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Rev. 01.1

MODEL 42-109

BECK®

INSTRUCTION MANUAL

ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

INTRODUCTION TO THE MANUAL

This manual contains the information needed to install, operate, and maintain Beck Model 42-109 Electronic Control Drives, manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

Group 42 drives are powerful control packages designed to provide precise position control on long, linear stroke applications requiring up to 1,000 lbs. of thrust.

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

The Group 42 drive combines years of electric actuation experience with state-of-the-art technologies to provide all the performance and reliability customers expect from Beck drives.

Designed for long linear stroke applications, the Group 42 offers simplicity, flexibility and an easy-to-use package. Ideally suited for burner air register type applications, the Group 42 is flexible and can be used on many long linear stroke applications.

Group 11 rotary drives ...
provide precise position control of dampers, quarter-turn valves, fluid couplings, and other devices requiring up to 8,000 lb-ft drive torque.

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

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

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

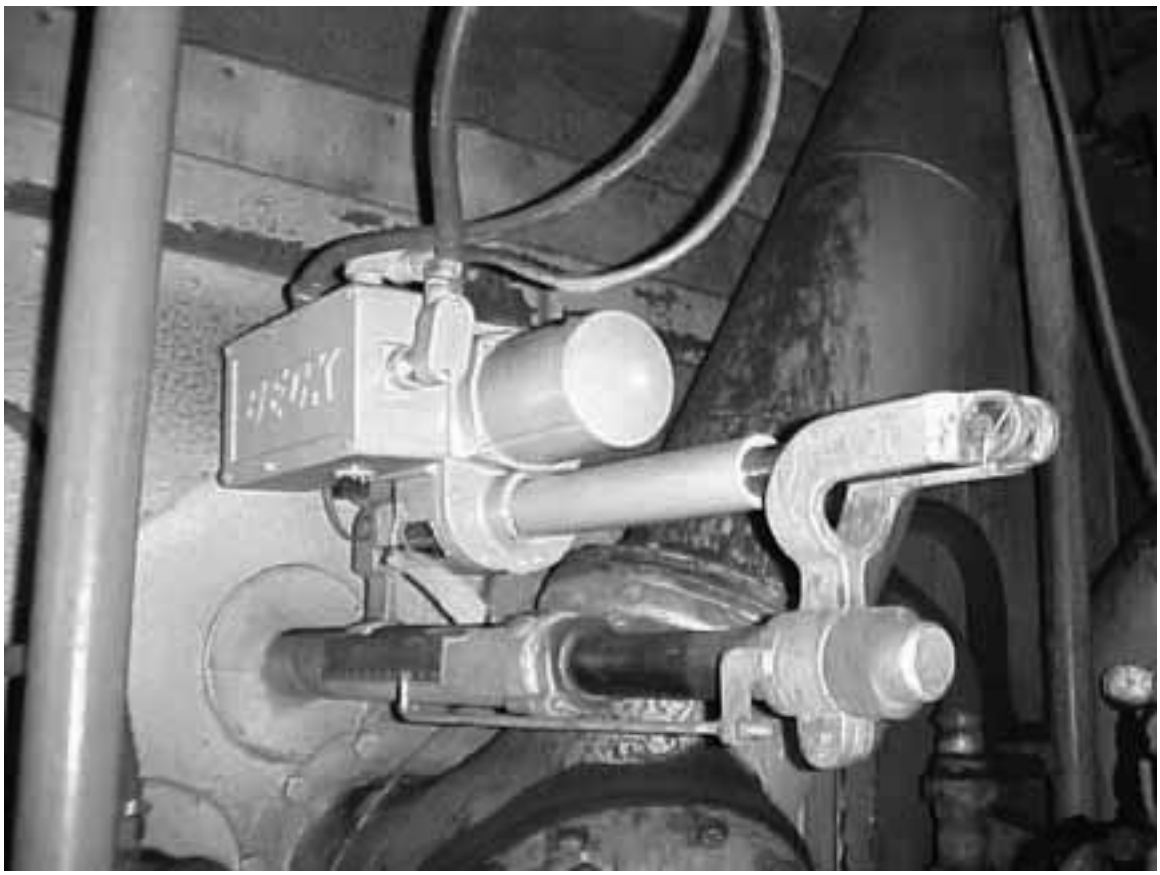
CONTENTS

PRODUCT DESCRIPTION

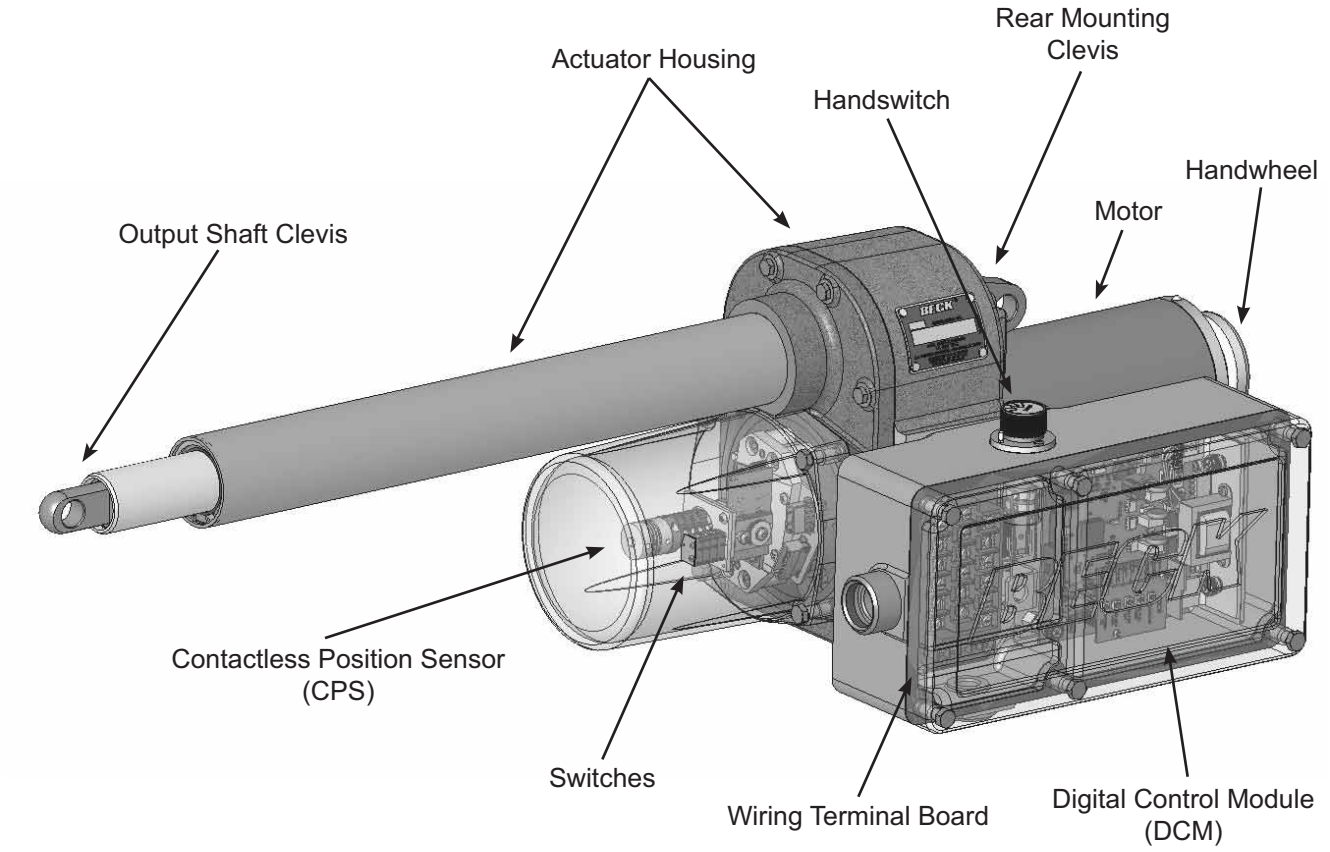
Beck's all-new Group 42 drives are designed to meet the actuation needs of long stroke linear applications. Typical applications include burner air registers and OFA port dampers, but they can be used on any application requiring up to 18 inches of linear stroke. Employing Beck's unique design characteristics, reliability and quality into a long stroke linear actuator design fills a much requested slot in the Beck family of products.

As with all Beck drives, the Group 42 is designed for simple installation, no duty cycle limitations, excellent performance and little or no required maintenance.

Ideally suited for harsh industrial environments, the Group 42 handles long stroke applications requiring up to 1,000 lbs. of thrust. The design employs a highly efficient ball screw coupled with a time-proven Beck motor and offers consistent, repeatable positioning as precise as 0.1% of span. Like all Beck drives, the Group 42 incorporates a heavy-duty, weather-proof, cast aluminum body.



42-109 Cutaway View



PRODUCT DESCRIPTION

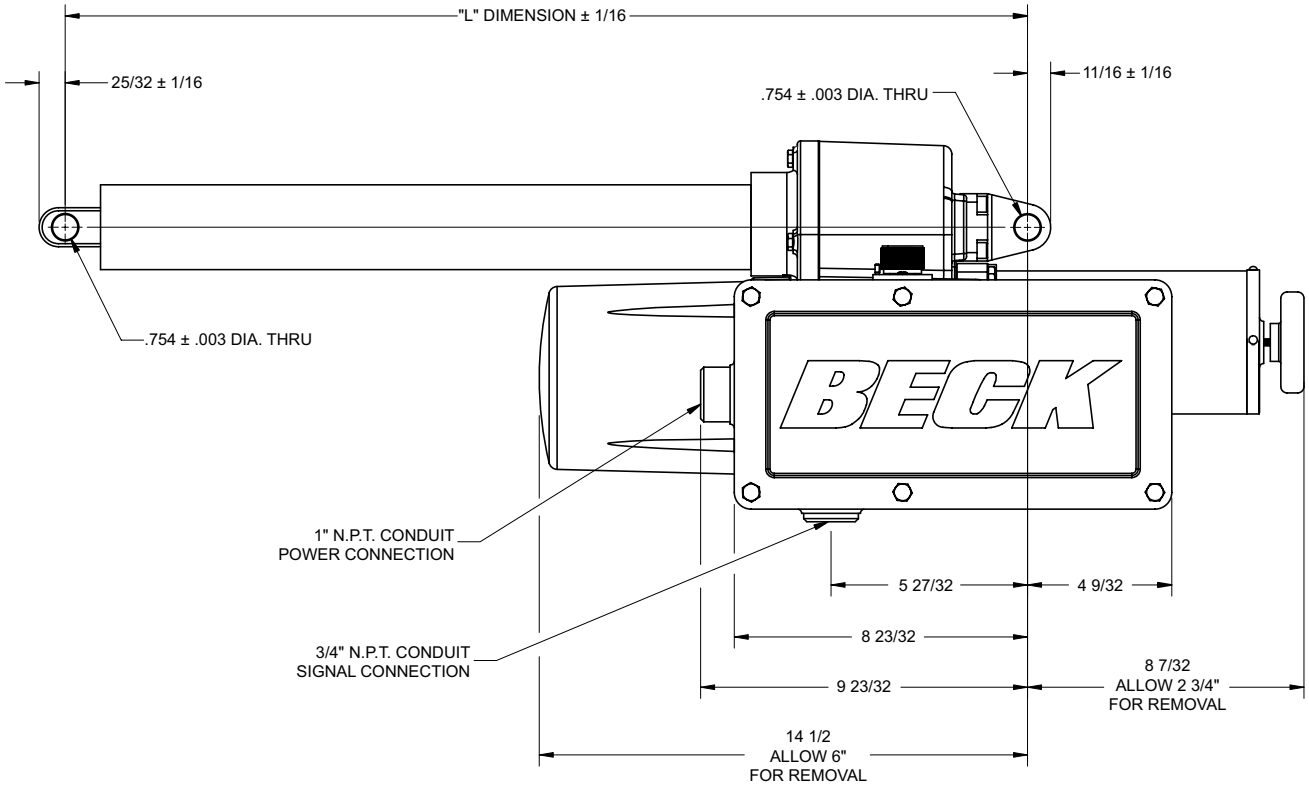
42-109 GENERAL SPECIFICATIONS

Output Thrust and Timing	1,000 lbs., 4.2 sec/in
Stroke Range	8 to 18 inches
Drive Power	120 V ac, single-phase, 50 or 60 Hz, 1.5 A 240 V ac, single-phase, 50 or 60 Hz, .75 A
Weight	Approx. 75–89 lbs., depending on selected options.
Operating Conditions	-40° to 85°C (-40° to 185°F) 0 to 99% relative humidity
Communication Interface	HART® protocol and local pushbutton/LED panel and RS-232 Serial commands.
Demand Input Signal Range	4–20 mA, 1–5 V dc
Minimum Step	0.1% of span
Hysteresis	0.25% of span at any point.
Demand Input Signal Characterization	Linear: Drive output shaft moves proportionally to the input signal. Square: Drive output shaft moves proportionally to the square of the input signal. Custom: 20 segment configurable curve fit.
Position Feedback Signal	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	Output shaft stays in last position.
Action on Loss of Input Signal (Power on)	Stay in place or runs to any preset position (configurable).
Over-thrust Protection	If the output thrust of the drive exceeds 150% of the drive rating, the motor will shut off (feature can be enabled/disabled).
Stall Protection	If the motor tries to run in one direction for more than 300 seconds (configurable from 30 to 300 seconds), the motor will shut off.

Over-travel Limit Switches	Two Form C (Retract and Extend) provide over-travel protection.
Auxiliary Switches (Field adjustable)	Two Form C rated for 1 A, 250 V ac.
Handswitch	Permits local electrical operation, independent of Demand input signal.
Handwheel	Provides manual operation without electrical power.
Motor	120 V ac, single-phase, no burnout, non-coasting. Capable of 60 starts per minute.
Enclosure	Precision-machined aluminum alloy, painted with corrosion-resistant polyurethane paint, to provide a rugged, dust-tight, weatherproof enclosure designed to meet NEMA 4X standards.
Mounting Orientation	Can be mounted in any orientation.

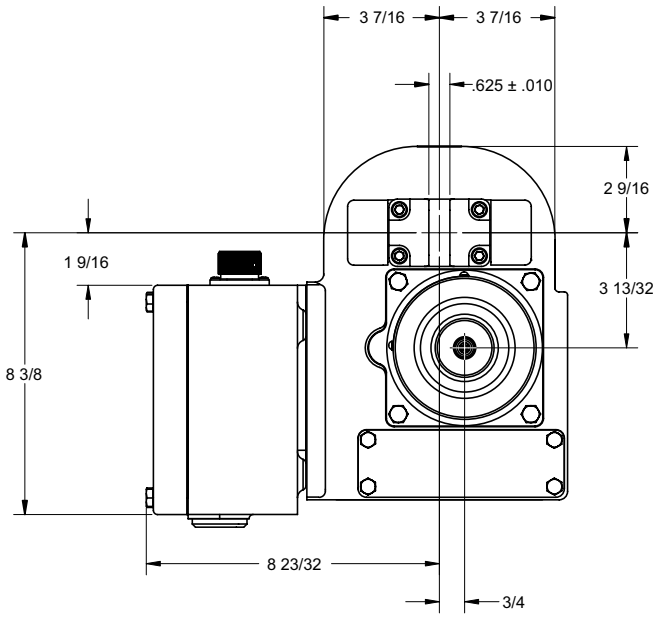
OUTLINE DIMENSION DRAWINGS

MODEL 42-109 SPECIFICATIONS
(*All dimensions in inches and subject to change*)

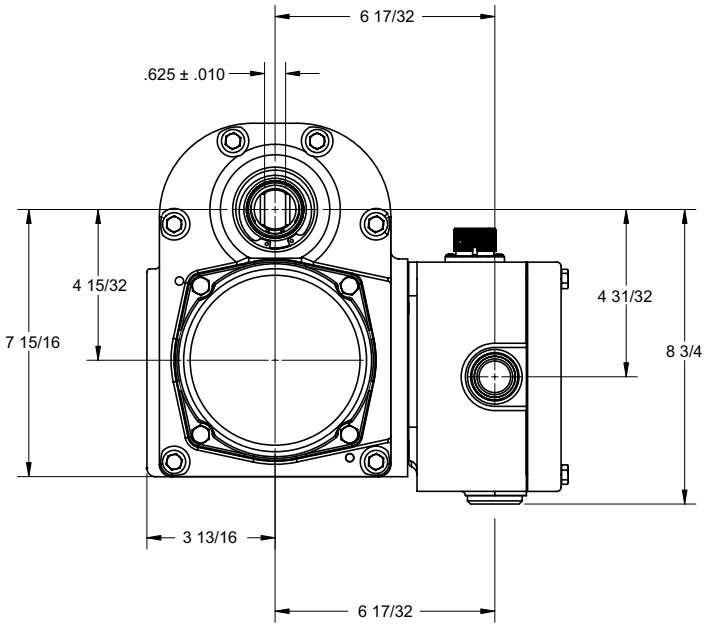


RIGHT SIDE VIEW

Max. Drive Travel	"L" Dim. Fully Ret.	"L" Dim. Fully Ext.	Approx. Wt. Lbs. (120V)	Approx. Wt. Lbs. (240V)
8	18 19/32	26 19/32	75	84
12	22 19/32	34 19/32	77	86
18	28 19/32	46 19/32	80	89



REAR VIEW



FRONT VIEW

INSTALLATION

SAFETY PRECAUTIONS

WARNING

Installation and service instructions are for use by qualified personnel only. To avoid injury and electric shock, do not perform any servicing other than that contained in this manual.

STORAGE INFORMATION

Beck Group 42 control drives should be stored in their shipping cartons in a clean, dry area.

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

UNPACKING

Group 42 drives are shipped in standardized cardboard shipping containers. Depending on the model ordered, the drive may also be secured to a wooden platform. After unpacking, this platform may be used to transport the drive to the installation site.

INSTALLATION—ELECTRICAL

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

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

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

A large, clearly labeled terminal block on the top of the drive is enclosed in a separate, gasketed metal enclosure. Terminals will accommodate up to 12 AWG wiring. See page 5 for location of the terminal block.

CAUTION

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

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

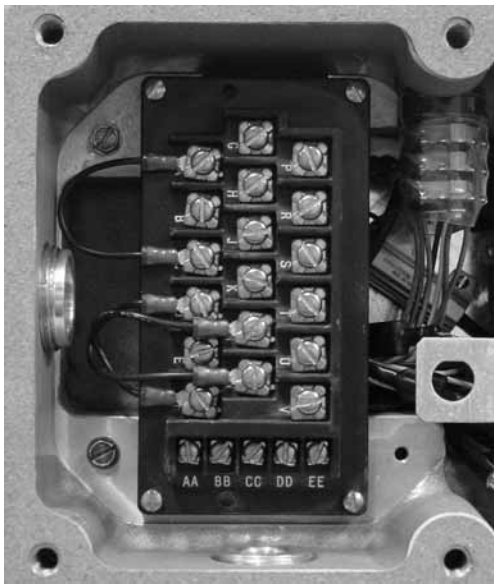
Your Beck drive has been supplied to match the signal source in your control loop. If it does not match, a 250 ohm input resistor may be added or removed to obtain the proper match. Consult the factory for details.

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

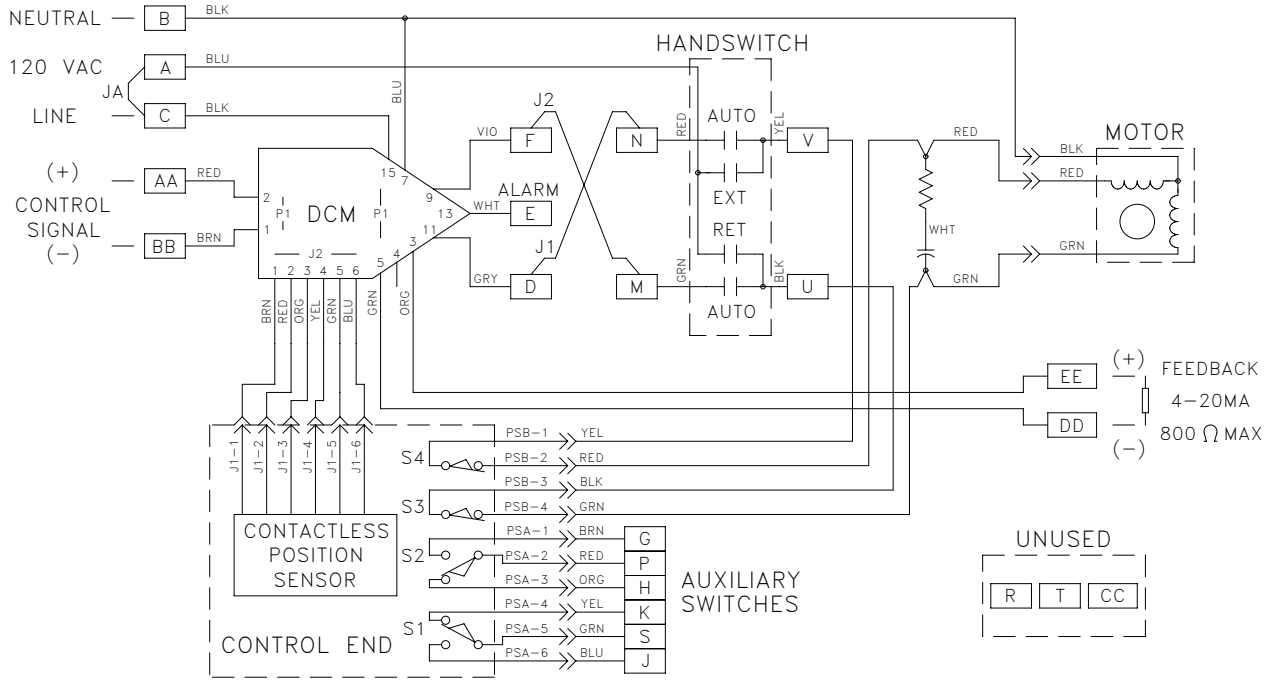
INSTALLATION *SIGNAL WIRING*

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

A drive can be ordered with up to two optional auxiliary switches. Wiring connections for these are described on page 19.



Typical Wiring Connections



POWER AND DEMAND INPUT CONNECTIONS

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

OPERATION

START-UP INSTRUCTIONS

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

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

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

Turn on the controller and operate the drive by varying the control signal. Check that the output shaft moves in the proper direction for a change in control signal. If not, check for proper wiring connections and verify control signal at the drive. If the wiring is correct, then change the direction of output shaft travel.

HOUSING

Beck Group 42 actuators have individual cast aluminum compartments for the main components: The control motor, wiring terminal block/DCM, drive train and control end. Gasketed covers and sealed shafts make the drives ideally suited to outdoor and high humidity environments.

Heavy cast mechanical stops built into the housing are designed to prevent accidental over-travel damage during manual cycling, and ensure that proper orientation is maintained between the output shaft and the feedback system. Drive travel is centered between the mechanical stops unless otherwise specified at time of order.

CONTROL MOTOR

The Beck control motor is a synchronous inductor motor which operates at a constant speed of 72 RPM in synchronism with the line frequency. Motors are able to reach full speed within 25 milliseconds and stop within 20 milliseconds; actual starting and stopping times will vary with load. Beck motors have double grease-sealed bearings and require no maintenance for the life of the motor.

DRIVE TRAIN

The drive train consists of the control motor, Handwheel, reduction gears, main gear and output shaft. The output shaft is limited by mechanical stops to 1/8" beyond the maximum stroke range.

SELF-LOCKING MECHANISM (SLM)

An integral part of every control motor is the self-locking mechanism. This mechanical device couples the motor to the gear train and transmits full motor torque when rotated in either direction. When the motor is de-energized, the SLM instantaneously locks and holds the output shaft in position.

HANDWHEEL

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

HANDSWITCH

A local electric Handswitch is provided on Beck drives to permit operation independent of the controller. As a safety feature, the Handswitch is designed so that the controller can operate the drive only when it is in the "AUTO" position. The sequence of the Handswitch is: "AUTO", "STOP", "RETRACT", "STOP", "EXTEND".

In the "AUTO" position, two contacts are closed and the DCM completes the control circuit. In the "RETRACT" or "EXTEND" positions, contacts are closed to operate the drive independently of the controller. In the "STOP" position, all contacts remain open.

SWITCHES

Two over-travel limit switches and up to two optional auxiliary switches are provided on Beck drives. Switch cams are clamped onto the control shaft which rotates in relation to the output shaft. Cam position is field-adjustable. Switches are rated 1 A, 250 V ac. All auxiliary switch connections are made on the terminal block.

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

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

POSITION: CONTACTLESS POSITION SENSOR (CPS)

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

The position sensing function of the CPS is provided by a ferrite magnetic sensing element. An electronic circuit translates the signal from the ferrite magnetic sensor into a position signal used by the DCM to control the drive. The typical output voltage of the CPS ranges from ~1.0 V at the Extend end of travel, to ~4.0 V at the Retract end of travel. A 4–20 mA position feedback signal is available for remote position indication. If the CPS Position signal to the DCM is out of the calibrated range limits, the "ERR" and "POSITION" LEDs will light. Alarm indication is available at terminal E .

THRUST PROTECTION AND INFORMATION

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

STALL PROTECTION AND ANNUNCIATION

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

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

TEMPERATURE

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

FEEDBACK SIGNAL

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

STOP/LIMIT INDICATION

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

DIGITAL CONTROL MODULE (DCM)

INPUT: DIGITAL CONTROL MODULE (DCM)

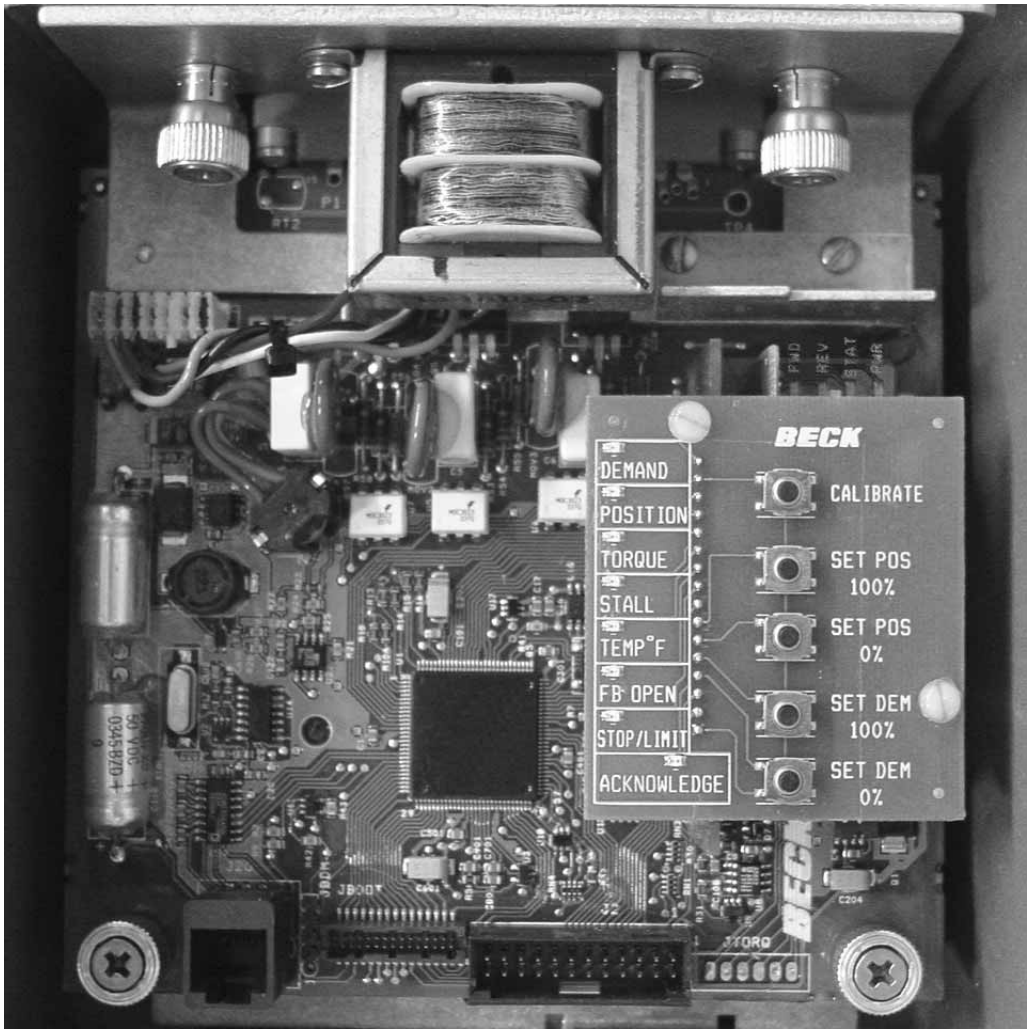
Beck modulating drives are equipped with a precision, digital control module (DCM) designed to receive conventional 4–20 mA or 1–5 V dc control signals directly—eliminating the need for contact protection devices, relays, switches and reversing starters.

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

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

The DCM permits two or more Beck drives to be operated by a single signal source. See "split range operation".

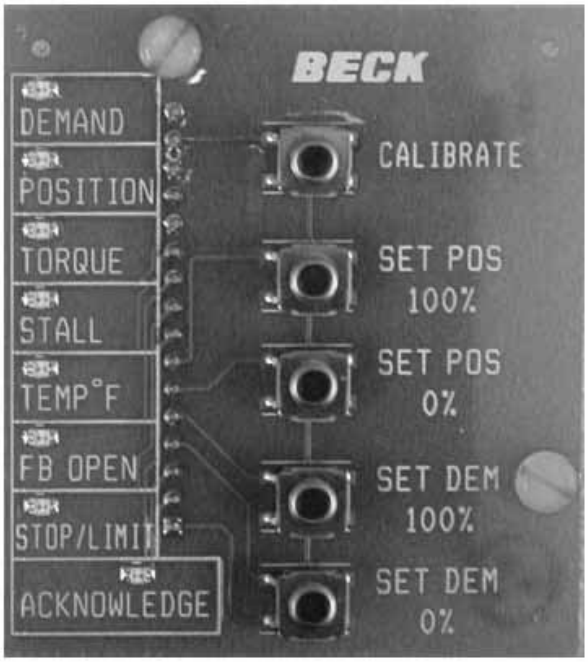
A square function is available to position the drive's output shaft proportionally to the square of the input signal. This function is factory configurable (specify at time of order) or may be configured using the HART interface or Serial interface.



DCM LOCAL INTERFACE *Operation*

OVERVIEW

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



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

Overview LEDs

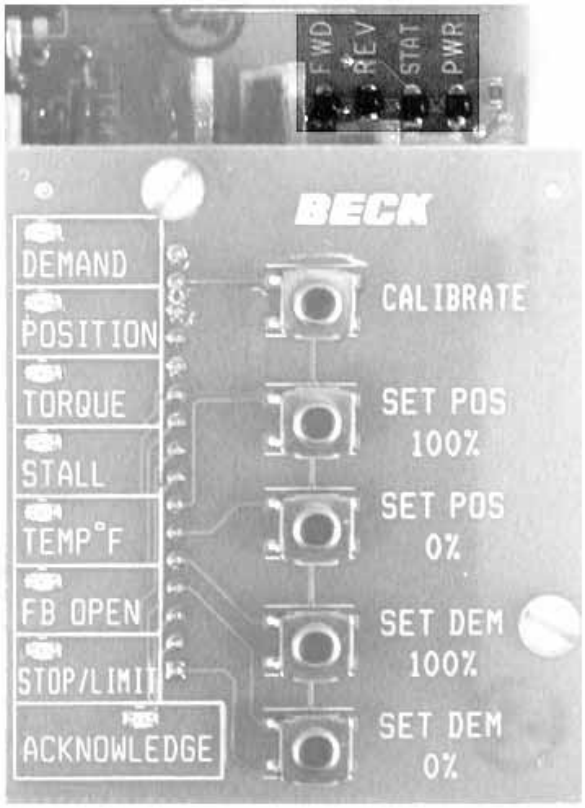
The four LEDs, as highlighted below, indicate the present state of the drive.

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

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

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

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



DCM LOCAL INTERFACE *Operation*

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 alarm is also available at terminal E. When the condition is corrected, the status will automatically reset. Each status LED is described below.

DEMAND
: Loss of the Demand input signal.

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

TORQUE
: This LED indicates that excessive thrust is present (over 105% of the drive rating).

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

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

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

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

Pushbutton Controls

The five pushbuttons (pictured below) on the DCM customer interface panel are used for calibration. When pressing a pushbutton, pressure should be maintained until the "ACKNOWLEDGE" LED lights; this confirms receipt of the pushbutton command. See the Calibration section, beginning on page 17, for further explanation of the calibration procedures. Pushbutton functions are as follows:

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

CAUTION

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

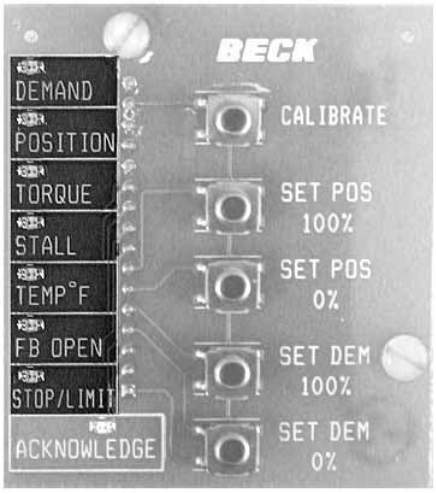
SET POS 100%
: Press to set the desired 100% position for drive movement (this will correspond to a 100% Demand signal).

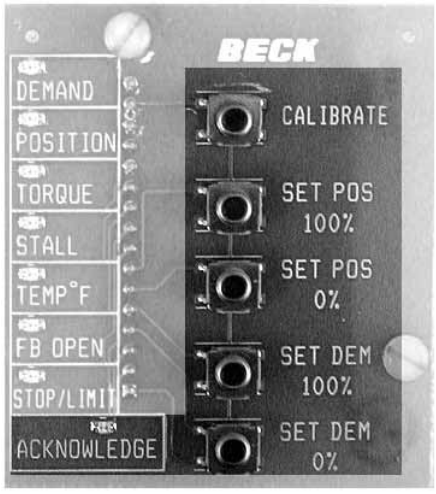
SET POS 0%
: Press to set the desired 0% position for drive movement (this will correspond to a 0% Demand signal).

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

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

Status Indication LEDs





Pushbutton Controls

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

Position reference and Demand calibration are performed using the DCM customer interface panel, but may also be configured using the HART or Serial interface. Calibration of over-travel limit and auxiliary switches must be performed using the procedure beginning on page 18.

CALIBRATION PRIORITY

Group 42 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft movement must occur within these stops, which are approximately 1/8" beyond each end of maximum stroke range.

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

If the drive is short-stroked—i.e., full travel is reduced to less than the standard span—it may be desirable to reset the over-travel limit switches (see page 18). If the limit switches are not reset, Handswitch operation of the drive (Retract, Extend) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. The switches should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

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

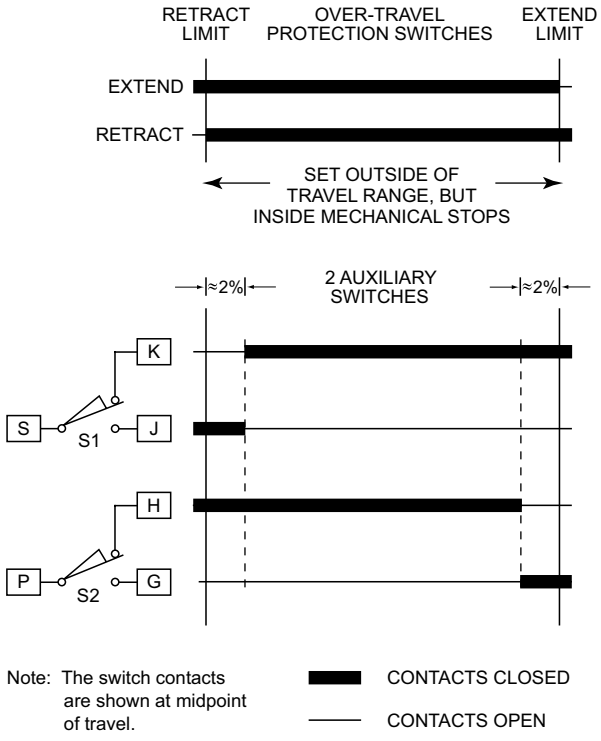
SWITCH CALIBRATION

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

Under normal operating conditions there is no need to recalibrate the control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the following procedures.

Switch Adjustments

All control drives are shipped with over-travel limit switches factory-set just outside the range of travel (unless otherwise specified at time of order). The switches are set to provide electrical over-travel protection. The switches must be set inside the range of the built-in mechanical stops. The switches can be reset to accomodate limited travel of the output shaft. Auxiliary switches are factory set, as shown in the illustration below, unless otherwise specified at time of order.



Standard Over-travel Protection and Auxiliary Switch Settings

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

CAUTION

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

Setting Over-travel Protection Switches S3 (Retract) and S4 (Extend)

This procedure should be used if the factory over-travel switch settings must be changed in the field. It is advisable to operate the drive fully in each direction—using the Handswitch and Handwheel—to check switch settings before attempting to change them. Use the following instructions if they require adjustment:

1. Remove the control end cover and terminal block/DCM cover (1/2" bolt heads).
2. Use the Handswitch to drive the control shaft so that the thumb nut locking screw is accessible. While holding the shaft coupling, use a 3/32" hex wrench and loosen the screw on the thumb nut. Loosen the thumb nut by turning it counter-clockwise approximately 1/4 turn. See the illustration on the following page.
3. Retract the output shaft to the end of travel limit.
4. Turn the Handswitch to the STOP position.
5. Use the Handwheel to position the output shaft at the desired over-travel limit.
6. Disconnect power from the drive.
7. Connect the continuity meter across the appropriate terminals. Refer to your drive wiring diagram (if not available, see the diagram on this page).
8. While holding the shaft coupling stationary, rotate the appropriate cam using the 3/32" hex wrench in one of the cam adjustment slots (see drawing on page 19 for location of slots) until the meter shows continuity (switch contacts closed, switch clicks).

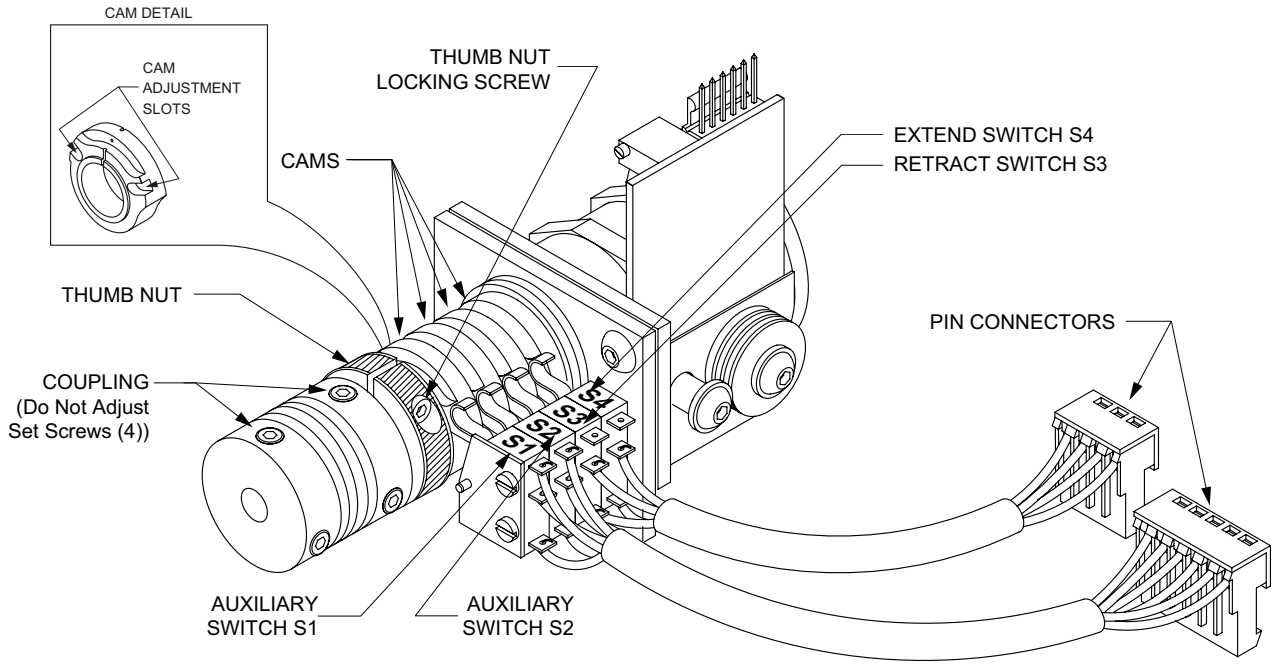
9. Turn the thumb nut clockwise until hand tight. Tighten the thumb nut locking screw to 5 lb-in torque.
10. Use the Handwheel and confirm that the contacts are open in the normal operating range and close at the desired over-travel limit.
11. Disconnect the meter and reconnect drive power.
12. Repeat instructions for setting (and verifying) the Extend over-travel protection switch (noting that referenced directions of travel should be opposite of those used for the Retract switch setting).
13. Replace covers and tighten cover bolts to 10 lb-ft torque.

Setting Auxiliary Switches

Standard switch settings for the 2 auxiliary switches are shown on the diagram on the preceeding page. The operating point of auxiliary switches is defined as a percentage of output shaft travel. 100% is defined as the Extend limit of shaft travel. The heavy line indicates a closed circuit. Use the following instructions to change the operating point of auxiliary switches:

NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved.

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the Handswitch to drive the control shaft so that the thumb nut locking screw is accessible. While holding the shaft coupling, use a 3/32" hex wrench and loosen the screw on the thumb nut. Loosen the thumb nut by turning it counter-clockwise approximately 1/4 turn. See illustration below.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the STOP position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. Refer to your drive wiring diagram (if not available, see the diagram on page 18).
7. While holding the shaft coupling stationary, rotate the appropriate cam using the 3/32” hex wrench in one of the cam adjustment slots (see drawing on this page for location of slots) until the meter shows continuity (switch contacts closed, switch clicks).
8. Turn the thumb nut clockwise until hand tight. Tighten the thumb nut locking screw to 5 lb-in torque.
9. Disconnect the meter and reconnect power.
10. Move the drive’s output shaft in the desired direction so that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
11. Replace covers and tighten cover bolts to 10 lb-ft torque.



CONTROL END / CONTACTLESS POSITION SENSOR

DEMAND CALIBRATION

DCM boards are designed to accept a 4–20 mA (or 1–5 V dc) analog Demand signal. Narrower spans within this range can also be accommodated for split range operation (see page 21). The input comes calibrated from the factory for the full range unless otherwise specified by the customer. It is not necessary to calibrate the Demand input when the drive is installed; however, it can be easily accomplished using the DCM pushbutton controls (or HART or Serial interface) and a signal source. Following this procedure is only necessary to compensate for slight differences between the signal source calibration and the DCM factory calibration, or if reduced range calibration is desired for special operating scenarios such as split ranging.

Calibration Procedure

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive (e.g., 4 mA for 4–20 mA input). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 11.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive (e.g., 20 mA for 4–20 mA input).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Turn the Handswitch to the "AUTO" position. NOTE: The drive may reposition.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the compartment covers and tighten the cover bolts to 10 lb-ft torque.

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

Split Range Operation

In applications where it is necessary (or preferable) to have more than one final control element controlling a single process, two to four Beck drives may be set up to respond to different portions of the Demand signal from the control system. The most common arrangement involves two drives; each operating on different halves of the input signal range. For example, if a 4–20 mA control signal is used, the first drive would move 100% of its stroke on a signal range of 4–12 mA, while the second operates on the 12–20 mA range.

To set up a split range operation, follow the steps listed below (see page 16 for location of pushbutton controls).

NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the configuration. See page 13 for information on changing L.O.S. settings.

1. Remove the DCM cover (1/2" bolt heads).
2. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
3. Apply the desired 0% Demand input signal to the drive. (Following the example above, the minimum signal for the first drive would be 4 mA. The second drive's minimum signal would be 12 mA). If the drive has not been wired, the Demand input signal is connected at terminals AA (+) and BB (–) as shown in the diagram on page 11.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Apply the desired 100% Demand input signal to the drive. (Following the example above, the maximum signal for the first drive would be 12 mA. The second drive's maximum signal would be 20 mA).
6. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET DEM 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
7. Repeat this process for the remaining drives to be split-ranged.
8. Run the drive through its full operating range to ensure proper response to the Demand input signal.
9. Replace the DCM cover. Tighten the cover bolts to 10 lb-ft torque.

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

Square Function

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

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

POSITION CALIBRATION

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

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

Calibration Procedure

NOTE: Prior to adjusting the travel range electronically (using the DCM), it is recommended that the over-travel protection switches be reset just outside the intended travel range (see page 18).

1. Remove the DCM cover (1/2" bolt heads).
2. Position the drive at the desired minimum position (i.e., the desired physical position of the drive's output shaft corresponding to the 0% Demand input signal).
3. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
4. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 0%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
5. Position the drive at the desired maximum position (i.e., the desired physical position of the drive's output shaft corresponding to the 100% Demand input signal).
6. Ensure the Handswitch is in the "STOP" position. This will prevent the drive from repositioning during this procedure.
7. Press and hold the "CALIBRATE" pushbutton on the DCM customer interface panel, then press the "SET POS 100%" pushbutton until the "ACKNOWLEDGE" LED is lit.*
8. Optional: Adjust the over-travel limit switches (see page 18) just outside the 0% and 100% limits.
9. Verify that the drive's 0% and 100% positions are correct. If not, repeat this procedure.
10. Replace the compartment cover and tighten the cover bolts to 10 lb-ft torque.

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

Short-stroke Operation (Reducing Drive Travel)

Typically, it is best to use the full travel of the drive in response to the 0–100% Demand input signal—this allows full flexibility in arranging the drive's thrust to be distributed for the best mechanical advantage relative to the driven load.

In certain applications, as a last resort, it may become necessary to reduce the full travel of the drive. In these applications, the DCM can be calibrated to accommodate reduced stroke. The recommended *minimum* full stroke travel is 60% (although it is advisable to make the range as close to 100% as possible for the highest position resolution attainable with the CPS.

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

DIRECTION OF OUTPUT SHAFT TRAVEL (EXTEND VS. RETRACT)

Direction of output shaft travel is defined as the movement of the output shaft produced by an increasing Demand signal. Unless otherwise specified at the time of order, the output shaft is factory set to extend in response to an increasing signal.

Changing the direction of output shaft travel is easily accomplished using the DCM customer interface panel (see page 16 for location of pushbutton controls) or the HART or Serial interface. Follow the steps below.

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

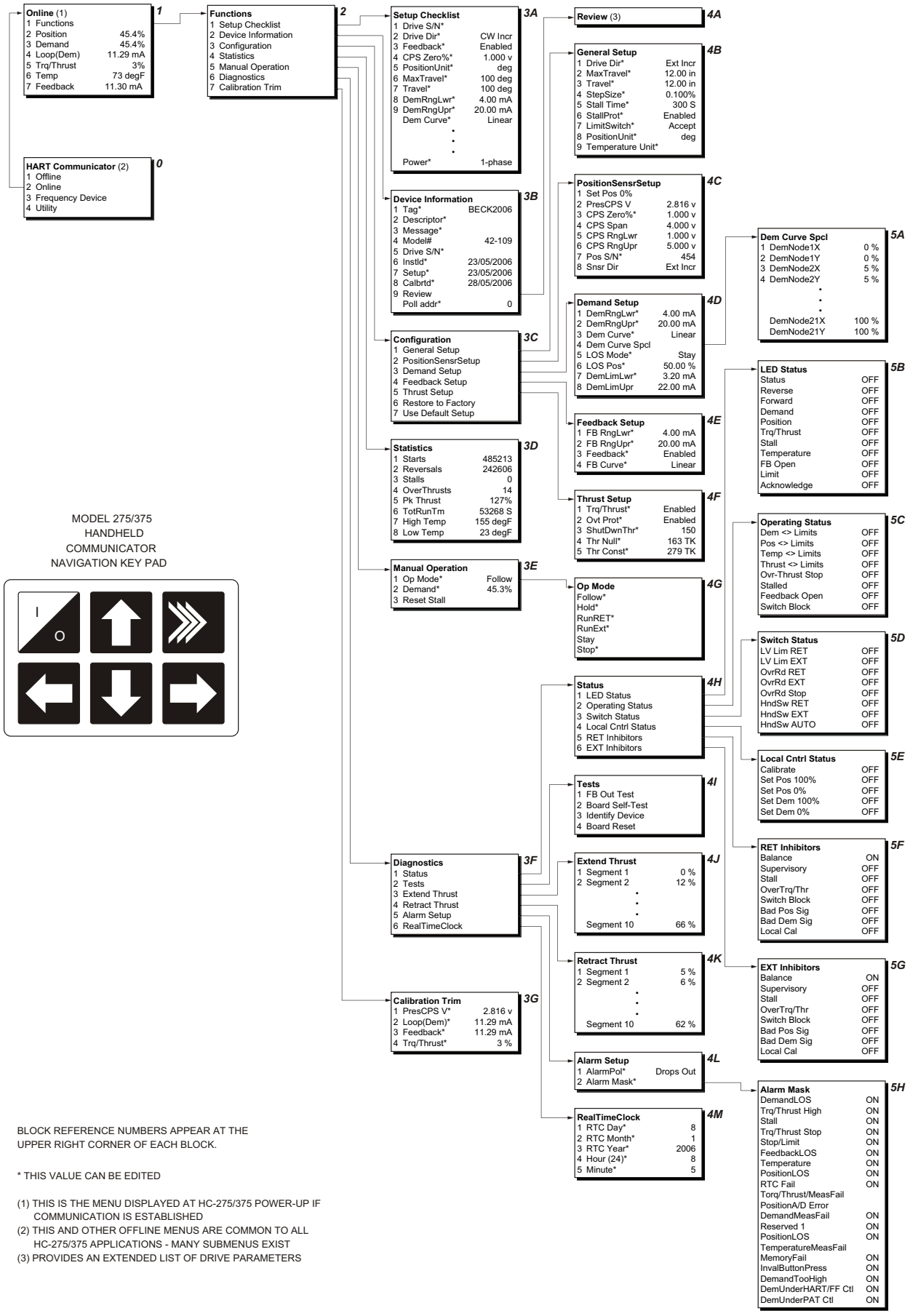
—OR—

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

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

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

HANDHELD COMMUNICATOR MENUS FOR THE DCM



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

* THIS VALUE CAN BE EDITED

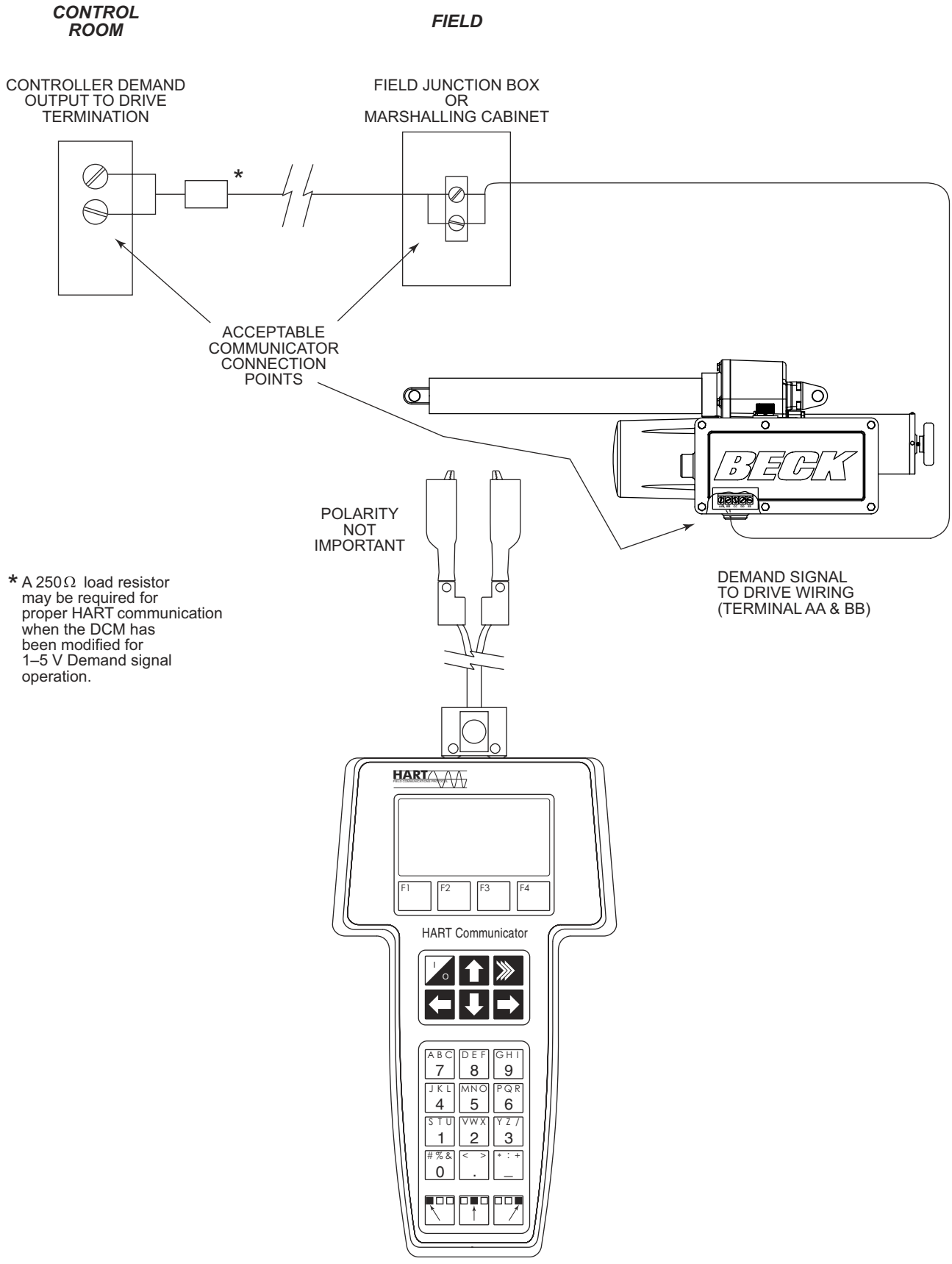
(1) THIS IS THE MENU DISPLAYED AT HC-275/375 POWER-UP IF COMMUNICATION IS ESTABLISHED

(2) THIS AND OTHER OFFLINE MENUS ARE COMMON TO ALL HC-275/375 APPLICATIONS - MANY SUBMENUS EXIST

(3) PROVIDES AN EXTENDED LIST OF DRIVE PARAMETERS

Figure 1

275/375 HANDHELD COMMUNICATOR WIRING CONNECTIONS



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

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

HART® INTERFACE

Figure 1, page 24, displays the interface menu tree for communicating with a DCM via a model 275/375 HART® communicator. This menu tree displays all the possible setup options, features and available information.

USING THE 275/375 COMMUNICATOR

The universal model 275/375 HART® Communicator leads should be connected in parallel with the analog Demand signal wiring (see Figure on page 25). This allows the communicator to simultaneously communicate over the analog input wires. This does not disturb the analog command signal, or disrupt the DCM functions. However, any program changes to the DCM will momentarily suspend the operation of the board (maintains last state) while the change is implemented. Typically, this is only for a second or two.

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

The communicator keypad and display is shown on page 25. There are four sections: 1) the liquid crystal message display, 2) four function keys beneath the LCD display, 3) six navigational keys in the center section, 4) alphanumeric entry keys at the bottom. For a complete description of the communicator , please see the HART® Communicator manual that is shipped with the communicator.

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

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

The six navigational keys consist of a black and white on/off key, four blue and white arrow keys, and a single "hot key". The hot key is not used for Beck drive applications, but can be configured by the user to select menus most often accessed. The right arrow key has two functions. It moves the cursor to the right when making or editing an entry, and it also is used to select a new menu. The left arrow key moves the cursor to the left and also backs out to a previous menu. Combined, these keys allow movement between menus as shown in Figure 1, page 24.

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

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

MENU DESCRIPTIONS
(See Figure 1, Page 24)

Online Menu
(Block 1)

When communications are established with the communicator, the Online menu is displayed. This is the gateway to all the other menus and it also provides current information about the drive. Numbered items 2 through 7 provide live, dynamic values of the drive's output position in percent, the Demand signal to the drive in percent, the Demand signal in milliamps, the thrust output of the drive in percent, the drive temperature, and the external position feedback signal in milliamps. Select the first menu item, "Functions", to gain access to the Functions menu. Backing out of the Online menu (using the left arrow key) results in selection of the Offline menu.

Offline Menu
(Block 0)

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

Functions Menu
(Block 2)

From the Functions menu, any of the DCM functional menus can be selected and accessed. There are seven functional areas: Setup Checklist, Device Information, Configuration, Statistics, Manual Operation, Diagnostics, and Calibration Trim.

The Setup Checklist (Block 3A) is a procedure that allows the user to setup all the details necessary for the drive to operate as desired. It sequentially walks the user through a series of questions and entries that enable the drive to be rapidly and completely setup. This method is entirely self-driven, and the user need only follow the questions and prompts to successfully complete the setup. The primary purpose of the Setup Checklist is to aid in the retrofit installation of a DCM board into an existing drive. It is normally not necessary to go through the Setup Checklist is the DCM is not being replaced.

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

Device Information Menu
(Block 3B)

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

1. **Tag** - This 8 character entry can be used in anyway; such as a unique label to a plant that correlates to a field device label.
2. **Descriptor** - This entry is a 16 digit field that can be used to provide any description desired.
3. **Message** - This entry is a 32 digit field that can be used to provide any message desired.
4. **Model** - This entry displays the model number of the drive in which the DCM board is installed. It normally is set at the factory if the board is installed in a drive. The user can edit the field if desired.
5. **Drive S/N** - This entry displays the serial number of the drive in which the DCM board is installed. It normally is set at the factory if the board is shipped in a drive. If the DCM is shipped as a spare or replacement part, the "Drive S/N" field will be blank. The user can edit the field if desired.
6. **Installed** - This is a date entry that is normally used to indicate the date that the drive or DCM board was installed. The date format is mm/dd/yyyy and it can be edited.
7. **Setup** - This is a date entry that is normally used to indicate the date that the DCM/drive setup was performed. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing a "Setup" to enter a date. Entering the date at the prompt automatically updates the date displayed. The date format is mm/dd/yyyy, and it can be edited.
8. **Calibrated** - This is a date entry that is normally used to indicate the date that the DCM/drive was last calibrated. Although this entry is viewed and can be edited in

Continued

Device Information menu, cont'd.

the "Device Information" menu, the user is prompted at the end of performing any "Calibration" method to enter a date. Entering the date at the prompt, automatically updates the date displayed here. The date format is mm/dd/yyyy, and it can be fully edited.

9. **Review** - Scrolls through all ten device information items, as well as all the other DCM settings, without accessing each item individually. This is an excellent tool for quickly determining how a particular drive is setup. To edit individual entries, the user must exit "Review" and proceed to the appropriate menu and item.
10. **Poll Address** - This entry can be edited; however, it is normally set to 0. A polling address from 1 to 15 can be entered if the drive resides on a common HART® network with other HART® devices.

Configuration Menu (Block 3C)

The Configuration menu serves as the gateway to all of the drive operating setup parameters. The user can select any of five different setup submenus that can be used to configure the drive based on the physical layout and the desired operation. The five setup submenus are described below. In addition to these five setup menus, there is a "Restore to Factory" selection which resets the drive configuration to its as-shipped settings. There is also a "User Default Setup" setting which resets the drive configuration to the settings typical of the applicable drive model type.

General Setup Submenu (Block 4B)

This menu sets drive operating parameters. The nine parameter entries are as follows:

1. **Drive dir** - Defines the direction of output shaft stroke for an increasing Demand signal. Stroke direction is relative to the actuator: Extend = out, Retract = in).
   When the direction of travel parameter is changed, the DCM automatically reverses the analog position feedback signal such that it is 4 mA at the 0% input signal position and 20 mA at the 100% position. No recalibration of the CPS is required. This parameter is normally set to Extend on an increasing Demand signal unless the user specified Retract prior to shipment of the drive.
2. **MaxTravel** - The maximum available travel distance of the output shaft in inches. This value is entered manually, and must correspond to the actuator design.
3. **Travel** - The number of inches of output shaft travel for 100% span. Edit this value to use a stoke shorter than the allowable "MaxTravel".
4. **StepSize** - The typical change in Demand signal that can occur before the output shaft will reposition (expressed in percent of span).
5. **Stall time** - The DCM provides stall protection to the entire drive by shutting off power to the motor and providing a HART® alarm. This entry configures the stall time required to trigger the stall protection. At the factory, stall time is normally set to 300 seconds, but can be edited and set for any value between 30 and 300 seconds. This value should be longer than the timing for full drive travel.
6. **StallProt** - This entry is set as either "Enabled" or "Disabled". It is used to remove motor power if "Stall time" is reached.
7. **LimitSwitch** - This entry is set as either "Accept" or "Alarm" and is used to define whether contacting a limit switch outside of the normal travel range (0% to 100%) will cause an error condition.
8. **PositionUnit** - Sets the numeric unit of measure for the output shaft position. May be set for degrees ("deg"), inches ("in") or millimeters ("mm").
9. **Temperature Unit** - The unit of measure for temperature. May be set for Fahrenheit ("degF") or Celsius ("degC").

PositionSensrSetup Submenu (Block 4C)

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

1. **Set Pos 0%** - Selecting this parameter sets the present position of the drive to the minimum travel position.
2. **PresCPS V** - Displays the present value of the internal Position Sensor voltage, which may also be measured at TP4(+) and TP1(–) on the DCM board. May be edited in the Calibration Trim menu for trimming the Position Sensor A/D converter.
3. **CPS Zero%** - Displays the CPS voltage at the zero percent output shaft position. May be edited to define the CPS voltage at the lowest operating point of travel.

4. **CPS Span** - Displays the CPS voltage span for the maximum allowable output shaft travel.
5. **CPS RngLwr** - Displays the CPS voltage at the lowest available point of travel. Normally set by the factory.
6. **CPS RngUpr** - Displays the CPS voltage at the highest available point of travel. Normally set by the factory.
7. **Pos S/N** - A number which uniquely identifies the position sensor. May be edited.
8. **Snsr Dir** - Displays which direction of output shaft movement will yield an increasing internal Position Sensor signal. Normally set at factory to "Ext Incr" (signal increases as the output shaft extends).

Demand Setup Submenu (Block 4D)

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

1. **DemRngLwr** - The value of the Demand signal (in mA) that corresponds to 0%. Normally set to "4.00 mA", this value should be set above the "DemLimLwr" value.
2. **DemRngUpr** - The value of the Demand signal (in mA) that corresponds to 100%. Normally set to "20.00 mA", this value should be set below the "DemLimUpr" value.
3. **Dem Curve** - Allows a choice in the relationship between the applied Demand signal and the desired position of the output shaft. Choices are: Linear, Square Root, Dem Curve Special, & Square.
4. **Dem Curve Spcl** - When "Dem Curve" above is set to "Special", this command allows access to a submenu to setup the preferred Demand curve.
5. **Los Mode** - Sets the output shaft response to a loss of Demand signal condition. Can be set to "Stay" or "Go-to-Pos".
6. **Los Pos** - If "Los Mode" has been set to "Go-to-Pos", this parameter allows the user to define the position (in percentage of travel) to where the output shaft will move during Loss of Signal conditions. May be set between -5.00% and 105.00%.
7. **DemLimLwr** - Sets the minimum usable value of Demand. Below this value, the Loss of Signal condition will be set. Values between 0 mA and 12 mA may be selected. This value should be set lower than the low Demand Range ("DemRngLwr").
8. **DemLimUpr** - Sets the maximum usable value of Demand. This value should be set higher than the upper Demand Range ("DemRngUpr").

Feedback Setup Submenu (Block 4E)

This menu is where all the Feedback signal related drive parameters are set. The four parameter entries are as follows:

1. **FBRngLwr** - The value of the Feedback signal (in mA) that corresponds to a 0% output shaft position. This value can range between 3.0 mA and 16.0 mA.
2. **FBRngUpr** - The value of the Feedback signal (in mA) that corresponds to a 100% output shaft position. This value can range between 7.0 mA and 21.0 mA.
3. **Feedback** - Enables or Disables the Feedback signal.
4. **FB Curve** - Allows a choice in the relationship between the applied Feedback signal and the actual position of the drive. Choices are: Linear & Inverted Demand ("InvDem").

Thrust Setup Submenu (Block 4F)

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

1. **Trq/Thrust** - Enables or Disables thrust related functions.
2. **Ovt Prot** - Enables or Disables over-thrust protection, which will remove power from the motor if excessive thrust is detected.
3. **ShutDwnThr** - Sets the value that, if exceeded, will cause the power to be removed from the motor (if "Ovt Prot" is enabled; see above). This will cause a shutdown alarm.
4. **Thr Null** - Sets the thrust value that corresponds to 0% thrust applied. This number is represented in "TK" units, and is noted on the label inside the DCM cover (also referred to as "Thrust Zero").
5. **Thr Const** - Sets the thrust value that corresponds to 100% thrust applied. This number is represented in "TK" units, and is noted on the label inside the DCM cover.

Statistics Menu (Block 3D)

This menu is where all the drive's stored operating statistics are available. There are eight different statistics available:

1. **Starts** - Logs and displays the total number of starts the drive motor has made.
2. **Reversals** - Logs and displays the total number of times the motor started in a direction opposite to the previous start.
3. **Stalls** - Logs and displays the total number of stalled conditions the drive has experienced. For the drive to register a stall, the DCM board must be unable to balance the drive position against the Demand input signal for a period exceeding the **Stall Time** set in the General Setup menu.
4. **OverThrusts** - Logs and displays the total number of times that excessive thrust was detected at the output shaft.
5. **Pk Thrust** - Logs and displays the maximum thrust sensed at the output shaft.
6. **TotRunTm** - Logs and displays the total run time of the drive motor in seconds.
7. **High temp** - Logs and displays the highest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM board.
8. **Low temp** - Logs and displays the lowest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM board.

Manual Operation Menu (Block 3E)

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

1. **Op mode** - This procedure allows the user to select the operating mode of the DCM. There are four possible choices: "Follow", "Hold", "Stay" and "Stop". The "Follow" mode is the normal state of operation and allows the DCM to control the drive operation by responding to the analog input Demand signal when the drive Handswitch is in the automatic position. The "Hold" mode causes positioning according to the HART Interface Demand Value. The "Stay" mode causes the output shaft to remain stationary and maintain its present position. Note that in "Stay" mode, the Handwheel cannot be freely turned. The "Stop" mode removes power from the motor. Note that in "Stop" mode the Handwheel can be freely turned. All operating modes can be overridden by the drive Handswitch.
2. **Demand** - This procedure sets the effective Demand signal. If **Op mode** is set to "Hold", entering a valid value (-5% to 105%) will control the motor. If **Op mode** is set to "Follow", the value will follow the Demand analog signal (unless an alarm condition exists).
3. **Reset Stall** - This procedure resets normal drive operation after a stall condition has caused the drive to shut down. Selecting this option and following the prompts will restore operation. Note that stall conditions can also be reset by simply reversing the input Demand signal or cycling the drive ac power.

Op Mode Submenu (Block 4G)

This menu is used to allow selection of the operating mode of the DCM with the HART® communicator. There are six operation mode selections available. Four of these selections are described in the previous section (see "Op mode"). The other two selections are "RunRET" and "RunExt", which will cause the drive shaft to move to the retract or extend travel limit.

Diagnostics Menu (Block 3F)

This menu provides access to all the DCM stored online diagnostic information about drive operation. The menu provides six submenus accessing drive statistics and online drive status.

Status Submenu (Block 4H)

This menu provides access to six submenus displaying various drive status settings: LED Status, Operating Status, Switch Status, Local Cntrl Status, RET Inhibitors, and EXT Inhibitors.

LED Status Submenu (Block 5B)

This menu displays the ON or OFF status of each of the LEDs on the DCM.

Operating Status Submenu (Block 5C)

This menu displays the ON or OFF status of eight drive parameters: Dem Limits, Pos Limits, Temp Limits, Thrust Limits, Ovr-Thrust Stop, Stalled, Feedback Open, and Switch Block.

Switch Status Submenu (Block 5D)

This menu displays the ON or OFF status of the eight switch parameters: LV Lim RET, LV Lim EXT, OvrRd RET, OvrRd EXT, OvrRd Stop, HndSw RET, HndSw EXT, and HndSw AUTO.

Local Control Status Submenu (Block 5E)

This menu displays the ON or OFF status of five local interface drive parameters: Calibrate, Set Pos 100%, Set Pos 0%, Set Dem 100%, and Set Dem 0%.

RET Inhibitors Submenu (Block 5F)

This menu displays the ON or OFF status of the contributing sources of retract movement inhibitors of motor operation: Balance, Supervisory, Stall, OverTrq/Thr, Switch Block, Bad Pos Sig, Bad Dem Sig, Local Cal.

EXT Inhibitors Submenu (Block 5G)

This menu displays the ON or OFF status of the contributing sources of extend movement inhibitors of motor operation: Balance, Supervisory, Stall, OverTrq/Thr, Switch Block, Bad Pos Sig, Bad Dem Sig, Local Cal.

Tests Submenu (Block 4I)

This menu provides procedures that allow the user to test, identify and reset the DCM board. They are as follows:

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

Extend Thrust Submenu (Block 4J)

This menu displays the thrust applied over ten segments of travel as the drive shaft extends.

Retract Thrust Submenu (Block 4K)

This menu displays the thrust applied over ten segments of travel as the drive shaft retracts.

Alarm Setup Submenu (Block 4L)

This menu allows customization of alarm indication:

1. **AlarmPol** - This determines whether the alarm relay "Drops Out" or "Pulls In" to indicate an alarm.
2. Alarm Mask - This leads to a submenu where alarm conditions may be set.

Alarm Mask Submenu (Block 5H)

This menu allows selection of conditions which will cause an alarm indication.

RealTimeClock Submenu (Block 4M)

This menu allows the date and time to be set. The settings are as follows:

1. **RTC Day** - Numerical entry sets the day of the month.
2. **RTC Month** - Numerical entry sets the month.
3. **RTC Year** - Numerical (4 digit) entry sets the year.
4. **Hour (24)** - Numerical entry sets the hour of the day (1–24).
5. **Minute** - Numerical entry sets the minute of the hour.

Calibration Trim Menu (Block 3G)

This menu displays/sets drive calibration values:

1. **PresCPS V** - Displays the present value of the internal Position Sensor voltage. This value can also be measured at TP4(+) and TP1(–) on the DCM board. This value can be edited to trim the Position Sensor.
2. **Loop(Dem)** - Displays the Demand signal as measured at the field wiring terminals. When the Demand control loop signal is being overridden by a special mode of operation, the effective Demand will not correspond to the mA value. This value can be edited to trim the Demand to ensure accurate measurement of the analog signal. Demand can only be trimmed at 4.0 mA and 20.0 mA.
3. **Feedback** - Displays the mA signal representing the output shaft position as measured at the field wiring terminals. This value can be edited.
4. **Trq/Thrust** - Displays the load measured at the output shaft as a percentage. This value can be edited.

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

There are a number of configuration setup parameters that can be changed to custom tailor the drive's operation to the application needs. The remainder of this section provides instructions for changing each of these parameters. The instructions below assume that the user has a model 275 HART® Communicator attached to the Demand wiring (at drive terminals AA and BB or anywhere across the wires all the way back to the source of the Demand signal), has established communications with a particular drive, and has a copy of the HART® Menu Tree (Figure 1, page 24) available.

DRIVE SHAFT TRAVEL

Drive shaft travel refers to the direction the output shaft of the drive moves in response to an increasing Demand input signal. The travel is either extend (CW) or retract (CCW). The control loop operation and physical design of the final control element determine the drive travel suitable for an application. If the drive travel needs to be changed, this is easily accomplished by changing the DCM configuration.

Changing Drive Shaft Travel

STEP 1 - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "Drive Dir" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

STEP 2 - With the "Drive Dir" parameter selected, press the right arrow key to display the two entry choices: "Ext incr" and "Ret incr". Use the up and down arrow keys to select the desired parameter.

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

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

WARNING

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

DEAD BAND

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

Changing the Dead Band

STEP 1 - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "StepSize" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

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

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

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

WARNING

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

STALL PROTECTION

The DCM board provides protection of the drive motor and gearing in the event of a stalled condition. The board accomplishes this by sensing that the drive is unable to balance for a set period of time known as the "stall time". If the DCM is unable to balance the drive for a period greater than the stall time, it shuts off power to the motor and prevents the drive from continuing to operate against the stall. Resetting the drive and restoring normal operation is achieved in several ways: Reversing the Demand signal to the drive, performing a stall reset procedure (see Manual Operation Menu, Figure 1, page 24), performing a board reset procedure (see Diagnostics Menu, Figure 1, page 24), or cycling the drive ac power.

Changing Stall Time

STEP 1 - From the HART® communicator "Online" menu, move to the "General Setup" menu and select the "Stall Time" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

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

WARNING

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

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

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

WARNING

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

OVERTRAVEL ANNUNCIATION

When communicating with the DCM via the 275 HART® Communicator, a number of different informational messages may be displayed for certain conditions that may exist. One such message is "H/S in STOP or drive at limit sw". This is displayed anytime the DCM is attempting to reposition the output shaft, but is unable to due to a break in the electrical power to the motor. This can happen if the Handswitch is put in STOP or if an over-travel limit switch is open. Normally, this is a useful message that should be displayed; however, in certain situations like split range operation (see split ranging, page 48), it can become a nuisance. For example, in a split range operation one or more of the drives will be interpreting the Demand input signal as out of range (i.e., either above 100% Demand or below 0% Demand) and will be against an over-travel limit switch at any given time. Since this is normal for split range operation, the message will be a nuisance rather than informational.

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

Continued

Overtravel Annunciation, cont'd.

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

POSITION FEEDBACK SIGNAL

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

Enabling / Disabling Position Feedback Signal

STEP 1 - From the HART® communicator "Online" menu, move to the "Setup Checklist" menu and select the "Feedback" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

STEP 2 - With the "Feedback" parameter selected, press the right arrow key to display the two entry choices: "Enabled" or "Disabled". Use the up and down arrow keys to select the desired parameter. "Enabled" enables the output signal, while "Disabled" disables the output.

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

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

DEMAND SIGNAL CHARACTERIZATION

The Beck DCM is designed to receive a 4–20 mA (1–5 V dc) input Demand signal and respond by repositioning the drive output shaft in proportion to the signal. There are four ways in which the DCM can interpret the Demand signal: Linear, Square Root, Dem Curve Special and Square. The Linear interpretation, which is most commonly employed, simply causes the drive to position the output shaft in a one-to-one relationship with the Demand. For example, a 1% change in Demand always causes a 1% position response. The Square Root relationship produces a response proportional to the square root of the Demand Signal. The Dem Curve Special relationship allows a customized Demand curve to be setup through a special submenu. The Square relationship produces a non-linear drive response proportional to the square of the Demand signal. For example, a 25% input Demand is interpreted as 0.25^2 or 0.0625 (6.25%). The square relationship helps to linearize flow response of final control elements that have quick opening characteristics.

Changing Characterization

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

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

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

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

WARNING

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

LOSS OF DEMAND INPUT SIGNAL

The DCM board has the capability of determining when the Demand input signal to the drive is lost, and then responding in the method most appropriate for the application. There are three setup parameters that must be configured in order to define this capability: "LOS Mode", "LOS Pos" and "DemLimLwr". The "LOS Mode" parameter determines how the drive should respond to the loss of the Demand input signal. It can be configured as "Stay" or "Go-to-Pos", which means the drive holds its position when the signal is lost, or it goes to a predetermined position. If the "Go-to-Pos" option is selected, the "LOS Pos" parameter is used to determine what output shaft position the drive must achieve when the input is lost. Finally, a loss of signal is sensed by the DCM when the signal drops below the value set by the "DemLimLwr" parameter. This value is represented in mA of the Demand input signal range. Therefore, the standard 3.2 mA value normally used for this parameter suggests that when the Demand input signal drops 5% below the calibrated 0% value, the DCM senses a lost Demand input and executes the configured loss-of-signal action.

Changing Loss (LOS) of Signal Action

STEP 1 - From the HART® communicator "Online" menu, move to the "Demand Setup" menu and select the "LOS Mode" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

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

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

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

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

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

WARNING

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

Changing LOS Trip Point

STEP 1 - From the HART® communicator "Online" menu, move to the "Demand Setup" menu and select the "DemLimLwr" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

STEP 2 - With the "DemLimLwr" parameter selected, press the right arrow key to display the modifiable entry block. Using the alphanumeric keypad, enter the desired Demand signal lower limit value in mA outside of the Demand signal range.

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

Continued

Changing LOS Trip Point, cont'd.

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

WARNING

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

THRUST OPTIONS

DCM boards have the capability to measure the drive's thrust output. This, in turn, makes it possible to provide several thrust-related features. The features include a live display of the thrust output on the 275/375 HART® Communicator display or any other device capable of communicating and displaying HART® transmitted variables. Included is the ability to store peak thrust values within the DCM and view them by accessing the device information menu. To protect the drive gearing and related equipment, the drive can be configured to shut off if the thrust exceeds 150% of the drive thrust rating. And finally, the DCM will provide a high thrust alarm, via HART® communications, that alerts the user to a high thrust condition when the thrust output exceeds a set value (normally set at 105% of the drive rating).

Enabling Thrust Functions

STEP 1 - From the HART® communicator "Online" menu, move to the "Thrust Setup" menu and select the "Trq/Thrust" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

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

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

Enabling Over-thrust Protection

STEP 1 - From the HART® communicator "Online" menu, move to the "Thrust Setup" menu, make sure that the "Trq/Thrust" parameter is enabled (if not, enable it using the prior procedure) and select the "Ovt Prot" parameter. This is accomplished by using the up and down arrow keys to select the appropriate item in each menu and then moving forward by pressing the right arrow key. Follow the Menu Tree (Figure 1, page 24) to navigate.

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

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

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

All Beck drives are shipped completely calibrated to the customer specifications, and are ready to be installed. If the need arises to change the drive calibration, confirm that the drive is installed as specified and operating properly before proceeding with the change. It is also helpful to verify the drive configuration. This can be done by reviewing the settings in the Configuration menu.

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

The DCM can be calibrated by using the "Position Setup" and "Demand Setup" menus.

Normally, calibration should not require adjustment; however, if the Position or Demand requires minor adjustment, the "Calibration Trim" menu may be used.

Any calibration changes that are made using any of the above described methods, can be reversed by using the “Restore to Factory” feature in the "Configuration" menu. Note that implementing the “Restore to Factory” feature returns all settings to the as-shipped factory settings.

DIRECTION OF SHAFT TRAVEL (RETRACT VERSUS EXTEND)

Direction of shaft travel is determined when looking at the output shaft. Direction of travel is defined as the direction of output shaft travel produced by an increasing Demand signal. Unless otherwise specified at the time of order, the output shaft is factory-set to extend in response to an increasing signal.

CALIBRATION PRIORITY

Group 42 drives are equipped with fixed, non-adjustable, built-in mechanical stops. All output shaft movement must occur within these stops, which are approximately 1/8" beyond each end of maximum stroke range.

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

If the drive is short-stroked—i.e., full travel is reduced to less than the standard span (see page 45)—it may be desirable to reset the over-travel limit switches (see page 42). If the limit switches are not reset, Handswitch operation of the drive (Retract, Extend) will still result in the original full range of travel. It is best to calibrate the drive and then set the limit switches when short-stroking the drive. The switches should be set just outside the calibrated range to avoid tripping the switch at the 0% and 100% positions.

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

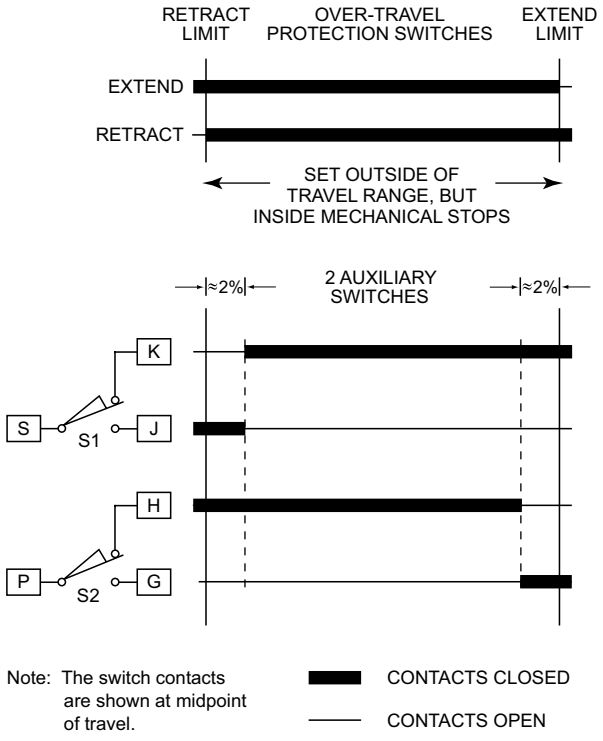
SWITCH CALIBRATION

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

Under normal operating conditions there is no need to recalibrate the control drive. However, if the application requirements change or are different than specified on the equipment order, the drive should be recalibrated according to the following procedures.

Switch Adjustments

All control drives are shipped with over-travel limit switches factory-set just outside the range of travel (unless otherwise specified at time of order). The switches are set to provide electrical over-travel protection. The switches must be set inside the range of the built-in mechanical stops. The switches can be reset to limit travel of the output shaft to any angle down to a minimum of approximately 60% of stroke. Auxiliary switches are factory set, as shown in the illustration below, unless otherwise specified at time of order.



Standard Over-travel Protection and Auxiliary Switch Settings

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

CAUTION

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

Setting Over-travel Protection Switches S3 (Retract) and S4 (Extend)

This procedure should be used if the factory over-travel switch settings must be changed in the field. It is advisable to operate the drive fully in each direction—using the Handswitch and Handwheel—to check switch settings before attempting to change them. Use the following instructions if they require adjustment:

1. Remove the control end cover and terminal block/DCM cover (1/2" bolt heads).
2. Use the Handswitch to drive the control shaft so that the thumb nut locking screw is accessible. While holding the shaft coupling, use a 3/32" hex wrench and loosen the screw on the thumb nut. Loosen the thumb nut by turning it counter-clockwise approximately 1/4 turn. See the illustration on the following page.
3. Retract the output shaft to the end of travel limit.
4. Turn the Handswitch to the STOP position.
5. Use the Handwheel to position the output shaft at the desired over-travel limit.
6. Disconnect power from the drive.
7. Connect the continuity meter across the appropriate terminals. Refer to your drive wiring diagram (if not available, see the diagram on this page).
8. While holding the shaft coupling stationary, rotate the appropriate cam using the 3/32" hex wrench in one of the cam adjustment slots (see drawing on page 43 for location of slots) until the meter shows continuity (switch contacts closed, switch clicks).

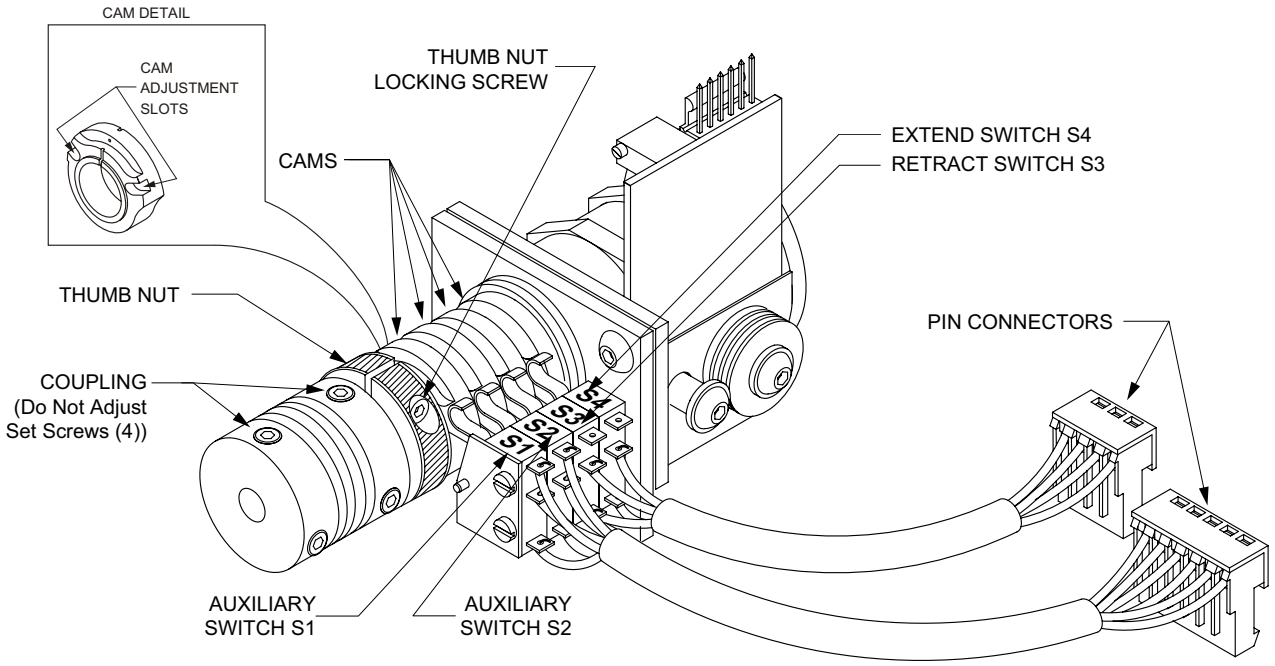
9. Turn the thumb nut clockwise until hand tight. Tighten the thumb nut locking screw to 5 lb-in torque.
10. Use the Handwheel and confirm that the contacts are open in the normal operating range and close at the desired over-travel limit.
11. Disconnect the meter and reconnect drive power.
12. Repeat instructions for setting (and verifying) the Extend over-travel protection switch (noting that referenced directions of travel should be opposite of those used for the Retract switch setting).
13. Replace covers and tighten cover bolts to 10 lb-ft torque.

Setting Auxiliary Switches

Standard switch settings for the 2 auxiliary switches are shown on the diagram on the preceeding page. The operating point of auxiliary switches is defined as a percentage of output shaft travel. 100% is defined as the Extend limit of shaft travel. The heavy line indicates a closed circuit. Use the following instructions to change the operating point of auxiliary switches:

NOTE: In the following procedure, it is assumed that switch settings are to be adjusted so that contacts are open when the desired position is achieved.

1. Remove the control end cover and the terminal block cover (1/2" bolt heads).
2. Use the Handswitch to drive the control shaft so that the thumb nut locking screw is accessible. While holding the shaft coupling, use a 3/32" hex wrench and loosen the screw on the thumb nut. Loosen the thumb nut by turning it counter-clockwise approximately 1/4 turn. See illustration below.
3. Move the output shaft to the desired position.
4. Turn the Handswitch to the STOP position.
5. Disconnect power from the drive and switch terminals.
6. Connect the continuity meter across the appropriate terminals. Refer to your drive wiring diagram (if not available, see the diagram on page 42).
7. While holding the shaft coupling stationary, rotate the appropriate cam using the 3/32” hex wrench in one of the cam adjustment slots (see drawing on this page for location of slots) until the meter shows continuity (switch contacts closed, switch clicks).
8. Turn the thumb nut clockwise until hand tight. Tighten the thumb nut locking screw to 5 lb-in torque.
9. Disconnect the meter and reconnect power.
10. Move the drive’s output shaft in the desired direction so that the cam lobe moves away from the switch lever. If not correct, return to step 2 and reset the cam to the proper orientation.
11. Replace covers and tighten cover bolts to 10 lb-ft torque.



POSITION SENSOR SETUP

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

All Beck drives are shipped completely set and calibrated to the customer specifications and are ready for installation. Normally, no adjustments are necessary.

If, however, the position calibration needs to be changed, the "PositionSensrSetup" submenu must be used. The "PositionSensrSetup" is accessible through the "Configuration" menu.

The "PositionSensrSetup" submenu will allow resetting of the minimum travel position of the drive (Set Pos 0%) and the CPS voltage at the minimum travel position (CPS Zero%). Online help is available through the communication device.

Short-stroke Operation (Reducing Full Travel)

Typically, it is best to use the full 100% travel of the drive in response to the 0–100% Demand input signal.

In certain applications, as a last resort, it may become necessary to reduce the full travel of the drive. In these applications, the DCM can be calibrated to accommodate reduced stroke. The recommended *minimum* full travel is 60%, although it is advisable to make the range as close to 100% as possible for the highest position resolution attainable with the CPS and to avoid possible reduction in thrust.

Reducing the full travel is referred to as "short-stroking" the drive. This can be easily accomplished by using a HART communication device.

First, navigate to the Configuration menu. Select the General Setup submenu. Select the Travel parameter. Reduce the stroke by entering a number (in inches) not less than 60% of the maximum travel of the drive. For example, if the desired stroke reduction is 50% and your maximum drive travel is 12 inches, then you would enter 6.00 in as the new Travel parameter.

FEEDBACK SIGNAL CALIBRATION

DCM boards have the capability of providing a 4–20 mA output signal so that the drive's true output shaft travel can be monitored remotely. The signal comes calibrated from the factory to provide a precise 4–20 mA signal corresponding to 0–100% drive travel. Normally, calibration is not required even if the position reference calibration or direction of travel are changed, because the DCM automatically compensates for these changes and appropriately scales the position feedback signal.

If the Feedback must be changed, it is accomplished by using a Hart communication device. First, navigate to the Configuration menu. Next, select the Feedback Setup submenu. Through this submenu, the Feedback range may be changed, as well as the curve. Online help is available through the communication device.

DEMAND SIGNAL CALIBRATION

DCM boards are designed to accept a 4–20 mA (or 1–5 V dc) analog Demand signal. Narrower spans within this range can also be accommodated for split range operation (see page 48). The input comes calibrated from the factory for the full range unless otherwise specified. It is not necessary to calibrate the Demand input when the drive is installed.

If the Demand must be changed, it is accomplished using a HART comunication device.

First, navigate to the Configuration menu. Select the Demand Setup submenu. Through this submenu, the Demand range limits and curve specifications may be changed. Online help is available through the communication device.

Split Range Operation

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

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

Split-ranging is easily accomplished by determining the break points (12 mA in the example above) and using a HART communication device.

First, navigate to the Configuration menu. Next, select the Demand Setup submenu. Change appropriate Demand range limit accordingly. In the example above, one drive's upper Demand range (DemRngUpr) would be changed from 20.00 mA to 12.00 mA; and the other drive's lower Demand range (DemRngLwr) would be changed from 4.00 mA to 12.00 mA.

NOTE: Ensure that the L.O.S. (Loss of Demand input signal) settings of the drives are appropriate for the new configuration. This would involve changing the appropriate Demand LOS limits (DemLimLwr or DemLimUpr). Typically, these settings are -5% and 105% of the Demand range. See page 13 for a description of the LOS function.

THRUST MEASUREMENT CALIBRATION

DCM boards have the capability of measuring the drive output thrust and providing several thrust-related features. The thrust measurement is calibrated to the drive's rated output at the factory. There is normally no reason to recalibrate this feature in the field, unless a new DCM board has been installed.

In the event that calibration is required, it is easily accomplished by using a HART communication device.

First, navigate to the Configuration menu. Next, select the Thrust Setup submenu. Select the Trq Null parameter, which will allow the 0% thrust value to be edited. Enter the number corresponding to the 0% thrust value that is shown on the inside of the DCM cover. Next, select the Trq Const parameter, and enter the number corresponding to the 100% thrust value that is shown on the inside of the DCM cover. Online help is available through the communication device.

COMMON HART® MESSAGES

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

Handswitch and Limit Switch Messages

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

Demand Signal and Process Variable Messages

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

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

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

Position Signal Messages

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

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

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

Miscellaneous Messages

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

COMMUNICATIONS

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

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

HyperTerminal Software

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

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

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

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

COMMANDS AND ARGUMENTS

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

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

The available commands are listed on page 54 and each is described in more detail on pages 55 through 58. The command description explains the use or uses of the command, while the argument column describes the applicable arguments for those commands that require them. In the command tables, arguments are denoted as *n*. Note that the commands described as "sets and/or displays" signify dual purpose commands that can be used with or without an argument for setting or verifying configuration settings.

SERIAL COMMANDS

The following is a list of serial commands available through the RS-232 interface. Error codes associated with these commands are listed on page 59.

General Configuration Commands (p. 55)

stepsize
drvdir
stalltime
sernum

Reset Factory Settings Commands (p. 55)

restoremodes

Demand Signal Commands (p. 55 & 56)

dem0pctma
dem100pctma
trimdem4ma
trimdem20ma
demfunc
demlos
demlosgtp

Position & Feedback Signal Commands (p. 57)

posisd
psisp
fdbk0pctma
fdbk100pctma
trimfdbk4ma
trimfdbk20ma
fdbkfunc
travel

Thrust Sensing Commands (p. 57 & 58)

thrust0k
thrustconst
thrust0pct
thrust100oct
thrustenable

Diagnostic and Information Commands (p. 58)

signals
stat
tempf
thrust

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

General Configuration Commands

Command	Description	Argument *n* and Information
stepsize *n*	Sets and/or displays the size (in degrees) of one incremental movement of the output shaft.	*n* = stepsize in degrees. The minimum value that can be entered is "0.10"; which is also the standard value. The maximum value is "2.50".
drvdir *n*	Sets and/or displays the drive output shaft direction resulting from an increasing Demand signal.	*n* = "0" (indicates Extend); or *n* = "1" (indicates Retract).
stalltime *n*	Sets and/or displays the time allowed for the drive to reach its Demand target. If the drive cannot reach the target in the allotted time, a stall condition is initiated.	*n* = time in seconds. Time to stall is configurable from 30 to 300 seconds. The default value is 300 seconds.
sernum *n*	Sets the serial number of the drive in which the DCM is installed. Model number information is derived from the serial number.	*n* = serial number.

Reset Factory Settings Commands

Command	Description	Argument *n* and Information
restoremodes 1	Resets the drive configuration back to the original factory settings.	No additional argument required.

Demand Signal Commands

Command	Description	Argument *n* and Information
dem0pctma *n*	Sets the Demand signal value that corresponds to 0% drive position.	*n* = the Demand signal as a decimal in milliamps. The minimum acceptable value is 0.50 mA. The maximum acceptable value is 100% Demand less 4.00 mA. For example, if the 100% Demand signal is 20.00 mA, then the 0% Demand signal must be 16.00 mA or less.
dem100pctma *n*	Sets the Demand signal value that corresponds to 100% drive position.	*n* = the Demand signal as a decimal in milliamps. The minimum acceptable value is the Demand at 0% plus 4.00 mA. For example, if the 0% Demand signal is 4.00 mA, then the 100% Demand signal must be 8.00 mA or greater. The maximum acceptable value is 21.00 mA.

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

Demand Signal Commands (con't)

Command	Description	Argument *n* and Information
trimdem4ma 4	Calibrates the Demand signal at 4 mA. This command should only be used when the Demand signal at the drive is 4 mA. If the Demand signal at the drive is greater or less than 4 mA, an error will be returned. Note: This parameter is factory configured and normally does not require recalibration.	A 4 mA Demand signal must be present at drive terminals 14 & 15.
trimdem20ma 20	Calibrates the Demand signal at 20 mA. This command should only be used when the Demand signal at the drive is 20 mA. If the Demand signal at the drive is greater or less than 20 mA, an error will be returned. Note: This parameter is factory configured and normally does not require recalibration.	A 20 mA Demand signal must be present at drive terminals 14 & 15.
demfunc *n*	Sets and/or displays the Demand signal input characterization function. The DCM provides linear, square root, special curve or square function characterization.	*n* = "0" (linear) *n* = "1" (square root) *n* = "4" (special curve) *n* = "5" (square).
demlos *n*	Sets and/or displays the Demand signal threshold below which the DCM 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 drive during LOS (Loss Of Signal). LOS action options are "sip" (stay in place) or "gtp" (go to position). Note that the command always reports both settings, but only sets one argument at a time. The command must be used twice to set the threshold and action. If the action is "gtp", then the command *demlosgtp* (see below) must also be set. The option "pat" is also available to prevent error messages if the DCM is not being used with a Demand signal.	*n* = the Demand signal in mA below which LOS occurs. For example, in a 4–20 mA drive, if the desired LOS is 5% below the minimum signal, then *n* = "3.20" mA. — OR — *n* = "sip", "gtp" or "pat". Note: *n* values must be set separately.
demlosgtp *n*	Sets and/or displays the position to which the drive will run upon loss of the Demand signal (LOS). This command has no effect if the drive is set to "sip" (stay in place).	*n* = the desired position of the drive expressed as a percentage of drive travel (e.g., if the desired LOS position is 50%, then *n* = "50.00").

Position and Feedback Signal Commands

Command	Description	Argument *n* and Information
travel *n*	Sets and/or displays the value that represents 100% travel.	*n* = the desired length of travel in inches or millimeters.
fdbk0pctma *n*	Sets and/or displays the mA value of the Feedback signal that represents the 0% drive position.	*n* = the desired Feedback signal for 0% drive position in mA. The minimum value is 3 mA ("3.00") and the maximum value is at least 4 mA less than the Feedback signal value for the 100% drive position.
fdbk100pctma *n*	Sets and/or displays the mA value of the Feedback signal that represents the 100% drive position.	*n* = the desired Feeback signal for 100% drive position in mA. The minimum value must be at least 4 mA greater than the Feedback signal value for the 0% drive position. The maximum value is 21mA ("21.00").
fdbkfunc *n*	Sets and/or displays whether or not the drive Feedback signal is enabled.	*n* = "0" (no feedback) or "1" (feedback).
posis *n*	Sets the point of drive travel in relation to the drive's current position. This command should only be used when the drive is at a known position of travel.	*n* = the present drive position as a degree of full drive travel to establish where the 0% point of travel should be.
trimfdbk4ma *n*	Trims the Feedback signal at 4 mA. If the Feedback signal is not within 1 mA of 4 mA, an error will be returned. Note: The Feeback sourcing circuit is factory calibrated and normally does not require recalibration.	*n* = the present Feedback signal from the drive as measured in mA at terminals 16 & 17. The minimum value is 3 mA ("3.000") and the maximum value is 5 mA ("5.000").
trimfdbk20ma *n*	Trims the Feedback signal at 20 mA. If the Feedback signal is not within 1 mA of 20 mA, an error will be returned. Note: The Feeback sourcing circuit is factory calibrated and normally does not require recalibration.	*n* = the present Feedback signal from the drive as measured in mA at terminals 16 & 17. The minimum value is 19 mA ("19.000") and the maximum value is 21 mA ("21.000").

Thrust Sensing Commands

Command	Description	Argument *n* and Information
thrust0k *n*	Assigns the count value to be associated with 0 thrust. This number is unique to each drive.	*n* = the zero thrust value in counts. This number is determined during manufacture and is noted on a tag affixed to the drive body within the electronics compartment.

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

Thrust Sensing Commands (con't)

Command	Description	Argument *n* and Information
thrustconst *n*	Assigns the count value to be associated with the thrust span. This number is unique to each drive.	*n* = the thrust span value in counts. This number is determined during manufacture and is noted on a tag affixed to the drive body within the electronics compartment.
thrustenable *n*	Enables or disables the thrust measurement feature of the drive.	*n* = "0" (disabled) or "1" (enabled).

Diagnostic and Information Commands

Command	Description	Argument *n* and Information
signals	Displays the present Position signal of the drive in volts and the Demand signal in milliamps.	No argument.
stat	Displays information on the status of the drive, including: Time / Date Demand (% and settings) Position (% / inches) Error (%) Stepsize (inches / %) Deadband (inches / %) Motor Status Run Time Line Frequency Starts (ext./ret./total) Reversals/Stalls Overloads Positive & Negative Peak Load (%) Positive & Negative Peak Thrust (% / inches) Extend and Retract Inhibit Setting Alarms	No argument.
tempf	Displays measured temperatures in the drive (°F.): Low extreme Present temperature High extreme	No argument.
thrust	Displays the drive's present thrust measurement as a percentage of rated thrust.	No argument.

Command Error Codes

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

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

NOTES

MAINTENANCE

ROUTINE

Beck drives require only a minimum of routine maintenance. A visual inspection is in order to verify that the connection to the final control element is intact and operating normally. If vibration is present, check the electrical terminal connections and other hardware for tightness.

COMPONENT REPLACEMENT

The table below lists the components of the Group 42 control drive that are field replaceable. Each of these components is available as a customer replacement kit which includes the component(s), necessary hardware and detailed instructions.

HOW TO ORDER SPARE PARTS

Any customer replacement kit may be purchased for spare parts. Contact your Beck Sales Engineer for recommended replacement parts particular to your application. Parts may be ordered by mail, telephone, fax or e-mail, with the confirming order sent to the factory (see back cover).

Customer Kit	Part Number
Capacitor Replacement, 6.0Nm B-R 72 & 120 RPM Motors, 60 Hz	12-8064-10
Capacitor Replacement, 6.0Nm B-R 72 & 120 RPM Motors, 50 Hz	12-8064-20
Resistor Replacement, 6.0Nm B-R 72 & 120 RPM Motors	12-8064-14
Motor (w/ SLM Replacement), 6.0Nm B-R 72 RPM (Motor P/N 20-2703-50)	12-8064-01
Motor (w/ SLM Replacement), 6.0Nm B-R 120 RPM (Motor P/N 20-2703-51)	12-8064-11
SLM Replacement	12-8064-03
Handswitch Replacement	12-8064-09
DCM Replacement	12-8064-04
Control End Replacement, CPS-4	12-8064-05
CPS-4 Switch Assembly	12-8064-06
CPS-4 Coupling	12-8064-08
CPS-4 P.C. Board Replacement	12-8064-07
Transformer (240 Volt)	12-8064-02
DCM Fuse Replacement	12-8064-16

SERVICES

PRODUCT DEMONSTRATIONS

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

SITE SURVEYS

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

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

APPLICATION REVIEWS

By sharing your needs with a Beck Sales Engineer you can take advantage of the best application advice for the type of control you need. This review will yield a better understanding of the versatility of Beck drives for your installations, as well as complete details on options and accessories to make the process as effective as possible.

SPECIFICATION WRITING

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

HOW TO OBTAIN SERVICE

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

THREE YEAR LIMITED WARRANTY STATEMENT

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

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

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

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

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

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