

# ***SM-1020***

## ***Process Variable Actuator***

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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.*

# GENERAL INFORMATION

## INTRODUCTION

Jordan Controls, Inc., 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 Jordan 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 Jordan 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 Jordan 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 Jordan Controls. Substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.
- 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

Before installing the actuator, make sure that it is suitable for the intended application. If you are unsure of the suitability of this equipment for your installation, consult Jordan Controls prior to proceeding.

## 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 Jordan Controls, Inc.

Unpack the product and information packet—taking care to save the shipping carton and any 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 will not be installed immediately, it should be stored in a clean, dry area where the ambient temperature is not less than -20° F. The actuator should be stored in a non-corrosive environment. The actuator is not sealed to NEMA 4 until the conduit entries are properly connected.

## EQUIPMENT RETURN

**A Returned Goods authorization (RG) number** is required to return any equipment for repair. This must be obtained from Jordan Controls. (Telephone: 414/461-9200) The equipment must be shipped, freight prepaid, to the following address after the RG number is issued:

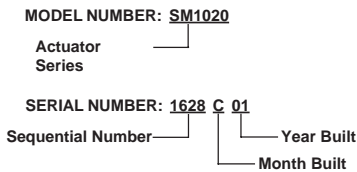
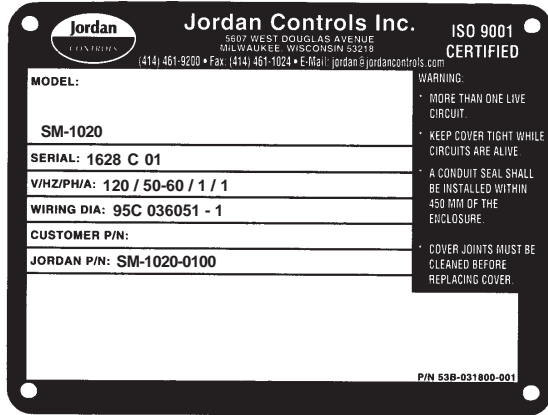
Jordan Controls, Inc.  
5607 West Douglas Avenue  
Milwaukee, Wisconsin 53218  
Attn: Service Department

To facilitate quick return and handling of your equipment, include:  
RG Number on outside of box  
Your Company Name, Contact Person, Phone/Fax No.  
Address  
Repair Purchase Order Number  
Brief description of the problem

# GENERAL INFORMATION

## IDENTIFICATION LABEL

An identification label is attached to each actuator cover. When ordering parts, requesting information or service assistance, provide all of the label information.



## GENERAL ACTUATOR DESCRIPTION

The 1000 Series Actuators are full-featured actuators offered as a standard package with the capability to accept analog current and voltage control signals. The design provides smooth, highly accurate positioning, with positive position-lock when not in motion. These rugged actuators may be mounted in any position and will withstand the most adverse environmental conditions.

The Process Variable Actuator provides a simple and accurate means of controlling a process without the need for external loop controllers. Inside the actuator, a printed circuit board contains all the electronics to operate the actuator and to change its position as needed in response to external sensor input. For instance, a pressure transmitter that can provide an output in 4-20mA units is connected to the actuator. The actuator is then given a setpoint command, either remotely or by the adjustment inside the actuator, which the actuator will control to. When the process is started the actuator will control the process automatically, opening if the pressure gets too low, and closing if it gets too high.

The actuator operates proportionally, finding just the right position to maintain the pressure needed. It allows the valve, or damper, to close more if the pressure gets too low, or open more if the pressure gets too high. The same actuator can be used just as easily to maintain flow, temperature, or other closed-loop processes. Normally, processes that do not require fast actuator response are compatible with a proportional loop controller such as this.

## ABBREVIATIONS USED IN THIS MANUAL

A or Amps	Ampere
ac	Alternating Current
° C	Degrees Celsius
CW	Clockwise
CCW	Counterclockwise
dc	Direct Current
° F	Degrees Fahrenheit
G	Earth Ground
Hz	Hertz
kg	Kilogram
L	Line (power supply)
lbs	Pounds
lbf.	Lbs. Force
LVDT	Linear Variable Differential Transformer
mA	Milliamp
mfd	Microfarad
mm	Millimeters
N	Newton (force)
NEMA	National Electrical Manufacturing Assoc.
Nm	Newton Meter
NPT	National Pipe Thread
Ph	Phase
PL	Position Limit Switch
P/N	Part Number
RPM	Revolutions per Minute
SEC	Second
TL	Thrust Limit Switch
Vac	Volts ac
Vdc	Volts dc
VR	Variable Resistance
W	Watt

## WARRANTY INFORMATION

Warranty: Subject to the following, Jordan expressly warrants the products manufactured by it as meeting the applicable Jordan product specifications and that such products are free from defects in material and workmanship for a period of one (1) year from the date of delivery. The foregoing is the sole and exclusive warranty made by Jordan with respect to the products. Jordan makes no other warranties, either express or implied (including, without limitation, warranties as to merchantability or fitness for a particular purpose). The purchaser retains responsibility for the application and functional adequacy of the offering. See Jordan's General Conditions of Sale - Product, for complete warranty information.

# SM-1020 PROCESS VARIABLE SPECIFICATIONS

**Standard Line Voltage:** 120/240 Vac,  $\pm 10\%$   
(Slide switch selectable)

**Frequency:** 50/60 Hz

**Power:** 18 VA

**Command Signal Inputs:**

*Current:* 4-20 mA

*Voltage:* 0-5 Vdc, 0-10 Vdc

*Incremental:* Dry contact closures, one for each direction

**End of Travel Limit Signals:**

*Internal:* Part of servo control

*External:* Open transistor, low level logic outputs, adjustable over stroke range. 40 Vdc and 40 mA max.

**Intermediate Limit Signals:**

Two 40 Vdc, 1 Amp contacts

**Position Feedback Signal:** Isolated 4-20 mA, loop powered with 12-36 Vdc external power supply

**Field Wiring Terminations:** Barrier terminal block, wire size range 26-14 AWC

**Command Signal Monitor:** (current command only)  
The 1000 series loss-of-signal circuitry monitors the command signal input. If the command signal drops below 3.2 mA or rises above 20.7 mA, the actuator will either lock in place, drive to the low limit position or drive to the high limit position. (DIP switch selectable)

**Current Limit:** Automatic, no adjustments needed

**Speed/Torque:** See curve on page 5

**Rotation:** 90°

**Output Shaft Motion:** All models can go in either direction on an increasing command signal. (DIP switch selectable)

**Weight:** 16 lbs. (7.3 kg)

**Conduit Entry:** Three 1/2 NPT

**Handwheel:** Push to engage, spring return on release (to be used with power off)

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

**Enclosure:** Explosion-proof for Class I, Division 1, Groups C and D; Dust-ignition-proof for Class II, Division 1, Groups E, F, and G. Type 4 (IP65), indoor or outdoor

**Duty Cycle:** Unrestricted modulating duty. (Cont. duty)

**Deadband:** Factory preset to 1% - field adjustable

# SM-1000 SERIES SPEED/TORQUE CURVE

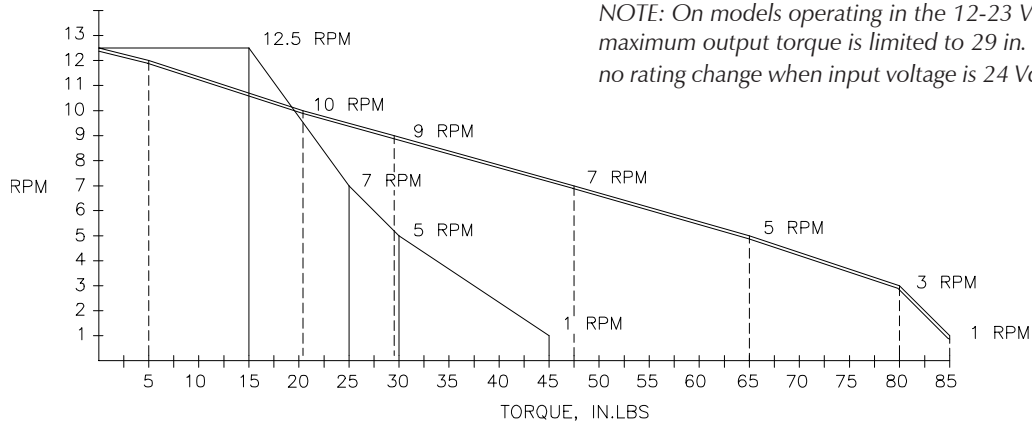
To calculate shift time (total stroke), use this formula:

$$\text{Shift time (sec.)} = \frac{\text{Maximum revolutions for total range} \times 60}{\text{Revolutions per minute}}$$

Example: 90° rotation at 1 rpm,  
80 in. lbs. torque

$$\frac{0.25 \times 60}{1} = 15 \text{ sec.}$$

SM-1015 ————— SM-1020 =====



NOTE: On models operating in the 12-23 Vdc range, maximum output torque is limited to 29 in. lbs. There is no rating change when input voltage is 24 Vdc or greater.

# INSTALLATION WIRING

## GENERAL

All wiring should be done in accordance with prevailing codes by qualified personnel.

Typical wiring diagrams are shown on page 9. Actual wiring should follow the print supplied with the actuator.

**Fusing must be installed in line power, and should be of the slow blow type. Recommend 1 amp for ac input models and 5 amp for dc input models.**

Wiring should be routed to the actuator through one of the 1/2 inch conduit openings. Generally, one conduit will contain input power and earth ground wires. The other conduit would then contain low level input and output signal wiring. It is required that all low level signal wiring be a shielded type with the shield grounded at source common.

After installation, it is required that all conduits be sealed to prevent water damage.

Maximum recommended wire size is 14 AWG, and minimum is 26 AWG.

## WIRING TO TB2

Input power terminates at TB2. For ac models, terminal 1 is hot, and terminal 2 is neutral. For dc models, terminal 1 is positive (+), and terminal 2 is negative (-).

The incoming power supply earth ground should be securely connected to the green ground screw located inside the actuator base between the two conduit entries.

## WIRING TO TB3

Current command (4-20 mA) wires terminate at terminal 3 (-) and to terminal 4 (+). Voltage command (0-5 Vdc or 0-10 Vdc) wiring terminates on terminals 5 (+) and 6 (-).

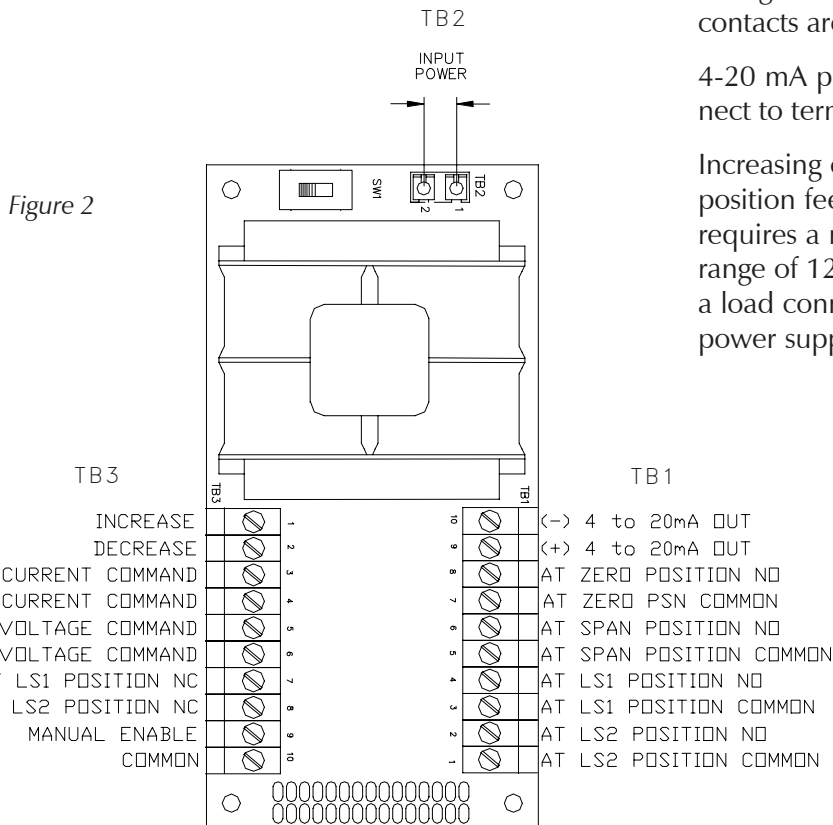
## WIRING TO TB1

If ZERO and SPAN are used as auxiliary position limit switches, the connection is TB1, 5 to 8. Maximum voltage is 40 Vdc and maximum current is 40 mA.

If LS1 and LS2 are used as auxiliary limit switches, the connection can be normally open or normally closed. The NO configuration uses TB1, 1 through 4. The NC configuration uses TB1, 1 & 3 and TB3, 7 & 8. The contacts are rated for 40 Vdc, 1 amp.

4-20 mA process variable feedback signal wires connect to terminals 9 (+) and 10 (-).

Increasing command signal will result in an increasing position feedback signal. Operation of the transmitter requires a regulated external dc power supply in the range of 12 Vdc (minimum) to 36 Vdc (maximum) and a load connected in series with one lead from the power supply. (see typical wiring diagrams on page 9)



# SETUP INFORMATION

## AMPLIFIER SETUP

**WARNING:** *This setup must be done with power off.*

### INPUT POWER

If input power is 120 or 240 Vac, the upper pc board slide switch must be placed in the appropriate position.

**Failure to do this can result in extensive damage.**

Dc powered units do not have this slide switch.

### DIP SWITCH SETTINGS

Refer to table 3, page 7.

#### Switch 1 – Direct or reverse acting selection

- A) For direct action on increasing command signal (output shaft will rotate CW), place Dip switch #1 into the “OFF” position.
- B) For reverse action on increasing command signal (output shaft will rotate CCW), place Dip switch #1 into the “ON” position.

#### Switch 2 & 3 – Loss of signal action

The loss of signal monitors the current command signals only (See switch 2&3 setting). This is active when the input command signal drops below 3.2 mA, or goes above 20.7 mA.

- A) Loss of signal lock in place is active when switch 2 is in the “OFF” position and switch 3 is in the “OFF” position. When a loss of signal condition is present, the actuator will stay in its current position.
- B) Loss of signal go to zero position is active when switch 2 is in the “ON” position and switch 3 is in the “OFF” position. When a loss of signal condition is present, the actuator will move to the preset zero position.
- C) Loss of signal go to span is active when switch 2 is in the “OFF” position and switch 3 is in the “ON” position. When a loss of signal condition is present, the actuator will move to the preset span position.
- D) If both switch 2 and switch 3 are in the “ON” position, then the actuator will lock in place during a loss of signal condition (see point A).

#### Switch 4 – Local operation

The local operation is active when switch 4 is placed in the “ON” position. This mode of operation is used for the setting of the zero, LS1, LS2, and span positions. In the mode of operation the actuator can be jogged using the increase and decrease push buttons located on the lower PC board. The entire range of motion of the actuator can be moved in this mode of operation, regardless of the zero and span settings.

#### Switch 5 – 0 to 5 volt command

This switch is used in conjunction with switch 7. When this switch is in the “ON” position, and switch 7 is in the “ON” position the actuator will respond to a 0 to 5 Vdc command signal. This is used, so that the actuator will go to its zero position when a 0 Vdc input command is received. The actuator will go to its span position when a 5 Vdc input command is received.

#### Switch 6 – Current command

The current command signal is enabled by placing switch 6 into the “ON” position. In this mode of operation, the actuator will go to the zero position on a 4 mA command. The actuator will go to the span position on a 20 mA command. The loss of signal mode is only active in this mode of operation.

#### Switch 7 – Voltage command

The voltage command is activated by placing switch 7 into the “ON” position. This mode of operation will work with a 0 to 10 Vdc command signal, or a 0 to 5 Vdc command signal, depending on the position of switch 5. If switch 5 is in the “OFF” position, then a 0 to 10 Vdc command signal will be used. If switch 5 is in the “ON” position, then a 0 to 5 Vdc command signal will be used.

#### Switch 8 – Local setpoint

The local setpoint is activated by placing Switch 8 into the “ON” position. In this mode of operation, the command will be based on the position of the setup potentiometer.

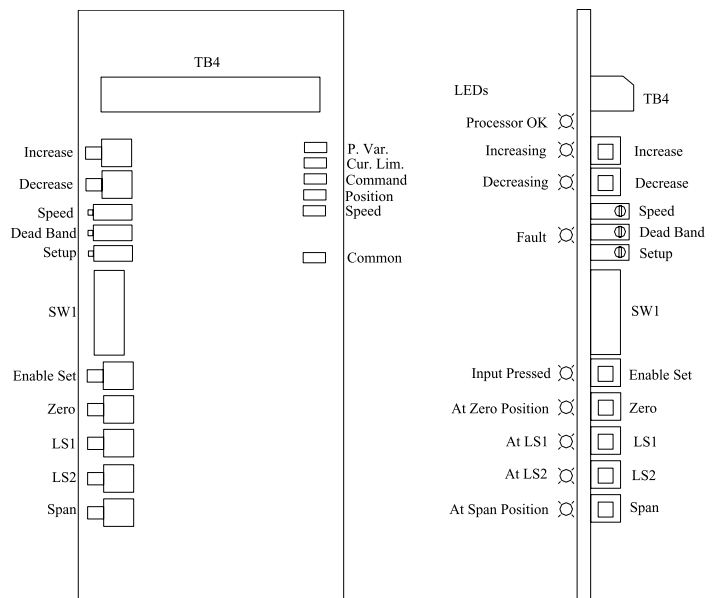


Figure 3

# NORMAL OUTPUT SHAFT MOTION FOR INCREASING SIGNAL

OBSERVATION	SM-1020
Standard output shaft motion for an increasing signal	CW
Switch 1 position for normal actuator operation	OFF Position
Stepper motor rotation for an increasing signal	CCW
Stepper motor drive indication for an increasing motion	INC LED is ON
Stepper motor drive indication for an decreasing motion	DEC LED is ON
ZERO and LS1 trip direction (for standard operation only)	CCW
SPAN and LS2 trip direction (for standard operation only)	CW
Output shaft movement with a CW handwheel rotation	CCW

The 1000 Series servo amplifier has directional references: NORMAL/REVERSE, HIGH/LOW, HI/LOW SETPOINTS and INCREASE/DECREASE.

Jordan Controls has established a standard for actuator output motion for all actuators including the VA-1020. Wiring drawings conform to this standard.

Table 1

## RECOMMENDED SPARE PARTS LIST

PART NUMBER	DESCRIPTION
68C-039430-001	Lower logic board
68C-039703-001	VA-1020B upper power supply
68C-039703-002	VA-1020E upper power supply
74B-010957-159	Cover O-Ring
18A-032667-001	Output shaft bushing
19B-003815-030	Output shaft seal
61B-036257-001	Feedback nut 7/8 acme, bronze
61B-036258-001	Feedback nut 7/8-24, bronze
62B-032198-001	Output shaft, 7/8 acme
62B-032197-001	Output shaft 7/8-24
61B-010954-116	Output shaft key
17B-003813-009	Output shaft bearing
16B-032189-001	Motor pinion gear
61A-034422-001	Handwheel shaft
74B-010957-014	Handwheel shaft O-Ring
20A-034422-001	Handwheel spring
61A-034423-001	Handwheel knob

Table 2

## DIP SWITCH CONFIGURATIONS

Dip Switch Configurations SW1		
Switch	Switch Position	Function
1	OFF	Direct Acting
	ON	Reverse Acting
2	Loss of Signal Operation (See Table 4)	
3		
4	OFF	Remote Operation Enabled
	ON	Local Operation Enabled
5	OFF	0-10 Vdc Command Signal
	ON	0-5 Vdc Command Signal
6 *	OFF	4-20 mA Command Signal (not being used)
	ON	4-20 mA Command Signal
7 *	OFF	Voltage Command Signal (not being used)
	ON	Voltage Command Signal
8 *	OFF	Local Command Signal (not being used)
	ON	Local Command Signal

Table 3

\* Only one of these three switches can be in the ON position

SW1 Position (2)	SW1 Position (3)	Function
OFF	OFF	Lock in Place
ON	OFF	Go to Zero
OFF	ON	Go to Span
ON	ON	Lock in Place

Table 4



# START-UP INFORMATION

## START UP FOR LOW LEVEL CURRENT OR VOLTAGE COMMAND SIGNALS

- 1) **Power.** Before applying AC or DC power to TB2 of the upper power supply board, as the appropriate model requires, set slide switch to the correct voltage.
- 2) **Setpoints.** These are the end of travel extremes corresponding to the actuator output shaft positions desired for low and high command signal levels. They are set by the ZERO and Span push buttons
  - A) Place the actuator into the local mode of operation by placing switch 4 into the "ON" position.
  - B) Jog the actuator using the increase or decrease push buttons, until the desired position has been reached.
  - C) Set the ZERO position by pressing the "ENABLE SET" and the "ZERO" push buttons at the same time. The LED under the "ENABLE SET" push button will come on while these push buttons are pressed.
  - D) Jog the actuator using the increase push button, until the desired maximum position has been reached.
  - E) Set the SPAN position by pressing the "ENABLE SET" and the "SPAN" push buttons at the same time. The LED under the ENABLE SET push button will come on while these buttons are pressed.
  - F) Remove the actuator from local mode by placing switch 4 into the "OFF" position
- 3) **Deadband** This adjustment establishes the actuator servo sensitivity and is set to tolerate electrical "noise" on the command signal, mechanical instability, backlash, etc. It governs the "tightness" of the operating servo loop. It is factory set and "sealed" at  $\pm 0.1$  mA command signal in current before actuator position is changed. If the actuator begins to oscillate (green and yellow LEDs turn on and off rapidly), decrease the sensitivity by turning the deadband pot slowly CW until oscillation stops.
- 4) **Speed Adjust** Actuator output speed is set by the motor speed pot. Adjust the motor speed pot to desired actuator output shaft speed. CW rotation increases speed. The desired speed can be adjusted by using the graph shown in Figure 4 with a voltmeter connected between "SPEED" and "COMMON" test points (Figure 3).
- 5) **Auxiliary limit switches.** These are electronic position switches that can be set throughout the range of the actuator. LS1 is "ON" when the actuator position is less than the ZERO position. LS2 is "ON" when the actuator position is greater than the SPAN position. These positions are set as follows:
  - A) Place the actuator into the local mode of operation by placing switch 4 into the "ON" position.
  - B) Apply the minimum process variable value desired to the process variable input (TB4 terminals 10 and 11 on the lower board). This must be at least 4 mA.
  - C) Once this has been applied, press the Red Enable Set push button and the Black LS1 at the same time. These buttons *must* be pressed at the same time to allow for the input to take place. Once this has been set, then the LED directly underneath the LS1 button becomes illuminated. This setting allows the actuator to stop its decreasing movement when in the remote operation and the process variable falls below the value applied to the process variable input at the time of setting.
  - D) Apply the maximum process variable value desired to the process variable input (TB4 terminals 10 and 11 on the lower board). This value must not be greater than 20mA.
  - E) Once this has been applied, press the Red Enable Set push button and the White LS2 push button at the same time. These buttons *must* be pressed at the same time to allow for the input to take place. Once this has been set, the LED directly underneath the LS2 button becomes illuminated. This setting allows the actuator to stop its increasing movement when in the remote operation and the process variable is above the value applied to the process variable input at the time of setting.
  - F) Remove the actuator from local mode by placing switch 4 into the "OFF" position
- 6) **Verify all settings** by running the actuator through its travel range several times. Also verify loss of signal (LOS) action.
- 7) **Transfer to Automatic** control and observe that operation is proper before replacing the cover and leaving the actuator unattended.

# SM-1020 SPEED VS. VOLTAGE AT TEST POINT

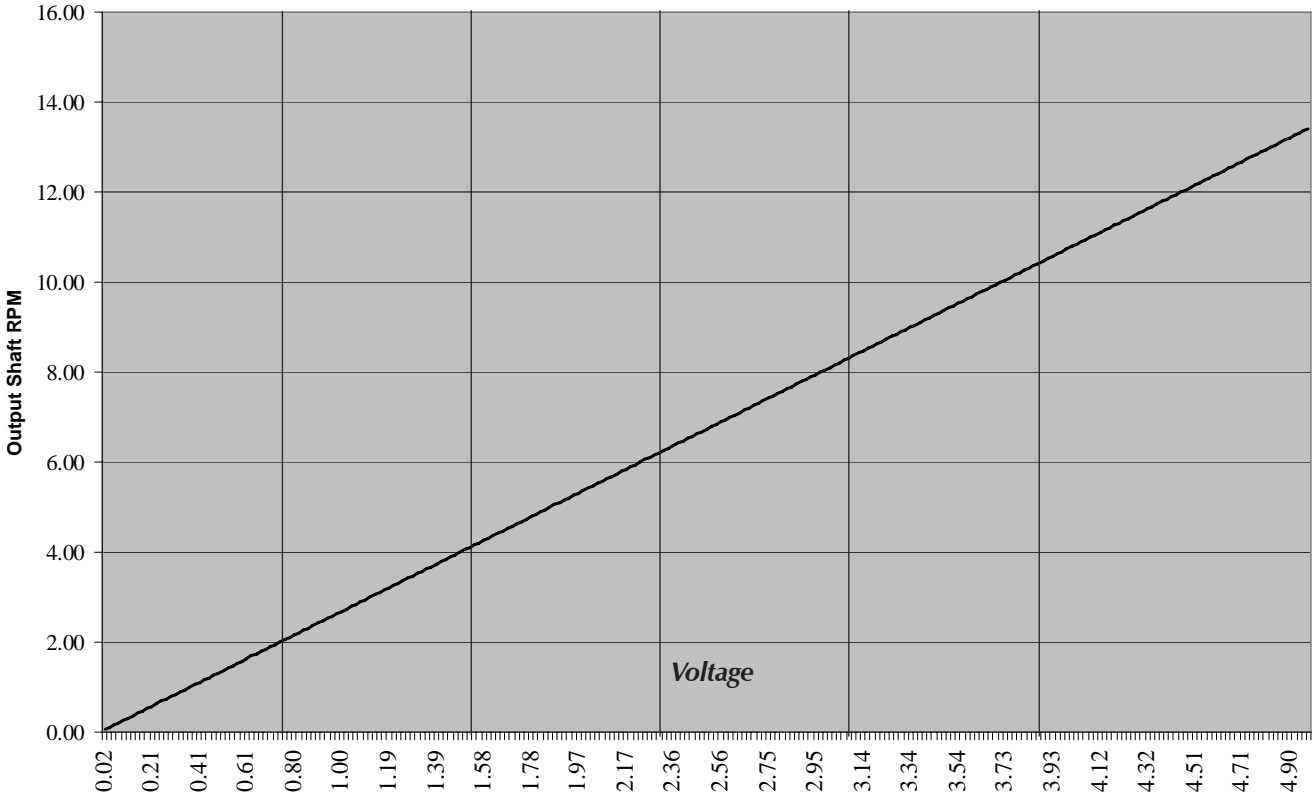
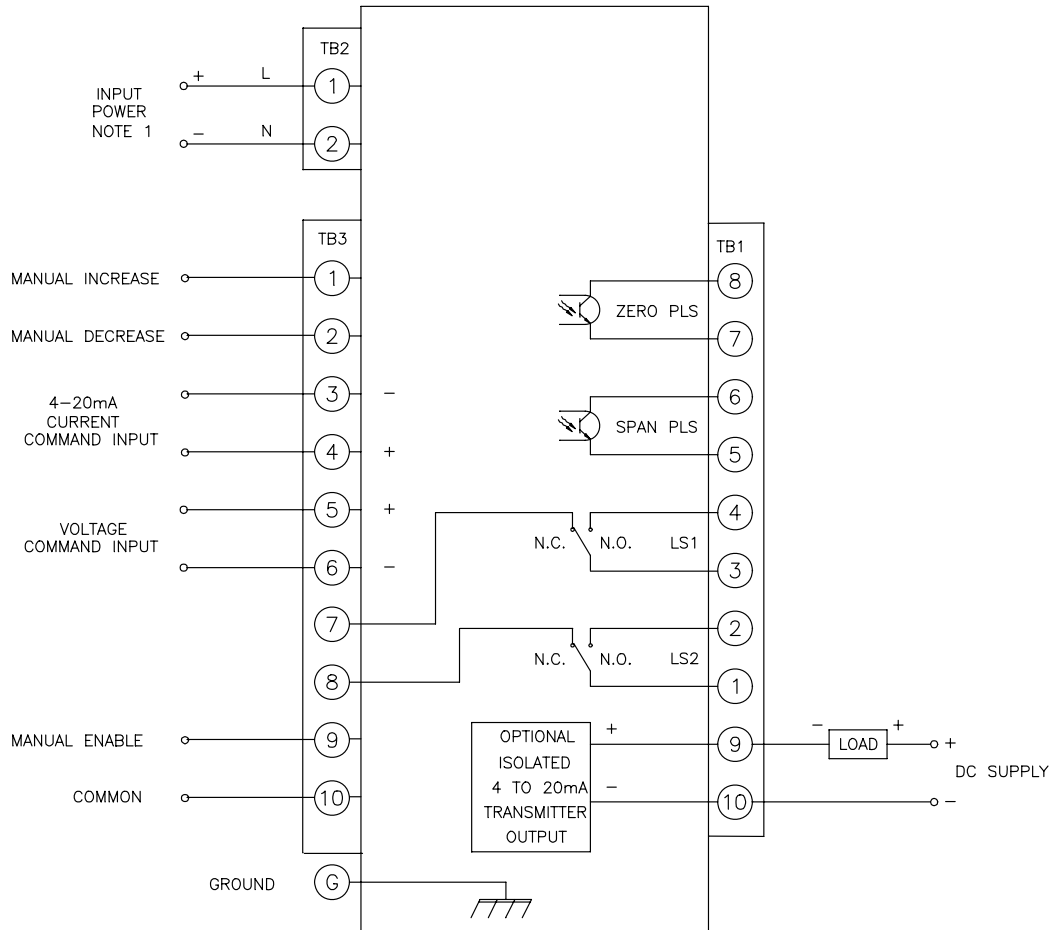


Figure 4

# TYPICAL WIRING DIAGRAM



**Note 1**

Input Power:  
 120/240 Vac, 50/60 Hz  
 Input power to terminals TB2-1 & TB2-2  
 Select desired input power by sliding power selection switch on Upper P.C. Board

24 Vdc  
 Input power to terminals TB2-1 & TB2-2

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

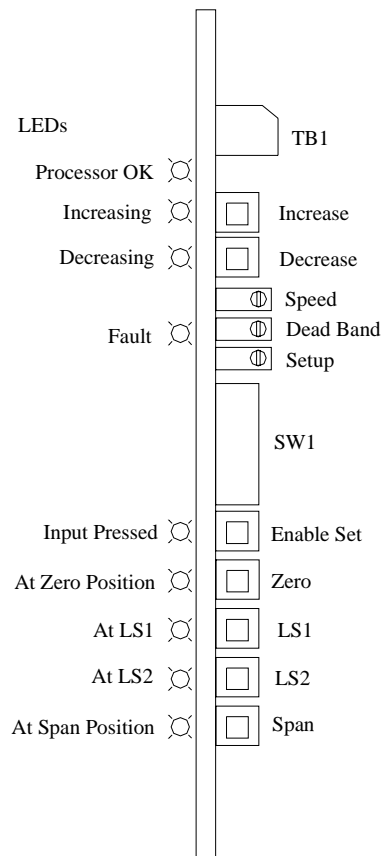
# TROUBLESHOOTING GUIDE

## VISUAL TROUBLESHOOTING

For visual troubleshooting, LEDs are provided to display the status of the actuator. These are located on the same side of the lower board as SW1. The identification of these LEDs are shown in the table below, and are ordered as the LEDs appear: left to right.

LED	Function
Microprocessor running	This LED is on when power is applied to the microprocessor, and the microprocessor is running. If this is not on, then verify power to the board, as well as the SW1 setting on the top board
Actuator Increasing	This LED is on when the actuator is moving in the increasing direction
Actuator Decreasing	This LED is on when the actuator is moving in the decreasing direction.
Fault	This LED will flash when a fault is present. The LED will flash at a given rate. If the LED is flashing at 0.5 second intervals, then a LOS for the remote set point is present. If the LED is flashing a 2 second intervals, then the remote operation is disabled because the zero and span positions have not been set.
Set Point Pressed	This LED will be on when the set push button and one of the other four setup push buttons have been pressed at the same time
Zero Position	This LED will be on when the actuator is at or below its set zero position.
LS1 Position	This LED will be on when the process variable is at or below its minimum value.
LS2 Position	This LED will be on when the process variable is at or above its maximum value.
Span Position	This LED will be on when the actuator is at or above its span position.

Table 5



# TROUBLESHOOTING GUIDE

## ELECTRICAL TROUBLESHOOTING

Electrical troubleshooting can be performed using the six test points that are located on the motor connector side of the lower board (see figure 3). The black test point labeled COM is used for the common connection for the voltage meter or oscilloscope. The functions and valid range of the remaining five red test points are shown in the table below.

Test Point	Function	Range
SPD (Speed)	The value from potentiometer R3 for the speed of the actuator.	0 to 5 volts should be read at this test point. See Figure 4
PSN (Position)	The position of the actuator based on the linear potentiometer located underneath the lower board.	A value of 1.57 to 4.49 volts should be read at this test point.
CMD (Command)	The set point command.	1) If 4 to 20ma is selected, then 0.8 volts to 4 volts is the expected value. See Figure 5.
		2) If 0 to 5 v is selected then, 0 to 5 volts is the expected value.
		3) If 0 to 10v is selected, then 0 to 5 volts is the expected value.
		4) If local set point is selected, then 0 to 5 volts is the expected value.
CL (Current Limit)	The current limit value	Factory set for system calibration. Do not re-adjust
PV (Process Variable)	The process variable	A value of 0.8 to 4.0 volts is expected (0.8 corresponds to 4mA, and 4.0 corresponds to 20mA. See Figure 5

Table 6

**Voltage at Test Point (Command) vs Input Command Current (mA)**  
Used to verify proper command input

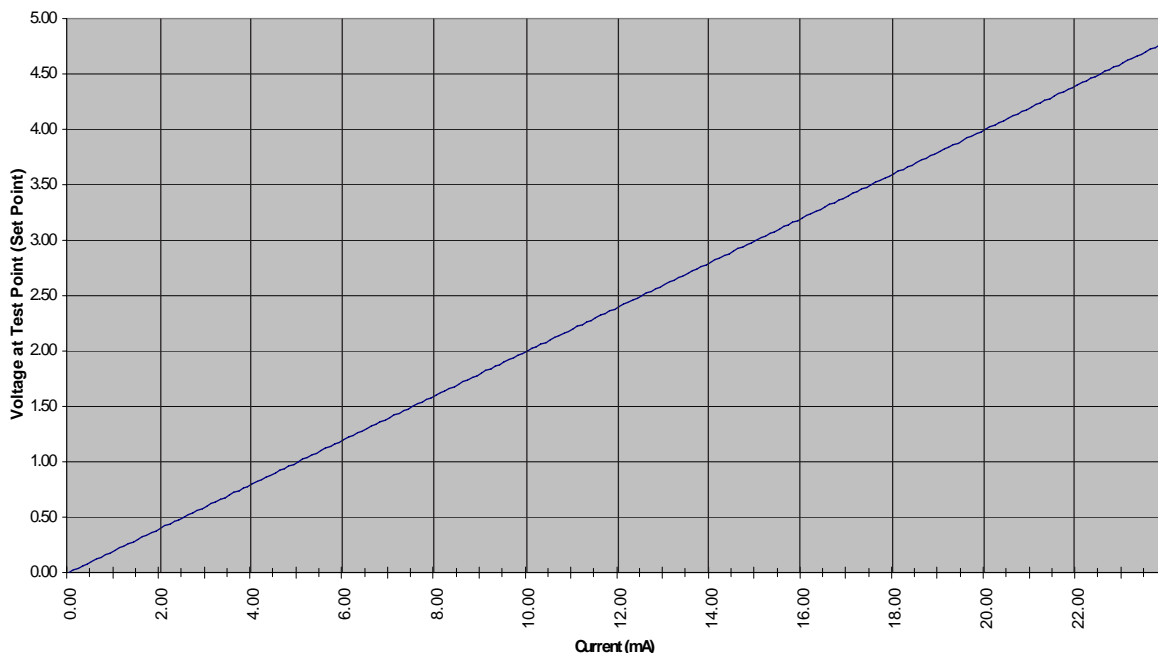


Figure 5

# MAJOR DIMENSIONS

INCHES  
(MILLIMETERS)

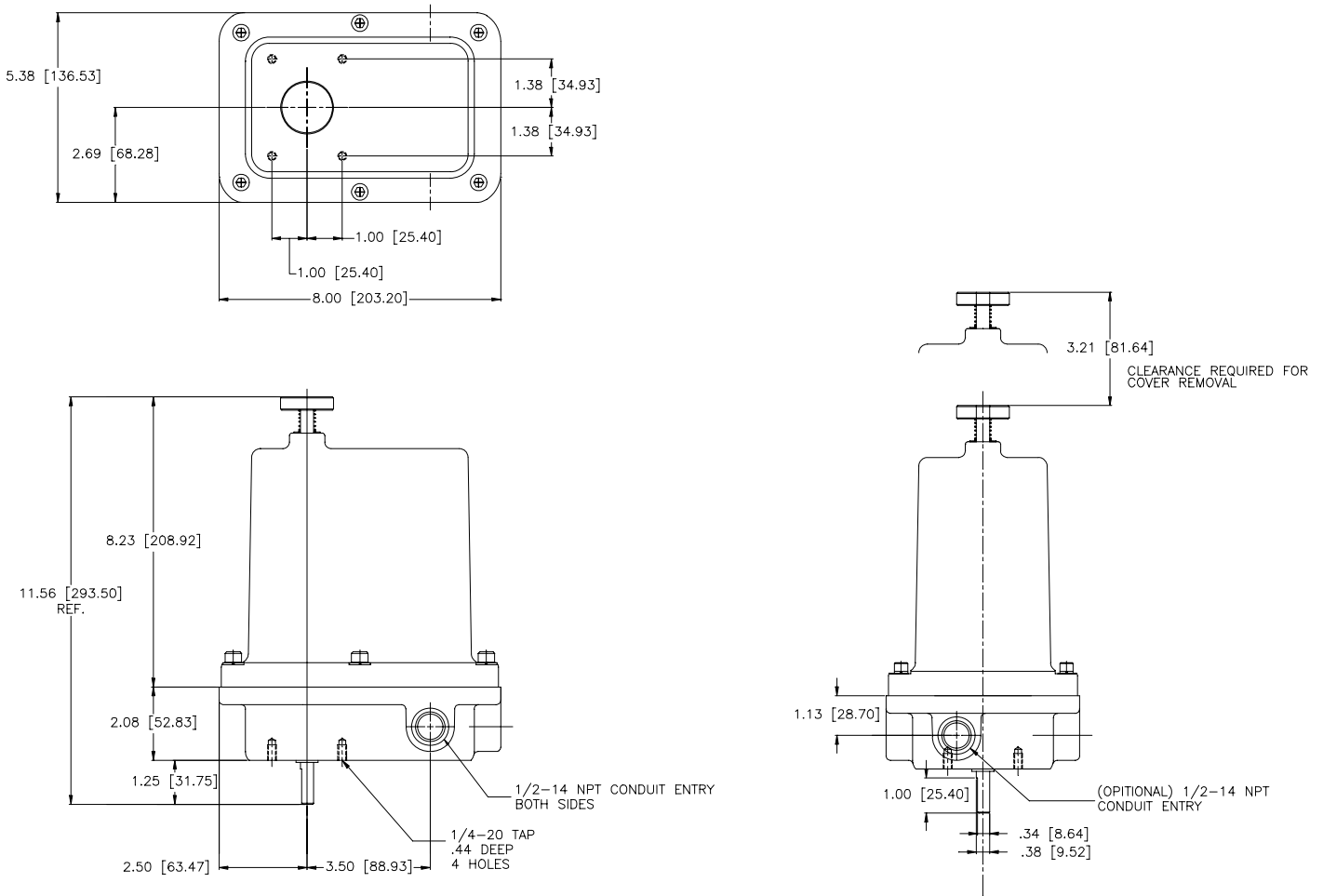
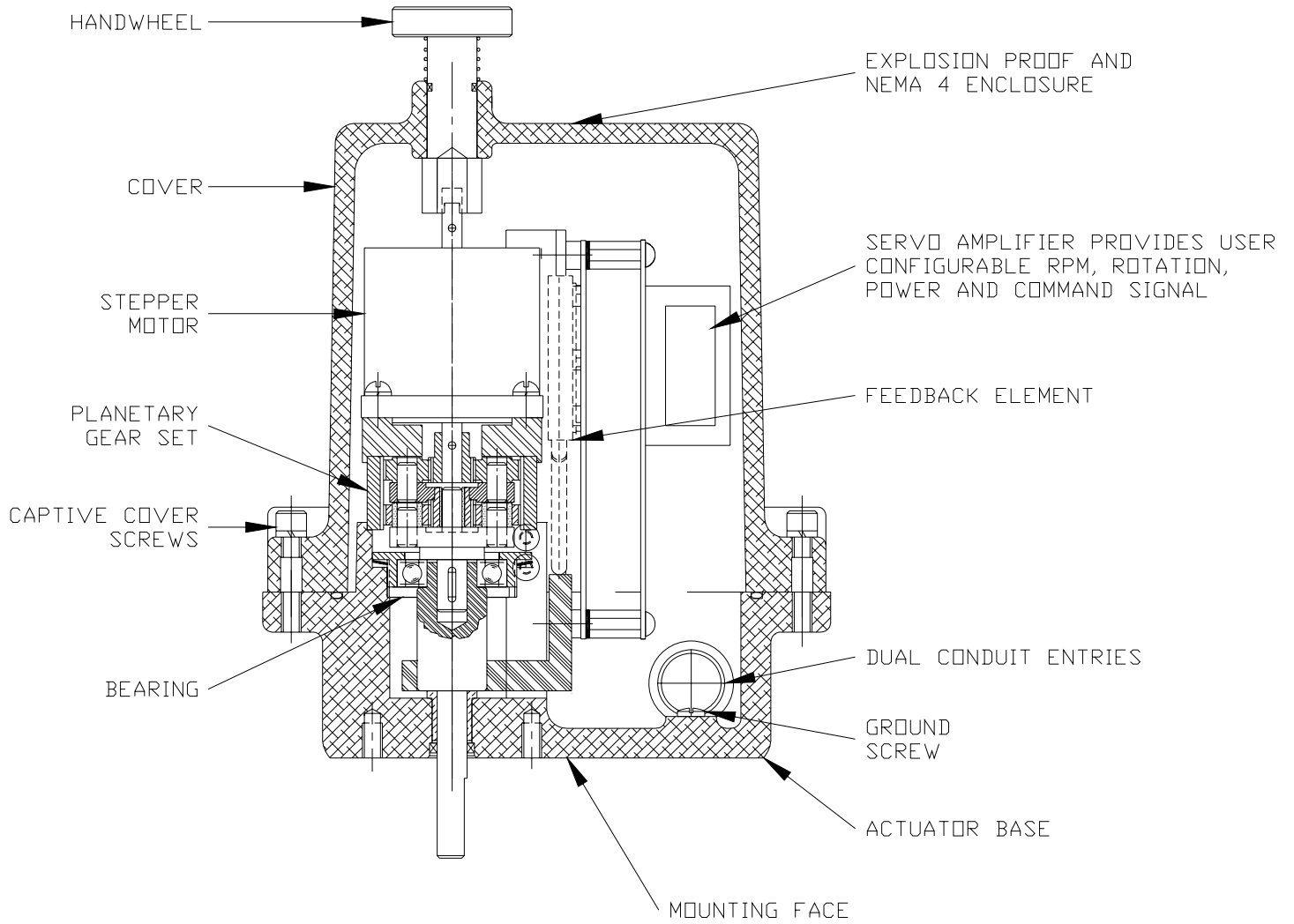


Figure 6

These dimensions are subject to change without notice and should not be used for preparation of drawings or fabrication of installation mounting. Current installation dimension drawings are available on request.

# COMPONENT IDENTIFICATION



JORDAN CONTROLS, INC.  
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FAX: (414) 461-1024  
E-Mail: [jordan@jordancontrols.com](mailto:jordan@jordancontrols.com)  
[www.jordancontrols.com](http://www.jordancontrols.com)  
IM-0645 6/05

The dimensions in this manual are subject to change without notice and should not be used for preparation of drawings or fabrication of installation mounting. Current installation dimension drawings are available upon request.

