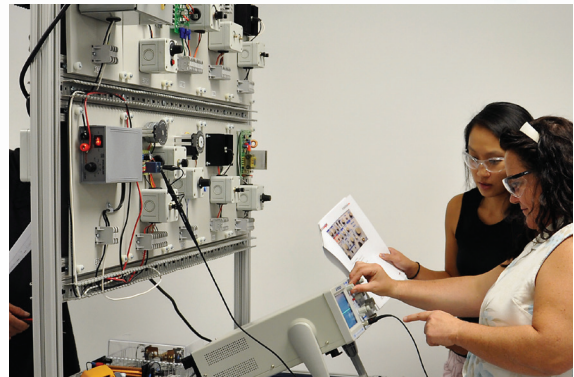


# Industrial Power Electronics

The JobMaster® Industrial Maintenance and Mechatronics Training teaches the specialized skills required for today's industrial technicians.

JobMaster provides a superior blended learning solution for automated manufacturing training by combining industrial-grade components with engaging e-learning content.

JobMaster courses are entirely skill-based, consisting of individual exercises that reproduce essential tasks performed by maintenance technicians, equipment operators, and machine repairmen.



## Course List

### Oscilloscope

Oscilloscope guides students through hands-on activities using industrial-grade test equipment.

#### Course Outline

- Reading the Oscilloscope Screen
- Identifying Oscilloscope Controls
- Setting Up and Operating the Oscilloscope
- Adjusting Probe Compensation
- Performing AC Voltage Calculations
- Measuring AC Voltage and Frequency
- Performing DC Voltage Calculations
- Measuring DC Voltage

#### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Materials Included

Oscilloscope, LearnMate course, Lab  
Teachers' Guide

#### (2) Flexponent™ panels:

- ◇ Panel E087 Adjustable Power Supply
- ◇ Panel E153 AC/DC Circuit

Oscilloscope (BK Precision Model 2120B or equivalent)

#### Hardware Specifications

##### ■ Panel E087: Adjustable Power Supply

- ◇ Panel type: Single
- ◇ 1 Adjustable power supply, 3-12V @ 2A

##### ■ Panel E153: AC/DC Circuit

- ◇ Panel type: Single
- ◇ 1 Transformer, 24v output, 40 VA rating
- ◇ 1 Encapsulated solar cell, 0.45V/200mA
- ◇ 1 Bridge rectifier, 4A, 50PIV
- ◇ 1 Candelabra socket
- ◇ 1 Lightbulb, 24Vs
- ◇ Oscilloscope
- ◇ 30 MHz dual trace
- ◇ Dual or single trace operation
- ◇ 5 mV/div sensitivity
- ◇ Compact low profile

### Digital Multimeter

Using an industrial grade digital multimeter as well as components on the two included Flexponent™ panels, students gain essential skills in the function and operation of a digital multimeter.

#### Course Outline

- Digital Multimeter Safety
- DMM Controls and Features
- Locating & Reading DMM Icons & Symbols
- Reading the Liquid Crystal Display
- Setting Up the DMM for Reading AC Voltage
- Measuring AC Voltage
- Calculating & Converting AC Voltage
- Measuring DC Voltage
- Measuring Resistance
- Discharging a Capacitor
- Measuring Capacitance
- Testing Capacitors
- Measuring Current
- Measuring DC Millivolts
- Performing Continuity Tests
- Testing Grounds & Bonds
- Measuring Frequency

#### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Materials Included

Oscilloscope, LearnMate course, Lab  
Digital Multimeter

Teachers' Guide

Digital Multimeter (Fluke Model 115 or equivalent)

#### (2) Flexponent™ panels:

- ◇ Panel E052: Resistors
- ◇ Panel E055: Filters/Capacitors

### Hardware Specifications

#### ■ Digital Multimeter

- ◇ True-rms
- ◇ CAT III 600 V safety rated
- ◇ AC/DC volts, millivolts, amps
- ◇ Continuity
- ◇ Resistance
- ◇ Diode Test
- ◇ Capacitance
- ◇ Hz (V or A input)

#### ■ Panel E052: Resistors

- ◇ Panel type: Single
- ◇ 2 Composition, 470Kohm, 10%, 2W, ceramic
- ◇ 1 Ceramic power resistor 180ohm, 5%, 5W
- ◇ 1 Ceramic power resistor 330ohm, 5%, 5W
- ◇ 1 Ceramic power resistor 470ohm, 5%, 5W
- ◇ 1 Ceramic power resistor 680ohm, 5%, 10W
- ◇ 1 Ceramic power resistor 900ohm, 5%, 8W
- ◇ 1 Ceramic power resistor 1.2Kohm, 5%, 5W
- ◇ 1 Ceramic power resistor 2.7Kohm, 5%, 10W
- ◇ 1 Ceramic power resistor 3.3Kohm, 5%, 5W
- ◇ 1 Ceramic power resistor 6Kohm, 5%, 5W
- ◇ 1 Ceramic power resistor 10Kohm, 5%, 5W
- ◇ 1 47ohm resistor

#### ■ Panel E055: Filters/Capacitors

- ◇ Panel type: Single
- ◇ 1 Capacitor, 2.2Uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 10uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 22uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 100uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 220uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 470uf, 50V, axial, aluminum
- ◇ 2 Capacitor, 1000uf, 50V, axial, aluminum
- ◇ 1 Capacitor, 150uf, 10V, axial, aluminum
- ◇ 1 Inductor, high current, 27uH, 10%, 4.8A, Axial

## Industrial Power Electronics (continued)

### Hand-held Digital Oscilloscope

Hand-held Digital Oscilloscope covers eight skills including identifying oscilloscope controls, performing AC voltage calculations, and measuring frequency.

#### Course Outline

- Reading the Oscilloscope Screen
- Identifying and Using Oscilloscope Controls
- Setting Up and Operating the Oscilloscope
- Performing AC Voltage Calculations
- Measuring AC Voltage and Frequency
- Performing DC Voltage Calculations
- Measuring DC Voltage
- Storing and Recalling Screen Displays

#### Materials Required (sold separately)

JobMaster® Learning Station  
Power Control Panel (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Materials Included

Hand-held Digital Oscilloscope, LearnMate course, Lab

Teachers' Guide

(2) Flexponent™ panels:

- ◇ Panel E087: Adjustable Power Supply
- ◇ Panel E153: AC/DC Circuit

Hand-held Digital Oscilloscope

#### Hardware Specifications

- **Panel E087: Adjustable Power Supply**
  - ◇ Panel type: Single
  - ◇ 1 Adjustable power supply, 3-12V @ 2A
- **Panel E153: AC/DC Circuit**
  - ◇ Panel type: Single
  - ◇ 1 Transformer, 24v output, 40 VA rating
  - ◇ 1 Encapsulated solar cell, 0.45V/200mA
  - ◇ 1 Bridge rectifier, 4A, 50PIV
  - ◇ 1 Candelabra socket
  - ◇ 1 Lightbulb, 24Vs
- **Hand-held Digital Oscilloscope**
  - ◇ 5MHz Bandwidth
  - ◇ 25MS/s (dual channel); 50MS/s (single channel) max. sample rate per channel
  - ◇ 512 single shot; 256 all other modes record length
  - ◇ Single shot, roll, normal sample mode
  - ◇ 50mV max vertical sensitivity
  - ◇ 600V DC or AC rms max input voltage
  - ◇ Auto, normal, single trigger modes
  - ◇ Channel A, B, external trigger source
  - ◇ AC, DC trigger coupling
  - ◇ 1µS to 5S timebase
  - ◇ 1MΩ input impedance
  - ◇ Compact low profile

### DC Power Supplies

DC Power Supplies delivers hands-on skills in operating industrial-grade bridge rectifiers, transformers and test equipment.

#### Course Outline

- Drawing a Power Supply Block Diagram
- Drawing Schematic Symbols
- Testing a Transformer
- Locating Diodes and Symbols
- Testing a Diode
- Drawing a Half-Wave Rectifier
- Connecting and Operating a Half-Wave DC Power Supply
- Drawing a Full-Wave Rectifier
- Connecting and Operating a Full-Wave Rectifier
- Drawing a Single-Phase Bridge Rectifier
- Connecting and Operating a Single-Phase Bridge Rectifier

#### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Prerequisite Courses

Digital Multimeter

#### Materials Included

DC Power Supplies, LearnMate course, Lab  
Teachers' Guide

(3) Flexponent™ panels:

- ◇ Panel E039: Single-Phase Bridge Rectifier
- ◇ Panel E061: Low-voltage Transformer
- ◇ Panel E062: Diode Rectifiers

#### Hardware Specifications

- **Panel E039: Single-Phase Bridge Rectifier**
  - ◇ Panel type: Single
  - ◇ 1 Bridge rectifier, 25A, 200V
  - ◇ 1 Heatsink, TO-3, 76.2mm
  - ◇ 2 Fault switch, 4A, 250V, push-on/push-off momentary
- **Panel E061: Low-voltage Transformer**
  - ◇ Panel type: Single
  - ◇ 1 Transformer, bobbin, 115V to 24V, 96A
  - ◇ 1 Midget fuse block, 30A
  - ◇ 1 Fuse, midget, 10A, fast acting
  - ◇ 2 Fault switch, 4A, 250V, push-on/push-off momentary
- **Panel E062: Diode Rectifiers**
  - ◇ Panel type: Single
  - ◇ 2 Recovery rectifier, 16A, 1.23V
  - ◇ 1 Heatsink, TO-3, 76.2mm
  - ◇ 2 Fault switch, 4A, 250V, push-on/push-off momentary

### Single-phase & Three-phase Power Supplies

Single-phase and Three-phase Power Supplies builds on the concepts learned in the prerequisite course: DC Power Supplies.

#### Course Outline

- Drawing Filter Schematic Diagrams
- Connecting and Operating a Power Supply
- Drawing Zener Schematic Symbols
- Connecting and Operating a Zener Diode Voltage Regulator
- Locating an IC Voltage Regulator
- Connecting and Operating a DC Power Supply with an IC Voltage Regulator
- Connecting and Operating a Bleeder Resistor
- Connecting and Operating a Voltage Divider
- Troubleshooting a DC Power Supply
- Confirming 3-Phase Bridge Rectifier Operation
- Testing a Three-Phase Bridge Rectifier
- Connecting and Operating a Three-Phase Bridge Rectifier
- Troubleshooting a Three-Phase Bridge Rectifier

#### Materials Required (sold separately)

JobMaster Learning Station

Power Control Panel (120V)\*

Power Control Panel (220V) 3-Phase

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Prerequisite Courses

DC Power Supplies

#### Materials Included

Single-phase and Three-phase Power Supplies, LearnMate course, Lab

Teachers' Guide

(3) Flexponent™ panels:

- ◇ Panel E049: Zener Diode
- ◇ Panel E050: Regulated Power Supply
- ◇ Panel E053: Three-Phase Bridge Rectifier

#### Hardware Specifications

- **Panel E049: Zener Diode**
  - ◇ Panel type: Single
  - ◇ 1 Zener diode, 15V, 170mA
  - ◇ 1 Heatsink, TO-3, 76.2mm
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary
- **Panel E050: Regulated Power Supply**
  - ◇ Panel type: Single
  - ◇ 1 Adjustable voltage power supply
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary
- **Panel E053: Three-Phase Bridge Rectifier**
  - ◇ Panel type: Single
  - ◇ 1 Bridge rectifier, 3P, 1200V, 60A
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary

## Thyristor Electric Motor Drives

Thyristor Electric Motor Drives brings students in contact with the same industrial-grade components used in industrial electric motor drives.

### Course Outline

- Locating an SCR & Drawing the Schematic Symbol
- Testing an SCR
- Connecting and Operating an SCR
- Confirming Full-Wave SCR Control
- Connecting and Operating a Full-Wave SCR DC Motor Drive
- Troubleshooting a Full-Wave SCR DC Motor Drive
- Locating the TRIAC & Drawing the TRIAC Symbol
- Testing a TRIAC
- Demonstrating TRIAC Control Principles
- Locating a DIAC and Drawing the Schematic Symbol
- Connecting and Operating a DIAC-Controlled TRIAC AC Motor Drive
- Connecting and Operating a Schmitt Trigger-Controlled TRIAC AC Motor Drive
- Troubleshooting a TRIAC Motor Drive
- Demonstrating PWM Principles
- Connecting & Operating a PWM DC Motor Drive

### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

### Prerequisite Courses

Single-phase and Three-phase Power Supplies

### Materials Included

Thyristor Electric Motor Drives, LearnMate course, Lab

Teachers' Guide

(8) Flexponent™ panels:

- ◇ Panel E034: DC Motor
- ◇ Panel E081: SCR
- ◇ Panel E082: Full-Wave SCR Drive
- ◇ Panel E083: TRIAC
- ◇ Panel E084: DIAC Adjustable Resistors
- ◇ Panel E085: TRIAC with Schmidt Trigger
- ◇ Panel E088: Pulse Width Modulation (PWM) Motor Driver
- ◇ Panel E157: Universal AC/DC Motor and PMDC Motor

## Stepper Motor Drives

Stepper Motor Drives delivers hands-on skills using stepper motor systems found in robots, precision linear positioning devices, CNC machines and other devices that provide motion control with calculated accuracy.

### Course Outline

- Identifying Detent Torque
- Confirming Stepper Motor Step Angle
- Demonstrating Stepper Motor Principles
- Confirming Stator Winding Connections
- Demonstrating Unipolar Stepper Motor Drive
- Installing, Connecting and Monitoring a Basic Stepper Motor Drive
- Testing and Troubleshooting a Basic Stepper Motor and Drive

### Hardware Specifications

- **Panel E034: DC Motor**
  - ◇ Panel type: Double
  - ◇ 1 Motor, 90VDC, .13hp
  - ◇ 1 Fault switch: 4A, 250V push-on/push-off momentary
- **Panel E081: SCR**
  - ◇ Panel type: Single
  - ◇ 1 Heatsink, TO-3, 76.2mm
  - ◇ 1 SCR thyristor, 25A
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary
- **Panel E082: Full-Wave SCR Drive**
  - ◇ Panel type: Single
  - ◇ 1 Speed control, DC 115V, SCR
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary
- **Panel E083: TRIAC**
  - ◇ Panel type: Single
  - ◇ 1 Heatsink, TO-3, 76.2mm
  - ◇ 1 TRIAC, 15A, 600V
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary
- **Panel E084: DIAC Adjustable Resistors**
  - ◇ Panel type: Single
  - ◇ 1 DIAC, 36V
  - ◇ 1 Capacitor, 0.1uf, 600VDC, radial, metallized polyester
  - ◇ 1 50K-ohm linear potentiometer 0.125 shaft
  - ◇ 1 500K-ohm linear potentiometer 0.125 shaft
- **Panel E085: TRIAC with Schmidt Trigger**
  - ◇ Panel type: Single
  - ◇ 1 Speed control, TRIAC
  - ◇ 1 Switch, toggle, DPDT, flat lever
- **Panel E088: Pulse Width Modulation (PWM) Motor Driver**
  - ◇ Panel type: Single
  - ◇ 1 Speed control, PWM
- **Panel E157: Universal AC/DC Motor and PMDC Motor**
  - ◇ Panel type: Single
  - ◇ 1 AC/DC motor, 1/15hp, 5000rpm
  - ◇ 1 DC Motor, 12/24V, 1/44hp 12 VDC, 1/18hp 24VDC, 1800rpm 12 VDC, 4300rpm 24 VDC
  - ◇ 2 Fault switch, 4A, 250V push-on/push-off momentary

### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

### Prerequisite Courses

Electronic Timers

### Materials Included

Stepper Motor Drives, LearnMate course, Lab  
Teachers' Guide

(1) Flexponent™ panel:

- ◇ Panel E090: Stepper Motor and Drive

## Electronic Timers

In the Electronic Timers course, students work with industrial-grade timer devices used extensively in time-delay relays, motor drives and digital circuits.

### Course Outline

- Locating Timer Pins
- Verifying a Monostable Timer Circuit
- Connecting and Operating a 555 Timer in Monostable (One-Shot) Mode
- Verifying an Astable Timer Circuit
- Connecting and Operating a 555 Timer in Astable (Multivibrator) Mode
- Verifying a Pulse Train Circuit
- Connecting and Operating an Electronic Pulse Train

### Materials Required (sold separately)

JobMaster Learning Station

Power Control Panel: (120V)\*

Learning Management System (LMS)

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

### Prerequisite Courses

- Thyristor Electric Motor Drives (EB03)

### Materials Included

Electronic Timers, LearnMate course, Lab

Teachers' Guide

(1) Flexponent™ panel:

- ◇ Panel E089: Timers and Triggers

### Hardware Specifications

- **Panel E089: Timers and Triggers**
  - ◇ Panel type: Single
  - ◇ 1 Timer
  - ◇ 1 Potentiometer
  - ◇ 1 NO pushbutton switch

### Hardware Specifications

- **Panel E090: Stepper Motor and Drive**
  - ◇ Panel type: Single
  - ◇ 1 Stepper motor
  - ◇ 1 Stepper drive
  - ◇ 1 NO pushbutton switch
  - ◇ 1 Potentiometer
  - ◇ 1 Dial
  - ◇ 1 IC test clip, 16-position
  - ◇ 2 Fault switch, 4A, 250V, push-on/push-off momentary

## Industrial Power Electronics (continued)

### Servo Motor Drives

Servo Motor Drives guides students through six additional skills with an industrial-grade servo motor and drive mounted on a Flexponent™ panel.

#### Course Outline

- Demonstrating Closed-Loop Servo Motor Control Principles
- Demonstrating Closed-Loop Servo Motor Principles
- Demonstrating Servo System Feedback Device Principles
- Demonstrating Analog and Digital Servo Motor Drive Principles
- Installing, Connecting and Monitoring a Basic Servo Motor Drive
- Testing and Troubleshooting a Basic Servo Motor Drive

#### Materials Required (sold separately)

JobMaster Learning Station  
Power Control Panel: (120V)\*

\* International step-down transformer package (Order #10-PC09-0000) required for international applications.

#### Prerequisite Courses

Stepper Motor Drives

#### Materials Included

Servo Motor Drives, LearnMate course, Lab Teachers' Guide

(1) Flexponent™ panel:

- ◇ Panel E091: Servo Motor and Drive

#### Hardware Specifications

##### ■ Panel E091: Servo Motor and Drive

- ◇ Panel type: Single
- ◇ 1 Servo motor
- ◇ 1 Servo drive
- ◇ 1 NO pushbutton switch
- ◇ 1 Potentiometer
- ◇ 1 Dial
- ◇ 1 IC test clip, 16-position

### Ordering Information

#### Electrical Series Bundles

Oscilloscope	JM-POWR-EB01A
Digital Multimeter	JM-POWR-EB01B
Hand Held Digital Oscilloscope	JM-POWR-EB01C
DC Power Supplies	JM-POWR-EB02A
Single Phase & Three Phase Power Supplies	JM-POWR-EB02B
Thyristor Electric Motor Drives	JM-POWR-EB03
Electronic Timers & Triggers	JM-POWR-EB04
Stepper Motors & Drivers	JM-POWR-EB05
Servo Motor Drives	JM-POWR-EB06
Complete Industrial Power Electronics Series with 2-Sided Bench	JM-POWR-ELEC

#### Electrical Series Hardware

JobMaster® Learning Station	10-LS00-0200
Single phase power control panel 120V	10-PC04-0000
Power Control Panel (220V) 3-Phase	10-PC06-0000
Portable Panel Storage rack	10-PPSU-0001



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