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**1. General**

The X-Dot Analog can interface 3rd party devices with a 5V analog output to the Nexmosphere platform. This document provides explanation of the available functionalities and instructions on how to install and integrate the interface into your digital signage installation.

*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.*

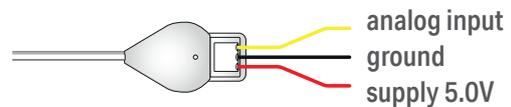
**2. Product overview**

The X-Dot Analog interface is available in 1 model:

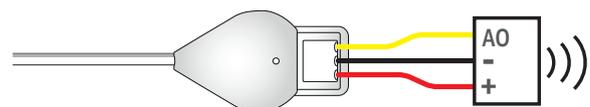
	<b>XDW-A50</b>
<b>Supply voltage</b>	5.0 V
<b>Interface Analog devices</b>	✔
<b>Analog input range</b>	0.0 - 5.0 V



The X-Dot Analog interface has a wire-to-board connector which allows for connecting 3rd party analog devices such as rotary knobs, sliders, PIR sensors and ultrasonic sensors to the Nexmosphere platform. There are 3 connections: Analog Input, Ground and Supply.



The supply (or +) wire - typically red - needs to be connected to the output pin and the ground (or -) wire - typically black - needs to be connected to the ground pin. The analog output (AO) wire of the 3rd party sensor should be connected to the Analog input pin of the X-Dot Analog.



## 3. Functionalities and API commands

The X-Dot Analog provides the following functionalities:

1. **Interface analog devices** - and trigger on default range triggers
2. **Custom range triggers** - define custom trigger zones
3. **Absolute value output**- provides the absolute value of the connected analog device

The following section will cover these functionalities in detail. Please note that for each API example in this document, X-talk interface address 001 is used (X001). When the sensor is connected to another X-talk channel, replace the "001" with the applicable X-talk address.

### 3.1 - Interface analog devices

A device with analog output indicates it's status or measurement via a voltage level. The X-Dot Analog can interface these devices and convert the analog voltage level to a digital value between 0 - 1023 (AD conversion). This number is mapped linearly on the voltage reference range, which is 0.0V - 5.0V per default. For example, if the output of the analog device is 2.5 Volt, the digital value will be halfway the range as well (512). Per default, the X-Dot Analog divides the digital value (0-1023) into ranges of 50 each. When the output of the connected analog device transitions into a new range, an API command is triggered, indicating the current range. This API message has the following format:

**X001B[Dr=\*\*]**                      \*\*= default range 00-20

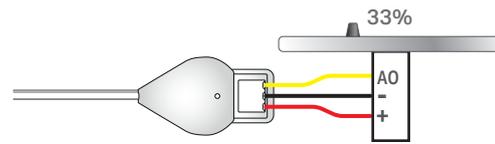
In the table below, the digital values and analog input (voltage level) for the default ranges are provided:

Range	digital value	analog input (V)
00	00-49	0.00 - 0.23
01	50-99	0.24 - 0.48
02	100-149	0.49 - 0.72
03	150-199	0.73 - 0.97
04	200-249	0.98 - 1.21
05	250-299	1.22 - 1.45
06	300-349	1.46 - 1.70
07	350-399	1.71 - 1.94
08	400-449	1.95 - 2.19
09	450-499	2.20 - 2.43
10	500-549	2.44 - 2.68
11	550-599	2.69 - 2.92
12	600-649	2.93 - 3.16
13	650-699	3.17 - 3.41
14	700-749	3.42 - 3.65
15	750-799	3.66 - 3.90
16	800-849	3.91 - 4.14
17	850-899	4.15 - 4.38
18	900-949	4.39 - 4.63
19	950-999	4.64 - 4.87
20	1000-1023	4.88 - 5.00

### Example commands

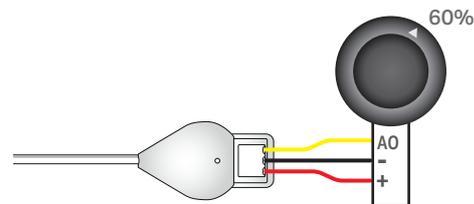
Slider set at 33% (1.65V output)

**X001B[Dr=06]**



Rotary knob set at 60% (3.00V output)

**X001B[Dr=12]**



When implementing analog input triggers, consider the following:

- For compatible Nexmosphere accessories, additional information is available on page X.
- When the analog output range of the connected device is less than 5V, it can be beneficial to adjust the voltage reference of the X-Dot Analog. For more information please see Settings, page X.
- The supply voltage of the X-Dot Analog is 5V and can provide 200mA max, please make sure the specifications of the connected analog device comply.

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## 3.2 - Custom range triggers

Instead of using the default range triggers as listed on the previous page, the X-Dot Analog also offers the options to define custom trigger ranges. This can be useful when larger ranges are required to reduce the amount of triggers, or to define small precise trigger ranges. The API command to define a custom range is as follows:

Define **bottom** value of a custom range:

**X001B [CR\*\* :BOT=XXXX]**      \*\*= range number 00-20      XXXX= digital value 0000-1023

Define **top** value of a custom range:

**X001B [CR\*\* :TOP=XXXX]**      \*\*= range number 00-20      XXXX= digital value 0000-1023

When defining custom range triggers, please consider the following:

- A top or bottom value of a custom range can be cleared by placing \*\*\*\* as value.
- All custom ranges can be cleared at once by sending the command **X001B [CRALL=\*\*\*\*]**
- Performing a Factory Reset will also clear all custom ranges **X001B [FACTORYREST]**
- When custom ranges overlap, a trigger will only be sent when the current range is exited, not when the new range is entered.

In order to trigger on custom ranges instead of default ranges, the output mode setting must be adjusted:

**X001S [4 : 2]**      Set output mode to custom ranges

When triggering on Custom ranges instead of Default ranges, the API command has the following format:

**X001B[Cr=\*\*]**      \*\*= Custom range 00-20

## 3.3 - Absolute value output

Next to default or custom range triggers, the X-Dot Analog can also be set to provide the absolute digital value as output. In order to do so, the output mode must be adjusted by sending the following setting command:

**X001S [4 : 3]**      Set output mode to Absolute value

The API command for absolute value output will have the following format:

**X001B[Av=XXXX]**      XXXX= digital value 0000-1023

## Data requests

Each data type can also be requested at any time by sending one of the following API command:

**X001B [RANGE?]**      Request current range.

The reply will be either in Default range or Custom range, depending on the output mode setting.

**X001B [VALUE?]**      Request current absolute digital value

## Example commands

Define Custom range 06 as 0510 - 0514 (2.49V - 2.51V)

**X001B [CR06 :BOT=0510]**

**X001B [CR06 :TOP=0514]**

Define Custom range 20 as 918- 1023 (4.48V - 5V)

**X001B [CR20 :BOT=0918]**

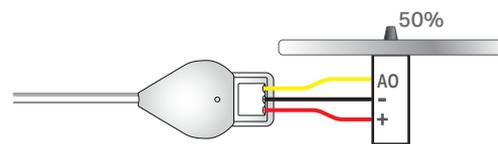
**X001B [CR06 :TOP=1023]**

Clear the bottom value of Custom range 03

**X001B [CR03 :BOT=\*\*\*\*]**

## Example commands

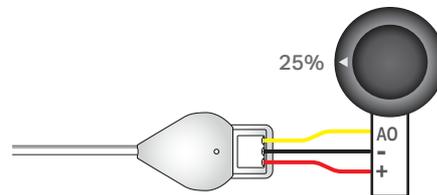
Slider set at 50% (512 digital value, 2.50V output), triggering on Custom range 06 as defined in the example above: **X001B[Cr=06]**



## Example commands

Rotary knob set at 25% (256 digital value, 1.25V output)

**X001B[Av=0256]**



## 4 - Installation requirements and guidelines

When integrating an X-Dot Analog interface into your digital signage installation, several installation requirements and guidelines need to be taken into account in order for the sensor to perform optimal and operate stable.

### 4.1 Electrical installation requirements

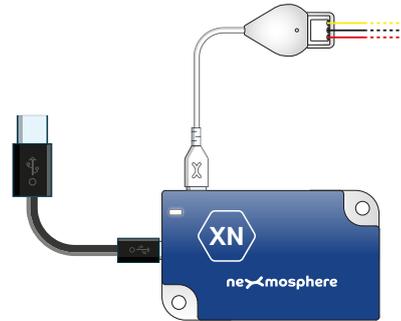
The maximum amount of power which the Output pin can provide is 200mA @ 5V. Please make sure the specifications of the connected 3rd party analog device comply.

### 4.2 Connection Diagrams

The X-Dot Analog can be connected to any X-talk interface and is therefore compatible with all Xperience controllers. Make sure the X-Dot Analog is connected to the X-talk interface before powering the Xperience controller. Otherwise, the X-Dot Analog will not be recognized by the Xperience controller and no output will be provided.



Example connection to XC Controller



Example connection to XN Controller

## 4.3 X-Dot Analog- Accessories

### Ultrasonic sensors

Nexmosphere offers Ultrasonic sensors which can measure distance and are compatible with the XDW-A50.

The part codes are:

*Indoor, suitable for people detection:*

**S-ULS21** 2.5m range, wide beam ([MB1000](#))

**S-ULS22** 1.5m range, normal beam ([MB1010](#))

*Outdoor, suitable for car detection:*

**S-ULS41** 5m range, normal beam ([MB7360](#))

**S-ULS42** 10m range, normal beam ([MB7363](#))

They come with 15cm color-coded wires connected to the sensor and with ferrules for easy connection to the X-Dot Analog interface. Please see the schematic on the right for the correct pinning.

The analog output is linearly scaled to the detected distance.

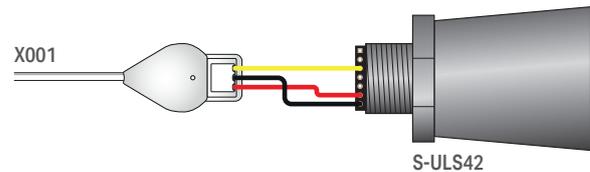
**S-ULS21/S-ULS22** Output (V) = (Vcc/1311) per cm

**S-ULS41** Output (V) = (Vcc/512) per cm

**S-ULS42** Output (V) = (Vcc/1024) per cm

The XDW-A50 provides a theoretical Vcc of 5V, but in practice this can vary based on the actual supply voltage of the controller as well as the amount of sensors which are connected. Typically, in practice, the Vcc is within 4.8-5.1V. For **S-ULS21/S-ULS22**, the sensor output will stay below 1.0V @ 2.5 meters. Therefore we recommend to adjust the voltage reference to obtain a higher resolution in trigger ranges. Please see Settings page X for more information.

For more detailed information on the ultrasonic sensors and their characteristics and behaviour, please check the datasheets of the manufacturer (MaxBotix) by clicking on the links after the partcodes listed above.



### API example commands Ultrasonic sensor trigger

**S-ULS21** detects person at **220cm** distance.

Output (V) = (5V/1311)\*220cm = 0.84V

**0.84V** is **default range 03** (with default voltage reference)

**X001B[Dr=03]**

**S-ULS22** detects person at **100cm** distance.

Output (V) = (5V/1311)\*100cm = 0.38V

**0.38V** is **default range 01** (with default voltage reference)

**X001B[Dr=01]**

**S-ULS41** detects car at **460cm** distance.

Output (V) = (5V/512)\*460cm = 4.49V

**4.49V** is **default range 18** (with default voltage reference)

**X001B[Dr=18]**

**S-ULS42** detects car at **720cm** distance.

Output (V) = (5V/1024)\*720cm = 3.52V

**3.52V** is **default range 14** (with default voltage reference)

**X001B[Dr=14]**

## 5 - Settings

The X-Dot Analog has multiple settings which determine the behaviour and output of the interface. The settings can be adjusted by sending X-talk setting commands via the API. After a power cycle, the settings always return back to default.

### Setting 1: Status LED behaviour

- |                                       |                         |
|---------------------------------------|-------------------------|
| 1. LED always on                      | <code>X001S[1:1]</code> |
| 2. LED always off                     | <code>X001S[1:2]</code> |
| 3. LED on, blink at trigger (default) | <code>X001S[1:3]</code> |
| 4. LED off, blink at trigger          | <code>X001S[1:4]</code> |

### Setting 4: Output mode

- |                                     |                         |
|-------------------------------------|-------------------------|
| 1. Default range triggers (default) | <code>X001S[4:1]</code> |
| 2. Custom range triggers            | <code>X001S[4:2]</code> |
| 3. Absolute value output            | <code>X001S[4:3]</code> |
| 4. No triggers, use data requests   | <code>X001S[4:4]</code> |

For more info, please see section 3, page 2 and 3.

### Setting 5: Change in absolute value for trigger

Set trigger value `X001S[5:X]`

X is a value between **1-50** and its default value is **5**. It indicates the required change in the absolute digital value for an API output message to trigger when the sensor is set to absolute value output mode (setting 4:3).

### Setting 6: Hysteresis for range change

Set hysteresis threshold `X001S[6:X]`

X is a value between **1-20** and its default value is **2**. It indicates the hysteresis threshold in absolute digital value for a new API message to be triggered when the sensor is set to default or custom range change (setting 4:1 or 4:2). This setting can avoid an overload of API messages jumping back and forth between two adjacent ranges when the absolute digital value is near the transition value. The lower the X value, the less change is required (with the previous measured value) for the interface to output a new range trigger. Vice versa, the higher the X value, the more change is required for the interface to output a new range trigger.

### Setting 7: Sample averaging

- |   |                          |
|---|--------------------------|
| 1. No averaging                           | <code>X001S[7:1]</code>  |
| 2. Running average of 2 samples (default) | <code>X001S[7:2]</code>  |
| 3. Running average of 4 samples           | <code>X001S[7:3]</code>  |
| 4. Running average of 8 samples           | <code>X001S[7:4]</code>  |
| 5. Running average of 16 samples          | <code>X001S[7:5]</code>  |
| 6. Running average of 32 samples          | <code>X001S[7:6]</code>  |
| 7. Running average of 64 samples          | <code>X001S[7:7]</code>  |
| 8. Running average of 128 samples         | <code>X001S[7:8]</code>  |
| 9. Running average of 256 samples         | <code>X001S[7:9]</code>  |
| 10. Running avg of 512 samples            | <code>X001S[7:10]</code> |
| 11. Running avg of 1024 samples           | <code>X001S[7:11]</code> |
| 12. Running avg of 2048 samples           | <code>X001S[7:12]</code> |

This setting determines the number of samples which are averaged from the 3rd party analog device, to determine the interface's output value. The higher the number of samples, the less responsive the sensor will be to change, but also the more stable in case of fluctuating circumstances. The lower the number of samples, the more responsive the sensor will be to change. Please note that typically this setting does not need to be adjusted.

### Setting 8: Stable input timer for sending new value

- |                            |                         |
|----------------------------|-------------------------|
| 1. No time delay (default) | <code>X001S[8:1]</code> |
| 2. 100mS                   | <code>X001S[8:2]</code> |
| 3. 250mS                   | <code>X001S[8:3]</code> |
| 4. 500mS                   | <code>X001S[8:4]</code> |
| 5. 1000mS                  | <code>X001S[8:5]</code> |
| 6. 2000mS                  | <code>X001S[8:6]</code> |
| 7. 3000mS                  | <code>X001S[8:7]</code> |

This setting determines how long a new value must be stable before it will generate an output trigger. This setting can help to make the output of the interface more stable in case of challenging circumstances and to filter out short output spikes from the 3rd party analog device. The higher the duration, the longer the analog input must be stable before the interface sends out a new trigger. Vice versa, the lower the duration, the shorter the analog input must be stable before the interface sends out a new trigger.

*see next page for Setting 9*

## 5 - Settings (cont)

### Setting 9: Voltage reference (Vref) of AD conversion

1. 0V - 5V (Vcc) (default)
2. 0V - 4.096V (regulated)
3. 0V - 2.048V (regulated)
4. 0V - 1.024V (regulated)

**X001S[9:1]**  
**X001S[9:2]**  
**X001S[9:3]**  
**X001S[9:4]**

The X-Dot Analog converts the analog to a digital value between 0 - 1023 (AD conversion). This number is mapped linearly on the voltage reference range. When the output range of the 3rd party analog device is less than the default 0.0 - 5.0V, the voltage reference can be adjusted to increase the resolution of the range triggers. In the tables on this page, the mapping for all 4 options is provided.

Range	digital value	analog input Vref 0 - 5V
00	00-49	0.00 - 0.23
01	50-99	0.24 - 0.48
02	100-149	0.49 - 0.72
03	150-199	0.73 - 0.97
04	200-249	0.98 - 1.21
05	250-299	1.22 - 1.45
06	300-349	1.46 - 1.70
07	350-399	1.71 - 1.94
08	400-449	1.95 - 2.19
09	450-499	2.20 - 2.43
10	500-549	2.44 - 2.68
11	550-599	2.69 - 2.92
12	600-649	2.93 - 3.16
13	650-699	3.17 - 3.41
14	700-749	3.42 - 3.65
15	750-799	3.66 - 3.90
16	800-849	3.91 - 4.14
17	850-899	4.15 - 4.38
18	900-949	4.39 - 4.63
19	950-999	4.64 - 4.87
20	1000-1023	4.88 - 5.00

Range	digital value	analog input Vref 0 - 2.048V
00	00-49	0.000 - 0.100
01	50-99	0.101 - 0.200
02	100-149	0.201 - 0.300
03	150-199	0.301 - 0.400
04	200-249	0.401 - 0.500
05	250-299	0.501 - 0.600
06	300-349	0.601 - 0.700
07	350-399	0.701 - 0.800
08	400-449	0.801 - 0.900
09	450-499	0.901 - 1.000
10	500-549	1.001 - 1.100
11	550-599	1.101 - 1.200
12	600-649	1.201 - 1.300
13	650-699	1.301 - 1.400
14	700-749	1.401 - 1.500
15	750-799	1.501 - 1.600
16	800-849	1.601 - 1.700
17	850-899	1.701 - 1.800
18	900-949	1.801 - 1.900
19	950-999	1.901 - 2.000
20	1000-1023	2.001 - 2.048

Range	digital value	analog input Vref 0 - 4.096V
00	00-49	0.00 - 0.20
01	50-99	0.21 - 0.40
02	100-149	0.41 - 0.60
03	150-199	0.61 - 0.80
04	200-249	0.81 - 1.00
05	250-299	1.01 - 1.20
06	300-349	1.21 - 1.40
07	350-399	1.41 - 1.60
08	400-449	1.61 - 1.80
09	450-499	1.81 - 2.00
10	500-549	2.01 - 2.20
11	550-599	2.21 - 2.40
12	600-649	2.41 - 2.60
13	650-699	2.61 - 2.80
14	700-749	2.81 - 3.00
15	750-799	3.01 - 3.20
16	800-849	3.21 - 3.40
17	850-899	3.41 - 3.60
18	900-949	3.61 - 3.80
19	950-999	3.81 - 4.00
20	1000-1023	4.01 - 4.096

Range	digital value	analog input Vref 0 - 1.024V
00	00-49	0.000 - 0.050
01	50-99	0.051 - 0.100
02	100-149	0.101 - 0.150
03	150-199	0.151 - 0.200
04	200-249	0.201 - 0.250
05	250-299	0.251 - 0.300
06	300-349	0.301 - 0.350
07	350-399	0.351 - 0.400
08	400-449	0.401 - 0.450
09	450-499	0.451 - 0.500
10	500-549	0.501 - 0.550
11	550-599	0.551 - 0.600
12	600-649	0.601 - 0.650
13	650-699	0.651 - 0.700
14	700-749	0.701 - 0.750
15	750-799	0.751 - 0.800
16	800-849	0.801 - 0.850
17	850-899	0.851 - 0.900
18	900-949	0.901 - 0.950
19	950-999	0.951 - 1.000
20	1000-1023	1.001 - 1.024

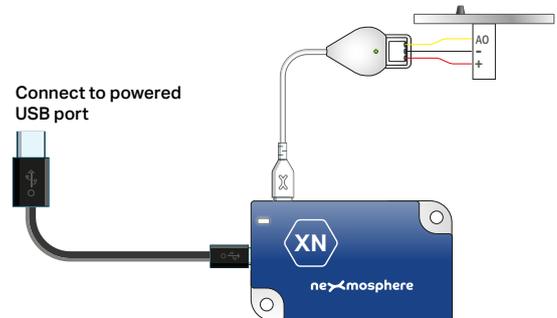
## 6. Quick test

In order to test if the X-Dot Analog is installed correctly, please follow the test procedure below:

### Step 1 - Setup

First, connect an analog device such as a slider to the X-Dot Analog. Secondly, connect the X-Dot Analog to an Xperience controller and power the Xperience controller.

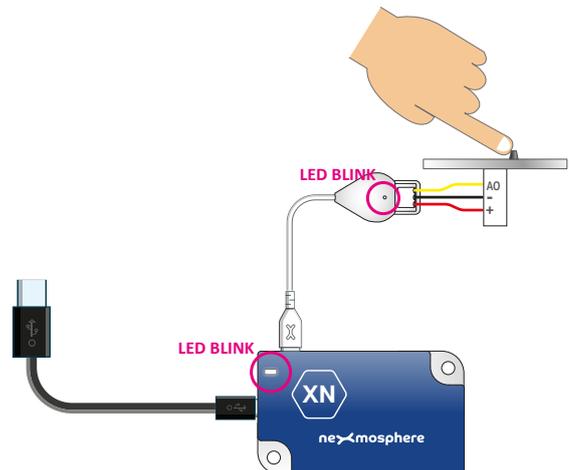
The green status LED of the X-Dot Analog should go on. The status LED of the controller will start to blink and once power-up is completed will be lit continuously



### Step 2 - Test

Adjust the analog input device (e.g. slide the slider)

Both the green status LED of the sensor and the status LED of the controller should blink.



In case any of the steps above does not provide the expected result, please check the installation guidelines in this document.

For a full test we recommend to connect the setup to a mediaplayer or PC and test all API commands listed in this document (see section 3, page 2-3). For more information on how to setup a test for your controller, please see the Quick Start Guide of the Xperience controller you are using. These are available on [nexmosphere.com/support-documentation](https://nexmosphere.com/support-documentation)

Please contact [support@nexmosphere.com](mailto:support@nexmosphere.com) for any support questions you may have.