Foxboro Evo™ Process Automation System

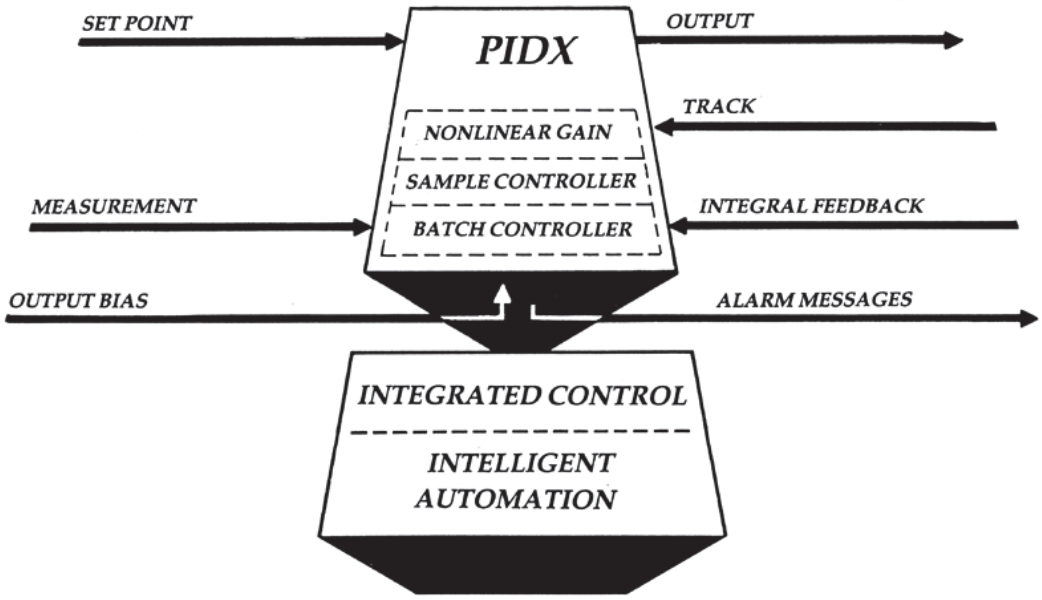
Product Specifications

Foxboro®

by Schneider Electric

PSS 31S-3PIDX

Extended Proportional-Integral-Derivative (PIDX) Controller



The Extended Proportional-Integral-Derivative (PIDX) block adds batch control, a sample-data controller mode, a nonlinear controller mode, and output tracking to the basic PID block functions for advanced control applications.

OVERVIEW

Extended Control Functions

As a batch controller, this control block can be used to avoid integral windup and the attendant overshoot response that is characteristic of restarting batch-type processes where controllers are left in automatic. As a preloadable controller, it works with the integral modes of the PID controller and an integral preload input. A user-specified value of "preload" replaces a saturated integral value when the output of the controller is at its high output limit. The output of the controller can be made to respond *before* the measurement exceeds the set point.

As a sample-data controller, the control block can be used to improve closed-loop control where a measurement signal is available on a periodic basis rather than a continuous basis (e.g., measurement from a chromatograph). The controller is switched from Manual to Auto on a scheduled basis (usually after a "new" or "fresh" measurement becomes available) and is allowed to stay in Auto for a specified time before being switched back to Manual. When a new measurement value becomes available, the cycle is repeated. A built-in timer allows this cycling to self-repeat for convenient integral-only control of dead time-dominant processes.

As a nonlinear controller, the control block can be used to improve closed-loop response where the process has a high nonlinear gain characteristic (Figure 1), such as a pH process. In a pH process, the set point is at or near the equivalence point as observed by titrating a sample of the process. The nonlinear characteristic of the controller is adjusted by the user to approximate the mirror image of the process titration curve. This feature can also be used as a non-linear noise filter, filtering low-amplitude high-frequency noise, while allowing high-gain responses to significant process upset.

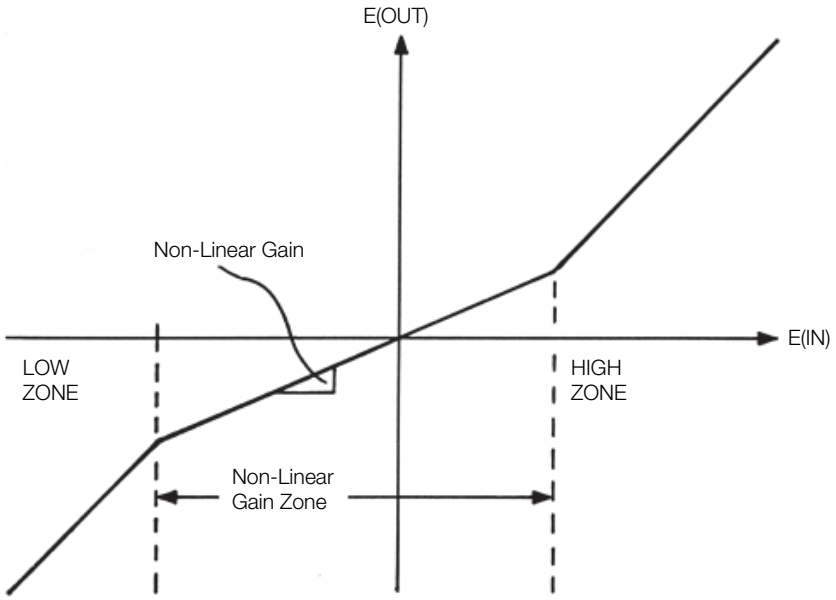


Figure 1. Nonlinear Gain Characteristics

PID Control Functions

The PID control functions of the PIDX block (Figure 2) are the same as the standard PID block and can be configured to operate in one of the following five controller modes:

- Proportional-plus-Integral-plus-Derivative (PID)
- Proportional-plus-Integral (PI)
- Proportional-plus-Derivative (PD)
- Proportional (P)
- Integral (I)

The output signal is computed in response to the set point and the measurement and the particular configured controller mode operation.

Integral control action is generated by the integral feedback signal through a first-order lag filter with a time constant equal to the integral time parameter. The positive feedback arrangement of this loop produces the desired integral control action. The integral feedback signal is usually connected to the back calculation output of the downstream block to avoid integral windup.

The derivative action of the PID or PD controller modes is responsive only to the measurement signal. Through proper filtering, the derivative feature of the controller is less sensitive to measurement noise, allowing more effective use of derivative action. The filter time is adjustable between 0.1 and 0.02 (0.1 = default) of the derivative time.

Outputs may be clamped between specified limits.

A complete complement of alarming capability (absolute, deviation, and output) is available with user-specifiable text for each alarm type. The delayed alarming feature reduces the number of nuisance alarms as a block parameter crosses over an alarm limit multiple times in a short period.

The status (Local/Remote, Auto/Manual, and tracking) of a given controller is available for connection(s) to other control blocks. This ensures proper action of upstream blocks connected to a given controller when the operator assumes local control.

Supervisory Control

Supervisory Control (SSC) allows a user's application program to perform supervisory control over the PIDX block's set point. SSC can be enabled/disabled by an operator, or enabled by the supervisory application program at a control block group or control block level. If SSC is enabled in the control block, the back calculated value status requests the application program initialization.

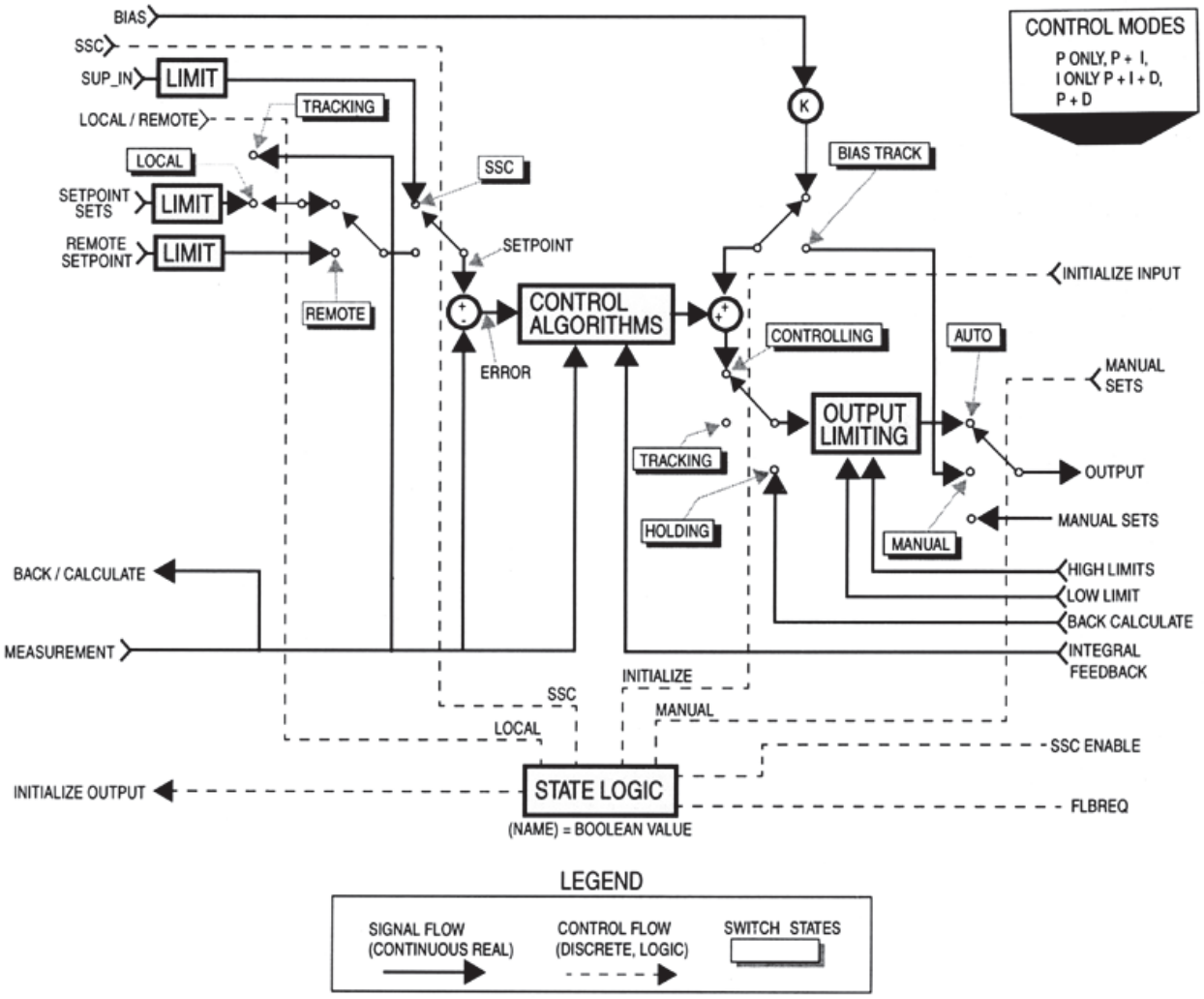


Figure 2. PIDX Block, Simplified Diagram

The application program must send the supervisory set point to the block periodically. While SSC is enabled, the control block parameters associated with local set point are not settable by the operator. If the operator asserts fallback or if a supervisory application program failure is detected, the control block falls back to a configured fallback mode (Manual, Auto, Remote, or Local).

Standard Extended Feature

- Output tracking

Standard PID Features

- Manual/Auto control of the outputs, which can be initiated by either a host process or another block
- Local/Remote set point source selection
- Enhanced derivative filtering for improved controller performance

- Adjustable derivative gain
- External integral feedback to prevent windup during closed-loop operation
- Assignable engineering range and units to measurement, bias, and output
- Automatic scaling, based on assigned engineering ranges, so that the controller gain is normalized in proportional band
- Output biasing with scaling
- Output clamping between variable output limits
- Bad inputs detection and handling
- Bumpless transfer of the output signal when the block returns to controlling operation in Auto, which is inherent in all controller modes
- Automatic cascade handling that includes:
    - Explicit initialization input/output parameters that provide proper coordination and initialization of cascade schemes
    - Back calculation of the reference or set point input for the upstream block to provide bumpless cascade operation
- Set point clamp limits in Remote, Local, or Supervisory mode

Extended Options

- Nonlinear gain compensation
- Sampling controller mode
- Batch control, with preloadable integral

PID Options

- Set point tracking of the measurement signal allows bumpless return to automatic control when the block or any downstream block returns to normal operation.
- Manual override forces the block to Manual if either the measurement or feedback inputs are off scan, disconnected, or bad. Return to automatic control requires external intervention.
- Absolute alarming of the measurement.
- Deviation alarming of the set point -- measurement error signal.
- Absolute alarming of the output.
- Manual alarming allows all configured alarm options to be operational in Manual.
- Reverse action: measurement increases cause controller output to increase.
- Output clamping when block is in Manual
- Bias tracking forces bias to track the output when block is in Manual. Operational only in the P and PD controller modes.
- Local set point ramping and limiting - the local set point can be ramped to a new target value at a user set rate by toggling a switch. Ramping stops when the set point reaches the target or when the controller is placed in manual.
- Workstation lock access allows write access to only the Display Manager which owns the lock.
- Loop identifier allows the user to identify the loop or process unit that contains the block.
- Supervisory Control (SSC) of the block's set point.

Additional Features

- Delayed alarming. A configurable timer delays alarm detection or return-to-normal messages for a specific alarm to reduce the number of alarm messages generated when a block parameter crosses back and forth over an alarm limit.
- Quality Status output parameter provides a single source for the block's value record status, block status, and alarm status.

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