio signals can be routed on a per-channel basis. Routing and volume controls for the Analog Outputs are initiated from the “Analog I/O” page, and for the AES/EBU Digital Outputs from the “Digital

I/O & Settings” page. The Aurora is capable of two sources per output at any sample rate. LSLLOT sources will represent MADI signals when an LT-MADI card is installed.

The features on the Output section of the “Analog I/O” page are described below:



- ① These indicators will illuminate when three consecutive full-scale samples are detected on the Aurora Analog inputs and outputs or when a summing overrun occurs on the Aurora Analog outputs. The indicator will remain illuminated for 250ms.
- ② These meters display the instantaneous peak level of audio being sent to the Aurora Analog inputs and outputs.
- ③ These buttons allow the Analog input or output trims to be set. Each button allows groups of four channels to be toggled between +4dBu (the default) and -10dBV. This setting will only appear on the Analog I/O page.
- ④ These tabs allow monitor source groups to be selected for the Analog outputs when Remote Routing is utilized. The Aurora can be set for global routing (i.e. AES In routes to Analog Out) or Remote Routing. With Remote Routing up to two sources (Source A

and Source B) can be established for each output. For these custom monitor sources to be active, the TO ANALOG OUT switch on the Digital I/O & Settings page must be set to “Remote”. In this state all three LEDs for the TO ANALOG OUT button on the Aurora front panel will be illuminated.

- 5 These buttons allow individual monitor sources to be selected for each analog output when using Remote Routing. Clicking a button allows selection of any Analog, Digital or LSLOT input source (LSLOT = MADI). Holding down the CTRL key while selecting a source causes the remaining channels to be set sequentially (i.e. if you select LSLOT In 1 as the monitor source for Analog Out 1 while holding down the CTRL key, LSLOT In 1-16 will be assigned to Analog Out 1-16).
- 6 These faders allow control over the output level of each monitor source when in Remote Routing mode. This level attenuation occurs in the digital domain, so it is recommended to leave these faders in their default, maximum position in situations where the highest fidelity is required. Holding down the SHIFT key on the keyboard while adjusting a fader, will cause adjustment of channel pairs.
- 7 This display reveals the amount of attenuation, in dB, of a monitor source.
- 8 This button enables the mute function for the associated monitor source.

Any input sources assigned to an output can be assigned multiple times, for instance, a stream coming in to MADI inputs 1 and 2, can be routed to Analog outputs 1 and 2, as well as Analog outputs 9 and 10. With an Aurora 16 it is important to be aware of whether the Aurora is operating in 16 or 32-channel mode. This will determine the number of MADI input channels that will be available for routing.

Some examples of possible routing combinations would be:

Routing MADI input streams to Analog outputs AND routing Analog inputs to Analog outputs:

TO ANALOG OUT = “REMOTE”

Source A = LSLOT 1-16

Source B = Analog In 1-16

Routing 16-channels of MADI input streams to Analog out 1-16 AND Digital out 1-16:

TO ANALOG OUT = “Remote”

TO DIGITAL OUT = “Remote”

Analog Source A = LSLOT 1-16

Digital Source A = LSLOT 1-16

Sending a stereo MADI stream to 16 MADI outputs:

TO DIGITAL OUT = “Remote”

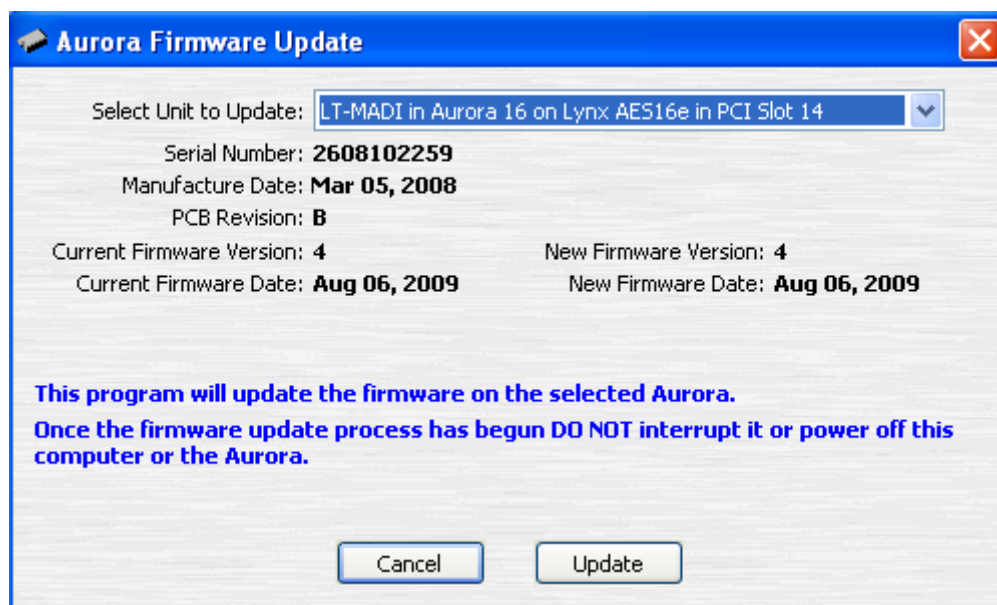
Digital Source A = LSLOT 1/2, LSLOT 1/2, etc.

10 Updating the firmware on the LT-MADI

Updating the firmware on the LT-MADI uses the same process as updating the firmware on the Aurora. With the most current Aurora Firmware Update program, a properly installed LT-MADI can be selected as the device to program.

Instructions for downloading and running the Aurora Update program for Windows or OSX are available at: www.lynxstudio.com > Support > Downloads > Product = Aurora.

At the Aurora Firmware Update screen, simply select the LT-MADI from the “Select Unit to Update” pulldown menu, and click “Update” to run. If the LT-MADI does not appear as an option here, verify that the LT-MADI is properly installed and the Current Aurora firmware revision is 24 or higher.



When the update process is complete, it is important to press the front-panel Power button to shut down the Aurora AND then **disconnect the Aurora from its power source.**

11 Specifications

MADI PORTS	
Type	Coaxial input and output / fiber optic input and output
Channels	In 56 Channel Mode: 56 channels @ 48kHz 28 channels @ 96kHz 14 channels @ 192kHz In 64 Channel Mode: 64 channels @ 48kHz 32 channels @ 96kHz 16 channels @ 192kHz
CLOCK SYNCHRONIZATION	
Clock Sources	MADI or Aurora slave
ARCHITECTURE	
Core	FPGA-based core. Support for firmware field upgrades.
CONNECTIONS	
I/O Ports	(2) Bracket-mounted BNC connectors. (2) Bracket-mounted fiber optic SC connectors.
Other	LSlot expansion header (to Aurora)
SUPPORTED CABLE TYPES	
Coaxial	75 Ohm with BNC connectors.
Fiber Optic	50/125 or 62.5/125 network cables with SC Type optical connectors
GENERAL	
Host Interface	Lynx proprietary LSlot™ Interface: 400 Mbps bi-directional
Requirements	Aurora 16/Aurora 8 with Firmware Revision 24 or higher and available LSlot expansion slot.
Size	3.0" H X 5.0" W X 0.75" D
EMI	FCC and CE
Certifications	
Shipping Weight	1 pound

12 Support

We are devoted to making your experience with the LT-MADI trouble-free and productive. If the operational sections of this manual did not help resolve your questions, several support options are available to you:

12.1 Lynx Website Support Resources

Logging on to <http://www.lynxstudio.com/support.html> will provide several options for resolving your support issues:

Support Ticket

For direct attention from the Lynx Technical Support Staff, registered users can submit a support ticket online that details their problem and steps they've taken to resolve it. Most Support Ticket submissions are responded to within 24 hours.

Frequently Asked Questions

An extensive catalog of FAQs derived directly from our most common tech support inquiries. Our FAQ section is updated regularly and designed to allow users to find the answers to their most common questions quickly.

Firmware and Driver Downloads

A library of current firmware and driver files are available for download and installation. Check back regularly to insure that your Aurora and LT-MADI are up-to-date.

Lynx Support Forum

An online Lynx users support forum provides a venue for customers to post questions and issues and receive responses from other users as well as Lynx technical administrators. Searching previous posts is often an excellent way to uncover valuable information about Aurora operation and troubleshooting. See <http://www.lynxstudio.com/forum>.

12.2 Telephone Support

Telephone support is available by calling +1 (714) 545-4700 extension 206 from 9AM to 5PM Pacific Time, Monday through Friday, excluding United States Holidays.

12.3 Registering your LT-MADI

Lynx is committed to providing you with the best service possible. To help us serve you better, please be sure to register your LT-MADI using one of the following methods:

- Fill out and mail the Warranty Registration Card included with your LT-MADI.
- Register on the web at: <http://www.lynxstudio.com/> > Support > Register Your Products

Once you are registered you will automatically receive notifications of new products and upgrades.

12.4 Return Policy

If you have a unit that you suspect is defective or is malfunctioning contact Lynx technical support via one of the means described above for diagnosis. If the technician determines that the unit is faulty, they will issue an RMA number so you can send the unit in for repair. Units received without a valid RMA number will be refused. All RMA numbers are valid for 30 days from the date of issue.

13 Warranty Information

One year Free Labor / One year Parts Exchange
This product must be returned to the factory for repair.

Who Is Covered?

You must have proof of purchase to receive warranty service. A sales receipt or other document showing when and where you purchased the product is considered proof of purchase. This warranty is enforceable only by the original retail purchaser. To be protected by this warranty, the purchaser must complete and return the enclosed warranty card or register online within 14 days of purchase.

What Is Covered?

Warranty coverage begins the day you buy your product. *For one year thereafter*, Lynx shall, at its sole and absolute option, either repair or replace free of charge any product that proves to be defective on inspection by Lynx or its authorized service representative. In all cases disputes concerning this warranty shall be resolved as prescribed by law. All parts, including repaired and replaced parts, are covered only for the original warranty period. When the warranty on the product expires, the warranty on all replaced and repaired parts also expires.

What Is Excluded?

Your warranty does not cover:

- Labor charges for installation or setup of the product.
- Product repair and/or part replacement because of misuse, accident, unauthorized repair or other cause not within the control of Lynx.
- A product that requires modification or adaptation to enable it to operate in any country other than the country for which it was designed, manufactured, approved and/or authorized, or repair of products damaged by these modifications.
- Incidental or consequential damages result from the product, damage to property, damage based on inconvenience or on loss of use of the product, and, to the extent permitted by law, damages for personal injury. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.
- A product that is used for rental purposes.

To Get Warranty Service...

To obtain warranty service, the purchaser must first call or email Lynx at the email address or telephone number printed in Section 12 to obtain a Return Authorization Number and instructions concerning where to return the unit for service. All inquiries must be accompanied by a description of the problem. All authorized returns must be sent to Lynx or an authorized Lynx repair facility postage prepaid insured and properly packaged. Proof of purchase must be presented in the form of a bill of sale, canceled check or some other positive proof that the product is within the warranty period. Lynx reserves the right to update any unit returned for repair. Lynx reserves the right to change or improve design of the product at any time without prior notice.

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LT-MADI™ User Manual, October 14, 2009.

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