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1. General

The Nexmosphere X-Wave range offers a selection of animated LED strips which can be set to a variety of animated patterns of which the color, speed, and brightness can be adjusted. This document offers explanation, instructions, and examples of how the X-Wave LEDs can be controlled.

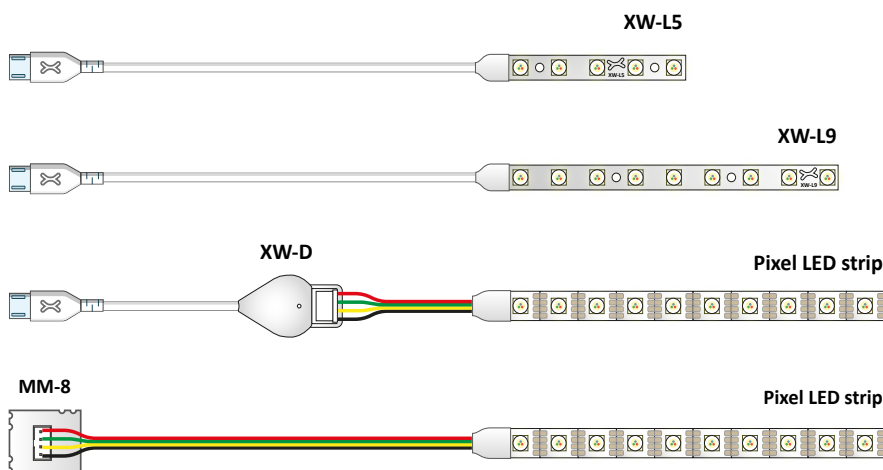
The information in this document is created for users who are familiar with the Nexmosphere API and are able to control a basic setup with a Nexmosphere API controller. If this is not the case yet, please read the general documentation on the Nexmosphere serial API first.

2. Product overview

The X-Wave range consists out of 4 main products:



The XW-L5 and XW-L9 are rigid linear LED boards which each have a fixed number of LEDs: 5 and 9. The XW-D and MM-8 are X-Wave interfaces for flexible pixel LED strips of which the amount of LEDs is variable. All examples in this document are created to control an XW-L5 or XW-L9. The commands can also be used to control an XW-D or MM-8 with a pixel LED strip of 5 or 9 LEDs. If a pixel LED strip with a different amount of LEDs is connected, the LED output for these example commands will vary depending on the number of LEDs on the pixel LED strip. In section 5 (page 6) of this document, more elaborate information on the XW-D and MM-8L is provided.



3. Functionality

All products in the X-Wave range provide the following functionality:

1. **Creating custom LED colors** - program custom colors with RGB values
2. **Single ramp LED output** - set LED strip to a specific brightness and color within a specified ramp time
3. **Pulse LED output** - set LED strip to a pulsing fade in/fade out animation
4. **Wave LED output** - set LED strip to an animated wave effect with numerous options and variables

The following sections will cover each of these functionalities in detail and provide specific examples for each functionality.

3.1 - Creating custom LED colors

Each X-Wave controller has 16 pre-programmed colors, labeled from 0 to F. These color labels are used in the LED output commands to indicate the color(s) to which the X-Wave LED should be set. On the right, an overview of the default color palette is provided.

In case a non-default color is required, a custom color can be created and stored in one of the 16 available labels. Storing a custom color will over-write a default color that was previously stored in the label.

The API command for programming a color label is as follows:

X001B[1ARRGGBB]

- 1 = **Command type** - fixed - indicating the command type, which in this case is "program custom color" (1)
- A = **Color label** - value between 0-F - indicating the color label
- RR = **RGB Red value** - hex value between 00-FF
- GG = **RGB Green value** - hex value between 00-FF
- BB = **RGB Blue value** - hex value between 00-FF

On the right, some example commands for programming custom colors are provided. When creating custom colors, consider the following:

- Programming a custom color does not set the LED output. Thus when sending one of the example commands (on the right), the LED output of the X-Wave product does not change. Only when sending a LED output command in which the color label of a custom color is used, the LEDs will be set to the custom color (see next pages).
- After a power cycle, the color labels are set back to default. Thus each time the system is started, the custom color commands need to be re-send.

Default colors

0	 R: 255 FF G: 255 FF B: 255 FF	4	 R: 255 FF G: 255 FF B: 0 00	8	 R: 255 FF G: 0 00 B: 128 80	C	 R: 0 00 G: 128 80 B: 255 FF
1	 R: 255 FF G: 0 00 B: 0 00	5	 R: 255 FF G: 0 00 B: 255 FF	9	 R: 128 80 G: 255 FF B: 0 00	D	 R: 255 FF G: 179 B3 B: 179 B3
2	 R: 0 00 G: 255 FF B: 0 00	6	 R: 0 00 G: 255 FF B: 255 FF	A	 R: 0 00 G: 255 FF B: 128 80	E	 R: 179 B3 G: 255 FF B: 179 B3
3	 R: 0 00 G: 0 00 B: 255 FF	7	 R: 255 FF G: 128 80 B: 0 00	B	 R: 128 80 G: 0 00 B: 255 FF	F	 R: 179 B3 G: 179 B3 B: 255 FF

Example commands

All examples assume the X-Wave product is connected to an Xperience controller on X-Talk interface 1 (address 001).

Program color label 0 to RGB #3C96FF (60, 150, 255)

```
X001B[103C96FF]
```

Program color label 3 to RGB #AAFF90 (170, 255, 144)

```
X001B[13AAFF90]
```

Program color label A to RGB #FF9090 (255, 144, 144)

```
X001B[1AFF9090]
```

Program color label F to RGB #B22598 (178, 37, 152)

```
X001B[1FB22598]
```

3.2 - Single ramp LED output

Each X-Wave controller can be set to control a specific LED color and intensity within a specified ramp time. This is the most basic X-Wave LED output command available. It sets all LEDs on the X-Wave product to the same value.

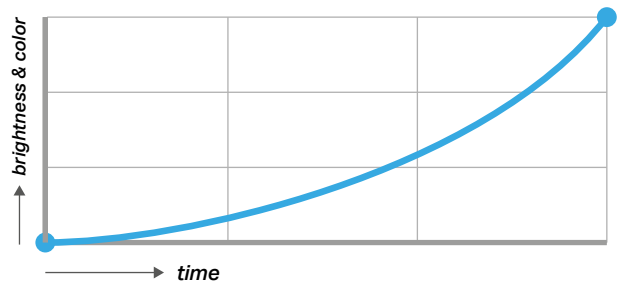
The API command for setting a single ramp LED output is as follows:

X001B[2HCTT]

2 =	Command type - fixed - indicating the command type, which in this case is "single ramp" (2)
II =	LED intensity - value between 00-99 - indicating the brightness
C =	Color label - value between 0-F - indicating the color
TT =	Ramp time - value between 00-99 - units of 0.1s

On the right, example commands for setting the LED output to a single ramp are provided. When setting single ramp LED outputs, take the following into account:

- A single ramp LED command will set all LEDs on the X-Wave LED strip to the same value. Thus the command for a single ramp LED output for an XW-L5 and XW-L9 are the same and provide the same result.
- When changing the color of one of the color labels (see page 2), the single ramp LED output command must be sent again in order to set the LEDs to the new color.
- The maximum LED intensity value is 99. Although 99 suggests that there is 1 percent intensity left, 99 coincides with the absolute max. brightness that the LEDs can emit.
- The ramp starts from the state the LED strip is in at the time the command is sent. This means that the ramp animation towards an end state (light output value) can vary depending on the start state. E.g. if the X-Wave LED is at 50% white, a 1,0-second ramp towards 100% will appear slower than as it would when starting from 0% white.



Example commands

All examples assume the X-Wave product is connected to an Xperience controller on X-Talk interface 1 (address 001). The visualizations of the LED outputs in the examples are based on the default color palette.

Set LED output (2) to **50%** intensity with color **1** in **0,5s**

X001B[250105]

LED output result



Set LED output (2) to **80%** intensity with color **3** in **1,0s**

X001B[280310]

LED output result



Set LED output to **90%** intensity with color **C** in **9,9s**

X001B[290C99]

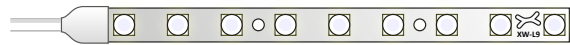
LED output result



Set LED output (2) to **99%** intensity with color **0** in **0,7s**

X001B[299007]

LED output result



3.3 - Pulsing LED output

Each X-Wave controller can be set to control a pulsing pattern with fade in/fade out ramps between two states. It sets all LEDs on the X-wave LED board or strip to the same value.

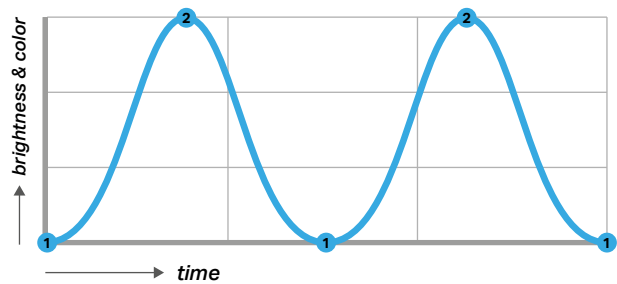
The API command for setting a pulsing LED output is as follows:

X001B[3IICCTTPPOIICTRRTT]

3 =	Command type - fixed - indicating the command type, which in this case is "pulse" (3)
II =	LED intensity state 1- value between 00-99
C =	Color label state 1 - value between 0-F
TT (1)=	Time at state 1- value between 02-99 -including ramp time
PP =	Animation program - fixed - only program available (01)
O =	Animation option- fixed - no options available (0)
II =	LED intensity state 2- value between 00-99
C =	Color label state 2 - value between 0-F
TT (1)=	Time at state 1- value between 02-99 -including ramp time
RR =	Number of pulses - value between 00-99 (00 = infinite)
TT =	Ramp time- value between 02-99 (must be <= then TT(1) and TT(2)

On the right, example commands for setting the LED output to a pulse are provided. When setting pulsing LED outputs, take the following into account:

- Time at state 1 and Time at state 2 are including the ramp time. For example, if Time at state 1 is 2.0 seconds and ramp time is 0.5 seconds, state 1 LED output will be for 1.5 seconds.
- The total time of 1 pulse is Time at state 1 + Time at state 2.
- The ramp time must be smaller than or equal to Time at state 1 and Time at state 2.
- Animation program (01) and Animation option (0) are fixed and are therefore the same in every command.
- If the number of pulses is set to 00, the pulse will go on indefinitely.
- If the number of pulses is set to a fixed number, for example 3, the end state will be State 2.
- A pulse LED command will set all LEDs on the X-Wave LED board to the same value. Thus the command for a pulse LED output for an XW-L5 and XW-L9 are the same and provide the same result.



Example commands

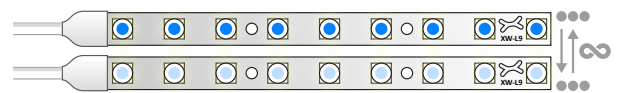
All examples assume the X-Wave product is connected to an Xperience controller on X-Talk interface 1 (address 001). The visualizations of the LED outputs in the examples are based on the default color palette.

Set LED output to Pulse (3)

State 1: 99% intensity - color C - 1.8 seconds
 Animation: program is fixed: 01 - option is fixed: 0
 State 2: 20% intensity - color C - 1.8 seconds
 Timing: infinite repeats (00) - ramp time: 1.8 seconds

X001B[399C1801020C180018]

LED output result



Set LED output to Pulse (3)

State 1: 99% intensity - color 2 - 0.6 seconds
 Animation: program is fixed: 01 - option is fixed: 0
 State 2: 82% intensity - color 0 - 0.6 seconds
 Timing: repeats (03) - ramp time: 0.4 seconds

X001B[399206010820060304]

LED output result

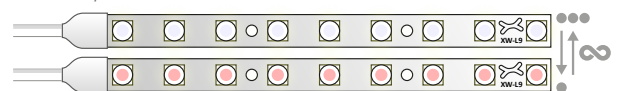


Set LED output to Pulse (3)

State 1: 00% intensity - color D - 1.8 seconds
 Animation: program is fixed: 01 - option is fixed: 0
 State 2: 99% intensity - color D - 0.6 seconds
 Timing: infinite repeats (00) - ramp time: 0.6 seconds

X001B[300D1801099D060006]

LED output result



3.4 - Wave LED output

Each X-Wave controller can be set to control an animated wave pattern which moves across the X-wave product.

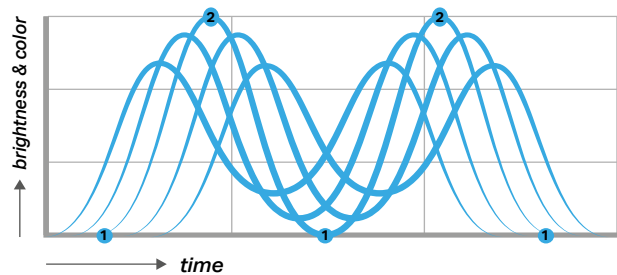
The API command for setting a Wave LED output is as follows:

X001B[4IICDDPP0IICUULL]

4 =	Command type - fixed - indicating the command type, which in this case is "wave" (4)
II =	LED intensity state 1 - value between 00-99
C =	Color label state 1 - value between 0-F
DD =	Duration of wave animation - value between 02-99
PP =	Animation program - 00-01 (sinewave) or 51-59 (discrete) 00 = Symmetrical sinewave 01 = Asymmetrical sinewave 51-59 = Discrete running light (1-9 LEDs "running")
O =	Animation option - 1-4 indicated direction 1 = Left 2 = Right 3 = Outwards 4 = Inwards
II =	LED intensity state 2 - value between 00-99
C =	Color label state 2 - value between 0-F
RR =	Reserved - currently unused in this command type - 00-99
LL =	Number of LEDs for animation - value between 02/04-99 For XW-L5, 02 is the minimum, for XW-L9 04 is the minimum

On the right, example commands for setting the LED output to a wave animation are provided. When setting pulsing LED outputs, take the following into account:

- The LL variable (number of LEDs for animation), determines the "length" of the wave animation. E.g. if LL is set to "4" and the X-Wave strip is an XW-L9, the result will be a double sinewave, each with a length of 4 LEDs. Vice versa, LL can also be set to a higher number of LEDs than the number of LEDs available on the X-Wave strip, resulting in a longer, calmer appearing wave animation.
- Animation program 01 is an asymmetrical sinewave with a short front and long tail.



Example commands

All examples assume the X-Wave product is connected to an Xperience controller on X-Talk interface 1 (address 001). The visualizations of the LED outputs in the examples are based on the default color palette.

Set LED output to Wave (4)

State 1: 99% intensity - color C
Animation: 1.8s - program 00 (sine) - option 2 (right)
State 1: 20% intensity - color C
Timing: Unused variable 00 - LEDs for animation: 16

X001B[499C1800220C0016]

LED output result



Set LED output to Wave (4)

State 1: 99% intensity - color D
Animation: 2.1s - program 01 (sine) - option 4 (inward)
State 1: 33% intensity - color 0
Timing: Unused variable 00 - LEDs for animation: 09

X001B[499D210143300012]

LED output result



Set LED output to Wave (4)

State 1: 99% intensity - color 6
Animation: 2.4s - program 01 (sine) - option 3 (outward)
State 1: 00% intensity - color 0
Timing: Unused variable 00 - LEDs for animation: 09

X001B[4996240130000009]

LED output result



Set LED output to Wave (4)

State 1: 99% intensity - color 1
Animation: 0.6s - program 53 (discrete 3) - option 1 (left)
State 1: 99% intensity - color 3
Timing: Unused variable 00 - LEDs for animation: 18

X001B[4991065319930018]

LED output result



4. Power consumption

When creating an installation including X-Wave products, the power consumption of the LEDs, versus the max power that the Xperience controller can provide should be taken into account. Use the table below to calculate the power consumption of the X-Wave products.

Brightness	White - FFFFFF (mA per LED)	Red - FF0000 (mA per LED)	Green - 00FF00 (mA per LED)	Blue - 0000FF (mA per LED)
100%	50	22	18	19
80%	36	16	14	14
60%	23	10	9	9
40%	13	6	5	6
20%	5	3	2	2

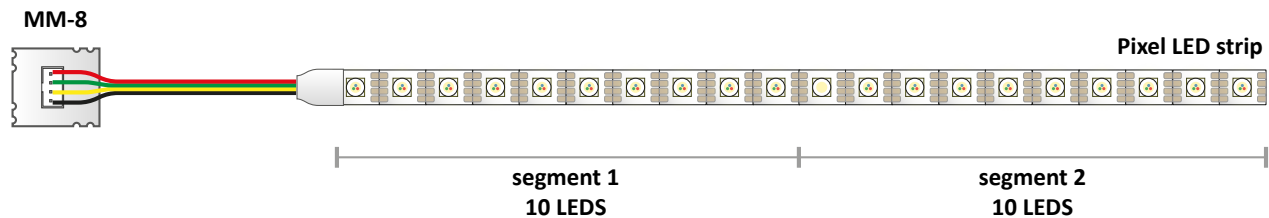
Example calculation

When connecting 4x X-Wave L9 to an Xperience controller, the maximum power consumption @100% white is
4 (number of products) * 9 (number of LEDs on each product) * 50mA (power consumption @ 100% white) = 1800mA.

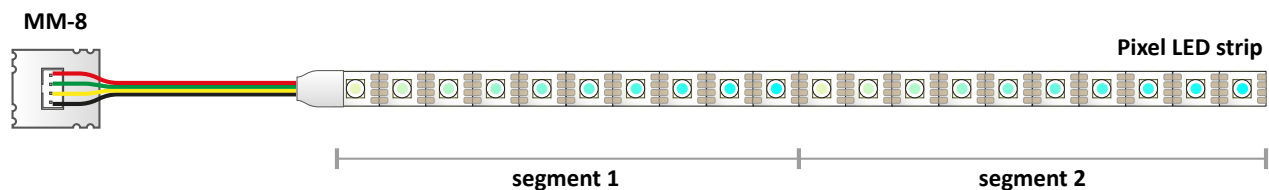
The max power consumption of all Xperience controllers is indicated on the datasheet of the controller under Electrical specifications. When in doubt if the power consumption of an installation falls within specification of the Xperience controller, contact support@nexmosphere.com for advice.

5. X-Wave control for flexible Pixel LED strips (XW-D and MM-8L)

The XW-D and MM-8 are X-Wave interfaces for flexible pixel LED strips of which the number of LEDs is variable. The maximum amount of LEDs that can provide an X-wave animation is 12. If a pixel LED strip longer than 12 LEDs is connected to the XW-D or MM-8L, the X-Wave animation can be duplicated over multiple segments. For example, a pixel LED strip of 20 LEDs could be divided into 2 segments of 10 LEDs each:



In this case, the output of the control command will be duplicated on both segments.



The duplication is done automatically and therefore all commands explained in this document are applicable. The amount of segments and LEDs per segment is adjustable, but does need to be pre-programmed at Nexmosphere. In Q2 2019 the MM-8L and XW-D will be released with additional setting-features which can be used to adjust the amount of segments and LEDs per segment via X-Talk setting commands.