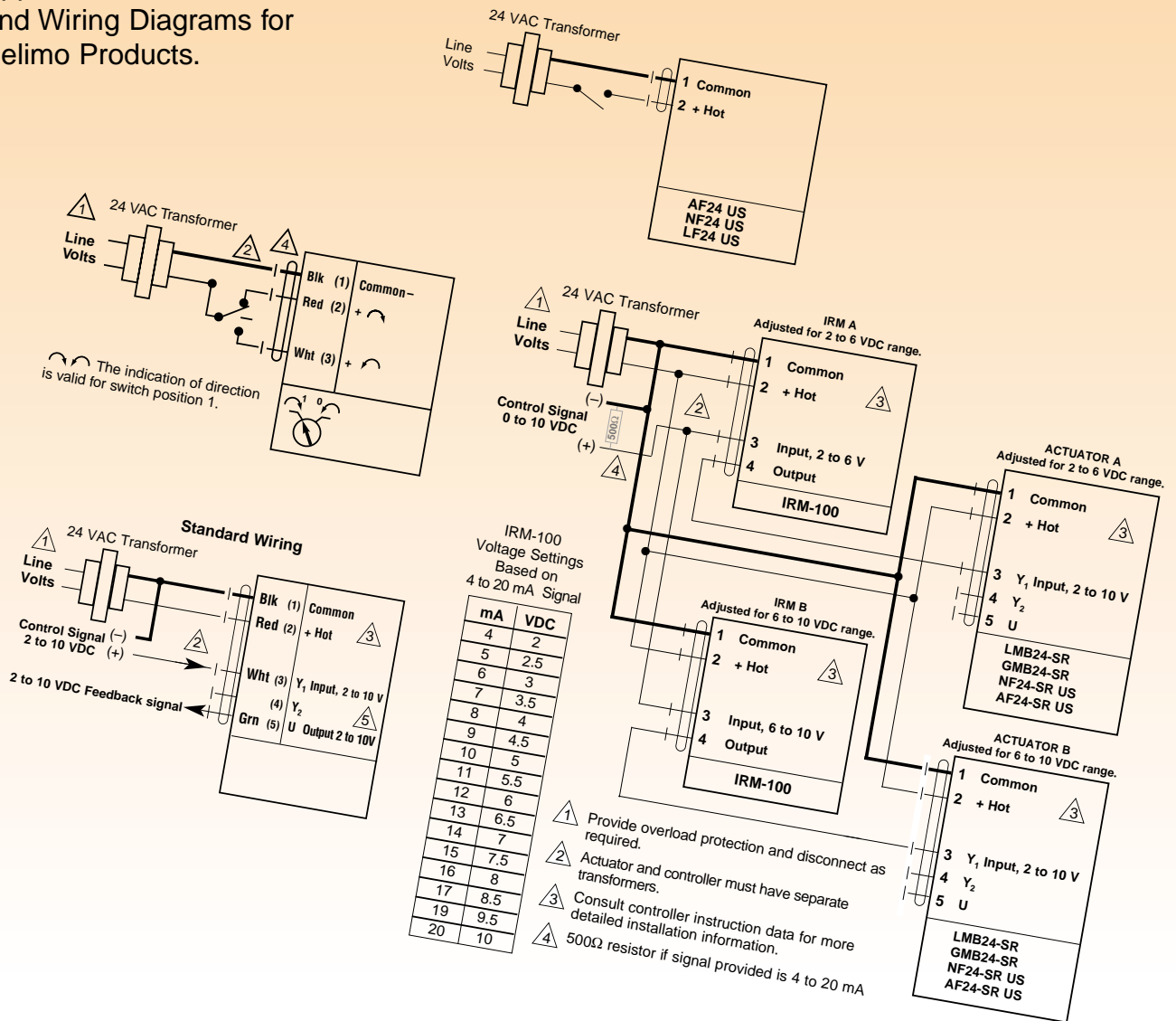


A CLOSER LOOK...

Application Information and Wiring Diagrams for Belimo Products.



The Belimo Difference

- Basic Electricity
- Understanding Wiring Diagrams
- Analog Outputs
- Wiring Diagrams for Belimo Products
- Applications
- Specifications

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I. BASIC ELECTRICITY

I-A. Abbreviations

DC = Direct Current
 AC = Alternating Current
 VDC = Direct Current Voltage
 VAC = Alternating Current Voltage

I-B. Current

A = Ampere
 mA = Milliampere = Thousandths of an ampere. (*Example:* 12mA = 12/1000 = .012A)
 I = The symbol for current in mathematical formulas.

I-C. Voltage

V = Volt*
 mV = Millivolt = Thousandths of a volt. (*Example:* 5mV = 5/1000 = .005V)
 E = The symbol for voltage in mathematical formulas.

I-D. Resistance

Ω = Ohm = Resistance
 k Ω = Kilo ohm = Thousands of ohms. 1k Ω = 1,000 Ω
 M Ω = Mega ohm = Millions of ohms. 1M Ω = 1,000k Ω = 1,000,000 Ω
 R = The symbol for resistance in mathematical formulas.

I-E. OHM's Law

E = Voltage I = Current R = Resistance

E = I x R *Example:* I = 20mA, R = 500 Ω Therefore, E = .020 x 500 = 10V

R = E/I *Example:* E = 1.35V, I = 10mA Therefore, R = 1.35/.010 = 135 Ω

I = E/R *Example:* E = 120V, R = 50 Ω Therefore, 120/50 = 2.4A

I-F. Power

W = Watt*
 mW = Milliwatt = Thousandths of a watt (*Example:* 7mW = 7/1000 = .007W)
 kW = Kilowatt = Thousands of watts (*Example:* 1kW = 1,000W)

I-G. Power Calculations

W = E x I *Example:* V = 24V, I = 260mA Therefore, W = 24 x .260 = 6.24W

W = R x I² *Example 1:* R = 100 Ω , I = 3A
 W = 100 x 3² = 100 x 3 x 3 = 900W

Example 2: R = 500 Ω , I = 20mA = .020A
 W = 500 x .020² = 500 x .020 x .020 = 500 x .0004 = .2W or 200mW.

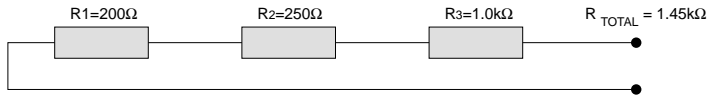
W = E²/R *Example:* V = 24V, R = 100, Therefore, W = 24²/100 = 24 x 24/100 = 5.76W

* I.S.O. standard indicates "U" be used for voltage and "P" for power.

I-H. Series Connection of Resistors

Resistors that are connected in series have a total resistance value that is equal to the sum of all the resistance values of the resistors.

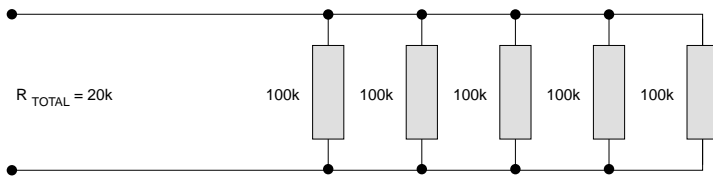
Example: $R_1 = 200\Omega$ $R_2 = 250\Omega$ $R_3 = 1.0k\Omega$ $R_{Total} = R_1 + R_2 + R_3 = 200\Omega + 250\Omega + 1.0K\Omega = 1.45k\Omega$



The total resistance is always larger than the largest single resistor!

I-I. Parallel Connection of Resistors

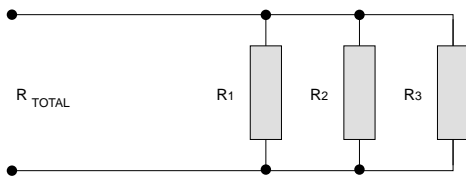
If all the resistors have the same resistance value, the total resistance will be equal to the resistance value of one resistor divided by the number of resistors.



Example: Five equal resistors $R = 100k$ are connected in parallel.

The total resistance $R_{Total} = R/5 = 100/5 = 20k$

If the resistors that are connected in parallel have different values, the following formula must be used:



The total resistance is always smaller than the smallest single resistor!

Example: $R_1 = 200$ $R_2 = 250$ $R_3 = 1.0k$

$$\frac{1}{R_{TOTAL}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{TOTAL}} = \frac{1}{200} + \frac{1}{250} + \frac{1}{1000} = .005 + .004 + .001 = .01$$

$$R_{TOTAL} = \frac{1}{.01} = 100\Omega$$

$$R_{TOTAL} = 100\Omega$$

I-J. Impedance

The expression “impedance” is used in the BELIMO literature in the following way:

- **Input impedance:** The input circuit of a control device, based on its circuitry, has a certain electrical resistance. The value of this resistance determines how much current the device will draw from the controller. This value must be taken into consideration when connecting any device to a controller output. *Example:* “Input impedance 100 kΩ.” This means that the DC resistance between the input (Y or Y1) and common (COM) is 100 kΩ (100,000 ohm). When the signal is 10 VDC, using Ohm’s Law ($I=E/R$), the current draw on the output of the controller will be $(10V/100,000 \Omega) = .0001A = .1 \text{ mA}$ for each actuator that is connected to the signal. **The combined input impedance must be higher than the controller output impedance.**

- **Output impedance:** The output of a controller has a limited amount of current capacity to supply to the devices it is controlling. The capacity can be given in one of 2 ways. One way is by stating it as “Maximum output current .2 mA.” The other is by giving its output impedance. The output impedance must always be lower than the combined input impedance of the devices being controlled.

Example I: “Output impedance 1000Ω minimum.” This means that the combined input impedance of the devices being controlled must be greater than 1000Ω.

Example II: “Maximum output current .2 mA.” Based on a 0 to 10 VDC control signal, the output impedance would be equal to $R=E/I$ or $(10V)/(.0002A) = 50k\Omega$

In general, the higher the input impedance, the lower the current draw, therefore less strain on the controller output. The lower the output impedance, the more current available; the more current available, the more devices can be controlled.

I-K. Power Consumption (W) / Volt Amperes (VA)

When a device is powered with direct current (DC), or alternating current (AC) into a pure resistive load (bulb, heater, etc.), the rated power consumption is watts (W) and is the product of the current (I) and voltage (E), ($W = E \times I$).

When an actuator is powered with alternating current (AC), the actual power consumption in watts (W) inside the actuator will remain the same. However, due to the inductive and capacitive character of the load, a shift between current and voltage occurs (phase shift). This results in an “apparent” power consumption, which is higher than the actual power consumption. The “apparent” power consumption is expressed in volt-amperes (VA), which is the product of AC volts and the current ($VA = V \times I \times \text{efficiency}$.)

The size of a transformer is expressed in volt-amperes (VA) and not in watts (W). **The VA rating of a transformer must be at least as large as the combined VA rating of all the actuators connected to the transformer.**

Example: Actuator AM24 us.
Power consumption: 2.5 W. Transformer sizing: 4.5 VA

If five (5) AM24 us are connected to one transformer, the VA rating of the transformer must be $5 \times 4.5 \text{ VA} = 22.5 \text{ VA}$, or larger.

It is better to use a number of small transformers than one large one.

The Belimo products are designed to be powered from Class II transformers for UL applications. These transformers have internal power limitation. A Class II transformer must not provide more than 30 V and no more than 100 VA output. **Do not use a Class I transformer and fuse, because it does not constitute a Class II power source!**

I-L . Wire Sizing

Using the correct wire size is important when long wire runs are used. Using too small of a wire increases the resistive losses of the run. The result of this may be too low of a voltage at the actuator to operate correctly. The above chart can be used to determine the correct wire size to use for an application.

Example I: Three AM24-SR us actuators are powered from the same wire. The wire run is 100 feet.

Step #1. Calculate the total power required.

The AM24-SR us requires 5 VA, 3 actuators are being used. $3 \times 5 = 15 \text{ VA Total}$.

Step #2. Locate 15 VA on the vertical axis of the chart and 100 feet on the horizontal axis.

Step #3. Find the intersection of 15VA and 100 Ft (Point “A”)

Step #4. Read the diagonal line to the **right** of point “A”. It is the 18 ga. wire gauge line. Use 18 ga. or larger wire.

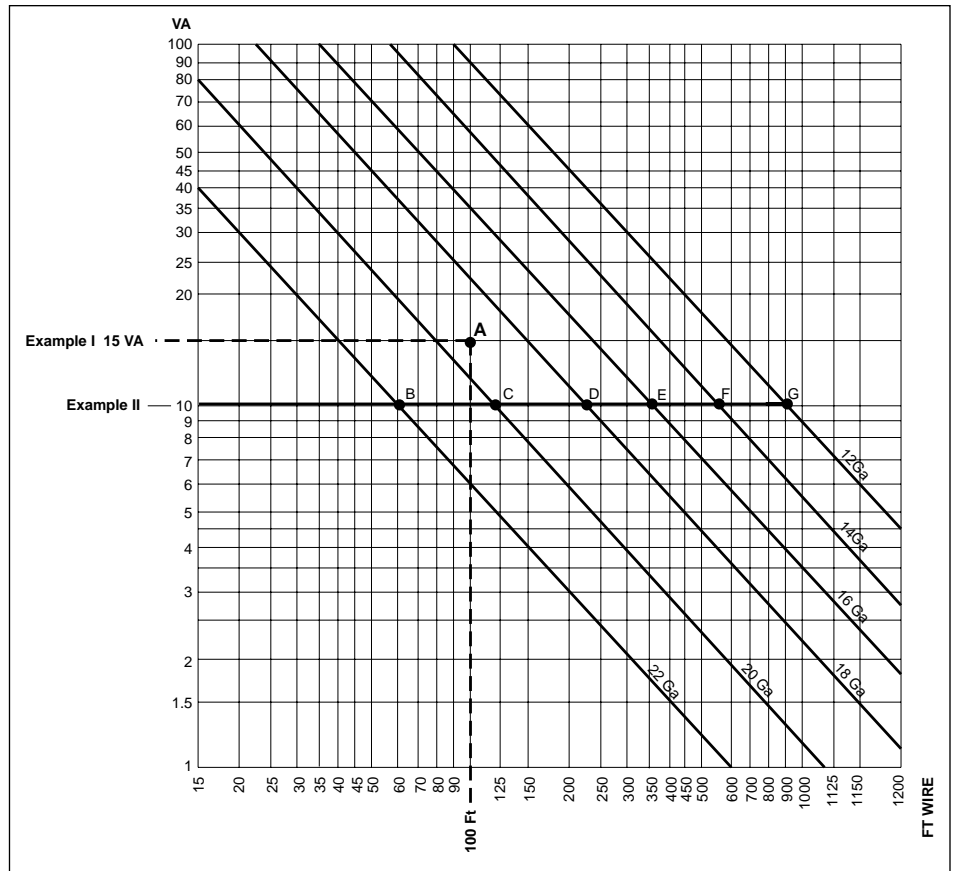


Chart 1

Note: A low gauge number = a thicker wire; A high gauge number = a thinner wire.

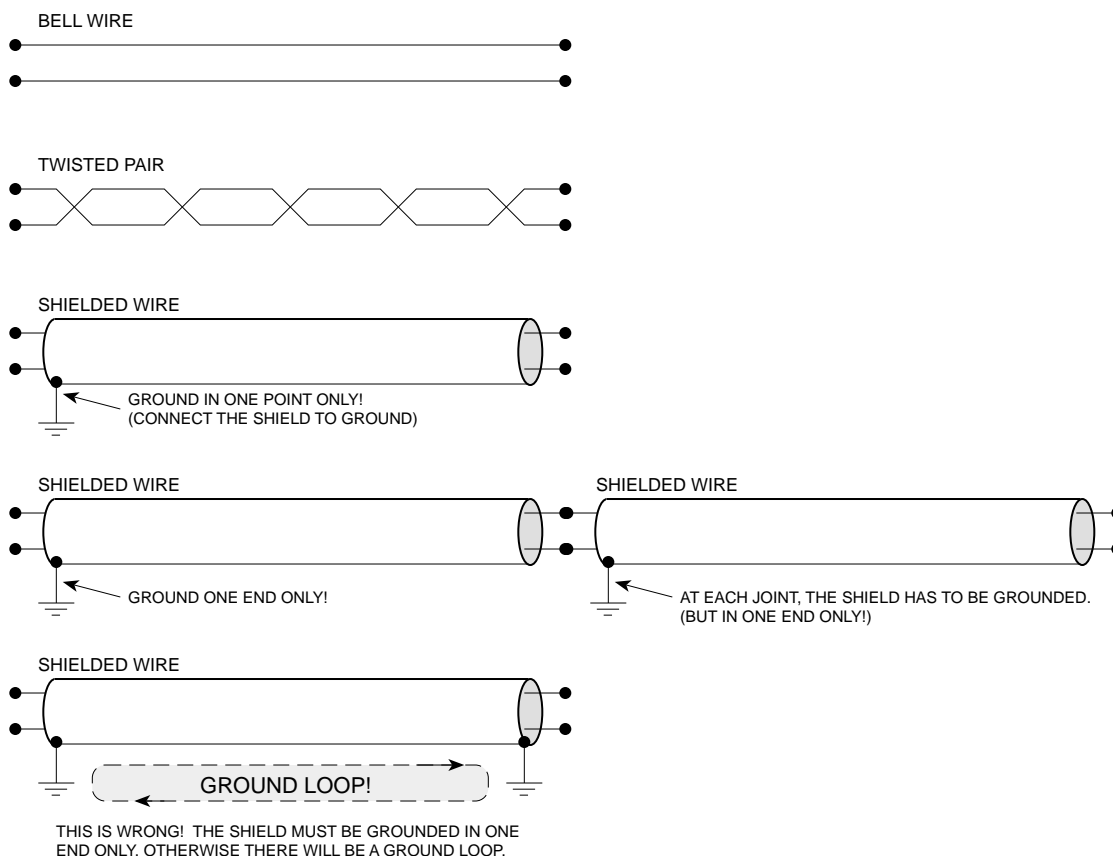
Example II: The maximum wire length for a 10 VA power consumption using different wire gauges.

Point “B”	22 Ga	Max. 60 FT	Point “E”	16 Ga	Max. 350 FT
Point “C”	20 Ga	Max. 120 FT	Point “F”	14 Ga	Max. 550 FT
Point “D”	18 Ga	Max. 220 FT	Point “G”	12 Ga	Max. 900 FT

I-M. Multi-Conductor Wire Types

- “*BELL WIRE*” has parallel wires, which may act as an antenna and is therefore sensitive to electrical noise. This type of wire should not be used for control circuits.
- “*TWISTED PAIR*” cancels out most of the electrical noise because the wires alternate their positions. This is the type of wire that is used for most control circuits.
- “*SHIELDED WIRE*” is a twisted pair that is surrounded by a metal foil or wire mesh which acts as a shield and prevents electrical noise from reaching the wires inside.

Shielded wires are used for the BELIMO actuators only if the electrical noise is very severe. Normally twisted pairs are sufficient. *Remember! The shield must be grounded in one point only!*



I-N. Ground Loops

If a shield is grounded at both ends of a shielded wire, a ground loop is created. Ground loops will defeat the purpose of shielding, and aggravate the electrical noise problem.

Ground loops can also be created by using more than one wire for signal common (COM \perp). The (-) signal common terminals on the controller are usually interconnected. Therefore, a ground loop is formed when two or more signal common terminals of the controller are wired to the same transformer. (See Fig. 11-5 and 11-6, page 175.)

Signal common (COM \perp) is necessary, as a reference, but only one connection should be used.

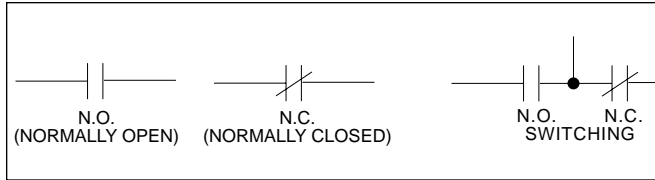
Redundant signal common terminals should not be connected.

A ground loop acts as an antenna and will pick up electrical noise. This should be avoided, by using the correct wiring practice.

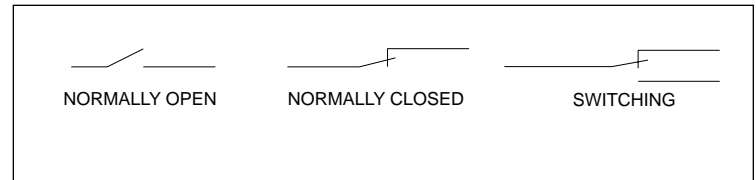
II. UNDERSTANDING WIRING DIAGRAMS

II-A. Electrical Symbols

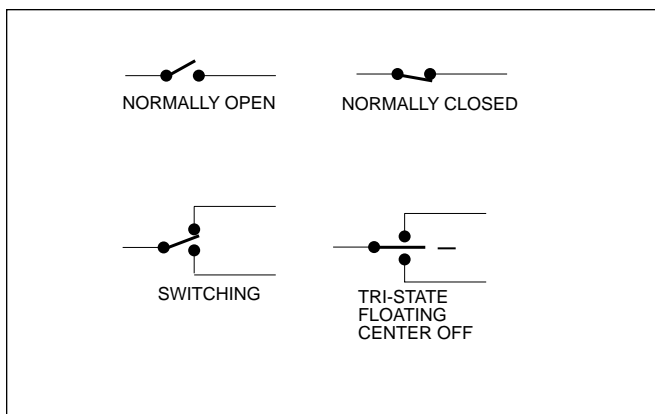
U.S. Electrical Symbols for Contacts



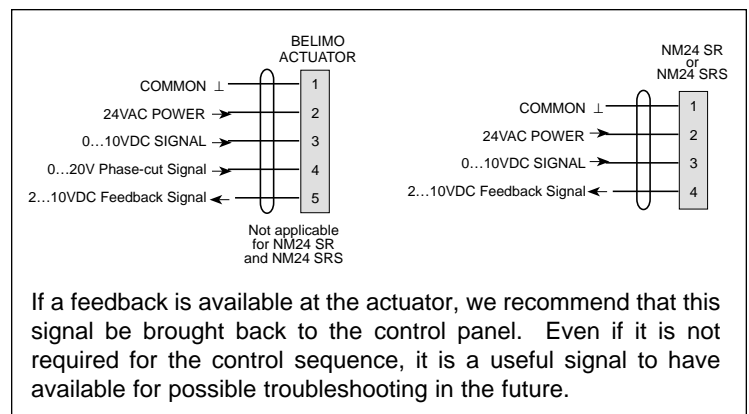
International Symbols for Contacts



Traditional Electronic Symbols for Contacts

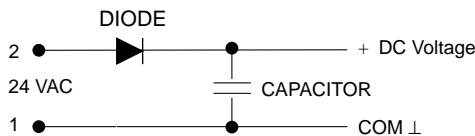


Belimo Proportional Actuators- Wire Symbols and Numbers



II-B. Compatibility of Different Power Supplies

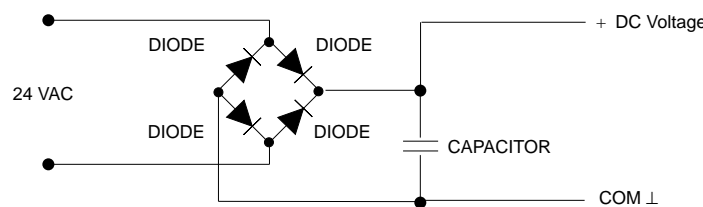
Power Supply with Half-Wave Rectifier



Half-wave rectifiers offer the advantage of using the same connection for the AC common and DC common. Therefore, the common of different devices using half-wave rectifiers can be interconnected and use the same power source.

Some devices, typically DDC controllers, have full-wave rectifiers. In this case, always use a separate transformer for the controller.

Power Supply with Full-Wave Rectifier



Full-wave rectifiers provide more current capacity. Their disadvantage is that the AC and DC sides cannot be interconnected.

Every device which has a full-wave rectifier must be powered from *its own separate transformer*, if the COM ⊥ wire is connected to the Common of other devices.

Note: If a device with a full-wave rectifier is powered from the same transformer as a device with a half-wave rectifier, **a short circuit will result** if the commons (COM ⊥) are interconnected.

The Belimo products use half-wave rectifiers. Therefore, they may be connected to the same transformer as long as all commons (COM ⊥) are connected to the same leg of the transformer. However, anytime actuators are connected to a controller a separate transformer should be used for the controller power supply unless you know that the controller also uses a half-wave rectifier.

II-C. Connection of Actuators

0 to 10 V Control Signals

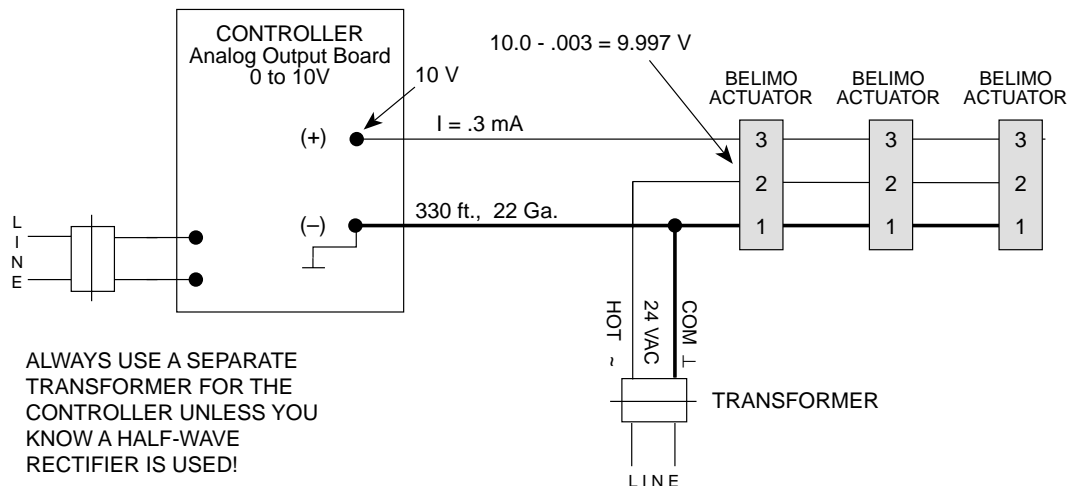
Signal Loss

Due to the high input impedance (100kΩ) of the actuators, the current through the signal wire is very low. Therefore, the loss of signal will be negligible, even if with long wire runs.

Example: Three actuators are connected via a 330 ft. (100 meters) long pair of 22 Ga. wires. Each wire has a resistance of 5Ω.

The current draw from each actuator is $(I = E/R) 10/100,000 = 0.1 \text{ mA}$, when the signal is 10 VDC.

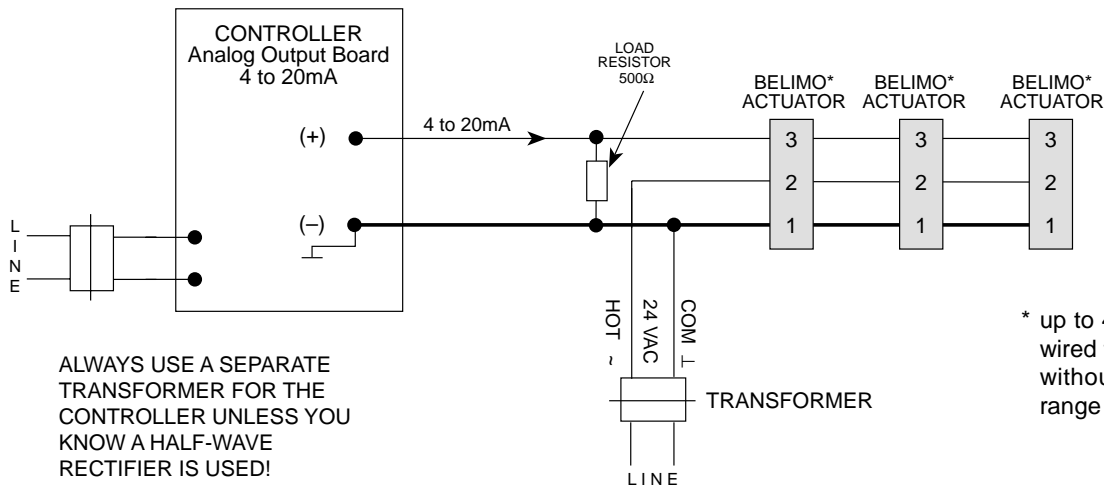
The current in the wire will be $3 \times 0.1 = 0.3 \text{ mA}$. Because 2 wires, the Common and the Source, go to the actuator, the resistance in the wires is $2 \times 5\Omega = 10\Omega$. The loss of signal will be $(E = R \times I) 10 \times 0.3 = 3 \text{ mV} = -.003\text{V}$.



4 to 20 mA Control Signals

The controller will regulate the output current (signal) to the desired value, regardless of the resistance (up to a specified value) in the wires and the load resistor.

The resistance in the wires will only cause the output voltage of the controller to be slightly higher than the input of the actuators. The advantage with a 4 to 20 mA output signal to the actuators is that wire resistance does not cause any error to the control signal, and that electrical interference is rejected.



* up to 4 actuators may be wired to one load resistor without a significant range shift.

The input impedance of the actuators will reduce the resulting resistance of the load resistor. However, the error is so small that there is no need to compensate for this by using a slightly higher resistance value. A 500Ω load resistor will give an adequate accuracy. Use a 499Ω, 1%, 1/2w resistor or two 1kΩ, 1%, 1/4 w resistors in parallel.

Modulating Control Signal Wiring

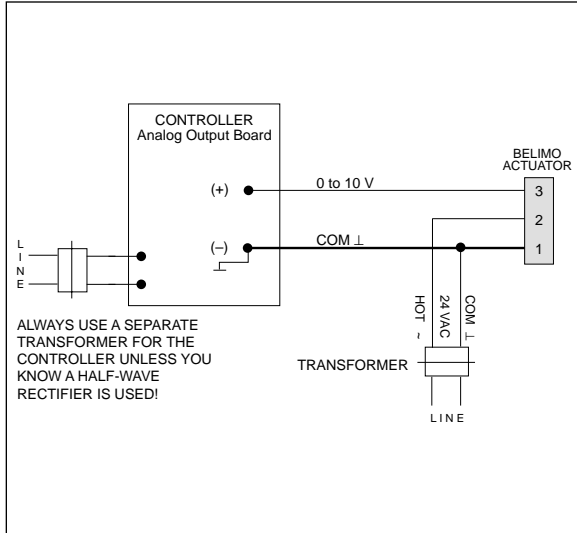


Fig. II-1 Single Output to Single Actuator

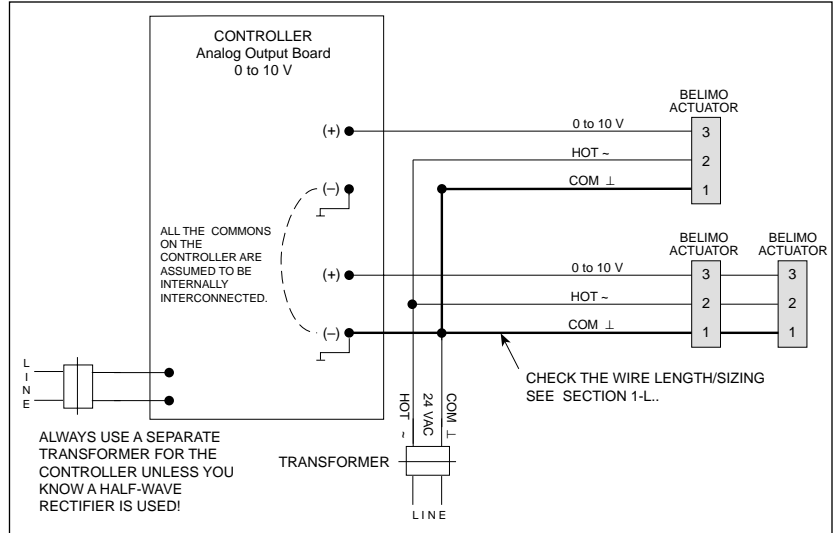


Fig. II-2 Multiple Outputs to Multiple Actuators Using 1 Transformer for Actuators

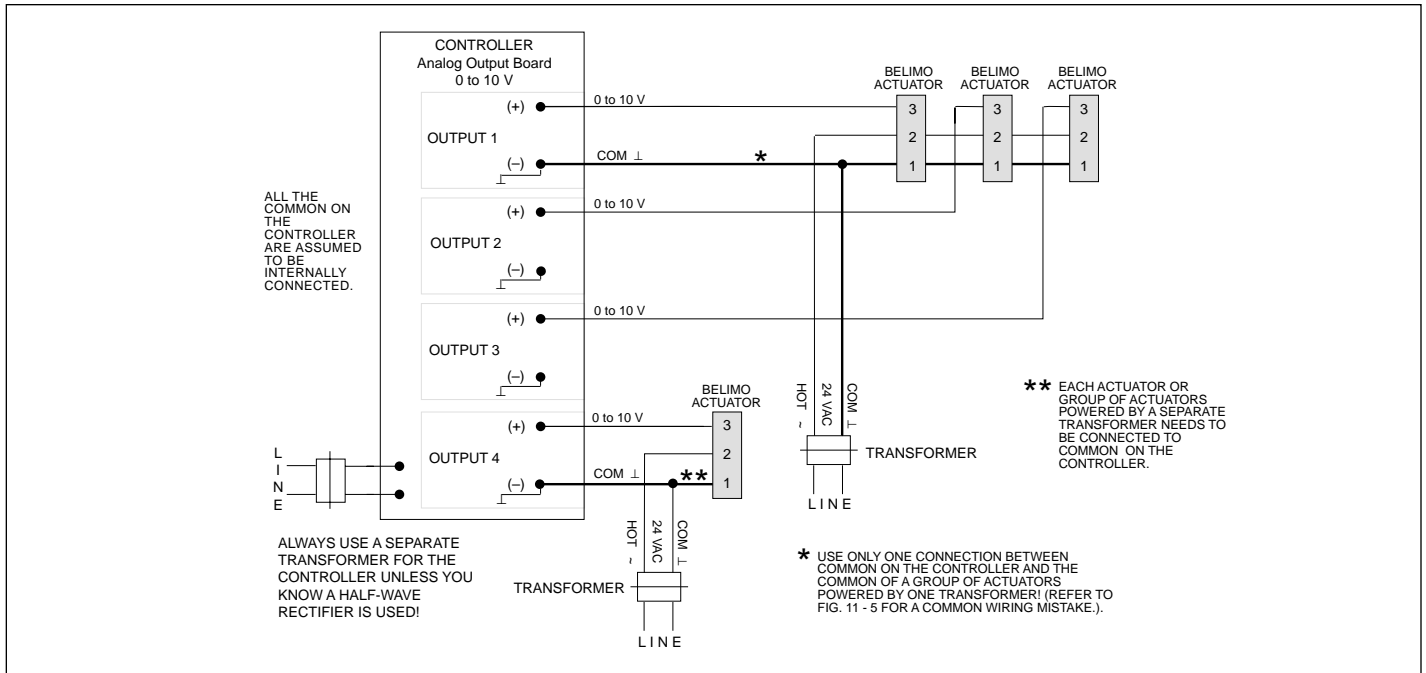


Fig. II-3 Multiple Outputs to Multiple Actuators Using 2 Transformers for Actuators

II-D. Long Distance Wiring

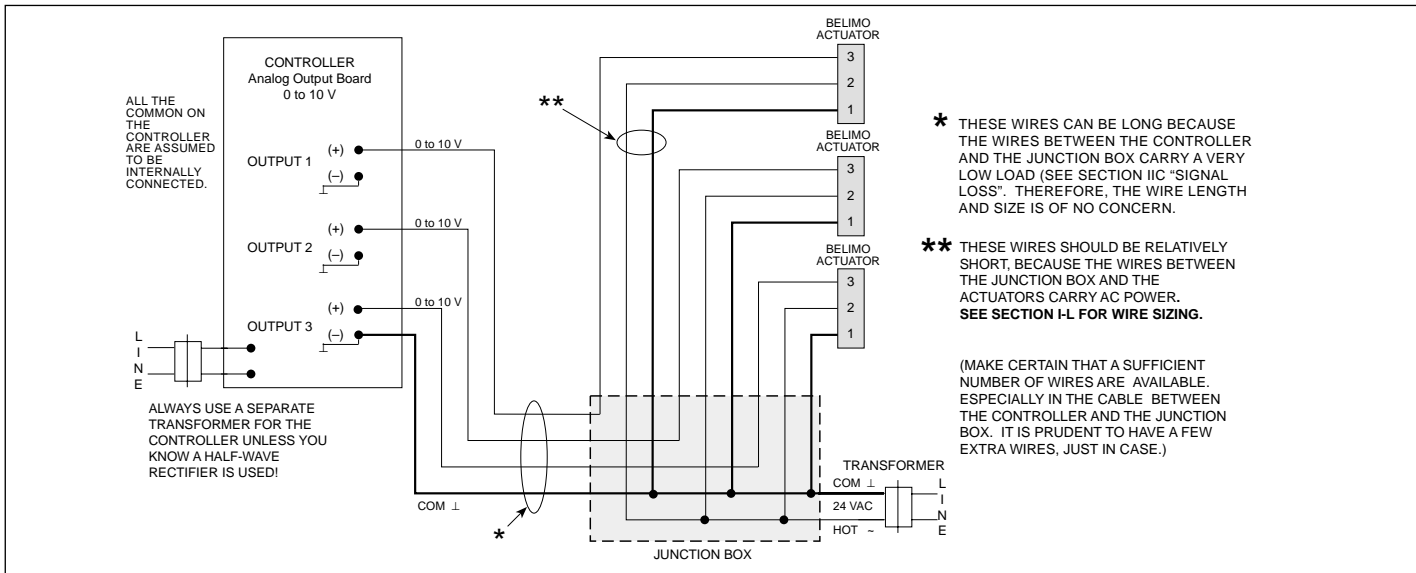


Fig. II-4

II-E. Wiring Mistakes

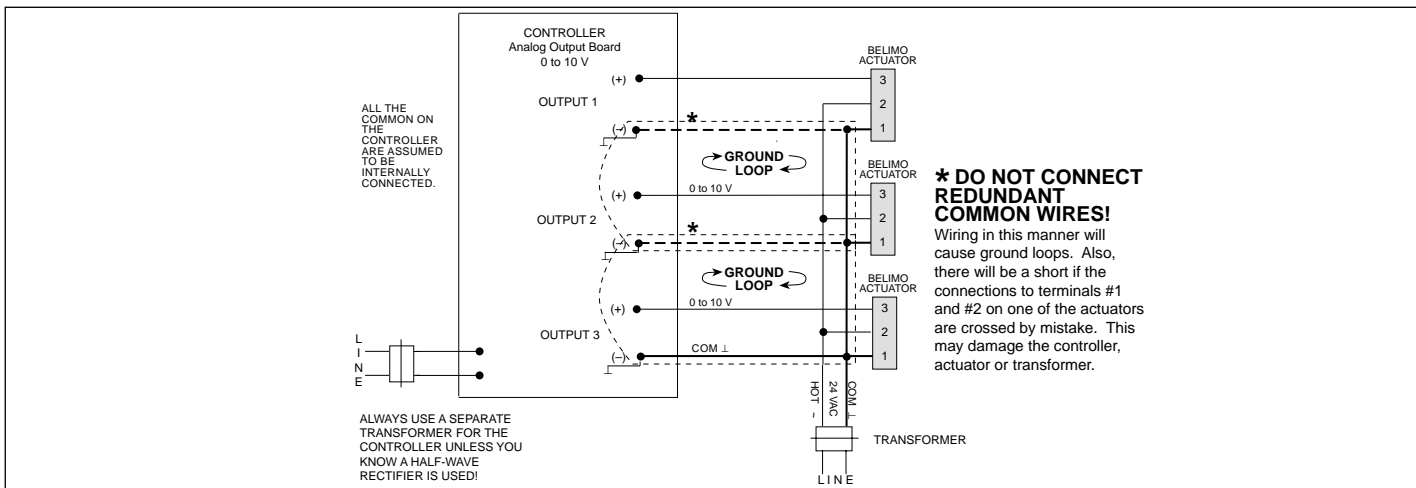


Fig. II-5 A Common Wiring Problem

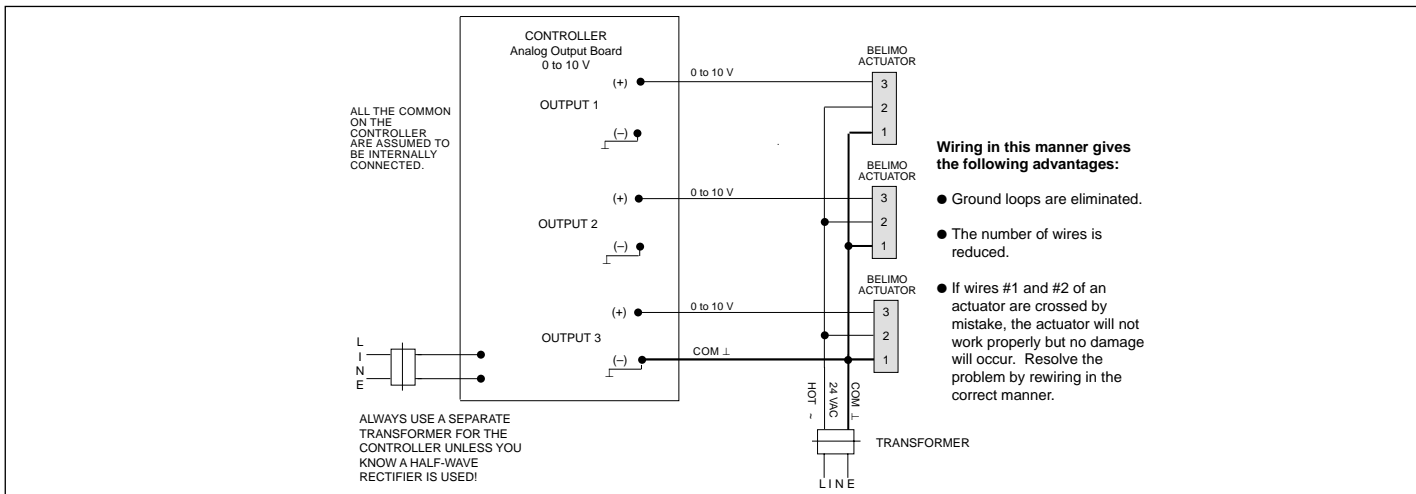


Fig. II-6 Correct Wiring

III. ANALOG OUTPUTS

III-A. 2 to 10 Volt Analog Output

The controller produces a variable voltage between signal common and the analog output.

The signal common (wire #1) of the actuator must be connected to the signal common of the controller, and the output of the controller is connected to actuator signal input (wire #3).

III-B. Sourcing 4 to 20 mA Analog Output

A sourcing 4 to 20mA analog output sends out a current to the actuator, and receives it at the signal common terminal.

It is similar to a 0 to 10 V output. The only difference is that one 500Ω resistor has to be installed between wires #3 and #1 at the actuator. The resistor converts the current (4 to 20 mA) to a 2 to 10 V signal. The resistor should be located at the actuator.

III-C. Sinking 4 to 20 mA Analog Output

A sinking 4 to 20 mA output uses a different logic to create a control signal. In both a 0 to 10 VDC and sourcing 4 to 20 mA application, the signal is regulated at the positive (+) source of the signal. In a sinking application the signal is regulated between the device being controlled and common. For this reason, the term “Output” in a sinking application is sometimes confusing.

The controller has one terminal that supplies a constant DC voltage (often +24V). The input of the actuators (wire #3) are connected to the constant voltage. A 500Ω resistor is connected between wires #1 and #3 on one actuator connected to each output. (One resistor for each output.) Terminal #1 on the actuator is connected to the output of the controller.

The current will run from the constant voltage on the controller, to wire #3 on the actuator, through the 500 Ω resistor, to wire #1, and back to the input of the controller.

From the controllers point of view, all the #3 terminals of the actuators are at a “common” constant +24VDC. The signal common, wire #1, of the actuators will vary with the control signal.

Because the signal common of the actuators is variable, each output requires a separate transformer. The signal common of actuators connected to different outputs must never be interconnected. (See note ** in the wiring diagram)

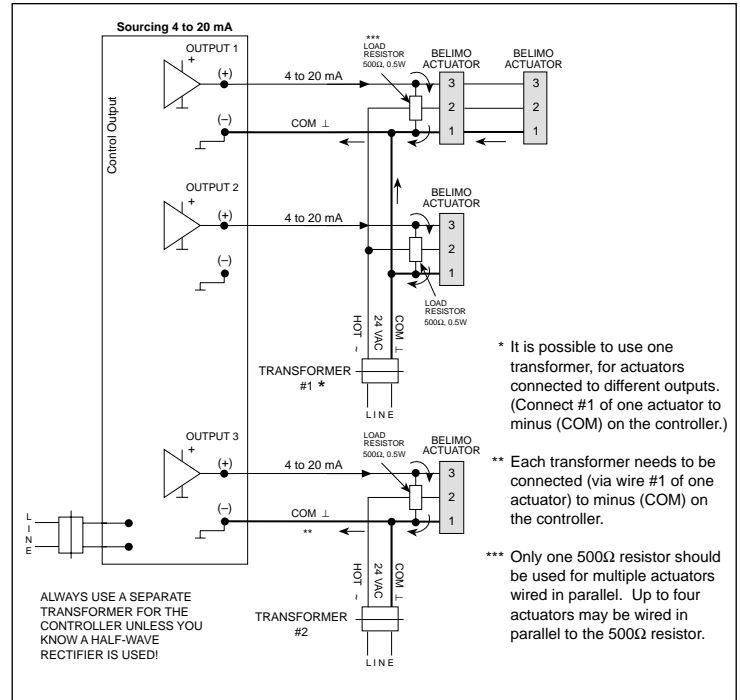


Fig III-1

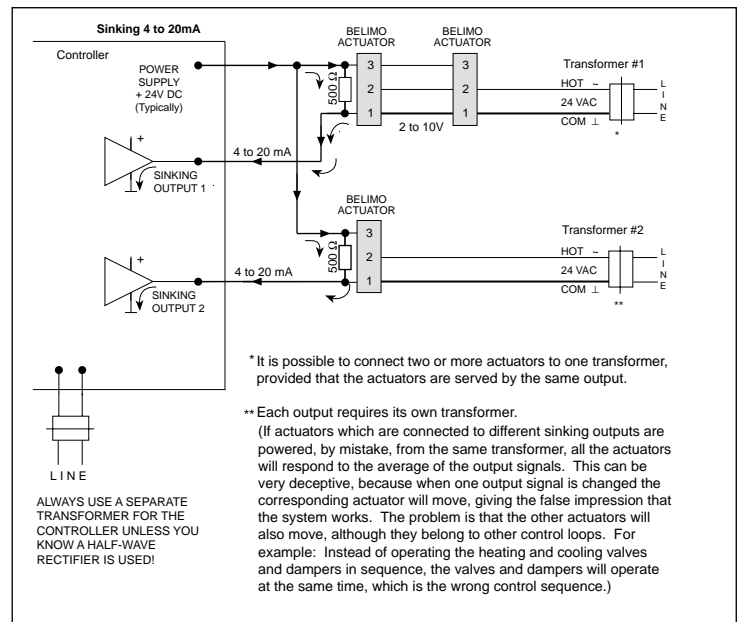


Fig. III-2 Sinking 4 to 20 mA

III-D. Parallel Operation

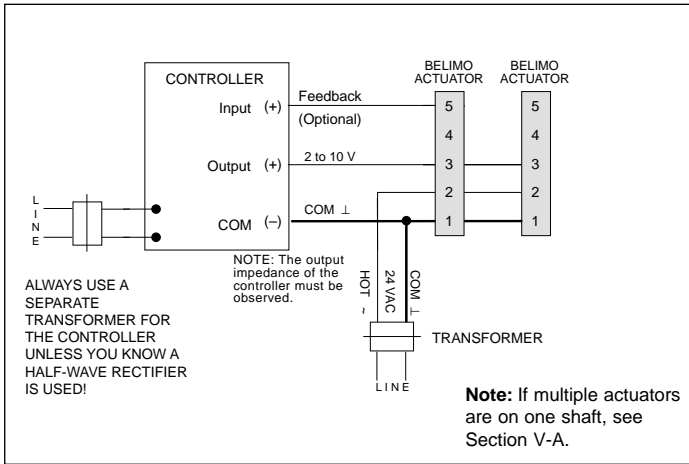


Fig III-3

III-E. Master-Slave operation

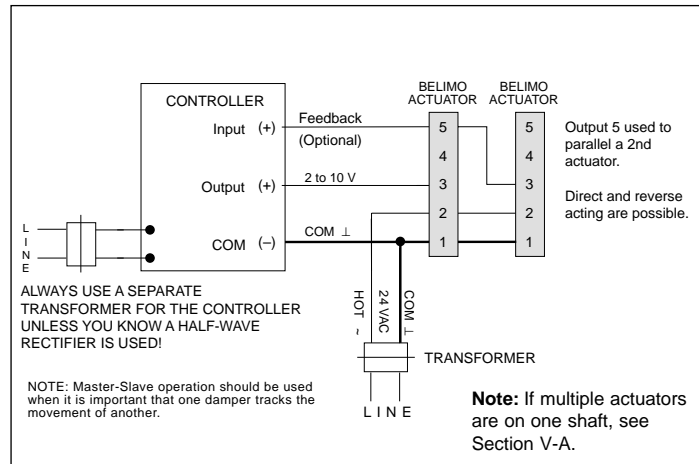


Fig III-4

III-F. Monitoring feedback with a remote indicator

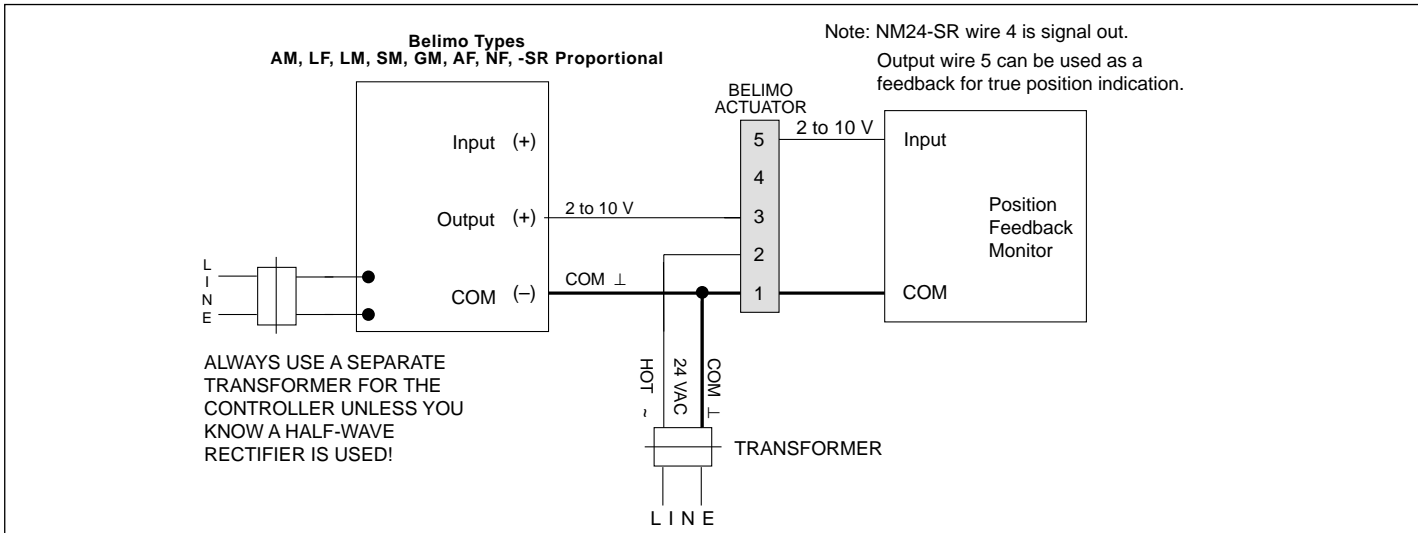


Fig. III-5

III-G. One Output/Multiple Transformers

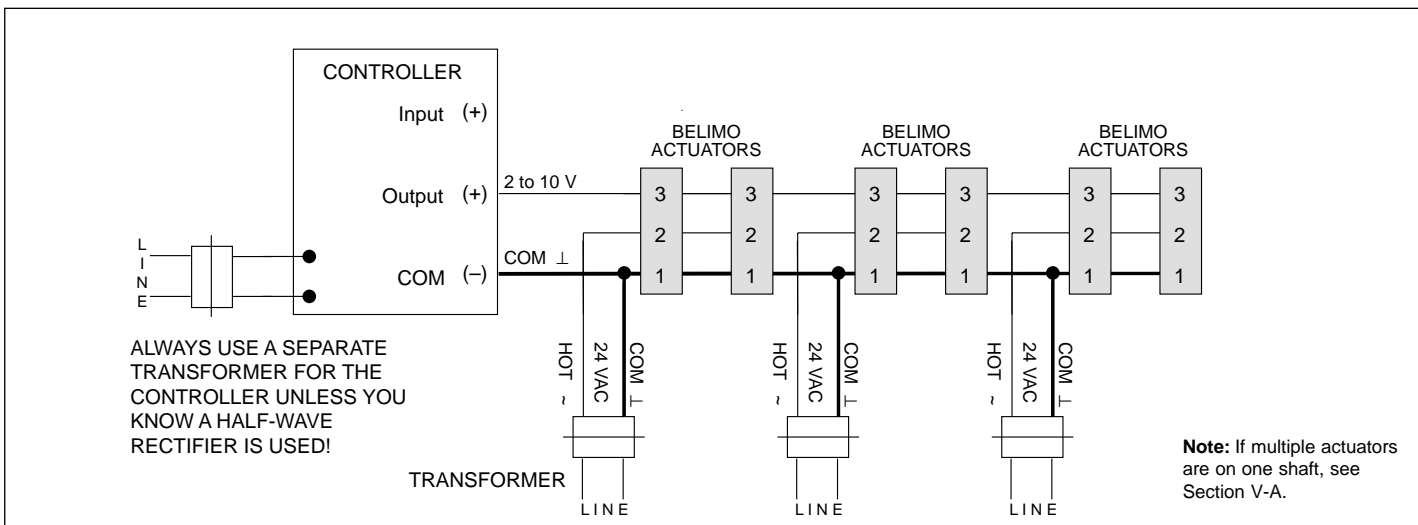


Fig. III-6

IV. WIRING DIAGRAMS FOR BELIMO PRODUCTS

IV-A. IV-A. On/Off Control, 24V

W419

Notes:

- ⚠ Provide overload protection and disconnect as required.
- ⚠ Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- ⚠ Actuators may also be powered by 24 VDC.
- ⚠ Meets cULus or UL and CSA requirements without the need of an electrical ground connection.
- ⚠ Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- ⚠ Ground connection required only for Fire and Smoke actuators.

IV-B. On/Off Control, 120/230V

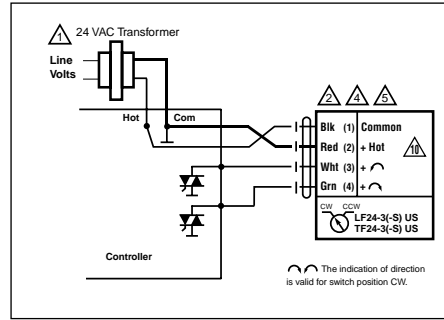
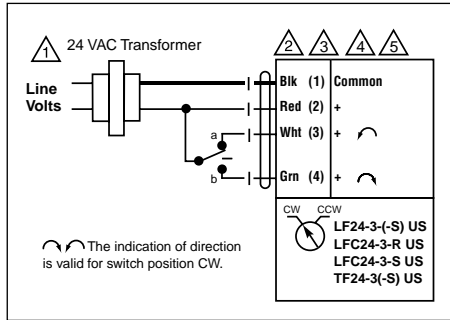
W420

Notes:

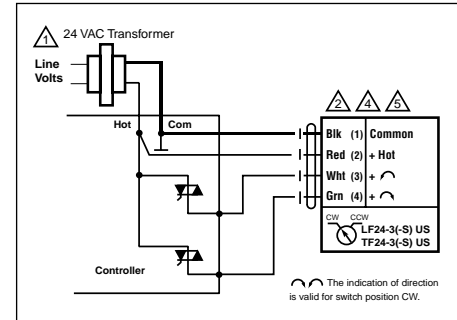
- ⚠ Provide overload protection and disconnect as required.
- ⚠ Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- ⚠ TF, GM, AM, NM, and LM can be supplied with both 120 VAC and 230 VAC
- ⚠ Meets cULus or UL and CSA requirements without the need of an electrical ground connection.
- ⚠ Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- ⚠ Ground connection required only for Fire Smoke actuators.

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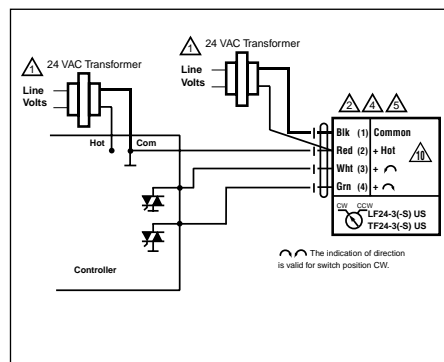
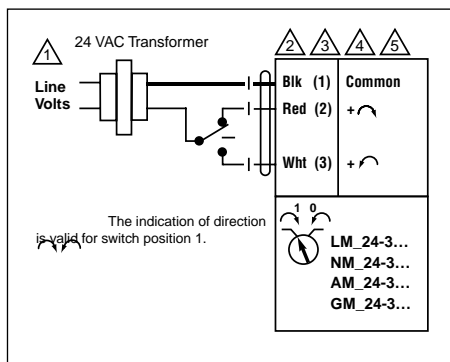
IV-C. Floating Point Control, 24V



Triac sink



Triac source

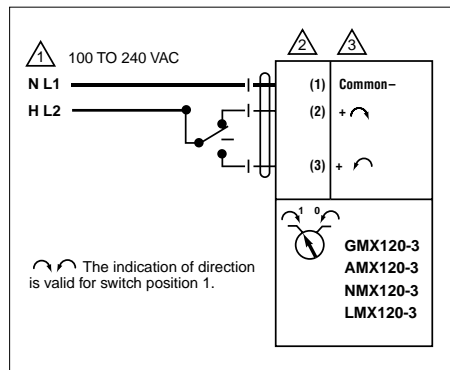


Triac sink with separate transformer

Notes:

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Meets cULus, or UL or CSA requirements without the need of an electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance rated cable use numbers.
- 10 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.

IV-D. Floating Point Control, 120/230V



Notes:

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 3 LM, NM, AM, GM, LR, and AR can be supplied with both 120 VAC and 230 VAC.
- 4 Meets cULus requirements without the need of an electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.

IV-E. Proportional Control, 24V

W423

Notes:

- 1 Provide overload protection and disconnect as required.
- 2 Up to Four Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 3 Actuator may also be powered by 24 VDC.
- 4 Meets cULus or UL and CSA requirements without the need of electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 6 Only connect common to neg. (-) leg of control circuits.
- 7 A 500 resistor converts the 4 to 20mA control signal to 2 to 10 VDC.)

Functions	a	b	c
Min*	0% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mid*	50% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Max*	100% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Normal**	Control mode acc. to Y	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

IV-F. Proportional Control, 120/230V

W424

Notes:

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be connected in parallel. Power consumption and input impedance must be observed.
- 3 LM, NM, and AM can be supplied with both 120 VAC and 230 VAC.
- 4 Meets cULus requirements without the need of an electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 6 Only connect common to neg. (-) leg of control circuits.
- 7 A 500 resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- 8 24 VAC power supply output.

Functions	a	b	c
Min*	0% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mid*	50% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Max*	100% \leftarrow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Normal**	Control mode acc. to Y	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

IV-G. Multi-Function Control

Spring Return

VDC/4-20 mA

Two Position

PWM

Floating Point

Override control to min, mid, max, positions

Functions	a	b	c
Min*	0% <	-	-
Mid*	50% <	-	-
Max*	100% <	-	-
Normal**	Control mode acc. to Y	-	-

* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

Notes:

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Meets cULus or UL and CSA requirements without the need of an electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 7 A 500 resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- 8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
- 9 Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
- 10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller.
- 11 Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatible.
- 12 IN4004 or IN4007 diode. (IN4007 supplied, Belimo part number 40155)

Non-Spring Return

VDC/4-20 mA

Two Position

PWM

Floating Point

Override control to min, mid, max, positions

Functions	a	b	c
Min*	0% <	-	-
Mid*	50% <	-	-
Max*	100% <	-	-
Normal**	Control mode acc. to Y	-	-

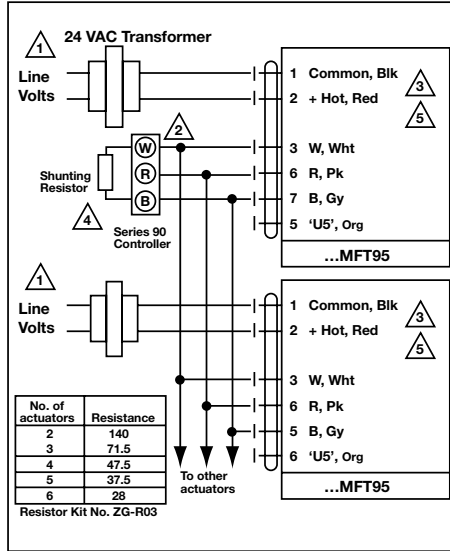
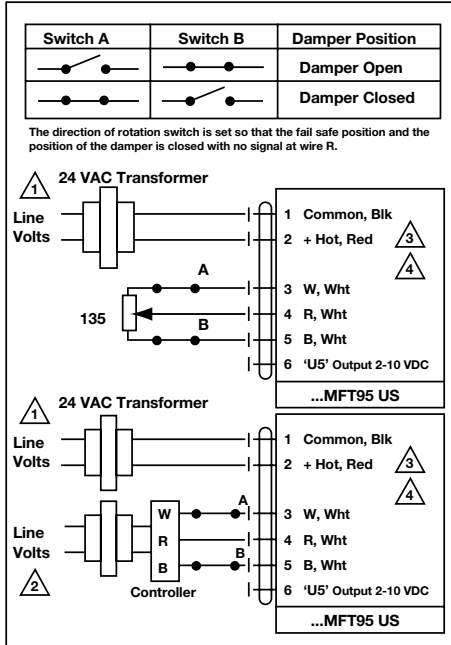
* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

Notes:

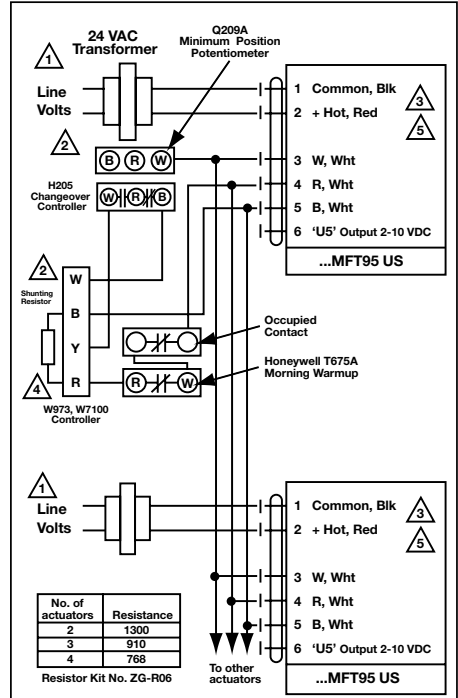
- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Meets cULus or UL and CSA requirements without the need of an electrical ground connection.
- 5 Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 7 A 500 resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.
- 8 Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
- 9 Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
- 10 For triac sink the Common connection from the actuator must be connected to the Hot connection of the controller.
- 11 Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatible.

IV-H. 0 to 135Ω Control

W427

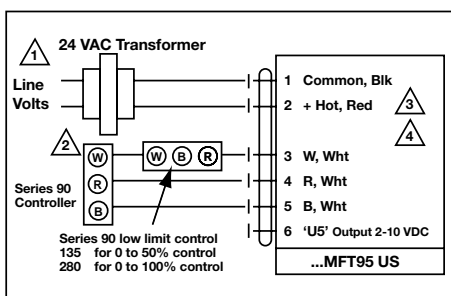


Wiring multiple actuators to a Series 90 controller.

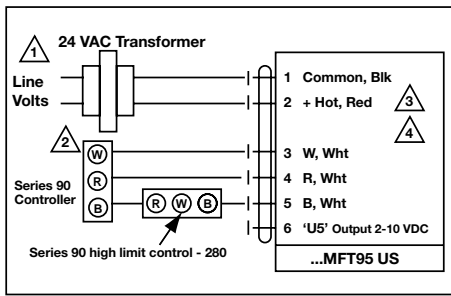


Used with the W973 and W7100 controllers.

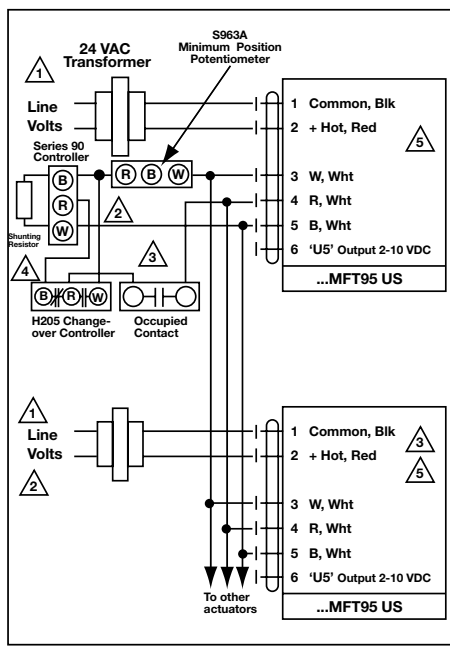
Override



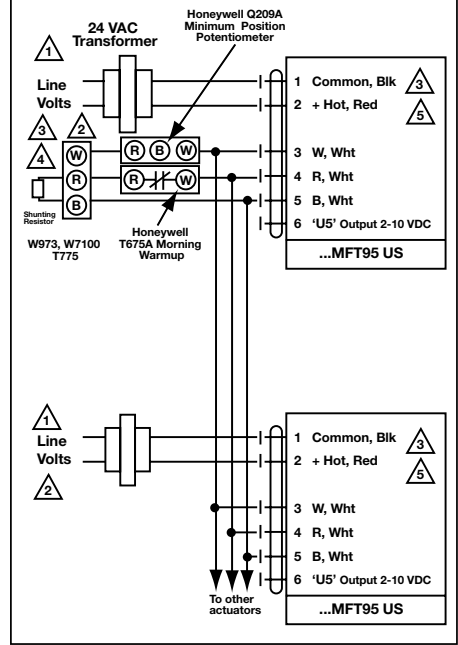
Low Limit Control



High Limit Control



Wiring multiple actuators to a Series 90 controller using a minimum position potentiometer.



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

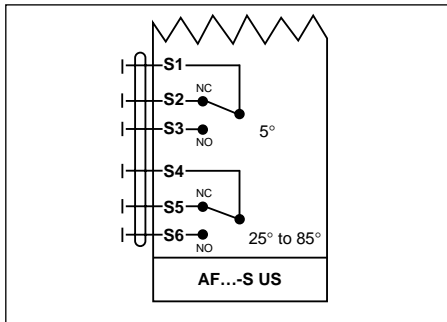
- 1 Provide overload protection and disconnect as required.
- 2 Actuators and controller must have separate transformers.
- 3 Consult controller instruction data for more detailed installation information.

- 4 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.
- 5 To reverse control rotation, use the reversing switch.

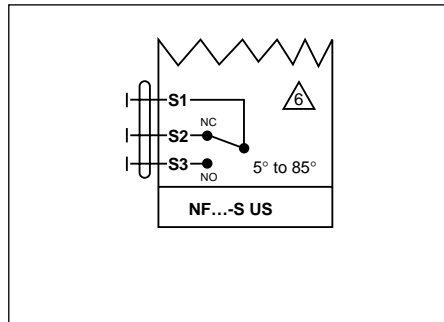
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Special Wiring

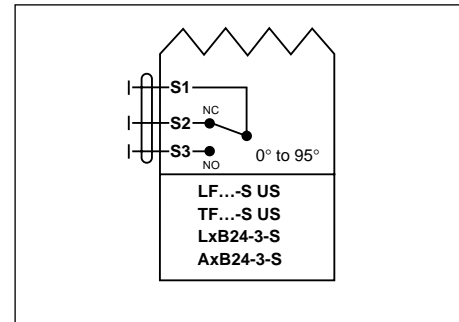
IV-I. Auxiliary Switch Wiring



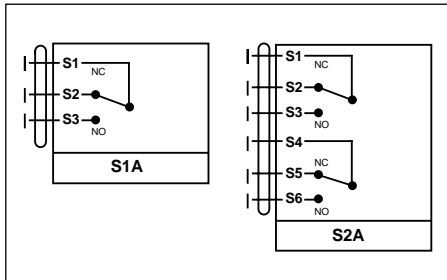
Auxiliary switch wiring for AF...-S US



Auxiliary switch wiring for NF...-S US



Auxiliary switch wiring for LF...-S US, TF...-S, LxB24-3-S, and AxB24-3-S



Add on Auxiliary Switches
S1A/S2A for GM, AM, NM and LM

Product	Voltage	Resistive Load	Inductive Load
AF...-S US	250	7.0 A	2.5 A
NF...-S US	250	7.0 A	2.5 A
LF...-S US	250	6.0 A	1.5 A
TF...-S US	250	3.0 A	0.5 A
AM...-S	250	3.0 A	0.5 A
LM...-S	250	3.0 A	0.5 A
S1A, S2A	250	3.0 A	0.5 A

Auxiliary Switch Ratings

Notes:

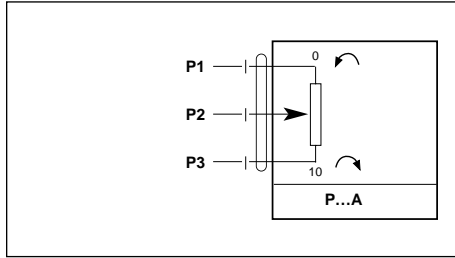
Two built-in auxiliary switches (2xSPDT), for end position indication, interlock control, fan startup, etc.

One built-in auxiliary switch (1xSPDT), for end position indication, interlock control, fan startup, etc.

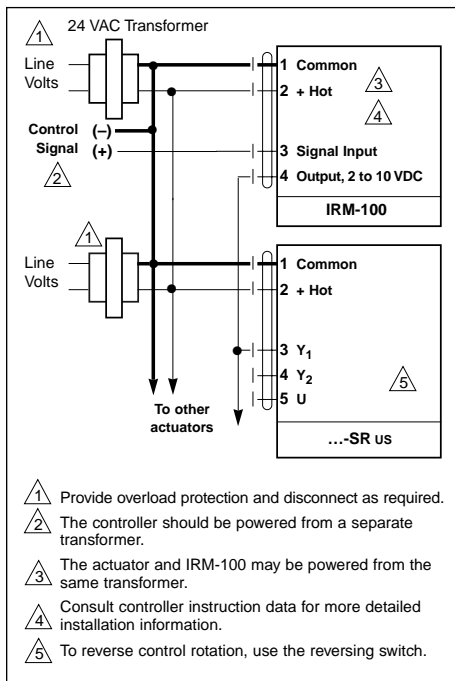
Meets cULus or UL and CSA requirements without the need of an electrical ground connection.

W428

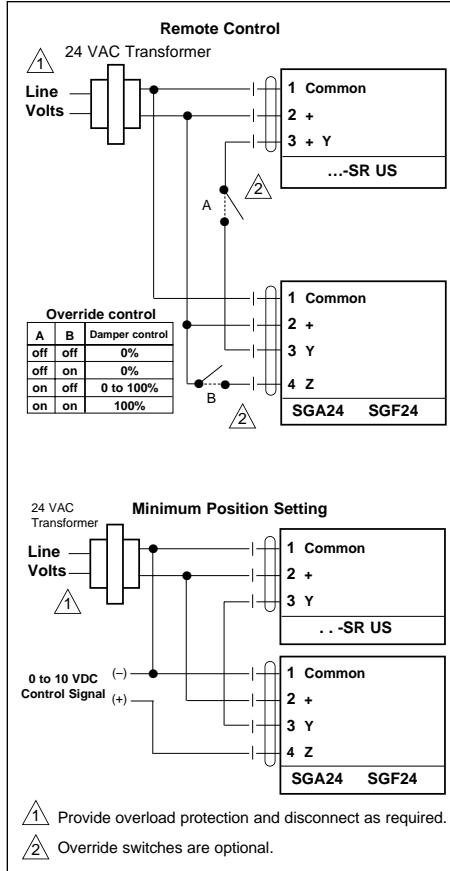
IV-J. Accessories



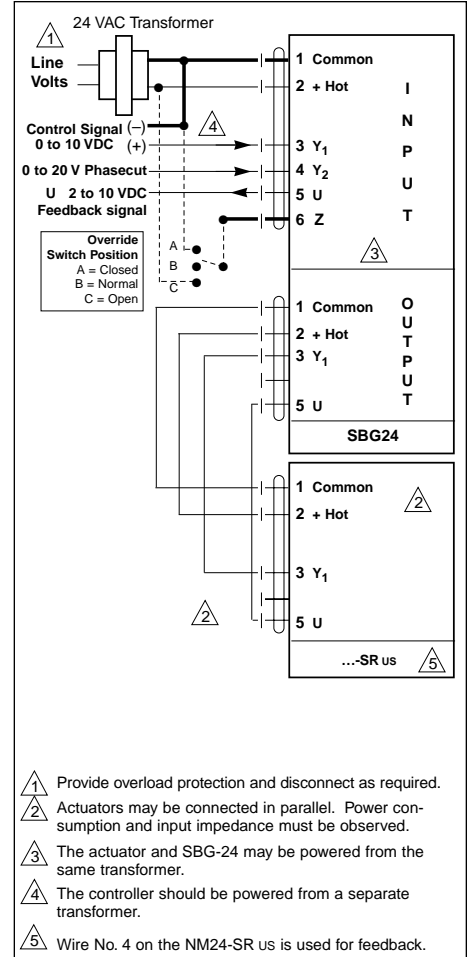
**Feedback Potentiometer
P...A used with GM/AM/NM/LM**



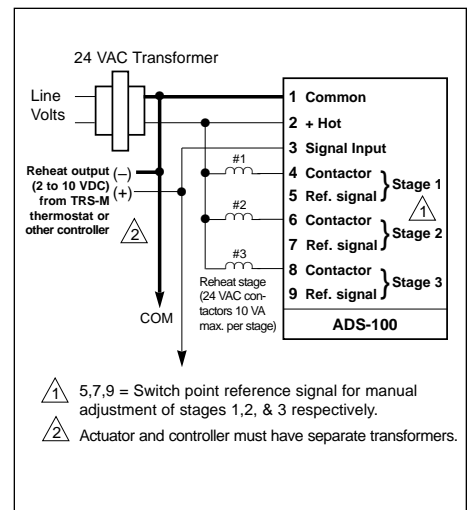
IRM-100 Input Rescaling Module



SGA, SGF Positioners

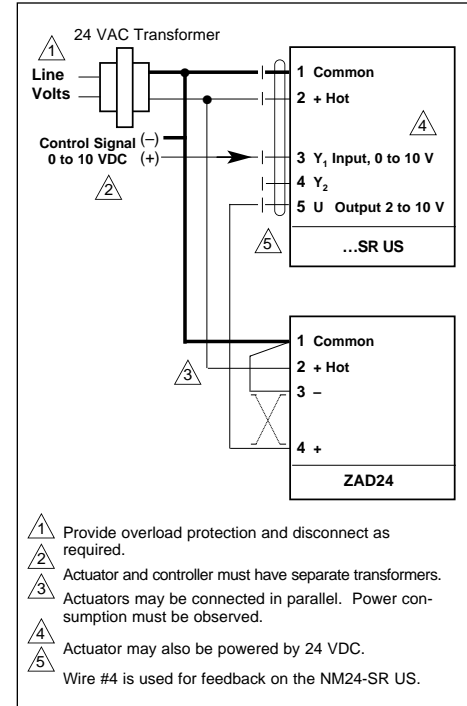
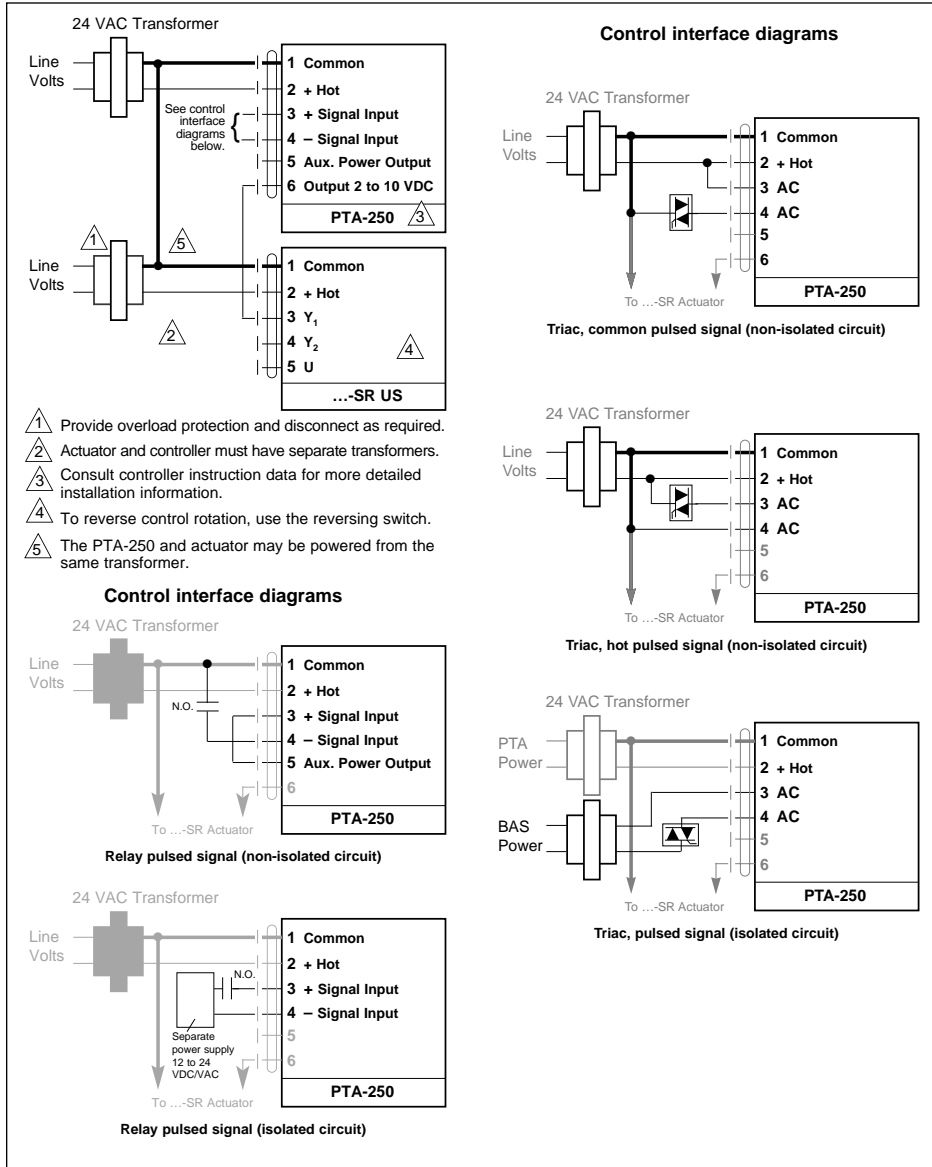


SBG 24 Range Controller

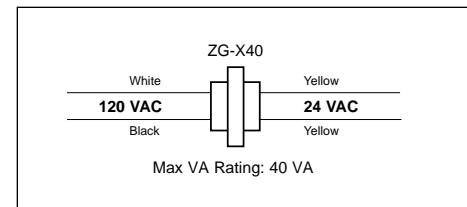


ADS-100 Analog to Digital Switch

IV-J. Accessories (continued)

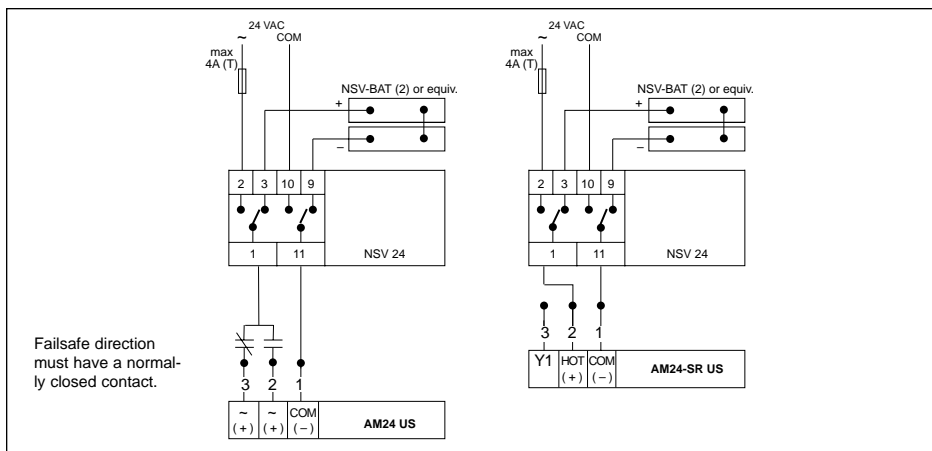


ZAD24 Digital Position Indicator

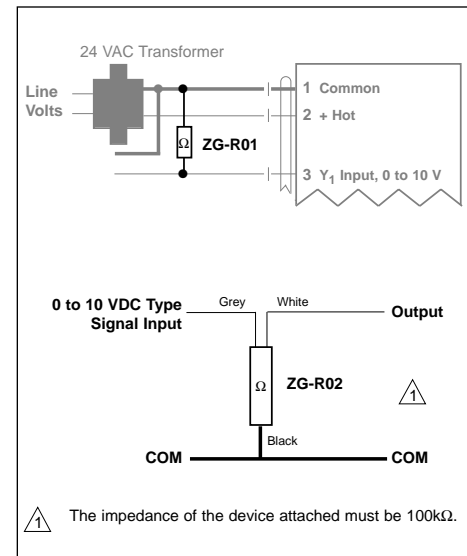


ZG-X40 Transformer

PTA-250 Pulse Width Modulation Interface



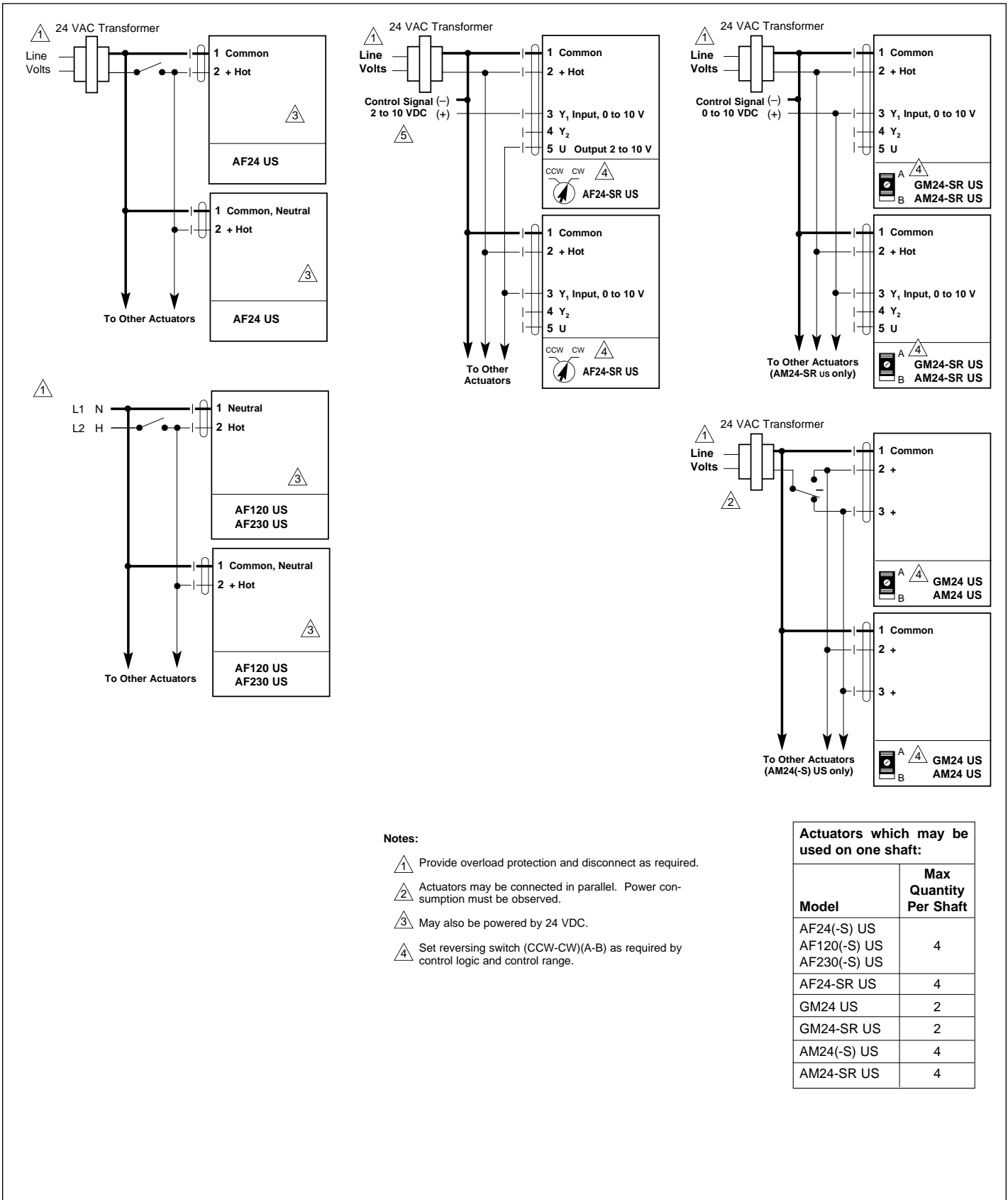
NSV 24 Battery Back-up Module



ZG-R01, ZG-R02 Resistor Kits

V. APPLICATION INFORMATION

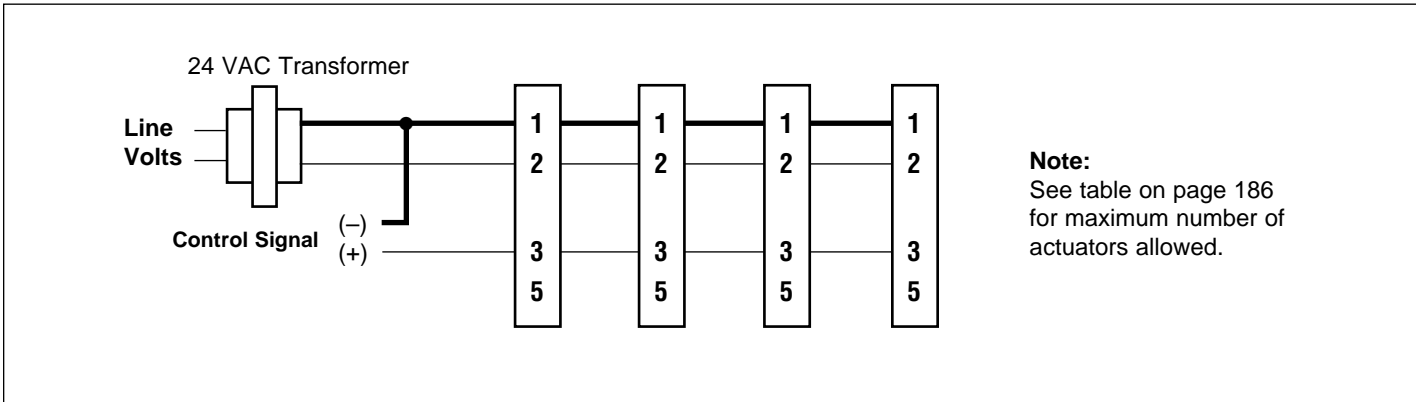
V-A. Wiring for Multiple Actuators on One Shaft (AF/GM, for other actuators use next higher torque actuator)



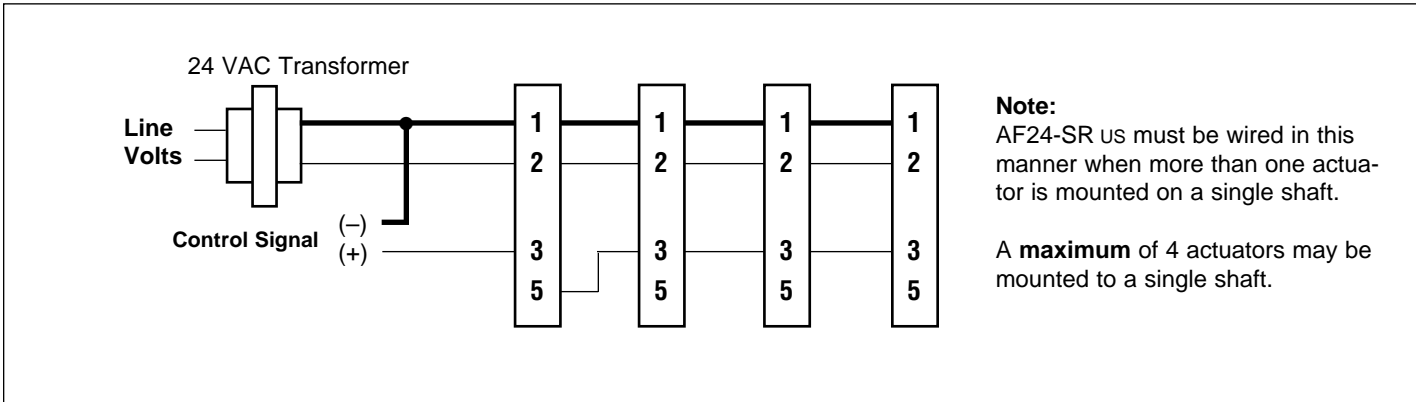
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Actuators which may be used on one shaft:	
Model	Max Quantity Per Shaft
AF24(-S) US AF120(-S) US AF230(-S) US	4
AF24-SR US	4
GM24 US	2
GM24-SR US	2
AM24(-S) US	4
AM24-SR US	4

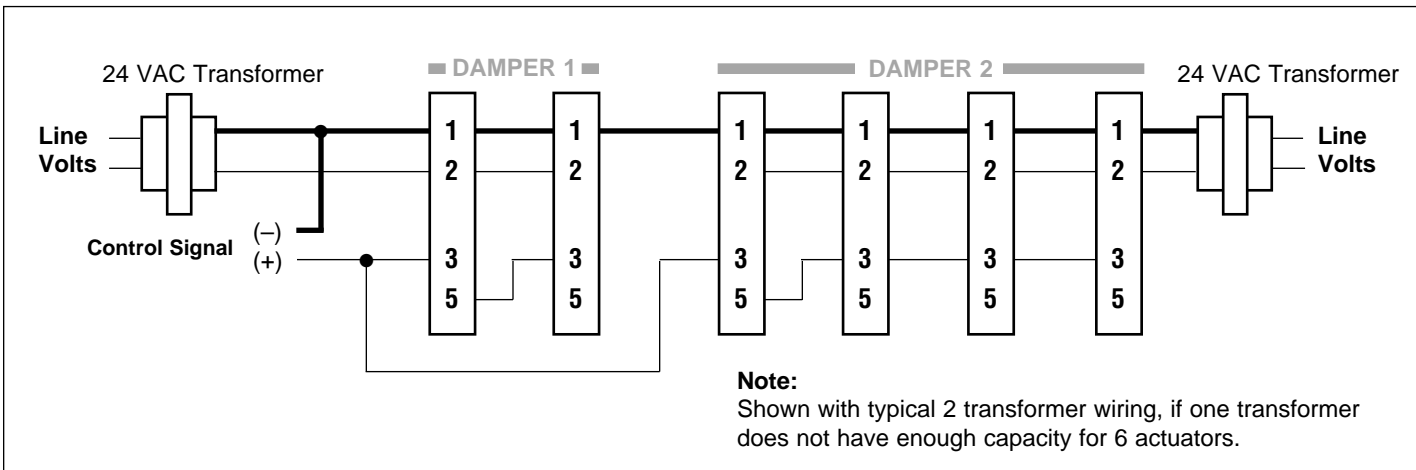
V-A. (continued) Wiring for Multiple Actuators on One Shaft (AF/GM, for other actuators use next higher torque actuator)



All actuators except AF24-SR US

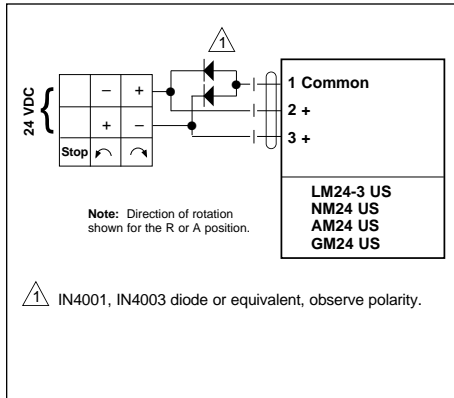


AF24-SR US

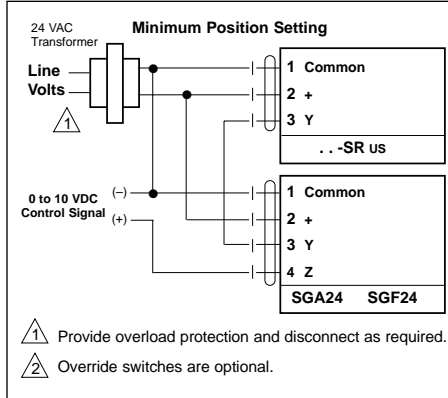


Typical wiring of multiple dampers with more than one AF24-SR US mounted on a single shaft.

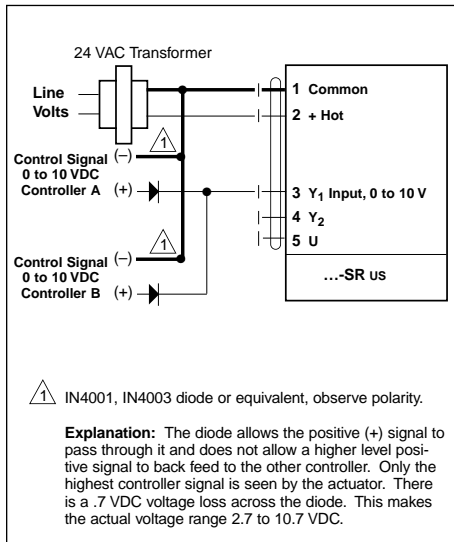
V-E. Floating Control Using a 2-wire DC Control Signal



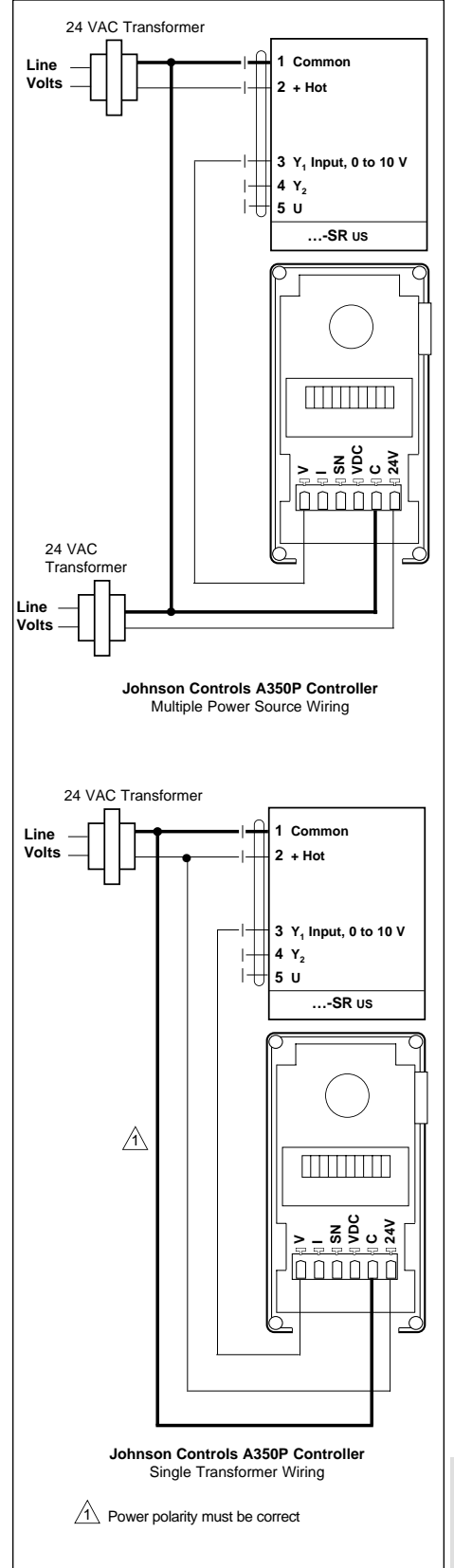
V-G. Minimum Position with 0 to 10 VDC Actuators



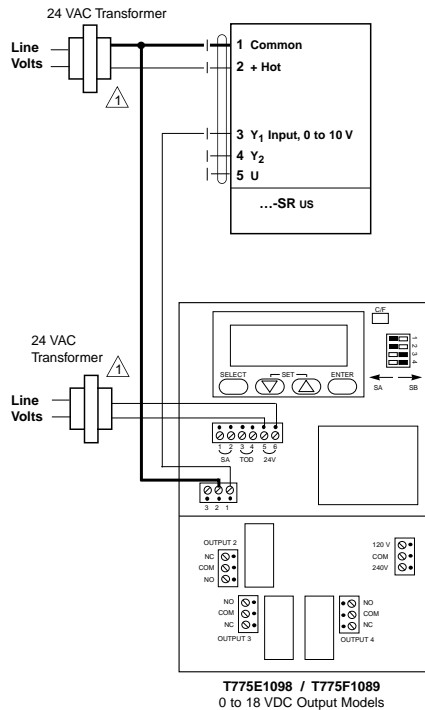
V-F. Operating two 0 to 10 VDC Controllers with the Higher of Two Control Signals



V-H Wiring to Johnson Controls A350P Controller

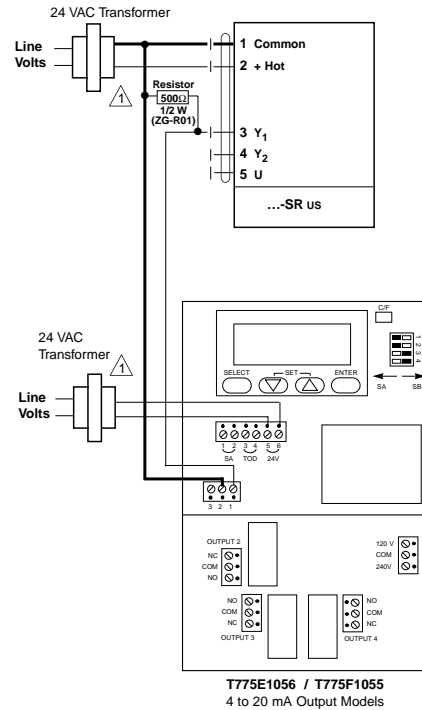


V-I. Wiring to Honeywell T775 Controller

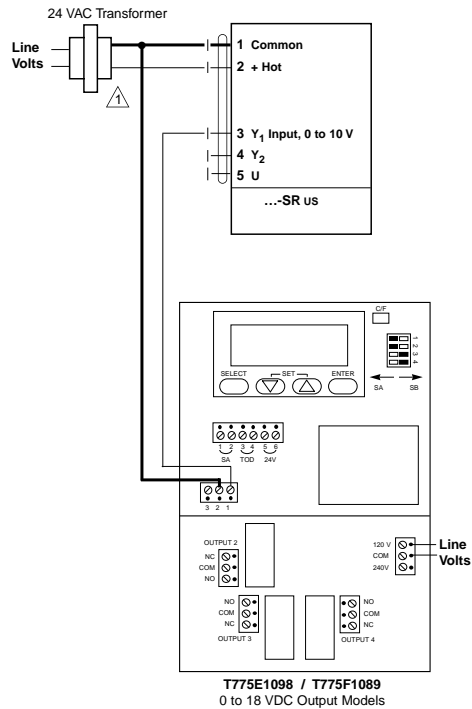


⚠ Use separate transformer for T775 if powering from 24 VAC.

Note: The T775 Controllers have an adjustable control range of 0 to 18 VDC. Use the T775 Calibration instructions to calibrate a 2 to 10 VDC range.

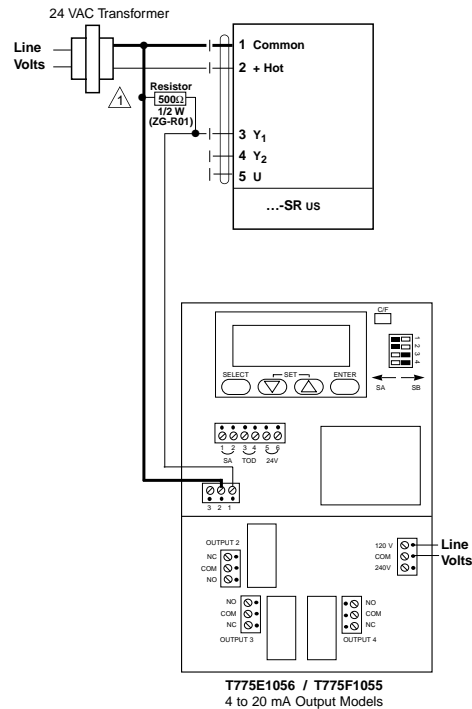


⚠ Use separate transformer for T775 if powering from 24 VAC.



⚠ Use separate transformer for T775 if powering from 24 VAC.

Note: The T775 Controllers have an adjustable control range of 0 to 18 VDC. Use the T775 Calibration instructions to calibrate a 2 to 10 VDC range.



⚠ Use separate transformer for T775 if powering from 24 VAC.