

# Application Circuit of Low Noise Op-Amp TC75S67TU for Pyroelectric Infrared Sensor

# Reference Guide

## RD160-RGUIDE-01

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### Overview

This Reference Guide (hereinafter referred to as "this guide") describes the specifications, circuits, board pattern diagrams, usage, and operation of pyroelectric infrared human sensor using low-noise op-amp TC75S67TU. Operation control and result display can be performed on a PC using a microcontroller, and the software is also prepared. Please refer to this guide when designing pyroelectric infrared human sensors using TC75S67TU.

## TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

## Table of Contents

<b>1. Introduction .....</b>	<b>3</b>
<b>2. Pyroelectric Infrared Sensor .....</b>	<b>4</b>
2.1. Specifications .....	4
2.2. Appearance .....	4
<b>3. Schematics and Board Pattern .....</b>	<b>5</b>
3.1. Schematics.....	5
3.2. Bill of Materials .....	6
3.3. Board Pattern Drawing .....	7
<b>4. Operation Procedure .....</b>	<b>10</b>
4.1. About Arduino and Processing.....	10
4.2. Connecting to Arduino.....	10
4.3. Start and Stop.....	11
4.4. Precautions for Detection .....	13
<b>5. Detection Results.....</b>	<b>14</b>

## 1. Introduction

The pyroelectric infrared sensors (hereinafter referred to as "this sensor") described in this guide use IRA-S410ST01 and IML-0687 manufactured by the Murata Manufacturing as a condensing lens. The detection range is up to 7 m, and it is designed to detect movements such as people within this range, and can be widely used for various applications such as automatic lighting of toilets and entrances, open/close control of automatic doors, and crime prevention lights.

In addition, Arduino can be used in the microcontroller to control the operation and to display the measured results on the personal computer. The power supply also uses the 5 V DC voltage supplied from Arduino, so in addition to this sensor, if you have Arduino and a personal computer, it can be used as an infrared human sensor.

To download of the various offer information on this sensor reference design → [Click Here](#)

Other components of the op-amp also use surface mount type, and the board size of the sensor part is compact, 20 mm×20 mm, making it easy to use for a variety of applications.

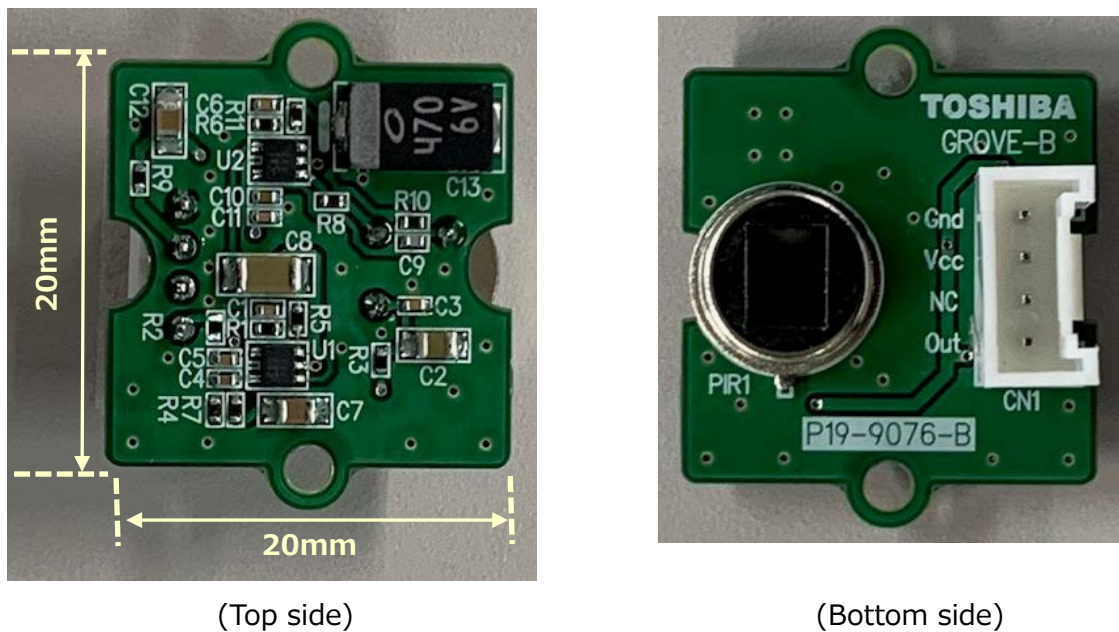
## 2. Pyroelectric Infrared Sensor

### 2.1. Specifications

**Table2.1 Specifications**

Item	Specifications
Interface	Arduino connections
Control method	Control from Arduino and Shield Connected PCs
Power supply voltage	5 V from Arduino and Shield board
Detection range	Approx. 7 m
Onboard pyroelectric sensor	Murata Manufacturing IRA-S410ST01
Fresnel lens	Murata Manufacturing IML-0687
Onboard operational amplifier	Toshiba Device & Storage TC75S67TU

### 2.2. Appearance



**Fig.2.1 Appearance**

## 3. Schematics and Board Pattern

### 3.1. Schematics

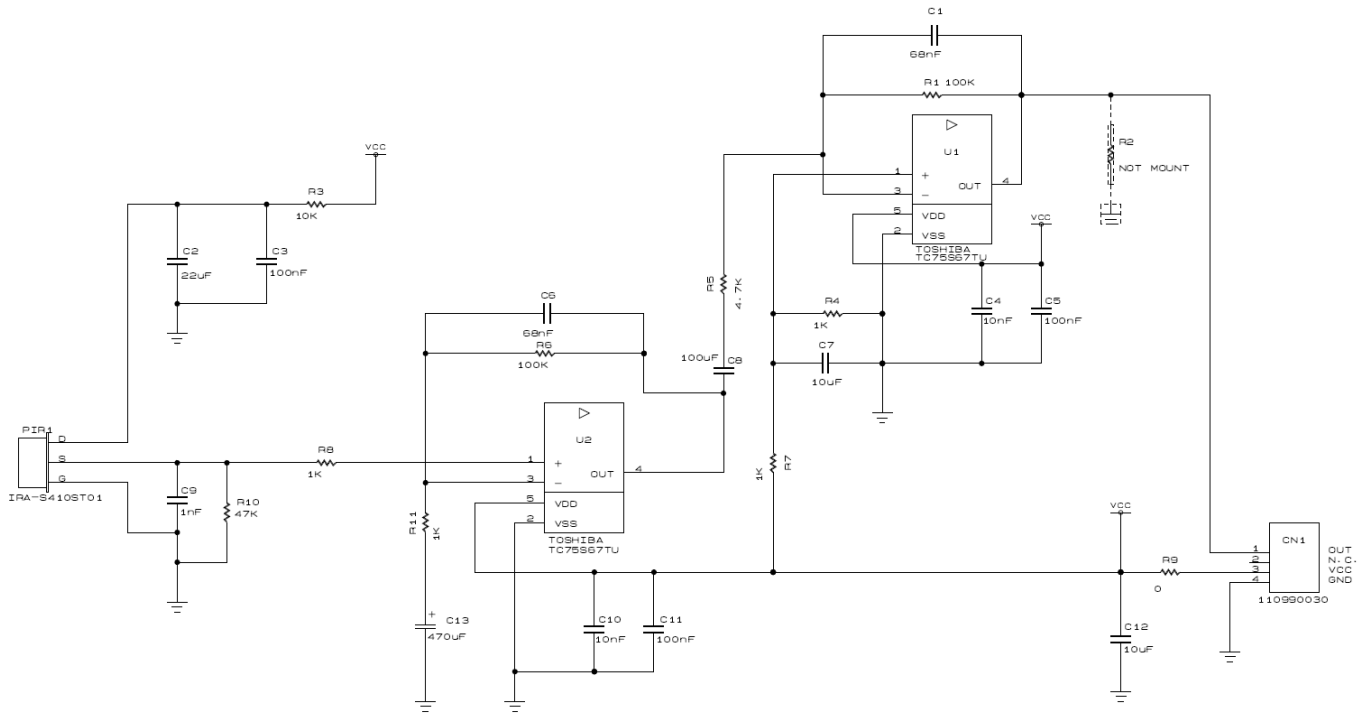


Fig.3.1 Schematics

### 3.2. Bill of Materials

**Table3.1 Bill of Materials**

Item	Part	Quantity	Value	Part name	Manufacturer	Description	Package Name	Standard Dimensions mm (inch)	Comment
1	PIR1	1	-	IRA-S410ST01	Murata Manufacturing	Pyroelectric infrared Sensor		Φ9.2×4.7	
2	U1, U2	2	-	TC75S67TU	TOSHIBA	Operational amplifier	SOT-353F	2.0×2.1×0.7	
3	C1, C6	2	68 nF			Ceramic 10 V, ±10 %		1.0×0.5 (0402)	
4	C2	1	22 μF			Ceramic 6.3 V, ±10 %		2.0×1.2 (0805)	
5	C3, C5, C11	3	100 nF			Ceramic 16 V, ±10 %		1.0×0.5 (0402)	
6	C4, C10	2	10 nF			Ceramic 25 V, ±10 %		1.0×0.5 (0402)	
7	C7, C12	2	10 μF			Ceramic 25 V, ±10 %		2.0×1.2 (0805)	
8	C8	1	100 μF			Ceramic 6.3 V, ±10 %		3.2×1.6 (1206)	
9	C9	1	1 nF			Ceramic 50 V, ±5 %		1.0×0.5 (0402)	
10	C13	1	470 μF			Tantalum 6.3 V, ±20 %		7.3×4.3 (2917)	
11	R1, R6	2	100 kΩ			100 mW, ±1 %		1.0×0.5 (0402)	
12	R2	1						1.0×0.5 (0402)	Not mounted Dummy load
13	R3	1	10 kΩ			100 mW, ±1 %		1.0×0.5 (0402)	
14	R4, R7, R8, R11	4	1 kΩ			100 mW, ±1 %		1.0×0.5 (0402)	
15	R5	1	4.7 kΩ			100 mW, ±1 %		1.0×0.5 (0402)	
16	R9	1	0 Ω			1 A		1.0×0.5 (0402)	
17	R10	1	47 kΩ			100 mW, ±1 %		1.0×0.5 (0402)	
18	CN2	1	-	110990030	Seeed Studio	Grove connector 4-pin/straight		10×5.1×8.1	

### 3.3. Board Pattern Drawing

This board consists of both top and bottom side pattern. The part mounting side is shown as the top side and the ultrasonic sensor and connector are mounted on the bottom side.

<Top Side (Parts Mounting Side)>

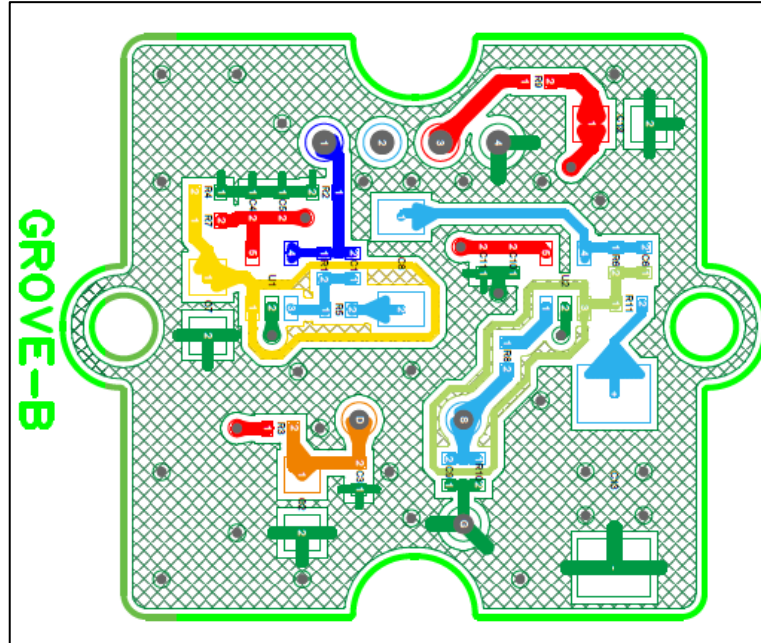


Fig.3.2 Board Top Pattern

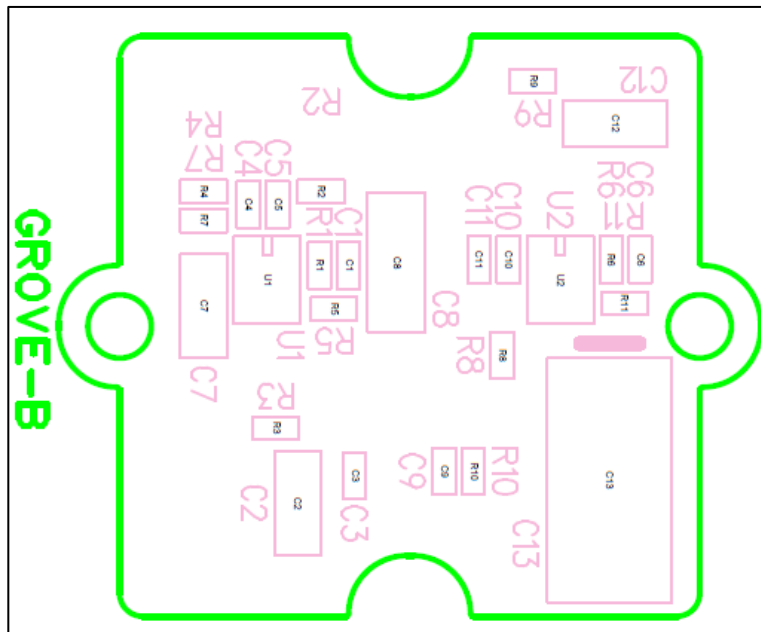


Fig.3.3 Board Top Silk

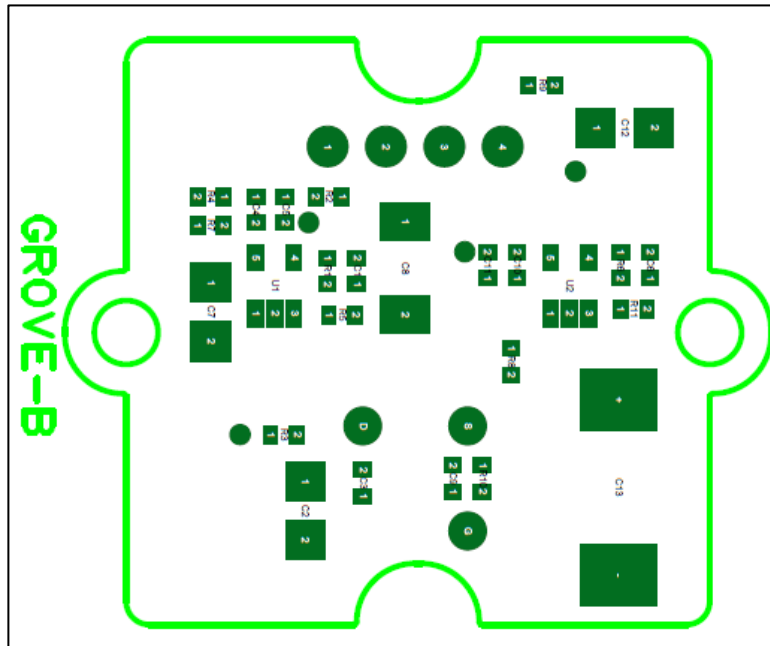


Fig.3.4. Board Top Solder

<Bottom Side>

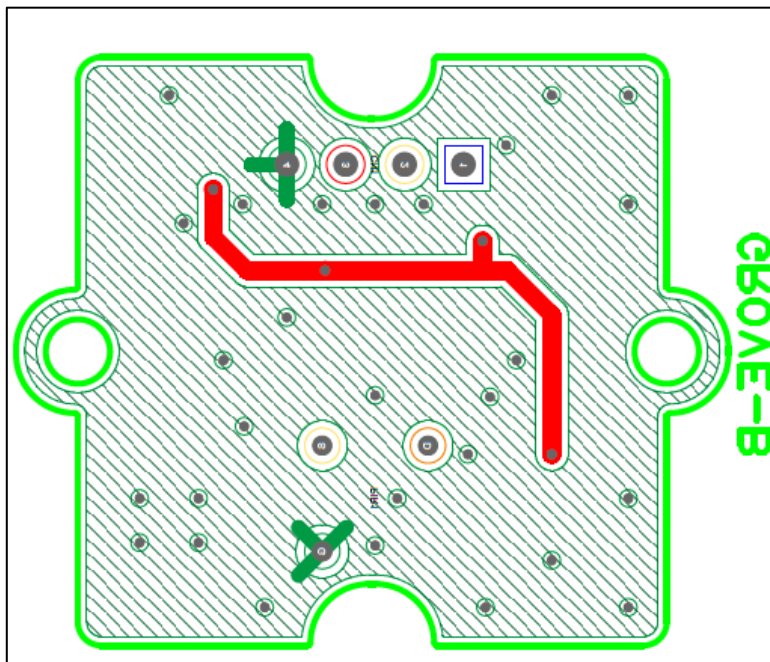


Fig.3.5 Board Bottom Pattern



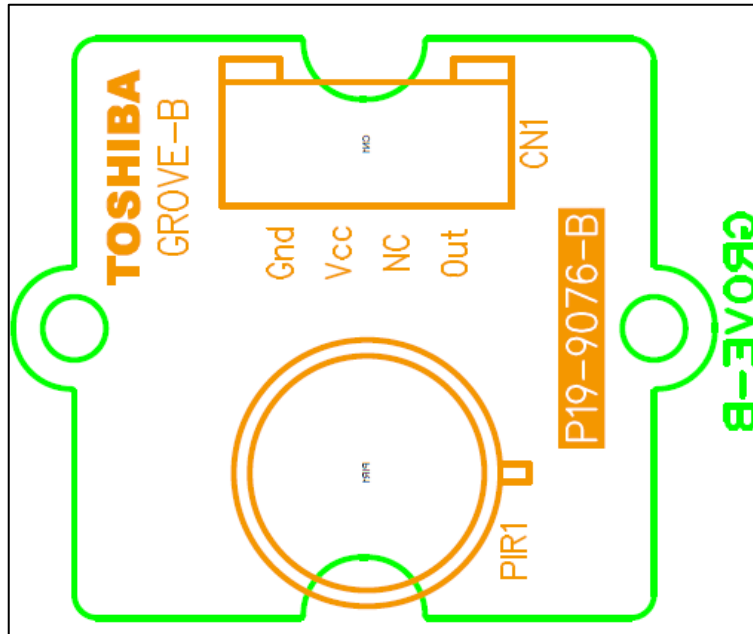


Fig.3.6 Board Bottom Silk

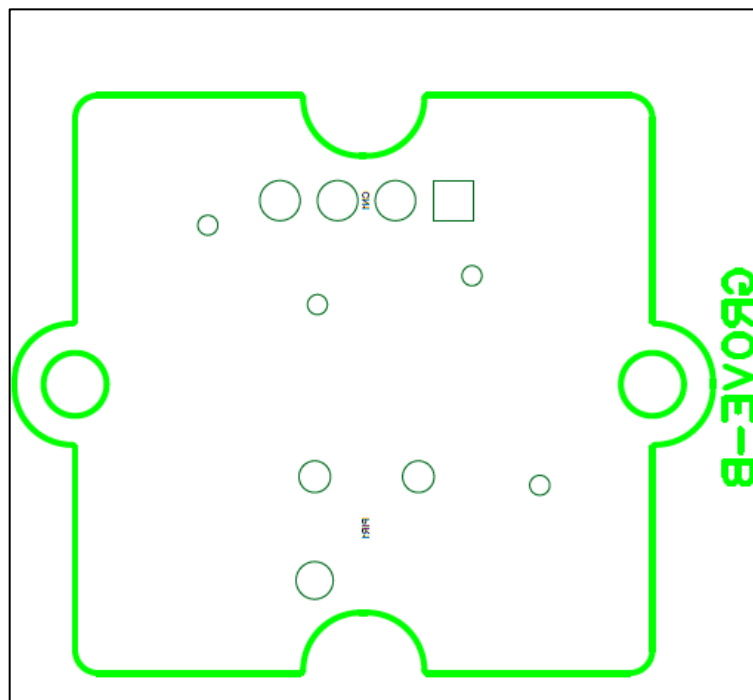


Fig.3.7 Board Bottom Solder

## 4. Operation Procedure

### 4.1. About Arduino and Processing

Arduino is a palm-sized one-board microcontroller. The microcontroller is selected as the control microcontroller for this reference design because it is generally available on the market and can be easily got, and if the program is transferred once, the sensor can be operated without a PC. Use the Processing to display the measurement results on the PC-screen.

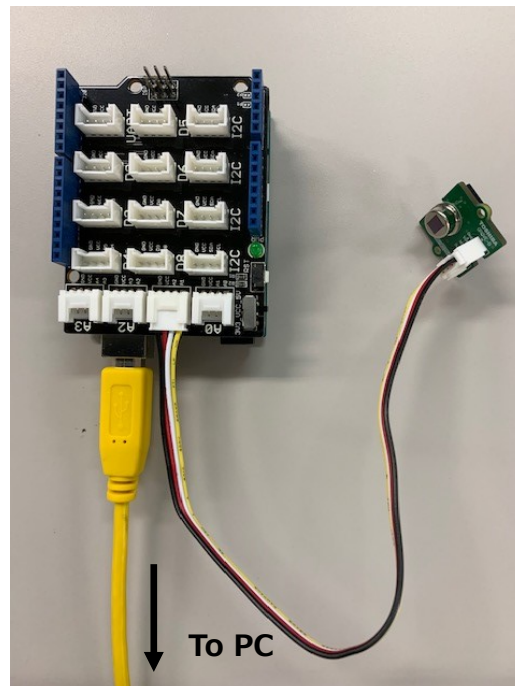
This reference design provides Arduino operating program and a Processing program that displays the status of measurements. To run this program, you must install Arduino IDE and Processing 3 on your PCs. Both software are available free of charge on their official sites. Download the software and install it on your PC in advance. These software are also needed to edit each program. These programs are called "sketches" in Arduino, Processing.

Moreover, in the case of Windows10, a display window for result of Processing may not start. In such a case, it is necessary to change the configuration file of initial value that generated automatically at the first time start-up of Processing. Since a solution change with PCs, please implement a suitable solution with reference to Web etc.

Refer to the Commercial Instructions for more information on Arduino and Processing.

### 4.2. Connecting to Arduino

Fig.4.1 shows the connections to the Arduino.



**Fig.4.1 Connections to Arduino**

Arduino is used with "seed studio Base Shield". The connection port of the base shield to the sensor is connected A1 terminal. Connect the base shield and the PC with a USB cable.

### 4.3. Start and Stop

When the compressed file "RD160-SKETCH-01\_E.zip" of the sketch prepared for this sensor is downloaded from the following link and decompressed in an appropriate place on the PC, the folder containing the two files "PE\_sensor\_Arduino.ino" and "Pyroelectric\_sensor.pde" and the usage convention is created. Save the file as is.

To download sketches →

[Click Here](#)

Start Arduino IDE and select "File" → "open" to open the saved PE\_sensor\_Arduino.ino file. The window shown on the left of Fig. 4.2 opens separately from the window opened at startup. Select "Sketch" → "Upload" to start compiling the files and write the sketch to the Arduino after compiling. When writing is completed successfully, a message appears at the bottom of the window. Arduino is now ready.

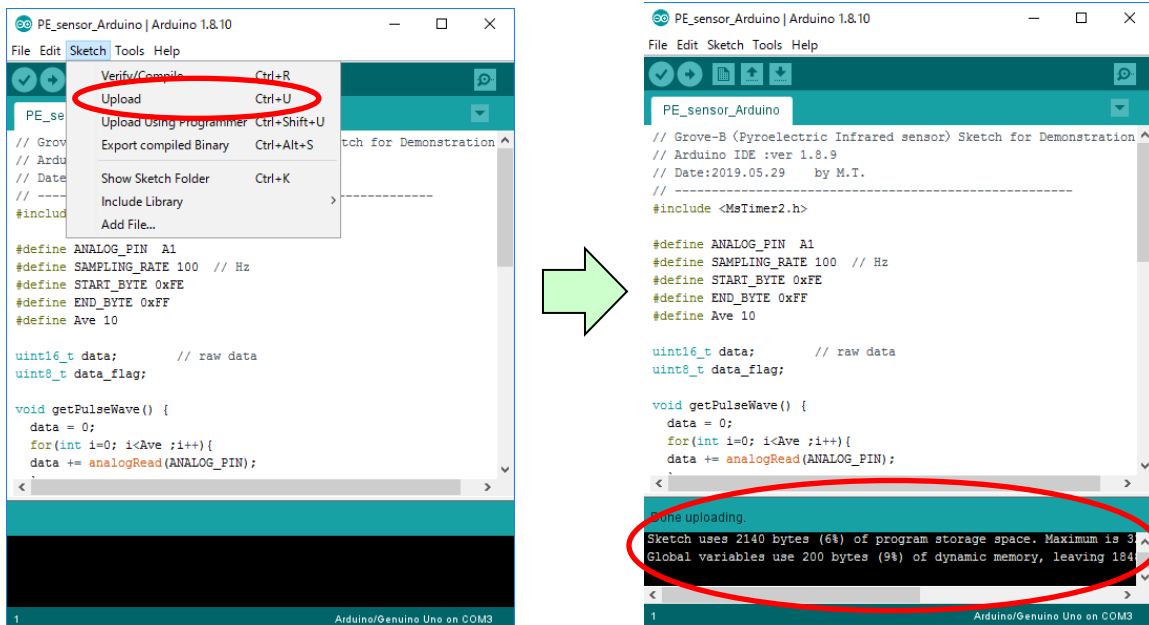
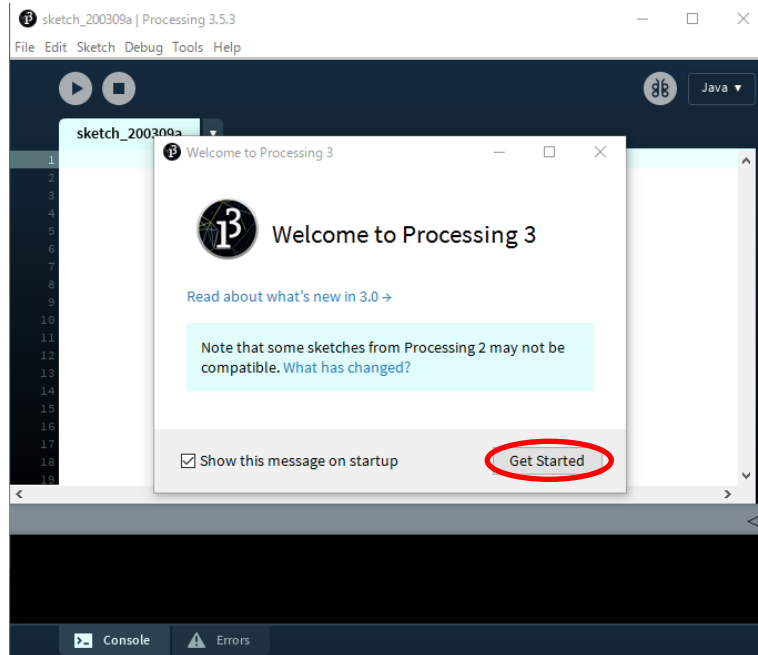


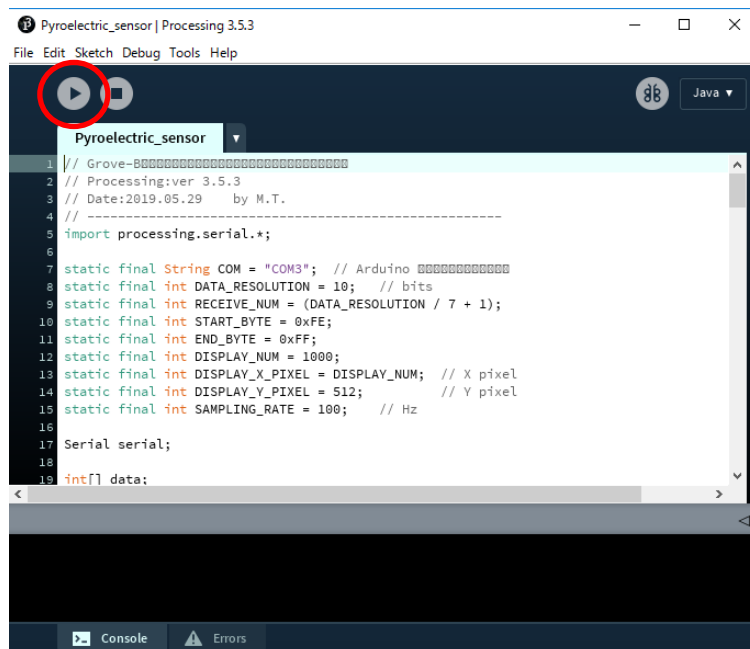
Fig.4.2 Arduino IDE Window

Then start the Processing 3. When you start the Processing 3, the window shown in Fig.4.3 opens. Click Get Started at the bottom right of the child window. Then, select File → Open to open the saved Pyroelectric\_sensor.pde file.



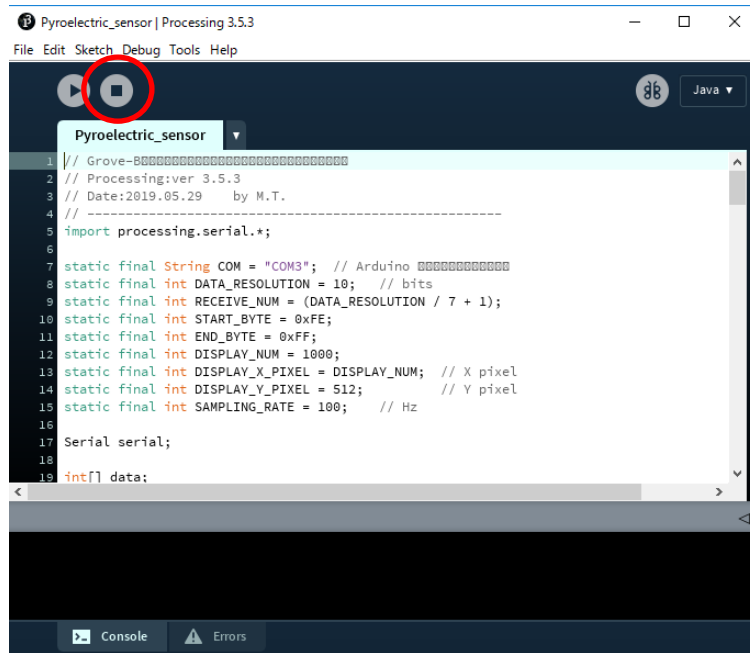
**Fig.4.3 Startup Window of Processing 3**

The window shown in Fig.4.4 opens separately from the window opened at startup. Click the operation button (red circle) here to open the result display window and start the measurement.



**Fig.4.4 Processing Measurement Start Window**

Click the stop button (red circle in Fig.4.5) on this screen to finish the measurement. The Result View window closes and the measurement ends. Then close the open windows sequentially.



**Fig.4.5 Processing Measurement Completion Window**

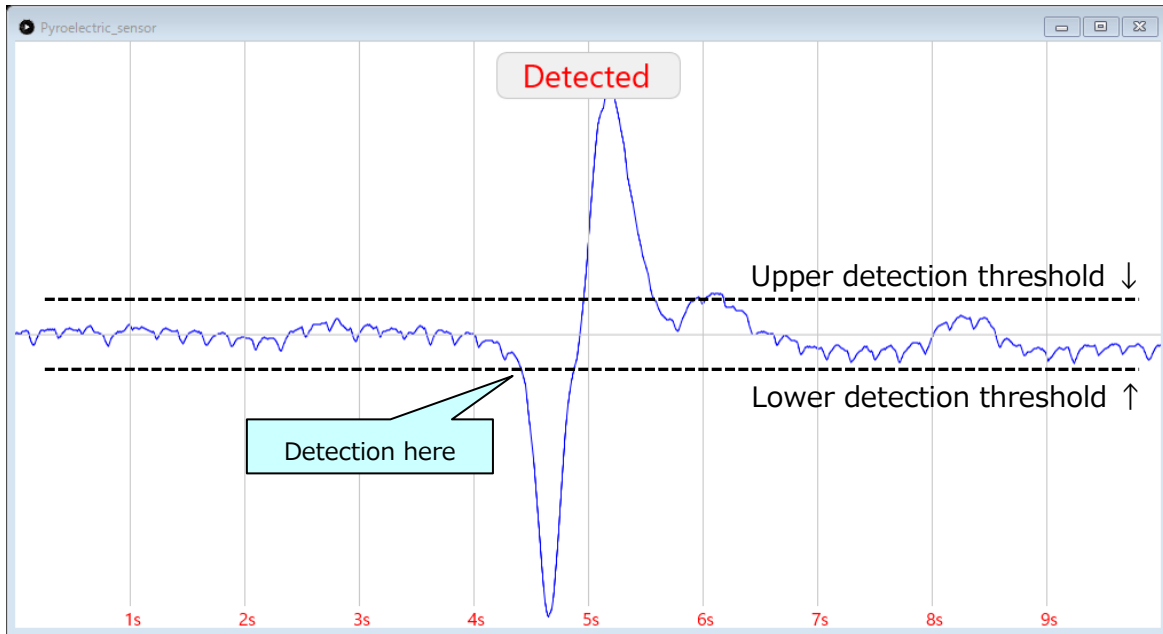
You can pause the measurement by clicking on the result display window while the measurement is being performed. At this time, the result display window is not closed and the measurement waveform remains stopped. To restart the measurement, click on the window again.

#### 4.4. Precautions for Detection

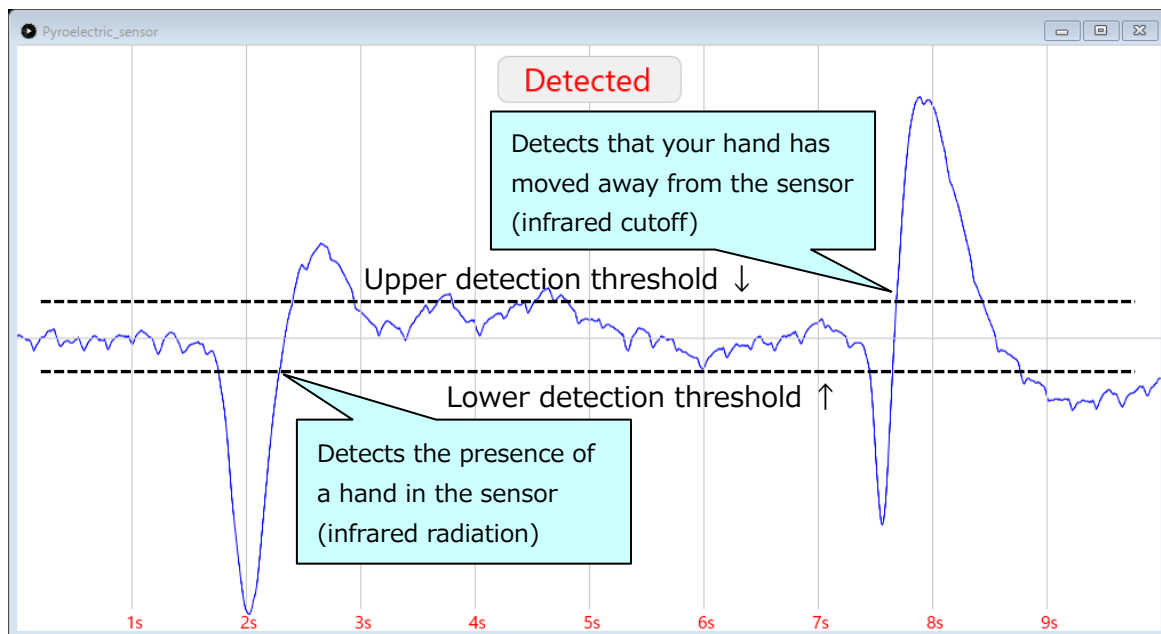
- Pyroelectric infrared sensors detect the presence of people, etc. by using the charge transfer inside the pyroelectric element due to the fluctuation of infrared rays. Therefore, detection may not be possible if the object is stationary and there is no fluctuation of infrared rays.
- Pyroelectric infrared sensors must be pre-charged to polarize the pyroelectric elements. Therefore, it takes a certain amount of time (about a few seconds) until the pyroelectric element is polarized by turning on the power and is actually detectable. Detection is not possible during this period.

## 5. Detection Results

Fig.5.1 and 5.2 show examples of the measurement result display window by Processing. In Processing, "Detected" is displayed in red as shown in the illustration when a human or the like is detected. If it is not detected, "Undetected" is displayed in black.



**Fig.5.1 Examples of Measuring Waveforms by Processing (1)**



**Fig.5.2 Examples of Measuring Waveforms by Processing (2)**

Fig.5.1 shows the waveform of the measurement results when the sensor is moved around 50 cm in front of the sensor, and Fig.5.2 shows the measurement results when the sensor is kept stationary for about 5 seconds in front of the sensor and then released. You can see that the detection signal is not output while the sensor is stationary, even if your hand is held at the front of the sensor.

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