What are Transducers? Activity

Instructor Guide

Notes to Instructor

This is the activity for the *Introduction to Transducers Learning Module*.

Introduction to Transducers consists of the following units:

- Knowledge Probe (KP) - Pretest
- Introduction to Transducers
- **Activity: What are Transducers?**
- Final Assessment (FA)

This companion Instructor Guide (IG) contains all of the information in the PG as well as answers to the Post-Activity questions.

Description and Estimated Time to Complete

This learning module is one of three SCME modules that discuss the types of components found in microelectromechanical systems (MEMS). This module covers "transducers" – what they are, how they work and how they are used in both macro and micro-sized systems. Two related learning modules cover MEMS sensors and actuators.

This activity provides you the opportunity to further increase your knowledge and understanding of transducers both in the macro and micro-scales. You will explain how specific transducers work.

Estimated Time to Complete
Allow 2 hours to complete this activity.

Introduction

A transducer is any device that converts one form of energy into another. For example, a microphone converts sound into electrical impulses and a loudspeaker converts electrical impulses into sound (i.e., sound energy to electrical energy and vice versa). A solar cell converts light energy into electricity (electrical energy) and a thermocouple converts heat energy into electrical energy.

A sensor is a device that receives and responds to a signal. This signal must be produced by some type of energy such as heat, light, electrical, motion, or chemical reaction. In many cases, the energy input to a sensor is the output of a transducer.

Transducers and sensors usually work hand-in-hand. Many sensors consist of a transducer and the electronics needed to evaluate the transducer's input and output. Therefore, a sensor can be defined as a device that receives and responds to a signal. This signal is produced by some type of energy, such as heat, light, motion, or chemical reaction that, in many cases, is the output from a transducer. Once a sensor detects one or more of these signals (an input), it converts it into a readable representation of the input signal.

Activity Objectives and Outcomes

Activity Objectives

- Define transducer.
- Explain how two different types of transducers work.
- Identify the micro equivalent of two macro-sized transducers.

Activity Outcomes

Upon completion of this activity you should have a more in-depth understanding of transducers, the different types of transducers, and the differences and similarities between macro and micro-sized transducers..

Documentation

The documentation for this activity consists of a written report. Details of the report are given in the following procedure.

Documentation should include the following:

- Information required in the activity procedure
- Graphics (if available)
- References for materials, information, and graphics
- Answers to the Post-Lab Questions

Activity: What are Transducers?

Procedure:

1. Select two transducers that you would like to research further. The transducers you select can be from the following list or one from the list and another from your personal interests.
   a. Thermocouple
   b. Gyroscope
   c. Light bulb
   d. Battery
   e. Microphone
   f. Motor
2. Research the two transducers and write a report that addresses no less than the following:
   a. Type of transducer
      i. What type of transducer is this (electrochemical, thermoelectric, etc.)?
      ii. Is this transducer macro-sized, micro-sized or both?
   b. Operation
      i. How does this transducer work at the macro-scale?
      ii. How does this transducer work at the micro-scale?
      iii. If this is a macro-sized only transducer, what is a micro-sized transducer that works similar or is used in similar applications?
      iv. What are the similarities and differences between the macro and micro-scaled transducers?
   c. Applications
      i. What are some current applications for this transducer in both the macro and micro-scales?
      ii. What are some possible applications for which this transducer could be used?

Post-Lab Questions

1. What is a transducer?
2. How does a transducer differ from a sensor?
3. How does a transducer differ from an actuator?
4. Identify at least five types of transducers or sensors found in your home and explain what is transduced.

Post-Lab Questions / Answers

1. What is a transducer?

   A transducer is a device that converts one form of energy to another form of energy

2. How does a transducer differ from a sensor?

   A sensor does not just convert energy from one form to another. Many sensors consist of a transducer (which does the energy conversion) and the electronics needed to evaluate the transducer's input and output. Therefore, a sensor is as a device that receives and responds to a signal. This signal is produced by some type of energy, such as heat, light, motion, or chemical reaction that, in many cases, is the output from a transducer. Once a sensor detects one or more of these signals (an input), it converts it into a readable representation of the input signal.

3. How does a transducer differ from an actuator?

   An actuator is a device that creates motion or moves something. Not all transducers create movement; however, a motor that is a transducer does convert electrical energy to motion, therefore, a motor is both a transducer and an actuator.

4. Identify at least five devices in your home that use transducers. What is the device, what is the transducer and what types of energies are converted by the transducer?

   Heating and cooling thermostats (Sensors that use a thermocouple to convert heat energy to electrical energy)

   Lightbulbs (incandescent light bulbs use tungsten filaments to convert electricity to heat to light)

   Stereo speakers (electrical energy to sound)

   Security Alarms (transducers that convert motion to electrical energy or temperature to electrical energy)

   Hot water tanks (thermocouple – temperature to voltage)

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