Pyro Electric Infrared Sensor
Fresnel Lens

Features
- Excellent S/N
- Low voltage operation available

Applications
- Intrusion Detectors
- Lighting Automation

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

Condition of electric charge

Sensor output
(Voltage)
3. Optical filter

Pyro-electric infrared sensor using optical filter on the top

All object emitting infrared ray and the peak wavelength of infrared ray is corresponding to the surface temperature. (This is Wien's law).

However pyro-electric ceramic itself don’t have wavelength dependence, so we have to use optical filter which have suitable transmittance to detect target object.

Generally, we use 5um cut-on long pass filter as an optical filter for the application of human body detection, because the peak wavelength of infrared ray emitted from human body is around 10um and 5um cut-on filter has high transmittance around this wavelength.

4. Pyro-electric infrared sensor function

What is necessary to achieve the motion detection.

<table>
<thead>
<tr>
<th>Products</th>
<th>Sensor</th>
<th>Optical system (ex. Lens)</th>
<th>Circuit (Ref. Circuit Diagram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Heat → Electricity</td>
<td>Area design Angle, Range</td>
<td>Sensor Signal amplification Signal filtering</td>
</tr>
</tbody>
</table>

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Doc.:No.DM-R16-148 Rev.2 201711 4 / 12
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.

Output signal in the area overlaps red and blue circle is canceled.

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.

<table>
<thead>
<tr>
<th>Target</th>
<th>Detection area</th>
<th>Signal output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>Sensitivity (Amplitude of signal)</td>
<td>Small</td>
</tr>
<tr>
<td>Short</td>
<td>Period of signal</td>
<td>Long</td>
</tr>
</tbody>
</table>

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

5.2 Element arrangement

⚠️ Note: Element arrangement

〇 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-070

6.1 Appearance

![TOP side](image1)

![BACK side](image2)

![TOP side with IML-0685 or IML-0688](image3)

6.2 Circuit diagram of PIR sensor starter kit

Vcc=5V±0.5V

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6.3 Frequency response of amplifier

![Graph showing frequency response of amplifier](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 diagram](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)
6.5 Note for PCB design

1. Avoid placing heat-generating components near the pyro sensor.
   (Pyro sensor reacts to heat change and generate output signal.)
2. Voltage regulator should be used as stabilized power supply to pyro sensor and amplifier circuit.
   ※To avoid output voltage change due to supply voltage change
3. Rs(resistor between source and ground) should be not so high resistance.
4. Avoid placing RF components near the pyro sensor.
   (e.g. antenna, RF transmitter and module)
5. Wiring pattern should be wide and short.
6. Sufficiently enhancing ground plane.
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 (SO_2, Cl_2, NO_x 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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