

Application Note—AN1009A

Determining occupancy with motion sensing

This application note describes methods for determining room occupancy based on motion detected by NetSensor models KMD-1261 or KMD-1281.

NetSensor models KMD-1261 and KMD-1281 include an internal sensor to detect motion in a room. With a Control Basic program, the presence or absence of motion can be used to determine room occupancy. Occupancy can then be used to control lights or adjust setpoints.

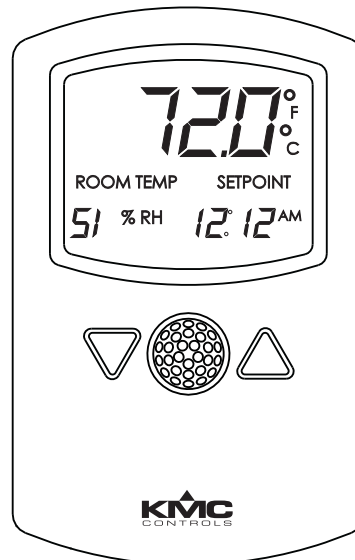


Illustration 1 KMD-1281

Applicable models

The Control Basic programs described in this application note can be operated on KMD and BACnet controllers that are compatible with models KMD-1261 and KMD-1281.

Related materials

In addition to the material presented in this application note, review and have available the following reference materials.

- ◆ The installation and operation guide for the KMD-1261 and KMD-1281 NetSensors.
- ◆ The installation and operation guide for the controller to which the NetSensor is connected.
- ◆ Installation and operation guides for other equipment such as external motion sensors that will be used with the controller.
- ◆ Reference manuals, user's manuals, or help for BACstage, WinControl XL Plus, or TotalControl.

Installation

Mount the NetSensors on a wall that will have an unobstructed view of the typical traffic in the coverage area. When choosing a location, do not install the NetSensor in the following areas.

- ◆ Behind curtains or other obstructions
- ◆ In locations that will expose it to sunlight or heat sources
- ◆ Near a heating/cooling duct.

For details on the coverage pattern, see the installation and operation guide supplied with the NetSensor.

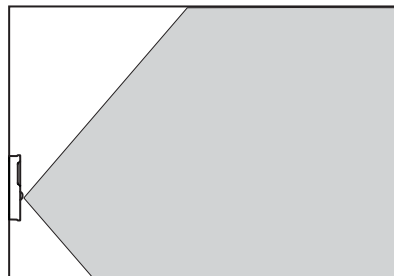


Illustration 2 Typical motion sensing coverage area

The effective detection range is approximately 10 meters or 33 feet. Factors that may reduce the range include:

- ◆ The difference between the surface temperature of the object and the background temperature of the room is too small.
- ◆ Object movement in a direct line toward the sensor.
- ◆ Very slow or very fast object movement.
- ◆ Obstructions as shown in the illustration [Large room with obstructions](#) on page 4-77.

False detections may be triggered by:

- ◆ The temperature inside the detection range suddenly changes because of the entry of cold or warm air from an air-conditioning or heating unit.
- ◆ The sensor being directly exposed to sunlight, an incandescent light, or other source of far-infrared rays.
- ◆ Small animal movement.

For some applications—such as hotel rooms, bedrooms, and other sleeping quarters—the lack of detected motion may not be a true indication that the room is unoccupied. For a more accurate determination of occupancy, combine motion sensors with door contacts. If no motion is detected during a predetermined time after a door opens or closes, then the mode changes to unoccupied. However, if motion is detected during the period after a door has been opened or closed, then the room can be assumed to be occupied. Custom programming for this type of application is not covered in this application note.

Extending the coverage area

For areas that cannot be covered with a single NetSensor, add one or more remote motion sensors. Remote sensors may be required for the following applications.

- ◆ For areas that are too large for adequate coverage with a single the NetSensor.
- ◆ In areas with obstructions that block the sensor coverage.
- ◆ When the area is an irregular shape with blind spots such as an L-shaped room.

To extend the range of the sensor in the NetSensor, connect one or more remote motion sensors to controller input terminals. Exact wiring details for the remote sensors will depend on the type of external sensor.

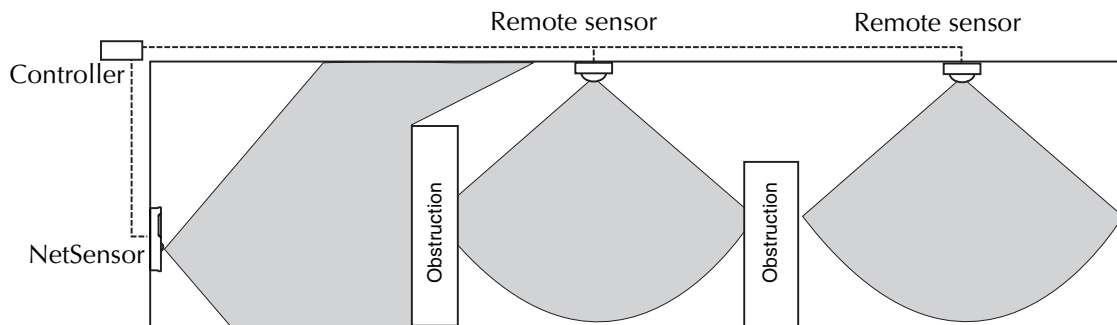


Illustration 3 Large room with obstructions

Programming KMD controllers to detect occupancy

Use the following programs with KMD series Tier 2 controllers to set occupancy status based on motion detected in a room. Add the example Control Basic program to the KMD controller to which the NetSensor is connected. In addition to adding the Control Basic programs, configure the variables as described in section [Variable points](#) on page 4-79.

The controller to which the NetSensor is connected is typically programmed for setpoint, temperature and other functions. This programming is described in the installation and operation guide supplied with the NetSensor and in the help for WinControl XL Plus and TotalControl.

The next Control Basic examples are for applications using a single NetSensor to detect motion in a room.

```
10 IF+ VAR8 = -1 THEN START VAR9 , STOP A
20 IF VAR8 = -2 THEN START A
30 IF TIME-ON( A ) > 0:20:00 THEN STOP VAR9
```

The following program determines occupancy using both a NetSensor and a remote sensor connected to input IN1. For this example, the remote sensor value switches without delay between periods of motion or no motion.

```
10 IF+ VAR8 = -1 OR IN1 = 1 THEN START VAR9 , STOP A
20 IF VAR8 = -2 AND IN1 < 1 THEN START A
30 IF TIME-ON( A ) > 0:20:00 THEN STOP VAR9
```

If NetSensor is used with a remote motion sensor and the remote motion sensor includes an internal timer that resets when motion is detected, use the following Control Basic program. Set the time in line 30 (0 : 20 : 00) to match the time in the remote motion sensor.

```
10 IF+ VAR8 = -1 OR IN1 = 1 THEN START VAR9 , STOP A
20 IF VAR8 = -2 THEN START A
30 IF TIME-ON( A ) > 0:20:00 AND IN1 < 1 THEN STOP VAR9
```

Local variables

The Control Basic examples use only Local Variable A to control a timer.

Variable points

The variable points in these examples were chosen to be compatible with most factory programs supplied in KMD series controllers. Other variables can be used if the programs are modified.

VAR8—NetSensorAux This variable is associated with the Auxiliary function in the NetSensor. The Auxiliary function is explained in the installation and operation guide supplied with the NetSensor.

- ◆ A value of -1 indicates motion
- ◆ A value of -2 indicates no motion
- ◆ A value of 0 or 1 indicates the auxiliary function is active.

The value of the auxiliary function will remain at 0 for approximately 30 seconds after power is applied to the NetSensor.

VAR9—RoomOccupied When true, indicates the room is occupied based on motion.

Table 1 KMD analog and digital variable settings

| | Description | Manual | Value | Units | Label | Type |
|-----|-------------------------------|---------------|--------------|-----------------|--------------|-------------|
| 1-7 | Not used for motion detection | | | | | |
| 8 | NetSensorAux | | | Unused | NSaux | Analog |
| 9 | RoomOccupied | | | Unocc./Occupied | RmOcc | Binary |
| 10- | Not used for motion detection | | | | | |

Programming BACnet controllers for occupancy

Use the following programs with BACnet BAC-5800, BAC-7000, BAC-7300 and BAC-7400 series controllers to set occupancy status based on motion detected in a room. Add the example Control Basic program to the controller to which the NetSensor is connected. In addition to adding the Control Basic programs, configure the value objects as described in section [Analog value objects](#) on page 4-81 and [Binary value objects](#) on page 4-81.

The controller to which the NetSensor is connected must also be programmed for setpoint, temperature and other functions. This programming is described in the installation and operation guide supplied with the NetSensor and in help for BACstage and TotalControl.

The following Control Basic example uses only the NetSensor to detect motion in a room.

```
10 IF+ AV8 = -1 THEN START BV9 , STOP A
20 IF AV8 = -2 THEN START A
30 IF TIMEON( A ) > 0:02:00 THEN STOP BV9
```

The following program determines occupancy using both a NetSensor and a remote sensor connected to input BI1. For this example, the remote sensor value switches without delay between periods of motion or no motion.

```
10 IF+ AV8 = -1 OR BV1 = 1 THEN START BV9 , STOP A
20 IF AV8 = -2 AND BV1 < 1 THEN START A
30 IF TIMEON( A ) > 0:20:00 THEN STOP BV9
```

If NetSensor is used with a remote motion sensor and the remote motion sensor includes an internal timer that resets when motion is detected, use the following Control Basic program. Set the time in line 30 (0:20:00) to match the time in the remote motion sensor.

```
10 IF+ AV8 = -1 OR BI1 = 1 THEN START BV9 , STOP A
20 IF AV8 = -2 THEN START A
30 IF TIMEON( A ) > 0:20:00 AND BI1 < 1 THEN STOP BV9
```

Analog value objects

AV8—NetSensorAux This variable is associated with the Auxiliary function in the NetSensor. The Auxiliary function is explained in the installation and operation guide supplied with the NetSensor.

- ◆ A value of -1 indicates motion
- ◆ A value of -2 indicates no motion
- ◆ A value of 0 or 1 indicates the auxiliary function is active.

The value of the auxiliary function will remain at 0 for approximately 30 seconds after power is applied to the NetSensor.

Table 2 BACnet analog value objects

| Value object | Description | Name | Present Value | Units | Out of service |
|--------------|-------------------------------|--------------|---------------|-------|----------------|
| AV1–AV7 | Not used for motion detection | | | | |
| AV8 | NetSensorAuxillary | NetSensorAux | | | |
| AV9–AV40 | Not used for motion detection | | | | |

Binary value objects

BV9—RoomOccupied When true, indicates the room is occupied based on motion.

Table 3 BACnet binary value objects

| Value object | Description | Name | Present Value | Active Inactive text | Units |
|--------------|--------------|-------|---------------|----------------------------|-----------------|
| BV1-BV8 | Not used | | | | |
| BV9 | RoomOccupied | RmOcc | | | Unocc./Occupied |
| BV10–AV40 | | | | | |

