



**COMPRESSOR  
CONTROLS  
CORPORATION**

# Series 3 Plus Speed Controller

## for Steam Turbines

### Description

The Series 3 Plus Speed Controller provides a versatile, compact, and economical way to regulate a steam turbine's speed or power, protect against overspeed damage, and automatically sequence startups and shutdowns. It is applicable to both variable-speed loads and synchronous generators. Its redundant inputs, fault detection, fallback strategies, and backup controller features define a new, more economical approach to fault tolerance for such machines.

For single extraction turbines, the Speed Controller can be combined with a *Series 3 Plus Extraction Controller* [PB308] to provide coordinated control of both power and extraction flow or pressure. For turbine-driven compressors, it can be joined with our Anti-surge and Performance Controllers. It can also be easily integrated into a distributed control system using Modbus-based serial communication features.

### 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 droop (that is, the difference between the speed and set point) equal to a function of the valve position.
- Power droop keeps the generator's power output proportional to the droop.

Isochronous control is used for variable-speed loads (such as compressors), while generator applications use discrete inputs to select an appropriate mode. Each mode adjusts to changing system dynamics by varying its gain and reset rate as functions of the speed or steam flow rate. Redundant inputs can be used for power droop, and the controller can fall back to valve droop if both fail.

### Critical and Overspeed Protection

The Speed Controller offers several features that prevent critical and overspeed damage to your turbine. And, because the overspeed features remain in effect even during manual operation, you are assured of uninterrupted protection.

*Description, continued on rear panel*

### Benefits

Series 3 Plus Speed Controllers offer many benefits over other mechanical and electronic governors:

- **More precise control of turbine 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 and fallback modes provide fault tolerant control
- **Simplified operation** due to integral manual control, protective override, and automated sequencing
- **Less downtime and reduced maintenance costs** because electronic circuits are more reliable than mechanical and hydraulic components

*Benefits, continued on rear panel*



### **Description**, continued from front panel

Rotational speeds are determined from up to three magnetic pickup signals, using 2-out-of-3 voting when appropriate. An alarm is 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. If it reaches a user-specified limit, the electronic overspeed trip immediately shuts down the turbine. The Speed Controller will also idle or stop the turbine if any load-loss discrete input is set.

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

The controller also records the turbine's highest speed, which can be displayed or reset at will. Plus,

the overspeed test allows you to accelerate the turbine until its primary trip is triggered, capturing that maximum speed for later display as well.

### **Start-Up Sequencing**

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

Failure to consistently follow these procedures can cause unnecessary wear or damage. To minimize these risks, the Speed Controller offers automatic start-up sequencing that includes precise control of the idle speed, configurable acceleration ramps that exclude two critical speed ranges, and discrete start permissive inputs.

### **Control Valve Flexibility**

In addition to 20 mA and 5 Vdc outputs, the Speed Controller can also generate any current signal (up to 200 mA) required by pneumatic transducers or hydraulic actuators. For valves that need an external positioner, the controller can be ordered with a positioning loop that bases its output on the deviation of a valve position signal from the desired value calculated by the control loop.

When you need to directly regulate the governor valve, the Speed Controller can also be operated manually. Your operator or DCS can then directly manipulate the intended valve position instead of the speed set point.

## **Summary of Features**

The many built-in, keyboard-configurable features of the Series 3 Plus Speed Controller include:

- 2-out-of-3 voting on rotational speed (selected value can be transmitted to companion controllers)
- 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
- overspeed trip closes the governor valve if a user-defined maximum speed is exceeded
- overspeed test captures the overspeed trip limit
- automatic start-up and shut-down ramps avoid up to two critical speed ranges
- automatic, bumpless switching to redundant controllers in the event of a controller failure
- Modbus interface enables communications with host computers or distributed control systems
- compatible with pneumatic and hydraulic actuators
- standard hardware simplifies maintenance and spare parts stocking

### **Benefits**, continued from front panel

- **Lower repair costs** because automated start-up sequence provides consistent warmups and prevents operation at critical speeds
- **Lower control system costs** because more functionality and a more economical approach to fault tolerance are combined in one compact unit
- **Lower capital costs** because automated start-up sequencing and overspeed protection prolongs the life of your turbine

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