2-PID Control Algorithm

Optimised response in temperature regulation

SCOPE

Analogue parameters such as temperature, pressure and humidity may be simple concepts, but controlling them in today's complex industrial processes can be anything but simple. That's because they are subject to the constant demand for ever greater optimization. This whitepaper explains how we can help you.

CONTENT

WHITEPAPER

Executive Summary

Proportional-Integral-Differential (PID) algorithms can be used to control a very wide range of physical quantities. They are therefore one of the most popular regulation methods for a wide range of industrial processes. However, each process is unique. For example, you may require fast ramp-up to a final Set Point (Step Response). Or, you may need high stability during control without overshoot when a disturbance occurs (Disturbance Response). Or you may want both.

With a conventional PID algorithm it is unlikely to achieve both goals at the same time. So you may need to make compromises, solving only part of the problem. With the Omron 2-PID algorithm no such compromise is necessary.

1. How standard PID control works

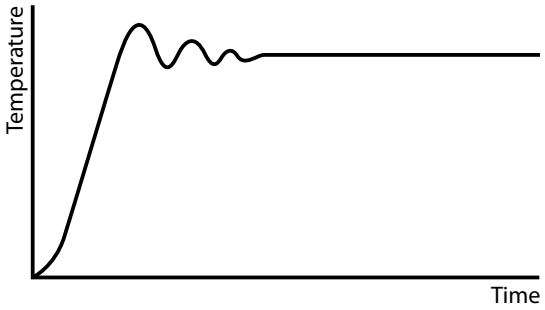
The Set Point is normally input to operate the Temperature Controller. The time required for stable temperature regulation varies with the controlled object.
As a general rule, attempting to shorten the response time by playing with different PID values only, will usually result in temperature overshoot. However, attempting to eliminate the overshoot may delay achieving the required Set Point temperature.

There are applications - such as package sealing - that require the prompt, stable control of waveform 1, despite overshoot.

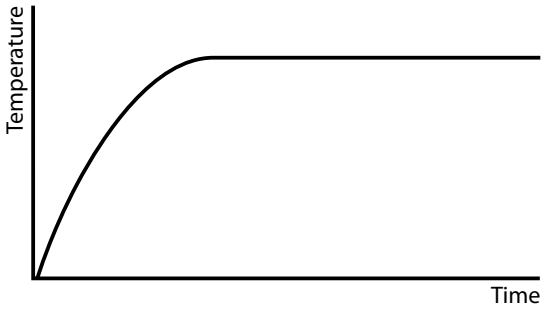
And there are other applications - such as ovens with longer lag times - that cannot have any overshoot, and therefore require waveform 3, despite the long time that is required to stabilize the temperature.

Waveform 2 is usually considered to be the proper response for standard applications.

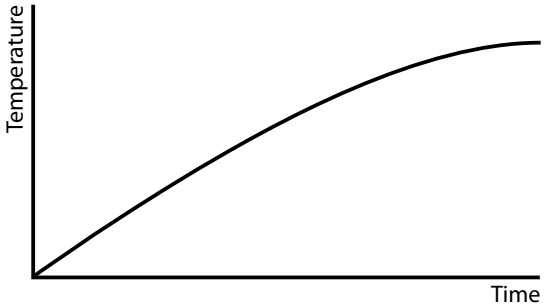
In short, the type of required temperature regulation depends on the application.



1. The temerature stabilizes after overshooting several times



2. Proper response

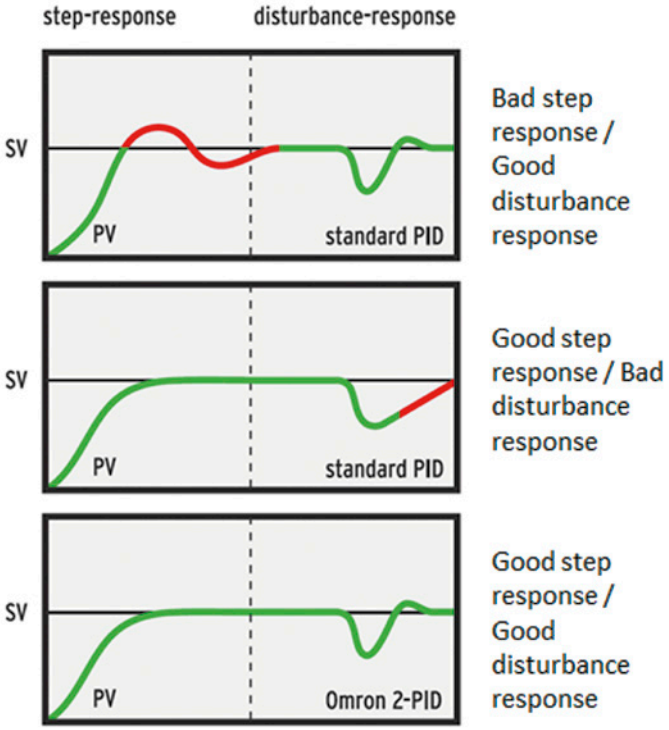


3. The response is slow to reach the Set Point

2. 2-PID control - the next level

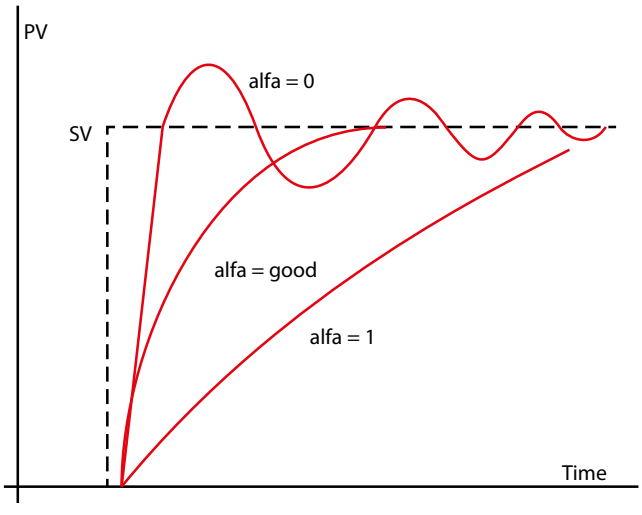
In 2-PID control you get both good step response and good disturbance response

All our temperature controllers feature 2-PID control: a complex technology that uses a powerful algorithm developed by our designers. This unique feature enables the controller to be automatically PID-tuned to give a good disturbance response, and to independently set the reaction speed to changes in the Set Point using a simple tuning procedure.



What's even better is that you do not need to take any special action: the controller's built-in technology does all the work for you. All our temperature controllers are factory pre-set with a default "alfa" value that gives responses with minimal overshoot for most heating applications. The benefits include faster start-up production times, and much more stable temperature control during production, which helps lead to better quality products.

You can even achieve faster start-up or more stable control without changing PID variables and adjust the default waveform behaviour simply by changing the alfa parameter (0...1) – all via the auto-tuning feature.



3. Proven business benefits and examples

Up to 35% faster set temperature recovery

A powerful example of why 2-PID control is so beneficial is Italian manufacturer by Ecocaps,
In this case, several of our In-panel temperature controllers (EJ1) precisely regulate the temperatures of 60 sealing heads mounted on a carousel. These seal foil hygiene overcaps placed over the ends of filled beverage cans, reliably handling line speeds of up to 90,000 cans per hour. Each sealing head takes exactly 0.6 second to polymerise the lacquer on each foil capsule at a temperature of precisely 230°C. This is where our 2-PID control delivers an important advantage over standard PID control: the ability to recover to set temperature values more quickly. In fact, 2-PID allows a machine to return to a set temperature up to 35% faster than many other PID controllers on the market.

For more information read online
https://industrial.omron.eu/en/solutions/packaging/customer-references/ecocaps

Adjusting PID in your own work environment

Moreover, another Italian packaging machine specialist, Clever, developed a heat-shrink sleeve applicator using a film cutter on electronic cams. Compared to conventional solutions - where mechanical cams are used - this electronic architecture allows operators to change product and format without reducing production speed, simply by setting the pitch of the feed screw and the length of the film. The system uses an Omron NJ-Series Machine Controller which provides exceptional flexibility, enabling operators to modify both the label application phase on the bottles as well as the cutting phase. Temperature control is handled centrally through the Omron NJ Auto-tuning functions. Clever was able to use the PID internal learning functions inside the NJ to adjust the PID parameters automatically, according to the working environment. The machine was operating at high efficiency in a very short period of time, according to Andrea Parlato, a Clever technician: “Normally, you need entire days to adjust the PID effectively. This type of solution dramatically shortens that time, by allowing the PID to be adjusted directly in your own work environment.”

For more information read online
https://industrial.omron.eu/en/solutions/packaging/customer-references/clever

4. Conclusion

It is highly beneficial to use a temperature controller that can be automatically PID-tuned to give both:
1. a good disturbance response
2. and to independently set the reaction speed to changes in the Set Point

This benefit is achieved via a 2-PID algorithm, and that's why every Omron temperature controller features 2-PID control: a complex technology that uses a powerful algorithm developed by our designers.

What's even better is that you don't need to take any special action, the controller's built-in technology does all off the work for you.

Omron Corporation

80 years experience in sensing and control

- Over 37,000 employees worldwide
- Support in every European country
- Over 1,800 employees in 19 European countries
- 800 specialized field engineers
- 7% of turnover invested in R&D
- More than 200,000 products
- 11,000+ issued and pending patents

Omron Industrial Automation

Headquartered in Kyoto, Japan, Omron Corporation is a global leader in the field of automation. Established in 1933. Omron has more than 37,000 employees in over 210 locations worldwide working to provide products and services to customers in a variety of fields including industrial automation, electronic components industries, and healthcare. The company is divided into five regions and head offices are in Japan (Kyoto), Asia Pacific (Singapore), China (Hong Kong), Europe (Amsterdam) and US (Chicago). The European organisation has its own development and manufacturing facilities, and provides local customer support in all European countries. For more information, visit Omron's Web site at www. industrial.omron.eu.

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Educated as an Electronic Engineer, Klaus Zeller started his professional career as products engineer on component devices at Omron Italy. He joined Omron in 1999 covering not only a technical role related to products, but also improving upon his market and application knowledge as a New Business Developer for Temperature Control devices. In the last 8 years he has taken on the responsibility of Product Management for several component products like Timers, Counters, Temperature Controllers and switching devices such as Solid State Relays and Electromechanical Relays. In 2015 he joined the European Product Marketing team responsible for stand-alone Temperature Controllers.