MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

Sensors & Actuator for Automatic Systems

LAB # 04

INFRA RED TRANSMISSION & DETECTION

Roll No:	**Date:**
Checked by:	**Grade:**

Object: Understand basic concepts of infra-red transmission and reception, and use of the IR sensors especially photoconductive sensors.

Theory:

InfraRed (IR) signals are used extensively for short range communication. Devices ranging from entertainment systems to transportation and security systems use some sort of IR signals for "remote communication". In this lab we will explore the characteristics of these signals from generation to detection and will also design and construct support circuits for the detection of such signals

This lab aims at designing an IR (Infrared) detector circuit that will consist of an IR transmitter and IR receiver circuit. An infrared detector is a detector that reacts to infrared (IR) radiation. The two main types of detectors are thermal and photonic (photodetectors). In this lab we will utilize photodetector type circuit in order to detect infrared radiations.

Infrared radiation s the electromagnetic waves in the wavelength region longer than visible light wavelengths lying from 0.75µm to 1000µm. the wavelength region of 0.75µm to 3µm is termed as near infrared region, the wavelength region of 3µm to 6µm the middle infrared and the wavelength region of 6µm to 15µm the far infrared region.

Infrared radiations has following characteristics

1. **Invisible to human eyes**

   This is useful for security applications, but sometimes makes measurements and optical system design difficult.

2. **Small energy**

   Infrared radiation energy is equal to vibrational or rotational energy of molecules. This phenomenon makes it possible to identify molecules.

3. **Long wavelength**

This means infrared radiation is less scattered and offers better transmission through various medium.

4. **Emitted from all kinds of objects.**

These radiation are emitted from all kinds of bodies having certain mass.

Infrared detection

Infrared radiation is used in wide variety of applications and new applications are constantly being developed. A typical system for detecting infrared radiation is something like shown below.

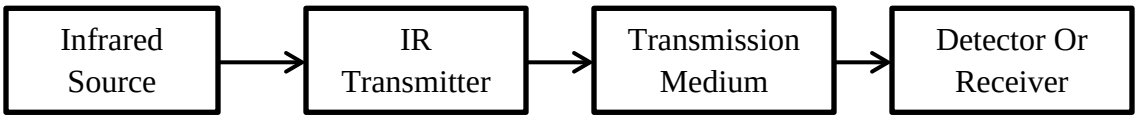


Fig:01 Infrared detection Block diagram

1. **Infrared source**

All objects with an absolute temperature above 0K emit infrared radiations even human beings at a temperature of 310 K (37°C) radiate infrared energy with a peak wavelength of about 10µm. infrared sources include blackbody radiators, tungsten lamps, silicon carbide and other substances. In this lab, we are using GaAs LED as an infrared source because it emits infrared radiations.

2. **IR Transmitter**

The next phase of the design process would be an IR transmitter. A rough sketch of the overall design of an IR transmitter and receiver circuit is shown in Fig:02

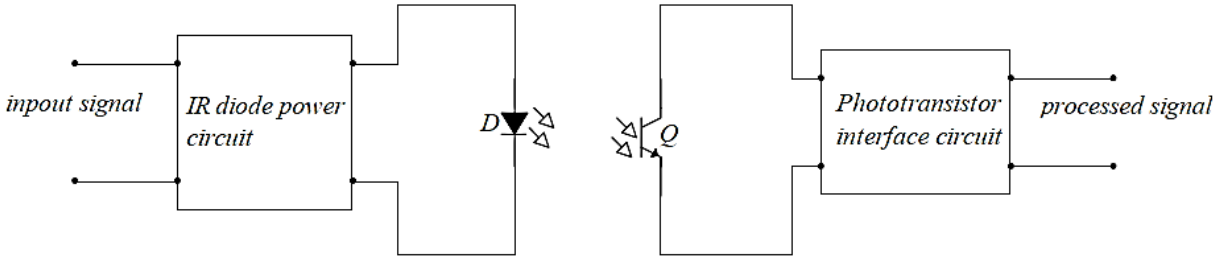


Fig: 02 Infrared Detection

The important step here will be to design an IR diode power circuit. Here in this lab we are designing it using a Schmitt trigger circuit. Schmitt trigger is basically used here for Automatic threshold control (ATC).

Schmitt trigger circuit is important here in a sense that In quiescent mode (no data signal present), there should be no output signal due to noise, i.e. the threshold of the comparator is set above the noise floor. When a signal is received, the comparator threshold level is adjusted upward to a higher value. This shift prevents random pulses occurring during a data message. A further benefit of the ATC is the stabilization of the output pulse width. Without the ATC, the output pulses would vary with the strength of the IR input signals. The circuit symbol for a Schmitt trigger is shown below.

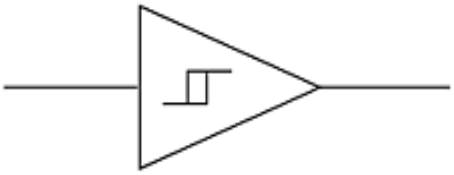


Fig:03 Schmitt Trigger

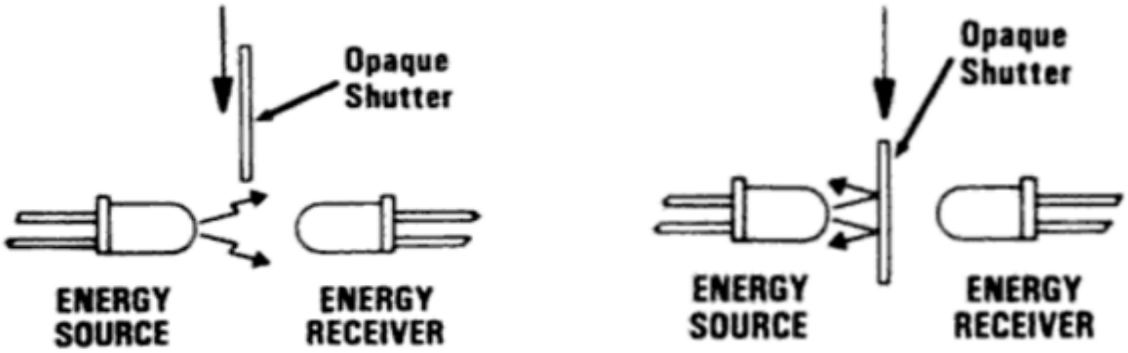
3. Transmission medium

Here there is nothing in between means air is the transmission medium. Any hindrance between the transmission and reception path may hinder the transmission process and detection will not be possible.

4. Reception or Detection

At the detector end major components are photodetector (phototransistor in this lab) and phototransistor interface circuit which drives a particular load.

Phototransistor is a type of photoconductive device that conducts current when exposed to light. The phototransistor is a semiconductor light sensor formed from a basic transistor with a transparent cover that provides much better sensitivity than a photodiode.



(a) (b)

Fig:04 IR Detection when (a) No barrier (b) with barrier in between

The transmission will take place only when there is no any barrier in between the transmitter and receiver as shown below.

Lab Activity:
Short Answer Questions

1. Measure the current that flows through IR transmitter LED.
2. Also measure the output voltage of the circuit.
3. Name any textile machine that uses IR detector circuit and what IR detector circuit does in that machine.