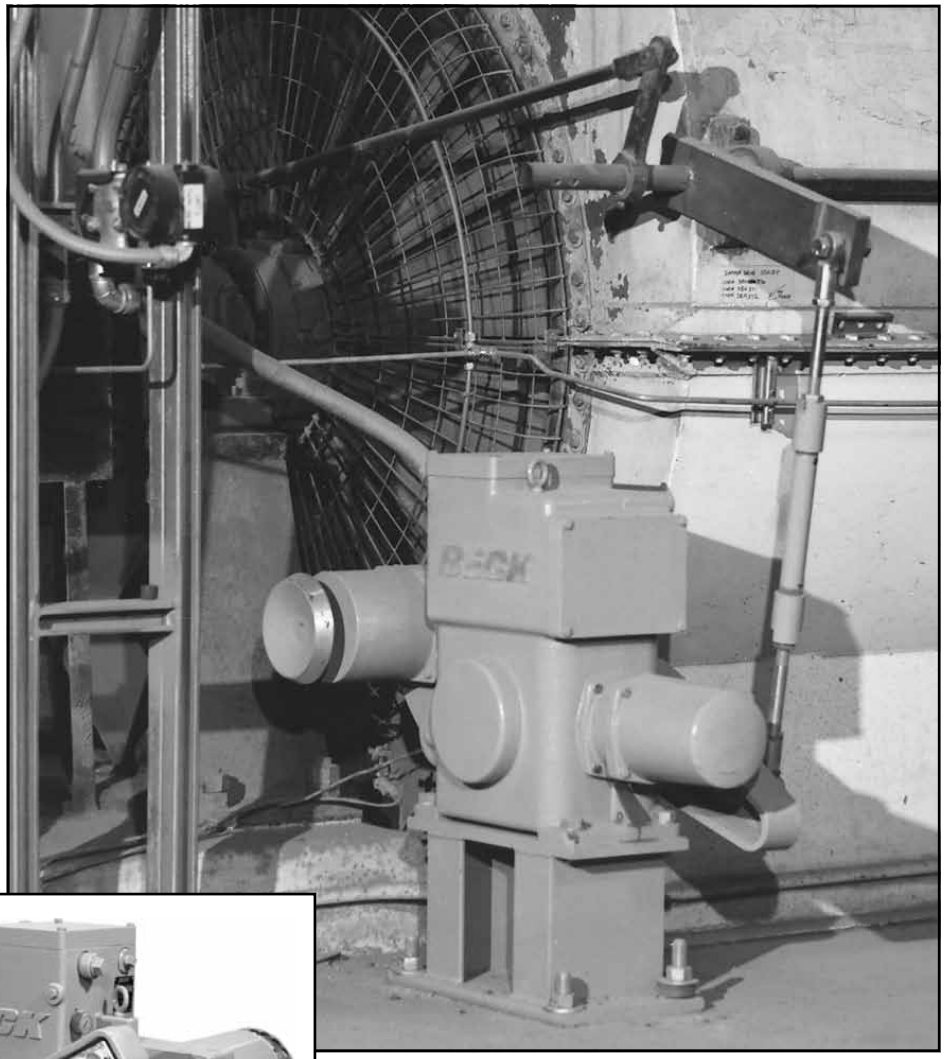
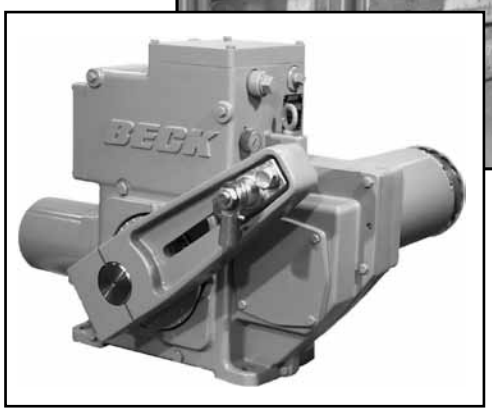
80-1100-03
Rev. 16.6

MODELS 11-15_
11-20_
11-30_
11-40_

BECK®

INSTRUCTION MANUAL





For actuators built after September 1999 with CW / CCW Handswitch

ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

This manual contains the information needed to install, operate and maintain the Beck 11-150, 11-200, 11-300 and 11-400 Electronic Control Drives, manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

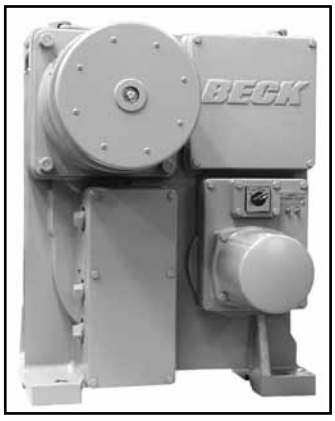
The Group 11 drive is a powerful control package designed to provide precise position control of dampers, valves, fluid couplings and other devices requiring up to 1,800 lb-ft (2 440 N•m) of drive torque.

IMPORTANT: This manual contains 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 your drive.

This manual also applies to Group 11 & 11E hazardous location drives and, with such orders, is provided along with Beck Manual Supplement 80-1100-14.

The Beck Group 11 fills an industry need for a reliable electronic control drive. Exceptionally stable and trouble-free, these rotary drives are in use throughout the world in valve and damper applications.

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 22 digital control drives ...
are designed for accurate, reliable, modulating, digital control of high torque applications. The drive is ideal for use in large boiler applications, such as ID/FD fan dampers.

Group 29 linear valve drives ...
are ideally suited for globe valves from 1" to 8" (25 mm to 203 mm) diameter. Beck's unique "Tight-Seater™" coupling provides positive seating of valves.

Group 31 compact rotary drives ...
are particularly suited for coupling to ball, plug, and butterfly valves up to 4" (102 mm) diameter, and small dampers.

CONTENTS

PRODUCT DESCRIPTION

Beck control drives are engineered for precise, reliable operation of dampers, quarter-turn valves and fluid drives. 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 23 for stall protection and annunciation information). Gear modules and motors can be interchanged in the field to alter the torque and timing as needed if the application requirements change. Mechanical stops in the gear train prevent overtravel.

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

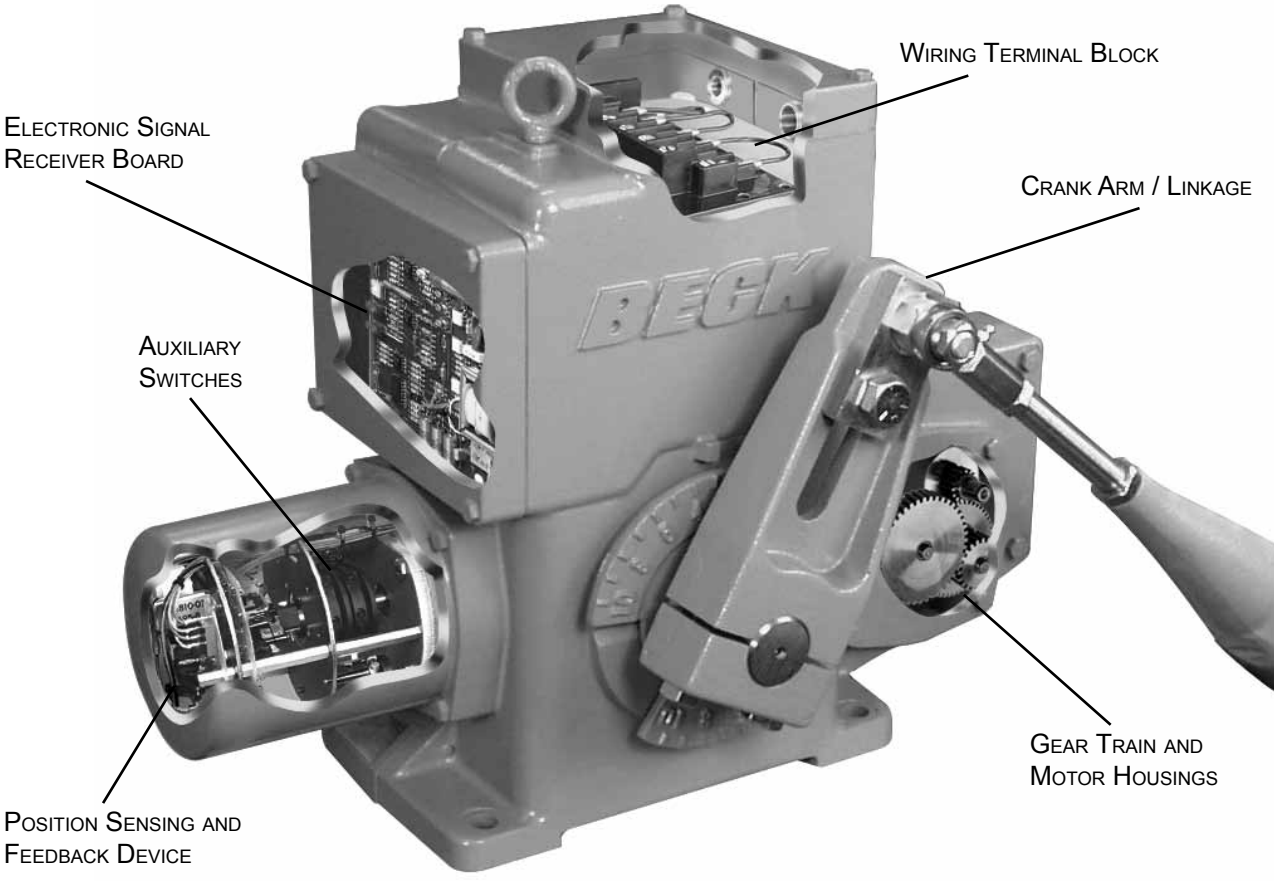
Dampers and valves may also be operated at their individual locations with built-in electric Handswitches.

The heavy-duty crank arm of these control drives can be field-adjusted to travel anywhere in the 360° range. The forged rod end fitting may be field-adjusted to any point in the cast slot of the crank arm. Special linkage arrangements allow total application versatility for connection directly on or remote from the driven load.

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 full control drive travel.

Beck electronic control drives are designed with individual weatherproof enclosures to protect the main components. The cutaway illustration below is intended to provide the user with a basic orientation to the product.

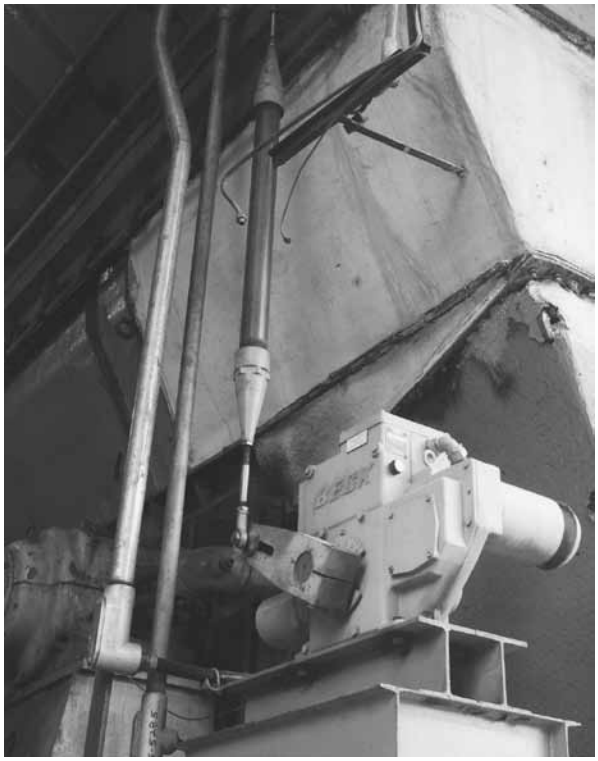


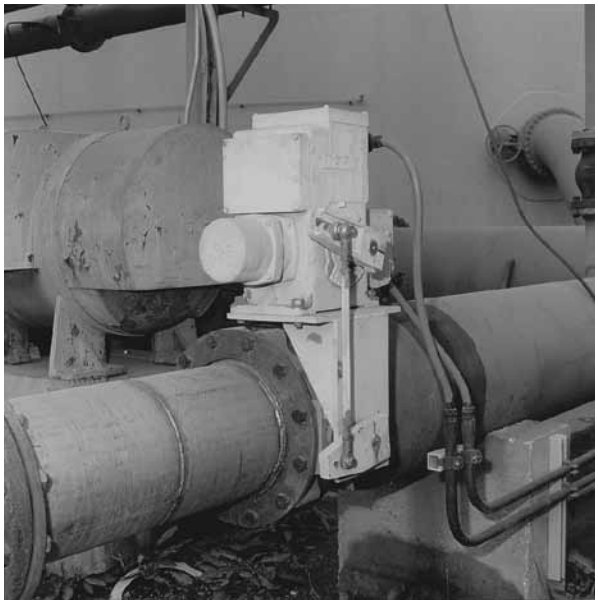
TYPICAL APPLICATIONS

Beck control drives are ideally suited for use on ball, plug and butterfly valves, as well as dampers and fluid drives. When equipped with a sheave and multi-turn option (consult your Beck Sales Engineer for details), the drive can be used to raise and lower a weight-balanced damper.

Beck drives are designed for precise position control in modulating applications, and also for dependable long-term operation in two-position (open / close) applications (see page 11 for control options). The drive is best utilized when its full 100° travel is employed to achieve its greatest sensitivity and resolution, although the driven device may operate through a considerably smaller range. Beck drives can be configured with special linkage to deliver greater torque where needed, so that drive size and resultant cost can be minimized.

Valves can be furnished by Beck as unitized assemblies with control drives mounted and tested in the factory. Also, drives may be installed in the field with mounting hardware furnished by Beck or the customer. Drives for dampers are generally installed at the site on a mounting platform separate from the damper.





BECK LINKAGE KITS

Beck hex and pipe linkage kits are available for completing the mechanical connection from the drive crank arm to the load. Through the use of a 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 drives are furnished with a crank arm and rod end (see pages 8–10 and 20 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” (38 mm) without removal of the crank arm or load lever, making final mechanical calibration simple.

PRODUCT DESCRIPTION

GENERAL SPECIFICATIONS—ALL MODELS

Drive Power	120 V ac, single-phase, 60 Hz (standard), 50 Hz (optional) 208, 240, 380, 415, 480 & 575 V ac, 50 or 60 Hz (optional)	Allowable Tolerance: +10% - 15%

		Max. Current (Amps) by Supply Voltage (V ac)						
		Voltage						
Model	**Power (W)**	**120**	**208**	**240**	**380**	**415**	**480**	**575**
11-150	50	0.45	0.26	0.23	0.14	0.13	0.11	0.09
11-200 11-300	104	0.88	0.51	0.44	0.28	0.25	0.22	0.18
11-400	400	3.10	1.79	1.55	0.98	0.89	0.78	0.65

Operating Conditions	-40° to 185°F (-40° to 85°C) 0 to 100% relative humidity
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 to 10 V dc
Input Signal Span Adj.	50% to 400% of span (except -10 to 10 V dc)
Input Signal Zero Adj.	-100% to +275% of span (except -10 to 10 V dc)
Dead band	0.6% of span (recommended dead band for most applications). Narrower and wider dead bands are available.
Sensitivity	25% of dead band
Direct AC Control	120 V ac for 2-position, multi-position or modulating V ac control
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 to +10 V dc
Output Stability	0.25% of span from 102 to 132 V ac ±0.03% of span/°C for 0 to 50°C, ±0.05% of span/°C for -40° to 85°C
Linearity	±1% of span, max. independent error
Hysteresis	0.25% of span at any point
Isolation	Max. leakage of 10 µA at 60 V rms, 60 Hz from output to ground
Film Potentiometer	1,000 ohms
Max. Voltage	40 V
Wattage	2 W max.
Linearity	±0.5%
Max. Wiper Current	1 mA

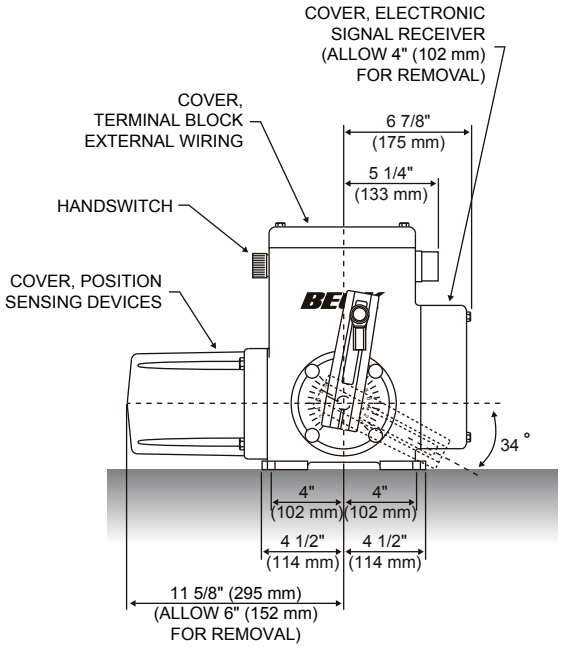
GENERAL SPECIFICATIONS—ALL MODELS (cont'd)

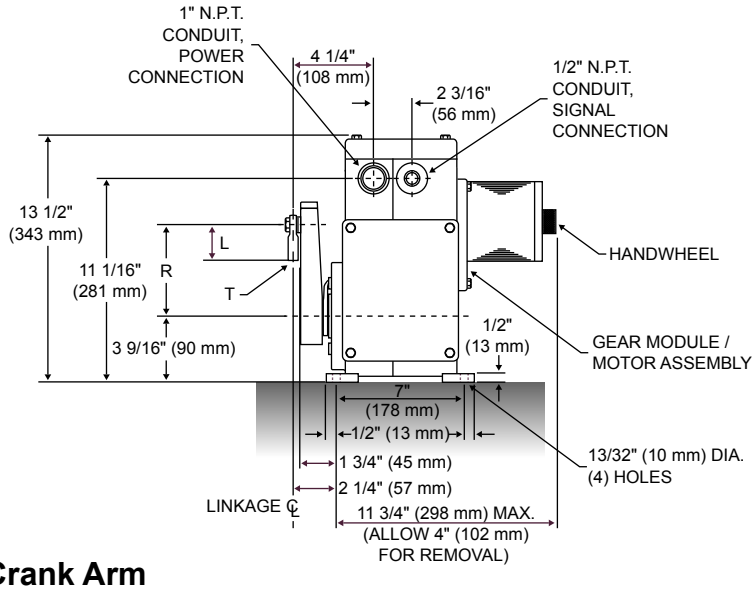
Action on Loss of Power	Stays in place
Action on Loss of Input Signal (Power On)	Stays in place or moves to full travel or zero position. Drives to any preset position with optional switch assembly on Models 11-__7 and 11-__8. Field adjustable.
Stall Protection and Annunciation (Optional)	If the motor tries to run in one direction for more than 300 seconds, the Stall Protection Module will shut off power to the motor and a solid state relay will change state. The relay is rated for 120 V ac or dc, 10 VA.
Limit Switches	Two SPDT, one for CW and one for CCW limit of travel. Control drives having position sensing capability (Options 5 thru 8), have over-travel limit switches set 1/2° outside the CW and CCW travel range (typically, –0.5° and 100.5°). Control drives without position sensing (Options 3 and 4), have end-of-travel limit switches set at the CW and CCW travel range (typically, 0° and 100°).
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1–S4 and are cam-operated, field-adjustable. S1 and S4 are set to operate just before reaching the CCW travel limit. S2 and S3 are set to operate just before reaching the CW travel limit.
Handswitch	Permits local electrical operation, independent of controller signal. Standard on all units. An auxiliary contact is available for auto indication (rated 2.5A at 120 Vac).
Handwheel	Provides manual operation without electrical power.
Motor	120 V ac, single-phase, no-burnout, non-coasting motor has instant magnetic braking. Requires no contacts or moving parts. Can remain stalled for approximately 4 days (cumulative) without damaging the gear train.
Gear Train	High-efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears. Interchangeable gear modules permit field change of torque and timing.
Mechanical Stops	Prevent overtravel during automatic or manual operation.
Enclosure	Precision-machined aluminum alloy castings, painted with corrosion-resistant polyurethane paint, provide a rugged, dust-tight, weatherproof enclosure. Type 4X; IP68, 3 meters/48 hours*. *Internal water damage is not covered by warranty.
Standards*	CSA listed CE compliant

*NOTE: For specific standards, please call Beck for more intormation at 215-968-4600.

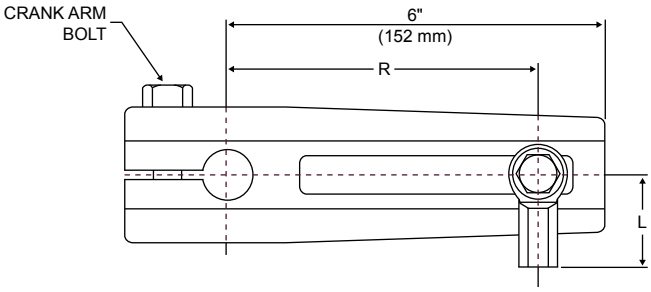
PRODUCT DESCRIPTION

MODEL 11-150 SPECIFICATIONS

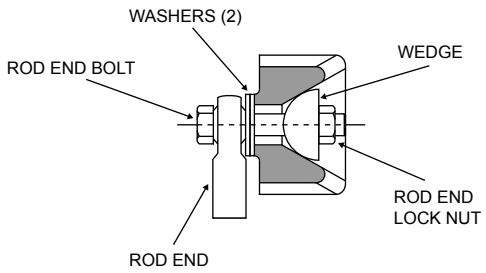




Crank Arm



ADJUSTABLE RADIUS "R" 1 1/2" (38 mm) TO 5 1/8" (130 mm)



Recommended Bolt Torques

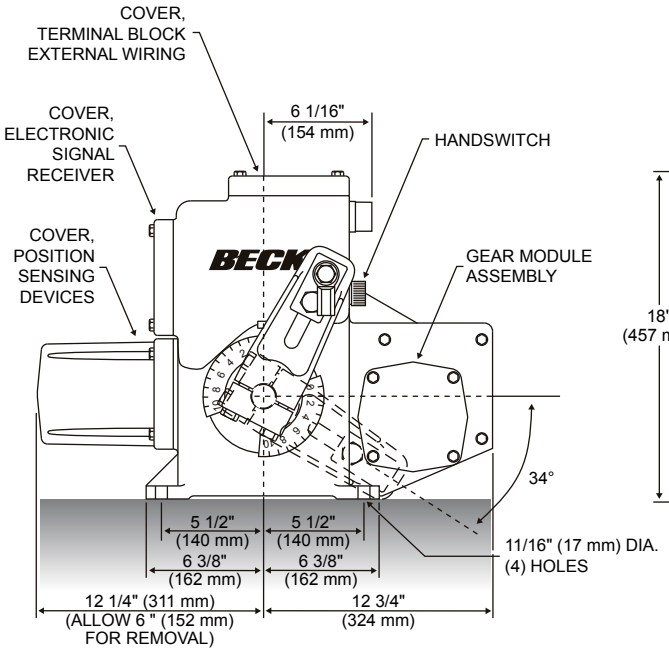
		Torque	
	Size (in.)	(lb-ft)	(N•m)
Crank Arm Bolt	1/2-13	75	102
Rod End Bolt	1/2-13	35	47
Rod End Lock Nut	1/2-13	55	75
Cover Bolts	5/16-18	10	14
Motor/Gear Module Bolts	1/4-20	6	8
Body Bolts	5/16-18	10	14
Body Bolts	3/8-16	20	27

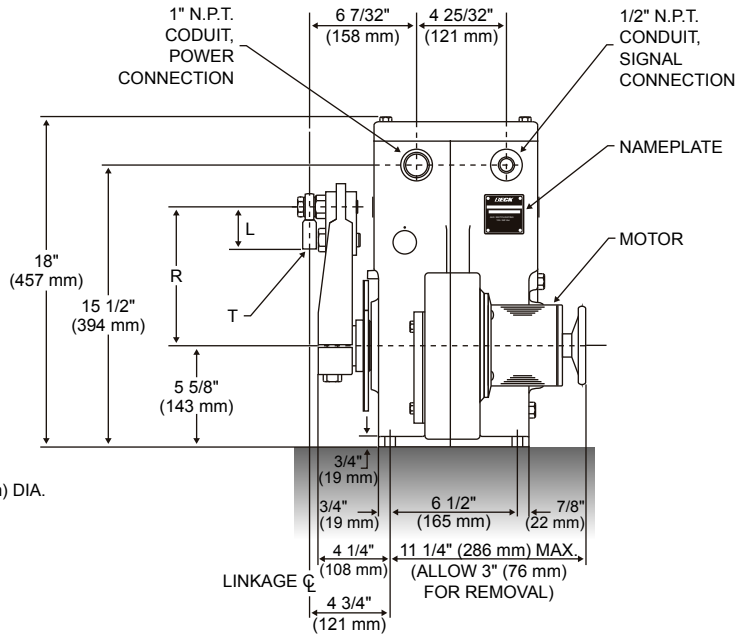
NOTE: All dimensions subject to change.

Model 11-150 Linkage Part Numbers & Model Information

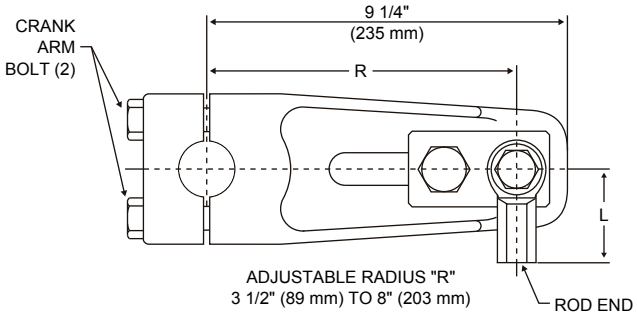
Crank Arm Assembly	10-3491-05
Crank Arm	10-3491-02
Crank Arm Bolt	30-0306-56
Washers (2)	30-0313-03
Wedge	11-8060-02
Rod End Bolt	30-0306-56
Rod End Lock Nut	30-0309-11
Rod End	12-2840-02
Dim. "L" (Length)	2.125" (54 mm)
Dim. "T" (Thread)	1/2-20 x 1-1/8" (29 mm)
Output Shaft Dia.	3/4" (19 mm)
Approx. Weight	50 lbs (23 kgs)
Max. Overhung Load	750 lbs (340 kgs)

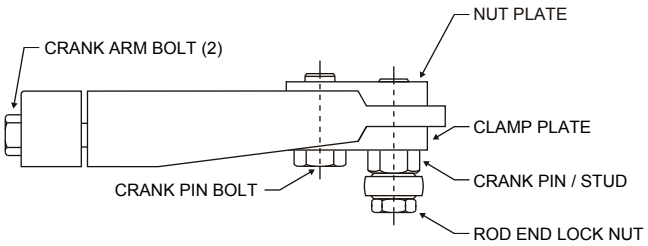
MODEL 11-200 & 11-300 SPECIFICATIONS





Crank Arm





Recommended Bolt Torques

		Torque	
	Size (in.)	(lb-ft)	(N•m)
Crank Arm Bolt	5/8-18	240	325
Crank Pin Bolt/Stud	3/4-16	300	407
Crank Pin Bolt	3/4-16	300	407
Rod End Lock Nut:			
(11-200)	1/2-20	35	47
(11-300)	5/8-18	65	88
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Cover Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Gear Module Bolts	5/16-18	10	14

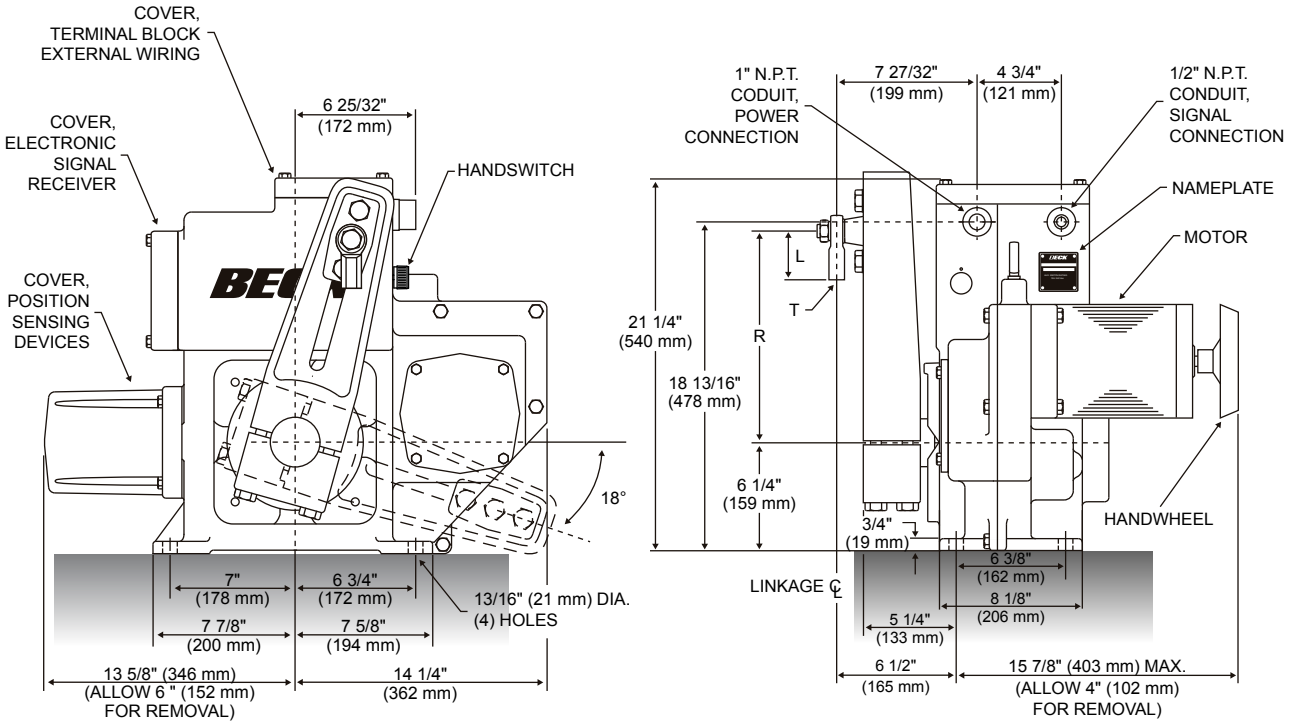
NOTE: All dimensions subject to change.

Model 11-200/-300 Linkage Part Numbers & Model Information

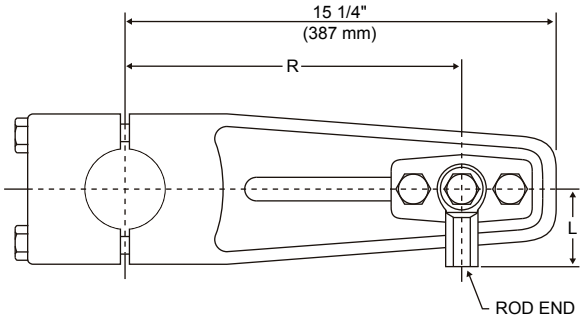
	11-200	11-300
Crank Arm Assembly	14-7330-26	14-8010-34
Crank Arm	14-8008-02	14-8008-01
Crank Arm Bolt (2)	30-0308-75	30-0308-75
Clamp Plate	14-9883-01	14-9883-01
Crank Pin/Stud	14-9920-06	14-9920-07
Crank Pin Bolt	30-0308-61	30-0308-61
Nut Plate	14-9883-02	14-9883-02
Rod End Lock Nut	30-0309-19	30-0309-23
Rod End	12-2840-02	12-2840-03
Dim. "L" (Length)	2.125" (54 mm)	2.5" (64 mm)
Dim. "T" (Thread)	1/2-20 x 1-3/16" (30 mm)	5/8-18 x 1-1/2" (38 mm)
Output Shaft Dia.	1 1/2" (38 mm)	1 3/4" (44 mm)
Approx. Weight	120 lbs (54 kgs)	125 lbs (57 kgs)
Max. Overhung Load	3,000 lbs (1361 kgs)	4,500 lbs (2041 kgs)

PRODUCT DESCRIPTION

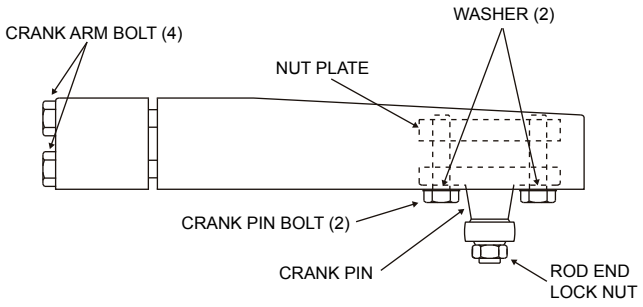
MODEL 11-400 SPECIFICATIONS



Crank Arm



ADJUSTABLE RADIUS "R" 6" (152 mm) TO 12" (305 mm)



Recommended Bolt Torques

		Torque	
	Size (in.)	(lb-ft)	(N•m)
Crank Arm Bolts	5/8-18	170	230
Crank Pin Bolt	3/4-16	300	407
Rod End Lock Nut	3/4-16	120	163
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Cover Bolts	5/16-18	10	14
Motor Bolts	3/8-16	16	22
Gear Module Bolts	5/16-18	10	14

NOTE: All dimensions subject to change.

Model 11-400 Linkage Part Numbers & Model Information

Crank Arm Assembly	14-8018-02
Crank Arm	14-8018-01
Crank Arm Bolt (4)	30-0308-07
Washer (2)	30-0313-27
Crank Pin	14-9882-01
Crank Pin Nut Plate	20-2641-01
Crank Pin Bolt (2)	30-0308-03
Rod End Lock Nut	30-0309-24
Rod End	12-2840-04
Dim. "L" (Length)	2.875" (73 mm)
Dim. "T" (Thread)	3/4-16 x 1 3/4" (44 mm)
Output Shaft Dia.	2 3/4" (70 mm)
Approx. Weight	270 lbs (122 kgs)
Max. Overhung Load	9,000 lbs (4 082 kgs)

TABLE 1:
SUMMARY OF CONTROL OPTIONS

MODEL NUMBER	CONTROL TYPE	INPUT SIGNAL	ESR-4 BOARD NO.	FEEDBACK DEVICE	EXTERNAL OUTPUT SIGNAL	CPS-2 PART NO.	AUXILIARY SWITCH OPTIONS
11-__8	Electronic Modulating	0–5 or 1–5 mA	13-2245-02	CPS-2 Contactless Position Sensor	1–5 V dc or 4–20 mA	20-3400-12	None, 2, 4, 2+INTLOS
					16 V dc or 50 mA max.	20-3400-13	
		4–20 mA	13-2245-03		0–15 V dc	20-3400-14	
					-10–10 V dc	20-3400-15	
		10–50 mA	13-2245-04				
11-__7		1–5 V dc	13-2245-05	1000 ohm Potentiometer 20-3060-03	None, 1000 ohm Aux. Pot.	n/a	None, 2, 4, 2+INTLOS
		-10–10 V dc	13-2245-08				
11-__6	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	20-3400-04	
		Low Power dc	13-2245-51 (Relay Board)		-10–10 V dc	20-3400-05	
11-__5		120 V ac	None	1000 ohm Potentiometer 20-3060-03	1000 ohm Pot.	n/a	None, 2, 4
		Low Power 120 V ac	13-2245-50 (Relay Board)				
		Low Power dc	13-2245-51 (Relay Board)				
11-__4	5 Position	120 V ac	n/a	None	None		None
	4 Position						None
	3 Position						None, 2
11-__3	2 Position Open/Close						None, 2, 4

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 drive should be stored in its shipping carton in a clean, dry area.

If it is necessary to store the drive outdoors for a long period of time, it should be removed from its shipping carton and stored above ground. A waterproof cover should be securely fastened over it. Do not stack drives on top of one another. Stored drives should be periodically checked to make sure no condensation has formed in the control compartments. Damage due to moisture while in storage is not covered by warranty.

UNPACKING

Beck drives are packed in standardized cardboard shipping containers. Drives mounted on valves are strapped to a skid and crated. After unpacking, the wooden platform may be used to transport the drive to the installation site.

INSTALLATION—MECHANICAL

Beck drives may be installed in any convenient orientation, because the gearing does not require an oil bath. Refer to the outline dimension drawings on pages 8–10 for physical dimensions and required clearances.

When installing a Beck drive in a location remote from the damper or valve, be sure it is firmly bolted to a flat mounting surface that will not yield to the stresses created from operating the device. A rigid, vibration-free surface will generally prolong the life of the drive's components.

The output shaft of the drive should be parallel to the damper or valve shaft, and the linkage should be in a plane 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 on the Beck crank arm. The drive's crank arm can be positioned at any angle on the shaft.

Beck drives can be furnished with valves mounted as unitized assemblies ready for pipeline installation. Beck linkage kits are available for convenient field installation (see page 5 for more information on linkage kits).

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 for power and signal wiring to the drive. The 1/2" conduit is provided for signal wiring connections, and the 1" conduit is provided for power and auxiliary switch connections. A sealant must be used on threaded conduit connections to keep moisture out. Conduits should be routed from below the drive so that condensation and other contaminants entering the conduit cannot enter the drive.

Power and signal wires must be routed to the drive separately and be either shielded cables or installed in conductive conduit and/or cable trays.

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 AWG (3.31 mm^2) 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 17, for information on how to change the input signal range.

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

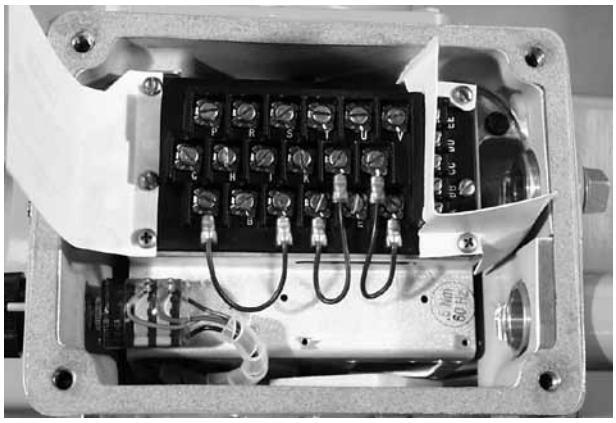
INSTALLATION *DEMAND SIGNAL WIRING*

Each Beck drive is custom built with one of six separate control configurations provided to match the control requirements of your system. Basic wiring connections for each control option are described in the following paragraphs and diagrams.

The wiring diagram specific to each drive is attached to the inside of the wiring terminal cover. See Table 1, page 11, 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 15 and 16.

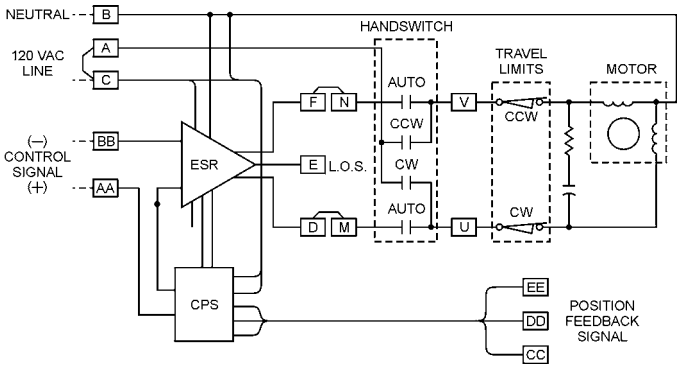
A drive can be ordered with up to four optional auxiliary switches. Wiring connections for these are described on page 24.



Option 8, Modulating

Analog Position Control with Contactless Position Sensing

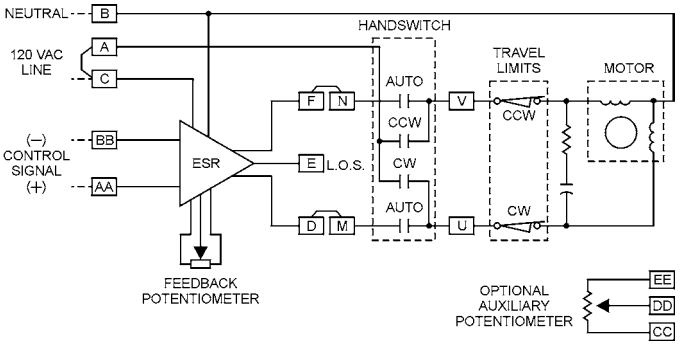
Customer must supply two wires to power the drive: One 120 V ac line (terminal C), and one neutral (terminal B). Customer must supply two wires for the modulating analog control signal: Connect to terminal AA (+) and to terminal BB(-). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 15 and 16 for connections). The drive's feedback circuit power supply is derived from the 120 V ac line, so 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.

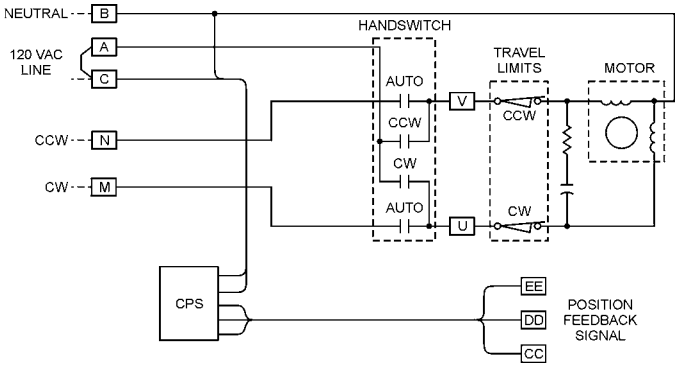


INSTALLATION *DEMAND SIGNAL WIRING*

Option 6, Modulating

Direct AC Control with Contactless Position Sensing

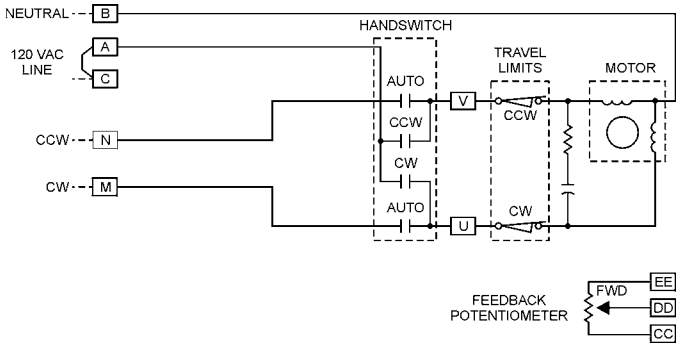
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). Customer may supply two additional wires to monitor the analog position feedback signal (see pages 15 and 16 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

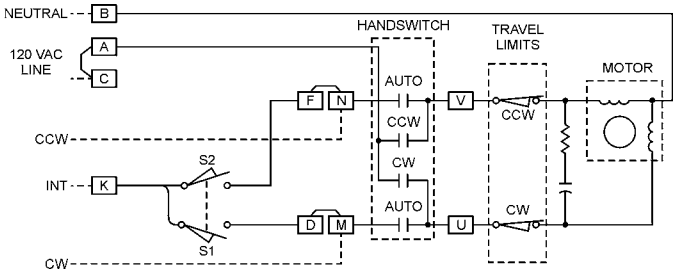
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). The position feedback potentiometer connections are available at terminals CC (reverse), DD (wiper), and EE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



Option 4, Multi-Position

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

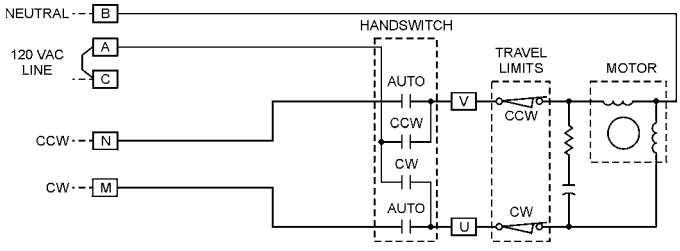
Customer must supply three wires to directly control the drive motor direction: One 120 V ac line to run CW (terminal M), one 120 V ac line to run CCW (terminal N), and one neutral (terminal B). Up to six intermediate stop positions may be specified, each requiring an additional 120 V ac line.



Option 3, Open / Close

Direct AC Control

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



240 V ac Operation

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

INSTALLATION *FEEDBACK SIGNAL WIRING*

CPS-2 SIGNAL CONNECTIONS

Beck drives equipped with the Contactless Position Sensor (CPS-2) are shipped ready for installation to match the proper 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 13, page 51, for information on output signal ranges, output terminals, range-changing resistance values, and terminals to which the ranging resistor or jumper is connected.

NOTE: For output shaft rotation of less than 80°, refer to Calibration Procedure, page 29.

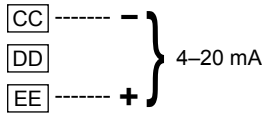
To verify that the feedback signal range is correct for your drive, see the instructions on page 29.

NOTE: Ranging resistors must be connected to the control drive output terminals. If ranging resistor change is required, use a resistor with ±1% tolerance. Resistors can be ordered from Beck.

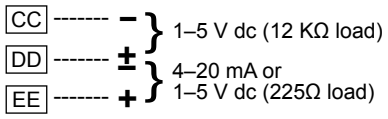
CPS-2 Model 20-3400-02, -12 Terminal Connections

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.

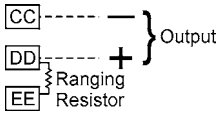
The ranging resistor value is given in Table 13, page 51, or can be calculated using the following equation:

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

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", page 31.

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.

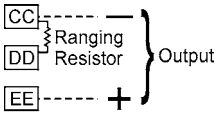
The ranging resistor value is given in Table 13, page 51, or can be calculated using the equation:

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

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”, page 31.

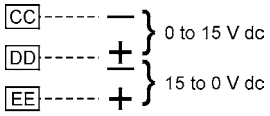
Voltage Output



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

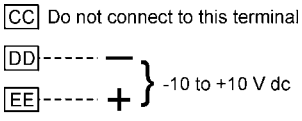
The three-terminal output from these models is provided for replacing potentiometers in three-terminal potentiometer feedback applications used in many controllers. It is suitable for 0–15 V dc applications of either positive or negative polarity. CC must be connected to the negative lead from the controller,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



INSTALLATION *WIRING OPTIONS*

INPUT SIGNAL OPTIONS

Beck 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 which require a signal change or to situations calling for operation of multiple drives from a common demand input signal.

Input Range Change to ESR-4

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 5 on page 34 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 instructions on page 32. If a proper resistor with ±1% tolerance cannot be obtained locally, it can be ordered from Beck.

NOTE: If changing from or to an input signal range of -10 to 10 V dc, resistors R4, R34 and Jumper J1 must be changed in addition to R-in. Consult the factory for details.

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. Use the equation below to determine the value of the shunting resistor:

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

Where:

"N" = the number of drives; and

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

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

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 (TOL. 1%)	INPUT RESIS-TANCE
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
-10–10 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 ranging resistor must be added across input terminals AA and BB on one of the Beck drives to produce a span between 2 and 6 volts across each board for its active portion of the range. For a 4–20 mA range 3-way split, the ranging resistor range would be 425 to 1650 ohms.

Follow the steps for calibrating the input signal, page 32, 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 5, page 34, to locate 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 ranging resistor (Beck P/N 13-2510-03) is adequate. Proceed as in the case of the 2-way split, first setting the span, then the zero. When setting the ESR-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 at 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.

LINKAGE REQUIREMENTS

In most rotary valve applications, the best control will result when the linkage is adjusted so that the full 100° angular travel of the Beck drive output shaft is used, even though the valve or damper 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 valve / damper 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 (this procedure assumes that the Beck drive will open the valve/damper in response to an increasing signal):

1. Position the driven shaft to the full valve or damper closed position.
2. Set the driven shaft lever to its predetermined starting angle in relation to the driven shaft and output shaft centerline.
3. Remove the rod end from the Beck crank arm. Attach to the connecting link.
4. Adjust the connecting link to the predetermined length.
5. Connect the connecting link to the driven lever at the predetermined radius.
6. Loosen the Beck crank arm clamping bolts.
7. Position the drive's output shaft to its full decreasing signal limit.
8. Set the crank pin on the Beck crank arm to the predetermined radius.
9. Swing the crank arm into position to assemble the rod end to the crank arm crank pin.
10. Tighten the crank arm clamp bolts to the torque recommended on pages 8–10.
11. Tighten the coupling and rod end jam nuts.
12. Lubricate rod end bearings.

Carefully move the drive's output shaft to the increasing signal limit. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also observe that the driven shaft rotates the proper amount. Ensure that the drive reaches the 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 on the Beck drive rather than adjusting the connecting link length. Return to step 5 and repeat adjustments.

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

Do not change limit switch settings to obtain desired valve or damper travel. This shortens the travel of the feedback device and reduces the control resolution, repeatability, and accuracy of the drive.

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 valve / damper lever arm. 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 valve / damper and drive are mounted in place.

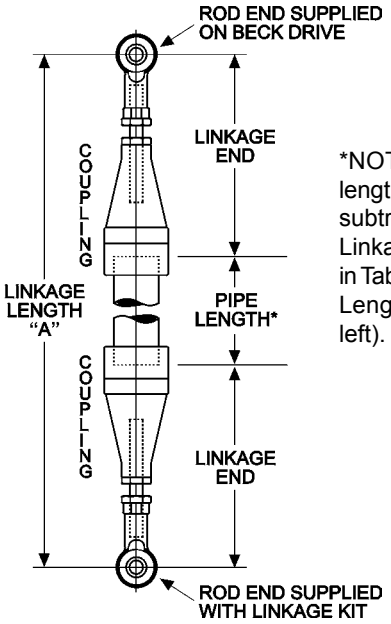
Each linkage kit includes the essential pipe linkage end connections, rod end and all necessary

INSTALLATION *START-UP*

(LINKAGE KITS, CON'T.)

hardware. Schedule 40 pipe is not included and must be cut to length and threaded in the field (see Table 3, this page, for instructions to calculate pipe length). To simplify installation of the pipe link, the kit accepts NPT 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" in the figure below. Select the kit part number from Table 3, below. For lengths beyond those listed in the table, contact your Beck sales engineer.



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

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, 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 damper or valve 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 change the direction of output shaft rotation (see page 26).

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.

TABLE 3:
PIPE LINKAGE KITS

Beck Drive Model No.	Linkage Length Range "A"	Pipe Size	Min. Pipe Nipple Length	Rod End Thread (UNF)	Beck Pipe Linkage Kit Part No.	Length of 2 Linkage Ends (Total Adj. ±1 1/2" (38 mm))	Approx. Weight*
11-150	22–84" (559–2 134 mm)	1" (25 mm)	1 1/2" (38 mm)	1/2-20	20-1730-05	20 1/2" (521 mm)	5 lbs (2 kg)
	31–120" (787–3 048 mm)	1 1/2" (38 mm)	1 3/4" (44 mm)		20-1740-06	29 1/4" (743 mm)	9 lbs (4 kg)
11-200	22–45" (559–1 143 mm)	1" (25 mm)	1 1/2" (38 mm)	1/2-20	20-1730-05	20 1/2" (521 mm)	5 lbs (2 kg)
	31–84" (787–2 134 mm)	1 1/2" (38 mm)	1 3/4" (44 mm)		20-1740-06	29 1/4" (743 mm)	9 lbs (4 kg)
	33 1/4–120" (845–3 048 mm)	2" (51 mm)	2" (51 mm)		20-1750-05	31 1/4" (794 mm)	13 lbs (6 kg)
	37–120" (940–3 048 mm)	2 1/2" (64 mm)	2 1/2" (64 mm)		20-1760-05	34 1/2" (876 mm)	22 lbs (10 kg)
11-300	22 1/2–36" (572–914 mm)	1" (25 mm)	1 1/2" (38 mm)	5/8-18	20-1730-06	21" (533 mm)	5 lbs (2 kg)
	31 1/2–72" (800–1 829 mm)	1 1/2" (38 mm)	1 3/4" (44 mm)		20-1740-07	29 3/4" (756 mm)	9 lbs (4 kg)
	33 3/4–96" (857–2 438 mm)	2" (51 mm)	2" (51 mm)		20-1750-06	31 3/4" (806 mm)	13 lbs (6 kg)
	37 1/2–120" (953–3 048 mm)	2 1/2" (64 mm)	2 1/2" (64 mm)		20-1760-06	35" (889 mm)	22 lbs (10 kg)
11-400	23 1/4–34" (590–864 mm)	1" (25 mm)	1 1/2" (38 mm)	3/4-16	20-1730-07	21 3/4" (552 mm)	5 lbs (2 kg)
	32 1/4–48" (819–1 219 mm)	1 1/2" (38 mm)	1 3/4" (44 mm)		20-1740-08	30 1/2" (775 mm)	9 lbs (4 kg)
	34 1/2–72" (876–1 829 mm)	2" (51 mm)	2" (51 mm)		20-1750-07	32 1/2" (826 mm)	13 lbs (6 kg)
	38 1/4–120" (972–3 048 mm)	2 1/2" (64 mm)	2 1/2" (64 mm)		20-1760-07	35 3/4" (908 mm)	22 lbs (10 kg)

* Does not include customer supplied pipe.

OPERATION

HOUSING

Beck electronic control drives have individual cast aluminum compartments for each of the five main components: The control motor, wiring terminal block, drive train, electronic signal receiver, and control end. Gasketed covers and sealed shafts make the drives ideally suited to outdoor and high humidity environments.

Heavy cast mechanical stops built into the housing are designed to prevent accidental over-travel damage during manual cycling, and ensure that proper orientation is maintained between the output shaft and the feedback system.

CONTROL MOTOR

The Beck control motor is a synchronous inductor motor which operates at a constant speed of 72 RPM 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 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 gear, output shaft, and crank arm. The main gear / output shaft and third stage gears are common to all units of a particular drive model. 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. See Table 11, page 49 for details.

On standard models, the output shaft is limited by mechanical stops to 108° of rotation. Optional main gear / output shaft assemblies are available that permit multi-revolution output rotation. Mechanical stops are not included on these models. Mechanical transmission of output shaft position to the control end is provided by a right angle gear set driven directly by the output shaft.

SELF-LOCKING MECHANISM (SLM)

An integral part of every 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, the SLM instantaneously locks and holds the output shaft in position.

HANDWHEEL

Every Beck control drive is furnished with a Handwheel to permit manual operation of the valve or damper 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", "CW", "STOP", "CCW".

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

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

In the "STOP" position, all contacts remain open.

SWITCHES

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

OPERATION

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 end-of-travel limit switches provide open / close operation upon closure of an automatic controller or manually operated switch. Travel limits are adjustable over the full range of travel and provide precise positioning repeatability.

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

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

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

Modulating option 7: For automatic operation in response to milliamp or 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 either analog or microprocessor control systems, and is designed to operate continuously in temperatures up to 185°F (85°C).

The ESR-4 requires a position feedback signal from either the CPS-2 monitor / isolator board or a film potentiometer. This feedback signal is compared to the input signal. A difference in 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 page 17 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 a different signal current. An optional “Relay board” version of the ESR-4 permits operation on low current 120 V ac with an external diode / resistor module or low voltage DC input signals (5 to 24 V dc). This topic is covered on page 35.

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. The position sensing function of the CPS-2 is provided by a ferrite magnetic sensing element. An 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.

When used with the ESR-4, the CPS-2 includes a monitor / isolator board that delivers an isolated position feedback signal to the 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.

POSITION FEEDBACK: FILM POTENTIOMETER

The film potentiometer produces a voltage that is a 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.

CALIBRATION

STALL PROTECTION AND ANNUNCIATION

The Beck Stall Protection Module (SPM) is an optional feature for the Group 11 drives. 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 SIGNAL (L.O.S.)

Beck drives equipped with the ESR-4 have the ability to move to a predetermined position upon loss of demand signal. When the demand signal drops to approx. 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 at terminal E for remote alarm, 0.12 to 5 A, 120 V, 50 or 60 hz)
2. REVLOS = Move to the minimum limit switch position. Connect terminal E to F.
3. FWDLOS = Move to the maximum limit switch position. Connect terminal E to D.
4. INTLOS = Move to predetermined intermediate auxiliary switch position. Consult factory.

When the demand 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 directional switches are turned off. The output of the L.O.S. switch is connected to terminal E which is wired for one of the predetermined operating modes listed above.

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

CALIBRATION PRIORITY

Standard Group 11 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft rotation must occur within these stops, which are outside the electrical range of travel.

The over-travel or end-of-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart then the drive's intended full range of electronic operation for options 5 thru 8 (typically 100°). The over-travel limit switches are positioned to provide an electrical overtravel protection (typically 101°). For options 3 & 4, the end-of-travel limit switches are set at the drive's intended full range of operation (typically 100°).

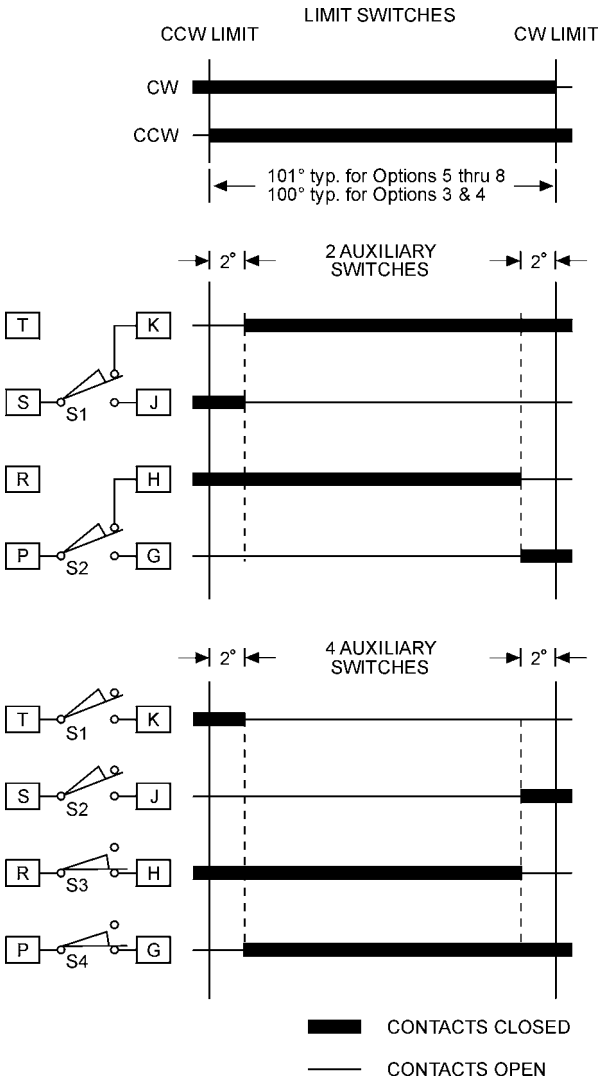
If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation—it may be desirable to reset the limit switches (see page 24). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. Over-travel limit switches (options 5 thru 8) should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

The auxiliary switches are also cam operated, but have no affect on drive operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

CALIBRATION *SWITCHES*

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 following procedures.



Standard Limit and Auxiliary Switch Settings

SWITCH ADJUSTMENTS

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

NOTE: The limit switches are located next to the drive body. To adjust these switches, it is necessary to remove the control end cover.

Switches are operated by cams which are clamped onto 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 Limit Switches CW and CCW

This procedure should be used if the factory limit switch settings must be changed in the field. It is advisable to operate the 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:

Note that the direction of rotation of the drive's output shaft is the same as its control shaft for models 11-20_, 11-30_ and 11-40_. However, on model 11-15_ the shafts rotate in opposite directions.

1. Remove the control end cover and extensions, if applicable, and terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the control shaft so that the CW switch cam screw is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft. See Figure 1, below.
3. Move the output shaft clockwise to the desired maximum CW limit switch position (for options 5 thru 8, this position should be just outside the desired CW electronic travel position).
4. Turn the Handswitch to the “STOP” position.
5. ***Disconnect power from the drive.***
6. Turn the Handswitch to the "AUTO" position.
7. Connect the continuity meter across terminals B and M. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
8. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
9. Disconnect meter and turn the Handswitch to the "STOP" position.
10. Reconnect drive power.
11. Rotate the drive’s output shaft in the CCW direction away from the CW limit switch position. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If not correct, return to step 2 and reset the cam to the proper orientation.
12. Rotate the output shaft again to the desired CW travel limit. If the desired stopping point is reached, the switch is properly set.

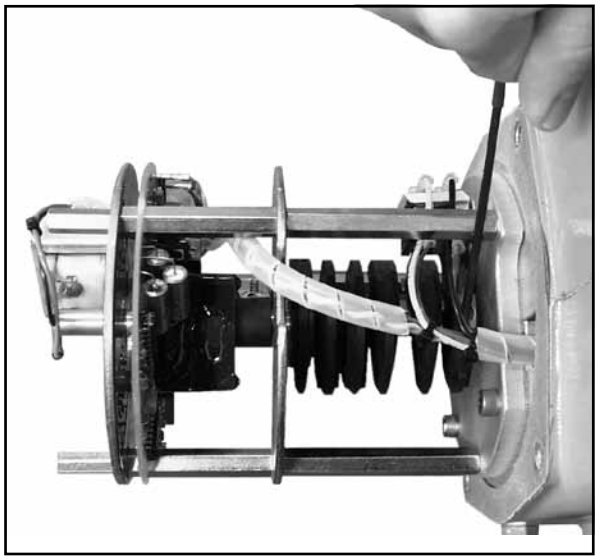


Figure 1

13. Repeat instructions for setting CCW limit switch position (noting that referenced directions of rotation should be opposite of those used for CW switch setting). Connect continuity meter across terminals B and N.
14. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.
15. Rotate index (or index pointer on model 11-15_) to correspond with output shaft rotation.

Setting Auxiliary Switches

Standard switch settings for drives with 2 or 4 auxiliary switches are shown on the diagram on page 24. 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 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 24 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in (.56 N•m) 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 cover bolts to 10 lb-ft (14 N•m) torque.

CALIBRATION *DIRECTION CHANGE*

DIRECTION OF OUTPUT SHAFT ROTATION

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

NOTE: Changing direction of rotation does not change the setting of the auxiliary switches.

CHANGING DIRECTION OF OUTPUT SHAFT ROTATION

Procedures vary depending upon the drive model number. The number is listed on the drive nameplate. Determine the model number and refer to one of the following procedures.

CAUTION

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

Models 11- __3 and 11- __4

No changes are necessary for these models other than resetting travel index.

Model 11- __5

1. Remove the control end cover and extensions, if applicable (1/2" bolt heads).
2. Interchange the wires connected to terminals 1 and 5 of the potentiometer (i.e., the wire to terminal 1 should be moved to terminal 5 and vice versa). The wire to terminal 3 should not be moved (wiper connection). See Table 4, page 27.
3. Reset the travel index.
4. Reset the potentiometer wiper according to the film potentiometer calibration instructions on page 28.

Model 11-__7

NOTE: On Model 11-__7 units equipped with an auxiliary film potentiometer, the auxiliary potentiometer is the one mounted closest to the drive body.

1. Remove the terminal cover, control end cover and extensions, if applicable (1/2" bolt heads).
2. Interchange the wire jumpers connected to terminals M and N.
3. Change the wires connected to the ends of the potentiometer for the ESR—this is the potentiometer farthest from the drive body—using Table 4, page 27, as a guide (i.e., the wire to terminal 1 should be moved to 5 (or vice versa) and the wire to terminal 2 should be moved to 4 (or vice versa)). The wire to terminal 3 should not be moved (wiper connection).
4. If your drive is not equipped with an auxiliary potentiometer, skip to step 6.
5. Interchange the wires connected to terminals 1 and 5 of the auxiliary potentiometer—this is the potentiometer closest to the drive body (i.e., the wire to terminal 1 should be moved to terminal 5 and vice versa). The wire to terminal 3 should not be moved.
6. Replace the terminal cover. Torque the cover bolts to 10 lb-ft (14 N•m). Reset travel index.
7. Reset the potentiometer wiper according to the film potentiometer calibration instructions on page 28.

Models 11-__6 and 11- __8

1. Remove the terminal compartment cover, control end cover and extensions, if applicable (1/2" bolt heads).
2. For model 11-__8, interchange the wire jumpers connected to terminals M and N.
3. For both models, 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 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 13, page 51 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. Ensure Handswitch is in “STOP” position.
8. Using a 7/64" hex wrench, loosen the CPS-2 rotor clamp.

TABLE 4

STANDARD FILM POTENTIOMETER CONNECTIONS FOR ESR						
Model	**Output Shaft Rotation Increasing Signal**	**Wire Connections To Potentiometer Terminals***				
		1	**2**	**3**	**4**	**5**
157	CW	ORG		YEL	GRN	
	CCW		GRN	YEL		ORG
207, 307, 407	CW		GRN	YEL		ORG
	CCW	ORG		YEL	GRN	
*ORG wire is ESR pin 3 YEL wire (wiper connection) is ESR pin 4 GRN wire is ESR pin 5						
STANDARD FILM POTENTIOMETER CONNECTIONS FOR EXTERNAL FEEDBACK						
Model	**Output Shaft Rotation Increasing Signal**	**Wire Connections To Potentiometer Terminals***				
		1	**2**	**3**	**4**	**5**
155, 157	CW	ORG		YEL		GRN
	CCW	GRN		YEL		ORG
205, 207, 305, 307, 405, 407	CW	GRN		YEL		ORG
	CCW	ORG		YEL		GRN
*ORG wire is Terminal Block location EE YEL wire (wiper connection) is Terminal Block location DD GRN wire is Terminal Block location CC						

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.
11. Run the drive to the 0% and 100% positions. Record the CPS-2 output at these positions.
12. Subtract the outputs recorded at the two positions 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.
13. With the drive at the 100% position, 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. Turning the span potentiometer CCW decreases the span equally at both ends. See Figure 4, page 30, 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 range up or down.
15. Tighten the CPS-2 rotor clamp to 5 lb-in (.56 N•m) torque. Maintain a 0.031" (.8 mm) clearance between the rotor clamp and stator.
16. Run the drive to the 0% and 100% positions and check the output signal for desired span. If incorrect, repeat the procedure from step 2.
17. Remove the meter and resistor and reconnect the feedback wiring.
18. Replace covers and tighten cover bolts to 10 lb-ft torque. Reset travel index.
19. Model 11-__8: Check ESR-4 board calibration by following the “Checking Calibration Procedure” on page 32.

CALIBRATION *FEEDBACK SIGNAL*

FEEDBACK SIGNAL CALIBRATION

Feedback signal calibration is necessary to ensure that the signal correctly corresponds to the drive's output shaft position. All drives are 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 on Group 11 drives is 60°.

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

NOTE: The over-travel limit switches should be properly adjusted before the feedback signal is calibrated. The feedback signal must be calibrated before the demand input signal can be calibrated.

Film Potentiometer Calibration Models 11-__5 and 11-__7

NOTE: On Model 11-__7, units equipped with an auxiliary film potentiometer, the auxiliary potentiometer is mounted closest to the drive body.

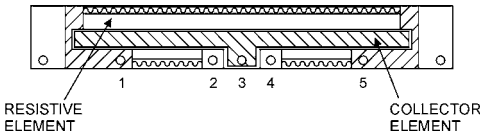
When properly adjusted, the auxiliary potentiometer feedback signal should be maximum with the drive output shaft at the 100% (maximum input signal) position. At 50% of travel the signal should be mid-span. At the 0% position, the signal should be minimum.

If either the auxiliary or main potentiometer on option 7 units is out of calibration, or if the feedback potentiometer on option 5 units is out of calibration:

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. Move the drive to the 0% position.
4. On Model 11-__7, connect a voltmeter between the terminal with the green lead (either terminal 2 or 4) and the adjacent terminal (either terminal 1 or 5). Measure and record the voltage. Now connect the voltmeter between the terminal with the yellow lead (+) and the terminal with the green lead (–) and set the wiper on the potentiometer until the meter reads 30 mV greater than the voltage recorded in the first part of this step.

   On models 11-__5, set the wiper about 5 degrees above the position where the minimum output is reached, or as required by the control system. See Table 4, page 27.

NOTE: Be sure that the wiper spans the resistive 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 (.56 N•m) torque.
6. Operate the drive between the 0% and 100% positions. Verify that the feedback signal is properly adjusted.
7. Use the manual Handwheel to move the drive to the mechanical limit; do not over-torque, as damage may result.
8. Check that the wiper does not come off the resistive element. This may be verified by monitoring the output voltage and ensuring it does not fall from maximum value. If not correct, return to step 2.
9. Replace the control end cover and the ESR cover. Torque the cover bolts to 10 lb-ft (14 N•m).

CPS-2 Calibration Model 11-__6 and 11-__8

These models are equipped with a Contactless Position Sensor (CPS-2) for position sensing and feedback. On model 11-__8, the CPS-2 also delivers a position signal to the Electronic Signal Receiver (ESR-4). Adjusting the remote feedback signal will automatically adjust the position signal to the ESR-4 on these models.

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. This board monitors the CPS-2 position signal and compares it to established limits. If the output exceeds normal signal conditions, the board relay contact opens. This relay may be used for 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 adjust the feedback signal, first 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 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 13, page 51 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 at the 100% (maximum input signal) position. At 50% travel the signal should be mid-span. At 0%, 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 a 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) to change the range of the span adjustment. An R8 value of 100 K ohms produces shaft output range of 80° to 100°; R8 = 249 K ohms produces shaft output range of 70° to 79°; and removing R8 produces shaft output range of 60° to 69°. See Figure 4, page 30, for location of R8 (positioned on raised turrets).

Tools required for calibration:
- mA / V dc Multimeter
- 3/32" Screwdriver
- 7/64" Hex Wrench
- 1/4" Screwdriver
- 1/2" Combination Wrench
- 1/32" (.8 mm) Thickness Feeler Gauge
- 200 ohm Resistor

1. Put electric Handswitch in “STOP” position.
2. Remove the terminal 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). This wiring diagram is located under the terminal cover.
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 13, page 51, for feedback terminals.
5. Move the drive to the 0% and 100% positions and record the CPS-2 output at these positions.
6. Subtract the outputs recorded at the two positions 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.

CALIBRATION *FEEDBACK SIGNAL*

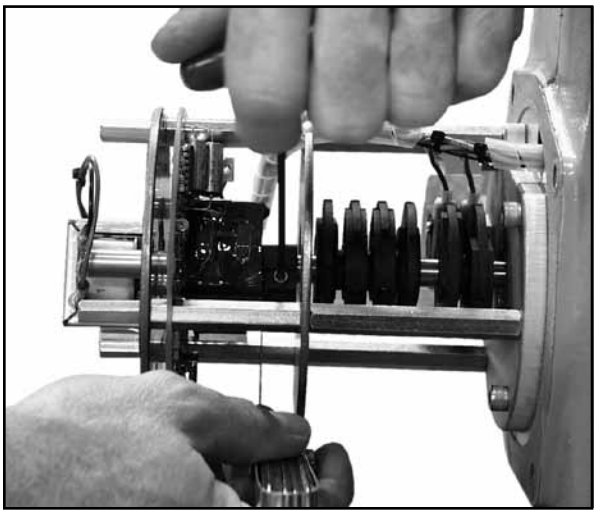
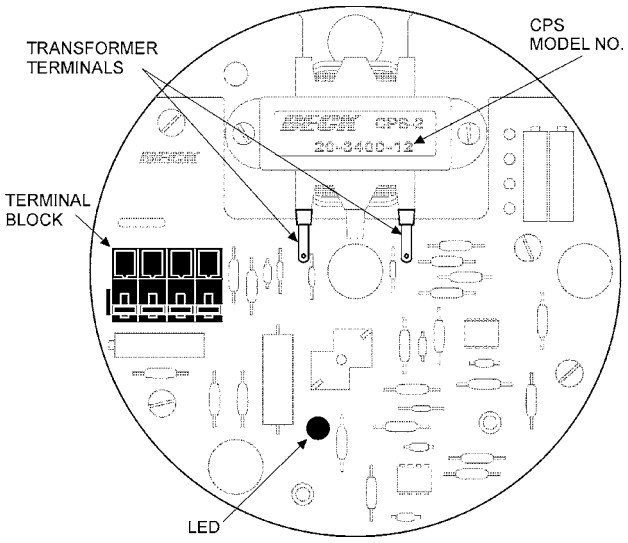
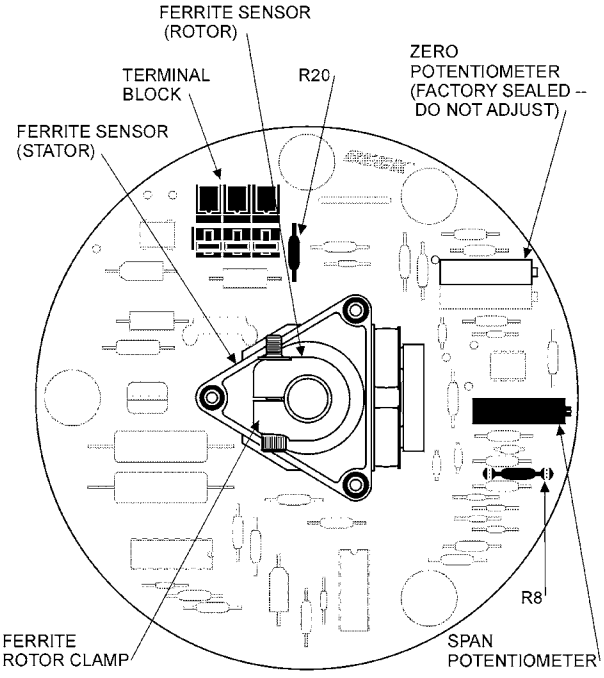


Figure 2

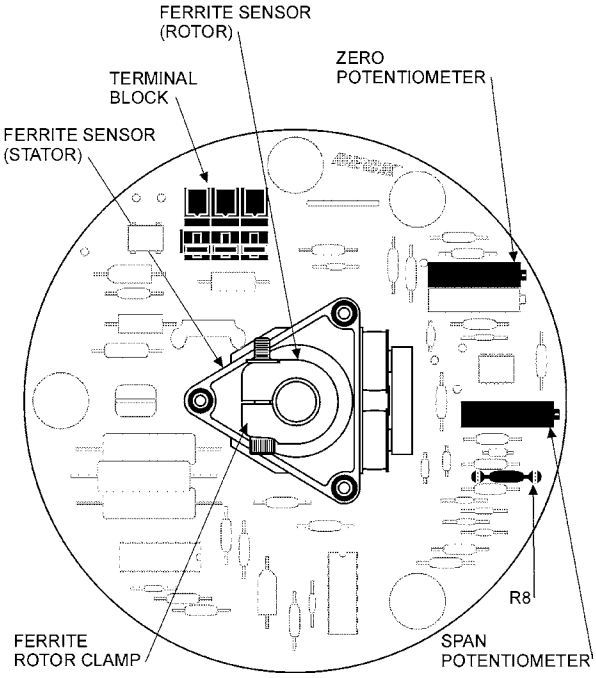


CPS-2 MONITOR / ISOLATOR ASSEMBLY

Figure 3



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



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

Figure 4

7. With the drive at the 100% position, turn the span potentiometer to adjust the CPS-2 feedback 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 4, page 30, for the location of the span potentiometer.
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 range up or down.
9. Tighten the CPS-2 rotor clamp to 5 lb-in torque. Maintain a 0.031" (.8 mm) clearance between the rotor clamp and stator.
10. Run the drive to the 0% and 100% positions and check the feedback signal for desired span. If not correct, repeat the procedure from step 5.
11. Remove the meter and resistor and reconnect the feedback wiring.
12. Replace covers and tighten the cover bolts to 10 lb-ft (14 N•m) torque.
13. Model 11-__8: Check ESR-4 board calibration by following the "Checking Calibration Procedure" on page 32.

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.

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 will result.

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

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

1. Install the 1–5 V dc unit as a 1–5 V dc range. Do not make any adjustments other than setting the rotor position.
2. Remove jumper from terminals CC to DD and replace with a 3.01 K ohm resistor (see Table 13 on page 51). 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 demand 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 signal to the Electronic Signal Receiver (ESR-4). The board 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 (L.O.S.) operation of the drive.

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

Signal Monitor Sensing Operation

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

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

Loss of Signal Operation (L.O.S.)

Drives equipped with Electronic Signal Receivers (ESR-4) are configured so that the demand signal is connected through the position signal monitoring relay on the Monitor / Isolator 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 —contact the factory for details and instructions. For more information on the L.O.S. function, review the following section on Demand Signal Calibration.

CALIBRATION *DEMAND SIGNAL*

DEMAND SIGNAL CALIBRATION

All drives equipped for milliamp or DC analog modulating applications include an 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 demand signal it receives. A position signal is delivered to the board from either a potentiometer or the CPS-2, which is compared with the demand signal. The error signal is then amplified and used to actuate either of two switches to drive the output shaft clockwise or counterclockwise until the signals are balanced.

The third output switch is energized when the demand signal falls below a given setting (Loss Of Signal). The L.O.S. feature can be used to drive the output shaft to a predetermined position. See section on L.O.S., page 23, for further details.

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

Checking Calibration

Using the demand input 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 demand 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 demand 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 5, page 34). Monitor the “FWD” and “REV” lamps to make adjustments. When the drive is balanced (with Handswitch in “AUTO” and not at an over-travel limit) or in L.O.S. mode, both lamps are lit. 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. Clockwise rotation of either span or zero adjustment causes the output shaft to drive toward the zero (minimum demand signal) position.

Calibration Procedures

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.

CAUTION

Drive will run during the following procedures.

Tools required:

- 3/32" Screwdriver
- 1/2" Combination Wrench
- 1/4" Screwdriver
- mA / V dc Multimeter
- 200 Ohm Resistor

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

1. Turn the Handswitch to the "STOP" position.
2. Remove the ESR cover and the terminal block cover (1/2" bolt heads).
3. Determine the correct external feedback signal terminals from the wiring diagram supplied with the drive (located on the inside of the terminal block cover). Connect a meter (if applicable) to monitor the feedback signal. Refer to the "Feedback Signal Calibration" section beginning on page 28 for instructions on how to connect the meter. Note: For drives equipped with control option 7 without an auxiliary potentiometer, it is not possible to use terminals CC, DD and EE for signal measurements during calibration. Instead, an external reference must be used to determine the drive output shaft position.
4. Connect a signal source to the demand signal terminals, AA (+) and BB (–).
5. Turn the Handswitch to the "AUTO" position.
6. Apply the desired 0% demand signal to the drive (e.g., 4 mA for a 4–20 mA input).

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

For a span error greater than 15%:

1. Turn the Handswitch to the "STOP" position.
2. Remove the ESR cover and the terminal block cover (1/2" bolt heads).
3. Determine the correct external feedback signal terminals from the wiring diagram supplied with the drive (located on the inside of the terminal block cover). Note: For drives equipped with control option 7 without an auxiliary potentiometer, it is not possible to use terminals CC, DD and EE for signal measurements during calibration. Instead, an external reference must be used to determine the drive output shaft position.
4. Connect a meter (if applicable) to monitor the feedback signal.
5. Turn the Handswitch to the "AUTO" position.
6. Short the demand signal terminals AA and BB.
7. Short out resistor R35 temporarily with a clip lead (see Figure 5, page 34, for location). Note: The board has conformal coating; take extra care to ensure proper connection.
8. Using a 3/32" screwdriver, adjust the zero potentiometer CW in small increments until the output shaft is at the 0% position. For drives equipped with external feedback, the feedback signal reads 0% (e.g., 4 mA for a 4–20 mA signal).
9. Remove the short on the demand signal terminals and apply a demand signal equal to the span (e.g., 16 mA for a 4–20 mA signal). If the drive has not been wired, the demand signal is connected at terminals AA (+) and BB (–).
10. Using a 3/32" screwdriver, adjust the span potentiometer CCW in small increments until the output shaft is at the 100% position. For drives equipped with external feedback, the feedback signal reads 100% (e.g., 20 mA for a 4–20 mA signal).
11. Remove the clip lead from resistor R35 so that it is not shorted. Apply the desired 100% demand signal (e.g., 20 mA for a 4–20 mA signal).
12. Adjust the zero potentiometer CCW (may require 10–15 turns) until the output shaft is at the 100% position (the feedback signal reads 100%).
13. Apply the desired 0% demand signal and confirm that the output shaft is at the 0% position (the feedback signal reads 0%). If not, adjust the zero potentiometer.
14. Apply the desired 100% demand signal and confirm that the output shaft is at the 100% position (the feedback signal reads 100%). If not, adjust the span potentiometer.
15. Repeat steps 13 and 14 until satisfied with the adjustment.
16. Remove the meter and any local signal sources and reinstall the demand signal and feedback signal wiring. Replace the compartment covers and tighten the bolts to 10 lb-ft (14 N•m).

CALIBRATION *DEMAND SIGNAL*

Span

The basic span adjustment of the ESR-4 is 2–6 volts dc. This is adjustable with the 20-turn span potentiometer. To make the span adjustable from 2–9 volts dc, remove resistor R4. To make the span adjustable from 9–12 volts dc, remove jumper wire J1. To make the span adjustable from 12–16 V dc remove R4 and J1. See Figure 5, this page, for location of R4 and J1.

Zero

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 5, this page, for location of R35 and R36.

Filter Adjustment

The input filter is adjusted at the factory for maximum attenuation of disturbances on the demand signal (fully CW). This introduces a 1% drift (with 60 second timing) in response to a loss of input signal when “stay-in-place” is selected. If this is objectionable or if livelier response is desired, the filter action can be reduced by turning the filter adjustment potentiometer CCW a sufficient amount. Fully 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. See Figure 5, this page for location.

Dead band Adjustment

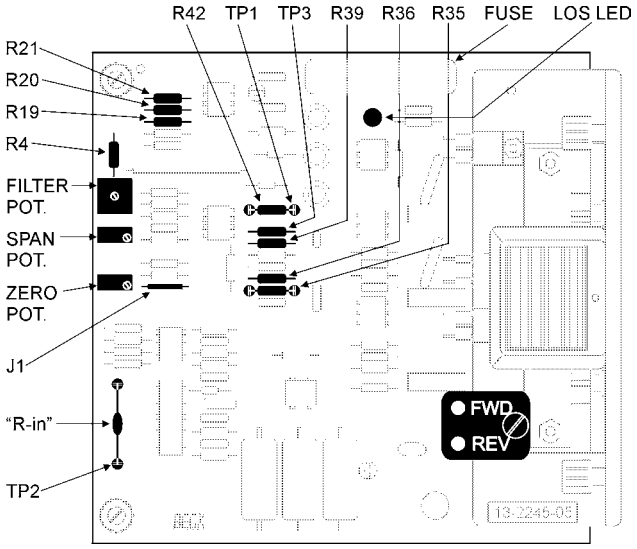
The dead band values of 0.6% for CPS-2 or film potentiometer operation are chosen to satisfy the requirements of most control systems. If excessive process and / or signal noise is present, the drive may be subject to unnecessary cycling. It is recommended that excessive noise be reduced at the source 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 dead band can be widened; however, this will reduce the resolution of the drive. Widening the dead band to 1% can be accomplished by removing resistor R39. Further change of the dead band is possible (please contact the factory for details).

L.O.S. TRIP POINT

If the input signal drops below a predetermined value, the L.O.S. feature is activated. For example, if the input signal is 4–20 mA, the L.O.S. trip point would be approx. 1.92 mA, with normal operation resuming before the signal reaches 4.0 mA. If the input signal is 1–5 V, the L.O.S. trip point would be 0.48 V, with normal operation resuming before the signal reaches 1 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.



ESR-4 Components

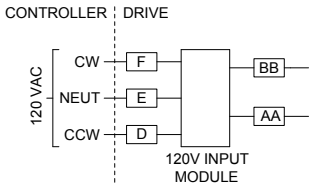
Figure 5

RELAY BOARD OPERATION AND CALIBRATION

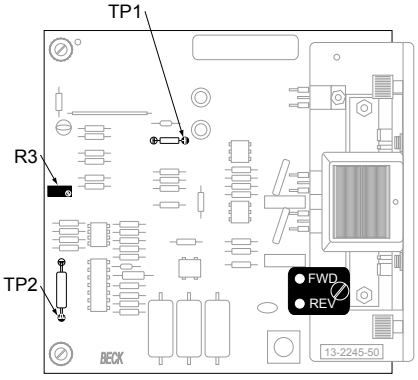
The Relay board is a solid-state interface to permit switching large control motor currents with low-current ac or low-voltage dc inputs.

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

NOTE: When used in low-current AC applications, the Relay board provides a load of 10 mA to the controller. If the controller requires a larger minimum load, the user must provide additional load external to the control drive.



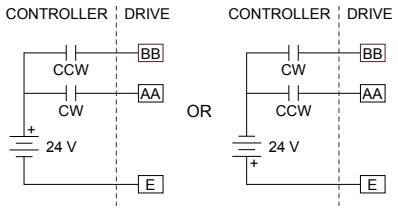
1. Disconnect drive from line voltage and remove terminal cover and ESR cover (1/2" bolt heads).
2. Remove control signal wires from terminals D, E and F.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 6, this page, for location of test points on the Relay board.
4. Turn on line voltage.
5. Adjust potentiometer R3 to bring meter reading to +0.17 volts ±0.01 V dc. See Figure 6 for location of potentiometer R3.
6. Disconnect drive from line voltage and reconnect control signal wires to terminals D, E and F.
7. Check operation of drive with system signals.
8. Replace covers and tighten cover bolts to 10 lb-ft (14 N•m) torque.



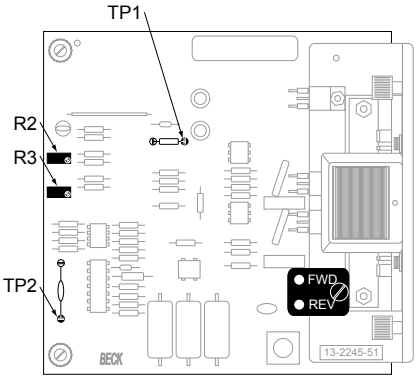
Low Current 120 V ac Relay Board Components

Figure 6

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 control signal wires from terminals AA and BB.
3. Attach voltmeter to test points TP1 (+) and TP2 (-). See Figure 7, this page, for location of test points on the Relay board.
4. Turn on line voltage.
5. Adjust zero potentiometer R3 for -0.2 V at TP1 with neither input signal applied. See Figure 7 for location of zero potentiometer R3.
6. Adjust span potentiometer R2 for -0.2 V at TP1 with both control signals applied simultaneously. See Figure 7 for location of span potentiometer R2.
7. Disconnect drive from line voltage and reconnect control 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 (14 N•m) torque.



Low Voltage 24 V dc Relay Board Components

Figure 7

MAINTENANCE *ROUTINE*

Beck drives require only a minimum of routine maintenance. A visual inspection is in order 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.

Refer to pages 8–10 for all torque values.

LUBRICATION

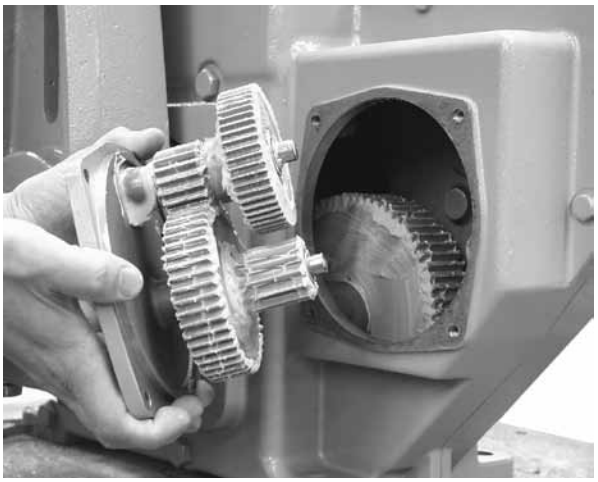
Periodic lubrication is not required on Beck control drives. However, it is recommended that during major shutdowns or outages, the drives in the most severe applications be inspected to determine the need to relubricate the drive gear train.

To extend the life of the linkage rod ends, they should be included in your scheduled lubrication program.

CAUTION

Before removing the gear module assembly, block the control drive crank arm to prevent the crank arm and the gear train from moving when the change module is removed.

To inspect the gears, remove the gear module assembly on the 11-200, -300 and -400. On Model 11-150, the motor must be removed to access the gears. Clean the gears thoroughly, removing all old lubrication.



11-400 Gear Module

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

If there is no evidence of damage to the gearing, recoat the teeth and shaft bores of all gears with a heavy layer of Fiske Lubriplate GR-132 or equivalent (GR-132 is an E.P. grease with polymer additives).

Replace the gear module assembly (or motor, if the drive is a Model 11-150).

MAINTENANCE *COMPONENT REPLACEMENT*

This section covers replacement of many components of the drive. Note that some components are not field-repairable. Refer to the drive outline dimension drawings on pages 8–10 and to the cutaway drawings on pages 46–48 for location of components on the drive.

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. During a major overhaul, the factory repair department will update the drive to include all possible engineering improvements. See "HOW TO OBTAIN SERVICE" on page 55.

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 and O-rings 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 only 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" (6.35 mm) wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Pry up on the seal and force it out of the housing. Clean the shaft and housing then press in the replacement seal with the closed side facing outward.

Bearings

The Beck control drive contains ball bearings on the output shaft, control end shaft, and motor shaft. Bushings and thrust washers are used on combination gears. Field replacement of these components is not recommended.

Motor shaft bushings in the body of the 11 -150 and 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.

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 re-magnetizing.

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.

To remove the motor, first disconnect the motor wires in the terminal compartment of the control drive. In the 11-200, -300, and -400 drives, remove the terminal block and plate as an assembly. Remove the black wire from the terminal post, cut the red motor wire near the red-yellow-red butt joint and disconnect the green 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 recommended values. Reconnect the motor wires. See the following section for reinstalling the terminal plate.

Motor Resistor and Capacitor

The motor resistor and capacitor are located under the terminals in the terminal compartment. To replace a resistor or capacitor, remove the terminal cover. In the 11-200, -300, and -400, remove the terminal plate. Remove the existing part and transfer the wires one at a time to the replacement part. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m).

Limit and Auxiliary Switches

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.

Transfer the wires one at a time to the replacement assembly using the push-on lugs provided. Install the replacement assembly and note that it rotates around one screw to permit an adjustment of the cam-to-switch lever spacing and switch operating point. To properly set the switch, use a .030" (.75 mm) shim between the cam and switch lever and loosely position the switch assembly so that the switch is just actuated. The switch lever should be on the low or minimum radius portion of the cam when setting the switches. DO NOT overstress the switch lever. Tighten both screws to 10 lb-in (1.13 N•m) torque and remove the shim. When properly adjusted the switch lever 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 up to four switches.

If the control drive output 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 6, page 45, for switch part numbers.

Self-Locking Mechanism (SLM)

In normal service, the SLM friction surface should not require replacement; however, a combination of excessive modulation and load can cause wear to the SLM mechanism. If the SLM has been damaged, rebuild kits are available (see Table 5, below).

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

See the illustration below for component identification.

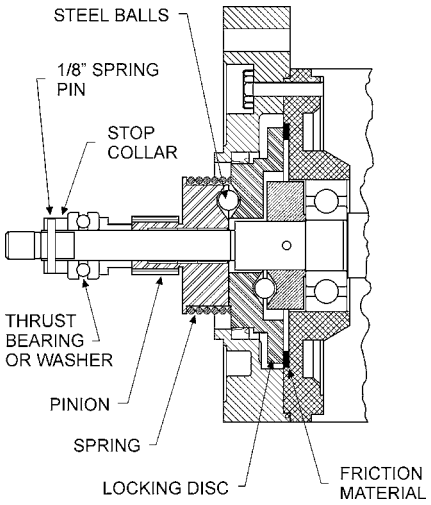


Figure 8

TABLE 5:
SLM PART NUMBERS

Motor Part No.	SLM Rebuild Kit	Instruction Sheet
11-150		
20-2700-20	12-8060-15	80-0016-05
20-2701-20	12-8060-16	80-0016-05
11-200/-300		
20-2704-21	12-8060-17	80-0016-07
20-2705-21	12-8060-18	80-0016-07
11-400		
20-2201-21, -22, -23	12-8060-11	80-0016-01
20-2201-31, -32, -33	12-8060-13	80-0016-02

HANDSWITCH

To replace the Handswitch, remove the terminal cover, and then remove the terminal plate (11-200/-300 and -400 only). 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 below. Splice the wires color for color. Inspect the terminal plate gasket and replace if necessary. To ensure a watertight seal between the plate and the gasket, coat the gasket with a thin film of grease before replacing the terminal plate. Torque the screws to 3 lb-ft (4 N•m). Do not over-torque. Replace the terminal cover. Torque bolts to 10 lb-ft (14 N•m).

NOTE: When the Handswitch is turned fully clockwise, "AUTO" should be indicated.

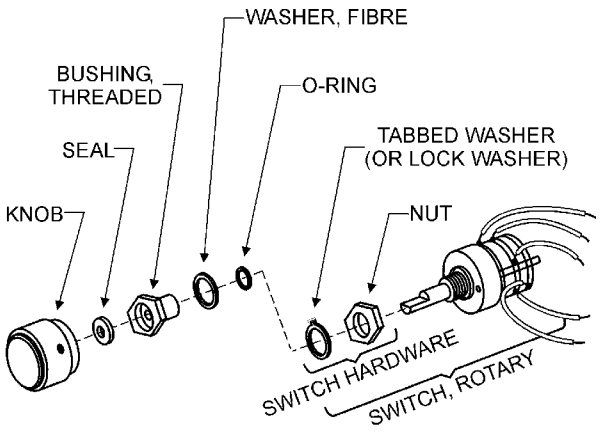


Figure 9

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, remove the Electronic Signal Receiver 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. See Figure 10, below.

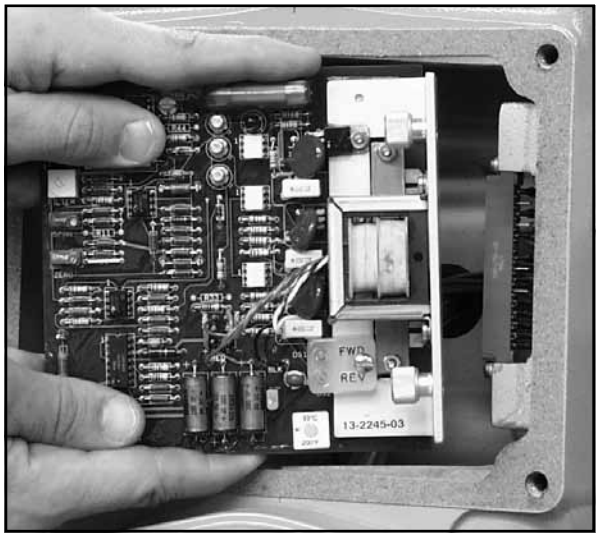


Figure 10

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 thumb screws and replace the compartment cover. Torque cover bolts to 10 lb-ft (14 N•m).

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 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°.)
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 3, page 30), then disconnect the wires. The terminals are spring-loaded. To remove a wire, press the tip of a small screwdriver into the slot at the top of the small, white lever. Push down on the lever 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. Ensure that the inboard hex stud is not loosened 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 (7 N•m).
3. Thread the wires through the wire holes in the CPS-2 and reconnect them to the transformer and terminal block.
4. Restore 120 V ac power to the drive and connect a meter to the output.

   CURRENT FEEDBACK APPLICATIONS: Record the color and location of the feedback signal wires for re-connection later. Remove the two feedback wires. Connect a mA meter in series with a 200 ohm load resistor.

   VOLTAGE FEEDBACK APPLICATIONS: Connect a voltmeter across the feedback terminals. DO NOT remove the signal feedback wires.
5. Insert a 0.031" (.80 mm) feeler gauge between the rotor clamp and stator. Position the clamp 0.031" (.80 mm) from the stator.
6. Rotate the rotor on the control shaft until the output on the mA or voltmeter reads 50% of signal span, then tighten the clamp to 5 lb-in (.56 N•m) torque.
7. Check the feedback signal calibration as described on page 29.

MAINTENANCE *TROUBLESHOOTING*

If your unit contains a Stall Protection Module (SPM), refer to publication 80-0017-03, “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.	a. Return Handswitch to AUTO position.
	b. No 120 V ac line supply.	b. Check fuses and switches in power panel.
	c. Fuse F1 open.	c. Check for possible shorts, then replace fuse. Use only Beck part no. 13-2230-03 for proper protection of triacs.
	d. External auto / man switch in wrong position (Position-All).	d. Return switch to AUTO position.
	e. ESR-4 board failure.	e. Replace ESR-4 circuit board. See page 39.
	f. Jumpers between terminals F–N and D–M are not connected.	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.	a. Check power source. Check CPS-2 power supply voltage. Check CPS-2 power transformer.
	b. Control drive positioned beyond calibrated limits.	b. Position drive with Handwheel and check limit switch settings.
	c. CPS-2 rotor position not set properly.	c. Set CPS-2 rotor position. See page 40.
	d. CPS-2 not calibrated correctly.	d. Calibrate CPS-2. See page 28.
	e. CPS-2 failure.	e. Replace CPS-2. See page 40.
3. Control drive runs in one direction only in AUTO and both directions with Handswitch on CW and CCW.	a. ESR-4 zero adjustment incorrect.	a. Readjust ESR-4 zero. See Input Signal Calibration, page 32.
	b. Handswitch failure.	b. Check continuity from terminal N to V and M to U with Handswitch in AUTO position. See wiring diagram.
	c. Loss of input signal with REVLOS or FWDLOS selected.	c. Check input signal.
	d. ESR-4 circuit board failure.	d. Replace ESR-4 circuit board. See page 39.
	e. Loss of feedback signal.	e. Check signal from CPS-2 or potentiometer at TP3 on ESR-4.
	f. Jumper between F–N or D–M (F–M or D–N) not connected.	f. Connect jumper.
4. Loss of ESR-4 signal lamp lights (red LED) with input signal applied.	a. ESR-4 zero adjustment incorrect.	a. Readjust ESR-4 zero. See Input Signal Calibration, page 32.
	b. Input signal reversed.	b. Check polarity of input signal. Terminal AA (+), Terminal BB (-).
	c. ESR-4 circuit board failure.	c. Replace ESR-4 circuit board. See page 39.
	d. Slidewire-equipped drive with ESR-4 board calibrated for CPS-2.	d. Cut R22 and R39 resistors and recalibrate ESR-4 board. See Figure 5, page 34.
	e. Incorrect film potentiometer setting.	e. Reset film potentiometer. See page 28.
	f. Control signal wired through CPS-2 monitor relay. Monitor LED lamp is out.	f. Control drive position beyond calibrated range. Use Handswitch or Handwheel to put drive within normal operating range.

MAINTENANCE *TROUBLESHOOTING*

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
5. Control drive runs in the wrong direction with input signal applied.	a. Input signal reversed.	a. Check polarity of input signal. Terminal AA(+), termianl BB (-).
	b. Drive configured for wrong direction of travel.	b. See page 26 for changing direction of shaft rotation.
6. Control drive does not follow input signal until maximum or minimum signal is reached, then drives uncontrollably to limit.	a. Wire jumpers on termianls M and N are reversed or potentiometer end connections are reversed.	a. Change direction of shaft rotation; see page 26. Check correct film potentiometer connections. See Table 4, page 27.
	b. CPS-2 feedback out of phase with control motor.	b. Restore proper phasing of CPS-2 feedback with control motor. See page 28.
7. Control drive motor oscillates in AUTO mode.	a. Feedback potentiometer dirty.	a. Clean or replace potentiometer.
	b. Excessive noise on input signal.	b. Check setting of input filter. May require increased dead band setting if oscillation remains with maximum filter setting. See page 34.
	c. Physical obstruction (e.g., valve jammed or load greatly exceeds rating of drive).	c. Check operation with Handswitch and remove obstruction if present. Handswitch bypasses ESR-4 board.
	d. ESR-4 circuit board failure.	d. Replace ESR-4 circuit board. See page 39.
	e. Excessive wear in gear train or bearings.	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.	a. Replace control motor. See page 37.
	b. Control motor capacitor shorted or open.	b. Replace capacitor. See page 37.
	c. Control motor resistor open.	c. Replace resistor. See page 37.
9. Control drive will not run in either direction or one direction in automatic or manual operation.	a. Limit switch failure.	a. Replace limit switch. See page 38.
	b. Handswitch failure.	b. Replace Handswitch. See page 39.
10. Control drive runs erratic from 100º to 0º and runs normally from 0º to 100º in AUTO.	a. Feedback potentiometer dirty. Loss of feedback voltage drives the unit toward the 100% limit.	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.	a. Recalibrate ESR-4 board. See Input Signal Calibration, page 32.
	b. Limit switches adjusted incorrectly.	b. Readjust limit switches. See page 24.
	c. Loss of input signal. Check LED on ESR-4 circuit board.	c. Restore input signal to control drive.
	d. Limit switch failure.	d. Replace limit switch. See page 38.
	e. CPS-2 calibration incorrect.	e. Calibrate CPS-2. See page 20.

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
13. Loss of input signal feature does not function.	a. CPS-2 equipped control drive used with ESR-4 board calibrated for slidewire.	a. Reconnect R22 and R39 resistors and recalibrate. See page 32.
	b. Incorrectly set potentiometer.	b. Reset potentiometer. See page 28.
	c. CPS-2 calibration incorrect.	c. Calibrate CPS-2. See page 28.
14. Control drive drives to 100% limit with small change in input signal.	a. Feedback potentiometer power supply shorted.	a. Check potentiometer and wiring for shorts.
	b. ESR-4 circuit board failure of 2.7 V power supply (feedback potentiometer only).	b. Replace ESR-4 circuit board. See page 39.
	c. Wiper and low end of feedback potentiometer reversed.	c. Check writing on feedback potentiometer for proper connections.
	d. Open potentiometer element.	d. Replace potentiometer.
	e. CPS-2 feedback out of phase with control motor.	e. Restore proper phasing of CPS-2 feedback with motor control. See page 28.
15. Control drive drives to 100% and stays.	a. Handswitch left in CW / CCW position.	a. Return Handswitch to AUTO position.
	b. Potentiometer open or complete loss of contact with wiper.	b. Check potentiometer and replace if necessary.
	c. Loss of input signal when FWDLOS is selected. ESR-4 LED on.	c. Restore input signal to drive.
	d. ESR-4 zero adjustment incorrect.	d. Readjust ESR-4 zero. See Input Signal Calibration, page 32.
	e. ESR-4 circuit board failure.	e. Replace ESR-4 circuit board. See page 39.
	f. CPS-2 feedback out of phase with control motor.	f. Restore proper phasing of CPS-2 feedback with control motor. See page 28.
	g. Jumper between terminal F–N (F–M) not connected.	g. Connect jumper.
	h. CCW / CW limit switch failure.	h. Replace limit switch. See page 38.
16. Control drive travel very non-linear:		
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%.	a. Wiper and high end of feedback potentiometer reversed.	a. Check feedback potentiometer for proper connections.
b. Response normal from zero to mid-range; then runs to 100%.	b. CPS-2 power supply failure.	b. Check CPS-2 power supply voltage. See item 21.b. on this chart.
c. Output is 25% with 50% input signal, but OK at 0% and 100% inputs.	c. Drive has square function ESR-4	
17. L.O.S. operates at too high a signal level.	a. Special requirement.	a. Change L.O.S. trip point. See page 34.

MAINTENANCE *TROUBLESHOOTING*

CONDITIONS	POSSIBLE CAUSES	CORRECTIONS
18. CPS-2 LED goes out during normal travel.	a. CPS-2 not calibrated correctly.	a. Calibrate CPS-2. See page 28.
19. Potentiometer or CPS-2 output decreases when it should increase.	a. CPS-2 rotor position not set for proper rotation.	a. Reset CPS-2 rotor position. See page 28.
	b. End connections on potentiometer reversed.	b. See potentiometer calibration, page 28.
20. CPS-2 output non-linear.	a. CPS-2 rotor position not set properly.	a. Reset CPS-2 rotor position. See page 28.
	b. CPS-2 zero potentiometer misadjusted.	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.	a. Check load resistance against suggested feedback signal terminal hook-up. See page 50.
	b. Low voltage: • CPS-2 power failure.	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. CPS-2 rotor not set properly.	c. Reset CPS-2 rotor position. See page 28.
	d. CPS-2 zero potentiometer misadjusted.	d. Refer to factory.
22. CPS-2 out of calibration.	a. CPS-2 zero potentiometer inadvertently reset.	a. Refer to factory.
23. CPS-2 signal will not calibrate down to 4 mA.	a. Not enough load on meter circuit.	a. Connect 200 ohm resistor in series with meter.
	b. Unit being calibrated for shorter than 80º rotation.	b. Remove R8. See calibration, page 29.
24. Control drive does not stay in place with power off.	a. SLM friction surface worn.	a. Replace SLM friction surface. see page 38.
25. Control motor runs but output shaft does not move in one or both directions.	a. SLM failure.	a. Replace control motor. 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 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 35.

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 6, below.

HOW TO ORDER SPARE PARTS

Select from the spare parts list given below. Specify the drive's model / serial number (e.g., 11-308-031891-01-02) given on the nameplate to allow the factory to verify the part selection. Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover).

TABLE 6: RECOMMENDED SPARE PARTS

DESCRIPTION	PART NO.		DESCRIPTION	PART NO.
Limit switch assembly	20-3202-10		Film Potentiometer (Option 5 & 7 only)	20-3060-03
Auxiliary switch assembly (2 switches)	20-3202-11		ESR-4 circuit board (Option 7 & 8 only)	See Table 1, p. 11
(4 switches)	20-3202-12			
Gasket set	See below		Fuse, 6 A, 250 V	13-2230-03
Control motor	See below		Relay Board (Option 5 & 6 only)	See Table 1, p. 11
Motor resistor	See below		CPS-2 (Option 6 & 8 only)	See Table 1, p.11
Motor capacitor	See below			

TABLE 7: GASKETS, MOTORS[1], RESISTORS AND CAPACITORS

DRIVE MODEL NO.	GASKET KIT PART NO.	MOTOR				CAPACITOR		RESISTOR	
		PART NO.	CURRENT (AMPS AT 60 HZ[2])	RPM	FREQ. (HZ)	PART NO.	VAL. (µf)	PART NO.	VAL. (Ω)
11-150	20-3110-01	20-2700-20	0.17	72	60	14-2840-02	2	11-5802-03	500
					50	14-2840-13	3	11-5802-03	500
		20-2701-20	0.31		60	14-2840-11	4	11-5802-02	475
					50	14-2840-31	6	11-5802-06 (2 req'd)	180 ea.
		20-2701-51	0.43	120	60	14-2840-16	5	11-5801-12**	220
					50	14-2840-31	6	11-5801-12**	220
11-200 & 11-300	20-3110-02	20-2704-21	0.43	72	60	14-2840-16	5	20-1971-13	220[3]
					50	14-2840-19	7	20-1971-13	220[3]
		20-2705-21	0.70		60	14-2840-05	8	20-1971-12	110[3]
					50	14-2840-30	13	20-1971-12	110[3]
		20-2705-51	0.86	120	60	14-2840-29	9	20-1971-14	68[3]
					50	14-2840-30	13	20-1971-15	72[3]
11-400	20-3110-03	20-2201-31	1.30	72	60	14-2840-17	15	20-1971-03	75[3]
					50	14-2840-16	5	20-1971-03	75[3]
						14-2840-17	15		
		20-2201-32	2.30		60	14-2840-15	25	20-1971-04	37.5[3]
					50	14-2840-05	8	20-1971-04	37.5[3]
						14-2840-15	25		
		20-2201-33	3.00	120	60	14-2840-15	25	20-1971-06	18[3]
						14-2840-09	6		
					50	14-2840-15	25	20-1971-10	24[3]
						14-2840-05	8		
						14-2840-09	6		

1 All motors are rated 120 V ac.
2 50 Hz currents do not exceed 120% of 60 Hz levels.
3 Resistor assembly.
** Alternate power options (other than 120 or 240 V ac) require (2) 110Ω resistors, part no. 11-5802-05, in lieu of resistor shown.

APPENDIX *COMPONENTS*

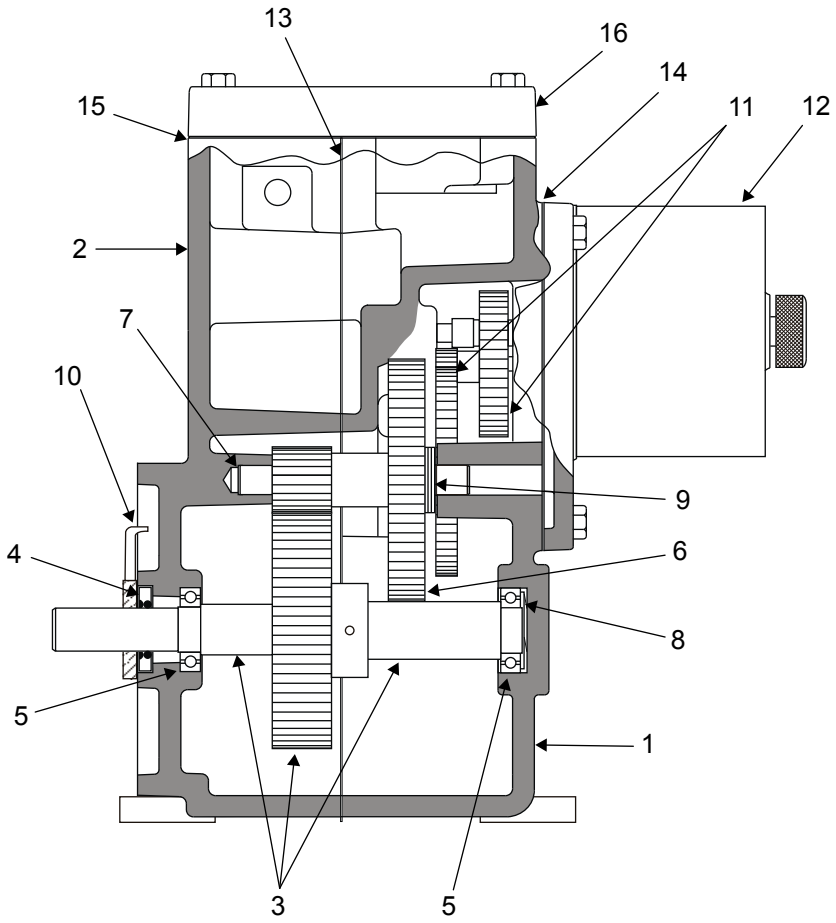


TABLE 8:
DRIVE COMPONENTS FOR MODEL 11-150*

ITEM NO.	DESCRIPTION	PART NO.	ITEM NO.	DESCRIPTION	PART NO.
1	Body, rear	Field Replacement is not recommended Contact Beck for additional information	12	Motor assembly	See Table 11
2	Body, front		13	Gasket, body	20-0660-83
3	Output shaft assembly		14	Gasket, motor assembly	20-0660-15
4	Seal, output shaft		15	Gasket, terminal cover	20-0660-16
5	Ball bearing, output shaft (2)		16	Terminal compartment cover	14-9744-20
6	Gear, 3rd combination		17	Terminal block assembly** (23 terminals)	20-1541-01
7	Pin, 3rd combination gear				
8	Spring washer		18	Control end compartment cover	11-0990-20
9	Thrust washer		19	Gasket, control end cover**	10-8080-02
10	Index pointer	10-4620-01	20	Gasket, DCM cover**	20-0660-17
11	Gear module assembly	See Table 11	21	ESR compartment cover**	13-2341-01

*To ensure exact replacement parts, contact Beck with the model / serial no. found on the drive nameplate.
**Not shown in this view.

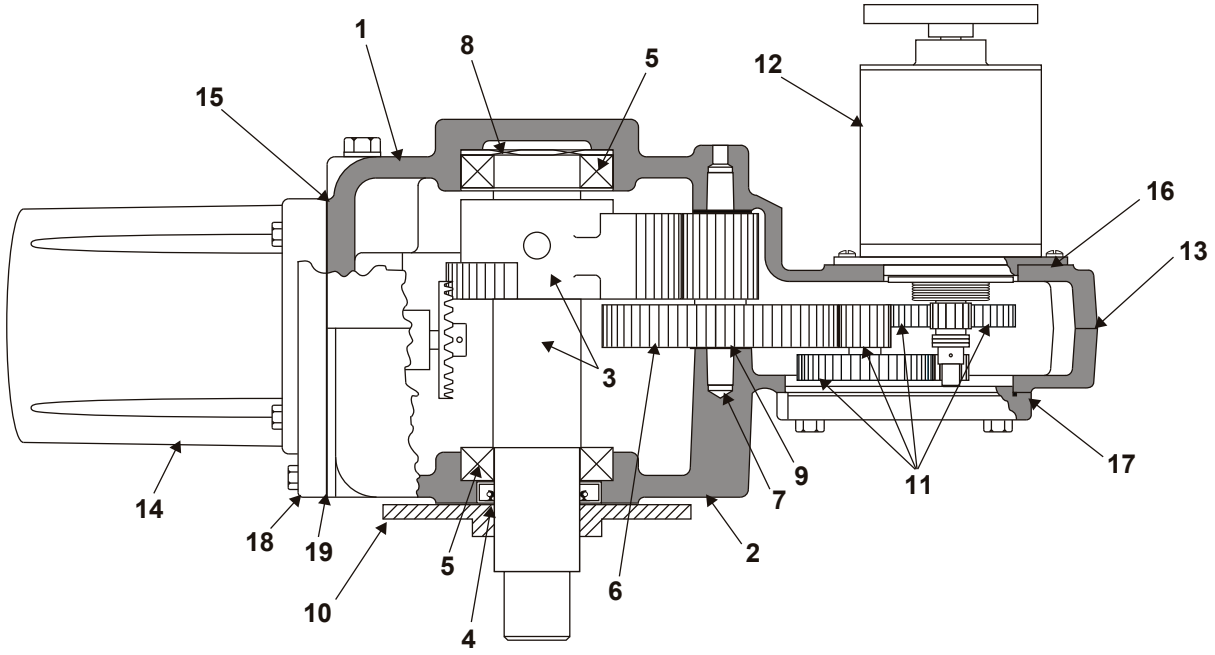


TABLE 9:
DRIVE COMPONENTS FOR MODEL 11-200 / -300

ITEM NO.	DESCRIPTION	PART NO.	ITEM NO.	DESCRIPTION	PART NO.
1	Body, rear	Field Replacement is not recommended Contact Beck for additional information	12	Motor assembly	See Table 11
2	Body, front		13	Gasket, body	20-0660-06
3	Output shaft assembly		14	Control end compartment cover	11-0990-20
4	Seal, output shaft		15	Gasket, control end cover	10-8080-02
5	Ball bearing, output shaft (2)		16	Gasket, motor assembly	20-0660-27
6	Gear, 3rd combination		17	Gasket, gear module assembly	20-0660-26
7	Pin, 3rd combination gear		18	ESR, Terminal compartment cover	14-9741-03
8	Spring washer		19	Gasket, ESR compartment cover	20-0660-03
9	Thrust washer		20	Terminal block assembly**	20-1541-01
10	Index pointer	14-9900-01	21	Barrier Plate**	20-2960-08
11	Gear module assembly	See Table 11	22	Gasket, barrier plate**	20-0660-22

*To ensure exact replacement parts, contact Beck with the model / serial no. found on the drive nameplate.
**Not shown in this view.

APPENDIX *COMPONENTS*

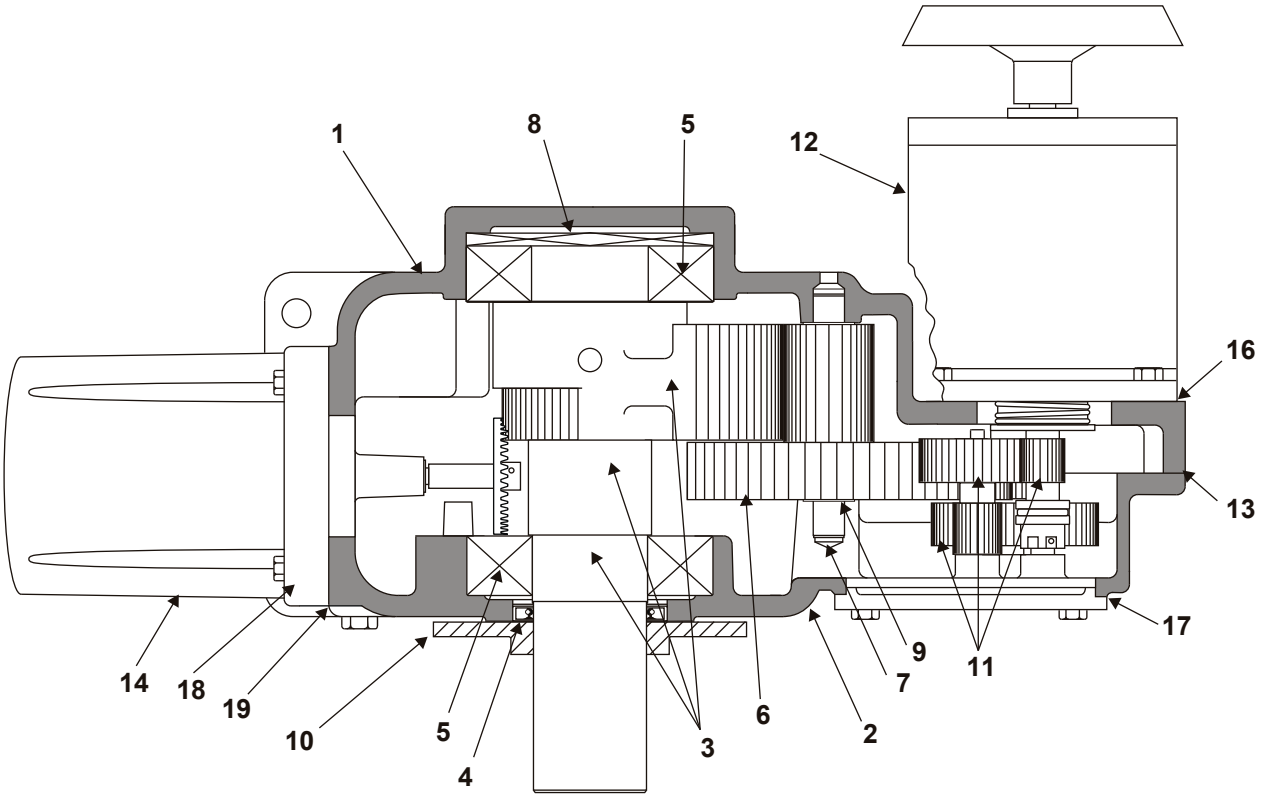


TABLE 10:
DRIVE COMPONENTS FOR MODEL 11-400

ITEM NO.	DESCRIPTION	PART NO.	ITEM NO.	DESCRIPTION	PART NO.
1	Body, rear	Field Replacement is not recommended Contact Beck for additional information	12	Motor assembly	See Table 11
2	Body, front		13	Gasket, body	20-0660-09
3	Output shaft assembly		14	Control end compartment cover	11-0990-20
4	Seal, output shaft		15	Gasket, control end cover**	10-8080-02
5	Ball bearing, output shaft (2)		16	Gasket, motor assembly	20-0660-08
6	Gear, 3rd combination		17	Gasket, gear module assembly	20-0660-07
7	Pin, 3rd combination gear		18	ESR, Terminal compartment cover	14-9741-03
8	Spring washer		19	Gasket, ESR compartment cover	20-0660-03
9	Thrust washer		20	Terminal block assembly**	20-1541-01
10	Index pointer	14-9901-02	21	Barrier Plate**	20-2960-08
11	Gear module assembly	See Table 11	22	Gasket, barrier plate**	20-0660-22

*To ensure exact replacement parts, contact Beck with the model / serial no. found on the drive nameplate.
**Not shown in this view.

TABLE 11:
TORQUE & TIMING OPTIONS LISTED BY MOTOR & GEAR MODULE ASSEMBLY

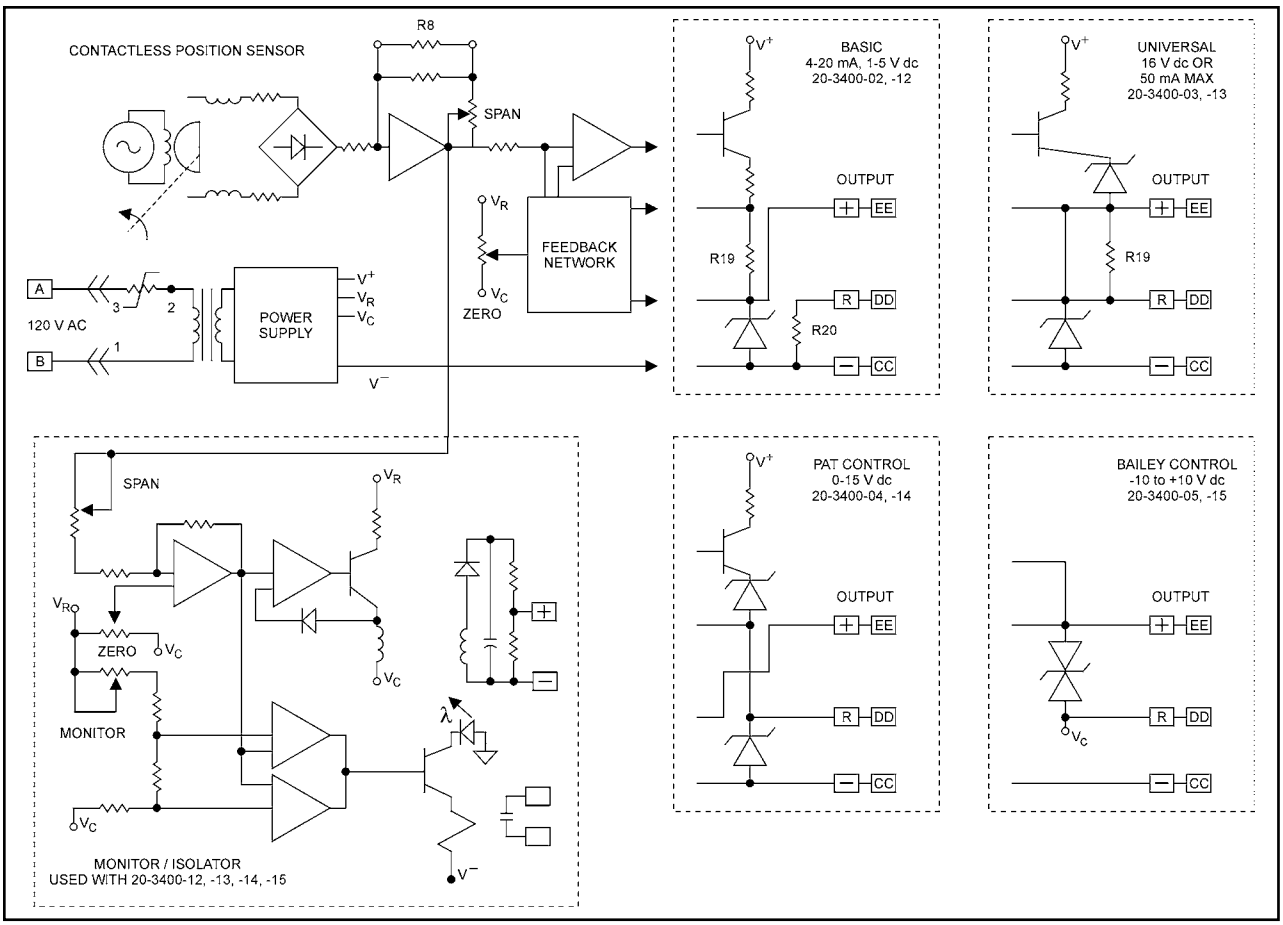
DRIVE MODEL NO.	MOTOR PART NO.	MOTOR CURRENT (AMPS AT 120 VAC, 60 HZ[1])	GEAR MODULE NO.	TORQUE (LB-FT)	TIMING @ 60 HZ[2] (SEC./100°)
11-150	20-2700-20	0.17	14-9733-04	20 (27 N•m)	20
			14-9733-03	40 (54 N•m)	40
			14-9733-02	60 (81 N•m)	60
			14-9733-01	80 (108 N•m)	90
	20-2701-20	0.31	14-9733-05	15 (20 N•m)	11
			14-9733-04	40 (54 N•m)	20
			14-9733-03	80 (108 N•m)	40
	20-2701-51	0.43	14-9733-03	80 (108 N•m)	24
11-200	20-2704-21	0.43	14-9730-04	125 (169 N•m)	40
			14-9730-05	175 (237 N•m)	60
			14-9730-08	250 (339 N•m)	75
	20-2705-21	0.70	14-9730-02	125 (169 N•m)	20
			14-9730-04	250 (339 N•m)	40
	20-2705-51	0.86	14-9730-04	250 (339 N•m)	24
11-300	20-2704-21	0.43	14-9730-09	300 (407 N•m)	100
	20-2705-21	0.70	14-9730-04	300 (407 N•m)	40
			14-9730-05	400 (542 N•m)	60
			14-9730-08	550 (746 N•m)	75
			14-9730-09	650 (881 N•m)	100
	20-2705-51	0.86	14-9730-04	300 (407 N•m)	24
			14-9730-05	400 (542 N•m)	36
11-400	20-2201-31	1.30	14-9732-05	350 (475 N•m)	24
			14-9732-07	550 (746 N•m)	40
			14-9732-02	800 (1085 N•m)	60
			14-9732-04	1,000 (1356 N•m)	75
			14-9732-03	1,500 (2034 N•m)	100
	20-2201-32	2.30	14-9732-05	650 (881 N•m)	24
			14-9732-07	1,000 (1356 N•m)	40
			14-9732-02	1,800 (2440 N•m)	60
	20-2201-33	3.00	14-9732-07	1,000 (1356 N•m)	24
			14-9732-02	1,800 (2440 N•m)	36

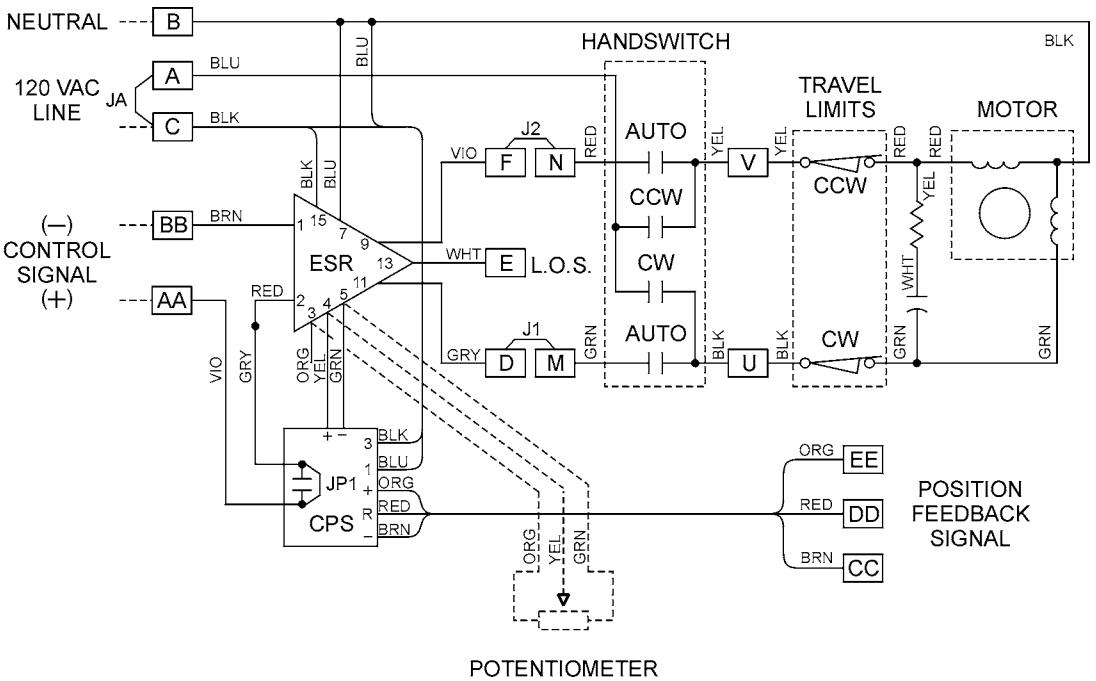
CAUTION: Use only the motor and gear module combinations listed above; other combinations may cause internal damage to the drive and/or damage to the external equipment.

[1]50 Hz currents do not exceed 120% of 60 Hz levels.

[2]50 Hz timing = 1.2 x 60 Hz timing.

APPENDIX *CPS-2 FUNCTIONAL BLOCK DIAGRAMS*





Typical Schematic for Control Option 7 or 8

APPENDIX *CPS-2 DATA*

TABLE 12:
CPS-2 SYSTEM APPLICATION DATA SUMMARY

FEEDBACK SIGNAL OPTIONS	CPS-2 MODEL NO.	EXTERNAL LOAD RESISTANCE	COMPATIBLE CONTROL SYSTEMS
CURRENT			
4 to 20 mA	20-3400-02 & -12 20-3400-03 & -13*	800Ω (Max.) 500Ω (Max.)	Industry Std (ISA)
10 to 50 mA	20-3400-03 & -13*	200Ω (Max.)	Foxboro
1 to 5 mA	20-3400-03 & -13*	2KΩ (Max.)	General Use
VOLTAGE			
1 to 5 V DC	20-3400-02 & -12 20-3400-03 & -13*	12KΩ (Min.) 250Ω (Min.)	Industry Std (ISA) Beck Position-All (27-301, -401, -501)
0 to 5 V DC	20-3400-03 & -13*	250Ω (Min.)	Leeds and Northrup
0 to 10 V DC	20-3400-03 & -13*	1KΩ (Min.)	Bailey, Foxboro, & Westinghouse
0 to 16 V DC	20-3400-03 & -13*	1KΩ (Min.)	Leeds and Northrup
0 to 15 V DC	20-3400-04 & -14	6KΩ (Min.)	Leeds and Northrup
-10 to 10 V DC	20-3400-05 & -15	2KΩ (Min.)	Bailey

*The 20-3400-03 and -13 may be connected for signal ranges so noted. See Wiring Diagrams on pages 13–14 for details

TABLE 13:
CPS-2 SIGNAL OUTPUT TERMINAL CONNECTIONS AND LOADING

SIGNAL RANGE	OUTPUT TERMINALS (+) (–)	RANGING RESISTOR		RESISTOR CONNECTIONS	MAXIMUM EXTERNAL LOAD
		VALUE	BECK PART NO.		
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			400µA
One or Two 1 to 5 V dc Signals	DD—CC EE—DD	255Ω Open	13-2511-03	DD—EE	400µA 400µA
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	1.5 KΩ	13-2512-02	CC—DD	16 mA
0 to 15 V dc*	EE—CC	2.74 KΩ	13-2513-42	CC—DD	16 mA
1 to 5 V dc	EE—CC	Jumper		CC—DD	16 mA
2 to 10 V dc	EE—CC	1.00 KΩ	13-2512-01	CC—DD	16 mA
0 to 16 V dc*	EE—CC	3.01 KΩ	13-2513-26	CC—DD	16 mA
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 31.

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

THREE YEAR LIMITED WARRANTY STATEMENT*

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

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

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES OF BECK. In no case shall Beck be liable for any special, incidental or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. Such damages include, but are not limited to, loss of profits, loss of revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of any substitute equipment, facilities or service, downtime, the claims of third parties including customers and injury to property.

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

***Note: Internal water damage is not covered by warranty.**

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