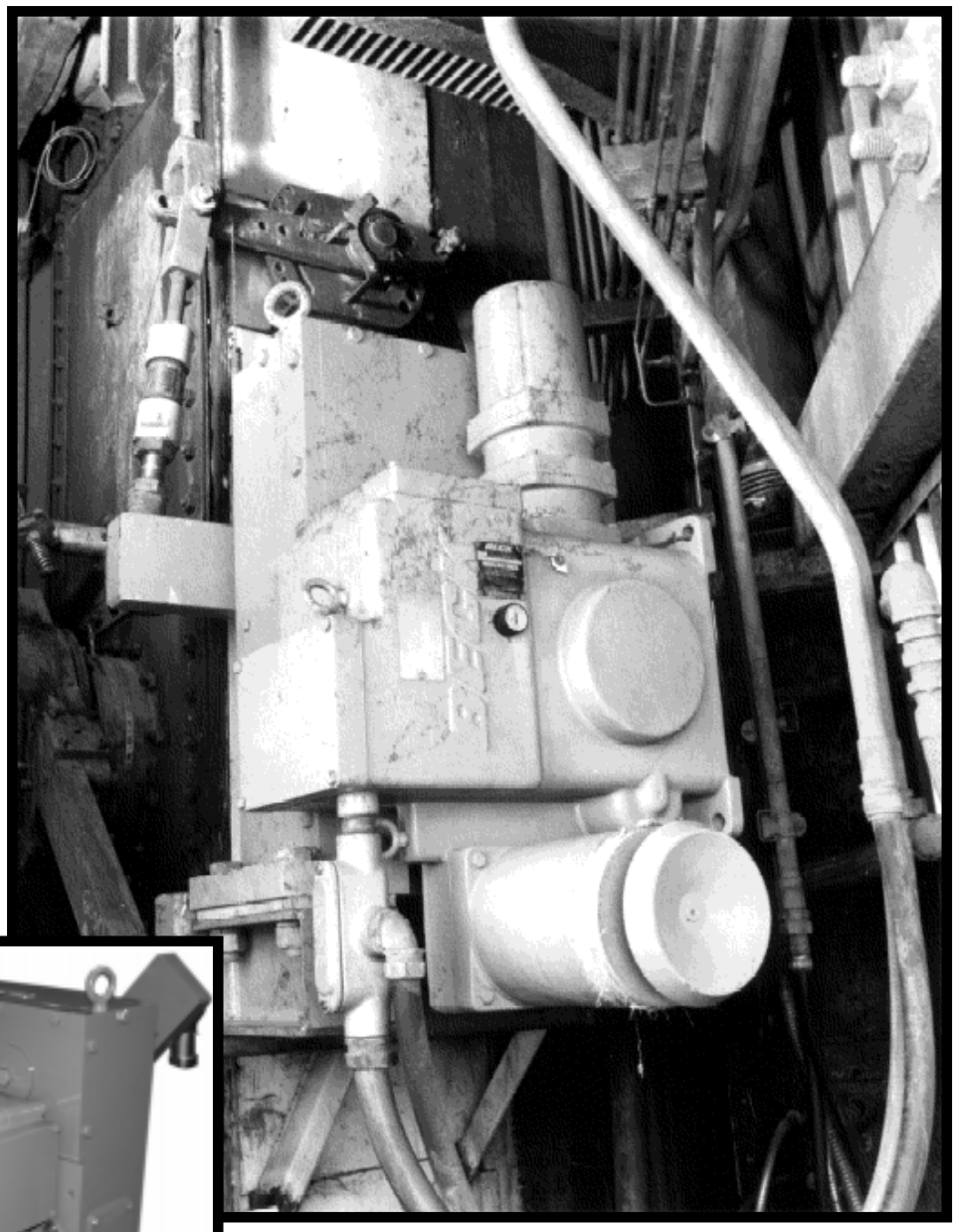
80-1100-05
Rev. 07a

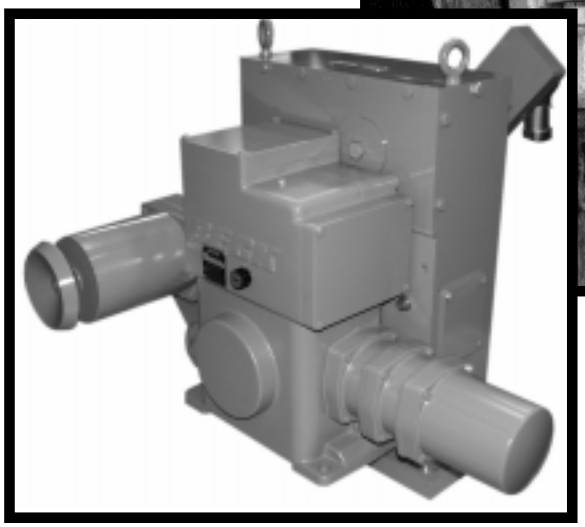
For drives built before October 1999 with FWD / REV Handswitch

BECK ELECTRONIC CONTROL DRIVES

MODEL 11-430

INSTRUCTION MANUAL





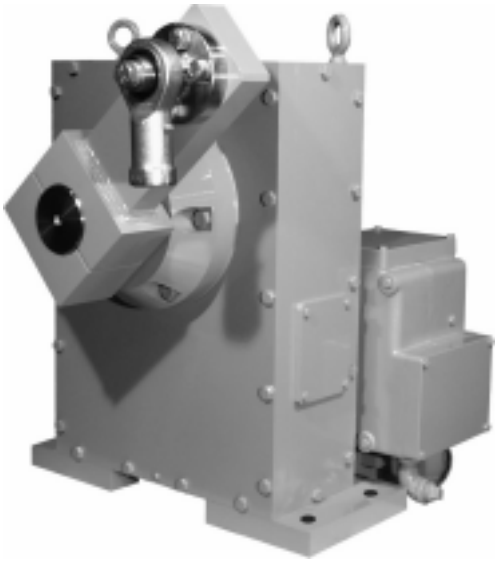
BECK®

INTRODUCTION TO THE MANUAL

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

The 11-430 is a high torque electronic control drive designed to provide precise position control of multiple burner tilt arrays, dampers, and other devices requiring up to 5,200 lb-ft of drive torque. The 11-430 consists of a Beck 11-400 Electronic Control Drive 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 drive.



Beck drives fulfill an industry need for a reliable electronic control drive. Exceptionally stable and trouble-free, these drives are in use on valve and damper applications throughout the world.

Group 11 quarter-turn drives ...
are designed specifically for use with ball, plug, and butterfly valves. Direct-coupled, factory-mounted assemblies are available from Beck for easy installation.

Group 14 linear drives ...
are ideally suited for globe valves from 1" to 8" diameter. Beck's unique "Tight-Seater™" coupling provides positive seating of valves.

Group 31 rotary drives ...
are particularly suited for coupling to ball, plug, and butterfly valves up to 4" diameter, and small dampers.

CONTENTS

PRODUCT DESCRIPTION

The Beck 11-430 control drive 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 Control Drive 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.

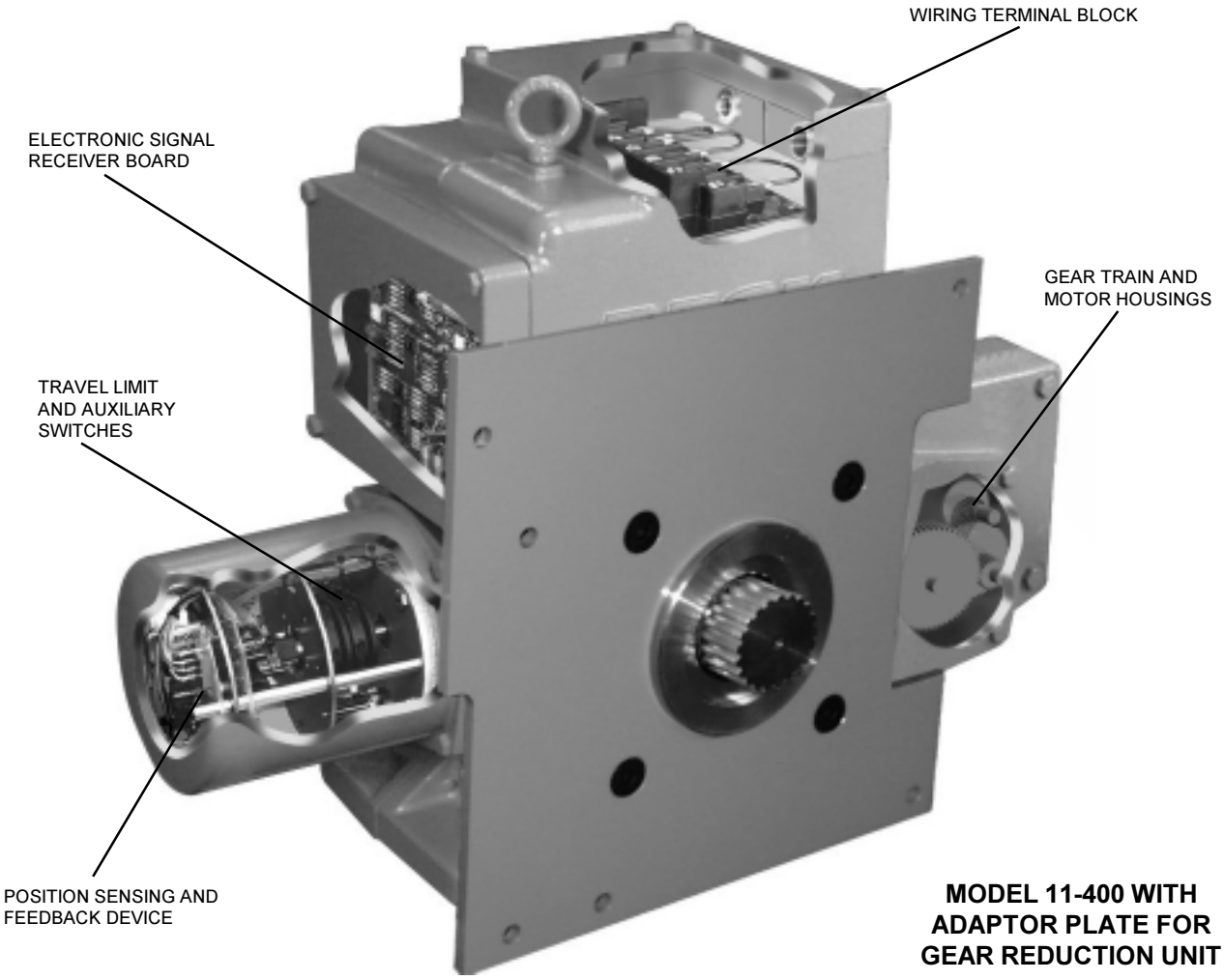
The driven shaft may also be operated at its individual location by utilizing the drive's built-in electric Handswitch.

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

Beck's ESR-4 Electronic Signal Receiver provides precise drive control from either conventional analog or computer based control systems.

Beck's CPS-2 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-2 provides infinite resolution with linearity error of less than ±1% of span over the drive's full travel.

The Beck 11-430 electronic control drive is designed with individual weatherproof enclosures to protect the main components. The cutaway illustration below is intended to provide the user with a basic introduction of the features of the 11-400.



MODEL 11-400 WITH ADAPTOR PLATE FOR GEAR REDUCTION UNIT

BECK LINKAGE KITS

Beck pipe linkage kits are available for completing the mechanical connection from the drive 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 drive and driven device are installed.

All Beck 11-430 drives 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 ±1 1/2” without removal of the crank arm or load lever, making final mechanical calibration simple.

See page 20 for linkage requirements.

PRODUCT DESCRIPTION

11-430 GENERAL SPECIFICATIONS

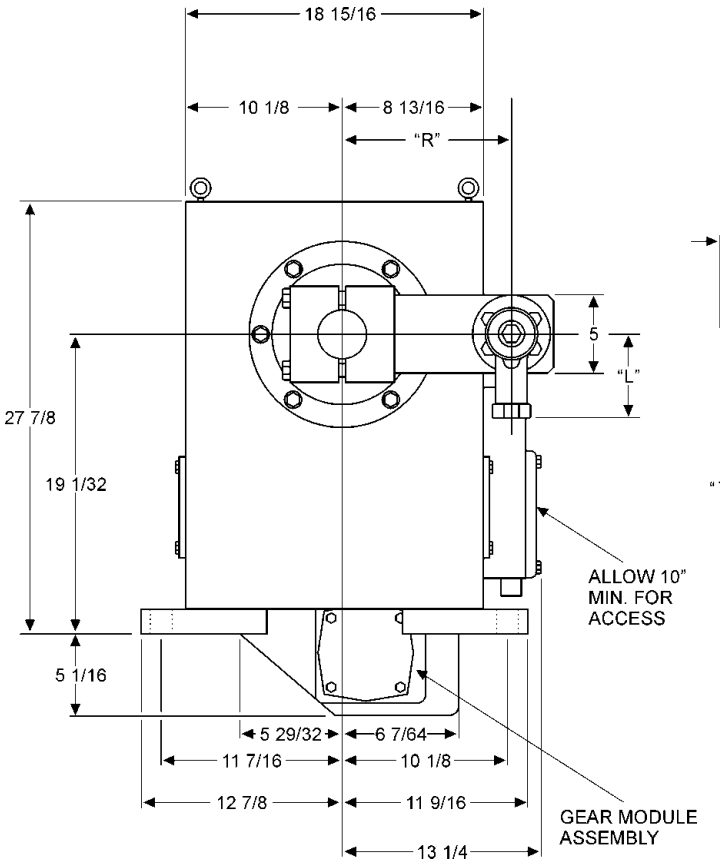
Input Power	120 V ac, 3.10 A, single-phase 50 or 60 Hz 240 V ac, 1.55 A, single-phase 50 or 60 Hz
Operating Conditions	-40 to 185°F. (-40 to 85°C.) 0 to 99% relative humidity
Input Signal Options, with Electronic Signal Receiver (ESR-4)	0–5 mA 1–5 mA 4–20 mA 10–50 mA 1–5 V dc -10–10 V dc
Input Signal 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
Sensitivity	25% of deadband
Direct AC	120 V ac for 2-position, multi-position or modulating V ac control
Square Function (Optional)	Drive output shaft moves proportionally to the square of the input signal
Feedback Signal Options, with Contactless Position Sensor (CPS-2)	1–5 mA 4–20 mA 10–50 mA 1–5 V dc 0–16 V dc -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 ohm
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 extended limit of travel. Standard switch setting is for 100° of travel.
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 four days without failure of motor or gearing.
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	Precision-machined aluminum alloy castings, protected with corrosion-resistant polyurethane paint, provide a rugged, dust-tight, weatherproof enclosure.
Gear Reduction Unit	Precision-machined aluminum plates, protected with corrosion-resistant polyurethane paint, provide a rugged, dust-tight, weatherproof enclosure.
Crank Arm	Manufactured to the radius required by the application.

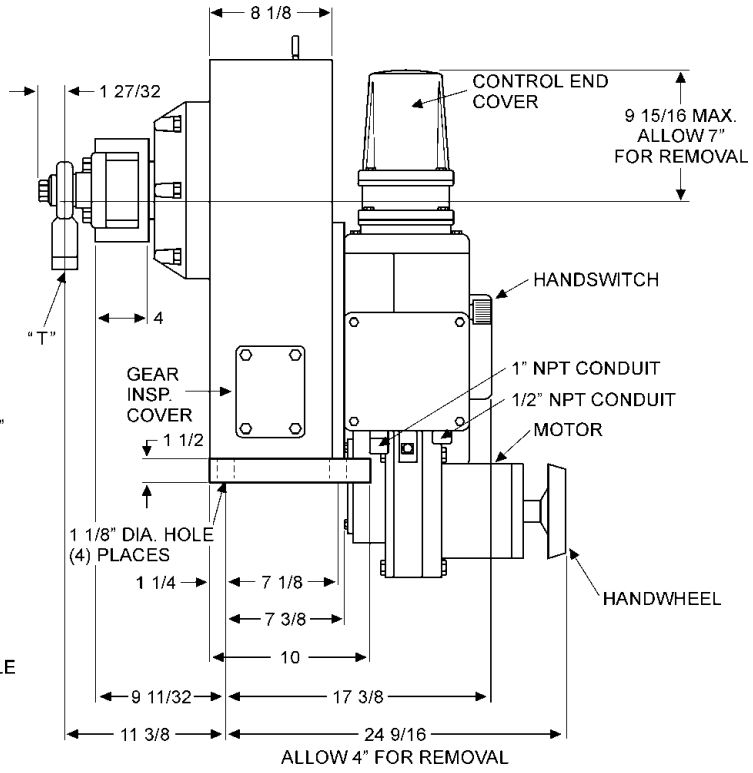
PRODUCT DESCRIPTION

All Dimensions are in inches.

ORIENTATION A



Front View



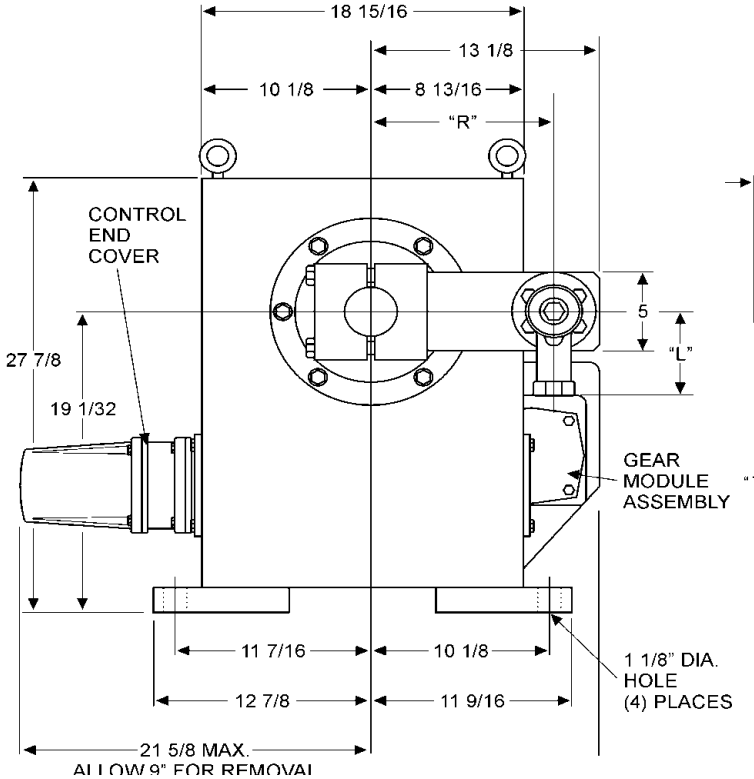
Side View

BECK MODEL 11-430

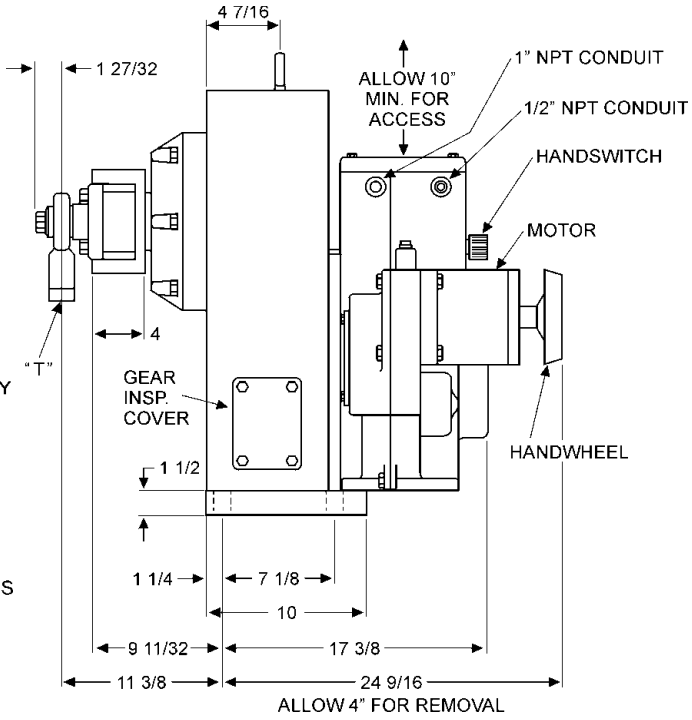
TORQUE (lb-ft)	TIMING (sec)	NET WT (lb.)	OUTPUT SHAFT DIA. (in.)	CRANK ARM & ROD END SUPPLIED AS STANDARD			MAXIMUM OVERHUNG LOAD (lb.)
				CRANK ARM RADIUS AVAILABLE "R" (in.)	ROD END LENGTH "L" (in.)	ROD END INTERNAL THREAD "T" (in.)	
5,200	108 180	790	3.938	See note*	5 3/8	1 1/2-12 x 2 5/8	30,000
2,900	72 120						

*Crank arm is manufactured to the radius required by the application.

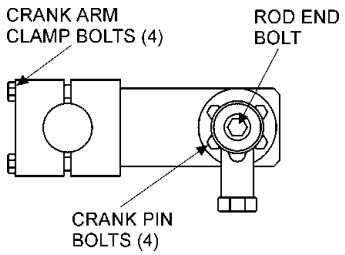
ORIENTATION B



Front View



Side View



MODEL 11-430 RECOMMENDED BOLT TORQUES

GEAR REDUCTION UNIT	THREAD SIZE	TORQUE (lb-ft)
Crank Arm Clamp Bolts (4)	3/4-16	420
Rod End Bolt	3/4-16	220
Crank Pin Bolts (4)	5/8-18	170
Gear Inspection Cover Bolts (8)	5/16-18	10
11-400 DRIVE	**THREAD SIZE**	**TORQUE (lb-ft)**
Cover Bolts	5/16-18	10
Motor Bolts	3/8-16	16
Gear Module Bolts	5/16-18	10
Adaptor Plate to Gear Reduction Unit Bolts (4)	1/2-13	45

PRODUCT DESCRIPTION

TABLE 1:
SUMMARY OF CONTROL OPTIONS

MODEL NUMBER	CONTROL TYPE	INPUT SIGNAL	ESR-4 BOARD NO.	INTERNAL FEEDBACK DEVICE	EXTERNAL OUTPUT SIGNAL	CPS-2 PART NO. W/O MONITOR	CPS-2 PART NO. W/ MONITOR	AUXILIARY SWITCH OPTIONS
11-438	Electronic Modulating	0-5 or 1-5 mA dc	13-2245-02*	CPS-2 Contactless Position Sensor	1-5 V dc or 4-20 mA	N / A	20-3400-12	None 2 4 2+INTLOS
					16 V dc or 50 mA max.		20-3400-13	
		4-20 mA dc	13-2245-03*		0-15 V dc PAT Control		20-3400-14	
					-10 to 10 V dc		20-3400-15	
		10-50 mA dc	13-2245-04*	1000 Ω Potentiometer 20-3060-03	None (std)		N / A	None 2 4 2+INTLOS
11-437		1-5 V dc	13-2245-05*					
		-10 to 10 V dc	13-2245-08*		Aux. Pot. (optional)			
11-436	Direct AC Control (Modulating)	120 V ac	None	CPS-2 Contactless Position Sensor	1-5 V dc or 4-20 mA	20-3400-02		None 2 4
					16 V dc or 50 mA max.	20-3400-03		
		Low Power 120 V ac	13-2245-50 (Relay Board)		0-15 V dc PAT Control	20-3400-04		
		Low Power dc	13-2245-51 (Relay Board)		-10 to 10 V dc	20-3400-05		
11-435		120 V ac	None	None	1000 Ω Potentiometer 20-3060-03	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	6 Position	120 V ac	N / A		None			None
	5 Position							
	3 Position							None 2
11-433	2 Position Open / Close							None 2 4

*13-2245-09 Square Function Board is available in these ranges.

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.

STORAGE INFORMATION

The 11-430 should be stored in its shipping crate in a clean, dry area.

If it is necessary to store the drive 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 drive is shipped in a slatted wooden crate. The crate is braced internally at the top and sides of the drive. 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 drive 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 drive to its final mounting platform. The pedestal provides a mounting base for the drive and also protects the 11-400 control motor. Do not remove the drive from the pedestal or the protective cover from the motor until the drive 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 drive to its final mounting platform. Do not remove the drive from the skid or the protective cover from the motor until the drive 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.

Continued

MODEL 11-430 CONTROL DRIVE

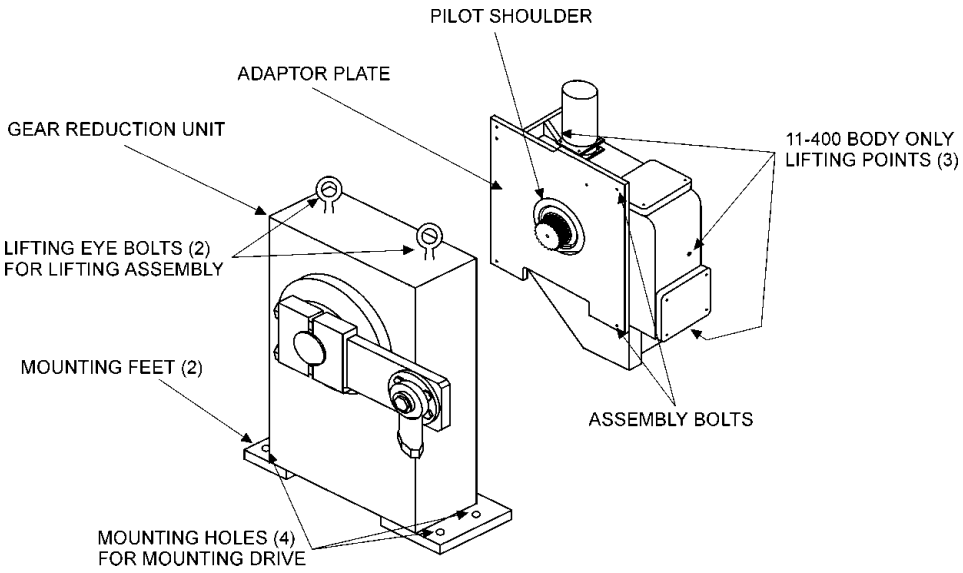


Figure 1

Mounting Instructions, cont'd.

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 drive's components. Place shims under the feet of the drive to correct for any unevenness in the mounting surface before the mounting bolts are tightened.

The output shaft of the drive 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.

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 drive. 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 drive orientation.

INSTALLATION—ELECTRICAL

NOTE: All Beck drives are shipped from the factory ready for installation; no electrical adjustments are required before placing them in operation. Each drive 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 drive so that condensation and other contaminants entering the conduits cannot enter the drive.

A large, clearly labeled terminal block on the top of the drive is enclosed in a separate, gasketed, metal enclosure. Terminals will accommodate up to 12 GA 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 drive.

Refer to the wiring diagram furnished with your Beck drive 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 drive 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 drive.

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

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

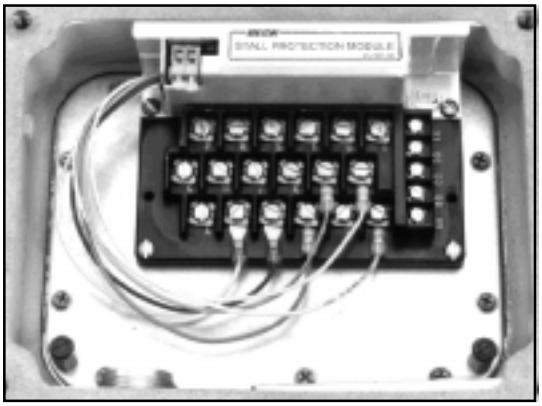
INSTALLATION *INPUT SIGNAL WIRING*

Each Beck drive is available with six separate control configurations, which are provided to match the control requirements for your system. Typical functional wiring connections for each control option are described in the following paragraphs and diagrams. See the wiring diagram on the inside of the terminal cover for specific wiring connections. See Table 1 on page 10 for model numbers and control selections.

Feedback connections for drives incorporating the Contactless Position Sensor (CPS-2) for control options 6 and 8 are described on pages 16 and 17.

A drive can be ordered with up to four optional auxiliary switches. Wiring connections for these are described on page 26.

To disable the Handswitch, remove the jumper between terminals A and C, and add jumpers between terminals N and V, M and U.

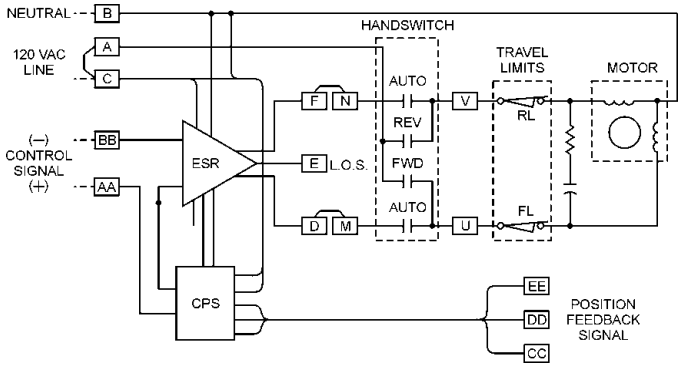


NOTE: Stall Protection Module shown is available as an option.

Option 8, Modulating

Analog Position Control with Contactless Position Sensing

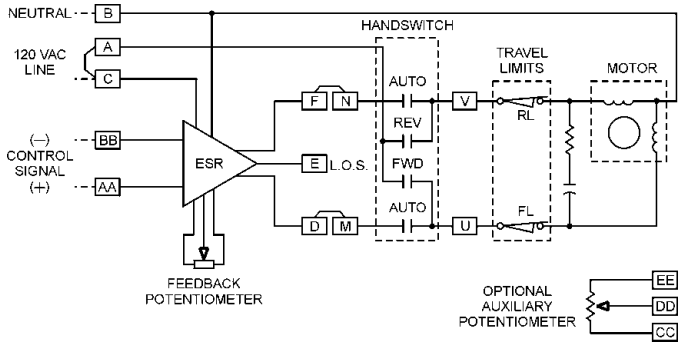
Customer must supply two wires to power the drive: One 120 V ac line (terminal C), and one neutral (terminal B). Customer must supply two wires for the modulating analog control signal: Connect to terminal AA (+) and to terminal BB(-). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 16 and 17 for connections). The drive'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.



Option 7, Modulating

Analog Position Control with Potentiometer Position Sensing

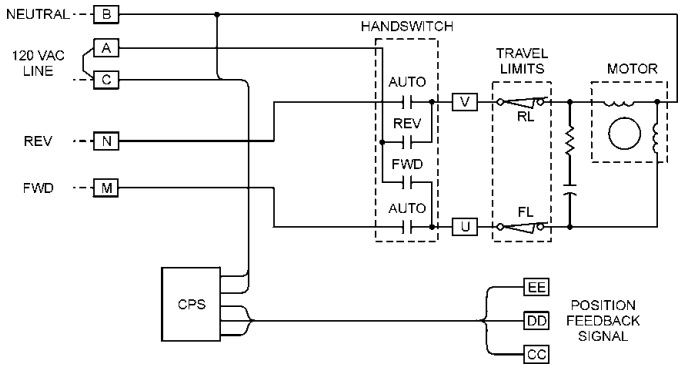
Customer must supply two wires to power the drive: One 120 V ac line (terminal C), and one neutral (terminal B). Customer must supply two wires for the modulating analog control signal: Connect to terminal AA (+) and to terminal BB (-). If position feedback monitoring is required, an optional auxiliary 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

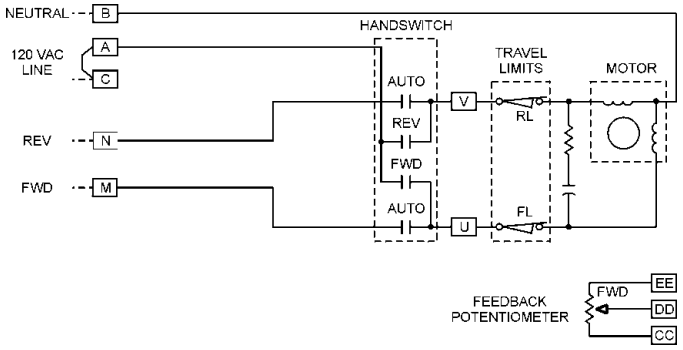
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal M), one 120 V ac line to run Reverse (terminal N), and one neutral (terminal B). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 16 and 17 for connections). If position feedback monitoring is desired, a 120 V ac line must be connected to terminal C. The drive'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

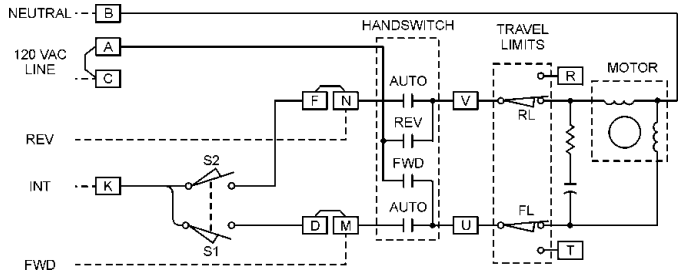
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal M), one 120 V ac line to run Reverse (terminal N), and one neutral (terminal B). The position feedback potentiometer connections are available at terminals CC (Reverse), DD (Wiper),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



Option 4, Multi-Position

Direct AC Control with Cam-Operated Switches to Stop Drive Travel

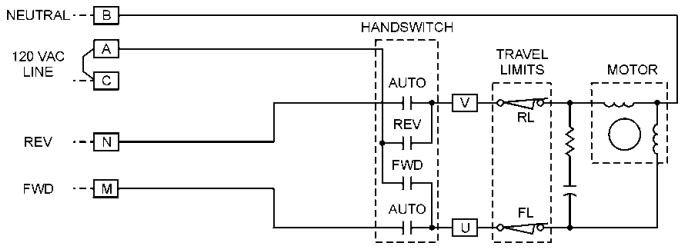
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal M), one 120 V ac line to run Reverse (terminal N), and one neutral (terminal B). Up to six intermediate stop positions may be specified, each requiring an additional 120 V ac line.



Option 3, Open / Close

Direct AC Control

Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run Forward (terminal M), one 120 V ac line to run Reverse (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.

CPS-2 SIGNAL CONNECTIONS

Beck 11-430 drives equipped with the Contactless Position Sensor (CPS-2) 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-2 model are described in the following diagrams and paragraphs. Refer to Table 12, page 50 for a table of output signal ranges, output terminals, range changing resistance values, and terminals to which the ranging resistor or jumper is connected.

NOTE: The value of 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).

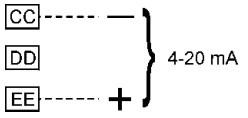
To verify that the feedback signal range is correct for your drive, see instructions on page 31.

NOTE: Ranging resistors must be connected to the control drive 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.

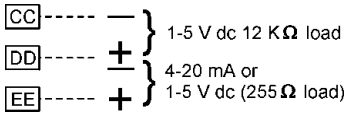
CPS-2 Model 20-3400-02, -12 Terminal Connections

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. For 4–20 mA and / or 1–5 V dc output, 4–20 mA is available across EE (+) and DD (-); 500 ohms is the maximum external load (for larger loads see Item 1 above). A 1–5 V dc signal is available across DD (+) and CC (-) into a 12 K ohm resistive load when the circuit between EE and DD is completed.

4–20 mA Signal Output



Dual Signal Output



CPS-2 Model 20-3400-03, -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.

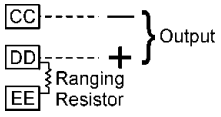
The ranging resistor value is given in Table 12, page 50, or can be calculated using the following equation:

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

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-2 Model 20-3400-03, -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.

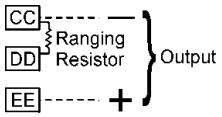
The ranging resistor value is given in Table 12, page 50, or can be calculated using the equation:

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

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.

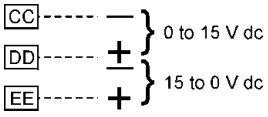
Voltage Output



CPS-2 Model 20-3400-04, -14 Terminal Connections

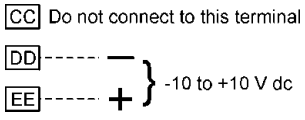
The three-terminal output from these models is provided for replacing potentiometers in three-terminal potentiometer feedback applications used in many controllers. It is suitable for 0–15 V dc applications of either positive or negative polarity. CC must be connected to the negative lead from the controller, 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-2 Model 20-3400-05, -15 Terminal Connections

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



INPUT SIGNAL OPTIONS

Beck 11-430 drives configured for milliamp or dc analog modulating applications include an Electronic Signal Receiver (ESR-4). Several control options are available with the ESR-4, such as operating more than one drive with a single signal source.

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

Input Signal Range Change

If it is necessary to change the range of an ESR-4 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 ±1% tolerance cannot be obtained locally, it can be ordered from Beck.

Series Operation

Beck drives can be connected in series from the same signal for concurrent operation. Care must be taken to keep the polarity correct in each drive's input terminals. Two or three drives may usually be connected in series. The number of drives 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 drive's calibration for series operation. An interruption in the circuit will actuate loss of input signal (L.O.S.) on the drives in the circuit.

Parallel Operation

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

For parallel operation, use ESR-4 board no. 13-2245-05 in each drive, and add a shunting resistor across input terminals AA and BB on one of the Beck drives. The value of the resistor is:

$$\frac{\text{Input Resistance} \times 10\ \text{K}\Omega}{10\ \text{K}\Omega - (\text{N}) \times \text{Input Resistance}}$$

Where N = the number of drives.

Refer to Table 2 for the input resistance. For example, a 278 ohm shunting resistor should be used for four drives in parallel with a 4–20 mA input signal. If the resistance calculation is not a standard value, then select the nearest standard value.

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

TABLE 2:
ESR-4 BOARD MODELS

INPUT SIGNAL	ESR-4 BOARD PART NO.	R-in (TOLERANCE 1%)	NET CIRCUIT INPUT RESISTANCE
0-5* or 1-5 mA dc	13-2245-02	13-2511-01 1.05K ohms	1K ohms
4-20 mA dc**	13-2245-03	13-2511-03 255 ohms	250 ohms
10-50 mA dc	13-2245-04	13-2511-02 100 ohms	100 ohms
1-5 V dc**	13-2245-05	13-2512-05 20K ohms	10K ohms
-10 to 10 V dc	13-2245-08	13-2512-05 20K ohms	50K ohms

*Span and zero adjustment required.
**Standard ISA Range (S 50. 1/1975).

Split Range Operation

Two or three Beck drives may be operated over their full range by a portion of the controller's output signal range. The most common arrangement involves two drives operating on equal halves of the input signal range. For example, if a 4–20 mA control signal is used, the first drive 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-4 boards are the same as would be used for parallel operation (13-2245-05), but calibrated to the range required for each drive. A shunting resistor must be added across input terminals AA and BB on one of the Beck drives to produce a 2.0–6.0 volt span across each board for its active portion of the range. For a 4–20 mA range three-way split, the shunting resistor range would be 425–1,650 ohms.

Follow the steps for calibrating the input signal, page 34, for each drive 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 drive (12 mA), cut one lead of resistor R35 on the ESR-4 board. See figure 7, page 35, for location of R35.

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 drives 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 shunting resistor (Beck P/N 13-2510-03) is adequate. Proceed as in the case of the two-way split, first setting span, then the zero. When setting the ESR-4 board in the first drive, set the zero at 4 mA. Then, on the second drive, cut the R35 resistor on the board and set its zero at 9.33 mA. Before setting zero in the board of the third drive, short out the R34 resistor by adding a jumper, adjust its zero to 14.67 mA, cut resistors R35 and R36 from the board, then remove the jumper from R34. Check operation of all drives by running the input signal through its complete range. If it is necessary to recalibrate the same board later, you may jumper resistors R35 and R36 by connecting the R35 turrets together.

START-UP INSTRUCTIONS

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

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

Turn on the power supply. Operate the drive 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 drive is to be operated with automatic control, turn on the controller and operate the drive 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 drive. If the wiring is correct, then reverse the direction of travel (see page 28).

If the drive is to be push-button actuated, (options 3, 4, 5, or 6) operate the drive 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 drive 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 valve or damper lever through the correct arc as it travels from 0° to 100°.
5. The drive 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 drive and the driven shaft:

1. Position the driven shaft to the full reverse position.
2. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and drive shaft centerline.
3. Remove the rod end from the Beck crank arm. Thread the rod end fully onto the pipe coupling stud.
4. Adjust the pipe coupling to the predetermined length.
5. Connect the pipe coupling to the driven lever at the predetermined radius.
6. Loosen the Beck crank arm clamping bolts.
7. Position the drive's output shaft to its full reverse (minimum input signal) limit.
8. Swing the crank arm into position to assemble the rod end to the crank arm crank pin with the rod end bolt and washers.
9. Tighten the rod end bolt to the torque recommended on page 9.
10. Tighten the coupling and rod end jam nuts.
11. Tighten the crank arm clamping bolts (4) to the torque recommended on page 9.
12. Lubricate rod end bearings with LGI #1 EP grease, Mobil grease #28 or equivalent.

Carefully move the drive's output shaft to the full forward (maximum input signal) 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. Check that the drive reaches the forward limit switch and shuts off.

If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius, if possible, or adjust the connecting link length.

To adjust linkage length, alter the thread engagement in the couplings and, if necessary, the rod ends. The couplings have right- and left-hand threads, so it is not necessary to disconnect the ends to make a length adjustment. Rod end adjustment, however, will require disconnecting the linkage.

CAUTION

The stud threads must be engaged at least 1.0 diameter deep into the rod ends and pipe couplings.

If binding still occurs, it may be necessary to change the radius of the driven lever or reduce the rotation of the drive. Consult the factory for details.

For an input control signal change, do not adjust the linkage. The span adjustment on the ESR-4 board is used to adjust the amount of rotation when a change in maximum input signal or span is required.

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

Link-Assist™

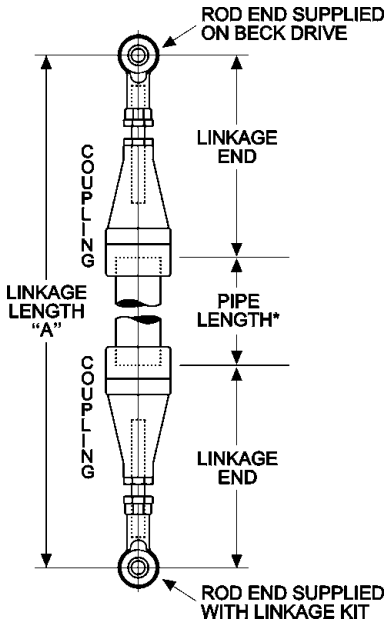
The Beck Link-Assist™ computer program optimizes the linkage configuration for your load's torque characteristics to help you select the minimum drive size for your application. Contact your Beck Sales Engineer to take advantage of Beck's Link-Assist™ program.

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 drive 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) from Linkage Length ("A").

TABLE 3:
11-430 PIPE LINKAGE KITS

LINKAGE LENGTH RANGE "A" (in.)	PIPE SIZE (in.)	MIN. PIPE NIPPLE LENGTH (in.)	ROD END THREAD	BECK PIPE LINKAGE KIT PART NO.	LENGTH OF 2 LINKAGE ENDS (TOTAL ADJUSTMENT ±1 1/2") (in.)	APPROX. WEIGHT (lbs.)[1]
23 1/2 - 40	2	2	1 1/2-12	20-1760-13	21 1/2	28
37 3/4 - 144	3	2 5/8		20-1760-10	35 1/8	32
59 3/4 - 144	3	2 5/8		20-1760-09[2]	57 1/8	41

[1]Does not include customer supplied pipe.

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

OPERATION

HOUSING

The 11-430 consists of a Beck 11-400 Control Drive 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 constructed from precision-machined aluminum plates; bolted together, pinned and sealed to provide 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 drive housing. The second and first stage gears are part of the field-interchangeable gear module. Different combinations of gear modules and drive motors determine the drive'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 drive.

HANDWHEEL

The 11-430 control drive 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 drives 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 drive only when it is in the AUTO position. The sequence of the Handswitch is: AUTO, STOP, FWD, STOP, REV.

In the AUTO position, two contacts are closed and the ESR-4 or external controller contact completes the control circuit.

In the FWD or REV positions, contacts are closed to operate the drive independently of the controller.

In the STOP position, all contacts remain open.

SWITCHES

Two end-of-travel switches and up to four optional auxiliary switches are provided on the 11-430 drive. Switch cams are clamped onto the control shaft, which rotates in relation to the output shaft. Cam position is field-adjustable. Switches are enclosed in high-impact thermoplastic. 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 have a repeatability of 0.1°.

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 positioning repeatability of 1° over the range of operation.

Direct ac control option 5: Operated in forward / reverse from a remote location; includes a 1,000 ohm film potentiometer for remote feedback.

Direct ac control option 6: Provides continuous positioning capability over the full range of drive travel by direct ac from either an automatic controller or manually operated switches. Includes Contactless Position Sensor (CPS-2) 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-4).

Modulating option 8: For automatic operation, as in option 7 above; includes Contactless Position Sensor (CPS-2) for position sensing and feedback to the ESR-4.

INPUT: ELECTRONIC SIGNAL RECEIVER (ESR-4)

Beck modulating drives are equipped with precision electronic control modules (ESR-4) 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-4 provides for drive control with analog control systems, and is designed to operate continuously in temperatures up to 185°F.

The ESR-4 requires a position feedback signal from either the CPS-2 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-4 permits two or more Beck drives 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 drive is changed, the ESR-4 allows for easy modification to accept different signals. An optional “Relay Board” version of the ESR-4 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 on page 37.

An optional square function positions the drive’s output shaft proportionally to the square of the input signal. See page 36 for details.

POSITION FEEDBACK: CONTACTLESS POSITION SENSOR (CPS-2)

The CPS-2 provides a continuous feedback signal proportional to the position of the drive’s output shaft. It is used for remote position indication as well as for automatic control loop feedback to the Electronic Signal Receiver (ESR-4). When used with the ESR-4, the CPS-2 includes a monitor / isolator board that delivers an isolated position feedback signal to the Electronic Signal Receiver (ESR-4). The Monitor function monitors the CPS-2 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 drive.

The position sensing function of the CPS-2 is provided by a ferrite magnetic sensing element consisting of two parts: A ferrite stator mounted on the CPS-2 circuit board and a ferrite rotor mounted on the control shaft, driven by the Beck drive’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 drives equipped with an ESR-4 board, two film potentiometers are required: One for position feedback and the second to supply a feedback signal to the ESR-4.

STALL PROTECTION

The Beck Stall Protection Module is an optional feature of the 11-430 Drive (240 V ac drives cannot utilize the SPM). The SPM monitors the motor current at terminals N and M. The SPM will be activated when the drive 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 drive 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 drives equipped with the ESR-4 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-4 provides an annunciating signal with one of the following options:

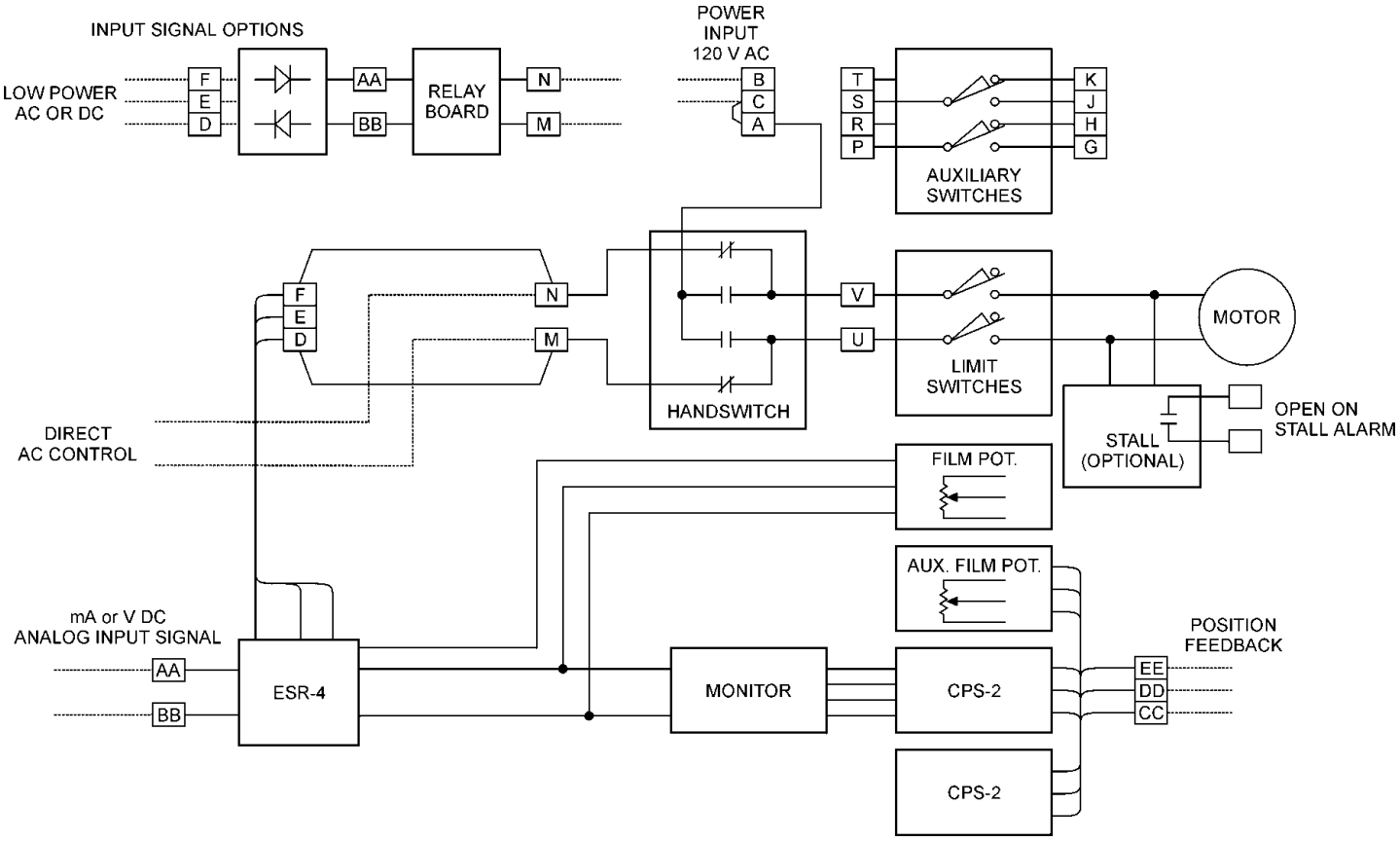
1. STALOS = Stay in place, lock in last position (triac output available for remote alarm 0.12 to 5A, 120V, 50 or 60 HZ).
2. REVLOS = Reverse to the end-of-travel limit switch position. Connect terminal E to F.
3. FWDLOS = Forward to the end-of-travel limit switch position. Connect terminal E to D.
4. 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-4 board is energized, a red LED on the board lights and the FWD and REV 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 upon ordering.

NOTE: Your Beck drive was shipped from the factory ready for installation; no electrical adjustments are required before placing it in operation. Each drive 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 control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the "Calibration" section beginning on page 26.

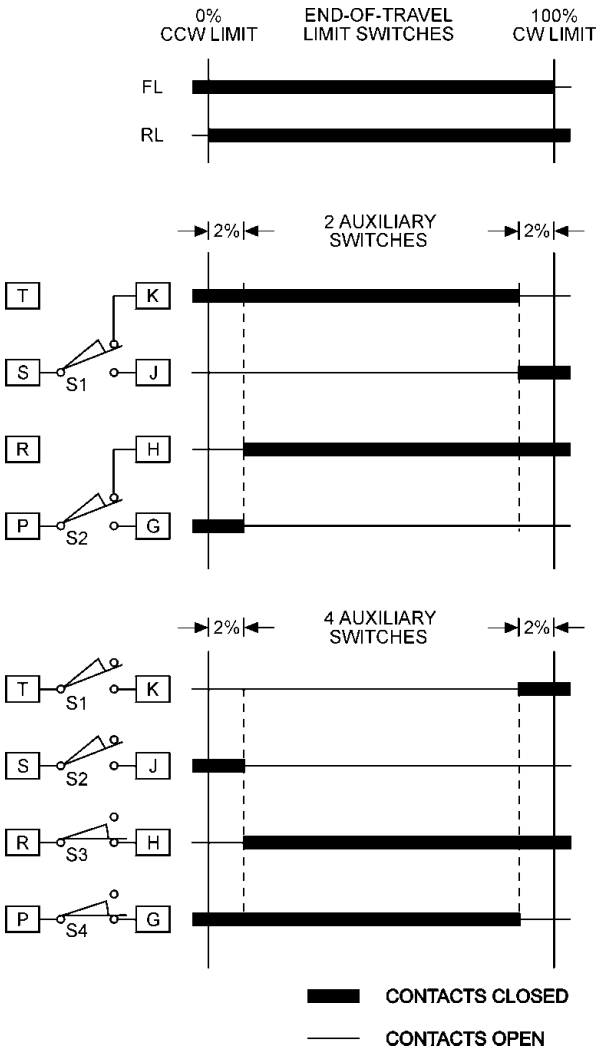


CONTROL DRIVE BLOCK DIAGRAM

SWITCH ADJUSTMENTS

The 11-430 drive is shipped with end-of-travel limit switches and all auxiliary switches factory adjusted for 100% 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 60°.

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



STANDARD END OF TRAVEL LIMIT AND AUXILIARY SWITCH SETTINGS

All switches are SPDT and are rated at 6 A, 120 V ac. 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 drive is disconnected from the line voltage and auxiliary switches are disconnected from external power sources.

Setting Travel Limit Switches FL and RL

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

1. Remove the control end cover and cover extensions, if applicable, and terminal block cover (1/2” bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the FL switch cam is accessible. Using a 7/64” hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 2, below.
3. Move the output shaft clockwise to the desired CW limit.

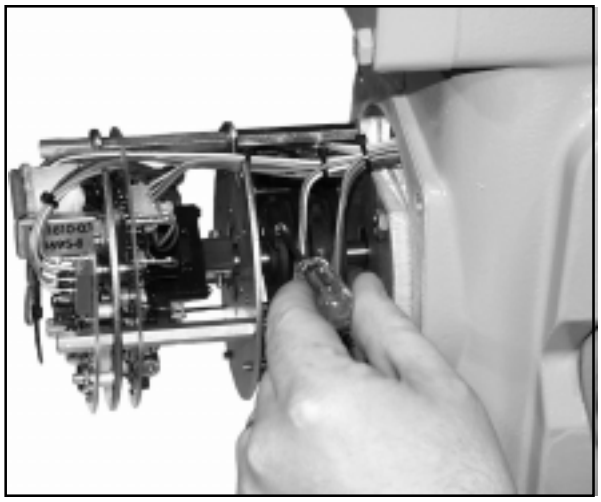


Figure 2

4. Turn the Handswitch to the STOP position.
5. Disconnect power from the drive.
6. Connect the continuity meter across terminals B and U. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
7. Tighten the cam locking screw to 5 lb-in torque.
8. Disconnect the meter and reconnect switch wires and drive power.
9. Rotate the drive's output shaft in the CCW direction away from the CW travel limit. 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 this is not correct, return to step 2 and reset the cam to the proper orientation.
10. Rotate the output shaft again to the desired CW travel limit. If the stopping point is reached, the switch is properly set.
11. Repeat instructions for setting RL travel limit switch except that direction of rotation (CW / CCW) is opposite of that used for FL switch setting. Connect continuity meter across terminals B and V.
12. Replace covers and tighten cover bolts to 10 lb-ft torque.

Setting Auxiliary Switches

Standard switch settings for drives with 2 or 4 auxiliary switches are shown on the diagram on page 26. The operating point of all auxiliary switches is defined as a percent of output shaft travel. 100% is defined as the clockwise limit of shaft travel when facing the end of the shaft where the crank arm is located. 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 (1/2" 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 drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 26 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in torque.
8. Disconnect the meter and reconnect power.
9. Move the drive'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 torque.

CALIBRATION *DIRECTION CHANGE*

CHANGING DIRECTION OF TRAVEL

Forward direction of travel is defined as the direction of output shaft rotation produced by an increasing signal. Unless otherwise specified at the time of order, the output shaft is factory-set to rotate clockwise in response to an increasing signal.

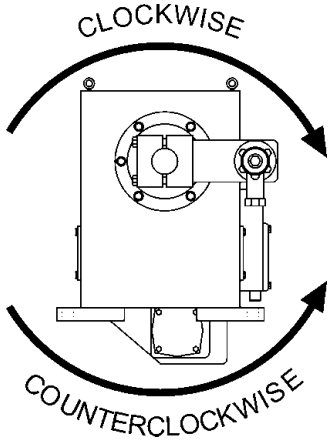


Figure 3

The procedure to change the direction of travel of the output shaft varies by model number. The model number is listed on the drive name plate. 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

1. Remove the control end cover and extensions if applicable (1/2" bolt heads).
2. Interchange the yellow and black wires on the common terminals of the FL and RL travel limit switches.
3. Replace the control end covers. Torque the cover bolts to 10 lb-ft.

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 drive body.

1. Remove the control end cover and extensions if applicable (1/2" bolt heads).
2. Interchange the yellow and black wires on the common terminals of the FL and RL 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.

TABLE 4:
SHAFT ROTATION, FEEDBACK, AND METER CONNECTIONS

MODEL	OUTPUT SHAFT ROTATION INCREASING SIGNAL	CONTROL SHAFT ROTATION	REMOTE FEEDBACK TERM. CONNECTIONS (+) Supply Voltage (-) / (+) Feedback (-)			WIRE CONNECTIONS TO POTENTIOMETER TERMINALS / METER CONNECTION (-) 1		(+) 3	(-) 4	5
435, 437	CW CCW	CW CCW	EE EE	DD DD	CC CC	ORG	GRN	YEL YEL	GRN	ORG

Models 11-436 and 11-438

1. Open the terminal compartment (1/2" bolt heads) and remove the control end cover (1/2" bolt heads) and extensions, if applicable.
2. Interchange the yellow and black wires on the common terminals of the FL and RL travel limit switches.
3. Determine the correct feedback signals from the wiring diagram supplied with your drive (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 12, page 50 for feedback terminals.
5. Reconnect drive power.
6. Drive the output shaft until the CPS-2 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-2 rotor clamp.
9. Rotate the CPS-2 rotor 180° and set the output back to the mid-range (e.g. 12 mA).
10. Tighten the rotor clamp. See Figure 4, below.

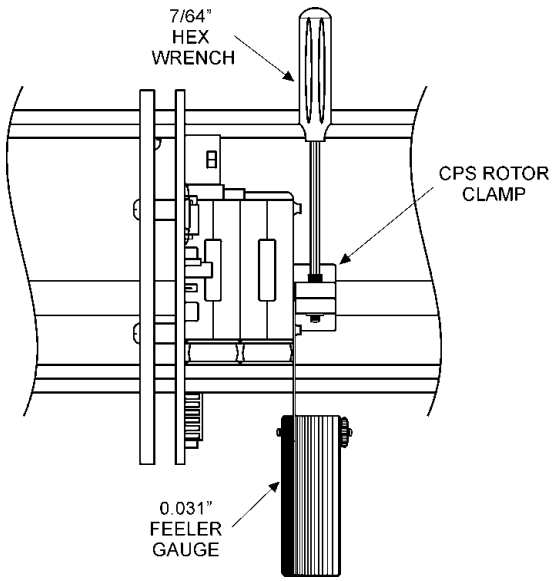


Figure 4

11. Run the drive to the 0% and 100% limits using the Handswitch. Record CPS-2 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 drive at the 100% limit, turn the span potentiometer to adjust the CPS-2 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-2 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-2 rotor moves the entire signal span up or down.
15. Tighten the CPS-2 rotor clamp to 5 lb-in torque. Maintain a 0.031" clearance between the rotor clamp and stator.
16. Run the drive 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 torque.
19. Model 11-438: Check ESR-4 board calibration by following the "Checking Calibration" procedure on page 34.

FEEDBACK SIGNAL CALIBRATION

Feedback signal calibration is necessary to ensure that signal current or voltage correctly corresponds to the drive's output shaft position. The 11-430 drive 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 drive name plate. Determine the model number and refer to the proper procedure below.

NOTE: The shaft travel limit switches must be properly adjusted before the feedback signal is calibrated. The feedback signal must be calibrated before the input signal can be 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 mounted closest to the drive body.

When properly adjusted, the auxiliary potentiometer feedback signal should be maximum with the drive shaft in the full forward (maximum input signal) position. At 50% of travel the signal should be mid-span. At full reverse the signal should be minimum.

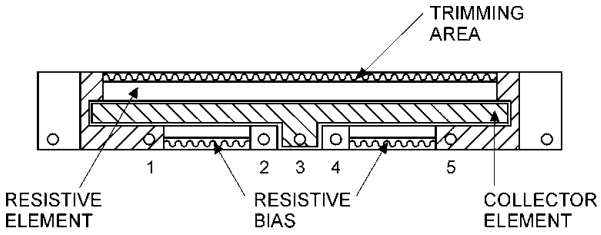
On 11-437 units, potentiometer feedback to the ESR-4 board should read 0.52 V dc at the minimum input signal position and 2.41 ±6% V dc at the maximum input signal.

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 (1/2" 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. Use the Handswitch to run the drive to the 0% position.
4. On Model 11-437 set the wiper on the potentiometer for 0.52 volt feedback to the ESR. The feedback can be read on the ESR board at TP3 & TP2 (see Figure 7 on page 35). The feedback can also be read at the yellow and green leads at the film potentiometer.

   On Model 11-435 set the wiper about 5 degrees above the position where the minimum output is reached; or as required by the control system.

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 torque.
6. Operate the drive between the electrical limits. Verify that the feedback signal is properly adjusted.
7. Check that the wiper does not come off the resistive element or output voltage does not fall from maximum value. If not correct, return to step 2.
8. Replace the cover, and tighten the cover bolts to 10 lb-ft.

CPS-2 Calibration Model 11-436 and 11-438

These models are equipped with a Contactless Position Sensor (CPS-2) for position sensing and feedback. On model 11-438, the CPS-2 also delivers a feedback signal to the Electronic Signal Receiver (ESR-4). Adjusting the remote feedback signal also automatically adjusts the signal to the ESR-4 on models so equipped.

CPS-2 units are designed to provide position feedback without contacting or wiping surfaces. On option 8 units, the CPS-2 includes a Monitor / Isolator board which detects high and low out-of-limit conditions. The Monitor function monitors the CPS-2 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 drive.

The CPS-2 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-2 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 bock cover and the control end cover (1/2" bolt heads).
3. Determine the correct feedback terminals from the wiring diagram supplied with your drive (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 12, page 50, 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 drive's output shaft in the full forward (maximum input signal) position. At 50% travel, the signal should be mid-span. At full reverse, the signal should be minimum. If not correct, proceed with the calibration procedure.

Note: Tolerance on factory calibration is ±0.5% of span.

Calibration Procedure

Adjustment of the CPS-2 is necessary if the signal range requires an increase or decrease in value relative to the drive's output shaft rotation. Calibrate by turning the Span Potentiometer CW to increase the gain of the CPS-2. 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-2 model and ranging resistor selected.

CAUTION

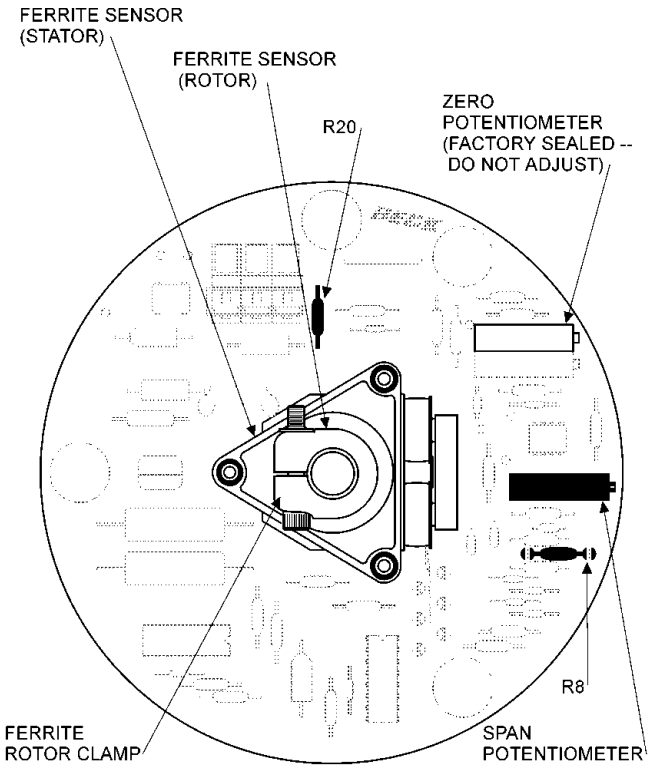
Do not adjust the zero potentiometer to shift the span.

To adjust the span, turn the Span Potentiometer on the CPS-2 circuit board. The Span Potentiometer adjusts the CPS-2 so that the drive output shaft rotation from 80° to 100° produces the specified output signal range.

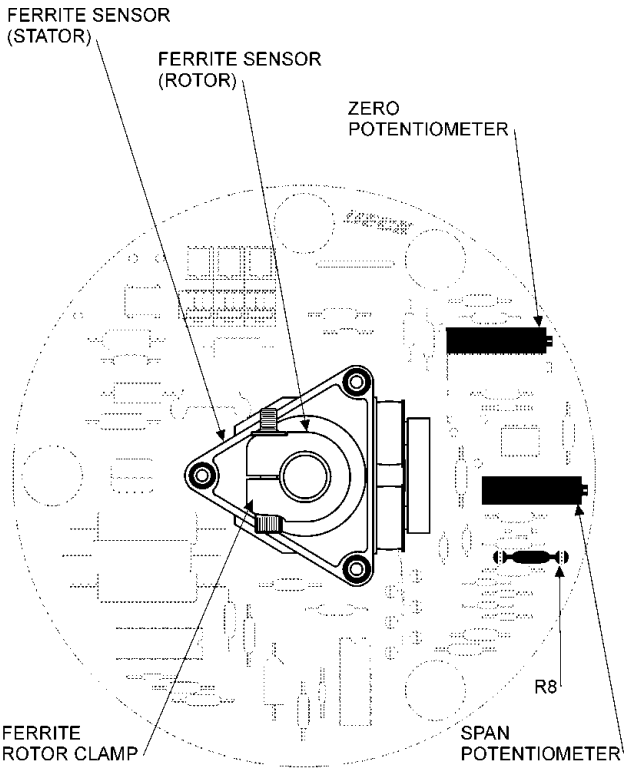
For output shaft rotation of between 60° and 79°, it may be necessary to remove resistor R8 (100 K ohm), which is on raised turrets, to change the range of the span adjustment. An R8 value of 100 K ohms produces a shaft output range of 80° to 100°; an R8 value of 249 K ohms produces a shaft output range 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 (1/2" bolt heads).
3. Determine the correct feedback terminals from the wiring diagram supplied with your drive (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 12, page 50, for feedback terminals.
5. Run the drive to the 0% and 100% limits using the Handswitch. Record the CPS-2 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 drive at the 100% limit, turn the span potentiometer to adjust the CPS-2 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.

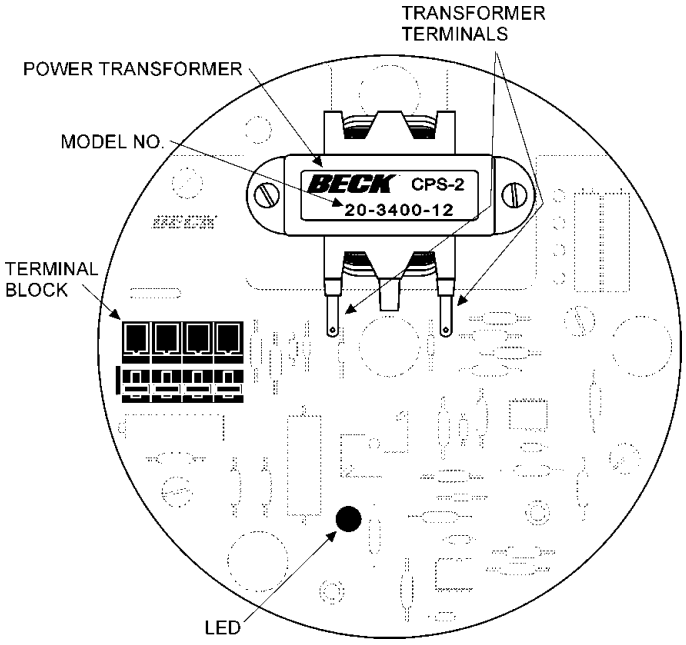


CPS-2 POSITION SENSOR
MODELS 20-3400-02, -04, -05, -12, -14, -15



CPS-2 POSITION SENSOR
MODELS 20-3400-03, -13

Figure 5



CPS-2 MONITOR / ISOLATOR ASSEMBLY

Figure 6

CALIBRATION PROCEDURE, CONT'D.

8. Loosen the CPS-2 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-2 rotor moves the entire signal span up or down.
9. Tighten the CPS-2 rotor clamp to 5 lb-in torque. Maintain a 0.031" clearance between the rotor clamp and stator.
10. Run the drive 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 torque.
13. On Model 11-438: Check ESR-4 board calibration by following the "Checking Calibration" procedure on page 34.

Adjusting the Zero Potentiometer

The Zero Potentiometer is provided on CPS-2 models 20-3400-03 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-2 units except 20-3400-03 and -13. Do not attempt to adjust the zero on other models as misadjustment of feedback signal and monitor / isolator functions of the ESR-4 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 ohm resistor (see Table 12, page 50). This shifts the range to 4–20 V dc.
3. Using a voltmeter at the appropriate output terminals, adjust the zero potentiometer with the drive 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-2 models 20-3400-12, -13, -14, and -15 are provided with a Monitor / Isolator board that delivers an isolated position feedback signal to the Electronic Signal Receiver (ESR-4). The Monitor function monitors the CPS-2 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 drive.

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

Feedback Signal Monitor Sensing Operation

A red LED indicator and an SPDT relay are mounted on the Monitor / Isolator board to indicate that power is on and that the CPS-2 output signal is within normal range. The contacts open at -4% and +104%, and close at -1% and +101%.

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

Stay in Place on Loss of Feedback

Drives equipped with Electronic Signal Receivers (ESR-4) are configured so that the input control signal is connected through the feedback signal monitoring relay on the monitor board of the CPS-2. The Loss-of-Signal (L.O.S.) function of the ESR-4 may therefore be activated when the CPS-2 signals are outside the normal range (see above). To have an out-of-range CPS-2 signal trigger the L.O.S. mode, remove the jumper JP1 on the monitor board (Figure 6, page 32). For details on L.O.S. function, review the following section on "Input Signal Calibration".

INPUT SIGNAL CALIBRATION

11-430 drives equipped for milliamp or dc analog modulating applications include a fourth generation Electronic Signal Receiver (ESR-4). The ESR-4 board consists of a voltage regulator, a signal amplifier, an error amplifier, and three solid state output switches.

The ESR-4 board controls the position of the Beck drive according to the input signal it receives. A feedback signal is delivered to the board from either a potentiometer or the CPS-2, which is then compared with the input 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. 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 input 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 input signal can be calibrated.

Checking Calibration

Using the input control signal, drive the output shaft through its complete range. Check the position feedback signal to confirm that a 10% input 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 input signals, then the ESR-4 must be calibrated. The tolerance on factory calibration is ±0.5% of span.

CAUTION

The signal circuit on ESR-4 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-4 board (see Figure 7, page 35). Monitor the FWD and REV lamps to make adjustments. When the drive is balanced or in L.O.S. mode, both lamps are on. When the output shaft is moving, the lamp designating its direction of travel goes out. When the drive reaches its end of travel before balance is achieved, the lamp will stay out. Trim the adjustment so that the drive 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 input 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

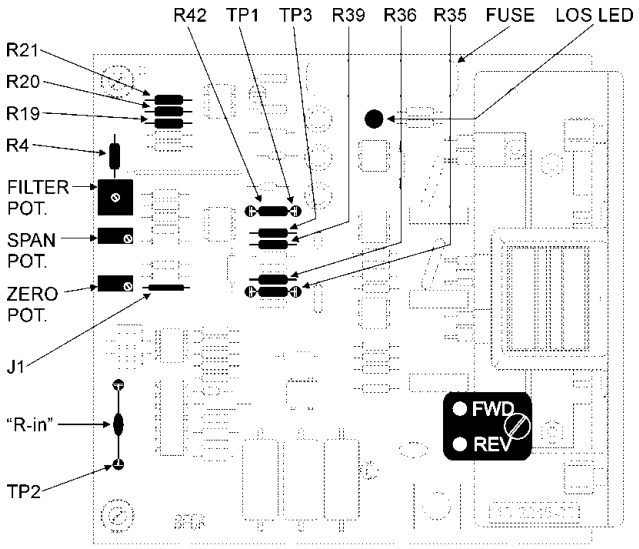
If the span is in error by less than 15%:

1. Remove the ESR cover and the terminal compartment cover (1/2” bolt heads).
2. Turn the Handswitch to the AUTO position.
3. Remove the controller output signal wires from terminals AA and BB. Record the wire color location for reconnection at a later time.
4. Connect a portable current source, positive to terminal AA and negative to terminal BB.
5. Adjust the current source to minimum signal (e.g. 4 mA for 4–20 mA input). The drive runs to the 0% position and stops.
6. Adjust the zero potentiometer CCW until the drive motor runs. Both the forward and reverse lamps will remain on.
7. Adjust the zero potentiometer CW in small increments until the reverse lamp goes out and the motor does not run.
8. Adjust the portable signal source output to maximum signal (20 mA). The drive runs to the 100% position and stops.
9. Adjust the span potentiometer CW until the drive motor runs and both the forward and reverse lamps remain on.
10. Adjust the span potentiometer CCW in small increments until the forward lamp goes out and the motor does not run.

11. Adjust the signal source to minimum signal (4 mA) and recheck the zero potentiometer adjustment.
12. Reinstall the input signal wires, remove the test box (if used), replace the compartment covers and tighten the cover bolts to 10 lb-ft torque.

For a span error greater than 15%:

1. Remove the ESR cover and the terminal compartment cover (1/2" bolt heads).
2. Turn the Handswitch to the AUTO position.
3. Short input terminals AA and BB.
4. Short out resistor R35 temporarily with a clip lead (see Figure 7, this page, for location). NOTE: Drive will run in forward direction.
5. Using a 3/32" screwdriver, turn the zero adjustment potentiometer CW in small steps until the reverse lamp goes out and the motor does not run.
6. Remove short on input terminals and, using the system controller or a portable current source, apply an input signal equal to the span (e.g. 16 mA for 4–20 mA span). NOTE: The drive may run.
7. Using a 3/32" screwdriver, turn the span adjustment potentiometer CW until drive runs, then CCW until drive just reaches the 100% position (forward lamp out, motor off).
8. Remove the clip lead on resistor R35 so that it is not shorted. Apply 100% (full range) position signal (e.g. 20 mA).
9. Turn the zero potentiometer CCW (may require 10–15 turns) to position the drive at the 100% position (forward lamp out, motor off).
10. Adjust the signal source output to the minimum signal (e.g. 4 mA). The drive runs to 0% and the motor stops.
11. Adjust the zero potentiometer CCW until both lights remain on.
12. Adjust the zero potentiometer CW in small increments until the reverse lamp goes out and the motor does not run.
13. Adjust the current source output to maximum signal (20 mA). The drive runs to 100%.
14. Adjust the span potentiometer CW until the drive motor runs and both the forward and reverse lamps remain on.
15. Adjust the span potentiometer CCW in small increments until the forward lamp goes out and the motor does not run.
16. Adjust the portable current source for minimum signal (4 mA). The drive runs to 0%. Recheck the zero potentiometer adjustment.
17. Reinstall the input signal wires, remove the test box (if used), replace the compartment covers and tighten the cover bolts to 10 lb-ft torque.



ESR-4 COMPONENTS

Figure 7

Span

The basic V span adjustment of the ESR-4 is 2 volts to 6 volts dc. This is adjustable with the 20 turn span potentiometer. To make the span adjustable from 2 to 9 volts dc, remove resistor R4. To make the span adjustable from 9 to 12 volts dc, remove jumper wire J-1. To make the span adjustable from 12 to 16 V dc, remove R4 and J1. See Figure 7, above, for location of R4 and J1.

Zero (Supp.)

The basic zero adjustment is -20% to 100% of span. This is adjustable with the zero potentiometer. For 2-way split range applications, remove resistor R35 to shift the zero adjustment to 20% to 150% of span. For 3-way split range operation, remove resistors R35 and R36 to shift the zero adjustment to 150% to 275%. For other split range applications, consult factory for adjustment. See Figure 7, above, for location of R35 and R36.

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,

Continued

FILTER ADJUSTMENT, CONT'D.

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-2 or film potentiometer operation are chosen to satisfy the requirements of most control systems. If excessive process and / or signal noise is present, the drive 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 drive's deadband can be widened; however, this will reduce the resolution of the drive. Widening the deadband to 1% can be accomplished by removing resistor R39. Further change of the deadband is possible by changing the value of R42 (only after R39 is removed). Various values and corresponding deadbands are listed below. See Figure 7, page 35, for the location of R39 and R42.

R39	R42	Deadband
Remove	4.99 M ohms	1.0%
Remove	2.70 M ohms	1.9%
Remove	2.00 M ohms	2.5%

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.

SQUARE FUNCTION OPERATION

With the optional Square Function ESR-4 board (Beck part no. 13-2245-09) the drive output shaft position changes proportionally to the square of the input signal as in the following table:

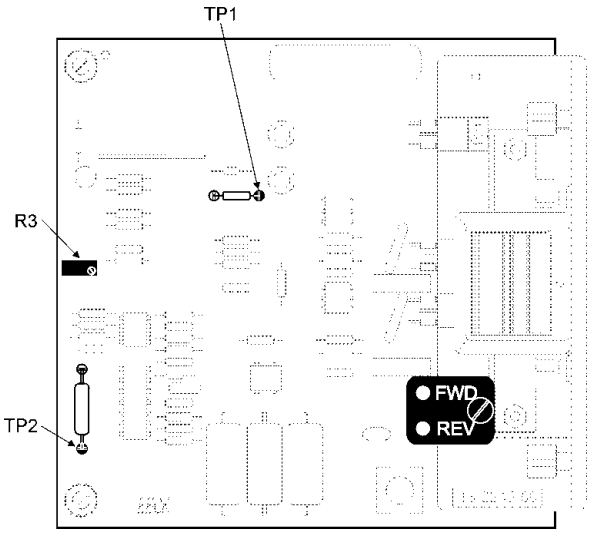
TABLE 5

INPUT SIGNAL (mA)	STANDARD OUTPUT (% OF SPAN)	SQUARE FUNCTION ACTUAL OUTPUT POSITION (% OF SPAN)
4.0	0	0
5.6	10	1
12.0	50	25
15.2	70	49
18.4	90	81
20.0	100	100

For input signal calibration, follow the calibration procedure beginning on page 34. Component locations are the same as shown in Figure 7, page 35.

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 COMPONENTS

Figure 8

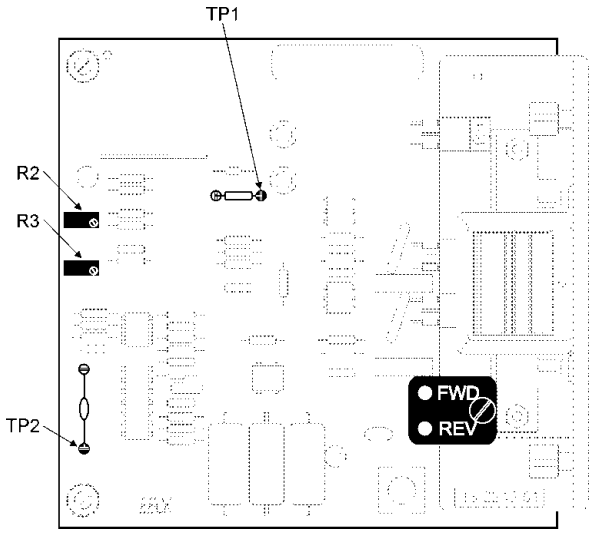
Relay Board Calibration

The purpose of calibrating the Relay Board is to ensure that forward and reverse input signals are balanced (e.g., a 24 V dc signal will run the drive in the forward direction, a -24 V dc signal will run the drive in the reverse direction, and the drive will not run when the signal is zero).

Two calibration procedures are described below. 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 drive from line voltage and remove terminal cover and ESR cover (1/2" bolt heads).
2. Remove input signal wires from terminals AA and BB.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 8, page 36, 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 volts ± 0.01 V dc. See Figure 8 for location of potentiometer R3.
6. Disconnect drive from line voltage and reconnect input signal wires to terminals AA and BB.
7. Check operation of drive with system signals.
8. Replace covers and tighten cover bolts to 10 lb-ft torque.



RELAY BOARD COMPONENTS

Figure 9

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

1. Disconnect drive from line voltage and remove terminal cover and ESR cover (1/2" bolt heads).
2. Remove input signal wires from terminals AA and BB.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 9, below, 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 FWD and REV input at zero volts. See Figure 9 for location of Zero Potentiometer R3.
6. Adjust Span Potentiometer R2 for -0.2 V at TP1 with FWD and REV input at -24 V. See Figure 9 for location of Span Potentiometer R2.
7. Disconnect drive from line voltage and reconnect input signal wires to terminals AA and BB.
8. Check operation of drive with system signals.
9. Replace covers and tighten cover bolts to 10 lb-ft 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 control drive using resistors from each input to neutral (drive terminals F to E and D to E). Since these resistors generate heat, sufficient means for cooling must be provided.

MAINTENANCE *ROUTINE*

The Beck 11-430 drive 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 drive elements are secure and operating normally.

LUBRICATION

It is recommended that during major outages, drives 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 control drive 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, a detailed examination of the main gear is recommended. This requires complete disassembly of the drive. Clean all parts thoroughly, removing all old lubrication. All damaged or worn parts should be replaced.

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 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 drive.

To inspect the gears on the gear reduction unit, remove the gear inspection covers (1/2” bolt heads). See pages 8 and 9 for location of covers. 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 covers. Torque bolts to 10 lb-ft.

This section covers replacement of many components of the 11-430 drive. 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 drive should be returned to the factory.

GASKETS

During routine service, inspect the cover, motor, and change gear plate gaskets for wear or damage. In order to protect internal components, worn or damaged gaskets should be replaced.

To remove, scrape all of the old adhesive and gasket material from the body housing and cover. Cement the new gasket to the drive body using a gasket cement such as 3M #847 Rubber and Gasket Adhesive, or equivalent.

The gasket between the body halves should be replaced if the body halves are taken apart. No cement is used on this gasket. Trim the outside edges of the gasket after assembly as required.

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" 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 control drive 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.

CAUTION

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

To remove the motor, first disconnect the motor wires in the terminal compartment of the control drive. 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 drive 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 drive 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. Reconnect the motor wires.

See the following section for reinstalling the terminal plate.

MOTOR RESISTOR AND CAPACITOR

CAUTION

Disconnect line voltage before replacing motor resistor and / or capacitor.

Continued

Motor Resistor and Capacitor, cont'd.

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.

LIMIT AND AUXILIARY SWITCHES

Complete switch assemblies may be replaced. It is not possible to replace individual switches. To replace switch assemblies, remove the control end cover (1/2" bolt heads) and extensions, if applicable. Remove the screws holding the switch assembly to the plate and slide it out to the side. Note the configuration of the assembly, right-hand or left-hand. Right-hand assemblies have screws in the "R" holes and left-hand assemblies have screws in the "L" holes.

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-roller spacing and switch operating point. To properly set the switch, use a .030" shim between the cam and roller and loosely position the switch assembly so that the switch is just actuated. The roller should be on the low or minimum radius portion of the cam when setting the switches. DO NOT overstress the actuating lever. Tighten both screws to 20 lb-in torque and remove the shim. When properly adjusted, the switch roller should remain in contact with the cam throughout the control drive travel.

ADDING SWITCHES

It is usually possible to add switches to a control drive in the field. Remove the control end cover (1/2" bolt heads) and extensions, if applicable. If the drive has no auxiliary switches, it is possible to add two more switches. Determine the configuration of the switch assembly to be added. Right-hand switches are set to operate at the CW control shaft limit and left-hand switches at the CCW limit.

If the control drive shaft does not have unused switch cams, extra switches may be added but additional parts will be required. Consult the factory, giving the control drive 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 control drive 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 7, page 47, for switch part numbers.

SLM FRICTION SURFACE

In normal service, the SLM friction surface will last for five to ten years. Faster rates of wear can occur in any drive operating near its rated torque and with a frequency of operation greater than one per minute on a 24 hour schedule. The following procedure can be used to determine the amount of wear life remaining on the friction surface: Turn the Handswitch to STOP. Carefully turn the Handwheel back and forth. If there is free play in the Handwheel (up to one tenth of a full Handwheel rotation) the SLM has sufficient wear life. If there is no free play in the Handwheel, the drive may not hold position and the friction surface should be replaced.

If the friction surface needs to be replaced, order the appropriate SLM kit as shown in Table 6, below. Two kits are available: SLM Friction Kit and SLM Rebuild Kit.

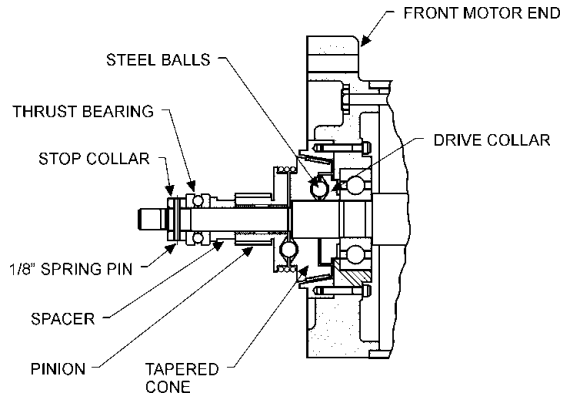
The SLM Friction Kit consists of friction material, spring pin, steel shims, control motor gasket, thrust washer, terminal joints, slip-on terminal and instruction sheet.

The SLM Rebuild Kit consists 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 Figures 10 and 11, page 41, to identify the components of a particular motor.

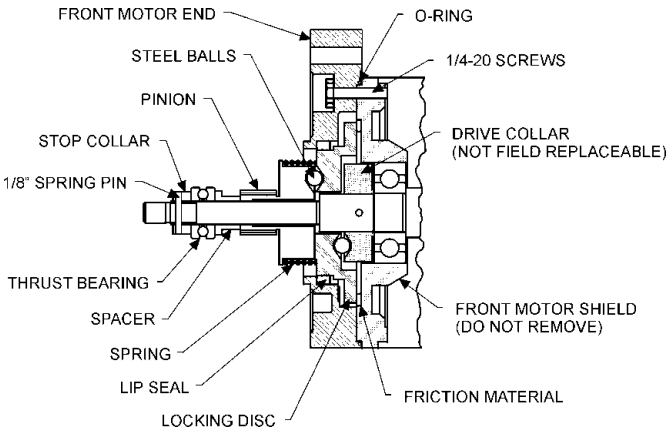
TABLE 6

MOTOR PART NO.	SLM FRICTION KIT	SLM REBUILD KIT
20-2201-22, -23	12-8060-01	12-8060-11
20-2201-32, -33	12-8060-03	12-8060-13



MOTORS 20-2201-22 & -23

Figure 10



MOTORS 20-2201-32 & -33

Figure 11

HANDSWITCH

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. Do not over torque. Replace the terminal cover. Torque bolts to 10 lb-ft. Handswitch part number is 20-3300-07.

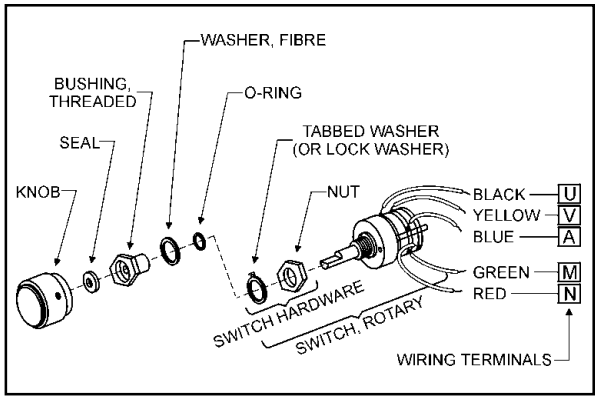


Figure 12

ESR-4 BOARD

Field service of the ESR-4 board is not recommended. The factory maintains a stock of replacement boards for immediate shipment. To replace the ESR-4 board, open the Electronic Signal Receiving compartment cover (1/2" bolt heads). Loosen the four captive thumb 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 with a rocking motion.

To install an ESR-4 board, lightly press the board connector into its receptacle until the mounting bracket is flush with its mounting surface. Tighten the four captive screws and replace the compartment cover. Torque cover bolts to 10 lb-ft.

CPS-2

Field repair of the CPS-2 assembly is not recommended. The factory maintains a stock of replacement assemblies for immediate shipment. If it is necessary to replace the CPS-2, replace both the rotor and stator / circuit board assembly. When returning the CPS-2 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-2:

1. Run the control drive 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°.)

Continued

CPS-2, CONT'D.

2. Disconnect 120 V ac power to the drive. Remove the terminal compartment and control end covers (1/2" bolt heads).
3. Record the wire colors on the terminal block of the CPS-2 (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-2.
5. Loosen and remove the 3 hex studs that clamp the CPS-2 in place. Support the inboard hex stud with a wrench as the outboard stud is loosened.
6. Slide the CPS-2 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-2:

1. Remove the rotor from the replacement CPS-2 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-2 assembly over the studs and rotor. Replace the hex nuts but do not tighten. Carefully slide the rotor back into the CPS-2 assembly. Twist the rotor while sliding to prevent damage to the assembly. Tighten hex nuts to 5 lb-ft.
3. Thread the wires through the wire holes in the CPS-2 and reconnect them to the transformer and terminal boards.
4. Restore 120 V ac power to the drive 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" feeler gauge between the rotor clamp and stator. Position the clamp 0.031" 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 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-4 Board. No lamps lit on ESR-4 board.	a. Handswitch left in wrong position. b. No 120 V ac line supply. c. Fuse F-1 open. d. External auto / man switch in wrong position (Position-AII). e. ESR-4 board failure. f. Jumpers between terminals F-N and D-M are not connected.	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-4 circuit board. See page 41. f. Connect jumpers.
2. Control drive will not run in either direction with input signal applied to ESR-4 board. CPS-2 LED light out and jumper removed from monitor board relay.	a. No power. b. Control drive positioned beyond calibrated limits. c. CPS-2 rotor position not set properly. d. CPS-2 not calibrated correctly. e. CPS-2 failure.	a. Check power source. Check CPS-2 power supply voltage. Check CPS-2 power transformer. b. Position drive with Handwheel and check limit switch settings. c. Set CPS-2 rotor position. See page 41. d. Calibrate CPS-2. See page 30. e. Replace CPS-2. See page 41.
3. Control drive runs in one direction only in auto, and both directions with Handswitch in FWD and REV.	a. ESR-4 zero adjustment incorrect. b. Handswitch failure. c. Loss of input signal with “Drive to Zero” or “Drive to full travel” selected. d. ESR-4 circuit board failure. e. Loss of feedback signal.	a. Readjust ESR-4 zero. See Input Signal Calibration, page 34. 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-4 circuit board. See page 41. e. Check signal from CPS-2 or potentiometer at TP3 on ESR-4.
4. Loss of ESR-4 signal lamp lights (red LED) with input signal applied.	a. ESR-4 zero adjustment incorrect. b. Input signal reversed. c. ESR-4 circuit board failure. d. Incorrect film potentiometer setting. e. Control signal wired through CPS-2 monitor relay.	a. Readjust ESR-4 zero. See Input Signal Calibration, page 34. b. Check polarity or input signal. Terminal AA (+), Terminal BB (-). c. Replace ESR-4 circuit board. See page 41. d. Reset film potentiometer. See page 30. e. Control drive position beyond calibrated range. Use Handswitch or Handwheel to put drive within normal operating range.

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
5. Control drive runs in the wrong direction with input signal applied.	a. Input signal reversed. b. Drive configured for wrong direction of travel.	a. Check polarity of input signal. Terminal AA (+), terminal BB (-). b. See page 28 for changing direction of travel.
6. Control drive does not follow input signal until maximum or minimum signal is reached, then drives uncontrollably to limit.	a. Yellow and black wires on FL and RL limit switches reversed or potentiometer end connections reversed. b. CPS-2 feedback out of phase with control motor.	a. Change direction of travel; see page 28. Check correct film potentiometer connections; see Table 4, page 28. b. Restore proper phasing of CPS-2 feedback with control motor. See page 30.
7. Control drive motor oscillates in auto mode.	a. Feedback potentiometer dirty. b. Excessive noise on input signal. c. Physical obstruction (e.g., valve jammed or load greatly exceeds rating of drive). d. ESR-4 circuit board failure. e. Excessive wear in gear train or bearings.	a. Clean or replace potentiometer. b. Check setting of input filter. May require increased deadband setting if oscillation remains with maximum filter setting; see page 36. c. Check operation with Handswitch and remove obstruction if present. Handswitch bypasses ESR-4 board. d. Replace ESR-4 circuit board. See page 41. e. Replace worn drive train parts.
8. Control drive motor erratic or runs in wrong direction in automatic or manual operation.	a. Control motor winding open. b. Control motor capacitor shorted or open. c. Control motor resistor open.	a. Replace control motor. See page 39. b. Replace capacitor. See page 39. c. Replace resistor. See page 39.
9. Control drive will not run in either direction or one direction in automatic or manual operation.	a. Limit switch failure. b. Handswitch failure.	a. Replace limit switch. See page 40. b. Replace Handswitch. See page 41.
10. Control drive erratic while driving from 100° to 0° and runs normally from 0° to 100° in auto.	a. Feedback potentiometer dirty. Loss of feedback voltage drives the unit in FWD direction.	a. Clean feedback potentiometer with mild soap and water.
11. Control drive runs uncontrollably to some position, then oscillates.	a. Feedback potentiometer open.	a. Replace feedback potentiometer.
12. Control drive does not stop at normal or desired limit of shaft travel.	a. ESR-4 span or zero adjusted incorrectly. b. Limit switches adjusted incorrectly. c. Loss of input signal. Check LED on ESR-4 circuit board.	a. Recalibrate ESR-4 board. See page 34. b. Readjust limit switches. See page 26. c. Restore input signal to control drive.

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
12. Control drive does not stop at normal or desired limit of shaft travel (cont'd.).	d. Limit switch failure. e. CPS-2 calibration incorrect.	d. Replace limit switch. See page 40. e. Calibrate CPS-2. See page 31.
13. Loss of input signal feature does not function.	a. CPS-2 equipped control drive used with ESR-4 board calibrated for slidewire. b. Incorrectly set potentiometer. c. CPS-2 calibration incorrect.	a. Reconnect R22 and R39 resistors and recalibrate. See page 34. b. Reset potentiometer. See page 30. c. Calibrate CPS-2. See page 31.
14. Control drive runs to FWD limit with small change in input signal.	a. Feedback potentiometer power supply shorted. b. ESR-4 circuit board failure of 2.7 V power supply (feedback potentiometer only). c. Wiper and low end of feedback potentiometer reversed. d. Open potentiometer element. e. CPS-2 feedback out of phase with control motor.	a. Check potentiometer and wiring for shorts. b. Replace ESR-4 circuit board. See page 41. c. Check wiring on feedback potentiometer for proper connections. d. Replace potentiometer. e. Restore proper phasing of CPS-2 feedback with control motor. See page 30.
15. Control drive runs to 100% and stays.	a. Handswitch left in FWD position. b. Potentiometer open or complete loss of contact with wiper. c. Loss of input signal when FWDLOS is selected. ESR-4 LED on. d. ESR-4 zero adjustment incorrect. e. ESR-4 circuit board failure. f. CPS-2 feedback out of phase with control motor. g. Jumper between terminal F-N not connected. h. Reverse limit switch failure.	a. Return Handswitch to auto position. b. Check potentiometer and replace if necessary. c. Restore input signal to drive. d. Readjust ESR-4 zero. See Input Signal Calibration, page 34. e. Replace ESR-4 circuit board. See page 41. f. Restore proper phasing of CPS-2 feedback with control motor. See page 30. g. Connect jumper. h. Replace limit switch. See page 40.
16. Control drive travel very nonlinear — a. e.g., 4–19 mA change on input causes drive 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%. c. Output is 25% with 50% input signal, but OK at 0% and 100% inputs.	a. Wiper and high end of feedback potentiometer reversed. b. CPS power supply failure. c. Drive has square function ESR-4.	a. Check feedback potentiometer for proper connections. b. Check CPS power supply voltage. See 21-b of this chart.

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
17. L.O.S. operates at too high a signal level.	a. Special requirement.	a. Change L.O.S. trip point. See page 36.
18. CPS-2 LED goes out during normal travel.	a. CPS-2 not calibrated correctly.	a. Calibrate CPS-2. See page 31.
19. Potentiometer or CPS-2 output decreases when it should increase.	a. CPS-2 rotor position not set for proper calibration. b. End connections on potentiometer reversed.	a. Reset CPS-2 rotor position. See page 41. b. See potentiometer calibration, page 30.
20. CPS-2 output nonlinear.	a. CPS-2 rotor position not set properly. b. CPS-2 zero potentiometer misadjusted.	a. Reset CPS-2 rotor position. See page 41. b. Refer to factory.
21. CPS-2 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 power supply failure. c. CPS-2 rotor not set properly. d. CPS-2 zero potentiometer misadjusted.	a. Check load resistance against suggested feedback signal terminal hook-up. See Table 12, page 50. b. Check line voltage at CPS-2 transformer terminals 1 and 3. Check CPS-2 voltage at resistor. Check CPS-2 power supply voltage across capacitors C8 (13 V, except -05:15 V), C9 (15 V), C10 and C11 (28 V). c. Reset CPS-2 rotor position. See page 41. d. Refer to factory.
22. CPS-2 out of calibration.	a. CPS-2 zero potentiometer inadvertently reset.	a. Refer to factory.
23. Control drive does not stay in place with power off.	a. SLM friction surface worn.	a. Replace SLM friction surface. See page 40.
24. Control motor runs but output shaft does not move in one or both directions.	a. SLM failure.	a. Replace control motor. See page 39.
25. Control drive equipped with Modulating Option 5 or 6 and an optional Relay Board does not run reliably in one or both directions in AUTO.	a. Controller output requires a greater holding current than the Relay Board load draws.	a. Check the controller output required AC holding current. If greater than 10 mA, additional load must be provided. See page 37.
26. Control drive equipped with Modulating Option 5 or 6 and an optional Relay Board does not run reliably in one or both directions in AUTO.	a. Controller output requires a greater load current than that provided by the Relay Board.	a. Check minimum AC load requirement of controller. If greater than 10 mA, additional load must be provided. See page 37.

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 control drive is required. The types of parts are listed in Table 7, below.

HOW TO ORDER SPARE PARTS

Select the needed spare parts from Table 7, 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 7
RECOMMENDED SPARE PARTS

DESCRIPTION	PART NO.	DESCRIPTION	PART NO.
Limit switch assembly	20-3202-10	Relay board (Model 11-435 and 11-436 only)	13-2245-XX (See Table 1, page 10, for part no. based on input signal)
Auxiliary switch assembly (2 switches)	20-3202-11		
(4 switches)	20-3202-12		
Gasket set	20-3110-03	CPS-2 (Model 11-436 and 11-438 only)	20-3400-XX (See Table 1, page 10, for part no. based on output signal)
Control Motor	See Table 9		
Motor resistor	See Table 9		
Motor capacitor	See Table 9		
Film potentiometer (Model 11-435 and 11-437 only)	20-3060-03	SLM Taper Cone (Motor 20-2201-22, -23)	12-8060-01
		SLM Flat Disc (Motor 20-2201-32, -33)	12-8060-03
ESR-4 circuit board (Model 11-437 and 11-438 only)	13-2245-XX (See Table 1, page 10, for part no. based on input signal)		

TABLE 8
MOTORS, CAPACITORS, AND RESISTORS

MOTOR PART NO.	VOLTAGE	HERTZ	AMP.	CAPACITOR PART NO.	VALUE	RESISTOR PART NO.	VALUE
20-2201-22, 32	120	60	2.20	14-2840-15	25 µf	20-1971-04	37.5 Ω *
		50	2.20	14-2840-05	8 µf	20-1971-04	37.5 Ω *
				14-2840-15	25 µf		
20-2201-23, 33	120	60	3.00	14-2840-15	25 µf	20-1971-06	18 Ω *
				14-2840-09	6 µf		
		50	3.00	14-2840-15	25 µf	20-1971-10	24 Ω *
				14-2840-05	8 µf		
				14-2840-09	6 µf		

*This is a resistor assembly.

TABLE 9
MODEL 11-400 GEARS

SPUR GEARING RATIO / 1	STROKING SPEED sec / 100°			GEAR PART NUMBER		
	MOTOR					
	20-2201-23, -33	20-2201-22, -32				
	60 Hz 120 RPM	60 Hz 72 RPM	50 Hz 60 RPM	GEAR MODULE GEAR SET	OUTPUT SHAFT ASSEMBLY	THIRD COMB. GEAR
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*

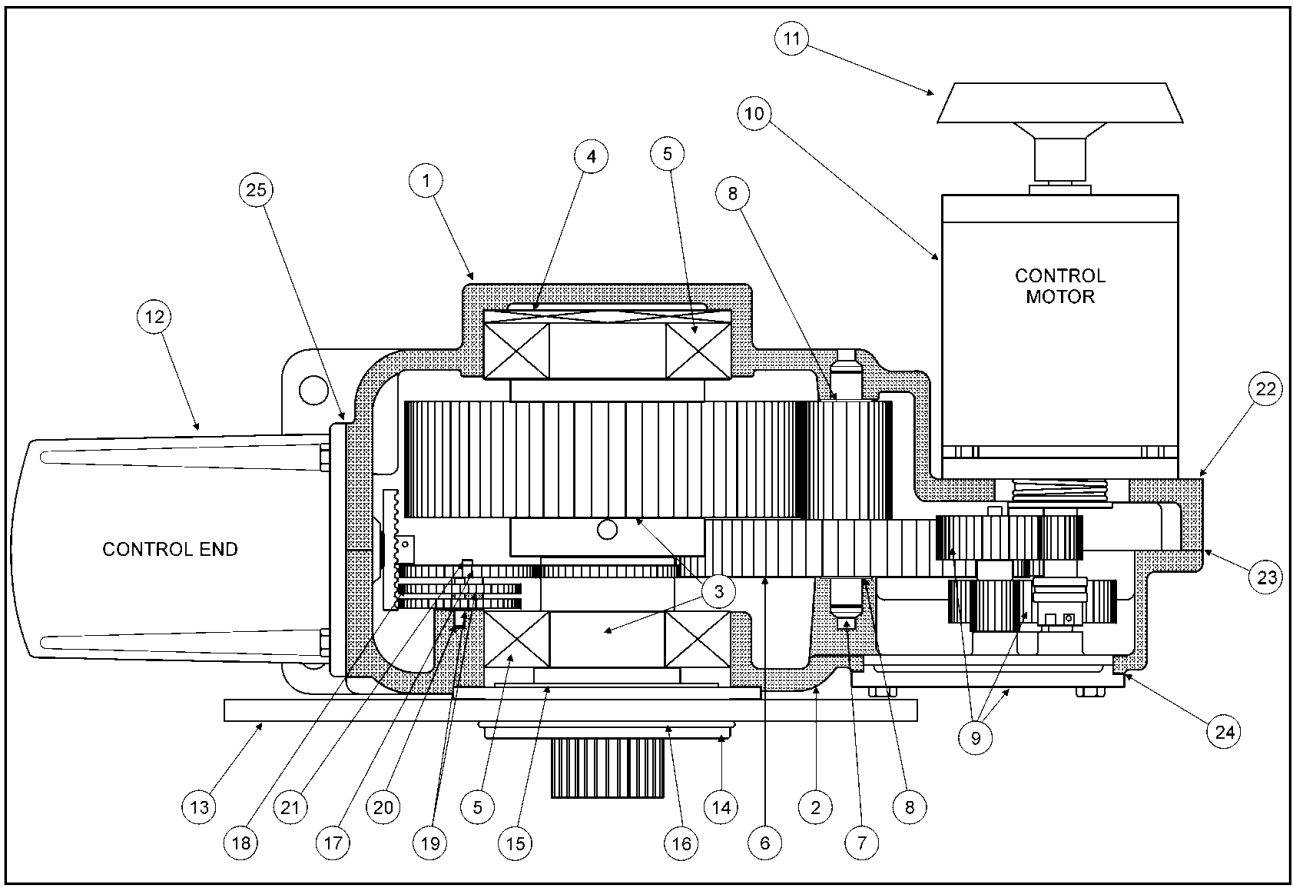


TABLE 10
DRIVE COMPONENTS*

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 9, page 47, for a complete list of part numbers	21	Pin, 1st combination spur gear
		22	Gasket, control motor
10	Control motor, see Table 8, page 47, for a complete list of part numbers	23	Gasket, body
		24	Gasket, change gear plate
11	Handwheel, 6 1/2" O.D.	25	Gasket, control end cover
12	Control end cover		

*To ensure exact replacement parts, include all nameplate data of the Beck drive with the order.

APPENDIX *CPS-2 DATA*

TABLE 11
CPS-2 SYSTEM APPLICATION DATA SUMMARY

FEEDBACK SIGNAL OPTIONS	CPS-2 MODEL	EXTERNAL LOAD RESISTANCE	COMPATIBLE CONTROL SYSTEMS
CURRENT			
4-20 mA	20-3400-02 & -12 20-3400-03 & -13*	800 Ω (Max.) 500 Ω (Max.)	Industry Std (ISA
10-50 mA	20-3400-03 & -13*	200 Ω (Max.)	Foxboro
1-5 mA	20-3400-03 & -13*	2 K Ω (Max.)	General Use
VOLTAGE			
1-5 V dc	20-3400-02 & -12 20-3400-03 & -13*	12 K Ω (Min.) 250 Ω (Min.)	Industry Std (ISA) & Beck Position-All (27-301, -401, -501)
0-5 V dc	20-3400-03 & -13*	250 Ω (Min.)	Leeds and Northrup
0-10 V dc	20-3400-03 & -13*	1 K Ω (Min.)	Bailey, Foxboro, & Westinghouse
0-16 V dc	20-3400-03 & -13*	1 K Ω (Min.)	Leeds and Northrup
0-15 V dc	20-3400-04 & -14	6 K Ω (Min.)	Leeds and Northrup
-10 to +10 V dc	20-3400-05 & -15	2 K Ω (Min.)	Bailey

*The 20-3400-03 and -13 may be connected for signal ranges so noted. See Wiring Diagrams on pages 16-17 for details.

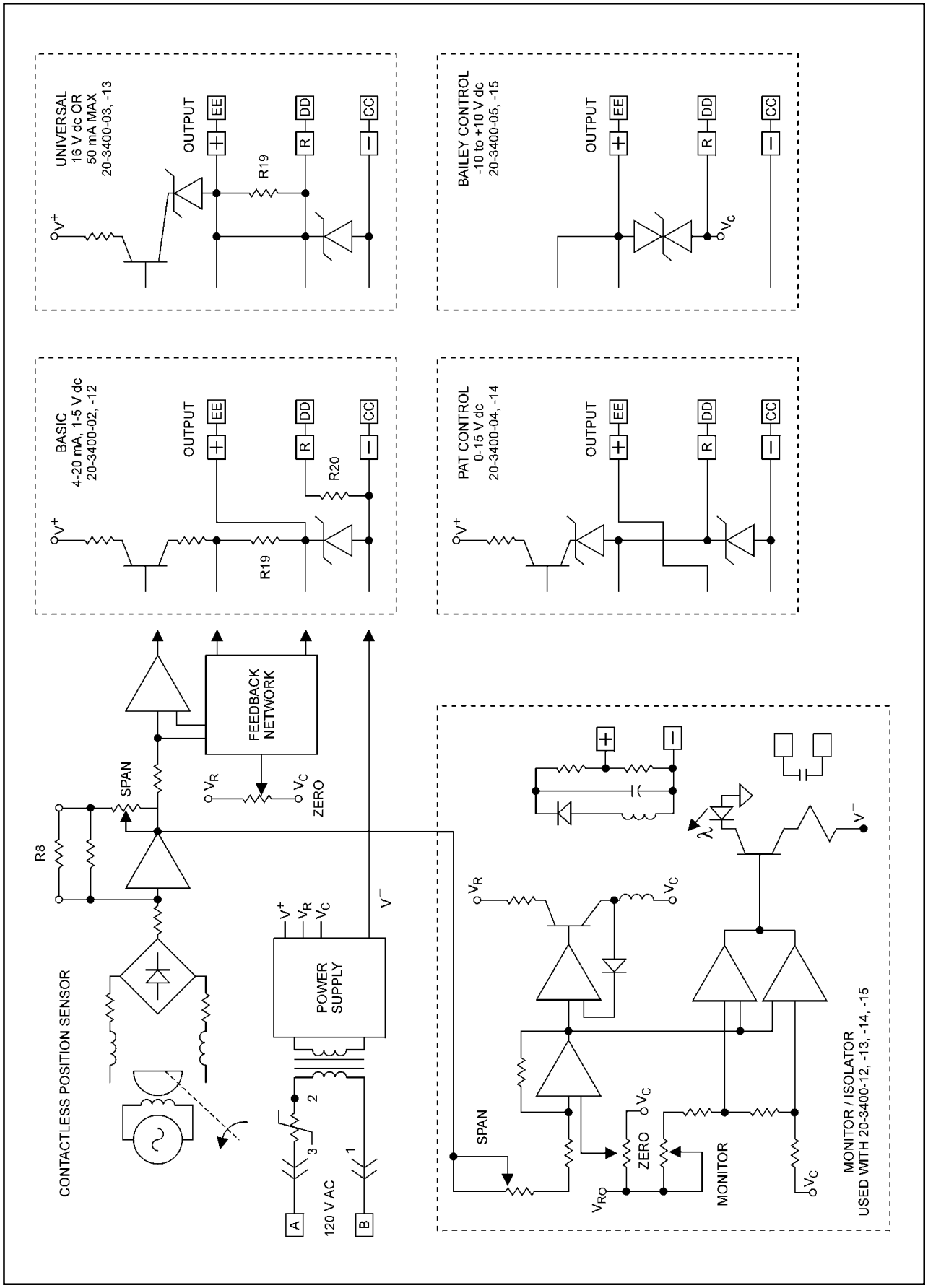
APPENDIX *CPS-2 DATA*

TABLE 12
CPS-2 SIGNAL OUTPUT TERMINAL CONNECTIONS AND LOADING

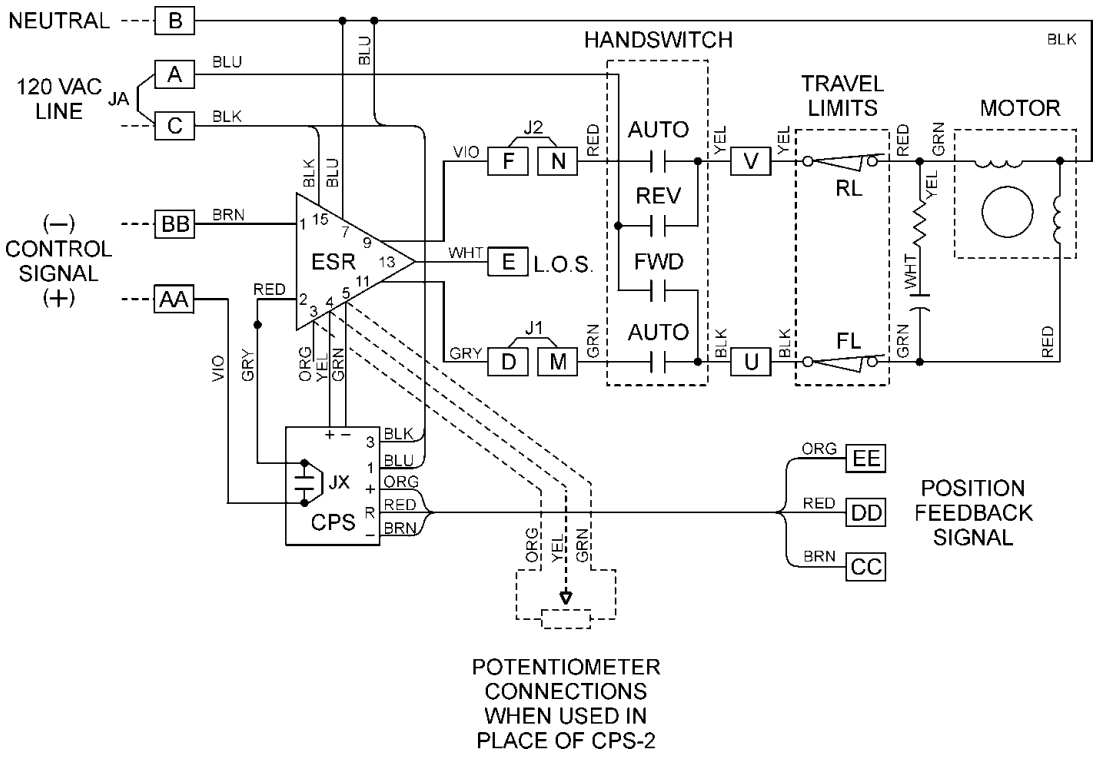
SIGNAL RANGE	OUTPUT TERMINALS (+) (−)	RANGING RESISTOR VALUE	RANGING RESISTOR BECK PART NO.	RESISTOR CONNECTIONS	MAXIMUM EXTERNAL LOAD
Model 20-3400-02 & -12					
4 to 20 mA	EE - CC	Open			800Ω
4 to 20 mA	EE - DD	Open			500Ω
1 to 5 V dc	DD - CC	Open			400 µA
One or Two					
1 to 5 V dc	DD - CC	255Ω	13-2511-03	DD - EE	400 µA
Signals	EE - DD	Open			400 µA
Model 20-3400-03 & -13					
Current Output					
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
Voltage Output					
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	1.50 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
Model 20-3400-04 & -14					
0 to 15 V dc	DD - CC	Open			2.5 mA
15 to 0 V dc	EE - DD	Open			2.5 mA
Model 20-3400-05 & -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-2 FUNCTIONAL BLOCK DIAGRAM*



CONTROL DRIVE ELECTRICAL SCHEMATIC



TYPICAL SCHEMATIC FOR CONTROL OPTION 7 OR 8

NOTES

INDEX

SERVICES

PRODUCT DEMONSTRATIONS

Each of Beck's Sales Engineers has access to a complete set of drive models so that he can demonstrate virtually any of their features at your location. In order to arrange to see a Beck drive 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, identify the material with your company name, billing and shipping addresses, and a purchase order 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.

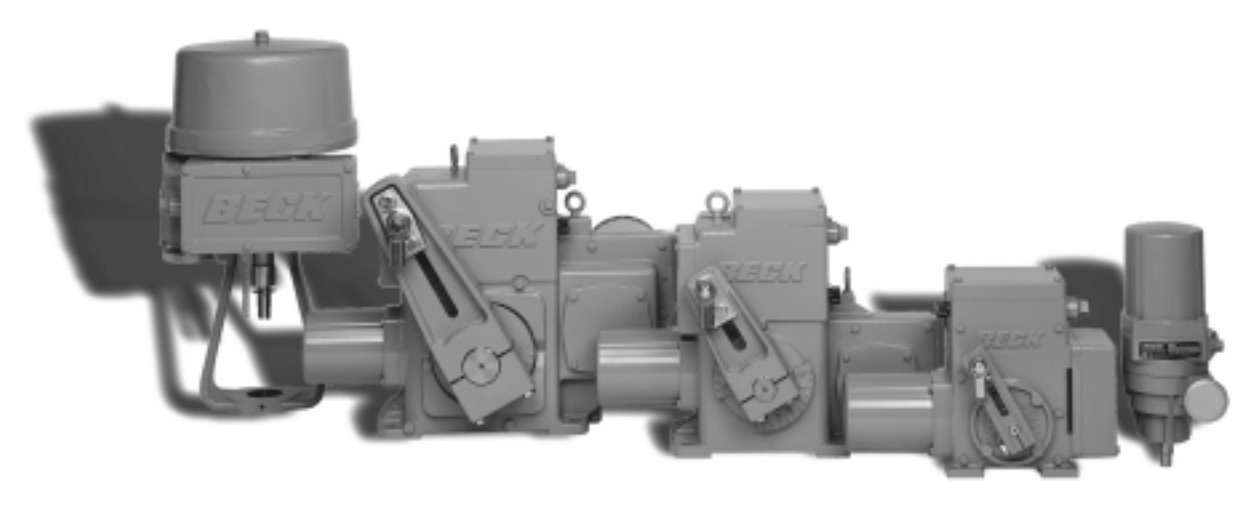
WARRANTY STATEMENT

The Seller warrants that the equipment sold hereunder shall conform to Seller's standard specifications. The Seller warrants said equipment to be free from defects in materials and workmanship. This warranty applies to normal recommended use and service for one year from the date on which the equipment is shipped. The Seller's obligation under this warranty, and Buyer's exclusive remedy, will be the repair or replacement, without charge, at the Seller's factory, of any defective equipment covered by this warranty. In no event will the Seller's liability exceed the contract price for the goods claimed to be defective.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF THE SELLER INCLUDING INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES.

Buyer acknowledges its responsibility under OSHA, related laws and regulations and other safety laws, regulations, standards, practices or recommendations which are principally directed to the use of equipment in its operating environment. Buyer acknowledges that the conditions under which such 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 Seller's control. BUYER HEREBY AGREES TO INDEMNIFY SELLER AGAINST ALL CLAIMS, DAMAGES, COSTS OR LIABILITIES (INCLUDING, BUT NOT LIMITED TO, ATTORNEYS' FEES AND OTHER LEGAL EXPENSES), WHETHER ON ACCOUNT OF NEGLIGENCE OR OTHERWISE, EXCEPT THOSE CLAIMS BASED SOLELY UPON THE NEGLIGENCE OF SELLER AND THOSE CLAIMS ASSERTED BY SELLER'S EMPLOYEES WHICH ARISE OUT OF OR RESULT FROM THE OPERATION OR USE OF THE EQUIPMENT BY SELLER'S EMPLOYEES.

Beck Control Drives are covered by the following patents: 3,667,578 and 4,690,168.



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