

Product Manual 40175 (Revision C) Original Instructions

GS3/LQ Valve Driver

Used with LQ3, LQ25, LQ25T, and LQ Bypass Liquid Valves with Single Speed Feedback Resolver

Installation and Operation Manual



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

Practice all plant and safety instructions and precautions.

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



Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual 26311, Revision Status & Distribution Restrictions of Woodward Technical Publications, on the publications page of the Woodward website:

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Proper Use

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.



If the cover of this publication states "Translation of the Original Instructions" please note:

Translated Publications

The original source of this publication may have been updated since this translation was made. Be sure to check manual 26311, Revision Status & Distribution Restrictions of Woodward Technical Publications, to verify whether this translation is up to date. Out-of-date translations are marked with . Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

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Warnings and Notices

Important Definitions



This is the safety alert symbol. It is 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.

MARNING

Overspeed /
Overtemperature /
Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

MARNING

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.



Start-up

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.



Automotive Applications On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

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NOTICE

Battery Charging Device To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- 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).
- Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.
- Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.

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.

Follow these precautions when working with or near the control.

- 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:

These listings are limited only to those units bearing the LCIE agency identification and the CE marking.

EMC Directive: Declared to 89/336/EEC COUNCIL DIRECTIVE of 03

May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

ATEX – Potentially Declared to 94/9/EEC COUNCIL DIRECTIVE of 23

March

Explosive 1994 on the approximation of the laws of the Member

States

Atmospheres concerning equipment and protective systems intended

for use

Directive: in potentially explosive atmospheres.

LCIE 01 ATEX 6012 X

Zone 2, Category 3, Group II G, EEx nC IIC T3

North American Compliance:

These listings are limited only to those units bearing the CSA agency identification.

CSA: CSA Certified Class I, Division 2, Groups A, B, C, and D

and Class I, Zone 2, Group IIC, T4A at 55 °C ambient.

For use in Canada and the United States

Certificate 160584-2500002243

Wiring must be in accordance with North American Class I, Division 2 or Zone 2, or European Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Special Conditions for Safe Use:

Field wiring must be suitable for at least 90 °C and 10 °C above the maximum fluid and ambient temperatures.

The driver must be mounted within an enclosure that ensures an IP54 protection degree per EN 60529 required by the European Standard EN 60079-15.

The GS3/LQ driver is designed for use with the LQ3, LQ25, LQ25T, or LQ Bypass valves. The drivers for the Woodward GS10 and GS25 Gas Fuel Valves cannot be used with the LQ3/25.

Connect ground terminals to earth ground. The actuator and driver earth grounds are to be the same grounding system.

This equipment is to be connected to a Class 1 circuit only.

Resolver wiring is non-incendive and may be installed in accordance with wiring methods suitable for ordinary locations.

Torque driver terminal block wiring to 7–9 N·m (5–7 lb-ft).

Replace the fuses in the drivers with 30 A, 32 V fuses only.

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MARNING

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.

AVERTISSEMENT

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.

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Chapter 1. General Information

Introduction

The GS3/LQ Valve Driver is an integrated liquid fuel metering system which features; valve position control, all electric actuation, fuel bypass, fuel flow regulation, and fault indication.

The GS3/LQ Valve Driver controls the valve/actuator position proportional to a 4–20 mA input signal. The driver also provides fault indication and Remote Shutdown/Reset functions. The driver requires power from a 18–32 Vdc power supply.

The accompanying valve/actuator assembly is a brushless dc limited angle torquer which positions a valve for liquid fuel flow control. The actuator is directly coupled to both the valve metering port and position feedback resolver. There are no intervening gears, linkages, or flex couplings. See the appropriate manual for the valve/actuator.

Figure 1-1 shows the GS3/LQ Valve Driver outline drawing. Figures 1-2, 1-3, and 1-4 are the Control Wiring Diagrams. Refer to the valve manuals for detailed valve information.



Turbine stability and response are set by the controlling device, not by the GS3/LQ driver and valve/actuator. Follow the instructions for the controlling device while setting up the turbine control system. Failure to follow instructions can cause personal injury and/or property damage.

Connections to the GS3/LQ Driver

The GS3/LQ Driver has the following connections to customer-supplied equipment:

Earth Ground

Power Input
 18-32 Vdc measured at the driver,

3-5 mm² (10-12 AWG) wire

Demand Input
 Position Feedback Output
 4-20 mA, shielded twisted pair
 4-20 mA, shielded twisted pair

Remote Shutdown/Reset Contact Input

Close contact for normal operation. Open contact to command valve to minimum fuel and reset faults.

Driver Fault Contact Output

Closed indicates normal operation.

Open indicates a fault in the driver or valve.

The GS3/LQ Driver has the following connections to the valve/actuator. Cable length must be 60 meters or less.

Power Output (4) 3 mm² (12 AWG) wires

IMPORTANT

If the power cable between the driver and valve is less than 10 m long, two (2) 3 mm² (12 AWG) wires may be used.



As an alternative to three shielded twisted pairs, a single shielded cable with six twisted conductors may be used to make resolver connections.

- DIMENSIONS IN INCHES WITH MILLIMETERS SHOWN IN PARENTHESIS.
 RECOMMENDED MOUNTIN DIMENSIONS FOR
- #8 HARDWARE

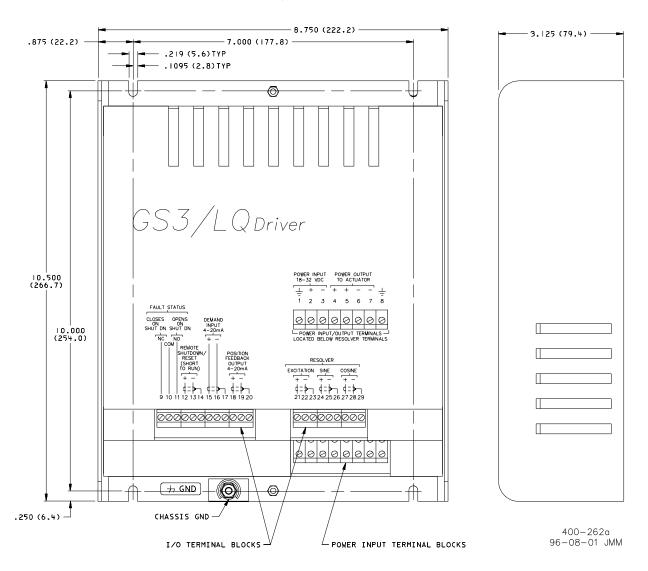
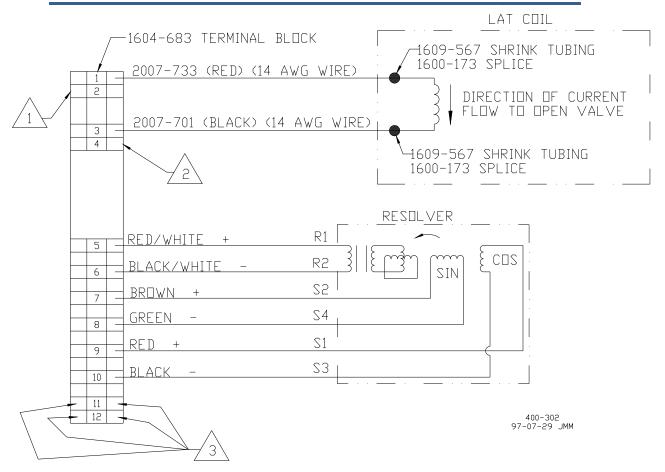


Figure 1-1. GS3/LQ Driver Outline Drawing





- 1. Positions 1/2 are connected together with an internal jumper.
- 2. Positions 3/4 are connected together with an internal jumper.
- 3. Positions 11/12 are to be used for customer ground connection and also used as extra termination ends.

Figure 1-2. LQ3 Valve Wiring Diagram

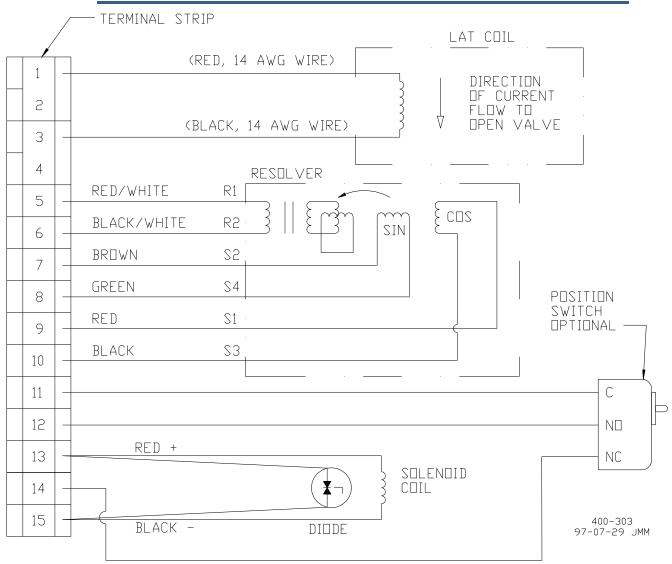


Figure 1-3. LQ25 Valve Wiring Diagram

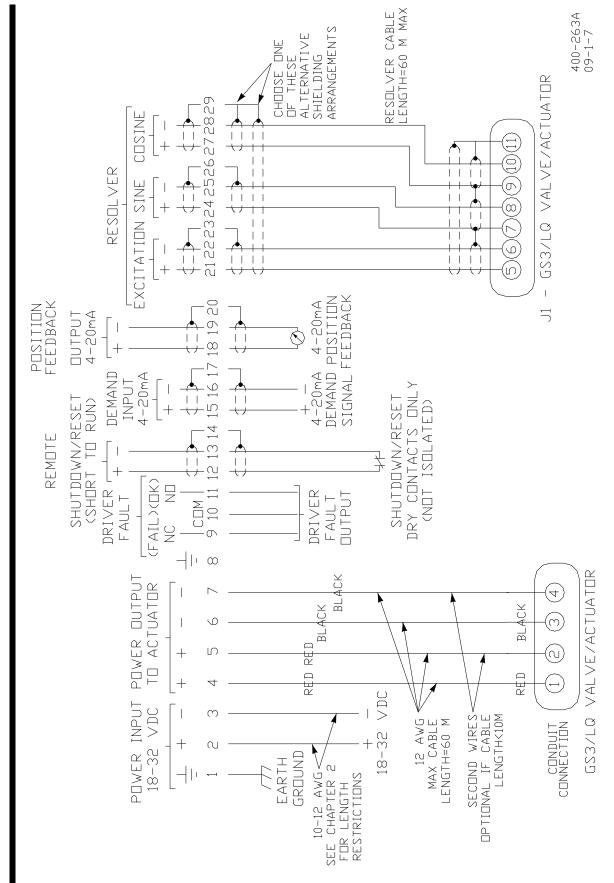


Figure 1-4. Control Wiring Diagram

Chapter 2. Installation

Unpacking

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

Mounting

The driver is designed to operate within a temperature range of -20 to +55 °C (-4 to +131 °F).

To meet European Zone 2 requirements, the driver must be mounted within an enclosure that ensures an IP54 protection degree per EN 60529. Mount the driver in a location with space for adjustment and wiring access. Do not expose the driver to sources of radiant heat.

Mount the driver close enough to the valve and the driver power supply to meet wire length requirements. The cable between the driver and the valve must be no longer than 60 m (197 ft). The cable between the driver power supply and the driver must be short enough to assure that the voltage at the input to the driver does not drop below 18.0 Vdc, with a current of 20 A. Steady state current stays below 4 A, but current peaks can reach 20 A when the valve is moving at high slew rates. More information is provided later in this chapter.

Since the driver will generate heat all surfaces except the mounting surface must be open to normal air movement. No forced air ventilation is required.

Ideally, the driver should be mounted flush to the metal side of a control cabinet, protected from the weather and high humidity, and close to the turbine being controlled. Do not install the driver directly on the turbine. The location should provide protection from vibration, high-voltage or high-current devices, and devices which produce electromagnetic interference. During normal operation, access to the driver will not be required.

Connections

The valve/actuators must be connected to the GS3/LQ Driver. The GS10 and GS25 drivers cannot be used. Each valve requires its own separate driver. Valves and drivers of suitable type may be used interchangeably; they are not a matched set.

Wiring for the driver power input and power output to the actuator must be suitable for at least 90 °C.

This equipment is to be connected to a Class 1 circuit only.

Resolver wiring is non-incendive and may be installed in accordance with wiring methods suitable for ordinary locations.

Torque driver terminal block wiring to 7–9 N⋅m (5–7 lb-ft).

Connect ground terminal of driver to earth ground. Connect ground terminal of actuator to earth ground. The two earth grounds are to be the same grounding system.

Replace the fuses in the drivers with 30 A, 32 V fuses only.



EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.



RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

External wiring connections and shielding requirements for a typical control installation are shown in the control wiring diagram (see Figure 1-2).

Input voltage is 18–32 Vdc, measured at the driver input. Input current is typically less than 2.0 A, but momentary current peaks can reach 20 A during large, fast transients, such as when a shutdown command is issued to the driver. For proper operation of the valve and driver, the driver power supply cable must be sized so that the voltage at the input to the driver does not drop below 18.0 Vdc if 20 A are required. Recommended wire sizes for the power cable are 5 mm² or 10 AWG. The power cable from the driver power supply to the driver must be as short as possible, and must be a direct connection back to the driver power supply, not shared by other equipment. 3 mm² (12 AWG) wire may be used if the voltage at the input to the driver does not drop below 18.0 Vdc with the peak current of 20 A flowing. Voltages less than 18 Vdc may severely degrade valve performance. Voltages less than 14 Vdc may cause a driver fault and command the valve/actuator to minimum position.



Here is an example of calculating the effect of a certain wire length: 5 mm² (10 AWG) wire has a resistance of 3.3 m Ω /m (1.0 m Ω /ft) at room temperature. If the length of 5 mm² (10 AWG) cable between the driver and the battery is 20 m (66 ft), the total wire resistance in both directions is 0.13 Ω . The resistance of circuit breakers should be added to the wire resistance. With 20 A flowing, the voltage drop in this cable is 0.13 Ω * 20 A = 2.6 V. Neglecting the effects of circuit breaker resistance, the battery voltage must not drop below 20.6 V to guarantee 18.0 V at the driver.

The cable length from the driver to the actuator must be no longer than 60 m (197 ft). Use four (4) 3 mm² or 12 AWG wires, two red and two black. If the length of this cable is less than 10 m (32.8 ft), then two (2) 3 mm² or 12 AWG wires, one red and one black, may be used.

The valve/actuator has a third lead wire (green) which must be connected to earth ground. This may be connected to the terminal provided on the driver (TB1-8) or more directly to earth ground near the valve. The earth connections on both the valve and the driver must be connected to the same earth grounding system.

The driver includes two 30 A slow-blow fuses on the input wires. The size of any circuit breaker used in the power wiring must be selected according to local codes. A minimum rating of 20 A is recommended. To avoid nuisance trips, a time-delay or slow-blow circuit breaker is recommended.

Shielded Wiring

All shielded cable must be twisted conductor pairs with either a foil or a braided shield. All signal lines should be shielded to prevent picking up stray signals from nearby equipment. Connect the shields as shown in the Plant Wiring Diagram (Figure 1-2). Wire exposed beyond the shield must be as short as possible.

All wiring shields in the GS3/LQ Driver are connected to earth ground. For best noise immunity, also connect the other end of all shields to earth ground.

NOTICE

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 shields to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 1-2).

For best noise immunity, run power wires and shielded signal wires in separate conduits or cable trays. See Woodward manual 50532, *EMI Control for Electronic Governing Systems*, for more information.

Installations with severe electromagnetic interference (EMI) may require shielded cable run in conduit, double shielded wire, or other precautions. Contact Woodward for more information.

Driver Adjustments

The GS3/LQ driver and accompanying valve are fully calibrated at the factory, and contain no user-accessible adjustments. Minimum flow is set by the control mA.

Unpacking

Use care when unpacking the driver and valve/actuator. Abuse can damage seals, installation surfaces, and factory adjustments. Notify the shipper and Woodward if damage is found.

Connections to the Valve/Actuator

Make electrical connections between the valve and driver according to the plant wiring (Figure 1-2). Wiring between the valve and driver must be suitable for at least 90 °C.

The electrical connections and valve function can be checked by providing an adjustable 4–20 mA signal to the GS3/LQ Driver. Monitor the 4–20 mA position feedback signal from the electronic driver and validate that the feedback signal follows demand.

Cables between the driver and the actuator may be no longer than 60 m (197 ft).

These cables make the following connections:

 Actuator power—four 3 mm² (12 AWG) wires, 2 for positive and 2 for negative. (For cable lengths of less than 10 m, two 3 mm² (12 AWG) wires may be used, 1 for positive and 1 for negative.)

 The optional shutoff valve and position switch in the LQ25 are not connected to the GS3/LQ Driver. They must be wired to the turbine control system directly.

Resolver Wire Requirements

- Wire used for the resolver must be three shielded twisted pairs or one shielded twisted six-conductor cable.
- Wire Type: 15 pF/ft (49 pF/m) or maximum total capacitance of the total wire length should be less than 5 nF
- Maximum wire length: 60 m (197 ft)
- Wire Gauge Range: 16–20 AWG (0.5 to 1.3 mm²)
- Resolver cable must be run separately from the motor cable to avoid coupling between the high voltage switching drive signal and the low level resolver feedback signals.



Turbine manufacturer's requirements for fuel flow to the turbine can vary considerably depending on fuel pressures, fuel types, fuel and ambient temperatures, turbine size, etc. Contact Woodward for information on predicting fuel flow through the valve as a function of command input signal from the driver. This fuel flow information may be critical to the proper operation of your gas turbine and may be required information for the electronic control system to accelerate and/or decelerate the turbine properly.

Chapter 3. Description of Operation

GS3/LQ Driver

Demand Input

The position demand input signal is 4–20 mA. The actual valve positions corresponding to the 4 mA and 20 mA are beyond the fully closed and max rated port area positions, respectively. The max mechanical stop is located above the 20 mA position. The max rated port area is exceeded at the max mechanical stop position.

The position demand input is electrically isolated (up to 500 Vdc) from earth ground and the input power potential.

The demand signal connections include a shield connection tied to earth ground. Use of a shielded twisted pair is recommended. See cautionary note in next section.

Position Feedback Output

The driver provides a position output signal that reflects the actual position of the valve as reported by the resolver. The feedback signal is 4–20 mA and reflects the same scaling as set for the demand signal. During normal steady state operation, the position feedback will be the same as the demand input signal within 0.2 mA (1%).

The driver continuously compares the demanded valve position with the actual position. If the difference between these signals is greater than 5% of full scale (0.8 mA) for more than 250 ms, the driver will force the valve shut and signal a fault.

If a problem exists in the resolver wiring or other circuitry the Driver Fault output will indicate that a problem exists and the driver will command the valve to the minimum position while the problem exists..

The position feedback output is electrically isolated (up to 500 Vdc) from earth ground, input power, and all other control connections. This isolation permits the signal to be connected to a meter or to a control system, as needed.

The position feedback connections include a shield connection tied to earth ground. Use of a shielded twisted pair is recommended.

NOTICE

On some control systems, the shield connection for analog outputs and inputs may be tied to circuit common, or "instrument ground." If a cable shield connects circuit common (at the control end) to earth ground (at the driver end), this will eliminate the isolation of the control system, and may cause control malfunctions. For best immunity from influences by RF interference, the shield should be terminated to earth ground on both ends of the cable.

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Driver Fault Output

The GS3/LQ Driver provides one status output to show that the driver and actuator are functioning normally.

This connection is a relay contact, rated for 2 A resistive at 28 Vdc. The relay is energized to show OK status and is de-energized to indicate a fault or shutdown status.

Three connections (NO-Com-NC) are provided.

Remote Shutdown/Reset Inputs

The Remote Shutdown/Reset input is provided for connection to a relay or other dry contact. When shorted, 10–20 mA of current will run through the contact.

When this input is shorted, the driver is in normal run mode. If a fault occurs in the driver, the driver will shut off and de-energize the driver fault relay. To reset this fault, open the Shutdown/Reset input and close it again.

When the Shutdown/Reset input is opened, the driver will reset any fault latches and drive the valve to minimum fuel. When the Shutdown/Reset input is closed again, after a delay of approximately 0.5 seconds, the driver will return the valve to the position requested by the demand input, unless a fault still exists which prohibits the unit from functioning.

It is not necessary to connect a switch or contact to the Shutdown/Reset input, but the input must be shorted to enable the driver to open the valve. If the Shutdown/ Reset input is shorted and a fault occurs, cycling power to the driver may be used to reset the fault.

Fault Detection

Most faults which may occur with the GS3/LQ Driver, actuator/valve, resolver, or intervening wiring will be detected by the driver. If possible in the fault state, the actuator will be moved to its minimum stop to shut off the fuel flow. The driver fault output will indicate the presence of a fault, and this signal must be used to engage auxiliary shutdown valves.



The valve may not return to minimum fuel for all faults.

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

In the fault descriptions below, when the driver detects a fault, it "signals the fault" by de-energizing the Driver Fault output. In all cases, the driver can be restored to normal operation by first correcting all faults, and then opening and closing the Shutdown/Reset input.

• Shutdown/Reset input open—Although this is not a fault, the GS3/LQ Driver de-energizes the Driver Fault output when the Shutdown/ Reset is in the open (Shutdown) state. After the Shutdown/Reset input is closed again, the driver waits for approximately 0.5 second; then, if no faults are present, the Driver Fault output is energized to indicate OK state.

- Input power voltage too low—If the driver does not have enough input voltage to run its logic and control circuits, it will signal a fault and attempt to close the valve. This situation may not be detected unless the input voltage is extremely low (approximately 12 V). In the region between 12 V and 18 V, the dynamic performance of the valve and driver is reduced, which may affect the dynamics of the prime mover system. Low input voltage must be avoided by using power wires large enough and short enough that the driver input voltage always stays above 18 V, even with a peak current of 20 A flowing. Guidelines to size wire are given in Chapter 2.
- Input power voltage too high—Surges and transients of typical duration (50 ms or less) will be absorbed by components in the driver without damage. However, prolonged operation above 32 V input voltage will damage the driver.
- **Demand signal < 4 mA or reversed polarity**—This situation is not detected as a fault by the driver. Any demand signal of less than 4 mA will cause the driver to fully close the valve.
- Demand signal > 20 mA—When the driver detects this situation, it signals
 a fault and shuts down the valve. The trip point is approximately 23.5 mA.
 Note that if the demand signal exceeds ± 25.0 mA for a prolonged period,
 the burden resistor in the driver could be damaged.
- Actuator power wire open—The driver can not perform a continuity check
 on these wires. If this circuit opens either in the actuator or in the cable, the
 actuator will lose power and will remain in the last operating position. If the
 demand signal then changes, the driver will detect an error between
 demanded and actual valve position and will signal the fault.
- Actuator power wires shorted—In the event of a short circuit, the driver
 will turn off all current drive to the actuator and will signal a fault. In this
 state, the actuator will remain in the last operating position. The driver
 should not be damaged by a short circuit, and will resume normal operation
 after the short is removed and the driver is reset.
- Actuator wiring ground fault—The driver continuously looks for unbalanced current in the actuator power wires. This could happen if the wires become shorted to earth, or to the positive or negative battery terminals. In this event, the driver will turn off all current drive to the actuator and will signal a fault. The actuator will stay in position. The driver should not be damaged by a ground fault, and will resume normal operation after the fault is removed and the driver is reset.
- Resolver wiring open, shorted, or backwards—The driver monitors all three resolver windings for opens, short circuits or reversed polarity. In any of these situations, the driver will force the valve shut and signal a fault. The position feedback output will not be accurate while this problem exists.

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Valve position error—The driver continuously compares the demanded valve position with the actual position. If the difference between these signals is greater than 5% of full scale (0.8 mA) for more than 250 ms, the driver will force the valve shut and signal a fault. If the situation is caused because the valve is mechanically jammed by some obstruction, the valve may not be able to clear the obstruction or to fully close until the obstruction is removed.

Resetting after a Fault

After a fault occurs, and the driver fault relay is de-energized, first clear the cause of the fault; then open and close the Remote Shutdown/Reset input to restore normal operation of the driver. Alternatively, if the Remote Shutdown/Reset input is not used and is always shorted, return the demand signal to 4 ma and cycle the input power off and on to reset the driver.

If the driver does not reset by energizing the driver fault relay, the cause of the fault may still be present. See the troubleshooting information in Chapter 4 for more information.

LQ25 Valve Options

Actuator Voltage Requirements

 With 18–32 Vdc supplied to the final driver, the maximum voltage at the actuator must be 15–30 Vdc.

Actuator Current from GS3/LQ Driver

- 2 A max expected steady state
- Transient current may go up to 20 A with maximum of 20% duty cycle
- Duty Cycle: 0–100%

Chapter 4. Troubleshooting

Diagnostics

The GS3/LQ Driver continuously monitors the fuel metering system operation. Many types of problems with the driver, valve, or cabling will be automatically detected by the driver. If a fault is detected, the driver will shut the valve and denergize the Driver Fault relay output.



The valve may not fail shut in every situation. If the driver is unable to shut the valve in a fault situation, the valve will stay open. For safe turbine operation in fault situations, the valve must be used in conjunction with additional high speed shutoff valve(s) and the driver fault relay tied into the engine protection system.

Chapter 3 contains a description of many types of problems which could affect the operation of the GS3/LQ Driver and valve, under the heading "Fault Detection." Each type of problem is discussed along with the action the driver and valve will take in that situation. Being familiar with this information will help you to identify the cause of any unexpected problem.

Troubleshooting

This troubleshooting section does not give the certain cause of any problem. Neither does it cover all possible problems, nor all possible causes of any problem. This section will not enable a technician to locate a faulty component in the GS3/LQ Driver or valve.

When the results of these procedures indicate that the driver or valve may be faulty, replace the suspected unit with a driver or valve known to be good to verify that the cause of the problem is in the driver or valve.

If, after following these troubleshooting procedures, you are unable to find the cause of a problem and repair it, contact the Woodward Governor Company for assistance.

When trouble occurs, use Figure 4-1, the Troubleshooting Flowchart, as a guide to locate and repair the problem.

Follow the flow chart down from the title block to the next block. Rectangular boxes contain suggestions on where to look for a problem. Diamond-shaped boxes ask you questions based on the information you have gathered. The answer to that question will guide you to the next step in the troubleshooting procedure.

By following the flowchart, you should be able to identify and correct most problems which may occur with the valve and driver.

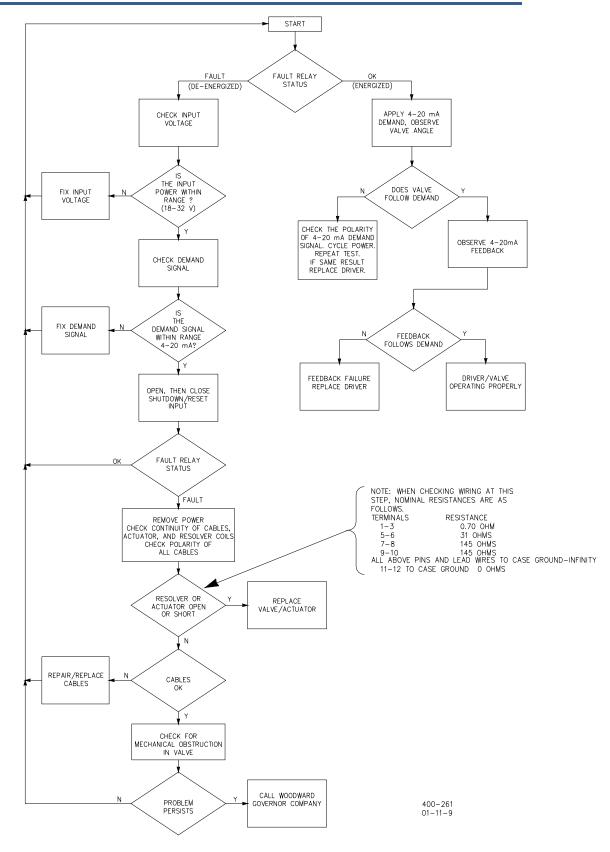


Figure 4-1. Troubleshooting Flow Chart

Chapter 5. Service Options

Product Service 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 and 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 Engine Retrofitter (RER) is an independent company that
 does retrofits and upgrades on reciprocating gas engines and dual-fuel
 conversions, and can provide the full line of Woodward systems and
 components for the retrofits and overhauls, emission compliance upgrades,
 long term service contracts, emergency repairs, etc.
- 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.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Manual 40175 GS3/LQ Valve Driver

Woodward Factory Servicing 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

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 "likenew" 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: www.woodward.com.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems FacilityPhone Number	Engine Systems FacilityPhone Number	Turbine Systems FacilityPhone 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+49 (0) 21 52 14 51	Germany+49 (711) 78954-510	India+91 (129) 4097100
India+91 (129) 4097100	India+91 (129) 4097100	Japan+81 (43) 213-2191
Japan+81 (43) 213-2191	Japan+81 (43) 213-2191	Korea+82 (51) 636-7080
Korea+82 (51) 636-7080	Korea+82 (51) 636-7080	The Netherlands - +31 (23) 5661111
Poland+48 12 295 13 00	The Netherlands - +31 (23) 5661111	Poland+48 12 295 13 00
United States +1 (970) 482-5811	United States +1 (970) 482-5811	United States +1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Woodward Part Number & Rev. Letter Control Description or Governor Type	
Control Description or Governor Type	
Control Description or Governor Type Serial Number	
Control Description or Governor Type Serial Number Control/Governor #2	
Control Description or Governor Type Serial Number Control/Governor #2 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	
Control Description or Governor Type Serial Number Control/Governor #2 Woodward Part Number & Rev. Letter Control Description or Governor Type Serial Number	
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	

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.

Declarations

DECLARATION OF CONFORMITY

According to EN 45014

Manufacturer's Name: WOODWARD GOVERNOR COMPANY (WGC)

Industrial Controls Group

Manufacturer's Address: 1000 E. Drake Rd.

Fort Collins, CO, USA, 80525

Model Name(s)/Number(s): GS3 and GS10 Drivers, p/n's 9907-135, 9907-186 and similar

Conformance to Directive(s): 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the

approximation of the laws of the Member States relating to electromagnetic compatibility as amended by 92/31/EEC and

93/68/EEC.

94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially

explosive atmospheres

Applicable Standards: EN50081-2, August 1993: EMC Generic Emissions Standard, Part 2:

Industrial Environment

EN50082-2, March 1995: EMC Compatibility - Generic Standards for

Industrial Environment

EN50021, 1999: Electrical apparatus for potentially explosive

atmospheres - Type of protection 'n'

3rd Party Certification: LCIE 01 ATEX 6012 to Standard EN50021

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Full Name

Jennifer R. Williams

Position

Engineering Manager

Place

WGC, Fort Collins, CO, USA

Date

3-12-01

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 40175C.





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Email and Website—www.woodward.com

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.