Foxboro Evo™ Process Automation System

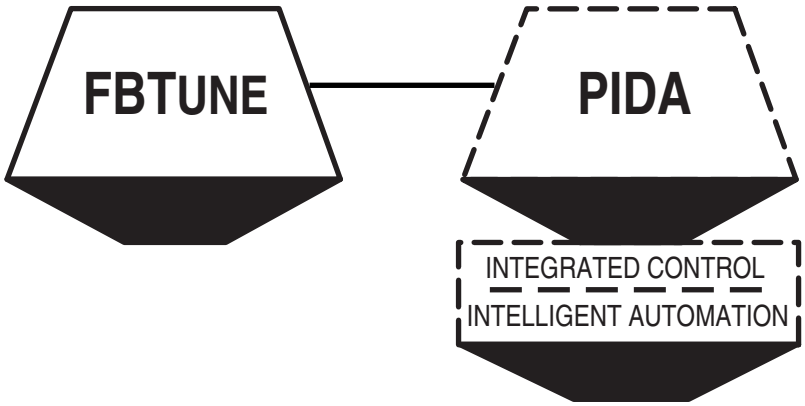
Product Specifications

Foxboro®

by Schneider Electric

PSS 31S-3FBTUNE

Feedback Tuner (FBTUNE) Block



The Feedback Self-Tune (FBTUNE) block performs when a significant natural or deliberate upset occurs causing the control error to exceed a user-set threshold.

OVERVIEW

FBTUNE is an extender block used to adaptively tune the feedback control parameters of the PIDA controller block. It can be attached or detached without reconfiguring the PIDA.

FBTUNE pretunes and continuously updates tuning for all PID and deadtime controller modes (excluding P, I, and PD).

PID Modes

FBTUNE adapts P, I, D, and a setpoint filter gain for interacting PID, non-interacting PID, and PI controller modes.

Deadtime Modes

FBTUNE adapts P, I, D, and deadtime (tau) for the PITAU and PIDTAU controller modes.

PRETUNE

The pretune function is used to establish an initial tuning for the feedback controller. To start pretune, the process should be in steady state with the controller in manual. The pretuner applies a sequence of positive and negative pulse changes to the controller output and observes the process measurement's response. The pulse height is user-specified and the pulse width is determined automatically.

Time-domain response features including peak heights and times are used to fit a three-parameter gain-lag-delay or a four-parameter gain-2_lag-delay model to the process. The user may elect the three-parameter model to achieve more robust controller tuning or the four-parameter model to achieve faster control loop performance. If the iterative four-parameter model identifier fails to converge, perhaps because the process is not well approximated by a gain-2_lag-delay model, the three-parameter model is identified by a direct method.

An algebraic tuning method is used to achieve values of the tuning parameters for the particular controller mode selected and the identified process. The tuning algorithms are designed to make an unmeasured load step response (applied at the controller output) approximate a Gaussian probability density curve and the set point step response to approximate its integral.

If self-tune is turned on, the PIDA transitions to AUTO automatically on completion of pretune.

TUNING UPDATE

The feedback self-tuner is designed to operate when a significant natural or deliberate upset occurs, causing the control error to exceed a user-set threshold. The self-tuner looks for pattern features such as peak values and times in the control-error signal. If three (non-noise) error peaks can be confirmed or the error transient settles, the controller tuning is updated using one of two methods.

When pretune has been used and the response is oscillatory, a complex frequency method can identify two of the process model parameters, gain and delay. The ratios of the process lag times to the delay time are assumed to remain the same as determined by pretune. The algebraic method used in pretune is also used by self-tune to update the controller parameters.

Alternatively, when an oscillatory error response starts from the quiet state and the interacting PID or PI controller mode is selected, a fuzzy-logic method can be used to interpolate a stored data table to determine the controller tuning parameters.

When the response is not oscillatory (one peak confirmed), expert rules are used to tighten the tuning until a nearly symmetric load response is achieved.

There are six sets of stored tuning constants, each associated with a sub-range of a user-selected variable and an initial error-response direction. When a new response is detected, the most appropriate tuning set is inserted into the controller and updated after the peak search. This provides an adapter gain scheduling or learning to anticipate the behavior of a nonlinear process. The user may elect to use gain scheduling but freeze adaptation.

Figure 1 shows a typical startup. The first response is the pretune, initiated by the user when the process reached steady state while the PIDA is in MANUAL. Following pretune, the PIDA was placed in AUTO and the self-tune function turned on.

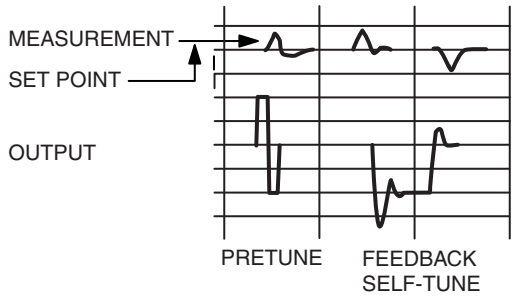


Figure 1. Response of Single Loop Adaptive Multivariable Control with FBTUNE

The second of these responses shows the effectiveness of the controller settings determined by pretune. The third one shows the effectiveness of the controller settings as determined by the first self-tune adaptation. These two load upsets are sufficient for self-turning to compute new settings for the controller in both directions.

Adaptation can be turned on and off or suspended and restarted.

User set fall back tunings may be activated when the adaptor state is HOLD.

FBTUNE is not available in the CP10.

PATENT NOTICE

This product is protected by one or more of the following U.S. Patents; and other patents pending.

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