SAX Electronic Valve Actuator

Non-spring Return, 24 Vac, Proportional Control

Description

The SAX Non-spring Return (NSR), Electronic Valve Actuator requires a 24 Vac supply and receives a 0 to 10 Vdc or a 4 to 20 mA control signal to proportionally control a valve. This actuator is designed to work with Flowrite 599 Series 2-way and 3-way valves or Siemens flanged, Pressure Independent Control Valves with a 3/4-inch (20 mm) stroke.

Features

- 24Vac/Vdc operating voltage
- Direct-coupled installation requires no special tools or adjustments
- Visual and electronic stroke indication
- Manual override
- Automatic stroke calibration
- LED status indication
- Overload and stall protection.
- Optional functions with auxiliary switches, function module, and stem heater
- Maintenance-free

Application

These electronic actuators are designed to be used with Flowrite 599 Series valves with 3/4-inch (20 mm) stroke in hot and chilled water, and low pressure (<15 psi) steam service applications, or with Siemens flanged, Pressure Independent Control valves with 3/4-inch (20 mm) stroke in hot and chilled water applications in closed loop HVAC systems.

Product Number

SAX61.03U (Actuator Prefix Code 371)
### Specifications

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Operating voltage</th>
<th>24 Vac ± 20% / 24 Vdc + 20% / -15%, Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>45 to 65 Hz</td>
<td></td>
</tr>
<tr>
<td>Fusing of supply lines</td>
<td>Max. 10A slow</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>Stem retracts/extends</td>
<td>8 VA/3.75 W</td>
</tr>
</tbody>
</table>

#### Function data

- Positioning times: 30 s
- Positioning force: 800 N
- Nominal stroke: 20 mm
- Permissible medium temperature (valve fitted): -13°F to 266°F (-25°C to 130°C)

#### Signal inputs

- Positioning signal “Y”
  - (0 to 10 Vdc) Current draw: ≤ 0.1 mA
  - Input impedance: > 100K Ω
  - (4 to 20 mA) Current draw: DC 4 to 20 mA ± 1%
  - Input impedance: ≤ 500 Ω

#### Parallel operation

- ≤ 10 (depending on controller output)

#### Forced control

- Positioning signal “Z”
  - SAX61.03U
  - R = 0 to 1,000 Ω, G, G0
  - Stroke proportional to R
  - Maximum stroke: 100%
  - Minimum stroke: 0%
  - Max. 24 Vac ± 20%
  - Max. 24 Vdc + 20% / - 15%
  - Current draw: ≤ 0.1 mA

#### Position feedback

- Position feedback U
  - Current draw: 0 to 10 Vdc ± 1%
  - Load impedance: > 10K Ω res.
  - Maximum: 1mA

#### Connecting cable

- Wire gauge: 16 to 24 AWG
- Cable entries: 3 entries for 1/2” conduit connection

#### Degree of protection

- Housing from vertical to horizontal: IP54, as per EN 60529
- With Weathershield ASK39.1: NEMA 3R
- Insulation class (for 24 Vac/Vdc): Class III, as per EN 60730

#### Environmental conditions

- Operation
  - Climatic conditions: IEC 60721-3-3
  - Class 3K5
  - Indoors (weather-protected)
  - Temperature: 23°F to 131°F (-5°C to 55°C)
  - Humidity (non-condensing): 5 to 95% rh

- Transportation
  - Climatic conditions: IEC 60721-3-2
  - Class 2K3
  - Temperature: -13°F to 158°F (-25°C to 70°C)
  - Humidity: < 95% rh

- Storage
  - Temperature: IEC 60721-3-1
  - 5°F to 131°F (-15°C to 55°C)
  - Humidity: 5 to 95% rh

- Max. media temperature when mounted on a valve: 266°F (130°C)
## Specifications (Continued)

### Environmental compatibility
- ISO 14001 (environment)
- ISO 9001 (quality)
- SN36350 (environment-compatible products)
- RL 2002/95/EG (RoHS)

### Standards
- CE conformity
- As per EMC directive
- Immunity
- Emissions
- Australia
- UL conformity (24 Vac/Vdc)
- C-UL conformity (24 Vac/Vdc)
- 2014/30/EU
- EN 61000-6-2:2005 Industrial
- EN 61000-6-3:2007 Residential
- RCM
- UL 873
- Certified to Canadian standard C22.2 No. 24-93

### Accessories
- Auxiliary switch ASC10.51
- Switching capacity: 24 to 230 Vac, 6A res., 2A Ind.
- Stem heating element ASZ6.6
- 24 Vac, 40 VA/30W

### NOTE:
Installation instructions are included with each accessory.

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Auxiliary Switch ASC10.51</th>
<th>Function Module AZX61.1</th>
<th>Stem Heating Element ASZ6.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAX61.03U</td>
<td>Max. 2</td>
<td>Max. 1</td>
<td>Max. 1</td>
</tr>
</tbody>
</table>

**Auxiliary Switch ASC10.51**

Auxiliary switch ASC10.51 switches on or off when a certain position is reached. The switching point can lie between 0 to 100%.

**Function Module AZX61.1**

Function module AZX61.1 offers the following choices for changing control:
- Changeover of acting direction
- Sequence control (adjustable start and span)

**Stem Heating Element ASZ6.6**

Stem heating element ASZ6.6 prevents the formation of ice on the stem when the medium temperature drops below 32°F (0°C). It is suited for universal use with valves having a stem or spindle diameter of 10 or 14 mm.
Accessories, continued

Weather Shield ASK39.1 protects the actuator when installed outdoors. Provides NEMA 3R protection.

Components

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Manual adjuster (with slide switch)</td>
</tr>
<tr>
<td>B</td>
<td>Wiring knockouts</td>
</tr>
<tr>
<td>C</td>
<td>Position indication</td>
</tr>
<tr>
<td>D</td>
<td>Status indication</td>
</tr>
<tr>
<td>E</td>
<td>Housing cover</td>
</tr>
<tr>
<td>F</td>
<td>Valve stem coupling</td>
</tr>
<tr>
<td>G</td>
<td>Yoke</td>
</tr>
<tr>
<td>H</td>
<td>Valve neck coupling</td>
</tr>
</tbody>
</table>

Operation

The actuator accepts a 0 to 10 Vdc or a 4 to 20 mA control signal and a microprocessor produces a stroke proportional to the input signal.

In the event of a power failure or with no control voltage, the damper actuator holds its position.
Stroke Calibration

To determine the stroke positions 0 and 100% in the valve, calibration is required when the valve/actuator are commissioned for the first time.

The actuator must be mechanically connected to a valve and must have a 24 Vac power supply. The calibration procedure can be repeated as often as necessary.

**CAUTION:**
Before starting calibration, be sure the manual adjuster is set to **Automatic** to register the actual values.

There is a slot on the printed circuit boards of the actuators. To initiate the calibration procedure, insert a flat-blade screwdriver into the calibration slot on the circuit board.

Calibration proceeds as follows: (See Figure 1).

1. Actuator runs to the 0% stroke position, and detects upper end position; green LED flashes.
2. Actuator then runs to the 100% stroke position, and detects lower end position; green LED flashes.
3. Measured values are stored in the EPROM. The actuator now moves to the position defined by control signal Y, and the green LED now glows steadily (normal operation).
   - Throughout this procedure, output U is inactive; meaning, the values only represent actual positions when the green LED stops flashing and remains on continuously.
   - Observe status indication LED during and after calibration. (See Table 1.)
   - If the actuator does not detect the second end position within an appropriate stroke range (25 mm), the first end stop will be adopted, and the actuator operates with a working range of 20 mm.

**Table 1. LED Status.**

<table>
<thead>
<tr>
<th>LED</th>
<th>Display</th>
<th>Function</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>ON</td>
<td>Automatic mode</td>
<td>Normal operation</td>
</tr>
<tr>
<td></td>
<td>Flashing</td>
<td>Calibration In Progress</td>
<td>Wait until calibration is finished (then green or red light)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Manual mode</td>
<td>Manual adjuster in MAN position</td>
</tr>
<tr>
<td>Red</td>
<td>ON</td>
<td>Calibration error</td>
<td>Start calibration again</td>
</tr>
<tr>
<td></td>
<td>Flashing</td>
<td>Detection of foreign object</td>
<td>Check the valve actuator</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>OFF</td>
<td>No power or faulty electronics</td>
</tr>
</tbody>
</table>

**Position Indication**

The actuator position indicated by the position output signal "U" is calculated by a potentiometer that sends a feedback signal via the U terminal.
Manual Override
Automatic mode

When the motor drives the manual adjuster turns. In Automatic Mode, the manual adjuster is used for indication of travel. If the manual adjuster is held firm in this mode, there is no transmission of power to the gear train.

Manual operation

When pushing the manual adjuster down (1), it engages and the actuator can be manually operated.

When turning the manual adjuster in a clockwise/counterclockwise direction (2), the actuator’s stem extends/retracts.

An overload protection prevents damage to the manual adjuster.

Setting the position

When the black slide switch is pushed out, the manual adjuster remains engaged.

When in this mode, do not turn the manual adjuster.

Disengaging the setting

When the black slide switch is pushed back in, and the manual adjuster is not pressed down, the manual adjuster returns to Automatic Mode.
### Automatic operation

The actuator will return to automatic operation when the manual adjuster is released.

### Signal Priorities

The actuators are controlled via different interlinked positioning signal paths (positioning signal “Y”, forced control input “Z”, or manual override). The signal paths are assigned the following priorities (1 = highest priority, 3 = lowest priority):

<table>
<thead>
<tr>
<th>Priority</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The manual override always has priority 1, thus overriding all signals active at “Z” or “Y”, independent of whether or not power is applied.</td>
</tr>
<tr>
<td>2</td>
<td>As soon as a valid positioning signal is active at input “Z”, the position is determined via positioning signal “Z” (forced control). Prerequisite: The manual override is not used.</td>
</tr>
<tr>
<td>3</td>
<td>The position is determined via positioning signal “Y”. The manual override is not used and on “Z” there is no active signal.</td>
</tr>
</tbody>
</table>

### Mounting and Installation

**Indoor Use**

1) Only in connection with Weather Shield ASK39.1 for NEMA 3R protection.

**Figure 2. Acceptable Mounting Positions.**

The vertical position is the recommended position for mounting. Figure 2 shows the acceptable mounting positions.

Allow 8 inches (200 mm) above and on the wiring side of the actuator, and four inches (100 mm) on all other sides of the actuator. This service envelope is the minimum space required to access and service the actuator. See Dimensions for actuator dimensions and the recommended service envelope.

**CAUTION:**

Do not rotate the actuator on a Pressure Independent Control Valve (PICV) once the actuator and valve stem are connected. Doing so will inadvertently adjust the flow setting of the valve.
Positioning Signal and Flow Characteristic Selection

DIP switches

<table>
<thead>
<tr>
<th>Position</th>
<th>Positioning Signal &quot;Y&quot;</th>
<th>Position Feedback &quot;U&quot;</th>
<th>Flow Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF 1)</td>
<td>ON 0 to 10 Vdc</td>
<td>0 to 10 Vdc</td>
<td>log = equal-percentage</td>
</tr>
<tr>
<td>ON</td>
<td>OFF DC 4 to 20 mA</td>
<td>0 to 10 Vdc</td>
<td>lin = linear</td>
</tr>
</tbody>
</table>

1) Factory setting: All DIP switches are set to OFF

Start-Up

Switch 1: Control Signal
Select between 0 to 10 Vdc or 4 to 20 mA input signal for terminal Y (0 to 10 Vdc default).

Switch 2: Flow Characteristic

CAUTION:
Do not change the characteristic switch. The proper flow characteristic is designed into the Flowrite 599 Series valve.

Changing the default setting will modify an equal percentage valve to a linear flow characteristic. When set to default, the flow characteristic is determined by the valve body.

NOTE: Set the actuator switches as specified. These switches do not reverse the action from NO to NC or vice versa. The valve body assembly determines the complete assembly action.

Check the wiring for proper connections.

Normally Closed Valve
Increasing the control signal extends the actuator (0 to 1): Valve opens.
Decreasing the control signal retracts the actuator (1 to 0): Valve closes.

Normally Open Valve
Increasing the control signal extends the actuator (0 to 1): Valve closes.
Decreasing the control signal retracts the actuator (1 to 0): Valve opens.

Three-Way Valve
Increasing the control signal extends the actuator (0 to 1): Valve opens between Ports A and AB (through port).
Decreasing the control signal retracts the actuator (1 to 0): Valve opens between Ports B and AB (bypass port).
Wiring

**NOTE:** All wiring must conform to national and local codes and regulations (NEC, CE, and so on).

Do not use auto transformers. Use earth ground isolating step-down Class 2 power supplies.

Determine supply transformer rating by summing total VA of all actuators used.

The maximum rating for Class 2 step-down transformer is 100 VA. It is recommended that no more than 10 actuators are powered by one transformer.

Up to 10 actuators can be driven in parallel from a single controller output with a 1 mA rating. The SAX61.03U proportional actuator has an input impedance of 100K ohm.

![Diagram of connecting terminals](image)

**Figure 3. Connecting Terminals.**

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**Wiring Terminals**

| 24 Vac/Vdc, 0 to 10 Vdc, 4 to 20 mA, 0 to 1,000 Ω |
|---|---|---|---|
| **G0** | System neutral (SN) |
| **G** | System potential (SP) |
| **Y** | Positioning signal for 0 to 10 Vdc/4 to 20 mA |
| **M** | Measuring neutral |
| **Z** | Position feedback 0 to 10 Vdc |
| **U** | Positioning signal forced control |

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**Internal Diagrams**

![Internal diagram](image)

**Accessories**

- **A** and/or **B**
  - 1x ASC10.51 Auxiliary Switch
    - 24 Vac to 230V / 6 (3) A
      - 51
    - 104%
    - 83
    - 82
  - 1x ASC10.51 Auxiliary Switch
    - 24 Vac to 230V / 6 (3) A
      - 51
      - 83
      - 82

The diagram shows all possible connections. The application determines which connections are used.

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**Troubleshooting**

- Check that the wires are connected correctly and attached securely.
- Check for adequate power supply.
- If the actuator moves erratically in very small steps, check that it is receiving adequate power.
Dimensions

Figure 4. Dimensions in Inches (Millimeters).

Service envelope

Minimum access space recommended

<table>
<thead>
<tr>
<th>Product Numbers</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>C2</th>
<th>D</th>
<th>E</th>
<th>►</th>
<th>▶▶</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>lbs (kg)</td>
</tr>
<tr>
<td>SAX61.03U</td>
<td>9.53</td>
<td>4.88</td>
<td>5.91</td>
<td>2.66</td>
<td>3.23</td>
<td>3.15</td>
<td>3.94</td>
<td>3.94</td>
<td>7.87</td>
<td>4.1 (1.85)</td>
</tr>
<tr>
<td>(242)</td>
<td>(124)</td>
<td>(150)</td>
<td>(68)</td>
<td>(82)</td>
<td>(80)</td>
<td>(100)</td>
<td>(100)</td>
<td>(100)</td>
<td>(200)</td>
<td></td>
</tr>
<tr>
<td>With ASK39.1</td>
<td>10.51</td>
<td>6.06</td>
<td>11.81</td>
<td>7.87</td>
<td>3.94</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>4.6</td>
<td>4.1 (2.08)</td>
</tr>
<tr>
<td>(267)</td>
<td>(154)</td>
<td>(300)</td>
<td>(200)</td>
<td>(100)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(1.85)</td>
<td></td>
</tr>
</tbody>
</table>

Dimensions

A

B

1/2 inch

C

D

E

VE0396R2

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