

# LQ6 Liquid Fuel Valve

## with On-board Driver

### Applications

The LQ6 provides the flow range, accuracy, and response characteristics necessary for the control of industrial gas turbines in the 3 MW to 15 MW power range. By integrating Woodward's proprietary electric actuation technology with a proven fuel-metering concept, exceptional performance and robustness are achieved in a compact, cost effective package. The use of on-board driver electronics simplifies system design and reduces installation space, time, and cost.

Please refer to Woodward Installation and Operation Manual 26515 for complete details of this product, its application and installation.

### Description

The LQ6 incorporates an electrically actuated rotary metering valve, a bypassing regulator, and an on-board driver module. These components are packaged within a common assembly to reduce cost and improve performance.

Highly accurate flow control is achieved by the use of a rotary plate element, embodying a precision-machined metering port. A seal shoe is loaded against the plate to achieve accurate flow area control over a wide range. The self-cleaning, shear-type action keeps the metering port free from contaminant deposits and system debris.

The metering section utilizes a single moving part with the valve plate, actuator rotor, and position feedback resolver mounted on a single shaft. Accurate flow versus input signal characteristics are achieved by the precision machining of the valve metering port, the use of large valve travels, and a high-precision resolver for valve position feedback. The LQ valve can achieve flow turn-down ratios in excess of 100 to 1.

The pressure differential across the metering valve port is held virtually constant by a bypassing-type regulator. When this pressure difference exceeds the selected level, the regulator piston progressively opens to bypass excess inlet flow back to the fuel pump inlet area. This pressure regulation system requires the use of a positive displacement, high-pressure fuel pump upstream of the LQ6 valve.

The use of rare-earth permanent magnets in an efficient electromagnetic circuit results in high actuation forces while minimizing package size. The closely integrated mechanical design eliminates backlash and provides virtually infinite valve positioning resolution.



- All-electric actuation
- On-board driver
- Highly accurate fuel metering
- For use with gear and other positive displacement type fuel pumps
- Fast dynamic response
- Single moving part for reliable performance
- Robust self-cleaning valve
- Digital and/or (4 to 20) mA interface
- Discrete fault output and independent shutdown
- Certified for use in Hazardous Locations



## Specifications

### Electrical Characteristics

Input Voltage Range	(18 to 32) V (dc)
Nominal Input Current Range (steady-state, maximum)	(0.2 to 3.0) A
Maximum Continuous Input Current	3.0 A
Maximum Transient Input Current	7.0 A

### Mechanical Characteristics

Valve Geometric Area Available	32.3 mm <sup>2</sup> (0.05 in <sup>2</sup> )/max flow = 1814 kg/h (4000 pph*) 43.2 mm <sup>2</sup> (0.067 in <sup>2</sup> )/max flow = 2495 kg/h (5500 pph*) 96.8 mm <sup>2</sup> (0.15 in <sup>2</sup> )/max flow = 4900 kg/h (10 800 pph*)
Weight	29.5 kg (65.0 lb)
Mounting	See installation drawings
Fuel connections	See installation drawings

### Environmental

Fuel Type	The valve is compatible with most types of diesels, kerosenes, gasolines, heavy and light distillates including naphtha, gas turbine fuels and fuel oils, and other liquid fuels such as biodiesel that are compatible with fluorocarbon (FKM) type elastomers and conform to international standards for utility, marine, and aviation gas turbine service. Ultra low sulfur diesels are also acceptable with proper lubricity additives. Other fuels such as ethanol or methanol may be acceptable with internal seal compound substitutions. Contact Woodward for these and other special fuel applications.
Fuel Viscosity	Fuel viscosity must be between 0.5 cSt and 12.0 cST.
Fuel Cleanliness	Liquid fuel must be filtered to limit particulate size to 20 µm or smaller. Water and sediment must be limited to 0.1 % by volume. Total particulate concentration must be limited to 2.64 mg per liter of fuel.
Ingress Protection	IP56 per IEC EN 60529

### Pressure

Operating Inlet Fuel Pressure Range	(690 to 8274) kPa / (100 to 1200) psig / (6.9 to 83) bar
Proof Pressure	12 411 kPa (1800 psig)
Burst Pressure	41 370 kPa (6000 psig)
Maximum Fuel Bypass Pressure	690 kPa (100 psig)

### Temperature

Ambient	(-28 to +93) °C / (-18 to +200) °F
Fuel Temperature	(-28 to +93) °C / (-18 to +200) °F

### Vibration and Shock

Swept Sine Vibration	Per US MIL-STD-810C, Method 514.2, Procedure I, Figure 514.2-2, Curve AR (2g)
Shock	Per US MIL-STD-810C, Method 516.2, Procedure I, (10g)

### Flow Characteristics

Accuracy	The accuracy of fuel flow scheduling is better than ±5 % of point for (0.4 to 5.7) L/min / (0.1 to 1.5) US gal/min and ±3 % for >5.7 L/min (1.5 US gal/min) at room temperature.
Temperature Drift	The maximum temperature drift for positional accuracy will be 0.09 % of full-scale input demand (4 mA to 20 mA) per °C (0.05 % per °F).

### Regulatory Compliance

#### European Compliance for CE Marking:

<b>EMC Directive:</b>	2004/108/EC
<b>ATEX Directive:</b>	94/9/EC per Zone 1, Category 2, Group II, G, Ex d IIB T3 Gb, TUV 13 ATEX 7404X Zone 2, Category 3, Group II, G, Ex nA IIC T3 Gc, TUV 13 ATEX 7409X

#### Other European and International Compliance:

Compliance with the following European Directive does not qualify this product for application of the CE Marking:

<b>Machinery Directive:</b>	Compliant as partly completed machinery with 2006/42/EC
<b>Pressure Equipment Directive:</b>	Compliant as "SEP" per Article 3.3 to 97/23/EC

<b>IECEx:</b>	Ex d IIB T3 Gb or Ex nA IIC T3 Gc per IECEx Tur 11.0014X
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#### North American Compliance:

<b>CSA:</b>	CSA Certified for Class I, Division 1, Groups C and D, T3, and Class I, Division 2, Groups A, B, C, and D, T3 at 93 °C ambient for use in Canada and the United States
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## On-board Driver

The valve driver and wiring terminal box are integral with the valve assembly, eliminating interconnecting wiring, reducing package size requirements, and lowering the installed cost. The on-board driver can be interfaced to the turbine control via a (4 to 20) mA input and feedback signals or through a DeviceNet™\*/CANopen network. The LQ6 can be configured to accept both the (4 to 20) mA signal and DeviceNet/CANopen position command in a redundant configuration. With this arrangement, if either demand signal fails, the driver will switch to the healthy input demand signal. The valve operates with an (18 to 32) V (dc) power supply.

\*—DeviceNet is a trademark of ODVA (Open DeviceNet Vendor Association, Inc.)

The on-board valve driver performs these functions:

- Fast and accurate closed loop position control of the liquid valve in response to the (4 to 20) mA or DeviceNet/CANopen input command signal
- Actual valve position feedback via (4 to 20) mA or DeviceNet/CANopen
- Independent remote shutdown input
- Valve/driver fault output

The driver includes protection and alarm indications for these faults:

- Analog input out of range
- Feedback—open wire and short
- Input power out of range
- Position error
- Internal driver faults
- Actuator open/short
- Driver overcurrent

All fault indications are available through the DeviceNet/CANopen connection or via an RS-232 or RS-485 connection when using an analog control interface.

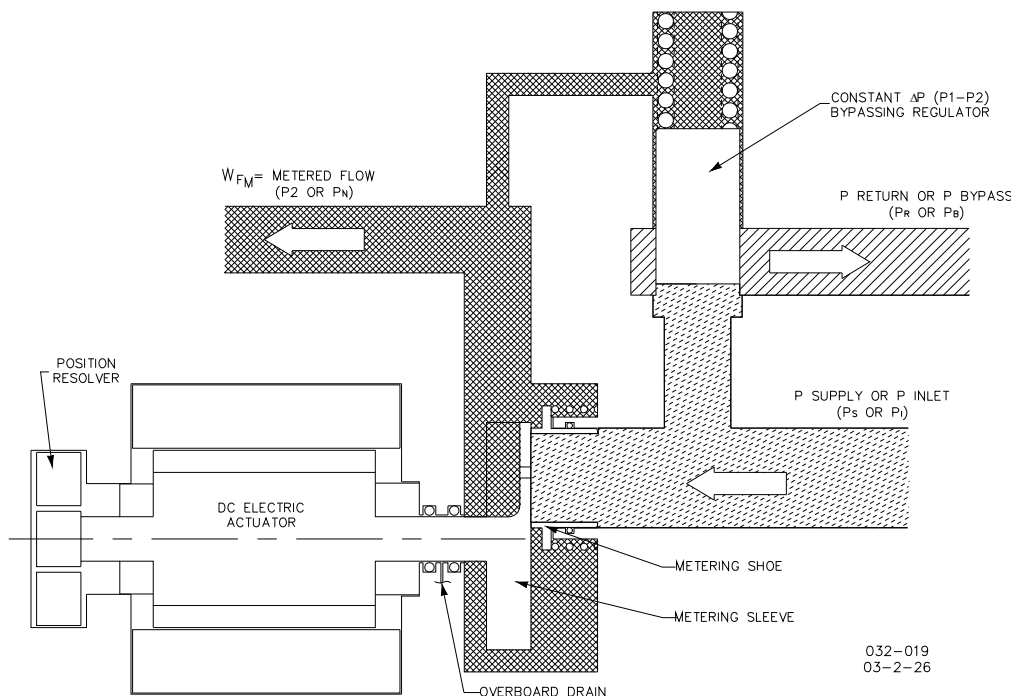
## Port Sizes

The LQ6 is available with three different metering port sizes to optimize valve performance for various engine flow requirements. Standard port geometric area sizes are:

- 32.3 mm<sup>2</sup> (0.05 in<sup>2</sup>)/max flow = 1814 kg/h (4000 pph\*)
- 43.2 mm<sup>2</sup> (0.067 in<sup>2</sup>)/max flow = 2495 kg/h (5500 pph\*)
- 96.8 mm<sup>2</sup> (0.15 in<sup>2</sup>)/max flow = 4900 kg/h (10800 pph\*)

\*Approximate maximum metered flow capabilities are stated in kg/h or lb/h (pph) of 0.82 specific gravity liquid fuel.

The standard metering ports are contoured to provide approximately equal percentage relationships between commanded position and effective area.



LQ6 Valve Schematic



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