

# ME5000

## MEMS Technologies Courseware

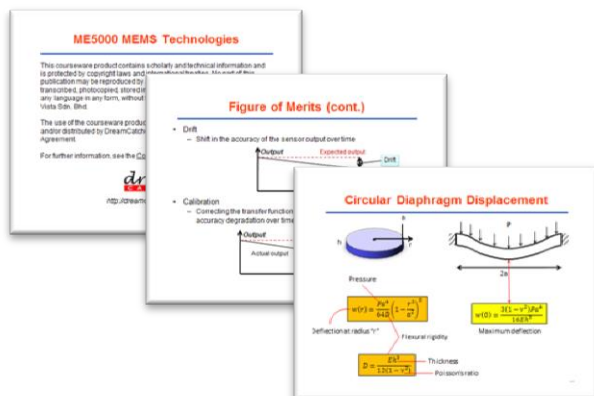
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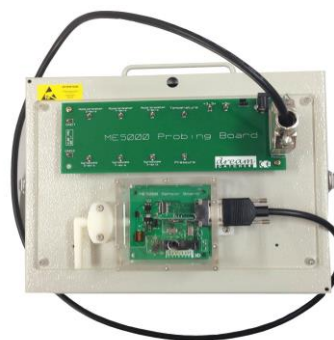
### Teaching slides

- Editable Microsoft® PowerPoint® slides
- Covers 45 hours of teaching



### Training kit

- MEMS hardware kit and accessories
- Lab sheets and model answers
- Problem-based assignments
- Covers 24 hours of labs



Target university subject	Target year of study	Prerequisite(s)
MEMS Technologies	Third or final year undergraduate	Basic Electronics

The ME5000 serves as a ready-to-teach package in Micro-Electro-Mechanical Systems (MEMS) technologies, micro fabrication process, electrical characterization, and its various applications. This is a resource for lecturers consisting of teaching slides, training kits, lab sheets, and problem-based assignments.

### Learning Outcomes

Upon completion of this course, students would be able to:

- Describe various MEMS technologies and micro-fabrication processes
- Evaluate specifications of MEMS sensors and actuators
- Perform precision parametric measurements on MEMS devices
- Perform data processing and analysis on MEMS sensors

### Benefits of the ME5000 courseware

- A practical hands-on approach of learning MEMS principles and measurements using industry-grade precision source/measure unit
- Hands-on experiments on 6 degree-of-freedom (DOF) motion sensing using MEMS accelerometers and gyros
- Practical exercises on MEMS layout drawing and simulation using the advance CAE tool



## Teaching Slides

More than 300 editable Microsoft PowerPoint teaching slides, covering 45 hours of teaching for one full semester are provided. The slides cover the following topics:

- Introduction to MEMS Technologies
- Micro Fabrication Processes
- Micro Sensing Sensors and Systems
- Micro Actuators and Actuating Systems
- MEMS Measurement Basics
- MEMS Applications and Case Studies



## Training Kit

### MEMS Hardware Kit

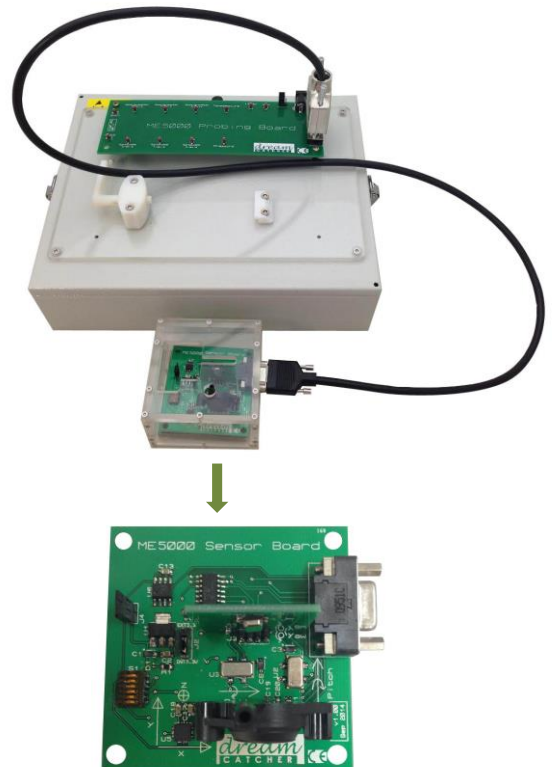
The hardware kit consists of a Sensor board and a Probing board.

Sensor board:

1. Three DOF Accelerometer X, Y, Z
  - o Sensitivity: 300 mV/g
2. Three DOF Gyro Roll, Pitch, Yaw
  - o Raw sensitivity: 0.67 mV/deg/s
  - o Full scale range: 300 deg/s
3. Amplified Pressure Sensor
  - o Absolute pressure variants: 0-15 PSI, 0-30 PSI
  - o Pressure sensitivity: 0.075 PSI

The kit was designed to facilitate:

1. Parametric measurements
2. Static and Dynamic measurements



### Accessories

The following accessories are provided with the training kit.

Item	Quantity
Power adapter, 5 Vdc, 2 A	1
USB A-B cable; D-sub cable assembly; Antistatic wrist strap	1 each
Resistor - 1 K Ohms; Diode - 1N4001; NPN Transistor - BC547	1 each

## Lab Sheets

The training kit includes eight lab sheets in editable Microsoft® Word format. Each lab requires three hours to complete. Model answers are provided with all lab sheets. The required instrument and software for the labs are listed below.

	Required tool	
	B2902A	CAE Software
1. Introduction to B2902A Precision SMU	✓	
2. Parametric Measurement of MEMS Sensors	✓	
3. MEMS Sensing - Static Measurements	✓	
4. MEMS Sensing - Dynamic Measurements	✓	
5. MEMS Sensing - Application	✓	
6. MEMS Layout Drawing and Anisotropic Etch Simulation		✓
7. Electrostatic Comb-drive of MEMS device		✓
8. Diaphragm deflection simulation of MEMS device		✓

## Problem-Based Assignments

The problem-based assignments below allow students to enhance their problem-solving skills.

1. Designing a Capacitive Pressure Sensor
2. Designing a Piezoresistive Accelerometer



## Instruments

### Instrument - Keysight SMU

The Keysight B2902A Precision Source / Measure Unit (SMU) is a 2-channel, compact and cost-effective bench-top SMU with the capability to source and measure both voltage and current. It is versatile to perform I/V (current vs. voltage) measurement easily with high accuracy.

The recommended Keysight U2902A Precision Source Measure Unit is used to characterize the MEMS devices and to as a precision data acquisition unit for noise modelling and analysis of MEMS sensors.



### CAE Software - IntelliSuite

The ME5000 lab exercises also include usage of IntelliSuite, the industry standard MEMS CAE tool. IntelliSuite is a tightly integrated design environment that will link your entire MEMS organization together. Built to scale from a point tool to an organization-wide tool, IntelliSuite unifies various engineering and manufacturing tasks into a single living design environment. Designed around collaboration, IntelliSuite allows the design, process, packaging and system teams collaborate on MEMS devices that can be prototyped and manufactured with fewer costly iterations.

The recommended instruments and software, to be purchased separately, are listed below.

Instrument/Software <sup>[1]</sup>	Mode
Precision Source Measure Unit <sup>[2]</sup>	Keysight B2902A Precision Source/Measure Unit, 2 channels Keysight U8201A Combo Test Lead Kit
CAE software for MEMS <sup>[3]</sup>	Intellisuite package recommended, Item Number: ISC-ME5000 Modules required: AnisE, 3DBuilder, Blueprint, FabViewer, ThermoElectroMechanical

[1] Refer to the Lab sheets section for the instrument/software selection.

[2] The courseware is designed to work with this instrument which is to be purchased separately. Other models with equivalent performance may be used with alterations to the lab procedures. For enquiry, please visit Keysight website at [www.keysight.com](http://www.keysight.com)

[3] The courseware is designed to work with this software which is to be purchased separately. For enquiry, please contact [sales@intellisense.com](mailto:sales@intellisense.com) or visit [www.intellisense.com](http://www.intellisense.com)

# Training Kit Hardware Specifications

## Hardware kit

DC Power source	+5 V
Accelerometer Sensitivity	300 mV/g
Gyro Raw Sensitivity	0.67 mV/deg/s
Gyro Full Scale Range	300 deg/s
Pressure Sensor with analog output:	
- Absolute pressure variants	0 - 15 PSI, 0 - 30 PSI
- Pressure sensitivity	0.075 PSI

## General

EMC compliance	Class B, Part 15 of FCC
Warranty	1 year

## Ordering Information

Description	Package	Product Number
Teaching Slides	1 user license	ME5000-100
Training Kit	1 set	ME5000-200
Teaching Slides + Training Kit	1 user license + 1 set	ME5000-300
Instrument/Software	Where applicable	Purchase separately

Training courses related to subject matter are available on request. Visit [dreamcatcher.asia](http://dreamcatcher.asia) for details.

For more information or enquiries:

Website: [dreamcatcher.asia/cw](http://dreamcatcher.asia/cw)  
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