
What are Actuators? Activity

Instructor Guide

Notes to Instructor

This is the Activity for the *Introduction to Actuators Primary Knowledge (PK) unit*.

Introduction to Actuators Learning Module consists for the following:

- Knowledge Probe (Pre-assessment)
- Introduction to Actuators PK
- **Activity: What are Actuators?**
- Final Assessment

This companion Instructor Guide (IG) contains all of the information in the PG as well as answers to the Post-Activity questions. The Instructor Guide and PowerPoint presentation can be downloaded by registered users from the SCME website (<http://scme-nm-org>).

Description and Estimated Time to Complete

This activity provides you the opportunity to further enhance your knowledge and understanding of actuators both in the macro and micro-scales. You will explain how specific actuators work. Try to choose actuators that you may be used in areas that interest you.

Estimated Time to Complete

Allow 2 hours to complete this activity.

Introduction

An actuator is a device that actuates or moves something. An actuator uses some type of energy to provide motion or to apply a force. For example, an electric motor used electrical energy to create a rotational movement or to turn on object, or to move an object. A tire jack uses mechanical energy to provide enough force lift a car. So in short, an actuator converts some type of energy into motion. Actuators consist of motors, gears, pumps, valves, and switches.

Activity Objectives and Outcomes

Activity Objectives

- Compare and contrast actuators and transducers.
- Explain how two different types of actuators work.
- Identify the micro-equivalent of two macro-sized actuators.

Activity Outcomes

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

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 Actuators?

Procedure:

1. Research the operation of two different actuators from different classifications. The classification of actuators is listed below.
 - a. Thermal actuators
 - b. Manual actuators
 - c. Hydraulic/Pneumatic actuators
 - d. Electric actuators
2. Research the two actuators and write a report that addresses no less than the following information:
 - a. Type of actuator
 - i. What is the classification of this actuator (thermal, manual, hydraulic/pneumatic or electric)?
 - ii. Is this actuator macro-sized, micro-sized or both?
 - b. Operation
 - i. How does this actuator work at the macro scale? (if applicable)
 - ii. How does this actuator work at the micro scale? (if applicable)
 - iii. If this is a macro-sized only actuator, what is a micro-sized actuator that can produce the same “motion”?
 - iv. What are the similarities and differences between the macro and micro scaled actuators?
 - c. Applications
 - i. What are some current applications for this actuator in both the macro and micro-scales?
 - ii. What are some possible applications for which this actuator could be used?

Post-Lab Questions

1. What is the difference between an actuator and a transducer?
2. What are some of the challenges that researcher and designers face in the development of micro-sized actuators?
3. What are three MEMS actuators? For each actuator, what is the input energy and what is the output “motion”?

Post-Lab Questions / Answers

1. What is the difference between an actuator and a transducer?

An actuator converts an input energy into motion. However, unlike a transducer, an actuator does not always convert to a “different” type of energy. For example, a manual actuator like a tire jack, uses mechanical energy to raise a car – mechanical to mechanical.

2. What are some of the challenges that researchers and designers face in the development of micro-sized actuators?

Answers will vary. Answers should address some of the problems of small-scale components, such as the following:

Fabricating moving components in the micro-scale

Overcoming some of the forces that dictate materials in the micro-scale (e.g., stiction, Van De Waals)

Moving fluids through solid matter at such a small scale

Developing materials that are not affected by changes in temperature

3. What are three MEMS actuators? For each actuator, what is the input energy and what is the output “motion”?

Answers will vary.

a. Bimetallic switch – heat (input) to movement of an upward or downward bend

b. Comb drive – electric or electrostatic (input) to oscillating movement

c. Gears – mechanical (input) to mechanical (rotational or linear)

d. Piezoelectric switch or valve – electric (input) to up/down or sideways movement

Summary

In this activity you enhanced your knowledge of “actuators” what they are and what they do. You also studied but macro and micro-sized actuators and identified their differences and similarities.

Support for this work was provided by the National Science Foundation's Advanced Technological Education (ATE) Program through Grants. For more learning modules related to microtechnology, visit the SCME website (<http://scme-nm.org>).