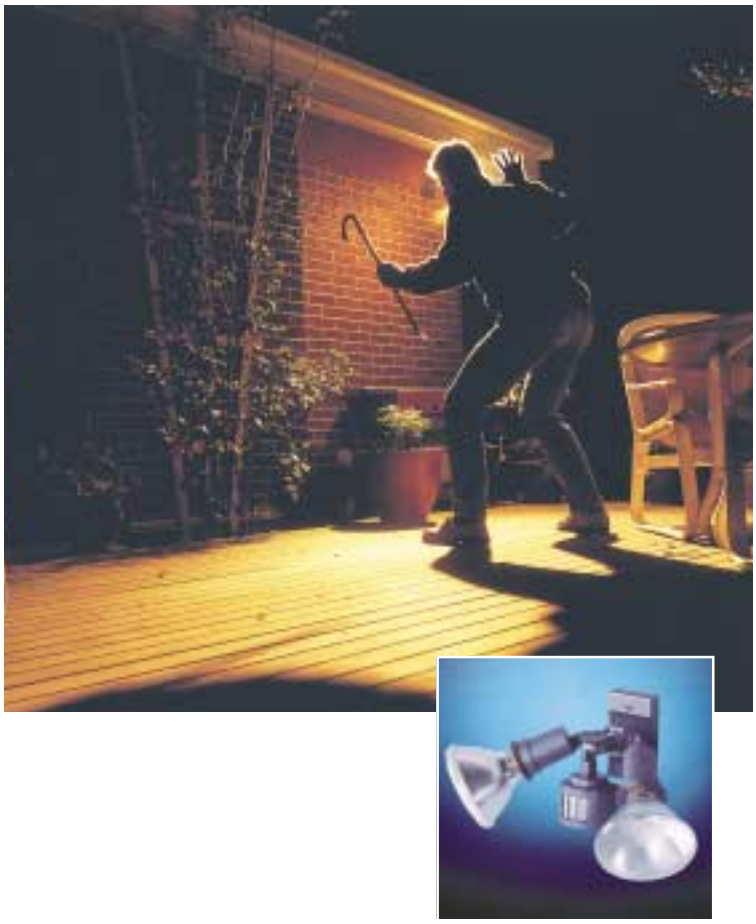
PDL
PIR SENSOR
TECHNICAL GUIDE



PDL ELECTRICAL PRODUCTS

INDEX

This handbook has been designed as a guide to the installation and operation of PDL Passive Infra-Red Sensors.

Statements contained in the handbook are general guidelines only and in no way are designed to supersede the instructions contained with each model of sensor.

The instructions with every PDL sensor should always be followed.

Local Wiring Regulations and Codes of Practice should be followed for installing PDL sensors.

We recommend that the advice of a registered electrician be sought before any installation work commences.

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INTRODUCTION

This handbook has been produced to assist contractors and wholesalers in selecting the best location for a sensor and it explains how to adjust light, time and sensitivity controls to appropriate settings to get the best performance from the unit.

BACKGROUND

Passive Infra-Red Sensors have been around since the 1940s, originally being used for military and scientific applications.

Now the technology is being used in a wide range of products designed specifically for commercial and domestic automatic lighting. Today's modern sensor maximises efficiencies in automatic light control, promoting convenience, safety and cost-savings.

COMMON SITUATIONS FOR PIR SENSORS

Nearly any area where people only occasionally walk or move through and which is not required to be continuously lit, could benefit from the installation of a PIR sensor. Some examples are hallways, foyers, paths, driveways, garden areas and carparks.

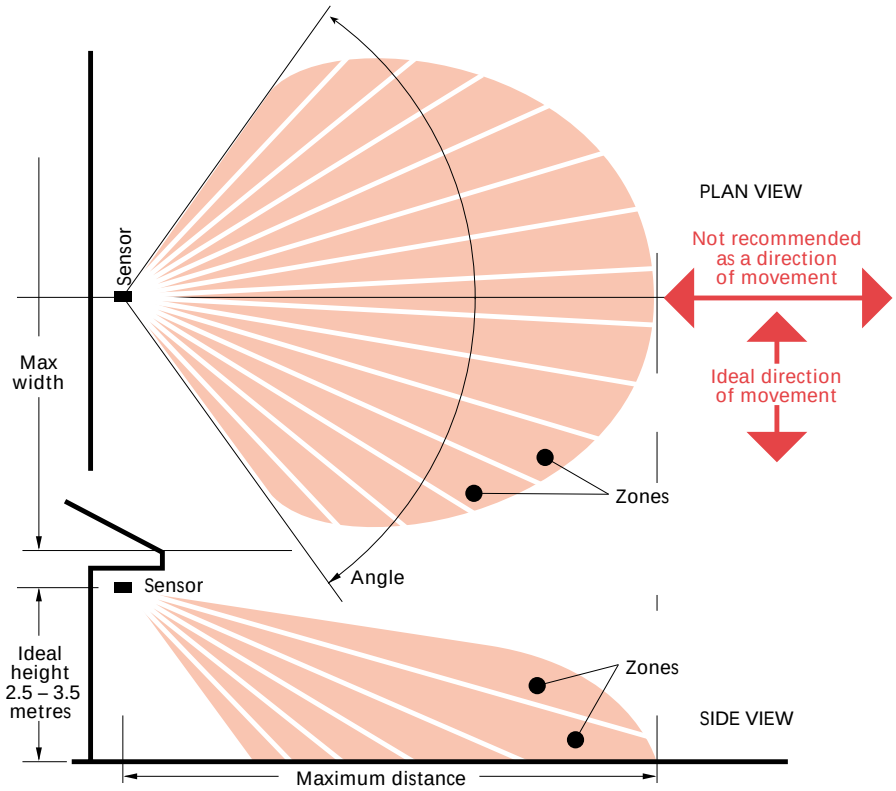
HOW PASSIVE INFRA-RED SENSORS WORK

All PIR sensors detect changes in infra-red radiation, in the form of heat emitted by a number of bodies including people, cars and, to a lesser extent, dogs or other small animals.

The bigger the body, the more infra-red radiation is emitted and the easier it is for a PIR sensor to detect.

The **field of view** is the area in which changes in infra-red radiation can be detected. The field of view can alter with changes in temperature and the size of the heat source.

The construction of the PIR and the Fresnel Lens (see page 5) divide the field of view into a number of zones both vertically and horizontally, as shown in the diagram overleaf.



Each zone is constantly monitored by the sensor. When a person or other heat source enters any zone, the level of infra-red radiation in that zone increases.

This change is detected and processed by the sensor, switching on the connected lighting and starting the in-built 'Time' process.

Providing the heat source (person) continues to move in the field of view, the PIR sensor will keep processing the changes in infra-red radiation and the lighting will stay on. If a person stands still in the field of view or moves out of the detection area, the sensor will not detect any changes in infra-red radiation between the zones and the lights will go out after the 'Time' period is complete.

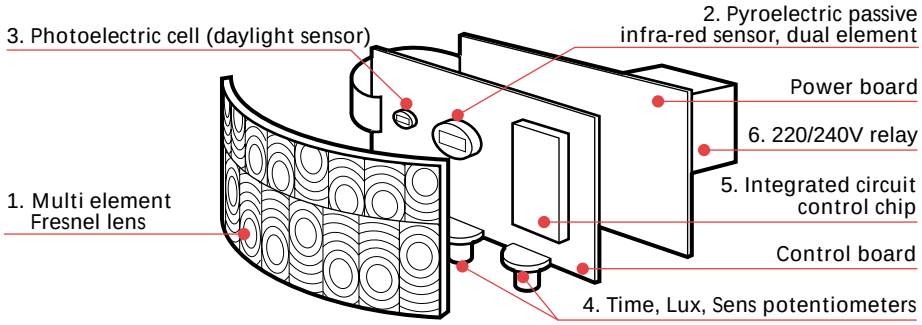
In order for the sensor to most effectively detect changes in heat between zones, it is advisable to walk across the zones not up or along a zone.

PIR sensors are passive devices, they do not emit or radiate any energy or beams.

A PIR sensor is an electronic ON – OFF switch designed specifically for switching lighting loads.

'Time' period begins after the last movement is detected.

TYPICAL CONSTRUCTION OF A PIR SENSOR



1. Multi Element Fresnel Lens

The lens focuses the infra-red radiation given out by a heat source (person) on to the Pyroelectric sensor. The different elements or facets of the lens divide the incoming infra-red radiation into vertical and horizontal zones.

2. Pyroelectric Passive Infra-Red Sensor

The dual element Pyroelectric sensor receives the incoming infra-red radiation from the various zones. The two elements of the sensor receive varying amounts of infra-red radiation and this difference is amplified, turning into a signal via the IC. This signal activates the switching relay. The sensor detects infra-red radiation in the wave length range of 8 to 14 µm.

3. Photoelectric Cell (Daylight Sensor)

The photoelectric cell registers the light intensity (Lux level) of the surrounding area. When the light intensity exceeds the pre-set value, the signal from the PIR sensor is then prevented from switching the load. When the Lux level is below the pre-set value, the signal from the PIR sensor is then allowed to switch the load.

4. Time, Lux and Sens Potentiometers

Control potentiometers are provided for the external adjustment of Time, Lux and PIR sensitivity (for selected models only).

5. Integrated Circuit Control Chip (IC)

This is a customised chip which controls the various modes of operation, timing functions and the processing of the signal from the sensor to drive the output relay.

6. 220/240V Relay

Because all PDL PIR sensors use a 220/240V relay, there is no minimum load requirement. Do not exceed the maximum rating of the sensor especially with fluorescent loads.

EFFECTS OF TEMPERATURE CHANGES ON PIR SENSORS

All PIRs operate by detecting the temperature difference between the ambient air temperature and a moving heat source (person).

Outside air temperature changes have the greatest effect on the operating performance of PIRs. The sensitivity of the sensor increases on cold nights and decreases on hot nights.

On cold nights, the difference in temperature between a person (normal body temperature is 37°C) and the outside air temperature, is relatively large, giving an apparent increase in performance of the sensor. On hot nights, this difference in temperature is relatively small and a decrease in performance of the sensor can be expected.

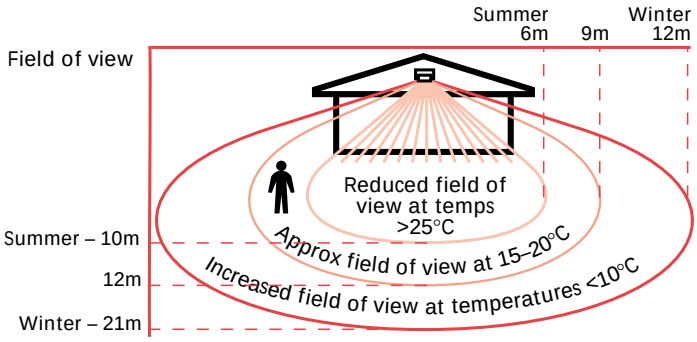
At 15° – 20°C, the sensor should perform according to the stated specifications. If the ambient temperature increases to 30°C or more, the following changes occur:

1. The maximum distance and field of view significantly decrease (up to as much as 50%).
2. The distance a heat source has to move across the zones to activate the sensor increases.
3. The size of the heat source required to activate the sensor increases.

At an ambient temperature of 10°C or less, the opposite occurs:

1. The maximum distance and field of view increases.
2. The distance a heat source has to move across the zones to activate the sensor decreases.
3. The size of the heat source required to activate the sensor decreases.

Nuisance tripping is usually more prevalent in winter. In the summer, problems of short detection distance and reduced field of view occur more often.



The effect of temperature on range and field of view is easily corrected by changing the angle of the sensor head eg angle up for summer or angle down for winter.

Alternatively, if the unit has a sensitivity adjustment feature, increase the sensitivity during summer and decrease the sensitivity during winter.

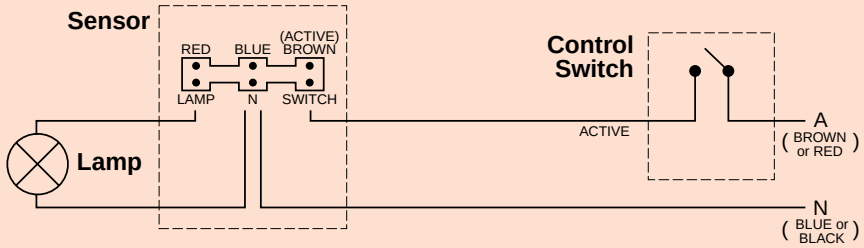
OPERATION

PDL PIR Sensors have three modes of operation:

AUTO MODE Turn the control switch ON. The sensor is now in Automatic Mode and will operate according to the pre-set Time, Sens (where available) and Lux adjustment.
Note: When the sensor is initially switched on, the lights could come on for a period of up to 45 seconds.

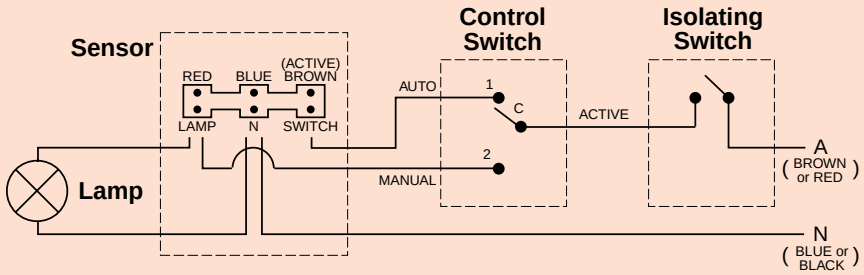
LIGHTS PERMANENTLY OFF Turn the control switch OFF.

Auto-Only Diagram



LIGHTS PERMANENTLY ON There is no in-built Test or Permanently On mode. Turning the lights Permanently On can only be achieved by the wiring method indicated in the connection diagram below.

Auto By-pass (permanently ON) Diagram



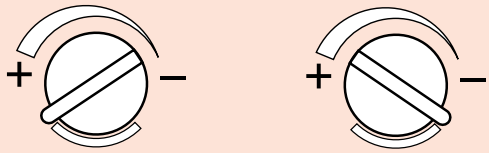
Warning: the unit will be destroyed if incorrectly wired.
Incorrect wiring nullifies the warranty.

INITIAL SET-UP

1. Turn on power to the sensor and wait one or two minutes for the sensor to stabilise.
2. Turn the 'Time' control to minimum ('–') and the 'Lux' control to maximum (+).
3. Walk in front of the sensor unit so that the light comes on. This checks the operation of the sensor and the field of view.

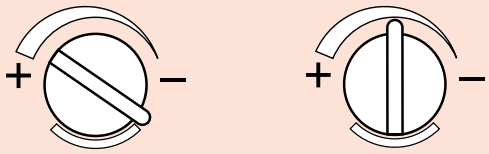
   Once the light comes on, move to a new position and stand still until the light goes out (approx. 10 sec), move again until the light comes on.
4. Repeat step 2 and adjust the angle of the sensor head until the optimum field of view is achieved.
5. Turn the 'Time', 'Lux' and 'Sens' (where available) controls to the desired positions for AUTO operation (see 'Settings' section, pages 12 - 14).

NOTE: Turning the control switch OFF prevents the lights from coming on; it DOES NOT ISOLATE the circuit. Always disconnect the power to the sensor at the switchboard before carrying out any maintenance.



Initial Set-Up

Recommended Setting



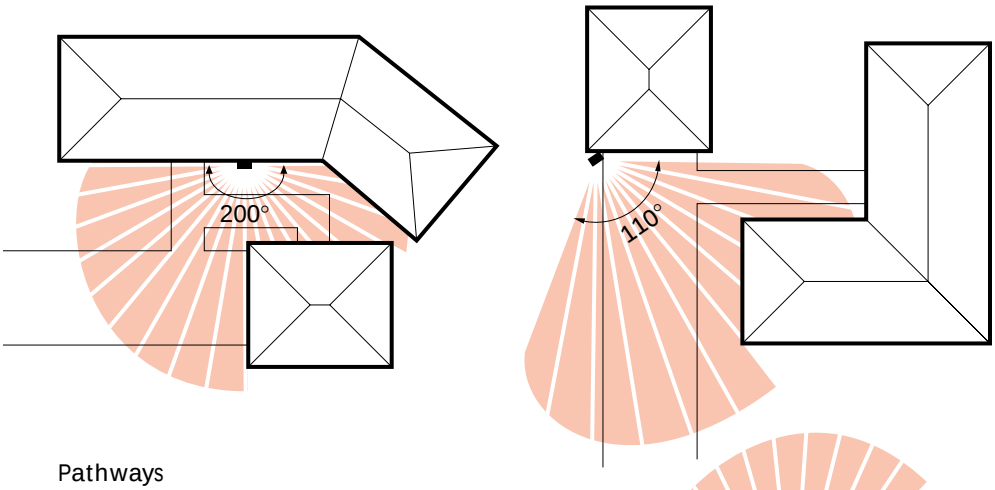
Auto Operation

Recommended Setting

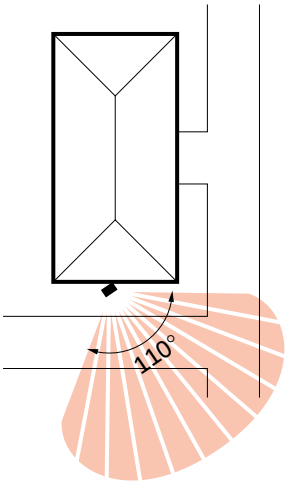
If the lights don't stay on long enough, turn the 'Time' control up slightly.
If the lights won't come on early enough at night, turn the 'Lux' control up.

COMMON HOUSE LOCATIONS FOR PIR SENSORS

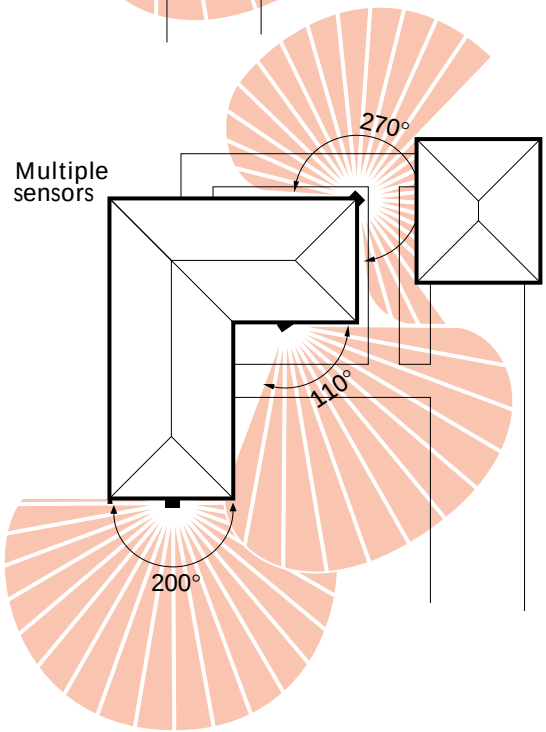
Driveways



Pathways



Multiple sensors

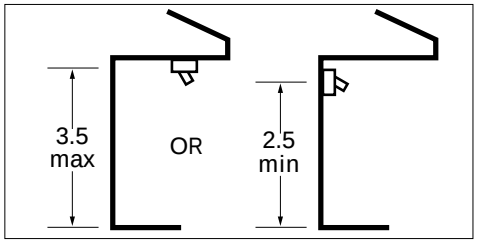


Position the sensor so your normal direction of movement is ACROSS the PIR Zones.

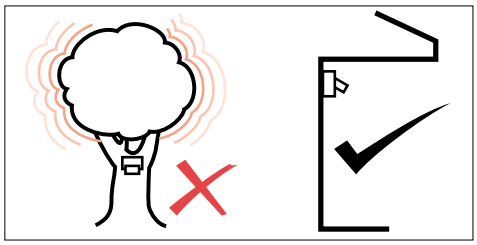
MOUNTING YOUR SENSOR

The key to successful operation of any PIR sensor is choosing the correct location. A sensor mounted in an unsuitable location has the potential to cause nuisance tripping and reduced performance. The main rules that should be followed to ensure trouble-free operation are:

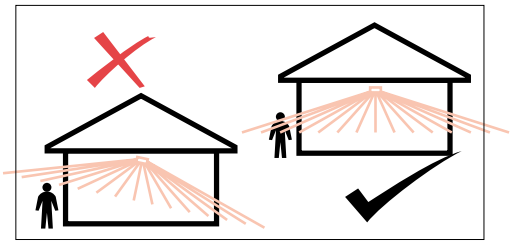
1. Mount the sensor 2.5 to 3.5 metres above ground level to achieve the optimum detection area.



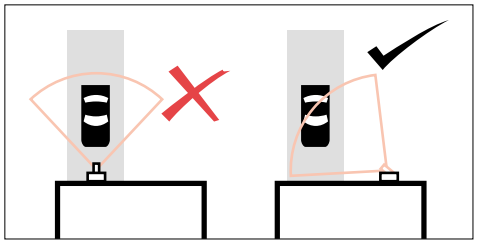
2. Mount the sensor on a stable surface. This prevents nuisance tripping problems caused by vibration of the sensor.



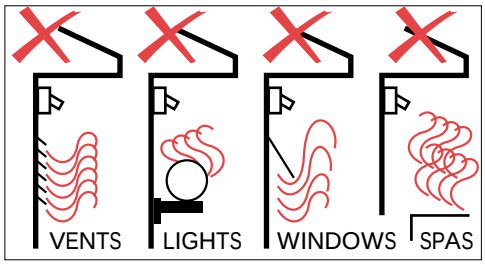
3. Mount the sensor level to ensure the detection area is even from side to side. A small degree of angle from level can have a large effect on the detection area.



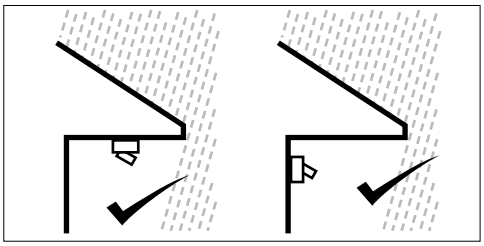
4. The ideal direction of movement is across the field of view, not along it. PIR sensors detect changes in heat between zones. The more zones the heat source crosses, the more easily it is detected.



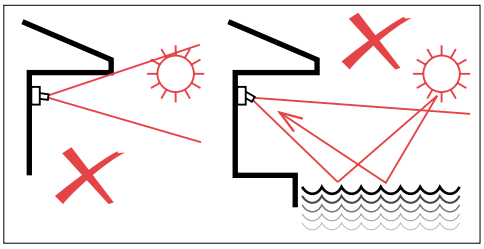
5. Rapid temperature changes in the sensing area can cause nuisance tripping. Avoid mounting sensors above opening windows, doors, air vents, outside lamps, spas or near swimming pools. These areas can radiate or direct heat over the face of the sensor causing nuisance tripping.



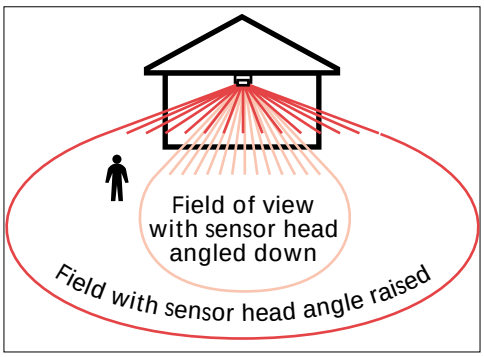
6. Protect the sensor from the extremes of weather by sheltering it under a soffit or eave if possible.



7. The electronics inside the sensor can be destroyed by aiming the head at the sun or by light reflected from bright surfaces such as mirror windows or swimming pools.



8. The range and field of view can be altered considerably by the angle of the sensor head. Angling the sensor head up will increase the field of view and angling it down will decrease the field of view.



The key to successful operation of any PIR sensor is choosing the correct location. The greater the field of view, the greater the chance of nuisance tripping.

LIGHT LEVEL (LUX)

LUX is the measure of illumination or light intensity.

Commonly found Lux levels are:

	Approximate Lux level
Total darkness	0
Dark night	5-20
Dusk/Dawn	20-60
Corridors, stairways	70-150
Factories	180-600
Clerical offices	400-1000
Overcast days	>2000
Bright sunny days	>10000

PDL PIR sensors all have an adjustable Lux, controlled via the photoelectric cell (daylight sensor).

The Lux adjustment controls the light level at which the sensor will switch on the lights when movement is sensed.

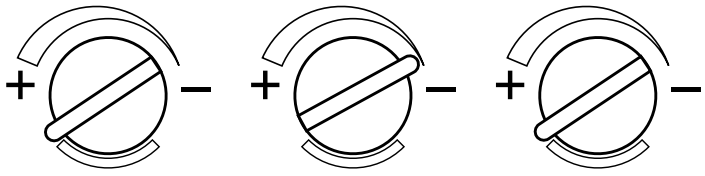
If set to the maximum ('+' end) it will switch during most light conditions from darkness to sunlight (40 Lux to 2000 Lux).

If set to minimum ('–' end) the sensor will only operate at dusk or light conditions darker than this. This is the ideal position for general early evening and night operation.

You can adjust the Lux control so that the sensor will work in any light level from 40 Lux upwards to approximately 2000 Lux by moving the control further towards the '+' end.

Ideally, the Lux control should be set at dusk or for the light conditions at which the sensor and lights are expected to start operating.

LUX CONTROL SETTING



Minimum approx 40 Lux

Ideal for dusk/dawn operation 20–60 Lux

Maximum approx 2000 Lux

NOTE: When the lighting load is switched on, the photoelectric cell is overridden to prevent the external lights affecting the sensor. When the lighting switches off, the photoelectric sensor begins operating again.

TIME

All PDL PIR sensors have an adjustable 'Time' control which is adjustable from approximately 10 seconds to 5 minutes.

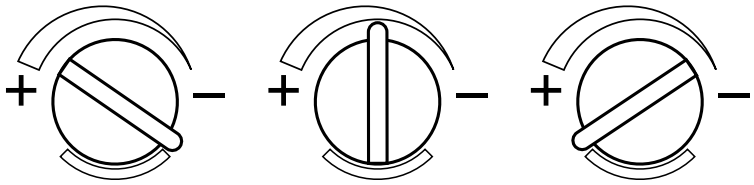
When infra-red radiation from a moving heat source is detected, the sensor switches on the lighting load and begins timing out according to the pre-set 'Time' period. After the 'Time' period has elapsed, the lighting load will be switched OFF.

If the heat source continues to move in the PIR field of view, the time control will keep resetting itself and the lighting load will remain ON.

Once the heat source stops moving or moves outside the field of view, the time control will start timing out and eventually switch the lighting load off.

NOTE: If the sensor is set at 5 minutes and it detects a moving heat source every three or four minutes, the light will stay on continuously. The ideal ON time for general domestic situations is two to three minutes.

TIME SETTING



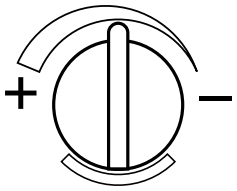
SENSITIVITY (SENS)

Selected models have a sensitivity (Sens) adjustment which allows the owner to tune the sensor to their own specific requirements.

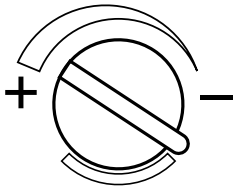
The sensitivity adjustment affects the following:

1. Minimum and maximum range
2. Amount of infra-red radiation (heat) required to trigger the sensor.

The sensitivity adjustment can also be used to compensate for the changes in outside air temperature in winter and summer.



With the sensitivity control set to the middle position and the ambient air temperature between 15°–20°C, the sensor will perform similar to the specified range and performance, with nuisance tripping to a minimum.



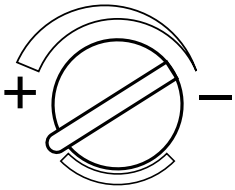
Minimum

If the sensitivity control is set at the '–' end, the sensor becomes less sensitive and generally the range and performance will decrease.

If the ambient air temperature remains between 15°–20°C, adjusting the sensitivity to the minimum could decrease the range by up to 50%.

If the ambient air temperature drops below 10°C, the sensitivity of the sensor is greatly increased (see 'Effects of Temperature Changes', page 6). The range and performance will also increase. These increases can be compensated for, if need be, by decreasing the sensitivity as shown.

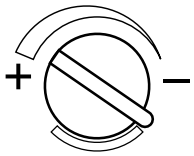
Nuisance tripping problems caused by small animals or rapid changes in heat due to air movement can also be reduced by moving the sensitivity control towards the '–' end.



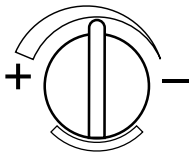
Maximum

If the sensitivity control is set at the '+' end, the sensor becomes more sensitive and the range and performance will increase. With an ambient air temperature between 15°–20°C, adjusting the sensitivity to the maximum could increase the range by up to 25%.

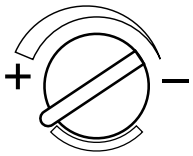
The disadvantage of increasing the sensitivity is that incidents of nuisance tripping also increase because small animals or rapid changes in heat due to air movement are more easily detected. When the ambient air temperature increases to 30°C or more, the sensor has trouble detecting the small changes in heat and the sensitivity has to be increased to compensate for this.



Minimum
Ideal for cold winter conditions or when nuisance tripping is a problem



Mid position
Ideal setting for average domestic situations



Maximum
Ideal for hot summer conditions or to increase the range

NOTE: Sensors without a 'Sens' adjustment are factory set at the equivalent of the mid position.

If you are experiencing nuisance tripping problems, decrease the sensitivity (Sens).

If the field of view is too small, increase the sensitivity (Sens).

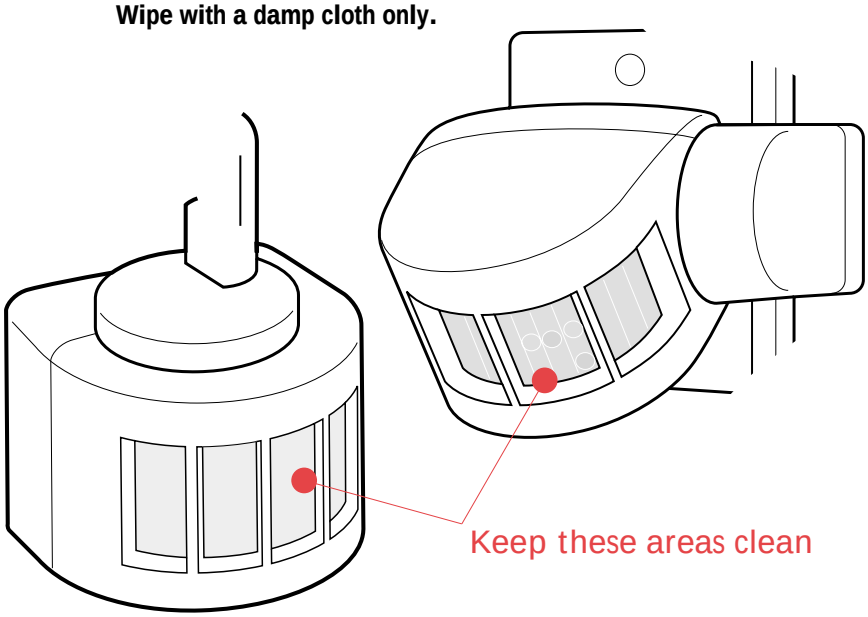
MAINTENANCE

A small amount of maintenance is required to keep a PIR sensor functioning correctly.

1. Keep the sensor lens free from dust, paint and spider webs by wiping clean occasionally (every 3 to 6 months) with a damp cloth.

   Do **NOT** clean with chemical cleaners or solvents of any kind.

   Wipe with a damp cloth only.



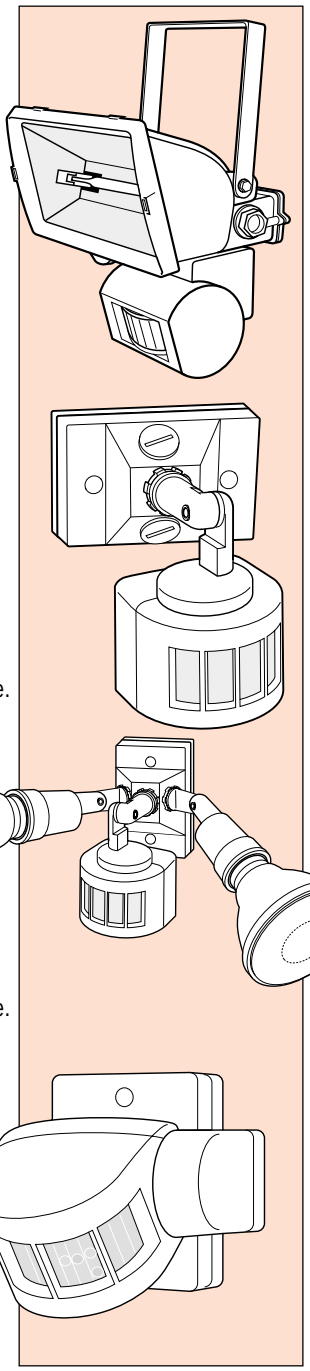
2. In winter and summer, the PIR sensor operates differently due to the differences in ambient air temperature.

   The SENS control may have to be adjusted at the beginning of winter and again at the beginning of summer to maintain the desired operating performance. See 'Effects of Temperature Changes' page 6 and 'Sensitivity' pages 13 & 14.

The internal componentry is factory sealed and is not to be altered in any way. No user serviceable parts are present.

To reduce the risk of nuisance tripping, keep the lens of the sensor free from dust, paint and spiderwebs.

PDL PIR SENSORS



96VH90/150W — outdoor, IP44, 150W halogen light fitting

Mounting: wall or soffit
Electrical: 220–240V a.c. 50Hz
150 Watt Halogen (Lamp included)
Field of view: 90° elliptical
Range (under ideal conditions):
12m forward, 8m either side of centre
Settings: Light "ON" time — 20 sec to 10 min
Light level (Lux) — Non adjustable, pre-set to operate at 40 LUX (dusk)
Sensitivity adjustment (Sens)
Adjustments: head swivels 180° vertical.

98VH110 — outdoor, IP44

Mounting: wall or soffit
Electrical: 220–240V a.c. 50Hz
500 Watt incandescent maximum
250 Watt fluorescent maximum
Field of view: 110° elliptical
Range (under ideal conditions):
12m forward, 9m either side of centre
Settings: Light "ON" time — 10 sec to 5 min
Light level (Lux) — 40 Lux upwards
Adjustments: head swivels 180° vertical, 180° each side of centre.

96VH110/TS — outdoor IP44, twin spot light fitting

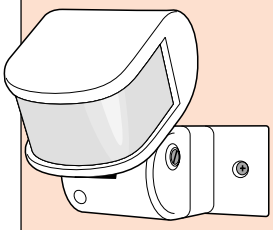
Mounting: wall or soffit
Electrical: 220–240V a.c. 50Hz
300 Watt incandescent
2 x 150 Watts PAR 38 lamps (not included)
Field of view: 110° elliptical
Range (under ideal conditions):
12m forward, 9m either side of centre
Settings: Light "ON" time — 10 sec to 5 min.
Light level (Lux) — 40 Lux upwards
Adjustments: head swivels 180° vertical, 180° each side of centre.

98VH200 — outdoor, IP54, 1 kW switching

Mounting: universal, horizontal/vertical
Electrical: 220–240V a.c. 50Hz
1000 Watt incandescent maximum
500 Watt fluorescent maximum
Field of view: 200° elliptical
Range (under ideal conditions):
12m forward, 12m either side of centre
Settings: Light "ON" time — 10 sec to 5 min
Light level (Lux) — 40 Lux upwards
Sensitivity adjustment (Sens)
Adjustments: head swivels 180° in either mounting position.

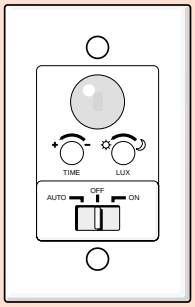
98CR270 — outdoor, IP54

Mounting: corner mounting to sense 2 sides of a building
Electrical: 220–240V a.c. 50Hz
1000 Watt incandescent maximum
500 Watt fluorescent maximum
Field of view: 270° elliptical
Range (under ideal conditions):
12m forward, 7m either side of centre
Settings: Light "ON" time — 10 sec to 5 min
Light level (Lux) — 40 Lux upwards
Sensitivity adjustment (Sens).



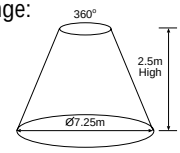
556 — indoor, standard flush plate

Mounting: replaces existing light switch
with 84mm mounting centres
Electrical: 220–240V a.c. 50Hz
500 Watt incandescent maximum
250 Watt fluorescent maximum
Field of view: 90° elliptical
Range (under ideal conditions):
5m forward, 5m either side of centre
Settings: Light "ON" time — 20 sec to 10 min
Light level (Lux) — 5 Lux upwards.



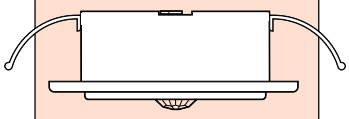
360 SP — indoor, ceiling mounting, double insulated

Mounting: ceiling (surface/flush)
Electrical: 220–240V a.c. 50Hz
1000 Watt incandescent maximum,
750W tungsten halogen maximum
500 Watt fluorescent maximum
Motors 0.25kW maximum
Field of view: 360°
Range:



Height	Sensing Diameter
2.0m	6.50m
2.5m	7.25m
3.0m	8.00m
3.5m	8.75m
4.0m	9.50m

Settings: Light 'ON' time — 10 sec to 1 hour
Light level (Lux) — 5 Lux upwards.



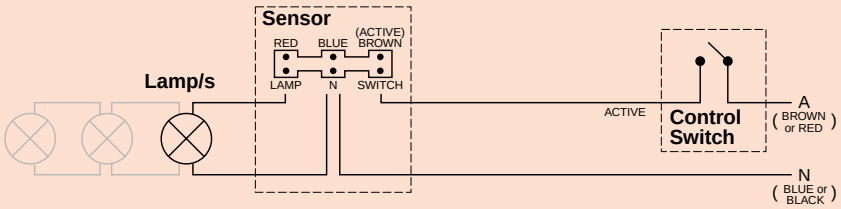
For IP rating explanation, refer to the chart on the back cover.

WIRING

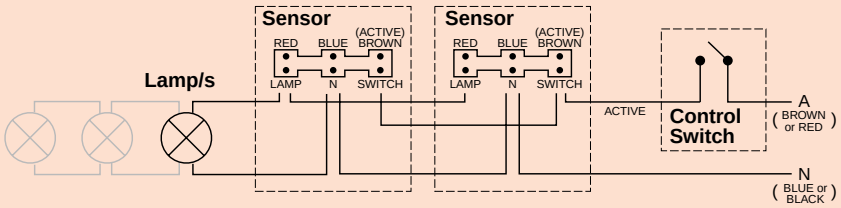
Important points to note:

- All PDL PIR sensors must be installed according to local Wiring Regulations and Codes of Practice.
- Each sensor circuit should be on a separate control switch. Hard wiring directly to the switchboard is not recommended.
- Ensure the power supply to the sensor is disconnected at the switchboard before beginning electrical wiring or electrical maintenance.
- PDL sensors require that a Neutral is wired to the sensor terminal block. DO NOT attempt to operate the sensor without a Neutral.
- PDL sensors use a relay in their circuitry and there is no minimum load requirement. The maximum recommended load must not be exceeded.
- Up to three sensors and any number of lights can be connected to one circuit providing the load doesn't exceed the recommended maximum for any one sensor.
- In multiple sensing situations, if any one sensor detects heat movement, all the lighting will be activated. The 'Time' period will start timing from when the last sensor has detected heat movement. Multiple sensing situations are more prone to nuisance tripping problems than single sensing situations due to the larger combined fields of view.

1 Single Sensing (one or more lamps)



2 Multiple Sensing (one or more lamps)



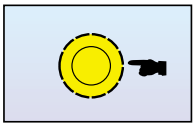
TROUBLE SHOOTING GUIDE

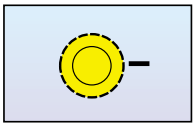
PROBLEM	CAUSE	POSSIBLE SOLUTION
Lights won't come on.	• Power not on. • Wired incorrectly. • Light bulb blown. • PIR not detecting movement. • Light conditions too bright.	• Turn on indoor switch or check fuse. • Check wiring is the same as wiring diagram. • Check the bulb still functions or replace. • Adjust the angle and direction of the PIR. For best results walk across the beam. • Wait until light conditions are darker (at dusk or under 40 Lux) or turn the 'Lux' up.
Lights stay on.	• 'Time' set too high. • Wired incorrectly. • Frequent changes in heat are being detected. • Control switch in permanently on position.	• Turn 'Time' knob towards '-' end (10 secs to 5 min adjustable). • Check wiring is the same as wiring diagram. • Check sensing area for possible heat sources i.e. air vents, moving vehicles, moving trees, and re-position the sensor, adjust the aim or alter the 'Sens' control towards the '-' end (if present). • Check status of control switch and change if required.
Lights keep turning on and off (cycling).	• Changes in heat are being detected from a fixed heat source. • Changes in heat are being detected from a moving object. • Light and heat are being reflected back onto the sensor. • Sudden temperature changes due to storms or high winds.	• Check the sensing area for air vents, light fittings or fans and either re-position the sensor or adjust the aim. • Check the sensing area for moving vehicles, pedestrians, animals, moving trees and alter the aim of the sensor accordingly. • Alter aim of the sensor or paint the reflecting surface with a dull finish. • Turn sensor off until storm passes or install in a sheltered location.
Sensing angle and distance appear incorrect.	• Angle of sensor head is incorrect. • Sensitivity set too low.	• Adjust the sensor head to alter the sensing distance and angle. • Turn 'Sens' knob toward the '+' end.
Sensor operates differently in hot and cold conditions.	• Temperature differences are affecting the sensitivity of the sensor.	• Turn on sensor models with a Sensitivity control knob toward the '+' end for summer (hot conditions) and toward the '-' for winter (cold conditions). This compensates for the variations in temperature.

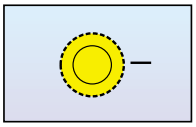
IP DESIGNATIONS

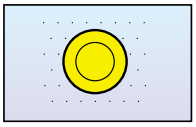
1st Figure

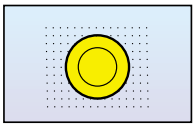
Protection against foreign solid objects

2  Protected against solid bodies larger than 12mm (eg finger of the hand).

3  Protected against solid bodies larger than 2.5mm (eg tools, wire).

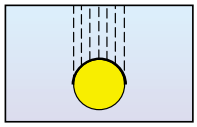
4  Protected against solid bodies larger than 1mm (fine tools and small wires).

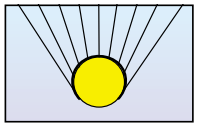
5  Protected against dust (no harmful deposits).

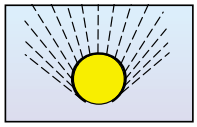
6  Completely protected against dust.

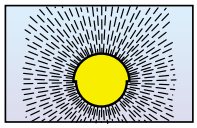
2nd Figure

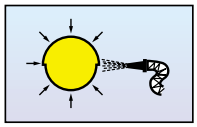
Protection against harmful ingress of water

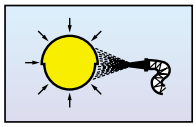
1  Protected against vertically falling drops of water.

2  Protected against drops of water falling at up to 15° from the vertical.

3  Protected against spraying water at up to 60° from the vertical.

4  Protected against splashing water from all directions.

5  Protected against jets of water from all directions.

6  Protected against jets of water of similar force to heavy seas.

For full details of “IP” classification, refer to AS 1939:1990.

PDL Industries Limited, Telarc Reg. No. 061 registered to ISO 9002.

PDL PIR Sensors are distributed in New Zealand by

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