



PhaseX

Application
guide

dmf

The background of the page is a photograph of a modern architectural space. On the left, there's a pool of water reflecting the sky and surrounding greenery. In the center and right, a modern building with large glass windows and a flat roof is visible. The building's interior is partially visible through the glass, showing a lounge area with a sofa and armchairs. The overall atmosphere is bright and airy, with a focus on natural light and outdoor living.

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Introduction

Introducing PhaseX, DMF Lighting's groundbreaking digital lighting solution that revolutionizes how spaces are lit and experienced. PhaseX combines the wiring simplicity of wireless, the reliability of wired systems, and the flexibility of open protocols to deliver unparalleled performance and adaptability.

Imagine tunable white lighting that adapts to your daily rhythms, soft zoning that lets you fine-tune lighting scenes and groupings without rewiring, and precise 0.1% dimming for ultimate ambiance control—all while reducing wiring complexity and hardware requirements.

With PhaseX, you get a robust, scalable solution designed for new construction, remodel, and retrofit of centralized dimming systems. Available in both the Artafex 2" and 4" product families. It's exclusive to integrators and delivers premium lighting at a reasonable cost, empowering you to bring more digital and tunable lighting projects to life.

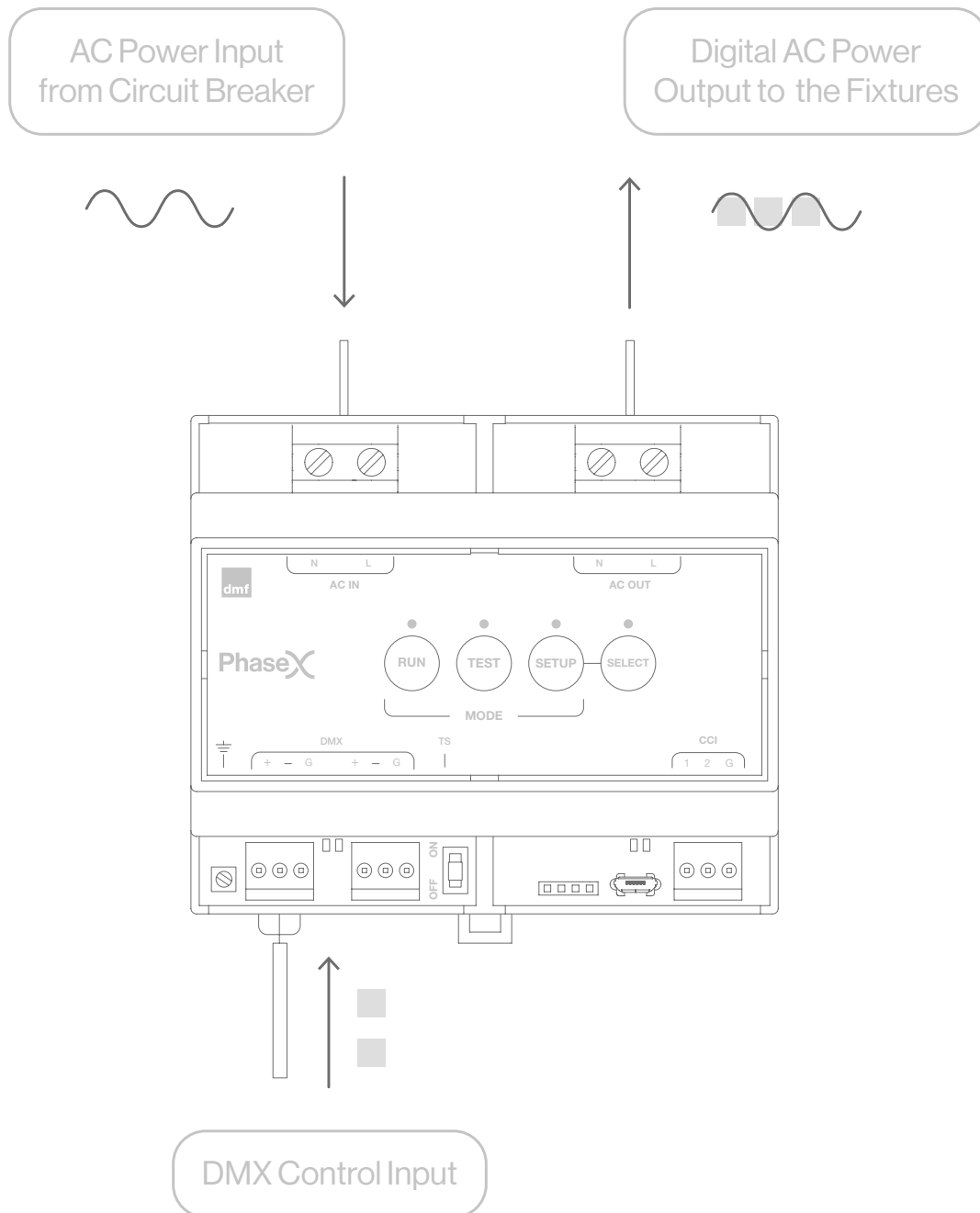
Design and implementation of a PhaseX system has some key requirements and factors to consider. This Application Guide will provide an overview of the technology and its requirements, and help in determining projects which are best suited for PhaseX installations.



System Overview

How does PhaseX Work?

PhaseX technology works by combining standard 120VAC power and a DMX-512 control signal and transmitting them together through a single combined output, over standard AC wiring. PhaseX modules, wired to the gateway's output, are then controlled by a standard DMX signal. A PhaseX lighting system consists of just three main components - the DMF's PhaseX Gateway, DMF PhaseX enabled light modules, and any standard DMX-512 controller. Because PhaseX is based around an industry standard, open protocol, it allows for flexibility and compatibility with any major industry controls vendor that supports DMX-512 implementation. The key to the system's reliability lies in the gateway, which provides an isolated AC output, preventing any possible distortion or interference from other electrical equipment, such as motors or standard home appliances.



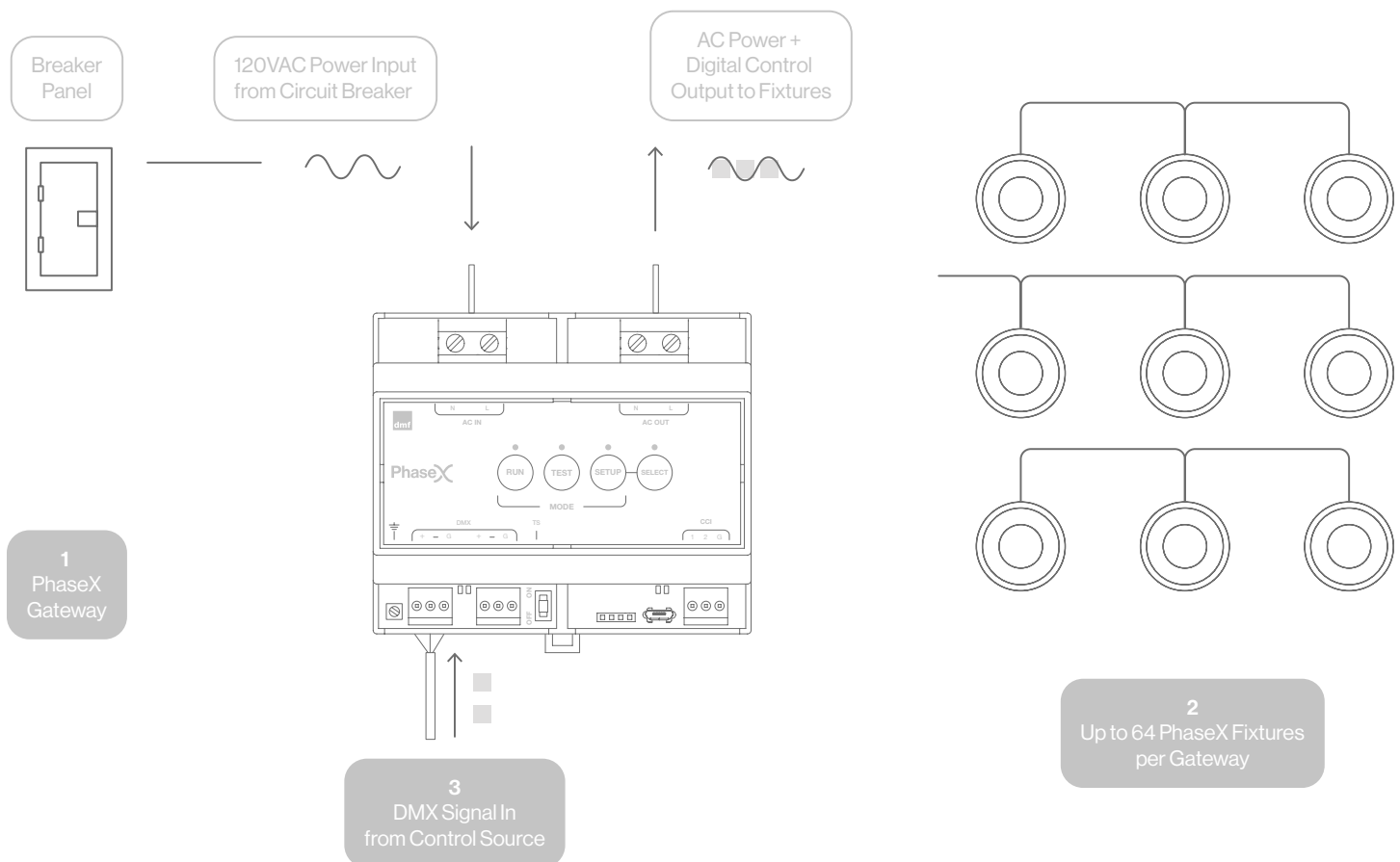
The PhaseX Gateway is the heart of any PhaseX installation, and provides filtered AC Output with DMX data to fixtures.

Advantages of PhaseX?

- PhaseX eliminates the need to run specialty wiring to each fixture, and allows for best in class performance and reliability without the additional investment in material or labor for specialty control wiring, allowing for tunable white lighting to be installed much more simply.
- PhaseX utilizes DMX, a wired, open protocol to control fixtures within the system. The stability inherent to a fully wired solution means that PhaseX installations provides an elegant lighting solution that performs to a standard that homeowners have come to expect from the custom integrator channel.
- DMX is a very fast protocol, so PhaseX provides a seamless user experience, in which lights fade seamlessly and in unison, without any “pop-corn” effect, and with imperceptible latency from user input.
- DMX is an industry standard, and open protocol. PhaseX installations are flexible and able to integrate with any control system that supports DMX, giving the integrator the ability to choose the system that is best suited for any particular project.
- PhaseX supports RDM (remote device management) and has native integrations with some lighting controls vendors, making commissioning a straightforward and intuitive process.

Basic System Architecture

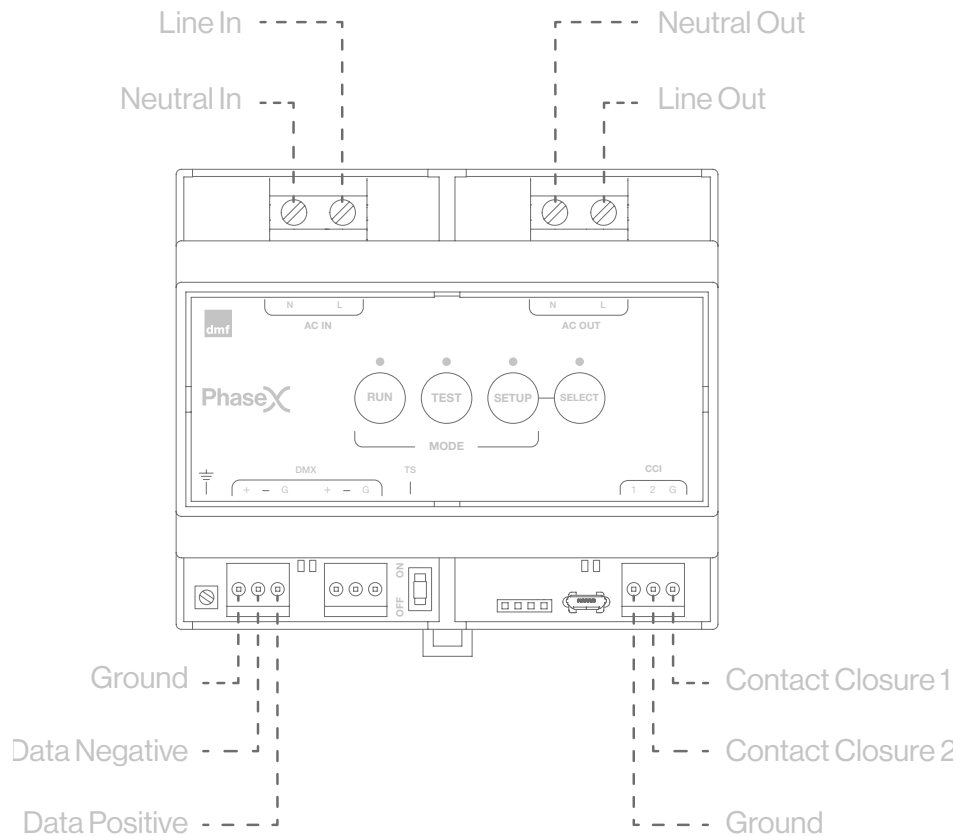
The PhaseX system architecture consists of standard residential power (120V AC), fed from an individual circuit breaker, a PhaseX Gateway installed within an electrical enclosure, DMF PhaseX enabled light fixtures, and a DMX control source.



The PhaseX Gateway (ART-GWX)

The PhaseX Gateway is the heart of any PhaseX installation. It provides the interface between the DMX based control source and the AC powered fixture wiring, and facilitates automatic device and network configuration as well as RDM communication between modules and the DMX controller.

Most importantly, the PhaseX Gateway acts as an electrical filter, isolating the PhaseX network from any potential noise or interference that may be present from typical electrical loads in a residential setting (refrigerators, motors, and major appliances). This creates a robust and reliable link for communication between lighting fixtures via a standard residential power wiring.



DMF PhaseX Enabled Lighting Modules

DMF's PhaseX enabled light modules will initially be available in the Artafex 2 and Artafex 4 product line, for Tunable White (4000k-1800k), Fixed Downlight and Adjustable modules. To facilitate integration with the major controls manufacturers, PhaseX modules also have a variety of pre-configured DMX Profiles or Personalities, to allow for mapping of DMX addresses that best suits each installation.

PhaseX modules share the same form factors, features and options from DMF's current offerings for Tunable White fixtures, and are compatible with the majority of housings, including new construction, flangeless, remodel and retrofit kits. For a full list of compatible modules and housings, see the PhaseX compatibility page, linked in appendix A.

DMX Control Source

Any standard DMX controller can be used to control PhaseX fixtures through the gateway, and depending on the manufacturers implementation may also support RDM functionality for remote device discovery and commissioning.

It is important to note that the implementation of DMX support across lighting control systems may vary in their capacity of DMX addresses, devices and functionality.

For more complete guidance on integrating PhaseX with various control systems, reference the Control Systems Integration section of this guide.

System Design Guide

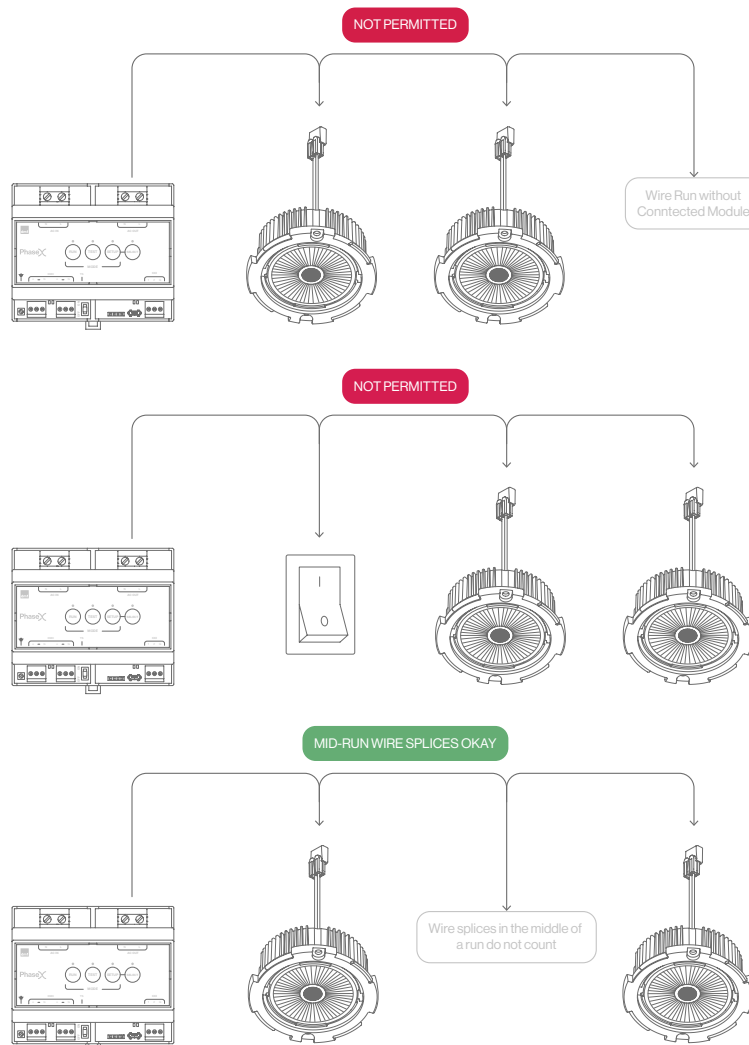
Please note: The following wiring and device limitations and capacity limits must be followed and are crucial to a successful installation:

Wiring and Device Limitations

1. Install ONLY PhaseX enabled lighting fixtures on the output side of the gateway.
2. Every wire run from the gateway to lighting fixtures MUST be terminated with a PhaseX module. Unterminated lines can cause signal reflections and lead to system performance degradation (see examples below)
3. Every fixture run must have both hot and neutral conductors connected directly to the gateway output (or to bonded terminal blocks in the case of multiple wire runs per gateway).
 - a. The PhaseX system relies on both hot and neutral conductors to transmit control signals and will not work without both conductors connected.
 - b. NOTE: Use caution with retrofit applications where neutral wires may be externally bonded, separate from dimming cards. See further guidance in the Application Guide section.
4. Do not wire mechanical switches on the output side of the gateway. Use only DMX for control of lighting fixtures.

Examples of Unterminated Lines

Unterminated lines include: wired fixture housings without a module, capped off wire runs, wired receptacles, and mechanical switches or circuit breakers outside of the gateway enclosure.



Wiring Topologies

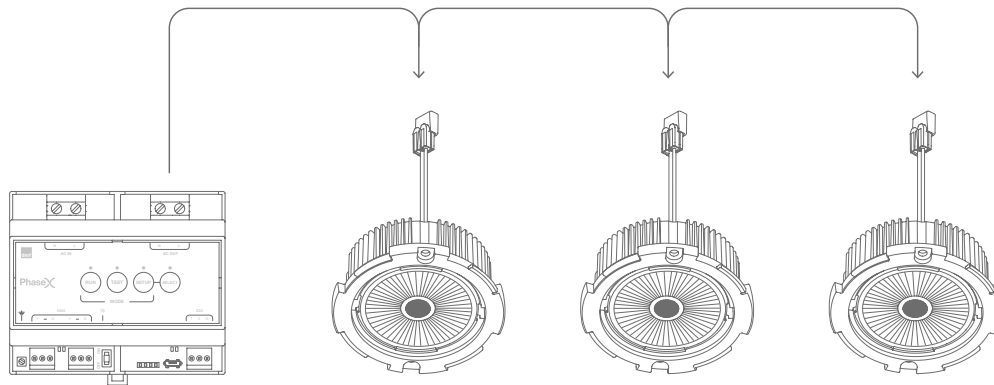
PhaseX systems can be wired using a number of different wiring topologies, including those commonly used in the construction industry. Below are the few most commonly used to facilitate typical installations. Note that these wiring topologies are not mutually exclusive, and are often used in combination. For example, a daisy chain may follow off of a t-tap branch.

Remember when planning wire runs that for all wiring topologies, unterminated stubs of any kind are not permitted and will cause system performance degradation.

Wiring topologies that create multiple points of input (eg. mesh topology) or infinite loops (ring topology) are not permitted with PhaseX installations. Both types of wiring can cause DMX signal reflections and lead to system performance degradation.

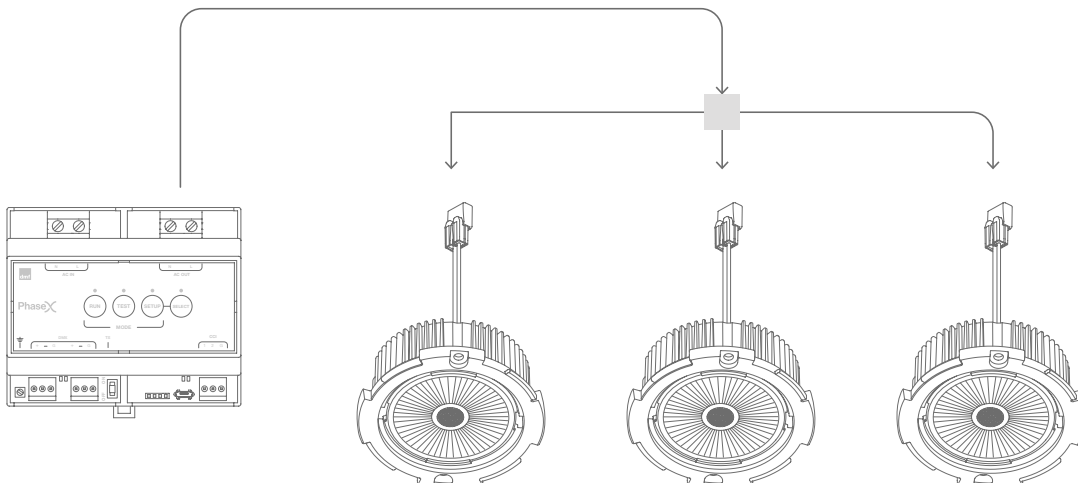
Daisy Chain Topology

Daisy chain is perhaps the most commonly seen in lighting fixture installations. The incoming power, fixture wiring and outgoing wires are all combined together to easily facilitate wiring the next fixture in the line.



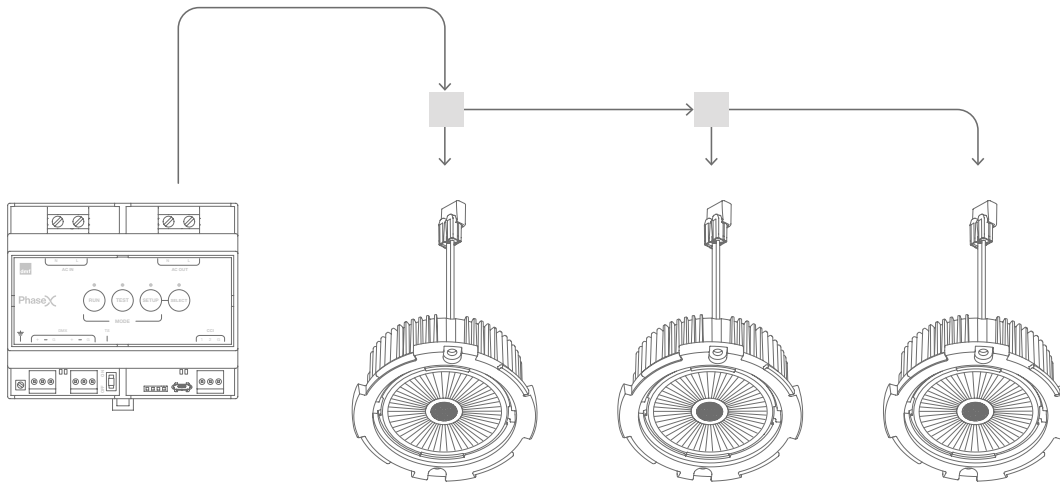
Star Topology

A star topology involves a central point with multiple spokes coming out. It is often seen coming from a junction box, allowing a single wire run to go to multiple points without interconnection directly between fixtures. Note: the total number of branches may be limited by wire connector capacity.



T-Tap Topology

T-tap topology involves splicing a branch wire off another wire run going to existing fixtures. The example below has two t-taps running to additional fixtures.



Gateway Installation

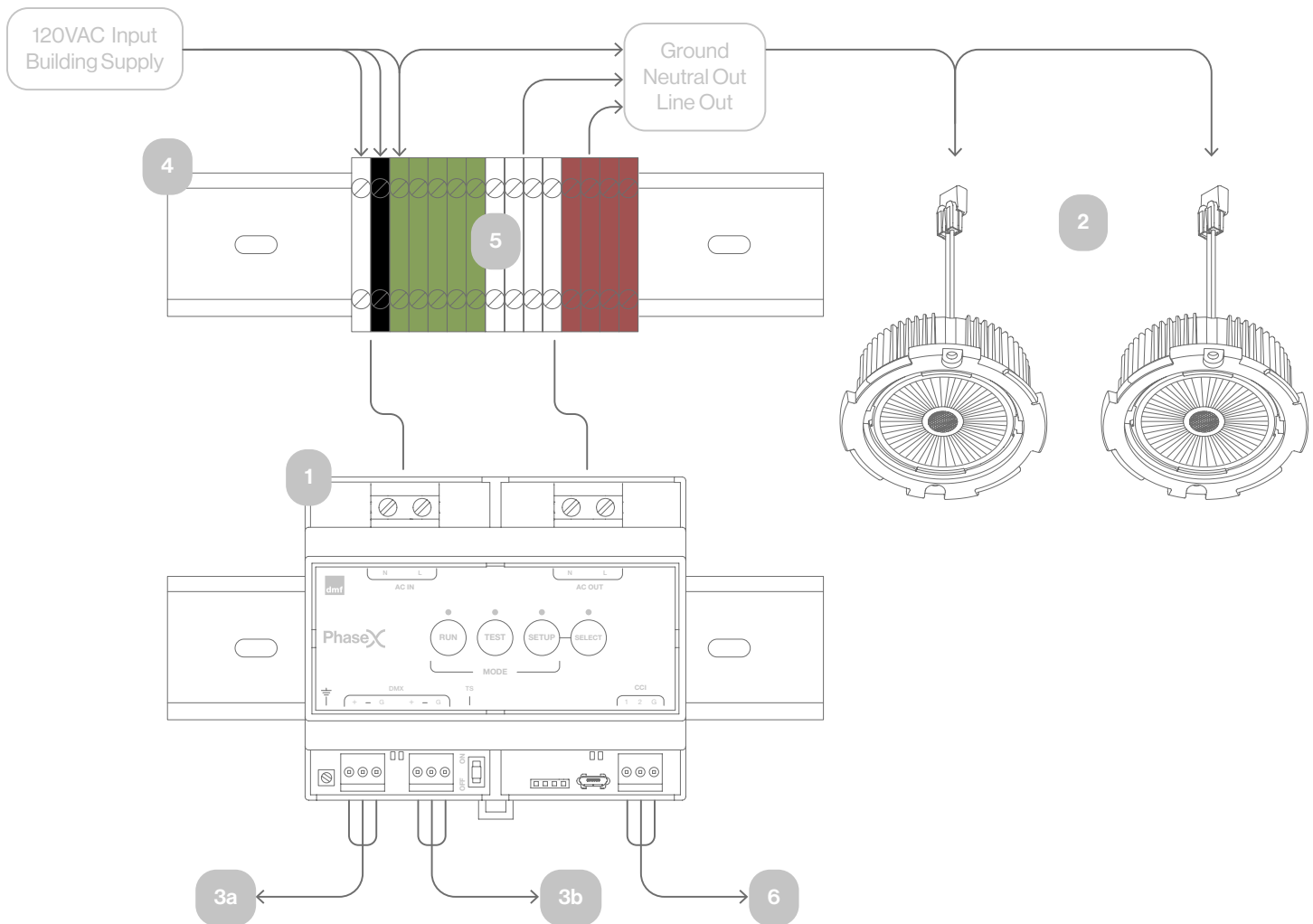
Take into account the following gateway installation requirements when choosing an installation location and enclosure for the gateway. Additionally, note the wire run length limits and system device capacity limits when laying out fixtures in relation to the enclosure location.

Installation Enclosure	Must install in a UL Listed electrical enclosure, (min. 8"x8"x4") Mounts to 35 mm EN 60715 DIN Rail
Mechanical Dimensions	3.54" x 4.17" x 2.28" (H x W x D) 6 DIN module spaces (108 mm)
Environmental	32° to 104 °F (0° to 40 °C) 10% to 90% RH (noncondensing)
Electrical Input	120VAC, 50/60Hz Feed each gateway from an individual circuit breaker
Electrical Output	120VAC, 50/60Hz 8A Max Connect ONLY PhaseX Lighting devices
Line Voltage Wiring	Use only 12 AWG or 14 AWG Stranded or Solid Copper Conductors Use conductors rated for minimum 60°C
Low Voltage Wiring	DMX signal must be provided via twisted pair wire and should conform to ANSI E1.27-2 standards.
Control Standards	DMX512 ANSI E1.11 – (control) RDM ANSI E1.20-2010 – (setup)
Wire Run Length Limits	Per Wire Run - 250 ft (from gateway to terminal fixture) Per Gateway - 1000 ft
System Device Capacity Limits*	Per Wire Run - 32 PhaseX Modules Per Gateway - 64 PhaseX Modules Usable DMX Addresses - 500

*Note - Some DMX control interfaces/lighting control systems may limit the total number of usable addresses or devices on a DMX Gateway. Consult individual lighting manufacturers for specifics on DMX implementation for each lighting control system.

Typical Gateway Enclosure Installation

- A gateway enclosure may contain more than one gateway, as well as other lighting controls equipment, such as DMX Gateways, terminal blocks for field wiring and traditional phase dimming control modules.
- The DMX control source need not be installed within the same enclosure, and may come from a separate lighting control panel.
- Terminal blocks are recommended to land all field wiring for cleanliness and organization, and for bonding conductors where necessary. Terminal blocks may be bonded on the output side to facilitate multiple fixture homeruns.
 - a. Note: the gateway does not provide a building ground connection. Building and fixture ground conductors must be externally bonded via terminal block.
- Optional contact closure inputs may be used for emergency or manual lighting control
- If additional disconnect means are required for individual fixture runs, circuit breakers may be used on the output side of the gateway, but **MUST** be contained within the electrical enclosure with the gateway.



1. DMF PhaseX Gateway
2. DMF PhaseX Enabled Lighting Fixtures
3. DMX Signal
 - a. DMX In - from 3rd Party DMX Gateway / Control Source from Lighting Control System
 - b. DMX Out - daisy chain to next DMX device (optional)
4. 35mm DIN Rail
5. DIN rail mounted terminal blocks for field wiring
6. Contact Closure Inputs

Application Guide

Where can PhaseX be used?

As outlined in the previous section (the System Design Guide) there are a few particular rules for PhaseX installations. Those are:

1. A PhaseX Gateway can have only PhaseX modules installed on its output wiring, and PhaseX light modules can only be powered by a PhaseX Gateway.
2. Each wire run must be terminated by a PhaseX module.
3. Both the hot and neutral conductors must be connected from the gateway output to the lighting fixtures.

Because of these rules, PhaseX should only be used for new construction projects or for retrofits of existing projects where centralized dimming cabinets are already in place.

Particularly for retrofits of centralized dimming systems, care must be taken to ensure that each fixture leg has separated hot and neutral wiring coming back to the same enclosure, and that each leg of fixtures ultimately only contains PhaseX fixtures, and no extraneous wiring or devices.

Retrofit projects that have non-centralized dimming (ie. traditional wall box dimmers) are NOT suitable for PhaseX retrofit installation, as there can be too many unknown variables in wiring, such as wired receptacles and additional branch circuits sharing the same neutral wires.

Please Note: PhaseX systems will not work if the neutral wires from fixture runs are bonded externally from the gateway. PhaseX operates as a closed system, and both wires must be connected to the isolated output of the gateway to ensure data transmission and reliable performance.

New Construction Projects

New construction projects are generally the most straightforward for the design and planning of a PhaseX installation and also provide for the most flexibility when laying out gateways and fixtures. There are two main approaches: a fully centralized approach where the PhaseX gateway(s) are located in one remote enclosure, or a more distributed method, where multiple PhaseX gateways are located in smaller enclosures throughout the home. Each method has some advantages and drawbacks, which will be covered below.

Best Practices for New Construction Projects

- It is recommended to make separate home runs for fixture groups in a logical manner. Typically, this is on a room-by-room basis (ie. kitchen, living room, dining room, etc...)
- Separate home runs are also recommended when the total wire length of one leg is greater than 250 feet or has more than 32 devices.
- If provisions for possible future expansion are necessary, DO NOT leave disconnected wire at any point in the run. Possible solutions include:
 - a. Running additional homeruns to the gateway enclosure location and leaving them disconnected from the gateway.
 - b. Running additional runs from an accessible junction box that can later be wired in once fixtures are installed.

Fully Centralized Design

A fully centralized design follows a similar architecture to traditional centralized dimming systems. PhaseX gateway(s) are installed in a remote electrical enclosure, often in a mechanical room or closet in the home, and all fixture wiring comes back to the same remote enclosure. Power feeds from the buildings main supply panel feed the necessary number of circuits for lighting loads, and lighting control system components are often installed in the same location to facilitate ease of wiring and maintain one centralized location for all equipment (be it the same enclosure or a neighboring one).

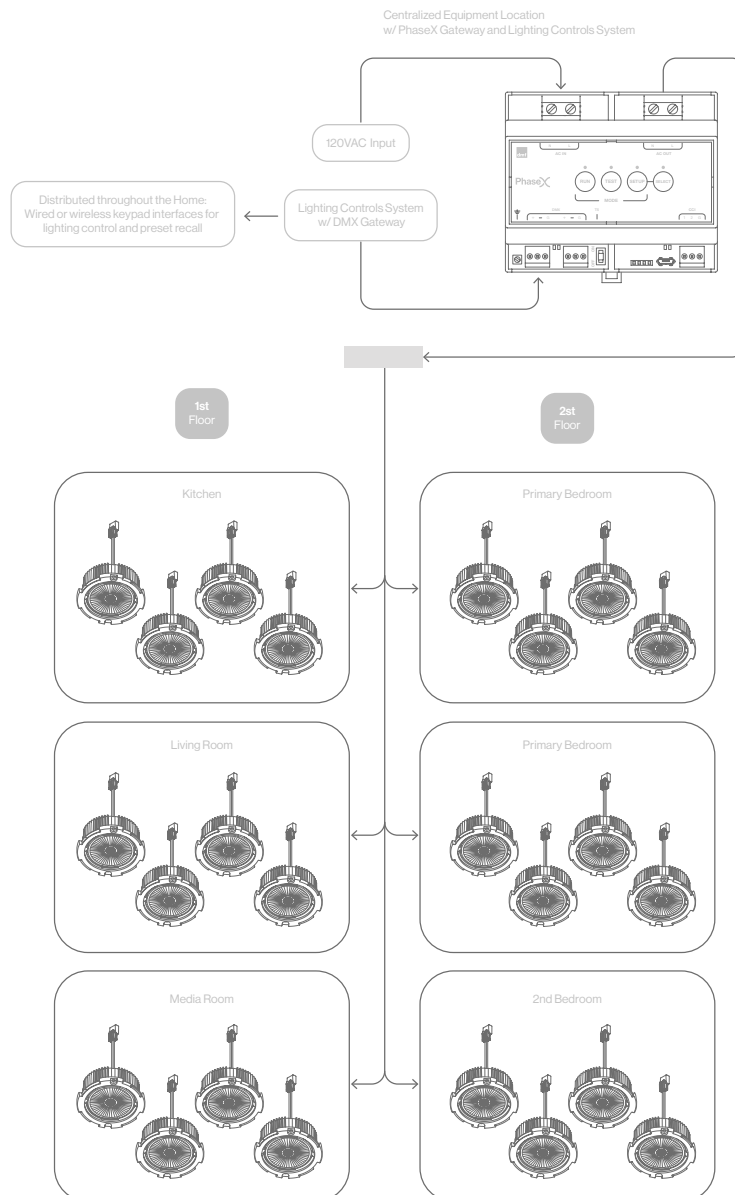
Pros:

- One central location for equipment can sometimes be simpler for planning and servicing.
- Equipment can be closely located to the buildings main power supply panel, reducing complexity for branch circuiting.
- Reduces other equipment locations/enclosures throughout the home.

Cons:

- May require longer runs and higher quantity of wiring going to fixtures.
- Remote enclosures and associated equipment often require larger rooms.
- Homes without basements or auxiliary spaces may be hard to fit these in.
- May not be well suited for particularly large homes where wiring length limits can quickly be exceeded.

Example Diagram of a Fully Centralized Design



Distributed Design

A distributed system design involves placing multiple PhaseX gateways in strategic areas of the home. Each gateway can be installed in a smaller electrical enclosure, and feed a more localized collection of fixtures. This approach may be best suited for particularly large installations, where wire run length limits might be exceeded with a fully centralized approach, or for homes that don't have enough dedicated space for larger equipment enclosures. Examples of locations for gateway enclosures include inside closets and equipment racks. When choosing a location, ensure that the installation meets all applicable code requirements.

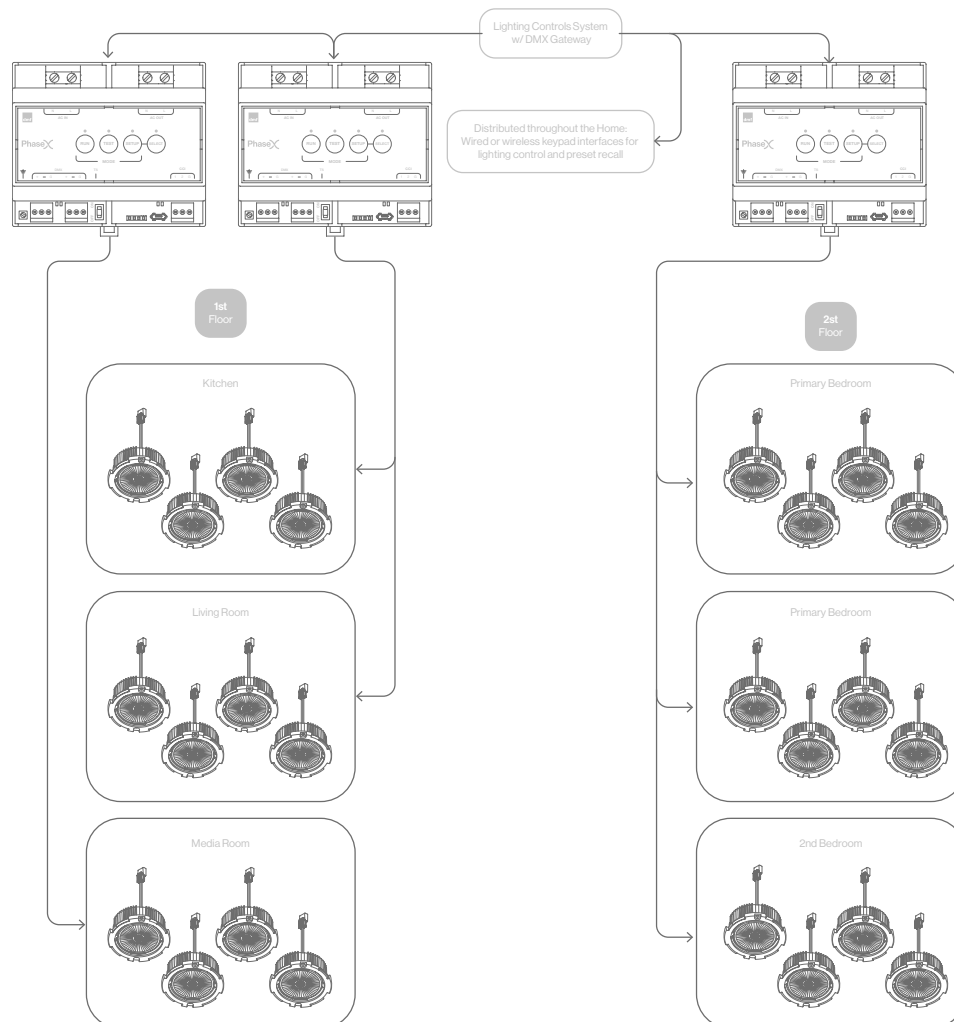
For distributed systems with multiple gateways, each gateway enclosure can have a dedicated DMX gateway from the lighting control system, or DMX wiring can be run from a central location to individual enclosures. The lighting controls system its capacity will largely dictate which approach is necessary, as some DMX gateways limit the number of available address to as low as 32. When running DMX wiring throughout the home, consult ANSI E1.27-2 standards to ensure integrity of the DMX signal. For example, use plenum rated cable where required and do not run DMX wiring and line voltage wiring through the same conduit or junction boxes. Also note that installations with a DMX gateway in each enclosure still may require some low voltage wiring to interconnect the lighting controls system components.

Pros:

- Reduces wire run lengths between the gateway and fixtures.
- Easier to service, as one gateway may be feeding fewer areas of the home.
- Potentially easier to interface with lighting controls system, depending on architecture.

Cons:

- Will require longer runs of branch circuits to reach remote enclosures.
- Typically requires more PhaseX gateways, enclosures and possibly DMX gateways.
- Can require more planning and coordination to find spaces throughout the home.



Retrofits Existing Centralized Dimming Systems

In addition to new construction projects, PhaseX technology can dramatically simplify the process to retrofit existing installations and upgrade them to a fully digital, tunable solution. When considering PhaseX for retrofit applications, it is crucial to keep in mind the wiring and device limitations, previously outlined in the System Design Guide. To summarize, the three main rules are:

1. A PhaseX Gateway can have only PhaseX modules installed on its output wiring, and PhaseX light modules can only be powered by a PhaseX Gateway.
2. Each wire run must be terminated by a PhaseX module.
3. Both the hot and neutral conductors must be connected from the gateway output to the lighting fixtures.

Given these main rules, PhaseX retrofits should be limited to existing centralized dimming systems. These lighting systems have a central location where all fixture wiring comes back to, and have typically been purpose designed and built to have only one type of lighting load connected to each fixture leg. They also typically already have some form of lighting controls system with preset keypads throughout the home. This means that most projects only require that dimming cards be replaced with a PhaseX gateway, light fixtures be replaced with PhaseX modules and that the lighting controls system is upgraded or modified to support DMX control. The remaining infrastructure, such as control wiring, fixture wiring and electrical enclosures may often be reused, extending their serviceable life.

For many typical existing installations, a single PhaseX gateway may replace up to 3 or 4 traditional 4 slot phase dim modules, however this is dependent on the number of individual fixtures (remember, PhaseX Gateways can control up to 64 fixtures from a single output). Additionally, keep in mind that some traditional phase control dimming may still be required for non-PhaseX loads, such as decorative lighting.

Below are some guidelines for determining if an existing system is a good candidate for a PhaseX retrofit:

1. Existing lighting loads are controlled from a centralized panel system, and fixture wiring is easily identifiable and traceable within the electrical enclosure.
2. Ensure that candidate fixture runs have both hot and neutral wiring present in the enclosure, and that neutral wiring is not externally bonded elsewhere in the installation.
3. Recessed fixtures are able to either be replaced or retrofitted with DMF's solutions, such as retrofit trims, conversion kits or remodel housings.
4. Existing lighting control infrastructure (keypads, processors, wiring) can be repurposed or upgraded to support DMX implementation, or wireless keypads and controls can be installed.

Tips for Inspecting Existing Wiring

NOTE: Follow best practices and electrical safety measures, including use of appropriate personal protective equipment, and do not inspect or work in any enclosure with live electricity. Electrical testing and diagnosis should be performed by a qualified, licensed electrician where required.

- Verify that candidate lighting zones have both hot and neutral wires present in the enclosure:
- Verify visually (eg. conductors share a single NMB jacketed cable)
- Use electrical circuit testers to ensure wiring is as expected.
- Perform continuity checks between neutral wires to rule out bonding elsewhere in the system.

Rule out any potential additional wiring devices. While uncommon, ensure that things such as receptacles or mechanical switches in the fixture chain are not permitted. To verify, perform a thorough inspection of all electrical devices:

- Turn each zone of lighting on and off to note connected fixtures.
- Plug in a device into every outlet - portable light fixtures work well. Ensure outlets remain on when lighting zones are dimmed or off.
- Test all physical switches in the area to verify none are connected to candidate control zones.

Rule out the possibility of any unterminated lines.

- In homes with accessible wiring (eg. though attics) trace wiring and look for any unterminated lines.
- For homes without access, inspect wiring through existing fixture housings if possible.

Lighting Control System Integrations

PhaseX is based around an industry standard, open protocol, DMX. Therefore, any DMX controller, be it standalone or part of a full lighting control system, can work with a PhaseX installation. Below are some guidelines for how PhaseX can integrate with some prominent controls manufacturers in the Custom Integration channel. Please note these are high level guidelines, and additionally, manufacturers may at any point change hardware or software implementation of DMX. Consult with specific controls manufacturers to verify system components and capabilities. Below is some general information on DMX, as well as guidance on DMX integrations with lighting control systems.

Basics of DMX

DMX stands for Digital Multiplexing. It is a control signal that was initially developed for the control of entertainment and theatrical lighting equipment. The standard is maintained by ESTA or the Entertainment Services and Technology Association, and the most current version was approved by ANSI in 2008. The current standard is titled "E1.11 – 2008, USITT DMX512-A", but is commonly referred to as DMX-512-A.

The DMX signal consists of 512 "addresses", each with a corresponding "level" (ranging from 0-255). Due to the nature of its intended application, DMX is a very fast protocol, and can provide an update for all 512 addresses as often as 44 times per second. DMX devices can occupy a single address (eg. a traditional dimmer) or multiple addresses (eg. tunable white LED's). A DMX device's Profile or Personality determines how DMX addresses correspond to different fixture attributes (eg. 1 for intensity, 2 for CCT). Both the DMX Controller and the Lighting Device must be set to the same profile for proper control. The DMX address is set on the device and stored locally.

DMX Integration with Lighting Controls

- Most manufacturers support DMX implementation through a DMX gateway, which is different from the PhaseX Gateway. A lighting controls DMX Gateway interfaces with the lighting controls processor and produces a DMX signal. Some gateways combine digital lighting protocols on one gateway and support both DMX and DALI control.
- Most gateways will state how many "directly connected devices" are supported on each output. This is referring to the number of DMX devices wired in a daisy chain off of one output. Examples include individual DMX drivers and the PhaseX Gateway. In this instance, the PhaseX gateway counts as one (1) DMX device.
- Some gateways will support less than a full universe (512 addresses) of DMX from one output (eg. only 32 addresses of control).
- Some control platforms may also have a software limitation on the number of devices supported from one DMX Gateway (eg. 64 fixtures from one output). This is different than the number of supported addresses, and many fixtures take more than one address for control.
- Systems that support a full universe of DMX addresses may utilize a DMX Splitter to facilitate wiring multiple devices or devices in multiple locations. Note that DMX can not be split simply by splicing wires. A DMX Splitter (also known as an Opto Splitter or DMX Repeater) must be used to reliably propagate the DMX signal.
- Some manufacturers may support RDM (remote device management), an provision in the DMX specification that allows for remote device discovery and configuration. The PhaseX Gateway and modules support RDM for such functions.

PhaseX DMX Implementation

PhaseX modules have 3 standard DMX profiles which can be set to best suit the installations control manufacturers integration.

1. Tunable White (2 DMX Slots) – this two channel profile will work well for most implementations of DMX and provides two sequential channels for Intensity and CCT control.
2. Crestron Tunable White (2 DMX Slots) – this profile operates similarly to the standard Tunable White profile and is optimized for use with Crestron Home, allowing PhaseX modules to be treated as native Crestron devices.
3. Lutron Profile with Circadian Support (5 DMX Slots) – this profile is optimized for use with Lutron Homeworks and enables a Circadian Lighting effect using simple timeclock events.

For full information on each profile's DMX attributes, reference the PhaseX commissioning guide, linked at the end of this document.

	Crestron Home	Lutron Homeworks	Control4	Vantage
DMX Gateway Part Number	DIN-GWDL	QSE-CI-DMX	CRE-EDIDIO-10-2X	DMX-DALI-GW
Native PhaseX Integration	Yes - PhaseX treated as DMX-C Devices	No	No	No
Number of Supported Connected Devices (per output)	82	64	256	256
Max Number of Supported Zones	82	16	256	256
Min # of PhaseX Gateways (ART-GWX)	2	1	4	4
Number of Supported Addresses	512	32	512	512
Support for RDM	Yes	No	Yes	Yes
Support for CCT / Color Control	Yes	Yes	Yes	Yes
Native Support for Circadian Lighting Schedules	Yes	No	Yes	Yes

Additional Documentation

PhaseX Technical Reference Guide



Contains all technical information for the PhaseX system:

- System Components & Diagrams
- System Specifications
- Installation Requirements
- System Design

PhaseX Commissioning Guide



Contains information for commissioning PhaseX systems:

- PhaseX DMX Profiles
- Using the DMF PhaseX Commissioning Utility
- Commissioning with Crestron Home
- Commissioning with Lutron Homeworks
- Commissioning with Control4

PhaseX Product Page





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