80-2900-03
Rev. 01.3

MODELS 29-109
29-103
29E-109
29E-103

BECK®

INSTRUCTION MANUAL

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ELECTRIC ACTUATORS FOR INDUSTRIAL PROCESS CONTROL

INTRODUCTION TO THE MANUAL

This manual contains the information needed to install, operate, and maintain Beck Model Group 29 Electronic Control Drives, manufactured by Harold Beck & Sons, Inc. of Newtown, Pennsylvania.

The Group 29 linear drive is a powerful control package designed to provide precise position control of valves and other devices requiring up to 1,000 lb (4 450 N) 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.

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 (10 839 N•m) drive torque.

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

CONTENTS

PRODUCT DESCRIPTION

The Beck Group 29 & 29E linear valve drive offers the excellent performance and maintenance-free design typical of Beck drives. Engineered to provide precise, reliable control of all types of modulating globe valves, the Group 29 is available with microprocessor-based electronics to support advanced control features and flexibility. The Group 29 is also available in a model for open/close operation through direct AC control.

Ideally suited for process control applications in even the harshest environments, the Group 29 is easily mounted on most valves and handles valve thrust requirements up to 1,000 lbs (4 450 N).

The Beck control motor is specially designed to work with the drive's on-board control electronics. The motor will not coast or over-shoot, and will not overheat, even under continuous modulation. Beck motors have grease-sealed bearings and require no maintenance.

A ball screw design, along with an advanced drive control algorithm and Beck motor, ensures repeatable modulation as precise as 0.1% of span.

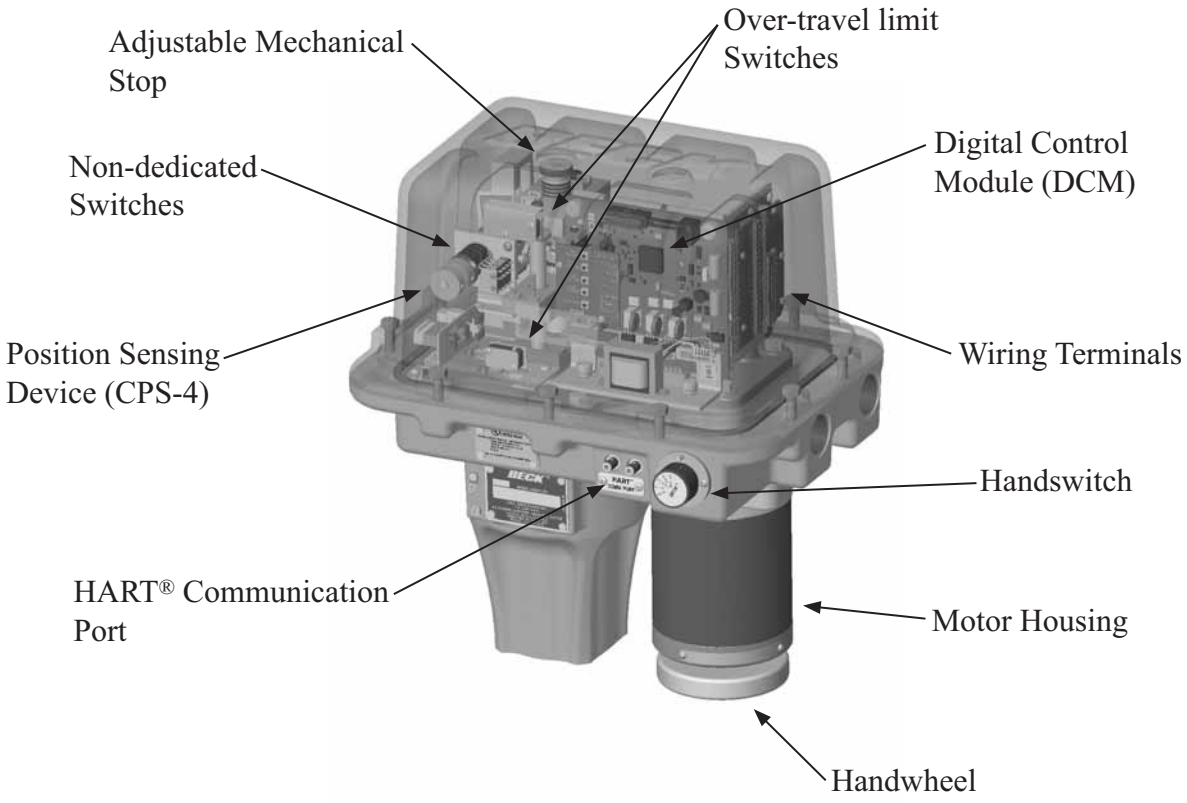
An easy to turn, spoke-free Handwheel is incorporated into the design of Group 29 drives to allow manual operation during installation or power outages. The Handwheel can be used to easily operate valves even under full load conditions.

Valves may also be operated at their individual locations with a built-in electric Handswitch.

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

Beck's CPS-4 Contactless Position Sensor provides accurate position measurement in demanding environmental conditions, with no contacting or wiping surfaces to wear or intermittently lose contact.

All Beck electronic control drives have individual weatherproof enclosures to protect the main components. Group 29E drives are also available for use in hazardous locations.



CONTROL & OPERATING FEATURES

In addition to drive control, the microprocessor-based electronics provide a host of features and functions. Some of the advanced features include:

- Compatible with common asset management systems.
- Two-way digital communications via HART protocol or RS-232 serial connection.
- Simplified calibration without any mechanical or electrical adjustment.
- Drive diagnostics and operating statistics available locally or remotely.
- Easy configuration, setup and documentation of drive operating parameters.
- Live thrust measurement and protection against excessive thrust.
- Stall protection with configurable stall time setting.
- The choice of linear, square or 20-segment custom input signal characterization.
- All operating parameters including internal temperature can be displayed via HART.
- Configurable action on loss of demand input signal.
- Read/write parameters including tag and descriptor information, last calibration date, and model and serial numbers are saved on board.
- Ability to restore all drive calibration and setup information to the factory “as-built” configuration.

HAZARDOUS LOCATION CONTROL DRIVES FOR GAS AND DUST AREA CLASSIFICATIONS (OPTIONAL)

Group 29E Control Drives are available approved for the following Protection Methods and Protection Concepts:

Class I, Division 2 Groups C & D T6
Class I, Zone 1 AEx d IIB T6
Temperature codes based on an ambient of 40°C per NEC 500
NEMA 4X; and
CE II 3G EEx nC IIB T6
Tamb = -20°C to 40°C IP66
II 3D T85°C
Tamb = -20°C to 40°C
per ATEX Directive 94/9/EC
EN 50014: 1997 E Incl. A1 + A2
EN 50018: 2000 + A1: 2002
EN 50281-1-1: 1998 + A1: 2002
EN 60079-15: 2003
Certificate No.: DEMKO 06 ATEX 0509928

PRODUCT DESCRIPTION

GENERAL SPECIFICATIONS

Drive Power	120 V ac single-phase, 50 or 60 Hz 240 V ac single-phase, 50 or 60 Hz
Allowable Tolerance	+10% / –15%
Max. Current and Power	.65A, 78W @ 120 V ac; .33A, 78W @ 240 V ac
Weight	94 lbs (43 kg), including yoke
Operating Conditions	-40° to 185°F (-40° to 85°C) 0 to 99% relative humidity Drives designed for hazardous locations are available.
Communication Interface*	HART protocol, local pushbutton/LED panel and RS-232 Serial commands.
Demand Input Signal Range (DCM)*	4–20 mA, 1–5 V dc
Minimum Step*	0.1% typical
Linearity*	±1% of span, max. independent linearity
Hysteresis*	0.25% of span typical
Demand Input Signal Characterization*	Linear (drive output shaft moves proportionally to input signal). Square (drive output shaft moves proportionally to square of input signal). Twenty segment custom input signal characterization (through DCM serial interface only).
Position Feedback Signal*	4–20 mA or 1–5 V dc
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)*	Stays in place or runs to any preset position (configurable).
Excessive thrust Protection (Optional)*	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 and two Form A, rated for 1 A, 250 V ac.

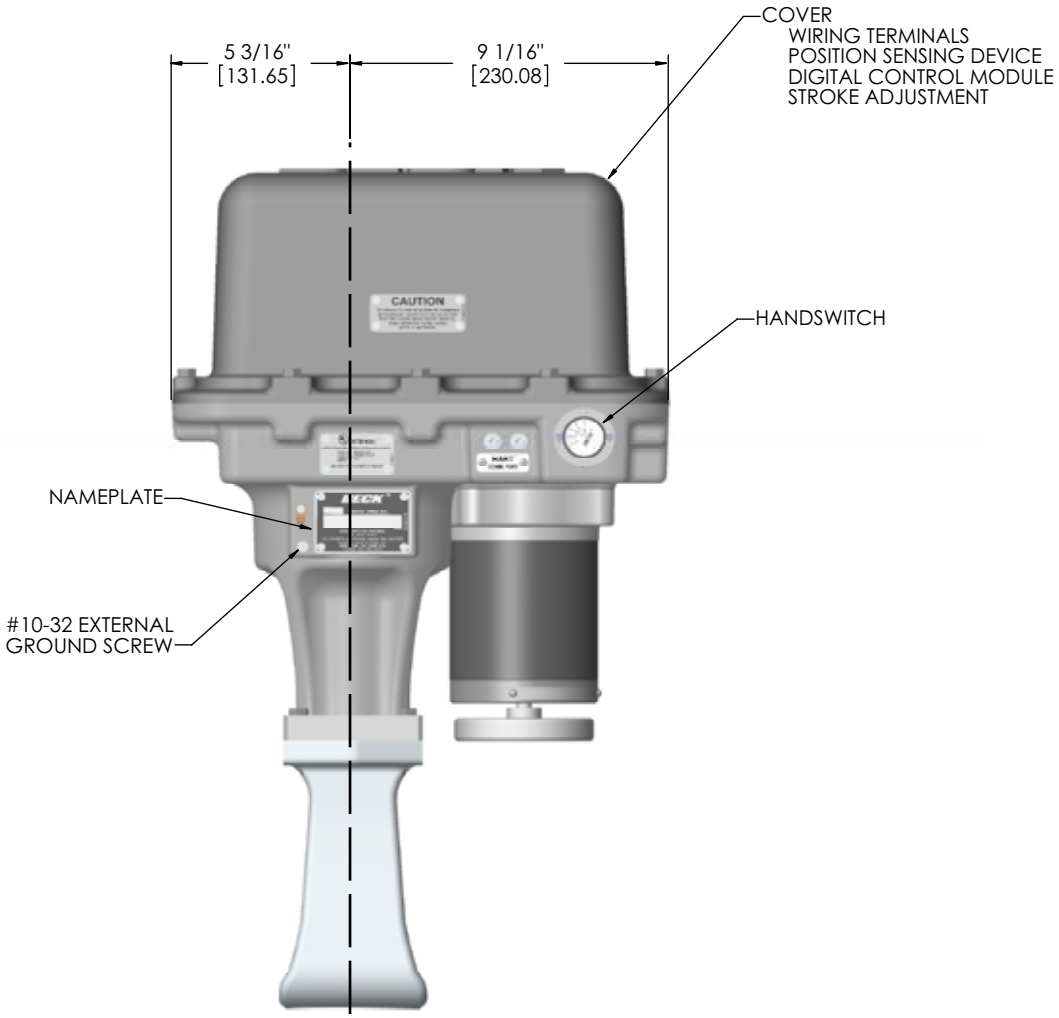
*Applicable to Option 9 model only.

Customer Wiring	Terminals accommodate up to 12 AWG (3.31 mm^2).
Handswitch	Permits local electrical operation, independent of Demand Input signal.
Handwheel	Provides manual operation without electrical power.
Motor	Does not coast or overshoot and will not overheat, even under continuous modulation.
Gear Train	High efficiency, precision-cut, heat-treated alloy steel and ductile iron spur gears.
Mechanical Stops	One fixed and one adjustable mechanical stop prevent over-travel during automatic or manual operation.
Enclosure	Precision-machined aluminum alloy casting, painted with corrosion-resistant polyurethane paint, provides a rugged, dust-tight, weatherproof enclosure. NEMA 4X; IP66. Drives designed for hazardous locations are also available. *Internal water damage is not covered by warranty.
Mounting Orientation	Any orientation—no limitations.
Standards*	UL listed CE compliant

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

OUTLINE DIMENSION DRAWINGS

MODEL 29-100 SPECIFICATIONS



FRONT VIEW

ALL DIMENSIONS ARE IN INCHES, WITH METRIC EQUIVALENT IN BRACKETS [ ].

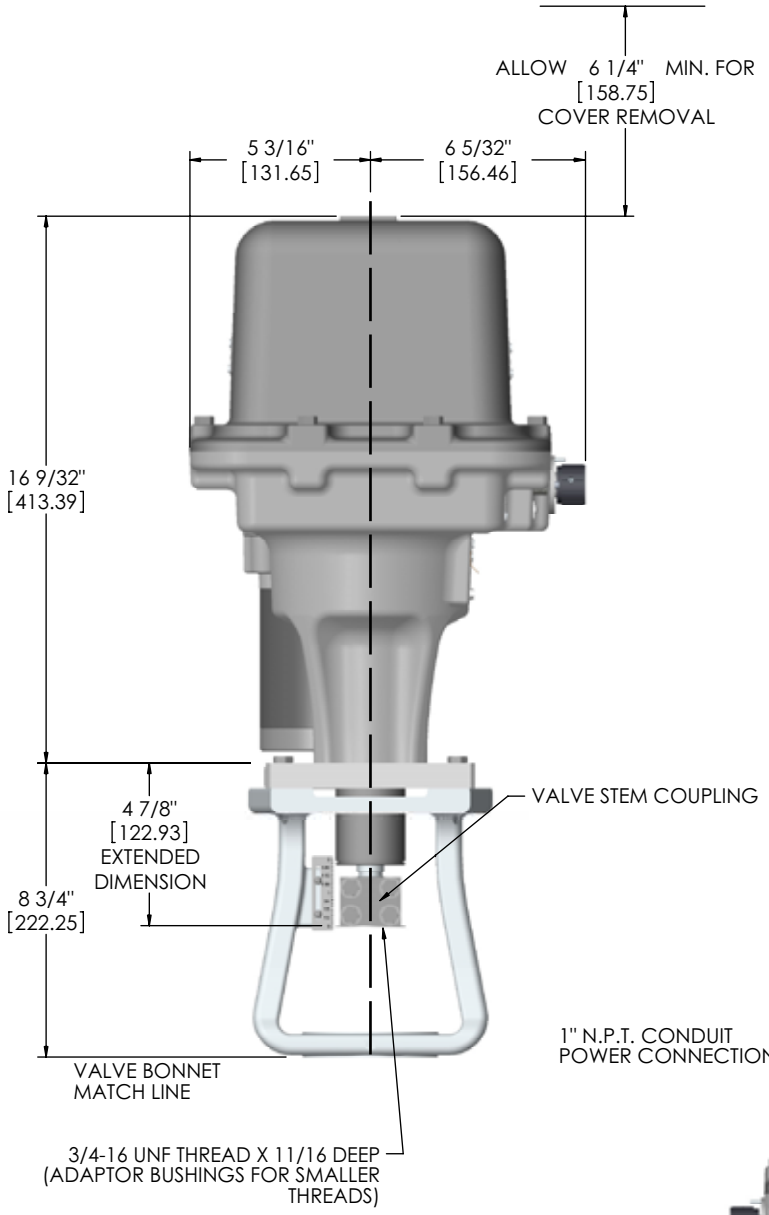
THE ORIENTATION BETWEEN THE DRIVE AND MOUNTING YOKE MAY NOT BE ROTATED.

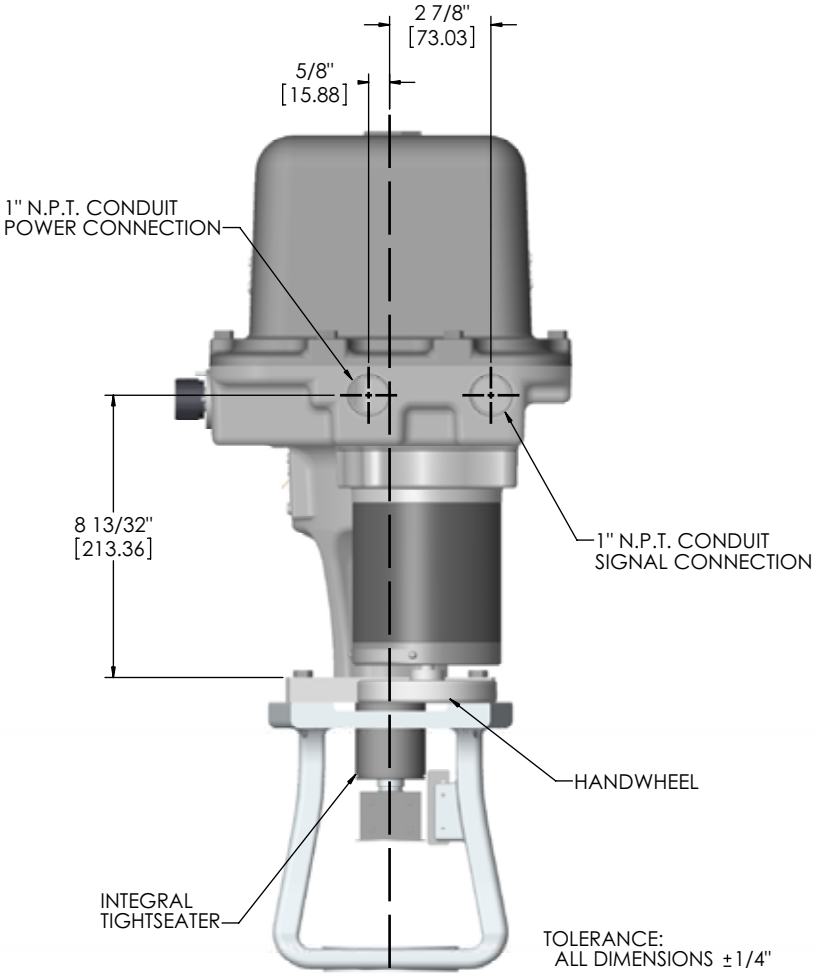
BECK DRIVE MODEL NO.	DRIVE STEM TRAVEL RANGE	APPROX. WEIGHT
29-10_	1/2"–2" [12.7–50.8 mm]	94 Lbs. [43 Kg]

FASTENER GUIDE

	SIZE (IN.)	TORQUE (LB-FT)	TORQUE (N•m)
VALVE STEM COUPLING SCREWS	1/4-20 UNC	8	11
COVER SCREWS	5/16-18 UNC	14	19
MOTOR SCREWS	5/16-18 UNC	11	15
YOKE ADAPTOR PLATE TO BODY SCREWS	5/16-18 UNC	17	23
YOKE TO ADAPTOR PLATE SCREWS	5/16-18 UNC	17	23

SIDE VIEWS


ALLOW 6 1/4" MIN. FOR
[158.75]
COVER REMOVAL
5 3/16"
[131.65]
6 5/32"
[156.46]
16 9/32"
[413.39]
4 7/8"
[122.93]
EXTENDED
DIMENSION
8 3/4"
[222.25]
VALVE STEM COUPLING
VALVE BONNET
MATCH LINE
3/4-16 UNF THREAD X 11/16 DEEP
(ADAPTOR BUSHINGS FOR SMALLER
THREADS)


2 7/8"
[73.03]
5/8"
[15.88]
1" N.P.T. CONDUIT
POWER CONNECTION
8 13/32"
[213.36]
1" N.P.T. CONDUIT
SIGNAL CONNECTION
HANDWHEEL
INTEGRAL
TIGHTSEATER
TOLERANCE:
ALL DIMENSIONS ±1/4"

INSTALLATION *GENERAL*

STORAGE INFORMATION

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

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

UNPACKING

Group 29 drives are shipped in standardized shipping containers. Drives mounted on valves may be packed in cardboard containers or strapped to a skid and crated, depending on size. After unpacking, the wooden platform may be used to transport the drive to the installation site.

WARNING

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

INSTALLATION—MECHANICAL

Beck drives can be furnished with valves mounted as unitized assemblies ready for pipeline installation.

CAUTION

Whenever a control drive is being mounted on a valve, it is good practice to remove the valve from service. Observe the following precautions:

- **Know what fluid is in the line**
- **Wear the proper protective equipment**
- **Disconnect electrical power**
- **Depressurize the pipeline**
- **Refer to the valve maintenance manual for specific instructions**

Installing the Drive on a Valve or Removing the Drive from a Valve

Consult the *Beck Valve Mounting Specification sheet* that was shipped with the drive for detailed instructions.

Installing the Valve / Drive Assembly

The Beck control drive can be mounted in any convenient orientation. There is no preferred operating position. See pages 8 and 9 for dimensions and cover removal clearance requirements.

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

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

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

INSTALLATION—ELECTRICAL

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

Two 1" N.P.T. conduit connections are provided for power and signal wiring to the drive. 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. Terminal locations and connections for model 29-109 drives are described beginning on page 12 and a typical wiring schematic is provided on page 14 (29-103 drives have different terminal connections; see page 15 for typical wiring schematic).

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 is located under the drive cover. Terminals are designed to accommodate one wire. Redundancy of the terminals (i.e., 1A, 2A, 3A, etc.) is provided for additional wiring connections, if necessary. See page 13 for terminal block detail.

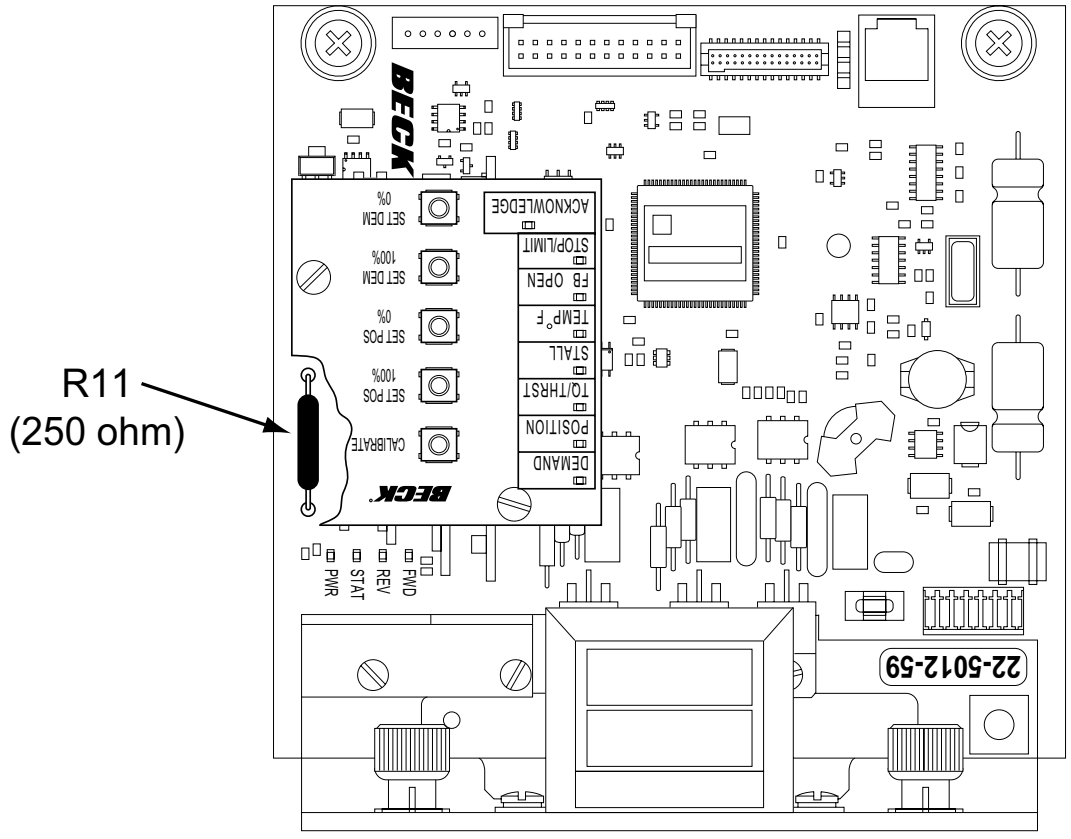
CAUTION

Always close the cover 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 attached to the inside of the 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 for 4–20 mA operation unless otherwise specified as 1–5 V dc operation at the time of order. To convert to 1–5 V dc operation, remove resistor R11 from the DCM board (see illustration below). To convert to 4–20 mA operation, add a 250 ohm resistor to the DCM board in the R11 location (shown below).

For maximum safety, the Beck drive body should be grounded. Use the power and signal grounding terminals in the wiring compartment of the drive.



TERMINAL CONNECTIONS

Capacity: #12 AWG (3.31 mm^2) wire (see page 13)

Input Power Terminals 1 and 2

The 29-100 is available configured for either 120 or 240 Vac, single-phase (refer to drive nameplate for specific voltage rating). Input power connects to terminals 1 and 2; ground connects to an enclosure ground screw.

Form C Non-dedicated Switches Terminals 3 through 8

Group 29 drives include two Form C "auxiliary" switches which are actuated by cams on the control shaft. These switches are useful for indicating drive shaft position information to the plant control system. Connections to the switches are at terminals 3 through 8. The switch contacts are rated 250 Vac, 1 A.

System Alarm Terminals 9, 10 and 11

The alarm relay is 250 Vac, 1A with Form C contacts (terminal 10 is common). Terminals 10 and 11 should be used if the contacts are to open during alarm conditions and stay closed during normal operation. Terminals 9 and 10 should be used if the contacts are to close during alarm conditions and stay open during normal operation.

Handswitch Auto Indication Terminals 12 and 13

Indication for the position of the Handswitch is available at terminals 12 and 13. The switch contacts are Form A. When the Handswitch is in AUTO, the contacts are closed; and when the Handswitch is not in AUTO, the contacts are open. The contacts are rated 250 Vac, 1 A.

Form A Non-dedicated Switches Terminals 14 through 17

Group 29 drives include two Form A "auxiliary" switches which are actuated by cams on the control shaft. These switches are useful for indicating drive shaft position information to the plant control system. Connections to the switches are at terminals 14 through 17. The switch contacts are rated 250 Vac, 1 A.

Demand Signal Terminals 18 and 19

The DCM monitors the signal at terminals 18 (–) and 19 (+), and changes the output shaft position to match the signal at these terminals.

Feedback Signal Terminals 20 and 21

The Feedback module transmits a signal on terminals 20 (–) and 21 (+) that is proportional to the drive output shaft position.

Control Override Inputs Terminals 22 through 25

The override terminals are provided to override the standard analog demand input signal by means of relay logic input signals .

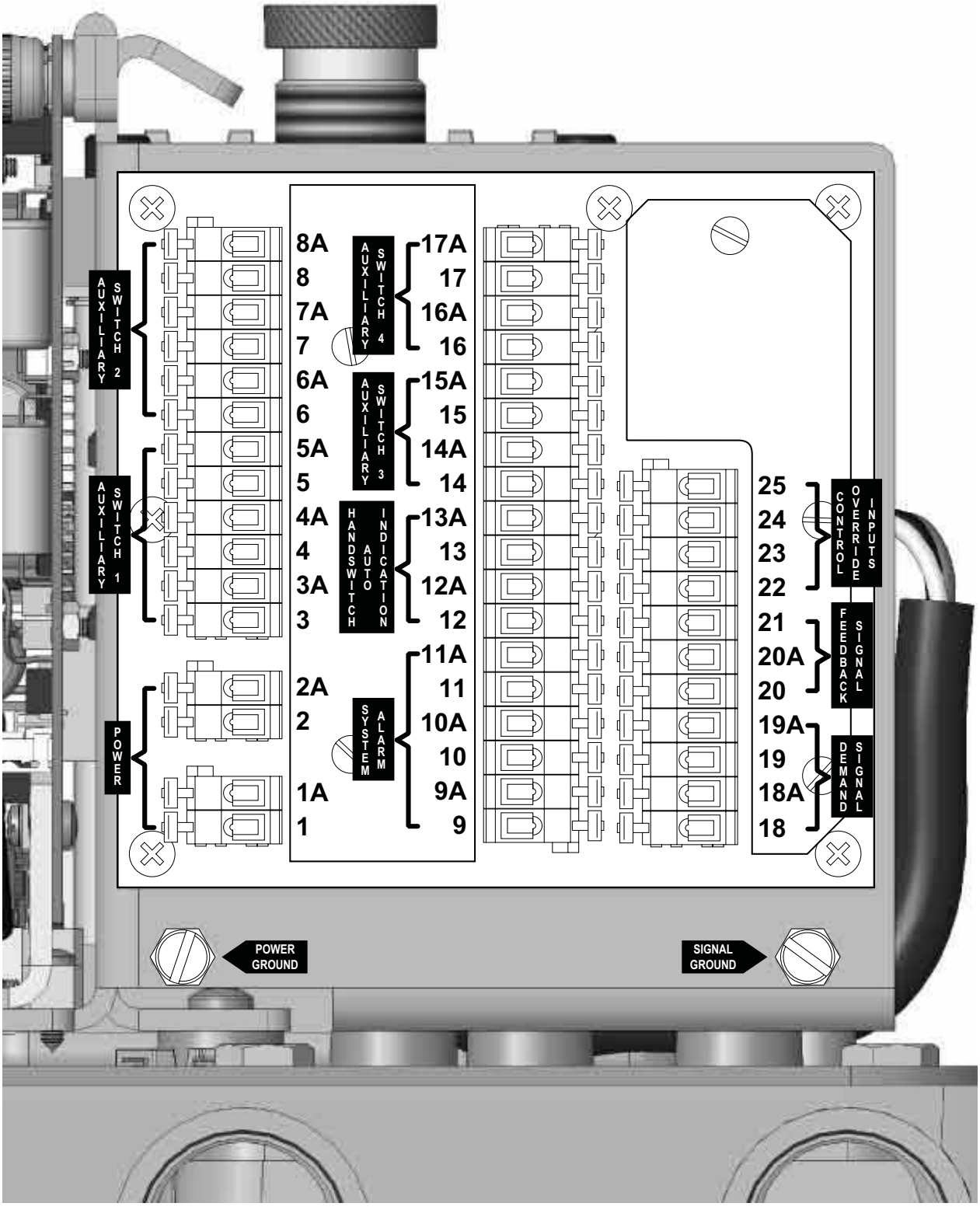
CAUTION

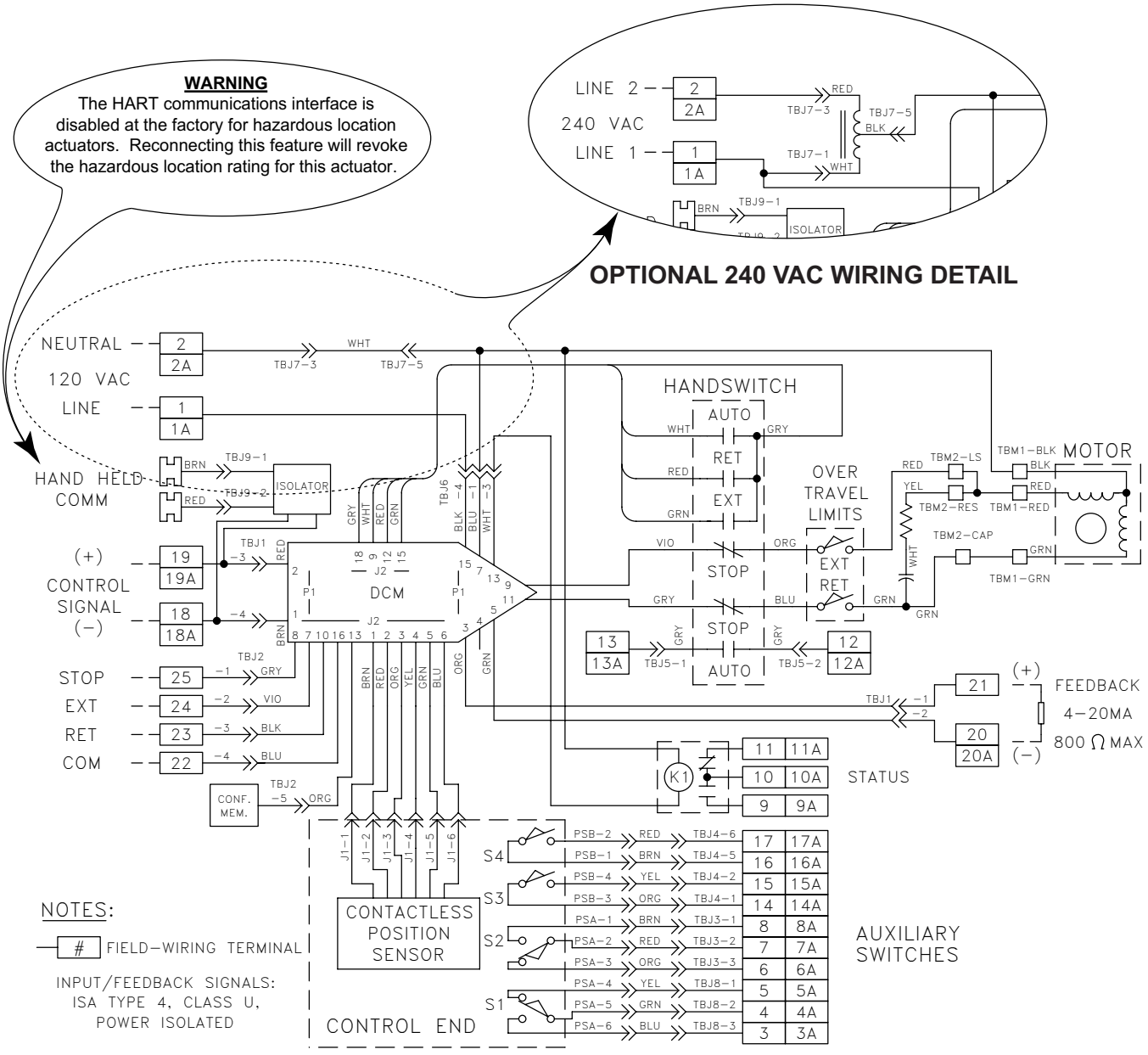
Do not connect an external voltage source to override terminals 22–25; an external voltage source may damage the DCM circuitry.

Connecting terminal 23 (RET) to terminal 22 (COM) will cause the drive shaft to retract. Similarly, the drive shaft will extend when terminal 24 (EXT) is connected to terminal 22 (COM). The drive will stop regardless of other input signals when terminal 25 (STOP) is connected to terminal 22 (COM).

The connection to terminal 22 is designed to be made through relay contacts or through a solid state switch capable of sinking at least 5 mA dc. When the circuit is open, terminals 23, 24, and 25 are 5 V dc with respect to terminal 22.

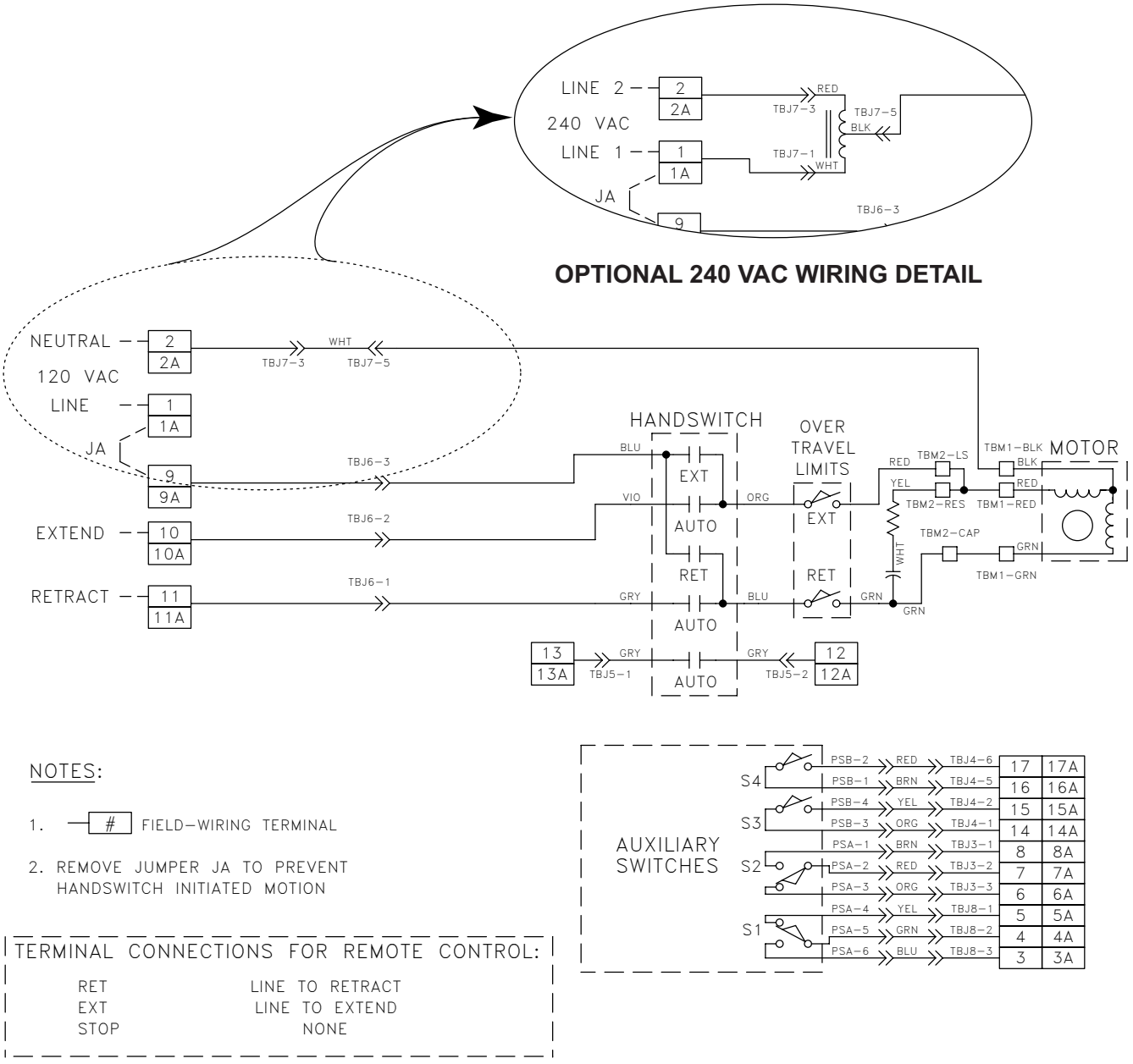
MODEL 29-109 TERMINAL CONNECTIONS





MODEL 29-109 TYPICAL WIRING SCHEMATIC

NOTE: A wiring schematic specific to each drive is located under the wiring terminal cover.



OPTIONAL 240 VAC WIRING DETAIL

NOTES:

1. —[#] FIELD—WIRING TERMINAL
2. REMOVE JUMPER JA TO PREVENT HANDSWITCH INITIATED MOTION

TERMINAL CONNECTIONS FOR REMOTE CONTROL:	
RET	LINE TO RETRACT
EXT	LINE TO EXTEND
STOP	NONE

MODEL 29-103 TYPICAL WIRING SCHEMATIC

NOTE: A wiring schematic specific to each drive is located under the wiring terminal cover.

BEFORE START-UP

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. If your requirements have changed since the time of order, the following sections will provide the instruction necessary to reconfigure your drive.

Confirm that the proper input power voltage is available. Check the drive configuration to make certain the drive matches the power and control system specifications (refer to the drive nameplate). Inspect the drive shaft-to-valve stem connection and drive-to-valve mounting fasteners for correct installation and torque value.

AFTER POWER IS APPLIED

Using the Handswitch (see Outline Dimension Drawings, pages 8–9), run the drive in the RETRACT and EXTEND direction. The drive should run smoothly to each end of travel. If the drive does not run smoothly, switch off power to the drive and recheck the installation wiring.

If the above checks are satisfactory, move the Handswitch to AUTO and control the drive with the Demand signal.

CAUTION

The drive output shaft will reposition.

Vary the signal and ensure the drive responds appropriately. If applicable, check the feedback signal to see if it is realistic for the drive output shaft position. If the drive does not respond as expected, check for alarm indications on the LEDs of the DCM board or use a HART compatible communicator to check for error messages. Drive status may also be viewed through use of the RS-232 connector (see page 46 for details).

CONFIGURATION & SETUP

All Beck drives are shipped completely calibrated to customer specifications, and are ready to be installed. If the need arises to change the drive calibration, confirm that the drive is installed correctly and operating properly before proceeding with the change. It is also helpful to verify the drive configuration.

Calibration is performed using the DCM HART interface, the DCM pushbutton local interface, or the DCM serial interface (via an RS-232 connector for direct computer communication—see page 46 for details).

If using the HART interface and you are unfamiliar with the HART communicator, please review the Communications section of this manual before continuing.

There are four standard attributes that can be calibrated using the HART interface and communications tool or the serial interface: Position, Demand, Feedback, and Thrust. The local interface allows Position and Demand calibration.

Any drive calibration changes made using any method can be reversed by using the “Restore to Factory” feature in the HART communicator menu. This feature restores all calibration and setup information to the "as shipped" values. Commands are also available to restore individual parameters.

CONFIGURATION PRIORITY

Group 29 drives are equipped with one fixed mechanical stop and one adjustable mechanical stop with integral over-travel limit switches. All output shaft travel occurs within these stops, which are outside the electrical range of travel.

The over-travel protection switches are used to limit the electrical control range of the drive and are factory-set for 101% of travel (unless otherwise specified at time of order). These switches are activated directly by drive travel and are set 1/64" (.4 mm) before the mechanical stops. The switches are positioned to provide an electrical over-travel protection without opening in the normal operating range.

If there is a need to change the factory calibration and configuration of the drive, it should be done in a priority sequence as follows:

1. If required, use the adjustment knob to simultaneously adjust the over-travel limit switch and mechanical stop at the RETRACT end of travel.
2. Make any required operating changes such as changing the direction of travel, action upon loss of signal, minimum drive step size, etc.
3. If required, perform a drive position calibration.
4. If required, perform a drive demand calibration.
5. Verify that the drive operates as desired.

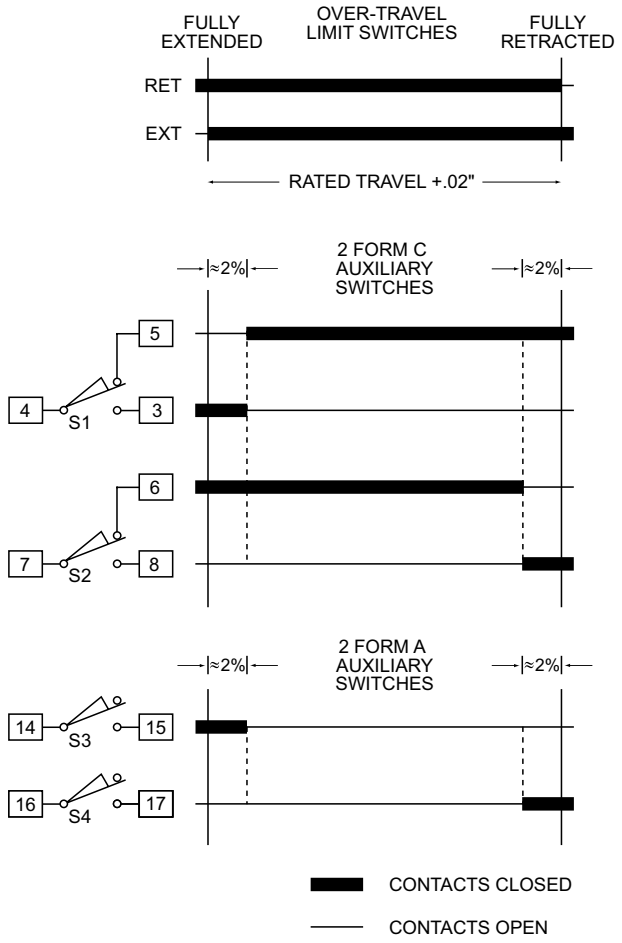
For example, if the drive is short-stroked (i.e., the full travel from 0–100% is reduced to less than the standard 100% travel—see the Short-stroking instructions in the appropriate DCM section that follows), the adjustable over-travel protection switch (RETRACT) should be reset. Because the over-travel protection switch defines the drive’s maximum range, if it is to be reset, it should be adjusted before performing DCM calibration procedures. Calibration procedures for these switches are the same regardless of the DCM interface (i.e., HART, local or serial) utilized.

The auxiliary switches are cam operated and have no effect on DCM operation; therefore, they 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 beginning with the switches, according to the following procedures.

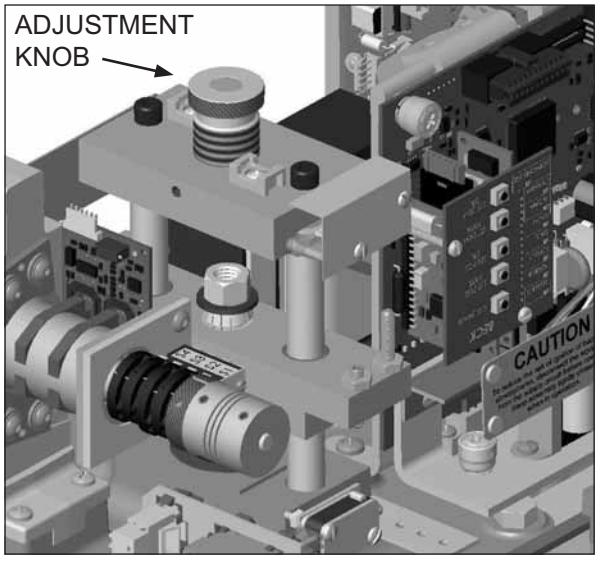


Standard Over-travel Limit and Auxiliary Switch Settings

Over-travel Limit Switch Adjustments

All Group 29 control drives are shipped with two over-travel limit switches. In option 9 drives (model 29-109), the switches provide electrical over-travel protection. In option 3 drives (model 29-103), the switches establish the drive travel limits. The switches are set inside the range of the mechanical stops. The switches can be reset to provide over-travel protection (or limit travel) down to a minimum of approximately 45%. Auxiliary switches are factory-set (as shown in the diagram at left) unless otherwise specified at time of order.

Over-travel switches are triggered by adjustable screws that move with the output shaft. These over-travel limit switches are set at the factory relative to their respective mechanical stop. If a need exists to modify drive travel, this may be accomplished through adjustment of the RETRACT limit switch by simply rotating the adjustment knob (see illustration below). Because the limit switch is integral to the mechanical stop, rotating the adjustment knob will also adjust the mechanical stop.



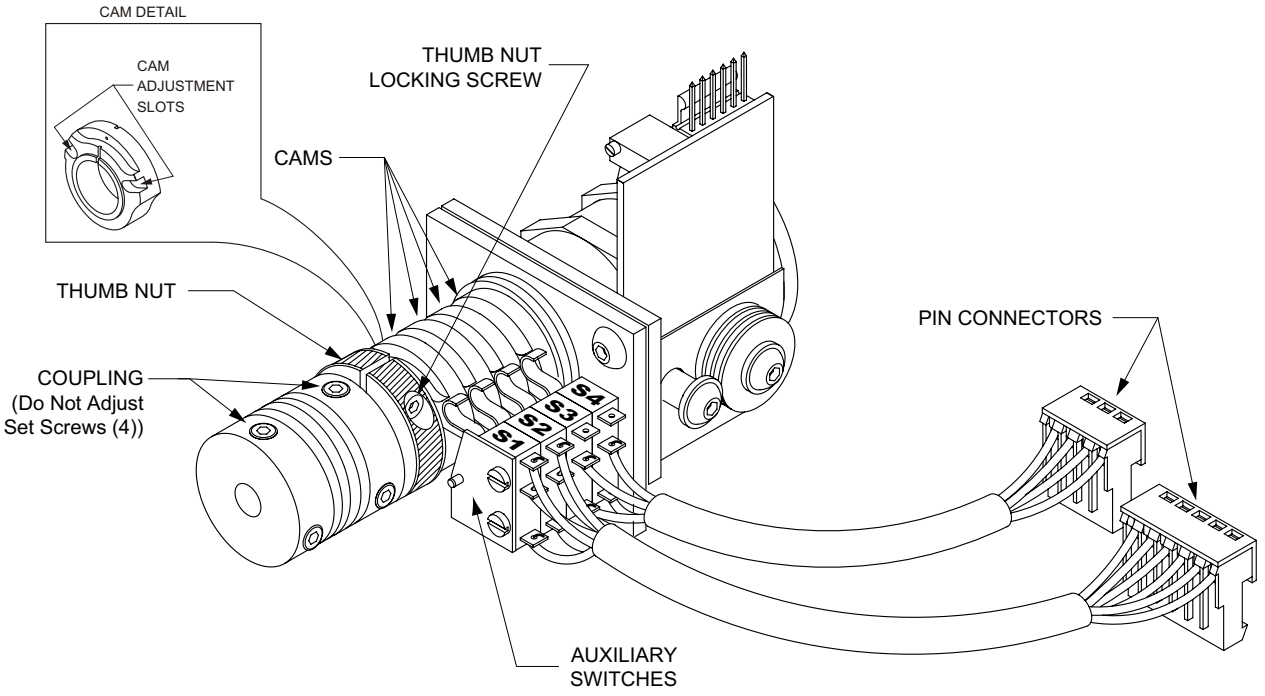
Location of Adjustment Knob

Setting Auxiliary Switches

Standard switch settings for the 4 auxiliary switches are shown on the diagram on the preceding page. The operating point of auxiliary switches is defined as a percentage of output shaft travel. 100% is defined as the limit of shaft travel in the "RETRACT" direction. The heavy line indicates a closed circuit. Auxiliary switches are operated by cams which are clamped onto the control shaft. Use the following instructions to change the trigger 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 cover (see outline dimensions beginning on page 8).
2. Use the Handswitch to drive the control shaft so that the thumb nut locking screw is accessible (see illustration below). While holding the shaft coupling, use a 3/32" (2,38 mm) hex wrench and loosen the screw on the thumb nut. Loosen the thumb nut by turning it counter-clockwise approximately 1/4 turn.
3. Move the output shaft to the desired position (the Handwheel may be used to make fine adjustments to the position of the output shaft).
4. Turn the Handswitch to the STOP position.
5. Disconnect power from the drive and switch terminals.
6. Connect a continuity meter across the appropriate terminals as depicted in the diagram on page 18.
7. While holding the shaft coupling stationary, rotate the appropriate cam using a 3/32" (2,38 mm) hex wrench in one of the cam adjustment slots (see drawing on this page for location of slots) until the meter shows continuity (the switch clicks audibly when the switch contact closes).
8. Turn the thumb nut clockwise until hand tight. Tighten the thumb nut locking screw to 5 lb-in (.56 N•m) 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 cover and tighten cover bolts to appropriate torque (see fastener guides beginning on page 9).



CONTROL END / CONTACTLESS POSITION SENSOR

DIGITAL CONTROL MODULE (DCM)

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 is easily accomplished using one of the three following methods:

One method that may be used to change drive parameters is the HART interface and a communications tool (model 275 or 375 HART Communicator) as described in the Communications section (see page 30). The following section (beginning on page 21) explains how the drive is configured using the HART interface and provides instructions for changing each particular setup parameter available. This section is intended to build upon the Communications section, which provides a detailed description of the HART Menu structure and defines all the parameters and commands.

If unfamiliar with the HART communicator and Beck drives, please review the Communications section (beginning on page 29) before proceeding.

Another method that may be used to change drive parameters is the local interface (using the push-button configuration panel located on the DCM). This method does not use HART protocol; therefore, to facilitate configuration modifications, the panel has an integral interface that allows basic configuration and diagnostic functions to be performed local to the drive. Drive direction of travel, span of travel and demand signal response can all be easily modified using this interface. Operating parameters less commonly modified can only be changed using the HART (aforementioned) or serial communications (described below).

The third method that may be used to change drive parameters is the serial interface (using the RS-232 connector on the DCM for direct computer communication—see page 47 for details). The serial interface may be used for drive configuration changes, drive information reporting and to assist in troubleshooting.

If the HART interface is typically used, serial communications are simply an alternative to using the HART configuration. If the local interface is typically used, serial communications not only provide an alternate configuration method, but also provide access to parameters that cannot be changed using the local configuration panel.

A number of configuration setup parameters can be changed to tailor the drive's operation to the application needs. The following section provides instructions for changing these parameters using the HART interface via a HART Communicator connected to the drive's HART communication port (see page 4 for location). Reference the copy of the HART Menu structure (see foldout at the back of this manual) when following these instructions. To change these parameters using the Serial Interface, see pages 47–54.

The DCM default values for both the HART and Serial Interface are listed in the chart below. If not otherwise specified at the time of order, these are the values set in the DCM.

NOTE: The instructions on pages 21–38 are applicable to the HART interface only. The instructions on pages 39–45 are applicable to the local interface only.

CAUTION

Throughout the following instructions, some configuration changes will cause the drive to reposition—this can adversely affect the process and cause potentially dangerous conditions.

DCM HART and SERIAL INTERFACE DEFAULT VALUES

OPERATING PARAMETERS	HART INTERFACE		SERIAL INTERFACE	
	Variable Name	Default Value	Command	Default Value
Drive Direction (Increasing Signal)	Drive Dir	RET	drvdir	0 (RET)
Operation Mode	Op Mode	Follow	opmode	0 (Follow)
Thrust Zero	Thrust Null	*	thrust0k	*
Thrust Constant	Thrust Const	*	thrustconst	*
CPS Volts at 0%	CPS Zero	0.900	cpsvatzero	0.900
CPS Volts per 100%	CPS Span	3.000	cpsvspanab	3.000
Percent Travel	Deg Rot	100.00	travel	100.00
Demand LOS Threshold (mA)	DemLimLwr	3.20	demlos	3.20
Demand LOS Mode	LOS Mode	Stay	demlos	sip
Demand LOS Go To Position (%)	LOS Pos	50.00	demlosgtp	50.00
0% Demand (mA)	DemRngLwr	4.00	dem0pctma	4.00
100% Demand (mA)	DemRngUpr	20.00	dem100pctma	20.00
Stall Protection	--	--	Stallprot	1 (enabled)
Stall Time (Sec)	Stall Time	300	stalltime	300
Demand Function	Dem Curve	Linear	demfunc	linear
Step Size	Step Size	0.15	stepsize	0.15
IO Mode	Feedback	Enabled	iomode	1 (fdbk)
0% Feedback (mA)	FB RngLwr	4.00	fdbk0pctma	4.00
100% Feedback (mA)	FB RngUpr	20.00	fdbk100pctma	20.00
Thrust Enable	Thrust Snsr	Enabled	thrustenable	1 (enabled)
Over Thrust Protection	Ovt Prot	Disabled	ovtstop	0 (go)
Polling Address	Poll Addr	0	polladdr	0
Limit Alarm	LimitSwitch	Accept	limitalarm	0
Drive Model	Model	29-109	drvmodel	15 (29-109)

*** The specific numbers for these values are unique to each drive and are determined during manufacture. These numbers are noted on a tag affixed under the cover within the control area.**

NOTE: These instructions are applicable to the DCM HART interface. The instructions on pages 39–45 are applicable to the DCM local interface.

DRIVE SHAFT DIRECTION

Drive shaft direction refers to the direction the output shaft of the drive moves in response to an increasing Demand input signal. The direction is either retract or extend as shown in the figure on this page. 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 Direction

To change the drive shaft direction using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Drive Setup"
> "Drv dir"

Simply enter the desired travel direction in response to an increasing Demand signal (i.e., "RET incr" or "EXT incr"). Use the up and down arrow keys to select the desired parameter, then press the ENTER key. Remember to press the SEND key to execute the change.

Reducing Full Travel (Short-stroke Operation)

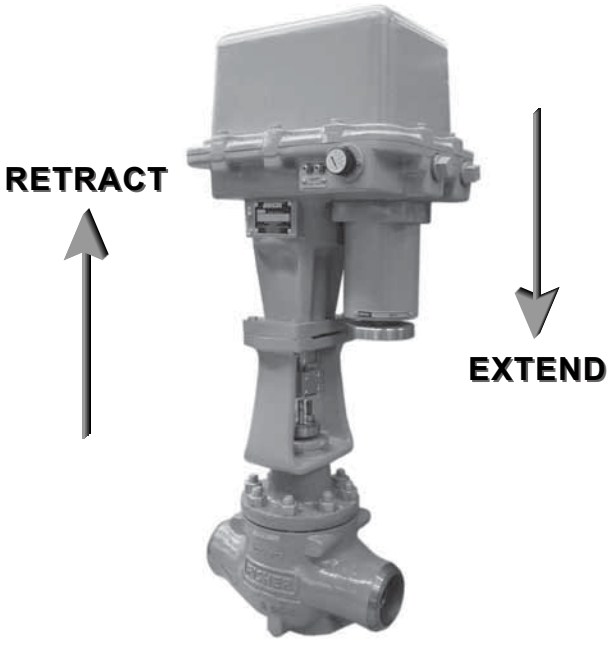
Typically, it is best to use the full 100% travel of the drive in response to the 0–100% Demand input signal. However, in certain applications it may become necessary to reduce this response to less than 100%. In these applications, the DCM can be calibrated to accommodate reduced stroke. The minimum full stroke is 45% (although travel this short is not recommended). It is desirable to make the range as close to 100% as possible.

The following is an example of how to short-stroke a drive.

To check or set the 0–100% travel distance using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Drive Setup"
> "TravelSpan"

Simply enter the desired full travel length in inches and press the ENTER key. Remember to press the SEND key to execute the change.



Direction of travel in response to an increasing Demand signal

STEP SIZE

The step size defines the minimum position change increment made by the drive. The standard step size setting is 0.15%, which produces the performance required for precision control. Typically, there is no need to adjust this parameter, but it can be increased through the DCM configuration. The maximum step size setting is 2.5%; however, this large a step size is typically unwarranted. It may be advantageous in certain applications where noise or other problems exist, to increase the step size slightly to prevent excessive modulation and wear to the drive and driven elements.

Changing the Step Size

To select a Step Size using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Drive Setup"
> "Step Size"

Enter a desired value (between 0.15% and 2.5%) and press the ENTER key. Remember to press the SEND key to execute the change.

STALL PROTECTION

The DCM provides protection of the drive motor and gearing in the event of a stalled condition. The DCM 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 to prevent the drive from continuing to operate against the stall and will create an alarm condition at terminals 9, 10 and 11 (see page 12). 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 on the foldout at the rear of the manual)
- Performing a board reset procedure (see "Diagnostics" menu on the foldout at the rear of the manual)
- Cycling the drive ac power

Changing Stall Time

To select a Stall Time using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Drive Setup"
> "Stall time"

Enter a desired value in seconds (between 30 and 300) and press the ENTER key (the default setting is 300 seconds). Remember to press the SEND key to execute the change.

WARNING

It is possible that the stall time can be set to a value less than the full stroking time of Group 29 drives. This could lead to false stall conditions if the drive is moving through its full operating range.

POSITION FEEDBACK SIGNAL

The Feedback Sourcing module provides a mA analog output signal (typically 4–20 mA) that represents the drive output shaft position in terms of 0–100% of full 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 unused (i.e., not wired to a load) a HART alarm message will be present while communicating using the 275 or 375 Communicator. This message is helpful in alerting the user to open feedback wiring, but it is not useful when the feedback is purposely disconnected or unused. Disabling the feedback signal turns off the output and eliminates the alarm message; which can also be eliminated by placing a load resistor (e.g., 250Ω) across the feedback terminals 20 & 21.

Enabling / Disabling Position Feedback Signal

To enable or disable the Feedback signal using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Position setup"
> "I/O select"

Select "FB out" or "None" and press the ENTER key. Remember to press the SEND key to execute the change.

DEMAND SIGNAL CHARACTERIZATION

The Beck DCM is designed to receive a 4–20 mA or 1–5 V dc input Demand signal and to respond by repositioning the drive output shaft in proportion to the signal. The DCM can interpret the Demand signal using one of three methods: (1) linear, (2) square, or (3) demand curve special.

The linear interpretation, which is most commonly employed, simply causes the drive to position the output shaft in a one-to-one relationship with the Demand. For example, a 1% change in Demand always causes a 1% position response.

The square relationship produces a non-linear drive response proportional to the square of the Demand signal. For example, a 25% input Demand is interpreted as 0.25^2 or 0.0625 (6.25%). The square relationship helps to linearize response of final control elements that have quick opening characteristics.

The Dem Curve Special relationship allows a 20 segment, customized Demand curve to be setup through a special submenu.

Changing Characterization

To change the characterization using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "Dem curve"

Select the desired characterization and press the ENTER key. Remember to press the SEND key to execute the change.

LOSS OF DEMAND INPUT SIGNAL

The DCM 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” (drive holds position when the signal is lost) or “Go to pos” (drive moves to a predetermined position when the signal is lost).

If the “Go to pos” option is selected, the “LOS pos” parameter is used to determine what output shaft position the drive will achieve when the input is lost.

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 as a percentage of the Demand input signal range. Therefore, the standard –5% value normally used for this parameter suggests that when the Demand input signal drops 5% below the calibrated 0% value, the DCM senses a lost Demand input and executes the configured loss-of-signal action.

Changing Loss (LOS) of Signal Action

To change the LOS signal mode using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "LOS Mode"

Select the desired mode ("Stay" or "Go to pos") and press the ENTER key. Remember to press the SEND key to execute the change.

Changing Loss (LOS) of Signal Position

To select the position that the drive will run to during a LOS condition (if the “Go to pos” option is selected), use the HART Communicator and proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "LOS Pos"

Select the desired value ("–5% to "105%") and press the ENTER key. Remember to press the SEND key to execute the change.

Changing LOS Trip Point

The default value for the LOS trip point is 5% of the signal span below the minimum span value (e.g., a 4–20 mA drive would have an LOS trip point of 3.2 mA). To change the LOS trip point using the HART Communicator, proceed through the following menus:

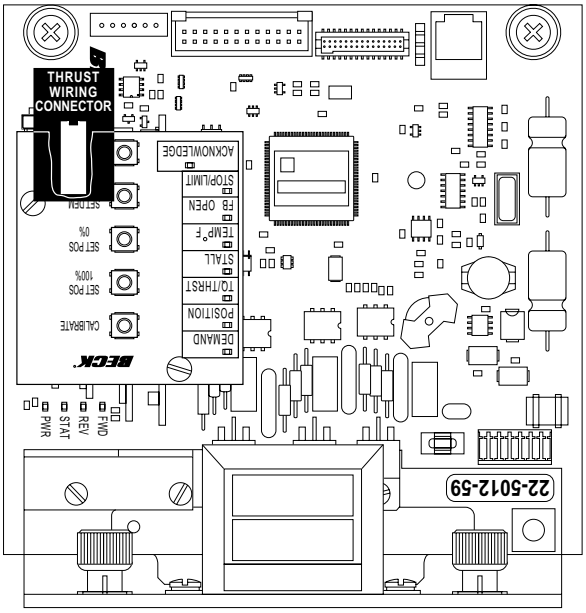
"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "DemLimLwr"

Select the desired value (in mA) and press the ENTER key. Remember to press the SEND key to execute the change.

THRUST OPTIONS

Group 29 DCMs have the capability to measure the drive's thrust output and provide several thrust-related features. These features include a live display of the thrust output on the 275 or 375 HART Communicator display (or any other device capable of communicating and displaying HART transmitted variables). Peak thrust values are stored within the DCM and viewed by accessing the Statistics 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, by enabling over-thrust protection. The DCM also provides 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), and creates an alarm condition at terminals 9, 10 and 11 (see page 12).

The thrust features of the drive can be enabled or disabled using the "Thrust Snsr" menu item.



DCM Board showing location of Thrust Wiring Connection

Enabling/Disabling Thrust Sensing

To enable or disable thrust sensing using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Thrust Setup"
> "Thrust Snsr"

Select Enabled or Disabled and press the ENTER key. Remember to press the SEND key to execute the change.

Enabling/Disabling Over-thrust Protection

To enable or disable over-thrust protection using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Thrust Setup"
> "Ovt Prot"

Select Enabled or Disabled and press the ENTER key. Remember to press the SEND key to execute the change.

CONTACTLESS POSITION SENSOR (CPS) SIGNAL RANGE

In order for the drive to position properly, the DCM must be configured with the CPS voltages that correspond to the voltage at 0% (CPS Zero) and the voltage span for 100% travel (CPS Span). The value of CPS Zero is typically 1.034 volt and CPS Span is typically 2.932 volts. If the CPS has been changed, these values may require adjustment. To check if these signal ranges are correct:

Run the drive to the exact 0% position (usually fully extended).
Place Handswitch in STOP.
Read the voltage displayed by the HART Communicator at menu location:
"Online"
> "Functions"
> "Present Status"
> "Raw Pos"
Compare the voltage displayed by the HART Communicator at menu location:
"Online"
> "Functions"
> "Configuration"
> "Position Setup"
> "CPS Zero"

If the readings are different by more than 0.005 volts, updating of the CPS Zero value may be desirable. To enter a new value, select the CPS Zero menu item and enter the voltage that was displayed at Raw Pos. Remember to press the SEND key to execute the change.

Run the drive to the exact 100% position (usually fully retracted).
Place Handswitch in STOP.
Read the voltage displayed by the HART Communicator at menu location:
"Online"
> "Functions"
> "Present Status"
> "Raw Pos"
Subtract the CPS Zero voltage reading from the Raw Pos voltage reading at the 100% position.
Compare the voltage displayed by the HART Communicator at menu location:
"Online"
> "Functions"
> "Configuration"
> "Position Setup"
> "CPS Span"

If the readings are different by more than 0.015 volts, updating of the CPS Span value may be desirable. To enter a new value, select the CPS Span menu item and enter the result calculated above. Remember to press the SEND key to execute the change.

DEMAND INPUT SIGNAL RANGE

In order for the drive to properly follow the Demand input signal, the DCM must be configured with the Demand values that correspond to 0% and 100%. The most common value for 0% is 4 mA, and for 100% is 20 mA. The value for 0% must be greater than 0.5 mA and the value for 100% must be less than 21 mA. The difference between 0% and 100% must be at least 4 mA.

To check or set the 0% value (Demand Range Lower) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "DemRngLwr"

If the existing value is not appropriate, enter the desired value in mA and press the ENTER key. Remember to press the SEND key to execute the change.

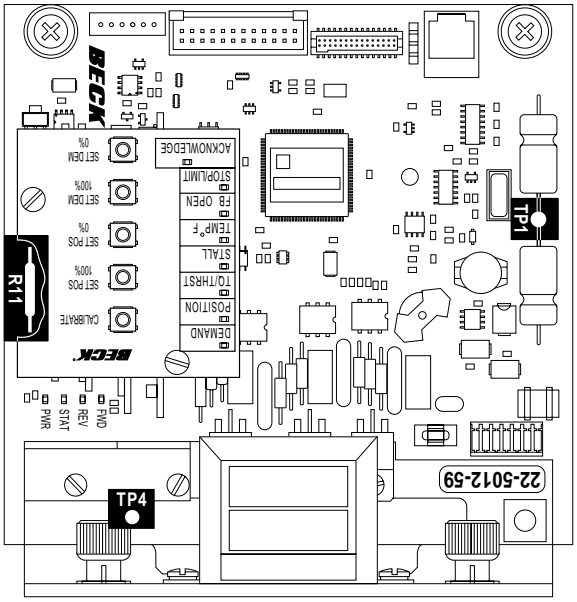
To check or set the 100% value (Demand Range Upper) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "DemRngUpr"

If the existing value is not appropriate, enter the desired value in mA and press the ENTER key. Remember to press the SEND key to execute the change.

Split Range Operation

Split range operation allows two or more drives to operate from one signal source. To set up two or more drives for split range operation, connect the Demand input signals of each drive in parallel. The DCM R11 resistor (see illustration below) must be removed from all but one drive. Decide the appropriate Demand signal range for each drive and refer to the Demand Input Signal Range section detailed on page 26.



DCM Board showing Resistor R11 and Test Points TP1 & TP4

FEEDBACK OUTPUT SIGNAL RANGE

In order for the drive to supply the appropriate Feedback signal, the DCM must be configured with the Feedback values that correspond to 0% and 100%. The most common value for 0% is 4 mA, and for 100% is 20 mA. The value for 0% must be greater than 3 mA and the value for 100% must be less than 21 mA. The difference between 0% and 100% must be at least 4 mA.

To check or set the 0% value (Feedback Range Lower) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Feedback Setup"
> "FB RngLwr"

If the existing value is not appropriate, enter the desired value in mA and press the ENTER key. Remember to press the SEND key to execute the change.

To check or set the 100% value (Feedback Range Upper) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Demand Setup"
> "FB RngUpr"

If the existing value is not appropriate, enter the desired value in mA and press the ENTER key. Remember to press the SEND key to execute the change.

THRUST SENSOR RANGE SETUP

In order for the drive to properly measure thrust, the DCM must be configured with the thrust sensor values that correspond to 0% and 100%. These values are unique to each drive and are labeled inside the DCM electronics compartment on the drive body wall. These values are also available from the factory.

When replacing the DCM for any reason, the thrust values must be checked and reset to the values labeled in the drive for proper operation.

To check or set the 0% value (Trq Null) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Thrust Setup"
> "ThrustNull"

If the existing value is not appropriate, enter the appropriate value and press the ENTER key. Remember to press the SEND key to execute the change.

To check or set the 100% value (Trq Const) using the HART Communicator, proceed through the following menus:

"Online"
> "Functions"
> "Configuration"
> "Thrust Setup"
> "ThrustConst"

If the existing value is not appropriate, enter the appropriate value and press the ENTER key. Remember to press the SEND key to execute the change.

HART INTERFACE *CALIBRATION (SIGNALS)*

WARNING

If recalibrating, be aware that the drive will be required to reposition. Additionally, as with any change in the DCM configuration, the drive may reposition when restored to normal operation.

This section is for trimming signals for accuracy; refer to pages 26–27 for instructions to set signal ranges.

INTERNAL POSITION CALIBRATION

This calibrates the circuits that measure the CPS-4 internal position signal, which is not available at the customer terminal block. This signal is calibrated at the factory and recalibration should not be necessary. To check if calibration is required:

Place Handswitch in STOP.

Measure the voltage (Vdc) on the control board between test points 1 (–) and 4 (+) (see figure on page 27 for location of test points).

Compare the voltage to the value displayed by the HART Communicator at menu location:

"Online"
> "Functions"
> "Present Status"
> "Raw Pos"

If the readings are different by more than 0.025 volts, recalibration may be desirable. To recalibrate, select the “Raw Pos” value and enter the voltage measured between test points 1(–) and 4(+).

DEMAND SIGNAL CALIBRATION

This calibrates the circuits that measure the Demand input signal. This signal is calibrated at the factory and normally does not require recalibration; however, some users may want to do so to account for slight variations between the drive calibration and their own instrument calibration. To check if calibration is required:

Place Handswitch in STOP.

Supply a 4.00 mA signal to the customer terminal block at terminals 18(–) and 19(+).

Compare 4.00 mA to the value displayed by the HART Communicator at menu location:

"Online"
> "Functions"
> "Present Status"
> "Loop(Dem)"

If the readings are different by more than 0.03 mA, recalibration may be desirable. To recalibrate, select the “Loop(Dem)” value and enter 4.00 mA.

Supply a 20.00 mA signal to the customer terminal block at terminals 18(–) and 19(+).

Compare 20.00 mA to the value displayed by the HART Communicator at menu location:

"Online"
> "Functions"
> "Present Status"
> "Loop(Dem)"

If the readings are different by more than 0.03 mA, recalibration may be desirable. To recalibrate, select the “Loop(Dem)” value and enter 20.00 mA.

FEEDBACK SIGNAL CALIBRATION

This calibrates the circuits that create the customer Feedback signal (available at terminals 20 and 21). This signal is calibrated at the factory, but recalibration to correspond to customer instrumentation may be desirable. To check if calibration is required, follow the steps below (Note: These steps require the Feedback signal range to be set at 4.00—20.00 mA):

Run the drive to the 0% travel position.

Measure the mA signal at terminals 20(–) and 21(+) using a high accuracy meter.

Compare the reading to the value displayed by the HART Communicator at menu location:

"Online"
> "Functions"
> "Present Status"
> "Feedback"

If the readings are different by more than 0.03 mA, recalibration may be desirable. To recalibrate, select the “Feedback” value and enter the meter reading.

Run the drive to the 100% travel position.

Measure the mA signal at terminals 20(–) and 21(+) using a high accuracy meter.

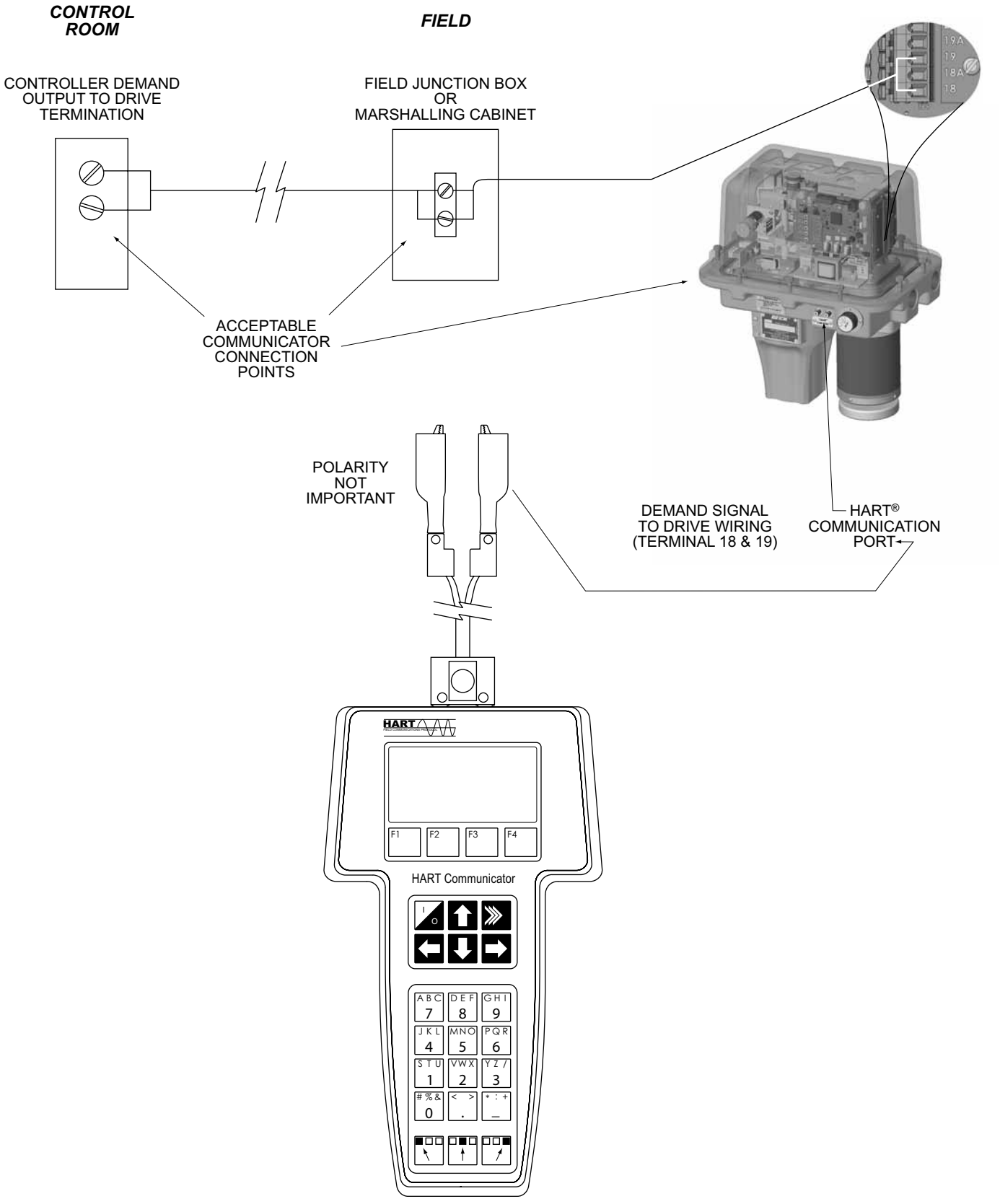
Compare the reading to the value displayed by the HART Communicator at menu location:

"Online"
> "Functions"
> "Present Status"
> "Feedback"

If the readings are different by more than 0.03 mA, recalibration may be desirable. To recalibrate, select the “Feedback” value and enter the meter reading.

HART INTERFACE *COMMUNICATION*

275 or 375 HANDHELD COMMUNICATOR WIRING CONNECTIONS



The DCM is the control center of the drive. Drive configuration and calibration are accessed and set through the DCM. Interfacing to the board requires a HART compatible communicator. Typically, a universal model 275 or 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 or 375 HART Communicator.**

HART INTERFACE

The foldout at the end of the manual displays the interface menu tree for communicating with a DCM via a model 275 or 375 HART communicator. This menu tree displays all the possible setup options, features and available information. Some of the features may not be available. If a particular feature is not available, a message to that effect will be displayed when an attempt to access or change the feature is made.

USING THE 275 OR 375 COMMUNICATOR

The universal model 275 or 375 HART Communicator should be connected to the drive's HART communication port (see page 29). 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 module (maintains last state) while the change is implemented. Typically, this is only for a second or two.

With the communicator connected, turn on the communicator and wait for communications to be established. Once communicating, the "Online" display (foldout, 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 the foldout 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, ensure that the communicator is securely connected to the drive's HART communication port, 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 29. 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

The LCD displays all the information and actions available. In addition to the 21 character display that provides 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 such as 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 the foldout.

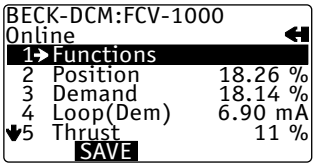
The alphanumeric keys are used to type in entries. Whenever a selected menu or method requires a value or description to be entered, this keypad is used. Since each key represents four different characters, three shift keys are provided at the bottom of the pad. A particular alphanumeric character is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

Before moving on, it may be 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 (the foldout).

MENU DESCRIPTIONS

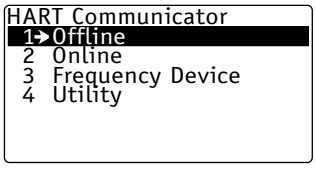
(A foldout of the menu structure is located at the end of the manual for easy reference).

Online Menu (Foldout, block 1)



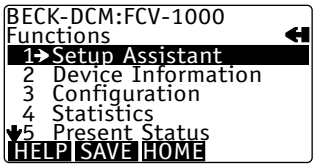
When communications are established with the communicator, the "Online" menu is displayed. This menu is the gateway to all the other menus and it also provides current information about the drive. Numbered items 2 through 7 provide live, dynamic values of the drive's output position in percent, the Demand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

Offline Menu (Foldout, block unmarked)



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

Functions Menu (Foldout, block 2)

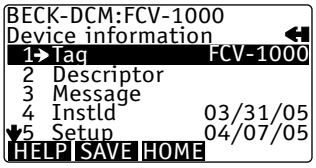


From the Functions menu, any of the DCM functional menus can be selected and accessed. Essentially, there are seven functional areas which include: Setup Assistant, Device Information, Configuration, Statistics, Present Status, Manual Operation and Diagnostics.

The "**Setup Assistant**" (foldout, block 3) is a procedure that allows the user to setup all the details necessary to get the drive up and running as desired. It sequentially walks the user through a series of questions and entries that enable the drive to be rapidly and completely setup. This method is entirely self-driven, and the user need only follow the questions and prompts to successfully complete the setup. Because control drives are set up at the factory according to customer specifications, it is normally not necessary to go through the Setup Assistant.

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

Device Information Menu (Foldout, block 4)



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

1. **Tag** - This 8 character entry can be edited to reflect the loop tag number/name.
2. **Descriptor** - This entry is a 16 digit field that can be used to provide any description the user desires. This entry is normally blank when shipped from the factory unless the user specifies a description prior to shipment. The user can edit the field if desired.

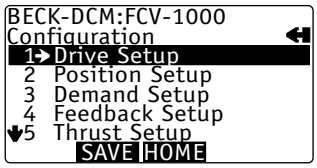
Continued

Device Information Menu, cont'd.

3. **Message** - This entry is a 32 digit field that can be used to provide any message the user desires. This entry is normally blank when shipped from the factory unless the user specifies a message prior to shipment. The user can edit the field if desired.
4. **InstId** - This is a date entry that is normally used to indicate the date that the drive or DCM was installed. The date format is mm/dd/yyyy and it can be fully edited.
5. **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 fully edited.
6. **Calbrtd** - This is a date entry normally used to indicate the date that the DCM/drive was last calibrated. Although this entry is viewed and can be edited in the "Device Information" menu, the user is prompted at the end of performing any "calibration" method to enter a date. Entering the date at the prompt automatically updates the date displayed. The date format is mm/dd/yyyy and can be edited.
7. **Model** - This entry displays the model number of the drive in which the DCM is installed. It normally is set at the factory when the DCM is installed in a drive. The user can edit the field if desired.
8. **Drive S/N** - This entry displays the serial number of the drive in which the DCM is installed. It normally is set at the factory when the DCM 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.
9. **Poll Addr** - 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.

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

Configuration Menu (Foldout, block 5)

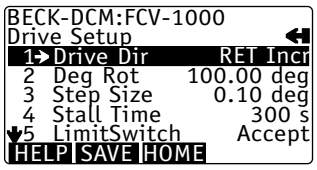


The Configuration menu serves as the gateway to all of the drive operating setup parameters. The user can select any of five different setup submenus that can be used to configure the drive based on the physical layout and the desired operation.

Also available under Configuration is the "Restore to Factory" walk-through procedure which may be used to set the DCM back to its original setup (as shipped from the factory) and calibration. By selecting the "Restore to Factory" procedure, every drive operating parameter that may be edited, along with all calibrations, are returned to their factory settings.

The five setup submenus are as follows:

Drive Setup Menu (Foldout, block 5A)



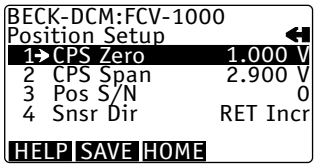
This menu is used to set drive operating parameters. The five parameter entries are as follows:

1. **Drive Dir** - This parameter is used to select the travel direction of the drive. The options available are retract (RET) or extend (EXT). Direction of travel always refers to the movement of the drive output shaft, given an increasing Demand signal, looking at the output shaft (see illustration on page 21).

   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. This parameter is normally set to RET unless the user specified EXT prior to shipment of the drive. For editing procedure, see page 21.

2. **Deg Rot** - This value is typically set for 100.00% of travel in response to the 0–100% Demand input signal. This value may be changed to as little as 60.00%, if necessary (see "Reducing Full Travel", page 21).
3. **Step Size** - This value sets the typical minimum step size for output shaft movements expressed as a percentage of travel. Values between 0.1% and 2.5% may be selected (see "Changing the Step Size, page 22).
4. **Stall time** - The DCM provides stall protection to the entire drive by shutting off power to the motor and providing a HART alarm. This entry allows the stall time required to trigger the stall protection to be configured. At the factory it is normally set to 300 seconds, but can be edited and set for any value between 30 and 300 seconds. For editing procedure, see page 22.
5. **LimitSwitch** - This setting defines whether contacting a limit switch, outside the normal travel range of 0% to 100%, will cause an alarm condition. Two settings may be selected, either Accept or Alert. If the Accept option is selected, contacting a limit switch will not cause an alarm condition; and if the Alert option is selected, then an alarm condition will occur if a limit switch is contacted.

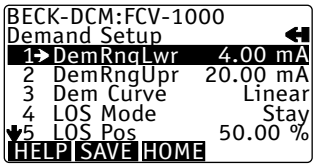
Position Setup Menu (Foldout, block 5B)



This menu is used to perform the position sensor setup. The four parameter entries are as follows:

1. **CPS Zero** - This sets the value of the signal, in volts, from the CPS-4 that corresponds to the 0% output shaft position, typically 1.0 volts. For editing procedure, see page 26.
2. **CPS Span** - This sets the value of the signal span, in volts, from the CPS-4 that corresponds to 100% of output shaft travel; typically 2.9 volts. For editing procedure, see page 26.
3. **Pos S/N** - This parameter displays the serial number of the position sensor installed in the drive. New drives will have this information entered at the factory. DCMs shipped as spare parts will have this entry left blank. The user can enter the appropriate information if desired, but it is not required.
4. **Snsr Dir** - This parameter displays the position sensor direction (i.e., the direction in which the drive output shaft moves to increase the internal position sensor output signal). This value cannot be edited. Typically, all new drives built with a DCM use RET direction for increasing position signal (RET Incr).

Demand Setup Menu (Foldout, block 5C)



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

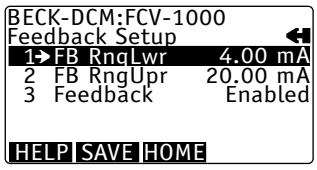
1. **DemRngLwr** - This parameter is used to set what the DCM interprets as the lower range of the Demand input signal. This value may be edited to accommodate split ranging up to four drives. For editing procedure, see page 26.
2. **DemRngUpr** - This parameter determines what the DCM interprets as the upper range of the Demand input signal. This value may be edited to accommodate split ranging up to four drives. For editing procedure, see page 26.
3. **Dem curve** - This is a dual choice entry that is used to set the Demand input characterization. The two characterization choices are "Linear" and "Square". Linear means that the Demand signal is interpreted linearly and the drive responds to the Demand with a linear relationship. The Square setting means that the Demand signal is interpreted with a square function and the drive output positions in a square relationship with respect to Demand. For example, at 25% Demand the drive position equals 0.25^2 or 0.0625 (6.25%). At Demands of 50%, 75% and 100% the position would be 25%, 56.25%, and 100% respectively. This nonlinear curve can be used to compensate for valves with quick opening characteristics. This entry will always be set to Linear by the factory unless otherwise specified by the user. For editing procedure, see page 23.

Continued

DEMAND SETUP MENU, CONT'D.

4. **LOS Mode** - This parameter is used to set the drive action upon loss of the Demand input signal. Two options are available: "Stay" or "Go-to-Pos". Selecting the "Stay" option configures the drive such that the output shaft will stay in its last position if the Demand signal is lost for any reason. Selecting the "Go-to-Pos" option configures the drive to move to a predetermined position (see **LOS Pos** below) upon loss of the Demand signal. This parameter is set to "Stay" by the factory, unless otherwise specified by the user. For editing procedure, see page 24.
5. **LOS Pos** - This parameter is used to set the predetermined position when the LOS mode described above is set to "Go-to-Pos". This parameter is normally shipped from the factory set at 50.00%, but it has no effect on loss-of-signal action unless the "Go-to-Pos" option is selected. The value can be edited and set anywhere between -5% and 105%. For editing procedure, see page 24.
6. **DemLimLwr** - This parameter is used to set what the DCM interprets as the lower limit of the Demand input signal range. Input signals below this setting are interpreted by the DCM as a lost signal, and the LOS mode function takes over drive operation.
7. **DemLimUpr** - This parameter determines what the DCM interprets as the upper limit of the Demand input signal range.

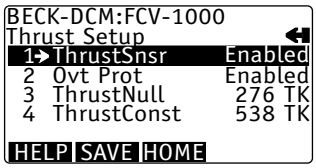
Feedback Setup Menu (Foldout, block 5D)



This menu provides access to the feedback parameters. The three parameters are as follows:

1. **FB RngLwr** - This sets the value of the feedback signal, in mA, that corresponds to a 0% output shaft position. For editing procedure, see page 27.
2. **FB RngUpr** - This sets the value of the feedback signal, in mA, that corresponds to a 100% output shaft position. For editing procedure, see page 27.
3. **Feedback** - This parameter is used to either enable or disable the external analog feedback signal.

Torque (thrust) Setup Menu (Foldout, block 5E)



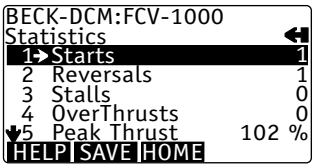
This menu provides access to the thrust measurement related parameters. The four parameters are as follows:

1. **ThrustSnsr** - This parameter is used to enable or disable the thrust measurement feature of the DCM.
2. **Ovt Prot** - If the thrust sensor is enabled, the DCM has the ability to remove power from the motor in the event that the thrust output of the drive exceeds 115% of its rated output. This parameter is used to enable or disable this feature. For editing procedure, see page 25.
3. **ThrustNull** - This parameter is determined during the construction of the drive. For editing procedure, see page 27.
4. **ThrustConst** - This parameter is determined during the construction of the drive. For editing procedure, see page 27.

Restore to Factory (Foldout, block 5F)

"Restore to Factory" is a procedure that returns many of the drive's settings back to their original (as shipped from the factory) setup. The items restored include: Model, Drive Dir, Deg Rot, Step Size, Stall Time, LimitSwitch, CPS Zero, CPS Span, DemRngLwr, DemRngUpr, Dem Curve, LOS Mode, LOS Pos, DemLimLwr, FB RngLwr, FB RngUpr, Feedback, Trq Snsr, Ovt Prot, Trq Null, Trq Const, Line Freq, Raw Pos trim value, Loop(Dem) trim values, Feedback trim values, Expansion 1, Expansion 2, Max Error, Power, and Max Freq.

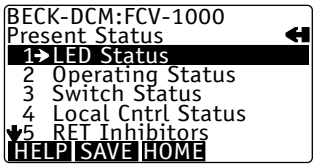
Statistics Menu (Foldout, block 6)



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

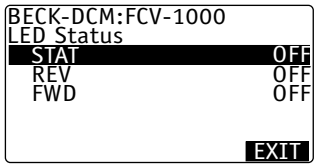
1. **Starts** - This statistic logs and displays the total number of starts the drive motor has made.
2. **Reversals** - This statistic logs and displays the total number of reversals the drive motor has made.
3. **Stalls** - This statistic logs and displays the total number of stalled conditions the drive has experienced. For the drive to register a stall, the DCM must be unable to balance the drive position against the Demand input signal for a period exceeding the **Stall time** set in the Drive Setup menu.
4. **OverThrusts** - This statistic logs and displays the total number of overthrust conditions that have occurred. An overthrust condition results when the drive output thrust exceeds the thrust limit value.
5. **Peak Thrust** - This statistic displays the highest absolute thrust value in percent of rating measured by the drive.
6. **Run Time** - This statistic logs and displays the total run time of the drive motor in seconds.
7. **High Temp** - This statistic logs and displays the highest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM.
8. **Low Temp** - This statistic logs and displays the lowest temperature in degrees Fahrenheit measured by a temperature sensor resident on the DCM.

Present Status Menu (Foldout, block 7)



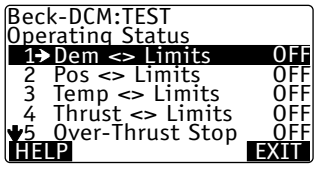
This menu is where the drive's current operating status is displayed. There are sixteen status indicators available, and six of these show tabulated data as follows:

LED Status (Foldout, block 7A)



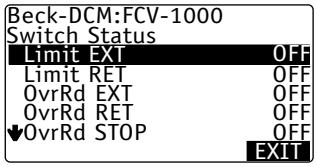
This display is where the status of the DCM LEDs is available. Each of the LEDs listed will display either an "OFF" or "ON" status. The LEDs listed are: Status, Reverse and Forward.

Operating Status (Foldout, block 7B)



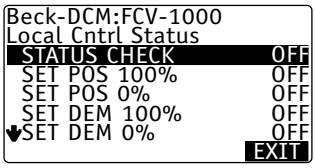
This display provides detailed status of the drive and process alarm conditions. A number of problems can occur that may result in an alarm condition. These problems include: Demand signal out of limits, position signal out of limits, temperature beyond drive rating, thrust beyond drive rating, thrust greater than thrust alarm level, drive stalled, feedback circuit is open, or main power voltage is low. This display lists all these possible problems that activate the alarm condition. Each of the problems will display either an "OFF" or "ON" status. One or more problem(s) displaying the "ON" status means that each are responsible for the alarm condition.

Switch Status (Foldout, block 7C)



This display shows the status of the drive's switches. Each of the switches listed will display either an "OFF" or "ON" status. The switches listed are: The RET and EXT over-travel limit, the EXT, RET and STOP overrides, the EXT, RET and AUTO Handswitch.

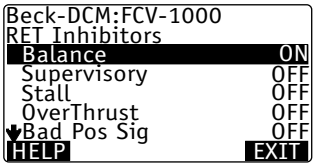
Local Control Status (Foldout, block 7D)



This block is currently non-functional and is reserved for future use.

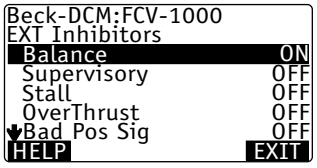
If your DCM is also equipped with a customer interface panel, this display shows the status of the DCM local functions. Each of the pushbuttons listed will display either an "OFF" or "ON" status. The pushbuttons listed are: STATUS CHECK, SET POS 100%, SET POS 0%, SET DEM 100%, and SET DEM 0%.

RET Inhibitors (Foldout, block 7E)



This display provides information about the retract (RET) motor control status. Any number of conditions can occur to inhibit the output shaft from driving in the RET direction. These conditions include: The drive is at balance, a supervisory condition, a stall protection condition, an over-thrust protection condition, a failed position signal, a failed Demand signal, a Handswitch, override, limit switch condition, or a local calibration is in process. This display lists all these possible inhibiting conditions that prevent the drive shaft from driving in the RET direction. Each of the conditions will display either an "OFF" or "ON" status. One or more conditions displaying the "ON" status means that those conditions are currently preventing the drive from driving its output shaft in the RET direction.

EXT Inhibitors (Foldout, block 7F)



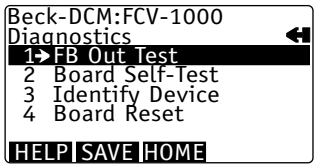
This display provides information about the extend (EXT) motor control status. Any number of conditions can occur to inhibit the output shaft from driving in the EXT direction. These conditions include: The drive is at balance, a supervisory condition, a stall protection condition, an over-thrust protection condition, a failed position signal, a failed Demand signal, a Handswitch, override, limit switch condition, or a local calibration is in process. This display lists all these possible inhibiting conditions that prevent the drive shaft from driving in the EXT direction. Each of the conditions will display either an "OFF" or "ON" status. One or more conditions displaying the "ON" status means that those conditions are currently preventing the drive from driving its output shaft in the EXT direction.

Manual Operation Menu (Foldout, block 8)

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

1. **Op mode** - This procedure allows the user to select the operating mode of the DCM. There are four possible choices: “Follow”, “Hold”, “RunRET”, “RunEXT”. 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 AUTO position. The “Hold” mode forces the DCM to maintain the drive output shaft position regardless of the input Demand signal. The user can select to hold the position just where it is, or alternately provide the drive a position to run to and hold. The “RunRET” and “RunEXT” modes of operation simply cause the drive to run to its RET and EXT extremes respectively, and hold.
2. **Reset stall** - This procedure resets normal drive operation after a stall condition has caused the drive to shut down. Selecting this option and following the prompts will restore operation. Note that stall conditions can also be reset by simply reversing the input Demand signal or cycling the drive ac power.

Diagnostics Menu (Foldout, block 9)



This menu provides access to four procedures that allow the user to test and reset the DCM. They are as follows:

1. **FB Out Test** (foldout, block 9A) - This procedure allows the user to test the position feedback output signal. Following the prompts through this procedure allows the user to verify the output signal value.
2. **Board Self-Test** (foldout, block 9B) - This procedure runs an automatic test that verifies the “health” of the DCM. It runs a checksum memory test and checks for the proper installation of the position sensor (CPS rotor). Running the test causes the drive to reposition temporarily, so it should only be run offline. The CPS test runs automatically as part of some calibration and setup procedures. Unless a DCM problem is suspected, there are few reasons to implement this test.
3. **Identify Device** (foldout, block 9C) - This procedure causes the ACKNOWLEDGE LED to flash for two seconds on drives equipped with the local Control option. It can be used to identify the drive if it is multidropped with other devices on a single Hart network.
4. **Board Reset** (foldout, block 9D) - 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; however, few reasons to manually implement the reset procedure should arise.

COMMON HART MESSAGES

HART protocol maintains both standard and device specific informational messages that are displayed on the 275 or 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 an explanation of typical HART Communicator messages and message sequences. It does not include all possible messages, only the most common.

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, Thrust, Temperature) are outside their design or calibrated ranges.

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.
"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.

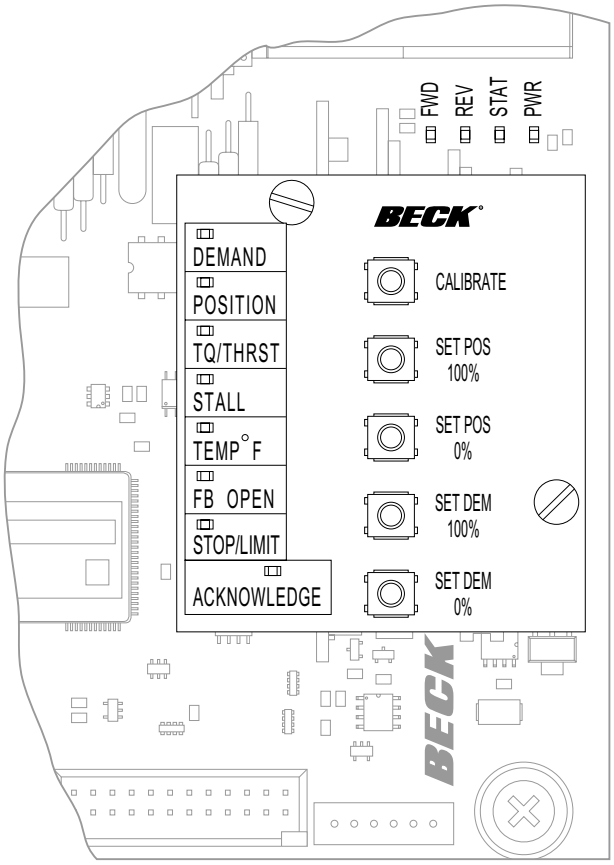
LOCAL INTERFACE *CONFIGURATION & SETUP*

NOTE: These instructions are applicable to the DCM local interface. The instructions on pages 21–38 are applicable to the DCM HART interface.

OPERATION

The local customer interface panel (pictured below) allows the user to easily calibrate the drive and troubleshoot conditions. The following information will provide an overview of the 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. Note that when the Handswitch is in the RETRACT or EXTEND position, the FWD and REV LEDs represent the drive movement corresponding to the Handswitch position.

FWD

This LED is lit when the Handswitch is in STOP or AUTO, and the drive is receiving a Demand signal greater than its position.

REV

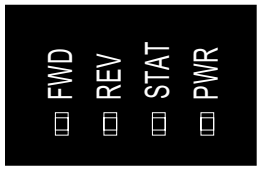
This LED is lit when the Handswitch is in STOP or AUTO, and the drive is receiving a Demand signal smaller than its position.

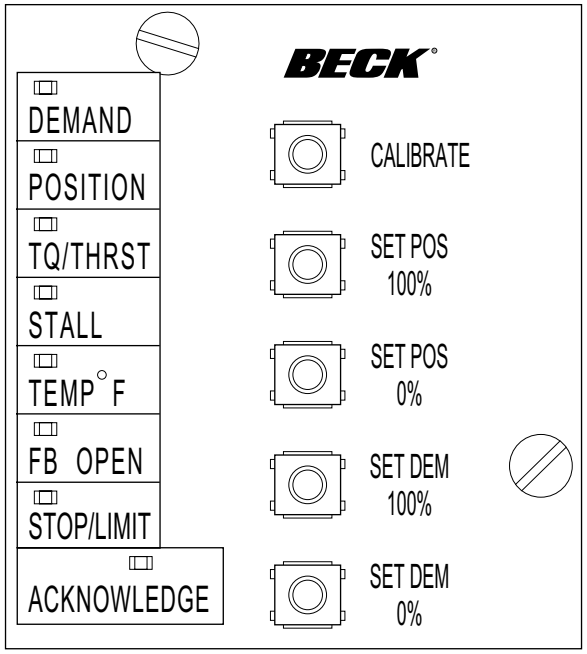
STAT

This LED is lit when additional status is available. For details regarding possible conditions, see “Status Indication LEDs” on page 40.

PWR

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





Status Indication LEDs

When the "STAT" LED is lit, the applicable status indication alarm LED(s) (pictured below) will light to reveal the condition(s) as described below. When the condition is corrected, the status will automatically reset, and the LED will turn off. Each status LED is described below, with a more detailed explanation of the function provided on page 41.

DEMAND
: Loss of the Demand input signal.

POSITION
: The Position signal to the DCM from the CPS 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.

TQ/THRST
: 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
: 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 42, for further explanation of the calibration procedures.

CALIBRATE
: This button is a safety feature and must be pressed and held while pressing the pushbuttons described below to set the Position and Demand signal limits.

CAUTION

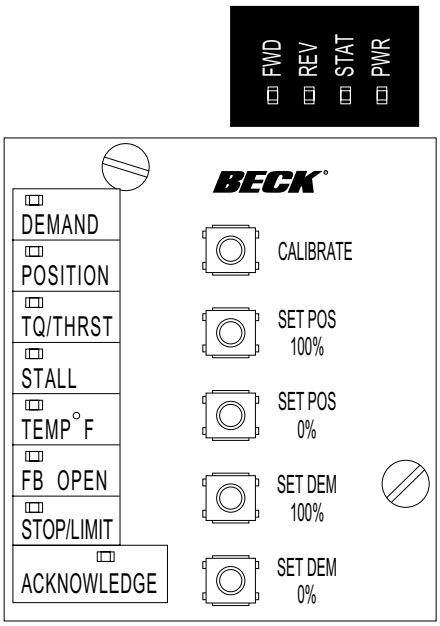
Pressing the following buttons may change calibration and cause the drive to reposition.

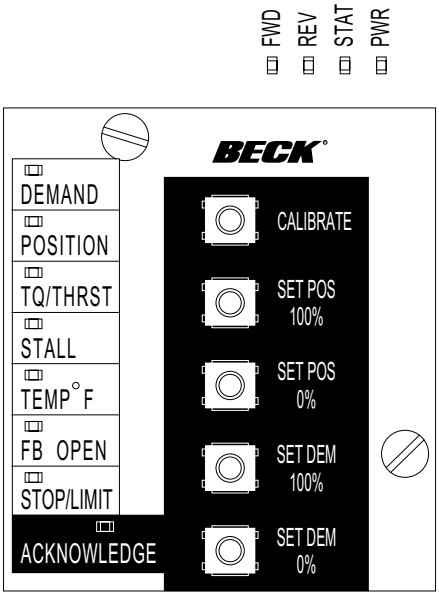
SET POS 100%
: With the drive at the desired position resulting from a 100% Demand signal, press this button.

SET POS 0%
: With the drive at the desired position resulting from a 0% Demand signal, press this button.

SET DEM 100%
: With a 100% Demand input signal applied to the drive, press this button.

SET DEM 0%
: With a 0% Demand input signal applied to the drive, press this button.





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

When the Demand input signal drops to approximately 3.2 mA (~5% of span below the minimum signal), 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 factory configured to run the drive to a predetermined position. Under the L.O.S. condition, the “STAT” and “DEMAND” LEDs will light and an alarm condition will result at terminals 9, 10 and 11 (see page 12). When the input signal is corrected, the drive will automatically resume normal operation.

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 EXT end of travel, to 3.9 V at the RET end of travel. This specific signal is not available for external connections. If the Position signal is outside the anticipated range, the “STAT” and “POSITION” LEDs will light, and an alarm condition will result at terminals 9, 10 and 11 (see page 12). When the Position signal is corrected, the drive will automatically resume normal operation.

THRUST PROTECTION

DCMs are equipped with a thrust sensing module that will light the “STAT” and “TQ/THRST” LEDs in the event excessive thrust is detected, and an alarm condition will result at terminals 9, 10 and 11 (see page 12). This alarm is normally set to activate when thrust exceeds 105% of the drive rating. Thrust above 150% of the drive rating will cause the DCM to prevent the drive from operating in the direction of the high thrust. When the over-thrust condition is corrected, the drive will automatically resume normal operation.

STALL PROTECTION AND ANNUNCIATION

If the drive output shaft cannot reach a desired position within the configured time, the DCM shuts off power to the motor and the “STAT” and “STALL” LEDs will light, and an alarm condition will result at terminals 9, 10 and 11 (see page 12). The stall condition timing is factory configurable from 300 seconds to as low as 30 seconds and is set according to the specification at time of order (factory default setting is 300 seconds).

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) or switching the drive power off and on. When the stall condition is cleared, the drive will automatically resume normal operation.

TEMPERATURE

DCMs are equipped with a temperature sensing circuit. The “STAT” and “TEMP °F” LEDs will light when the drive’s ambient temperature exceeds the rating of the drive (185ºF. / 85°C.), and an alarm condition will result at terminals 9, 10 and 11 (see page 12).

FEEDBACK SIGNAL

A feedback sourcing module in the DCM provides a 4–20 mA analog output signal that represents the drive output shaft position in terms of 0–100% of full rotational travel. This signal can be remotely monitored or used by a controller or indicator. The “STATUS” and “FB OPEN” LEDs will light if the function is enabled and there is no current in the loop, and an alarm condition will result at terminals 9, 10 and 11 (see page 12). The Feedback signal can be disabled at the factory or in the field using the DCM HART or serial interface.

STOP/LIMIT INDICATION

The "STAT" and "STOP/LIMIT" LEDs will light if the drive is at a limit and is not in balance.

LOCAL INTERFACE *CALIBRATION (DEMAND)*

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 43). 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 pushbutton controls and a signal source. Following this procedure is only necessary if the factory settings are inappropriate.

Calibration Procedure

1. Remove the cover (see outline dimensions beginning on page 8).
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).
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 cover and tighten the cover bolts to 14 lb-ft (19 N•m) torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too closely 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 40 for location of pushbutton controls).

1. Remove the cover (see outline dimensions beginning on page 8).
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).
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 cover. Tighten the cover bolts to 14 lb-ft (19 N•m) torque.

* If the "ACKNOWLEDGE" LED does not light, but the "DEMAND" LED does light, the signal is out of acceptable range and was not accepted by the DCM. This is typically caused by trying to set 0% and 100% values too closely 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 input signal (see table below). This function is factory configurable, or can be configured in the field using the HART or serial interface.

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

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.

SHORT-STROKE OPERATION (Reducing Full Travel)

Typically, it is best to use the full travel of the drive in response to the 0–100% Demand input signal. However, in certain applications it may become necessary to reduce this response to less than full travel. In these applications, the DCM can be calibrated to accommodate reduced stroke. The minimum full stroke travel is 45% (although travel this short is not recommended—it is ideal to make the range as close to 100% as possible for the highest position resolution attainable with the CPS).

Reducing the full travel is referred to as "short-stroking" the drive. This can be accomplished by using the DCM customer interface panel.

Calibration Procedure

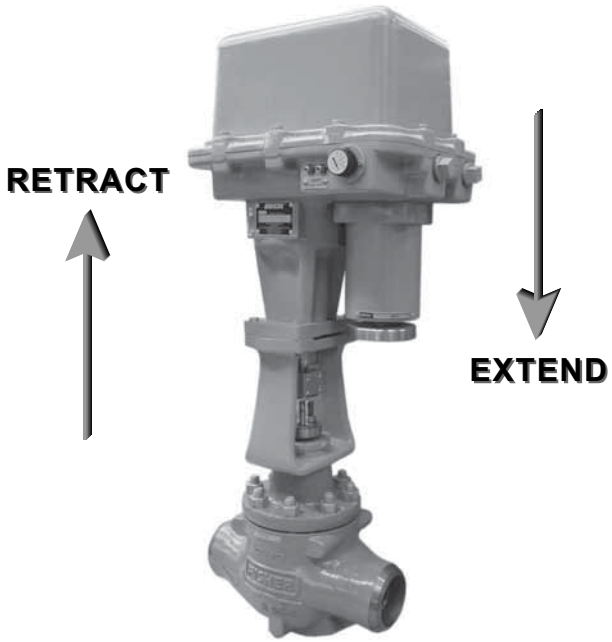
1. Remove the cover (see outline dimensions beginning on page 8).
2. Position the drive at the desired minimum position (i.e., the desired physical position of the drive's output shaft corresponding to the 0% Demand input signal).
3. Ensure the Handswitch is in the "STOP" position. This will prevent 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. Verify that the drive's 0% and 100% positions are correct. If not, repeat this procedure.
9. Replace the cover and tighten the cover bolts to 14 lb-ft (19 N•m) torque.

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

LOCAL INTERFACE *CALIBRATION (DIRECTION CHANGE)*

DIRECTION OF OUTPUT SHAFT TRAVEL (RET vs. EXT)

The direction of output shaft travel is determined by observing the output shaft (see illustration below). 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 retract in response to an increasing signal.



Direction of travel in response to an increasing Demand signal

Changing the direction of output shaft travel is easily accomplished using the DCM customer interface panel (see page 40 for location of pushbutton controls). Follow the steps below.

1. Remove the cover (see outline dimensions beginning on page 8).
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—

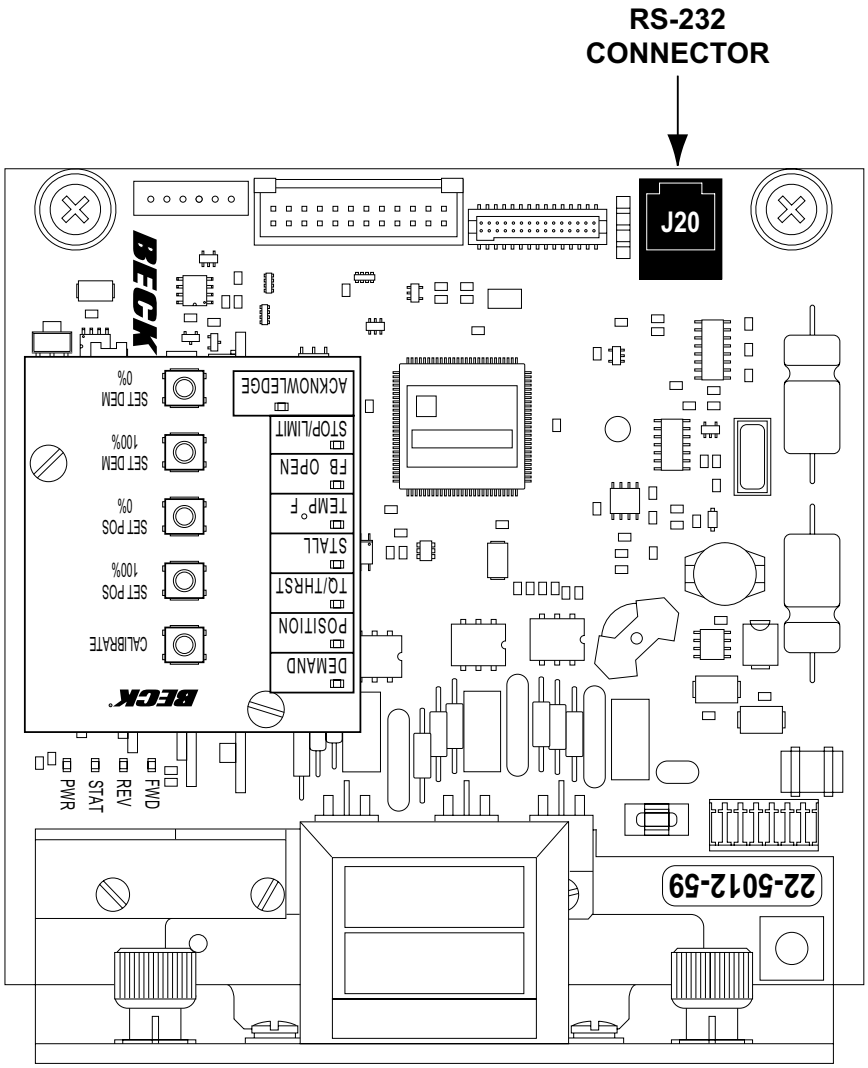
2. Position the drive at the present 100% position.
3. Press and hold the “CALIBRATE” pushbutton on the DCM customer interface panel, then press the “SET POS 0%” pushbutton until the “ACKNOWLEDGE” LED is lit.*
4. Ensure the drive operates as desired.
5. Replace the cover and tighten the cover bolts to 14 lb-ft (19 N•m) torque.

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

COMMUNICATIONS

The Beck Digital Control Module (DCM) is equipped with a serial interface which allows for direct communication with a computer. Using a communication cord, 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 cord 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.



Location of RS-232 Connector on the DCM Board

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 plugged into 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, which include 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 "deadband" 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 "dem0pctma" and "posisp" commands.
4. Execute action commands. These commands serve to reset, enable or disable features. Entering these commands produces an immediate action. Examples include the "restoremodes" and "thrustenable" command.

The available commands are listed on page 49 and each is described in more detail on pages 50 through 53. 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 INTERFACE *COMMANDS*

LIST OF SERIAL COMMANDS

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 movement resulting from an increasing Demand signal.	*n* = "0" (indicates retract); or *n* = "1" (indicates extend).
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.
drvtiming *n*	Sets and/or displays the timing of the drive.	*n* = seconds per 100% of travel. The minimum value is "20" and the maximum value is "300".
drvmodel *n*	Sets and/or displays the model number of the drive in which the DCM is installed.	*n* = "15" (model 29-109)

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.

Note: For specific information on the following functions, see the appropriate sections of the manual.

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.
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 18 & 19.
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 18 & 19.
demfunc *n*	Sets and/or displays the Demand signal input characterization function. The DCM provides linear, square, or 20-segment custom characterization.	*n* = "0" (indicates linear); or. *n* = "4" (indicates special curve or custom characterization; or n = "5" (indicates 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 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 next page) must also be set.	*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" or "gtp". Note: *n* values must be set separately.

Demand Signal Commands (con't)

Command	Description	Argument *n* and Information
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
travelspan *n*	Sets and/or displays the 100% travel distance.	*n* = the desired travel of the drive in inches. The minimum value is 0.50 ("0.50") and the maximum value is 2 ("2.00").
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 feedback 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").
iomode *n*	Sets and/or displays whether or not the drive Feedback signal is enabled.	*n* = "0" (no feedback) or "1" (feedback).
posisd *n*	Sets the 0% 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. If the drive is set up for 100% of travel and is at the 0% travel position, 0% ("0") should be entered.
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 feedback 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 20 & 21. 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 feedback 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 20 & 21. The minimum value is 19 mA ("19.000") and the maximum value is 21 mA ("21.000").

Note: For specific information on the following functions, see the appropriate sections of the manual.

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.
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 mA.	No argument.
stat	Displays information on the status of the drive, including: Position (%) Demand (%) Step size (%) Motor starts, reversals and stalls Total run time (seconds) Number of over-thrusts Maximum torque (%) Alarm codes (none or alarm code) Position LOS, Demand LOS and Stalled motor condition (if currently applicable) Operational mode Current drive travel direction or stop Line power cycles (Hz) Internal DCM voltage Motor drive frequency Limit switch status, if contacted Handswitch status	No argument.
tempf	Displays measured temperatures in the drive (°F.): Low extreme Present temperature High extreme	No argument.
torq	Displays the drive's present thrust measurement as a percentage of rated thrust.	No argument.

Explanation of Error Codes

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 memory error has occurred.
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.

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 fasteners for tightness.

Lubrication

Periodic lubrication is not required on Beck control drives. However, it is recommended that during major shutdowns or outages, the drives in the most severe applications be inspected.

CAUTION

Disconnect electrical power. Before removing the motor, block the valve stem to prevent the gear train from moving when the motor is removed.

To inspect the gears, remove the motor assembly (5/16" bolt heads). Carefully pull the motor away from the drive body (it will be necessary to remove the top cover and cut the wire tie which holds the motor wires in place). Remove all old lubrication from the accessible gearing. Examine the gear teeth and shafts for indication of excessive wear, scoring or other damage. If evidence of damage is present, the drive should be returned to the factory for a detailed examination of all gearing, which requires complete disassembly of the drive (see "HOW TO OBTAIN SERVICE" on the inside back cover).

If there is no evidence of damage to the gearing, recoat the teeth and shaft bores of all gears with a heavy layer of Mobiltemp SHC 32 or equivalent.

Carefully replace the motor. Tighten the motor bolts to 11 lb-ft (15 N•m) torque. Rebundle the motor wires with a wire tie. Replace the top cover and tighten cover bolts to 14 lb-ft (19 N•m) torque.

COMPONENT REPLACEMENT

The following table lists the components of the Group 29 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

Customer replacement kits 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 inside back cover).

CUSTOMER REPLACEMENT KITS

Customer Kit	Part No.
3.0 N•m Motor Resistor/Capacitor (60 Hz)	12-8063-11
3.0 N•m Motor Resistor/Capacitor (50 Hz)	12-8063-12
6.0 N•m Motor Resistor/Capacitor (60 Hz)	12-8063-13
6.0 N•m Motor Resistor/Capacitor (50 Hz)	12-8063-14
7.0 N•m Motor Resistor/Capacitor (60 Hz)	12-8063-15
7.0 N•m Motor Resistor/Capacitor (50 Hz)	12-8063-16
14.0 N•m Motor Resistor/Capacitor (60 Hz)	12-8063-17
14.0 N•m Motor Resistor/Capacitor (50 Hz)	12-8063-18
3.0 N•m Motor w/ SLM (Motor 20-2703-41)	12-8063-01
6.0 N•m Motor w/ SLM (Motor 20-2703-42)	12-8063-21
7.0 N•m Motor w/ SLM (Motor 20-2201-41)	12-8063-41
14.0 N•m Motor w/ SLM (Motor 20-2201-45)	12-8063-51
3.0 N•m SLM	12-8063-03
6.0 Nm SLM	12-8063-23
7.0/14.0 N•m SLM	12-8063-43
Handswitch (Option 3) (Handswitch 20-3310-15)	12-8063-19
Handswitch (Option 9) (Handswitch 20-3310-16)	12-8063-20
Digital Control Module (DCM)	12-8063-02
Limit Switch	12-8063-55
Control End (Option 3) (23-2500-02)	12-8063-05
Control End (Option 9) (23-2501-01)	12-8063-25
Switch Assembly, CPS-4 (20-3200-21)	12-8063-06
Coupling, Control End	12-8061-08
PC Board, CPS-4	12-8061-07

NOTES

SERVICES

PRODUCT DEMONSTRATIONS

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

SITE SURVEYS

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

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

APPLICATION REVIEWS

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

SPECIFICATION WRITING

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

HOW TO OBTAIN SERVICE

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

THREE YEAR LIMITED WARRANTY STATEMENT

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

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

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

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

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

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

Serving the Process Industries since 1936 ...

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