Flex500

Digital Control for Turbines, Engines, or Compressors

Applications

The Flex500 control system represents a new generation of turbine and engine control. This controller is an industrial hardware platform that offers robust, low-cost control for a wide variety of turbine, engine, and compressor applications. The platform's real-time operating system and dedicated inputs and outputs provide deterministic performance for key prime-mover-control functionality.

Designed to function as a distributed control system, Woodward-based RTCnet™ and/or LINKnet HT™ distributed I/O modules can be used in conjunction with this platform to expand the number and type of input and output signals as required by the specific application.

Ethernet, serial and CAN communication ports, and the related Modbus® * TCP/IP and CANopen protocols also make this platform ideal for functioning as part of an overall plant distributed control system (DCS) or as a standalone controller. Four Ethernet ports and four CAN ports allow for the network flexibility and redundancy necessary for today's critical control system architectures. The Flex500 controller is a custom-programmed hardware platform designed specifically for prime-mover-control applications such as:

- Gas turbines
- Compressor control and protection
- Gas and diesel engines
- Steam turbines
- Hydro turbines

All controller inputs, outputs, and statuses can be monitored, and all start/stop or enable/disable commands can be given, through industry-standard Modbus TCP or OPC protocols. The Flex500 platform uses SNTP (synchronized network time protocol) over Ethernet to allow users to synchronize its real-time clock to a plant distributed control system.

* Modbus is a trademark of Schneider Automation Inc.

Description

The Flex500 control is packaged in an industrial hardened enclosure designed to be bulkhead or panel mounted within a system control panel located in a plant control room or next to the turbine/engine. Optionally, this controller can be purchased and applied with or without a front panel HMI (human machine interface). Panel-mount models include an 8-inch (20 cm) graphical front panel screen and related keypad. Bulkhead-mount models do not include a graphical display nor keypad and are designed to be mounted within an Ordinary Location or Zone-2 Hazardous Location environment.

- Powerful real-time microprocessor control for turbines & engines
- Optional integrated graphical operator control panel
- Fast, accurate on-board I/O channels
- Combines real time control with PLC programming
- Deterministic scan rates as fast as 5 ms
- Distributed I/O capability
- Compliant with time synchronization protocol SNTP
- Networked control
- 4 Ethernet ports
- 4 CANopen ports
- RTCnet compatible
- Low cost alternative to a general purpose PLC
- Sulfur-resistant conformal coating
- Certified for Hazardous Locations

The control's optional front panel serves as both an engineering station and operator control panel (OCP). This user-friendly front panel allows plant operators to easily start/stop the turbine and enable/disable any control mode, as well as enabling engineers to access and service the unit as required. Password security is used to protect access to all unit operation and service modes. The optional controller's 8-inch graphical display allows operators to view actual and setpoint values from the same screen, simplifying operation.

Woodward's Control Interface Studio (CIS) is an Integrated Development Environment (IDE) that control engineers or graphical user interface (GUI) developers can use to create custom graphical user interfaces for use on or with Woodward's Flex500 control platform. Once installed onto a computer this software program allows users rapid development of custom GUI applications, which can be downloaded onto the Flex500 platform or a Windows, based computer or touch panel. Refer to Woodward product spec 03448 for more information on this program.

Interface to the Flex500 control's on-board input and output channels and communication ports is located on the controller's side and lower panels (see Figure 1). Un-pluggable terminal blocks allow for easy system installation, troubleshooting, and replacement. Optionally users can increase the number and type of input and output signals to/from the Flex500 controller by utilizing and connecting Woodward's RTCnet and or LINKnet HT distributed I/O modules to the Flex500's CAN communication ports. Refer to Woodward product specification 03402 to better understand the application of RTCnet and LINKnet HT distributed I/O modules.

The Flex500 control's on-board and remote I/O are optimized for prime mover control. This controller's 0.5 ms I/O scan times, high accuracy, and software program synchronization make it ideal for use in controlling and protecting critical high speed rotating equipment.

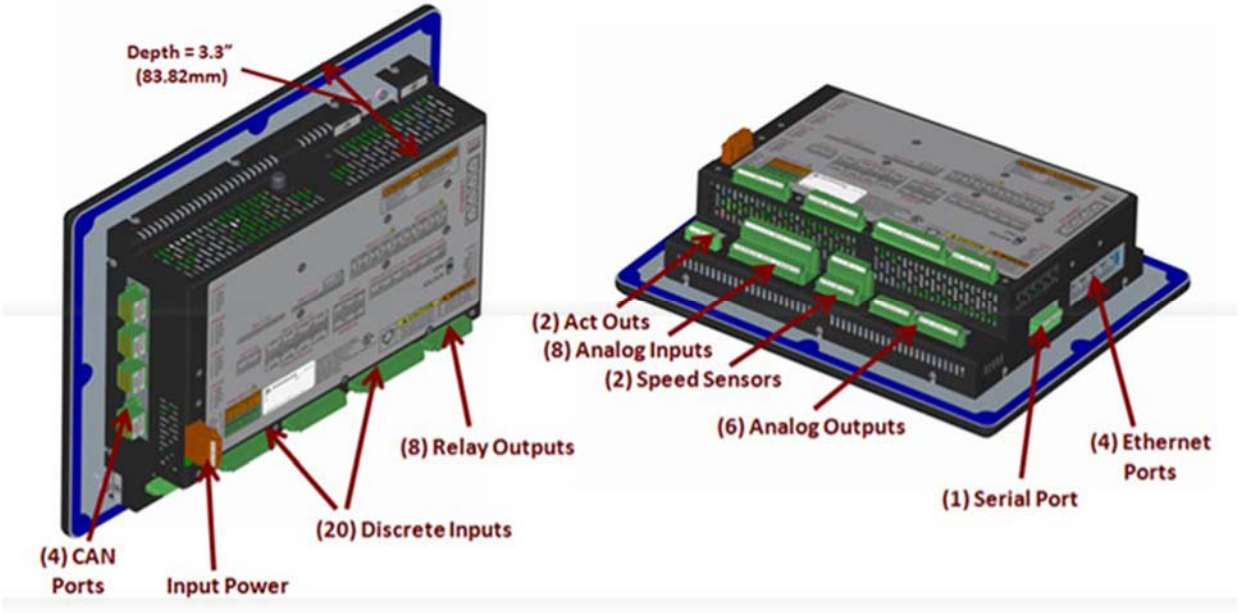

Figure 1. On-Board Inputs and Output Channels

Programming and Simulation

The Flex500 control is programmed via Woodward's popular GAP™ (Graphical Application Programming) language, which has been qualified and specified by many rotating original equipment manufacturers (OEMs). This picture-to-code graphical programming tool allows rotating machinery experts to easily and efficiently create complex control algorithms without having to be software programming experts as well. GAP is a mature IEC1131-3 compliant programming language and can be programmed using function blocks, ladder logic, and/or structured text.

One of the major advantages of Woodward's GAP language is its many libraries of field-proven function blocks. These blocks of functional algorithms have been used by turbine, compressor, and engine OEMs for years to quickly and efficiently implement complex (or simple) control logic and or algorithms. Users can easily drag and drop functions into the program, then connect them via drawn lines between the function blocks.

An essential part of any complex rotating control system is the capability to test and validate the related control logic and algorithms before using it to operate/protect a real machine. Woodward's NetSim™ simulation program links the prime mover and package models (created in standard modeling packages—MATLAB®/Simulink® *, MATRIXX® **, ACSL) to the created GAP software application program. With this simulation program, the created GAP-based control code can be completely tested and validated within an office environment before field commissioning begins.

* MATLAB and Simulink are trademarks of The MathWorks, Inc.
** MATRIXX is a trademark of MATRIXX Software, Inc.

The performance of NetSim software is optimized to provide simulation results that correlate very tightly to actual field results. Woodward's worldwide organization has unequaled turbine and engine control expertise. To support its OEM and packager customers, Woodward and our channel partners can supply software tools, or entire solutions, or a variety of options in-between.

Real-Time Operating System (RTOS)

The Flex500 controller's structured scan rate and synchronized software-to-I/O architecture enforce fast, deterministic, and completely repeatable dynamic behavior. Thorough and extensive FFT testing has proven that screw-to-screw response times are exactly the same for every scan rate, regardless of what is happening elsewhere in the controller. PLCs make use of a less rigid scan rate and synchronization structures that can introduce dynamic instability as the processor becomes busy or code is added or removed.

Communications

The Flex500 control can communicate directly with plant Distributed Control Systems and/or touch-screen operator control panels through four Ethernet ports using Modbus TCP or OPC communication protocols, or via one serial Modbus port. The included serial port supports either RS-232 or RS-485 communications and can be configured to use ASCII or RTU Modbus protocols. Communications between the Flex500 control and a plant DCS can also be performed through hardwired connections.

Control Specifications

INPUTS

Power:	LV models = 18–32 Vdc HV models = 88–264 Vac & 90–150 Vdc
Speed:	2 Passive MPUs or 2 Active Proximity probes (0.5–32 000 Hz)
Discrete Inputs:	20 configurable contact inputs (optionally, additional inputs can be added via distributed I/O modules)
Analog Inputs:	8 Configurable 4–20 mA Inputs (optionally, additional inputs can be added via distributed I/O modules)

OUTPUTS

Valve/Actuator Drivers:	2 actuator outputs, 4–20 mA or 20–200 mA
Discrete Outputs:	8 configurable relay outputs (2 relays rated for 24 Vdc @ 5 A, 6 relays rated for 24 Vdc @ 2 A) (optionally, additional outputs can be added via distributed I/O modules)
Analog Outputs:	6 programmable 4–20 mA outputs (optionally, additional outputs can be added via distributed I/O modules)

COMMUNICATIONS

Ethernet:	4 ports (Modbus TCP or OPC protocols)
Serial:	1 Modbus port (ASCII or RTU) comm ports (RS-232 or RS-485 compatible)
CAN:	4 ports (CANopen protocol)

Engineering Service Tools

Control Assistant Service Tool—Windows-based trend viewing tool used to view high-speed datalog captures or perform other useful utilities (program compare functions, etc.; see product specification 03201).

AppManager Service Tool—Windows-based tool used to upload and download GAP and GUI (graphical user interface) based application programs, retrieving datalog files, and starting/stopping the programs

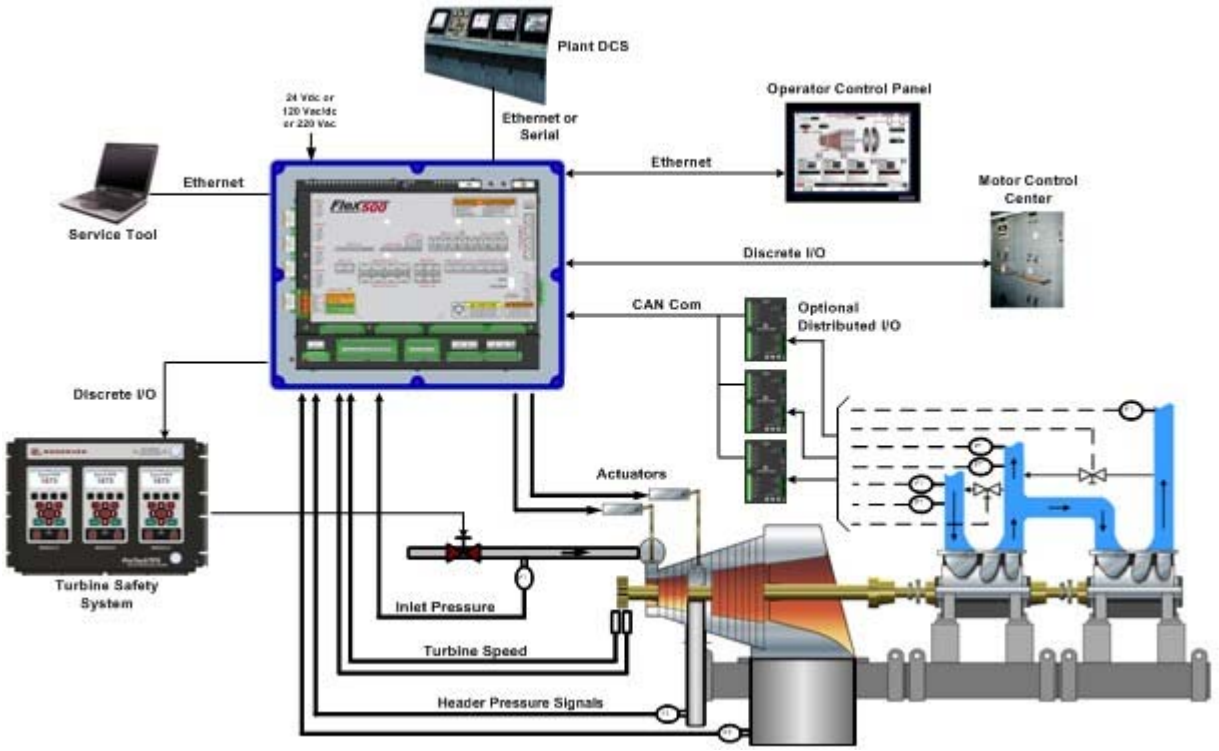

Figure 2. Typical Flex500 Application—Bulkhead-Mount Model

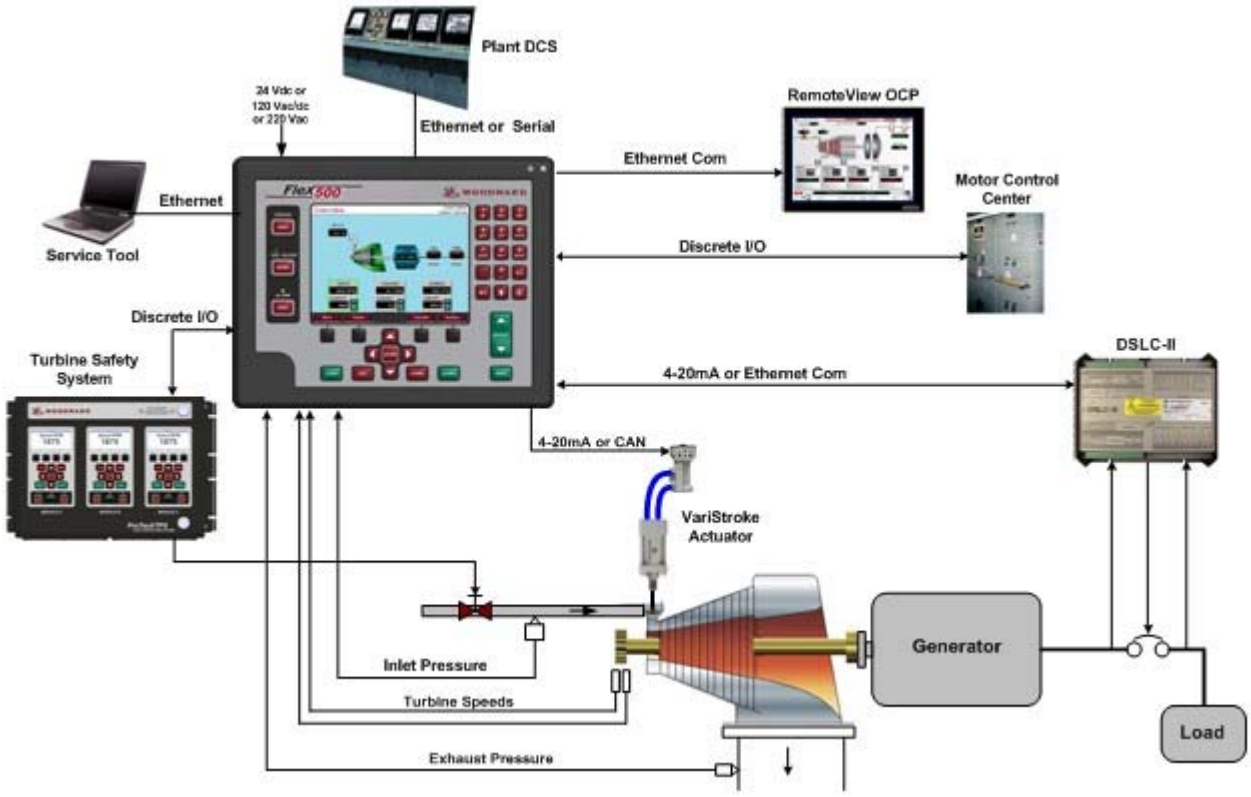

Figure 3. Typical Flex500 Application—Panel-Mount Model

Operating Conditions

- -30 to +70 °C ambient air temperature range with LCD/Panel Mount
- -40 to +70˚C ambient air temperature without LCD/Bulkhead Mount
- Humidity: 5% to 95% per Lloyd's ENV3 test #1
- Dry Heat: Lloyd's ENV3
- Shock: 10G, 3x Axis per Woodward MS1 Procedure
- Vibration: 8.2Grms, Industrial Skid mount per Woodward RV1
  Lloyd's ENV3, Vibration Test #1

Pollution Resistance

- Particulate Pollution Resistance: IEC 60664-1, Pollution Degree 2 (Normally only non-conductive pollution occurs).
- Gaseous Pollution Resistance: Module conformal coating withstands NO_2, CO_2, SO_2, and H_2S gases.

Regulatory Compliance

European Compliance for CE Marking

These listings are limited to only those units bearing the CE Marking.

- EMC Directive: 2014/30/EU COUNCIL DIRECTIVE
- LVD Directive: 2014/35/EU COUNCIL DIRECTIVE
- ATEX Directive: 2014/34/EU COUNCIL DIRECTIVE Zone 2, Category 3, Group IIG Ex ic nA IIC T4 X Gc IP20

Other International Compliance

- IECEx Ex ic nA IIC T4 Gc: Certificate No. IECEx CSA 15.0020X
- EAC CU-TR: Certified as 2Ex ic nA IIC T4 Gc X

North American Compliance

- CSA Listed for Ordinary Locations Certificate 70006135 (LR 79726)
- CSA Listed for Class I, Division 2, Groups A, B, C, and D, T4 at +70 °C: Certificate 70006135 (LR 79726)

Marine Type Approval Compliance

- Lloyd's Register (LR): Environmental Category ENV1, ENV2, ENV3, Lloyd's Register Type Approval Test Specification Number 1, 2013.
- DNV-GL: Temperature Class D, Humidity Class B, Vibration Class A, EMC Class A, Enclosure; Required protection according to the Rules shall be provided upon installation on board, Standard for Certification No. 2.4, April 2006.

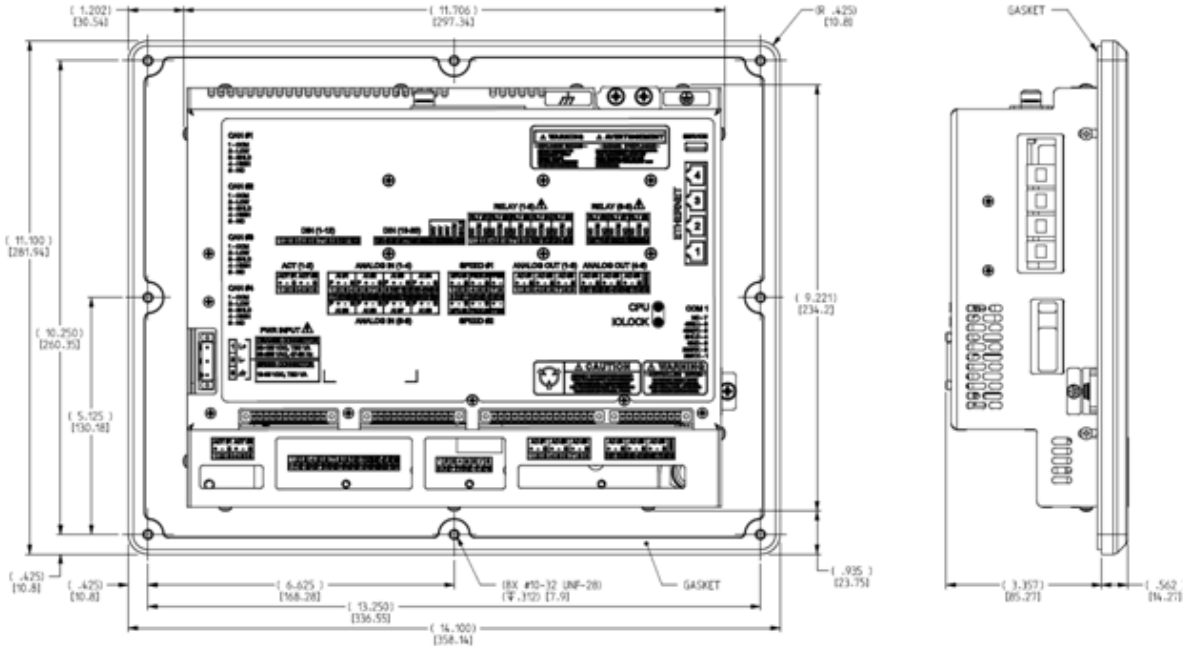

Figure 4. Flex500 Dimensions (Do not use for construction)

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