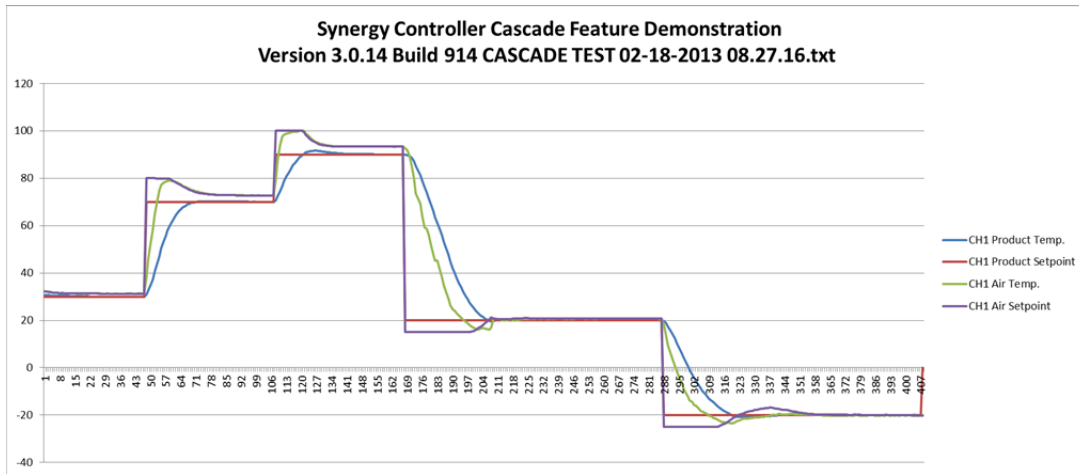# Synergy Cascade (Product Temperature) Control Feature

Introduction

Tidal Engineering's Synergy Controllers including the Synergy Micro 2, Synergy Quattro, and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger. They are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.
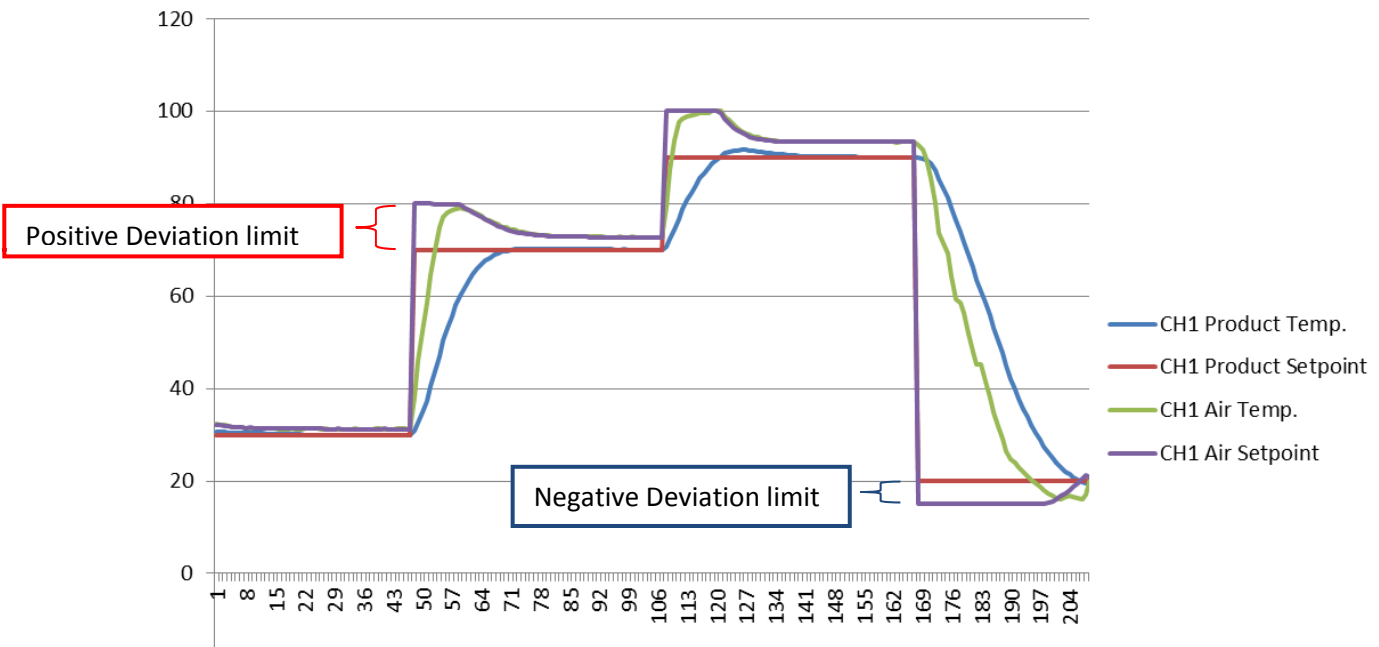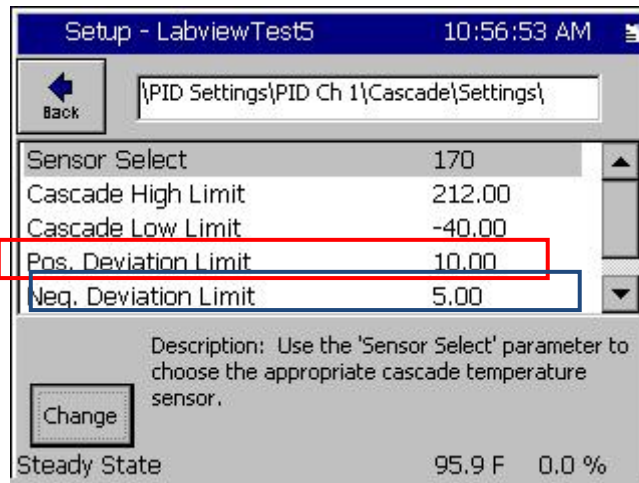
The Cascade Temperature Control feature available as an option on all Synergy Controllers uses two control loops and two sensors to provide better performance than can be achieved with one loop alone. With this feature, the product temperature generally reaches its set-point quicker and with less overshoot than with single loop control.   See the log plot example at the end of this application note. In addition, since the product temperature is the primary feedback temperature, the product temperature is controlled with greater precision since it is controlled directly rather than indirectly.

This application describes the cascade feature behavior in 3.0.13 Build 914. In this version the Deviation Limits are calculated from the Product Setpoint. In prior versions, the deviation limits are calculated from the Actual Temperature. The chart on the following page shows how the deviation limits control the Air Temperature setpoints. Note that additional Cascade Feature setup instructions are included in the Synergy Controller technical manual.
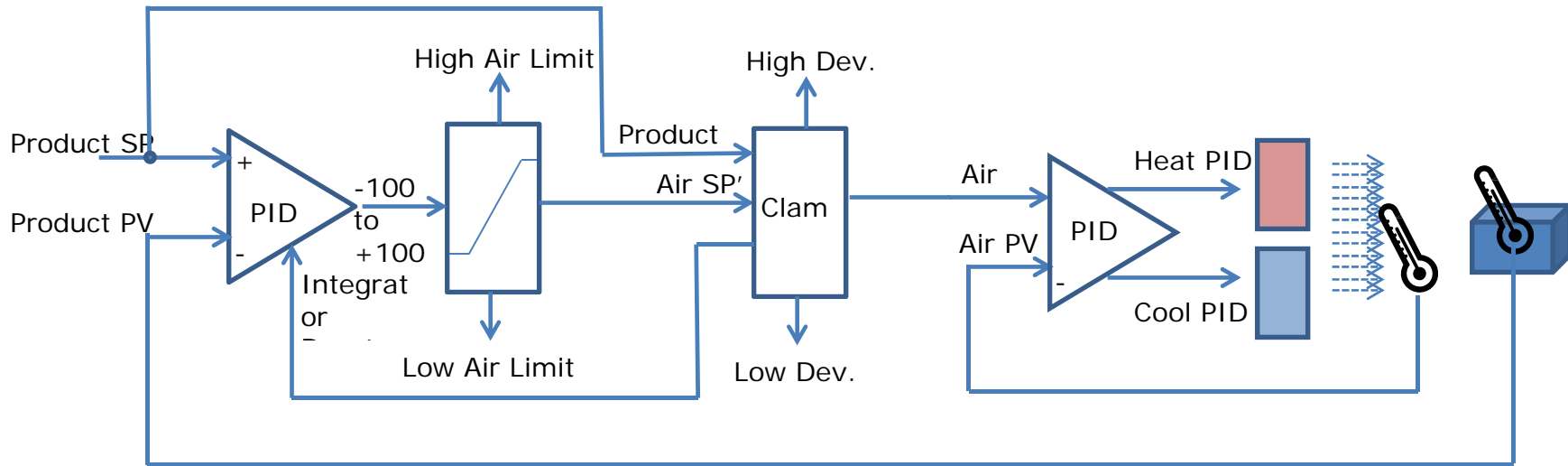
Single loop control compares the temperature of the discharge air leaving the conditioning section to a temperature set-point, and adjusts the heating / cooling systems accordingly.

In Cascade Control the inner loop monitors the discharge air from the conditioning system and compares it to the temperature set point generated by the outer loop. The error signal is calculated and then the Heat and Cool PIDs are calculated. An output power level signal ranging from 0 to 100% is calculated and sent to the heating and cooling systems.

As noted above, this application describes the cascade feature behavior starting in 3.0.13 Build 914. The Deviation Limits in this new version are calculated from the Product Setpoint. In prior versions, the deviation limits are calculated from the Actual temperature. The deviation limits are identified in the following graph.
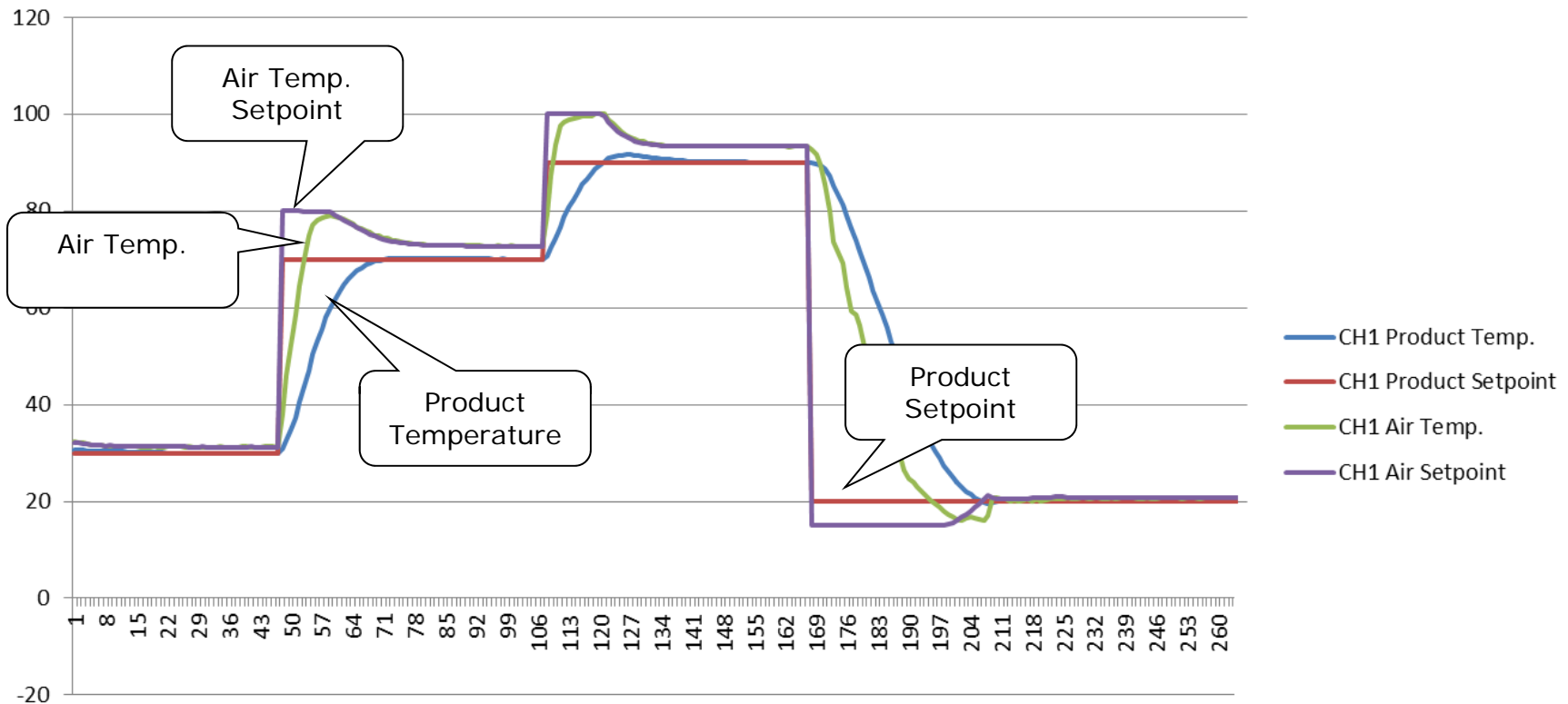
Synergy Controller Cascade
Feature Block Diagram

High Air Limit

High Dev.

Product SP

Product PV

PID

+

-

-100 to +100 Integrat or

Product

Air SP'

Low Air Limit

Clam

High Dev.

Low Dev.

Air

Air PV

PID

-

Heat PID

Cool PID

The chart below shows the benefits of the Cascade Control feature. The Air Temperture Setpoint (violet) drives the Air Temperature (green) a controlled 10 degrees above the Product Setpoint (red) which increases the rate of change of the Product Temperature and then adjusts to 2 degrees over the Product Setpoint as the Product Temperature reaches the setpoint. This residual 2 degree difference is required by the thermal system to maintain the product setpoint and is automatically provided by the Cascate Temprrature Control feature.

Synergy Controller Cascade Feature Demonstration
Version 3.0.14 Build 914 CASCADE TEST 02-18-2013 08.27.16.txt

About the Synergy Controller Family

Tidal Engineering's Synergy Controllers including the Synergy Micro 2, Synergy Quattro, and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

Synergy Controller feature highlights includes:

➔ Color touch screen
➔ Ethernet, RS-232 and GPIB communications
➔ Built in 100 MB Data logger with USB drive support
➔ Data Acquisition, up to 64 T-type thermocouples (Optional)
➔ Built-in Web Server for remote control; WebTouch Remote ™
➔ Compatible with Synergy Manager for PC based control, monitoring and programming.
➔ Built-in FTP Server for factory automation and test and measurement applications

For more information regarding these controllers please see the Synergy Controller Technical Manual on our website at http://www.tidaleng.com/synergy.htm

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building award-winning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company is recognized for technical expertise in such areas as environmental test chamber control, Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems.

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