Wiring for Damper Actuators and Control Valves

General Wiring Instructions

WARNING: The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer’s installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformer(s)

Belimo actuators require a 24 VAC Class 2 transformer. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- Software Class A: Mode of Operation Type 1
- Low Voltage Directive: 2006/95/EC

Example: 3 AF Actuators Supplied, 16 Ga. wire (refer to table on page 3)

350 ft. (allowable wire length) ÷ 3 actuators = 117 ft. maximum wire run

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple actuators, one transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:
1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hot leg. Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple actuators, multiple transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:
1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire type and wire installation tips

For most installations, 18 or 16 Ga. cable works well with Belimo actuators. Review job requirements and determine whether a plenum or appliance rated cable is appropriate. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

Wire length for actuator installation

Keep power wire runs below the lengths listed in the following tables. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

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*Belimo actuators and auxiliary switches are designed as a IEC protection class II, double insulated, and do not require an independent ground wire to earth, unless otherwise indicated in this document*
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</tbody>
</table>

The NEC mandates that 24 VAC over 100 VA power requires CLASS 1 wiring conduit. Local codes may vary. Do NOT mix CLASS 1 & CLASS 2 circuits in the same conduit. Generally, 24 VAC actuators over 100 VA should be changed to 120 VAC models.
Wiring for Damper Actuators and Control Valves
On/Off, Spring Return, Electronic Fail-Safe, 24V

Actuators: EFB24(-S)  EFX24(-S)  AF24(-S) US  NFB24(-S)  NFX24(-S)  LF24(-S) US  TF24(-S) US  GKB24-3  GKX24-3  NKQB24-1  NKQX24-1

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠️ Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

⚠️ LIVE ELECTRICAL COMPONENTS!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

Provide overload protection and disconnect as required.

Actuators may also be powered by 24 VDC.

Actuators with plenum rated cable do not have numbers on wires; use color codes instead.

Actuators with appliance cables are numbered.

APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

On/Off

Refer to page 26 for auxiliary switch (-S models) wiring.
Wiring for Damper Actuators and Control Valves
On/Off, Spring Return, 120, 230V and UP

Actuators: EFB120(-S) EFX120(-S) AFBUP(-S) AFXUP(-S) AF120(-S) US/AF230(-S) US
          NFBUP(-S) NFXUP(-S) LF120(-S) US/LF230(-S) US TF120(-S) US

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES
1. TF120(-S) US can be supplied with both 120 VAC and 230 VAC.
2. UP models and TF120(-S) US uses “L” instead of “H” on #2 wire.
3. All 120 VAC, 230 VAC and UP actuators use appliance rated cables.
4. Universal Power Supply (UP) models can be supplied with 24 VAC up to 240 VAC.

APPLICATION NOTES
Meets cULus requirements without the need of an electrical ground connection.

On/Off

Refer to page 26 for auxiliary switch (-S models) wiring.
Wiring for Damper Actuators and Control Valves
Floating Point, Spring Return, 24V

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

WARNING
Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

APPLICATION NOTES
Meets cULus requirements without the need of an electrical ground connection.

INSTALLATION NOTES
Actuators may also be powered by 24 VDC.
Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
Actuators Hot wire must be connected to the control board common.
For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. The actuator must be connected to the control board common.

Floating Point

Triac Source

Triac Sink

Triac Sink with Separate Transformer

Refer to page 26 for auxiliary switch (-S models) wiring.
Wiring for Damper Actuators and Control Valves
On/Off and Floating Point, Non-Spring Return, 24V

**Hazard Identification**
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠ Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

⚠ **WARNING**
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**INSTALLATION NOTES**
- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- The TR24-3-T US actuators are provided with a numbered screw terminal strip instead of cable.
- TR24-3 US actuators cannot be wired in parallel.

**APPLICATION NOTES**
Meets cULus requirements without the need of an electrical ground connection.

---

**On/Off**

<table>
<thead>
<tr>
<th>Line Volts</th>
<th>Blk (1)</th>
<th>Common</th>
<th>Red (2)</th>
<th>Wht (3)</th>
</tr>
</thead>
</table>

The indication of direction is valid for switch position 1.

**Floating Point**

<table>
<thead>
<tr>
<th>Line Volts</th>
<th>Blk (1)</th>
<th>Common</th>
<th>Red (2)</th>
<th>Wht (3)</th>
</tr>
</thead>
</table>

The indication of direction is valid for switch position 1.

---

**On/Off – SPDT Switch**

<table>
<thead>
<tr>
<th>Line Volts</th>
<th>Blk 1</th>
<th>Common</th>
<th>Red 2</th>
<th>Wht 3</th>
</tr>
</thead>
</table>

**Floating Point**

<table>
<thead>
<tr>
<th>Line Volts</th>
<th>Blk 1</th>
<th>Common</th>
<th>Red 2</th>
<th>Wht 3</th>
</tr>
</thead>
</table>

Note: TR24-3 (T) US cannot be wired in parallel with any actuator.

Refer to page 26 for auxiliary switch (-S models) and -P5, -P10 potentiometer wiring.
**Floating Point**

- **24 VAC Transformer**
- **Blk (1)** Common – Hot +
- **Red (2)** Y1 Input
- **Wht (3)** Y2 Input
- **Pnk (4)** Feedback Signal

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- Equipment damage! Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**APPLICATION NOTES**

- Meets cULus requirements without the need of an electrical ground connection.
Wiring for Damper Actuators and Control Valves
On/Off and Floating Point, Non-Spring Return, 100 to 240V

**Actuators:**
- LMX120-3
- AMX120-3
- LRX120-3
- CMB120-3
- NMX120-3
- GMX120-3
- ARX120-3

---

### Hazard Identification

**WARNINGS and Cautions** appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- **Equipment damage!**
  - Actuators may be connected in parallel. Power consumption and input impedance must be observed.

- **WARNING**
  - **Live Electrical Components!**
    - During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

---

#### INSTALLATION NOTES

- LMB(X), NMB(X), AMB(X), GMB(X), LRB(X), and ARB(X) can be supplied with either 120 VAC or 230 VAC.
- All 120VAC and 230VAC actuators use appliance rated cables.
- Actuators with appliance cables are numbered.

---

#### APPLICATION NOTES

- Meets cULus requirements without the need of an electrical ground connection.

---

### On/Off

- **100 to 240 VAC**
- **N L1**
- **H L2**
- **Blu (1) Common**
- **Blk (2) +**
- **Wht (3) +**
- The indication of direction is valid for switch position 1.

### Floating Point

- **100 to 240 VAC**
- **N L1**
- **H L2**
- **Blk (1) Common**
- **Red (2) +**
- **Wht (3) +**
- The indication of direction is valid for switch position 1.

---

Refer to page 26 for auxiliary switch (-S models) wiring.
**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠️ Equipment damage!

Up to four actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

⚠️ **WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**APPLICATION NOTES**

- Meets cULus requirements without the need of an electrical ground connection.
- A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- The AFA24-SR US and TF24-SR(-S) US are supplied without position feedback.

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
- Actuators with appliance cables are numbered.
- Only connect common to neg. (–) leg of control circuits.

**Wiring for Damper Actuators and Control Valves**

Proportional, Spring Return, 24V

Refer to page 26 for auxiliary switch (-S models) wiring.
**Wiring for Damper Actuators and Control Valves**

**Proportional, Non-Spring Return, Electronic Fail-Safe, 24V**

### Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- Equipment damage!
  - Up to four actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

### INSTALLATION NOTES

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
- Actuators with appliance cables are numbered.
- Only connect common to neg. (–) leg of control circuits. Terminal models (-T) have no-feedback.

### APPLICATION NOTES

- Meets cULus requirements without the need of an electrical ground connection.
- A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

---

**24 VAC Transformer**

- **Line Volts**: 24 VAC
- **Control Signal VDC/mA**: 2 to 10 VDC
- **Feedback Signal VDC/mA**: 2 to 10 VDC
- **Common (+) Volts**: 24 VDC
- **Feedback Signal (-) Volts**: 2 to 10 VDC
- **Org (5) Output, 2 to 10 V**: 2 to 10 V

**TR24-SR (-T) US**

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

---

### Equipment Damage!

Up to four actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

---

### Meets cULus requirements without the need of an electrical ground connection.

A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
Wiring for Damper Actuators and Control Valves
Proportional, Non-Spring Return, 100 to 240V

Actuators: LMX120-SR AMX120-SR ARX120-SR
NMX120-SR LRX120-SR

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Equipment damage!
Actuators may be connected in parallel. Power consumption and input impedance must be observed.

WARNING
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

INSTALLATION NOTES

- LMB(X), NMB(X), AMB(X), GMB(X), LRB(X), and ARB(X) can be supplied with either 120 VAC or 230 VAC.
- Only connect common to neg. (–) leg of control circuits.
- All 120 VAC and 230 VAC actuators use appliance rated cables.
- Actuators with appliance cables are numbered.

APPLICATION NOTES

- Meets cULus requirements without the need of an electrical ground connection.
- A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

**Wiring Diagram:**

- 100 to 240 VAC
- N L1
- H L2
- Blk (1) Neutral
- Wht (2) Hot +
- Blk (2) Common
- Red (2) Hot +
- Org (5) U Output, 2 to 10V
- Wht (3) Y Input, 2 to 10V
- VDC/mA (+)
- Feedback Signal
- Control Signal
- (+)
- (-)
- 500 Ω

Equipment damage!
Cable 1
B2 B1
B2 B1
A2 A1
A2 A1
Blk (1) Common
Red (2) Hot +
**Actuators:**

- AF24-PC US
- LMX24-PC
- AMX24-PC
- LRX24-PC
- NMX24-PC
- GMX24-PC
- ARX24-PC

---

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Equipment damage!

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

---

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

---

**APPLICATION NOTES**

- Meets cULus requirements without the need of an electrical ground connection.

---

**Wiring for Damper Actuators and Control Valves**

**Phasecut Control Signal, Spring Return and Non-Spring Return, 24V**

---

**24 VAC Transformer**

- Blk (1) Common –
- Red (2) Hot +
- Wht *(3) Y Input, 0 to 10V phasecut
- Org‡ (5) U Output, 2 to 10V

...PC

---

* White color wire for AF24-PC US, Pink color for all others.
‡ White color wire for AF24-PC US, Orange color for all others.
### Wiring for Damper Actuators and Control Valves

**Proportional, Spring Return, 24V, 3 kΩ or 10 kΩ Control Input**

**Actuators:** LF24-ECON-R03 US  LF24-ECON-R10 US  AF24-ECON-R03 US

#### Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

#### Override Control

<table>
<thead>
<tr>
<th>Wire</th>
<th>Input Signal</th>
<th>AF24-ECON LF24-ECON... position</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>24 VAC</td>
<td>Drive closed (0%)</td>
<td>Morning warm-up cycle</td>
</tr>
<tr>
<td>Y1</td>
<td>Common</td>
<td>Drive open (100%)</td>
<td>Smoke Purge</td>
</tr>
<tr>
<td>Y1</td>
<td>Open wire</td>
<td>Drive to min. position</td>
<td>Mechanical cooling in use, RTU thermostat calls for heat. Override potentiometer via a remote CO2 sensor/controller or DDC controller.</td>
</tr>
<tr>
<td>Y2</td>
<td>0 VDC to 10 VDC</td>
<td>Min. position of 0% to 100%</td>
<td>Override potentiometer via a remote CO2 sensor/controller or DDC controller.</td>
</tr>
</tbody>
</table>

#### Standard Economizer Mode Wiring

- **24 VAC Transformer**
- **Line Volt**
- **3 kΩ NTC* MA thermistor setpoint 55°F**
- **Control Signal 0 to 10 VDC**

*10 kΩ NTC thermistor for -R10 types.

#### INSTALLATION NOTES

- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.
- A relay or switch can spring return the actuator when the RTU fan de-energizes, or if low ambient temperature is sensed.
- A standard relay can be used to close the sensor circuit to engage economizer mode, e.g., outside air changeover device like a dry bulb or enthalpy limit switch. Honeywell logic module W7459A and enthalpy sensor C7400 also provide terminals for this switching.
- A remote CO2 sensor or DDC controller can change the standard relay opening or closing the sensor circuit. This device can be a relay or a dry bulb/enthalpy limit switch.
- Override control for Y2 only accepts 0 to 10 VDC override control.
**Wiring for Damper Actuators and Control Valves**

Proportional, Spring Return, 24V, 2 to 10 VDC (or 4 to 20 mA) Control Signal or Three-Position On/Off Control

**Actuators: LF24-SR-E US**

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

![Equipment damage!](image)

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**APPLICATION NOTES**

Meets cULus requirements without the need of an electrical ground connection.

Provide overload protection and disconnect as required.

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- A 500 Ω resister converts the 4 to 20 mA control signal to 2 to 10 VDC.
- Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.
- For three-position control set direction of rotation to CW (default).
- Switch A, actuator spring returns when open (e.g., fan interlock).

**Three-Position Control with a SPDT Switch or Two Contact Closures (e.g. fan, cooling Y)**

<table>
<thead>
<tr>
<th>Switch A</th>
<th>Wire 2-Red (x)</th>
<th>Wire 3-White (D)</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open**</td>
<td>Any</td>
<td>Any</td>
<td>Closed (via spring)</td>
</tr>
<tr>
<td>Closed</td>
<td>24 VAC</td>
<td>Open</td>
<td>Min-position*</td>
</tr>
<tr>
<td>Closed</td>
<td>Open</td>
<td>24 VAC</td>
<td>Full Open*</td>
</tr>
<tr>
<td>Closed</td>
<td>24 VAC</td>
<td>24 VAC</td>
<td>Full Open*</td>
</tr>
</tbody>
</table>

* Desired position achieved by driving actuator with motor.

**Min-Position with Full Open Override (with a single contact closure)**

**APPLICATION NOTES**

- Meets cULus requirements without the need of an electrical ground connection.
- Provide overload protection and disconnect as required.

**Three-Position Control Signals**

- Switch A
- Wire 2-Red (x)
- Wire 3-White (D)
- Position

2 to 10 VDC Control of LF24-SR-E US

**24 VAC Transformer**

<table>
<thead>
<tr>
<th>Line</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 VAC</td>
<td>24 VAC</td>
</tr>
</tbody>
</table>

**Warnings and Cautions**

- CAUTION
  - Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
- WARNING
  - Live Electrical Components!
  - During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Hazard Identification**

- Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

- CAUTION
  - Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- WARNING
  - Live Electrical Components!
  - During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.
Wiring for Control Valves
On/Off and Floating Point, Spring and Non-Spring Return, 24V

**Wiring Diagrams**

- **Floating Point and On/Off Control (diagram shown with default position of S1.2: Off)**
- **On/Off Control (diagram shown with default position of S1.2: Off)**
- **On/Off Control-using actuator to drive open/close, spring upon power loss. (diagram shown with default position of S3.2: 3-way Off, 2-way On)**
- **Triac Source Floating Point**
- **Triac Sink Floating Point**

**Hazard Identification**
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- **Equipment damage!** Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**APPLICATION NOTES**
- Meets cULus requirements without the need of an electrical ground connection.

**WARNING**
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

**APPLICATION NOTES**
- Meets cULus requirements without the need of an electrical ground connection.
**Wiring for Control Valves**

MFT, Spring and Non-Spring Return, 24V

---

**Actuators:**
- NVF24-MFT (-E) US
- NVFD24-MFT (-E) US
- NV24-MFT US
- NVD24-MFT US

---

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

❗️ Equipment damage!

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

---

**Floating Point Control. (diagram shown with default position of S3.2: 3-way Off, 2-way On.)**

![Diagram for Floating Point Control](image)

---

**Pulse Width Modulation Control Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)**

![Diagram for Pulse Width Modulation Control Wiring](image)

---

**MFT Typical 2 to 10 VDC or 4 to 20 mA Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)**

![Diagram for MFT Wiring](image)

---

**APPLICATION NOTES**

Meets cULus requirements without the need of an electrical ground connection.

Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.

IN4004 or IN4007 diode.

(IN4007 supplied, Belimo part number 40155)

---

**SPRING RETURN ACTUATORS MODEL DESIGNATION**

<table>
<thead>
<tr>
<th>Actuator Type</th>
<th>Model Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retracting plunger (spring up)</td>
<td>NVF24-MFT US, NVF24-MFT-E US</td>
</tr>
<tr>
<td>Extending plunger (spring down)</td>
<td>NVFD24-MFT US, NVFD24-MFT-E US</td>
</tr>
</tbody>
</table>

---

**INSTALLATION NOTES**

For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a triac sink controller. The actuator internal common reference is not compatible.

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

---

**WARNING**

Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

---

**equipment damage!**

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

---

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---

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

❗️ Equipment damage!

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

**WARNING**

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---

**Floating Point Control. (diagram shown with default position of S3.2: 3-way Off, 2-way On.)**

![Diagram for Floating Point Control](image)

---

**Pulse Width Modulation Control Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)**

![Diagram for Pulse Width Modulation Control Wiring](image)

---

**MFT Typical 2 to 10 VDC or 4 to 20 mA Wiring (diagram shown with default position of S3.2: 3-way Off, 2-way On)**

![Diagram for MFT Wiring](image)
Wiring for Damper Actuators and Control Valves
MFT, Spring Return, 24V

Actuators: TF24-MFT US LF24-MFT(-S) US

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Equipment damage!
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

WARNING
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Floating Point

Two Position

Override Control to min, mid, max, Positions

† Actuator Wire Number Color
TF24-MFT US 5 Org
LF24-MFT US 5 Wht

APPLICATION NOTES
Meets cULus requirements without the need of an electrical ground connection.

A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.

IN4004 or IN4007 diode. (IN4007 supplied, Belimo part number 40155).

Refer to page 26 for auxiliary switch (-S models) wiring.

INSTALLATION NOTES
Actuators may also be powered by 24 VDC.

Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.

For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatible.
**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠ Equipment damage! Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

⚠ **WARNING**

Live Electrical Components! During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

### VDC/4-20 mA

![VDC/4-20 mA Diagram](image)

**Floating Point (except NKQ)**

![Floating Point Diagram](image)

**Triac Source and Sink Diagrams (See page 21)**

**PWM (except NKQ)**

![PWM Diagram](image)

### INSTALLATION NOTES

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
- For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller. Position feedback cannot be used with a triac sink controller. The actuator internal common reference is not compatible.

### APPLICATION NOTES

- Meets cULus requirements without the need of an electrical ground connection.
- A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.

### Two Position

![Two Position Diagram](image)

### Override Control to min, mid, max, Positions

![Override Control Diagram](image)

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

**WARNING**

Live Electrical Components!
**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠️ Equipment damage!

Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

⚠️ WARNING

Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**APPLICATION NOTES**

Meets cULus requirements without the need of an electrical ground connection.

**INSTALLATION NOTES**

- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- Only connect common neg (-) leg of control circuits.
- For triac sink with common connection from the actuator must be connected to the hot connection of the controller. The actuator must be connected to the control board common.

---

**Wiring for Damper Actuators and Control Valves**

**MFT, Non-Spring Return, 24V**

<table>
<thead>
<tr>
<th>Actuators:</th>
<th>LMX</th>
<th>LRX</th>
<th>NMX</th>
<th>AMX</th>
<th>ARX</th>
<th>ARX24-MFT-5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ARB24-MFT-5</td>
<td>GMX24-MFT</td>
<td>GMX24-MFT-X1</td>
<td>GRX24-MFT-5</td>
<td>GRX24-MFT-7</td>
<td>GRB24-MFT-5</td>
</tr>
</tbody>
</table>

**Triac Sink**

![Triac Sink Diagram](image1.png)

**Triac Sink with Separate Transformer**

![Triac Sink with Separate Transformer Diagram](image2.png)

**Triac Source**

![Triac Source Diagram](image3.png)
Wiring for Damper Actuators and Control Valves

Wiring Multiple MFT Actuators

**Control Type:** PWM

**Hazard Identification**
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠️ Equipment damage! Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

⚠️ **WARNING**
Live Electrical Components!
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Wiring multiple...MFT actuators to single shaft and/or on valves. All MFT actuators are wired in master-slave configuration.

MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.

Example

<table>
<thead>
<tr>
<th>Controller Output</th>
<th>Master Feedback</th>
<th>Slave Input</th>
<th>Slave Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 25.5 sec</td>
<td>2 to 10 VDC</td>
<td>2 to 10 VDC</td>
<td>0 to 5 VDC</td>
</tr>
</tbody>
</table>

**Multiple Actuators Mounted to One Control Shaft**

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. Qty Per Shaft</th>
<th>Torque Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFB24-MFT(-S)</td>
<td>3</td>
<td>810 in-lb</td>
</tr>
<tr>
<td>EFX24-MFT(-S)</td>
<td>3</td>
<td>810 in-lb</td>
</tr>
<tr>
<td>AFB24-MFT(-S)</td>
<td>3</td>
<td>432 in-lb</td>
</tr>
<tr>
<td>AFX24-MFT(-S)</td>
<td>3</td>
<td>432 in-lb</td>
</tr>
<tr>
<td>GMX(B)24-MFT</td>
<td>2</td>
<td>640 in-lb</td>
</tr>
<tr>
<td>GKCX(B)24-MFT</td>
<td>2</td>
<td>640 in-lb</td>
</tr>
</tbody>
</table>

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- Control signal may be pulsed from either the Hot or Common 24 VAC line.

**Pulse Width Modulation**

Equipment damage!

2 to 10 VDC

0.1 to 25.5 sec
Wiring for Damper Actuators and Control Valves

Spring Return and Non-Spring Return, 24V for use with Honeywell® Electronic Series 90, or a 0 to 135 Ω input

**INSTALLATION NOTES**

Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

Provide overload protection and disconnect as required.

Actuators and controller must have separate transformers.

Consult controller instruction data for more detailed information.

Resistor value depends on the type of controller and the number of actuators. No resistor is used for one actuator. Honeywell® resistor kits may also be used.

To reverse control rotation, use the reversing switch.

**Wire Colors**

1 = Black 3 = White 5 = Gray
2 = Red 4 = Pink 6 = Orange

**Override**

Switch A Switch B Damper Position

- Damper Open
- Damper Closed

The direction of rotation switch is set so that the fail safe position and the position of the damper is closed with no signal at wire R.

**Wiring Multiple Actuators to a Series 90 Controller**

**High Limit Control**

**Typical wiring diagrams for multiple actuators used with the W973, W7100 and T775 controllers**

**Low Limit Control**

Actuators: AFB24-MFT95 AFX24-MFT95 GMX24-MFT95 AMX24-MFT95 NMX24-MFT95 LMX24-MFT95
Wiring for Damper Actuators and Control Valves

Proportional, Spring Return, 24V, 6 to 9 VDC
Output Power Supply 20 VDC provides power to controllers

Actuators: LF24-MFT-20 US  LF24-MFT-S-20 US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Equipment damage!

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

WARNING

Live Electrical Components!

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INSTALLATION NOTES

Actuators may also be powered by 24 VDC

Provide overload protection and disconnect as required.

Typical Control Wiring for MP-52XX Series Actuators to Controllers Requiring External 20 VDC Power Supply

6 to 9 VDC Control of LF24-MFT (-S) -20 US

Multiple LF24-MFT (-S) -20 US Actuators from One Controller

Refer to page 26 for auxiliary switch (-S models) wiring.
Wiring Multiple MFT Actuators

Control Type: VDC or 4-20mA  MFT95

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- **Equipment damage!**
  - Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

- **WARNING**
  - **Live Electrical Components!**
  - During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- Provide overload protection and disconnect as required.
- Consult controller instruction data for more detailed information.
- To reverse control rotation, use the reversing switch.

Wiring multiple...MFT actuators to single shaft and/or on valves. All MFT actuators are wired in master-slave configuration.

MFT actuator configurations should also co-ordinate with each other. Meaning the master input = controllers output. Master output = slave input. Slave output = controller input.

**Example**

<table>
<thead>
<tr>
<th>Controller Output</th>
<th>Master Feedback</th>
<th>Slave Input</th>
<th>Slave Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 10 VDC</td>
<td>2 to 10 VDC</td>
<td>2 to 10 VDC</td>
<td>0 to 5 VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple Actuators Mounted to One Control Shaft</th>
</tr>
</thead>
</table>

**Model** | **Max. Qty Per Shaft** | **Torque Generated** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EFB24-MFT(-S)</td>
<td>3</td>
<td>810 in-lb</td>
</tr>
<tr>
<td>EFX24-MFT(-S)</td>
<td>3</td>
<td>432 in-lb</td>
</tr>
<tr>
<td>AFB24-MFT(-S)</td>
<td>3</td>
<td>810 in-lb</td>
</tr>
<tr>
<td>AFX24-MFT(-S)</td>
<td>2</td>
<td>640 in-lb</td>
</tr>
<tr>
<td>GMX(B)24-MFT</td>
<td>2</td>
<td>640 in-lb</td>
</tr>
<tr>
<td>GKP(B)24-MFT</td>
<td>2</td>
<td>640 in-lb</td>
</tr>
</tbody>
</table>

**GMX(B)24-MFT**

**GKP(B)24-MFT**
**Wiring for Damper Actuators and Control Valves**

**Auxiliary Switch Wiring**

**INSTALLATION NOTES**
- One built-in auxiliary switch (1xSPDT), for end position indication, interlock control, fan startup, etc.
- Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.

**WARNING**
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**APPLICATION NOTES**
- Meets cULus requirements without the need of an electrical ground connection.
- Same voltage must be used for dual switch models. Either 24 VAC or line voltage, not both.

**Auxiliary Switch Ratings**

<table>
<thead>
<tr>
<th>Product</th>
<th>Voltage</th>
<th>Resistive Load</th>
<th>Inductive Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFB...-S, EFX...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>AFB...-S, AFX...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>AF...-S US</td>
<td>250</td>
<td>7.0 A</td>
<td>2.5 A</td>
</tr>
<tr>
<td>NFB...-S, NFX...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>LF...-S US</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>TF...-S US</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>AMB(X)...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>LMB(X)...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>ARB(X)...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>LRB(X)...-S</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>S1A, S2A</td>
<td>250</td>
<td>3.0 A</td>
<td>0.5 A</td>
</tr>
</tbody>
</table>

**Add on Auxiliary Switches**
S1A/S2A for GMB(X), AMB(X), NMB(X), LMB(X), GRB(X), ARB(X), NRB(X), LRB(X)

**Potentiometer and Auxiliary Switch Wiring for LMB(X)24-3(-S)(-P5)(-P10)**

---

**Actuators:**
- EFB...-S
- EFX...-S
- AFB...-S
- AFX...-S
- AF...-S US
- NFB...-S
- NFX...-S
- LF...-S US
- TF...-S US
- AMB(X)...-S
- LMB(X)...-S
- ARB(X)...-S
- LRB(X)...-S
- S1A/S2A
- LMB(X)...(-P5)(-P10)
## Installation Notes

**Note:**
1. Motor CAMS have been factory calibrated and should not be moved.
2. An adaption must be performed if any limit switch is adjusted. This will calibrate the beginning and end stopping points. Press the adaption button for 3 seconds and release.

---

### Actuators: SYx-MFT

**Notes:**
1. Motor CAMS have been factory calibrated and should not be moved.
2. An adaption must be performed if any limit switch is adjusted. This will calibrate the beginning and end stopping points. Press the adaption button for 3 seconds and release.
**SYx-P Interface Wiring Detail**

**Potentiometer (Factory Pre-set)**

*On modulating actuators DO NOT master/slave using optional potentiometer.

For 2-position actuators with 1k feedback option
Potentiometer points 1, 2, 3 are wired to terminal blocks 8, 9, 10.
When a valve is closed: 8, 9 → 1k Ω, 9, 10 → 0k Ω
When a valve is opened: 8, 9 → 0k Ω, 9, 10 → 1k Ω

For modulating actuators with 1k feedback option*
Potentiometer points 1, 2, 3 are wired to terminal blocks 8, 9, 10.
When a valve is closed: 8, 9 → 1k Ω, 9, 10 → 0k Ω
When a valve is opened: 8, 9 → 0k Ω, 9, 10 → 1k Ω

**LED Close**

**LED Open**

**N Power Supply (4)**

**+ Power Supply (5)**

**Control Signal (6)**

**Control Signal (7)**

**Feedback (11)**

**Feedback (12)**

**VR1**

**VR2**

**Sensitivity**

**INPUT = 2-10 VDC**

**INPUT = 4-20mA**

**INPUT = 1-5 VDC**

**OUTPUT = 2-10 VDC**

**OUTPUT = 4-20mA**

**LOSS OF SIGNAL = STOP**

**LOSS OF SIGNAL = CLOSED**

(Direct Acting)

**LOS OF SIGNAL = OPEN**

(Reverse Acting)

**RESPONSE = REVERSE**

**RESPONSE = DIRECT**

**Notes:**
1. Do not change sensitivity or dip switch settings with power applied!
2. VR1 and VR2 are factory calibrated and should not be moved.
3. Motor CAMS have been factory calibrated and should not be moved.

**WARNING**

**INSTALLATION NOTES**

**CAUTION**

1. Do not change sensitivity or dip switch settings with power applied!
2. VR1 and VR2 are factory calibrated and should not be moved.
3. Motor CAMS have been factory calibrated and should not be moved.
**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!

Power consumption and input impedance must be observed.

**NOTES SY1...5-24**

- Each actuator should be powered by a single, isolated control transformer.
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" (L2) cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.

**NOTES SY1...12-24V or 230V**

- **Caution:** Power Supply Voltage
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" (L2) cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.

**NOTES SY1...12-120V or 230V**

- **Caution:** Power Supply Voltage
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- "H" (L2) cannot be connected to terminal #3 and #4 simultaneously.
- **Required:** Terminal #7 needs to be field wired to enable heater circuit.
Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!

Power consumption and input impedance must be observed.

NOTES SY1…24P

Each actuator should be powered by a single, isolated control transformer.

- Power supply Com/Neutral and Control Signal "-" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately.
- Do not change sensitivity or dip switch settings with power applied.

APPLICATION NOTES

Ground shielded wire at control panel chassis.
Tape back ground at actuator.
Use of feedback is optional.

NOTES SY1…110P (220P)

- Caution: Power supply voltage.
- Power supply Com/Neutral and Control Signal "-" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately.
- Do not change sensitivity or dip switch settings with power applied.

24V AC/DC Transformer

Line Voltage

Control signal

Feedback

G Ground
4 Power Supply Com
5 Power Supply Hot
6 Control Signal (-)
7 Control Signal (+)
8 Internal Use Only
9 Internal Use Only
10 Internal Use Only
11 Feedback (-)
12 Feedback (+)

120 or 230 VAC

N L1
H L2

Control signal

Feedback

A B
C
E
F

G Ground
4 Power Supply Com
5 Power Supply Hot
6 Control Signal (-)
7 Control Signal (+)
8 Internal Use Only
9 Internal Use Only
10 Internal Use Only
11 Feedback (-)
12 Feedback (+)

A B
C
E
F

G Ground
4 Power Supply Com
5 Power Supply Hot
6 Control Signal (-)
7 Control Signal (+)
8 Internal Use Only
9 Internal Use Only
10 Internal Use Only
11 Feedback (-)
12 Feedback (+)
Wiring for Damper Actuators and Control Valves
Proportional, 24V, 120V or 230V

Actuator: SY2...5-24MFT  SY2...12-120MFT  SY2...12-230MFT

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

NOTES SY2...5-24MFT
Each actuator should be powered by a single, isolated control transformer.
• Power supply Com/Neutral and Control Signal ‘-’ wiring to a common is prohibited.

NOTES SY2...12-120MFT (230MFT)
• Caution: Power supply voltage.

APPLICATION NOTES
Ground shielded wire at control panel chassis.
Tape back ground at actuator.
Use of feedback is optional.

INSTALLATION NOTES
Observe Class 1 and Class 2 wiring restrictions.
Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A X 24 VAC = 90VA Transformer)

APPLICATION NOTES
Ground shielded wire at control panel chassis.
Tape back ground at actuator.
Use of feedback is optional.

NOTES SY2...12-120MFT (230MFT)
• Caution: Power supply voltage.
Wiring for Damper Actuators and Control Valves
On/Off, 24V, 120 or 230V

SY Actuator Wiring Diagram, SY1...5-24 – Multiple Wiring
SY1...12-110 (220) – Multiple Wiring

Hazard Identification
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

![Diagram of 24V AC Transformer](image)

Installation Notes
Observe class 1 and class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)
(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A x 24 VAC = 90VA Transformer).

Notes
- Caution: Power Supply Voltage.
- Isolation relays must be used in parallel connection of multiple actuators using a common control signal input.
- “H” (L2) cannot be connected to terminal #3 and #4 simultaneously.
- Required: Terminal #7 needs to be field wired to enable heater circuit.

![Diagram of SY2...5-24 Actuator Wiring](image)

Warning: The isolation relays may not be needed. Dependent on signal.

![Diagram of SY1 Contact Arrangements](image)
**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

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Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage! Power consumption and input impedance must be observed.

**INSTALLATION NOTES**

Observe class 1 and class 2 wiring restrictions.

Transformer sizing = SY actuator draw X 1.25 (safety margin)

(Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A X 24 VAC = 90VA Transformer).

**NOTES SY1-24P**

- Each actuator should be powered by a single, isolated control transformer.
- **SY1-24P notes:** Power supply Com/Neutral and Control Signal "-" wiring to a common is prohibited. Terminals 4 and 6 need to be wired separately otherwise irreversible damage will occur.
- Do not change sensitivity or dip switch settings with power applied.

**APPLICATION NOTES**

- Recommended twisted shielded pair for control wiring.
- Ground shielded wire at control panel chassis.
- Tape back ground at actuator.
- Use of feedback is optional.

**APPLICATION NOTES**

- Use of feedback is optional.

---

**SY Actuator Wiring Diagram, SY1-24P – Multiple Wiring**

**24V AC/DC Transformer**

<table>
<thead>
<tr>
<th>G</th>
<th>Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Power Supply Com</td>
</tr>
<tr>
<td>5</td>
<td>Power Supply Hot</td>
</tr>
<tr>
<td>6</td>
<td>Control Signal (-)</td>
</tr>
<tr>
<td>7</td>
<td>Control Signal (+)</td>
</tr>
<tr>
<td>8</td>
<td>Internal Use Only</td>
</tr>
<tr>
<td>9</td>
<td>Internal Use Only</td>
</tr>
<tr>
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</tr>
<tr>
<td>11</td>
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</tr>
<tr>
<td>12</td>
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**24V AC/DC Transformer**

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<td>12</td>
<td>Feedback (+)</td>
</tr>
</tbody>
</table>

**APPLICATION NOTES**

- Recommended twisted shielded pair for control wiring.
- Ground shielded wire at control panel chassis.
- Tape back ground at actuator.
- Use of feedback is optional.
Actuators: SY2...5-24MFT

**Hazard Identification**
Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!
Power consumption and input impedance must be observed.

**INSTALLATION NOTES**
Observe class 1 and class 2 wiring restrictions.
Transformer sizing = SY actuator draw X 1.25 (safety margin) (Ex. SY2-24 requires 3.0A x 1.25 = 3.75A, 3.75A X 24 VAC = 90VA Transformer).

**NOTES SY2...5-24MFT**
Each actuator should be powered by a single, isolated control transformer.

**APPLICATION NOTES**
Recommended twisted shielded pair for control wiring.
Ground shielded wire at control panel chassis.
Tape back ground at actuator.
Use of feedback is optional.

---

**Wiring for Control Valves**
Proportional, Multiple Wiring, 24V
Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!

Power consumption and input impedance must be observed.

INSTALLATION NOTES

Observe class 1 and class 2 wiring restrictions.

APPLICATION NOTES

Recommended twisted shielded pair for control wiring. Ground shielded wire at control panel chassis. Tape back ground at actuator.

Use of feedback is optional.

NOTES SY1-110P (220P)

• Caution: Power supply voltage.
• Do not change sensitivity or dip switch settings with power applied.
**Wiring for Control Valves**
Proportional, Multiple Wiring, 120/230V

**Actuators:** SY2...12-120MFT  SY2...12-230MFT

---

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Indicates an action or condition that may cause irreversible damage to the actuator(s) or associated equipment.

Equipment damage!

Power consumption and input impedance must be observed.

---

**INSTALLATION NOTES**

Observe class 1 and class 2 wiring restrictions.

---

**APPLICATION NOTES**

Recommended twisted shielded pair for control wiring.

Ground shielded wire at control panel chassis.

Use of feedback is optional.

---

**NOTES SY2...12-120MFT (230MFT)**

- Caution: Power supply voltage.

---

**APPLICATION NOTES**

Recommended twisted shielded pair for control wiring.

Ground shielded wire at control panel chassis.

Use of feedback is optional.

---

**NOTES SY2...12-120MFT (230MFT)**

- Caution: Power supply voltage.

---

**APPLICATION NOTES**

Recommended twisted shielded pair for control wiring.

Ground shielded wire at control panel chassis.

Use of feedback is optional.

---

**NOTES SY2...12-120MFT (230MFT)**

- Caution: Power supply voltage.

---

**APPLICATION NOTES**

Recommended twisted shielded pair for control wiring.

Ground shielded wire at control panel chassis.

Use of feedback is optional.

---

**NOTES SY2...12-120MFT (230MFT)**

- Caution: Power supply voltage.
Wiring for Control Valves
On/Off, 24V, 120V

Actuators: ZONE 24NC ZONE24NO ZONE24NC-S ZONE24NO-S ZONE120NC ZONE120NO ZONE120NC-S ZONE120NO-S

Built-in Auxiliary Switch (optional) (-S models)
Wiring Diagrams for Fire and Smoke Damper Actuators

**Actuators:**
- FSLF120(-S) US
- FSLF24(-S) US
- FSNF120(-S) US
- FSNF24(-S) US
- FSAF120(-S) US
- FSAF24(-S) US

---

**Hazard Identification**

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- Equipment damage!
- Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- Equipment damage!
- Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

**APPLICATION NOTES**

- Meets cULus requirements without the need of an electrical ground connection.

All **on this page indicates manual reset high temperature limit or relay.**

---

**INSTALLATION NOTES**

- Actuators may also be powered by 24 VDC.
- Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.
- Provide overload protection and disconnect as required.
- S4 makes to S6 when the actuator is powered open.
- Double insulated.
- Two built-in auxiliary switches (2xSPST), for end position indication, interlock control, fan startup, etc.

---

**Auxiliary Switch Wiring for FSLF24-S US, FSLF120-S US**

<table>
<thead>
<tr>
<th>Wiring Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ground for 24V models</td>
</tr>
</tbody>
</table>

**Auxiliary Switch Wiring for FSNF24-S US, FSNF120-S US**

1. **Neutral**
2. **Hot**
3. **Ground**

---

**Auxiliary Switch Wiring for FSAF24-S US, FSAF120-S US**

<table>
<thead>
<tr>
<th>Wiring Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ground on 24 V models</td>
</tr>
</tbody>
</table>

---

**24 VAC Transformer**

<table>
<thead>
<tr>
<th>Wiring Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ground for 24V models</td>
</tr>
</tbody>
</table>

---

**Wiring Colors**

- **Violet**
- **Gray**
- **White**
- **Red**
- **Black**

---

**Equipment damage!**

- Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- Equipment damage!
- Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

---

**CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
Auxiliary Switch Wiring for FSAF24-BAL-S US, FSAF24-SR-S US

Hazard Identification

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

- Equipment damage!
- Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- Equipment damage!
- Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.

APPLICATION NOTES

- Meets cULus or UL requirements without the need of an electrical ground connection.

INSTALLATION NOTES

- Actuators may also be powered by 24 VDC.
- Only connect common neg (-) leg of control circuits.
- A 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.
- Provide overload protection and disconnect as required.
- Only connect Hot, Wire 2 to Wire 3 override controls.
- Double Insulated

All on this page indicates manual reset high temperature limit or relay.

Auxiliary Switch Wiring for FSAF24-S US, FSAF120-S US

Balancing Control Fire and Smoke

Proportional Control Fire and Smoke
Belimo Platinum Distributors

Aireco Supply
9120 Washington Boulevard
Savage, MD 20763-0144
Phone: 301-953-8800
With branches in MD, VA

Amcon Controls, Inc.
11906 Warfield Street
San Antonio, TX 78216
Phone: 210-349-6161
Houston, TX branch 713-464-7002
Mandeville, LA branch 985-624-3303

Applied Automation
A Wilson Mohr Company
3186 South Washington Street, #230
Salt Lake City, UT 84115
Phone: 801-486-6454

Boston Aircontrols, Inc.
8 Blanchard Road
Burlington, MA 01803
Phone: 781-272-5800

Charles D. Jones Co., Inc.
445 Bryant Street, Unit #1
Denver, CO 80204-4800
Phone: 800-777-0910
With branches in CO, MO, KS

Climatic Control Div/ICD
5061 W. State Street
Milwaukee, WI 53208
Phone: 800-242-1656
With branches in WI

Cochrane Supply and Engineering, Inc.
30303 Stephenson Highway
Madison Heights, MI 48071-1633
Phone: 800-482-4894
With branches in MI and Maumee, OH

Columbus Temperature Control
1053 E. 5th Avenue
Columbus, OH 43201
Phone: 800-837-1837

Controlco
985 3rd Street
Oakland, CA 94607
Phone: 510-836-7900
With branches in CA, NV

Control Products
9101 Jameel, Suite 130
Houston, TX 77447
Phone: 713-849-7200

Edward C. Smyers & Co.
223 Fort Pitt Boulevard
Pittsburgh, PA 15222-1505
Phone: 412-471-3222

Engineered Control Systems
4805 N.W. 93rd Avenue
Suite 11
Miami, FL 33166
Phone: 305-418-8901
With branches in FL

G & O Thermal Supply
5435 N. Northwest Highway
Chicago, IL 60630
Phone: 773-763-1300
With branches in IL

Industrial Controls Distributors LLC
1776 Bloomsbury Avenue
Wanamassa, NJ 07712
Phone: 800-631-2112
With branches in GA, KY, IN, MA, ME, NC, NY, OH, PA, TN

Interstate HVAC Controls
30 Vineland Street
Brighton, MA 02135
Phone: 617-782-9000

Jackson Controls
1708 E. 10th Street
Indianapolis, IN 46201
Phone: 317-231-2200

M & M Controls
9E West Aylesbury Road
Timonium, MD 21093
Phone: 410-252-1211
With a branch in Alexandria, VA

MICONTROLS, Inc.
6516 5th Place South
Seattle, WA 98124
Phone: 800-877-8026
With branches in WA, OR

Meier Supply
123 Brown Street
Johnson City, NY 13790
Phone: 607-797-7700
With branches in NY, PA

Minvalco, Inc.
3340 Gorham Avenue
Minneapolis, MN 55426-4267
Phone: 952-920-0131
With branches in MN

RSD/Refrigeration Supply Distribution
26021 Atlantic Ocean Drive
Lake Forest, CA 92630
Phone: 949-380-7878
With branches in CA, NV, OR, AK, AZ, ID, UT, WA, MT

Saint Louis Boiler Supply, Co.
617 Hanley Industrial Court
St. Louis, MO 63144
Phone: 314-962-9242

Temperature Control Systems
10315 Brockwood Road
Dallas, TX 75238
Phone: 214-343-1444
With branches in OK, TX

Tower Equipment Co., Inc.
1320 West Broad Street
Stratford, CT 06615
Phone: 800-346-4647

Twinco Supply Corporation
56 Craven Street
Huntington Station, NY 11746-2143
Phone: 800-794-3188
With branches in NY

Wilson-Mohr, Inc.
12610 West Airport Blvd, Suite 100
Sugarland, TX 77478
Phone: 281-295-8850

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For a complete list of distributors in Latin America and the Caribbean, please visit our website: www.belimo.us or call: 203-791-8396