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1. General

The XZ Light sensor can detect the amount of light that reaches the sensor. Typically, this value is used to determine whether an object is picked-up from the sensor, or placed back. 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.

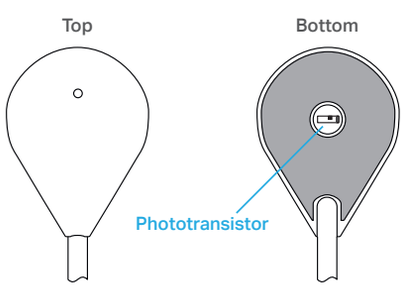
2. Product overview

The XZ Light sensor is available in 1 model: **XZ-L20**

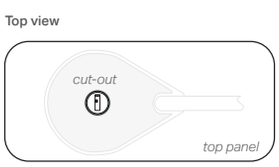
	XZ-L20
Pick-up detection (light measurement)	✔
Manual calibration controls	✔
Auto calibration	✔

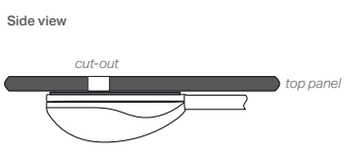

XZ-L20

The XZ Light sensor utilizes a Phototransistor which can measure the amount of light reaching the sensor. The phototransistor is located on the bottom (flat) side of the sensor.



Typically, the sensor is installed behind a cut-out of a top panel. On the top panel, objects are placed of which a pick-up or place-back needs to be detected. When a product is picked-up, light reaches the phototransistor. When a product is placed back, the cut-out is covered, blocking the light.





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3. Functionalities and API commands

The XZ Light sensor provides the following functionalities:

1. **Pick-up and place-back detection** - detect if an object is picked-up or placed-back
2. **Raw light measurement**- measure the raw value of the light reaching the sensor

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 - Pick-up and place-back detection

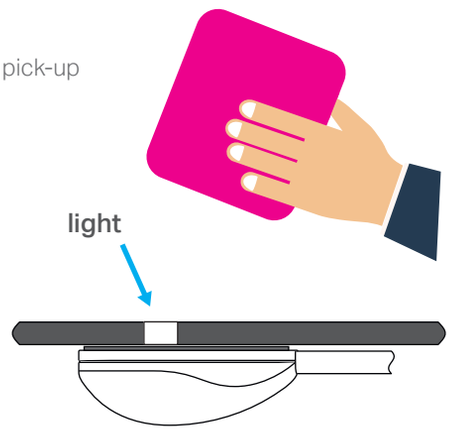
When an object is picked up, light will reach the sensor and an API command is triggered. Vice versa, when the object is placed back, less light will reach the sensor and an API command is triggered as well. These API messages have the following format:

X001A[3]	*Object is picked up*
X001A[0]	*Object is placed back*

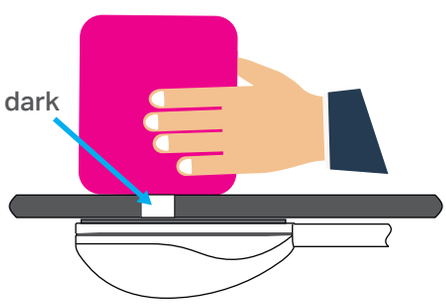
When implementing pick-up or place-back detection, consider the following:

- If the object or top panel is translucent, light can still reach the sensor when the object is placed back. In this case additional calibration might be required. Please see page 3 and 4 for more information.
- Particularly in retail environments, LED strips are often placed in such a way that the top panel is lit. In these cases we recommend to add a small non-translucent shaft in the cut-out, to block light coming from the lit top panel. Please see page 3 for more information.

pick-up



place-back



3.2 - Raw light measurement

The XZ Light sensor can also indicate the amount of light reaching the sensor as a raw decimal value.

X001A[*X*]	X = *raw light value*	value between **0-255**

Per default, the sensor is set to pick-up detection mode. In order to activate Raw light measurement output, send the following setting: `X001S[4:2]`

The raw decimal value is a unfiltered direct AD conversion of the light measurement circuit and will therefore fluctuate. **We recommend to not use Raw Light values for normal operation**. Instead, the Raw light measurement mode is intended to be used for calibration purposes. Please see page 4 for more information.

The higher the raw light value, the more light is reaching the sensor. The lower the light value, the darker.

Example commands

The measured raw light value is "7"
X001A[7]

The measured raw light value is "51"
X001A[51]

The measured raw light value is "178"
X001A[178]

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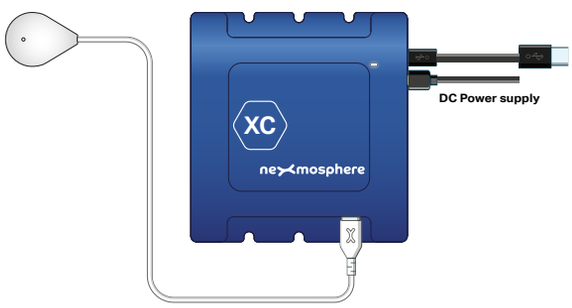
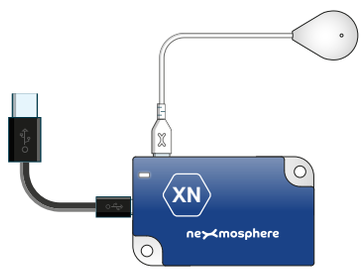
4.1 Connection Diagrams

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



Example connection to XC Controller



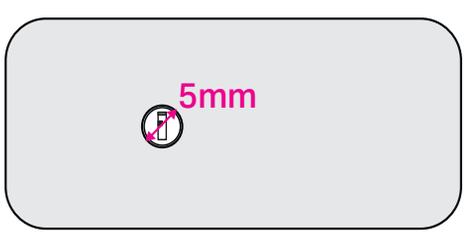
Example connection to XN Controller

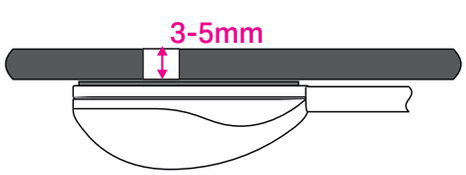
4.2 Hardware integration guidelines

Installation behind top panel

The XZ Light sensor is typically installed behind a top panel with a cut-out. We recommend to make a circular cut-out of **5mm diameter** in the top panel behind which the sensor can be placed using the double sided tape on the bottom (flat) side of the sensor.

A common thickness for the top panel is 3-5mm. The thicker the top panel, the less light will be able to reach the sensor, especially when the top panel is made out of dark (light-absorbing) material. In these cases, we recommend to either make sure there is a light source directly perpendicular above the sensor, or increase the diameter of the cut-out.

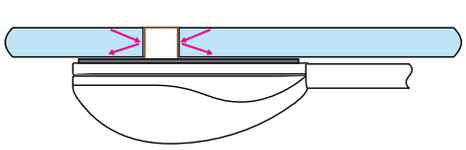




Translucent or lit top panel

Particularly in retail environments, it is a common practice to create lit top panels by using translucent materials and adding LED strips. In these cases the light sensor might not be able to detect a pick-up or place-back as light will also reach the sensor via the lit/translucent top panel when an object is placed back.

In these cases we recommend to add a small non-translucent shaft in the cut-out, to block light coming from the lit top panel



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Environmental light conditions

In order for the sensor to function, the space in which the sensor is installed needs to have sufficient light. This can be either natural sunlight or artificial light. Typically any level of lighting you usually see in public spaces such as stores or museums is more than enough for the sensor to function properly and stable.

In case of natural sunlight, the light intensity can fluctuate highly during the day. In these cases, it is important that no light can reach the sensor when the object is placed back. Therefore we recommend the following:

- Use a non-translucent material for the top panel
- Or, add a non-translucent shaft in the cut-out when using a translucent material for the top panel
- Make sure the object which is picked-up or placed back is non-translucent

In environments with stable light conditions, it is possible (to some extend) to use a translucent top panel or translucent object. However in these cases it might be necessary to calibrate the sensor.

4.3 Manual calibration procedure

In most installations, the default factory calibration of the light sensor will work perfectly. However when working with translucent materials, it might be necessary to calibrate the sensor. Calibrating the sensor is done utilizing X-talk settings. All available settings for the light sensor are listed on page 5 and 6. Below, the calibration procedure is provided. Before starting calibration, make sure the sensor is installed in the same way as it will be during operation. If either the setup or environment changes, the sensor may need to be calibrated again.

Measure raw light values

1. Set the sensor to "Raw light values" via setting 4. The command to do so is **X001S[4:2]**.
2. Place the object on the sensor. Write down the value of the incoming API command . **For example X001A[30]**. *
3. Pick-up the object from the sensor. Write down the value of the incoming API command . **For example X001A[120]**. *

** In case both values are very low (e.g. 0 and 14) go to step A at the bottom of this page.*

** In case both values are very high (e.g. 231 and 255) go to step B at the bottom of this page.*

Adjust trigger values

4. Calculate the centre value of the raw light values measured in step 2 and 3. **For example (30 + 120) / 2 = 75**.
5. Adjust the "place-back" threshold via setting 11. Set the threshold to the calculated centre value, minus a small buffer (e.g. 5). In this **example, 75-5=70.** The settings command would therefore be **X001S[11:70]**.
6. Adjust the "pick-up" threshold via setting 12. Set the threshold to the calculated centre value, plus a small buffer (e.g. 5). In this **example, 75+5=80**. The settings command would therefore be **X001S[12:80].**

Test pick-up and place-back detection

7. Set the sensor back to Pick-up/Place-back detection via setting 4. The command to do so is **X001S[4:1]**.
8. Place the object on the sensor. The API output should be **X001A[0]**. *If this is not the case, redo step 1-9*
9. Pick-up the object from the sensor. The API output should be **X001A[3]**. *If this is not the case, redo step 1-9*

Calibration is now done.

Optional: Adjust the sensor sensitivity

A. In case step 2 and 3 resulted in low raw light values, increase the sensitivity via setting 18. The default value is 50. We recommend increasing with steps of 50. The first try would therefore be **X001S[18:100]**. Now repeat step 2 and 3.
B. In case step 2 and 3 resulted in high raw light values, decrease the sensitivity via setting 18. The default value is 50. We recommend decreasing with steps of 10. The first try would therefore be **X001S[18:40]**. Now repeat step 2 and 3.

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5.1 - Settings

The XZ Light sensor has multiple settings which determine the behaviour and output of the sensor. 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	`X001S[1:1]`
2. LED off	`X001S[1:2]`
3. LED on, blink at trigger (default)	`X001S[1:3]`
4. LED off, blink at trigger	`X001S[1:4]`

Setting 4: Trigger mode

1. Pick-up/place-back detection (def)	`X001S[4:1]`
2. Raw light values	`X001S[4:2]`
3. Pick-up/place back detection with auto-calibration (advanced)	`X001S[4:3]`

When set to 4:1, the sensor will provide a trigger on pick-up and place-back of an object. When set to 4:2, the sensor will provide the Raw Light measurements. See page 2 for more information.

When set to 4:3, the sensor will provide a trigger on pick-up and place-back of an object (see page 2). Furthermore, it will continuously auto-calibrate by automatically adjusting the sensor's sensitivity (setting 18) in such a way that in case of a place-back the raw light value is between 0-25 (setting 14) and in case of a pick-up the raw light value is between 225-255 (setting 15). For example: in case the raw light value is 255 (max), the sensor will automatically decrease the sensitivity until the light value will be just above 225.

Activating auto-calibration can be a solution in cases where fluctuating light conditions cause unstable behavior of the sensor. However we recommend to always first try to create a stable application by manual calibration (see page 5) or adjusting the physical integration (see page 4 and 5) of the sensor.

Setting 6: Sample averaging (advanced)

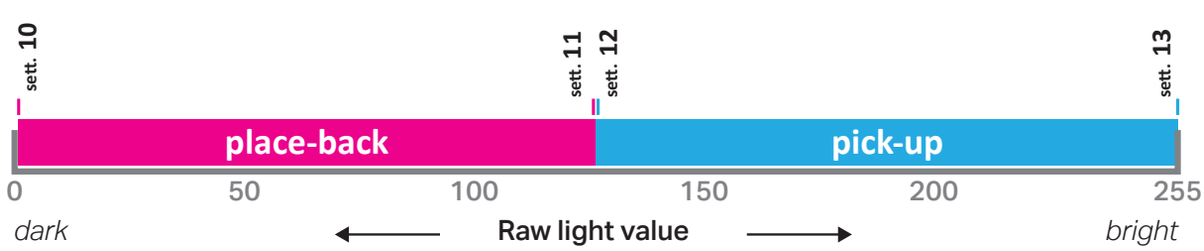
1. No averaging	`X001S[6:1]`
2. Running average of 2 samples (def)	`X001S[6:2]`
3. Running average of 4 samples	`X001S[6:3]`
4. Running average of 8 samples	`X001S[6:4]`
5. Running average of 16 samples	`X001S[6:5]`
6. Running average of 32 samples	`X001S[6:6]`
7. Running average of 64 samples	`X001S[6:7]`
8. Running average of 128 samples	`X001S[6:8]`
9. Running average of 256 samples	`X001S[6:9]`
10. Running avg of 1024 samples	`X001S[6:10]`
11. Running avg of 2048 samples	`X001S[6:11]`
12. Running avg of 4096 samples	`X001S[6:12]`

This setting specifies the number of samples which are averaged to determine 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 10-13: Trigger ranges for Pick-up / Place-Back

The sensor continuously measures the amount of light reaching the sensor to determine if an object is picked up (bright) or placed back (dark). The thresholds levels for a pick-up or place-back can be adjusted using raw light values. For more information please see the manual calibration process on page 4.

Set lower value for place-back Default, X is set to **0**	`X001S[10:X]`
Set upper value for place-back Default, X is set to **128**	`X001S[11:X]`
Set lower value for pick-up Default, X is set to **129**	`X001S[12:X]`
Set upper value for pick-up Default, X is set to **255**	`X001S[13:X]`



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Setting 14-15: Auto-calibration thresholds (advanced)

When the sensor is set the auto-calibration (setting 4:3), the sensor will continuously auto-calibrate by automatically adjusting the sensor's sensitivity (setting 18).

This is done in such a way that in case of a place-back the raw light value is just below the "dark calibration threshold" (**setting 14, default 25**) and in case of a pick-up the raw light value is just above the "bright calibration threshold" (**setting 15, default 225**).

For example: in case the raw light value is 255, the sensor will automatically decrease the sensitivity until the light value will be just above 225. Vice versa, in case the raw light value is 0, the sensor will automatically increase the sensitivity until the light value is just below the "dark threshold (default 25).

Set dark calibration threshold `X001S[14:X]`
Default, X is set to **25**

Set bright calibration threshold `X001S[15:X]`
Default, X is set to **225**

Setting 18: Sensor sensitivity (advanced)

Set sensor sensitivity `X001S[18:X]`

X is a value between **1-250** and its default value is **50**. It indicates the duration of a light measurement cycle in steps of 0.1mS.

The higher the X value, the longer the duration, the more sensitive the sensor will be to light. The lower the X value, the shorter the duration, the less sensitive the sensor will be to light.

Example: if the output of a raw light measurement is 255 and X is decreased to 10, the Raw light value will decrease as well (e.g. to 210). So the less sensitive, the lower the raw light value will be in the same light conditions.

Example: if the output of a raw light measurement is 0 and X is increased to 150, the Raw light value will increase (e.g. to 20). So the more sensitive, the higher the raw light value will be in the same light conditions.

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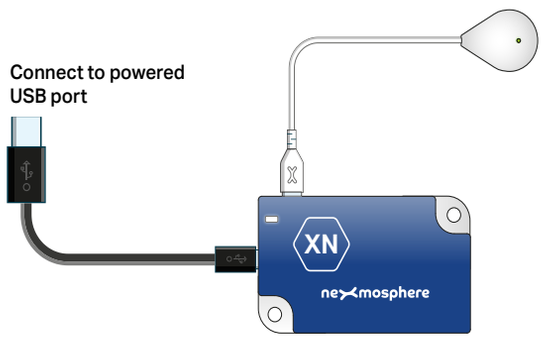
6. Quick test

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

Step 1 - Setup

First, connect the Light sensor to an Xperience controller. Secondly, power the Xperience controller.

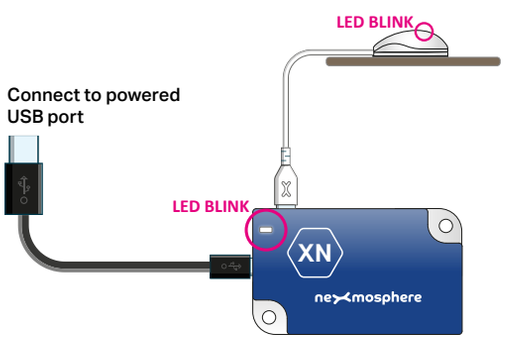
The green status LED of the XZ Light sensor should go on. The status LED of the controller will start to blink and once power-up is completed will be lit continuously.



Step 2 - Pick-up and place-back detection

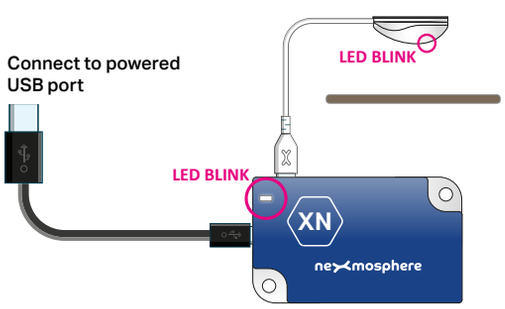
Cover the light sensor to trigger a place-back. If the sensor is not yet installed behind a front panel, you can for example place the sensor with the bottom (flat) side on a table.

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



Uncover the light sensor to trigger a pick-up. If the sensor is not yet installed behind a front panel, you can rotate the sensor so that the bottom (flat) side is facing upwards and towards the light.

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). 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

Please contact support@nexmosphere.com for any support questions you may have.

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