

**Southwest Center for Microsystems Education (SCME)  
University of New Mexico**

# **Manufacturing Technology Training Center (MTTC) Pressure Sensor Process**

*This learning module provides a detailed, step-by-step fabrication process of a MEMS (MicroElectroMechanical System) pressure sensor. One of the activities is designed for a cleanroom environment where you perform each step of the process and end up with a working MEMS pressure sensor. If you don't have access to a cleanroom, the other activities provide the opportunity to better understand each process step as well as the process as a whole.*

*A learning module map is provided that is a suggested outline for this implementation of this module.*

Target audiences: High School, Community College, University

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Website: [www.scme-nm.org](http://www.scme-nm.org)

# Learning Module Map for MTTC Pressure Sensor Process Learning Module

*This learning module provides a detailed, step-by-step fabrication process of a MEMS (MicroElectroMechanical System) process sensor. One of the activities is designed for a cleanroom environment where you perform each step of the process and end up with a working MEMS pressure sensor. If you don't have access to a cleanroom, the other activities provide the opportunity to better understand each process step as well as the process as a whole.*

*MTTC is the Manufacturing Technology Training Center at the University of New Mexico.*

Learning Module units (8):

- Knowledge Probe (KP) or Pre-Quiz
- MTTC Pressure Sensor Process Primary Knowledge
- MTTC Pressure Sensor Process Activity (Requires cleanroom or fabrication facility)
- A MEMS Process Model Activity
- Micro Pressure Sensor Process Activity\*
- Surface Micromachining: Lift-Off Process Activity\*
- Bulk Micromachining: An Etch Process Activity\*
- Final Assessment

\*Kit available through [scme-nm.org](http://scme-nm.org) while supply lasts

**Following is a suggested map on the implementation of this learning module.**

IMPORTANT STEPS	KEY POINTS	REASONS
<u>Knowledge Probe (KP):</u> Have the	Have the participants complete the Knowledge Probe at the beginning of their learning modules	This KP is designed to test the participants' current knowledge of a MEMS pressure sensor process before starting the learning module

<p><u>Inquiry Activity</u> – “Guessing” the correct order of process steps.</p>	<p>There are 10 steps to the fabrication of the MTTC Pressure Sensor. The PS Process Kit has a set of “bug boxes” that contains a chip for each step of the process. To get the participants interested, ask them to arrange the chips in the order in which they were processed. You could give the step 1 and step 10 and have the fill in the middle.</p> <p>Supply them with a list of the ten steps and challenge them to match the chips to the correct step.</p>	<p>By introducing this first, the participants will become curious as to why the chips look different and the particular processes that created the differences. It will also generate curiosity of how each process step is done and why the steps are done in a certain sequence.</p>
<p><u>Unit (PK) Presentation 1: Present the MTTC Pressure Sensor Process Overview</u></p>	<p>Participants should read the PK.</p> <p>A PowerPoint presentation can be downloaded from <a href="http://scme-nm.org">scme-nm.org</a> and presented to all participants.</p>	<p>An introduction into MTTC Pressure Sensor and its fabrication process will prepare the participants for the activities in this learning module</p>
<p><u>MTTC Pressure Sensor Process Cleanroom Activity</u> (OPTIONAL)</p>	<p>This activity requires a fabrication facility or cleanroom; however, you may choose to go over this step by step process because it provides the equipment and process step criteria for the fabrication process covered in the PK.</p>	<p>By reviewing this process, participants could better understanding what it takes to build a MEMS devices in terms of equipment, time, and quality control.</p>
<p><u>Activity: A MEMS Process Model</u></p>	<p>Participants demonstrate their understanding of the pressure sensor process by developing an animation of the process or by building a model of the process by constructing a macro pressure sensor using available materials.</p>	<p>This activity allows participants to use their creativity and knowledge of the process to produce a visual model or animation of a MEMS Pressure Sensor process.</p>

<p><u>Micro Pressure Sensor (PS) Process Activity</u></p> <p><i>There is a SCME kit for this activity that can be ordered through <a href="http://scme-nm.org">scme-nm.org</a>.</i></p>	<p>Participants study actual process chips for the ten (10) fabrication steps of the MTTC PS process. They identify the process step for each chip and arrange the chips in the correct process order. (If done as an inquiry activity, the students can now verify the initial arrangement of steps.)</p>	<p>This activity leads to a better understanding of how micro pressure sensors are fabricated and the order in which they are fabricated.</p>
<p><u>Activity: Surface Micromachining: Lift-off Process</u></p> <p><i>There is a SCME kit for this activity that can be ordered through <a href="http://scme-nm.org">scme-nm.org</a>.</i></p>	<p>This activity requires the use of acetone; however, it can be completed in a classroom with good ventilation and the proper safety equipment.</p> <p>Given an actual process chip, participants will observe the lift-off process.</p>	<p>Seeing is believing. This process is somewhat unique to MEMS fabrication and is very visual. By studying the graphics supplied in the materials, participants should be able to explain exactly what is happening during the lift-off process.</p>
<p><u>Activity: Bulk Micromachining: An Etch Process</u></p> <p><i>There is a SCME kit for this activity that can be ordered through <a href="http://scme-nm.org">scme-nm.org</a>.</i></p>	<p>This activity requires the use of sodium hydroxide, a fume hood, and proper safety equipment.</p> <p>Using the finished lift-off chip from the previous activity or another chip supplied in the etch kit, participants will observe the anisotropic etch process which takes place on the backside of the chip.</p> <p>Observe the final product under a microscope in order to see the results.</p>	<p>Seeing is believing. This process demonstrates bulk micromachining. By studying the graphics supplied in the materials, participants should be able to explain exactly what is happening during the etch process.</p>

<p><u>Assessment:</u> Complete the Assessment.</p>	<p>Issue the Final Assessment to determine the participants' level of learning.</p>	<p>Participants are evaluated on what they have learned about MEMS pressure sensor fabrication. Compare the results of this assessment to that of the KP to determine the participants' level of learning as a result of this learning module and related activities.</p>
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*Adapted from Graupp, P. & Wrona, R. (2006) The TWI Workbook: Essential Skills for Supervisors. New York, NY. Productivity Press.*

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