Introduction

SMART Logic provides the basis for tuning PID loops controlled by the SSi 7EK, 20Q, and 20PQ controllers. SMART Logic is an adaptive control algorithm that implements the Auto-Tune and Self-Tune functions of the instrument.

Definition of *Error*

Error is defined as the difference between the setpoint (SP) and process variable (PV), or measured value. If the difference is negative, the negative sign is dropped. *Examples:* If SP is 800 and PV is 400, the error is 400. If SP is 200 and PV is -300, the error is 100 since 200 minus -300 is -100, and the negative sign is dropped in determining the error.

Auto-Tune Mode

This mode is a closed loop PID tuning procedure working on 0% to 100% of the output span. This mode can be activated when the operator turns the SMART parameter ON, at which time the SMRT LED on the face of the display will illuminate and flash. Once started, Auto-Tune will calculate changes to the PID parameters. After the PID calculation, Auto-Tune will automatically switch off and Self-Tune mode will be engaged, causing the SMRT LED to remain solidly lit (not flashing). Self-Tune mode will remain on until the operator disables it.

Self-Tune Mode

Self-Tune mode identifies patterns in a process in order to recalculate PID parameters. Self-Tune analyzes the closed loop behavior by observing the error response generated by a disturbance in the process. After the identification phase, Self-Tune recalculates PID parameters on the basis of error observation and decision-making algorithms. When this mode is on, the SMRT LED will remain solidly lit (not flashing).

Activating SMART Logic

SMART Logic activates the Auto-Tune or Self-Tune mode on the controller. To active SMART Logic, set the SMART parameter ON. Do this by pushing the FUNC pushbutton until the "Snrt" parameter is shown. Push ▲ or ▼ to set the display "On" and then push the FUNC pushbutton. The SMRT LED will then be displayed. If "SMRT" is flashing, Auto-Tune is on. If "SMRT" is displayed but not flashing, Self-Tune is on.

IMPORTANT: Super Systems Inc. recommends activating SMART Logic for Auto-Tune mode only when the error is 20% or more of the input span.

Deactivating SMART Logic

To disable the SMART function, push the FUNC pushbutton again until the "Snrt" parameter is shown. Push ▲ or ▼ to set the display "Off" and then push the FUNC pushbutton.

How SMART Logic Determines Tuning Mode

The following procedure will be followed for activating tuning modes:

1. First Calculation: The threshold (limit) of the output is calculated as 10% of the input span away from the SP value—that is, SP - (10% of Span) or SP + (10% of Span). If the error is greater than 20% of the input span, Auto-Tune is activated.
2. Second Calculation: The threshold (limit) of the output is calculated as error divided by 2. If the error is between 10% and 20% of the input span, Auto-Tune can still be activated. After the Auto-Tune procedure has been completed, the Self-Tune procedure is automatically activated.
3. If the error is less than 10% of the input span, the Auto-Tune method will not be activated. This is done in order to avoid overshoot. In this case, Self-Tune will be activated. If the instrument is shut down when the SMART parameter is still ON, Self-Tune will be active at the next power up.