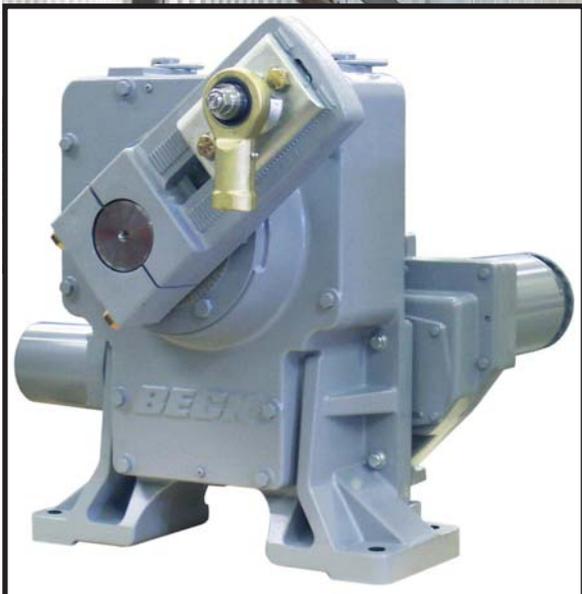




INSTRUCTION MANUAL



For actuators equipped with the
ESR-5 & CPS-5 (11/01/16 & later)

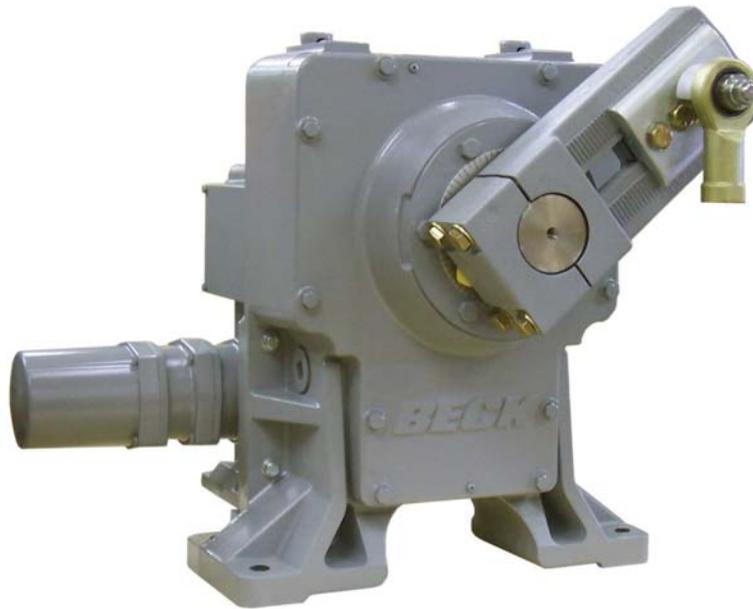


ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

INTRODUCTION

This manual contains the information needed to install, operate, and maintain the Beck 11-430 Electronic Actuator, manufactured by Harold Beck & Sons, Inc.

The 11-430 is a high torque electric actuator designed to provide precise position control of multiple burner tilt arrays, dampers, and other devices requiring up to 5,200 lb-ft (7 046 N•m) of actuator torque. The 11-430 consists of a Beck 11-400 actuator connected to a large gear reduction unit that increases the output torque of the 11-400 by a factor of 3:1.



NOTICE: This manual includes information that will make installation simple, efficient, and trouble-free. Please read and understand the appropriate sections in this manual before attempting to install or operate the Model 11-430 actuator.

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PRODUCT DESCRIPTION

The Beck 11-430 actuator is engineered for precise, reliable operation of dampers and multiple burner tilt arrays. The cool, stable operation of Beck's control motors coupled with the powerful gear train provide the tight, responsive control required by modern control loops to optimize output while keeping operating costs low.

The unique all spur gear construction used in the Beck Actuator is designed for long term durability. The gear train can withstand accidental stalls of up to four days without failure, and will resume instant response immediately upon removal of the condition (see page 24 for Stall Protection information). Mechanical stops in the gear train prevent over-travel.

An easy-to-turn, spoke-free Handwheel is incorporated into the 11-430 design to allow manual operation during installation or power outages. The Handwheel can be used to move a driven shaft to any position smoothly and easily under full load conditions.

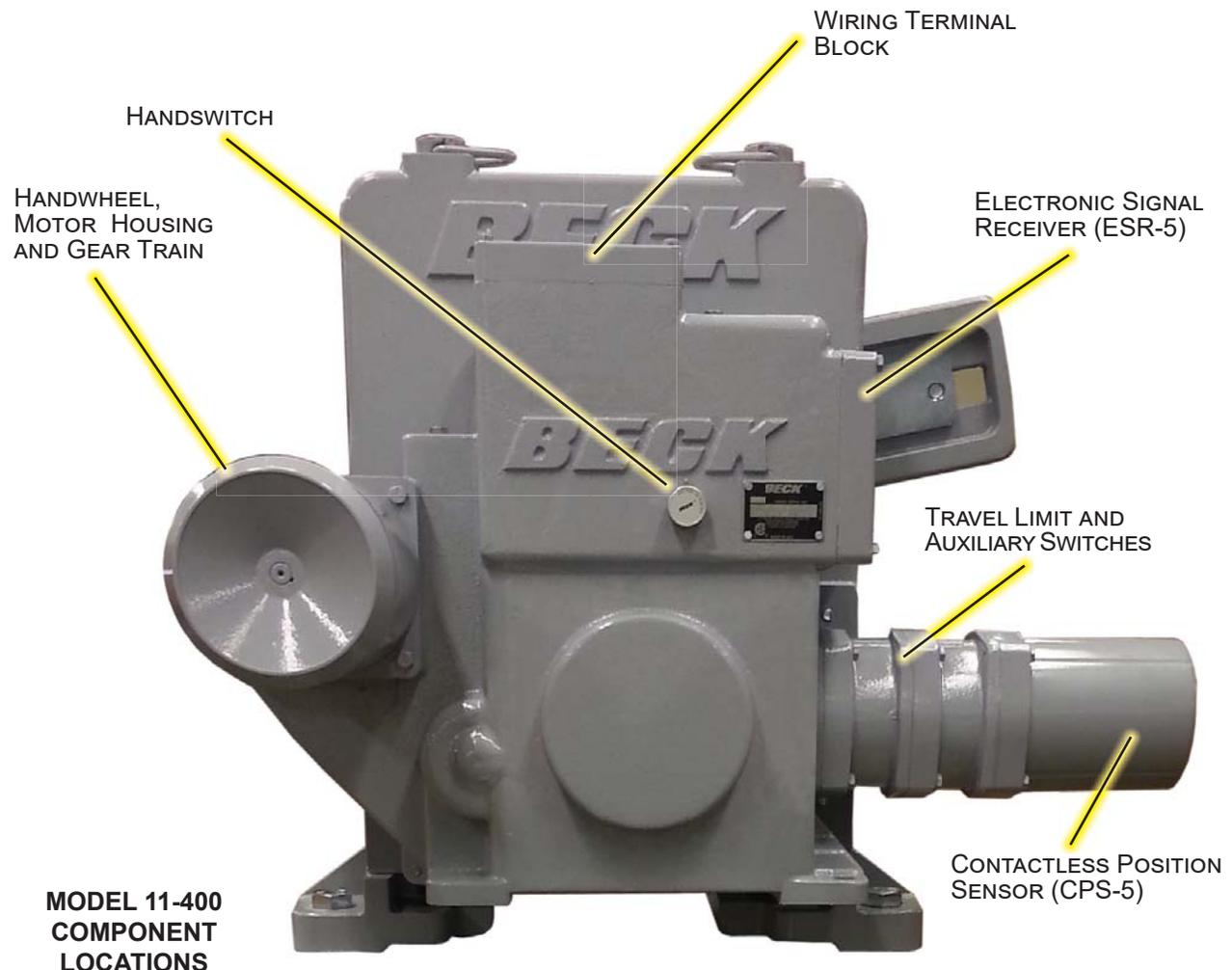
The driven shaft may also be operated at its individual location by utilizing the actuator's built-in electric Handswitch.

The heavy-duty crank arm of the 11-430 actuator can be field-adjusted to travel anywhere in the 360° range.

Beck's ESR-5 Electronic Signal Receiver provides precise actuator control from either conventional analog or computer based control systems.

Beck's CPS-5 Contactless Position Sensor provides accurate position feedback in demanding environmental conditions, with no contacting or wiping surfaces to wear or intermittently lose contact. The CPS-5 provides infinite resolution with linearity error of less than $\pm 1\%$ of span over the actuator's full travel.

The Beck 11-430 electronic actuator is designed with individual weatherproof enclosures to protect the main components. The cutaway illustration below shows the basic features of the 11-400 as well as their locations.



BECK LINKAGE KITS

Beck pipe linkage kits are available for completing the mechanical connection from the actuator crank arm to the load. Through the use of standardized selection, the linkage can be ordered even if the exact length is not determined until the actuator and driven device are installed.

All Beck 11-430 actuators are furnished with a crank arm and rod end (see pages 8, 9, and 21 for dimensions). All rod ends furnished by Beck incorporate bearings to accommodate some lateral misalignment. Once the connection is made, linkage kits can be adjusted $\pm 1 \frac{1}{2}$ " (38 mm) without removal of the crank arm or load lever, making final mechanical calibration simple.

See page 20 for linkage requirements.



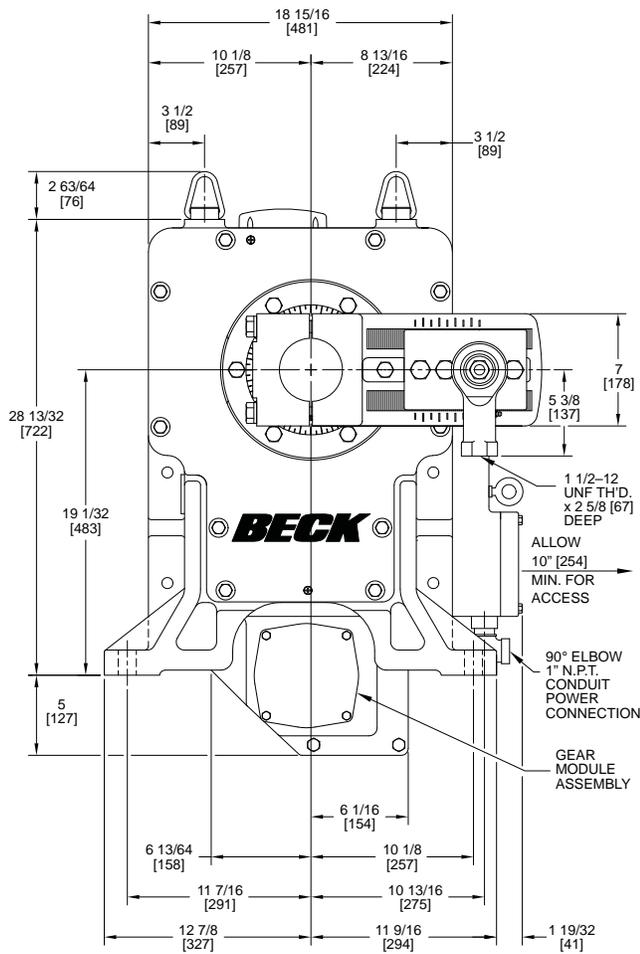
GENERAL SPECIFICATIONS

Actuator Power	120 V ac, single-phase, 60 Hz (standard), 50 Hz (optional) 208, 240, 380, 415, 480 & 575 V ac, 50 or 60 Hz (optional)	Allowable Tolerance: +10% - 15%						
Max. Current (Amps) by Supply Voltage (V ac)								
		Voltage						
Model	Power (W)	120	208	240	380	415	480	575
11-430	400	3.10	1.79	1.55	0.98	0.89	0.78	0.65
Operating Conditions	-40 to 185°F. (-40 to 85°C.) 0 to 100% relative humidity							
Demand Signal Options, with Electronic Signal Receiver (ESR-5)	0–5 mA	10–50 mA						
	1–5 mA	1–5 V dc						
	4–20 mA	-10–10 V dc						
Input Signal Span Adj.	50% to 400% of 4 V span (except -10–10 V dc)							
Input Signal Zero Adj.	-100 to 275% of span (except -10–10 V dc)							
Deadband	0.6% of span (recommended deadband for most applications); narrower and wider deadbands are available							
Sensitivity	25% of deadband							
Direct AC	120 V ac for 2-position, multi-position or modulating V ac control							
Square Function (Optional)	Actuator output shaft moves proportionally to the square of the input signal							
Feedback Signal Options, with Contactless Position Sensor (CPS-5)	1–5 mA	1–5 V dc						
	4–20 mA	0–16 V dc						
	10–50 mA	-10–10 V dc						
Output Stability	0.25% of span from 102 to 132 V ac ±0.03%/°C. of span for 0 to 50°C. ±0.05%/°C. of span for -40 to 85°C.							
Linearity	±1% of span, max. independent error							
Hysteresis	0.25% of span at any point							
Isolation	Max. leakage of 10 µA at 60 V rms, 60 Hz from output to ground							
Film Potentiometer	1,000 ohms							
Max. Voltage	40 V							
Wattage	2 W max.							
Linearity	±0.5%							
Max. Wiper Current	1 mA							
Action on Loss of Power	Stays in place							
Action on Loss of Input Signal (Power On)	Stays in place or moves to full travel or zero position. Drives to any preset position with optional switch assembly on Models 11-437 and 11-438. Field adjustable.							

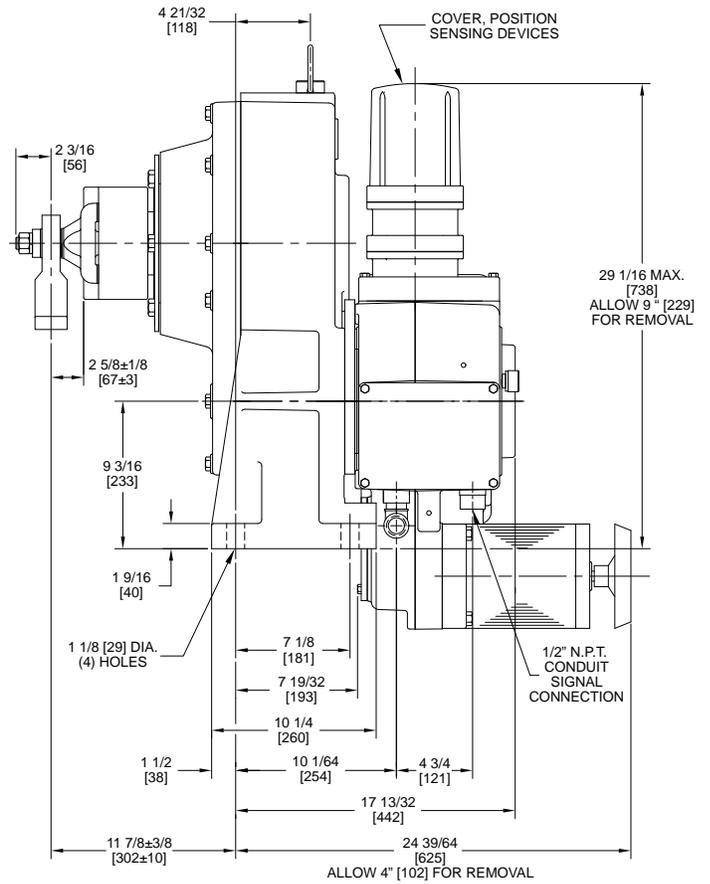
Stall Protection and Annunciation (Optional)	If the motor tries to run in one direction for more than 300 seconds, the Stall Protection Module will shut off power to the motor and a relay contact will change state. The relay is rated for 120 V ac or dc, 10 VA. For more information, see Beck publication 80-0017-03.
Limit Switches	Two SPDT, one for CW and one for CCW limit of travel. Actuators having position sensing capability (Options 5 thru 8), have over-travel limit switches set 1/2° outside the CW and CCW travel range (typically, -0.5° and 100.5°). Actuators without position sensing (Options 3 and 4), have end-of-travel limit switches set at the CW and CCW travel range (typically, 0° and 100°).
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1 to S4 and are cam-operated, field-adjustable. S1 and S4 are set to operate just before reaching CCW travel limit. S2 and S3 are set to operate just before reaching CW travel limit.
Handswitch	Permits local electrical operation, independent of controller signal. Standard on all units. An optional auxiliary contact can be used to indicate that the Handswitch is in AUTO mode or to sound an alarm if it is taken out of AUTO.
Handwheel	Provides manual operation without electrical power.
Motor	120 V ac, single-phase, no-burnout, non-coasting motor has instant magnetic braking. Requires no contacts or moving parts. Can remain stalled for approximately four days (cumulative) without damaging the gear train.
Gear Train	High-efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears. Interchangeable gear modules permit field change of timing.
Mechanical Stops	Prevent over-travel during automatic or manual operation.
Enclosures	
11-400 Drive	Type 4X, precision-machined aluminum alloy castings painted with corrosion-resistant polyurethane paint, provide a rugged, dust-tight, weatherproof enclosure.
Gear Reduction Unit	Precision-machined aluminum alloy casting painted with corrosion-resistant polyurethane paint, provides a rugged, dust-tight, weatherproof enclosure.

OUTLINE DIMENSION DRAWINGS

ORIENTATION A



Front View



Side View

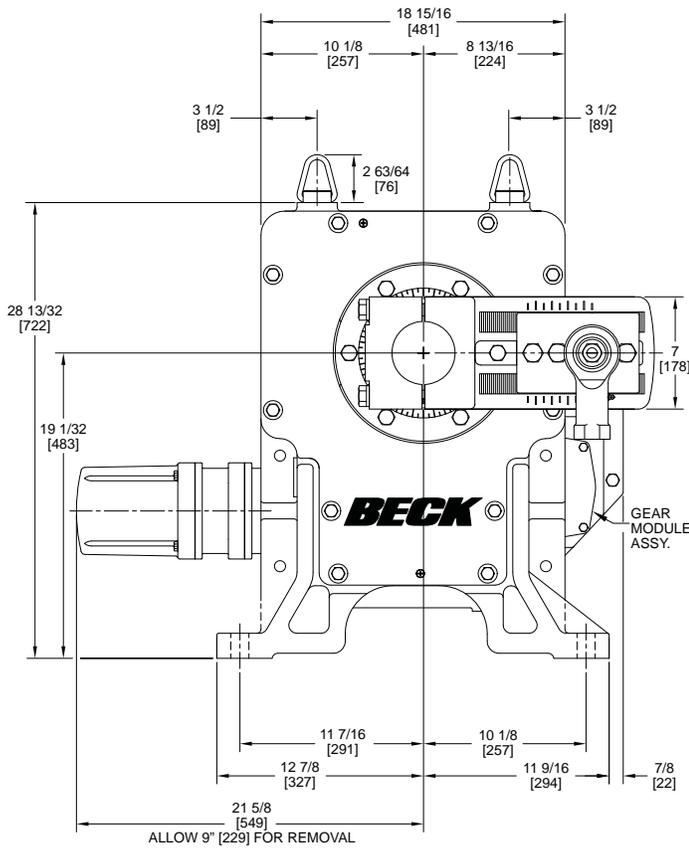
BECK MODEL 11-430

Torque lb-ft (N•m)	Timing (sec.)	Net Wt. lb (kg)	Output Shaft Dia. in (mm)	Max. Overhung Load lb (kg)
5,200 (7 046)	108	790 (358)	3 15/16 (100)	20,000 (9 072)
	180			Crank Arm 14-8022-42
2,900 (3 929)	72			OR
	120			15,000 (6 804)
				Crank Arm 14-8022-44

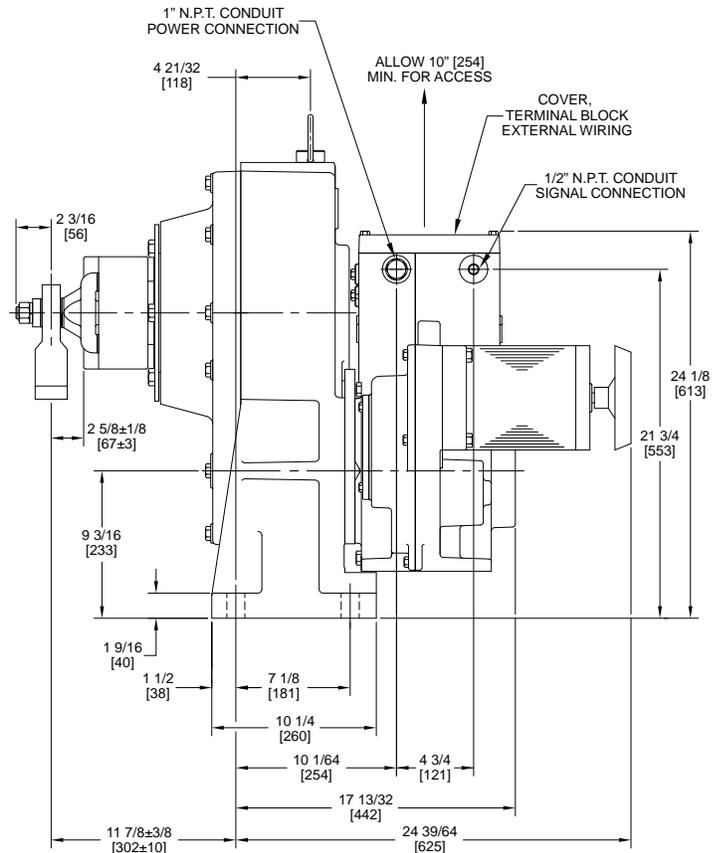
RECOMMENDED SCREW TORQUES

	Size	Torque	
	in	lb-ft	N•m
Gear Reduction Unit			
Crank Arm Clamp Screws (4)	3/4-16	420	569
Rod End Nut	3/4-16	200	271
Crank Pin Screws (3)			
(14-8022-42 crank arm)	3/4-16	420	569
(14-8022-44 crank arm)	3/4-16	300	407
11-400 Actuator			
Cover Screws	5/16-18	10	14
Motor Screws	3/8-16	16	22
Gear Module Screws	5/16-18	10	14
Adaptor Plate to Gear Reduction Unit Screws (4)	1/2-13	45	61

ORIENTATION B



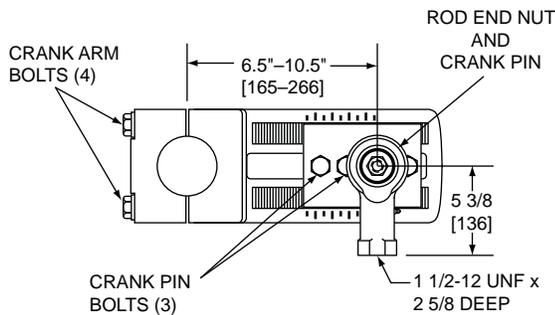
Front View



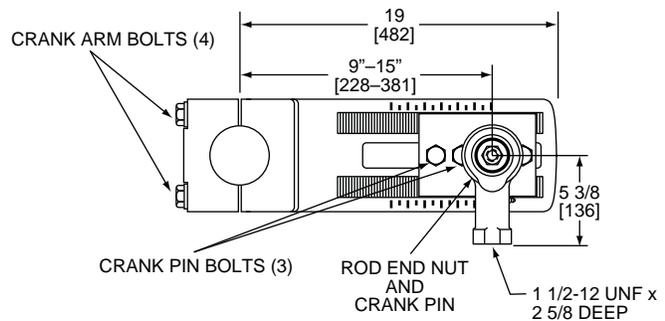
Side View

AVAILABLE CRANK ARMS (WITH ROD ENDS)

STANDARD CRANK ARM

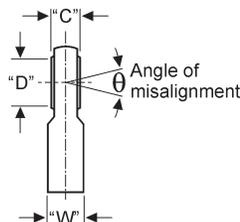


ALTERNATE CRANK ARM



ROD END DETAIL

Thread Size	1 1/2-12
Dim. "C"	1.312"
Dim. "D"	1.500"
Dim. "W"	2.000"
Angle Ø	6.5°



All Dimensions are in inches and [mm] and are subject to change.

CONTROL OPTIONS

**TABLE 1:
SUMMARY OF CONTROL OPTIONS**

MODEL NO.	CONTROL TYPE	INPUT SIGNAL	ESR-5 PART NO.*	FEEDBACK DEVICE	EXTERNAL OUTPUT SIGNAL	CPS-5 PART NO.*	AUXILIARY SWITCH OPTIONS
11-438	Electronic Modulating	0–5 or 1–5 mA	13-2246-02	CPS-5 Contactless Position Sensor	4–20 mA	20-4400-12	None, 2, 4, 2+INTLOS
					1–5 V dc	20-4400-13	
					16 V dc or 50 mA max.	20-4400-13	
		4–20 mA	13-2246-03		0–15 V dc	20-4400-14	
		10–50 mA	13-2246-04		-10–10 V dc	20-4400-15	
11-437	Electronic Modulating	0–10 V dc	13-2246-07	1000 ohm Potentiometer 20-3060-03	None, 1000 ohm Aux. Pot.	n/a	None, 2, 4, 2+INTLOS
		1–5 V dc	13-2246-05				
		-10–10 V dc	13-2246-08				
11-436	Direct AC Control (Modulating)	120 V ac	None	CPS-5 Contactless Position Sensor	4–20 mA	20-4400-02	None, 2, 4
					1–5 V dc	20-4400-03	
		Low Power 120 V ac	13-2245-50 (Relay Board)		16 V dc or 50 mA max.	20-4400-03	
					0–15 V dc	20-4400-04	
					Low Power dc	13-2245-51 (Relay Board)	
11-435	Direct AC Control (Modulating)	120 V ac	None	1000 ohm Potentiometer 20-3060-03	1000 ohm Pot.	n/a	None, 2, 4
		Low Power 120 V ac	13-2245-50 (Relay Board)				
		Low Power dc	13-2245-51 (Relay Board)				
11-434	5 Position	120 V ac	n/a	None	None	n/a	None
	4 Position						None, 2
	3 Position						
11-433	2 Position Open/Close						None, 2, 4

*ESR-5 series 13-2246-XX boards replace ESR-5 series 13-2245-XX boards.
CPS-5 series 20-4400-XX boards replace CPS-5 series 20-3400-XX boards.

INSTALLATION

SAFETY PRECAUTIONS



WARNING
Installation and service instructions are for use by qualified personnel only. To avoid injury and electric shock, do not perform any servicing other than that contained in this manual. Please read and understand the appropriate sections in this manual before attempting to install or operate your drive.

STORAGE INFORMATION

The 11-430 should be stored in its shipping crate in a clean, dry area where the temperature is between -40° and 85°C (-40° to 185°F).

If it is necessary to store the actuator outdoors for a long period of time, it should be stored above ground and covered with a waterproof cover. Do not stack 11-430 crates on top of one another. Stored drives should be checked periodically to make sure no condensation has formed in the electronic and terminal compartments. Damage due to moisture while in storage is not covered by warranty.

UNPACKING

The actuator is shipped in a slatted wooden crate. The crate is braced internally at the top and sides of the actuator. To unpack, remove the top of the crate first. Then remove the sides of the slatted crate, carefully removing the support braces. After unpacking, the skid may be used to transport the actuator to the installation site.

Orientation Option A (Page 8)

The 11-430, orientation option A, is bolted to a removable wooden pedestal with four $3/4$ " hex head bolts. These bolts are not to be used for mounting the actuator to its final mounting platform. The pedestal provides a mounting base for the actuator and also protects the 11-400 control motor. Do not remove the actuator from the pedestal or the protective cover from the motor until the actuator is ready to be placed on its final mounting platform. The pedestal is attached to the wooden shipping skid with metal banding.

Orientation Option B (Page 9)

The 11-430, orientation option B, is bolted directly to the wooden shipping skid. These bolts are not to be used for mounting the actuator to its final mounting platform. Do not remove the actuator from the skid or the protective cover from the motor until the actuator is ready to be placed on its final mounting platform.

MOUNTING INSTRUCTIONS

The Beck 11-430 can be installed in any convenient orientation because the gear train does not require an oil bath. Refer to the outline dimension drawing for physical dimensions and required clearances.

The 11-430 must be bolted firmly to a mounting surface which will not yield to the stresses created from operating the device. Use 1" diameter grade 5 bolts and torque to 480 lb-ft. A flat, rigid, vibration-free surface will generally prolong the life of the actuator's components. Place shims under the feet of the actuator to correct for any unevenness in the mounting surface before the mounting bolts are tightened.

The output shaft of the actuator should be parallel to the driven shaft, and the linkage should be perpendicular to the plane of the two shafts. Small misalignments can be tolerated if a rod end fitting is used on the driven lever similar to that provided on the Beck crank arm.

MODEL 11-430 ACTUATOR

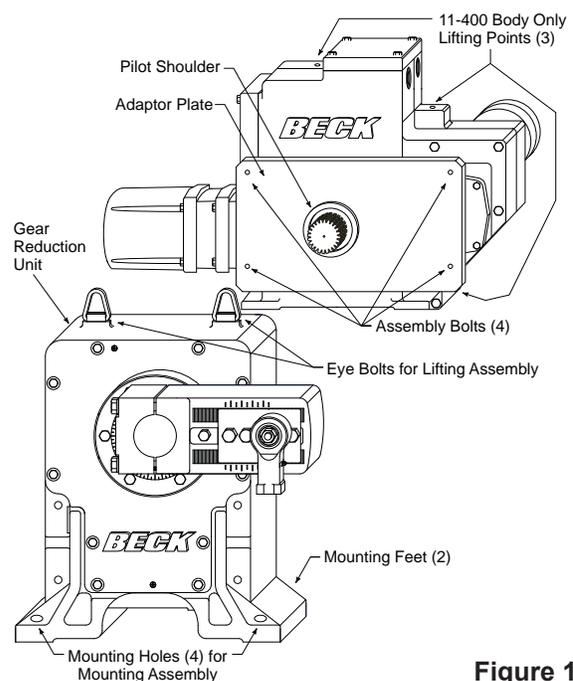


Figure 1

INSTALLATION

ORIENTATION OPTIONS

The 11-400 can be assembled to the 11-430 gear reduction unit in two different positions. These are shown as Orientation Options A and B in the outline dimension drawings on pages 8 and 9. The choice of orientation option depends on the installation and the need to access the wiring and electrical adjustments of the 11-400 actuator. Normally the orientation option is selected at the time of order and factory-assembled to that specification. The orientation option can be changed. Caution: Consult the factory before attempting to change the actuator orientation.

INSTALLATION—ELECTRICAL

NOTE: All Beck actuators are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each actuator is set up and calibrated to the customer's specifications that were written into the equipment order.

Two N.P.T. conduit connections are provided. The 1/2" conduit is for signal wiring connections, and the 1" conduit is for power and auxiliary switch connections.

A sealant must be used on the threaded conduit connections to keep moisture out. The conduits should be routed from below the actuator so that condensation and other contaminants entering the conduits cannot enter the actuator.

A large, clearly labeled terminal block on the top of the actuator is enclosed in a separate, gasketed, metal enclosure. Terminals will accommodate up to 12 AWG wiring (see page 4 for location of the terminal block).



CAUTION

Always close covers immediately after installation or service to prevent moisture or other foreign matter from entering the actuator.

Refer to the wiring diagram furnished with your Beck actuator for proper AC power and signal connections. It is advisable to provide normal short circuit protection on the AC power line. A copy of the wiring diagram is shipped with each actuator and is fastened to the inside of the terminal block cover. If there is no wiring diagram available, you may obtain a copy from Beck by providing the serial number of your actuator.

Your Beck actuator has been supplied to match the signal source in your control loop. If it does not match, refer to the "Demand Signal Options" section of this manual, page 18, for information on how to change the input signal range.

For maximum safety, the Beck actuator body should be grounded. Use the grounding terminal provided in the actuator body.

TERMINAL SCREW TORQUES

Each terminal screw should be torqued to the proper specification upon landing the wire.

Terminals	Torque	
	(lb-in)	(N•m)
A-V	16	1.8
AA-EE	12	1.4
FF-SS*	9	1.0
1-3*	20	2.3

* Terminals included only with certain optional features.

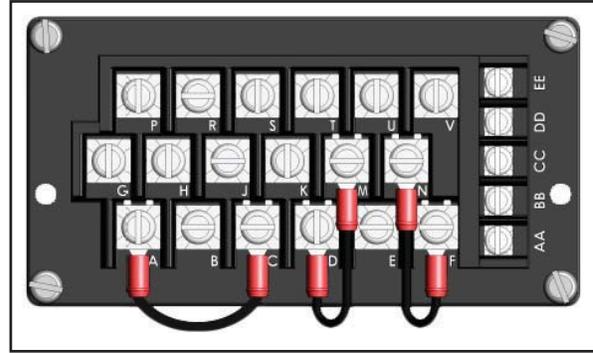
INSTALLATION Demand Signal Wiring

The terminal block is located in a separate, gasketed compartment at the top of the actuator. Line voltage connections are made on terminal designations A through V and are oriented at a right angle from the low voltage signaling terminals designated AA through EE.

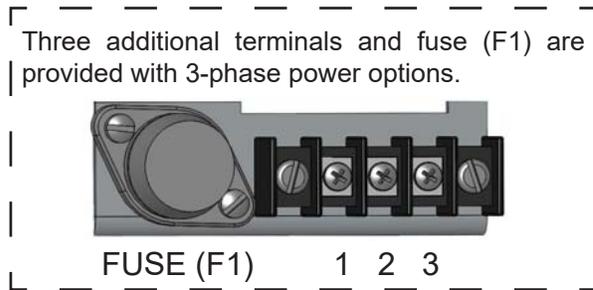
Actuators equipped with optional transformers to accommodate popular voltages include an additional terminal strip and fuse for power wiring (with the exception of the 240 volt option). See optional transformer wiring connections below.

Terminal screws will accept standard spade or ring terminals. Terminals A through V are size #8, and terminals AA through EE are size #6. Optional transformer terminal screws (designated 1, 2, & 3) are size #10. For wiring versatility, the screw-down clamp design will also accept unterminated wire. All terminals will accept up to #12 AWG (3.31 mm²), with up to #10 AWG wire acceptable for optional transformer terminals (1-3).

Typical wiring connections are shown below. See the wiring diagram on the inside of the terminal cover for specific wiring connections. Each actuator can be ordered with up to four optional auxiliary switches (wiring connections are described in the Configuration/Calibration section).



CAUTION
AC power to the actuator must be turned off before removing the jumper.

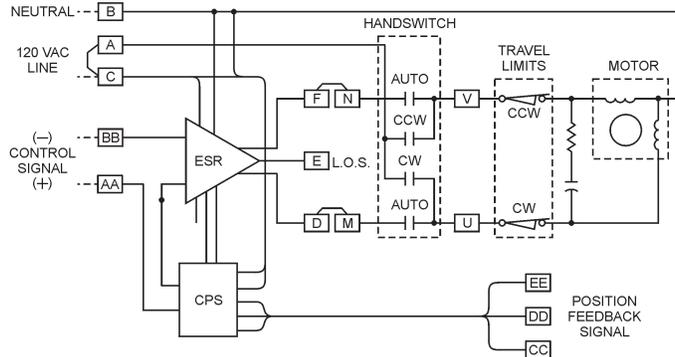


Three additional terminals and fuse (F1) are provided with 3-phase power options.

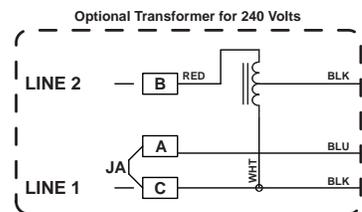
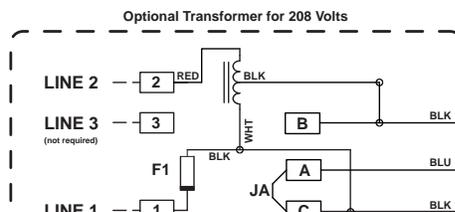
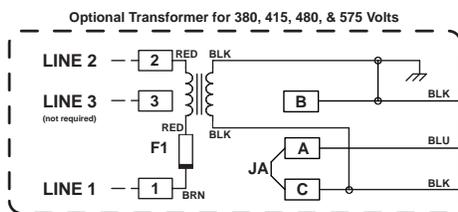
Option 8, Modulating

Analog Position Control with Contactless Position Sensing

Customer must supply two wires to power the actuator: One 120 V ac line (terminal C), and one neutral (terminal B). Customer must supply two wires for the modulating analog control signal: Connect to terminal AA (+) and to terminal BB(-). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 16 and 17 for connections). The actuator's feedback circuit power supply is derived from the 120 V ac line, therefore the feedback signal must be wired to a "4-wire" type non-powered analog input.



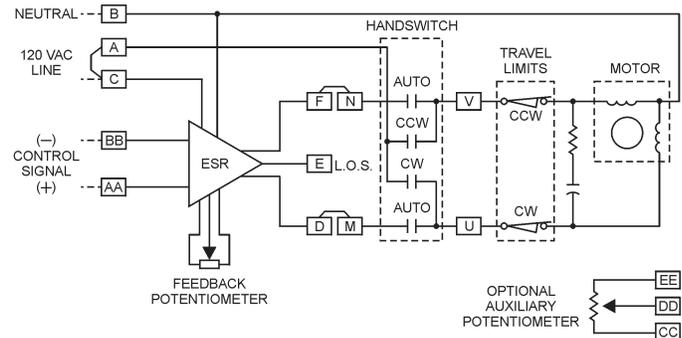
CONNECTIONS FOR ALTERNATE POWER OPTIONS



INSTALLATION Demand Signal Wiring

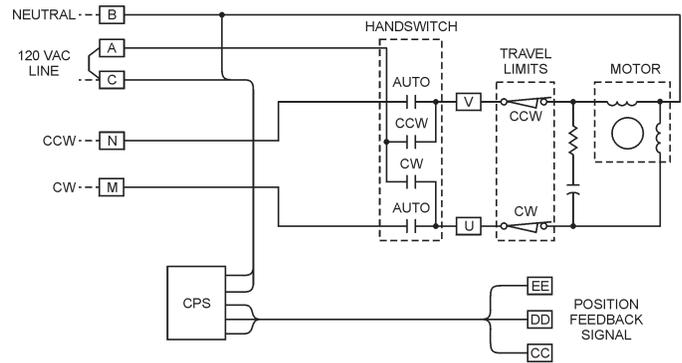
Option 7, Modulating Analog Position Control with Potentiometer Position Sensing

Customer must supply two wires to power the actuator: One 120 V ac line (terminal C), and one neutral (terminal B). Customer must supply two wires for the modulating analog control signal: Connect to terminal AA (+) and to terminal BB (-). If position feedback monitoring is required, an optional auxiliary potentiometer can be ordered. The optional auxiliary potentiometer connects to terminals CC (Reverse), DD (Wiper), and EE (Forward) and is compatible with standard "slidewire" style inputs.



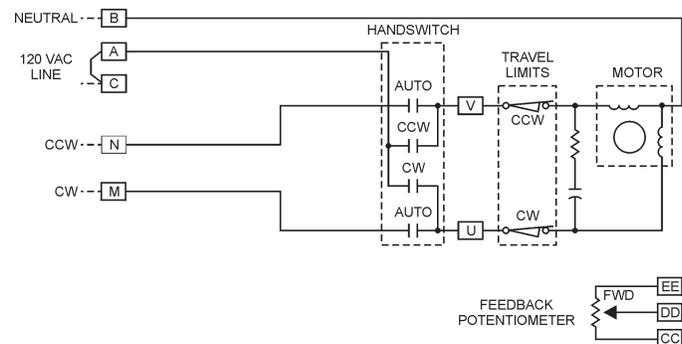
Option 6, Modulating Direct AC Control with Contactless Position Sensing

Customer must supply three wires to directly control the actuator motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 16 and 17 for connections). If position feedback monitoring is desired, a 120 V ac line must be connected to terminal C. The actuator's feedback circuit power supply is derived from this 120 V ac line, therefore the feedback signal must be wired to a "4-wire" type, non-powered analog input.



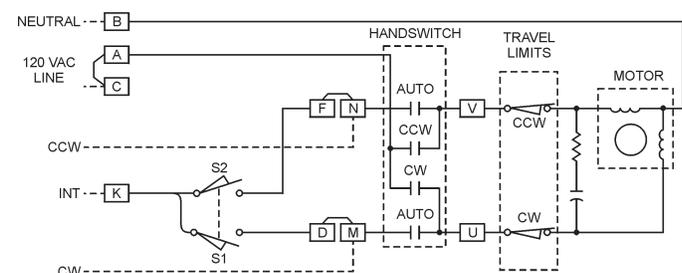
Option 5, Modulating Direct AC Control with Potentiometer Position Sensing

Customer must supply three wires to directly control the actuator motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). The position feedback potentiometer connections are available at terminals CC (Reverse), DD (Wiper), and EE (Forward).



Option 4, Multi-Position Direct AC Control with Cam-Operated Switches to Stop Actuator Travel

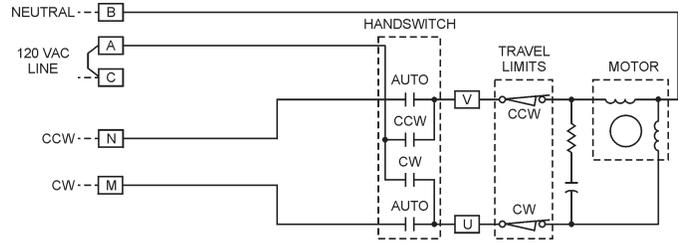
Customer must supply three wires to directly control the actuator motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). Up to six intermediate stop positions may be specified, each requiring an additional 120 V ac line.



Option 3, Open / Close

Direct AC Control

Customer must supply three wires to directly control the actuator motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B).



240 V ac Operation

All of the options described above are available for 240 V ac operation instead of 120 V ac operation. In all cases, the power neutral is replaced with Line 2 of the 240 V ac, and the 120 V ac line is replaced with Line 1 of the 240 V ac.

INSTALLATION *Feedback Signal Wiring*

CPS-5 SIGNAL CONNECTIONS

Beck 11-430 actuators equipped with the Contactless Position Sensor (CPS-5) are shipped ready for installation. They are engineered to match the mA or V dc feedback range in your system.

Customer connections for feedback signal wiring on each CPS-5 model are described in the following diagrams and paragraphs. Refer to Table 11, page 48 for a table of output signal ranges, output terminals, range changing resistance values, and terminals to which the ranging resistor or jumper is connected.

The value of the R8 Feedback Gain Resistor affects output shaft rotation range; where:

R8 = 100 K ohms produces a shaft output range of 80–100°; R8 = 249 K ohms produces a shaft output range of 70–80°; and R8 removed produces a shaft output range of 60–70° (see Figure 5, page 32 for location of R8).

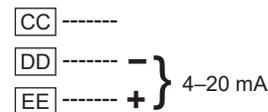
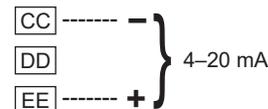
To verify that the feedback signal range is correct for your actuator, see instructions on page 31.

NOTE: Ranging resistors must be connected to the actuator output terminals. If a ranging resistor change is required, it may be obtained locally. If resistors with ±1% tolerance are not available, they can be ordered from Beck.

CPS-5 Model 20-4400-02, -12 Terminal Connections

1. A single 4–20 mA current output is available between terminals EE (+) and CC (-) when driving into an external load between 250 and 800 ohms. No ranging resistor is required.
2. 4–20 mA output is also available across EE (+) and DD (-); 500 ohms is the maximum external load (for larger loads see Item 1 above).

4-20 mA Signal Output



CPS-5 Model 20-4400-03, -13 Current Feedback Terminal Connections

The universal model has current sensing terminals, which allow for various current signal ranges. Current output is available between terminals DD (+) and CC (-) with the proper ranging resistor connected across terminals DD and EE.

Units are factory-calibrated for specified signal ranges and are provided with proper resistors installed.

The ranging resistor value is given in Table 11, page 48, or can be calculated using the following equation:

$$R = \frac{4}{(I - .004)} \Omega$$

Where R = Resistor (Ohms) Connected from DD to EE

I = Output Current Span (Amp)

If converting to a zero-based range (a range that includes zero as an end point), refer to “Adjusting the Zero Potentiometer” section, page 33.

Current Output



CPS-5 Model 20-4400-03, -13

Voltage Feedback

Terminal Connections

The universal model has a voltage divider network, which allows for various voltage signal ranges. Voltage output ranges are available across terminals EE (+) and CC (-) with the proper ranging resistor connected across terminals CC and DD.

Units are factory-calibrated for specified signal ranges and are provided with proper ranging resistors installed. Other voltage ranges are attainable by adding a ranging resistor across terminals CC and DD.

The ranging resistor value is given in Table 11, page 48, or can be calculated using the equation:

$$R = \left(\frac{V}{4} - 1 \right) \text{K } \Omega$$

Where R = Resistor Connected from CC to DD

V = Output Voltage Span

If converting to a zero-based range (a range that includes zero as an end point), refer to “Adjusting the Zero Potentiometer” section, page 33.

Voltage Output

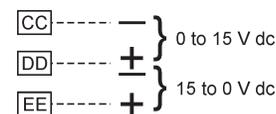


CPS-5 Model 20-4400-04, -14

Terminal Connections

The three-terminal output from these models is provided for replacing potentiometers in three-terminal potentiometer feedback applications used in many controllers. It is suitable for 0–15 V dc applications of either positive or negative polarity. CC must be connected to the negative lead from the controller, and EE to the positive lead from the controller, with DD connected to the controller lead accepting the feedback from the potentiometer wiper. These models can “source” 10 mA to the controller, or they can “sink” 2.5 mA from the controller.

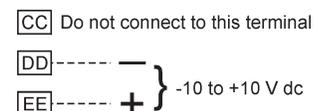
Potentiometer Equivalent



CPS-5 Model 20-4400-05, -15

Terminal Connections

Voltage signal -10 to +10 V dc is available across terminals EE (+) and DD (-). The maximum load is 5 mA.



INSTALLATION *Wiring Options*

DEMAND SIGNAL OPTIONS

Beck 11-430 actuators configured for milliamp or dc analog modulating applications include an Electronic Signal Receiver (ESR-5). Several control options are available with the ESR-5, such as operating more than one actuator with a single signal source.

The instructions below apply to applications that require a signal change or to situations calling for operation of multiple actuators from a common input signal.

Demand Signal Range Change

If it is necessary to change the range of an ESR-5 board to receive a different input signal current, the "R-in" resistor must be changed. See Table 2 below for the proper value, and Figure 7 on page 35 for its location on the board. It is mounted on turrets to facilitate the change. After soldering the new resistor in place, recalibrate in accordance with the instructions on page 34. If a proper resistor with $\pm 1\%$ tolerance cannot be obtained locally, it can be ordered from Beck.

Series Operation

Beck actuators can be connected in series from the same signal for concurrent operation. Care must be taken to keep the polarity correct in each actuator's input terminals. Two or three actuators may usually be connected in series. The number of actuators that may be connected in series is limited only by the controller's (signal source) capability to feed current into the total

resistance of the circuit involved. Consult the controller manufacturer's recommendations.

No change is required to the actuator's calibration for series operation. An interruption in the circuit will activate loss of input signal (L.O.S.) on the actuators in the circuit.

Parallel Operation

Beck actuators can be connected in parallel to the same signal for concurrent operation. Up to four actuators may be connected in parallel.

For parallel operation, use ESR-5 board no. 13-2246-05 in each actuator, and add a shunting resistor across input terminals AA and BB on one of the Beck actuators. Use the equation below to determine the value of the shunting resistor:

$$\frac{IR \times 10K}{10K - (N) \times IR} = \text{Resistor Value } (\Omega)$$

Where:

"N" = the number of actuators; and

"IR" = Input Resistance from Table 2, below.

For example, four actuators are to be connected in parallel with a 4–20 mA input signal. A 4–20 mA signal has an input resistance of 250 Ω (see Table 2). Using the equation above, where "IR" = 250 and "N" = 4, the shunting resistor needed would be 278 Ω . (Note that if the resistance calculation is not a standard value, then select the nearest standard value; for this example, a 270 Ω resistor).

A minor span adjustment is required for each actuator in a parallel circuit. An interruption in the circuit to one actuator will not prevent the other actuators from functioning, but there will be a slight calibration shift.

**TABLE 2:
ESR-5 BOARD MODELS***

INPUT SIGNAL	ESR-5 PART NO.	CHANGE FROM 22-2246-03	RESULTING Rin VALUE	INPUT RESISTANCE
1–5 mA	13-2246-02	Remove J10	1.05 k Ω	1 k Ω
4–20 mA	13-2246-03	None	255 Ω	250 Ω
10–50 mA	13-2246-04	Remove J11 add Rin4	Rin4=100 Ω	100 Ω
1–5 Vdc	13-2246-05	Remove J9	20.0 k Ω	10 k Ω
0–10 Vdc	13-2246-07	Remove J1 and J9	20.0 k Ω	10 k Ω
-10–10 Vdc	13-2246-08	Remove J1,J2,J6,J7,J8 and J9	20.0 k Ω	50.0 k Ω

*ESR-5 series 13-2246-XX boards replace 13-2245-XX series boards.

Split Range Operation

Two or three Beck actuators may be operated over their full range by a portion of the controller's output signal range. The most common arrangement involves two actuators operating on equal halves of the input signal range. For example, if a 4–20 mA control signal is used, the first actuator would move 100% of its stroke on a signal range of 4–12 mA, while the second operates on the 12–20 mA portion of the signal. In this case, the ESR-5 boards are the same as would be used for parallel operation (13-2246-05), but calibrated to the range required for each actuator. A ranging resistor must be added across input terminals AA and BB on one of the Beck actuators to produce a span between 2 and 6 volts across each board for its active portion of the range. For a 4–20 mA range 3-way split, the ranging resistor range would be 425 to 1650 ohms.

Follow the steps for calibrating the Demand signal, page 34, for each actuator unit, using half span values for the input signal. Use the proper starting point for each half-range when setting the zero; 4 mA and 12 mA. Before setting the zero on the second actuator (12 mA), cut J4. See Figure 7 on page 35 for its location on the board.

In a split range configuration, connect terminals E and F (L.O.S. wire) to prevent undesired "stay-in-place" operation of the second or third drive due to fast downward signal changes.

When three actuators are to be operated on equal portions of the input signal, the 4–20 mA range would split into 4–9.33 mA, 9.33–14.67 mA, and 14.67–20 mA signals. A 487 ohm ranging resistor (Beck P/N 13-2510-03) is adequate. Proceed as in the case of the 2-way split, first setting the span, then the zero. When setting the ESR-5 board in the first drive, set the zero at 4 mA. Then, on the second drive cut J4 and set its zero at 9.33 mA. Before setting zero in the board of the third drive, short out R34 by adding a jumper from J13 to J6, adjust its zero at 14.67 mA, cut jumpers J4 and J5, then remove the jumper from J13 to J6. Check operation of all drives by running the input signal through its complete range.

INSTALLATION *Start-Up*

START-UP INSTRUCTIONS

After the actuator is mounted and its wiring connections are made, it is ready to be tested for proper operation.

NOTE: All Beck actuators are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each actuator is set up and calibrated to the customer's specifications that were written into the equipment order.

Turn on the power supply. Operate the actuator with the Handswitch and run it through its full stroke in both directions. Observe that the driven device travels through its desired stroke. If satisfactory, set Handswitch to the AUTO position.

If the actuator is to be operated with automatic control, turn on the controller and operate the actuator by varying the control signal. Check that the driven shaft strokes in the proper direction for a change in control signal. If it does not, first check for proper wiring connections and verify control signal at the actuator. If the wiring is correct, then reverse the direction of travel (see page 28).

If the actuator is to be push-button actuated, (options 3, 4, 5, or 6) operate the actuator using the Handswitch and observe that direction of travel is correct. When travel of the driven device is satisfactory with reference to the control signal or the push-buttons, the unit is ready for operation.

LINKAGE REQUIREMENTS

In most applications, the best control will result when the linkage is adjusted so that the full 100° angular travel of the Beck actuator shaft is used, even though the driven shaft may travel less than 100°.

The general requirements for a good linkage are:

1. It must be rigid enough to carry the link thrust without bending or deforming.
2. It must have a built-in means of adjustment so that the length of the connecting link can be changed a small amount.
3. Rod end bearings, similar to those furnished on the Beck crank arm, should be used at both ends of the connecting link. This type of device permits small angular misalignments and helps prevent binding of the linkage.
4. The radius of the Beck crank arm must be calculated so that it will move the damper lever through the correct arc as it travels from 0° to 100°.
5. The actuator and driven shafts must be parallel and the linkage should be in a plane perpendicular to the shafts.

The following procedure is recommended to couple the linkage between the Beck actuator and the driven shaft:

 1. Position the driven shaft to its fully closed position.
 2. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and actuator shaft centerline.
 3. Remove the rod end from the Beck crank arm. Thread the rod end fully onto the connecting link.
 4. Adjust the connecting link to the predetermined length.
 5. Connect the connecting link to the driven lever at the predetermined radius.
 6. Set the crank pin (see illustration on page 9) on the Beck crank arm to the predetermined radius (6.5–10.5 inches (165–266 mm) or 9–15 inches (228–381 mm), depending on the crank arm); this is done by loosening the crank pin screws and sliding the crank pin to the predetermined position. Tighten the crank pin screws to the torque recommended on page 8.
 7. Loosen the crank arm screws.



CAUTION

The crank arm will pop free (approx. 125 lbs (57 kgs)) allowing adjustment for 360° around the shaft.

8. Position the actuator's output shaft to correspond with the driven shaft's fully closed position.
9. Swing the crank arm into position and assemble the rod end to the crank arm crank pin. Tighten the rod end nut to the torque recommended on page 8.
10. Tighten the crank arm screws evenly, in a cross-pattern, to the torque recommended on page 8.
11. Lubricate the rod end bearings with LGI #1 EP grease, Mobil grease #28 or equivalent.
12. Carefully move the actuator's output shaft to correspond with the driven shaft's fully open position. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also, observe that the driven shaft rotates the proper amount. Ensure that the actuator reaches the proper limit and shuts off. If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius on the Beck actuator rather than adjusting the connecting link length. Return to step 5 and repeat adjustments.

If necessary, the linkage length may be adjusted by altering the thread engagement in the couplings. The couplings have right- and left-hand threads, so it is not necessary to disconnect the ends to make a length adjustment. The stud threads must be engaged 1.2 diameters deep into the rod ends. Make adjustments by altering thread engagement in couplings only. Be careful not to expose more than 7" (178 mm) of stud between rod end and coupling.

Once again, check operation to determine that no binding occurs between the linkage and crank arm or driven shaft lever. Surrounding objects must not interfere.

Do not change limit switch settings to obtain desired driven shaft lever travel. This shortens the travel of the feedback device and reduces the control resolution, repeatability, accuracy of the actuator, and available torque.

For an input control signal change, do not adjust the linkage. The span adjustment on the ESR-5 board is used to adjust the amount of rotation when a change in maximum input signal or span is required.

Link-Assist™

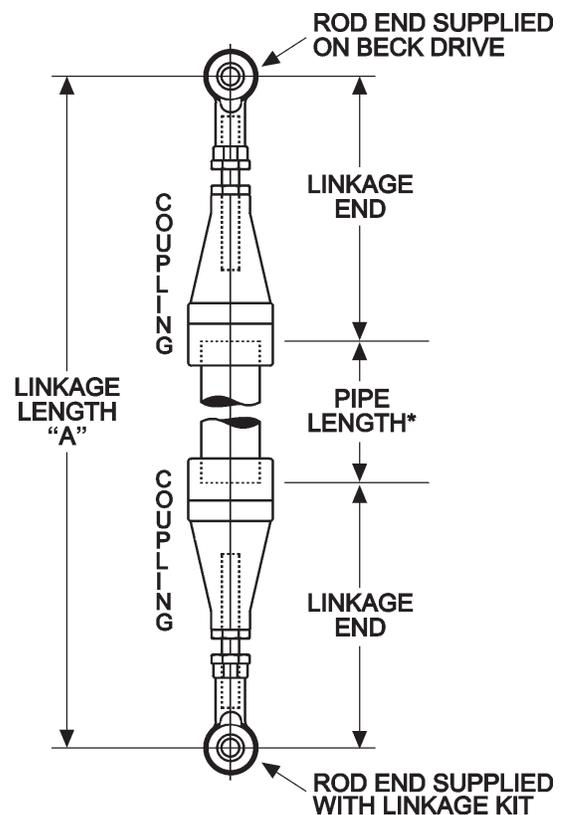
The Beck Link-Assist™ computer program optimizes the linkage configuration for your load's torque characteristics to help you select the minimum actuator size for your application. Contact your Beck Sales Engineer to take advantage of Beck's Link-Assist™ program.

Linkage Kits Available

Standard Beck linkage kits are made to accommodate a wide variation in linkage lengths without requiring modification of end fittings. This adaptability makes it possible to order the essential linkage end connections even though the exact linkage length may not be known until the actuator is mounted in place.

Each linkage kit includes the essential pipe linkage end connections and all necessary hardware except for pipe and crank arm rod end. To simplify installation of the pipe link, the kit accepts N.P.T. right-hand threads on both ends of the pipe. Left-hand threads are internal to the linkage kit assembly, making final length adjustments quick and easy.

To order Pipe Linkage Kits, first obtain the approximate overall linkage length "A". Select the kit part number from Table 3, below. For lengths beyond those listed in the table, contact your Beck Sales Engineer. Additional Linkage information can be found in the Beck Drive Specification Guide (DSG).



*NOTE: To calculate length of pipe required, subtract "Length of 2 Linkage Ends" (shown in Table 3 below) from Linkage Length "A" (shown in diagram above).

**TABLE 3:
11-430 PIPE LINKAGE KITS**

Linkage Length Range "A"	Pipe Size	Min. Pipe Nipple Length	Rod End Thread (UNF)	Beck Pipe Linkage Kit Part No.	Length of 2 Linkage Ends (Total Adj. $\pm 1 \frac{1}{2}$ " (38 mm))	Approx. Weight ¹
23 1/2–40" (597–1016 mm)	2" (51 mm)	2" (51 mm)	1 1/2-12	20-1760-13	21 1/2" (546 mm)	28 lbs (13 kg)
37 3/4–144" (959–3658 mm)	3" (76 mm)	2 5/8" (67 mm)	1 1/2-12	20-1760-10	35 1/8" (892 mm)	32 lbs (15 kg)
59 3/4–144" (1518–3658 mm)	3" (76 mm)	2 5/8" (67 mm)	1 1/2-12	20-1760-09 ²	57 1/8" (1451 mm)	41 lbs (19 kg)

¹Does not include customer supplied pipe.

²Use when the angle between the linkage and crank arm is less than 25°.

OPERATION

HOUSING

The 11-430 consists of a Beck 11-400 actuator assembled to a 3:1 gear reduction unit. The 11-400 has cast aluminum compartments for each of the five main components: The control motor, wiring terminal board, drive train, electronic signal receiver, and control end. Gasketed covers and sealed shafts make this product ideally suited to outdoor and high-humidity environments.

The gear reduction unit is cast aluminum and provides a rugged, dust-tight, weatherproof enclosure.

CONTROL MOTOR

The Beck control motor is a synchronous inductor motor that operates at a constant speed of 72 or 120 RPM in synchronism with the line frequency.

Motors are able to reach full speed within 25 milliseconds and stop within 20 milliseconds; actual starting and stopping times will vary with load.

Beck motors have double grease-sealed bearings and require no maintenance for the life of the motor.

GEAR TRAIN

The 11-400 gear train is a four-stage reduction, spur gear drive constructed with only heat-treated alloy steel and ductile iron gears for durability and long life.

The drive train consists of the control motor and Handwheel, reduction gears, main gears, and splined output shaft. The main gear / output shaft and third stage gears are built into the actuator housing. The second and first stage gears are part of the field-interchangeable gear module. Different combinations of gear modules and actuator motors determine the actuator's output torque and timing.

The drive train in the gear reduction unit is a single-stage reduction, spur gear drive consisting of a ductile iron gear and a heat-treated alloy steel pinion. An internal spline in the pinion engages with the external spline on the output shaft of the 11-400. In this way, the output torque of the 11-400 is increased by a factor of 3.

The output shaft is limited by mechanical stops to 108° of rotation. Mechanical transmission of the output shaft position to the control end is provided by a right angle gear set driven directly by the 11-400 output shaft.

SELF-LOCKING MECHANISM (SLM)

An integral part of the 11-430 control motor is the self-locking mechanism. This mechanical device couples the motor to the gear train and transmits full motor torque when rotated in either direction. When the motor is de-energized, it instantaneously locks and holds the output shaft in position, up to two times the rated torque of the actuator.

HANDWHEEL

The 11-430 actuator is furnished with a Handwheel for movement of the driven shaft without electrical power. Its solid construction design includes no spokes or projections, and turns at a safe, slow speed. The Handwheel is located at the rear of the control motor housing. The Handwheel is coupled directly to the motor shaft and rotates when the motor runs. Manual operation of the Handwheel (with electric Handswitch in STOP position) turns the motor and the rest of the drive train without incorporating a clutch.

HANDSWITCH

A local electric Handswitch is provided on Beck actuators to permit operation at the valve or damper, independent of the controller. As a safety feature, the Handswitch is designed so that the controller can operate the actuator only when it is in the AUTO position. The sequence of the Handswitch is: AUTO, STOP, CW, STOP, CCW.

In the AUTO position, two contacts are closed and the ESR-5 or external controller contact completes the control circuit.

In the CW or CCW positions, contacts are closed to operate the actuator independently of the controller.

In the STOP position, all contacts remain open.

SWITCHES

Two over-travel limit switches (control options 5 thru 8) or two end-of-travel limit switches (control options 3 and 4) and up to four optional auxiliary switches are provided on the 11-430 actuator. Switch cams are clamped onto the control shaft, which rotates in relation to the output shaft. Cam position is field-adjustable. Switches are rated 6 A, 120 V ac. All auxiliary switch connections are made on the terminal block.

CONTROL OPTIONS

Two basic types of control are available: 120 V ac contact closure (options 3, 4, 5, and 6) and milliamp or dc analog modulating (options 7 and 8). Each option is described below.

Open / close option 3: For simple 2-position control using manual push-buttons or an automatic controller. Preset travel limit switches provide open / close operation upon closure of an automatic controller or manually operated switch. Travel limits are adjustable over the full range of travel and provide precise positioning repeatability.

Multi-position option 4: Adjustable cam operated switches provide up to six discrete stop positions upon closure of an automatic controller or manually operated switch. Three, four, five, and six predetermined position settings are possible, with precise positioning repeatability.

Direct ac control option 5: Provides continuous positioning capability over the full range of actuator travel by direct ac control from either an automatic controller or manually operated switches. Includes a 1,000 ohm film potentiometer for remote feedback.

Direct ac control option 6: Provides continuous positioning capability over the full range of actuator travel by direct ac from either an automatic controller or manually operated switches. Includes Contactless Position Sensor (CPS-5) for feedback and position indication.

Modulating option 7: For automatic operation in response to milliamp or V dc analog control; includes a film potentiometer for position sensing and feedback to the Electronic Signal Receiver (ESR-5).

Modulating option 8: For automatic operation, as in option 7 above; includes Contactless Position Sensor (CPS-5) for position sensing and feedback to the ESR-5.

INPUT: ELECTRONIC SIGNAL RECEIVER (ESR-5)

Beck modulating actuators are equipped with precision electronic control modules (ESR-5) to receive conventional 4–20 mA or 1–5 V dc control signals directly, eliminating the need for contact protection devices, relays, switches, and reversing starters.

The ESR-5 provides actuator control with analog or microprocessor control systems, and is designed to operate continuously in temperatures up to 185°F.

The ESR-5 requires a position feedback signal from either the CPS-5 or a film potentiometer.

The feedback signal is compared to the input signal. The difference between these signals—the error—is amplified and used to actuate either of two electronic motor power switches. These switches drive the motor in the proper direction to force the error to zero. The input signal is adjustable from 50% to 400% of the 4 volt span, with the zero adjustable from -100 to +275% of span.

The ESR-5 permits two or more Beck actuators to be operated by a single signal source, for series, parallel, or split range operation. See pages 18–19 for details on these control options.

If the input signal to the Beck actuator is changed, the ESR-5 allows for easy modification to accept different signals. An optional “Relay Board” version of the ESR permits operation on low-power DC voltage input signals (5–24 V dc) or, with an external diode / resistor module, on low-power 120 V ac. This topic is covered beginning on page 36.

POSITION FEEDBACK: CONTACTLESS POSITION SENSOR (CPS-5)

The CPS-5 provides a continuous feedback signal proportional to the position of the actuator's output shaft. It is used for remote position indication as well as for automatic control loop feedback to the Electronic Signal Receiver (ESR-5). When used with the ESR-5, the CPS-5 includes a monitor / isolator board that delivers an isolated position feedback signal to the Electronic Signal Receiver (ESR-5). The Monitor function monitors the CPS-5 position signal and compares it to established limits. If the output exceeds normal signal conditions, the monitor relay contact opens. This relay may be used for either a remote signal indication or activation of Loss-of-Signal operation of the actuator.

The position sensing function of the CPS-5 is provided by a ferrite magnetic sensing element consisting of two parts: A ferrite stator mounted on the CPS-5 circuit board and a ferrite rotor mounted on the control shaft, driven by the Beck actuator's output shaft through the crown gear assembly. The electronic circuit translates the signal from the ferrite magnetic sensor into an analog position feedback signal designed to interface with electronic control systems and indicating instruments.

OPERATION

POSITION FEEDBACK: FILM POTENTIOMETER

The film potentiometer produces a voltage that is some fraction of the voltage applied across its resistive element. That voltage fraction is determined by the position of the wiper on the resistive element. The potentiometer assembly also includes two fixed resistors, one on each end of the resistive element. These resistors permit suppressed ranges as well as zero-based position feedback voltages. If position feedback is desired on actuators equipped with an ESR-5 board, two film potentiometers are required: One for position feedback and the second to supply a feedback signal to the ESR-5.

STALL PROTECTION

The Beck Stall Protection Module is an optional feature of the 11-430 Actuator (240 V ac actuators cannot utilize the SPM). The SPM monitors the motor current at terminals N and M. The SPM will be activated when the actuator cannot reach a desired position within approximately 300 seconds. When a stall is sensed, the SPM shuts off power to the motor and a solid state relay in the SPM changes state. The relay is rated for 120 V ac or dc, 10 VA. Two terminals connected to the solid state relay are located on the SPM. Use of the relay for annunciation of a stall is optional and will not affect the other functions of the SPM. A sensed stall condition is cleared by either reversing the motor direction command in the controller, or by turning the actuator power off and on. An LED is included on the SPM to show the operating status of the module.

LOSS OF CONTROL SIGNAL (L.O.S.)

Beck actuators equipped with the ESR-5 have the ability to move to a predetermined position upon loss of input control signal. When the input signal drops to 13% of span below the zero setting, the ESR-5 provides an annunciating signal with one of the following options:

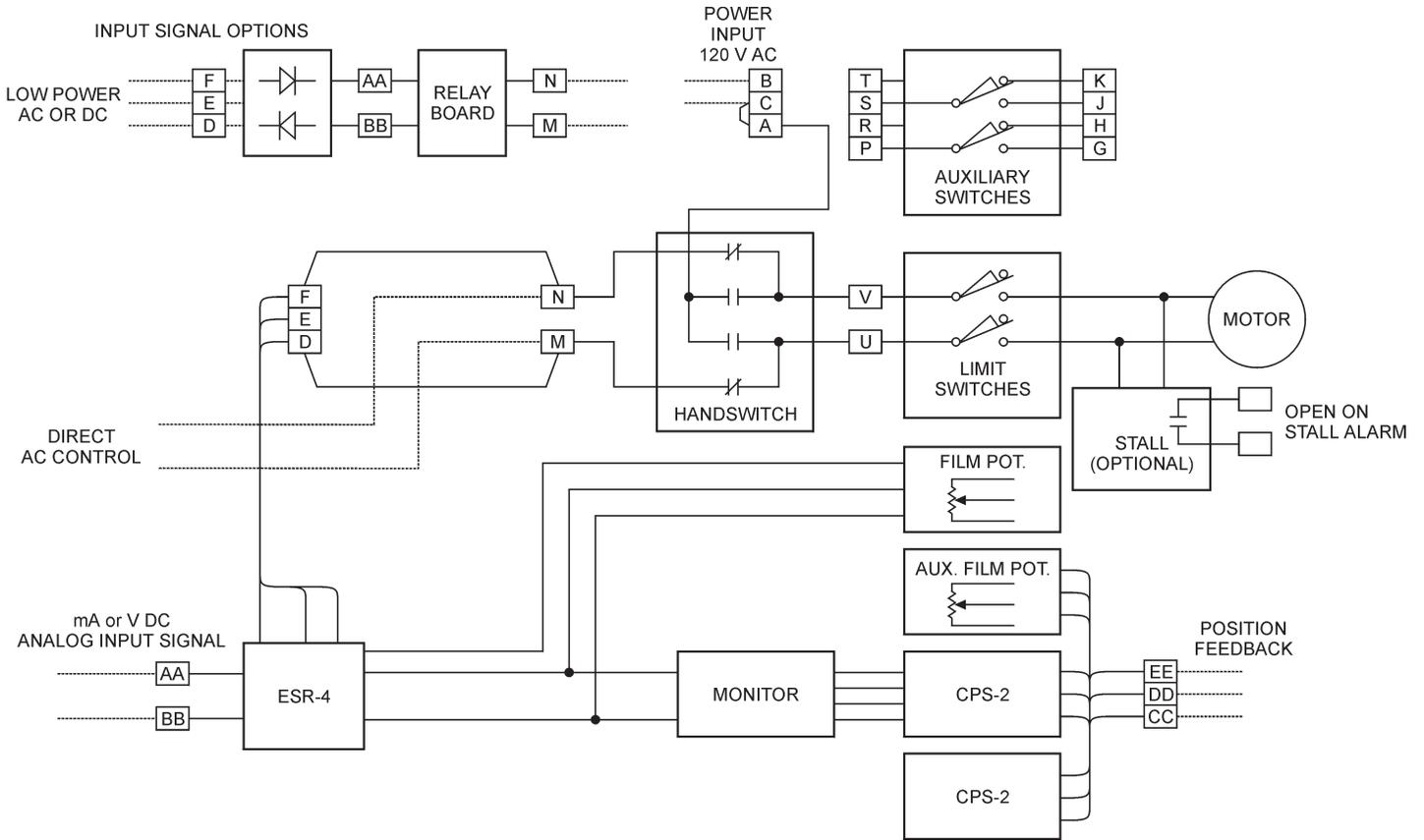
1. STALOS = Stay in place, lock in last position (triac output available for remote alarm 0.12 to 5A, 120V, 50 or 60 HZ).
2. REVLOS = To the 0% end-of-travel limit switch position. Connect terminal E to F.
3. FWDLOS = To the 100% end-of-travel limit switch position. Connect terminal E to D.
4. INTLOS = Move to predetermined intermediate auxiliary switch position. Consult factory.

When the input signal is lost but the power remains on, the L.O.S. switch on the ESR-5 board is energized, a red LED on the board lights and the directional switches are turned off. The output of the L.O.S. switch is connected to terminal E which is wired for one of the predetermined operating modes listed above.

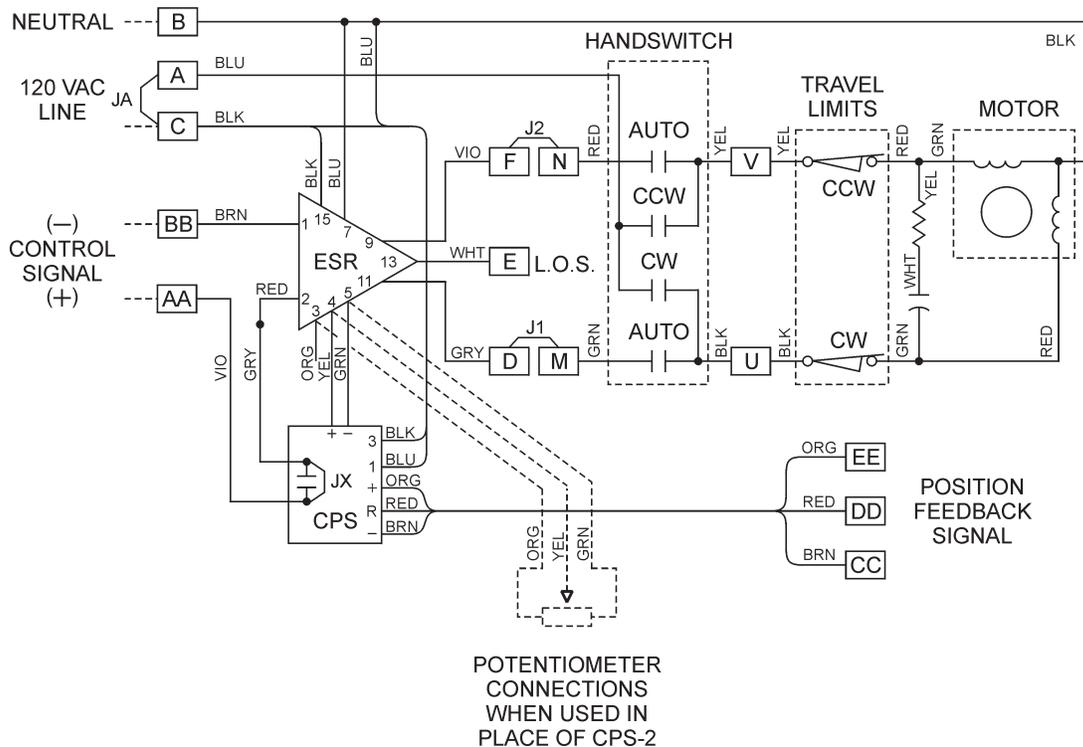
When REVLOS, FWDLOS, or INTLOS is selected, an additional relay is required to provide the annunciating signal. This should be specified when ordering.

NOTE: Your Beck actuator was shipped from the factory ready for installation; no electrical adjustments are required before placing it in operation. Each actuator is set up and calibrated to the customer's specifications that were written into the equipment order.

Under normal operating conditions there is no need to recalibrate the actuator. However, if the application requirements change or are different than specified on the equipment order, the actuator should be recalibrated according to the "Calibration" section beginning on page 26.



ACTUATOR BLOCK DIAGRAM

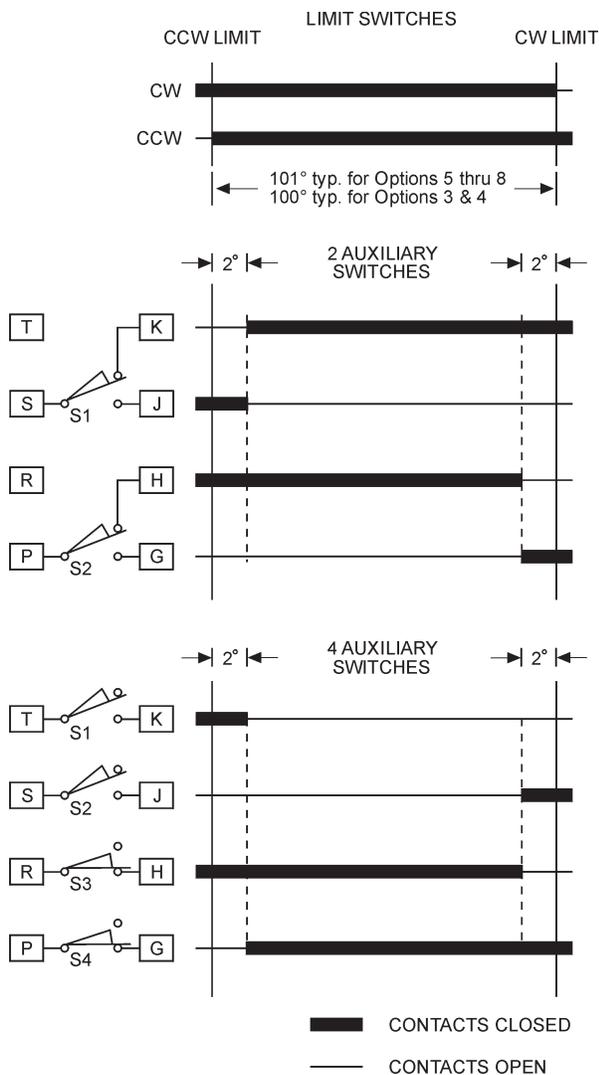


TYPICAL SCHEMATIC FOR CONTROL OPTION 7 OR 8

CALIBRATION *Switches*

SWITCH ADJUSTMENTS

Over-travel limit switches (options 5 thru 8) are factory set $1/2^\circ$ outside each end of travel unless otherwise specified at time of order. End-of-travel limit switches (options 3 & 4) are factory set at each end of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the built-in mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of approximately 60° . Auxiliary switches are set as shown in the illustration at left unless otherwise specified at time of order.



**STANDARD LIMIT
AND AUXILIARY SWITCH SETTINGS**

NOTE: On Beck 11-430 actuators, the control end cover may consist of two or three parts (cover plus cover extensions). The travel limit switches are located next to the actuator body. To adjust the travel limit switches, it is necessary to remove the control end cover and all cover extensions.

Switches are operated by cams which are clamped on to the control shaft. Setting a switch involves loosening the cam, moving the output shaft to the desired position, and positioning the cam so that it just operates the switch at that point. In the following procedure, the use of a continuity meter is recommended to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.



CAUTION

Do not attach the meter or attempt to move the switch cams until the actuator is disconnected from the line voltage and auxiliary switches are disconnected from external power sources.

Setting Limit Switches CW and CCW

This procedure should be used if the factory limit switch settings must be changed in the field. It is advisable to operate the actuator fully in each direction, using the electric Handswitch to check switch settings before attempting to change them. Follow these instructions if they require adjustment:



Figure 2

1. Remove the control end cover and cover extensions, if applicable, and terminal block cover (5/16" bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the CW switch cam screw is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 2, page 26.
3. Move the output shaft clockwise to the desired maximum CW limit switch position (for options 5 thru 8, this position should be just outside the desired CW electronic travel position).
4. Turn the Handswitch to the "STOP" position.
5. **Disconnect power from the actuator.**
6. Turn the Handswitch to the "AUTO" position.
7. Connect the continuity meter across terminals B and M. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
8. Tighten the cam locking screw to 5 lb-in (0.56 N•m) torque.
9. Disconnect the meter and turn the Handswitch to the "STOP" position.
10. Reconnect actuator power.
11. Rotate the actuator's output shaft in the CCW direction away from the CW limit switch position. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If not correct, return to step 2 and reset the cam to the proper orientation.
12. Rotate the output shaft again to the desired CW travel limit. If the desired stopping point is reached, the switch is properly set.
13. Repeat instructions for setting CCW limit switch position (noting that referenced directions of rotation should be opposite of those used for CW switch setting). Connect continuity meter across terminals B and N.
14. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.
15. Rotate index to correspond with output shaft rotation.

Setting Auxiliary Switches

Standard switch settings for actuators with 2 or 4 auxiliary switches are shown on the diagram on page 26. The heavy line indicates a closed circuit. Follow these instructions to change the operating point of auxiliary switches:

NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved. If they are to be adjusted to close, it may be necessary to reverse the operating mode of the switch by reversing the leads on the switch itself. Be sure to disconnect power from the switch terminals first.

1. Remove the control end cover and cover extensions, if applicable, and the terminal block cover (5/16" bolt heads).
2. Use the electric Handswitch to drive the shaft so that the switch cam is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the STOP position.
5. Disconnect power from the actuator and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 26 or the actuator wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in (0.56 N•m) torque.
8. Disconnect the meter and reconnect power.
9. Move the actuator's output shaft in the desired direction so that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
10. Replace covers and tighten bolts to 10 lb-ft (14 N•m) torque.

CALIBRATION *Direction Change*

CHANGING DIRECTION OF OUTPUT SHAFT ROTATION

The direction of output shaft rotation is determined by observing the end of the actuator output shaft. The rotation direction desired from an increasing signal—clockwise or counterclockwise—should be specified at the time of order. If not specified, the output shaft is factory-set to rotate clockwise in response to an increasing signal.

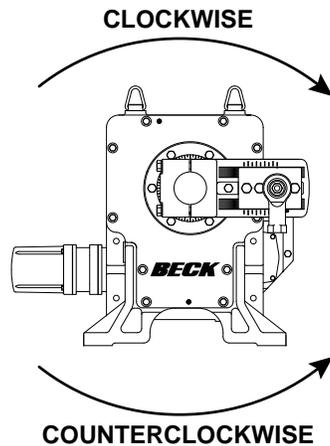


Figure 3

The procedure to change the direction of travel of the output shaft varies by model number. The model number is listed on the actuator nameplate. Determine the model number and refer to one of the following procedures:



CAUTION

Be sure the drive is disconnected from the line voltage and that all auxiliary switches are disconnected from the external power sources before beginning the direction change procedure.

Models 11-433 and 11-434

No changes are necessary for these models.

Models 11-435 and 11-437

NOTE: On Model 11-437 units equipped with an auxiliary film potentiometer, the auxiliary potentiometer is mounted closest to the actuator body.

1. Remove the control end cover and extensions if applicable (5/16" bolt heads).
2. Interchange the yellow and black wires on the common terminals of the CW and CCW travel limit switches.
3. Interchange the wires connected to the ends of the potentiometer. The wire on terminal 1 or 5 should be moved to the opposite terminal. Also move the wire on terminal 2 or 4 to the opposite terminal. The wire to terminal 3 remains unchanged. See Table 4, below.
4. Reset the potentiometer wiper according to the instructions on page 30.

Auxiliary Potentiometer Only

4. Reverse the wires connected to the ends of the potentiometer. The wire on terminal 1 or 5 or on terminal 2 or 4 should be moved to the opposite terminal (See Table 4).
5. Replace the control end covers. Torque the cover bolts to 10 lb-ft (14 N•m).

TABLE 4:
SHAFT ROTATION, FEEDBACK, AND METER CONNECTIONS

Model	Output Shaft Rotation Increasing Signal	Control Shaft Rotation	Remote Feedback Terminal Connections			Wiring Connections to Potentiometer Terminals				
			(+) Supply Voltage	(-) Fdbk	Meter Connections					
					1	(-) 2	(+) 3	(-) 4	5	
435, 437	CW	CW	EE	DD	CC		GRN	YEL		ORG
	CCW	CCW	EE	DD	CC	ORG		YEL	GRN	

Models 11-436 and 11-438

1. Open the terminal compartment (5/16" bolt heads) and remove the control end cover (5/16" bolt heads) and extensions, if applicable.
2. Interchange the yellow and black wires on the common terminals of the CW and CCW travel limit switches.
3. Determine the correct feedback signals from the wiring diagram supplied with your actuator (CC, DD, EE).
4. **FOR CURRENT FEEDBACK APPLICATIONS:** Record the color and location of the feedback signal wires for reconnection later. Remove the two feedback wires. Connect the mA meter in series with a 200 ohm load resistor.
FOR VOLTAGE FEEDBACK APPLICATIONS: Connect a voltmeter across the feedback terminals, DO NOT remove the feedback signal wires. See Table 11, page 48 for feedback terminals.
5. Reconnect actuator power.
6. Drive the output shaft until the CPS-5 output is 50% of the range (e.g., for 4–20 mA signal range, set output to 12 mA).
7. Set Handswitch to STOP position.
8. Using a 7/64" hex wrench, loosen the CPS-5 rotor clamp.
9. Rotate the CPS-5 rotor 180° and set the output back to the mid-range (e.g. 12 mA).
10. Tighten the rotor clamp. See Figure 4, below.
11. Run the actuator to the 0% and 100% limits using the Handswitch. Record CPS-5 output at these limits.
12. Subtract the outputs recorded at the two limits and compare with the desired output signal span (e.g., 16 mA for a 4–20 mA signal range). The difference between the measured span and the desired span is the error.
13. With the actuator at the 100% limit, turn the span potentiometer to adjust the CPS-5 output signal by 1/2 of the span error calculated in step 12. Turning the span potentiometer CW increases the span equally at both ends. See Figure 5, page 32, for the location of the span potentiometer.
14. Loosen the CPS-5 rotor clamp and rotate to achieve the desired value of maximum output signal (e.g., 20 mA for a 4–20 mA signal range). Rotation of the CPS-5 rotor moves the entire signal span up or down.
15. Tighten the CPS-5 rotor clamp to 5 lb-in (0.56 N•m) torque. Maintain a 0.031" (.8 mm) clearance between the rotor clamp and stator.
16. Run the actuator to 0% and 100% limits and check the output signal for desired span. If not correct, repeat the procedure from step 11.
17. Remove the meter and resistor and reconnect the feedback wiring.
18. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.
19. Model 11-438: Check ESR-5 board calibration by following the "Checking Calibration" procedure on page 34.

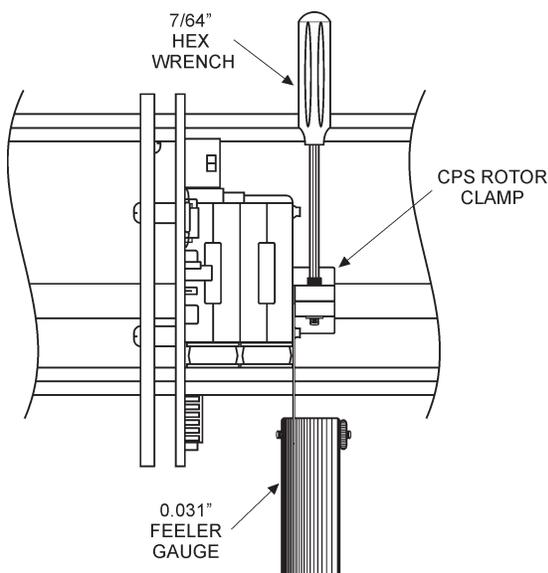


Figure 4

CALIBRATION *Feedback Signal*

FEEDBACK SIGNAL CALIBRATION

Feedback signal calibration is necessary to ensure that signal current or voltage correctly corresponds to the actuator's output shaft position. The 11-430 actuator is shipped with the feedback calibrated for full 100° travel of the output shaft unless otherwise specified at the time of order. Minimum shaft travel available is 60°.

The procedure to check and set feedback calibration varies by model number. The model number is listed on the actuator nameplate. Refer to the proper procedure below.

NOTE: The limit switches must be properly adjusted before the feedback signal is calibrated. The feedback signal must be calibrated before the input signal is calibrated.

Film Potentiometer Calibration Models 11-435 and 11-437

NOTE: On Model 11-437 units equipped with an auxiliary film potentiometer, the auxiliary potentiometer is closest to the actuator body.

Properly adjusted, the auxiliary potentiometer feedback signal should be maximum with the actuator shaft at the 100% (maximum input signal) position. At 50% of travel, the signal should be mid-span. At 0%, the signal should be minimum.

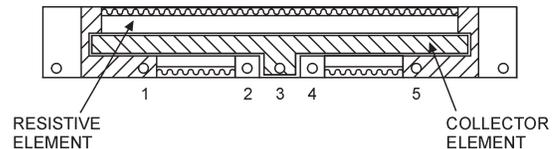
On 11-437 units, potentiometer feedback to the ESR-5 board should read 0.52 V dc at the minimum input signal position and $2.41 \pm 6\%$ V dc at the maximum input signal.

If either the auxiliary or main potentiometers on 11-437 units is out of calibration, or if the feedback potentiometer on 11-435 units is out of calibration, the procedure to recalibrate is the same:

1. Remove the ESR cover and the control end cover (5/16" bolt heads).
2. Loosen the clamping screw (use 9/64" hex wrench) on the potentiometer wiper so that it is just snug on the shaft.
3. Move the actuator to the 0% position.
4. On Model 11-437, connect a voltmeter between the terminal with the green lead (either terminal 2 or 4) and the adjacent terminal (either terminal 1 or 5). Measure and record the voltage. Now connect the voltmeter between the terminal with the yellow lead (+) and the terminal with the green lead (-) and set the wiper on the potentiometer until the meter reads 30 mV greater than the voltage recorded in the first part of this step.

On models 11-435, set the wiper about 5 degrees above the position where the minimum output is reached, or as required by the control system. See Table 4, page 28.

NOTE: Be sure that the wiper spans the resistor and collector elements equally, and does not touch the areas of low resistance at either end of the film element.



5. Tighten the clamping screw to 5 lb-in (0.56 N•m) torque.
6. Operate the actuator between the electrical limits. Verify that the feedback signal is properly adjusted.
7. Use the manual Handwheel to move the actuator to the mechanical limit; do not over-torque, as damage may result.
8. Check that the wiper does not come off the resistive element. This may be verified by monitoring the output voltage and ensuring it does not fall from maximum value. If not correct, return to step 2.
9. Replace the covers and tighten the cover bolts to 10 lb-ft (14 N•m).

CPS-5 Calibration Model 11-436 and 11-438

These models are equipped with a Contactless Position Sensor (CPS-5) for position sensing and feedback. On Model 11-438, the CPS-5 also delivers a feedback signal to the Electronic Signal Receiver (ESR-5). Adjusting the remote feedback signal will also adjust the signal to the ESR-5 on models so equipped.

CPS-5 units provide position feedback without contacting or wiping surfaces. On option 8 units, the CPS-5 includes a Monitor / Isolator board which detects high and low out-of-limit conditions. The Monitor function monitors the CPS-5 position signal and compares it to established limits. If the output exceeds normal signal conditions, the monitor relay contact opens. This relay may be used for either a remote signal indication or activation of the Loss-of-Signal function.

The CPS-5 provides infinite resolution by incorporating a ferrite rotor on the control shaft and a ferrite stator mounted on the position sensing circuit board. To make feedback signal adjustments, adjust the span, then change the position of the rotor on the control shaft to adjust the zero.

Checking Feedback Signal Calibration

The following procedure should be followed to check CPS-5 calibration:

Tools required:

- mA / V dc Multimeter
- 1/2" Combination Wrench
- 200 ohm Resistor

1. Put electric Handswitch in STOP position.
2. Remove the terminal block cover and the control end cover (5/16" bolt heads).
3. Determine the correct feedback terminals from the wiring diagram supplied with your actuator (CC, DD, EE).
4. FOR CURRENT FEEDBACK APPLICATIONS: Record the color and location of the feedback signal wires for reconnection later. Remove the two feedback wires. Connect a mA meter in series with a 200 ohm load resistor.
FOR VOLTAGE FEEDBACK APPLICATIONS: Connect a voltmeter across the feedback terminals, DO NOT remove the feedback signal wires. See Table 11, page 48, for feedback terminals.
5. Drive the output shaft through its full range and check the feedback signal.

When properly adjusted, the feedback signal should be maximum with the actuator's output shaft at the 100% (maximum input signal) position. At 50% travel, the signal should be mid-span. At the 0% position, the signal should be minimum. If not correct, proceed with the calibration procedure.

Note: Tolerance on factory calibration is $\pm 0.5\%$ of span.

Calibration Procedure

Adjustment of the CPS-5 is necessary if the signal range requires an increase or decrease in value relative to the actuator's output shaft rotation. Calibrate by turning the Span Potentiometer CW to increase the gain of the CPS-5. This has the effect of increasing the output at the high end and lowering the output at the low end equally.

Signal Span is determined by the CPS-5 model and ranging resistor selected.



CAUTION

Do not adjust the zero potentiometer to shift the span.

To adjust the span, turn the Span Potentiometer on the CPS-5 circuit board. The Span Potentiometer adjusts the CPS-5 so that the actuator output shaft rotation from 80° to 100° produces the specified output signal range.

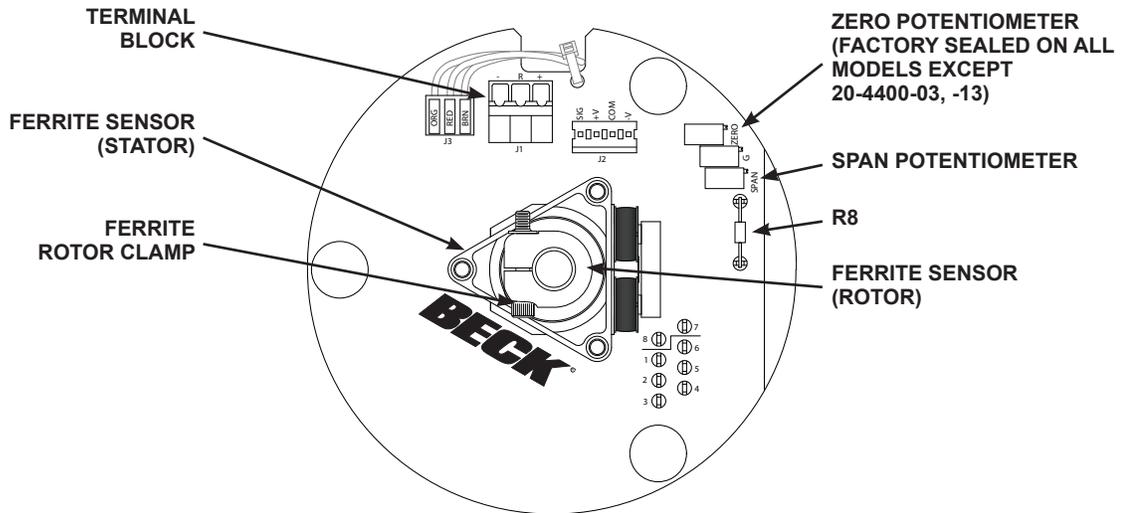
For output shaft rotation of between 60° and 79°, it may be necessary to remove resistor R8 (100 K ohm), which is on raised turrets, to change the range of the span adjustment. An R8 value of 100 K ohms produces a shaft output range of 80° to 100°; an R8 value of 249 K ohms produces a shaft output range of 70° to 79°; and removing R8 produces a shaft output range of 60° to 69°. See Figure 5, page 32, for location of R8.

Tools required for calibration:

- mA / V dc Multimeter
- 3/32" Screwdriver
- 7/64" Hex Wrench
- 1/4" Screwdriver
- 1/2" Combination Wrench
- 1/32" Thickness Feeler Gauge
- 200 ohm Resistor

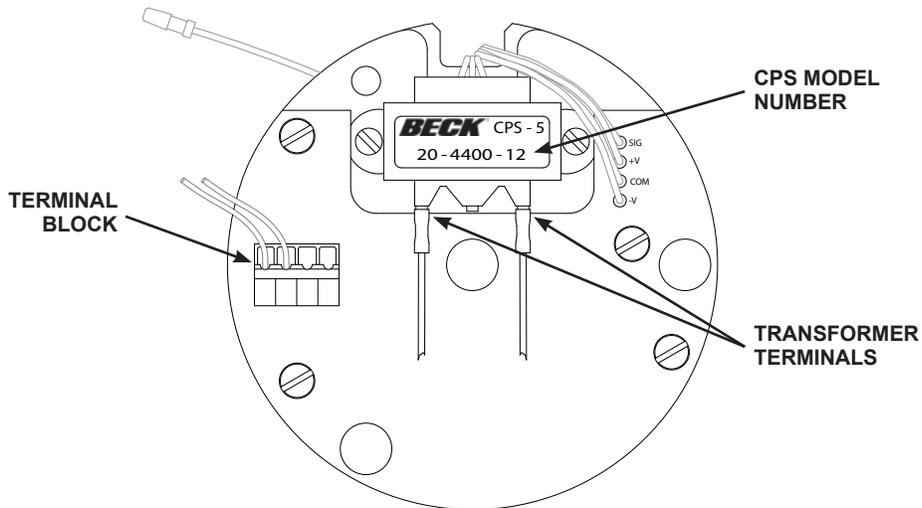
1. Put electric Handswitch in STOP position.
2. Remove the terminal block cover and the control end cover (5/16" bolt heads).
3. Determine the correct feedback terminals from the wiring diagram supplied with your actuator (CC, DD, EE).
4. FOR CURRENT FEEDBACK APPLICATIONS: Record the color and location of the feedback signal wires for reconnection later. Remove the two feedback wires. Connect a mA meter in series with a 200 ohm load resistor.
FOR VOLTAGE FEEDBACK APPLICATIONS: Connect a voltmeter across the feedback terminals, DO NOT remove the feedback signal wires. See Table 11, page 48, for feedback terminals.
5. Run the actuator to the 0% and 100% limits using the Handswitch. Record the CPS-5 output at these limits.
6. Subtract the outputs recorded at the two limits and compare with the desired output signal span (e.g. 16 mA for a 4–20 mA signal range). The difference between the measured span and the desired span is the span error.
7. With the actuator at the 100% limit, turn the span potentiometer to adjust the CPS-5 output signal by 1/2 of the span error calculated in step 6. Turning the span potentiometer CW increases the span equally at both ends. Turning the span potentiometer CCW decreases the span equally at both ends. See Figure 5, page 32, for the location of the span potentiometer.

CALIBRATION Feedback Signal



CPS-5 POSITION SENSOR

Figure 5



CPS-5 MONITOR / ISOLATOR ASSEMBLY

Figure 6

CALIBRATION PROCEDURE, CONT'D.

8. Loosen the CPS-5 rotor clamp and rotate to achieve the desired value of maximum output signal (e.g., 20 mA for a 4–20 mA signal range). Rotation of the CPS-5 rotor moves the entire signal range up or down.
9. Tighten the CPS-5 rotor clamp to 5 lb-in (0.56 N•m) torque. Maintain a 0.031" (.8 mm) clearance between the rotor clamp and stator.
10. Run the actuator to the 0% and 100% limits and check the output signal for desired span. If not correct, repeat the procedure from step 5.
11. Remove the meter and resistor and reconnect the feedback wiring.
12. Replace covers and tighten the cover bolts to 10 lb-ft (14 N•m) torque.
13. On Model 11-438: Check ESR-5 board calibration by following the "Checking Calibration" procedure on page 34.

Adjusting the Zero Potentiometer

The Zero Potentiometer is provided on CPS-5 models 20-4400-03 and -13 to change from a suppressed zero to a zero-based range (e.g., from 1–5 V dc to 0–16 V dc). The zero is adjustable from -5% to +30% of span.

NOTE: Do not adjust the zero potentiometer to shift calibration. Adjust the rotor position only to shift calibration.



CAUTION

The zero is factory sealed on all CPS-5 units except 20-4400-03 and -13. Do not attempt to adjust the zero on other models as misadjustment of feedback signal and monitor/ isolator functions will result.

The following example is given to illustrate how the zero is adjusted to effect a range change from 1–5 V dc to 0–16 V dc.

1. Install the 1–5 V dc unit as a 1–5 V dc range. Do not make any adjustments other than setting the rotor position.
2. Remove jumper from terminals CC to DD and replace with a 3.01 K ohm resistor (see Table 11, page 48). This shifts the range to 4–20 V dc.

3. Using a voltmeter at the appropriate output terminals, adjust the zero potentiometer with the actuator at minimum input signal position so that output reads 0 V dc. This changes the range to 0–16 V dc.

FEEDBACK SIGNAL MONITOR / ISOLATOR

CPS-5 models 20-4400-12, -13, -14, and -15 are provided with a Monitor / Isolator board that delivers an isolated position feedback signal to the Electronic Signal Receiver (ESR-5). The Monitor function monitors the CPS-5 position signal and compares it to established limits. If the output exceeds normal signal conditions, the monitor relay contact opens. This relay may be used for either a remote signal indication or activation of Loss-of-Signal operation of the actuator.

No adjustments should be made on the Monitor / Isolator board.

Feedback Signal Monitor Sensing Operation

A red LED indicator and an SPST relay are mounted on the Monitor / Isolator board to indicate that power is on and that the CPS-5 output signal is within normal range. The contacts open at -4% and +104%, and close at -1% and +101%.

The SPST relay is rated for 0.1 A resistive at 100 V dc.

Stay in Place on Loss of Feedback

Actuators equipped with the Electronic Signal Receiver (ESR-5) are configured so that the input control signal is connected through the feedback signal monitoring relay on the monitor board of the CPS-5. The Loss-of-Signal (L.O.S.) function of the ESR-5 may therefore be activated when the CPS-5 signals are outside the normal range (see above). It is possible to have an out of range CPS-5 signal trigger the L.O.S. mode—contact the factory for details and instructions. For details on L.O.S. function, review the following section on "Input Signal Calibration".

CALIBRATION Demand Signal

DEMAND SIGNAL CALIBRATION

11-430 actuators equipped for milliamp or dc analog modulating applications include a fourth generation Electronic Signal Receiver (ESR-5). The ESR-5 board consists of a voltage regulator, a signal amplifier, an error amplifier, and three solid state output switches.

The ESR-5 board controls the position of the Beck actuator according to the demand signal it receives. A feedback signal is delivered to the board from either a potentiometer or the CPS-5, which is then compared with the demand signal. The error signal is amplified and used to actuate either of two switches to drive the output shaft forward or reverse until the signals balance and the error is zero.

The third output switch is energized when the signal falls below a given setting. This L.O.S. output can be used to drive the output shaft to a predetermined position. See section on L.O.S., page 36, for further details.

NOTE: The demand signal is calibrated relative to the output (feedback) signal. Therefore, the shaft travel limit switches must be properly adjusted and the feedback signal calibrated before the demand signal can be calibrated.

Checking Calibration

Using the demand control signal, drive the output shaft through its complete range. Check the position feedback signal to confirm that a 10% demand signal delivers a 10% position, a 50% signal delivers a 50% position, and a 90% signal delivers a 90% position. If the feedback signals do not correspond to the appropriate demand signals, then the ESR-5 must be calibrated. The tolerance on factory calibration is $\pm 0.5\%$ of span.



CAUTION

The signal circuit on ESR-5 units is not grounded. If grounding is required, connect terminal BB in the terminal compartment to ground, either on the drive body or externally.

Calibration Tips

The input signal can be varied by the automatic controller, but if that is impractical, a test box may be used. Connect the test box to positive terminal AA and negative terminal BB of the terminal block in place of the controller input.

Span and zero adjustments are located near the edge of the ESR-5 board (see Figure 7, page 35). Monitor the FWD and REV lamps to make

adjustments. When the actuator is balanced (with Handswitch in AUTO and not at an end-of-travel limit) or in L.O.S. mode, both lamps are off. When the output shaft is moving, the lamp designating its direction of travel is lit and the other LED is off. When the actuator reaches its end of travel before balance is achieved, the lamp will stay lit. Trim the adjustment so that the actuator just reaches the limit switch and the motor does not run. Clockwise rotation of either span or zero adjustment causes the output shaft to drive toward the zero (minimum demand signal) position.

Calibration Procedure

NOTE: Two calibration procedures are described below. The first procedure is to be followed if the span is in error by less than 15%. If the span is in error by more than 15% follow the second procedure.

Tools required:

3/32" Screwdriver

1/2" Combination Wrench

1/4" Screwdriver

If the span is in error by less than 15%:

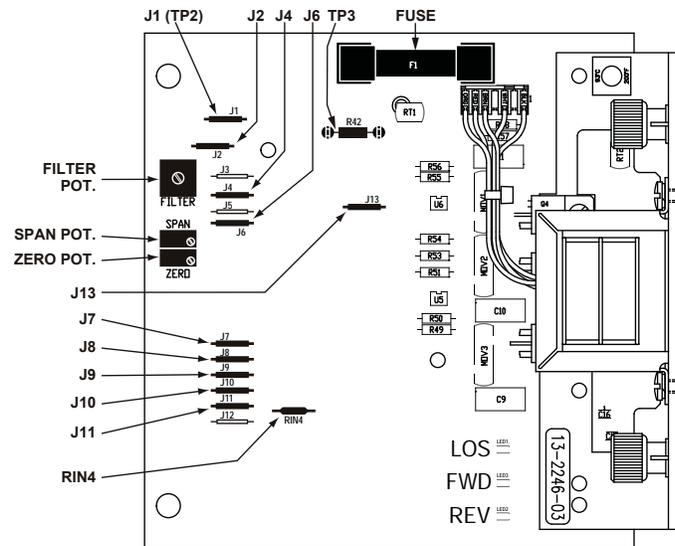
1. Turn the Handswitch to the "STOP" position.
2. Remove the ESR cover and the terminal block cover (5/16" bolt heads).
3. Determine the correct external feedback signal terminals from the wiring diagram supplied with the drive (located on the inside of the terminal block cover). Connect a meter (if applicable) to monitor the feedback signal. Refer to the "Feedback Signal Calibration" section beginning on page 30 for instructions on how to connect the meter. Note: For drives equipped with control option 7 without an auxiliary potentiometer, it is not possible to use terminals CC, DD and EE for signal measurements during calibration. Instead, an external reference must be used to determine the drive output shaft position.
4. Connect a signal source to the demand signal terminals, AA (+) and BB (-).
5. Turn the Handswitch to the "AUTO" position.
6. Apply the desired 0% demand signal to the drive (e.g., 4 mA for a 4–20 mA input).
7. Using a 3/32" screwdriver, adjust the zero potentiometer CCW until the motor runs and the output shaft position is at least 2° from the desired 0% position. Both the "REV" & "FWD" lamp should be off.
8. Adjust the zero potentiometer CW in small increments until the output shaft is at the 0% position. For actuators equipped with external

feedback, the feedback signal reads 0% (e.g., 4 mA for a 4–20 mA signal). Once at the 0% position, both lamps should be off.

9. Apply the desired 100% demand signal to the drive (e.g., 20 mA for a 4–20 mA signal).
10. Using a 3/32" screwdriver, adjust the span potentiometer CW until the drive motor runs and the output shaft position is at least 2° from the desired 100% position. The "FWD" lamp will light and remain lit.
11. Adjust the span potentiometer CCW in small increments until the output shaft is at the 100% position. For drives equipped with external feedback, the feedback signal reads 100% (e.g., 20 mA for a 4–20 mA signal). The "REV" lamp will light and the "FWD" lamp deactivate. Once at the 100% position, both lamps should be off.
12. Apply the desired 0% demand signal and confirm that the output shaft is at the 0% position (the feedback signal reads 0%). If not, adjust the zero potentiometer.
13. Apply the desired 100% demand signal and confirm that the output shaft is at the 100% position (the feedback signal reads 100%). If not, adjust the span potentiometer.
14. Repeat steps 12 and 13 until the meter readings stay within an acceptable range.
15. Remove the meter and any local signal sources and reinstall the demand signal and feedback signal wiring. Replace the compartment covers and tighten the bolts to 10 lb-ft (14 N•m).

For a span error greater than 15%:

1. Turn the Handswitch to the "STOP" position.
2. Remove the ESR cover and the terminal block cover (5/16" bolt heads).
3. Determine the correct external feedback signal terminals from the wiring diagram supplied with the drive (located on the inside of the terminal block cover). Note: For drives equipped with control option 7 without an auxiliary potentiometer, it is not possible to use terminals CC, DD and EE for signal measurements during calibration. Instead, an external reference must be used to determine the drive output shaft position.
4. Connect a meter (if applicable) to monitor the feedback signal.
5. Turn the Handswitch to the "AUTO" position.
6. Short the demand signal terminals AA and BB.
7. Use a clip lead between J4 and the right side pad of RIN4. Note: The board has conformal coating; take extra care to ensure proper connection.
8. Using a 3/32" screwdriver, adjust the zero potentiometer CW in small increments until the



ESR-5 COMPONENTS
(13-2246-03 shown)

Figure 7

output shaft is at the 0% position. For drives with external feedback, the feedback signal reads 0% (e.g., 4 mA for a 4–20 mA signal).

9. Remove the short on the demand signal terminals and apply a demand signal equal to the span (e.g., 16 mA for a 4–20 mA signal). If the drive has not been wired, the demand signal is connected at terminals AA (+) and BB (–).
10. Using a 3/32" screwdriver, adjust the span potentiometer CCW in small increments until the output shaft is at the 100% position. For drives equipped with external feedback, the feedback signal reads 100% (e.g., 20 mA for a 4–20 mA signal).
11. Remove the clip lead. Apply the desired 100% demand signal (e.g., 20 mA for a 4–20 mA signal).
12. Adjust the zero potentiometer CCW (may require 10–15 turns) until the output shaft is at the 100% position (the feedback signal reads 100%).
13. Apply the desired 0% demand signal and confirm that the output shaft is at the 0% position (the feedback signal reads 0%). If not, adjust the zero potentiometer.
14. Apply the desired 100% demand signal and confirm that the output shaft is at the 100% position (the feedback signal reads 100%). If not, adjust the span potentiometer.
15. Repeat steps 13 and 14 until satisfied with the adjustment.
16. Remove the meter and any local signal sources and reinstall the demand signal and feedback signal wiring. Replace the compartment covers and tighten the bolts to 10 lb-ft (14 N•m).

CALIBRATION *Demand Signal*

Span

The basic span adjustment of the ESR-5 is 2–6 volts dc. This is adjustable with the 20-turn span potentiometer. To make the span adjustable from 2–9 volts dc, remove jumper J4. To make the span adjustable from 9–12 volts dc, remove jumper wire J1. To make the span adjustable from 12–16 V dc, remove J1 and J2. See figure below for location of jumpers on the ESR-5 board.

Zero (Supp.)

The basic zero adjustment is -20% to 100% of span. This is adjustable with the zero potentiometer. For split range applications, see page 19.

Filter Adjustment

The input filter is adjusted at the factory for maximum attenuation of disturbances on the input signal (fully CW). This introduces a 1% drift (with 60 second timing) in response to a loss of input signal when stay-in-place is selected. If this is objectionable or if livelier response is desired, the filter action can be reduced by turning the filter adjustment potentiometer CCW a sufficient amount. Full CCW takes the filtering out completely, but in some cases may lead to undesirable cycling. If this happens, turn the adjustment CW until the cycling is damped out.

Deadband Adjustment

The deadband values of 0.6% for CPS-5 or film potentiometer operation are chosen to satisfy the requirements of most control systems. If excessive process and / or signal noise is present, the actuator may be subject to unnecessary cycling. It is recommended that excessive noise be reduced at the source in order to prevent unnecessary cycling. This will improve process control and prolong component life.

If it is not possible to eliminate the excessive noise, the actuator's deadband can be widened; however, this will reduce the resolution of the actuator. Widening the deadband to 1% can be accomplished by removing J13. Further change of the deadband is possible (please contact the factory for details).

L.O.S. TRIP POINT

If the input signal drops below a predetermined value, the L.O.S. feature is activated. The standard factory setting of this feature is approximately 13% of the signal span below the minimum signal value. For example, if the input signal is 4–20 mA, 13% of that 16 mA span is 2.08 mA. Therefore, the L.O.S. trip point would be 1.92 mA (4.0 mA minus 2.08 mA). If the input signal is 1–5 V, 13% of that 4 V span is 0.52 V. Therefore, the L.O.S. trip point would be 0.48 V (1.0 V minus 0.52 V).

If it is necessary to change the L.O.S. trip point, this may be done by replacing resistors on the ESR board. Consult the factory for details.

RELAY BOARD OPERATION

The Relay Board is a solid-state interface to permit switching large control motor currents with low voltage dc or low current ac inputs.

Relay Board Calibration

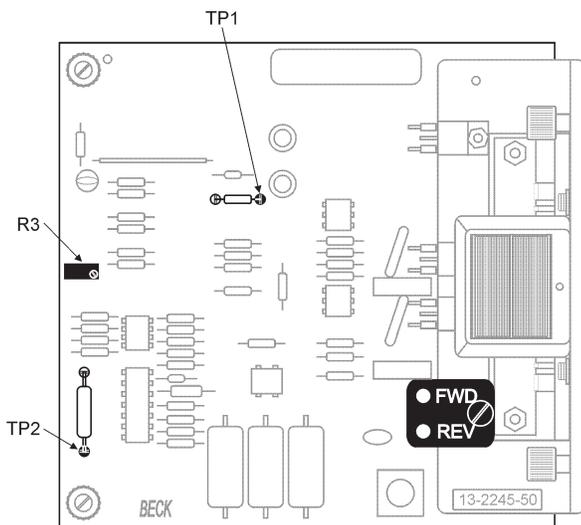
The purpose of calibrating the Relay Board is to ensure that clockwise and counterclockwise input signals are balanced (e.g., if a 24 V dc signal runs the actuator in the clockwise direction, a -24 V dc signal should run the actuator in the counterclockwise direction, and the actuator should not run when the signal is zero).

Two calibration procedures are described on page 37. The first applies to low current 120 V ac input signals. The second applies to low voltage 24 V dc input signals.

Low current 120 V ac Relay Board Calibration Procedure (Relay Board 13-2245-50):

1. Disconnect actuator from line voltage and remove terminal cover and ESR cover (5/16" bolt heads).
2. Remove input signal wires from terminals AA and BB.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 8, below, for location of test points on the Relay Board.
4. Turn on line voltage.
5. Adjust potentiometer R3 to bring meter reading to $+0.17 \text{ volts} \pm 0.01 \text{ V dc}$. See Figure 8 for location of potentiometer R3.
6. Disconnect actuator from line voltage and reconnect input signal wires to terminals AA and BB.
7. Check operation of actuator with system signals.
8. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.

NOTE: When used in low-current AC applications, the Relay Board provides a 10 mA load to the controller outputs. If the controller outputs require greater than a 10 mA holding current, the user must provide additional load external to the actuator using resistors from each input to neutral (actuator terminals F to E and D to E). Since these resistors generate heat, sufficient means for cooling must be provided.

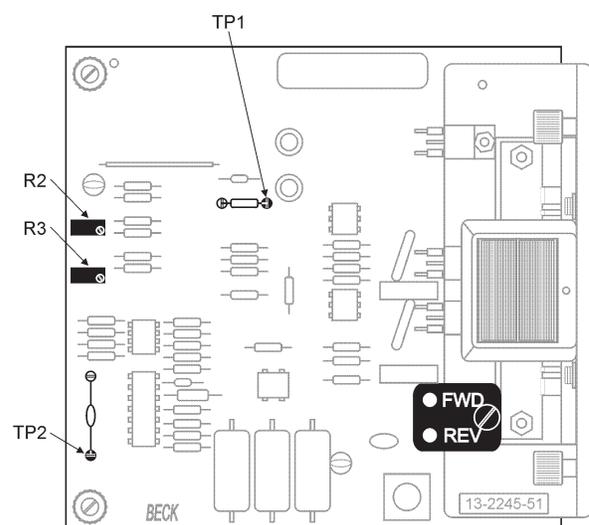
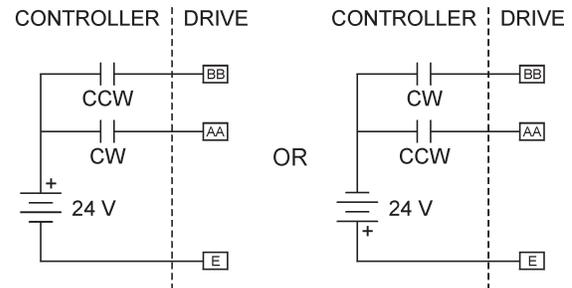


Low Current 120 V ac
Relay Board Components

Figure 8

Low voltage 24 V dc Relay Board Calibration Procedure (Relay Board 13-2245-51):

1. Disconnect actuator from line voltage and remove terminal cover and ESR cover (5/16" bolt heads).
2. Remove input signal wires from terminals AA and BB.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 9, this page, for location of test points on the Relay Board.
4. Turn on line voltage.
5. Adjust Zero Potentiometer R3 for -0.2 V at TP1 with neither input signal applied. See Figure 9 for location of Zero Potentiometer R3.
6. Adjust Span Potentiometer R2 for -0.2 V at TP1 with both input signals applied simultaneously. See Figure 9 for location of Span Potentiometer R2.
7. Disconnect actuator from line voltage and reconnect input signal wires to terminals AA and BB.
8. Check operation of actuator with system signals.
9. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.



Low Voltage 24 V dc
Relay Board Components

Figure 9

MAINTENANCE Routine

The Beck 11-430 actuator requires only minimal routine maintenance. Periodic lubrication of the gearing is recommended to extend gear life. Periodic visual inspections are recommended to verify that the connection to the final control element is intact and operating normally. If vibration is present, check the electrical terminal connections and other hardware for tightness. Inspections of body mounting bolts and crank arm linkages are also recommended to ensure the actuator elements are secure and operating normally.

LUBRICATION

It is recommended that during major outages, actuators be inspected to determine the need to relubricate the drive gear train. It is also recommended that the linkage rod ends be lubricated at this time to extend life.



CAUTION

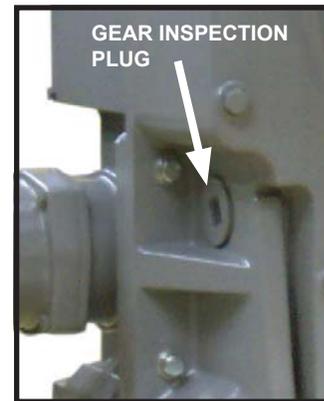
Before removing the 11-400 from the gear reduction unit, block the actuator crank arm to prevent the crank arm and the gear train from moving when the 11-400 is removed.

Remove the assembly gear module. Remove the gears from their shafts and clean them thoroughly, removing all old lubrication.

Examine the gear teeth, shaft bore, and gear shafts for signs of excessive wear, scoring, or other damage. If evidence of this damage is present, the actuator should be returned to the factory for a detailed examination of the main gear, which requires complete disassembly of the actuator. See "HOW TO OBTAIN SERVICE" on page 55.

If there is no evidence of damage to the gearing, recoat the teeth and shaft bores of all gears with a heavy layer of Fiske Lubriplate GR-132 or equivalent. GR-132 is an E.P. grease with polymer additives and a temperature range of -40°F. to +350°F. The ball bearing on the output shaft and crown gear shaft have added, double grease seals and require no maintenance for the life of the bearings. Inspect all grease seals and replace any that show wear. Reassemble the actuator.

To inspect the gears on the gear reduction unit, remove the gear inspection plug (see photo below for location). If possible, move the output shaft to the full CW or CCW limit of travel. This will expose the gear teeth in use on the output gear. Turn the Handswitch to the STOP position. Recoat the gear teeth with a heavy layer of Fiske Lubriplate GR-132 or equivalent. Replace the gear inspection plug.



MAINTENANCE *Component Replacement*

This section covers replacement of many components of the 11-430 actuator. Note that some components are not field repairable.

If it should ever be necessary to replace the output gear, shaft, or output shaft bearings, a major overhaul is required and the actuator should be returned to the factory.

GASKETS

During routine service, inspect removed cover gaskets for wear or damage. In order to protect internal components, worn or damaged gaskets and O-rings should be replaced.

To remove, scrape all of the old adhesive and gasket material from the body housing and cover. The ESR cover, Terminal Block cover and Position Sensing (Control End) cover have self-adhering, silicone rubber gaskets. Peel the backing off the replacement gasket and carefully apply to the actuator body. Other gaskets are a cork-rubber composite. Cement the new gasket to the actuator body using a gasket cement such as 3M #847 Rubber and Gasket Adhesive, or equivalent.

SEALS

Worn or damaged output shaft, control end shaft, and motor shaft seals should be replaced to prevent damage to internal bearings and drive train parts.

To remove the shaft seal, push the blade of a small screwdriver along the shaft and under the seal lip. CAUTION: The seal is approximately 1/4" (6 mm) wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Pry up on the seal and force it out of the housing. Clean the shaft and housing and press in the replacement seal with the closed side facing outward.

BEARINGS

The 11-400 actuator contains ball bearings on the output shaft, control end shaft and motor shaft. Bushings and thrust washers are used on combination gears. The gear reduction unit contains tapered roller bearings on the output shaft and ball bearings on the pinion shaft.

11-400 control end shaft ball bearings may be replaced by carefully pressing the bearing out of the retainer. When pressing the new bearing into the retainer, be certain the bearing inner and outer race are properly supported and the bearing is held perpendicular to the retainer.

Motor shaft ball bearings are not field replaceable. Disassembly of the motor will result in a loss of torque that can only be restored by returning the motor to the factory for remagnetizing.

The motor shaft bushing in the body of the 11-400 can be replaced. TIP: To remove, fill the bushing with a heavy grease. Select a drive pin that slip fits into the bushing. Insert the pin into the bushing and tap with a mallet. This will force the bushing out of the body casting.

Bushings on combination gears are not field replaceable. If this bushing is worn, the combination gear must be replaced.

MOTOR

The control motor is not field-repairable. Disassembly of the motor will result in a loss of torque that can only be restored by returning the motor to the factory for remagnetizing.



WARNING

Electrical shock hazard. Disconnect power before proceeding.



CAUTION

Before removing the control motor, block the actuator crank arm to prevent the crank arm and the gear train from moving when the motor is removed. Also, disconnect line voltage from actuator.

To remove the motor, first disconnect the motor wires in the terminal compartment of the actuator. The wiring is under the terminal board. Remove the terminal block and plate as an assembly. Remove the black wire from the terminal post, cut the green motor wire near the green-yellow-red butt joint and disconnect the red wire from the motor capacitor. Remove the mounting bolts and motor. Carefully slide the motor out of the actuator body.

To install the motor, insert the three-wire sleeve through the wire hole in the motor mount and into the terminal compartment. Carefully slide the motor into the actuator body, rotate the motor shaft if necessary to engage the pinion with the first combination gear. Install motor mounting bolts and torque to 16 lb-ft (22 N•m). Reconnect the motor wires.

See the following section for reinstalling the terminal plate.

MAINTENANCE *Component Replacement*

MOTOR RESISTOR AND CAPACITOR



WARNING

Electrical shock hazard. Disconnect power before proceeding.

The motor resistor and capacitor are located under the terminals in the terminal compartment. To replace a resistor or capacitor, remove the terminal cover. Remove the terminal plate. Remove the existing part and transfer the wires one at a time to the replacement part. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m).

LIMIT AND AUXILIARY SWITCHES



WARNING

Electrical shock hazard. Disconnect power before proceeding.

Complete switch assemblies may be replaced. It is not possible to replace individual switches. To replace switch assemblies, remove the control end cover (5/16" bolt heads) and extensions, if applicable. Remove the screws holding the switch assembly to the plate and slide it out to the side.

Transfer the wires one at a time to the replacement assembly using the push-on lugs provided. Install the replacement assembly and note that it rotates around one screw to permit an adjustment of the cam-to-switch lever spacing and switch operating point. To properly set the switch, use a .030" (.75 mm) shim between the cam and switch lever and loosely position the switch assembly so that the switch is just actuated. The switch lever should be on the low or minimum radius portion of the cam when setting the switches. DO NOT overstress the switch lever. Tighten both screws to 10 lb-in (1 N•m) torque and remove the shim. When properly adjusted, the switch lever should remain in contact with the cam throughout the actuator travel.

ADDING SWITCHES

It is usually possible to add switches to an actuator in the field. Remove the control end cover (5/16" bolt heads) and extensions, if applicable. If the actuator has no auxiliary switches, it is possible to add up to four more switches.

If the actuator shaft does not have unused switch cams, extra switches may be added but additional parts will be required. Consult the factory, giving the actuator model and serial number so that a correct list of parts required may be supplied to you.

Install wiring onto the switch push-on lugs and route the wires into the actuator terminal area. Remove the terminal cover and solder wires to the underside of the terminal assembly according to the wiring diagram included with the new switch assembly. Install the new switch assembly and adjust according to the instructions above. See Table 6, page 46, for switch part numbers.

SELF-LOCKING MECHANISM (SLM)

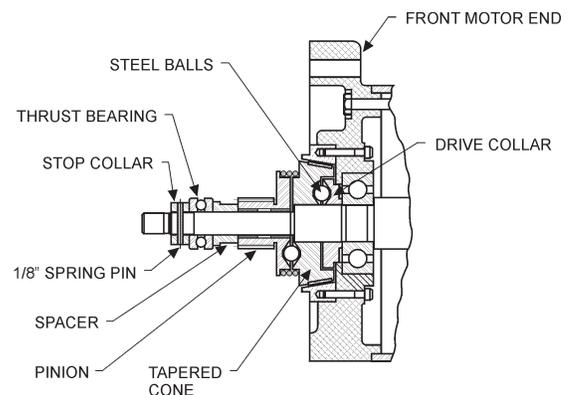
In normal service, the SLM friction surface should not require replacement; however, a combination of excessive modulation and load can cause wear to the SLM mechanism. If the SLM has been damaged, rebuild kits are available (see Table below).

SLM Rebuild Kits typically consist of friction material, spring, spring pin, thrust washer, pinion, steel balls, locking disc, steel shims, control motor gasket, terminal joints, slip-on terminal and instruction sheet.

See the illustrations below and on the following page for component identification.

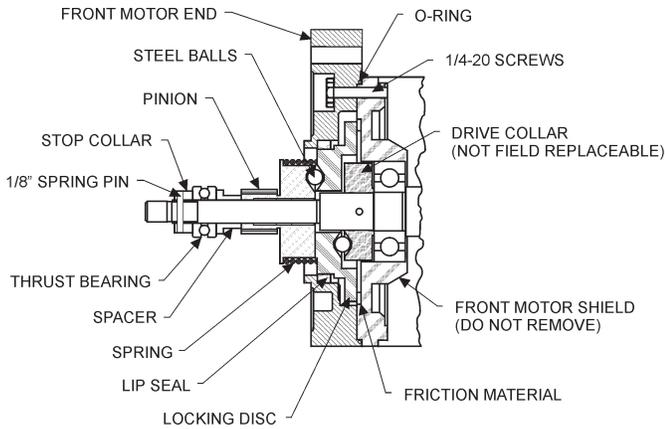
TABLE 5

Motor Part No.	Pipe Size
20-2201-22, -23	12-8060-11
20-2201-32, -33	12-8060-13



MOTORS 20-2201-22 & -23

Figure 10



MOTORS 20-2201-32 & -33

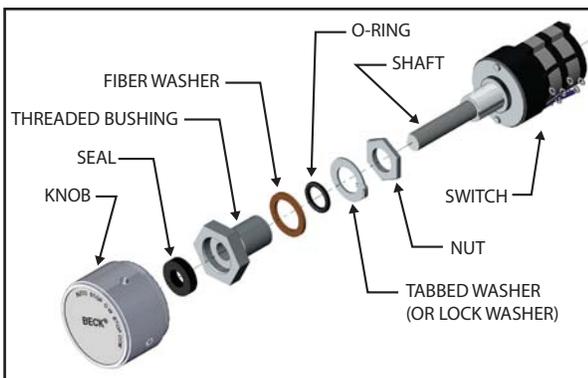
Figure 11

HANDSWITCH



WARNING
 Electrical shock hazard. Disconnect power before proceeding.

To replace the Handswitch, remove the terminal cover, and then remove the terminal plate. Clip the five wires from the old Handswitch. Remove the knob and the nut under the knob to remove the switch. Install the new Handswitch as shown in Figure 12, this page. Splice the wires color for color. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m). Do not over torque. Replace the terminal cover. Torque bolts to 10 lb-ft (14 N•m).



HANDSWITCH COMPONENTS

Figure 12

ESR-5 BOARD

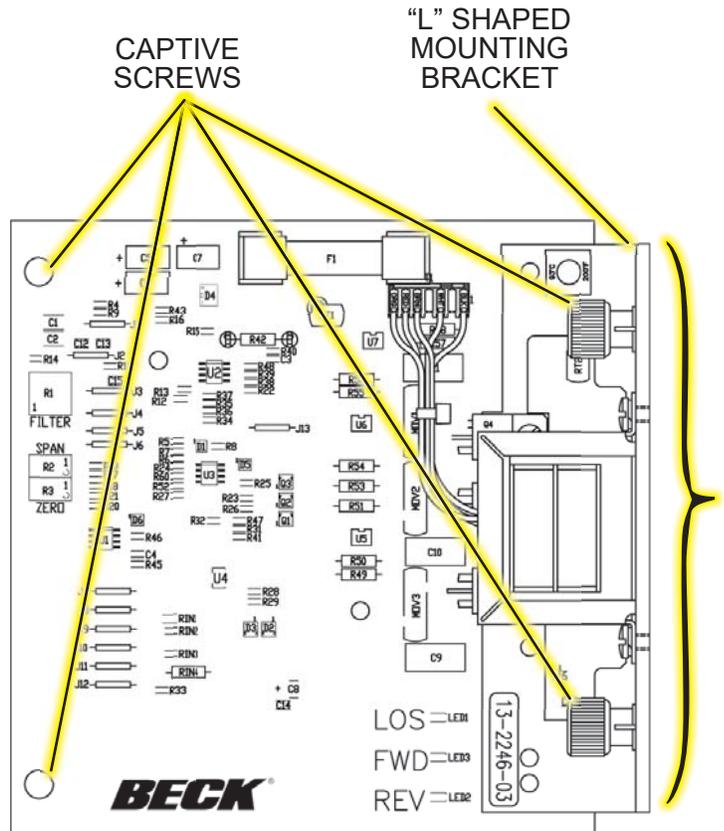
Field service of the ESR-5 board is not recommended.



WARNING
 Electrical shock hazard. Disconnect power before proceeding.

To replace the ESR-5 board, remove the ESR-5 compartment cover (four captive, 5/16" hex head screws). Loosen the four captive screws holding the board to its mounting pads. Note the "L" shaped mounting bracket on the end of the board. To remove the board, pull the mounting bracket away from its mating surface and connector receptacle, using a gentle, rocking motion.

To install an ESR-5 board, lightly press the board connector into its receptacle until the mounting bracket is flush with its mating surface. Tighten the four captive screws to 8 lb-in (0.9 N•m). Replace the ESR-5 compartment cover and tighten the cover screws to 10 lb-ft (14 N•m) of torque.



MAINTENANCE *Component Replacement*

CPS-5

Field repair of the CPS-5 assembly is not recommended.



WARNING

Electrical shock hazard. Disconnect power before replacing the CPS-5.

If it is necessary to replace the CPS-5, replace both the rotor and stator / circuit board assembly. When returning the CPS-5 to the factory for service, include the rotor and stator / circuit board assembly. Do not separate the stator or circuit boards from their mounting plates. It is recommended that the rotor be held inside the stator with rubber bands and the hex studs be reattached to the mounting plate for protection during shipment.

To remove the CPS-5:

1. Run the actuator to its midpoint of travel with the local Handswitch. (If the standard rotation of 100° has been reduced to 80°, the midpoint of travel is 40°.)
2. Disconnect 120 V ac power to the actuator. Remove the terminal compartment and control end covers (5/16" bolt heads).
3. Record the wire colors on the terminal block of the CPS-5 (see Figure 5, page 32), then disconnect the wires. The terminals are spring-loaded. To remove a wire, insert a 3/32" screwdriver in the slot above the wire. Rock the screwdriver away from the wire to open the spring-loaded contact and release the wire.
4. Pull the wires from the monitor board and transformer back through the wire hole in the CPS-5.
5. Loosen and remove the 3 hex studs that clamp the CPS-5 in place. Support the inboard hex stud with a wrench as the outboard stud is loosened.
6. Slide the CPS-5 stator assembly off the three mounting bolts.
7. Note the position of the rotor clamp, then loosen the rotor clamp screw and remove the rotor from the shaft.

To install the new CPS-5:

1. Remove the rotor from the replacement CPS-5 assembly. Slide the rotor, clamp end first, onto the control shaft as close to the mounting plate as possible. Leave the clamp loose. Position the clamp in the same general location as the one removed previously.
2. Slide the new CPS-5 assembly over the studs and rotor. Replace the hex nuts but do not tighten. Carefully slide the rotor back into the CPS-5 assembly. Twist the rotor while sliding to prevent damage to the assembly. Tighten hex nuts to 5 lb-ft (7 N•m).
3. Thread the wires through the wire holes in the CPS-5 and reconnect them to the transformer and terminal boards.
4. Restore 120 V ac power to the actuator and connect a meter to the output.

FOR CURRENT FEEDBACK APPLICATIONS:

Record the color and location of the feedback signal wires for reconnection later. Remove the two feedback wires. Connect a mA meter in series with a 200 ohm load resistor.

FOR VOLTAGE FEEDBACK APPLICATIONS:

Connect a voltmeter across the feedback terminals. DO NOT remove the signal feedback wires.

5. Insert a 0.031" (.8 mm) feeler gauge between the rotor clamp and stator. Position the clamp 0.031" (.8 mm) from the stator.
6. Rotate the rotor on the control shaft until the output on the mA or voltmeter reads 50% of signal span, then tighten the clamp to 5 lb-in (.6 N•m) torque.
7. Check the feedback signal calibration as described on page 31.

MAINTENANCE *Troubleshooting*

If your unit contains a Stall Protection Module (SPM) refer to publication 80-0017-03, page 7, "Troubleshooting".

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
1. Control drive will not run in either direction with input signal applied to ESR-5. No LEDs lit on ESR-5.	<ul style="list-style-type: none"> a. Handswitch left in wrong position. b. No 120 V ac line supply. c. Fuse F1 open. d. External auto/man switch in wrong position (Position-All). e. ESR-5 failure. f. Jumpers between terminals F–N and D–M are not connected. 	<ul style="list-style-type: none"> a. Return Handswitch to AUTO position. b. Check fuses and switches in power panel. c. Check for possible shorts, then replace fuse. Use only Beck part no. 13-2230-03 for proper protection of triacs. d. Return switch to AUTO position. e. Replace ESR-5. f. Connect jumpers.
2. Actuator will not run in either direction with input signal applied to ESR-5 board. CPS-5 LED light out and jumper removed from monitor board relay.	<ul style="list-style-type: none"> a. No power. b. Actuator positioned beyond calibrated limits. c. CPS-5 rotor position not properly set. d. CPS-5 not calibrated correctly. e. CPS-5 failure. 	<ul style="list-style-type: none"> a. Check power source. Check CPS-5 power supply voltage. Check CPS-5 power transformer. b. Position actuator with Handwheel and check limit switch settings. c. Set CPS-5 rotor position. d. Calibrate CPS-5. e. Replace CPS-5.
3. Actuator runs in only one direction in AUTO and both directions with Handswitch on CW and CCW.	<ul style="list-style-type: none"> a. ESR-5 zero adjustment incorrect. b. Handswitch failure. c. Loss of input signal with REVLOS or FWDLOS selected. d. ESR-5 circuit board failure. e. Loss of feedback signal. 	<ul style="list-style-type: none"> a. Readjust ESR-5 zero. See Input Signal Calibration. b. Check continuity from terminal N to V and M to U with Handswitch in AUTO position. See wiring diagram. c. Check input signal. d. Replace ESR-5. e. Check signal from CPS-5 or potentiometer at TP3 on ESR-5.
4. Loss of ESR-5 signal lamp lights (red LED) with input signal applied.	<ul style="list-style-type: none"> a. ESR-5 zero adjustment incorrect. b. Input signal reversed. c. ESR-5 failure. d. Incorrect film potentiometer setting. f. Control signal wired through CPS-5 monitor relay. Monitor LED lamp is out. 	<ul style="list-style-type: none"> a. Readjust ESR-5 zero. See Input Signal Calibration. b. Check polarity of input signal. Terminal AA(+), Terminal BB(–). c. Replace ESR-5. d. Reset film potentiometer. f. Actuator position beyond calibrated range. Use Handswitch or Handwheel to put drive within normal operating range.
5. Actuator runs in the wrong direction with input signal applied.	<ul style="list-style-type: none"> a. Input signal reversed. b. Actuator configured for wrong direction of travel. 	<ul style="list-style-type: none"> a. Check polarity of input signal. Terminal AA(+), terminal BB(–). b. Change direction of rotation.
6. Actuator does not follow input signal until maximum or minimum signal is reached, then drives uncontrollably to limit.	<ul style="list-style-type: none"> a. Wire jumpers on terminals M and N are reversed or potentiometer end connections are reversed. b. CPS-5 feedback out of phase with control motor. 	<ul style="list-style-type: none"> a. Change direction of shaft rotation. Check correct film potentiometer connections. b. Restore proper phasing of CPS-5 feedback with control motor.

MAINTENANCE Troubleshooting

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
7. Actuator motor oscillates in AUTO mode.	<ul style="list-style-type: none"> a. Feedback potentiometer dirty. b. Excessive noise on input signal. c. Physical obstruction (e.g., valve jammed or load greatly exceeds rating of actuator). d. ESR-5 failure. e. Excessive wear in gear train or bearings. 	<ul style="list-style-type: none"> a. Clean or replace potentiometer. b. Check setting of input filter. May require increased dead band setting if oscillation remains with maximum filter setting. c. Check operation with Handswitch and remove obstruction if present. Handswitch bypasses ESR-5. d. Replace ESR-5. e. Replace worn drive train parts.
8. Actuator motor erratic or runs in wrong direction in automatic or manual operation.	<ul style="list-style-type: none"> a. Control motor winding open. b. Control motor capacitor shorted or open. c. Control motor resistor open. 	<ul style="list-style-type: none"> a. Replace control motor. b. Replace capacitor. c. Replace resistor.
9. Actuator will not run in either direction or one direction in automatic or manual operation.	<ul style="list-style-type: none"> a. Limit switch failure. b. Handswitch failure. 	<ul style="list-style-type: none"> a. Replace limit switch. b. Replace Handswitch.
10. Actuator runs erratic from 100° to 0° and runs normally from 0° to 100° in AUTO.	<ul style="list-style-type: none"> a. Feedback potentiometer dirty. Loss of feedback voltage drives the unit towards the 100% limit. 	<ul style="list-style-type: none"> a. Clean feedback potentiometer with mild soap and water.
11. Actuator runs uncontrollably to some position, then oscillates.	<ul style="list-style-type: none"> a. Feedback potentiometer open. 	<ul style="list-style-type: none"> a. Replace feedback potentiometer.
12. Actuator does not stop at normal or desired limit of shaft travel.	<ul style="list-style-type: none"> a. ESR-5 span or zero adjusted incorrectly. b. Limit switches adjusted incorrectly. c. Loss of input signal. Check LED on ESR-5 . d. Limit switch failure. e. CPS-5 calibration incorrect. 	<ul style="list-style-type: none"> a. Recalibrate the ESR-5 board. b. Readjust limit switches. c. Restore input signal to actuator. d. Replace limit switch. e. Calibrate CPS-5.
13. Loss of input signal feature does not function.	<ul style="list-style-type: none"> a. Incorrectly set potentiometer. b. CPS-5 calibration incorrect. 	<ul style="list-style-type: none"> a. Reset potentiometer. b. Calibrate CPS-5.
14. Actuator drives to 100% limit with small change in input signal.	<ul style="list-style-type: none"> a. Feedback potentiometer power supply shorted. b. ESR-5 failure of 2.7V power supply (feedback potentiometer only). c. Wiper and low end of feedback potentiometer reversed. d. Open potentiometer element. e. CPS-5 feedback out of phase with control motor. 	<ul style="list-style-type: none"> a. Check potentiometer and wiring for shorts. b. Replace ESR-5. c. Check wiring on feedback potentiometer for proper connections. d. Replace potentiometer. e. Restore proper phasing of CPS-5 feedback with motor control.
15. Actuator drives to 100% and stays.	<ul style="list-style-type: none"> a. Handswitch left in CW / CCW position. b. Potentiometer open or complete loss of contact with wiper. c. Loss of input signal when FWDLOS is selected. ESR-5 LED on. d. ESR-5 zero adjustment incorrect. e. ESR-5 circuit board failure. f. CPS-5 feedback out of phase with control motor. g. Jumper between terminal F–N (F–M) not connected. h. CCW / CW limit switch failure. 	<ul style="list-style-type: none"> a. Return Handswitch to AUTO position. b. Check potentiometer and replace if necessary. c. Restore input signal to actuator. d. Readjust ESR-5 zero. See Input Signal Calibration. e. Replace ESR-5. f. Restore proper phasing of CPS-5 feedback with control motor. g. Connect jumper. h. Replace limit switch.

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
16. Actuator travel very non-linear: a. e.g., 4–19 mA change on input causes actuator to drive from 0% to 30%; 19–20 mA change drives 30% to 100%. b. Response normal from zero to mid-range, then runs to 100%.	a. Wiper and high end of feedback potentiometer reversed. b. CPS-5 power supply failure.	a. Check feedback potentiometer for proper connections. b. Check CPS-5 power supply voltage. See 21.b. on this chart.
17. L.O.S. operates at too high a signal level.	a. Special requirement.	a. Change L.O.S. trip point.
18. CPS-5 LED goes out during normal travel.	a. CPS-5 not correctly calibrated.	a. Calibrate CPS-5.
19. Potentiometer or CPS-5 output decreases when it should increase.	a. CPS-5 rotor position not set for proper rotation. b. End connections on potentiometer reversed.	a. Reset CPS-5 rotor position. b. Calibrate potentiometer.
20. CPS-5 output non-linear.	a. CPS-5 rotor position not set properly. b. CPS-5 zero potentiometer improperly adjusted.	a. Reset CPS-5 rotor position. b. Refer to factory.
21. CPS-5 output does not reach maximum signal, but low end calibration is correct.	a. Output is overloaded: • load resistance is too low for voltage range. • load resistance is too high for current range. b. Low voltage: • CPS-5 power failure. c. CPS-5 rotor not properly set. d. CPS-5 zero potentiometer not properly adjusted.	a. Check load resistance against suggested feedback signal terminal hook-up b. Check line voltage at CPS-5 transformer terminals 1 and 3. Check CPS-5 voltage at resistor. Check CPS-5 power supply voltage across capacitors C8 (13 V, except -05.15 V), C9 (15 V), C10 and C11 (28 V). c. Reset CPS-5 rotor position. d. Refer to factory.
22. CPS-5 out of calibration.	a. CPS-5 zero potentiometer inadvertently reset.	a. Refer to factory.
23. CPS-5 signal will not calibrate down to 4 mA.	a. Not enough load on meter circuit. b. Unit being calibrated for less than 80° rotation.	a. Connect 200 ohm resistor in series with meter. b. Remove R8.
24. Actuator does not stay in place with power off.	a. SLM friction surface worn.	a. Replace SLM friction surface.
25. Control motor runs but output shaft does not move in one or both directions.	a. SLM failure.	a. Replace control motor.
26. Actuator equipped with modulating option 5 or 6 and an optional relay board does not run reliably in one or both directions while in AUTO.	a. Controller output requires a greater holding current than the relay board draws.	a. Check the controller output required AC holding current. If greater than 10 mA, additional load must be provided.

APPENDIX Spare Parts

RECOMMENDED SPARE PARTS

It is recommended that certain replacement parts be stocked for quick availability in the event that service of your Beck actuator is required. The types of parts are listed in Table 6, below.

HOW TO ORDER SPARE PARTS

Select the needed spare parts from Table 6, below. Specify the drive's model / serial number (example: 11-438-031891-01-02) given on the nameplate to allow the factory to verify the part selection. Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover).

**TABLE 6:
RECOMMENDED SPARE PARTS**

Description	Part Number	Description	Part Number
ESR-5 board (option 7 & 8 only)	See Table 1, p. 10	Limit switch assy. (CW / CCW)	20-3202-10
Relay board (option 5 & 6 only)	See Table 1, p. 10	Auxiliary switch assy.	
Fuse, 6A, 250V	13-2230-03	2 switches (S1-S2)	20-3202-11
CPS-5 assembly (option 6 & 8 only)	See Table 1, p. 10	4 switches (S1-S4)	20-3202-12
Control motor	See Table 7, below	Film potentiometer (option 5 & 7 only)	20-3060-03
Motor resistor	See Table 7, below	Gasket kit	20-3110-03
Motor capacitor	See Table 7, below		

**TABLE 7:
MOTORS, CAPACITORS, AND RESISTORS**

Motor*			Capacitor		Resistor	
Part Number	Current (Amps at 120 Vac)	Freq. (Hertz)	Part Number	Value (µf)	Part Number	Value (Ω)†
20-2201-22, -32	2.30	60	14-2840-15	25	20-1971-04	37.5
	‡	50	14-2840-05 14-2840-15	8 25	20-1971-04	37.5
20-2201-23, -33	3.00	60	14-2840-15	25	20-1971-06	18
			14-2840-09	6		
	‡	50	14-2840-15 14-2840-05 14-2840-09	25 8 6	20-1971-10	24

*All motors listed are rated 120 V ac regardless of operating voltages using optional transformers.

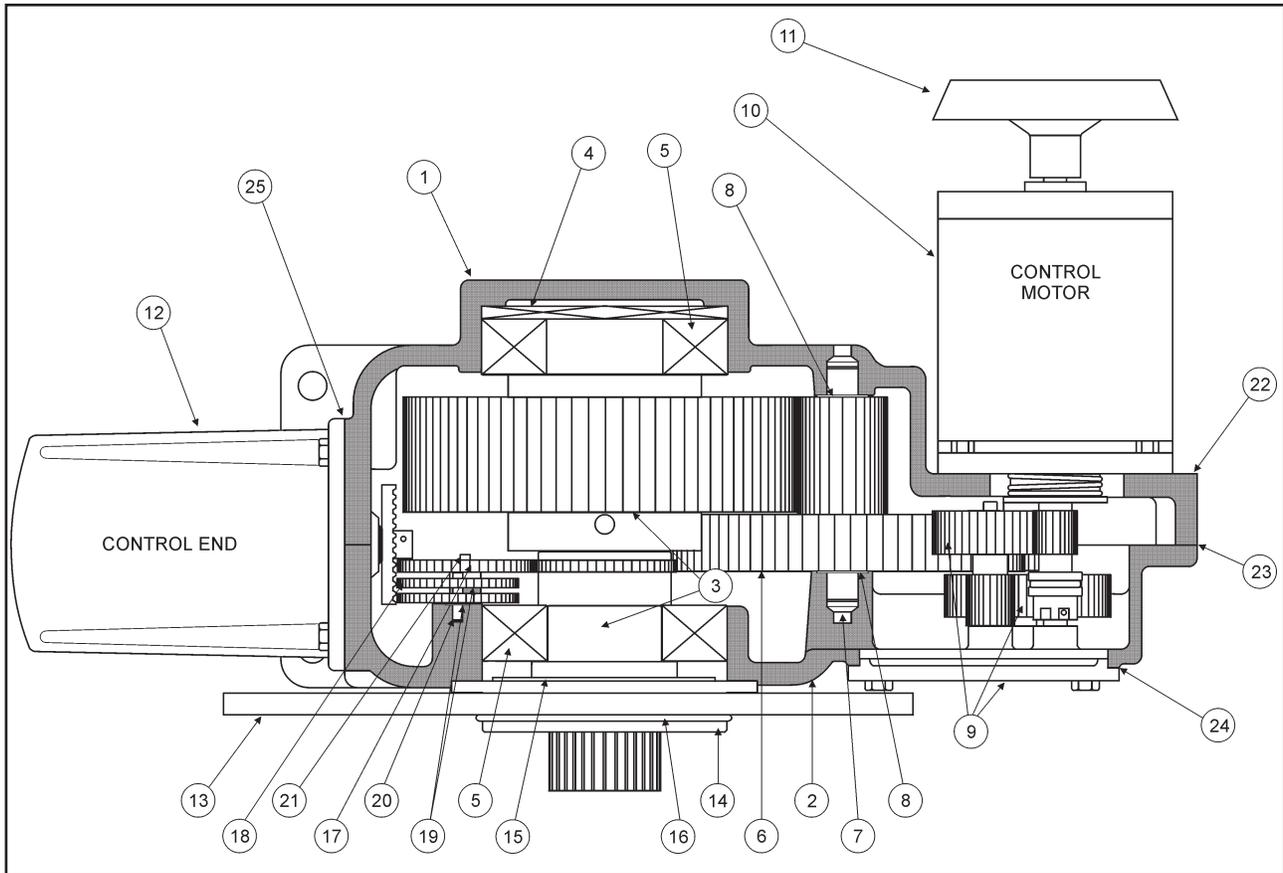
†These are resistor assemblies.

‡50 Hz currents do not exceed 120% of the 60 Hz levels.

**TABLE 8:
MODEL 11-400 GEARS**

Spur Gearing Ratio / 1	Stroking Speed (sec./100°)			Gear Part Number		
	Motor					
	20-2201-23, -33	20-2201-22, -32		Gear Module Gear Set	Output Shaft Assembly	Third Comb. Gear
	60 Hz 120 RPM	60 Hz 72 RPM	50 Hz 60 RPM			
756	108	180	216	14-9732-02	14-9872-10	14-9692-03
525	72	120	144	14-9732-07	14-9872-10	14-9692-03

APPENDIX Control Assembly



**TABLE 9:
ACTUATOR COMPONENTS***

Item No.	Description	Item No.	Description
1	Body rear	13	Adaptor plate
2	Body front	14	Sleeve, pilot tube
3	Output shaft assembly with main gear	15	Gasket, sleeve, pilot tube
4	Spring washer	16	O-ring
5	Ball bearings, output shaft	17	Spur gear, 1st combination
6	Gear, 3rd combination	18	Spur gear, 2nd combination
7	Pin, 3rd combination gear	19	Washers, flat fiber
8	Thrust washers	20	Pin, 2nd combination spur gear
9	Gear module assembly, see Table 8, p.46	21	Pin, 1st combination spur gear
10	Control motor, see Table 8, p.46	22	Gasket, control motor
11	Handwheel, 6 1/2" O.D.	23	Gasket, body
12	Control end cover	24	Gasket, change gear plate
		25	Gasket, control end cover

*To ensure exact replacement parts, include all nameplate data from the actuator with your order.

APPENDIX CPS-5 Data

**TABLE 10:
CPS-5 SYSTEM APPLICATION DATA SUMMARY**

FEEDBACK SIGNAL OPTIONS	CPS-5 MODEL NUMBERS	EXTERNAL LOAD RESISTANCE	COMPATIBLE CONTROL SYSTEMS
<u>Current Signals</u>			
4 to 20 mA	20-4400-02 & -12 20-4400-03 & -13†	800Ω (Max.) 500Ω (Max.)	Industry Std (ISA)
10 to 50 mA	20-4400-03 & -13†	200Ω (Max.)	Foxboro
1 to 5 mA	20-4400-03 & -13†	2KΩ (Max.)	General Use
<u>Voltage Signals</u>			
1 to 5 V DC	20-4400-03 & -13†	250Ω (Min.)	Industry Std (ISA) Beck Position-All (27-301,-401,-501)
0 to 5 V DC	20-4400-03 & -13†	250Ω (Min.)	Leeds and Northrup
0 to 10 V DC	20-4400-03 & -13†	1KΩ (Min.)	Bailey, Foxboro, & Westinghouse
0 to 16 V DC	20-4400-03 & -13†	1KΩ (Min.)	Leeds and Northrup
0 to 15 V DC	20-4400-04 & -14	6KΩ (Min.)	Leeds and Northrup
-10 to 10 V DC	20-4400-05 & -15	2KΩ (Min.)	Bailey

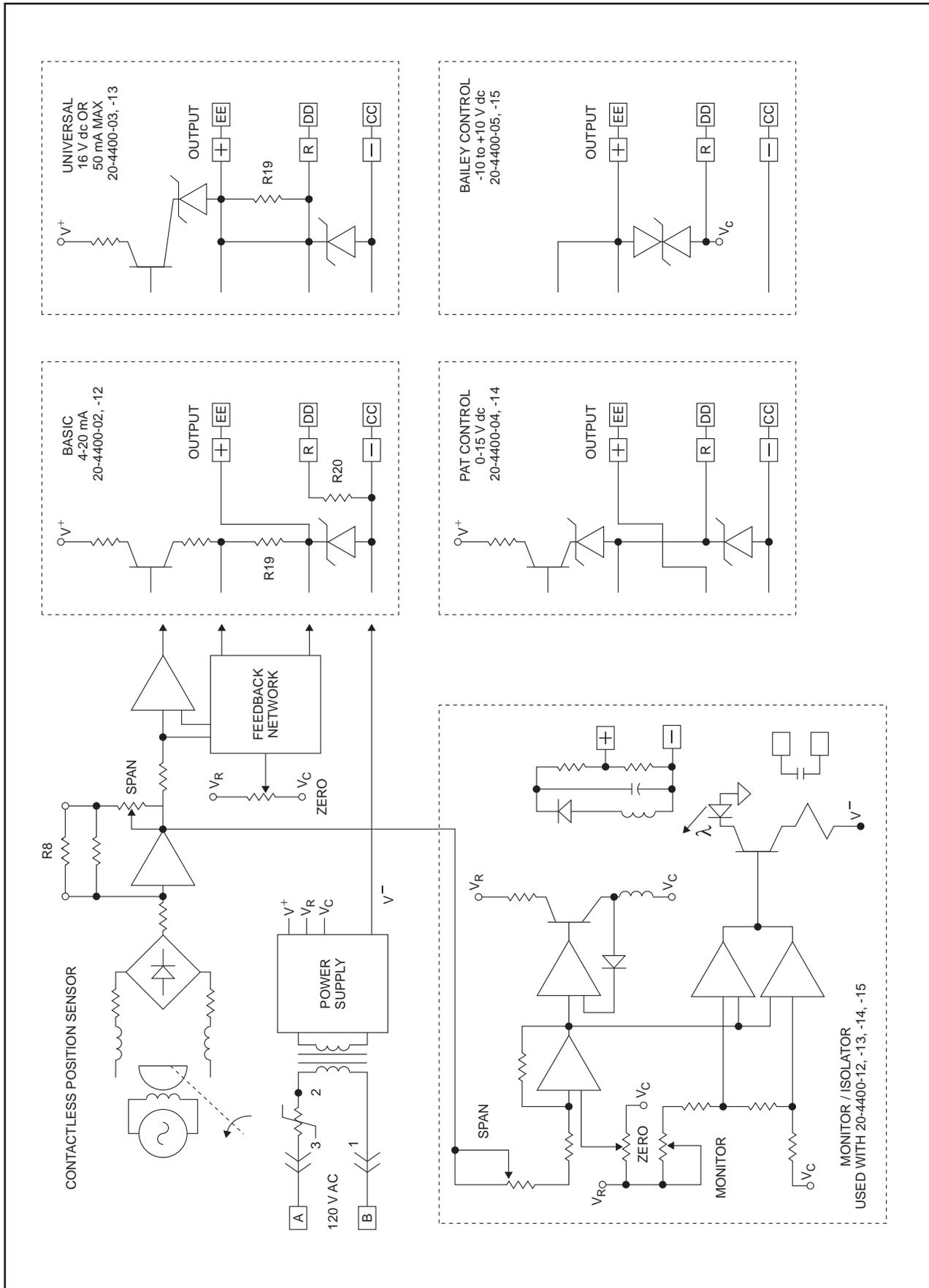
†The 20-4400-03 and -13 may be connected for signal ranges so noted. See Wiring Diagrams on pages 13–14 for details.

**TABLE 11:
CPS-5 SIGNAL OUTPUT TERMINAL CONNECTIONS AND LOADING**

SIGNAL RANGE	OUTPUT TERMINALS (+) (-)	RANGING RESISTOR		RESISTOR CONNECTIONS	MAXIMUM EXTERNAL LOAD
		VALUE	BECK PART NO.		
Models 20-4400-02, -12					
4 to 20 mA	EE—CC	Open			800Ω
4 to 20 mA	EE—DD	Open			500Ω
Models 20-4400-03, -13					
<u>Current Output</u>					
0 to 4 mA*	DD—CC	Open			2 KΩ
1 to 5 mA	DD—CC	Open			2 KΩ
4 to 20 mA	DD—CC	332Ω	13-2511-06	DD—EE	500Ω
10 to 50 mA	DD—CC	110Ω	13-2510-25	DD—EE	200Ω
<u>Voltage Output</u>					
0 to 4 V dc*	EE—CC	Jumper			16 mA
0 to 5 V dc*	EE—CC	249Ω	13-2511-08	CC—DD	16 mA
0 to 10 V dc*	EE—CC	1.5 KΩ	13-2512-02	CC—DD	16 mA
0 to 15 V dc*	EE—CC	2.74 KΩ	13-2513-42	CC—DD	16 mA
1 to 5 V dc	EE—CC	Jumper		CC—DD	16 mA
2 to 10 V dc	EE—CC	1.00 KΩ	13-2512-01	CC—DD	16 mA
0 to 16 V dc*	EE—CC	3.01 KΩ	13-2513-26	CC—DD	16 mA
Models 20-4400-04, -14					
0 to 15 V dc	DD—CC	Open			2.5 mA
15 to 0 V dc	EE—DD	Open			2.5 mA
Models 20-4400-05, -15					
-10 to 10 V dc	EE—DD	Open			5 mA

*If factory set for 4–20 mA, zero potentiometer adjustment is required after installation. See page 33.

APPENDIX CPS-5 Functional Block Diagram



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SERVICES

PRODUCT DEMONSTRATIONS

Each of Beck's Sales Engineers has access to a complete set of actuator models so that he can demonstrate virtually any of their features at your location. In order to arrange to see a Beck actuator in your plant or office, contact Beck's Sales Department.

SITE SURVEYS

Beck Sales Engineers are available to discuss your process control requirements. Often a visit to your location is the best way to gain a thorough understanding of your needs, in order to meet them most accurately and completely.

Mounting hardware, torque requirements, linkage, control signal information, and optional equipment can be analyzed most effectively at the worksite. Beck's analysis at the jobsite can help ensure that specifications are accurate, especially in the case of complex applications.

APPLICATION REVIEWS

By sharing your needs with a Beck Sales Engineer you can take advantage of the best application advice for the type of control you need.

This review will yield a better understanding of the versatility of Beck drives for your installations, as well as complete details on options and accessories to make the process as effective as possible.

SPECIFICATION WRITING

Beck provides specification writing assistance in order to help you specify and order the right drives for your applications. Beck Sales Engineers will work with you to make it easier for you to obtain the proper equipment and give you confidence that no details are overlooked.

HOW TO OBTAIN SERVICE

Factory repair of drives or subassemblies is available for both normal and emergency service. To assure prompt processing, contact the factory to receive a Returned Material Authorization (RMA) number. If a repair estimation is desired, please send the name and phone number of your contact for service authorization. It is helpful to include a description of the work desired with the shipment or, in the event of a problem, the malfunction being experienced.

THREE YEAR LIMITED WARRANTY STATEMENT

Harold Beck & Sons, Inc. (Beck) warrants that our equipment shall conform to Beck's standard specifications. Beck warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for three years from the date on which the equipment is shipped. Improper installation, misuse, improper maintenance, and normal wear and tear are not covered.

The Buyer must notify Beck of any warranty issues within 37 months of original shipment date and return the goods in question, at Buyer's expense, to Beck for evaluation. If the product fails to conform to the warranty, Beck's sole obligation and the Buyer's exclusive remedy will be: 1) the repair or replacement, without charge, at Beck's factory, of any defective equipment covered by this warranty, or 2) at Beck's option, a full refund of the purchase price. In no event will Beck's liability exceed the contract price for the goods claimed to be defective.

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Buyer acknowledges its responsibilities under OSHA, related laws and regulations, and other safety laws, regulations, standards, practices or recommendations that are principally directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which the equipment will be used, its use or combination with, or proximity to, other equipment, and other circumstances of the operation of such equipment are matters beyond Beck's control. **Buyer hereby agrees to indemnify Beck against all claims, damages, costs or liabilities (including but not limited to, attorney's fees and other legal expenses), whether on account of negligence or otherwise, except those claims based solely upon the negligence of Beck and those claims asserted by Beck's employees which arise out of or result from the operation or use of the equipment by Beck's employees.**

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Beck Actuators are covered by the following patents: 3,667,578; 4,690,168; 6,563,412 B2; 6,639,375 B2; and 6,769,527 B1 with other patents pending.



81-0002-01-

Declaration of Incorporation of Partly Completed Machinery

Manufacturer:
Harold Beck and Sons, Inc
11 Terry Drive
Newtown, PA 18940
USA
1 (215)-968-4600

Authorized Representative in Europe:
David Riley, Actuator Engineering
Abbeyville, Brake Road, Walesby
Newark, Nottinghamshire NG22 9N1,
United Kingdom

declare that:

Brand: Beck

Type and Description of Equipment: Rotary Actuator / Control Drive

Product: Models: 11-11X, 11-15X, 11-16X, 11-20X, 11-21X, 11-26X,
11-30X, 11-31X, 11-36X, 11-40X, 11-41X, 11-43X, 11-46X
(where 'X' denotes Control Type – 3, 4, 5, 6, 7, 8 or 9)

are in conformity with the provisions of the following EC Directives:

Machinery Directive (MD): 2006/42/EC

The following harmonised standards have been applied: EN ISO 12100:2010

The partly completed machinery specified in this Declaration must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the Directive 2006/42/EC.

The following essential requirements of the Machinery Directive (Annex I) have been applied:

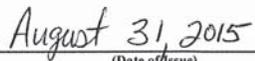
1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.4.1, 1.3.1, 1.3.2, 1.3.4, 1.3.6, 1.3.7, 1.3.8, 1.5.1, 1.5.2, 1.5.5, 1.5.6, 1.5.7, 1.5.10, 1.5.11, 1.6.2, 1.7.1, 1.7.3, 1.7.4

The partly completed machinery specified in this Declaration are also in conformity with the provisions of Directives 2006/95/EC (Low Voltage) and 2004/108/EC (Electromagnetic Compatibility).

Technical documentation has been compiled in accordance with Annex VII, Pt. B of the Machinery Directive. This documentation will be made available electronically if requested by the national authorities.


(Signature)

Hans H. Schmolk
Engineering Manager


(Date of Issue)



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