

Lutron Solutions for DMX512-A

DMX512-A (Digital MultipleX) is an RS485 standard protocol for digital communication that is commonly used to control stage lighting and theatrical effects. Examples of this include moving lights, color changing lights, and fog machines. DMX512-A is also used to control color changing fixtures in both general lighting and commercial applications. The DMX512-A standard was developed by the Entertainment Services and Technology Association (ESTA). Currently, the standard is maintained by the Professional Lighting and Sound Association (PLASA). The current version of the standard is E1.11 – 2008, USITT DMX512-A, or just DMX512-A. This document will use 'DMX' to refer to this standard.

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Purpose

The rise of LEDs in commercial lighting has caused an increase in the number of applications using DMX to control LED lighting. This document describes the DMX protocol and how Lutron systems can both control loads with a DMX output and also receive DMX as an input.

Terminology

Channels:

DMX consists of up to 512 channels of control. Channels are commonly used as intensity levels, but can be used to control motion in motorized screens or lights, among other functions. RGB control takes 3 separate channels of control in DMX; one for Red, one for Green, and one for Blue. Some fixtures add a 4th channel A for amber. Each channel has 256 steps. For example, channel 1 can have a value anywhere from 0-255. This is useful in color mixing applications – three channels for RGB control with 256 values in each channels allows for over 16.7 million possible combinations of color. The first channel which a fixture listens to is known as the fixture's "Address" (see "Address" definition below). It is important to understand that a DMX device can listen to more than one channel.

DMX Receiver:

Also called a DMX device, this is a physical object that listens to a DMX control and reacts based on the value of certain channels. For example, this could be a lighting fixture or a fog machine. DMX devices have a start address, but may listen to multiple consecutive channels. For example an RGB lighting fixture on address 1 may listen to channels 1, 2 and 3 (for Red, Green and Blue) with the next fixture then taking address 4.

DMX Transmitter:

Also called a DMX source or control, this is the originator of commands on a DMX bus. For example, this could be a theatrical console or a colorwheel.

DMX-over-Ethernet:

Sometimes referred to as 'Ethernet DMX,' is a network-based version of DMX512 that is transmitted over Ethernet, commonly utilizing network protocols such as Art-Net and sACN. Using a standard network for transmission of data, devices can be discovered and addressed digitally, systems can be much larger, and downstream DMX devices are capable of providing feedback data.

Merger:

Sometimes referred to as a "combiner", a device used to allow multiple transmitters to control a single DMX device. Typically, the transmitter with the higher value for a given channel will 'win' in the case of a conflict. However, some DMX combiners have the ability to assign priority to certain inputs. Since DMX communication works by the transmitter broadcasting the value of every channel out, concurrent control by multiple transmitters can be done. For example, a merger may be used so two transmitters can control the same load, but they also may each have their own loads that they don't share control over. In that case, each transmitter is capable of concurrently controlling loads.

Node:

A node is a device that is primarily used to split up multiple DMX Universes streaming over an individual Ethernet cable into individual parallel DMX Universes. In some cases, typically larger installations, DMX transmitters (controllers) may be installed that can supply multiple Universes of DMX control throughout the entire DMX system. A node is designed to accept the DMX-over-Ethernet input from the controller and convert it to single DMX universes with standard DMX512 wiring connections on each of its many outputs.

Remote Device Management (DMX/RDM):

A protocol enhancement feature designed to layer on top of the standard uni-directional DMX512 protocol. It allows for bi-directional communication between connected DMX devices, allowing for fixture discovery and addressing, gathering of fixture information, and configuration. Both DMX transmitters and receivers must be enabled with this feature in order to utilize its capability.

Splitter:

Sometimes referred to as a 'repeater', a splitter is a device used to split up a DMX bus into multiple parallel buses. A single bus can have up to 32 unit loads. Normally a "unit load" is one device and a DMX bus can communicate with 32 devices. However, it is now common for fixtures to have a unit load of less than 1, allowing for more devices to be connected to the same DMX bus. A splitter allows for more than 32 devices to exist as part of the same universe.

Terminology (*continued*)

Start Address:

An address is the channel that a DMX receiver starts listening to and is configured on the device itself. For example, an address of 4 means the DMX device will start listening to channel 4 in the universe (see “Universe” definition below). The device will listen to as many channels as it is capable of. If a device is a 3 channel device, it would listen to channels 4, 5, and 6. There is no requirement for all fixtures to use contiguous addresses. A fixture could use address 4 and another fixture could use address 8, with 5, 6, and 7 potentially being unused. Devices can also share the same address. For example, multiple fixtures can be set to the same start-address so that they will behave identically. The channels that a DMX device consumes is commonly referred to as its’ DMX footprint. An address is typically set by DIP switches or dials on the DMX receiver. Some newer DMX devices are addressed with DMX-RDM, which Lutron does not support. See the DMX-RDM section for more details.

Universe:

A DMX ‘Universe’ is made up of 512 channels. When a single channel is mapped to a single Lutron lighting zone, the 0-255 scale of DMX values is linearly mapped to the 0-100% values of a Lutron lighting zone.

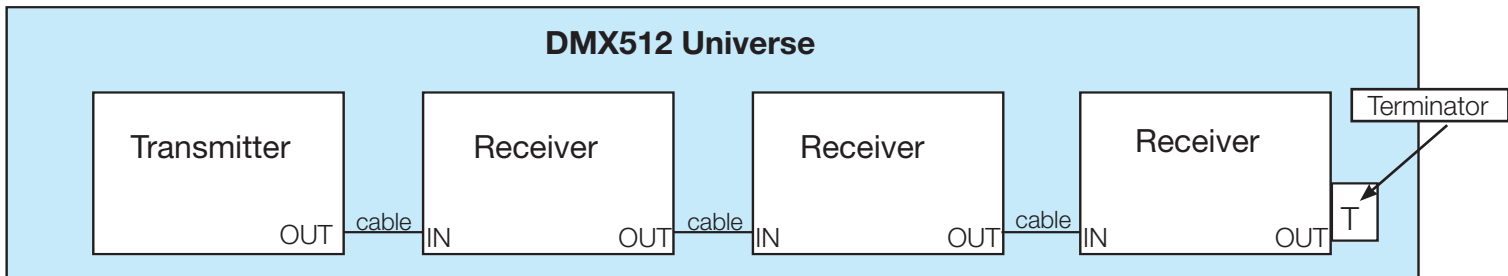
Wireless DMX:

A method of deploying a DMX network, but without the use of wiring between DMX transmitter and DMX receiver, typically consisting of an RF transmitter and series of receivers in either a mesh or fixed RF network.

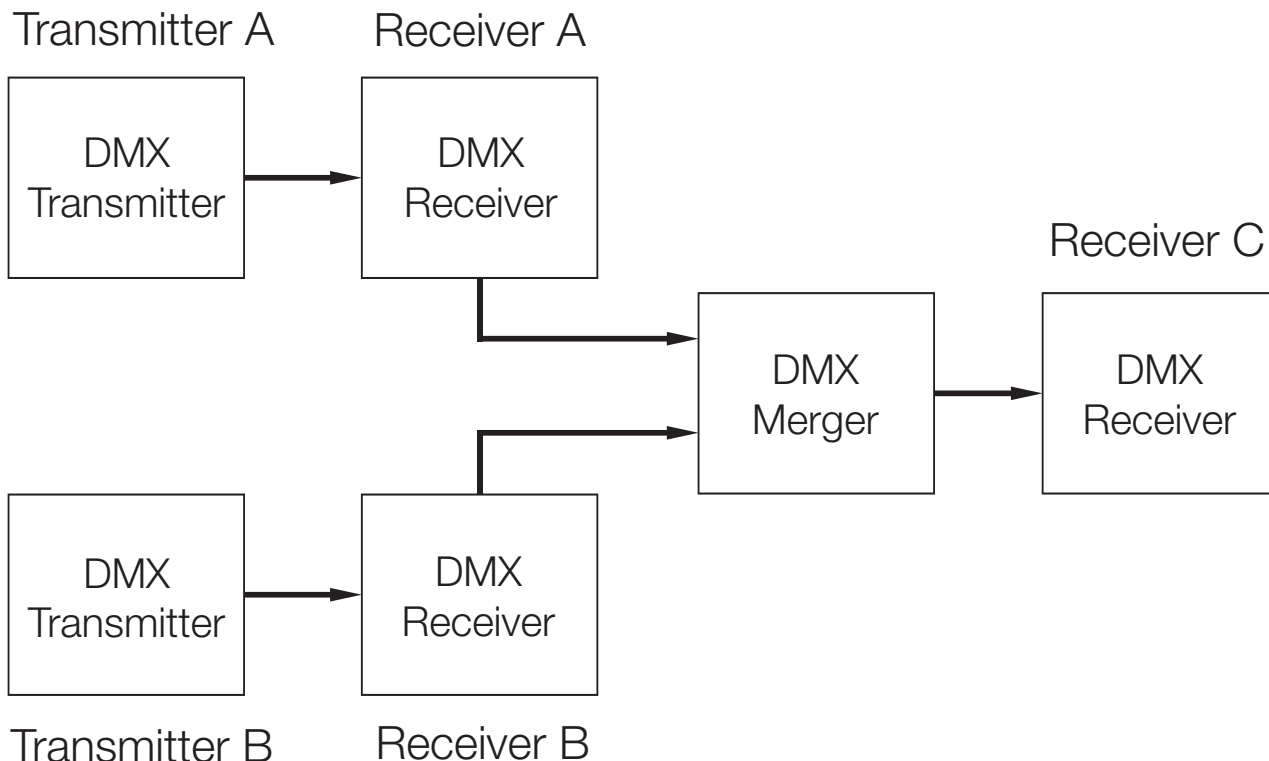
Wireless DMX is commonly being used in, many times in portable or fast moving applications, and also in architectural lighting installations where cable length or access to cable can be prohibitive.

Protocol

DMX is a one-way communication protocol that uses a transmitter/receiver paradigm for communication. For example, a transmitter could be a theatrical console and a receiver could be a spotlight. Communication always flows from the transmitters (also called ‘controllers’) to the receivers. Note that this is different from RDM (not currently supported by Lutron), which sends data in both directions.



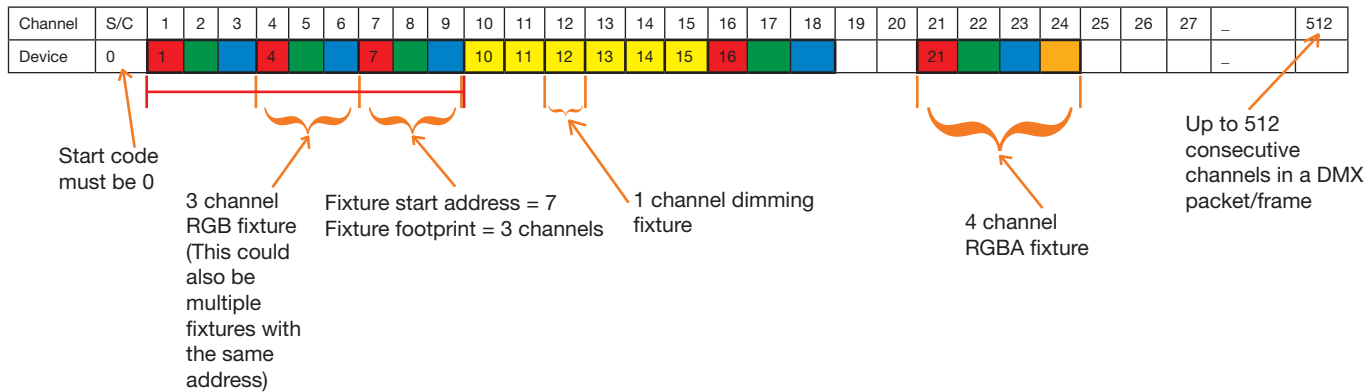
Packets of DMX data (always starting at channel 1 and including up to 512 channels of “level” data) are transmitted repeatedly by the controller, typically up to 30 times per second. DMX data defines the levels instantaneously requested for each channel, rather than using a fade-rate. Cross-fades between levels or “animation” between color selections are performed by sending consecutive packets of DMX data with small changes to the channel values. Typically, there is only a single transmitter in a given DMX universe. However, multiple transmitters can control a single DMX universe through the use of a DMX merger. Any receivers that are downstream of a merger will listen to all transmitters upstream of the merger. Any receivers located before the merger will only listen to the transmitter upstream from them. For example, in the diagram below, Receiver B would only listen to Transmitter B. Similarly, Receiver A would only listen to Transmitter A. However, Receiver C would listen to both Transmitter A and Transmitter B. In the case of a conflict, typically the highest value will take precedence. It is also important to note that concurrent control is possible. Transmitter A could control Receiver A at the same time that Transmitter B is controlling Receiver B. It is also possible for both Transmitter A and Transmitter B to attempt to control Receiver C at the same time, but the highest value for each channel Receiver C is listening to will win control.



DMX512-A System Rules:

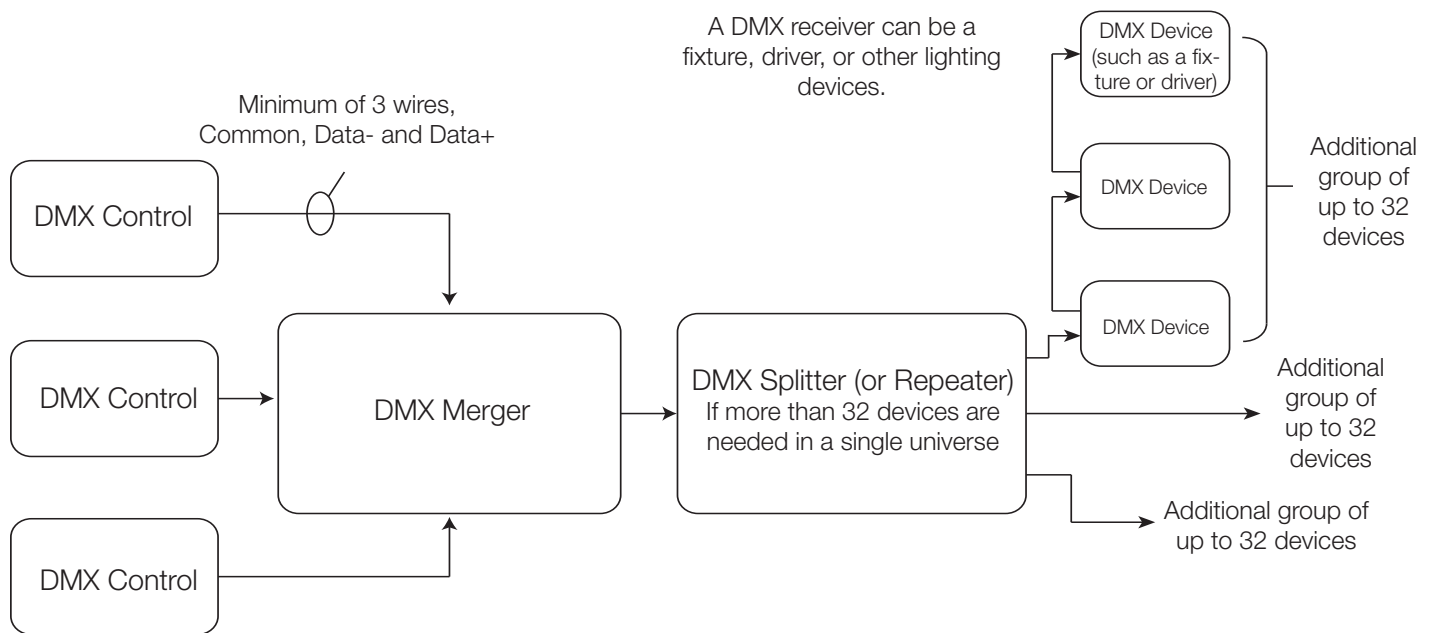
1. Max of 512 channels in a DMX universe
2. No more than 32 DMX unit loads (normally one device is a single unit load, but some fixtures will present a unit load of less than one) on a single DMX bus – a splitter is needed if more than 32 DMX unit loads are required.
3. If there is more than one DMX control source, a DMX merger is needed. More than one merger can be used.
4. Devices can be set to the same address if they are intended to be controlled together. This is a way of creating a control zone. For example, if 10 lighting fixtures need to respond the same way to the same commands, they can be all set to the same address.

DMX512-A Addressing Example

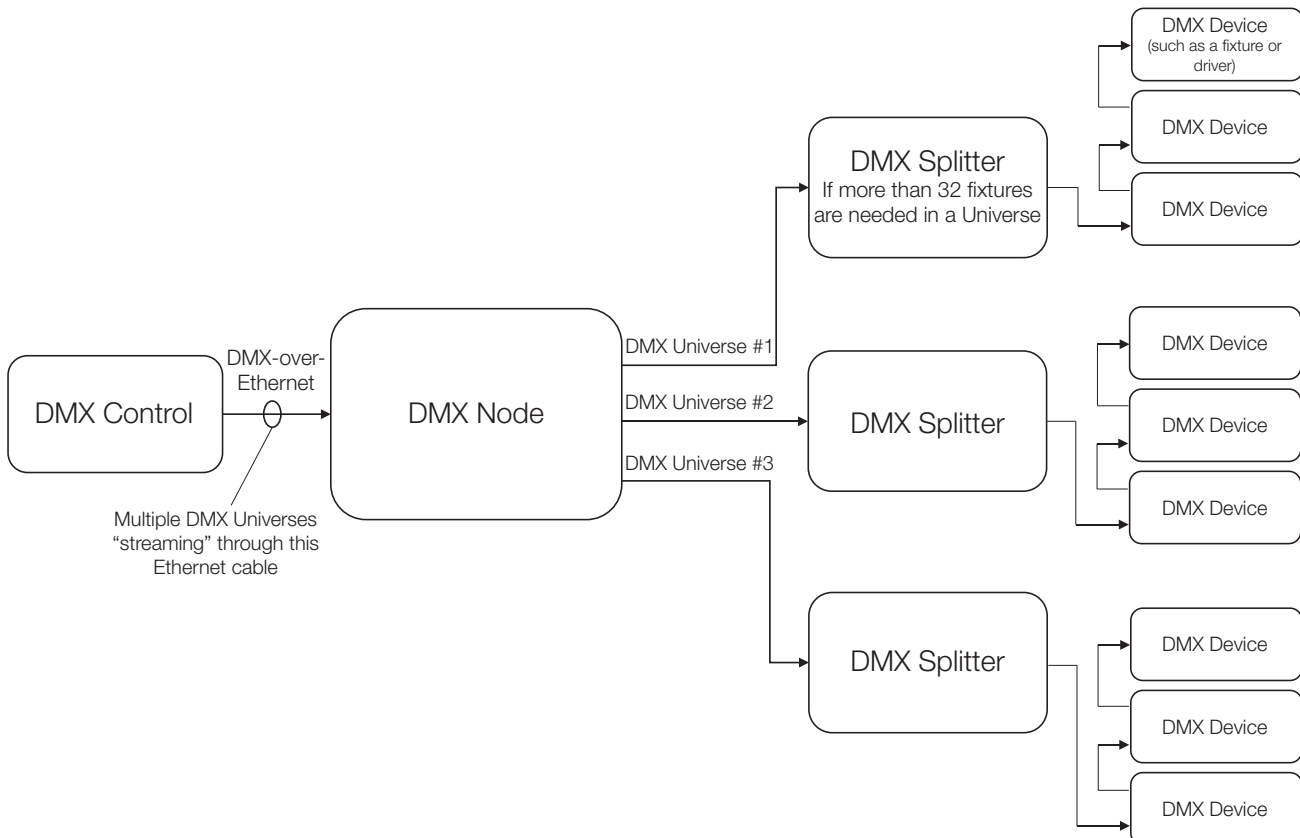


DMX512-A System Examples

Example 1



Example 2



Wiring

DMX wiring is only permitted in a daisy-chain fashion. DMX transmitters typically only have an 'OUT' connection, while the receivers have both an 'IN' and 'OUT' (or 'THRU') connection. Connections are made using a standard 5 pin XLR connector pictured below. Many DMX devices only use 3 pins, even though this is expressly prohibited by section 7.1.2 of the ANSI E1.11 standard. Up to 32 unit loads can be wired together on a single network bus. A DMX universe can consist of multiple buses by using DMX splitters, which allows a universe to contain more than 32 devices. The DMX specification also calls for a wiring terminator (a 120 ohm resistor between Data+ and Data-) to be used to terminate a bus; however, receivers often have built in terminators that can be toggled on with a switch. As a general rule, DMX links are typically kept shorter than 1000 ft (304.8 m), and often less for theatrical applications.

XLR-5 pinout
1. Signal Common
2. Data 1- (Primary Data Link)
3. Data 1+ (Primary Data Link)
4. Data 2- (Optional Secondary Data Link)
5. Data 2+ (Optional Secondary Data Link)

XLR-3 pinout
1. Signal Common
2. Data 1-
3. Data 1+

For DMX-over-Ethernet, the distance limit follows the standard Ethernet guidelines which is 328 ft (100 m). DMX-over-Ethernet networks can be extended using a standard switch.

DMX-over-Ethernet pinout	Color
1. Data 1+	White/Orange
2. Data 1-	Orange
3. Data 2+	White/Green
4. N/C	Blue
5. N/C	White/Blue
6. Data 2-	Green
7. Data 1 Common	White/Brown
8. Data 2 Common	Brown

Wireless DMX is utilized many times in portable or fast moving applications, and also in architectural lighting installations where cable length or access to cable can be prohibitive. Wireless DMX typically consists of an RF transmitter and series of receivers in either a mesh or fixed RF network. Lutron devices do not support the use of wireless DMX.

DMX-RDM

Remote Device Management (RDM, ANSI E1.20) is a protocol enhancement of the DMX protocol that involves two-way communication between the DMX controller and the DMX device. RDM devices often need to be addressed over the DMX link by the DMX transmitter. Lutron does not support RDM. However, if a RDM device comes pre-addressed, or is able to be addressed with other equipment, it may still be compatible with a Lutron DMX output. RDM was designed to be backwards compatible with existing DMX equipment. RDM uses start-bytes with a non-zero value.

How do Lutron Systems Work with DMX?

Lutron systems are capable of both accepting a DMX input and providing a DMX output. When a DMX transmitter, such as a theatrical console, wants to control lighting loads controlled by Lutron gear, a DMX input is required. When the goal is to have the Lutron gear control a DMX load, a DMX output is required.

Best Practices

1. Verify how many channels a fixture requires to ensure the correct number of interfaces are used. For example, a RGBW fixture may require 4 channels (one for each Red, Green, Blue, and White control) or it may only require 2 channels (one for white control and one for the RGB values mapped to a single channel, which is explained in the DMX output sections later in this document).
2. Verify that fixtures do not require RDM to be addressed. Lutron does not currently support RDM, although if the fixture comes pre-addressed, or can be addressed with third-party equipment, a Lutron DMX output should be able to control the device since RDM is backwards compatible.
3. Verify that Lutron gear is not being relied upon for fast moving effects. A DMX show can be triggered on third-party gear with a contact closure output for this purpose.

Common Examples

1. For general illumination that requires DMX control, such as a color tuning or white tuning fixtures, the DMX control should be handled by the Lutron system. For example, a GRAFIK Eye QS unit can control white tuning fixtures that require two DMX channels with a QSE-CI-DMX. One channel for intensity and one channel for temperature. Each channel gets mapped to a zone on the GRAFIK Eye QS unit. See Application Note #579 (P/N 048579) at www.lutron.com for more information on color-tuning applications.
2. For triggering complex, fast-moving, and dynamic lighting shows controlled by third-party equipment, the Lutron system can provide a contact closure output. For example, a Lutron keypad may have a button that triggers a lighting show. The keypad button press would activate a contact closure on a QSE-IO, which would trigger the lighting show to start on a third-party controller.
3. When a theatrical console or other DMX controller wants to temporarily control the general or house lighting controlled by a Lutron system, using a DMX input to the Lutron system is appropriate. For example, a theatrical console that controls the stage light may also be required to be able to dim the non-theatrical lights up and down.

Quantum

DMX Output

Lutron systems are capable of providing a DMX signal output. In Quantum systems, this can be accomplished with either the Quantum processor or the QSE-CI-DMX interface.

Using the Quantum processor for DMX output (only available in Quantum 3.4 or higher): When the configurable link on the Quantum processor is configured as a DMX output it can control 512 channels in a DMX universe.

Using the QSE-CI-DMX for DMX output: Up to 16 QSE-CI-DMX interfaces can be used on the same QS link with Quantum. Each interface can control 32 channels in a DMX universe.

Quantum system DMX output details: Remember that there is a limit of 32 DMX unit loads per DMX link, unless DMX splitters are used. For quick calculations you can assume that each DMX fixture is equivalent to one DMX unit load. Some DMX fixtures may be less than one DMX unit load, which may allow you to add more than 32 DMX fixtures on a DMX link. The DMX fixture unit load details should be called out on the fixture spec sheet.

Each DMX channel counts as one switchleg toward the 512 switchleg limit on a QS link. A single zone in a Quantum system is equal to ONE of the following:

- One channel for intensity with a value range of 0-100 ***Note that the actual DMX channel value will go from 0-255 linearly as the zone value goes from 0-100.**
- Three channels for RGB control with a value range of 0-255. Each zone value from 0-255 gets mapped to THREE unique DMX channel values. The values for each channel for each zone level can be configured in the Q-Design software.
- One channel for integration with a value range of 0-255.

In Quantum systems, a GRAFIK Eye QS unit can be zone mapped to a single DMX channel for intensity only.

Daylighting, Nightlight, and Load Shed are not supported for DMX loads.

Only lighting zones mapped to a single DMX channel for intensity will display in the Quantum Vue and Q-Control+ Graphical User Interfaces (GUIs).

Similar to the PC tool used for standalone GRAFIK Eye QS systems, the 3 channel control is programmed by a color table built into the Quantum design software. See Application Note #579 (P/N 048579) at www.lutron.com for more information on color-tuning applications.

There is no specific limit on sequencing lighting zones that are mapped to DMX channels in Quantum systems. Any sequence that the Quantum system is capable of doing with lighting zones can also be done with lighting zones mapped to DMX channels. However, Quantum systems are not intended for theatrical DMX control. When using sequences in Quantum the time resolution between sequence steps is 250 ms. This results in a minimum time between steps of 250 ms, which may be too slow for theatrical or dynamic DMX lighting. For fast moving lighting sequences, Lutron recommends using a third-party control that can integrate with the Lutron system.

Quantum (continued)

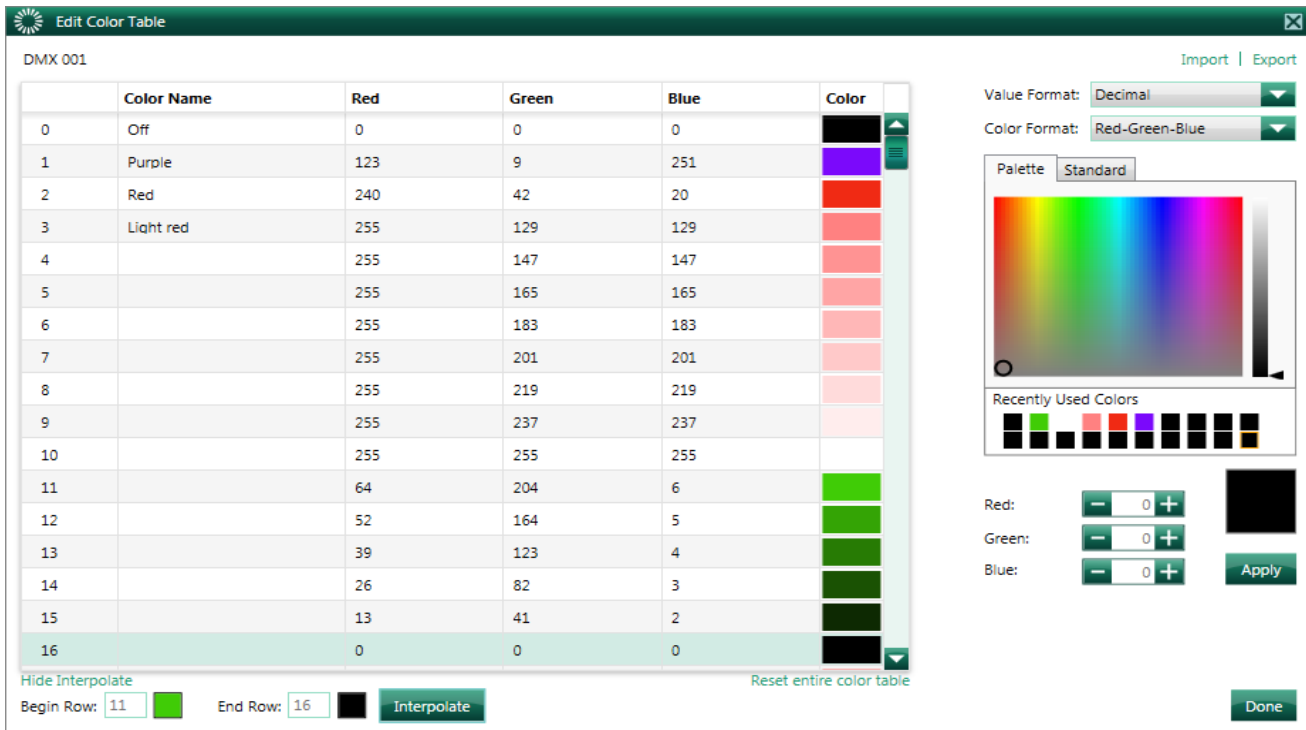


Figure 1. Color table editing in Lutron Design Software. Note the far left column is the zone intensity value (0-255). Each zone intensity value is mapped to a unique value for three DMX channels (Red, Green, and Blue columns). The 'Interpolate' feature allows you to program a smooth transition between two colors. This is shown between zone intensity values 2 and 10, where red transitions to white.

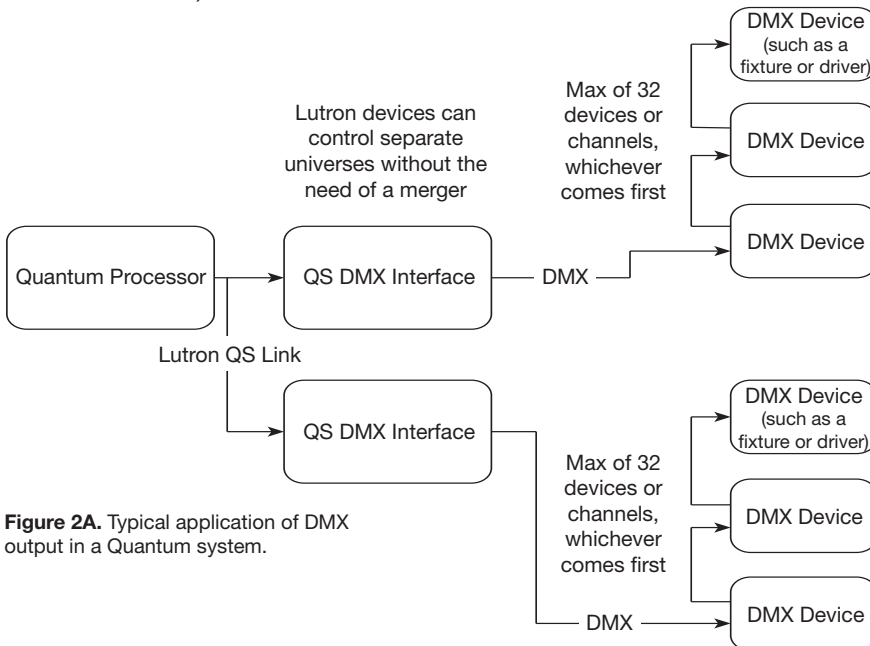


Figure 2A. Typical application of DMX output in a Quantum system.

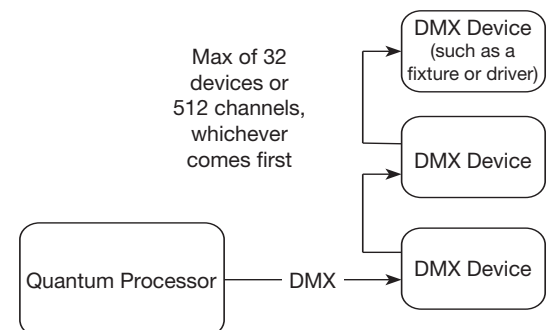


Figure 2B. Only available in Quantum 3.4 and higher

Quantum (continued)

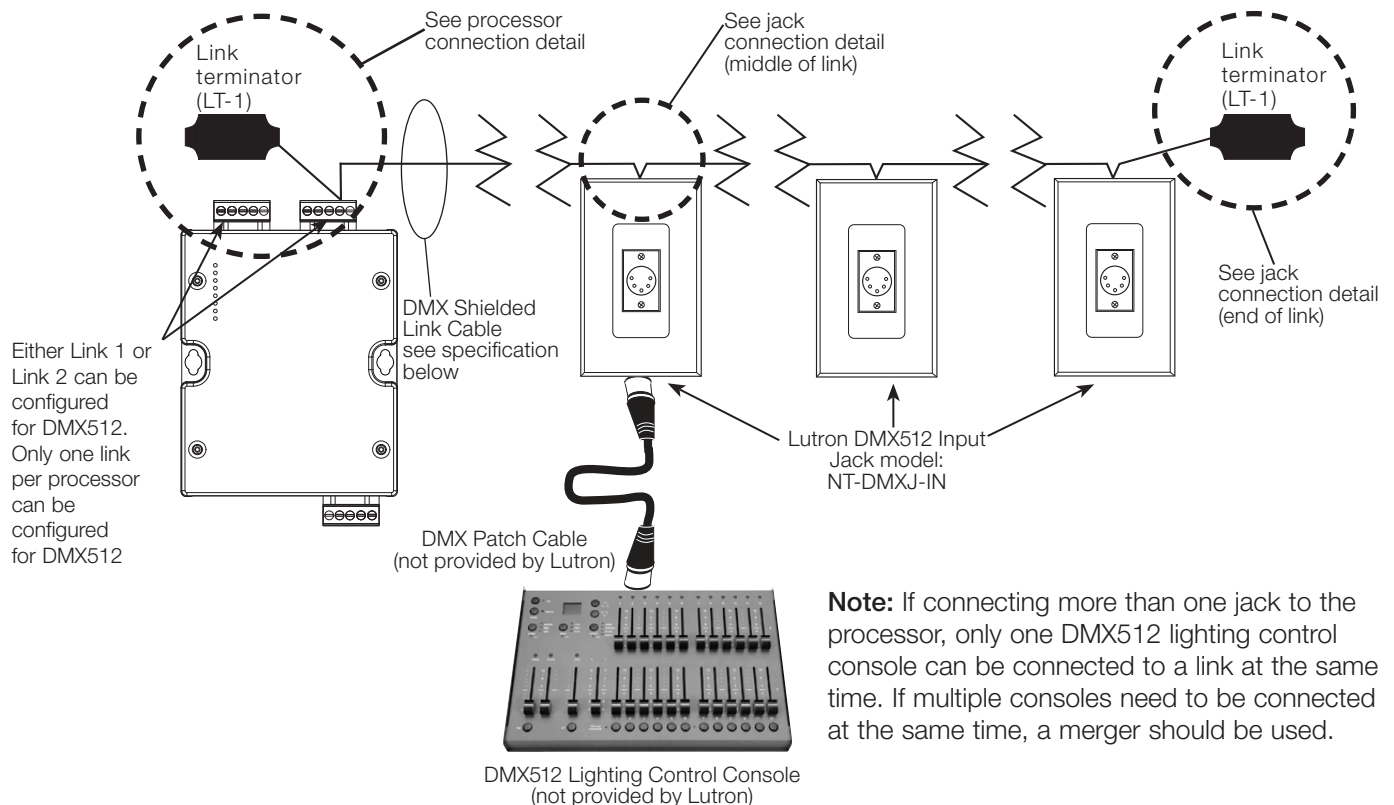
DMX Input

There are several options for accepting a DMX input into Lutron systems. In all cases, the input to a Lutron system is acting as a DMX receiver.

In Quantum system version 3.1 and higher, the Quantum processor is capable of configuring one of its two configurable links as a DMX input link. This input link supports up to 512 DMX channels, or one complete DMX universe, and each channel can be mapped to a single zone in the Lutron system. Only ONE processor link can be dedicated to DMX input. DMX control is activated by enabling a scene in the Quantum subsystem, which then allows the DMX input to take control of the zones. For more information and detailed specification points please reference the spec sheet found here: www.lutron.com/TechnicalDocumentLibrary/369965.pdf.

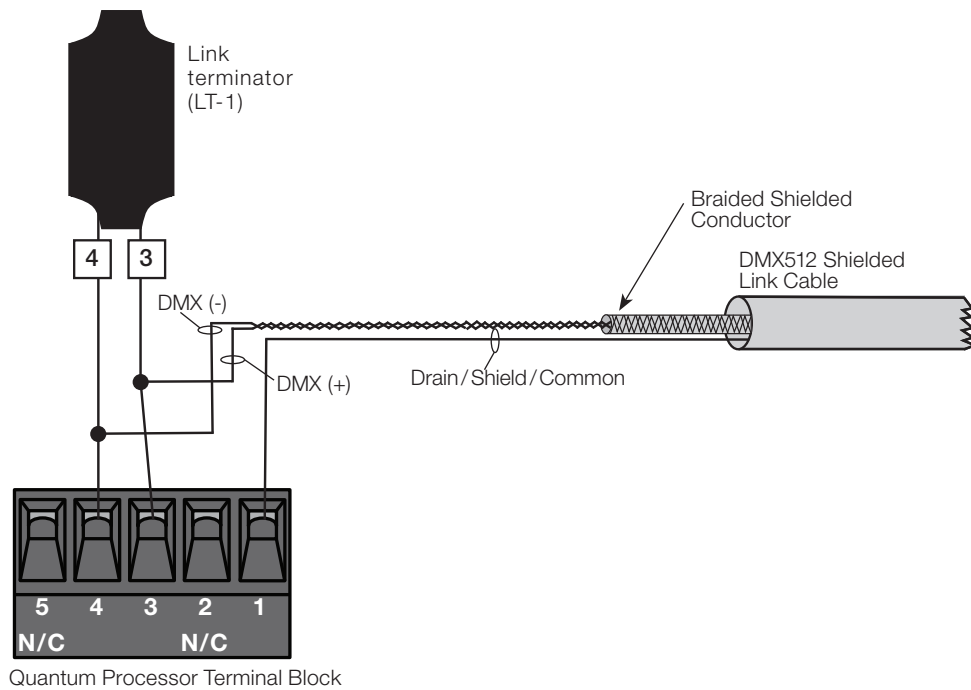
When using DMX input on a Quantum processor, a DMX scene must be activated for the DMX transmitter to take control of the zones mapped to DMX channels. The DMX transmitter will not automatically take control. As an example, if a DMX theatrical console is required to control the house lighting that is on the Lutron system, there would first have to be some input to the Lutron system to activate the DMX scene (CCI, keypad button press, timeclock event, Quick Control in Quantum Vue system, etc). Once the DMX scene has been activated, the theatrical console would have control of the lights until the scene was changed on the Lutron system. For this reason, it is often desirable to have the same control that activates the DMX scene also disable other controls and disable time clock events to avoid an unexpected return of control to the Lutron system.

DMX512 Input Typical 1-Line Diagram

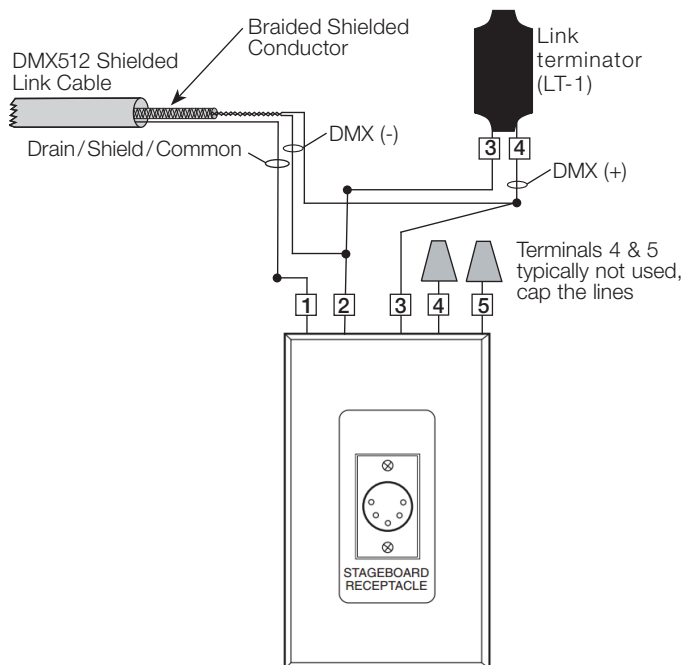


Quantum (continued)

DMX512 Quantum Processor Connection Details

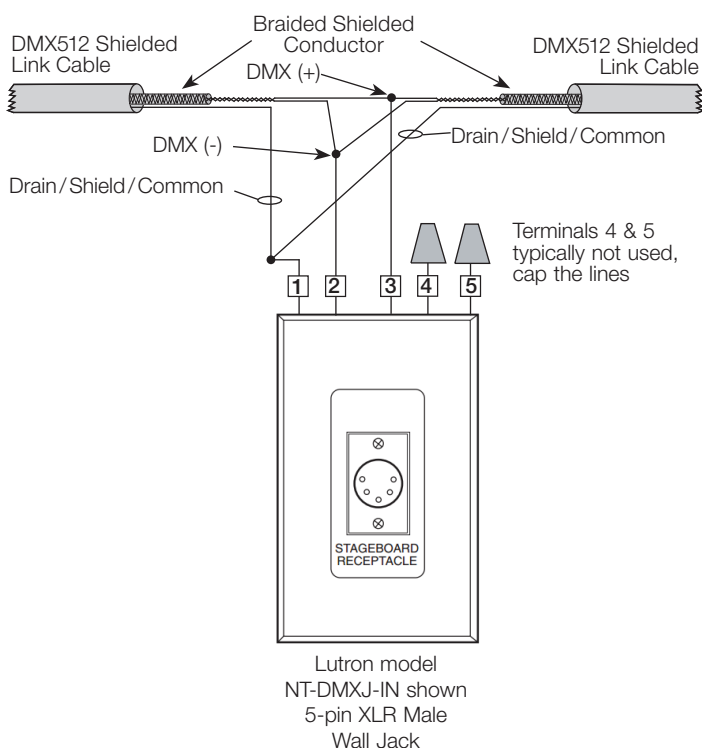


Jack Connection Detail (End of Link)



Alternate XLR Jack Pinouts

Male	Female

Quantum (continued)**Jack Connection Detail (Middle of Link)****DMX XLR Jack Pinout Standard**

1	Drain/Shield/Common
2	DMX (-) Primary Link
3	DMX (+) Primary Link
4	DMX (-) Secondary Link
5	DMX (+) Secondary Link

DMX Cable Wiring Table

The table below provides information pertaining to Lutron-provided (optional) DMX cable and how it should be terminated. For third-party cable, consult with the manufacturer for their connection recommendations and always use shielded cable that complies with the ANSI E1.11-2008, USITT DMX512-A standard.

Manufacturer	Model	Signal Name	Wire Color	Lutron model NT-DMXJ-IN connection	Lutron Quantum Processor Connection
Lutron	GRX-CBL-DMX-250 or GRX-CBL-DMX-500	Drain/Shield/Common	Use braided wire that surrounds the twisted pairs	Pin 1 - Drain/Shield/Common (white with black stripe)	Pin 1 - Common
		DMX (-) Primary Link	White or pink	Pin 2 - DMX (-) Primary Link (red)	Pin 4 - MUX
		DMX (+) Primary Link	Black	Pin 3 - DMX (+) Primary Link (yellow)	Pin 3 - MUX
		DMX (-) Secondary Link	Green	Pin 4 - DMX (-) Secondary Link (blue)	No connection (cap the wire)
		DMX (+) Secondary Link	Red	Pin 5 - DMX (+) Secondary Link (black)	No connection (cap the wire)

Lutron DMX cable: http://www.lutron.com/TechnicalDocumentLibrary/GRX_CBL_DMX_Cable_Accessories.pdf

Quantum (continued)

Panels

The 2Link circuit selector can also accept a DMX input. The 2Link circuit selector is used on the following panels that can also talk to a Quantum processor or GRAFIK Eye 4000 unit:

- GP: www.lutron.com/TechnicalDocumentLibrary/369-401_120.277_V_GP_Dimming_Panels.pdf
- LP: www.lutron.com/TechnicalDocumentLibrary/lp_240.pdf
- XP: www.lutron.com/TechnicalDocumentLibrary/xp.pdf
- CCP: www.lutron.com/TechnicalDocumentLibrary/ccp_120.pdf

The DMX input can ONLY control the loads on the panel it is connected to – not any load on the system. The priority for control is detailed in Appendix A. One DMX channel can be mapped to one or multiple circuits in the panel. Multiple panels can be included in the DMX universe by daisy-chaining the DMX connection to multiple 2Link circuit selectors.

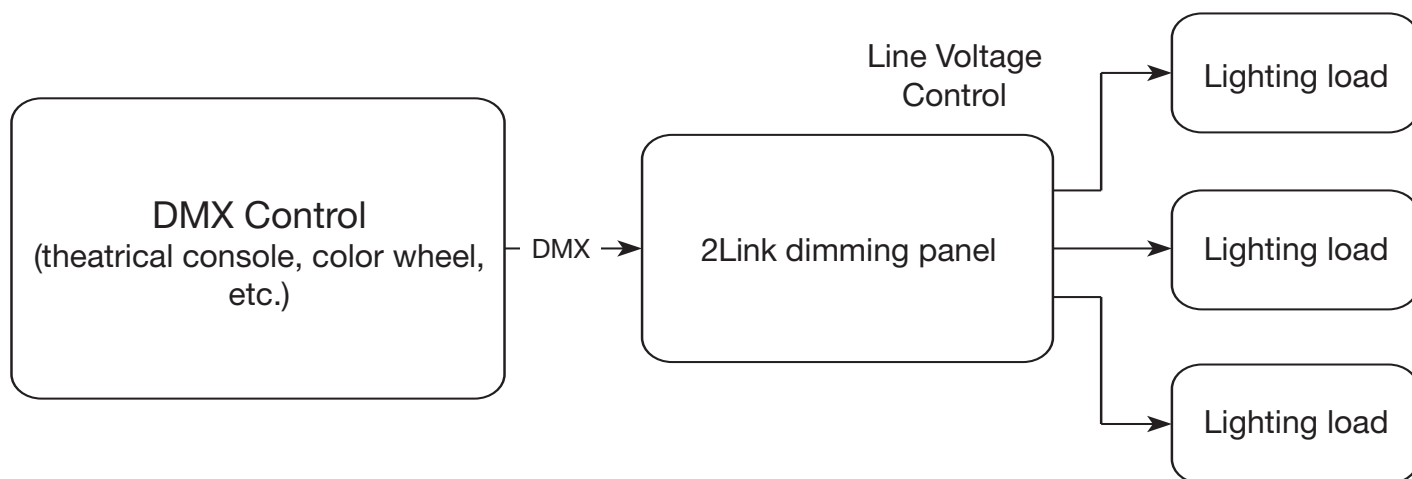


Figure 4. Typical DMX input application with 2Link panels.

DMX Cable Type	Wire	From Circuit Selector	To DMX Jack
Belden 9729/89729	(2) drain/shield	C	C (1) (white/black)
	black	+	– (2) (red)
	white	–	+ (3) (yellow)
	black	No Connect	– (4) (blue)
	red	No Connect	+ (5) (black)
Duraflex 22/4WS or Lutron GRX-CBL-DMX-250/500	(2) drain/shield	C	C (1) (white/black)
	white	+	– (2) (red)
	black	–	+ (3) (yellow)
	green	No Connect	– (4) (blue)
	red	No Connect	+ (5) (black)

* Both the DMX controller and the cable used to communicate with the Quantum processor must meet the ANSI E1.11-2008, USITT DMX512-A standard. The Quantum processor does not have a built in terminator for a DMX link.

Athena

DMX Output

In the Athena system, DMX output can be accomplished by using the QSE-CI-DMX. Up to 16 QSE-CI-DMX interfaces can be used on the same QS link. Each interface can control 32 channels in a DMX universe.

Remember that there is a limit of 32 DMX unit loads per DMX link, unless DMX splitters are used. For quick calculations you can assume that each DMX fixture is equivalent to one DMX unit load. Some DMX fixtures may be less than one DMX unit load, which may allow you to add more than 32 DMX fixtures on a DMX link. The DMX fixture unit load details should be called out on the fixture spec sheet.

Each DMX channel counts as one switchleg toward the 512 switchleg limit on a QS link. A single zone in an Athena system is equal to ONE of the following:

- One channel for intensity with a value range of 0-100 ***Note that the actual DMX channel value will go from 0-255 linearly as the zone value goes from 0-100.**
- Three channels for RGB control with a value range of 0-255. Each zone value from 0-255 gets mapped to THREE unique DMX channel values. The values for each channel for each zone level can be configured in the Athena Designer software.
- One channel for integration with a value range of 0-255.

Daylighting, Nightlight, and Load Shed are not supported for DMX loads.

Similar to the PC tool used for standalone GRAFIK Eye QS systems, the 3 channel control is programmed by a color table built into the Athena design software. See Application Note #579 (P/N 048579) at www.lutron.com for more information on color-tuning applications.

There is no specific limit on sequencing lighting zones that are mapped to DMX channels in Athena systems. Any sequence that the Athena system is capable of doing with lighting zones can also be done with lighting zones mapped to DMX channels. However, Athena systems are not intended for theatrical DMX control. When using sequences in Athena the time resolution between sequence steps is 250 ms. This results in a minimum time between steps of 250 ms, which may be too slow for theatrical or dynamic DMX lighting. For fast moving lighting sequences, Lutron recommends using a third-party control that can integrate with the Lutron system.

GRAFIK Eye QS Systems (Not Quantum Systems)

DMX Output

In GRAFIK Eye QS systems, there are two options for mapping lighting zones on the GRAFIK Eye QS unit to DMX channels. A zone can be mapped to a single DMX channel for intensity control. A single zone can also be configured to simultaneously control three DMX channels for RGB color control applications. Using the DMX Color Configuration Tool, the colors can be specified for each level of the zone. For example, zone intensity '1' can specify a value of 212 for the one channel, 172 for another channel, and 78 for the third channel. These three channels represent RGB values. The tool also allows you to easily interpolate between colors for a smooth transition from one color to the next as the zone is dimmed up and down.

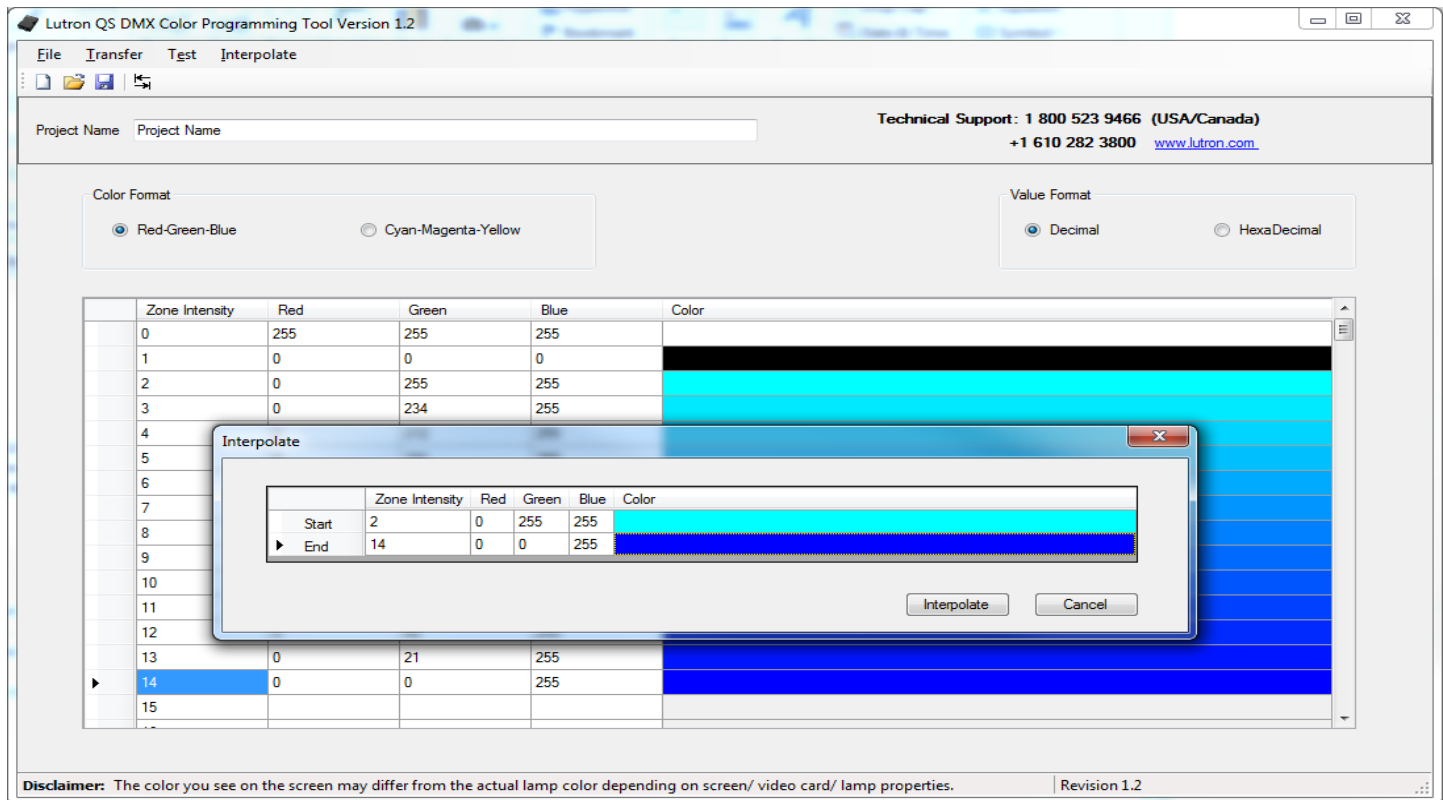


Figure 5. Lutron DMX Color Configuration Tool. Note the far left column is the zone intensity value (0-255). Each zone intensity value is mapped to a unique value for three DMX channels (The Red, Green, and Blue columns). The 'Interpolate' feature allows you to program a smooth transition between two colors. This is shown between zone intensity values 2 and 14, where green-blue transitions to blue.

GRAFIK Eye QS Systems (Not Quantum Systems) (continued)

There are several rules to keep in mind when using the QSE-CI-DMX in GRAFIK Eye QS systems.

1. Sequencing limited to scenes 1-4 or 5-16. Sequencing steps through scenes (in order) at programmed fade rate.
2. Number of DMX channels is limited to the number of GRAFIK Eye QS zones.
3. Each QSE-CI-DMX interface can output up to 32 DMX channels. Each DMX channel counts as one switch leg toward the 512 switchleg limit.
4. Daylighting is not supported for DMX loads.
5. Cannot have DMX loads sequencing through colors and have independent scene control of other zones. To achieve this functionality in QS Standalone systems, multiple GRAFIK Eye QS units would be required.
6. A zone on a GRAFIK Eye QS that is being used to control DMX cannot be used to control any other load type (i.e., can't control both DMX and phase control from a single zone).
7. A maximum of one QSE-CI-DMX can be used per QS link in a QS Standalone solution.
8. Multiple QSGs can be used with a single QSE-CI-DMX, provided all other device limitations are met (i.e., 32 DMX channels per QSE-CI-DMX control interface).

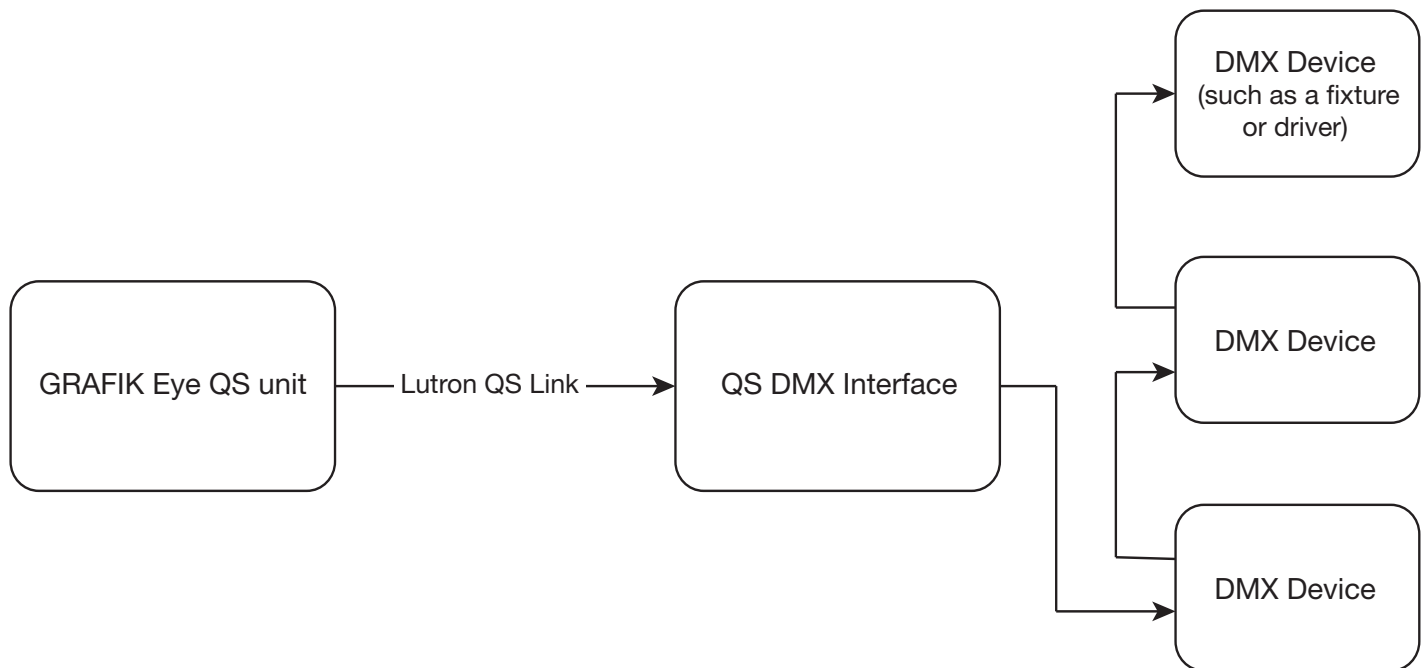


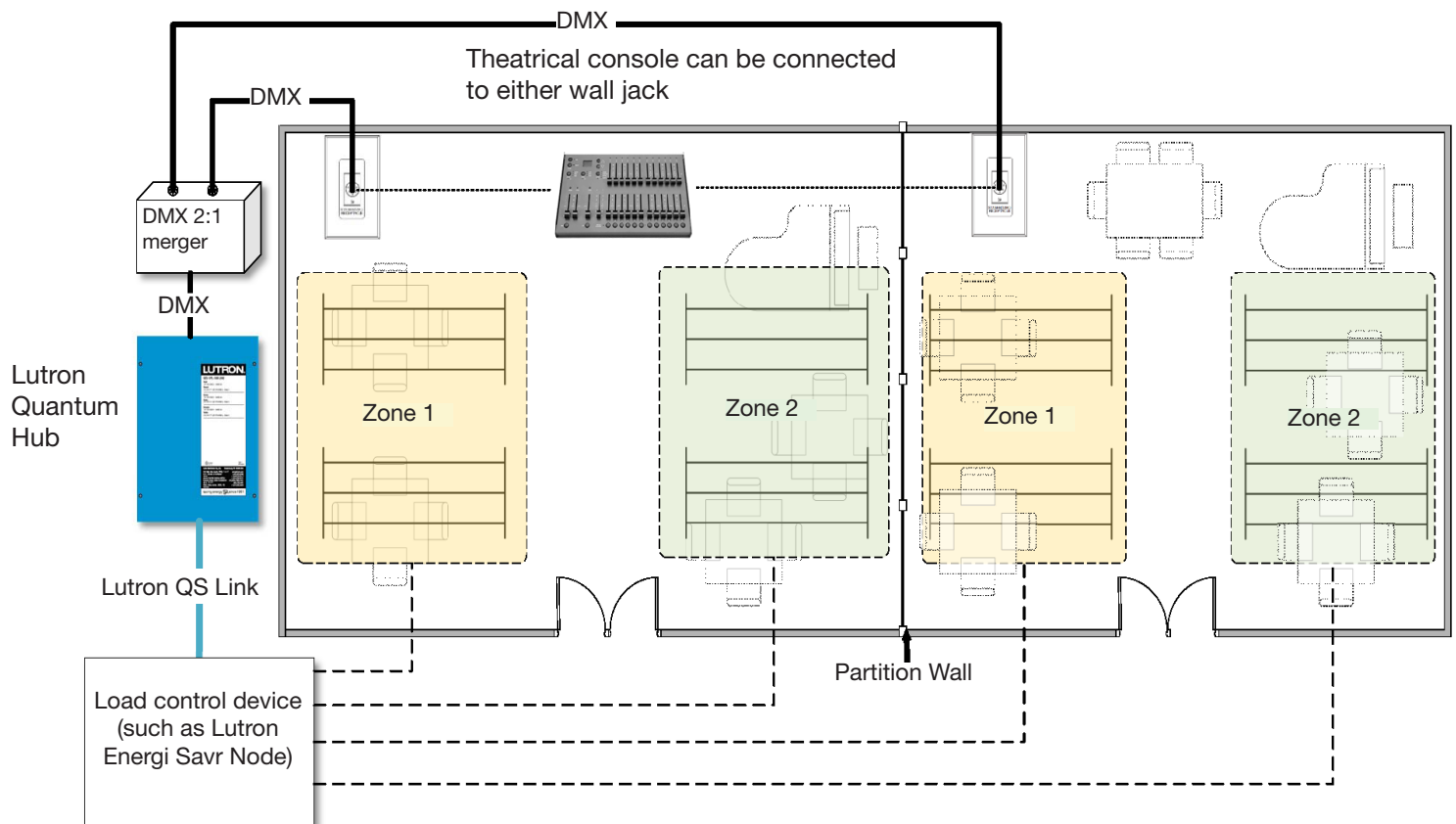
Figure 6. Typical application of DMX output in GRAFIK Eye QS systems (not Quantum QS systems)

Common Application Diagrams

Quantum Systems with DMX Input

In this example, there is a partitioned space. Each partitioned room has a DMX input jack that a theatrical console can be plugged into. The theatrical console can control the Quantum system from either location through the use of a merger. Lighting zones in the Quantum system will zone chain across partitions when the wall is open. This behavior also applies to DMX lighting zones, both single channel intensity and 3-channel RGB. For example, when the wall is open, controlling Zone 1 in the first room will also control Zone 1 in the second room. When the wall is closed, those zones will be controlled independently.

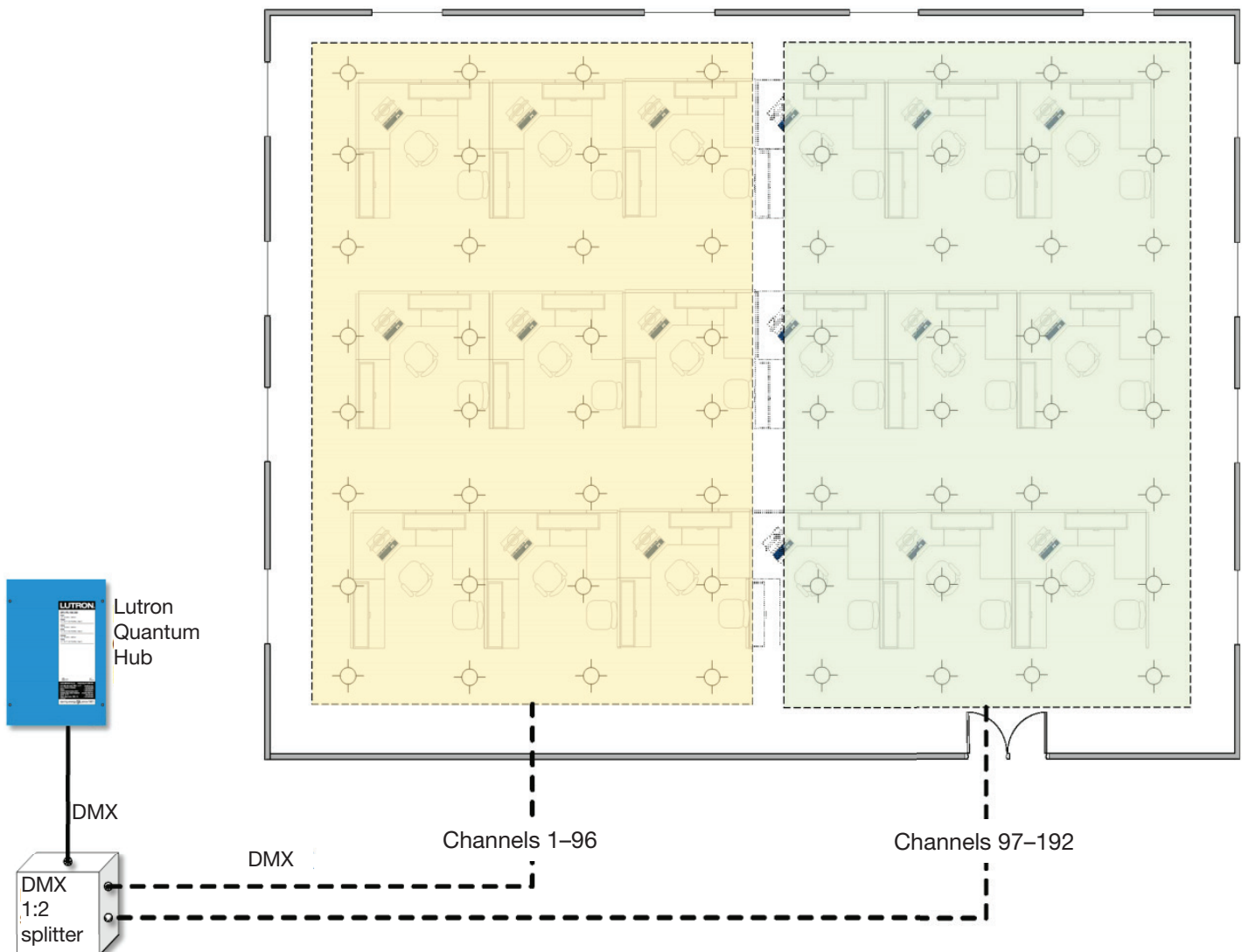
Important Note: A DMX scene must be activated in the Quantum system in order for the theatrical console to take control of the lights. The DMX scene can be triggered through a keypad, contact closure, Quantum Vue, integration, occupancy sensor, or timeclock event.



Common Application Diagrams (continued)

Quantum Systems with DMX Output: 3-Channel RGB - Only available in Quantum 3.4 or higher

In this example, there is an open office with 64 lighting fixtures. Each fixture consumes three DMX channels for RGB control. There are three ways to achieve this in a Quantum system. The first way is to configure the output of a Quantum processor as a DMX output link (only available in Quantum 3.4 and higher), which can control up to 512 channels. However, there is a limit of 32 devices on a DMX link and each fixture counts as a device, so a splitter is used to split the output of the processor up into two different DMX runs with no more than 32 devices on a single link.

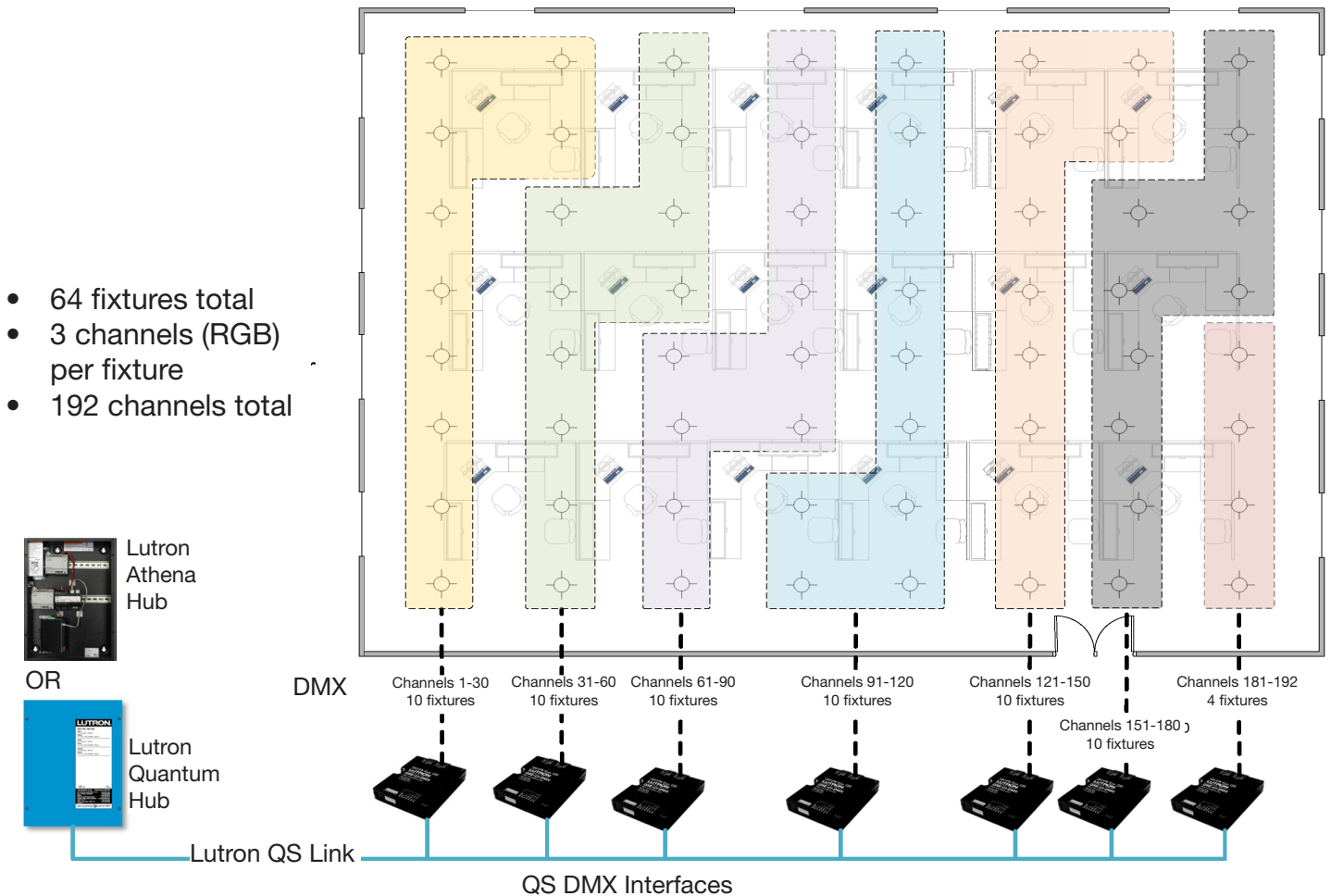


Common Application Diagrams (continued)

DMX Output: 3-Channel RGB

This example can be used in Quantum and Athena systems. This example has 64 lighting fixtures with 3 DMX channels each for RGB control, just like the previous example. However this example uses a QSE-CI-DMX instead of a DMX output link on a Quantum processor.

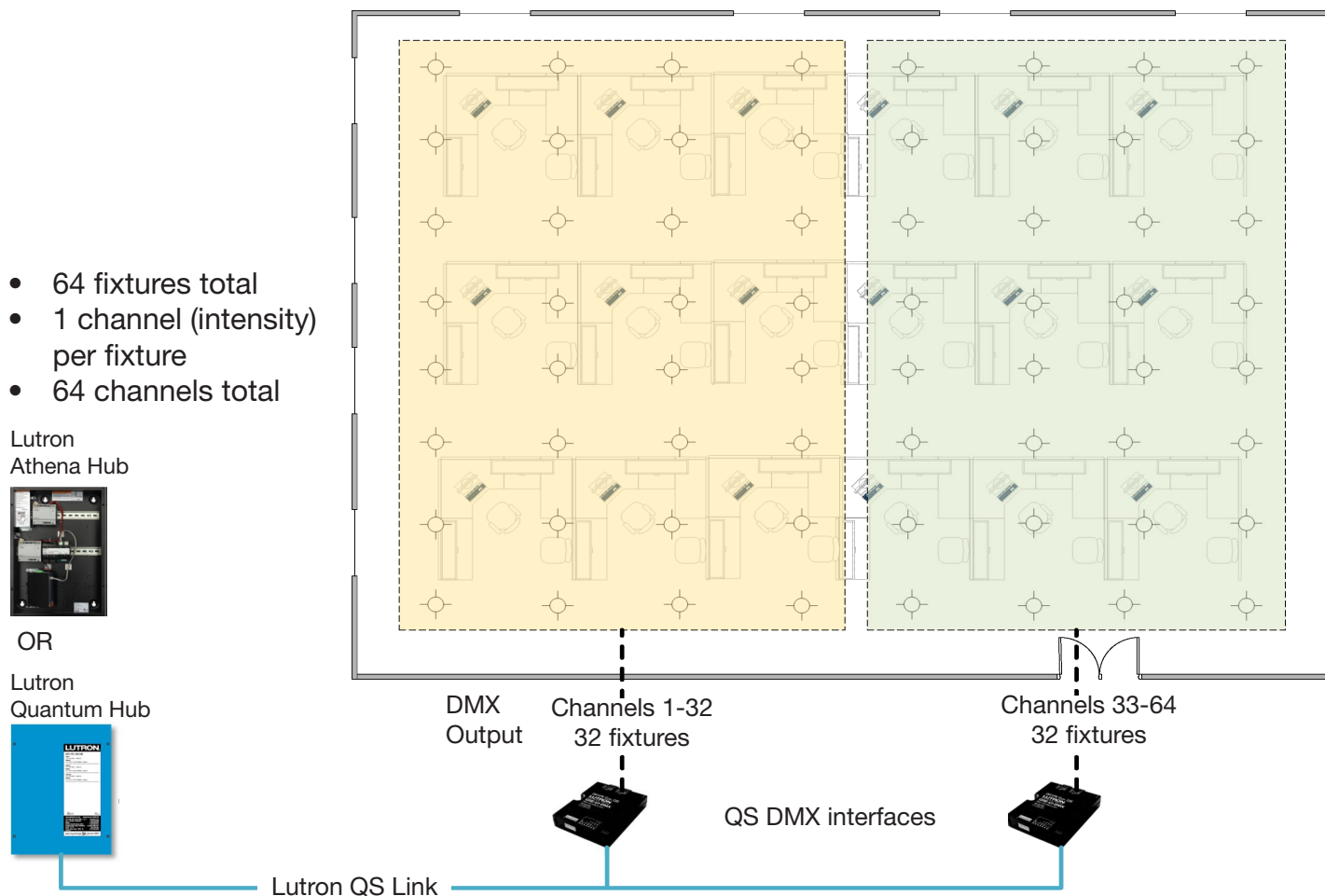
This option involves a homerun of the output of the QSE-CI-DMX interfaces to a group of fixtures. Since the maximum number of channels that a QSE-CI-DMX can output is 32, the maximum number of fixtures that can be controlled by a single QSE-CI-DMX interface is 10. Seven interfaces are required using this method.



Common Application Diagrams (continued)

DMX Output: Single Channel Intensity – Quantum & Athena

This example can be used both in Quantum and Athena systems. In this example, there is an open office with 64 lighting fixtures. Each fixture consumes a single DMX channel for intensity control. Since each device only takes a single channel, the output of the QS DMX interface can be wired directly to 32 fixtures. In this example, only two DMX interfaces are needed to control all 64 fixtures.

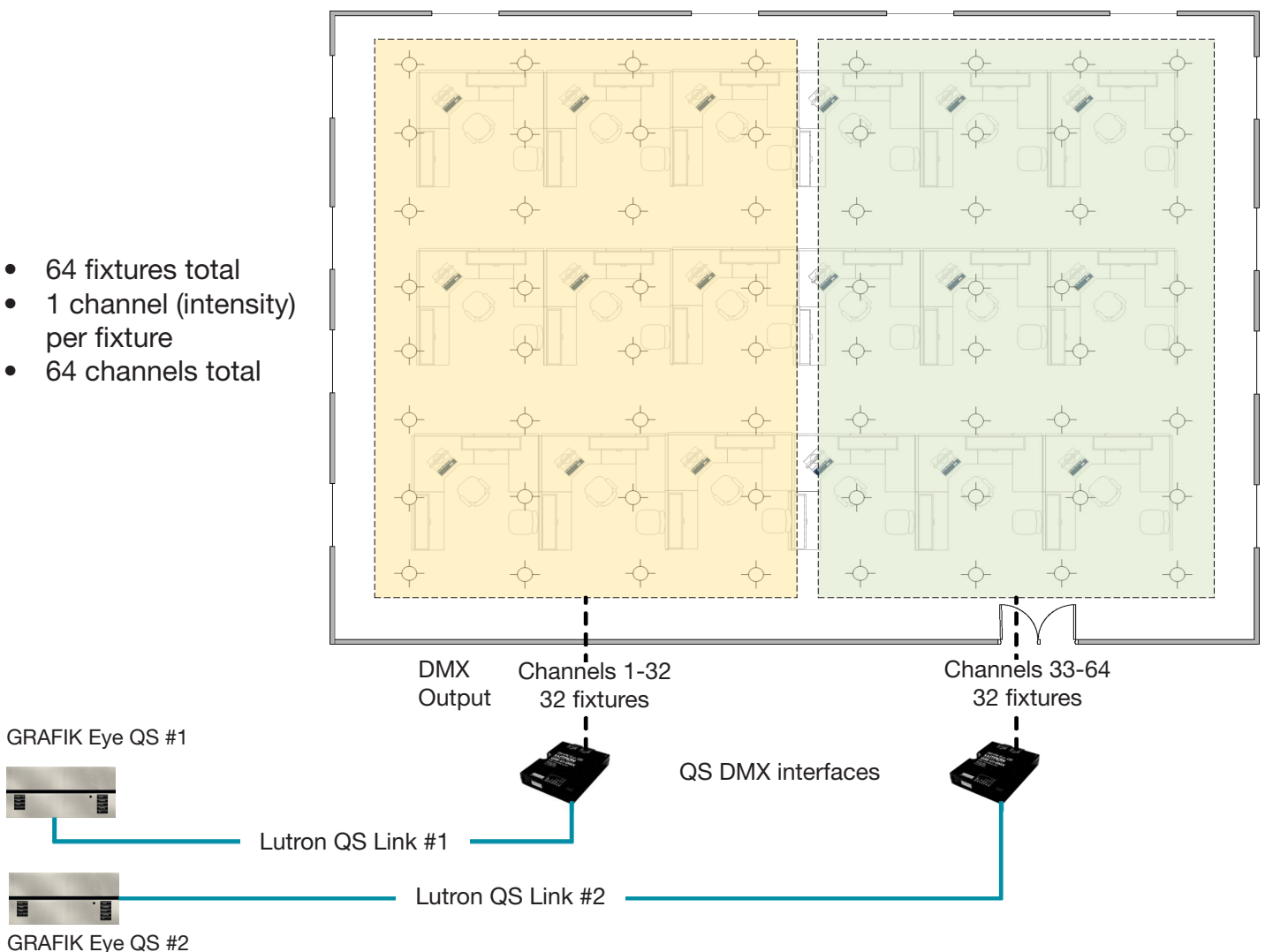


Common Application Diagrams (continued)

DMX Output: Single Channel Intensity - Standalone QS Solutions

This example can be used in standalone QS solutions with GRAFIK Eye QS and no Quantum processor. Similar to the previous example, there is an open office with 64 lighting fixtures. Each fixture consumes a single DMX channel for intensity control. Since each device only takes a single channel, the output of the QS DMX interface can be wired directly to 32 fixtures. Similar to the previous example, only two DMX interfaces are needed to control all 64 fixtures.

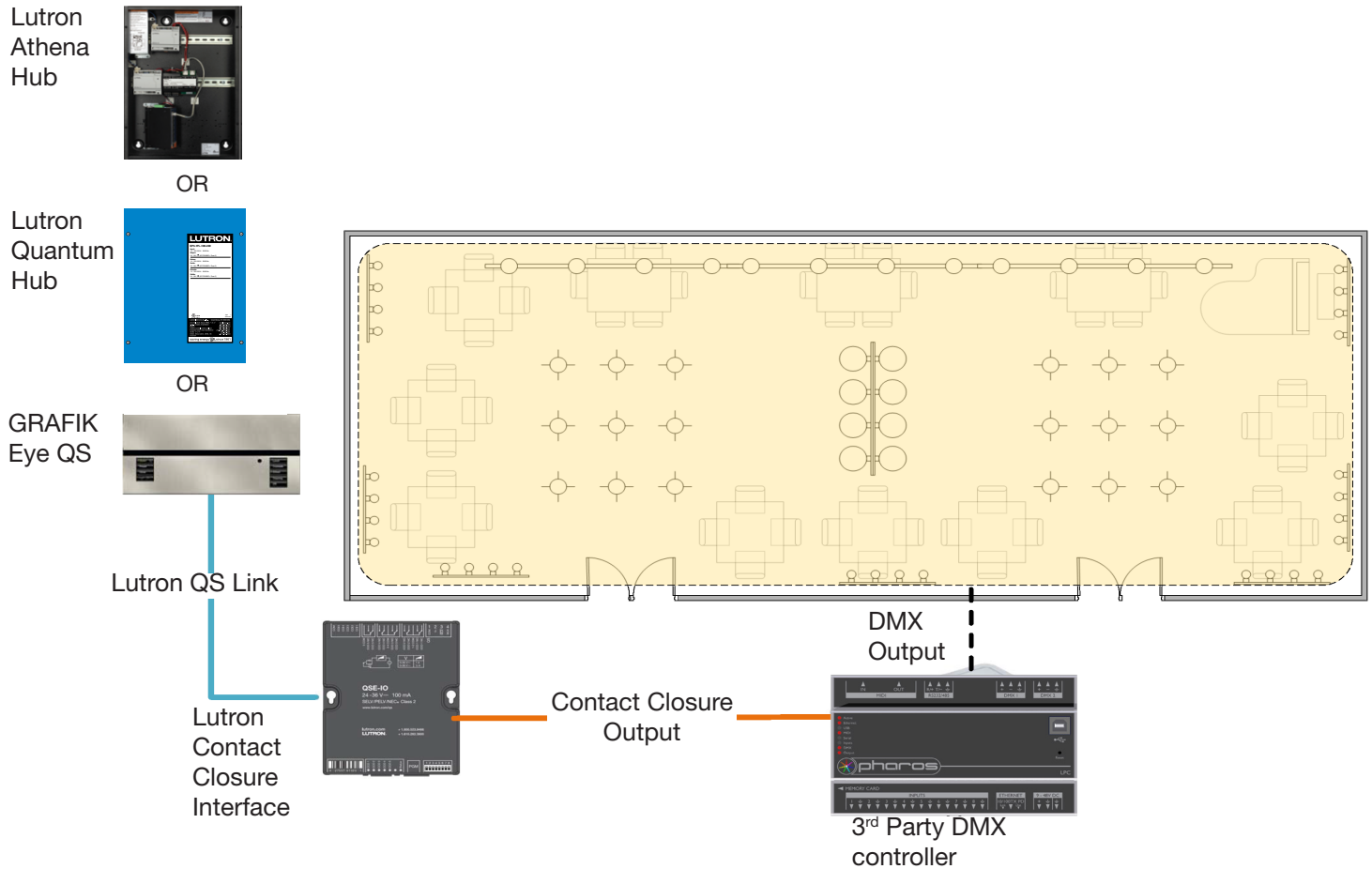
Note: The major difference between this solution and the previous page is the requirement for two GRAFIK Eye QS main units since each GRAFIK Eye QS main unit can only have one QS DMX interface. In QS standalone, a maximum of one QSE-CI-DMX can be used per QS link, therefore each GRAFIK Eye QS can only control its designated DMX zones. This rule does not apply to Quantum. For more information regarding system-level limits, reference Lutron Residential and Commercial System Rules (369821) at www.lutron.com.



Common Application Diagrams (continued)

DMX Output Through Contact Closure Integration

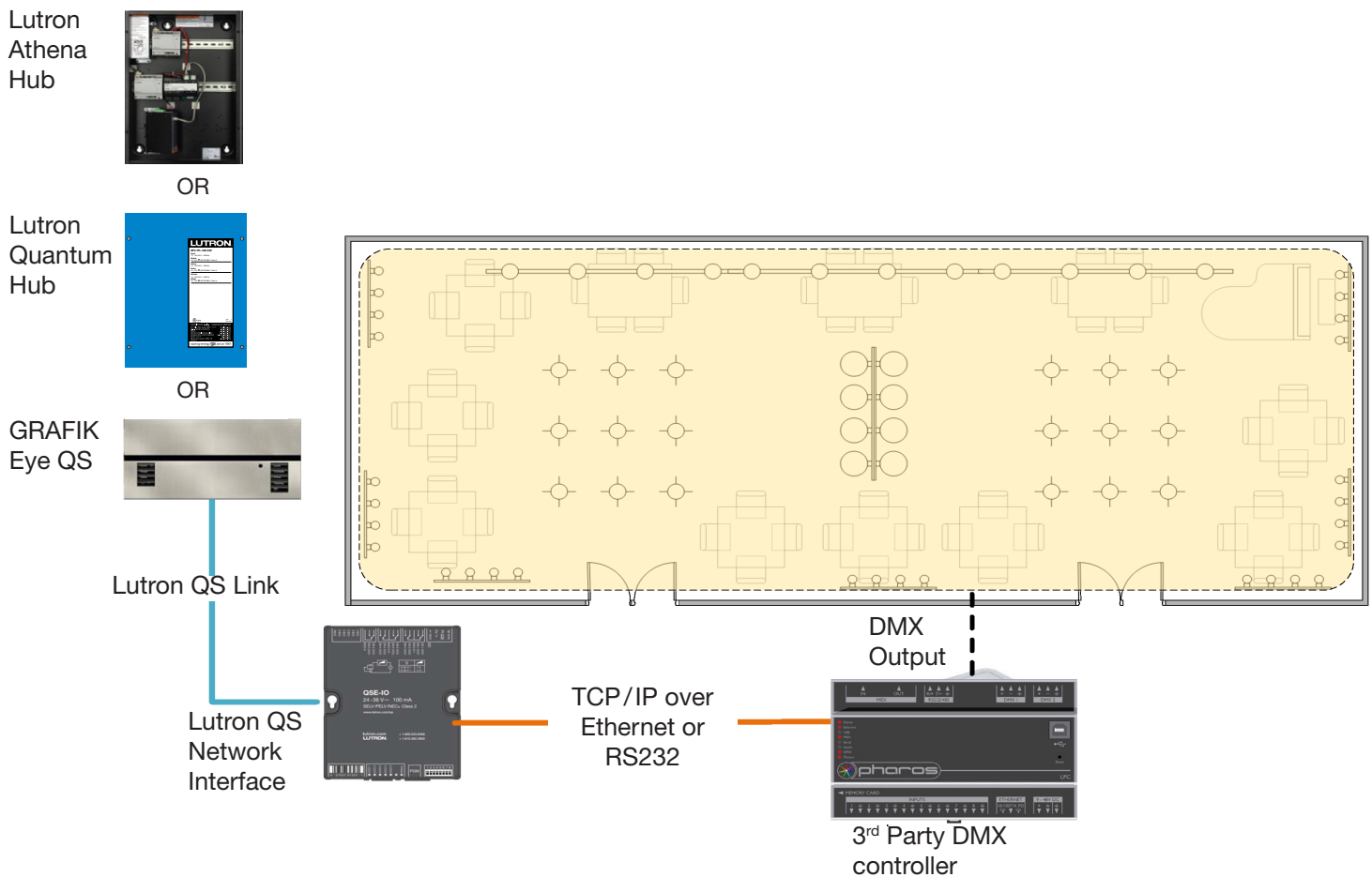
In this example, there is a ballroom with many DMX lighting fixtures. The fixtures are intended to be used for fast moving lighting shows. The best practice here is to use a Lutron contact closure output device, such as a QSE-IO, to trigger DMX shows, scenes, or timelines on a third-party DMX controller.



Common Application Diagrams (continued)

DMX Output Through Ethernet/RS232 Integration

Just like the last example, there is a ballroom with many DMX lighting fixtures that are intended to be used for fast moving lighting shows. Instead of using contact closures to trigger DMX scenes, shows, or timelines on a third-party DMX controller, TCP/IP over Ethernet or RS232 is being used to connect to the Lutron system through a QSE-CI-NWK-E. In this type of integration, the third-party controller will monitor Lutron system commands such as button presses, timeclock events, and other scene activations in order to trigger those DMX scenes, shows, or timelines.



Lutron DMX Input/Output Reference Table

	DMX input	DMX output	Contact Closure output (to trigger DMX shows on 3 rd party devices)
Quantum System	Yes - two ways: 1) One link per processor can be configured to DMX input for 512 channels 2) Using a panel with a 2Link circuit selector	Yes - two ways: 1) 512 channels* per DMX output link on a Quantum processor (only available in Quantum 3.4 and higher) 2) 32 channels* per QSE-CI-DMX	Yes
GRAFIK Eye QS Standalone System	No	Yes, 32 channels* per QSE-CI-DMX	Yes
2-link circuit selector panels	Yes, for control of loads in the panel ONLY (works with Quantum and GRAFIK Eye 4000 systems only)	No	No
HomeWorks QS System	No	Yes, 32 channels* per QSE-CI-DMX	Yes
myRoom Plus System	No	Yes, 32 channels* per QSE-CI-DMX	Yes
Vive System	No	No	Yes
Athena System	No	Yes, 32 channels* per QSE-CI-DMX	Yes

* Each channel counts as 1 switch leg toward the 512 switch leg per link limit.

Specification Table

Common DMX applications		
DMX Input		
Application	Example	How does Lutron achieve this?
Theatrical console control of all load types (on a subsystem).	A theater has house lights and pre-function spaces controlled by Lutron gear. During a performance, the lighting technician needs to be able to take control of these through their DMX theatrical console.	DMX Input to a dedicated Configurable Link (QS Link, Panel Link, DMX-In Link) set to DMX-input on a Quantum processor.
Theatrical console control of only panel based loads (local panel only)	A convention center utilizing panel-based dimming needs to be able to control the general lighting during an event using a theatrical console or show controller.	DMX Input to a 2Link Circuit Selector in each panel that needs to be controlled. DMX wiring to each 2Link Circuit Selector is required.
DMX Output		
Application	Example	How does Lutron achieve this?
Theatrical shows and dynamic sequences	Color chases around a stadium, fast strobing of lights, pre-game light shows, etc.	Through the use of the QSE-IO or the QSE-CI-NWK to trigger shows in a 3rd party DMX show controller or system from a Quantum system, GRAFIK Eye QS system, HomeWorks QS, or Athena system.
Sequenced color scenes	Slow fading cove lights or façade lighting.	Through the use of the QSE-CI-DMX and sequencing in a Quantum, Homeworks QS, or Athena system.
Static color scenes	Having a button press activate a scene that turns RGB fixtures red.	Through the use of the QSE-CI-DMX in a Quantum system, GRAFIK Eye QS system, HomeWorks QS system, or Athena system.
General lighting control or Color temperature control	A fixture that is capable of changing intensity and color temperature separately via DMX.	Through the use of the QSE-CI-DMX in a Quantum system, GRAFIK Eye QS system, HomeWorks QS system, or Athena system.

What type of DMX fixtures can Lutron control?

- While Lutron traditionally uses single channel DMX and 3 channel RGB DMX as load types, it is possible to control fixtures that have other channel requirements. For example, a 2 channel fixture that uses one channel for intensity and one for color temperature can be controlled by a Lutron system. Similarly, fixtures with more than 3 channels, such as a 5 channel fixture with channels for Red, Green, Blue, White, and Amber can also be controlled. See Application Note #579 (P/N 048579) at www.lutron.com for more information on color-tuning applications.

Appendix A

The 2Link circuit selector has two programmable links. It also has a programmable hierarchy that determines which link has priority. The table below serves as a reference guide for this hierarchy of control.

Hierarchy	Primary Link	Secondary Link	Description of Functionality
A	A	-	Link A only (Default)
b	b	-	Link B only
A1	A	b	Link A unless B is present
A2	A	b	Link A unless Link B is present and zone X on Link B is > 50%
b1	b	A	Link B unless link A is present
b2	b	A	Link B unless Link A is present and zone X on Link A is > 50%
Ab1	A	b	Link A or Link B – whichever zone intensity is the highest
Ab2	A	b	Link A or Link B – whichever zone intensity is the lowest

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Lutron Contact Numbers

WORLD HEADQUARTERS

USA
Lutron Electronics Co., Inc.
7200 Suter Road
Coopersburg, PA 18036-1299
TEL: +1.610.282.3800
FAX: +1.610.282.1243
support@lutron.com

www.lutron.com/support

North & South America Customer Assistance

USA, Canada, Caribbean:
1.844.LUTRON1 (1.844.588.7661)
Mexico:
+1.888.235.2910
Central/South America:
+1.610.282.6701

UK AND EUROPE:

Lutron EA Limited
125 Finsbury Pavement
4th floor, London EC2A 1NQ
United Kingdom
TEL: +44.(0)20.7702.0657
FAX: +44.(0)20.7480.6899
FREEPHONE (UK): 0800.282.107
Technical Support: +44.(0)20.7680.4481
lutronlondon@lutron.com

ASIA:

Lutron GL Ltd.
390 Havelock Road
#07-04 King's Centre
Singapore 169662
TEL: +65.6220.4666
FAX: +65.6220.4333
Technical Support: 800.120.4491
lutronsea@lutron.com

Asia Technical Hotlines

Northern China: 10.800.712.1536
Southern China: 10.800.120.1536
Hong Kong: 800.901.849
Indonesia: 001.803.011.3994
Japan: +81.3.5575.8411
Macau: 0800.401
Taiwan: 00.801.137.737
Thailand: 001.800.120.665853
Other Countries: +65.6220.4666