# KL-630
## MEMS Training System


MEMS (Micro-electromechanical Systems) based sensors such as accelerometer, gyroscope and magnetometer are crucial components used in smart portable devices, like smart phone and tablet PC. The demand of MEMS sensors has been increased dramatically and identified as one of the most promising technologies nowadays.

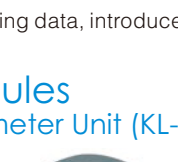
K&H develop world's first series of MEMS-based training system to facilitate students learning various MEMS functions and applications more systemically. 4 different types of MEMS based sensors are introduced in this training system, including 3-axis accelerometer, 3-axis gyroscope, barometer and magnetometer. To ensure quality results for experiment, module with XYZ-Axis Rotation Stand is specially designed to carry out three-dimensional motion experiments with operation of accelerometer and gyroscope module.

## ● Features

1. Each module is powered with 9V battery. There is no power cable to interfere the module motion during performing experiments.
2. Each module is communicated with PC via Bluetooth interface, no communication cable to interfere module motion during performing experiments.
3. Each module equipped with a LCD display shows instant results from DEMO experiments.
4. All sensing data are acquired, calculated, and recorded in software for further analysis.
5. Round shape PCB module suitable for accelerometer experiment, gyroscope experiment, and electronic compass in magnetometer experiment.
6. The protocol of sensing data, introduced in experiment manual, is available for expanding more experiments and student projects.

## ● List of Modules

### 3-Axis Accelerometer Unit (KL-67001)



#### Features

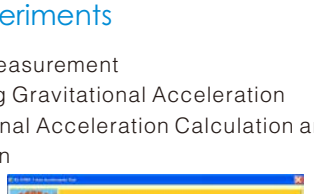
1. Learning the relation between accelerometer and gravity field in three dimensional space.
2. Converting the sensing signal into gravity unit step by step from software interface.
3. Converting the gravity data into tilting angle step by step from the software interface.
4. Easy to mount on XYZ-axis rotation stand to design and carry out more advanced experiments.
5. Under Demo mode operation, the Z-axis gravity data can be measured and displayed without connecting to PC.

#### Specifications

| | | |
|---|---|---|
| 1. Measurement Range | : | ±2g / ±4g / ±8g / ±16g |
| 2. Nonlinearity (Full Scale) | : | ±0.5% |
| 3. Inter-axis Alignment Error | : | ±0.1 degree |
| 4. Degrees Cross-axis Sensitivity | : | ±1% |
| 5. Power | : | 9V battery |
| 6. PC Connection | : | Bluetooth |
| 7. Display | : | LCM 8x2 |
| 8. Selection Mode | : | demo / PC |
| 9. Power Switch x 1 | | |
| 10. Reset Switch x 1 | | |

#### List of Experiments

1. Gravity Measurement
2. Measuring Gravitational Acceleration
3. Gravitational Acceleration Calculation and Offset Calibration




4. Tilt Angle
5. Pitch Rotation
6. Roll Rotation


7. Pitch & Roll Demo
8. Gravitational Acceleration Waveforms

Note : KL-67101 and KL-67102 are required to carry out above experiments.

## 3-Axis Gyroscope Unit (KL-67002)

### Features

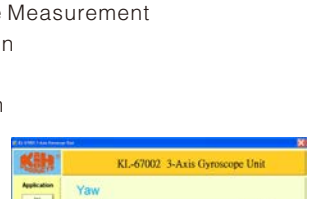
1. Learning the relation between gyroscope and its rotation in three dimensional space.
2. Converting the sensing signal into rotation angle step by step from software interface.
3. Easy to mount on XYZ-axis rotation stand to design and carry out more advanced experiments.
4. The experiment results from XYZ axis can be acquired and analyzed simultaneously from software interface.
5. Under Demo mode operation, the Z-axis rotation angle can be measured and displayed without connecting to PC.

### Specifications

| | |
|---|---|
| 1. Measurement Range | : ±250dps/±500dps/ ±2000dps |
| 2. Nonlinearity (Full scale) | : ±0.2% |
| 3. Sensitivity Change vs. Temperature | : ±2% |
| 4. Power | : 9V battery |
| 5. PC Connection | : Bluetooth |
| 6. Display | : LCM 8x2 |
| 7. Selection Mode | : demo / PC |
| 8. Power Switch x 1 | |
| 9. Reset Switch x 1 | |

### List of Experiments

1. Angle Measurement
2. Measuring Angular Rate
3. Angular Rate Calculation and Offset Calibration
4. Noise Filtering
5. X-Axis Angle Measurement
6. Y-Axis Angle Measurement
7. Z-Axis Angle Measurement
8. Pitch Rotation
9. Roll Rotation
10. Yaw Rotation




11. Angular Rate Waveforms


Note : KL-67101 and KL-67102 are required to carry out above experiments.

## Magnetometer Unit (KL-67003)

### Features

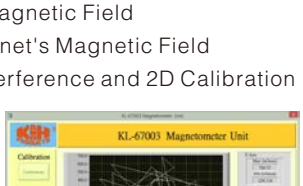
1. Learning the relation between magnetometer and magnetic field in three dimensional space.
2. Converting the sensing signal into magnetic field unit step by step from software interface.
3. Using sensing signal to find magnetic north step by step from software interface.
4. Under Demo mode operation, the magnetic north can be identified and displayed without connecting to PC.

### Specifications

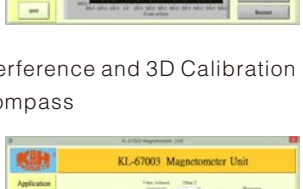
| | |
|---|---|
| 1. Measurement Range | : ±1.3gauss/±1.9gauss/ ±2.5gauss/±4.0gauss/ ±4.7gauss/±5.6gauss/ ±8.1gauss |
| 2. Magnetic Cross-axis Sensitivity | : ±1% FS/gauss |
| 3. Power | : 9V battery |
| 4. PC Connection | : Bluetooth |
| 5. Display | : LCM 8x2 |
| 6. Selection Mode | : demo/PC |
| 7. Power Switch x 1 | |
| 8. Reset Switch x 1 | |

### List of Experiments

1. Magnetic North Identification
2. Measuring Magnetic Field
3. Sensing Magnet's Magnetic Field
4. Magnetic Interference and 2D Calibration




5. Magnetic Interference and 3D Calibration
6. Electronic Compass




7. Magnetometer and Accelerometer Output Waveforms

## Digital Barometer Unit (KL-67004)

## Features

1. Converting the sensing signal into temperature and pressure step by step from software interface.
2. Using 2-way portable pump to increase or decrease the pressure of glass locker case.
3. Integrating with mechanical-based temperature meter and barometer to compare MEMS-based sensor results.
4. Under Demo mode operation, the temperature and pressure can be measured and displayed without connecting to PC.

## Specifications

### Module

1. Power : 9V battery
2. PC Connection : Bluetooth
3. Display : LCM 8 x 2
4. Selection Mode : demo/PC
5. Barometer : 600hPa~1040hPa
6. Temperature Meter : -30°C~50°C
7. Power Switch x 1
8. Reset Switch x 1

### Pressure sensor

1. Measurement Range(Absolute Pressure) : 50kPa~115kPa
2. Operating Temperature : -40°C ~ 85°C
3. Resolution : 0.15kPa
4. Accuracy : ±1kPa

### Temperature

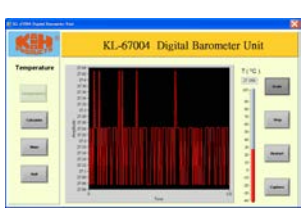
Measurement Range : -40°C ~ 105°C

### Accessories

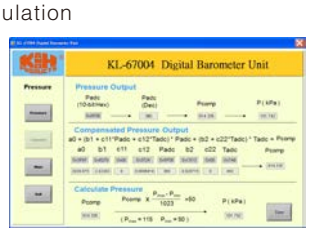
1. 2-way portable pump : hand pump with inflate and deflate function
2. Glass locker case : use 2-way portable pump to change the pressure inside the case

## List of Experiments

1. Measuring Temperature and Pressure
2. Temperature Measurement




3. Temperature Calculation
4. Pressure Measurement
5. Pressure Calculation




## Experiments Required

KL-67101 KL-67102

## XY-axis angle plate (KL-67101)

1. Function : to measure x-axis or y-axis rotation angle of XYZ-axis rotation stand (KL-67102)
2. Measure Range : 0~360 degree
3. Resolution : 7.5 degree / tick
4. Plate Material : acrylic

## XY-axis rotation stand (KL-67102)

1. Function : to mount 3-Axis Accelerometer Unit (KL-67001) or 3-Axis Gyroscope (KL-67002)
2. Degree of Freedom : three, X / Y / Z axis
3. X-axis Rotation : 0~360 degree, fixed with 2 screw knob, uses XY- axis angle plate (KL-67101) to measure rotation angle
4. Y-axis Rotation : 0~360 degree, fixed with 2 screw knob, uses XY- axis angle plate (KL-67101) to measure rotation angle
5. Z-axis Rotation : 0~360 degree, fixed with 1 screw knob, uses angle pointer to measure rotation angle
6. Z-axis Angle Plate : 0~360 degree, 2 degree/tick
7. X,Y,Z axis Can Rotate Simultaneously
8. Use Screw Knobs to Mount Corresponding MEMS Units on Stand Frame

## System Requirement

1. PC : 1GHz or faster 32-bit (x86) or 64-bit (x64) processor, 1GB RAM, 2GB more free disk space, Bluetooth receiver
2. OS : Windows XP SP3 / Windows 7 / 8 / 10

## Extra Requirement

9-V Battery (PP3) should be locally prepared

## Accessories

Experiment manual

## Optional Module

Bluetooth USB adapter