

Electric Actuators and Control Systems

# rotork<sup>®</sup> Process Controls

Established Leaders in Valve Actuation

**AD-9120**

**Instruction Manual**

Publication P972E Issue 08/09

# *AD-9120*

## *Digital Servo Amplifier*

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*Due to wide variations in the terminal numbering of actuator products, actual wiring of this device should follow the print supplied with the unit.*

## INTRODUCTION

Rotork Process Controls, designs, manufactures, and tests its products to meet many national and international standards. For these products to operate within their normal specifications, they must be properly installed and maintained. The following instructions must be followed and integrated with your safety program when installing, using, and maintaining Rotork Process Controls products:

- Read and save all instructions prior to installing, operating, and servicing this product.
- If you do not understand any of the instructions, contact your Rotork Process Controls representative for clarification.
- Follow all warnings, cautions, and instructions marked on, and supplied with, the product.
- Inform and educate personnel in the proper installation, operation, and maintenance of the product.
- Install equipment as specified in Rotork Process Controls installation instructions and per applicable local and national codes. Connect all products to the proper electrical sources.
- To ensure proper performance, use qualified personnel to install, operate, update, tune, and maintain the product.
- When replacement parts are required, ensure that the qualified service technician uses replacement parts specified by Rotork Process Controls. Substitutions may result in fire, electrical shock, other hazards, or improper equipment operation, and will void product warranty.
- Keep all product protective covers in place (except when installing, or when maintenance is being performed by qualified personnel), to prevent electrical shock, personal injury, or damage to the actuator.

### WARNING - SHOCK HAZARD

Installation and servicing must be performed only by qualified personnel.

### WARNING - ELECTROSTATIC DISCHARGE

This electronic control is static-sensitive. To protect the internal components from damage, never touch the printed circuit cards without using electrostatic discharge (ESD) control procedures.

## RECEIVING/INSPECTION

Carefully inspect for shipping damage. Damage to the shipping carton is usually a good indication that it has received rough handling. Report all damage immediately to the freight carrier and Rotork Process Controls. Unpack the product and information packet—taking care to save the shipping carton and packing material should return be necessary. Verify that the items on the packing list or bill of lading agree with your own.

## STORAGE

If the product is not installed immediately, it should be stored in a clean, dry, non-corrosive environment.

## EQUIPMENT RETURN

**A Returned Goods (RG) authorization number** is required to return any equipment for repair. This must be obtained from Rotork Process Controls (414/461-9200). The equipment must be shipped, freight prepaid, to the following address after the RG number is issued:  
Rotork Process Controls  
5607 West Douglas Avenue  
Milwaukee, Wisconsin 53218  
Attn: Service Department

### *To facilitate quick return and handling, include:*

RG Number on outside of box  
Your Company Name, Contact Person, Phone, Fax  
Address  
Repair Purchase Order Number  
Brief description of the problem

## ABBREVIATIONS USED IN THIS MANUAL

AC Alternating Current  
C° Degrees Celsius  
DC Direct Current  
DEC Decrease  
DIP Dual Inline Package (switch)  
F° Degrees Fahrenheit  
Hz Hertz  
IGBT Integrated Gate Bipolar Transistor  
INC Increase  
IPM Intelligent Power Module  
LED Light Emitting Diode  
LOS Loss of Signal  
mA Milliamp  
NC No Connection  
RG Return of Goods  
Vac Volts ac  
Vdc Volts dc

## GENERAL DESCRIPTION

The AD-9120 Digital Servo-Amplifier is designed for integral or remote mount to control appropriate Jordan Controls Actuators. A microprocessor-based control and an IGBT-based intelligent power module (IPM) is used to drive the actuator to perform highly accurate, bidirectional positioning.

The "Rapid Setup" feature allows actuator setup using push-buttons (no potentiometers or jumpers). Self diagnostics and prompts are available through an on-board lighted display.

## ACTUATOR COMPATIBILITY

The AD-9120 Digital Servo Amplifier can be mounted integral to all SM-5000, LA-5000 and LA-2000 Series 90 and 180 Vdc input power actuators, or installed remotely for all other 90 and 180 Vdc power actuators.

## BASIC MODELS

**AD-9120** 120/208/240 Vac, single phase, 50/60 Hz input power designed for integral mounting. \*

**AD-9120-P** Same as above but plate mounted.

**AD-9120-R73** Same as AD-9120, but designed for remote mounting as a retrofit to the older AD-7300 Servo Amplifier.

**AD-9120-E** Same as AD-9120-P inside a 14"x12"x6" NEMA 4 Enclosure

## SPECIFICATIONS

**Power Input:** 120/208/240Vac, +/- 10%, single phase, 50/60 Hz \*

**Power Output:** Up to 90 Vdc/180 Vdc, 15 Amperes Peak

**Command Inputs:** 4-20mA into 200 ohm shunt or 0-10 Vdc into 100k minimum impedance or 0-5 Vdc into 100k minimum impedance

**Position Feedback Signal:** 1000 ohm potentiometer 4-20mA (optional)

**Position Signal Output:** Loop powered, isolated, 2 wire 4-20mA signal. Shows actuator position.

**Other Inputs:** End-of-travel limit switches (from actuator)

Overtorque limits witches (from actuator)

Auto/Manual switch

- Selects between Automatic and Manual mode

Automatic Mode: 4-20mA command input controls actuator position

Manual Mode: Increase and Decrease inputs control actuator position as follows:

Increase (INC)- Commands actuator to increase when in manual mode.

Decrease (DEC)- Commands actuator to decrease when in manual mode.

**Other Outputs:** Form C fault relay output Contact Rating 120 Vac, 2 Amperes

Cycles On Events:

- Loss of 4-20mA signal
- Loss of position feedback signal
- MIN/MAX limit switch reached
- IPM Fault
- Motor stalled condition
- Button noise

LED Indication:

- Power
- Fault

**Ambient Temperature Range:** -40°F to 150°F (-40°C to 65°C)

**Approx. Weights:** AD-9120-P, -R73 or -R2TC: 10 lbs. AD-9120-E: 35 lbs.

\* 208 voltage requires a special board set.

## INSTALLATION WIRING

Most installations locate the servo amplifier inside a Jordan Controls actuator, for ease of mounting and to protect the amplifier. This is the preferred mounting arrangement. For remote mounting, the servo amplifier and actuator should be as close to each other as possible, not exceeding 50 feet of wire lengths.

Ensure all connections are correct and tight before applying power. Power, command signal, feedback signal and motor output are the minimum required connections.

- All wiring must be done in accordance with prevailing codes by qualified personnel.
- Typical wiring diagrams are shown on page 8. ***Due to wide variations in terminal numbering of various actuator products, actual wiring should follow the print supplied with the actuator.***
- Over current protection compatible with motor control must be installed in line power.
- After installation, all conduits *must* be sealed to prevent water damage.
- All low level signal wiring must be shielded type with the shield grounded at source common. Failure to shield these terminations properly may result in improper operation and premature failure.

## OPERATION

### Display

First Character of First Line

A == Automatic mode

M == Manual mode

S == Setup mode

In automatic and manual modes, Line 1 shows position and command in percent of Span – Zero range.

Line 2 provides status, diagnostic or fault information.

### Buttons

**SW1** Reset clears microprocessor registers and restarts control program. Do not press during normal operation. Not required for setup.

**SW2** ↑ (Increase, or INC)

*Manual Mode:* Press and hold to increase actuator position (normally Clockwise or extend)

*Setup Mode:* Cycle through parameters to change. When SPAN, ZERO, or PRESET are selected, ↑ will increase actuator position

**SW3** MODE switches between *Manual Mode* and *Setup Mode*. Aborts a parameter change during setup mode

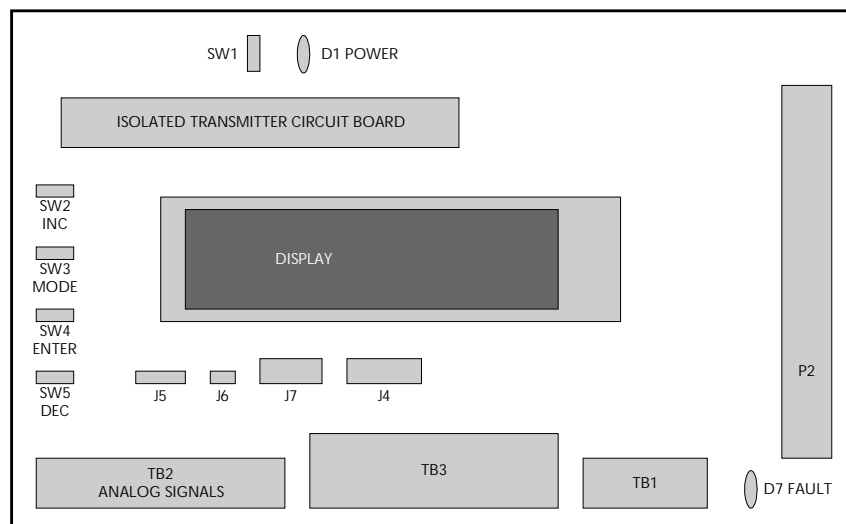
**SW4** ENTER in *Setup Mode* selects which parameter to change, then accepts the new value.

**SW5** ↓ (Decrease, or DEC)

*Manual Mode:* press and hold to decrease actuator position (normally Counter-Clockwise or retract)

*Setup Mode:* Cycle through parameters to change.

When SPAN, ZERO, or PRESET are selected, ↓ will decrease actuator position.



## SETUP AND CALIBRATION

1. Place Actuator's Auto/Man switch to MAN (if supplied), or remove jumper TB3-3 from TB3-4.
2. Press MODE button on EC-10861 once to put into *Setup Mode*.

### ***Span Adjustment***

1. Press ↓ button until SPAN = xxxx appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to move actuator to desired SPAN position.
4. Press ENTER to accept new SPAN position, or press MODE to abort changing SPAN.

### ***Zero Adjustment***

1. Press ↑ or ↓ buttons until ZERO = xxxx appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to move actuator to desired ZERO position.
4. Press ENTER to accept new ZERO position, or press MODE to abort changing ZERO.

### ***Deadband Adjustment***

*Note: Suggested starting deadband value: 1.0*

1. Press ↑ or ↓ buttons until DEADBAND = xx.x appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to change Deadband value. Deadband will increase or decrease by 0.1% with each press of ↑ or ↓.
4. Press ENTER to accept new Deadband, or press MODE to abort changing Deadband.

### ***Maximum Command Calibration***

*Note: The maximum calibration adjusts the amplifier's internal span command level to match the command given at the input terminals during this setup.*

1. Press ↑ or ↓ buttons until the Max CAL = xxxx appears on line 2 of the display.
2. Press the ENTER button.

3. Provide the maximum command for the actuator to terminals TB2-1 (+) and TB2-2 (-) for current command, or terminals TB2-4 (+) and TB2-3 (-) for voltage command. **Note: see command type setting section for more information.**
4. Press ENTER to accept the maximum command calibration, or press MODE to abort the change.

### ***Minimum Command Calibration***

*Note: The minimum calibration adjusts the amplifier's internal zero command level to match the command given at the input terminals during this setup.*

1. Press ↑ or ↓ buttons until the Min CAL = xxxx appears on line 2 of the display.
2. Press the ENTER button.
3. Provide the minimum command for the actuator to terminals TB2-1 (+) and TB2-2 (-) for current command, or terminals TB2-4 (+) and TB2-3 (-) for voltage command. **Note: see command type setting section for more information.**
4. Press ENTER to accept the minimum command calibration, or press MODE to abort the change.

### ***Speed***

*Note: Use speed  $\leq 80$  with SM-5480 actuators.*

1. Press ↑ or ↓ buttons until SPEED = xxxx appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to desired actuator run speed as a percent of maximum (maximum = 100). Each ↑ or ↓ press changes by +/-5.
4. Press ENTER to accept SPEED command calibration, or press MODE to abort changing SPEED.

### ***Input Voltage Selection***

*Note: User must set EC-10832 to proper ac input voltage using SW1*

1. Press ↑ or ↓ buttons until Input Voltage = xxx appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to change Input Voltage between 120, 208 and 240 Vac.
4. Press ENTER to accept new Input Voltage position, or press MODE to abort changing Input Voltage.

### **Motor Rating Selection**

1. Press ↑ or ↓ buttons until Motor Rating = xxx appears on line two of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to change Motor Rating between 90 and 180 Vdc.
4. Press ENTER to accept new Motor Rating position, or press MODE to abort changing Motor Rating.

### **Proportional Gain Constant**

*Note: Suggested starting value:  $KP=4$ .*

1. Press ↑ or ↓ buttons until  $KP = xx$  appears on line 2 of the display.
2. Press ENTER button.
3. Press ↑ or ↓ to change  $KP$  value. Large  $KPs$  increase acceleration, while small  $KPs$  increase the proportional band and decrease oscillations around setpoint.
4. Press ENTER to accept new  $KP$ , or press MODE to abort changing  $KP$ .

### **Command Type Calibration**

*Note: A current command or a voltage command can be used for the control of the actuator. The appropriate type of command must be wired to the terminals, as shown in the typical wiring diagram section of this document.*

1. Press ↑ or ↓ buttons until the Command = xxxxxxxx appears on line 2 of the display.
2. Press the ENTER button.
3. Use the ↑ or ↓ buttons to toggle between Voltage and Current.
4. When the desired command type is selected press ENTER to accept the command type, or press MODE to abort the change.

### **Loss of Signal Action Setup**

*Note: The amplifier can either lock in place or go to a position during the loss of command signal condition. The loss of signal will go into effect when the input command is less than 2.5 % of the minimum command setting, or the input command is 10% greater than the maximum command setting. The loss of signal mode of operation is intended for the current input command, and will not work correctly for the*

*voltage input command when the minimum command setting is less than 0.5 VDC.*

1. Press ↑ or ↓ buttons until the LOS action = xxxx appears on line 2 of the display.
2. Press the ENTER button.
3. Use the ↑ or ↓ buttons to toggle between lock and POS. Lock will cause the actuator to lock in place during a loss of signal condition. POS will cause the actuator to go to the preset position during a loss of signal condition.
4. When the desired command type is selected press ENTER to accept the loss of signal action, or press MODE to abort the change.

### **Loss of Signal Position Setup**

*Note: The loss of signal action must be set to position for this setting. If the loss of signal action is not set to position, the following display screens will not appear to the user.*

1. Press ↑ or ↓ buttons until the LOS POS = xxxx appears on line 2 of the display.
2. Press the ENTER button.
3. Press the ↑ or ↓ buttons to move the actuator to the desired loss of signal position.
4. Press ENTER to accept the new loss of signal position, or press MODE to abort changing the loss of signal position.

### **Save Configuration**

**Any parameter changes must be saved to EEPROM prior to power off. On power up, amplifier will use last saved parameters. Old parameters are lost when new parameters are saved.**

1. Press ↑ or ↓ buttons until Save Parameters appears on line two of the display.
2. Press ENTER to Save Parameters, or press MODE to abort saving parameters.

### **Setup Complete**

1. Press MODE button to return to Manual mode.
2. Place Actuator's Auto/Man switch to Auto (if supplied), or place jumper TB3-3 to TB3-4.

## DIAGNOSTICS

Diagnostics appear on line two of the display. When more than one diagnostic is active, only the highest priority will show.

**Fault: Increase Limit** Torque Limit Switch or End of Travel Limit Switch for the increasing direction is tripped.

*Decrease actuator to move off limit switch.*

**Fault: Decrease Limit** Torque Limit Switch or End of Travel Limit Switch for the decreasing direction is tripped.

*Increase actuator to move off limit switch.*

**Fault: IPM** Power stage has over-current or over-temperature condition and has shut down.

**Fault: Stalled** Actuator is not moving as fast as amplifier expects.

*Momentary stall or IPM faults are sel-resetting. Continuous or repetitive stall or IPM faults indicate an improperly loaded actuator or operation above rated duty cycle. Reduce load or duty cycle.*

**Fault: LOS-Command** Loss of command signal. Command has fallen below approximately 3.6mA, or above 21.6mA

*Return command signal to 4-20 mA range.*

**Fault: LOS-Feedback** Feedback pot has been disconnected, or feedback signal has risen above approximately 4.9 V.

**Fault: Button Noise** Noise detected on buttons and/or switches.

*Occasional button noise has no effect on amplifier performance. excessive button noise faults indicate poor wiring or other noise.*

**Fault: System Failure** Microprocessor has detected a system failure.

*Reset amplifier and consult factory.*

**Status Information** During *Auto* or *Manual* Mode, line two of the display shows status information when there are no FAULTS.

Press ENTER to cycle through the information.

Amp Starts = xxxx Total times the amplifier has been powered up or reset.

Act Starts = xxxx Total times the motor has been started since last power up.

Temp. °C xx Temperature in °C of the amplifier (under the display).

Voltage xxx Absolute value of dc motor voltage.

Current +/- xx.x Motor current.

IPM Faults xx The number of IPM faults that have occurred since the last power up.



# Troubleshooting

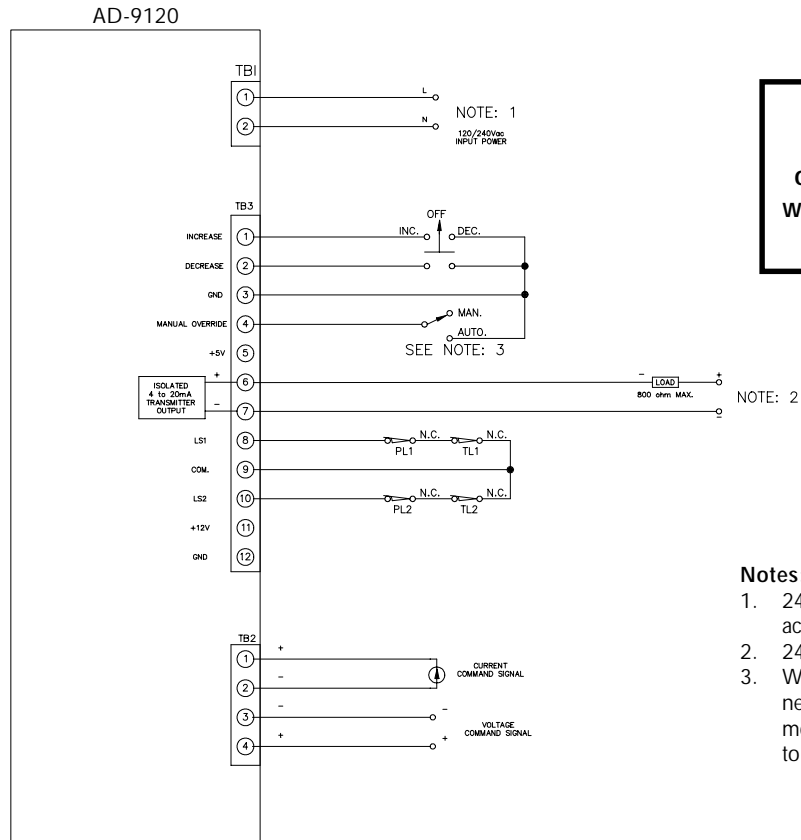
| Trouble                                   | Possible Cause   | Solution   |
|---|--|--|
| Actuator will increase, but not decrease. | LS2 is tripped<br>Actuator is at ZERO (position = 0% +/- deadband)   | Increase actuator to normal operating range.<br>Check LS2 and ZERO setup.  |
| Actuator will decrease, but not increase. | LS1 is tripped<br>Actuator is at SPAN (position = 100% +/- deadband) | Decrease actuator to normal operating range.<br>Check LS1 and SPAN setup.  |
| Actuator will not move                    | No actuator power  | Is LED D1 on? If no, turn off power and re-check electrical connections.   |
|   | Motor is not connected   | Connect motor as shown in wiring diagram.  |
|   | LS1 and LS2 are both tripped   | Verify LS1 and LS2 are set up correctly.   |
| Actuator will not move and LOS-Feedback   | Feedback pot is disconnected   | Check feedback pot connections   |
|   | Actuator position is out of normal operating range.                  | Hand crank actuator to normal operation range.   |
| Nothing shows on the display              | No power to control/logic board                                      | Is LED D1 on? Is 50 pin ribbon cable connected?  |
| Position transmitter output is 0          | No power to transmitter.   | Transmitter is loop powered. See wiring diagram to supply isolated power to transmitter. External wiring is bad. |
|   | Transmitter is defective.  | Replace transmitter.   |
| Position transmitter output is >30mA      | Isolated loop power supply polarity is reversed.                     | Swap transmitter power supply leads.   |
| D7 Fault LED is on                        | A Fault has occurred.  | See Diagnostics on page 6.   |

## Spare Parts List

|   |                   |                |
|---|-------------------|----------------|
| 1 | Driver Board      | 68C-038504-001 |
| 2 | 208 Vac Board Set | 68C-038504-002 |
| 3 | Interface Board   | 68C-038698-001 |
| 4 | Ribbon Cable      | 25A-035285-002 |
| 5 | AC Line Filter    | 74B-038954-003 |
| 6 | Transmitter Board | 68A-038691-001 |

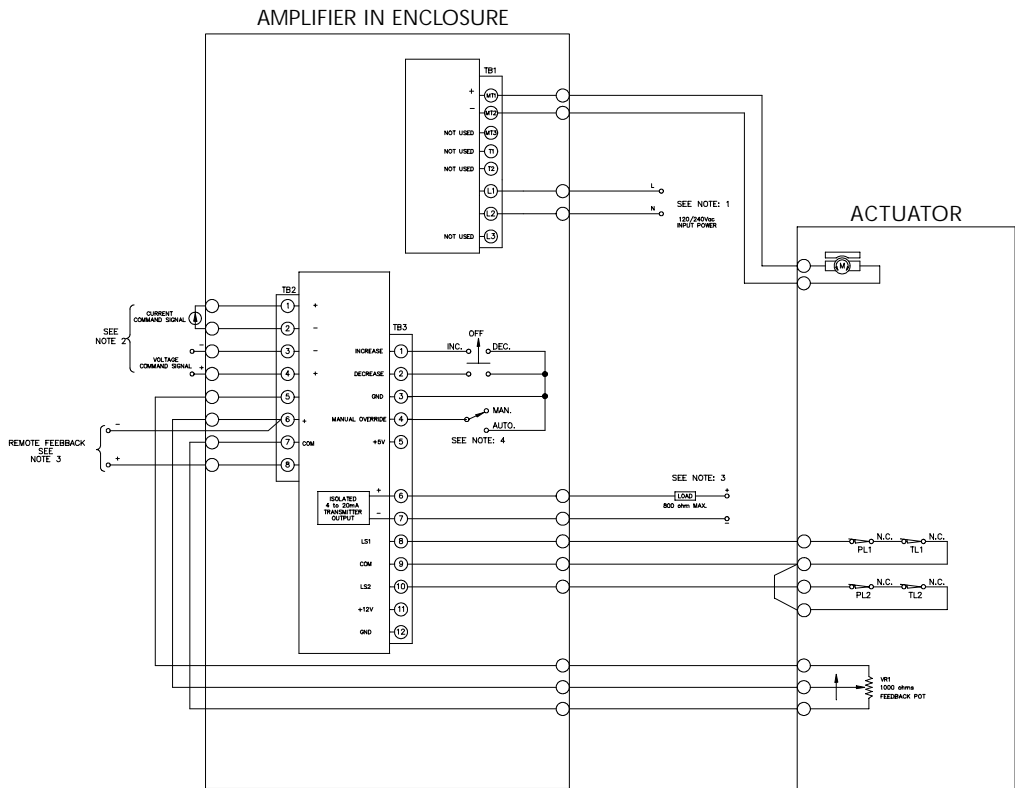
# Typical Wiring Diagrams

## With AD-9120 Integral to Actuator



- Notes:
1. 240 Vac input is required where actuator nameplate voltage is 180 Vdc.
  2. 24 Vdc power supply is required.
  3. When TB3-3 and TB3-4 are connected, actuator will run in automatic mode, which is positioning in response to input command signals.

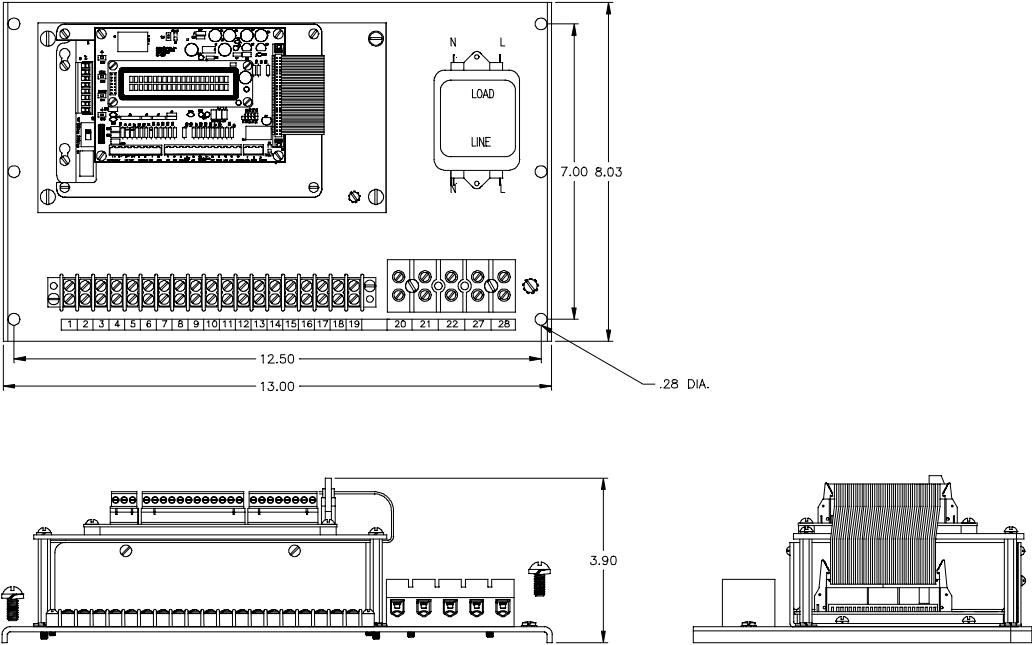
## With AD-9120 Remote from Actuator



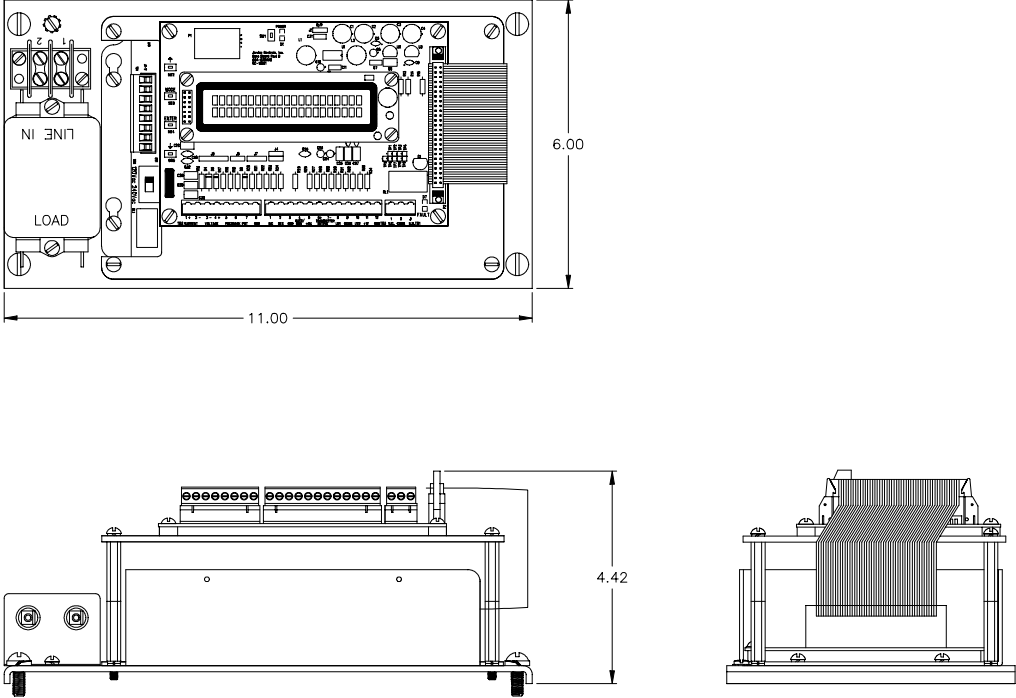
- Notes:
1. 240 Vac input is required where actuator nameplate voltage is 180 Vdc.
  2. For 4-20mA signal to actuator.
  3. 24 Vdc power supply is required.

# Major Dimensions (Remote Mount)

AD-9120-R Panel Style or Retro-fit for AD-7300



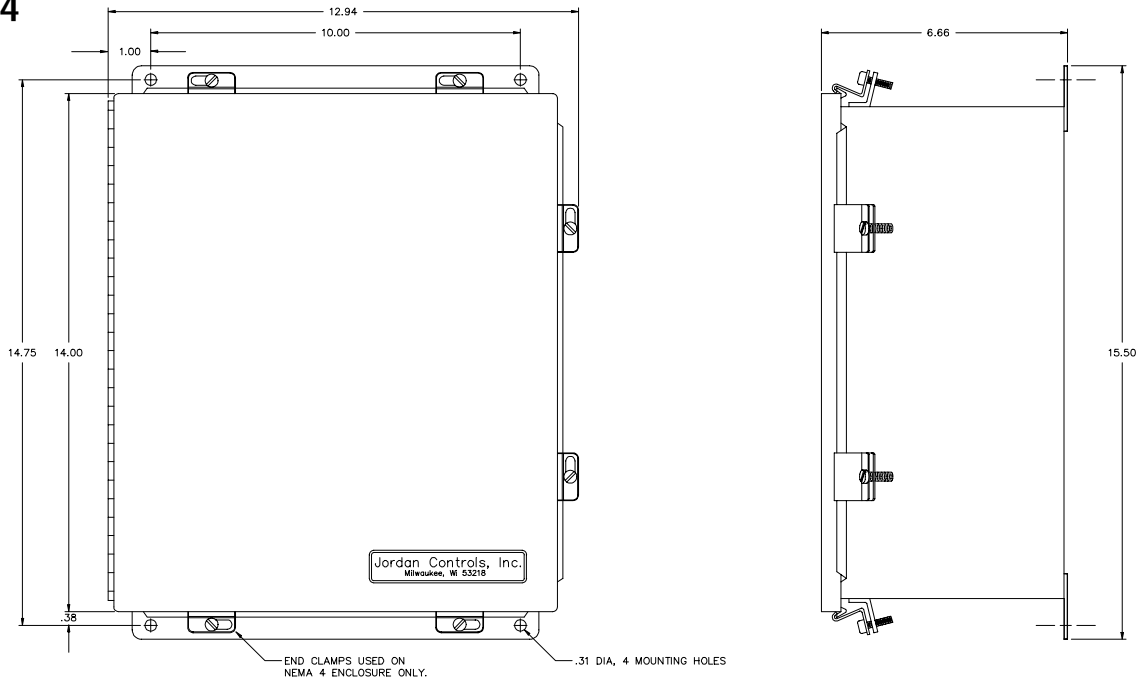
## AD-9120-P Panel Mount



# Major Dimensions (Remote Mount)

AD-9120-E Installed in remote enclosure

NEMA 4



## NOTES:

1. For use when the AD-9120 series amplifier is remotely located. 50 foot wire run maximum between amplifier and actuator.
2. Shielded wiring is **required** with the shield grounded at source common for all low level circuits. This includes command & feedback signals and actuator limit switches.

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### UK

Rotork plc

*tel* +44 (0)1225 733200

*fax* +44 (0)1225 333467

*email* mail@rotork.com

### USA

Rotork Process Controls

*tel* +1 (414) 461 9200

*fax* +1 (414) 461 1024

*email* rpcinfo@rotork.com

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