# *i*de@Lab-200

## Intelligent Digitize Emulated Achievement Lab


*i*de@Lab-200 intelligent digitize emulated achievement lab is a digitized-based training system, which utilizes integrated Hardware Platform, Experimental Modules and Software Platform to help students to learn various electronic subjects. Hardware Platform is composed of multiple measuring instruments, such as digital storage oscilloscope, logic analyzer, frequency synthesizer, digital multi-meters, and programmable DC power supply as well as output display unit.

Experimental Modules contain versatile electronic based topics for students to implement, including basic electronic circuit, digital circuit, micro-controller circuit and communications, etc.

### ▶ Features

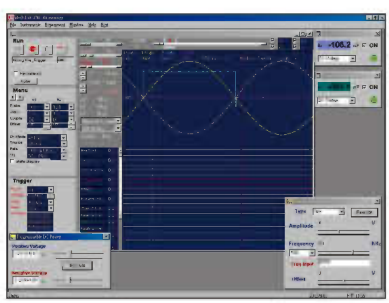
- The *i*de@Lab (Intelligent Digitize Emulated Achievement Lab) is a multimedia digitized experiment/learning platform. It consists of three major parts including hardware experiment platform, experiment modules and application software platform.
- The hardware experiment platform includes digital storage oscilloscope, logic analyzer, frequency synthesis signal generator, two digital multi meters, programmable DC power supply, internal central control and coordination interface such as output display interface, module communication interface and the interface used for command and data exchange between *i*de@Lab and personal computer.
- The operating modes of hardware experiment platform includes a touch-panel manual control mode and a PC control mode via USB interface.
- The *i*de@Lab system separates modules into extension unit and experiment module. The extension unit is designed to satisfy the special needs of experiment modules. The subjects of experiment modules cover basic electricity, electronic circuits, digital circuits, microcomputer and communications, etc. Each subject involves several experiment modules. The application software platform contains the front-panel controls and displays of hardware experiment platform, experiment module window, procedure steps and experiment manual.

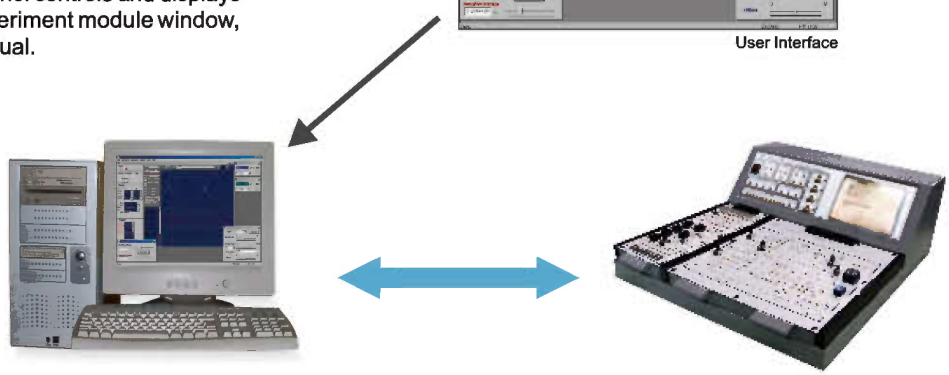
### ❖ Software

The user interface of *i*de@Lab system contains the instruments (DMM, DSO, FG, PDC, LA) which correspond to the instruments equipped on the front panel of *i*de@Lab-21001 main unit, as well as the explanation algorithm of the programming language for human-machine communication. For easy reference, the required data and information are stored in experiment manual which represented in HTML format.

Provide experimental simulation files(*.TSC)designed by Tina Design Suite.

### ❖ System Diagram


User Interface



## ▶ Specification

### ▶ Main Unit (ide@Lab-21001)

**1. Digital Storage Oscilloscope**

(1) Channel : 4 Channels
(2) Input coupling : DC, AC
(3) Input impedance : 1MΩ ±2% // 17pF
(4) Max. input voltage : ±50V
(5) Sample rate : 1ch~1GSa/s
2ch~1Sa/s~500MSa/s by 1,2,5 sequence
4ch~1Sa/s~250MSa/s by 1,2,5 sequence
(6) Bandwidth : 1ch DC~200MHZ
2ch DC~125MHZ
4ch DC~80MHZ
(7) Resolution : 8bits
(8) Record length : 1ch~16K point
2ch~8K point
4ch~4K point
(9) Repetitive mode : Sampling up to 20 GHz

**2. Logic Analyzer**

(1) Channels : 12
(2) Bandwidth : DC~30MHz
(3) Sample rate : Max. 125MHZ
(4) Record length : 4K point
(5) Imput impendence: 50KΩ // 9pF
(6) Max. input voltage : ±50V
(7) Threshold voltage: -4V~ +3.98V
(8) Trigger word : 0.1 x (don't care) setting for all digital channels

**3. DDS FG (Direct Digital Synthesis FG)**

(1) Channels : OUT, $\overline{OUT}$, TTL
(2) Waveform type : Sine, Square, Triangle, Ramp, GND
(3) Waveform amplitude range : 0~20Vpp
0~10Vpp to 50Ω load
(4) Frequency range : 1Hz~2MHz
(5) Frequency resolution : 0.03Hz
(6) Waveform DC offset range : 0~±10Vpp
0~±5Vpp to 50Ω load
(7) Output impendence : 50Ω ±10%

**4. DMM1 and DMM2 (Digital Multi-Meters)**

(1) Resistance (Ω) : 400Ω, 4KΩ, 40KΩ, 400KΩ, 4MΩ, 40MΩ auto range
(2) DC Voltage (DCV) : 400mV, 4V, 40V auto range
Input Impedance : ⩾10MΩ
(3) AC Voltage (ACV) : 400mV, 4V, 40V, 400V rms auto range
Input Impedance : ⩾10MΩ
(4) DC Current (DCA) : 400mA(0.5A/250V fuse protected)
(5) AC Current (ACA) : 400mA(0.5A/250V fuse protected)

**5. Programmable DC Power Supply**

DC output : 2 channels
• Positive output : 0.5~10V/0.5A
• Negative output : -0.50~-10V/0.5A

**6. Fixed DC Output** : +12V/0.5A, -12V/0.5A, +5V/0.5A

**7. Breadboard (Ide@Lab-90001) :**

1680 tie-point breadboard module

**8. Communication and Display Interface**

(1) PC control and display : Communicating with PC via USB cable
(2) Manual control and display : Touch panel

**9. Extension Unit (*ide@Lab-12001 Basic I/O Elements*)**

This unit extends the functions of main unit to satisfy the needs of experiment tasks when it is added to the ide@Lab system.

(1) Universal Counter :
Function : Logic Probe/Frequency/Period 8-digit 7-segment LED display and function select key
(2) LED Display : L0~L7, input, TTL level
(3) Debounce PB switch : 4 pushbuttons PSW1~PSW4 with debounce outputs
(4) Pulser : 2 sets, output A, $\overline{A}$, TTL level with P.P. & P.S. switch
(5) Clock Generator : 1 set(50Hz~14KHz), output, TTL level
(6) Standard Frequency: 7 sets(0.1Hz, 1Hz, 10Hz, 1KHz, 10KHz, 100KHz, 1MHz), output, TTL level
(7) Data Switch : DP0~DP7, output, TTL level


12001

● **Experiment Modules**

A series of experiment modules is designed for different subjects.

### ▶ List of Modules

**1. ide@Lab-131xx : Basic Electricity**


13101
Basic Device Module


13102
Basic Electricity Experiments Module


13103
Magnetism Element Introduction Module


13104
Magnetic Field Module


13105
Ampere's Rule Module

13106
Fleming's Rule Module

13107
Electromagnetic Induction

## 2. ide@Lab-132xx : Electronic Circuits

13201
Diode, Clipper & Clamper Module

13202
Rectifier, Differential & Integral Circuit Module

13203
Transistor Amplifier Circuit Module

13204
Multi-Stage Amplifier Circuit Module

13205
FET Circuit Experiment Module

13206
OP Amplifier Circuit Module (1)

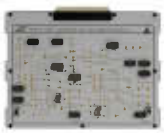
13207
OP Amplifier Circuit Module (2)

13208
OP Amplifier Circuit Module (3)

13209
OP Amplifier Circuit Module (4)

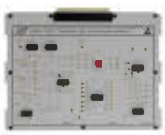
13210
OP Amplifier Circuit Module (5)

## 3. ide@Lab-133xx : Digital Logic Circuits



13301
Combinational Logic Circuit Experiment Module (1)

13302
Combinational Logic Circuit Experiment Module (2)

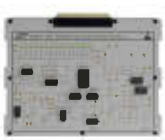


13303
Combinational Logic Circuit Experiment Module (3)

13304
Combinational Logic Circuit Experiment Module (4)

13305
Combinational Logic Circuit Experiment Module (5)

13306
Sequential Logic Circuit Experiment Module (1)



13307
Sequential Logic Circuit Experiment Module (2)

## List of Experiments

### ide@Lab-131xx : Basic Electricity

**• 13101 Basic Device Module**

1. Potentiometer characteristics
2. Resistor characteristics
3. Inductor characteristics
4. Diode characteristics
5. Zener diode characteristics
6. LED characteristics
7. Capacitor characteristics
8. FET characteristics
9. Transistor characteristics
10. SCR characteristics
11. UJT characteristics

**• 13102 Basic Electricity Experiments Module**

1. DC voltage measurement
2. DC current measurement
3. Ohm's law application
4. AC voltage measurement
5. Series network and kirchhoff's law
6. Power in DC circuit
7. Maximum power transfer theorem
8. Power in AC circuit
9. Parallel network and kirchhoff's law
10. AC current measurement
11. Superposition, thevenin's and norton's theorems
12. DC RC circuit and transient phenomena
13. AC RC circuit
14. DC RL circuit and transient phenomena
15. AC RL circuit
16. Transformer characteristics
17. AC RLC circuit
18. Series-resonant circuit
19. Parallel-resonant circuit
20. Wheastone bridge

**• 13103 Magnetism Element Introduction Module**

1. Compass characteristic
2. Drawing magnetic curves
3. Reed switch characteristic
4. Reed relay characteristic
5. Relay characteristic
6. SSR relay characteristic

**• 13104 Magnetic Field Module**

1. Magnetic field
2. Lenz's and faraday's laws
3. Magnetic field strength

**• 13105 Ampere's Rule Module**

1. Ampere's rule 1
2. Ampere's rule 2

**• 13106 Fleming's Rule Module**

1. Fleming's rule 1
2. Fleming's rule 2

**• 13107 Electromagnetic Induction**

1. Self induction
2. Mutual induction
3. Magnetic flux detection

### ide@Lab-132xx : Electronic Circuits

**• 13201 Diode, Clipper & Clamper Module**

1. V-I curve of Si diode-DSO
2. V-I curve of Si diode(Forward)- M.M.
3. V-I curve of Si diode(Reverse)- M.M.
4. V-I curve of Ge diode(Forward)- M.M.
5. V-I curve of Ge diode(Reverse)- M.M.
6. V-I curve of Ge diode-DSO
7. V-I curve of zener diode(Forward)- M.M.
8. V-I curve of zener diode(Reverse)- M.M.
9. V-I curve of zener diode-DSO
10. Series diode clipping circuit
11. Series diode clipping circuit with bias
12. Parallel diode clipping circuit
13. Parallel diode clipping circuit with bias
14. Diode clamping circuit
15. Diode clamping circuit with bias
16. Testing for the relation between I and brightness
17. Measuring I values of LED
18. Photodiode characteristics

**• 13202 Rectifier, Differential & Integral Circuit Module**

1. Measuring Ie, Ib and Ic of PNP transistor
2. Measuring Ie, Ib and Ic of NPN transistor
3. Transistor characteristic curves
4. Voltage doubler
5. Half-wave rectifier without filter capacitor
6. Half-wave rectifier with filter capacitor
7. Full-wave rectifier without filter capacitor
8. Full-wave rectifier with filter capacitor
9. Bridge rectifier without filter capacitor
10. Bridge rectifier with filter capacitor
11. Dual-power rectifier
12. RC circuit
13. Differentiator circuit
14. Integrator circuit
15. RL circuit

**• 13203 Transistor Amplifier Circuit Module**

1. CE Amplifier fixed bias
2. CE Amplifier emitter self-bias
3. CE Amplifier bias independent of $\beta$ value
4. CE Amplifier collector-feedback bias
5. Common-base amplifier
6. Common-collector amplifier
7. Measuring ON and Off current of transistor
8. Transistor used as relay driver

**• 13204 Multi-Stage Amplifier Circuit Module**

1. RC-coupled amplifier
2. Direct-coupled amplifier
3. Dual-end push-pull amplifier
4. Transformer-coupled amplifier

- ***13205 FET Circuit Experiment Module***
  1. Measuring basic characteristics of darlington Amplifier
  2. Photoelectric control circuit
  3. Time delay circuit
  4. JFET measuring IDSS
  5. JFET measuring IGS
  6. JFET measuring VP
  7. MOSFET measuring IDSS
  8. MOSFET measuring VP
  9. JFET CS amplifier with self-bias
  10. JFET CS amplifier with voltage-dividing bias
  11. JFET CD amplifier with self-bias
  12. JFET CD amplifier with volatge-dividing bias
  13. MOSFET CS amplifier with self-bias
  14. MOSFET CS amplifier with volatge-dividing bias

- ***13206 FET Circuit Experiment Module***
  1. Differential amplifier in OP Amp
  2. OP AMP measuring Zi
  3. OP AMP measuring Zo
  4. OP AMP measuring slew rate
  5. OP AMP measuring bandwidth
  6. OP AMP adjusting offset voltage of inverting amplifier
  7. OP AMP adjusting offset voltage of noninverting amplifier

- ***13207 OP Amplifier Circuit Module (2)***
  1. Clipping circuit
  2. Constant voltage circuit
  3. Constant current circuit
  4. Differentiator
  5. Integrator
  6. Inverting amplifier
  7. Noninverting amplifier
  8. Voltage follower
  9. Subtractor
  10. Adder

- ***13208 OP Amplifier Circuit Module (3)***
  1. Active high-pass filter
  2. Active low-pass filter
  3. Active band-pass filter
  4. Instrumentation amplifier

- ***13209 OP Amplifier Circuit Module (4)***
  1. Tone control circuit
  2. Zero comparator
  3. Comparator with bias
  4. Schmitt trigger
  5. Window comparator

- ***13210 OP Amplifier Circuit Module (5)***
  1. Monostable multivibrator
  2. Astable multivibrator square wave generator
  3. Astable multivibrator pulse generator
  4. Sine wave oscillator RC phase-shift
  5. Sine wave oscillator wien bridge

### ▸▸ ide@Lab-133xx : Digital Logic Circuits

- ***13301 Combinational Logic Circuit Experiment Module (1)***
  1. Constructing XOR gate with basic gates
  2. AOI gate circuits
  3. Constructing comparator with basic logic gates
  4. NAND gate circuit
  5. Constructing XOR gate with NAND gates
  6. TTL circuit
  7. Measuring TTL threshold voltage
  8. Measuring TTL I/O voltage and current
  9. Measuring AND gate characteristics
  10. Measuring OR gate characteristics
  11. Measuring NOT gate characteristics
  12. Measuring NAND gate characteristics
  13. Measuring NOR gate characteristics
  14. Measuring XOR gate characteristics
  15. NOR gate circuit
  16. CMOS circuit
  17. Measuring CMOS threshold volatge
  18. Measuring CMOS voltage and current

- ***13302 Combinational Logic Circuit Experiment Module (2)***
  1. Constructing half-and full-adders with basic logic gates
  2. Constructing half-and full-subtractors with basic logic gates
  3. Parity generator constructed with XOR gates
  4. Constructing 4-bit full-adder with IC
  5. Constructing BCD adder
  6. Constructing 4-bit full-subtractor with IC
  7. Constructing 4-to-10-line decoder with TTL IC

- ***13303 Combinational Logic Circuit Experiment Module (3)***
  1. Constructing 4-to-2-line encoder with basic gates
  2. Constructing BCD-to-7-segment decoder
  3. Constructing 2-to-4-line decoder with basic gates

- ***13304 Combinational Logic Circuit Experiment Module (4)***
  1. Constructing 10-to-4-line encoder with TTL IC
  2. Constructing 1-to-8-line demultiplexer with CMOS IC
  3. Analog multiplexer/demultiplexer circuits
  4. Constructing 2-to-1-line multiplexer with basic gates
  5. Constructing 1-to-2-line demultiplexer with basic gates
  6. Using multiplexer to create function
  7. Constructing 8-to-1-line multiplexer with TTL IC

- ***13305 Combinational Logic Circuit Experiment Module (5)***
  1. Constructing comparator with TTL IC
  2. Arithmetic logic unit (ALU) circuit
  3. Parity generator IC
- ***13306 Sequential Logic Circuit Experiment Module (1)***
  1. Constructing shift register with D flip-flops
  2. Preset left / right shift register
  3. Constructing RS flip-flop with basic logic gates
  4. Constructing D flip-flop with RS flip-flop
  5. Constructing JK flip-flop with RS flip-flop
  6. Constructing master-slave JK flip-flop with RS flip-flop
  7. Constructing noise elimination circuit with RS flip-flops
- ***13307 Sequential Logic Circuit Experiment Module (2)***
  1. Moving LED control
  2. Constructing divide-by-8 counter with 7490
  3. Constructing BCD counter with 7490
  4. Traffic light control
  5. Constructing divide-by-8 counter with JK flip-flops
  6. Constructing synchronous counter with JK flip-flops

## System Requirement

**Hardware :** 1GHz or faster 32-bit (x86) or 64-bit (x64) processor, 512 MB RAM , 200MB available hard disk space

**Software :** Windows XP/Vista/7

## Accessory

Connection leads and plugs and Storage rack 3sets (13191/13291/13391)

## Option

Circuit simulation software TINA design suite