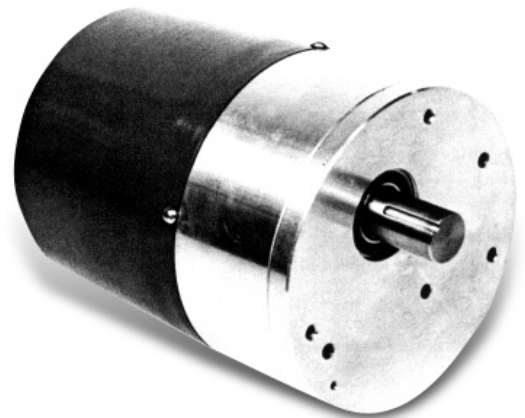


Electric Actuators and Control Systems

# rotork<sup>®</sup> Process Controls

Established Leaders in Valve Actuation



## SM-1500/1600 Series

Instruction Manual

*Where logo shown or copy refers to Jordan Controls  
please now read as Rotork Process Controls*

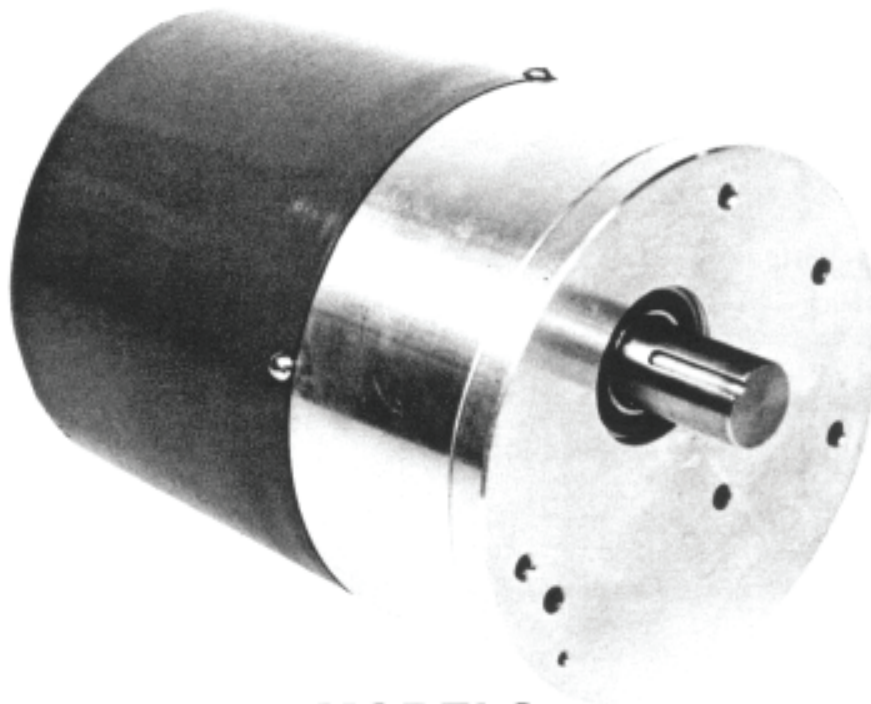
**IM-0402**

## **Instruction Manual**

## **ROTARY ACTUATOR**

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

**SM-1500/1600 SERIES  
SM-1500/AD-8200 SERIES  
SM-1600/AD-8200 SERIES**



### **MODELS**

<b>SM-1510</b>	<b>SM-1540</b>	<b>SM-1570</b>	<b>SM-1510/AD-8210</b>	<b>SM-1550/AD-8220</b>
<b>SM-1520</b>	<b>SM-1550</b>	<b>SM-1580</b>	<b>SM-1520/AD-8210</b>	<b>SM-1570/AD-8220</b>
<b>SM-1530</b>	<b>SM-1560</b>	<b>SM-1590</b>	<b>SM-1530/AD-8210</b>	<b>SM-1590/AD-8220</b>
<b>SM-1630</b>	<b>SM-1650</b>	<b>SM-1630/AD-8210</b>		
<b>SM-1640</b>	<b>SM-1660</b>	<b>SM-1650/AD-8220</b>		

## PRODUCT IDENTIFICATION

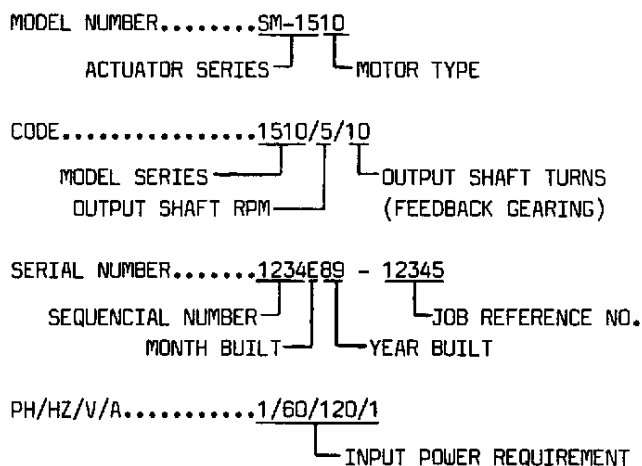
### IDENTIFICATION LABEL

An identification label is attached to each actuator cover. The serial number is also stamped on the aluminum housing, directly above the conduit entry. When ordering parts, requesting information or service assistance, please provide all of the label information.

**EXAMPLE:**

```

MODEL      SM-1510
CODE       1510/5/10
SERIAL     1234E89 - 12345
PH/HZ/V/A  1/60/120/1
    
```



PH = PHASE  
 HZ = HERTZ  
 V = VOLTAGE  
 A = AMPERES

NOTE: Model number for actuators with built-in amplifier.

```

MODEL NUMBER....SM-1510/AD-8210
MODEL NUMBER OF ———
BUILT-IN AMPLIFIER
    
```

### OUTPUT SHAFT TURNS

The last number in the CODE indicates the nominal OUTPUT SHAFT TURNS for the range of the feedback gearing in the actuator.

Nominal OUTPUT SHAFT TURNS are given as if the unit is built with cam activated position limit switches and/or a 1 turn feedback potentiometer.

If the unit is built with a multi-turn switch assembly and/or a 10 turn potentiometer, the nominal output shaft turns range is 12 times the turns indicated by the code number.

EXAMPLE: CODE.....1510/5/10

└── Nominal output turns with cam activated switches and/or a 1 turn potentiometer.

CODE.....1510/5/10

└── 10 x 12 = 120 turns  
 Nominal output turns with multi-turn switch assembly and/or a 10 turn pot.

Refer to page 17 for the actual feedback gearing used.

# ***SM-1500/1600 Series***

## ***Rotary Actuators***

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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 INSTRUCTIONS \*\***

Jordan Controls designs, manufactures, and tests its products to meet many national and international standards. However, for these products to operate within their normal specifications, you must properly install, use, and maintain these products. The following instructions must be adhered to and intergrated with your safety program when installing, using and maintaining Jordan Controls Inc. products.

Read and save all instructions prior to installing, operating, and servicing the 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 your personnel in the proper installation, operation, and maintenance of the product.

Install your equipment as specified on Jordan Controls Inc. installation instructions and per applicable local/national codes. Connect all products to the proper electrical sources.

Handle, move, and install each product using the appropriate number of personnel and moving devices/equipment (dolly, forklift, crane, etc.). Failure to do so could cause serious personal injury.

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. Unauthorized substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.

Ensure all actuator protective covers are in place, except when maintenance is being performed by qualified personnel, to prevent electrical shock, personal injury, or damage to the actuator.

**\*\* CAUTION \*\***

Before beginning actuator installation, make sure the actuator supplied is suitable for the intended application with respect to environmental conditions and the voltage/frequency of available line power. If you are unsure of the suitability of this equipment for your installation, consult Jordan Controls Inc. prior to proceeding.

**\*\* WARNING - SHOCK HAZARD \*\***

Installation and servicing must be performed only by qualified personnel. De-energize all sources of power BEFORE removing actuator cover. KEEP COVER TIGHT WHEN CIRCUITS ARE ALIVE. Failure to follow these precautions may result in serious injury or death.

DESCRIPTION

The SM-1500/1600 series rotary actuators are self contained bi-directional electrically operated devices with a maximum gear train rating of 400 in. lbs. for the SM-1500 series and 1000 in. lbs. for the SM-1600 series. The drive motor may be AC or DC. The unit may contain position feedback, limit switches, motor brake, heater and thermostat, manual handcrank and built-in amplifier. The positioning range with selected feedback gear ratios will control the output shaft from 1/4 revolution to 324 revolutions. The actuator may be mounted in any position. The gearing is totally enclosed, permanently lubricated. The actuator housing may be NEMA 12 Inside Industrial, NEMA 4 Watertight or Explosionproof rated for Class I, Div. 1, Groups C,D and Dust-ignitionproof Class II, Div. 1, Groups E, F, G Hazardous Location.

BASIC MODEL

MOTOR USED (ac motors are single phase, permanent split capacitor, plug reversible)  
(dc motors are permanent magnet)

SM-1510	120 V ac, modulating duty, run current .44 A, stall .65 A
SM-1510/AD-8210	SM-1510 above with built-in amplifier
SM-1520	120 V ac, intermittent duty, run current 2.5 A, stall 2.9 A
SM-1520/AD-8210	SM-1520 above with built-in amplifier
SM-1530	120 V ac, modulating duty, run current .9 A, stall 1.2 A
SM-1530/AD-8210	SM-1530 above with built-in amplifier
SM-1540	24 V dc (PM), run current 1.7 A, max. cont. duty 1.9 A
SM-1550	240 V ac, intermittent duty, run current .45 A, stall .5 A
SM-1550/AD-8220	SM-1550 above with built-in amplifier
SM-1560	90 V dc (PM), run current .4 A, max. cont. duty .5 A
SM-1570	240 V ac, modulating duty, run current .27 A, stall .4 A
SM-1570/AD-8220	SM-1570 above with built-in amplifier
SM-1580	24 V dc (PM) with tach, run current 5.2 A, max. cont. duty 6.25 A
SM-1590	240 V ac, intermittent duty, run current 1.1 A, stall 1.6 A
SM-1590/AD-8220	SM-1590 above with built-in amplifier
SM-1630	120 V ac, modulating duty, run current .9 A, stall 1.2 A
SM-1630/AD-8210	SM-1630 above with built-in amplifier
SM-1640	24 V dc (PM), run current 1.7 A, max. cont. duty 1.9 A
SM-1650	240 V ac, modulating duty, run current .45 A, stall .5 A
SM-1650/AD-8220	SM-1650 above with built-in amplifier
SM-1660	90 V dc (PM), run current .4 A, max. cont. duty .5 A

ACTUATOR SPEED/TORQUE

MODEL	SM-1510 SM-1570	SM-1520 SM-1590	SM-1530 SM-1550	SM-1540 SM-1560	SM-1580	SM-1630 SM-1650	SM-1640 SM-1660
SPEED (rpm)  TORQUE (in-lb)	.4 400	.5 400	.4 400	.8 400	1 400		
	1.5 400	2 400	1.5 400	3 400	3.5 400	2 1000	4 720
	3 210	4 400	3 400	6 400	7.5 400	4 500	8 350
	5 150	6 400	5 400	10 300	12 400		
	10 75	14 400	10 200	20 140	25 270		
	18 37	24 300	18 100	36 80	44 160		
	28 25	38 190	28 67	56 52	70 100		
	36 18	49 150	36 50	73 40	90 75		

## PHYSICAL INSTALLATION

### Actuator Characteristics

- The actuator is permanently lubricated, it is not oil or grease filled and may be mounted in any desired plane.
- The actuator weighs approximately 20 lbs. The mass of the actuator varies, depending upon the configuration of options selected.
- The actuator output shaft is made of stainless steel and the housing is aluminum.
- The keyway in the output shaft is not correlated in relation to the mounting holes, unless the customer has specified correlation at time of order.
- The actuator is a very effecient design and the output shaft may coast or be back-driven by the load if the actuator is not supplied with the optional motor brake.

### Mounting Brackets

- When designing mounting brackets and considering mounting locations, allow adequate clearance from the top of the actuator cover to any obstructions such as brick walls or steel structures that could interfere with cover removal.
- Consideration should be given for the location of the conduit entry as conduit will be connected to the actuator.
- If the actuator is supplied with a manual handcrank, allow for operator access.
- The standard SM-1500 series actuators are designed to be face mounted with two, 5/16-18 Grade 5 (or better) mounting bolts. The mounting holes are tapped 1/2 inch deep and the bolts selected should engage a minimum of 6 full threads (5/16").
- The standard SM-1600 series actuators are designed to be face mounted with three, 3/8-16 Grade 5 (or better) mounting bolts. The mounting holes are tapped 1/2 inch deep and the bolts selected should engage a minimum of 6 full threads (3/8").
- Care should be taken not to use bolt lengths that are too long which will bottom in the tapped holes. This will cause a loose mount and applying excessive torque to further tighten the bolts may damage the aluminum threads or shear the bolts.

### Coupling the Output Shaft

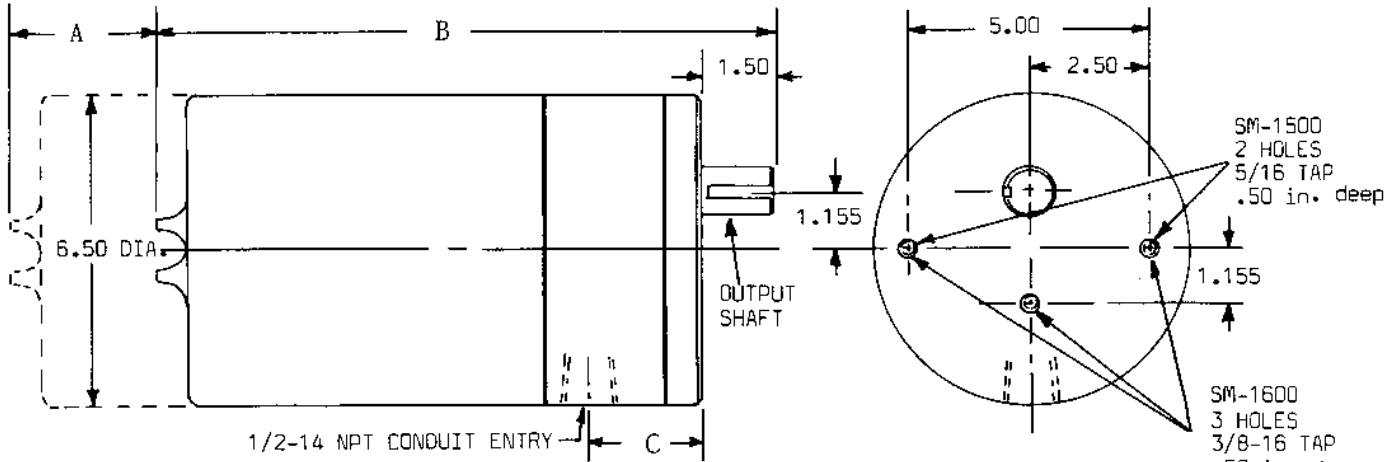
- For maximum actuator life and efficiency, avoid side loading caused by incorrect shaft alignment. The use of solid, one piece couplings is not recommended.
- When coupling the actuator shaft to the driven shaft, select flexible couplings that can transfer the proper torque without any lost motion or the driven shaft may not be positioned as it should be in relation to the actuator's output shaft.
- The coupling end placed on the actuator's output shaft should be a slip fit. Avoid forcing or pounding the coupling onto the shaft as you may damage the actuator or the coupling.

### Overhung Loads and End Thrust on Output Shaft

- Overhung loads on the actuator output shaft are limited to a maximum of 350 lbs on the SM-1500 series and 650 lbs on the SM-1600 series actuators as measured from a point (center of keyway) .81 inches from the mounting face of the actuator.
- The maximum allowable end thrust applied to the output shaft of the SM-1500 or SM-1600 series actuator is 780 lbs.

INSTALLATION DIMENSIONS  
(NOMINAL)  
INCHES

Clearance  
Required  
for cover  
removal



Handcrank and Manual Brake Release options not shown.  
 Approximate Mass: 20 pounds  
 Maximum overhung or side load on output shaft as measured .81" from actuator face:  
 SM-1500 = 350 pounds. SM-1600 = 650 pounds.  
 Maximum allowable end thrust on output shaft: SM-1500 or SM-1600 = 780 pounds.

HOUSING TYPE	MODEL	A				B				C
		Options 1,3,5,6	Options 1,4,6	Options 2,3,5,6	Options 2,4,6	Options 1,3,5,6	Options 1,4,6	Options 2,3,5,6	Options 2,4,6	
Nema 12	SM-1510,70	5.25	7.99	N/A	N/A	9.70	12.44	N/A	N/A	2.86
	SM-1530,50	6.25	7.99	N/A	N/A	10.70	12.44	N/A	N/A	2.86
	SM-1630,50									
	SM-1520,40,60,90	6.25	9.24	N/A	N/A	10.70	13.69	N/A	N/A	2.86
	SM-1640,60									
	SM-1580	6.25	N/A	N/A	N/A	10.70	N/A	N/A	N/A	2.86
Nema 4	SM-1510,30,50,70	6.88	8.00	10.00	11.12	12.01	13.13	15.13	16.25	3.20
	SM-1630,50									
	SM-1520,90	6.88	9.44	10.00	11.12	12.01	14.58	15.13	16.25	3.20
	SM-1540,60	6.88	9.44	N/A	N/A	12.01	14.58	N/A	N/A	3.20
	SM-1580	6.88	N/A	N/A	N/A	12.01	N/A	N/A	N/A	3.20
Explosionproof	SM-1500, SM-1600	6.88*	N/A	10.00*	N/A	12.01*	N/A	15.13*	N/A	3.20

OPTIONS

- 1 -- Without built-in AD-8200 Amplifier    3 -- Without Motor Brake    5 -- Without Handcrank  
 2 -- With built-in AD-8200 Amplifier    4 -- With Motor Brake    6 -- With Handcrank

\* ---- Explosionproof Units are not available with Handcrank Option #6.

N/A = Not Available.

	SM-1500 Series	SM-1600 Series
Output Shaft Diameter	.7490/.7496"	.9990/.9996"
Keyway Dimensions	.187"W x .105"D x 1.25" long	.250"W x .145"D x 1.25" long
Key (supplied)	3/16" Sq. x 1.19" long	1/4" Sq. x 1.19" long



## FIELD WIRING

### \*\* WARNING - SHOCK HAZARD \*\*

Installation and servicing must be performed only by qualified personnel.

De-energize all sources of power BEFORE removing the actuator cover. KEEP COVER TIGHT WHEN CIRCUITS ARE ALIVE. Voltages hazardous to your health are applied to these actuators. Failure to follow these precautions may result in serious injury or death.

EXPLOSIONPROOF and DUST-IGNITIONPROOF ACTUATORS are not explosionproof or dust-ignitionproof until final installation is complete. "Hazardous location enclosures must be installed in accordance with The National Electric Code requirements as well as state and local codes".

WATERTIGHT ACTUATORS are not watertight until final installation is complete with conduit entry sealed and actuator cover in place.

### \*\* CAUTION \*\*

All ac powered actuators contain single phase, 3 wire, permanent split capacitor motors. Motor power is applied across the motor common winding wire and one of the directional input wires. The capacitor creates a phase shift to the other motor directional input wire. This allows the motor to run and develop torque. With external input power applied to one winding, the opposite winding (energized by the capacitor) will have a voltage on it which is greater than the applied voltage while the motor is running. The voltage will be approximately 150 V ac for 120 V ac units and 300 V ac for 240 V ac units. Because of this characteristic the actuator directional input wires must never be connected in parallel from one actuator to another. No inductive or resistive load can be connected in parallel with the directional inputs. When operating more than one actuator from a common source, the use of isolated contacts between each actuator is required. Wiring ac actuators in parallel without isolation will cause one of the actuators to operate at a reduced torque when an end of travel limit switch in the other actuator is opened. The actuator with the opened switch may continue to run, receiving power to the direction winding with the closed switch, by way of the power supplied from the actuator that has not reached its limit switch.

END OF TRAVEL LIMIT SWITCHES built into single phase, ac motor driven units are factory wired in series with the proper motor directional winding. When a switch is tripped (opened), motor power will be removed from the winding and the motor will stop.

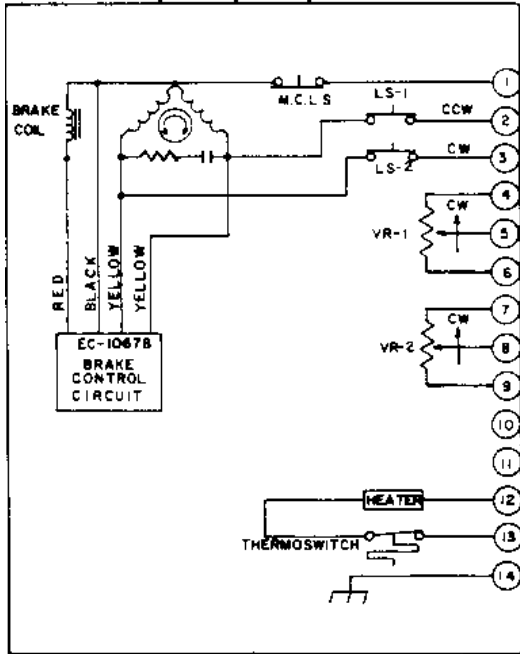
END OF TRAVEL LIMIT SWITCHES built into dc motor driven units are wired to the field wiring terminals and will only stop the motor when they are properly phased and wired to your motor control circuit.

FUSING IS NOT PROVIDED WITHIN THE ACTUATOR. Line fusing must be provided by the customer. Fuse rating should not exceed 5 amperes and fuses should be motor type.

All installation must be in accordance with The National Electric Code requirements as well as state and local codes.

# AC ACTUATOR WIRING

SM-1510, 1520, 1530, SM-1630  
SM-1550, 1570, 1590, SM-1650



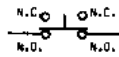
"YOUR ACTUATOR MAY OR MAY NOT BE WIRED AS SHOWN"

**NOTES:**

- 1) The SM-1510, 1520, 1530 and SM-1630 use 120 V ac input power. The SM-1550, 1570, 1590 and SM-1650 use 240 V ac input power.
- 2) Voltage applied across terminals 1 and 3 will result in "CW" rotation of the output shaft (as viewed from the shaft end). Voltage applied across terminals 1 and 2 will result in "CCW" output shaft rotation.
- 3) When the optional Motor Brake is supplied, an electro-mechanical brake and a brake circuit (EC-1067B) will be wired as shown. The brake releases whenever the motor is energized.
- 4) Clockwise rotation of the actuator output shaft results in decreasing resistance as measured across terminals 4 and 5 when feedback pot VR-1 is supplied and decreasing resistance across terminals 7 and 8 when feedback pot VR-2 is supplied.
- 5) Position Limit Switch LS-1 "trips" at the "CCW" end of actuator output shaft rotation and LS-2 "trips" at the "CW" end of actuator output shaft rotation. Switches are shown at mid-travel.

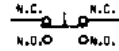
Single Turn Feedback Ass'y:

LS-1 is operated by a white cam. LS-2 is operated by a red cam. LS-1 and LS-2 are wired with the N.O. contacts as shown.



Multi-turn Feedback Ass'y:

LS-1 and LS-2 are operated with screws on a "travel nut" and are wired using the N.C. contacts as shown.



- 6) M.C.L.S. indicates the Manual Crank Limit Switch. The switch is only supplied on units with the Manual Handcrank option. The switch is normally closed. When the Manual Handcrank is engaged, the circuit to the motor is opened.
- 7) Optional Heater Circuit:  
The heater is powered thru the thermoswitch. The switch closes at 90°F and opens at 110°F. 120 V ac units use a 30 WATT heater and 240 V ac units use a 75 WATT heater.
- 8) Optional Transmitter:  
The ST-4130, 4 to 20mA TRANSMITTER wired as shown will result in a DECREASING SIGNAL for "CW" rotation of the actuator output shaft. Operation requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

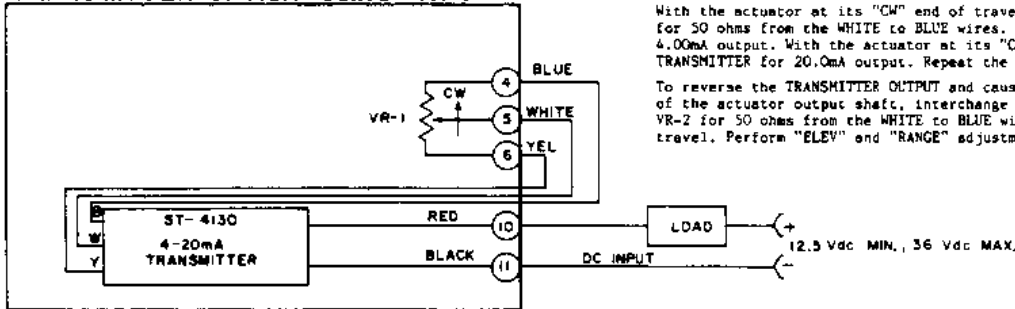
$$\text{POWER SUPPLY VOLTAGE} - 12V = \text{LOAD RESISTANCE MAX.} \times .020A$$

Connect Power Supply polarity as shown.

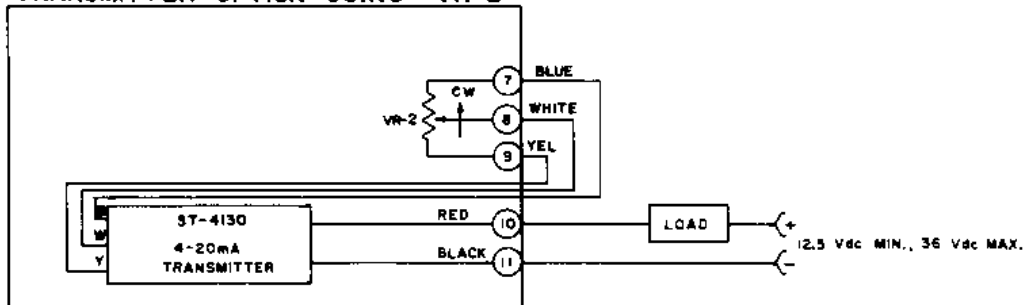
With the actuator at its "CW" end of travel, adjust VR-1 or VR-2 (the one being used), for 50 ohms from the WHITE to BLUE wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the actuator at its "CCW" end of travel, adjust "RANGE" on the TRANSMITTER for 20.0mA output. Repeat the "ELEV" and "RANGE" adjustments.

To reverse the TRANSMITTER OUTPUT and cause the signal to DECREASE for "CCW" rotation of the actuator output shaft, interchange the BLUE and YELLOW wires. Adjust VR-1 or VR-2 for 50 ohms from the WHITE to BLUE wires with the actuator at its "CCW" end of travel. Perform "ELEV" and "RANGE" adjustments.

**TRANSMITTER OPTION USING VR-1**

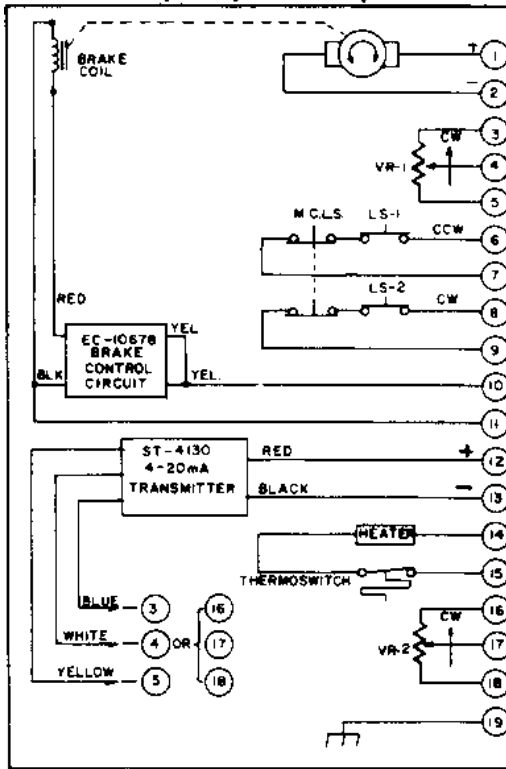


**TRANSMITTER OPTION USING VR-2**



# DC ACTUATOR WIRING

## SM-1540, 1560, SM-1640, 1660



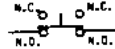
"YOUR ACTUATOR MAY OR MAY NOT BE WIRED AS SHOWN"

### NOTES:

- 1) The SM-1540 and SM-1640 use 24 V dc input power. The SM-1560 and SM-1660 use 90 V dc input power.
- 2) Voltage applied to terminals 1 and 2 with the polarity shown will result in "CW" rotation of the output shaft (as viewed from the shaft end). Reversing the polarity reverses the direction.
- 3) When an optional Motor Brake is supplied, an electro-mechanical brake and a brake circuit (EC-10678) will be wired as shown. 120 V ac must be applied across terminals 10 and 11 to release the brake whenever the motor is energized.
- 4) Clockwise rotation of the actuator output shaft results in decreasing resistance as measured across terminals 3 and 4 when feedback pot VR-1 is supplied and decreasing resistance across terminals 16 and 17 when feedback pot VR-2 is supplied.
- 5) Position Limit Switch LS-1 "trips" at the "CCW" end of actuator output shaft rotation and LS-2 "trips" at the "CW" end of actuator output shaft rotation. Switches are shown at mid-travel.

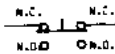
#### Single Turn Feedback Ass'y:

LS-1 is operated by a white cam. LS-2 is operated by a red cam. LS-1 and LS-2 are wired with the N.O. contacts as shown.



#### Multi-turn Feedback Ass'y:

LS-1 and LS-2 are operated with screws on a "travel nut" and are wired using the N.C. contacts as shown.



- 6) M.C.L.S. indicates the Manual Crank Limit Switch. The switch is only supplied on units with the Manual Handcrank option. The switch is normally closed. When the Manual Handcrank is engaged, the switch is opened. Provision must be made in the customer wiring to interrupt the motor circuit when the Handcrank is engaged.
- 7) Optional Heater Circuit:  
The heater is powered thru the thermoswitch. The switch closes at 90°F and opens at 110°F. 120 V ac power is applied across terminals 14 and 15. The heater is 30 WATTS.
- 8) Optional Transmitter:  
The ST-4130, 4 to 20mA TRANSMITTER wired as shown to either VR-1 or VR-2 will result in a DECREASING SIGNAL for "CW" rotation of the actuator output shaft. Operation of the TRANSMITTER requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

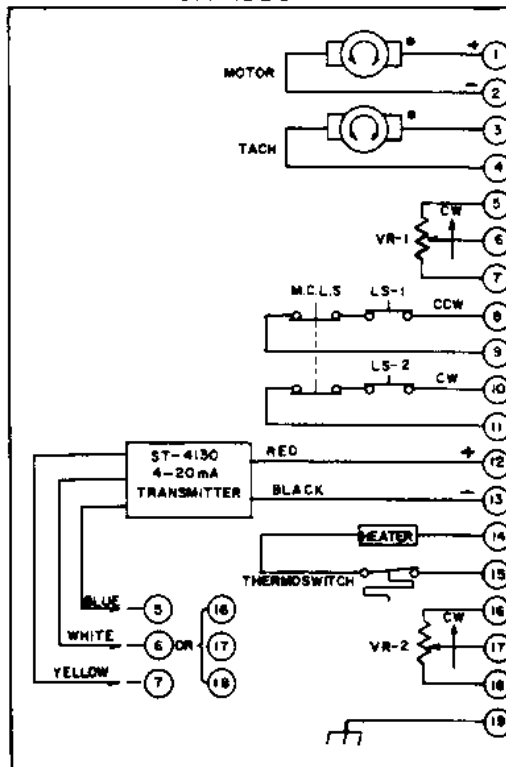
$$\frac{\text{POWER SUPPLY VOLTAGE} - 12V}{.020A} = \text{LOAD RESISTANCE MAX.}$$

Connect Power Supply polarity as shown.

With the actuator at its "CW" end of travel, adjust VR-1 or VR-2 (the one being used), for 50 ohms from the WHITE to BLUE wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the actuator at its "CCW" end of travel, adjust "RANGE" on the TRANSMITTER for 20.0mA output. Repeat the "ELEV" and "RANGE" adjustments.

To reverse the TRANSMITTER OUTPUT and cause the signal to DECREASE for "CCW" rotation of the actuator output shaft, interchange the BLUE and YELLOW wires. Adjust VR-1 or VR-2 for 50 ohms from the WHITE to BLUE wires with the actuator at its "CCW" end of travel. Perform "ELEV" and "RANGE" adjustments.

## SM-1580



### NOTES:

- 1) The SM-1580 uses 24 V dc input power to the armature.
- 2) The motor has a built-in tachometer.
- 3) Voltage applied to terminals 1 and 2 with the polarity shown will result in "CW" rotation of the output shaft (as viewed from the shaft end). "CW" rotation of the output shaft results in tachometer output of terminal 4 positive with respect to terminal 3. Reversing the polarity at terminals 1 and 2 will reverse the output shaft rotation and the tachometer output polarity at terminals 3 and 4.
- 4) Clockwise rotation of the actuator output shaft results in decreasing resistance as measured across terminals 5 and 6 when feedback pot VR-1 is supplied and decreasing resistance across terminals 16 and 17 when feedback pot VR-2 is supplied.
- 5) For Limit Switches, Heater and Transmitter see notes 5 thru 8 above.

START-UP  
Actuators without built-in AD-8200 Series Amplifier

NOTE: Unless specified by the customer at time of order, the keyway on the actuator output shaft has no specific orientation to the actuator mounting face.

The actuator has been factory calibrated for the range specified by the customer and only minor adjustments should be needed to match it to the controlled equipment.

FINAL ALIGNMENT CONSISTS OF:

- A) Setting the end of travel limit switches for the range of the driven unit without running the actuator into any type of mechanical stops.
- B) Aligning the feedback potentiometer (pot) to the range of the actuator set by the end of travel limit switches.
- C) Calibrating the 4 to 20 mA transmitter (if supplied).

ACTUATOR ALIGNMENT ac UNITS

- 1) If the actuator has been mounted and coupled to the controlled equipment, remove the coupling between the actuator shaft and the driven unit.
- 2) Remove the actuator cover to gain access to the limit switches, feedback pot and terminals.
- 3) Determine which direction of rotation (CW or CCW) is to be the "zero" end of travel on the driven shaft and on the actuator output shaft. This will be the starting point for alignment.
- 4) Apply power across terminals 1 and 2 to drive the actuator output shaft "CCW" or to terminals 1 and 3 to drive the shaft "CW" (looking at the shaft from the mounting face side). Select the appropriate terminals to drive the shaft to the "zero" position as it relates to the shaft being controlled.
- 5) With both shafts at the "zero" starting position, couple the shafts together. If the keyway on the actuator output shaft must be orientated to obtain coupling, apply power to the actuator to move the shaft in the increase direction until the keyway is located where you want it.
- 6) At this position it is necessary to set the "zero" limit switch to just "trip" before a mechanical stop (if the driven unit has one) is reached.

If only a very small amount of adjustment is needed, loosen 3 truss head screws (item 11 on page 11) and rotate the complete limit switch assembly until the switch just trips. Tighten the 3 screws.

If a large amount of adjustment is needed, remove the 3 screws, lift the switch assembly off of the mounting plate, turn the switch shaft until the switch just trips, re-insert the frame into the mounting plate and install the 3 screws.

- 7) If the actuator is equipped with a feedback pot (VR-1), measure the resistance from terminal 5 to terminal 4 or 6 (whichever is the zero end). Loosen the pot body nut (shown on page 19, Fig. 2 and 6) and rotate the body of the pot for a resistance reading of 5% of the total pot value. Rotating the pot too far may cause the pot terminals to hit the cover or motor. If this is the case refer to step 6 and re-adjust the switch shaft and end of travel switch.
- 8) Monitor the feedback pot from terminal 5 to the terminal which represents the increase end. Apply power to drive the actuator to the desired maximum rotation position. Do not allow the actuator to drive into a mechanical stop and do not drive the pot to less than 5% of its value at the actuator end of travel. Travel to the ends of a pot will break a ten turn pot or cause the signal to be lost on a one turn pot.
- 9) If the actuator is supplied with a 4 to 20 mA transmitter, refer to the appropriate wiring diagram (supplied with the actuator) for transmitter calibration. (or pages 8 and 9).  
When alignment is complete or when stopping work on the actuator, install the actuator cover to protect the internal components.

ACTUATOR ALIGNMENT dc UNITS

The alignment of a dc actuator is similar to that of the ac actuator with a few exceptions.

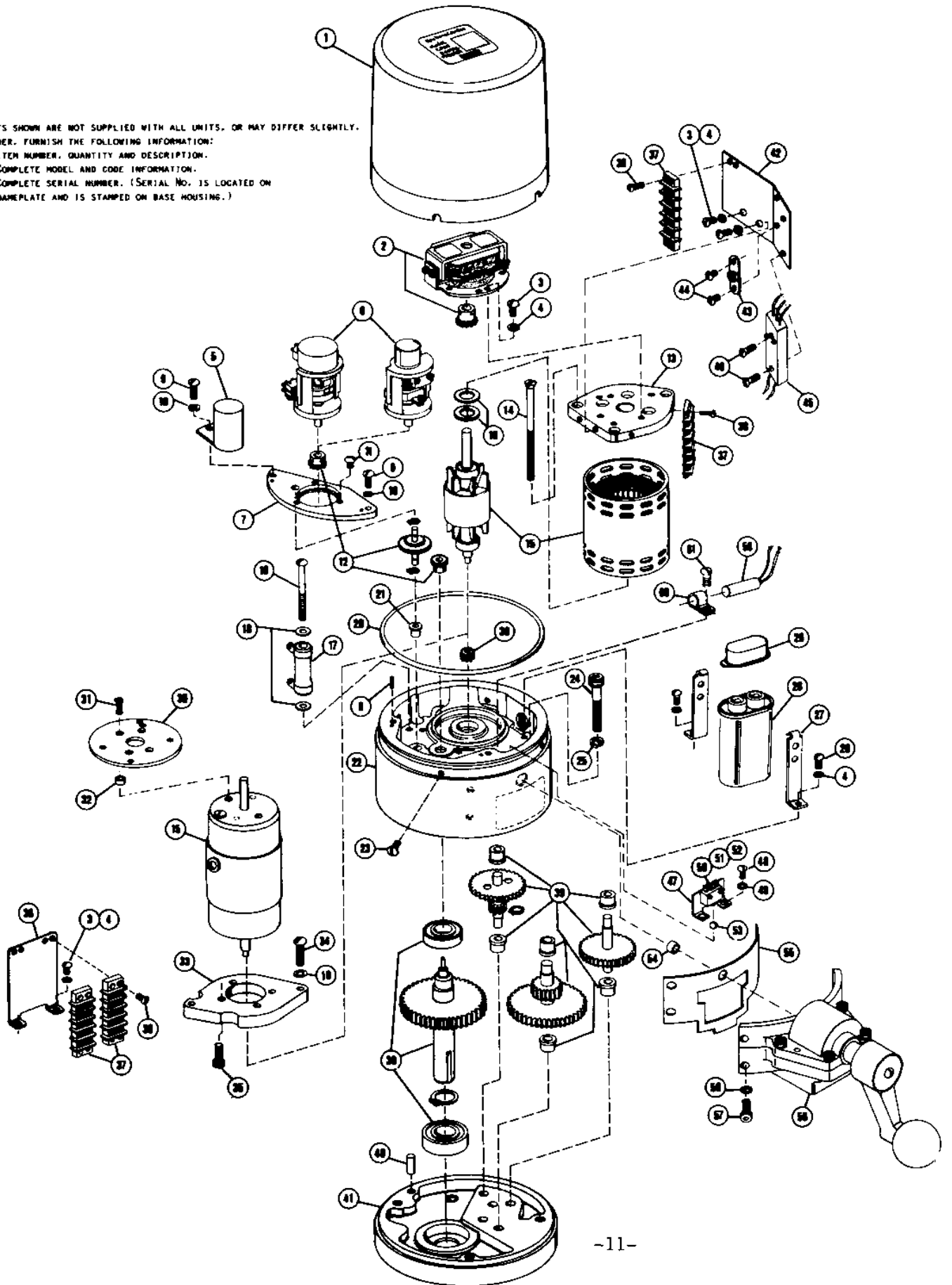
- 1) The input power is applied across terminals 1 and 2. The polarity of the input power determines the actuator output shaft direction of rotation.
- 2) The end of travel position limit switches are not wired in series with the motor and must be field wired to your motor control circuit and phased properly to turn off motor power when the proper switch is "tripped".
- 3) If the actuator is supplied with a motor brake, power must be supplied from an external source to the motor brake terminals. When motor power is applied, brake power must also be applied.
- 4) The terminal numbers for the components in the dc actuator are different than the terminal numbers in an ac actuator.
- 5) The operation and phase control of the limit switch circuit should be checked with the actuator near its center of travel, to prevent damage of the controlled unit or the actuator. Improper phasing of the limit switch circuit will cause the actuator motor to receive power and run when the switch is supposed to stop it.

# PARTS ORDER PROCEDURE

ALL PARTS SHOWN ARE NOT SUPPLIED WITH ALL UNITS, OR MAY DIFFER SLIGHTLY.

TO ORDER, FURNISH THE FOLLOWING INFORMATION:

1. ITEM NUMBER, QUANTITY AND DESCRIPTION.
2. COMPLETE MODEL AND CODE INFORMATION.
3. COMPLETE SERIAL NUMBER. (SERIAL No. IS LOCATED ON NAMEPLATE AND IS STAMPED ON BASE HOUSING.)



PARTS LIST  
(ALL MODELS)

ITEM	DESCRIPTION	PART NUMBER	QTY	ITEM	DESCRIPTION	PART NUMBER	QTY
1	Cover	See Page 13	1	26	Capacitor	See Page 13	1
2	Motor Brake		1	27	Capacitor Bracket	See Page 13	2
	(Without Manual Release)			28	Bracket Screws	See Page 13	2
	SM-1510,20,30, SM-1630	22B-009033-001		29	Boot	24B-004066-110	1
	SM-1550,70,90, SM-1650	22B-009033-003		30	Brake Mounting Plate	61A-021327-001	1
	SM-1540,60, SM-1640,60	61A-021147-001		31	4-40x.75 Flat Hd Screw	58B-024244-013	4
	(With Manual Release)			32	Spacer	61B-SP1324-100	4
	SM-1510,20,30, SM-1630	68B-017132-001		33	DC Motor Mounting Plate (not used if motor has a brake on it)	60B-020716-001	1
	SM-1550,70,90, SM-1650	68B-017132-003		34	10-24x1.00 Rd Hd Screw	54A-015043-100	2
	SM-1540,60, SM-1640,60	68B-017132-006		35	DC Motor Mounting Screws		
3	8-32x.31 Rd Hd Screw	54A-015033-031	6		M5x10MM for mtg to plate	58B-024244-024	4
4	#8 Lockwasher	56A-015190-002	8		M5x15MM for mtg to housing	58B-024244-029	4
5	Brake Control Circuit	70A-022661-001	1		SM-1580 10-32x1.00 long	54A-015050-100	2
6	Pot/Limit Switch Assy	See Page 18	1	36	Terminal Bracket	13B-024486-001	1
7	Feedback Mounting Plate	61A-SM2542-001	1	37	Terminal Block 7 Pin	43B-003888-107	2
8	.093 x .50 Dowel Pin	57A-015176-050	2		Terminal Block 8 Pin	43B-003888-108	
9	10-24x.50 Rd Hd Screw	54A-015043-050	2		Terminal Block 6 Pin	43B-003888-106	
10	#10 Lockwasher	56A-015200-001	4	38	6-32x.38 Rd Hd Screw	54A-015023-038	8
11	8-32x.25 Truss Hd Screw	54A-015032-025	3	39	Power Gearing & Bearings	See Page 15 & 16	
12	Feedback Gearing	See Page 17		40	.250x.88 Dowel Pin	57A-015226-088	1
13	Motor Top	60C-012753-001	1	41	Gear Housing Cover	See Page 14	1
	Motor Top	61B-017133-001	1	42	Accessory Mtg Bracket	13B-024555-001	1
	(use with brake release)			43	Thermal Switch	74A-023565-001	1
14	Motor Screws 10-24 Thread		3	44	6-32x.19 Rd Hd Screw	54A-015023-019	2
	SM-1510,70 4.00 long	54A-015044-400		45	4 to 20 mA Transmitter	70A-019948-001	1
	SM-1520,30,50 5.00 long	54A-015044-500		46	6-32x.75 Rd Hd Screw	54A-015023-075	2
	SM-1590 5.50 long	54A-015044-550		47	Switch Bracket	12A-015384-001	1
	SM-1630,50 5.00 long	54A-015044-500		48	6-32x.38 Fil Hd Screw	54A-015183-038	2
15	Motor	See Page 13	1	49	#6 Lockwasher	56A-015180-002	2
16	Belleville Washer	56A-005478-001	2	50	Switch SPDT	46B-004053-405	1
17	Resistor		1		Switch DPDT	46B-004053-414	
	SM-1510,30,50,70,90	33B-003852-205		51	2-56x.38 Rd Hd Screw	54A-015003-038	2
	SM-1520	33B-003852-305		52	#2 Lockwasher	56A-023922-004	2
	SM-1630,50	33B-003852-205		53	.250 Dia. Steel Ball	74A-014865-001	1
18	Fiber Washer	56B-005479-003	2	54	Bushing	18B-003814-055	1
19	Screw, 10-24 Thread		1	55	Gasket	13B-015482-001	1
	SM-1510,30,50,70,90	54A-015043-250		56	Handcrank Assy SM-1500	68D-022196-001	1
	SM-1630,50 2.50 long	54A-015043-250			Handcrank Assy SM-1600	68D-022196-002	1
	SM-1520 4.50 long	54A-015043-450		57	1/4-20x.75 Soc Hd Screw	54A-015060-075	4
20	O'Ring			58	1/4" Lockwasher	56A-015210-001	4
	NEMA 12 Units	74B-004108-001	1	59	Heater 120 Vac 30 Watt	74A-016946-001	1
	NEMA 4 & Explosionproof	74B-010957-163	2		Heater 240 Vac 75 Watt	74A-016946-002	
21	Bushing	18B-SP1988-001	1	60	Clamp for 120 V Heater	74A-016947-001	1
22	Gear Housing	See Page 14	1		Clamp for 240 V Heater	74A-016947-002	
23	10-24x.25 Rd Hd Screw	54A-015043-025	4	61	8-32x.38 Rd Hd Screw	54A-015033-038	1
24	5/16-18x2.25 Soc Hd Screw	54A-015070-225	3				
25	5/16 Hi Collar Lockwasher	56A-015221-001	3				

COVER SELECTION ITEM 1

NEMA 12 UNITS  
WITHOUT MOTOR BRAKE RELEASE

MODEL	PART NUMBER
SM-1510,70	118-SM1197-002
SM-1520,30,40,50,60,80,90	118-SM1197-005
SM-1630,40,50,60	118-SM1197-005

NEMA 12 UNITS  
WITH MOTOR BRAKE RELEASE

MODEL	PART NUMBER
SM-1510,70	68C-017138-004
SM-1520	68C-017138-007
SM-1530,50, SM-1630,50	68C-017138-002
SM-1540,60, SM-1640,60	68C-017138-010
SM-1590	68C-017138-008

NEMA 4 and EXPLOSIONPROOF UNITS  
WITHOUT MOTOR BRAKE RELEASE  
WITHOUT BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
SM-1500, SM-1600 ALL	60B-001573-001

NEMA 4 and EXPLOSIONPROOF UNITS  
WITHOUT MOTOR BRAKE RELEASE  
WITH BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
SM-1500, SM-1600 ALL	60C-024806-001

NEMA 4 UNITS  
WITH MOTOR BRAKE RELEASE  
WITHOUT BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
SM-1510,70	68C-017138-003
SM-1520	68C-017138-005
SM-1530,50, SM-1630,50	68C-017138-001
SM-1540,60, SM-1640,60	68C-017138-009
SM-1590	68C-017138-006

NEMA 4 UNITS  
WITH MOTOR BRAKE RELEASE  
WITH BUILT-IN AD-8200 AMPLIFIER

MODEL	PART NUMBER
SM-1510,70	68C-025134-001
SM-1520	68C-025134-002
SM-1530,50, SM-1630,50	68C-025134-003
SM-1590	68C-025134-004

MOTOR SELECTION ITEM 15

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK
MODEL				
SM-1510	61B-021200-002	23B-020702-001	61B-021200-002	23B-020702-001
SM-1520	61B-021200-004	23B-011999-002	61B-021200-004	23B-011999-002
SM-1530, SM-1630	61B-021200-003	23B-020700-001	61B-021200-003	23B-020700-001
SM-1540, SM-1640	61B-021694-001	61B-021089-002	61B-021694-001	61B-021089-003
SM-1550, SM-1650	61B-021200-005	61B-021240-001	61B-021200-005	61B-021240-001
SM-1560, SM-1660	61B-021694-002	61B-021089-001	61B-021694-002	61B-021089-004
SM-1570	61B-021200-001	23B-020701-001	61B-021200-001	23B-020701-001
SM-1580	23B-012722-001	NOT AVAILABLE	23B-012722-001	NOT AVAILABLE
SM-1590	61B-021200-006	23B-018106-002	61B-021200-006	23B-018106-002

CAPACITOR and MOUNTING HARDWARE SELECTION ITEMS 26, 27 and 28

MODEL	CAPACITOR DESCRIPTION	CAPACITOR PART NUMBER	CAPACITOR MTG. BRACKET	MOUNTING SCREWS DESCRIPTION	SCREW PART NUMBER
SM-1510	5uf, 330 Vac	24B-029812-005	24B-029943-103	8-32 x .88 long	54A-015033-088
SM-1520	30uf, 236 Vac	24B-029812-009	24B-029943-111	8-32 x 2.75 long	54A-015033-275
SM-1530, SM-1630	10uf, 330 Vac	24B-029812-008	24B-029943-103	8-32 x 2.50 long	54A-015033-250
SM-1550, SM-1650	3uf, 440 Vac	24B-029812-004	24B-029943-103	8-32 x 1.00 long	54A-015033-100
SM-1570	1.5uf, 440 Vac	24B-029812-002	24B-029943-103	8-32 x .50 long	54A-015033-050
SM-1590	7.5uf, 440 Vac	24B-029812-006	24B-029943-111	8-32 x 1.50 long	54A-015033-150

NEMA 12 GEAR HOUSING (ITEM 22)

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	COVER (ITEM 41)
ACTUATOR MODEL					
SM-1510, 20, 30, 50, 70, 90	60D-005914-001	60D-005914-001	60D-015375-001	60D-015375-001	60C-005916-001
SM-1540, 60	60D-005914-001	60B-021360-001	60D-015375-001	60D-015375-004	60C-005916-001
SM-1580	60C-017188-001	NOTE #2	60C-017188-002	NOTE #2	60C-005916-001
SM-1630, 50	60D-022670-001	60D-022670-001	60D-015375-002	60D-015375-002	60C-016393-001
SM-1640, 60	60D-022670-001	60B-021360-002	60D-015375-002	60D-015375-005	60C-016393-001

NEMA 12

ACTUATOR CONFIGURATION	UNITS WITH 2A GEARING		UNITS WITH 2B GEARING		COVER (ITEM 41)
	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	
ACTUATOR MODEL					
SM-1510, 20, 30, 50, 70, 90	60C-022077-001	60C-022077-001	60C-022078-001	60C-022077-002	60C-022078-002
SM-1540, 60	60C-022077-001	60C-022077-005	60C-022078-001	60C-022077-002	60C-022078-002
SM-1580	60C-022077-009	NOTE #2	60C-022078-001	60C-022077-010	60C-022078-002

NEMA 4 and EXPLOSIONPROOF GEAR HOUSING (ITEM 22)

ACTUATOR CONFIGURATION	NO MOTOR BRAKE NO HANDCRANK	WITH MOTOR BRAKE NO HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	COVER (ITEM 41)
ACTUATOR MODEL					
SM-1510, 20, 30, 50, 70, 90	60D-018267-001	60D-018267-001	60D-016586-001	60D-016586-001	60C-018268-001
SM-1540, 60	60D-018267-001	60B-021091-001	60D-016586-001	60D-016586-006	60C-018268-001
SM-1580	60D-018279-001	NOTE #2	60D-016586-007	NOTE #2	60C-018268-001
SM-1630, 50	60D-018914-001	60D-018914-001	60D-016586-004	60D-016586-004	60C-018269-001
SM-1640, 60	60D-018914-001	60B-021091-002	60D-016586-004	60D-016586-008	60C-018269-001

NEMA 4

ACTUATOR CONFIGURATION	UNITS WITH 2A GEARING		UNITS WITH 2B GEARING		COVER (ITEM 41)
	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	NO MOTOR BRAKE WITH HANDCRANK	WITH MOTOR BRAKE WITH HANDCRANK	
ACTUATOR MODEL					
SM-1510, 20, 30, 50, 70, 90	60C-022077-003	60C-022077-003	60C-022078-003	60C-022077-004	60C-022078-004
SM-1540, 60	60C-022077-003	60C-022077-007	60C-022078-003	60C-022077-004	60C-022078-004
SM-1580	60C-022077-011	NOTE #2	60C-022078-003	60C-022077-012	60C-022078-004

NOTES: #1 FOR SM-1500 ACTUATORS WITH 2A or 2B POWER GEARING AND HANDCRANK OPTION, REFER TO PROPER CHART.

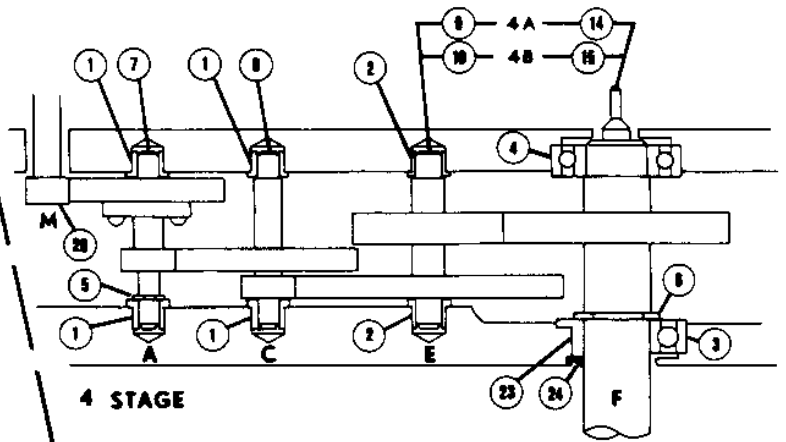
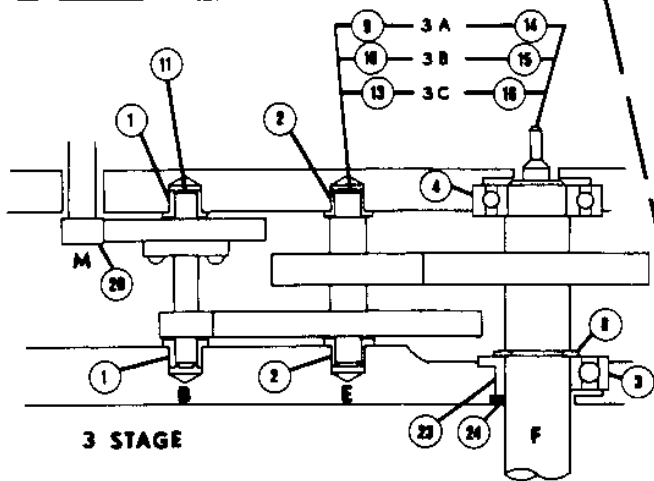
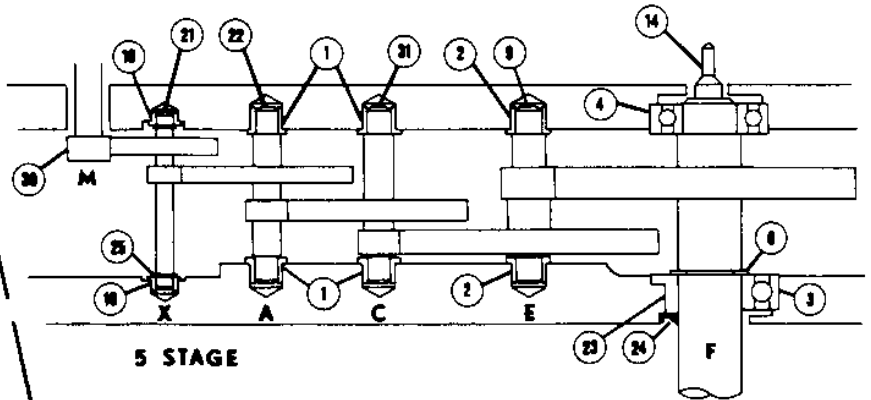
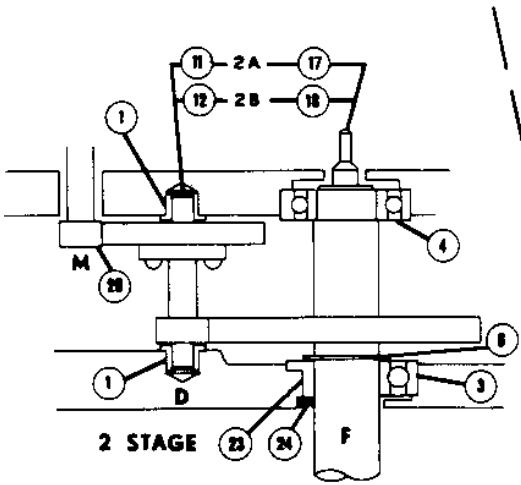
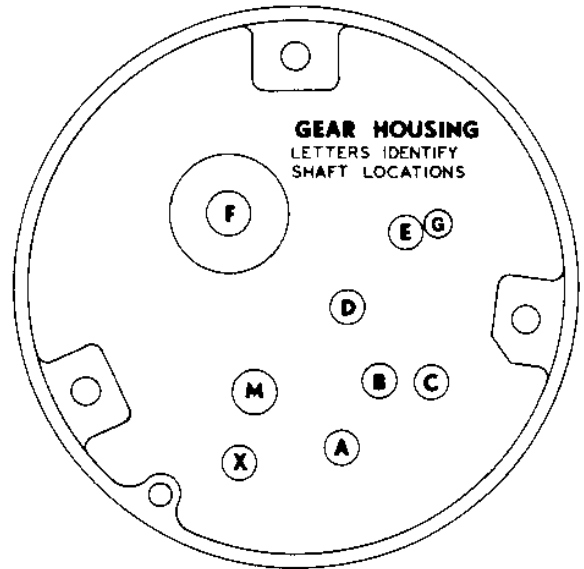
#2 SM-1580 IS NOT AVAILABLE WITH MOTOR BRAKE.

#3 EXPLOSIONPROOF UNITS ARE NOT AVAILABLE WITH HANDCRANK OPTION.



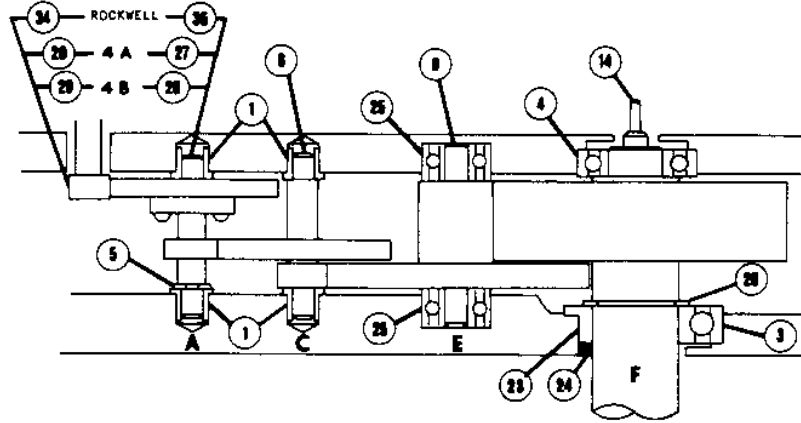
# SM 1500 SERIES POWER GEARING VARIATIONS AND LOCATIONS

SM 1510 SM 1530 SM 1550 SM 1570	SM 1520 SM 1590	SM 1540	SM 1560	SM 1580	POWER GEARING STAGES
← R.P.M. →					
.4	.5	.6	.8	1	5 A
1.5	2	3	3	3.5	4 A
3	4	6	6	7.5	4 B
5	6	10	10	12	3 A
10	14	20	20	25	3 B
18	24	36	36	44	3 C
28	38	56	56	70	2 A
36	49	73	73	90	2 B



# SM 1600 SERIES POWER GEARING VARIATIONS AND LOCATIONS

SM 1630 SM 1650	SM 1640	SM 1660	POWER GEARING STAGES
← R.P.M. →			
2	4	4	4 A
4	8	8	4 B



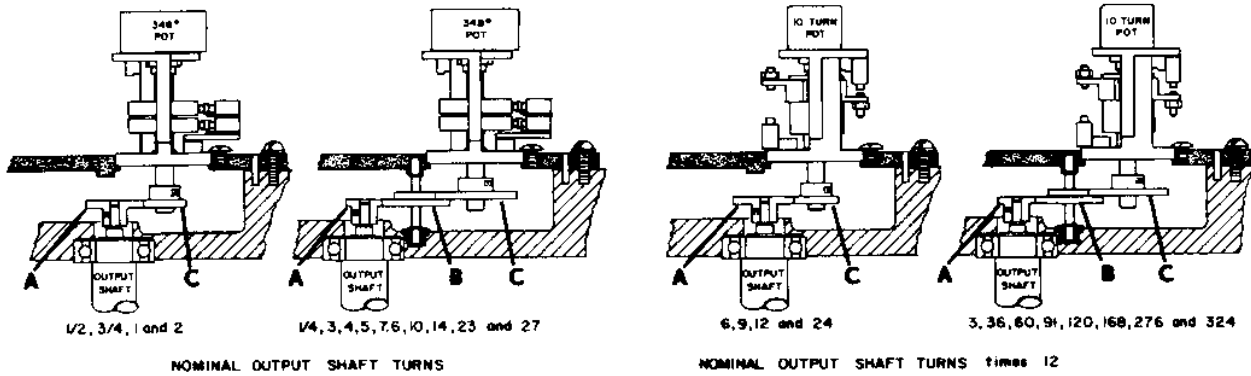
## POWER GEARING PARTS LIST

ITEM	DESCRIPTION	SM-1500 SERIES		SM-1600 SERIES	
		NEMA 12 INSIDE INDUSTRIAL HOUSING	NEMA 4 WATER-TIGHT and EXPLOSIONPROOF HOUSING	NEMA 12 INSIDE INDUSTRIAL HOUSING	NEMA 4 WATER-TIGHT and EXPLOSIONPROOF HOUSING
		PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER
1	Bushing	18B-SP1988-006	18B-SP1988-006	18B-SP1988-006	18B-SP1988-006
2	Bushing	18B-SP1988-007	18B-SP1988-007		
3	Bearing	17B-003813-012		17B-003813-031	
4	Bearing	17B-003813-010	17B-003813-010	17B-003813-010	17B-003813-010
5	C'Ring 5100-25	58B-014183-025	58B-014183-025	58B-014183-025	58B-014183-025
6	C'Ring 5100-75	58B-014183-075	58B-014183-075		
7	Gear Assembly	65A-022648-001	65A-022648-001		
8	Gear Assembly	65A-022649-001	65A-022649-001	65A-016691-001	65A-016691-001
9	Gear Assembly	65A-SM3265-001	65A-SM3265-001	65A-016856-001	65A-016856-001
10	Gear Assembly	65A-SM3265-002	65A-SM3265-002		
11	Gear Assembly	65A-200485-003	65A-200485-003		
12	Gear Assembly	65A-200485-001	65A-200485-001		
13	Gear Assembly	65A-SM3265-003	65A-SM3265-003		
14	Output Shaft Assembly	65A-005901-001	65A-005901-002	65A-009632-001	65A-009632-003
15	Output Shaft Assembly	65A-005902-001	65A-005902-002		
16	Output Shaft Assembly	65A-005903-001	65A-005903-002		
17	Output Shaft Assembly	65A-005899-001	65A-005899-002		
18	Output Shaft Assembly	65A-005900-001	65A-005900-002		
19	Bushing	18B-SP1988-011	18B-SP1988-011		
20	Motor Pinion	16B-003806-003	16B-003806-003	16B-003806-003	16B-003806-003
21	Gear Assembly	65A-016312-001	65A-016312-001		
22	Gear Assembly	65A-016313-001	65A-016313-001		
23	Bushing		18B-SP1988-017		18B-SP1988-034
24	Seal		19B-003815-019		19B-003815-020
25	Bearing			17B-003813-017	17B-003813-017
26	C'Ring 5100-100			58B-014183-100	58B-014183-100
27	Gear Assembly			65A-009637-001	65A-009637-001
28	Gear Assembly			65A-009637-002	65A-009637-002
29	Motor Pinion			16B-003806-021	16B-003806-021
30	Motor Pinion	16B-003804-011	16B-003804-011		
31	Gear Assembly	65A-200488-001	65A-200488-001		
32	Gear Assembly (NOTE #2)	65A-022076-001	65A-022076-001		
33	Bushing (NOTE #2)	18B-SP1988-011	18B-SP1988-011		
34	Motor Pinion 16 Tooth			16B-003806-027	16B-003806-027
35	Gear Assy (NOTE #3)			65A-027904-001	65A-027904-001

**NOTES:**

- 1 Output Shaft Assemblies are standard:  
SM-1500 --- .750" dia., 1.50" long with 3/16" keyway.  
SM-1600 --- 1.00" dia., 1.50" long with 1/4" keyway.  
(Consult factory for special shafts.)
- 2 Gear Assy (item 32) and Bushings (item 33) not shown are used in hole G when actuator is built with 2A or 2B gearing and a handcrank.
- 3 Motor Pinion (item 34) and Gear Assy (item 35) are used for 4 RPM Rockwell units.

# POTENTIOMETER AND LIMIT SWITCH GEARING



NOMINAL OUTPUT SHAFT TURNS	FEEDBACK GEAR RATIO	GEARS (NO. OF TEETH)			PART NUMBER		
		A	B	C	GEAR A	GEAR ASSY B	GEAR C
1/4	.346:1	60	52-90	36	168-003811-058	65A-007127-001	168-003811-036
1/2	.647:1	62	---	42	168-003811-062	---	168-003811-039
3/4	1.000:1	52	---	52	168-003811-049	---	168-003811-051
1	1.311:1	45	---	59	168-003811-042	---	168-003811-057
2	2.714:1	28	---	76	168-003811-023	---	168-003811-077
3	3.934:1	36	76-44	82	168-003811-033	65A-007127-002	168-003811-082
4	5.277:1	36	76-36	90	168-003811-033	65A-007127-003	168-003811-091
5	6.739:1	34	78-32	94	168-003811-030	65A-007127-004	168-003811-095
7.6	10.136:1	26	86-31	95	168-003811-019	65A-007127-005	168-003811-097
10	13.279:1	21	91-31	95	168-003811-016	65A-007127-006	168-003811-097
14	19.846:1	26	86-18	108	168-003811-019	65A-007127-008	168-003811-110
23	31.333:1	18	94-18	108	168-003811-011	65A-007127-009	168-003811-110
27	36.000:1	16	96-18	108	168-003811-007	65A-007127-010	168-003811-110

NOMINAL OUTPUT SHAFT TURNS	FEEDBACK GEAR RATIO	POTENTIOMETER USAGE 348° POT			LIMIT SWITCH RESET	POTENTIOMETER USAGE 10 TURN POT			LIMIT SWITCH RESET
		60%	90%	100%		60%	90%	100%	
1/4	.346:1	72.37°	108.57°	120.62°	3.5°	2.08T	3.12T	3.46T	70.0°
1/2	.647:1	141.44°	212.16°	235.74°	4.0°	4.06T	6.09T	6.77T	120.0°
3/4	1.000:1	208.80°	313.20°	348.00°	5.5°	6.00T	9.00T	10.00T	210.0°
1	1.311:1	273.74°	1.14T	1.26T	8.0°	7.86T	11.79T	13.11T	215.0°
2	2.714:1	1.57T	2.36T	2.62T	15.0°	16.28T	24.42T	27.14T	535.0°
3	3.934:1	2.28T	3.42T	3.80T	25.0°	23.60T	35.40T	39.34T	1.9T
4	5.277:1	3.06T	4.59T	5.10T	35.0°	31.66T	47.49T	52.77T	2.6T
5	6.739:1	3.91T	5.86T	6.51T	40.0°	40.43T	60.65T	67.38T	3.6T
7.6	10.136:1	5.88T	8.82T	9.79T	60.0°	60.81T	91.22T	101.36T	5.9T
10	13.279:1	7.70T	11.55T	12.83T	75.0°	79.77T	119.51T	132.79T	6.5T
14	19.846:1	11.51T	17.26T	19.18T	112.0°	119.07T	178.61T	198.46T	9.5T
23	31.333:1	18.17T	27.25T	30.28T	170.0°	187.99T	281.99T	313.33T	15.7T
27	36.000:1	20.87T	31.31T	34.79T	200.0°	216.00T	324.00T	360.00T	17.5T

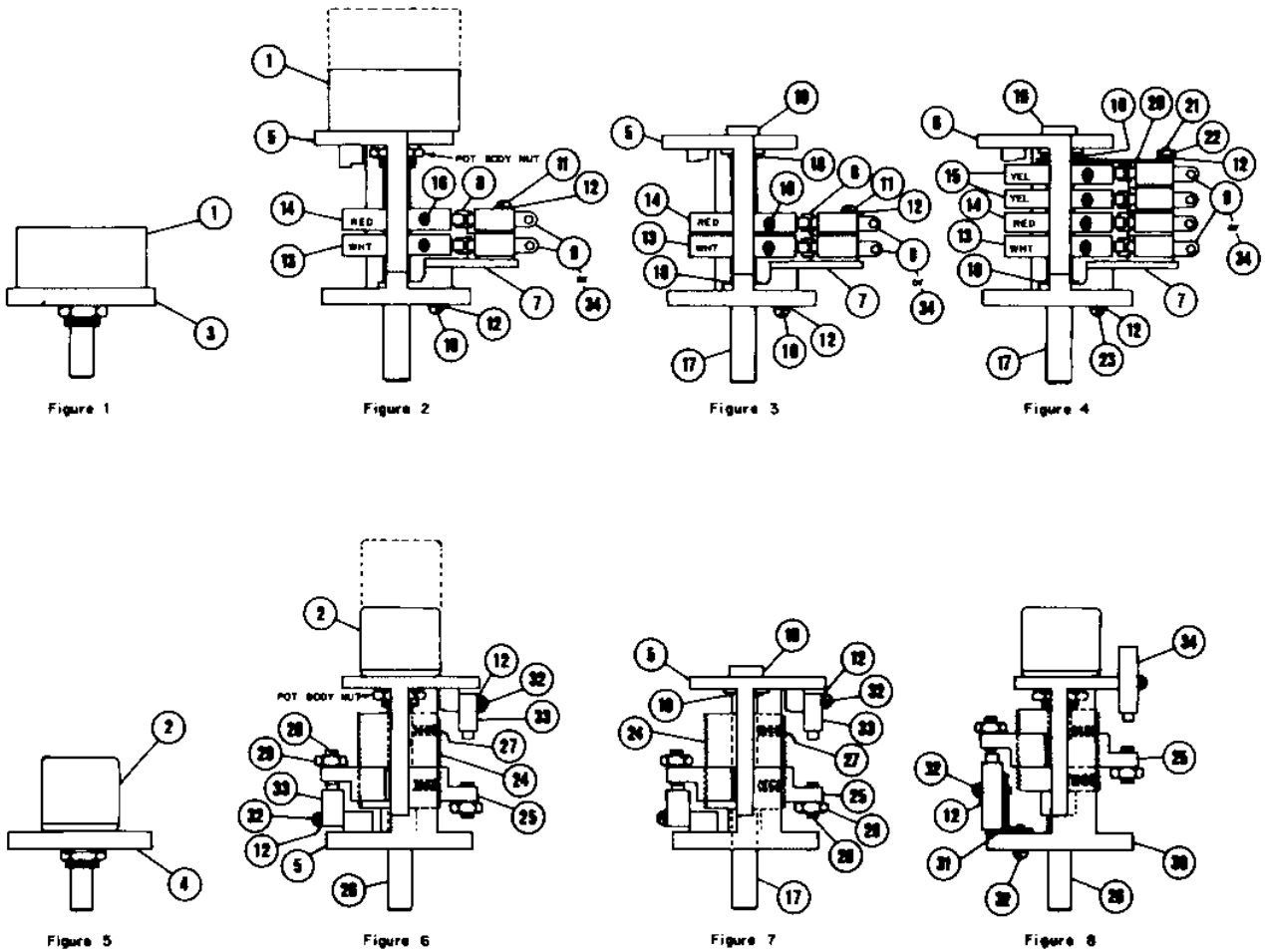
**LIMIT SWITCH RESET:**

THE MAXIMUM REVERSE ROTATION REQUIRED OF THE ACTUATOR OUTPUT SHAFT TO RESET THE END OF TRAVEL POSITION LIMIT SWITCH AFTER IT HAS BEEN TRIPPED.

**MAXIMUM RECOMMENDED OUTPUT SHAFT ROTATION:**

THE MAXIMUM RECOMMENDED OUTPUT SHAFT ROTATION IS 90% OF THE FEEDBACK POTENTIOMETER. USING MORE THAN 90% OF THE POT WILL CAUSE OVERLAP OF THE CAM OPERATED LIMIT SWITCHES AND COULD CAUSE BRAKAGE OF A TEN TURN POTENTIOMETER.

# POTENTIOMETER AND LIMIT SWITCH ASSEMBLIES



## ITEMIZED PARTS LIST

ITEM	DESCRIPTION	PART NUMBER
1	POTENTIOMETER, 1 TURN, 1K	34C-015848-001
	POTENTIOMETER, 1 TURN, TANDEN, 1K/1K	34B-003956-026
	POTENTIOMETER, 1 TURN, 10K	34B-100032-014
2	POTENTIOMETER, 10 TURN, 1K	34B-100033-001
	POTENTIOMETER, 10 TURN, TANDEN, 1K/1K	34B-100033-007
	POTENTIOMETER, 10 TURN, 10K	34B-100033-002
3	POT MOUNTING DISC (for 1 turn pot)	61A-SM3304-001
4	POT MOUNTING DISC (for 10 turn pot)	61A-SM3304-003
5	MOUNTING FRAME	14C-008600-001
6	MOUNTING FRAME (4 switch only)	61A-009180-001
7	SWITCH MOUNTING PLATE	13A-010187-001
8	SWITCH LEVER	46B-004053-406
9	LIMIT SWITCH (SPDT)	46B-004053-405
10	2-56 x .50 lg. RD. HD. SCREW	54A-015003-050
11	2-56 x .62 lg. RD. HD. SCREW	54A-015003-062
12	#2 STAINLESS	56A-015160-002
13	CAM (WHITE)	14B-SM2341-001
14	CAM (RED)	14B-SM2341-004
15	CAM (YELLOW)	14B-SM2341-007
16	8-32 x .38 lg. SET SCREW	54A-015037-038
17	SHAFT (units without potentiometer)	62A-005942-001
18	2"RING 5133-25	58A-024086-001
19	BUSHING	18B-SP1988-005
20	SWITCH SUPPORT PLATE	61A-014663-001
21	2-56 x .88 lg. THRD. STOCK (3 sw units)	54A-015088-001
	2-56 x 1.19 lg. THRD. STOCK (4 sw units)	54A-015539-119
22	2-56 NUT	55A-015088-001
23	2-56 x .31 lg. RD. HD. SCREW (4 sw units)	54A-015033-031
24	MULTI-TURN SCREW	61A-006804-001
25	TRAVEL NUT	14B-008602-001
26	SHAFT	62A-006806-001
27	8-32 x .25 lg. SET SCREW	54A-015037-025
28	8-32 x .50 lg. SET SCREW	54A-015037-050
29	8-32 NUT	55A-015038-001
30	MOUNTING FRAME (for DPDT switches)	14C-014391-001
31	SWITCH MOUNTING BRACKET	13A-014392-001
32	2-56 x .38 lg. RD. HD. SCREW	54A-015003-038
33	LIMIT SWITCH (SPDT)	46B-004053-409
34	LIMIT SWITCH (DPDT)	46B-004053-414

## COMPLETE ASSEMBLY

FIGURE	DESCRIPTION	PART NUMBER
(FIGURES 1 thru 4 are single turn assemblies)		
1	1K POT AND MOUNTING DISC	68A-007162-003
	10K POT AND MOUNTING DISC	68A-007162-004
2	1K POT, 2 SWITCHES (SPDT)	68B-018200-001
	1K POT, 3 SWITCHES (SPDT)	68B-018200-002
	1K POT, 4 SWITCHES (SPDT)	68B-018200-003
	1K POT, 2 SWITCHES (DPDT)	68B-018200-004
	1K/1K TANDEN POT, 2 SWITCHES (SPDT)	68B-018200-009
	10K POT, 2 SWITCHES (SPDT)	68B-018200-017
3	NO POT, 2 SWITCHES (SPDT)	68B-018200-006
	NO POT, 2 SWITCHES (DPDT)	68B-018200-038
4	NO POT, 3 SWITCHES (SPDT)	68B-018200-007
	NO POT, 4 SWITCHES (SPDT)	68B-018200-008
(FIGURES 5 thru 8 are ten turn assemblies)		
5	1K POT AND MOUNTING DISC	68A-007162-005
	10K POT AND MOUNTING DISC	68A-007162-006
6	1K POT, 2 SWITCHES (SPDT)	68B-006800-001
	10K POT, 2 SWITCHES (SPDT)	68B-006800-002
	1K/1K TANDEN POT, 2 SWITCHES (SPDT)	68B-006800-046
7	NO POT, 2 SWITCHES (SPDT)	68B-006800-003
8	1K POT, 2 SWITCHES (DPDT)	68B-006800-026
	NO POT, 2 SWITCHES (DPDT)	68B-006800-032
<p>NOTE:                      DUE TO THE MANY CONFIGURATIONS POSSIBLE NOT ALL ARE LISTED.                      ONLY STANDARD POTENTIOMETER VALUES ARE LISTED.                      CONSULT FACTORY FOR OTHER COMBINATIONS.</p>		

TROUBLE-SHOOTING  
SM-1500/1600 ACTUATOR WITHOUT BUILT-IN AMPLIFIER

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Motor won't run in either direction.	<ol style="list-style-type: none"> <li>1. Power not applied from source.</li> <li>2. Motor overheated and internal thermal switch tripped.</li> <li>3. Motor is burnt out.</li> <li>4. Motor brake not releasing.</li> <li>5. Both end of travel switches open or one open and one defective.</li> <li>6. Actuator output shaft stalled.</li> <li>7. Manual handcrank engaged or handcrank switch M.C.L.S. is open.</li> <li>8. Defective motor run capacitor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check source, fuses, wiring.</li> <li>2. Let motor cool, determine why overheating occurred.</li> <li>3. Replace motor and determine what caused burn out.</li> <li>4. Check brake and brake circuit.</li> <li>5. Adjust switch settings or replace defective switch.</li> <li>6. Check load on output shaft.</li> <li>7. Disengage handcrank to close switch.</li> <li>8. Replace capacitor.</li> </ol>
Motor hums but does not run.	<ol style="list-style-type: none"> <li>1. Actuator output shaft stalled.</li> <li>2. Power applied to both directions of rotation at same time.</li> <li>3. Jammed, damaged power gearing.</li> <li>4. Motor brake not releasing.</li> <li>5. Defective motor run capacitor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check load on output shaft.</li> <li>2. Apply power to only one direction of rotation at a time.</li> <li>3. Repair gearing.</li> <li>4. Check brake and brake circuit.</li> <li>5. Replace capacitor.</li> </ol>
Motor runs only one way.	<ol style="list-style-type: none"> <li>1. Power not applied for other direction.</li> <li>2. Power always applied to one direction and electrically stalls when applied for opposite direction.</li> <li>3. Open limit switch for other direction.</li> <li>4. Open motor winding.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct power problem.</li> <li>2. Correct power problem.</li> <li>3. Reset switch adjustment or replace.</li> <li>4. Replace motor.</li> </ol>
Motor runs, output shaft does not turn.	<ol style="list-style-type: none"> <li>1. Broken or worn power gearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair power gearing.</li> </ol>
Motor does not shut off at limit switch.	<ol style="list-style-type: none"> <li>1. Switch defective or wired wrong.</li> <li>2. Actuator is coasting thru switch cam dwell area and switch is resetting.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace switch or correct wiring.</li> <li>2. Change power gearing to slower speed. Add motor brake and brake circuit.</li> </ol>
Motor brake does not hold motor shaft.	<ol style="list-style-type: none"> <li>1. Brake disc worn.</li> <li>2. Set screws in brake hub are loose.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust brake air gap.</li> <li>2. Remove brake and tighten set screws.</li> </ol>
Motor brake does not release.	<ol style="list-style-type: none"> <li>1. Defective brake control circuit.</li> <li>2. No brake air gap.</li> <li>3. Defective brake coil.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace control circuit.</li> <li>2. Adjust air gap.</li> <li>3. Replace entire brake.</li> </ol>
Pot feedback signal not present at some position of actuator output shaft.	<ol style="list-style-type: none"> <li>1. Pot not aligned with end of travel switches and is being driven thru dead region.</li> <li>2. Pot signal is erratic or pot broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Align pot to range of actuator.</li> <li>2. Replace pot.</li> </ol>
Pot signal does not change as output shaft turns.	<ol style="list-style-type: none"> <li>1. Broken or burnt out pot.</li> <li>2. Feedback gear not turning pot shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace pot.</li> <li>2. Check gearing engagement and set screws in gear hubs.</li> </ol>
Pot signal is reversed for output shaft rotation.	<ol style="list-style-type: none"> <li>1. Pot is wired wrong to terminals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reverse wiring from ends of pot at actuator terminal block.</li> </ol>
Output shaft rotates wrong direction for CW and CCW input power.	<ol style="list-style-type: none"> <li>1. Wiring to actuator incorrect.</li> <li>2. Wiring from motor to terminals or switches is backward.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct field wiring.</li> <li>2. Correct internal actuator wiring.</li> </ol>
Water droplets inside motor area of actuator.	<ol style="list-style-type: none"> <li>1. Condensation caused by temperature variations and humidity.</li> <li>2. Water entering actuator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Add heater and thermostat circuit or keep existing circuit energized.</li> <li>2. Keep cover tight, check conduit entry.</li> </ol>

## AD-8200 SERIES ( BUILT-IN ) AMPLIFIER

### DESCRIPTION:

The built-in AD-8200 Series Amplifiers are used to control the actuator output shaft position, in relation to the CUSTOMER SUPPLIED 4 to 20 mA COMMAND SIGNAL.

The amplifier requires two input signals. One signal is from the CUSTOMER SUPPLIED 4 to 20 mA COMMAND SIGNAL and the other is the FEEDBACK SIGNAL from the actuator.

The 4 to 20 mA COMMAND SIGNAL is converted to a .8 V dc to 4.0 V dc signal at the amplifiers input, by use of a 200 ohm shunt resistor. The FEEDBACK SIGNAL is obtained from a 1000 ohm potentiometer built into the actuator. The potentiometer has a dc voltage applied to it from the amplifier. The voltage applied to the potentiometer is adjustable with the HI-TRIM and LO-TRIM adjustments located on the amplifier circuit board. The feedback potentiometer is gear driven from the actuator output shaft and the voltage derived from it changes as the output shaft is rotated. The LO-TRIM is used to adjust the minimum signal from the feedback potentiometer to a level of .8 V dc and the HI-TRIM is used to adjust the maximum signal from the feedback potentiometer to a level of 4.0 V dc. When properly adjusted for the range of the actuator output shaft, the feedback signal and the command signal will be equal at the minimum and maximum voltage levels and the actuator output shaft will follow the command signal in a linear fashion.

If the two signals are equal, the amplifier's output circuit is "OFF" and both light emitting diodes (LED 1 and LED 2) on the amplifier will be "OFF". When the COMMAND SIGNAL is greater than the FEEDBACK SIGNAL, LED 2 will be turned "ON" and power from the amplifier will drive the actuator in the "increase" direction. When the COMMAND SIGNAL is less than the FEEDBACK SIGNAL, LED 1 will be turned "ON" and power from the amplifier will drive the actuator in the "decrease" direction. The actuator motor will run until the FEEDBACK SIGNAL is equal to the COMMAND SIGNAL (within the amplifier DEADBAND setting) and the LED turns "OFF" or until an end of travel limit switch is tripped in the actuator. If a limit switch is tripped and the LED is "ON", the HI and LO TRIM adjustments are not properly adjusted. The DEADBAND adjustment on the amplifier is used to adjust the amplifier's sensitivity to the difference of the COMMAND and FEEDBACK SIGNALS. It must be adjusted to stabilize the AMPLIFIER/ACTUATOR loop, in final installation with the CUSTOMER COMMAND SIGNAL.

A DYNAMIC BRAKE CIRCUIT is built into the amplifier. The function of this circuit is selected with a jumper for "ON" or "OFF" by the customer. When the jumper is in the "OFF" position the circuit is not used. When the jumper is in the "ON" position, the circuit causes both motor directional outputs to be turned "ON" for a period of 130 ms whenever the amplifier nulls. This electrically stalls the motor by applying power to both the INCREASE and DECREASE windings at the same time to prevent motor coasting. The use of the DYNAMIC BRAKE CIRCUIT depends upon the number of actuator positioning changes per hour, as each time the circuit is energized heat will be generated within the motor. Excessive motor heat will cause the thermal overload in the motor to shut off the motor. The overload will reset automatically when the motor windings cool down.

The amplifier has a built-in LOSS OF SIGNAL (LOS) detection circuit. This circuit monitors the 4 to 20 mA COMMAND SIGNAL. Loss of signal may be either a broken wire or a "low command signal". The detection level is adjustable from 0 to 7 mA with the "LOS" pot on the amplifier. When in "LOS", a jumper on the amplifier is selected to cause the actuator to "RUN TO HI LIMIT, LOCK IN PLACE" or "RUN TO LOW LIMIT". Adjusting the "LOS" pot for a signal detection level above 4 mA will not allow normal signal control at 4.0 ma. The "LOS" pot is normally adjusted for a 3.6 mA trip point.

If the actuator has a built-in motor brake, the brake coil is energized from the amplifier each time one of the LEDs turn "ON" to drive the motor. When the LED turns "OFF" the motor brake friction disc stops the motor. This is not the same function as "DYNAMIC BRAKING" previously described. When the actuator is supplied with a motor brake, the DYNAMIC BRAKE CIRCUIT JUMPER should be selected to the "OFF" position.

## START-UP

### Actuators with built-in AD-8200 Series Amplifier

(Actuators without built-in AD-8200 Series Amplifier -- Refer to page 10)

The ACTUATOR/AMPLIFIER combination has been factory calibrated and only minor adjustments will need to be made during installation.

### INITIAL INSTALLATION CALIBRATION

- 1) If the actuator has been mounted and coupled to the controlled equipment, remove the coupling from the actuator output shaft to the driven unit.
- 2) Apply a COMMAND SIGNAL that can be varied from 0 to 20 mA.  
Adjust the signal for 12.0 mA.
- 3) Apply INPUT POWER. A light emitting diode (LED) on the amplifier will turn "ON" and the actuator output shaft will be rotated to mid-travel. Upon positioning to this set point, the LED will turn "OFF" and the output shaft will stop.
- 4) Set the COMMAND SIGNAL to 4.0 mA. The actuator output shaft will rotate in the "DECREASE" direction until LED 1 turns "OFF" or the "DECREASE" END OF TRAVEL LIMIT SWITCH (in the actuator) is tripped. Adjust "LO TRIM" (on the amplifier) to just turn "OFF" LED 1 before the limit switch trips. If the switch trips before LED 1 turns "OFF", adjust "LO TRIM" to turn LED 1 "OFF" with the switch tripped.
- 5) Determine the amount of actuator output shaft rotation needed for the travel of the driven unit.
- 6) Mark the output shaft with a pencil and slowly give the amplifier an INCREASING COMMAND SIGNAL while counting the output shaft revolutions. When the shaft rotation corresponds to the rotation required for the driven unit, adjust the "INCREASE" END OF TRAVEL LIMIT SWITCH to just trip.
- 7) Set the COMMAND SIGNAL to 20.0 mA.
- 8) Adjust "HI TRIM" on the amplifier to just turn "OFF" LED 2 before the switch trips.
- 9) Repeat the "LO" and "HI TRIM" adjustments until the actuator stops at each end of travel, just before the ends of travel switches are tripped and the LEDs turn "OFF".
- 10) Set the COMMAND SIGNAL to 4.00 mA and allow the actuator to stop running.
- 11) With the actuator output shaft and the driven units shaft at the 4.00 mA position, couple the shafts together.
- 12) Adjust the COMMAND SIGNAL to various settings between 4 and 20 mA and adjust the "DEADBAND" potentiometer (on the amplifier) for best response without having the actuator oscillate at set points.
- 13) Repeat the "LO" and "HI TRIM" adjustments until LED 1 and LED 2 TURN "OFF" just before their respective end of travel limit switch trips.
- 14) Select the "LOS" jumper for the desired function - RUN HI, LOCK-IN-PLACE or RUN LO.
- 15) Adjust the COMMAND SIGNAL to 3.6 mA. The "LOS" function selected should occur. If it doesn't, adjust "LOS TRIM" to trip at 3.6 mA.

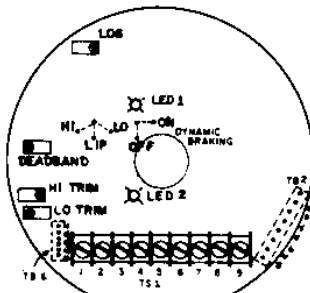
### REVERSING THE ACTUATOR ROTATION WITH RESPECT TO AN INCREASING COMMAND SIGNAL

- 1) Refer to NOTE 2 on PAGE 22.
- 2) Perform INITIAL INSTALLATION CALIBRATION.

### CALIBRATION IF LIMIT SWITCHES HAVE BEEN ALTERED or POTENTIOMETER REPLACED

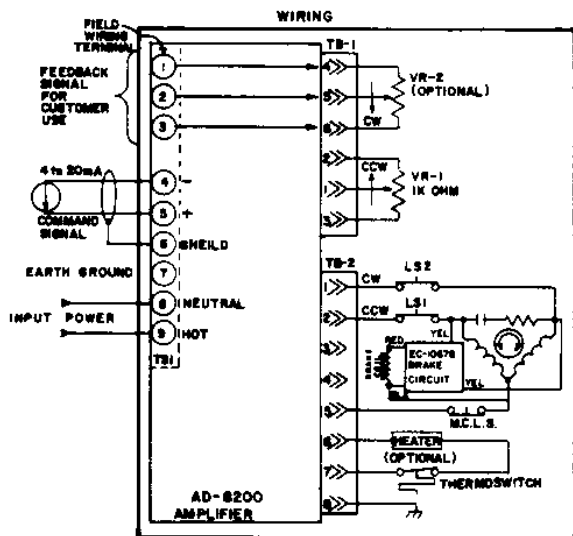
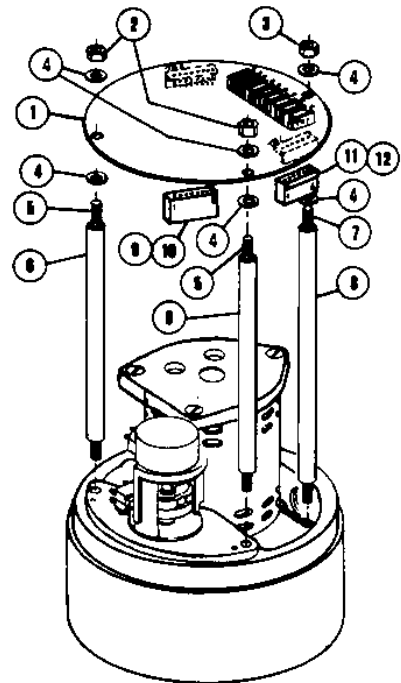
- 1) If an INCREASING COMMAND SIGNAL is to result in "CCW" rotation of the actuator output shaft.
  - A) Remove plug TB-1 from the amplifier.
  - B) Loosen the pot bushing nut holding the feedback pot VR-1.
  - C) Rotate the body of the pot until 50 ohms is measured from PIN 1 to PIN 3 of TB-1.
  - D) Tighten the pot bushing nut.
  - E) Adjust limit switch LS-2 to trip at this point.
  - F) Insert plug TB-1 on the amplifier and perform INITIAL INSTALLATION CALIBRATION.
- 2) If an INCREASING COMMAND SIGNAL is to result in "CW" rotation of the actuator output shaft.
  - A) Same as above except step E - change LS-2 to read LS-1.

# ACTUATOR WITH BUILT-IN AMPLIFIER

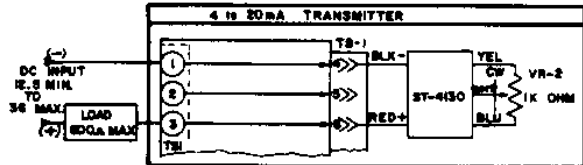


AD-B200  
AMPLIFIER TOP  
VIEW

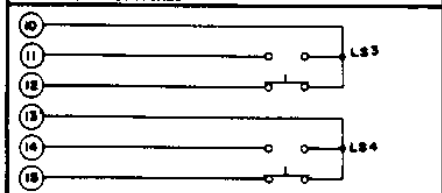
ITEM	DESCRIPTION	PART NUMBER	QTY
1	AMPLIFIER AD-8210 (120 Vac) AD-8220 (240 Vac)	70A-023903-001 70A-023903-002	1
2	10-24 ESM Nut	588-024244-206	2
3	8-32 ESM Nut	588-024244-205	1
4	Fiber Washer	568-005479-003	6
5	10-24x.93 long stud	61A-025129-001	2
6	Spacer 5.911 long	61A-025128-001	2
7	8-32x.06 long stud	61A-025130-001	1
8	Spacer 7.281 long	61A-025128-003	1
9	Connector 8 Pin	45B-019344-108	1
10	Crimp Terminals	45B-019344-201	8
11	Connector 6 Pin	45B-023445-806	1
12	Crimp Terminals	45B-023445-101	6



### OPTIONS



### LIMIT SWITCHES



### NOTES:

- The SM-1510, 20, 30/AD-8210 and the SM-1630/AD-8210 require 120 Vac INPUT POWER. The SM-1550, 70, 90/AD-8220 and the SM-1650/AD-8220 require 240 Vac INPUT POWER.  
**FUSING IN NOT PROVIDED WITHIN THE ACTUATOR/AMPLIFIER:**  
Fuse the INPUT POWER LINE for a value slightly higher than the units rating. In most cases a 2 AMP SLO-BLO fuse will be the proper size.
- An INCREASING COMMAND SIGNAL will result in "CCW" ROTATION of the ACTUATOR OUTPUT SHAFT (as viewed facing the output shaft end).  
If it is desired that an INCREASING COMMAND SIGNAL result in "CW" ROTATION of the ACTUATOR OUTPUT SHAFT, it will be necessary to interchange the MOTOR DIRECTION wires to PINS 1 and 2 in the PLUG of TB-2 and also the POTENTIOMETER wires to PINS 2 and 3 in the PLUG of TB-1. After reversing the wires and with LIMIT SWITCH LS-1 just tripped, remove PLUG TB-1 from the AMPLIFIER, loosen the pot bushing nut and rotate the body of VR-1 until 50 ohms is read from PIN 1 to PIN 3 of PLUG TB-1. Tighten the pot nut and insert the plug into the amplifier connector.
- CALIBRATION: Refer to AMPLIFIER/ACTUATOR CALIBRATION.
- When VR-2 is supplied for FEEDBACK (for customer use), resistance as measured between FIELD WIRING TERMINALS 1 and 2 will be INCREASING as the ACTUATOR OUTPUT SHAFT rotates in the "CW" direction.
- OPTIONAL TRANSMITTER:  
The ST-4130 4 to 20mA TRANSMITTER wired as shown will result in an INCREASING SIGNAL for "CW" rotation of the ACTUATOR OUTPUT SHAFT. Operation of the TRANSMITTER requires an EXTERNAL DC POWER SUPPLY with an output in the range of 12.5 Vdc (MIN) to 36.0 Vdc (MAX) and a LOAD connected in series with one lead from the power supply.

$$\text{POWER SUPPLY VOLTAGE} - 12V = \frac{\text{LOAD}}{0.020A} = \text{LOAD RESISTANCE MAX.}$$

Connect (-) to FIELD WIRING TERMINAL 1 and (+) to FIELD WIRING TERMINAL 3.  
With the ACTUATOR at it's "CCW" end of travel, adjust VR-2 pot body for 50 ohms from the WHITE to BLUE pot wires. Adjust "ELEVATION" on the TRANSMITTER for 4.00mA output. With the ACTUATOR at it's "CW" end of travel, adjust "RANGE" for 20.0mA output. Repeat the "ELEV" AND "RANGE" adjustments.

To reverse the TRANSMITTER OUTPUT and cause the signal to INCREASE for "CCW" rotation, interchange the BLUE AND YELLOW WIRES AT THE POT TERMINALS. Adjust the body of the pot for 50 ohms across the WHITE and BLUE pot wires with the ACTUATOR at it's "CW" end of travel. Adjust "ELEV" for 4.00mA output. With the ACTUATOR at it's "CCW" end of travel adjust "RANGE" for 20.0mA output.

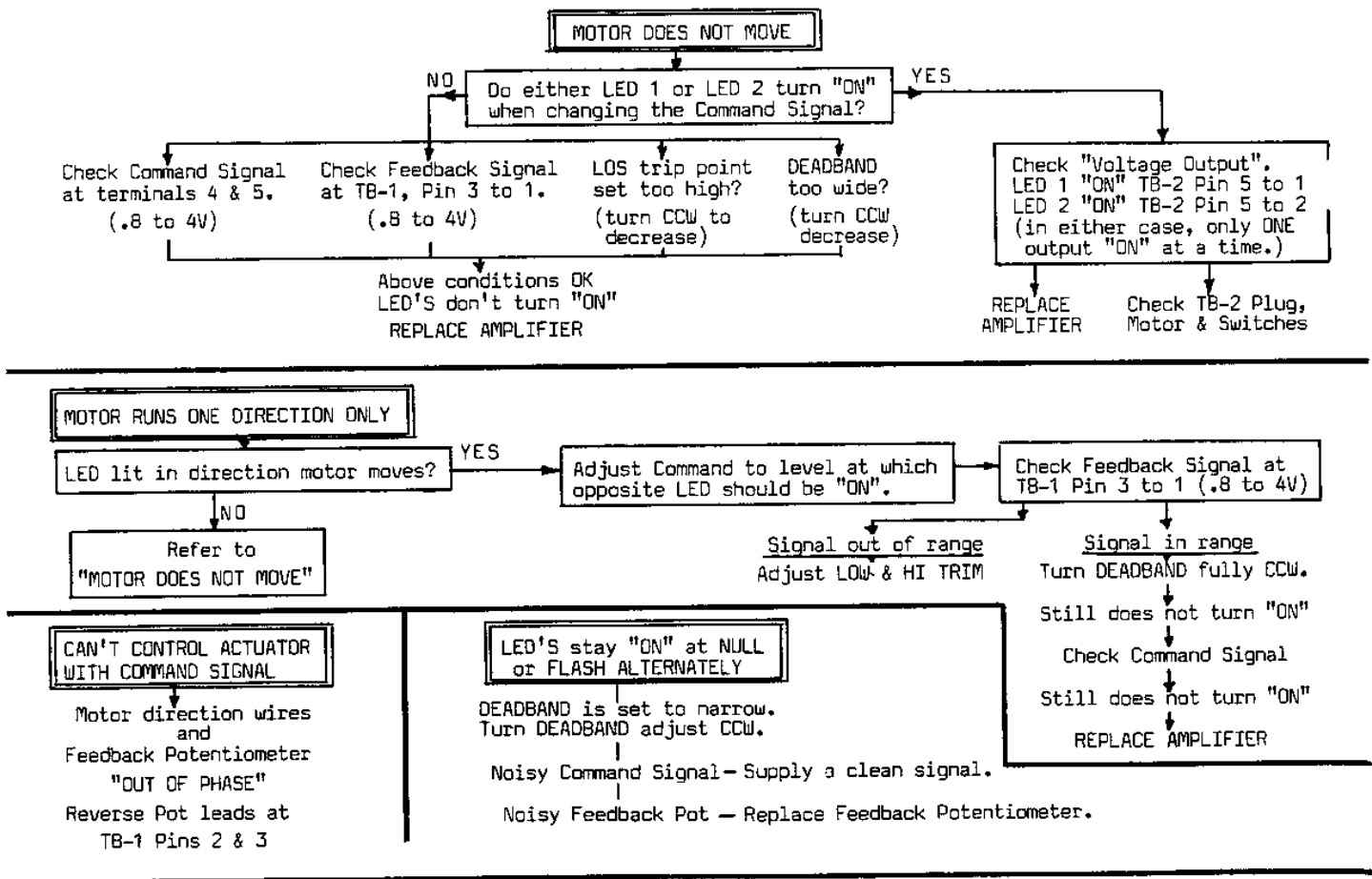
- Shielded wiring is recommended for all incoming COMMAND and FEEDBACK SIGNAL wiring. Connect the shield to TERMINAL 6.
- OPTIONAL LIMIT SWITCHES LS-3 and LS-4 are available on "CAM" activated switch assemblies only and may be adjusted with YELLOW CAMS to trip anywhere within the range of the actuators end of travel limits.
- SWITCH M.C.L.S. (MANUAL CRANK LIMIT SWITCH) is only used on units equipped with the MANUAL HANDCRANK OPTION. The switch is normally closed and when the handcrank is engaged the motor power circuit is opened.
- OPTIONAL HEATER and THERMOSWITCH:  
The HEATER is powered thru the THERMOSWITCH from the AMPLIFIERS LINE POWER. The THERMOSWITCH is CLOSED at 90°F and OPENS at 110°F. 120Vac units use a 30 WATT HEATER and 240Vac units use a 75 WATT HEATER.
- Refer to IN-0530 for further information on the AD-8200 SERIES AMPLIFIER.



TROUBLE-SHOOTING  
ACTUATOR WITH AD-8200 BUILT-IN AMPLIFIER

FUNCTION TO TEST	MEASUREMENT TO BE MADE	CORRECTION TO MAKE
INPUT POWER "ON".	Line voltage at terminals 8 to 9.	Check INPUT POWER source.
Command set to 12.0mA	2.4V dc, terminal 4 (-), terminal 5 (+)	Check Command signal and resistor R23 (200 ohms) on amplifier.
Feedback Power Supply	TB-1 Pin 3 (-), to Pin 2 (+) should read 15V dc or less depending on settings of LOW and HI TRIM pots on amp.	Read nothing -- Replace amplifier. Read 15V dc -- Check pot VR-1 in actuator and plug connections.
Feedback Pot Signal	TB-1 Pin 3 to Pin 1 Should read signal input from VR-1 The signal changes as actuator is running.	No signal or erratic Check pot VR-1 in actuator and plug.
Decrease the Command Signal to cause LED 1 to turn "ON" then increase to turn "OFF".	With LED 1 "ON" measure Voltage Output TB-2 Pin 5 to Pin 1. *LED 1 "OFF" read 0 volts out.	If output does not turn "ON" and "OFF". Replace amplifier.
Increase the Command Signal to cause LED 2 to turn "ON" then decrease to turn "OFF".	With LED 2 "ON" measure Voltage Output TB-2 Pin 5 to Pin 2. *LED 2 "OFF" read 0 volts out.	If output does not turn "ON" and "OFF". Replace amplifier.

\* With motor running, a voltage greater than "Voltage Output" will be present. -- caused by Motor/Capacitor phase shift.



## MAINTENANCE and PARTS REPLACEMENT

### \*\* WARNING - SHOCK HAZARD \*\*

Maintenance must be performed only by qualified personnel.  
Voltages hazardous to your health are applied to these actuators.  
De-energize all sources of power before removing actuator cover.  
Failure to follow these precautions may result in serious injury or death.

#### LUBRICATION

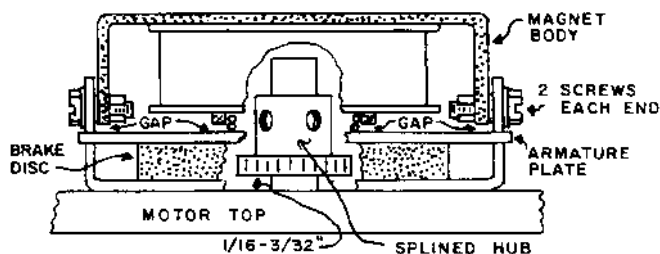
The gearing is permanently lubricated with AMOCO-RYKON PREMIUM GREASE #2 or equal. Re-lubrication is only required during repairs to the power gearing.

The bronze bushings are lubricated with a few drops of SAE-10 or 20 NON-DETERGENT oil, re-lubricate when repairs are made.

#### MOTOR BRAKE REPLACEMENT

Refer to page 11.

- 1) Remove 2 screws and lockwashers (3 & 4).
- 2) Remove brake ass'y (2) from motor top (13).
- 3) The brake hub is held to the motor shaft with 2 set screws. Loosen the set screws and remove the brake hub from the motor shaft.
- 4) Place the new brake hub on the motor shaft with the spline toward the motor top, positioning the hub 1/16 to 3/32" from the motor top. Tighten the set screws.
- 5) Place the new brake ass'y over the hub, engaging the brake disc with the spline hub.
- 6) Rotate the brake ass'y to align the mounting holes and secure with screws and lockwashers.
- 7) Remove the old brake coil wires at their terminations and connect the new wires.
- 8) Measure the brake gap using feeler gages and adjust if required.



#### "BRAKE GAP ADJUSTMENT"

When air gap between magnet body and armature plate exceeds .025" reset to .010".

Loosen 4 screws holding magnet body in place. Insert feeler gages between magnet body and plate. Push magnet body down against feeler gages and tighten 4 screws. Remove feeler gages and check brake operation.

#### MOTOR REPLACEMENT ac MOTORS

- 1) If the actuator has a built-in amplifier as shown on page 22, remove the amplifier. Refer to page 11.
- 2) Remove the motor brake (2) if supplied.
- 3) Remove 3 screws (14), motor top (13) Belleville washers (16) and motor stator (15).
- 4) Pull rotor with pinion gear out of housing.
- 5) Insert new rotor with pinion gear into housing.
- 6) Install new stator with the thermal overload (on one end of the windings) outward away from the housing. This may be opposite of the way the old stator was mounted. Care must be taken to prevent nicking or cutting the windings when guiding the stator over the rotor.
- 7) Place the Belleville washers (16) on top of the rotor bearing with the first washer "cupped" down to touch the outer race of the bearing and the second washer "cupped" upward.
- 8) Position the motor top over the motor, install the motor mounting screws and tighten evenly. The rotor must rotate freely.
- 9) Remove old motor wires and wire the new motor. The motor wire colors may or may not match the old motor. If the old motor was mounted with the thermal overload opposite of the new, the motor direction leads must be reversed as compared to the original wiring.
- 10) Install any other parts that were removed and test the actuator.

#### MOTOR REPLACEMENT dc MOTORS

- 1) IF MOTOR IS MOUNTED WITH ADAPTOR PLATE (33).
  - A) Remove 2 screws and lockwashers (34 & 10).
  - B) Remove motor with adaptor plate from housing.
  - C) Remove screws (35) holding motor to plate.
  - D) Mount new motor with pinion gear attached to its shaft, insert and tighten screws (35).
  - E) Mount motor and adaptor to housing with screws and lockwashers (34 & 10), tighten evenly.
  - F) Remove old motor wires and connect new wires.
  - G) Install any other parts removed and test.
- 2) IF MOTOR IS NOT MOUNTED USING ADAPTOR PLATE (33).
  - A) Remove feedback ass'y and feedback gearing.
  - B) Remove housing screws and washers (24 & 25).
  - C) Remove gear housing cover (41).
  - D) Remove motor mounting screws (35) from inside of actuator housing.
  - E) Install new motor with pinion gear attached and tighten screws (35) evenly.
  - F) Remove old motor wires, connect new wires.
  - G) Test actuator and align feedback for range.

## FEEDBACK GEARING REPLACEMENT

Refer to page 11

- 1) Remove 2 screws and lockwashers (9 & 10) holding mounting plate (7) to housing (22).
- 2) Carefully lift mounting plate (7) off of the locating dowel pins (8).
- 3) Refer to page 17. Depending upon the gear ratio, the feedback gearing will consist of only gears A and C or it will include gear assembly B.
- 4) Gear A is attached to the output shaft tip with either 2 set screws in its hub or it is pressed onto the tip and loctite is used to bond it. If loctite is used and removal is required, the gear will be destroyed. To remove it, apply heat and carefully pull the gear off without bending the shaft tip. If the gear is held with set screws, loosen them to remove the gear.
- 5) Gear C is held to the pot/switch shaft using 2 set screws in its hub. Loosen them to remove the gear.
- 6) Gear ass'y B consists of two gears pressed onto a shaft with retaining rings on each end to position it in the housing. If replacing this assembly, replace the complete assembly, do not attempt to salvage a gear or the shaft.
- 7) If the gear ratio is being changed and gear B is being added, a bushing must be installed in the housing (item 21 on page 12).
- 8) Changing the gear ratio to add or delete gear assembly B will change the rotation of the potentiometer/limit switch assembly in relation to the actuator output shaft. This will require re-wiring of the limit switches and potentiometer for proper direction of rotation. Failure to re-wire will result in switches not shutting off motor power when they are tripped and reverse phasing of the potentiometer signal.
- 9) Install the gearing in the reverse order and check for proper gear mesh. The gears should have at least 90% face width engagement. Lightly grease the gears. Test and align unit.

## POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT

Refer to page 11

- 1) Remove 3 truss head screws (11).
- 2) Lift the feedback ass'y off the mounting plate.
- 3) A gear is attached to the shaft on the bottom of the ass'y. Measure the distance from the bottom of the disc or frame to the outer face of the gear. Loosen 2 set screws in the gear hub and remove the gear from the shaft.
- 4) Place the gear on the new ass'y to the dimension measured above and tighten the set screws.
- 5) Insert the ass'y into the mounting plate, check gear mesh and install 3 truss head screws.
- 6) Using a 25 watt solder iron, transfer the wires from the old ass'y to the new, one at a time to prevent wiring errors.
- 7) Test and align the actuator.

## LIMIT SWITCH REPLACEMENT

Refer to page 18

Switches are mounted with screws, remove the screws, remove the switch, mount the new switch, transfer the wires from the old switch to the new.

Check the cam action with the switch and switch lever for proper operation.

Check the switch alignment for ends of travel.

## POTENTIOMETER REPLACEMENT

- 1) Perform POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT steps 1, 2 and 3.
- 2) Refer to page 18. The assembly will look like one of those shown. Perform step 3A, 3B, 3C or 3D.
- 3A) BUILT AS SHOWN IN Fig. 1
  - A) Remove the pot body nut and lockwasher.
  - B) Separate the potentiometer from the disc.
  - C) Measure the length of the old pot shaft.
  - D) Carefully cut the shaft of the new pot to the length of the old and de-burr the shaft.
  - E) Mount the pot to the disc using the new nut and lockwasher supplied.
  - F) Perform steps 4 thru 7 of POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT.
- 3B) BUILT AS SHOWN IN Fig. 5
  - A) Same as Fig. 1 instructions but pot is a 10 turn device, shaft does not need cutting.
- 3C) BUILT AS SHOWN IN Fig. 2
  - A) Loosen set screws holding the cams to the pot shaft. Observe the relation of the set screws to that of the dwell in the cams. The cams must be installed properly to allow access to the set screws in final adjustment.
  - B) Loosen the pot body nut and remove the pot from the frame. Replace cams if needed.
  - C) Insert the new pot into the top of the frame, guiding the shaft thru the lockwasher, pot nut, cams and bottom hole of the frame.
  - D) Tighten the pot nut and perform steps 4 thru 7 of POT/LIMIT SWITCH ASS'Y REPLACEMENT.
- 3D) BUILT AS SHOWN IN Fig. 6 or 8
  - A) Hold the frame and rotate shaft (26) "CW" until upper set screw (27) is visible.
  - B) Loosen the set screw and the pot body nut.
  - C) Remove the pot from the top of the frame.
  - D) If the travel nut needs replacing, turn shaft (26) until the lower set screw (27) is visible loosen the screw and remove the shaft. Install new nut with switch adjustment screws set so end of each screw is exposed 2 threads. Position the travel nut to mid-travel on the multi-turn screw. With the shoulder of the multi-turn screw touching the inside bottom of the frame, insert shaft (26). With the shaft extended .70" from the bottom of the frame tighten lower set screw (27).
  - E) Turn the shaft of the new pot to its center of travel (5 turns from either end) and insert into the frame guiding the shaft thru the lockwasher, nut and into the multi-turn screw. Tighten the pot body nut.
  - F) With the multi-turn screw just touching the inside bottom of the frame, tighten upper set screw (27).
  - G) Turn shaft (26) fully "CW" until the end stop of the pot is touched then turn it "CCW" 1/2 turn and set the lower adjusting screw to just trip the lower limit switch.
  - H) Turn the shaft (26) 9 revolutions "CCW" and set the upper adjusting screw to just trip the upper limit switch.
  - I) Turn the shaft (26) to position the assembly to mid-travel between the switches and perform steps 4 thru 7 of POTENTIOMETER/LIMIT SWITCH ASSEMBLY REPLACEMENT.

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