Intelligent Proximity Positioner with Keypad Calibration and On-Board Sensors

ICoT™ 5200

Intelligent Positioner with Keypad

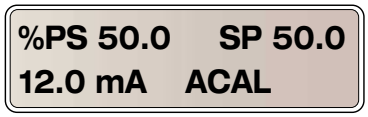
AutoCal

The ICoT™ 5200 is equipped with a 3-button keypad interface and a 4-digit, .5" tall LCD that allows for automated calibration of the positioner.

System calibration is performed easily requiring only minutes to accomplish. During the calibration process, the microprocessor measures position sensor voltage along with input setpoint current and establishes the amount of control signal required to move the valve to its end limits.

An on-board microprocessor uses the calibration data to provide accurate operation over the full span of valve travel during normal operation. The actual valve position measured and the amount of control signal applied at any time is a result of microprocessor interpolation. The interpolation method is operator selectable and can be Linear, Quick Opening, or Equal Percentage.

Split range and reverse acting operation are easily configured.



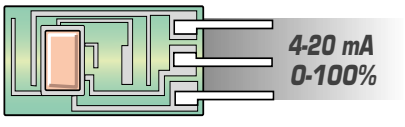
Local LCD Display

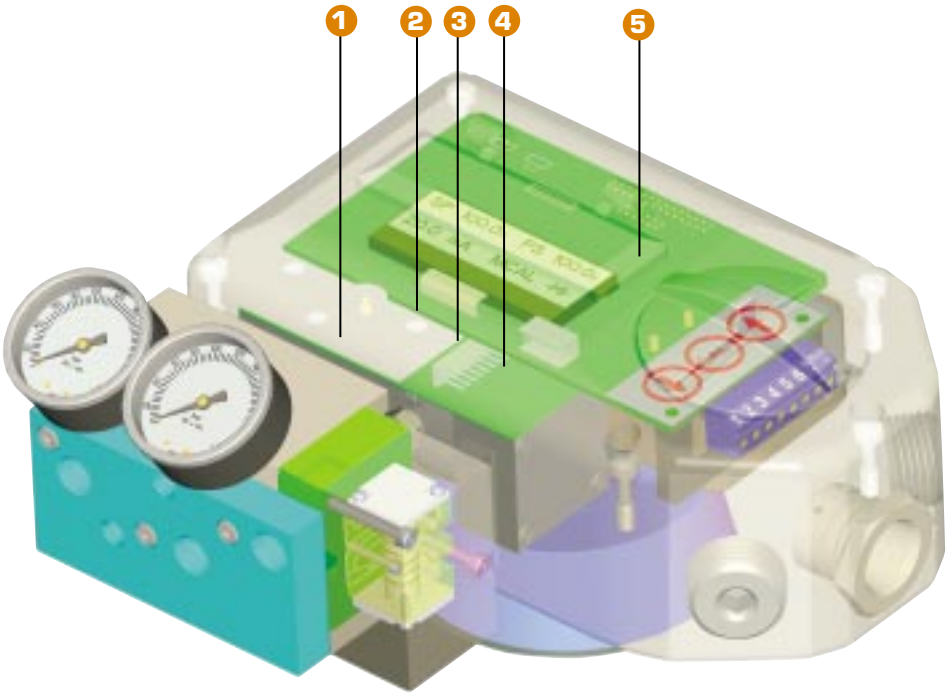
The local LCD display provides a multitude of onsite diagnostic information. While the valve is being controlled by the positioner, and the error signal is NOT zero, the displayed information will alternate between setpoint and position as percentage. Each value is displayed for a period of two seconds. Once the setpoint and valve position agree to within less than ± 0.5%, the display will only show position.

The range of values displayed are from 0.0% (fully closed) to 100% (fully open). Displayed resolution is in 0.1% increments, however, internal calculations are maintained at higher precision.

Integrated Position Transmitter

The ICoT 5200 is optionally available with an integrated 4-20 mA position feedback transmitter. As opposed to conventional devices, position sensing is performed by non-contacting means, based upon characterization of flux strength as a function of axial position.





On-Board Sensors

%PS 50.0	SP 50.0
12.0 mA	ERR3

The ICoT™ positioner has the capability to constantly monitor its own 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 PC maintenance station. The following codes are provided:

Err1 = Clogged nozzle or change filter

Err3 = Low input pressure or clogged filter

Err6 = Calibration error

The above alarm conditions and additional diagnostic capabilities are provided through a number of sensor elements in the transducer which are capable of indicating problematic operation.

Remote Mount Capability

Since valve position feedback to the ICoT positioner is accomplished by non-contacting means, the ICoT 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 either a high vibration or extremely corrosive environment, the non-contact position feedback feature allows for isolated placement of the positioner.

1. A pressure transducer compares actuator output pressure to the incoming transducer signal for diagnostic purposes. These two parameters are graphically displayed via the HART® interface and provide valuable data. For example, the relationship between actuator pressure and valve travel allows for stem friction, spring rate, and benchset parameters to be calculated. Excessive stem friction may imply the presence of packing or guide bushing problems. Additionally, detection of a non-operational spool valve within the ICoT™ positioner is also made possible by the pressure sensor whose output is utilized for comparison with the servo output command to the transducer.
2. A pressure switch detects abnormal internal pressure within the transducer indicative of a restricted nozzle or punctured diaphragm.
3. A pressure switch detects low air pressure entering the positioner. In conjunction with a supply pressure switch, a determination can be made that either a restricted filter is responsible for low air pressure entering the positioner or a bonafide low supply pressure conditions exists.
4. Low air supply pressure is detected by a pressure switch upstream of the internal filter and provides warning of insufficient power for valve stroking.
5. A 0-100% position feedback transmitter is available integrated within the electronics of the ICoT positioner.

ICoT™ 5200

Intelligent Positioner w/ Keypad

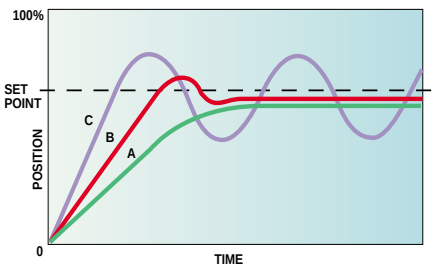
PID Control

A positioner is a servo system that continuously controls the position (output) of a valve in accordance with an external control signal referred to as setpoint. In a proportional type system, the setpoint is constantly being subtracted from the output (position). This signal, resulting from the constant subtraction, is termed as error (setpoint - output = error) which multiplied by a constant is used to modify the final output. The magnitude of this product is termed proportional gain or "P" (error x constant = P).

It would seem that the greater one makes "P" the less the error would appear in the final output. Unfortunately, in practice, this does not hold true.

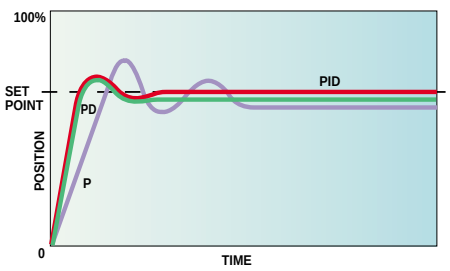
Graph #1 displays the response of a positioner to a sudden change of setpoint for different values of "P". Setting a small value to "P" results in a final output which differs from the desired output by a large error (curve A). Setting a large value to "P" results in an uncontrollable continuous oscillation of output termed "Ultimate P" (curve C). By interpolating different values of "P", a value may be obtained which produces a medium error having a stable response (curve B). However, the result of a proportional only type system still results in a relatively large error and slow speed of response.

GRAPH #1



The ICoT smart positioner greatly enhances the performance of the proportional only type system. A derivative ("D") is added to the servo of the ICoT. "D" is the derivative of the output with respect to time or the speed at which the valve position moves multiplied by a constant (speed x constant = "D"). The positioner is now converted into a "PD" servo type system. The addition of "D" into the system increases speed of response while decreasing overshoot. It also allows for "P" to increase above the ultimate proportional value, thereby reducing the final error (see graph #2).

GRAPH #2



In order to decrease the error even further, a third function,"I", is added to the "PD" servo. The integrator ("I") slowly decreases the error when the position reaches stability. This addition of the "I" function converts the ICoT into a "PID" servo type system.

Autotuning

The setting of the proportional, integral, and derivative functions ("PID"), also referred to as "tuning" can become quite complex and tedious. By utilizing the microcontroller within the ICoT, Westlock has designed an algorithm which automatically tunes all three parameters. This procedure is referred to as "autotuning".

Upon receiving a request for autotune, the positioner enters into a digital mode and overrides any setpoint command. It initiates the routine by setting "P", "I", and "D" at their lowest values. It will then begin to increase the "P" value until it reaches "Ultimate P". At this instance the CPU records "Ultimate P" and the coinciding period of oscillation. With the recorded data in memory, the CPU then performs a modified Ziegler-Nichols analysis and correspondingly assigns correct values to the "P", "I", and "D" functions.

AGENCY APPROVALS

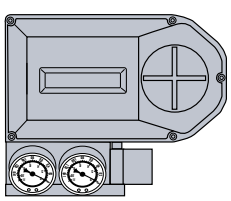
Intrinsically Safe: Class I, II & III Groups A- G, Divisions 1 & 2	Nonincendive: Class I, Groups A-D Class II & III, Groups F-G, Div. 2
Intrinsically Safe: Class I, Groups A-D, Class II & III Groups E-G, Div. 1 Exia IIC T4; Class I, Zone 0	Nonincendive: Class I, Groups A-D Class II & III Groups F-G, Div. 2
AEx II 2 G EExib IIC T4	

OPERATING SPECIFICATIONS

MODEL 5200	LINEAR	ROTARY
Input Current	4 to 20 mA (Analog) 4 mA (Digital HART)	
Voltage Drop	12.3 Volts	
Supply Air Pressure	(low) 15 to 45 PSI (high) 40 to 120 PSI	
Standard Stroke	.25 to 48 inches	0 to 95 Degrees
Resolution	0.2% of span	
*Linearity	1% of span (0.4" to 1.25")	0.5% of span
Hysteresis	0.2% of span	
Repeatability	0.2% of span	
Thermal Coefficient	2% / 100°C	
Output Flow Rates	(low) 8.0 scfm @ 25 PSI (high) 16.2 scfm @ 90 PSI	
Air Consumption	(low) .003 scfm @ 20 PSI (high) .008 scfm @ 90 PSI	
Operating Temp. Range	-40°C to 85°C (-40°F to 185°F)	
Gain	Electronically Adjustable w/ Autotuning	
Speed Response	Electronically Adjustable	
Feedback	Magnetic (Non-contact)	
Diagnostics	LCD Display	
Air Connection Ports	1/4" NPT	
Calibration Method	Electronic Keypad	

*NOTE: For linear graphs displaying deviation from straight line (0.4" to 20") see technical manual #374.

ORDERING GUIDE

ICoT™ 5200	MOUNTING CONFIGURATION	CONSTRUCTION	PRESSURE/ CALIBRATION	CONDUIT ENTRY	POSITION SENSOR	POSITION TRANSMITTER
52  Nema 4, 4X **Nonincendive** Groups A - G, Division 2 **Intrinsically Safe** Groups A - G, Divisions 1 & 2	**STANDARD** **LINEAR** Nonincendive **10NI** Intrinsically Safe **10IS** **ROTARY** Nonincendive **30NI** Intrinsically Safe **30IS** **REMOTE MOUNT** **LINEAR** Nonincendive **15NI** Intrinsically Safe **15IS** **ROTARY** Nonincendive **35NI** Intrinsically Safe **35IS**	Engineered Resin **E**	High Pressure (40 to 120 PSI) **HK** Low Pressure (15 to 45 PSI) **LK** High Flow (40-120 PSI) **VK**	1/2" NPT **A** M20 **B**	**(Rotary Only)** No Sensors **0** Magnum One SPST **1** Magnum Two SPST **2** Position switches not available on remote mount	Without Transmitter **A** 4-20 mA **B**