KL-310

Advanced Digital Logic Lab

The KL-310 Advanced Digital Logic Lab is designed for students and engineers interested in developing and testing prototype circuits. The lab includes combinational logic, sequential logic, memory, ADC/DAC..etc. experiment circuits and offers several application circuits (PWM, timer, motor control..etc.).

All the necessary equipment for digital logic experiments such as power supply, clock generator, switches, displays are built-in on the main unit. The lab has 10 experiment modules and one CPLD & breadboard experiment module.

Features

1. The whole trainer is fully designed by FPGA/CPLD logic circuit. Buffer circuits have enhanced protection for each module which is powered by main unit through power socket, avoiding wrong input power source during the experiment.
2. Covers different levels of logic circuit experiments, ranging from combinational logic, sequential logic as well as the logic circuit interfacing with microcontroller and practical application circuit for daily use.
3. Students can implement their own circuit from universal CPLD & breadboard experiment module, making it possible to prototype most analog and digital circuits in the system.
4. Includes various types of ADC & DAC circuits to learn different interfacing circuits between analog and digital signal.
5. Built-in 8-channel multiplexer in main unit to measure multiple digital signals in real time.
6. Multiple operation modes from 4-digit 7-segment display (a)scanning display mode, (b) individual digit display mode, (c)frequency counter mode for measurement of internal and external clock.
7. Individual keep case for all modules for easy storing and carrying

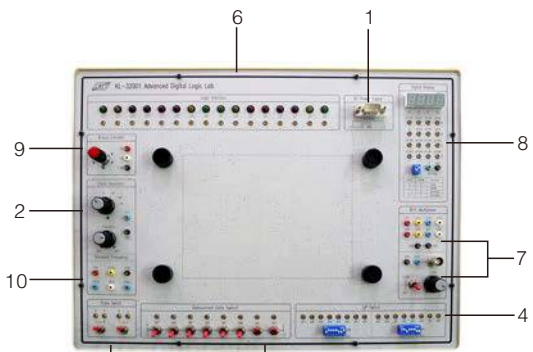
Main Unit(KL-32001)

1. The main unit is equipped with built-in power supply, clock generator, switches, logic signal indicators, multi-signal tracer, and other peripheries as handy tools to interface with experiment modules.
2. Four on-board holders located on the panel surface to firmly fix experiment modules.
3. The main unit provides a 9-pin DC power supply socket for module connection.

Specifications

1. DC Power supply
   (1) Fixed DC power supply :
   +5V/2A ; -5V/0.5A; +12V/2A
   (2) With overload protection
2. Clock generator
   (1) Signal amplitude output : 3.3V
   (2) With adjustable output frequency :
   square wave, 1Hz ~ 1MHz, 6 range
   (3) Frequency display :
   4 digits 7-segment LED
3. Logic level switch
   Toggle switches x 8, 3.3V output
4. Data level switch
   8-bit DIP switch x 2, 3.3V output
5. Pulse signal generator
   (1) 2 sets of toggle switch with independent control output
   (2) Each set with Q, $\overline{Q}$ output
   (3) Pulse width >5ms, each with De-bounce circuit
6. Logic level indicator
   (1) 16-bit LED with driver and protection circuit
   (2) Input Impedance : >100KΩ
7. 8 Channel logic signal tracer
   (1) 8 logic signal input :
   input impedance : ≥100KΩ , 3.3V input
   (2) Fixed DC level shift for each channel
   (3) Input signal attenuation ratio : 1/8
   (4) Output signal : BNC or 2mm plug
   (5) Oscilloscope SYNC. select :
   ALT/CHOP and scan-frequency adjustment
   (6) The function can be used only with analog oscilloscope

8. 7-Segment LED display & frequency measurement
   2 DIP switches select the function :
   (1) 00: Scanning display mode
      a. Common anode for the control of 7-segments a~g
      b. Scanning cathode for the control of 4-digit S0~S3
   (2) 01: Independent display mode
      a. Input 4 digits of data individually and decode the data at 7-segment display separately
      b. Independent binary input and hexadecimal output
   (3) 10: Frequency counter for internal clock
      a. Display the frequency of clock generator from main unit
      b. Frequency range : 0.001KHz ~ 999.9KHz
   (4) 11: Frequency counter for external clock
      a. Display the frequency of clock signal from external unit
      b. Frequency range : 0.001KHz ~ 999.9KHz
9. Rotary encoder
   Rotary encoder output :
   PA, PB and GND signal, 3.3V output
10. Standard signal generator
    5 sets of frequency : 20MHz, 1MHz, 10KHz, 100Hz, 1Hz



KL-32001

Experiment Module

1. All built-in DC power socket module supply DC power from the main unit.
2. Each module includes a CPLD chip to implement all digital circuits shown on module panel.
3. 2mm sockets, bridge plugs, and cables are used throughout all modules so that students can easily create the circuits and compare different results in short time.
4. With comprehensive experiment manual.

List of Modules

KL-34001
Combinational Logic Circuit Experiment

KL-34002
Arithmetical Logic & Tri-State & Code Converter Experiment

KL-34003
Encoder, Decoder & Multiplexer Logic Circuit Experiment

KL-34004
Flip-Flop & Sequential Logic & Counter Circuit Experiment

KL-34005
Oscillator/Pulse ; Load Up/Down Counter Circuit Experiment

KL-34006
Memory ; Matrix LED ; DAC/ADC & MCU Interface Circuit Experiment

KL-34007
Digital & Analog Timer ,Pulse Generator Circuit Experiment

KL-34008
Continual Compare/SAC. & Dual-Slope ADC Converter Experiment

KL-34009
Keyboard & Display for Stepping Motor Position Control

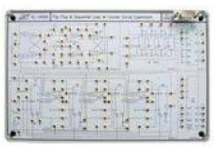
KL-34010
Precision Digital Clock Timer

KL-34011
Universal CPLD & Breadboard Experiment


KL-34001


KL-34002

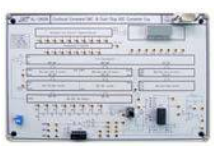

KL-34003


KL-34004


KL-34005

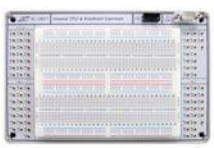

KL-34006


KL-34007


KL-34008


KL-34009


KL-34010


KL-34011

List of Experiments

1. KL-34001 Combinational Logic Circuit Experiment
   (1) NOR gate circuit
   (2) NAND gate circuit
   (3) XOR gate circuit
      a. Constructing XOR gate with NAND gate
      b. The combination with basic gates
   (4) AND-OR-INVERTER (A-O-I) gate circuit
   (5) Comparator circuit
      a. Comparator constructed with basic logic gates
      b. Comparator constructed with TTL IC
   (6) Schmitt gate circuit
   (7) Open-collector gate circuit
      a. High voltage/current circuit
      b. Constructing an AND gate with open-collector gate
   (8) Half-adder and full-adder circuit
      Construct HA with basic logic gates
   (9) Half-subtractor and full-subtractor circuit
      Subtractor circuit constructed with basic logic gates
   (10) Bit parity generator circuit
      Bit parity generator constructed with XOR gates
   (11) Constructing a 4-to-10 decoder with TTL IC
   (12) The switch characteristics of TTL level conversion circuit

2. KL-34002 Arithmetical Logic & Tri-State & Code Converter Experiment
   (1) CMOS FET tristate gate circuit
      a. Truth table measurements
      b. Constructing an AND gate with tristate gate
      c. Bidirectional transmission circuit
   (2) Half-adder and full-adder circuit
      a. Full-adder circuit with IC
      b. High-speed adder carry generator circuit
      c. BCD code adder circuit
   (3) Half-subtractor and full-subtractor circuit
      Full-adder and inverter circuit
   (4) Arithmetic Logic Unit (ALU) circuit
   (5) Bit parity generator circuit
      Bit parity generator IC
   (6) Hex to Dec/Dec to Hex digital conversion
      a. Eight-digit Dec-to-Hex conversion
      b. 8-bit Hex-to-Dec conversion

3. KL-34003 Encoder, Decoder & Multiplexer Logic Circuit Experiment
   (1) Encoder circuit
      a. Constructing a 4-to-2 encoder with basic gates
      b. Constructing a 9-to-4 encoder with TTL IC
   (2) Decoder circuit
      a. Constructing a 2-to-4 decoder with basic gates
      b. BCD-to-7-segment decoder (KL-34003 block d)
   (3) Multiplexer circuit
      a. Constructing a 2-to-1 multiplexer
      b. Using multiplexers to create functions
      c . Constructing a 8-to-1 multiplexer circuit with TTL IC
   (4) Demultiplexer circuit
      Constructing a 2-output demultiplexer with basic logic gates
   (5) Digitally controlled analog multiplexer/demultiplexer circuit
   (6) The switch characteristics of CMOS level conversion circuit

4. KL-34004 Flip-Flop & Sequential Logic & Counter Circuit Experiment
   (1) Flip-flop circuits
      a. Construct R-S flip-flop with basic logic gates
      b. Construct D flip-flop with R-S flip-flops
      c. Construct noise elimination circuit with R-S flip-flops
      d. Construct J-K flip-flop with D flip-flops
      e. The J-K flip-flop of delay and differential
      f. Construct master-slave J-K flip-flops with dual R-S flip-flops
      g. Construct shift register with D flip-flops
      h. Preset left/right shift register
   (2) J-K flip-flop counters
      a. Asynchronous binary up counter
      b. Asynchronous binary down counter
      c. Asynchronous decade up counter
      d. Synchronous binary counter
      e. Synchronous binary up counter
      f. Synchronous binary up/down counter
      g. Johnson counter
      h. Ring counter

5. KL-34005 Oscillator, Pulse & Load Up/Down Counter Circuit Experiment
   (1) Constructing Random Access Memory (RAM) with D flip-flop
   (2) 64-bit Random Access Memory (RAM) circuit
   (3) Erasable Programmable Read Only Memory (EPROM) circuit
   (4) Asynchronous four-bit binary up counter (use of 7493 IC)
   (5) Presetable binary up/down counter
   (6) Presetable decimal up/down counter
   (7) Construct Non-retriggerable circuit with the specialized CMOS IC
   (8) Construct retriggerable circuit with CMOS IC
   (9) Construct a variable duty cycle oscillator circuit with dual monostable multivibrators

6. KL-34006 Memory, Matrix LED & DAC/ADC & MCU Interface Circuit Experiment
   (1) Electronic EPROM (EEPROM) circuit
   (2) DAC0800 unipolar conversion circuit experiments
   (3) Bipolar output conversion circuit
   (4) ADC0804 8-bit SAC analog-to-digital converter experiment
   (5) Constructing dynamic scanning counter with single-chip microprocessor

7. KL-34007 Digital & Analog Timer, Pulse Generator Circuit Experiment
   (1) Constructing oscillator circuit with basic logic gates
      a. Resistor-capacitor multivibrator
      b. Resistor-capacitor crystal multivibrator
   (2) Constructing oscillator circuit with schmitt gate
      a. Resistor-capacitor oscillator
      b. Variable duty cycle resistor-capacitor oscillator
   (3) 555 IC oscillator circuit
      a. 555 oscillator circuit
      b. Voltage controlled oscillator circuit
   (4) Monostable multivibrator circuits
      a. Low-speed monostable multivibrator circuits
      b. Monostable ON/OFF delay circuit
      c. Monostable ON/OFF timer circuit
      d. Construct monostable multivibrator circuit with 555 IC
   (5) Numerically-Controlled Oscillator (NCO) signal generator
   (6) Precise-frequency function generator
   (7) Variable-duty-cycle NCO signal generator
   (8) Variable-ON/OFF delay and difference control experiments
   (9) Precise 15-bit symmetric / asymmetric PWM generator

8. KL-34008 Continual Compare / SAC. & Dual-Slop ADC Converter Experiment
   (1) Simple R-2R unipolar output D/A converter experiments
   (2) 8-bit digital-ramp A/D converter experiment
   (3) 8-bit successive-approximation A/D converter experiment
   (4) 8-bit dual-slope A/D converter experiment

9. KL-34009 Keyboard & Display For Stepping Motor Position Control
   (1) Stepper motor position/speed control experiment

10. KL-34010 Precision Digital Clock Timer
   (1) Clock experiment
   (2) Timer experiment

11. KL-34011 Universal CPLD & Breadboard Experiment
   (1) Create block diagram/schematic file in QUARTUS II
   (2) 16-bit Hex counter
   (3) 16-bit decimal counter
   (4) 16-bit presetable decimal up/down counter
   (5) 16-bit scanning controller for 7-segment display
   (6) 16-bit up/down counter and its indication by a 7-segment display
   (7) Electronic music box
   (8) The traffic light with animation and time indication

System Requirement

1. PC : 1GHz or faster 32-bit (x86) or 64-bit (x64) processor
   2GB RAM, 5GB more free disk space

2. OS : Windows XP / Vista / 7

Accessories(KL-39001)

1. Experiment manual : 1pce
2. Connection leads and plugs : 1set
3. Software : QUARTUS II Web Edition for KL-34011 use
4. USB-Blaster : for KL-34011 use