

Experiment 11

Aim: Introduction to electrical sensors and relays and Testing proximity sensors

Objectives:

Understand the different types of sensors and transducers and Be familiar with using relays as switching element.

Understand the two classifications of sensors.

Introduction:

A sensor is a device that receives and responds to a physical signal, it detects the changing in process parameter or any physical stimulus.

In other hand transducers is defined as a device that converts one form of energy to another, so transducers is more specific as it have the ability to detect and sense the desired physical input and then convert it to an output in another form in order to use these signals in controlling or intelligent applications and calculations. (Sensing element is a part of transducer)

In this experiment, different type of sensors which used in industrial environment will be discussed. The output signal from both sensors and transducers is used to activate actuators in order to control the physical measured parameter.

Sensors can be classified into two groups according to the needed of electrical power supply:

- Active sensors.
- Passive sensors.

Active sensors generate electrical voltage or current directly in response to environmental changing of measured parameter, Such as thermocouples. In other hand passive sensors require electrical energy for excitation, such as thermistors.

Theory:

In this experiment, student will work with proximity sensors and a relays as switching elements for controlling circuit by low power signal.

Proximity sensors:

Is a sensor able to detect the present of nearby object without any physical contact? Figure (1) shows one of proximity sensor.



Figure (1): proximity sensor.

A typical proximity sensor consists of a transmitter and a receiver. It has three terminals, two of them for power supply, the other for output pulse generated signal which is

generated when any object (metal, plastic or human hand) is presented in the sensor active region. Three proximity sensors will be discussed and used, (inductive, capacitive and photo sensors).

- Inductive proximity sensors:

These sensors utilize the magnetic phenomena of inductance, Figure 2 show one of inductive sensor used in industrial environment.



Figure (2)

Capacitive proximity sensors:

Capacitive sensors detect any material which is conductive or a dielectric different than air. Capacitive sensor is similar to the human interface device (HID) technology, can take input from human.



Figure

Photoelectric proximity sensors:

Photo electric sensors detects object nearby using light sensitive elements, it consists of emitter (light source) and receiver. Figure 4 shows some types of photoelectric sensors.



Figure (4): photo electric sensors.

Photoelectric sensors can be classified according to internal construction and reflection as follows:

1- **Direct reflection (diffused):**

Emitter and receiver are housed together and uses the light reflected directly of the detected object See figure (5).



Figure 5

2- **Reflection with reflector(retro-reflective):**

Emitter and receiver are housed together, and a reflector object is the third part required of the sensor. An object is detected when it interrupts the light beam between the sensors and the reflection part. See figure (6).



Figure 6

3- **Thru beam:**

Emitter and receiver are housed separately and detect an object when it interrupts the light beam between the emitter and receiver. See figure (7).



Figure 7

Relays and Contactors:

In this experiment , we are going to discuss one type of control systems, which is the **On Off control** system that is mainly built using a certain types of electromechanical components. One of those electromechanical components is about to be discussed in this experiment. which is the relays.

Relays:

A relay is an electrically operated switch consisted of two parts; coil and contact. When the electric current passes through the coil of the relay it creates a magnetic field which attracts a lever and changes the position of the contacts.

The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. See figure (8)

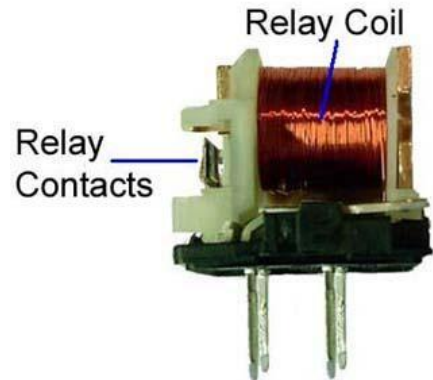
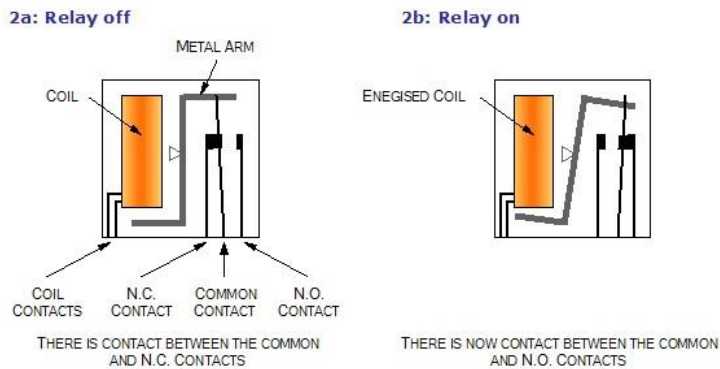


Figure 8

Contactors:

A contactor is an electrically controlled switch (relay) used for switching a power or control circuit. See figure 9.

A contactor is controlled by a circuit which has a much lower power level than the switched circuit. Contactors come in many forms with varying capacities and features. Unlike a circuit breakers contactors are not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amps and 24 V dc to thousands of amps and many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side.

Contactors are used to control electric motors, lighting, heating, banks, and other electrical loads.



Figure 9 capacitor

Components and apparatus:

- Power supply 24 VDC .
- Proximity sensors (inductive , capacitive and photo sensor) - Electrical Relay kit.
- Electrical LEDs and Push buttons kit.
- Wires.

Procedure:

1. Connect the electrical wiring diagram as in figure (10):
2. Place the photo sensor as in the diagram
3. Use different materials such as plastic pen, metal conductor, your hand for testing the sensors.
4. Place the capacitive sensor and repeat step 4.

5. Place the inductive sensor and repeat step 4.

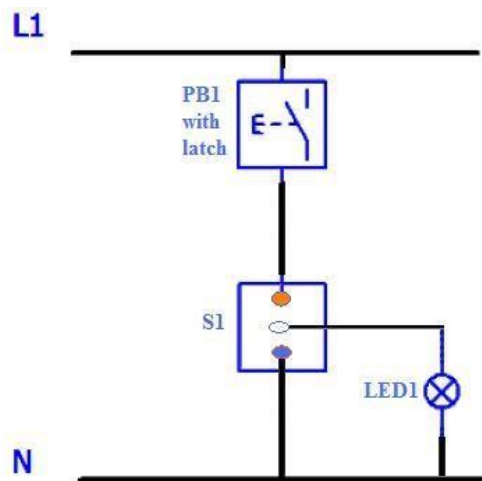


Figure (10): proximity sensor connection in electrical wiring diagram.

Where:

S1 is a proximity sensor (you should test the three types in the laboratory).

PB1 is a normally open push button with latch (spring).

LED1: is a light indicator.