KL-210
Basic Electrical / Electronic Circuit Lab

KL-210 Basic Electrical / Electronic Circuit Lab is ideal for electrical, mechanical, automotive, science, civil & electronics engineering learning.

All the necessary equipment for electric circuit experiments such as power supply, function generator, analog and digital meters are installed on the main unit for the requirement of experiment.

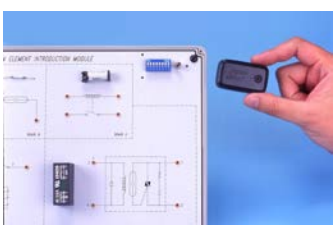
The whole essential topics of electrical circuit learning are studied by different modules.

+ Simulation

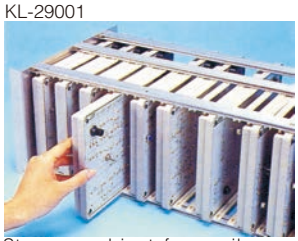
● Features

1. Ideal for students to learn the design of electrical, electronics and digital logic circuits.
2. To learn efficiently, power supply, function generator and measurement unit are all included.
3. All supply units are secured with overload protection.
4. With one main unit, user can choose the needed modules for different learning topics.
5. Including computer - based training

◎KL-210 Basic Electrical / Electronic Circuit Lab is the best choice for beginners to learn electricity circuit completely.



KL-29001

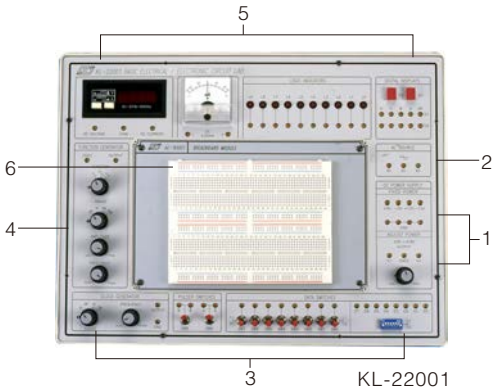


Storage cabinet for easily storing all modules

● Specifications

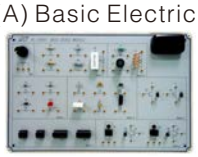
Main Unit (KL-22001)

1. DC Power Supply
   (1) Fixed DC power supply
      a. Voltage : ±5V, ±12V
      b. With output overload protection
   (2) Dual DC power supply
      a. Voltage range : ±3V~ ±18V, continuously adjustable
      b. With output overload protection
2. AC Power Supply
   (1) Voltage range : 9V~0V~9V
   (2) With output overload protection
3. Signal Generator
   (1) Pulse generator : (TTL level)
      a. Frequency range : 1Hz~10KHz/4 settings, continuously adjustable
      b. Fan out : 10 TTL load
   (2) Pulse switches
      a. 2 independent output, TTL level
      b. With Q, $\overline{Q}$ output, pulse width > 5ms
      c. Fan out : 10 TTL load
   (3) Data switches
      a. 8 sets independent control output, TTL level with Debounce circuit.
      b. Fan out : 10 TTL load
4. Function Generator
   (1) Output waveform : Sine, triangle, square
   (2) Output frequency : 10~100KHz/4 settings, continuously adjustable
   (3) Output amplitude : ⩾18Vpp (open circuit) ⩾ 9Vpp (50 Ω load)
5. Testing And Display
   (1) 3 1/2 digital voltmeter/ammeter
      a. DC voltage range : 2V, 200V
      b. DC voltage accuracy : ±0.3% of reading+1digit
      c. DC current range : 200μA, 2000mA
      d. DC current accuracy : ±0.5% of reading +1digit
   (2) Galvanometer
      a. Current range : ±50mA
      b. Accuracy : Class 2.5
   (3) LED indicator :
      a. 10 sets independent LED indicates high/low logic state
      b. Input impedance : ⩾100K Ω
   (4) Digital display
      a. 2 sets independent 7-segment LED
      b. With BCD-7segment decoder/driver and DP Input
      c. Input with 8-4-2-1 code
6. Breadboard (AC-90001)
   1680 tie-point breadboard on top panel can be easily put into and taken off.



List of Modules

(A) Basic Electricity Experiment Modules



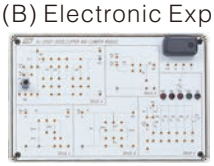
KL-24001
Basic Device Module

KL-24002
Basic Electricity Experiment Module

KL-24003
Sensor Module(1)

KL-24004
Sensor Module(2)

(B) Electronic Experiment Modules



KL-25001
Diode, Clipper and Clamper Module

KL-25002
Rectifier, Differentiator Integrator Circuit Module

KL-25003
Transistor Amplifier Circuit Module

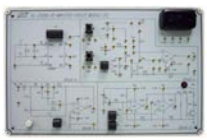
KL-25004
Multi-Stage Amplifier Circuit Module

KL-25005
FET Circuit Experiment Module

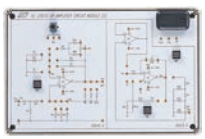
KL-25006
OP Amplifier Circuit Module (1)

KL-25007
OP Amplifier Circuit Module (2)

KL-25008
OP Amplifier Circuit Module (3)

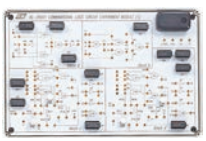


KL-25009
OP Amplifier Circuit Module (4)



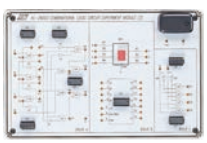
KL-25010
OP Amplifier Circuit Module (5)

(C) Digital Logic Experiment Modules

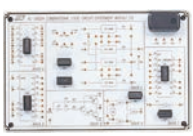


KL-26001
Combination Logic Circuit Experiment Module (1)

KL-26002
Combination Logic Circuit Experiment Module (2)



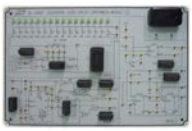
KL-26003
Combination Logic Circuit Experiment Module (3)



KL-26004
Combination Logic Circuit Experiment Module (4)

KL-26005
Combination Logic Circuit Experiment Module (5)

KL-26006
Sequential Logic Circuit Experiment Module (1)



KL-26007
Sequential Logic Circuit Experiment Module (2)

(D) Motor Experiment (Option)

KL-28001 (Option)
Low Voltage Electrical Control Module
(3Ø 220V is required)

KL-28003 (Option)
Single-phase Motor Module (1Ø AC 220V)

KL-28004 2 pcs Required (Option)
Three-phase Motor Module (3Ø 220V)

KL-28006 (Option)
Load Unit Module

KL-28010 (Option)
System Transformer(Δ→Y)

Note :
When any of above optional module is purchased, KL-28010 System Transformer is essential.

EM-3390-1A (Option)
Connecting Lead Holder

(1) Mobile type with 5-foot tubular steel base and five casters

(2) Height : 1400mm, iron plate suitable with 20 connecting leads slots

List of Experiments

(A) Basic Electricity Experiments

1. Basic Measurements
   - 1-1 Resistance measurement ..... KL-24001(A)
   - 1-2 Potentiometer characteristics ..... KL-24002(VR)
   - 1-3 DC Voltage measurement KL-22001
   - 1-4 DC Current measurement ..... KL-24002(A)
   - 1-5 Ohm's law application ..... KL-24002(A)
   - 1-6 AC voltage measurement ..... KL-24002(A)
   - 1-7 AC current measurement ..... KL-24002(C)
2. DC Circuits
   - 2-1 Series-parallel network and kirchhoff's law ..... KL-24002(A.B)
   - 2-2 Wheatstone bridge ..... KL-24002(K)
   - 2-3 Superposition, thevenin's and norton's theorems ..... KL-24002(C)
   - 2-4 Power in DC circuit ..... KL-24002(A)
   - 2-5 Maximum power transfer theorem ..... KL-24002(A)
   - 2-6 DC RC circuit and transient phenomena ..... KL-24002(D)
   - 2-7 DC RL circuit and transient phenomena ..... KL-24002(F)
3. AC Circuits
   - 3-1 AC RC circuit ..... KL-24002(E)
   - 3-2 AC RL circuit ..... KL-24002(F)
   - 3-3 AC RLC circuit ..... KL-24002(H)
   - 3-4 Series-resonant circuit ..... KL-24002(I)
   - 3-5 Parallel-resonant circuit ..... KL-24002(J)
   - 3-6 Power in AC circuit ..... KL-24002(A)
4. Control Circuits
   - 4-1 Water level controller KL-24003
   - 4-2 Metal detector ..... KL-24004(B)
   - 4-3 Light controller ..... KL-24004(A)

(B) Electronic Circuit Experiments

1. Diode Characteristics
   - 1-1 PN-junction diode characteristics ..... KL-25001(A)
   - 1-2 Zener diode characteristics ..... KL-25001(A)
   - 1-3 LED characteristics ..... KL-25001(E)
   - 1-4 Photodiode characteristics ..... KL-25001(E)
2. Rectifiers and Filters
   - 2-1 Half-wave rectifier ..... KL-25002(C)
   - 2-2 Full-wave rectifier ..... KL-25002(C)
   - 2-3 Bridge rectifier ..... KL-25002(C)
   - 2-4 Dual-power rectifier ..... KL-25002(C)
   - 2-5 Voltage doubler ..... KL-25002(B)
3. Diode Clipping and Clamping Circuits
   - 3-1 Clipping circuits ..... KL-25001(B.C)
   - 3-2 Clamping circuits ..... KL-25001(D)
4. Differentiator and Integrator
   - 4-1 RC circuit ..... KL-25002(D)
   - 4-2 Differentiator circuit ..... KL-25002(D)
   - 4-3 Integrator circuit ..... KL-25002(D)
   - 4-4 RL circuit ..... KL-25002(D)
5. Transistor Characteristics
   - 5-1 Basic transistor characteristics ..... KL-25002(A)
   - 5-2 Transistor characteristic curves ..... KL-25002(A)
6. Transistor Amplifiers
   - 6-1 Common-emitter amplifier ..... KL-25003(A)
   - 6-2 Common-base amplifier ..... KL-25003(B)
   - 6-3 Common-collector amplifier ..... KL-25003(C)
   - 6-4 Switching circuit ..... KL-25003(C)
   - 6-5 Darlington amplifier ..... KL-25005(A)
7. Multistage Amplifiers
   - 7-1 RC-coupled amplifier ..... KL-25004(A)
   - 7-2 Direct-coupled amplifier ..... KL-25004(A)
   - 7-3 Transformer-coupled amplifier ..... KL-25004(C)
   - 7-4 Dual-end push-pull amplifier ..... KL-25004(B)
8. FET Characteristics
   - 8-1 JFET characteristics ..... KL-25005(B)
   - 8-2 MOSFET characteristics ..... KL-25005(B)
9. FET Amplifiers
   - 9-1 JFET CS amplifier ..... KL-25005(C)
   - 9-2 JFET CD amplifier ..... KL-25005(C)
   - 9-3 MOSFET CS amplifier ..... KL-25005(D)
10. OPA AMP Characteristics
    - 10-1 Differential amplifier in OP AMP ..... KL-25006(A)
    - 10-2 OP AMP characteristic measurements ..... KL-25006(B)
11. Basic OP AMP Circuits
    - 11-1 Inverting amplifier ..... KL-25007(B)
    - 11-2 Noninverting amplifier ..... KL-25007(B)
    - 11-3 Voltage follower ..... KL-25007(B)
    - 11-4 Differential amplifier ..... KL-25007(B)
    - 11-5 Adder ..... KL-25007(B)
    - 11-6 Clipping circuit ..... KL-25007(A)

11-7 Constant voltage circuit ..... KL-25007(A)
11-8 Constant current circuit ..... KL-25007(A)
11-9 Differentiator ..... KL-25007(A)
11-10 Integrator ..... KL-25007(A)
11-11 Instrumentation amplifier ..... KL-25008(A)

12. OP AMP Applications
12-1 Active high-pass filter ..... KL-25008(A)
12-2 Active low-pass filter ..... KL-25008(A)
12-3 Active band-pass filter ..... KL-25008(A)
12-4 Tone control circuit ..... KL-25009(B)

13. OP AMP Comparators and Oscillators
13-1 Comparators ..... KL-25009(C)
13-2 Schmitt trigger ..... KL-25009(C)
13-3 Window comparator ..... KL-25009(D)
13-4 Monostable multivibrator ..... KL-25010(A)
13-5 Astable multivibrator ..... KL-25010(A)
13-6 Sine wave oscillator ..... KL-25010(B)
13-7 Crystal oscillator ..... KL-25009(A)

(C) Digital Logic Experiments

1. Basic Logic Gates
1-1 Logic gate circuit
A. TTL circuit ..... KL-26001(C)
B. CMOS circuit ..... KL-26001(D)
1-2 Threshold voltage measurement
A. Measuring TTL threshold voltage ..... KL-26001(C)
B. Measuring CMOS threshold voltage ..... KL-26001(D)
1-3 Voltage/current measurement
A. Measuring TTL I/O voltage and current ..... KL-26001(C)
B. Measuring CMOS voltage and current ..... KL-26001(D)
1-4 Characteristics of basic logic gates
A. Measuring AND gate characteristics ..... KL-26001(C)
B. Measuring OR gate characteristics ..... KL-26001(C)
C. Measuring NOT gate characteristics ..... KL-26001(C)
D. Measuring NAND gate characteristics ..... KL-26001(C)
E. Measuring NOR gate characteristics ..... KL-26001(C)
F. Measuring XOR gate characteristics ..... KL-26001(C)
1-5 Interface between logic
A. TTL to CMOS interface ..... KL-26001(C.D)
B. CMOS to TTL interface ..... KL-26001(C.D)

2. Combinational Logic Circuits
2-1 NOR gate circuit ..... KL-26001(C)
2-2 NAND gate circuit ..... KL-26001(B)
2-3 XOR gate circuit
A. Constructing XOR gate with NAND gates ..... KL-26001(B)
B. Constructing XOR gate with Basic gates ..... KL-26001(A)
2-4 AOI gate circuits ..... KL-26001(A)
2-5 Comparator circuits
A. Constructing comparator with basic logic gates ..... KL-26001(A)
B. Constructing comparator with TTL IC ..... KL-26005(A)

3. Adders and Subtractors
3-1 Half- and Full-Adder Circuits
A. Constructing half- and full-adders with basic logic gates ..... KL-26002(A)
B. Constructing 4-bit full-adder with IC ..... KL-26002(B)
C. Constructing BCD adder ..... KL-26002(B)
3-2 Half- and Full-Subtractor Circuits
A. Constructing half-/full-subtractors with basic logic gates ..... KL-26002(A)
B. Constructing 4-bit full-subtractor with IC ..... KL-26002(B)

4. Encoders and Decoders
4-1 Encoder circuits
A. Constructing 4-to-2-line encoder with basic gates ..... KL-26003(A)
B. Constructing 10-to-4-line encoder with TTL IC ..... KL-26004(A)
4-2 Decoder circuits
A. Constructing 2-to-4-line decoder with basic gates ..... KL-26003(C)
B. Constructing 4-to-10-line decoder with TTL IC ..... KL-26002(C)
C. Constructing BCD-to-7-segment decoder.. KL-26003(B)

5. Multiplexers and Demultiplexers
5-1 Multiplexer circuits
A. Constructing 2-to-1-line multiplexer with basic gates ..... KL-26004(E)
B. Using multiplexer to create function ..... KL-26004(F)
C. Constructing 8-to-1-line multiplexer with TTL IC ..... KL-26004(F)
5-2 Demultiplexer circuits
A. Constructing 1-to-2-line demultiplexer with basic logic gates ..... KL-26004(E)
B. Constructing 1-to-8-line demultiplexer with CMOS IC ..... KL-26004(B)
5-3 Analog Multiplexer/demultiplexer circuits ..... KL-26004(C.D)

6. Arithmetic Elements
6-1 Arithmatic Logic Unit (ALU) circuit ..... KL-26005(B)
6-2 Parity generator circuit
A. Parity generator constructed with XOR gates ..... KL-26002(A)
B. Parity generator IC ..... KL-26005(C)

7. Sequential Logic Circuits
7-1 Flip-flops
A. Constructing RS flip-flop with basic logic gates ..... KL-26006(C)
B. Constructing D flip-flop with RS flip-flop ..... KL-26006(C)
C. Constructing JK flip-flop with RS flip-flop .. KL-26006(C)
D. Constructing master-slave JK flip-flop with RS flip-flop ..... KL-26006(C)
E. Constructing shift register with D flip-flops ..... KL-26006(A)
F. Preset left/right shift register ..... KL-26006(B)
G. Constructing noise elimination circuit with RS flip-flops ..... KL-26006(C)
7-2 Counters
A. Constructing divide-by-8 counter with JK flip-flops ..... KL-26007(C)
B. Constructing synchronous counter with JK flip-flops ..... KL-26007(C)
C. Constructing divide-by-8 counter with 7490 ..... KL-26007(B)
D. Constructing BCD Counter with 7490 ..... KL-26007(B)

8. Sequential Logic Applications
8-1 Moving LED control ..... KL-26007(A)
8-2 Traffic light control ..... KL-26007(B)

(D) Motor Experiments (Option)
1. Motor start , stop and overload control ... KL-28001, KL-28003, KL-28004
2. Motor forward/reverse control KL-28001, KL-28003, KL-28004
3. Motor sequence control KL-28001, KL-28004, KL-28006
4. Motor alternatively running control KL-28001, KL-28004, KL-28006
5. Wye-delta reduced voltage starting of three-phase induction motor KL-28001, KL-28004

● Accessories(KL-29004)
1. Experiment manual and instructor's manual
2. Connection leads and plugs : 1set
3. Key : 1pce

● Computer-Based Training
1. Built-in circuit simulation of experiment modules.
2. Fault simulation is allowed.
3. Users can flexibly compare the simulation analysis result with hardware signal output.
4. Support virtual instrument.