CONTINENTAL CONTROLS CORPORATION

ISO 9001 CERTIFIED

FOR RICH OR LEAN BURN ENGINES

CONTINENTAL CONTROLS ULTRA-LOW EMISSIONS SYSTEM

Air-Fuel Ratio Control For Gas Engines

BENEFITS

- MAINTAIN EMISSONS COMPLIANCE EVEN WITH CHANGES IN SPEED AND LOAD
- WIDE RANGE LOAD CONTROL
- MEETS TOMORROW'S EMISSION STANDARDS TODAY
- FULL AUTHORITY
- FULLY AUTOMATIC
- COMPLETE INSTALLATION KIT
- MOD BUS COMMUNICATION
- OPTIONAL DISPLAY & DP
- CATALYST TEMPERATURE MONITORING
- HANDLES CHANGES IN GAS BTU
- IMPROVED MIXING,MONITORING AND AUTO TUNE
- CAN BUS J-1939

EMISSIONS REQUIREMENT

The ECV5 valve offers full authority fuel control for almost any size of a gas engine. The variable pressure control technique allows for fast and precise control.

CONTINENTAL CONTROLS SOLUTION

Continental Controls offers a complete system that will maintain compliance of emissions levels of all gas engines in compliance with even the most severe local, state, and federal emissions regulations while maintaining peak operating efficiency. Ideally, the ECV5 will be used to control fuel pressure to a CCC mixing venturi to achieve the lowest possible emissions under all load conditions. The ECV5 can also be used as the primary fuel valve controlling fuel to the carburetor on an aftermarket AFR installation. The ECV5 is basically an electronic variable pressure regulator that will vary the fuel pressure to the engine based on input from a Wide Band Oxygen Sensor (UEGO). The ECV5 also can accept an input from the CCC Catalyst Monitor via Can Bus to dynamically adjust the O2 Sensor setpoint based on changing sensor or catalyst conditions.

ECVI THEORY OF OPERATION

The *Continental Controls Corporation* ECVI is the user interface for our air-to-fuel ratio product, the ECV5, and the Catalyst monitor. It serves as the central hub to which all of the separate components of the system are connected. The individual components communicate with each other via Can Bus while the user interface communicates to each device with a Modbus serial port. The system consists of the following components:

The ECVI – the box and display, with terminal strips to land wire from the various other components.

The ECV5 – the AFR control valve. The ECV5 contains a microprocessor that reads a voltage from an oxygen sensor and modulates the outlet pressure of the valve to control the air to fuel ratio of the engine. The system can contain one or two ECV5s depending if the application is a single bank or dual bank engine.

The Catalyst monitor – The cat monitor controls the wide band o2 sensors and NOx sensors with the ECV5. The cat monitor can make minor adjustments to the o2 sensor set point within the ECV5 by monitoring NOx sensor. The catalyst monitor should be mounted near the exhaust and no more than 30ft from the o2 sensors. The NOx sensor is connected to the cat monitor via CanBus. The NOx sensor cable length should be no more than 100ft. Distance from the Catalyst monitor to the ECVI can be up to 100ft.

O2 sensors – The catalyst monitor can connect and control up to two wideband O2 sensors. One O2 sensor for the left bank and one for the right bank. The system uses a Bosch LSU4.2 o2 sensor.

NOx sensors – The Nox sensor is located in the exhaust post catalyst. On Rich-burn engines, the NOx sensor is located after the catalyst. The NOx sensor is connected to the Cat monitor via the Can Bus and provides final feedback in the control loop.

Venturi – The Venturi serves as a fuel mixer, evenly distributing and providing a homogenous mix of fuel through the airflow. The Venturi is located downstream of the ECV5 and somewhere on the air inlet of the engine. The Venturi can be standalone or be a “drop-in” style that replaces the diaphragm assembly inside the carburetor. this minimizes plumbing changes for the install.

HOW THE SYSTEM WORKS

The ECV 5 is an electronically controlled valve that functions as a zero-pressure regulator with no droop. A precise low-pressure transducer is embedded in the valve and is used to sense the discharge pressure, which is the gas injection pressure to the carburetor or mixing venturi device

CLOSED LOOP PRESSURE CONTROL

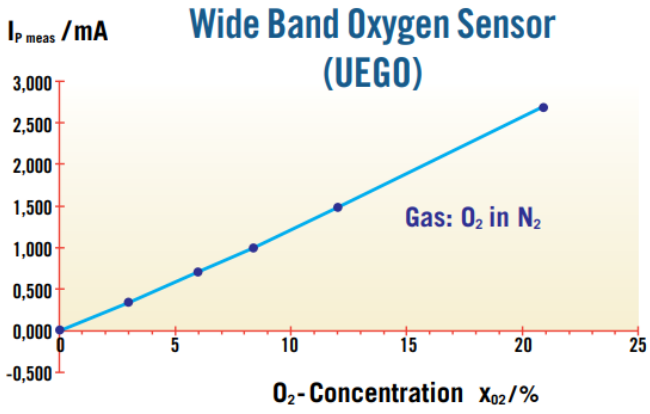
The proportional and integral control provide a fast responding, no-droop pressure regulator. The pressure set point is the default pressure and is selected to run the engine when the O2 sensor is not operating.

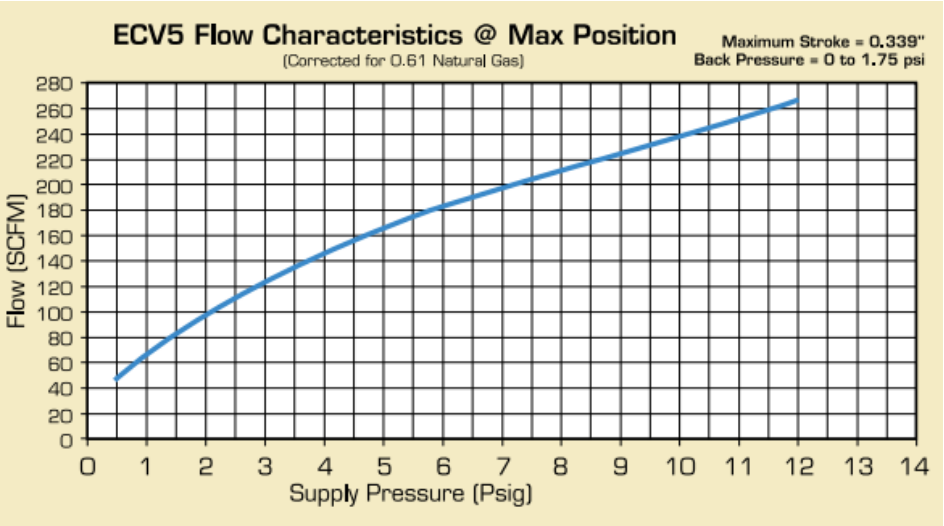
GAS SUPPLY PRESSURE

The required minimum gas supply pressure is the sum of the gas injection pressure and the pressure drop across the valve. The valve pressure drop is a function of the flow through the valve and is shown in the diagram in the next column. The supply pressure should be regulated to ideally allow the ECV 5 to operate in the 50% to 75% range when the engine is at full load.

SUPPORT FOR WIDEBAND OXYGEN SENSOR (UEGO)

Traditionally most Air-Fuel Controllers for gas engines have supported only a narrow band Zirconia Sensor. These are a switching type of sensor quickly switching back and forth from a rich to a lean indication. They were designed to operate very near the stoichiometric point on a gasoline engine. This switching signal is not ideal for controlling natural gas engines and CCC believes that the Wide Band (Universal Exhaust Gas Oxygen Sensor UEGO) is a faster, more stable, sensor that drifts less, and is less affected by changing ambient conditions. It is all around a more suitable sensor for controlling the AFR of Natural Gas Engines. For this reason, all of CCC’s products are designed to accept input from the Wide Band (UEGO) sensor, not the older narrow band sensor. The use of the Wide Band Sensor also allows CCC’s AFR products to be used in rich burn applications with less than .5% O2 in the exhaust to lean-burn applications with as much as 12% O2 in the exhaust.





As can be seen from the chart, if the injection pressure is zero and the gas flow is 60 scfm, 1 psi of of gas pressure is required.

DESCRIPTION OF THE ECV5

The ECV 5 is an electronically controlled servo valve. The electronic assembly is located inside the cover and includes an embedded microcomputer. The main components of the valve include the poppet valve, the voice coil actuator, the LVDT for position feedback, and the pressure transducer. The valve has two control loops that are closed with feedback. The inner loop is the position control with the LVDT providing the position feedback signal. This inner loop gives the valve an unusually fast response. The outer loop is the pressure control with the pressure transducer providing the feedback signal. The pressure control amplifier is proportional and integral, which is required to operate the valve without droop, meaning the pressure does not change when the gas flow changes. The valve is nearly all aluminum, except for the magnetic steel parts and the stainless steel shaft.

TURBO CHARGED ENGINES

The fuel system of engines turbocharged after the carburetor will be connected like the naturally aspirated engines. When the turbocharger is before the carburetor, a reference line must be connected from the air inlet of the carburetor to the reference port on the ECV5 to allow control to the ECV5 to control on fuel above boost pressure.

DUAL BANK ENGINES

Dual bank engines with a single point of fuel injection and a single turbocharger are connected like a single bank engine. A dual bank engine with a turbocharger for each bank and an O2 sensor on each bank will require an ECV5. Each will be connected with its own O2 sensor.

LOAD TRANSIENTS RESPONSE

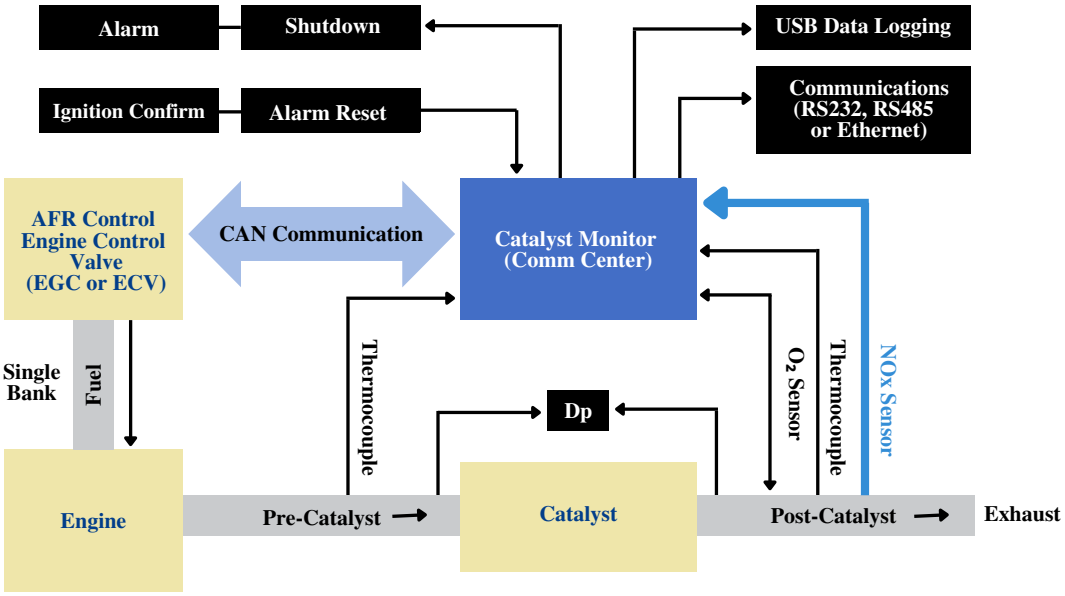
The valve is very fast and will transition from open to closed in less than 50ms. This will result in a very fast responding pressure regulator. If a load transient occurs, the fuel flow will change and the valve will adjust its position almost instantly and change to minimize the effect of the transient. The engine will run through the transient without falling out of compliance, or will correct quickly after the transient.

REDUCED EMISSIONS

Since the ECV5 eliminates much of the lag in the response of the fuel system, the control loop gain can be higher, which will control the O2 sensor voltage very close to its set point. The ECV 5 can maintain the oxygen content in the exhaust within the NSCR compliance window for 3-way catalysts or at the desired control point for all other applications. This can provide the lowest possible emissions control or the maximum achievable efficiency depending on the control point of the ECV 5.

INSTALLATION

The ECV 5 system is easy to install and simple to set up for any engine. The complete kit includes wiring, cables, sensors, a cat monitor, and a display unit, which is available as an option. The figure above illustrates the wiring necessary to fully implement the system.



CATALYST MONITOR- SYSTEM LEVEL

CM1	Catalyst Monitor
CM-2 + CM3	Catalyst Monitor with Intelligent Feedback

USER INTERFACE

The ECVI is a miniature PLC and is programmed to provide an over-temperature alarm or shutdown to prevent damage to the catalytic converter. The ECVI can be used to monitor the temperature rise in the catalyst due to the exothermic reaction. The differential temperature can also be displayed, logged, and exported via the serial port. The ECVI also is provided with a serial port for MOD-BUS communications with other control and data logging systems.

The ECVI monitor screens display the ECV5 and Catalyst monitor functions via a graphical interface in real-time such as flow rate, pressure, actuator position, pressure setpoints, pre and post Cat temperatures, etc. Screens for dual bank engine configuration are pictured on the right. Where there is only one screen, it is good for both configuration.

CATALYTIC CONVERTER

To maximize the reduction of NOx, CO, and NMHC's, the ECV 5 is used on a rich burn engine with a 3-Way Catalytic converter in the exhaust. An oxygen sensor is placed in the exhaust stream before the converter. The ECV 5 valve controls the air fuel mixture to maintain very precise control of oxygen content in the exhaust at the oxygen sensor. This precise control will not only maximize the effectiveness of the catalyst which will allow the system to meet the most stringent emissions requirements, but it will also extend the life expectancy of the catalyst.

Class I, Div 2, Group D: T4 ISO 9001:2008 CERTIFIED

CATALYST MONITOR & DATA LOGGER

The catalyst monitor is a product that evolved over several years to meet the many needs of an effective AFR / Emissions Reduction system. The Catalyst Monitor is much more than what the name implies, it supports recording various inputs, alarms and shutdowns as well as monitoring many everyday operating parameters on a Gas Engine.

The Cat monitor has built in support for up to 2 wide band (UEGO) O2 sensors. Put just that in a CSA certified box and you have a product. Add support for reading and recording differential pressure (Dp) across the catalyst, 2 thermocouple inputs for pre and post Cat temperatures, dedicated input for a NOx sensor, CAN Communications with all of the CCC valve and measurement products including flow measurement (FM50) and you have a very feature rich product. All of those inputs can be recorded hourly, daily, weekly monthly and annually on the built in flash drive.

All of these are designed not just for the user and for operations but also to meet a variety of local and federal emissions logging requirements. This data can show evidence of engine compliance and fuel consumption (Carbon) over an extended period of time.

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