## Table of content

## 1. General

The X-Eye Presence & Airbutton sensors can detect if a person is in front of the sensor and - if so - indicate the distance of that person in relation to the sensor. Next to this, the sensor will provide an Airbutton trigger when a person places their hand close to the sensor. 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 X-Eye Presence & Airbutton sensors are available in 2 different models:



XY-240       XY-241       XY-251

The shape of the models are different, please refer to the datasheets for mechanical dimensions.
The sensor specifications are as follows:

| | XY-240 | XY-241 | XY-251 |
|---|---|---|---|
| detection range | 0 - 250 cm | 0 - 170 cm | 0 - 170 cm |
| beam angle | 27° | 27° | 27° |

The X-Eye Presence & Airbutton sensors utilize InfraRed laser emitters with an SPAD receiving array and Time-of-Flight technology to measure the distance of a person or object in relation to the sensor. The working principle is that the sensor emits photons which are reflected by the objects or persons in front of the sensor. The reflected photons are received by and an array of photodetectors. By measuring the time of flight of the reflected photons, the distance of the person or object in front of the sensor is calculated.

### 3. Functionalities and API commands

The X-Eye Presence sensors provide the following functionalities:

1. **Presence & Airbutton detection** - detects if a person or object is present and indicates the detected distance zone
2. **Absolute distance measurement** - detects if a person or object is present and indicates the absolute distance in cm

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 - Presence & Airbutton detection (distance zones)

The X-Eye sensor divides its detection range into distance zones of 25cm each. When a person or object in front of the sensor moves into a new distance zone, an API command is triggered, indicating the current distance zone. This API message has the following format:

**X001B[Dz=**\*\*]**    \*\*= *distance zone*  **01-10** or **AB** or **XX**

In the table below, the absolute distances for the default distance zones are provided:

| Zone | XY-240 |
|------|--------|
| AB | 0 - 10 cm |
| 01 | 10 - 25 cm |
| 02 | 25 - 50 cm |
| 03 | 50 - 75 cm |
| 04 | 75 - 100 cm |
| 05 | 100 - 125 cm |
| 06 | 125 - 150 cm |
| 07 | 150 - 175 cm |
| 08 | 175 - 200 cm |
| 09 | 200 - 225 cm |
| 10 | 225 - 250 cm |
| XX | Out of Range |

| Zone | XY-241 |
|------|--------|
| AB | 0 - 10 cm |
| 01 | 10 - 25 cm |
| 02 | 25 - 50 cm |
| 03 | 50 - 75 cm |
| 04 | 75 - 100 cm |
| 05 | 100 - 125 cm |
| 06 | 125 - 150 cm |
| 07 | 150 - 170 cm |
| XX | Out of Range |

When implementing distance zone triggers, consider the following:

- For touchless input, a dedicated "Airbutton" detection zone is available (AB). The detection range for the Airbutton zone can be adjusted, please see page 6, Settings.
- When no person is in front of the sensor, the distance zone will be either XX (Out of Range) or the nearest object in front of the sensor within its range. For example if a wall is placed at 240cm of the sensor, the detected distance zone will be 10 in case no person is present.
- The "Range of Interest" which determines when an object or person is Out of Range can be adjusted, please see page 6, Settings.



04  Distance zone 04
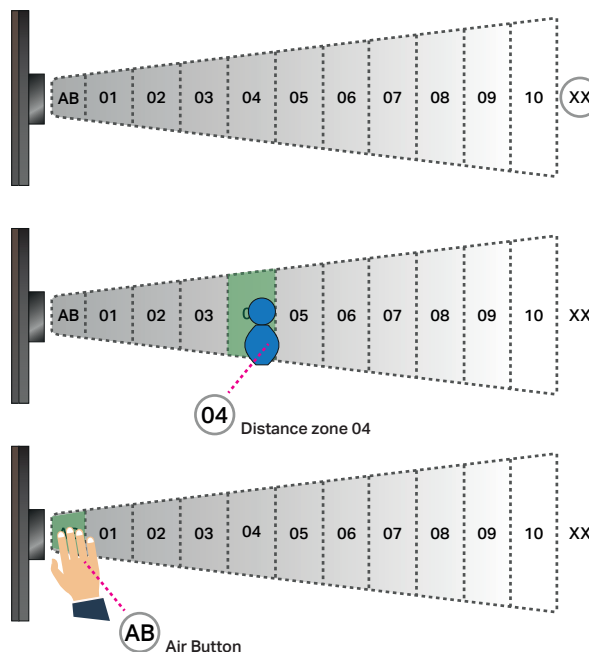
AB  Air Button

*Example commands*

*Person detected in distance zone 4 (75-100cm)*
**X001B[Dz=04]**

*Person detected in distance zone 10 (225-250cm)*
**X001B[Dz=10]**

*Out of Range, no person detected (>250cm)*
**X001B[Dz=XX]**

*Airbutton detected (0-10cm)*
**X001B[Dz=AB]**

The detected distance zone can always be request by sending the following API command:

**X001B[ZONE?]**  Request current distance zone

The reply will be identical to the triggered API messages such as the examples listed above.

### 3.2 - Absolute distance measurement

Next to providing distance zone information, the X-Eye sensor can also be set to provide absolute distance measurements in units of 1 cm. This mode can be activated by sending the following setting:

`X001S[4:2]`    Set trigger mode to abs. distance

When a person or object moves in front of the sensor, an API command is triggered, indicating the current distance zone. This API message has the following format:

X001B[Dv=***]    ***= *distance in cm* **000-250** or **XXX**

When implementing absolute distance measurement triggers, consider the following:

- When no person is in front of the sensor, the distance measurement will be either XXX (Out of Range) or the nearest object in front of the sensor within its range.
- The required change in measured distance for a new API message to be triggered is set to 10cm per default. This value can be adjusted, please see page 6, settings.

*Example commands*

*Person detected at 43cm distance*
X001B[Dv=043]

*Person detected at 195cm distance*
X001B[Dv=195]

*Person (or hand) detected at 7cm distance*
X001B[Dv=007]

*Out of Range, no person detected (>250cm)*
X001B[Dv=XXX]

The measured distance can always be request by sending the following API command:

`X001B[DIST?]`    Request current distance (cm)

The reply will be identical to the triggered API message such as the examples listed above.

### Raw sensor values

For debug and testing purposes, the sensor can also be set to output raw sensor values in addition to the measured distance. This mode can be activated by sending the following setting:

`X001S[4:4]`    Set trigger mode to raw values

In this mode, the sensor continuously sends out API messages with the following format:

X001B[Dr=*distance*:*noise*:*signal*:*error*]

| | |
|---|---|
| *distance in cm* | **000-500** |
| *noise level (kcps per 4 photodetectors)* | **000-999** |
| *signal level (kcps per 4 photodetectors)* | **000-999** |
| *error status* | **0-7** |

There are multiple settings available to set thresholds and filtering levels based on the raw sensor values. For more information on this please see page 8.

*Example commands*

*Distance 48cm, noise 37, signal 344, error 0*
X001B[Dr=048:037:344:0]

*Distance 203cm, noise 35, signal 53, error 0*
X001B[Dr=203:035:053:0]

*Distance 274cm, noise 43, signal 19, error 7*
X001B[Dr=274:043:019:7]

The raw sensor values can always be request by sending the following API command:

`X001B[RAW?]`    Request current raw values

The reply will be identical to the triggered API message such as the examples listed above.

### 4 - Installation requirements and guidelines

When integrating an X-Eye Presence & Airbutton 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 Laser safety considerations

The X-Eye Presence & Airbutton sensor contains a laser emitter and corresponding drive circuitry. The laser output is designed to remain within Class 1 laser safety limits under all reasonably foreseeable conditions including single faults in compliance with IEC 60825-1:2014 (third edition). The laser output power must not be increased by any means and no optics should be used with the intention of focusing the laser beam.

**Caution:** Use of controls or adjustments or performance of procedures other than those specified in this document may result into hazardous radiation exposure.



### 4.2 Connection Diagrams

The X-Eye sensor can be connected to any X-talk interface and is therefore compatible with all Xperience controllers. Make sure the X-Eye 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.
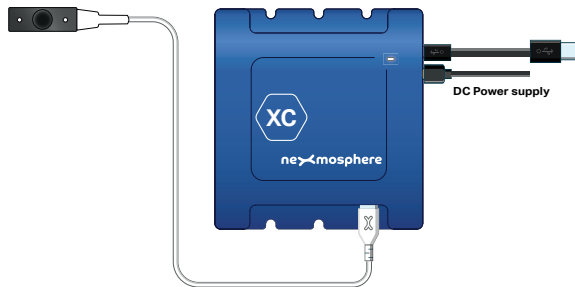


*Example connection to XC Controller*
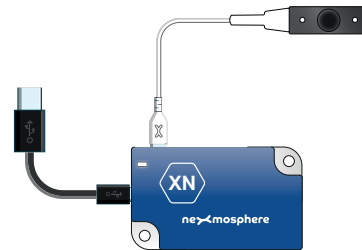


*Example connection to XN Controller*

### 4.3 Hardware integration guidelines

**Field of View**

The X-Eye Presence & Airbutton sensors have a Field of View (FoV) of approximately 27°. Please take this into consideration when designing your setup and determining the position of the sensor. The sensors FoV can be adjusted using advanced settings. Please see page 7, for more information.

### Installation behind front panel

Both the XY-240 and XY-241 can be installed behind a front panel with a cut-out. The XY-241 has an embossed cylinder of 9.8mm diameter. We recommend to make a circular cut-out of 10mm diameter in the front panel through which the embossed cylinder can be placed. In this case, the thickness of the front panel should not exceed 5mm. In case of installing the XY-240, the same circular cut-out and alignment can be applied. Alternatively, the XY-240 can be placed in a cut-out which fit the dimensions of the entire sensor outline.
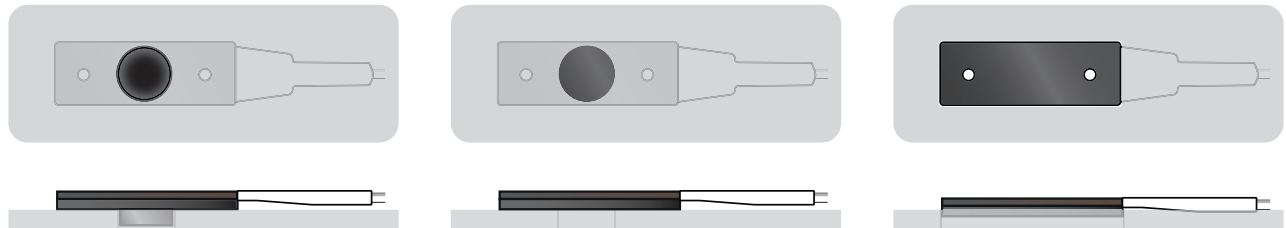


### Ambient Light conditions

In environments with bright ambient light, the maximum detection range of the sensor can be less then 250cm. Due to this, the sensor is not suitable for outdoor measurements and we recommend to place the sensor in such a way that it is not directed perpendicular towards a window.

The level of ambient light can be measured by setting the sensor to raw data mode and reading the Noise level. The sensor performs optimal when the ambient light level is less than 50 kcps (per 4 photodetectors).

### Smudge and dust on sensor

In case there is smudge or heavy dust on the sensor, the sensor readings may become less accurate and unstable. In this case, the sensor output will typically indicate a very short distance between 1-10cm.
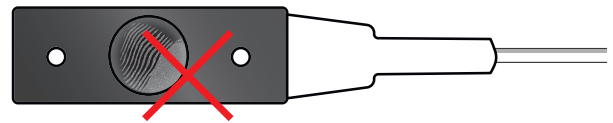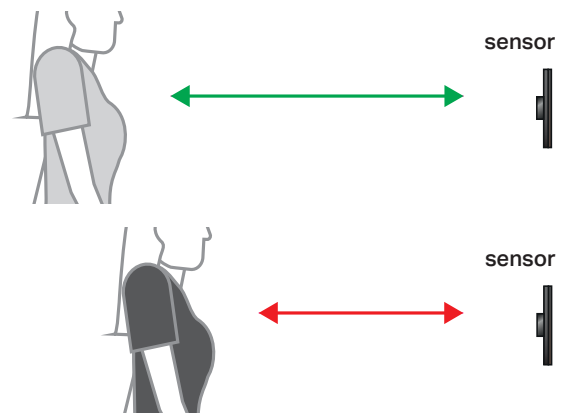


### Multiple sensors

The X-Eye Presence & Airbutton sensors are designed in such a way that they do not interfere with each other. Therefore it is possible to place multiple sensors side-by-side with a small clearance in between of 15cm or more.
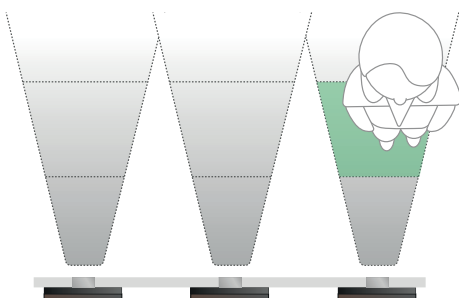


### Colour of detection target

Light-coloured objects are easier to detect for the sensor as these reflect more IR signals than dark-coloured objects. In practice, this means that the maximum detection distance at which a person can be detected by the sensor may vary depending on the colour of the clothing the person is wearing.



5

### 5.1 - Settings

The X-Eye 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. Distance zone triggers (default) | `X001S[4:1]` |
| 2. Absolute distance change triggers | `X001S[4:2]` |
| 3. No triggers, use data requests | `X001S[4:3]` |
| 4. Raw data mode, continuous data | `X001S[4:4]` |

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

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

Set trigger distance     `X001S[5:X]`

X is a value between **1-250** and its default value is **10**. It indicates the required change in measured distance for an API output message to trigger when the sensor is set to absolute distance mode (setting 4:2).

#### Setting 6: Range of Interest

Set Range of Interest     `X001S[6:X]`

X is a value between **1-50** and its default value is **25** (XY-240) and **17** (XY-241). It indicates the sensor's range of interest in units of 10cm, so the default range of interest is **250cm** (XY-240) and **170cm** (XY-241). If an object is detected at a longer distance than the Range of Interest, it is considered to be Out of Range, which will be indicated as such in the output message. For more info, please see section 3, page 2 and 3.

#### Setting 7: Sample averaging (advanced)

| | |
|---|---|
| 1. No averaging (default) | `X001S[7:1]` |
| 2. Running average of 2 samples | `X001S[7:2]` |
| 3. Running average of 3 samples | `X001S[7:3]` |
| 4. Running average of 4 samples | `X001S[7:4]` |
| 5. Running average of 5 samples | `X001S[7:5]` |
| 6. Running average of 6 samples | `X001S[7:6]` |
| 7. Running average of 7 samples | `X001S[7:7]` |
| 8. Running average of 8 samples | `X001S[7:8]` |

This setting determines 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 8: Hysteresis for distance zones

Set hysteresis threshold     `X001S[8:X]`

X is a value between **1-50** and its default value is **25**. It indicates the hysteresis threshold in millimetres for a new API message to be triggered when the sensor is set to distance zone mode (setting 4:1). This setting can avoid an overload of API messages jumping back and forth between two adjacent distance zones when a person is standing at the edge of two distance zones. The lower the X value, the less change in distance is required (with the previous measured distance) for the sensor to output a new distance zone. Vice versa, the higher the X value, the more change in distance is required for the sensor to output a new distance zone.

#### Setting 9: Sensor measurement duration (advanced)

| | |
|---|---|
| 1. 20mS | `X001S[9:1]` |
| 2. 33mS | `X001S[9:2]` |
| 3. 50mS | `X001S[9:3]` |
| 4. 100mS | `X001S[9:4]` |
| 5. 200mS (default) | `X001S[9:5]` |
| 6. 500mS | `X001S[9:6]` |

This setting determines the duration of one measurement cycle. The higher the duration, the higher the maximum detection distance and the better the repeatability of the sensor's output. The lower the measurement duration, the faster the sensor will detect a change in detected distance, but the less stable the output will be and the lower the maximum detection distance will become. Please note that typically this setting does not need to be adjusted.

#### Setting 20: Airbutton zone enable / disable

| | |
|---|---|
| 1. Disable Airbutton zone | `X001S[20:1]` |
| 2. Enable Airbutton zone (default) | `X001S[20:2]` |

When Airbutton zone is enabled, the sensor will output *Dz=AB* when an object or hand is detected within the Airbutton zone (default 0-10cm). When the Airbutton zone is disabled, the default distance range allocated for the Airbutton zone (0-10cm) will be added to distance zone 1.

#### Setting 21: Airbutton zone range

Set range Airbutton zone     `X001S[21:X]`

X is a value between **1-250** and its default value is **10**. It indicates the range of the Airbutton zone in cm, starting at 0. For example, when set to 10 (default), the Airbutton zone is defined as 0-10cm.

### 5.2 - Advanced settings: Field of View adjustment

The following settings provide advanced control over the sensor's Field of View (FoV). Adjusting these settings can cause the sensor to stop being able to make accurate measurements. After a power cycle, the settings always return back to default.

The sensor has a 16x16 grid of SPAD photodetectors. Per default, the detection values of all 256 SPAD's are used to measure the distance of the object or person in front of the sensor. By disabling part of the 16x16 grid, it is possible to make the Field-of-View angle smaller or ignore a specific section of the Field-of-View. Typically these settings are used when the sensor's FoV is obstructed with objects which should be ignored. For example when the sensor is installed in the back wall of a retail shelf and the shelf is partially in the sensor's FoV.

### Setting 10: FoV quick adjust (square grid, auto-centre)

Set active grid size `X001S[10:X]`

X is a value between **4-16** and its default value is **16**. It determines both the number of "columns" and "rows" and will auto-centre the Field of View. Please note that decreasing the grid size can cause the maximum detection distance to decrease. When setting the grid size to its minimum setting (4x4), the FoV will be approximately 15**°**. At the default maximum setting (16x16), the FoV is approximately 27°.

**Example:** when setting 10 is set to 8 (**10:8**), the FoV will be as indicated in the image on the right.
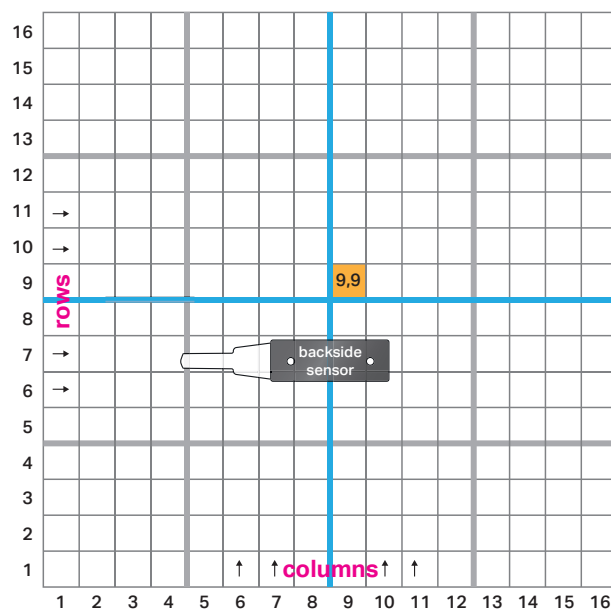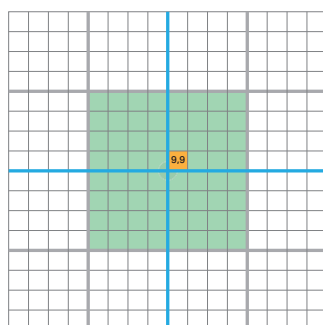




*The **centre anchor** in case of an even number of columns or rows is the first cell to the right/top of the middle row and cell. Therefore with the default 16x16 grid, the centre anchor is cell 9,9. In case of an odd number of columns or rows, the centre anchor is the middle row and column.*

### Setting 11: Number of active columns
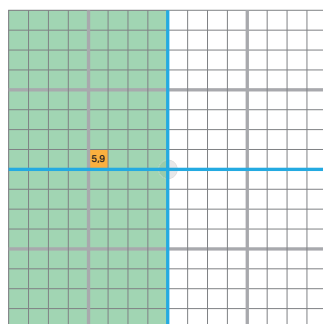
Set number of active columns `X001S[11:X]`

X is a value between **4-16** and its default value is **16**. It determines the number of active "columns". Decreasing X will make the FoV less "wide".

### Setting 12: Set X-location centre anchor

Set X-location centre anchor `X001S[12:X]`

X is a value between **3-15** and its default value is **9**. It determines where on the grid the X-location of the centre anchor of the FoV is located.

**Example:** when setting 11 is set to 8 (**11:8**) and setting 12 is set to 5 (**12:5**) the FoV will be as indicated in the image on the right.



### Setting 13: Number of active rows.

Set number of active columns `X001S[13:X]`

X is a value between **4-16** and its default value is **16**. It determines the number of active "rows". Decreasing X will make the FoV less "high".

### Setting 14: Set Y-location centre anchor

Set Y-location centre anchor `X001S[14:X]`

X is a value between **3-15** and its default value is **9**. It determines where on the grid the Y-location of the centre anchor of the FoV is located.

**Example:** when setting 13 is set to 12 (**13:10**) and setting 14 is set to 11 (**14:11**) the FoV will be as indicated in the image on the right.
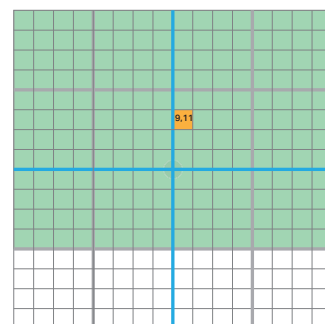
### 5.3 - Advanced settings: Output and error filtering

The following settings provide advanced control over the sensor's filter settings and error handling which determine the requirements for a sensor reading to be considered valid. Next to that, they provide control over the output format. Please note that typically these settings do not need to be adjusted. Within these settings, the following parameters are utilized:

**Signal Level**: indicates the level of the measurement signal in Kcps (kilo counts per second) per 4 SPAD's. The higher the Signal Level, the higher the accuracy of the measurement.
**Noise Level**: indicates the level of the background noise in Kcps (kilo counts per second) per 4 SPAD's. The higher the background noise, the less accurate the measurements will be, especially at higher distances. Background noise is typically caused due to a high amount of ambient light, such as sunlight shining through a window.
**Error status**: the sensor can provide several status levels, each indicating a specific type of warning or error:

| | | | |
|---|---|---|---|
| 0 | | No error or warnings | |
| 1 | Warning: | repeatability or standard deviation of the measurements is bad due to a decreasing signal/noise ratio | |
| 2 | Warning: | the return signal may be too weak to do a accurate measurement | |
| | | *Likely causes are that the target is too far away, the target is not reflective enough (e.g. dark clothing) or that the target is too small* | |
| 3 | Warning: | there may be a target "out of bounds" which could result into inconsistent measurements | |
| | | *Typically this occurs when a bright target is placed at +/- 5 meters of the sensor* | |
| 4 | Error: | there is a target "out of bounds" which likely results into inconsistent and inaccurate measurements | |
| | | *Typically this occurs when a very bright target is placed between 5-6 meters of the sensor.* | |
| 5 | Error: | the Signal/Noise ratio is lower than the set minimum (see setting 15) | |
| 6 | Error: | the minimum signal level is lower than the set threshold (see setting 16 and 17) | |
| 7 | Error: | the measured distance is longer than the set Range of Interest (see setting 6, page 6) | |
| 8 | Error: | the signal level is too low for the short distance measured. *Typically this occurs when the sensor is aimed at a void.* | |

The signal level, noise level and error status can be accessed by setting the sensor to Raw Data mode. Please see page 3 and page 6 (setting 4).

### Setting 15: Minimum Signal/Noise ratio

Set minimum signal-noise ratio          `X001S[15:X]`

X is a value between **1-250** and its default value is **50**. It determines how much noise there can be in relation to the signal level for the measurement to be considered valid. X sets the noise ratio value in steps of 0.1. Some examples:

When X is set to 5, the Signal/Noise ratio is 1 : 0.5
When X is set to 10, the Signal/Noise ratio is 1:1
When X is set to 50, the Signal/Noise ratio is 1:5 (default)
When X is set to 100, the Signal/Nosie ratio is 1:10

### Setting 16: Minimum Signal level for 0cm distance

Set minimum signal level for 0cm          `X001S[16:X]`

X is a value between **1-250** and its default value is **120**. It determines the minimum signal level (per 4 SPADs) for a measurement of 0cm to be considered valid and not categorized as error status 6. The higher the minimum signal level, the better the signal needs to be for a measurement to be considered valid. Decreasing this setting can cause for ghost measurements when the sensor is directed toward a void.

### Setting 17: Minimum Signal level for >150cm distance

Set minimum signal level for 150cm          `X001S[17:X]`

X is a value between **1-100** and its default value is **15**. It determins the minimum signal level (per 4 SPADs) for a measurement of >100cm to be considered valid and not categorized as error 6. Increasing this setting can cause the maximum detection distance to shorten.

### Setting 18: Error status filtering (for Error status 1-4)

1. No readings are blocked          `X001S[18:1]`
2. Readings w/ error 4 blocked          `X001S[18:2]`
3. Readings w/ error 3-4 blocked          `X001S[18:3]`
4. Readings w/ error 2-4 blocked          `X001S[18:4]`
5. Readings w/ error 1-4 blocked (d)          `X001S[18:5]`

When a reading is blocked, it won't be used for any output, except Raw Data mode.

### Setting 19: Error output format (for Error status 5-8)

1. Send XX in case of error 7-8 (def)          `X001S[19:1]`
2. Send XX in case of error 6-8          `X001S[19:2]`
3. Send XX in case of error 5-8          `X001S[19:3]`
4. Send XX in case of all errors          `X001S[19:4]`
5. Send X + error number          `X001S[19:5]`
6. No output for all errors          `X001S[19:6]`

Default, the sensor will provide XX as distance zone output in case of error 7. In case of error 5 and 6, there will be no output. This setting can be used to adjust the output behaviour for the different error levels.



*enlarged image available on next page*
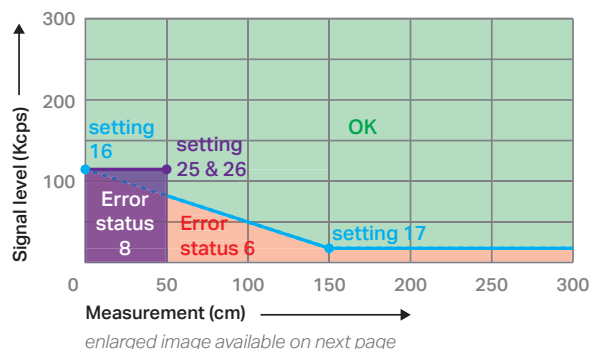
### Setting 25: Maximum distance for Error 8

Set max distance for Error 8     `X001S[25:X]`

X is a value between **1-250** and its default value is **50**. It determines the maximum distance in cm for which an Error 8 can occur, so the default maximum distance for an Error 8 is 50 cm. The minimum distance for Error 8 is fixed at 0cm.

### Setting 26: Maximum signal level for Error 8

Set max signal level for Error 8     `X001S[26:X]`

X is a value between **1-250** and its default value is **120**. It determines the maximum signal level (per 4 SPADs) for a measured distance lower than the maximum distance indicated in setting 25 to be considered as an Error 8.

Error 8 occurs when the sensor is aimed at a void. As this is independent of most other parameters of a setup, setting 25 and 26 typically do not need to be adjusted.
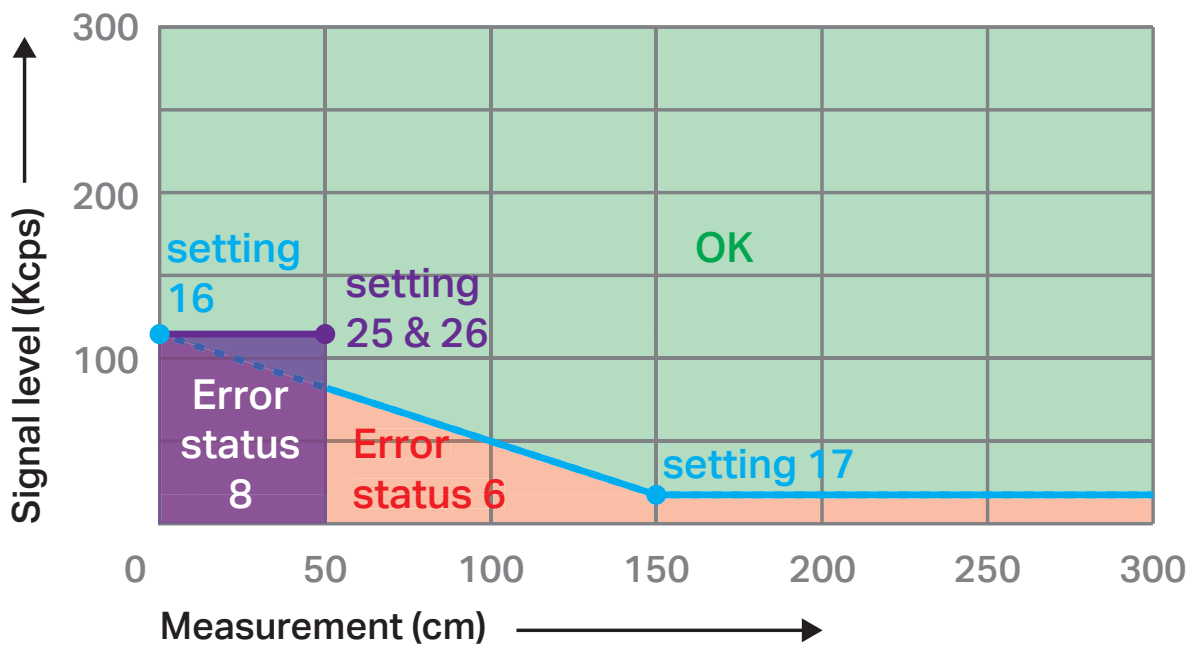
## 6. Quick test

In order to test if the X-Eye Presence & Airbutton sensor is installed correctly, please follow the test procedure below:

### Step 1 - Setup

First, connect the X-Eye sensor to an Xperience controller. Secondly, power the Xperience controller.

The green status LED of the X-Eye 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
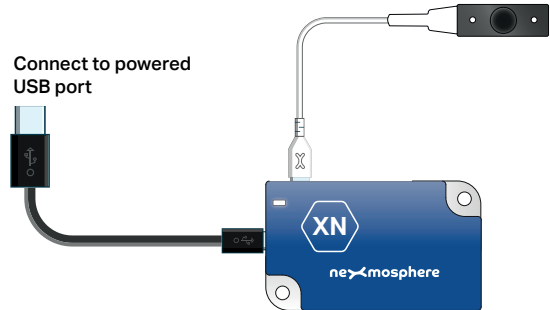
### Step 2 - Test detection

Stand +/-30cm in front of the X-Eye Presence sensor.

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

sensor

Move in perpendicular direction towards or away from the sensor

Both the green status LED of the sensor and the status LED of the controller should blink each time your enter a new distance zone.

LED BLINK

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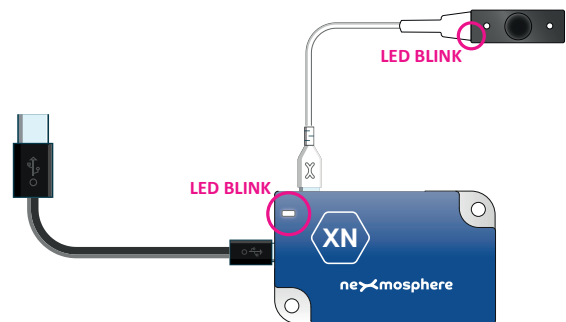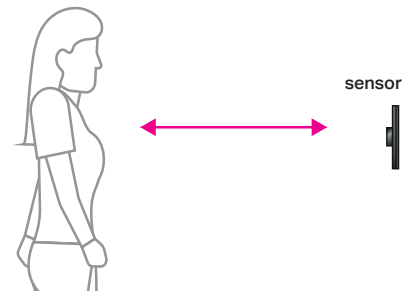
In case any of the steps above does not provide the expected result, please check the installation guidelines in this document.

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

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