KL-730

Biomedical Measurement Training System

This equipment is designed for students to learn how to design specific measuring circuits and detect the basic physiological signals with practical operation.

Moreover, students can understand electrical characteristics of sensor and transducer explicitly after completing the experiments we provided.

Features

1. KL-730 contains twelve modules, including Electrocardiogram Measurement, Electromyogram Measurement, Electrooculogram Measurement, Electroencephalogram Measurement, Blood Pressure Measurement, Photoplethysmogram Measurement, Respiratory Ventilation Detection, Pulse Meter, Body Impedance Detection, Doppler Ultrasound Blood Velocity, TENS and Respiration Flow / Vital Capacity Meter.
2. The sensors and transducers used in this equipment include pressure transducer, infrared photocoupler, strain gauge, temperature sensor, surface electrode, dual element transducer and pneumotach transducer.
3. Each module has many test points for changing the frequency bandwidth and amplifier gain. Thus students can understand the correlation between physiological signal and each circuit stage.

Display Methods of the Output Signal

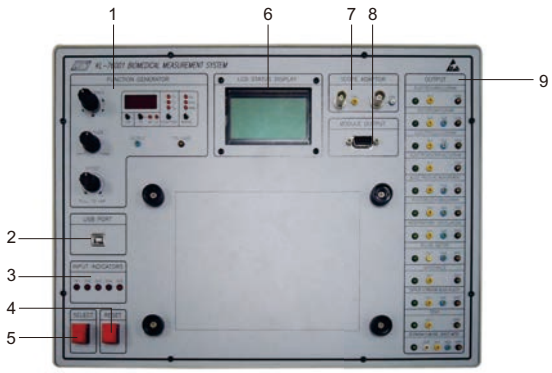
1. The main unit has a 128 x 64 LCD graphic display to show the real-time physiological parameters such as heart rate, respiratory rate...etc.
2. The physiological signal can be displayed on Digital Storage Oscilloscope (DSO).
3. With the embedded 10 bits A/D converters (2.4 Kbits/s) to convert physiological signal into digital form and transmit the real-time digital signal to computer via USB port for display and storage.

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. Analysis software available for ECG, EMG, EOG, EEG, Blood Pressure Measurement and Respiration Flow / Vital Capacity Meter

Specifications

Main Unit (KL-76001)



KL-76001

1. Function Generator
   a. Output waveform: Sine, square, triangle.
   b. Frequency range: 0.01 Hz ~ 1MHz, continuously adjustable
   c. Amplitude range : 50 mVpp ~ 18 Vpp (open circuit)
   d. DC offset : - 10V to + 10V
   e. Display : 4-digit,7-segment display
2. Interface Port
   USB interface : Type B
3. Input Indicators
   IN1、IN2、IN3、IN4、IN5 LED to lead the student connecting the sensor used for ECG, EMG, EOG, EEG and body impedance.
4. Reset Switch
   For MCU reset
5. Select Switch
   Select the module
6. LCD Status Display
   a. Display the frequency of function generator
   b. Display the measurement modules: Electrocardiogram measurement, Electromyogram measurement, Electrooculogram measurement, Electroencephalogram measurement, Blood pressure measurement, Photoplethysmogram measurement, Respiratory ventilation detection, Pulse meter, Body impedance detection, Doppler Ultrasound Blood Velocity, TENS, Respiration Flow/Vital Capacity Meter.
   c. Heart Rate(KL-75006), Respiration(KL-75007), Pulse Rate (KL-75008) and Doppler Ultrasound Blood(KL-75010).
7. BNC Adaptor Connector
   For 2mm socket / BNC socket
8. Module Output
   DB9 connector
9. Output
   a. Electrocardiogram (ECG) : One output
   b. Electromyogram (EMG) : Two outputs
   c. Electrooculogram (EOG) : Two outputs
   d. Electroencephalogram (EEG) : One output
   e. Blood pressure measurement : Two outputs
   f . Photoplethysmogram : Two outputs
   g. Respiratory ventilation : Two outputs
   h. Pulse meter : Two outputs
   i . Impedance : One output
   j . Doppler Ultrasound Blood Velocity: Two outputs
   k. TENS : One output
   l . Respiration Flow/Vital Capacity Meter : Two outputs

Module Units (KL-75001~75012)

KL-75001 Electrocardiogram ECG Module

Feature:

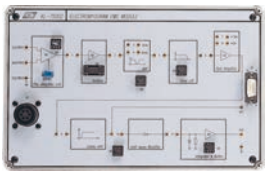
Understand the phenomenon of the action potential when heart beats. This measurement module uses six limb leads to detect the electrocardiogram. With the explicit experimental procedure, students learn how to design the Wilson network and the isolated circuits easily.

Specifications	List of Experiments	Equipment Required
1. Limb lead inputs 2. Limb electrode 3. Six limb leads : Lead I, Lead II, Lead III, aV R, aV L, aV F 4. Isolation circuit 5. Gain : 100~5000 6. Band-pass filter : 0.1~100 Hz 7. One output ECG signal	1. HPF Characteristic Experiment 2. Amplifier Experiment 3. LPF Characteristic Experiment 4. BRF Characteristic Experiment 5. ECG Simulator Experiment (Optional) 6. ECG Experiment	1. KL-76001 Main Unit 2. KL-75001 Electrocardiogram Module 3. Digital Storage Oscilloscope (Option) 4. Lead Clamp - ⑥ 5. Electrode Lead - ⑰ 6. 5-Conductor Electrode Cable - ⑱ 7. Alcohol Prep. Pad - ⑪ 8. Trimmer 9. Connection Leads - ⑳ 10. 2mm Bridging Plug - ㉑ 11. 2mm Terminal - ㉒ 12. KL-79106 ECG Simulator (Option)

KL-75002 Electromyogram EMG Module

Feature:

Comprehend 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 skeletal muscle specific.

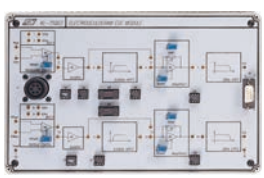


Specifications	List of Experiments	Equipment Required
1. Surface electrode 2. Gain : x 1000, x 2000 3. Isolation circuit 4. Band-pass filter : 100 ~1000 Hz 5. Two outputs a. Electromyogram signal b. Muscle force signal	1. BRF Characteristic Experiment 2. LPF Characteristic Experiment 3. Gain Amplifier Experiment 4. HPF Characteristic Experiment 5. Half-Wave Rectifier Characteristic Experiment 6. Integrator Characteristic Experiment 7. EMG Experiment	1. KL-76001 Main Unit 2. KL-75002 Electro myogram Module 3. Digital Storage Oscilloscope (Option) 4. Body Surface Electrodes - ⑧ 5. Electrode Lead -⑰ 6. 5-Conductor Electrode Cable - ⑱ 7. Alcohol Prep. Pad - ⑪ 8. Dumbbell - ① 9. Trimmer 10. Connection Leads - ⑳ 11. 2mm Bridging Plug - ㉑ 12. 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 signal from horizontal and vertical movements of the eye ball are detected and processed in the module.

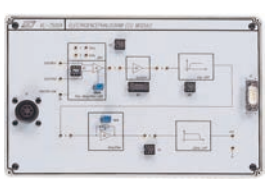


Specifications	List of Experiments	Equipment Required
1. Surface electrode 2. Gain : 5~3000 3. Isolation circuit 4. Band-pass filter : 0.05~30 Hz 5. Two outputs a. Horizontal signal b. Vertical signal	1. Horizontal & Vertical Electro Circuit Calibration Experiment 2. BRF Characteristic Experiment 3. HPF Characteristic Experiment 4. Amplifier Experiment 5. LPF Characteristic Experiment 6. EOG Experiment	1. KL-76001 Main Unit 2. KL-75003 Electrooculogram Module 3. Digital Storage Oscilloscope (O ption) 4. Body Surface Electrodes - ⑧ 5. Electrode Lead - ⑰ 6. 5-Conductor Electrode Cable - ⑱ 7. Alcohol Prep. Pad - ⑪ 8. Trimmer 9. Connection Leads - ⑳ 10. 2mm Bridging Plug - ㉑ 11. 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 avoid the noise.

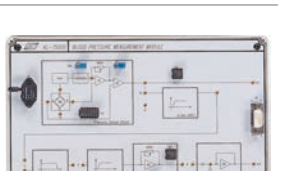


Specifications	List of Experiments	Equipment Required
1. EEG electrode 2. Gain : 50~5000 3. Isolation circuit 4. Band-pass filter : 1~20 Hz 5. One output EEG signal	1. Pre-Amplifier Calibration Experiment 2. BRF Characteristic Experiment 3. HPF Characteristic Experiment 4. Amplifier Experiment 5. LPF Characteristic Experiment 6. EEG Experiment	1. KL-76001 Main Unit 2. KL-75004 Electroencephalogram Module 3. Digital Storage Oscilloscope (Option) 4. EEG Electrode - ⑯ 5. 5-Conductor Electrode Cable - ⑱ 6. Alcohol Prep. Pad - ⑪ 7. Electrical Conductivity Jelly - ② 8. Medical Tape - ⑩ 9. Elastic Head Bandage - ⑨ 10. Trimmer 11. Connection Leads - ⑳ 12. 2mm Bridging Plug - ㉑ 13. 2mm Terminal - ㉒ 14. EEG Simulator (Option)

KL-75005 Blood Pressure Measurement Module

Feature:

Realize how to measure the blood pressure noninvasively and compare its accuracy with the auscultator and oscillometric method. In this experiment, students know the way to calibrate the pressure transducer directly and indirectly.

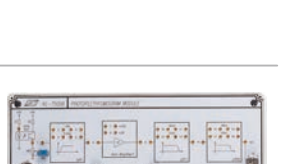


Specifications	List of Experiments	Equipment Required
1. Pressure transducer: a. Differential pressure model b. Pressure range : 0~5 psid c. Accuracy : 0.5 % d. Input impedance : 5KΩ 2. Pressure calibration circuit 3. Gain amplifier : 20~800 4. Band-pass filter : 0.3~3 Hz 5. Two outputs a. Cuff pressure signal b. Oscillometric pulse signal	1. Pressure Sensor Calibration Experiment 2. HPF1 Characteristic Experiment 3. LPF Characteristic Experiment 4. HPF2 & Amplifier Characteristic Experiment 5. Rectifier Characteristic Experiment 6. Auscultatory Blood Pressure measurement Experiment 7. Oscillometric Blood Pressure Measurement Experiment	1. KL-76001 Main Unit 2. KL-75005 Blood Pressure Measurement Module 3. Digital Storage Oscilloscope (Option) 4. Mechanical Sphygmomanometer - ④ 5. Trimmer 6. Connection Leads - ⑳ 7. 2mm Bridging Plug - ㉑ 8. 2mm Terminal - ㉒

KL-75006 Photoplethysmogram Module

Feature:

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

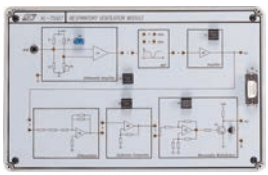


Specifications	List of Experiments	Equipment Required
1. Infrared light-emitting diode a. Rated forward current IF = 60 mA b. Rated reverse voltage VR = 4 V c. Peak wavelength λp = 880 nm d. Δθ = ±53 deg 2. Phototransistor a. Rated C-E voltage VCEO = 20 V b. Rated collector power Pc = 75 mW c. Peak wavelength λp = 800 nm d. Δθ = ±50 deg. 3. Gain : x 50~500, x 100~1000 4. Band-pass filter : 0.3~40 Hz 5. Two outputs a. Plethysmogram signal b. Heart rate pulse	1. Infrared Photocoupler Calibration Experiment 2. HPF Characteristic Experiment 3. Gain Amplifier Experiment 4. 4th-order LPF Characteristic Experiment 5. Differentiator Experiment 6. Amplifier Experiment 7. Comparator Experiment 8. Monostable Multivibrator Experiment 9. Photoplethysmogram Measurement Experiment	1. KL-76001 Main Unit 2. KL-75006 Photoplethysmogram Module 3. Digital Storage Oscilloscope (Option) 4. Infrared Photocoupler Sensor - ⑬ 5. Trimmer 6. Connection Leads - ⑳ 7. 2mm Bridging Plug - ㉑ 8. 2mm Terminal - ㉒

KL-75007 Respiratory Ventilation Module

Feature:

To learn the usage of temperature sensor and circuit configuration, users can comprehend how to detect and process the respiratory signal including stop breathing capacity, over-respiration and respiratory rate.

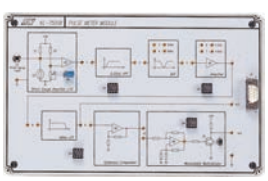


Specifications	List of Experiments	Equipment Required
1. Temperature sensor a. Thermister : 5KΩ (at 25°C) b. Tolerance : ± 5% 2. With temperature compensation circuit 3. Gain : 20 4. Two outputs a. Pneumograph signal b. Respiratory rate pulse	1. Differential Amplifier Calibration Experiment 2. BRF Characteristic Experiment 3. Amplifier Experiment 4. Differentiator Experiment 5. Hysteresis Comparator Experiment 6. Monostable Multivibrator Experiment 7. Respiratory Ventilation Detection Experiment	1. KL-76001 Main Unit 2. KL-75007 Respiratory Ventilation Module 3. Digital Storage Oscilloscope (Option) 4. Temperature Sensor Mask - ⑦ 5. Trimmer 6. Alcohol Prep. Pad - ⑪ 7. Connection Leads - ⑳ 8. 2mm Bridging Plug - ㉑ 9. 2mm Terminal - ㉒

KL-75008 Pulse Meter Module

Feature:

Understand how to use the strain gauge and configure the circuit for detecting and processing the radial pulse waveform and learn vascular characteristics under different Transmural pressure conditions.

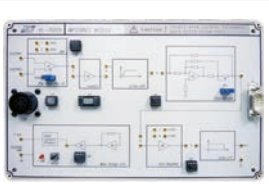


Specifications	List of Experiments	Equipment Required
1. Strain gauge 5 mm grid, 120Ω 2. Gain : x 2500, x 5000 3. Band-pass filter : 0.05 ~ 40 Hz 4. Two outputs a. Pulse wave b. Heart rate pulse	1. Strain Gauge Amplifier Calibration Experiment 2. HPF Characteristic Experiment 3. BRF Characteristic Experiment 4. Gain Amplifier Experiment 5. LPF Characteristic Experiment 6. Hysteresis Comparator Experiment 7. Monostable Multivibrator Experiment 8. Pulse Meter Experiment 9. Arterial Vessel Experiment	1. KL-76001 Main Unit 2. KL-75008 Pulse Meter Module 3. Digital Storage Oscilloscope (Option) 4. Strain Gauge Tie - ⑫ 5. Wrist-type Cuff - ⑤ 6. Mechanical Sphygmomanometer - ④ 7. Trimmer 8. Connection Leads - ⑳ 9. 2mm Bridging Plug - ㉑ 10. 2mm Terminal - ㉒

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

Feature:

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

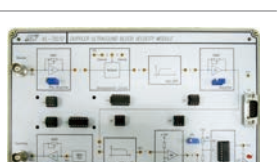


Specifications	List of Experiments	Equipment Required
1. Band-pass filter : 0.1~10Hz 2. Sine wave generator circuit : 50 KHz 3. Surface electrode 4. Isolation circuit 5. Gain : x 1250, x 2500 6. With overcurrent protection and reset circuits 7. One output Body impedance signal	1. Pre-Amplifier Calibration Experiment 2. BRF Characteristic Experiment 3. Wien-Bridge Oscillator Experiment 4. HPF Characteristic Experiment 5. Demodulator Experiment 6. Gain Amplifier Experiment 7. LPF Characteristic Experiment 8. Impedance Detection Experiment	1. KL-76001 Main Unit 2. KL-75009 Impedance Module 3. Digital Storage Oscilloscope (Option) 4. Body Surface Electrodes - ⑧ 5. Electrode Lead - ⑰ 6. 5-Conductor Electrode Cable - ⑱ 7. Alcohol Prep. Pad - ⑪ 8. Trimmer 9. Connection Leads - ⑳ 10. 2mm Bridging Plug - ㉑ 11. 2mm Terminal - ㉒

KL-75010 Doppler Ultrasound Blood Velocity Module

Feature:

Aims to enable students to understand the principle of ultrasonic sensor, and the theory about how the ultrasound probe measure the blood flow velocity and its basic circuit theory.



Specifications	List of Experiments	Equipment Required
1. Dual Element Transducer Frequency : 5MHz 2. Gain : 16~100 3. Band-pass filter : 1~40Hz 4. Two Output a. Plethysmogram signal b. Heart rate pulse	1. OSC Experiment 2. Pre-Amplifier Experiment 3. Demodulation Experiment 4. HPF Characteristic Experiment 5. Amplifier Experiment 6. LPF Characteristic Experiment 7. Comparator Experiment 8. Monostable Multivibrator Experiment	1. KL-76001 Main Unit 2. KL-75010 Doppler ultrasound blood velocity module 3. Digital Storage Oscilloscope (Option) 4. Dual Element Transducers Sensor - ㉓ 5. Trimmer 6. Alcohol Prep. Pad - ⑪ 7. Connection Leads - ⑳ 8. 2mm Bridging Plug - ㉑ 9. 2mm Terminal - ㉒ 10. Electrical conductivity jelly - ②

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

Feature:

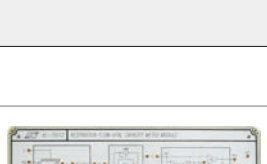
Aims to enable students to understand the basic circuit theory of transcutaneous electrical nerve stimulation (TENS) and the physiological responses of muscles which are stimulated by the different frequency and amplitude.

Specifications	List of Experiments	Equipment Required
1. Electrode lead 2. One Output 555 Timer-Astable signal a. Frequency Adjust : 25~115Hz b. Duty Cycle : 91~98%	1. 555 Timer-Astable Experiment 2. Transistor Switch Circuit Experiment 3. Transistor Bias Circuit Experiment	1. KL-76001 Main Unit 2. KL-75011 TENS module 3. Digital Storage Oscilloscope (Option) 4. Body surface electrodes (for KL-75011) - ⑭ 5. Electrode lead (for KL-75011) - ⑮ 6. Connection Leads - ⑳ 7. 2mm Bridging Plug - ㉑ 8. 2mm Terminal - ㉒

KL-75012 Respiration Flow/Vital Capacity Meter Module

Feature:

Aims to enable students to understand the respiratory parameters, including the physiological principles of respiratory volume and flow, and the measurement of the basic circuit.



Specifications	List of Experiments	Equipment Required
1. Pneumotach transducer a. Excitation voltage : 6V b. Flow range: 2-35 L/min c. Resolution : 700P/L d. Maximum operation pressure : 25 Bar 2. Two Output a. Respiration flow signal b. Counting pulse	1. Hall & Differential Experiment 2. Frequency to Voltage Experiment 3. Comparator Experiment 4. AND Gate Experiment 5. Decade Counter Experiment 6. Decoder Experiment 7. 7-Segment Experiment	1. KL-76001 Main Unit 2. KL-75012 Respiration flow/Vital capacity meter module 3. Digital Storage Oscilloscope (Option) 4. Respiration transducer - ⑲ 5. Trimmer 6. Connection Leads - ⑳ 7. 2mm Bridging Plug - ㉑ 8. 2mm Terminal - ㉒

Experiment Module Features

1. All terminals on the module accepts 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 : 255x165x30mm ± 10%
5. With storage cabinet for easy storing
6. Comprehensive experiment and instructor's manuals are provided.

Accessories

Optional Accessories

1. Digital Storage Oscilloscope (DSO)
2. KL-79106 ECG simulator
3. EEG simulator
4. Electrical conductivity jelly
5. Body surface electrode
6. Alcohol prep pad
7. Elastic head bandage
8. Temperature sensor mask
9. Medical tape
10. Body surface electrode (for KL-75011)

NOTE : Since item No. 4 to 10 are consumables, the order quantity depends on user's choice.

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