

Gas Turbine Products

Custom Digital Controls (Programmable)



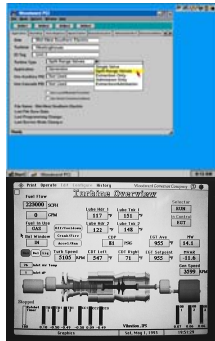
The **MicroNet™ Controller** is a state-of-the-art, programmable, digital controller. It can be programmed to control any prime mover and its associated processes, as well as system sequencing, high speed system monitoring, surge control, vibration monitoring and station control. The MicroNet™ digital control is available in both simplex and triple modular redundant (TMR) configurations.

(product spec 85583)



The **AtlasPC™ control system** is a new generation of turbine control that provides the power of PC technology in a rugged and deterministic system that uses the same powerful software as the MicroNet control in a lower-cost package designed around network distributed I/O.

(product spec 03213)



The many decades of Woodward experience with controlling engines and turbines, has been translated into a **sophisticated suite of software tools** specially tailored to prime mover applications.

- **GAP™**—Graphical Application Programmer 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 and allows program inputs to be changed to simulate the open-loop operation of the control. GAP can be compiled directly for PC Simulation with NetSim against engine models in ACSL, MATRIXx, Simulink, or Matlab.
(product specs 03292 & 03293)
- **Service Tools**—A range of options from on control displays for local control and service, debug, and configuration functions, to PC based windows software programs for advanced troubleshooting and maintenance.

SA (Standard Application) Configurable Digital Controls



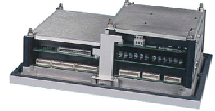
The **GCT250 control** is an industrial platform that offers robust, low-cost control for a wide variety of aero-derivative gas turbine applications. Most importantly, this control is designed to be a true "network based platform" that interfaces seamlessly with a wide variety of modern communication and field bus architectures. The GTC250 couples state-of-the-art PC technology with a proven real time operating system to provide reliable and deterministic performance that is required for recursion-rate sensitive applications. Dedicated inputs and outputs (I/O) are available onboard for key control signals while distributed I/O can be used for other less critical parameters.

(product spec 03303)



The PC-based **GTC190 control system** is an ideal solution for controlling a single-shaft large industrial gas turbine. Typical large industrial gas turbine control loops (speed, load, EGT, etc.) come standard within the core system, while distributed I/O can be used for other less critical parameters. Both single and dual fuel capabilities are available with the GTC190.

(product spec 03294)



The **GTC100 and GTC200 industrial controllers** offer robust, low-cost control for a wide variety of dual-fuel gas turbine applications. The GTC100 controls single-shaft turbines, and the GTC200 controls two-shaft machines. Industrial microprocessor technology is coupled with a proven real time operating system to provide reliable and deterministic performance that is required for recursion-rate-sensitive applications. Dedicated inputs and outputs (I/O) are available onboard for key control signals, while expansion I/O is used for other less sensitive parameters.

(product spec 03319)



The **2301D-GT Digital Load Sharing and Speed Control** is a microprocessor-based control with integral application software designed for single-shaft gas turbine applications driving either mechanical or generator loads. Like Woodward's 2301A line of controls, this control is housed in a sheet-metal chassis and consists of a single printed circuit board. To facilitate unit retrofits, the 2301D-GT's I/O terminals are located in the same general location as Woodward's 2301A line of controls. This control is designed to perform the core fuel control functions of a small gas turbine package. The application software is field configurable, allowing it to be configured and modified to meet site-specific requirements.

(product spec 03236)



The **STExcite™ system** is a high-energy exciter for industrial gas turbine ignition systems. The unit is compatible with existing high-energy turbine ignition systems. Versions are available with single (STExcite 2010) and dual (STExcite 2020) outputs. The use of digital circuitry allows for advanced diagnostics, improved reliability, and network communication options. In addition, the unit is UL Listed and CE approved.

(product spec 03308)



HMI (Human Machine Interface) for Woodward electronic controls is primarily Windows based PC software. Utilizing proven Intellution® 32-bit software that is compatible with both Windows 95, 2000, and XP 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.

Gas Fuel Metering



The **SonicFlo™ valve** controls the flow of gas fuel to the combustion system of an industrial or utility gas turbine from 15–300 MW in size. The SonicFlo valve is available as a hydraulically-actuated 2", 3", 4", or 6" valve size with maximum gas pressure of 1724 to 3965 kPa (250 to 575 psig). Electric SonicFlo valves are also available in 2" or 3" valve size with maximum gas pressure of 2070 to 3450 kPa (300 to 500 psig). The unique design yields a linear flow characteristic unaffected by discharge pressure up to a pressure ratio (P_2/P_1) of 0.8. The design also integrates the valve and actuator into a compact assembly. The key characteristics of this valve are a highly linear critical gas flow versus stroke relationship at constant upstream pressure. The integral actuator is a single-acting spring-loaded design for failsafe operation. The actuator includes an onboard hydraulic filter for last chance filtration of the fluid to ensure reliability of the servovalve and actuator. The servovalve is electrically redundant with triple coil design. Feedback for the actuator is provided by a dual coil, dual rod LVDT (linear variable differential transformer) directly coupled to the hydraulic piston.

(product specs 03285, 03287)



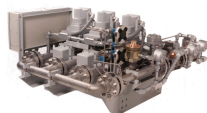
The Woodward **Gas Stop/Ratio Valve** performs a dual function for industrial or utility gas turbines. One function rapidly shuts off fuel to the turbine fuel control system. Another function provides accurate control of gas fuel pressure at the outlet of the stop/ratio valve. This pressure is applied to the inlets of the gas fuel control valve. The Gas Stop/Ratio Valve comes in 2", 4", 6", and 8" valve sizes and features a modular design, and meets critical control characteristics while allowing the same valve design to accommodate a variety of stroke, force output, and mechanical interface arrangements. The electrical and mechanical interfaces have been designed for quick and easy assembly or removal of the valve, at the factory or in the field. The components include an on-board hydraulic filter, electrohydraulic servo valve, trip valve, single-acting hydraulic cylinder, and dual LVDTs.

(manuals 26093, 26230)

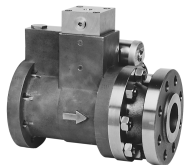


The 3103 gas valve is a stainless steel valve capable of metering gas flow between 23 and 18 144 kg/h (50 and 40 000 lb/h). It is designed to be corrosion resistant and self-cleaning, allowing it to operate in sour gas environments (high sulfur content gas) that can cause problems for other valves. This valve is available with either electric or hydraulic actuation. When used in conjunction with an EM35MR electric actuator and EM 24 V digital driver, the 3103 valve delivers the demanding accuracy needed for DLE applications.

(product specs 03209, 40106, 40156)

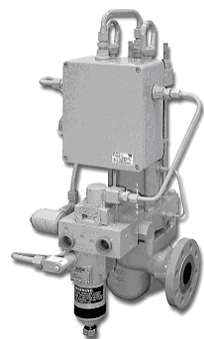


Woodward is a leader in fuel metering for **Dry Low Emissions and Catalytic Combustion Control**. For applications requiring from 2 up to 5 parallel paths Woodward can provide the fuel metering system and the control. Our DLE fuel metering systems are capable of 2.0% of point, mass flow accuracy and our current programs cover multiple small industrial engines and aero-derivatives.



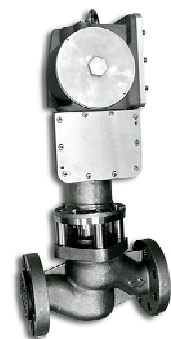
The Gas Shutoff Valve is designed to provide extremely fast shutoff to gaseous flow and to be used for emergency and normal shutdown operation. The valve operates at pressures up to 900 psia and its all stainless steel construction assures availability of the valve under all operating conditions. The valve design allows minimum pressure drop by utilizing a straight through flow, this also keeps all critical moving parts and seals out of the flow stream.

(product spec 03286, 40128, 40176)



The **Hydraulic Globe Valves (HGV)** control the flow rate of natural gas fuel to various stages of an industrial gas turbine combustion system. The unique design integrates the valve and actuator into a cost-effective, compact assembly. The valve is designed to provide a highly accurate flow-versus-stroke characteristic. The integral actuator is a single-acting spring-loaded design that will quickly close the valve upon loss of electrical or hydraulic signals. This valve comes in 2", 3", and 4" sizes with maximum gas pressure of 3792 kPa (550 psig). The servovalve is an electrically redundant dual-coil design. A dc-powered LVDT (DCDT) provides feedback for the actuator.

(product spec 03314)



Electric Globe Valves (EGV) control the flow of gas fuel to the combustion system of an industrial or utility gas turbine. This product is a globe-style plug valve that provides linear flow area characteristics as a function of valve opening. The integral electric actuator consists of a brushless dc motor and resolver for motor communication and position sensing. The actuator also contains a failsafe spring designed to close in less than 250 ms upon loss of electrical signals. This product comes in 1.5" and 2" port sizes with maximum gas pressure of 7309 kPa (1060 psig) up to 182 °C and 7067 kPa (1025 psig) up to 204 °C.

(manual 26186)



Woodward **GS series gas fuel metering systems** are designed for use on industrial gas turbines in the 200 kW to 30 MW output power range. The assemblies provide reliable, cost effective interfaces between electronic engine control systems and gas turbines used in power generation, compressor, and mechanical drive applications.

(GS3/GS10 product spec 45021)

(GS6 product spec 03256)

(GS16 product spec 03284)



The Woodward **Swift™ Gas Metering System (GMS)** is suitable for use on microturbines, miniturbines, small industrial gas turbines (up to 2 MW), and high-pressure fuel cell applications. The Swift system has four valve sizes with maximum fuel flows between 6.3 and 88.9 g/s (50 and 695 lb/h) of standard natural gas, depending on system pressures. The system is designed for installation within the engine enclosure and can operate with gas temperatures up to 121 °C (250 °F).

(product spec 03252)

Liquid Fuel Metering



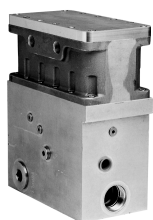
The Three-way Fuel Oil Bypass Control Valve is used to control the flow of liquid fuel to a gas turbine. This valve contains 3" ports and has a maximum fluid supply pressure of 8274 kPa (1200 psig). The valve contains no feedback device, so it relies on external flow measurement as a form of feedback to control the flow. Upon loss of electrical command signal or hydraulic pressure, the valve will divert fuel to the bypass port for a safe turbine shutdown. The valve utilizes a fully integrated valve and actuator design. The design is equivalent to a dual acting electrohydraulic actuator and a three-way bypassing valve.

(manuals 26088, 26226)



The Three-way Fuel Oil Stop Valve is a two position valve used to shut off the flow of liquid fuel to the turbine and divert it to the fuel pump suction. This valve contains 3" ports and has a maximum fluid supply pressure of 8274 kPa (1200 psig). The valve position is controlled by a low level trip pressure acting on the pilot operated trip circuit integrated into the valve. The valve uses a failsafe spring to ensure the shutoff of fuel from the turbine on loss of hydraulic control pressure or hydraulic actuation pressure. The valve utilizes a fully integrated valve and actuator design. This design is equivalent to a single acting hydraulic actuator and a three-way shut-off valve.

(manuals 26088, 26226)



The **Liquid Shutoff Valve 25** is an electric three-way valve designed to rapidly shut off all liquid fuel flow and prevent leakage to the turbine. In the de-energized state, the valve diverts inlet flow to bypass ports, preventing pressure damage to positive displacement fluid systems. Normal installation of the 45 lb (20 kg) valve is in the fuel line between the fuel regulating valve and the turbine. The valve diverts flows from the discharge to bypass ports any time the operating electrical signal is lost. The valve is available in two voltage configurations. The valve is designed for a normal operating supply pressure of up to 1200 psig (8274 kPa) and has a rated flow of 30 000 lb/h (13608 kg/h) based on Mil-C-7024 calibrating fluid at 70 °F (21 °C).

(product spec 40169)



Woodward's LQ series of liquid fuel metering valves are designed for use on industrial and aero-derivative gas turbine engines in the 1000 kW to 42 000 kW output power range. LQ series valves are designed for flows from 80–4000 lb/h (36–1814 kg/h) for the LQ3, 80–10 800 lb/h (36–4900 kg/h) for the LQ6, and 80–26 000 lb/h (36–11 794 kg/h) for LQ25 valves with 0.82 specific gravity liquid fuels. The assemblies provide reliable, cost-effective interfaces between electronic engine control systems and gas turbines used in power generation, mechanical drive, and marine applications. The LQ valves utilize corrosion resistant, shear-type metering components that are positioned by high torque electric actuators to assure extended operation in all types of liquid fuel service.

(LQ Series product spec 40174)

(LQ6 with on-board driver product spec 03288)

(LQ25T product spec 40179)

Fuel Nozzles



Woodward FST offers one of the widest ranges of technology options available for fuel spray components, including gas injection, liquid injection, dual fuel, and dry low emissions. These FST product lines incorporate an unmatched combination of products, technologies and application expertise:

- Pressure Atomizing Nozzles
- Airblast and Air Assist Nozzles
- Hybrid Airblast Nozzles
- Industrial Nozzles (standard and DLE)
- Augmentor Spray Manifolds
- Augmentor Spraybars
- Fuel Metering and Distribution Valves

Specialty Valves



The EBV63 and EBV100 electrically actuated bleed valves are modulating high temperature butterfly valves with all electric actuators for Gas Turbine air control. Common applications for these valves include compressor bleed scheduling for control of air/fuel ratios, anti-surge control, and thrust balance control. The valve assembly consists of a high temperature butterfly valve with a double shaft offset, and can flow 940 lb/min (426 kg/min). This design minimizes the aerodynamic load on the valve butterfly and enables the use of an electric actuator. The offset shaft also creates a differential load in the valve, providing a bias to open upon loss of power. The valve contains a metallic main seal that is designed to minimize leakage when the butterfly is closed. The double offset shaft allows the use of a static seal in the valve housing, providing reliable seal performance throughout the life of the valve. The valve shaft is sealed with carbon bearings.

(product spec 03212)



The 3151A Water Valve/EML100 Actuator assembly is used as part of a gas-turbine nitrous oxide emission-reduction system, and can flow up to 78 US gal/min (295 L/min). The unit meters water injected into an industrial gas turbine's combustion chamber, lowering combustion temperature. This assembly is designed to be used with the Woodward EM Digital Driver.

(product spec 40187)

On Engine Accessories



Woodward provides a variety of actuators, pumps, servovalves, and hydraulic control units to deal with variable geometry needs on the engine. Typical applications control variable stator vanes, inlet guide vanes, variable bleed valves, thrust balance, etc.

Power Management



The DSLC™ control is a microprocessor-based synchronizer and load control designed for use on three-phase AC generators equipped with Woodward or other compatible speed controls and compatible automatic voltage regulators. The DSLC control is a synchronizer, a load sensor, a load control, a dead bus closing system, and optionally a VAR/PF and process control, all integrated into one powerful, yet convenient package.

(product spec 02006)



The MSLC control is a microprocessor-based load control designed for three-phase electric power generation sites equipped with Woodward DSLC Digital Synchronizer and Load Control units which operate in parallel with the utility. The MSLC is a synchronizer, a utility load sensor, an import/export load level control, a power factor control, and a master process control.

(product spec 02021)



Designed for medium- and large-sized generators, the **EGCP-3** is a complete turbine-generator power management package designed to work with automatic voltage regulators and speed controls, and contains advanced IEEE protection algorithms, revenue-grade metering, individual control of utility and inter-tie breakers, added input/output capabilities and backward compatibility with Woodward DSLC/MSLC synchronizers. A network of up to 16 EGCP-3 controls can handle your most sophisticated base-load, peak shaving or backup power generation applications. Based on Woodward's powerful GAP™ application programming tools, the EGCP-3 can be easily customized.

(EGCP-3 LS Multi-unit Load Share product spec 03300)

(EGCP-3 MC Multi-unit Mains Controller product spec 03301)



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