



KL-730

Biomedical Measurement Training System



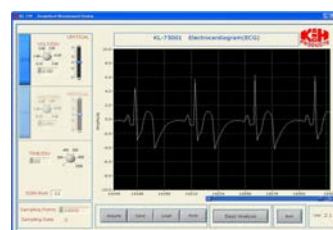
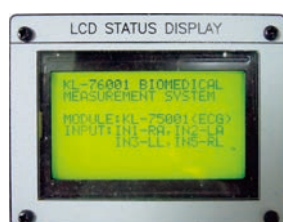
The Biomedical Measurement Training System (KL-730) provides a platform for students to learn how to extract various body signals using bio-electronics sensors. There are a total of 12 modules covering a variety of topics, including: Electrocardiogram (ECG), Electromyogram (EMG), Electrooculogram (EOG), Electroencephalogram (EEG), Blood pressure (BP), Photoplethysmogram (PPG), Respiratory ventilation detection, Pulse meter measurement, Body impedance detection, Doppler ultrasound blood velocity measurement, and Respiration flow/vital capacity meter measurement.

Through the system, students can construct a circuit to process and convert signals into readable forms for further observation and analysis. Also, hands-on practices and experiments allow students to understand the characteristics of various bio-electronics sensors and transducers.

*Notebook is excluded

● Features

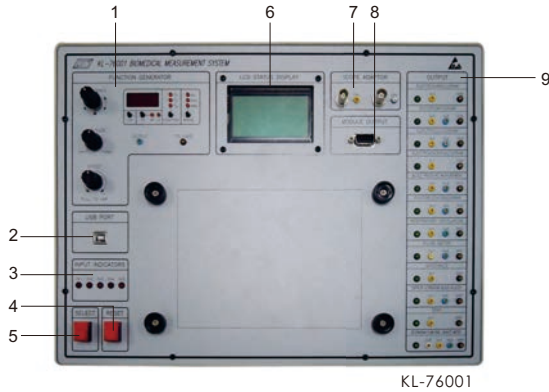
1. There are test points for adjustment of frequency bandwidth and amplifier gain, allowing students to learn the relationship between a circuit and a corresponding signal on each processing stage.
2. The system consists of several bio-electronics sensors and transducers, including pressure transducers, infrared photocouplers, strain gauges, temperature sensors, surface electrodes, dual element transducers, and pneumotach transducers.
3. Display and storage of signals
The main unit of the system (KL-76001) has a 128 x 64 LCD graphic display to show the real-time physiological parameters. Physiological signals can be displayed on a digital storage oscilloscope (DSO).
4. With embedded 10-bit A/D converters (2.4 Kbits/s), physiological signals can be converted to digital forms and transmitted to computers in real-time via a USB port.
5. Graphic user interface software
 - (1) Communication port : USB
 - (2) Physiological signal can be analyzed after connection
 - (3) Easy operation
 - (4) X-axis : TIME/DIV ; Y-axis : VOLT/DIV
 - (5) Data can be stored, replayed, or printed
 - (6) Storage formats : *.BMP, *.JPEG, *.XLS
 - (7) Measurements of ECG, EMG, EOG, EEG, blood pressure, respiration flow/vital capacities are available for analysis.





Specifications

▶ Main Unit (KL-76001)



1. Function Generator

- (1) Output Waveform : Sine, Square, and Triangle.
- (2) Frequency Range : 0.01Hz ~ 1MHz,
continuously adjustable
- (3) Amplitude Range : 50mVpp ~ 18Vpp (open circuit)
- (4) DC Offset : - 10V to +10V
- (5) Display : 4-digit,7-segment display

2. Interface Port

USB Interface : Type B

3. Input Indicators

IN1、 IN2、 IN3、 IN4、 IN5 LEDs, indicating the corresponding connection for students when conducting experiments of ECG, EMG, EOG, EEG and body impedance.

4. Reset Switch
for MCU reset

5. Select Switch
for selection of the modules

6. LCD Status Display

- (1) Display the output frequency of the function generator
- (2) Display the module selected
- (3) Display Heart Rates (KL-75006), Respiration (KL-75007), Pulse Rates (KL-75008) and Doppler Ultrasound Blood (KL-75010).

7. BNC Adaptor Connector
for 2mm sockets / BNC sockets

8. Module Output
DB9 connector

9. Output

- (1) Electrocardiogram (ECG) : 1 output
- (2) Electromyogram (EMG) : 2 outputs
- (3) Electrooculogram (EOG) : 2 outputs
- (4) Electroencephalogram (EEG) : 1 output
- (5) Blood pressure measurement : 2 outputs
- (6) Photoplethysmogram : 2 outputs
- (7) Respiratory ventilation : 2 outputs
- (8) Pulse meter : 2 outputs
- (9) Impedance : 1 output
- (10) Doppler Ultrasound Blood Velocity : 2 outputs
- (11) TENS : 1 output
- (12) Respiration Flow/Vital Capacity Meter : 2 outputs

▶ Module Units (KL-75001~75012)

KL-75001 Electrocardiogram ECG Module

Feature:

Understand the potential phenomenon when the heart beats. This measurement module uses 6 limb leads to detect the electrocardiogram. With the explicit experimental procedure, students can easily learn how to design the Wilson network and the isolated circuits.



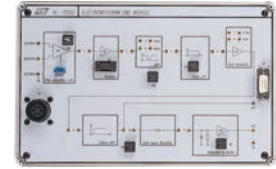
Specifications	List of Experiments	Equipment Required
<ul style="list-style-type: none"> 1. Limb lead inputs 2. Limb electrode 3. 6 limb leads : Lead I, Lead II, Lead III, aVR, aVL, aVF 4. Isolation circuit 5. Gain : 100~5000 6. Band-pass filter : 0.1~100Hz 7. 1 output ECG signal 	<ul style="list-style-type: none"> 1. HPF Characteristic Experiment 2. Amplifier Experiment 3. LPF Characteristic Experiment 4. BR Characteristic Experiment 5. ECG Simulator Experiment (Option) 6. ECG Experiment 	<ul style="list-style-type: none"> 1. KL-76001 Main Unit 2. KL-75001 Electrocardiogram Module 3. Digital Storage Oscilloscope (Option) 4. Lead Clamp - ⑥ 5. Electrode Lead - ⑦ 6. 5-Conductor Electrode Cable - ⑧ 7. Alcohol Prep. Pad - ⑩ 8. Trimmer 9. Connection Leads - ⑪ 10. 2mm Bridging Plug - ⑫ 11. 2mm Terminal - ⑬ 12. KL-79106 ECG Simulator (Option)



KL-75002 Electromyogram EMG Module

Feature:

Understand the electrical activity of muscle under the isotonic and isometric conditions and simultaneously detect the amount of muscle force. From the measured waveform, students can realize the motion function made by the specific skeletal muscle.

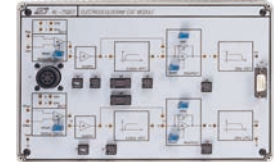


Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Surface electrode Gain : x 1000, x 2000 Isolation circuit Band-pass filter : 100 ~1000Hz 2 outputs <ol style="list-style-type: none"> Electromyogram signal Muscle force signal 	<ol style="list-style-type: none"> BRF Characteristic Experiment LPF Characteristic Experiment Gain Amplifier Experiment HPF Characteristic Experiment Half-Wave Rectifier Characteristic Experiment Integrator Characteristic Experiment EMG Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75002 Electromyogram Module Digital Storage Oscilloscope (Option) Body Surface Electrodes - ⑧ Electrode Lead - ⑰ 5-Conductor Electrode Cable - ⑱ Alcohol Prep. Pad - ⑪ Dumbbell - ① Trimmer Connection Leads - ⑳ 2mm Bridging Plug - ㉑ 2mm Terminal - ㉒

KL-75003 Electrooculogram EOG Module

Feature:

Have a thorough grasp of the electrical activity of the eye muscle under eye movements. Two kinds of electrical signals from horizontal and vertical movements of the eyeball are detected and processed in the module.

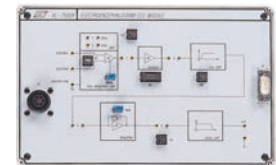


Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Surface electrode Gain : 5~3000 Isolation circuit Band-pass filter : 0.05~30Hz 2 outputs <ol style="list-style-type: none"> Horizontal signal Vertical signal 	<ol style="list-style-type: none"> Horizontal & Vertical Electro Circuit Calibration Experiment BRF Characteristic Experiment HPF Characteristic Experiment Amplifier Experiment LPF Characteristic Experiment EOG Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75003 Electrooculogram Module Digital Storage Oscilloscope (Option) Body Surface Electrodes - ⑧ Electrode Lead - ⑰ 5-Conductor Electrode Cable - ⑱ Alcohol Prep. Pad - ⑪ Trimmer Connection Leads - ⑳ 2mm Bridging Plug - ㉑ 2mm Terminal - ㉒

KL-75004 Electroencephalogram EEG Module

Feature:

Understand the electrical activity of the brain. In the experimental procedure, the α -wave will be evoked when the eyes open and close. Because the EEG signal is very weak, this module implements a high gain amplifier and filters to reduce noise.



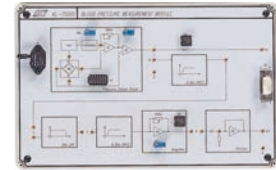
Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> EEG electrode Gain : 50~5000 Isolation circuit Band-pass filter : 1~20Hz 1 output EEG signal 	<ol style="list-style-type: none"> Pre-Amplifier Calibration Experiment BRF Characteristic Experiment HPF Characteristic Experiment Amplifier Experiment LPF Characteristic Experiment EEG Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75004 Electroencephalogram Module Digital Storage Oscilloscope (Option) EEG Electrode - ⑯ 5-Conductor Electrode Cable - ⑱ Alcohol Prep. Pad - ⑪ Electrical Conductivity Jelly - ② Medical Tape - ⑩ Elastic Head Bandage - ⑨ Trimmer Connection Leads - ⑳ 2mm Bridging Plug - ㉑ 2mm Terminal - ㉒ EEG Simulator (Option)



KL-75005 Blood Pressure Measurement Module

Feature:

Realize how to measure the blood pressure noninvasively and compare the accuracy between the measurement from the auscultator and from the oscilloscope. In this experiment, students know the way to calibrate the pressure transducer directly and indirectly.

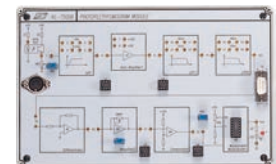


Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Pressure transducer: <ol style="list-style-type: none"> Differential pressure model Pressure range : 0~5 psid Accuracy : 0.5% Input impedance : 5K Ω Pressure calibration circuit Gain amplifier : 20~800 Band-pass filter : 0.3~3Hz 2 outputs <ol style="list-style-type: none"> Cuff pressure signal Oscillometric pulse signal 	<ol style="list-style-type: none"> Pressure Sensor Calibration Experiment HPF1 Characteristic Experiment LPF Characteristic Experiment HPF2 & Amplifier Characteristic Experiment Rectifier Characteristic Experiment Auscultatory Blood Pressure measurement Experiment Oscillometric Blood Pressure Measurement Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75005 Blood Pressure Measurement Module Digital Storage Oscilloscope (Option) Mechanical Sphygmomanometer - ④ Trimmer Connection Leads - ② 2mm Bridging Plug - ② 2mm Terminal - ②

KL-75006 Photoplethysmogram Module

Feature:

Understand how to use the noninvasive method and configure the circuit to detect and process the Plethysmogram. The volume change in blood capillary is detectable by an infrared photocoupler.



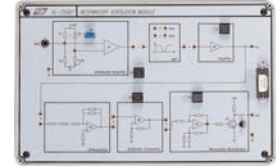
Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Infrared light-emitting diode <ol style="list-style-type: none"> Rated forward current IF = 60mA Rated reverse voltage VR = 4V Peak wavelength $\lambda_p = 880\text{nm}$ $\Delta \theta = \pm 53\text{deg.}$ Phototransistor <ol style="list-style-type: none"> Rated C-E voltage VCEO = 20V Rated collector power Pc = 75mW Peak wavelength $\lambda_p = 800\text{nm}$ $\Delta \theta = \pm 50\text{deg.}$ Gain : x 50~500, x 100~1000 Band-pass filter : 0.3~40Hz 2 outputs <ol style="list-style-type: none"> Plethysmogram signal Heart rate pulse 	<ol style="list-style-type: none"> Infrared Photocoupler Calibration Experiment HPF Characteristic Experiment Gain Amplifier Experiment 4th-order LPF Characteristic Experiment Differentiator Experiment Amplifier Experiment Comparator Experiment Monostable Multivibrator Experiment Photoplethysmogram Measurement Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75006 Photoplethysmogram Module Digital Storage Oscilloscope (Option) Infrared Photocoupler Sensor - ③ Trimmer Connection Leads - ② 2mm Bridging Plug - ② 2mm Terminal - ②



KL-75007 Respiratory Ventilation Module

Feature:

After practicing using temperature sensors and configuring circuits, users can understand how to detect and process respiratory signals including stop breathing capacity, over-respiration, and respiratory rate.

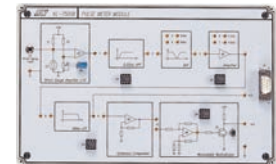


Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Temperature sensor <ol style="list-style-type: none"> Thermistor : 5KΩ (at 25°C) Tolerance : \pm5% With temperature compensation circuit Gain : 20 2 outputs <ol style="list-style-type: none"> Pneumograph signal Respiratory rate pulse 	<ol style="list-style-type: none"> Differential Amplifier Calibration Experiment BRF Characteristic Experiment Amplifier Experiment Differentiator Experiment Hysteresis Comparator Experiment Monostable Multivibrator Experiment Respiratory Ventilation Detection Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75007 Respiratory Ventilation Module Digital Storage Oscilloscope (Option) Temperature Sensor Mask - ⑦ Trimmer Alcohol Prep. Pad - ⑪ Connection Leads - ⑫ 2mm Bridging Plug - ⑬ 2mm Terminal - ⑭

KL-75008 Pulse Meter Module

Feature:

Understand how to use the strain gauge and configure the circuit to detect and process the waveforms of the radial pulse and learn the characteristics the vascular under various transmural pressure conditions.

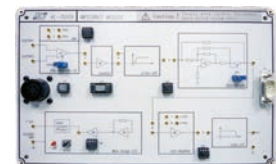


Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Strain gauge <ol style="list-style-type: none"> 5 mm grid, 120Ω Gain : x 2500, x 5000 Band-pass filter : 0.05 ~ 40Hz 2 outputs <ol style="list-style-type: none"> Pulse wave Heart rate pulse 	<ol style="list-style-type: none"> Strain Gauge Amplifier Calibration Experiment HPF Characteristic Experiment BRF Characteristic Experiment Gain Amplifier Experiment LPF Characteristic Experiment Hysteresis Comparator Experiment Monostable Multivibrator Experiment Pulse Meter Experiment Arterial Vessel Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75008 Pulse Meter Module Digital Storage Oscilloscope (Option) Strain Gauge Tie - ⑬ Wrist-type Cuff - ⑤ Mechanical Sphygmomanometer - ④ Trimmer Connection Leads - ⑫ 2mm Bridging Plug - ⑬ 2mm Terminal - ⑭

KL-75009 Impedance Module (People with cardiac pacemaker must avoid using this module)

Feature:

Realize how to detect the body impedance. When students Inject a constant alternating current to the body and the alternating current passes through the chest, a change of body impedance will be detected when the chamber volume of both the ventricle and atrium is changed.



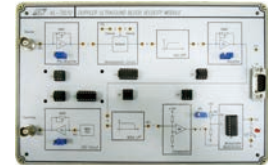
Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Band-pass filter : 0.1~10Hz Sine wave generator circuit : 50KHz Surface electrode Isolation circuit Gain : x 1250, x 2500 With overcurrent protection and reset circuits 1 output <ol style="list-style-type: none"> Body impedance signal 	<ol style="list-style-type: none"> Pre-Amplifier Calibration Experiment BRF Characteristic Experiment Wien-Bridge Oscillator Experiment HPF Characteristic Experiment Demodulator Experiment Gain Amplifier Experiment LPF Characteristic Experiment Impedance Detection Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75009 Impedance Module Digital Storage Oscilloscope (Option) Body Surface Electrodes - ⑧ Electrode Lead - ⑰ 5-Conductor Electrode Cable - ⑱ Alcohol Prep. Pad - ⑪ Trimmer Connection Leads - ⑫ 2mm Bridging Plug - ⑬ 2mm Terminal - ⑭



KL-75010 Doppler Ultrasound Blood Velocity Module

Feature:

Understand the operating principles of ultrasonic sensors, how the ultrasound probe measures the velocity of blood flow, and the fundamental circuit theory of the ultrasound probe.



Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Dual Element Transducer Frequency : 5MHz Gain : 16~100 Band-pass filter : 1~40Hz 2 Outputs (1) Plethysmogram signal (2) Heart rate pulse 	<ol style="list-style-type: none"> OSC Experiment Pre-Amplifier Experiment Demodulation Experiment HPF Characteristic Experiment Amplifier Experiment LPF Characteristic Experiment Comparator Experiment Monostable Multivibrator Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75010 Doppler ultrasound blood velocity module Digital Storage Oscilloscope (Option) Dual Element Transducers Sensor - ⑳ Trimmer Alcohol Prep. Pad - ㉑ Connection Leads - ㉒ 2mm Bridging Plug - ㉓ 2mm Terminal - ㉔ Electrical conductivity jelly - ㉕

KL-75011 TENS Module (People with cardiac pacemaker must avoid using this module)

Feature:

Understand the fundamental circuit theory of the transcutaneous electrical nerve stimulation (TENS) and the physiological responses of muscles which are stimulated by different frequencies and amplitudes.



Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Electrode lead 1 Output 555 Timer-Astable signal (1) Frequency Adjust : 25~115Hz (2) Duty Cycle : 91~98% 	<ol style="list-style-type: none"> 555 Timer-Astable Experiment Transistor Switch Circuit Experiment Transistor Bias Circuit Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75011 TENS module Digital Storage Oscilloscope (Option) Body surface electrodes (for KL-75011) - ㉖ Electrode lead (for KL-75011) - ㉗ Connection Leads - ㉘ 2mm Bridging Plug - ㉙ 2mm Terminal - ㉚

KL-75012 Respiration Flow/Vital Capacity Meter Module

Feature:

Understand the respiratory parameters (including the respiratory volume and respiratory flow) and the measurement of the basic circuit.



Specifications	List of Experiments	Equipment Required
<ol style="list-style-type: none"> Pneumotach transducer (1) Excitation voltage : 6V (2) Flow range : 2-35L/min (3) Resolution : 700P/L (4) Maximum operation pressure : 25 Bar 2 Outputs (1) Respiration flow signal (2) Counting pulse 	<ol style="list-style-type: none"> Hall & Differential Experiment Frequency to Voltage Experiment Comparator Experiment AND Gate Experiment Decade Counter Experiment Decoder Experiment 7-Segment Experiment 	<ol style="list-style-type: none"> KL-76001 Main Unit KL-75012 Respiration flow/Vital capacity meter module Digital Storage Oscilloscope (Option) Respiration transducer - ㉛ Trimmer Connection Leads - ㉜ 2mm Bridging Plug - ㉝ 2mm Terminal - ㉞



● The Features of the Experiment Modules

1. All terminals on the module are connectable with 2mm plugs.
2. Circuit symbols, blocks, and components are printed on the surface of each module.
3. Modules are secured in plastic housings.
4. Dimension : 255 x 165 x 30mm ± 10%
5. Comprehensive experiment and instructor's manuals are provided.

● System Requirement

1. Above INTEL P4 compatible PC
2. USB port
3. Above 1G bytes memory
4. Disk space more than 2G bytes
5. DVD-ROM driver for installing PC
6. OS : Windows 7/8/10

● Accessories

▶ Optional Accessories

1. Digital Storage Oscilloscope (DSO)
2. KL-79106 ECG simulator
3. EEG simulator

Consumables

1. Electrical conductivity jelly
2. Body surface electrode
3. Alcohol prep pad
4. Elastic head bandage
5. Temperature sensor mask
6. Medical tape
7. Body surface electrode (for KL-75011)



▶ Standard Accessories (KL-79003)



- ① Dumbbell
- ② Electrical conductivity jelly
- ③ Accessory box
- ④ Mechanical sphygmomanometer
- ⑤ Wrist-type cuff
- ⑥ Lead clamp
- ⑦ Temperature sensor mask
- ⑧ Body surface electrodes
- ⑨ Elastic head bandage
- ⑩ Medical tape
- ⑪ Alcohol prep pad

- ⑫ Strain gauge tie
- ⑬ Infrared photocoupler sensor
- ⑭ Body surface electrode for KL-75011
- ⑮ Electrode lead for KL-75011
- ⑯ EEG electrode
- ⑰ Electrode lead
- ⑱ 5-conductor electrode cable
- ⑲ Respiration transducer
- ⑳ Connection leads
- ㉑ 2mm bridging plug
- ㉒ 2mm terminal
- ㉓ Dual Element transducer

