# Robotics 1 Learning System

**96-ROB1-A**

AT AUTOMATION

*96-ROB1-A*


*Interactive Multimedia and Student Reference Guide*

## Learning Topics:

- Basic Robot Operation
- Manual Operation
- Homing
- End Effector Operation
- Basic Robot Programming
- Teaching Points
- Movement and End Effector Commands
- Interfacing and Material Handling
- Looping and Speed Commands
- I/O Interfacing
- Material Handling

Amatrol's Robotics 1 Learning System (96-ROB1-A) teaches articulated arm servo robotics and how it's applied in industrial tasks like assembly, material handling, machine tending, gluing, and inspection. This learning system includes 5-axis articulated servo robot arm with a 360 degree work envelope, mobile workstation, industrial controller, and state-of-the-art teach pendant which are used to practice over 140 executable commands using the powerful MCL II language.

The 96-ROB1-A also includes world-class multimedia curriculum covering the major topic areas of basic robot operation, basic robot programming, and interfacing and material handling. Within these topics, learners will study: the operation of homing procedures for a servo robot; commands like grasp, release, and Pmove; applications of robots in material handling; and much more! Amatrol's combination of theoretical knowledge and hands-on practice allows learners to gain both conceptual and practical knowledge, which broadens their competency in robotic applications. This is just one reason why Amatrol is the world-leader in skills-based, interactive technical learning.

AMATROL®

## Technical Data

Complete technical specifications available upon request.

**Pegasus Servo Robot**
- 5-Axis Servo Robot Arm with Electric Servo Gripper
- Motor Cable
- Encoder Cable
- Teach Pendant
- Pegasus Control Software
- Servo Controller
- Power Cord
- Mounting Hardware
- USB Cable

**Flexible Workstation**
- Robotics Workstation
- Controller Mounting Module (2)
- Keyboard / Monitor Mounting Module
- Utilities Distribution Module
- Electrical Power Module
- Compressed Air Distribution Module

**Basic Rectangular Parts Set**
**Parts Feeder**
**Parts Bins (3)**
**Manual Pushbutton**
**Indicator Light**
**Interactive Multimedia Curriculum (MB761)**
**Instructor's Guide (CB761)**
**Installation Guide (DB761)**
**Student Reference Guide (HB761)**
**Additional Requirements:**
- Computer, See requirements: http://www.amatrol.com/support/computer-requirements/

**Utilities:**
- Electricity (120 VAC/60 Hz/1 phase)

## Industrial Quality Pegasus II Robot

The 96-ROB1-A features a powerful, 5-axis Pegasus II articulated servo robot arm with a gripper. This robot features a double-jointed arm that enables it to work on both sides of its work cell and has a 360 degree work envelope, which increases work cell efficiency. The robot also has industrial quality repeatability (0.18mm) due to worm screw drives, high-resolution encoders, infrared homing sensors, and multiple microprocessors. This repeatability supports training of more precise industrial tasks such as assembly.

## Learn Programming Using a Teach Pendant

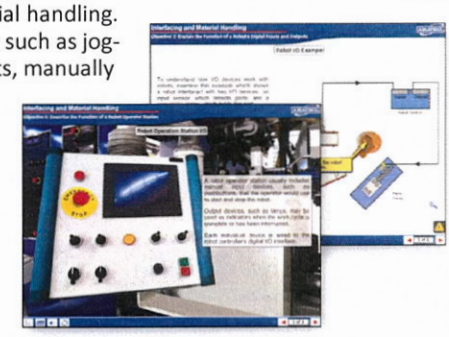
The 96-ROB1-A's teach pendant is a state-of-the-art device that features two-line display, an emergency stop button, jog capability, and four soft keys which allows the robot to take on a variety of functions according to the menu shown on the teach pendant display. This unit becomes a handheld programming terminal, enabling users to enter and edit teach points.

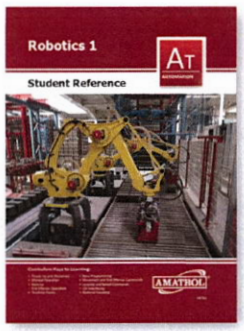
## Robotics Workstation Provides Various Programming Opportunities

The 96-ROB1-A also features a heavy-duty, mobile robotics workstation capable of supporting industrial quality robots, feeders, fixtures and other accessories. The workstation is constructed of heavy-duty welded tube steel and a perforated steel top. The perforated work surface enables fixtures and tooling to be quickly attached and removed, allowing multiple groups to share the use of the robotic workstation.

## Interactive Multimedia Curriculum Brings Robotics Training to Life!

This course's multimedia curriculum covers a vast range of topics related to robot operation and programming. Sample topics inlcude robot homing, teach points, end effector commands, looping and speed control, I/O interfacing, and material handling. Learners will use this information to practice skills such as jogging a servo robot, testing and editing teach points, manually test discrete inputs and outputs, and design a robot program that uses a manual operator station. This world-class multimedia format features vibrant interactive quizzes, 3D animations, videos, and audio voiceovers of all of the text.






## Student Reference Guide

A sample copy of the Robotics 1 Student Reference Guide is also included with the system for your evaluation. Sourced from the system's multimedia curriculum, the Student Reference Guide takes the entire series' technical content contained in the learning objectives and combines them into one perfect-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.

AMATROL®

2400 Centennial Blvd. Jeffersonville, IN 47130 USA 800.264.8285 812.288.8285 www.amatrol.com

**ROBOTICS 1 LEARNING SYSTEM**
This system teaches articulated arm servo robotics and how it's applied in industrial tasks like assembly. This system requires a computer and electricity (120 VAC/60 Hz/1 phase). This system shall include:

**Pegasus II Robot**
Shall include servo robot arm, computer controller, servo gripper, teach pendant, on-line/ off-line programming software and cable set. These components shall meet the minimum specifications listed below.

**Manipulator Arm**
The robot arm shall be of industrial quality with articulated arm-type motion with a minimum of (5) electric drive axes plus gripper. All cables required for connection to controller are included. The computer controller shall be compatible with the robot arm and include at least five (5) axes of control including five (5) axes with closed loop speed, position and acceleration/deceleration programmable. The below minimum specifications shall apply.

- Construction: articulated, double jointed, revolute
- Axes: 5
- Payload: 2.2 lb. (1 kg.)
- Repeatability: +.007 in. (.18 mm)
- Maximum speed: 23.6 inches/second (599.4 mm/sec)
- Actuators: 6 DC servo motors with closed loop control
- Feedback: optical encoders on all axes
- Working envelope:
  - Waist: 345°
  - Shoulder: 220°
  - Elbow: 270°
  - Pitch: 270°
  - Roll: unlimited
  - Maximum reach: 24 inches (609.6 mm)
- Double jointed design with a plan envelope of 360º
- Gripper opening: 3 inches (76.2 mm)
- Transmission: gears, chains, and lead screw
- Homing reference: infrared, high precision sensors on all axes
- Gripper type: servo type with encoder
- Safety covers: metal covers on encoders, covers on all axes

**Controller**
The controller shall be a high performance design contained in a compact enclosure. Indicator lights shall be mounted on the front panel of the enclosure to show controller operating status and discrete I/O status. The controller shall have the minimum specifications listed below.

- Control software that runs on a PC
- Accept commands on the fly from control software running on PC
- Provide feedback to the user via context sensitive screens on PC
- Virtually unlimited storage on PC
- Ethernet communications software via PC
- RS232 communications software via PC
- Additional interface functionality via PC
- Controller type: multiprocessor, real time, pulse width modulated
- Communication: USB 2.0 standard
- Internal visual system status indicators (10)
- Number of servo axes: 8 standard
- Axis control type: high performance PID motion processors that provide trajectory generation and related motion control functions. The system shall consist of high-speed Digital Signal

Processor (DSP) computation units, along with ASIC (Application Specific Integrated Circuit). The PID filter loop shall be capable of operating at 100 microsecond loop cycle time per axis.

- State of the art surface mount technology multi-layer control circuit board
- Motor shall be driven by Power MOSFET UltraFet technology
- Power supplies shall be of a high efficiency switching type capable of running on an international power input 100-240VAC @50/60Hz and shall be short circuit protected.
- Discrete inputs/outputs: 16 inputs that are 300 VDC reverse peak protected and have front panel indicators, 16 outputs that are relay-type and have front panel indicators.
- Discrete I/O interface panel- to include LED for each input/output point and a terminal connection
- Front panel indicators for power, robot enable and drive fault
- User notification of cable disconnect
- User power supply: built-in; 24 VDC, 3 amp with external terminal connections
- Safety features: axis over current protection (without using fuses or circuit breakers)
- Programming language: high level automation/robotic programming language with a minimum of 140+ executable commands
- Coordinates system: Cartesian and joint frame
- Motion Types: linear, circular and point-to-point move commands

**Teach Pendant**

An industrial quality teach pendant shall be supplied which includes a 2 line display, 4 function keys which can assume a large variety of specific functions according to the menu on the display, emergency stop push-button, jog capability, ability to enter and edit teach points, ability to tune servo axes, and perform startup of robot. The teach pendant shall have the ability to jog axes in four modes: joint, compensated joint, tool frame and Cartesian.

**Programming Cable**

A USB cable shall be supplied to enable users to transfer programs from the controller to a personal computer.

**Robot Control Software**

Shall be Windows-based software, which permits users to develop programs either on-line or off-line for the servo robot. Shall include mouse driven functions, program storage, robot startup, virtual teach pendant, full screen program editor, point file storage/display in Cartesian coordinates, real time robot position display in Cartesian coordinates and robot homing. The system shall display Cartesian coordinate commands in metric and English units. Shall include the commands listed below.

- Linear, circular and point-to-point move commands
- X,Y,Z Cartesian, X,Y,Z relative to variable tool plane
- Ability to create variable regional coordinate systems
- Palletizing command set
- Device interrupt, safety interrupt
- Ethernet communications
- Serial communications
- Gripper measurement command
- Multitasking variable sharing between programs
- Math functions
- Data manipulation functions
- Discrete and analog I/O control
- User display screen interaction

**Flexible Workstation Package**

This station shall include: (1) flexible workstation, (2) controller mounting modules; (1) utilities distribution and mounting module, (1) electrical power module and (1) compressed air distribution module. The components shall meet the minimum specifications listed below.

**Flexible Workstation**
This station shall be constructed of 1.5-in (3.81 cm) square steel to be welded and braced. The minimum dimensions shall be 60" (152.4 cm) L x 30" (76.2 cm) H x 32" (81.28) W. The top shall provide a slotted-hole matrix compatible with other system components. Four casters shall be supplied. Mounting holes shall be provided to mount computer shelves, keyboard shelves, monitor shelves, and programmable controller modules. The workstations shall be able to be fastened to one another, both end-to-end and side-to-side to create larger application work surfaces. The workstation surface shall use a minimum of 11-gauge steel which is plated with a protective coating. This surface shall be bolted to the workstation frame so that it can easily be removed. The workstation frame itself shall be primed and painted.

**Controller Mounting Module**
This module shall provide the capability to securely mount various types of controllers including PC compatible computers underneath the workstation. The construction shall use a minimum of 16-gauge pre-formed gauge sheet steel with pre-drilled holes for mounting to the workstation. Holes shall also be provided for coupling modules together in order to mount more controllers. All required bolts and washers shall be included. The minimum dimensions shall be 8.5" H x 19.75" W x 18" L. The module shall be painted.

**Keyboard and Monitor Mounting Module**
This module shall provide mounting of computer keyboard and monitor that can be attached to the workstation through a raised arm that swivels. It shall be designed to quickly and easily hook into the perforated surface of the workstation or detach for storage in the computer-mounting module. The construction shall be pre-formed sheet steel. The module shall be primered and painted.

**Utilities Distribution and Mounting Module**
This module shall be designed to mount underneath any workstation to provide controlled channeling of cables and hoses and to provide mounting of the compressed air, electrical power distribution modules, and power supply. This unit shall be made of high quality 16-gauge sheet steel. It shall be constructed as a channel measuring 9" (22.86 cm) W x 2" (5.08 cm) H x 60" (152.40 cm) L. It shall be painted.

**Electrical Power Module**
This unit shall provide plug-in power connections to devices on a workstation. It shall provide at least six plug-in connections, illuminated power switch, surge protector, circuit breaker, grounded power cord, and mounting panel maximum combined current of all devices shall be at least 15 amperes. The mounting module shall be painted and labeled. It shall be designed to mount to the utilities distribution module.

**Compressed Air Distribution Module**
This module shall provide connections for the compressed air supply lines from various control devices in the work cell including pallet positioners, feeders, vises, chucks, and pallet transfers. This unit shall be designed to mount to the utilities distribution module. This module shall consist of the below components.

- Relieving type pressure regulator
- Pressure gauge
- 8-station control air manifold with quick-connect fittings
- Power air quick-connect for powering a pneumatic robot
- 20' (6.1 m) of air hose for connection to an external supply

**Basic Rectangular Parts Set**

Shall include the below components:

- (9) Aluminum blocks measuring 1 ¼-in on each side to include:
  - (3) Anodized red, machined with a hole straight through block
  - (3) Anodized blue, solid no drilled holes
  - (3) Anodized gold, machined with the hole drilled to a depth of ¾-in

**Parts Feeder**
This shall be able to feed both cylindrical and rectangular parts for use in a robotic tending application. The system should be adjustable in part size, angle of feed, and part positioning. Adjustable guides: 1" to 4"; adjustable slope: 0-40 degrees; mounting legs, 12" feeder length; adjustable height legs, heavy gauge steel construction.

**Parts Bins**
To consist of (3) plastic bins measuring 6-in X 4-in, colored: red, blue, and yellow

**Manual Push Button**
This component is a normally open industrial pushbutton switch used as an input device for the Pegasus robot controller.

**Indicator Light**
This component is an output device that is normally activated by the Pegasus robot controller. It is a 24 VDC red indicator with robot/PLC interface cable.

**Multimedia Curriculum**
The multimedia curriculum supplied shall be designed in a skill-based format that focuses on teaching industry relevant tasks. This curriculum shall be designed for use in a self-directed student-learning environment, which promotes a sense of rapid accomplishment and student motivation. The objectives shall be accomplished by organizing the learning material into a series of multimedia modules, which are further subdivided into three or more segments per module. All learning materials needed shall be contained in the modules including text material, laboratory equipment activities, and multimedia directions. No external text sources shall be required. 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 multimedia curriculum shall consist of three (3) multimedia modules. It shall contain at least 24 industry skills covering topics such as: basic robot operation; manual operation; homing; end effector operation; basic robot programming; teaching points; movement and end effector commands; interfacing and material handling; looping and speed commands; I/O interfacing; and material handling.

**Teacher's Assessment Guide**
The teacher's assessment guide shall contain student data sheets, data sheet solutions, self-review answers, quizzes, quiz answers, student skill record sheets, and assessment directions. The student data sheets shall be designed with data collection blanks to permit students to record data without consuming the learning activity packets. A quiz shall be provided for each packet. A question shall be provided in each quiz for each cognitive objective taught and correlated as such. All tasks listed in the packet shall be listed on personalized student record sheets. The teacher's assessment package shall include methods for both cognitive objective assessment and authentic skills assessment, with all skill assessment criteria explained in detail. Detailed instructions and any supplemental material shall be provided for the teacher to perform live assessment of each student.

**Amatrol Model No. 96-ROB1-A or equal**

# 96-ROB1A
# ROBOTICS 1 LEARNING SYSTEM

## LAP 1 BASIC ROBOT OPERATION

| | |
|---|---|
| **SEGMENT 1** | **POWER UP AND SHUTDOWN** |
| OBJECTIVE 1 | Define a robot and give an application |
| OBJECTIVE 2 | Describe three advantages of robots |
| OBJECTIVE 3 | Describe the five basic robot components |
| Activity 1 | Identification of robot components |
| OBJECTIVE 4 | List eight rules of robot safety |
| OBJECTIVE 5 | Describe the operation of five types of robot safety devices |
| Activity 2 | Pegasus control software component identification |
| SKILL 1 | Power up and shut down servo robot |
| **SEGMENT 2** | **MANUAL OPERATION** |
| OBJECTIVE 6 | Describe six axes of a robot manipulator |
| OBJECTIVE 7 | Describe three types of jog applications |
| OBJECTIVE 8 | Describe the function of a robot teach pendant |
| SKILL 2 | Jog a servo robot using a teach pendant |
| SKILL 3 | Jog a servo robot using the Pegasus control software |
| SKILL 4 | Adjust the fast and slow jog speed settings |
| **SEGMENT 3** | **HOMING** |
| OBJECTIVE 9 | Describe the functions of the four components of a servo robot axis |
| Activity 3 | Identification of robot axis components |
| OBJECTIVE 10 | Describe the function of the homing procedure |
| OBJECTIVE 11 | Describe the operation of the homing procedure for a servo robot |
| SKILL 5 | Home a servo robot |
| **SEGMENT 4** | **END EFFECTOR OPERATION** |
| OBJECTIVE 12 | Describe the functions of two types of end effectors |
| OBJECTIVE 13 | List two types of gripper finger designs and describe their operation |
| SKILL 6 | Manually operate a robot gripper |
| SKILL 7 | Move parts using the manual jog function |

## LAP 2 BASIC ROBOT PROGRAMMING

| | |
|---|---|
| **SEGMENT 1** | **TEACHING POINTS** |
| OBJECTIVE 1 | Describe the function and operation of a robot program |
| OBJECTIVE 2 | Describe how position points are recorded in a robot's memory |
| SKILL 1 | Use a teach pendant to teach robot position points |
| SKILL 2 | Test teach points |
| SKILL 3 | Edit teach points |
| **SEGMENT 2** | **BASIC PROGRAMMING** |
| OBJECTIVE 3 | Describe the function of robot programming software and give an advantage |
| SKILL 4 | Enter and edit a basic robot program |
| OBJECTIVE 4 | Explain four ways to stop a servo robot |
| SKILL 5 | Run a servo robot program |
| SKILL 6 | Stop a servo robot program |

| | |
|---|---|
| **SEGMENT 3** | **MOVEMENT AND END EFFECTOR COMMANDS** |
| OBJECTIVE 5 | Describe the operation of the command: Pmove |
| OBJECTIVE 6 | Describe the operation of a robot program |
| SKILL 7 | Enter a robot program that uses the Pmove command |
| OBJECTIVE 7 | Describe the operation of the program commands: Grasp and Release |
| SKILL 8 | Enter a robot program that uses the Grasp and Release commands |
| SKILL 9 | Design a robot program to perform a basic material handling task |

## LAP 3 INTERFACING AND MATERIAL HANDLING

| | |
|---|---|
| **SEGMENT 1** | **LOOPING AND SPEED COMMANDS** |
| OBJECTIVE 1 | Describe the operation of the commands: Label and Branch |
| SKILL 1 | Enter a robot program that uses the Label and Branch commands |
| OBJECTIVE 2 | Describe the operation of the program commands: Speed and Delay |
| SKILL 2 | Enter a robot program that uses the Speed and Delay commands |
| SKILL 3 | Design a robot program that uses looping, speed and delay commands to move an object |
| **SEGMENT 2** | **I/O INTERFACING** |
| OBJECTIVE 3 | Explain the function of a robot's digital inputs and outputs |
| SKILL 4 | Connect digital input and output devices to a robot controller |
| OBJECTIVE 4 | Describe the function of a robot operator station |
| SKILL 5 | Manually test discrete inputs and outputs |
| OBJECTIVE 5 | Describe the operation of the I/O interface commands: Waiti and Writeo |
| SKILL 6 | Enter a program that has Waiti and Writeo commands |
| SKILL 7 | Design a robot program that uses a manual operator station |
| **SEGMENT 3** | **MATERIAL HANDLING** |
| OBJECTIVE 6 | Describe three applications of robots in material handling |
| OBJECTIVE 7 | Describe how robots are applied to plastic injection molding and list an advantage |
| SKILL 8 | Design a robot program that will unload an automatic machine |