ES53 Series Electric Spring Return Actuators

Installation on Dampers

IMPORTANT: ES53 Series actuators are intended to control equipment under normal operating conditions. Where failure or malfunction of an ES53 Series actuator could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of or protect against failure or malfunction of an ES53 Series actuator must be incorporated into and maintained as part of the control system.

For replacement products and accessories, refer to the *ES53 Series Electric Spring Return Actuators Product Bulletin (LIT-10000047)*.

Parts Included

- ES53 actuator
- anti-rotation bracket
- two No. 12-24 sheet metal screws

Special Tools Required

- 1/4 in. (7 mm) and 1/8 in. (3 mm) flat-blade screwdrivers
- 5/16 in. (8 mm) nut driver
- 5/16 in. (8 mm) square socket or 3/8 in. (10 mm) 12-point socket
- center punch and drill

Setup and Adjustments

Spring Return Direction

Counterclockwise (CCW) Operation

For CCW spring return operation, mount the actuator to the damper shaft so the CCW face of the actuator (shown in Figure 1) is away from the damper as. The coupler is positioned at the 0° position to drive CW and spring return CCW.

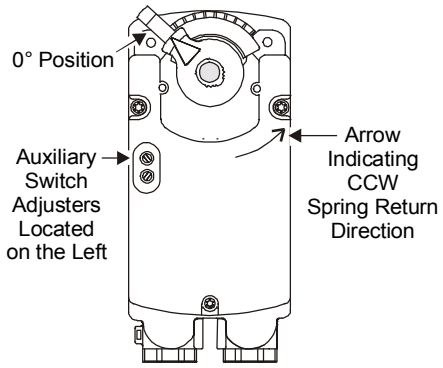


Figure 1: CCW Face of the Actuator

Clockwise (CW) Operation

To change the spring return direction to CW, mount the actuator to the damper shaft so the CW face of the actuator (shown in Figure 2) is away from the damper. The actuator now drives CCW from the 0° position.

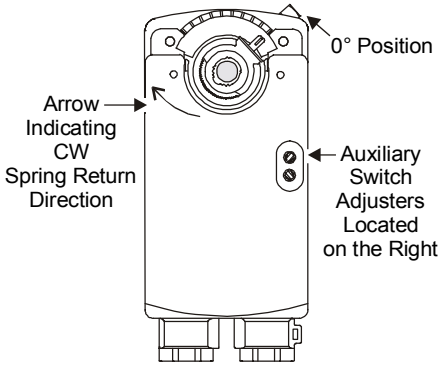


Figure 2: CW Face of the Actuator

Note: The coupler can be inserted in the CW face of the actuator for easier access to the coupler set screw. (Refer to the *Removable Coupler* section.)

Removable Coupler

If the damper shaft is less than 3.2 in. (80 mm) long, the coupler must be inserted in the face of the actuator closest to the damper.

Note: If the damper shaft is shorter than 1.7 in. (42 mm), a shaft extension is required to mount the actuator.

To change the coupler's position, refer to Figure 3 and proceed as follows:

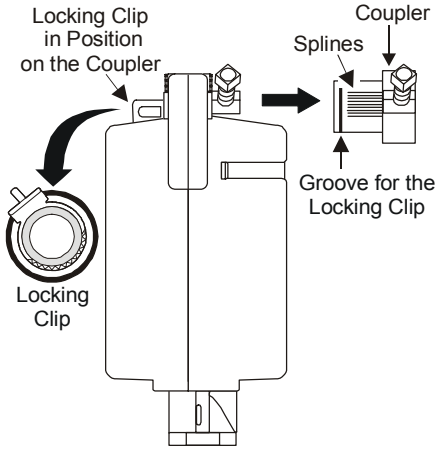


Figure 3: Changing the Position of the Coupler

1. Pull the locking clip off the coupler, and remove the coupler from the actuator.

Note: Proceed to the *Rotation Range* section for a rotation range less than 90°.

2. Reinsert the coupler into either the CW or CCW face of the actuator (determined by the shaft length discussed earlier in this section).

Note: The coupler splines (shown in Figure 3) are designed to prevent inserting the coupler at the wrong end of the rotation range.

IMPORTANT: For 0 to 93° rotation, the coupler must fit as close as possible to, but not on top of, the metal plate at the spring return position.

3. Snap the locking clip securely into the coupler groove to retain the coupler in the actuator.

Mounting

ES53 Series actuators can be mounted in any convenient orientation. They can be installed on a 3/8 to 1/2 in. (10 to 13 mm) round shaft and a 3/8 in. (10 mm) square shaft. If the shaft extends less than 3.2 in. (80 mm), refer to the *Removable Coupler* section.

To mount the actuator, proceed as follows:

1. Bend or cut the anti-rotation bracket to fit the damper frame or duct as shown in Figure 4. (The bracket can be bent to fit a round damper.)

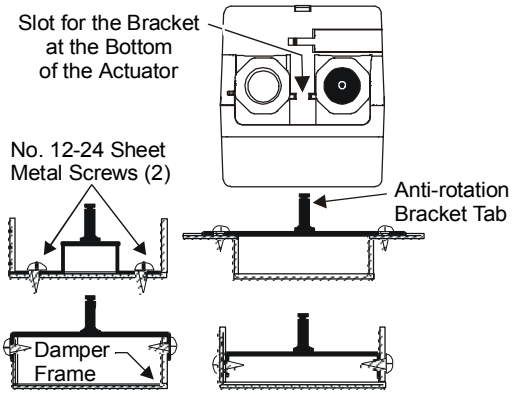


Figure 4: Anti-rotation Bracket Positions

2. Slide the actuator onto the damper shaft.
3. Position the anti-rotation bracket into the slot at the bottom of the actuator. (See Figure 4.)

IMPORTANT: The tab on the anti-rotation bracket must fit midpoint in the actuator slot. This prevents actuator binding and premature wear, and makes actuator removal easier.

4. Refer to the "A" through "D" dimensions in Figure 5 and Table 1 to ensure the anti-rotation bracket tab fits midway in the actuator slot.

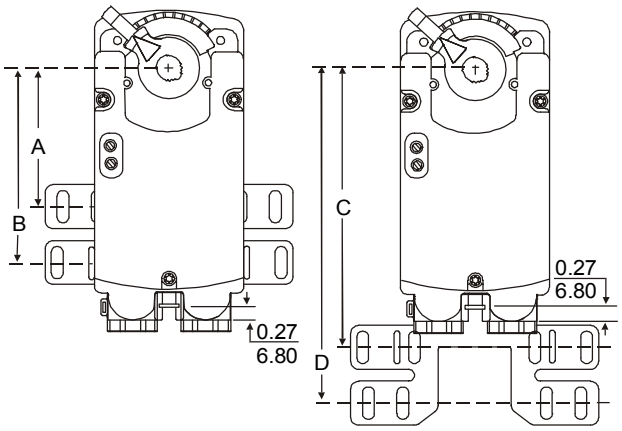


Figure 5: Mounting Positions, in/mm

Table 1: Shaft Sizes and Distances from the Anti-rotation Bracket to Shaft Center

Dimensions in. (mm)	Shaft Diameter	
	1/2 in. (mm)	3/8 in. (mm)
"A"	3.00 (76.3)	2.94 (74.7)
"B"	4.23 (107.5)	4.17 (105.9)
"C"	6.11 (155.3)	6.05 (153.7)
"D"	7.35 (186.6)	7.30 (185.0)

5. Use the anti-rotation bracket as a guide, and drill the holes in the damper frame or duct for the bracket (based on the measurements obtained in Figure 5 and Table 1).
6. Rotate the damper to the position desired when power is lost. If a tight seal is required, rotate the actuator 3° away from the spring return direction.
7. Tighten the coupler set screw onto the damper shaft. Recommended torque for the set screw is 150 to 180 lb·in (17 to 20 N·m).
8. Attach the anti-rotation bracket to the damper frame or duct with the two sheet metal screws provided, using a 5/16 in. (8 mm) nut driver.

IMPORTANT: Do not overtighten the sheet metal screws to avoid stripping the mounting surface. Make sure the anti-rotation bracket tab remains properly positioned in the actuator slot. Keep the actuator parallel to the mounting surface.

9. Verify that the actuator rotates freely throughout the range by applying a full stroke control signal.

Rotation Range

The actuator is factory set for 0 to 93° rotation. If the rotation range is reduced, the end-stop is reached with a reduced input signal. Refer to the *Calibration* section, *Fixed or Auto*.

To reduce the rotation range, reposition the coupler as follows:

1. Make sure that the damper blade is visually accessible or its position is permanently marked on the end of the damper shaft as shown in Figure 6.

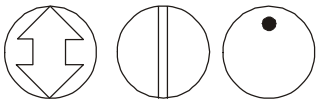
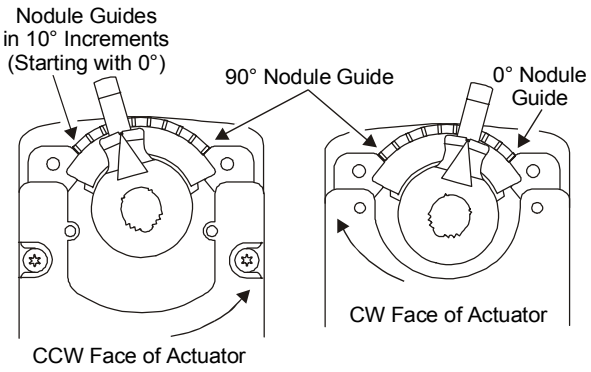


Figure 6: Damper Position Icons

2. Determine the desired rotation range, and subtract this amount from 90°.
3. Remove the locking clip from the coupler. (See Figure 3.)
4. Manually reposition the coupler, so the coupler set screw aligns with the nodule guide that corresponds to the value determined in Step 2.

Examples:

- For a rotation range of 60°, move the coupler so the coupler set screw is at the 30° nodule guide (90° – 60° = 30°). Refer to Figure 7.



Note: Coupler set screw is shown at 30° in both applications.

Figure 7: Actuator Set for 60° Rotation

- For a rotation range of 45°, move the coupler so the coupler set screw is midway between the 40 and 50° nodule guides (90° – 45° = 45°).

Note: The minimum rotation range is 34.5°.

5. Snap the locking clip securely into the coupler groove to retain the coupler in the actuator.

Feedback Signal (Proportional Models)

A change to the rotation range changes the feedback signal and the operating range proportionally in the FIXED mode. (See Figure 8.) Refer to the *Calibration* section, *Fixed or Auto* and *Direction of Action*.

Direction	Feedback	Rotation Range						
		0°*	15°	30°	45°	60°	75°	90°
Direct Acting	0-10V	0.0V	1.7V	3.3V	5.0V	6.7V	8.3V	10.0V
	2-10V	2.0V	3.3V	4.7V	6.0V	7.3V	8.7V	10.0V
	6-9V	6.0V	6.5V	7.0V	7.5V	8.0V	8.5V	9.0V
Reverse Acting	0-10V	10.0V	8.3V	6.7V	5.0V	3.3V	1.7V	0.0V
	2-10V	10.0V	8.7V	7.3V	6.0V	4.7V	3.3V	2.0V
	6-9V	9.0V	8.5V	8.0V	7.5V	7.0V	6.5V	6.0V

* 0° is the spring return position.

Figure 8: Nominal Feedback Signal Relative to the Rotation Range

Wiring

Damper or Valve Applications

WARNING: Electrical Shock Hazard.
Disconnect all power supplies before wiring connections are made or prior to performing maintenance, and make sure all unused wire leads are insulated to avoid the risk of electrical shock or damage to the equipment. More than one disconnect may be necessary to remove power from the actuator and both auxiliary switches.

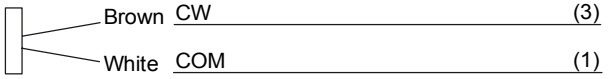
CAUTION: Equipment Damage Hazard.
Check all wiring connections before applying power to the system. Short-circuited or improperly connected wires results in permanent damage to the equipment.

IMPORTANT: Make all wiring connections in accordance with the National Electrical Code and local regulations.

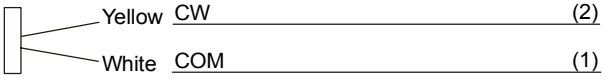
Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging the actuator's electronic circuits.

Refer to Figure 9 to wire the applicable ES53 model.

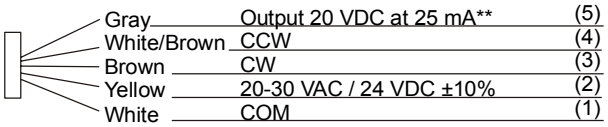
On/Off Control*
Models: ES53C2, ES53C2-MP, ES53C2-S, and ES53C2-S-MP



Models: ES53A2 and ES53A2-S



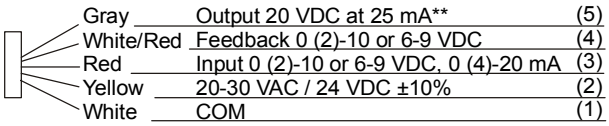
Floating Control*
Models: ES53C2, ES53C2-MP, ES53C2-S, and ES53C2-S-MP



* CW becomes CCW, and CCW becomes CW when the actuator is mounted for CW spring return operation for both on/off and floating control.

** Only available on -MP models.

Proportional Control
Models: ES53B2, ES53B2-MP, ES53B2-S, and ES53B2-S-MP



Auxiliary Switches
Models: ES53A2-S, ES53C2-S, ES53C2-S-MP ES53B2-S, and ES53B2-S-MP
(Shown Factory Set)

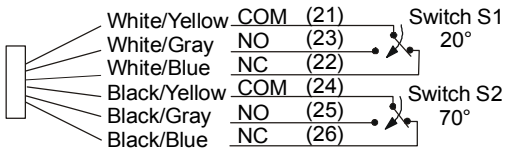


Figure 9: Wiring Diagrams for ES53 Models

Output (-MP Models)

The -MP models operate in response to a 6 to 9 VDC control signal and include a 20 VDC at 25 mA auxiliary power output used to power external devices, such as thermostats and controllers.

Note: The -MP models are compatible with a number of Barber-Colman® thermostat/controllers.

Using Conduit

If it is necessary to use conduit or other electrical fittings for a specific actuator application, refer to Figure 10 and proceed as follows:

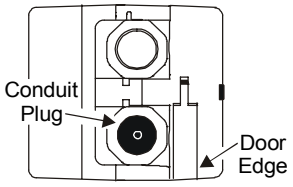


Figure 10: Bottom of the Actuator

1. Pry the plastic plug out of the wired conduit opening (if present) with a flat-blade screwdriver.
2. Slide the plug off the wiring cable and discard it.
3. Insert the conduit fitting (not provided) into the 1/2 in. conduit opening, and hand tighten in a CW direction.

IMPORTANT: Use flexible metallic conduit or its equivalent with the conduit fitting. To avoid stressing a mounted actuator, use a tool to grasp the conduit housing when installing the fitting. Do not overtighten the fitting into the actuator to avoid damaging the actuator housing.

4. Feed the wiring cable through the conduit assembly, and finish wiring.

WARNING: Electrical Shock Hazard.
Do not remove the conduit fitting on the -S (auxiliary switch) models to avoid the risk of electrical shock and to maintain the double insulation and strain relief.

Calibration (Proportional Models)

Mode Selection

The mode switches on these ES53 models are located behind the door on the bottom of the actuator. To open the door to access these switches, insert a flat-blade screwdriver in the slot at the door edge. (See Figure 10.)

Note: The ES53A2 and ES53C2 models do not have mode switches.

See Table 2 for the mode settings available.

Table 2: Mode Selection Information

Mode Switches	Switch Functions	Factory Settings
5	VDC or mA	VDC
4	0-10 VDC (0-20 mA) or 2-10 VDC (4-20 mA)	0-10
3	Direct Acting (DA) or Reverse Acting (RA)	DA
2	FIXED or AUTO (See the *Fixed or Auto* section.)	FIXED
1	— or 6-9 VDC	—

Note: The 6-9 VDC setting of Switch 1 overrides Switch 4.

The mode switches are factory set with all five switches positioned as shown in Figure 11:

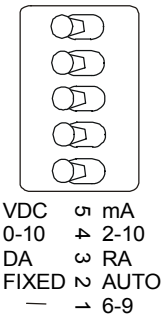


Figure 11: Position of the Mode Switches

To change a factory setting, use a 1/8 in. (3 mm) flat-blade screwdriver to position the mode switch to the alternate setting. Close the door when finished.

VDC or mA

The type of input control signal is determined by the position of Switch 5. When Switch 5 is in the VDC position (factory setting) the input signal is DC voltage. When Switch 5 is in the mA position, the input signal changes to current input. (See Figure 11 and Table 3.)

Table 3: Available Input Control Signals

Control Signal		Mode Switch 5		Mode Switch 4		Mode Switch 1	
		VDC	mA	0-10	2-10	—	6-9
Voltage Input (VDC)	0-10	X		X		X	
	2-10	X			X	X	
	6-9	X		X			X
Current Input (mA)	0-20		X	X		X	
	4-20		X		X	X	

Input Signal

The range of the input signal is determined by the position of Switches 1 and 4. (See Table 3.)

Note: With Switch 5 in the mA position, the feedback signal varies within the 0-10V, 2-10V, or 6-9V ranges.

Direction of Action

The actuators are factory set for DA operation with Switch 3 in the DA position. In the DA mode, an increasing control signal drives the actuator away from the spring return position. For RA operation, position Switch 3 to the RA position. In the RA mode, an increasing control signal drives the actuator toward the spring return position.

The actuator's drive direction is dependent upon the position of Switch 3 and the spring return direction as shown in Table 4.

Table 4: Settings for Direction of Action

Position of Switch 3 and the Direction of Spring Return	Drive Direction with a Minimum Input Signal	Drive Direction with a Maximum Input Signal
DA/CCW	CCW	CW
RA/CCW	CW	CCW
DA/CW	CW	CCW
RA/CW	CCW	CW

Note: To change the spring return direction, see the *Setup and Adjustment, Spring Return Direction* section.

Fixed or Auto

The actuators are factory set with Switch 2 in the FIXED position, where a 0 to 10 VDC input signal (selected with Switches 1, 4, and 5) corresponds with a 0 to 93° rotation. If the rotation range is reduced, the end-stop is reached with a reduced input signal. For example, if a 0 to 10 VDC input signal is selected and the rotation range is limited to 75°, the end-stop is reached at 8 VDC.

The auto calibration or AUTO mode enables the actuator to redefine the selected input signal and feedback proportionally across a reduced rotation range. The actuator stores the reduced range in nonvolatile memory (retains data when power is lost or removed).

To activate the AUTO mode, move Switch 2 to the AUTO position, and leave it in this position. The actuator drives to the spring return position, then to the full stroke position, and stores these positions in nonvolatile memory. The actuator drives to the setpoint determined by the control signal applied after going through the AUTO mode.

During normal operation, if the actuator stroke increases in the AUTO mode due to seal or seat wear, the input is redefined to the increased rotation range in approximately 2° increments.

Note: If the actuator's mounting position is changed or the linkage adjusted, respan by moving Switch 2 to FIXED for 5 seconds and then back to AUTO. This reinitiates the AUTO mode.

Auxiliary Switches (-S Models)

WARNING: Electrical Shock Hazard.
Insulate all unused auxiliary switch leads to avoid the risk of electrical shock or damage to the equipment.

The -S models have two built-in auxiliary switches with switch adjusters accessible on either face of the actuator. (See Figures 1 and 2.) Factory settings are 20° for Auxiliary Switch 1 (SW #1) and 70° for Auxiliary Switch 2 (SW #2). Refer to *Auxiliary Switch Rating* in the *Technical Data* section.

IMPORTANT: Do not force the switch adjuster out of the allowable range, or damage to the switch may occur.

Switch points are independently and continuously adjustable from 0 to 70° for SW #1 and 20 to 90° for SW #2. For the most accurate positioning of the switches, refer to Figure 12, and use the following method. These procedures serve as examples.

Adjusting SW #1

To change the trip point of SW #1 to 30°:

1. Connect SW #1 to a power source or an ohmmeter, and apply a 3.3 VDC input signal to the actuator. (An actuator set for 0 to 10 VDC input drives to the 30° position.)

Note: SW #1 trips when the actuator reaches the 20° factory setting.

2. When the actuator reaches 30°, use a 1/8 in. (3 mm) flat-blade screwdriver to turn SW #1 adjuster until SW #1 trips again.

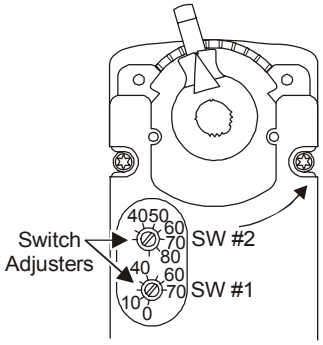


Figure 12: Switch Trip Point Settings

Note: The normally open contact opens, and the normally closed contact closes. (See Figure 9, *Auxiliary Switches*.)

Adjusting SW #2

To change the trip point of SW #2 to 60°:

1. Connect SW #2 to a power source or an ohmmeter, and apply a 6.6 VDC input signal to the actuator. (An actuator set for 0 to 10 VDC input drives to the 60° position.)
2. When the actuator reaches 60°, use the flat-blade screwdriver to turn SW #2 adjuster until SW #2 trips.

Note: The normally open contact closes, and the normally closed contact opens. (See Figure 9, Auxiliary Switches.)

Technical Data

Product	ES53 Series Electric Spring Return Actuators
Power Requirements	20 to 30 VAC at 50/60 Hz or 24 VDC ±10%, Class 2, 16 VA minimum at 32 to 140°F (0 to 60°C) 22 VA minimum at -22 to 32°F (-30 to 0°C) 25 VA minimum at -40 to -22°F (-40 to -30°C)
Input Signal	Floating: 20 to 30 VAC at 50/60 Hz or 24 VDC ±10%, 4.8 mA On/Off: 20 to 30 VAC at 50/60 Hz or 24 VDC ±10%, 533 mA at 32 to 140°F (0 to 60°C) 733 mA at -22 to 32°F (-30 to 0°C) 833 mA at -40 to -22°F (-40 to -30°C) Proportional: 0 (2) to 10 VDC, 6 to 9 VDC, or 0 (4) to 20 mA
Input Signal Adjustments	Proportional (Voltage Input or Current Input) Factory Setting: 0 to 10 VDC, CW rotation with signal increase Switch Selectable: 0 (2) to 10 VDC, 6 to 9 VDC, or 0 (4) to 20 mA Direction of Action: Switch selectable Direct or Reverse with signal increase
Input Impedance	Proportional: Voltage Input, 200,000 ohms; Current Input, 500 ohms
Feedback Signal	Proportional: 0 (2) to 10 VDC for 90° (10 VDC at 2 mA) or 6 to 9 VDC Corresponds to input signal selection and also rotation limits
Power Supply Output	17 to 22 VDC at 25 mA (-MP models)
Auxiliary Switch Rating	-S Models: Two Single-Pole, Double-Throw (SPDT), double insulated switches Rating per Switch: 24 VAC, 50 VA pilot duty 120 VAC, 5.8A resistive, 1/4 hp, 275 VA pilot duty 240 VAC, 2.9A resistive, 1/4 hp, 275 VA pilot duty
Spring Return	Direction is selectable with the mounting position of the actuator: CCW face of the actuator away from the damper for CCW spring return; CW face of the actuator away from the damper for CW spring return
Mechanical Output	Running torque: 53 lb·in (6 N·m)
Rotation Range	Adjustable from 34.5 to 90°, mechanically limited to 93°
Rotation Timing	90 seconds for 93° with 0 to 53 lb·in (0 to 6 N·m)
Electrical Connections	Actuator: 48 in. (1.2 m) cable with 20 AWG wire leads Auxiliary Switches: 48 in. (1.2 m) cable with 18 AWG wire leads
Mechanical Connection	3/8 to 1/2 in. (10.0 to 12.7 mm) diameter round shaft 3/8 in. (10 mm) square shaft
Enclosure	NEMA 2, IP42
Ambient Conditions	Operating: -40 to 140°F (-40 to 60°C); 10 to 90% RH, non-condensing Storage: -85 to 190°F (-65 to 88°C); 5 to 95% RH, non-condensing
Dimensions (H x W x D)	-S Models: 8.32 x 3.25 x 3.58 in. (211.3 x 82.6 x 91.0 mm) with conduit fitting All Other Models: 6.98 x 3.25 x 3.58 in. (177.3 x 82.6 x 91.0 mm)
Shipping Weight	3.45 lb (1.56 kg)
Agency Compliance	UL 873 Listed, File E191697, CCN XAPX CSA C22.2 No. 139 Certified, File LR703163, Class 3221 02 CE Mark: CE Directive 89/336/EEC; Low Voltage Direction 73/23/EEC

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local DEI - Dodge Engineering & Controls, Inc. office. DEI - Dodge Engineering & Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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