

USER MANUAL
FOR
EMITTER-DETECTOR
FUNCTIONAL MODULE

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1. INTRODUCTION

Transistors, for all intents and purposes, are voltage or current switches. When the base on the linear transistor receives a signal, it allows a current to run from the collector to the emitter. This is a step up from mechanical switches.

Another sort of physical response is in the form of sensing. Sensors detect changes in a user-independent physical stimulus; humidity and temperature are a few examples. These devices—and, necessarily, their stimuli—include opto-electronic sensors, pressure sensors, and temperature sensors, and humidity sensors. Here we deal with an opto-electronic sensor. The opto-electronic sensor that we use in the lab is a non-amplified emitter-detector.

The emitter-detector releases an infrared signal across the device's gap. This signal is received on the other side of the gap and then induces a current. The purpose of this manual is to explain the operation of the emitter-detector. In addition, we will describe the conditions under which the device's function varies. Figure 1 shows the optoelectronic emitter-detector circuit.

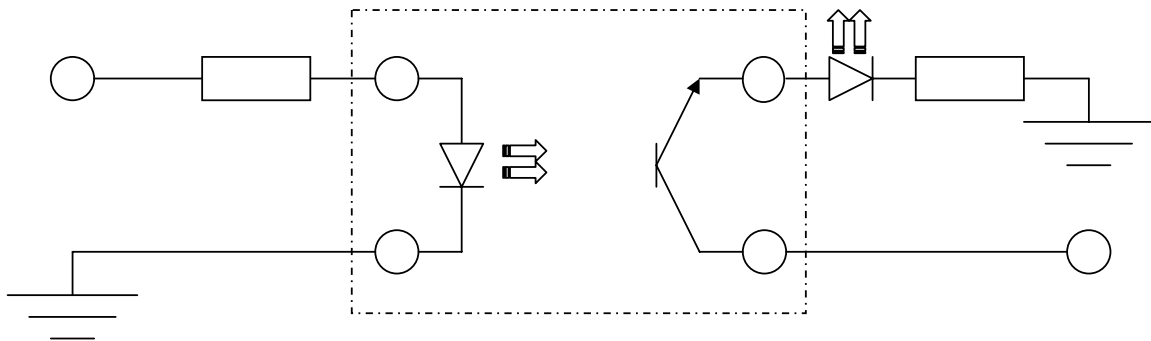


Figure 1 Optoelectronic emitter-detector circuit.

2. THEORY AND PREDICTIONS

The emitter-detector works in the same way that a transistor allows a collector-emitter current to flow once a base current is induced. It allows a current to flow across the detector once the detector picks up the infrared signal from the emitter.

The emitter, for all practical purposes, is a diode. A signal comes in from the input voltage, passes across the emitter, and then to the ground. The signal cannot flow backwards. The voltage drop across the emitter is responsible for the release of infrared light to the detector. When the gap between the emitter and the detector is unobstructed, current flows across the detector; when the gap is obstructed, no current flows.

The detector, for all practical purposes, functions in the same way as the collector-emitter on the linear transistor. Once the detector receives a certain amount of infrared light from the emitter, a certain amount of current flows to the ground. This current varies with the amount of light received. A number of scenarios can explain this variance. First, if the slots on the emitter-detector are not lined up, this does not allow the maximum number of infrared photons to pass across the gap. Second, if the gaps are too far apart, but lined up, the number of photons received by the detector slowly decreases when it travels through the gap. This is mainly due to the fact that light is scattered according to an inverse square law which states that the number of photons in a square foot vary inversely as the square of the distance from the source. Thirdly, a decrease in the current across the emitter would result in fewer released photons which would, again, decrease the current across the detector.

Regardless of the cause for variation, the signal across the detector varies linearly; there are no other characteristics of the circuit that would affect the current. In an aligned

emitter-detector at a fixed distance, the amount of current should vary linearly with the current across the emitter.

Notice that in this circuit there is a second diode, a light-emitting diode (LED). This LED is not a fundamental part of the circuit. It is simply to show that the emitter-detector is working. The LED uses the voltage drop across it to generate a certain amount of light. Experimentation shows that this voltage drop is *always* 1.8 volts. For an allowed voltage *down to* 1.8 volts, the voltage after the diode is always the pre-existing voltage minus 1.8 volts. Below 1.8 volts, 1.8 volts is always allowed across the diode, and the final voltage is zero. This variance of voltages is mainly a function of the ballast resistor after the diode.

3. FUNCTIONAL MODULE DESCRIPTION

Figure 2 contains a picture of the emitter detector functional module. The major electronic components in the following functional module are the resistors the emitter light emitting diode, the detector diode the input terminal and the ground terminal. The input terminal receives +5V, and the ground terminal receive 0V. The functional module consists of one circuit in which the circuit is broken when an item is placed in between the emitter and detector.

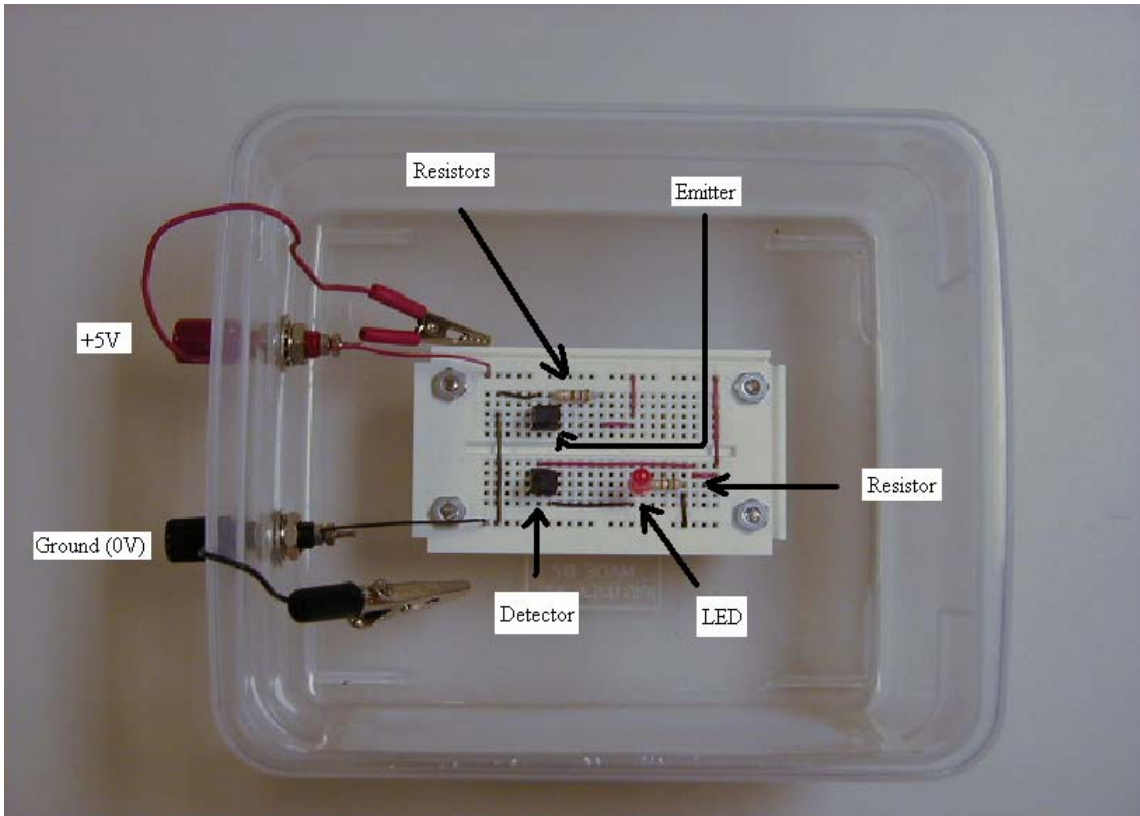


Figure 2 Picture of Emitter Detector Functional Module

4. WIRING INSTRUCTIONS

Table 1 Wiring of the Emitter Detector

Red	V_{in} (+5 volts) to Emitter and Detector
Black	Ground (0 volts)
	Emitter to ground (0 volts)
	Detector to ground (0 volts)

5. APPARATUS

Table 1 Apparatus Needed for Testing

Digital multimeter, or equivalent ohmmeter and voltmeter
Power source
Emitter Detector module, with ground (0 volts) and +5 volt outlets
Sheet of notebook paper

6. TESTING SEQUENCE

Connect the ground alligator clip to a wire and place the wire in the ground terminal of the voltage source. Connect the +5 V alligator clip to a wire and place this wire in the +5V terminal. Take note that the LED display is lit up. This means that the detector is receiving an infrared signal from the emitter. Place a sheet of notebook paper between the emitter and detector and look at the LED. Notice that the LED is not lit up. This is because the detector is not receiving any signal from the emitter, thus there is no voltage across the LED.

7. REFERENCES

GIURGIUTIU, VICTOR. Notes Concerning Mechanical Engineering 367, Fundamentals of Microcontrollers