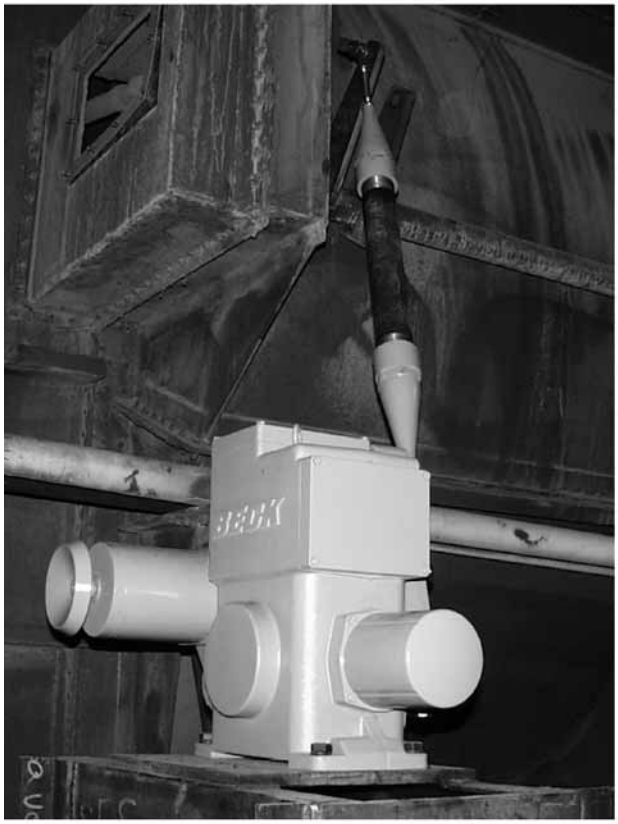
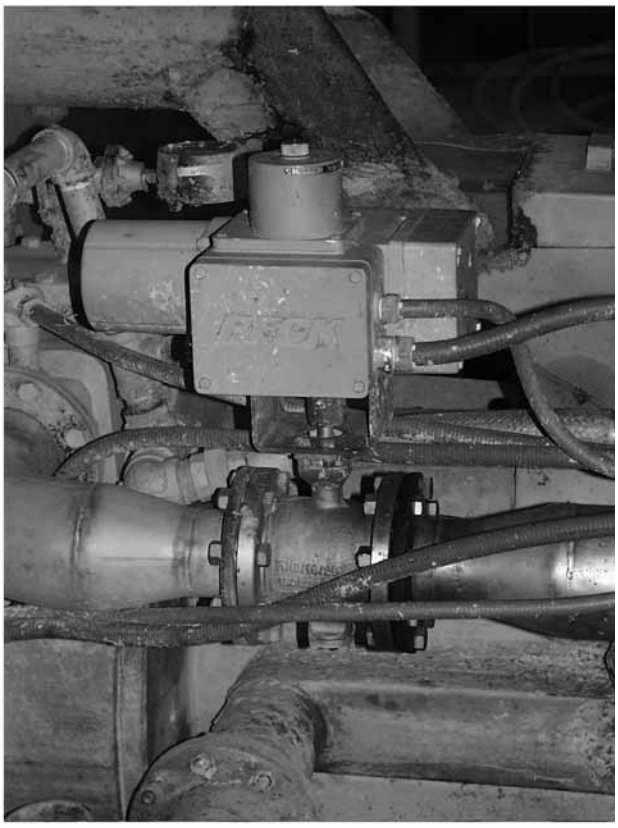
80-1102-02
Rev. 03

MODELS 11-1_9
11-2_9
11-3_9
11-4_9

BECK®

INSTRUCTION MANUAL





ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

INTRODUCTION TO THE MANUAL

This manual contains the information needed to install, operate and maintain Beck Model Group 11 Electronic Control Drives equipped with the Digital Control Module (DCM), 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 22 digital control drives ... are designed for accurate, reliable, digital control in high torque applications. The drive is ideal for use in large boiler applications, such as ID/FD fan dampers.

Group 14 linear drives ... are ideally suited for globe valves from 1" to 8" (25 to 203 mm) diameter. Beck's unique "Tight-Seater™" coupling provides positive seating of valves.

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. 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.

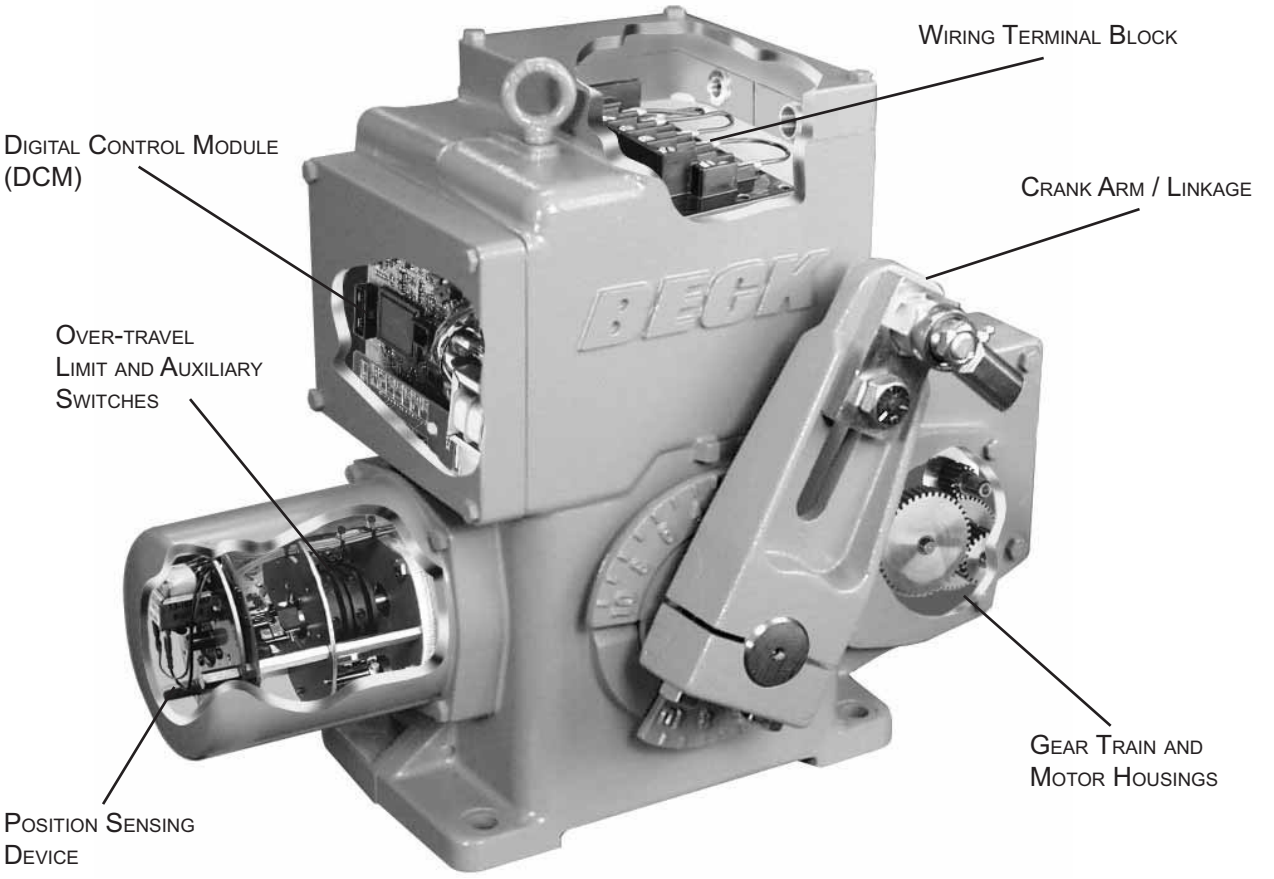
Dampers and valves may also be operated at their individual locations with built-in electric Handswitches.

The heavy-duty crank arm (if applicable) 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 Digital Control Module (DCM) provides precise drive control in response to a modulating Demand input signal. It also provides intelligent calibration, easy drive setup changes, and diagnostic information. A local interface provides quick pushbutton setup and diagnostics without the need for a handheld or remote device. A HART® communications interface allows remote access of all features and information. A serial interface also allows for drive configuration changes, drive information reporting and to assist in troubleshooting.

Beck's CPS-2 Contactless Position Sensor provides accurate position measurement 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.

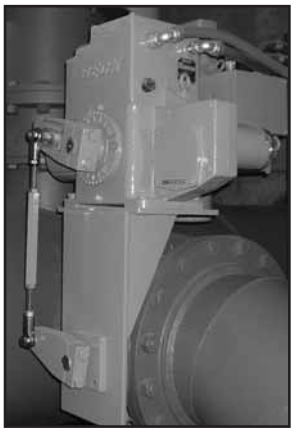


TYPICAL APPLICATIONS

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.

DCM equipped Beck drives are designed for precise position control in modulating applications. The drive is best utilized when its full 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. Depending on the valve and application, valves can be mounted directly or using a bracket and linkage. 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 foot-mounted drives are furnished with a crank arm and rod end (see pages 8, 10 and 13 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 50 or 60 Hz 240 V ac single-phase 50 or 60 Hz	Allowable Tolerance	+10% -15%

Model	Max. Current and Power			
	120 V ac		240 V ac	
11-159, -169	.40 A	48 W	.20 A	48 W
11-209, -269	.65 A	78 W	.33 A	78 W
11-309, -369	.65 A	78 W	.33 A	78 W
11-409, -469	3.10 A	400 W	1.55 A	400 W

Operating Conditions	-40° to 185°F (-40° to 85°C) 0 to 100% relative humidity
Communication Interface	HART protocol, local pushbutton/LED panel and RS-232 Serial commands.
Demand input Signal Options (DCM)	4–20 mA (1–5 V dc input is possible with the removal of the "R-in" resistor located on the DCM board (see diagram on page 83).
Adjustability for Split Range Operation	0%: 0.1 V to 4 V dc 100%: 0% + 1 V min. to 5 V max.
Dead band	0.6% of span (configurable).
Minimum Step	0.1% typical.
Linearity	±1% of span, max. independent error
Hysteresis	0.25% of span at any point
Demand input Signal Characterization	Linear: Drive output shaft moves proportionally to the input signal. Square: Drive output shaft moves proportionally to the square of the input signal.
Position Feedback Signal for Remote Indication	4–20 mA
Isolation	Demand input and position Feedback signals are isolated from ground and the ac power line. Signal buffering provides 24 V dc isolation between the Demand and Feedback signals.
Action on Loss of Power	Stays in place
Action on Loss of Input Signal (Power On)	Stays in place or drives to any preset position (configurable).
Stall Protection	If the motor tries to run in one direction for more than 300 seconds (configurable from 30 to 300 seconds), the DCM will shut off power to the motor.

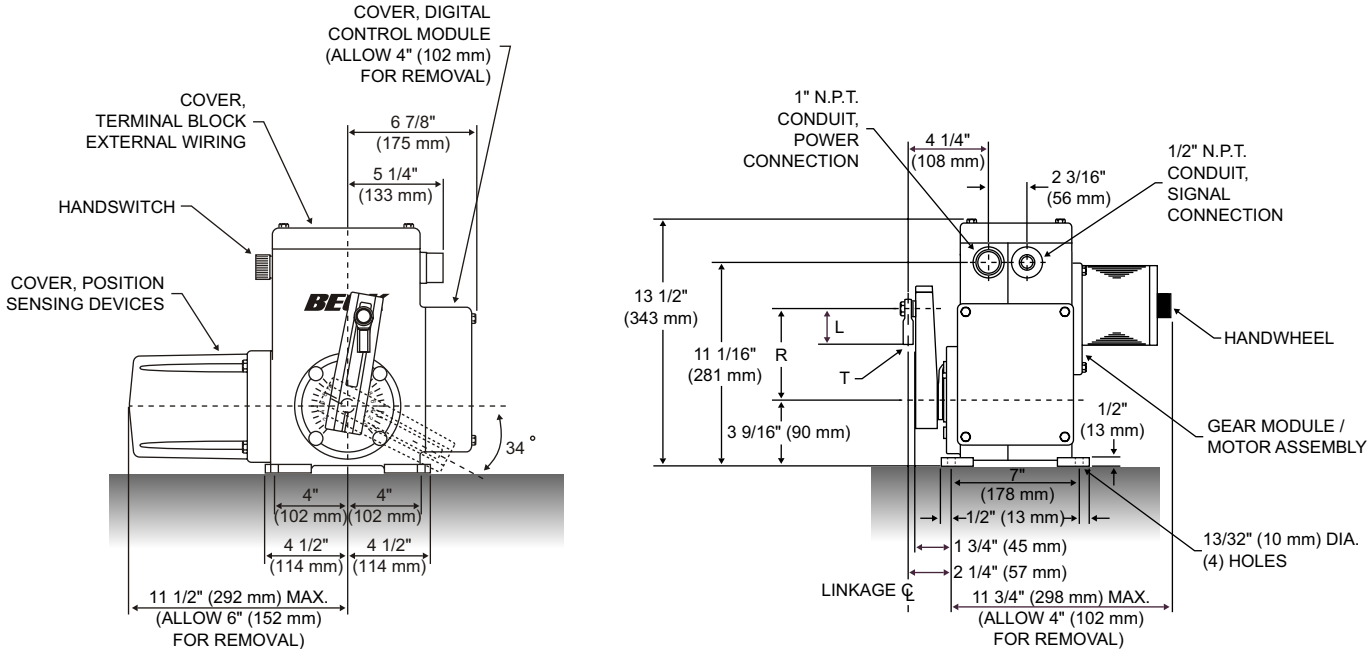
GENERAL SPECIFICATIONS—ALL MODELS (cont'd)

Overtorque Protection (Optional)	If the output torque of the drive exceeds 115% of the drive rating, the motor will shut off (feature can be enabled/disabled).
Alarm Annunciation	120 V, 80 mA max. available at terminal E (not available on drives configured for 240V operation).
Temperature Indication	Measures the internal temperature of the drive and triggers an alarm when the temperature exceeds the rating range.
Over-travel Limit Switches	Two SPDT (CW and CCW) provide over-travel protection.
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1 to S4 and are cam-operated, field-adjustable. Unless otherwise specified, auxiliary switches are factory set: 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 2.5 A at 120 V ac).
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.
Gear Train	High-efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears. Interchangeable gear modules permit field change of timing.
Mechanical Stops	Prevent 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. Drives designed for hazardous classified locations are also available. NEMA 4X; IP68, 3 meters/48 hours*. *Internal water damage is not covered by warranty.
Mounting Orientation	Any orientation—no limitations.
Standards*	UL Listed CSA Listed CE Compliant

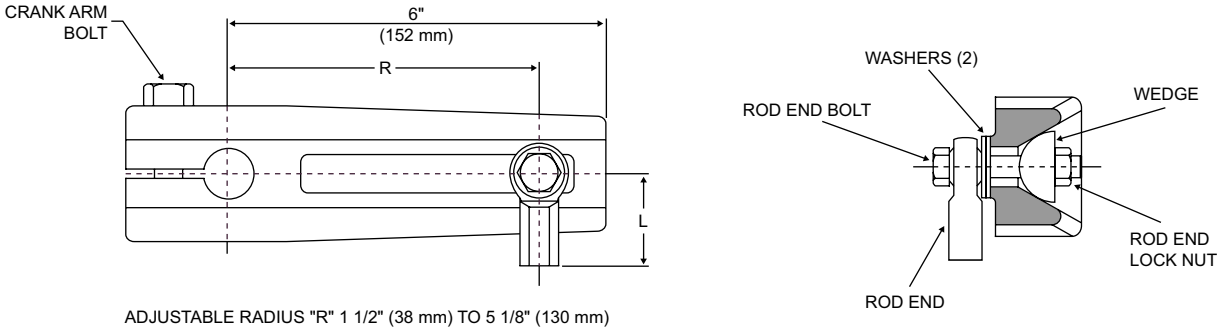
*NOTE: For standards not specifically listed, please call Beck for more information at 215-968-4600.

OUTLINE DIMENSION DRAWINGS

MODEL 11-159 SPECIFICATIONS



Crank Arm



Recommended Bolt Torques

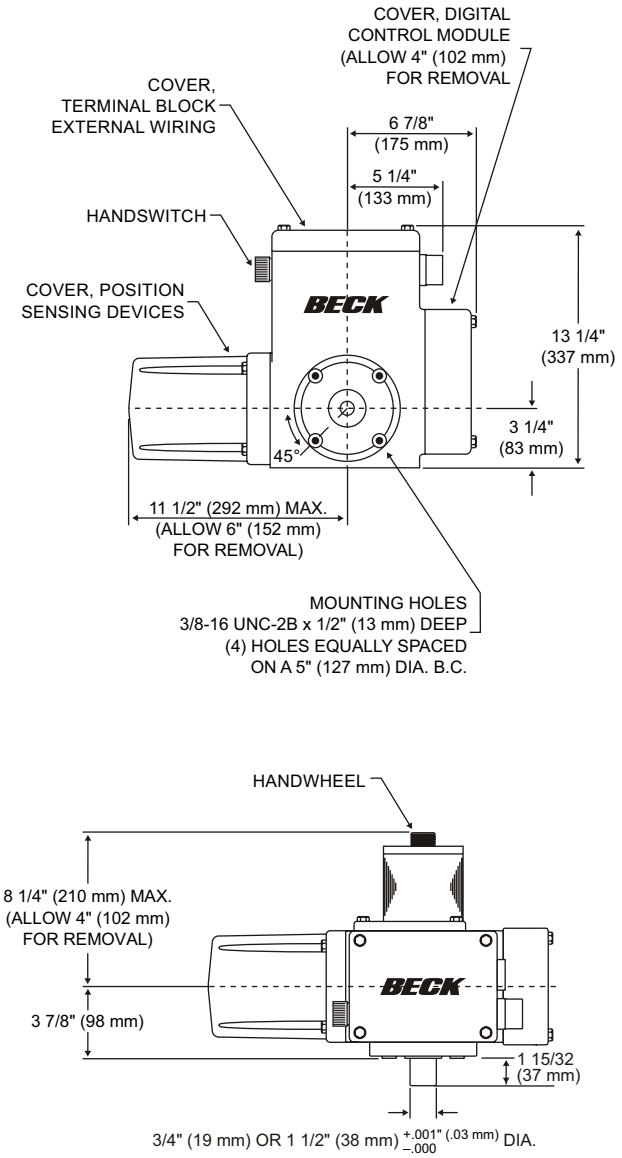
		Torque	
	Size (in.)	(lb-ft)	(N•m)
Crank Arm Bolt	1/2-13	75	102
Rod End Bolt	1/2-13	35	47
Rod End Lock Nut	1/2-13	55	75
Cover Bolts	5/16-18	10	14
Motor/Gear Module Bolts	1/4-20	6	8
Body Bolts	5/16-18	10	14
Body Bolts	3/8-16	20	27

Model 11-159 Linkage Part Numbers & Model Information

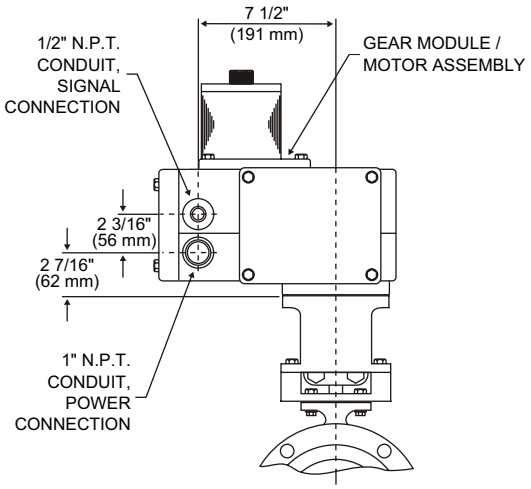
Crank Arm Assembly	10-3491-05
Crank Arm	10-3491-02
Crank Arm Bolt	30-0306-56
Washers (2)	30-0313-03
Wedge	11-8060-02
Rod End Bolt	30-0306-56
Rod End Lock Nut	30-0309-11
Rod End	12-2840-02
Dim. "L" (Length)	2.125" (54 mm)
Dim. "T" (Thread)	1/2-20 x 1-1/8" (29 mm)
Output Shaft Dia.	3/4" (19 mm)
Approx.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

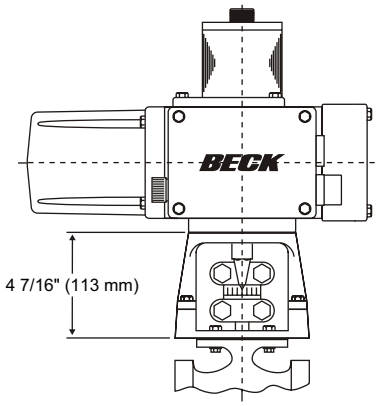
NOTE: All dimensions subject to change.

MODEL 11-169 SPECIFICATIONS



BASIC CONTROL DRIVE





TYPICAL VALVE MOUNTING

Model Information

Approximate Weight	56 lbs. (25 kg)
Maximum Overhung Load	750 lbs. (340 kg)

NOTE: All dimensions subject to change.

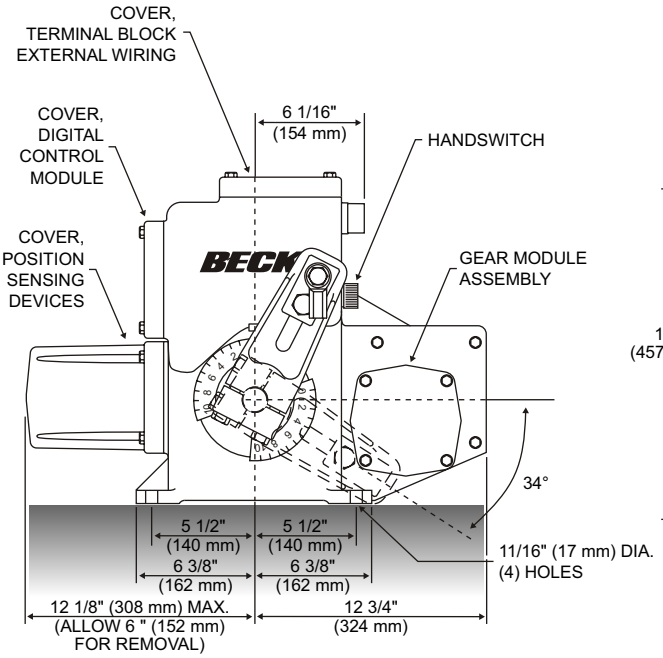
Recommended Bolt Torques

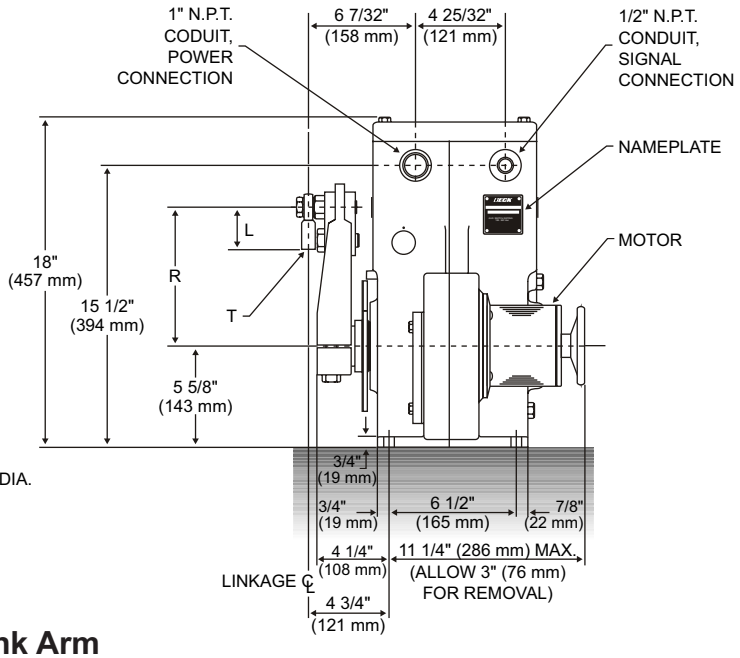
		Torque	
	Size (in.)	(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Motor/Gear Module Bolts	1/4-20	6	8
Body Bolts	5/16-18	10	14
Body Bolts	3/8-16	20	27
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	3/8-24	50*	68*
Mounting Bracket Screws (Flat Head)	3/8-16	25	34

*May vary per application. Refer to valve mounting specification sheet shipped with your drive.

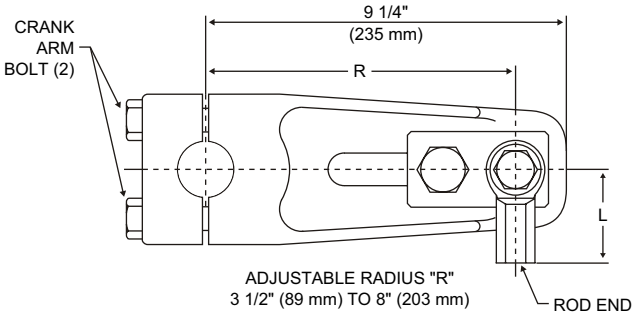
OUTLINE DIMENSION DRAWINGS

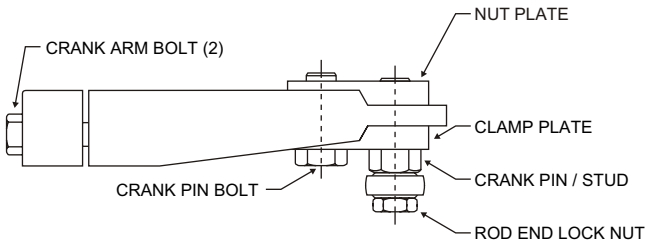
MODEL 11-209 & 11-309 SPECIFICATIONS





Crank Arm





Recommended Bolt Torques

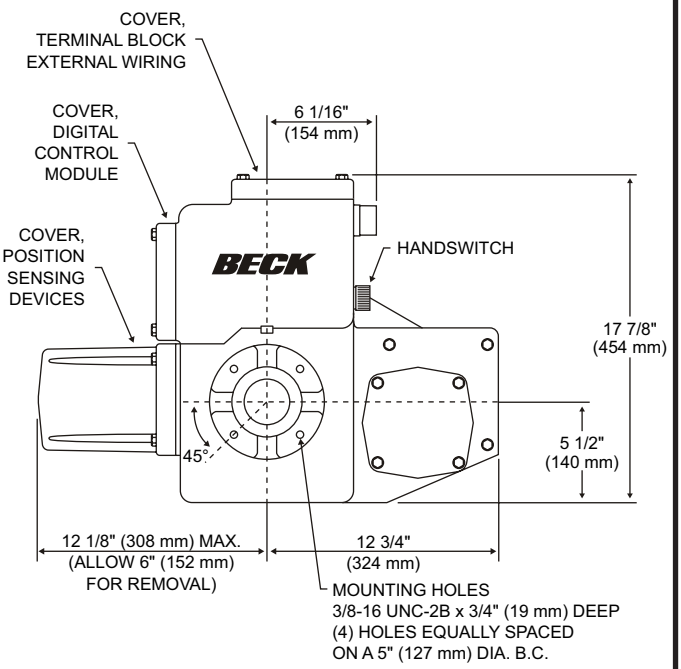
		Torque	
	Size (in.)	(lb-ft)	(N•m)
Crank Arm Bolt	5/8-18	240	325
Crank Pin Bolt / Stud	3/4-16	300	407
Crank Pin Bolt / Stud	3/4-16	300	407
Rod End lock nut:			
(11-209)	1/2-20	35	47
(11-309)	5/8-18	65	88
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Cover Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Gear Module Bolts	5/16-18	10	14

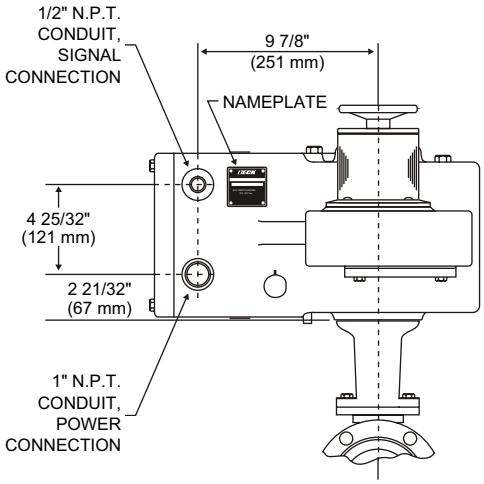
NOTE: All dimensions subject to change.

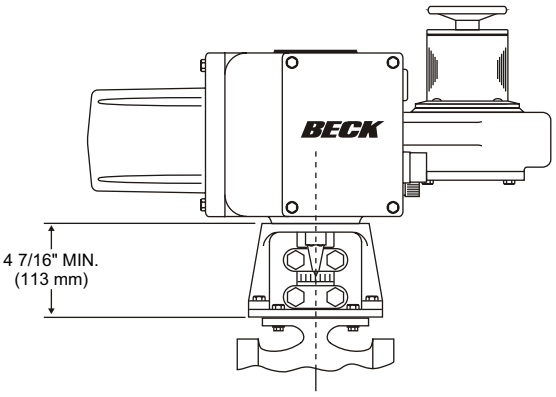
Model 11-209 / -309 Linkage Part Numbers & Model Information

	11-209	11-309
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 1/8" (54 mm)	2 1/2" (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 (1,361 kgs)	4,500 lbs (2,041 kgs)

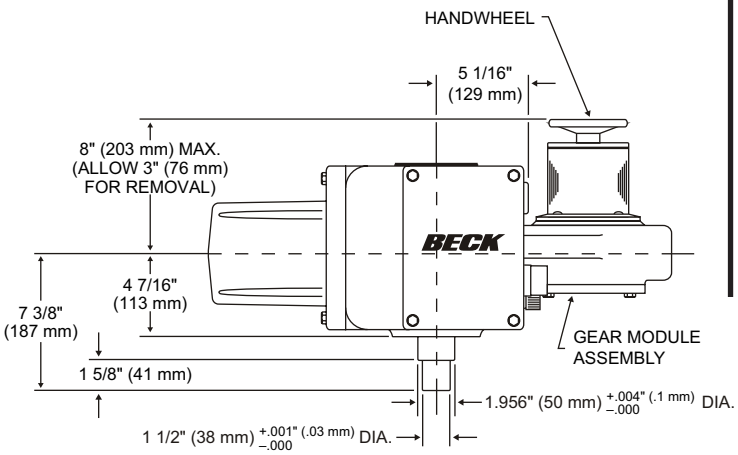
MODEL 11-269 SPECIFICATIONS







TYPICAL VALVE MOUNTING



BASIC CONTROL DRIVE

Model Information

Approximate Weight	115 lbs. (52 kg)
Maximum Overhung Load	3,000 lbs. (1 361 kg)

NOTE: All dimensions subject to change.

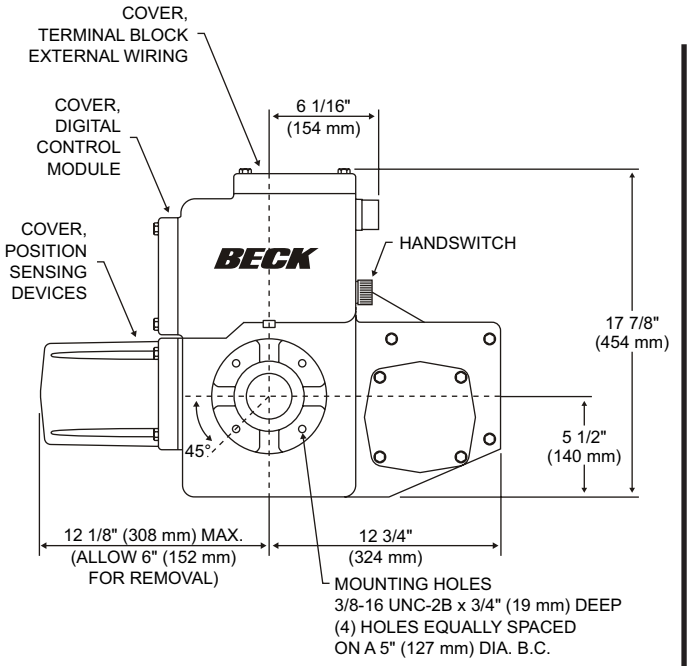
Recommended Bolt Torques

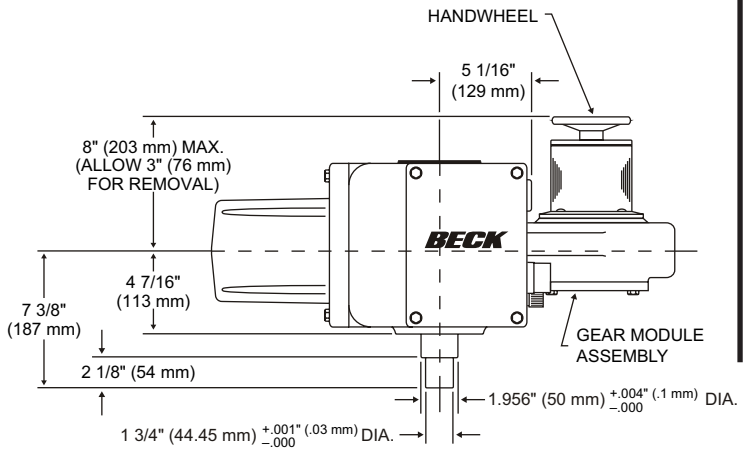
		Torque	
	Size (in.)	(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Screws (Flat Head)	3/8-16	25	34

*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

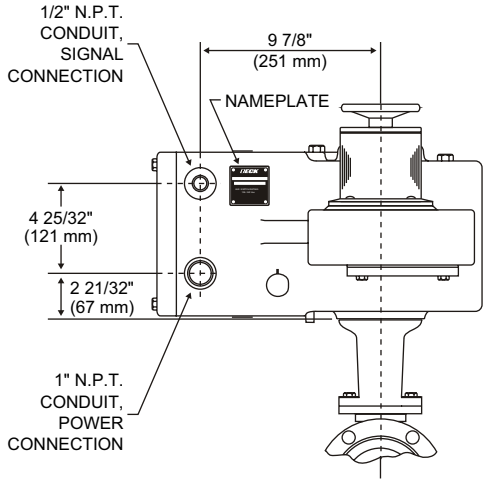
OUTLINE DIMENSION DRAWINGS

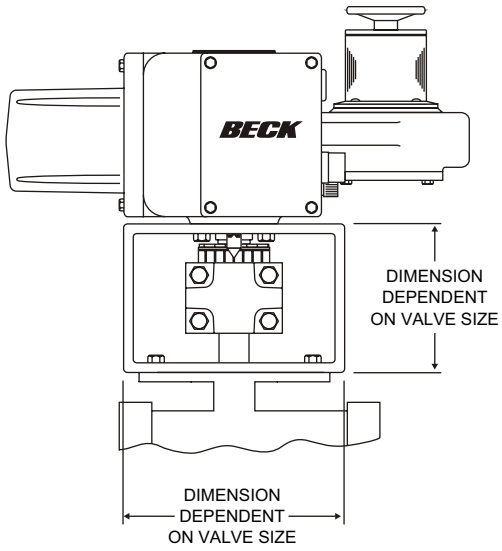
MODEL 11-369 SPECIFICATIONS





BASIC CONTROL DRIVE





TYPICAL VALVE MOUNTING

Model Information

Approximate Weight	115 lbs. (52 kg)
Maximum Overhung Load	4,500 lbs. (2 041 kg)

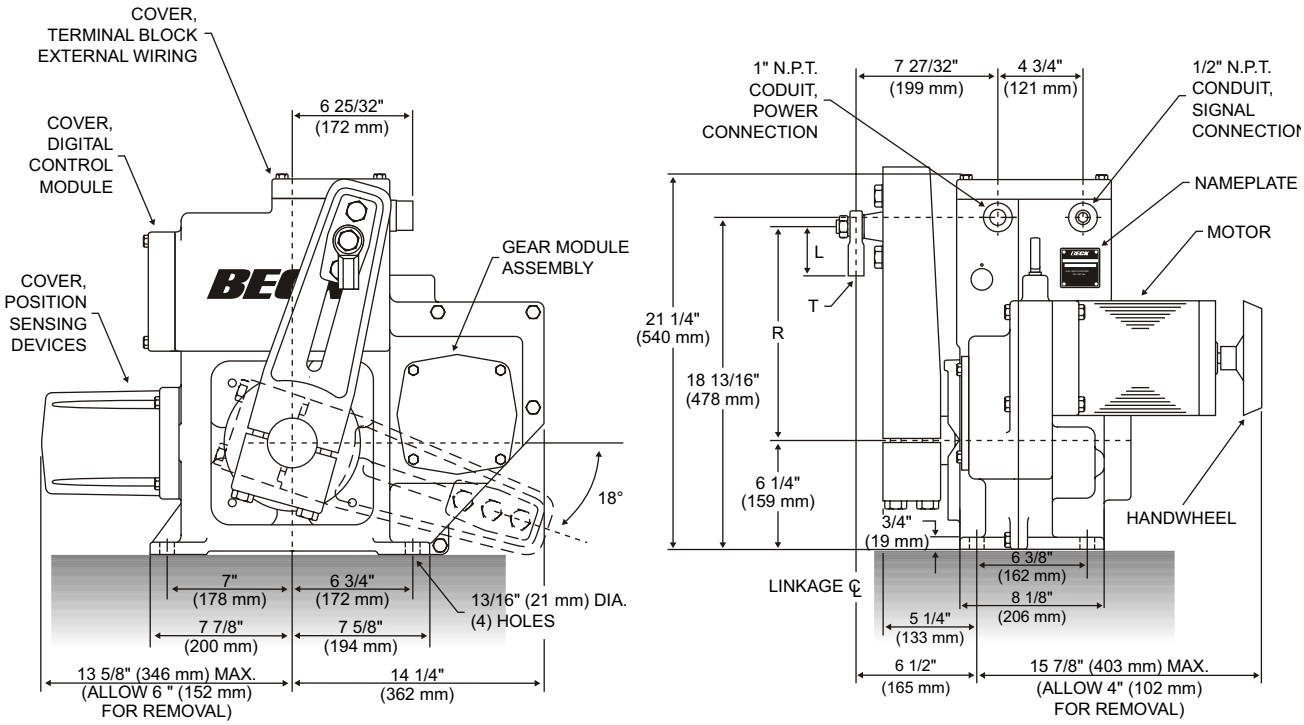
Recommended Bolt Torques

		Torque	
	Size (in.)	(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	1/4-20	6	8
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Screws	1/2-13	50	68

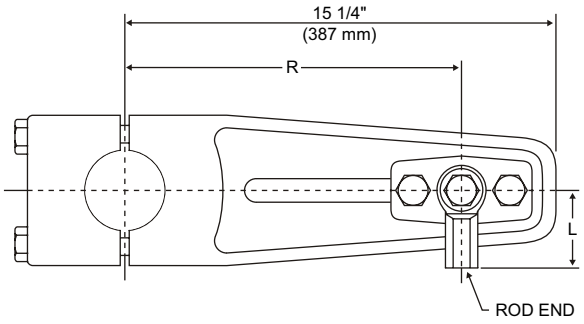
NOTE: All dimensions subject to change.

*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

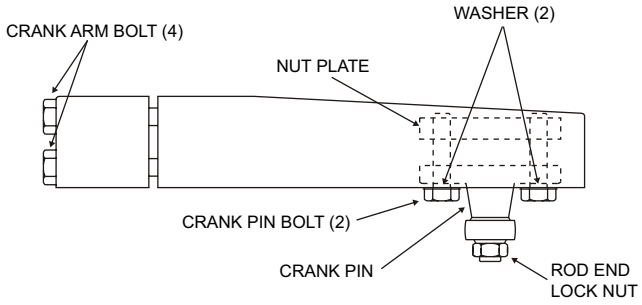
MODEL 11-409 SPECIFICATIONS



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

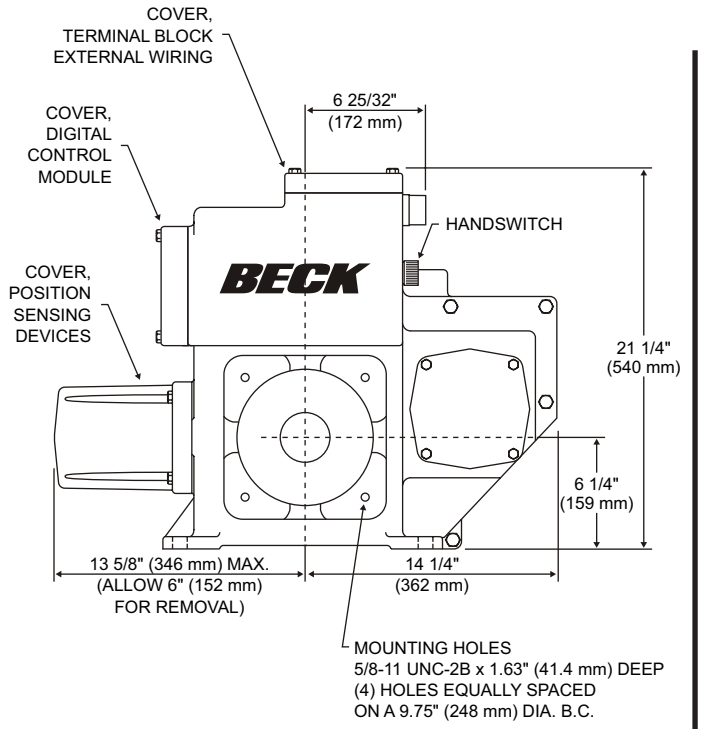
NOTE: All dimensions subject to change.

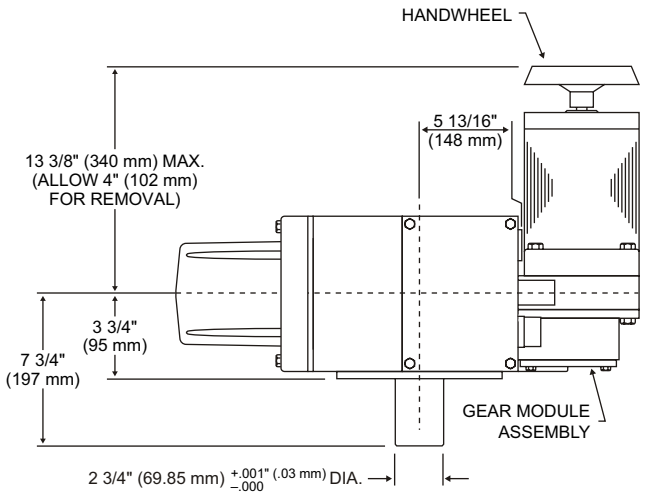
Model 11-409 Linkage Part Numbers & Model Information

	11-409
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 7/8" (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)

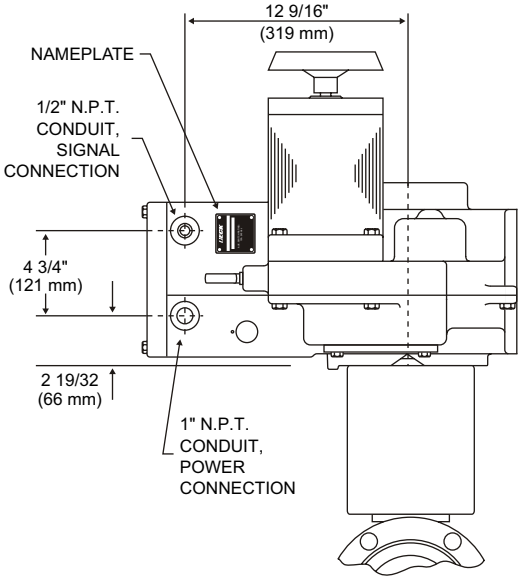
OUTLINE DIMENSION DRAWINGS

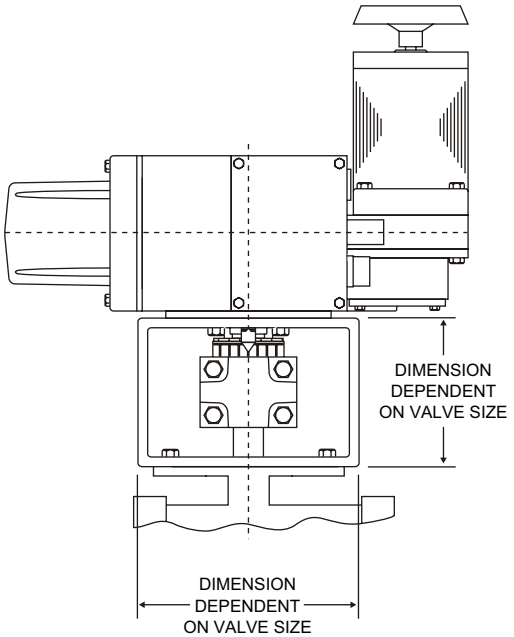
MODEL 11-469 SPECIFICATIONS





BASIC CONTROL DRIVE





TYPICAL VALVE MOUNTING

Model Information

Approximate Weight	216 lbs. (98 kg)
Maximum Overhung Load	9,000 lbs. (4 082 kg)

NOTE: All dimensions subject to change.

Recommended Bolt Torques

		Torque	
	Size (in.)	(lb-ft)	(N•m)
Cover Bolts	5/16-18	10	14
Gear Module Bolts	5/16-18	10	14
Motor Bolts	3/8-16	16	22
Body Bolts	3/8-16	20	27
Body Bolts	1/2-13	50	68
Control End Cover Bolts	5/16-18	10	14
Coupling Bolts	5/8-18	170*	230*
Mounting Bracket Bolts	5/8-11	100	135

*May vary per application. Refer to Valve Mounting Specification sheet shipped with your drive.

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

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 8–14 for physical dimensions and required clearances.

Installing a Drive with Linkage

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 that 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).

Installing a Direct-coupled Drive

CAUTION

Whenever a control drive is being mounted on a valve, it is good practice to remove the valve from service and observe these precautions:

- **Know what fluid is in the line.**
- **Wear proper protective equipment.**
- **Disconnect electrical power.**
- **Depressurize the pipeline.**
- **Refer to the valve maintenance manual for specific instructions.**
- **Consult the *Beck Valve Mounting Specification sheet* shipped with the drive for instructions.**

Installing a Unitized Valve/Drive Assembly on a Pipeline

Inspect the valve and pipe flanges to ensure they are clean. Be certain that other pipelines in the area are free from pipe scale or welding slag that could damage the gasket surfaces.

Carefully lift the assembly and position the valve in the pipeline. Install and tighten the flange bolts according to the valve and/or gasket manufacturer's instructions.

NOTE: The valve may have undergone temperature variations in shipment. This could result in seepage past the stem seals. Refer to the valve manufacturer's maintenance instructions for packing adjustments.

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, a 250 ohm input resistor may be added or removed to obtain the proper match. Consult the factory for details.

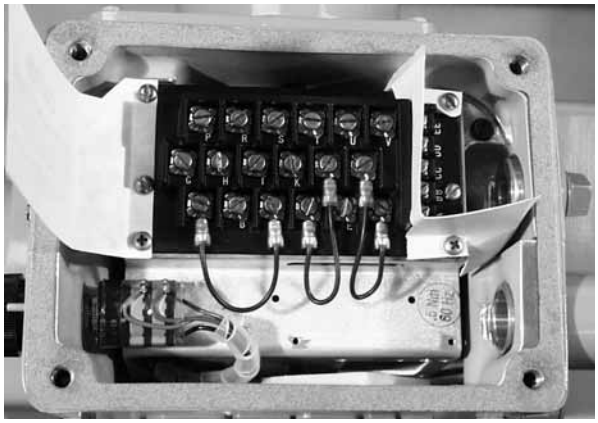
For maximum safety, the Beck drive body should be grounded. Use the grounding terminal in the wiring compartment of the drive.

INSTALLATION *SIGNAL WIRING*

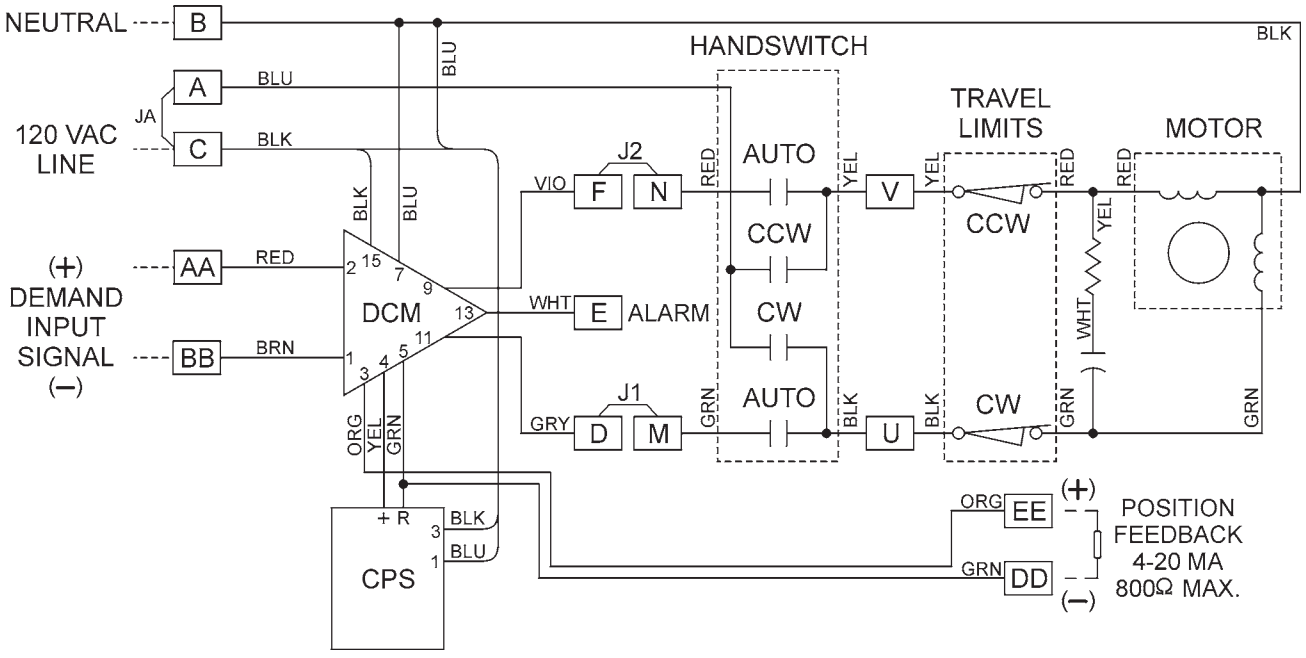
Each Beck drive is custom built to match the control requirements of your system specified at the time of order. Each drive has a specific wiring diagram attached to the inside of the wiring terminal cover. Typical wiring connections are described below.

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

To prevent Handswitch initiated motion, remove the jumper between terminals A and C. ***CAUTION: AC power to the drive must be turned off before removing the jumper.***



Typical Wiring Connections



POWER AND DEMAND INPUT CONNECTIONS

Customer must supply 120 V ac to power the drive and control circuitry. 120 V ac line connects to terminal C and neutral to terminal B. Input signal wires connect to terminals AA (+) and BB (–).

NOTE: Alarm indication at Terminal E is not available on drives configured for 240V operation.

LINKAGE REQUIREMENTS (If Applicable)

In most 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 the lever 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 damper/valve in response to an increasing signal) :

1. Position the driven shaft to the 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 correspond with the driven shaft's fully closed position.
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 and 13.
11. Tighten the coupling and rod end jam nuts.
12. Lubricate rod end bearings.
13. Carefully move the drive's output shaft to to correspond with the driven shaft's fully open position. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also, observe that the driven shaft rotates the proper amount. Ensure that the drive reaches the proper limit and shuts off. If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius on the Beck 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.

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.

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, accuracy of the drive, and available torque.

For an input control signal change, do not adjust the linkage. Refer to the Calibration section of this manual.

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.

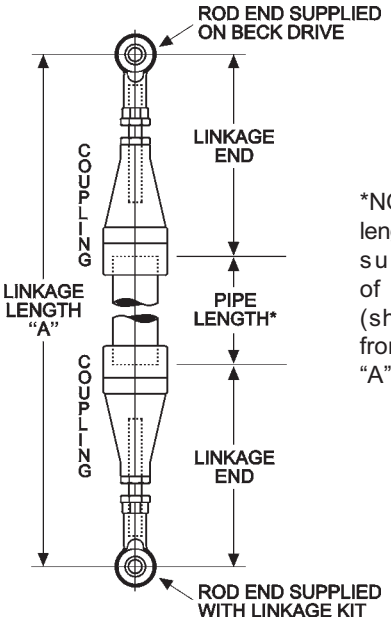
Linkage Kits Available

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 hardware. Schedule 40 pipe is not included and must be cut to length and threaded

in the field (see Table 1, below, 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 1, 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 1) 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.

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 applicable instructions on page 31, 53 or 73).

TABLE 1:
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
11-159	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)
11-209	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)
11-309	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)
11-409	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)

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, digital control module, 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. Drive travel is centered between the mechanical stops unless otherwise specified at time of order.

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 9, page 88 for details.

On all models except the 11-169, the output shaft is limited by mechanical stops to 108° of rotation. On model 11-169 drives, the output shaft is limited by mechanical stops to 98° 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". When the Handswitch is turned fully clockwise, "AUTO" should be indicated.

In the "AUTO" position, two contacts are closed and the DCM 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.

To prevent Handswitch initiated motion, remove the jumper between terminals A and C. ***CAUTION: AC power to the drive must be turned off before removing the jumper.***

SWITCHES

Two over-travel limit switches 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.

LOSS OF DEMAND INPUT SIGNAL (L.O.S.)

When the Demand input signal drops to approximately –5%, the DCM considers the Demand input signal to be invalid. DCMs are typically configured to stop the drive during L.O.S. conditions, but may be configured by the factory or by using the HART or Serial interface to run the drive to a predetermined position. Under the L.O.S. condition, the “ERR” and “DEMAND” LEDs will light. When the input signal is corrected, the drive will automatically resume normal operation. The value for LOS activation is configurable using the HART (see page 49) or Serial interface (see page 74). Alarm indication is available at terminal E.

POSITION: CONTACTLESS POSITION SENSOR (CPS)

The CPS provides the DCM with a continuous feedback signal proportional to the position of the drive’s output shaft.

The position sensing function of the CPS is provided by a ferrite magnetic sensing element. An electronic circuit translates the signal from the ferrite magnetic sensor into a position signal used by the DCM to control the drive. The typical output voltage of the CPS ranges from 1.0 V at the CCW end of travel, to 5.0 V at the CW end of travel. A 4–20 mA position feedback signal is available for remote position indication (see page 17). If the CPS Position signal to the DCM is out of the calibrated range limits, the "ERR" and "POSITION" LEDs will light. Alarm indication is available at terminal E.

TORQUE PROTECTION AND INFORMATION (OPTIONAL)

DCMs may be equipped with a torque sensing module that will light the “ERR” and “TORQUE” LEDs in the event excessive torque is detected. This alarm is normally set to activate when torque exceeds 105% of the drive rating. Torques above 150% of the drive rating will cause the DCM to stop trying to run in the direction of the high torque. When the over torque condition is corrected, the drive will automatically resume normal operation. The torque sensing module also provides a number of torque related features using the HART interface (see page 50). Torque may be enabled or disabled using the HART (see page 50) or Serial interface (see page 76). Alarm indication is available at terminal E.

STALL PROTECTION AND ANNUNCIATION

If the drive output shaft cannot reach a desired position within approximately 300 seconds, the DCM shuts off power to the motor and the “ERR” and “STALL” LEDs will light. The stall condition timing is factory configurable (or configurable using the HART or Serial interface) from 300 seconds to as low as 30 seconds and is initially set according to the specification at time of order.

A sensed stall condition is cleared by either reversing the Demand input signal from the controller (such that the drive tries to run in the direction opposite the blocked direction), performing a "Reset Stall" or "Board Reset" using the HART interface (see page 43), or by switching the drive power off and on. Alarm indication is available at terminal E.

TEMPERATURE

DCMs are equipped with a temperature sensing circuit. The “ERR” and “TEMP °F” LEDs will light when the drive’s ambient temperature exceeds the rating of the drive. Specific temperature readings are available using the HART (see page 44) or Serial (see page 77) interface. Alarm indication is available at terminal E.

FEEDBACK SIGNAL

The feedback sourcing module provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full rotational travel (configurable via the HART (see page 56) or Serial (see page 75) interface). This signal can be remotely monitored or used by a controller or indicator. The “ERR” and “FB OPEN” LEDs will light if the function is enabled and there is no current in the loop. The Feedback signal can be factory configured as disabled, or disabled using the HART (see page 48) or Serial (see page 75) interface. Alarm indication is available at terminal E.

STOP/LIMIT INDICATION

The “ERR” and “STOP/LIMIT” LEDs will light if the Handswitch is in the “STOP” position. These LEDs will also light if the drive is at a limit and is not in balance. Alarm indication is available at terminal E.

DIGITAL CONTROL MODULE (DCM)

INPUT: DIGITAL CONTROL MODULE (DCM)

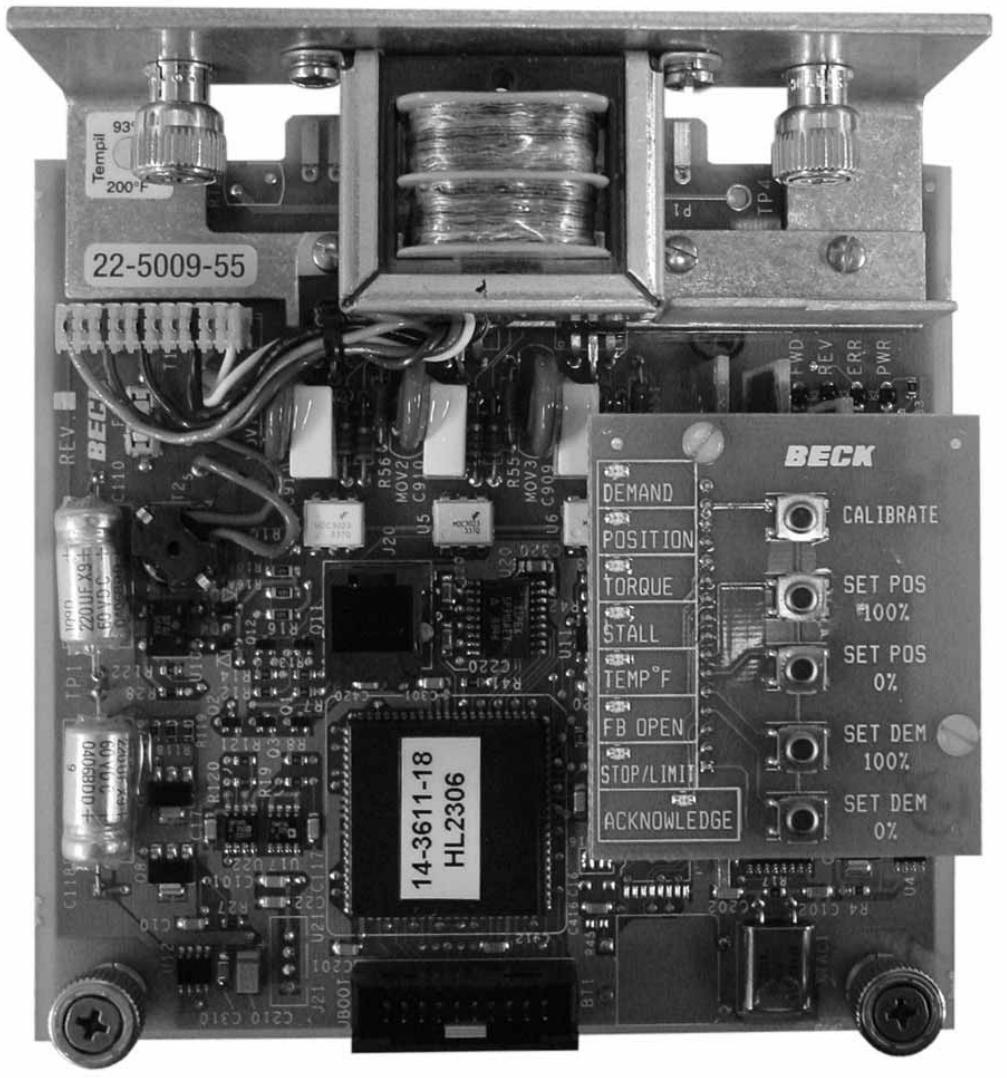
Beck modulating drives are equipped with a precision, digital control module (DCM) designed to receive conventional 4–20 mA or 1–5 V dc control signals directly—eliminating the need for contact protection devices, relays, switches and reversing starters.

The DCM modulates the drive output shaft in response to an analog Demand input signal and is designed to operate continuously in temperatures up to 185°F (85ºC).

The DCM provides intelligent calibration, easy drive setup changes, and diagnostic information. A **Local interface** provides quick pushbutton setup and diagnostics without the need for a handheld or remote device (see page 23). A **HART communications interface** allows remote access of all features and information (see page 36). A **Serial interface** also allows for drive configuration changes, drive information reporting and to assist in troubleshooting (see page 70).

The DCM permits two or more Beck drives to be operated by a single signal source. See pages 29 and 59 for details on split range operation.

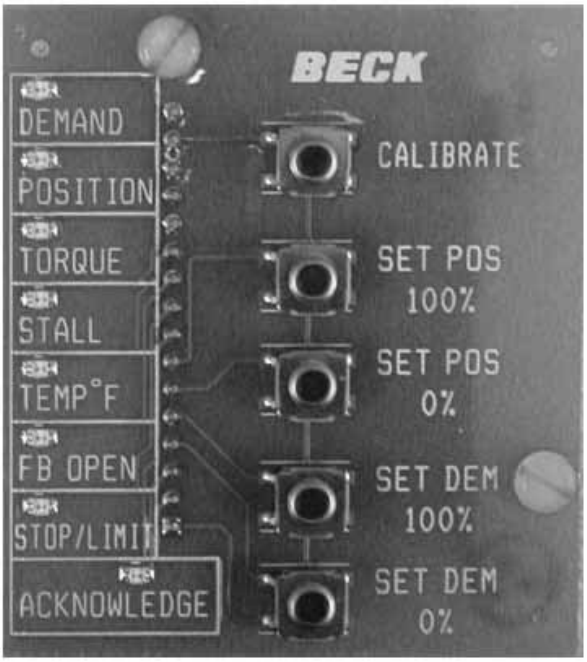
A square function is available to position the drive's output shaft proportionally to the square of the input signal. This function is factory configurable (specify at time of order) or may be configured using the HART interface (see page 48) or Serial interface (see page 74).



DCM LOCAL INTERFACE *Operation*

OVERVIEW

The DCM customer interface panel (pictured below) allows the user to easily calibrate the drive and troubleshoot conditions. The following information provides an overview of the DCM customer interface panel features.



NOTE: Beck drives are shipped from the factory set up and calibrated to customer specifications placed at the time of order and are ready for installation.

Overview LEDs

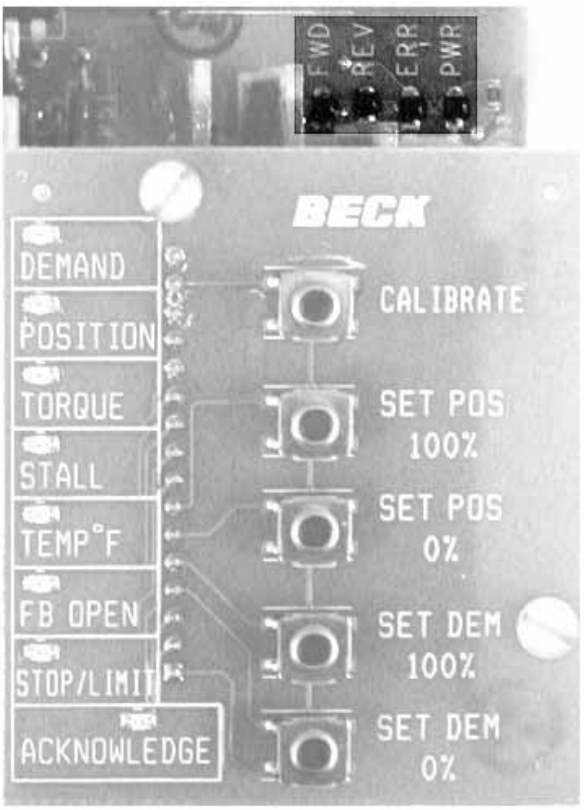
The four LEDs, as highlighted below, indicate the present state of the drive.

FWD
: This LED is lit when the drive is receiving a Demand signal greater than its position.

REV
: This LED is lit when the drive is receiving a Demand signal smaller than its position.

ERR
: This LED is lit when additional status is available. For details regarding possible conditions, see “Status Indication LEDs” on page 24.

PWR
: This LED is lit when power is applied to the drive.



DCM LOCAL INTERFACE *Operation*

Status Indication LEDs

When the "ERR" LED is lit, the applicable status indication LED(s) (pictured below) will light to reveal the condition(s) as described below. An alarm is also available at terminal E. When the condition is corrected, the status will automatically reset. Each status LED is described below, with a more detailed explanation of the function provided on page 21.

DEMAND
: Loss of the Demand input signal.

POSITION
: The CPS Position signal to the DCM is out of the calibrated range limits. The lower limit is –5% and the upper limit is 105% of the calibrated range. This LED may also indicate a CPS or internal wiring failure.

TORQUE
: This LED indicates that excessive torque is present (over 105% of the drive rating). This LED is functional only when the drive is equipped with optional torque sensing.

STALL
: The drive is in a stall condition and stall protection has been activated.

TEMP °F.
: Drive's internal temperature is outside of rating.

FB OPEN
: External position Feedback signal is enabled, but not wired to an external load or the wiring has failed between the drive and the monitoring device.

STOP/LIMIT
: Handswitch is in "STOP" position or the drive is at a limit and is not in balance.

Pushbutton Controls

The five pushbuttons (pictured below) on the DCM customer interface panel are used for calibration. When pressing a pushbutton, pressure should be maintained until the "ACKNOWLEDGE" LED lights; this confirms receipt of the pushbutton command. See the Calibration section, beginning on page 25, for further explanation of the calibration procedures. Pushbutton functions are as follows:

CALIBRATE
: A safety feature, this button must be pressed and held while pressing the pushbuttons described below to set the Position and Demand signal limits.

CAUTION

Pressing the following buttons may change calibration and cause the drive to reposition.

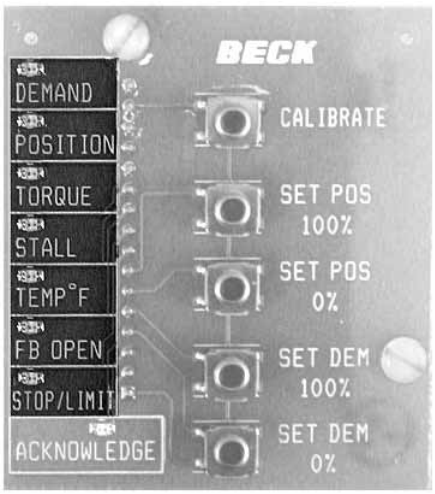
SET POS 100%
: Press to set the desired 100% position for drive movement (this will correspond to a 100% Demand signal).

SET POS 0%
: Press to set the desired 0% position for drive movement (this will correspond to a 0% Demand signal).

SET DEM 100%
: Press to set the Demand input signal that corresponds to 100% Demand.

SET DEM 0%
: Press to set the Demand input signal that corresponds to 0% Demand.

Status Indication LEDs



Pushbutton Controls

All Beck drives are shipped completely calibrated to the customer's specifications that were written into the equipment order and are ready to be installed. If the need arises to change the drive calibration, first confirm that the drive is installed as specified and operating properly before proceeding with the change.

Position reference and demand calibration are performed using the DCM customer interface panel, but may also be configured using the HART or Serial interface. Calibration of over-travel limit and auxiliary switches must be performed using the procedure beginning on page 26.

CALIBRATION PRIORITY

Models 11-159, -209, -309 & -409

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 approximately 108° apart.

The over-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 (typically 100°). The limit switches are positioned to provide an electrical overtravel protection (typically 101°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation (see page 30)—it may be desirable to reset the over-travel limit switches (see page 26). 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. The switches 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 and DCM operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.

Models 11-169, -269, -369 & -469

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 approximately 108° apart; except for the 11-169 stops, which are 98° apart.

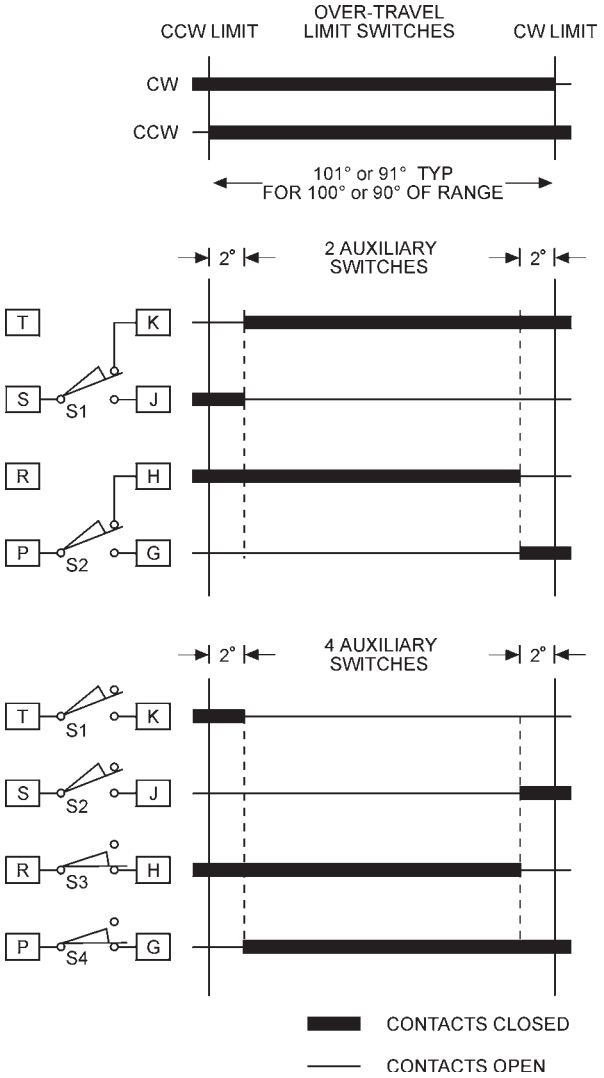
The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart then the drive's intended full range of electronic operation (typically 90°). The limit switches are positioned to provide an electrical overtravel protection (typically 91°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 90° rotation (see page 30)—it may be desirable to reset the over-travel limit switches (see page 26). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. Because the over-travel limit switches define the maximum electrical drive range, if they are to be reset, they should be adjusted before performing DCM (demand and position) calibration procedures.

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

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 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 Over-travel Limit and Auxiliary Switch Settings

SWITCH ADJUSTMENTS

Control drives are shipped with over-travel limit switches factory-set for either 101° (11-159, -209, -309, -409) or 91° (11-169, -269, -369, -469) of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the built-in, non-adjustable mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of 60°. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

NOTE: The over-travel limit switches are the switches closest to the drive body. To adjust the over-travel limit 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.

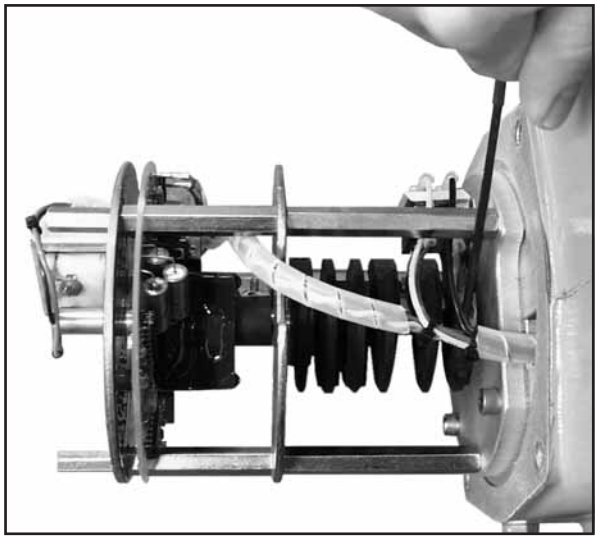
CAUTION

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 Over-travel Limit Switches CW and CCW

This procedure should be used if the factory over-travel 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:

1. Remove the control end cover 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 illustration below).
3. Move the output shaft clockwise to the desired CW limit.
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 travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If 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 stopping point is reached, the switch is properly set.



Loosening Switch Cam

13. Repeat instructions for setting CCW travel limit switch (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 models 11-159 or -169) 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 26. The heavy line indicates a closed circuit. Follow these instructions to change the operating point of auxiliary switches:

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

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the electric Handswitch to drive the shaft so that the switch cam is accessible. Using a 7/64" hex wrench, loosen the screw so that the cam is just snug on the shaft.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the “STOP” position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. See the diagram on page 26 or the drive wiring diagram. Rotate the cam to operate the switch.
7. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
8. Disconnect the meter and reconnect power.
9. Move the drive’s output shaft in the desired direction to verify 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.

DEMAND CALIBRATION

DCM boards are designed to accept a 4–20 mA (or 1–5 V dc) analog demand signal. Narrower spans within this range can also be accommodated for split range operation (see page 29). The input comes calibrated from the factory for the full range unless otherwise specified by the customer. It is not necessary to calibrate the Demand input when the drive is installed; however, it can be easily accomplished using the DCM pushbutton controls (or HART or Serial interface) and a signal source. Following this procedure is only necessary to compensate for slight differences between the signal source calibration and the DCM factory calibration, or if reduced range calibration is desired for special operating scenarios such as split ranging.

Calibration Procedure

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive (e.g., 4 mA for 4–20 mA input). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive (e.g., 20 mA for 4–20 mA input).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Turn the Handswitch to the "AUTO" position. NOTE: The drive may reposition.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the compartment covers and tighten the cover bolts to 10 lb-ft (14 N•m) torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).

Split Range Operation

In applications where it is necessary (or preferable) to have more than one final control element controlling a single process, two to four Beck drives may be set up to respond to different portions of the Demand signal from the control system. The most common arrangement involves two drives; each operating on different 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 range.

To set up a split range operation, follow the steps listed below (see page 24 for location of pushbutton controls).

NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the configuration. See page 21 for information on changing L.O.S. settings.

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive. (Following the example above, the minimum signal for the first drive would be 4 mA. The second drive's minimum signal would be 12 mA). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 17.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive. (Following the example above, the maximum signal for the first drive would be 12 mA. The second drive's maximum signal would be 20 mA).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Repeat this process for the remaining drives to be split-ranged.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the DCM cover. Tighten the cover bolts to 10 lb-ft (14 N•m) torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too close together (i.e., less than 4 mA difference).

Square Function

Beck drives can be set up to position the output shaft proportionally to the square of the Demand input signal (see table below). This function is factory configurable, or may be configured using the HART or Serial interface.

Demand Input Signal (mA)	Standard Output (% of Span)	Square Function Actual Output Position (% of Span)
4.0	0	0
5.6	10	1
12.0	50	25
15.2	70	49
18.4	90	81
20.0	100	100

POSITION CALIBRATION

In order to correctly position the drive output shaft in response to the Demand input signal, the DCM receives a position signal from the drive's position sensor and compares this actual position to the Demand input. This process requires that the DCM interprets the position signal appropriately for the full range of desired travel. This procedure will calibrate the DCM to accept the position signal and interpret the appropriate 0–100% range. Note that all drives come factory calibrated and there is no need to re-calibrate unless changes in operation are desired.

It is also possible to calibrate the position signal using the HART or Serial interface.

Calibration Procedure

NOTE: Prior to adjusting the travel range electronically (using the DCM), it is recommended that the over-travel protection switches be reset just outside the intended travel range (see page 26).

1. Remove the DCM cover (1/2" bolt heads).
2. Position the drive at the desired minimum position (i.e., the desired physical position of the drive's output shaft corresponding to the 0% Demand input signal).
3. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Position the drive at the desired maximum position (i.e., the desired physical position of the drive's output shaft corresponding to the 100% Demand input signal).
6. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
7. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
8. Optional: Adjust the over-travel limit switches (see page 26) just outside the 0% and 100% limits.
9. Verify that the drive's 0% and 100% positions are correct. If not, repeat this procedure.
10. Replace the compartment cover and tighten the cover bolts to 10 lb-ft (14 N•m) torque.

* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM.

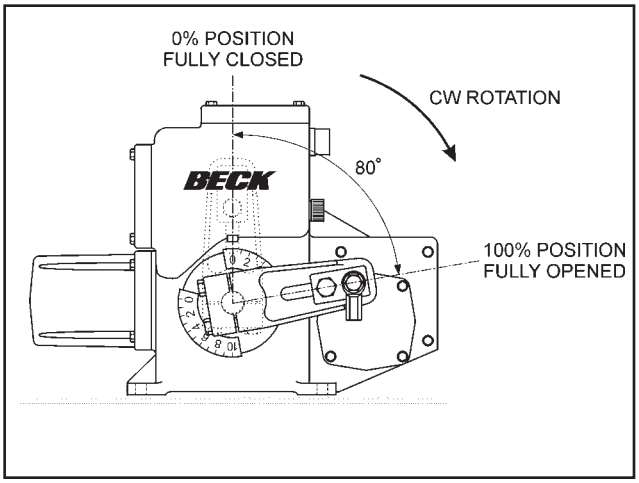
Short-stroke Operation (Reducing Full Rotation)

Typically, it is best to use the full 100° (or 90° for quarter-turn valve drives) rotation of the drive in response to the 0–100% Demand input signal—this allows full flexibility in arranging the drive's torque to be distributed for the best mechanical advantage relative to the driven load.

In certain applications, as a last resort, it may become necessary to reduce the full rotation of the drive. In these applications, the DCM can be calibrated to accommodate reduced stroke. The recommended *minimum* full stroke rotation is 60° (although it is advisable to make the range as close to 100° (or 90°) as possible for the highest position resolution attainable with the CPS and to avoid reduction in torque (linkage connected drives); if the driven element stroke rotation is less than 100° (where applicable), a linkage can be used to allow the driven element to move the correct rotation while still allowing the drive to rotate 100°).

To reduce the full rotation of the drive (short-stroke), use the customer interface panel and follow the "position calibration" instructions (this page). Short-stroking can also be accomplished by using the HART (see page 57) or Serial (see page 75) interface.

The illustration below represents a Beck drive with linkage requiring an 80° full stroke rotation. (Please note that the crank arm may be adjusted to any start angle orientation).

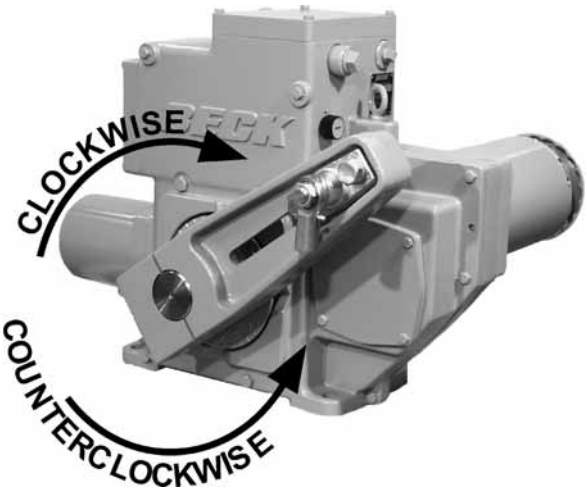


NOTE: Crank arm may be adjusted to any start angle orientation. The orientation shown above has been randomly selected for the purpose of this example.

DCM LOCAL INTERFACE *Calibration - Direction Change*

DIRECTION OF OUTPUT SHAFT ROTATION (CW vs. CCW)

Direction of output shaft rotation is determined by observing the end of the output shaft (see illustrations below). Direction of rotation is defined as the direction of output shaft rotation produced by an increasing Demand signal. Unless otherwise specified at the time of order, the output shaft is factory set to rotate clockwise in response to an increasing signal.



Changing the direction of output shaft rotation is easily accomplished using the DCM customer interface panel (see page 23 for location of pushbutton controls) or the HART or Serial interface. Follow the steps below.

1. Remove the DCM cover (1/2" bolt heads).
2. Position the drive at the present 0% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*

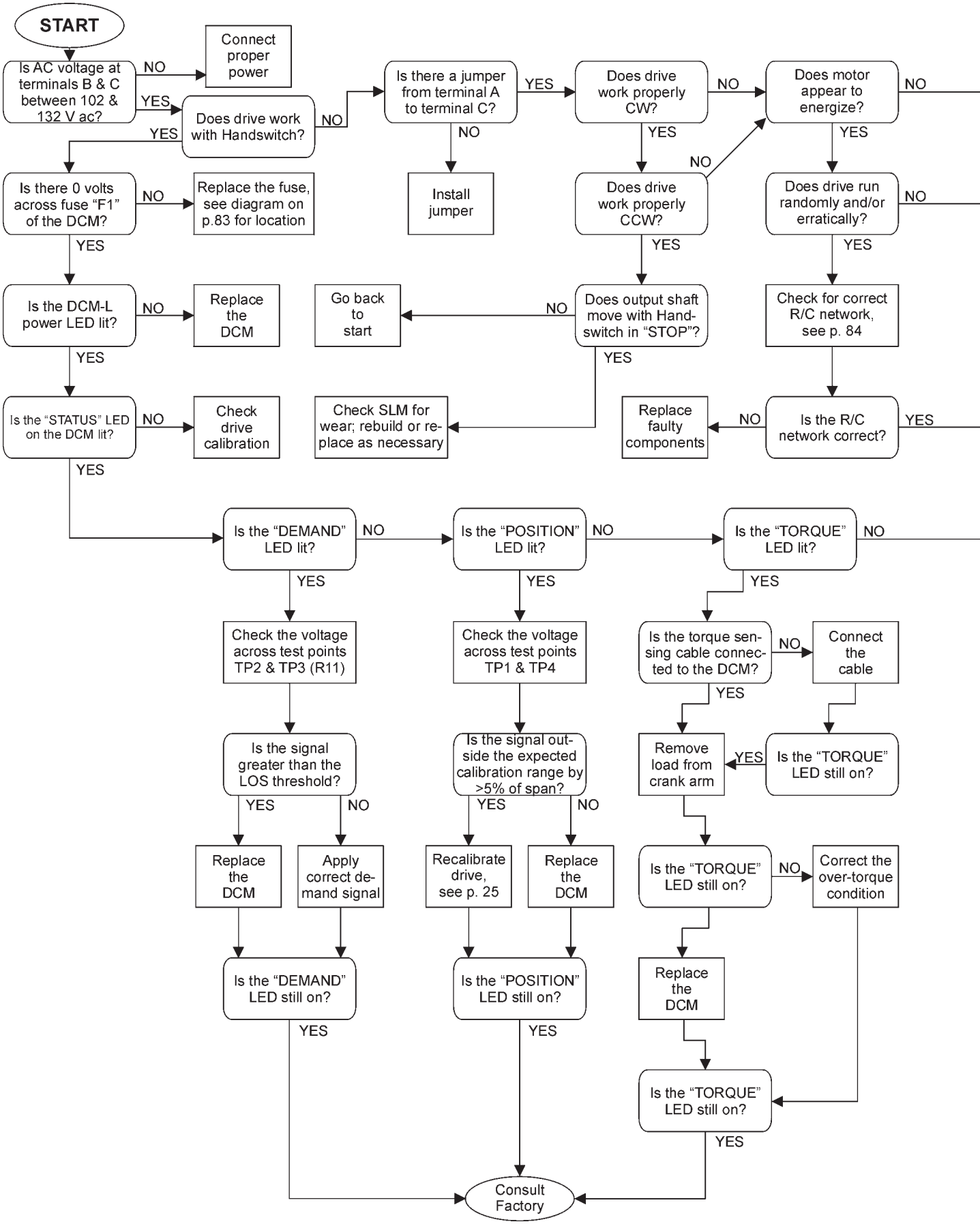
—OR—

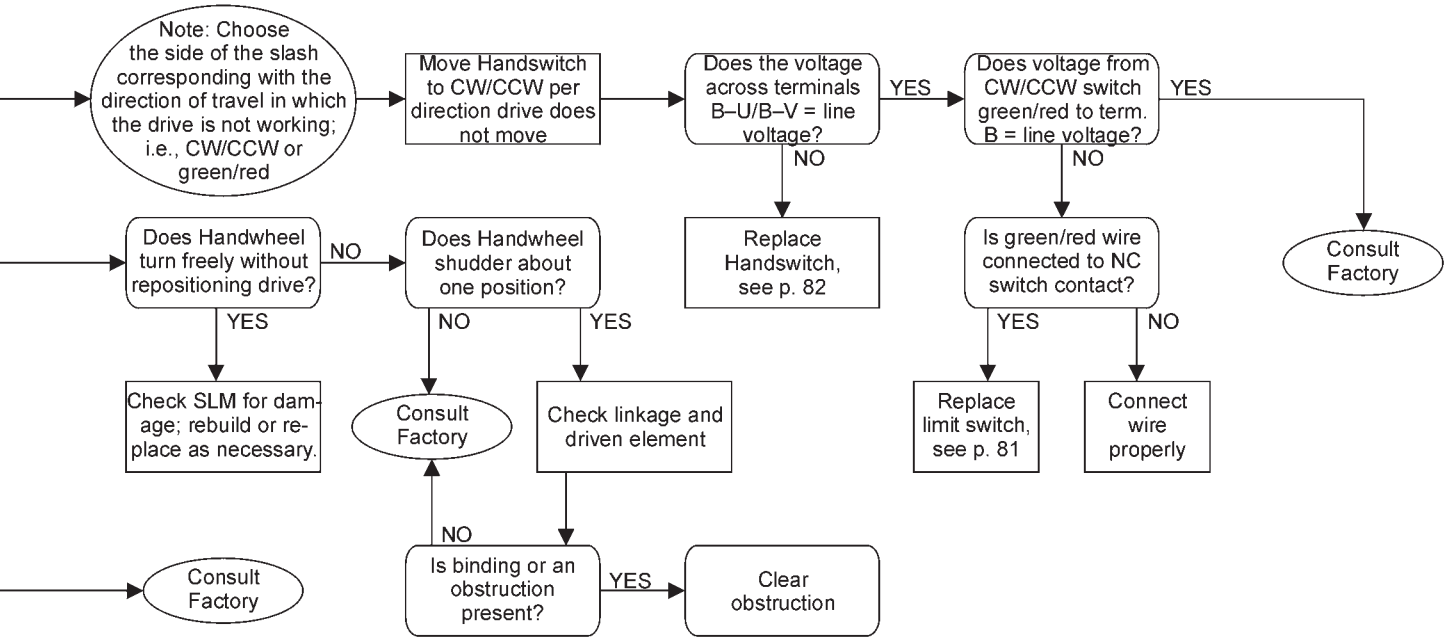
2. Position the drive at the present 100% position.
3. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
4. Ensure the drive operates as desired.
5. Replace the DCM cover and tighten the cover bolts to 10 lb-ft (14 N•m) torque. Reset travel index.

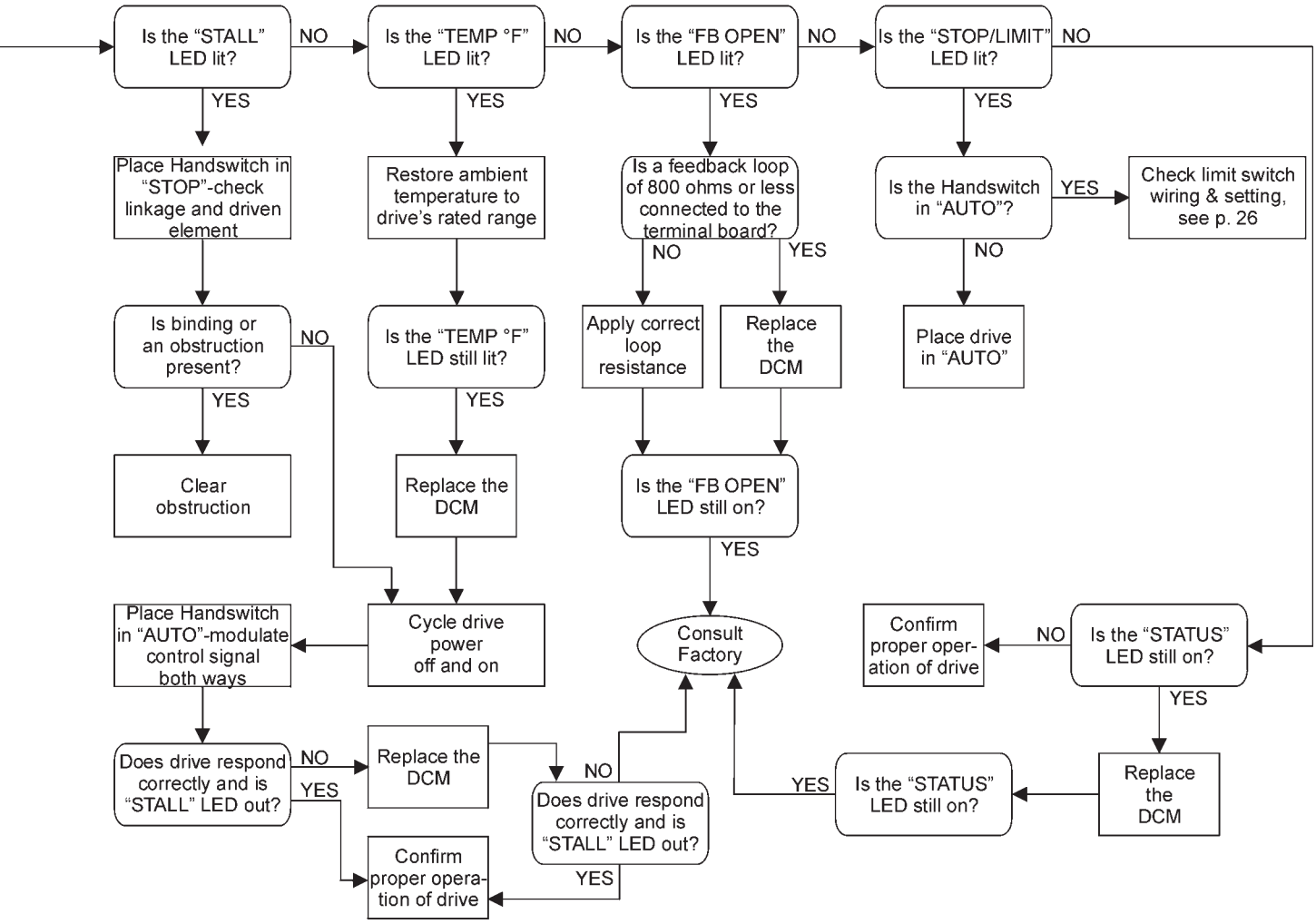
* If the "ACKNOWLEDGE" LED does not light, but the "POSITION" LED does light, the signal is out of acceptable range and was not accepted by the DCM.

NOTE: When either of the above procedures is performed, both the 0% and 100% positions are automatically set.

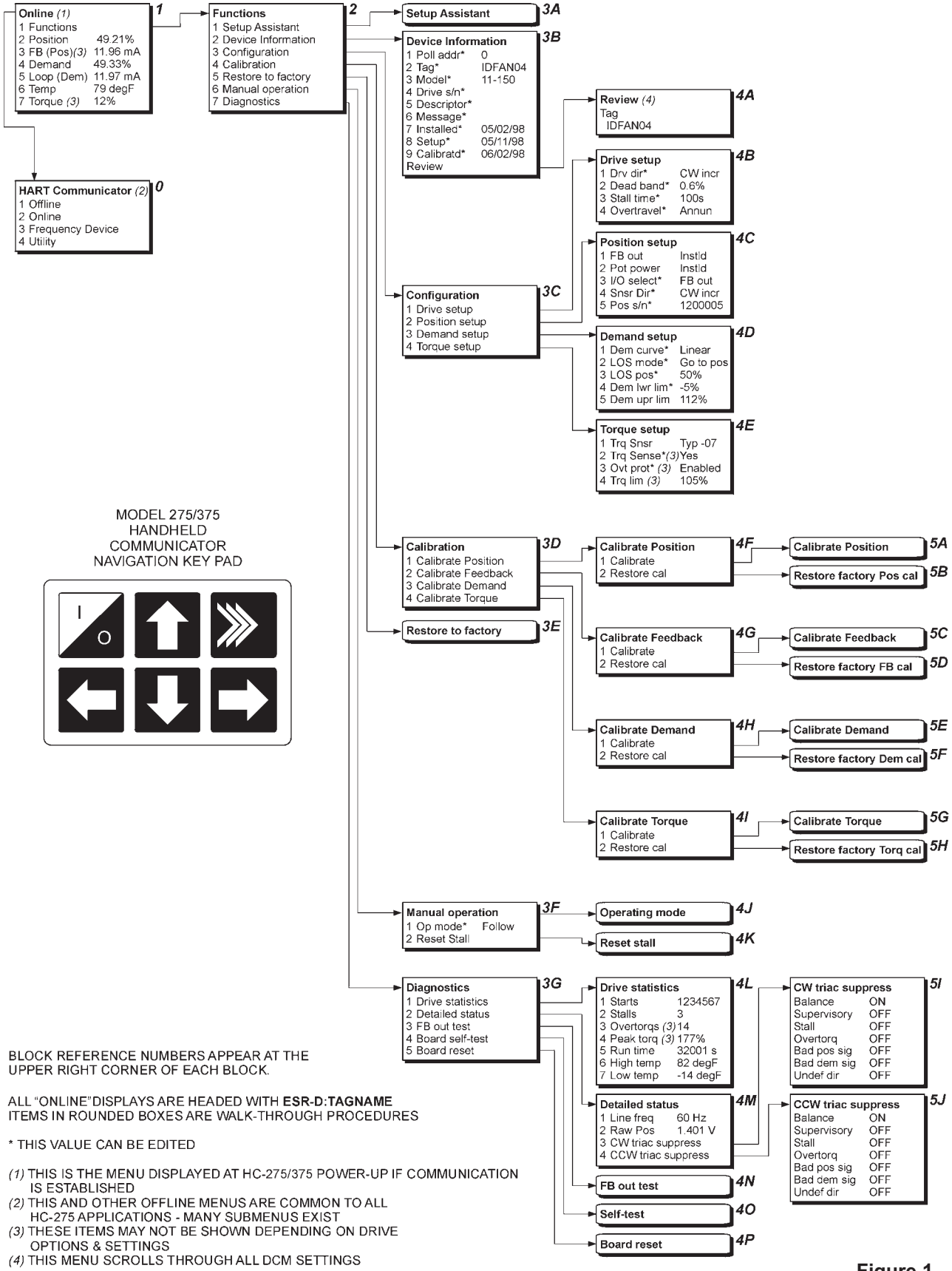
DCM LOCAL INTERFACE *Troubleshooting*




Note: Choose the side of the slash corresponding with the direction of travel in which the drive is not working; i.e., CW/CCW or green/red
Move Handswitch to CW/CCW per direction drive does not move
Does the voltage across terminals B–U/B–V = line voltage?
YES
NO
Does voltage from CW/CCW switch green/red to term. B = line voltage?
YES
NO
Consult Factory
Replace Handswitch, see p. 82
Does Handwheel turn freely without repositioning drive?
NO
YES
Does Handwheel shudder about one position?
NO
YES
Is green/red wire connected to NC switch contact?
YES
NO
Check SLM for damage; rebuild or replace as necessary.
Consult Factory
Check linkage and driven element
Replace limit switch, see p. 81
Connect wire properly
NO
Consult Factory
Is binding or an obstruction present?
YES
Clear obstruction


Is the "STALL" LED lit?
NO
YES
Is the "TEMP °F" LED lit?
NO
YES
Is the "FB OPEN" LED lit?
NO
YES
Is the "STOP/LIMIT" LED lit?
NO
YES
Place Handswitch in "STOP"-check linkage and driven element
Restore ambient temperature to drive's rated range
Is a feedback loop of 800 ohms or less connected to the terminal board?
NO
YES
Is the Handswitch in "AUTO"?
YES
NO
Check limit switch wiring & setting, see p. 26
Is binding or an obstruction present?
NO
YES
Is the "TEMP °F" LED still lit?
YES
Apply correct loop resistance
Replace the DCM
Place drive in "AUTO"
Clear obstruction
Replace the DCM
Is the "FB OPEN" LED still on?
YES
Place Handswitch in "AUTO"-modulate control signal both ways
Cycle drive power off and on
Consult Factory
Confirm proper operation of drive
NO
Is the "STATUS" LED still on?
YES
Does drive respond correctly and is "STALL" LED out?
NO
YES
Replace the DCM
NO
Does drive respond correctly and is "STALL" LED out?
YES
YES
Is the "STATUS" LED still on?
Replace the DCM
Confirm proper operation of drive
YES

HANDHELD COMMUNICATOR MENUS FOR THE DCM



BLOCK REFERENCE NUMBERS APPEAR AT THE UPPER RIGHT CORNER OF EACH BLOCK.

ALL "ONLINE" DISPLAYS ARE HEADED WITH **ESR-D:TAGNAME**
ITEMS IN ROUNDED BOXES ARE WALK-THROUGH PROCEDURES

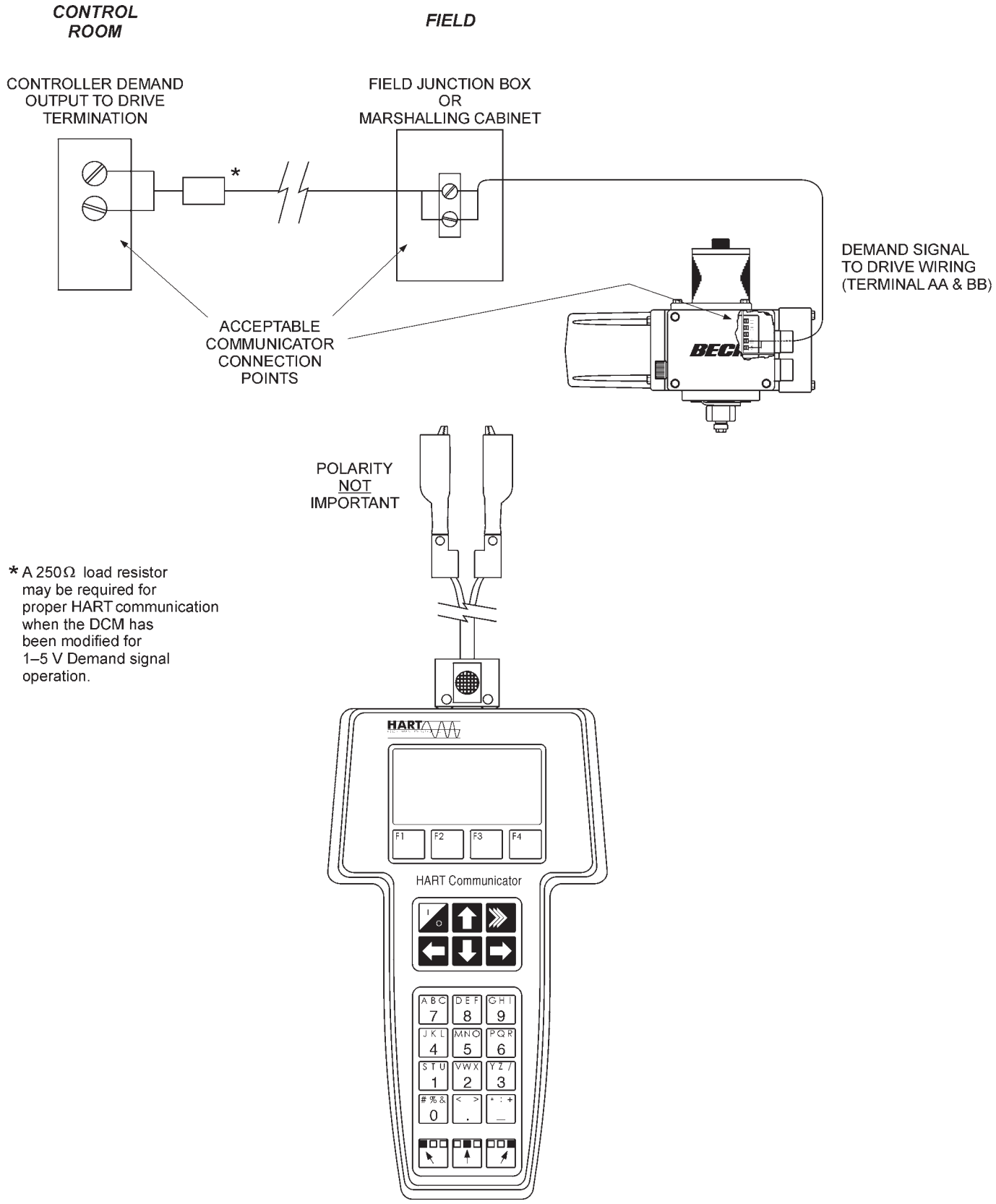
* THIS VALUE CAN BE EDITED

(1) THIS IS THE MENU DISPLAYED AT HC-275/375 POWER-UP IF COMMUNICATION IS ESTABLISHED
(2) THIS AND OTHER OFFLINE MENUS ARE COMMON TO ALL HC-275 APPLICATIONS - MANY SUBMENUS EXIST
(3) THESE ITEMS MAY NOT BE SHOWN DEPENDING ON DRIVE OPTIONS & SETTINGS
(4) THIS MENU SCROLLS THROUGH ALL DCM SETTINGS

Figure 1

NOTE: A foldout copy of this figure is located at the end of the manual for easy reference.

275/375 HANDHELD COMMUNICATOR WIRING CONNECTIONS



* A 250Ω load resistor may be required for proper HART communication when the DCM has been modified for 1–5 V Demand signal operation.

The DCM board is the control center of the drive. Drive configuration and calibration are accessed and set through the DCM board. Using the HART interface requires a HART® compatible communicator. Typically, a universal model 275/375 HART® communicator is used, but any device, computer or controller capable of communicating with HART® devices and supporting the Beck DCM device description can be used. **This instruction only covers the model 275/375 HART® Communicator.**

HART® INTERFACE

Figure 1, page 34, displays the interface menu tree for communicating with a DCM via a model 275/375 HART® communicator. This menu tree displays all the possible setup options, features and available information. Some of the features may not be available depending on how the DCM board is ordered. If a particular feature is not available, a message to that effect will be displayed when an attempt to access or change the feature is made.

USING THE 275/375 COMMUNICATOR

The universal model 275/375 HART® Communicator leads should be connected in parallel with the analog demand signal wiring (see Figure on page 35). This allows the communicator to simultaneously communicate over the analog input wires. This does not disturb the analog command signal, or disrupt the DCM functions. However, any program changes to the DCM will momentarily suspend the operation of the board (maintains last state) while the change is implemented. Typically, this is only for a second or two.

With the communicator connected in parallel anywhere across the analog demand wires, it is ready to communicate. Turn on the communicator and wait for communications to be established. Once communicating, the "Online" display (Figure 1, menu block #1) will appear in the communicator window. If the drive is multidropped with other devices on a single HART® network, the first display screen will list all devices and require a selection before the "Online" display is shown. The "Online" display provides online information about the present drive operating conditions. Entering any of the menus shown in Figure 1 is accomplished by following the display and using the communicator's arrow keys. **If the communicator is unable to communicate with the DCM, it will display the message, "No Device Found". If this occurs, check to make sure the leads are securely connected to the demand wiring and retry. If communications still do not occur, the communicator polling setup may be improperly set. Check the "utility" menu and make sure communications polling is set to "always poll".**

The communicator keypad and display is shown on page 35. There are four sections: 1) the liquid crystal message display, 2) four function keys beneath the LCD display, 3) six navigational keys in the center section, 4) alphanumeric entry keys at the bottom. For a complete description of the communicator , please see the HART® Communicator manual, MAN 4250, that is shipped with the communicator.

The LCD displays all the information and actions available, providing the communication between the user and the Beck drive. The bottom line of the LCD displays dynamic labels that define the purpose of the function keys directly below each label.

The function keys are used to perform certain actions like entering settings, accessing help screens, sending commands, paging up and down within methods and exiting methods. The function of each key may change depending on the menu or method selected. As functions change, so do the dynamic labels in the LCD.

The six navigational keys consist of a black and white on/off key, four blue and white arrow keys, and a single "hot key". The hot key is not used for Beck drive applications, but can be configured by the user to select menus most often accessed. The right arrow key has two functions. It moves the cursor to the right when making or editing an entry, and it also is used to select a new menu. The left arrow key moves the cursor to the left and also backs out to a previous menu. Combined, these keys allow movement between menus as shown in Figure 1, page 34.

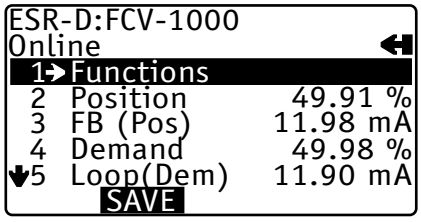
The alphanumeric keys are used to type in entries. Whenever a selected menu or method requires a value or description to be entered, this key pad is used. Since each key represents four different characters, three shift keys are provided at the bottom of the pad. A particular alphanumeric character is selected by pushing the shift key then pushing the alphanumeric key.

Before moving on, it is helpful to practice with the communicator. Connect the communicator as described, turn it on and establish communications. Then use the arrow keys to move through the various menus as shown in the menu tree (Figure 1).

MENU DESCRIPTIONS

(A foldout copy of Figure 1 (page 34) is located at the end of the manual for easy reference).

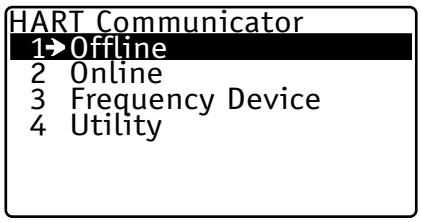
Online Menu (Figure 1, block 1)



DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

When communications are established with the communicator, the "Online" menu is displayed. This is the gateway to all the other menus and it also provides current information about the drive. Numbered items 2 through 6 provide live, dynamic values of the drive's output position in percent, the external position feedback signal in milliamps , the demand signal to the drive in percent, the demand signal in milliamps, the drive temperature, and the torque output of the drive in percent (when equipped with optional torque measurement). Select the first menu item, "Functions" (by first highlighting it and then using the right arrow key to select it), to gain access to the Functions menu. By backing out of the Online menu using the left arrow key, selection of the "Offline" menu is accomplished.

Offline Menu (Figure 1, block 0)



The Offline menu applies only to the 275/375 HART® Communicator setup and configuration. This, and the many submenus that exist, are typical to all model 275/375 HART® Communicator applications. **It is unlikely that this menu will need to be consulted unless it is impossible to establish communications with the drive; in which case the "Utility" menu should be selected.** Once within the "Utility" menu, use the right arrow key to select "Configure Communication", then "Polling", and finally "Always Poll". Use the ENTER function key to select to implement the Always Poll change. Back out to the main "Offline" menu using the left arrow key. Once at the main menu, select "Online" and use the right arrow key to return to the Online menu.

Functions Menu (Figure 1, block 2)

DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

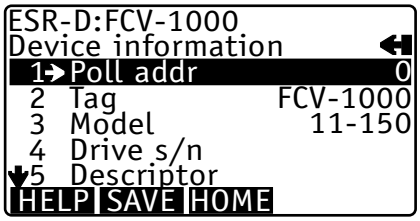
From the Functions menu, any of the DCM functional menus can be selected and accessed. Essentially, there are seven functional areas which include: Setup Assistant, Device Information, Configuration, Calibration, Restore to Factory, Manual Operation, Diagnostics.

The "**Setup Assistant**" (Figure 1, block 3A) is actually a procedure that allows the user to setup all the details necessary to get the drive up and running as desired. It sequentially walks the user through a series of questions and entries that enable the drive to be rapidly and completely setup. This method is entirely self-driven, and the user need only follow the questions and prompts to successfully complete the setup. The primary purpose of the Setup Assistant is to aid in the retrofit installation of an DCM board into an existing drive. It is normally not necessary to go through the Setup Assistant if a drive was originally built with an DCM board installed.

"**Restore to factory**" is also a procedure, which is used to set the DCM back to its original (as shipped from the factory) setup and calibration. By selecting the restore to factory procedure, every drive operating parameter that may be edited, and all calibrations, are returned to their factory settings.

The other five functional areas and menus are described in more detail as follows.

Device Information Menu (Figure 1, block 3B)



DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

The Device Information menu is strictly an informational page. By entering this menu, a selection of useful information can be viewed and/or edited. There are a total of nine information entries:

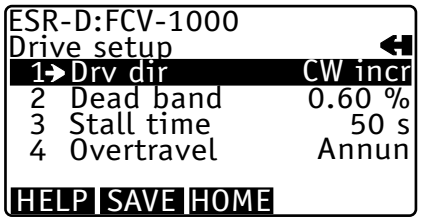
1. **Poll Address** - This entry can be edited; however, it is normally set to 0. A polling address from 1 to 15 can be entered if the drive resides on a common HART® network with other HART® devices.
2. **Tag** - This 8 character entry can be edited to reflect the loop tag number/name.
3. **Model** - This entry displays the model number of the drive in which the DCM board is installed. It normally is set at the factory if the board is installed in a drive. If the DCM is shipped as a spare or replacement, the model field default entry is "11-150". The user can edit the field if desired.
4. **Drive S/N** - This entry displays the serial number of the drive in which the DCM board is installed. It normally is set at the factory if the board is shipped in a drive. If the DCM is shipped as a spare or replacement part, the "Drive s/n" field will be blank. The user can edit the field if desired.
5. **Descriptor** - This entry is a 16 digit field that can be used to provide any description the user desires. This entry is normally blank when shipped from the factory unless the user specifies a description prior to shipment. The user can edit the field if desired.
6. **Message** - This entry is a 32 digit field that can be used to provide any message the user desires. This entry is normally blank when shipped from the factory unless the user specifies a message prior to shipment. The user can edit the field if desired.
7. **Installed** - This is a date entry that is normally used to indicate the date that the drive or DCM board was installed. The date format is month/day/year and it can be fully edited.
8. **Setup** - This is a date entry that is normally used to indicate the date that the DCM/drive setup was performed. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing a "setup" to enter a date. Entering the date at the prompt automatically updates the date displayed. The date format is month/day/year, and it can be fully edited.
9. **Calibrated** - This is a date entry that is normally used to indicate the date that the DCM/drive was last calibrated. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing any "calibration" method to enter a date. Entering the date at the prompt, automatically updates the date displayed here. The date format is month/day/year, and it can be fully edited.

A final available selection is "**Review**" (Figure 1, block 4A). Selecting this item using the right arrow key allows for a quick scroll through all nine device information items, as well as all the other DCM settings, without accessing each item individually. This is an excellent tool for quickly determining how a particular drive is setup. To edit individual entries, the user must exit review and go to the appropriate menu and item.

Configuration Menu (Figure 1, block 3C)

The configuration menu serves as the gateway to all of the drive operating setup parameters. The user can select any of four different setup submenus that can be used to configure the drive based on the physical layout and the desired operation. The four area submenus are as follows:

Drive Setup Submenu (Figure 1, block 4B)

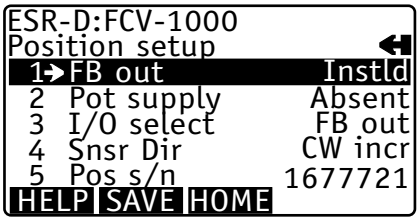


This menu is where drive operating parameters are set. The four parameter entries are as follows:

1. **Drive dir** - This parameter is where the rotation of the drive is selected. The options available are clockwise (CW) rotation, or counterclockwise (CCW). Direction of travel always refers to the rotation of the drive output shaft, given an increasing demand signal, looking into the output shaft (see page 53).

   When the direction of travel parameter is changed, the DCM automatically reverses the analog position feedback signal such that it is 4 mA at the 0% input signal position and 20 mA at the 100% position. No recalibration of the CPS is required. This parameter is normally set to CW unless the user specified CCW prior to shipment of the drive. For editing procedure, see page 46.
2. **Dead band** - The drive dead band can be changed by selecting this entry. All drives and boards are shipped with a 0.6% dead band setting. This is typically the best setting to provide good control and stability. The dead band can be reduced to a 0.25% minimum value or increased. Caution should be used when changing the dead band. Reducing the dead band can cause instability under certain conditions and may subject the drive to an increase in the number of starts and stops without improving control. Conversely, increasing the dead band can reduce the control performance of the drive (see "Dead band", page 46 for more information). For editing procedure, see page 46.
3. **Stall time** - The DCM provides stall protection to the entire drive by shutting off power to the motor and providing a HART® alarm. This entry allows the stall time required to trigger the stall protection to be configured. At the factory it is normally set to 300 seconds, but can be edited and set for any value between 30 and 300 seconds. For editing procedure, see page 47.
4. **Overtravel** - This entry is set as either "ignore" or "annun" (annunciate). It is used to determine if an overtravel condition (i.e., hitting either over-travel limit switch) should produce a HART® alarm. It is normally set to annunciate, but the user can select either status. For editing procedure, see page 47.

Position Setup Submenu (Figure 1, block 4C)



This menu is where all position sensor and external position feedback signal setup is performed. The five parameter entries are as follows:

1. **FB out** - This parameter is used to indicate if an analog 4-20 mA position feedback signal is available from the drive. This parameter is informational only and cannot be edited. "FB out" will show an "instld" message in the display. See page 48.
2. **Pot supply** - Indicates if power for a film potentiometer feedback device is present. This parameter is informational only and cannot be edited. Typically, power will be present and "Pot supply" will display "instld". Potentiometer power is only required, however, for control option 7 drives that utilize a film potentiometer. This would normally be a DCM retrofit application.
3. **I/O select** - This parameter is used to select whether or not the position feedback signal is turned on. For example, if the position sourcing board is present (see "FB out" above), and an analog position feedback signal is available, this parameter is used to enable and disable the signal. Normally, it would be enabled and the display message would read "FB out". When the signal is enabled, a HART® communicated error will be present if the signal is not wired to an external load. The error message is displayed when communicating with the drive via HART®. To

Continued

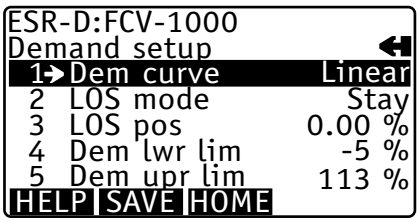
Position Setup Submenu, cont'd.

eliminate this error, the feedback signal must be connected to a load, or disabled by using the right arrow key to select "I/O select" and entering the "none" selection. For editing procedure, see page 48.

Note that when installing a DCM into a drive using a film potentiometer (see "Pot power" on the previous page), the I/O select parameter will display a "Pot power" selection. This must be selected for these applications.

4. **Snsr Dir** - This parameter is used to select the appropriate position sensor (CPS or film pot) rotation (i.e., the direction in which the drive output shaft rotates to increase the position sensor output signal). It should only need to be accessed in the case of a DCM retrofit into an existing drive because all new drives built with a DCM use CW rotation for increasing position signal. If this parameter is changed for any reason, an incorrect entry is automatically detected by the DCM and corrected.
5. **Pos s/n** - This parameter displays the serial number of the position sensor (CPS or film potentiometer) installed in the drive. New drives with DCM boards installed at the factory will have this information pre-entered. DCM boards shipped as spare parts or for retrofits will have this entry left blank. The user can enter the appropriate information if desired, but it is not required.

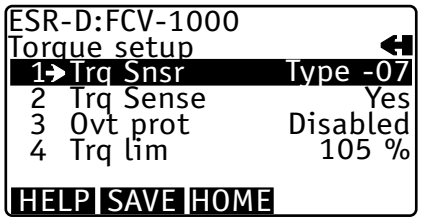
Demand Setup Submenu (Figure 1, block 4D)



This menu is where all the Demand input signal related drive parameters are set. The five parameter entries are as follows:

1. **Dem curve** - This is a dual choice entry that is used to set the Demand input characterization. The two characterization choices are "Linear" and "Square". Linear means that the demand signal is interpreted linearly and the drive responds to the demand with a linear relationship. The square setting means that the demand signal is interpreted with a square function and the drive output positions in a square relationship with respect to demand. For example, at 25% demand the drive position equals 0.25^2 or 0.0625 (6.25%). At demands of 50%, 75% and 100% the position would be 25%, 56.25%, and 100% respectively. This nonlinear curve can be used to compensate for valves and dampers with quick opening characteristics. This entry will always be set to linear by the factory unless otherwise specified by the user. For editing procedure, see page 48.
2. **LOS mode** - This parameter is used to set the drive action upon loss of the Demand input signal. Two options are available: "stay" or "go to pos". Selecting the "stay" option configures the drive such that the output shaft will stay in its last position if the demand signal is lost for any reason. Selecting the "go to pos" option configures the drive to move to a predetermined position (see **LOS pos** below) upon loss of the demand signal. This parameter is set to "stay" by the factory, unless otherwise specified by the user. For editing procedure, see page 49.
3. **LOS pos** - This parameter is used to set the predetermined position when the LOS mode described above is set to "go to pos". This parameter is normally shipped from the factory set at 50%, but it has no effect on loss-of-signal action unless the "go to pos" option is selected. The value can be edited and set anywhere between -5% and 105%. For editing procedure, see page 49.
4. **Dem lwr lim** - This parameter is used to set what the DCM interprets as the lower limit of the Demand input signal range. Input signals below this setting are interpreted by the DCM as a lost signal, and the LOS mode function takes over drive operation. This value is set to -5% at the factory. It can be edited and set anywhere from 0% to -320%. The -320% allows split ranging up to four drives while maintaining the demand loss function. For editing procedure, see page 49.
5. **Dem upr lim** - This parameter determines what the DCM interprets as the upper limit of the Demand input signal range. Demand signals above this value are ignored by the DCM. This is an informational only parameter and cannot be edited. For normal demand setup where 4–20 mA or 1–5 V dc demand signals represent 0–100% Demand input, this parameter displays approximately 113%. For split range operation, the value increases proportionally.

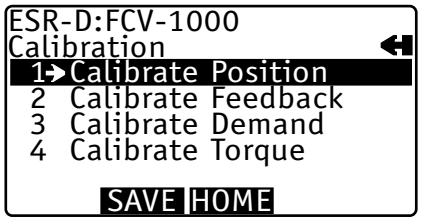
Torque Setup Submenu (Figure 1, block 4E)



This menu provides access to all the torque measurement related parameters. The four parameters are as follows:

1. **Trq Snsr** - This is a factory set informational only parameter that provides the last two digits of the Torque Sensing module P/N installed on the DCM board. There are three potential messages that can appear: “-07”, “-06” and “absent”. If there is no Torque Sensing module installed, and the “absent” message is displayed, then none of the other three parameters are displayed.
2. **Trq Sense** - This parameter is used to enable ("Yes") or disable ("No") the torque measurement features on DCM boards with a Torque Sensing module installed. If it is disabled, the **Ovt prot** and **Trq lim** parameters defined below are not displayed, and all torque sensing features, alarms and displays do not operate. If Trq view is enabled, but the drive does not have the required strain gauges installed—as may be the case when retrofitting a board to an existing drive—a HART® torque sensing error will be displayed on the 275/375 Communicator. For editing procedure, see page 50.
3. **Ovt prot** - DCM boards equipped with a Torque Sensing module have the ability to shut the drive off in the event that the torque output of the drive exceeds 150% of its rated output. This parameter is used to “Enable” or “Disable” this feature. For editing procedure, see page 50.
4. **Trq lim** - This parameter is used to set a high torque alarm trip point. This alarm is only available via HART® communications and in no way affects drive operation, nor is it related to the over torque protection (**Ovt prot**) trip point. It can be set by the factory from 90% to 130% of rated torque, but normally is set to 105%.

Calibration Menu (Figure 1, block 3D)



The calibration menu serves as the gateway to all the various routines necessary to completely calibrate the drive. The user can select any of four different calibration submenus. Each submenu provides a method that, when followed, calibrates a particular drive area in a quick and easy fashion. These methods replace the need to make physical adjustments to the drive. Each submenu is described as follows:

Calibrate Position Submenu (Figure 1, block 4F)

This menu is used to calibrate the position end points of the drive such that the DCM control board can determine the drive output shaft’s full rotation and position. Two procedures are available within this menu. They are as follows:

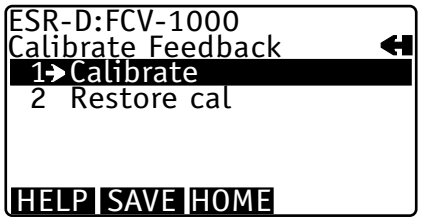
1. **Calibrate** - This procedure is used to calibrate or set the actual output shaft full rotary travel limits (i.e., allow the DCM to determine the 0% and 100% travel points). Two methods are available: Full automatic calibration of both (0% and 100% travel) position travel limits; or a manual method which allows setting one limit at a time. Normally, the automatic method is the easiest calibration procedure. This method automatically strokes the drive and sets the over-travel limits based on the position of the mechanical drive limit switches. The manual method allows the user to set the 0% and 100% limits independently and provides the means by which “short-stroking” the drive is accomplished. See page 57 for more information on short-stroking.

Continued

Calibrate Position Submenu, cont'd.

2. **Restore cal** - This procedure allows the user to return the position calibration to the original factory calibration, regardless of any calibration changes made.

Calibrate Feedback Submenu (Figure 1, block 4G)



This menu is used to access the procedures for calibration of the 4–20 mA external position feedback signal. DCM boards are calibrated at the factory to provide a 4–20 mA position feedback signal that can be monitored by a controller, indicator or some other device external to the drive. The 4–20 mA signal corresponds to 0–100% output shaft rotation. Two procedures are available within this menu. They are as follows:

1. **Calibrate** - This procedure is used to calibrate the 4–20 mA position feedback signal. The signal is only intended to support a 4–20 mA range, and is calibrated at the factory. Therefore, recalibration is normally not required, but can be performed to compensate for slight calibration differences between the signal calibration and the receiving device calibration.
2. **Restore cal** - This procedure allows the user to return the feedback calibration to the original factory calibration, regardless of any calibration changes made.

Calibrate Demand Submenu (Figure 1, block 4H)

This menu is used to access the procedures for the Demand input signal calibration. The DCM is designed to operate with analog signal ranges up to 4–20 mA or 1–5 V dc. Two procedures are available within this menu. They are as follows:

1. **Calibrate** - This procedure is used to calibrate the 4–20 mA position Demand input signal. The DCM is intended to support a 4–20 mA (1–5 V dc) signal range or narrower. A narrower range is used when split range operation with multiple drives is desired. The standard factory calibration is 4–20 mA to represent 0–100% demand, unless otherwise specified by the user. Two methods are available: Calibration of the 0% and 100% points combined, or calibration of either the 0% or 100% point alone. The latter method is useful when split-ranging is desired.
2. **Restore cal** - This procedure allows the user to return the demand calibration to the original factory calibration, regardless of any calibration changes made.

Calibrate Torque Submenu (Figure 1, block 4I)

This menu is used to access the procedures for the torque measurement calibration. It is only available when the DCM is equipped with the Torque Sensing module.

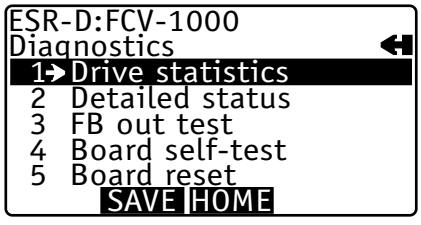
1. **Calibrate** - This procedure is used to calibrate the torque measurement system in the drive. Calibration requires a standard table of constants (see Table 2, page 62) or the application of a known load to the crank arm. For more information about calibrating torque, see the Torque Calibration section on page 61. Torque is calibrated at the factory when the board is shipped as a part of a complete drive. Replacement or spare boards, equipped with the Torque Sensing module, must be calibrated after they are installed in a drive.
2. **Restore cal** - This procedure allows the user to return the torque calibration to the original factory calibration, regardless of any calibration changes made.

Manual Operation Menu (Figure 1, block 3F)

This menu is used to allow manual drive operation with the HART® communicator. There are two manual operation procedures available. They are as follows:

1. **Op mode** - This procedure allows the user to select the operating mode of the DCM. There are four possible choices: "Follow", "Hold", "RunCW", "RunCCW". The "Follow" mode is the normal state of operation and allows the DCM to control the drive operation by responding to the analog input demand signal when the drive Handswitch is in the automatic position. The "Hold" mode forces the DCM to maintain the drive output shaft position regardless of the input demand signal. The user can select to hold the position just where it is, or alternately provide the drive a position to run to and hold. The "RunCW" and "RunCCW" modes of operation simply cause the drive to run to its CW and CCW extremes respectively, and hold.
2. **Reset stall** - This procedure resets normal drive operation after a stall condition has caused the drive to shut down. Selecting this option and following the prompts will restore operation. Note that stall conditions can also be reset by simply reversing the input demand signal or cycling the drive ac power.

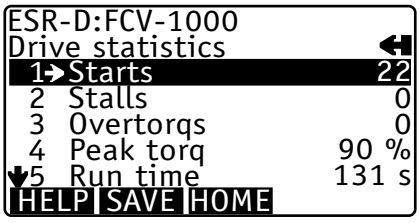
Diagnostics Menu (Figure 1, block 3G)



This menu provides access to all the DCM stored online diagnostic information about drive operation. The menu provides two submenus (**Drive statistics** & **Detailed status**) that provide stored drive statistics and online drive status. It also provides three procedures that allow the user to test and reset the DCM board. They are as follows:

1. **FB out test** (Figure 1, block 4N) - This procedure allows the user to test the 4–20 mA position feedback output signal. Following the prompts through this procedure allows the user to physically verify the output signal value at 4 mA, 20 mA, and anywhere in between.
2. **Board self-test** (Figure 1, block 40) - This procedure runs an automatic board test that verifies the health of the DCM control board. It runs a checksum memory test and checks for the proper installation of the position sensor (CPS rotor). Running the test causes the drive to reposition temporarily, so it should only be run offline. The CPS test runs automatically as part of some calibration and setup procedures. Unless an DCM problem is suspect, there are few reasons to implement this test.
3. **Board reset** (Figure 1, block 4P) - This procedure resets the board without powering down the drive. There are many communicator procedures that implement the reset procedure automatically to ensure the proper initialization of the DCM board; however, manually implementing the reset procedure is not typically necessary.

Drive Statistics Submenu (Figure 1, block 4L)



DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

This menu is where all the drive's stored operating statistics are available. There is a total of seven different statistics available when the DCM is equipped with a Torque Sensing module and five statistics available with DCM boards not equipped with the torque measurement feature. The seven possible statistics are as follows:

1. **Starts** - This statistic logs and displays the total number of starts the drive motor has made.

Continued

Drive Statistics Submenu, cont'd.

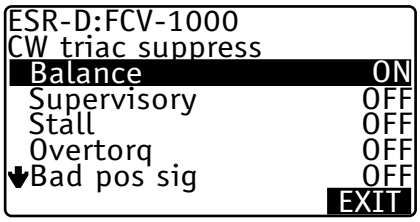
2. **Stalls** - This statistic logs and displays the total number of stalled conditions the drive has experienced. For the drive to register a stall, the DCM board must be unable to balance the drive position against the Demand input signal for a period exceeding the **Stall time** set in the Drive setup menu.
3. **Overtorqs** - This statistic logs and displays the total number of overtorque conditions that have occurred. An overtorque condition results when the drive output torque, as measured by the torque measurement system on the DCM board, exceeds the torque limit value (**Trq lim**) set in the Torque setup menu. This statistic is only available when the DCM is equipped with the Torque Sensing module.
4. **Peak torq** - This statistic displays the highest absolute torque value in percent of rating measured by the drive. This statistic is only available when the DCM is equipped with the Torque Sensing module.
5. **Run time** - This statistic logs and displays the total run time of the drive motor in seconds.
6. **High temp** - This statistic logs and displays the highest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM board.
7. **Low temp** - This statistic logs and displays the lowest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM board.

Detailed Status Submenu (Figure 1, block 4M)

This menu provides detailed information about the status of the drive power, raw position signal and motor control. The information displayed can be useful in troubleshooting operating problems. This submenu displays two values directly:

1. **Line freq** - This display value is the drive power line frequency in hertz (50 or 60 Hz). Line frequency is used within the DCM program to synchronize the data converter and reject AC line noise pickup, and also to determine the motor run time. These reasons, among others, make the line frequency important to drive operation.
2. **Raw pos** - This value is the true position signal from the position sensor to the DCM board. In new drives equipped with an DCM from the factory, the raw signal is normally 1–5 V dc for 0–100% of drive rotation. In older drives where DCM boards have been retrofitted, the range is approximately 0.5–2.6 V dc for either 0–100% or 100–0% depending on the drives original configuration. In all cases drives that are short stroked will have a proportionately smaller raw position signal range. This raw signal is what the Feedback Sourcing module uses to calculate the 4–20 mA position feedback output signal that can be monitored external to the drive. This value can be used to verify the health of the position sensor (CPS).

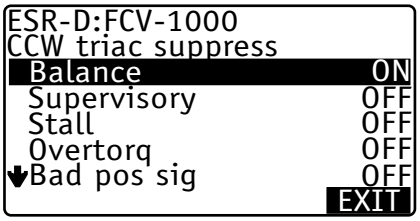
CW Triac Suppress Submenu (Figure 1, block 5I)



DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

This menu is a submenu of the Drive status submenu. It provides information about the clockwise (CW) motor control triac status. The CW triac controls the CW motor winding by conducting 120 V ac power in order to move the drive output shaft in the CW direction. Therefore, any number of conditions can occur to suppress the triac and prevent the output shaft from driving in the CW direction. These conditions include: The drive is at balance, a supervisory condition, a stall protection condition, an over-torque protection condition, a failed position signal, a failed demand signal, a program error has caused an undefined direction condition to exist. This submenu displays all these possible suppressing conditions that prevent the drive shaft from driving in the CW direction. Each of the conditions will display either an "OFF" or "ON" status. One or more conditions displaying the "ON" status means that those conditions are currently preventing the drive from driving its output shaft in the CW direction.

CCW Triac Suppress Submenu (Figure 1, block 5J)



DISPLAY ARROW INDICATES MORE INFO. AVAILABLE -- USE THE DOWN ARROW KEY ON THE HANDHELD TO ACCESS.

This menu is a submenu of the Drive status submenu. It provides information about the counterclockwise (CCW) motor control triac status. The CCW triac controls the CCW motor winding by conducting 120 V ac power in order to drive the output shaft in the CCW rotation. Therefore, any number of conditions can occur to suppress the triac and prevent the output shaft from driving in the CCW direction. These conditions include: The drive is at balance, a supervisory condition, a stall protection condition, an over-torque protection condition, a failed position signal, a failed demand signal, a program error has caused an undefined direction condition to exist. This submenu displays all these possible suppressing conditions that prevent the drive shaft from driving in the CCW direction. Each of the conditions will display either an “OFF” or “ON” status. One or more conditions displaying the “ON” status means that those conditions are currently preventing the drive from driving its output shaft in the CCW direction.

All drives are shipped completely configured to the customer's specifications and are ready to be installed. If the need arises to change the configuration of the drive (i.e., change one or more of the setup parameters that define how the drive operates), this may be accomplished utilizing the HART® interface and a communications tool (model 275 or 375 HART® Communicator) as described in the Communications section of this manual. This section of the manual covers how the drive is configured and gives instructions for changing each particular setup parameter available. It is intended to build upon the Communications Section, which provides a detailed description of the HART® Menu Tree and defines all the parameters and commands. **If unfamiliar with the HART® communicator and Beck drives, please review the Communications section before proceeding.**

There are a number of configuration setup parameters that can be changed to custom tailor the drive's operation to the application needs. The remainder of this section provides instructions for changing each of these parameters. The instructions below assume that the user has a model 275/375 HART® Communicator attached to the demand wiring (at drive terminals AA and BB or anywhere across the wires all the way back to the source of the demand signal), has established communications with a particular drive, and has a copy of the HART® Menu Tree (Figure 1, page 34) available.

DRIVE SHAFT ROTATION

Drive shaft rotation refers to the direction the output shaft of the drive rotates in response to an increasing Demand input signal. The rotation is either clockwise (CW) or counterclockwise (CCW) as shown on page 53. The control loop operation and physical design of the final control element determine the drive rotation suitable for an application. If the drive rotation needs to be changed, this is easily accomplished by changing the DCM configuration. Remember to reset the travel index.

Changing Drive Shaft Rotation

STEP 1 - From the HART® communicator "Online" menu, move to the "Drive setup" menu and select the "Drv rotn" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Drv rotn" parameter selected, press the right arrow key to display the two entry choices: "CW incr" and "CCW incr". Use the up and down arrow keys to select the desired parameter.

STEP 3 - With desired parameter selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "Drive setup" main menu.

STEP 4 - At the bottom of the "Drive setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter will cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

DEAD BAND

The width of the dead band, or the ability of the drive to respond to small signal changes, can be adjusted through the DCM configuration. The standard dead band setting is 0.6%, which produces a good balance between control sensitivity and rejection of erroneous signal changes. Reducing the dead band causes the drive to respond to smaller changes, while increasing the dead band has the opposite effect. The dead band can be adjusted from 0.25% up to 5%. Neither extreme is typically warranted, and caution should be exercised when the dead band is changed. Under certain conditions, reducing the dead band too much can cause self-induced drive instability.

Changing the Dead Band

STEP 1 - From the HART® communicator "Online" menu, move to the "Drive setup" menu and select the "Dead band" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Dead band" parameter selected, again press the right arrow key to display the modifiable entry box, and using the alphanumeric keypad, type in the desired dead band value. Values between 0.25% and 5% are valid.

STEP 3 - With the desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "Drive setup" main menu.

STEP 4 - At the bottom of the "Drive setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing drive setup parameters can cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

STALL PROTECTION

The DCM board provides protection of the drive motor and gearing in the event of a stalled condition. The board accomplishes this by sensing that the drive is unable to balance for a set period of time known as the "stall time". If the DCM is unable to balance the drive for a period greater than the stall time, it shuts off power to the motor and prevents the drive from continuing to operate against the stall. Resetting the drive and restoring normal operation is achieved in several ways: Reversing the demand signal to the drive, performing a stall reset procedure (see Manual Operation Menu, Figure 1, page 34), performing a board reset procedure (see Diagnostics Menu, Figure 1, page 34), or cycling the drive ac power.

Changing Stall Time

STEP 1 - From the HART® communicator "Online" menu, move to the "Drive setup" menu and select the "Stall time" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Stall time" parameter selected, again press the right arrow key to display the modifiable entry box, and using the alphanumeric keypad, type in the desired stall trigger time value. It is normally set to a maximum of 300 seconds, but can be changed to a minimum of 30 seconds.

WARNING

It is possible that the stall time can be set to a value less than the full stroking time of some drives. This could lead to false stall conditions when making very large changes. Typically, this would only occur during start-up, shut down or some other condition that might require a large change in demand from the controller.

STEP 3 - With the desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "Drive setup" main menu.

STEP 4 - At the bottom of the "Drive setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing drive setup parameters can cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

OVERTRAVEL ANNUNCIATION

When communicating with the DCM via the 275/375 HART® Communicator, a number of different informational messages may be displayed for certain conditions that may exist. One such message is "H/S in STOP or drive at limit sw". This is displayed anytime the DCM is attempting to reposition the output shaft, but is unable to due to a break in the electrical power to the motor. This can happen if the Handswitch is put in STOP or if an over-travel limit switch is open. Normally, this is a useful message that should be displayed; however, in certain situations like split range operation (see split ranging, page 59), it can become a nuisance. For example, in a split range operation one or more of the drives will be interpreting the Demand input signal as out of range (i.e., either above 100% demand or below 0% demand) and will be against an over-travel limit switch at any given time. Since this is normal for split range operation, the message will be a nuisance rather than informational.

Setting the "Overtravel Annunciate" feature to "Ignore" will eliminate the message, but only when the demand signal is above 100% or below

Continued

Overtravel Annunciation, cont'd.

0% and an over-travel limit switch is open. This eliminates the nuisance message, but does not eliminate the message for other scenarios like the Handswitch being in the STOP position.

POSITION FEEDBACK SIGNAL

DCM boards are equipped with a Feedback Sourcing module that provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full rotational travel. This signal can be remotely monitored or used by a controller or indicator. The user has the option of enabling or disabling the signal. Normally, the signal should be enabled , but in a situation where the feedback is present, but unused (i.e., not wired to a load) a HART® alarm message will be present while communicating using the 275/375 Communicator. This message is helpful in alerting the user to open feedback wiring, but it is a nuisance when the feedback is purposely disconnected or unused. Disabling the feedback signal turns off the output and eliminates the message.

Enabling / Disabling Position Feedback Signal

STEP 1 - From the HART® communicator "Online" menu, move to the "Position setup" menu and select the "IO select" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "IO select" parameter selected, press the right arrow key to display the two entry choices: "FB out" or "None". (A third choice, "Pot power", is also available when pot power is installed). Use the up and down arrow keys to select the desired parameter. "FB out" enables the output signal, while "None" disables the output.

STEP 3 - With desired choice selected, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the "Position Setup" main menu.

STEP 4 - At the bottom of the "Position setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change. This change should not effect drive positioning but, as with all configuration changes, **carefully follow the on-screen warnings and messages when proceeding.**

DEMAND SIGNAL CHARACTERIZATION

The Beck DCM is designed to receive a 4–20 mA (1–5 V dc) input demand signal and respond by repositioning the drive output shaft in proportion to the signal. There are two ways in which the DCM can interpret the demand signal; linearly, or in a non-linear square relationship. The linear interpretation, which is most commonly employed, simply causes the drive to position the output shaft in a one-to-one relationship with the demand. For example, a 1% change in demand always causes a 1% position response. The square relationship produces a non-linear drive response proportional to the square of the demand signal. For example, a 25% input demand is interpreted as 0.25^2 or 0.0625 (6.25%). The square relationship helps to linearize flow response of final control elements that have quick opening characteristics.

Changing Characterization

STEP 1 - From the HART® communicator "Online" menu, move to the "Demand setup" menu and select the "Dem curve" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Dem curve" parameter selected, press the right arrow key to display the two entry choices: "Linear" or "Square". Use the up and down arrow keys to select the desired parameter.

STEP 3 - With desired choice selected, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the "Demand setup" main menu.

STEP 4 - At the bottom of the "Demand setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online will cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

LOSS OF DEMAND INPUT SIGNAL

The DCM board has the capability of determining when the Demand input signal to the drive is lost, and then responding in the method most appropriate for the application. There are three setup parameters that must be configured in order to define this capability: "LOS mode", "LOS pos", and "Dem lwr lim". The "LOS mode" parameter determines how the drive should respond to the loss of the Demand input signal. It can be configured as "Stay" or "Go pos", which means the drive holds its position when the signal is lost, or it goes to a predetermined position. If the "go pos" option is selected, the "LOS pos" parameter is used to determine what output shaft position the drive must achieve when the input is lost. Finally, a loss of signal is sensed by the DCM when the signal drops below the value set by the "Dem lwr lim" parameter. This value is represented as a percentage of the Demand input signal range. Therefore, the standard -5% value normally used for this parameter suggests that when the Demand input signal drops 5% below the calibrated 0% value, the DCM senses a lost Demand input and executes the configured loss-of-signal action.

Changing Loss (LOS) of Signal Action

STEP 1 - From the HART® communicator "Online" menu, move to the "Demand setup" menu and select the "LOS mode" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "LOS mode" parameter selected, press the right arrow key to display the two entry choices: "Stay" or "Go pos". Use the up and down arrow keys to select the desired parameter.

STEP 3 - With desired choice selected, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the "Demand setup" main menu. If the "Go pos" choice was selected, go to **STEP 4,** if "Stay" was selected, go to **STEP 6.**

STEP 4 - After entering "Go pos", select the "LOS pos" parameter and use the right arrow key to display the modifiable entry block. Unless otherwise specified, this value is set to 50% at the factory. Using the alphanumeric keypad, enter the desired loss of signal position as a percentage of full output shaft rotation. Values from -5% to 105% are valid.

STEP 5 - With desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "Demand setup" main menu.

STEP 6 - At the bottom of the "Demand setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online could cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

Changing LOS Trip Point

STEP 1 - From the HART® communicator "Online" menu, move to the "Demand setup" menu and select the "Dem lwr lim" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Dem lwr lim" parameter selected, press the right arrow key to display the modifiable entry block. Using the alphanumeric keypad, enter the desired demand signal lower limit value as a percentage of the demand signal range.

STEP 3 - With desired value correctly typed into the entry box, push the F4 function key which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the value and reverts the display back to the "Demand setup" main menu.

Continued

Changing LOS Trip Point, cont'd.

STEP 4 - At the bottom of the "Demand setup" menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change.

WARNING

Carefully follow the on-screen warnings and messages when proceeding, because changing this parameter online could cause the drive to reposition. This can adversely affect the process and cause potentially dangerous conditions.

TORQUE OPTIONS

DCM boards that are equipped with a Torque Sensing module have the capability to measure the drive's torque output. This, in turn, makes it possible to provide several torque related features. The features include a live display of the torque output on the 275/375 HART® Communicator display or any other device capable of communicating and displaying HART® transmitted variables. Included is the ability to store peak torque values within the DCM and view them by accessing the device information menu. To protect the drive gearing and related equipment, the drive can be configured to shut off if the torque exceeds 150% of the drive torque rating. And finally, the DCM will provide a high torque alarm, via HART® communications, that alerts the user to a high torque condition when the torque output exceeds a set value (normally set at 105% of the drive rating). In order to use the Torque Sensing module and features, the drive must also be equipped with strain gauges on the output shaft; therefore, if a DCM board equipped with a Torque Sensing module is retrofitted into an older drive, or installed in a drive not originally equipped with torque sensing, the torque features cannot be used.

DCM boards that are not equipped with a Torque Sensing module will still display the Torque Setup menu, however, the "Trq snsr" parameter will display "Absent" and none of the other menu parameters will be displayed. This setting can be changed by the factory only. Boards that have the Torque Sensing module installed will display "-07". With the module installed, the second menu parameter, "Trq view" is also displayed. This parameter allows the user to enable or disable the torque measurement features and displays. Boards with the Torque Sensing module that are installed in a drive without the strain gauges, should have the "Trq view" parameter disabled to prevent HART® communicated errors from occurring.

Enabling Torque Functions

STEP 1 - From the HART® communicator "Online" menu, move to the "Torque setup" menu and select the "Trq view" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Trq view" parameter selected, press the right arrow key to display the two entry choices: "Enabled" or "Disabled". Use the up and down arrow keys to select the desired parameter. Enabling this parameter will activate the torque measurement features and displays, while disabling the parameter will turn them off.

STEP 3 - With the desired choice selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the "Torque setup" main menu. "Trq view" is now enabled. **Carefully follow the on-screen warnings and messages to return to normal operation.**

Enabling Over-torque Protection

STEP 1 - From the HART® communicator "Online" menu, move to the "Torque setup" menu, make sure that the "Trq view" parameter is enabled (if not, enable it using the procedure above) and select the "Ovt prot" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Ovt prot" parameter selected, press the right arrow key to display the two entry choices: "Enabled" or "Disabled". Use the up and down arrow keys to select the desired parameter. Enabling this parameter will activate the over-torque protection, while disabling the parameter will turn it off.

STEP 3 - With the desired choice selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key enters the selected parameter and reverts the display back to the “Torque setup” main menu.

STEP 4 - At the bottom of the “Torque setup” menu, the F2 function key should now be defined as the **SEND** key. Push this key to execute the change. This change should not effect drive positioning but as with all configuration changes, **carefully follow the on-screen warnings and messages when proceeding.**

All Beck drives are shipped completely calibrated to the customer specifications, and are ready to be installed. If the need arises to change the drive calibration, confirm that the drive is installed as specified and operating properly before proceeding with the change. It is also helpful to verify the drive configuration. This can be done by running the “Setup Assistant” feature available under the “Functions” menu of the HART communicator.

With the exception of the settings for the over-travel limit switches, auxiliary limit switches and CPS, all calibration is performed using the HART interface and a communications tool (model 275/375 HART Communicator), as described in the Communications section of this manual. If unfamiliar with the HART communicator and Beck drives, please review the Communications section of this manual before continuing.

There are two standard DCM calibration procedures available: Position calibration, and Demand calibration. There is potentially one more calibration procedure available depending on how the DCM board is equipped. This procedure is Torque Calibration. Torque calibration is available for drives equipped with the optional torque measurement capability, which requires a Torque Sensing module to be installed on the DCM board.

Any calibration changes that are made, using any of the three calibration procedures can be reversed by using the “Restore cal” feature in the specific calibration procedure menu. Implementing the “Restore cal” feature returns the calibration to the original factory calibration.

DIRECTION OF SHAFT ROTATION (CW VERSUS CCW)

Direction of shaft rotation is determined when looking at the end of the output shaft (see figure at right). Direction of rotation is defined as the direction of output shaft rotation produced by an increasing demand signal. Unless otherwise specified at the time of order, the output shaft is factory-set to rotate clockwise in response to an increasing signal.

CALIBRATION PRIORITY

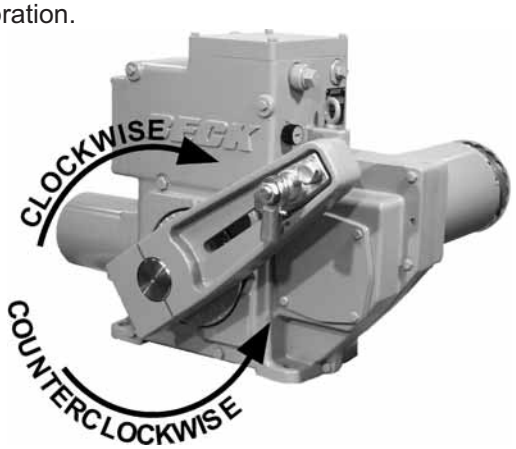
Models 11-159, -209, -309 & -409

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 approximately 108° apart.

The over-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 (typically 100°). The limit switches are positioned to provide an electrical overtravel protection (typically 101°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 100° rotation (see page 57)—it may be desirable to reset the over-travel limit switches (see page 54). 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. The switches 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 and DCM operation. Therefore, the auxiliary switches can be adjusted at any time without affecting performance or calibration.



Models 11-169, -269, -369 & -469

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 approximately 108° apart; except for the 11-169 stops, which are 98° apart.

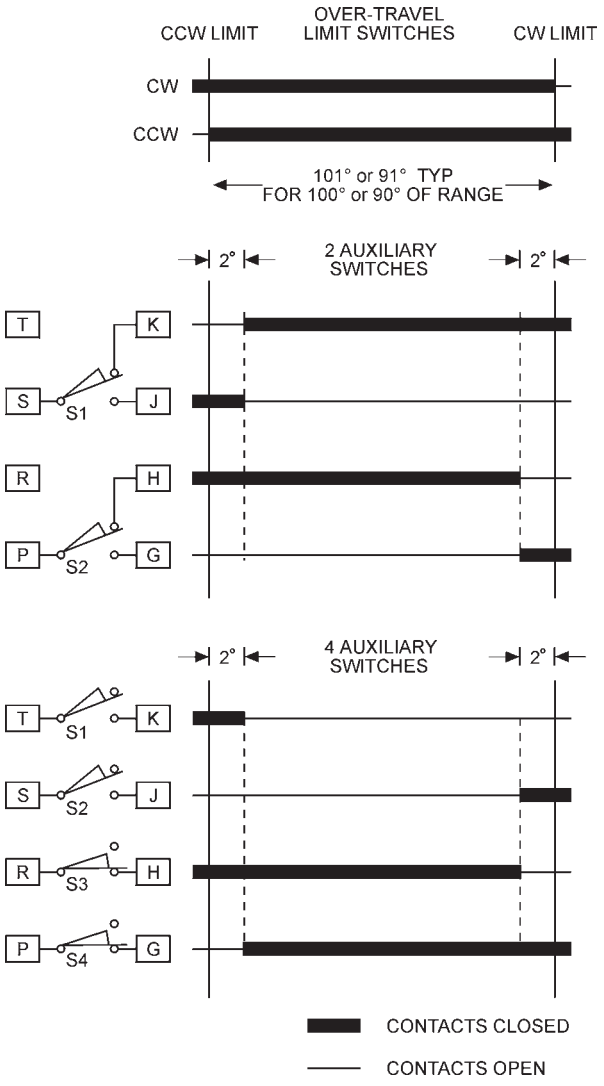
The over-travel limit switches are used to limit the electrical control range of the drive. These switches are cam operated and are set slightly wider apart then the drive's intended full range of electronic operation (typically 90°). The limit switches are positioned to provide an electrical overtravel protection (typically 91°).

If the drive is short-stroked—i.e., the full travel rotation from 0–100% is reduced to less than the standard 90° rotation (see page 57)—it may be desirable to reset the over-travel limit switches (see page 54). If the limit switches are not reset, Handswitch operation of the drive (CW, CCW) will still result in the original full range of travel. Because the over-travel limit switches define the maximum electrical drive range, if they are to be reset, they should be adjusted before performing DCM (demand and position) calibration procedures.

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

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 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 Over-travel Limit and Auxiliary Switch Settings

SWITCH ADJUSTMENTS

Control drives are shipped with over-travel limit switches factory-set for either 101° (11-159, -209, -309, -409) or 91° (11-169, -269, -369, -469) of travel unless otherwise specified at time of order. Limit switches must be set inside the range of the fixed, non-adjustable, built-in mechanical stops to prevent stalling of the motor. Limit switches can be reset to limit travel of the output shaft to any angle down to a minimum of 60°. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

NOTE: The over-travel limit switches are the switches located closest to the drive body. To adjust the over-travel limit 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.

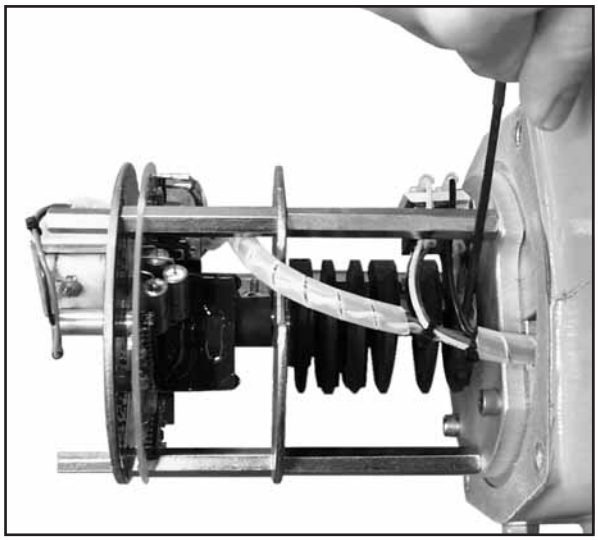
CAUTION

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 Over-travel Limit Switches CW and CCW

This procedure should be used if the factory over-travel 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:

1. Remove the control end cover 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 illustration below).
3. Move the output shaft clockwise to the desired CW limit.
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 travel limit. Note the direction of rotation of the lobe of the cam. The correct cam lobe motion is away from the switch lever with the switch lever on the lower part of the cam. If 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 stopping point is reached, the switch is properly set.



Loosening Switch Cam

13. Repeat instructions for setting CCW travel limit switch (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 models 11-159 or -169) 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 54. 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 moving the wire lead to the other terminal on the switch itself. Be sure to disconnect power from the switch terminals first.

1. Remove the control end cover 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 17 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.

POSITION REFERENCE CALIBRATION

In order to correctly position the drive output shaft in response to the input demand signal, the DCM board receives a position signal from the drive's position sensor (CPS) and compares this actual position to the desired Demand input. This process requires that the DCM interprets the CPS signal appropriately for the full range of desired travel. The position reference calibration procedure is used to calibrate the DCM to accept the CPS position signal and interpret the appropriate 0–100% range.

There are two procedures available: Fully automatic and manual. The automatic procedure strokes the drive to both over-travel limit switches, interprets those two extreme positions as -0.5% and 100.5% of full travel, and then automatically interprets the CPS signal for the 0–100% travel range.

The manual calibration procedure allows the user to select the lower and upper position limits and perform the same calibration. This procedure makes it possible to customize the stroke of the drive, and provides the ability to short-stroke such that the full 0–100% of travel corresponds to less than 100° of rotation. It also makes it possible to calibrate the full 100 degrees of travel in situations where an installed drive cannot be stroked through its entire range. This is done by stroking the drive as far as possible and entering the relative position in terms of 0–100% full rotation.

Calibration Procedure

CAUTION

When following this calibration procedure, be aware that the drive will be required to reposition during the procedure. Additionally, as with any change in the DCM configuration, the drive may reposition when restored to normal operation.

NOTE: Prior to adjusting the travel range electronically (using the DCM), it is recommended that the over-travel protection switches be reset just outside the intended travel range (see page 26).

STEP 1 - With a HART® Communicator communicating with the appropriate Beck drive, move from the "Online" menu to the "Calibration" menu and select the "Calibrate Position" procedure. This is accomplished by using the up and down arrow keys to select a particular menu item, and using the right and left arrow keys to move forward and back between menus. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Calibrate position" procedure selected, press the right arrow key to display the technique selections: "Auto 0–100%", "Select lower pt", and "Select upper pt". Use the up and down arrow key to select the desired technique. The automatic technique is the best choice if the drive is to be calibrated to the full 100 degrees of rotation. If "Automatic" is selected, go to **STEP 6**.

STEP 3 - With either the "Select lower pt" or "Select upper pt" selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key will initiate the calibration procedure. The display will prompt the user to move the drive to a position less than 50% if the "Select lower pt" procedure is selected or to a position greater than 50% if the "Select upper pt" procedure is selected.

STEP 4 - Once the drive is positioned as per the request, the F4 **ENTER** key should be pushed again. The display will ask the user to enter the value, as a percentage of full rotation, that this position represents. The default value for this value will be displayed. It is -0.5% for the lower point procedure and 100.5% for the upper point. These values represent the extreme end of rotation. If the position the user moved the drive to is different than the desired extreme rotation limits, enter the appropriate value in the modifiable entry box.

STEP 5 - With the desired position value entered, the F4 function key must again be pushed to complete the calibration of the lower or upper position calibration point. Depending on the user's calibration objectives, only the lower, only the upper, or both position points can be calibrated. If both limits are to be calibrated manually, perform **STEP 3** through **5** again for the other choice. If calibration is complete, go to **STEP 7**.

STEP 6 - With the "Auto 0–100%" technique selected, push the F4 function key, which is defined as the **ENTER** key at the bottom of the display. Pushing this key will alert the user that continuing the procedure will cause the drive to reposition automatically. If this is not a problem, press the F4 function key, now defined as the **OK** key, to initiate the calibration procedure. Otherwise, push the F3 function key to abort. With the procedure initiated, the drive will reposition and calibrate automatically.

STEP 7 - With the calibration procedure complete, the display will prompt the user to enter the date. Follow the prompts and use the function keys and alphanumeric keys to make the entry. This date is stored and can be referenced under the "Device information" menu to determine when the last calibration was performed. Continue to follow the prompts carefully to return to normal operation.

Short-stroke Operation (Reducing Full Rotation)

Typically, it is best to use the full 100° (or 90° for quarter-turn valve drives) rotation of the drive in response to the 0–100% Demand input signal—this allows full flexibility in arranging the drive's torque to be distributed for the best mechanical advantage relative to the driven load.

In certain applications, as a last resort, it may become necessary to reduce the full rotation of the drive. In these applications, the DCM can be calibrated to accommodate reduced stroke. The recommended *minimum* full stroke rotation is 60° (although it is advisable to make the range as close to 100° (or 90°) as possible for the highest position resolution attainable with the CPS and to avoid reduction in torque (linkage connected drives); if the driven element stroke rotation is less than 100° (where applicable), a linkage can be used to allow the driven element to move the correct rotation while still allowing the drive to rotate 100°).

Reducing the full rotation is referred to as "short-stroking" the drive. This can be easily accomplished by following the manual calibration procedure described in the previous section (the drive may also be short-stroked using the Local interface panel or Serial interface). Calibrate the lower, upper or both end of travel points as necessary to establish the full stroke of the drive. If a span of less than the minimum acceptable is entered, the communicator display provides a "Span too small" message and does not allow the calibration values to be entered.

The following is a typical example of how to short-stroke a drive. The figure below shows a Beck drive requiring an 80 degree full stroke rotation as shown. To short-stroke the drive, such that the full 0–100% rotation is 80 degrees, and the 0% and 100% position points correspond to the particular points shown in the figure, a manual position reference calibration technique should be used.

Begin at calibration **STEP 1** above, move to **STEP 2** and choose the "Select lower pos" technique, then move to **STEP 3**. When prompted, use the drive Handswitch to position the drive at the 0% position shown in the Figure. At **STEP 4**, enter 0% when prompted. Move to **STEP 6**. Repeat **STEPS 3–5** for the "Select upper pos" technique and enter 100% when prompted in **STEP 4**. Continue through **STEP 7** and the short-stroke procedure will be complete. The output shaft will now rotate 80 degrees from a 0% position to a 100% position as shown in the figure.

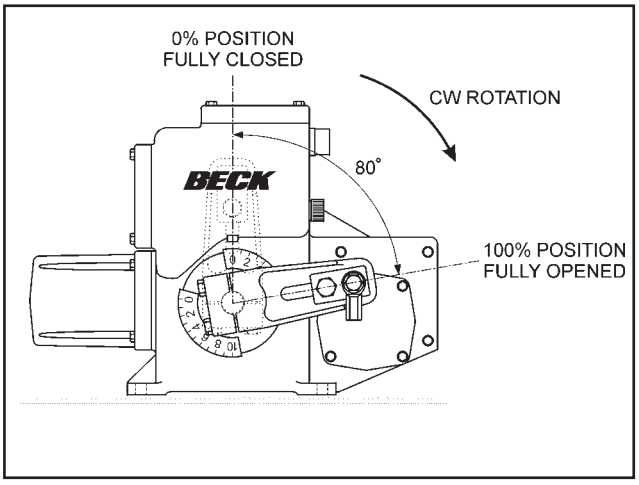


Figure 6

NOTE: Crank arm may be adjusted to any start angle orientation. The orientation shown above has been randomly selected for the purpose of this example.

POSITION FEEDBACK SIGNAL CALIBRATION

DCM boards have the capability of providing a 4–20 mA output signal so that the drive's true output shaft rotation can be monitored remotely. The signal comes calibrated from the factory to provide a precise 4–20 mA signal corresponding to 0–100% drive rotation. Normally, calibration is not required even if the position reference calibration or direction of rotation are changed, because the DCM automatically compensates for these changes and appropriately scales the position feedback signal. Running the calibration procedure, therefore, is only necessary if there is a small calibration mismatch between the 4–20 mA output signal and the 4–20 mA interpretation of the receiving device (e.g., controller, recorder, display, etc.). Calibration can be used to fine tune the relationship.

Calibration Procedure

CAUTION

When following this calibration procedure, be aware that the drive will be required to hold the last output during the procedure. Additionally, as with any change in the DCM configuration, the drive may reposition when restored to normal operation.

STEP 1 - With a HART® Communicator communicating with the drive, move from the "Online" menu to the "Calibration" menu and select the "Calibrate Feedback" procedure. This is accomplished by using the up and down arrow keys to select a particular menu item, and using the right and left arrow keys to move forward and back between menus. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Calibrate feedback" procedure selected, press the right arrow key to move to the "Calibrate feedback" submenu. Use the up and down arrow key to select the "calibrate" procedure, and press the right arrow key again to initiate the calibration procedure.

STEP 3 - Follow the display prompts and place the control loop in manual to reduce the risk of disturbing control. Press the F4 function key (**OK** key) to continue.

STEP 4 - Use the alphanumeric keys to enter the measured feedback signal value in milliamps. This requires measuring the signal current with a meter or other suitable device. The signal is available at the drive's wiring termination board on terminals EE(+) and DD(-). See the Wiring section of this manual for more detail. It will first require the 4 mA entry and then the 20 mA entry. Be sure to enter exactly what is measured to fine tune the calibration. The F4 function key (**ENTER** key) must be pushed after each entry.

STEP 5 - With the calibration procedure complete, the display will prompt the user to enter the date. Follow the prompts and use the function keys and alphanumeric key to make the entry. This date is stored and can be referenced under the "Device information" menu to determine when the last calibration was performed. Continue to follow the prompts carefully to return to normal operation.

DEMAND INPUT SIGNAL CALIBRATION

DCM boards are designed to accept a 4–20 mA (or 1–5 V dc) analog demand signal. Narrower spans within this range can also be accommodated for split range operation. The input comes calibrated from the factory for the full range unless otherwise specified. It is not necessary to calibrate the Demand input when the drive is installed; however, it can be easily accomplished using the 275 Communicator, and a signal source. Running the procedure is only necessary to compensate for slight differences between the signal source calibration and the DCM factory calibration, or it can be done if a reduced range calibration is desired for special operating scenarios such as split ranging. To accommodate special ranges, the calibration procedure allows the user to calibrate only one demand signal endpoint at a time. For example, if the standard calibration from the factory is set for 4–20 mA, but the user decides to operate the full rotation of the drive in response to a 4–12 mA signal instead, then it is only necessary to calibrate the upper point of the demand signal range such that 12 mA represents 100%.

Calibration Procedure

CAUTION

When following this calibration procedure, be aware that the drive will be required to hold last output during the procedure. Additionally, as with any change in the DCM configuration, the drive may reposition when restored to normal operation.

STEP 1 - With the a HART® Communicator communicating with the drive, move from the "Online" menu to the "Calibration" menu and select the "Calibrate Demand" procedure. This is accomplished by using the up and down arrow keys to select a particular menu item, and using the right and left arrow keys to move forward and back between menus. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Calibrate Demand" procedure selected, press the right arrow key to move to the "Calibrate Demand" submenu. Use the up and down arrow key to select the "calibrate" procedure, and press the right arrow key again to initiate the calibration procedure.

STEP 3 - Follow the display prompts and place the control loop in manual to reduce the risk of disturbing control. Press the F4 function key (**OK** key) to continue.

STEP 4 - After continuing, the user is prompted to select one of three calibration techniques: 0%, 100% points; 0% point; 100% point. Use the up and down arrow keys to select the desired technique. The "0%, 100% point" technique allows both extremes of the demand signal to be calibrated, whereas the other two techniques allow either the lower or upper signal extreme to be calibrated. With the desired technique selected, press the F4 function key (**ENTER** key) to continue.

STEP 5 - With a known signal source connected to drive terminals AA(+) and BB(-), follow the display prompts, and set the signal source to the appropriate value. For example, if the display prompt reads, "Set demand signal to 0%", the signal source should be adjusted to the value representing 0%, or 4 mA in a standard calibration. This procedure is the same regardless of the calibration technique selected in **STEP 4**. Press the F4 function key (**OK** key) to proceed.

STEP 6 - With the calibration procedure complete, the display will prompt the user to enter the date. Follow the prompts and use the function keys and alphanumeric keys to make the entry. This date is stored and can be referenced under the "Device information" menu to determine when the last calibration was performed. Continue to follow the prompts carefully to return to normal operation.

Split Range Operation

It is sometimes desirable or necessary to have more than one final control element controlling a single process. Often, this type of control strategy requires that two to four Beck drives each respond to different portions of one 4–20 mA demand signal from the control system.

This type of operation is called split range operation. For example, consider the most common split range scenario—two drives split ranged for 50% of the 4–20 mA demand signal input. Both drives are wired in parallel to receive the same 4-20 mA signal (note that the total loop resistance should be 250 Ohms as specified by the HART® communications protocol. The 250 Ohm R11 resistor must be removed from one of the two drive DCM boards to allow HART® communications. If more than two drives are split ranged, the R11 resistor must be removed from all the DCM boards but one), but each drive's interpretation of the signal must be different. One drive must interpret 4–12 mA as 0–100% demand, and one drive must interpret 12–20 mA as 0–100% demand. This requires that the drives have different demand signal calibrations.

Split-ranging is easily accomplished by determining the break points (12 mA in the example above) and following the demand calibration procedure discussed above. Any of the three calibration techniques will work. In the example above, one drive is calibrated for a 0% point of 4 mA and a 100% point of 12 mA, while the other is calibrated for a 0% point of 12 mA and a 100% point of 20 mA.

NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the configuration. See page 21 for information on changing L.O.S. settings.

TORQUE MEASUREMENT CALIBRATION

DCM boards equipped with an optional Torque Sensing module have the capability of measuring the drive output torque and providing several torque related features. This is normally a factory installed option, since the torque measurement also requires strain gauges internal to the drive that cannot be installed in the field. Drives that are equipped with this feature have the torque measurement calibrated to the drive's rated output at the factory. There is normally no reason to recalibrate this feature in the field, unless a new DCM board has been installed.

In the event that calibration is required, there are two different techniques available: "Standard" and "Apply known torque". The "Standard" technique allows the user to enter a calibration gauge factor which can be found on the label affixed to the inside of the Digital Control Module compartment of the drive. If this information is not available, use the appropriate number from Table 2 (page 62). The "Apply known torque" technique allows the user to calibrate to a torque applied to the output shaft. Application of the torque can be accomplished using the crank arm and weights, or any similar method.

Calibration Procedure

CAUTION

When following this calibration procedure, be aware that it requires disconnecting the drive from its load. This should only be attempted with the process offline or with the final control element locked in place.

STEP 1 - With a HART® Communicator communicating with the drive, move from the "Online" menu to the "Calibration" menu and select the "Calibrate Torque" procedure. This is accomplished by using the up and down arrow keys to select a particular menu item, and using the right and left arrow keys to move forward and back between menus. Follow the Menu Tree (Figure 1, page 34) to navigate.

STEP 2 - With the "Calibrate Torque" procedure selected, press the right arrow key to move to the "Calibrate Torque" submenu. Use the up and down arrow key to select the "Calibrate" procedure, and press the right arrow key again to initiate the calibration procedure.

STEP 3 - Follow the display prompts and place the control loop in manual to reduce the risk of disturbing control. Press the F4 function key (**OK** key) to continue.

STEP 4 - Next, the user is prompted to select one of two calibration techniques: "Standard" and "Apply known torque". Use the up down arrow keys to select the desired technique. The "Standard" technique requires the user to enter a torque calibration factor (see the label affixed to the inside of the DCM compartment or, if unavailable, use the appropriate number from Table 2, page 62). The "Apply known torque" selection requires the user to actually apply a torque of known magnitude to the drive's output shaft. With the desired technique selected, press the F4 function key (**ENTER** key) to continue.

STEP 5 - Follow the display prompt and disconnect the drive output shaft from the driven load. Press the F4 function key (**OK** key) to continue. Go to **STEP 8** if the "Standard" technique is selected, or go to **STEP 6** if "Apply known torque" is selected.

STEP 6 - With the "Apply known torque" technique selected and the load disconnected from the drive, the user is prompted to apply a torque load greater than 50% of the drive rating. This requires knowledge of the drive's rating. Applying the torque is most easily accomplished using weights attached to the drive output shaft, at a known radius parallel to the ground. Once the load is applied, press the F4 function key (OK key) to continue.

STEP 7 - The user is now prompted to enter the torque value as a percentage of the drive's torque rating. This is calculated by the following equation:

(W x R)/T where,

W = weight in lbs. (N)

R = crank arm radius in inches (mm)

T = torque rating of the drive in lb-ft (N•m)

Use the alphanumeric keys to enter the value, and the press the F4 function key (**ENTER** key) to complete the calibration. Remove the weight and correctly reposition the output shaft and crank arm, if applicable. Go to **STEP 9**.

Continued

Calibration Procedure, cont'd.

STEP 8 - With the "Standard" technique selected and the load disconnected from the drive, the user is prompted to enter the torque calibration factor (see the label affixed to the inside of the DCM compartment or, if unavailable, use the appropriate number from Table 2, at right). This factor allows the DCM to calculate the theoretical torque calibration for the particular drive being calibrated. Use the alphanumeric keys to enter the correct factor and press the F4 function key (**ENTER** key) to complete the calibration. Go to STEP 9.

STEP 9 - With the calibration procedure complete, the display will prompt the user to enter the date. Follow the prompts and use the function keys and alphanumeric keys to make the entry. This date is stored and can be referenced under the "Device information" menu to determine when the last calibration was performed. Continue to follow the prompts carefully. Reconnect the drive to the driven load before returning to normal operation.

TABLE 2:
TORQUE CALIBRATION FACTORS

Model No.	Torque Rating	Calibration Factor
11-159	15 lb-ft (20 N·m)	150
	20 lb-ft (27 N·m)	200
	40 lb-ft (54 N·m)	401
	60 lb-ft (81 N·m)	602
	80 lb-ft (108 N·m)	803
11-209	125 lb-ft (169 N·m)	80
	175 lb-ft (237 N·m)	112
	250 lb-ft (339 N·m)	160
11-309	300 lb-ft (407 N·m)	192
	400 lb-ft (542 N·m)	257
	550 lb-ft (746 N·m)	353
	650 lb-ft (881 N·m)	417
11-409	350 lb-ft (475 N·m)	79
	550 lb-ft (746 N·m)	125
	650 lb-ft (881 N·m)	148
	800 lb-ft (1 085 N·m)	182
	1,000 lb-ft (1 356 N·m)	228
	1,500 lb-ft (2 034 N·m)	342
	1,800 lb-ft (2 440 N·m)	411

Model No.	Torque Rating	Calibration Factor
11-169	15 lb-ft (20 N·m)	80
	20 lb-ft (27 N·m)	106
	40 lb-ft (54 N·m)	213
	60 lb-ft (81 N·m)	318
	80 lb-ft (108 N·m)	426
11-269	125 lb-ft (169 N·m)	80
	175 lb-ft (237 N·m)	112
	250 lb-ft (339 N·m)	160
11-369	300 lb-ft (407 N·m)	192
	400 lb-ft (542 N·m)	257
	550 lb-ft (746 N·m)	353
	650 lb-ft (881 N·m)	417
11-469	350 lb-ft (475 N·m)	79
	550 lb-ft (746 N·m)	125
	650 lb-ft (881 N·m)	148
	800 lb-ft (1 085 N·m)	182
	1,000 lb-ft (1 356 N·m)	228
	1,500 lb-ft (2 034 N·m)	342
	1,800 lb-ft (2 440 N·m)	411

DCM HART INTERFACE *Maintenance - Alarm Messages*

COMMON HART® MESSAGES

HART® protocol maintains both standard and device specific informational messages that are displayed on the 275/375 Handheld Communicator when various conditions occur. They can also be used to trigger alarms and messages in other HART® compatible monitoring systems. These messages alert the user to various alarm conditions and make it much easier to diagnose problems. Below is a table of typical Beck drive messages and message sequences. It does not include all possible messages, only the most common.

Handswitch and Limit Switch Messages

Message	Description
"H/S is in STOP or drive at limit sw"	This message will appear if a condition prevents current flow to the motor. Some of the most common conditions are: The drive Handswitch is put in the STOP position; either of the drive over-travel limit switches are open; or the motor control triacs fail.

Demand Signal and Process Variable Messages

Message	Description
"Process applied to the non-primary variable is outside the operating limits of the field device"	This is a standard HART®-defined message that appears whenever one of the three HART® non-primary variables (Demand signal, Torque, Temperature) are outside their design or calibrated ranges. The Demand input signal to the drive is typically the problem source; however, the message can also appear if either the torque measurement (optional) or temperature measurement is outside the design or calibrated ranges. The Beck specific messages below provide more descriptive information.
"Demand signal out of range"	This is a Beck-specific message that can appear after the HART®-defined message above. It specifically pinpoints the Demand input signal to the DCM as the problem source, and indicates that the signal is outside the calibrated range limits. The lower limit is configurable as a percentage of the calibrated range (default is -5%). The upper range is the highest readable input voltage (5.5 VDC) expressed as a percentage of the calibrated range (e.g., approximately 112% for a 4–20 mA* or 1–5 V dc standard input range).
"Demand out of sensor range"	This is a Beck-specific message that can appear after the "Demand signal out of range" message above. It further defines the demand signal problem by indicating that the signal is not only out of the calibrated range, but also out of the design range of the drive. The lower and upper limits are 0.1 V dc and 5.55 V dc respectively.*

*Note that current input DCM boards utilize a 250 Ohm input resistor to convert the current signal to voltage.

Message	Description
"Torque is excessive"	This is a Beck-specific message that can appear after the HART®-defined ("Process applied to the non-primary variable is outside the operating limits of the field device") message mentioned previously, on drives equipped with the optional torque measurement feature. It serves to further define the condition, and indicates that the drive's torque output is exceeding 105% of the calibrated torque range of the drive.
"Overtorque protection is engaged"	This Beck-specific message appears after the "Torque is excessive" message if the torque measurement has exceeded 150% of the calibrated range and thus gone into a protective mode of operation to prevent excessive torque in the event of an obstruction or other problem. The drive ceases driving against the load until the condition is reset. Although unlikely, it is possible to also get a "Drive in stall" message (see misc. messages) with this message.
"Temperature is out of range"	This is a Beck-specific message that can appear after the HART®-defined ("Process applied to the non-primary variable is outside the operating limits of the field device") message mentioned previously. It serves to further define the condition, and indicates that the drive's internal temperature is outside the -40° to 195°F (-40º to 91ºC) range.

Position Signal Messages

(*The position signal is defined as the signal from the position sensor (CPS) to the DCM*)

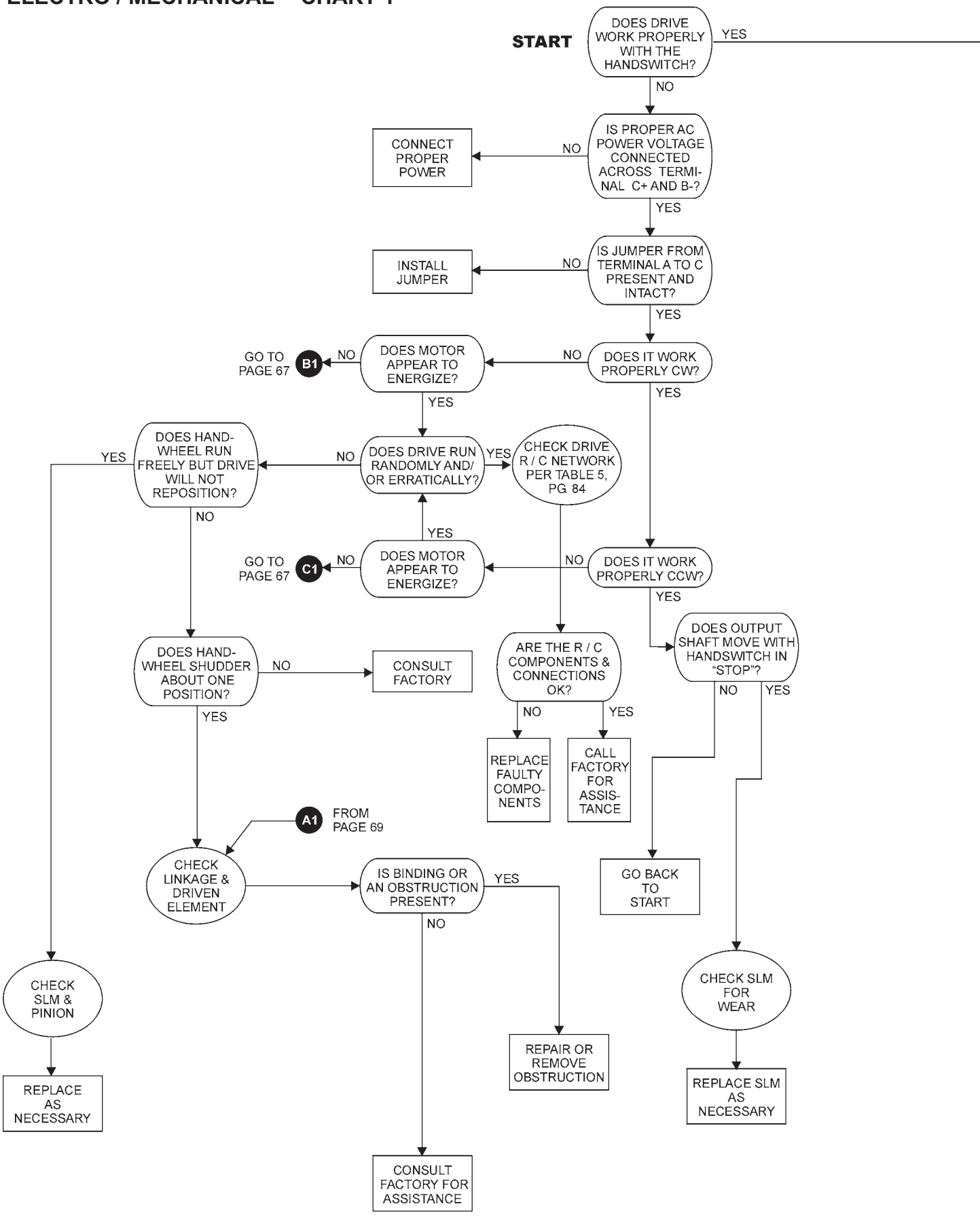
Message	Description
"Process applied to the primary variable is outside the operating limits of the field device"	This is a standard HART®-defined message that appears whenever the HART® primary variable (Position signal) is outside the design or calibrated range. The DCM is designed to accept a maximum position signal range of 0.25 to 5.35 V dc, and can be calibrated anywhere within this range depending on the type of CPS and desired stroke of the drive. Normally, new drives would be calibrated for a 1–5 V dc position signal. Retrofit applications are typically calibrated for a 0.45–2.6 V dc range.
"Analog output 1 and its digital representation are outside the operating range limits, and not responding to input"	This is an additional standard HART®-defined message that appears whenever the HART® primary variable (Position signal) is outside the design or calibrated range. It accompanies the message above.
"Position is out of range"	This is a Beck-specific message that appears after the HART®-defined messages above. It specifically pinpoints the position signal to the DCM as the problem source, and indicates that the signal is outside the calibrated range limits. The upper and lower limits are -5% and 105% of the calibrated range respectively.

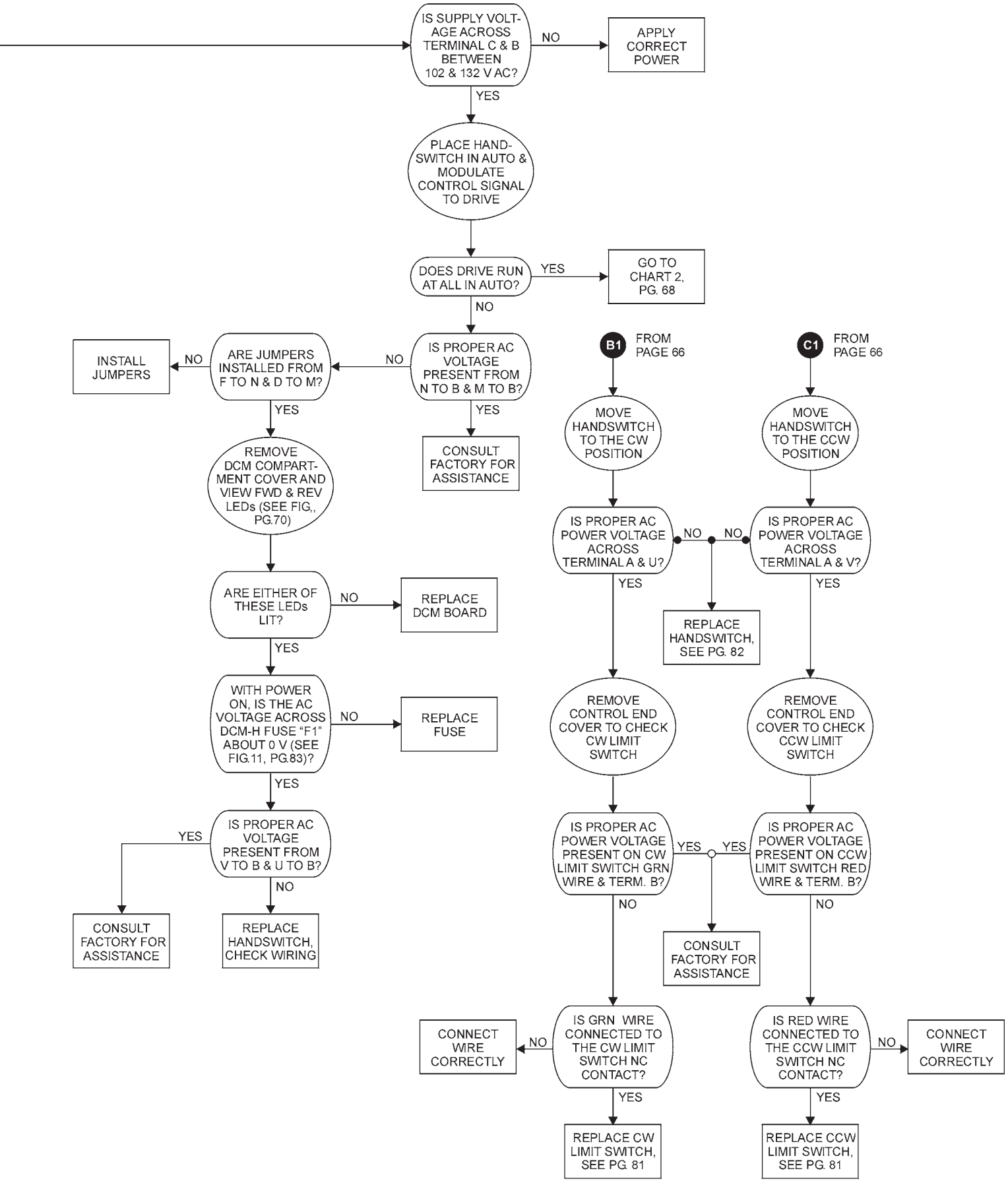
Message	Description
“Position signal in LOS”	This is a Beck-specific message that appears after the HART®-defined messages above. It specifically pinpoints the position signal to the DCM as the problem source, and is intended to indicate a CPS or wiring failure. The message is triggered when the position signal is outside the minimum and maximum limits of 0.25 V dc and 5.35 V dc respectively. In this case, the LOS message above will also be present.
“Position out of sensor range”	This is a Beck-specific message that appears after the HART®-defined messages previously mentioned. It specifically pinpoints the position signal to the DCM as the problem source, and indicates that the signal is outside the 0.25–5.35 V dc design range. The LOS message above will also be present when this message is present.

Miscellaneous Messages

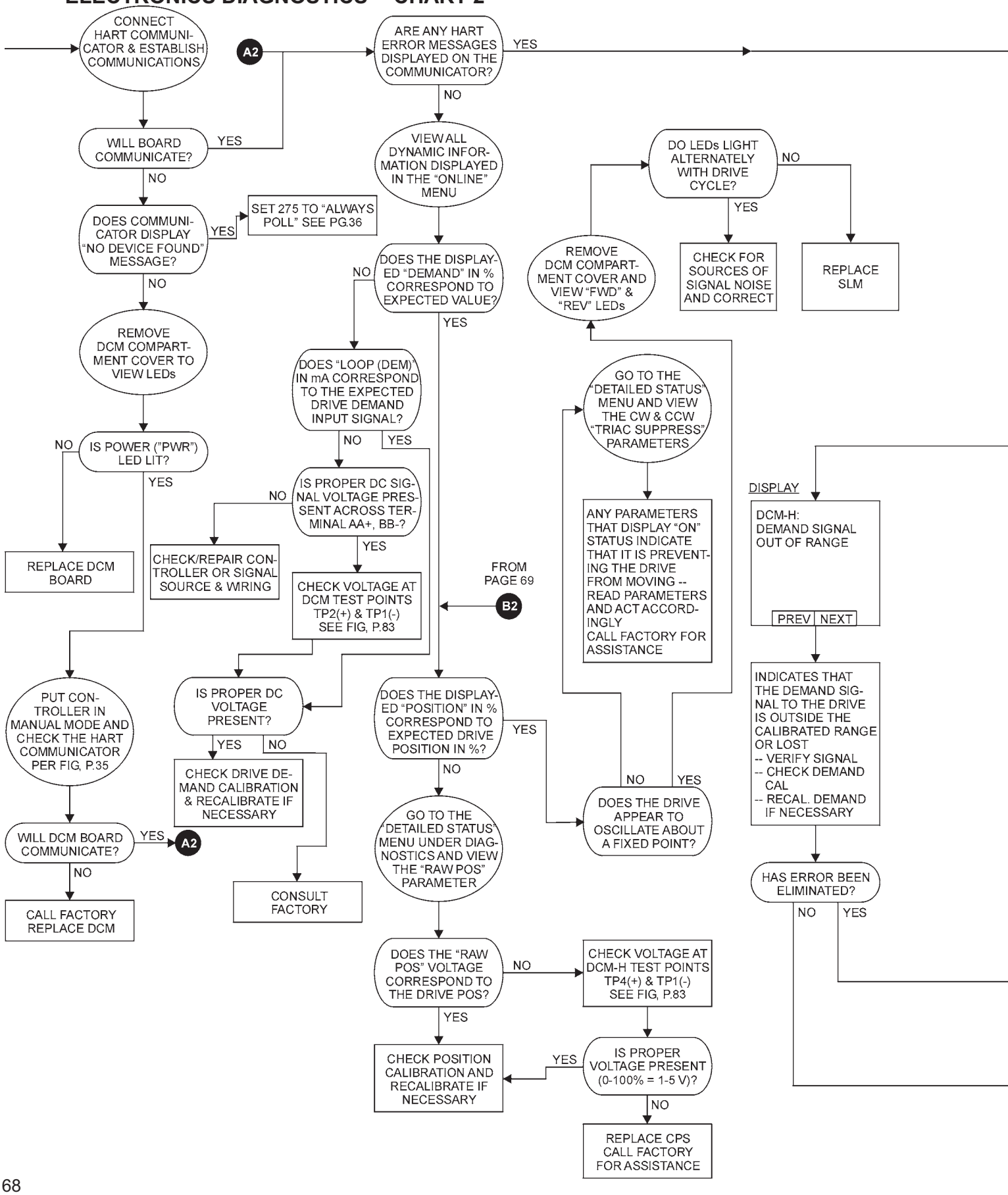
Message	Description
“Feedback circuit is disconnected”	This is a Beck-specific alarm message that alerts the user that external position feedback signal is installed and enabled, but not wired to an external load. If the signal is wired to an external load and this message appears, it implies that a wiring failure somewhere between the drive and the monitoring device has occurred. If the DCM board is equipped with the feedback module, but the signal is not being used, this message can be eliminated by disabling the feedback in the configuration.
“Drive is in Stall”	This is a Beck-specific alarm message alerting the user that the drive is in a stalled condition and is no longer trying to fight the load. This condition occurs if the drive cannot reach the demand position in the ime allotted by the stall time setting (configurable from 30–300 seconds, default 300 sec.). In drives equipped with optional torque measurement, this message may not occur due to the pre-emptive action of overtorque protection.

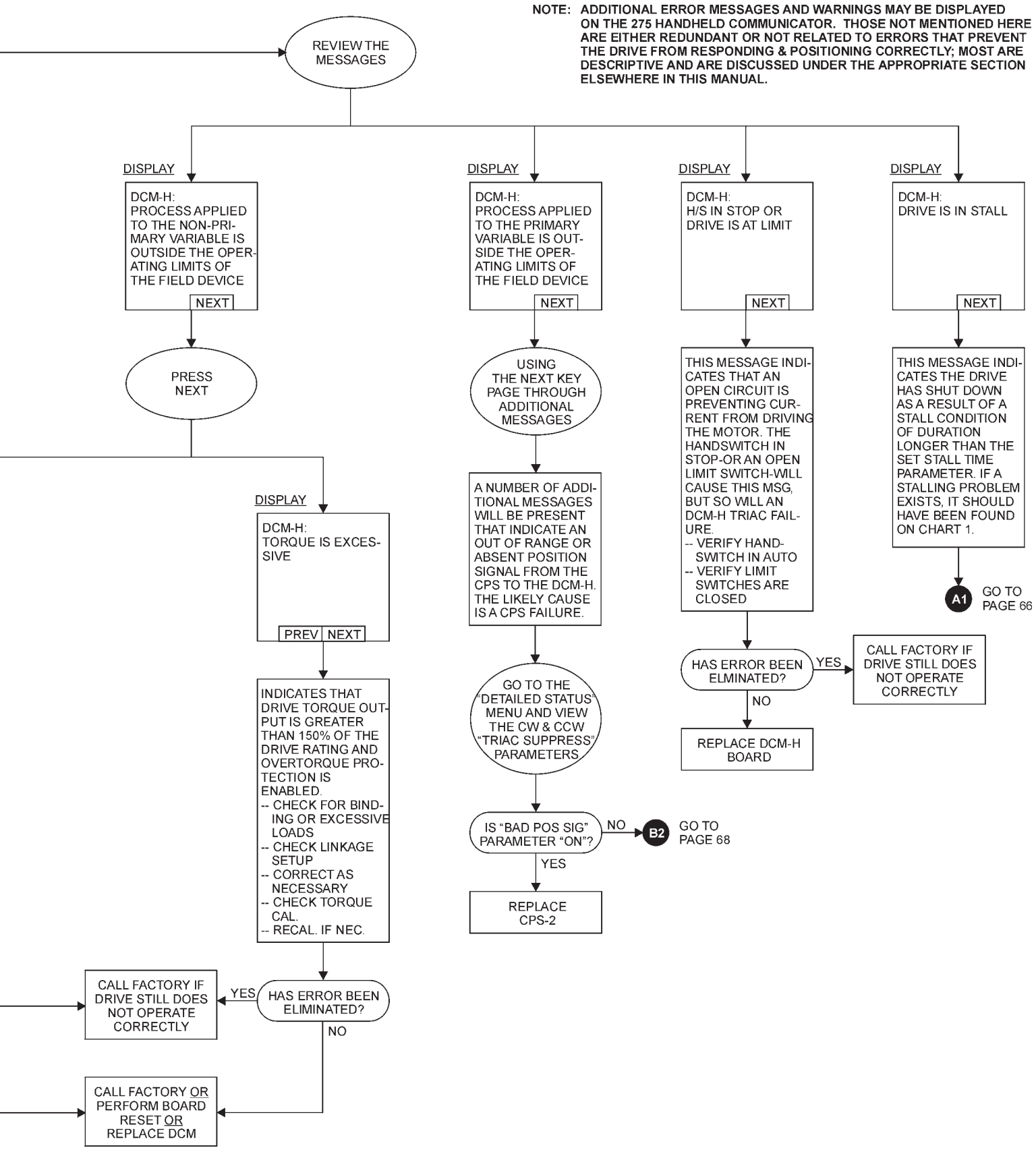
ELECTRO / MECHANICAL -- CHART 1




IS SUPPLY VOLTAGE ACROSS TERMINAL C & B BETWEEN 102 & 132 V AC?
NO
APPLY CORRECT POWER
YES
PLACE HAND-SWITCH IN AUTO & MODULATE CONTROL SIGNAL TO DRIVE
DOES DRIVE RUN AT ALL IN AUTO?
YES
GO TO CHART 2, PG. 68
NO
IS PROPER AC VOLTAGE PRESENT FROM N TO B & M TO B?
NO
ARE JUMPERS INSTALLED FROM F TO N & D TO M?
NO
INSTALL JUMPERS
YES
CONSULT FACTORY FOR ASSISTANCE
YES
REMOVE DCM COMPARTMENT COVER AND VIEW FWD & REV LEDs (SEE FIG,, PG.70)
ARE EITHER OF THESE LEDs LIT?
NO
REPLACE DCM BOARD
YES
WITH POWER ON, IS THE AC VOLTAGE ACROSS DCM-H FUSE "F1" ABOUT 0 V (SEE FIG.11, PG.83)?
NO
REPLACE FUSE
YES
IS PROPER AC VOLTAGE PRESENT FROM V TO B & U TO B?
YES
CONSULT FACTORY FOR ASSISTANCE
NO
REPLACE HANDSWITCH, CHECK WIRING
B1
FROM PAGE 66
MOVE HANDSWITCH TO THE CW POSITION
IS PROPER AC POWER VOLTAGE ACROSS TERMINAL A & U?
NO
YES
REMOVE CONTROL END COVER TO CHECK CW LIMIT SWITCH
IS PROPER AC POWER VOLTAGE PRESENT ON CW LIMIT SWITCH GRN WIRE & TERM. B?
YES
NO
IS GRN WIRE CONNECTED TO THE CW LIMIT SWITCH NC CONTACT?
NO
CONNECT WIRE CORRECTLY
YES
REPLACE CW LIMIT SWITCH, SEE PG. 81
C1
FROM PAGE 66
MOVE HANDSWITCH TO THE CCW POSITION
IS PROPER AC POWER VOLTAGE ACROSS TERMINAL A & V?
NO
YES
REPLACE HANDSWITCH, SEE PG. 82
REMOVE CONTROL END COVER TO CHECK CCW LIMIT SWITCH
IS PROPER AC POWER VOLTAGE PRESENT ON CCW LIMIT SWITCH RED WIRE & TERM. B?
YES
NO
CONSULT FACTORY FOR ASSISTANCE
IS RED WIRE CONNECTED TO THE CCW LIMIT SWITCH NC CONTACT?
NO
CONNECT WIRE CORRECTLY
YES
REPLACE CCW LIMIT SWITCH, SEE PG. 81

ELECTRONICS DIAGNOSTICS -- CHART 2




NOTE: ADDITIONAL ERROR MESSAGES AND WARNINGS MAY BE DISPLAYED ON THE 275 HANDHELD COMMUNICATOR. THOSE NOT MENTIONED HERE ARE EITHER REDUNDANT OR NOT RELATED TO ERRORS THAT PREVENT THE DRIVE FROM RESPONDING & POSITIONING CORRECTLY; MOST ARE DESCRIPTIVE AND ARE DISCUSSED UNDER THE APPROPRIATE SECTION ELSEWHERE IN THIS MANUAL.
REVIEW THE MESSAGES
DISPLAY
DCM-H: PROCESS APPLIED TO THE NON-PRIMARY VARIABLE IS OUTSIDE THE OPERATING LIMITS OF THE FIELD DEVICE
NEXT
PRESS NEXT
DISPLAY
DCM-H: TORQUE IS EXCESSIVE
PREV NEXT
INDICATES THAT DRIVE TORQUE OUTPUT IS GREATER THAN 150% OF THE DRIVE RATING AND OVERTORQUE PROTECTION IS ENABLED.
-- CHECK FOR BINDING OR EXCESSIVE LOADS
-- CHECK LINKAGE SETUP
-- CORRECT AS NECESSARY
-- CHECK TORQUE CAL.
-- RECAL. IF NEC.
HAS ERROR BEEN ELIMINATED?
YES
CALL FACTORY IF DRIVE STILL DOES NOT OPERATE CORRECTLY
NO
CALL FACTORY OR PERFORM BOARD RESET OR REPLACE DCM
DISPLAY
DCM-H: PROCESS APPLIED TO THE PRIMARY VARIABLE IS OUTSIDE THE OPERATING LIMITS OF THE FIELD DEVICE
NEXT
USING THE NEXT KEY PAGE THROUGH ADDITIONAL MESSAGES
A NUMBER OF ADDITIONAL MESSAGES WILL BE PRESENT THAT INDICATE AN OUT OF RANGE OR ABSENT POSITION SIGNAL FROM THE CPS TO THE DCM-H. THE LIKELY CAUSE IS A CPS FAILURE.
GO TO THE "DETAILED STATUS" MENU AND VIEW THE CW & CCW "TRIAC SUPPRESS" PARAMETERS
IS "BAD POS SIG" PARAMETER "ON"?
NO
B2
GO TO PAGE 68
YES
REPLACE CPS-2
DISPLAY
DCM-H: H/S IN STOP OR DRIVE IS AT LIMIT
NEXT
THIS MESSAGE INDICATES THAT AN OPEN CIRCUIT IS PREVENTING CURRENT FROM DRIVING THE MOTOR. THE HANDSWITCH IN STOP-OR AN OPEN LIMIT SWITCH-WILL CAUSE THIS MSG, BUT SO WILL AN DCM-H TRIAC FAILURE.
-- VERIFY HANDSWITCH IN AUTO
-- VERIFY LIMIT SWITCHES ARE CLOSED
HAS ERROR BEEN ELMINATED?
YES
CALL FACTORY IF DRIVE STILL DOES NOT OPERATE CORRECTLY
NO
REPLACE DCM-H BOARD
DISPLAY
DCM-H: DRIVE IS IN STALL
NEXT
THIS MESSAGE INDICATES THE DRIVE HAS SHUT DOWN AS A RESULT OF A STALL CONDITION OF DURATION LONGER THAN THE SET STALL TIME PARAMETER. IF A STALLING PROBLEM EXISTS, IT SHOULD HAVE BEEN FOUND ON CHART 1.
A1
GO TO PAGE 66

COMMUNICATIONS

The Beck Digital Control Module (DCM) is equipped with a serial interface which allows for direct communication with a computer. Using a communication cable, connect the DCM to the computer using the DCM's RS-232 (J20) connector (see illustration on this page) and the computer's COM port. Ensure that the COM port on the computer is active, and that the cable is plugged into the proper COM port if more than one is present (e.g., COM1, COM2, etc.). Note that a plug end adapter may be necessary for connection to the computer's COM port.

Once connected, communication can be established between the DCM and the computer using a terminal emulation program, such as HyperTerminal. This method of communication will allow for configuration, calibration and verification of drive DCM settings without the use of custom software applications.

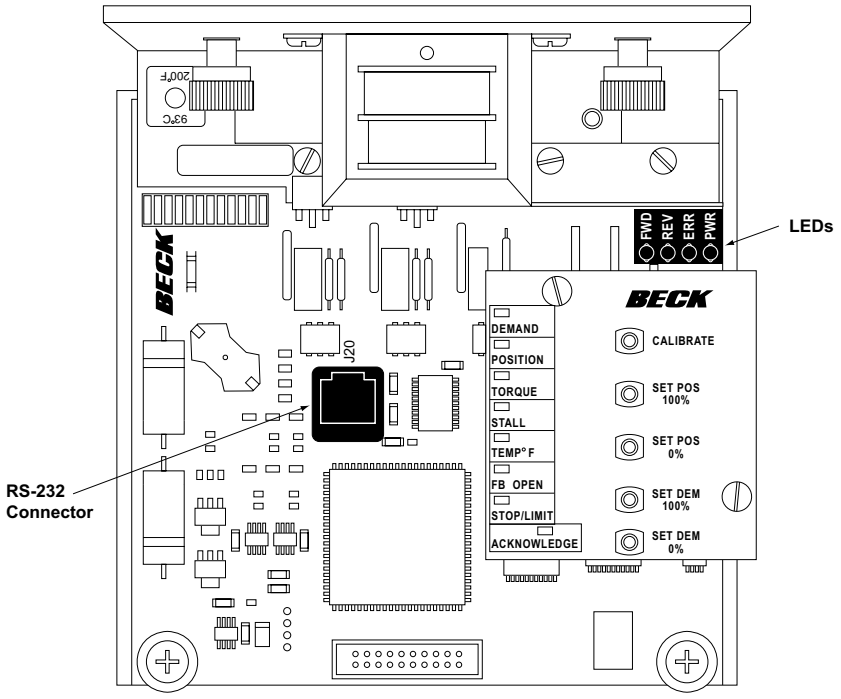
HyperTerminal Software

HyperTerminal is the standard ASCII terminal emulation software provided with Microsoft® Windows®. If using HyperTerminal, the following instructions will assist in setup. Note that some variation to these instructions may be necessary depending on the version of HyperTerminal being used.

Once the computer has been connected to the DCM, access HyperTerminal by clicking first on "Start", then "Programs", then "Accessories", then "Communications", then "HyperTerminal".

Double-click on the "Hypertrm.exe" icon to start the program. Once HyperTerminal is running, it is necessary to set up a file with the proper settings to communicate with the DCM. Proceed as follows:

1. If prompted to install a modem, answer "no". Proceed to enter a name (e.g., "DCM") and select an icon (any will suffice) in the "Connection Description" box. Click the "OK" button.
2. The "Connect to" box should open next. At the bottom of the box, set the "Connect using" selection to the computer COM port that has been connected to the DCM. Click the "OK" button.
3. The COM port properties box should open next. This is where the communication settings are established. The correct settings are:
   a. Bits per second = "1200"
   b. Data bits = "8"
   c. Parity = "none"
   d. Stop bits = "1"
   e. Flow control = "none"
4. With the appropriate settings entered from Step 3, above, click "OK". Communications should now be enabled.
5. Press the "Enter" key twice. "Ok" should be displayed indicating that HyperTerminal is communicating with the DCM.



COMMANDS AND ARGUMENTS

Commands can be used for a variety of functions including changing the operating configuration of the drive, verifying operation settings, calibration and accessing diagnostic information. There are essentially four different types of commands:

1. Dual-purpose commands. These commands can be used to either modify drive configuration settings or display the settings already set in the drive. In order to set or make a change to the settings, the command requires an argument (*n*). If the command is used for display purposes only, the argument is omitted. Examples of these commands include "dead band" and "demlos".
2. Display only commands. These commands are used to display diagnostic or operating information like present signal values. No arguments are required. Examples include the "stat" command and the "signals" command.
3. Set only commands. These commands serve only to make a parameter change. Typically, they apply to the drive calibration. This type of command requires an argument, but unlike dual-purpose commands, they return an error message when entered without an argument. Examples include the "demis" and "posis" commands.
4. Execute action commands. These commands serve to reset, enable or disable features and do not require an argument. Entering these commands produces an immediate action. Examples include the "revert" and "torqen" command.

The available commands are listed on page 72 and each is described in more detail on pages 73 through 78. The command description explains the use or uses of the command, while the argument column describes the applicable arguments for those commands that require them. In the command tables, arguments are denoted as *n*. Note that the commands described as "sets and/or displays" signify dual purpose commands that can be used with or without an argument for setting or verifying configuration settings.

DCM SERIAL INTERFACE *Commands*

Note: For specific information on the following functions, see the HART interface section of the manual.

SERIAL COMMANDS

The following is a list of serial commands available through the RS-232 interface. Error codes associated with these commands are listed on page 78.

General Configuration Commands (p. 73)

dead band
drvrotation
stalltime

Reset Factory Settings Commands (p. 73)

resettrim
revert

Demand Signal Commands (p. 74)

demis
demfunc
demlos
demlosgtp

Position & Feedback Signal Commands (p. 75)

posis
fbis
iomode

Torque Function Commands (p. 76)

torqis
torq0
torq100
torqdis
torqen

Diagnostic and Information Commands (p. 77)

signals
stat
tempf
torq

General Configuration Commands

Command	Description	Argument *n* and Information
dead band *n*	Sets and/or displays the drive dead band in % of Demand signal span.	*n* = dead band in % x 100 (e.g., the standard dead band is 0.6%, thus *n* = "60" (0.6 x 100)). Valid *n* values range from "25" to "500" (0.25% to 5% dead band).
drvrotation *n*	Sets and/or displays the direction of drive output shaft rotation resulting from an increasing Demand signal (as viewed) looking into the end of the drive output shaft).	*n* = "0" (indicates clockwise rotation); or *n* = "1" (indicates counterclockwise rotation).
stalltime *n*	Sets and/or displays the time allowed for the drive to reach its Demand target. If the drive cannot reach the target in the allotted time, a stall condition is initiated.	*n* = number of line cycles. This number is calculated by multiplying the desired stall activation time in seconds by the line power cycles of the drive (50 or 60 Hz). For example, if the desired time to stall activation is 200 seconds and the drive operates at 60 Hz, *n* = "12000" (200 x 60). Time to stall is configurable from approx. 30 seconds ("1800") to 300 seconds ("18000"). The default value is "18000" (300 sec.).

Reset Factory Settings Commands

Command	Description	Argument *n* and Information

resettrim *n*	Resets any of the four drive calibration trims to the original factory settings. An argument is required to select the desired calibration. This will overwrite any calibration performed by the user.
	WARNING—Implementing this command may cause the drive to reposition.
		n = "0" (Drive position calibration, see "posis");
		n = "1" (Demand signal calibration, see "demis");
		n = "3" (Torque calibration (optional), see "torqis", "torq0 0", & "torq 100");
		n = "32" (Feedback signal calibration, see "fbis").

revert	Resets all the configurable drive features back to the factory settings, returning the drive to as-shipped operation. WARNING—This overwrites any configuration changes made by the user and can cause the drive to reposition and function differently.	No argument required.

DCM SERIAL INTERFACE *Commands*

Note: For specific information on the following functions, see the HART interface section of the manual.

Demand Signal Commands

Command	Description	Argument *n* and Information
demis *n*	Calibrates the DCM's interpretation of the analog Demand signal to the drive, and requires an argument indicating the signal level in terms of percent of signal span. This command also requires the application of a signal to the drive when the command is used. This command must be applied twice to allow the DCM to fit a straight-line function. One entry must be for a signal level below 50% of span and the second must be for a signal level greater than 50% of span. If only one end point needs to be changed for purposes such as split ranging, this can be achieved implementing the command only once.	*n* = the Demand signal level as a percentage multiplied by a factor of 100. For example, calibrating a drive with a 4–20 mA Demand signal would first require setting the Demand signal to a level less than 50% of span (i.e., less than 12 mA, preferably 4 mA). The demis command should then be entered with the argument *n* equal to the percent of the signal span x 100. For example, with the Demand signal at 4 mA, *n* is calculated by 0% x 100 = 0; therefore *n* = "0". If the signal was at some other level below 50%, such as 8 mA, the argument *n* will equal 25% x 100 or *n* = "2500". The demis command should then be reapplied with the Demand signal now set for a value greater than 50% of span (i.e., greater than 12 mA, preferably 20 mA). For example, 20 mA would be 100% x 100, thus *n* = "10000"; or 16 mA would be 75% x 100, thus *n* = "7500".
demfunc *n*	Sets and/or displays the Demand signal input characterization function. The DCM provides either linear or square function characterization.	*n* = "linear"; or *n* = "square".
demlos *n*	Sets and/or displays the Demand signal threshold level below which the DCM recognizes that the signal is lost. The threshold level is described in terms of mV for the DCM or percentage of signal span for the DCM. This command also sets and/or displays the LOS (Loss Of Signal) action the drive inititiates when the Demand signal drops below the threshold value. The options for the LOS action include stay in place ("sip") or go to a predetermined position ("gtp"). Note that the command always reports both settings, but only sets one argument at a time. The command must be used twice if both the threshold and action need to be set.	*n* = the threshold value. This value is in mV and must be greater than or equal to 0. With a 4–20 mA drive (1–5 Volt Demand signal dropped across the board input resistor), the threshold could be set between 0 and 1 Volt. For example, if 0.5 Volts (500 mV) is selected as the threshold, then *n* = "500". The default value for *n* = "850" (850 mV). The threshold value is expressed as a percentage of demand signal span, and must be a negative number. For example, with a 4–20 mA drive, and a desired threshold of 3.2 mA, which is 5% below the 0% demand (-5%) signal value, then *n* = "-500" (-5 x 100). — OR — *n* = "sip" or "gtp", and must be entered separately from *n*.
demlosgtp *n*	Sets and/or displays the position (in terms of a percentage of full drive travel) that the drive will run to upon loss of the demand signal if the drive is set to "gtp" (go to position) (see "demlos" above). This command has no effect when the drive is set to "sip" (stay in place). See "demlos" command.	*n* = desired position of the drive when the demand signal is lost. The position is expressed as a percentage of full drive travel x 100. For example, if the desired position is 50% of full travel, then *n* = "5,000" (50 x 100).

Position & Feedback Signal Commands

Command	Description	Argument *n* and Information
posis *n*	Calibrates the DCM interpretation of the position reference signal from the drive's position sensor (CPS) to the DCM. Calibrating this enables the DCM to determine the travel limits of the drive. This command must be used twice to establish the drive's travel range (i.e., at a position less than 50% of travel, and at a position greater than 50% of travel). The drive must be positioned at a known point when entering this command. If only one end of travel needs to be modified for short stroke operation, then the command need be applied only once for that end of travel.	*n* = the present drive position as a percentage of full drive travel x 100. For example, if the drive is to be calibrated for 100° of travel, the drive should first be positioned at the 0° or 0% travel position. Once at this position, the "posis" command should be executed with *n* = "0" (0% x 100). In this example, the position of the drive could be anywhere less than 50%, with that percentage multiplied by 100. Next, the drive should be run to the 100% position (100° away in the example above). Once at this position, the "posis" command should be executed with *n* = "10,000" (100% x 100). The position of the drive could be anywhere greater than 50%, with that percentage multiplied by 100.
fbis *n*	Trims the drive's 4–20 mA position Feedback signal calibration. Implementing this command is normally not necessary, since the signal is factory calibrated to 4–20 mA; however, it allows the user to compensate for minor calibration differences between the signal and the display instrumentation calibrations. It can be applied to either or both ends of the signal range, but should only be used if a Demand signal calibration has been performed. This ensures that slight Feedback signal display errors are not a result of Demand signal calibration errors. The recommended way to use this command is to apply it at the drive's 0% travel position and again at its 100% position.	*n* = the measured Feedback signal as a percentage of the signal range. For example, if the drive is positioned to its 0% position, the position Feedback signal should be very close to 4 mA (± 0.06 mA). However, calibration differences between the Feedback signal and the measuring/display instruments may result in a more sizable difference. For example, assume that the drive is at 0% position, but the Feedback displayed is 3.9 mA. *n* is calculated by first finding the percent signal represented by 3.9 mA and multiplying by 100. That is, –0.1 mA (3.9 – 4.0) divided by 16 mA (signal span), which is –0.635%, multiplied by 100. Therefore, *n* = –63.5. Similarly, the 100% travel point can be trimmed by positioning the drive at its 100% position and performing the same calculation. For example, if at 100% the Feedback measured is 19.9 mA instead of the desired 20.0 mA, "fbis" should be implemented with n = 99.375% ({19.9 – 20.0} ÷ 16 x 100).
iomode *n*	Sets the Feedback option for the drive. This is a hardware configuration command that enables/disables the external position Feedback or is used to configure the drive for retrofit into an older, control option 7 drive.	*n* = the number representing the Feedback source: "0" = none (disables external position feedback), "1" = Feedback (enables external position feedback sourced by the DCM), "2" = Potentiometer (provides power for feedback pot. used in option 7 drives).

DCM SERIAL INTERFACE *Commands*

Note: For specific information on the following functions, see the HART interface section of the manual.

Torque Function Commands (if applicable—torque sensing is an option)

Command	Description	Argument *n* and Information
torqis *n*	Calibrates the torque signal in the drive based on the application of known loads to the drive. This method of calibrating torque should only be used if known loads can be applied to the drive. This command must be used twice to establish the torque range (i.e., at a percentage less than 50%, and at a percentage greater than 50%). See "torq0" and "torq100" for an alternate method of calibrating torque using constant calibration factors.	*n* = the percentage of torque applied x 100. For example, if the drive is rated for 40 lb-ft (54 N·m), first remove the load from the drive. Execute the "torqis" command with *n* = "0" (0% x 100). This lower torque percentage could also be any known load resulting in less than 50% torque (with the value of *n* changing accordingly). Next, a known load should be applied resulting in the maximum rated torque of the drive (in this example, 40 lb-ft (54 N·m)). Execute the "torqis" command once again with *n* = "10,000" (100% x 100). This higher torque percentage could also be any known load resulting in greater than 50% torque.
torq0 0	Used in conjunction with "torq100 *n*", calibrates the torque signal in the drive based on constant calibration factors. The "torq0 0" command calibrates 0% torque.	When the drive is at 0% torque (no load applied), "torq0 0" should be executed to set the current torque value to 0%.
torq100 *n*	Used in conjunction with "torq0 0", calibrates the torque signal in the drive based on constant calibration factors. The "torque100 *n*" command calibrates 100% torque.	*n* = the calibration factor as noted in the table below. The factor used is dependent upon the drive model and torque rating of the drive. For example, for an 11-159 control drive rated at 40 lb-ft (54 N·m) of torque, *n* = "401".

TORQUE CALIBRATION FACTORS

Model No.	Torque Rating	Calibration Factor
11-159	15 lb-ft (20 N·m)	150
	20 lb-ft (27 N·m)	200
	40 lb-ft (54 N·m)	401
	60 lb-ft (81 N·m)	602
	80 lb-ft (108 N·m)	803
11-169	15 lb-ft (20 N·m)	80
	20 lb-ft (27 N·m)	106
	40 lb-ft (54 N·m)	213
	60 lb-ft (81 N·m)	318
	80 lb-ft (108 N·m)	426
11-209 & 11-269	125 lb-ft (169 N·m)	80
	175 lb-ft (237 N·m)	112
	250 lb-ft (339 N·m)	160

Model No.	Torque Rating	Calibration Factor
11-309 & 11-369	300 lb-ft (407 N·m)	192
	400 lb-ft (542 N·m)	257
	550 lb-ft (746 N·m)	353
	650 lb-ft (881 N·m)	417
11-409 & 11-469	350 lb-ft (475 N·m)	79
	550 lb-ft (746 N·m)	125
	650 lb-ft (881 N·m)	148
	800 lb-ft (1 085 N·m)	182
	1,000 lb-ft (1 356 N·m)	228
	1,500 lb-ft (2 034 N·m)	342
	1,800 lb-ft (2 440 N·m)	411

torqdis	Disables the drive's torque measurement (if applicable).	No argument required.
torqen	Enables the drive's torque measurement (if applicable).	No argument required.

Diagnostic and Information Commands

Command	Description	Argument *n* and Information
signals	Displays the current value of the Position signal and the Demand signal. When executed, the "signals" command will return the current value of the Position signal in millivolts (mV) followed by the current value of the Demand signal in microamps (µA).	No argument required.
stat	Displays information on the status of the drive. Information displayed includes: Position (% x 100) Demand (% x 100) Dead band (% x 100) Motor starts, reversals and stalls (hexadecimal) Total run time (hexadecimal-seconds) Overtorques (hexadecimal) Maximum Torque (%) Alarm codes (none or alarm code) Position LOS, Demand LOS and Stalled motor, if currently applicable Operational mode Current drive travel direction or stop Line power cycles (Hz) Demand or Position error, if applicable	No argument required.
tempf	Displays measured temperatures in the drive. Information is displayed in °F. and includes: Low temperature extreme recorded by the DCM Current temperature High temperature extreme recorded by the DCM	No argument required.
torq	Displays torque settings and current torque measurement. Information displayed includes: Current torque value (in counts) 0% torque setting (in counts) 100% torque setting (in counts) Current torque value (percentage) Over range alarm if the current torque value exceeds the alarm threshold.	No argument required.

Command Error Codes

When an error is encountered using the serial commands, an "ERROR XX" message is returned. The table below provides a description of the error codes ("XX").

Code	Description	Information
2	Invalid selection	Displayed when an unknown command has been entered.
3	Value too big	Displayed when an entered numeric value exceeds expected parameters.
4	Value too small	Displayed when an entered numeric value is less than expected parameters.
5	Data length error	Displayed when the wrong number of arguments is entered.
6	General error	Displayed when a combination of circumstances prevents a better description of the error.
9	Process too high	Displayed when the entered value exceeds acceptable parameters when calibrating a 0% value.
10	Process too low	Displayed when the entered value is less than acceptable parameters when calibrating a 100% value.
14	Span too small	Displayed when entered values for a 0% point and a 100% point are too close.
32	Busy	Displayed when a memory store is requested and another memory store is already in process.
64	Not implemented	Displayed when an entered command is defined, but cannot be implemented.

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.

LUBRICATION

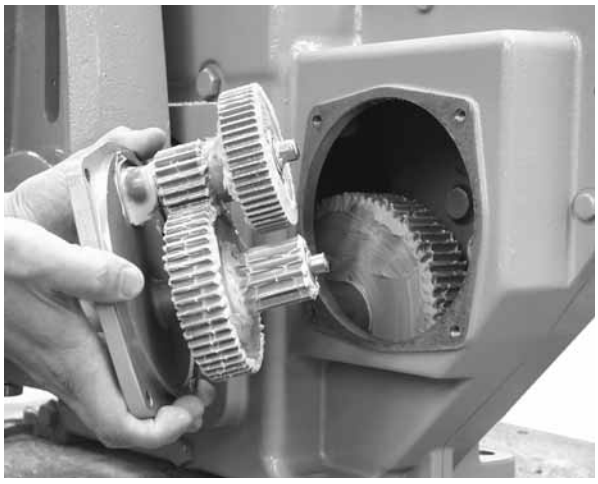
Periodic lubrication is not required on Beck control drives. However, it is recommended that during major shutdowns or outages, the drives in the most severe applications be inspected to determine the need to relubricate the drive gear train.

If your drive has a linkage, to extend the life of the linkage rod ends, they should be included in your scheduled lubrication program.

CAUTION

If your drive has a linkage, 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 11-209/-269, -309/-369 and -409/-469. On Model 11-159/-169, the motor must be removed to access the gears. Clean the gears thoroughly, removing all old lubrication.



11-409 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 91.

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). The ball bearing on the output shaft and crown gear shaft have added double grease seals and require no maintenance for the life of the bearings. Inspect all grease seals and replace any that show wear. Reassemble the drive, referencing pages 8–14 for appropriate bolt torques.

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 8–14 and to the cutaway illustration on page 4 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 91.

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.

SEALS

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

To remove the shaft seal, push the blade of a small screwdriver along the shaft and under the seal lip. CAUTION: The seal is approximately 1/4" (6 mm) wide. Do not force the screwdriver blade beyond the width of the seal; damage to the shaft bearing could result. Pry up on the seal and force it out of the housing. Clean the shaft and housing 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 11-159/-169 and 11-409/-469 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

If your drive has a linkage, 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 11-159/-169 drives, the Handswitch must first be removed from the body before removing the terminal block and plate as an assembly. Follow the instructions in the paragraphs below.

In the 11-209/-269, -309/-369, and -409/-469 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. See pages 8–14 for torque 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 11-159/-169 drives, the Handswitch must first be removed from the body before removing the terminal block and plate as an assembly. Follow the instructions in the following paragraph.

In the 11-209/-269, -309/-369, and -409/-469, 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).

OVER-TRAVEL 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 set the switch, place a .030" (.75 mm) shim between the cam and switch lever. The switch lever should be on the low or minimum radius portion of the cam when setting the switches. Position the switch assembly so that the switch is just actuated. DO NOT overstress the switch lever. Tighten both screws to 10 lb-in (14 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). If the drive has no auxiliary switches, it is possible to add up to four switches. See Table 4, page 84, for switch assembly part numbers.

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 preceding instructions.

SELF-LOCKING MECHANISM (SLM)

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

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

See the illustration below for component identification.

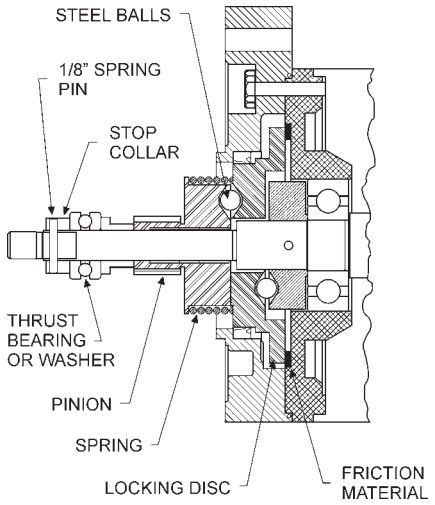


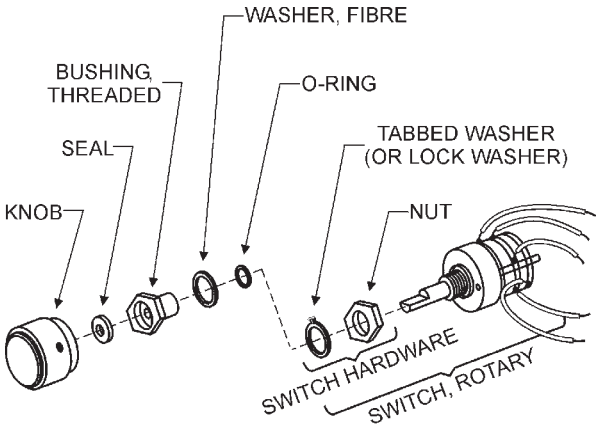
TABLE 3:
SLM PART NUMBERS

Motor Part Number	SLM Rebuild Kit	Instruction Sheet
11-159/-169		
20-2700-20	12-8060-15	80-0016-05
20-2701-20	12-8060-16	80-0016-05
11-209/-269, -309/-369		
20-2704-21	12-8060-17	80-0016-07
20-2705-21	12-8060-18	80-0016-07
11-409/-469		
20-2201-21, -22, -23	12-8060-11	80-0016-01
20-2201-31, -32, -33	12-8060-13	80-0016-02

HANDSWITCH

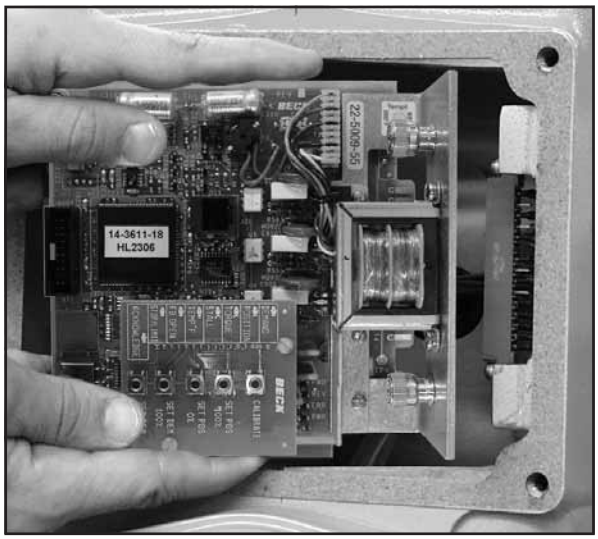
To replace the Handswitch, remove the terminal cover, and then remove the terminal plate (11-209/-269, -309/-369, and -409/-469 only). Clip the five wires from the old Handswitch. Remove the knob and the nut under the knob to remove the switch. Install the new Handswitch as shown below. Splice the wires 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.



DCM BOARD

Field service of the DCM board is not recommended. The factory maintains a stock of replacement boards for immediate shipment. To replace the DCM board, remove the Digital Control Module compartment cover (1/2" bolt heads). If applicable, disconnect the torque sensing wires from the bottom of the customer interface panel by gently pulling on the connector. Loosen the four captive screws holding the board to its mounting pads. Note the "L" shaped mounting bracket on the end of the board. To remove the board, pull the mounting bracket away from its mating surface. See illustration below.



To install a DCM board, lightly press the board connector into its receptacle until the mounting bracket is flush with its mating surface. Tighten the four captive screws to 8 lb-in (.9 N•m). If applicable, connect the torque sensing wires to the bottom of the customer interface panel by gently pressing the connector into its receptacle. Replace the compartment cover. Torque cover bolts to 10 lb-ft (14 N•m).

CPS-2

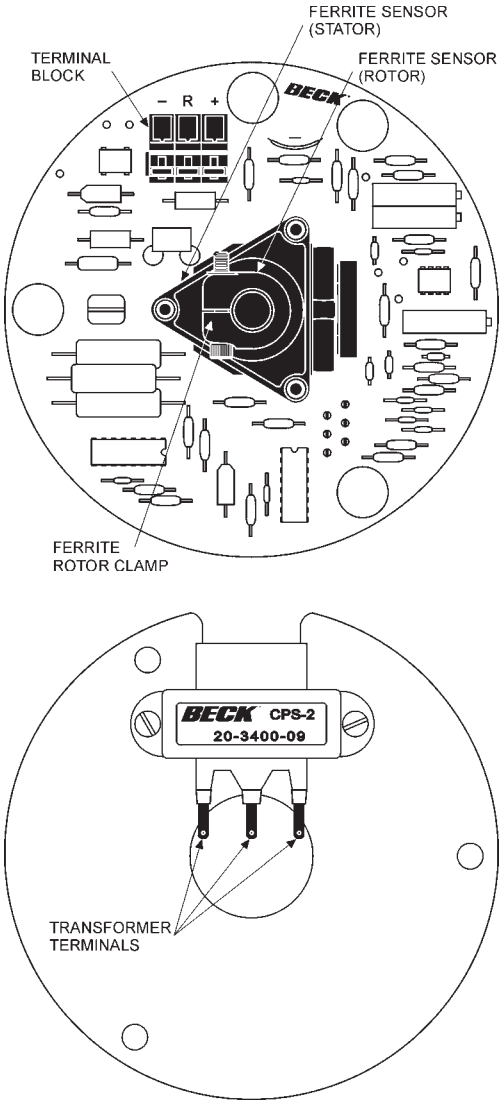
Field repair of the CPS-2 assembly is not recommended. The factory maintains a stock of replacement assemblies for immediate shipment. If it is necessary to replace the CPS-2, replace both the rotor and stator / circuit board assembly. When returning the CPS-2 to the factory for service, include the rotor and stator / circuit board assembly. Do not separate the stator or circuit boards from their mounting plates. The rotor should be held inside the stator with rubber bands for protection during shipment.

To remove the CPS-2:

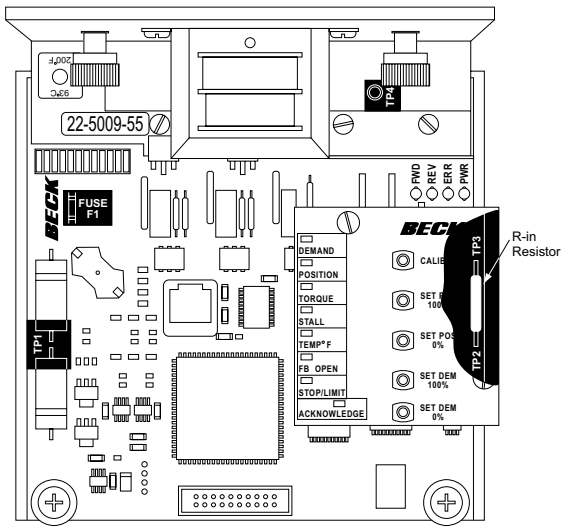
1. Run the control drive to its midpoint of travel with the local Handswitch. (If the standard rotation of 100° has been reduced to 80°, the midpoint of travel is 40°.)
2. Disconnect 120 V ac power to the drive. Remove the terminal, DCM compartment and control end covers (1/2" bolt heads).
3. Record the wire colors on the terminal block of the CPS-2 (see illustration at right), 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 lever. Push down to open the spring-loaded contact and release the wire.
4. Pull the wires from the transformer (see illustration at right) 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.
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 (only a minor adjustment should be necessary) on the control shaft until the output voltage measured across TP4 and TP1 (see illustration at right) reads 50% (approx. 3 volts) of the signal span. Tighten clamp to 5 lb-in (.6 N•m) torque.
7. Perform a position calibration procedure as described on page 30 or page 56.



CPS-2 Components



DCM Test Points

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 4, below.

HOW TO ORDER SPARE PARTS

Select the needed parts from the spare parts list given below. Specify the drive's model / serial number (e.g., 11-309-031891-01-02) 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 4: RECOMMENDED SPARE PARTS

DESCRIPTION	PART NO.	DESCRIPTION	PART NO.
Limit switch assembly	20-3202-10	Control motor	See Table 5, below
Auxiliary switch assembly		Motor resistor	See Table 5, below
(2 switches)	20-3202-11		
(4 switches)	20-3202-12	Motor capacitor	See Table 5, below
Gasket set:		DCM Board w/o Torque	22-5009-55
Model 11-159, -169	20-3110-01	w/ Torque	22-5009-59
Model 11-209, -269	20-3110-02		
Model 11-309, -369	20-3110-02	Fuse, 7A, 125V	11-1373-01
Model 11-409, -469	20-3110-03		
		CPS-2	20-3400-09

TABLE 5: MOTORS, CAPACITORS AND RESISTORS

USED ON MODEL NO.	MOTOR PART NO.	VOLTAGE	HERTZ	AMP.	CAPACITOR PART NO.	VALUE	RESISTOR PART NO.	VALUE
11-159/-169	20-2700-20	120	60	.17	14-2840-02	2 µf	11-5802-03	500Ω
			50	.17	14-2840-13	3 µf	11-5802-03	500Ω
	20-2701-20	120	60	.32	14-2840-11	4 µf	11-5802-02	475Ω
			50	.32	14-2840-11	4 µf	11-5802-02	475Ω
11-209/-269 and 11-309/-369	20-2704-21	120	60	.35	14-2840-16	5 µf	20-1971-13	220Ω*
			50	.35	14-2840-19	7 µf	20-1971-13	220Ω*
	20-2705-21	120	60	.56	14-2840-05	8 µf	20-1971-12	110Ω*
			50	.56	14-2840-06	10 µf	20-1971-12	110Ω*
11-409/-469	20-2201-21, -31	120	60	1.25	14-2840-17	15 µf	20-1971-03	75Ω*
			50	1.25	14-2840-16	5 µf	20-1971-03	75Ω*
					14-2840-17	15 µf		
	20-2201-22, -32	120	60	2.20	14-2840-15	25 µf	20-1971-04	37.5Ω*
			50	2.20	14-2840-05	8 µf	20-1971-04	37.5Ω*
					14-2840-15	25 µf		
	20-2201-23, -33	120	60	3.00	14-2840-15	25 µf	20-1971-06	18Ω*
					14-2840-09	6 µf		
			50	3.00	14-2840-15	25 µf	20-1971-10	24Ω*
					14-2840-05	8 µf		
					14-2840-09	6 µf		

*This is a resistor assembly.

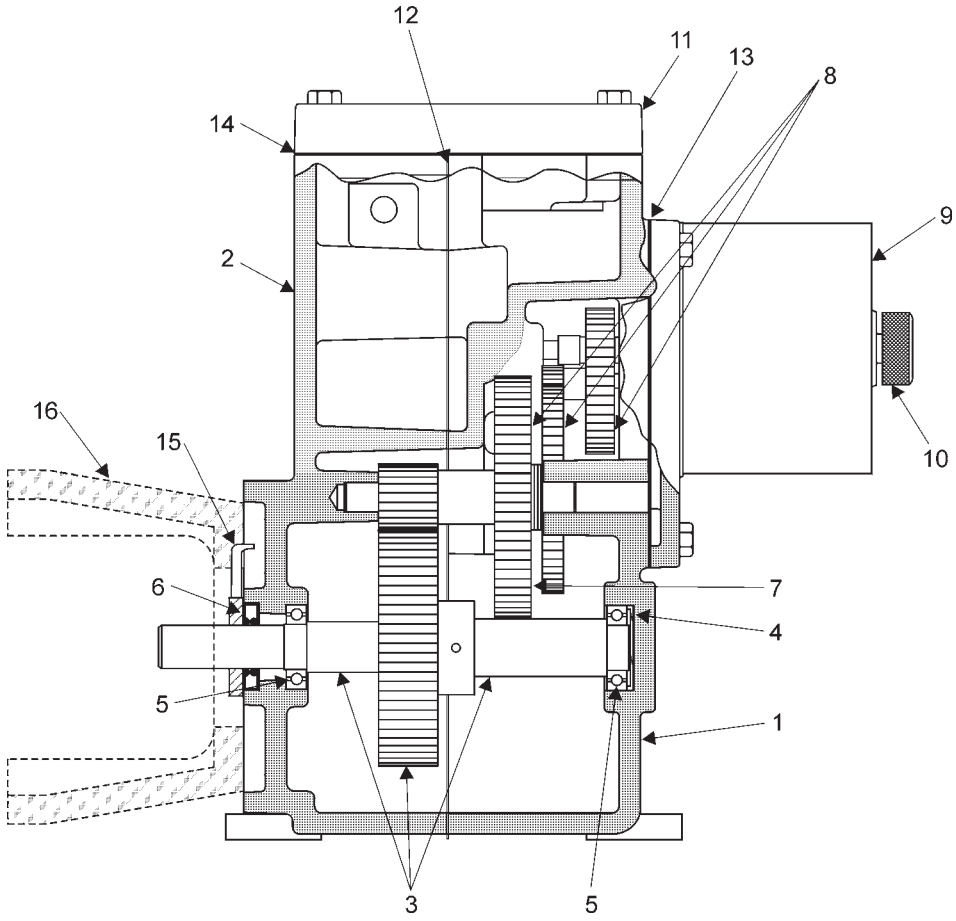


TABLE 6:
DRIVE COMPONENTS FOR MODEL 11-159 / -169

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	11	Terminal / DCM compartment cover
2	Body front	12	Gasket, body
3	Output shaft assembly and main gear	13	Gasket, control motor
4	Spring washer	14	Gasket, terminal cover
5	Ball bearing, output shaft		Gasket, DCM cover
6	Seal, output shaft		Gasket, control end cover
7	Gear, 3rd combination		Control end cover
8	Gear module assembly, see Table 9, page 88, for part number		Control end cover extension Terminal block
9	Control motor, see Table 5, page 84, for part number		Barrier, insulator, terminal compartment
10	Handwheel	15	Index pointer (-159 only)
		16	Bracket (-169 only)

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

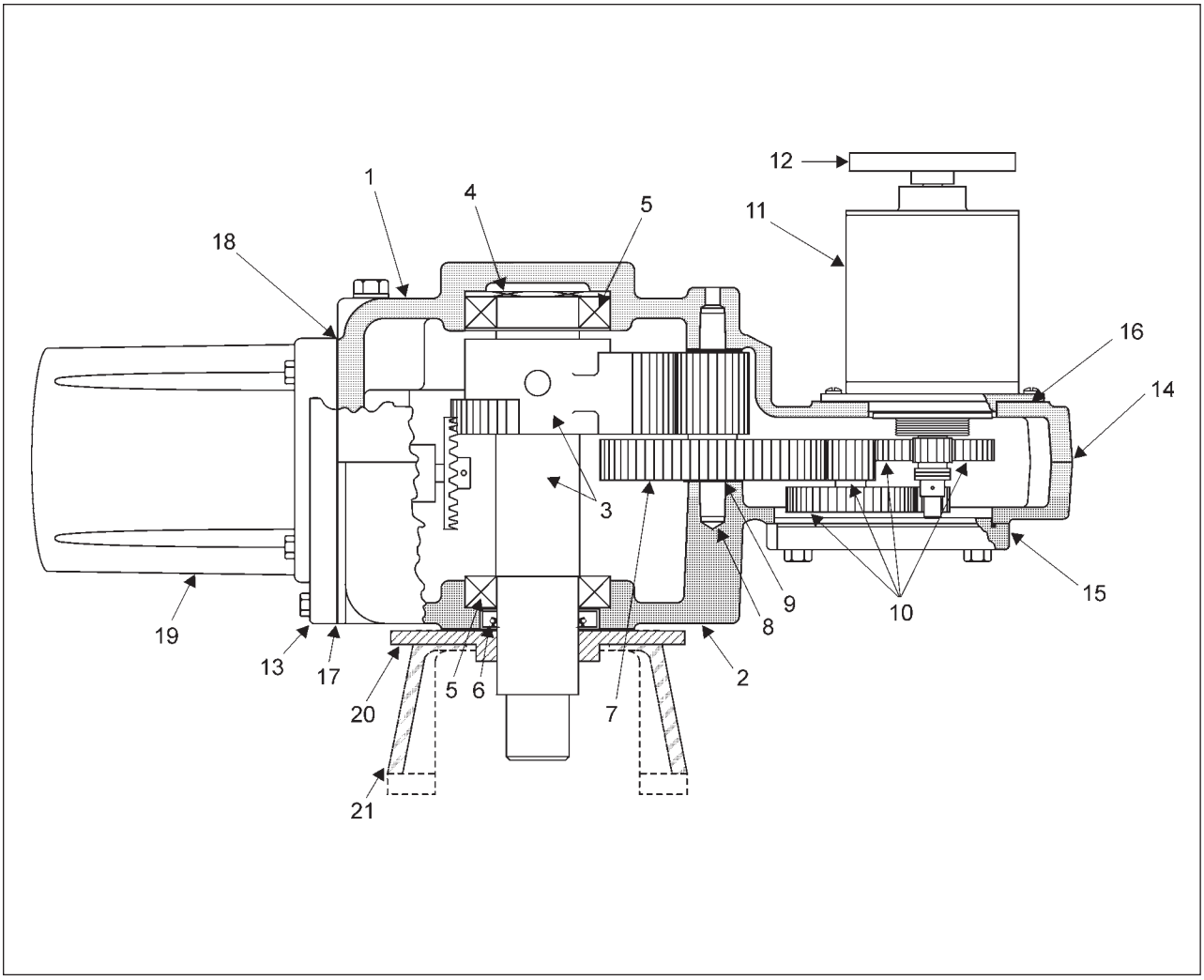


TABLE 7:
DRIVE COMPONENTS FOR MODEL 11-209 / -269 / -309 / -369

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	13	Terminal / DCM compartment cover
2	Body front	14	Gasket, body
3	Output shaft assembly and main gear	15	Gasket, gear module
4	Spring washer	16	Gasket, control motor
5	Ball bearing, output shaft	17	Gasket, DCM & terminal cover
6	Seal, output shaft	18	Gasket, control end cover
7	Gear, 3rd combination	19	Control end cover
8	Pin, 3rd combination gear		Control end cover extension
9	Thrust washer		Terminal block
10	Gear module assembly, see Table 9, page 88, for part number		Barrier, insulator, terminal compartment
			Barrier plate
11	Control motor, see Table 5, page 84, for part number		Gasket, barrier plate
		20	Index (-209 / -309 only)
12	Handwheel	21	Bracket (-269 / -369 only)

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

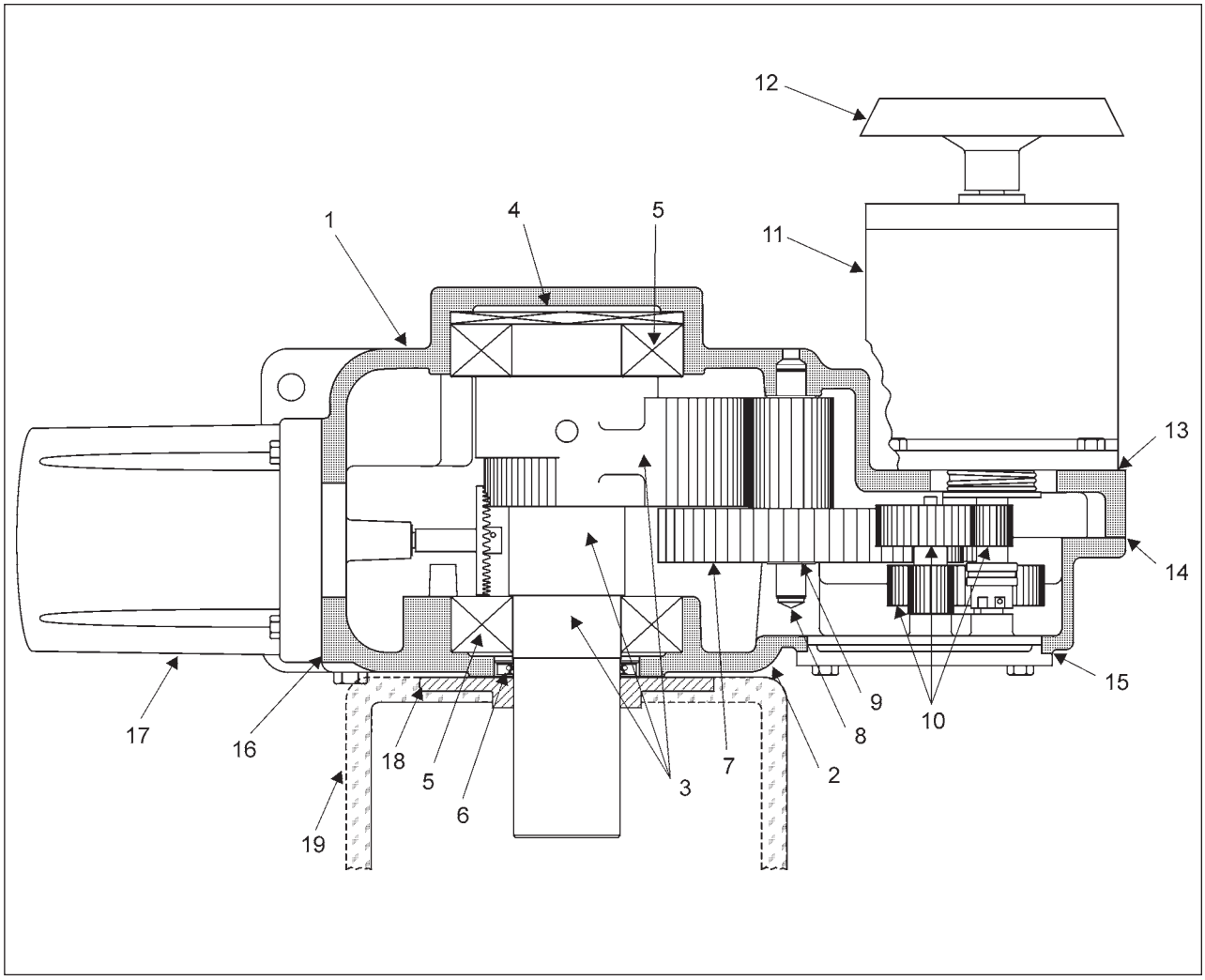


TABLE 8:
DRIVE COMPONENTS FOR MODEL 11-409 / -469

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body rear	12	Handwheel
2	Body front	13	Gasket, control motor
3	Output shaft assembly and main gear	14	Gasket, body
4	Spring washer	15	Gasket, gear module
5	Ball bearing, output shaft	16	Gasket, control end cover
6	Seal, output shaft	17	Control end cover
7	Gear, 3rd combination		Control end cover extension
8	Pin, 3rd combination gear		Terminal block & barrier plate
9	Thrust washer		Gasket, barrier plate
10	Gear module assembly, see Table 9, page 88, for part number		DCM & terminal compartment cover
			Gasket, DCM & terminal cover
11	Control motor, see Table 5, page 84, for part number		Barrier, insulator, terminal compartment
		18	Index (-459 only)
		19	Bracket (-469 only)

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

TABLE 9:
GEARS, TORQUE AND TIMING OPTIONS

Drive Model Number	Approx. Weight	Maximum Overhung Load	Motor Part Number	Motor Current @ 120 V ac, 60 Hz*	Gear Module Number	Torque	Models -159 & -_09 Timing (sec/100°) @ 60 Hz**	Models -_69 Timing (sec/90°) @ 60 Hz**
11-159	50 lbs (23 kgs)	750 lbs (340 kgs)	20-2700-20	.17	14-9733-01	80 lb-ft (108 N·m)	90	81
					14-9733-02	60 lb-ft (81 N·m)	60	54
11-169	56 lbs (25 kgs)				14-9733-03	40 lb-ft (54 N·m)	40	36
					14-9733-04	20 lb-ft (27 N·m)	20	18
			20-2701-20	.32	14-9733-03	80 lb-ft (108 N·m)	40	36
					14-9733-04	40 lb-ft (54 N·m)	20	18
					14-9733-05	15 lb-ft (20 N·m)	11	10
11-209	120 lbs (54 kgs)	3,000 lbs (1 361 kgs)	20-2704-21	.35	14-9730-04	125 lb-ft (169 N·m)	40	36
					14-9730-05	175 lb-ft (237 N·m)	60	54
11-269	115 lbs (52 kgs)				14-9730-08	250 lb-ft (339 N·m)	75	68
			20-2705-21	.56	14-9730-02	125 lb-ft (169 N·m)	20	18
					14-9730-04	250 lb-ft (339 N·m)	40	36
11-309	125 lbs (57 kgs)	4,500 lbs (2 041 kgs)	20-2704-21	.35	14-9730-09	300 lb-ft (407 N·m)	100	90
			20-2705-21	.56	14-9730-04	300 lb-ft (407 N·m)	40	36
11-369	115 lbs (52 kgs)				14-9730-05	400 lb-ft (542 N·m)	60	54
					14-9730-08	550 lb-ft (746 N·m)	75	68
					14-9730-09	650 lb-ft (881 N·m)	100	90
11-409	270 lbs (122 kgs)	9,000 lbs (4 082 kgs)	20-2201-21, -31	1.25	14-9732-02	800 lb-ft (1 085 N·m)	60	54
					14-9732-03	1,500 lb-ft (2 034 N·m)	100	90
11-469	216 lbs (98 kgs)				14-9732-04	1,000 lb-ft (1 356 N·m)	75	68
					14-9732-05	350 lb-ft (475 N·m)	24	22
					14-9732-07	550 lb-ft (746 N·m)	40	36
			20-2201-22, -32	2.20	14-9732-02	1,800 lb-ft (2 440 N·m)	60	54
					14-9732-05	650 lb-ft (881 N·m)	24	22
					14-9732-07	1,000 lb-ft (1 356 N·m)	40	36
			20-2201-23, -33	3.00	14-9732-02	1,800 lb-ft (2 440 N·m)	36	32
					14-9732-07	1,000 lb-ft (1 356 N·m)	24	22

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

* 50 Hz motor currents do not exceed 110% of 60 Hz levels.

** 50 Hz timing = 1.2 x 60 Hz timing.

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 work site. Beck's analysis at the job site 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.**

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

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11 TERRY DRIVE • NEWTOWN, PENNSYLVANIA 18940 • USA
PHONE: 215-968-4600 • FAX: 215-860-6383 • www.haroldbeck.com

07/06