Get to Know Your Temperature Controller

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Closed-loop temperature controllers are the heart of any temperature sensing and control system. Take a look at how some common features can give your more control over your process.

Temperature controllers are used on ovens, dryers, chillers and other heat processing equipment to control the heating process. Whether the goal is simply to ramp and hold at a certain temperature, or if the process involves multiple heating stages, a temperature controller can drive the process.

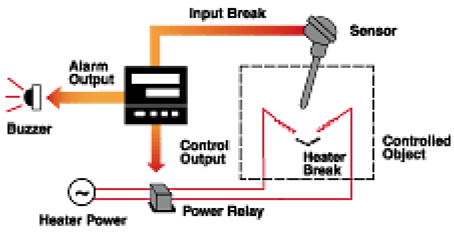

Figure 1. Closed-loop control consists of four components: the temperature controller, power device, temperature sensor and the controlled object.

A form of feedback control, closed-loop control is used in most process applications. The loop consists of four components:

- A temperature sensor such as a thermocouple, resistive temperature detector (RTD) or thermistor.
- A temperature controller.
- A power device or final control such as a magnetic relay, solid-state relay, mercury contactor, silicon-controlled rectifier or valve.
- The controlled object such as the electric heating element, flame control valve or other load.

To obtain accurate control of the process loop, it is necessary to properly match the characteristics of all four components (figure 1). The controlled object's temperature is detected by the sensor and converted into an electric signal, which is then fed into the controller and compared with the setpoint as a feedback value. If any deviation exists, the process variable is calculated from the deviation, and the power device delivers the appropriate corrective power to the controlled object.

The closed-loop process is the most precise form of process control. Temperature is the most frequently controlled process variable, but other process variables such as pressure, flow and level also are controlled with process controllers.

8 Features You May Need

Depending on the process to be controlled, a simple on/off controller may be appropriate, or you may need a range of features to master the process. Understanding what a controller can provide for your process can help you select a controller with enough -- but not too much -- muscle.

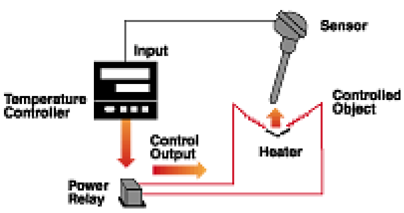

Figure 2. Loop break detection monitors every part of the control loop.

1 Anti-Reset Windup

Anti-reset windup inhibits the integral action until the process value is within the proportional band, thus reducing overshoot on startup. This action is measured as a percentage of the proportional band and can be set from 0 to 100% on most process controllers.

2 Heat/Cool Control

Heat/cool control provides heating and cooling control capabilities in one controller. This is particularly effective when both heating and cooling control is required such as to control the temperature of an extruder barrel during plastics processing.

3 Operation Modes

A controller can utilize one of three modes. Auto mode is automatic action, where the controller performs closed-loop control with values established via the instrument's front keypad or through digital communications. Remote control is similar to automatic output operation, but the setpoint is established through an external analog signal. Manual mode adjusts the control output to a selected level independent of the sensor input (open loop).

4 Data Communications

Data communications can be achieved with parallel or serial communications. Parallel communications refers to data bits that are transmitted in parallel format with separate lines for each bit through simple interface circuitry. Serial communications refers to data bits that are transmitted sequentially through a single line. For longer cable lengths, serial communications are less expensive than parallel communications.

5 Autotuning

Implementing proper PID values often can be difficult and time-consuming, but accurate PID values helps processors achieve stable control. With the autotuning function, PID values are automatically measured, computed and set. The controller's autotuning feature is activated when the temperature rises or when control is stabilized from any process state. The PID parameters are derived via the microprocessor-based controller's software. The microprocessor calculates the amplitude of the slope of the rise and fall of the process over time and automatically establishes the PID values. This allows the process engineer to tune precise PID loops.

6 Heater Break Alarm

Controllers with a heater break alarm have a current transformer that digitally displays the current in a circuit. When the control output is on and the load current drops below a specified minimum, an alarm is triggered, indicating that a heater has failed. When the control output is off and the heater current is still present, the heater break alarm is used to signal a welded relay contact or failed solid-state relay. Early detection of a broken heater or relay can limit costly damage to machinery and materials.

7 Loop Break Alarm

In the past, protection against control loop breaks such as a broken thermocouple was provided by adding a high impedance turn-off signal to the signal from the thermocouple. But, a complete temperature control loop has several hundred elements such as integrated circuits, resistors, connections, etc., that may fail. A failure in any one of these can cause the output to go full-on and overheat the process, or full-off and underheat the process. A loop break alarm solves these problems by monitoring almost every part of the entire control loop.

8 Fuzzy Logic

Fuzzy logic allows controllers to emulate human thinking to determine responses between two values. This technology allows the temperature controller to function like an expert operator.

Fuzzy logic technology can effectively suppress overshoot, shorten the startup time, suppress process upsets when frequent load changes occur and minimize process upsets that occur with setpoint changes.

Sidebar: Don't Be Alarmed!

Deviation and process alarms are designed to keep you apprised of your process. The alarm function activates an alarm lamp and relay if a deviation or measured value (process value) reaches the alarm set value. Here are a few common alarms:

Deviation Alarm. This alarm function is activated if the measured process value reaches a preset deviation from the set value. Its value moves with a set value change. Examples include high alarm, low alarm, high/low alarm and band alarm.

Process Alarm. This alarm function is activated if the measured process value reaches the alarm set value. An absolute value that is separate from the setpoint, this value will remain constant.

Hold and Rehold Action. The alarm hold action permits the process engineer to configure the alarm to be masked or suppressed upon startup or at setpoint changes, as desired.

Alarm Delay Timer. The alarm delay timer function is used to delay the alarm action or trigger an event that needs some delay before activation. If the alarm state is released during this delay period, the alarm output will not be activated. External disturbances such as noise may cause a process value to momentarily rise into the alarm area. The alarm delay function prevents alarm output in these cases.

There are other alarm functions, depending on your process. The key thing to remember is don't be alarmed -- these alerts are designed to warn you of the changing status in your process. By responding correctly, you can keep your process running smoothly.