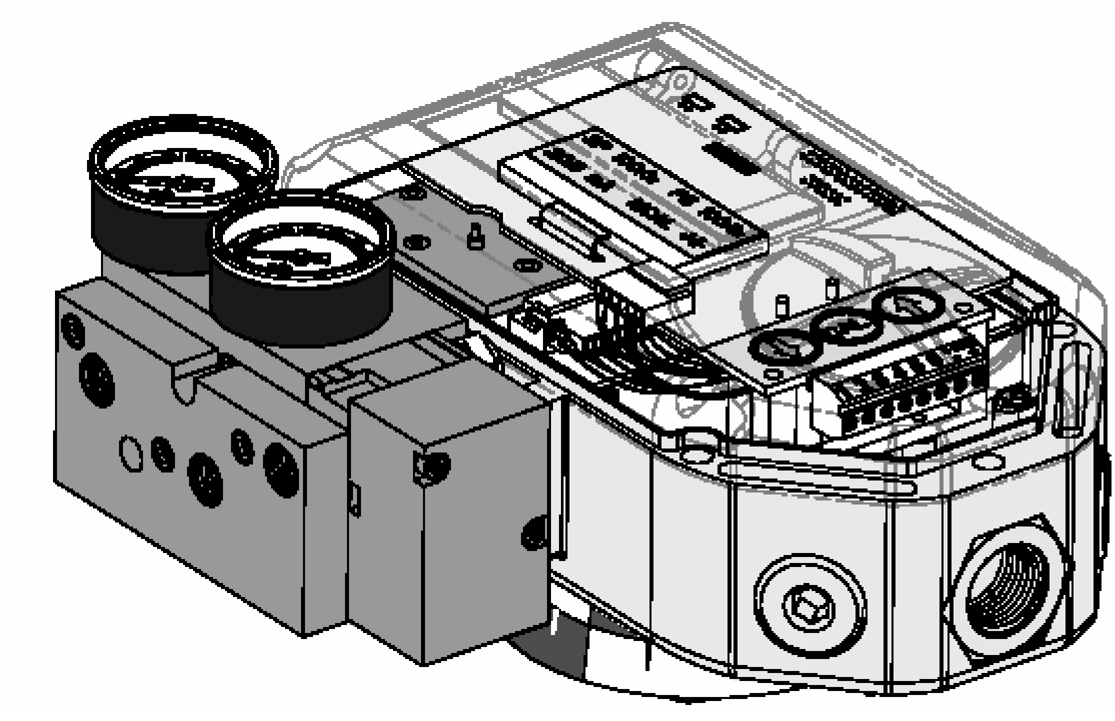
WESTLOCK
CONTROLS CORPORATION

Foundation Fieldbus
5400-IS ICoT Positioner



Installation and Operation Manual

FOUNDATION

1. Revision History

1.1. Revision 1.0

24 March, 2003

Initial Version

1.2 Revision 1.2

4 May, 2005

Updated content and included FISCO Control Drawing in Appendix A

Table of Contents

2. Definitions, Acronyms and Abbreviations

This section contains definitions to all acronyms or abbreviations used in this document.

Table 1 - Definitions and Acronyms	
HW	Hardware
SW	Software
DCS	Distributed Control System
DD	Device Description
AI	Analog Input
AO	Analog Output
PID	Proportional Integrative Derivative
DI	Discrete Input
DO	Discrete Output
FB	Function Block
FF	Foundation Fieldbus
RB	Resource Block
TB	Transducer Block
Rout	Remote-Output mode
RCas	Remote-Cascade mode
Cas	Cascade mode
Auto	Automatic mode
Man	Manual mode
LO	Local Override mode
IMan	Initialization Manual mode
OOS or O/S	Out Of Service mode

Table 2 - Abbreviations	
fieldbus	**FOUNDATION** Fieldbus

3. Reference

- ICoT/SmartCal FOUNDATION FIELDBUS Interface – 11 October 2002
- Fieldbus Foundation - FOUNDATION Specification Function Block Application Process, Part 1 (FF-890)
- Fieldbus Foundation - FOUNDATION Specification Function Block Application Process, Part 2 (FF-891)
- Fieldbus Foundation - FOUNDATION Specification Transducer Block Application Process, Part 1 (FF-902)
- Fieldbus Foundation - FOUNDATION Specification Transducer Block Application Process, Part 2 (FF-903)
- Fieldbus Foundation - FOUNDATION™ Specification Common File Format (FF-103)
- Fieldbus Foundation - FOUNDATION™ Specification Device Description Language (FF-900)
- IEEE Software Engineering Standards

4. Device Overview

4.1. About FOUNDATION Fieldbus™

FOUNDATION Fieldbus is an open networking standard which provides an open specification for both the control application and the communication on the bus. The specification grew out of work done by the IEC and the ISA to define an international fieldbus standard.

Two areas of application were defined and labeled as H1 and H2. The H1 specification was intended as a digital replacement for standard 4-20mA field instrumentation and later referred to as process automation. The H2 specification was intended to extend the H1 concept to control and data collection systems and later referred to as manufacturing automation. Development of the H2 specification was halted in 1998 in favor of the High Speed Ethernet (HSE) specification. The final H1 specification[1] was released in August of 1996 while the final specification for HSE[2] was released in April of 2000.

The Fieldbus Foundation™ oversees the FOUNDATION Fieldbus specification and conformance testing of FOUNDATION Fieldbus products. It is open to any manufacturer or user of this protocol with a worldwide membership of over 100 companies.

FOUNDATION Fieldbus is a powerful networking solution that reduces the cost and time required to install and wire industrial automation devices. A single Fieldbus Intellis System will accommodate up to 32 valves and 192 discrete I/O points. FF has the capability to interconnect complex and simple devices from multiple vendors on the same network. FOUNDATION Fieldbus supports true distributed control allowing for configuration of devices for local control in the field, in the host or both.

4.2. Fieldbus Foundation™ Conformance Documentation, CFF and DD Availability

The Westlock 5400 IS FF ICoT is a Fieldbus Foundation registered device having successfully completed the required conformance tests. The Device ID is *4668472000B0F585FhgTestBlock0037* and the CFF and DD are downloadable from the Foundation's website at www.fieldbus.org or at www.westlockcontrols.com

[1] Part 1, FF-890 and Part 2, FF-891
[2] FF-044-1.0-1

Table 3 - Fieldbus Foundation™ Conformance Documentation	
Manufacturer	Westlock Controls
Model	ICoT Valve Controller 5400-IS
Category	Final Control Element
Type	IS Pneumatic Positioner
Tested Function Blocks	1xAI(S), 1xAO(s), 1xPID(s)
Other Blocks:	2xTB(c)
H1 Profile Class	31PS
H1 Device Class	Basic
Test Camp. Number	IT019200
MANUFAC_ID	0x574343
DEV_TYPE	0x1100
DEV_REV	0x01
ITK Version	4.51

4.3.Host System Compatibility Documentation

4.3.1. Allen-Bradley ProcessLogix

- FF ICOT passed all stress and interoperability testing and certified for installation in Allen-Bradley ProcessLogix systems
- For Allen-Bradley registered DD/CFF files download at: http://www.AB.com

4.4.Intrinsically Safe Design Criteria and Agency Approvals

The Westlock 5400-IS FF ICOT is designed in accordance with the criteria defined in FM 3615. Agency Approvals are listed in Table 4.

The FF ICOT 5400-IS requires the use of an agency approved IS barrier. For information on the barrier used by Westlock Controls Corp. and to obtain the agency approvals listed above, appropriate network architecture, entity parameters and segment device limits refer to ***Control Drawing WD-11704***, ***Installation and Reference for Entity Parameter IS Installation or WD-11835 FISCO IS Installation*** located in Appendix A of this document.

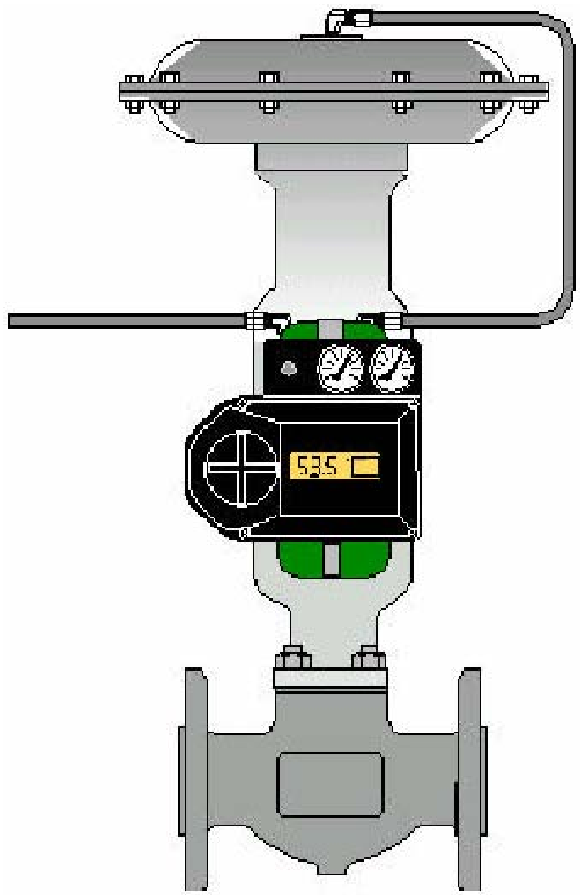
Table 4 – Hazardous Ratings		
FM	Intrinsically Safe Class I, II & III, Groups A-G, Divisions 1, T4 and Class I, Zone 0 AEx ia IIC, T4	Non-Incendive Class I, Groups A-D Class II & III, Groups F-G Division 2

4.5. Westlock FOUNDATION Fieldbus 5400-IS ICoT Positioner

4.5.1. Description of ICoT Positioner

The 5400-IS FF ICoT Smart Valve Positioner is an electro-pneumatic servo system that continuously controls the position of a valve based on the fieldbus input signal. The ICoT senses valve position via a non-contact Hall Effect sensor and controls valve position through a current to pressure transducer

The ICoT is a two wire, polarity insensitive instrument that receives both signal and power from the bus. Current consumption of the ICoT is 25 mA with an operating voltage of 9 – 35 Vdc.



The positioner has a local LCD display which indicates valve position, set-point in percentage open, calibration status, alarms status and whether the ICoT is in local or fieldbus control. The ICoT has the capability to self monitor operation. If a failure condition occurs, an error message is displayed on the local LCD display and communicated to the Host system via fieldbus.

Accurate measurements of valve stem position, input signal, actuator pressure and travel time are recorded during normal operation. With the ICoT's internal trending capability, information for control valve signature generation is developed for use in predictive maintenance.

There are several accessories that can be integrally supplied with the ICoT. Among these are an opto-isolated discrete output for alarm notification to external hardware, hermetically sealed non-contact limit sensors and a fugitive emissions monitor.

For data exchange to occur on the bus, the linking device or other interface automatically programs each fieldbus device connected to the fieldbus network with a unique address between 16 and 247.

It is possible to exchange or add devices to the network during normal operations without interfering with communications to other nodes.

Use of any standard 4-20 mA instrumentation cable (twisted shielded pair) for trunk and drops is permissible. For maximum trunk and drop distances the use of "Type A" cable[3] is required. *For a more detailed treatment of* FOUNDATION Fieldbus *physical media requirements refer to **IEC 1158-2** and Fieldbus Foundation's document **"Fieldbus Installation & Planning Guide"** (Cat. No. AG-165). For IS installations refer to Fieldbus Foundation's document "31.25 kbit/s Intrinsically Safe Systems" (Cat. No. AG-163).*

4.5.2. Specifications

Table 5 – Electro-pneumatic	
Signal	two wire FOUNDATION Fieldbus
Voltage	9 – 35 Vdc
Pressure:	Low: 15 - 45 psi
	High: 40 - 120 psi
Position Feedback	Magnetic (Non-Contact)

Table 6 –Pneumatic and Mechanical	
Flow Rate	Low: 8.0 scfm @ 25 psi
	High: 16.2 scfm @ 90 psi
Pressure	Low: 0 to 45 psi
	High 0 to 120 psi
Actuator	Single Acting or Double Acting
Stroke	Linear: 0.25 to 24 inches
	Rotary: 0 to 95 Degrees

[3] See IEC 1158-2 Physical Layer Standard, paragraph 11.7.2

Table 7 –Performance	
Resolution	2% Full Travel
Linearity	Rotary 0.5% Full Scale Linear 1% Full Scale
Hysteresis	0.2% Full Scale
Repeatability	0.2% Over One Hour
Operating Temp	-40°C to 85°C (-40°F to 185°F)
Thermal Coefficient	2% / 100°C
Air Consumption	Low: 0.003 scfm @ 25 psi High: 0.008 scfm @ 90 psi

Table 8 –Enclosure	
Material	Engineered Resin
Class of Equipment	NEMA type 4
Weight	7.2 Pounds
Air Connections	1/4” NPT
Conduit Connections	Standard:1/2” NPT Optional:M20

4.6.Principal of Operation

Unlike conventional positioners, the 5400-IS FF ICoT develops valve position feedback without the need for linkages, levers, or rotary and linear seals. Position sensing is performed by non-contacting means through the utilization of a solid state sensing element. This innovation insures a position feedback signal of high resolution with negligible hysteresis. Precision feedback coupled with state of the microprocessor controlled electronics enables the ICoT to deliver exceptional linearity, and repeatability in both rotary and linear applications (See Table 7).

5. FOUNDATION Fieldbus™ Communications Overview

FOUNDATION Fieldbus communications protocol is an industry proven international standard (IEC 61158) designed for use in the process industry. Features include multi-drop capabilities (as many as 32 devices per segment), extended trunk length, single loop integrity, "control in the field", power and communication on a shielded twisted pair network, and compatibility with intrinsically safe networks. A key feature of the FF protocol is the ability to select where control of the process is situated - in the host, in the field, or in various combinations of both locations.

The Fieldbus Foundation defined application layer is based on Function Blocks. Function Blocks are structures with defined behavior used to represent different types of functions that the device performs. **Figure 1** below illustrates a simple control loop with an AI FB in a level transmitter linked to a PID FB whose signal is controlling the position of the control valve via the DO FB. Both the PID and DO reside within the control valve.

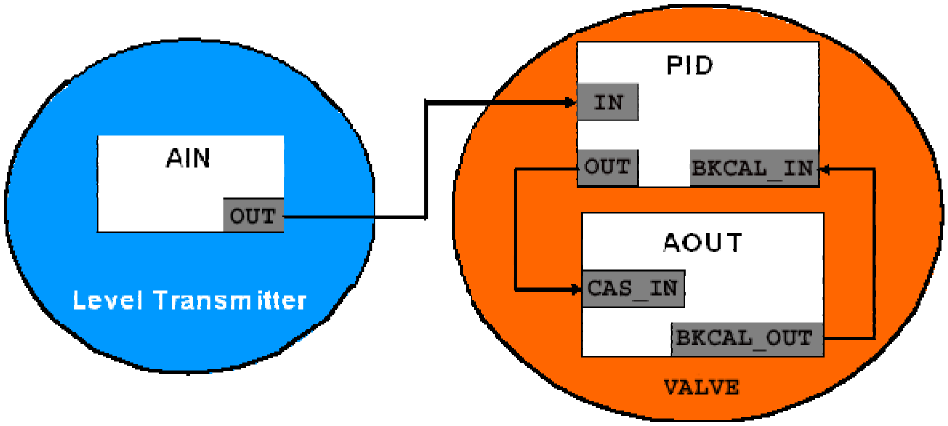


Figure 1 – Linked Function Blocks

The parameters of these blocks follow a standard framework, but manufacturers are free to enhance standard features and add additional functions as necessary. Every FOUNDATION Fieldbus device has a Resource Block, Function Blocks, and possibly a Transducer Block.

Once the hardware of a Fieldbus device is configured, Fieldbus communication is used to configure the transducer block parameters. The desired transducer functionality is associated with a specific function block via a Channel. A Channel links real world HW with the functionality of associated FB(s) as shown in **Figure 2**.

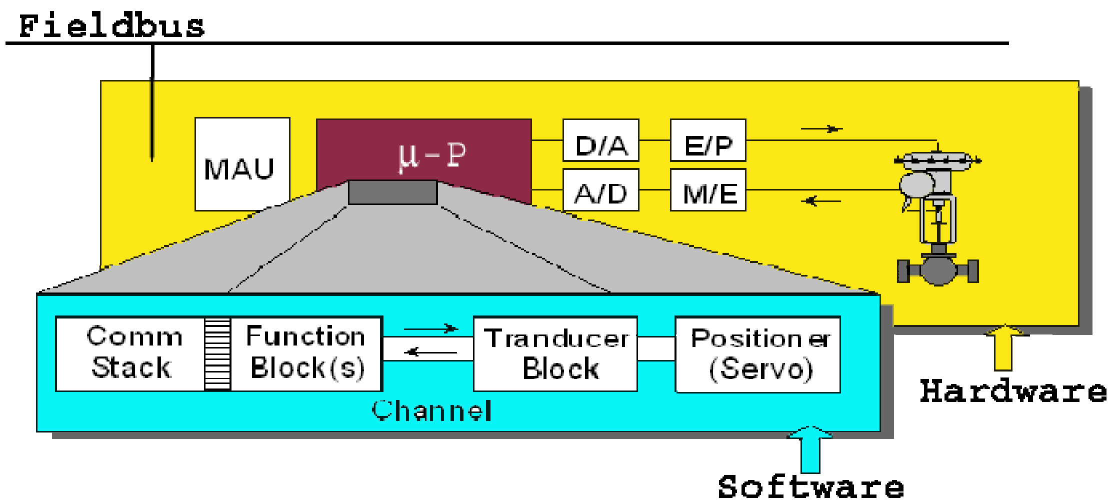


Figure 2 – Channel Linking HW via TB Configuration with FB(s)

The host system's Engineering Station is used to link the function blocks together to create a control application that can be downloaded to the devices on the H1 segment as illustrated in **Figure 3**.

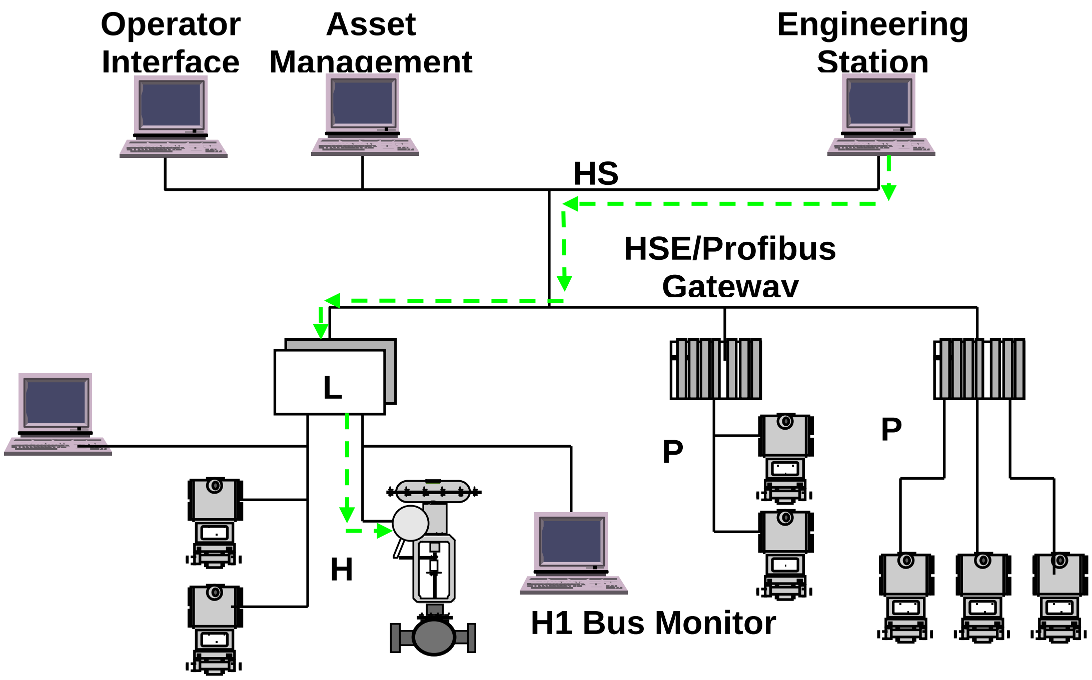


Figure 3 – Download of Control Application to Field Device

FOUNDATION Fieldbus provides the user with standardized calibration, diagnostic, and status data that enables users of Fieldbus Foundation registered products to benefit from the advantages of "smart" instruments.

5.1.Channels

Channels are used to connect a Function Block to hardware functionality in the Transducer Block. **There can be only one physical output or input per Channel**. Multiple Channels may reference the same physical output or input, though not at the same time.

The Analog Input Channel is the analog information the FF ICoT-IS hardware provides to the Fieldbus AI Function Block. The FF ICoT-IS analog input signal is the actual position of the actuator. Analog Input Channels are listed in Table 17.

The Analog Output Channel is the analog information the FF ICoT-IS hardware receives from the Fieldbus AO Function Block. The FF ICoT-IS analog output signal is the setpoint for the actual position of the actuator. Analog Output Channels are listed in Table 18.

Discrete Input Channels are the discrete information the FF ICoT-IS hardware provides to the Fieldbus DI Function Blocks. FF ICoT-IS discrete inputs may come from an internal event such as an alarm or a limit switch closing or opening or from an external event via one or both of the

Auxiliary inputs, such as a High Level switch. Discrete Input Channels are always mapped to Discrete Input function blocks. Discrete Input Channels are listed in Table 19.

Discrete Output Channels are the discrete information provided to the FF ICoT-IS hardware from the Fieldbus DO Function Blocks. Discrete Output Channels are mapped to Discrete Output function blocks on the Fieldbus. Discrete Output Channels are listed in Table 20.

5.2. Analog Input

An Analog Input block takes the manufacturer's analog input data, selected by channel number, and makes it available to other function blocks for use in control. The AI takes the feedback of the actual valve position and makes it available to the Fieldbus for use in control.

5.3. Analog Output

An Analog Output block converts the value received across the Fieldbus to a positioning signal for the hardware in the device. The AO will send a control signal to the hardware based upon the channel configuration selected. This will drive the valve to the desired position.

5.4. Discrete Input

A Discrete Input block takes the manufacturer's discrete input data, selected by channel number, and makes it available to other function blocks for use in control. The DI takes a physical state change such as push button, limit switch, or alarm generation and makes it available to the Fieldbus for use in control.

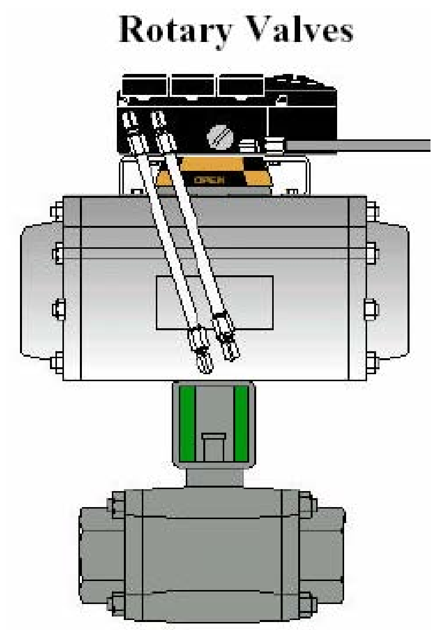
5.5. Discrete Output

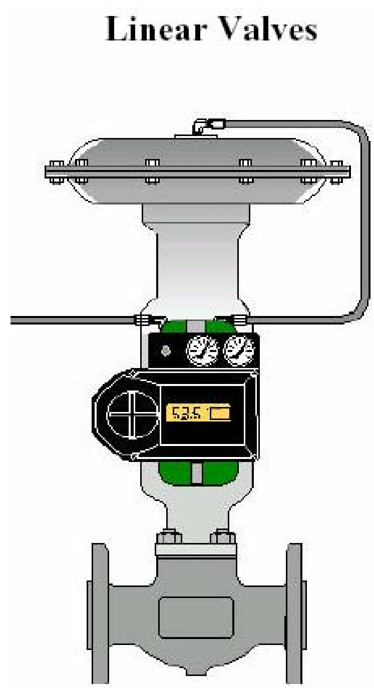
A Discrete Output block converts the value received across the Fieldbus to something useful for the hardware in the device. The DO will send a control signal to the hardware based upon channel configuration selected. The hardware may turn a motor on or off, open or close a valve, or sound a buzzer, etc.

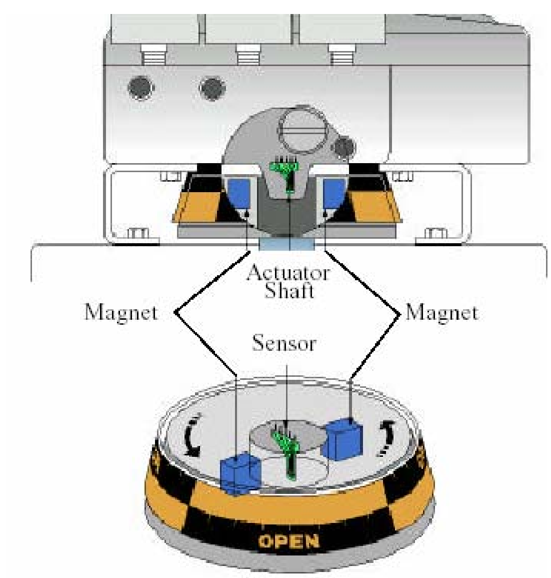
6. Special Features

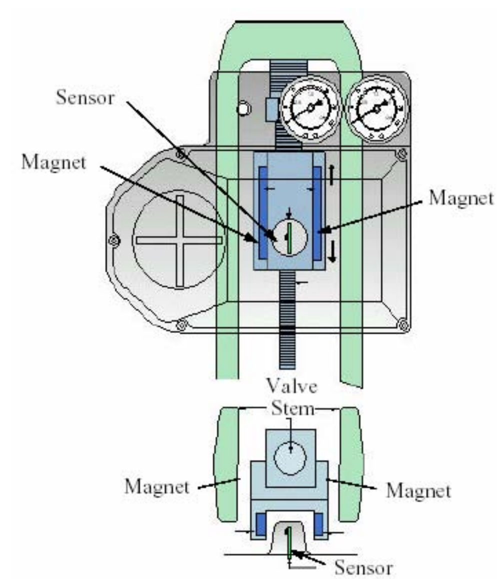
6.1. Non-Contact Position Feedback

To provide consistently accurate performance 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-contacting means based upon the characterization of flux strength as a function of position.



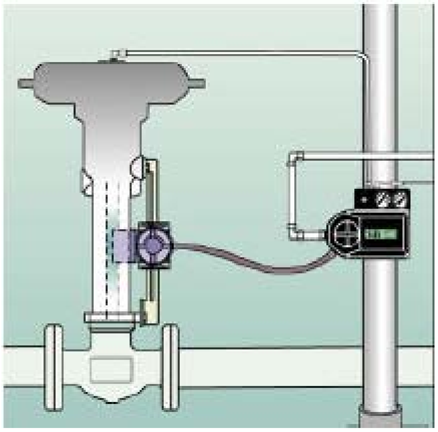






280 Midland Ave., Saddle Brook, NJ 07663 USA
Phone: (201) 794-7650 Fax: (201) 794-0913
www.westlockcontrols.com

6.2.Remote Position Control



Since valve position feedback to the FF ICoT-IS positioner is accomplished by non-contacting means, the FF ICoT-IS has the unique ability to be mounted remotely (up to a distance of 50 feet) from the device it is controlling. In the event the control valve is located in high vibration, extreme temperature or extremely corrosive environments, the non-contact position feedback feature allows for remote placement of the positioner.

6.3.Local LCD

The FF ICoT-IS positioner is fully configurable via Fieldbus or the 3-button keypad local interface. The local dot matrix LCD provides a multitude of onsite diagnostic information as well as calibration and operation status. The display also indicates whether the valve is in local or Fieldbus control.

While the valve is being controlled by the positioner, and there is a nonzero error signal, the displayed information will alternate between setpoint and position as a percentage. Each value is displayed for a period of two seconds. Once the setpoint and valve position agree to within less than 0.5%, the display will only show position. The range of values displayed is from 0.0% to 100.0%. Displayed resolution is in 0.1% increments, however, internal calculations are maintained at higher precision.

6.4.On-Board Sensors

The FF ICoT-IS positioner has the capability to self monitor its operation. If an error or failure condition occurs, the host system is updated as to the status of the device as well as being displayed on the local LCD. Note: Error codes are denoted on a label affixed to the LCD flip-up protective cover. For a listing of Error codes see also Table 16.

6.5.Local Keypad

All positioners are provided with a 3-button local control interface. All calibration routines, zero and span adjustments, manual PID and gain settings as well as valve characterization adjustments can be initiated via the local interface.

6.6. Intelligent Calibration via FF

The parameters of the FF ICoT-IS positioner are fully accessible via Fieldbus. Manual or Automatic calibration can be initiated via the bus and parameters for altering internal servo loop tuning are fully configurable. In this manner, positioner performance may be optimized with a wide combination of valves and actuators via Fieldbus.

6.7. Negligible Bleed

Designed to consume the least possible amount of control air at steady state, the FF ICoT-IS 5400 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. See Table 7 for specifications.

6.8. Predictive Alarming

There are device specific operational alarms.

- The **Cycle Limit Alarm** is activated when the time between the setpoint command being issued and the valve reaching the setpoint exceeds the time limit set during configuration of the **Cycle_Limit_Alarm** parameter (located in the TB).
- The **Out of FF Control** alarm is activated when the FF ICoT-IS has determined that it is unable to respond to a setpoint command from the bus, such as during a local calibration procedure.

These conditions can trigger Fieldbus alarms on the bus that can be handled via the standard Fieldbus alarm mechanism. For critical applications the Maskable Signal described in Section 5.11 can be used to link the alarms directly to a DI. This allows the alarm state to be linked directly to another FB for immediate action in the process.

6.9. Preventative Maintenance Alarming

Maintenance alarms can be generated when the user configured Cycle Count Limit is reached. The device will have a continuous cycle count for each change in setpoint command. The **Cycle_Count_Limit** parameter (located in the TB) is set during configuration. The maintenance alarm will be generated when **Cycle_Count** accumulates a number larger than the associated **Cycle_Count_Limit**. This condition can trigger an Fieldbus alarm on the bus that can be handled via the standard Fieldbus alarm handling.

7. General Features

- Fieldbus Foundation™ Conformant Stack and hardware
- Intrinsically Safe
- Solid State Hall Effect position Sensor
- User configurable custom alarms
- Transducer with diagnostic features
- 2 wire device, polarity insensitive
- Available Blocks: 1x Resource Block
  2x Transducer Blocks
  - Analog Transducer Block
  - Positioner Specific Transducer Block

  1x AO Block
  1x AI Block
  1x PID Block
- 20 configurable VCR(s)
- Valve driver: electro-pneumatic servo
- Operating voltage: 9-32VDC
- Maximum voltage: 35VDC
- Maximum current consumption: 25 mA

8. Mounting the Positioner

IMPORTANT: If the FF ICoT-IS is already in the field mounted on an actuator and valve, please follow the field wiring instructions in Section 9.

WARNING: The FF ICoT-IS should always be handled with care when the cover is removed and wired to an electrical power source.

8.1. Mounting Positioner on a Rotary Actuator

8.1.1. 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 4 below).

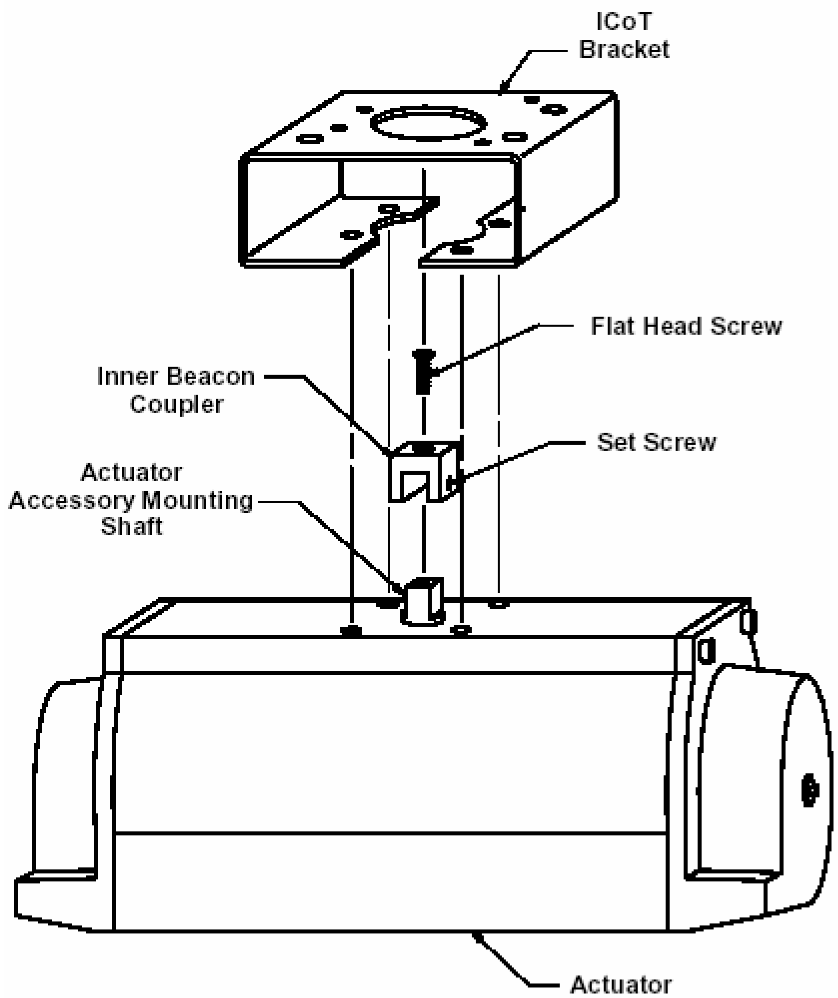


Figure 4

8.1.2. 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 Figures 5 and 6 below).

8.1.3. 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.

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**

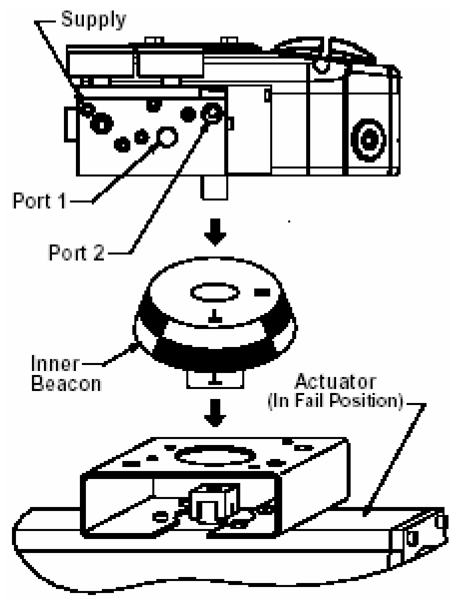


Figure 5

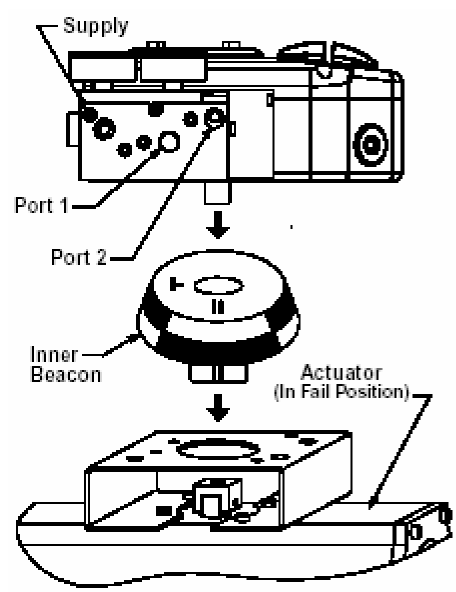


Figure 6

8.2.Mounting Remote Positioner on a Rotary Actuator

8.2.1. Mount bracket and inner beacon coupler to actuator as described in Section 7.1.1.

8.2.2. 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 Figure8 and 9).

8.2.3. 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.

8.2.4. Mount positioner at a remote location, wire the positioner sensor back to the positioner using the cable provided (See Figure 7).

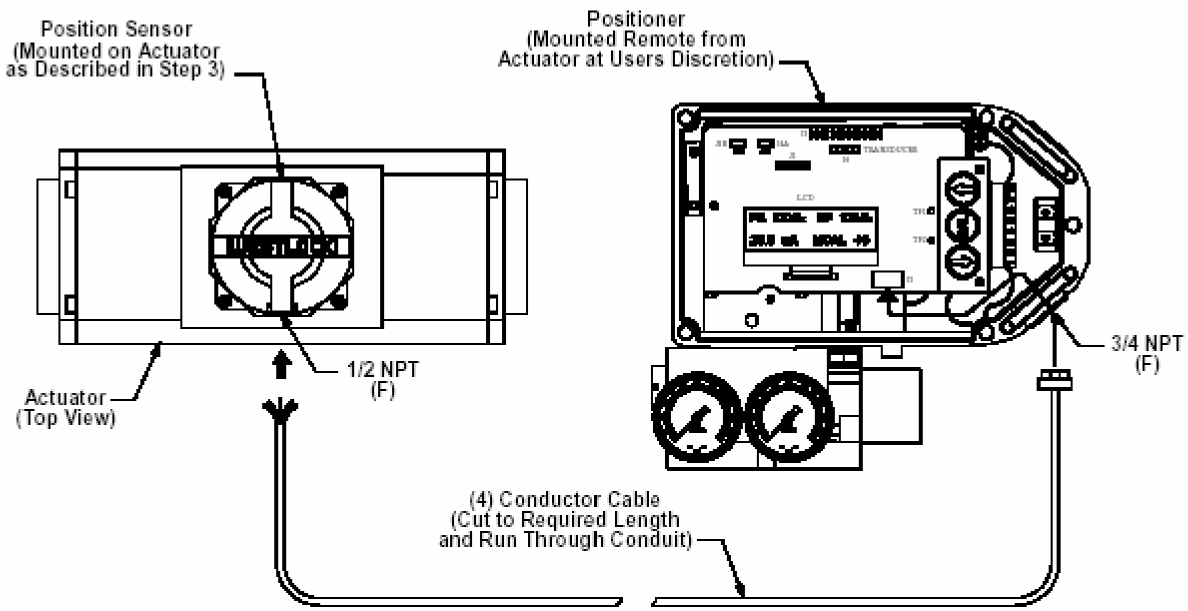


Figure 7

8.2.5. For wiring instructions for the remote sensor housing see Section 8.3.

280 Midland Ave., Saddle Brook, NJ 07663 USA
Phone: (201) 794-7650 Fax: (201) 794-0913
www.westlockcontrols.com

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**

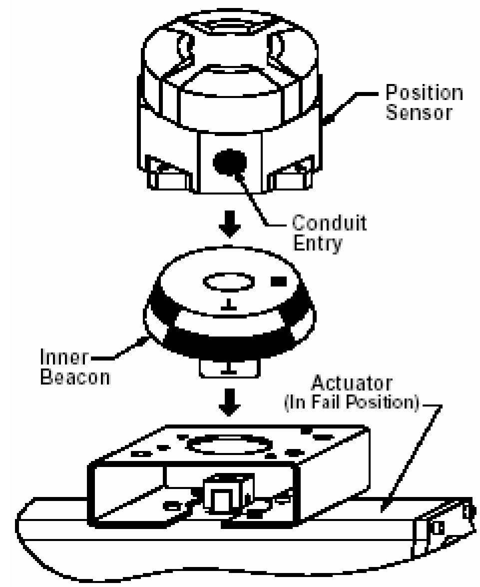


Figure 8

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**

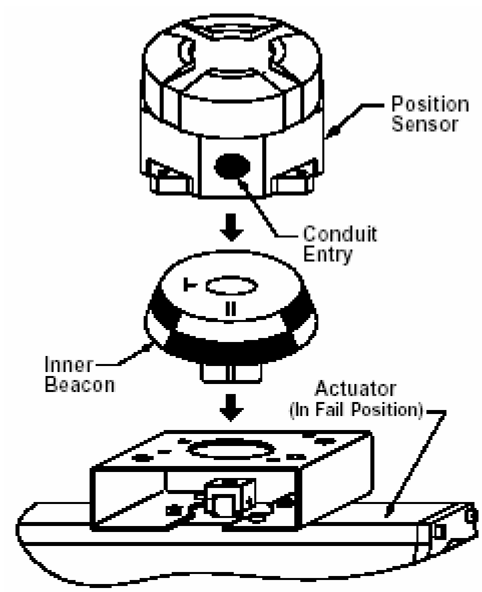


Figure 9

8.3.Mounting Positioner on a Linear Actuator

8.3.1. Mount the magnet assemble 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 Hall Effect Sensor.

8.3.2. Fasten the mounting bracket to the actuator.

8.3.3. Mount the positioner to the mounting bracket. The positioner should be mounted so the Hall Effect Sensor 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" of the back of the positioner (1/16" is ideal). (See Figure 10).

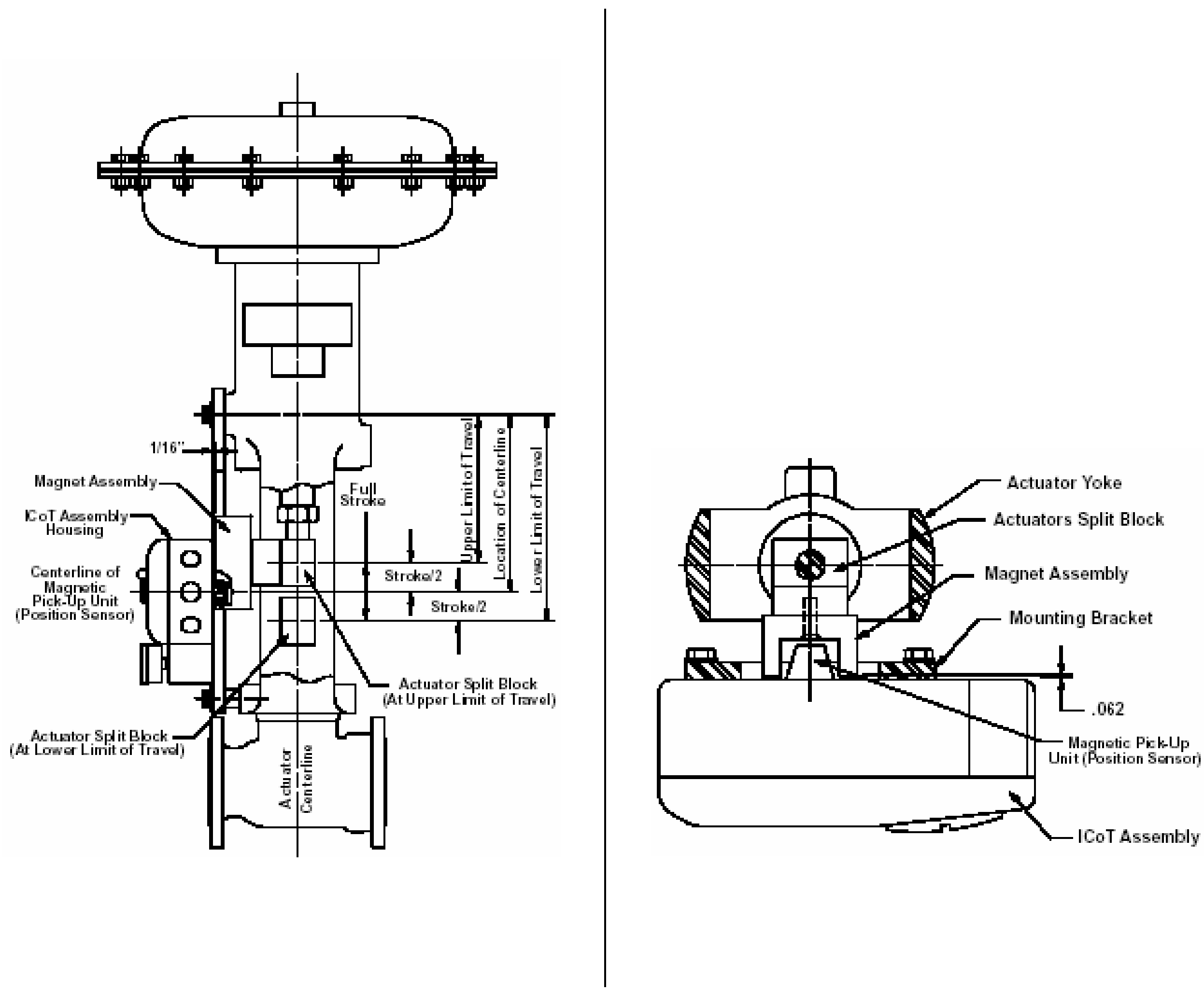


Figure 10

NOTE: For Fisher actuators model 657 and 667, sizes 34 – 70, Westlock Controls supplies a slotted mounting kit. This will allow the user to easily center the positioner sensor between limits of the magnet assembly's stroke.

8.3.4. To Center the Positioner

8.3.5. 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.

8.3.6. 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.

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

8.3.8. Lastly, mount the positioner to the bracket so that the positioner sensor (nose) of the ICoT lines up with the midpoint mark (See Figure 11).

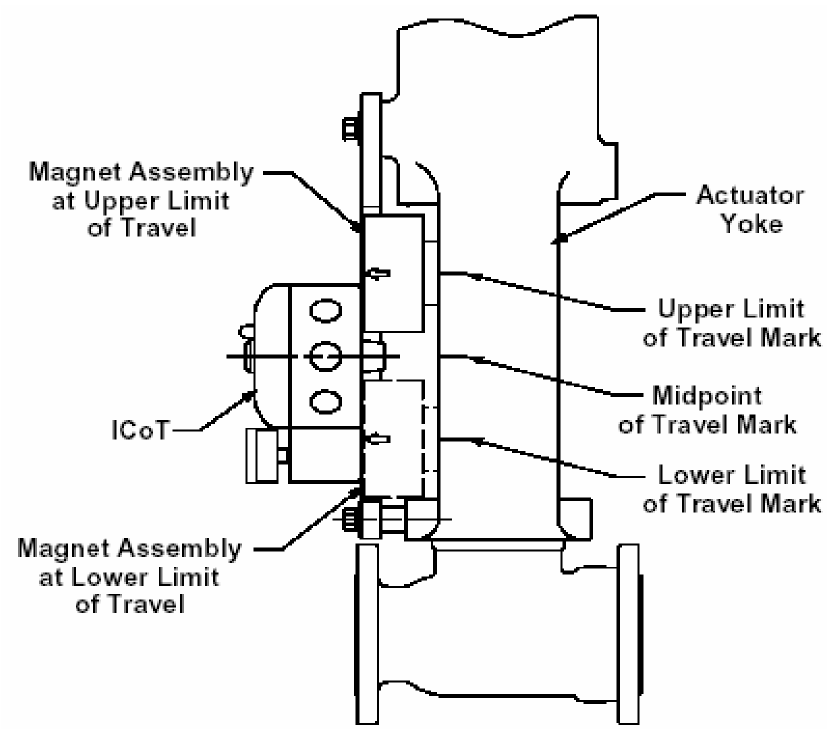


Figure 11

8.4.Mounting Remote Positioner on a Linear Actuator

8.4.1. Mount the magnet assembly and bracket to the actuator as described in Section 7.3.1.

8.4.2. Mount the position sensor housing so that the conduit entry faces away from the diaphragm or cylinder (See Figure 12)

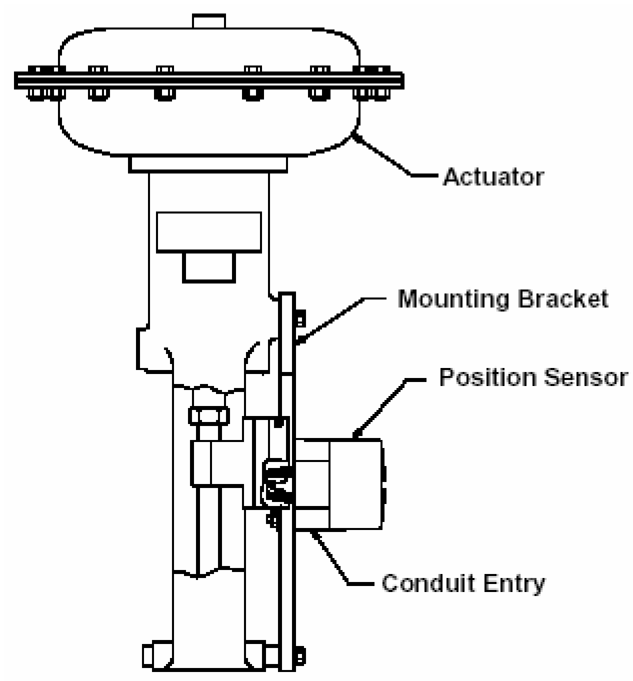
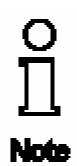


Figure 12



NOTE: For Fisher actuators model 657 & 667 sizes 34 thru 70, Westlock Controls supplies a slotted mounting kit, 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.

8.4.3. Mount positioner at a remote location, wire the positioner sensor back to the positioner using the cable provided (See Figure 13).

8.4.4. For wiring instructions for the remote sensor housing see Section 8.3.

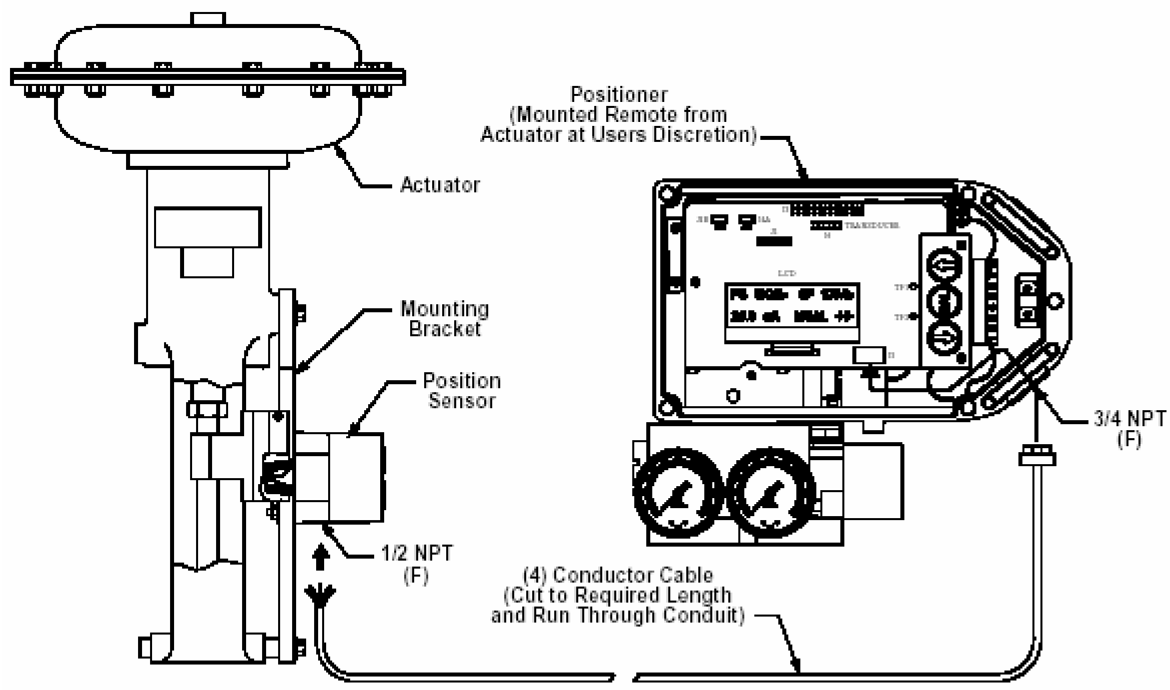

Positioner
(Mounted Remote from
Actuator at Users Discretion)
Actuator
Mounting
Bracket
Position
Sensor
1/2 NPT
(F)
(4) Conductor Cable
(Cut to Required Length
and Run Through Conduit)
3/4 NPT
(F)

Figure 13

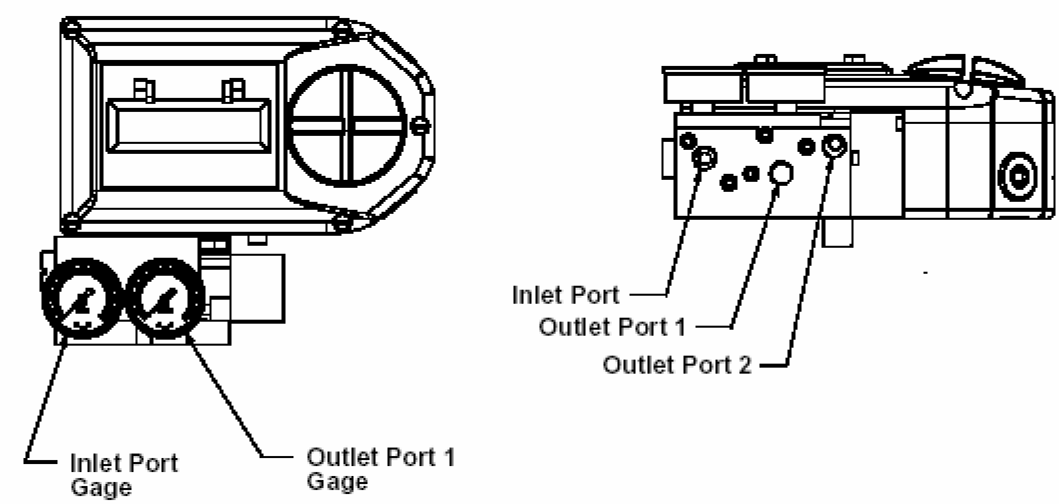
9. Pneumatic Connections

9.1. Single Acting Actuator (Spring Return):

9.1.1. 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. An increase in signal will cause the pressure to increase in Outlet Port 1 of the positioner (Refer to Figure 14).

9.2. Double Acting Actuator (Double Return):

9.2.1. For double acting actuators Outlet Port 2 is piped to drive the actuator to the fail position. Outlet Port 1 is piped to drive the actuator away from the fail position. An increase in signal will cause the pressure in Outlet Port 1 of the positioner to increase and the pressure in Outlet Port 2 to decrease (Refer to Figure 14).



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 power pressure fails to Outlet Port 2.

Figure 14

10. Wiring Instructions for the FF ICoT-IS

10.1. General Wiring Instructions

WARNING: TO PREVENT IGNITION OF HAZARDOUS ATMOSPHERES, **ALWAYS** check the enclosure nameplate to confirm the agency approval ratings coincide with the application.

1. All wiring must be in accordance with National Electrical Code (ANSI-NFPA-70) for the appropriate area classifications. For agency approved barriers, wiring and installation guidelines for the FF ICoT-IS, refer to ***Control Drawings WD-11704, Installation and Reference for IS Installation or WD-11835 FISCO IS Installation*** located in Appendix A of this document.
2. When the FF ICoT-IS is installed in accordance with approved practices and safety barriers it is agency approved as Intrinsically Safe (Entity and FISCO, see Section 4.4) for service in Class I, II and III, Division 1, Groups A-G, T4 and Class I, Zone 0 AEx ia IIC, T4 hazardous locations.
3. The FF ICoT-IS enclosure, is approved for indoor/outdoor (NEMA type 4, 4X) applications.
4. The wiring diagram for the FF ICoT-IS is shown in Figure 15 below. The wiring diagram for your unit is also shown on the inside of the enclosure cover.
5. Replace the electronics housing cover or junction housing cover.
6. Unit is now ready for automatic operation. If any assistance is required, please contact Westlock Controls Corp. (See Appendix B).

10.2. Connecting the FF ICoT-IS to the Bus

10.2.1. Remove positioner cover.

10.2.2. Locate terminal strip and carefully disconnect (See Figure 15).

10.2.3. Connect the brown (+) and blue (-) bus wires to the pins marked (+) and (-).

Note: This bus input wiring for this device is polarity insensitive.

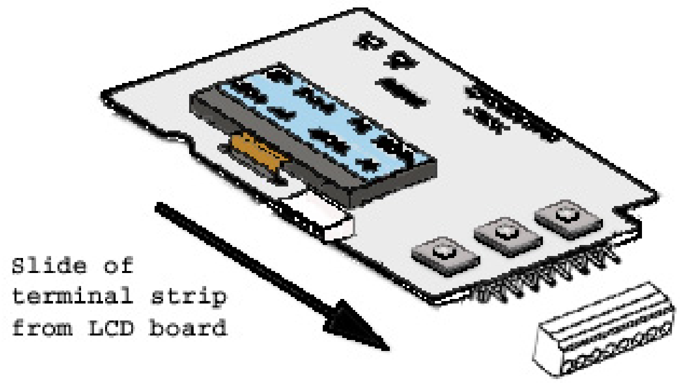


Figure 15

10.3. Connecting the FF ICoT-IS Remote Position Sensor Housing

10.3.1. Connect the remote sensor housing cable as shown in Figure 16 below.

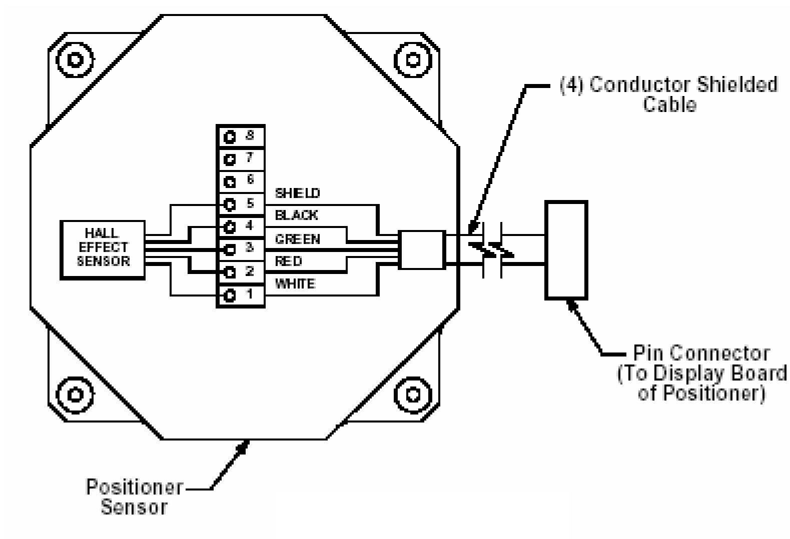


Figure 16

11.Switch Adjustment on Rotary ICoT

- Open the actuator to the desired extreme.
- Loosen magnetic trigger bolt #1 per Figure 17.
- Slide trigger bolt #1 beneath the first switch and tighten with wrench.
- Operate the actuator to the opposite extreme.
- Loosen magnetic trigger bolt #2.
- Slide trigger bolt #2 beneath the second switch and tighten with wrench.

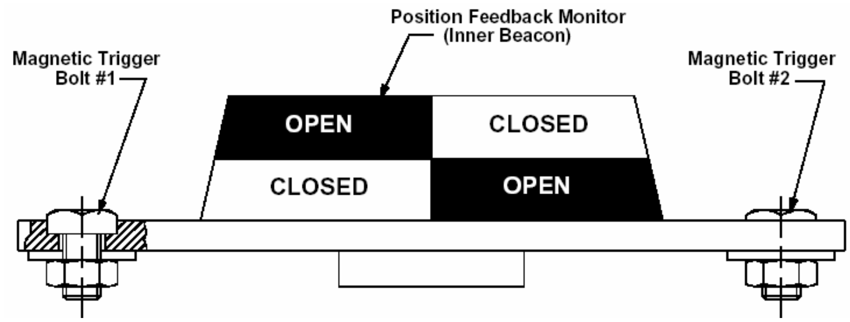


Figure 17

12. FOUNDATION™ Fieldbus Supported Topologies

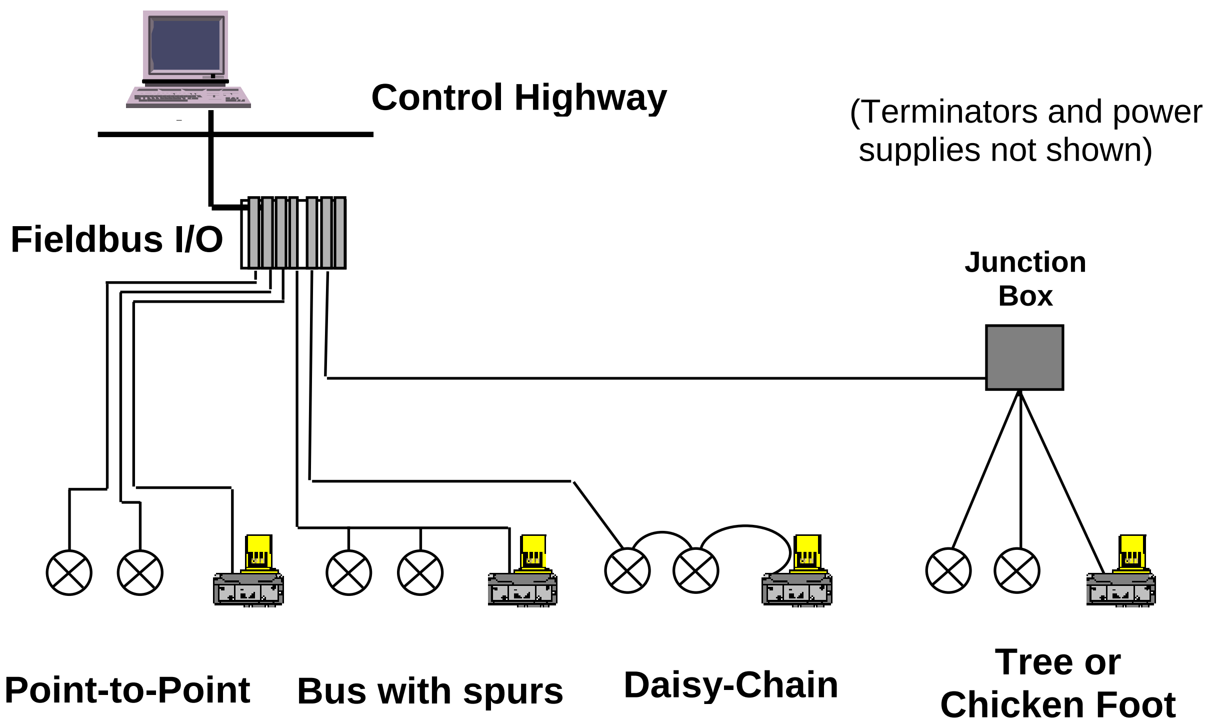


Figure 18

13.FF ICoT-IS Display

13.1. Run Time Display

13.1.1. The run time display indicates the following parameters as shown in Figure 19.

1. Setpoint
2. Valve position
3. Indication of positioner in Fieldbus control or not in Fieldbus control
4. Error type indicated if present

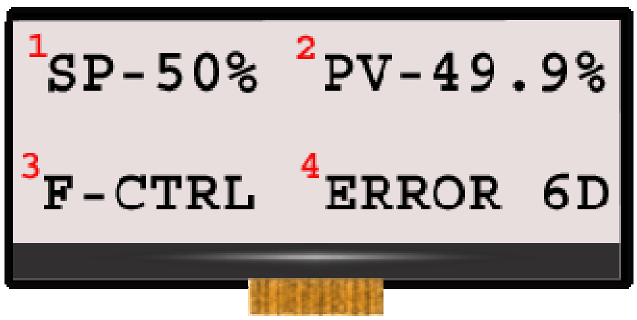


Figure 19

13.2. Calibration Display

13.2.1. The calibration display indicates the following parameters as shown in Figure 20.

1. Setpoint
2. Valve position
3. Indication of positioner in Fieldbus control or not in Fieldbus control
4. Error type indicated if present

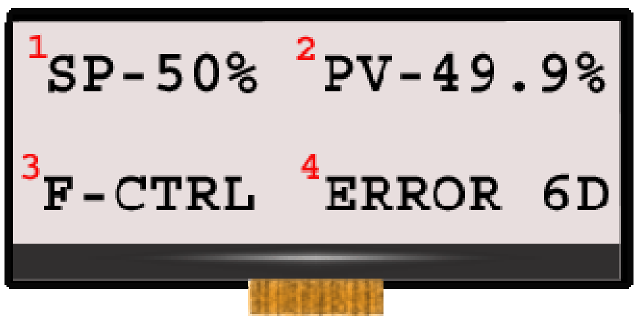


Figure 20

14. Configuration Instructions for Fieldbus Parameters

See Section 28 for a detailed list of configurable parameters.

15. Calibration Instructions

15.1. Enter Calibration (Menu Level)

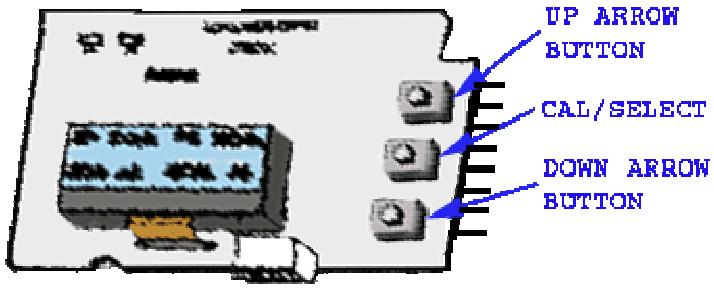


Figure 21

15.1.1. Enter the calibration routine by pressing and holding the **CAL** button.

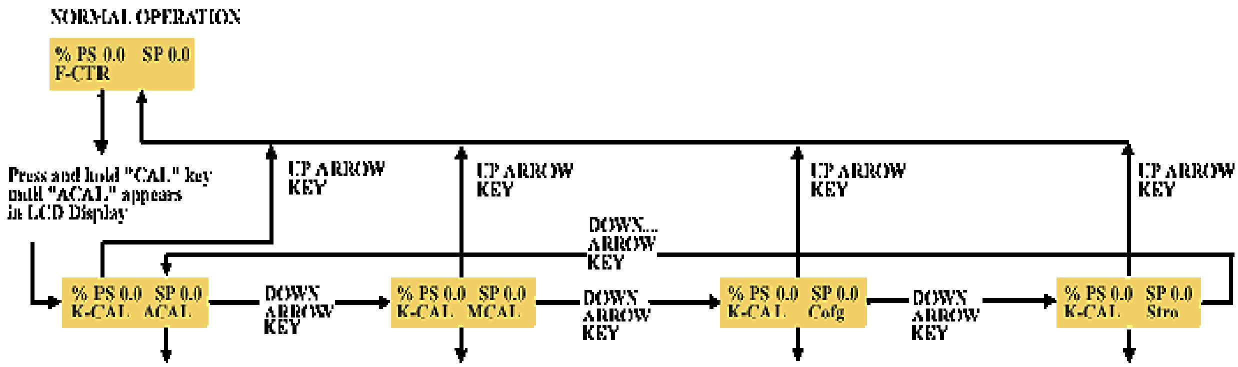
15.1.1.1. Continue to hold the **CAL** button until **ACAL** appears on the LCD.

15.1.2. **ACAL** (Auto Cal Menu) is the first of four menus. By pressing the down arrow button you can cycle through the four menus.

15.1.2.1. The remaining three menus are:

- **MCAL** (Manual Cal Menu)
- **Cofg** (Configuration Menu)
- **Stro** (Manual Position Override Menu).

The menu level is shown in Figure 22 below.



See Section 15.3 See Section 15.4.2 See Section 15.2 See Section 15.6

Figure 22

Return to Calibration Instructions

Return to Table of Contents

15.2. Configuration Instructions for Positioner Parameters (Cofg)

15.2.1. From the menu level press the down arrow button until the **Cofg** (Configuration Menu) is shown on the display (Configuration Routine shown in Figure 23 below).

15.2.2. Enter this menu and change any of the parameters if other than the factory settings are required. The factory settings are highlighted in blue.

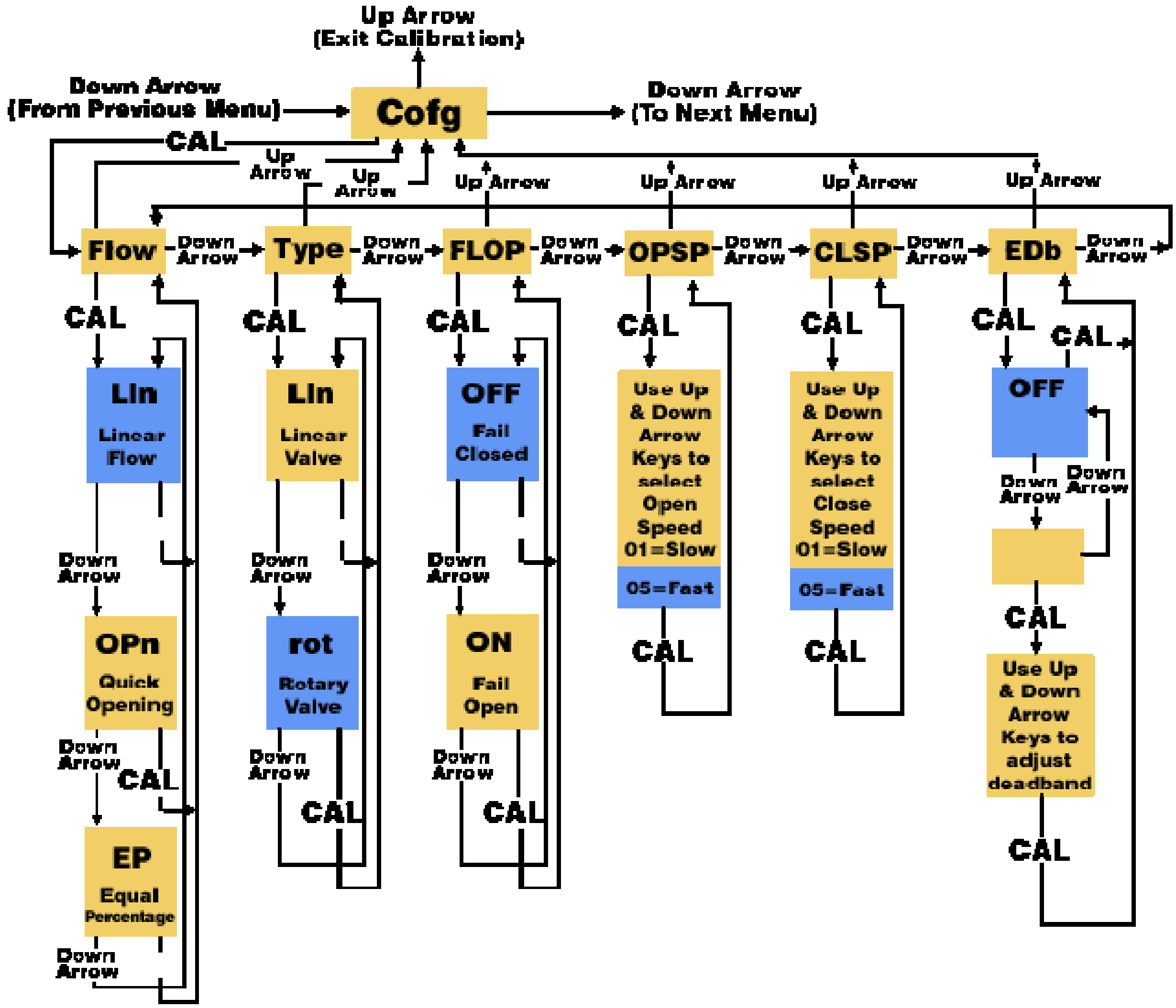


Figure 23

Return to Calibration Instructions

Return to Table of Contents

15.3. Automatic Calibration Procedure (ACAL)

15.3.1. The Automatic Calibration (**ACAL**) performs several self-adjustments, as well as a zero calibration, a span calibration, and tunes the positioners PID gain settings.

15.3.2. Enter and start the Automatic Calibration from the Menu level. From the menu level press the down arrow button until **ACAL** is shown on the display (**ACAL** Routine shown in Figure 24 below).

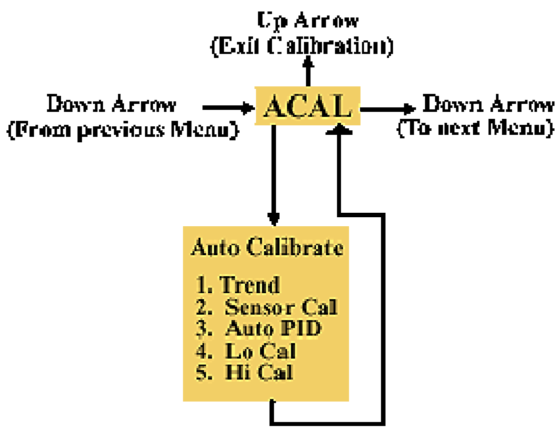


Figure 24

Return to Calibration Instructions

Return to Table of Contents

15.3.3. Proceed to Exiting Calibration or Perform Advanced Calibration.

15.4. Manual Calibration (MCAL)

15.4.1. At this point the calibration of the positioner is complete. The Automatic Calibration that was performed in Section 15.3 is adequate for most applications. If advanced calibration is not required proceed to Section 15.5 to exit calibration.

15.4.2. If the user requires the advanced settings to fine tune the positioner he may proceed with the remainder of this step and perform adjustments and calibrations in the Manual Calibration Menu (**MCAL**).

15.4.3. From the menu level press the down arrow button until **MCAL** is shown on the display (**MCAL** Routine shown in Figure 26 below).

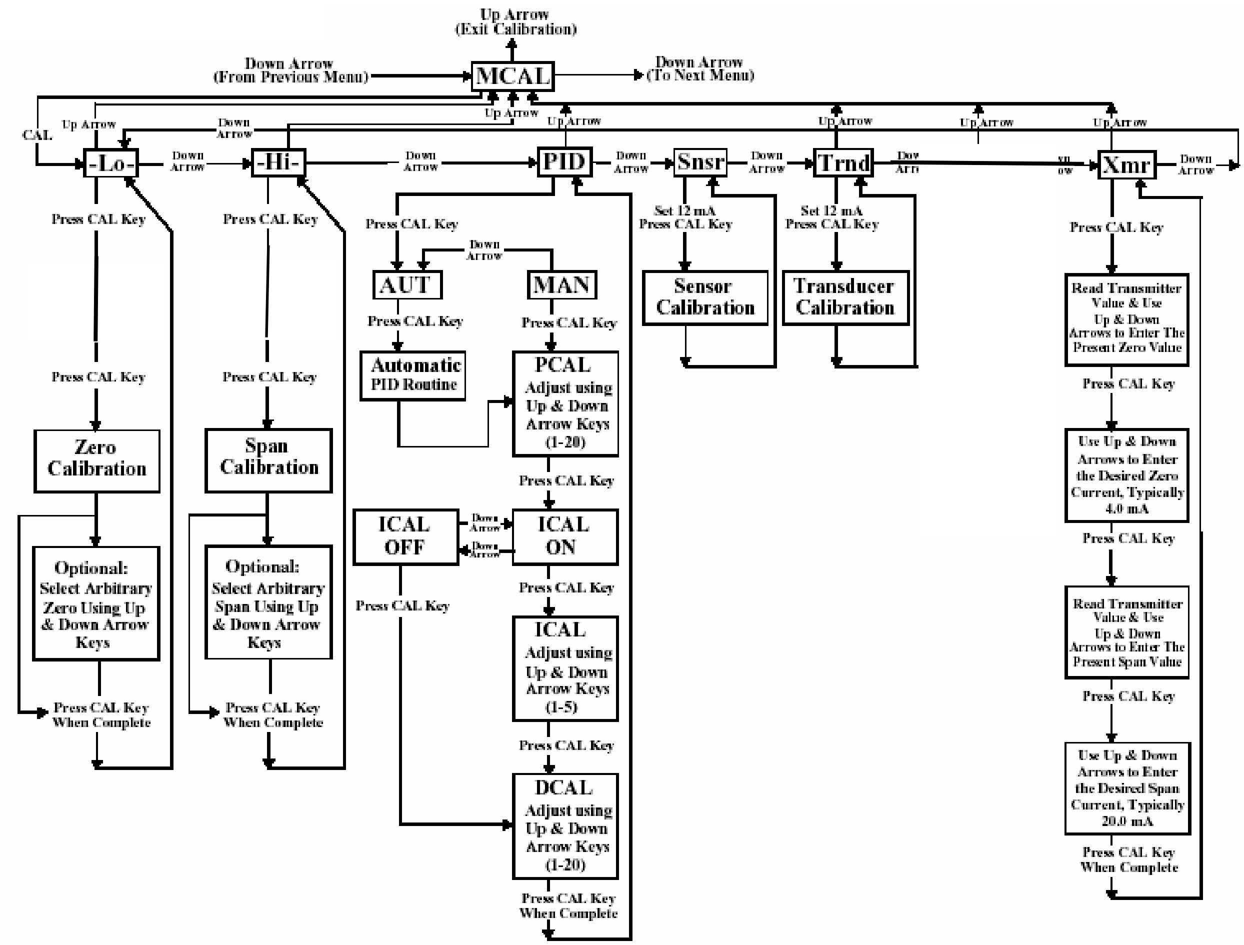


Figure 26

Return to Calibration Instructions

Return to Table of Contents

15.5. Exiting Calibration

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

15.5.1.1. 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.

15.5.1.2. 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.

15.5.1.3. The LCD will display “OK” when positioner is out of Menu level.

NOTE: When a calibration function is initiated, the user must wait until the function’s calibration is complete before being able to exit calibration. The **up arrow** key can be used, as described above, to move to the Menu level and then to exit **CAL** mode only after the calibration procedure is complete.

15.6. Manual Override of Input Signal via On-Board Keypad (Stro)

The positioner has a feature which allows the operator to override the FF control signal and change valve position from the keypad. This is done from the **Stro (Manual Override-Stroke Menu).** Enter calibration as described in section 15.1 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.

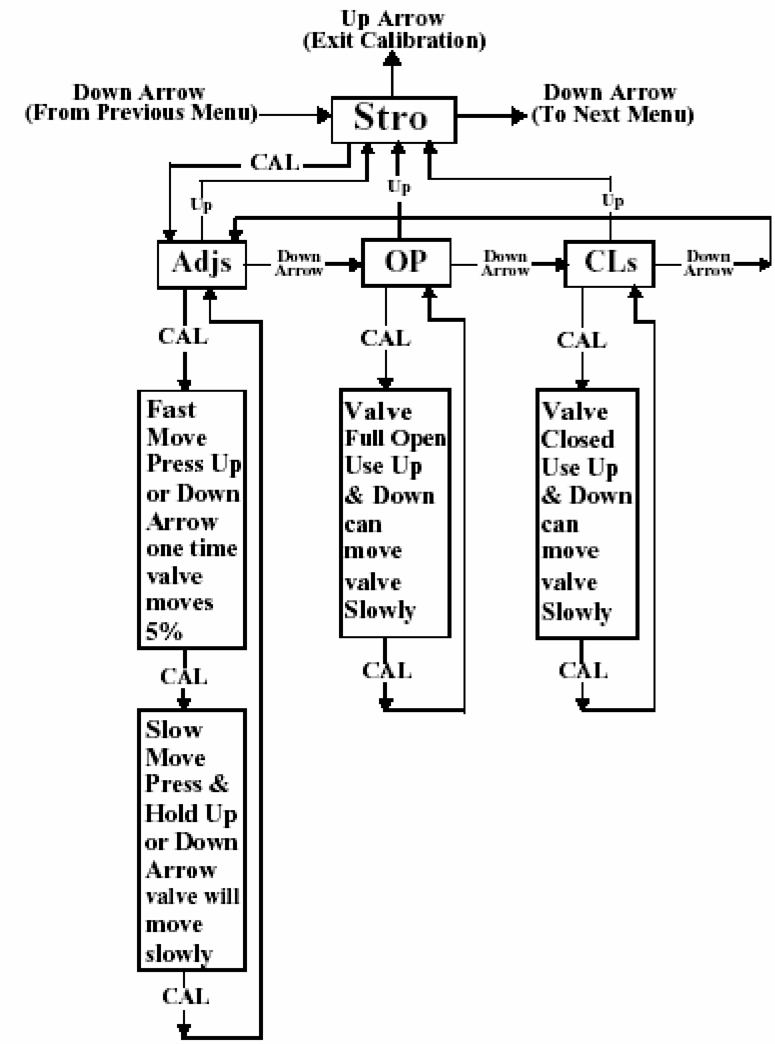


Figure 27

Return to Calibration Instructions

Return to Table of Contents

16.Description of Menus

The calibration functions of the positioner are organized into four menus as shown in Table 9.

Table 9 –Calibration Menus	
Abbreviation	**Menu**
ACAL	Automatic Calibration
MCAL	Manual Calibration
Cofg	Positioner Configuration
Stro	Stroke – manual override of input signal

16.1. Menu 1: ACAL (Automatic Calibration)

The positioner will automatically perform a shallow (input current independent) calibration in the sequence listed in Table 10.

Entering this menu allows you to initiate an approximately 6.5 minute self-calibration function.

Table 10 –ACAL Calibration Functions	
Abbreviation	**Function**
Snsr	Hall Effect Sensor Calibration
Trnd	Transducer Calibration
Lo	Low (Zero) Calibration
Hi	High (Span) Calibration
Auto	Automatic PID Tuning

16.2. Menu 2: MCAL (Manual Calibration)

Entering this menu allows you to access the calibration functions listed in Table 11 via the keypad.

Table 11 –MCAL Calibration Functions	
Abbreviation	**Function**
Lo Hi PID	Low (Zero) Calibration High (Span) Calibration Proportional, Integrative and Derivative Gain Adjustment
Snsr Trnd Auto	Hall Effect Sensor Calibration Transducer Calibration Automatic PID Tuning

16.3. Menu 3: Cofg (Configuration)

Entering this menu allows you to access the configuration functions listed in Table 12 via the keypad.

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

Table 12 –Cofg Calibration Functions	
Abbreviation	**Function**
Flow Type Flop	Positioner Output Flow Characteristics Positioner Recognition of Magnetic Feedback, Rotary or Linear Positioner Fail Position, Open or Closed
OPSP CLSP	Positioner Opening Speed Adjustment Positioner Opening Speed Adjustment

16.4. Menu 4: Stro (Manual Override of Input Signal)

Entering this menu allows you to access the stroking functions listed in Table 13 via the keypad.

These functions remove the positioner from FF control mode (input signal independent) and therefore allow override of the control signal.

Table 13 –Stro Calibration Functions

Abbreviation	Function
Adjs	Local Adjustment of Positioner Setpoint Using Up/Down Keypad Arrows
OP	Open, Sets the Valve to the Full Open Position
CLS	Close, Sets the Valve to the Full Closed Position

17. Description of Functions

17.1. 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 (see Figure 14).

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. After approximately 30 seconds pressure will again increase in Outlet Port 1 and the valve will be driven off of the hard stop (approx. 10% of full travel), and then driven back to the hard stop.

The calibration function is making note of the torques required to fully seat and un-seat the valve from the hard stop. 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.

17.2. 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 (see Figure 14).

After a short period of time pressure will increase in Outlet Port 2 and will be driven off of the hard stop (approx. 10% of full travel), and then driven back to the hard stop.

The calibration is making note of the torques required to fully seat and un-seat the valve from a hard stop. 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.

17.3. PID

The PID function allows the user to enter or change the PID settings of the positioner. This unction is most often used to fine tune the PID values obtained from the automatic calibration function (**ACAL**).

This function will allow the user to optimize the dynamic response of the positioner with respect to speed of response, overshoot and percent error by varying the appropriate gain settings.

The 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 larger the number selected the higher the gain setting.**

17.4. Snsr

The sensor calibration function calibrates 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 in a new application and only if the **ACAL** routine is not performed.

17.5. Trnd

The purpose of this function is to calibrate the positioner's transducer. The transducer is calibrated on all new positioners at the factory; therefore this procedure does not need to be performed for a new positioner. Perform this calibration function only if a replacement transducer or electronic canister was installed in the positioner.

17.6. Flow

This function allows configures 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.

17.7. Type

This function configures the positioner for the type of valve. The options are **rot** (Rotary) and **lin** (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.

17.8. 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).

17.9. 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.

Table 14 –OPSP Settings

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

17.10. 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.

Table 15 –CLSP Settings

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

17.11. EDb

This feature configures the positioner's operating deadband. The configuration options are "**off**" and "**on**". The positioner factory default setting is "**off**".

When the deadband feature is "**off**" it operates with nominal value of ± 0.3% of full scale for deadband.

When the feature is turned "**on**", the deadband can be set using the up and down arrow buttons to a value from 1 to 20. The value 1 (*lowest deadband when turned* "**on**") has a deadband range of 1%, which is equivalent to a deadband of ± 0.5%. The value 20 (*highest deadband value*) has a range of 20%, which is equivalent to a deadband of ± 10%.

17.12. Adjs

This function allows for the adjustment of the positioner to any position via the keypad. This function places the positioner in local control mode (input signal 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 incrementally via the keypad.

17.13. 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 local control mode (input signal independent) and therefore allows override of the control signal.

17.14. CLs

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

18. Error Codes

Table 16 lists the Error Codes the positioner will display for the listed fault conditions.

Table 16 –Error Codes	
Abbreviation	**Indication**
Er0 3 (Error 3)	Low Input Pressure or Clogged Filter
Er6A (Lo cal)	Calibration Error - Positioner could not successfully perform Lo calibration
Er6B (Hi cal)	Calibration Error - Positioner could not successfully perform Hi calibration
Er6C (PID cal)	Calibration Error - Positioner could not successfully perform PID calibration

19. Channels

Channels are used to connect a Function Block to hardware functionality in the Transducer Block. A Channel links real world HW with the functionality of associated FB(s) as shown in **Figure 2**.*There can be only one physical output or input per Channel*. Multiple Channels may reference the same physical output or input, though not at the same time.

19.1. Analog Channels

The Analog Input Channel links the analog information of the FF ICoT-IS hardware to the fieldbus AI Function Block. The FF ICoT-IS analog input signal is the actual position of the actuator.

The Analog Output Channel links the analog information of the fieldbus AO Function Block to the FF ICoT-IS hardware. The FF ICoT-IS analog output signal is the setpoint for the actual position of the actuator.

ReadBack is the actual discrete state value provided by the Limit Sensors (if appropriately configured in **IO_OPTS** located in the DO FB). The actual discrete state is passed back through the Discrete Output function block via the **READBACK_D** parameter. Control schemes may use the **READBACK_D** value to reflect the actual position of the affected controlled element.

Discrete Output Channels link the discrete output information of the Discrete Output function blocks on fieldbus through the TB to the FF ICoT-IS Discrete Output HW (servo driver) and always includes ReadBack.

19.2. Channel Errors

Write checks limit the writing to only valid channels based upon the configuration already present. If no channels are currently configured, the first channel written determines the limits on subsequent channels.

Attempts to run devices with invalid channel selections will result in the blocks not running and the generation of active block alarms from one of the following errors:

- No Output Channels
- Close without Open
- Open without Close
- Conflicting Channels Assigned

19.3. Available Analog Input Channels

Table 17 – Analog Input Channels

Channel	Channel Name	Channel Description
0	No Transducer Connection	
2	Actual Position	Feedback of actual valve position
21	No Op - testing	

19.4. Available Analog Output Channels

Table 18 – Analog Output Channels		
Channel	**Channel Name**	**Channel Description**
0	No Transducer Connection	
1	Valve Position	Drives Valve to Open or Closed Position
21	No Op - testing	

20. Conditionals

Conditionals are expressions in the device description that allow the enumerations of one parameter to be based on the value of another parameter. In other words, conditionals can be used to present the user a certain list of **OUT_D** enumerated values based on the Channel that was selected for the block.

NOTE: Some host systems handle conditionals correctly while others do not. Please note that these tables may be very useful for those using host systems that do not process conditionals correctly and are unable to display the appropriate text strings.

The device contains several conditionally evaluated parameters. These conditionals are listed in this section.

21. Mode

Mode is a parameter of four parts:

1. Actual mode
2. Target mode
3. Permitted mode(s)
4. Normal mode.

Target mode may be set and monitored by the user. Target mode determines which mode the user wants the block to transfer.

Actual mode is set by the block during its execution and reflects the mode used during execution.

Allowed target modes are defined by permitted mode(s). This is configured in each block.

Normal mode is the desired operating mode of the block in normal operation.

When a block is in **Out of Service** mode (**O/S** or **OOS**) it will not evaluate and the associated data will have **Bad Status**. If the mode is **OOS** the output of the function block is usually maintained at the last value but can be configured to go to a predefined **Fail State**.

Parameter configurations are usually performed in **OOS** mode so there is no bump in a running process. Before a particular block will be usable in a configuration, the mode must not be **OOS** and block specific parameters may need modification (appropriate Channel or **Action_Element** selected, etc.).

21.1. Supported Modes and Enumerations:

Note

NOTE: Some host systems handle enumerations correctly while others do not. Please note that these tables may be very useful for those using host systems that do not process enumerations correctly and are unable to display the appropriate text strings.

Table 25 – Mode Enumerations	
Numerical Value	**Enumerations**
0x01	Remote-Output (Rout)
0x02	Remote-Cascade (RCas)
0x04	Cascade (Cas)
0x08	Automatic (Auto)
0x10	Manual (Man)
0x20	Local Override (LO)
0x40	Initialization Manual (IMan)
0x80	Out of Service (OOS or O/S)

22. Supported Modes by Block Type

22.1. Analog Output Block Supported Modes

Table 26 - AO Block– Supported Modes	
Numerical Value	**Enumerations**
0x02	Remote-Cascade (RCas)
0x04	Cascade (Cas)
0x08	Automatic (Auto)
0x10	Manual (Man)
0x20	Local Override (LO)
0x40	Initialization Manual (IMan)

22.2. Analog Input Block Supported Modes

Table 27 – AI Block – Supported Modes	
Numerical Value	**Enumerations**
0x08	Automatic (Auto)
0x10	Manual (Man)
0x80	Out of Service (O/S)

22.3. Transducer Block Supported Modes

Table 30 – TB – Supported Modes	
Numerical Value	**Enumerations**
0x08	Automatic (Auto)
0x10	Manual (Man)
0x80	Out of Service (O/S)

Note

NOTE: The modes supported by the transducer block are defined by the **device manufacturer**. In **Man** mode the *DO channel values are not acted upon*, but instead the output can be set using the **SP_D** and **SP_D2** parameters.

22.4. Resource Block Supported Modes

Table 31 – RB – Supported Modes	
Numerical Value	**Enumerations**
0x08	Automatic (Auto)
0x40	Initialization Manual (IMan)
0x80	Out of Service (O/S)

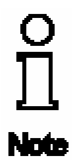
Resource block supported modes are defined by the FF Specifications.

23. Status

Input and Output parameters have a value, and status. The status tells the condition of the value, whether the data is Bad, Uncertain, Good (cascade), or Good (non-cascade). A sub-status tells more about the value, such as possible reasons for the status. The Quality narrows the conditions even more.

Status can assist in diagnosing issues in the system and is used for validating communicated data.

24. ReadBack



NOTE: FOUNDATION fieldbus output blocks have a **READBACK** parameter. **For different Channels it may show different values**. Control schemes may use the **READBACK** value to reflect **the actual state of the affected controlled element**.

To enable **READBACK** in any standard FOUNDATION fieldbus output block two options must be verified.

1. In the RB, **FEATURE_SEL** must include bit 5-"Out ReadBack" (**FEATURE_SEL** enumeration 0x20). To change **FEATURE_SEL**, the RB must be in OOS.

2. In the Discrete Output block, the **IO_OPTS** Bit 9-"Use PV for **BKCAL_OUT**" must be selected to enable **READBACK**. Be sure the DO block is in OOS before modifying **IO_OPTS**.

25.Fault State

NOTE: The **FAULT_STATE** parameter, located in the RB, defines the action taken by a block when stale data or communication failure is detected. **FAULT_STATE** is also used when **bad** or **uncertain** quality is specified for each block. Function blocks that provide process output (DO, PID, etc.) will have parameters to allow a special "Fault State" action to be specified on detection of an input with bad or uncertain quality (stay put, fail open, etc.).

The actual **FAULT_STATE** parameter is included in the RB since it is common to all function and transducer blocks. The **FAULT_STATE** parameter determines the response of an output block if one or more **FAULT_STATE** conditions are present in the device longer than **FSTATE_TIME**. **FAULT_STATE** conditions include:

- loss of communications to **CAS_IN**
- Initiate **FAULT_STATE** status at **CAS_IN** when the target mode is **CAS**
- Initiate **FAULT_STATE** status at **RCAS_IN** when the target mode is **RCAS**

If a fault state condition does not clear within the user-defined **FSTATE_TIME**, then the block output will be automatically driven to the predefined fault state and, optionally, the target mode will be set to manual. The **FSTATE_TYPE** parameter determines the action to be taken - hold last value or go to the state defined by the user via the **FSTATE_VAL_D** parameter.

Writing the **SET_FSTATE** parameter of the RB may also put this block into the predefined **FAULT_STATE**. To clear the fault state, either the condition clears, or the user may write the **CLR_FSTATE** parameter in the RB.

The "Fault State to value" **IO_OPTION** determines whether the action is simply to hold the current state, or move to **FSTATE_VAL_D**. If the **IO_OPTION** is 0, the value will hold the current (freeze) if a fault is detected. If the **IO_OPTION** is 1, the output will go to the preset **FSTATE_VAL_D** value, if a fault is detected.

The "Target to Manual if IFS" **IO_OPTION** may be used to latch the **FAULT_STATE**. Setting this **IO_OPTION** will cause a **FAULT_STATE** block alarm and cause the target mode to automatically change to manual when a fault is detected. **The target mode needs to be manually changed from manual when conditions are corrected**.

An FF alarm will be generated upon transition to an active fault state. The alarm will be handled using the standard alarm handling mechanism.

The choices for **FSTATE_VAL_D** are:

Table 32 – FSTATE_VAL_D Enumerations	
Numerical Value	**Enumeration**
0	Close
1	Open
2	Stop
3	No-Op

26.Resource State

`**NOTE:** The **RS_State** (Resource State) parameter, located in the RB, reflects the overall status of the function block application. There are 6 resource state enumerations. The **RS_State** can be used to determine hardware and resource failures that effect operation of the device.

Table 33 – RB State Enumerations		
Numerical Value	**Enumeration**	**Description**
0x01	Restart	The resources are restarting and are unavailable at this time.
0x02	Init	Block resources are initializing. All Alarms are acknowledged and cleared automatically.
0x03	Linking	Links are being established, blocks are not yet ready for control.
0x04	Online	Operational, all systems functional. Links established and parameters evaluated.
0x05	Standby	Block mode is OOS.
0x06	Failure	Memory or other hardware failure that prevents reliable operation.

27.Block_Error

NOTE: Use the **Block_Error** parameter as an aid in troubleshooting.

The **Block_Error** parameter, common to all blocks, will remain active until the condition causing the error is no longer active. The values for **Block_Error** are defined by the Fieldbus FOUNDATION.

Table 34 – Block Error Enumerations

Numerical Value	Enumeration
0x0001	Other
0x0002	Block Configuration
0x0004	Link Configuration
0x0008	Simulation
0x0010	Override
0x0020	Fault State
0x0040	Maintenance Needed Soon
0x0080	Input Failure
0x0100	Output Failure
0x0200	Memory Failure
0x0400	Lost Static Memory
0x0800	Lost NV Memory
0x1000	ReadBack Failure
0x2000	Maintenance Needed Now
0x4000	Power Up
0x8000	Out of Service

28. Westlock Specific Parameters

28.1. Block_Alarms_Active

Note Use the **Block_Error** parameter as an aid in troubleshooting

The **Block_Alarms_Active** parameter, located in the TB, gives the user further insight into configuration errors that prevent expected operation of the device. After the error is identified, the user must take the appropriate steps to eliminate the error before the device will function as intended.

Table 35 – Block_Alarms_Active Enumerations

Numerical Value	Enumeration	Description
0x00000000	None Active	No active block alarms.
0x08000000	Fault State Active	Fault State is active in the transducer block due to an invalid input or misconfiguration.
0x04000000	Invalid Mode	The computed actual mode for the block is not supported, the block's actual mode will go to out of service
0x02000000	Bad Output Configuration	Conflicting output channels have been assigned. Please review channels assignments and make appropriate corrections.
0x01000000	Invalid Input	The target position is not valid for the current device configuration.
0x00800000	Out Of Service	Transducer block is out of service.
0x00400000	No Output Channels	No output channels have been assigned, i.e. there can be no action.
0x00200000	Open without Close	An 'Open' output channel has been assigned without a 'Close' channel.
0x00100000	Conflicting Channels	Conflicting output channels have been assigned, please review and correct.
0x00080000	Both Contacts Closed	Both contacts are closed.
0x40000000	Mode Error	The mode calculator detected an error

28.2. Start_Up_State

The **Start_Up_State** parameter, located in the TB, specifies the initial position of the valve upon startup of the device.

Table 36 – Start_Up_State Enumerations	
Numerical Value	**Enumeration**
0	Close
1	Open
2	Stop
3	No-Op

28.3. Fault_State

NOTE: If the status from the associated function block is bad or if the TB has determined a problem, the valve will default to this position.

The first valve is the target of the **FAULT_STATE** and the second valve is the target of **FAULT_STATE_2**. Both parameters are located in the TB.

Table 37 – Fault_State Enumerations	
Numerical Value	**Enumeration**
0	Close
1	Open
2	Stop
3	No-Op

28.4. Discrete_State

The **Discrete_State** parameter, located in the TB, provides indication of the state of the following variables; Auxillary1 active, Auxilliary2 active, Write Protect Jumper Enabled, Simulate Jumper Enabled, Valve 1 Active, or Valve 2 Active.

Table 38 – Discrete_State Enumerations	
Numerical Value	**Enumeration**
0x01	Write Protect Jumper
0x02	Simulate Jumper
0x04	Valve1 Active
0x08	Valve2 Active
0x10	Auxiliary 1
0x20	Auxiliary 2

28.5. Action_Element

The **ACTION_ELEMENT** parameter is located in the TB and is user configurable. This parameter determines the type of valve operation required by the process application.

Table 39 – Action_Element Enumerations	
Numerical Value	**Enumeration**
0	No Selection
1	Single Action
3	Double Action
4	Single Action, Reverse Acting
6	Double Action, Reverse Acting
8	Independent, both Normal Acting
9	Independent, 1Reverse Acting 2Normal Acting
10	Independent, 1Normal Acting 2Reverse Acting
11	Independent, both Reverse Acting

Note The selection of action element will affect the meaning of the outputs of the device. It **MUST** be configured and configured correctly or the device will not operate.

28.6. Cycle_Time_History

Cycle_Time_History is a configurable parameter located in the TB. A set of up to 400 cycle times can be stored in the device and later retrieved using the standard fieldbus trend system.

To store the cycle times the **CYCLE_TIME_COLECT_TYPE** parameter must be enabled. Either “continuous collection” or “one-time collection” may be chosen.

To initiate the collection of timing data the **COLLECT_CYCLE_TIME** parameter must be set to “Active”. If you select “continuous collection”, select “Inactive” to stop the collection of data.

To report the collected data, configure the **CYCLE_TIME_HISTORY** parameter as a standard fieldbus trend. Once configured, set the **COLLECT_CYCLE_TIME** parameter to “Report”. The collected data will be sent via the standard trend mechanism. Once all the collected data has been reported, the report will stop. To have the report sent again, set **COLLECT_CYCLE_TIME** parameter to “Report” again.

29.Block Parameter Tables

Tables 24 – 27 list and define all parameters for each block contained in this device. The parameters are listed by name as they appear in the **Device Description (**see Section 4.2 above).

NOTE: Some parameters are Read/Write and others are read-only. Some Write parameters are only configurable when the appropriate interlocks are configured.

29.1. Transducer Block Parameter Descriptions

Table 40(a) – Transducer Block Parameter Descriptions

Parameter	**Description**
ACT_FAIL_ACTION	Specifies the final failure position of the actuator as defined in section 4.6 of FF-903 rev PS3.0
ACT_MAN_ID	The actuator manufacturer identification number.
ACT_MODEL_NUM	The actuator model number.
ACT_SN	The actuator serial number.
ACTION_ELEMENT	User configurable parameter to determine the type of valve operation needed. It MUST be set before operation.
ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
AUXINPUT1	State of first auxiliary discrete state.

AUXINPUT2	State of second auxiliary discrete state.
BLOCK_ALM	Used for all configuration, hardware, connection failure, or system problems in the block. The cause of the alert is entered in the subcode field. Queued and reported as generated.
BLOCK_ALMS_ACTIVE	Detailed listing of active block alarms to assist troubleshooting.
BLOCK_ERR	The error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
BREAKAWAY_TIME	Westlock reported time taken for valve to begin moving.
CLEAR_CYCLE_COUNT	User writable to clear the cycle count of the first valve and begin counting from 0 again.
CLEAR_CYCLE_COUNT2	User writable to clear the cycle count of the second valve and begin counting from 0 again.
CLOSE_LIM_SWITCH	Discrete showing state of the close limit switch as seen in Shared Data.
COLLECT_CYCLE_TIME	Enables the collection of Cycle_Time in Cycle_Time_History
CYCLE_COUNT	Westlock reported number of cycles on the first valve.
CYCLE_COUNT_ALM	Alarm generated when the number of cycles on the first valve exceeds the limit.
CYCLE_COUNT_LIM	User configurable limit of number of cycles on first valve before alarm is generated.
CYCLE_COUNT2	Westlock reported number of cycles on the second valve.

Table 40(b) – Transducer Block Parameter Descriptions	
Parameter	**Description**
CYCLE_TIME	Westlock reported time taken to cycle the valve.
CYCLE_TIME_ALM	Alarm generated when valve does not cycle in the desired time.
CYCLE_TIME_COLLECT_TYPE	Selects Continuous or stop when full collection of cycle time.
CYCLE_TIME_HISTORY	Last Cycle_Time, used for trending Cycle_Time
CYCLE_TIME_LIM	User configurable Floating Point value used as limit to determine Cycle Time alarm.
CYCLE_TIME_PRI	User configurable priority of Cycle Time alarm
DEVICE_ERR	Errors preventing proper operation of device.
DISCRETE_STATE	FI generated value indicating whether Auxillary1 active, Auxilliary2 active, Write Protect Jumper Enabled, Simulate Jumper Enabled, Valve 1 Active, or Valve 2 Active.
FAULT_STATE	If the status from the associated function block is bad or if the transducer block has determined a problem, the first valve will default to this position.
FAULT_STATE2	If the status from the associated function block is bad or if the transducer block has determined a problem, the second valve will default to this position.
FINAL_POSITION_VALUE_D	Actual position of the first valve.
FINAL_POSITION_VALUE_D2	Actual position of the second valve.
FINAL_VALUE_D	The requested position and status written by a discrete function block for the first valve.
FINAL_VALUE_D2	The requested position and status written by a discrete function block for the first valve.
HI_TEMP_LIMIT	Sets the threshold for the HI_TEMP alarm
LO_TEMP_LIMIT	Sets the threshold for the LO_TEMP alarm
MASKABLE_SIGNAL	User configurable mask that allows alarms to be linked as discrete parameter.
MODE_BLK	The actual, target, permitted, and normal modes of the block.
MODULE_TEMP	Displays the ambient temperature of the FPAC-NI-ULP
OPEN_LIM_SWITCH	Discrete showing state of the open limit switch as seen in Shared Data.

Table 40(c) – Transducer Block Parameter Descriptions	
Parameter	**Description**
SHARED_DATA	The shared data structure used for communication between FF Function Blocks and hardware. This is available for debugging and troubleshooting.
SP_D	The discrete setpoint of the first valve.
SP_D2	The discrete setpoint of the second valve.
START_UP_STATE	The initial position of the valve upon startup.
ST_REV	The revision level of the static data associated with the function block. To support tracking changes in static parameter attributes, the associated block's static revision parameter will be incremented each time a static parameter attribute value is changed. Also, the associated block's static revision parameter may be incremented if a static parameter attribute is written but the value is not changed.
STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
SUPPORTED_MODES	Read only parameter that indicates the modes supported by the block.
TAG_DESC	The user description of the intended application of the block.
TRAVEL_TIME	Westlock reported time needed for the valve to move between limit switches.
UPDATE_EVT	This alert is generated by any change to the static data.
VALVE_MAN_ID	The valve manufacturer identification number.
VALVE_MODEL_NUM	The valve model number.
VALVE_SN	The valve serial number.
XD_CAL_DATE	The date of the last positioner calibration.
XD_CAL_LOC	The location of last positioner calibration. This describes the physical location at which the calibration was performed.
XD_CAL_WHO	The name of the person responsible for the last positioner calibration.
XD_ERROR	One of the error codes defined in section 4.8 XD_ERROR and Block Alarm Subcodes (FF-903 revPS3.0 section 4.8)
VALVE_TYPE	The type of the valve as defined in section 4.7 Valve Type.

29.2. Resource Block Parameters

Table 41(a) – Resource Block Parameters	
Parameter	**Description**
ST_REV	The revision level of the static data associated with the function block. To support tracking changes in static parameter attributes, the associated block's static revision parameter will be incremented each time a static parameter attribute value is changed. Also, the associated block's static revision parameter may be incremented if a static parameter attribute is written but the value is not changed.
TAG_DESC	The user description of the intended application of the block.
STRATEGY	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	The actual, target, permitted, and normal modes of the block.
BLOCK_ERR	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
RS_STATE	State of the function block application state machine.
TEST_RW	Read/write test parameter – used only for conformance testing.
DD_RESOURCE	String identifying the tag of the resource which contains the Device Description for this resource.
MANUFAC_ID	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
DEV_TYPE	Manufacturer's model number associated with the resource – used by interface devices to locate the DD file for the resource.
DEV_REV	Manufacturer revision number associated with the resource – used by an interface device to locate the DD file for the resource.
DD_REV	Manufacturer revision number associated with the resource – used by an interface device to locate the DD file for the resource.
GRANT_DENY	Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.

Table 41(b) – Resource Block Parameters	
Parameter	**Description**
HARD_TYPES	The types of hardware available as channel numbers.
RESTART	Allows a manual restart to be initiated. Several degrees of restart are possible. They are 1: Run, 2: Restart resource, 3: Restart with defaults, and 4: Restart processor.
FEATURES	Used to show supported resource block options.
FEATURE_SEL	Used to select resource block options.
CYCLE_TYPE	Identifies the block execution methods available for this resource.
CYCLE_SEL	Used to select the block execution method for this resource.
MIN_CYCLE_T	Time duration of the shortest cycle interval of which the resource is capable.
MEMORY_SIZE	Available configuration memory in the empty resource. To be checked before attempting a download.
NV_CYCLE_T	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_TIME, only those parameters which have changed (as defined by the manufacturer) need to be updated in NVRAM
FREE_SPACE	Percent of memory available for further configuration. Zero in a preconfigured resource.
FREE_TIME	Percent of the block processing time that is free to process additional blocks.
SHED_RCAS	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_RCAS = 0.
SHED_ROUT	Time duration at which to give up on computer writes to function block ROut locations. Shed from Rout shall never happen when SHED_ROUT = 0.
FAULT_STATE	Condition set by loss of communication to an output block, fault promoted to an output block or a physical contact. When Fault State condition is set, Then output function blocks will perform their FSTATE actions.
SET_FSTATE	Allows the Fault State condition to be manually initiated by selecting Set.
CLR_FSTATE	Writing a Clear to this parameter will clear the device fault state if the field condition, if any, has cleared.
MAX_NOTIFY	Maximum number of unconfirmed notify messages possible.
LIM_NOTIFY	Maximum number of unconfirmed alert notify messages allowed.

Table 41(c) – Resource Block Parameters	
Parameter	**Description**
CONFIRM_TIME	The time the resource will wait for confirmation of receipt of a report before trying again. Retry shall not happen when CONFIRM_TIME = 0.
WRITE_LOCK	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
UPDATE_EVT	This alert is generated by any change to the static data.
BLOCK_ALM	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALARM_SUM	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
ACK_OPTION	Selection of whether alarms associated with the block will be automatically acknowledged.
LS_CAL_SWITCH	Parameter must be enabled for the Limit Sensor Calibration Switch to be operative.
SET_CURRENTSINK	Allows user to select Ultra-low Current mode (FPAC-NI consumes 18 mA) by disabling I/O LED(s).
WRITE_PRI	Priority of the alarm generated by clearing the write lock.
WRITE_ALM	This alert is generated if the write lock parameter is cleared.
ITK_VER	Major revision number of the interoperability test case used in certifying this device as interoperable. The format and range of the version number is defined and controlled by the Fieldbus Foundation. Note: The value of this parameter will be zero (o) if the device has not been registered as interoperable by the FF.
BLOCK_ALMS_ACT	Enumerations of the active blocks alarms for improved debugging.
SUPPORTED_MODES	The modes supported by the block.
IKEY	License key.
REVISION_ID	The revision identifier of the device.
REVISION_DATE	The revision date of the device.

30.Transducer Block Views

30.1. Analog Transducer Block Views

Table 42 – Analog Transducer Block Views					
Parameter	**Relative Index**	**VIEW_1**	**VIEW_2**	**VIEW_3**	**VIEW_4**
ST_REV	1	1	2	3	4
TAG_DESC	2				
STRATEGY	3				4
ALERT_KEY	4				4
MODE_BLK	5	1		3	
BLOCK_ERR	6	1		3	
UPDATE_EVT	7				
BLOCK_ALM	8				
XD_ERROR	9	1			
FINAL_VALUE	10	1			
FINAL_POSITION_VALUE	11	1			
FINAL_VALUE_RANGE	12		2		
SP	13	1			
BLOCK_ALMS_ACT	14	1			
SUPPORTED_MODES	15				4

30.2. Health Transducer Block Views

Table 43(a) – Health Transducer Block Views

Parameter	Relative Index	VIEW_1	VIEW_2	VIEW_3	VIEW_3(2)	VIEW_4	VIEW_4(2)	VIEW_4(3)	VIEW_4(4)	VIEW_4(4)
ST_REV	1	1	2	3	3	4	4	4	4	4
TAG_DESC	2									
STRATEGY	3					4				
ALERT_KEY	4					4				
MODE_BLK	5	1		3						
BLOCK_ERR	6	1		3						
UPDATE_EVT	7									
BLOCK_ALM	8									
XD_ERROR	9	1		3						
BOARD_STATUS	10	1		3						
VALVE_MAN_ID	11						4			
VALVE_MODEL_NUM	12						4			
VALVE_SN	13						4			
VALVE_TYPE	14						4			
XD_CAL_DATE	15							4		
XD_CAL_LOC	16							4		
XD_CAL_WHO	17							4		
ACT_FAIL_ACTION	18								4	
ACT_MAN_ID	19								4	
ACT_MODEL_NUM	20								4	
ACT_SN	21								4	
PRESSURE_VALUE	22				3					
DAMPING_VALUE	23				3					
SENSOR_SN	24				3					
MIN_SENSOR_SPAN	25				3					
FLOW_TYPE	26				3					
LIMIT_ENABLE	27				3					

Table 43(b) – Health Transducer Block Views

Parameter	Relative Index	VIEW_1	VIEW_2	VIEW_3	VIEW_3(2)	VIEW_4	VIEW_4(2)	VIEW_4(3)	VIEW_4(4)	VIEW_4(4)
FLOP_MODE	28				3					
CUTOFF_MODE	29				3					
COMPENSATOR_GAIN_SETTING	30				3					
COMPENSATOR_DERIVATIVE_GAIN_SWITCH	31				3					
COMPENSATOR_DERIVATIVE_GAIN_SETTING	32				3					
INTEGRATOR_SETTING	33				3					
VALVE_OPEN_SLEW_LIMIT	34				3					
VALVE_CLOSE_SLEW_LIMIT	35				3					
INTEGRAL_CONTROL_ENABLE	36				3					
TRAVEL_UPPER_LIMIT	37				3					
TRAVEL_LOWER_LIMIT	38				3					
AUTO_CALIBRATION	49				3					
LOW_CALIBRATION	40				3					
HIGH_CALIBRATION	41				3					
DIGITAL_TUNING	42				3					
AUTO_PID_CALIBRATION	43				3					
SENSOR_CALIBRATION	44				3					
TRANSDUCER_CALIBRATION	45				3					
TERMINATE_CALIBRATION	46				3					
MASKABLE_SIGNAL	47		2							4
SIGNAL_MASK	48		2							4
BLOCK_ALMS_ACTIVE	49	1		3						
SUPPORTED_MODES	50									4

31. Configuring the Device for Operation

31.1. Transducer Block

31.1.1. Required Configuration

- ACTION_ELEMENT
- MODE_BLK.TARGET

31.1.2. Suggested Configuration

- SIGNAL_MASK
START_UP_STATE
- FAULT_STATE1
- FAULT_STATE2
- CYCLE_COUNT_LIM
- CYCLE_COUNT_PRI
- CYCLE_TIME_LIM
- CYCLE_TIME_PRI
- HI_TEMP_LIMIT
- LO_TEMP_LIMIT

31.1.3. Optional Configuration

- TAG_DESC
- ACT_FAIL_ACTION
- ACT_MAN_ID
- ACT_MODEL_NUM
- ACT_SN
- VALVE_MAN_ID
- VALVE_MODEL_NUM
- VALVE_SN
- VALVE_TYPE
- XD_CAL_LOC
- XD_CAL_DATE
- XD_CAL_WHO
- COLLECT_CYCLE_TIME
- CYCLE_TIME_COLLECT_TYPE
- CLEAR_CYCLE_COUNT
- CLEAR_CYCLE_COUNT2

31.2. Resource Block

31.2.1. Required Configuration

- MODE_BLK.TARGET

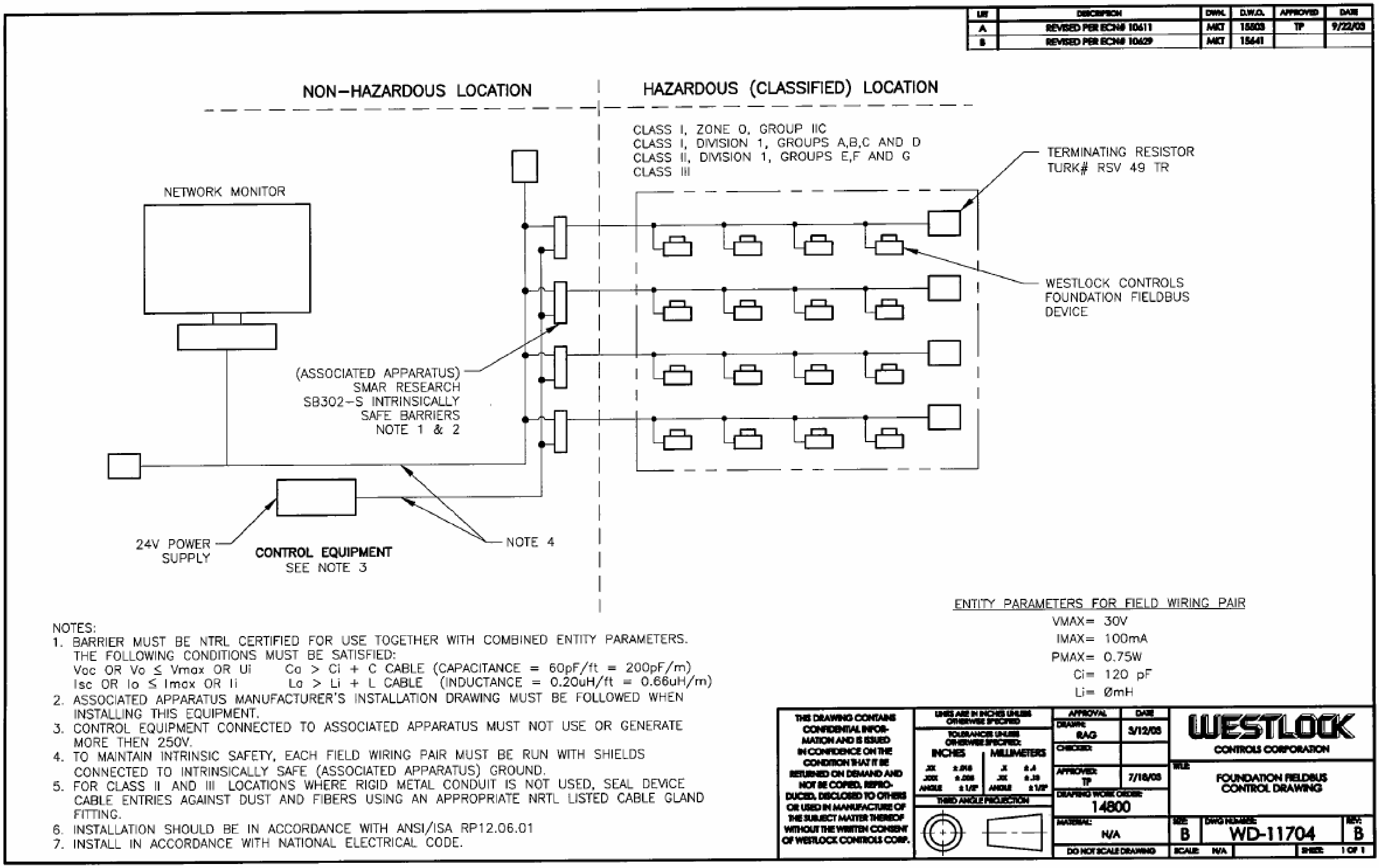
31.2.2. Suggested Configuration

- FEATURE_SEL
- SET_CURRENTSINK
- LS_CAL_SWITCH

31.2.3. Optional Configuration

- TAG_DESC
- SHED_RCAS
- SHED_ROUT
- FAULT_STATE
- WRITE_PRI

Appendix A



REVISED PER ECN# 10611
REVISED PER ECN# 10629
NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
CLASS I, ZONE 0, GROUP IIC
CLASS I, DIVISION 1, GROUPS A,B,C AND D
CLASS II, DIVISION 1, GROUPS E,F AND G
CLASS III
NETWORK MONITOR
TERMINATING RESISTOR
TURK# RSV 49 TR
WESTLOCK CONTROLS
FOUNDATION FIELDBUS
DEVICE
(ASSOCIATED APPARATUS)
SMAR RESEARCH
SB302-S INTRINSICALLY
SAFE BARRIERS
NOTE 1 & 2
24V POWER
SUPPLY
CONTROL EQUIPMENT
SEE NOTE 3
NOTE 4
ENTITY PARAMETERS FOR FIELD WIRING PAIR
VMAX= 30V
IMAX= 100mA
PMAX= 0.75W
Ci= 120 pF
Li= ØmH
NOTES:
1. BARRIER MUST BE NTRL CERTIFIED FOR USE TOGETHER WITH COMBINED ENTITY PARAMETERS. THE FOLLOWING CONDITIONS MUST BE SATISFIED:
Voc OR Vo ≤ Vmax OR Ui   Ca > Ci + C CABLE (CAPACITANCE = 60pF/ft = 200pF/m)
Isc OR Io ≤ Imax OR Ii   La > Li + L CABLE (INDUCTANCE = 0.20uH/ft = 0.66uH/m)
2. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THEN 250V.
4. TO MAINTAIN INTRINSIC SAFETY, EACH FIELD WIRING PAIR MUST BE RUN WITH SHIELDS CONNECTED TO INTRINSICALLY SAFE (ASSOCIATED APPARATUS) GROUND.
5. FOR CLASS II AND III LOCATIONS WHERE RIGID METAL CONDUIT IS NOT USED, SEAL DEVICE CABLE ENTRIES AGAINST DUST AND FIBERS USING AN APPROPRIATE NRTL LISTED CABLE GLAND FITTING.
6. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06.01
7. INSTALL IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE.
THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION AND IS ISSUED IN CONFIDENCE ON THE CONDITION THAT IT BE RETURNED ON DEMAND AND NOT BE COPIED, REPRODUCED, DISCLOSED TO OTHERS OR USED IN MANUFACTURE OF THE SUBJECT MATTER THEREOF WITHOUT THE WRITTEN CONSENT OF WESTLOCK CONTROLS CORP.
INCHES
MILLIMETERS
THIRD ANGLE PROJECTION
APPROVAL
DATE
RAG
3/12/03
TP
7/18/03
14800
N/A
DO NOT SCALE DRAWING
WESTLOCK
CONTROLS CORPORATION
FOUNDATION FIELDBUS
CONTROL DRAWING
B
WD-11704
B

FISCO–Concept

The FISCO concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination.
The criteria for interconnection is that the voltage (Ui or Vmax), the current (Ii or Imax) and the power (Pi or Pmax) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (Uo or Voc or Vt), the current (Io, Isc or It) and the power (Po or Pmax) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (Ci) and inductance (Li) of each apparatus (other than the termination) connected to the Fieldbus must be less than or equal to 5 nF and 10 µH respectively.

In each segment only one active device, normally the associated apparatus, is allowed to provide the necessary energy for the Fieldbus system.
The voltage Uo (or Voc or Vt) of the associated apparatus has to be limited to the range of 14V to 24V d.c. All other equipment connected to the bus cable has to be passive, meaning that they are not allowed to provide energy to the system, except to a leakage current of 50 uA for each connected device. Separately powered equipment needs a galvanic isolation to assure that the intrinsically safe Fieldbus circuit remains passive.

The cable used to interconnect the devices needs to have the parameters in the following range:

loop resistance R':	15...150 Ohm/km
inductance per unit length L':	0.4...1 mH/km
capacitance per unit length C':	80...200 nF/km

C'=C' line/line +0.5 C' line/screen, if both lines are floating or
C'=C' line/line +C' line/screen, if the screen is connected to one line

length of spur cable:	≤ 30m
length of trunk cable:	≤ 1km
length of splice:	≤ 1m

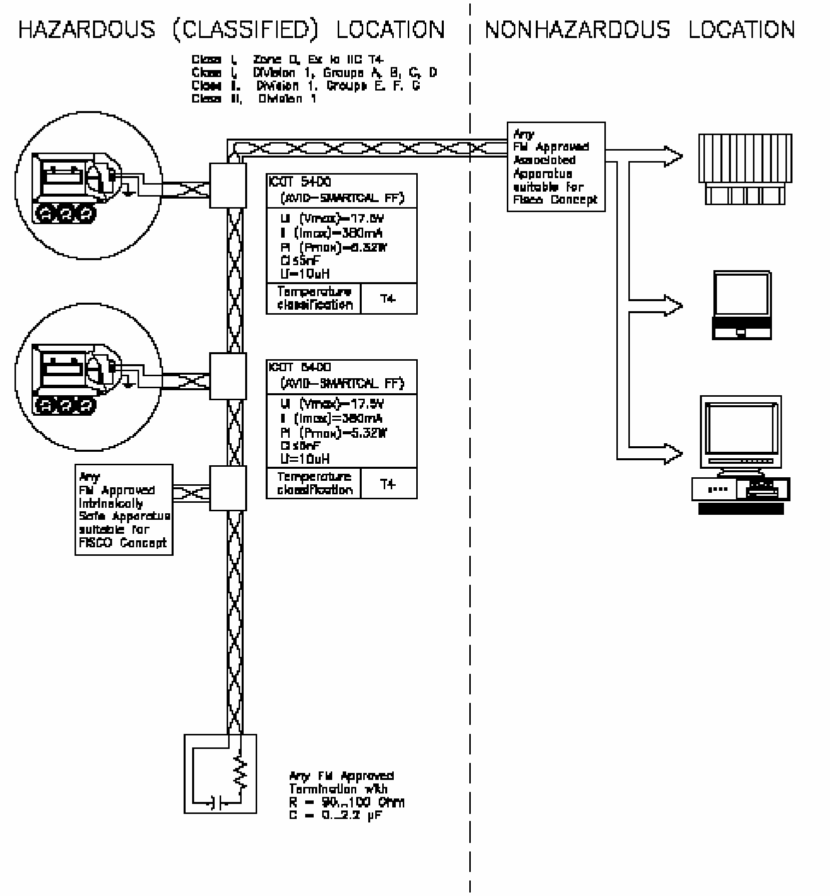
At each end of the trunk cable an approved infallible line termination with the following parameters is suitable:

R = 90...100 Ohm
C = 0...2.2 µf

One of the allowed terminations might already be integrated in the associated apparatus.
The number of passive devices connected to the bus segment is not limited due to I.S. reasons. If the above rules are respected, up to a total length of 1000 m (sum of the length of trunk cable and all spur cables), the inductance and capacitance of the cable will not impair the intrinsic safety of the installation.

Notes:
INTRINSICALLY SAFE CLASS I, DIV.1, GROUPS A, B, C, D
1. FM Approved apparatus must be installed in accordance with manufacturer instructions.
2. FM Approved associated apparatus must meet the following requirements:
   Uo or Voc or Vt ≤ Ui (Vmax) and Io or Isc or It ≤ Ii(Imax) and Po or Pmax ≤ Pi(Pmax).
3. The maximum non-hazardous area voltage must not exceed 250 V.
4. The installation must be in accordance with the National Electrical Code NFPA 70 and ANSI/ISA– Rp 12.6 (except chapter 5).
5. Multiple earthing of screen is allowed only, if high integrity equipotential system is realised between the points of bonding.
6. Caution: Use only supply wires suitable for 5 °C above surrounding temperature.
7. Warning: Substitution of components may impair intrinsic safety.

NONINCENDIVE, CLASS 1, DIV.2, GROUP A, B, C, D AND DIP for CLASS II AND III, DIV.1, GROUP E, F, G HAZARDOUS LOCATION INSTALLATION
1. INSTALL PER NATIONAL ELECTRICAL CODE (NEC) USING THREADED METAL CONDUIT.
   Intrinsic safety barrier not required. Max. supply voltage 30V. For T-code see table.
2. A Dust tight seal must be used at the conduit entry when the transmitter is used in a CLASS II & III Location.
3. WARNING: Explosion Hazard – do not disconnect equipment unless power has been switched off or the area is known to be Non-Hazardous.
   WARNING: Substitution of components may impair suitability for CLASS I, Division 2.



THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION AND IS ISSUED IN CONFIDENCE ON THE CONDITION THAT IT BE RETURNED ON DEMAND AND NOT BE COPIED, REPRODUCED, DISCLOSED TO OTHERS OR USED IN MANUFACTURE OF THE SUBJECT MATTER THEREOF WITHOUT THE WRITTEN CONSENT OF WESTLOCK CONTROLS CORP.	UNITS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES UNLESS OTHERWISE SPECIFIED: INCHES: .XX ±.015, .XXX ±.005, ANGLE ±1/2° MILLIMETERS: .X ±.4, .XX ±.13, ANGLE ±1/2° THIRD ANGLE PROJECTION	APPROVAL / DATE DRAWN: MKT 7/27/04 CHECKED: APPROVED: DRAFTING WORK ORDER: 16264 MATERIAL: N/A DO NOT SCALE DRAWING	WESTLOCK CONTROLS CORPORATION TITLE: WIRING DIAGRAM FF/ICOT FISCO CONTROL DRAWING SIZE: C DWG NUMBER: WD-11835 REV: SCALE: N/A SHEET: 1 OF 1

280 Midland Ave., Saddle Brook, NJ 07663 USA
Phone: (201) 794-7650 Fax: (201) 794-0913
www.westlockcontrols.com

Appendix B

Global Contacts

USA

Westlock Controls Corp.
280 Midland Ave.
Saddle Brook, NJ 07663
Phone: (201) 794-7650 ● Fax: (201) 794-0913
Email: herbtucker@westlockcontrols.com
Internet http://www.westlockcontrols.com

Europe

Westlock Controls UK
Chapman Way, Tunbridge Wells
Kent, England TN23EF
Phone: 011-441-892-519046 ● Fax: 011-441-892-516279

South America

Westlock Equipmentos De Controles Ltda.
Rua São Paulo, 291 - Alphaville
Barueri - São Paulo
Cep 06465-130
Phone: 011-55-11-7291-0930 ● Fax: 011-55-11-7291-0931

Appendix C

Ordering Guide

53	3	0	NI	E	H	B	A	0	B	N
SERIES	ACTUATOR TYPE	MOUNTING	HAZ. RATING	ENCLOSURE	PRESSURE	CALIB. / COMM.	CONDUIT ENTRY	SWITCHES	OUTPUT OPTION	GAIN

SERIES

- **52** Non-HART
- **53** HART
- **54** Foundation Fieldbus
- **55** Profibus

ACTUATOR TYPE

- **1** Linear
- **3** Rotary

MOUNTING

- **0** Standard
- **5** Remote

HAZARDOUS RATING

- **IS** Intrinsically Safe
- **NI** Non-Incendive

ENCLOSURE

- **E** Engineered Resin

PRESSURE

- **H** Above 40 PSI
- **L** 40 PSI or less
- **V** High Flow

CALIBRATION/COMMUNICATION

- **B** Both Keypad & HART
- **F** Both Keypad & FF
- **K** 3 Button On-Board Keypad
- **P** Both Keypad & Profibus

CONDUIT ENTRY

- **A** One 1/2" NPT, Two 3/4" NPT
- **B** One M20, Two 3/4" NPT

SWITCHES

- **0** None
- **1** One SPST Magnum
- **2** Two SPST Magnum

OUTPUT OPTION

- **A** None
- **B** 4-20 mA Analog

GAIN

- **B** 1/4" BSP (3/8" for High Flow)
- **N** 1/4" NPT (3/8" for High Flow)