Sharp Optoelectronic Components

Product Introduction
Photointerrupters
Photointerrupter Principles

- A photointerrupter is a non-contact optical switch which has many kinds of applications.
- There are two main types: Transmissive and Reflective.
Photointerrupter Applications

• Printer operation:
  • Paper pass, paper presence, cover open, paper exit detection
• Motor control:
  • Operate a stepping motor for a sewing machine
• Lens control:
  • Detect position of zoom lens in a digital camera or projector
• Position sensing:
  • For optical pickup mechanism in blu-ray players
• Consumer/toy robotics
  • Origin detection for joint parts
• VR/gaming systems
  • Detect position of gear wheel for head mounted displays
• Available Models:
  [Link to SHARP optoelectronicComponents_Photointerrupter.php](http://www.socle-tech.com/SHARP_optoelectronicComponents_Photointerrupter.php)
Photointerrupter Applications

Photo interrupters are used for detecting the presence or the movement of various objects.

Example: the lens unit for camera

Lens position control
GPI5396HCP5F to detect rotation
Photointerrupter Applications by Type and Size

Transmissive Type
- Sales volume: approximately 60 million pieces/year
- GP1A173LCS5F

Reflective Type
- Sales volume: approximately 20 million pieces/year
- ・Well-defined, narrow detection area characteristics
  ⇒ flexible design for paper-to-paper gap
- ・Very high immunity for both ambient light and electrical noise, from DC to high frequency, and ESD spikes, by internal signal processing.
  ⇒ Can be used at highly noisy environment

Subminiature Transmissive Type
- Sales volume: approximately 140 million pieces/year
- ・Industry smallest (GP15396 series)
  ⇒ Easy design for lens position detection or origin detection for joint parts.
- GP1S194HCZOF
- GP1S396HCPSF

Subminiature Reflective Type
- Sales volume: approximately 28 million pieces/year
- GP2S60
- GP2S700HCP

Applications:
- Head-mounted displays
- Mobile printer
- Ink jet printer
- Water meter
- DLP projector
Examples of Subminiature Photointerrupter Applications

**DSC**

*Digital camera Lens Unit*

- **Focus**
  - 1pc: Detection the origin point of focus lens

- **Zoom**
  - 1 to 2pcs: Detection the position of zoom lens

- **Lens cover, shutter etc**
  - 0 to 2pcs: Sensing lens cover, home-position, etc.

**Mobile phone**

*Camera phone Lens Unit*

- **Zoom lens**
- **Focus lens**

**Blu-ray player and recorder**

*Blu-ray Pick-Up Unit*

*Example optical pickup mechanism*

- **Position sensing for aberration correction**

*photo-interrupter*
# Sharp Photointerrupter Lineup

## Transmissive type, connector-terminal

<table>
<thead>
<tr>
<th>Output type</th>
<th>Vcc</th>
<th>2.0 mm pitch connector</th>
<th>1.5 mm pitch connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>デジタル出力</td>
<td>5.5V</td>
<td>GP1A175LCSSF</td>
<td>GP1A173LCSSF</td>
</tr>
<tr>
<td>PHOTIC Output</td>
<td>5.0V</td>
<td>GP1A175LCSSF</td>
<td>GP1A173LCSSF</td>
</tr>
</tbody>
</table>

*Applicable to both 5.5V and 5.0V supply

## Reflective type, synchronized detection

<table>
<thead>
<tr>
<th>Light modulation</th>
<th>Vcc</th>
<th>GP2A200LC50F</th>
<th>GP2A240LC50F</th>
<th>GP2A250LC50F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light modulation</td>
<td>5.0V</td>
<td>GP2A200LC50F</td>
<td>GP2A240LC50F</td>
<td>GP2A250LC50F</td>
</tr>
</tbody>
</table>

*Applicable to both 5.5V and 5.0V supply

## Subminiature package

<table>
<thead>
<tr>
<th>Subminiature Package</th>
<th>[Gap width: 1.0 mm]</th>
<th>[Gap width: 2.0 mm]</th>
<th>[Gap width: 3.0 mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD, with positioning pin</td>
<td>GP1S106HC20F</td>
<td>GP1S109HC20F</td>
<td>GP1S109HC20F</td>
</tr>
<tr>
<td>Thread hole</td>
<td>GP1S109HC20F</td>
<td>GP1S109HC20F</td>
<td>GP1S109HC20F</td>
</tr>
</tbody>
</table>

*SMALL, with positioning hole

## Subminiature Reflective

<table>
<thead>
<tr>
<th>Reflective Subminiature</th>
<th>[Gap width: 1.0 mm]</th>
<th>[Gap width: 1.5 mm]</th>
<th>[Gap width: 1.7 mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD, Industry smallest</td>
<td>GP1S106HC20F</td>
<td>GP1S106HC20F</td>
<td>GP1S106HC20F</td>
</tr>
<tr>
<td>Through hole</td>
<td>GP1S106HC20F</td>
<td>GP1S106HC20F</td>
<td>GP1S106HC20F</td>
</tr>
</tbody>
</table>

*SMALL, Industry smallest

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**Notes:**
- Under development
- Very high immunity for ambient light and electrical noise
- Low power consumption (10mA max)
### Photointerrupter - Popular models

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>TYPE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1A52HRJ00F</td>
<td>Transmissive, Standard</td>
<td>OPIC output, through-hole design</td>
</tr>
<tr>
<td>GP1A57HRJ00F</td>
<td>Transmissive, Standard</td>
<td>OPIC output, through-hole design, wide gap, positioning pin</td>
</tr>
<tr>
<td>GP1S092HCPF</td>
<td>Transmissive, Compact</td>
<td>Phototransistor output, tape and reel packaging, surface mount</td>
</tr>
<tr>
<td>GP1S094HCF0F</td>
<td>Transmissive, Compact</td>
<td>Phototransistor output, compact size, positioning pin</td>
</tr>
<tr>
<td>GP1S396HCPF</td>
<td>Transmissive, Compact</td>
<td>Phototransistor output, compact size, low profile, narrow gap</td>
</tr>
<tr>
<td>GP1S51VJ000F</td>
<td>Transmissive, Standard</td>
<td>Compact, long distance type, no external control signal required</td>
</tr>
<tr>
<td>GP2A25J0000F</td>
<td>Reflective, Standard</td>
<td>OPIC output, screw fixing holes, positioning pin, 3-pin connector</td>
</tr>
<tr>
<td>GP2S60</td>
<td>Reflective, Compact</td>
<td>Phototransistor output, tape and reel packaging, surface mount</td>
</tr>
<tr>
<td>GP2S700HCP</td>
<td>Reflective, Compact</td>
<td>Phototransistor output, tape and reel packaging, surface mount</td>
</tr>
</tbody>
</table>

Note: "OPIC" (Optical IC) is a trademark of SHARP Corporation. An OPIC consists of a light-detecting element and signal-processing circuit integrated onto a single chip.
Photocouplers

- A **photocoupler** is a component which transfers electrical signals between isolated circuits using an LED and a phototransistor. Also known as an **optocoupler** or **optoisolator**.
- To prevent high voltages from affecting the system receiving the signal.
- **Applications:**
  - Power switch for heaters, fans, motors
  - Temperature control
  - Power supplies
- **Available models:**
  - PC354 / PC355 / PC357 series
  - PC364 / PC365 / PC367 series
  - PC3H / PC3L series
  - PC400 / PC451 / PC452 / PC457 series
  - PC817 / PC851 / PC852 series
  - Models in **RED** have 24 week lead-time due to factory over-capacity

![Photocoupler illustrations](image-url)
IR Detecting Unit

- IR Detecting Unit / Receiver for remote control applications.
- Applications:
  - Audio/visual equipment
  - Home appliances
  - Consumer robotics and toys using IR sensor
  - Remote control door/garage openers
- Available models:
  - GP1UX511QS
  - GP1UX511RK
  - GP1UM272RKVF
Other Sharp Components

- **Infrared Emitting Diodes**
  - GL100MN1MP1
- **Phototransistors**
  - PT100MFOMP1
- **Phototriac Coupler**
  - Provides triggering for triacs which are used to switch on and off devices which require AC loads (heaters, fans, motors, valves).
  - PC3SD21YXPDH
  - S2S3 / S2S4 / S2S5 series
- **Solid State Relays**
  - Electronic switching device that switches on or off when a small external voltage is applied across its control terminals.
  - PR39MF22NSZH
  - PR39MF51NSLH
About Socle Technology Corp.

• Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
• Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
• 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
• Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
• Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
• Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

http://www.socle-tech.com/
Sharp Microwave Sensor
Product Introduction

August 2018
Microwave Sensor (MWS) Key Features

- Human presence / absence detection
- Detect velocity and direction of human motion
- Detect body motion at a distance of 10m
- Wide angle detection area
- Detect a person approaching versus crossing an area
- Sensor module can be hidden within resin enclosure without any window needed
- Resists environmental impact of ambient light and temperature
- Alternative to PIR (Passive Infra-Red) / Pyroelectric sensors
Microwave Sensor Principles

- Microwaves are a type of RF (Radio Frequency) wave - Sharp’s MWS uses RF frequency of 24 GHz

<table>
<thead>
<tr>
<th>Low freq</th>
<th>Medium freq</th>
<th>High freq</th>
<th>Very high freq</th>
<th>Ultra high freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>30kHz ~ 300kHz</td>
<td>300kHz ~ 3MHz</td>
<td>3MHz ~ 30MHz</td>
<td>30MHz ~ 300MHz</td>
<td>300MHz ~ 3GHz</td>
</tr>
<tr>
<td>Radio clock</td>
<td>AM broadcast</td>
<td>Short-wave broadcasting</td>
<td>Analog TV</td>
<td>Satellite broadcast</td>
</tr>
<tr>
<td></td>
<td>Aeronautical beacon</td>
<td>Aircraft radio</td>
<td>FM broadcast</td>
<td>Wireless LAN</td>
</tr>
<tr>
<td></td>
<td>Marine beacon</td>
<td>Ship radio</td>
<td>Mobile phone</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wireless LAN</td>
<td>Speed gun</td>
</tr>
</tbody>
</table>

If frequency is low, it is easy to travel far away
If frequency is high, it is easy to be reflected by an object
Microwave Sensor Principles - The Doppler Effect

What is the Doppler effect?

Example) Measure the speed of the ball with a speed gun

1. When the ball approaches, the interval between the reflected waves becomes narrower with respect to the transmitted wave.
2. When the ball moves away, the interval between the reflected waves becomes wider with respect to the transmitted wave.

⇒ Application of this principle
[measuring approach and separation]
Microwave Sensor Principles - The Doppler Effect

1) an example of a sound wave (ambulance siren)

   ① For an approaching object
   As the space pf the wave becomes small, the sound becomes high.

   ② For a receding object
   As the space of the wave becomes wide, the sound becomes low.

2) an example of a radio wave (speed gun)

   ① For an approaching object
   The space of a radio wave becomes small.

   ② For a receding object
   The space of a radio wave becomes large.

⇒ It can measure body motion based on this principle.
Our company has a lot of know-how for microwave technology that has been cultivated by the development of TV tuner and module for receiving satellite broadcast for many years.
## Compare Microwave Sensor with other technologies / solutions

<table>
<thead>
<tr>
<th>Method</th>
<th>Microwave sensor</th>
<th>Camera</th>
<th>Pyroelectric sensor (Far-infrared sensor)</th>
<th>Pressure sensor (Mat sensor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle</td>
<td>Doppler effect of microwave</td>
<td>Video monitoring for a target person</td>
<td>Detect far-infrared rays from a target person</td>
<td>Detect the pressure change of a target person</td>
</tr>
<tr>
<td>Privacy</td>
<td>○ No problem</td>
<td>× Having the risk of the intrusion of the privacy</td>
<td>○ No problem</td>
<td>○ No problem</td>
</tr>
<tr>
<td>Detection system</td>
<td>○ Contactless</td>
<td>○ Contactless</td>
<td>○ Contactless</td>
<td>× Contact</td>
</tr>
<tr>
<td>Detectable Min action quantity</td>
<td>○ Several millimeters</td>
<td>○ Several centimeters</td>
<td>× Several centimeters</td>
<td>- -</td>
</tr>
<tr>
<td>Environmental condition</td>
<td>○ none</td>
<td>△ brightness</td>
<td>△ Room temperature</td>
<td>○ none</td>
</tr>
<tr>
<td>Setting place</td>
<td>© Possible to be embedded and installed under a bed and a wall</td>
<td>× No shield is allowed in front of the lens</td>
<td>× No shield is allowed in front of the sensor</td>
<td>× Under a mattress or on a floor</td>
</tr>
</tbody>
</table>
Microwave Sensor Applications - Human motion sensing

- Control opening and closing of the toilet lid
  - The sensor can be installed in an invisible place
    (Built-in sensor on toilet lid and Chamber pot)
  - Design improvement
  - No sensor cover (Black-window) required

- Can be built in lighting fixtures, Energy saving possible
  - Can be installed in the cover (No design change required)
  - Improve detection accuracy (Detection of slight movement)
  - Use for security

- Improve detection accuracy
  - Infrared sensor problem avoidance
    - You can also detect people wearing clothes without exposure
  - There is no influence of temperature and humidity environment

- Prevent erroneous opening and closing of the automatic door
  - Detection of slight movement
  - Improve detection accuracy
Microwave Sensor Applications - Printer standby control

- MFP (Multi Function Printer) standby control

- When people are detected, standby mode cancellation.
  → Standby is released at the approaching stage, and printing is possible immediately.

- Transition to standby mode upon detecting absence
  → Standby without waiting, so it realizes further low power consumption.

< Characteristic of microwave compact human detection sensor >

1. Hidden sensor
   (Sensors can also be installed in invisible places in the resin enclosure. No window required.)
   → Improving the design of the equipment

2. Compact and thin size
   (It also carries parts on the antenna side, realizing a compact thin type module)
   → Sensor installation space is easy to secure.

3. Wide detection range
   → People approaching from the oblique direction (60 degrees) are also detected.

4. Detect motion direction
   (Detect approach / separation)
   → It is also possible to set not to detect people away from the sensor or people crossing the sensor.

5. Resistant to environmental impact
   → The following items need consideration with Pyroelectric Sensor do not affect the performance of the microwave sensor:
     - Ambient light
     - Temperature
# Sharp Microwave Sensor Module Lineup

<table>
<thead>
<tr>
<th>Sharp P/N</th>
<th>Part Description</th>
<th>Features</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Analog output)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Digital UART output)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Human Motion Sensor Module (Analog) - Overview

● Features
Ultra-compact module that is easy to install in various equipment.
- 24.0 x 15.0 x 1.5 mm (Pin header not included)
- Operating frequency: 24.10GHz
- 4 elements Tx/Rx plane antenna
- Contributing to improving equipment design without requiring a window on the sensor (It can be hidden in the resin case)
- RoHS Compliance

● Application
- Control opening and closing of the toilet lid Sensor
- Automatic lighting ON / OFF Sensor
- Automatic door Sensor
- General purpose human sensor
- Security system

● Operating range

<table>
<thead>
<tr>
<th>item</th>
<th>unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>GHz</td>
<td>24.075</td>
<td>24.10</td>
<td>24.175</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>ºC</td>
<td>-25</td>
<td>24.10</td>
<td>50</td>
</tr>
</tbody>
</table>

● Specification (TBD)

<table>
<thead>
<tr>
<th>item</th>
<th>unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission power (EIRP)</td>
<td>dBm</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna pattern (Azimuth)</td>
<td>deg</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna pattern (Elevation)</td>
<td>deg</td>
<td>110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature drift</td>
<td>MHz/°C</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power-supply voltage</td>
<td>V</td>
<td>3.2</td>
<td>3.3</td>
<td>3.4</td>
</tr>
<tr>
<td>power consumption</td>
<td>mA</td>
<td>47</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

● External dimensions (TBD)

[Diagram showing dimensions: 24.0 mm width, 15.0 mm height, t = 1.5 mm]
1. Human Motion Sensor Module (Analog) - Specifications

Features (TBD):
- Measure non-contact using Doppler effect
- Output frequency: 24.05 to 24.25 GHz
- Planar antenna with 4 patch Tx/Rx antenna elements
- Motion detection through resin casing (no sensor cover)
- Stable detection without being affected by temperature, direct sunlight, color of reflector
- Applicable operating speed: walking
- Output signal: I/Q signal (analog)

Specifications (TBD):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Characteristics</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output frequency</td>
<td>f</td>
<td>24.05 to 24.25</td>
<td>GHz</td>
</tr>
<tr>
<td>Output power</td>
<td>Pout</td>
<td>Max. 20</td>
<td>dBm</td>
</tr>
<tr>
<td>Antenna</td>
<td></td>
<td>Planar antenna</td>
<td></td>
</tr>
<tr>
<td>Antenna angle (Azimuth)</td>
<td>H-plane</td>
<td>Typ. 70</td>
<td>deg</td>
</tr>
<tr>
<td>Antenna angle (Elevation)</td>
<td>E-plane</td>
<td>Typ. 140</td>
<td>deg</td>
</tr>
<tr>
<td>Detected distance</td>
<td></td>
<td>Max. 10</td>
<td>m</td>
</tr>
<tr>
<td>Output signal</td>
<td></td>
<td>I/Q signal (analog)</td>
<td></td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>Vin</td>
<td>3.2 to 3.4</td>
<td>V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>I</td>
<td>Typ. 47</td>
<td>mA</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Top</td>
<td>-20 to 60</td>
<td>°C</td>
</tr>
<tr>
<td>Product size</td>
<td></td>
<td>24x15x1.5</td>
<td>mm</td>
</tr>
</tbody>
</table>

Block diagram (TBD):

Outline dimensions (TBD):

- 24 mm
- Thickness: 1.5 mm
1. Human Motion Sensor Module (Analog) - Detect approach versus area crossing

Introduction of our experimental data

As a human sensor, "human absence detection" is the basic function, but by analysis of the waveform, it seems to be able to distinguish between "approach and crossing". Here are the data.

- **In case of approaching**
  1. When approaching from the front
  2. When approaching from 60 degrees direction

- **When approaching**
  - Waveform characteristics in case of approaching
    - The amplitude and frequency increase.
    - The frequency component increases as it moves, and the frequency decreases when it stops.

- **In case of crossing**
  1. When crossing 3 m (60 degrees away)
  2. When crossing 1 m (60 degrees away)

- **Crossing**
  - Waveform characteristics in case of crossing
    - There is no large increase in amplitude.
    - Frequency component fluctuation can not be seen.
1. Human Motion Sensor Module (Analog) - Block diagram

The module itself outputs two signals I, Q. For human sensor applications, it can only be used with the I signal.
1. Human Motion Sensor Module (Analog) - Connection to customer board

In order to reduce the module size, only the hole for pin header mounting is opened in the SHARP microwave sensor module.

Please prepare a pin header suitable for your installation and install it in this hole.

We also plan to ship a straight pin header (Example 1) with SHARP.

Mounting image on customer's board

Example 1

Example 2

SHARP module
Customer board

SHARP module
Customer board
2. Human Motion Sensor Module (Digital) - Overview

**Features**
Small single board module with microcomputer
It can be used immediately as a radio wave type human sensor.
Built-in detection start distance adjustment function

- 50.0 x 15.0 x 3.8 mm (Module Size)
- Operating frequency 24.10GHz
- 4 elements Tx/Rx plane antenna
- Contributing to improving equipment design without requiring a window on the sensor (It can be hidden in the resin case)
- RoHS Compliance

**application**
- Control opening and closing of the toilet lid Sensor
- Automatic lighting ON / OFF Sensor
- Automatic door Sensor
- General purpose human sensor
- Security system

**Operating range**

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<td>+50</td>
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**specification (TBD)**

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<td>mA</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**External dimensions (TBD)**

Dimensions: 50.0 mm (Width) x 15.0 mm (Height) x 3.8 mm (Thickness)
2. Human Motion Sensor Module (Digital) - Specifications

**Features (TBD)**
- Measure non-contact using Doppler effect
- Output frequency: 24.075 to 24.175 GHz
- Planar antenna with 4 patch Tx/Rx antenna elements
- Motion detection through resin casing (no sensor cover)
- Stable detection without being affected by temperature, direct sunlight, color of reflector
- Applicable operating speed: walking
- Output signal: UART interface, Low/High (digital)

**Specification (TBD)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Characteristics</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output frequency</td>
<td>f</td>
<td>24.075 to 24.175</td>
<td>GHz</td>
</tr>
<tr>
<td>Output power</td>
<td>Pout</td>
<td>Max. 20</td>
<td>dBm</td>
</tr>
<tr>
<td>Antenna</td>
<td></td>
<td>Planar antenna with 4 patch Tx/Rx antenna elements</td>
<td></td>
</tr>
<tr>
<td>Antenna angle (Azimuth)</td>
<td>H-plane</td>
<td>Typ. 40</td>
<td>deg</td>
</tr>
<tr>
<td>Antenna angle (Elevation)</td>
<td>E-plane</td>
<td>Typ. 110</td>
<td>deg</td>
</tr>
<tr>
<td>Detected distance</td>
<td></td>
<td>Max. 10</td>
<td>m</td>
</tr>
<tr>
<td>Output signal</td>
<td>UART interface, Low/High (digital)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>Vin</td>
<td>3.2 to 3.4</td>
<td>V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>I</td>
<td>TBD</td>
<td>mA</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Top</td>
<td>-20 to 50</td>
<td>°C</td>
</tr>
<tr>
<td>Product size</td>
<td></td>
<td>50x15x3.8</td>
<td>mm</td>
</tr>
</tbody>
</table>

**Outline dimensions (TBD)**

- 15mm length
- 50mm length
- Thickness: 3.8 mm
## 2. Human Motion Sensor Module (Digital) - Comparison with competitor

<table>
<thead>
<tr>
<th>Brand</th>
<th>SHARP</th>
<th>Socionext</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>DC6S4xN31xx</td>
<td>SC1211AU2</td>
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<tr>
<td>Frequency</td>
<td>24.075 ~ 24.175 GHz</td>
<td>24.15 ± 0.1 GHz</td>
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<tr>
<td>Output Power</td>
<td>20 dBm</td>
<td>5 dBm</td>
</tr>
<tr>
<td>Antenna Pattern (10bB-BW)</td>
<td>70 deg (Azimuth)</td>
<td>160 deg (Azimuth)</td>
</tr>
<tr>
<td>Antenna Pattern (10bB-BW)</td>
<td>140 deg (Elevation)</td>
<td>160 deg (Elevation)</td>
</tr>
<tr>
<td>Antenna</td>
<td>4 elements transmitting / receiving, plane</td>
<td>1 element transmitting / receiving, plane</td>
</tr>
<tr>
<td>Distance</td>
<td>0.5 ~ 10m</td>
<td>8m</td>
</tr>
<tr>
<td>Power Supply</td>
<td>3.3V (3.2 ~ 3.4V)</td>
<td>2.5V</td>
</tr>
<tr>
<td>Consumption Current</td>
<td>49 ~ 62 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>Output Signal</td>
<td>UART, Threshold control &amp; Low/High Level (Built-in Microcomputer)</td>
<td>SPI, AD conversion data (without Microcomputer)</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-20 ~ +50 deg C</td>
<td>-20 ~ +80 deg C</td>
</tr>
<tr>
<td>Size</td>
<td>15 mm(L) x 50mm(W) x 3.8mm(T)</td>
<td>12mm x 7.0mm x 1.0mm</td>
</tr>
</tbody>
</table>

**SHARP advantage:**
Built-in MCU, high sensitivity, free from signal processing, and space-saving design.
2. Human Motion Sensor Module (Digital) - Block diagram

- Digital output (Low / High) of the human detection result from the distance corresponding to the voltage applied to the CTRL terminal.
- It receives adjustment commands via the UART terminal, outputs human detection results, waveform data, etc. (This function is under design planning)
2. Human Motion Sensor Module (Digital) - Connection to customer board

[ Physical connections ]
Since two screw holes are provided, please screw to the customer’s cabinet and board with reference to the figure below.

[ Electrical connections ]
To facilitate handling, the SHARP microwave sensor module has a 6-pin connector. Please have CABLE ready.
※The connector is scheduled for "11002W90-6P-S-5A-HF" made by JCTC. For housing use "11002H00-6P-HF" made by JCTC is recommended. http://jctc.com.cn/

● Since the hole of Φ 2.1 is opened in the module, please use screw of M2.
● Resin screws are recommended. Although metal screws can also be used, please be aware that it may be affected by radio wave radiation pattern.
● There is wiring on the back of the module. Therefore, when attaching a module to a metal object etc., please use a resin spacer.

Installation example 1
SHARP module
Mounting on Customer Body (Metal)
Some spacers are necessary to prevent contact of the module backside pattern.

Installation example 2
SHARP module
Mounting on Customer Body (Resin)
Spacers are not required for insulators.

Installation example 3
It is possible to install the microwave module to "user favorite angle" at the "remote position" from the customer main board.
About Socle Technology Corp.

- Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
- Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
- 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
- Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
- Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
- Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

http://www.socle-tech.com/
Sharp Image Sensors (CCD and CMOS)
Product Introduction

July 2018
SHARP CCD/CIS Worldwide Customer Connections

Sharp has a long history of sales with major customers worldwide.

DSC
Canon
Samsung
Nikon

Surveillance Camera
HIKVISION
Panasonic
Bosch

Broadcasting Camera
Ikegami
JVC

FA / ITS
Aihua
FLIR

Medical
Fujifilm
CCD Sensors
Applications of CCD Sensors based on number of pixels and subject speed

- **Security Camera**
  - 270k/320k
  - 420k/470k
  - 520k/610k
  - 1.3M
  - 2M
  - 5M

- **IP Camera**
  - 1.3M

- **Factory Automation (FA) Camera**
  - Analog
  - 1.3M
  - 2M
  - 5M

- **ITS Camera**
  - ITS: Intelligent Transport Systems
  - Auto license plate check
  - ETC monitoring etc.

- **Defect and quality inspection**
- **Shape and size measurement**
- **Assembly and processing monitoring etc.**
# Sharp CCD Lineup for CCTV Cameras

[http://www.socle-tech.com/SHARP_image_Sensors_CCD.php](http://www.socle-tech.com/SHARP_image_Sensors_CCD.php)

<table>
<thead>
<tr>
<th>Optical format</th>
<th>Total pixels</th>
<th>Model No.</th>
<th>Standard</th>
<th>Horizontal TV lines</th>
<th>Image pixel (HxV)</th>
<th>Pixel size HxV (um)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 type</td>
<td>270k</td>
<td>RJ2411FA0PB</td>
<td>NTSC</td>
<td>330</td>
<td>512 x 492</td>
<td>7.2 x 5.6</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>320k</td>
<td>RJ2421FA0PB</td>
<td>PAL</td>
<td>330</td>
<td>512 x 582</td>
<td>7.2 x 4.73</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>410k</td>
<td>RJ2455DA0PB</td>
<td>NTSC</td>
<td>480</td>
<td>768 x 494</td>
<td>4.0 x 5.6</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>470k</td>
<td>RJ2465DA0PB</td>
<td>PAL</td>
<td>480</td>
<td>752 x 582</td>
<td>5.0 x 4.77</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>520k</td>
<td>RJ2431AA0PB</td>
<td>NTSC</td>
<td>650</td>
<td>976 x 494</td>
<td>3.75 x 5.56</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>610k</td>
<td>RJ2441AA0PB</td>
<td>PAL</td>
<td>650</td>
<td>976 x 582</td>
<td>3.75 x 4.74</td>
<td>Complementary</td>
</tr>
<tr>
<td>1/3 type</td>
<td>410k</td>
<td>RJ2355DA0PB</td>
<td>NTSC</td>
<td>480</td>
<td>768 x 494</td>
<td>6.4 x 7.5</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>470k</td>
<td>RJ2365DA0PB</td>
<td>PAL</td>
<td>480</td>
<td>752 x 582</td>
<td>6.53 x 6.39</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>520k</td>
<td>RJ2331BA0PB</td>
<td>NTSC</td>
<td>650</td>
<td>976 x 494</td>
<td>5.0 x 7.4</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>610k</td>
<td>RJ2341BA0PB</td>
<td>PAL</td>
<td>650</td>
<td>976 x 582</td>
<td>5.0 x 6.3</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>520k</td>
<td>RJ3331AA0PB</td>
<td>NTSC</td>
<td>650</td>
<td>976 x 494</td>
<td>5.0 x 7.4</td>
<td>Complementary</td>
</tr>
<tr>
<td></td>
<td>610k</td>
<td>RJ3341AA0PB</td>
<td>PAL</td>
<td>650</td>
<td>976 x 582</td>
<td>5.0 x 6.3</td>
<td>Complementary</td>
</tr>
</tbody>
</table>
## Sharp CCD Lineup for IP / FA / ITS Cameras

[http://www.socle-tech.com/SHARP_image_Sensors_CCD.php](http://www.socle-tech.com/SHARP_image_Sensors_CCD.php)

<table>
<thead>
<tr>
<th>Optical format</th>
<th>Total pixels</th>
<th>Model No.</th>
<th>Video performance</th>
<th>Image pixel (HxV)</th>
<th>Pixel size HxV (um)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3 type</td>
<td>350k</td>
<td>RJ3B3AA0DT</td>
<td>VGA 120fps (1ch output)</td>
<td>660 x 494</td>
<td>7.4 x 7.4</td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RJ3B3AD0DT</td>
<td>VGA 240fps (2ch output)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1350k</td>
<td>RJ33J3CA0DT</td>
<td>1.3M 30fps, 720p 30fps</td>
<td>1320 x 976</td>
<td>3.75 x 3.75</td>
<td>Primary</td>
</tr>
<tr>
<td>1/1.8 type</td>
<td>2100k</td>
<td>RJ31N3AA0DT</td>
<td>2M 25fps (1ch output)</td>
<td>1644 x 1236</td>
<td>4.4 x 4.4</td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td>2130k</td>
<td>RJ31N3AD0DT</td>
<td>2M 50fps (2ch output)</td>
<td></td>
<td></td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td>2960k</td>
<td>RJ31P3AA0DT</td>
<td>2.8M 17fps (1ch output)</td>
<td>1940 x 1460</td>
<td>3.69 x 3.69</td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RJ31P3AD0DT</td>
<td>2.8M 30fps (2ch output)</td>
<td></td>
<td></td>
<td>Primary</td>
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<tr>
<td>2/3 type</td>
<td>5240k</td>
<td>RJ32S3AA0DT</td>
<td>5M 9fps (1ch output)</td>
<td>2456 x 2058</td>
<td>3.45 x 3.45</td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RJ32S3AD0DT</td>
<td>5M 15fps (2ch output)</td>
<td></td>
<td></td>
<td>Primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RJ32S3AF0DT</td>
<td>5M 30fps (4ch output)</td>
<td>2456 x 2056</td>
<td></td>
<td>Primary</td>
</tr>
<tr>
<td>1/1 type</td>
<td>6090k</td>
<td>RJ3DT3AF0DT</td>
<td>6M 30fps (4ch output)</td>
<td>2758 x 2208</td>
<td>4.54 x 4.54</td>
<td>Primary</td>
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<tr>
<td></td>
<td>8290k</td>
<td>RJ3DV3AF0DT</td>
<td>8M 25fps (4ch output)</td>
<td>3320 x 2496</td>
<td>3.88 x 3.88</td>
<td>Primary</td>
</tr>
<tr>
<td>4/3 type</td>
<td>8340k</td>
<td>RJ3EV3EF0DT</td>
<td>8M 25fps (4ch output)</td>
<td>3848 x 2108</td>
<td>5.14 x 5.14</td>
<td>Primary</td>
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</tbody>
</table>
Compare Sharp CCD models with Soxx company models

<table>
<thead>
<tr>
<th>Model (So company)</th>
<th>Proposed Model *1 (SHARP)</th>
<th>Optical Size</th>
<th>Pixel</th>
<th>Color Filter</th>
<th>Scan</th>
<th>Compatibility</th>
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<tbody>
<tr>
<td></td>
<td></td>
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<td>Primary</td>
<td>Comp.</td>
<td>B/W</td>
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<td>ICX212</td>
<td>RJ3351AAQT</td>
<td>1/3 type</td>
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<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX213</td>
<td>RJ3381AAQT</td>
<td>1/3 type</td>
<td>470k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX274</td>
<td>RJ31N3AA0DT</td>
<td>1/1.8 type</td>
<td>2M</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>ICX424</td>
<td>RJ33B3AA0DT</td>
<td>1/3 type</td>
<td>350k</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>ICX445</td>
<td>RJ33J3CA0DT</td>
<td>1/3 type</td>
<td>1.3M</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX625</td>
<td>RJ32S3AD0DT</td>
<td>2/3 type</td>
<td>5M</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX838</td>
<td>RJ2355DA0PB</td>
<td>1/3 type</td>
<td>410k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX839</td>
<td>RJ2365DA0PB</td>
<td>1/3 type</td>
<td>470k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX842</td>
<td>RJ2411FA0PB</td>
<td>1/4 type</td>
<td>270k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX843</td>
<td>RJ2421FA0PB</td>
<td>1/4 type</td>
<td>320k</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>ICX848</td>
<td>RJ2455DA0PB</td>
<td>1/4 type</td>
<td>410k</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>ICX849</td>
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<td>1/4 type</td>
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<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>ICX855</td>
<td>RJ32S3AA0DT</td>
<td>2/3 type</td>
<td>5M</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>ICX862</td>
<td>RJ3331AA0PB</td>
<td>1/3 type</td>
<td>520k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX863</td>
<td>RJ3341AA0PB</td>
<td>1/3 type</td>
<td>610k</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>ICX878</td>
<td>RJ2431AA0PB</td>
<td>1/4 type</td>
<td>520k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX879</td>
<td>RJ2441AA0PB</td>
<td>1/4 type</td>
<td>610k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX887</td>
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<td>1/1.8 type</td>
<td>2.8M</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX894</td>
<td>RJ3D3AF0DT</td>
<td>1/1 type</td>
<td>6M</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX872, ICX810, ICX872</td>
<td>RJ2331AA0PB</td>
<td>1/3 type</td>
<td>520k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ICX873, ICX811, ICX873</td>
<td>RJ2341AA0PB</td>
<td>1/3 type</td>
<td>610k</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
CMOS Image Sensors (CIS)
Sharp CMOS Image Sensors (CIS)

- High-resolution image sensors which can be used in digital cameras and digital camcorders, and can support 4K 60fps video.
- Sharp CIS have higher near-infrared (NIR) sensitivity than competitors.
- Sharp CIS have lower vertical noise than competitors:

  ![Vertical Noise Level Comparison Diagram]

  - **Available Models:**
    - RJ5DY1BA0LT - 13M, 4K2K 60fps, 4144x3096 resolution
    - RJ52V1BA0LT - 9M, 4K2K 60fps, 3968x2232 resolution
## Compare Sharp CMOS Image Sensor with competitor models

<table>
<thead>
<tr>
<th>Specification</th>
<th>SHARP</th>
<th>S company</th>
<th>O company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Name</td>
<td>RJ52V1BA0LG (2/3’ 8M)</td>
<td>(1&quot; 20M)</td>
<td>(1/9&quot; VGA)</td>
</tr>
<tr>
<td>Fab.</td>
<td>Fukuyama F4</td>
<td>S company</td>
<td>T company</td>
</tr>
<tr>
<td>Process Generation</td>
<td>130nm FSI</td>
<td>65nm BSI</td>
<td>110nm FSI</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>2.5um²</td>
<td>2.4um²</td>
<td>2.5um²</td>
</tr>
<tr>
<td>Voltage Supply</td>
<td>3.0V/1.8V</td>
<td>2.9V/1.8V/1.2V</td>
<td>2.8V/1.5V/1.8V</td>
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<tr>
<td>Dynamic Range</td>
<td>75.4dB</td>
<td>75.3dB</td>
<td>71dB</td>
</tr>
<tr>
<td>Max SN-ratio</td>
<td>43dB</td>
<td>42dB</td>
<td>38dB</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>19.5ke/luxs</td>
<td>17ke/luxs</td>
<td>18ke/luxs</td>
</tr>
<tr>
<td>Full Well Capacity</td>
<td>10ke</td>
<td>12ke</td>
<td>6.5ke</td>
</tr>
<tr>
<td>Read Noise</td>
<td>1.6e</td>
<td>1.75e</td>
<td>2.0e</td>
</tr>
<tr>
<td>Dark Current @60℃</td>
<td>15e/sec</td>
<td>10e/sec</td>
<td>100e/sec</td>
</tr>
<tr>
<td>White Pixel @60℃</td>
<td>500ppm</td>
<td>400ppm</td>
<td>2,000ppm</td>
</tr>
</tbody>
</table>
SHARP continues to develop CIS for a wide range of applications, not only for surveillance but also for FA, ITS, Drone, 3D-IR and more.

<table>
<thead>
<tr>
<th>~2016FY</th>
<th>2017FY</th>
<th>2018FY</th>
<th>2019FY～</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8K model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1type 12Mpixels CIS RJ5DY1BA0LT</td>
<td><strong>4/3” 33M RS-CIS</strong>&lt;br&gt;Pixel size 2.45um&lt;br&gt;60fps/30fps</td>
<td><strong>4/3” 35M RS-CIS</strong>&lt;br&gt;Pixel size 2.32um&lt;br&gt;60fps/30fps&lt;br&gt;Cinema size 17:9&lt;br&gt;TS:2018/11 MP:2019/01</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>4/3” 33M RS-CIS</strong>&lt;br&gt;Pixel size 2.45um&lt;br&gt;60fps/30fps</td>
<td><strong>2/3” 35M RS-CIS</strong>&lt;br&gt;Pixel size 1.9um&lt;br&gt;TS:2019/01 MP:2019/08</td>
</tr>
<tr>
<td><strong>Under 4K model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1/3.8” 1.4M IR GS-CIS</strong>&lt;br&gt;Pixel size 2.8um&lt;br&gt;TS:2019/11 MP:2020/03</td>
<td><strong>1/3” 2M-IR GS-CIS</strong>&lt;br&gt;Pixel size 2.8um&lt;br&gt;TS:2019/11 MP:2020/03</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1/1.8” 8.9M GS-CIS</strong>&lt;br&gt;Pixel size 3.45um&lt;br&gt;TS:2018/11 MP:2019/10</td>
<td><strong>1/3” 5M GS-CIS</strong>&lt;br&gt;Pixel size 3.45um&lt;br&gt;TS:2018/08 MP:2018/10</td>
<td><strong>1/3” 1.4M-IR GS-CIS</strong>&lt;br&gt;Pixel size 2.8um&lt;br&gt;TS:2019/01 MP:2019/08</td>
</tr>
<tr>
<td></td>
<td><strong>4K2K</strong></td>
<td><strong>4K2K</strong></td>
<td></td>
</tr>
</tbody>
</table>
About Socle Technology Corp.

- Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
- Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
- 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
- Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
- Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
- Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

http://www.socle-tech.com/
Sharp Dust Sensors

Product Introduction

July 2018
Dust Sensor Applications

- Air purifier / air cleaner
- Air conditioner
- Air quality monitor
- Vacuum cleaner
- HVAC, environmental monitoring
- Portable consumer products
- Wearable products and smartphone integration
- Customers range from home appliance makers to startup companies
- Lots of interest from research institutions / universities (search GP2Y1010)
Dust Sensor Principles

**Principle**

Measuring the intensity of the scattered light by dust

**Applications**

- Air pollution Alert
- Fan control
- Information by smartphone
- Air purifier
- Air conditioner

**Internal structure**

- Photo detector
- Lens
- Light Emitter

**Size:** 40 x 30 x 17.0mm

**Conventional Model**

- Analog Output
- Concentration
  - Output [V]
  - Total concentration only

**New Model**

- Particle counter method by new original control IC
- Selectable particle size (PM2.5/PM10)
- Compact and Low power consumption

**Dust signal**

- PM10
- PM2.5

- No dust

**Digital output**
## Key Concepts

<table>
<thead>
<tr>
<th>Dust Size</th>
<th>PM$_{2.5}$</th>
<th>PM$_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>is the diameter of a dust particle which is measured in microns (µm) which is the same as a micrometre.</td>
<td>is particulate matter $&lt; 2.5$ microns in diameter such as combustion particles, organic compounds and metals. Also called fine particles and most are hazardous to human health.</td>
<td>is particulate matter $&lt; 10$ microns in diameter such as dust, pollen and mold. Human hair is 50 to 70 microns in diameter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dust Density</th>
<th>Output Voltage</th>
<th>Sensitivity Accuracy</th>
<th>Fan / Airflow</th>
<th>Output At No Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td>is measured in units of mass / volume such as µg/m$^3$ or mg/m$^3$.</td>
<td>Sharp Dust Sensors generally output a voltage. The higher the voltage, the higher the dust density.</td>
<td>Detect changes in dust density of 100 µg/m$^3$ with Accuracy of 15%.</td>
<td>Sharp dust sensors generally require some airflow. This can be from a fan or wind generating air speed of 0.5~3m/s.</td>
<td>When there is no dust, sensor may still output a value Voc which can help distinguish between sensor not working versus no dust situation.</td>
</tr>
</tbody>
</table>

**Design Considerations**
- Placement and orientation of sensor,
- mounting method
# Sharp Dust Sensors - Current Product Lineup

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>SUITABLE FOR NEW DESIGN</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DUST SENSORS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP2Y1010AU0F</td>
<td>N</td>
<td>Active, older model, very well-known product</td>
</tr>
<tr>
<td>GP2Y1014AU0F</td>
<td>Y</td>
<td>Low cost, high volume sales worldwide, lots of interest from cost down projects, similar to GP2Y1010AU0F</td>
</tr>
<tr>
<td>GP2Y1023AU0F</td>
<td>N</td>
<td>Active, but not very popular, PWM output model</td>
</tr>
<tr>
<td>GP2Y1026AU0F</td>
<td>Y</td>
<td>Launched in 2017, promotable model for new designs. Demo kit with sensor, cable, and Arduino source code available.</td>
</tr>
<tr>
<td>GP2Y1027AU0F</td>
<td>Y</td>
<td>New product launched in Q1, 2018</td>
</tr>
<tr>
<td>GP2Y1030AU0F</td>
<td>Y</td>
<td>Launched in 2017, few production customers, high cost</td>
</tr>
<tr>
<td><strong>PM2.5 ONLY SENSOR MODULES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN7C3CA007</td>
<td>N</td>
<td>Very few production customers, very high cost, may be phased out</td>
</tr>
<tr>
<td>DN7C3CD015</td>
<td>N</td>
<td>Very few production customers, very high cost, may be phased out</td>
</tr>
</tbody>
</table>
Sharp Dust Sensors Roadmap

2017

- **Low End**
  - Analog output
    - MP: Now
    - Basic model
    - GP2Y1010AU0F
    - Measurement accuracy 100μg/m³ ± 30%
  - Improved accuracy
    - MP: Now
    - GP2Y1014AU0F
    - Measurement accuracy 100μg/m³ ± 15%

2018

- **With Microcomputer**
  - Advanced accuracy
    - MP: Now
    - GP2Y1023AU0F
    - PWM output
      - Measurement accuracy 100μg/m³ ± 15%
  - For Air purifier
    - UART output
      - Measurement accuracy 100μg/m³ ± 10% (Current model is ± 15%)

2019

- **Super Small Size**
  - Under planning
    - GP2Y10**AU0F
    - For smart phone
      - Reflective type
      - Super small package
      - Detect PM2.5/PM10/Total dust qty separately
      - Detectable in no wind condition

---

**Detectable PM2.5/PM10 separately**

- TS: Now
- MP: Now
- GP2Y1030/31AU0F
  - Output: UART/I2C
  - Particle counter method
    - Smaller than PM2.5/Bigger than PM2.5
    - ALL separate detectable

---

**Dust sensor with fan (Laser Type)**

- TS: 2018/7
- MP: 2018/11
- GP2Y10**AU0F
  - High accuracy without being affected by air volume
    - PM2.5/PM10/total separate detectable

---

**Middle Range**

- GP2Y1030/31AU0F
  - Output: UART/I2C
  - Particle counter method
    - Smaller than PM2.5/Bigger than PM2.5
    - ALL separate detectable

---

**Particle Size PM2.5 only model**

- Analog output
  - MP: Now
  - DN7C3CA007
- Digital output
  - MP: Now
  - DN7C3CD015
## Comparison between Recommended Models for New Design

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>KEY FEATURES</th>
<th>OUTPUT INTERFACE</th>
<th>SENSITIVITY ACCURACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP2Y1014AU0F</td>
<td>Improved accuracy over GP2Y1010AU0F</td>
<td>Analog output</td>
<td>0.5 ± 0.075V 100µg/m³ Accuracy ±15%</td>
</tr>
<tr>
<td>GP2Y1026AU0F</td>
<td>Built-in LED pulse drive circuit, built-in microcomputer to provide offset correction, averaging, and temperature correction. Supports wider range of dust concentrations.</td>
<td>Digital output (UART)</td>
<td>0.35 ± 0.06V 100µg/m³ Accuracy ±15%</td>
</tr>
<tr>
<td>GP2Y1027AU0F</td>
<td>Similar to GP2Y1026AU0F but with improved accuracy</td>
<td>Digital output (UART)</td>
<td>100µg/m³ Accuracy ±10%</td>
</tr>
<tr>
<td>GP2Y1030AU0F</td>
<td>Particle counter method, detect PM$<em>{2.5}$ or PM$</em>{10}$ separately or both</td>
<td>Digital output (UART)</td>
<td>100µg/m³ Accuracy ±15%</td>
</tr>
</tbody>
</table>
GP2Y1014AU0F - Analog output, basic model

- Analog output, similar in function to GP2Y1010AU0F
- Newer sensor model which can replace GP2Y1010AU0F
- Improved accuracy over GP2Y1010AU0F (15% versus 30%)
- Lower cost than GP2Y1010AU0F due to higher volume worldwide sales

<table>
<thead>
<tr>
<th>Model</th>
<th>GP2Y1010AU0F</th>
<th>GP2Y1014AU0F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outline</strong></td>
<td>Normal sensitivity</td>
<td>Improved Accuracy</td>
</tr>
<tr>
<td></td>
<td>For general customer</td>
<td>Narrow output range when</td>
</tr>
<tr>
<td></td>
<td></td>
<td>there is no dust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For general customer</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td><strong>Output at no dust</strong></td>
<td><strong>Output at no dust</strong></td>
</tr>
<tr>
<td></td>
<td>0 ~ 1.5V</td>
<td>0.1 ~ 1.1V</td>
</tr>
<tr>
<td><strong>Sensitivity Accuracy</strong></td>
<td>Normal sensitivity</td>
<td>Normal sensitivity</td>
</tr>
<tr>
<td></td>
<td>0.5 ± 0.15V / (0.1mg/m³)</td>
<td>0.5 ± 0.075V / (0.1mg/m³)</td>
</tr>
<tr>
<td></td>
<td>Accuracy ±30%</td>
<td>Accuracy ±15%</td>
</tr>
</tbody>
</table>
## GP2Y1014AU0F - Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GP2Y1014AU0F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light emitting element</td>
<td>LED</td>
</tr>
<tr>
<td>Minimum dust size</td>
<td>0.5μm</td>
</tr>
<tr>
<td>Sensing range (PM2.5)@tabacco-smoke</td>
<td>~ 580μg/m³ (Actual value)</td>
</tr>
<tr>
<td>Sensitivity accuracy</td>
<td>±15%</td>
</tr>
<tr>
<td>Output interface</td>
<td>Analog voltage</td>
</tr>
<tr>
<td>Sensing time</td>
<td>&lt; 1 second</td>
</tr>
<tr>
<td>Sensing of each dust size separately</td>
<td>No (measures total dust density only)</td>
</tr>
<tr>
<td>Sensor lifetime</td>
<td>5 years</td>
</tr>
<tr>
<td>User maintenance</td>
<td>suction by vacuum cleaner</td>
</tr>
<tr>
<td>Power consumption</td>
<td>105 mW</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-10 ~ 65°C</td>
</tr>
</tbody>
</table>
GP2Y1026AU0F - Digital output (UART), built-in microcomputer

Features

1. High accuracy: ±15%
2. Built-in LED Pulse Drive Circuit
3. Built-in Microprocessor. ★ Dust concentration is converted to Uart signal output. ★ No need for offset correction nor averaging in set.

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td></td>
<td>46×34×17.6mm</td>
</tr>
<tr>
<td>Output interface</td>
<td></td>
<td>Serial Uart</td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>Vcc</td>
<td>5 ± 0.25 V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>Max 20mA</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>K</td>
<td>±15%</td>
</tr>
<tr>
<td>Operating temp.</td>
<td>Topr</td>
<td>-10 to 65 °C</td>
</tr>
<tr>
<td>Storage temp.</td>
<td>Tstq</td>
<td>-20 to 80 °C</td>
</tr>
<tr>
<td>Temp. correction</td>
<td></td>
<td>Correction by microcomputer</td>
</tr>
</tbody>
</table>

*Comparison with model GP2Y10S1AU0F

Outline dimensions

Block diagram
GP2Y1027AU0F - Digital output (UART), high accuracy (NEW)

Features

1. High accuracy: ±10%
   (Current model (GP2Y1026AU0F) is ±15%)

2. Built-in LED Pulse Drive Circuit

3. Built-in Microprocessor:
   ★ Dust concentration is converted to Uart signal output.
   ★ No need for offset correction nor averaging in set.


Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td></td>
<td>46x34x17.6mm</td>
<td>Same</td>
</tr>
<tr>
<td>Output interface</td>
<td></td>
<td>serial Uart</td>
<td>Same</td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>Vcc</td>
<td>5 ± 0.25 V</td>
<td>Same</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>Max 20mA</td>
<td>Same</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>K</td>
<td>±10%</td>
<td>@</td>
</tr>
<tr>
<td>Operating temp. Topr</td>
<td></td>
<td>-10 to 65 °C</td>
<td>Same</td>
</tr>
<tr>
<td>Storage temp. Tstg</td>
<td></td>
<td>-20 to 80 °C</td>
<td>Same</td>
</tr>
<tr>
<td>Temp. correction</td>
<td></td>
<td>Correction by microcomputer</td>
<td>Same</td>
</tr>
</tbody>
</table>

Outline dimensions

Block diagram
GP2Y1027AU0F - Comparison with other models

<table>
<thead>
<tr>
<th>Compare Item</th>
<th>Dust sensor Current model (GP2Y1026AU0F)</th>
<th>High accuracy Dust sensor (Target spec.) (GP2Y1027AU0F)</th>
<th>VS Dust sensor (Laser type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing system</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Minimum dust size</td>
<td>–</td>
<td>0.5μm</td>
<td>0.3μm</td>
</tr>
<tr>
<td>Sensing range (PM2.5)@Tabacco-smoke</td>
<td>–</td>
<td>~1000ug/m³ (Actual value)</td>
<td>~550ug/m³</td>
</tr>
<tr>
<td>Sensitivity accuracy</td>
<td>×</td>
<td>±15%</td>
<td>±10%</td>
</tr>
<tr>
<td>Output interface</td>
<td>–</td>
<td>Serial data (UART)</td>
<td>Serial data (UART)</td>
</tr>
<tr>
<td>Sensing time</td>
<td>1sec</td>
<td>1sec</td>
<td>&lt;10sec</td>
</tr>
<tr>
<td>Sensing of each dust size</td>
<td>×</td>
<td>No(Total dust density)</td>
<td>1.0/2.5/10μm</td>
</tr>
<tr>
<td>Life time</td>
<td>5years</td>
<td>5years</td>
<td>3years</td>
</tr>
<tr>
<td>User maintenance</td>
<td>Cleaning by vacuum</td>
<td>Cleaning by vacuum</td>
<td>Impossible (Structure dust tends to accumulate)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>125mW</td>
<td>125mW</td>
<td>500mW (With fan motor)</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-10~65°C</td>
<td>-10~65°C</td>
<td>-20 ~ 50 °C</td>
</tr>
</tbody>
</table>
GP2Y1027AU0F - Accuracy Data

Technology of SHARP (GP2Y1027AU0F)

- GP2Y1027 adopted the “average concentration method”
  High-speed averaging. Averaging 100 times the detection signal in one second.
  Stable dust concentration measurement can be conducted!
- Good correlation with TSI measuring instrument!
  TSI Inc. easily calculate the concentration display value. No heavy work!

![Graph showing accuracy data]

- Measurement conditions:
  [Installation situation]:
  "China standard TSI Inc.(Type8630)", "SHARP (#1027)", simultaneous measurement
  in the environment BOX (size:1m³). (n=4)
  [China standard TSI Inc. DustTrak®8630]
  Note: Adopt the coefficient K = 0.27, K value, you must decide to suit your measurement environment.
  [Measurement Particles]: tobacco smoke (Nevius)
GP2Y1030AU0F - Digital output (UART), PM2.5 / PM10 separately detectable

**Features**

1. PM2.5 >, PM2.5 <, TOTAL detected separately. Up to 3 mode can be measured.
2. Serial Data Output (UART/I2C)
3. Little influence of dust deposition on characteristics. Possible to clean the lens and inside wall surface.

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>Vcc</td>
<td>5V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>TYP. 26mA</td>
</tr>
<tr>
<td>Dust Range</td>
<td></td>
<td>~ 200μg/m³</td>
</tr>
<tr>
<td>Minimum dust size</td>
<td></td>
<td>&lt; 1μm</td>
</tr>
<tr>
<td>Start-up time</td>
<td></td>
<td>&lt; 5sec</td>
</tr>
<tr>
<td>Output interface</td>
<td></td>
<td>UART/I2C</td>
</tr>
<tr>
<td>Detection dust size</td>
<td></td>
<td>PM2.5/PM10/etc.</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>Topr</td>
<td>-10 ~ 50°C</td>
</tr>
<tr>
<td>Storage Temp.</td>
<td>Tstr</td>
<td>-20 ~ 80°C</td>
</tr>
</tbody>
</table>

**Outline dimensions**

![Outline dimensions diagram]

**Block diagram**

![Block diagram]
### GP2Y1030AU0F - Comparison with other models

<table>
<thead>
<tr>
<th>Compare Item</th>
<th>SHARP Dust sensor (GP2Y1023AU0F)</th>
<th>New Dust sensor (Target spec.) (GP2Y1030AU0F)</th>
<th>Another S company Dust sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum dust size</td>
<td>○ 0.5µm</td>
<td>○ 1µm</td>
<td>○ 1µm</td>
</tr>
<tr>
<td>Sensing range (PM2.5)@Tabacco smoke</td>
<td>○ 25~500ug/m³</td>
<td>○ 25~500ug/m³</td>
<td>○ ~500ug/m³</td>
</tr>
<tr>
<td>Sensitivity accuracy</td>
<td>±15%</td>
<td>±15%</td>
<td>2700pcs./283ml ± 35% (Lo Pulse Time 5%)</td>
</tr>
<tr>
<td>Output interface</td>
<td>PWM</td>
<td>Serial data (UART/I2C)</td>
<td>Pulse duty</td>
</tr>
<tr>
<td>Start-up time</td>
<td>&lt;1sec</td>
<td>&lt;5sec</td>
<td>60sec</td>
</tr>
<tr>
<td>Sensing time</td>
<td>&lt;1sec</td>
<td>10sec</td>
<td>10 ~ 30sec</td>
</tr>
<tr>
<td>System for separating PM2.5</td>
<td>× No</td>
<td>× No</td>
<td>× No</td>
</tr>
<tr>
<td>Sensing of each dust size</td>
<td>No</td>
<td>Yes (Output of 3 range particle size is possible)</td>
<td>No (Possible in data processing)</td>
</tr>
<tr>
<td>Temp. correction</td>
<td>Correction by microcomputer</td>
<td>Correction by sensor circuit</td>
<td>Unknown</td>
</tr>
<tr>
<td>User maintenance</td>
<td>Suction by vacuum cleaner</td>
<td>Cleaning inside of sensor</td>
<td>Cleaning inside of sensor</td>
</tr>
<tr>
<td>Power consumption</td>
<td>125mW Possible intermittent operation</td>
<td>125mW Possible intermittent operation</td>
<td>450mW</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-10 ~ 65°C</td>
<td>-10~65°C</td>
<td>Sensing system</td>
</tr>
</tbody>
</table>
GP2Y10**AU0F - High accuracy dust sensor with built-in Fan (Laser Diode)

Features
- High accuracy: High correlation with TSI ±10%
  (The accuracy is same level as plantower in total dust quantity(Cigarette))
- PM2.5>, PM2.5<, Total detected separately.
- Using laser diode for light emitting element
- With fan motor to prevent the effect of airflow

Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output interface</td>
<td>I2C</td>
<td>~100kHz</td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>$V_{CC}$</td>
<td>4.5-5.5V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>$I_{CC}$</td>
<td>Max.140mA</td>
</tr>
<tr>
<td>Accuracy</td>
<td>$K$</td>
<td>±10%</td>
</tr>
<tr>
<td>Operating temp.</td>
<td>$T_{op}$</td>
<td>-10 to 65°C</td>
</tr>
<tr>
<td>Storage temp.</td>
<td>$T_{stg}$</td>
<td>-20 to 80 °C</td>
</tr>
</tbody>
</table>

Block diagram

Outline

*Using laser diode for light emitting element.

Under Planning
Dust Sensor Resources

- https://github.com/sharpsensoruser/sharp-sensor-demos/wiki
- Application Note for Sharp dust sensor GP2Y1010AU0F
- http://arduinodev.woofex.net/2012/12/01/standalone-sharp-dust-sensor/
- https://github.com/Trefex/arduino-airquality/tree/master/Module_Dust-Sensor
- https://github.com/PaulZC/GP2Y1010AU0F_Dust_Sensor
- https://github.com/vlytsus/arduinosensor
- https://github.com/chiknhed/sharp_dust_gp2y1010au
- http://hazardweatherstation.blogspot.ca/2012/06/optical-dust-sensor.html
- http://arduinosensor.tumblr.com/page/2
Dust Sensor Resources

- https://pdfs.semanticscholar.org/d641/19160b9effd57448b44d39d5ac5468ed0eff.pdf
- http://eereview.com/article/gp2y1014au0f-pm25-optical-dust-density-sensor
- https://www.ama-science.org/proceedings/getFile/ZwD2BD==
- http://www.aresok.org/npg/nioshdb斯(calc.htm
About Socle Technology Corp.

• Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
• Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
• 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
• Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
• Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
• Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

http://www.socle-tech.com/
Sharp Distance Sensors (DMS and TOF)

Product Introduction

July 2018
Sharp Distance Sensors

- Multiple product lines related to distance sensing (DMS, ToF, Proximity)
- **DMS** = Distance Measuring Sensor (measure position of reflected light)
- **ToF** = Time-of-Flight Sensor (measure time it takes to receive reflected light)
- Most DMS and ToF sensors return absolute distance
- Some DMS and Proximity sensors are designed for object detection only
- Each type of sensor has an effective measuring range (or distance)

DMS - GP2Y0A41SK0F
ToF - GP2AP0AVT10F
ToF Module - MTOF171000C0
Proximity - GP2AP070S00F
DMS
Distance Measuring Sensor Applications

- Robot vacuum cleaners
- Automatic faucets
- ATM, self-service kiosk
- Consumer/toy robotics
- Copier, vending machine, video game machine
- Automatic control of lighting
- Factory automation
- Sharp has 70% market share for DMS worldwide
Distance Measuring Sensor Principles - PSD (position sensitive detector)

Principle of DMS

- Reflected infrared light from a distant object will reach the PSD at a different position than infrared light from a nearby object.
- Current I1, I2 change proportionally to infrared spot position.
- Distance determined by calculation.

Graphs showing output voltage Vs distance for GP2Y0D21YK0F and GP2Y0A21YK0F.
Distance Measuring Sensor Applications

- Detecting obstacle for robot cleaner
  - GP2Y0A15*
  - GP2Y0AF30*
  - GP2Y0E**

- Detecting to sit on toilet seat
  - Auto ON/OFF control for seat heater
  - GP2Y0AF30*

- Auto ON/OFF control for sanitary equipments
  - GP2Y0D805Z0F
  - GP2Y0D810Z0F

- Hand dryer/Flush valve
  - GP2Y0D805Z0F
  - GP2Y0D810Z0F

- Auto ON/OFF control for PC monitor
  - GP2Y0A60S20F

- Detecting human body for ATM
  - GP2Y0A21YK0F

**Note:** SHARP logo is present at the bottom left and right corners of the image.
Distance Measuring Sensor Applications

- Auto ON/OFF control for illumination
  - GP2Y0A02YK0F

- Detecting paper through for copier
  - GP2Y0D810Z1F

- Detecting amount of paper for copier
  - GP2Y0AF30*

- Measuring distance for Auto focus of projector
  - GP2Y0A710K0F

- Sensing amount of ice for refrigerator
  - GP2Y0AF30*

- Detecting hand for amusement equipment
  - Switch the view by touch-less operation
  - GP2Y0E**
DMS #1 Application: Robot cleaner

**Features**. Step detection sensor - (Triangulation method) infrared sensor
- In the dark, the infrared sensor that can detect a difference in level.
- Less influence of the floor color (Black or White), accurately detect the floor!

**Features**. Detecting a distance from the wall. Anti-collision sensor to the wall.
The CMOS sensor mounting distance measuring sensor.
- Detection distance range 4~50cm. Detection accuracy ±10%.
- Communication specification, Both Analog and I2C type, Analog output type, I2C output type.
Lineup of DMS

**Analog output type**
- Standard type
  - GP2Y0A51SK0F: 2～15 cm, 27 x 10.8 x 12 mm
  - GP2Y0A41SK0F: 4～30 cm, 29.5 x 18.9 x 13.5 mm
  - GP2Y0A21YK0F: 10～80 cm, 29.5 x 18.9 x 13.5 mm
  - GP2Y0A02YK0F: 20～150 cm, 29.5 x 18.9 x 21.6 mm
- Compact connector type
  - GP2Y0AF15: 1.5～15 cm, 21.2 x 8.9 x 6.3 mm
  - GP2Y0AF30: 4～30 cm, 20 x 8.9 x 9.0 mm

**I2C output type**
- Compact&Hi-accuracy CMOS type
  - GP2Y0E02A: Measuring range 4～50 cm, 18.9 x 8 x 5.2 (height) mm
- Both Analog / I2C type
  - Compact&Hi-accuracy CMOS type
    - GP2Y0E02B: Measuring range 4～50 cm, 18.9 x 8 x 5.2 (height) mm
    - GP2Y0E03: Measuring range 4～50 cm, 16.7 x 11 x 5.2 (height) mm

**1bit Hi/Low digital Output type**
- Standard type
  - GP2Y0D413K0F: 13 cm, 29.5 x 13 x 13.5 mm
  - GP2Y0D21YK0F: 24 cm, 29.5 x 18.9 x 13.5 mm
  - GP2Y0D02YK0F: 80 cm, 29.5 x 18.9 x 21.6 mm
- Compact lead type
  - GP2Y0D805Z0F / GP2Y0D810Z0F / GP2Y0D815Z0F: Identifying distance 5 cm / 10 cm / 15 cm, Able to be driven by battery 13.6 x 7 x 7.96 mm
## Distance Measuring Sensors - Analog Output

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>MEASURING RANGE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP2Y0AF15Q</td>
<td>1.5 cm ~ 15 cm</td>
<td>Compact, connector type, other models GP2Y0AF15Y, GP2Y0AF15R</td>
</tr>
<tr>
<td>GP2Y0A51SK0F</td>
<td>2 cm ~ 15 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td>GP2Y0A41SK0F</td>
<td>4 cm ~ 30 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td>GP2Y0A21YK0F</td>
<td>10 cm ~ 80 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td>GP2Y0A02YK0F</td>
<td>20 cm ~ 150 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td>GP2Y0A60SZLF</td>
<td>10 cm ~ 150 cm</td>
<td>Compact, long distance type, no external control signal required</td>
</tr>
<tr>
<td>GP2Y0A710K0F</td>
<td>100 cm ~ 550 cm</td>
<td>Long distance type, no external control signal required</td>
</tr>
</tbody>
</table>

### ANALOG OUTPUT - CMOS TYPE

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>MEASURING RANGE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP2Y0E02A</td>
<td>4 cm ~ 50 cm</td>
<td>Compact, high accuracy, CMOS type, Analog Output</td>
</tr>
<tr>
<td>GP2Y0E03</td>
<td>4 cm ~ 50 cm</td>
<td>Compact, high accuracy, CMOS type, Analog / I2C Output</td>
</tr>
</tbody>
</table>
## Distance Measuring Sensors - Digital Output

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>MEASURING RANGE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIGITAL OUTPUT - 1 BIT HIGH/LOW FOR OBJECT DETECTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP2Y0D805Z0F</td>
<td>5 cm</td>
<td>Compact, lead type</td>
</tr>
<tr>
<td>GP2Y0D810Z0F</td>
<td>10 cm</td>
<td>Compact, lead type</td>
</tr>
<tr>
<td>GP2Y0D815Z0F</td>
<td>15 cm</td>
<td>Compact, lead type</td>
</tr>
<tr>
<td>GP2Y0D21YK0F</td>
<td>24 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td>GP2Y0D02YK0F</td>
<td>80 cm</td>
<td>Standard type</td>
</tr>
<tr>
<td><strong>DIGITAL OUTPUT - CMOS TYPE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP2Y0E02B</td>
<td>4 cm ~ 50 cm</td>
<td>Compact, high accuracy, CMOS type, I2C Output</td>
</tr>
</tbody>
</table>
TOF Sensor
Sharp ToF Sensor

- Time-of-Flight distance ranging sensor **GP2AP01VT10F**
- Operates using a Class 1 laser (940 nm)
- Measures absolute distance with high accuracy
- Effective distance range from 5 cm to 120 cm
- Small ceramic package (4.4 x 2.4 x 1.0mm)
- I2C interface for input and output
- High speed ranging - max 30 ms
- Applications:
  - High-speed autofocus (AF) for smartphone camera
  - Continuous AF for video
  - User detection for PCs, laptops, tablets
  - Robotics obstacle detection
  - White goods hand detection for automatic faucets
Sharp ToF Sensors Roadmap - Proximity ToF, long range ToF, multi-point ToF

**ToF (Time of flight)**

⇒ SPAD (※) original circuit design technology

**Differentiation, Low power consumption.**

※Single Photon Avalanche Diode

- **2017**
  - ① GP2AP01VT10F 1D-ToF
    - Measurement range: 120cm
    - (for Smart home/PC)
      - Camera AF assistance
      - Human detection for PC
      - Size: 4.4×2.2×1.0mm

- **2018**
  - ② Small package 1D-ToF
    - Measurement range: 70cm @ Grey
    - (for Smartphone)
      - Size: 3.6×2.2×1.0mm
      - Direct distance output without calculation
      - Proximity function by absolute distance
      - Low power consumption
  - ③ Ultra Long range, 1D-ToF
    - Measurement range: 10m
    - (for Robot/FA)
      - Ultra Long range detection
      - Tolerant of noises
  - ④ Multipoint-ToF (128×128)
    - Measurement range: 500cm
    - (for VR/AR)
      - Ultra low power consumption
      - Gesture recognition detection
      - Assistance for 3D image sensor

- **2019**
  - ⑤ Ultra long range, multipoint-ToF
    - Measurement range: 10m
    - (for FA/Robot/Smart Home)
      - Ultra long range for surveillance
      - Super high resolution
  - Under planning: TS: Apr., 2019
  - Under planning: TS: Dec., 2018

**NOW**

- MP: Now
### Features
- All in one (SPAD detector, IR-VCSEL emitter)
- Small package: 4.4 × 2.4 × 1.0 mm
- ToF sensing using low-cost standard CMOS process
- Eye safe optimization by excellent light emission drive circuit
- Realization of low crosstalk noise due to ceramic structure

### Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td></td>
<td>4.4 × 2.4 × 1.0 mm</td>
</tr>
<tr>
<td>Output interface</td>
<td></td>
<td>I2C 0.4MHz</td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>Vcc</td>
<td>2.6 ~ 3.5V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>30mA</td>
</tr>
<tr>
<td>Ranging speed</td>
<td></td>
<td>33ms</td>
</tr>
<tr>
<td>Ranging distance</td>
<td></td>
<td>10cm ~ 120cm (white card)</td>
</tr>
<tr>
<td>Accuracy at 10cm</td>
<td>K</td>
<td>±20% (black card)</td>
</tr>
<tr>
<td>Operating temp.</td>
<td>Topr</td>
<td>-20 to 70°C</td>
</tr>
<tr>
<td>Storage temp.</td>
<td>Tstg</td>
<td>-40 to 85 °C</td>
</tr>
</tbody>
</table>

### Outline dimensions
Compare DMS with TOF Sensors - Field of View (FOV)

**FOV small area good case**
- DMS good
- Front view only
- Glass door
- Glass wall
- Front view only
- Step detection (High and Low)

**DMS (Small area)**
- Spot size: Φ 20cm

**TOF (Wide area)**
- Spot size: Φ 45cm

**FOV wide area good case**
- TOF good
- AF camera of smartphone
- Wide view object detection
- Wide long view
Compare DMS with TOF and Proximity Sensors - Panel Mounting

Please select sensor by panel mounting condition.

### Distance Measuring Sensor
- **Panel mount condition**: Air Gap: 0 ~ 1.0mm
  - Below 1.0mm: (IR Transmittance: 85%+25%)

#### Detection distance range
- 2~15cm: Model: GP2Y0A51SKOF
- 4~50cm: Model: GP2Y0E03
- 10~80cm: Model: GP2Y0A21YKOF
- 20~150cm: Model: GP2Y0A02YKOF

- **Easy mounting. With Connector and screw holes.**

### TOF Sensor/Proximity Sensor
- **Panel mount condition**: Air Gap: Must 0 ~ 0.5mm
  - Below 0.8mm: (IR Transmittance: 85%+25%)

#### Proximity Sensor
- 0~10cm: Model: GP2AP008/070S
  - Distance accuracy: 10cm±10mm
- **Low Price**

#### TOF Sensor
- 4~120cm: Model: GP2AP01VT10F
  - Distance accuracy: 120cm±5cm
- **Middle range**
- 4~500cm: Next Model TS:03/2018
- **Long range**

- **Multi Long range**
  - Safety sensor
  - AR/VR/Robotics
  - Proximity sensor/Grip Sensor
  - AF Camera of smartphone
## Compare DMS with TOF Sensors - Specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Distance Measuring Sensor TYPE: PSD</th>
<th>Distance Measuring Sensor TYPE: C-MOS</th>
<th>Distance Measuring Sensor TYPE: TOF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Signal Type</strong></td>
<td>Analog voltage output or 1bit digital output (High/Low)</td>
<td>Analog voltage output (I2C output) *Slave address 8 item</td>
<td>I2C output *Slave address 1 item</td>
</tr>
<tr>
<td><strong>Panel design</strong></td>
<td>From panel to sensor distance (Gap)</td>
<td>0 to 1.0mm If a “plate” is inserted between receiving and emitting: 0 to 2.0mm</td>
<td>0 to 1.0mm If a “plate” is inserted between receiving and emitting: 0 to 2.0mm</td>
</tr>
<tr>
<td><strong>Panel thickness</strong></td>
<td>below 1.0mm</td>
<td>below 1.0mm</td>
<td>below 0.8mm</td>
</tr>
<tr>
<td>(IR Transmittance 85 to 95%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Package type</strong></td>
<td>With board. Connector connection possible.</td>
<td>With board. Connector connection possible.</td>
<td>SMD Surface Mount Device</td>
</tr>
<tr>
<td><strong>Package Size</strong></td>
<td>Large Size</td>
<td>Small Size</td>
<td>Ultra-Small Size</td>
</tr>
<tr>
<td><strong>FOV (Field Of View)</strong></td>
<td>±2~5° Spot Size 20cm (at 100cm)</td>
<td>±2~5° Spot Size 10cm (at 50cm)</td>
<td>±13° Spot Size 45cm (at 100cm)</td>
</tr>
<tr>
<td><strong>Detection distance accuracy</strong></td>
<td>Distance 5cm 5cm±1cm</td>
<td>Distance 10cm 10cm±2cm</td>
<td>Distance 120cm 120cm±20cm</td>
</tr>
</tbody>
</table>
## Compare DMS with TOF Sensors - Specification

<table>
<thead>
<tr>
<th>Item</th>
<th>DMS (PSD type)</th>
<th>Small PSD (CMOS type)</th>
<th>Lazar DMS (TOF)</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output type</strong></td>
<td>Analog output High / Low output</td>
<td>Analog output I2C output (Possible to set up 8 slave address)</td>
<td>I2C output (Fixed only one slave address)</td>
<td>CMOS type is suitable in case operating some number at Same timing.</td>
</tr>
<tr>
<td><strong>Panel Design (from Sensor to Panel)</strong></td>
<td>Less than 1 mm (More than 1 mm if shielding wall installs.)</td>
<td>Less than 1 mm (More than 1 mm if shielding wall installs)</td>
<td>Less than 0.5 mm</td>
<td>For panel design, DMS is easier than ToF.</td>
</tr>
<tr>
<td><strong>Panel Thickness</strong></td>
<td>unspecified Recommend less than 2.0 mm</td>
<td>unspecified Recommend less than 1.0 mm</td>
<td>Required less than 0.8 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>Mounted on board with connector</td>
<td>Mounted on board with connector</td>
<td>SMD part</td>
<td>TOF: world smallest parts, but require to mount and need around some parts DMS: Easy to connect</td>
</tr>
<tr>
<td><strong>Distance Measuring Accuracy</strong></td>
<td>Short Range (5 cm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long Range (120 cm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-10°C – 60°C</td>
<td>-10°C – 60°C</td>
<td>-20°C – 70°C</td>
<td>TOF has advantage</td>
</tr>
<tr>
<td><strong>Detection the object has surface like mirror</strong></td>
<td>Impossible</td>
<td>Impossible</td>
<td>Possible</td>
<td>TOF has advantage</td>
</tr>
<tr>
<td><strong>Detection Time</strong></td>
<td>Max: 52.9 ms</td>
<td>Max: 40 ms</td>
<td>28.6 ms (Default)</td>
<td>TOF has advantage</td>
</tr>
<tr>
<td><strong>Operating Voltage</strong></td>
<td>4.5V ~ 5.5V</td>
<td>2.7V ~ 5.5V</td>
<td>2.6V ~ 3.5V</td>
<td>CMOS type DMS has advantage</td>
</tr>
</tbody>
</table>
TOF Module
MTOF17001’s time-of-flight sensing technology is realized by Sharp’s original SPAD (Single Photon Avalanche Diodes) using low-cost standard CMOS process. It enables accurate ranging result, higher immunity to ambient light and better robustness to work by special optical package design.
TOF Applications

Socle’s high performance MTOF17001 is a cost-effective ToF (time-of-flight) Module system. Best-in-class distance measurement performance for a wide range of applications, including robot vacuum cleaners, tablets, drones, and smart home applications.
TOF Applications

Socle’s high performance MTOF17001 is a cost-effective ToF (time-of-flight) Module system. Best-in-class distance measurement performance for a wide range of applications, including robot vacuum cleaners, tablets, drones, and smart home applications.
Product Benefits - MTOF171000C0

- Compact module package
- 940nm Class 1 laser IEC 60825-1:2014-3rd ed
- Measure absolute distance up to 1.2 m
- Shorter working distances may be added later
- High speed distance measurement response
- Advanced optical cross-talk compensation
- Easy to set
- No additional optical calibration requirement
- Single power supply
- Lead-free, RoHS compliant
- Initial version with UART interface only
- I2C may be added if there is sufficient demand
- Demo kit available with module, cable, Arduino code and application manual
- Product brochure

Fundamental function

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCU</td>
<td>8051</td>
</tr>
<tr>
<td>ToF Sensor</td>
<td>GP2AP01VT10F</td>
</tr>
<tr>
<td>F/W version</td>
<td>MTOF17001_D1801_1U</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-20 ~ 70°C</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>2.6V ~ 3.5V</td>
</tr>
<tr>
<td>Current consumption</td>
<td>30mA ( at 2.8V )</td>
</tr>
<tr>
<td>Working Cycle time</td>
<td>33msec</td>
</tr>
<tr>
<td>Working Distance</td>
<td>10cm ~ typ 120cm (White card)</td>
</tr>
<tr>
<td></td>
<td>10cm ~ typ 70cm (Gray card)</td>
</tr>
<tr>
<td>Measurement Accuracy</td>
<td>±4% at 120cm (White card)</td>
</tr>
<tr>
<td></td>
<td>±7% at 70cm (Gray card)</td>
</tr>
<tr>
<td>Control Interface</td>
<td>Uart / I2C Selectable</td>
</tr>
<tr>
<td>Sensor board Package</td>
<td>6pin / 10×12×3.5mm</td>
</tr>
</tbody>
</table>
TOF Module versus Sensor

- The TOF sensor GP2AP01VT10F is typically not used just by itself
- Usually it requires PCBA consideration, a cover glass, and calibration
- ToF applications involve optical + mechanical + electrical system
- This requires some expertise with optical design and calibration
- Many customers do not have ability to tune or modify the TOF firmware
- Some customers also only know how to use UART or GPIO interface
- So the **TOF Module** has been developed for ease of customer use
- First version of TOF Module will have UART interface only, I2C will follow if demand
- Shorter working distance range may also be supported
- Applications include smart home, robot cleaners, lighting control
- Some customers may require changes to PCBA layout or the cover lens
  - Order MOQ will be higher in these cases requiring customization
TOF Module Outline
TOF Module Views

Top / Angle View

Bottom / Angle View
About Socle Technology Corp.

- Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
- Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
- 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
- Sales and marketing for Sharp Optoelectronics components and sensors in North America and China since 2017
- Parts are still designed and manufactured by Sharp, no change in production or packaging or branding
- Authorized distributors: WPG Americas, Future Electronics, Mouser, Digi-Key, WPI Group

For more information, contact: Socle_Sales_NA@socle-tech.com

http://www.socle-tech.com/
Sharp Proximity Sensors
Product Introduction
July 2018
Sharp Proximity Sensors

• Proximity sensors are small, low-cost sensors designed for smartphones
• Used for object detection but generally do not return absolute distance
• Primary application is user detection (e.g. 10 cm)
• Potential for off-label use such as touchless switch, robot cleaners
• Current Models (I2C Output):
  • GP2AP070S00F - Proximity Sensor (high accuracy)
  • GP2AP007A00F - Proximity + ALS (Ambient Light Sensing)
  • GP2AP054A00F - Proximity + Gesture + ALS
• New Models under Development:
  • GP2AP080C00F - Proximity + RGB - for AMOLED display, camera adjustment
  • GP2AP090S00F - Laser Diode (IR-VCSEL) Proximity Sensor
• Under Planning:
  • Proximity function using 1D-TOF sensor (can return absolute distance)
Proximity Sensor and Ambient Light Sensor Basics

- **Proximity Sensor (PS)**
  - Cell Phone Touch-Screen Auto Disable/ Auto Enable.
  - Mechanical Switch Replacement.

- **Ambient Light Sensor (ALS)**
  The Ambient Light Sensor (ALS) has a wide range of performance allowing accurate ALS measurements in lighting environments ranging from low-light to bright sunlight.

  This Sensor is particularly useful for display management dimming or brightness control with the purpose of reducing power consumption, extending battery life, and providing the optimum viewing in diverse lighting conditions.

- **Principle of operation and configuration**
  Illuminate the infrared LED, digitally output the amount of light reflected from the object and convert it into distance.

  Various malfunction prevention algorithms are realized with hardware and software.

  By our proprietary packaging technology, the proximity sensor and the illuminance sensor interfere.

  It is formed without integral formation.
Sharp Proximity Sensors Roadmap

2018

New① Under development [VCSEL Proximity Sensor]
- GP2AP090S00F Mount easy type!
- Not need a height board.
- Not need a rubber cap.
- TS: May, 2018
- MP: September, 2018

New② Under development [RGB with Proximity sensor]
- GP2AP080C00F One hole, hidden type for OLED Display
- TS: September, 2018
- MP: December, 2018

New③ Under planning [Ultra wide FOV Proximity sensor]
- Side wall mounting type
- Ultra wide FOV Proximity for bezel-less smartphone
- TS: December, 2018

Mass production Lineup (Now product)

[Small Type Proximity with ALS]
- GP2AP007A00F One hole type & Small size
- ES: Now
- MP: Now
- Grip sensing.
- For frame less display.

[High accuracy of Proximity sensor]
- GP2AP070S00F PS variability under ±10%
- ES: Now
- MP: Now (Production results 5000K/Month)
Compare Proximity Sensors with DMS and TOF Sensors - Panel Mounting

Please select sensor by panel mounting condition.

Distance Measuring Sensor

- Detection distance range
  - 2～15cm: Model GP2Y0A51SK0F
  - 4～50cm: Model GP2Y0A03
  - 10～80cm: Model GP2Y0A21YK0F
  - 20～150cm: Model GP2Y0A02YK0F

Easy mounting. With Connector and screw holes.

TOF Sensor/Proximity Sensor

- Proximity Sensor
  - 0～10cm: Model GP2AP008/070S
    - Low Price
      - Distance accuracy: 10cm ± 10mm
  - 4～120cm: Model GP2AP01VT10F
    - Middle range
      - Distance accuracy: 120cm ± 5cm

- TOF Sensor
  - 4～500cm: Under planning

Small spacing.
Proximity Sensor - GP2AP070S00F

**Features**

**Type:** GP2AP070S00F

**Overview**
- All in one (Photo-diode detector, LED emitter)
- Two hole window type
- Package Size: 4.0mm × 2.0mm × 1.1mm
- Operation voltage: 2.2V to 3.6V
- Low Power consumption: 0.18μm process technology with 1.8V, I2C bus interface
- Design:
  - Hidden design by black Regine Integrated IR LED and Synchronous LED Driver

**Proximity function**

*High accuracy of Proximity Sensor, Factory calibrated PS detection.*

- Cancellation of cross-talk: offset adjustment registers
- Full Scale: Up to 14-Bits

**I2C Interface compatible**

- Clock frequency: Up to 400kHz
- Dedicated Interrupt Pin

**Specification**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Characteristics</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation voltage</td>
<td>Vcc</td>
<td>2.2 to 3.6V</td>
<td></td>
</tr>
<tr>
<td>Consumption current</td>
<td>Icc</td>
<td>Typ 170 μA</td>
<td>At non-detecting</td>
</tr>
<tr>
<td>LED peak current</td>
<td>ILED</td>
<td>82 mA</td>
<td></td>
</tr>
<tr>
<td>LED peak wavelength</td>
<td>λps</td>
<td>Typ. 940 nm</td>
<td></td>
</tr>
<tr>
<td>Detecting distance</td>
<td>Lon</td>
<td>90~110 mm</td>
<td></td>
</tr>
<tr>
<td>Operation temperature</td>
<td>Topr</td>
<td>-30 to +85 °C</td>
<td></td>
</tr>
</tbody>
</table>

**Outline dimensions**

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99
Proximity Sensor with ALS - GP2AP007A00F

For frameless display: Type: GP2AP007A00F

“Proximity Sensing” or “Grip Sensing”

(1) “Grip only”. Display power on.
(2) “Grip” and “Telephone call”. Display power off.
(3) “Grip only”. Screen does not rotate.

Recommended model “One hole type”.
- GP2AP007A00F

Proximity Sensor with ALS (Proximity with Ambient Light Sensor)

Left Side (Proximity Sensor)

Grip Right Side (Proximity Sensor)

Flameless display

No problem. Many kind case type.
- Hard case type.
- Note book type.
- Soft case type.
Proximity Sensor with ALS - GP2AP007A00F

Features

Type: GP2AP007A00F

- Small Window and Small Size Package Proximity with ALS.
  Panel window size: Min: 1.2mm × 1.75mm
- Detecting distance [*1]: Typ. 0~100mm
- Small package: 2.5 × 2.0 × 1.0 mm
- Single package with receiving light and LED parts easy to design
- Even the low illumination (0.02 lx) can be detected.
  [*1] Kodak Gray Card (white side [r=0.9])

Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Characteristics</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation voltage</td>
<td>Vcc</td>
<td>2.2 ~ 5.5V</td>
<td></td>
</tr>
<tr>
<td>DC voltage</td>
<td>VI2C</td>
<td>1.7 ~ Vcc</td>
<td></td>
</tr>
<tr>
<td>Consumption current (proximity)</td>
<td>Ioc_PS</td>
<td>Typ. 170μA</td>
<td>Ta=25°C, Vcc=V2C=3.0V</td>
</tr>
<tr>
<td>Consumption current (ALS)</td>
<td>Ioc_ALS</td>
<td>Typ. 100μA</td>
<td>Ta=25°C, Vcc=V2C=3.0V</td>
</tr>
<tr>
<td>Consumption current (shut off)</td>
<td>Icc_s</td>
<td>Max. 5μA</td>
<td>Ta=25°C, Vcc=V2C=3.0V</td>
</tr>
<tr>
<td>Operation temperature</td>
<td>Toper</td>
<td>-30~+85°C</td>
<td>Vcc=V2C=3.0V</td>
</tr>
</tbody>
</table>

PS part

- LED current 1 | ILED1 | Typ. 19mA | IS[1:0]=00 |
- LED current 2 | ILED2 | Typ. 38mA | IS[1:0]=01 |
- LED current 3 | ILED3 | Typ. 75mA | IS[1:0]=10 |
- LED current 4 | ILED4 | Typ. 150mA | IS[1:0]=11 |
- Peak wavelength | λLED | 940nm |
- Detecting distance | Lon | Typ. 100mm | ILED=130mA [*1] |

ALS part


[*1] ILED=140mA / without panel / the detection object: Gray Card (white side [r=0.9]), 100x20mm

Outline dimensions

Unit: mm
Proximity Sensor (Laser Diode/VCSEL Type) - GP2AP090S00F

**Features**

**Type:** GP2AP090S00F

- All in one Laser Diode (IR-VCSEL) emitter, Photo-diode detector
- **One Hole window type.**
- Low crosstalk and low power consumption.
- Crosstalk reduction function.
- Dynamic calibration and Auto calibration.
- High packaging structure. Easy mounting.
- Package height is 2.5 times higher than Standard type.
- No need rubber cap. No need height adjustment board.
- Package Size (2.0 × 3.65 × Height: 2.5mm)

**Simple Design**

New devices increased. The hole also increased.

**Easy mounting**

High packaging structure. Easy mounting.

- No need rubber cap.
- No need height adjustment board.

**Low crosstalk**

- Dynamic calibration
  - Automatic correction of crosstalk initial value.
- Auto calibration
  - Automatic correction of crosstalk value in real time.

**NEW**

One Hole window type Simple Design.

- Hole size Φ 1.8mm～

**TS:** May 2018  **MP:** Sep 2018

**Graph:**

- Crosstalk (count) vs. GAP (mm)
  - Before
  - After

- MAX 3.7mm
  - Tolerance range of actual inside height
- MAX 1.2mm
  - Tolerance range of Gap
Proximity Sensor with RGB - GP2A080C00F

**For OLED display**  : Type : GP2A080C00F

【Definition】Sensor for sensing the 3 primary colors of light. Measure the color temperature (CCT) of light. So it is able to control color conditions for the OLED. Other applications include: camera white balance, exposure and flash light adjustment, panel display color tone and brightness adjustment.

Light of environment

[Photo diode pattern]

- For measure CCT, Sensor use photo diode & color filter

Convert RGB wavelength:
- Color temperature
- Illuminance

Color optimization, White balance adjustment of display.

[Spectral Characteristics]

- One-hole type
  - Φ2.3mm~
- One Package Type
  - 4.0 x 2.0 x 1.0mm

For OLED display Type GP2A080C00F

[Photo diode & color filter]

- Normalized Θ
- X axis

SHARP (GP2AP080C00F)

- Good

FOV
- -40°~+50°
Proximity Sensor with RGB - GP2A080C00F

**Features**

- **Type:** GP2AP080C00F
  - Simple design model. One-Hole type RGB sensor.
  - **Two-Hole type**
  - **One-Hole type**
    - Hole size: \( \Phi 2.3\text{mm} \)
  - **Black lens Type**
  - Cost reduction!
  - No need panel paint.
  - No look sensor.

- **Proximity Detecting distance \(^{[1]} \):** Typ. 100mm
- **All in one:** \( \times 3.65 \times 2.0 \times 1.0 \text{mm} \)

**Outline dimensions**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin name</th>
<th>Symbol</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply (VCC)</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>VCC data line</td>
<td>DMA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VCC data line</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VCC data line</td>
<td>VCC</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ground (GND)</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ground (GND)</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ground (GND)</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

**Block diagram**

**Specification**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Spec</th>
<th>Unit</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Power supply voltage</td>
<td>VCC</td>
<td>12</td>
<td>16</td>
<td>0-3.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LED voltage</td>
<td>V1, V2</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>I(_L) : LED current</td>
<td>I(_L)</td>
<td>7</td>
<td>16</td>
<td>0</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Temp</td>
<td>-40</td>
<td>85</td>
<td>0</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>SCL, SDA input low level</td>
<td>VLL</td>
<td>0.35</td>
<td>0.54</td>
<td>0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>SCL, SDA input high level</td>
<td>VHH</td>
<td>2.6</td>
<td>5.0</td>
<td>0</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

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SHARP

TS: Sep 2018  MP: Dec 2018
Ultra wide FOV Proximity Sensor for bezel-less smartphone

**Ultra wide angle Proximity Sensor**

- **Proximity sensor mounting position**
  - To mount on the front of the display.
  - It is not suitable for narrow frame panel design.

**New mounting position**
- Ultra wide angle proximity sensor mounted on the “side wall”.
- Improve the proximity in the horizontal direction.

**Plan**

**Now**
- The sensor FOV specification can not detect objects.
- FOV = ±15deg
  - horizontal direction distance ~ 2cm

**New sensor (Ultra wide angle Proximity Sensor)**
- Ultra wide angle specification can detect objects.
- FOV = +70deg
  - horizontal direction distance ~ 10cm
**Proximity-TOF sensor** - Under Planning

**Proximity ToF for wake up Face-ID system**

**Proposal for Face-ID system**

**Exploded picture of product “X”**

**Face recognition system (structured light)**

**Proximity sensor (1D ToF)**

**1D-ToF type proximity sensor**

**Features**

- Small package: $3.6 \times 2.2 \times 1.0$ mm
- Active power consumption $\sim 10$ mW
- All in one (SPAD detector, IR-VCSEL emitter)
- Detecting distance: Typ. 70 cm @18% Grey
- Considering S/N improvement;
  ① High accuracy $\sim 3\%$
  ② Robust cross talk (Panel reflection)
    $\sim$ Gap = 0.5 mm
  ③ Tolerant of sunlight noise

※ Specs., sample providing schedule and so forth are subjects to change.
Proximity-TOF sensor - Under Planning

Proximity ToF for wake up Face-ID system

Small package 1D-ToF for face recognition

3D image sensor is higher power consumption
- Depth sensor, power consumption ~3.0 W
- Impossible to keep it power ON

How to start 3D sensor to reduce power consumption?
- Press a hard switch of a smartphone? → Not Smart.
- Recognize handling by human with motion sensor? → Complicated

Solution

“Proximity function by absolute distance”
1. ToF can detect the access of a human face in the range of 40cm~50cm.
2. Then starts 3D image sensor for face recognition.

Smart and easy system with low power consumption ~ 10 mW

Small package with original optical design and effective circuit design
- High accuracy of distance output ~3%
- Robust over cross talk from a panel
About Socle Technology Corp.

- Founded in 2001, Socle Technology Corp is a leading semiconductor design firm headquartered in Taiwan
- Socle provides SoC (System-on-Chip) design services for IoT, server, automotive, multimedia, and peripheral market segments
- 100% owned by Foxconn Technology Group (Hon Hai Precision Industry Co., Ltd.)
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