PhaseX

Technical
reference guide

dmf

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Introduction

The PhaseX Technical Reference Guide provides and overview of PhaseX technology, system components and how it can be installed and used.

System Overview

PhaseX is a technology solution developed exclusively for the Custom Integrator lighting market that simplified the installation and implementation of digital and tunable white lighting in the luxury residential market. PhaseX delivers ultra-fast, reliable and flexible digital control of lighting fixtures over standard line voltage power wiring, using wiring methods that are already familiar to electricians and installers.

PhaseX provides ultra-low 0.1% dimming depth, stability and consistency of dimming across fixtures, flexible soft zoning, and ultra-fast bi-directional communication between lighting fixtures and lighting control systems. This allows for bio-adaptive lighting that mimics the natural color path of the sun, and intuitive, responsive lighting systems that work with the reliability of a wired digital system, without the installation complexity or cost.

Technology Overview

PhaseX systems have three major components – PhaseX enabled modules, a PhaseX Gateway and a 3rd party DMX capable lighting controller / controls system. The PhaseX Gateway is the heart of the system – it works by combining standard 120v AC power and a standard DMX control signal and transmits them over traditional romex wiring that is ubiquitous in residential lighting installations.

PhaseX is not the first ever powerline carrier technique in the CI market, but the reason it is able to deliver high perforamnce features and rock solid reliability lies directly in the gateway. The PhaseX Gateway provides a filtered AC output, which electrically isolates PhaseX fixtures from any potential interference that could come from standard household equipment, such as appliances, motors or other electronics.

DMX Integration

Fixtures connected to the output of the gateway are individually addressable and controlled via DMX/RDM.

During normal operation, the PhaseX Gateway receives standard DMX512 packets from the lighting control system. During setup, RDM packets can be used to query fixtures and assign fixtures to specific DMX channels.

The DMX and RDM packets are forwarded on to the lighting fixtures over the power line using the PhaseX transmission protocol.

Fixtures can be configured to use a specific DMX profile to suit the lighting control system's capabilities and the system programmer's preference. The various DMX Profiles are explained in a later section.

NOTES:

- *The wiring and device count rules for PhaseX differ from standard DMX. See the System Design section for details.*
- *The PhaseX Gateway supports 500 usable DMX Addresses. DMX Addresses 501 through 512 are reserved for system use, and values for those addresses will be ingnored.*

System Components

PhaseX Gateway ART-GWX

The Gateway provides the interface between the DMX based control source and the AC powered fixture wiring.

The Gateway is fed from a standard residential circuit breaker, (15A, 20A, AFCI). The AC Output of the Gateway feeds power to up to 64 PhaseX fixtures. The Outputted power also includes the PhaseX data to control each of the connected fixtures.

The Gateway provides a DMX port for connection to a DMX control source. A second DMX terminal simplifies daisy chaining multiple Gateways to the same DMX control source.

A slide switch next to the DMX input allows a termination resistor to be connected if the Gateway is at the end of the DMX line.

NOTE: This is important for long DMX runs.

Line Voltage Connections

1. INPUT AC
    a. 2-pole terminal block for connection to circuit breaker*
    b. 120VAC input
    c. Accepts #14 or #12 solid copper wire

2. OUTPUT AC
    a. 2-pole terminal block for connection to lighting fixtures*
    b. Accepts #14 or #12 solid copper wire
    c. Max Output: 8Amp / 64 fixtures

NOTES:

- *The Gateway does not provide connections for building ground. A grounding busbar must be used to connect the fixture ground and building ground.*
- *It is recommended that field wiring terminal blocks be used to land all field wiring and make connections to the Gateway.*

Low Voltage Connections

1. DMX
    a. Two (2), 3-pole pluggable terminal blocks for DMX+, DMX-, G
2. CONTACT CLOSURES
    a. Two contact closure inputs to trigger emergency override actions (CCI1, CCI2, COM)
3. USB
    a. For PC connection when using the PhaseX Commissioning Utility

Local Control Buttons

1. RUN
    a. Press to put system into normal operating mode. The DMX input controls the connected fixtures
2. TEST
    a. Press to manually control the connected fixtures
    b. Pressing the button cycles through the following states: All On, All Off, Blink All
    c. The TEST mode allows manual testing and verification of the system without any prior DMX commissioning.
3. SETUP
    a. Hold SETUP to initialize the PhaseX Network
    b. Tap to enter SETUP Mode
        I. While in SETUP mode, basic PhaseX parameters may be changed such as the PhaseX Network Channel

Fixtures

PhaseX control is available in Artafex 2 and Artafex 4 LED modules.Artafex modules with PhaseX control are available as tunable white 1800-4000K in Downlight or Adjustable.

1. ART2D10TT1__X Artafex 2” Downlight 1000lm 1800-4000K Tunable White, PhaseX
2. ART2A07TT1__X Artafex 2” Adjustable 750lm 1800-4000K Tunable White, PhaseX
3. ART4D10TT1__X Artafex 4” Downlight 1000lm 1800-4000K Tunable White, PhaseX
4. ART4A07TT1__X Artafex 4” Adjustable 750lm 1800-4000K Tunable White, PhaseX

System Design

Rules

Each Gateway allows up to 64 fixtures to be connected to its output with up to 1000ft total of Romex or MC cable (14 or 12AWG).

The fixtures can be connected by one or more home runs.

Each home run can be up to 250ft in length and connect up to 32 fixtures.

- Per Fixture Run
  a. 250ft max wire run
  b. 32 fixtures on a wire run
- Per Gateway
  a. 1000ft wire total
  b. 64 fixtures total
- Every wire run must be terminated by a PhaseX module. Unterminated stubs are not permitted

PhaseX fixtures must be connected to the output of a PhaseX gateway, and cannnot be controlled through other means. Likewise, only PhaseX fixtures (and no other devices) can be connected to the output of a PhaseX Gateway.

Design and Application Notes

PhaseX can dramatically simplify the installation materials and labor required for digital lighting solutions. In doing so, the rules mentioned above must be followed to ensure proper system performance. Failure to follow said rules can and will result in system performance degredation. For full details and application examples, see the PhaseX Design Application Guide, published on the PhaseX product page, at dmfluxury.com.

New Construction Best Practice

For new construction projects, multiple wire home runs may be used to simplify installation. Grouping fixtures by logical zones, such as by room or floor can help to segment the PhaseX system and allow for easier tracing in the case of any troubleshooting.

Gateway(s) can be located all in a single central location, such as in a traditional exquipment room, or located in semi-decentralized loations, such as in closets throughout the home. The PhaseX Design Applicaiton Guide outlines some of these examples, and their pros and cons.

Retrofits of Existing Centralized Dimming Systems

PhaseX enables an easy retrofit and upgrade of existing centralized dimming systems.

A single PhaseX Gateway can replace one or more standard 4-channel dimming modules and the fixtures replaced with PhaseX enabled 2" or 4" fixtures. Ensure compliance with system limits and restrict the total number of home runs to a Gateway to 8.

When approaching retrofits of centralized dimming systems, take extra caution to abide by the PhaseX system rules, and ensure that all wire runs are terminated with a PhaseX fixture and that wire runs are not shared with other fixture types.

PhaseX Installation

Gateway

One or more PhaseX Gateways may be mounted within a UL listed electrical enclosure measuring at least 8” x 8” x 4”.

The Gateway mounts to standard DIN rail.

Separate field wiring terminal blocks should be used to land field wiring and make connections to the Gateway.

A dedicated breaker is recommended to feed each Gateway and associated fixtures.

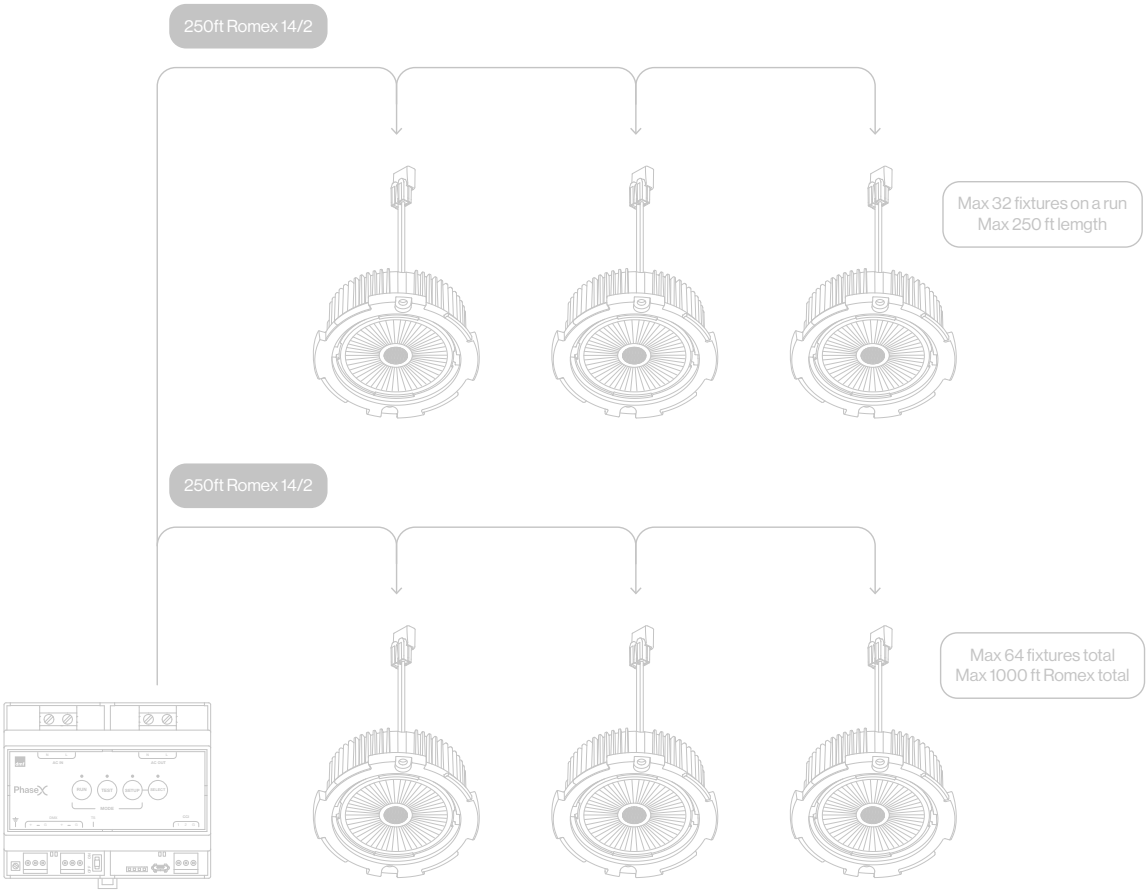
Magnetic or Arc-Fault (AFCI) breakers may be used (15A or 20A). Ground Fault (GFCI) and Combination AFCI-GFCI breakers are also compatible.

DMX wiring should be connected to the DMX input terminal. The DMX signal may be daisy chained using the second DMX terminal block. Low voltage DMX wiring must be kept separated from the line voltage AC wiring per national and local electrical code.

Gateway Specifications

Mechanical Dimensions	3.54" x 4.17" x 2.28" (H x W x D) 6 DIN module spaces (108 mm) Mounts to 35 mm EN 60715 DIN Rail
AC Terminals	AC Input and Output (H,N): 12-14AWG stranded or solid copper conductors
Electrical Input	120VAC, 50/60Hz
Electrical Output	120VAC, 50/60Hz 8A Max Connect only PhaseX Lighting devices
Environmental	32° to 104 °F (0° to 40 °C) 10% to 90% RH (noncondensing)
Certification	UL 508 listed File: E543629
Communication Protocol	DMX512 ANSI E1.11 – (control) RDM ANSI E1.20-2010 – (setup)
Contact Closure Inputs	2 x Contact Closure inputs (10kOhm, Pull up to 3.3V)

Wiring for a typical Gateway installation is shown below:



Fixtures

Fixture wiring is identical to standard TRIAC dimmable fixture wiring, i.e. connections are Hot, Neutral and Ground.

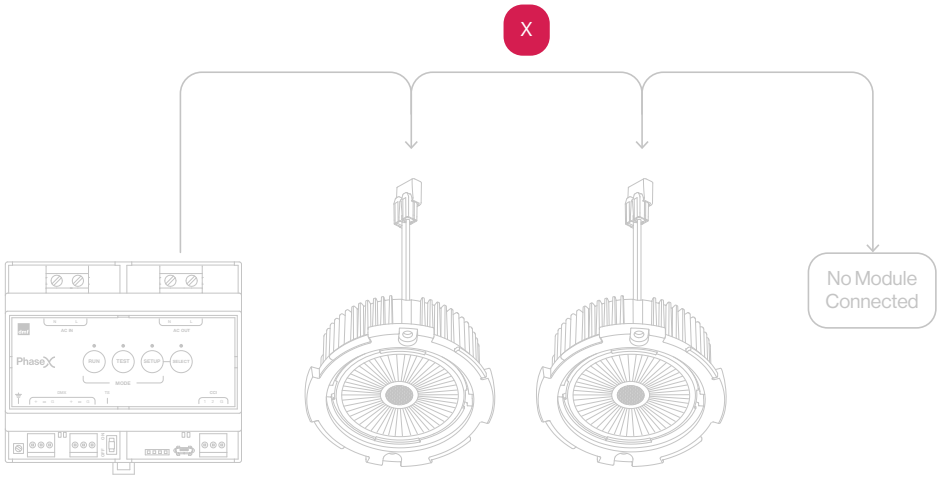
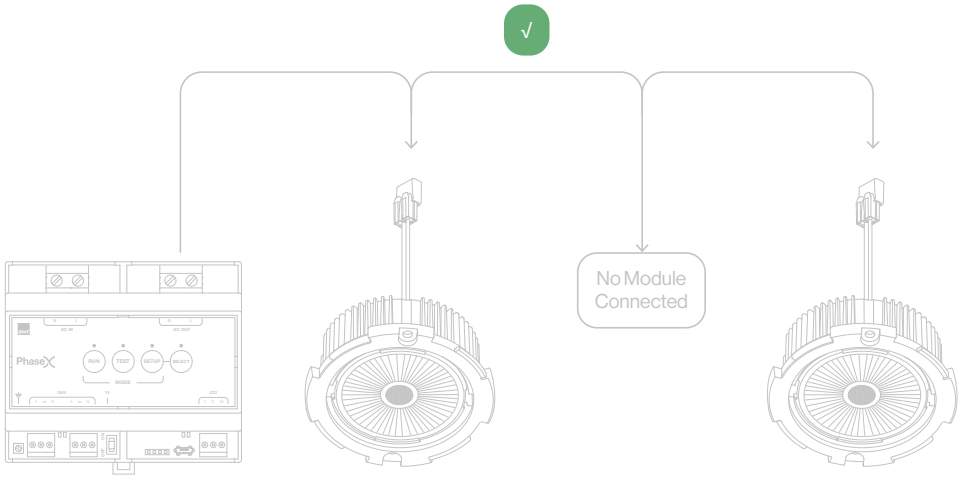
All PhaseX fixtures use a 6-pin Molex connector, same as DMF DALI and 0-10V fixtures.

The connection is compatible with standard X Series housings.

For M Series housings, the pigtail is included with the ART4 module.

Impotant Notes:

- *Unterminated stubs, i.e. wire connections that do not have a fixture connected are not permitted. Operating the system with stubs present will affect system operation.*
- *Only PhaseX fixtures may be connected to the output of a PhaseX Gateway. Connecting other equipment will affect system operation.*

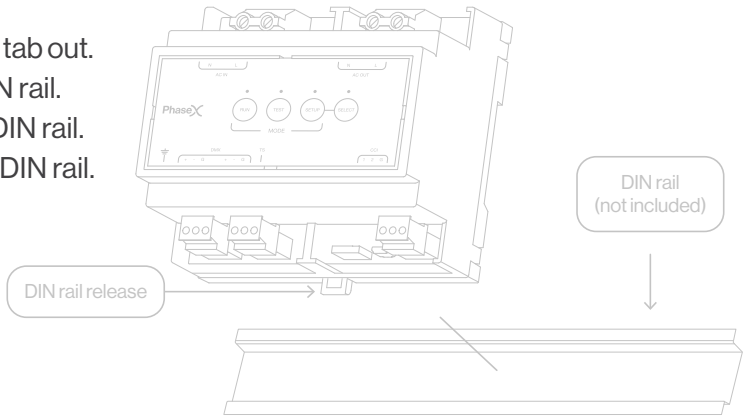
No module installed at end of wire run. Results in reflections and potential communication errors	
No module connected in the middle of the run does not form a stub	

NOTE: When separate circuit breakers are desired to protect different areas of the home, multiple Gateways should be used, each fed from its own breaker.

Gateway Physical Installation Steps

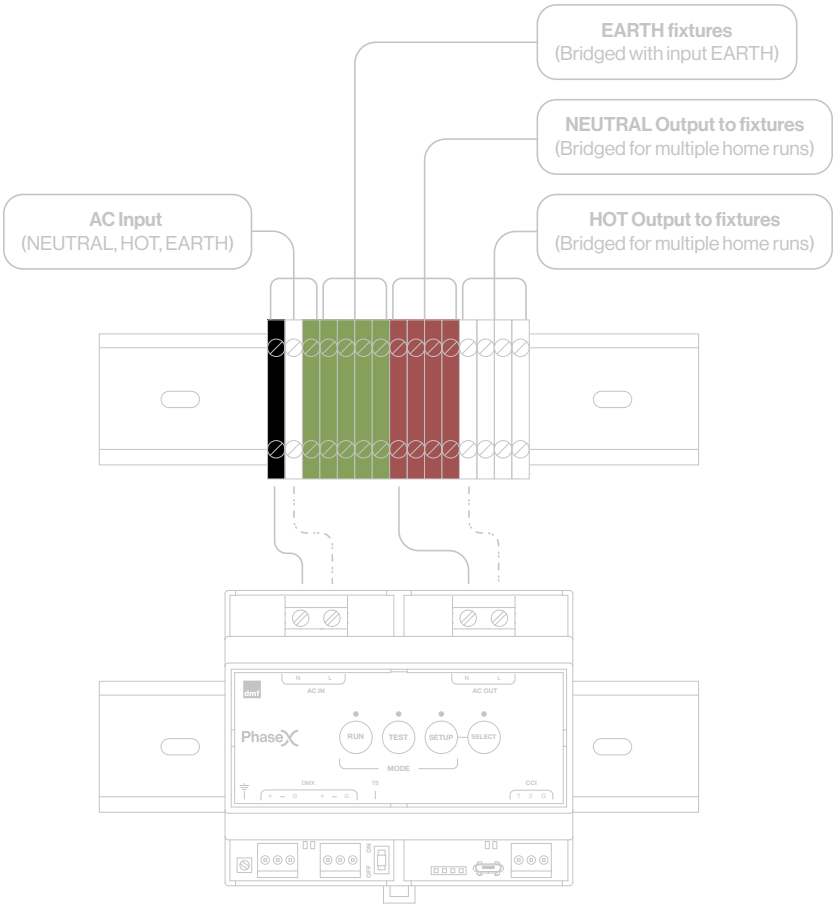
1. Mount Gateway to DIN Rail

   a. Use flat head screw driver to DIN rail release tab out.
   b. Place top of Gateway over the top of the DIN rail.
   c. Tilt bottom of Gateway over lower edge of DIN rail.
   d. Push DIN release tab in to lock Gateway to DIN rail.



2. Mount field wiring terminal blocks
   It is recommended to install DIN terminal blocks to facilitate field wiring.

   a. Mount field wiring terminal blocks to DIN rail and arrange as shown below. The number of terminals to install may vary based on the number of home runs to be connected to the Gateway.
   b. Make wiring connections from AC Input (HOT and NEUTRAL) to Gateway AC input terminal.
   c. Make wiring connections from AC Output terminals (HOT and NEUTRAL) to Gateway AC output terminal.
   d. Make electrical connection from breaker (Max 20A) to AC input terminals. Ensure terminals are torqued down. Do not over torque.



System Power Up

Once the Gateway and fixtures are installed, basic testing can be initiated from the Gateway to verify all wiring.

Note: Do not proceed with testing until all fixtures are completely wired and installed. For systems with more than one gateway, it is recommended that each gateway be powered up and initialized independently (without other gateways powered on).

1. Disconnect the green terminal block from the DMX Control Source.
2. Turn on the circuit breaker feeding the gateway.
3. The RUN indicator LED will light in green and blink, indicating no DMX Signal is present.
4. Shortly after, all fixtures should turn on to full brightness at 3000K. Verify that all fixtures are on at 3000K.

Auto Setup & Initialization

The Gateway communicates to the PhaseX fixtures using one of six frequency channels. By default, all Gateways and fixtures operate on Channel 1. The ideal communication channel depends on field conditions. Once all fixtures are connected, run the Auto Setup function to detect and set the best operating channel. The process can be re-run at any stage. Once again, the Auto Setup should be performed with only one gateway powered on at a time.

1. Press the SETUP button once. The SETUP indicator LED will light solid red, which indicates Auto Setup is in process. Once complete (typically less than 1 minute), the SELECT Indicator LED will blink red.
2. Auto Setup is complete. Proceed to TEST mode, or press RUN to enter normal operation.

Fixture Test Mode

At any time, the TEST button may be used to cycle through various preset scenes. To do so:

1. Press TEST to enter test mode.
2. Press SELECT to cycle through presets:
    a. Full Brightness, Cool CCT
    b. Low Brightness, Cool CCT
    c. Full Brightness, Warm CCT
    d. Low Brightness, Warm CCT
    e. Flash (cycle between Full and Dim)
3. To restore normal operation, press the RUN button and replace the DMX Signal terminal block. All fixtures will resume operation based on the incoming DMX stream.

PhaseX DMX Profiles

PhaseX modules have 3 DMX profiles or personalities to select from. Those are:

1. Tunable White (2 DMX Slots) - Two sequential DMX slots are used to independently control Intensity (0-100%) and CCT (1800K to 4000K). This profile should suit most standard installations.
2. Crestron Tunable White (2 DMX Slots) - This profile operates identically to the first profile (Tunable White), but is optimized for use with Crestron Home systems and treats PhaseX Modules as native Crestron Home devices.
3. Lutron Tunable White w/ Circadian Support (5 DMX Slots) - This profile is optimized for use with Lutron Homeworks systems, and provides two slots for manual fixture control, a slot for Circadian Enable and two slots for Circadian Intensity and CCT. This allows for use of simple time clock events to set a master circadian schedule for the entire home, and for users to toggle between manual scene control and circadian lighting schedules control.

Note that by default all fixtures are assigned to follow DMX channel 1 for intensity and DMX channel 2 for Color Temperature.

For full DMX profile information, please reference the PhaseX Commissioning Guide, linked to under Additional Documentation.

Commissioning

Once fixtures have been installed and wired to the gateway, and confirmed to be working, the system may be commissioned to interface with the lighting controls system. The commissioning process will vary based on the lighting controls system and its capabilities.

Reference the PhaseX Commissioning Guide for guidance and details, linked to under Additional Documentation at the end of this document.

Trouble Shooting

Symptom	Possible Cause	Action
Fixture(s) stays off.	Fixture(s) stays off.	• Verify AC power is present at the fixture with a multimeter. • Check for loose splices at the fixture and throughout the run. • Verify other fixtures on the same run are receiving power.
	The fixture may be receiving DMX data instructing it to turn off.	• Verify fixture is wired to the Gateway that is in TEST mode.
	The fixture may be receiving DMX data instructing it to turn off.	• Verify black quick connect is secure.
Fixture turns on to 3000K but does not react to any TEST mode states.	The Gateway and Fixtures may be operating on different channels.	• Tap SETUP button. • Wait until SELECT LED begins blinking red (indicating the Setup process is complete). This process announces operating channel to all fixtures. • Tap TEST to verify.
	The Gateway communication channel may need to be channel.	• Use the PhaseX Commissioning Utility to change the operating channel.
	Output wiring is feeding a receptacle or non-PhaseX fixture.	• Ensure that only PhaseX fixtures are connected to the Gateway output. • Do not feed receptacles, dimmers or mechanical switches from the Gateway output.
	Unterminated line, i.e. no fixture connected at the end of a wire run Or output wiring is feeding a disconnect switch / breaker that is open.	• Ensure there are no unterminated wire runs, i.e. all LED engines are installed. This is particularly important for fixtures at the end of a wire run. • If using disconnect means on the output of the gateway, ensure they are all closed.
	The maximum wire lengths may be exceeded.	• Ensure maximum wire length of a single home run is less than 250ft. • Ensure the total wire run connected to the gateway is less than 1000ft. • If multiple home runs are connected, disconnect one or more for troubleshooting.

Additional Documentation

PhaseX Product Page:

PhaseX Commissioning Guide:

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