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

[2] Flexponent™ panels:

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

Oscilloscope (BK Precision Model 2120B or equivalent)

**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

**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

**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
### 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
- 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 Light bulb, 24Vs
- **Hand-held Digital Oscilloscope**
  - 5MHz Bandwidth
  - 25MS/s (dual channel), 50MS/s (single channel) max. sample rate per channel
  - 912 single shot; 25s 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 35 lissimbase
  - 1MO 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.

#### Materials Included
- DC Power Supplies, LearnMate course, Lab
- 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, bobbins, 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
  - 1 Bridge 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


#### 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) J-Phase

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

#### Materials Included
- Single-phase and Three-phase Power Supplies, LearnMate course, Lab
- 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
- Confirming Full-Wave SCR Control
- Connecting and Operating a Full-Wave SCR DC Motor Drive
- Locating a DIAC and Drawing the Schematic Symbol
- Verifying a Pulse Train Circuit
- Connecting & Operating a PWM DC Motor Drive
- Panel E157: Universal AC/DC Motor and Drive
- Connecting and Operating a 555 Timer in Monostable Mode
- Locating a DIAC and Drawing the Schematic
- Verifying a Pulse Train Circuit
- Connecting and Operating an Electronic Pulse Train
- Demonstrating PWM Principles
- Panel E090: Stepper Motor and Drive
- Testing and Troubleshooting a Basic Stepper Motor Drive
- Demonstrating Stepper Motor Principles
- Identifying Detent Torque
- Confirming Stepper Motor Step Angle
- Demonstrating Stepper Motor Principles
- Confirming Stepper Motor Brake
- Demonstrating Unipolar Stepper Motor Drive
- Installing, Connecting and Monitoring a Basic Stepper Motor Drive
- Testing and Troubleshooting a Basic Stepper Motor Drive
- 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

Materials Required (sold separately)

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

Hardware Specifications

- Panel E034: DC Motor
  - Panel type: Double
  - 1 Motor, 9V DC, 13hp
  - 1 Fault switch, 4A, 250V push-on/push-off momentary
- Panel E081: SCR
  - Panel type: Single
  - 1 Heatsink, TO-3, 7.6mm
  - 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, 7.6mm
  - 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
- 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, 1/18hp, 12 VDC, 1/18hp 24VDC, 1800rpm 12 VDC, 4300rpm 24 VDC
  - 2 Fault switch, 4A, 250V push-on/push-off momentary

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)

Prerequisite Courses

- Thyristor Electric Motor Drives [EB03]

Hardware Specifications

- Panel E089: Timers and Triggers
  - Panel type: Single
  - 1 Timer
  - 1 Potentiometer
  - 1 N0 pushbutton switch

Materials Included

- Electronic Timers, LearnMate course, Lab Teachers’ Guide
- Panel E089: Timers and Triggers
Industrial Power Electronics [continued]

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
- Panel E091: Servo Motor and Drive

Ordering Information

Electrical Series Bundles

<table>
<thead>
<tr>
<th>Product</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope</td>
<td>JM-POWR-EB01A</td>
</tr>
<tr>
<td>Digital Multimeter</td>
<td>JM-POWR-EB01B</td>
</tr>
<tr>
<td>Hand Held Digital Oscilloscope</td>
<td>JM-POWR-EB01C</td>
</tr>
<tr>
<td>DC Power Supplies</td>
<td>JM-POWR-EB02A</td>
</tr>
<tr>
<td>Single Phase &amp; Three Phase Power Supplies</td>
<td>JM-POWR-EB02B</td>
</tr>
<tr>
<td>Thyristor Electric Motor Drives</td>
<td>JM-POWR-EB03</td>
</tr>
<tr>
<td>Electronic Timers &amp; Triggers</td>
<td>JM-POWR-EB04</td>
</tr>
<tr>
<td>Stepper Motors &amp; Drivers</td>
<td>JM-POWR-EB05</td>
</tr>
<tr>
<td>Servo Motor Drives</td>
<td>JM-POWR-EB06</td>
</tr>
<tr>
<td>Complete Industrial Power Electronics Series with 2-Sided Bench</td>
<td>JM-POWR-ELEC</td>
</tr>
</tbody>
</table>

Electrical Series Hardware

<table>
<thead>
<tr>
<th>Product</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>JobMaster® Learning Station</td>
<td>10-LS00-0200</td>
</tr>
<tr>
<td>Single phase power control panel 120V</td>
<td>10-PC04-0000</td>
</tr>
<tr>
<td>Power Control Panel (220V) 3-Phase</td>
<td>10-PC06-0000</td>
</tr>
<tr>
<td>Portable Panel Storage rack</td>
<td>10-PPSU-0001</td>
</tr>
</tbody>
</table>

Materials Required (sold separately)
- JobMaster Learning Station
- Power Control Panel: (120V)*

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

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

Materials Required (sold separately)
- Panel E091: Servo Motor and Drive

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
- Panel E091: Servo Motor and Drive

Ordering Information

Electrical Series Bundles

<table>
<thead>
<tr>
<th>Product</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope</td>
<td>JM-POWR-EB01A</td>
</tr>
<tr>
<td>Digital Multimeter</td>
<td>JM-POWR-EB01B</td>
</tr>
<tr>
<td>Hand Held Digital Oscilloscope</td>
<td>JM-POWR-EB01C</td>
</tr>
<tr>
<td>DC Power Supplies</td>
<td>JM-POWR-EB02A</td>
</tr>
<tr>
<td>Single Phase &amp; Three Phase Power Supplies</td>
<td>JM-POWR-EB02B</td>
</tr>
<tr>
<td>Thyristor Electric Motor Drives</td>
<td>JM-POWR-EB03</td>
</tr>
<tr>
<td>Electronic Timers &amp; Triggers</td>
<td>JM-POWR-EB04</td>
</tr>
<tr>
<td>Stepper Motors &amp; Drivers</td>
<td>JM-POWR-EB05</td>
</tr>
<tr>
<td>Servo Motor Drives</td>
<td>JM-POWR-EB06</td>
</tr>
<tr>
<td>Complete Industrial Power Electronics Series with 2-Sided Bench</td>
<td>JM-POWR-ELEC</td>
</tr>
</tbody>
</table>

Electrical Series Hardware

<table>
<thead>
<tr>
<th>Product</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>JobMaster® Learning Station</td>
<td>10-LS00-0200</td>
</tr>
<tr>
<td>Single phase power control panel 120V</td>
<td>10-PC04-0000</td>
</tr>
<tr>
<td>Power Control Panel (220V) 3-Phase</td>
<td>10-PC06-0000</td>
</tr>
<tr>
<td>Portable Panel Storage rack</td>
<td>10-PPSU-0001</td>
</tr>
</tbody>
</table>