Electronic line

Expertise in the field of electronics is increasingly becoming a necessity for most professionals.
Degem's extensive line of electronics training systems ranges from the introductory level through various advanced areas of specialization.
Modern electronics is taught through our well-known EB-2000 system. Its innovative methodology combines hands-on training with interactive computer-assisted support.
The EB-2000 is targeted at a broad population.
The system supports every stage of learning, starting from theory review and evaluation through hands-on experiments and practice, troubleshooting, and final testing.
Starting from a single workstation, the EB-2000 can be upgraded into a fully computerized, integrated, multi-station laboratory.
Specialization is provided through advanced training equipment.

FUNDAMENTALS OF ELECTRICITY & ELECTRONICS

EB-101 ***DC CIRUITS I***
EB-102 ***DC CIRUITS II***
EB-103 ***AC CIRUITS***
EB-105 ***ELECTROMAGNETISM***

SEMICONDUCTORS DEVICES

EB-111 ***SEMICONDUCTOR FUNDAMENTALS I***
EB-112 ***SEMICONDUCTOR FUNDAMENTALS II***
EB-113 ***INDUSTRIAL SEMICONDUCTORS***
EB-114 ***OPTOELECTRONIC SEMICONDUCTOR***

LINEAR ELECTRONICS

EB-121 ***OPERATIONAL AMPLIFIERS I***
EB-122 ***OPERATIONAL AMPLIFIERS II***
EB-215 ***FEEDBACK, DIFFERENTIAL, AND POWER AMPLIFIERS***
EB-216 ***OSCILLATORS, FILTERS, AND TUNED AMPLIFIERS***
EB-141 ***POWER SUPPLIES***

MOTORS GENERATORS & INVERTERS

EB-109 ***MOTORS & GENERATORS***
EB-116 ***SENSORS & STEPPER MOTORS***
EB-145 ***AC-DC CONVERSION CIRCUITS***

DIGITAL LOGIC

EB-220 ***LOGIC FAMILIES***
EB-131 ***LOGIC CIRCUITS I***
EB-132 ***LOGIC CIRCUITS II***
EB-133 ***SEQUENTIAL CIRCUITS***
EB-134 ***COMPLEX DIGITAL CIRCUITS***

MICROPROCESSORS & MICROCOMPUTERS

EB-151 ***MICROPROCESSORS I***
EB-152 ***MICROPROCESSORS II***
EB-153 ***MICROCONTROLLERS***
EB-160 ***RISC PROCESSOR***
EB-136 ***EPLD***

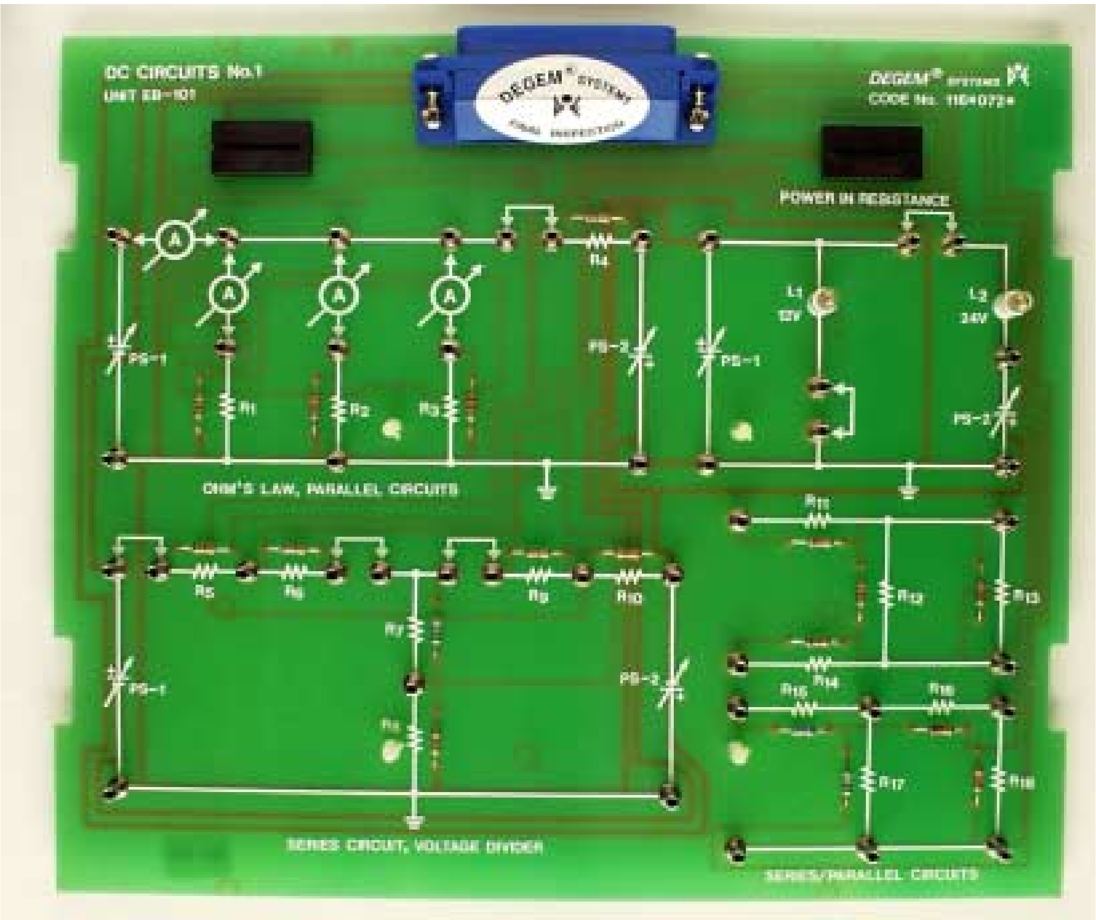
BASIC COMMUNICATION

EB-170 ***AM COMMUNICATION***
EB-171 ***FM STEREO COMMUNICATION***

DEGEM ®
SYSTEMS

EB-2000

EB-101



The EB-101 DC Circuits I board is a comprehensive instructional module designed to teach the fundamental concepts of DC circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-101 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Digital multi-meter (DMM or VOM)
- Measure voltage
- Measure current
- Measure resistance
- Read polarity

2. Resistance color code
- Determine resistance from the color code
- Measure resistance with a DMM
- Determine if measured re-sistance lies within tolerance

3. Ohm's law
- Verify Ohm's law by experiment
- Calculate resistance from voltage and current measurements.
- Determine current from measured voltage and resistance color code
- Determine voltage from measured current and resistance color code

4.Power in a resistance
- Determine power in a circuit from the measured voltage and current
- Compare the amount of light produced by two light bulbs from the applied voltage and current

5.Resistors in series
- Use a DMM to measure resistors in series
- Measure voltage drops of resistors in series
- Locate faults such as open and short circuits

6.Kirchoff's Voltage Law
- Use a DMM to measure voltage drops in series circuits
- Verify KVL for series circuits

7.Voltage dividers
- Calculate voltages using voltage division principle
- Verify the voltage division principle by measurement
- Troubleshoot voltage dividers

8.Resistors in parallel
- Connect resistors to form parallel circuits
- Measure the resistance of parallel circuits using the DMM as an ohmmeter

9.Kirchoff's Current law
- Measure currents in parallel circuits
- Verify KCL by measuring currents

10. Current dividers
- Calculate conductance in parallel circuits
- Use current divider principle to calculate current
- Verify current divider principle by measuring currents in parallel circuits

11. Series-Parallel Circuits
- Calculate equivalent resistance of a series-parallel circuit
- Measure equivalent resistance with a DMM

12. Troubleshooting DC Circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- DL-20 patch cord kit

COMPUTER MINMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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Specifications subject to change without prior notice.

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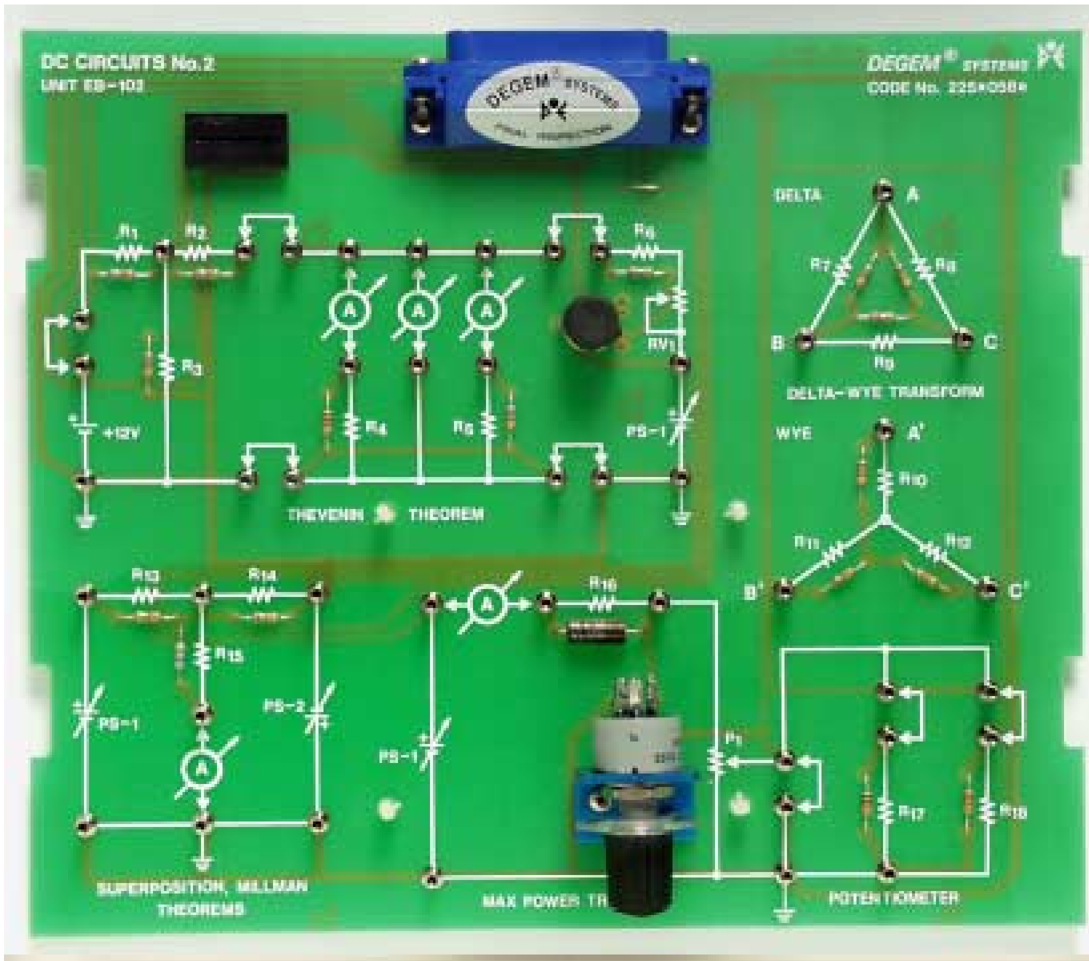
SYSTEMS

EB-2000

EB-102



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schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-102 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Thevenin's theorem
- Measure Vthevenin
- Measure Rthevenin
- Set up a Thevenin equivalent circuit
- Compare-Thevenin equivalent circuit with original circuit

2.Potentiometer
- Connect a potentiometer as a voltage divider
- Measure no-load and full-load outputs of voltage divider
- Plot a graph showing output voltage versus wiper-arm angle

3. Millman's theorem
- Calculate output voltage from a multiple-voltage circuit
- Verify Millman's theorem by measurement

4.Superposition theorem
- Measure load voltage and current in a circuit having two voltage sources
- Verify the superposition theorem by measuring voltage and current

5.Voltage source
- Determine the internal resistance by measurements
- Calculate the voltage regulation of a voltage source
- Compare the voltage regulation of various voltage sources

6.Maximum power transfer theorem
- Determine power from voltage and current measurements
- Plot graphs of voltage, current and power versus resistance
- Determine the resistance relationship that produced maximum power transfer

7. Wye-delta and delta-wye conversions
- Convert a wye-resistive circuit to a delta circuit
- Convert a delta circuit to a wye circuit
- Measure the resistance of equivalent-wye-delta circuits

8. Troubleshooting DC Circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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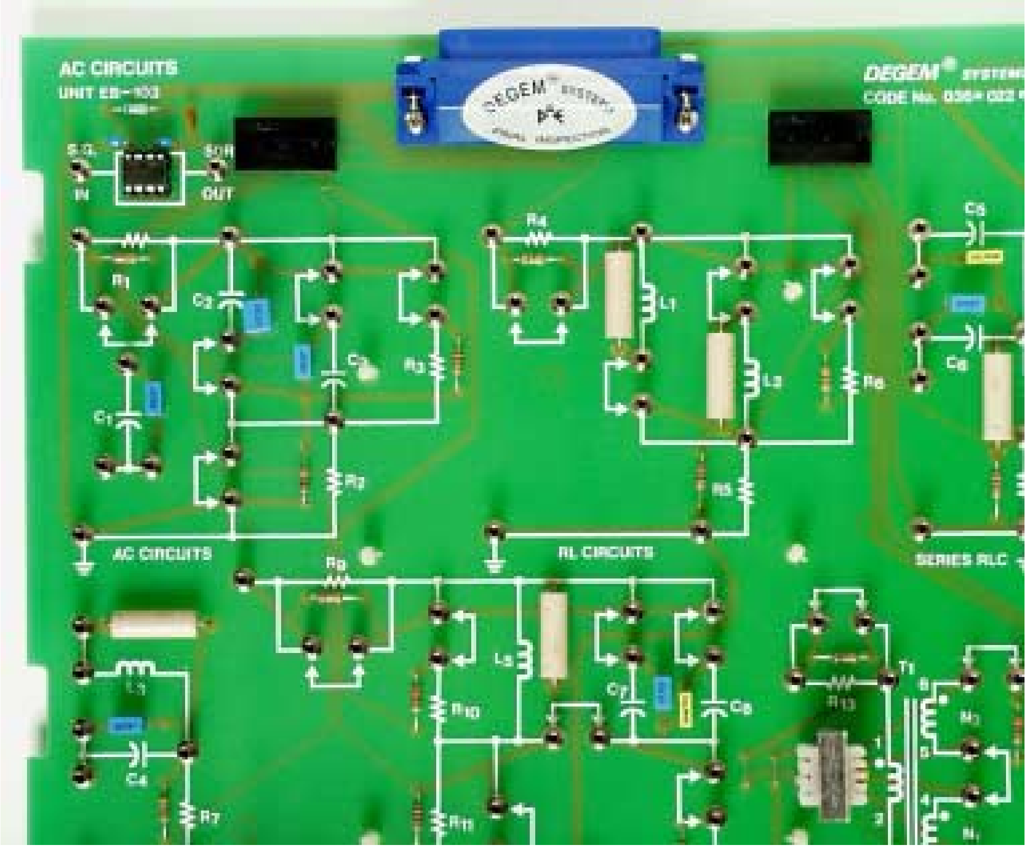
Cat. No. 9092310210

EB-2000

EB-103



The EB-103 AC Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of AC circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-103 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. AC waveform
- Measure peak voltage with an oscilloscope
- Measure RMS voltage with a DMM
- Measure the period
- Calculate frequency

2. AC current
- Determine peak current from voltage measurements and convert to RMS current
- Determine current from the voltage measured across a resistor
- Determine capacitive reactance from measured voltage and current
- Measure the phase angle between voltage and current

3. Capacitors
- Determine reactance from measurements
- Determine capacitance from reactance
- Determine the total capacitance of capacitors in series and in parallel

4. R/C circuits
- Determine phase angle, input voltage and impedance of a series RC circuit

5. Inductors
- Determine reactance from measurements
- Determine inductance from reactance
- Determine the total inductance of inductors in series and in parallel

6.R/L circuits
- Determine phase angle, input voltage and impedance of a series RL circuit
- Determine phase angle, input voltage and impedance of a parallel RL circuit

7.Resonance
- Measure the resonant frequency, Q-factor and impedance of a series circuit
- Measure the resonant frequency, Q-factor and impedance of a parallel circuit
- Plot the frequency response

8.R/C filters
- Plot the frequency response of a low-pass filter
- Determine the cut-off frequency and phase shift
- Determine the frequency response, cut-off frequency and attenuation of a high-pass filter

9.L/R filters
- Determine the cut-off frequency and phase shift of a low-pass filter
- Determine the frequency response, cut-off frequency and attenuation in db of a high-pass filter.

10. Bandpass filters
- Determine the frequency response of a band pass filter
- Determine the frequency response and bandwidth of a Wien bridge filter

11. The transformer
- Determine the turns ratio from measurements
- Series aiding and opposing connections
- Determine frequency response, bandwidth, primary impedance, input and output power
- Impedance matching

12. Troubleshooting DC Circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM, 40 x CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

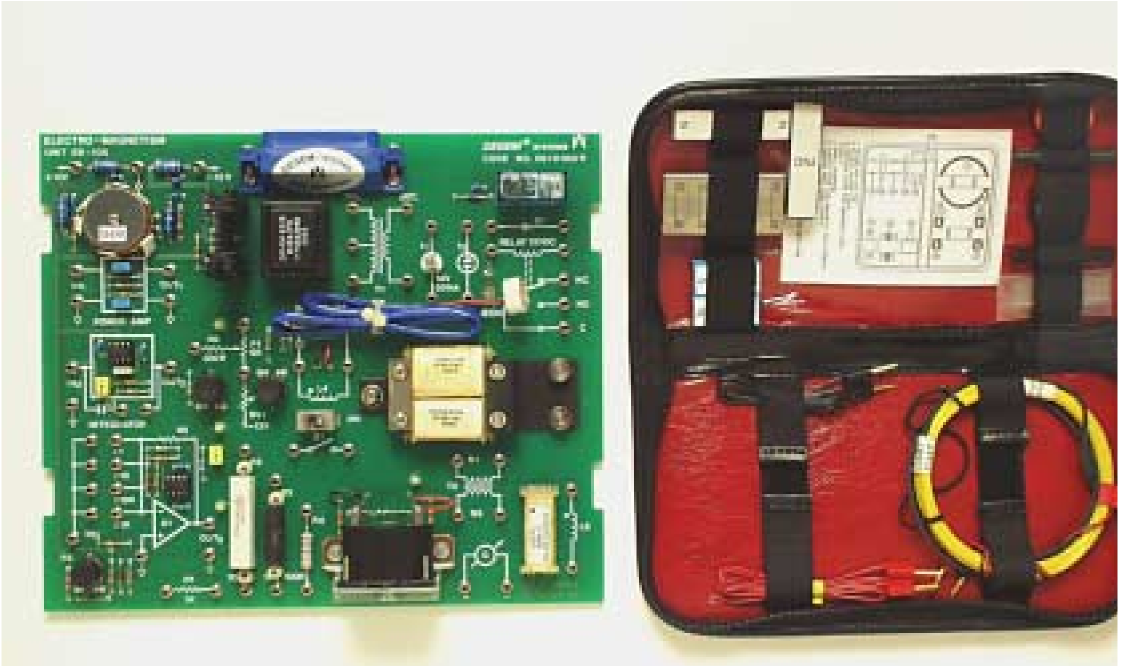
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-105



The EB-105 Electromagnetism board is a comprehensive instructional module designed to teach the fundamental concepts of electromagnetism, which specifically illustrate the relation of magnetic fields and electricity to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-105 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Magnetic field
- Magnetic force
- Permanent magnets and lines of force
- Shape of magnetic fields created by various magnets
- Magnetizing a ferromagnetic material
- Various magnetic field sources
- Magnetic force applied on a conducting wire
- Simple electric motor - how magnetic force produces motion

2. Magnetic field produced by an electric current
- Measure field with a ballistic galvanometer
- Magnetic field of a long, straight wire
- Magnetic field in a current loop
- Magnetic field produced by different types of coils

3.Induced voltage
- Faraday and Lenz's laws
- Self-inductance
- Magnetic circuit with an air gap
- Magnetic field in the center of a loop
- Calculate the permeability of a ferromagnetic core with an air gap

4.Transformers
- Transformer characteristics
- Transformer equivalent circuit
- Measure the copper resistance of a transformer
- Measure the equivalent re-sistance of the core losses
- Compare transformer per-formance with the ideal model
- Compare a transformer with a toroid
- Compare the toroid trans-former with the ideal model
- Frequency response
- Transformer saturation

5.Hysteresis
- Display the hysteresis curve on an oscilloscope of a transformer driven by an AC signal

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

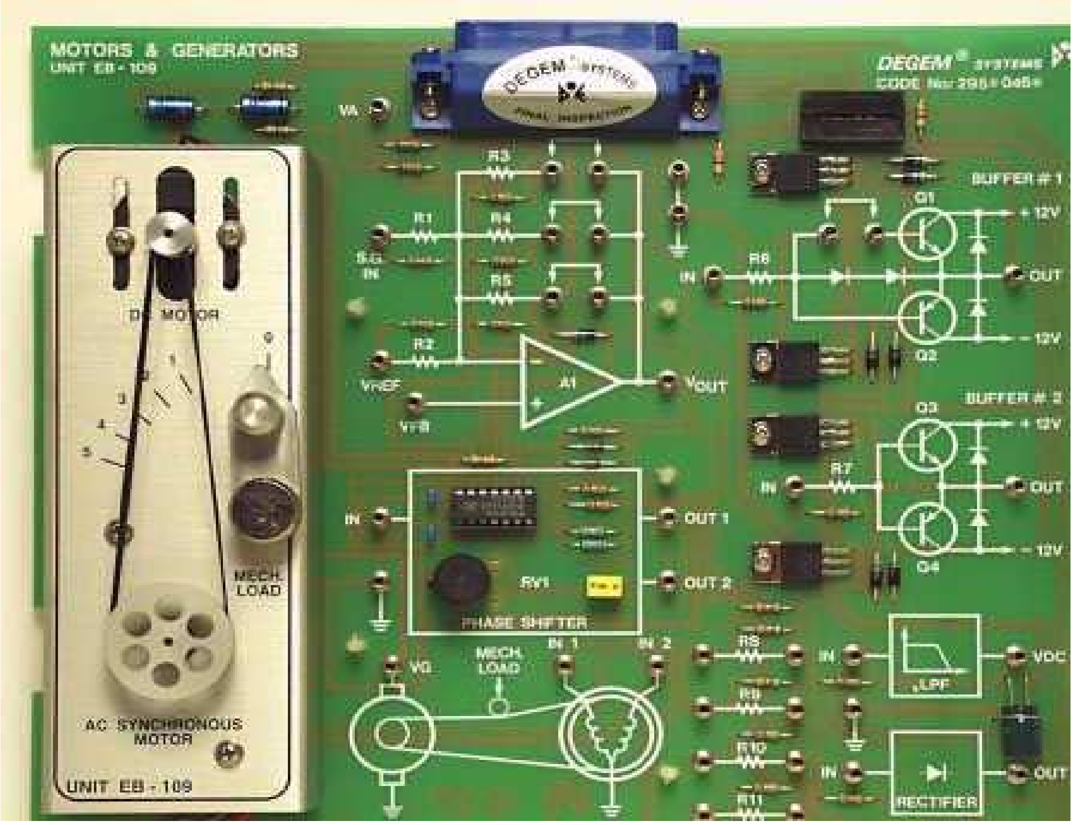
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-109



The EB-109 Motors and Generators board is a comprehensive instructional module designed to teach the fundamental concepts of motors and generators to students in high schools, technical schools and colleges

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student’s comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student’s level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student’s level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-109 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Measure the speed of a motor
- Determine the speed of a DC motor
- Determine the speed of an AC generator

2.Back-emf of a DC motor
- Determine the back-emf and resistance of a DC motor
- Determine the back-emf constant (k) of a DC motor
- Determine the motor speed by using k

3.Loading the DC motor
- Effect of AC generator load on DC motor speed and current
- Effect of mechanical load on DC motor speed and current

4.Speed regulation, efficiency, torque and power
- Torque and power in a DC motor and AC generator
- Relation between DC motor armature current and torque
- Maximum power transfer theorem
- Measure DC motor speed regulation for various loads
- Measure efficiency of the DC motor - AC generator system
- Measure the DC motor input power and AC generator output power

5.AC motor and DC generator
- Speed - frequency relation of an AC synchronous motor
- Speed torque relation of an AC synchronous motor
- Use a DC motor as a generator

6.Load the AC motor with a DC generator
- Effect of mechanical and electrical loading on AC motor speed
- Determine the efficiency and maximum power output of the DC generator

7.Closed-loop DC motor speed control
- Basic operational amplifier theory
- Effect of closed-loop control of speed regulation for various loads
- Effect of various amplification values on speed regulation

8.Closed loop control of AC generator voltage
- Study closed-loop control performance for various loads and amplifier gains
- Observe the effect of saturation in closed-lop control

9.PWM speed control of a DC motor
- Fundamentals of pulse-width modulation (PWM)
- Effect of duty cycle on applied voltage to the motor
- Observe applied PWM voltage for various reference voltages
- Measure duty cycle for mechanical loads
- Determine speed regulation for various mechanical loads

10.Troubleshoot a DC motors

-AC generator system

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- Counter timer
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092310910

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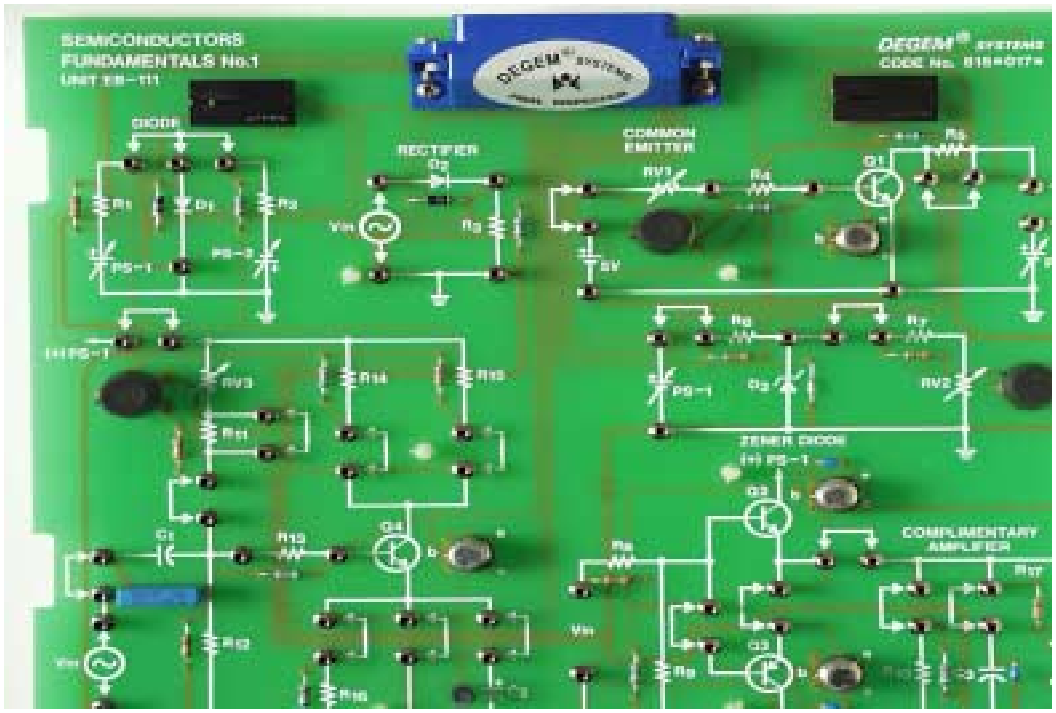
DEGEM ®
SYSTEMS

EB-2000

EB-111



The EB-111 Semiconductor Fundamentals I board is a comprehensive instructional module designed to teach the fundamental concepts of semiconductor devices and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-111 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Junction diode characteristics
- Measure forward-biased diode voltage and current
- Measure reverse-biased diode voltage and current
- Plot the voltage-current curve of a diode
- Determine the dynamic resistance of a diode
- Determine the model of a reverse-biased diode

2. Diode rectifier
- Measure the input and output voltage waveforms of a rectifier
- Compare diode performance with an ideal diode
- Display the voltage transfer curve on an oscilloscope

3. Zener diode regulator
- Plot the characteristic curve of a Zener diode
- Determine the Zener breakdown voltage from measured values to plot the characteristic curve
- Test a Zener diode regulator circuit
- Determine the voltage regulation from measured values

4.Bipolar transistor characteristic
- Plot the input characteristic curves from measured values
- Determine the current gain (β) from measured values
- Test a common emitter-circuit as a current source
- Plot the output characteristic curves from measured values

5. Basic transistor amplifier
- Determine the base current by measuring the voltage across a known resistor
- Calculate the voltage gain from measured values
- Calculate the current gain from measured values
- Calculate the power gain from the voltage and current gain
- Determine the reason for distortion in the output waveform

6.Basic transistor amplifier II
- Determine the frequency response from measured values
- Measure the rise time of a transistor amplifier
- Test a digital inverter

7.Emitter follower and push-pull amplifier
- Test the voltage gain of a common-collector, emitter-follower circuit
- Test the emitter follower in a voltage regulator circuit
- Determine the voltage regulation of the regulator circuit
- Observe the input and output waveforms of a push-pull amplifier

8.Troubleshooting semi-conductor circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092311110

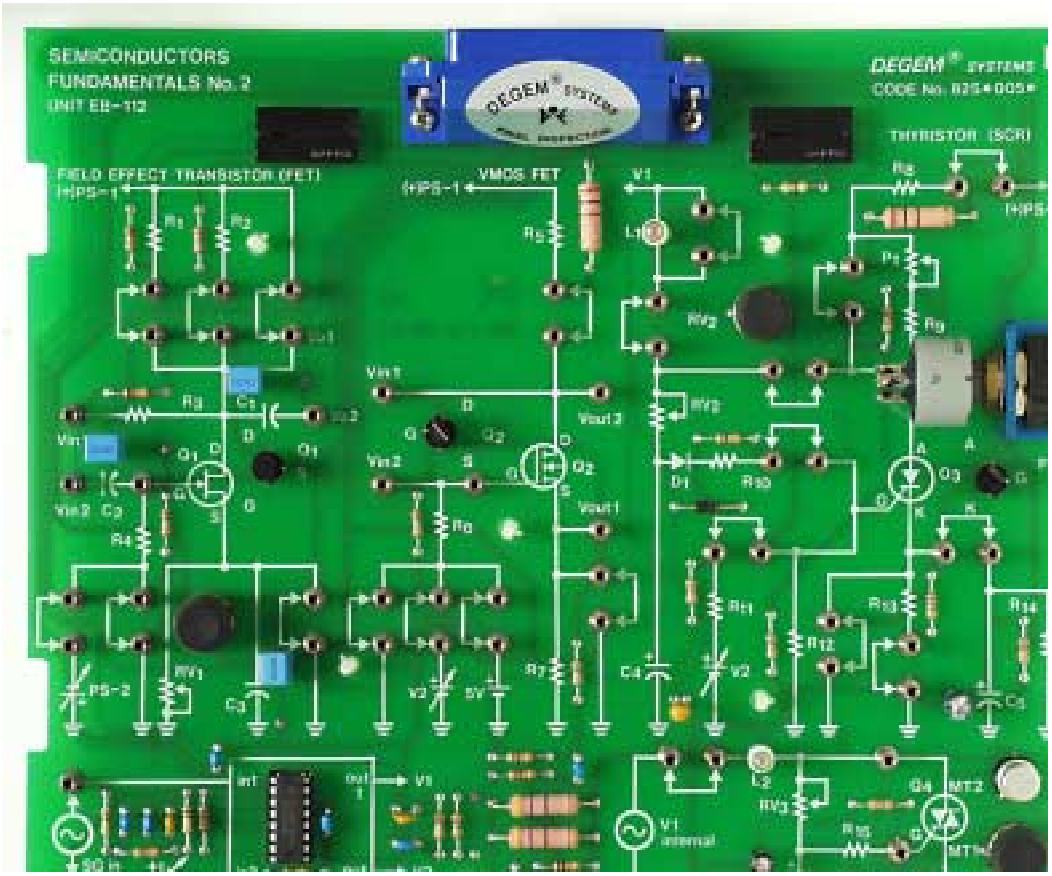
Another Quality Product From:
Specifications subject to change without prior notice.

DEGEM ®
SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-112



The EB-112 Semiconductor Fundamentals II board is a comprehensive instructional module designed to teach the fundamental concepts of semiconductor devices and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-112 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Field effect transistor (FET) characteristics
- Plot the drain characteristic curves from measured values
- Plot the transfer characteristic curves from measured values
- Determine the channel resistance (RDS) from measured values
- Use a FET in an attenuator circuit
- Calculate the trans-conductor from measured parameters

2. FET amplifiers
- Measure the DC bias values in a FET, common-source amplifier circuit
- Determine the frequency response from measured values
- Observe effect of load resistor on voltage gain

3.VMOS FET
- Plot the drain characteristic curves from measured values
- Observe VMOS digital switch operation and determine switching characteristics
- Observe VMOS analog switch operation determine switching characteristics

4.Thyristor (SCR)
- Determine the characteristics of a silicon-controlled rectifier (SCR)
- Connect the thyristor to obtain forward conduction
- Determine the holding current
- Determine the triggering voltage and current
- Measure the firing angle in a phase-control circuit
- Observe how the phase of a thyristor can control the output of a DC power supply

5.Triac
- Measure the firing angle of a triac in a phase-shift trigger circuit
- Measure the circuit voltages
- Sketch the measured waveforms

6.Troubleshooting semi-conductor circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

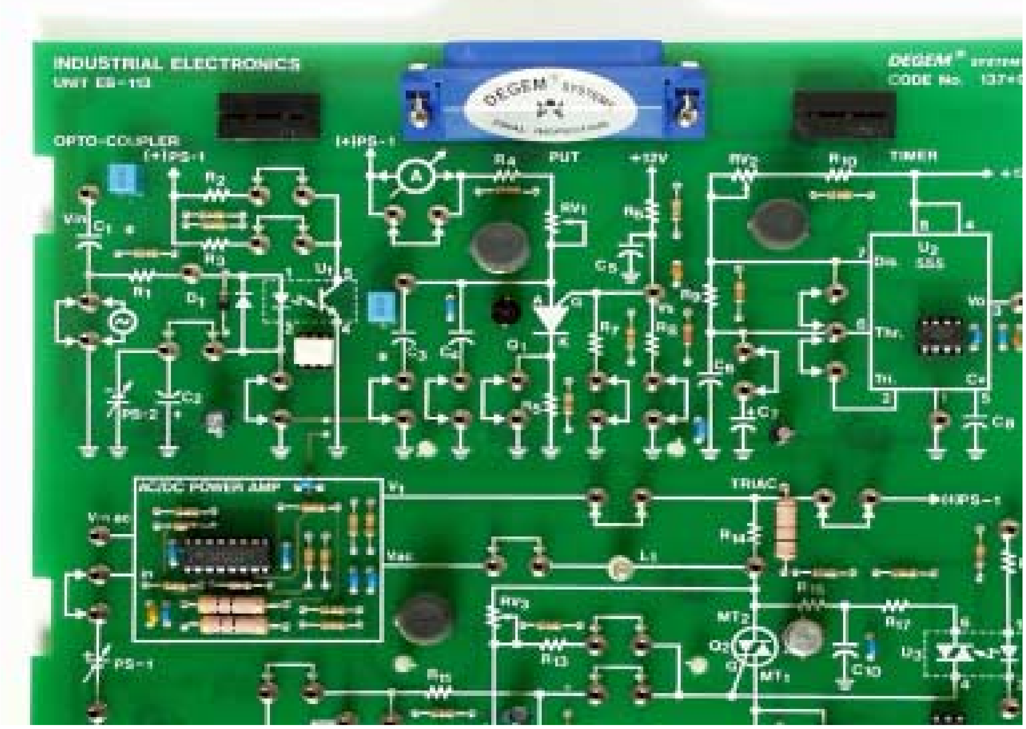
Cat. No. 9092311210

Another Quality Product From:
Specifications subject to change without prior notice.

DEGEM ®
SYSTEMS

EB-2000

EB-113



The EB-113 Industrial Electronics board is a comprehensive instructional module designed to teach the fundamental concepts of industrial control components and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-113 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Optocoupler

- Measure and plot current transfer characteristics
- Examine frequency response
- Observe isolating features
- Observe effect of component changes on circuit performance

2. Programmable uni-junction transistor (PUT)

- PUT operation and biasing
- Determine PUT parameters (VS, VP, IP, VV, IV, VF, IF)
- Construct a PUT oscillator
- Observe effect of component changes on circuit performance

3. 555 timer

- Internal structure and operating conditions
- Astable multivibrator using a 555 timer
- Monostable multivibrator using s 555 timer
- Use a PUT oscillator to trigger a monostable multivibrator
- Observe effect of component changes on circuit performance

4. Triac

- Internal structure and 4 operating modes
- Measure important triac parameters (VG, VF, IG, IF)
- Using a triac in a phase-control circuit
- Construct a light dimmer circuit with a triac
- Optocoupler control of a triac
- Observe effect of component changes on circuit performance

5. Troubleshooting an industrial electronics control circuit

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-114

The EB-114 Opto-electronics I board is a comprehensive instructional module designed to teach the fundamental concepts of basic opto-electronic components and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-114 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Light Dependent Resistor

- LDR structure and operating characteristics
- Set up circuits to determine LDR characteristics
- Determine LDR resistance as a function of illumination
- LDR light-controlled switch
- Photo-attenuator

2.Photodiode

- Photodiode structure and operating principles
- Set up circuits to determine photodiode characteristics
- Measure photodiode current as a function of illumination
- Measure dynamic characteristics with an oscilloscope
- Observe photovoltaic effect
- Photodiode light-controlled switch

3.Phototransistor

- Phototransistor structure and operating principles
- Set up circuits to determine phototransistor characteristics
- Measure phototransistor collector current as a function of illumination and VCE
- Measure dynamic characteristics with an oscilloscope
- Measure the gain of a phototransistor amplifier
- Photodiode light-controlled switch
- Measure rise time and fall time

4.Light-emitting diode (LED)

- LED structure and operating principles
- Practical LED circuits
- Set up circuits to determine photodiode characteristics
- Measure LED current as a function of applied voltage
- Compare emitted light intensity of red, yellow and green LED's
- Display LED characteristics with an oscilloscope
- Drive an LED with a digital logic interface

5.Incandescent lamp

- Lamp construction and operating principles
- Determine effect of applied voltage on lamp resistance
- Measure effect of current on relative light intensity
- Measure inrush current
- Measure effect of lamp preheating on inrush current

6.LED Alphanumeric display

- Basic construction and operating principles of the dot matrix display
- Related control circuits
- Set up a hexadecimal driven by an up-counter
- Observe circuit waveforms with an oscilloscope
- Observe circuit waveforms & down counter with a scope
- Set up a decade display and observe its operation
- Effect of the blanking input on the display

7.Liquid Crystal Display (LCD)

- Basic construction and operating principles
- LCD drive circuits
- Observe the operation of a DC drive circuit
- Verify the required logic levels of the control input to display hexadecimal digits
- Observe the operation of an AC drive circuit
- Compare the LCD with the LED display

8.Troubleshooting opto-electronic circuits

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092311410

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SYSTEMS

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SYSTEMS

EB-2000

EB-115

The EB-115 Opto-electronics II board is a comprehensive instructional module designed to teach the fundamental concepts of semiconductor devices and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-115 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Optocoupler

- Construction and operating principles
- Use the opto-coupler as an isolator
- Troubleshoot an opto-coupler circuit

2.Optical switches

- Photo-interrupter switch construction and operating characteristics
- Reflector switch construction and operating characteristics
- Frequency response of photo-interrupter and reflector switches
- Rise and fall times of the output signals

3.Semiconductor laser diode

- Infrared laser diode theory and operation
- Measure and plot laser diode current versus voltage
- Measure and plot laser diode optical output versus input current
- Use a laser beam to transmit digital information

4.Fiber optics

- Basic fiber optic theory
- Observe fiber optic channel operation
- Determine the frequency response
- Troubleshoot a fiber optic data transmission channel

5.Troubleshooting an opto-electronics system

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Another Quality Product From:
Specifications subject to change without prior notice.

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SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-116

The EB-116 Position Control and Stepper Motor board is a comprehensive instructional module designed to teach the fundamental concepts of semiconductor devices and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-116 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Stepper motor and driver
- Permanent magnet stepper motor construction and operation
- Full step and half step switching sequence
- Stepper motor controllers
- Observe the switching sequence for full-step and half-step operation

2.Absolute encoder
- Rotary encoder construction
- Gray code
- Observe the output codes for a 16-position absolute encoder
- Observe Gray to binary decoder circuit operation

3.Digital comparator
- 4-bit binary comparator and related signals
- Record comparator output signals for various position-related

4.Closed-loop digital position control
- Fundamental construction and operation
- Observe actual angular positions and compare to related reference position

5.Closed-loop analog position control
- Digital to analog converter fundamentals
- Inverting amplifier basics
- Analog comparator circuit
- Observe digital to analog converter output voltage for various angular positions
- Measure relative rotation increment for various analog selector positions

6.Hall effect incremental encoder
- Basic theory and operation
- Measure incremental encoder output for various rotational movements
- Observe how direction of rotation can be detected by a D flip-flop

7.Closed-loop position control with an incremental encoder
- Set up a digital position control system
- Measure the number of revolutions the motor turns for each reference position value
- Determine the rotational increment for each reference position
- Set up an analog position control system
- Measure the number of revolutions the motor turns for each reference position value
- Sketch the measured waveforms

8.Troubleshoot a closed-loop digital position control system

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092311610

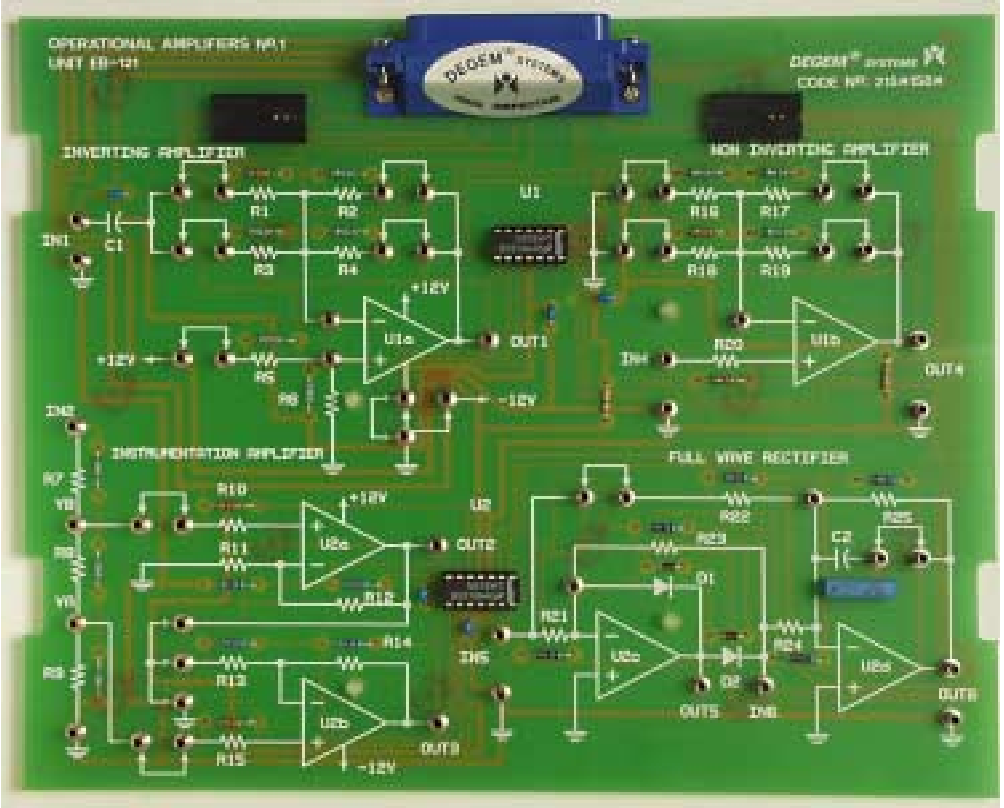
Another Quality Product From:
Specifications subject to change without prior notice.

DEGEM ®
SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-121



The EB-121 Operational Amplifiers I board is a comprehensive instructional module designed to teach the fundamental concepts of operational amplifiers and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-121 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Inverting DC amplifier
- Calculate the DC gain of an inverting amplifier from circuit values
- Measure the gain of an inverting amplifier
- Observe the effect of amplifier saturation

2.Inverting AC amplifier
- Calculate the AC gain of an inverting amplifier
- Measure the gain of an inverting amplifier
- Determine the frequency response
- Test the amplifier for saturation

3.Single-supply amplifier
- Calculate the required bias voltage
- Measure the bias voltage
- Calculate the voltage gain
- Determine the voltage gain from measured values

4.Non-inverting amplifier
- Calculate the gain from measured values
- Measure the input and output impedance

5.Instrumentation difference amplifier
- Determine the relationship between the input and output of the differential test amplifier
- Use measurements to test if the differential amplifier loads the input signal source
- Test difference amplifier operation

6.Instrumentation rectifier
- Observe performance of a half-wave rectifier
- Observe the performance of a full-wave rectifier
- Rectifier frequency response
- Rectifier with a filter

7.Troubleshooting a system that consists of several operational amplifier circuits

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

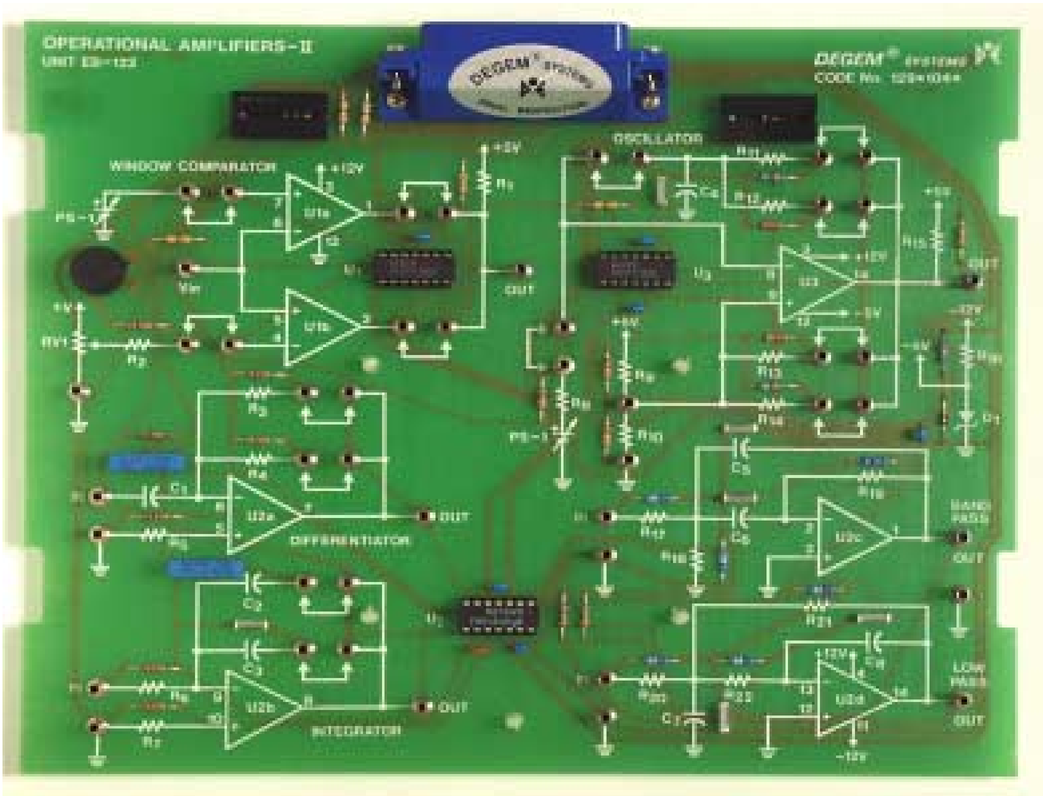
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-122



The EB-122 Operational Amplifiers II board is a comprehensive instructional module designed to teach the fundamental concepts of operational amplifiers and circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student’s comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student’s level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student’s level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-122 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Comparators
- Observe the input and output waveforms of an inverting comparator
- Determine the transfer characteristic of an inverting comparator
- Measure the input and output waveforms of a non-inverting comparator
- Determine the transfer characteristic of a non-inverting comparator
- Measure the input and output waveforms of a window comparator
- Determine the transfer characteristic of a window comparator

2.Integrator
- Measure the input and output waveforms
- Effect of feedback capacitor on the output waveform
- Determine how the value of feedback capacitor effects the gain

3.Differentiators
- Measure the input and output waveforms
- Determine how the value of the input resistor effects the gain

4.Low-pass and bandpass filters
- Measure input and output voltages at various frequencies
- Calculate the gain for various frequencies
- Plot the frequency response
- Determine the half-power or corner frequency of the low-pass filter
- Determine the half-power or corner frequency of the band pass filter
- Determine the center frequency and bandwidth

5.Schmitt trigger
- Measure the output waveform with an oscilloscope
- Determine the transfer input-output characteristic

6.Square wave generator
- Observe the generated signal on an oscilloscope
- Determine the frequency of the square wave

7.Troubleshoot an analog signal processing circuit

ACCESSORIES

Required Accessories
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

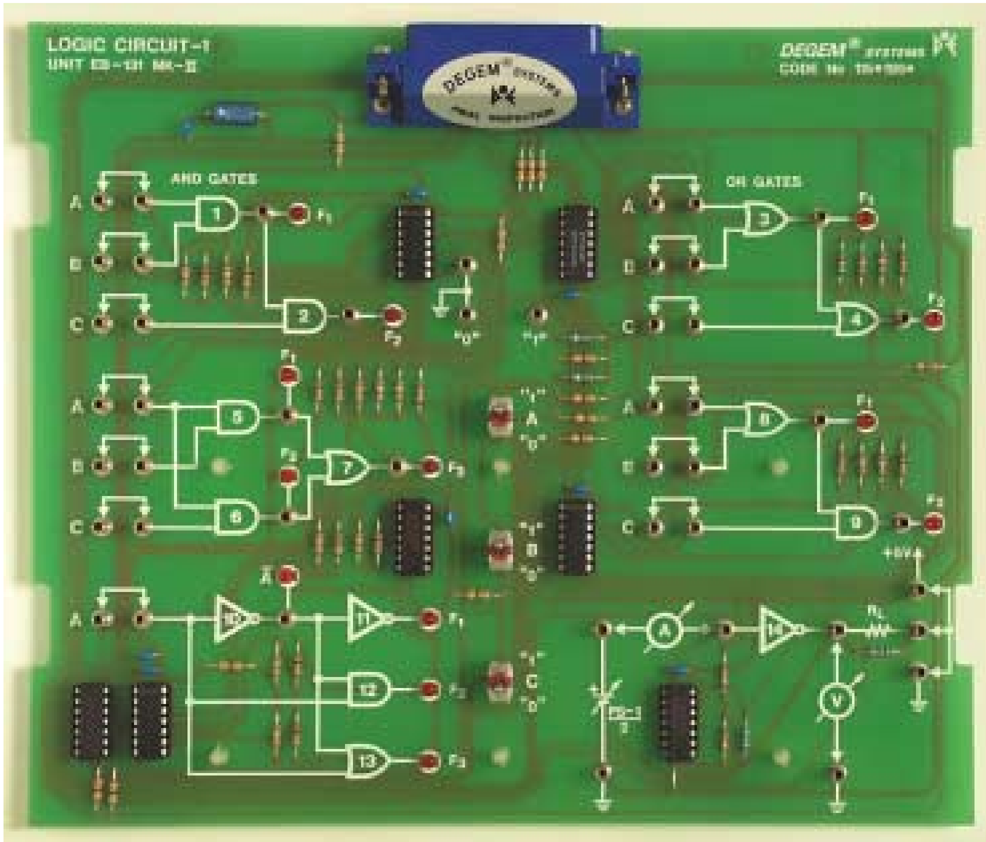
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-131



The EB-131 Logic Circuits I board is a comprehensive instructional module designed to teach the fundamental concepts of digital logic gates and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-131 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.AND gates
- Determine the relation between inputs and output
- Complete the AND gate truth table from observed results
- Write a Boolean expression for a circuit with two AND gates
- Construct a 3-input AND gate from two 2-input AND gates
- Detect a malfunction in an AND gate circuit
- Optional design exercises

2.OR gates
- Determine the relation between inputs and output
- Complete the OR gate truth table from observed results
- Write a Boolean expression for a circuit with two OR gates
- Determine the output function of a two OR gate circuit
- Detect a malfunction in an OR gate circuit
- Optional design exercises

3.Combining logic gates
- Observe the output functions of AND-OR combinations
- Complete the AND-OR gate truth table from observed results
- Write a Boolean expression for combinatorial logic circuits
- Detect malfunctions in AND-OR gate circuits
- Optional design exercises

4.NOT gates and Boolean algebra
- Use a NOT gate
- Verify some Boolean algebra laws
- Equivalent logic circuits
- Optional design exercises

5.Logic levels
- Measure input and output voltages of a logic gate
- Measure input and output currents of a logic gate
- Detect improper logic levels

6.Troubleshoot a digital logic system

ACCESSORIES

Required Accessories
- EB 2000 workstation
- Digital multi meter
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

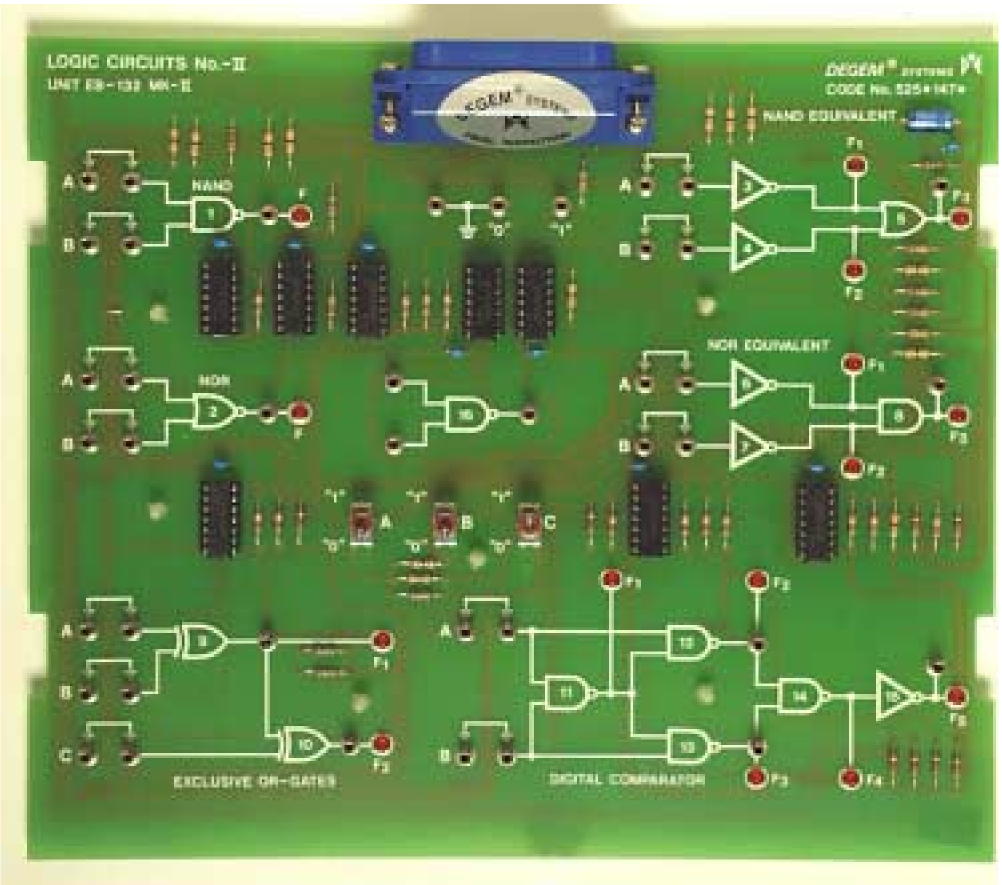
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-132



The EB-132 Logic Circuits II board is a comprehensive instructional module designed to teach the fundamental concepts of digital logic gates and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-132 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.NAND gates
- Determine the relation between inputs and output
- Complete the NAND gate truth table from observed results
- Write a Boolean expression for a NAND circuit
- Detect a malfunction in a NAND gate circuit

2.NAND equivalent circuit
- Determine the output function of a NAND equivalent circuit
- Complete its truth table from observed results
- Write the corresponding Boolean expression
- Detect a malfunction in a NAND equivalent circuit

3.NOR gates
- Determine the relation between inputs and output
- Complete the NOR gate truth table from observed results
- Write a Boolean expression for a NOR circuit
- Detect a malfunction in a NOR gate circuit

4.NOR equivalent circuit
- Use a NOR equivalent circuit
- Complete its truth table from observed results
- Write the corresponding Boolean expression
- Detect a malfunction in a NAND equivalent circuit

5.EXCLUSIVE-OR gates
- Use an exclusive-OR gate (XOR)
- Complete its truth table from observed results
- Write the corresponding Boolean expression
- Detect a malfunction in a XOR circuit
- Optional design exercises

6.Digital comparator
- Determine the relation between inputs and output
- Complete the truth table from observed results
- Write a Boolean expression for the digital comparator
- Detect a malfunction in a digital comparator circuit

7.Troubleshoot a digital logic system

ACCESSORIES

Required Accessories
- EB 2000 workstation
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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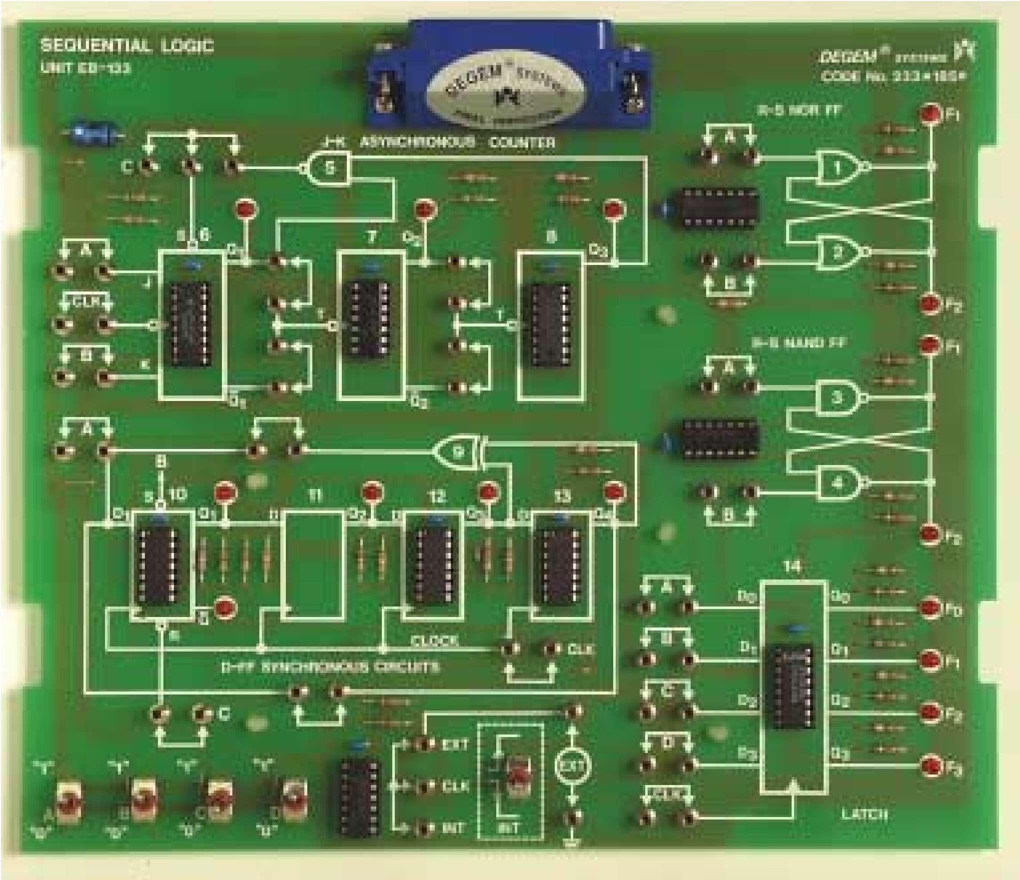
DEGEM ® SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-133



The EB-133 Sequential Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of sequential logic devices and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-133 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. RS flip-flops
- Observe the operation of an RS NOR flip-flop
- Observe the operation of an RS NAND flip-flop
- Complete their truth table from observed results
- Analyze the related timing diagrams to determine the input and output states

2. Latches
- Observe the operation of a latch
- Analyze the related timing diagrams to determine the input and output states
- Complete the truth table from observed results
- Detect malfunctions in a latch circuit

3. JK flip-flop
- Observe the operation of a JK flip-flop
- Analyze the related timing diagrams to determine the input and output states
- Complete the truth table from observed results

4. JK asynchronous counters
- Observe up-counter operation
- Observe down-counter operation
- Complete the related timing diagrams and analyze the relation between input and output states
- Complete their truth tables from observed results
- Detect malfunctions by analyzing the measured timing diagram.

5. D flip-flop
- Record the timing diagram from measured results
- Complete the truth table from observed results
- Detect a malfunction by analyzing the measured timing diagram
- Detect a malfunction by analyzing the measured timing diagram

6. D flip-flop synchronous circuits
- Record the output states of a 4-bit synchronous counter in a timing diagram
- Record the truth table of a 4-bit synchronous counter
- Record the timing diagram and truth table of a synchronous ring counter
- Record the timing diagram and truth table of a shift register
- Analyze the modified timing diagram of a shift register to detect a malfunction

7. Troubleshoot a sequential logic system

ACCESSORIES

Required Accessories
- EB 2000 workstation
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092313310

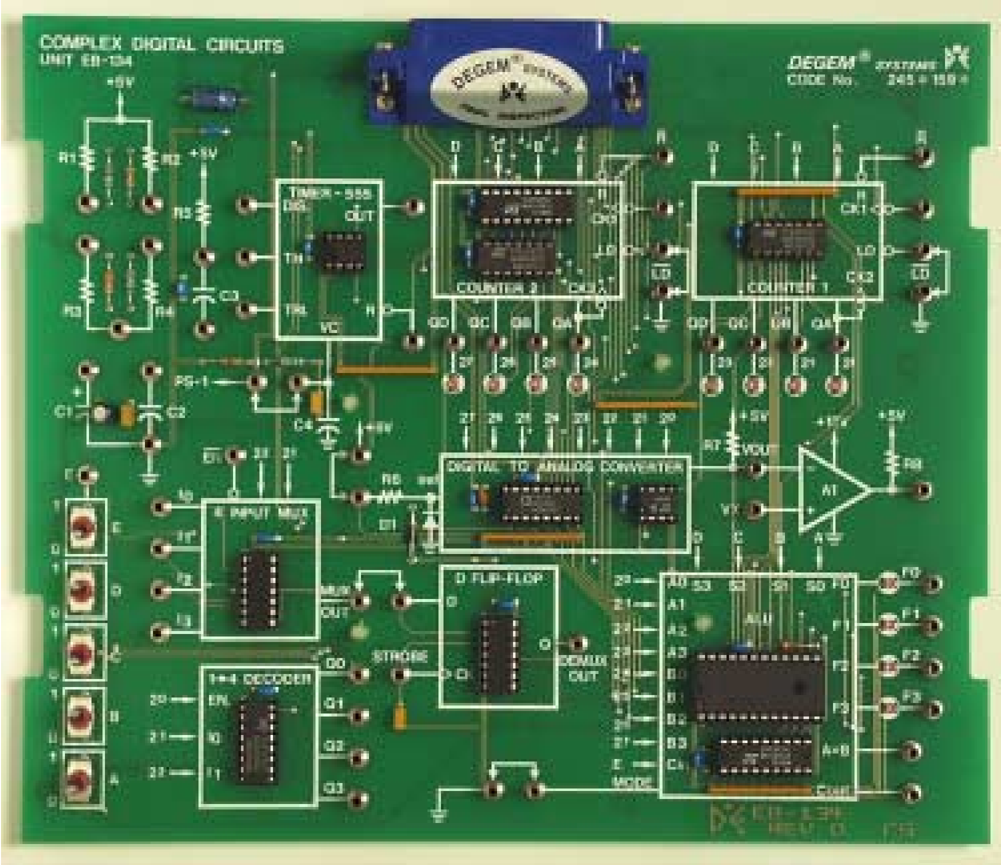
Another Quality Product From:
Specifications subject to change without prior notice.

DEGEM ®
SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-134



The EB-134 Complex Digital Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of complex digital devices and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-134 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. 555 timer
- Learn the basic principles of a stable operation
- Learn the basic principles of mono-stable operation
- Compare calculated mono-stable pulse width with calculated values
- Compare calculated a stable pulse widths with calculated values
- Determine the effect of power supply voltage on a stable pulse period and frequency

2.Binary ripple counters
- Describe the basic functions of a 4-bit binary ripple counter
- Cascade counters to increase the count
- Use the counters as a frequency divider
- How to reset a counter
- How to parallel load a binary number
- Use a counter as a storage register

3.Digital to analog (D/A) converter
- Learn how to calculate step size
- Calculate the output voltage as a function of the digital input
- Measure A/D binary outputs for various input voltage values
- Compare calculated binary output values with measured values.
- Use the multiplying characteristic of a D/A

4.Analog to digital (A/D) converter
- How to calculate step size and decimal equivalent of a given input voltage
- Construct an A/D from a 555 oscillator, binary counter, D/A, and voltage comparator
- Complete the related timing diagrams and analyze relation between input and output states
- Complete their truth tables from observed results
- Detect malfunctions by analyzing the measured timing diagram

5.Decoders, multiplexers and de-multiplexer
- Describe multiplexed operation, by multiplexing several signals on to a single output
- Observe how a multiplexed can select any signal from 4 different signals
- Describe decoder operation
- Record the decoder timing diagram from measured values
- Construct a de-multiplexer from a multiplexed and a decoder
- Record de-multiplexed timing diagram

6.Arithmetic logic unit (ALU)
- Describe the functions and applications of an ALU
- Observe how an ALU can be programmed by a control word to perform logic functions
- Observe how an ALU can be programmed by a control word to perform arithmetic functions

7.Troubleshoot a complex digital system

ACCESSORIES

Required Accessories
- EB 2000 workstation
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

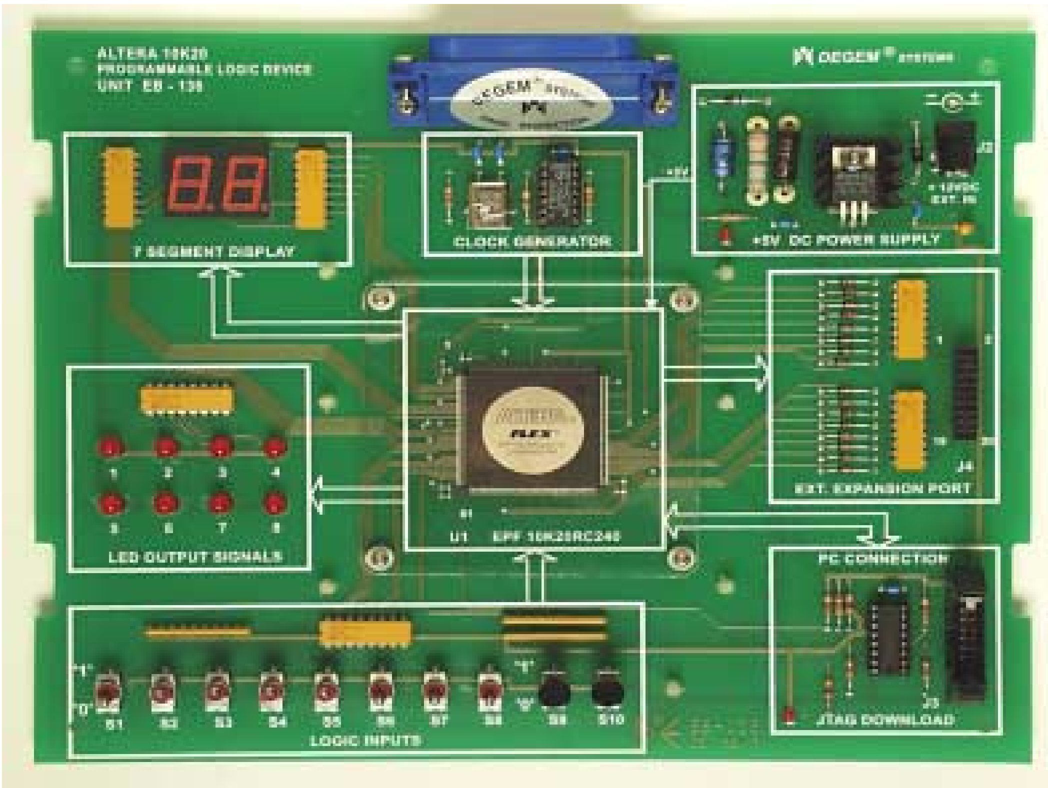
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-136



The EB-136 Erasable Programmable Logic Devices (EPLD) board is a comprehensive instructional module designed to teach how to design digital logic systems using state-of-the-art, professional software development tools to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-136 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Using the MAX+Plus II Compiler
- Compile a graphic source file
- Download this file to the on-board 10K20
- Verify that the Altera device emulates the function
- Define a waveform files
- Verify logic design using a simulator program

2. Creating a Graphic Design File
- Draw a logic circuit and save it as a GDF
- Compile, download and test the graphic design

3. Graphic Design File (GDF) for Sequential Logic
- Create a flip-flop with MAX+Plus II
- Compile, download and test the design

4. Frequency Division with a D Flip-Flop
- Design a frequency divider with a D flip-flop
- Simulate circuit operation

5. Frequency Divider with a Bounce Filter
- Compile, download and test the frequency divider
- Observe the contact bounce caused by the push button
- Modify the circuit to eliminate contact bounce

6. Libraries of Parameterized Modules (LPM)
- Learn how to specify and use LPMs
- Compile, download and test a binary counter with a contact debounce circuit

7. Seven-Segment Display and Decoder
- Learn about 7-segment displays and binary coded decimal (BCD) numbers
- Compile, download and test a 7-segment decoder and display

8.Creating User-Defined Symbols
- Learn how to represent an entire logic circuit with a single symbol
- Create a symbol to represent a BCD counter and a 7-segment decoder

9.Two-Digit BCD Counter
- Use a default symbol to create a 2-digit BCD counter and display
- Compile, download and test the design that uses two copies of the default symbol

10. Frequency Division
- Design a counter circuit to reduce the system clock frequency
- Convert the design to a single user-defined symbol
- Compile, download and test the design

11. Creating a 0 - 99 Second Clock
- Integrate the user-defined symbols for the frequency divider and the 2-digit BCD counter to create a 0 – 99 second clock with display
- Compile, download and test the design

12. Implementing a RAM Circuit
- Design a RAM device with the 10K20 device
- Compile, download and test the design

13. Implementing a ROM Circuit
- Design a ROM device with the 10K20 device
- Learn how to initialize ROM contents with a MIF file
- Compile, download and test the design

14. Introduction to Altera Hardware Description language AHDL
- Learn about AHDL
- Write a program to describe a logic function using AHDL
- Compile, download and test the design using MAX+Plus II

15. Designing Sequential Logic with AHDL
- Write a program to describe a flip-flop using AHDL
- Compile, download and test the design using MAX+Plus II

Required Accessories
- EB-2000 workstation
- Stand alone mode
  - Power supply – 12 V/0.5 A
- Personal computer
  - Pentium PC
  - 32 Mbyte RAM
  - hard disk with 40 Mbytes free
  - RS-232 port
  - mouse
  - parallel printer port
  - MS-WIN 95/98/NT or better
  - Novell 3, 4 or 5; NT4 network
  - Email access

OPTIONAL ACCESSORIES
- EB-136 software

INSTRUCTIONAL MATERIALS

Windows-based courseware, student theory manuals, student experiment manuals and instructor manuals are prepared by pedagogic experts and in electronics technology professionals to support every stage of the learning process.

DEGEM ®
SYSTEMS

EB-2000

EB-141

The EB-141 Power Supply Board is a comprehensive instructional module designed to teach the fundamental concepts of power supply circuits and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-141 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Unregulated power supplies

- Connect a half-wave rectifier circuit
- Observe the input and output waveforms on an oscilloscope
- Observe the effect of a filter capacitor
- Measure the ripple voltage
- Connect and observe the behavior of a full-wave rectifier circuit
- Connect and observe the behavior of a bridge rectifier circuit
- Observe the performance of a dual complimentary supply circuit
- Determine the effect of loading on the amount of ripple voltage
- Troubleshoot rectifier circuits

2.Transistor regulator circuits

- Connect transistor regulator circuits
- Measure the DC voltage of a regulator circuit
- Measure the output voltage with an oscilloscope
- Measure the output voltage for various loads
- Observe regulator performance with current limit
- Observe the effect of voltage feedback
- Troubleshoot transistor regulator circuits

3.Monolithic linear regulator

- Connect a fixed-voltage regulator.
- Measure output voltage and ripple
- Measure the voltage regulation of a variable voltage regulator
- Plot voltage regulation as a function of potentiometer setting
- Measure the voltage output and plot it as a function of load
- Understand regulator performance when connected as a current load
- Troubleshoot monolithic regulator circuits

4.Basic switching voltage regulators

- Observe waveforms in a step-down switching regulator
- Measure the duty cycle and plot the voltage-current curve
- Observe the effect of switching frequency on DC output voltage and ripple
- Observe the effect of voltage feedback on output voltage
- Observe waveforms in a step-up switching regulator
- Measure the duty cycle and plot the voltage-current curve
- Observe the effect of switching frequency on DC output voltage

5.Hybrid voltage regulator

- Connect a linear regulator after a switching regulator
- Measure the output voltage for various loads
- Plot the output voltage to output current characteristic
- Compare load regulation and output ripple voltage to that of a conventional switching regulator

6.Troubleshoot an electronic power supply and voltage regualtor circuits

ACCESSORIES

Required Accessories

- EB 2000 workstation
- Digital multi-meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092314110

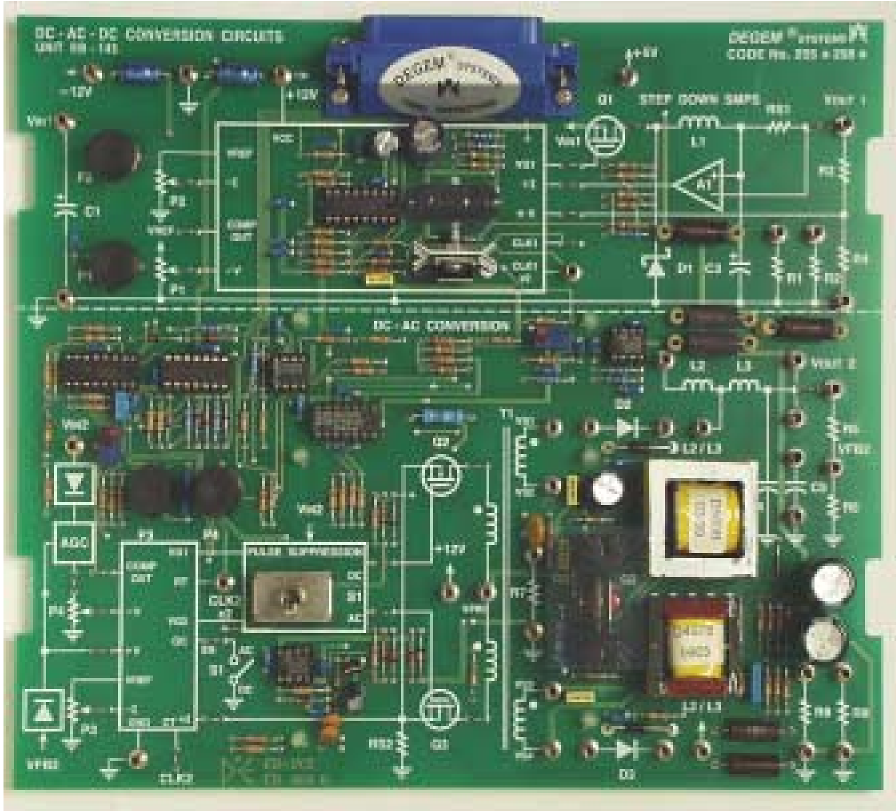
Another Quality Product From:
Specifications subject to change without prior notice.

DEGEM ®
SYSTEMS

DEGEM ®
SYSTEMS

EB-2000

EB-145



The EB-145 DC-DC & DC-AC Conversion Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of DC-DC switching supplies and DC-AC inverters to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-145 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Linear & switching supplies
- How PWM switching can step down voltage
- Relation between duty cycle and output voltage
- Compare efficiency of switching and linear supplies

2.DC-DC switching regulator
- TL-494 switching regulator
- Measure switching regulator waveforms

3.Reject input voltage variations
- Measure output voltage for various input voltages to supply
- Calculate input voltage variation rejection

4.Current limit
- How current limit regulation works
- Measure short circuit current
- Effect of current limit on output voltage for various load conditions

5.Voltage regulation under load
- Determine regulation of output voltage for different loads
- Measure noise in output voltage
- DC-DC regulator efficiency
- Measure voltage and current at input and output of a switching supply
- Calculate switching supply efficiency

6.Push-pull switching supply
- Operation of push-pull switching circuit
- Measure push-pull circuit waveforms

7.Step-up DC-DC switching supply
- Measure voltage regulation
- Measure current limit
- Calculate efficiency

8.Inverting DC-DC switching supply
- Measure voltage regulation
- Measure current limit
- Calculate efficiency

9.DC-AC switching inverter I
- Inverter operation
- Measure push-pull inverter waveforms

10.DC-AC switching inverter
- Measure voltage regulation
- Measure current limit
- Calculate efficiency

11.DC-DC & DC-AC inverter
- Measure inverter voltage regulation and efficiency with reduced DC input to inverter

12. Troubleshooting a DC-DC switching power supply & DC-AC inverter

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

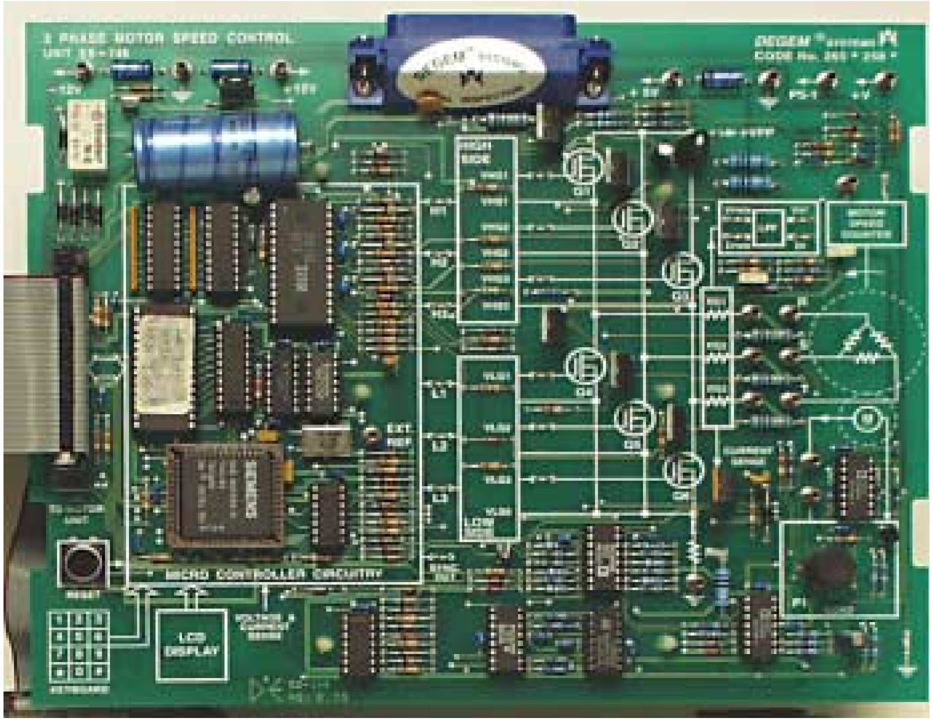
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-146



The EB-146 DC-DC & DC-AC Conversion Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of DC-DC switching supplies and DC-AC inverters to students in high schools, technical schools and colleges.

The EB-146 Three-Phase Synchronous Motor board is a comprehensive instructional module designed to teach the fundamental concepts of frequency and voltage control of a three-phase synchronous AC motor to students in high schools, technical schools and colleges.

The training system consists of the EB-146 plug-in board that contains all of the control circuits and a motor-generator unit. The training system hardware contains the inverter DC power supply, the AC motor, DC generator load, operating keyboard and LCD alphanumeric display for showing DC input voltage and current to the inverter, inverter frequency, synchronous motor speed, line-to-line AC voltage and line current for each phase of the synchronous motor. This unique feature not only simplifies the measurement procedure, but also reduces the cost of measuring instruments.

The EB-146 board contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student’s comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure as well as the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student’s level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student’s level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-146 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Familiarization with three phase AC drive system

- Use the LCD display to measure AC motor RPM, DC input voltage and current, three phase AC voltages and currents
- Use an oscilloscope to measure the 6 gate drive pulses, phase-to-phase AC voltage, phase current on an oscilloscope for square wave and PWM modes of operation.

2. Voltage to frequency relation of a synchronous motor

- Measure the starting voltage at 10, 20, 30, 40, 50 and 60 Hz for PWM mode of operation

3. Speed to torque relation of a synchronous motor

- Measure the motor speed for no load (0 mA); medium load (50 mA) and full load (120 mA)

4. Single-phase operation of a synchronous motor

- Measure the motor speed and phase currents of the motor before and after disconnecting one phase
- Determine the maximum load permitted by increasing the generator current

5. Short circuit protection

- Measure the DC input current and AC phase currents for a line-to-line short circuit, when all three phases are short-circuited and when all three phases are shorted to common.
- Measure the motor speed and phase currents of the motor before and after disconnecting one phase
- Determine the maximum load permitted by increasing the generator current

6. Motor efficiency

- Calculate the electrical power supplied to the motor, its output torque and mechanical output power from 10 to 80 Hz for half and full load conditions

7. Controller efficiency

- Calculate the electrical power input, power output

8. Improve motor efficiency by reducing operating voltage

- Observe reduction of motor input current when the three-phase input voltage is reduced at 50 or 60 Hz
- Determine minimum operating voltage for no and full load at 50 or 60 Hz.
- Calculate efficiency and cos ϕ (power factor)

9. Troubleshooting a three-phase motor control system

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP

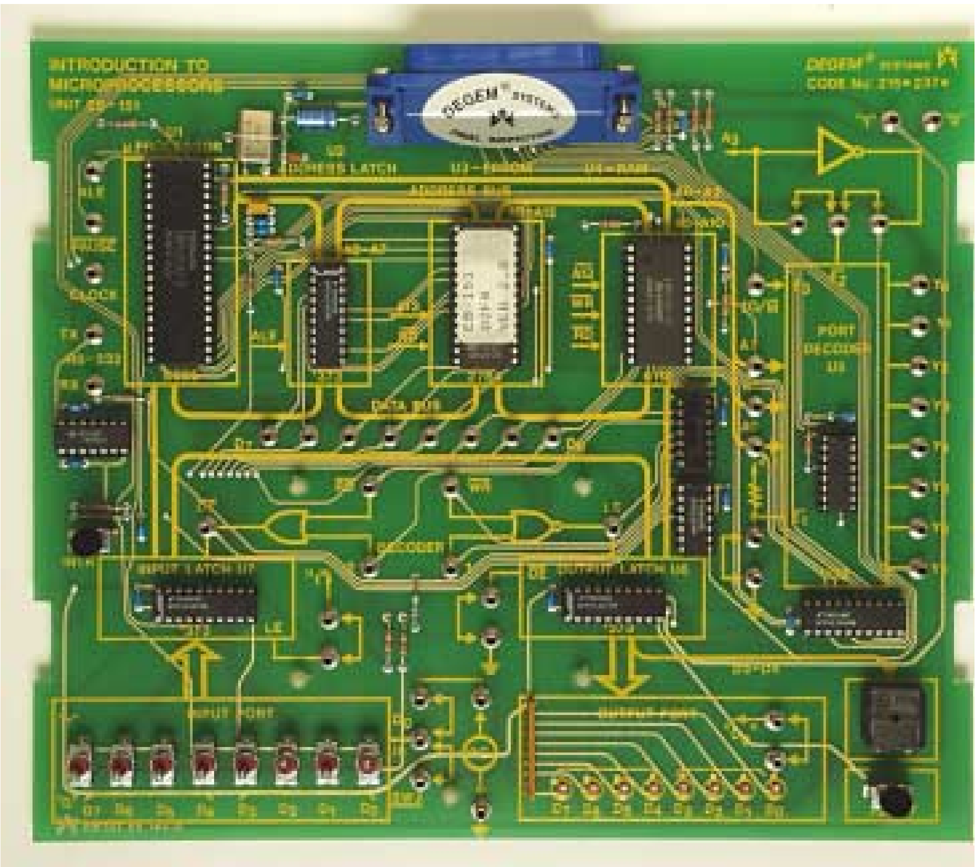
INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

DEGEM ®
SYSTEMS

EB-2000

EB-151



The EB-151 Introduction to Microprocessors I board is a comprehensive instructional module designed to teach the fundamental concepts of microprocessors and their applications to students in high schools, technical schools and colleges

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-151 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Getting to know the EB-151
- Identify main components and describe their function
- Identify signal buses and describe their function
- Run a simple program

2.Input/output ports
- Use the input and output ports of a microprocessor
- Explain how a decoder is used to select different output ports
- Describe the function of a 3-state circuit
- Run various data transfer and programs

3.Logic and arithmetic operations
- Observe how a microprocessor makes decisions
- Observe how a microprocessor can solve arithmetic problems
- Understand the CLOCK and ALE waveforms
- How to stop microprocessor operation using the PAUSE control signal

4.Interrupts
- Understand how microprocessors use interrupt routines
- Run programs that use interrupts

5.Bus signals
- Describe the microprocessor control signals
- Analyze the timing of the control signals
- Observe microprocessor control signals with an oscilloscope

6.Address decoders
- Understand how decoders select input/output ports
- Analyze the microprocessor address bus
- Locate faults in decoder circuits
- Troubleshooting decoder circuits

7.Data bus
- Analyze data flow in microprocessor systems
- Understand the meaning of the wait state
- Locate faults in the data bus

8.Troubleshoot a microprocessor system

ACCESSORIES

Required Accessories
- EB 2000 workstation
- Digital multi-meter
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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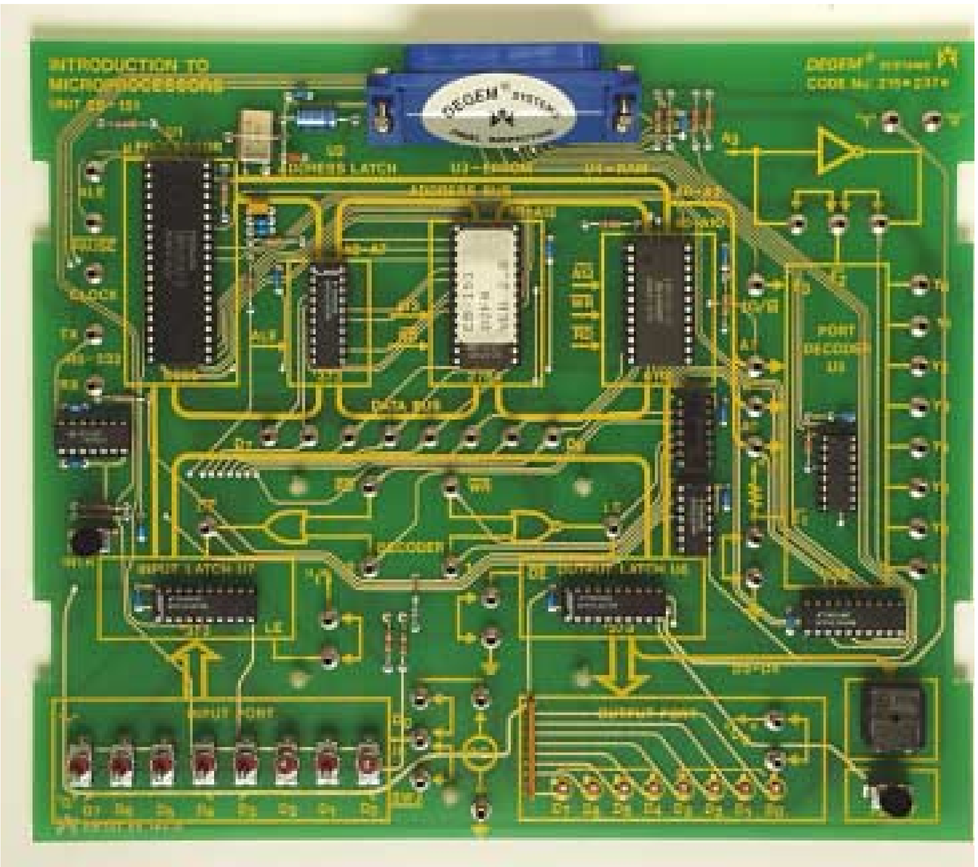
SYSTEMS

EB-2000

EB-152



The EB-152 Introduction to Microprocessors II board is a comprehensive instructional module designed to teach the fundamental concepts of microprocessors and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-152 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Getting to know the EB-152
- Identify and use the keyboard
- Identify and use the display fields
- Alter contents of memory cells in EB-151
- Execute a program that runs on EB-151
- Examine the registers of the EB-151 microprocessor

2.Introduction to programming
- Understand hexadecimal and mnemonic instructions
- Use the following 8085 instructions: LDA, CMA, STA, RST, MOV, LXI, INX, ADD, AND, OR, XOR
- Modify existing programs to comply with new requirements
- Enter and execute machine language instructions
- Calculate the running time of programs

3.Processing data arrays
- Use the breakpoint facility
- Understand how to monitor the 8085 registers
- Use the microprocessor status bits
- Understand and use the following 8085 commands: CMP B, JC, MVI B, SUB A, DCR B, JZ, JMP, NOP
- Execute data arrays programs
- Understand basic flowcharting

4.The stack and subroutines
- Understand the reason for and use of the stack
- Understand the reason for and use of subroutines
- Write subroutines
- Use the following 8085 instructions: LXI, CALL, RET, ADI, JC, PUSH, POP

5.Interrupts
- Understand the use of 8085 interrupts
- Write interrupt service routines
- Use the following 8085 instructions: DI, EI, SIM

6.Arithmetic operations
- Understand the use of 8085 arithmetic instructions
- Carry out arithmetic operations with a microprocessor
- Use the following 8085 instructions: DAD, LHLD, DCR, SHLD, RAL

7.Signature analysis
- Understand the use of a signature analyzer
- Locate defective components using a signature analyzer

8.Troubleshooting with a logic analyzer
- Troubleshoot electronic circuits with a logic analyzer
- Observe proper microprocessor system operation
- Troubleshoot a microprocessor system using a logic analyzer

ACCESSORIES

Required Accessories

- EB-2000 workstation
- EB-151 microprocessor board
- Digital multimeter
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Another Quality Product From:
Specifications subject to change without prior notice.

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SYSTEMS

EB-153

The EB-153 8051 Micro-controller board is a comprehensive instructional module designed to teach the fundamental concepts of micro-controllers and their applications to students in high schools, technical schools and colleges

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-153 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Getting to know the EB-153
- Identify the main components and describe their function
- Identify input/output signals and describe their function
- Use monitor functions to analyze micro-controller operation

2.Monitor subroutines
- Run simple programs
- Use monitor routines
- Execute programs in step-by-step and real-time modes
- Assemble and disassemble a program

3.Data transfer instructions
- Understand different 8051 addressing modes
- Write programs that use data transfer instructions
- Transfer data from and to various memory types

4.Input/output (I/O) ports
- Manipulate Boolean variables
- Use the I/O capabilities of a micro-controller
- Assemble programs that use I/O ports
- Program the 8255 programmable parallel I/O port controller
- Write program that use the Boolean processing instruction subset
- Troubleshooting I/O ports

5.Arithmetic and logic operations
- Perform calculations with a micro-controller
- Replace logic functions by micro-controller functions
- Write programs that use arithmetic and logic functions
- Write main programs and subroutines
- Troubleshooting implemented logic function

6.Control transfer operations
- Understand stack operations
- Write programs that use control stack operations
- Use a software program to control a buzzer

7.External interrupts
- Understand external hardware interrupts
- Write interrupt service routines
- Control real-time events
- Timers and event counters
- Understand the operation of the 8051 timers and event counters
- Configure the input to the timer or counter
- Generate various timing signals

8.Serial communications
- Understand the operation of the 8051 serial port
- Transmit ASCII characters in asynchronous serial format
- Use the EB-153 board to communicate with a personal computer

9.Troubleshooting with a micro-controller-embedded system

ACCESSORIES

Required Accessories

- EB-2000 workstation
- EB-153 microprocessor board
- Digital multi-meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

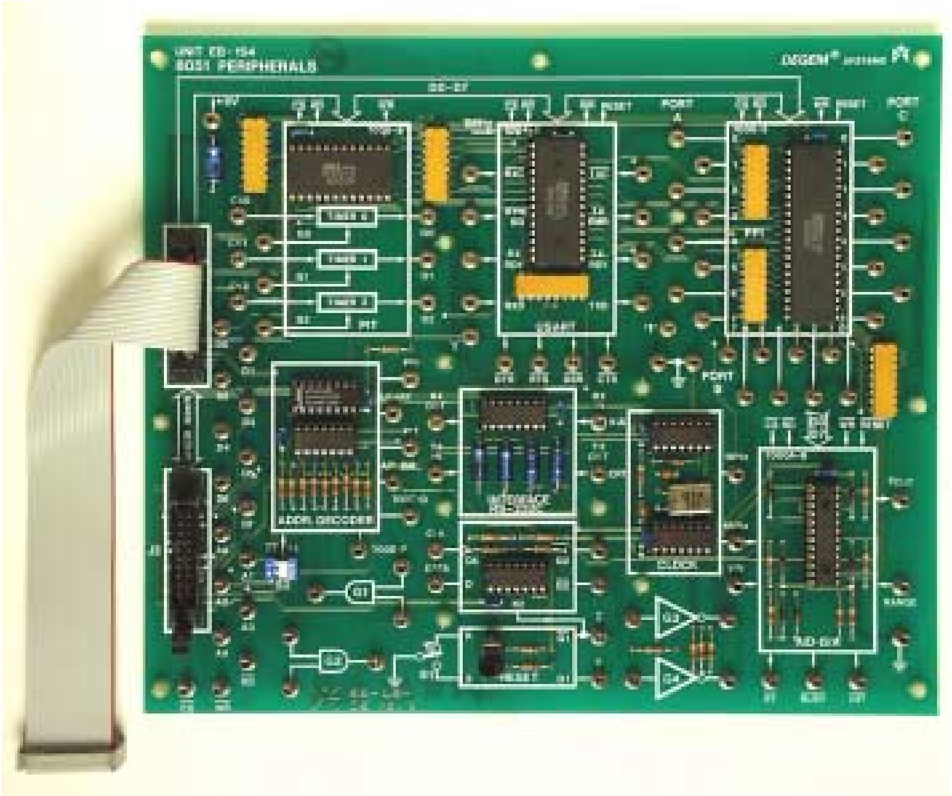
Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

EB-2000

EB-154



The EB-154 8051 Peripherals board is a comprehensive instructional module designed to teach the fundamental concepts of micro-controllers and their applications to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-154 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Microprocessor signals
- Identify microcomputer bus signals and describe their function
- Understand the function of the address decoder
- Control hardware connected to a microcomputer
- Analyze the bus activity of a micro-controller

2.Programmable timers
- Interface an 8253 program-mable interval timer to an 8051-embedded system
- Learn about the 6 modes of operation
- Generate various signal waveforms by programming the control word registers
- Program the 8053 for one-shot operation
- Use digital signals to trigger a counter
- Read the current count value by latching the count

3.Peripheral interfaces
- Basic input/output (I/O) systems
- 8255 programmable parallel port operation and control words
- Understand communication between I/O ports
- Program the 8255 for strobe inputs and outputs

4.Real world signals
- Analyze real world signals
- Interface analog signals to a microprocessor
- Convert analog inputs to digital values
- Convert digital values to analog signals
- Observe the operation of a data acquisition system

5.Communication interfaces
- Understand the operation and control words of the 8251 device
- Examine RS-232 signals
- Understand asynchronous serial communications
- Use a transmitter-receiver interface
- Link a microcomputer to a personal computer

6.Integrating peripheral devices
- Use different peripherals in a complete system
- Analyze the operation of a complex system
- Program and observe the operation of an interrupt-driven data acquisition system
- Connect a controller and its peripherals to a computer

ACCESSORIES

Required Accessories

- EB-2000 workstation
- EB-154 microprocessor board
- Digital multi-meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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EB-2000

EB-160

The EB-160 32-bit, 80960SA RISC Processor board is a comprehensive instructional module designed to teach the fundamental concepts of reduced instruction set processors (RISC) and their applications to students in high schools, technical schools and colleges.

Degem Systems has been authorized to distribute the professional development software free of charge when supplying the EB-160 training system to educational institutions. The EB-160 training system provides a unique opportunity for many technical schools and universities to provide industry-standard, state-of-the-art experiments to introduce the student to the hardware and software of an industrial RISC computer. The student learns how to use professional software development tools such as the Intel C compiler and debugger as well as the Intel MON-960 monitor. The student becomes familiar with the 960 architecture and machine instructions more quickly by compiling, linking and debugging the related programs supplied, rather than spending a great deal of time writing and debugging programs. After the student acquires the necessary experience to comprehend the underlying principles, he may modify the source, compile, download it to the EB-160 board and verify the modified program for proper operation. He is then prepared to develop his own programs by himself.

Practical experiments use the EB-160 target board to illustrate how the i960 machine instructions can control parallel and serial I/O, timers, interrupts and analog to digital and digital to analog conversion. A troubleshooting exercise shows how to troubleshoot an embedded microprocessor system with a diagnostic program. An expansion bus connector enables the students to design their own projects to interface with the 80960SA RISC processor. The training system can also be used as a student development system to design and test complex computer control projects in industrial automation, process control and data communications.

SPECIFICATIONS

DESCRIPTION

The EB-160 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.The debugger environment
- Connect EB-160 to a PC and verify proper operation
- Examine CPU registers
- Examine memory locations
- Modify memory contents
- Load and execute a simple program

2.Download and debug a program
- Compile and link a test program
- Start the debugger and download the test program
- Learn the basic debugger commands
- Inspecting and watching variables
- Setting and using breakpoints
- Single stepping

3.Data movement instructions
- Understand i960 data movement instructions
- Compile and link the test program
- Observe simple register to register transfers
- Observe single-byte, 2-byte, 4-byte and 8-byte register and memory transfers

4.I/O commands with the 8255
- Understand 8255 operation
- Learn how to program the control registers for reading and writing data

5.Arithmetic instructions
- Learn how addition, subtraction, multiplication and division are implemented by the i960

6.Logic and branch instructions
- Learn about various i960 logic instructions
- Learn about compare and conditional branch instructions

7.Understanding sub-routines
- Learn about the basic principles of subroutines
- Analyze the subroutine call in the i960 processor
- Learn about parameter passing

8.Understanding interrupts
- Understand the interrupt mechanism of the i960 CPU
- Program the interrupt structure for an application interrupt program

9.Serial communications
- Understand the concept of serial communications
- Observe a serial asynchronous signal with an oscilloscope
- Understand and observe serial-to-parallel and parallel-to-serial conversion
- Understand and observe the loop back mode of operation

10.Programming the UART
- Understand the internal architecture of the 16240 UART
- Initial various UART registers
- Write a program to change the UART's characteristics via its registers

11.A/D and D/A conversion
- Initialize the devices
- Generate single output voltage and measure them on an oscilloscope
- Measure analog voltage digitally with the A/D device and the debugger

12.Programming the serial D/A
- Understand the internal architecture of the LTC1446 device
- Be able to program the device
- Run a sample program to illustrate the concept

13.8254 programmable timers
- Understand some of the 8254 operating modes
- Learn how to program the 8254 timer
- Program the 8254 to generate square waves in mode 3 and pulse in mode 2
- Count external pulses in mode 0

14.Multitasking
- Understand the concept of multitasking
- Run a sample program and use the debugger to illustrate important concepts

15.Debugging a C program
- Use the debugger to locate and correct a bug in a program

16. Debugging an assembly program
- Use the debugger to locate and correct a bug in a program

17.Troubleshooting with a RISC-embedded system

ACCESSORIES

Required Accessories

- EB-2000 workstation
- EB-160 microprocessor board
- Digital multi meter
- Dual trace oscilloscope
- DL-20 patch cord kit

Cat. No. 9092316010

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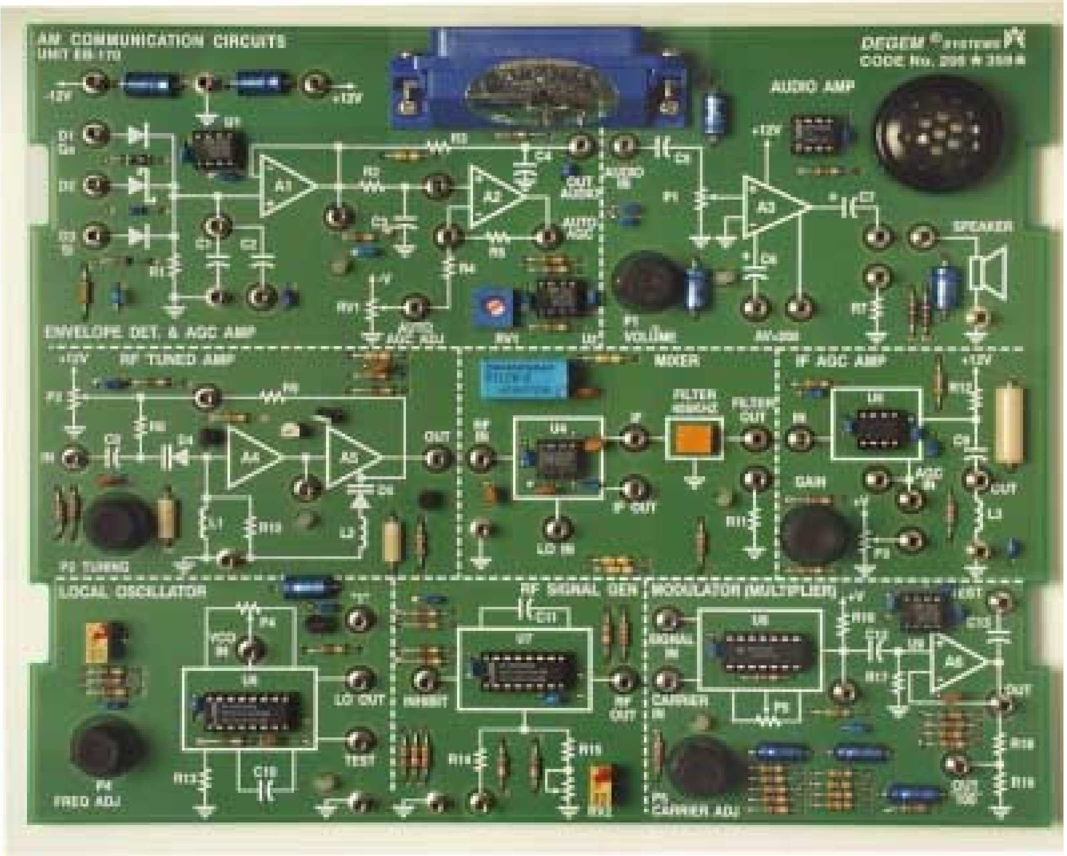
EB-2000

EB-170



The EB-170 AM Communication Circuits board is a comprehensive instructional module designed to teach the fundamental concepts of AM communication circuits and systems to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-170 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Signal sources
- Observe and describe the signal characteristics produced by the radio frequency (RF) signal generator
- Understand the operation of a voltage-controlled oscillator (VCO)
- Observe and describe the shape, amplitude and frequency range of the local oscillator output

2.Amplitude modulation using a multiplier
- Be able to use a multiplier as a modulator
- Measure the modulation level (index) of an AM signal
- Be familiar with sine, triangular and square wave modulating signals
- Determine the bandwidth of the modulating signal for constant, undistorted power
- Understand and observe how the carrier wave is suppressed in double sideband, suppressed carrier(DSB/SC) modulation
- Be able to vary the level of modulation in DSB/SC modulation

3.RF tuned amplifier
- Be familiar with RF tuning using a variable capacitive diode
- Measure the frequency response of an RF tuned amplifier
- Check RF reception selectivity and image rejection

4.IF mixer
- Understand the operation of the intermediate frequency (IF) mixer
- Understand how to calculate the relative IF gains in dB.
- Determine the bandwidth of an IF filter
- Determine the ability of an IF mixer to reject neighboring channels
- Determine the image frequency of an IF mixer
- Understand how the modulating signal frequency affects the level of modulation

5.IF amplifier with automatic gain (AGC) control
- Understand IF amplifier operation
- Check the dependence of IF gain on the AGC voltage
- Determine the relative attenuation in dB for various AGC voltages

6.Envelope detection and AGC amplification
- Understand detector operation for sinusoidal, triangular and square wave modulation
- Check the DC and AC compo-nents of the detector output and their dependence on carrier strength and modulation level
- Understand the effect of the filter time constant on detector operation
- Understand the effect of the diode type on detector fidelity
- Understand the influence of the AGC feedback loop on the envelope detector and AGC amplifier

7.Superheterodyne receiver performance
- Understand the super-heterodyne receiver block diagram
- Adjust the receive to receive a desired signal
- Perform measurements at the various receiver stages
- Check detected signal fidelity
- Check the receiver bandwidth
- Check AGC operation
- Receive local AM broadcast stations
- Troubleshooting a super-heterodyne receiver

8.Troubleshooting a super-heterodyne receiver

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multimeter
- Function generator
- Frequency counter
- Dual trace oscilloscope
- DL-20 patch cord kit

Cat. No. 9092317010

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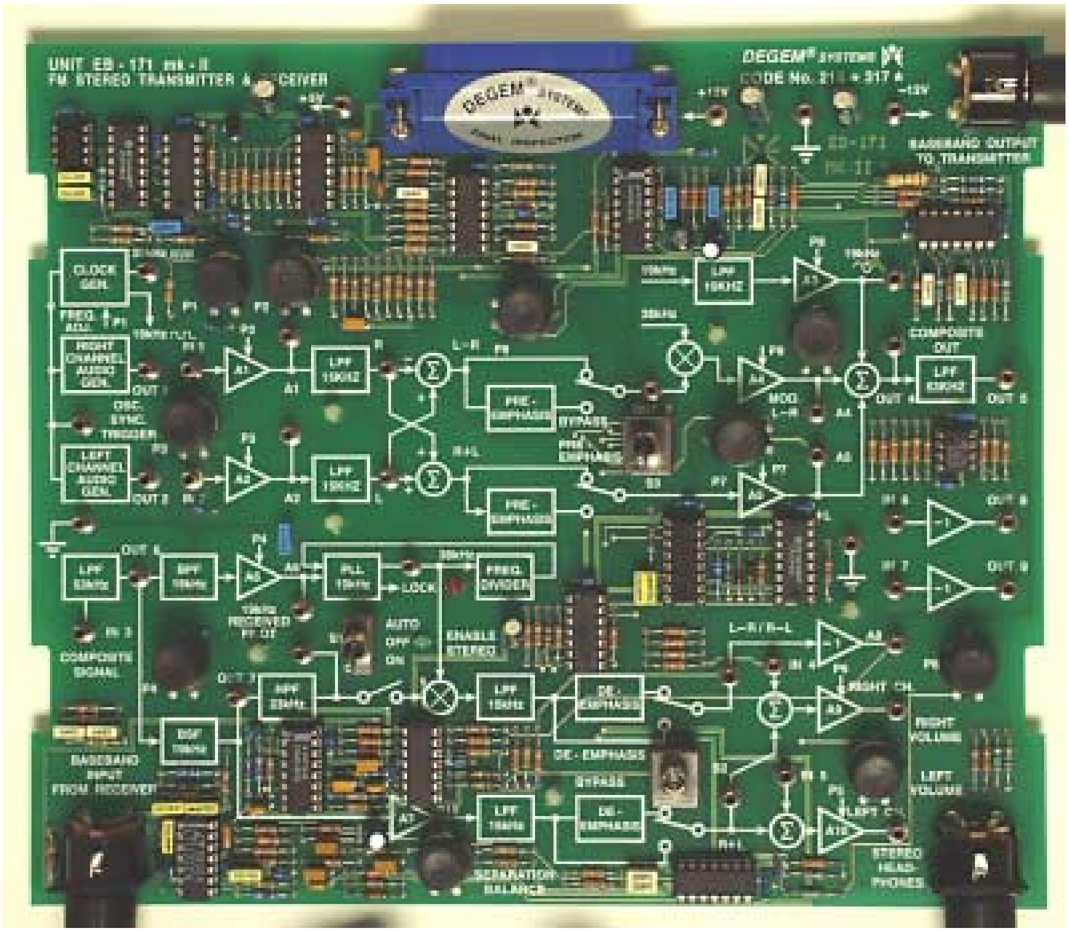
EB-2000

EB-171



The EB-171 Stereo Transmission and Reception Board is a comprehensive instructional module designed to teach the fundamental concepts of FM stereo communication circuits and their application in an FM stereo transmitter and receiver to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-171 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Principles of linear circuits
- Understand the function of the basic stages of an FM transmitter
- Observe the 38 kHz pilot signal
- Observe the right and left audio test signals
- Observe the signals at the other stages of the FM stereo transmitter

2.DSSC modulation
- Understand double sideband suppressed carrier (DSSC) modulation
- Observe the DSSC signal for various levels of right and left audio signals
- Observe the composite stereo signal at the output of the 53 kHz low-pass filter

3.Sub-carrier recovery in the receiver
- Understand how the phase-locked loop synchronizes the 38 kHz pilot
- Determine the capture range and lock range of the PLL
- Observe the effect of pilot signal strength on the capture and lock range

4.DSSC demodulation
- Understand DSSC synchronized operation
- Observe the effect of varying the phase of the recovered pilot signal on stereo signal recovery

5.Stereo separation in the receiver
- Understand how stereo signal is separated into two different channels
- Observe the operation of the stereo separation matrix
- Determine the bandwidth of the recovered right channel signal
- Calculate the cross talk between the two channels

6.FM stereo transmission and reception
- Understand the fundamentals of FM stereo broadcasting
- Understand the function of the pre-emphasis and de-emphasis networks
- Transmit and receive a wireless FM stereo signal
- Receive local, standard FM stereo broadcasts
- Observe effect of the de-emphasis and stereo/mono switches on the recovered stereo signals

7.Troubleshooting the stereo combiner and seperator

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Frequency counter
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM
40 X CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Another Quality Product From:
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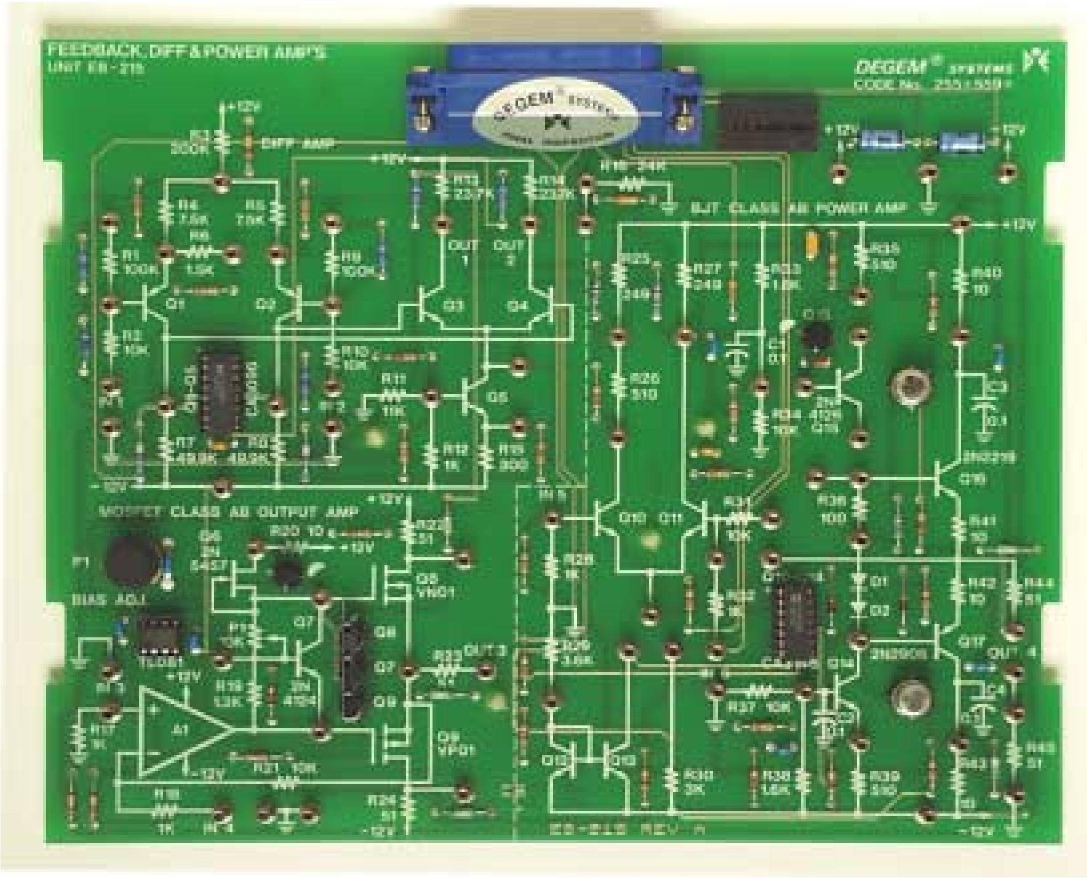
SYSTEMS

EB-2000

EB-215



The EB-215 Feedback, Differential and Power Amplifiers board is a comprehensive instructional module designed to teach the concepts of operational amplifier architecture and power amplifiers to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-215 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. Two-stage differential amplifier
- Know how to measure the circuit bias voltages, circuit gain, common mode gain, output resistance, input resistance and bandwidth
- Observe the effect of feedback on output resistance, input resistance and bandwidth

2. Class AB amplifier with MOSFET output stage
- Know how a class AB amplifier is built
- Know how to measure bias voltages
- Know how to calculate and measure AC voltage gain
- Observe the effect of changing the DC operating point of the MOSFET stage on the output signal

3. Class AB power amplifier with bi-polar transistors
- Know how to measure the DC bias voltages
- Know how to calculate and measure AC voltage gain
- Measure the output resistance

4. Troubleshooting a differential amplifier and a power amplifier

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM, 40 x CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

Cat. No. 9092321510

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EB-2000

EB-216

The EB-216 Oscillators, Filters and Tuned Amplifiers board is a comprehensive instructional module designed to teach the fundamental concepts of radio frequency communications circuits to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-216 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1.Phase shift oscillator

- Know how to measure the output waveform of the oscillator
- Know how to measure the oscillator frequency
- Know how to measure the voltage gain of the positive feedback loop

2.Wien bridge oscillator

- Know how to measure the output waveform of the oscillator
- Know how to measure the oscillator frequency
- Know the effect that the feedback gain has on the output signal

3.Tuned amplifiers

- Know how to plot the frequency response
- Know how to measure the resonant frequency of a tuned amplifier
- Know the amplifier response for a square wave input

4.Oscillators

- Calculate and measure the frequency of a Colpitts oscillator
- Know the effect of supply voltage on the output signal
- Observe the operation of Colpitts oscillator with a crystal
- Know how to convert a tuned amplifier to an oscillator
- Observe the output wave-form of a crystal oscillator.
- Observe crystal oscillator frequency with an LC circuit

5.Switched capacitor filter

- Know how to set up low-pass, band-pass, band-stop and high-pass filter configurations
- Measure the filter frequency response in these four configurations
- Know what the effect of clock input frequency has on the filter performance

6.Troubleshooting RF communication circuits

ACCESSORIES

Required Accessories

- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM, 40 x CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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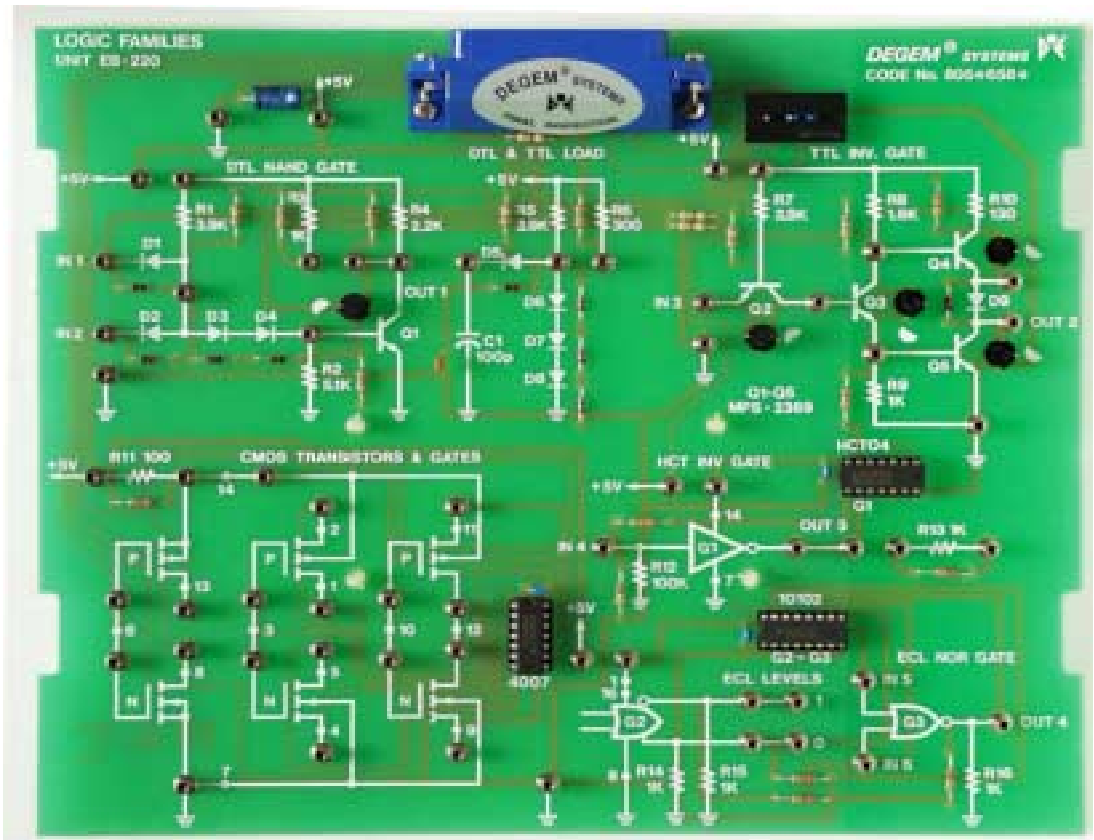
EB-2000

EB-220



The EB-220 Logic Families board is a comprehensive instructional module designed to teach the fundamental concepts of various digital logic families and interfacing techniques between them to students in high schools, technical schools and colleges.

The module contains various practical circuits with which the student can perform a number of meaningful experiments, which help reinforce the student's comprehension of the related concepts. The individual circuits and the required test equipment can be quickly wired by connecting the 2-mm jacks associated with the necessary points. Students perform a minimal amount of wiring, thereby increasing the time available for training. Randomly inserted faults modify the circuits under test to provide valuable true-to-life troubleshooting exercises, which develop diagnostic skills.

A comprehensive student experiment manual clearly details the experiment procedure. An optional theory manual provides the necessary theory to help students achieve the experiment objectives. Optional Windows-based, graphics courseware enhances the learning procedure by providing the essential background theory, testing the student's level of competence, providing detailed experiment procedures, evaluating all measurements and answers to questions and testing the student's level of achievement at the end of the experiment. The student may learn in the standalone mode or under CML (Computer Managed Laboratory), which allows the instructor to monitor student and class progress and records pertinent records in a database for future retrieval.

SPECIFICATIONS

DESCRIPTION

The EB-220 printed circuit board is designed to minimize circuit wiring time when setting up experiments. The board dimensions are 234.5 x 200 mm and may be powered by either PU-2000 or PUZ-2000 base units. All components are mounted on the printed circuit board and the schematic diagrams of all circuits are silk-screened to help the student identify components and system operation. The board is provided with plastic standoff protectors to protect the bottom side of the board, which is solder-masked. All major signals can be accessed from the 2-mm jacks to simplify connections within the circuit and to test equipment. All integrated circuits and transistors are mounted on sockets. The printed circuit board can be stored in the supplied plastic binder for convenient storage.

EXPERIMENTS COVERED

1. CMOS logic gates
- Know how to construct CMOS NAND and NOR inverter gates
- Measure various CMOS family characteristics for various load conditions
- Observe the operation of a CMOS inverter

2. DTL NAND gates
- Know how a DTL NAND circuit works
- Measure various DTL family DC and AC characteristics
- Observe the effect of loading the output

3. TTL inverter gate
- Know how a TTL inverter circuit works
- Measure various TTL family DC and AC characteristics
- Observe the effect of loading the output

4. ECL NOR gate
- Know how to read the data sheet for the NOR gate
- Measure the current drain and output voltages

5. Combining different logic families
- Know how to drive a TTL load from a CMOS inverter
- Know how to drive CMOS gates from a TTL inverter

6. Troubleshoot a digital logic system that consists of various families

ACCESSORIES

Required Accessories
- EB-2000 workstation
- Digital multi meter
- Function generator
- Dual trace oscilloscope
- DL-20 patch cord kit

COMPUTER MINIMUM CONFIGURATION

Pentium II 350MHz with:
64 MB RAM, 40 x CD
COM1 or COM2 port
SVGA card with 8 Mbytes
Operating System: Windows 95/98/NT/2000/XP
Microsoft Internet Explorer 5 or 6

INSTRUCTIONAL MATERIALS

Pedagogical experts who train technicians in electronics technology wrote the courseware and experiments.

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