

# Vertex-Pro

## Motor-Driven Compressor Control

### Description

The Vertex-Pro is an anti-surge controller, designed to control and protect industrial-sized motor-driven axial and centrifugal compressors. This purpose-built controller is available in standard off-the-shelf models or custom models. Standard off-the-shelf models are available for one or two recycle loop applications, while custom models (Vertex-Pro-C models) are available for larger three and four recycle loop applications.

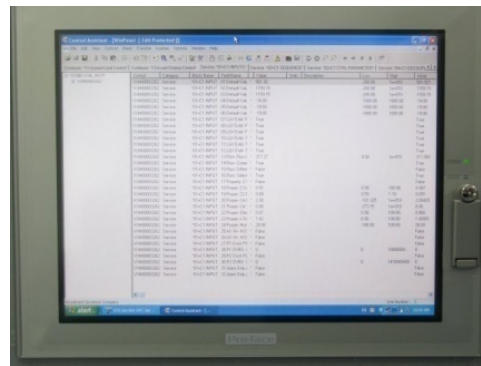
OEM-qualified algorithms are used to ensure that proper start sequences are followed, proper and accurate compressor load calculations are used, and proper protection and recovery actions are performed.

Basic functionality includes:

- Motor Drive Interface Logic
- Inlet Throttle Valve Control
- Inlet Guide Vane Control
- Recycle Valve(s) Control
- Surge Control
- Performance Control (suction or discharge)
- Surge Anticipation Logic
- Surge Protection Logic
- Surge Recovery Logic
- Load Sharing

The Vertex-Pro is built on Woodward's field-proven MicroNet™ platform, and is available in simplex or dual-redundant models. All models utilize the MicroNet's compact 8-slot chassis and robust field termination modules. Simplex models include one of every module, while dual-redundant models include two of every module, allowing users to perform both bumpless on-line program changes and on-line module replacements.

The Vertex-Pro chassis is designed to be bulkhead-mounted in a cabinet or control panel, and contains the required I/O and core control software to control industrial motor-driven compressors. Typically, this controller is located in an enclosure that is rated for the site-specific environment. Field termination modules (with integrated circuit fuse protection) are included with this controller to allow users to easily land and manage compressor and system interface wiring. The control also supplies source power for associated sensors and I/O circuits.



- Integrated controller
  - 1–4 loop anti-surge control
  - Motor current limiter
  - Performance control
  - Load sharing
- Incipient surge detection logic
- OEM-qualified algorithms
- Standard off-the-shelf availability
  - 1 & 2 recycle loop models
  - Field-configurable
  - Field-serviceable
- Increased availability
  - Dual-redundant models
  - On-line program changes
  - On-line repair
- Open architecture
  - Ethernet & serial interface
  - OPC & Modbus protocols
  - Control Assistant service tool included
- User-friendly service tool
  - Configuration & operation
  - Password-based security
- Standard 307 mm (12.1") panel-mount touchscreen with keyboard and mouse
- Replaces CCC series-3 controllers
- API 617 compliant

This control is field-configurable, allowing users to easily configure the control to application-specific requirements. A menu-driven software program (Control Assistant) is provided with the control, and when installed on any Windows-based computer or laptop, serves as the human interface to the control and or compressor. This Control Assistant is used to configure, service, and optionally operate the control.

Optionally a touchscreen OpView™ panel is available for use as a local or remote operator control panel. This OpView panel is comprised of a 307 mm (12.1”) touchscreen computer, and connects to the control via an Ethernet link.

## Applications

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The Vertex-Pro anti-surge control is designed for industrial-sized axial or centrifugal compressors with 1 to 4 recycle loops. Standard off-the-shelf models are available and field configurable for 1 or 2 recycle loop applications, while custom models are available for larger 3 or 4 recycle loop applications. This controller includes specifically designed algorithms and logic to start, stop, control, and protect industrial compressors driven by a stationary speed motors or variable-frequency drive motors. OEM-qualified algorithms are used within the Vertex-Pro for straight-through, iso-cooled, double-flow, single side-stream, and back-to-back compressor applications.

Designed to replace CCC Series-3 and Series 3++ anti-surge controllers, the Vertex-Pro can be configured to function like these controllers but uses two-times faster scan rates, improved surge anticipation logic, and one integrated package for all control functions (anti-surge control loop 1, anti-surge control loop 2, performance control, and dual-redundant control).

The standard Vertex-Pro models (1 & 2 recycle loops) are field-configurable, allowing users to configure/select the specific control algorithm required for the specific compressor loop and application. Since 3–4 loop compressor applications tend to be complex, Vertex-Pro-C models (3 & 4 recycle loops) are custom programmed by Woodward engineers, ensuring that the correct control and optimization algorithms are used to meet the specific application requirements.

For critical applications requiring increased reliability and availability, users can order dual-redundant control models, which have manual switch-over and automatic fail-over capabilities. These redundant control models also allow users to replace/repair modules and perform program changes while the compressor is operating on-line, thus greatly improving system availability.

The Vertex-Pro controller includes the following PID control & protection functions:

- Anti-Surge PID Control
- Rate PID Control
- Boost (open-loop backup line response)
- Surge Recovery
- Surge Minimum Position
- Start, Purge, Stop, Shutdown, & Zero Speed Sequencing Positions
- Alarm & Shutdown Logic

Alternatively, the following functions can be configured, depending on the application requirements:

### Motor

- Current limit PID Control
- Start Sequence Logic

### Compressor

- Throttle or Inlet Guide Vane Ramp Loading (motor protection)
- Performance Control (compressor suction or discharge pressure, flow, or external signal)
- Load Sharing (parallel compressors up to three trains)

## Redundancy

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With Vertex-Pro dual-redundant models, the CPU modules operate in a special master/slave configuration, using synchronized memory and one-millisecond transfers to ensure bumpless transfers, and allow on-line repairs, and program changes, to increase overall system availability. These models allow for automatic and/or manual transfers between the two sets of modules in cases of external I/O, internal module, or input power failures. Dual-redundant models allow any module to be replaced while the unit is operating on-line. Annunciation of any control failure or transfer is provided through all communication links and event logs.

## Configurability

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The following I/O list is utilized by Vertex-Pro models only. Vertex-Pro-C models are customized to the specific application and may use the same, or more or less I/O signals, depending on the application. Vertex-Pro inputs and outputs (I/O) are arranged into pre-defined and configurable groups. Pre-defined I/O is fixed based on its use in all or most applications. Configurable I/O is selected based on the specific needs of each application.

### INPUT SIGNALS:

#### Power Sources (Simplex or Redundant)

- AC/DC—Power Supply (88–132 Vac/47–63 Hz or 100–150 Vdc)
- HVAC—Power Supply (180–264 Vac/47–63 Hz)

#### Discrete Inputs (38)

Two discrete inputs are assigned pre-determined functions and thirty-six are configurable:

- Emergency Shutdown
- Reset
- Configurable Discrete Inputs (36)

#### Analog Inputs (24)

Five analog inputs are assigned pre-determined functions, and twenty-one are configurable:

- Compressor Flow Signal (4–20 mA)
- Compressor Suction Pressure Signal (4–20 mA)
- Compressor Discharge Pressure Signal (4–20 mA)
- Compressor Suction Temperature Signal (4–20 mA)
- Compressor Discharge Temperature Signal (4–20 mA)
- Configurable Analog Inputs (19) (4–20 mA)

### OUTPUT SIGNALS:

#### Discrete Outputs (20)

Two discrete outputs are assigned pre-defined functions and, eighteen are configurable:

- Motor/Compressor Shutdown
- Motor/Compressor Alarm
- Configurable Discrete Outputs (18)

#### Analog Outputs (8)

One analog output is assigned pre-defined functions and seven are configurable:

- Anti-surge Valve (4–20 mA)
- Configurable Analog/Actuator Outputs (7) (4–20 mA)

#### Communication Ports (3)

- (2) Ethernet ports (OPC or Modbus® \*)
- (1) Serial RS-232, RS-422, RS-485 Modbus port

\*—Modbus is a trademark of Schneider Automation Inc.

## Control Functions

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### Motor Start-up/Shutdown

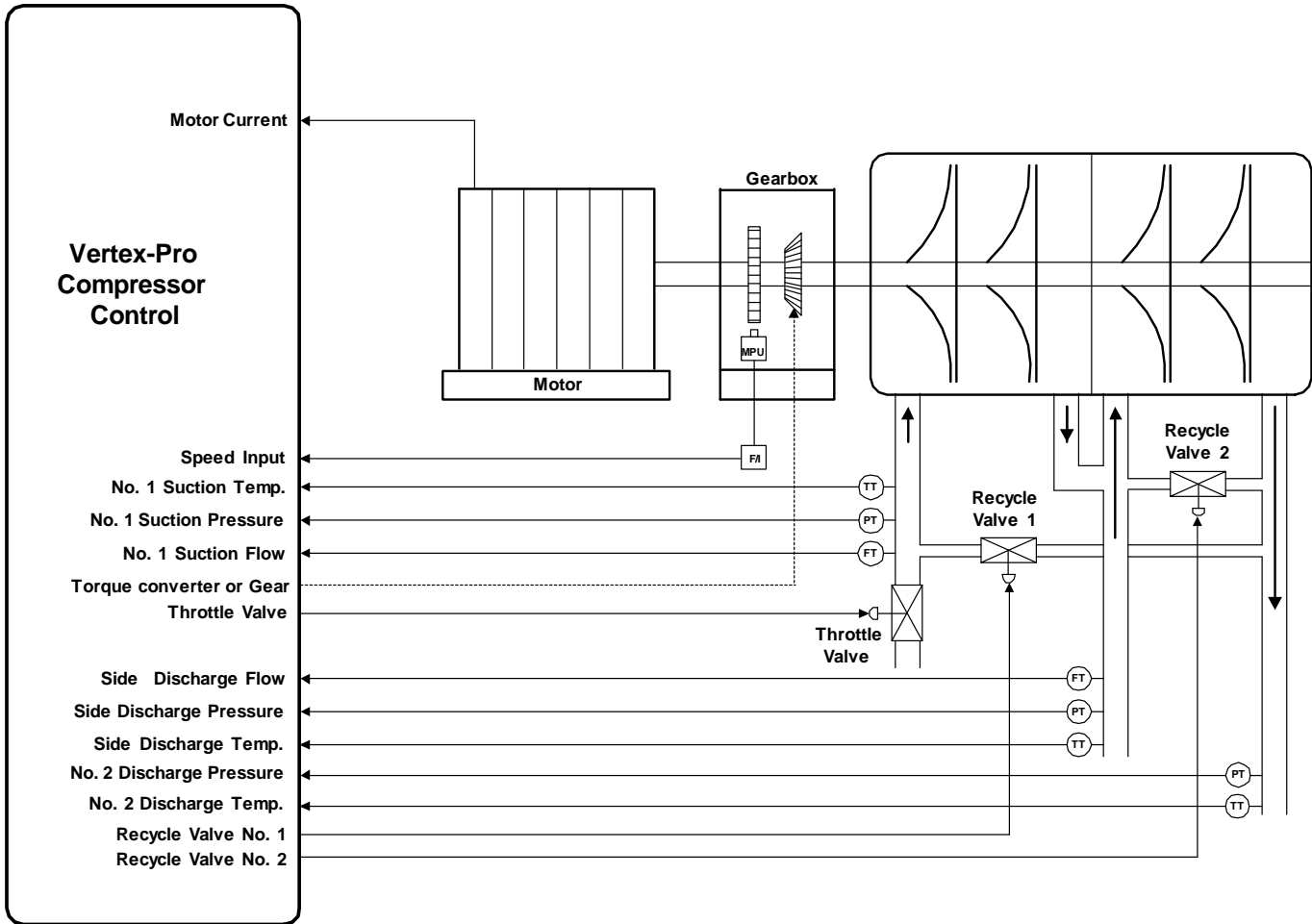
The Vertex-Pro provides three selectable start-up modes—Manual, Semi-Auto, and Sequence. In the manual mode, the throttle valve or inlet guide vane (IGV) is opened by an operator manually raising/positioning the Vertex-Pro's valve demand signal. In the semi-automatic mode, the valve/vanes are automatically opened to the user-defined position at a user-defined rate. In the sequence mode, the Vertex-Pro automatically controls valve position based on a defined sequence in order to prevent a motor overcurrent condition.

### Motor Current Limit Control

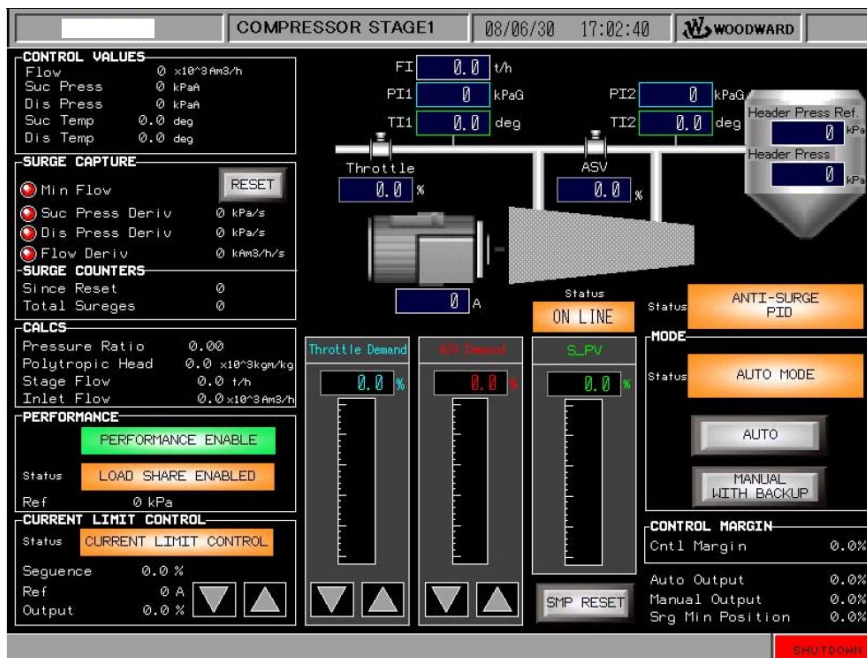
When configured, this control function senses motor current and limits compressor load to protect against motor overload conditions.

### Anti-Surge Control

The anti-surge PID uses compressor pressure, temperature, and flow signals to calculate each compressor stage's operating point, then compares this value to the specific surge map and surge control line to position the respective recycle valve, and hold the compressor away from surge.



Typical Vertex-Pro Interface Diagram



Example OpView™ Overview Screen

## Surge Protection & Recovery Functions

Quick-acting Rate and Boost functions are also available to open the recycle valve and protect the compressor should a transient process condition step the compressor towards surge. A Pre-Pack feature is also configurable to improve system response times by compensating for lag times associated with long recycle piping runs. If a surge event occurs in spite of all performed corrective actions, Surge Recovery and Surge Minimum Position functions take over to protect the unit until process stability is achieved.

## Performance Control

When configured, this control function is used to control compressor suction pressure, compressor discharge pressure, compressor flow, or any process variable related to compressor flow or load. This control function compares an analog input signal to an internal setpoint and, depending on the programmed configuration, positions the compressor throttle valve, inlet guide vanes, torque converter, and/or motor speed (VFD) to accomplish the desired control.

## Load Sharing Control

When configured, this control function is used to share compressor load with up to two other identical compressors in parallel. When connected to one or two other Vertex-Pro controllers operating identical compressors in parallel, these paralleled controllers work together to maintain overall suction/discharge header pressure while controlling each compressor equidistant from their surge control lines.

## Communications

Simplex Vertex-Pro models include one Serial and two Ethernet communication ports for interface to the unit service tool, optional OpView HMI touchscreen, and the plant DCS (distributed control system). OPC, Modbus-TCP, and Modbus-UDP protocols are available via the unit's Ethernet communication ports, while a Modicon Modbus-based protocol is used on the Serial communications port. Dual-Redundant Vertex-Pro models include two Serial and four Ethernet ports for added system communication redundancy.

## Specifications

### Operating Conditions

Temperature:	0 to 55 °C (32 to 131 °F) ambient air temperature range
Shock:	US MIL-STD-810C, method 516.2-1, procedure 1B (15 G, 11 ms half-sine pulse)
Vibration:	Lloyd's ENV2 test #1
Emissions:	EN55011, Class A, Gr 1
Immunity:	EN50082-2

## Regulatory Compliance

Listings are limited only to those units bearing the appropriate Marking or Agency Identification.

### European Compliance for CE Marking:

EMC Directive:	89/336/EEC
Low Voltage Directive:	2006/95/EC

### North American Compliance:

UL:	UL Listed for Class I, Division 2, Groups A, B, C, & D, T3A at 65 °C surrounding air temperature. For use in Canada and the United States UL File E156028
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