Pyro Electric Infrared Sensor
Fresnel Lens

Features
- Excellent S/N
- Low voltage operation available

Applications
- Intrusion Detectors
- Lighting Automation

Please select IML-0685 or IML-0688 depend on your application and target detection area

What is Pyro-electric infrared sensor.
Pyro electric infrared sensor is used the pyroelectric effect of pyro-electric ceramic which is a kind of piezo-electric ceramic.
Pyro-electric effect is a phenomenon such as;
When the temperature of pyro-electric ceramic is changed, spontaneous polarization of ceramic is changed by the amount of temperature change. Then the amount of electric charge is varied depending on the change of spontaneous polarization. Pyro-electric infrared sensor generates signal output when it detect temperature change of ceramic. On the other hands, pyro-electric infrared sensor does not generate signal output when the temperature of ceramic is stable, this is not depend on the absolute value of temperature.
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2. Pyro-electric effect:
output = behavior electric charge

Infrared energy input

Temp. charge of PIR element
Stabled / balanced

Condition of electric charge
Floating electric charge
Polarization
Dipole moment (amount of polarization)

Sensor output
(Voltage)

Output signal is generated at the time of temperature charge of pyro-electric
3. Optical filter

Pyro-electric infrared sensor using optical filter on the top

All objects emitting infrared rays and the peak wavelength of infrared rays is corresponding to the surface temperature. (This is Wien’s law).

However, the pyro-electric ceramic itself does not have wavelength dependence, so we have to use optical filters that have suitable transmittance to detect target objects.

Generally, we use 5μm cut-off long pass filters as optical filters for the application of human body detection, because the peak wavelength of infrared rays emitted from human body is around 10μm and 5μm cut-off filters have high transmittance around this wavelength.

4. Pyro-electric infrared sensor function

What is necessary to achieve the motion detection.

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<thead>
<tr>
<th>Product</th>
<th>Function</th>
<th>Optical system (ex. Lens)</th>
<th>Circuit (Ref. Circuit Diagram)</th>
</tr>
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<tr>
<td>Sensor</td>
<td>Heat ⇔ Electricity</td>
<td>Area design Angle, Range</td>
<td>Sensor Signal amplification Signal filtering</td>
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4.1 Why optical system is necessary

If don’t use optical system in front of sensor,

Directivity of the sensor is as shown in the left figure and the detection area is not formed.

We therefore use optical system to condense the infrared-ray to the element. 

**Detection area is designed by the optical system.**
4.2 Lens Variation

**IML-0685** (Inline type)
- mainly used for wall mount unit

**IML-0688** (Round type)
- Mainly used for ceiling mount unit

*Assembled with Murata sensor IRA-S210ST01*
5. Detection area

The size of detection area is changed by the distance.

Optical system should be designed by detection distance and detection area which would like to detect human body.

Temperature distribution in the detection area
5.1 Output signal against detection area size
Under the condition that the detection distance is same.

![Diagram showing output signal against detection area size]

- Large Sensitivity (Amplitude of signal) → Small
- Short Period of signal → Long

⚠️ Need to adjust the amplification circuit (frequency response and gain)

5.2 Element arrangement

⚠️ Note: Element arrangement

- Place the element in horizontal direction in series.
  - Dual element has the advantage in detection of motion across the detection area.

- Place the element in vertical direction in series
  + - : Polarity of element
6. PIR sensor starter kit : IMX-060

6.1 Appearance

**TOP side (IMX-060)**

**BACK side (IMX-060)**

**TOP side (IMX-060 with IML-0685 or IML-0688)**

6.2 Circuit diagram of PIR sensor starter kit

Vcc=5V±0.5V

IC2 : op-amp
IC3 : comparator

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6.3 Frequency response of amplifier

![Frequency response graph](image)

**Default setting**
- Amplifier gain: 64.6dB (at 2.0Hz)
- Cut-off frequency (-3dB): 0.63~6.9Hz

*To change the frequency response of amplifier*
Please change the value of **components shown in red letters** in circuit diagram (R3, R4, R5, R8, C4, C5, C6, C7)

6.4 Waveform example

![Waveform graph](image)

**Default setting**
- Upper threshold: 2.25V
- Lower threshold: 1.05V

*To adjust the threshold level, please change the value of **components shown is blue letters** in circuit diagram (R9, R10, R11, R12)
7. Caution

■ Notice in design

1) In the case of outdoor use, suitable Optical Filter and water and humidity proof structure should be applied.
2) To prevent failure or malfunction, Please use a stabilized power supply.
3) Please avoid using the sensor & fresnel lens in the following conditions because it may cause failure or malfunction:
   - In such a fluid as water, alcohol etc. corrosive gas (SO₂, Cl₂, NOₓ etc.) or sea breeze.
   - In high humidity.
   - In a place exposed directly to sunlight or headlight of automobile.
   - In a place exposed to rapid ambient temperature change.
   - In a place exposed directly to blow from air-conditioner or heater.
   - In a place exposed to strong vibration.
   - In a place exposed to strong electromagnetic field.
   - In such a place where infrared ray is shaded.
   - In such a place are charge field and static electricity field.
   - In any other place similar to the above (a) through (i).

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