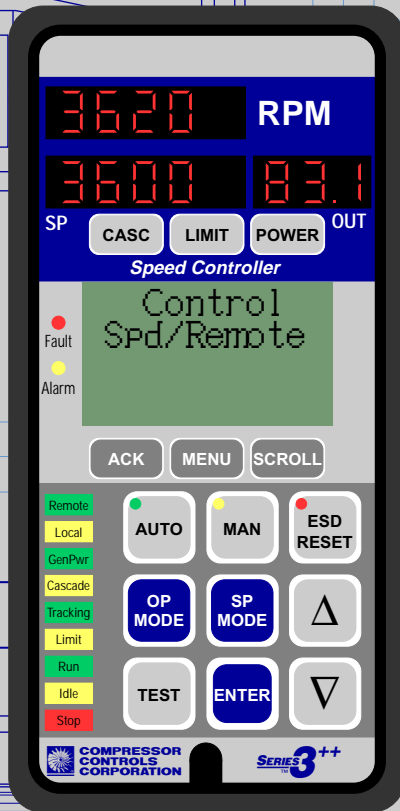


**SERIES 3<sup>++</sup>**  
TM



# Speed Controller

## for Steam Turbines



The Series 3<sup>++</sup> Speed Controller provides a versatile, compact, and economical way to govern a steam turbine's speed or power, protect against overspeeding, and sequence startups and shut-downs. It is applicable to both variable-speed and synchronous generator applications. Its redundant inputs, fault detection, fall-back strategies, and online-backup features define a economical approach to fault tolerance for such machines.

For single extraction turbine applications, it can be combined with a companion Extraction Controller (see [PB3308](#)) to provide coordinated control of both power and the extraction pressure or flow. For turbine-driven compressors, it can be joined with our Antisurge and Performance Controllers. It can also be integrated into a distributed or supervisory control system using Modbus serial or ethernet communication.

### **Speed and Load Control**

The Speed Controller offers isochronous and droop control modes with selectable local, remote, and cascade (isochronous mode only) set points:

- Isochronous control keeps the speed at its set point.
- Valve droop keeps the difference between the speed and its set point (the droop) equal to a function of the valve position.
- Power droop keeps the generator's power output proportional to the droop, and the controller can fall back to valve droop if the power input fails.

Isochronous control is used for variable-speed loads (such as compressors), while generator applications use discrete inputs to select an appropriate mode. All modes adjust to changing process dynamics by varying its gain and reset rate as functions of the speed or steam flow.

### **Critical and Overspeed Protection**

The Speed Controller offers several features that prevent critical and overspeed damage. And they remain in effect even during manual operation, thus providing uninterrupted protection.

Rotational speeds are determined from up to three magnetic pickup signals, using 2-out-of-3 voting when appropriate. Alarms are generated when any MPU fails, and the turbine is shut down if all of them fail.

The speed set point can vary only between your minimum and maximum governor settings.



## **Features:**

- *2-out-of-3 voting on speed*
- *speed or droop control for synchronous generators*
- *local, remote, or cascade control of speed set point*
- *bumpless transfer among all control modes*
- *variable gain and reset rate*
- *automatic override allows manual valve positioning without endangering equipment*
- *automatically idles or stops turbine when load-loss discrete inputs are set*
- *electronic overspeed trip*
- *overspeed test captures the overspeed trip limit*
- *coordinated start-up and shut-down sequencing*
- *start-up and shut-down ramps avoid two critical speed ranges*
- *optional, automatic switching to redundant controllers in the event of critical failures*
- *compatible with pneumatic and hydraulic actuators*
- *standard hardware simplifies maintenance and parts stocking*
- *Modbus RTU or TCP interface for DCS/SCADA communication*

All set point ramps can skip up to two critical speed ranges. The start-up sequence slows the turbine to a safe speed if it fails to clear a critical range within a configured amount of time.

Alarms, discrete outputs, and computer communication can signal operation beyond either of two speed switch thresholds.

If the speed reaches a configured electronic overspeed trip limit, the turbine is immediately shut down. It will also be shut down or idled if any load-loss discrete input is set. The overspeed test allows you to accelerate the turbine until its primary trip device is triggered, capturing that maximum speed for later display.

## **Start-Up Sequencing**

Improper start-up is perhaps the greatest threat to steam turbine longevity. To avoid damage and minimize wear, the unit must be warmed up at an appropriate idle speed. If various conditions are not met (proper lube oil pressure, for example), the procedure must be aborted. Speeds at which vibration or other damage is likely must be avoided.

Failure to consistently follow the proper procedures can cause unnecessary wear or damage. To minimize such risks, this controller provides automatic sequencing with precise control of up to three idle speeds, configurable acceleration ramps, two critical speed ranges, and discrete start-permissive inputs.

## **Control Valve Flexibility**

In addition to its two standard 20 mA / 5 Vdc outputs, the Speed Controller has a high-current output that can generate uni- or bipolar current-loop signals ranging up to 200 mA.

## **Benefits**

Series 3<sup>++</sup> Speed Controllers offer benefits you can't get from general-purpose controllers, including:

- **More precise control of speed** by eliminating mechanical deadtime and hysteresis effects
- **More precise control of turbine-driven compressors** because control functions are integrated
- **More reliable operation** because redundant inputs, fallback mode and online backups provide fault tolerant control
- **Simplified operation** due to integral manual control, protective override, and automated sequencing
- **Lower repair costs** because automated sequencing provides consistent warmups and prevents operation at critical speeds
- **Lower capital costs** because automated start-up sequencing and overspeed protection prolongs the life of your turbine