EcoStruxure™

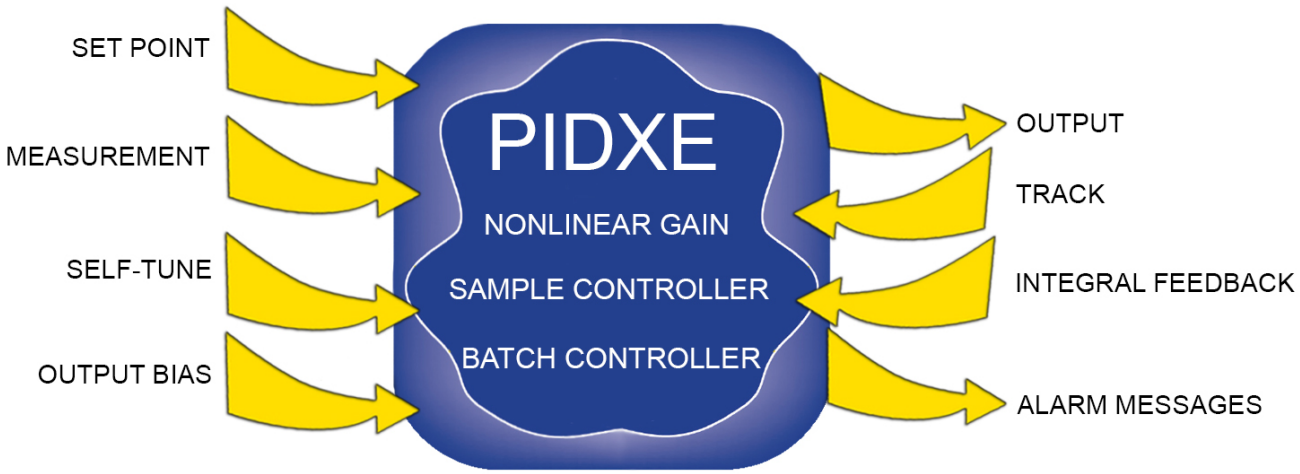
Foxboro™ DCS

Extended EXACT Proportional-Integral-Derivative (PIDXE) Controller

PSS 41S-3PIDXE

Product Specification

May 2019



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Legal Information

Overview

The Extended EXACT Proportional-Integral-Derivative (PIDXE) block provides EXACT (EXpert Adaptive Controller Tuning) adjustment of PID control tuning parameters for tuning a continuous or discontinuous process.

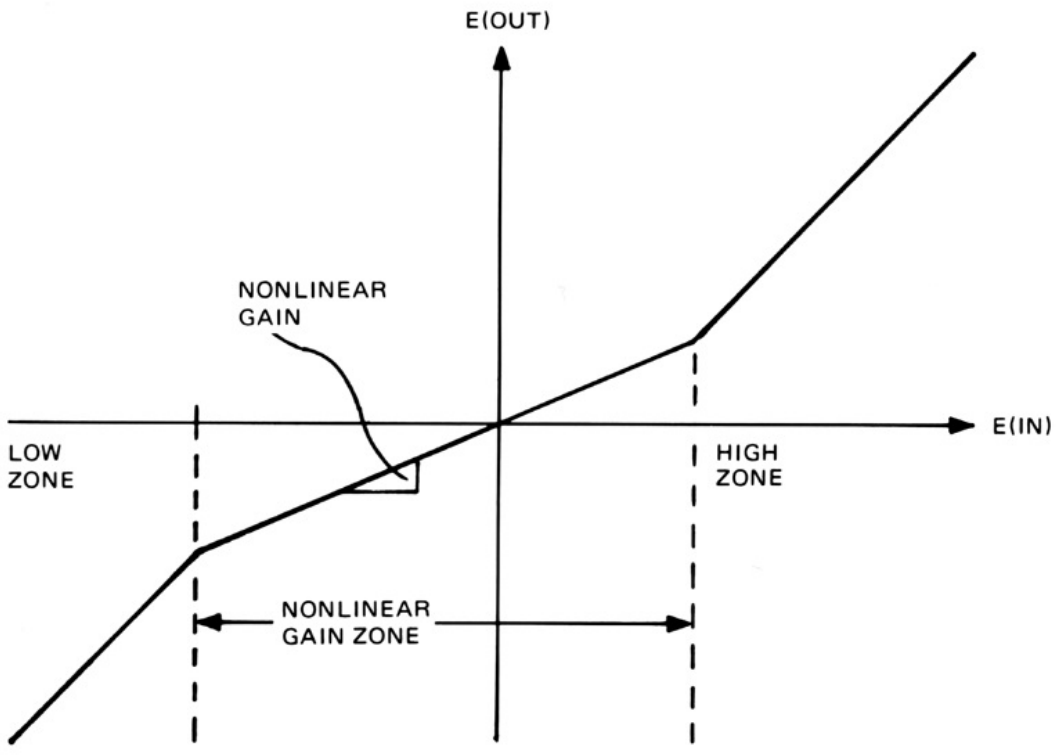
The PIDXE is a self-tuning PIDX controller for advanced control applications. It adds batch control, a sample-data controller mode, a nonlinear controller mode, and output tracking to the PIDE algorithm containing EXACT self-tuning.

The EXACT PID algorithm monitors the closed-loop recovery following a disturbance to the set point or load. EXACT compares the observed process response to a user-desired response. Based on the difference between the observed and desired response, EXACT estimates new values for P, I, and D to minimize process recovery time without exceeding error signal trajectories acceptable to the user.

The controller operates in one of three tuning modes:

- *Pre-Tune* permits the user to perform an open-loop response test of the control loop. At completion of the open-loop test, EXACT estimates the starting value of P, I, and D as well as other key loop characteristics before proceeding to self-tuning.
- *Self-Tune* allows the EXACT algorithm to monitor and compare observed versus desired loop response to load and set point disturbance and to adjust tuning constants as required.
- *Manual Tune* functions as a conventional PID controller (that is, it allows manual modification of the PID parameters).

Figure 1. Nonlinear Gain Characteristics



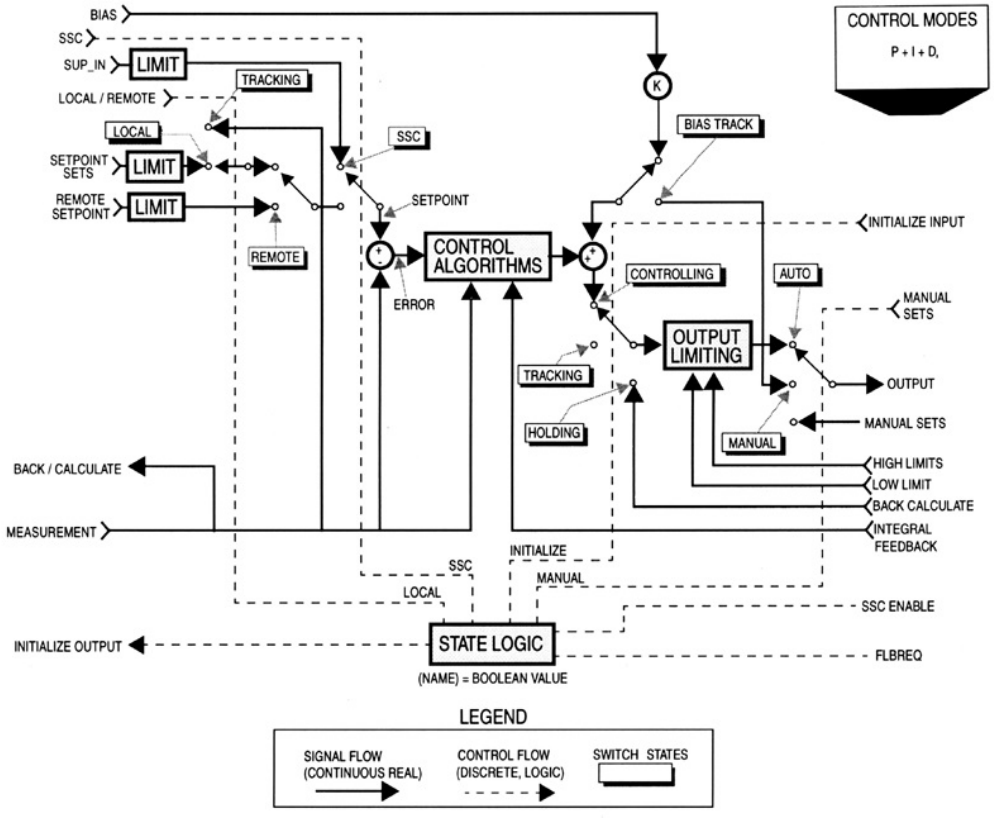
As a batch controller, this control block can be used to avoid integral windup and the attendant overshoot response that is characteristic of restarting batch-type processes where controllers are left in automatic. As a preloadable controller, it works with the integral modes of the PID controller and 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 self-tuning controller in a discontinuous process, a self-tune override feature permits the self-tuning function to be bypassed when the controller is off control. This helps prevent the computation of improper P, I, and D tunings during a process discontinuity, which can result in overshoot or overdamped responses when the process is restarted. The self-tune override feature is triggered by a Boolean input that identifies a process discontinuity. In addition, a memory recall feature allows a previously chosen set of tunings to be given to the controller after the discontinuity, until the self-tune function is allowed to continue.

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 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 2. PIDXE Controller, Simplified Diagram



Supervisory Control

Supervisory Control (SSC) allows a user's application program to perform supervisory control over the PIDXE 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. 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 Features

- Tuning mode
  - Self-Tune
  - Self-Tune override
  - Pre-Tune
  - Manual Tune
- Output tracking
- 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 help prevent windup during open-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 modes

Options

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

WARNING: This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.p65warnings.ca.gov/.

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