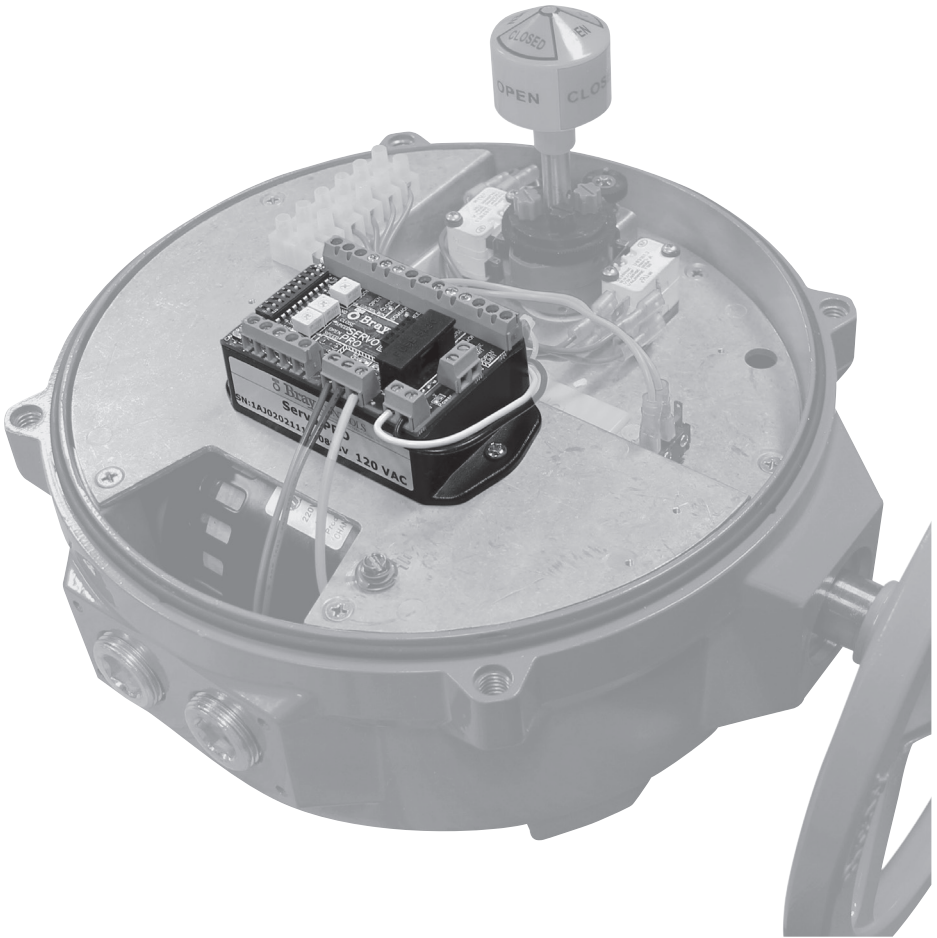




Your Global Flow Control Partner™

**Series 70**  
**SERVO PRO Version 3.0**  
Operation and Maintenance Manual







## Table of Contents

1.0	Safety Instructions - Definition of Terms . . . . .	2
1.1	Hazard-free Use . . . . .	2
1.2	Qualified Personnel . . . . .	2
1.3	Intended Use . . . . .	3
1.4	Warranty Information . . . . .	3
2.0	Description of Operation. . . . .	3
2.1	Terminal Connections . . . . .	4
2.2	Configuration Switches . . . . .	5
2.3	Configuration Switch Function Description. . . . .	6
2.4	Factory Default Settings for Servo Pro Rev F or Higher . . . . .	6
2.5	Previous Revisions of Servo Pro. . . . .	7
3.0	Quick Setup Instructions . . . . .	8
3.1	Calibration Procedure . . . . .	11
4.0	Diagnostic Indicators. . . . .	11
4.1	Power LED . . . . .	11
4.2	Motor Power LEDs . . . . .	11
4.3	Status LED . . . . .	11
4.4	Status LED Flash Codes . . . . .	12
5.0	Hardware Description . . . . .	13
5.1	Terminal Block Connections . . . . .	13
5.1.1	Power Input Terminals . . . . .	13
5.1.2	Command Signal Input Terminals . . . . .	13
5.1.3	Output Signal Terminals . . . . .	14
5.1.4	Handwheel Switch Terminals. . . . .	14
5.1.5	Travel Limit Switch Terminals . . . . .	15
5.1.6	Torque Limit Switch Terminals . . . . .	15
5.1.7	Feedback Potentiometer . . . . .	16
5.1.7.1	Feedback Potentiometer Installation and Calibration . . . . .	16
5.1.8	Control Box Terminal. . . . .	17
5.1.8.1	Control Box Wiring . . . . .	17
6.0	Troubleshooting Guide. . . . .	18
6.1	Troubleshooting Example . . . . .	18
6.2	Troubleshooting Chart . . . . .	19

## 1.0 Safety Instructions - Definition of Terms

### READ AND FOLLOW THESE INSTRUCTIONS SAVE THESE INSTRUCTIONS

	<b>WARNING</b>	indicates a potentially hazardous situation which, if not avoided, <b>could</b> result in death or serious injury.
	<b>CAUTION</b>	indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
	<b>NOTICE</b>	used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

### 1.1 Hazard-free Use

This device left the factory in proper condition to be safely installed and operated in a hazard-free manner. The notes and warnings in this document must be observed by the user if this safe condition is to be maintained and hazard-free operation of the device assured.

Take all necessary precautions to prevent damage to the Servo Pro due to rough handling, impact, or improper storage. Do not use abrasive compounds to clean the Servo Pro, or scrape its surfaces with any objects.

Configuration and calibration procedures are described in this document. Proper configuration and calibration is required for the safe operation of the Servo Pro.

The control system in which the Servo Pro is installed must have proper safeguards to prevent injury to personnel, or damage to equipment, should failure of system components occur.

This document does not cover every detail about every version of the product described. It cannot take into account every potential occurrence in installation, operation, maintenance and use.

If situations transpire that are not documented in sufficient detail, please request the required information from the Bray Distributor or Representative responsible for your area.

### 1.2 Qualified Personnel

A qualified person in terms of this document is one who is familiar with the installation, commissioning and operation of the device and who has appropriate qualifications, such as:

- Is trained in the operation and maintenance of electric equipment and systems in accordance with established safety practices
- Is trained or authorized to energize, de-energize, ground, tag and lock electrical circuits and equipment in accordance with established safety practices
- Is trained in the proper use and care of personal protective equipment (PPE) in accordance with established safety practices
- Is trained in first aid
- In cases where the device is installed in a potentially explosive (hazardous) location – is trained in the operation, commissioning, operation and maintenance of equipment in hazardous locations



## WARNING

The actuator must only be installed, commissioned, operated and repaired by qualified personnel.

The actuator is designed for installation inside the Bray S70 Electric Actuator, and to position an industrial quarter-turn valve. It must be installed according to its intended purpose.

The Servo Pro controls the movement of an electric actuator that generates large mechanical forces.

To prevent injury, installation, commissioning, operation and maintenance must be carried out under strict observation of the applicable safety regulations.

The specifications of the examination certificate valid in the applicable country must be observed. This includes the actuator in which the Servo Pro is installed.

Reference is specifically made here to observe the applicable safety regulations for actuators installed in potentially explosive (hazardous) locations. This includes the actuator in which the Servo Pro is installed.

Verify that the main electric power supplied to the Servo Pro is compliant with the specifications on the product label and the specifications in the examination certificate valid in the applicable country.

Avoid electrostatic discharges within hazardous areas.

The housings and external connections on the actuators (in which the Servo Pro is installed) are designed for use in potentially explosive (hazardous) locations and may only be opened after all electrical power to the actuator has been removed.

Correct and safe operation of the Servo Pro is dependent upon proper transport, storage and installation in addition to proper operation and maintenance.

### 1.3 Intended Use

The actuator described in this guide has been developed, manufactured, tested and documented with all relevant safety standards taken into account. If the handling rules and safety information for configuration, calibration, installation and maintenance are observed, and the product is used for its intended purpose, there is normally no danger with regard to material damage or personnel health.

## 1.4 Warranty Information

The content of this document is not part of, and does not modify, a previous or current agreement, undertaking or legal relationship. Bray Controls is bound solely by the contract of sale, which also contains the complete and exclusive warranty. The contractual warranty conditions are neither extended nor restricted by this document.

## 2.0 Description of Operation

The Bray Series 70 Servo Pro provides complete control and monitoring of the Bray S70 Electric Actuator.

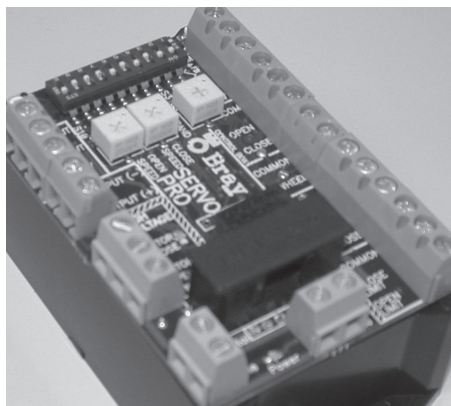


Figure 1: S70 Servo Pro  
Revision F or Higher

The basic function of the Servo Pro is to position the S70 Actuator in response to a command signal from a process controller. The process controller contains a desired process setpoint entered by the user, and continually monitors the process variable (such as flow rate, tank level, etc.) through some type of sensor. Varying the command signal to the Servo Pro will cause the actuator to change

position, which will move the associated control valve to modify the process variable. The process controller continually calculates and transmits the appropriate command signal to the Servo Pro to maintain the process at the desired set point.

The command signal to the Servo Pro can be various DC current, voltage or resistance ranges selected by configuration switches.

The Servo Pro simultaneously provides a feedback output signal representing the current actuator position. The feedback signal can be various DC current or voltage ranges selected by configuration switches.

2.1 Terminal Connections

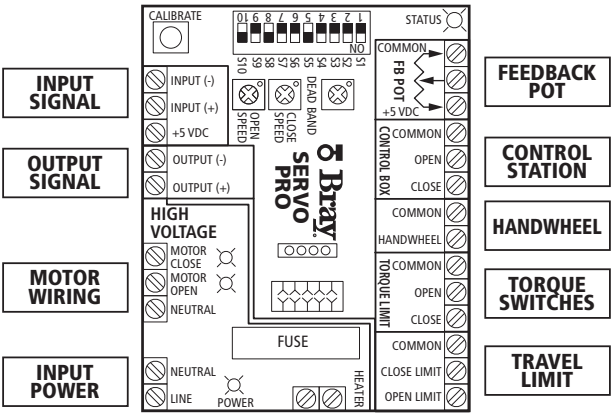


Figure 2: 110VAC or 220VAC Servo Pro Terminals  
Revision F or Higher

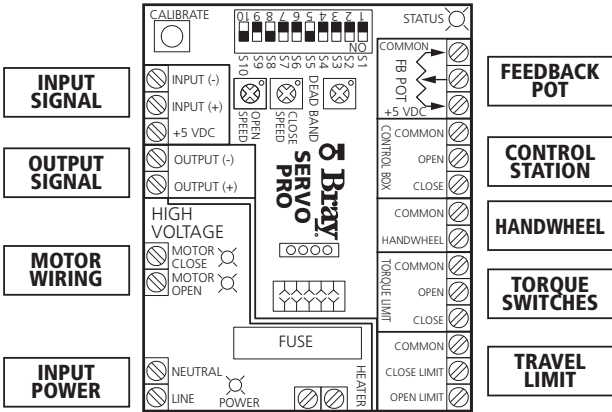


Figure 2: 24VAC Servo Pro Terminals  
Revision F or Higher

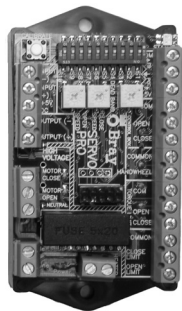
2.2 Configuration Switches

NOTICE

Disconnect all electric power to the Servo Pro prior to adjusting configuration switches. Reconnect electric power only after all the configuration switches are in the proper position.

The configuration switches are located on the top edge of the Servo Pro Revision F or higher, between the Calibration button and the Status LED.

Carefully observe the ON and OFF orientation for each section of the configuration switches when selecting desired options

Switch	Command Signal Input			
	4-20 mA DC	0-5 VDC *	0-10 VDC	2-10 VDC
1	Off	On	On	On
2	Off	Off	On	On
3	Off	Off	Off	On
Feedback Output Signal				
	4-20 mA DC	0-5 VDC	0-10 VDC	2-10 VDC
4	Off	On	On	N/A
5	On	Off	Off	N/A
6	Off	On	Off	N/A
	Forward Acting	Reverse Acting		
7	Off	On		
	Fail in Last Position	Fail Enable **		
8	Off	On		
	Fail Close	Fail Open		
9	Off	On		
10	Torque Switch Enable	Torque Switch Disable		
	Off	On		

\*To control the Servo Pro with a remote potentiometer, set the Command Input to 0-5VDC (see Command Signal Notice section; page 8).

\*\*Fail position is the position that the Servo Pro will move the actuator when the control signal is removed. It does not apply to 0-5VDC or 0-10VDC Command Signals.

Table 1: Configuration Switch Chart for Servo Pro  
Revision F or Higher

### 2.3 Configuration Switch Function Description

**Command Signal Input** – the signal from the process controller that represents the desired actuator position.

**Feedback Output Signal** – the signal from the Servo Pro that represents the current actuator position.

**Forward Acting** – the actuator will move toward the open direction with an increase in command signal.

**Reverse Acting** – the actuator will move toward the close direction with an increase in command signal.

**Fail Enable** – the actuator will move to a position selected by the user upon loss of command signal.

#### NOTICE

The command signal is considered lost when it is below the low limit of the selected range.

The command signal cannot be out of range when 0-5 VDC or 0-10 VDC are selected because 0 VDC is a valid value.

The fail position will not be reached if command signal AND electric power are both removed from the Servo Pro. Electric power must be maintained in order to move the motor in the actuator.

**Fail in Last Position** – The actuator will remain in the position it reached when the command signal was lost.

**Fail Close** – The actuator will move to the fully closed position when the command signal is lost.

**Fail Open** – The actuator will move to the fully open position when the command signal is lost.

**Torque Switch Enable** – The actuator will respond to the optional switches connected to the torque limit inputs. If the open torque switch is activated (the switch has been tripped by the torque switch cam) the actuator will not move any closer to the fully open position. If the close torque switch is activated (the switch has been tripped by the close torque switch cam) the actuator will not move any closer to the fully closed position.

#### NOTICE

If the Torque Switch Enabled option is selected, the actuator must be equipped with properly set torque switches wired to the Servo Pro. The absence of properly set torque switches will prevent actuator movement in one, or both, directions.

**Torque Switch Disable** – the Servo Pro will not respond to any switches connected to the Torque Switch inputs. This option should be used when the optional torque switches are not installed in the actuator.

### 2.4 Factory Default Settings for Servo Pro Rev F or Higher

Unless specified by the user, the configuration switches on the Servo Pro Revision F or higher are set to the following default positions when shipped from the Bray factory:

Switch 1 – Off

Switch 2 – Off

Switch 3 – Off

Switch 4 – Off

**Switch 5 – On**

Switch 6 – Off

Switch 7 – Off

**Switch 8 – On**

Switch 9 – Off

**Switch 10 – On**

The factory default settings will place the Servo Pro Revision F or higher in the following configuration:

**Command Signal** - 4-20 mADC

**Feedback Output Signal** – 4-20 mADC

**Forward Acting**

**Fail Enable**

**Fail Closed**

**Torque Switch Disable**

2.5 Previous Revisions of Servo Pro

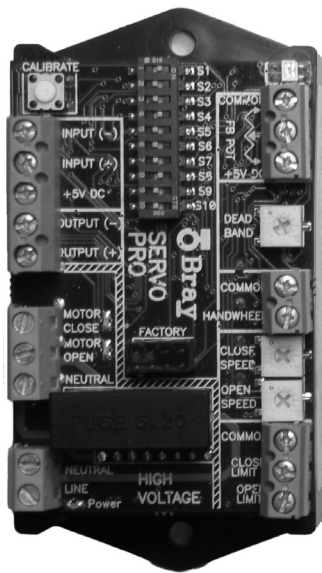
The previous version of Servo Pro (Revision D) has a different physical layout and configuration switch arrangement than Revision F or higher.

Revision D does not include terminals for wiring the Local Control Box, or for Torque Switches, or for wiring the Anti-Condensation Heater.

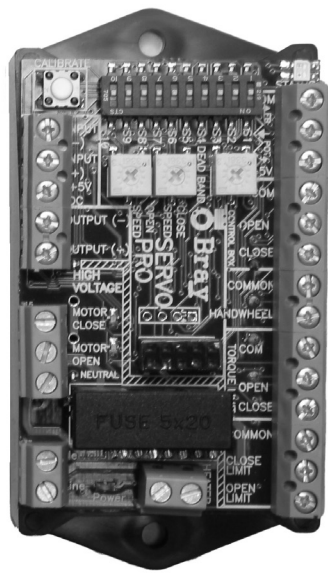
There are two very distinct differences between Revision D and F or higher: (a) the Configuration switch arrangement, and (b) the physical layout of the PCB. Please be sure to refer to the images below, and or the serial number on the unit to determine the Revision before attempting to set the Configuration switches.

NOTICE

The third character in the serial number indicates the Revision Level of the Servo Pro.



Servo Pro Revision D



Servo Pro Revision F or higher

Figure 3: Photographic Comparison of Servo Pro Revision D and Revision F or Higher

NOTE: The following chart is for configuration of an older model Servo Pro (Rev. D). Please verify that the model you are using is the same model before consulting this chart.

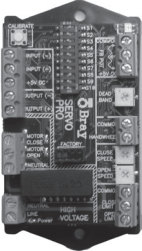
Switch	Command Input			
	4-20 mA DC	0-5 VDC	0-10 VDC	2-10 VDC
1	On	Off	Off	Off
2	Off	Off	On	On
3	Off	Off	Off	On
10	Off	On	On	On
	Output			
	4-20 mA DC	0-5 VDC	0-10 VDC	2-10 VDC
4	On	Off	Off	N/A
5	Off	On	On	N/A
6	Off	On	On	N/A
	Forward Acting	Reverse Acting		
7	Off	On		
	Fail in Last	Fail Enable		
8	Off	On		
	Fail Close	Fail Open		
9	Off	On		

Table 2: Configuration Switch Chart for Servo Pro  
Revision D

3.0 Quick Setup Instructions



WARNING

Do not connect the electric power supply until instructed to do so.

Refer to the Configuration Switch charts and descriptions in Sections 2.1, 2.2 and 2.3 when performing the Quick Setup.

- A. Set the Command Signal Input configuration.
- B. Set the Feedback Output Signal configuration.
- C. Select the Operating Mode (Forward Acting or Reverse Acting)

- D. Select Fail Enable or Fail in Last Position
  - a. If Fail Enable is selected, then select Fail Open or Fail Close with Switch 9
  - b. If Fail Enable is not selected, the actuator will Fail in Last Position
- E. Verify (or adjust) the travel stop limits in the actuator
  - a. Bray actuators are shipped with the travel switches in the factory default position - close travel limit set at 0 degrees and the open travel limit set at 90 degrees
  - b. Bray actuators equipped with Servo Pro have the internal feedback potentiometer set in the

proper position to match the travel switch factory default (fully close at 0 degrees and fully open at 90 degrees)

- c. If the travel switch settings are moved from the factory default position, the internal feedback potentiometer must be adjusted to match the new travel switch setting. This is done by performing a calibration routine.
- d. For more details on setting the travel switch settings, refer to the S70 Operation and Maintenance Manual.

### F. Select the Torque Switch Enable or Disable

- a. If optional torque switches are installed in the actuator, select Torque Switch Enable. The optional torque switches must be properly set and wired to the Servo Pro. Refer to the S70 Operation and Maintenance Manual for more information.
- b. If optional torque switches are not installed in the actuator, select Torque Switch Disable.



### WARNING

Before applying the appropriate electrical supply voltage, verify that the actuator and Servo Pro have been properly wired to the factory supplied wiring diagram.

### NOTICE

To prevent noise coupling between conductors, power lines and signal/communication lines should not be routed together in the same conduit or cable tray. If they must cross each other, then it should only be done at right angles

Recommended distances below should be maintained between power and signal/communication conduit:

### Metal Conduit:

Conductor carrying less than 20A = At least 4 in.

Conductor carrying more than 20A up to 100kVA = At least 8 in.

Conductor carrying more than 100kVA = At least 1.5 ft.

### Non-Metallic Conduit:

Conductor carrying less than 20A = At least 8 in

Conductor carrying more than 20A up to 100kVA = At least 2 ft.

Conductor carrying more than 100kVA = At least 3 ft.

Please refer to NEC guidelines for proper wiring techniques in USA. Other countries must follow all local codes for safety requirements.

### Shielding

Signal/communication lines should be shielded. Shield must be grounded at one end only, preferably at the controller. Grounding the shield at more than one location can introduce noise in the circuitry by forming ground loops.

### G. Apply the command signal input

#### NOTICE

**Ensure that your controller is able to provide the proper command signal range given the following input impedance values:**

4-20 mA	200 Ohm
0-5 VDC	>10 MOhm
0-10 VDC	>10 MOhm

- a. The command signal must be connected to the proper terminals. Refer to the wiring diagram.
- b. The command signal input must match the range selected with the configuration switches.
- c. The command signal must be a valid value (i.e., if 4-20 mA DC is selected, the value must be no less than 4 mA and no greater than 20 mA.)

**d. Note:** a good value to select for Calibration would be mid-travel (i.e. 12 mA DC)

### Isolation Transformers

For circuits that are located in the proximity of excessive electrical noise generators, isolation transformers should be used to filter and prevent noise from entering into the circuitry.

### Transient Suppression

Electromagnetic Interference (EMI) can result from inductive loads, which can adversely affect electronic circuits.

Appropriately sized surge suppressors should be installed whenever inductive loads such as transformers, relays, solenoids, motors, etc. are operated. This will help prevent transient EMI surges from damaging the sensitive electronic circuits.

H. Apply the appropriate supply voltage to the power input terminals.

- a. Verify the Status LED is flashing normal operation – a green “heartbeat” consisting of a repeating pattern one second **on** and one second **off**.
- b. If the Status LED is flashing red, the problem must be resolved before Calibration can begin. Refer to the Troubleshooting section of this manual and the Status Code Flash Table for more information.

I. Accept or Adjust the Deadband - Optional

- a. The factory default is midrange – the deadband potentiometer is midway between fully clockwise and fully counter-clockwise. If this is acceptable, no further adjustment is necessary.
- b. Rotate the deadband potentiometer clockwise to increase the deadband.
- c. Increasing the deadband reduces the potential for the actuator to oscillate around the desired setpoint. This oscillation is often called “hunting.” An actuator responding to a moving setpoint is not hunting, but is operating properly.
- d. Decreasing the deadband allows the actuator to reach a position closer to the desired position, as long as the actuator does not oscillate (hunt) around the setpoint.

J. Accept or Adjust the Open Speed - Optional

- a. The factory default is full speed – the open speed potentiometer is in the fully counter-clockwise position. If this is acceptable, no further adjustment is necessary.
- b. The full speed (fastest speed) of the actuator is listed on the label.
- c. Rotate the open speed potentiometer clockwise to reduce the opening speed of the actuator.

- d. Reducing the opening speed of the actuator can allow more precise positioning of the actuator.

K. Accept or Adjust the Close Speed - Optional

- a. The factory default is full speed – the close speed potentiometer is in the fully counter-clockwise position. If this is acceptable, no further adjustment is necessary.
- b. The full speed (fastest speed) of the actuator is listed on the label.
- c. Rotate the close speed potentiometer clockwise to reduce the closing speed of the actuator.
- d. Reducing the closing speed of the actuator can allow more precise positioning of the actuator.

### NOTICE

Reducing the closing speed of the actuator can also reduce the potential of water hammer damage. Electric actuators are usually slow enough to avoid water hammer even at the full speed setting – but the user should verify this setting.

### Shielding

Signal/communication lines should be shielded. Shield must be grounded at one end only, preferably at the controller. Grounding the shield at more than one location can introduce noise in the circuitry by forming ground loops.

L. Connect the Output Signal to the process controller - Optional

- a. Wire the positive conductor to the OUTPUT (+) terminal.
- b. Wire the negative conductor to the OUTPUT (-) terminal.
- c. Select the desired output signal range using the Configuration switches 4, 5 and 6.

M. Connect the Anti-Condensation Heater – Optional

- a. Connect the wires from the Anti-Condensation Heater to the HEATER terminals.
- b. The Heater rating must match the voltage rating of the Servo Pro.

### 3.1 Calibration Procedure

The calibration procedure should be run when the Servo Pro is first commissioned, and anytime that a subsequent change is made to either the Servo Pro Configuration or the actuator in which the Servo Pro is installed.

1. Engage the actuator handwheel by pulling it outward, and manually move the actuator to the mid-travel position.
2. Disengage the actuator handwheel by pushing it inward.
3. Press the Calibration button, hold it for a minimum of 2 seconds, and release the button.
4. The Servo Pro should enter the Calibration routine and move the actuator toward the fully closed position. After reaching the fully closed position, it will reverse travel and move toward the fully open position. After reaching the fully open position, the Servo Pro will write the calibration value to memory, return to normal operation, and move the actuator to the position that matches the command input signal.
5. After a successful calibration, the Status LED will return to the normal heartbeat pattern.
6. After an unsuccessful calibration attempt, the Status LED will flash an error code of "red-green-red-green." For more information on the error codes, refer to the Status LED Flash Code Table. Correct the error and run the calibration procedure again.

### 4.0 Diagnostic Indicators

The Servo Pro has several diagnostic indicators, such as the Power LED, Motor Open LED, Motor Close LED, and Status LED. The Servo Pro is constantly performing self-diagnostics. These indicators assist the user in confirming proper operation of the Servo Pro, and troubleshooting various operational problems.

#### 4.1 Power LED

The Power LED will light solid green when the proper electrical power is supplied to the Servo Pro power terminals. If the Power LED is not solid green, then the power supply is not working and the Servo Pro will not function.

The fuse must be installed for the Power LED to light.

#### 4.2 Motor Power LEDs

There are two Motor Power LEDs.

The Motor Open LED will light green when the Servo Pro is powering the motor in the open direction. This occurs when the current actuator position is below the command signal (desired actuator position.) The actuator should be moving in the open direction when the Motor Open LED is lit.

The Motor Close LED will light red when the Servo Pro is powering the motor in the close direction. This occurs when the current actuator position is above the command signal (desired actuator position.) The actuator should be moving in the closed direction when the Motor Close LED is lit.

#### 4.3 Status LED

The Status LED is a bi-color LED (red/green) that indicates various operational conditions of the Servo Pro. The Status LED flashes the green "heartbeat" pattern – a repeating cycle of one second ON followed by one second OFF – to indicate normal operation.

Any flashing pattern other than the green heartbeat indicates either an advisory condition or an error condition.

Advisory conditions are combinations of green flashes. These indicate the Servo Pro is operating, but it may not be in an optimal condition. An example would be Reverse Acting mode selected. The user may desire this condition, but it may also be an oversight that requires correction.

Error conditions are combinations of red flashes. These indicate the Servo Pro is not operating properly. An example would be handwheel engaged. The Servo Pro cannot move the actuator motor in either direction when the handwheel is engaged.

#### NOTICE

Any Status LED Flash Code with green flashes is simply an advisory that should be noted and may, or may not, require adjustment. Actuators can operate properly while the Status LED is flashing green.

Any Status LED Flash Code that contains red flashes is an error that must be corrected before the actuator can operate properly.

### 4.4 Status LED Flash Codes

Table 3 shows various diagnostic Flash Codes and their descriptions.

If more than one advisory condition or error condition exists, only one Flash Code will appear at a time. The first condition must be corrected before the second (or subsequent) Flash Code will appear.

**Table 3: Status LED Flash Codes**

No.	Indication	Description	Possible Solution(s)
1	Steady Green Flash (1 second on, 1 second off) "Heartbeat"	Normal Operation	Servo Pro Functioning Normally
2	2 Green Flashes	Calibration Defaults Loaded	Calibration may be acceptable, but if not, adjust travel limits and restart the Calibration
3	3 Green Flashes	Reverse Acting Mode Selected	This is an advisory that the Reverse Acting mode has been selected. Adjust Configuration switch 7 if forward operation is required.
4	4 Green Flashes	HVAC 2-10 VDC Command Signal Selected	This is an advisory that the HVAC 2-10 VDC input has been selected. Adjust Configuration switches 1, 2 and 3 if this Command Signal is not required.
5	1 Red Flash	Handwheel engaged	Push the Handwheel in towards the actuator to Disengage
6	2 Red Flashes	Command Signal Failure	Verify Command Signal, verify wiring, adjust Configuration switches to match Command Signal
7	3 Red Flashes	Feedback Pot Fault	Verify feedback pot wiring, position the feedback Pot cam correctly, see Feedback Pot calibration notes
8	4 Red Flashes	Limit Switch Fault	Verify wiring of limit switches, verify limit switch cam settings, verify that both limit switches are not tripped simultaneously (the actuator cannot be fully open and fully closed at the same time)
9	5 Red Flashes	Torque Switch Fault	Verify that optional torque switches are installed and wired correctly, reverse direction of actuator, correct over-torque condition – OR – if optional torque switches are not installed, disable the torque switch input setting Configuration switch 10 to ON.
10	6 Red Flashes	Feedback Pot Wired In Reverse	This check is only performed during Calibration. Remove power from the Servo Pro, correct the wiring to the feedback pot, reapply power to the Servo Pro, and restart the Calibration.

## 5.0 Hardware Description

The microprocessor-controlled Servo Pro enhances the operation of the S70 actuator by providing full positioning control, supplying an actuator position feedback signal, responding to various switch input conditions, performing self-diagnostics and indicating operational status.

The Servo Pro microprocessor eliminates the need to adjust potentiometers during calibration. Calibration is performed by simply pressing a button. The Servo Pro will automatically seek the fully closed and fully open travel limits and store the values in non-volatile memory.

### 5.1 Terminal Block Connections

#### NOTICE

The Servo Pro will accept wire sizes ranging from 14 to 24 AWG.

18 AWG wire is recommended.

Larger wire than 14 AWG could damage the terminal block connections and should not be used.

Each terminal connection on the Servo Pro is clearly labeled on the top silk screen to simplify wiring as shown in Figures 2 and 3.

#### 5.1.1 Power Input Terminals

The electric power supplied to the Servo Pro drives the actuator motor, all the circuitry inside the module, plus all the devices connected to the module such as the limit switches, torque switches, handwheel switch, control box, output signal and anti-condensation heater.

#### NOTICE

The electric power supplied to the Servo Pro must match the rating shown on the Servo Pro nameplate.

Each different rating (100 VAC, 220 VAC or 24 VAC) requires a different Servo Pro unit.

The Servo Pro must be installed in an actuator that matches the rating shown on the Servo Pro nameplate. For instance, a 110 VAC Servo Pro must be installed in a 110 VAC actuator.



#### CAUTION

The terminal block connections designed for high voltage are placed behind a solid line labeled HIGH VOLTAGE on the silk screen. Dangerous high voltage (110 VAC or higher) can be present on any of these conductors when the Servo Pro is operating. Use caution to avoid injury to personnel or damage to equipment.

Do not connect any 110 VAC or 220 VAC conductors to any terminal blocks outside this labeled area.

The Servo Pro is designed to accept a single phase AC line voltage of the proper value.

The Live conductor should be connected to the Live terminal. The Neutral conductor should be connected to the Neutral terminal.

#### 5.1.2 Command Signal Input Terminals

Apply the command signal input

#### NOTICE

**Note: Ensure that your controller is able to provide the proper command signal range given the following input impedance values:**

4-20 mA	200 Ohm
0-5 VDC	>10 MOhm
0-10 VDC	>10 MOhm

The Servo Pro accepts a command signal from the process controller that represents the desired position of the actuator. The customer wires the command signal to an output from their process controller.

The command signal has polarity that must be observed. Connect the positive conductor of the command signal to the INPUT (+) terminal. Connect the negative conductor of the command signal to the INPUT (-) terminal.

The command signal has four different ranges selectable through configuration switches.

A potentiometer 10k ohm (or larger) can be used to generate a command signal. Wire one fixed terminal of the pot to the terminal labeled +5 Volts. Wire the wiper of the pot to the terminal labeled INPUT (+). Wire the other fixed terminal of the pot to the terminal labeled INPUT (-). Set the command signal to 0-5VDC using Configuration switches 1, 2 and 3.

Refer to the configuration Switch Chart in Section 2.2.

The potentiometer command signal option is useful to demonstrate an actuator equipped with a Servo Pro when a 4-20 mA DC calibration device is unavailable.



### CAUTION

Do not connect any high voltage power to the command signal input terminals as damage could result.

### NOTICE

#### Shielding

Signal/communication lines should be shielded. Shield must be grounded at one end only, preferably at the controller. Grounding the shield at more than one location can introduce noise in the circuitry by forming ground loops.

The command signal supplied to the Servo Pro must be isolated from all other external circuits.

### 5.1.3 Output Signal Terminals

The Servo Pro supplies an output signal that represents the current position of the actuator. The customer wires the output signal to an input of their process controller.

The output signal has polarity that must be observed. Connect the positive conductor of the output signal to the OUTPUT (+) terminal. Connect the negative conductor of the output signal to the OUTPUT (-) RETURN terminal.

The output signal has four different ranges selectable through configuration switches. The available ranges are:

4-20 mADC

0-5 VDC

0-10 VDC

The output signal is sometimes called the Retransmission signal, or position feedback signal.

The output signal is calibrated by the microprocessor at the same time the command signal is calibrated.



### CAUTION

Do not connect any high voltage power to the output signal terminals as damage could result.

The Servo Pro provides an active (powered) output signal. Do not apply any additional power source to this circuit.

### NOTICE

The output signal in the 4-20mA mode is limited to a total maximum load impedance of 400 ohms. The output signal in the 0-5V or 0-10V mode is limited to a minimum load impedance of 10K Ohms.

The output signal should be isolated from all other external circuits.

The process controller receiving the output signal should be adjusted to allow for a +/- 2% variance.

There is no change in the output signal range if Reverse Acting mode is selected. The output signal always operates in Forward Acting mode.

### 5.1.4 Handwheel Switch Terminals

The Servo Pro monitors the position of the actuator manual override handwheel through switches connected to the handwheel terminals.

The wiring to the handwheel terminals is connected at the factory and should not require any adjustment by the customer.

### NOTICE

If the actuator handwheel is engaged (pulled fully outward) the Servo Pro cannot power the actuator motor in either direction.

The actuator handwheel must be disengaged (pushed fully inward) for the Servo Pro to power the actuator motor.



### CAUTION

Do not connect any high voltage power to the hand-wheel switch terminals as damage could result.

Engaging the handwheel prevents the actuator motor from becoming energized, but it does not remove electric power from the Servo Pro. Exercise caution to avoid personnel injury or damage to property.

## 5.1.5 Travel Limit Switch Terminals

The Servo Pro accepts signals from travel limit switches installed in the actuator that indicate when the fully closed and fully open positions are reached. When a travel limit is reached, the Servo Pro will not power the actuator motor any farther in that direction.

The wiring to the travel limit switch terminals is connected at the factory and should not require any adjustment by the customer. If a field repair is required, refer to the wiring diagram to make sure the open limit switch is wired between the **OPEN LIMIT** terminal and the **COMMON** terminal, and the close limit switch is wired between the **CLOSE LIMIT** terminal and the **COMMON** terminal.

Normal operation requires a closed contact between **OPEN LIMIT** and **COMMON**, and between **CLOSE LIMIT** and **COMMON**.

The travel switches are used during the calibration routine to indicate the fully closed and fully open actuator positions.

Refer to the actuator manual for information on adjusting the travel limit switches.



### CAUTION

Do not connect any high voltage power to the travel limit switch terminals as damage could result.

## 5.1.6 Torque Limit Switch Terminals

The Servo Pro accepts signals from optional torque limit switches installed in the actuator that indicate when an over-torque condition exists while the motor is moving in the closed or open direction. When a torque limit is reached, the Servo Pro will not power the actuator motor any farther in that direction.

The wiring to the torque limit switch terminals is connected at the factory and should not require any adjustment by the customer. Torque switches cannot be added to actuators in the field because factory calibration is required.

Normal operation requires a closed contact between the **TORQUE LIMIT OPEN** and **COMMON**, and between the **TORQUE LIMIT CLOSE** and **COMMON**.

### NOTICE

A travel switch that is broken, improperly wired, improperly adjusted or missing from the actuator can result in an open contact which will be interpreted by the Servo Pro as the actuator reaching the travel limit.

Do not activate both travel switches simultaneously as this will create an error condition. The actuator cannot be fully open and fully closed at the same time.

### NOTICE

A torque switch that is broken, improperly wired, or missing from the actuator can result in an open contact which will be interpreted by the Servo Pro as the actuator being at its max torque limit.

If the optional torque switches are not installed, select Torque Switch Disable by setting Configuration switch 10 to ON.



### CAUTION

Do not connect any high voltage power to the torque limit switch terminals as damage could result.

## 5.1.7 Feedback Potentiometer

The Servo Pro uses the signal from the internal feedback potentiometer to determine the current actuator position.

The wiring to the feedback potentiometer is connected at the factory and should not require any adjustment by the customer. If a field repair is required, follow the instructions below:

### 5.1.7.1 Feedback Potentiometer Installation and Calibration

1. Install the internal feedback potentiometer next to the actuator indicator shaft using the two threaded mounting holes provided.
2. The potentiometer assembly must be mounted in the correct orientation in order to successfully calibrate the Servo Pro.
3. Remove the indicator rotor from the indicator shaft so that the drive slot on the top is visible.
4. Engage the handwheel (pulling it fully outward) and manually move the actuator to the fully open (counterclockwise) position.
5. Use the black feedback pot knob to rotate the black feedback pot cam until the raised green rib on the pot gear (see Figure 4 below) is directly in-line with the slot on the top of the indicator shaft.
6. The actuator is now ready for the calibration procedure described in Section 3.1.

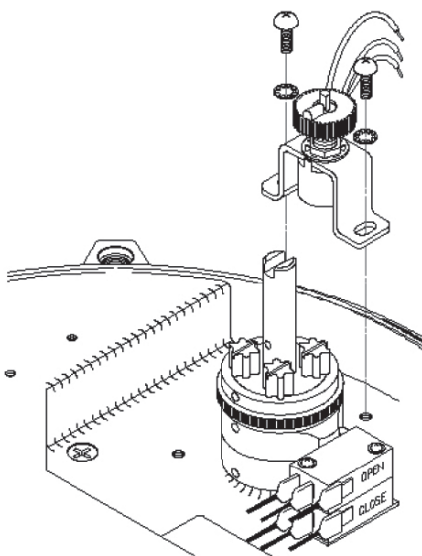


Figure 4: Feedback Pot Mounting and Positioning.

### NOTICE

The wiring of the feedback pot is critical to proper operation.

Connect the orange wire from the wiper pin of the pot to the middle terminal.

Connect the gray wire from the fixed pin of the pot that is closest to the wiper pin to the +5V terminal.

Connect the white wire from the fixed pin of the pot that is farthest from the wiper pin to the COM terminal.

Connect a voltmeter between the middle terminal and the COMMON terminal. Apply power to the Servo Pro, move the actuator to the fully open position, and the reading should be close to +5 VDC. Move the actuator to the fully closed position, and the reading should be close to 0 VDC.



### CAUTION

Do not connect any high voltage power to the feedback pot terminals as damage could result.

### 5.1.8 Control Box Terminal

The Servo Pro accepts signals from the optional Local Control Box which may be mounted integrally or remotely.

The wiring to the local Control Box is connected at the factory and should not require any adjustment by the customer. If a field repair is required, follow the wiring instructions in Section 5.1.8.1.

The Control Box has the following functions:

#### Local / Off / Remote Switch:

**Local** – The Servo Pro responds to position signals from the local Control Box and ignores the command signal from the remote process controller.

**Off** – The Servo Pro will not respond to position signals from either the local Control Box or the command signal from the remote process controller.

**Remote** – The Servo Pro responds to the command signal from the remote process controller and ignores position signals from the local Control Box.

### Open / Stop / Close Switch

**Open** – the Servo Pro powers the actuator motor in the open direction.

**Stop** – the Servo Pro will stop the actuator motor.

**Close** – the Servo Pro powers the actuator motor in the closed direction.

#### 5.1.8.1 Control Box Wiring

An optional local Control Box can be factory supplied, or installed and wired in the field according to the wiring diagram in Figure 5.

For open and close travel limit lamp indication to function, an optional set of auxiliary travel limit switches must be installed in the actuator. Please consult the factory for more details.

#### NOTICE

The diagram below is for Control Box wiring only; all other wiring is not shown. Please refer to the complete wiring diagram on the inside cover of the actuator.

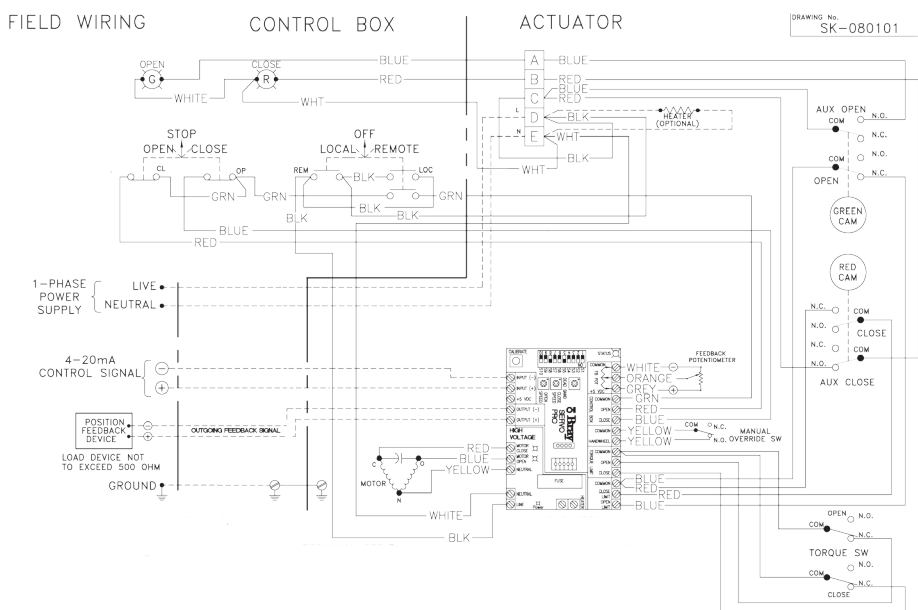


Figure 5: Sample wiring diagram of Control Box to Servo Pro Revision F or higher with an extra set of auxiliary limit switches for actuator end of travel indication

## 6.0 Troubleshooting Guide

The Servo Pro is easy to configure and operate, but if problems do occur, the following guide can assist troubleshooting.

The first step is to observe the Power LED to verify that the proper electrical power has been connected. Then observe the Status LED and note the Flash Code. If it is not the normal green heartbeat indication, refer to the Status LED Flash Code chart in Section 4.4.

### 6.1 Troubleshooting Example

The following example demonstrates a typical troubleshooting process.

Assume these starting conditions:

1. The handwheel is engaged (pulled away from the actuator).
2. The Servo Pro has never been calibrated.
3. The Servo Pro has been configured to accept a command signal of 0-10 VDC
4. The command signal from the process controller is actually 4-20 mA DC, and it is connected in reverse polarity – the positive conductor is connected to INPUT (-) and the negative conductor is connected to INPUT (+)

The Power LED is solid green indicating the power is properly applied.

The Status LED is flashing a single-red error pattern. The Status LED Flash Code in Section 4.4 indicates this is because the handwheel is engaged, preventing the Servo Pro from moving the actuator motor. This error condition can be corrected by disengaging the handwheel (pushing it toward the actuator.)

Now the Status LED is flashing a two-red Flash Code error. Section 4.4 indicates that the Servo Pro is not receiving a proper command signal. This could be caused by various issues—in this case, Configuration switches 1, 2 and 3 must be set to accept the 4-20 mA DC command signal AND the polarity of the wiring must be corrected - the positive conductor must be connected to INPUT (+) and the negative conductor must be connected to INPUT (-). If only one correction is made, the two-red Flash Code will continue. BOTH of these corrections must be made to establish the proper command signal and clear the two-red Flash Code error.

The Status LED is now flashing the two-green Flash Code, indicating that the default calibration values have been loaded. This will move the actuator in the proper general direction (increasing the command signal will power the motor open and decreasing the command signal will power the motor closed) but the Servo Pro has not been exactly calibrated to this particular actuator. This advisory can be cleared by performing the Calibration Procedure in Section 3.1.

After the Calibration Procedure has completed successfully, the Status LED is flashing the green heartbeat pattern and is ready for service.

### 6.2 Troubleshooting Chart

Problem	Possible Cause	Possible Solutions
Actuator moves back and forth near setpoint (hunts)	Signal is fluctuating beyond the deadband setting	Increase the deadband using the Deadband trim pot
	Signal has interference	Shield signal from interference.
Actuator does not travel fully open or fully closed	Travel limit switches are not set correctly	Set travel limit switches for 90° operation
	Servo DIP switches are not set correctly	See Quick Setup Instructions on page 9.
	Mechanical travel stops are not set correctly	Set mechanical travel stops just outside the electrical travel limit switch positions
Actuator motor does not run in either direction and the green Power LED is off	Power does not match Servo Pro voltage and phase, fuse is missing or blown, power is turned off	Verify fuse, verify power voltage and phase, turn power on & recalibrate
Actuator motor does not run in either direction and the green Power LED is on	Limit switches or torque switches are activated	Verify that the travel limit switches are properly set; verify torque switches are presents or set configuration to Torque Switch Disabled
	Handwheel is engaged	Push handwheel in (disengage)
	Servo Pro is not wired correctly	Check all Servo Pro wiring
	Motor has thermally tripped	Allow motor to cool down
Actuator does not properly respond to a command signal	Potentiometer gear is not engaged or adjusted properly	Engage and adjust potentiometer gear
	Command signal does not match Configuration switches	Set the Configuration switches correctly
	Command signal is faulty or wired incorrectly	Verify the value of the command signal with a meter and verify the wiring polarity is correct.
Actuator runs in one direction only	Wiring is incorrect	Correct Wiring
	Potentiometer wired backwards	Reverse white and gray wires, see wiring diagram inside cover
	Limit switch or torque switch is activated	Verify continuity between the wires coming from the switches. If your actuator has reached its travel limit, reverse direction. If one of your torque switches has tripped, reverse the actuator direction and correct the over torque condition
	Command signal is faulty or wired incorrectly	Verify the value of the command signal with a meter and verify the wiring polarity is correct





# Bray<sup>®</sup> CONTROLS

A Division of BRAY INTERNATIONAL, Inc.

13333 Westland East Blvd. • Houston, Texas 77041

Tel: 281.894.5454 Fax: 281.894.9499 [www.bray.com](http://www.bray.com)

All statements, technical information, and recommendations in this bulletin are for general use only. Consult Bray representatives or factory for the specific requirements and material selection for your intended application. The right to change or modify product design or product without prior notice is reserved. Patents issued and applied for worldwide.

Bray<sup>®</sup> is a registered trademark of Bray International, Inc. | © 2016 Bray International, Inc. All rights reserved. | OM-70-002 06-2016