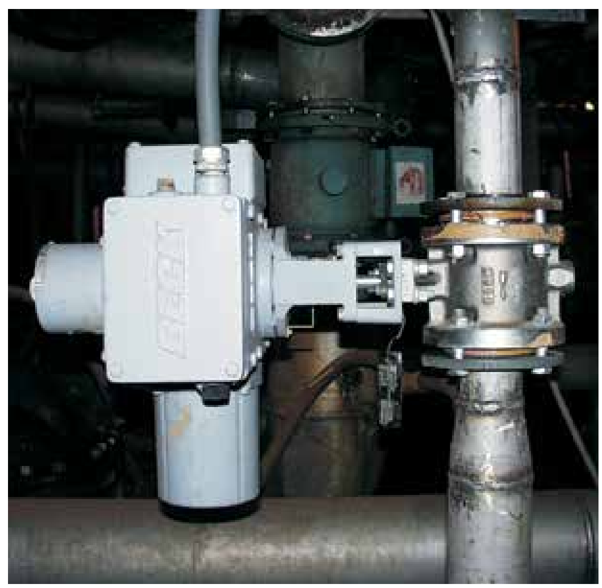
80-1103-01
Rev. 6.5

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

INSTRUCTION MANUAL

For actuators manufactured after March 2019 equipped with Foundation Fieldbus



ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

INTRODUCTION

This manual contains the information needed to install, operate and maintain Beck Model Group 11 Electric Actuators equipped with the Digital Control Module (DCM-3), manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

The Group 11 actuator 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 actuator torque.

The Beck Group 11 is an electric actuator for industrial process control. Exceptionally stable and trouble-free, this rotary actuator is in use throughout the world in valve and damper applications.

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 actuators and, with such orders, is provided along with Beck Manual Supplement 80-1100-14.

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

Group 14 linear actuators 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.

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HART® is a registered trademark of the Hart Communication Foundation.

PRODUCT DESCRIPTION

The Group 11 product line is a family of rotary electric actuators designed for industrial process control. Group 11 actuators consist of a motor driven gear box with self-contained, microprocessor-based electronics for modulating control. This section describes the main components and general functions.

HOUSING

Beck actuators have individual cast aluminum compartments for each of the five main components: The control motor, field wiring terminal block, actuator train, digital control module (DCM-3), and control end. Gasketed covers and sealed shafts achieve NEMA 4X enclosure ratings ideally suited to outdoor and high humidity environments.

Heavy cast internal mechanical stops for the output shaft are designed to prevent accidental over-travel damage during manual cycling.

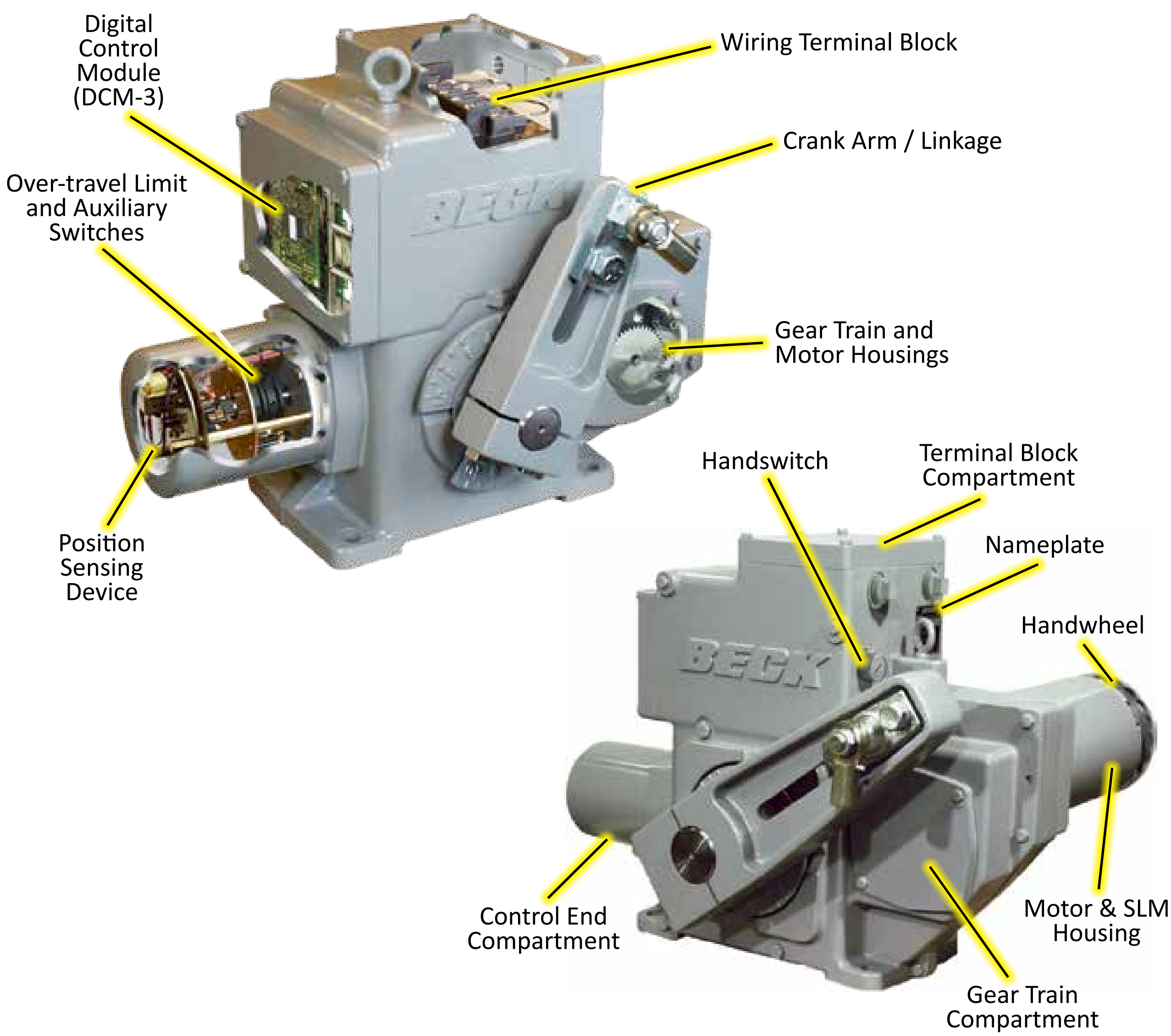
GEAR TRAIN

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

The first and second stage gears are part of the field-interchangeable gear module. Different combinations of gear modules and motors determine the drive's output torque and timing. Refer to Gears, Torque and Timing Options (page 93).

CRANK ARM / LINKAGE

Depending on the application, the actuator output shaft will be connected to the driven load through either an inline coupling, called direct-coupled, or through a crank arm and linkage. A linkage offers several adjustments that can simplify and improve the actuator installation. Refer to LINKAGE APPLICATIONS (page 15).



CONTROL MOTOR

The Beck control motor is a synchronous motor that operates at a constant speed of 72 RPM (60 Rpm at 50 Hz) or 120 RPM (100 RPM at 50Hz). Typically, motors reach full speed within 25 milliseconds and stop within 20 milliseconds.

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

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 in either direction. When the motor is de-energized, the SLM prevents backdriving of the output shaft.

HANDSWITCH

All Group 11 actuators are equipped with a Handswitch for local electrical control. Refer to MODES OF OPERATION (page 22).

WIRING TERMINAL BLOCK

All field wiring connections are made in the terminal block compartment. Refer to INSTALLATION—ELECTRICAL (page 18).

DIGITAL CONTROL MODULE (DCM-3)

In Automatic mode, power to run the motor is controlled by the DCM-3 circuit board assembly. This circuit board receives signals from the external control system, interprets the signal as an intended output shaft position, then runs the motor until the output shaft matches that position. The DCM-3 also contains most configuration information, maintains statistics related to actuator performance, and creates signals to send back to the external control system.

A DCM-3 model is available that communicates with Foundation Fieldbus (FF) networks, and a model is available that communicates with HART Communication Foundation (HART) networks. The FF models communicate using digital signaling. The HART models can receive and send analog and/or digital signals. The HART models include a local configuration interface for analog control systems that do not use the HART protocol. All models have a DB9 serial interface that can be used for configuration and diagnostics.

Refer to DCM-3 OVERVIEW (page 24).

CONTROL END

The control end provides electronic and electro-mechanical sensing of the output shaft position. Electronic sensing is provided by the CPS-5 Contactless Position Sensor, which provides a signal to the DCM-3. The DCM-3 uses this signal to determine the actual position of the output shaft. Electro-mechanical sensing is provided by sets of cam-operated switches. Two of these switches act as over-travel limit switches to ensure the motor cannot actuator the output shaft beyond the desired range. Other switches are available to the external control system for indication and interlock functions. Refer to OUTPUT SHAFT POSITION SENSING (page 36) for information related to the DCM-3 interaction with the CPS-5 signal. Refer to Control End Overview (page 41) for information on setting up the control end.

SERIAL NUMBER

The Beck serial number is important in several respects. The serial number begins with Group number, which is followed by the model number. These numbers allow a person to determine the specifications of the actuator. The model number is followed by the sales order number. Using the sales order as an index, Beck maintains complete build information for every actuator built.

The serial number is stamped into the nameplate, which is fixed to the outside of the actuator housing.

The serial number is also useful to the DCM-3. Using the serial number, the DCM-3 can determine the Group and model numbers, and from these can determine what product-specific configurations are available.

The format of the serial number is:

GG MMM-SSSSSS-LL-XX
e.g., 11-159-113065-01-02

where: GG is the Group number
MMM is the model number
SSSSSS is the sales order number
LL is the sales order line item number
XX is the sales order sequence number

When entering the serial number into the DCM-3, use the dashes as shown. The Group and model numbers are mandatory entries because the DCM-3 identifies model-specific configuration information from these fields. The sales order information is useful for documentation, but is not needed by the DCM-3. For information on how the DCM-3 uses the serial number information, refer to OUTPUT SHAFT POSITION SENSING (page 36).

GENERAL SPECIFICATIONS

Actuator Power	120 V ac, single-phase, 60 Hz (Standard), 50 Hz (Optional) 240 V ac, single-phase, 60 Hz (Standard), 50 Hz (Optional)	Allowable Tolerance	+10% -15%

Maximum Current (Amps) by Supply Voltage

Model	Maximum Power (W)	Voltage (V ac) 120	Voltage (V ac) 240
11-159 / 11-169	50	0.44	0.21
11-209 / 11-269 11-309 / 11-369	104	0.74	0.43
11-409 / 11-469	400	3.00	1.67

Operating Conditions	-40° to 185°F (-40° to 85°C) 0 to 100% relative humidity, non-condensing
Communication Interface	HART: (Rev. 5 -- burst mode is not supported), local pushbutton/LED panel and local DB9 serial commands FOUNDATION FIELDBUS and local DB9 serial commands.
Demand (analog) Signal Options (DCM-3) (not available w/ FF)	4–20 mA (1–5 V dc input is possible with the removal of the "R11" resistor located on the DCM-3 board. For resistor location, refer to DCM-3 Test Points and Resistor (page 88)
Adjustability for Split Range Operation	0%: 0.1 V to 4 V dc 100%: 0% + 1 V min. to 5 V max.
Minimum Step Size	0.1% typical (page 28)
Linearity	±1% of span, max. independent error
Hysteresis	0.25% of span at any point
Demand Signal Characterization	Linear: Actuator output shaft moves proportionally to the input signal Square: Actuator output shaft moves proportionally to the square of the input signal Custom: Actuator output shaft moves according to the custom demand response curve
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 450 seconds), the DCM-3 will shut off power to the motor (feature can be enabled/disabled).

Overtorque Protection (Optional)	The DCM-3 can shut off power to the motor if the output torque of the actuator exceeds 150% (adjustable from 70% to 150%) of the actuator rating. Refer to page 29.
Alarm Annunciation	Available at field wiring terminals, typically terminal E. Refer to page 24.
Temperature Indication	Measures the internal temperature of the actuator and triggers an alarm when the temperature exceeds the rating range. Refer to page 27.
Over-travel Limit Switches	Two SPDT (CW and CCW) provide over-travel protection. Refer to page 41.
Auxiliary Switches	Up to four 6 A, 120 V ac switches available. Switches are labeled S1 to S4 and are cam-operated, field-adjustable. Refer to page 43.
Handswitch	Permits local electrical operation, independent of controller signal. Standard on all units. An optional auxiliary contact can provide remote AUTO indication (rated 2.5 A at 120 V ac). Refer to page 22.
Handwheel	Provides manual operation without electrical power. Refer to page 21.
Motor	120 V ac, single-phase, no-burnout, non-coasting motor has instant magnetic braking. Requires no contacts or moving electrical 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. Refer to page 41.
Enclosure	Precision-machined, aluminum alloy castings painted with corrosion-resistant polyurethane paint provide a rugged, dust-tight, weatherproof enclosure. Actuators designed for hazardous classified locations are also available. Type 4X; IP68, 3 meters/48 hours*. *Internal water damage is not covered by warranty.
Mounting Orientation	Any orientation—no limitations.
Standards*	CSA Listed; CE Compliant; UKCA Compliant

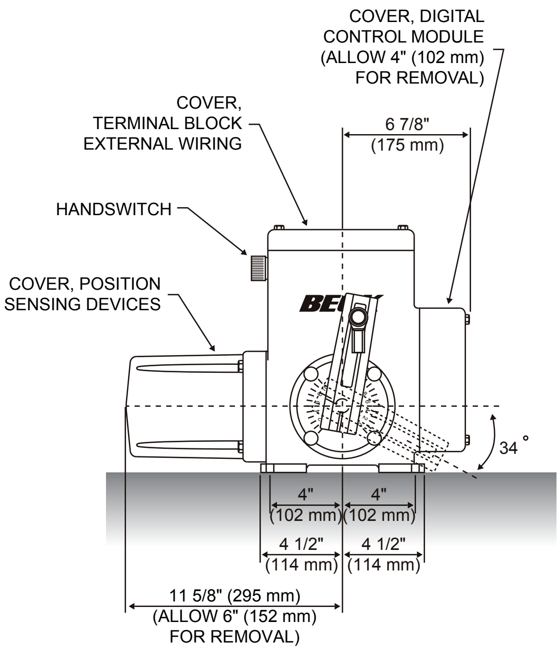
*NOTE: May not be available with all options and models. For more information, please call Beck at 215-968-4600.

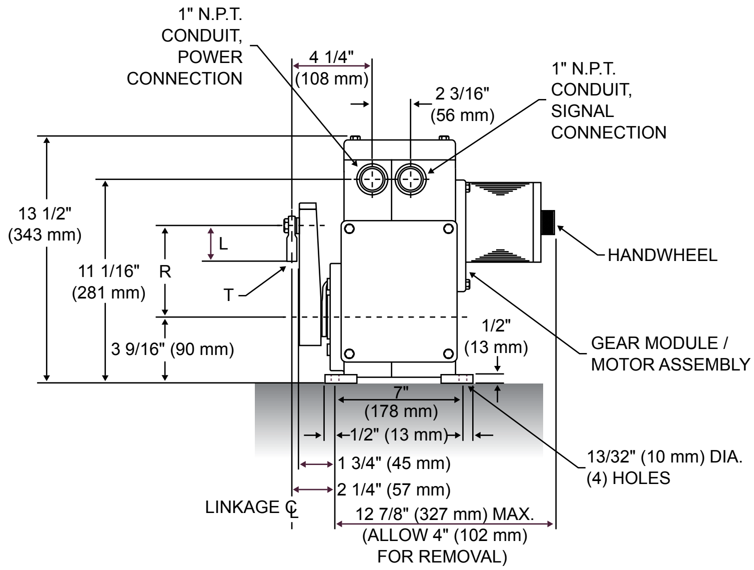
Maximum Output Shaft Rotation

MODEL	DEGREES
11-169, 11-269 11-369, 11-469	90
11-159, 11-209, 11-309, 11-409	100

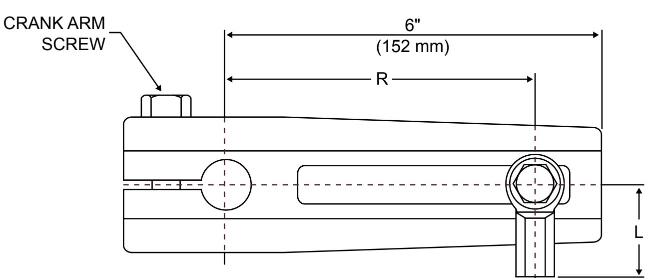
OUTLINE DIMENSION DRAWINGS

MODEL 11-159

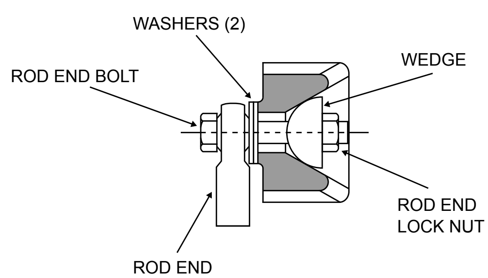




Crank Arm



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



NOTE: All dimensions subject to change.

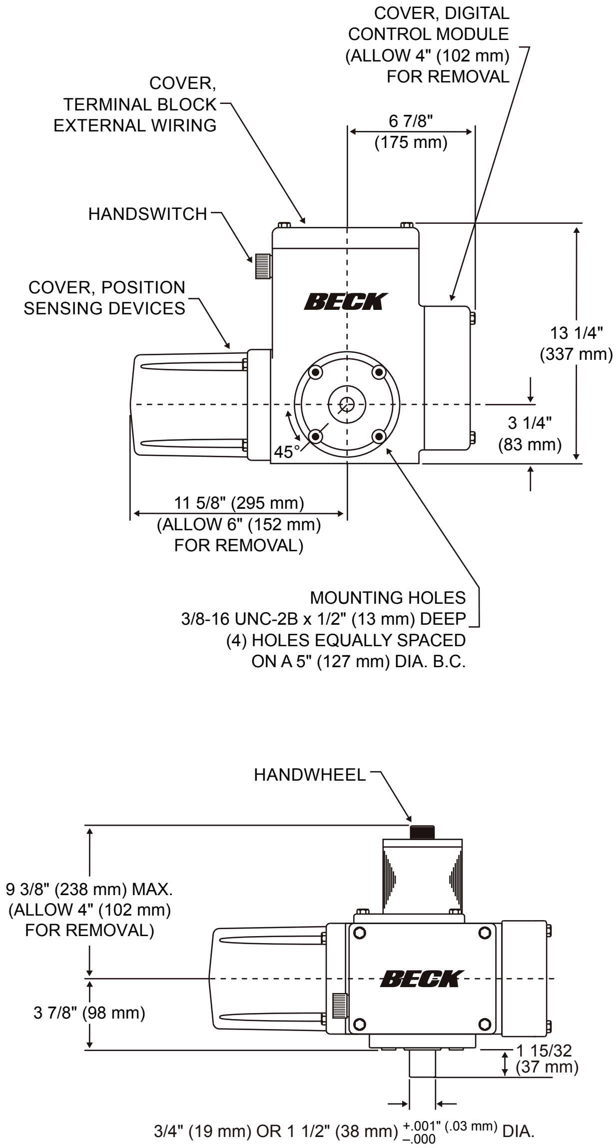
Recommended Screw Torques

	Screw Size (in.)	Wrench Size (in.)	Torque	
			lb-ft	N•m
Crank Arm Screw	1/2-13	3/4	75	102
Rod End Screw	1/2-13	3/4	35	47
Rod End Lock Nut	1/2-13	3/4	35	47
Body Screw	5/16-18	1/2	10	14
Body Screw	3/8-16	9/16	20	27
Cover Screw	5/16-18	1/2	10	14
Motor / Gear Module Screw	1/4-20	7/16	6	8

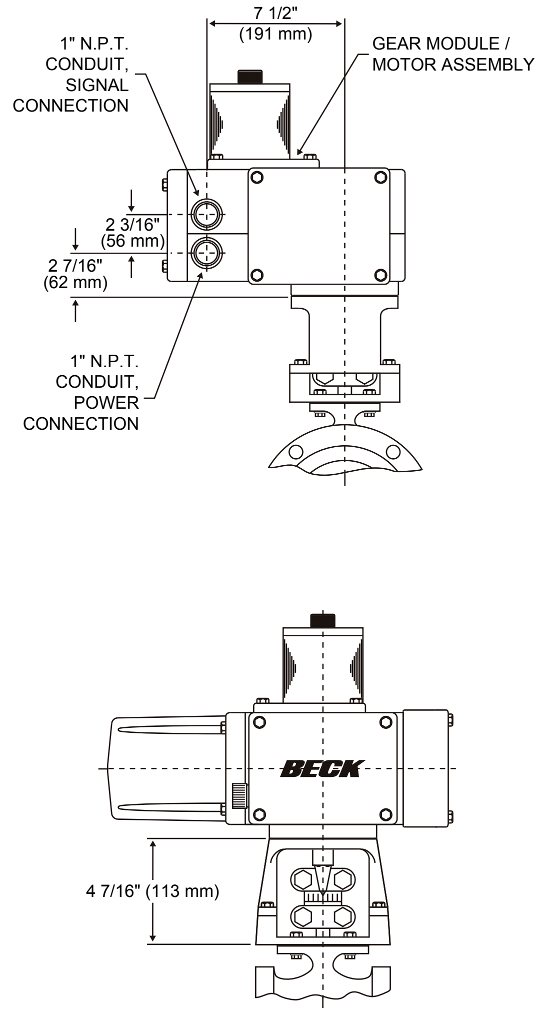
Model 11-159 Crank Arm Part Numbers & Model Information

Crank Arm Assembly	10-3491-05
Crank Arm	10-3491-02
Crank Arm Screw (1)	30-0306-56
Washer (2)	30-0313-03
Wedge	11-8060-02
Rod End Screw	30-0306-56
Rod End Lock Nut	30-0309-11
Rod End	12-2840-02
Dim. "L" (Length)	2 1/8" (54 mm)
Dim. "T" (Thread)	1/2-20 x 1-3/16" (30 mm)
Output Shaft Diameter	3/4" (19 mm)
Approximate Weight	50 lbs (23 kgs)
Max. Overhung Load	750 lbs (340 kgs)

MODEL 11-169



BASIC CONTROL DRIVE



TYPICAL VALVE MOUNTING

NOTE: All dimensions subject to change.

Model Information

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

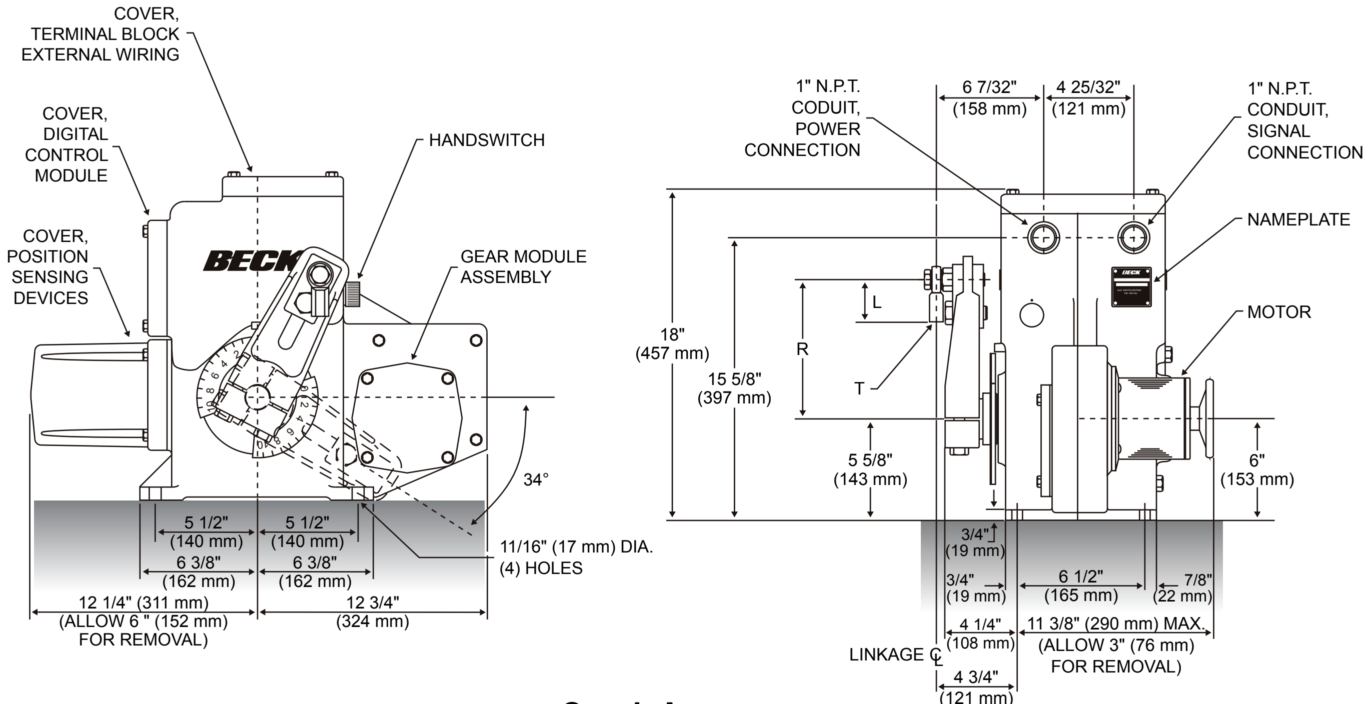
Recommended Screw Torques

	Screw Size (in.)	*Wrench Size (in.)*	*Torque*	
			lb-ft	*N•m*
Coupling Screw	-	-	*	*
Mounting Bracket Screw (Flat Head)	3/8-16	-	25	34
Body Screw	5/16-18	1/2	10	14
Body Screw	3/8-16	9/16	20	27
Cover Screw	5/16-18	1/2	10	14
Motor / Gear Module Screw	1/4-20	7/16	6	8

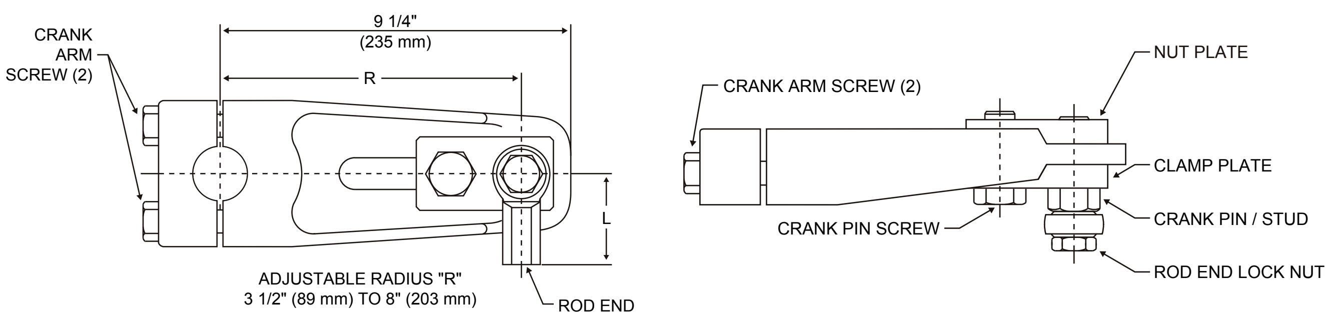
*Varies per application. Refer to the valve mounting specification sheet shipped with your actuator.

OUTLINE DIMENSION DRAWINGS

MODEL 11-209 & 11-309



Crank Arm



NOTE: All dimensions subject to change.

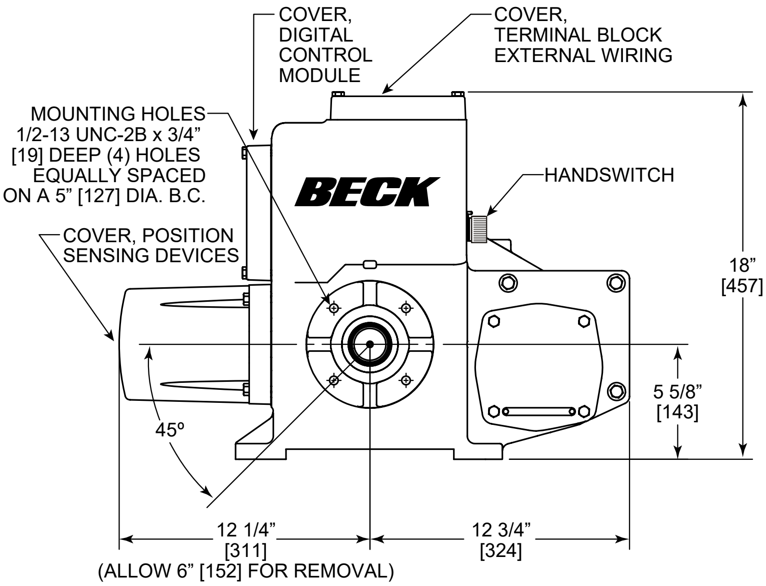
Recommended Screw Torques

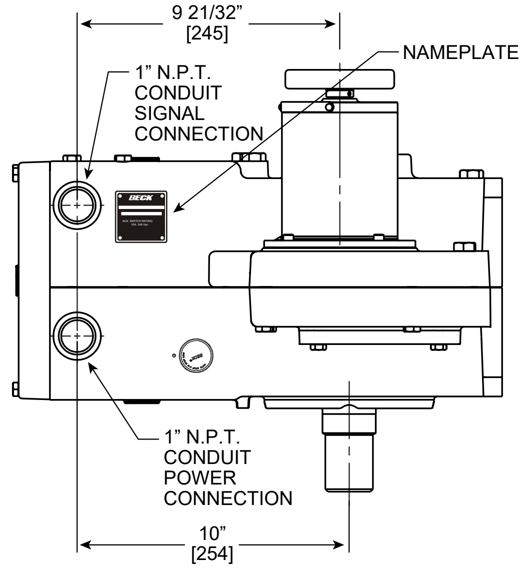
	Screw Size (in.)	Wrench Size (in.)	Torque lb-ft	Torque N•m
Crank Arm Screw	5/8-18	15/16	240	325
Crank Pin / Stud	3/4-16	1-1/8	300	407
Crank Pin Screw	3/4-16	1-1/8	300	407
Rod End Lock Nut				
(11-20_)	1/2-20	3/4	35	47
(11-30_)	5/8-18	15/16	65	88
Body Screw	3/8-16	9/16	20	27
Body Screw	1/2-13	3/4	50	68
Cover Screw	5/16-18	1/2	10	14
Motor Screw (Hex Wrench)	1/4-20	3/16	6	8
Gear Module Screw	5/16-18	1/2	10	14

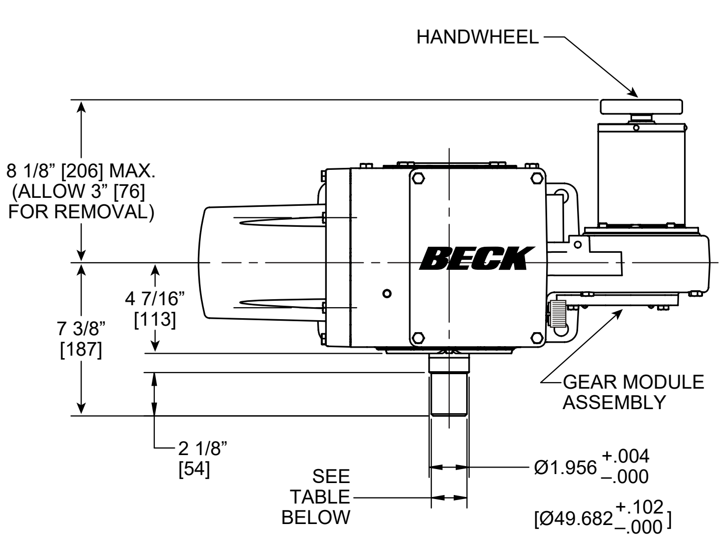
Model 11-209 / 11-309 Crank Arm Part Numbers & Model Information

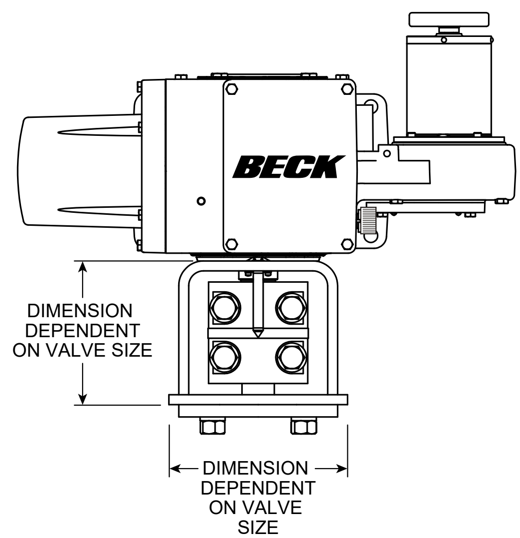
	11-20_	11-30_
Crank Arm Assembly	14-7330-26	14-8010-34
Crank Arm	14-8008-02	14-8008-01
Crank Arm Screw (2)	30-0308-75	30-0308-75
Clamp Plate	14-9883-01	14-9883-01
Crank Pin / Stud	14-9920-06	14-9920-07
Crank Pin Screw	30-0308-61	30-0308-61
Nut Plate	14-9883-02	14-9883-02
Rod End Lock Nut	30-0309-19	30-0309-23
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 Diameter	1 1/2" (38 mm)	1 3/4" (44 mm)
Approximate 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 & 11-369 SPECIFICATIONS









Model Information

Model No.	Torque Range	Approx. Weight	Maximum Overhung Load	Output Shaft Diameter
11-269	125–250 (lb-ft)	120 lbs.	3,000 lbs.	1.500 in. (+.001/-.000)
	169–339 (N•m)	54 kgs.	1 361 kgs.	38.100 mm. (+.025/-.000)
11-369	300–650 (lb-ft)	120 lbs.	4,500 lbs.	1.750 in. (+.001/-.000)
	407–881 (N•m)	54 kgs.	2 041 kgs.	44.450 mm. (+.025/-.000)

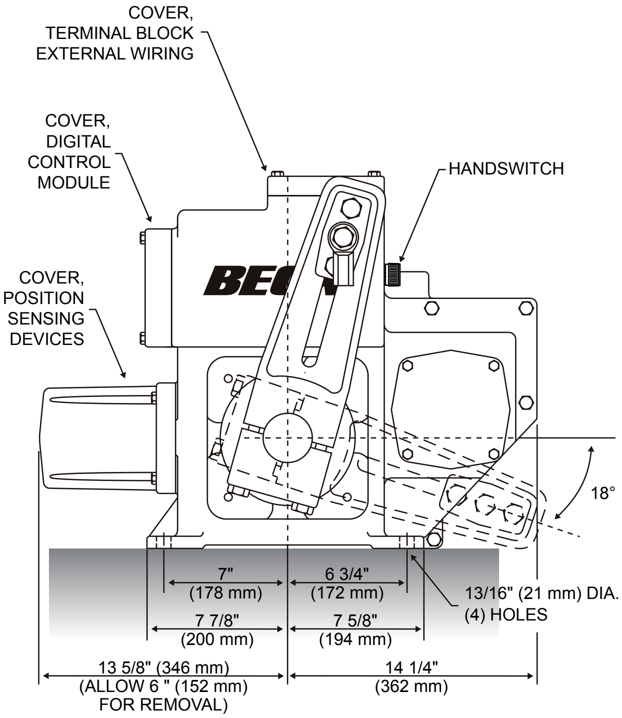
Recommended Screw Torques

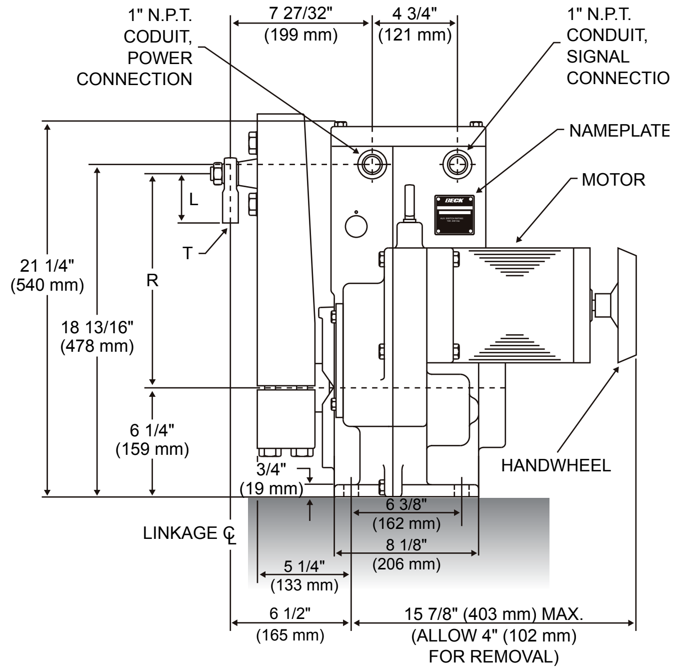
	Screw Size (in.)	Wrench Size (in.)	Torque lb-ft	Torque N•m
Coupling Screw	5/8-18	15/16	*	*
Mounting Bracket Screw (Flat Head)	1/2-13	-	50	68
Body Screw	1/2-13	3/4	50	68
Body Screw	3/8-16	9/16	20	27
Cover Screw	5/16-18	1/2	10	14
Motor Screw (Hex Wrench)	1/4-20	3/16	6	8
Gear Module Screw	5/16-18	1/2	10	14

*Varies per application. Refer to the valve mounting specification sheet shipped with your actuator.

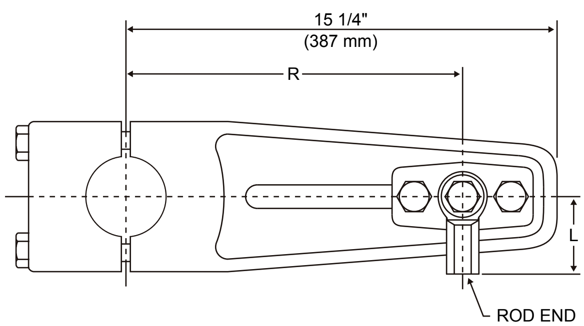
OUTLINE DIMENSION DRAWINGS

MODEL 11-409

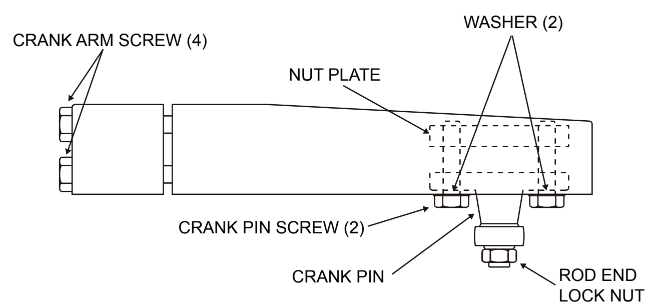




Crank Arm



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



NOTE: All dimensions subject to change.

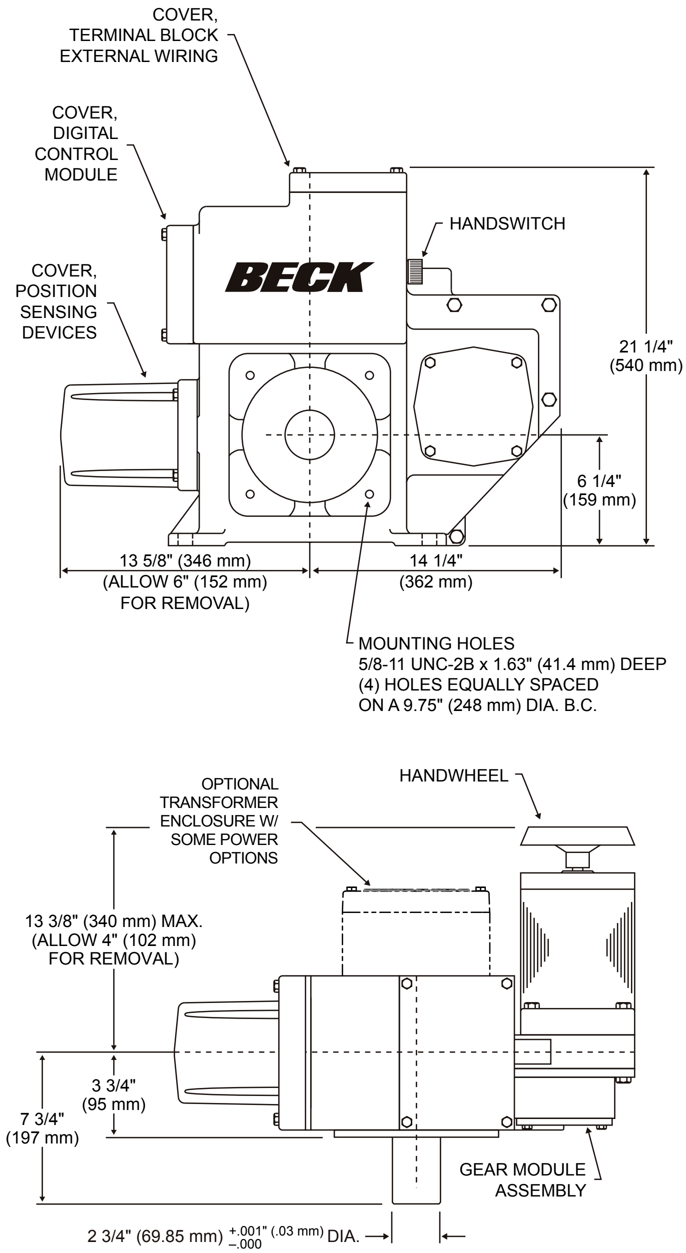
Recommended Screw Torques

	Screw Size (in.)	Wrench Size (in.)	Torque lb-ft	Torque N•m
Crank Arm Screw	5/8-18	15/16	170	230
Crank Pin Screw	3/4-16	1-1/8	300	407
Rod End Lock Nut	3/4-16	1-1/8	120	163
Body Screw	3/8-16	9/16	20	27
Body Screw	1/2-13	3/4	50	68
Cover Screw	5/16-18	1/2	10	14
Motor Screw	3/8-16	9/16	16	22
Gear Module Screws	5/16-18	1/2	10	14

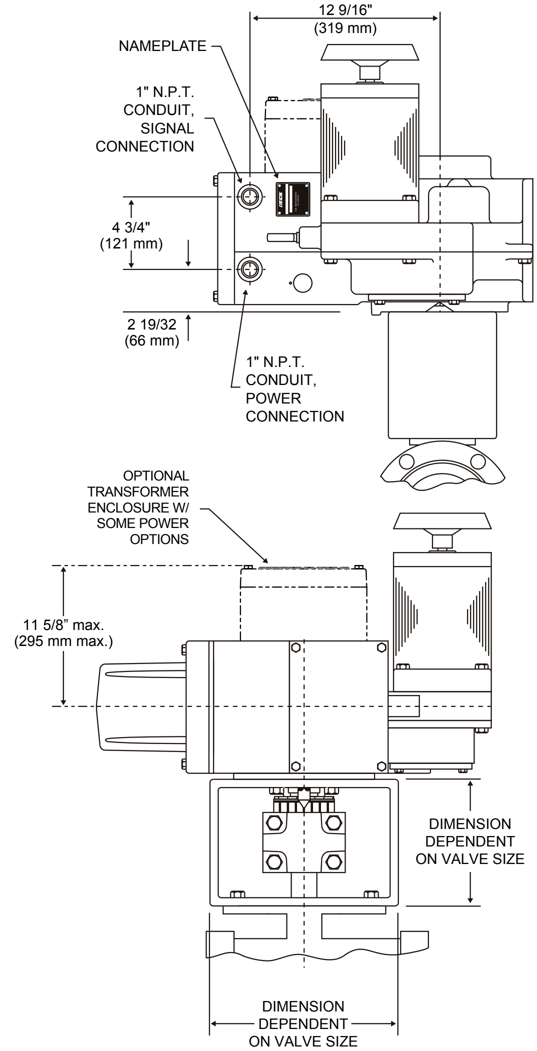
Model 11-409 Crank Arm Part Numbers & Model Information

	11-409
Crank Arm Assembly	14-8018-02
Crank Arm	14-8018-01
Crank Arm Screw (4)	30-0328-43
Washer (2)	30-0313-27
Crank Pin	14-9882-01
Crank Pin Nut Plate	20-2641-01
Crank Pin Screw (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 Diameter	2 3/4" (70 mm)
Approximate Weight	270 lbs (122 kgs)
Max. Overhung Load	9,000 lbs (4 082 kgs)

MODEL 11-469



BASIC CONTROL DRIVE



TYPICAL VALVE MOUNTING

NOTE: All dimensions subject to change.

Model Information

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

Recommended Screw Torques

	Screw Size (in.)	*Wrench Size (in.)*	*Torque lb-ft*	*Torque N•m*
Coupling Screw	-	-	*	*
Mounting Bracket Screw	5/8-11	15-16	100	135
Body Screw	1/2-13	3/4	50	68
Body Screw	3/8-16	9/16	20	27
Cover Screw	5/16-18	1/2	10	14
Motor Screw	3/8-16	9/16	16	22
Gear Module Screw	5/16-18	1/2	10	14

*Varies per application. Refer to valve mounting specification sheet shipped with your actuator.

INSTALLATION

SAFETY PRECAUTIONS

WARNING

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

STORAGE INFORMATION

Beck actuators should be stored in a clean, dry area where the temperature is between -40° and 85°C (-40° to 185°F).

UNPACKING

Beck actuators are packed in standardized cardboard shipping containers. Actuators mounted on valves are strapped to a skid and crated.

MOUNTING (LINKAGE APPLICATIONS)

Beck Group 11 actuators may be installed in any convenient orientation, because the gearing does not require an oil bath. If mounting near obstructions such as pipes or beams, take into consideration access to the field wiring terminals and the output shaft. Check the outline dimension drawings for the clearance necessary to remove covers.

Before the actuator is bolted into place, the mounting surface must be shimmed for flatness to within 0.020 inches. Each shim must support at least 75% of the mounting foot surface area. Improper shimming or mounting can damage mounting feet.

If the actuator is to be bolted to a mounting plate, the plate must be rigid must not yield to the stresses created from operating the actuator. Check the linkage specification for an estimate of force produced by the linkage. If the mounting plate is not rigid or the mounting bolts are not sufficiently tightened, damage to the actuator housing could result. A rigid, vibration-free surface will generally prolong the life of the actuator's components.

INSTALLING AN ACTUATOR WITH A LINKAGE

When installing the linkage, make certain enough clearance exists around the linkage for safe operation.

The linkage connects the crank arm on the Beck actuator to the lever arm on the driven load. Both the crank arm and lever arm are mounted to shafts that rotate. These two shafts should be parallel.

The plane of rotation of the crank arm and the plane of rotation of the level arm should be aligned. If the planes are aligned, axial force on each shaft will be minimized. As supplied, the crank arm linkage termination is a rod end. If the lever end linkage termination is also a rod end, small misalignments can be tolerated. Minimizing the misalignments will reduce overall loading on the actuator shaft and on the actuator load shaft.

Make certain all linkage components are properly tightened.

INSTALLING A DIRECT-COUPLED ACTUATOR

CAUTION

Working with valves installed in a pipeline can be dangerous. Take appropriate precautions when mounting to installed valves.

Direct-coupled applications require the valve shaft to be coupled directly inline with the actuator output shaft typically using a rigid coupling. The mounting of the actuator is critical to provide good shaft alignment. The shafts must be aligned for straightness and centerline accuracy. Mountings must be rigid so shaft alignment is not compromised during operation.

All applications require correct matching between the actuator rotation range and the driven load rotation range. In direct-coupled applications, access to determine correct rotation is usually restricted. Direct-coupled systems are usually less forgiving of errors than linkage systems. Be certain the rotation ranges are correct. Refer to TRAVEL (page 36). Consult the Beck Valve Mounting Specification (VMS) sheet supplied with the Beck mounting hardware for proper mounting instructions.

INSTALLING A UNITIZED VALVE/ ACTUATOR ASSEMBLY ON A PIPELINE

Inspect the valve and pipe flanges to ensure they are clean. Any contamination could result in damage or leaks. 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, if required.

LINKAGE APPLICATIONS (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 actuator 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 actuator 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 actuator and the driven shaft (this procedure assumes that the Beck actuator 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 actuator'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 recommendations starting on page 8.
11. Tighten the coupling and rod end jam nuts.
12. Lubricate rod end bearings.
13. Carefully move the actuator's output shaft to correspond with the driven shaft's fully open position. Check that no binding occurs between the linkage, crank arm, driven shaft lever, and surrounding obstructions. Also, observe that the driven shaft rotates the proper amount. Ensure that the actuator reaches the proper limit and shuts off. If binding in the linkage occurs due to too much travel of the driven lever, reduce the crank arm radius on the Beck actuator rather than adjusting the connecting link length or actuator travel. 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.

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 travel settings to obtain desired valve or damper travel. Reducing the travel of the actuator reduces the overall accuracy of the system and reduces the torque advantage the linkage can provide.

LINK-ASSIST™

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

LINKAGE KITS AVAILABLE

Beck linkage kits are made to accommodate a wide variation in linkage lengths without requiring modification of end fittings. Linkage kits are also available in stainless steel for use in corrosive environments.

Hex Linkage kits are available for applications with linkage length requirements between 9" (229 mm) and 33" (838 mm). Each hex linkage kit comes complete with a rod end, studs, threaded hex bar, and jam nut hardware.

To order hex linkage kits, first obtain the approximate overall linkage length “A” in the hex linkage figure on page 17. Select the kit part number from the corresponding table. For lengths beyond those listed in the table, contact your Beck sales engineer.

Pipe linkage kits are available for longer linkage length requirements and include the essential linkage end connections, rod end, studs, and jam nut hardware. Schedule 40 pipe is not included and must be cut to length and threaded in the field (see the table on page 17 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 on page 17. Select the kit part number from the corresponding table. For lengths beyond those listed in the table, contact your Beck sales engineer.

Pipe Linkage

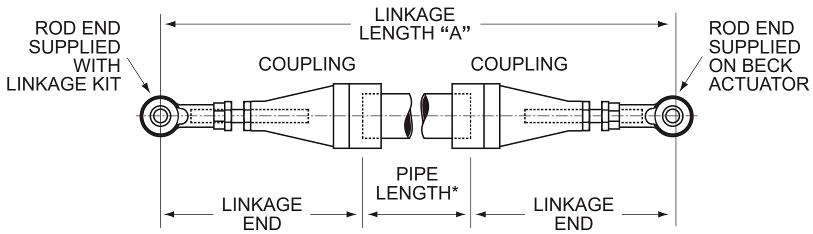
Hex Linkage
(Stainless Steel Option)

PIPE LINKAGE KITS

Beck Actuator Model No.	Linkage Length	Linkage Kit Part No.	Stainless Steel Linkage Kit Part No.	Pipe Size	Rod End Thread	Length of 2 Linkage Ends (+/- 1.5" (38 mm))
11-159	22-84" (559-2 134 mm)	20-1730-05	20-1730-15	1" (25 mm)	1/2-20 UNF	20 1/2" (521 mm)
	31-120" (787-3 048 mm)	20-1740-06	20-1740-16	1.5" (38 mm)		29 1/4" (743 mm)
11-209	22-45" (559-1 143 mm)	20-1730-05	20-1730-15	1" (25 mm)	1/2-20 UNF	20 1/2" (521 mm)
	31-84" (787-2 134 mm)	20-1740-06	20-1740-16	1.5" (38 mm)		29 1/4" (743 mm)
	33 1/4-120" (845-3 048 mm)	20-1750-05	20-1750-15	2" (51 mm)		31 1/4" (794 mm)
	37-120" (940-3 048 mm)	20-1760-05	20-1760-16	2.5" (64 mm)		34 1/2" (876 mm)
11-309	22 1/2-36" (572-914 mm)	20-1730-06	20-1730-16	1" (25 mm)	5/8-18 UNF	21" (533 mm)
	31 1/2-72" (800-1 829 mm)	20-1740-07	20-1740-17	1.5" (38 mm)		29 3/4" (756 mm)
	33 3/4-96" (857-1 219 mm)	20-1750-06	20-1750-16	2" (51 mm)		31 3/4" (806 mm)
	37 1/2-120" (953-3 048 mm)	20-1760-06	20-1760-16	2.5" (64 mm)		35" (889 mm)
11-409	23 1/4-34" (590-864 mm)	20-1730-07	20-1730-17	1" (25 mm)	3/4-16 UNF	21 3/4" (552 mm)
	32 1/4-48" (819-1 219 mm)	20-1740-08	20-1740-18	1.5" (38 mm)		30 1/2" (775 mm)
	34 1/2-72" (876-1 829 mm)	20-1750-07	20-1750-17	2" (51 mm)		32 1/2" (826 mm)
	38 1/4-120" (972-3 048 mm)	20-1760-07	20-1760-17	2.5" (64 mm)		35 3/4" (908 mm)

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

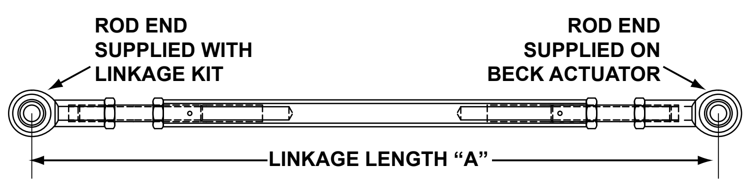
Pipe Linkage



HEX LINKAGE KITS

Beck Actuator Model No.	Linkage Length	Linkage Kit Part No.	Stainless Steel Linkage Kit Part No.	Hex Size	Rod End Thread
11-159	9-11.5" (229-292 mm)	14-8300-22	14-8300-64	5/8" [15.88]	1/2-20 UNF
	10.5-14.5" (269-371 mm)	14-8300-32	14-8300-72		
	14.5-18.5" (368-470 mm)	14-8300-04	14-8300-48		
	18-22" (457-559 mm)	14-8300-06	14-8300-50		
	22-26" (559-660 mm)	14-8300-16	14-8300-58		
11-209	9-11.5" (229-292 mm)	14-8300-22	14-8300-64	5/8" [15.88]	1/2-20 UNF
	10.5-14.5" (269-371 mm)	14-8300-32	14-8300-72		
	14.5-18.5" (368-470 mm)	14-8300-04	14-8300-48		
	18-22" (457-559 mm)	14-8300-06	14-8300-50		
	22-26" (559-660 mm)	14-8300-16	14-8300-58		
11-309	13.5-18" (343-457 mm)	14-8860-24	14-8860-62	1" [25.40]	5/8-18 UNF
	17.5-22" (445-559 mm)	14-8860-08	14-8860-48		
	22-26.5" (559-673 mm)	14-8860-02	14-8860-42		
	26.5-31" (673-787 mm)	14-8860-04	14-8860-44		
11-409	13.5-17.5" (343-445 mm)	15-0110-26	15-0110-68	1" [25.40]	3/4-16 UNF
	18-22" (457-559 mm)	15-0110-20	15-0110-62		
	22-26" (559-660 mm)	15-0110-03	15-0110-46		
	26-30" (660-762 mm)	15-0110-22	15-0110-64		
	29-33" (737-838 mm)	15-0110-02	15-0110-44		

Hex Linkage



INSTALLATION Electrical

Electrical installation requires the connection of AC line power and the connection of signal wiring. Without line power, the motor cannot run and digital communications will not be functional. Never connect power lines to signal connections.

The AC power is typically 120 V ac or 240 V ac. Check the actuator nameplate. The signal type is determined by the DCM-3 circuit board, and can be either Foundation Fieldbus (page 18) or analog/HART (page 19). Check the purchasing documents for DCM-3 signal compatibility.

NOTE: The technicians installing the equipment are responsible to make certain the equipment installation is compliant to national and local electrical codes.

Two N.P.T. conduit connections are provided. Temporary plugs are installed in the conduit entrances at the factory for shipping only and are not intended for permanent use.

The 1/2” conduit is for signal wiring connections, and the 1” conduit is for power and auxiliary switch connections. Conduits should be routed from below the actuator so that condensation and other contaminants flow away from the conduit. Prior to actuator operation, all conduit entrances must be properly sealed in accordance with National Standards or Regulatory Authorities.

To maintain signal integrity and meet most electrical codes, power and signal wires must be routed to the actuator separately. The signal wiring should be either shielded cables or be installed in conductive conduit and/or cable trays.

Beck motors have negligible inrush current, so wiring overload protection can be set only moderately above the actuator rated current.

Beck actuators must always be properly grounded.

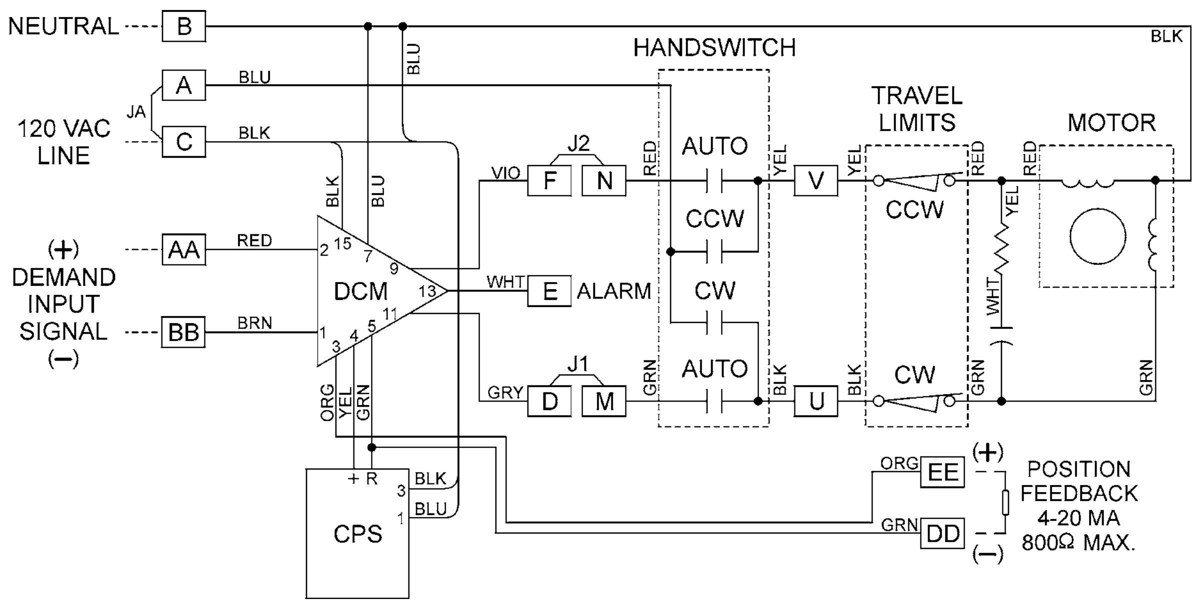
A large, clearly labeled terminal block on the top of the actuator is enclosed in a dedicated compartment. Terminals will accommodate up to 12 AWG (3.31 mm^2) wiring. For the locations of the terminal block compartment, refer to the actuator outline drawings starting on page 8.

Field Wiring Terminals

Beck actuators are shipped calibrated and tested to the customer’s specifications that were written into the equipment order. If your actuator does not appear to match the system requirements, the actuator configuration may be able to be modified for a better match. If the mismatch appears too large to correct with configuration changes, contact the Beck factory.

All Beck actuators are shipped with a wiring diagram that shows the correct wiring for that actuator. Always refer to that wiring diagram to be certain the correct connections are being made. If the actuator internal wiring is changed in the field, be certain the attached wiring diagram is updated.

Typical Wiring Connections



FOUNDATION FIELDBUS COMMUNICATION OVERVIEW

The Foundation Fieldbus communication interface is a method of superimposing digital data onto a DC voltage power supply bus. Details and specifications of the interface are maintained by the Fieldbus Foundation.

The Foundation defines a large list of predefined function blocks and defines the method of using these function blocks. The Beck DCM-3 includes five blocks: One Resource Block, one Transducer Block and three function blocks.

1. Resource Block

This block is a fieldbus requirement, and is not directly used in controlling the Beck drive. This block is a standard block as defined by Fieldbus Foundation, and resembles all other standard Resource Blocks.

For typical automatic operation, this block must be in Auto mode.

2. Transducer Block

This block is a fieldbus requirement, and is generally not directly used in controlling the Beck actuator. The Transducer Block is used to read and write actuator-specific calibration, configuration, and status information. Calibration and configuration information will have a significant effect on the performance of the actuator. For example, the direction of rotation for an increasing set point is determined by a setting in this block.

When installing the actuator pay particular attention to Actuator Dir (DRIVE_INFO2. DRIVE_DIRECTION) to configure the direction of actuator movement in response to an increasing actuator set point (page 37).

For typical automatic operation, this block must be in Auto mode, and the Op Mode parameter (DRIVE_OPERATING_MODE) set to Hold.

3. Analog Output (designated Channel 1)

This is a standard Analog Output function block as defined by Fieldbus Foundation, and is used to control the Beck actuator. Because it is a standard Analog Output block, it resembles all other standard Analog Output blocks.

Apply the actuator set point to CAS_IN. The actuator set point is typically scaled in “percent. ”This set point is propagated to Transducer Block variable “Demand” (DEMAND_VALUE).

For typical automatic operation, set Channel to 1, set SHED_OPT to NormalShed_ NormalReturn, and set the mode to Cas|Auto. For information on how the actuator utilizes Demand, refer to DEMAND (page 32).

4. Analog Input (designated Channel 2)

This is a standard Analog Input function block as defined by Fieldbus Foundation, and is used to measure torque load on the output shaft. Because it is a standard Analog Input block, it resembles all other standard Analog Input blocks.

The measurement units are percent. Calibration of the torque/thrust sensor is established by the Transducer Block.

For typical operation, set Channel to 2, and set L_TYPE to Indirect. Torque measurement sensors are optional equipment. Check the purchase specification to see if sensors are included with this specific actuator. For more information on torque sensing functions, refer to TORQUE SENSING CONFIGURATION (page 30).

5. Analog Input (designated Channel 3)

This is a standard Analog Input function block as defined by Fieldbus Foundation, and is used to measure the internal temperature of the actuator. Because it is a standard Analog Input block, it resembles all other standard Analog Input blocks.

Minimum and maximum recorded temperatures can be viewed in the Transducer Block. For typical operation, set Channel to 3, and set L_TYPE to Indirect. For more information on temperature sensing, refer to TEMPERATURE SENSING (page 28).

ANALOG CONTROL OVERVIEW

Actuators to be used with analog signaling technique, such as 4 mA to 20 mA are capable of providing very accurate control. However, with the addition of computer communications, access to configuration parameters and status parameters is very limited. The Demand signal magnitude and the output shaft position that represents 0% and 100% can both be adjusted using a pushbutton interface. For information on the Demand adjustment, refer to page 32; for information on the output shaft position, refer to page 36.

When installing the actuator, give attention to the direction the output shaft rotates in response to an increasing Demand signal. For more information on rotation direction, refer to page 38.

HART COMMUNICATION OVERVIEW

The HART communication interface is a method of superimposing digital data onto what appears to be a conventional 4 mA to 20 mA control signal. Details and specifications of the interface are maintained by the HART Communication Foundation (HCF).

In a typical HART application, the HART signals share the two wires typically used for Demand in analog systems. HART specifically targets analog systems based on the 4 mA to 20 mA, 250 ohm signaling convention. If the resistance in the loop is significantly higher or lower than 250 ohms, digital communication may fail. HART communication frequencies are 1200 Hz and 2200 Hz. Instruments powered from the mA signal may not have a measurable resistance of 250 ohm, but must have signal filtering so the resistance appears to be 250 ohm at the communication frequencies. Resistance of 250 ohm must describe the master-slave connection, but the effective resistor can be in the master or in the slave. Consistent with the connection scheme for actuators, Beck uses a passive 250 ohm resistor on the DCM-3.

The HART communication system is based on a master-slave data exchange. The master controls writing and reading data. In the HART system, the control system or hand held communicator is the master, and the field device, such as the Beck actuator, is the slave.

HCF specifies the format of the data and some of the data content, but most of the data communicated is at the discretion of the field device manufacturer, such as Beck. The DCM-3 HART interface has access to a large set of data. To access this data, the technician's HART communication device must be aware of what data is available. This data awareness is controlled by what is called a Device Description (DD). The Beck DD for the DCM-3 is registered with HCF and is available from HCF. The proper DD is described by the manufacturer number (Beck is 0x68) and the DD number (0xEF).

For compatibility with older DCM installations, the DCM-3 is able to be set to communicate with HART devices using an older DD. However, the older DD does not give access to all the DCM-3 functionality, and this DD should only be used if the newer DD is not available. This older DD is denoted by the same Beck manufacturer number (0x68) and a different DD number (0x01).

As defined by the HART protocol, a slave device can identify only one compatible DD type. Therefore, to have the DCM-3 identify an older DD type, an internal DCM-3 configuration change is necessary. This is accomplished by using the BCP command harttype (page 78). This command tells the DCM-3 which DD number to send to the master. There are presently three DD's created by Beck and registered with HCF. Depending on the documentation system, the DD's may be represented by the decimal values 1, 2, 239, or may be represented by hexadecimal values 0x01, 0x02, 0xEF, respectively.

HART PRESENTATION OF DATA

Data available over the HART network is independent of the type of master used to read the data. Presentation of the data on a computer screen is controlled by the master, and is not specified by the HART protocol.

The protocol does specify a menu system, and the DD contains the information needed by the master to construct the menu system. This instruction manual describes the HART interface based on the menu system as included in the Beck DD (DD number 0xEF).

SERIES CONNECTED OPERATION

In some applications, two or more Beck actuators may have the Demand signals connected in series to operate multiple actuators from the same signal. In this situation, the loop resistance increases by 250 ohms for each Beck actuator. If the Demand signal from the control system is an analog signal and can actuator the resistance created by placing the actuators in series connection, the analog system will operate as intended. Note that this configuration can obstruct HART communication.

HART is not intended to be used with series connected devices. Therefore, the control system will not be able to communicate with the series connected actuators. However, each actuator will be able to be accessed one at a time if a local HART master is connected directly across the Demand signal of that actuator.

PARALLEL CONNECTED OPERATION

In some applications, two or more Beck actuators may have the Demand signals connected in parallel to operate multiple actuators from the same signal. In this situation, the loop resistance should be maintained at 250 ohms for the entire parallel connection. This is usually accomplished by removing the 250 ohm resistor from all DCM-3's, then adding a parallel 250 ohm resistor across the field wiring terminals of one actuator. In this situation, the loop remains at 250 ohm, the voltage generated across the 250 ohm resistor is 1 V dc to 5 V dc, and each DCM-3 Demand sensing circuit is fed the same voltage. If any DCM-3 is removed, the voltage across the parallel connection does not significantly change. If the actuator with the resistor is disconnected, the loop resistance becomes too high.

HART can communicate with parallel connected actuators because the loop remains at 250 ohm and all DCM-3 have access to the same loop wires. In this situation, the polling addresses of each DCM-3 should be made unique.

Unless otherwise specified, the polling address of each DCM-3 is set to 0, the HART standard for single devices. If multiple actuators are sharing the Demand loop, the polling addresses should be changed before adding the actuator to the loop. If there are two polling addresses the same, the HART master will not be able to communicate. The Beck Configuration Port can change the polling address regardless of whether the actuators are already installed in parallel.

To change the polling address:

HART Modify parameter Poll addr.
BCP polladdr

Generally, HART masters look first for a device at polling address 0. Looking for devices at other addresses is called polling the bus. Some masters may not automatically poll the bus.

START-UP / OPERATION

BEFORE POWER IS APPLIED

Confirm that the proper input power voltage is available. Check the actuator configuration to make certain the actuator matches the power feed and control system specifications. Check the output shaft and linkage (or direct-couple) for proper attachment and for proper rotation. Inspect the mounting method and the hold-down bolts. Make certain the over-travel limit switch settings are appropriate for the given installation.

For increased personal safety on the first start-up, place the Handswitch in a STOP position. Make certain no movement of the output shaft and linkage (or direct-couple) can cause personal injury.

AFTER POWER IS APPLIED

Check the position signal from the DCM-3 to see if it is realistic for the output shaft position. Refer to SHAFT POSITION OUTPUT SIGNAL (page 39).

Using the Handswitch, try running the actuator CW and CCW. The actuator should run smoothly to each over-travel limit. If the actuator does not run smoothly, switch off power to the actuator and recheck the installation both mechanically and electrically.

If the DCM-3 is exposed, check the PWR LED. The PWR LED should be pulsing slowly (this indicates completed diagnostics).

Attach a digital communication interface to the DCM-3 or, if available, read the local status LEDs. Refer to DCM-3 OVERVIEW (page 24). There should not be any alarms related to Position, Torque, Stall, Temperature or Feedback. Alarms related to Demand are not uncommon during start-up. Alarms related to STOP/LIMIT are common when the Handswitch is not in AUTO.

CHECK AUTOMATIC MODE

If all the checks under Handswitch CW and CCW appear correct, try moving the Handswitch to AUTO.

Use the Demand signal to stroke the output shaft from 0% position to 100% position. Make certain the driven load is moved to the proper 0% point and the proper 100% point. If the 0% point and 100% point are swapped, refer to DIRECTION OF OUTPUT SHAFT ROTATION (page 38).

With the Handswitch in AUTO and the actuator operating properly, there should be no alarms.

MODES OF OPERATION

The Beck Group 11 is a family of rotary electronic control drives: the output shaft angular position is varied in response to a set of input control functions. There are three basic modes of control:

1. Handwheel operation
2. Handswitch operation, which is local electrical control
3. Automatic mode, which is remote electrical operation

The maximum available angular movement is dependent on the specific control actuator model. Refer to Maximum Output Shaft Rotation (page 7).

HANDWHEEL

Every Beck actuator 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. Before using the Handwheel, place the Handswitch in the “STOP” position. Manual operation of the Handwheel (with electric Handswitch in “STOP” position) turns the motor and the rest of the actuator train without incorporating a clutch.

Handwheel operation can be used at any time, but is especially useful during initial installation or when power is not available. The Handwheel can also be used as an indication of motor movement.

HANDSWITCH

Handswitch operation allows manual electric control at the valve or damper. In the "STOP" position, the motor is electrically blocked from running. As a safety feature, the Handswitch is designed so that the controller can operate the actuator only when the Handswitch is in the "AUTO" position. In the "CW" or "CCW" positions, the motor runs to move the output shaft in the corresponding direction. Refer to DIRECTION OF OUTPUT SHAFT ROTATION (page 38) for information on interpreting the output shaft movement direction.

When moving the output shaft using the Handswitch, the motor will stop when the over-travel limit switches are actuated.

To prevent the Handswitch "CW" and "CCW" positions from running the motor, remove the jumper between field wiring terminals A and C (page 18).

CAUTION

AC power to the actuator must be turned off before removing the jumper (JA).

AUTOMATIC

The actuator is in Automatic mode when the Handswitch is in "AUTO." In this mode, the motor runs to move the output shaft to a position as determined by a control system. The control system signal to the actuator can take several forms:

1. 120 V ac pulsed control
2. Analog control signal such as 4 mA to 20 mA
3. Digital network control

Other system signals are compatible with Beck products. This instruction manual describes actuators that accept analog signals, combined analog/digital signals, and purely digital signals.

The control system signal to the actuator is called the Demand signal.

Regardless of the signaling technology, basic automatic operation of the actuator is the same: The motor runs so the percent of output shaft angle matches the percent indicated by the Demand signal. Proper configuration of the actuator assures the proper relationship between the Demand signal percentage and the shaft angle percentage. All Beck actuators are shipped from the factory configured as specified on the customer order.

In Automatic mode, motor voltage is controlled by a computerized circuit board called the DCM-3. Refer to General Component Location (page 4) for the typical location of the DCM-3.

MODE INTERACTION WITH SIGNALS

The mode of operation can interact with various control actuator signals and diagnostic functions. As described in AUTOMATIC, the Demand signal does not operate the actuator unless the Handswitch is in "AUTO." With the Handswitch in other modes, the actuator monitors the Demand, but Demand does alter the output shaft position.

Beck actuators also provide a signal output so the control system can monitor the output shaft position. This output signal is called Feedback, and is available in all operating modes.

The DCM-3 computerized circuit board in the Beck actuator monitors and records many conditions and events. Some of these conditions and events are not recorded or are not effective in Handwheel or Handswitch modes. For example, the DCM-3 does not count the number of motor starts in Handwheel or Handswitch modes.

DCM-3 Features

DCM-3 OVERVIEW

This instruction manual describes two basic types of DCM-3. One type is compatible with Foundation Fieldbus networks, and one type is compatible with HART networks and analog control systems.

The DCM-3 is a computerized circuit board that receives the Demand signal from the control system, monitors the position of the output shaft, and runs the motor to move the output shaft to match the Demand signal. The DCM-3 also provides alarms and status information back to the control system, contains indicating LED's for local indication, and records information related to control actuator performance.

Output shaft position sensing is performed by a circuit board located in the Control End called the CPS-5. The CPS-5 sends a signal directly to the DCM-3. Refer to General Component Location (page 4) for the typical location of the CPS-5.

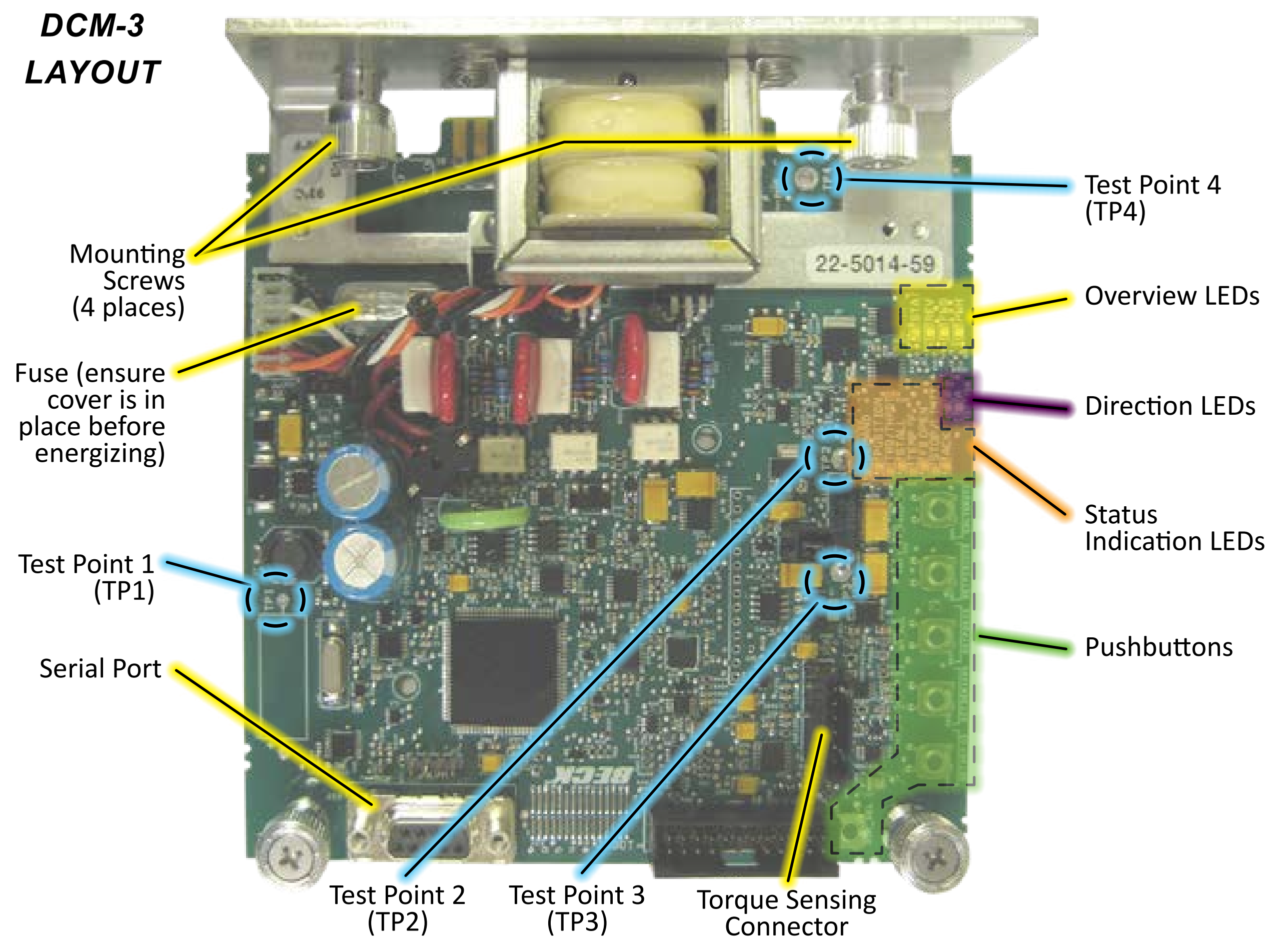
Although configuration information is stored in the DCM-3, the Control End applies some limitations on the DCM-3 functionality. For example, the DCM cannot cause the output shaft to rotate beyond the settings of the over-travel limit switches that are located in the Control End. The Control End is shipped from the factory entirely configured and tested, and most applications will not require changes. For more information on the Control End, refer to OUTPUT SHAFT POSITION SENSING (page 36), and Control End Overview (page 41).

Except for the interface being either Foundation Fieldbus or HART/analog, most aspects of the DCM-3 models are the same regardless of the network type. For example, both models have adjustable step size, measure the output shaft position by monitoring the signal from the CPS-5, and have the ability to measure ambient temperature. Both models store the same statistical data. The different interface circuitry makes the models specific for each interface.

DCM-3 PHYSICAL LAYOUT

DCM-3's differ based on the required control system interfaces, but all are physically interchangeable and have common features. The physical interchangeability allows for adapting to control system updates. The common features provide a universal foundation for operation.

DCM-3 LAYOUT



FUSE

A fuse is located in the top left corner of the DCM-3 boards shown on the opposite page (circled in yellow). This fuse protects the motor wiring, but is not necessary for the low power sections of circuit board. Therefore, if the fuse is cleared, the circuit board will appear to function but the DCM-3 cannot run the motor. Because of the very low inrush current of Beck motors, the peak motor current is much lower than the fuse rating. Fuse clearing is extremely rare, and is almost always caused by erroneous customer wiring during installation.

ALARM OUTPUT RELAY

A solid state relay is included to connect line power to an external alarm circuit. Typically, any condition that lights the STAT LED also issues an external alarm through this relay. The choice can be made if the relay indicates alarm by closing or opening. Also, the exact status indications that can signal an alarm can be set through a mask. Refer to ALARM OUTPUT CONFIGURATION (page 30).

BECK CONFIGURATION PORT (BCP)

The Beck Configuration Port is used during Beck factory testing. The port uses traditional "DB9" signaling, and can access all internal DCM-3 parameters and information. Many customers have found this port useful. This port can be used to configure any DCM-3, but it is not related to Foundation Fieldbus or to HART interfaces. Both Foundation Fieldbus and HART communicate through the Demand signal wiring at the field wiring terminals (page 18).

For more details on using this configuration port, refer to Beck Configuration Port (page 74).

TORQUE SENSING

DCM-3 boards are capable of measuring the actuator's torque output. For the DCM-3 to measure the torque, the actuator body must be built with an optional measurement-compatible output shaft.

Torque sensing makes it possible to provide several torque-related features. Foundation Fieldbus and HART interfaces can read data that include real time output torque, recorded peak output torque, and torque history profiles, An over-torque protection feature can be activated to reduce overloads to the actuator gear train.Refer to TORQUE SENSING CONFIGURATION (page 30).

OVERVIEW LEDs

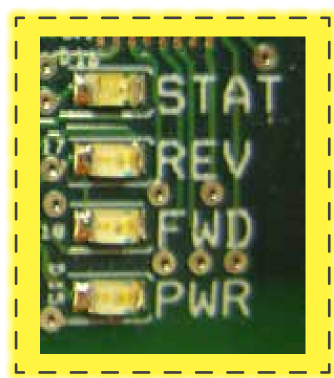
Located on the DCM-3 board (pictured at left), these LEDs indicate the basic, real-time state of the actuator. A description of each LED follows.

<u>**STAT**</u>
This red LED illuminates during a system alarm. Explanation of the specific alarm is available through the Fieldbus or Serial interface. See the Troubleshooting section for additional information.

<u>**REV**</u>
This green LED illuminates when the actuator is receiving a Demand signal less than its position.

<u>**FWD**</u>
This green LED illuminates when the actuator is receiving a Demand signal greater than its position.

<u>**PWR**</u>
This green LED illuminates when power is applied to the actuator. This LED pulses from bright to dim indicating the DCM-3 is operational.

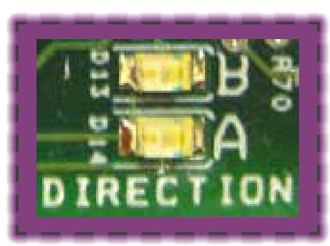


OVERVIEW LEDs

DIRECTION LEDs

These green LEDs indicate the direction of travel resulting from an increasing Demand signal.

DIRECTION LEDs



A = CCW **B** = CW

DCM-3 Features

DCM-3 FOR FOUNDATION FIELDBUS

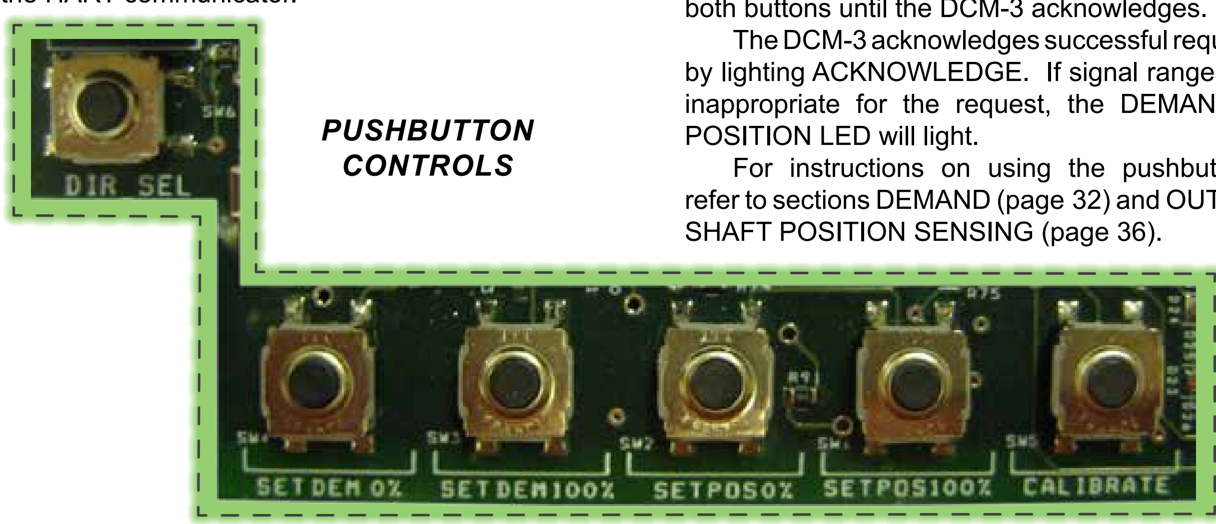
The Foundation Fieldbus version of the DCM-3 includes a fieldbus-powered interface to permit fieldbus access to the DCM-3 operational parameters.

DCM-3 FOR ANALOG OR HART

The HART version of the DCM-3 interfaces to analog systems and HART systems. This model of DCM-3 includes a pushbutton and LED interface to allow configuration and diagnostic actions without the need of a computer interface. Configuration changes resulting from the pushbuttons can be read through the computer interface.

PUSHBUTTON CONTROLS

The pushbuttons provide a simple method of configuring the Demand and the position sensing ranges. These pushbuttons overwrite internal DCM-3 signal ranging information. If using a HART communicator to configure the actuator, do not also use the pushbuttons. Although the HART and pushbutton systems fully cooperate inside the DCM-3, the values inserted into the configuration registers may not agree with the values written by the HART communicator.



PUSHBUTTON CONTROLS

When using the pushbuttons, pressing a button will cause the DCM-3 to stop trying to run the motor until the button is released. When pressing any button, LEDs on the local configuration interface panel that were illuminated will temporarily pause from illuminating.

Pressing only one button will cause the DCM-3 to pause, but will not change the configuration. To change the configuration, the CALIBRATE button and the appropriate range button must be pressed together. Either button can be pressed first. Press both buttons until the DCM-3 acknowledges.

The DCM-3 acknowledges successful requests by lighting ACKNOWLEDGE. If signal ranges are inappropriate for the request, the DEMAND or POSITION LED will light.

For instructions on using the pushbuttons, refer to sections DEMAND (page 32) and OUTPUT SHAFT POSITION SENSING (page 36).

STATUS INDICATION LEDs

When the “STAT” LED is lit, the applicable status indication LED(s) (pictured below) will light to reveal the condition(s) as described below.

An external alarm connection is available. Refer to ALARM OUTPUT CONFIGURATION (page 31).

DEMAND

This alarm is caused by the analog Demand signal being out of the accept range. The bottom of the range is defined as described in LOSS OF DEMAND SIGNAL (L.O.S.) (page 33). This alarm can also be set if the Demand signal exceeds approximately 5.5 V dc.

POSITION

The CPS-5 Position signal to the DCM-3 is out of the selected range limits. Refer to OUTPUT SHAFT POSITION SENSING (page 36).

TRQ/THRUST

This LED indicates that excessive torque is present. Refer to TORQUE SENSING CONFIGURATION (page 30).

STALL

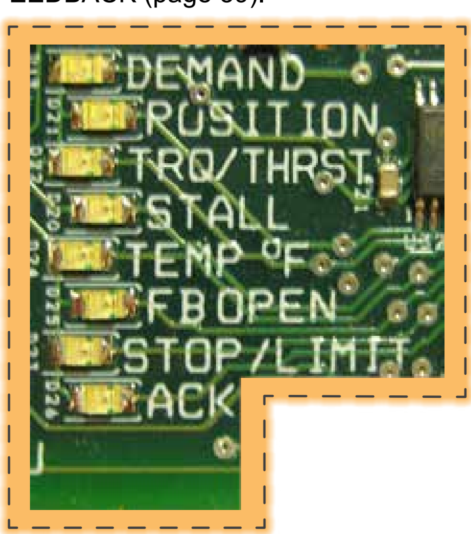
The actuator is in a stall condition and stall protection has been activated. Refer to STALL PROTECTION (page 29).

TEMP °F.

Drive’s internal temperature is too low or too high. Refer to TEMPERATURE SENSING (page 28).

FB OPEN

External position Feedback signal is enabled, but not wired to an external load or the wiring has failed between the actuator and the monitoring device. Refer to CONFIGURING FEEDBACK (page 39).



STATUS INDICATION LEDs

STOP/LIMIT

Handswitch is in “STOP” position or the actuator is at a limit. There is no alarm unless the DCM-3 is trying to run the motor. Refer to STOP/LIMIT INDICATION (page 29).

When more than one status LED is required at one time, the illuminated LEDs will cycle rather than illuminate all at once.

CONFIGURATION INSTRUCTIONS FORMAT

The DCM-3 configuration section of this manual is written from the perspective of identifying configuration concepts, then explaining how to accomplish the configuration with the appropriate configuration tool.

FF

Foundation Fieldbus compatible DCM-3’s must be connected to a Foundation Fieldbus compatible control system. All configuration and diagnostic settings are available through the fieldbus interface. The Foundation Fieldbus DCM-3 does not have a local configuration interface or the associated status LED’s.

HART

HART Communication Foundation compatible DCM-3’s are used in analog control systems. Analog signal configuration is typically part of using a HART communicator. Digital information can also be sent and received over the network.

BCP

This notation indicates commands to enter using the “Beck Configuration Port,” which is available on all models. This port can be used for configuration or diagnostic information.

Local

Some applications are fully analog with no digital communication available. These applications are served by the HART compatible DCM-3. This model has a local configuration interface that allows basic changes to match the control system requirements. The interface also includes status LED’s to assist technicians who do not have the benefit of digital communication.

RESTORE FACTORY CONFIGURATION

All DCM-3's ship from the factory configured as specified in the sales order. After this configuration is tested for accuracy, a second copy of the configuration data is electronically written into the DCM-3. This second copy is available in the field to undo configuration changes and return to the configuration that was originally shipped from the factory. Restoring the configuration erases configuration changes, but does not erase data such as stored statistical information.

FF Execute Reset Settings with the option Recall Factory Settings.

HART Execute Restore to Factory.

BCP restoremodes

STEP SIZE

Step size is the incremental movement of the output shaft in response to signal changes. When operating in AUTO mode with the DCM-3 controlling the motor, the DCM-3 runs the motor until the output shaft position matches the percentage of Demand signal. When the correct output shaft position has been reached, the position and Demand are balanced, and the DCM-3 removes power from the motor. From this balance condition, the Demand signal must change by the step size before power is returned to the motor.

The step size is factory set at 0.15% unless otherwise specified at the time of order. The step size is adjustable from 0.1% to 2.5%.

FF Modify the parameter StepSize.

HART Modify the parameter StepSize.

BCP stepsize

TEMPERATURE SENSING

DCM-3s are equipped with an ambient temperature sensing circuit. The present temperature and the temperature extremes are available to the computer network.

Temperature unit of measure can be selected to be either Fahrenheit or Celsius.

An alarm condition is asserted if the actuator's ambient temperature exceeds the rating of the actuator. This alarm condition is automatically reset when the temperature is brought back within the actuator rating.

This alarm lights the STAT LED, and on models with a local configuration panel, lights the TEMP °F LED.

To read the present temperature:

FF Read parameter Ambient Temp.

HART Read parameter Temp.

BCP temperature

To read the temperature extremes:

FF Read parameters High and Low under Ambient Extreme.

HART Read parameters Low Temp and High Temp.

BCP temperature

To select the unit of measure:

FF Modify parameter Temp Unit.

HART Modify parameter Temperature Unit.

BCP temperature

STOP/LIMIT INDICATION

The DCM-3 monitors the motor current when the Handswitch is in AUTO. If the DCM-3 is trying to run the motor, but does not measure appropriate current, an alarm is generated. The alarm clears automatically if the DCM-3 stops trying to run the motor or if the DCM-3 measures appropriate motor current. This alarm is most often caused either by placing the Handswitch into a mode other than AUTO, or by an output shaft over-travel limit switch blocking motor current.

If the DCM-3 is not trying to run the motor, no alarm is generated. Therefore, placing the Handswitch into a mode other than AUTO will not generate the alarm unless the DCM-3 tries to run the motor.

This alarm lights the STAT LED, and on models with a local configuration panel, lights the STOP/LIMIT LED.

To observe the status of the alarm using a computer interface:

FF Check parameter Operating Status in record DCM BIST.

HART Check parameter Operating Status.

BCP codes

Although the over-travel limit switches are intended to be beyond the normal travel range of the output shaft, some applications are configured so an over-travel limit switch is often actuated. A configuration parameter can be set to modify the Stop/Limit alarm behavior near the ends of travel. This modification suppresses the alarm if the position of the output shaft is beyond the range of 0% to 100%. The concept is: the actuator has reached the end of travel, so do not create an alarm because the current is being blocked. To suppress the alarm, choose Accept. To allow the alarm, choose Alert.

To change the alarm behavior:

FF Modify parameter LimitSwitch.

HART Modify parameter LimitSwitch.

BCP limitalarm

STALL PROTECTION

The DCM-3 can be configured to shut off power to the motor if the actuator output shaft cannot reach the desired position within a certain time period. The time period can be configured to a value between 30 seconds and 450 seconds. This timer is automatically reset whenever the position signal matches the Demand signal. The timer does not continue to count if the Handswitch is not in AUTO mode or if an over-travel limit switch is blocking power to the motor.

If the Stall timer is set to a time shorter than the travel time of the actuator, Stall alarms will be created erroneously.

Under the Stall. condition, the “STAT” and “STALL” LEDs will light. If Stall Protection is disabled, the Stall alarm is created, but power is not removed from the motor.

The number of recorded Stall conditions is available to the computer network.

This alarm is not automatically self-correcting. Any of these actions will eliminate the alarm: reverse the Demand input signal from the controller (such that the actuator tries to run in the direction opposite the blocked direction), perform a "Reset Stall" or "Board Reset", or by switching the actuator power off and on.

To enable or disable Stall Protection:

FF Modify the parameter StallProtect.

HART Modify the parameter StallProt.

BCP stallprot

To select the stall time:

FF Modify the parameter Stall Time.

HART Modify the parameter Stall Time.

BCP stalltime

To read the number of Stall conditions:

FF Read the parameter Stalls.

HART Read the parameter Stalls.

BCP stat

To Reset Stall:

FF Issue the command Reset Stall.

HART Issue the command Reset Stall.

BCP unstall

To perform a Board Reset:

FF Issue the command Reset.

HART Issue the command Board Reset.

BCP reset

TORQUE SENSING CONFIGURATION

Torque sensing makes it possible to provide several torque-related features. Foundation Fieldbus and HART interfaces can read data that include real time output torque, recorded peak output torque, and torque history profiles, An over-torque protection feature can be activated to reduce overloads to the actuator gear train. For information on how to access the recorded peak torque and the history profiles, refer to TORQUE STATISTICS (page 31).

Configuration of the torque sensing features requires:

1. torque sensing electrical connections are made
2. torque sensing is enabled
3. torque sensing scaling parameters are set properly
4. torque sensing alarm limits are chosen as desired
5. torque protection is enabled, if desired

The electrical connection is made at the location shown in DCM-3 LAYOUT (page 24), The cable that plugs into the DCM-3 is available in the DCM-3 compartment only if the actuator includes the optional torque sensing output shaft.

Torque sensing can be enabled or disabled within the DCM-3. In general, if the actuator output shaft does not have a torque sensing output shaft, torque sensing should be disabled within the DCM-3.

To enable or disable torque sensing:

FF Modify the parameter Trq/Thr.

HART Modify the parameter Trq/Thrust in the Torque Setup menu.

BCP torqenable

There are two torque scaling factors that must be established. One is the 0% point, and the other is the span value. Each of these points is entered as a numeric constant. The numeric constants relate to the internal measurement units within the DCM-3. These constants are not in percent units, but scale the internal DCM-3 values so the resulting torque measurements are in percent units.

The proper scaling factors are recorded and labeled inside the actuator during Beck factory testing. If these recorded values are available, enter them into the parameters as indicated below. If recorded values are not available, an appropriate span can be selected from table TORQUE SPAN VALUES (this page).

If the recorded 0% parameter value is not available, an empirical value must be entered. Start by entering a parameter value of 0. If the resulting torque measurement does not read 0%, increase or decrease the 0% point parameter until the torque measurement reads 0%.

To read the present torque:

FF Read parameter Trq/Thr %.

HART Read parameter Trq/Thrust in the Online menu.

BCP torq

To enter the 0% point:

FF Modify the parameter Trq/Thr Null.

HART Modify the parameter Trq Null.

BCP torq0k

To enter the span value:

FF Modify the parameter Trq/Thr Const.

HART Modify the parameter Trq Const.

BCP torqconst

TORQUE SPAN VALUES

Model	Rated Torque	Torque Span Constant
11-159	15	150
11-159	20	200
11-159	40	401
11-159	60	602
11-159	80	803
11-169	15	79
11-169	20	106
11-169	40	213
11-169	60	322
11-169	80	429
11-209, 11-269	125	80
11-209, 11-269	175	112
11-209, 11-269	250	160
11-309, 11-369	300	192
11-309, 11-369	400	257
11-309, 11-369	550	353
11-309, 11-369	650	417
11-409, 11-469	650	79
11-409, 11-469	650	125
11-409, 11-469	650	148
11-409, 11-469	650	182
11-409, 11-469	650	228
11-409, 11-469	650	342
11-409, 11-469	650	411

TORQUE ALARMS

There are three types of alarm associated with over-torque conditions. Each alarm lights the STAT LED, and if the local configuration panel is available, lights the TORQ/THRUST LED. Each alarm clears automatically when the condition is corrected.

The first type is a passive alarm to warn the control system that torque is high. The torque level associated with this alarm is adjustable within the range of 60% of rated load to 105% of rated load. This alarm does not stop the actuator motor.

To set the alarm level:

FF Modify the parameter Trq/Thr AlarmLevel.

HART Modify the parameter AlarmLevel.

BCP torqalarm

The second type of torque alarm can be set to stop the motor under severe over-torque conditions. This is called Torque Protection. The torque level associated with this protection is adjustable within the range of 70% of rated load to 150% of rated load. Note that this protection level can be set lower than AlarmLevel. Most users prefer AlarmLevel to be set lower than the protection level. When the measured torque is greater than the protection level, the alarm is asserted. This alarm can stop the actuator motor if the over-torque protection feature is enabled. When the torque is reduced to below the protection level, the motor will run. This alarm cannot stop the motor if the Handswitch is in not in AUTO mode.

Torque sensing is direction sensitive. Even with protection enabled and a high output load, the motor can run in the direction opposite of the output load. However, the motor will not run against the load.

To set the protection level:

FF Modify parameter Trq/Thr Shut Dn Level.

HART Modify parameter ShutDwnTrq.

BCP ovtstoplevel

To enable or disable protection:

FF Modify parameter Trq/Thr Protect.

HART Modify parameter Ovt Prot.

BCP ovtstop

The third type of alarm is generated when the torque sensing cable is not properly attached. A very large torque is artificially sensed by the torque circuitry. This condition is recognize by the DCM-3 as a measurement failure. The alarm is created, but the DCM-3 will not stop the motor under this circumstance.

TORQUE STATISTICS

As the DCM-3 measures torque, overall peak torque is monitored and recorded. This is recorded as a single value, and could be in either direction of motor movement and any portion of output shaft travel.

To read the peak torque:

FF Read parameter Peak Trq/Thr.

HART Read parameter Pk Torque.

BCP stat

The DCM-3 also generates a torque profile by recording the peak torque for each of 10 segments of output shaft travel. These segments are each 10 degrees for actuators with 100 degree maximum travel, and are 9 degrees for actuators with 90 degree maximum travel. Refer to Maximum Output Shaft Rotation (page 7). Segment number 1 is the segment closest to the CCW end of maximum travel, and segment number 10 is closest to the CW end of maximum travel. A total of 20 sets of data are stored. Separate data are stored for each motor direction in each segment.

To read the torque profile:

FF Read parameter values from the CW Trq/Thr record or the CCW Trq/Thr record.

HART Read parameter values from the CW Torque menu or the CCW Torque menu.

BCP torqprof

ALARM OUTPUT CONFIGURATION

An external alarm indication is available from a solid state relay on the DCM-3. This indication is a powered circuit, not a dry relay contact. Output voltage is either 120 V ac or 240 V ac, depending on the actuator power.

Depending on the model of actuator and on options that are installed, an optional electro-mechanical relay may be installed in the actuator. Check the wiring diagram that was attached to the actuator. The configuration information described here applies to the DCM-3 solid state alarm output circuit, not the optional electro-mechanical relay.
The choice is available as to whether the relay is open to indicate an alarm or closed to indicate an alarm. When line power is removed from the actuator, the relay is open regardless of the polarity setting.

An open relay results in negligible current flowing from the DCM-3 Status pin. A closed relay results in line power being connected to the Status pin. The Status pin in typically field wiring

cont'd

Alarm Output Config., cont'd

terminal E, but the wiring diagram attached to the actuator must be used to find the actual pin.

To set the desired alarm polarity:

FF Modify parameter Polarity.

HART Modify parameter AlarmPol.

BCP alarmout

A choice is also available as to what status situations create an external alarm indication. In FF and HART, make certain a check mark or “ON” is placed next to conditions that should create an external alarm.

FF Modify parameters Mask 1 and Mask 2.

HART Modify parameter Alarm Mask.

BCP alarmoutmask

Alarm	Analog HART Page Ref.	Foundation Fieldbus Page Ref.
Demand LOS	32	32
Torq/Thrust High	30	30
Stall	28	28
Torq/Thrust Stop	30	30
Stop/Limit	28	28
FeedbackLOS	38	38
Temperature	27	27
PositionLOS	35	35
RTC Fail	(1)	(1)
Torq/ThrustMeasFail	30	30
PositionA/D/ Error	(1)	(1)
DemandMeasFail	(1)	(1)
Reserved 1		
PositionLOS	35	35
TemperatureMeasFail	(1)	(1)
MemoryFail	(1)	(1)
InvalButtonPress	57	71
DemandTooHigh		
Reserved 2		
Reserved 3		
Reserved 4		
Reserved 5		
Reserved 6		
Reserved 7		
Reserved 8		
Reserved 9		
DemUnder HART/FF Ctl	58	
DemUnderPAT Ctl	58	
Reserved 10		
Reserved 11		
Reserved 12		
Reserved 13		

(1) = These alarms indicate a DCM-3 failure.

DEMAND

Demand is the signal the DCM-3 uses to determine the desired position of the output shaft. Depending on the type of control system and corresponding model of DCM-3, the DCM-3 is designed to accept a digital Demand signal or an analog Demand signal. Foundation Fieldbus signals are digital. Analog systems with HART can use an analog signal or a digital signal. All DCM-3 models have test modes that can be used to temporarily override the control system signal. For more information on checking the source of the Demand signal, refer Operating Mode (page 33).

FF

Demand is written to the Beck actuator as CAS-IN of the Analog Output block. The typical scaling is 0% CAS-IN is 0% Demand, and 100% CAS-IN is 100% Demand. Refer to Foundation Fieldbus Communication Overview (page 19). The correct Demand Op Mode (page 33) is Hold. The scaling of 0% to 100% is passed through the Demand Characterizer. Therefore, if Linear is not chosen for the characterization, 50% Demand may not correspond to 50% output shaft position. Refer to DEMAND SIGNAL CHARACTERIZATION (page 34).

ANALOG/HART

For analog systems and HART compatible DCM-3’s, Demand is usually an analog value between 4 mA and 20 mA. For the DCM-3 to properly interpret the Demand signal, the DCM-3 must know the appropriate Lower Range (0%) and Upper Range (100%) values of Demand.

Demand Lower Range and Upper Range values are set to the customer specification and tested at the Beck factory.

If using a HART system, the Demand Op Mode can be changed to allow the Demand to be assigned as a digital percent, similar to the FF method of assigning Demand. Refer to Operating Mode (page 33).

Analog values between 4 mA and 16 mA can be assigned as 0%, and values between 8 mA and 20 mA can be assigned as 100%. Note that the 0% value must be at least 4 mA less than the 100% value.

In analog systems, the term “split range” is occasionally used to describe more than one actuator working from the same Demand signal. A two-way split would be one actuator working from 4 mA to 12 mA and the second actuator working from 12 mA to 20 mA. If configuring for a two-way split range as described, the range values for one actuator would be 4 mA and 12 mA, and for the other actuator 12 mA and 20 mA.

To set the 0% signal level:

HART Modify parameter DemRngLwr

BCP dem0pctma

LOCAL Apply the desired 0% value then press and hold "CALIBRATE" and DEM 0% until the "ACKNOWLEDGE" LED lights. If the "DEMAND" LED lights, the signal is not within the acceptable range.

To set the 100% signal level:

HART Modify parameter DemRngLwr

BCP dem100pctma.

LOCAL Apply the desired 100% value then press and hold "CALIBRATE" and DEM 100% until the "ACKNOWLEDGE" LED lights. If the "DEMAND" LED lights, the signal is not within the acceptable range.

PARALLEL SIGNAL CONNECTIONS

Foundation Fieldbus devices are permitted to be connected in parallel for normal operation. Analog/HART devices can be connected in parallel with limitations as described in Parallel Connected Operation (page 20).

DEMAND SIGNAL CHARACTERIZATION

The DCM-3 can interpret the Demand as representing the desired output shaft position as a linear relationship or as a nonlinear relationship. The choices are Linear, Square, Square Root, and Special. Refer to SETTING DEMAND SIGNAL CHARACTERIZATION (page 34) for more details concerning each selection.

To choose the relationship:

FF Modify parameter Demand Curve.

HART Modify parameter Dem Curve.

BCP demfunc

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

If Demand is an analog signal, it is possible that the signal will drop below acceptable level and be considered invalid. This condition is called Demand L.O.S., and creates an alarm. The threshold for invoking the L.O.S. alarm is adjustable. DCM-3s are typically configured to stop the actuator during L.O.S. conditions. This is called L.O.S. Stay In Place. The DCM-3 can be configured to rotate the output shaft to a predetermined position. This is called L.O.S. Go to Position. Under the L.O.S. condition, the STAT and DEMAND LEDs will light. When the input signal is corrected, the actuator will automatically resume normal operation.

The DCM-3 can be configured to suppress the alarm even if the Demand signal is below the alarm threshold. This is called L.O.S. PAT mode.

To set the threshold level:

HART Modify parameter DemLimLwr.

BCP demlos

To set the action on L.O.S.:

HART Modify parameter LOS Mode.

BCP demlos

Set the predetermined position for an L.O.S. condition:

HART Modify parameter LOS Pos.

BCP demlosgtp

DEMAND OPERATING MODE

The Demand Op Mode can be changed to select a source of Demand signal other than the typical source.

The Demand Op Mode parameter can have the following values:

Follow: Follow the analog Demand signal. This mode is not available in Foundation Fieldbus systems. In analog/HART systems, this is the correct mode if an analog signal is being used as Demand.

Hold: Use the digital value transmitted by the Foundation Fieldbus or HART network. This is the correct mode for Foundation Fieldbus systems. In analog/HART systems, this mode can be used if the control system can write a digital value to the Demand parameter.

RunCW: Run the motor so the output shaft rotates CW until an over-travel limit is reached. This is a diagnostic mode that should only be used for closely controlled tests.

RunCCW: Run the motor so the output shaft rotates CCW until an over-travel limit is reached. This is a diagnostic mode that should only be used for closely controlled tests.

Stay: Run the motor to preserve present position. This mode is for special circumstances.

Stop: Remove power from the motor.

FF Modify parameter Op Mode. Whenever the Transducer Block is placed in AUTO, Op Mode returns to Hold. Hold allows the actuator to accept the digital Demand signal from the control system.

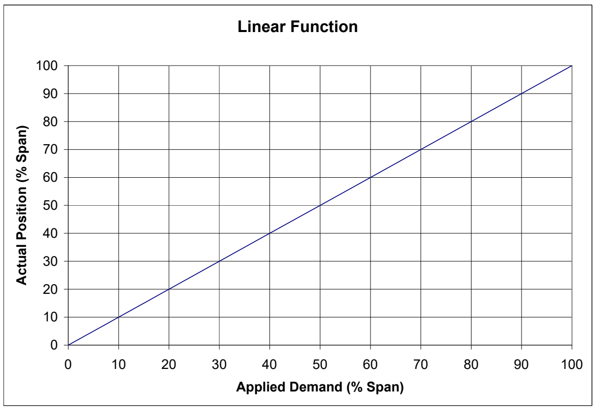
HART Modify parameter Op Mode.

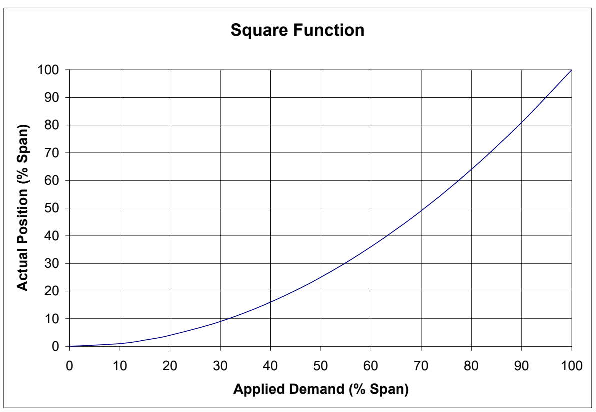
BCP opmode

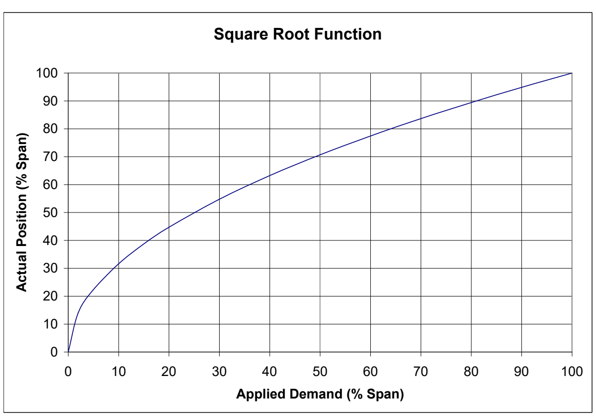
When the DCM-3 is installed in a system using analog control, Demand Op Mode should be set to Follow.

SETTING DEMAND SIGNAL CHARACTERIZATION

The DCM-3 incorporates a configurable Demand signal characterization feature. In addition to the standard linear response, there are three characterization curves available: a square function, a square root function, and a 20 segment custom characterizer. These options allow the user to set a non-linear response characteristic to compensate for non-linear final control elements.







NOTE: Implementing a square root characterization creates extremely high gain when the Demand signal is below 10%. This causes instability and is unsuitable for control in this region. Do not apply this curve if the conrol loop may need to modulate at the lower range of valve/damper travel.

SPECIAL CURVE

The 20-segment characterizer allows the user to emulate any curve profile by using a series of straight lines. The straight lines are called segments.

Special curves do not have to use all 20 segments, but the used segments must be grouped together. Segments cannot be skipped.

Each segment is defined by a starting point and an ending point. The starting and ending points are called nodes. A node is an X,Y point such as can be plotted on rectangular grid graph paper.

Segment 1 starts at node 1 and ends at node 2. Segment 2 starts at node 2 and ends at node 3. Segment 20 starts at node 20 and ends at node 21.

Unless otherwise specified, the Special curve ships from the factory defined as a linear function. This definition is accomplished by defining only 1 of the possible 20 segments. By defining the first segment start point (node 1) as (X = 0%, Y = 0%) and the first segment end point (node 2) as (X = 100%, Y = 100%), all points between are calculated to be on a straight line. To implement a curve, more than one segment can be defined.

X-values are chosen to give a reasonable spacing in Y-values. Y-values are calculated from X-values using the desired formula, or are chosen from X-values picked from a table of data.

When defining nodes, X-values and Y-values must increase as the node number increases. For example, the X-value and Y-value of node 2 must be higher than the X-value and Y-value of node 1. Nodes cannot be skipped. Always start at node 1.

The following example implements a special curve that approximates a square function. Mathematically, a square function multiplies the Demand signal by itself, and uses the result as the desired output. In this situation, Y-values are calculated from X-values.

This example uses 5 segments to approximate the square curve. Segments 1 through 5 are needed, so nodes 1 through 6 are used.

Table 2 on page 35 describes the Y-value calculation to determine the proper Y-value after X-values were chosen. The right side of Table 2 is the condensed result. The result values are entered into the DCM-3.

Unused nodes are technically set to "infinity." Some Foundation Fieldbus and HART interfaces do not properly handle infinity, so a work around is to set the X-values and Y-values to 1000%. Some interfaces do not properly display infinity, so the unused nodes may appear to have an unexpected value.

The first part of Table 2 below shows how the Y-value is calculated. The X-values are chosen as seems appropriate for this desired curve. The second part of Table 2 represents the resultant data. This resultant data must be entered into the DCM-3. The resultant function is shown plotted. The diamonds represent the nodes.

When entering values, enter the X-value and Y-value as a set, then send to the DCM-3. When increasing the number of nodes that are being used, start with node 1 and work to higher node numbers. When reducing the number of nodes that are being used, start with the highest node used and set that node to unused, and work back toward lower node numbers.

To enter the node values:

FF Modify parameter DemNode 1 through DemNode 21.

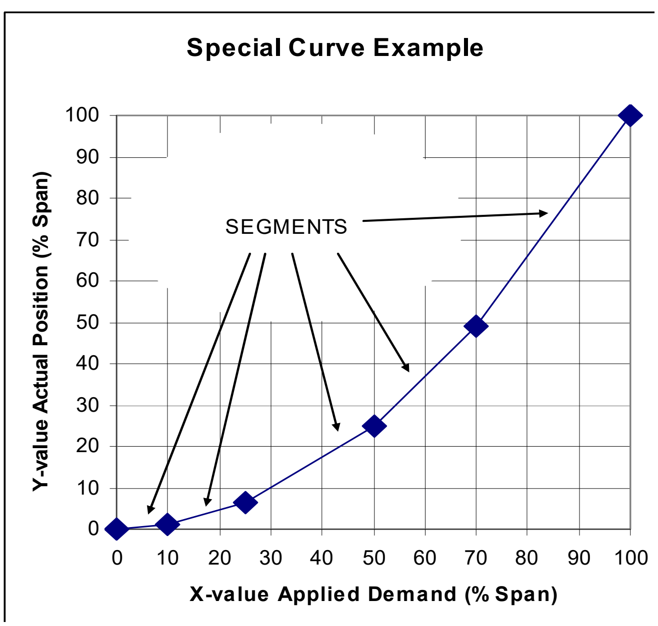
HART Modify parameters DemNode1X and DemNode1Y through DemNode21X and DemNode21Y.

BCP charset, charlist, charclear

**TABLE 2:
SPECIAL CURVE CALCULATIONS**

Node	X-value % Span	Y-value Calculation	Desired Position
1	0%	0% x 0% => 0.00 x 0.00 => 0.00	0%
2	10%	10% x 10% => 0.10 x 0.10 => 0.01	1%
3	25%	25% x 25% => 0.25 x 0.25 => 0.06	6%
4	50%	50% x 50% => 0.50 x 0.50 => 0.25	25%
5	75%	70% x 70% => 0.70 x 0.70 => 0.49	49%
6	100%	100% x 100% => 1.00 x 1.00 => 1.00	100%

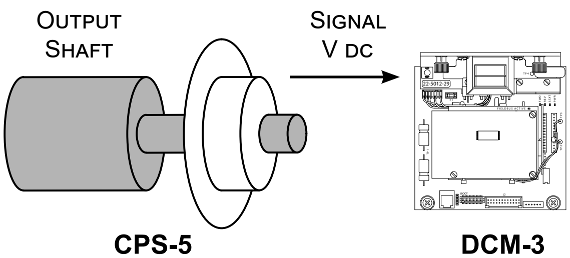
Node	X-value % Span	Y-value % Span
1	0%	0%
2	10%	1%
3	25%	6%
4	50%	25%
5	75%	49%
6	100%	100%



DCM-3 Configuration

OUTPUT SHAFT POSITION SENSING

Shaft position sensing is performed by the CPS-5 circuit board assembly. The DCM-3 must be configured to accept the appropriate signal range from the CPS-5. For more information on the CPS-5, refer to Control End Overview (page 41).



There are two standard signal ranges:

1. 1 V to 5 V for 100 degrees of output shaft rotation
2. 1.2 V to 4.8 V for 90 degrees of output shaft rotation

The appropriate signal range is determined by the control actuator model. Refer to Maximum Output Shaft Rotation (page 7). When determining the proper signal range, do not consider if a shorter rotation range is desired. Base the signal definition on the maximum capability of the actuator. If using less than the maximum travel, these voltages remain the correct values, but the parameter Travel is modified (page 37).

To confirm the DCM-3 is set for the correct output shaft Maximum Travel:

FF Read parameter MaxTravel.

HART Read parameter MaxTravel.

BCP travelmax

If the Maximum travel is not correct, follow the procedure listed in Setting Model Defaults.

The DCM-3 expects the CPS-5 signal to increase from minimum voltage to maximum voltage as the output shaft rotates in the CW direction. Although the internal CPS-5 signal increases with CW rotation, either end of travel can be configured to be 0% position. Refer to DIRECTION OF OUTPUT SHAFT ROTATION (page 38).

To confirm the DCM-3 expects the CPS-5 signal to increase as the output shaft rotates in the CW direction:

FF Read parameter Snsr Dir.

HART Read parameter Snsr Dir.

BCP cpsrotation

If the direction is not CW for increasing signal, follow the procedure listed in Setting Model Defaults.

If the position sensing signal to the DCM-3 is below -5% or above 105% of the range given above, a POSITION alarm is generated. These values are known as the Position lower limit (PosLwrLim) and Position upper limit (PosUprLim). The limit values are not adjustable. This alarm does not affect actuator performance.

If the signal drops out of the range of 0.25 V dc to 5.3 V dc, the CPS-5 is considered invalid. A separate Position LOS alarm is generated. The DCM-3 will not try to run the motor. This alarm automatically clears if the CPS-5 signal becomes valid.

Both alarms light the STAT LED, and if the local configuration panel is available, light the POSITION LED.

To confirm the correct signal ranges:

FF Read parameter CPS RngLwr.

HART Read parameter CPS RngLwr.

BCP cpsvatposa

and

FF Read parameter CPS RngUpr.

HART Read parameter CPS RngUpr.

BCP cpsvatposb

If the signal ranges are not correct, follow the procedure listed in Setting Model Defaults.

Setting Model Defaults

Several parameter values are intended to be set based on the actuator model. These parameters should not be changed as part of routine configuration. If these parameters are not correct, they can be set by using a command instruction to have the DCM-3 update the values based on the actuator serial number (parameter Actuator S/N). The affected DCM-3 parameters are the direction of rotation for an increasing CPS-5 signal, the expected range of CPS-5 signal, and the Maximum Travel. For information on the serial number format, refer to Serial Number (page 5).

Use the following procedure to install the correct values:

FF

1. Write parameter Actuator S/N. Make certain the parameter is written into the DCM-3.
2. Execute Reset Settings with the option Use Model Defaults.

HART

1. Write parameter Actuator S/N. Make certain the parameter is written into the DCM-3. If the HART master asks to use the default settings, agree.
2. If the master did not automatically use default settings, execute Use Default Setup.

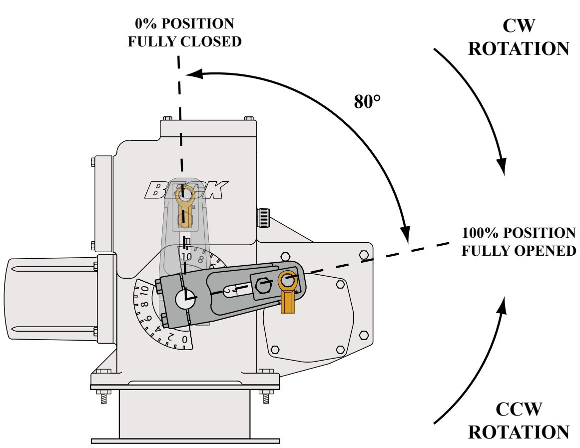
BCP

1. Write the serial number with command: sernum
2. Execute command configformodel.

After choosing the appropriate maximum voltage range, the 0% point can be set through parameter CPS Zero%. See OUTPUT SHAFT 0% POSITION (page 38).

LOCAL

If a computer interface is not available, the position sensing voltage ranges can be set using the local configuration interface. Using the local interface performs two functions simultaneously. First, the voltage range end point is defined. Second, the voltage end point is automatically defined as 0% or 100%. The parameter Snsr Dir (page 36) cannot be modified without a computer, but should already be set correctly to CW for increasing signal. To use the local interface, use the procedure described under TRAVEL.



TRAVEL

The parameter Travel is used to tell the DCM-3 how much rotation is desired for 100% signal change. Travel is always less than or equal to Maximum Travel, which is the maximum capability of the actuator. The DCM-3 parameter MaxTravel (page 36) should always correspond to the values in the Maximum Travel table on page 7.

Typically, the best practice is to use the full 100° (or 90° for quarter-turn actuators) rotation of the output shaft in response to the 0–100% Demand signal. This allows full flexibility in arranging the actuator’s torque to be distributed for the best mechanical advantage relative to the driven load.

In linkage applications, if the driven element rotation is less than 100°, the linkage can be used to allow the driven element to move the correct rotation while still allowing the actuator shaft to rotate 100°.

Certain applications may require a reduced full rotation of the output shaft. This reduced travel condition is referred to as being “short-stroked.” The minimum recommended travel for 100% movement is 60°. If changing the travel, consider changing the over-travel limit switch settings. Refer to Calibration Priority (page 41).

To set the desired travel distance:

FF Modify parameter Travel.

HART Modify parameter Travel.

BCP travel

LOCAL

1. Move the output shaft to the desired 0% angular position.
2. Press and hold “CALIBRATE” and POS 0% until the “ACKNOWLEDGE” LED lights.
3. Move the output shaft to the desired 100% angular position.
4. Press and hold “CALIBRATE” and POS 100% until the “ACKNOWLEDGE” LED lights.

If the “POSITION” LED lights, the signal is not within the acceptable range.

The illustration at left represents an actuator requiring an 80° full stroke rotation. Therefore, Travel has been set to 80. Parameter Actuator Dir (page 38) is set to CW so the output shaft rotates CW as the Demand signal increases.

The crank arm starting position was chosen at random, and may be adjusted to any start angle orientation. Refer to OUTPUT SHAFT 0% POSITION (page 38).

OUTPUT SHAFT 0% POSITION

When considering the desired 0% output shaft position, keep in mind that the output shaft and the external shaft coupling are separate objects. For example, the crank arm can be adjusted to any angle without changing the output shaft 0% definition. If using an inline coupling instead of a crank arm, the inline coupling can be adjusted to give proper 0% positioning. Changing the mechanical coupling may be necessary to gain proper alignment with linkages.

If desired, the DCM-3 can be configured for various 0% shaft positions. When changing the DCM-3 configuration, a limited amount of 0% adjustment is available. The total travel of the actuator output shaft is constrained by the mechanical stops inside the actuator body.

The parameter CPS Zero% can be modified to choose the exact 0% position. This parameter sets the CPS-5 voltage signal that the DCM-3 interprets as 0%. This parameter does not have to be changed in most installations: the travel distance is set with Travel, and the 0% point can be set with the shaft coupling or crank arm.

To set the voltage associated with 0%:

FF Modify parameter CPS Zero%.

HART Modify parameter CPS Zero%.

BCP cpsvat0pct

LOCAL Set CPS Zero% using the POS 0% button. Refer to OUTPUT SHAFT POSITION SENSING (page 36).

The CPS Zero% parameter is automatically changed when the DIRECTION OF OUTPUT SHAFT ROTATION (below) is changed. This is because what was the CPS-5 voltage at 100% becomes the CPS-5 voltage at 0%, and the voltage that was 0% becomes the voltage at 100%.

When changing CPS Zero% as part of reducing output shaft travel (this page), reduce Travel first, then change CPS Zero%. When changing CPS Zero% as part of increasing Travel, change CPS Zero% first, then change Travel.

DIRECTION OF OUTPUT SHAFT ROTATION (CW vs. CCW)

Direction of output shaft rotation is determined by observing the end of the output shaft as shown in the illustration Shaft Direction Reference.

A very important aspect of direction of rotation is whether the output shaft rotates CW or CCW in reaction to an increasing Demand signal.

The internal CPS-5 signal used by the DCM-3 always increases as the output shaft moves in the CW direction, but the correlation between the Demand signal from the control system and the shaft movement can be selected as either CW increasing or CCW increasing.

With an actuator configured to move CW with increasing Demand, the 0% endpoint will be at the CCW end of travel. With an actuator configured to move CCW with increasing Demand, the 0% endpoint will be at the CW end of travel.

To set the proper direction:

FF Modify parameter Actuator Dir.

HART Modify parameter Actuator Dir.

BCP drvdir

If using the DCM-3 pushbuttons for configuration, the direction of rotation can be changed using any of the three following methods:

1. Press and hold the “CALIBRATE” pushbutton, then press the “DIR SEL” pushbutton until the (opposite) “DIRECTION” LED is lit.

   OR

2. Move the output shaft to the desired 0% angular position.

   Press and hold “CALIBRATE” and POS 0% until the “ACKNOWLEDGE” LED lights.

   OR

3. Move the output shaft to the desired 100% angular position.

   Press and hold “CALIBRATE” and POS 100% until the “ACKNOWLEDGE” LED lights.

If the “POSITION” LED lights, the signal is not within the acceptable range.

Changing the shaft direction for increasing Demand signals does not change the CPS-5 signal ranges. The CPS-5 output voltage always increases with CW output shaft rotation. With CW increasing actuators, the CPS-5 signal is minimum at 0% and increases as the Demand increases. With CCW increasing actuators, the CPS-5 signal is largest at 0% and decreases as the Demand increases. The DCM-3 mathematically compensates for the CPS-5 signal direction so all signals remain correct for the chosen direction of rotation.

One of the changes the DCM-3 makes in response to changing the shaft direction for increasing signal is to automatically change the parameter CPS Zero% (this page). This is necessary because the relative end points of CPS-5 signal swap when the shaft direction choice is changed.

SHAFT POSITION OUTPUT SIGNAL: FEEDBACK

All DCM-3 circuit boards have the ability to inform the control system as to the actual position of the output shaft.

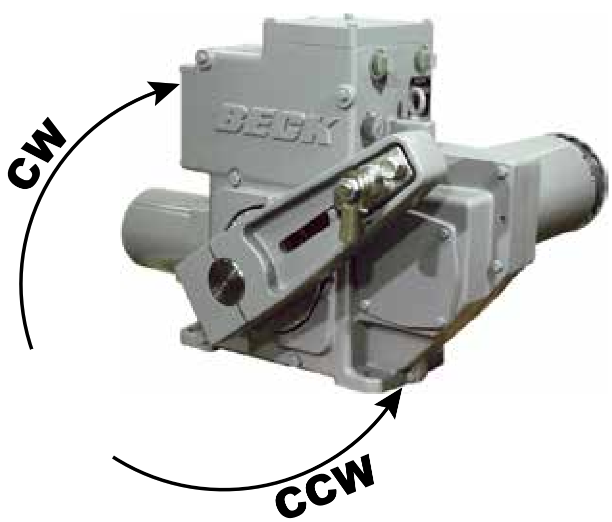
To read the actual position:

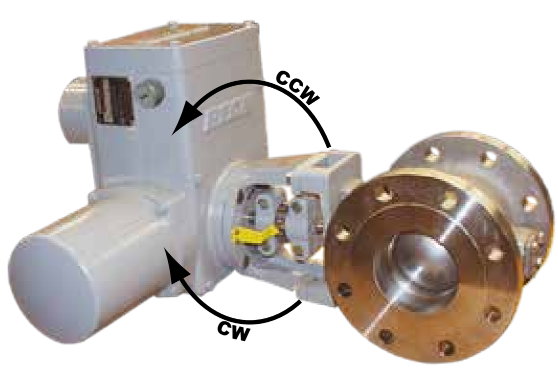
FF Read parameter Position or read PV in the Analog Output Block.

HART Read parameter Position.

BCP stat

In analog systems, an output current is available to allow the control system to monitor the actual position. This output signal is known as Feedback. Feedback is available at the field wiring terminals (page 18). The ranging information that controls Feedback can be modified. See CONFIGURING FEEDBACK (this page).





SHAFT DIRECTION REFERENCE

CONFIGURING FEEDBACK

The Feedback signal in analog systems is intended to be a 4 mA to 20 mA signal. Typically, 4 mA represents 0% shaft position, and 20 mA represents 100% shaft position.

This signal can be enabled or disabled. If the signal is enabled but the connection is left electrically open, a FDBK OPEN alarm condition is created. To eliminate the alarm, either close the electrical loop or disable the signal.

To enable or disable the Feedback function:

HART Modify parameter Feedback in the Feedback Setup menu.

BCP iomode

Feedback current representing 0% can be any-value between 3 mA and 16 mA. Feedback current representing 100% can be any-value between 8 mA and 21 mA. The current representing 100% must be at least 4 mA higher than the current representing 0%.

To set the current corresponding to 0%:

HART Modify parameter FB RngLwr.

BCP fdbk0pctma

To set the current corresponding to 100%:

HART Modify parameter FB RngUpr.

BCP fdbk100pctma

The relationship between the Feedback signal and the output shaft position is set to Linear unless otherwise specified. There are two choices: Linear, and Inverse Demand. The purpose of Inverse Demand is to allow a system to compare the Feedback signal to the Demand signal, even if the Demand signal is being used with characterization inside the DCM-3. For information on Demand characterization, refer to SETTING DEMAND SIGNAL CHARACTERIZATION (page 33).

For example, if the Demand is set to Square with a 4 mA to 20 mA range, then 12 mA Demand corresponds to 25% position. If Feedback is Linear with a range of 4 mA to 20 mA, then Feedback at 25% would be 8 mA. For some control systems, having the Demand at 12 mA and the Feedback at 8 mA is an issue. The Feedback characterization can be set to the inverse Demand curve so the Demand and Feedback match at signal balance. In this example, with Feedback set to Inverse Demand and the output shaft position at 25%, the Feedback signal would be 12 mA.

To choose Feedback characterization:

HART Modify parameter FB Curve.

BCP fdbkfunc

DCM-3 ANALOG SIGNAL CALIBRATION/TRIM

DCM-3 models that are configured to interface with analog control systems use analog/digital converters to handle the analog signals. These converters are high accuracy, low drift integrated circuits that are calibrated and tested at the Beck factory. Recalibration of these circuits should not be necessary.

TORQUE SENSING TRIM

Group 11 actuators that have been built with optional Torque sensing include DCM-3's with corresponding sensing circuits. These circuits do not require any calibration other than what is given in the instructions for configuring the actuator. Configuring the torque settings accounts for signal calibration. Refer to TORQUE SENSING CONFIGURATION (page 30).

DEMAND SENSING TRIM

If the DCM-3 model is intended to receive an analog Demand signal, the analog signal calibration can be adjusted. This is different than selecting the range as described in DEMAND (page 32). In that section, the choice of signal ranges was set. Calibration is intended to make certain that 4 mA is measured as 4 mA, and 20 mA is measured as 20 mA.

Analog Demand calibration does not apply to Foundation Fieldbus or installations using the local configuration interface. Foundation Fieldbus does not have an analog Demand signal. The local configuration interface uses whatever value is applied as Demand, and does not try to interpret the exact number of milliamps.

The technique for calibrating the analog Demand is to apply exactly 4 mA or 20 mA, then identify the value to the DCM-3.

To calibrate the analog Demand sensing at 4 mA, apply 4 mA, then:

HART Write 4 to parameter Loop(Dem) in the Calibration Trim menu.

BCP trimdem4 mA

To calibrate the analog Demand sensing at 20 mA, apply 20 mA, then:

HART Write 20 to parameter Loop(Dem) in the Calibration Trim menu.

BCP trimdem20 mA

FEEDBACK SOURCING TRIM

If the DCM-3 model is intended to transmit an analog Feedback signal, a digital-to-analog converter is used to generate the Feedback signal. Refer to SHAFT POSITION OUTPUT SIGNAL (page 39).

There is often confusion in the calibration of the Feedback signal. Situations can cause the appearance of an improperly trimmed Feedback signal, but as these examples show, the Feedback trim may not be the issue.

1. The output shaft is not at the desired angle, so the DCM-3 does not create the desired Feedback signal. In this situation, the output shaft should be moved to the correct position before changing Feedback settings.
2. The output shaft is at the desired angle, but the DCM-3 does not recognize the angle as being correct. In this situation, the DCM-3 position sensing configuration should be corrected.
3. An inaccurate measurement of the Feedback signal is being made. Check the Feedback current with an accurate meter at the actuator.

The examples mentioned here are responsible for almost all situations where the Feedback signal is thought to be trimmed improperly. The Feedback signal is trimmed and tested at the Beck factory.

The technique of trimming is comprised of having the DCM-3 output a theoretical 4 mA, then identifying to the DCM-3 the exact mA the control system is measuring. Then, have the DCM-3 output a theoretical 20 mA, and identify to the DCM-3 the exact mA measurement.

To get the DCM-3 to output a theoretical 4 mA signal, move the output shaft to the 0% position. The FB RngLwr parameter should be 4 mA for this trim procedure.

To trim the 4 mA output point:

HART Write measured value to parameter Feedback in the CALIBRATION TRIM menu.

BCP trimfdbk4 mA

To get the DCM-3 to output a theoretical 20 mA signal, move the output shaft to the 100% position. The FB RngUpr parameter should be 20 mA for this trim procedure.

To trim the 20 mA output point:

HART Go to the CALIBRATION TRIM menu and enter the exact measured Feedback current into the Feedback parameter.

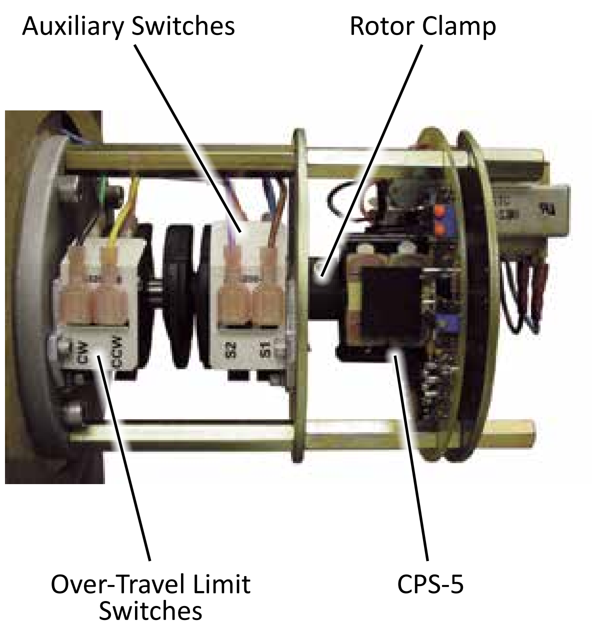
BCP trimfdbk20 mA

CONTROL END

CONTROL END OVERVIEW

The control end contains the devices that monitor the angular position of the output shaft. The position measurement devices can be grouped into three categories.

1. An electronic sensor assembly, named the CPS-5, monitors the position and creates an electrical signal representing the exact shaft location.
2. Cam-operated switches act as internal over-travel limits. These switches act to block motor power when actuated.
3. Cam-operated switches provide open/closed-style position sensing for the external control system. These switches are called Auxiliary switches.



The CPS-5 is a rotary differential transformer capable of providing accurate output shaft position measurements over a range exceeding 100 degrees of output shaft movement. The signal created by the CPS-5 if connected to the DCM-3. Customer access to the signal is through the DCM-3.

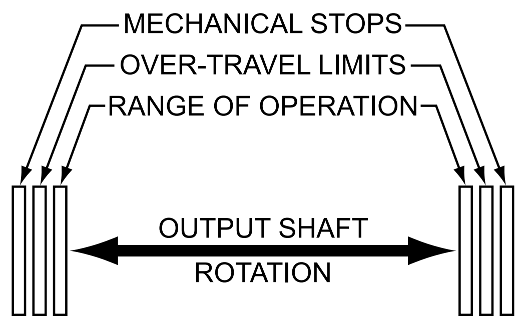
Over-travel limit switches provide electrical limits for Handswitch operation and Automatic operation.

Auxiliary switches are wired to the field wiring terminals in the actuator terminal block compartment. These switches are typically connected to the external control system to be used as needed.

CALIBRATION PRIORITY

Group 11 actuators are equipped with fixed, non-adjustable, built-in mechanical stops. The rotational distance between the stops is several degrees more than the Maximum Output Shaft Rotation rating (page 7). All output shaft rotation occurs within these stops.

The over-travel limit switches are used to limit the electrical control range of the actuator. These switches are cam operated and are set slightly wider apart then the actuator's intended full range of electronic operation. If the actuator's intended full range is 100°, the switch points are set to 101°. If the actuators intended full range is 90°, the switch points are set to 91°. The function of the switches is to let the output shaft move the correct distance for 100% signal change, but prevent the output shaft from moving much further.



DEFAULT CALIBRATION RELATIONSHIP

When changing the settings for the over-travel limit switches, keep in mind that the switch operating points should be kept several degrees from the actuator mechanical stops.

If changing the over-travel limit switch settings as part of a general recalibration, check the CPS-5 calibration before making any switch setting changes that could reduce the full range of output shaft travel.

If the intended full range of travel is less than the Maximum Output Shaft Rotation, the over-travel limit switch settings should be reduced to correspond to the reduced travel range. If the over-travel limit switch settings are not reduced, Handswitch operation in CW or CCW will still result in the original full range of travel. It may be convenient to change the DCM-3 configuration first, then change the switch settings as desired.
For information on reducing the full range of travel, refer to TRAVEL (page 37).

CONTROL END

BEFORE CHANGING THE CONTROL END

Proper control end calibration is important in all modes of actuator operation: Handswitch or Automatic. All Beck actuators are shipped completely calibrated and tested to the customer's specifications that were written into the equipment order. If the need arises to change the actuator calibration, first confirm that the actuator is installed as specified and operating properly before proceeding with the change. Nearly all routine configuration parameters are set in the DCM-3, which is not part of the control end. Before changing the control end, make certain desired changes are not intended to be set in the DCM-3.

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

CPS-5 SIGNAL RANGES

MAXIMUM OUTPUT SHAFT ROTATION	CPS-5 SIGNAL OVER FULL ROTATION
90°	1.2 V dc to 4.8 V dc
100°	1.0 V dc to 5.0 V dc

CPS-5 CALIBRATION

The CPS-5 is a rotary differential transformer capable of providing accurate output shaft position measurements over a range exceeding 100° of output shaft movement. CPS-5 calibration does not change from model to model of Group 11 actuators, and calibration should not be changed as part of end-user configuration. End-user configuration changes are made in the DCM-3.

CPS-5 calibration is defined based on the output shaft moving the Maximum Output Shaft Rotation (page 7). If the maximum is 90°, the signal is defined for 90°. If the maximum is 100°, the signal is defined for 100°. If the maximum is 100° but the travel (refer to Travel, page 36) is reduced to 90°, then the DCM-3 should still be set to the 100° CPS-5 range values, and the DCM-3 Travel parameter will use the appropriate amount of CPS-5 signal.

In all cases, the CPS-5 signal is approximately centered in the range between the actuator mechanical stops, and the CPS-5 output signal has a gain of 0.04 V dc per degree. This creates the calibration definition show in CPS-5 SIGNAL RANGES.

All CPS-5's are calibrated and tested after being assembled into the actuator. Re-calibration should not be necessary.

If calibration is necessary, use the following technique:

1. Establish the center of rotation between the mechanical stops.
2. Working from the center of rotation, establish ends of maximum rotation. This maximum rotation will be either 90° or 100° based on the Maximum Output Shaft Rotation or the actuator model.
3. Measure the CPS-5 output voltage at DCM-3 test points TP1(-) and TP4(+). Refer to DCM-3 Test Points and Resistor (page 88).
4. Adjust the CPS-5 calibration to achieve the correct signals at the ends of maximum rotation. To adjust the CPS-5 span, adjust trim potentiometer "SPAN". To adjust signal offset, shift the CPS-5 rotor position on the control shaft.
5. Make certain the CPS-5 output signal increases as the actuator output shaft moves in a CW direction. Refer to DIRECTION OF OUTPUT SHAFT ROTATION (page 38). If the output signal decreases as the actuator output shaft moves in a CW direction, loosen the CPS-5 rotor, turn the rotor half a turn, and repeat the calibration procedure.

SWITCH ADJUSTMENTS

Limit switches must actuate inside the range of the built-in, non-adjustable mechanical stops to prevent stalling of the motor. Control actuators 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.

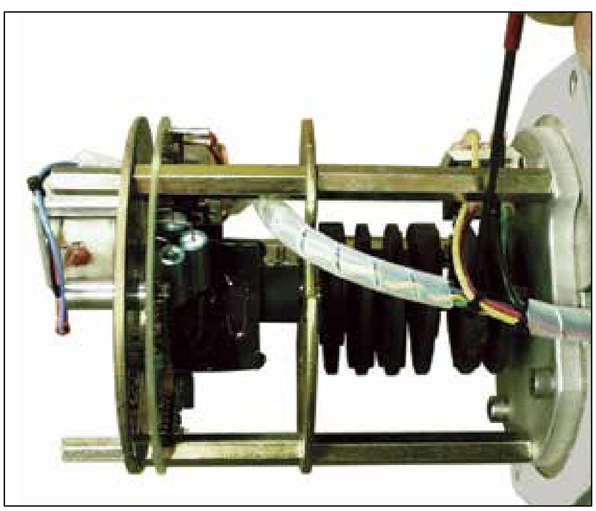
Over-travel limit switch settings should not need adjustment unless the desired range for 100% movement is being changed. Auxiliary switches are set as shown in the figure at left unless otherwise specified at time of order.

Over-travel limit switches and Auxiliary 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.

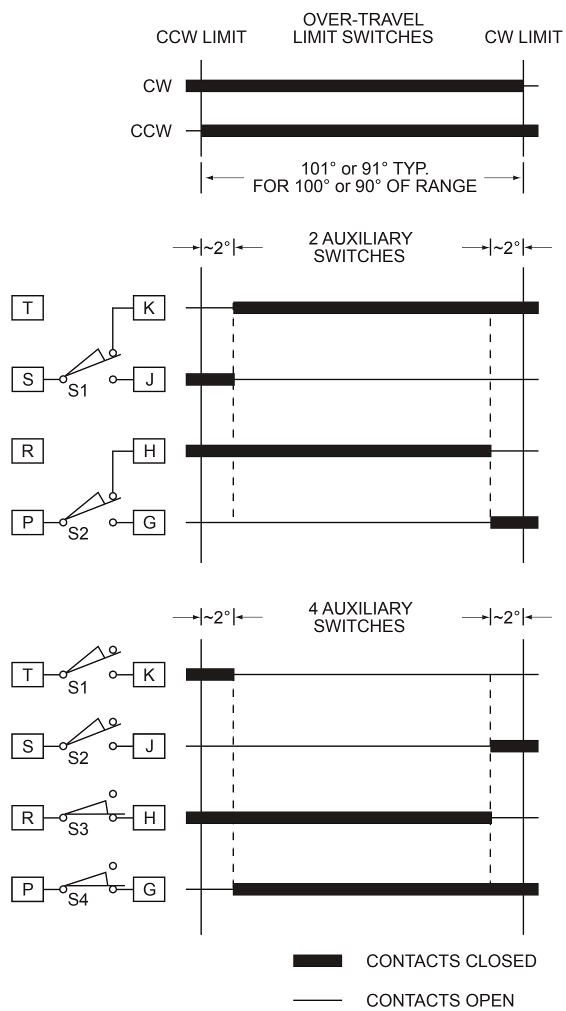
In the following procedure, the use of a continuity meter is recommended to determine when the switch opens or closes. If such a meter is not available, it is possible to hear the switch click as the contacts open and close.

CAUTION

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



ADJUSTING SWITCH CAM



STANDARD OVER-TRAVEL LIMIT AND AUXILIARY SWITCH SETTINGS

CONTROL END

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 actuator fully in each direction, using the electric Handswitch to check switch settings before attempting to change the settings.

Cover bolt sizes and recommended tightening torques are listed in the appropriate outline drawings starting on page 8.

To adjust the CW over-travel limit switch cam:

1. Use a 7/64” hex wrench to loose the cam locking screw. If the screw is not accessible, it may be necessary to rotate the output shaft until the screw is accessible. Adjust the locking screw so the cam is snug but not tight.
2. Move the output shaft to the desired CW limit.
3. Turn the Handswitch to the “STOP” position.
4. Disconnect power from the drive.
5. Check the wiring diagram supplied with the actuator. If the diagram indicates terminals B and U are connected as shown in Typical Wiring Connections (page 18), connect a continuity meter across terminals B and U. Rotate the cam until the meter shows no continuity (switch contacts open, switch clicks).
6. Tighten the cam locking screw to 5 lb-in (.56 N•m) torque.
7. Disconnect meter.
8. Reconnect actuator power.
9. Rotate the drive’s output shaft in the CCW direction away from the CW over-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 moving down to the lower part of the cam. If not correct, rotate the cam 180° and repeat the adjustment procedure.
10. Rotate the output shaft again to the desired CW travel limit. If the stopping point is reached, the switch is properly set.

Adjusting the CCW cam requires the same steps as adjusting the CW cam except the rotation directions are reversed. Check the wiring diagram supplied with the actuator. If the diagram indicates terminals B and V are connected as shown in Typical Wiring Connections (page 18), connect a continuity meter across terminals B and V.

SETTINGAUXILIARYSWITCHES

Standard switch settings for actuators with 2 or 4 auxiliary switches are shown on the diagram on page 43. The heavy line indicates a closed circuit. Auxiliary switches are for use with the external control system, and do not directly interact with the actuator performance. Changing the settings of the Auxiliary switches assumes there is a control system specification controlling the setting of the switches.

Check the wiring diagram supplied with the actuator. The standard settings indicated on page 43 may not apply to the specific actuator on which you are working.

Follow these instructions to change the operating point of auxiliary switches:

1. Use a 7/64” hex wrench to loose the cam locking screw. If the screw is not accessible, it may be necessary to rotate the output shaft until the screw is accessible. Adjust the locking screw so the cam is snug but not tight.
2. Move the output shaft to the desired position.
3. Turn the Handswitch to the “STOP” position.
4. Disconnect power from the actuator. Make certain to remove power from the switch terminals.
5. Connect a continuity meter across the appropriate terminals. Check the wiring diagram supplied with the actuator for appropriate field wiring connections for the meter.
6. 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 in the intended direction. If not correct, rotate the cam 180° and repeat the adjustment procedure.

DCM-3 HART® Menus

BECK-MK2 HART DEVICE DESCRIPTION (DD) COMMUNICATOR MENUS FOR THE DCM-3 (SHOWN WITH SAMPLE VALUES)

1 — Online (1)

1 Functions	
2 Position	45.4%
3 Demand	45.4%
4 Loop(Dem)	11.29 mA
5 Trq/Thrust	Disabled
6 Temp	73 degF
7 Feedback	11.30 mA

2 — Functions

1 Setup Checklist
2 Device Information
3 Configuration
4 Statistics
5 Manual Operation
6 Diagnostics
7 Calibration Trim

3A — Setup Checklist

1 Drive S/N*	
2 Drive Dir*	CW Incr
3 Feedback*	Enabled
4 CPS Zero%*	1.000 v
5 PositionUnit*	deg
6 MaxTravel*	100 deg
7 Travel*	100 deg
8 DemRngLwr*	4.00 mA
9 DemRngUpr*	20.00 mA
Dem Curve*	Linear
• • •	
Alarm Mask	0xffffffff

3B — Device Information

1 Tag*	BECK2015
2 Descriptor*	
3 Message*	
4 Model#	11-159
5 Drive S/N*	
6 InstId*	11/05/2015
7 Setup*	11/05/2015
8 Calbrtd*	18/05/2015
9 Review	
Poll addr*	0

3C — Configuration

1 General Setup
2 PositionSensrSetup
3 Demand Setup
4 Feedback Setup
5 Torque Setup
6 Restore to Factory**
7 Use Default Setup**

3D — Statistics

1 Starts	285213
2 Reversals	142606
3 Stalls	0
4 OverTorques	7
5 Pk Torque	107%
6 TotRunTm	32263 S
7 High Temp	135 degF
8 Low Temp	43 degF

3E — Manual Operation

1 Op Mode*	Follow
2 Demand*	42.3%
3 Reset Stall**	

3F — Diagnostics

1 Status
2 Tests
3 CW Torque
4 CCW Torque
5 Alarm Setup
6 RealTimeClock

3G — Calibration Trim

1 PresCPS V*	2.816 v
2 Loop(Dem)*	11.29 mA
3 Feedback*	11.29 mA
4 Trq/Thrust*	3%

4A — Review (3)

4B — General Setup

1 Drive Dir*	CW Incr
2 MaxTravel*	100 deg
3 Travel*	100 deg
4 StepSize*	0.100%
5 Stall Time*	300 S
6 StallProt*	Enabled
7 LimitSwitch*	Accept
8 PositionUnit*	deg
9 Temperature Unit*	degF

4C — PositionSensrSetup

1 Set Pos 0%**	
2 Set Pos 100%**	
3 PresCPS V	2.816 v
4 CPS Zero%*	1.000 v
5 CPS Span	4.000 v
6 CPS RngLwr	1.000 v
7 CPS RngUpr	5.000 v
8 Pos S/N*	454
9 Snsr Dir	CW Incr

4D — Demand Setup

1 DemRngLwr*	4.00 mA
2 DemRngUpr*	20.00 mA
3 Dem Curve*	Linear
4 Dem Curve Spcl	
5 LOS Mode*	Stay
6 LOS Pos*	50.00 %
7 DemLimLwr*	3.20 mA
8 DemLimUpr	21.00 mA

4E — Feedback Setup

1 FB RngLwr*	4.00 mA
2 FB RngUpr*	20.00 mA
3 Feedback*	Enabled
4 FB Curve*	Linear

4F — Torque Setup

1 Trq/Thrust*	Enabled
2 Ovt Prot*	Enabled
3 AlarmLevel*	105%
4 ShutDwnTrq*	150
5 Trq Null*	163 TK
6 Trq Const*	279 TK

4G — Op Mode

Follow*
Hold*
RunCW*
RunCCW*
Stay
Stop*

4H — Status

1 LED Status
2 Operating Status
3 Switch Status
4 Local Cntrl Status
5 Line Freq
6 CW Inhibitors
7 CCW Inhibitors

4I — Tests

1 FB Out Test**
2 Board Self-Test**
3 Identify Device**
4 Board Reset**

4J — CW Torque

1 Segment 1	0%
2 Segment 2	12%
• • •	
Segment 10	66%

4K — CCW Torque

1 Segment 1	5%
2 Segment 2	6%
• • •	
Segment 10	62%

4L — Alarm Setup

1 AlarmPol*	Drops Out
2 Alarm Mask*	

4M — RealTimeClock

1 RTC Day*	8
2 RTC Month*	8
3 RTC Year*	2014
4 Hour (24)*	8
5 Minute*	5

5A — Dem Curve Spcl

1 DemNode1X	0 %
2 DemNode1Y	0 %
3 DemNode2X	5 %
4 DemNode2Y	5 %
• • •	
DemNode21X	100 %
DemNode21Y	100 %

5B — LED Status

Status	OFF
Reverse	OFF
Forward	OFF
Demand	OFF
Position	OFF
Trq/Thrust	OFF
Stall	OFF
Temperature	OFF
FB Open	OFF
Limit	OFF
Acknowledge	OFF

5C — Operating Status

Dem <> Limits	OFF
Pos <> Limits	OFF
Temp <> Limits	OFF
Torq <> Lim	OFF
Ovr Torq Stop	OFF
Stalled	OFF
Feedback Open	OFF
Switch Block	OFF

5D — Switch Status

NOT APPLICABLE TO MODEL GROUP 11

5E — Local Cntrl Status

Calibrate	OFF
Set Pos 100%	OFF
Set Pos 0%	OFF
Set Dem 100%	OFF
Set Dem 0%	OFF

5F — CW Inhibitors

Balance	ON
Supervisory	OFF
Stall	OFF
OverTrq/Thr	OFF
Switch Block	OFF
Bad Pos Sig	OFF
Bad Dem Sig	OFF
Local Cal	OFF

5G — CCW Inhibitors

Balance	ON
Supervisory	OFF
Stall	OFF
OverTrq/Thr	OFF
Switch Block	OFF
Bad Pos Sig	OFF
Bad Dem Sig	OFF
Local Cal	OFF

5H — Alarm Mask

DemandLOS	ON
Trq/Thrust High	OFF
Stall	ON
Trq/Thrust Stop	OFF
Stop/Limit	ON
FeedbackLOS	ON
Temperature	ON
PositionLOS	ON
RTC Fail	ON
Torq/Thrust/MeasFail	OFF
PositionA/D Error	ON
DemandMeasFail	ON
Reserved 1	ON
PositionLOS	ON
TemperatureMeasFail	ON
MemoryFail	ON
InvalButtonPress	ON
DemandTooHigh	ON
DemUnderHART/FF Ctl	ON
DemUnderPAT Ctl	ON

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

* THIS VALUE CAN BE EDITED
** INDICATES AN ACTION RATHER THAN THE VIEWING OR EDITING OF A PARAMETER

(1) THIS IS THE MENU DISPLAYED BY THE HART COMMUNICATOR AT POWER-UP IF COMMUNICATION IS ESTABLISHED

(2) THIS AND OTHER OFFLINE MENUS ARE COMMON TO ALL HART COMMUNICATOR APPLICATIONS - MANY SUBMENUS EXIST

(3) PROVIDES AN EXTENDED LIST OF DRIVE PARAMETERS

DCM-3 HART ® Menus

HART MENUS AND DATA

Menu data included in the DD file defines a logical grouping of data and commands. The grouping uses a “tree” technique, with a root menu that branches into submenus. The root menu, by convention, is called “Online.”

HART masters may use techniques other than the menu tree system to display information. This instruction manual is based on the menu tree system included in the DD.

Menus can contain read/write parameters, read-only parameters, commands, and other menus.

When writing to a parameter, make certain the data is transferred to the slave device and not just recorded in the master. Most masters have a technique to “send” the data.

When reading a parameter, make certain the data is up-to-date. The DD provides information to the master on how often data should be updated, but the master has the responsibility of actually updating the data.

Commands typically tell the slave to change states, and may or may not change parameter data. For example, a HART command can cause the DCM-3 to go through a power-up reset cycle, but that doesn’t necessarily change any parameter data.

The same parameters can appear on multiple menus, and the read/write permission can be different on different menus. The labels used to display parameters can be used for multiple purposes. For example, the label Feedback is used in the Feedback Setup menu to identify if the Feedback function is enabled, and is used in the Online menu to identify the current signal.

Some data items only appear in appropriate circumstances, such as when corresponding hardware is installed in the field device.

MENU TREE

The menu tree to the right is defined in the DD for the DCM-3, but the display is master-dependent. Values shown for various parameters are hypothetical, actual values will differ. Some of the parameters shown in the menus are product configuration dependent; these parameters may not show in some applications.

A cross reference of parameter label to menu block can be found on page 52.

Online Menu (Block 1)

The first line of the Online menu is a link to the remainder of the menu tree. The other lines are the values of the process related parameters.

1 **Function**: The link to the remainder of the menu tree.

2 **Position**: The output shaft position displayed as percent of range. The range is selected with travel and 0% settings. (OUTPUT SHAFT POSITION SENSING, page 36)

3 **Demand**: The Demand signal displayed as percent of range. The range is selected by 0% and 100% values. (DEMAND, page 32)

4 **Loop(Dem)**: The milliamp signal from the customer wiring terminals measured at the DCM-3.

5 **Trq/Thrust**: The present reading of torque applied to the output shaft. (TORQUE SENSING CONFIGURATION, page 30)

6 **Temp**: the ambient temperature of the DCM-3. (TEMPERATURE SENSING, page 28)

7 **Feedback**: The milliamp output signal representing the present position of the output shaft. (SHAFT POSITION OUTPUT SIGNAL, page 38)

Function Menu (Block 2)

This menu allows branching out to the remainder of the menus.

Setup Checklist Menu (Block 3)

This is a summary of the parameters a technician will want to make certain are correct for installing an actuator. Most of these parameters also appear elsewhere in the menu tree, and are gathered here for convenience.

1 **Actuator S/N**: The serial number as shown on the actuator nameplate. (Serial Number, page 5)

2 **Actuator Dir**: The direction the output shaft moves in response to an increasing Demand signal. (DIRECTION OF OUTPUT SHAFT ROTATION, page 37)

3 **Feedback**: Determines whether the analog output signal representing the output shaft positionis enabled. (SHAFT POSITION OUTPUT SIGNAL, page 38)

4 **CPS Zero%**: This is the voltage from the CPS-5 to the DCM-3 that the DCM-3 will interpret as 0% output shaft position (OUTPUT SHAFT 0% POSITION, page 37)

5 **PositionUnit**: For Group 11 this is angular degrees

6 **MaxTravel**: The maximum output shaft rotation for this model of actuator. (OUTPUT SHAFT POSITION SENSING, page 35)

7 **Travel**: Amount of output shaft rotation for 100% signal change. (TRAVEL, page 36)

8 **DemRngLwr**: Signal strength representing 0% Demand. (DEMAND, page 31)

9 **DemRngUpr**: Signal strength representing 100% Demand. (DEMAND, page 31)

10 **Dem Curve**: Whether Demand is interpreted as linear or a curve. (DEMAND SIGNAL CHARACTERIZATION, page 32)

11 **DemLimLwr**: Below this level, the Demand signal is considered invalid. (LOSS OF DEMAND SIGNAL (L.O.S.), page 32)

12 **LOS Mode**: Action on loss of demand signal. (LOSS OF DEMAND SIGNAL (L.O.S.), page 32)

13 **LOS Pos**: Substitute Demand signal under some LOS modes. (LOSS OF DEMAND SIGNAL (L.O.S.), page 32)

14 **FB RngLwr**: Signal strength used to represent 0% shaft position. (CONFIGURING FEEDBACK, page 38)

15 **FB RngUpr**: Signal strength used to represent 100% shaft position. (CONFIGURING FEEDBACK, page 38)

16 **FB Curve**: Whether the Feedback signal is transmitted as linear or a curve. (CONFIGURING FEEDBACK, page 38)

17 **Trq/Thrust**: Whether the torque sensing function is enabled. (TORQUE SENSING CONFIGURATION, page 29)

18 **Trq Null**: The internal DCM-3 signal associated with 0% output shaft torque. (TORQUE SENSING CONFIGURATION, page 29)

19 **Trq Const**: The internal DCM-3 signal span associated with the output shaft torque. (TORQUE SENSING CONFIGURATION, page 29)

20 **AlarmLevel**: The output shaft torque that is interpreted as an over-torque. (Torque Alarms, page 30)

21 **Ovt Prot**: Whether the actuator motor will be turned off on severe over-torque conditions. (Torque Alarms, page 30)

22 **ShutDwnTrq**: The output shaft torque that is interpreted as a severe over-torque. (Torque Alarms, page 30)

23 **StallProt**: Whether actuator motor will be turned off if the Stall Time counter expires. (STALL PROTECTION, page 28)

24 **Stall Time**: The amount of time the motor will run before Stall Protection is initiated. (STALL PROTECTION, page 28)

25 **Temperature Unit**: Unit of measure for temperature sensing. (TEMPERATURE SENSING, page 27)

26 **StepSize**: The typical smallest Demand change that will cause an output shaft movement. (STEP SIZE, page 27)

27 **LimitSwitch**: Modifies the behavior of Stop/Limit alarm. (STOP/LIMIT INDICATION, page 28)

28 **AlarmPol**: Whether the solid state relay opens on alarm or closes on alarm. (ALARM OUTPUT CONFIGURATION, page 30)

29 **Alarm Mask**: Which alarms cause the solid state relay to change state. (ALARM OUTPUT CONFIGURATION, page 30)

Device Information Menu (Block 4)

The Device Information menu is primarily documentation information.

1 **Tag**: Label used by the HART system to identify the specific field device. Tag does not affect actuator operation. Tag can be written by the HART network

2 **Descriptor**: A text field required by the HART system, but with no formal HART definition on a use. Descriptor does not affect actuator operation. Descriptor can be written by the HART network

cont'd

Alarm Output Config., cont'd

3 **Message**: A text field required by the HART system, but with no formal HART definition on a use. Message does not affect actuator operation. Message can be written by the HART network

4 **Model#**: A field that is created within the DCM-3 by examining Actuator S/N. If this field does not match the model of actuator, change Actuator S/N

5 **Actuator S/N**: The serial number as shown on the actuator nameplate. (Serial Number, page 5)

6 **InstId**: The installation date. This is entered by a technician, and has not affect on actuator operation

7 **Setup**: The setup date has no affect on actuator operation

8 **Calbrtd**: The calibration date has no affect on actuator operation

9 **Review**: Link to the Review menu

10 **Poll addr**: HART uses this address to find the actuator. (Parallel Connected Operation, page 20)

Configuration Menu (Block 5)

This menu provides links to menus that contain common application-specific parameters, and contains two commands to use factory-defined configurations.

1 **General Setup:** Link to General Setup menu

2 **PositionSensrSetup**: Link to PositionSensrSetup menu

3 **Demand Setup**: Link to Demand Setup menu

4 **Feedback Setup**: Link to Feedback Setup menu

5 **Torque Setup**: Link to Torque Setup menu

6 **Restore to Factory**: Allows the technician to restore all field configurable parameters back to the settings in effect when the DCM-3 was shipped from the factory. (Restore Factory Configuration, page 27)

7 **Use Default Setup**: Allows a technician to change the DCM-3 position sensing voltage ranges to the proper ranges for the actuator model. (OUTPUT SHAFT POSITION SENSING, page 35).

Statistics Menu (Block 6)

The Statistics menu allows a technician to gauge workload and operating conditions of the actuator.

1 **Starts**: The total number of motor starts.

2 **Reversals**: The total number of times the motor has started in the direction opposite to the previous start.

3 **Stalls**: The total number of times the stall timer has timed out. (STALL PROTECTION, page 28)

4 **OverTorques**: The total number of times the first level of alarm has been reached. (Torque Alarms, page 30)

5 **Pk Torque**: The highest recorded torque on the output shaft. (TORQUE SENSING CONFIGURATION, page 29)

6 **TotRunTm**: Total amount of time the motor has been powered.

7 **High Temp**: Highest temperature recorded in the DCM-3 compartment. (TEMPERATURE SENSING, page 27)

8 **Low Temp**: Lowest temperature recorded in the DCM-3 compartment. (TEMPERATURE SENSING, page 27)

Manual Operation Menu (Block 7)

The Manual Operation menu provides for controlling the actuator with digital data carried on the HART interface. It includes a command to reset the Stall function.

1 **Op Mode**: Determines whether DCM-3 should use the analog Demand signal or a digital signal as the source for actuator control. (Op Mode parameter, page 32)

2 **Demand**: This displays the Demand when Op Mode is Follow, or sets the Demand when Op Mode is Hold.

3 **Reset Stall**: A method for resetting the Stall alarm. (STALL PROTECTION, page 28)

Diagnostics Menu (Block 8)

This menu includes paths to menus that allow investigation of actuator problems, access to self-test routines, detailed output shaft loading history, and alarm output relay setup.

Calibration Trim Menu (Block 9)

The Calibration Trim menu lists parameters that are dependent on signal interface circuits. The circuits can be adjusted for accuracy through this menu. Changing the calibration trim can cause signal measurement difficulties if improper trimming is performed.

1 **PresCPS V**: Displays and/or trims the DCM-3 voltage sensing of the CPS-5 shaft position signal as measured at DCM-3 test points TP1(-) and TP4(+) (refer to page 88). This trim is set and tested at the factory. Changing this trim can cause voltage measurement errors.

2 **Loop(Dem)**: Displays and/or trims the DCM-3 Demand sensing circuit. (DCM-3 ANALOG SIGNAL CALIBRATION/TRIM, page 40)

3 **Feedback**: Displays and/or trims the DCM-3 Feedback current sourcing circuit. (DCM-3 ANALOG SIGNAL CALIBRATION/TRIM, page 40)

4 **Trq/Thrust**: This is a "short cut" that allows a technician to set the 0% torque parameter (Trq Null) by removing load from the output shaft, then writing a "0" to this value. (TORQUE SENSING CONFIGURATION, page 29)

Review Menu (Block 10)

The Review menu allows a technician to view a large number of parameters in a summary format. In compliance with HART Communication Foundation recommendations, parameters cannot be edited in the Review menu.

General Setup Menu (Block 11)

The General Setup menu contains parameters that determine the overall actuator performance.

1 **Actuator Dir**: The direction the output shaft moves in response to an increasing Demand signal. (DIRECTION OF OUTPUT SHAFT ROTATION, page 37)

2 **MaxTravel**: The maximum output shaft rotation for this model of actuator. (OUTPUT SHAFT POSITION SENSING, page 35)

3 **Travel**: Amount of output shaft rotation for 100% signal change. (TRAVEL, page 36)

4 **StepSize**: The typical smallest Demand change that will cause an output shaft movement. (STEP SIZE, page 27)

5 **Stall Time**: The amount of time the motor will run before Stall Protection is initiated. (STALL PROTECTION, page 28)

6 **StallProt**: Whether actuator motor will be turned off if the Stall Time counter expires. (STALL PROTECTION, page 28)

7 **LimitSwitch**: Modifies the behavior of Stop/Limit alarm. (STOP/LIMIT INDICATION, page 28)

8 **PositionUnit**: for Group 11 this is angular degrees

9 **Temperature Unit**: Unit of measure for temperature sensing. (TEMPERATURE SENSING, page 27)

PositionSensrSetup Menu (Block 12)

This menu contains parameters that determine how the DCM-3 interprets the output shaft position signal from the CPS-5.

1 **Set Pos 0%**: Instructs the DCM-3 to change the 0% position to match the present output shaft position. This does not change Travel. (OUTPUT SHAFT 0% POSITION, page 37)

2 **Set Pos 100% Span**: Instructs the DCM-3 to change Travel so the present output shaft position is 100%. This does not change the 0% position. (TRAVEL, page 36)

3 **PresCPS V**: Displays the output shaft position voltage signal at the DCM-3 from the CPS-5. (OUTPUT SHAFT POSITION SENSING, page 35)

4 **CPS Zero%**: This is the voltage from the CPS-5 to the DCM-3 that the DCM-3 will interpret as 0% output shaft position (OUTPUT SHAFT 0% POSITION, page 37)

5 **CPS Span**: The voltage span from the CPS-5 for the maximum rotation of the output shaft. This is the upper range voltage less the lower range voltage. (OUTPUT SHAFT POSITION SENSING, page 35)

6 **CPS RngLwr**: The CPS-5 voltage signal corresponding to the CCW end of rotation when Travel is set to the maximum rotation.

7 **CPS RngUpr**: The CPS-5 voltage signal corresponding to the CW end of rotation when Travel is set to the maximum rotation

8 **Pos S/N**: A sequential number up to approximately 16 million that indicates the serial number of the CPS-5. Using this field is optional.

9 **Snsr Dir**: The direction of output shaft rotation that causes the CPS-5 signal to increase. Except in some custom configurations, this direction should always be CW.

Demand Setup Menu (Block 13)

The parameters on this menu determine the signal range and the characterization of the Demand. It includes the parameters that determine behavior when the Demand signal is absent.

1 **DemRngLwr**: Signal strength representing 0% Demand. (DEMAND, page 31)

2 **DemRngUpr**: Signal strength representing 100% Demand. (DEMAND, page 31)

cont'd

Alarm Output Config., cont'd

3 **Dem Curve**: Whether Demand is interpreted as linear or a curve. (DEMAND SIGNAL CHARACTERIZATION, page 33)

4 **Dem Curve Spcl**: Link to the Dem Curve Spcl menu

5 **LOS Mode**: Action on loss of demand signal. (LOSS OF DEMAND SIGNAL (L.O.S.), page 33)

6 **LOS Pos**: Substitute Demand signal under some LOS modes. (LOSS OF DEMAND SIGNAL (L.O.S.)

7 **DemLimLwr**: Below this level, the Demand signal is considered invalid. (LOSS OF DEMAND SIGNAL (L.O.S.), page 33)

8 **DemLimUpr**: Above this level, the Demand signal is considered invalid. The Demand alarm will be asserted until the signal is brought below this level

Feedback Setup Menu (Block 14)

Feedback Setup menu parameters that control the enable/disable state of the DCM-3 Feedback signal that represents the output shaft position, and the parameters that control the scaling.

1 **FB RngLwr**: Signal strength used to represent 0% shaft position. (CONFIGURING FEEDBACK, page 39)

2 **FB RngUpr**: Signal strength used to represent 100% shaft position. (CONFIGURING FEEDBACK, page 39)

3 **Feedback**: Determines whether the analog output signal representing the output shaft position is enabled. (SHAFT POSITION OUTPUT SIGNAL, page 39)

4 **FB Curve**: Whether the Feedback signal is transmitted as linear or a curve. (CONFIGURING FEEDBACK, page 39)

Torque Setup Menu (Block 15)

These parameters control the enable/disable state of the torque sensing, along with the scaling and the action to be taken if an over-torque exists.

1 **Trq/Thrust**: Whether the torque sensing function is enabled. (TORQUE SENSING CONFIGURATION, page 30)

2 **Ovt Prot**: Whether the actuator motor will be turned off on severe over-torque conditions. (Torque Alarms, page 31)

3 **AlarmLevel**: The output shaft torque that is interpreted as an over-torque. (Torque Alarms, page 31)

4 **ShutDwnTrq**: The output shaft torque that is interpreted as a severe over-torque. (Torque Alarms, page 31)

5 **Trq Null**: The internal DCM-3 signal associated with 0% output shaft torque. (TORQUE SENSING CONFIGURATION, page 30)

6 **Trq Const**: The internal DCM-3 signal span associated with output shaft torque. (TORQUE SENSING CONFIGURATION, page 30)

Status Menu (Block 16)

This menu provides a path to parameters that monitor the operational status of the actuator. Refer to page 50. It also includes the display of one parameter.

5 **Line Freq**: The power line frequency as measured by the DCM-3

Tests Menu (Block 17)

The Tests menu provides access to some routines that help determine if the actuator is running properly.

1 **FB Out Test**: Allows a technician to manually vary the Feedback output signal to check operation and accuracy. (SHAFT POSITION OUTPUT SIGNAL, page 39)

2 **Board Self-Test**: Instructs the DCM-3 to check various power and sensing circuits. This test should not be run unless sudden output shaft movements are allowable

3 **Identify Device**: Sends a HART command to the DCM-3 that causes the ACKNOWLEDGE LED to flash. This is to make certain the HART system is addressing the correct actuator

4 **Board Reset**: Causes the DCM-3 to go through a reset cycle similar to a power-up reset. This test should not be run unless sudden output shaft movements are allowable

CW Torque Menu (Block 18)

This menu displays the peak output shaft torque measured for 10 segments. (TORQUE STATISTICS, page 31). These torque values were measured with the motor running and moving the output shaft CW.

CCW Torque Menu (Block 19)

This menu displays the peak output shaft torque measured for 10 segments. (TORQUE STATISTICS, page 31). These torque values were measured with the motor running and moving the output shaft CCW.

Alarm Setup Menu (Block 20)

The Alarm Setup menu parameters allow modification of the behavior of the alarm output solid state relay.

1 **AlarmPol**: Whether the solid state relay opens on alarm or closes on alarm. (ALARM OUTPUT CONFIGURATION, page 31)

2 **Alarm Mask**: Which alarms cause the solid state relay to change state. (ALARM OUTPUT CONFIGURATION, page 31)

Real Time Clock Menu (Block 21)

The Real Time Clock menu allows setting of the real time clock inside the DCM-3. The real time clock does not influence actuator performance.

1 RTC Day: Day of the month (numeric value)

2 RTC Month: Month (numeric value)

3 RTC Year: Year (4 digits)

4 Hour (24): Hour of the day (24 hour format)

5 Minute: Minute of the hour (0 through 59)

Dem Curve Spcl Menu (Block 22)

This menu allows setting the Demand characterization nodes. (SETTING DEMAND SIGNAL CHARACTERIZATION, page 33)

LED Status Parameter (Block 23)

The LED Status parameter allows remote checking of which LED's on the DCM-3 are illuminated.

Operating Status Parameter (Block 24)

The Operating Status parameter is a summary of whether process-related conditions are inside or outside of anticipated limits. These conditions control the STATUS INDICATION LEDs (page 27).

1 **Demand**: Typically caused by the Demand signal falling below acceptable levels. (LOSS OF DEMAND SIGNAL (L.O.S.), page 33)

2 **Position**: Caused by the CPS-5 signal being outside the range anticipated by the DCM-3. (OUTPUT SHAFT POSITION SENSING, page 36)

3 **Temperature**: The ambient temperature of the DCM-3 is outside of the rating. (TEMPERATURE SENSING, page 28)

4 **Torque**: The first alarm level of torque is being exceeded. (Torque Alarms, page 31)

5 **Over-Torque Stop**: Over-torque protection is preventing the DCM-3 from running the motor. (Torque Alarms, page 31)

6 **Stalled**: A Stall alarm is active. (STALL PROTECTION, page 29)

7 **Feedback Open**: The Feedback signal is enabled, but cannot flow the proper current. (CONFIGURING FEEDBACK, page 39)

8 **Switch Block**: The DCM-3 cannot power the motor due to an electro-mechanical switch. Check the Handswitch and over-travel limit switches.

Switch Status Parameter (Block 25)

This parameter indicates which switches are being actuated. Group 11 actuators do not use this parameter.

Local Cntrl Status Parameter (Block 26)

This parameter allows remote monitoring of which buttons on the local configuration interface are being pressed. (PUSHBUTTON CONTROLS, page 26)

CW Inhibitors Parameter (Block 27)

This parameter allows a technician to view exactly what DCM-3 condition is preventing the actuator motor from running in the CW direction. Refer to Inhibitors Table (page 73).

CCW Inhibitors Parameter (Block 28)

This parameter allows a technician to view exactly what DCM-3 condition is preventing the actuator motor from running in the CCW direction. Refer to Inhibitors Table (page 73).

Alarm Mask Parameter (Block 29)

Alarm Mask parameter shows which alarms will cause the alarm out solid state relay to activate. (ALARM OUTPUT CONFIGURATION, page 31)

DCM-3 HART® Menus

HART Parameter Cross Reference

Menu Block Ref	Parameter Label	Menu Label
3	Alarm Mask	Setup Checklist
20	Alarm Mask	Alarm Setup
8	Alarm Setup	Diagnostics
3	AlarmLevel	Setup Checklist
15	AlarmLevel	Thrust Setup
3	AlarmPol	Setup Checklist
20	AlarmPol	Alarm Setup
17	Board Reset	Tests
17	Board Self-Test	Tests
4	Calbrtd	Device Information
2	Calibration Trim	Functions
16	EXT Inhibitors	Status
8	EXT Thrust	Diagnostics
2	Configuration	Functions
12	CPS RngLwr	PositionSensrSetup
12	CPS RngUpr	PositionSensrSetup
12	CPS Span	PositionSensrSetup
3	CPS Zero%	Setup Checklist
12	CPS Zero%	PositionSensrSetup
16	RET Inhibitors	Status
8	RET Thrust	Diagnostics
3	Dem Curve	Setup Checklist
13	Dem Curve	Demand Setup
13	Dem Curve Spcl	Demand Setup
1	Demand	Online
7	Demand	Manual Operation
5	Demand Setup	Configuration
3	DemLimLwr	Setup Checklist
13	DemLimLwr	Demand Setup
13	DemLimUpr	Demand Setup
22	DemNode10X	Dem Curve Spcl
22	DemNode10Y	Dem Curve Spcl
22	DemNode11X	Dem Curve Spcl
22	DemNode11Y	Dem Curve Spcl
22	DemNode12X	Dem Curve Spcl
22	DemNode12Y	Dem Curve Spcl
22	DemNode13X	Dem Curve Spcl
22	DemNode13Y	Dem Curve Spcl
22	DemNode14X	Dem Curve Spcl
22	DemNode14Y	Dem Curve Spcl
22	DemNode15X	Dem Curve Spcl
22	DemNode15Y	Dem Curve Spcl
22	DemNode16X	Dem Curve Spcl
22	DemNode16Y	Dem Curve Spcl
22	DemNode17X	Dem Curve Spcl
22	DemNode17Y	Dem Curve Spcl
22	DemNode18X	Dem Curve Spcl
22	DemNode18Y	Dem Curve Spcl
22	DemNode19X	Dem Curve Spcl
22	DemNode19Y	Dem Curve Spcl
22	DemNode1X	Dem Curve Spcl
22	DemNode1Y	Dem Curve Spcl
22	DemNode20X	Dem Curve Spcl
22	DemNode20Y	Dem Curve Spcl
22	DemNode21X	Dem Curve Spcl
22	DemNode21Y	Dem Curve Spcl
22	DemNode2X	Dem Curve Spcl
22	DemNode2Y	Dem Curve Spcl
22	DemNode3X	Dem Curve Spcl
22	DemNode3Y	Dem Curve Spcl
22	DemNode4X	Dem Curve Spcl
22	DemNode4Y	Dem Curve Spcl
22	DemNode5X	Dem Curve Spcl
22	DemNode5Y	Dem Curve Spcl
22	DemNode6X	Dem Curve Spcl
22	DemNode6Y	Dem Curve Spcl
22	DemNode7X	Dem Curve Spcl
22	DemNode7Y	Dem Curve Spcl
22	DemNode8X	Dem Curve Spcl
22	DemNode8Y	Dem Curve Spcl
22	DemNode9X	Dem Curve Spcl
22	DemNode9Y	Dem Curve Spcl
3	DemRngLwr	Setup Checklist
13	DemRngLwr	Demand Setup
3	DemRngUpr	Setup Checklist
13	DemRngUpr	Demand Setup
4	Descriptor	Device Information
2	Device Information	Functions
2	Diagnostics	Functions
3	Drive Dir	Setup Checklist
11	Drive Dir	General Setup
3	Drive S/N	Setup Checklist
4	Drive S/N	Device Information
3	FB Curve	Setup Checklist
14	FB Curve	Feedback Setup
17	FB Out Test	Tests
3	FB RngLwr	Setup Checklist
14	FB RngLwr	Feedback Setup
3	FB RngUpr	Setup Checklist
14	FB RngUpr	Feedback Setup
1	Feedback	Online
3	Feedback	Setup Checklist
9	Feedback	Calibration Trim
14	Feedback	Feedback Setup
5	Feedback Setup	Configuration
1	Functions	Online
5	General Setup	Configuration
6	High Temp	Statistics

21	Hour (24)	RealTimeClock
17	Identify Device	Tests
4	InstId	Device Information
16	LED Status	Status
3	LimitSwitch	Setup Checklist
11	LimitSwitch	General Setup
16	Line Freq	Status
16	Local Cntrl Status	Status
1	Loop(Dem)	Online
9	Loop(Dem)	Calibration Trim
3	LOS Mode	Setup Checklist
13	LOS Mode	Demand Setup
3	LOS Pos	Setup Checklist
13	LOS Pos	Demand Setup
6	Low Temp	Statistics
2	Manual Operation	Functions
3	MaxTravel	Setup Checklist
11	MaxTravel	General Setup
4	Message	Device Information
21	Minute	RealTimeClock
4	Model#	Device Information
7	Op Mode	Manual Operation
16	Operating Status	Status
6	OverTorques	Statistics
3	Ovt Prot	Setup Checklist
15	Ovt Prot	Thrust Setup
6	Pk Torque	Statistics
4	Poll addr	Device Information
12	Pos S/N	PositionSensrSetup
1	Position	Online
5	PositionSensrSetup	Configuration
3	PositionUnit	Setup Checklist
11	PositionUnit	General Setup
9	PresCPS V	Calibration Trim
12	PresCPS V	PositionSensrSetup
8	RealTimeClock	Diagnostics
7	Reset Stall	Manual Operation
5	Restore to Factory	Configuration
6	Reversals	Statistics
4	Review	Device Information
21	RTC Day	RealTimeClock
21	RTC Month	RealTimeClock
21	RTC Year	RealTimeClock
18	Seg 1	CW Torque
19	Seg 1	CCW Torque
18	Seg 10	CW Torque
19	Seg 10	CCW Torque
18	Seg 2	CW Torque
19	Seg 2	CCW Torque

18	Seg 3	CW Torque
19	Seg 3	CCW Torque
18	Seg 4	CW Torque
19	Seg 4	CCW Torque
18	Seg 5	CW Torque
19	Seg 5	CCW Torque
18	Seg 6	CW Torque
19	Seg 6	CCW Torque
18	Seg 7	CW Torque
19	Seg 7	CCW Torque
18	Seg 8	CW Torque
19	Seg 8	CCW Torque
18	Seg 9	CW Torque
19	Seg 9	CCW Torque
12	Set Pos 0%	PositionSensrSetup
12	Set Pos 100% Span	PositionSensrSetup
4	Setup	Device Information
2	Setup Checklist	Functions
3	ShutDwnTrq	Setup Checklist
15	ShutDwnTrq	Thrust Setup
12	Snsr Dir	PositionSensrSetup
3	Stall Time	Setup Checklist
11	Stall Time	General Setup
3	StallProt	Setup Checklist
11	StallProt	General Setup
6	Stalls	Statistics
6	Starts	Statistics
2	Statistics	Functions
8	Status	Diagnostics
3	StepSize	Setup Checklist
11	StepSize	General Setup
16	Switch Status	Status
4	Tag	Device Information
1	Temp	Online
3	Temperature Unit	Setup Checklist
11	Temperature Unit	General Setup
8	Tests	Diagnostics
5	Torque Setup	Configuration
6	TotRunTm	Statistics
3	Travel	Setup Checklist
11	Travel	General Setup
3	Trq Const	Setup Checklist
15	Trq Const	Thrust Setup
3	Trq Null	Setup Checklist
15	Trq Null	Thrust Setup
3	Trq Snsr	Setup Checklist
15	Trq Snsr	Thrust Setup
1	Trq/Thrust	Online
9	Trq/Thrust	Calibration Trim
5	Use Default Setup	Configuration

DCM-3 HART® Messages

Common HART Messages

HART protocol maintains both standard and device-specific informational messages that are displayed on the HART master when various conditions occur. Below is a table of typical Beck actuator messages and message sequences. It does not include all possible messages, only the most common.

Output Shaft Position Measurement Messages

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 position signal from the CPS-5, as measured at the DCM-3, is outside the design or calibrated range. This message should be accompanied by a Beck-specific message with more detail.
The Position Signal is less than -5% or greater than 105%.	This Beck-specific message indicates the DCM-3 is reading a CPS-5 signal that is not within the expected calibration range. Refer to OUTPUT SHAFT POSITION SENSING (page 35).
Position signal in LOS.	This is a Beck-specific message. The DCM-3 is reading a CPS-5 signal that is outside of the range associated with a functional CPS-5. Refer to OUTPUT SHAFT POSITION SENSING (page 36).
Position out of accurate measurement range.	This is a Beck-specific message. The DCM-3 is reading a CPS-5 signal that is outside of the range for accurate measurements. Refer to OUTPUT SHAFT POSITION SENSING (page 36).
Position sensing error.	This is a Beck-specific message. The DCM-3 circuitry for measuring the CPS-5 signal does not appear to be functioning properly.
Analog output 1 and its digital representation are outside the operating range limits, and not responding to input.	This is a standard HART®-defined message that appears whenever the position signal from the CPS-5, as measured at the DCM-3, is outside the range for accurate measurements. Refer to OUTPUT SHAFT POSITION SENSING (page 36). This message should be accompanied by a Beck-specific message with more detail.

Handswitch and Over-travel Limit Switch Message

Message	Description
Motor power is blocked, check switches.	This message will appear if a condition beyond control of the DCM-3 microcomputer prevents current flow to the motor. Refer to STOP/LIMIT INDICATION (page 29).

Stall Protection Message

Message	Description
Stall condition has been detected (see "Stall Time" in the "General Setup" menu).	This is a Beck-specific message indicating that the Stall Protection timer has determined an alarm exists. Refer to STALL PROTECTION (page 29).

Demand, Torque and Temperature Measurement 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 the Demand signal, Torque, or Temperature are outside their design or calibrated ranges. This message should be accompanied by a Beck-specific message with more detail.
The Demand Signal is outside of the intended limits (see Demand Setup menu).	This Beck-specific message indicates the Demand signal is invalid. Refer to LOSS OF DEMAND SIGNAL (L.O.S.) (page 33).
Demand out of accurate measurement range.	This is a Beck-specific message. The Demand signal is out of the reliable measurement range. The lower and upper limits are 0.1 V dc and 5.5 V dc, respectively. Note that current input DCM-3 boards utilize a 250 Ohm input resistor to convert the current signal to voltage.
Demand Signal is out of limit.	This Beck-specific message indicates the Demand signal is too high to measure accurately. The upper limits is 5.5 V dc. Note that current input DCM-3 boards utilize a 250 Ohm input resistor to convert the current signal to voltage.
Demand sensing error.	This is a Beck-specific message. The Demand sensing circuitry does not appear to be functioning properly.
The Torque/Thrust is greater than the output rating.	This Beck-specific message defines an output shaft torque overload problem. Refer to Torque Alarms (page 31).
Motor power has been removed due to excessive output torque.	This Beck-specific message indicates the DCM-3 has removed power from the motor due to excessive output shaft torque load. The Handswitch must be in AUTO mode for this alarm to be accurate. Refer to Torque Alarms (page 31).
Torque/Thrust out of accurate measurement range.	This is a Beck-specific message. The DCM-3 is not able to read a valid signal from the Torque sensor. Check the Torque sensing cable. Refer to Torque Alarms (page 31).
Torque/Thrust sensing error.	This is a Beck-specific message. The DCM-3 circuitry for measuring the Torque signal does not appear to be functioning properly. Check the Torque sensing cable. Refer to Torque Alarms (page 31).
The temperature is outside of -40°F to 185°F.	This is a Beck-specific message indicating that the temperature at the DCM-3 is outside of the acceptable range. Refer to TEMPERATURE SENSING (page 28).
Temperature out of accurate measurement range.	This is a Beck-specific message. The DCM-3 ambient temperature reading is extreme to the point of uncertainty.
Temperature A/D Fail.	This is a Beck-specific message. The DCM-3 circuitry for measuring the ambient temperature does not appear to be functioning properly.
The Feedback Signal is enabled but the loop is open.	This is a Beck-specific message indicating that the Feedback sourcing circuit is unable to create the proper signal current. Refer to CONFIGURING FEEDBACK (page 39).

DCM-3 HART ® Messages

Questionable Configuration Messages

Message	Description
Analog output 1 and its digital representation are in fixed mode, and not responsive to input changes.	This is a standard HART-defined message that appears whenever the Feedback signal has been manually assigned a value. Refer to FB Out Test: (page 50). This message should be accompanied by a Beck-specific message with more detail.
Feedback is in fixed mode.	This is a Beck-specific message indicating that the Feedback output signal is in a manually controlled mode, and probably does not represent the output shaft position. Refer to FB Out Test: (page 50).
Local control button pressed while locked-out.	This is a Beck-specific message indicating an incorrect combination of pushbuttons is being pressed on the local configuration interface, or the local control interface is disabled an a pushbutton is being pressed.
Loop Current Detected while under HART/FF Control.	This is a Beck specific alarm message that alerts the user that analog current is present on the Demand terminals, but the DCM-3 is in an Op Mode expecting digital control. Make certain the Op Mode parameter is set properly. Refer to Op Mode parameter (page 33).
Loop Current Detected while set for LOS PAT.	This is a Beck specific alarm message that alerts the user that analog current is present on the Demand terminals, but the DCM-3 is set to a LOS mode intended to be used without an analog signal. Refer to LOSS OF DEMAND SIGNAL (L.O.S.) (page 33).

DCM-3 Failure Messages

Message	Description
Real Time Clock hardware failure.	This is a Beck-specific message. The data in the Real Time Clock appears invalid. Refer to Real Time Clock Menu (page 51).
FRAM Memory has failed.	This is a Beck-specific message. The continuous built-in self-test cannot verify the memory for statistics information is operating properly.
Memory failure.	This is a Beck-specific message. The continuous built-in self-test cannot verify the microcomputer is operating properly.

Miscellaneous HART-Defined Messages

Message	Description
Field device has more status available.	This is a standard HART-defined message that appears whenever the DCM-3 signals the HART master that an alarm or other undesirable status exists. This is the HART protocol mechanism for displaying the other messages displayed in this section. If this message is displayed without an additional message, the status cleared before the HART master read the additional status.
A reset or self test of the field device has occurred, or power has been removed and reapplied.	This message is presented by the HART master if the DCM-3 has gone through a power-up reset sequence since the last communication with the master. This message is only displayed once after a reset.
A modification has been made to the configuration of the field device.	This message indicates that the DCM-3 has undergone a configuration change since the last time the HART master has reset the change flag. Many HART masters disregard the flag and do not report this message.
Field device has malfunctioned due to a hardware error or failure.	This message indicates that the continuous built-in self-test cannot verify the microcomputer is operating properly.

FOUNDATION FIELDBUS Parameters

FOUNDATION FIELDBUS PARAMETER PRESENTATION

The Beck DCM-3 parameters are accessed through five Foundation Fieldbus blocks: Resource, Transducer, Analog Out, Analog In 1, and Analog In 2. All of the blocks except the Transducer Block are standard Foundation Fieldbus blocks. The Transducer block is a custom block, and is the access path to most Beck-specific information. For more information on the other blocks, refer to Foundation Fieldbus Communication Overview (page 18).

Foundation Fieldbus networks are able to access the information in the standard blocks using data structure information provided by the Fieldbus Foundation. In order to access the data in the Transducer Block, a Device Description (DD) file is required.

The DD is used by fieldbus access tools to identify Beck-specific information. The DD for Foundation Fieldbus contains a set of menus which are similar to the HART menus, and provides a data list for the Transducer Block. Depending on the access tool, the menus may not be available to the technician. Also, the presentation of the data list varies significantly from system to system.

Some data in the Transducer Block is contained in groups of data called Records. Record names are included in the data list presented here in case the access tool emphasizes the record structure. The notation NameA: NameB is intended to indicate record A contains parameter B.

Some access tools can be customized to present certain data pieces in certain windows. If more data appears in the list supplied here than in the list in the access tool, check alternate windows or views.

CHANGING PARAMETER VALUES

Foundation Fieldbus distinguishes between parameters that are read-write and parameters that are read-only. There is also a technique of writing parameters as a command action. The command actions write values but do not read values. The Beck DD uses these three parameter classifications.

Parameters that are read-only cannot be written at any time. If the fieldbus access tools provide for automatic updating of values, the values should update without manual intervention. The Beck DCM-3 always provides up-to-date parameter information.

Parameters that are read-write can be changed by the technician, but changes have restrictions.

Some fieldbus access tools may apply restrictions based on user names or passwords. The Beck DCM-3 does not implement restrictions of this sort.

Foundation Fieldbus allows most changes to be blocked unless the mode of the block is set to OOS (Out of Service). The Beck DD uses this OOS requirement to protect the system from changes during loop operation. Therefore, parameter writes are blocked unless the mode is set to OOS.

PARAMETER LISTING

Two presentations of the Transducer Block are shown on the following pages. The first listing is in the order the data is listed in the DD. The second listing is an index to allow a person to find a parameter by label, then from that identify the data in the first listing.

In the first listing, the Relative Index column is for reference purposes only, and does not indicate an exact line count or computer index-value.

Parameters that are members of records are shown by the record index followed by the parameter label. Parameters that are not members of records are shown simply as the label name.

In the second listing, the parameters are shown in alphabetical order. The Relative Index-value can be used to find the parameter in the first listing.

RELATIONSHIP AMONG BLOCKS

The five Foundation Fieldbus blocks include three that are function blocks (Analog Out and two Analog In), the Resource Block, and the Transducer Block. The Resource Block contains access to some hardware level functions, but is not used in normal operation of the DCM-3. The Transducer Block and the three function blocks interact to operate the actuator.

In general, the Transducer Block establishes the configuration of the DCM-3 and the function blocks provide real time access for control and monitoring. The Transducer Block also displays the real time values some parameters in function blocks.

CONTROLING THE ACTUATOR: ANALOG OUT

The Analog Out function block provides cascade control of the actuator. Because this is a standard Foundation Fieldbus AO function block, the operation of the block is the same as other standard AO blocks. Using this block requires knowledge of the relationship of the AO parameters to the Transducer Block and the Beck DCM-3 configuration.

Two of the AO parameters are particularly important in the Beck application: CAS_IN and PV. CAS_IN is read by the DCM-3 as the Demand signal. PV is read from the DCM-3 as the actual position of the output shaft.

Both the Demand and the actual shaft position are also available in the Transducer Block. Demand is available as Demand % (reference line 15), and the actual output shaft position is available as Position % (reference line 13).

Other parameters in the Transducer Block are related to the Demand and Position. Some of the parameters modify the actuator performance and some of the parameters give additional details.

One of the most important Transducer Block parameters is the parameter for determining the rotation direction of the output shaft in response to an increasing Demand signal. This parameter is in the Info 2 record, and is called Actuator Dir. The formal name is Info 2: Actuator Dir.

These related parameters are informational:

Demand Unit	read-only
Position Unit	read-only
Position(deg/in/mm)	deg for Group 11
CPS Ranges:CPS Output Unit	read only
CPS Ranges:CPS Span	page 36
MaxTravel(deg/in/mm)	page 36
Position Limits: PosLwrLim	page 36
Position Limits: PosUprLim	page 36
Position Sense:Pres V	
Position Sense:Unit	
SigDif:DemPosDiff	
SigDif:DemPosDiff Unit	
Unit Select(deg/in/mm)	

These parameters change the operation:

Op Mode

CPS Ranges:CPS Zero%

CPS Ranges:CPS RngLwr

CPS Ranges:CPS RngUpr

Demand Source

Demand Curve

Info 2:Actuator Dir

Info 2:StepSize

Info 2:Max Error

Snsr Dir

Travel(deg/in/mm)

Transducer Block Listing

Relative Index	Record Name (if applicable): Parameter Label	Use
1	ST_REV	fieldbus use, no Beck use
2	TAG_DESC	fieldbus use, no Beck use
3	STRATEGY	fieldbus use, no Beck use
4	ALERT_KEY	fieldbus use, no Beck use
5	MODE_BLK	typically Auto or CASCADE (page 19)
6	BLOCK_ERR	fieldbus use
7	EVENT_UPDATE	fieldbus use
8	BLOCK_ALM	fieldbus use
9	TRANSDUCER_DIRECTORY	fieldbus use
10	TRANSDUCER_TYPE	fieldbus use
11	XD_ERROR	fieldbus use
12	COLLECTION_DIRECTORY	fieldbus use
13	Position %	present actuator position (page 61)
14	Position Unit	unit of measure for Position %
15	Demand %	present actuator Demand (page 61)
16	Demand Unit	unit of measure for Demand %
17	Op Mode	Demand Operating Mode (page 33)
18	Trq/Thr %	present output shaft Torque load (page 30)
19	Trq/Thr Unit	unit of measure for output shaft Torque
20	Ambient Temp	present DCM-3 temperature (page 28)
21	Temp Unit	unit of measure for Ambient temperature (page 28)
22-1	Inhibits: CCW 2 Inhibitor	not used in Group 11
22-2	Inhibits: CCW 1 Inhibitor	reason motor is not rotating output shaft CCW (page 73)
22-3	Inhibits: CW 2 Inhibitor	not used in Group 11
22-4	Inhibits: CW 1 Inhibitor	Reason motor is not rotating output shaft CW (page 73)
22-5	Inhibits: LED Status	allows remote checking of which LED's on the DCM-3 are illuminated
22-6	Inhibits: Switch Status	not used in Group 11
23-1	DCM BIST: Operating Status	summary of process-related conditions (page 74)
23-2	DCM BIST: BIST 1	built-in self-test results (page 74)
23-3	DCM BIST: BIST 2	built-in self-test results (page 75)
23-4	DCM BIST: BIST 3	built-in self-test results (page 75)
23-5	DCM BIST: analog_output_fixed1	not used in Group 11
23-6	DCM BIST: Analog Sig Saturated	analog signals are out of measurement range (page 75)
24-1	SigDif: DemPosDiff Unit	unit of measure for DemPosDiff
24-2	SigDif: DemPosDiff	the difference between the Demand and the Position
25-1	Statistics: TotalRunTm	total amount of time the motor has been powered.
25-2	Statistics: OverTrqs/Thrusts	the total number of times the first level of alarm has been reached. (Torque Alarms, page 31)
25-3	Statistics: Peak Trq/Thr	the highest recorded torque on the output shaft. (TORQUE SENSING CONFIGURATION, page 30)
25-4	Statistics: Reversals	the total number of times the motor has started in the direction opposite to the previous start.
25-5	Statistics: Stalls	the total number of times the stall timer has timed out. (STALL PROTECTION, page 29)
25-6	Statistics: Starts	the total number of motor starts
25-7	Statistics: LastRun	the duration of the last motor movement
25-8	Statistics: Set up OverTrqs/Thrusts	the number of over-torques during the installation period
25-9	Statistics: Set up Peak Trq/Thr	the peak torque during the installation period

26-1	Ambient Extreme: High	highest temperature recorded in the DCM-3 compartment. (TEMPERATURE SENSING, page 28)
26-2	Ambient Extreme: Low	lowest temperature recorded in the DCM-3 compartment. (TEMPERATURE SENSING, page 28)
27-1	Ambient Rating: Temp Lwr Lim	temperature allowed before alarm asserted (page 28)
27-2	Ambient Rating: Temp Upr Lim	temperature allowed before alarm asserted (page 28)
28	Position(deg/in/mm)	Position % (Relative Index 13) expressed in engineering units of degrees
29	Unit Select(deg/in/mm)	unit of measure for Position (Relative Index 28), always deg for Group 11
30-1	Position Sense: Unit	unit of measure for DCM-3 sensing circuit that receives the signal from the CPS-2, always volts
30-2	Position Sense: Pres V	displays the output shaft position voltage signal at the DCM-3 from the CPS-2. (OUTPUT SHAFT POSITION SENSING, page 36)
31-1	CPS Ranges: CPS Output Unit	unit of measure for CPS-2 output signal to the DCM-3, always volts
31-2	CPS Ranges: CPS Zero%	this is the voltage from the CPS-2 to the DCM-3 that the DCM-3 will interpret as 0% output shaft position (OUTPUT SHAFT 0% POSITION, page 38)
31-3	CPS Ranges: CPS Span	the voltage span from the CPS-2 for the maximum rotation of the output shaft. This is simply the upper range voltage minus the lower range voltage. (OUTPUT SHAFT POSITION SENSING, page 36)
31-4	CPS Ranges: CPS RngLwr	the CPS-2 voltage signal corresponding to the CCW end of rotation when Travel is set to the maximum rotation.
31-5	CPS Ranges: CPS RngUpr	the CPS-2 voltage signal corresponding to the CW end of rotation when Travel is set to the maximum rotation.
32-1	Position Limits: PosLwrLim	Position Lower Limit, the signal in percent allowed before an alarm is asserted (page 36)
32-2	Position Limits: PosUprLim	Position Upper Limit, the signal in percent allowed before an alarm is asserted (page 36)
33	Snsr Dir	the direction of output shaft rotation that causes the CPS-2 signal to increase. Except in some custom configurations, this direction should always be CW.
34	MaxTravel(deg/in/mm)	the maximum output shaft rotation for this model of actuator. (OUTPUT SHAFT POSITION SENSING, page 36)
35	Travel(deg/in/mm)	amount of output shaft rotation for 100% signal change. (TRAVEL, page 37)

36-1	CW Trq/Thr: 1	max torque, output shaft rotating CW, seg 1 (page 31)
36-2	CW Trq/Thr: 2	max torque, output shaft rotating CW, seg 2 (page 31)
36-3	CW Trq/Thr: 3	max torque, output shaft rotating CW, seg 3 (page 31)
36-4	CW Trq/Thr: 4	max torque, output shaft rotating CW, seg 4 (page 31)
36-5	CW Trq/Thr: 5	max torque, output shaft rotating CW, seg 5 (page 31)
36-6	CW Trq/Thr: 6	max torque, output shaft rotating CW, seg 6 (page 31)
36-7	CW Trq/Thr: 7	max torque, output shaft rotating CW, seg 7 (page 31)
36-8	CW Trq/Thr: 8	max torque, output shaft rotating CW, seg 8 (page 31)
36-9	CW Trq/Thr: 9	max torque, output shaft rotating CW, seg 9 (page 31)
36-10	CW Trq/Thr: 10	max torque, output shaft rotating CW, seg 10 (page 31)
37-1	CW Trq/Thr Pos: 1	position in seg 1 where max torque was measured
37-2	CW Trq/Thr Pos: 2	position in seg 2 where max torque was measured
37-3	CW Trq/Thr Pos: 3	position in seg 3 where max torque was measured
37-4	CW Trq/Thr Pos: 4	position in seg 4 where max torque was measured
37-5	CW Trq/Thr Pos: 5	position in seg 5 where max torque was measured
37-6	CW Trq/Thr Pos: 6	position in seg 6 where max torque was measured
37-7	CW Trq/Thr Pos: 7	position in seg 7 where max torque was measured
37-8	CW Trq/Thr Pos: 8	position in seg 8 where max torque was measured
37-9	CW Trq/Thr Pos: 9	position in seg 9 where max torque was measured
37-10	CW Trq/Thr Pos: 10	position in seg 10 where max torque was measured
38-1	CCW Trq/Thr: 1	max torque, output shaft rotating CCW, seg 1 (page 31)
38-2	CCW Trq/Thr: 2	max torque, output shaft rotating CCW, seg 2 (page 31)
38-3	CCW Trq/Thr: 3	max torque, output shaft rotating CCW, seg 3 (page 31)
38-4	CCW Trq/Thr: 4	max torque, output shaft rotating CCW, seg 4 (page 31)
38-5	CCW Trq/Thr: 5	max torque, output shaft rotating CCW, seg 5 (page 31)
38-6	CCW Trq/Thr: 6	max torque, output shaft rotating CCW, seg 6 (page 31)
38-7	CCW Trq/Thr: 7	max torque, output shaft rotating CCW, seg 7 (page 31)
38-8	CCW Trq/Thr: 8	max torque, output shaft rotating CCW, seg 8 (page 31)
38-9	CCW Trq/Thr: 9	max torque, output shaft rotating CCW, seg 9 (page 31)
38-10	CCW Trq/Thr: 10	max torque, output shaft rotating CCW, seg 10 (page 31)
39-1	CCW Trq/Thr Pos: 1	position in seg 1 where max torque was measured
39-2	CCW Trq/Thr Pos: 2	position in seg 2 where max torque was measured
39-3	CCW Trq/Thr Pos: 3	position in seg 3 where max torque was measured
39-4	CCW Trq/Thr Pos: 4	position in seg 4 where max torque was measured
39-5	CCW Trq/Thr Pos: 5	position in seg 5 where max torque was measured
39-6	CCW Trq/Thr Pos: 6	position in seg 6 where max torque was measured
39-7	CCW Trq/Thr Pos: 7	position in seg 7 where max torque was measured
39-8	CCW Trq/Thr Pos: 8	position in seg 8 where max torque was measured
39-9	CCW Trq/Thr Pos: 9	position in seg 9 where max torque was measured
39-10	CCW Trq/Thr Pos: 10	position in seg 10 where max torque was measured
40	Trq/Thr	whether the torque sensing function is enabled. (TORQUE SENSING CONFIGURATION, page 30)
41	Trq/Thr AlarmLevel	the output shaft torque that is interpreted as an over-torque. (Torque Alarms, page 31)
42	Trq/Thr Shut Dn Level	the output shaft torque that is interpreted as a severe over-torque. (Torque Alarms, page 31)
43	Trq/Thr Sensor Unit	unit of measure for torque alarm levels, always percent
44-1	Trq/Thr Range: Trq/Thr Null	the internal DCM-3 signal associated with 0% output shaft torque. (TORQUE SENSING CONFIGURATION, page 30)
44-2	Trq/Thr Range: Trq/Thr Const	the internal DCM-3 signal span associated with the output shaft torque. (TORQUE SENSING CONFIGURATION, page 30)
45	Trq/Thr Cal Unit	a custom unit defined for the DCM-3 internal torque signal

FOUNDATION FIELDBUS *Transducer Block*

46	Drive S/N	the serial number as shown on the actuator nameplate. (Serial Number, page 5)
47	Model#	a field that is created within the DCM-3 by examining Drive S/N. If this field does not match the model of actuator, change Drive S/N.
48	Type	a broad classification of DCM-3 type based on Drive S/N
49-1	Info 1: Shaft Dir	not used on Group 11
49-2	Info 1: Geometry	classification of output shaft movement: linear or rotary
49-3	Info 1: Embed Mem	not used on Group 11
49-4	Info 1: groupNumber	Beck Group number based on Drive S/N
49-5	Info 1: HandSwType	identifies whether Handswitch is a full power bypass of the DCM-3 or a low voltage input to the DCM-3
49-6	Info 1: LimSwType	identifies whether the over-travel limit switches act to block motor power or are low voltage inputs to the DCM-3
49-7	Info 1: modelNumber	model number based on Drive S/N
49-8	Info 1: Gear Ratio	not used on Group 11
49-9	Info 1: Gear Units	not used on Group 11
49-10	Info 1: Motor Poles	not used on Group 11
49-11	Info 1: Pole Units	not used on Group 11
49-12	Info 1: OutRating	not used on Group 11
49-13	Info 1: Output Units	not used on Group 11
49-14	Info 1: StrainGage	not used on Group 11
49-15	Info 1: StrainUnits	not used on Group 11
49-16	Info 1: ScrewTrav	not used on Group 11
49-17	Info 1: ScrewTravUnits	not used on Group 11
50-1	Info 2: LocalCntrl	not used on Group 11 for Foundation Fieldbus
50-2	Info 2: LOS Mode	not used on Group 11 for Foundation Fieldbus
50-3	Info 2: LOS Pos	not used on Group 11 for Foundation Fieldbus
50-4	Info 2: LimitSwitch	modifies the behavior of Stop/Limit alarm. (STOP/LIMIT INDICATION, page 31)
50-5	Info 2: Trq/Thr Protect	whether the actuator motor will be turned off on severe over-torque conditions. (Torque Alarms, page 31)
50-6	Info 2: StepSize	the typical smallest Demand change that will cause an output shaft movement. (STEP SIZE, page 28)
50-7	Info 2: Max Error	if the Demand signal doesn't change and a technician moves the Handwheel back and forth, this is the theoretical maximum movement translated to the output shaft.
50-8	Info 2: Drive Dir	the direction the output shaft moves in response to an increasing Demand signal. (DIRECTION OF OUTPUT SHAFT ROTATION, page 38)
50-9	Info 2: Stall Time	the amount of time the motor will run before Stall Protection
50-10	Info 2: Handswitch	the Handswitch is always enabled
51	StallProtect	whether actuator motor will be turned off if the Stall Time counter expires. (STALL PROTECTION, page 29)
52-1	Info 3: Flag Status	a copy of some date from the DCM BIST parameters
52-2	Info 3: Operating Status Alt	a copy of some date from the DCM BIST parameters
52-3	Info 3: Present Freq	not used on Group 11
52-4	Info 3: DC Volts	not used on Group 11
52-5	Info 3: Line Freq	the power line frequency as measured by the DCM-3
53	Power	the Group 11 is designed for 1-phase power
54	Max Freq	not used on Group 11
55	MaxTravelTm:	not used on Group 11
56	Feedback	with fieldbus, only used for special retrofit applications (page 39)

57-1	Alarm Contact: Polarity	whether the solid state relay opens on alarm or closes on alarm. (ALARM OUTPUT CONFIGURATION, page 31)
57-2	Alarm Contact: Mask 1	which alarms cause the solid state relay to change state. (ALARM OUTPUT CONFIGURATION, page 31)
57-3	Alarm Contact: Mask 2	which alarms cause the solid state relay to change state.
58	Demand Source	in Group 11 fieldbus applications, should read HART/FF
59	Demand Curve	whether Demand is interpreted as linear or a curve. (DEMAND SIGNAL CHARACTERIZATION, page 33)
60-1	DemNode1: DemNode1X	allows setting the Demand characterization nodes. (SETTING DEMAND SIGNAL CHARACTERIZATION, page 34)
60-2	DemNode1: DemNode1Y	
61-1	DemNode2: DemNode2X	
61-2	DemNode2: DemNode2Y	
62-1	DemNode3: DemNode3X	
62-2	DemNode3: DemNode3Y	
63-1	DemNode4: DemNode4X	
63-2	DemNode4: DemNode4Y	
64-1	DemNode5: DemNode5X	
64-2	DemNode5: DemNode5Y	
65-1	DemNode6: DemNode6X	
65-2	DemNode6: DemNode6Y	
66-1	DemNode7: DemNode7X	
66-2	DemNode7: DemNode7Y	
67-1	DemNode8: DemNode8X	
67-2	DemNode8: DemNode8Y	
68-1	DemNode9: DemNode9X	
68-2	DemNode9: DemNode9Y	
69-1	DemNode10: DemNode10X	
69-2	DemNode10: DemNode10Y	
70-1	DemNode11: DemNode11X	
70-2	DemNode11: DemNode11Y	
71-1	DemNode12: DemNode12X	
71-2	DemNode12: DemNode12Y	
72-1	DemNode13: DemNode13X	
72-2	DemNode13: DemNode13Y	
73-1	DemNode14: DemNode14X	
73-2	DemNode14: DemNode14Y	
74-1	DemNode15: DemNode15X	
74-2	DemNode15: DemNode15Y	
75-1	DemNode16: DemNode16X	
75-2	DemNode16: DemNode16Y	
76-1	DemNode17: DemNode17X	
76-2	DemNode17: DemNode17Y	
77-1	DemNode18: DemNode18X	
77-2	DemNode18: DemNode18Y	
78-1	DemNode19: DemNode19X	
78-2	DemNode19: DemNode19Y	
79-1	DemNode20: DemNode20X	
79-2	DemNode20: DemNode20Y	
80-1	DemNode21: DemNode21X	
80-2	DemNode21: DemNode21Y	

81	Device Status	a copy of some date from the DCM BIST parameters
82-1	Misc Status: analog_output_fixed2	not used on Group 11 for Foundation Fieldbus
82-2	Misc Status: analog_output_fixed3	not used on Group 11 for Foundation Fieldbus
82-3	Misc Status: analog_output_saturated2	not used on Group 11 for Foundation Fieldbus
82-4	Misc Status: analog_output_saturated3	not used on Group 11 for Foundation Fieldbus
82-5	Misc Status: xmtr_specific_status_4	not used on Group 11 for Foundation Fieldbus
82-6	Misc Status: xmtr_specific_status_5	not used on Group 11 for Foundation Fieldbus
83-1	Installed Features: Pot Supply	not used on Group 11 for Foundation Fieldbus
83-2	Installed Features: FB Out	not used on Group 11 for Foundation Fieldbus
83-3	Installed Features: Trq/Thr Snsr	not used on Group 11 for Foundation Fieldbus
84	Board Mfd	a reference manufacture date entered by Beck, has no affect on actuator operation
85	Calbrtd	the calibration date has no affect on actuator operation
86	Setup	the setup date has no affect on actuator operation
87-1	RT Clock: Day	real time clock, day of month, has no affect on actuator operation
87-2	RT Clock: Month	real time clock, month, has no affect on actuator operation
87-3	RT Clock: Year	real time clock, year, has no affect on actuator operation
87-4	RT Clock: Hour (24)	real time clock, hour (24 hour format), has no affect on actuator operation
87-5	RT Clock: Minute	real time clock, minute, has no affect on actuator operation
87-6	RT Clock: Second	real time clock, second, has no affect on actuator operation
87-7	RT Clock: rtc_status	not used on Group 11 for Foundation Fieldbus
88-1	Beck Software Info: DCM Software Rev	number used by Beck for version tracking purposes
88-2	Beck Software Info: Checksum	number used by Beck for version tracking purposes
89	Device ID	number used by Beck for DCM-3 tracking purposes
90	Status	a text message sent from the DCM-3 to summarize DCM-3 status
91	Reset Settings	reset the DCM-3 microcomputer (page 67)
92	Write Protect	allows or prevents changes to the DCM-3 configuration
93	Reset Changed Flag	resets the “configuration changed” flag in Device Status, has no effect on actuator performance
94	Perform Test	instructs the DCM-3 to check various power and sensing circuits. This test should not be run unless sudden output shaft movements are allowable.
95	Reset	this reset simulates switching the power off and back on
96	Identify	causes an LED on the DCM-3 to flash to indicate the DCM-
97	Reset Stall	a method for resetting the Stall alarm. (STALL PROTECTION, page 29)

RESET SETTINGS

The parameter causes an action. There are three choices:

1 **Recall factory settings**: this returns the DCM-3 to the configuration as shipped from the factor. (Restore Factory Configuration, page 28).

2 **Use Model Defaults**: update the DCM-3 configuration related to the CPS-5 signals based on the model number. (Setting Model Defaults, page 36).

3 **Reset Board**: this reset simulates switching the power off and back on.

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DemNode1Y	60-2
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DemNode21Y	80-2
DemNode2X	61-1
DemNode2Y	61-2
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TROUBLESHOOTING

DIAGNOSTICS

Several different diagnostic tools exist. This instruction manual includes several flow charts that can be used with or without the aid of a computer interface. If available, Foundation Fieldbus, HART, and the Beck Configuration Port can each provide significant help finding problems.

To begin diagnosing a situation, a technician should consider the following questions.

1. What seems wrong? Does the output shaft position reflect the Demand signal? Is output shaft movement irregular? Is the DCM-3 configuration correct?
2. Can the problem be categorized? Is the control system unsettled? Is there a mechanical problem? Does the problem appear electrical?
3. What is the condition of the control system? Is the actuator in the process of being installed? Has the process changed? Does the actuator have proper power and proper signals from the control system?

CHECKING HANDSWITCH OPERATION

The Handswitch on the Group 11 actuator bypasses the DCM-3 circuit board. When troubleshooting the actuator, the Handswitch can be used to help determine if there is a problem with the DCM-3 or with other components of the actuator.

In practice, if the actuator does not appear to be operating properly in Auto mode (MODES OF OPERATION, page 22), a technician can try the Handswitch to see if the actuator runs properly with the Handswitch.

Proper operation is described as runs in both directions, starts well, runs in the correct direction, run smoothly, and stops at the appropriate over-travel limit switch (Control End Overview, page 41).

If proper Handswitch operation is observed, proceed with troubleshooting the actuator electronics. Some indication of the problem can be seen by observing the power (PWR) and three status LED’s on the DCM-3. For information on these LED’s refer to Troubleshooting Using Local LED’s (page 68). Detailed information for Foundation Fieldbus DCM-3’s is found on page 69 and for HART DCM-3’s is found on page 72.

If Handswitch operation is improper, analyze the symptoms.

1. An actuator that runs in one direction but not the other is probably having difficulty with an over-travel limit switch.
2. An actuator that is starting poorly and often runs in the wrong direction is probably having trouble with the motor resistor-capacitor.
3. If the motor direction is correct but the actuator is not starting smoothly, there is probably too much torque load on the output shaft.

NOTE: The field wiring terminal block connections mentioned here are for the typical system. Check the wiring diagram that came with the specific actuator.

If one of the quick descriptions does not lead to the solution, follow the Handswitch power path. Power is connected to the actuator at terminal B. Terminal C connects through to the DCM-3. Terminal C is also connected to terminal A through a top side jumper. Terminal A connects through to the Handswitch. For the Handswitch to run the motor, power has to be present at terminal A.

Power is routed through the Handswitch to terminals U or V. Terminal U is powered in CW. Terminal V is powered in CCW. With either terminal powered, a reflected voltage will show at the other terminal because of the motor windings and the motor resistor-capacitor. This reflected voltage is typically a lower reading than the line power applied between terminals A and B.

With the Handswitch in CW, the voltage from terminal U to terminal B should measure the same as the line power applied to terminals A and B. With the CW switch closed, the voltage from terminal U to terminal B should be the same as the voltage from either side of the CW switch to terminal B.

With the Handswitch in CCW, the voltage from terminal V to terminal B should measure the same as the line power applied to terminals A and B. With the CCW switch closed, the voltage from terminal V to terminal B should be the same as the voltage from either side of the CW switch to terminal B.

The motor does not have any internal switching mechanisms. If there is voltage on the motor and the motor does not respond, the motor requires service.

TROUBLESHOOTING USING LOCAL LEDs

All DCM-3's include built-in self-test routines that run continuously. These routines can simplify the troubleshooting process.

Detail 1: The PWR (power) LED.

Is the PWR LED illuminated? The PWR LED should be illuminated whenever power is connected to the actuator. A cleared fuse on the DCM-3 does not prevent the PWR from lighting. The PWR LED being illuminated does not mean power is within specification. The LED will illuminate with approximately 70V ac applied to the actuator.

Is the PWR LED pulsing? The PWR LED should be changing brightness approximately each second (60 times per minute). This brightness change indicates that the self-test routines are running and have not found any errors in the DCM-3 microcomputer operation. This does not mean all the process variables are within acceptable limits or that the DCM-3 is operating exactly correctly, but does mean that the onboard microcomputer is running properly.

Detail 2: The FWD and REV LEDs

If the DCM-3 is trying to run the motor, either the FWD or the REV LED's should be illuminated. If the motor is running without one of the LED's illuminated, then either the DCM-3 is being bypassed (perhaps by the Handswitch), or the power output stage of the DCM-3 is "stuck" on.

The FWD and REV LED's indicate the signal level comparison between the Demand and the output shaft position (as measured by the CPS-5). FWD illuminated indicates the Demand is higher. REV illuminated indicates Demand is lower. Both OFF indicates either the signals are balanced, or that the DCM-3 has detected some status that prevents the motor from being run.

Detail 3: The STAT LED

The STAT (status) LED indicates the DCM-3 is aware of a problem. The severity of the problem is not immediately apparent through the STAT LED. Problems can range from relatively minor to major.

The following table lists the alarms and what the alarm means with regard to stopping the motor.

Y – alarm stops motor
N – alarm does not stop motor
C – circumstances and configuration matter
R – result of switch stopping motor

Alarm	Stop Motor?	Refer to Page	Local Configuration Panel LED
Demand LOS	C	33	DEMAND
DemandMeasFail	C		DEMAND
DemandTooHigh	C		DEMAND
DemUnderHART/FF Ctl	C		DEMAND
DemUnderPAT Ctl	C		DEMAND
Torq/Thrust High	N	31	TRQ/THRUST
Torq/Thrust Stop	Y	31	TRQ/THRUST
Torq/ThrustMeasFail	N	31	TRQ/THRUST
Stall	Y	29	STALL
Stop/Limit	R	29	STOP/LIMIT
FeedbackLOS	N	39	FEEDBACK
Temperature	N	28	TEMP
PositionLOS	Y	36	POSITION
PositionA/D Error	Y		POSITION
RTC Fail	N		—
TemperatureMeasFail	N		TEMP
MemoryFail	N		—

TROUBLESHOOTING USING FF

The actuator should run the motor so the output shaft position matches the Demand signal. If the output shaft does not reach the desired location, there are three questions to answer:

1. Check the Demand signal. Is the DCM-3 receiving the correct Demand signal?
2. Check the shaft position. Does the DCM-3 think the output shaft position matches the Demand signal?
3. If the position doesn't match the Demand, why doesn't the DCM-3 run the motor?

FIRST CHECKS

The Foundation Fieldbus version of the DCM-3 includes a fieldbus-powered interface to permit fieldbus access to the DCM-3 operational parameters. Whenever fieldbus signaling voltage is available on the fieldbus, this interface will respond to fieldbus communication, but access to the DCM-3 parameters requires that 120V ac (or 240V ac, if appropriate) is available at the actuator power terminals.

All configuration and diagnostic settings are controlled by the fieldbus network. Therefore, the Foundation Fieldbus DCM-3 does not have a local configuration interface or the associated status LED's. It does have the standard Overview LED's and the Beck Configuration Port (page 24).

If the fieldbus connections are correct and the AC power connections are absent, the actuator will appear on the network, but the fieldbus function blocks will not update properly and the Transducer Block will not go into Auto. If the AC power connections are correct and the fieldbus connections are absent, the actuator will not operate as expected and will not appear on the network.

If the fieldbus connections are correct and the AC power connection is correct, the actuator should appear on the network, the DCM-3 FIELDBUS ACTIVE LED should blink, and the DCM-3 PWR LED should pulse. If the LED's are not as described, the DCM-3 is not operating properly.

For DCM-3 to respond properly to the Demand signal,, the Resource Block and Transducer Block must both be in Auto mode, and the Analog Output Block must be in Cascade mode. Refer to Foundation Fieldbus Communication Overview (page 18).

CHECKING DEMAND

In Foundation Fieldbus systems, Demand is communicated to the DCM-3 as a percentage value through the CAS_IN input of the Analog Output function block. Using a communicator, the Demand should be readable as the process applied to that signal line. Also, the status of the CAS_IN signal should be Good.

For the CAS_IN signal line to be accepted by the Analog Output function block, the Analog Output Function Block must be in Cascade mode. Make certain the Beck Resource Block and Transducer Block modes are both Auto.

With the proper signal applied to the Analog Output block and the proper modes, the Demand value should readable in the Transducer Block as Demand %. Also, the OpMode parameter in the Transducer Block should read Hold.

If these conditions are not as described, the DCM-3 is not accepting the correct Demand signal. Refer to Foundation Fieldbus Communication Overview (page 18).

CHECKING SHAFT POSITION

The output shaft position can be read as the PV parameter of the Analog Output Block, and can be read as Position % in the Transducer Block.

Does Position % match Demand %? The exactness of the match is controlled by the parameter Step Size (page 28). If they match, the DCM-3 is not running the motor because the signals appear to match.

If the signals match, the next question is whether Position % is correct for the actual output shaft position. Refer to OUTPUT SHAFT POSITION SENSING (page 36). The CPS-5 signal voltage as measured by the DCM-3 is available in the Transducer Block as parameter Position Sense. The actual voltage can be measured with a voltage meter between test points TP4(+) and TP1(-). Refer to DCM-3 Test Points and Resistor (page 88).

POSITION AND DEMAND MISMATCH

If the shaft position and the Demand do not match and the motor is not running, then some factor is preventing the DCM-3 from running the motor. The fieldbus interface provides extensive information for finding this factor.

The Transducer Block contains two parameters that summarize why the motor is not running: one parameter for CW and one for CCW. The parameter names are CW Inhibitor and CCW Inhibitor. If the parameter is 0 (has not bits set), the motor should run that direction. If the parameter is not 0, the DCM-3 will not try to run the motor that direction. The bits that show in the parameter are the reasons the motor is not running that direction.

INHIBITORS

Label	Cause of Motor Not Running	Page
OverTrq/Thrust	Excessive torque load on output shaft.	31
Balance	Demand indicates motor should not run this direction.	38
Stall	Stall.	29
Supervisory	The DCM-2 is initializing.	
Switch Block	Not used on Group 11 actuators.	
Bad Pos Sig	The Position signal from the CPS-2 is not acceptable.	36
Bad Dem Sig	Not used on fieldbus systems.	
Local Cal	Not used on fieldbus systems.	

If the inhibitor parameter is 0 but the motor is not running, power to the motor is being blocked by something over which the DCM-3 microcomputer has no control. Possibility 1 listed below should lead to a Stall alarm (page 28). The other possibilities should create a Stop/Limit alarm (page 28).

1. The motor is stalled, and cannot rotate. This condition is unlikely if the motor operated properly with the Handswitch. For more information on the Handswitch, refer to Checking Handswitch Operation (page 67).
2. The Handswitch or an Over-travel Limit Switch is preventing power from reaching the motor. Make certain the Handswitch is in AUTO. The Handswitch and the DCM-3 both use the same over-travel limits, so if the limits do not prevent Handswitch operation, they should not prevent DCM-3 operation.
3. Wire jumpers are missing from terminals F-N and terminals D-M on the field wiring terminal block. Most installations of Group 11 actuators with Foundation Fieldbus compatibility require these wire jumpers. Check the wiring diagram that came with the specific actuator.
4. The output section of the DCM-3 is not delivering power to the motor.
5. The DCM-3 fuse is cleared. This fuse is rated at more than twice the motor current, and the Beck motor has no significant inrush current. Therefore, only in very rare circumstances is the fuse cleared. These circumstances are generally wiring errors during customer installation. For the fuse location, refer to DCM-3 LAYOUT (page 23).

BUILT-IN SELF-TEST (BIST)

The DCM-3 microcomputer continuously runs diagnostic routines in the background. These routines look for situations that could indicate the DCM-3 is not working reliably. Examples of tests are:

- whether a power failure has occurred
- if the motor should be running, is there motor current?
- does the temperature sensor appear to be functioning properly?

There are many built-in self-test routines. To simplify identifying test results, the tests are separated into five categories.

BIST: OPERATING STATUS

The Operating Status parameter is a summary of whether process-related conditions are inside or outside of anticipated limits. These conditions control the STATUS INDICATION LEDs (page 26).

9 **Position**: caused by the CPS-5 signal being outside the range anticipated by the DCM-3. (OUTPUT SHAFT POSITION SENSING, page 35)

10 **Temperature**: the ambient temperature of the DCM-3 is outside of the rating. (TEMPERATURE SENSING, page 27)

11 **Torque**: the first alarm level of torque is being exceeded. (Torque Alarms, page 30)

12 **Over-Torque Stop**: over-torque protection is preventing the DCM-3 from running the motor. (Torque Alarms, page 30)

13 **Stalled**: a Stall alarm is active. (STALL PROTECTION, page 28)

14 **Feedback Open**: the Feedback signal is enabled, but cannot flow the proper current. (CONFIGURING FEEDBACK, page 38)

15 **Switch Block**: the DCM-3 cannot power the motor due to an electro-mechanical switch. Check the Handswitch and over-travel limit switches.

BIST: BIST 1

Real Time Clock hardware failure
The data in the Real Time Clock appears invalid. Refer to Real Time Clock Menu (page 51).

Torque/Thrust sensing error
The DCM-3 circuitry for measuring the Torque signal does not appear to be functioning properly. Check the Torque sensing cable. Refer to Torque Alarms (page 30).

Position sensing error
The DCM-3 circuitry for measuring the CPS-5 signal does not appear to be functioning properly.

Demand processing error
The Demand signal appears to have a data format error.

FRAM Memory has failed
The continuous built-in self-test cannot verify the memory for statistics information is operating properly.

Position signal in LOS
The DCM-3 is reading a CPS-5 signal that is outside of the range associated with a functional CPS-5. Refer to OUTPUT SHAFT POSITION SENSING (page 35).

Temperature A/D Fail
The DCM-3 circuitry for measuring the ambient temperature does not appear to be functioning properly.

Memory failure
The continuous built-in self-test cannot verify the microcomputer is operating properly.

BIST: BIST 2

Local control activity detected
The microcomputer has detected an data error related to the local configuration interface. This interface is not available with the fieldbus DCM-3.

Demand Setting is out of limit
The Demand signal appears too high, and probably has a data format error.

Current Overlimit
Not used in Group 11.

Power Source Not Nominal
Not used in Group 11.

BIST: BIST 3

Loop Current Detected while under HART/FF Control
The microcomputer configuration does not appear valid for Foundation Fieldbus.

BIST: ANALOG SIG SATURATED

Position out of accurate measurement range
The DCM-3 is reading a CPS-5 signal that is outside of the range for accurate measurements. Refer to OUTPUT SHAFT POSITION SENSING (page 35).

Demand out of accurate measurement range
The Demand signal appears too low or too high, and probably has a data format error.

Temperature out of accurate measurement range
The DCM-3 ambient temperature reading is extreme to the point of uncertainty.

Torque/Thrust out of accurate measurement range
The DCM-3 is not able to read a valid signal from the Torque sensor. Check the Torque sensing cable. Refer to Torque Alarms (page 30).

TROUBLESHOOTING USING HART

The actuator should run the motor so the output shaft position matches the Demand signal. If the output shaft does not reach the desired location, there are three questions to answer:

1. Check the Demand signal. Is the DCM-3 receiving the correct Demand signal?
2. Check the shaft position. Does the DCM-3 think the output shaft position matches the Demand signal?
3. If the position doesn't match the Demand, why doesn't the DCM-3 run the motor?

FIRST CHECKS

The DCM-3 for HART requires 120 V ac/240 V ac connections and a Demand signal connection. The Demand signal can be analog, analog with HART, or HART only. If the Demand LED is illuminated, the Demand signal is either absent or reverse polarity. If the DCM-3 PWR LED is not pulsing, the DCM-3 is not operating properly.

Analog Demand signals require the proper settings for the 0% point and the 100% point. For more information on analog signal ranges, refer to DEMAND (page 31). If using the HART network to write Demand digitally, the value must be written in percent, For more information on writing values digitally, refer to Manual Operation menu (page 48).

CHECKING DEMAND

The HART system displays the present Demand as Demand in the Online menu. The value displayed is the present Demand, regardless of the source of the Demand. This value can have the following origins:

1. the analog value measured from the signal loop.
2. the digital value entered into the Manual Operation menu (page 48).
3. a value chosen from the LOS function (page 32)

If the LOS function is active, alarm bits will be set and most HART masters will display warnings that an alarm exists. When checking the Demand, make certain the Demand current (Loop(Dem)) and the Demand percentage (Demand) correspond.

HART systems also include the local configuration interface. If a Demand alarm exists, the STAT LED and the DEMAND LED are illuminated. This LED will blink if more than one status LED is illuminated.

If Demand is not displaying the correct value, the DCM-3 is not accepting the correct Demand signal.

CHECKING SHAFT POSITION

The output shaft position can be read as Position on the Online menu.

Does Position % match Demand %? The exactness of the match is controlled by the parameter Step Size (page 27). If they match, the DCM-3 is not running the motor because the signals appear to match.

If the signals match, the next question is whether Position % is correct for the actual output shaft position. Refer to OUTPUT SHAFT POSITION SENSING (page 35). The CPS-5 signal voltage as measured by the DCM-3 is available as PresCPS V in the PositionSensrSetup menu. The actual voltage can be measured with a voltage meter between test points TP4(+) and TP1(-). Refer to DCM-3 Test Points and Resistor (page 88).

POSITION AND DEMAND MISMATCH

If the shaft position and the Demand do not match and the motor is not running, then some factor is preventing the DCM-3 from running the motor. The HART interface provides extensive information for finding this factor.

The Status menu contains two parameters that summarize why the motor is not running: one parameter for CW and one for CCW. The parameter names are CW Inhibitors and CCW Inhibitors. If the parameter is 0 (has not bits set), the motor should run that direction. If the parameter is not 0, the DCM-3 will not try to run the motor that direction. The bits that show in the parameter are the reasons the motor is not running that direction.

INHIBITORS

Label	Cause of Motor Not Running	Page
OverTrq/Thrust	Excessive torque load on output shaft.	30
Balance	Demand indicates motor should not run this direction.	37
Stall	Stall.	28
Supervisory	The DCM is initializing.	
Switch Block	Not used on Group 11 actuators.	
Bad Pos Sig	The Position signal from the CPS-5 is not acceptable.	35
Bad Dem Sig	The applied Demand signal appears invalid.	32
Local Cal	A local configuration interface button is pressed.	25

If the inhibitor parameter is 0 but the motor is not running, power to the motor is being blocked by something over which the DCM-3 microcomputer has no control. Possibility 1 listed below should lead to a Stall alarm (page 28). The other possibilities should create a Stop/Limit alarm (page 28).

1. The motor is stalled, and cannot rotate. This condition is unlikely if the motor operated properly with the Handswitch. For more information on the Handswitch, refer to Checking Handswitch Operation (page 67).
2. The Handswitch or an Over-travel Limit Switch is preventing power from reaching the motor. Make certain the Handswitch is in AUTO. The Handswitch and the DCM-3 both use the same over-travel limits, so if the limits do not prevent Handswitch operation, they should not prevent DCM-3 operation.
3. Wire jumpers are missing from terminals F-N and terminals D-M on the field wiring terminal block. Most installations of Group 11 actuators with HART compatibility require these wire jumpers. Check the wiring diagram that came with the specific actuator.
4. The output section of the DCM-3 is not delivering power to the motor.
5. The DCM-3 fuse is cleared. This fuse is rated at more than twice the motor current, and the Beck motor has no significant inrush current. Therefore, only in very rare circumstances is the fuse cleared. These circumstances are generally wiring errors during customer installation. For the fuse location, refer to DCM-3 LAYOUT (page 23).

DCM-3 SERIAL INTERFACE Setup

Beck Configuration Port

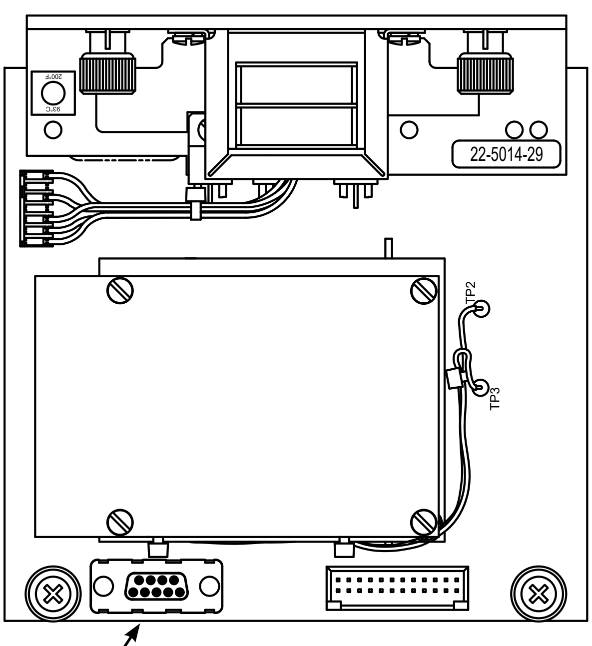
Local configuration of the Beck actuator can be accomplished using Serial commands through the DCM-3 Serial port.

The Beck Digital Control Module (DCM-3) is equipped with a Serial interface which allows for direct communication with a computer. Using a standard DB9 to USB cable, connect the DCM-3 to the computer using the DCM-3's DB9 connector (see below for location) and one of the computer's USB ports. Note: If your computer is equipped with an active COM port, a DB9 to DB9 cable may be utilized. See below for part numbers of cables available from Beck.

Once connected, communication can be established between the DCM-3 and the computer using a terminal emulation program, such as HyperTerminal®. This method of communication will allow for configuration, calibration and verification of actuator DCM-3 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.



DB9
CONNECTOR

After connecting the DCM-3 to the (Windows®-based) computer, 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-3. Proceed as follows:

1. If prompted to install a modem, answer "no". Proceed to enter a name (e.g., "DCM-3") 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 appropriate USB (or COM) port that has been connected to the DCM-3. Click the "OK" button.
3. The 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-3.

Beck Serial Communications Cables

DB9 to USB-A
P/N 20-0511-60

DB9 to DB9
P/N 20-0511-14

*Note cables may differ in appearance from depiction.

Hyperterminal® is a product of Hilgraeve, Inc.

Commands and Arguments

The interface provided by the Beck Configuration Port has a command – response format. Commands are typed through the terminal emulator into the DCM-3, and the DCM-3 responds to the commands.

As each letter is typed into the terminal emulator, that letter is sent to the DCM-3. The letters and numbers you see on the computer screen are not directly created by what has been typed, but are the characters sent back to the computer from the DCM-3. Therefore, if you see on the screen what you have typed, those characters have been sent to the DCM-3, have been recognized, and have been sent back to the computer screen. If you do not see what you have typed, the communication link is not fully operational.

After each recognized command, the DCM-3 responds with appropriate data, then sends a prompt sequence to alert the technician the DCM-3 is ready for the next command. If the Enter key is pressed without entering a command, the prompt sequence is sent back from the DCM-3 to indicate it is ready for a command.

If a command is entered in the wrong format, or if the command is invalid, and error code is reported before the new prompt is sent.

Commands can be used for a variety of functions including changing the operating configuration of the drive, verifying operation settings and calibration, and accessing diagnostic information.

Commands exist in several formats. Some commands query settings, some commands can query or change parameters, and some commands create actions that can affect several parameters.

There are four different types of commands:

1. Dual-purpose commands. These commands can be used to either modify DCM-3 configuration settings or display the settings already set in the DCM-3. In order to set or make a change to the settings, the command requires an argument. Argument is used to identify a characters typed-in after the name of the command, but before the enter key is pressed. If the command is being used for display purposes only, the argument is omitted. Examples of these commands include "stallprot" 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 actuator calibration. This type of command requires an argument, but unlike dual-purpose commands, they require an argument. Examples include the "trimdem4 mA" and "trimfdbk20mA" commands.
4. Execute action commands. These commands serve to reset, enable or disable features. Entering these commands produces an immediate action. Examples include the "reset" and "restore" commands. These commands require arguments to make certain the command was not entered by accident.

The available commands are listed on page 76. Each is described in more detail on the following pages. The command description explains the use or uses of the command, while the argument column describes the applicable arguments.

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-3 SERIAL INTERFACE Commands

BCP COMMANDS

The following is a list of serial commands available through the RS-232 interface.

General Configuration Commands (page 77)
alarmout
alarmoutmask
configformodel
drvdir
limitalarm
opmode
restoremodes
sernum
stallprot
stalltime
stepsize

HART® Configuration Commands (page 78)
harttype
polladdr

Demand Characterizer Commands (page 78)
charclear
charlist
charset
demfunc

Demand Signal Commands (page 79)
dem0pctma
dem100pctma
trimdem4mA
trimdem20mA
demlos
demlosgtp

Output Shaft Position Sensing Commands (page 80)
cpsrotation
cpsvat0pct
posisd
posisp
travel

Feedback Signal Commands (page 81)
fdbk0pctma
fdbk100pctma
fdbkfunc
trimfdbk4mA
trimfdbk20mA
iomode

Torque Sensing Commands (page 82)
ovtstop
ovtstoplevel
torq
torq0k
torq0pct
torq100pct
torqalarm
torqconst
torqenable
torqprof

Diagnostic and Information Commands (page 83)
codes
reset
signals
stat
temperature
unstall

General Configuration Commands

Command	Description	Argument n and Information
alarmout n (page 30)	Sets and/or displays the polarity of the alarm output solid state relay.	n = "0": Open on Alarm n = "1": Closed on Alarm
alarmoutmask n (page 31)	Sets and/or displays the hexadecimal mask of which alarms cause the alarm output relay to open or close.	n = bit-wise OR-ed, 32-bit hexadecimal value, high bits indicate alarm will change output relay Default value = 0xFFFFFFFF, which means all alarms cause the relay to change state.
configformodel n (page 36)	Sets the DCM-3 configuration for position sensing voltage range to the values appropriate for the actuator model and CPS-5 output signal.	n must equal “1” for the command to execute.
drvdir n (page 37)	Sets and/or displays the actuator output shaft direction resulting from an increasing Demand signal.	n = "0": CW rotation for increasing. n = "1": CW rotation for increasing.
limitalarm n (page 28)	Sets and/or displays a modifier to the Stop/Limit alarm.	n = "0": “mute” corresponds to “Accept” for FF and HART. n = "1": “always” corresponds to “Alert” for FF and HART.
opmode n (page 77)	Sets and/or displays the mode that controls the Demand signal source. This mode selects analog or digital control.	n = "0": “follow” is analog Demand. n = "1": “hold” is digital Demand. n = “2”: run CW. n = “3”: run CCW. n = “4”: stay. n = “5”: stop.
restoremodes n (page 27)	The DCM-3 configuration returns to the original factory settings.	n must equal “1” for the command to execute.
sernum n (page 5)	Sets the serial number of the actuator in which the DCM-3 is installed. Model number information used by the DCM-3 is derived from the serial number.	n = serial number.
stallprot n (page 28)	Sets and/or displays the enabled/ disabled value for Stall protection.	n = "0": disabled. n = "1": enabled.
stalltime n (page 28)	Sets and/or displays the time allowed for the actuator to reach its Demand target.	n = time in seconds. Time to stall is configurable from 30 to 450 seconds. The default value is 300 seconds.
stepsize n% (page 27)	Sets and/or displays the size (in %) of one incremental movement of the output shaft. Whether setting or displaying, include the % symbol. Without the % symbol, the unit of measure is degrees.	n = step size in %. The minimum value that can be entered is "0.10"; which is also the standard value. The maximum value is "2.50". Without the % symbol, the unit of measure is degrees.

HART® Configuration Commands

Command	Description	Argument n and Information
harttype n (page 20)	Sets and/or displays the DCM-3 HART device type. DD number 239 is the proper DD. The others are for temporary use with older DD's if the new DD is not available. If the DCM-3 is configured for Foundation Fieldbus, the device type must be set to 239.	n = "1": ESR-D n = "10": BECK-DCM n = "239": BECK-MK2
polladdr n (page 20)	Sets and/or displays the polling address used by the HART master to find individual devices if the HART bus has more than one device. Unless multiple HART devices are connected in parallel on a single bus, the polling address should be set to 0. If the DCM-3 is configured for Foundation Fieldbus, the polling address must be set to 0.	n = the polling address, a value between 0 and 15.

Demand Characterizer Commands

Command	Description	Argument n and Information
charclear n (page 34)	Sets the status of a characterizer node to "unused." Any nodes with higher node numbers are also set to unused.	n = node number to make unused
charlist n (page 34)	Displays the X-values and Y-values in percent of the nodes of the characterizer curve. The argument is which node to use to begin the display. This node number does not change which nodes are active.	n = node number to begin display OR n = "all": display all values
charset n (page 34)	Sets the X-values and Y-values of a specific node of the characterizer curve. Requires a set of three arguments separated with commas.	n1, n2, n2 = node number to modify, X-value in percent, Y-value in percent.
demfunc n (page 32)	Sets and/or displays the Demand signal characterization function.	n = "0": Linear n = "1": Square Root n = "4": Special Curve n = "5": Square

Demand Signal Commands

Command	Description	Argument n and Information
dem0pctma n (page 32) Used with analog Demand signals.	Sets and/or displays the Demand signal value that corresponds to 0%.	n = the Demand signal as a decimal in mA. The minimum acceptable value is 0.50. The maximum acceptable value is 100% Demand less 4.00. For example, if the 100% Demand signal is 20.00, then the 0% Demand signal must be 16.00 or less.
dem100pctma n (page 32) Used with analog Demand signals.	Sets and/or displaysthe Demand signal value that corresponds to 100%.	n = the Demand signal as a decimal in milliamps. The minimum acceptable value is the 0% Demand plus 4.00. For example, if the 0% Demand signal is 4.00, then the 100% Demand signal must be 8.00 or greater. The maximum acceptable value is 21.00.
trimdem4mA 4 (page 40) Used with analog Demand signals.	Trims the Demand analog-to-digital sensing circuit to be accurate at 4 mA. This command should only be used when the Demand signal at the actuator is exactly 4 mA. Trim is factory set. Recalibration should not be necessary.	Trim can only be performed at 4 mA.
trimdem20mA 20 (page 40) Used with analog Demand signals.	Trims the Demand analog-to-digital sensing circuit to be accurate at 20 mA. This command should only be used when the Demand signal at the actuator is exactly 20 mA. Trim is factory set. Recalibration should not be necessary.	Trim can only be performed at 20 mA.
demlos n (page 32) Used with analog Demand signals.	Sets and/or displays the Demand signal threshold below which the DCM-3 recognizes that the signal is lost. The threshold is entered as a value in mA. This command also sets and/or displays the action initiated by the actuator during LOS (Loss Of Signal). LOS action options are "sip" (stay in place) or "gtp" (go to position). Demlos always reports both settings, but only sets one argument at a time. Demlos must be used twice to set the threshold and action.	n = the Demand signal in mA below which LOS occurs. A typical value for a 4 mA–20 mA system is 3.20. — OR — n = "sip", "gtp" or "pat". Mode "pat" acts the same as Stay in Place, but suppresses the alarm. This is used in some pulsed applications.
demlosgtp n (page 32) Used with analog Demand signals.	Sets and/or displays the position to which the actuator will run upon loss of the Demand signal (LOS). This command has no effect if the actuator is set to "sip" (stay in place).	n = the desired position of the actuator expressed as a percentage of actuator travel. For example, if the desired go-to-position is 50%, then n = 50.00.

Output Shaft Position Sensing Commands

Command	Description	Argument n and Information
cpsrotation n (page 35)	Sets and/or displays the DCM-3 parameter for the expected output shaft direction for an increase in CPS-5 signal. This should be set to CW for increasing signal for all non-custom applications.	n = 0: CW increasing n = 1: CCW increasing
cpsvat0pct n (page 37)	Sets and/or displays the DCM-3 voltage setting used to determine 0% signal from the CPS-5. The CPS-5 calibration is defined by the actuator model. Refer to CPS-5 Calibration (page 42)	n = the desired length of travel in degrees. This value cannot exceed the maximum output shaft rotation of the actuator (page 7).
posisd n	Sets CPS Zero% (page 37) through an alternate method. Use this command if the exact CPS-5 signal voltage at 0% shaft position is not known. The output shaft can be positioned to 0%, then execute this command with an argument of 0. CPS Zero% will be adjusted to match the CPS-5 signal voltage at that point. Travel (page 36) does not change, so the 100% point will change.	n = the present actuator position in angular degrees.
posisp n	Sets Travel (page 36) through an alternate method. Use this command if an exact angular Travel is not known. The output shaft can be positioned to 100%, then execute this command with an argument of 100. Travel will be adjusted to the correct number of degrees for this to be 100%. The 0% point does not change, and therefore the 0% point should be set first. Refer to OUTPUT SHAFT 0% POSITION (page 37) for more information on the 0% point.	n = the present position in angular degrees.
travel n (page 36)	Sets and/or displays the number of degrees that represents 100% travel. This command does not shift the 0% position. When increasing travel from a reduced travel setting, the 0% position might have to be changed first in order to keep the travel with the acceptable end points. The end points are defined by the CPS-5 voltage range.	n = the desired length of travel in degrees. This value cannot exceed the maximum output shaft rotation of the actuator (page 7).

Feedback Signal Commands

Command	Description	Argument n and Information
fdbk0pctma n (page 39) Used with analog Feedback signals.	Sets and/or displays the mA value of the Feedback signal that represents the 0% output shaft position.	n = the desired Feedback signal in mA at 0% output shaft position . The minimum value is 3.00 and the maximum value is at least 4.00 less than the Feedback signal value for the 100% output shaft position.
fdbk100pctma n (page 39) Used with analog Feedback signals.	Sets and/or displays the mA value of the Feedback signal that represents the 100% output shaft position.	n = the desired Feeback signal in mA at 100% output shaft position. The minimum value must be at least 4.00 greater than the Feedback signal value for the 0% output shaft position. The maximum value is 21.00.
fdbkfunc n (page 39) Used with analog Feedback signals.	Sets and/or displays the curve used to calculate the Feedback signal.	n = "0": Linear (curve disabled) n = “1”: Inverse Demand (curve enabled)
trimfdbk4mA n (page 40) Used with analog Feedback signals.	Trims the Feedback signal at 4 mA. The Feeback sourcing circuit is factory calibrated and normally does not require recalibration.	n = the present Feedback signal from the DCM-3 as measured in mA.
trimfdbk20mA n (page 40) Used with analog Feedback signals.	Trims the Feedback signal at 20 mA. The Feeback sourcing circuit is factory calibrated and normally does not require recalibration.	n = the present Feedback signal from the DCM-3 as measured in mA.
iomode n (page 38) Used with analog Feedback signals.	Sets and/or displays the function of a DCM-3 connector pin. The DCM-3 pin that is used to source the Feedback signal can instead be used to power an output shaft position-sensing potentiometer on models of Beck actuator that do not use the CPS-5. If the pin use parameter is not set to Feedback, the Feedback circuit is disabled. If the pin use parameter is set to Pot, 5 V dc is output from this pin to power the potentiometer. Setting the parameter to None disables the Feedback and the potentiometer supply.	n = “0”: None n = “1”: Feedback enabled n = “2”: Potentiometer power enabled

DCM-3 SERIAL INTERFACE Commands

Torque Sensing Commands

Command	Description	Argument n and Information
ovtstop n (page 30)	Sets and/or displays whether motor power will be removed during severe output shaft over-torque conditions. Torque sensing must be installed and enabled for this to be effective.	n = “0”: disabled n = “1”: enabled
ovtstoplevel n (page 39)	Sets and/or displays the torque magnitude associated with severe output shaft over-torque conditions.	n = allowable torque magnitude without stopping motor, in percent of actuator rating.
torq	Displays the torque on the output shaft measurement as a percentage of actuator rating. Also displays related values such as torq0k and torqconst.	No argument.
torq0k n (page 29)	Sets and/or displays the value of DCM-3 internal measurement corresponding to 0% torque on the output shaft.	n = the zero torque value in counts.
torq0pct n	Sets torqk0k (page 29). This is an alternate method for setting torq0k, and is useful when the correct torq0k value is not already known. To use this command, remove all load from the output shaft, then execute torq0pct with argument = 0 to let the DCM-3 know that the torque sensing should be reading 0%.	n = 0
torq100pct n	Sets torqconst (page 29). This is an alternate method for setting torqconst, and is useful when the correct torqconst value is not known, but the exact output torque is known. To use this command, load the output shaft with an exact load, preferably 100%. Then execute torq100pct to let the DCM-3 know what the torque sensing should be reading.	n = the exact output shaft torque as a percent of rated load of the actuator.
torqalarm n (page 30)	Sets and/or displays the torque magnitude associated with the first level of alarm.	n = allowable torque magnitude without alarm, in percent of actuator rating.
torqconst n (page 29)	Sets and/or displays the value of DCM-3 internal measurement corresponding to the torque span (the measurement at 100% minus the measurement at 0%).	n = the torque span value in counts.
torqenable n (page 29)	Sets and/or displays the enabled or disabled status of torque sensing.	n = “0”: disabled n = “1”: enabled
torqprof (page 30)	Displays a table of three column: 1. Maximum travel divided into 10 segments 2. peak torque measured in each segment with motor running CW 3. peak torque measured in each segment with motor running CCW	No argument.

Diagnostics and Information Commands

Command	Description	Argument n and Information
codes	Displays the present status of motor power inhibitors, pushbutton status, LED status, the process variable inside/ outside limits status, analog signal measurement status, discrete input status, and alarm status. All information is in Bit-wise ORed hexadecimal notation. Each status word is decoded onscreen for convenience.	No argument.
reset n	The microcomputer performs the same reset sequence as when power is removed and reapplied.	n must equal “1” for the command to execute.
signals n	Displays the present DCM-3 readings of four signals: Position signal from CPS-5 Demand (analog systems) Feedback (analog systems) Torque.	If no argument, the signal readings are returned. n = “all”: an extended set of data is returned.
stat	Displays information on the status of the actuator, including: Time / Date Demand Position Error (Demand minus Position) Step size Dead band Motor Status Motor Run Time Line Frequency Motor Starts Motor Reversals/Stalls Number of Over-Torque conditions Positive & Negative Peak Torque (%) CW and CCW Inhibitor Status Alarms	No argument.
temperature n (page 27)	Displays three values describing the ambient temperature in the actuator. Low extreme, present, high extreme. Can also change the temperature units.	If no argument, the temperatures are displayed in the active units. n = “F”: change units to Fahrenheit n = “C”: change units to Celsius
unstall (page 28)	Resets the Stall Protection alarm to restore power to the motor. If the motor is still physically stalled, the Stall Protection alarm will recur.	No argument.

MAINTENANCE

Beck actuators require a minimum of 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.

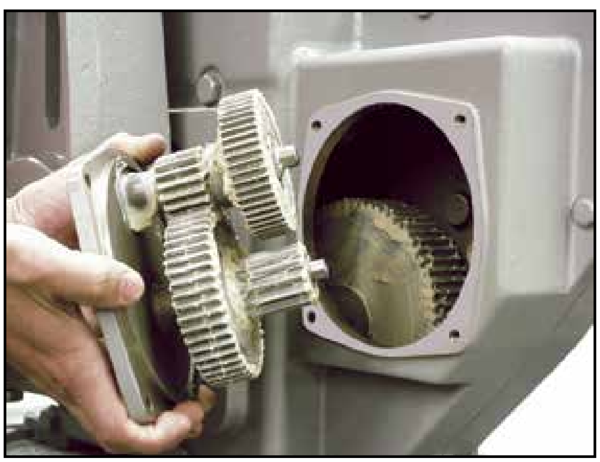
LUBRICATION

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

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

CAUTION

If your actuator has a linkage, before removing the gear module assembly, block the actuator crank arm to prevent it and the gear train from moving when the change module is removed.



11-409 Gear Module

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.

Examine the gear teeth, shaft bore, and gear shafts for signs of excessive wear, scoring, or other damage. If evidence of this damage is present, the actuator should be returned to the factory for a detailed examination of the main gear, which requires complete disassembly of the drive. See "HOW TO OBTAIN SERVICE" on page 103.

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 8–13 for appropriate bolt torques.

MAINTENANCE *Component Replacement*

This section covers replacement of many components of the drive. Note that some components are not field-repairable. Refer to the actuator outline dimension drawings on pages 8–13 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 actuator should be returned to the factory. During a major overhaul, the factory repair department will update the actuator to include all possible engineering improvements. See "HOW TO OBTAIN SERVICE" on page 103.

GASKETS

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

To remove, scrape all of the old adhesive and gasket material from the body housing and cover, if necessary. Replacement gaskets are self-adhering, silicone rubber. Peel the backing off the replacement gasket and carefully apply to the actuator body.

SEALS

Worn or damaged output shaft, control end shaft, and motor shaft seals should be replaced to prevent damage to internal bearings and actuator 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 actuator 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 actuator 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 actuator has a linkage, before removing the motor assembly, block the actuator crank arm to prevent it and the gear train from moving when the motor assembly is removed.

To remove the motor, disconnect the motor wires in the terminal compartment of the actuator. The terminal block, along with the barrier plate or chassis (depending upon the model), should be removed as an assembly from the actuator body to access the wires beneath.

After lifting the chassis or barrier plate assembly, the three motor wires may now be disconnected. 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 actuator body.

To install the motor, insert the three-wire sleeve through the wire hole in the motor mount and into the terminal compartment. Carefully slide the motor into the actuator body. Rotate the motor shaft, if necessary, to engage the pinion with the first combination gear. Install motor mounting bolts and torque to recommended values. See pages 8–13 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.

The terminal block, along with the barrier plate or chassis (depending upon the model), should be removed as an assembly.

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).

MAINTENANCE *Component Replacement*

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 actuator travel.

Adding Switches

It is usually possible to add switches to a control actuator in the field. Remove the control end cover (1/2" bolt heads). If the actuator has no auxiliary switches, it is possible to add up to four switches. See Table 4, page 89, for switch assembly part numbers.

Install wiring onto the switch push-on lugs and route the wires into the control actuator terminal area. Remove the terminal cover and solder wires to the underside of the terminal assembly according to the wiring diagram included with the new switch assembly. Install the new switch assembly and adjust according to the 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 on this page for component identification.

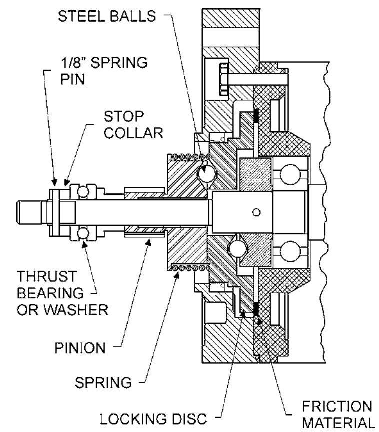


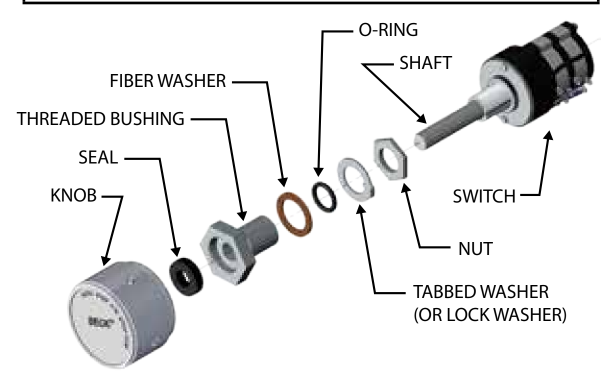
TABLE 3: SLM PART NUMBERS

Motor Part No.	SLM Rebuild Kit GL 181-134	Instruction Sheet
11-159/-169		
20-2700-20	12-8066-37	80-0016-05
20-2701-20, -51	12-8066-36	80-0016-05
20-2204-20	12-8066-38	80-0016-16
11-209/-269, -309/-360		
20-2704-21	12-8066-39	80-0016-07
20-2705-21, -51	12-8066-40	80-0016-07
11-409/-469		
20-2201-31, -32, -33	12-8067-13	80-0016-02
20-2201-35	12-8067-14	80-0016-02

HANDSWITCH

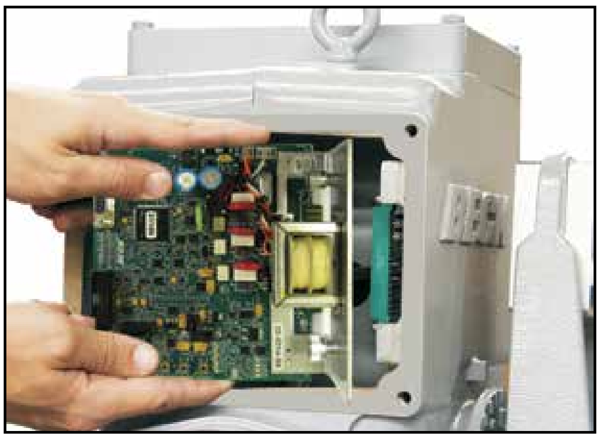
To replace the Handswitch, remove the terminal cover, and then remove the terminal plate (11-209/-269, -309/-369, and -409/-469 only). Clip the five wires from the old Handswitch. Remove the knob and the nut under the knob to remove the switch. Install the new Handswitch as shown below. Splice the wires 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-3 BOARD

Field service of the DCM-3 board is not recommended. The factory maintains a stock of replacement boards for immediate shipment. To replace the DCM-3 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 image below.



To install a DCM-3 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-5

Field repair of the CPS-5 assembly is not recommended. The factory maintains a stock of replacement assemblies for immediate shipment. If it is necessary to replace the CPS-5, replace both the rotor and stator / circuit board assembly. When returning the CPS-5 to the factory for service, include the rotor and stator / circuit board assembly. Do not separate the stator or circuit boards from their mounting plates. The rotor should be held inside the stator with rubber bands for protection during shipment.

To remove the CPS-5:

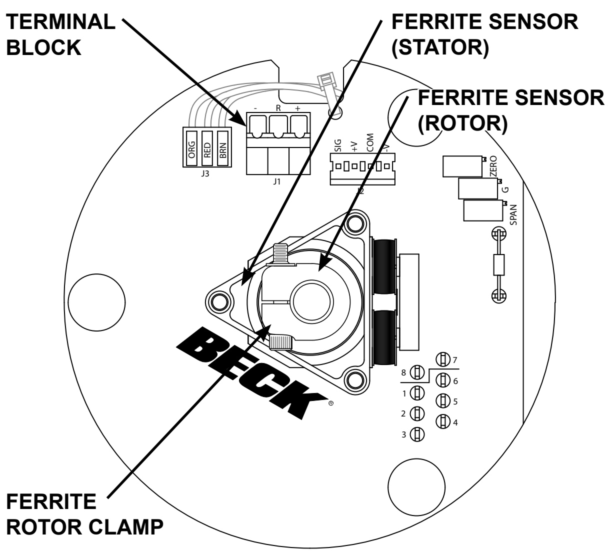
1. Run the control actuator to its midpoint of travel with the local Handswitch. (If the standard rotation of 100° has been reduced to 80°, the midpoint of travel is 40°.)
2. Disconnect 120 V ac power to the drive. Remove the terminal, DCM-3 compartment and control end covers (1/2" bolt heads).
3. Record the wire colors on the terminal block of the CPS-5 (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-5.
5. Loosen and remove the 3 hex studs that clamp the CPS-5 in place. Ensure that the inboard hex stud is not loosened as the outboard stud is loosened.
6. Slide the CPS-5 stator assembly off the three mounting bolts.
7. Note the position of the rotor clamp, then loosen the rotor clamp screw and remove the rotor from the shaft.

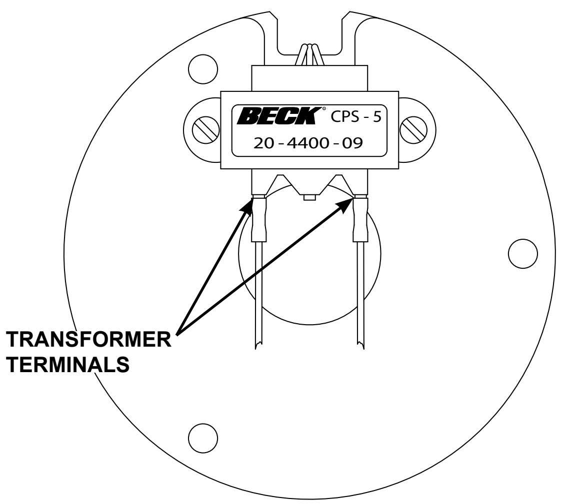
To install the new CPS-5:

1. Remove the rotor from the replacement CPS-5 assembly. Slide the rotor, clamp end first, onto the control shaft as close to the mounting plate as possible. Leave the clamp loose. Position the clamp in the same general location as the one removed previously.
2. Slide the new CPS-5 assembly over the studs and rotor. Replace the hex nuts but do not tighten. Carefully slide the rotor back into the CPS-5 assembly. Twist the rotor while sliding to prevent damage to the assembly. Tighten hex nuts to 5 lb-ft (7 N•m).
3. Thread the wires through the wire holes in the CPS-5 and reconnect them to the transformer and terminal block.
4. Restore 120 V ac power to the actuator 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, next page) 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 37.

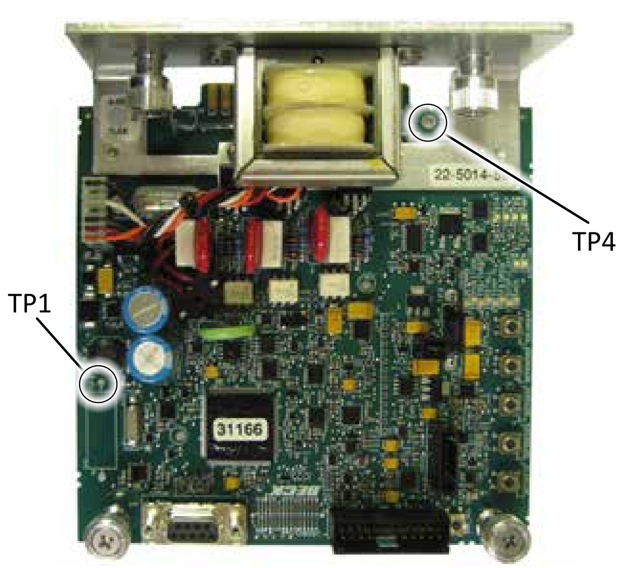
Continued

CPS-5 Components





Location of DCM-3 Test Points TP1 & TP4



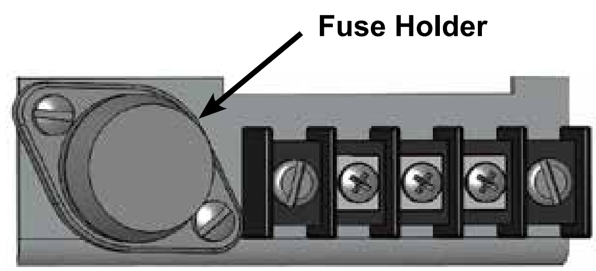
FUSE (F1) REPLACEMENT (FOR ACTUATORS EQUIPPED WITH OPTIONAL 240V POWER SUPPLY)

If it is necessary to replace the power fuse (F1), use the following procedure:

WARNING

Electrical shock hazard. Disconnect power before proceeding.

Remove the terminal block cover. Locate the fuse holder (similar to the illustration below).



Turn the fuse holder CCW while pressing down. The fuse holder should spring loose when free. Remove the fuse holder from the actuator. Pull the fuse free from the holder. Replace the fuse with the same type (see table below) by pushing it into place.

Reinsert the fuse holder into the actuator. Turn the fuse holder CW while pressing down to tighten. Replace the terminal block cover. Tighten the cover screws to 6 lb-ft (8 N•m) torque.

REPLACEMENT FUSES (F1)

Actuator	Input Voltage	Amps	Volts	Type	Part No.
11H-1xx	240	0.75	250	Time Delay	11-1370-23
11H-2/3xx	240	1.0	250	Time Delay	11-1370-24
11H-4xx	240	3.2	250	Time Delay	11-1370-25

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 actuator is required. The types of parts are listed in Table 4, below.

HOW TO ORDER SPARE PARTS

Parts may be ordered by mail, telephone or fax, with the confirming order sent to the factory (see back cover). Specify the drive's serial number (on the nameplate) to allow the factory to verify part selection.

TABLE 4: RECOMMENDED SPARE PARTS

Description	Part Number
DCM-3 board	22-5014-59
DCM-3 board w/ Foundation Fieldbus	22-5014-29
Fuse, 7A, 125V (For use on DCM-3)	11-1372-26
Fuse (F1) (w/ 240 V operation)	See page 88
CPS-5 assy.	20-4400-09

Description	Part Number
Overtravel limit switch assy. (CW / CCW)	20-3202-10
Auxiliary switch assy.	
2 switches (S1–S2)	20-3202-11
4 switches (S1–S4)	20-3202-12
Gasket kit, Motor assy., Capacitor, Resistor	See Below

TABLE 5: GASKETS, MOTORS[a], RESISTORS, & CAPACITORS

Actuator Model Number	Gasket Kit Part Number	Motor					Capacitor		Resistor	
		Part Number	Current (Amps at 120 Vac, 60 Hz[c])	Torque (N•m)	RPM	Freq. (Hertz)	Part Number	Value (µf)	Part Number	Value (Ω)
11-1_9	20-3110-01	20-2700-20	.17	0.5	72	60	14-2840-02	2	11-5802-03	500
						50	14-2840-13	3	11-5802-03	500
		20-2701-20	.31	1.0	72	60	14-2840-11	4	11-5802-02	475
						50	14-2840-31	6	11-5802-06 (2 req'd)	180 ea.
		20-2204-20	.44	1.5	72	60	14-2840-16	5	11-5801-12[d]	220
						50	14-2840-19	7	11-5801-12[d]	220
		20-2701-51	.32	1.0	120	60	14-2840-16	5	11-5801-12[d]	220
						50	14-2840-31	6	11-5801-12[d]	220
11-2_9 & 11-3_9	20-3110-02	20-2704-21	.43	1.5	72	60	14-2840-16	5	20-1971-13	220[b]
						50	14-2840-19	7	20-1971-13	220[b]
		20-2705-21	.71	3.0	72	60	14-2840-05	8	20-1971-12	110[b]
						50	14-2840-30	13	20-1971-12	110[b]
		20-2705-51	.74	3.3	120	60	14-2840-29	9	20-1971-14	68[b]
						50	14-2840-30	13	20-1971-15	72[b]
11-4_9	20-3110-03	20-2201-31	1.3	7.0	72	60	14-2840-17	15	20-1971-03	75[b]
						50	14-2840-16 14-2840-17	5 15	20-1971-03	75[b]
		20-2201-32	2.3	14.0	72	60	14-2840-15	25	20-1971-04	37.5[b]
						50	14-2840-05 14-2840-15	8 25	20-1971-04	37.5[b]
		20-2201-33	3.0	14.0	120	60	14-2840-15 14-2840-09	25 6	20-1971-06	18[b]
						50	14-2840-15 14-2840-05 14-2840-09	25 8 6	20-1971-10	24[b]

[a] All motors listed are rated 120 V ac regardless of operating voltages using optional transformers.
[b] This is a resistor assembly.
[c] 50 Hz currents do not exceed 120% of the 60 Hz levels.
[d] Alternate power options (other than 120 or 240 V ac) require (2) 110Ω resistors, part no. 11-5802-05, in lieu of resistor shown.

APPENDIX Components

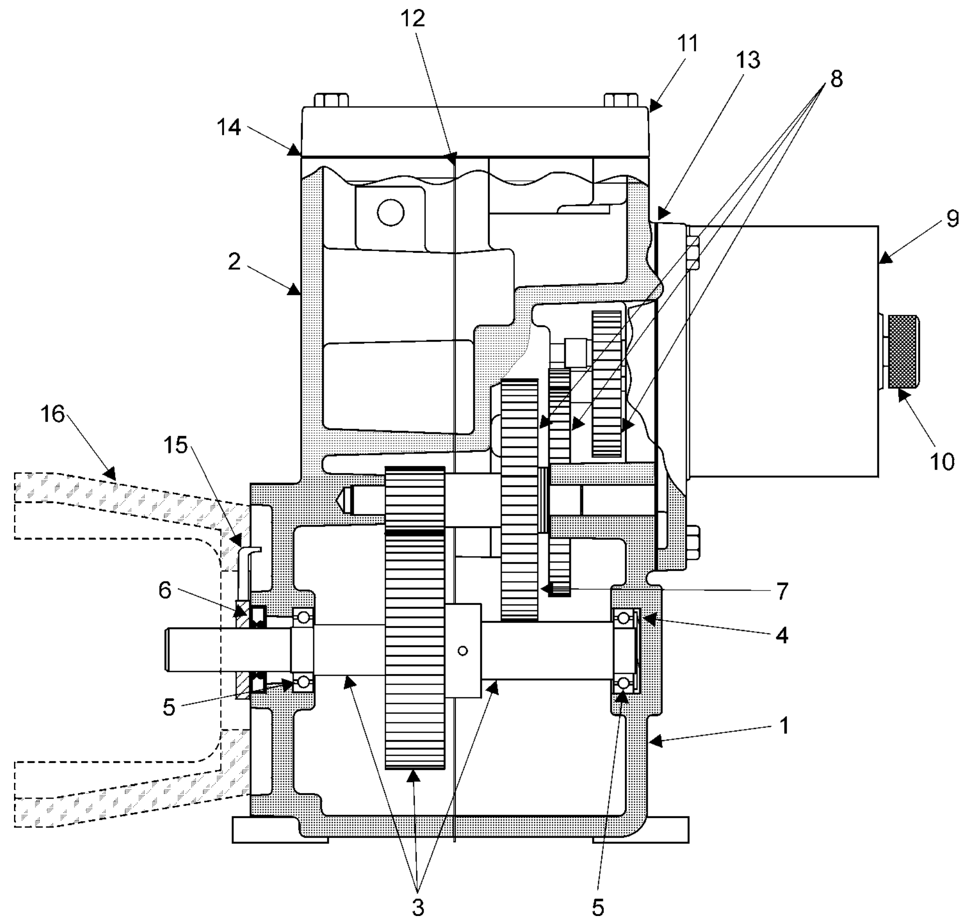


TABLE 6:
ACTUATOR COMPONENTS FOR MODEL 11-159 / -169

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body, rear	11	Terminal / DCM compartment cover
2	Body, front	12	Gasket, body
3	Output shaft assembly & 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		Control end cover extension
	for part number		Terminal block
9	Control motor, see Table 5		Barrier, insulator, terminal compartment
	for part number	15	Index pointer (-159 only)
10	Handwheel	16	Bracket (-169 only)

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

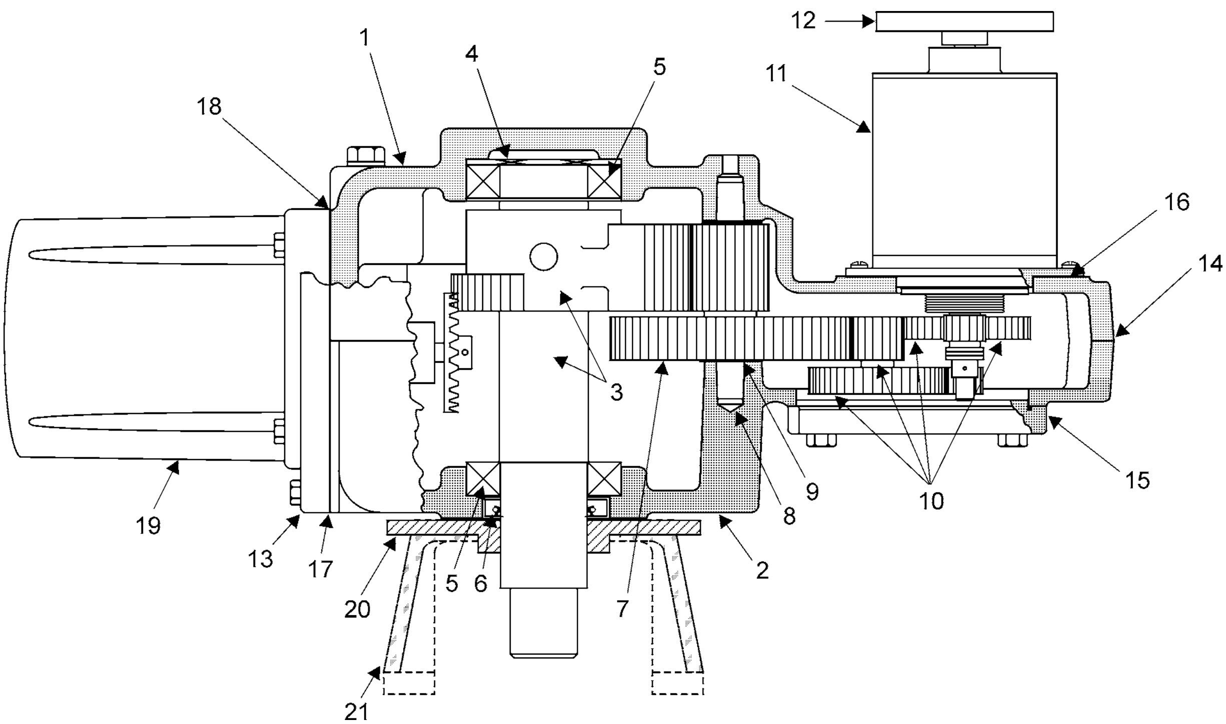


**TABLE 7:
ACTUATOR COMPONENTS FOR MODEL 11-209 / -269 / -309 / -369**

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body, rear	13	Terminal / DCM compartment cover
2	Body, front	14	Gasket, body
3	Output shaft assembly & 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 for part number		Barrier, insulator, terminal compartment Barrier plate
11	Control motor, see Table 5 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 actuator with the order.

APPENDIX Components

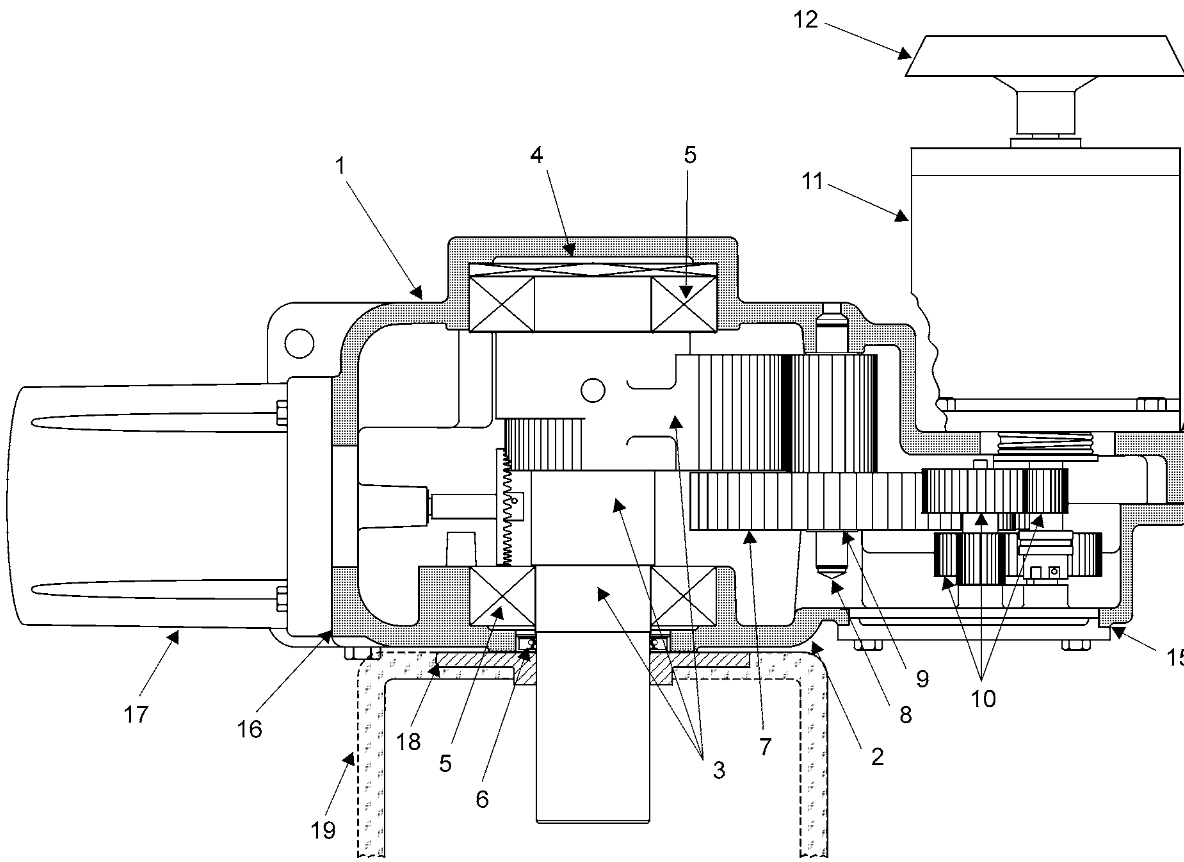


TABLE 8:
ACTUATOR COMPONENTS FOR MODEL 11-409 / -469

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Body, rear	13	Gasket, control motor
2	Body, front	14	Gasket, body
3	Output shaft assembly & main gear	15	Gasket, gear module
4	Spring washer	16	Gasket, control end cover
5	Ball bearing, output shaft	17	Control end cover
6	Seal, output shaft		Control end cover extension
7	Gear, 3rd combination		Terminal block & barrier plate
8	Pin, 3rd combination gear		Gasket, barrier plate
9	Thrust washer		DCM & terminal compartment cover
10	Gear module assembly, see Table 9 for part number		Gasket, DCM & terminal cover
			Barrier, insulator, terminal compartment
11	Control motor, see Table 5 for part number	18	Index (-409 only)
		19	Bracket (-469 only)
12	Handwheel		

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

TABLE 9:
GEARS, TORQUE AND TIMING OPTIONS

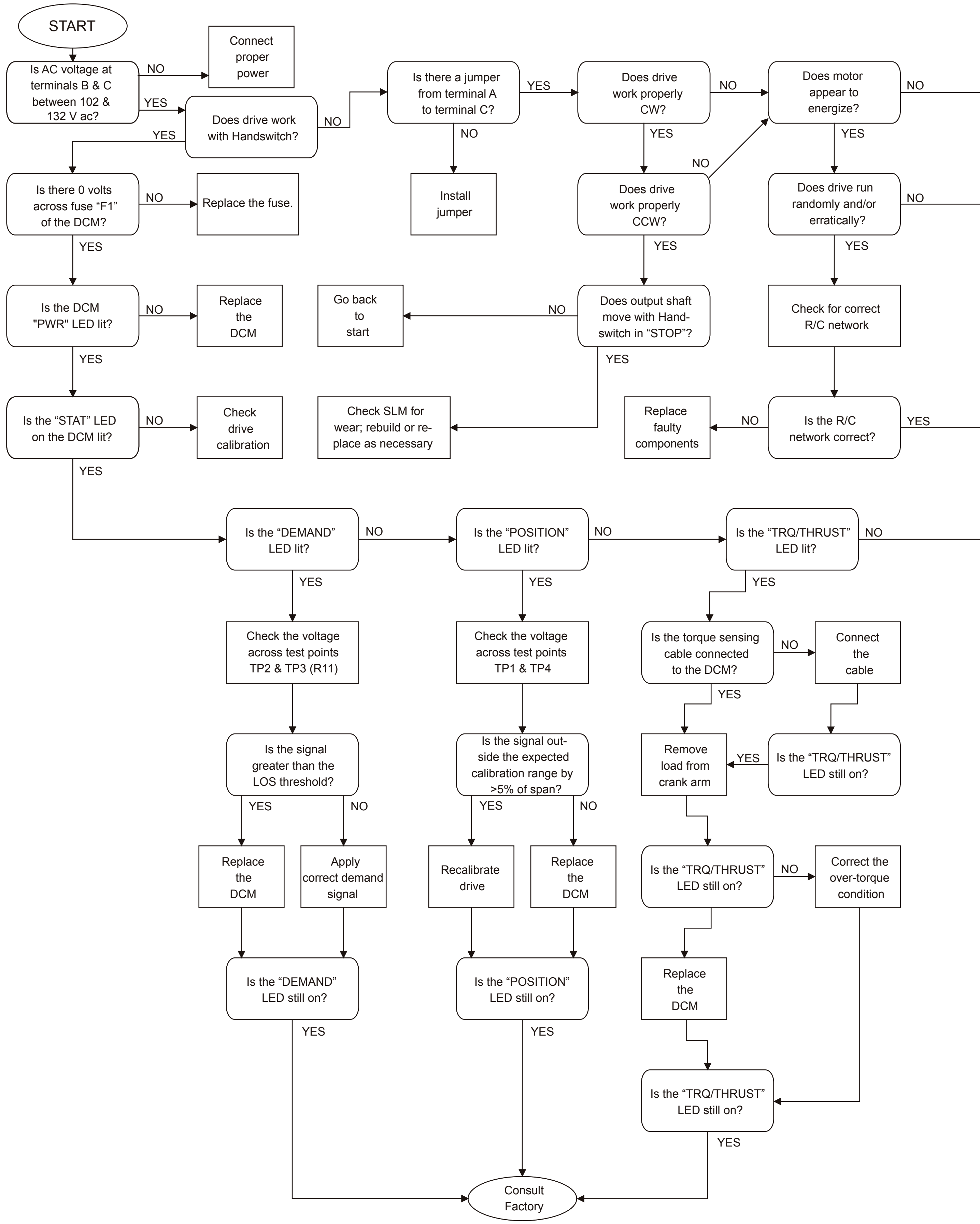
Actuator Model No.	Motor Part No.	Motor Current (Amps at 120 Vac, 60 Hz[1])	Gear Module No.	Torque (lb-ft)	Timing @ 60 hz[2] Models 11-159, -209, -309, -409 (sec./100°)	Timing @ 60 hz[2] Models 11-169, -269, -369, -469 (sec./90°)
11-1_9	20-2700-20	0.17	14-9733-04	20 (27 N•m)	20	18
			14-9733-03	40 (54 N•m)	40	36
			14-9733-02	60 (81 N•m)	60	54
			14-9733-01	80 (108 N•m)	90	81
	20-2701-20	0.31	14-9733-05	15 (20 N•m)	11	10
			14-9733-04	40 (54 N•m)	20	18
			14-9733-03	80 (108 N•m)	40	36
	20-2701-51	0.43	14-9733-04	40 (54 N•m)	12	11
			14-9733-03	80 (108 N•m)	24	22
	20-2204-01	0.43	14-9733-03	120 (163 N•m)	40	36
11-2_9	20-2704-21	0.43	14-9730-04	125 (169 N•m)	40	36
			14-9730-05	175 (237 N•m)	60	54
			14-9730-08	250 (339 N•m)	75	68
	20-2705-21	0.70	14-9730-02	125 (169 N•m)	20	18
			14-9730-04	250 (339 N•m)	40	36
	20-2705-51	0.86	14-9730-04	250 (339 N•m)	24	22
11-3_9	20-2704-21	0.43	14-9730-09	300 (407 N•m)	100	90
	20-2705-21	0.70	14-9730-04	300 (407 N•m)	40	36
			14-9730-05	400 (542 N•m)	60	54
			14-9730-08	550 (746 N•m)	75	68
			14-9730-09	650 (881 N•m)	100	90
	20-2705-51	0.86	14-9730-04	300 (407 N•m)	24	22
			14-9730-05	400 (542 N•m)	36	32
11-4_9	20-2201-31	1.30	14-9732-05	350 (475 N•m)	24	22
			14-9732-07	550 (746 N•m)	40	36
			14-9732-02	800 (1085 N•m)	60	54
			14-9732-04	1,000 (1356 N•m)	75	68
			14-9732-03	1,500 (2034 N•m)	100	90
	20-2201-32	2.30	14-9732-05	650 (881 N•m)	24	22
			14-9732-07	1,000 (1356 N•m)	40	36
			14-9732-02	1,800 (2440 N•m)	60	54
	20-2201-33	3.00	14-9732-07	1,000 (1356 N•m)	24	22
			14-9732-02	1,800 (2440 N•m)	36	32

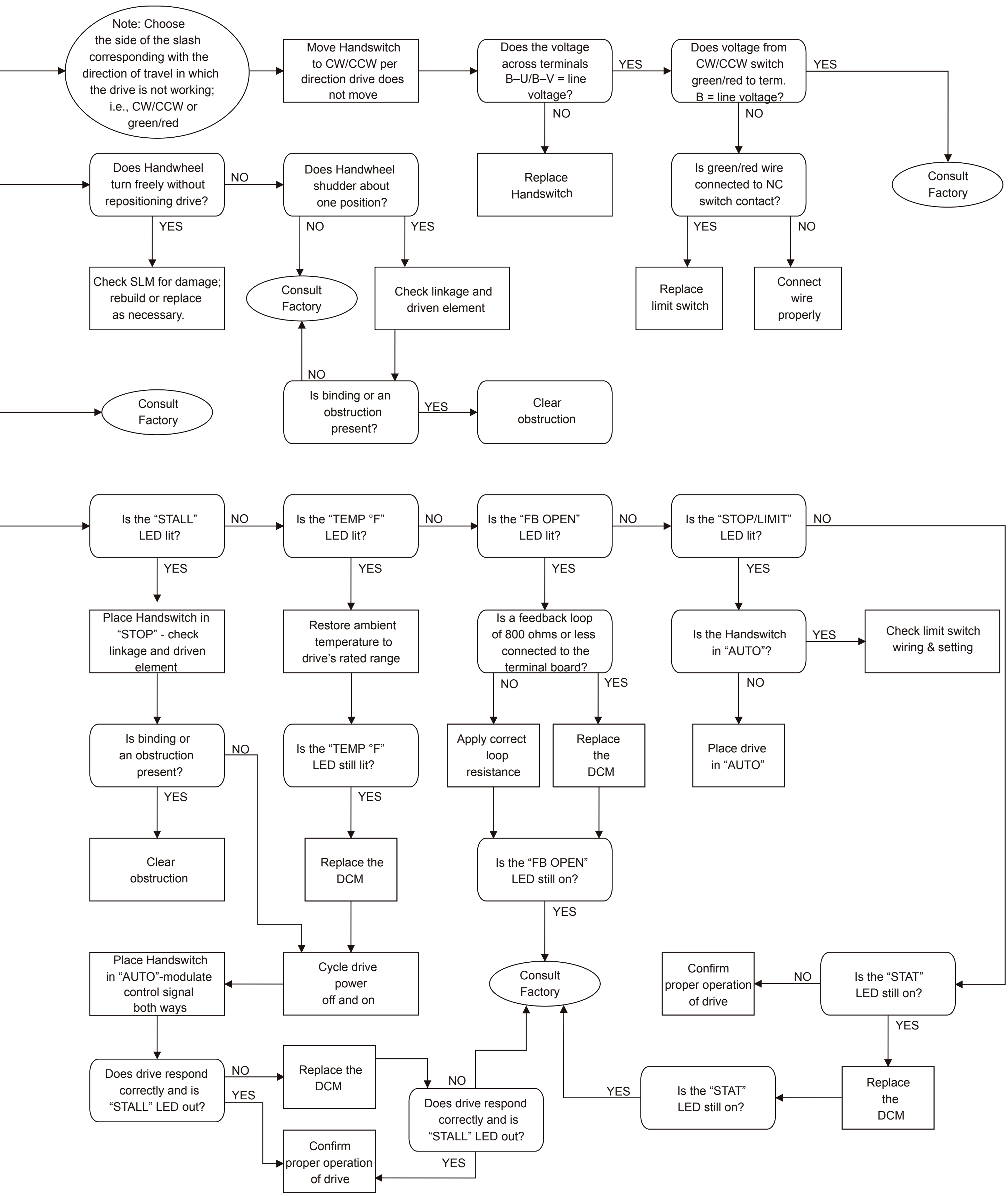
CAUTION: Use only the motor and gear module combinations listed above; other combinations may cause internal damage to the actuator and/or damage to the external equipment.

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

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

DCM-3 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
Does voltage from CW/CCW switch green/red to term. B = line voltage?
YES
NO
NO
Replace Handswitch
Is green/red wire connected to NC switch contact?
Consult Factory
YES
NO
Replace limit switch
Connect wire properly
Does Handwheel turn freely without repositioning drive?
NO
Does Handwheel shudder about one position?
YES
NO
YES
Check SLM for damage; rebuild or replace as necessary.
Consult Factory
Check linkage and driven element
NO
Is binding or an obstruction present?
YES
Clear obstruction
Consult Factory
Is the “STALL” LED lit?
NO
Is the “TEMP °F” LED lit?
NO
Is the “FB OPEN” LED lit?
NO
Is the “STOP/LIMIT” LED lit?
NO
YES
YES
YES
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?
Is the Handswitch in “AUTO”?
YES
Check limit switch wiring & setting
NO
YES
NO
Apply correct loop resistance
Replace the DCM
Place drive in “AUTO”
Is binding or an obstruction present?
NO
Is the “TEMP °F” LED still lit?
YES
YES
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 “STAT” LED still on?
YES
Replace the DCM
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 “STAT” LED still on?
Confirm proper operation of drive

DCM-3 HART INTERFACE Communication

BECK-MK2 HART DEVICE DESCRIPTION (DD) COMMUNICATOR MENUS FOR THE DCM-3 (SHOWN WITH SAMPLE VALUES)

1 — Online (1)
1 Functions
2 Position 45.4%
3 Demand 45.4%
4 Loop(Dem) 11.29 mA
5 Trq/Thrust Disabled
6 Temp 73 degF
7 Feedback 11.30 mA

2 — Functions
1 Setup Checklist
2 Device Information
3 Configuration
4 Statistics
5 Manual Operation
6 Diagnostics
7 Calibration Trim

3A — Setup Checklist
1 Drive S/N*
2 Drive Dir* CW Incr
3 Feedback* Enabled
4 CPS Zero%* 1.000 v
5 PositionUnit* deg
6 MaxTravel* 100 deg
7 Travel* 100 deg
8 DemRngLwr* 4.00 mA
9 DemRngUpr* 20.00 mA
Dem Curve* Linear
•
•
•
Alarm Mask 0xffffffff

3B — Device Information
1 Tag* BECK2015
2 Descriptor*
3 Message*
4 Model# 11-159
5 Drive S/N*
6 Instld* 11/05/2015
7 Setup* 11/05/2015
8 Calbrtd* 18/05/2015
9 Review
Poll addr* 0

3C — Configuration
1 General Setup
2 PositionSensrSetup
3 Demand Setup
4 Feedback Setup
5 Torque Setup
6 Restore to Factory**
7 Use Default Setup**

3D — Statistics
1 Starts 285213
2 Reversals 142606
3 Stalls 0
4 OverTorques 7
5 Pk Torque 107%
6 TotRunTm 32263 S
7 High Temp 135 degF
8 Low Temp 43 degF

3E — Manual Operation
1 Op Mode* Follow
2 Demand* 42.3%
3 Reset Stall**

3F — Diagnostics
1 Status
2 Tests
3 CW Torque
4 CCW Torque
5 Alarm Setup
6 RealTimeClock

3G — Calibration Trim
1 PresCPS V* 2.816 v
2 Loop(Dem)* 11.29 mA
3 Feedback* 11.29 mA
4 Trq/Thrust* 3%

4A — Review (3)

4B — General Setup
1 Drive Dir* CW Incr
2 MaxTravel* 100 deg
3 Travel* 100 deg
4 StepSize* 0.100%
5 Stall Time* 300 S
6 StallProt* Enabled
7 LimitSwitch* Accept
8 PositionUnit* deg
9 Temperature Unit* degF

4C — PositionSensrSetup
1 Set Pos 0%**
2 Set Pos 100%**
3 PresCPS V 2.816 v
4 CPS Zero%* 1.000 v
5 CPS Span 4.000 v
6 CPS RngLwr 1.000 v
7 CPS RngUpr 5.000 v
8 Pos S/N* 454
9 Snsr Dir CW Incr

4D — Demand Setup
1 DemRngLwr* 4.00 mA
2 DemRngUpr* 20.00 mA
3 Dem Curve* Linear
4 Dem Curve Spcl
5 LOS Mode* Stay
6 LOS Pos* 50.00 %
7 DemLimLwr* 3.20 mA
8 DemLimUpr 21.00 mA

4E — Feedback Setup
1 FB RngLwr* 4.00 mA
2 FB RngUpr* 20.00 mA
3 Feedback* Enabled
4 FB Curve* Linear

4F — Torque Setup
1 Trq/Thrust* Enabled
2 Ovt Prot* Enabled
3 AlarmLevel* 105%
4 ShutDwnTrq* 150
5 Trq Null* 163 TK
6 Trq Const* 279 TK

4G — Op Mode
Follow*
Hold*
RunCW*
RunCCW*
Stay
Stop*

4H — Status
1 LED Status
2 Operating Status
3 Switch Status
4 Local Cntrl Status
5 Line Freq
6 CW Inhibitors
7 CCW Inhibitors

4I — Tests
1 FB Out Test**
2 Board Self-Test**
3 Identify Device**
4 Board Reset**

4J — CW Torque
1 Segment 1 0%
2 Segment 2 12%
•
•
•
Segment 10 66%

4K — CCW Torque
1 Segment 1 5%
2 Segment 2 6%
•
•
•
Segment 10 62%

4L — Alarm Setup
1 AlarmPol* Drops Out
2 Alarm Mask*

4M — RealTimeClock
1 RTC Day* 8
2 RTC Month* 8
3 RTC Year* 2014
4 Hour (24)* 8
5 Minute* 5

5A — Dem Curve Spcl
1 DemNode1X 0 %
2 DemNode1Y 0 %
3 DemNode2X 5 %
4 DemNode2Y 5 %
•
•
•
DemNode21X 100 %
DemNode21Y 100 %

5B — LED Status
Status OFF
Reverse OFF
Forward OFF
Demand OFF
Position OFF
Trq/Thrust OFF
Stall OFF
Temperature OFF
FB Open OFF
Limit OFF
Acknowledge OFF

5C — Operating Status
Dem <> Limits OFF
Pos <> Limits OFF
Temp <> Limits OFF
Torq <> Lim OFF
Ovr Torq Stop OFF
Stalled OFF
Feedback Open OFF
Switch Block OFF

5D — Switch Status
NOT APPLICABLE TO MODEL GROUP 11

5E — Local Cntrl Status
Calibrate OFF
Set Pos 100% OFF
Set Pos 0% OFF
Set Dem 100% OFF
Set Dem 0% OFF

5F — CW Inhibitors
Balance ON
Supervisory OFF
Stall OFF
OverTrq/Thr OFF
Switch Block OFF
Bad Pos Sig OFF
Bad Dem Sig OFF
Local Cal OFF

5G — CCW Inhibitors
Balance ON
Supervisory OFF
Stall OFF
OverTrq/Thr OFF
Switch Block OFF
Bad Pos Sig OFF
Bad Dem Sig OFF
Local Cal OFF

5H — Alarm Mask
DemandLOS ON
Trq/Thrust High OFF
Stall ON
Trq/Thrust Stop OFF
Stop/Limit ON
FeedbackLOS ON
Temperature ON
PositionLOS ON
RTC Fail ON
Torq/Thrust/MeasFail OFF
PositionA/D Error ON
DemandMeasFail ON
Reserved 1 ON
PositionLOS ON
TemperatureMeasFail ON
MemoryFail ON
InvalButtonPress ON
DemandTooHigh ON
DemUnderHART/FF Ctl ON
DemUnderPAT Ctl ON

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

* THIS VALUE CAN BE EDITED

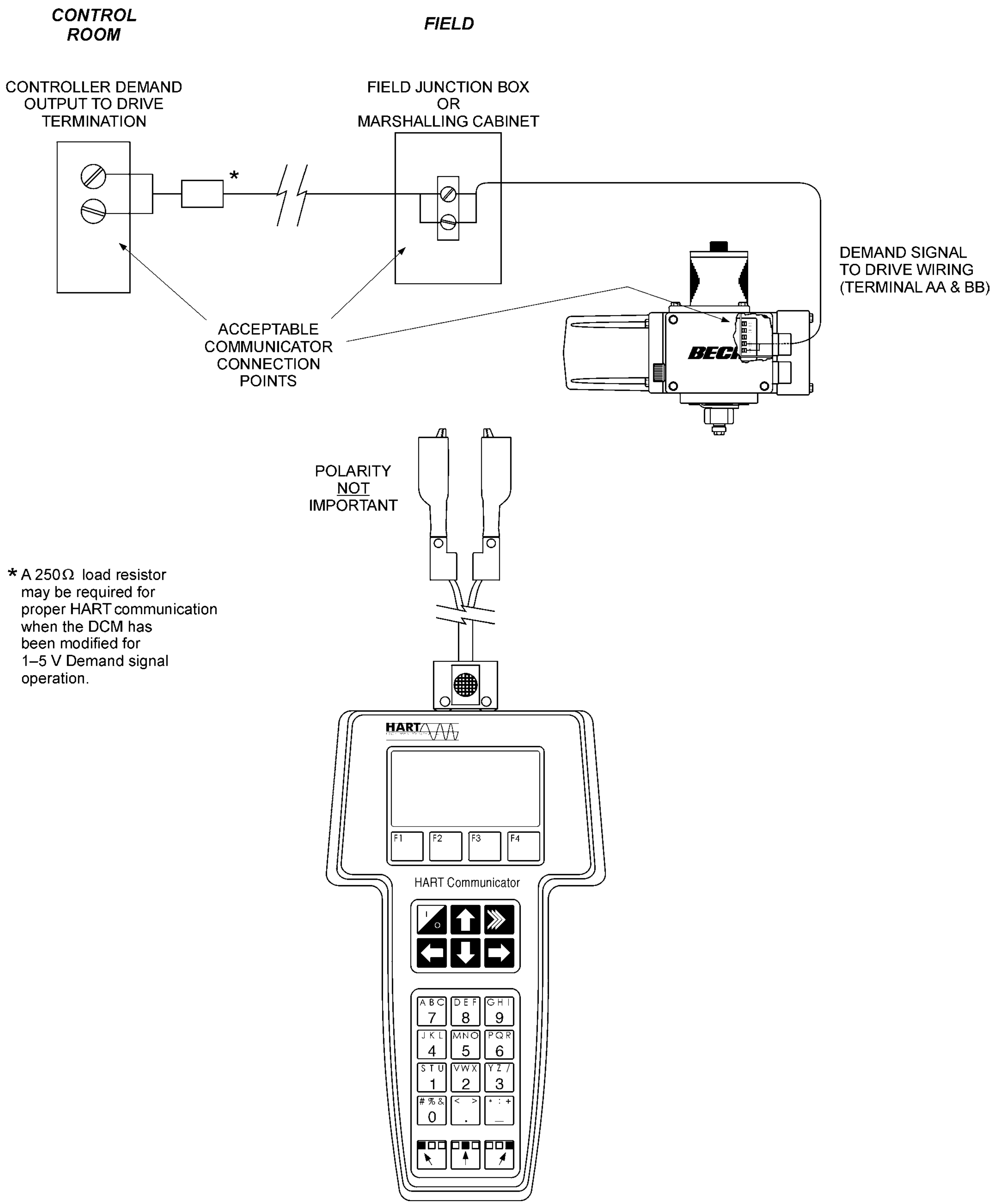
** INDICATES AN ACTION RATHER THAN THE VIEWING OR EDITING OF A PARAMETER

(1) THIS IS THE MENU DISPLAYED BY THE HART COMMUNICATOR AT POWER-UP IF COMMUNICATION IS ESTABLISHED

(2) THIS AND OTHER OFFLINE MENUS ARE COMMON TO ALL HART COMMUNICATOR APPLICATIONS - MANY SUBMENUS EXIST

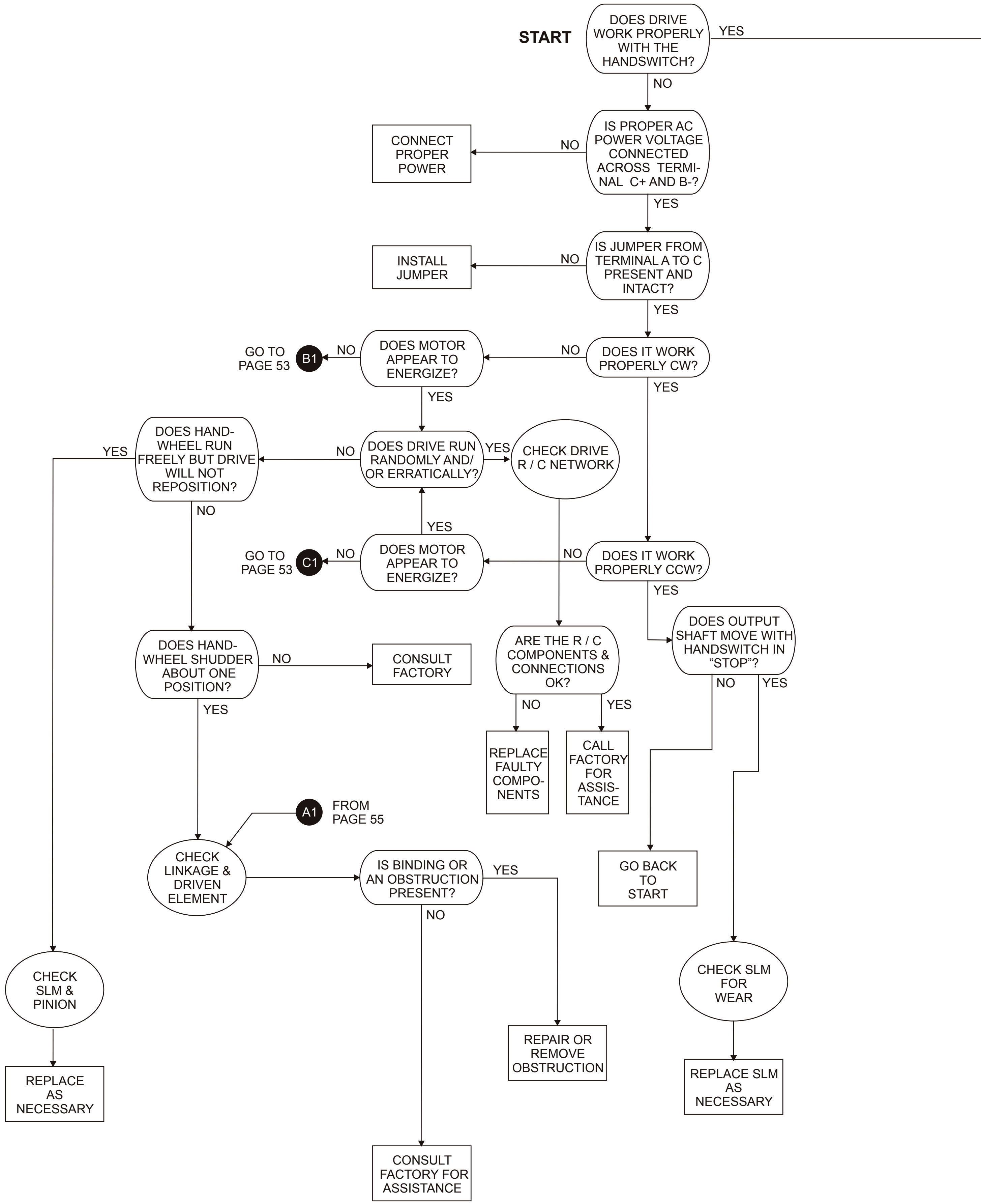
(3) PROVIDES AN EXTENDED LIST OF DRIVE PARAMETERS

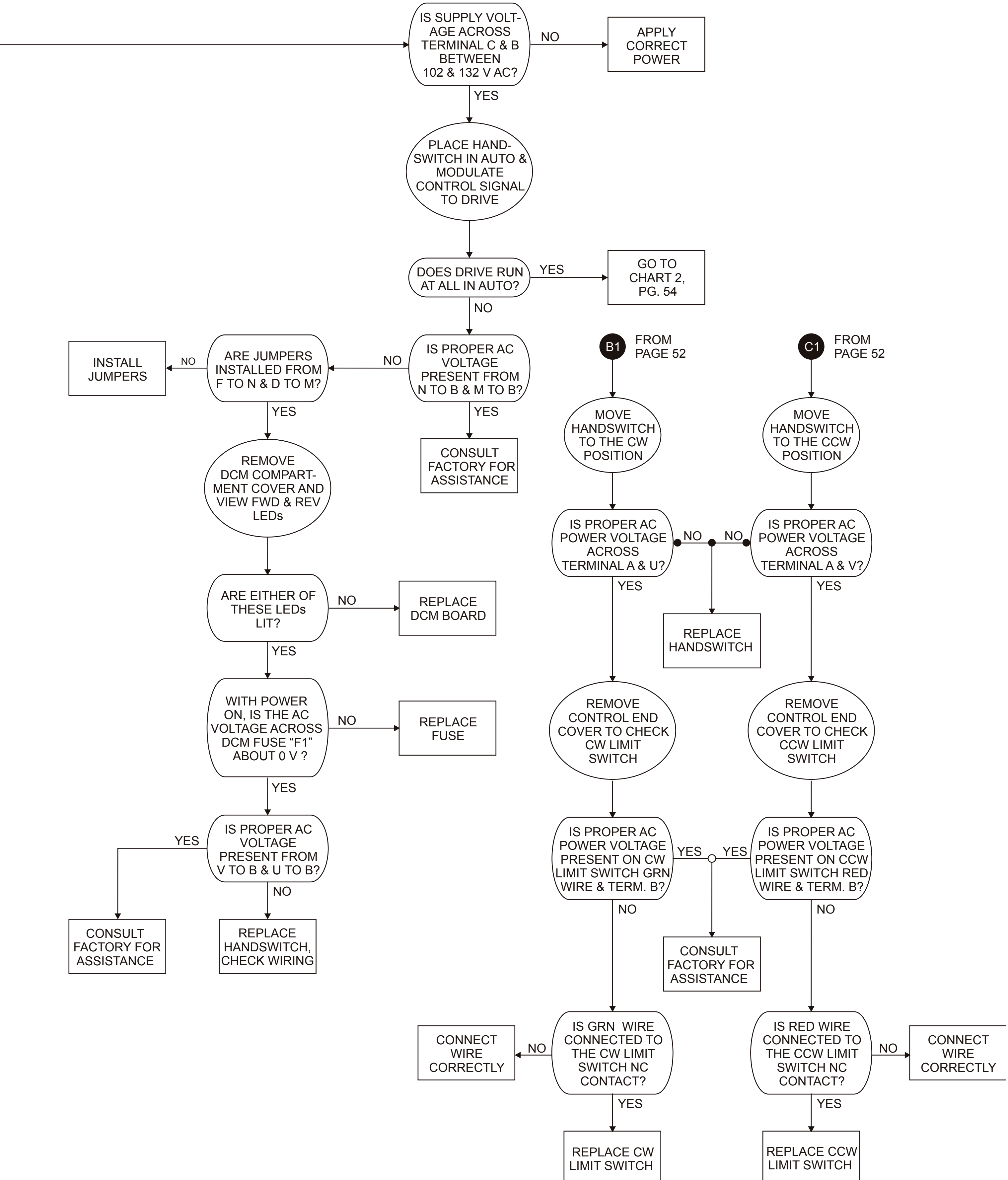
HANDHELD COMMUNICATOR WIRING CONNECTIONS



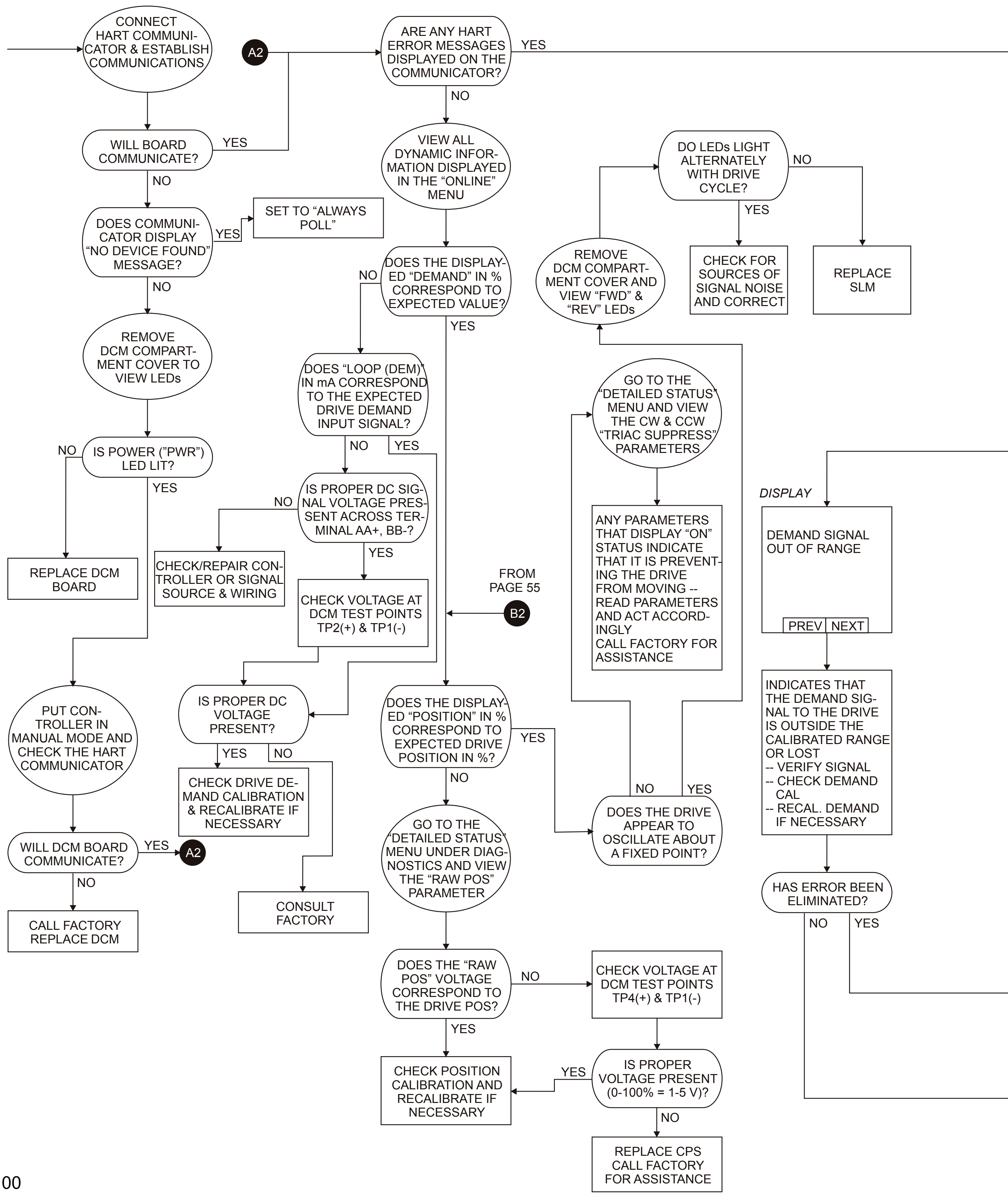
DCM-3 HART INTERFACE Troubleshooting

ELECTRO / MECHANICAL -- CHART 1

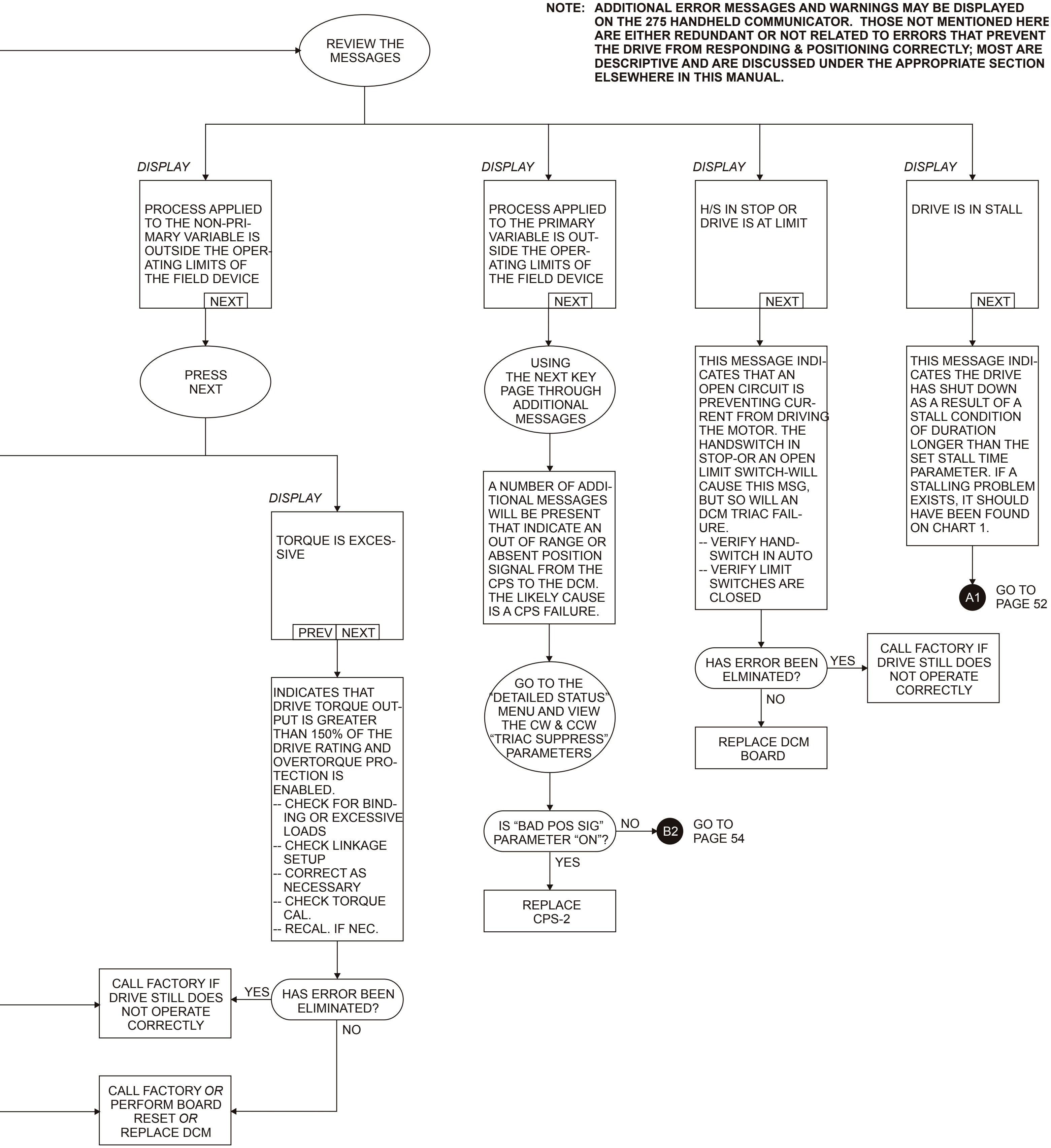



IS SUPPLY VOLTAGE ACROSS TERMINAL C & B BETWEEN 102 & 132 V AC?
NO
APPLY CORRECT POWER
YES
PLACE HANDSWITCH IN AUTO & MODULATE CONTROL SIGNAL TO DRIVE
DOES DRIVE RUN AT ALL IN AUTO?
YES
GO TO CHART 2, PG. 54
NO
IS PROPER AC VOLTAGE PRESENT FROM N TO B & M TO B?
NO
ARE JUMPERS INSTALLED FROM F TO N & D TO M?
NO
INSTALL JUMPERS
YES
CONSULT FACTORY FOR ASSISTANCE
YES
REMOVE DCM COMPARTMENT COVER AND VIEW FWD & REV LEDs
ARE EITHER OF THESE LEDs LIT?
NO
REPLACE DCM BOARD
YES
WITH POWER ON, IS THE AC VOLTAGE ACROSS DCM FUSE “F1” ABOUT 0 V ?
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 52
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
C1
FROM PAGE 52
MOVE HANDSWITCH TO THE CCW POSITION
IS PROPER AC POWER VOLTAGE ACROSS TERMINAL A & V?
NO
REPLACE HANDSWITCH
YES
REMOVE CONTROL END COVER TO CHECK CCW LIMIT SWITCH
IS PROPER AC POWER VOLTAGE PRESENT ON CCW LIMIT SWITCH RED WIRE & TERM. B?
YES
CONSULT FACTORY FOR ASSISTANCE
NO
IS RED WIRE CONNECTED TO THE CCW LIMIT SWITCH NC CONTACT?
NO
CONNECT WIRE CORRECTLY
YES
REPLACE CCW LIMIT SWITCH

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.



INDEX

SERVICES

PRODUCT DEMONSTRATIONS

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

SITE SURVEYS

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

Mounting hardware, torque requirements, linkage, control signal information, and optional equipment can be analyzed most effectively at the 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 actuators 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 actuators 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 actuators 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 Actuators are covered by the following patents: 6,563,412 and 6,639,375.

81-0002-01A

BECK®

Declaration of Incorporation of Partly Completed Machinery

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

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

declare that:

Brand: Beck

Type and Description of Equipment: Rotary Actuator / Control Drive

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

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

Machinery Directive (MD): 2006/42/EC

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

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

The following essential requirements of the Machinery Directive (Annex I) have been applied:
1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.4.1, 1.3.1, 1.3.2, 1.3.4, 1.3.6, 1.3.7, 1.3.8, 1.5.1, 1.5.2, 1.5.5, 1.5.6, 1.5.7, 1.5.10, 1.5.11, 1.6.2, 1.7.1, 1.7.3, 1.7.4

The partly completed machinery specified in this Declaration are also in conformity with the provisions of Directives 2014/35/EU (Low Voltage) and 2014/30/EU (Electromagnetic Compatibility).

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

(Signature)

F. William Belser, Jr.
Engineering Manager

6 August 2019
(Date of Issue)

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