IR Sensor
SS03 (TSOP1738)

Product Tutorial

Ver. 1.1

Designed & Manufactured in India by-
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IR Sensor

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Safety Instructions

Read the following safety instructions carefully before operating the instrument. To avoid any personal injury or damage to the instrument or any product connected to it.

Do not operate the instrument if you suspect any damage within.

The instrument should be serviced by qualified personnel only

For your safety:

Use proper Mains cord : Use only the mains cord designed for this instrument. Ensure that the mains cord is suitable for your country.

Ground the Instrument : This instrument is grounded through the protective earth conductor of the mains cord. To avoid electric shock the grounding conductor must be connected to the earth ground. Before making connections to the input terminals, ensure that the instrument is properly grounded.

Observe Terminal Ratings : To avoid fire or shock hazards, observe all ratings and marks on the instrument.

Use only the proper Fuse : Use the fuse type and rating specified for this instrument.

Use in proper Atmosphere : Please refer to operating conditions given in the manual.

- **Do not operate in wet / damp conditions.**
- **Do not operate in an explosive atmosphere.**
- **Keep the product dust free, clean and dry.**

IR Sensor SS03 (TSOP1738)

Introduction

IR Sensor SS03 is a module that can be interfaced with **Scientech 2311 Sensor Lab.** It is designed to learn basics of IR Sensor. The main emphasis is on the basic working principle and characteristics of IR Sensor.

SS03 IR Sensor

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Features

- IR Spectrum Detection
- Easy to Operate

Technical Specification

Sensor Output	:	4.5V (Approx.)
Sensor Operating Frequency Range	:	38KHz

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Theory

A sensor is a device that converts a physical quantity into an electrical signal. As such, sensors represent part of the interface between the physical world and the world of electrical devices, such as computers. The other part of this interface is represented by actuators, which convert electrical signals into physical phenomena.

Optical Transducers:

Light Sensors are used to measure the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infrared" to "Visible" up to "Ultraviolet" light. Light sensors are passive devices that convert this "light energy" whether visible or in the infrared parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo sensors" which can be grouped into two main categories, those which generate electricity when illuminated, such as Photovoltaic or Photo emissive etc, and those which change their electrical properties such as Photo resistors or Photoconductors. This leads to the following classification of devices.

- **Photo-emissive Cells** - These are photo devices which release free electrons from a light sensitive material such as cesium when struck by light.
- **Photo-conductive Cells** - These photo devices vary their electrical resistance when subjected to light. The most common photoconductive material is Cadmium Sulphide.
- **Photo-voltaic Cells -** These photo devices generate an e. m. f. in proportion to the radiant light energy received. The most common photovoltaic material is Selenium.
- **Photo-junction Devices -** These photo devices are mainly semiconductor devices such as the photodiode or phototransistor which use light to control the flow of electrons and holes across their PN-junction.

Phototransistor:

A phototransistor is a normal transistor in which the envelope enclosing the junction in transparent or the light reaches the base through the entitles, which has a wide band gap so it is transparent to the wavelengths detected. Alternatively it can be said that, it is a transistor in which light generates by transistor action making the device very sensitive.

The phototransistor has three layers of silicon containing tiny amOlll1ts of impurities. These layers are termed as emitter, base & collector. When a positive voltage is applied between collector & emitter a tiny reverse saturation current flows. This current is due to electrons and holes created by warmth. The geometry of a phototransistor allows light to shine on the collector-base junction and this creates additional current carriers. This current is amplified by transistor action. The device used is MEL 11 it is a high gain phototransistor in which the collector current is proportional to the incident light.

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With no light falling on the device there will be a small leakage current flow up due to thermally generated hole electron pairs and the output voltage from the circuit will be slightly less than the supply voltage due to the voltage drop across the load resistor R_L when light falls on the base region the leakage current increases with the base connection o/c, this cut flows out via the base emitter junction and is amplified by normal transistor action to give a large change in collector leakage current. With increased current flowing in load resistor R_L, output voltage reduces and is dependent upon falling light.

$$V_{out} = V - I_{CEO} R$$

Where,

V= Supply volt,

I_{CEO} = Collector leakage current,

R_L = Load resistance.

The dark current increases in a phototransistor exponentially with rise in temperature and if the temperature is sufficiently high the darks & light currents may be indistinguishable. At any given temperature the dark current can be reduced to a small value by biasing the base of the transistor which is normally left open circuited. The sensitivity is decreased but the ratio of light to dark current is increased.

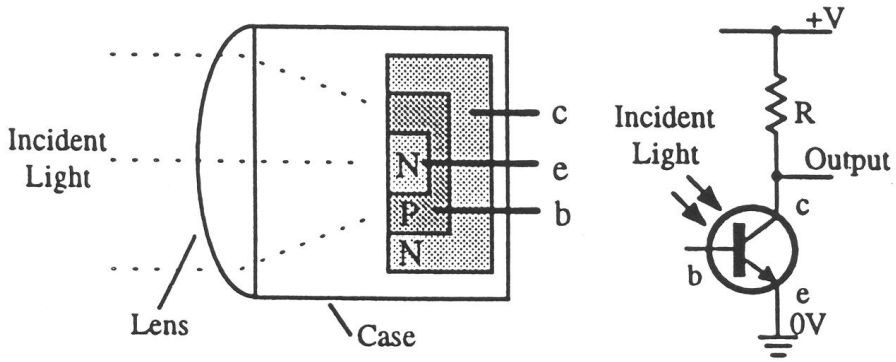

Figure 1

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Photo-Transistor Construction:

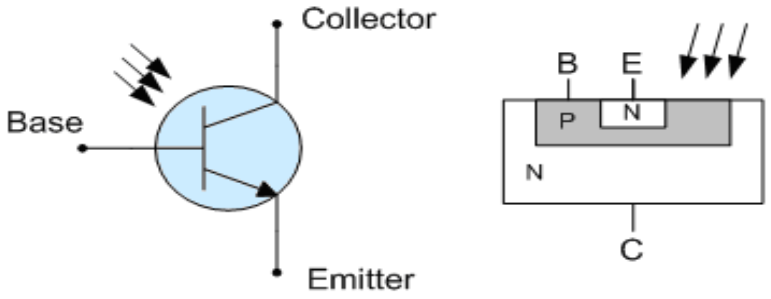


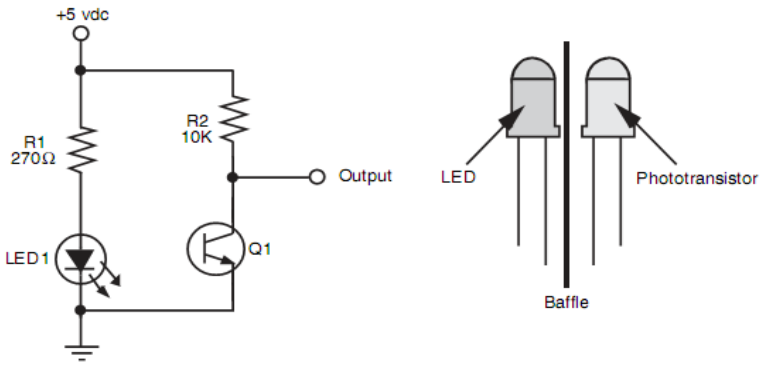
Figure 2

In the NPN transistor the collector is biased positively with respect to the emitter so that the base/collector junction is reverse biased. Therefore, with no light on the junction normal leakage or dark current flows which is very small. When light falls on the base more electron/hole pairs are formed in this region and the current produced by this action is amplified by the transistor. The sensitivity of a phototransistor is a function of the DC current gain of the transistor. Therefore, the overall sensitivity is a function of collector current and can be controlled by connecting a resistance between the base and the emitter but for very high sensitivity opto coupler type applications, Darlington phototransistors are generally used.

Simple Infrared Light Proximity Sensor :

Light may always travel in a straight line, but it bounces off nearly everything. You can use this to your advantage to build an infrared collision detection system. You can mount several infrared bumper sensors around the periphery of your robot. They can be linked together to tell the robot that something is out there, or they can provide specific details about the outside environment to a computer or control circuit.

The basic infrared detector is shown in figure 3. It provides an output that can be polled by a robot's controller comparator or ADC input. This uses an infrared LED and infrared phototransistor.



The basic design of the infrared proximity sensor

Figure 3

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Sensitivity can be adjusted by changing the value of R2; reduce the value to increase sensitivity. An increase in sensitivity means that the robot will be able to detect objects farther away. A decrease in sensitivity means that the robot must be fairly close to the object before it is detected.

IR detectors are little microchips with a photocell that are tuned to listen to infrared light. They are almost always used for remote control detection - every TV and DVD player has one of these in the front to listen for the IR signal from the clicker. Inside the remote control is a matching IR LED, which emits IR pulses to tell the TV to turn on, off or change channels. IR light is not visible to the human eye, which means it takes a little more work to test a setup.

There are a few difference between these and say a CdS Photocells:

- IR detectors are specially filtered for Infrared light, they are not good at detecting visible light. On the other hand, photocells are good at detecting yellow/green visible light, not good at IR light
- IR detectors have a demodulator inside that looks for modulated IR at 38 KHz. Just shining an IR LED won't be detected, it has to be PWM blinking at 38KHz. Photocells do not have any sort of demodulator and can detect any frequency (including DC) within the response speed of the photocell (which is about 1KHz)
- IR detectors are digital out - either they detect 38KHz IR signal and output low (0V) or they do not detect any and output high (5V). Photocells act like resistors, the resistance changes depending on how much light they are exposed to.

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Experiment 1-A

Objective: Study of TSOP1738

Equipments Required:

- Scientech 2311 Sensor Lab TechBook
- TechBook Power Supply
- Mains Cord
- SS03 IR Sensor Module
- Multi Meter
- Patch cords

Procedure:

- Place SS03 IR Sensor Module on Scientech 2311 SensorLab as shown below.

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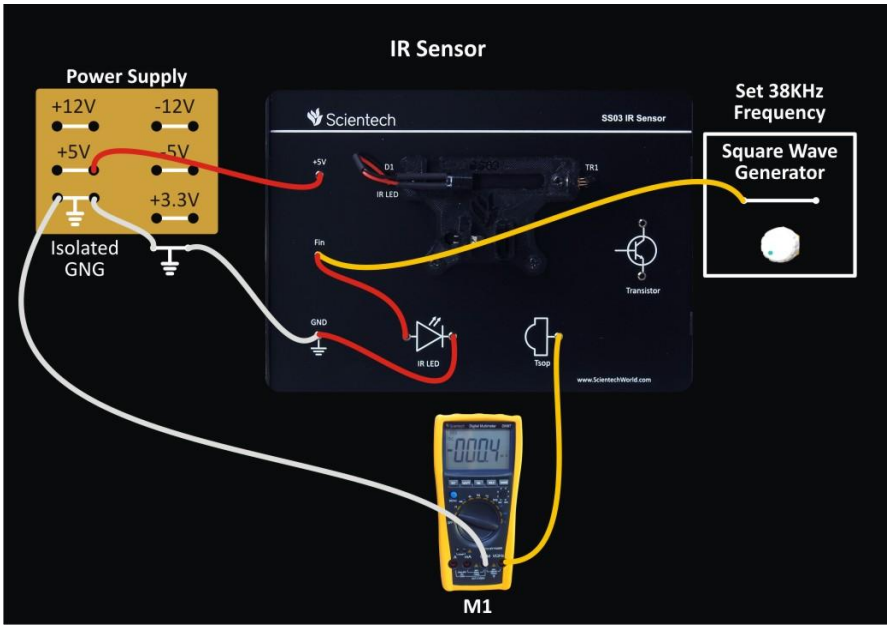
- Make connections as shown in the figure below.



- Switch ‘On’ the Power Supply.
- Set the Square Wave Generator output to 38 KHz.
- Initially the Digital Multi meter Voltage 4.5V (Approximately). Now obstruct the path by some opaque sheet and check the voltage on Multimeter.

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Experiment 1-B

Objective: To observe the real time characteristics of IR LED with TSOP1738 IR Receiver sensor on the LCD

Equipments Required:

- Scientech 2311 Sensor Lab TechBook
- Mains Cord
- TechBook Power Supply
- SS 03 IR Sensor Module
- Multi Meter
- Patch cords

Procedure:

- Place SS03 IR Sensor Module on Scientech 2311 SensorLab as shown below.

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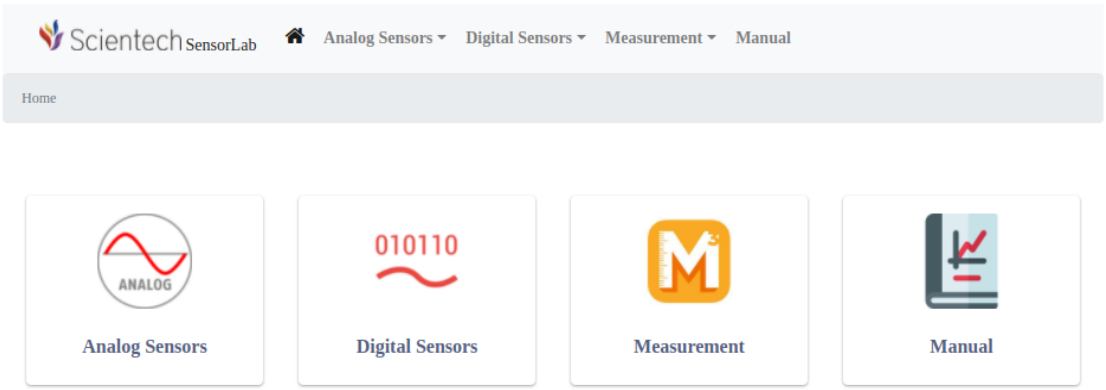
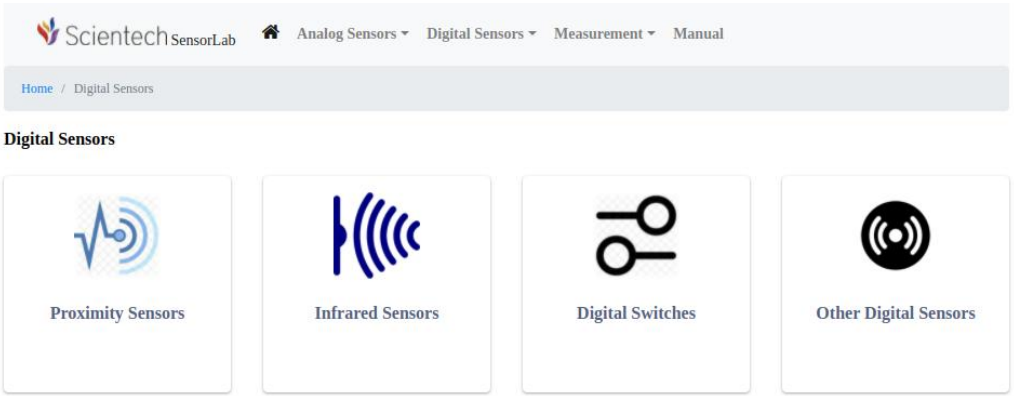
- Power ON the SensorLab by connecting the power adapter and the following screen will appear.



- Touch over the **Digital Sensors** button. The following screen appears on the LCD.



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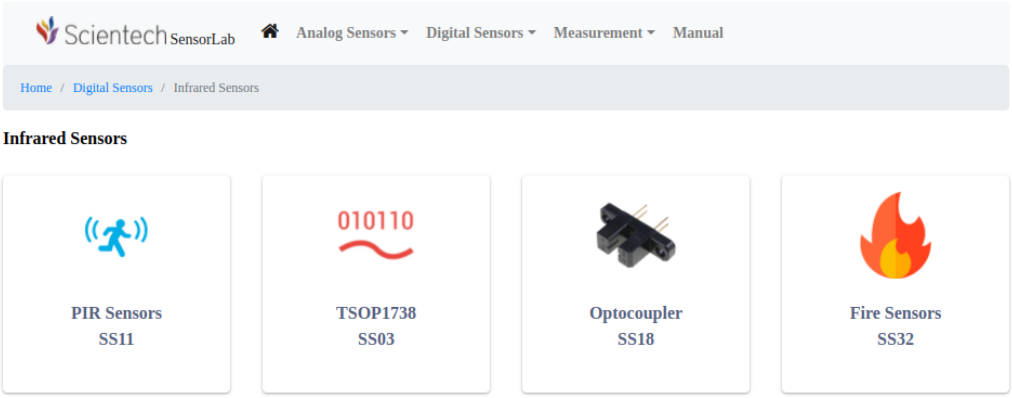
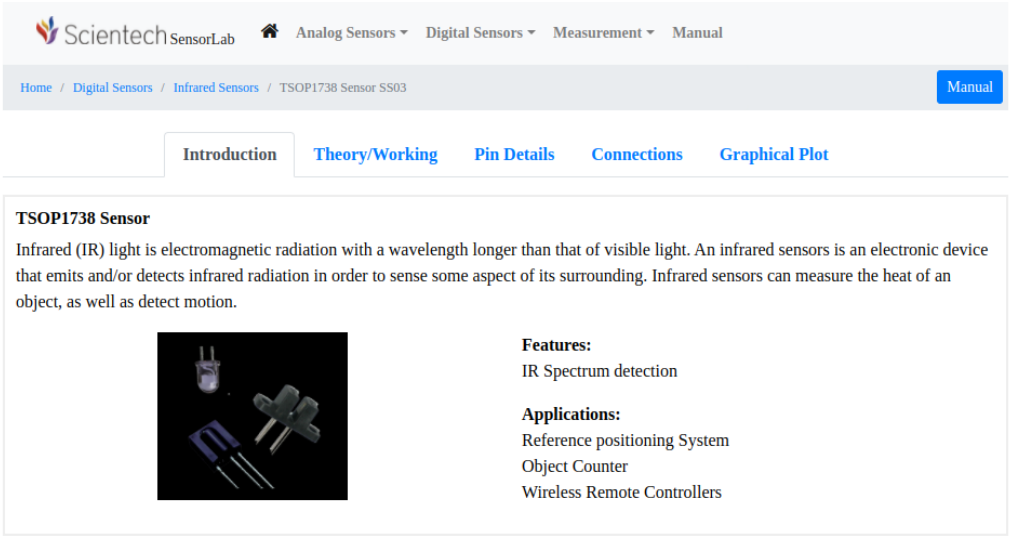
- Touch over Infrared Sensors and then touch on **SS03 TSOP1738** button.



- The following window appears on the screen. This screen displays some basic information about the **TSOP1738** sensor.



- For more information regarding the sensor, Touch over the **"Datasheet"** button. This will display the datasheet of the corresponding sensor in pdf format.

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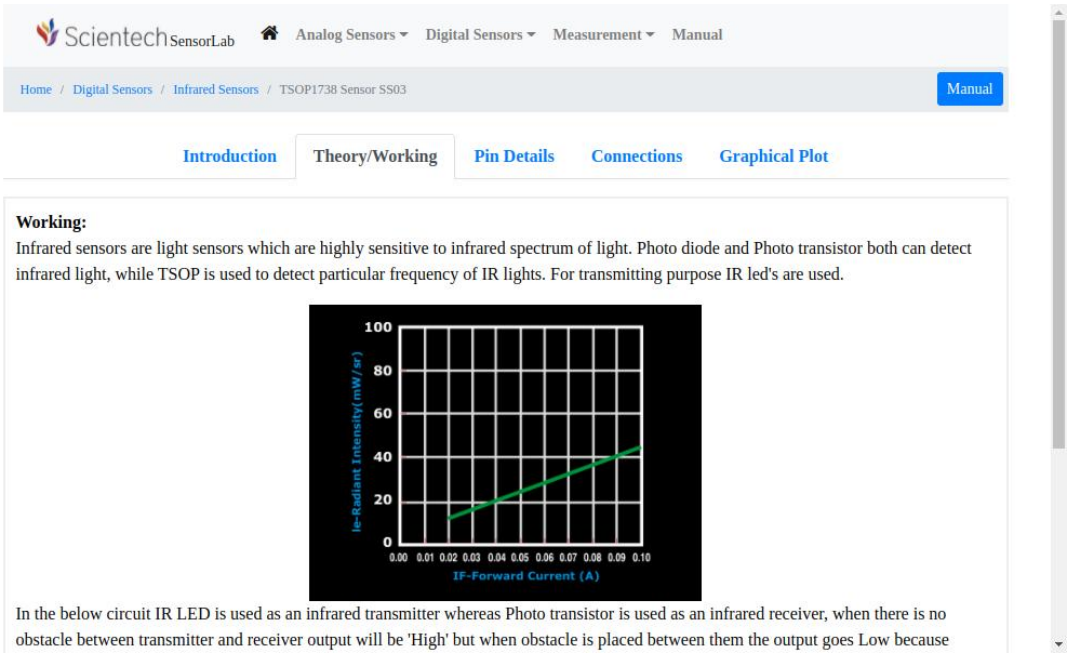
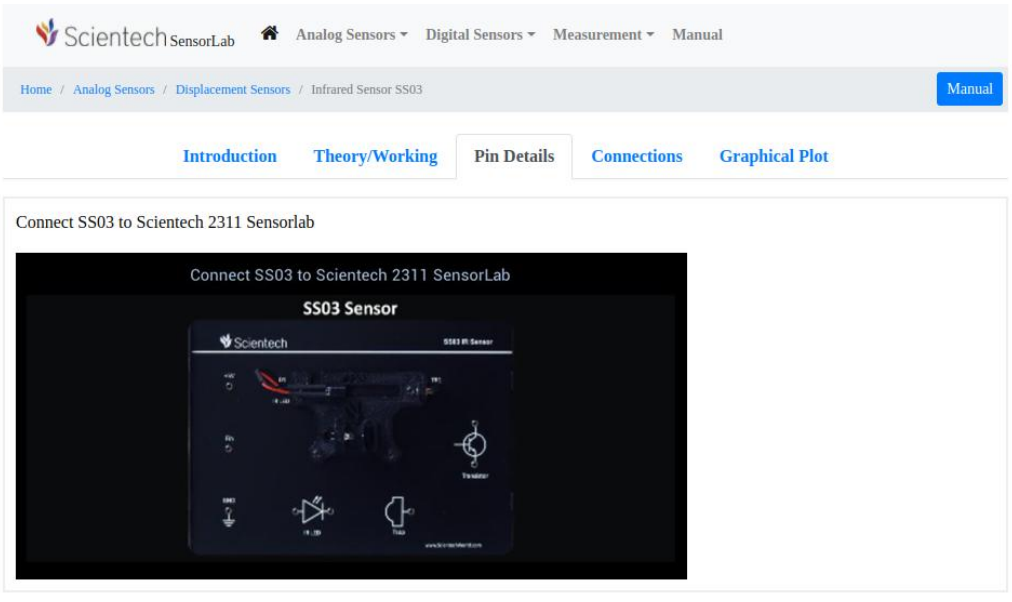
- Now, touch the theory button, this displays theory, description and working of the sensor.



- Now, touch the Pin details button. This window gives the pin description of the **SS03 PCB**. The window is as shown below



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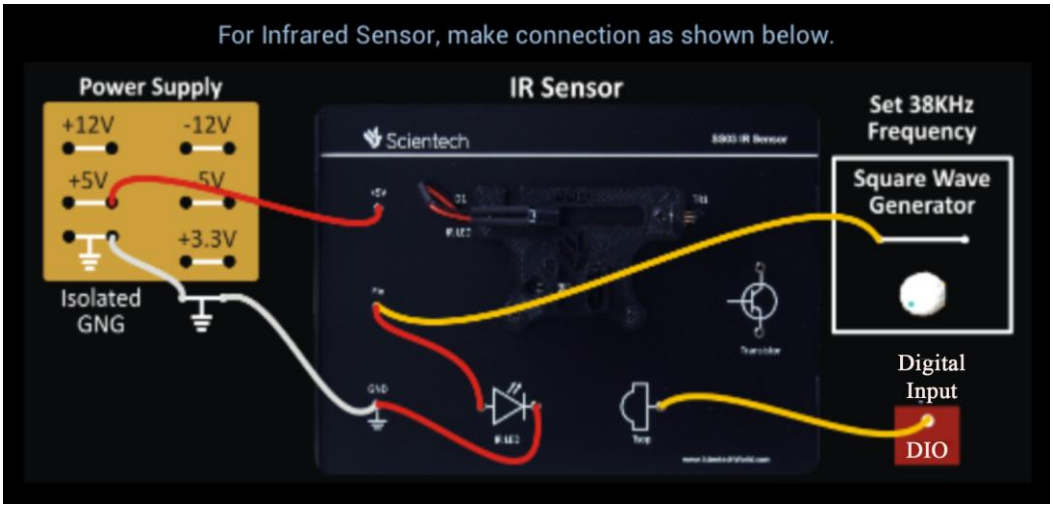
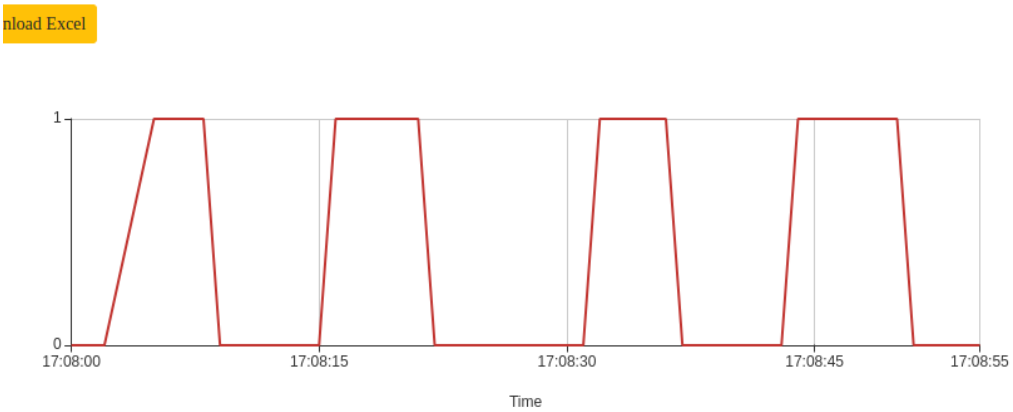
- Now, touch the connections button. This window shows the connections that have to be done on **Scientech 2311 Sensor Lab**. The window is as shown below.
- **Before starting to plot the graph, make sure to connect +5V to DI3 (Digital Input 3) pin to plot the graph.**



- Now, touch the graphical plot button. This section plots real time characteristics of the sensor in the form of a graph by taking values from the sensor. Observe the characteristics on the LCD. As soon as the TSOP sensor detects any object between the sensor, the output turns HIGH and is LOW when no object is detected.



Please Make sure that all the Ground Connection on Platform should be Common.

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Warranty

- We guarantee this product against all manufacturing defects for **12 months** from the date of sale by us or through our dealers.
- The guarantee will become void, if
  - The product is not operated as per the instruction given in the Learning Material.
  - The agreed payment terms and other conditions of sale are not followed.
  - The customer resells the instrument to another party.
  - Any attempt is made to service and modify the instrument.
- The non-working of the product is to be communicated to us immediately giving full details of the complaints and defects noticed specifically mentioning the type, serial number of the product and date of purchase etc.
- The repair work will be carried out, provided the product is dispatched securely packed and insured. The transportation charges shall be borne by the customer.

Hope you enjoy the Scientech Experience.

List of Accessories

1. 2mm patch cords (Black) 16” .....6 Nos