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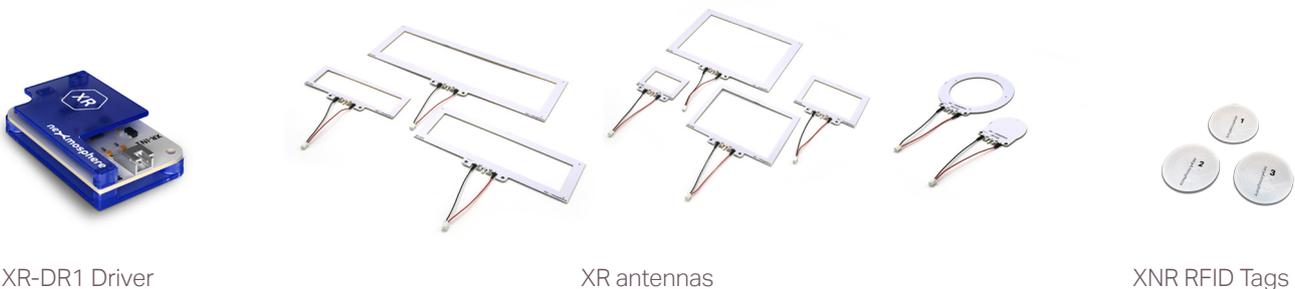
1. General

The Nexmosphere XR Range offers RFID sensors in various sizes which are able to detect when an RFID tag is either placed down or picked up from the RFID antenna. 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 XR Range consists out of the following product groups:

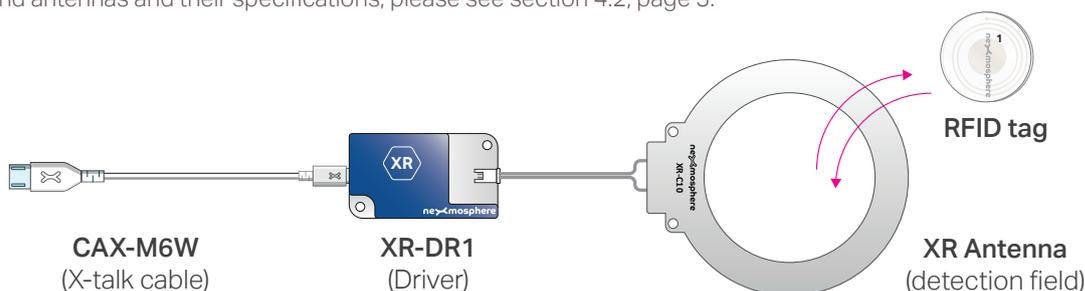


XR-DR1 Driver

XR antennas

XNR RFID Tags

To create an RFID sensor, an XR antenna needs to be connected to an XR-DR1 Antenna Driver. The XR-DR1 can then be connected to one of Nexmosphere's Xperience controller using a **CAX-M4W** (60cm) or **CAX-M6W** (180cm) X-talk cable. The XR-DR1 Driver creates an electromagnetic field on the XR antenna at a frequency of 13.56Mhz. When a RFID tag is placed in the antenna field, it modulates data containing the tag number which is detected by the XR-DR1. This data is communicated to the Xperience controller as either a "pick-up" or "place-back" event. For a detailed overview of all available tags and antennas and their specifications, please see section 4.2, page 3.



3. Functionalities and API commands

The XR Range sensors provide the following functionalities:

1. **RFID Tag "Pick-up" detection** - detects when an RFID tag is removed ("picked up") from the antenna field
2. **RFID Tag "Place-back" detection** - detects when an RFID tag is placed in the antenna field

3.1 - RFID Tag Pick-up detection

The XR Range sensors detect when an RFID tag is removed from an XR antenna. When this trigger occurs, two consecutive API messages are sent:

XR[PUXXX]	XXX = tag number	value between 001-250
X***A[1]	*** = X-talk address of the antenna on which the pick-up occurred	

When implementing RFID tag pick-up triggers, consider the following:

- The API messages are always sent in the same order: first the tag number which was picked up and secondly the X-talk address of the RFID antenna on which the pick-up event occurred.
- Up to 4 RFID tags can be placed simultaneously on 1 RFID antenna. For more information please see section 4.2, page 6.
- In order for pick-up detection to work, each tag within a setup must have a unique number.

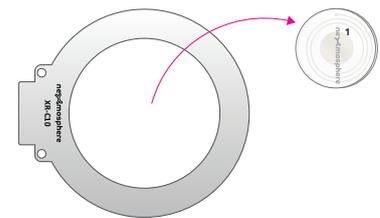
Example commands

Pick-up of tag 004 on antenna connected to X-talk address 001:

XR[PU004]
X001A[1]

Pick-up of tag 32 on antenna connected to X-talk address 006:

XR[PU032]
X006A[1]



3.2 - RFID Tag Place-back detection

The XR Range sensors detect when an RFID tag is placed on an XR antenna. When this trigger occurs, two consecutive API messages are sent:

XR[PBXXX]	XXX = tag number	value between 001-250
X***A[0]	*** = X-talk address of antenna on which the place-back occurred	

When implementing RFID tag pick-up triggers, consider the following:

- The API messages are always sent in the same order: first the tag number which was place-back and secondly the X-talk address of the RFID antenna on which the pick-up event occurred.
- Up to 4 RFID tags can be placed simultaneously on 1 RFID antenna. For more information please see section 4.2, page 6.
- In order for place-back detection to work, each tag within a setup must have a unique number.

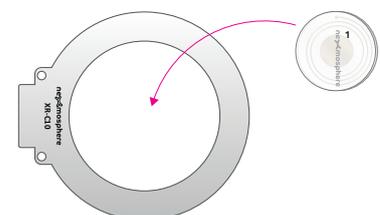
Example commands

Place-back of tag 012 on antenna connected to X-talk address 001:

XR[PB012]
X001A[0]

Place-back of tag 7 on antenna connected to X-talk address 003:

XR[PB007]
X003A[0]

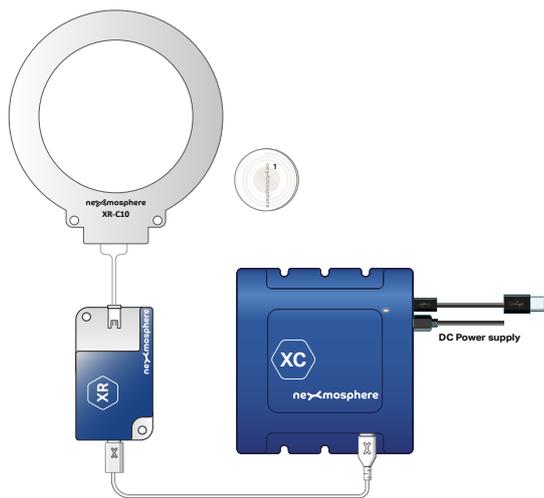


4 - Installation requirements and guidelines

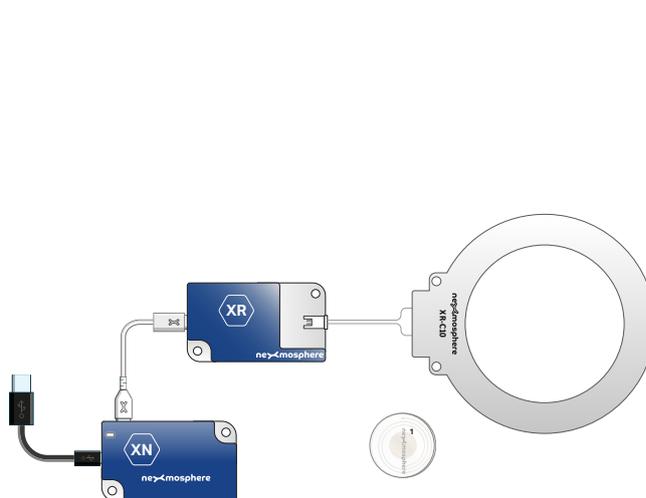
When integrating an XR RFID sensor into your digital signage installation, several installation requirements and guidelines need to be taken into account in order for the sensor to perform optimal and operate stable.

4.1 Connection Diagrams

The XR RFID sensor can be connected to any X-talk interface and is therefore compatible with all Xperience controllers. Make sure the XR RFID 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 sensor output will be provided.



Example connection to XC Controller



Example connection to XN Controller

4.2 Specifications and Hardware integration guidelines

Antenna sizes

The available shapes and sizes of the XR antennas are listed in the table below.

Antenna	Shape	Dimensions antenna			Dimensions detection area	
		Width	Height	Thickness	Width	Height
XR-A80	Rectangular	74mm	62mm	1.6mm	74mm	52mm
XR-A70	Rectangular	105mm	84mm	1.6mm	105mm	74mm
XR-A60	Rectangular	148mm	115mm	1.6mm	148mm	105mm
XR-A50	Rectangular	210mm	158mm	1.6mm	210mm	148mm
XR-A65	Stretched	148mm	62mm	1.6mm	148mm	52mm
XR-A55	Stretched	210mm	84mm	1.6mm	210mm	74mm
XR-A45	Stretched	297mm	115mm	1.6mm	297mm	105mm
XR-C05	Circular	50mm	60mm	1.6mm	50mm	50mm
XR-C10	Circular	100mm	110mm	1.6mm	100mm	100mm

Mechanical drawings of each RFID antenna are provided in the datasheets.

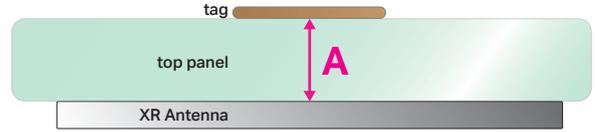
Each antenna size has a different detection range and installation specification with regards to clearance from metal objects and other XR antennas. On the followings page, these specifications are listed.

PRODUCT MANUAL | XR RANGE RFID SENSORS

Detection range and top panel

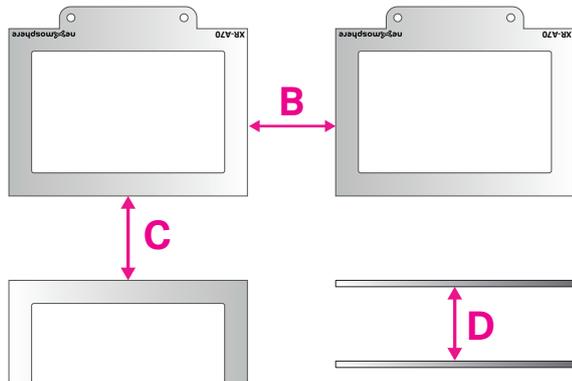
Each antenna size has a specific detection range, which is indicated in the table below. When installing the antennas, make sure that the thickness of the top panel is well within the detection range of the antenna. In case the RFID tags are not placed at the bottom of the product (e.g. inside a shoe), consider the total distance between the tag and the antenna.

Please note: **the XR antenna does not work behind a metal top panel (!)**. All other materials can be used for the top cover on the antenna, the type of material used can have a minor influence (both positive & negative) on the detection range. We recommend to always test and validate the final setup before starting production.



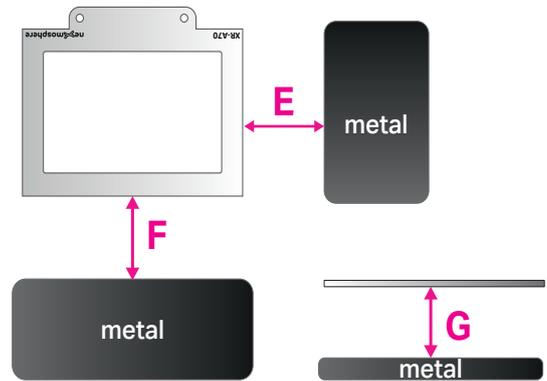
Clearance between multiple XR Antennas

When using multiple XR antennas, the electromagnetic fields of the antennas will interfere with each other when placing the antennas too close to each other. Therefore please make sure that the minimum spacings indicated in the **table below** are taken into account.



Clearance between XR Antenna and metal objects

Metal objects in or near the electromagnetic field of the antennas can cause interference which results into unstable behaviour of the sensor. Make sure that the minimum clearances indicated in the **table below** are implemented accordingly.



Antenna
XR-A80
XR-A70
XR-A60
XR-A50
XR-A65
XR-A55
XR-A45
XR-C05
XR-C10

A (mm)
<i>detection range</i>
<39
<30
<24
<39
<36
<33
<42
<39
<36

B (mm)	C (mm)	D (mm)
<i>recommended clearance from XR antennas</i>		
<i>short side</i>	<i>long side</i>	<i>parallel</i>
>45	>50	>130
>45	>60	>140
>75	>105	>230
>300	>360	>550
>60	>110	>190
>65	>140	>240
>170	>300	>490
>40	>40	>110
>60	>60	>180

E (mm)	F (mm)	G (mm)
<i>recommended clearance from metal surfaces</i>		
<i>short side</i>	<i>long side</i>	<i>parallel</i>
>10	>15	>45
>10	>15	>45
>20	>30	>50
>40	>50	>75
>20	>30	>50
>20	>30	>50
>40	>50	>70
>10	>15	>45
>10	>15	>45

these values were obtained in a test setup with the following specification:

- Default gain settings (38dB) - Top panel: 6mm acrylic - 3 antennas side-by-side / parallel - 1 tag placed on each antenna

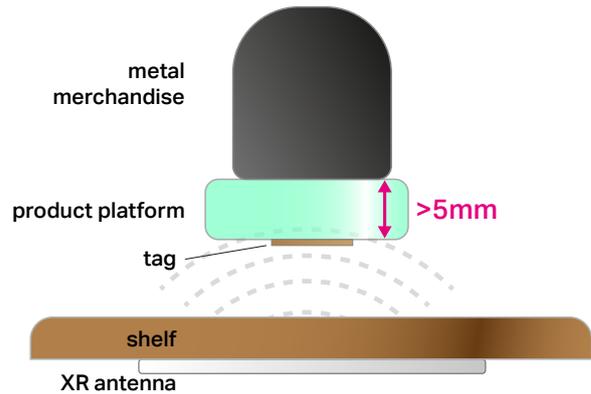
Both the proximity of metal and other XR antennas cause interference. The specifications in the columns above therefore cannot be seen separately, as both contribute to the interference level which causes instable behaviour. We recommend to design your installation in such a way that not all specification above are at a critical level, as in this case the total accumulated level of interference might become too high. Please note that in different setups, the required clearances can vary.

We recommend to always test and verify before making your installation or technical drawings final.

Merchandise containing metal

Metal objects in or near the electromagnetic field of the antennas can cause interference which results in unstable behaviour of the sensor. Therefore the XR range is not able to detect a tag which is placed on merchandise containing metal.

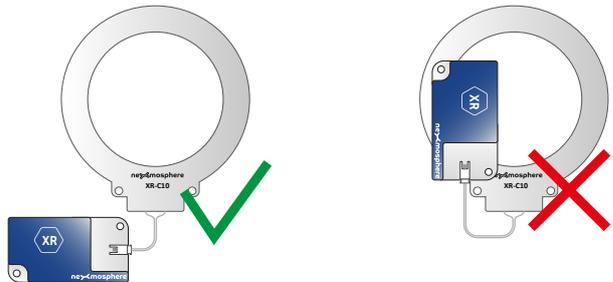
If nevertheless the XR range is used with metal products, a suggested solution is to place a non-metal platform between the merchandise and the tag, creating space between the electromagnetic field and the metal merchandise. The results of this solution vary highly depending on the specific characteristics of the setup. In any case, it is discouraged to use metal merchandise with the XR range. For setup-specific advice please contact applications@nexmosphere.com.



Mounting XR-DR1 antenna driver

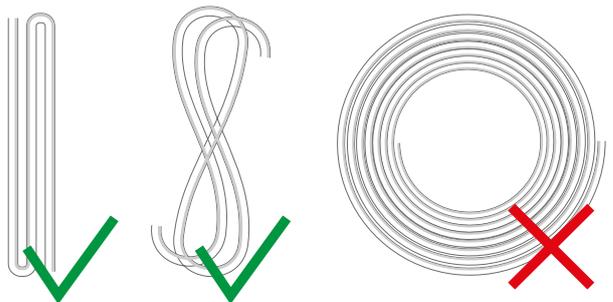
The XR-DR1 antenna driver should be mounted outside the antenna area in order to prevent interference and unstable behaviour.

The antenna cables have a length of 10cm. These can't be extended as this would detune the antenna which would result into unstable behaviour.



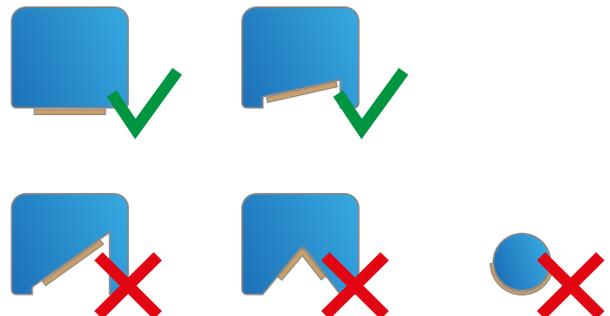
Excess cable

In case of excess cable length (for example when using the CAX-M6W X-talk cable), it is recommended to mount this in straight lines or in an "8" pattern instead of rolling the cable up in a circle. A cable rolled-up in a circle can create a coil which can interfere with the electromagnetic field of the antenna. Also keep in mind that shorter cables (e.g. CAX-M4W) are available.



Tag placement

The tag should be placed on the merchandise in such a way that it does not contain any sharp folds and that the angle between the tag and antenna does not exceed **30 degrees**. Placing the tag on a highly curved object (e.g. lipstick) will also cause unstable behaviour. The flatter a tag is placed on the merchandise, the better the responsiveness will be.



Tag size and specifications

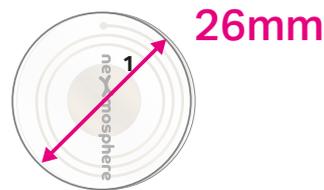
The default Nexmosphere XNR tags are circular tags with a diameter of 26mm.

Third party tags must have the following specifications in order to be compatible with the Nexmosphere XR Range:

Mifare Classic 1K

- Frequency: 13.56 Mhz
- Protocol: ISO/IEC 14443 A
- IC: S50
- Size: 26mm diameter

When using tags with a different shape and/or size, the behaviour and critical values of the XR range will change. Please contact applications@nexmosphere.com for application-specific advice.



Detecting multiple tags on 1 antenna (Multi-tag)

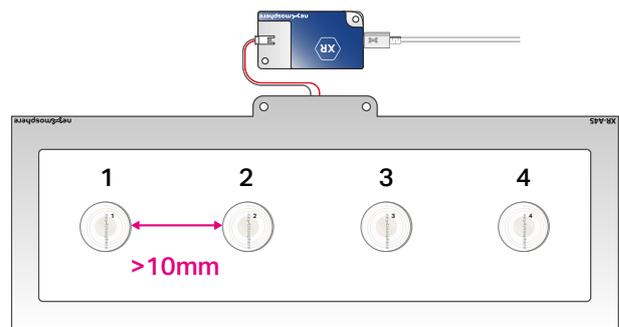
The XR-DR1 antenna driver is able to detect **up to 4 tags simultaneously** on one antenna. In this situation, the RFID tags should have a minimum clearance of 10mm between them. Also, each RFID tag should have a different number.

Multi-tag detection only works stable on the default gain setting (38dB).

When placing multiple tags on one antenna, the detection range for 100% stable operation can be less than the single-tag detection range indicated in the table on page 4, depending on the specific setup and environment.

Please keep in mind that the detection time of a pick-up can be longer when placing multiple tags on one antenna simultaneously.

In case a setup with multiple tags on one antenna is not working stable, we recommend to increase the filter level via setting 6. For more information please see page 7.



Red Error LED

The XR-DR1 Driver has a Red Error LED. In case there is interference which causes the XR-DR1 to potentially operate less stable, the Red Error LED will blink. Please see page 7 (setting 5) for more information.



5 - Settings

The XR-DR1 antenna driver 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 to 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, off when tag placed (def) | <code>X001S[1:3]</code> |
| 4. LED off, on when tag placed | <code>X001S[1:4]</code> |

Setting 4: Antenna gain level

- | | |
|--|-------------------------|
| 1. 23dB - minimum detection range | <code>X001S[4:1]</code> |
| 2. 33dB - medium detection range | <code>X001S[4:2]</code> |
| 3. 38dB - high detection range (default) | <code>X001S[4:3]</code> |
| 4. 43dB - very high detection range | <code>X001S[4:4]</code> |
| 5. 48dB - maximum detection range | <code>X001S[4:5]</code> |

The gain level determines how much power is sent from the driver to the antenna. The higher the gain level, the larger the electromagnetic field of the antenna becomes and the higher the detection range will be.

Please note that increasing the antenna gain will also result into more cross interference when using multiple antennas and will require a larger interspacing between the antennas. Vice versa, the required spacing can be decreased by decreasing the gain.

All components of the XR Range are calibrated to function optimally at the default gain level (38dB). **We therefore recommend to not change the gain level unless absolutely necessary.**

Setting 5: Interference indication on Red LED

- | | |
|--|-------------------------|
| 1. Show interference level 3 (default) | <code>X001S[5:1]</code> |
| 2. Show all interference levels | <code>X001S[5:2]</code> |
| 3. Off, don't show interference levels | <code>X001S[5:3]</code> |

Internally in the driver, a tag read-cycle consists out of multiple steps and actions. The amount and frequency of errors and retries within this process is an indication of the amount of interference and distortion in the antenna field. The driver keeps track of these errors and based on this can indicate a distortion level on the Red LED of the driver.

Level 3 - Red LED blink 3 times - (heavy interference)

a tag was completely "lost" multiple times in 1 second.

Level 2 - Red LED blink 2 times - (medium interference)

4 consecutive communication errors during tag-read

Level 1 - Red LED blink 1 times - (light interference)

communication error during tag-read, but retry succeeded

Setting 6: Filter level for ghost pick-ups

Set filter Level `X001S[6:X]`

X is a value between **1-20** and its default value is **2**. The filter level determines how many read cycles a tag must be completely lost in order for it to be considered a valid pick-up and trigger an API command.

In case of interference, a tag can be "lost" (not detected) by the driver for one or more read cycles, causing an API command trigger although the tag was not picked up (aka a "ghost trigger"). This setting is intended to decrease/eliminate the amount of undesired ghost triggers.

Increasing the filter level decreases the negative effect of interference and the amount of ghost triggers, but it will also decrease the responsiveness of the sensor.

Vice versa, decreasing X will increase the responsiveness of the sensor but can also result into more ghost triggers, as it will take less read-cycles of a tag not being detected for it to trigger an API command.



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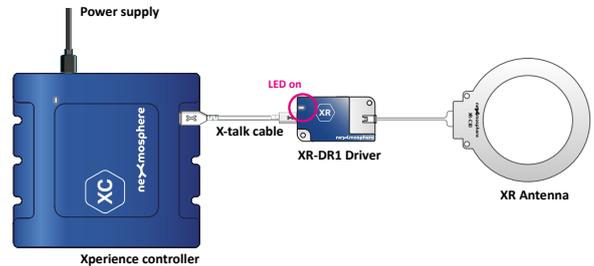
6. Quick test

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

Step 1 - Setup

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

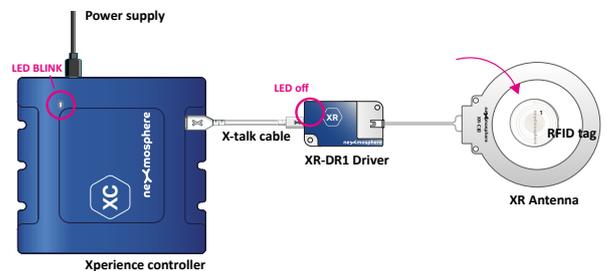
The white status LED of the XR driver should go on.
The status LED of the controller will start to blink and once power-up is completed will be lit continuously



Step 2 - Test Place-back trigger

Place an RFID tag on the XR Antenna.

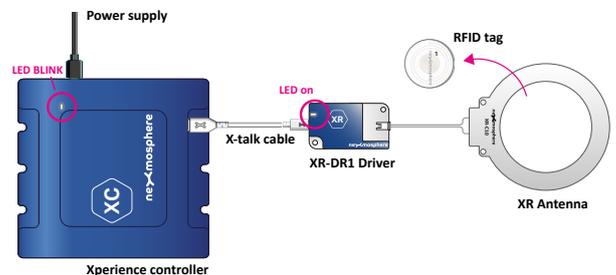
The white status LED of the XR driver should switch off.
The status LED of the controller should blink once.



Step 3 - Test Pick-up trigger

Remove the RFID tag on the XR Antenna.

The white status LED of the XR driver should switch on.
The status LED of the controller should blink once.



In case any of the 3 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.