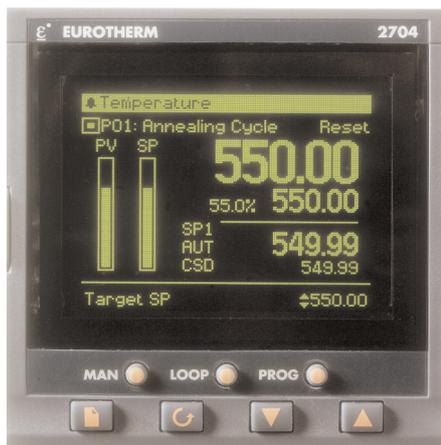


# 2604 2704 MODEL



## Cascade control supplement

### Ideal for:

- Heat treatment furnaces
- Vacuum furnaces
- Autoclaves
- Semiconductor diffusion
- Batch reaction vessels
- Heat exchangers
- Crystal growth
- Distillation columns

### Features:

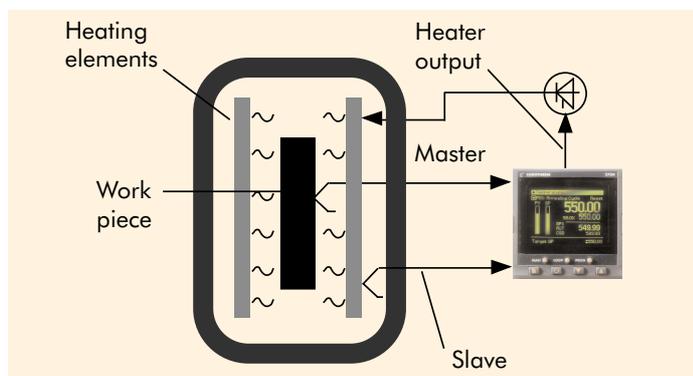
- Accurate control of load
- Compensation for process delays
- Overheating protection
- Optimum Process response

### What is cascade control

Cascade control is a technique used to enable processes with long lags to be controlled with the fastest possible response to process disturbances including setpoint changes, whilst still minimising the potential for overshoot. This is achieved by controlling a secondary, more responsive process that influences the main process. The main process is controlled using a master PID loop, the output of which is used to determine the setpoint of the secondary process which is controlled by a second PID loop. This second loop is referred to as the slave loop.

For example, in the vacuum heat treatment furnace shown below, the workpiece temperature can be controlled using a cascade configuration where the furnace workpiece temperature is used by the master loop and the heating element temperature is used by the slave loop.

The implementation of cascade control in the 26/2704 is available as a standard option. i.e. It is not necessary to use a dual loop controller to perform cascade control. There is one Auto/Manual switch for both master and slave loops. When the controller is placed in manual the slave working setpoint will track the value of the slave process value continually, thereby ensuring bumpless transfer. When cascade is deactivated the master loop will monitor the setpoint of the slave loop and provide a smooth transition of output power when the loop reverts back to cascade mode. All transitions between Auto, Manual and Cascade modes are handled automatically without the need for expert user intervention.



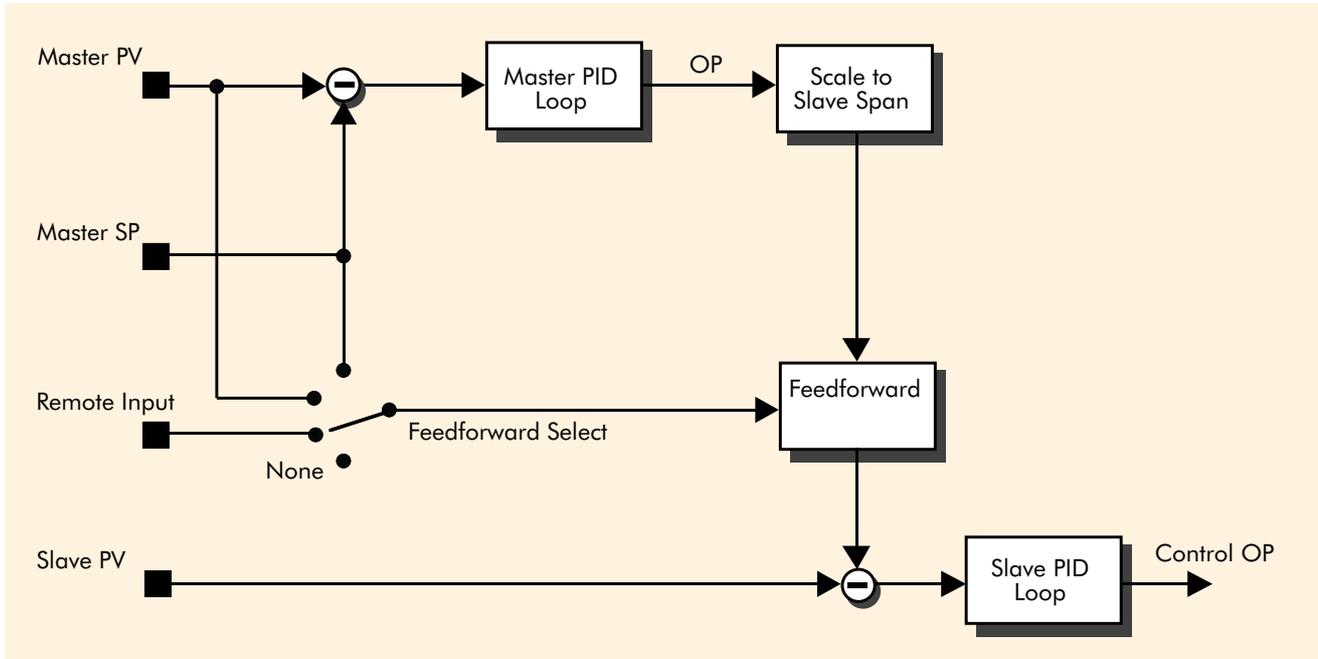
Vacuum heat treatment furnace

## Cascade with feedforward

Feedforward is an option available when using cascade control. It allows either the master PV, master SP or user defined variable to be fed forward so that it directly influences the slave setpoint (see diagram below). This minimises the amount of work required from the master PID loop.

## Master SP/PV feedforward

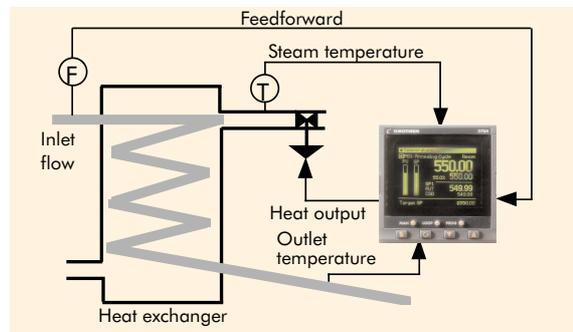
In this mode the feedforward limits are set directly in the slave loop's engineering units, which also adjusts the gain of the feedforward path. In the case of PV feedforward this allows the difference between the master and slave PV's to be limited and is often called "Delta T control". This is used on reactor vessels and autoclaves to limit temperature gradients, thus minimising processing time and ensuring consistent product quality.



**Cascade with feedforward**

## Process feedforward

An example where cascade control with feedforward can be used is in pasteurisation heat exchangers. The feedforward signal allows the controller to compensate for rapid variations in inlet flow therefore maintaining a stable outlet temperature.



**Pasteurisation**

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