Woodward's OH-1 control system is designed to control heavy-duty, lean-burn natural gas engines in urban buses and trucks and other alternative-fueled on-highway vehicles. The highly accurate closed-loop control system helps OEMs meet legislated emission levels, while maintaining diesel-like drivability and excellent fuel economy.

**Key Technologies**

This system is based on key technologies not available in other control systems on the market. These technologies include:

- **High Accuracy, Closed-Loop, Lean-Burn Control Strategy** results from using proprietary digital electronics and software technology that overcome the difficulties encountered with wide-range oxygen sensors (UEGO) in other systems available today.

- **Full-Authority Drive-by-Wire Strategy** is made possible by combining Woodward’s Flo-Tech™ throttle and electronic wastegate actuator designs with advanced load control technologies that provide unmatched fuel economy, excellent vehicle drivability, and engine protection from turbo-overspeed and engine overboost conditions.

- **Precise Open-Loop, Fuel Control Strategy** has been designed into our system. The strategy combines additional key sensors and control algorithm technologies that improve the accuracy of volumetric efficient calculations. It also includes advanced manifold filling calculations for handling large transient speed and load changes that must be accommodated in heavy-duty, lean-burn, spark-ignited gas engine control systems.

- **Advanced Diagnostic Features** are a powerful tool for development engineers, as well as field technicians, when diagnosing engine or vehicle problems.

- **Model-Based Control Strategy** is used to compare actual engine operation with expected values.

- **For urban buses & trucks and other alternative-fueled on-highway vehicles**

- **Helps meet legislated emission levels**

- **Improves fuel economy**

- **Diesel-like drivability**

- **Proven system**

- **Flexible configurations, available as a complete system or as components**

- **Complete systems engineering services**

- **Global engineering and service support**
Typical OH-1 Layout

FPP, FPP2/IVS, Fuel Gauge, TACH, Fast Idle Switch, MIL, Relay Control, Vbat, RSG

High Pressure Gas Shutoff
Tanks
Regulator
PræThrottle Pressure
Position Feedback
Spark Control
MAP
MAT
ECT
Oil Pressure Switch
Cam Position
Boost
UEGO
Fuel Metering Control
RS232 PC or ISO K or J1708
8 to 32 V Supply
Communications

OH1.2 Engine Controller

Heat Exchanger
Thermostat
Inter Cooler
Mixer
Compressed Air
Turbocharger
Recirculation Valve
Air Filter
Wastegate Control Valve
Exhaust

High Pressure Gas Shutoff
Tanks
Regulator
PræThrottle Pressure
Position Feedback
Spark Control
MAP
MAT
ECT
Oil Pressure Switch
Cam Position
Boost
UEGO
Fuel Metering Control
RS232 PC or ISO K or J1708
8 to 32 V Supply
Communications
OH-1 Control System Features

- Closed-loop, lean-burn, fuel control with adaptive-learn technology; fully-integrated, wide range oxygen sensor for precise fuel/air ratio control
- Speed-density control strategy with advanced transient compensation; provides improved transient fuel/air ratio tracking and durability over most mass-air flow based systems
- Electronic “Delta-P” wastegate control for improved thermal efficiency, torque rise, and drivability
- High-energy inductive ignition system; up to 6 individual or double-ended coils
- Full-authority drive-by-wire throttle system with min/max governing or all-speed governing
- Idle-speed control includes speed set-point modifications for coolant temperature, time from start, external fast-idle switch, and other inputs
- Max. governor uses programmable artificial droop for improved drivability
- High altitude turbocharger overspeed protection
- Constant-power and boost-derate features with inlet air and engine coolant temperature compensated boost control
- Advanced “turbo-lag” compensation for improved turbocharger response and drivability
- Deceleration/motoring fuel shut-off for improved thermal efficiency and emissions
- Electronic throttle-body
- Multiple diagnostic and vehicle serial links available, including SAE J1708/J1587, ISO-K, RS-232 hardware interface and several protocol specifications
- Over 100 individual diagnostic codes capable of detecting functional faults, intermittent faults, sensor and actuator failures, and engine protection problems
- Malfunction indicator lamp (MIL) with field-extractable fault code feature
- Extensive engine protection features including limp-home and derate modes for inlet air temperature, engine coolant temperature, oil pressure, overboost, and overspeed
- Fail-safe limp-home feature for all sensor failure modes; the only exception is the speed sensor which may be made redundant if desired
- Knock sensing for real-time adjustment of ignition timing and boost/torque for engine protection

OH-1 Components

**ECM—Engine Control Module**
Flash programmable module
8–32 volts compatible
Supports J1708/1587, ISO-K, RS-232
Built-in digital electronics for NGK UEGO sensor
60 pin I/O

**ICM—Ignition Control Module**
Inductive ignition
On-engine mount
6 cylinder coil per plug/12 cylinders waste spark
12 or 24 volt versions
Simple digital trigger/reset function for coil dwell and timing control
Ignition primary monitoring function

**High Pressure Gas Shutoff Valve**
12 or 24 volt versions
Pilot operated valve
SAE o-ring gas fittings

**High Pressure Gas Regulator**
Single-stage regulation—200 bar to 8 bar
MAP/boost bias port
Tank pressure port for sensor mounting
SAE o-ring gas fittings
Integrated PRD

**Heat Exchanger and Gas Thermostat**
Low pressure gas temperature control
Optimizes gas density delivered to FMV
Thermostat measures gas temperature directly

**FMV—Fuel Metering Valve**
Single-point metering
On-engine mount
Bosch or ServoJet CNG/LNG injectors depending on application
8 or 12 injectors depending on engine power
Integrated positive fuel shutoff
Integrated gas pressure and temperature sensors

**Flo-Tech™ Integrated Drive-by-Wire Throttle**
8–32 volt compatibility
48, 60, and 68 mm throttle bore sizes
Flow shaping for improved idle control
Simple PWM, 0–5 V, 4–20 mA, or 0–200 mA control signal

**Wastegate Control Valve**
12 or 24 volt versions
Digital valve provides air pressure to wastegate actuator
Vehicle supply or boost air

**Technical Manuals**
26220 (Calibration)
26221 (Systems)
OH-1 Applications

Complete Systems
- Daewoo Heavy Industries 11 L
- Daewoo Heavy Industries 8 L
- Hyundai Motor Company 11 L
- John Deere 6.8 L
- John Deere 8.1 L
- Mack Trucks 12 L
- Mercedes Benz 5.9 L

OH-1 Components
- Cummins
- Detroit Diesel
- Mercedes Benz

Distributors & Service
Woodward has an international network of distributors and service facilities. For your nearest representative, call the Fort Collins plant or see the Worldwide Directory on our website.

Copyright © Woodward 2000–2003, All Rights Reserved