WESTLOCK
CONTROLS CORPORATION

ICOT 6300 HART
SMART VALVE POSITIONER
OPERATING MANUAL

IOM: Tech-473		**Revision: B**	
Prepared By: M. Twardowski	**Date:** 4/5/13	**Drafting Work Order:** 20855	**ECN:** 12488
Reviewed By: M. Twardowski	**Date:** 3/4/14	**Approved By:** R. Frey	**Date:** 3/5/14

WESTLOCK CONTROLS CORPORATION
280N MIDLAND AVENUE, STE.258, SADDLE BROOK, NJ 07663 TEL: 201-794-7650 FAX: 201-794-0913

www.westlockcontrols.com

Revision History

Revision		
April, 2013	11/11/13	2/26/14
Initial release	Rev. A	Rev. B

Westlock Controls Offices

USA
Westlock Controls Corp.
280 North Midland Ave. Ste. 258, Saddle Brook, NJ 07663
Phone: (201) 794-7650 •Fax: (201) 794-0913
Email: westlockinfo@westlockcontrols.com
Internet http://www.westlockcontrols.com

Europe
Westlock Controls UK
22 Chapman Way, Tunbridge Wells
Kent, England TN23EF
Phone: 011-44-189-251-9046 •Fax: 011-441-892-516279
Email: sales@westlockuk.com
Internet: http://www.westlockuk.com

South America
Westlock Equipamentos de Controle Ltda.

Sales:
Al. Araguaia, 2044 - Sl. 1101, Bloco B
Edificio CEA - Alphaville
Barueri - Sao Paulo - Brazil
06455-000
Tel: + 55 11 2588-1400
Fax: + 55 11 2588-1410
Email: salescomercial@westlock.com.br
Internet: http://www.westlock.com.br

Operations:
Av. Antonio Bardella, 3000
Galpoes 2A e 2B - Alto da Boa Vista
Sorocaba - Sao Paulo - Brazil
18085-852
Tel: + 55 15 2102-7400
Fax: + 55 15 2102-7400

Table of Contents

1. Introduction

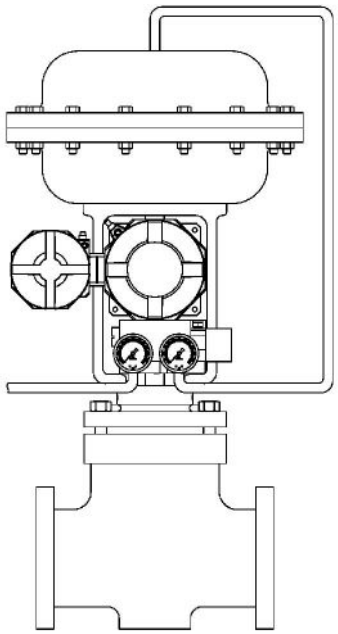
1.1 *Product Certification.*

IEC Ex		
US/FMG/ExTR100.0017/01 II 2 G Ex d IIB T5 Gb -50°C≤Tamb≤+85°C II 2 D Ex tb IIIC Db T85°C; IP66	FM13ATEX0081X II 2 G Ex d IIB T5 Gb -50°C≤Tamb≤+85°C II 2 D Ex tb IIIC Db T85°C; IP66	XP/I/1/C,D/T5 Ta= - 50°C to + 85°C DIP/II/III/E,F,G; TYPE 4X, IP66 AEx d IIB T5 (-50°C≤Tamb≤+85°C) I/1 Ex d IIB T5 (-50°C≤Tamb≤+85°C) ZONE 21 AEx d IIIC T85°C; IP66 TYPE 4X

1.2 *Warnings*

- Never remove enclosure cover or make/break electrical connections with power connected to the unit.
- Perform all wiring in accordance with site and local codes and the National Electric Code ANSI-NFPA-70 (US) or the Canadian Electric Code Part I (Canada) for the appropriate area classifications.
- Confirm that the ICOT model being installed is approved for the hazardous area (consult unit identification label).
- Ensure that approved and properly sized IS barriers are used in installations with IS approved ICOTS (confirm entity parameters from product ID label).
- Confirm that power supplied to unit is within rated specifications listed on the unit identification label.
- Protect the unit from exposure to aggressive substances or atmospheres to ensure that hazard rating is not compromised.
- Disconnect power to and the inlet air supply before conducting any service or maintenance. Avoid the introduction of any contaminants into the manifold/valve assembly.

1.3 *Description of ICoT Positioner*



The ICoT Smart Valve Positioner is an electro-pneumatic servo system that continuously controls the position of a valve based on a 4 to 20 mA input signal. The ICoT is an instrument that derives its power directly from a control systems current loop. The instrument senses valve position via a non-contact Hall Effect sensor and controls valve position through a current to pressure transducer.

The ICoT 6000 is available with HART® communication.. HART® allows calibration and access to on-line diagnostic information via Rosemount 375/475 hand-held terminal or through software.

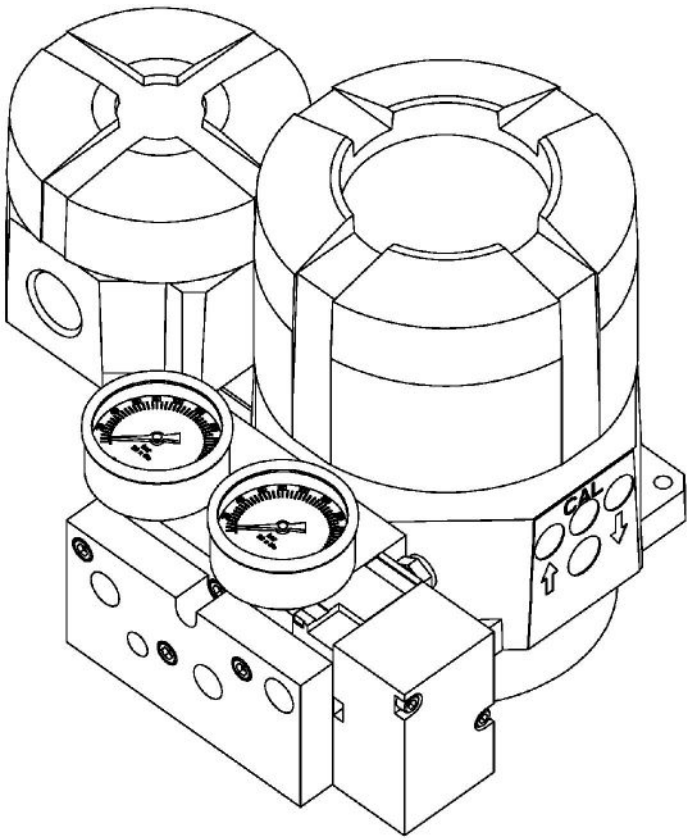
The positioner has a local liquid crystal display which indicates valve position and set-point in percentage of full span. It also displays error messages and indicates whether the positioner is in calibration mode.

In the event of a failure condition the ICot will display an error message on the LCD screen and reset the valve to a fail-safe position.

1.4 *Principle of Operation*

Unlike conventional positioners, the ICoT Smart Positioner feeds back valve position without the need for linkages, levers, or rotary and linear seals. Position sensing is performed totally by non-contacting means, permitting use of advanced control strategies where knowledge of valve position is used in predictive and other algorithms. By the integration of multiple components into a singular, cost efficient unit, microprocessor-based intelligence can now be used to implement advanced functions such as early warning diagnostics.

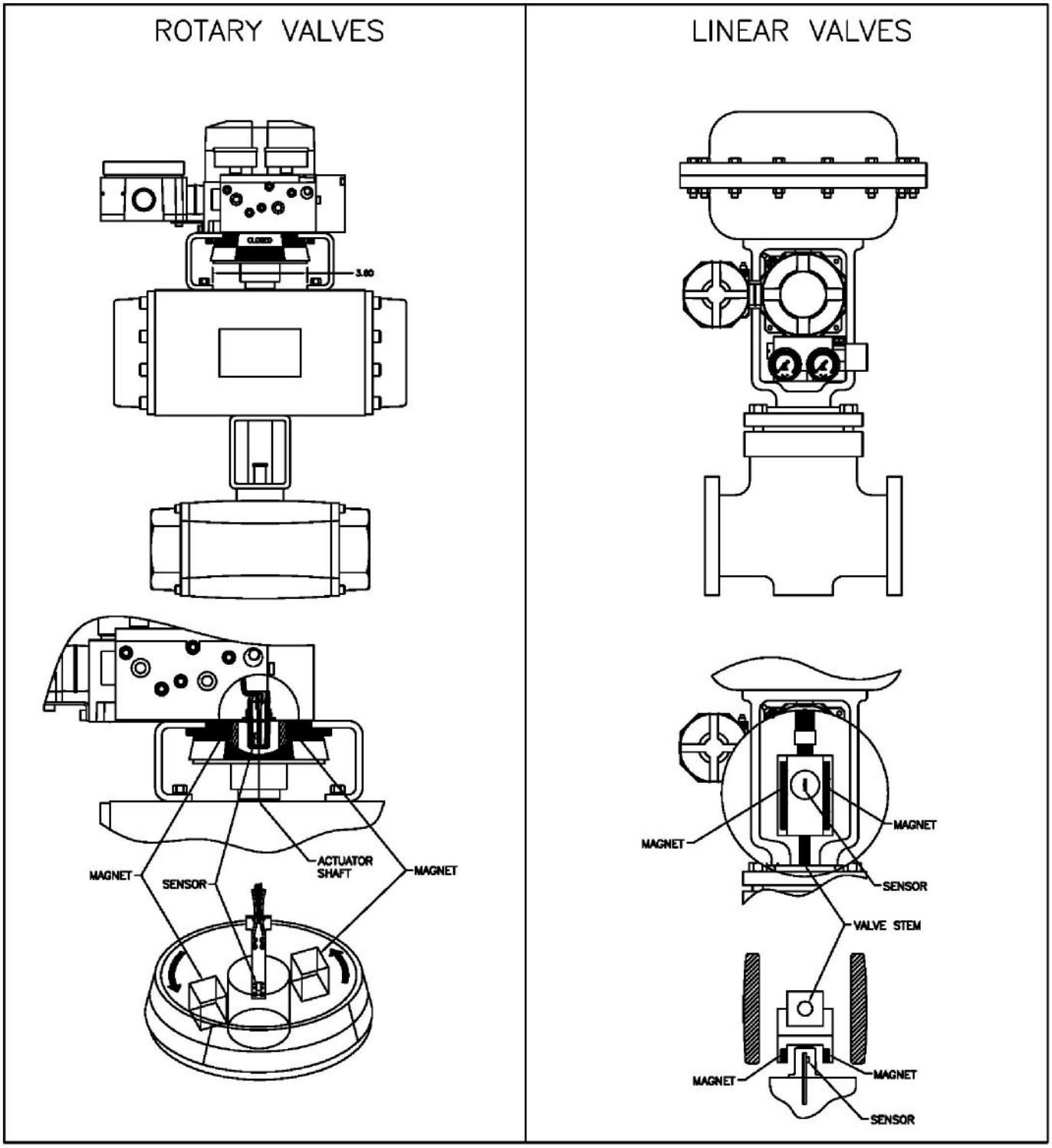
The ICoT positioner provides intelligence for the control valve through a microprocessor-based diagnostic system utilizing HART® communication. Accurate measurement of valve stem position, input signal, actuator pressure and travel time can be recorded during normal operation, thereby providing information for control valve signature generation.



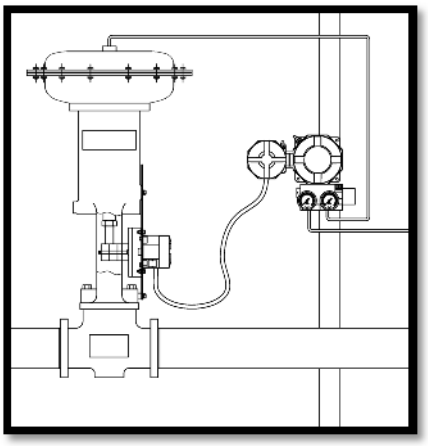
1.5 *Special Features*

Non-Contact Position Feedback

To provide consistently accurate performance information, all linkages, levers and connecting rods, from the positioner to the control valve have been eliminated from the design. Valve position sensing is performed totally by non-contact means based upon characterization of magnetic flux strength as a function of position.



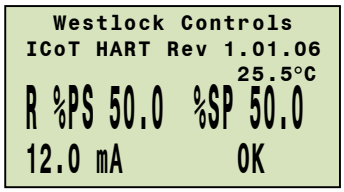
Remote Position Control



Since valve position feedback to the ICoT positioner is accomplished by non-contacting means, the ICoT has the unique ability to be mounted remotely. Only magnet and position sensor are mounted on the valve and are wired to the ICoT housing (up to a distance of 50 feet, optionally 150 feet) from the device it is controlling. The remote position sensor also has the ability to work over a wider temperature range, from -40°C to 125°C (-40°F to 257°F). In the event the control valve is located in a high vibration, high temperature or extremely corrosive environment, the non-contact position feedback feature allows for isolated placement of the positioner.

Local Graphic LCD

The ICoT positioner is supplied with a digital communication interface (HART®) or a 3-button keypad interface. Both versions are furnished with a graphic LCD, and allow for automated calibration of the positioner. The local LCD provides a multitude of onsite diagnostic information. The LCD shows input current, set-point and current position. The values displayed range from 0.0% to 100.0%. Displayed resolution is in 0.1% increments, however, internal calculations are maintained at higher precision.



On-Board Sensors

The ICoT positioner has the capability to monitor its operation. If an error or failure condition occurs, it will be displayed on the local LCD, or if the positioner is supplied with a HART® interface, the error codes will be displayed on a hand held terminal or a PC maintenance station. Note: Error codes are denoted on a label affixed to the LCD flip-up protective cover.

Local Keypad

The positioner is provided with a wear resistant 3-button keypad. The keypad can be used for zero and span adjustments, as well as valve characterization and gain adjustments.

Non-Intrusive Calibration

The positioner is equipped with three magnetic sensors that can be activated externally allowing the user to control ICoT 6000 without removing the cover. See Appendix F for instructions on how to use non-intrusive feature.

Intelligent Calibration (HART® Protocol)

The ICoT positioner responds to HART® commands for calibration and configuration. Calibration begins by seeking the “valve closed” position and assigns an instrument signal of 4 mA to this position. The counterpart of the operation for a full open state is implemented next by setting the span value. Action reversal is also configured. Additionally, provisions are made for altering internal servo loop tuning via the HART® link. In this manner, positioner performance may be optimized with a wide combination of valves and actuators.

Negligible Bleed

Designed to consume the least possible amount of control air at steady state, the ICoT 6000 Series positioner can greatly reduce the air consumption of your process and reduce the demand on instrument air compressors. To increase reliability, the ICoT employs a patented

lapped spool and floating sleeve design. This balanced construction relies on an air bearing which eliminates any metal to metal contact.

2 Ordering

The ICoT 6000 positioner is designed to handle a wide range of control valve applications. Please use the following ordering guide to help choose the positioner that best suits the application.

2.1 *ICoT 6000 Positioner Ordering Guide*

INTELLIGENT POSITIONERS/MA/ 4-20 MA HART

INTELLIGENT POSITIONERS / HART / FOUNDATION Fieldbus
ICOT 6300, 6400 & 6500 (Explosion Proof and Intrinsically Safe) Positioners

Base Model

63	Intelligent positioner with HART Capability
64	FOUNDATION Fieldbus positioner
65	Profibus PA positioner

Actuator Type

1	Linear	(Free magnet assy. included up to 2-1/2" stroke length; stroke lengths over 2-1/2" please consult with your Sales Representative)
3	Rotary	**NOTE: Linear valve stroke length and fail position must be specified at time of quotation.**

Mounting Style

0	Direct Mount (ICOT mounted on actuator)
5	Remote Mount, Aluminum Housing (ICOT mounted remote from actuator)
6	Remote Mount, Stainless Steel 316 housing (ICOT mounted remote from actuator)

Hazardous Rating

XP	Explosion Proof - Class I, Div, 1, Class 1, Zone 1 - AExd/Exd North America
AX	Flame Proof - ATEX EX D IIB+H2 T5 approved
IX	Flame Proof - IECEx EX D IIB+H2 T5 approved
MP	Explosion Proof - INMETRO Ex d IIC T6 Gb
MI	Intrinsically Safe INMETRO Ex ia IIC T4 Gb
MN	Non-sparking INMETRO Ex nA II T4

Housing Material

A	Aluminum "copper free"
S	Stainless Steel 316

Supply Pressure

H	STD flow High Pressure (40 - 120 psi)
L	STD flow Low Pressure (15 - 45 psi)
V	High Flow (40 - 120 psi, for larger actuators)

Calibration/Communication (External Calibration Standard)

B	3-Button on-board keypad & Hart Protocol **(Series 63 only)**
F	3-Button on-board keypad & FOUNDATION Fieldbus and Profibus PA **(Series 64/65)**

Conduit Entry

A	1/2" NPT (F)
B	M20 (F)

Limit Switch Options

0	None

Position Transmitter Output

A	None
B	4-20mA Transmitter (Series 63 only)
C	Discrete Output (Alarm/PST/SOB Series 64/65 only)

Pneumatic Connections

N	1/4" NPT (3/8" NPT with high flow option)
B	1/4" BSP (3/8" BSP with high flow option)
F	1/4" NPT w/ Filter-Regulator Assembly (3/8" NPT with High Flow option)

Pressure gages

N	No gages installed
M	Gages installed

63	3	0	XP	A	H	B	A	0	B	F	M = Model number: 6330XPAHBA0BFM

* Linear valve stroke and fail position must be specified at time of quotation.
** Not available with “Linear” Actuators type or “Remote Mounting Style”

Note: When ordering a linear ICoT 6000 positioner, (option “1” for the third digit in the part number) be prepared to supply the exact stroke length and fail direction of the application.

3 Initial Setup

3.1 *Mounting Positioner on a Rotary Actuator*

Step 1. Mount bracket and inner beacon coupler to actuator. If actuator shaft has a tapped hole, fasten using proper flat head screw. If actuator does not have a tapped hole, fasten using set screws on side of coupler. (See Figure 3-1)

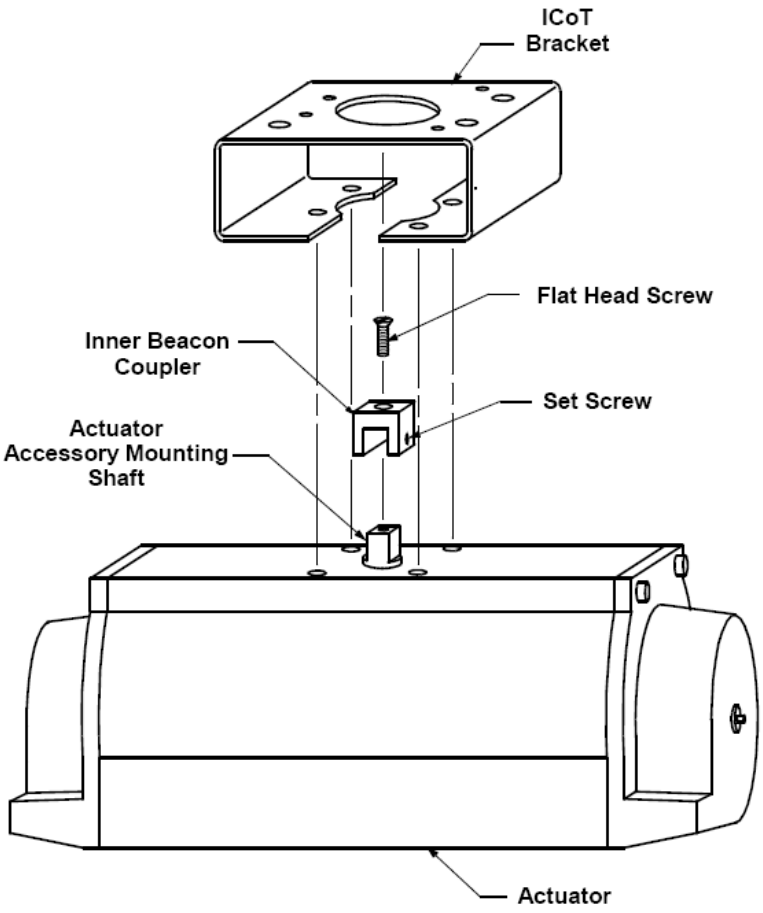


Figure 3-1

Step 2. Press fit the inner beacon to the inner beacon coupler. The inner beacon needs to be properly oriented. Use the symbols on the top of the inner beacon to mount as shown in Condition 1 or Condition 2. (see figure 3-2). Condition 1 and Condition 2 show the placement of the inner beacon with respect to the positioner housing while the actuator is in the fail position.

Step 3. Mount the positioner to the bracket. As stated in Step 2 make sure that the positioner is mounted in a fashion that properly orients it with respect to the inner beacon.

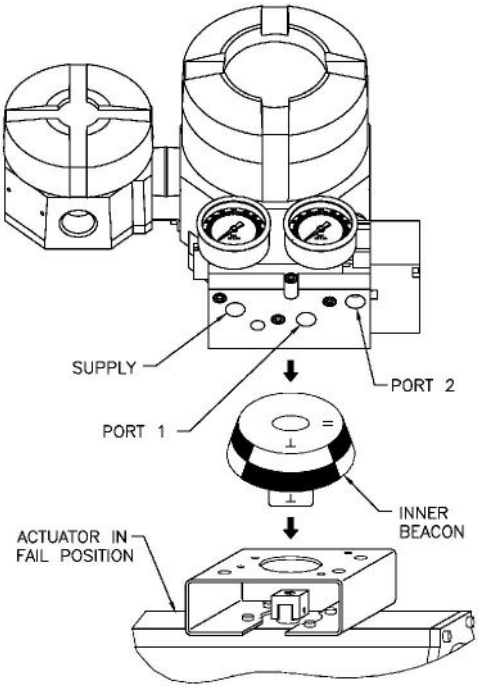
Condition 1: Actuator fails in a clockwise direction.

Spring Return
Output Port 2 is plugged
Output Port 1 is piped to turn the actuator counter clockwise

Double Acting
Output Port 2 is piped to turn the actuator clockwise
Output Port 1 is piped to turn the actuator counter clockwise

⊥ **Placed at 6:00**

∥ **Placed at 3:00**



Condition 2: Actuator fails in a counter clockwise direction.

Spring Return
Output Port 2 is plugged
Output Port 1 is piped to turn the actuator clockwise

Double Acting
Output Port 2 is piped to turn the actuator counter clockwise
Output Port 1 is piped to turn the actuator clockwise

⊥ **Placed at 9:00**

∥ **Placed at 6:00**

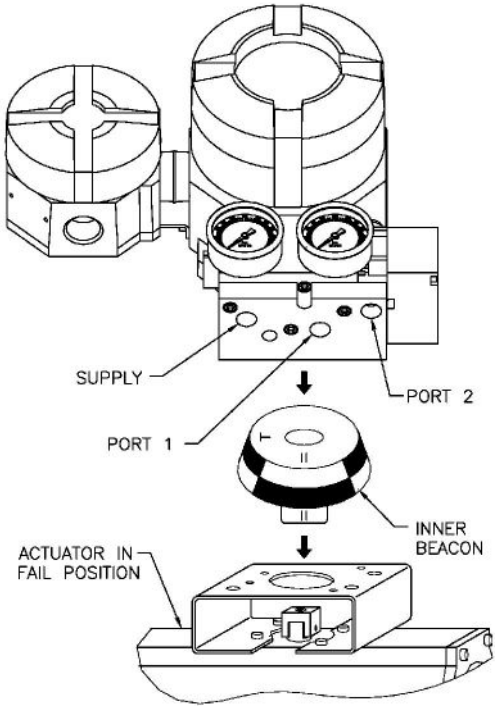


Figure 3-2

3.2 *Mounting Remote Positioner on a Rotary Actuator*

Step 1. Mount bracket and inner beacon coupler to actuator as described in Section 3.1 Step 1.

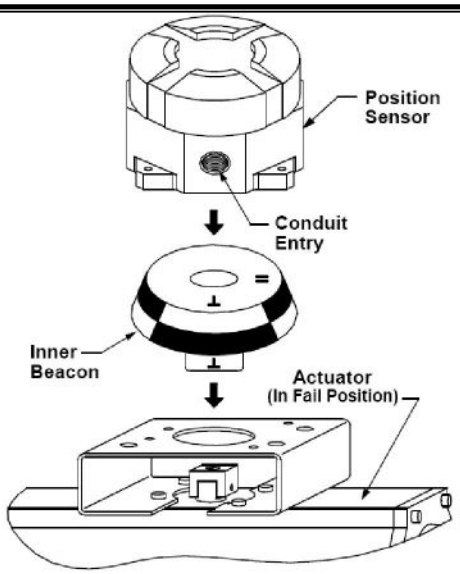
Step 2. Press fit the inner beacon to the inner beacon coupler. The inner beacon needs to be properly oriented. Use the symbols on the top of the inner beacon to mount as shown in Condition 1 or Condition 2. (See Figure 3-3). Condition 1 and Condition 2 show the placement of the inner beacon with respect to the position sensor housing while the actuator is in the fail position.

Step 3. Mount the position sensor to the bracket. As stated in Step 2 make sure that the position sensor is mounted in a fashion that properly orients it with respect to the inner beacon.

Condition 1: Actuator fails in a clockwise direction.

Spring Return
Output Port 2 is plugged
Output Port 1 is piped to turn the actuator counter clockwise
Double Acting
Output Port 2 is piped to turn the actuator clockwise
Output Port 1 is piped to turn the actuator counter clockwise

Placed at 6:00
Placed at 3:00



Condition 2: Actuator fails in a counter clockwise direction.

Spring Return
Output Port 2 is plugged
Output Port 1 is piped to turn the actuator clockwise
Double Acting
Output Port 2 is piped to turn the actuator counter clockwise
Output Port 1 is piped to turn the actuator clockwise

Placed at 9:00
Placed at 6:00

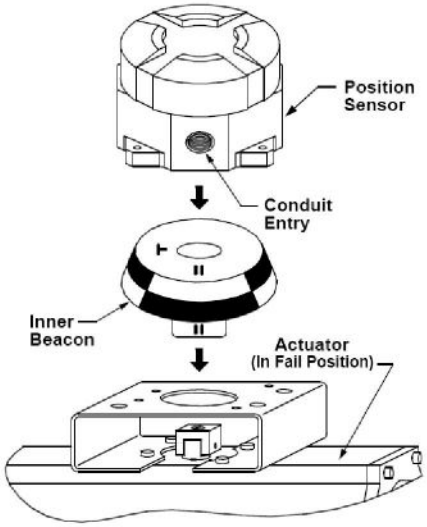


Figure 3-3

Step 4. Mount positioner at a remote location.

For wiring instructions on remote positioner see section 3.7

3.3 *Mounting Positioner on a Linear Actuator*

Step 1. Mount the magnet assembly to the stem of the actuator. A coupler block normally is needed to extend the magnet assembly outside the yoke area and into the sensing range of the magnetic pick-up unit.

Step 2. Fasten the mounting bracket to the actuator.

Step 3. Mount the positioner to the mounting bracket. The positioner should be mounted so the magnetic pick-up unit of the positioner is centered between the limits of the magnetic assembly's stroke. After mounting the positioner, the magnet assembly should be within 1/8" from the back of the positioner (1/16" is ideal), (See Figure 3-4)

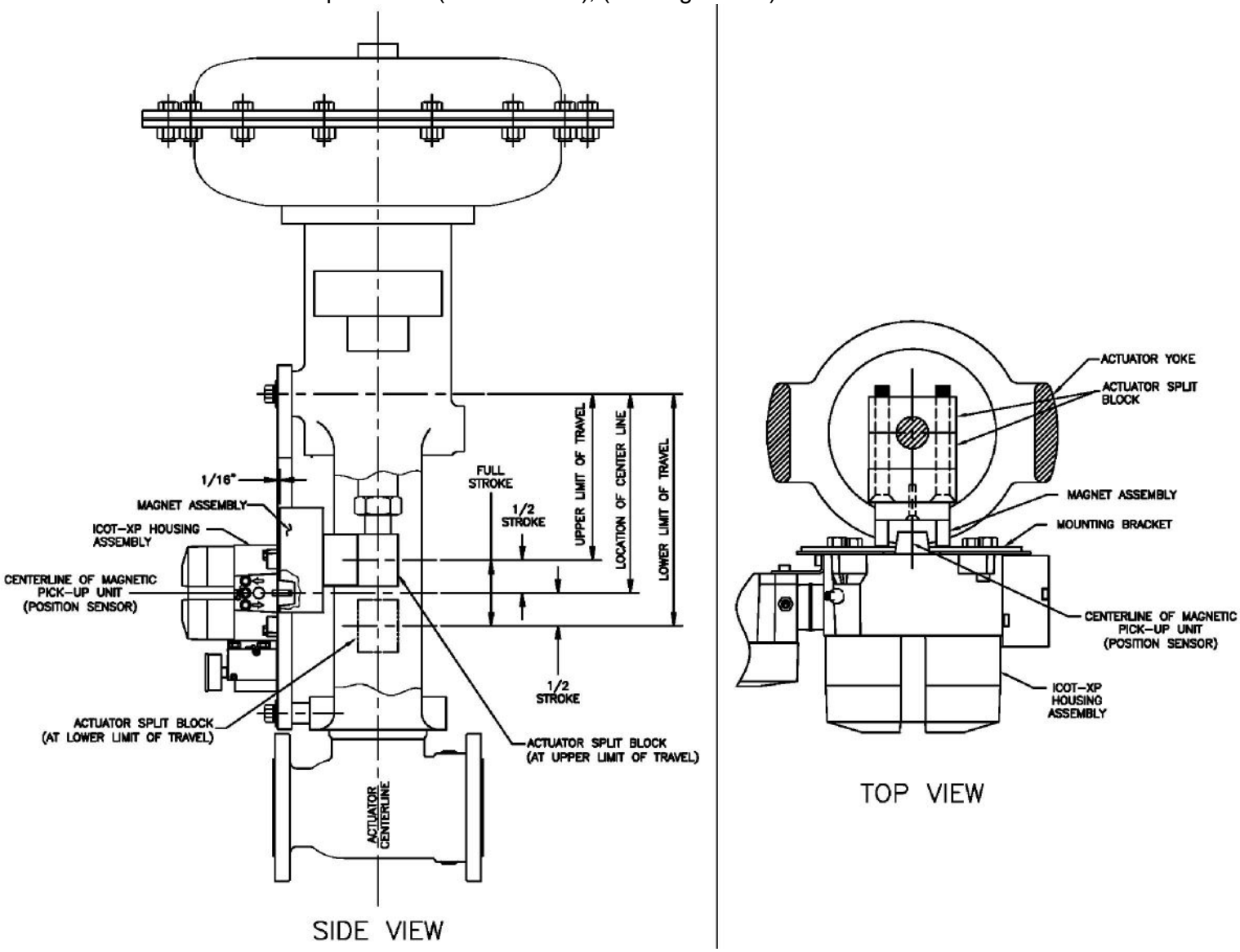


Figure 3-4

Note: For Fisher actuators model 657 & 667 sizes 34 thru 70, Westlock Controls can supply a slotted mounting kit design. This will allow the user to easily center the positioner sensor between the limits of the magnet assembly's stroke. Other mounting kits are available upon request.

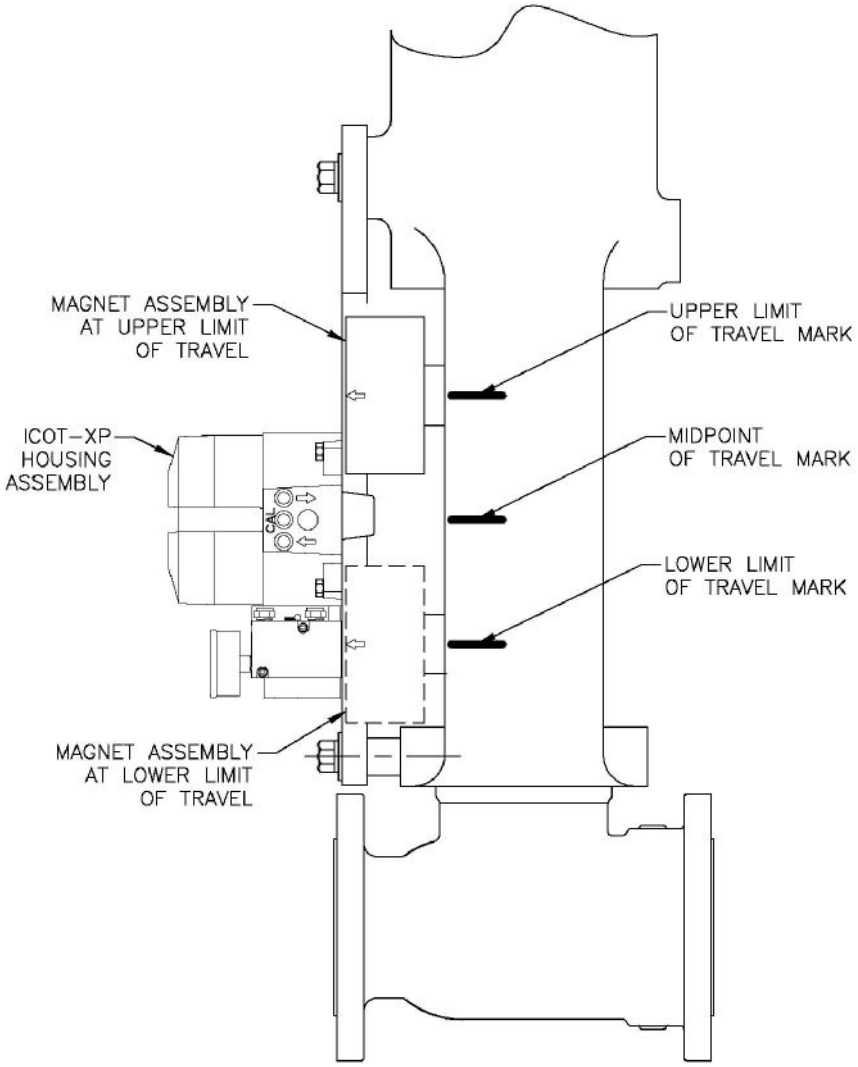


Figure 3-5

To Center the Positioner

1. Stroke the actuator to its upper limit and place a mark on the actuator's yoke that lines up with the red arrow on the magnet assembly.

2. Stroke the actuator to its lower limit and place a mark on the actuator's yoke that lines up with the red arrow on the magnet assembly.

3. Place a third mark on the yoke centered between the upper and lower limit marks.

4. Lastly, mount the positioner to the bracket so that the positioner sensor (nose) of the ICoT lines up with the midpoint mark. (See Figure 3-5).

3.4 *Mounting Remote Positioner on a Linear Actuator*

Step 1. Mount the magnet assembly and bracket to the actuator as described in Section 3.3 Step 1.

Step 2. Mount the position sensor housing so that the conduit entry faces away from the diaphragm or cylinder. (See Figure 3-6)

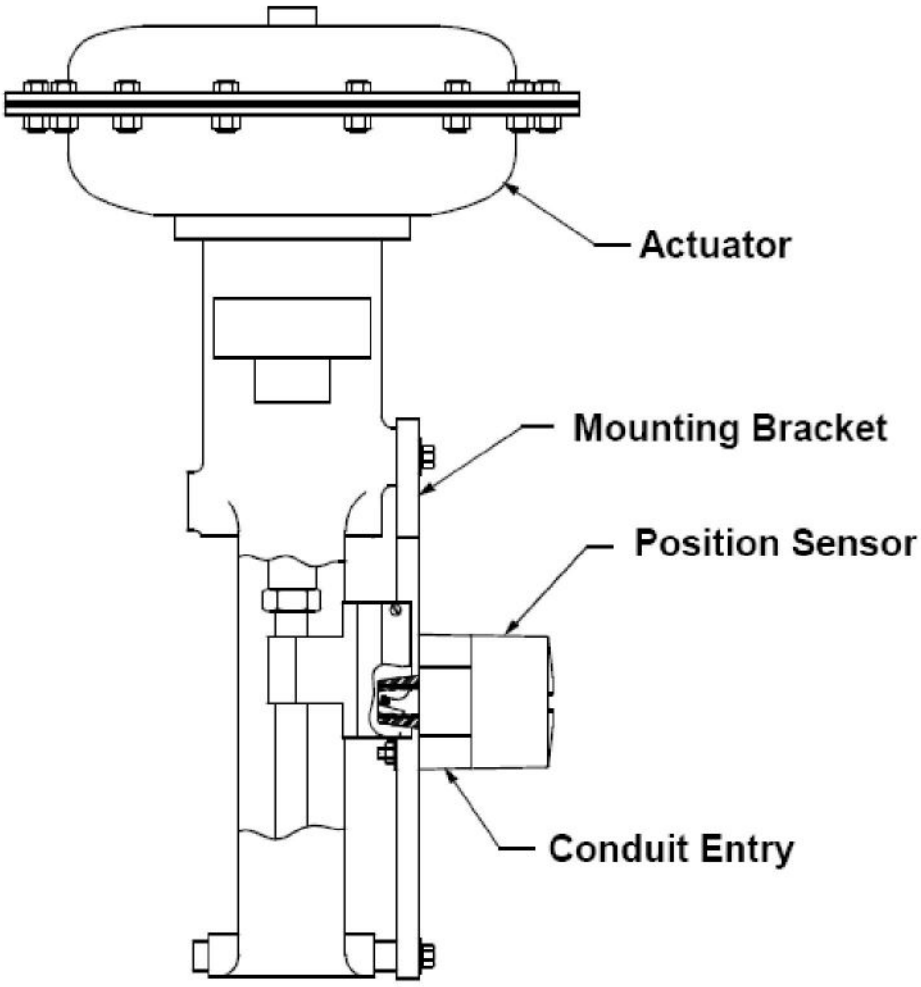


Figure 3-6

Note: For Fisher actuators model 657 & 667 sizes 34 thru 70, Westlock Controls supplies a slotted mounting kit design, to ease the mounting process. This will allow the user to easily center the positioner sensor between the limits of the magnet assembly's stroke. Other mounting kits are available upon request

Step 3. Mount positioner at a remote location.

For wiring instructions on remote positioner see section 3.8

3.5 *Pneumatic Connection*

Single Acting Actuator (Spring Return):
For single acting actuators Outlet Port 2 is to be plugged. Outlet Port 1 is to be piped to the actuator inlet port that acts against the spring (increasing set-point signal causes pressure to increase in Outlet Port 1 of the positioner).

Double Acting Actuator (Double Return):
For double acting actuators Outlet Port 2 is piped to drive the actuator towards the fail position. Outlet Port 1 is piped to drive the actuator away from the fail position. (increasing set-point signal causes pressure to increase in Outlet Port 1 of the positioner and pressure to decrease in Outlet Port 2 of the positioner).

Note: Air supply to the positioner must be clean, dry, oil free instrument air per ANSI/ISA-7.0.01-xxx and ISO 8573-1:xxx.

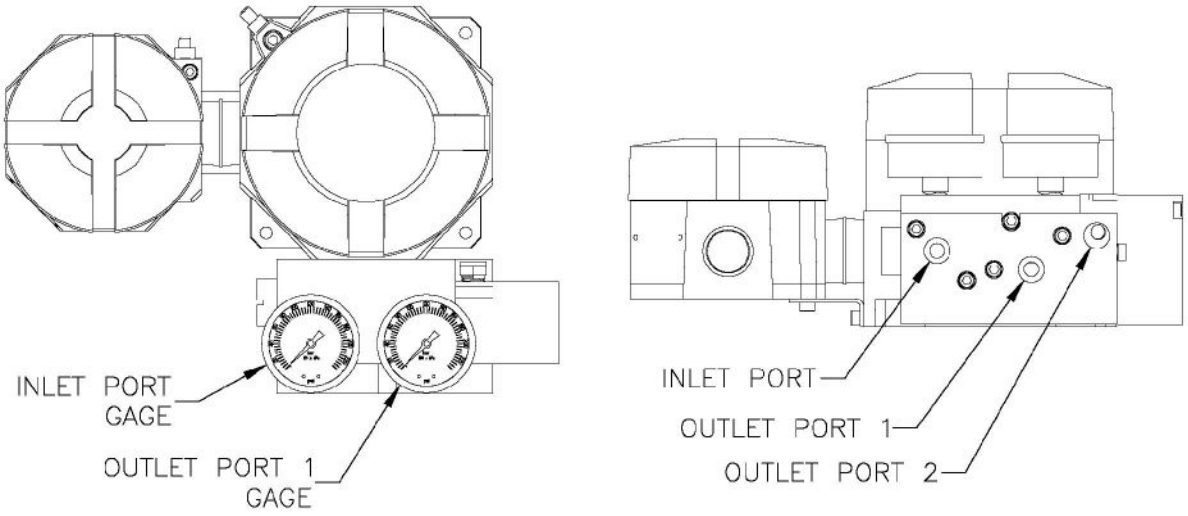
Maximum Particle Size and Concentration of Solid Contaminants

Class	Maximum Particle Size (Microns)	Maximum Concentration (mg/m^3)
3	5	5

Maximum Oil Content

Class	Maximum Concentration (mg/m^3)
3	1

Maximum supply pressure is 120 psi. All pneumatic connections are 1/4” NPT or BSP for standard flow, 3/8” NPT or BSP for High Flow.



1. Single Acting/Spring Return (Plug Outlet Port 2) increasing signal causes pressure to increase in Outlet Port 1.
2. Double Acting/Double Return (Pipe Outlet Port 2 to drive actuator towards the desired failure direction) increasing signal causes pressure to decrease in Outlet Port 2 and pressure to increase in Outlet Port 1.

Notes:
1. On loss of electrical power Outlet Port 1 has zero pressure and Outlet Port 2 has full pressure.

Figure 3-7

3.6 *SPECIAL NOTE Flow Capacity*

ICoT 6000 standard flow design is suitable for actuator swept volumes of a minimum 40 inch^3 (0.65 liters) to a maximum of 600 inch^3 (9.80 liters) for proper auto calibration functionality. It should also be noted that this is to be used as a general guideline only. The actuator/valve package dynamics would dictate the success of the Auto calibration routine and could be compromised by the following: instrument air supply, volume capacity, actuator sizing, tubing size and actuator/valve health.

ICoT 6000 Optional High Flow design is suitable for actuator swept volumes of a minimum 200 inch^3 (3.2 liters) to a maximum of 1000 inch^3 (16.30 liters) for proper Auto Calibration functionality. It should also be noted that this is to be used as a general guideline only. The actuator/valve package dynamics would dictate the success of the auto calibration routine and could be compromised by the following: instrument air supply volume capacity, actuator sizing, tubing size and actuator/valve health.

3.7 *Electrical Connection*

A) The ICot 6000 has been certified for use in hazardous locations to international standards. Although wiring practices may vary from region to region it is up to the end user to ensure that the electrical codes for installation have been satisfied.

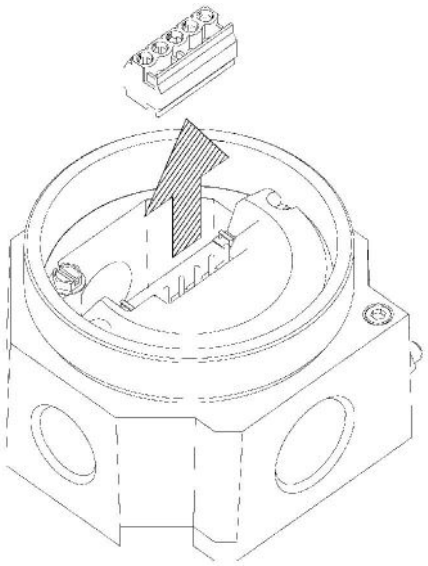
B) **All** unused cable entries **must** be plugged with suitably certified plugs that can maintain an ingress protection level of IP66.

C) For ambient temperatures below -10°C and above +60°C, use field wiring suitable for **both** minimum and maximum ambient temperatures.

D) Electromagnetic compatibility (emissions and susceptibility) is guaranteed only if, the unit and all cables are shielded and grounded as illustrated in Appendix B.

If the ICoT is optioned with a Remote Mount, reference section 3.8 (Electrical connection for Remote Mount). Then return to section 3.7 (Electrical connection) for standard wiring.

1. Remove cover from junction enclosure.
2. Locate terminal strip and carefully disconnect (pull off).
3. Connect the 4 to 20 mA loop signal to terminal points marked 1 and 2. See figure 3-8 for a wiring schematic.
4. If the positioner was ordered with an analog output, connect output wiring to terminal points 3 & 4, (polarities shown on Figure 3-8). The 4-20mA analog output is of the current sink type. Typically the 24VDC supply required comes from the HOST system (24VDC nominal).
5. Connect electrical ground wire to pin 5 (ground). Do not connect cable shield to pin 5. Cable shield at this end should be isolated using a shrink tubing or isolation tape.
6. External grounding is required for all zone installations. All wiring must be done in accordance with local and national electric code. See figure 3-8 for external ground connection.
7. After all connections have been made reconnect the terminal strip and replace junction cover.



CAUTION: Do not over tighten Terminal Screws. Max Torque 3.5 in. lb. /0.4Nm.

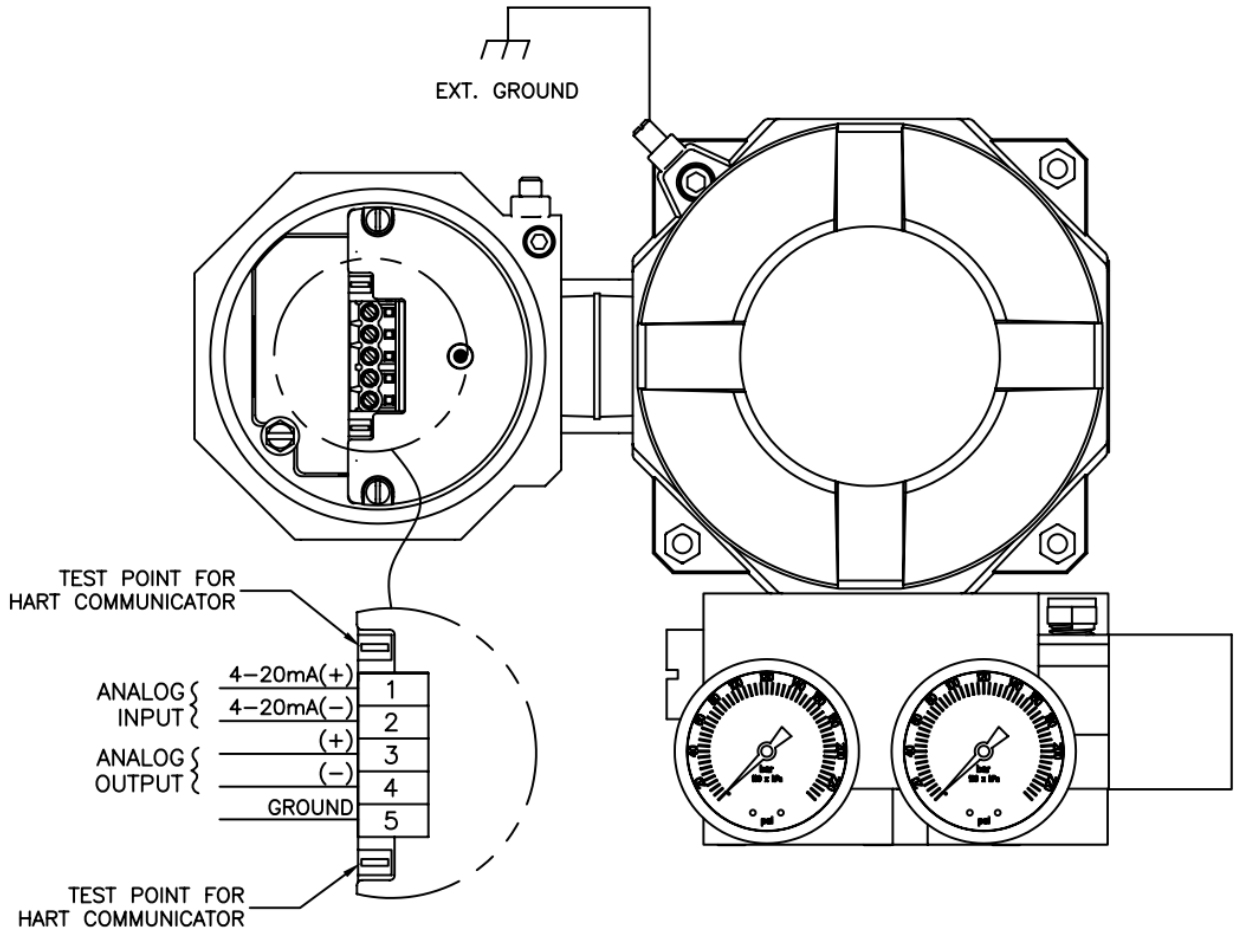


Figure 3-8

3.8 Electrical Connection for Remote Positioner

1. Remove cover from junction enclosure.
2. Locate terminal board mounting screws (See Figure 3-9), remove the two screws and lift up terminal board (See Figure 3-10).
3. Locate J3 & J4 connectors on the bottom of terminal board and connect 2 plugs as shown in Figure 3-11.
4. Replace the terminal strip board, replace the screws and replace the cover.
5. If necessary cut remote cable to required length, making sure to cut end opposite female connector.
6. Locate remote positioner enclosure and remove cover.
7. Wire the cable from junction enclosure to remote positioner as shown in Figure 3-13 & 3-12.
8. After all connections have been made replace remote positioner cover.

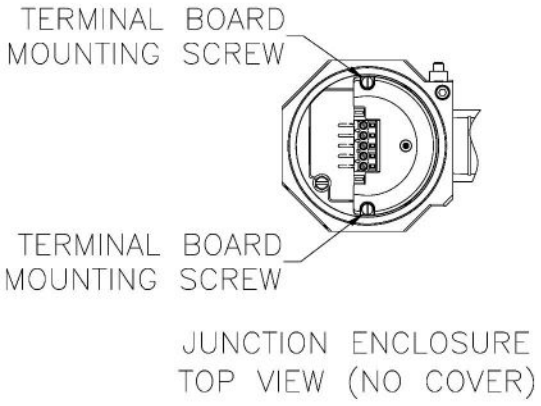


Figure 3-9

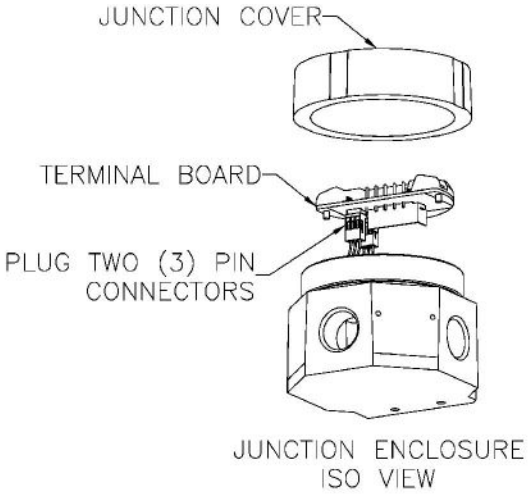


Figure 3-10

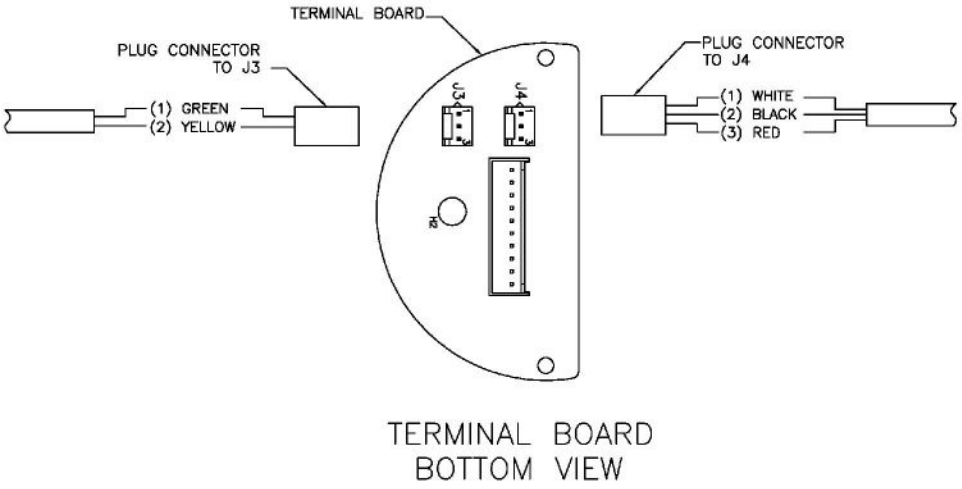


Figure 3-11

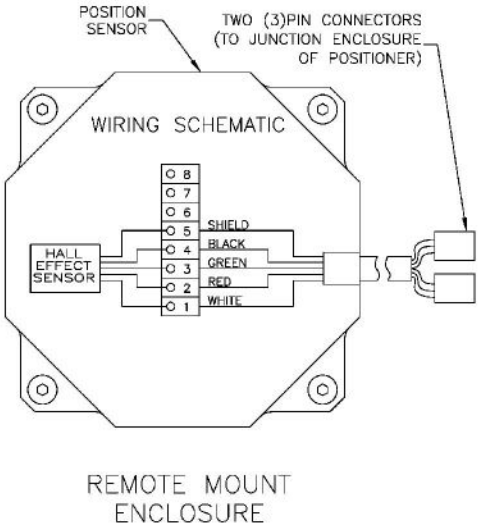


Figure 3-12

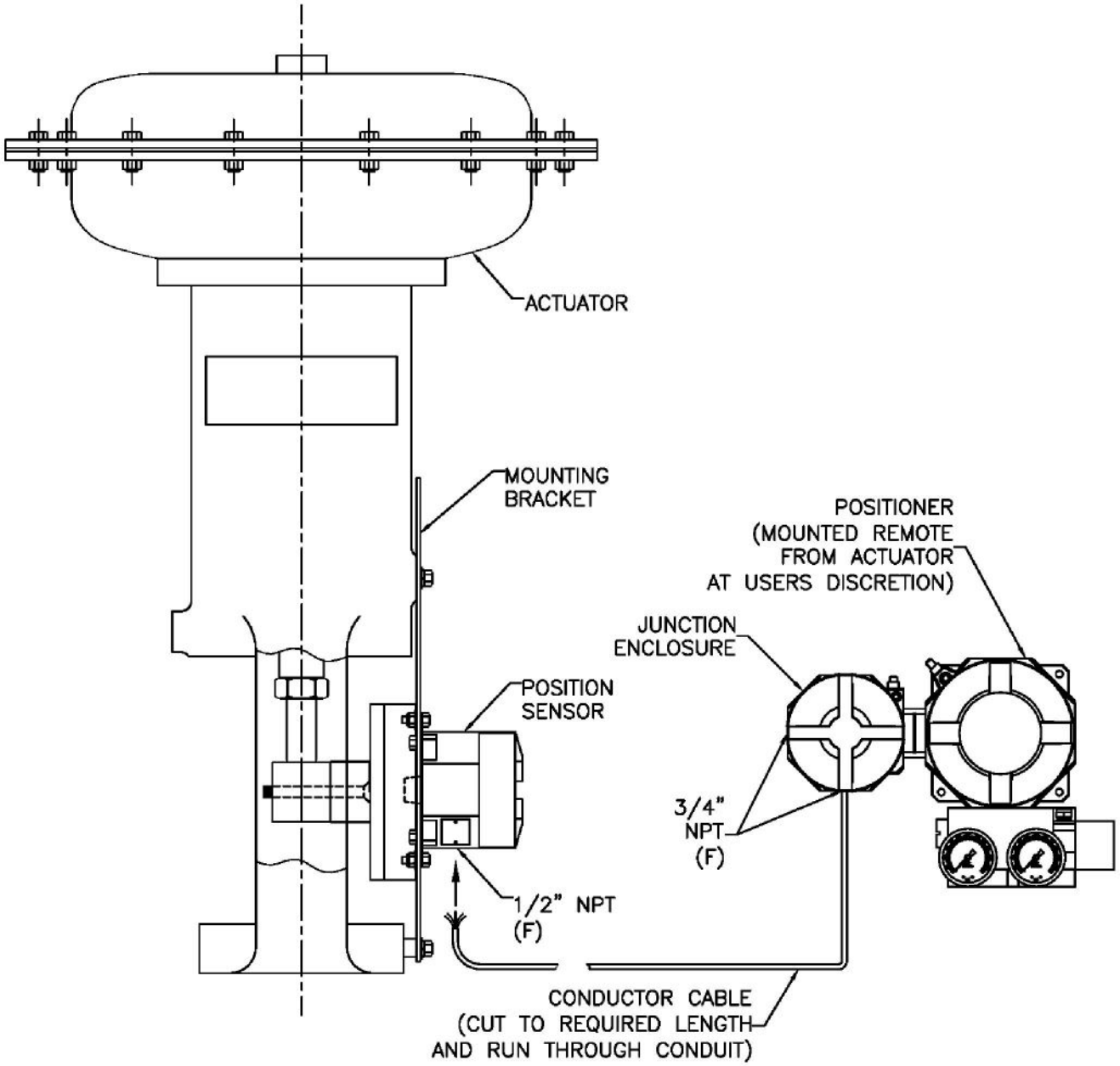

ACTUATOR
MOUNTING
BRACKET
POSITIONER
(MOUNTED REMOTE
FROM ACTUATOR
AT USERS DISCRETION)
JUNCTION
ENCLOSURE
POSITION
SENSOR
3/4"
NPT
(F)
1/2" NPT
(F)
CONDUCTOR CABLE
(CUT TO REQUIRED LENGTH
AND RUN THROUGH CONDUIT)

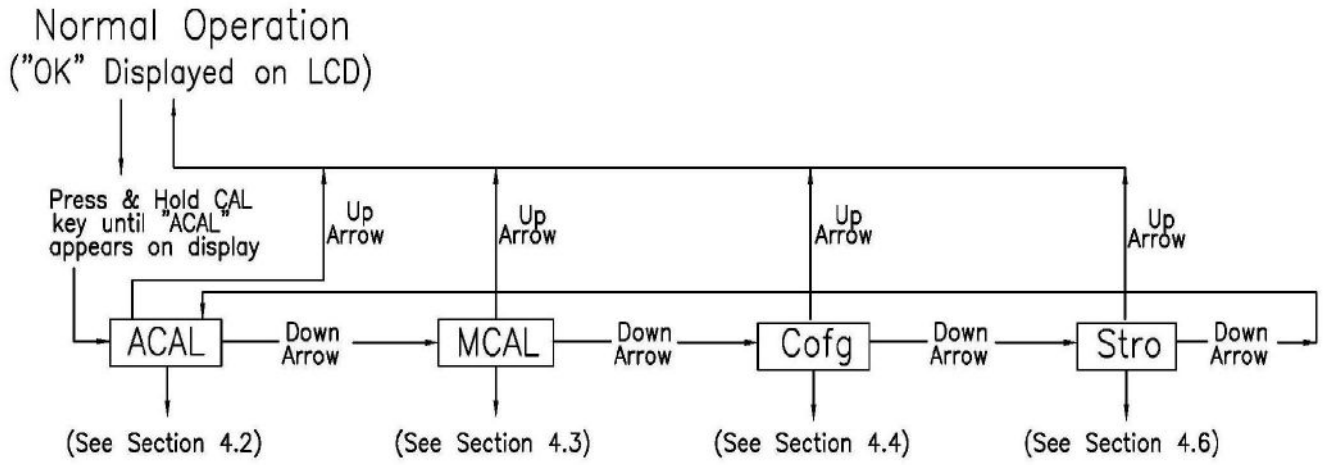
Figure 3-13

4 Calibration and Configuration

The ICoT positioner has an on-board menu structure that can be accessed internally by removing the cover and using electronics' buttons, and also externally, by using the non-intrusive calibration feature. In both cases, triggering the Cal switch will access the menu (see Appendix F for instructions on how to use non-intrusive feature). Exit any function by pressing both up and down arrow buttons simultaneously, anytime during calibration or configuration.

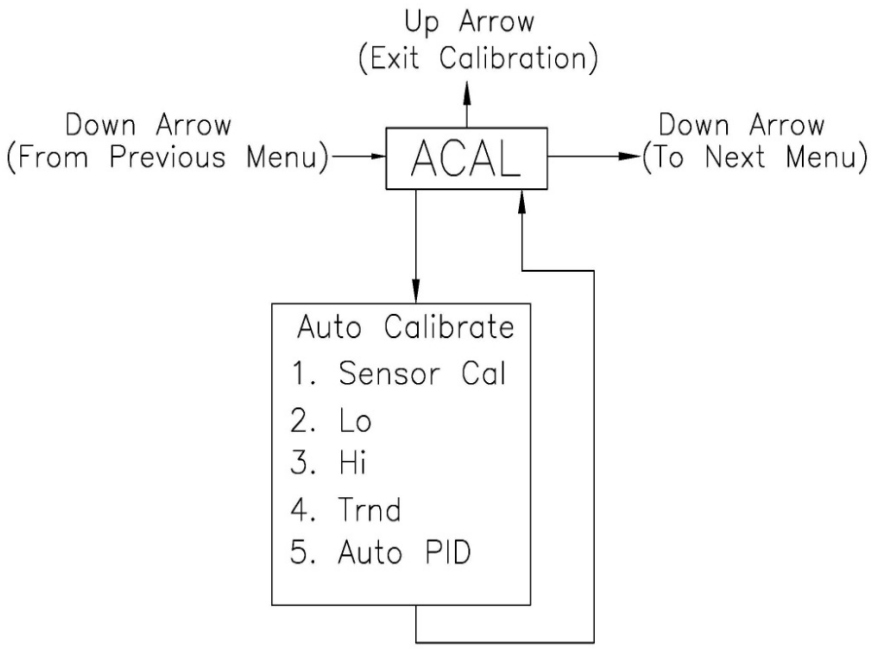
4.1 *Enter Calibration (Menu Level)*

Enter the calibration menu by pushing the CAL button. **ACAL** (Auto Cal Menu) is the first of four menus. By pressing the CAL button again you enter go to a lower level menu or start a routine. Pushing the down arrow button you can cycle through the menus. The remaining three menus are **MCAL** (Manual Cal Menu), **Cofg** (Configuration Menu), **Stro** (Manual Position Override Menu). Pushing the up arrow you exit the menu or go to an upper level menu. The menu level is shown below.



4.2 *Automatic Calibration (ACAL)*

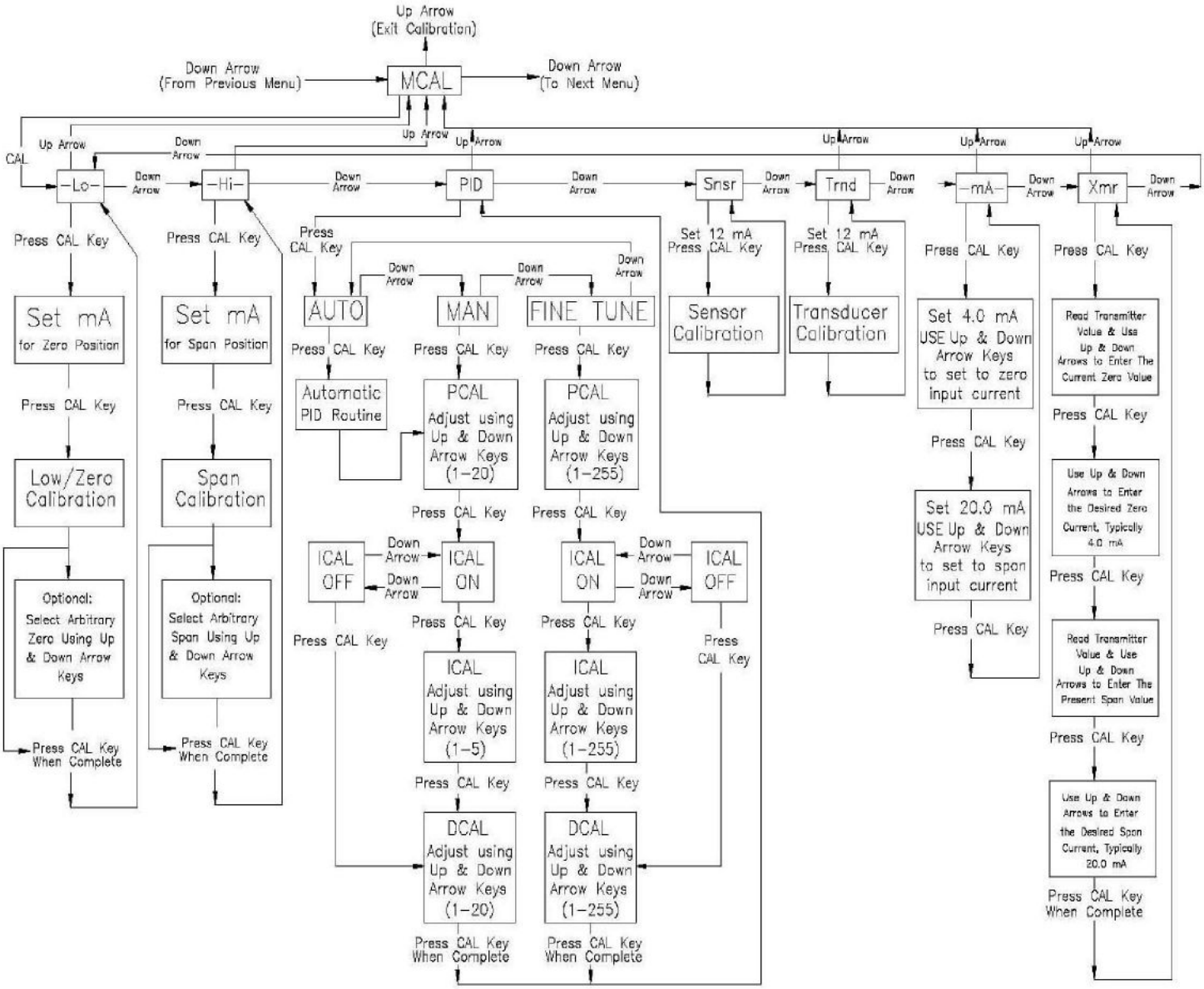
The Automatic Calibration (ACAL) performs several self-adjustments, as well as a zero calibration, a span calibration, and tunes the positioner's PID gain settings. From the normal operation screen, press the CAL button until ACAL is shown on the display (the ACAL routine is shown to the right). Press and hold the CAL button until it starts the automatic calibration, of which the first step in the sequence is the Sensor Calibration.



Automatic calibration goes through five sequences, when complete it goes back to ACAL menu. This Calibration is adequate for most applications. If automatic calibration does not give best results then an advanced calibration is required. Proceed to Section 4.4 to exit calibration. If advanced settings are required to fine tune the positioner, exit calibration (section 4.4) and proceed with Manual Calibration Menu (section 4.3)

4.3 *Manual Calibration (MCAL)*

Proceed with Manual Calibration Menu (MCAL). Follow MCAL routine shown below.



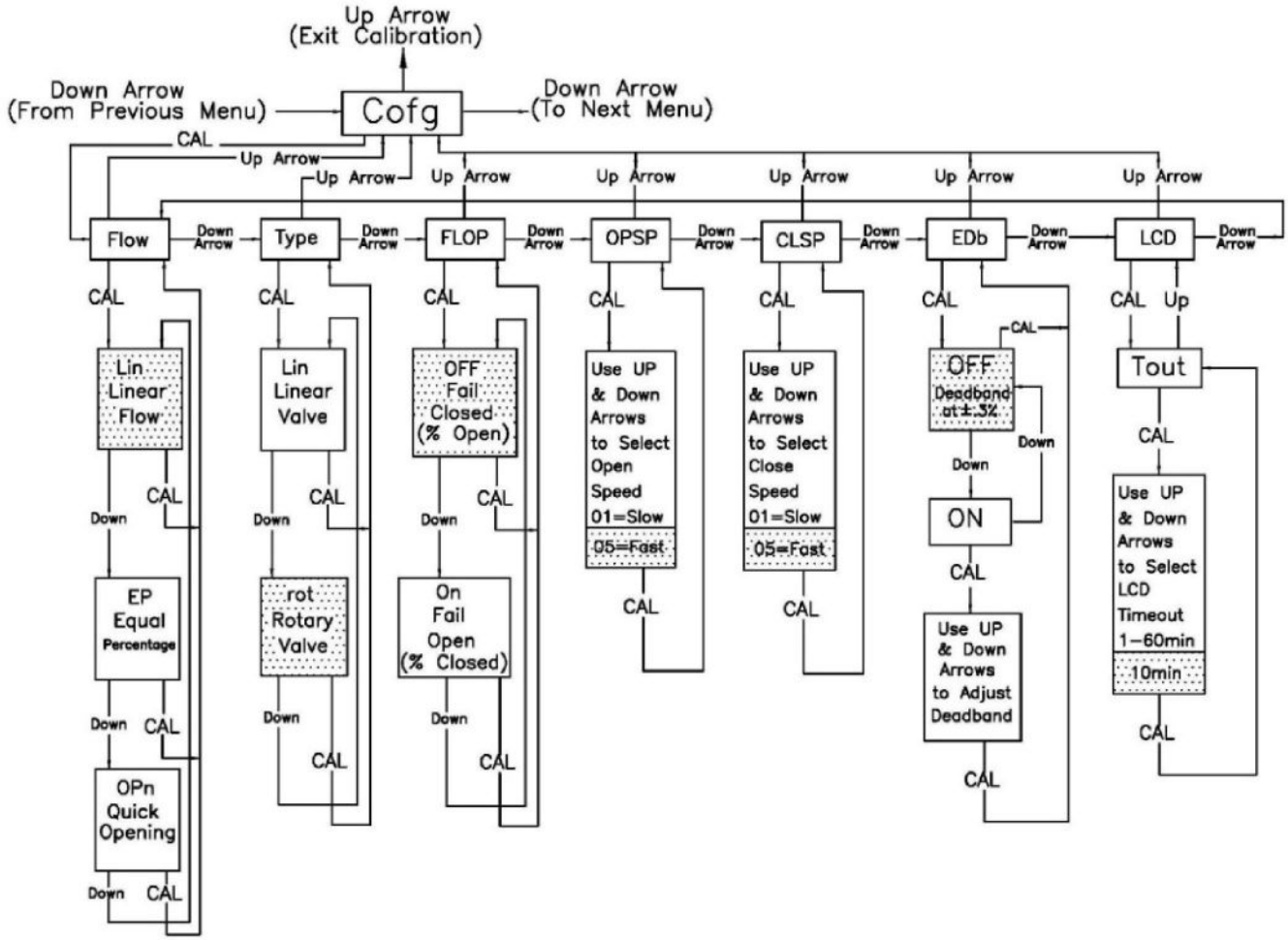
4.4 *Exiting Calibration*

To exit calibration mode and return to normal operation use the **up arrow** key as follows:

- If the positioner is at **Menu level** in the calibration, as determined by LCD displaying a Menu name only (**MCAL**, etc.), press the **up arrow** key once to exit **CAL** mode.
- If the positioner is at **function level** in the calibration, as determined by LCD displaying a function and Menu name only (**MCAL Lo**, etc.), press the **up arrow** key once to enter the Menu level and once more to exit **CAL** mode.
- If the positioner is performing any calibration function (e.g., **ACAL Trnd**), press up and down key simultaneously to abort the current operation and go to the normal operation screen.
- When the calibration mode is exited the Menu and function names will no longer be displayed by the LCD. The LCD will be displayed "OK".

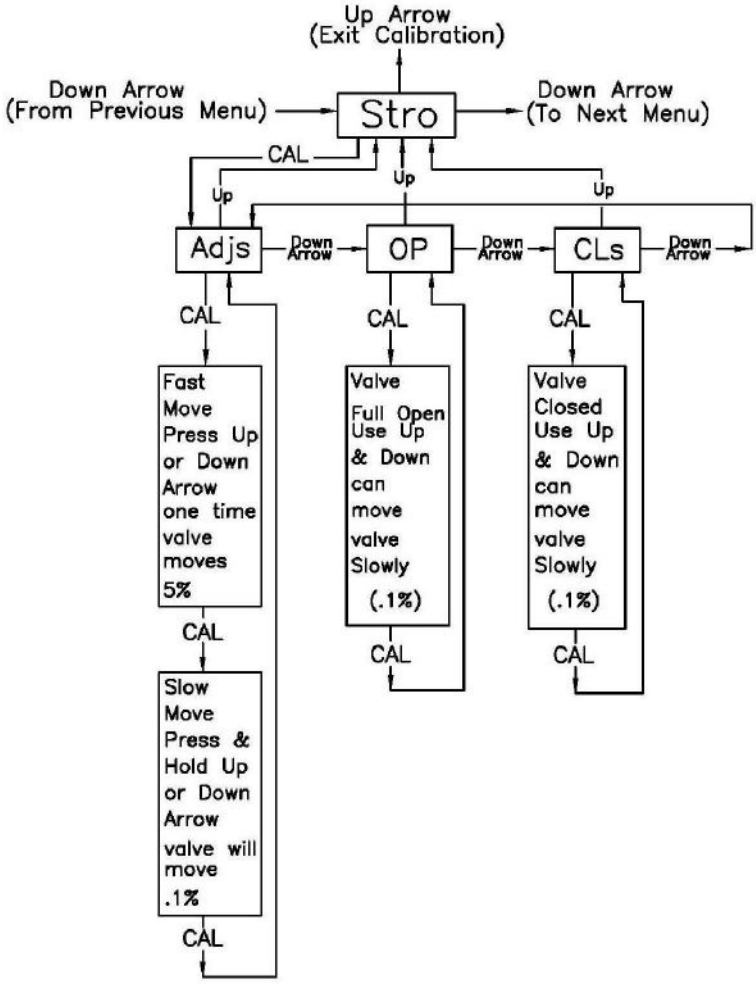
4.5 *Configure the Positioner's Parameters (Cofg)*

From the menu level press the down arrow button until the Cofg (Configuration Menu) is shown on the display (Configuration Routine Shown Below). Enter this menu and change any of the parameters, if other than the factory settings are needed. The factory settings are shaded.



4.6 *Manual Override of Input Signal Via On-Board Keypad (Stro)*

The positioner has a feature which allows the operator to override the analog set-point signal and change valve position from the keypad. This is done from the **Stro (Manual Override-Stroke Menu).** Enter calibration as described in section 4.1 and use the down arrow button to cycle to the **Stro** menu. Enter this menu and control the position of the valve as shown below.



4.7 *Description of Menus*

The calibration functions of the positioner are organized into the following four menus:

Menus

- Menu 1: **ACAL (Automatic Calibration)**
- Menu 2: **MCAL (Manual Calibration)**
- Menu 3: **Cofg (Configuration)**
- Menu 4: **Stro (Manual Override of Input Signal)**

Menu descriptions are as follows:

Menu 1: ACAL (Automatic Calibration)

Entering this menu allows you to initiate an approximately seven minute self-calibration function. The positioner will automatically enter digital control mode and perform a shallow **(input current independent)** calibration in the following sequence:

Function

1. **-Snsr-** Sensor Calibration
2. **-Lo-** Low (Zero) Calibration
3. **-Hi-** High (Span) Calibration
4. **-Trnd-** Transducer Calibration
5. **-Auto-** Automatic PID Tuning

Menu 2: MCAL (Manual Calibration)

Entering this menu allows you access to the following four calibration functions via the keypad:

1. **-Lo-** Low (Zero) Calibration
2. **-Hi-** High (Span) Calibration
3. **-PID-** Proportional, Integral and Derivative Gain Adjustment
4. **-Snsr-** Sensor Calibration
5. **-Trnd-** Transducer Calibration
6. **-mA-** Milliampere Calibration
7. **-Xmr-** Transmitter Calibration

Menu 3: Cofg (Configuration)

Entering this menu allows you access to the following five configuration functions via the keypad:

1. **-Flow-** Positioner Output Flow Characteristics
2. **-Type-** Positioner Recognition of Magnetic Feedback, Rotary or Linear
3. **-Flop-** Positioner Fail Position, Open or Closed
4. **-OPSP-** Positioner Opening Speed Adjustment
5. **-CLSP-** Positioner Opening Speed Adjustment
6. **-EDb-** Positioner Operating Dead-band Adjustment
7. **-LCD-** LCD Menu Timeout Adjustment

These functions allow display, speed and valve characteristic changes from standard factory settings.

Menu 4: Stro (Manual Override of Input Signal)

Entering this menu allows you access to the following three stroking functions via the keypad:

1. **-Adjs-** Adjustment of Positioner to Any Position Using Keypad Arrows
2. **-OP-** Open, Sets the Valve to the Full Open Position
3. **-CLs-** Close, Sets the Valve to the Full Closed Position

These functions set the positioner to digital control mode (**input current independent**) and therefore allow override of the control signal.

4.8 *Description of Functions*

LO This function serves to set the fail position of the actuator/valve. Initially during this calibration the valve is driven to the fail position (hard stop). The user will notice full pressure to Outlet Port 2 and zero pressure to Outlet Port 1. After a short period of time pressure will increase in Outlet Port 1 and the valve will be driven to the fully energized position and then back to the fail position. At this point the user has the option to select the hard stop as low (zero) position or to select an arbitrary position as low (zero) position.

HI This function serves to set the fully energized (full travel) position of the actuator/valve. Initially during this calibration the valve is driven to the fully energized (full travel) position (hard stop). The user will notice full pressure to Outlet Port 1 and zero pressure to Outlet Port 2. At this point the user has the option to select the hard stop as the high (span) position or to select an arbitrary position as the high (span) position.

PID The PID function allows the user to modify the PID settings of the positioner so the user can optimize the dynamic response of the positioner **regarding the** speed of response, overshoot and **steady-state** error by varying the appropriate gain settings. This function is often used to fine tune the PID values obtained from the automatic calibration function (**ACAL**). The PID entry allows the user to modify the tuning parameters in three different ways:

1. **Auto PID**: this option triggers the Auto PID procedure. It will override the positioner control and will modulate the valve in order to automatically find out the best P, I and D parameters.

2. **Manual PID**: the **Manual Proportional (PCAL)** and **Derivative (DCAL)** gain settings can be varied incrementally on a scale from 1-20. The **Integral (ICAL)** gain setting can be varied incrementally on a scale from 1-5. The Manual PID values are actually index representations of the Fine Tune settings that are reported through the HART communication.

3. **Fine Tuning: t**he **Fine Tune Proportional (PCAL)**, **Derivative (DCAL)** and **Integral (ICAL)** gain settings can be varied incrementally on a scale from 1-255. The fine tuning values are directly related to the actual time constant values (Ti or Td) and the Proportional gain value (Kc). The proportional gain (Kc) has a direct effect in the system response time. So, as higher the Kc as faster is the response time. The drawback of increasing the value of the Kc is the higher overshoot and settling time. Sometimes the valve's position control becomes instable, oscillating forever around the set point. The integrative term (Ti) affect the dynamic response of the position control by damping the positioner response according to the Ti value. So as lower the value of Ti as less damped is the dynamic response. This means that as lower the Ti as more oscillations are observed before the stabilization of the position and vice-versa. However, as higher the Ti as higher will be the settling time. Regarding the Derivative term (Td), as greater is its value as greater will be the derivative effect. Different from the proportional gain and integrative term, the derivative term is not proportional to the error but the variation of the position. The effect of Td is to decrease the overshoot and the control reacts against the variation of the position. The drawback is that as higher the Td as unstable can be the control system.

Snsr The sensor calibration is a self-adjustment that sets the positioner's Hall-Effect circuitry. This is automatically done during the **ACAL (Automatic Calibration)** routine. The sensor calibration also shows up under the **MCAL** menu. This

calibration only needs to be performed under the **MCAL** routine when the positioner is set-up on a new application and only if the **ACAL** routine is not performed.

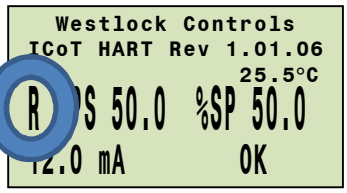
Trnd The purpose of this function is to calibrate the positioner's pressure transducer. It should be performed only after a manual sensor calibration.

mA This routine calibrates the positioner's electronics to recognizing input current. This is done using 4.0 mA and 20.0 mA as reference points. If exactly 4.0 mA or 20.0 mA cannot be given as inputs, the user can adjust the positioner's values to the input using the arrow buttons.

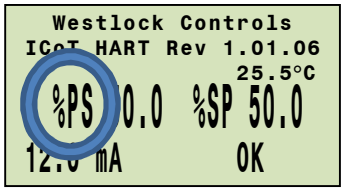
Xmr This routine calibrates the positioner's optional 4-20mA position transmitter. The transmitter calibration does not require the user to change the input current, although it does require the user to be able to read the transmitter's value in mA. For each, the zero and span, the user is first prompted to enter the value that the transmitter is presently at. This is done by using the up and down arrow buttons. The user is then prompted to enter the desired transmitter output (typically 4.0 mA for zero and 20.0 mA for span). The positioner then calculates the difference between the present and the desired output currents (for zero and span) and uses the differential to adjust the transmitter accordingly.

Flow This function allows for the setting of the flow characteristic of the positioner (not to be confused with the flow characteristic of the valve). The options are **Lin (Linear)**, **EP (Equal Percentage)** and **Opn (Quick Opening)**. A **Lin (Linear)** positioner characteristic duplicates the inherent characteristic of the valve and is the most often used setting.

Type This function configures the positioner for the type of valve. The options are **R (Rotary)** and **L (Linear)**. This setting needs to be done in order to configure the positioner to recognize the type of magnetic feedback being given to the positioner. This setting is shown on the left side of the LCD.



FLOP This function allows the user to configure the positioner to match the failure method of the valve/actuator. The options are **"off"** or **"on"**. The **"off"** option is for fail closed applications and the "on" option is for fail open application. When **"off"** is chosen the LCD will read 0% at the **zero (Lo Calibration)** and 100% at the **span (Hi Calibration)**. When **"on"** is chosen the LCD will read 100% at the **zero (Lo Calibration)** and 0% at the **span (Hi Calibration)**.



OPSP This function allows for the setting of the opening speed of the actuator/valve. The range is 1 thru 5. Setting 5 is the fastest opening speed and setting 1 is the slowest opening speed.

Setting	Approx.% Dynamic Speed
5	100%
4	80%
3	60%
2	40%
1	20%

CLSP This function allows for the setting of the closing speed of the actuator/valve. The range is 1 thru 5. Setting 5 is the fastest closing speed and setting 1 is the slowest closing speed.

Setting	Approx.% Dynamic Speed
5	100%
4	80%
3	60%
2	40%
1	20%

EDb This feature configures the positioner's operating dead-band. The configuration options are **"off"** and **"on"**. The positioner is factory set as **"off"**. When the dead-band feature is **"off"** it operates with nominal value of ± 0.3% of full scale for dead-band. When the feature is turned **"on"**, the dead-band can be set using the up and down arrow buttons to a value from 1 to 20. The value 1 **(lowest dead-band when turned "on")** has a dead-band range of 1%, which is equivalent to a dead-band of ± 0.5%. The value 20 **(highest dead-band value)** has a range of 20%, which is equivalent to a dead-band of ± 10%.

LCD This feature configures LCD menu timeout. The range is 1 to 60 minutes. It measures the amount of time there is no activity on the keypad and returns the system to the main screen after the configured timeout. The default value is 10 minutes.

Adjs This function allows for the adjustment of the positioner to any position via the keypad. This function places the positioner in digital control mode **(input current independent)** and therefore allows override of the control signal. Within this function there are **Fast** and **Slow move** modes. In **Fast move** mode the valve is opened or closed in 5% increments via the keypad. In **Slow move** mode the valve is opened or closed slowly via the keypad.

OP This function sets the valve to the fully energized position via the keypad **(Outlet Port 1 = Supply psi & Outlet Port 2 = 0 psi)**. This function places the positioner in digital control mode **(input current independent)** and therefore allows override of the control signal.

CLs This function sets the valve to the fully de-energized position via the keypad **(Outlet Port 1 = 0 psi & Outlet Port 2 = Supply psi).** This function places the positioner in digital control mode **(input current independent)** and therefore allows override of the control signal.

5 Trouble Shooting

5.1 *Preliminary Checks*

Before operating the positioner check the following:

5.1.1. Voltage

The positioner requires a 4-20 mA current source, with a minimum voltage of 9VDC at its terminals, over-current protected up to 35VDC.

Current range: 3.2mA to 22mA, accordingly to the following table (NAMUR NE43):

Loop Current [mA]	Electronics	Spool valve	HART comm
0.0 ≤ I < 3.2	OFF	OFF	OFF
3.2 ≤ I < 3.5	ON	OFF	OFF
3.5 ≤ I < 3.8	ON	OFF	ON
3.8 ≤ I ≤ 20.5	ON	ON	ON
I > 20.5	ON	ON	ON

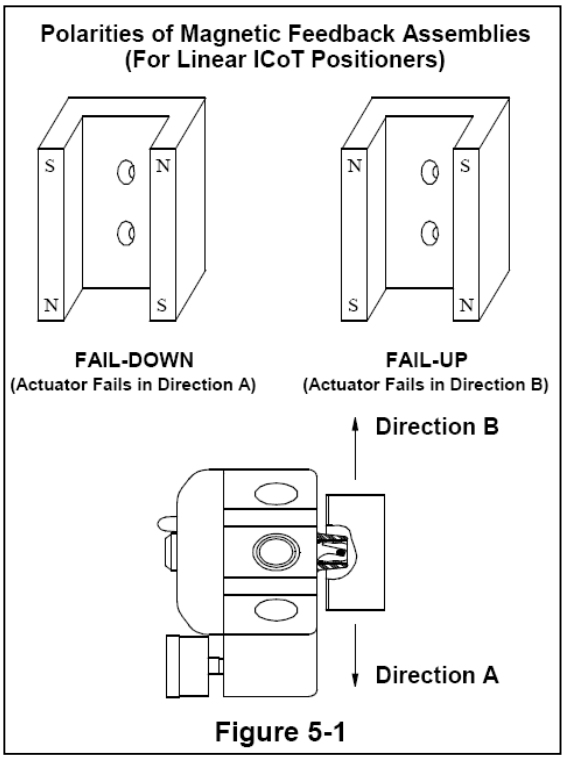


Figure 5-1

5.1.2. Electrical Connection

Check the polarity of the 4-20 mA loop current loop. The ICoT terminal strip visually designates the positive and negative terminal points for connection with #1 (+) and #2 (-), respectively.

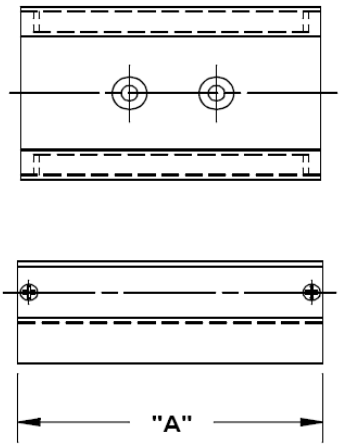
5.1.3. Pneumatic Connection

Single Acting: Output port 1 should be piped to drive the actuator away from the valves fail position. Output port 2 should be plugged. (See Section 3.5)

Double Acting: Output port 1 should be piped to drive the actuator away from the valves fail position. Output port 2 should be piped to drive the actuator towards the valves fail position. (See Section 3.5)

5.1.4. Magnetic Position Feedback

Rotary Positioner: The magnetic beacon should be set in the proper orientation, based on the direction of failure. (See Section 3.1)



STROKE LENGTH OF ACTUATOR/VALVE	DIM "A"	MAGNET ASSY' PART#
GREATER THAN 0.5" UP TO 1.0"	2.5	SW-30057
GREATER THAN 1.0" UP TO 1.5"	3.0	SW-30056
GREATER THAN 1.5" UP TO 2.0"	3.5	SW-30055
GREATER THAN 2.0" UP TO 2.5"	4.0	SW-30054
GREATER THAN 2.5" UP TO 3.0"	4.5	SW-30053

Figure 5-2

Linear Positioner: The magnetic assembly supplied with the positioner should correspond to the stroke length and failure direction of the actuator. To make sure you have the appropriate magnet assembly, check the part. The stroke length and failure direction should be printed on the part. On the older ICoT the magnet assembly is not printed with this information, although there should be a serial number. Contact the factory with the serial number to verify that it is correctly matched to the actuator. (See Figure 5-1 & Figure 5-2).

5.1.5. Supply Pressure

The supply pressure should be regulated appropriately with regard to the actuator. If there is question as to the proper supply pressure, the actuator manufacturer should be contacted.

5.1.6. Positioner Pressure Rating

If the supply pressure is above 40 PSI a high pressure ICoT positioner must be used. If the supply pressure is below 40 PSI a low pressure ICoT positioner must be used. (See Ordering Guide - Section 2.1)

5.2 *FAQ's*

Listed here are some FAQ's encountered with the ICoT positioner.

5.2.1. The LCD remains blank even after power is applied to the positioner.

- Check if loop current polarity matches positioner input.
- The positioner should be given a minimum current of 3.2mA and at least 9VDC @ 20mA. The voltage across the positioner can be checked by removing the cover and connecting a voltmeter across TP1 and TP2 on the display board.

5.2.2. The positioner has power but the position as shown on the LCD does not seem to match the actual position of the actuator/ valve.

- May need to be calibrated. Perform a manual step by step calibration or a full automatic calibration (see sections 4.2 and 4.3).
- Beacon may be incorrectly oriented.
- Check if it is properly configured as linear or rotary (see section 4.8 function **"Type"**).
- The flow characteristic during calibration was set to equal percentage or quick opening, not linear. If linear is desired enter calibration and make this change (See Calibration Instructions section 4.1 & 4.2).

.

5.2.3. The positioner is properly set-up, and air is applied to the positioner. When powering up the positioner, the actuator goes into a state of constant oscillation.

- Check for air leaks and if assembly is tightly coupled: tubing, actuator, bracket, cables etc.
- The gain settings are probably too high for the actuator/valve assembly. If not done yet, perform a full automatic calibration (see section 4.7).
- If full auto cal has not given good results, perform a manual auto PID (see section 4.8, function “PID”).
- If manual PID has not given good results, try to manually fine tune the PID. Enter the calibration mode and reduce the **PCAL** value until oscillation ceases.
- Try also to increase the **ICAL** setting until oscillation ceases.
- Try to adjust **PCAL**, **ICAL** and **DCAL** settings one at a time, until the dynamics response is satisfactory.

5.2.4. After removing power to the positioner there is full pressure to output port 1 and zero pressure to output port 2.

- On loss of power the positioner fails full air pressure to output port 2. If this does not happen the positioner is damaged. Contact factory.

5.2.5. An Err 6 (Calibration Error) is returned during a Lo or Hi Calibration.

- In the case of a rotary application, the beacon may be incorrectly oriented or the actuator may not have enough rotation. The positioner requires the actuator to stroke a minimum of 45 degrees.
- In the case of a linear application, the feedback magnet assembly needs to be ordered specific to the stroke of the actuator and the fail direction of the actuator. (See figure 5-1 & 5-2).

5.2.6. An Err 5 (Integrator Overflow) message is shown on the display.

- This message indicates a deviation between position and set-point. This error message does not clear itself after the problem ceases, therefore, try clearing the message.
- If the Err 5 returns, make sure all the preliminary checks, as described earlier in this section, have been made. If still the cause for the Err 5 cannot be diagnosed, call the factory for help.

6 Technical Specifications

Input

Set-point: 4-20 mA, two wire, Namur NE43
Normal Operation: 3.8≤ I ≤ 20.5 mA
Fail Condition: I≤3.6 or I≥21.0 Ma (Causes the valve to go to fail position)
Minimum current w/o reset: 3.2mA
Voltage: 9 to 35 VDC
Over-current protection: < 70mA, 40VDC
Impedance: 450 Ohms @ 20mA

Pressure: 15 - 45 psi (Low)
40 - 120 psi (High)

Instrumentation air quality must be in accordance with ISO 8573-1 “Air Quality Standards” (See Pneumatic Connection Section 3.5 for more details).

Output

Flow Rate: 8.0 scfm @ 25 psi (Low)
16.2 scfm @ 90 psi (High)
Pressure: 0 to 45 psi (Low pressure transducer)
40 to 120 psi (High pressure transducer)
Actuator: Single Acting or Double Acting
Optional position transmitter:
4-20 mA, two wire, Namur NE43
Normal Operation: 3.8≤ I ≤ 20.5 mA
Fail Condition: I≤3.6 or I≥21.0 mA selectable by switch
Maximum voltage: 35VDC
Maximum load impedance: 1 KOhm

Performance

Resolution: ± 0.2% Full Travel
Linearity: ± 0.5% Full Scale (Rotary)
± 1.0% Full Scale (Linear)
Hysteresis: ± 0.2% Full Scale
Repeatability: ± 0.2% Full Scale

Operating Temp: -40°C to 85°C (-40°F to 167°F)

LCD readable: -20°C to 70°C (-40°F to 158°F)

Remote Hall sensor: -40°C to 125°C
(-40°F to 257°F)

Thermal Coefficient: ± 2% / 100°C

Air Consumption: 0.03 scfm @ 25 psi (Low)
0.08 scfm @ 90 psi (High)

Stroke: 0.25 to 24 inches (Linear)
45 to 95 degrees (Rotary)

Position Feedback: Magnetic (Non-Contact)

Diagnostics: HART Protocol, Software Utilizing HART Protocol

Enclosure

Material: Aluminum or Stainless Steel

IP Rating: IP 66

Weight: 3.6 Kg / 7.9 Lb. aluminum enclosure (standard flow)
8.7 Kg / 19.2 Lb. stainless steel enclosure (standard flow)

Air Connections: 1/4” NPT or 1/4”BSP (STD Flow manifold)
3/8”NPT or BSP (High Flow manifold)

Conduit Connection: 1/2” NPT (Standard)
M20 (Optional)

EMC (Electromagnetic Compatibility)

IEC 61000-6-2:2005 Electromagnetic compatibility (EMC) – Immunity for industrial environments

IEC 61000-6-4:2006 Electromagnetic compatibility (EMC) – Emission standard for industrial environments

IEC 61326-2:2005 Electrical equipment for measurement, control and laboratory use - EMC requirements

7 Error codes and LCD messages

7.1 *Error codes that are backward compatible to previous versions of the ICoT positioner*

Err 3 (Error 3) Low Input Pressure

Err 5 (Error 5) Integrator Overflow – Actual position does not match set-point

Err 6 (Error 6) Calibration Error - Positioner could not successfully perform calibration

ALR (Alert 3) Valve position is not being maintained within the dead-band range. The dead-band range (EDb) is set from the configuration menu during calibration (Section 4). The EDb must be set to other than zero (0) to enable the Alert 3 message. Additionally, check the following items:

- Hall sensor connector and cable, especially if remote
- Pressure supply stability
- Actuator and tubing leaks
- Magnet assembly in correct position and tight
- Set-point stability
- Flow turbulence
- Sources of electromagnetic noise too close to the sensor or to the positioner cables, like AC cables for motors, inverters etc

7.2 *LCD error messages*

The ICoT positioner has built-in diagnostics that allow the user to identify and resolve most of the common installation and operation problems. The following table lists the available messages, their meaning and recommended solutions:

Message	Meaning	Solution
Valve position unstable	Position is unstable or oscillating too much during calibration	Check: • Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4) • Pressure supply stability • Actuator and tubing leaks • Magnet assembly in correct position and tightly coupled • Set-point stability • Actuator/Valve assembly integrity • Sources of electromagnetic noise too close to the sensor or to the positioner cables, like AC cables for motors, inverters etc • Perform a full auto CAL • Call factory for additional support
HALL sensor rail error	Position error during PID calibration	Check: • Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4) • Pressure supply stability • Actuator and tubing leaks • Perform a full auto CAL • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
PID gain error	PID calibration was not able to find proper gain values and control the valve position	Check: • Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4) • Pressure supply stability • Actuator and tubing leaks • Actuator/Valve assembly integrity • Perform a full auto CAL • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Transducer PWM error	During calibration an error occurred with the PWM signal that control the spool-valve driver	Check: • Cable between the inner canister and the pneumatic transducer assembly is tightly connected • Cable and connector between the transducer board and the spool-valve coil • Perform a full auto CAL • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry the calibration • Call factory for additional support

Message	Meaning	Solution
Input pressure unstable	Pressure was unstable during calibration	Check: • Pressure supply stability • Actuator and tubing leaks • Manifold and transducer assembly are tightly coupled to the enclosure and there are no leaks • Check if the cable between the inner canister and the pneumatic transducer assembly is tightly connected • Actuator/Valve assembly integrity • Perform a full auto CAL • Call factory for additional support

HALL span too small	Hall sensor used to read position is unstable	Check:
		• Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4)
		• Magnet assembly:
		  ○ For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3).
		  ○ For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6)
		• Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry the calibration
		• Grounding issues, cable shield is properly grounded; positioner ground is properly connected to a clean ground reference.
		• Sources of electromagnetic noise too close to the sensor or to the positioner cables, like AC cables for motors, inverters etc
		• Try to replace the Hall sensor and/or the magnet
		• Call factory for additional support

A2D span too small	One or more of the analog variables (position, pressure or loop current) does not have enough span to calibrate accordingly	Check:
		• Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4)
		• Magnet assembly:
		  ○ For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3).
		  ○ For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6)
		• Set-point stability, current generator, grounding issues, cable shield is grounded properly, cables entry ground is properly connected to a clean ground reference.
		• Pressure supply stability, actuator and tubing leaks
		• Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL
		• Grounding issues, cable shield is properly grounded; positioner ground is properly connected to a clean ground reference.
		• Sources of electromagnetic noise too close to the sensor or to the positioner cables, like AC cables for motors, inverters etc
		• Call factory for additional support

Message	Meaning	Solution
Comp range error	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support

Valve stuck	Problems in the movement detection during calibration	Check:
		• Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4)
		• Magnet assembly.
		  ○ For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3).
		  ○ For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6)
		• Pressure supply stability
		• Actuator and tubing leaks
		• Manifold and transducer assembly are tightly coupled to the enclosure and there are no leaks
		• Check if the cable between the inner canister and the pneumatic transducer assembly is tightly connected
		• Actuator/Valve assembly integrity
		• Try to repeat a full auto CAL
		• Call factory for additional support

Not possible to set down gain
 	
Not possible to set up gain
	The calibration of the position sensor could not find a proper gain to work with the current Hall sensor and magnet assembly	Check:
		• Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4)
		• Magnet assembly is in correct position.
		  ○ For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3).
		  ○ For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6). Check if the proper fail-down or fail-up magnet is being used (figure 5-1)
		• Try to repeat a full auto CAL
		• Try to replace the Hall sensor and/or the magnet
		• Remove power for at least 1 minute and retry
		• Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL
		• Call factory for additional support

Wrong delta value	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support

Message	Meaning	Solution

PWM overflow	During calibration an error occurred with the PWM signal that control the spool-valve driver and the position is not following the control signal	Check:
		• Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4)
		• Magnet assembly is in correct position.
		  ○ For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3).
		  ○ For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6). Check if the proper fail-down or fail-up magnet is being used (figure 5-1)
		• Check if the cable between the inner canister and the pneumatic transducer assembly is tightly connected
		• Check the cable and connector between the transducer board and the spool-valve coil.
		• Try to replace the Hall sensor and/or the magnet
		• Remove power for at least 1 minute and retry
		• Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL
		• Call factory for additional support

HALL sensor out of range	(SEN, LO, HI, T) Hall sensor used to read position is unstable	Check: • Hall sensor connector and cable, especially if remote (see Figure 3-9, 3-10 and 3-11, connection J3 & J4) • Magnet assembly. For rotary magnets check if it is not rotated 90 degrees (see figures 3-2 and 3-3). For linear magnets, check if the magnet assembly center is matching the actuator mid position (see figures 3-4, 3-5 and 3-6) • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry the calibration • Grounding issues, cable shield is grounded properly, positioner ground is properly connected to a clean ground reference. • Sources of electromagnetic noise too close to the sensor or to the positioner cables, like AC cables for motors, inverters etc • Try to replace the Hall sensor and/or the magnet • Call factory for additional support
mA input A/D is not in linear range	An invalid loop current is applied during set-point calibration	Check: • Check if the current generator is set at the proper value (between 3.8mA and 20.5mA) • Check the set-point value on the LCD and adjust the current generator accordingly • Make sure the minimum loop current span is at least 1.6mA • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Illegal calibration code	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support

Message	Meaning	Solution
Too few bytes received	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Current is not 12mA	The current operation needs the loop current set to 12mA	Check: • Check if the loop current is set at 12mA • Remove power for at least 1 minute and retry • Recalibrate the loop current input (see 4.8 item “mA”) • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Generic error	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Service not implemented	An unknown service was request via HART communication	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and retry a full auto CAL • Call factory for additional support
Other service running	A service request via HART communication was refused because another service is running	Check: • Wait for 1 minute maximum for the service to finish • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and a full auto CAL • Call factory for additional support
Failure mA. Not enough power	Device requires a minimum of 3.8mA to operate properly.	Check: • Check if the loop current is set at least at 3.8mA • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and a full auto CAL • Call factory for additional support
Unknown error code	An unknown error has occurred during calibration	Check: • Remove power for at least 1 minute and retry • Remove power for at least 1 minute, perform a factory default (see Appendix C) and a full auto CAL • Call factory for additional support

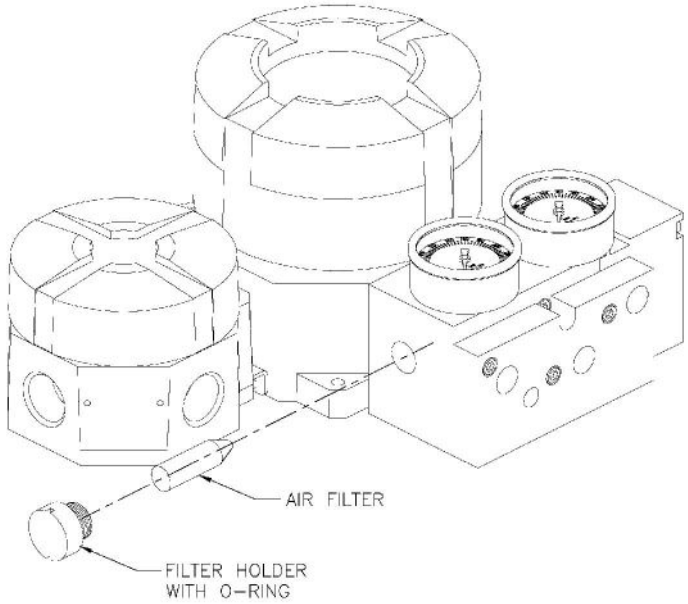
Appendix A

General Maintenance Standard Flow

The positioner's onboard filter should be replaced regularly or whenever it gets clogged. See diagram below for location of the filter. **Note:** the following instructions are for Standard Flow. For High Flow please contact the factory.

Important: The positioner's onboard filter is not a substitute for normal instrument air preparation. Supply air to the positioner should conform to ISO 8573-1 "Air Quality Standards" (See Pneumatic Connection Section 3.5 for more details).

Important: The filter's original color is chalk white. If the filter is discolored, its replacement should be performed more often. A discolored filter may also indicate the need for an evaluation of the air-supply quality. A filter/regulator with a 5 micron or better element, just prior to the positioner, is therefore recommended.



Spool valve cleaning

In favorable conditions (i.e. high quality supply air, healthy actuator) there will be minimal if any maintenance necessary on the spool valve. If unfavorable conditions exist (i.e. poor supply air quality or if lubrication and sediment from the actuator is being exhausted through the spool valve) it may become necessary to clean the spool valve to avoid operational failures due to valve sticking and to maintain optimum positioner performance.

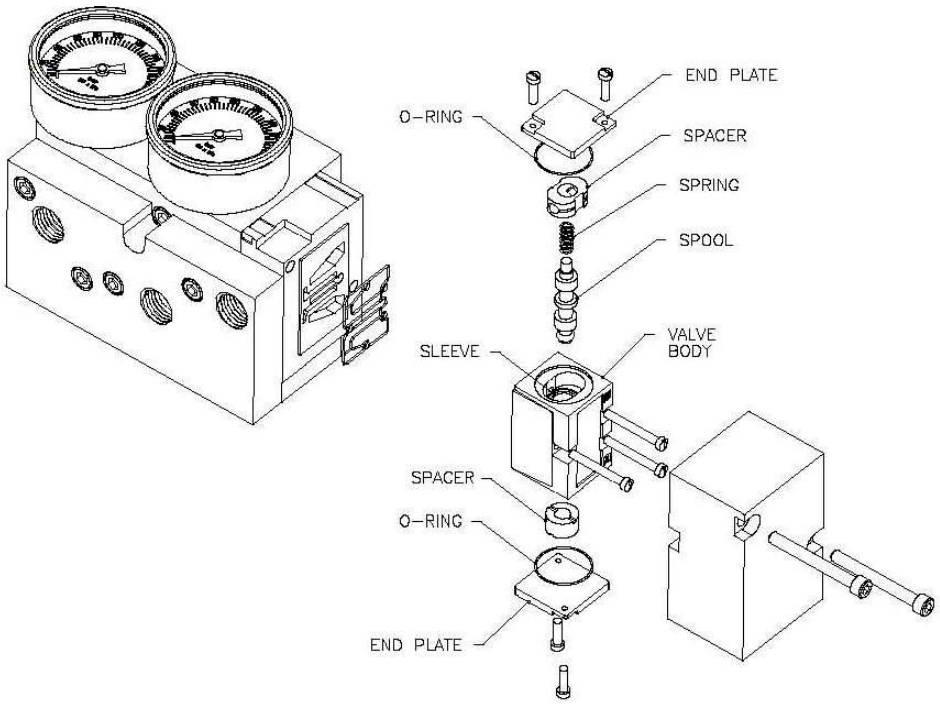
To clean the spool valve, the spool piece needs to be removed (see following diagram). Prior to removing the spool, make sure the positioner is out of service and all air pressure has been bled-off the positioner and the actuator. The spool piece and sleeve can be cleaned using any non-chlorinated cleaning solvent. To clean the spool, use a clean lint free cloth. To clean the I.D. of the sleeve a polyester lint free clean room swab is recommended. These items can be obtained from most industrial supply companies or catalogs.

Important: do not use an abrasive cleaner on the spool or sleeve. Never buff the spool or sleeve or use crocus cloth, and never attempt to remove the sharp edges from the spool lands. These practices will permanently damage the spool assembly and will affect the fit and action of the spool sleeve assembly.

Important: the spool and sleeve assembly are sold as a precision matched set. Spools are not interchangeable. To prevent mix-ups it is recommended that only one assembly be cleaned at a time. In case mix-up happen contact factory for additional support.

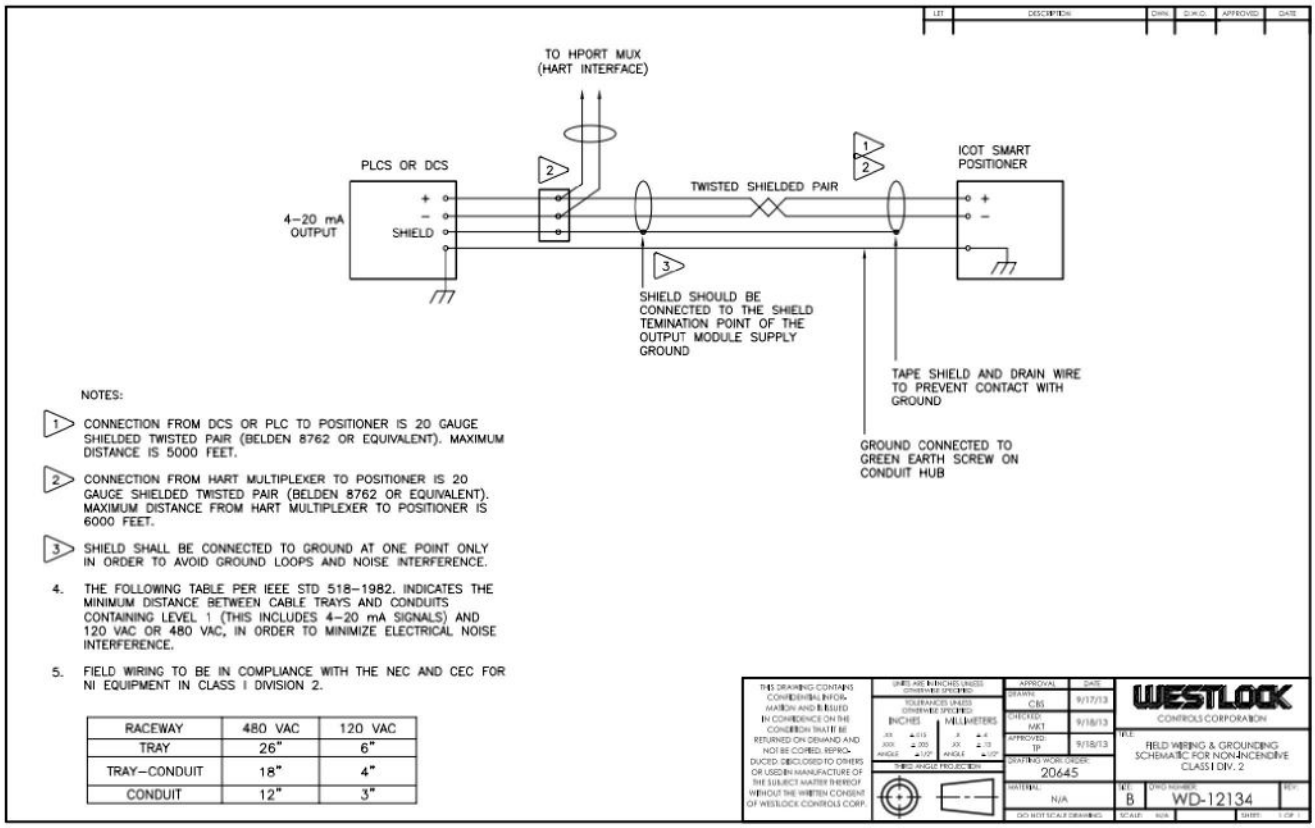
Important: after cleaning, gently insert the spool into the sleeve. Insert straight with a slight rotating motion. Do not cock the spool. Make sure the spool spins and moves freely. After the spool valve is cleaned and reassembled the positioner should recalibrated using the auto CAL function.

SPOOL/VALVE ASSY
PR-30034



Appendix B

Grounding Schematic



1 CONNECTION FROM DCS OR PLC TO POSITIONER IS 20 GAUGE SHIELDED TWISTED PAIR (BELDEN 8762 OR EQUIVALENT). MAXIMUM DISTANCE IS 5000 FEET.

2 CONNECTION FROM HART MULTIPLEXER TO POSITIONER IS 20 GAUGE SHIELDED TWISTED PAIR (BELDEN 8762 OR EQUIVALENT). MAXIMUM DISTANCE FROM HART MULTIPLEXER TO POSITIONER IS 6000 FEET.

3 SHIELD SHALL BE CONNECTED TO GROUND AT ONE POINT ONLY IN ORDER TO AVOID GROUND LOOPS AND NOISE INTERFERENCE.

4. THE FOLLOWING TABLE, PER IEEE STD 518-1982, INDICATES THE MINIMUM DISTANCE BETWEEN CABLE TRAYS AND CONDUITS CONTAINING LEVEL 1 (THIS INCLUDES 4-20 mA SIGNALS) AND 120 VAC OR 480 VAC, IN ORDER TO MINIMIZE ELECTRICAL NOISE INTERFERENCE.

RACEWAY	480 VAC	120 VAC
TRAY	26"	6"
TRAY-CONDUIT	18"	4"
CONDUIT	12"	3"

Appendix C

Procedure to Reset the Non-Volatile Memory to Factory Settings

The ICoT positioner is a digital device. Its operation relies on data that is stored in the positioner's non-volatile memory. Calibration and configuration data that has been established during the positioner's calibration is stored in this memory. Under abnormal conditions this stored information can become corrupted. If this occurs it is necessary to reset the memory and re-calibrate the positioner.

1. Remove power from the positioner. This can be done by removing the plug-in style terminal strip.

2. Press and hold the CAL button while replacing the terminal strip (returning power). The LCD will show "Starting Up…" for several seconds while holding down the CAL button.

3. Continue to hold the CAL button until the LCD shows "Factory Default Initialization. No?" When this statement appears release the CAL button and use the down arrow to select "Yes" or press once more to select "All". Then press the CAL button to begin the factory default procedure.
    a. "Yes" option resets all non-volatile data to default with exception of the position transmitter calibration data.
    b. "All" option resets all non-volatile memory contents including all factory and user calibration data.

4. After a few seconds you will be prompted to enter 4.0 mA to calibrate the loop current input. Change the current input to the positioner to exactly 4.0 mA and press the CAL button. If your zero position signal is other than exactly 4.0 mA then use the Up/Down arrow buttons to adjust the value shown on the positioner's LCD to match the zero position mA and press the CAL button.

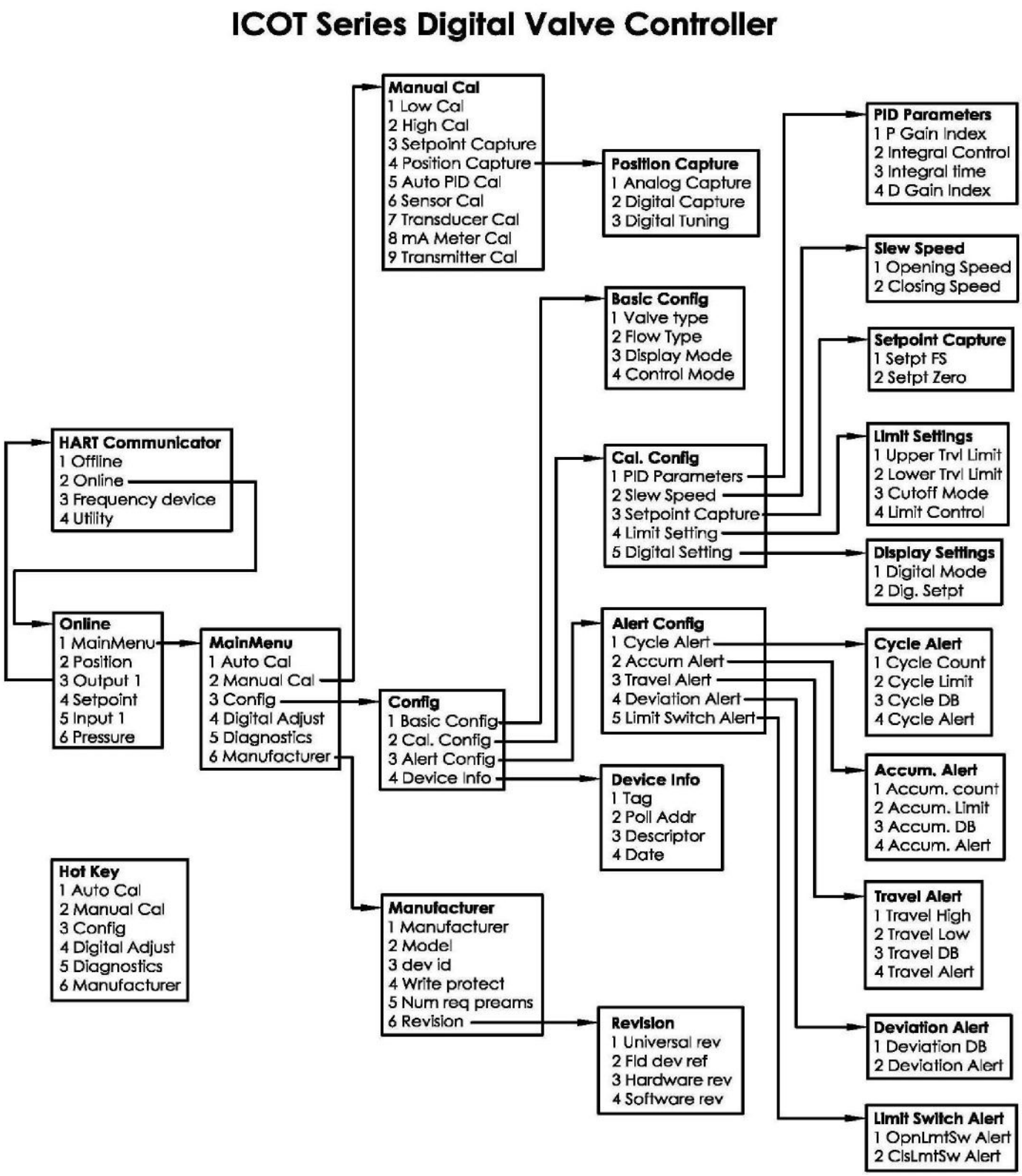
5. You will then be prompted to enter 20 mA. Change the current input to the positioner to exactly 20.0 mA and press the CAL button. If your full-scale position signal is other then exactly 20.0 mA then use the Up/Down arrow buttons to adjust the value shown on the positioner's LCD to match the full-scale position mA and press the CAL button.

6. The positioner will automatically return to normal operating mode.

It is recommended then to follow the normal calibration procedure as described in the manual section 4.7.

Appendix D

HART® Communicator Menu Flow Chart



Appendix E

DD and DTM for configuration and control system integration

The ICoT positioner can be fully integrated into most of the configuration tools, control systems and asset management systems in the market. Westlock Controls provides DD files and DTM for this integration.

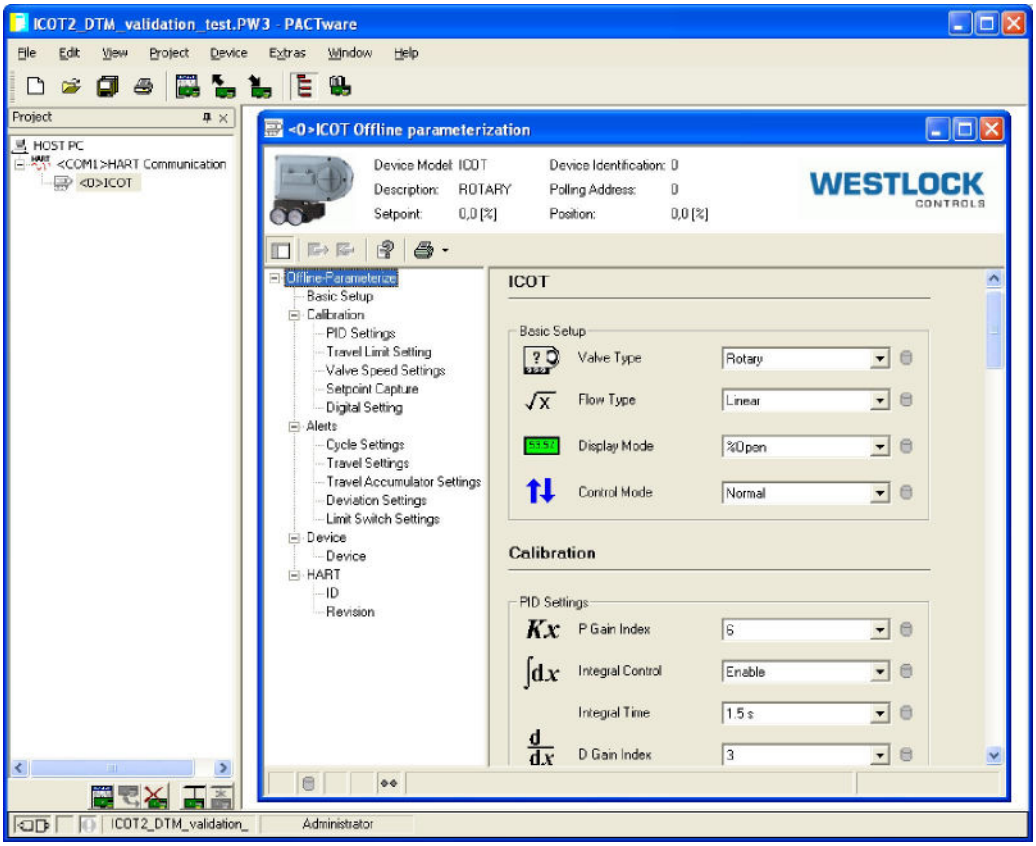
- DD files can be downloaded from:

http://www.hartcommproduct.com/inventory2/index.php?action=viewprod&num=928

- FDT certified DTM, compatible with FDT 1.2, contact Westlock Controls:

http://www.westlockcontrols.com

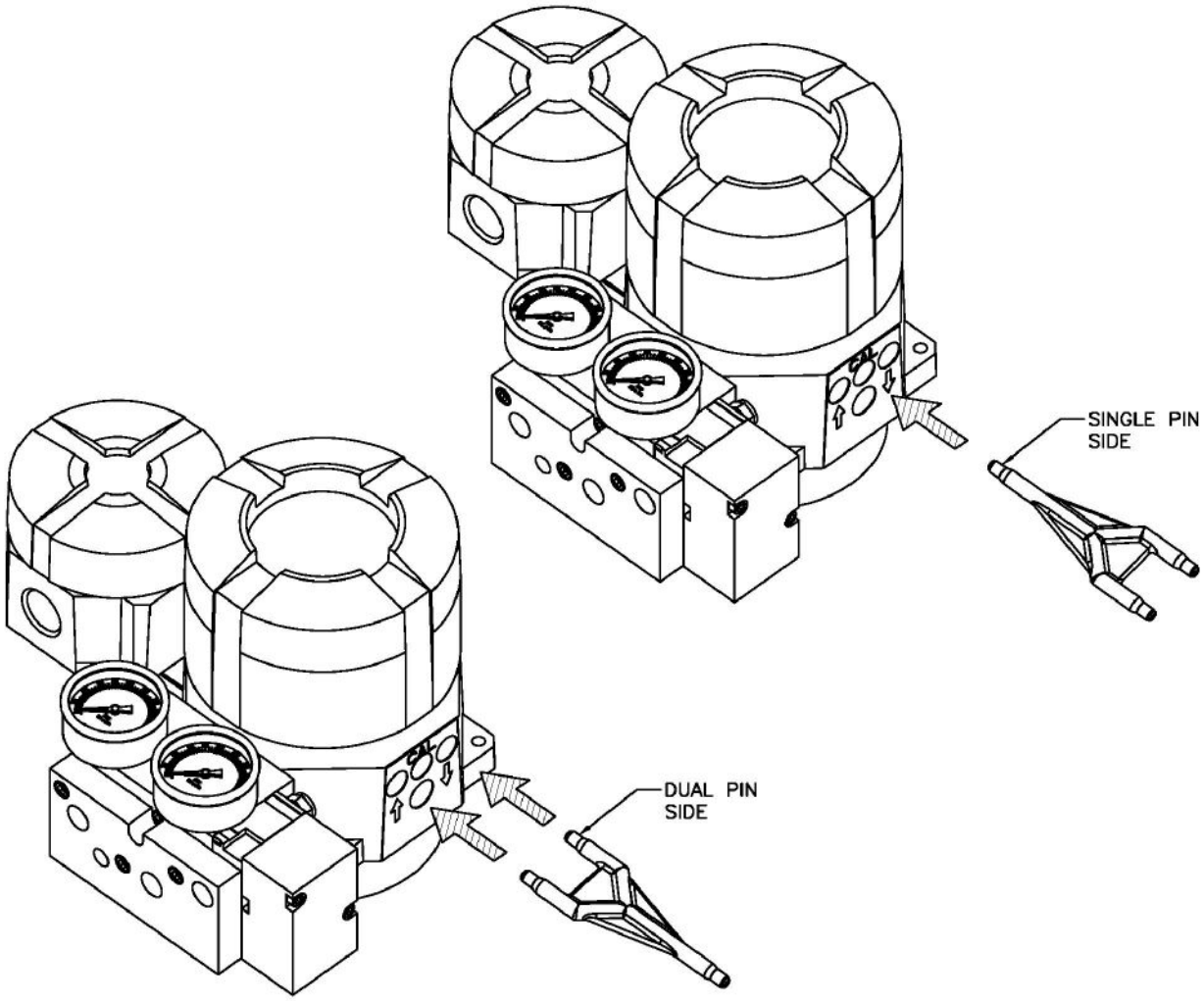
Westlock Controls also provides the FDT Pactware 3.0 that can be used in conjunction with the DTM to perform configuration and diagnostics. Contact us for more information. Visit also www.fdtgroup.org.



Appendix F

How to use Non-Intrusive Calibration Feature

The positioner is equipped with three magnetic sensors that can be activated externally allowing the user to calibrate and configure ICoT 6000 without removing the cover. Any button function accessed internally can be completed externally. The positioner comes with a magnetic tool part number TL-30003 that is used to operate the non-intrusive feature. Use single pin side or dual pin side of the magnetic tool depending on the needs of the calibration and configuration. Enter desired side of the tool into designated cavity (up arrow, cal or down arrow) to engage the sensor and remove the tool. Use non-intrusive feature to complete any part of section 4 (Calibration and Configuration).
See figures below on how to use the magnetic tool.



Appendix G

Cover Lock Operation

The cover lock employs an Allen Head Cap Screw to secure the underside of the cover edge when turned in the CCW direction. The screw cannot be removed due to the interference with the cover.

1. Use a .155 in. (3.95mm) Allen wrench turning in a CCW direction to engage the screw.
2. Tighten to 12in. lb. (1.35 nM).
3. To disengage turn screw in a CW direction to release.