

**Table of content**

<b>1. General</b>	<b>1</b>
<b>2. Product overview</b>	<b>1</b>
<b>3. Functionalities and API commands</b>	<b>2</b>
3.1 Angle measurement	2
3.2 Configuring and storing orientation positions	3
<b>4. Installation requirements and guidelines</b>	<b>4</b>
4.1 Connection Diagrams	4
4.2 Hardware integration guidelines	4
<b>5. Settings</b>	<b>5</b>
<b>6. Quick test</b>	<b>6</b>

**1. General**

The XZ Angle sensor determines its current orientation following the measurement of the angle relative to the X, Y and Z axis. This sensor facilitates applications such as detecting the position of a door or valve, or detecting the transition between orientations of a display (for example portrait to landscape). This document provides explanation of the available functionalities and instructions on how to install and integrate the sensor 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**

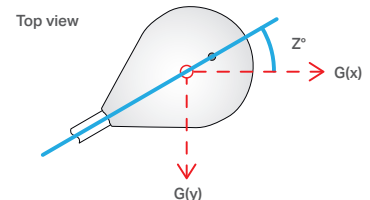
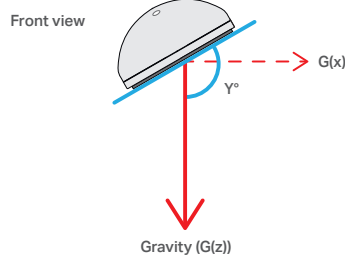
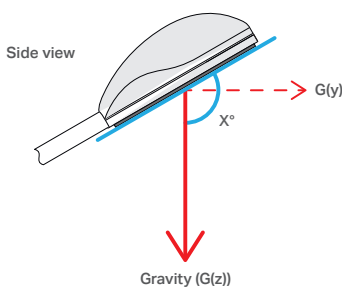
The XZ Angle sensor is available in 1 model:

	XZ-A40
Angle measurement	✓
Configurable orientation positions	✓



XZ-A40

The XZ Angle sensor continually measures its orientation angle. This angle is measured in three dimensions; it measures the angle relative to the X, Y and Z axis. In this way, the exact orientation of an object or surface can be derived. The sensor determines each of the three values relative to the gravity line(s). In the images below, these gravity lines are depicted in red and the sensor's orientation line and the angle are depicted in blue. Furthermore, these images also visualize the three different angles that are continually measured by the sensor.



## 3. Functionalities and API commands

The XZ Angle sensor provides the following functionality:

1. **Angle measurement** - determines the orientation of the surface it is adhered to
2. **Configuring and storing orientation positions** - trigger when certain orientation positions are reached

The following sections will cover each of 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 - Angle measurement

When the sensor is connected, it will immediately start measuring the current orientation angle. Per default, the sensor will send out an API command every time a change in the current angle with the X, Y or Z axis of the sensor is detected. This API command has the following format:

---

#### X001B[O=+XXX,+YYY,+ZZZ]

XXX = X-axis angle      -180 to +180 or \*\*\*\*  
YYY = Y-axis angle      -180 to +180 or \*\*\*\*  
ZZZ = Z-axis angle      -180 to +180 or \*\*\*\*

---

These three values respectively represent the sensor's angle relative to the X, Y and Z-axis. Every X, Y or Z value has lower and upper boundaries of -180° and 180°.

Furthermore, when it occurs that one of the three values is irrelevant for determining the orientation of the sensor, this value will be outputted as \*\*\*\*. This behavior will occur when two of the three values are (close to) -180, -90, 0, 90 or 180. This means that the sensor is oriented parallelly to either of the three XYZ dimension planes. The third value will then be outputted as \*\*\*\*. Also, see setting 9 and 10 on page 4.

When implementing this sensor, consider the following:

- To make the implementation of the sensor easier, several different orientation positions can be configured. Whenever the sensor finds itself in one of the configured orientation positions, a trigger will be sent. See section 3.2 for more info.
- The sensor can also be set to only output the X, Y or Z angles. This can be done by using setting 5 (page 6) to change the trigger axis or by requesting the singular values through sending any of the data requests on the right. In both cases, the output will have the following formats:

---

X001B[X=+XXX]      XXX = X angle      -180 to +180

---

X001B[Y=+YYY]      YYY = Y angle      -180 to +180

---

X001B[Z=+ZZZ]      ZZZ = Z angle      -180 to +180

---

#### Example API messages

The measured angle relative to the X-axis is 67°.  
The measured angle relative to the Y-axis is -110°.  
The measured angle relative to the Z-axis is 5°.

X001B[O=+067,-110,+005]

The sensor lays on a perfectly leveled horizontal surface, for example a table top.

X001B[O=+000,+000,\*\*\*\*]

#### Data requests

A trigger of the sensor's current angle can also always be requested by sending one of the following API commands:

- X001B[X?]      Request angle relative to X-axis
- X001B[Y?]      Request angle relative to Y-axis
- X001B[Z?]      Request angle relative to Z-axis
- X001B[ALL?]      Request all three angles separately
- X001B[V?]      Request raw vector values
- X001B[O?]      Request orientation in one command

The reply will be identical to the triggered API messages such as the examples listed on this page.

#### Example API messages

Orientation measured with 124° angle to X-axis  
X001B[X=124]

Orientation measured with 87° angle to Y-axis  
X001B[Y=087]

Orientation measured with 61° angle to Z-axis  
X001B[Z=061]

## 3.2 - Configuring and storing orientation positions

Instead of triggering on any change of the X, Y, or Z angles, this sensor can be set to trigger when certain orientation positions are reached. These orientation positions are completely configurable. In total, up to 8 different orientation positions can be stored. This output mode can be set by sending the following setting command:

**X001S[4:1]** Set output mode to position change

The API commands for entering a certain orientation position have the following format:

---

**X001B[P=X]** X = the current orientation position

---

Configuring these orientation positions can be done by fixing the sensor in a preferred orientation and sending the following API command to the sensor:

**X001B[STORE=PX]** X = number 1-8

Sending this command ensures that the orientation position that is currently held, is stored in slot PX.

These orientation positions can be cleared one by one by sending the following command to the sensor:

**X001B[CLEAR=PX]** X = number 1-8

Or cleared all at once by sending the following command:

**X001B[CLEAR=ALL]**

### Example API messages

The detected orientation matches orientation position 6  
**X001B[P=6]**

The detected orientation matches orientation position 8  
**X001B[P=8]**

### Example API commands

Store current position as orientation position 1

**X001B[STORE=P1]**

Store current position as orientation position 4

**X001B[STORE=P4]**

### Example API commands

Clear orientation position 3

**X001B[CLEAR=P3]**

Clear all orientation positions

**X001B[CLEAR=ALL]**

## Factory reset

The orientation positions, sensor sensitivity and all other settings can be reverted back to their default factory values by performing a factory reset.

This can be initiated by sending the following API command:

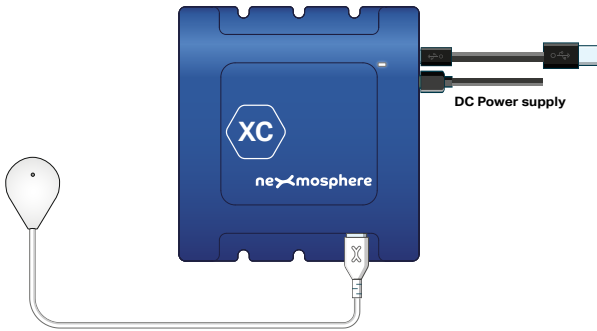
**X001B[FACTORYRESET]**

## 4. Installation requirements and guidelines

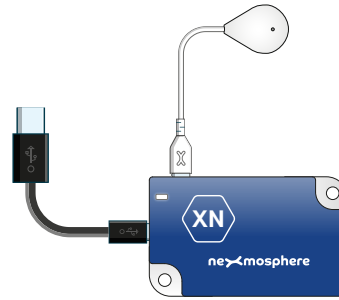
When integrating an XZ Angle sensor into your digital signage installation, several installation requirements and guidelines need to be taken into account in order for the sensor to perform optimal and operate stable.

### 4.1 - Connection Diagrams

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



Example connection to XC Controller

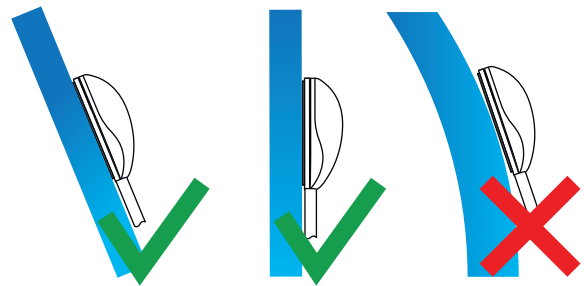
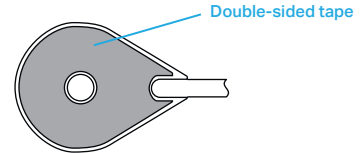


Example connection to XN Controller

### 4.2 - Hardware integration guidelines

#### Installation with double sided tape

The XZ Angle sensor is typically installed using the double-sided tape. Using this method, the sensor securely mounts on any flat surface, horizontal, vertical or slant. The XZ Angle sensor should be installed in a dry and dust-free environment. The tape is easily removable and non-marking.



## 5. Settings

The XZ Angle sensor 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 on                             | <code>X001S[1:1]</code> |
| 2. LED 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: Trigger mode

- |  |                         |
|--|-------------------------|
| 1. Trigger on position change (1-8)    | <code>X001S[4:1]</code> |
| 2. Trigger on orientation change (def) | <code>X001S[4:2]</code> |
| 3. Trigger on both value/pos change    | <code>X001S[4:3]</code> |
| 4. No triggers, use data requests      | <code>X001S[4:3]</code> |

When set to 4:1, the sensor will trigger upon reaching one of the configured orientation positions. At default (setting 4:2), the sensor will switch to triggering each time either of the three angles (X, Y, or Z) changes with 5°. This value can be adjusted, see setting 6. With setting 4:3, the sensor will trigger on both angle changes and orientation positions it has reached. When set to 4:4, the sensor will not trigger automatically but will only respond to any of the API commands for data requests (see page 2). For more general info, please see section 3, page 2/3.

### Setting 5: Trigger axis for value change

- |  |                         |
|--|-------------------------|
| 1. Trigger on X-axis change            | <code>X001S[5:1]</code> |
| 2. Trigger on Y-axis change            | <code>X001S[5:2]</code> |
| 3. Trigger on Z-axis change            | <code>X001S[5:3]</code> |
| 4. Trigger on X-axis and Y-axis change | <code>X001S[5:4]</code> |
| 5. Trigger on X-axis and Z-axis change | <code>X001S[5:5]</code> |
| 6. Trigger on Y-axis and Z-axis change | <code>X001S[5:6]</code> |
| 7. Trigger on all 3 axis (default)     | <code>X001S[5:7]</code> |

This setting can be used to adjust the amount of information each trigger holds. At default, the sensor triggers on changes of all three axis and sends the values of these axis together in one command.

### Setting 6: Sensitivity / Trigger bandwidth

Any number between 1-45 `X001S[6:X]`

X is a value between **1-45** and its default value is **5**. This setting determines the sensitivity of the sensor. In other words, the value of X determines how much either the X, Y or Z angle of the sensor (in degrees) must change before the sensor sends a new trigger. Furthermore, when the sensor is set to trigger orientation positions, this setting adjusts the lower and upper boundaries of a position. These boundaries determine how close the orientation of the sensor must match an orientation position before sending a trigger.

### Setting 7: Motion filter

Any number between 1-100 `X001S[7:X]`

X is a value between **1-100** and its default value is **20**. This setting applies to situations in which the sensor is set to trigger on orientation positions. Usually, the sensor will not trigger on an orientation position when it is in motion and 'passes' this orientation position without stopping on it. The value X determines the threshold for when the speed of this motion is slow enough for the sensor to send a trigger. The lower X is, the lower the speed of motion needs to be for a trigger. Vice versa, the higher X is, the higher the speed of motion can be for the sensor to still send a trigger.

### Setting 8: Sample averaging

Any number between 1-20 `X001S[8:X]`

X is a value between **1-20** and its default value is **8**. This setting determines the number of samples which are averaged to calculate the sensor's output. The higher the number of samples, the less responsive the sensor will be to change, but also the more stable in case of challenging environments. 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 9: Show irrelevant axis

- |   |                         |
|---|-------------------------|
| 1. Do not show irrelevant axis, show **** instead (default) | <code>X001S[9:1]</code> |
| 2. Show irrelevant axis                                     | <code>X001S[9:2]</code> |

Per default (9:1), this sensor will output \*\*\*\* when one angle value is irrelevant for determining the orientation of the sensor. This can be adjusted by sending the 9:2 setting, which will set the sensor to always send the irrelevant value. For more information on the irrelevancy of a value, see section 3.1 on page 2.

### Setting 10: Filter level for setting 9

Any number between 1-25 `X001S[10:X]`

X is a value between **1-25** and its default value is **15**. With X, you can determine the filter level of an irrelevant axis. In other words, at what point an axis is seen as irrelevant. Here, the rule applies; the higher the value, the sooner the sensor will categorize a value as 'irrelevant'. Please note that typically this setting does not need to be adjusted.

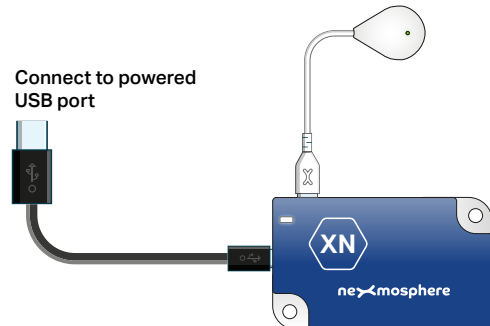
## 6. Quick test

In order to test if the XZ Angle sensor is installed correctly, please follow the test procedure below:

### Step 1 - Setup

Connect the XZ Angle sensor to an Xperience controller, make sure that the XZ sensor is not moving and power the Xperience controller.

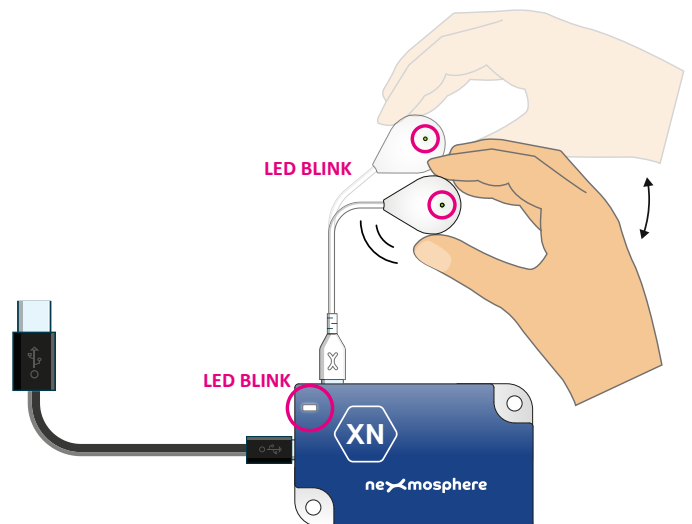
The green status LED of the XZ should be lit continuously. The status LED of the controller will start to blink and once power-up is completed will be lit continuously.



### Step 2 - Test

Move the XZ Angle sensor around.

Both the green status LED of the XZ and the status LED of the controller should blink each time a different orientation is detected.



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.