



Woodward supports control and safety of steam turbine operation with field-proven products and solutions utilized by key prime mover equipment manufacturers across the globe. Our over 40 000 installations speak for themselves in terms of reliability. For more information on the solutions in this document, or any of our rotating equipment product offerings, contact your local Woodward representative or visit:

[www.woodward.com/
IndustrialTurbineSolutions](http://www.woodward.com/IndustrialTurbineSolutions)

Steam Turbine Control and Safety

Products and Technologies Overview

Woodward reserves the right to update any portion of this publication at any time. Information provided by Woodward is believed to be correct and reliable. However, no responsibility is assumed by Woodward unless otherwise expressly undertaken.

Steam Turbine Control and Safety Products and Technologies Overview

Custom Digital Controls



MicroNet Plus

This digital controller can be programmed to control any prime mover and its associated processes, as well as system sequencing, high-speed system monitoring, surge control, vibration monitoring, and station control. It is available in simplex, dual-redundant, and triple-modular redundant (MicroNet TMR) configurations.

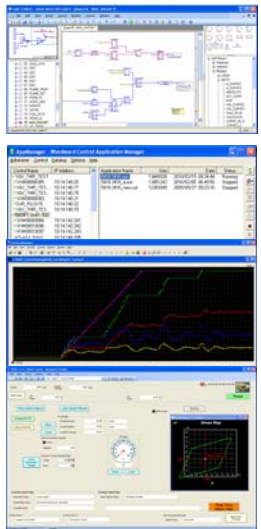
(product spec 03333)



Atlas-II

This industrial platform offers robust, low-cost control for a wide variety of turbine, engine, and compressor applications. With a proven, real-time operating system and dedicated inputs and outputs, the Atlas-II provides reliable and deterministic performance for key prime mover control functionality.

(product spec 03346)



Control Software

Many decades of Woodward experience controlling engines and turbines have been translated into a sophisticated suite of software tools for prime mover applications:

- GAP**—Graphical Application Programmer (GAP) is an IEC 61131-3 graphical programming environment with function blocks that are specialized for turbine and engine control applications.

(product spec 03216)
- Real-Time Operating System (RTOS)**—Provides the software architecture to meet the real-time requirements of the most complex turbine control problems.
- NetSim**—Simulation software that executes a GAP application program, allowing program inputs to be changed to simulate open-loop control operation. GAP can be compiled directly for PC simulation with NetSim against engine models written in ACSL, MATRIXx, Simulink, or MATLAB languages.

(product specs 03292 & 03293)
- Service Tools**—A range of options from on-control displays for local control, service, debug, and configuration functions, to PC based Windows software programs for advanced troubleshooting and maintenance.



Human Machine Interface (HMI)

HMI for Woodward electronic controls is primarily Windows based PC software. This solution utilizes proven Intellution 32-bit or 64-bit software that is compatible with the latest Windows operating systems. Customers can do on-line configuration, trending, reporting, statistical process control, alarming and alarm management, remote monitoring, and supervisory control and data acquisition. This intuitive interface features on-line help and offers true plug-and-play hardware compatibility.

Standard Application (SA) Configuration Digital Controls



5009FT

The 5009FT (fault-tolerant) control is a standard, off-the-shelf solution for industrial steam turbines used in critical compressor or generator drive applications. It is comprised of Woodward's field-proven MicroNet TMR hardware platform and standard steam turbine software algorithms. It is used both in standard OEM turbine packages and by system integrators in turbine upgrade projects. The 5009FT operates with any single point of failure without shutting down the turbine. Its TMR (triple modular redundant) design and hot-swap module capability enable easy system repairs while the turbine is online. (product spec 03373)



505

The 505 controller is designed to operate industrial steam turbines of all sizes and applications. This steam turbine controller includes specifically designed algorithms and logic to start, stop, control, and protect industrial steam turbines or turbo-expanders, driving generators, compressors, pumps, or industrial fans. (product spec 03422)



505XT

The 505XT controller is designed to operate single valve, or single extraction/admission industrial steam turbines of all sizes and applications. This steam turbine controller includes specifically designed algorithms and logic to start, stop, control, and protect industrial steam turbines or turbo-expanders, driving generators, compressors, pumps, or industrial fans. (product spec 03423)



505CC-2

The 505CC-2 is a microprocessor-based control with integral application software that controls a single-valve or two-valve (extraction/admission) steam turbine driving a one- or two-stage compressor load. The architecture is patterned after the popular 505/505E turbine controls. The anti-surge control provides the user with a choice between the standard Woodward anti-surge algorithm or a special 'minimum transducer' design that adapts to variable molecular weights. Like the 505, the 505CC-2 uses configurable software for maximum field flexibility. (product spec 03298)



Peak 150

The Peak 150 digitally controls a single-valve steam turbine driving a mechanical load. It provides tight control of speed (NEMA D). It includes an input for a 4–20 mA remote speed control signal, which can be used for a process-generated input to control the speed setting. Other features include dual speed control dynamics and overspeed trip test capabilities. (product spec 85549)

Actuation



VariStroke-I

The VariStroke-I is a linear electro-hydraulic actuator that is designed to provide the linear actuation force to operate steam turbine control valves or valve racks. This integrated actuator is intended for use on mechanical-drive or generator-drive steam turbines, and uses a low-pressure hydraulic oil source (typically turbine lube oil) to provide its output shaft force.

(product spec 03397)



VariStroke-II

The VariStroke-II is a linear electro-hydraulic actuator that is designed to provide the linear actuation force to operate steam turbine control valves or valve racks. This integrated actuator is intended for use on mechanical-drive or generator-drive steam turbines, and uses a low-pressure hydraulic oil source (typically turbine lube oil) to provide its output shaft force.

(product spec 03378)



TM-25LP and TM-200LP

These are electrohydraulic, proportional actuators for positioning steam and fuel-control valves requiring either 111 or 890 N (25 or 200 lb) of linear force.

(product spec 82451)



EML-100

The EML-100 electric actuator provides highly accurate, closed loop position control of steam and fuel valves that require a linear operator with up to 445 N (100 lb) of force and a stroke length between 13 and 38 mm (0.5 and 1.5 inches). This actuator is used with the Woodward EM digital driver.

(product spec 40186)



Hydraulic Amplifier

The electrically controlled Hydraulic Amplifier is a pilot-operated, linear servo actuator with up to 76 mm (3 inches) of stroke and up to 20 kN (4500 lb) of force. It is capable of operating the control mechanisms for steam turbines or large engines which require relatively large forces and work capacity.

(product spec 89007)



PGPL Actuator/Driver

The PGPL Actuator/Driver is a drop-in replacement for PG-PL mechanical governors. It has a proportional driver interface that can be used with electronic controls providing a 0 to 200 mA position signal. It can be used with all Woodward controls.

(product spec 37520)



TG-13E and TG-17E

The TG-13E and TG-17E self-contained electrohydraulic actuators are drop-in replacements for TG mechanical governors, for use on steam turbines where isochronous control, load sharing, or other functions are required. They can be used with all Woodward electronic governor controls and accessories.

(product spec 04044)



UG and UG-40 Actuators

The UG and UG-40 Actuators are drop-in replacements for UG mechanical governors. They offer the advantages of electronic control and load sharing systems while using the convenient, existing UG-type drives and linkages. They provide the muscle (up to 54 J / 40 ft-lb) for Woodward analog and digital controls. For use with diesel, gasoline, or natural gas engines, as well as steam and industrial gas turbines. The self-contained oil sump does not require a separate oil supply.

(product specs 37511 [UG-Actuator] & 37516 [UG-40 Actuator])



ProAct Digital Plus

The ProAct Digital Plus is an all-electric actuator that is mounted on-engine, to control varying functions. The actuator is effectively a positioner with an integral driver, which will accept a position command signal from another device in the system such as a speed control. This actuator includes an integral digital driver capable of controlling the actuator and of communicating with the outside control system. It contains onboard software and intelligence to realize monitoring and customizing functions.

(product spec 03231)



CPC-II Current to Pressure Converter

The CPC-II (current to pressure converter, generation II) is an electrohydraulic pressure-regulating valve control used in positioning single-acting steam turbine valve servos. Its superb accuracy and resolution make it ideal for steam turbine valve control and related turbine speed and load control. It accepts a 4–20 mA pressure demand signal and accurately controls oil pressure to precisely position single-acting steam turbine governor valves.

(product spec 03352)



SPC Servo Position Controller

The SPC Servo Position Controller is a servo-valve driver that accepts either a DeviceNet or 4–20 mA based position demand signal from a system controller. It accurately positions proportional or integrating servo valves. The SPC has the accuracy, responsiveness, and redundancy required for steam and gas turbine fuel valve control.

(product spec 03254)

Mechanical Governors



PG-PL, TG, and UG Governors

These are self-contained mechanical-hydraulic speed droop governors for use on small turbines which do not require isochronous (constant speed) operation.

(product specs 36700 [PG-PL Governor]; 04038 & 04044 [TG Governor]; and 03029, 03030, 03048 & 36209 [UG Governor])

Turbine Safety Systems

ProTech-GII



This overspeed device safely shuts down steam, gas, and hydro turbines of all sizes upon sensing an overspeed or over-acceleration event. It accurately monitors turbine rotor speed and acceleration via active or passive magnetic pickups (MPUs) and issues a shutdown command to the turbine's trip valve(s) or corresponding trip system. Depending on system design, the ProTech-GII includes either two dual-redundant trip relay outputs using a 2-out-of-3 voted architecture, or three independent, non-voted trip relay outputs. Individual alarm relays, 4–20 mA speed readouts, and Modbus communications enable easy integration into any turbine safety system.

(product spec 03370)

ProTech-SX



The ProTech-SX (ProTech Simplex) is a safety programmable logic controller (PLC) with integrated overspeed protection. It safely shuts down any plant process equipment, engine, or steam, gas, or hydro turbine upon sensing a safety event. This stand-alone safety system accepts two speed inputs and seven discrete/analog inputs. It uses programmed logic to determine when a safety event has occurred, then issues system shutdown commands and alarms. The ProTech-SX uses five fast acting, configurable relay outputs and a speed meter output to interface with/command the system or device being protected.

(product spec 03372)

ProTechTPS



The ProTechTPS is a safety programmable logic controller (PLC) with integrated overspeed protection. It safely shuts down any plant process equipment, engine, or steam, gas, or hydro turbine upon sensing a safety event. This stand-alone safety device accepts 10 discrete or analog inputs per module (30 total) and one speed (MPU or proximity probe) input (3 total). It uses custom-programmed logic to determine when a true safety event has occurred, then issues a command to safely shut down the equipment or turbine. It utilizes a triple modular redundant architecture and 2-out-of-3 voting logic to accurately determine unsafe conditions and ensure that no single-point failure will affect system reliability or availability. System failures (switches, transducers, modules) are detected, annunciated, and allowed to be repaired or replaced while the monitored system continues to operate on-line.

(product spec 03371)

MicroNet Safety Module (MSM)



The MSM is a safety programmable logic controller (PLC) with the same functionality as the popular ProTechTPS, plus one millisecond IRIG-B time synchronization capability and a sequence of events (SOE) log function.

(product spec 03375)

Quick Trip



The QuickTrip is an IEC61508 safety certified electro-hydraulic trip block assembly designed for use in gas or steam turbine shutdown systems for quick and reliable dumping of the turbine's trip oil header. This trip block assembly's 2-out of-3 voting design provides users with a high level of system reliability as well as compliance with industry standards like API-670, API-612, and API-611.

(product Spec 03415)

Speed Sensors



These speed sensors are designed for use in SIL-3, SIL-2, or SIL-1 (safety integrity level) rated turbine or engine safety systems. When applied with a SIL rated logic solver and final element, users can easily create an overspeed safety instrumented function (SIF) which meets the required safety integrity level for the specific application.

(product Spec 03429)

The following are trademarks of Woodward, Inc.:

Atlas-II	GAP
MicroNet	MicroNet TMR
NetSim	Peak
ProAct	ProTech

The following are trademarks of their respective companies:

DeviceNet (Open DeviceNet Vendor Association, Inc. [ODVA])
MATLAB; Simulink (The MathWorks, Inc.)
Modbus (Schneider Automation Inc.)
Windows; Windows NT; Windows XP (Microsoft Corporation)

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **51229D**.



B 5 1 2 2 9 : D



PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.