

E³ Lean Burn Full Authority Fuel Blending Control

for Industrial Lean-Burn, Spark-ignited Engines

Applications

Woodward's E³ Lean Burn Full Authority Fuel Blending control manages industrial gas engines used in power generation, pumping, and other stationary applications ranging from 300 kW to 2000 kW (400–2700 hp).

The highly accurate, closed-loop control maintains engine performance over a large range of fuel qualities without needing a plant-level fuel-blending facility. The E³ Lean Burn Full Authority Fuel Blending control blends fuel with a pair of Woodward TecJet™ valves on the engine, allowing complete flexibility in fuels with the lowest installed cost.

The E³ Lean Burn Full Authority Fuel Blending control is part of the Woodward line of E³ All-Encompassing Engine and Emissions controls designed to meet the performance and reliability needs of gas engine manufacturers, owners, and operators.

Control Overview

The E³ Lean Burn Full Authority Fuel Blending control is a fully integrated engine control solution that can have full authority over spark, fuel, and air, while remaining flexible enough to compensate for large variations in fuel quality. Additionally, diagnostics such as detonation and misfire as well as other health monitoring are integrated into the control.

The E³ Lean Burn Full Authority Fuel Blending control calculates and controls the air-to-fuel ratio from two different fuel sources simultaneously, in any proportion, to keep the engine's exhaust emissions within compliance limits. It can also control engine speed and power for the driven load as well as control ignition timing. The control uses engine speed, air manifold absolute pressure (MAP), and air manifold air temperature (MAT) to calculate the required mass flow of each gaseous fuel to its corresponding single point fuel injection device to directly control the combined air-to-fuel ratio without measuring oxygen in the exhaust for generator applications.

The E³ Lean Burn Full Authority Fuel Blending control commands two TecJet™ fuel control valves to simultaneously and independently control fuel flow from two separate sources. The first source must include one that has a consistent quality, constant-heating value fossil fuel such as pipeline quality natural gas or liquid petroleum gas (LPG). The second source can be a constant- or variable-heating value, bio-derived fuel such as digester or landfill gas. Fuel blending is performed while maintaining engine speed or load control, exhaust emissions, knock protection, and misfire protection.

The E³ Lean Burn Full Authority Fuel Blending control works in conjunction with Woodward's full range of gas engine components:

- Integrated throttle bodies ranging from 16 mm to 180 mm.
- TecJet fuel control valves of varying sizes to meet the application needs.
- IC-920 & IC-922 ignition controllers deliver ignition energy of up to 360 mJ for optimized combustion stability with complete control of ignition timing and ignition energy.

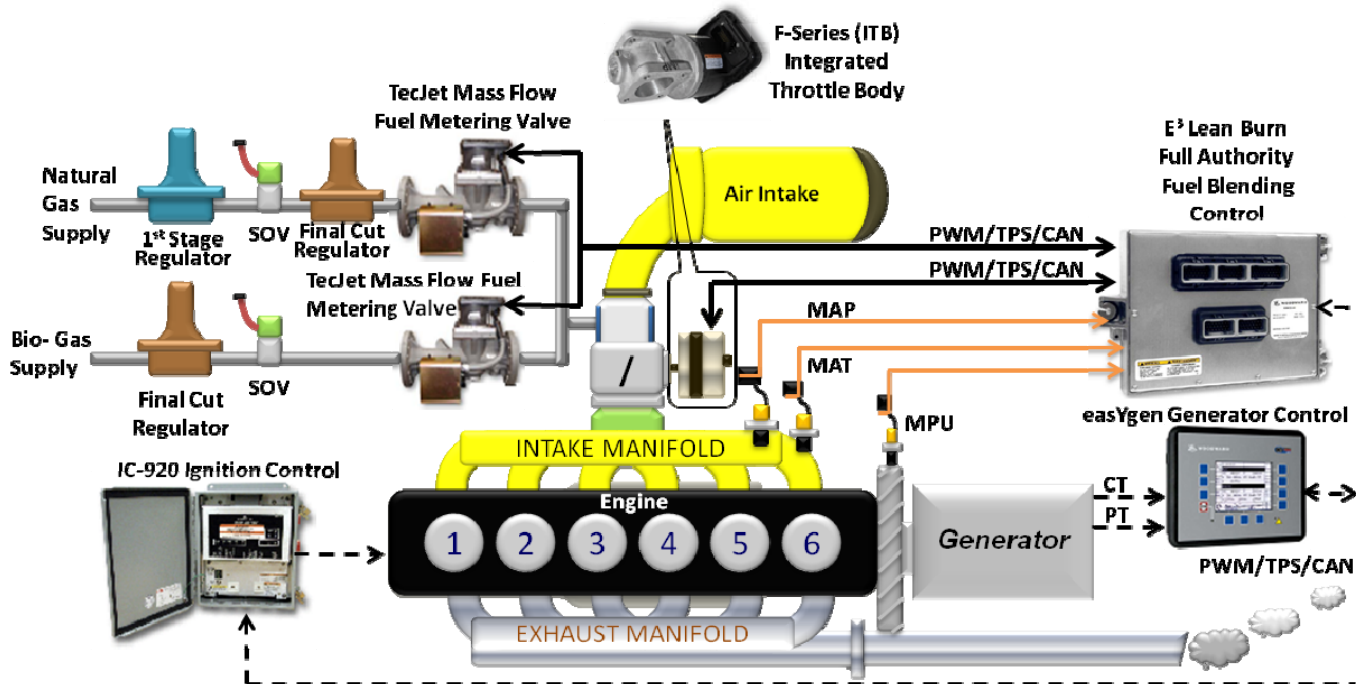


- Integrated approach reduces system complexity and reduces overall cost
- Speed-density-based Air Fuel Ratio controller
- Flexible Programming
- Four different blending modes:
 - External blend ratio with load shedding
 - Internal blend ratio with constant power
 - Pipeline gas avoidance with load shedding
 - Knock abatement with load shedding

The E³ Lean Burn Full Authority Fuel Blending control works with the easYgen™ power management products for generator load control, load sharing, and synchronization, and can form the gateway to external systems while also displaying information available from the E³ Lean Burn Full Authority Fuel Blending control.

The E³ Lean Burn Full Authority Fuel Blending control uses Woodward's GAP™ software and allows multiple password protection with the ability to perform custom software routines in addition to standard Woodward software allow the customer complete authority over the applications.

The following functional diagram shows how all the components are integrated into a system:



E³ Lean Burn Full Authority Fuel Blending Control System Configuration

Environmental Specifications

Operating Temperature:

–40 °C to +85 °C (–40 °F to +185 °F)

Storage Temperature:

–40 °C to +105 °C (–40 °F to +221 °F)

Mechanical Vibration:

Woodward Vibration Test RV2 (Procedure 3-04-6231): 0.1 G²/Hz, 10 Hz to 2000 Hz, 12.8 Grms, 3 h/axis w/vibration isolation dampeners

Mechanical Shock:

50 G, 11 ms, half-sine wave, 4 shocks in each direction (24 total shocks)

Ingress Protection:

IP66 per EN60529

EMC Specifications:

EN61000-6-2: Immunity for Industrial Environments
EN61000-6-4: Emissions for Industrial Environments

For environmental specifications of other system components, please refer to the applicable product specifications.

Regulatory Compliance

European Compliance for CE Marking—These listings are limited only to those units bearing the CE Marking.

EMC Directive: Declared to 2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.

North American Compliance—These listings are limited only to those units bearing the CSA agency identification.

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, D, T4 at 85 °C ambient. For use in Canada and the United States. Certificate 1604047.



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