

SENTINEL SERIES CONTROLLER



Sentinel Series Overview

The Sentinel Series Controller is an integrated package utilizing a powerful **Programmable Logic Controller (PLC)** for all process control, monitoring, and coordination in conjunction with a touch-screen operator display unit. The Sentinel provides the operator with a concise point of control for all processes related to a reactor system. In its standard configuration the unit controls and monitors the reactor's temperature, the vessel external temperature, the speed of the mixer, and the pressure within the reactor.

The Sentinel provides the operator with an overview screen displaying all of the reactor conditions. It also provides separate screens for each control loop, alarm/event summary, process variable trending, recipe generation/save/load, and system configuration.

The operator can vary the control of each of the reactor's processes separately, or coordinate their actions via an integrated 12-step ramp/soak style recipe.

With slight modifications the Sentinel can handle additional functions including but not limited to:

- Sample Valve
- Catalyst Injector
- Additional monitor/control thermocouples
- Liquid Pump(s)
- Control of external components
- Etc...

The customer should consult the factory for any of these types of additional features.

The Sentinel series can also be grouped together and operated via a single workstation computer. The workstation computer is configured to give the operator complete access to each connected Sentinel Controller including all operational capability, recipe functions, data acquisition, and configuration. The workstation will store all of the data acquired from each of the Sentinel Controllers.

Temperature Control

Temperature control is based on an internal thermocouple used as the process variable, and a second, external thermocouple located at the heater/vessel wall interface. The internal thermocouple is used as feedback to the PID algorithm within the PLC to determine the power required from the heater to meet the desired operator entered setpoint. The heater is normally an electric band heater wrapped around the outside diameter of the vessel. While the vessel is heating if the external thermocouple reaches the ASME temperature limit the heater is disabled until the external thermocouple indicates the temperature is within proper operating limits.

If the cooling valve option is selected the PLC will energize a cooling valve which will send water through the internal cooling coil and lower the reactor temperature. This option works in conjunction with the heater circuit.

Mixer Speed Control

Mixer speed control is based on a speed sensor attached to the magdrive, which senses the shaft rotation. Based on this feedback the motor speed signal is adjusted by the PLC to meet the desired operator entered setpoint. The PLC will automatically soft ramp transitions between setpoints to minimize system upset and bearing wear.

SENTINEL SERIES CONTROLLER

Pressure Control

Pressure control is accomplished via a pressure transducer attached to the reactor. The reactor pressure will be adjusted based on the valve control action selected on the Sentinel configuration screen. On/Off or proportional control valves can be utilized to control the pressure. The system can also utilize a mass flow controller to control and maintain reactor pressure. The valves can be placed on the inlet side of the reactor, the outlet side, or both. The Sentinel will adjust to the control scenario selected by the customer in the configuration screen.

Flow Control

The Sentinel provides the capability of integrating one or two Mass Flow Controllers (MFCs) into the system. The MFC(s) can be used to maintain pressure within the reactor via a closed loop pressure control configuration. It can also be used as an independent gas supply, with stand-alone control setpoint, while the system utilizes a backpressure valve to control reactor pressure.

General Specifications:

<u>Specification</u>	<u>Standard Sentinel</u>
Electrical Power Requirements	100 / 240 VAC, 50/60 Hz, 30 Amps
Dimensions	7.5" High x 18.5" Wide x 16.25" Deep (190mm High x 470mm Wide x 413mm Deep)
Customer Interlock	Voltage-free contact which has the capability of safely disabling the unit

SENTINEL SERIES CONTROLLER

Sentinel Controller Series Ordering Information

S A B C D E F G H J K L M N

A Voltage

- 1 = 100-120 VAC
- 2 = 200-240 VAC

B Temperature Control

- 0 = None
- 1 = Internal 20 Amp (Std)
- 2 = External Signal¹
- 3 = Internal 20 Amp w/Cooling²
- 4 = External Signal¹ w/Cooling²

C Temperature Sensor

- 1 = Type-K Thermocouple °C
- 2 = Type-J Thermocouple °C
- 3 = Type-K Thermocouple °F
- 4 = Type-J Thermocouple °F

D Overtemp Control Action

- 0 = None
- 1 = Latching
- 2 = Non-Latching

E Speed Control

- 0 = None
- 1 = Closed Loop DC Motor Control
- 2 = External Signal³

F Motor Size

- 0 = None
- 1 = 1/25 Horsepower
- 2 = 1/10 Horsepower
- 3 = 1/8 Horsepower
- 4 = 1/4 Horsepower
- 5 = 1/3 Horsepower
- 6 = 1/2 Horsepower

G Pressure Control & Indication

- 0 = None
- 1 = Indication Only
- 2 = On/Off Inlet Control
- 3 = On/Off Outlet Control
- 4 = On/Off Inlet & Outlet Control
- 5 = On/Off Inlet Control & Analog Outlet Control
- 6 = On/Off Outlet Control & Analog Inlet Control
- 7 = Analog Inlet Control
- 8 = Analog Outlet Control

H Pressure Indication Range

- 0 = None
- 1 = 500 psig (34 bar)
- 2 = 1,000 psig (69 bar)
- 3 = 3,000 psig (207 bar)
- 4 = 5,000 psig (345 bar)
- 5 = 10,000 psig (689 bar)

J Pressure Units

- 0 = None
- 1 = psig
- 2 = bar
- 3 = MPa

K Mass Flow Control

- 0 = None
- 1 = Single Unit Independent Control
- 2 = Dual Units Independent Control
- 3 = Single Unit for Pressure Control
- 4 = Dual Units for Pressure Control

L Communications Option

- 0 = None
- 1 = Ethernet
- 2 = RS-485

M Special Agency Approvals

- 0 = None
- 1 = CUL/UL
- 2 = CE

N Special Configuration

- 0 = Conforms to Catalog Number
- 1 = Addition requirements beyond Catalog Number

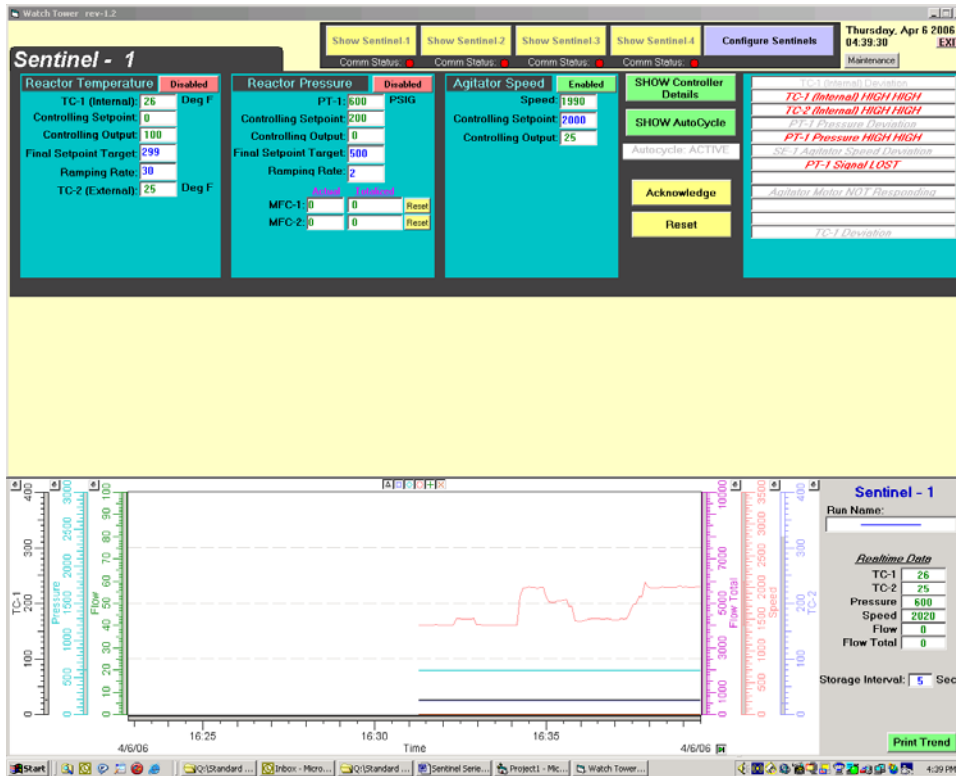
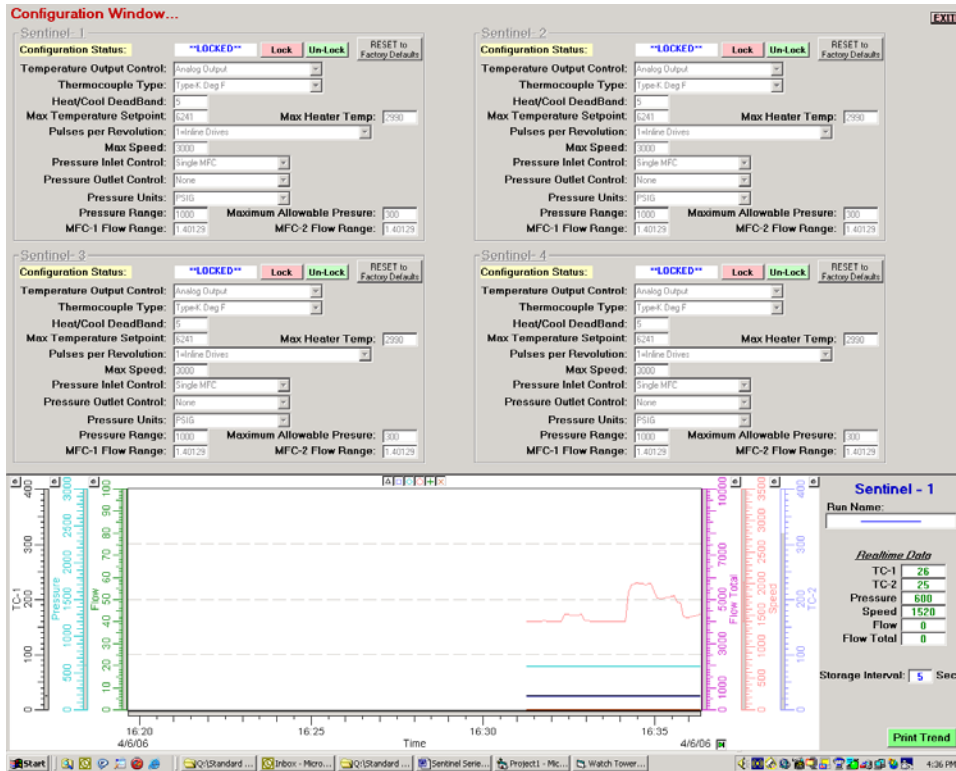
Notes:

1. An *External Signal* selection for **Temperature Control** routes an external signal to an External Power Module, which is supplied separately. The External Power Module is capable of handling heater power in excess of the Sentinel's internal 15 Amp capability.
2. A *Cooling* selection for **Temperature Control** provides an external signal to a cooling solenoid valve, which will circulate water through the vessel-cooling coil. The valve voltage will match that of the Sentinel input power provided.
3. An *External Signal* selection for **Speed Control & Indication** routes an external signal to an external motor speed controller, which is supplied separately. The external motor speed controller is capable of handling larger DC & AC motors in excess of the Sentinel's internal ½ Horsepower capability. The external signal can also be used to control an air regulator for an air motor.

SENTINEL SERIES CONTROLLER

WatchTower Software Package

The "WatchTower" package is designed to integrate up to four Sentinels onto a single supervisor workstation. From the workstation the operator can utilize the "WatchTower-Viewer" or the WatchTower Control and Acquisition" package, both of which are described below.



SENTINEL SERIES CONTROLLER

WatchTower-Viewer Software Package

The “WatchTower Viewer” package is provided free of charge for each Sentinel that is configured with a Communication Option. This package runs on a computer workstation and allows the operator to view only all aspects of the Sentinel. The package can handle up to four Sentinels.

WatchTower-Control and Acquisition Software Package

The “WatchTower Control and Acquisition” package provides all the capability of “WatchTower Viewer” with the following additional features:

- Full Configuration capability of the Sentinel.
- Full control of all Sentinel functions.
- Automatic Cycle creation and control capability.
- All event files saved to the workstation.
- All process data saved to the workstation in .csv format for import into Excel.

WatchTower Remote Access

Either version of the WatchTower software will facilitate the possibility of remote access by our engineers here at Autoclave to the Sentinel and its integrated environment. This requires connecting the workstation running the WatchTower to the Internet through which Autoclave Engineers will remotely connect and troubleshoot or update the Sentinels software and/or the WatchTower package. With the proper connection we can access customers anywhere in the world.