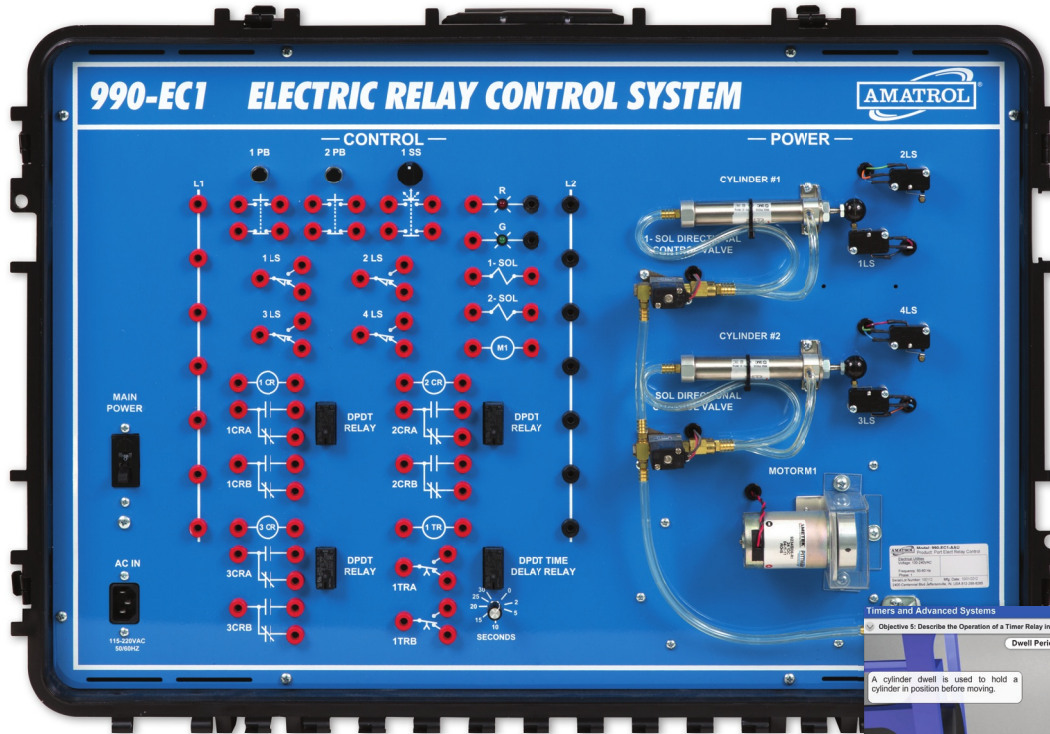
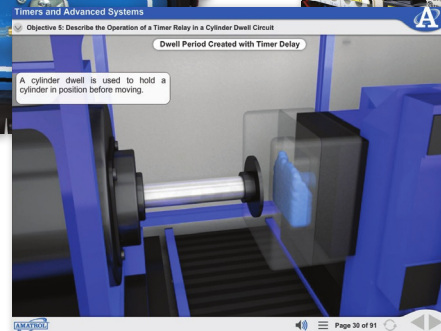
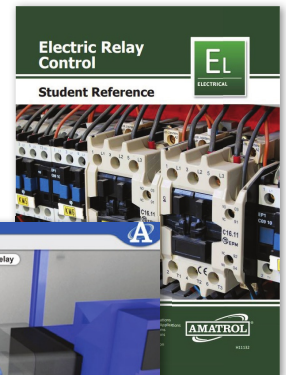


# Portable Electric Relay Control Learning System

990-EC1



990-EC1



Interactive Multimedia and Student Reference Guide

## Learning Topics:

- Control Logic
- Logic Elements
- Ladder Diagrams
- Electro-Pneumatic Solenoid Valves
- Sequencing Control
- Relay Operation and Applications
- Limit Switch Operation and Applications
- Timers and Advanced Systems
- Time-Delay Relay Operation and Applications
- Multiple Cylinder Control
- Machine Modes of Operation

Amatrol's Portable Electric Relay Control Learning System (990-EC1) teaches electric relay control concepts and hands-on skills in a highly-durable, easily-portable learning system. The world leader in skills-based technical learning systems, only Amatrol combines high-quality, real-world components with in-depth, interactive multimedia in a flexible, convenient package.

Widely-used in industrial, commercial, and residential applications to regulate electric motors and fluid power actuators, electric relay control is an important part of other automation systems, such as programmable controllers. The 990-EC1 features an electric relay control panel with pre-mounted electric control, pneumatic, and electric power components. Learners can connect electrical terminals to heavy-duty banana jacks to test various automation control circuits.



## Technical Data

Complete technical specifications available upon request.

### Portable Case

#### Electric Relay Control Panel

- 24V, 6000RPM Motor
- 15MM, 2" Stroke Double-Acting Cylinders (2)
- 4-Way Solenoid Operator Valves (2)
- Limit Switches (4)
- DPDT Relays (3)
- Timer Relay DPDT
- Pushbuttons (2)
- 3-Position Selector Switch
- Indicator Lights (2)

### Power Cord

#### Lead Set, 12" Stackable Banana (25)

#### Multimedia Curriculum (N11132)

#### Instructor's Guide (C11132)

#### Installation Guide (D11132)

#### Student Reference Guide (H11132)

### Additional Requirements:

- Compressed Air Supply (0.5 CFM @ 50 PSIG)
- Computer (Visit [www.amatrol.com/support/computer-requirements](http://www.amatrol.com/support/computer-requirements) for details.)

### Utilities:

- Electricity: 120VAC/60Hz/1 phase or 220VAC/50Hz/1 phase

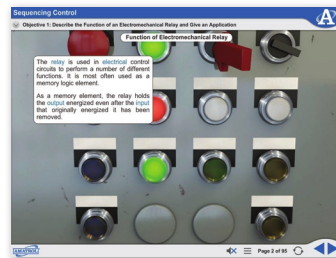
## Study Electric Relay Control and Practice with Real-World Components

Amatrol's Portable Electric Relay Control Learning System teaches the basics of electric relay control, from the elements of control logic to more advanced topics like a timer relay's operation within an unloaded motor start circuit. Learners will apply what they learn by practicing hands-on skills. For example, learners will study how multiple cylinders can be controlled by limit switches and then immediately operate a dual-cylinder control circuit using two limit switches. The combination of theoretical knowledge and hands-on skills solidifies understanding and creates a strong basis for pursuing more advanced skills.



Practice with Real-World Components

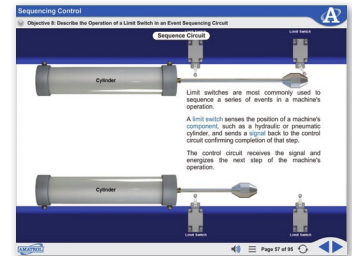
## Learn Electromechanical Relay Operation and Applications



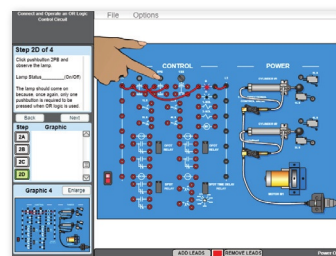
Electromechanical relays, most often used as memory logic elements, make electric relay control possible. Learners will study applications of these vital components, as well as the available styles of control relays and their ladder diagram symbols. The multimedia curriculum also teaches how relays are used to perform control logic, energize a fluid power solenoid, and make a seal-in circuit possible. Learners will then apply what they've learned to perform skills involving relays, such as designing a logic circuit that uses a relay and connecting and operating a relay to perform a seal-in function.

## Engaging, Highly-Interactive Multimedia

Amatrol's curriculum features a highly-interactive, multimedia format that includes stunning 3D graphics and videos, voiceovers of all text, and interactive quizzes and exercises designed to appeal to learners with different learning styles. For example, the 990-EC1's curriculum teaches learners about the operation of limit switches and their application in an event-sequencing circuit. Watching animated graphics of key concepts solidifies concepts in learners' minds.



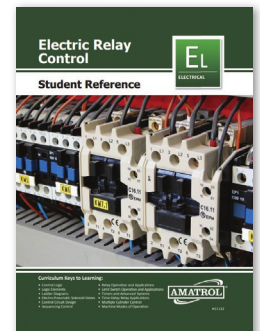
## Virtual Trainer for Online Relay Control Skill-Building



The Portable Electric Relay Control Training System also features a virtual multimedia trainer! Amatrol's virtual trainers replicate hands-on equipment in such great detail that learners will feel like they are using the actual equipment. Learners will perform essentially the same tasks using virtual trainers that they would perform using equipment hardware. Transition from theory to hands-on is a seamless process.

## Student Reference Guide

A sample copy of the Electric Relay Control Student Reference Guide is also included with the system for your evaluation. Sourced from the system's curriculum, the Student Reference Guide takes the entire series' technical content contained in the learning objectives and combines them into one perfectly-bound book. Student Reference Guides supplement this course by providing a condensed, inexpensive reference tool that learners will find invaluable once they finish their training, making it the perfect course takeaway.



## **PORTABLE ELECTRICAL RELAY CONTROL LEARNING SYSTEM**

This learning system is designed to teach modern electrical relay operations, skills, and applications used in industry today. It shall include a mobile carrying case, electrical relay control training panel, control components, lead set, power supply, student curriculum and teacher's assessment guide. The minimum requirements include:

### **Workstation**

- Mobile Carrying Case: 29.5-in W x 20.5-in H x 12-in D
- Workstation Mounting Panel

### **Control Components**

Each component's terminals shall be wired to plug-in jacks on the front of the panel, which are overlaid with a silk-screened schematic symbol of the component. The pneumatic and electrical components shall be arranged in such a manner to enable automated control circuits to be connected and operated. The components shall include the items listed below.

- DPDT relays (3)
- Timer relay DPDT
- Pushbuttons (2)
- Selector switch, 3-position
- Double-acting cylinders, 15 MM, 2-in stroke (2)
- Limit switches (4)
- Solenoid operator valves, 4-way (2)
- Indicator lights (2)

### **Lead Set**

A set of (25) stackable electrical connecting leads shall be supplied to enable circuits to be connected.

### **Power Supply**

A 24VDC 2.4AMP power supply shall be integrated into the base of the Electrical Relay Control Trainer, which provides power to all components on the trainer.

### **Student Curriculum**

Shall include one set of multimedia divided into 3 modules containing at least 31 skills in electrical relay control. The topics shall include: logic elements, ladder diagrams, electro-pneumatic solenoid valves, relay operation, relay application, limit switch operation, limit switch applications, time-delay relays, multiple cylinder control, and machine modes of operation.

The student curriculum shall be designed in a skill-based format that focuses on teaching industry-relevant tasks. The objectives shall be accomplished by organizing the learning material into a series of learning modules, which are further subdivided into three or more segments per module. All learning materials needed shall be contained in the packets including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. The specific cognitive skills taught by each text passage shall be identified next to the passage. Each lab activity shall be identified by the industrial task taught. All activities shall be highly detailed with step-by-step instructions to facilitate a self-directed learning environment. A combination of step-by-step enabling activities and creative, problem-solving activities shall be provided. A self-review of five to ten questions shall be provided after each segment. The curriculum must be capable of both self-directed and instructor directed study. All activities must correlate directly to the hardware supplied, with detailed illustrations and diagrams.

In addition to multimedia curriculum, this learning system includes access to Virtual Trainer skill-building. The student curriculum shall include three (3) interactive multimedia modules with at least thirty-one (31) electrical control industry skills. Major topics include: control logic; sequencing control; timers; and advanced systems. This software shall be provided as a one seat license or in multiples as required.

**Teacher's Assessment Guide**

A teacher's assessment guide shall be provided. It shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and authentic assessment. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment guide shall include directions for authentic skill assessment.

**Certification Alignment**

The 990-EC1 aligns with the SACA C-205 Sensor Logic Systems credential.

**Amatrol Model No. 990-EC1-A or equal**

**990-EC1**  
**PORTABLE ELECTRIC RELAY CONTROL LEARNING SYSTEM**

**MODULE 1    CONTROL LOGIC**

**SEGMENT 1**

OBJECTIVE 1  
OBJECTIVE 2  
OBJECTIVE 3  
SKILL 1  
OBJECTIVE 4  
SKILL 2

**LOGIC ELEMENTS (AND, OR)**

Describe the Function of Relay Control Logic Circuits  
List the Six Elements of Control Logic  
Describe the Function of AND Logic and Give an Application  
Connect and Operate an AND Logic Control Circuit  
Describe the Function of OR Logic and Give an Application  
Connect and Operate an OR Logic Control Circuit

**SEGMENT 2**

OBJECTIVE 5  
SKILL 3  
OBJECTIVE 6  
SKILL 4  
OBJECTIVE 7  
SKILL 5  
OBJECTIVE 8

**LOGIC ELEMENTS (NOT, NOR, NAND)**

Describe the Function of NOT Logic and Give an Application  
Connect and Operate a NOT Logic Control Circuit  
Describe the Function of NOR Logic and Give an Application  
Connect and Operate a NOR Logic Control Circuit  
Describe the Function of NAND Logic and Give an Application  
Connect and Operate a NAND Logic Control Circuit  
Describe the Function of MEMORY Logic and Give an Application

**SEGMENT 3**

OBJECTIVE 9  
Activity 1  
OBJECTIVE 10  
OBJECTIVE 11  
SKILL 6  
SKILL 7  
SKILL 8

**LADDER DIAGRAMS**

Describe the Function of a Ladder Diagram  
Identify the Four Basic Components of a Ladder Diagram  
Describe the Function of the Four Components of a Ladder Diagram  
Explain Five Rules of Drawing a Ladder Diagram  
Read and Interpret the Operation of a Circuit Given a Ladder Diagram  
Connect and Operate a Logic Circuit Given a Ladder Diagram  
Design a Ladder Diagram Using One or More Logic Elements

**SEGMENT 4**

OBJECTIVE 12  
OBJECTIVE 13  
SKILL 9  
  
SKILL 10  
  
Valve

**ELECTRO-PNEUMATIC SOLENOID VALVES**

Describe the Function of a Solenoid-Operated Fluid Power Valve  
Describe the Function of a Power Diagram  
Connect and Operate a Circuit Using a Solenoid Valve Given a Ladder Diagram  
Design a Control Circuit in a Ladder Diagram Format to Operate a Solenoid

**MODULE 2    SEQUENCING CONTROL**

**SEGMENT 1**

OBJECTIVE 1  
  
OBJECTIVE 2  
  
Activity 1  
SKILL 1

**LOGIC ELEMENTS (AND, OR)**

Describe the Function of an Electromechanical Relay and Give an Application  
Describe the Operation of an Electromechanical Relay and Give Its Ladder Diagram Symbol  
Relay Operation  
Read and Interpret a Basic Ladder Diagram with Detached Symbology

**SEGMENT 2**

OBJECTIVE 3

**RELAY APPLICATIONS**

Describe the Operation of a Relay Used to Energize a Fluidpower Valve

	Solenoid
SKILL 2	Connect and Operate a Relay to Energize a Fluidpower Solenoid
OBJECTIVE 4	Describe the Operation of a Relay Performing Control Logic
SKILL 3	Design a Logic Circuit That Uses a Relay
OBJECTIVE 5	Describe the Function and Operation of a Seal-in Circuit
SKILL 4	Connect and Operate a Relay to Perform a Seal-in Function
<b>SEGMENT 3</b>	<b>LIMIT SWITCH OPERATION</b>
OBJECTIVE 6	Describe the Function of a Limit Switch and Give an Application
OBJECTIVE 7	Describe the Operation of a Limit Switch and Give Its Schematic Symbol
Activity 2	Limit Switch Operation
OBJECTIVE 8	Describe the Operation of a Limit Switch in an Event Sequencing Circuit
SKILL 5	Connect and Operate an Event Sequencing Circuit Given a Ladder Diagram
SKILL 6	Design a Logic Circuit That Uses a Limit Switch to Sequence an Event
<b>SEGMENT 4</b>	<b>LIMIT SWITCH APPLICATIONS</b>
OBJECTIVE 9	Describe the Operation of a Limit Switch in a Single-Cycle Cylinder
Reciprocation Circuit	
SKILL 7	Connect and Operate a Single-Cycle Cylinder Reciprocation Circuit
OBJECTIVE 10	Describe the Operation of a Limit Switch in an Event De-energizing Circuit
OBJECTIVE 11	Describe the Operation of a Limit Switch in a Continuous-Cycle
Reciprocation Circuit	
SKILL 8	Connect and Operate a Continuous-Cycle Cylinder Reciprocation Circuit
OBJECTIVE 12	Describe the Operation of a Safety Interlock Circuit
SKILL 9	Design a Continuous-Cycle Cylinder Reciprocation Circuit with a Safety Interlock

### **MODULE 3 TIMERS AND ADVANCED SYSTEMS**

<b>SEGMENT 1</b>	<b>TIME-DELAY RELAYS</b>
OBJECTIVE 1	Describe the Function of a Time-Delay Relay and Give an Application
OBJECTIVE 2	Describe the Operation of an On-Delay Timer Relay and Give Its Ladder Diagram Symbol
SKILL 1	Connect and Operate a Control Circuit with a Timer Relay
SKILL 2	Design a Time-Driven Traffic Light Circuit
OBJECTIVE 3	Describe the Operation of an Off-Delay Timer Relay and Give Its Schematic Symbol
<b>SEGMENT 2</b>	<b>TIME-DELAY RELAY APPLICATIONS</b>
OBJECTIVE 4	Describe the Operation of a Timer Relay in an Unloaded Motor Start Circuit
SKILL 3	Connect and Operate a Control Circuit to Perform an Unloaded Start of a Motor
OBJECTIVE 5	Describe the Operation of a Timer Relay in a Cylinder Dwell Circuit
SKILL 4	Design a Control Circuit to Perform a Cylinder Dwell
OBJECTIVE 6	Describe the Function of a Time-Delay Relay in Time-Driven Sequencing
SKILL 5	Design a Control Circuit to Perform Time-Driven Sequencing
<b>SEGMENT 3</b>	<b>MULTIPLE CYLINDER CONTROL</b>
OBJECTIVE 7	Describe the Function of Multiple Cylinders in a Machine
OBJECTIVE 8	Describe How Multiple Cylinders Are Controlled Using One Limit Switch and Give an Application

SKILL 6	Design a Dual-Cylinder Sequence Circuit Using One Limit Switch
OBJECTIVE 9	Describe How Multiple Cylinders Are Controlled with Multiple Limit Switches and Give an Application
SKILL 7	Connect and Operate a Dual-Cylinder Control Circuit Using Two Limit Switches
SKILL 8	Design a Continuous-Cycle Multiple-Cylinder Circuit
<b>SEGMENT 4</b>	<b>MACHINE MODES OF OPERATION</b>
OBJECTIVE 10	Describe the Function of Manual and Automatic Modes in Machine Operation
SKILL 9	Connect and Operate a Circuit Having Both Automatic and Manual Modes of Operation
OBJECTIVE 11	Describe Two Applications of Manual Controls
SKILL 10	Connect and Operate a Control Circuit to Simulate a Two-Position Jog Circuit
OBJECTIVE 12	Describe Five Basic Guidelines to Follow When Working with Manual Control Circuits
SKILL 11	Connect and Operate a Two-Pushbutton Jog Circuit That Will Jog Two Cylinders Independently
SKILL 12	Design a Continuous-Cycle, Synchronized Cylinder Circuit with a Manual Mode