DRESSER Waukesha

AFM

Air/Fuel Module

Custom Engine Control

AFM

- CSA Certification, Class I, Division 2, Group D
- Optimizes performance
- Dual fuel capability
- Built-in diagnostics/operating status
- Continuous feedback monitoring
- Stoichiometric or lean burn operation
- PC/PLC interface capability

DESCRIPTION

Waukesha's Custom Engine Control® (CEC) Air/Fuel Module (AFM) has the ability to actively monitor exhaust temperature and oxygen content to adjust the air/fuel ratio for both stoichiometric and lean burn natural gas engines. Waukesha's patented sensor mounting system provides an accurate feedback measurement of air/fuel ratio and eliminates predictive adjustments found on other systems. The AFM offers a very broad adjustment range to accommodate large changes in fuel composition and atmospheric conditions. Although the adjustment range is broad, small adjustment steps are taken when needed for very precise air/fuel ratio control.

Unlike other systems which have single set-point control, the AFM permits the air/fuel mixture to be tailored with engine load to meet the specific needs of any application. It also employs safety limits to be sure no unsafe fueling conditions occur.

The AFM can be used with other CEC modules or separately to optimize engine performance even with changes to engine load, speed, fuel pressure, fuel quality, and ambient conditions.

FEATURES AND BENEFITS

Optimum Performance - By continuously monitoring the engine, the AFM adjusts the air/fuel ratio to the desired mixture. Depending on application, this maximizes fuel economy, maintains consistent emissions, provides maximum power, increases engine stability at part load, and promotes longer catalyst life.

Low Maintenance - The CEC AFM offers low maintenance operation. Once programmed, no adjustments are required. Oxygen sensors for rich burn applications have a life of approximately 2000 - 3000 hours. Oxygen sensors for lean burn have a life of 10,000+ hours.

Diagnostics - On board diagnostic LEDs allow visual confirmation of incoming power and alarm status. An alphanumeric LCD allows operators to monitor system parameters including inputs to the AFM and system faults such as sensor or actuator errors. An RS-232 serial port is provided for remote monitoring and logging of all system data with a PC or other data management system.

Application Flexibility - The AFM can accommodate many different types of fuel as well as significant changes in composition from a given fuel source. A start/fuel position which sets the fuel regulators, allows for easy engine startup. The module has the ability to establish distinct operating curves when using two fuels. The AFM system automatically changes an engine's air/fuel ratio in dual fuel or other applications where such a change might be required.

COMPONENTS

Waukesha's CEC AFM system consists of the electronic module, exhaust thermocouple, oxygen sensing system, intake manifold pressure transducer (catalyst and lean burn only), stepper motor, and wiring harnesses.

RETROFIT CAPABILITY

AFM is standard on the ATGL® engine, and is an option on VHP® and VGF® engines. Additionally, retrofit kits are available for existing ATGL, VHP, and VGF engines.

SPECIFICATIONS

Module Size
6.31" D
10.33" W
13.5" H

Mounting Centers
8" L
12.75" W

Waukesha
CUSTOM® ENGINE CONTROL

IGNITION MODULE

The CEC Ignition Module (IM) is a microcircuit-based, digital ignition system. With no scheduled maintenance, and built in diagnostics, the IM is designed to enhance the reliability and performance of your Waukesha Engine while maximizing engine up-time.

DETONATION SENSING MODULE

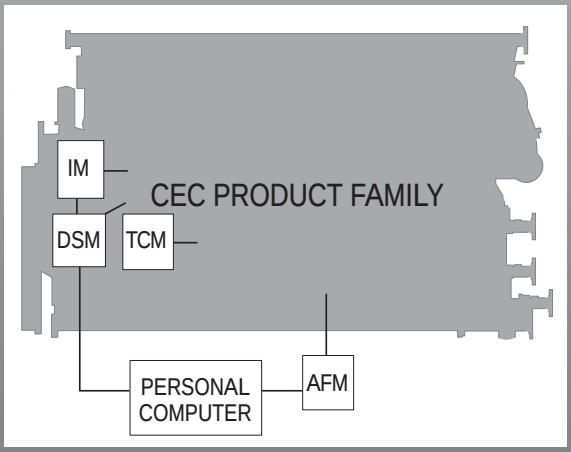
The CEC Detonation Sensing Module (DSM) works in conjunction with the ignition module to protect Waukesha spark ignited gas engines from damage due to detonation as well as maintain fuel economy and power output during adverse operating conditions.

AIR/FUEL MODULE

The CEC Air/Fuel Module (AFM) optimizes fuel consumption and emissions even when fuel composition and ambient conditions change dramatically.

TURBOCHARGER CONTROL MODULE

The CEC Turbocharger Control Module (TCM) improves turbocharger efficiency and enhances engine performance by precisely matching turbocharger output to engine needs under all operating conditions.



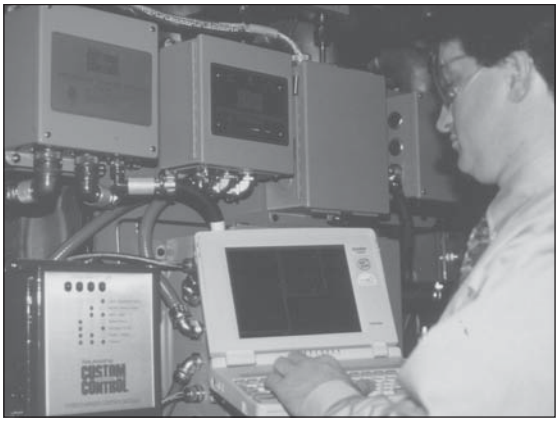
CEC Product Family

The CEC family consists of an Ignition Module (IM), Detonation Sensing Module (DSM), Air/Fuel Module (AFM), and, on ATGL engines, the Turbocharger Control Module (TCM). Together they form a comprehensive engine management system that optimizes engine performance. Even when large changes in operating conditions occur, there is no discernible difference in engine performance.

The Custom Engine Control Family includes (left to right) the Air/Fuel Module, Detontaion Sensing Module, Turbocharger Control Module, and Ignition Module. Together, they form a comprehensive engine management system that optimizes engine performance.

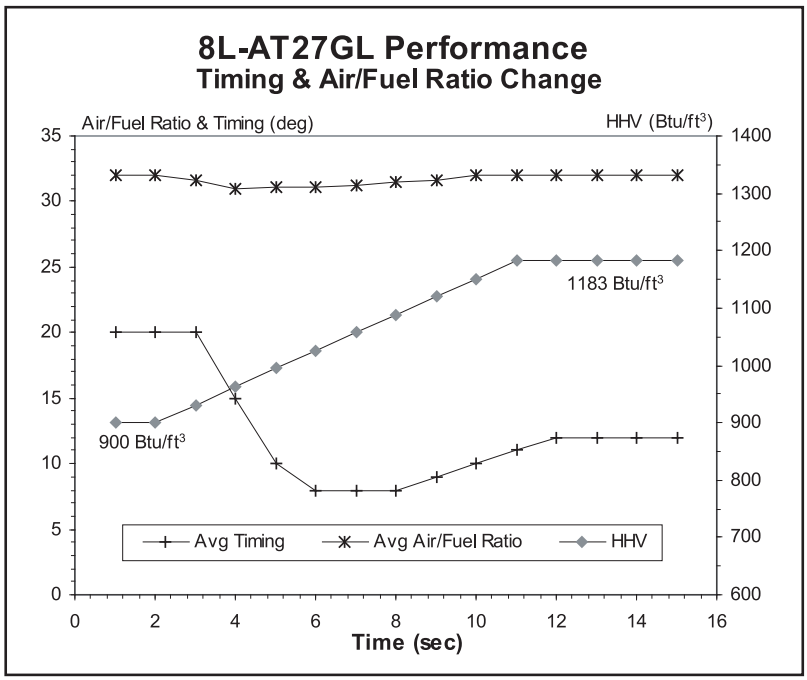
Programming Tailored To Your Needs

The AFM, DSM and TCM programs can be tailored to meet your performance needs. Thus emissions, fuel consumption and engine response can all be optimized for a given application. The AFM has dual programming schedules to accommodate dual fuel applications. Performance can be tailored on each fuel. There is no need to compromise performance on one fuel due to operating limitations that might be imposed by the other. Similarly, the DSM has dual timing schedules which permit operation in two different timing ranges. This might be required in dual fuel or other applications where optimum performance cannot be achieved with a single timing range. The operation of the TCM can be tailored to facilitate maximum engine response, maximum turndown capability, or maximum fuel efficiency whichever is most appropriate for the application.



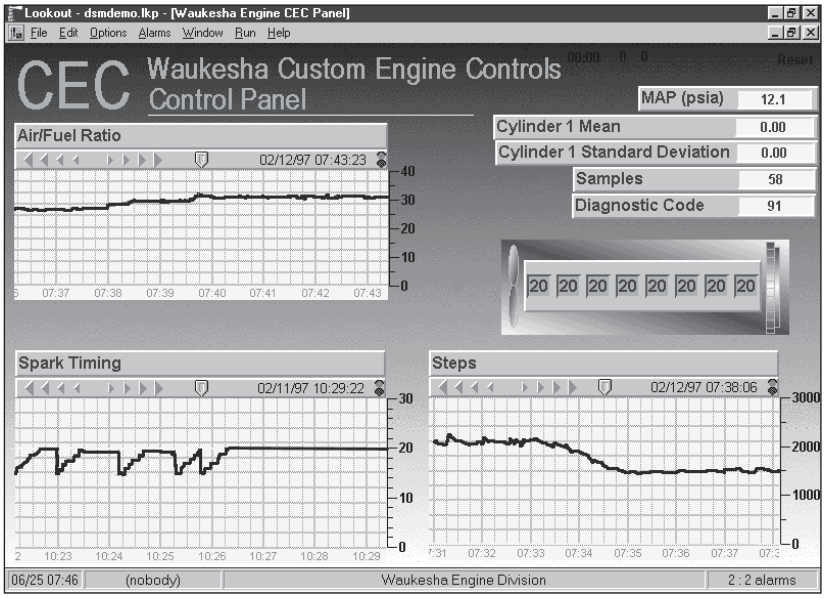
CEC PRODUCT PERFORMANCE

An example of system operation during significant changes in fuel composition is shown in the figure. In this severe test, the CEC family of products maintained peak engine performance under extreme conditions. Fuel composition was changed from a mixture with 900 Btu/ft^3 and a Waukesha Knock Index™ (WKI™) value of approximately 94, to nearly 1200 Btu/ft^3 with a WKI value of about 52 within 9 seconds. The CEC engine management system simultaneously adjusted all control parameters as required
to keep the engine running smoothly, at rated power and the best fuel economy emissions possible. The AFM system kept the engine from becoming too rich. Only a slight change in air/fuel ratio occurred during the transition in fuel composition. Thus, emissions were maintained and the tendency for detonating was reduced (refer to the average air/fuel ratio curve in the figure at the right). At the same time the AFM was adjusting air/fuel ratio, the DSM system was monitoring the combustion process to see if a change in ignition timing was required. In this test, even with proper air/fuel ratio control, the huge change in WKI necessitated a change in ignition timing. The DSM system retarded and advanced engine timing, via the CEC Ignition Module, to the optimum level. Power was maximized while maintaining detonation free combustion (see the average timing curve in the figure above). This is just one example of how the CEC family of products can enhance engine performance under even the most difficult operating conditions.



ABOVE: An example of system operation during significant changes in fuel consumption. In this test, the CEC family of products maintained peek engine performance under extreme conditions.

The CEC family forms a comprehensive engine management system that optimizes engine performance.

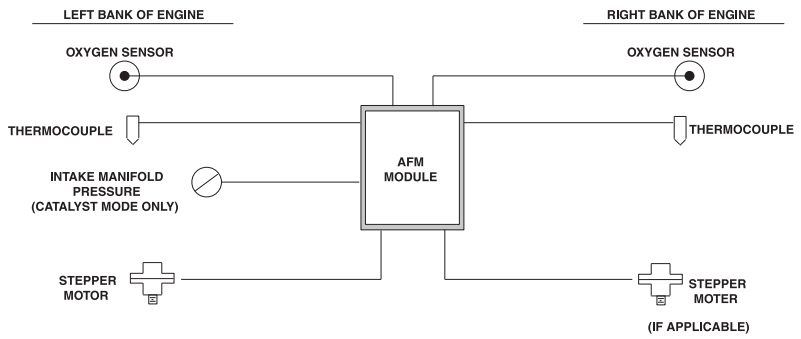


ABOVE: An example of a screen developed with data acquisition software which is used to display information and trend data on engine performance.

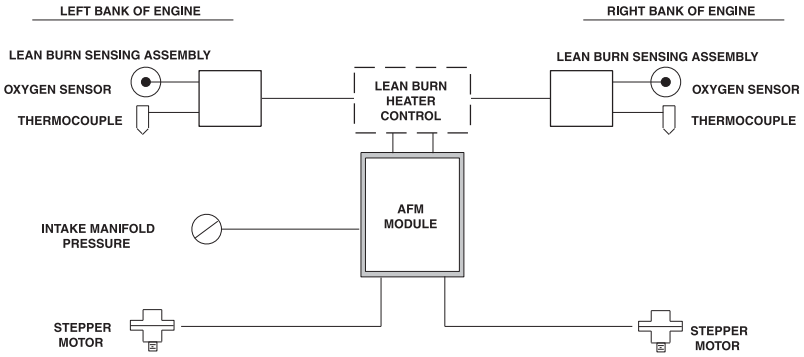
Data Acquisition Monitoring Capability

It is possible to acquire continuous streams of data about your engine's performance from the CEC product family using data acquisition software (provided by customer). The CEC data streams provide information such as knock sensor status, diagnostic codes, air/fuel ratio operating point, and individual cylinder timing. Through the use of a PC this information can be logged and used for system trending and analysis. The figure to the left is an example of a screen developed with data acquisition software which is used to display information and trend data on engine performance. The information format of the serial streams is available from Dresser Waukesha Application Engineering.

AIR/FUEL MODULE (AFM) SYSTEM LAYOUT*



RICH BURN APPLICATIONS



LEAN BURN APPLICATIONS

*Shown for VHP 12 cylinder, single fuel. Contact Dresser Waukesha Application Engineering for information on dual fuel.

AIR/FUEL MODULE SYSTEM POWER REQUIREMENTS

- Voltage ..... 24 VDC nominal
- Ripple Peak-to-Peak ..... less than 2 VAC
- Steady State Operation Current ..... 2.5 amps*
  18.0 amps**
  32.0 amps***

* All rich burn applications
** Lean burn applications
*** Lean burn applications on all ATGL and VHP 12 & 16 cylinder engines

ENVIRONMENTAL

- Ambient AirTemp. Range ..... -40° F (-40°C) to 150° F (66° C)
- Enclosure ..... NEMA Type 3R Design
- Meets CSA Class I, Division 2, Group D, hazardous location requirements

MINIMUM COMPUTER REQUIREMENTS

- Microprocessor ..... 80286 - 12 MHZ
- Floppy Disk Drive ..... 3.5″ 1.44 MB
- Serial Port RS-232
- MS-DOS ..... 3.3 or higher
- Serial Cable DB-9

OPERATOR INTERFACE

- Front Panel LCD ..... Inputs and Faults
- Front Panel Keypad ..... System Inputs
- Front Panel LEDs ..... Power, Alarms
- Data Stream Format ..... ASCII
- External Alarm Signal ..... (1 amp, sinking)

Consult your local Waukesha Distributor for system application assistance. The manufacturer reserves the right to change or modify without notice, the design or equipment specifications as herein set forth without incurring any obligation either with respect to equipment previously sold or in the process of construction except where otherwise specifically guaranteed by the manufacturer.

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