Daffodil International University (DIU)
Department of Electrical and Electronic Engineering

EEE 422: Measurement and Instrumentation Lab

EXPERIMENT NO: 10

NAME OF THE EXPERIMENT: INTRODUCTION TO OPTOCOUPLER, PHOTODIODE AND LED

Theory:

The device that converts non-electrical signal into electrical signal is called transducer. In broad sense, transducer is a device which when actuated transforms energy from one form to another. Therefore, it can be said that for instrumentation systems, transducer is an input or output device. For example, microphone is a transducer that acts as an input device and converts sound signal to electrical signal. On the other hand, speaker is a transducer that acts as an output device and converts electrical signal into sound signal.

Optocoupler:

Optocoupler consists of LED (Light Emitting Diode) and a photo transistor. They are coupled together without any physical connection. But the light of the LED affects the current flow through the transistor.

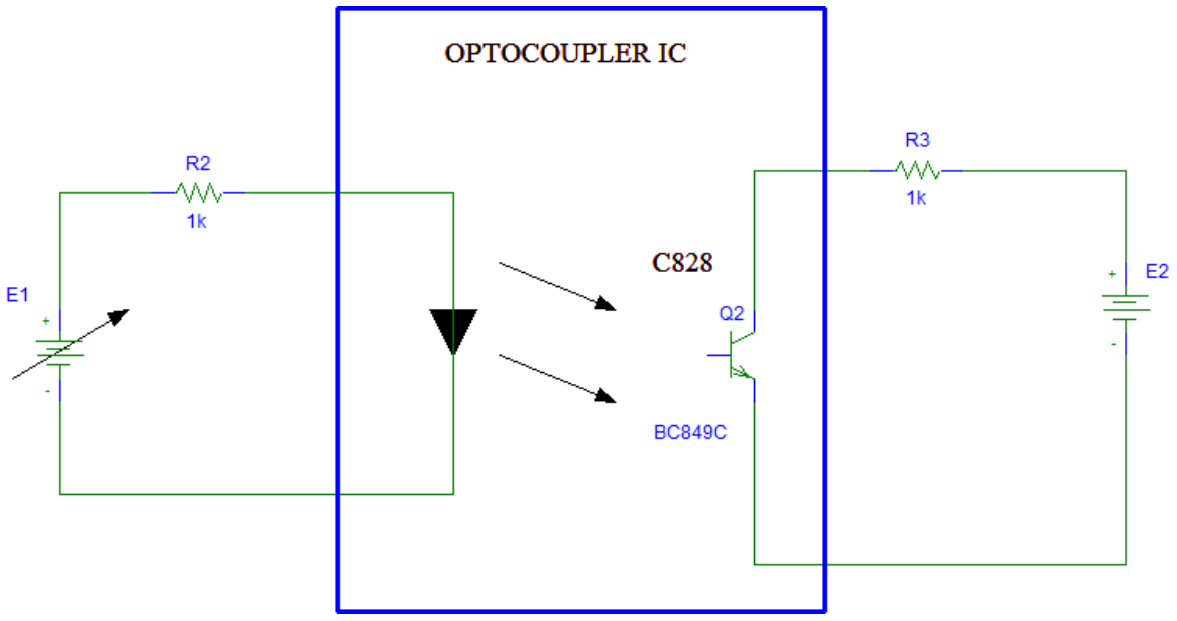

Fig .1: Circuit Setup for Optocoupler

List of Equipment:

1. Optocoupler IC 1pc
2. Resistor (1k) 2pcs
3. Trainer Board
4. Multimeter

Procedure:

1. Set up the circuit as shown in figure 1.
2. Set E_1 to 2V.
3. Vary E_1 and measure V_1 and V_2.
4. Calculate I_1 and I_2.

Report:

1. Describe the working principle of an optocoupler.
2. What is the use of optocoupler?
3. Plot I_1 , Vs, I_2 on a graph paper.

Photodiode

A Photodiode is a semiconductor device that is used for detecting and measuring light in devices like CD players, digital cameras etc. It is made of two doped layers (p and n). Since the combination is p material and n material, it is called PN diode. Light in ultraviolet, visible and infrared wavelengths can be measured.

How it works:

The device has p-n junction layers. When light falls on it, electrons are released due to the photovoltaic effect. These electrons in turn create a voltage that can be measured. Since the voltage produced is a function of the light, it is possible to accurately measure the amount of light. A reverse biased photodiode passes only a small amount of leakage current in the absence of appropriate light. But in the presence of appropriate light, current through the diode is almost directly proportional to the light intensity.

Selection:

The following factors are useful in selection:

1. Photodiode material: The semiconductor material can be made of Si (silicon), InGaAs (Indium Gallium Arsenide), Ge (Germanium), GaN(Gallium Nitride) and SiC(Silicon Carbide).
2. Spectral response range (nm)-Range of light wavelengths that are detected. Peak sensitivity wavelength (nm)-The wavelength at which sensitivity is the highest.
3. Sensitivity-The minimum input signal needed to generate the required output signal with a specified signal to noise ratio.
4. Rise time (ns) - Time for the voltage to rise from 10 % to 90 % of the peak value.
5. Dark Current (nA) - The output current of the photodiode when there is no light.
6. Capacitance-Measured as the amount of the voltage stored for a fixed charge. Measured in Farad.
7. Resitivity: The resistance to the flow of current measured in ohms. Other parameters are breakdown voltage, capacitance, impedance, active area etc.

Applications:

Photodiodes are used for light detection and measurement in devices like cameras, clock radios, automatic daylight detection and light switching in street lights, halls, buildings etc. and in remote controls for TVs, VCRs, audio equipment etc. They are not used for to measure lights of low intensity. They are also used in current to voltage converters.

List of Equipment:

1. Infrared LED
2. Photodiode
3. Signal Generator
4. Oscilloscope
5. Resistor (220 Ω, 100 k Ω)

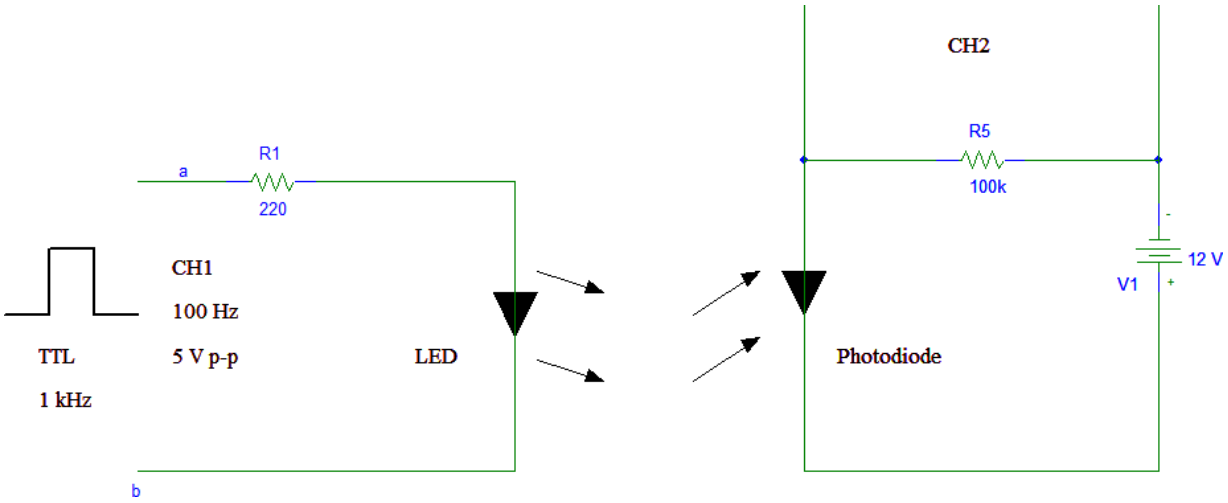

Fig. 2: Circuit Setup

Procedure:

1. Construct the circuit as shown in figure 1. Keep the infrared LED and the photodiode face to face.
2. Apply TTL Pulses of 1kHz between terminal ‘a’ and ‘b’. Observe the wave shape across the 100 k Ω resistor.
3. Increase the frequency of the applied pulses and observe the effect.
4. Increase the distance between the infrared LED and the photodiode and observe the effect.

Report:

1. Describe the working principle of LED and Photodiode.
2. Write the advantage, disadvantage and uses of LED and Photodiode.
3. Discuss the effect of increased frequency of pulses and the distance between the Infrared LED and the Photodiode