

MEMS Training System **KL-630**



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

K&H develop world's first series of MEMS-based training system so that students can learn 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 gain better experimental quality, a special module XYZ-Axis Rotation Stand is designed to carry out 3 dimensional motion experiments for accelerometer and gyroscope module.

► Features

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

► List of Modules

► 3-Axis Accelerometer Unit (KL-67001)



► Features

1. Learning the relation between accelerometer and gravity filed 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 from step by step from 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 | : $\pm 2 / \pm 4 / \pm 8 / \pm 16g$ |
| 2. Nonlinearity (full scale) | : $\pm 0.5\%$ |
| 3. Inter-Axis Alignment Error | : ± 0.1 Degree |
| 4. Degrees Cross-Axis Sensitivity | : $\pm 1\%$ |
| 5. Power | : 9V battery |
| 6. PC Connection | : Bluetooth 2.0 |
| 7. Display | : LCM 8x2 |
| 8. Selection mode | : Demo / PC |
| 9. Power switch | x 1 |
| 10. Reset switch | x 1 |

► List of Experiments

1. Measurement of gravity
2. Measurement of gravity with software interface
3. Sensing data analysis and gravity unit conversion

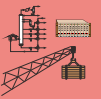


4. Calculation of tilt angle from X and Y plane
5. Pitch rotation analysis and calculation
6. Roll rotation analysis and calculation



7. Pitch & Roll demonstration
8. Data acquisition with sensing gravity

Note : KL-67101 and KL-67102 are required to carryout 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 carryout 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

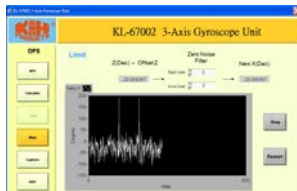
- | | |
|---------------------------------------|----------------------------------|
| 1. Measurement range | : $\pm 250/\pm 500/\pm 2000$ dps |
| 2. Nonlinearity (full scale) | : $\pm 0.2\%$ |
| 3. Sensitivity change vs. temperature | : $\pm 2\%$ |
| 4. Power | : 9V battery |
| 5. PC Connection | : Bluetooth 2.0 |
| 6. Display | : LCM 8x2 |
| 7. Selection mode | : Demo / PC |
| 8. Power switch x 1 | |
| 9. Reset switch x 1 | |

▶ List of Experiments

1. Measurement of angle
2. Measurement of angular velocity with software interface
3. Sensing data analysis and angle unit conversion
4. Digital zero-rate level calibration
5. X-axis angle measurement with software interface
6. Y-axis angle measurement with software interface
7. Z-axis angle measurement with software interface
8. Pitch rotation demonstration
9. Roll rotation demonstration
10. Yaw rotation demonstration



11. Data acquisition with sensing angular data



▶ Magnetometer Unit (KL-67003)



▶ Features

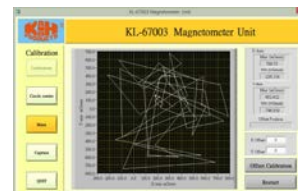
1. Learning the relation between magnetometer and magnetic field in three dimensional space.
2. Converting the sensing signal into magnetic field unit step by step from software interface.
3. Using sensing signal to find magnetic north step by step from software interface.
4. Under Demo mode operation,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

▶ Specifications

- | | |
|------------------------------------|---|
| 1. Measurement range | : $\pm 1.3/\pm 1.9/\pm 2.5/\pm 4.0/\pm 4.7/\pm 5.6/\pm 8.1$ gauss |
| 2. Magnetic cross-axis sensitivity | : $\pm 1\%$ %FS/gauss |
| 3. Power | : 9V battery |
| 4. PC Connection | : Bluetooth 2.0 |
| 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. 3-axis magnetic field sensing experiments
3. Sensing with magnet
4. Magnetic field interference and calibration



5. 8-motion calibration
6. Electronic compass



7. Data acquisition with sensing magnetic field

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



▶ 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 and 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 2.0
3. Display : LCM 8 x 2
4. Selection mode : Demo/PC
5. Barometer : 600 to 1040 hPa
6. Temperature meter : -30 to 50°C
7. Power switch x 1
8. Reset switch x 1



Pressure sensor

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

Temperature

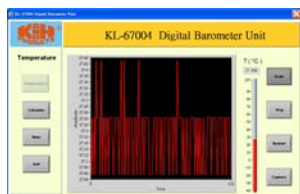
Measurement range : -40°C ~ 105°C

Accessories

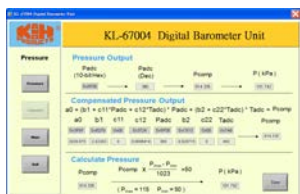
1. 2-way portable pump: hand pump with inflate and deflate function
2. Glass locker case : use 2-way portable pump to change the pressure inside the case

▶ List of Experiments

1. Measurement of room temperature and pressure
2. Measurement of temperature with software interface



3. Sensing data analysis and temperature unit conversion
4. Measurement of pressure with software interface
5. Sensing data analysis and pressure unit conversion



▶ 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, use XY- axis angle plate (KL-67101) to measure rotation angle
4. Y-axis rotation : 0~360 degree, fixed with 2 screw knob use XY- axis angle plate (KL-67101) to measure rotation angle
5. Z-axis rotation : 0~360 degree, fixed with 1 screw knob use 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 : CPU Pentium II or above
HDD 20GB
RAM 1GB
Bluetooth receiver
2. OS : Windows XP SP3 / Windows 7

● Accessories

1. Experiment manual
2. 9V Battery

● Optional Module

Bluetooth USB adapter

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