Overview

This Application Note describes general information about installation, performance and operation of RAPIX DALI-2 Passive Infra-Red Occupancy / Movement sensors.

Definition of Terms

Application Controller	*(DALI standard definition)* A control device that is connected to the bus and sends commands in order to control input devices and/or control gear connected to the same bus.
Detection Range	The distance, usually in metres where a Movement Sensor or Presence Sensor can perform a useful and reliable determination of movement, normally of a person.
Field of View	*(normally with reference to Passive Infra-Red Movement Sensors)* The detection area and pattern of the sensor. Typically, specified using units of distance (metres), and angles (in degrees).
Field of View Mask	A device or means that restricts the Field of View, for example, excluding an angular section. A typical use might to be reduce the detectability pointing at a doorway to prevent nuisance triggering by people walking past the open doorway and being detected outside the space of interest.
Light Level Sensor	An input device that measures the amount of light falling upon it. A Light Level Sensor is frequently mounted on a ceiling.
Movement	Sometimes also called Motion. A determination by a sensor, that a person is moving in the detection area of the sensor.
Movement Sensor	*(DALI standard definition)* A type of sensor based only on movement detection, where occupancy is determined by movement, and vacancy is concluded from the absence of movement during a specified amount of time.
Occupancy	A space is Occupied if there is a person in that space. Occupancy may be determined by a Movement sensor, or a Presence Sensor.

Passive Infra-Red	Abbreviated to PIR. This term normally is used to describe the technology type of a sensor. Example: Passive Infra-Red (Movement) Sensor. Passive means that the sensor device does not emit any energy to perform its detection function. Infra-Red describe the energy that the sensor is detecting – Infra-Red implies heat energy.
Presence Sensor	*(DALI standard definition)* A type of sensor based on means other than only movement detection, where occupancy and vacancy can be concluded immediately and where, in some cases, movement can also be detected.
Sensor	An input device that measures some property. Examples: light level, movement, voltage, current, fluid flow rate.
Vacancy	A determination, by a Movement Sensor or Presence Sensor, that a space is not occupied.

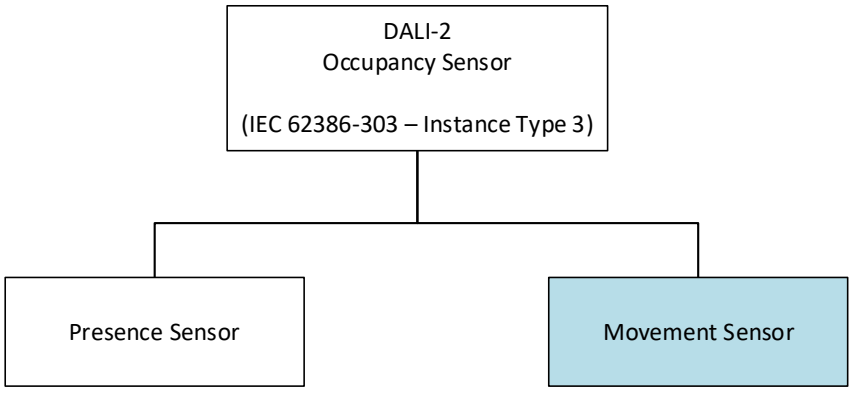
RAPIX Sensors Technology Type

Method of Operation

Passive Infra-Red Occupancy / Movement sensors, including those supplied by Ozuno, use either a pyro-electric sensor or a thermopile to detect movement.

Movement is detected by measuring small variations of heat radiated from a moving person, compared to the background environment.

According to the DALI standard IEC 62386-303, these sensors are classified as type Movement Sensor.



Installation and Handling

Fragile for Shock and Vibration

The sensing element used in Passive Infra-Red sensor products is fragile.

Do not subject PIR sensor products to large shocks.

Do not drop the PIR sensors during installation.

If a PIR sensor is dropped, the internal sensing element can be damaged. This can lead to false triggering, loss of performance, or product failure.

Sensitivity to Temperature Changes

Passive Infra-Red sensor products typically react where a subject is moving and also has a temperature about 4°C or more than the surrounding environment.

Air-conditioning outlets

False triggering may occur when Passive Infra-Red sensor products are mounted close to an air-conditioning outlet. Causes may be motor vibration or the air moving from the outlet.

Passive Infra-Red sensor products should be installed:

- 1.5 meters or more away from the air path of air-conditioning outlets;
- 0.5 metres or more away from the air-condition outlets, when not in the air path (for example at corners).

High ambient temperatures

Passive Infra-Red sensor products may have poor detection performance in high ambient temperatures, typically 33°C or more.

Multiple Movement Sensors to Cover a Space

When using multiple Movement Sensors to cover an area, the sensors should have a small overlap of detection coverage.

Recommended spacing is:

Spacing = Detection range (diameter) – 0.5 metres.

A larger spacing may be acceptable if people are normally actively moving in the region covered by the Movement Sensors.

Passive Infra-Red Sensors Require Line of Sight

Passive Infra-Red sensor products operate by detecting movement that crosses detection beams.

This sensor technology:

- Cannot detect movement through walls or windows;
- Cannot detect movement around corners.

Wiring

DALI is specified for operation up to 300 metres total of 1.5 mm^2 cable in a DALI line.

Using smaller cable cross-section is not recommended.

Installation

Each product includes an installation guide with safety precautions and details of mounting.

Movement Detection Performance

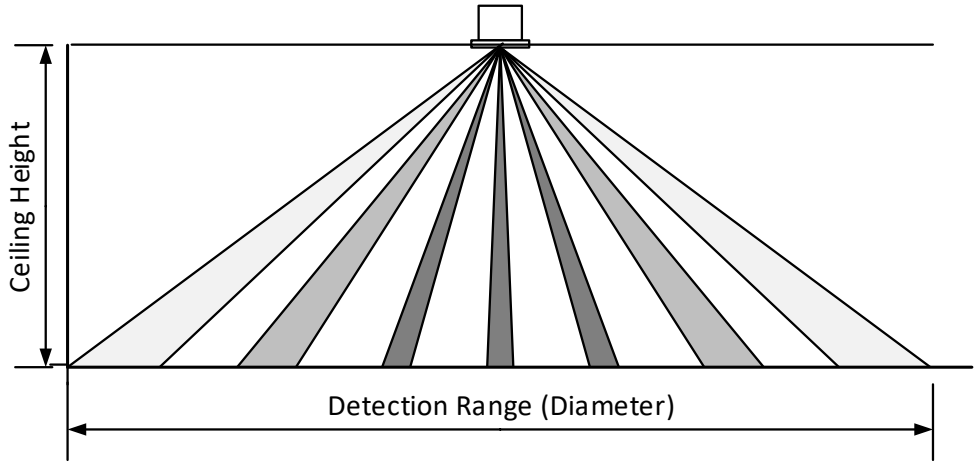
Sensors detect Movement

All Passive Infra-Red sensor products rely on a person moving in the beam pattern of the sensor.

If the person is stationary, the sensor may report that the space is not occupied.

Specified Detection Range

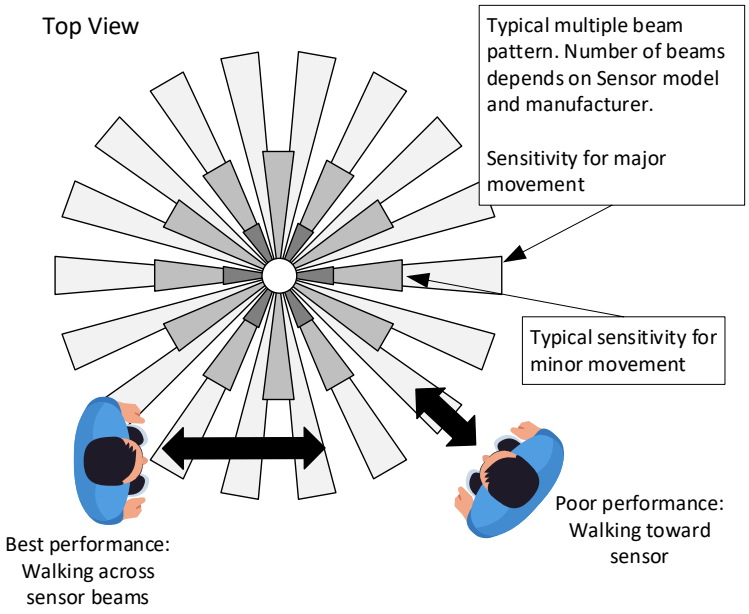
Performance specification for detection range applies at floor level:



Sensors Have a Beam Pattern

All Passive Infra-Red sensor products have a beam pattern:

- Minor movement is detected by crossing beams close to the sensor;
- The number of beams and their position varies between sensor models;
- Best detection performance is achieved when walking across the beams.



RAPIX Sensors Performance Specification

RAPIX Passive Infra-Red sensor products are tested using the procedure of *Occupancy Motion Sensors Standard*, NEMA WD7-2011, National Electrical Manufacturers Association, Virginia, USA, 2012.

This standard has the following definitions for major and minor motion:

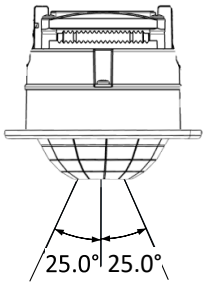
> Major motion: movement of a person walking into or through an area.
>
> Minor motion: movement of a person sitting at an office desk reaching for a telephone, turning the pages in a book, opening a file folder, picking up a coffee cup, etc

RAPIX Passive Infra-Red sensor products are tested using a major motion spacing of 1 metre, therefore a person inside the detection range and moving 1 metre should be detected.

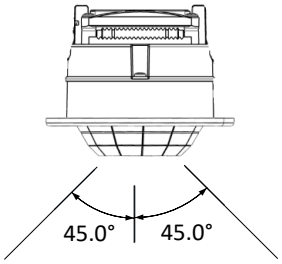
Masking the Field of View

The detection pattern for sensors can be reduced using a Field of View Mask.

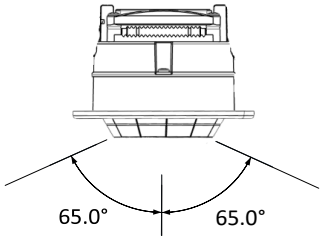
Mask with no segments removed:



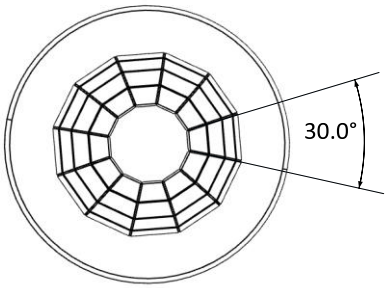
Mask with 1 row of segments removed:



Mask with 2 rows of segments removed:



Each segment is equivalent to an angle of approximately 30°



Light Level Measurement (Illuminance)

Some RAPIX DALI-2 Occupancy / Movement sensors also include a light level measurement function (Illuminance sensor).

DALI-2 Light Level Measurement

DALI-2 standards do not require that the light level measurement from a sensor has any defined units. Sensors may or may not transmit lux or other common units of measurement. No assumptions can be made about the value transmitted by a DALI-2 Light Level Sensor unless this is described in the manufacturer's literature.

DALI-2 Application Controllers can use a calibration method to convert the measurements from a Light Level Sensor to a form that can be used.

RAPIX sensors that include light level measurement also include an internal Application Controller that can convert the internal light level into a useful format and make use of the light level information.

When commissioned using RAPIX Integrator software and calibrated, RAPIX sensors that include light level measurement will transmit the light level in units of lux.

Not Certified Accuracy

A RAPIX DALI-2 sensor that includes light level measurement is not a certified illuminance meter. This means it includes a margin of error.

Measurement Location

RAPIX DALI-2 sensors with light level measurement are normally mounted on a ceiling. This means they detect the reflected light from a floor or desktop. This reflected light level is much lower than the light level on the floor or desktop. White or dark surfaces below the sensor will affect the light level measured by the light level sensor.

Calibration

RAPIX DALI-2 sensors with light level measurement include an optional calibration function. By using a calibrated light meter on a floor or desktop, the calibration function allows the RAPIX DALI-2 sensor to report an apparent light level at the floor or desktop.

Alternatively, DALI-2 Application Controllers may perform a separate calibration function.

Use of Light Level Measurement

Typically, light level measurement can be used for sensors located close to windows to control luminaires where natural daylight is present (“Daylight harvesting” or “Light level maintenance”, and other similar names).

Care should be taken during system commissioning so that the lighting is not controlled in a distracting manner, or produce light levels that are perceived as too low. Typical good practices are:

- Use calibration of light level sensing;
- Lighting response to changes of measured light level should be fade times of 1 minute or greater; and
- The amount of lighting dimming should be limited to approximately 30% to avoid a perception that the light level becomes too low.

Light Level Maintenance

Refer to separate application note APN-RAPIX-004 for more details about Light Level Maintenance in a RAPIX system using RAPIX sensors.

Using Sensors in a DALI-2 Lighting Control System

RAPIX Systems and DALI-2 Systems

RAPIX DALI-2 Occupancy / Movement Sensors can be used in Ozuno RAPIX DALI-2 systems or the DALI-2 systems from other manufacturers.

Programming Method using the built-in Controller for RAPIX Systems

When used in a RAPIX DALI-2 system, the RAPIX sensors normally use the built-in controller function to operate in co-operation with other sensors and (if present) switches and controllers. The template programming facilities in the RAPIX Integrator software allow quick and easy setup by a Systems Integrator.

Use of an external Application Controller (for example, a RAPIX Zone Controller) is optional, and may not be needed for small installations.

Programming Method for other manufacturer DALI-2 systems

When used in the DALI-2 systems of other manufacturers, the RAPIX sensors transmit DALI-2 EVENT messages for use by a DALI-2 Application Controller.

In these DALI-2 systems, an external Application Controller is supplied by some other manufacturer and programmed according to their instructions.

DALI-2 Systems

When RAPIX DALI-2 sensors are used in the DALI-2 systems from other manufacturers, they transmit DALI-2 EVENT messages. These can be further configured to transmit according to five (5) possible EVENT schemes:

Event Scheme Number	Description
0	Instance
1	Device
2	Device/Instance
3	Device Group
4	Instance Group

The Systems Integrator must:

- Determine and configure an appropriate event scheme for the sensors.
- Configure the Application Controller to receive and understand the event messages in the event scheme used by those sensors.
- Determine and configure appropriate settings for the sensor **Dead Time**, **Hold Time** and **Report Interval**. In many cases the default values (as required by the DALI standards) will be satisfactory but these values may need adjustment in large or complex DALI systems.
- Determine and configure the appropriate event filter settings for the sensor. In most cases the default values will be satisfactory, but the requirements of the Application Controller should be checked to ensure the sensor event filter settings are satisfactory.

Where multiple sensors are used to control a space, these settings must be applied for each sensor. The choice of event scheme is likely to be determined by the Application Controller and the number of sensors controlling the space.

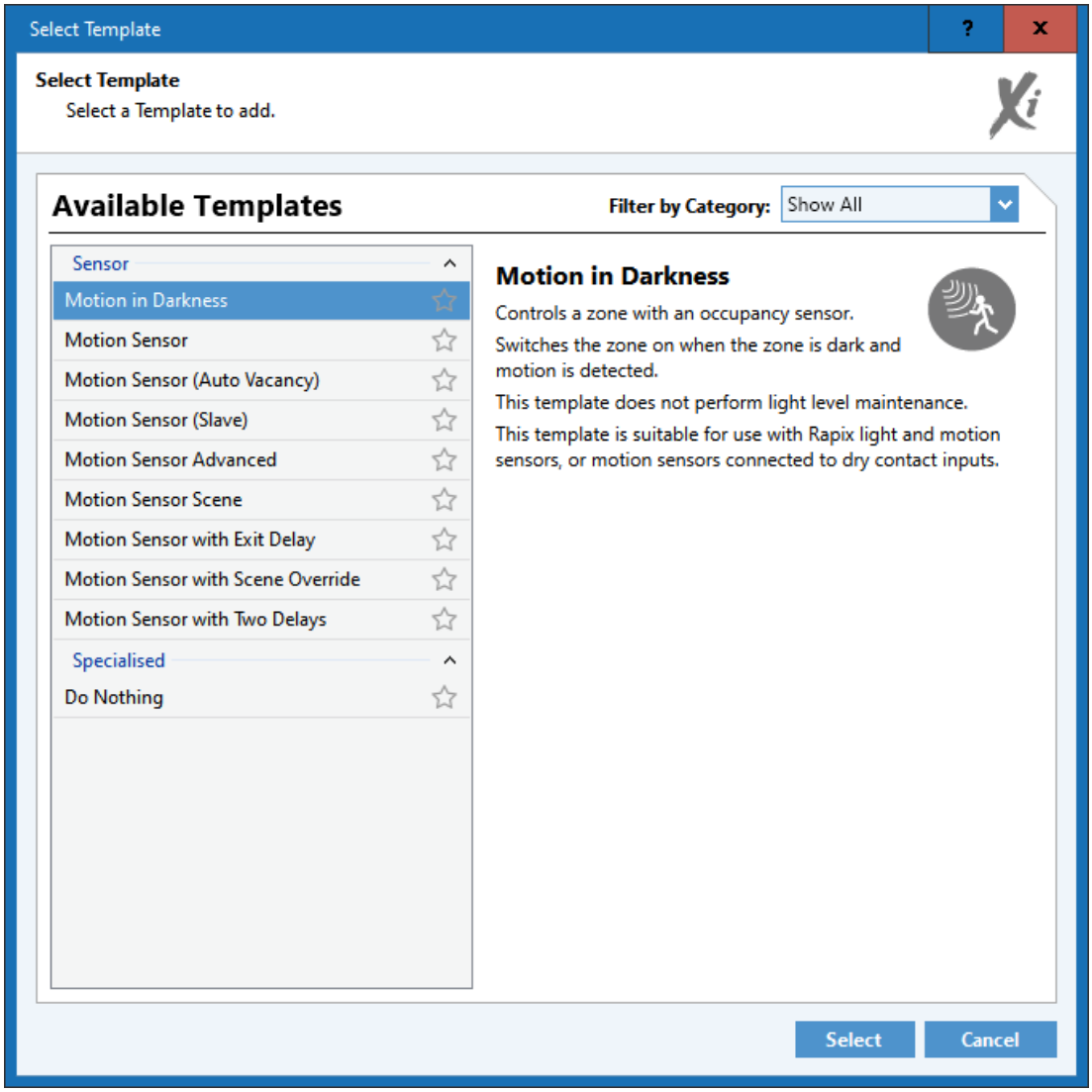
RAPIX Systems

Sensors are part of Zones (the space being controlled)

If using RAPIX DALI-2 Occupancy / Movement Sensors in a RAPIX Lighting Control System then only the Zone (space to be controlled) needs to be known. All other settings will be applied automatically.

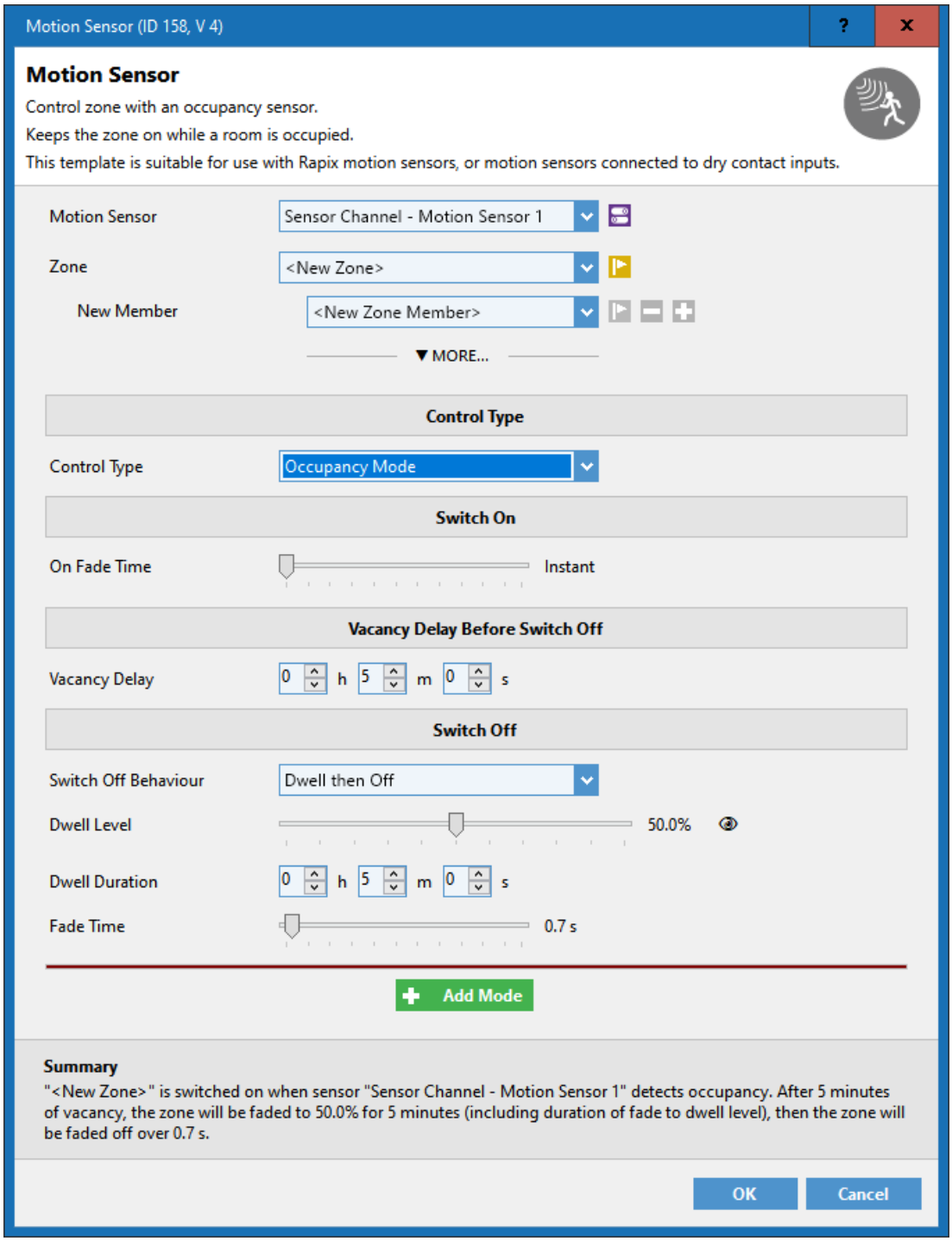
Sensor Functions

The RAPIX Integrator software allows programming of useful operations by selection of a functional template. A template defines the sensor operation. A variety of templates are available for sensors:



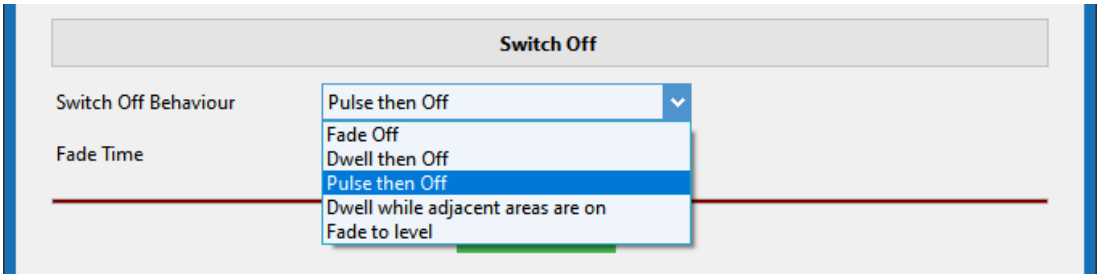
Some templates are linked to both the movement and light level sensors (for example, Motion in Darkness). Other templates apply only to the movement sensor (for example, Motion Sensor).

The selection of a template determines the function of the sensor. As an example:



This shows an example of an Occupancy Sensor that will switch on instantly when a space is entered, and hold the space on for 5 minutes after it has been vacated. The turn-off comprises a dwell to an intermediate level of 50% which is held for 5 minutes before a fade to off. Both fades in the switch-off process run over a period of 0.7 seconds.

The Motion Sensor (Advanced) template includes additional switch-off functions:

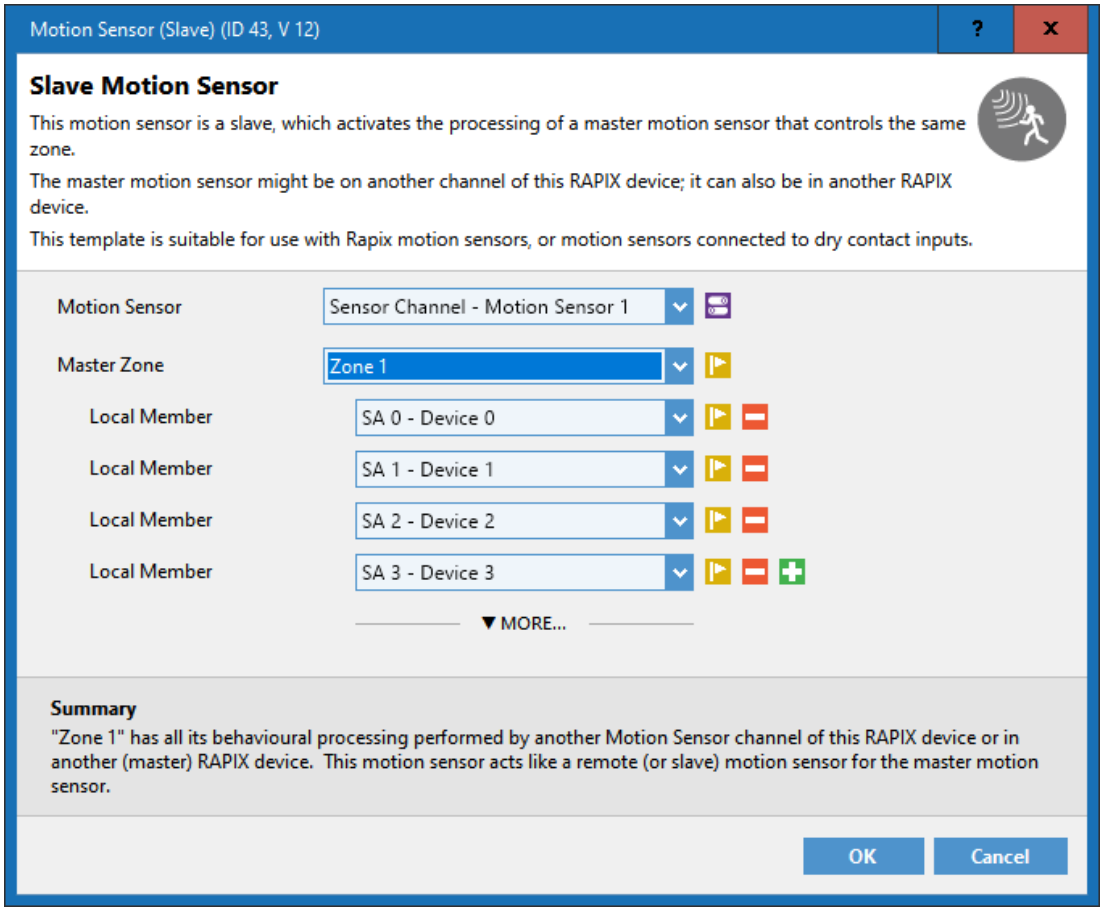


Master and Slave Sensors

When multiple sensors are to control a single space (a Zone), those sensors should be programmed as Master and Slave.

A **Master Sensor** contains all of the programming for the operations – for example, the turn on time, turn-off fade and dwell, and so on.

All other sensors that control the same space should be programmed as **Slave Sensor** and controlling the same Zone. No other programming of the slave sensors is needed. Example:



If Master and Slave sensors are on different DALI lines, a Zone Controller is needed to link the lines together and allow the sensors to work with each other.

Adjacent Area Control and Common Area Control

A RAPIX System allows adjacent areas to be held on when the space controlled by a sensor is on.

The application note APN-RAPIX-013 describes this setup in detail.

Enable and Disable Sensors

When RAPIX sensors are used in a RAPIX System, they can be enabled or disabled using rules.

The rules processing engine in the sensor allows selection of numerous options to enable or disable the sensor depending on the prevailing state of:

- A RAPIX flag in a flag group being SET or CLEAR; or
- A Short Address is ON or OFF; or
- A RAPIX Scene is ACTIVE; or
- Any combination of those.

For example, flags can be used to enable or disable sensors with the flag state being set by a schedule executing in a RAPIX Zone Controller.

System Modes

When RAPIX sensors are used in a RAPIX System, the behaviour of sensor can be changed by System Modes.

A System Mode allows a coordinated change of behaviour (for example, sensor timings, sensor enable, sensor on/off behaviour). Examples might include a retail store with modes:

- Normal Open;
- Night Fill;
- Store Closed; and
- On generator power.

A RAPIX system can support over 200 modes, though most systems need between about 1 and 6.

Change History

Rev	Date	Updated By	Comment
1	Jan 2024	A Q	Release.

Contact Information

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