## Table of content

1. General

The XZ Weight sensor (shelf type) can measure the amount of weight which is placed on the sensor, and swiftly detect weight deltas. Typically, this feature is used to determine whether objects, such as goods in a store, are picked up. Additionally it can be applied to measure how many items are stocked on a shelf. 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 Weight sensor shelf type is available in 2 models:

|	XZ-W4x	XZ-W8x
Pick-up detection (weight delta)	✔	✔
Stock count	✔	✔
Weight measurement	✔	✔
Anomaly detection	✔	✔
Maximum total weight	40KG	200KG
Minimum item weight	10g	20g
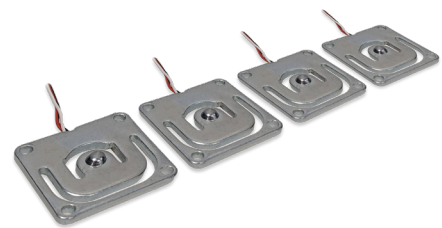
XZ-W4x | XZ-W8x

The XZ Weight sensor (shelf type) combines 4 Half Bridge Strain Gauges which convert the applied force into an electrical signal. This allows the sensor to accuractely measure weight (deltas) of larger surfaces, such as FMCG shelving.

These 4 metal elements are to be installed beneath the to-be-weighed shelving. The full weight of the shelf should be resting on the 4 elements. All elements are connected to a center board which analyzes the electrical signals and converts them to X-talk messages.

Top view
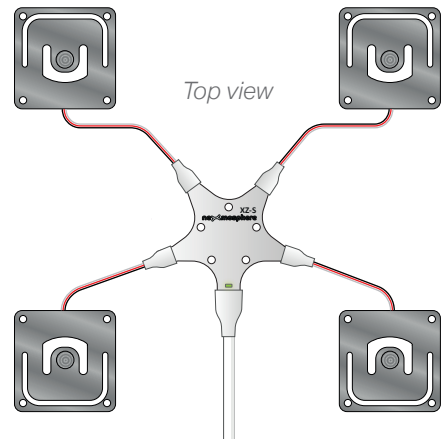
PRODUCT MANUAL | XZ WEIGHT SENSOR SHELF TYPE

The sensor will only work as intended when the applied weight is stable, as is the case when placing a product, or lifting it after. When applying manual force on the sensor, for example with your hand, the applied weight will typically fluctuate too much for the sensor to be responsive or provide any output at all. Therefore, we recommend to first install the sensor under a panel, before testing the API commands. For more information on mechanical installation, please see section 4.2, page 6 and 7.
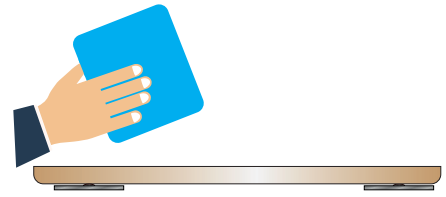
3. Functionalities and API commands
The XZ Weight sensor provides the following functionalities:

1. **Pick-up detection** - detect if any item is lifted
2. **Stock count** - keep track of how many items are stocked on a shelf
3. **Absolute weight measurement** - measure the absolute weight to use the sensor as a regular weight scale
4. **Sensor calibration** - calibrate the sensor to your setup for an accurate weight measurement

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 detection (Quick trigger)
The sensor can recognize when an item is lifted from the shelf. It does so by measuring weight, and checking if there is a small negative weight difference with the previous measured weight sample. This mechanism is designed to provide a fast and responsive "quick trigger" when an item is lifted, for example to start product related content. The API messages for pick-up detection is as follows:

X001B[PICKUP]   *Item is lifted (quick trigger)*

When implementing pick-up triggers, consider the following:
- The sensor has multiple settings to adjust its sensitivity and accuracy. Please see section 5 "Settings", page 8.
- Per default, the sensor is set to output both a pick-up message and a stock count message. To adjust this, please see section 5 "Settings", page 8.

Example commands

An item is lifted from the sensor connected to X-talk interface 005

X005B[PICKUP]

3.2 - Stock count
Next to providing a "quick trigger" , the sensor simultaneously executes a longer and more precise measuring process to count the number of items which are stocked on the shelf, after a product was lifted. To do so, the sensor must first be configured with the weight of the stocked item and the current stock level. This can be done with the following API commands:

`X001B[ITEMWEIGHT=XXX.XXX]`

*Set the **weight value** to the stocked item*
XXX.XXX = weight in kilograms **000.000-200.000**

`X001B[STOCKSET=XXX]`

Set the current stock level
XXX= nr of items **000-999**

Alternatively to assigning the weight of the item manually, the sensor can also measure the weight of the stocked item and store this value. To do so, place one or multiple units of the same item on the weight sensor and send the following command:

`X001B[STOCKMEASURE=XXX]`

Measure and store the weight of the stocked item
XXX = number of items placed on the sensor **001-999**

When configuring the item weight, consider the following:

- For an accurate item weight measurement, it is **crucial** to first manually calibrate the sensor when installed in the final setup. Please see section 3.4, page 5.

When the configuration of an item was successful, the sensor will reply with the following API message:

X001B[CALIBRATION=DONE]

Example API messages

Set the item weight to 410 grams on the weight sensor connected to X-talk interface 003

`X003B[ITEMWEIGHT=000.410]`

Set the item weight to 1285 grams on the weight sensor connected to X-talk interface 007

`X007B[ITEMWEIGHT=001.285]`

Measure the item weight of 14 stocked items on the weight sensor connected to X-talk interface 002

`X002B[STOCKMEASURE=014]`

Once the weight of the stocked item is set, the sensor will count the number of items which are stocked on the shelf each time a product is lifted or placed. Per default, the sensor is set to output the absolute stock value. In this output mode, the API messages have the following format:

X001B[STOCK=*XXX*]	*Stocked items currently on the shelf*	XXX= nr of items	**000-999**

Next to providing the absolute stock count when a product is lifted, the sensor can also be set to output the stock change. To enable this, the output mode must be adjusted:

`X001S[4:2]`   Product lift & incremental stock count

In this output mode, the API messages have the following format

X001B[STOCKCHANGE=+*XX*]	*Number of stocked items on the shelf increased*	XX= nr of items	**00-99**
X001B[STOCKCHANGE=-*XX*]	*Number of stocked items on the shelf decreased*	XX= nr of items	**00-99**

When implementing stock count, consider the following:

- The sensor has multiple settings to adjust its sensitivity and accuracy. Please see section 5 "Settings", page 8.
- Per default, the sensor is set to output both a pick-up message and a stock count message. To adjust this, please see section 5 "Settings", page 8.
- For absolute stock measurements, the sensor must be informed about the current stock level after each power cycle. Per default this is done automatically. To adjust this, please see the following.

The absolute stock count can be requested at any time by sending the following data request command:

`X001B[STOCK?]`

Example commands

Default mode (absolute stock count):
An item is lifted from a shelf on the sensor connected to X-talk interface 002, after which 17 items are left on the shelf

X002B[PICKUP]
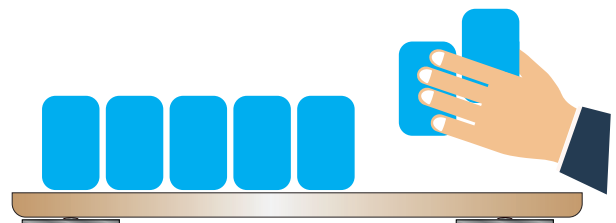X002B[STOCK=017]

Incremental mode:
Two items were lifted simultaneously from a shelf on the sensor connected to X-talk interface 008

X008B[PICKUP]
X008B[STOCKCHANGE=-02]

In case an item is placed on the shelf, of which the weight does not match that of the stock item, the sensor will detect this as an anomaly. The sensor can keep track of multiple anomalies over time. Each time new anomaly is detected, the following message will appear:

X001B[ANOMALY**=DETECTED]   *new anomaly detected*   *** = anomaly number 00-99*

When an item which has caused an anomaly is lifted, the detected anomaly is cleared and the following message will occur:

X001B[ANOMALY**=CLEARED]   *anomaly is cleared*   *** = anomaly number 00-99*

For absolute stock measurements, the sensor must be informed about the current stock level after each power cycle. Per default the sensor automatically stores the current stock level in its memory after each change. When the sensor has a power cycle, is reads the last stored stock level from its memory and sets this as its current level. This automated mechanism only works correctly if no stock changes have been done during the off-time of the sensor. The autostore feature can be disabled or enabled at any time by sending the following command.

`X001B[AUTOSTORE=OFF]`   *Disable the autostore stock feature*
`X001B[AUTOSTORE=STOCK]`   *Enable the autostore stock feature (default mode)*

When autostore is disabled, the stock level can be stored and recalled manually by sending the following API commands:

`X001B[STORE=STOCK]`   *Store current stock level in sensor memory*
`X001B[RECALL=STOCK]`   *Recall stored stock level and set as current stock level*

At any time, the current stock level can be set manually by sending the following API command:

`X001B[STOCKSET=XXX]`   *Set the current stock level*
XXX= nr of items   **000-999**

3.3 - Absolute weight measurement

The sensor can be set to output the absolute weight value applied on the sensor. In this mode, the sensor can be used as a regular weight scale. To enable the API output for absolute weight values, the output mode must be adjusted. This can be done by sending the following API command:

`X001S[4:6]`　　　Absolute weight output

In this output mode, the API messages have the following format:

X001B[WEIGHT=+*XXX.XXX*]　　　*Absolute weight on sensor*　　　XXX.XXX= *kilograms*　　**000.000-200.000**

When implementing absolute weight measurements, consider the following:

- Per default, the minimum required weight difference to trigger an API message is 10 grams. To adjust this, please see section 5 "Settings", page 8.
- The sensor automatically does a base calibration at start-up. For absolute weight measurement, it is important that either the sensor has no item placed on it at start-up, or it is recalibrated after. Please see section 3.4, page 5.
- The sensor has multiple settings to adjust its accuracy and measurement time. Please see section 5 "Settings", page 8.

The absolute total weight currently placed on the sensor can be requested at any time by sending the following data request command: `X001B[WEIGHT?]`

Example commands
An item weighing 1843 grams is placed on the sensor connected to X-talk interface 003
X003B[WEIGHT=+01.843]

An item weighing 71.5 kilograms is placed on the sensor connected to X-talk interface 004
X004B[WEIGHT=+071.500]

An item is lifted from the sensor connected to X-talk interface 007
X007B[WEIGHT=+000.000]

3.4 - Sensor calibration

The sensor will provide the most accurate output when it is calibrated in its final mechanical setup. This only needs to be done once during the setup of your installation. In order to so, please follow the steps below.

Install the sensor
1. Install the sensor below a panel or shelf (please see section 4.2, page 6 and 7 for more information).

Tare the sensor
2. Make sure no object is placed on the platform.
3. Send the following API command:
`X001B[CALIBRATE=BASE]`
4. When successful, the sensor will reply with the following command: X001B[CALIBRATION=DONE]
The sensor automatically does a base calibration at start-up. This doesn't affect the normal operation of "Pick-up detection" and "Stock count". For "Absolute weight measurement", it is important that either the sensor has no item placed on it at start-up, or it is recalibrated after.

Calibrate the sensor
5. Place an object on the sensor of which the exact weight is known, preferably between 5-10 Kilograms
6. Send the following API command, with the exact weight of the object. In case of 5 Kilograms:
`X001B[CALIBRATE=005.000]`
7. When successful, the sensor will reply with the following command: X001B[CALIBRATION=DONE]
The sensor calibration is now completed.

4.1 Connection Diagrams

The XZ Weight 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.
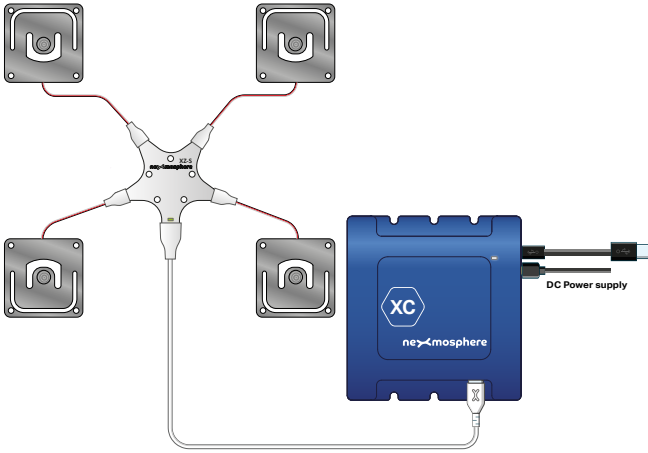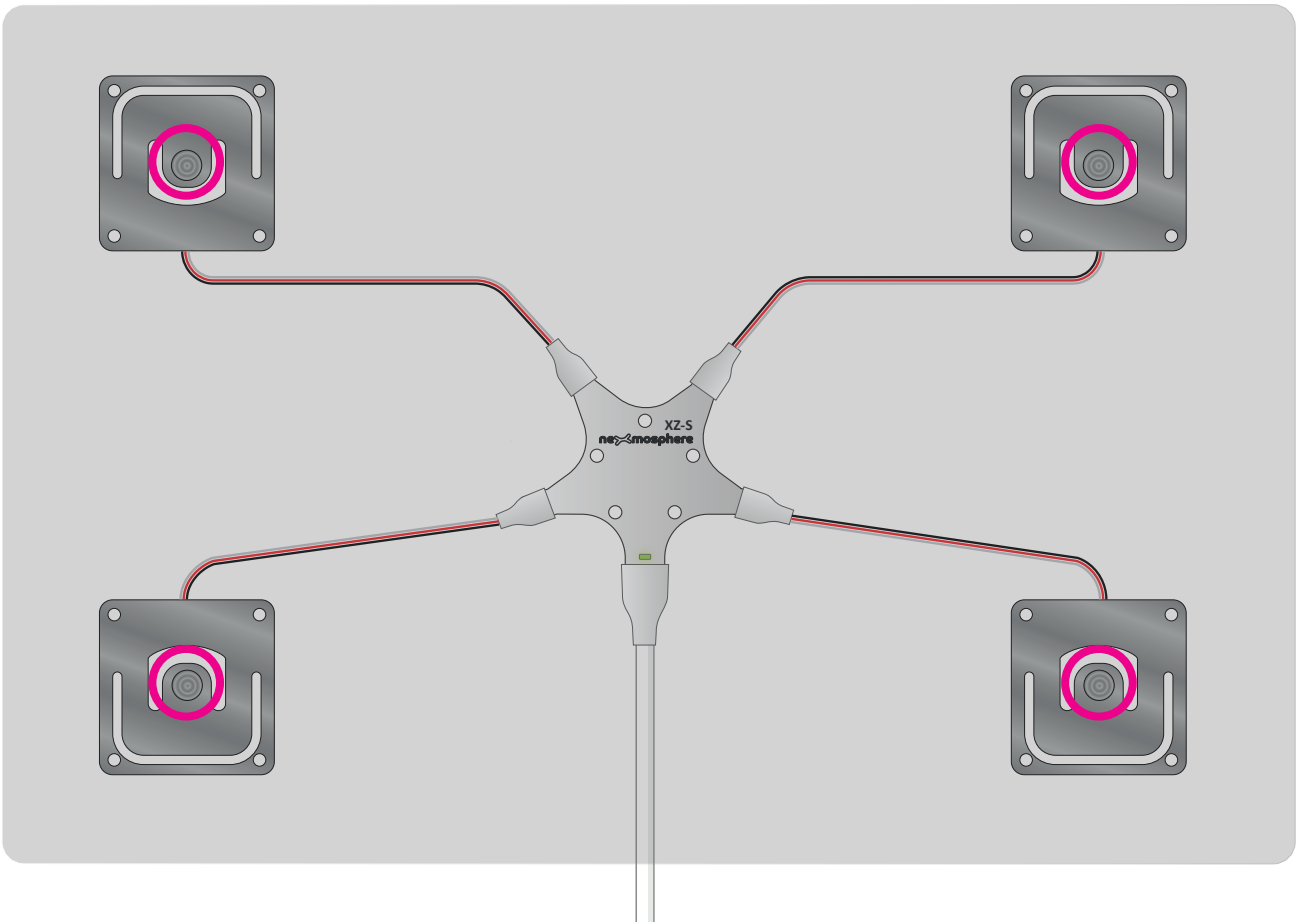

Example connection to XC Controller
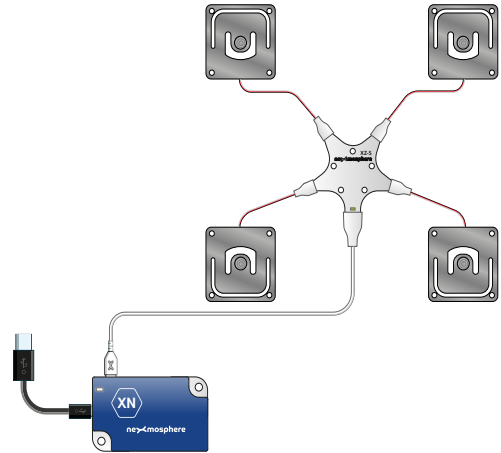
Example connection to XN Controller

4.2 Hardware integration guidelines

The sensor has 4 metal elements (strain gauges), which each are to be installed beneath the shelf which it should weigh. The full weight of shelf should be resting on the embossed center of the 4 elements.

The sensor themselves should be fixated on a bottom panel which is part of the physical frame structure. Looking from the side, the sensor is sandwiched between a bottom panel (frame structure) and a top panel. The products/merchandize are placed on the top panel.
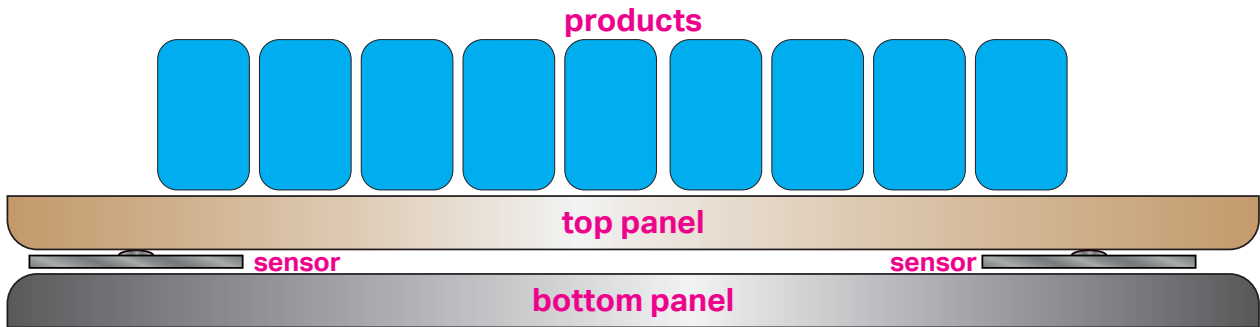

Fixation to bottom panel / frame structure

The 4 metal elements of the weight sensor each have 4 mounting holes available for installment onto the frame structure.
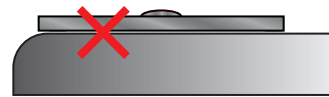
The mounting holes can be used to secure the elements directly onto the frame structure. A minimum spacing of 2mm between the metal element and the bottom panel is required.
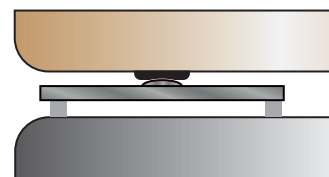
In case of using bolts and nuts to secure the sensor elements, please make that these are lower than the embossed center parts of the sensor elements.
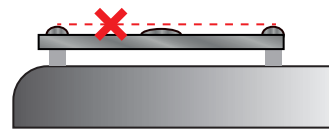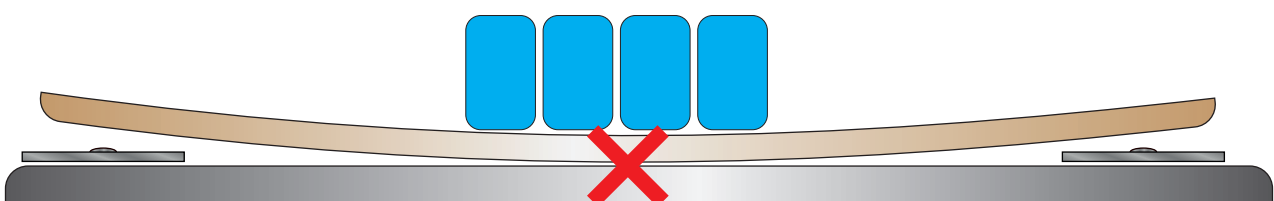
Installation of Top panel

The top panel needs to be placed on the sensor in such a way that the complete weight of the panel is resting on the embossed center dots of all 4 metal elements.

Make sure that the panel is rigid enough to hold the products in such a way that it does not bend beyond the height of the metal elements of the sensor

5.1 - Settings

The XZ Weight 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: Output mode

1. Pick-up only	`X001S[4:1]`
2. Pick-up & stock count incremental	`X001S[4:2]`
3. Pick-up & stock count absolute (d)	`X001S[4:3]`
4. Stock count incremental only	`X001S[4:4]`
5. Stock count absolute only	`X001S[4:5]`
6. Weight measurement	`X001S[4:6]`
7. No triggers, use data requests	`X001S[4:7]`

For more info, please see section 3, page 2 to 5.

Setting 5: Maximum weight deviation between samples

Max. weight deviation (grams)　　`X001S[5:X]`

X is a value between **1-50** and its default value is **10** grams. This setting specifies the maximum weight deviation between 2 internal weight samples, for them to be considered valid.

The higher the maximum weight deviation, the more responsive but less accurate the sensor will be. The lower the maximum weight deviation, the less responsive but the more accurate the sensor will be.

This setting is related to setting 7, which determines the number of consecutive valid samples the sensor must have for a measurement to be considered valid and generate a trigger.

Setting 6: Minimum weight difference for trigger

Min. weight difference (grams)　　`X001S[6:X]`

X is a value between **1-250** and its default value is **10**. This setting specifies the minimum weight difference between 2 valid measurements to trigger an API command. This setting applies for output mode 4:6 "Weight measurement".

Setting 7: Sample averaging

Number of samples for averaging　　`X001S[7:X]`

X is a value between **1-100** and its default value is **4**. This setting specifies the number of valid weight 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 8: Anomaly detection

Activate anomaly detection (def)	`X001S[8:1]`
Deactivate anomaly detection	`X001S[8:2]`

For more info, please see section 3, page 4.

Setting 9: Weight margin for anomaly detection

Weight margin for anomaly detection　`X001S[9:X]`

X is a value between **1-50** and its default value is **10**. It indicates the percentage which a weight measurement is allowed to differ from the set item weight for it to count it as a valid stock change.

Setting 10: Minimum weight difference for pick-up

Weight delta for pick-up (quick trig.)　`X001S[10:X]`

X is a value between **1-250** and its default value is **15** grams. It specified the minimum weight difference which needs to occur for a pick-up (quick trigger) to be generated. For more information, please see section 3.1, page 2.

6. Quick test

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

Step 1 - Setup
First, connect the weight sensor to an Xperience controller. Secondly, power the Xperience controller.

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

Connect to powered USB port

GREEN STATUS LED

WHITE STATUS LED

XN
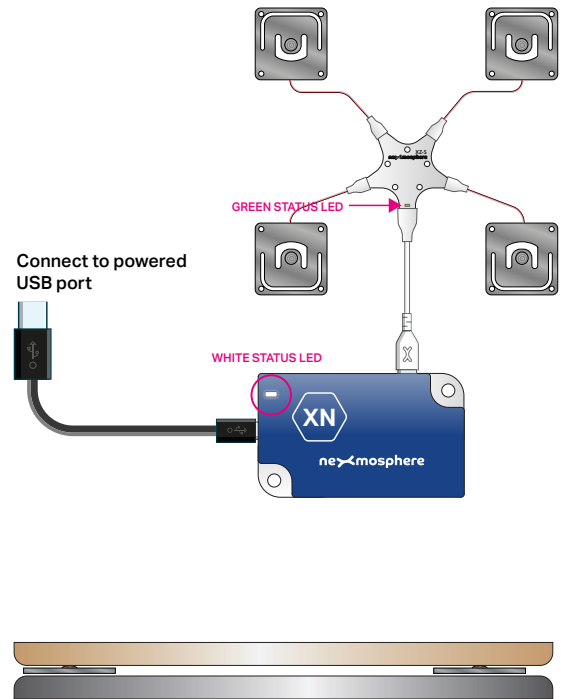
Step 2 - Install the sensor under a shelf panel
**Please see page 6 and 7 for installation guidelines.**
For quick on-desk testing, you place the sensors on your desk, and place a rigid panel on top of the sensors. Make sure the panel only rests on the 4 sensor elements.

Step 3 - Item placement and item lift
Place an item on the panel which is placed on the sensor. Then lift the item from the panel.

The status LED of the controller should blink.

Connect to powered USB port

LED BLINK

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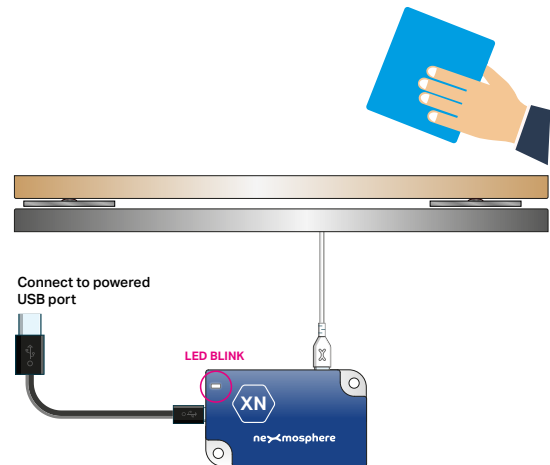
In case any of the steps above does not provide the expected result, please check the installation guidelines in this document.

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.