

## Product Manual 26207 (Revision L, 5/2017) Original Instructions



# LQ6 Liquid Fuel Metering System

## Fuel Valve with On-board Electronic Controller Analog and Digital Version

Installation and Operation Manual



Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

General Precautions Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.



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Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.



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# Warnings and Notices

#### **Important Definitions**



This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- NOTICE Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** Designates an operating tip or maintenance suggestion.



Personal Protective Equipment

- The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:
- Eye Protection
- Hearing Protection
- Hard Hat
- Gloves
- Safety Boots
- Respirator

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.



Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

# **Electrostatic Discharge Awareness**

NOTICE	Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:
Electrostatic Precautions	<ul> <li>Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).</li> <li>Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.</li> <li>Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.</li> <li>To prevent damage to electronic components caused by improper bondling, road and observe the presentions in Weadward manual.</li> </ul>
	82715, Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.

Follow these precautions when working with or near the control.

- 1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
- 2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
  - Do not touch any part of the PCB except the edges.
  - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
  - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

# **Regulatory Compliance**

#### **European Compliance for CE Marking:**

EMC Directive:	Declared to 2014/30/EU of the European Parliament and of the Council of 26 Februrary 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC).
ATEX—Potentially Explosive Atmospheres Directive:	Declared to 2017/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Zone 1, Category 2, Group II G, Ex d IIB T3 Gb TUV 13 ATEX 7404 X Zone 2, Category 3, Group II G, Ex nA IIC T3 Gc TUV 13 ATEX 7409 X

#### Other European Compliance:

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

Machinery Directive:	Compliant as partly completed machinery with DIRECTIVE 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.
Pressure Equipment Directive:	Compliant as "SEP" per Article 4.3 to Pressure Equipment Directive 2014/68/EU on the harmonization of the laws of the Member States concerning pressure equipment.
IECEx:	Certified for use in Hazardous Locations Ex d IIB T3 Gb or Ex nA IIC T3 Gc IECEx TUR 11.0014X

#### North American Compliance:

**CSA:** 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 Certificate 1214202

The LQ6 valve wiring must be in accordance with North American Class I, Division 1 or 2 or European Zone 1 or 2 wiring methods and in accordance with the authority having jurisdiction.

#### Special Conditions for Safe Use:

Field wiring for the LQ6 valve power input must be suitable for at least 103 °C.

A conduit seal must be installed within 457 mm (18 inches) of the conduit entry when the valve is used in Class I, Division 1 or Zone 1 hazardous locations.

Connect the ground terminal of the LQ6 valve to earth ground.

The RS-232/-485 interface must not be used in Class I, Division 2 applications unless the area is known to be non-hazardous.

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

# 

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2.

# 

RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2 ou Zone 2.

# Chapter 1. General Information

## Introduction

The LQ6 valve is an electrically actuated fuel valve with an on-board, electronic position controller. The valve is designed to accept a demand signal, and then accurately position the fuel metering element, exposing the port effective area proportional to flow. The metering element is designed to promote selfcleaning by a shear-type action created by the rotary plate and shoe. Position feedback is achieved using a resolver. The resolver is directly coupled to the fuel metering element, thus eliminating the need for couplings or gear trains and their associated inaccuracies. Liquid fuel control is achieved by a combination of accurately scheduling the metering valve port area and regulating the differential pressure across the metering port. The inclusion of the bypassing regulator creates the differential pressure across the metering port and allows the LQ6 valve to be used with positive displacement fuel pumps.

## **Connections to the LQ6 Valve**

The LQ6 valve requires the following electrical connections. Additional details are provided in Chapter 2, Installation.

Earth Ground	Provided through ground lug on housing
Power Input	(18 to 32) V (dc) measured at the LQ6 valve
Analog Input	(4 to 20) mA position command signal
CAN Network	DeviceNet position, status, and limited configuration
Analog Output	(4 to 20) mA output proportional to valve position
Shutdown Input	Relay or dry contact inputs for valve shutdown/reset
Status Output	Solid stead relay output for shutdown states

The LQ6 valve has one RS-232 service port for program upgrades by qualified service personnel.



Figure 1-1. LQ6 Valve Outline Drawing

# Chapter 2. Installation

### Introduction

	EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.
	Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.
	For Zone 1 / Division 1 products: Proper torque is very important to ensure that the unit is sealed properly.
-	
	The LQ6 valve weighs 23.2 kg (51.2 lb). In order to prevent injury, some form of lifting assistance (a lifting strap is recommended) should be used when handling the LQ6 valve.
	Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the LQ6 valve.
<u></u>	
	The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.
	Take care not to damage the cover seal, the cover surface, or the valve surface while removing or replacing the cover.
NOTICE	External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable

Be careful when unpacking the LQ6 valve. Check the assembly for signs of damage, such as bent or dented covers, scratches, and loose or broken parts. Notify the shipper and Woodward if damage is found.

requirements for their system.

## Mounting

The LQ6 valve is designed to operate within an ambient temperature range of (-28 to +93) °C / (-18 to +200) °F with a liquid fuel flow temperature of (-28 to +93) °C / (-18 to +200) °F.

The overboard (OBVD) drain port is a vent between dual redundant shaft seals. It must be connected by means of rigid steel piping to a fuel connection, purge, vent, or flare-off system so as not to be exposed to danger of obstruction, physical damage, or back pressure in excess of 69 kPa (10 psig).

The LQ6 should be mounted onto a flat plate with 0.250-28 size bolts. The piping connections (IN, OUT and BYP) are 1.312-12 UN STR THD Port (-16). Consideration must be given to the strength of the mounting plate in order to support the 23.2 kg (51.2 lb) mass of the LQ6.

**VARNING** Leak check all liquid fuel connections. Leaking liquid fuel can cause explosion hazards, property damage, or loss of life.

## **Electrical Connections**



The engine, turbine, or other type of prime mover should be equipped with an overspeed, misfire, detonation detection shutdown device(s), that operate totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the system fail.



Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.



Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 2-2).

The LQ6 valve is connected to the engine control system by the main terminal block connector (optional flying leads provided on some models). A conduit seal must be installed within 457 mm (18 inches) of the conduit entry when the valve is used in Class I, Division 1 or Zone 1 hazardous locations.

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the GS6 joint surfaces to ensure that they are not damaged or contaminated.

Terminals are spring-loaded type, accepting wire size from 0.08 to 3.0 mm<sup>2</sup> (28 to 12 AWG). Recommended wire sizes are 3.0 mm<sup>2</sup> (12 AWG) for Power In (+) and (–) and 1.0 mm<sup>2</sup> (16 AWG) for other signals. Refer to Figures 2-1 and 2-2, and to the description below, for LQ6 wiring requirements.

13	14	15	16	17	18	19	20	21	22	23	24
Power In -	Power In -	Power In +	Power In +	485 Shield	485 Lo	485 Com	485 Hi	Shut- down -	Shut- down +	Status Out Lo	Status Out Hi
1	2	3	4	5	6	7	8	9	10	11	12
Can Pwr	Can Shield	Can Gnd	Can Lo	Can Hi	4-20 In Shield	4-20 In -	4-20 In +	Shut- down Shield	4-20 Out Shield	4-20 Out -	4-20 Out +

Shading indicates terminal not used on analog version of LQ6



Figure 2-1. LQ6 Terminal Block Wiring Diagram

Control System

4-20 mA Position

Command

4-20 mA Position

Feedback

Figure 2-2. LQ6 Plant Wiring Diagram

6 Shield 8+

7 -

12+

11 -10 Shield

1

4-20 mA Analog

Input

4-20 mA Analog

Output

LQ6 Valve Terminal Block

Terminal			Wire Color &
Number	Terminal Name	Signal Definition	Description
6	(4 to 20) In	(4 to 20) mA Input Demand Shield	Twisted Pair White
	Shield		with Black Stripe
7	(4 to 20) In –	(4 to 20) mA Input Demand Negative	Twisted Pair Black
8	(4 to 20) In +	(4 to 20) mA Input Demand Positive	Twisted Pair White
10	(4 to 20) Out	(4 to 20) mA Feedback Shield	Twisted Pair White
	Shield		with Black Stripe
11	(4 to 20) Out –	(4 to 20) mA Feedback Negative	Twisted Pair Green
12	(4 to 20) Out +	(4 to 20) mA Feedback Positive	Twisted Pair Red
13	Power In –	(24.0 ± 2.0) V (dc) Input Power	Black
		Negative	
15	Power In +	(24.0 ± 2.0) V (dc) Input Power	Red
		Positive	
GND	Internal Ground	Internal Ground	Green

For valves shipped with flying leads installed, the leads are color coded as follows:

#### **Supply Voltage**

Terminal 15 and/or 16 = Supply voltage (+) Terminal 13 and/or 14 = Supply voltage (-)

The supply voltage during normal operation must be 18 to 32 V, measured at the LQ6 valve connectors. Input current is typically less than 2.0 A, but momentary current peaks can reach 7 A. The recommended power supply cable size is

3.0 mm<sup>2</sup> (12 AWG). Two terminals each are supplied for both Power In (+) and Power In (–). This allows for connecting two parallel power supply cables, each of 3.0 mm<sup>2</sup> (12 AWG) to reduce line loss in the power supply wiring. Power supply line losses can adversely affect dynamic performance of the LQ6 under conditions of minimum supply voltage, high temperature, and long line lengths. The power supply wiring must be fused outside of the valve. A slow-blow type,

10 A fuse is recommended. If parallel supply lines are used, each supply line must be fused, with one 10 A fuse in a common point.

The controller can produce transients on the power supply lines which may interfere with certain regulated power supplies. If this is the case, the interference may be reduced or eliminated by connecting a 100 V, 1000  $\mu$ F or larger electrolytic capacitor across the power supply lines, at the power supply. Correct polarity must be observed when connecting the electrolytic capacitor.

If batteries are not used, Woodward recommends the following power supply:

- Woodward P/N 1784-3032 (Phoenix Contact QUINT-PS-100-240AC/24DC/20, Phoenix Contact P/N 2938620) with 1000 μF 100 V electrolytic capacitor (Woodward P/N 1662-111) installed.
- Place the 1000 µF, 100 V capacitor across the + and dc output terminals on the power supply.

# **NOTICE** To prevent damage to the power supply, be sure to observe correct polarity.

This power supply accepts (85 to 264) V (ac) / (45 to 65) Hz or (90 to 350) V (dc). Output voltage is
rated at (22.5 to 28.5) V (dc).

#### (4 to 20) mA Input

Terminal  $\hat{8}$  = (4 to 20) mA Input (+) Terminal 7 = (4 to 20) mA Input (-) Terminal 6 = Shield

The (4 to 20) mA Input is the analog position command input for the LQ6 valve. Input scaling is such that 4 mA input current corresponds to 0 % valve position and 20 mA input current corresponds to 100 % valve position. Valve position (not flow) vs. input current is linear between these extremes. Input current less than

2 mA or greater than 22 mA will cause a shutdown condition where the valve will be driven to the 0 % position and the (4 to 20) mA Output will be set to 0 mA.

Recommended cable is 1.0 mm<sup>2</sup> (16 AWG) twisted, shielded pair. The input impedance of the (4 to 20) mA Input is approximately 200  $\Omega$  resistive. The input circuit will withstand a differential voltage up to 24 V and common mode voltage, with respect to Power Supply (–), up to ±500 V without damage at 25 °C. Presence of common mode voltage at the input terminals will cause a slight error in valve position. Performance to specifications is attainable only with common mode voltage less than ±40 V (dc).

#### **DeviceNet Interface**

Terminal 5 = CAN Hi Terminal 4 = CAN Lo Terminal 3 = CAN GND Terminal 2 = CAN Shield Terminal 1 = CAN Pwr (not connected internally)

The LQ6 Digital Version is controlled via DeviceNet. It can also be configured to accept DeviceNet and (4 to 20) mA position demand signals, and upon failure of either demand signal, switch to the healthy input demand signal. Terminal 1 is not connected internally and is provided as an optional place holder for the CAN power wire. This product has been self-tested by Woodward and found to comply with ODVA Protocol Conformance Test Version 16.

#### (4 to 20) mA Output

Terminal 12 = (4 to 20) mA Output (+) Terminal 11 = (4 to 20) mA Output (-) Terminal 10 = Shield

The (4 to 20) mA Output provides the analog output indication of the LQ6 valve position. Output scaling is such that 4 mA output corresponds to 0 % valve position and 20 mA output corresponds to 100 % valve position. Output between these extremes is a linear function of valve position. A shutdown condition (resulting from certain errors or from an open Shutdown Input) is indicated on the (4 to 20) mA Output by 0 mA output current.

Recommended cable is 1.0 mm<sup>2</sup> (16 AWG) twisted, shielded pair. The output will drive a load resistance up to 500  $\Omega$ . The output circuit is electrically isolated from all other LQ6 driver circuitry and will withstand common mode voltage up to

±500 V (dc) with respect to Power Supply (-) without damage at 25 °C.

#### **Shutdown Input**

Terminal 22 = Shutdown Input (+) Terminal 21 = Shutdown Input (-) Terminal 9 = Shield

The Shutdown Input provides a means to shut down and reset the LQ6 driver through a relay or other dry contact. For normal operation, the shutdown inputs must be closed, (+) and (–) shorted together. When the Shutdown Input is opened, the driver is held in shutdown state, the valve is driven to the 0 % position, the (4 to 20) mA Output is set to 0 mA, and the Status Output is put into shutdown. Upon closing the Shutdown Input, the driver is reset and will resume control of the valve position according to the input command.

Recommended cable is 1.0 mm<sup>2</sup> (16 AWG) twisted, shielded pair. Nominal current through the wiring and external contact is 10 mA.

#### **Status Output**

Terminal 24 = Status Output (+) Terminal 23 = Status Output (-)

The Status Output indicates if the LQ6 is shutdown or running. There are two ways for the LQ6 to be shut down—if the Shutdown/Reset input is in shutdown, or if a diagnostic has been triggered. If the LQ6 is in a shutdown situation, the status output is open (no current).



The engine, turbine, or other type of prime mover should be equipped with an overspeed, misfire, detonation detection shutdown device(s), that operate totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the system fail.

#### **Service Port**

The service port (Figure 2-3) provides an RS-232 connection for troubleshooting and program upgrades. The RS-232 service port is intended for use only by Woodward certified personnel. Connection to the service port should be made only when the area is known to be non-hazardous. When replacing the cover, torque the cover to 47 N·m (35 lb-ft).





Figure 2-3. Service Port



Figure 2-4. Service Port Close-Up

# Chapter 3. Description of Operation

## Description



Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the LQ6 valve.

The valve can be in four operational modes.

- Running
- Shutdown
- Shutdown Position
- Shutdown System

#### **Running:**

In this mode the valve is operating normally and is in position control. The Status Output terminals will be closed, and the (4 to 20) mA output will follow actual position of the valve.

#### Shutdown:

In this mode the valve is still in position control, but there has been a situation that forced the valve into shutdown. The position will be set to 0 %. The (4 to 20) mA output will be set to 0 mA, and the status output will be in shutdown (terminals open).

There are different situations that will force the valve into shutdown. See troubleshooting for more details.

#### **Shutdown Position:**

If the valve is into the shutdown position mode, the valve will not control position any more. The driver will try to close the valve in current control mode. The (4 to 20) mA output will be set to 0 mA, and the status output will be in shutdown.

#### Shutdown System:

If the valve is into shutdown system mode, the driver will try to close the valve with a PWM signal. This is the last attempt to close the valve. The (4 to 20) mA output will be set to 0 mA, and the status output will be in shut down.

See troubleshooting for more details on the different situations that will put the valve into the different modes.

#### **Position Control:**

The following table shows the operating states for the LQ6 Digital Version. Configuration for Backup Used and Analog Primary are done over the DeviceNet Interface. See Chapter 5 for a description of Shutdown Input, Tracking Error, DeviceNet Error, and Analog Error. The DeviceNet and Analog states indicate if the valve is controlled via the DeviceNet Interface or the Analog Input.

LQ6 Valve State	Shutdown Input	Backup Used	Tracking Err	DeviceNet Err	Analog Err	Analog Primary
DeviceNet	False	False	Don't Care	False	Don't Care	Don't Care
Shutdown	False	False	Don't Care	True	Don't Care	Don't Care
DeviceNet	False	True	Don't Care	False	True	Don't Care
Analog	False	True	Don't Care	True	False	Don't Care
DeviceNet	False	True	False	False	False	False
Analog	False	True	False	False	False	True
DeviceNet	False	True	True	False	False	Don't Care
Shutdown	False	True	Don't Care	True	True	Don't Care
Shutdown	True	Don't Care	Don't Care	Don't Care	Don't Care	Don't Care

Table 3-1. LQ6 Digital Version Operating States

# Chapter 4. Valve Sizing

## **Standard Liquid Valve Flow Calculations**

#### **Determination of Port Size**

In order to choose the proper size of valve for an application, the approximate geometric port area required to meet the maximum flow requirement must first be determined. Taking the Maximum Mass Flow Rate plus at least 10 % for margin and using the following equation will determine the maximum geometric port area.

$$A = \frac{Wf}{11978.3 \cdot \sqrt{dP \cdot SG}}$$

where:

A = Geometric Area (square inches)

Wf = Mass Flow Rate (pph [lb/h]) (maximum required plus at least 10 %)

dP = Delta Pressure across the metering port (=50 psid for the LQ6)

SG = Specific Gravity relative to water (0.82 typical for diesel fuel)

Once the maximum required geometric area is calculated, choose the LQ6 metering port size by picking the closest one of the three sizes available that is greater.

Below are graphs of the available metering port sizes for specific gravities of 0.82 and 0.975.

## **Metering Port Size Diagrams**

LQ6 Port Alternatives - 0.82 Specific Gravity



Input Demand (%)









Figure 4-2. Metering Port Size – 0.975 Specific Gravity

# Chapter 5. Troubleshooting

Possible Reason	Explanation	Action
Power up Reset	After power up, the valve will go into	Reset the valve after power
(Shutdown)	shutdown until the valve is reset by	up.
	the shutdown reset input.	
Shutdown Input Active	If the shutdown input is active (open),	Check wiring and/or control
(Shutdown)	the valve will be in shutdown.	system.
Analog Low Error	If the analog input is not connected,	Check the wiring and the
(Shutdown or switch to	an analog input low error (< 2 mA)	control system.
DeviceNet)	will shut down the valve.	
Analog High Error	If the analog input is mis-connected	Check the wiring and the
(Shutdown or switch to	or driven with more then the normal	control system.
DeviceNet)	current, an analog high error will shut	
	down the valve (> 22 mA).	
DeviceNet Error	I his error is caused by one of the	Check the wiring and the
(Shuldown or Switch to	following conditions.	control system.
Analog)	Incorrect or zero length message	
	Duplicate MAC ID	
	Bus Off	
Otartus Desition Error	No messages received	Depart the weburn and the test
Startup Position Error	During the startup of the valve, the	Reset the valve, and the test
(Shuldown Position)	valve is closed to detect if the	will be performed again if the
	position of this is not so, the valve will	there is an obstruction in the
	shutdown	valve. Check if the valve
	Shudown.	needs cleaning Check
		pressure rating
Position Error	During run time, the valve will check if	Check if there is an
(Shutdown Position)	the position feedback and the	obstruction in the valve. Check
(,	demanded position are the same. If	if the valve needs cleaning.
	not, a position error will be flagged,	Check pressure ratings.
	and the valve will be shut down.	
Tracking Error	The difference between the	Check the control system
	DeviceNet position demand and the	analog output and the valve
	Analog position demand is greater	analog input.
	than the configured limit (1 %	
	default).	
Position Sensor Error	The valve is continuously checking if	Check wiring in the valve.
(Shutdown Position)	the signals for the resolver are	Replace valve.
	correct. If the resolver signals are	
	missing or incorrect, a Position	
	Sensor Error 1 is set.	
Internal Error	There are different internal errors that	There is an internal error
	can be detected.	detected. Replace the valve.
	Supply voltage errors	
	AD converter errors	
	• Sonware errors (Watchdog)	
	Factory calibration and	
	parameter errors	
	All of these enois will make the valve	
	(Typical Shutdown System)	

The actions described may not be appropriate for all situations. The operator should verify that any actions taken while troubleshooting will not take equipment outside of specification, and will not damage property or result in dangerous situations. Also check with the local safety authority.

# Chapter 6. Maintenance

Periodic cleaning may be performed. A petrochemical solvent is recommended to clean (wash and brush) the valve. High-pressure power washing is **not** recommended. When cleaning the metering element and the inside of the valve body, do not use sharp objects that may scrape or dent the metering element, as this could degrade the accuracy of the valve.

When using solvent or water to clean the valve, be certain that all access points into the enclosure are closed or covered (electronics cover, conduit entry, OBVD port).

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the GS6 joint surfaces to ensure that they are not damaged or contaminated.



EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2.



To prevent possible serious personal injury, or damage to equipment, be sure all electric power, hydraulic pressure, and fluid pressure have been removed from the valve before beginning any maintenance or repairs.



Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

<b>WARNING</b> Do not lift or handle the valve by any conduit.	
--	--

**WARNING** Due to the protection

Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the LQ6 valve.





Take care not to damage the cover seal, the cover surface, or the valve surface while removing or replacing the cover.



Proper torque is very important to ensure that the unit is sealed properly.

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# Chapter 7. Software Upgrade

The software can be updated by loading a new program through the service port.

**WARNING** EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Connect a serial cable between a computer and the device. The device has a female 9-pin Sub-D connector, and connects to the 9-pin COM port of a PC using a standard cable (pins 2, 3, and 5 connected to pins 2, 3, and 5). Only pins 2, 3, and 5 are used (it is not a problem if the other pins are connected).

Set jumpers JPR3 and JPR5 to the RS-232 position (see Figure 7-1).

Load the ServLink and Watch Window software on the computer. Follow the procedure supplied with the software.

Activate the ServLink server and set the communication parameter. See server online documentation.

Parameters are: Baud rate = 38400 Bus mode = Point to Point Communication = 8N1

Open a new net and wait until the net is displayed on the server screen. Start Watch Window. Right click on the TAB. A menu will pop up. Select load application. Select the file and click "ok". Wait until Watch Window indicates that the application has been successfully changed.

Remove the serial cable and return jumpers JPR3 and JPR5 to the RS-485 position.

Read the documentation that is provided with the new "\*.SCP" file. This may contain additional information about changes to be made to the device to work with the new software.



An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.

NOTICE

Ensure that the serial cable is removed and the port cover is replaced after the software upgrade is complete. Electromagnetic robustness to high strength fields is not ensured with a cable connected.





# Chapter 8. Product Support and Service Options

## **Product Support Options**

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

**OEM or Packager Support:** Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

**Woodward Business Partner Support:** Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An Authorized Independent Service Facility (AISF) provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at www.woodward.com/directory.

## **Product Service Options**

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

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**Replacement/Exchange:** Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

**Flat Rate Repair:** Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

**Flat Rate Remanufacture:** Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in "like-new" condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

## **Returning Equipment for Repair**

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

#### Packing a Control

Use the following materials when returning a complete control:

- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength



To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.* 

## **Replacement Parts**

When ordering replacement parts for controls, include the following information:

- The part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- The unit serial number, which is also on the nameplate

## **Engineering Services**

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

**Technical Support** is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

**Product Training** is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

**Field Service** engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: <u>www.woodward.com</u>.

## **Contacting Woodward's Support Organization**

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at <u>www.woodward.com/directory</u>, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in	Products Used in	Products Used in Industrial
Electrical Power Systems	Engine Systems	Turbomachinery Systems
Facility Phone Number	FacilityPhone Number	Facility Phone Number
Brazil+55 (19) 3708 4800	Brazil +55 (19) 3708 4800	Brazil +55 (19) 3708 4800
China +86 (512) 6762 6727	China +86 (512) 6762 6727	China +86 (512) 6762 6727
Germany:	Germany +49 (711) 78954-510	India+91 (124) 4399500
Kempen +49 (0) 21 52 14 51	India+91 (124) 4399500	Japan+81 (43) 213-2191
Stuttgart - +49 (711) 78954-510	Japan+81 (43) 213-2191	Korea+82 (51) 636-7080
India+91 (124) 4399500	Korea+82 (51) 636-7080	The Netherlands+31 (23) 5661111
Japan+81 (43) 213-2191	The Netherlands+31 (23) 5661111	Poland+48 12 295 13 00
Korea+82 (51) 636-7080	United States+1 (970) 482-5811	United States+1 (970) 482-5811
Poland+48 12 295 13 00		
United States+1 (970) 482-5811		

## **Technical Assistance**

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General	
Your Name	
Site Location	
Phone Number	
Fax Number	
Prime Mover Information	
Manufacturer	
Turbine Model Number	
Type of Fuel (gas, steam, etc.)	
Power Output Rating	
Application (power generation, marine, etc.)	
<b>Control/Governor Information</b>	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Symptoms	
Description	

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

# LQ6 Valve Specifications

Electrical Characteristics	
Input Voltage Range: Nominal Input Current Range	(18 to 32) V (dc)
(steady-state, maximum):	0.2 to 3 A
Maximum Continuous Input Current:	3 A
Maximum Transient Input Current:	/ A
Mechanical Characteristics	
Valve Geometric Areas Available:	$32.3 \text{ mm}^2$ (0.05 in <sup>2</sup> )
	96.8 mm <sup>2</sup> (0.15 in <sup>2</sup> )
Weight:	23.2 kg (51.2 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
Fuel Viscosity	Fuel viscosity must be between 0.5 and 12.0 centistokes.
Fuel Cleanliness	Liquid fuel must be filtered to limit particulate size to 20 $\mu$ m or smaller. Water and sediment must be limited to 0.1 % by volume. Total particulate concentration must be limited to
Ingress Protection	2.64 mg per liter of fuel. IP56 per IEC EN 60529
Pressure	
Operating Inlet Fuel Pressure Range:	(690 to 8274) kPa / (100 to 1200) psig / (6.9 to 83) bar
Proot Pressure: Burst Pressure:	12 411 kPa (1800 psig) 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
Shock:	Per US MIL-STD-810C, Method 516.2, Procedure I, (10g)
Flow Characteristics	
Accuracy:	The accuracy of the port scheduling is better than $\pm 5$ % of point for 0.1 US gal/min (0.4 L/min) to 1.5 US gal/min (5.7 L/min) and $\pm 3$ % for >1.5 US gal/min (5.7 L/min) at room temperature
Temperature Drift:	The maximum temperature drift for positional accuracy will be 0.05 % of
Common Mode Rejection:	full-scale input demand ((4 to 20) mA) per degree F (0.09 % per degree C). Maximum common mode error for positional accuracy will be 0.025 % of full-scale input demand per volt common mode. Common mode voltage being the average voltage at (4 to 20) mA inputs with respect to power supply ground.

# **Revision History**

#### Changes in Revision L—

- Updated Compliance Directives
- Updated Declarations

#### Changes in Revision K—

• Expanded information on use of electrolytic capacitor (page 11)

#### Changes in Revision J—

- Updated Regulatory Compliance information
- Updated Declaration

#### Changes in Revision H—

Updated fuel particulate concentration to 2.64 mg/L

#### Changes in Revision G—

• Updated Declaration

#### Changes in Revision F—

• Added Maximum Fuel Bypass Pressure to Specifications page

# Declarations

EU DECLARATION OF CONFORMITY		
EU DoC No.: Manufacturer's Name:	00160-04-EU-02-01 WOODWARD INC.	
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA	
Model Name(s)/Number(s):	LQ6 Fuel Metering Valves	
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres	
	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)	
Markings in addition to CE marking:	Category 2, Group II G, Ex d IIB T3 or Category 3 Group II G, Ex nA IIC T3 IP56	
Applicable Standards:	EN 60079-0, 2006: Electrical apparatus for explosive gas atmospheres – Part 0: General Requirements EN 60079-1, 2007: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'd' EN 60079-15, 2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n' EN 13463-1:2006; Non-electrical equipment for potentially explosive atmospheres, Part 1: Basic method and requirements EN 61000-6-4, 2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments	
Third Party Certification:	IECEx Zone 1 & 2: TUR 11.0014X ATEX Zone 1: TUV 13ATEX7404X ATEX Zone 2: TUV 13ATEX7409X ATEX Annex IV - Production Quality Assessment 01 220 113542	
Conformity Assessment:	TUV Rheinland Industrie Service GmbH (0035) Am Grauen Stein, D51105 Cologne	

This declaration of conformity is issued under the sole responsibility of the manufacturer We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

	MANUFACTURER	
	Signature	
	Christopher Perkins	
	Full Name	
	Engineering Manager	
	Position	
	Woodward, Fort Collins, CO, USA	
	Place	
	06-JUN-2016	
-	Date	

5-09-1183 Rev 26

DECLARATION OF INCORPORATION Of Partly Completed Machinery 2006/42/EC		
File name: Manufacturer's Name: Manufacturer's Address: Model Names:	00160-04-EU-02-03 WOODWARD INC. 1041 Woodward Way Fort Collins, CO 80524 USA LQ6 Liquid Fuel Metering Valves	
This product complies, where applicable, with the following Essential Requirements of Annex I:	1.1, 1.2, 1.3, 1.5, 1.6, 1.7	
The relevant technical documenta Woodward shall transmit relevant authorities. The method of transmi	ation is compiled in accordance with part B of Annex VII. information if required by a reasoned request by the national ittal shall be agreed upon by the applicable parties.	
The person authorized to compile the	he technical documentation:	
Name: Dominik Kania, M Address: Woodward Poland	anaging Director Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland	
This product must not be put into se has been declared in conformity wi	rvice until the final machinery into which it is to be incorporated th the provisions of this Directive, where appropriate.	
The undersigned hereby declares, Fort Collins, Colorado that the 2006/42/EC as partly completed ma	on behalf of Woodward Governor Company of Loveland and above referenced product is in conformity with Directive achinery:	
	MANUFACTURER	
Signature	Christopher Perkins	
Full Name	Engineering Manager	
Position	codward Inc. East Colling. CO. USA	
Place	oodward Inc., Fort Collins, CO, USA	
Date	06-JUN-4016	

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **26207**.





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Email and Website—<u>www.woodward.com</u>

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.