

FireFly™

Detonation Detection for Gas Engines

Detonation Control

Efficiency, performance and emissions. In today's marketplace, these factors play a key role in gas engine development. As the engine's performance improves, the boundaries of knock draw in, threatening damage and reduced efficiency.



Meet the FireFly™ Detonation Detection Control. The FireFly control will detect the occurrence of knock and adjust the ignition timing to compensate. Thus protecting your gas engine from the harmful effects of knock, and thereby increasing efficiency.

The FireFly control uses knock sensors placed on the engine block. These sensors pick up vibration signals, and the FireFly control detects the specific vibrations associated with determining the knock condition. The FireFly control ensures that only knock-related vibration signals are acted upon, ignoring all usual vibration signals produced by a gas engine.

Using the FireFly control, each cylinder can be analyzed separately during individual cycles. This ensures that each cylinder is set to achieve optimum performance. Timing and/or load can be adjusted for individual cylinders, thus improving both emissions and performance.

FireFly Benefits

- Protects engines against damage from detonation.
- Improves engine performance by running the engine closer to the knock boundaries.
- Analyses each cylinder, resulting in improved engine management.
- Shared sensors reduce system cost and complexity.

- Monitoring capability for 8 separate vibration sensors
- Fully compatible with other Woodward systems
- Designed for on-skid mounting
- Analysis and adjustment per cylinder possible
- Flexible setup software
- Automatic sensor signal leveling
- Digital filtering ensures that only correct engine data is read

Application

The FireFly control monitors the occurrence of knock on high-speed gas engines used in power generation. Gas engines within the following ratings are particularly compatible with the FireFly control:

- Rated speed of 600 to 1800 rpm
- Rated loads of 100 to 2000 kW
- Number of cylinders from 4 to 16
- V and/or inline, 4-cycle engine types

In order to suit all applications within these ranges, the FireFly control can run in a “standalone” configuration (see Figure 1). When configured to stand alone, a single FireFly control supplies an analog output. This analog output indicates the severity of knock in the engine. It is possible to connect this output to the ignition system so that the timing of the spark can be biased.

Communication networks can also be used to provide a controlled load reduction algorithm. An additional FireFly control can be connected to the communication networks in situations where cylinders are firing too close (typically for ‘V’ engines).

Engine speed and position are measured by having speed and phase signals input into the FireFly control. For more accurate determination of knock detection, a 4–20 mA or 0–5 V sensor provides a load signal to the FireFly control.

For other larger applications, the FireFly control has to communicate with another Woodward control (see Figure 2). This is accomplished by using the communication networks to pass configuration data to the FireFly control and also to receive monitoring data from it. In this setup, the knock severity is passed over the network to the other control to be analyzed and used to alter the ignition timing module or load control module. The FireFly control also needs the engine speed signal, phase input signal, and an engine load input signal (4–20 mA or 0–5 V). It is also possible to receive the load over the CAN network from the Woodward control, which saves on connections to the FireFly control.

In both systems it is possible to detect the engine vibrations with up to 8 sensors for each box. The number of sensors depends on the application.

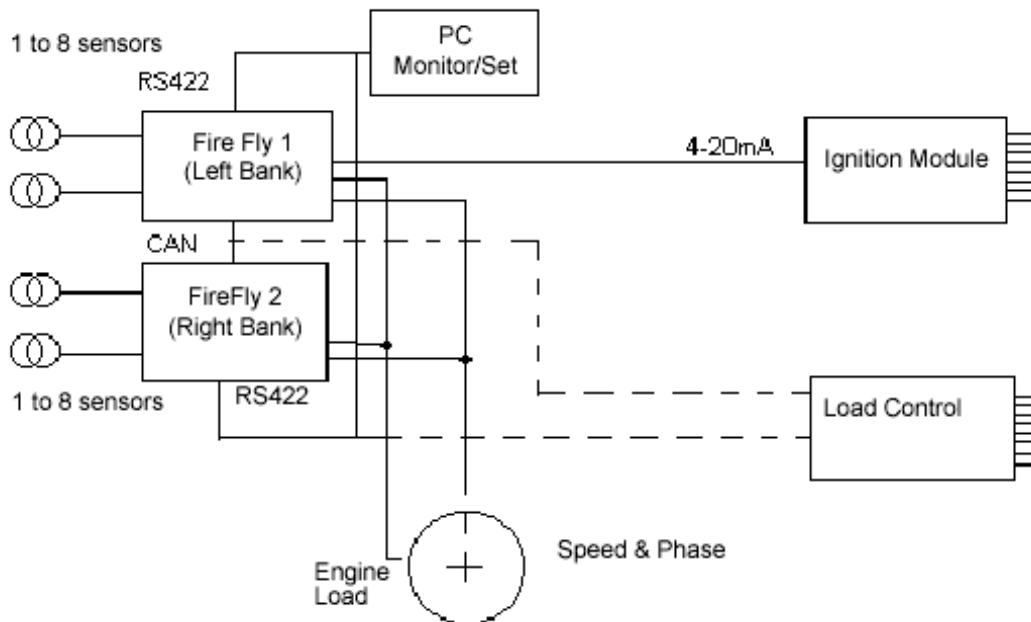


Figure 1. Standalone Configuration

Inputs and Outputs

Power Supply Input:

Power Rating	18–32 Vdc (24 Vdc nominal)
Power Consumption	10 W nominal (2 A power-up surge)

Analog Input Channel:

Number of Channels	1
Rating	4–20 mA @ 250 Ω or 0–5 Vdc
Usage	Engine load input

Analog Output Channel:

Number of Channels	1
Rating	4–20 mA @ 600 Ω
Usage	Timing bias or engine severity

Serial Communications Ports:

Number of Channels	2
Type	1 CAN and 1 RS-422 with Modbus
Usage	Monitoring and configuration

Discrete Output:

Number of Outputs	1
Ratings	1 A @ 24 Vdc breaking
Usage	Fault annunciation

Timing Inputs:

	Speed	Phase
Number of Channels	1	1
Type	NPN/PNP proximity probe (18–32 Vdc, 5 to 13 500 Hz) MPU probe (2 to 50 Vp-p, 100 to 13 500 Hz)	NPN/PNP proximity probe (5–32 Vdc, 5–160 Hz) MPU probe (2 to 50 Vp-p, 5–160 Hz)
Usage	Speed input	Phase input

Knock Sensor Inputs:

Number of Channels	8
Type	Wide-band piezo-electric vibration sensors Frequency range of 1 kHz to 30 kHz
Usage	Detecting knock condition

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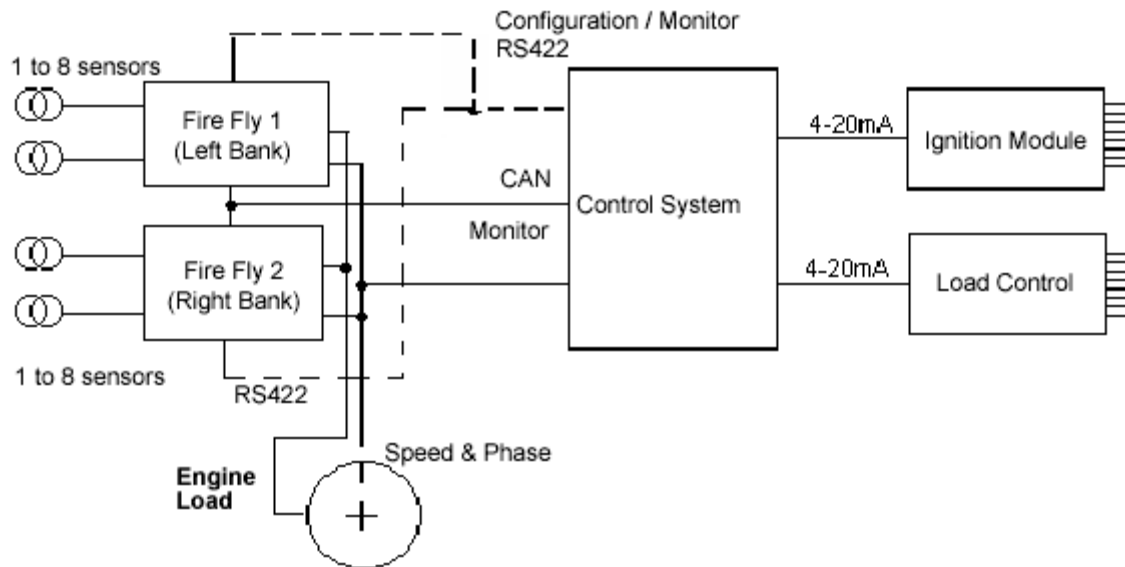


Figure 2. Full System

Environmental and Approvals

Climatics

Storage Temperature	-40 to +125 °C (-40 to +257 °F)
Operating Temperature	-40 to +70 °C (-40 to +158 °F)
Humidity	60 °C / 95% RH, NC
Enclosure Protection, Water	IEC 529 Class IP56

Dynamics

Vibration, Swept Sine	4 G, 5 mm, 5–2000 Hz, 3 h min/axis, 90 min dwells
Vibration, Random	0.04 G ² /Hz, 10–2000 Hz, 90 min/axis, 8.2 Grms
Shock	40 G, 11 ms sawtooth pulse

EMC

Load Dump/Power Variation	ISO 7637-2
EMC Immunity	EC Generic Immunity, EN50082-2
EMC Emissions	EC Generic Emissions, EN50081-2

Classification

Declaration of Incorporation for CE approval



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