

# DMX CONTROL SUPPORT WITH KETRA

September 25, 2018

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## Introduction

### ABOUT DMX

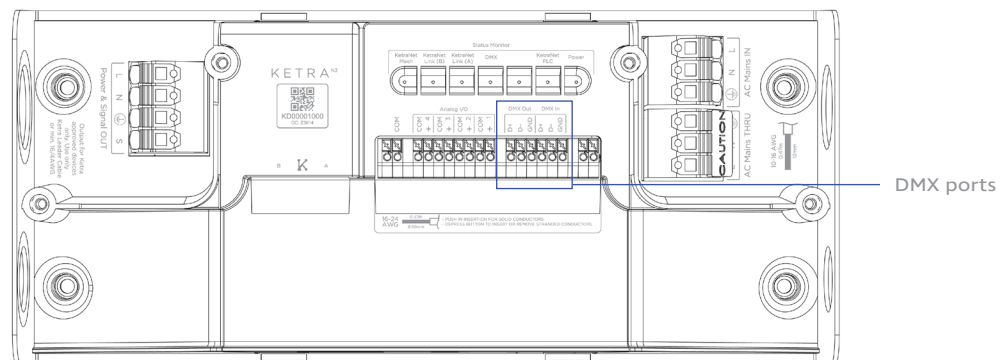
DMX512 is an industry-standard control protocol, built upon RS485, that has roots in entertainment and theatrical lighting applications. It is easy to use, robust, and low-cost, and has found its way into many applications beyond the theater. As the name suggests, it is a way to send 512 8-bit data values over a single cable.

There are several rules of thumb to follow when physically wiring DMX networks:

- Total run length should not exceed 300m (~1000 feet)
- Maximum number of receivers connected to the cable is 32
- The end of the cable run (farthest from transmitter) should be terminated properly with a 120-ohm resistor
- All products should be connected in a serial fashion, not in star or “home run” topologies

### N3 SATELLITE AS DMX CONSOLE

The N3 Satellite acts as a bridge between the external DMX system and the Ketra lighting system. Its DMX ports (shown below) can send or receive a full universe (512 channels) of DMX512-A.



An N3 can be configured as DMX master or DMX slave, which determines the directionality of control data.

- DMX master — N3 outputs DMX to a 3rd party device (i.e., Ketra controls external system)
- DMX slave — N3 receives DMX from a 3rd party device and relays it to the Ketra system (i.e., external system controls Ketra)

## DMX VS. ANALOG CONTROL

In addition to supporting DMX input and output, the N3 Satellite separately supports analog input and output, including 0-10V, 0-24V, and sustained contact closures. Each method is useful in different applications.

	Ideal Usage	Input Example	Output Example
<b>DMX</b>	Sending or receiving adjustable <b>color</b> and <b>intensity</b> configurations	Ketra controlled by a third-party console with sliders for red, green, blue, and intensity	Ketra controls third-party lighting with red, green, blue, and intensity parameters
<b>0-10V / 0-24V (Analog)</b>	Sending or receiving adjustable <b>intensity</b> configurations	Ketra controlled by a photosensor outputting a 0-10V signal	Ketra controls third-party lighting's intensity
<b>Contact Closure (Analog)</b>	Sending or receiving <b>triggers</b> , such as commands to turn on/off or play a scene	Ketra controlled by an occupancy sensor	Ketra controls a window shade with raise and lower commands

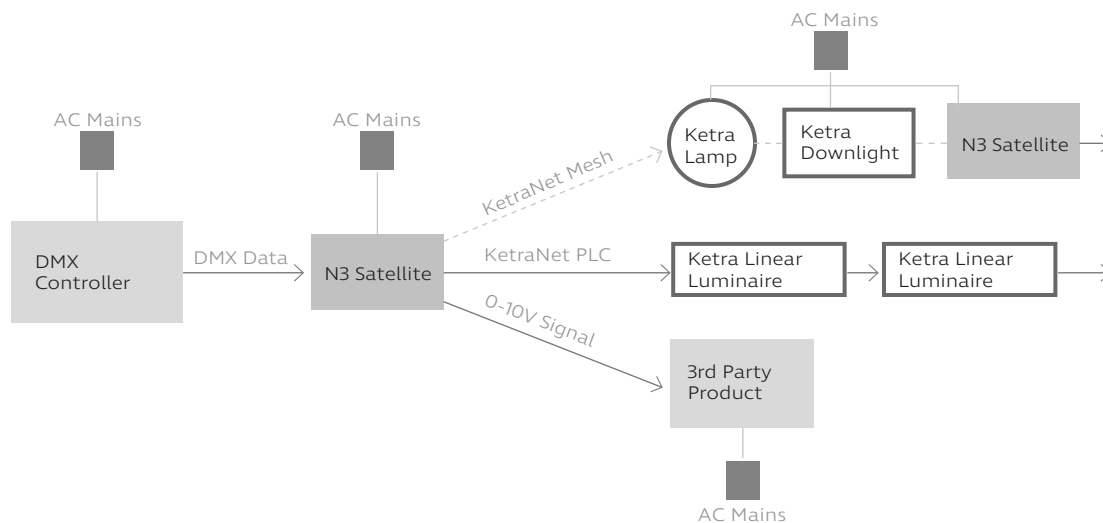
This app note discusses DMX, not analog integration.

## DMX Slave

When an N3 Satellite is configured as DMX slave, it enables external DMX to control the Ketra lighting system. The N3 receives data from a DMX driver, then *patches* (transmits) that data to Ketra groups (i.e., to each control zone's lights).

The N3 uses **any combination of 3 methods** to patch DMX data to Ketra groups:

- KetraNet Mesh — wireless communication between the N3 and Ketra products, including lamps, downlights, and other N3 Satellites
- KetraNet PLC — wired communication between the N3 and an attached run of linear fixtures
- 0-10V signal — wired communication between the N3 and a third party product that accepts 0-10V intensity information



## WORKFLOW

1. Physically install and connect power to Ketra's products.
2. Run the Design Studio software and create an installation file.
3. Create groups and add devices as required for project application.
4. Set up DMX profiles in Design Studio and select which lighting groups each profile is mapped to.
5. "Publish" Ketra installation data.
6. Set up 3rd party controller to send the corresponding DMX profile ranges to the Ketra N3 Satellite.

For instructions on steps 2-5, see the Design Studio user manual available on our website.

## PERFORMANCE

The N3 patches DMX to Ketra devices in 55-channel data frames, one frame at a time. Once all frames have been sent out, a final "go" command is issued and all of the affected lighting products change state in unison.

The frame rate varies based on whether data is being patched over wire or KetraNet Mesh.

- Over wire, the N3 patches data at a rate of 20 Hz, or ~20 f/s. So, patching a full DMX universe would take at most ~0.5 seconds. That means speed is seldom an issue when patching solely by wire.
- Over KetraNet Mesh, the N3 patches data at a rate of 0.67 Hz, or ~0.67 f/s (1.5 seconds per frame after the first frame). So, patching a full DMX universe would take up to ~13.5 seconds.

**Note:** In an application where both KetraNet Mesh and wired communication (KetraNet PLC or 0-10V output) are used, the wired communication speed will "downgrade" to match the KetraNet Mesh speed. This ensures that all devices change in sync.

Since the delay when communicating over KetraNet Mesh can be significant, we recommend reading **Wireless Latency** to calculate and account for delays.

## PERFORMING FADES

Fade rates should be sent from the DMX controller as a parameter.

Ketra offers profiles that include a fade rate parameter (e.g., RGBIF). When the N3 Satellite receives the DMX input, it will relay the fade value to Ketra groups; when the "go" command is given, the groups will transition to the desired color and intensity over the period of time set by the fade rate parameter.

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This is especially important in applications that patch DMX input over KetraNet Mesh. Due to wireless latency, initiating a fade up or fade down from a DMX console may result in the wireless Ketra lights making large steps in intensity rather than smoothly transitioning. Sending fade rate as a parameter eliminates this problem.

## WIRELESS LATENCY

If the N3 Satellite has to patch DMX data to at least 1 KetraNet Mesh device (lamp, downlight, or other N3 Satellite), you may experience delays between the beginning of transmission and the Ketra lights' response.

In most cases, the first 55-channel data frame broadcasts immediately. After the first frame, each additional frame requires up to 1.5 seconds to broadcast. Once all frames have been broadcast, a final "go" command is issued and all of the affected lighting products change state in unison.

**Note:** The 1.5-second delay occurs between all broadcasts. Therefore, the first 55-channel frame will only experience a delay if the N3 Satellite broadcast a frame from another command less than 1.5 seconds previously.

To calculate the maximum delay possible (in seconds), use the following four-step calculation:

1. Divide the number of DMX channels the N3 is listening to by 55. (You do not need to count the same channel range multiple times if you are patching it to multiple groups.)
2. Round up to nearest whole number.
3. Multiply the result by 1.5.
4. Subtract 1.5 to represent the first frame, assuming no other frame was broadcast within 1.5 seconds previously.

$$T = 1.5 \times \text{ceil} \left( \frac{n}{55} \right) - 1.5$$

where  $T$  is delay in seconds, and  $n$  is the number of DMX channels the N3 is listening to

**Note:** 1.5 seconds is a maximum figure. Actual latency time varies with signal interference.

*Example:* An N3 patches 60 DMX channels over KetraNet Mesh. 2 data frames will be required: 1 for the first 55 channels, and 1 for the remaining 5 channels. The first frame experiences no delay, while the second takes up to 1.5 seconds to broadcast. Therefore, the maximum latency is 1.5 seconds.

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One way to account for wireless delays is to calculate the expected latency using the formula above, then send the DMX values *that far in advance* of when a transition should occur. Most DMX controllers include timeline editing and can support this use case.

However, since 1.5 seconds per frame is a maximum figure, the transition may occur before the desired time. How much before depends on the number of data frames being broadcast. This is one reason we recommend against using Ketra's wireless network for live applications such as theatre.

## WIRELESS RESTRICTIONS

Only 1 N3 Satellite can wirelessly patch input per KNet. A KNet refers to all the devices associated with a single N4 Hub.

- If the installation only has 1 N4 Hub, then only 1 N3 Satellite can wirelessly relay DMX commands.
- If the installation has multiple N4 Hubs, each KNet can only receive wirelessly-patched DMX data from one N3.

Fig. 1 illustrates a **valid** DMX setup in an installation with multiple N4 Hubs. An N3 Satellite in KNet 1 wirelessly relays DMX commands to groups in both KNet 1 and KNet 2. Fig. 2 shows the same setup slightly altered to be **invalid**.

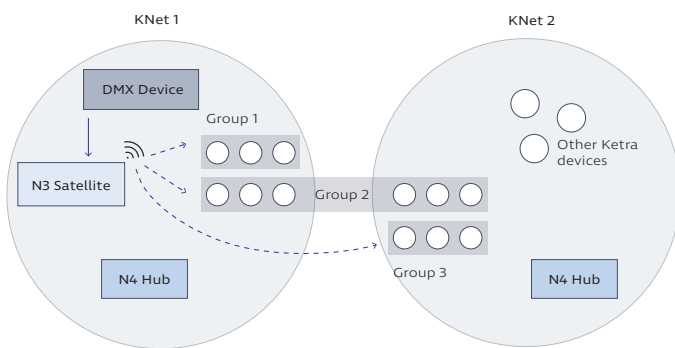


Fig. 1

Fig. 1's DMX wireless setup is valid. Neither KNet receives DMX data from more than 1 N3 Satellite

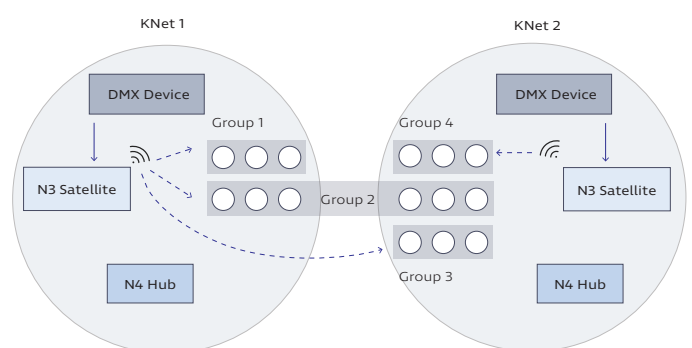


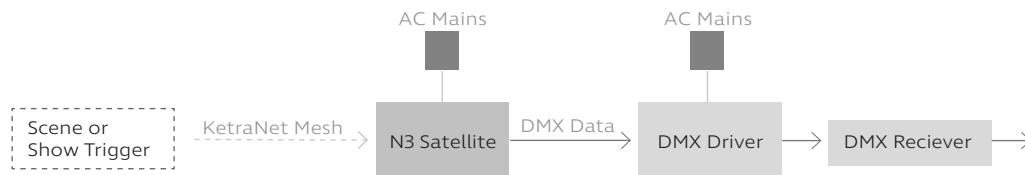
Fig. 2

Fig. 2's DMX wireless setup is invalid. KNet 2 receives DMX input from 2 different N3 Satellites.

Any groups that violate this rule will not appear in Design Studio as available groups for patching DMX data to.

## DMX Master

When an N3 Satellite is configured as DMX master, it enables the Ketra system to control an external DMX system. Using Design Studio, you can program DMX output values into Ketra scenes and shows. When one of those scenes or shows is triggered through the Ketra system (e.g., by a button press on a Ketra or Homeworks QS keypad), the N3 Satellite sends the corresponding DMX levels to the external DMX system.



The N3 Satellite's DMX output port supports a full DMX universe at 44 Hz frame rate.

### WORKFLOW

1. Physically install and connect power to Ketra's products.
2. Run the Design Studio software and create an installation file.
3. Create groups and add devices as required for project application.
4. Configure profile ranges for DMX output in Ketra Tech Tool and save configurations.
5. Sort each profile into a Ketra group in Design Studio.
6. Customize each group as part of a scene in Design Studio.
7. Assign the scene to an input source, i.e., a Homeworks QS keypad button, Ketra keypad button, contact-closure input, or time trigger in a show.
8. "Publish" Ketra installation data.
9. Set up 3rd party DMX receiver(s) to listen to the appropriate channels.

For instructions on steps 2-8, see the Design Studio user manual available on our website.

### PERFORMANCE

There is virtually no lag between input (e.g., keypad button press) and DMX receiver response.

## Ketra DMX Profiles

Ketra offers a huge variety of DMX profiles applicable to master and slave applications.

### Notes:

- All profiles have 8-bit and 16-bit options. 16-bit offers extremely fine control and takes up twice as many channels. 8-bit is sufficient for the vast majority of applications.
- Dimming requires either:
  - A profile with RGB (including RGB, RGBA, RGBW, etc.), or:
  - A profile with I (Intensity).
- For a parameter key, see **Ketra DMX Parameters**, page 10.

### Ketra DMX Profiles

RGB Control Profiles			
Profile	Channels (8-Bit)	Channels (16-Bit)	Notes
RGB	3	6	
RGBA	4	8	DMX Master only
RGBAF	5	10	DMX Master only
RGBAI	5	10	DMX Master only
RGBAIF	6	12	DMX Master only
RGBF	4	8	
RGBI	4	8	
RGBIF	5	10	
RGBW	4	8	
RGBWF	5	10	
RGBWI	5	10	
RGBWIF	6	12	
CCT Control Profiles			
Profile	Channels (8-Bit)	Channels (16-Bit)	Notes
Cct	1	2	Dimming not supported
CctDuvI	3	6	
CctDuvIF	4	8	

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## CCT Control Profiles Cont'd

Profile	Channels (8-Bit)	Channels (16-Bit)	Notes
CctDuvIV	4	8	
CctDuvIVF	5	10	
CctF	2	4	Dimming not supported
CctI	2	4	
CctIF	3	6	
CctIV	3	6	
CctIVF	4	8	
CctV	2	4	Dimming not supported
CctVF	3	6	Dimming not supported
<b>X/Y Control Profiles (CIE 1931)</b>			
Profile	Channels (8-Bit)	Channels (16-Bit)	Notes
XYIV	4	8	
XYIVF	5	10	
<b>Non-Color Control Profiles</b>			
Profile	Channels (8-Bit)	Channels (16-Bit)	Notes
I	1	2	
IF	2	4	
IV	2	4	
IVF	3	6	
MasterI	1	2	
MasterIF	2	4	
V	1	2	Dimming not supported
VF	2	4	Dimming not supported

## Ketra DMX Parameters

Every Ketra DMX profile contains a set of parameters, each corresponding to a channel.

*Example:* An RGB profile with starting channel 1 consists of the following:

- A **Red** value, outputting on channel 1
- A **Green** value, outputting on channel 2
- A **Blue** value, outputting on channel 3

When selecting a profile in Design Studio or Tech Tool, use the table below as a reference for each parameter.

### Ketra DMX Parameters

Color Parameters			
Symbol	Parameter Name	Range (Min = 0, Max = 255 8-bit or 65535 16-bit)	Implementation Notes
R	Red	Min: Off, Max: Red LED to full intensity	
G	Green	Min: Off, Max: Green LED to full intensity	
B	Blue	Min: Off, Max: Blue LED to full intensity	
W	White	Min: Off, Max: White LED to full intensity	
A	Amber	Min: Off, Max: Amber LED to full intensity	Ketra lights do not have an Amber emitter, so profiles with this parameter are unavailable for DMX Slave.
X	CIE 1931 x coordinate	Min: 0.0, Max: 1.0	
Y	CIE 1931 y coordinate	Min: 0.0, Max: 1.0	
Cct	Color temperature	Min: 2000K, Max: 9970K or 10000K (8-bit vs. 16-bit)	
Duv	Tint (distance from black body locus)	Min: -0.05, Max: +0.0496	At 50% (127 for 8-bit, 32768 for 16-bit), tint is +0.00, meaning the color temperature is on the black body locus.

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**Intensity Parameters**

Symbol	Parameter Name	Range (Min = 0, Max = 255 8-bit or 65535 16-bit)	Implementation Notes
I	Intensity	Min: 0%, Max: 100%	Use if at least one scene will set the receivers' intensity to a <100% value.
Master I	Master Intensity	Min: 0%, Max: 100%	Use if all scenes will leave the receivers' intensity at 100% unless dimmed from a keypad or other input.

**Other Parameters**

Symbol	Parameter Name	Range (Min = 0, Max = 255 8-bit or 65535 16-bit)	Implementation Notes
V	Vibrancy	Min: 0%, Max: 100%	At 0%, the current color point is powered more by the W emitter. At 100%, the color point is powered more by the RGB emitters. Objects illuminated at higher vibrancy typically appear more saturated.
F	Fade	Min: 0 seconds, Max: 255 seconds or 6553.5 seconds (8-bit vs. 16-bit)	If N3 is DMX slave, 'F' parameter is required for fades. If N3 is DMX master, 'F' parameter should only be used if receivers require fade times be sent as a parameter.

**Support**

For questions and technical support please contact:

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