

Description

The direct-coupled, 24 Vac, non-spring return electronic SmartX actuator is designed for modulating and three-position control of building HVAC dampers.

Features

- Synchronous motor technology with stall protection
- Unique self-centering shaft coupling
- Manual override
- 133 lb-in (15 Nm) torque
- 5° preload as shipped from factory
- Mechanical range adjustment capabilities
- Offset and span adjustment models available
- Models with independently adjustable, dual auxiliary switches available
- Built-in 1/2-inch conduit connection
- UL and cUL listed, CE certified

Application

Used in constant or variable air volume installations for the control of HVAC dampers requiring up to 133 lb-in (15 Nm) torque.

**Table-1 Product Numbers**

| | Operating Voltage | Control | | Built-in Control Options | | |
|----------------|----------------------|--------------------------|------------|--------------------------|-------------------------|--|
| | | Modulating (0 to 10 Vdc) | 3-position | Position Feedback | Dual Auxiliary Switches | Input Signal Selectable 0 to 10 Vdc or 2 to 10 Vdc |
| Product Number | 24 Vac ±20%, -15% | | | ● | | |
| MF41-6153 | ● | | | ● | | ● |
| MS41-6153 | ● | ● | | ● | | ● |
| MS41-6153-502 | ● | ● | | ● | ● | ● |



Precautions

Warning: Personal injury or loss of life may occur if you do not follow a procedure as specified.

Caution: Equipment damage or loss of data may occur if you do not follow a procedure as specified.

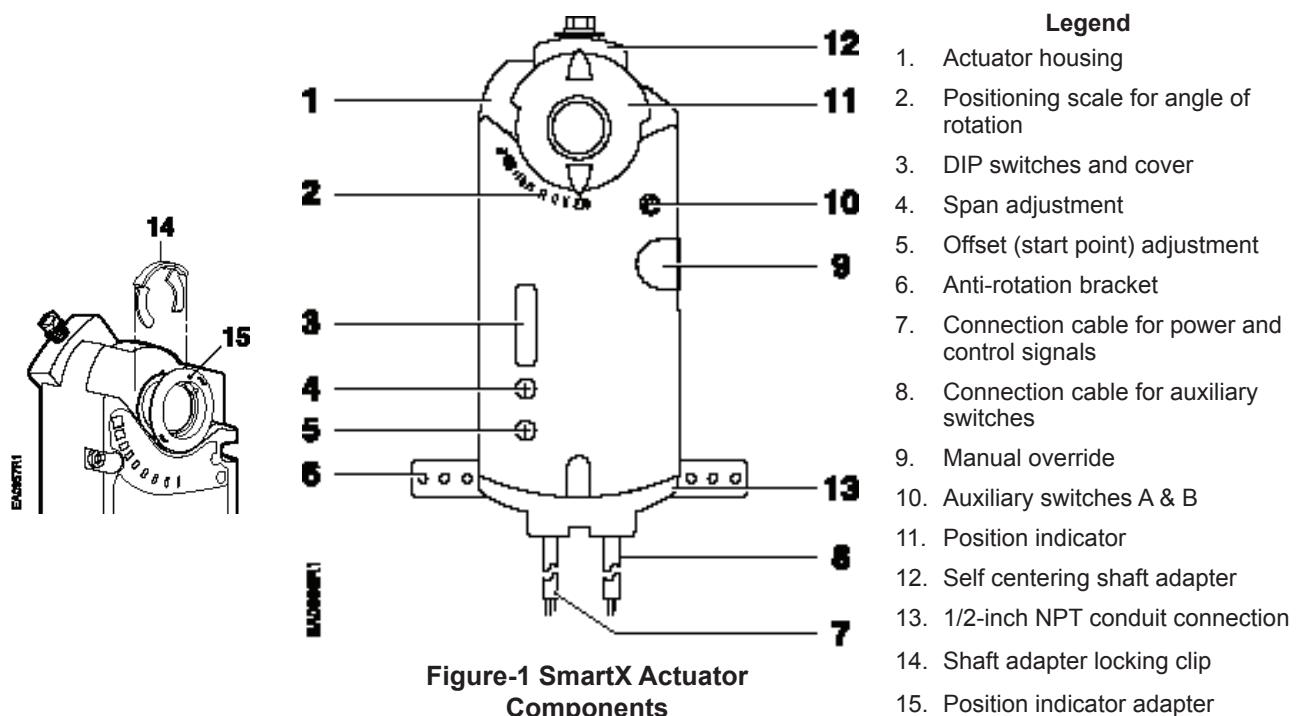
Specifications

| | | |
|------------------------------|--|--|
| | Operating voltage | 24 Vac +20%, -15% |
| | Frequency | 50/60 Hz |
| | Power consumption | |
| Specifications | Running: MS41-6153 Series | 24 Vac +20%, -15% |
| Power Supply | Frequency: MS41-6153 | 5 VA/4W |
| | Holding: MS41-6153 Series | 3 VA/3W |
| | Equipment rating | 1.2 VA/1W |
| | | Class 2, in accordance with UL/cUL |
| | | Class III per EN 60730 |
| Control Signal | Input signal (wires 8-2) MS41-6153 Series | |
| | Voltage-input | 0 to 10 Vdc (max. 35 Vdc) |
| | Input resistance | >100K ohms |
| Feedback Signal | Position output signal (wires 9-2) MS41-6153 Series | |
| | Voltage-output | 0 to 10 Vdc |
| | Maximum output current | ±1 mA |
| Function | Running torque | 133 lb-in (15 Nm) |
| | Runtime for 90° opening or closing | |
| | 60 Hz | 125 seconds |
| | 50 Hz | 150 seconds |
| | Nominal angle of rotation | 90° |
| | Maximum angular rotation | 95° |
| Mounting | Shaft size | 1/4" to 3/4" (6.4 mm to 20.5 mm) |
| | diameter | 1/4" to 1/2" (6.4mm to 13 mm) square |
| | Minimum shaft length | 3/4-inch (20 mm) |
| Housing | Enclosure | NEMA Type 1 |
| | Material | IP54 according to EN 60 529 |
| | Gear lubrication | Die-cast aluminum alloy |
| | Ambient temperature | Silicone-free |
| | Operation | -25°F to 130°F (-32°C to 55°C) |
| | Storage and transport | -40°F to 158°F (-40°C to 70°C) |
| | Voltage requirements at high temperatures: | |
| | Minimum voltage at | |
| | 85°F to 130°F (29°C to 55°C): | |
| | MF models | 24 Vac +20%, -5% |
| | MS models | 24 Vac +20%, -10% |
| | Ambient humidity (non-condensing) | 95% |
| Agency Certifications | UL 873 | cUL certified to Canadian Standard C22.2 No. 24-93 |

Specifications (cont.)

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| | | |
|---------------------------|--|--|
| | Product safety: Automatic electrical controls for household and similar use | EN 60 730-2-14 (Type 1) |
| CE Conformity | Electromagnetic compatibility (EMC) Immunity for all models Emissions for all models | 89/336/EEC EN 61 000-6-2 EN 50 081-1 |
| | Dual auxiliary switches | |
| | AC rating | 24 Vac AC 6A resistive, AC 2A inductive |
| | DC rating | 12 to 30 Vdc DC 2A |
| | Switch Range | |
| Auxiliary features | Switch A Recommended range usage Factory setting | 0° to 90° with 5° intervals 0° to 45° 5° |
| | Switch B Recommended range usage Factory setting | 0° to 90° with 5° intervals 45° to 90° 85° |
| | Switching hysteresis | 2° |
| | Pre-cabled connection | 18 AWG |
| | Cable length | 3 feet (0.9 m) length |
| Miscellaneous | Life cycle Dimensions: Inches (mm) | Five-year warranty 8-3/8 H x 3-1/4 W x 2-2/3 D (212 H x 83 W x 68 D) |
| | Weight | 2.2 lb (1 kg) |



MS41-6153 Series

Apply a 0 to 10 Vdc control signal between wire 8 (Y) and wire 2 (G0) to operate the damper actuator. The angle of rotation is proportional to the control signal. A 0 to 10 Vdc position feedback output signal is available between wire 9 (U) and wire 2 (G0) to monitor the position of the damper motor.

In the event of a power failure, the actuator holds its position. In the event that only the control signal is lost, the actuator returns to the "0" position.

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A floating control signal controls the damper actuator. The actuator's angle of rotation is proportional to the length of time the signal is applied. A 24 Vac control signal to wire 6 (Y1) causes the actuator coupling to rotate clockwise. A 24 Vac control signal to wire 7 (Y2) causes the actuator coupling to rotate counterclockwise.

To reverse the direction of rotation, wires 6 (Y1) and 7 (Y2) can be interchanged.

With no control voltage, the damper actuator holds its position.

| | |
|----------------------------|---|
| Overload protection | In the event of a blockage in the damper, the actuator is overload protected over the full range to prevent damage to the actuator. |
| Life expectancy | An improperly tuned loop will cause excessive repositioning that will shorten the life of the actuator. |

Sizing

The type of actuator required depends on several factors:

1. Obtain damper torque ratings (ft-lb/ft² or Nm/m²) from the damper manufacturer.
2. Determine the area of the damper.
3. Calculate the total torque required to move the damper:

$$\text{Total Torque} = \frac{\text{Torque Rating} \times \text{Damper Area}}{\text{SF}^1}$$

¹ Safety Factor: When calculating the total torque required, a safety factor should be included for unaccountable variables such as slight misalignments, aging of the damper, etc. A suggested safety factor is 0.80.

4. Select the non-spring return actuator type using Table 2.

Table-2 Actuator Torque Ratings

| Total Torque | Actuator |
|---------------------|--------------------------------|
| <35 lb-in (<4Nm) | MF41-6043 and MS41-6043 Series |
| <70 lb-in (<8Nm) | MF41-6083 and MS41-6083 Series |
| <133 lb-in (<15Nm) | MF41-6153 and MS41-6153 Series |

Mounting and Installation

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- Place the actuator on the damper shaft so that the front of the actuator is accessible. (The label and the manual override button are on the front side.)
- The minimum damper drive shaft is 3/4-inches (20mm). The shaft length determines whether the shaft adapter will be mounted on the front or back of the actuator.
- See *Specifications* for minimum and maximum damper shaft dimensions.
- Set auxiliary switches, DIP switches, and Offset/Span as required by your application. (See following sections for details.)
- The position indicator can be mounted to show either the clockwise or counterclockwise 0 to 90 scale.
- An anti-rotation bracket is included with the actuator.
- The shaft adapter and mounting parts are shipped in a separate container with the actuator.
- The actuator is shipped from the factory with a 5° pre-load to ensure tight damper close off.
- For detailed mounting instructions, see *Installation Instructions F-27212*.

Manual Override

To move the damper blades and lock the position with no power present:

1. Hold down the **PUSH** button.
2. Make adjustments to the damper position.
3. Release the **PUSH** button.

Once power is restored, the actuator returns to automated control.

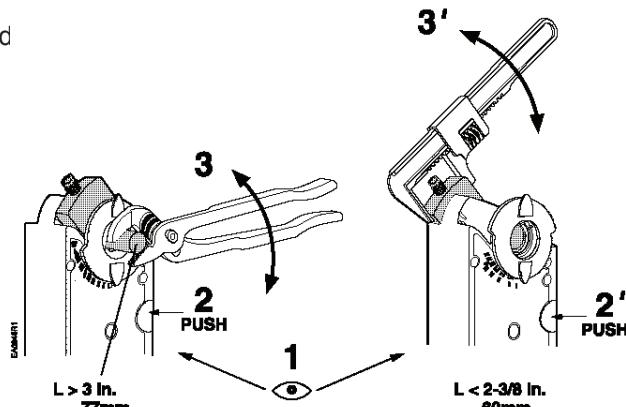


Figure 2. Manual Override.

Mechanical Range Adjustment

The angular rotation is adjustable between 0° and 90° at 5-degree intervals. The range of shaft movement is limited by mounting the shaft adapter:

1. Loosen the shaft adapter from the damper shaft and remove the actuator from the damper shaft.
2. Remove the clip and shaft adapter from the actuator.

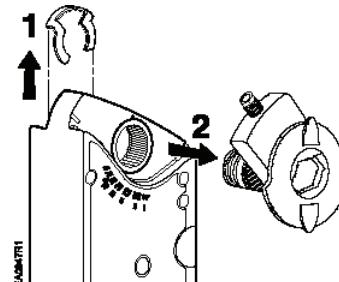


Figure 3.

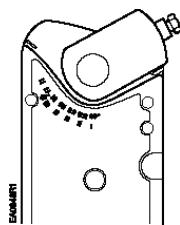


Figure 4.

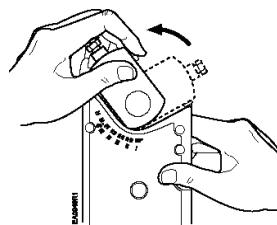


Figure 5

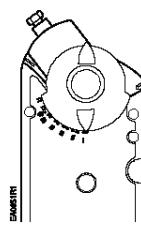


Figure 6.

Mechanical Range Adjustment (cont.)

3. Return the actuator gear train to the "0" position using the steps that follow for the clockwise or counterclockwise damper shaft rotation.

Clockwise to open:

- Insert the shaft adapter to the right as close as possible to the raised stop. See Figure 4.
- Hold down the **PUSH** button and rotate the shaft adapter to the left until it stops. See Figure 5.
- Release the **PUSH** button.
- If the shaft adapter is not resting against the left raised stop, remove the adapter and insert it against the left stop.
- Place the position indicator to the "0" position on the outside scale. See Figure 6.

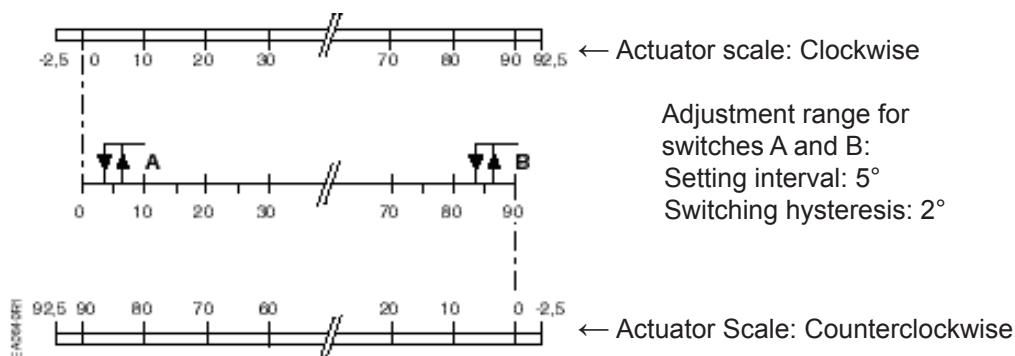
Counterclockwise to open:

- Insert the shaft adapter to the left as close as possible to the raised stop.
- Hold down the **PUSH** button and rotate the shaft adapter to the right until it stops.
- Release the **PUSH** button.
- If the shaft adapter is not resting against the right raised stop, remove the adapter and insert it against the right stop.
- Place the position indicator to "0" on the inside scale.

4. Determine the angle of rotation for the damper blade shaft. Subtract that amount from 90°.
5. Remove the shaft adapter and insert it with the position indicator pointing to the mark on the scale calculated in the previous step. See Figure 6.
6. Attach the clip.
7. Rotate the damper blade shaft to its "0" position.
8. Return the actuator to the damper shaft and tighten the shaft adapter to the damper shaft.

Dual Auxiliary Switch

MS41-6153-502



Dual Auxiliary Switch, (cont.)

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To change the settings of A and B:

NOTES:

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- The scale is only valid when the actuator is in the "0" position on clockwise motion.
- For the counterclockwise rotation, the shaft adapter/position indicator has to move from 90° to 0° and then adjust the auxiliary switches. After the auxiliary switches are adjusted, the shaft adapter/position indicator has to move back to the 90° position.
- Use the adjustment tool provided with the actuator to turn the switch adjustment dials to the desired signal setting.

Factory setting:

Switch A: 5°

Switch B: 85°

Recommended range:

Switch A: 0° to 45°

Switch B: 45° to 90°

NOTE: Use the long arm of the "t" to point to the position of switch A. Use the narrower tab on the red ring to point to the position of switch B.

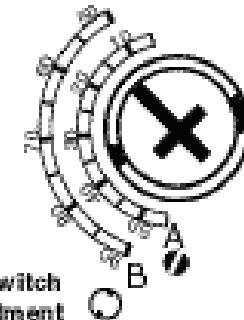


Figure 7. Dual Auxiliary Switch Dials.

DIP Switch Functionality

MS41-6153

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| Description | Label | | | Description | Function |
|------------------|---------|---|---------|-------------|---|
| Counterclockwise | ↻ | ■ | ↶ | Clockwise | Rotary angle direction |
| Active | ↔ | ■ | 0 | Off | Self-adaptation to mechanical range |
| 2 to 10 Vdc | 2 to 10 | ■ | 0 to 10 | 0 to 10 Vdc | MS41-6153: Positioning control signal 2 to 10 or 0 to 10 |

Figure-8 DIP Switches.

Rotary direction



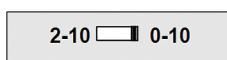
- The arrow direction must match the rotational direction of the actuator.
- Factory setting: ↶

Self-adapting



- Alternative switch-on/off for self-adaptation.
↔: ON
0: OFF
- Factory setting: 0

Positioning Control Signal: (MS41-6153)



- Alternative settings:
2 to 10 Vdc
0 to 10 Vdc
- Factory setting: 0 to 10



Caution:

When turning the self-adaptive feature on, or after a software reset with the feature on, the actuator will enter a five-minute calibration cycle as the actuator adjusts to the rotation limits of the system.

A software reset happens after power on, or may be caused by electrostatic discharge (ESD) at levels of 2kV and above.

Wiring

All wiring must conform to NEC and local codes and regulations.

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Use earth ground isolating step-down Class 2 transformers. Do not use autotransformers.

The maximum rating for a Class 2 step-down transformer is 100 VA. Determine the supply transformer rating by summing the VA ratings of all actuators and all other components used. It is recommended that one transformer power no more than 10 actuators (or 80% of its VA).



Warnings:

Installations requiring **CE** Conformance:

- Except for the auxiliary switches (See *Warning* above) all wiring for actuators must be safety extra-low voltage (SELV) or protective extra-low voltage (PELV) per HD384.
- Use safety transformers per EN61558 with double isolation, designed for 100% duty-cycle for supplying SELV or PELV circuits.
- Over-current protection for supply lines is maximum 10A.

Caution:

Do not parallel MF41-6153 actuators with any other type of actuator.

Wire Designations

Each wire has the standard symbol printed on it. See Table 3.

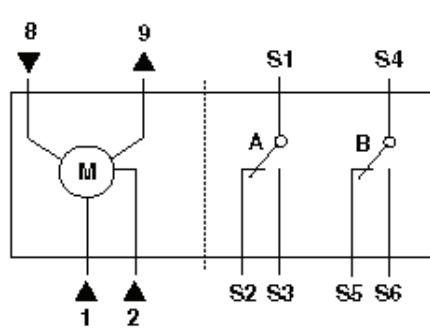


Figure-9 Modulating 0 to 10 Vdc Control
24 Vac Power Supply

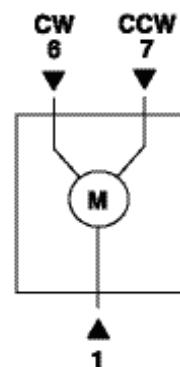


Figure-10 3-position Control
24 Vac Power Supply

Table-3 Wire Designations

| Actuators | Symbol | Function | Color |
|---------------------|--------|--|------------|
| 24 Vac Power Supply | 1 | Supply (SP) | Red |
| | 2 | Neutral (SN) | Black |
| | 6 | Control signal clockwise | Violet |
| | 7 | Control signal counterclockwise | Orange |
| | 8 | 0 to 10 Vdc input signal | Gray |
| | 9 | Output for 0 to 10 Vdc position indication | Pink |
| Auxiliary Switches | S1 | Switch A Common | Gray/red |
| | S2 | Switch A N.C. | Gray/blue |
| | S3 | Switch A N.O. | Gray/pink |
| | S4 | Switch B Common | Black/red |
| | S5 | Switch B N.C. | Black/blue |
| | S6 | Switch B N.O. | Black/pink |

Start-Up/ Commissioning

Non-spring Return Modulating Control (0 to 10 Vdc)

24 Vac

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1. Check Operation:

- a. Connect wires 1 (red) and 2 (black) to the 24 Vac power supply.
- b. Set the Digital Multimeter (DMM) dial to Vdc for the actuator input signal.
- c. Connect wires 2 (black) and 8 (gray) to a Digital Multimeter (DMM).
- d. Apply a full-scale input signal (10 Vdc) to wire 8 (gray).
- e. Allow the actuator shaft coupling to rotate from 0 to 90°.
- f. Stop the signal to wire 8 (gray). The shaft coupling returns to the "0" position.

2. Check Feedback:

- a. Set the DMM dial to Vdc.
- b. Attach wires 2 (black) and 9 (pink) to the DMM.
- c. Apply a full-scale input signal to wire 8 (gray). The reading at the DMM should increase.
- d. Remove the signal from wire 8 (gray). The reading at the DMM should decrease and the actuator shaft coupling returns to the "0" position.

3. Check Auxiliary Switch A:

- a. Set the DMM dial to ohms (resistance) or continuity check.
- b. Connect wires S1 and S3 to the DMM. The DMM should indicate open circuit or no resistance.
- c. Apply a full-scale input signal to wire 8 (gray). The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
- d. Connect wires S1 and S2 to the DMM. The DMM should indicate open circuit or no resistance.
- e. Stop the signal to wire 8 (gray). The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.

4. Check Auxiliary Switch B:

- a. Set the DMM dial to ohms (resistance) or continuity check.
- b. Connect wires S4 and S6 to the DMM. The DMM should indicate open circuit or no resistance.
- c. Apply a full-scale input signal to wire 8 (gray). The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
- d. Connect wires S4 and S5 to the DMM. The DMM should indicate open circuit or no resistance.
- e. Stop the signal to wire 8 (gray). The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.

5. Check Operation:

- a. Apply a control signal (24 Vac) to wires 1 (red) and 6 (violet).
- b. Allow the actuator shaft coupling to rotate from 0 to 90°.
- c. Stop applying a control signal to wires 1 (red) and 6 (violet).
- d. Apply a control signal (24 Vac) to wires 1 (red) and 7 (orange).
- e. Allow the actuator shaft coupling to rotate from 90° to 0°.

Service



Warning:

**Do not open the actuator.
If the actuator is inoperative, replace the unit.**

Troubleshooting

- Check that the wires are connected correctly.
- Check that auxiliary switches, DIP switches, and Offset/Span are set correctly.
- Set the DMM dial to Vac and verify that the operating voltage is within range.
- If the actuator is not working, check the damper for blockage. If blocked, remove the obstacle and cycle the actuator power off and on. The actuator should resume normal operating mode.

Dimensions

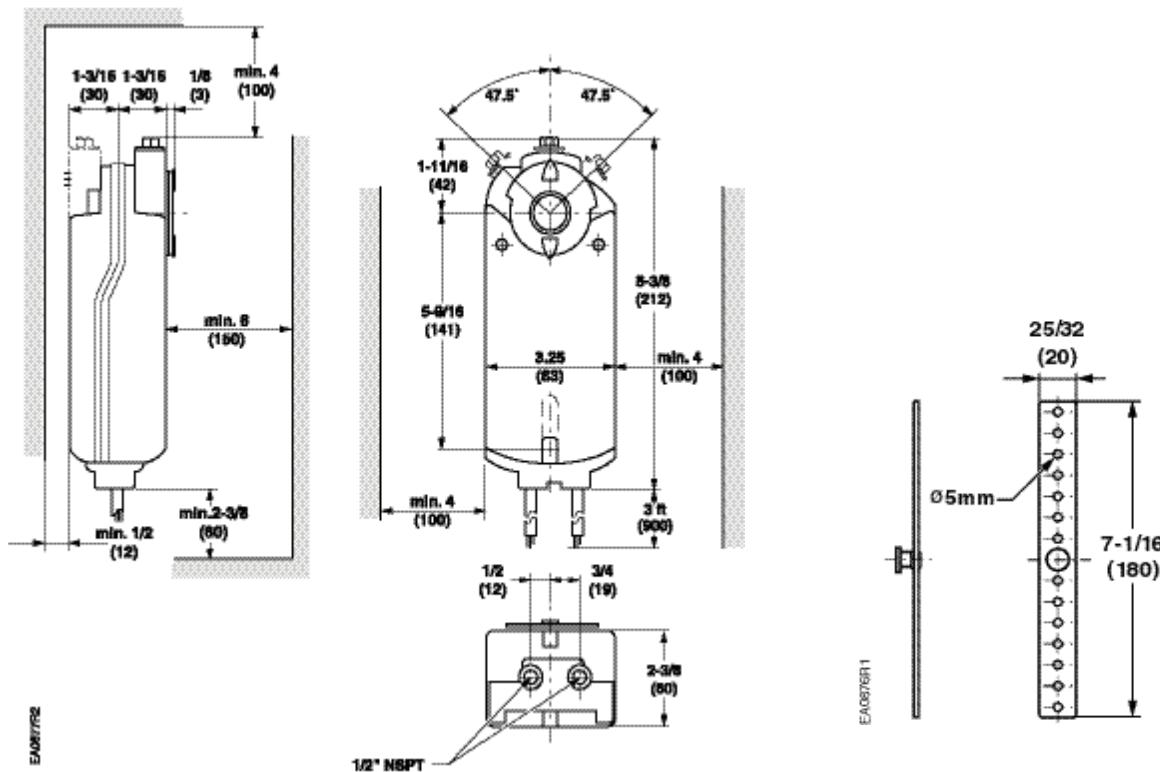


Figure-11 Dimensions of the SmartX Actuator and Anti-rotation Bracket in Inches (Millimeters).