WOODWARD

Product Manual 26514
(Revision AA, 10/2025)
Original Instructions

GS16
Gas Metering System

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

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. The latest version of most publications is available on the Woodward website.

Woodward Industrial Support: Get Help

If your publication is not there, please contact your customer service representative to get the latest copy.

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.

Translated Publications

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

The original source of this publication may have been updated since this translation was made. The latest version of most publications is available on the Woodward website.

Woodward Industrial Support: Get Help

Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

If your publication is not on the Woodward website, please contact your customer service representative to get the latest copy.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 26514

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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.

⚠WARNING

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.

⚠WARNING

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.

⚠WARNING

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.

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.

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, as 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. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

Regulatory Compliance

European Compliance for CE Marking:

EMC Directive: Declared to 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).

Pressure Equipment Directive (Valve Assembly): Directive 2014/68/EU on the harmonisation of the laws of the Member States relating to making pressure equipment available on the market.
PED Category II
PED Module H – Full Quality Assurance

ATEX – Potentially Explosive Atmospheres Directive: 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.
Zone 1: II 2 G, Ex db IIB T3 Gb, TUV 13ATEX7404X
Zone 2: II 3 G, Ex ec IIC T3 Gc, TUV 13ATEX7409X

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

ATEX: Exempt from the non-electrical portion of the ATEX Directive 2014/34/EU due to no potential ignition sources per EN ISO 80079-36:2016 for Zone 1 installation.

RoHS Directive: Restriction of Hazardous Substances 2011/65/EU:
Woodward Turbomachinery Systems products are intended exclusively for sale and use only as a part of Large-Scale Fixed Installations per the meaning of Art.2.4(e) of directive 2011/65/EU. This fulfills the requirements stated in Art.2.4(c) and as such the product is excluded from the scope of RoHS2.

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.

IECEx: Certified for use in Hazardous Locations
Ex db IIB T3 Gb or Ex ec IIC T3 Gc IECEx TUR 11.0014X

CCCx: **GS:** Gas Metering Valve
气体计量阀

6: 6,000 lbs. per hour flow rate
流速为 6,000 磅/小时

16: 16,000 lbs. per hour flow rate
流速为 16,000 磅/小时

FS: Fail-Safe Return Spring
故障安全复位弹簧

DR: Dual Resolver
双分解器

HP: High Pressure
高压

See additional certification information after the Declarations section of this manual.

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 USA and Canada Certificate 160584-1214202

Wiring must be in accordance with North American Class I, Division 1 or 2, or European Zone 1 or 2, Category 2 or 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Special Conditions for Safe Use

Field wiring for the GS16 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 hazardous locations.

Connect the ground terminal of the GS16 valve to earth ground for proper safety and EMC performance.

The RS-232/-485 interface must not be used in hazardous locations unless the area is known to be non-hazardous.
Only certified cable glands, plugs, or conduit entries, which are sufficient for the explosion protection, shall be used.

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.

⚠WARNING

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

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

⚠AVERTISSEMENT

Risque d'explosion—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

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

⚠WARNING

Due to typical noise levels in turbine environments, wear hearing protection when working on or around the GS16 valve.

⚠WARNING

The surface of this product can become hot 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.

NOTICE

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

Chapter 1.
General Information

Information

The GS16 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 spherical fuel-metering element, exposing the port effective area proportional to flow. The metering element is designed to promote self-cleaning by a shear-type action created by the spherical element and shoe. Position feedback is achieved using one resolver (Dual Resolver option not available in this configuration). The resolver is directly coupled to the fuel-metering element, thus eliminating the need for couplings or gear trains and their associated inaccuracies.

Connections to the GS16 valve

The GS16 valve has the following electrical connections. See Chapter 2 for additional details on installation.

Table 1-1. GS16 Electrical Connections

Earth Ground	Provided through ground lug on housing
Power Input	18–32 VDC measured at the GS16 valve
Analog Input	4–20 mA position command signal
CAN Network	DeviceNet position, status, and limited configuration
Analog Output	4–20 mA output proportional to valve position
Shutdown Input	Relay or dry contact inputs for valve shutdown/reset
Status Output	Solid state relay output for shutdown states

The GS16 valve has one RS-232 service port for program upgrades by qualified service personnel.

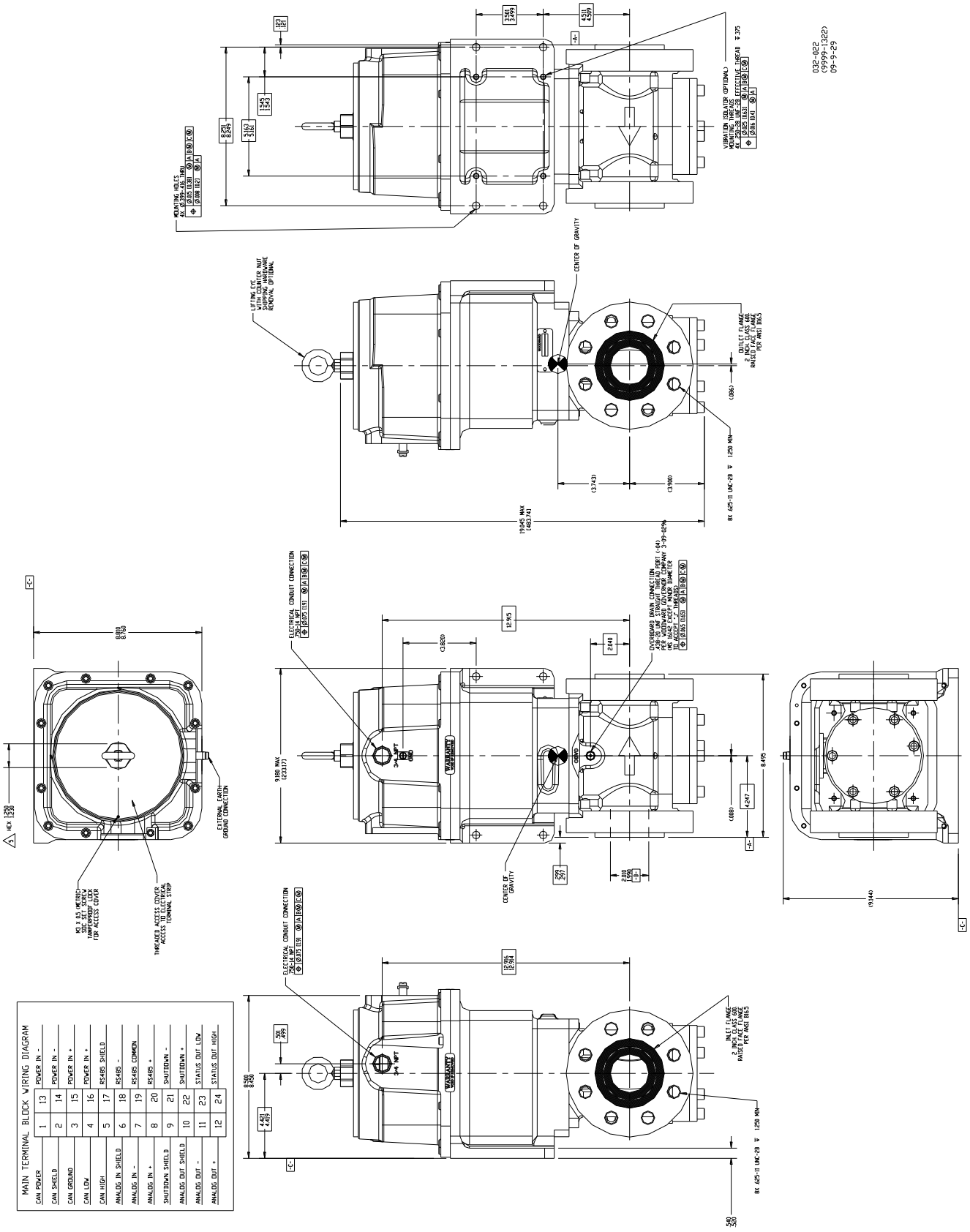


Figure 1-1. GS16 Valve Outline Drawing (Standard Valve; Dual Conduit)
(dimensions shown are in inches)

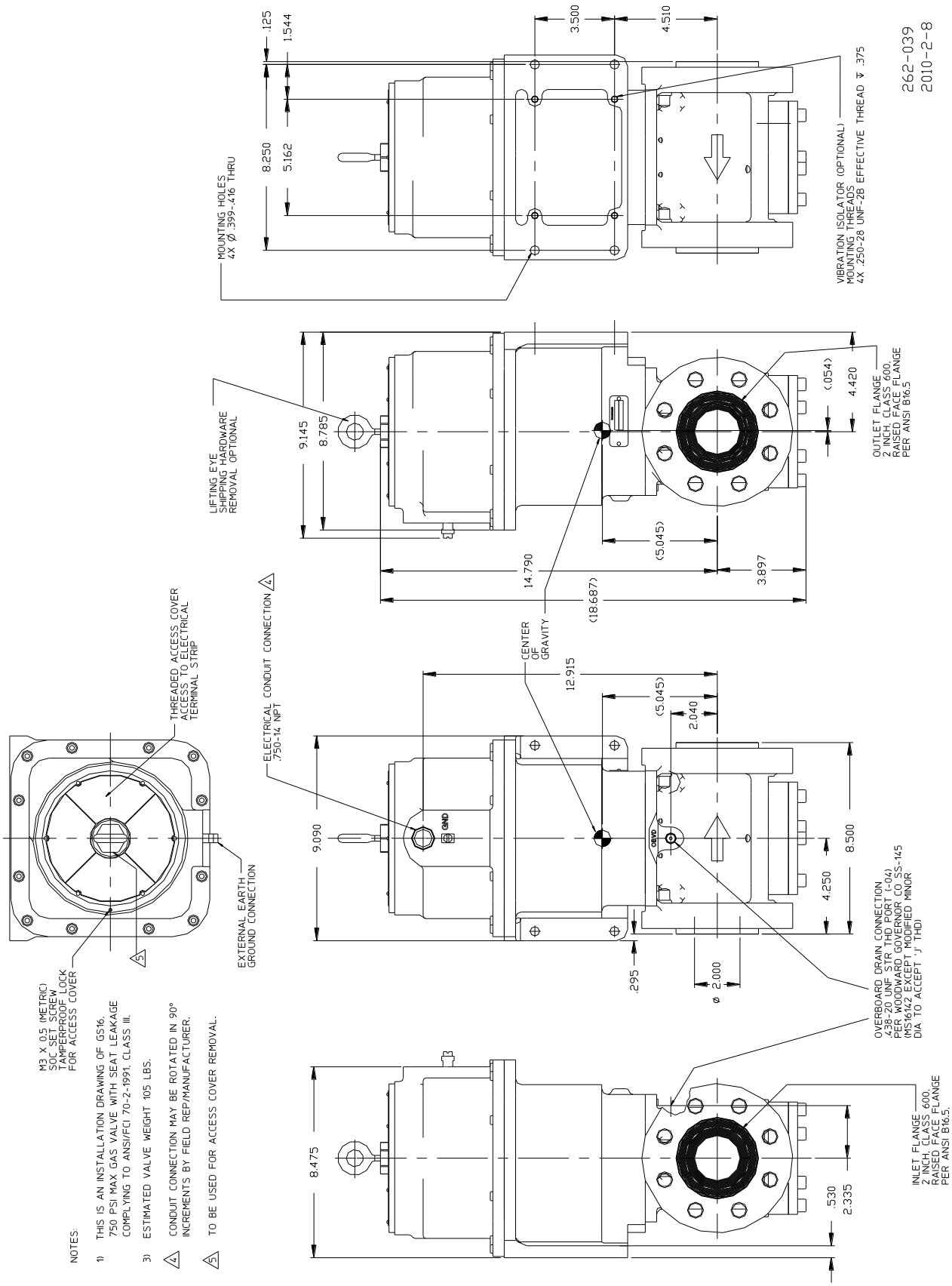


Figure 1-2. GS16 Valve Outline Drawing (Standard Valve; Single Conduit)
(dimensions shown are in inches)

Chapter 2.
Installation

Introduction

WARNING

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

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

WARNING

The GS16 valve weighs 48 kg (105 lb). To prevent injury, use the supplied lifting eye for lifting assistance.

WARNING

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the GS16 valve.

WARNING

The surface of this product can become hot 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.

NOTICE

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

Be careful when unpacking the GS16 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.

Mounting

The GS16 valve is designed to operate within a temperature range of –40 to +93 °C (–40 to +200 °F) with a gaseous fuel flow temperature of –40 to +93 °C (–40 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).

NOTICE

Pressures exceeding 10 psid (69 kPa) on the OBVD port will result in internal seal damage to the valve, resulting in excessive OBVD leakage. This leakage will change the flow accuracy of the valve.

Mount the GS16 onto a flat plate with 0.375 size bolts or mounted directly to the piping system using the 2.0-inch (50.8-mm) ANSI flanges. Consider the strength of the mounting plate or piping system to support the 48 kg (105 lb) weight of the GS16.

If mounted to a flat plate, maintain proper alignment of the mounting plate to the piping flanges to prevent binding loads on the GS16 body.

Woodward designed the mounting interfaces of the GS16 to support only the weight of the valve itself. Failure to properly support components (piping, valves, etc.) mounted to the GS16 can result in binding loads on the GS16 body and may adversely affect valve performance.

The inlet piping of the GS16 valve must be in accordance with ANSI/ISA-S75.02 as required for flow metering accuracy. Figure 2-1 summarizes these requirements.

WARNING

EXPLOSION HAZARD—Leak check all gaseous fuel connections. Leaking gaseous fuel can cause explosion hazards, property damage, or loss of life.

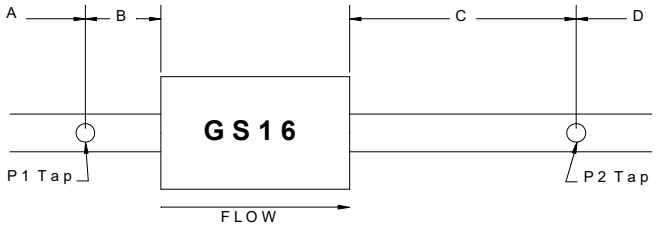


Figure 2-1. Piping Requirements

Dimensions should be:

A At least 18 nominal pipe diameters of straight pipe (36.0 inch/915 mm) [may be reduced to 8 nominal pipe diameters (16 inch/407 mm] if straightening vanes are used)
B 2 nominal pipe diameters of straight pipe (4.0 inch/102 mm)
C 6 nominal pipe diameters of straight pipe (12.0 inch/305 mm)
D At least 1 nominal pipe diameter of straight pipe (2.0 inch/51 mm)

Electrical Connections

WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed, misfire, and detonation detection shutdown device(s) that operate completely independent of the prime mover control device(s). This is 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.

WARNING

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

WARNING

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

⚠WARNING

For Zone 1 / Division 1 products: Proper torque is critical to ensure that the unit is sealed properly.

A conduit seal must be installed within 457 mm (18 inches) of the conduit entry when the GS16 is used in Class I, Division 1 hazardous locations.

NOTICE

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 diagrams (Figure 2-3).

Connect the GS16 valve to the engine control system by the main terminal block connector. Field wiring for the GS16 valve power input must be suitable for at least 103 °C.

The current-design GS16 valve has two ¾"-NPT conduit entries. If an entry is not used for wiring, it must be plugged when the valve is installed. For valves installed in hazardous locations, unused conduit entries must be plugged with certified stopping plugs. Use plugs sized for a 3/4" – 14 NPT conduit entry that meet the ambient temperature range of the product.

Class I, Division 1, and Zone 1 hazardous areas require plugs with specific certifications. In North America, the plug must be certified or listed for use in a Class I, Division 1, Groups C and D area. For European installations, an Ex d stopping plug certified for Zone 1, Category 2, Group II G, Ex d IIB must be used. Follow all manufacturer's installation instructions to ensure proper plug installation that meets the hazardous area requirements. Readapt Ltd part number PD-U-3-0-30-00 may be used in North American installations and Readapt Ltd part number PA-D-3-0-30-00 may be used in European installations.

For valves installed in Class I, Division 2, or Zone 2 areas, the stopping plug must meet installation requirements based on the jurisdiction with authority. For European Zone 2 units, the plug must provide a minimum ingress protection value of IP66 and may only be removed with the aid of a tool. Ensure that plugs or glands are properly torqued during installation.

Use of a cable gland or stopping plug that does not meet the hazardous area certification requirements or thread form or size will invalidate the suitability of the valve for hazardous locations.

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the cover and actuator joint surfaces for damage or contamination.

Terminals are spring-loaded type, accepting wire size from 0.08 to 3.0 mm² (28 to 12 AWG). Recommended wire sizes are 3.0 mm² (12 AWG) for Power In (+) and (–) and 1.0 mm² (16 AWG) for other signals. Refer to Figures 2-3 and 2-4, and to the description below, for GS16 wiring requirements.

Use terminal blocks on all GS16 valves. These terminal blocks are top load, cage clamp style, and are actuated by inserting a DIN 5264 screwdriver into the opening behind the wire slot. Once the cage clamp has been opened, the wire can be inserted and the screwdriver removed. Please see the illustration and instructions below:

- Insert the screwdriver into the operating slot up to the stop.
- The screwdriver blade holds the clamping spring open automatically so that the conductor can be introduced into the clamping unit.
- The screwdriver is withdrawn. The conductor is automatically clamped.

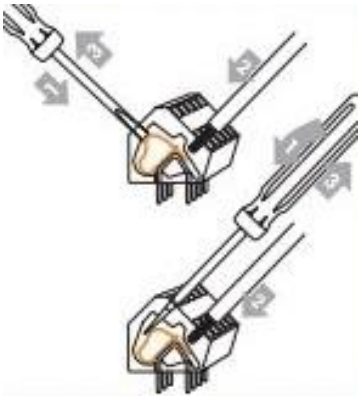


Figure 2-2. WAGO Terminal Block

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 +

Figure 2-3. GS16 Terminal Block Wiring Diagram

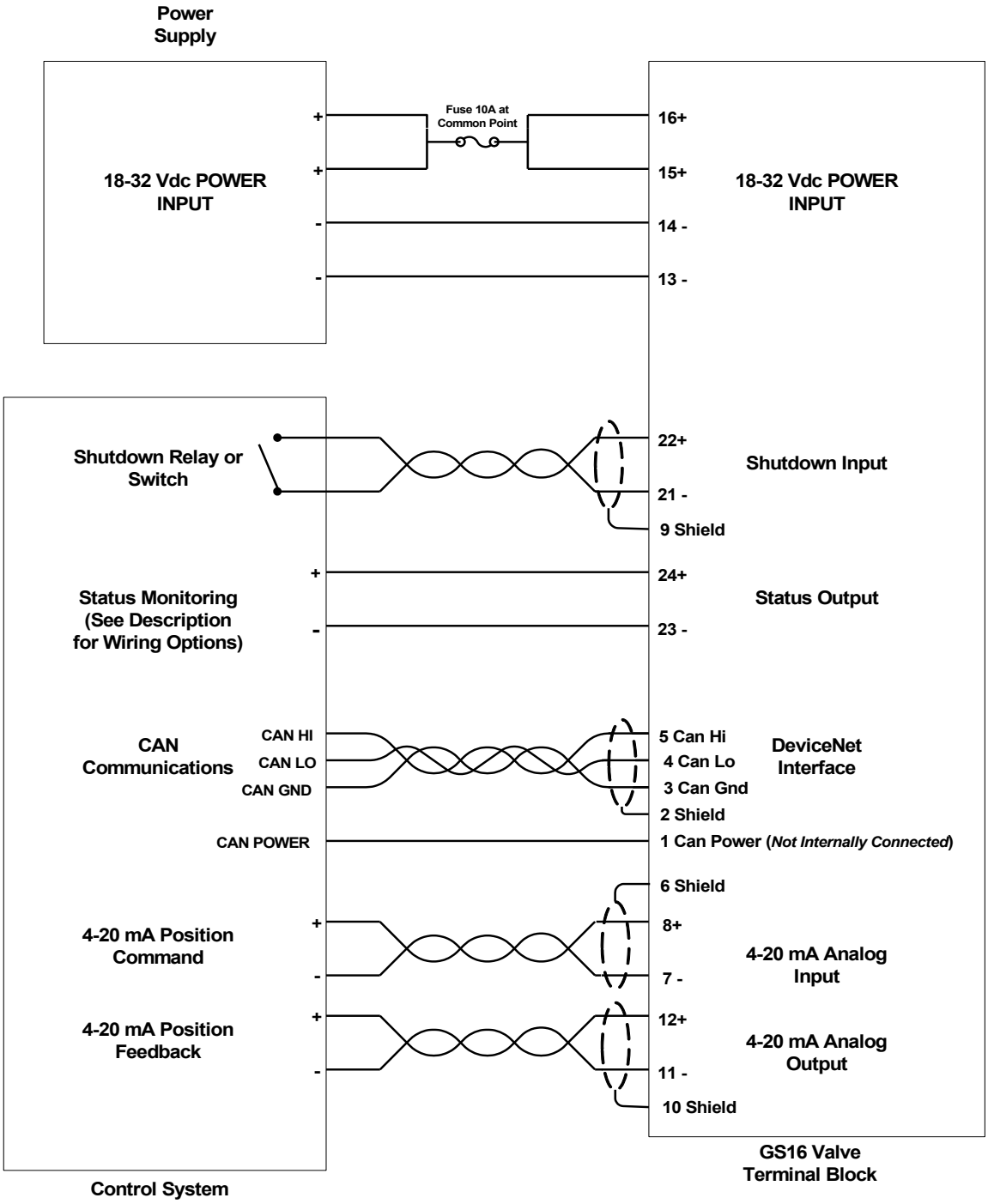


Figure 2-4. GS16 Plant Wiring Diagram

Shielded Wiring

All shielded cable must be twisted conductor pairs. Do not attempt to tin (solder) the braided shield. Shield all signal lines to prevent picking up stray signals from adjacent equipment. Connect the shields to the correct pins on the driver connector or wiring as specified in the wiring diagram. Do not connect shields to the actuator ground. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches). Leave the other end of the shields open and insulated from any other conductor. DO NOT run shielded signal wires along with other wires carrying large currents. Where shielded cable is required, cut the cable to the desired length, and prepare the cable as instructed below:

- Strip the outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.
- Using a sharp, pointed tool carefully spread the strands of the shield.
- Pull the inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
- Remove 6 mm (1/4 inch) of insulation from the inner conductors. Consider the shield as a separate circuit when wiring the system. Carry the shield through connectors without interruption.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.

Failure to provide shielding can produce future conditions, which are difficult to diagnose. Proper shielding at the time of installation is required to ensure satisfactory operation of the GS16 Gas Metering System.

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 GS16 valve connectors. Input current is typically less than 2.0 A, but momentary current peaks can reach 12 A. The recommended power supply cable size is 3.0 mm² (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 mm² (12 AWG) to reduce line loss in the power supply wiring. **Power supply line losses can adversely affect dynamic performance of the GS16 under conditions of minimum supply voltage, high temperature, and long line lengths. Each GS16 valve should have dedicated power supply lines to the power source. The power should not be daisy-chained between valves.** Fuse the power supply wiring to the outside of the valve. Recommend a slow-blow type, 10 A fuse. If parallel supply lines are used, each supply line must be fused, with one 10 A fuse in a common point.

Refer to Tables 2-1 and 2-2 below to determine the appropriate wire size and number for the supply power lines based on the distance from the GS16 driver to the power supply. Calculate the following line voltage drops at 27 °C ambient temperature.

Table 2-1. Wire Gauge Specifications

Wire Gauge (AWG)	Voltage Drop per Meter at 7 A Round-Trip (V)	Voltage Drop per Foot at 7 A Round-Trip (V)
14 AWG (2 mm²)	0.150	0.046
12 AWG (3 mm²)	0.094	0.028

Example Calculation (AWG): 12 AWG wires will drop 0.028 V/ft at 7 A. Using 50 feet of wire between the GS16 driver and the power supply would result in a voltage drop of 50 X 0.028 = 1.4 V. Therefore, the power supply must always provide between 19.4 and 32 VDC as specified on the input power.

Example Calculation (Metric): 3 mm² wires will drop 0.094 V/m at 7 A. Using 15 m of wire between the GS16 driver and the power supply would result in a voltage drop of 15 X 0.094 = 1.4 V. Therefore, the power supply must always provide between 19.4 and 32 VDC as specified on the input power.

Table 2-2. Cable Length Specifications

Maximum Cable Length		Terminal Pins 13, 15	Terminal Pins 14, 16	American Wire Gauge (AWG)	Metric Wire (mm²)
Meter	Feet				
12	40	X		14	2
24	79	X	X	14	2
19	62	X		12	3
39	128	X	X	12	3

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 µF 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 85–264 VAC (45–65 Hz) or 90–350 VDC. Output voltage is rated at 22.5 to 28.5 VDC.

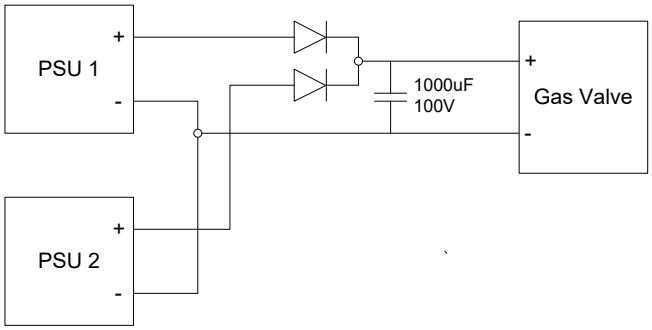


Figure 2-5. Recommended Parallel Power Supply Connection

4–20 mA Input

Terminal 8 = 4–20 mA Input (+)
Terminal 7 = 4–20 mA Input (–)
Terminal 6 = Shield

The GS16 analog version is controlled via the 4–20 mA Input. 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 4–20 mA Output will be set to 0 mA.

Recommended cable is 1.0 mm² (16 AWG) twisted, shielded pair. The input impedance of the 4–20 mA Input is approximately 200 Ω 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 VDC.

DeviceNet / CANopen Digital 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 GS16 digital version is controlled via either DeviceNet or CANopen. It can also be configured to accept DeviceNet / CANopen and 4–20 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.

For CANopen based CAN Networks:

- At 500 kbps, there should be no more than 15 active valves.
- At 250 kbps, there should be no more than 7 active valves.
- At 125 kbps, there should be no more than 3 active valves.

Table 2-3. CANopen Cable Limitation for GS16

Baud Rate	Distance (meters)	Distance (feet)
125 kbps	500 m	1640 ft
250 kbps	250 m	820 ft
500 kbps	100 m	328 ft

4–20 mA Output

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

The 4–20 mA Output provides the analog output indication of the GS16 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 4–20 mA Output by 0 mA output current.

Recommended cable is 1.0 mm² (16 AWG) twisted, shielded pair. The output will drive a load resistance up to 500 Ω. The output circuit is electrically isolated from all other GS16 driver circuitry and will withstand common mode voltage up to ±500 VDC 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 GS16 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 4–20 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 mm² (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 (–)

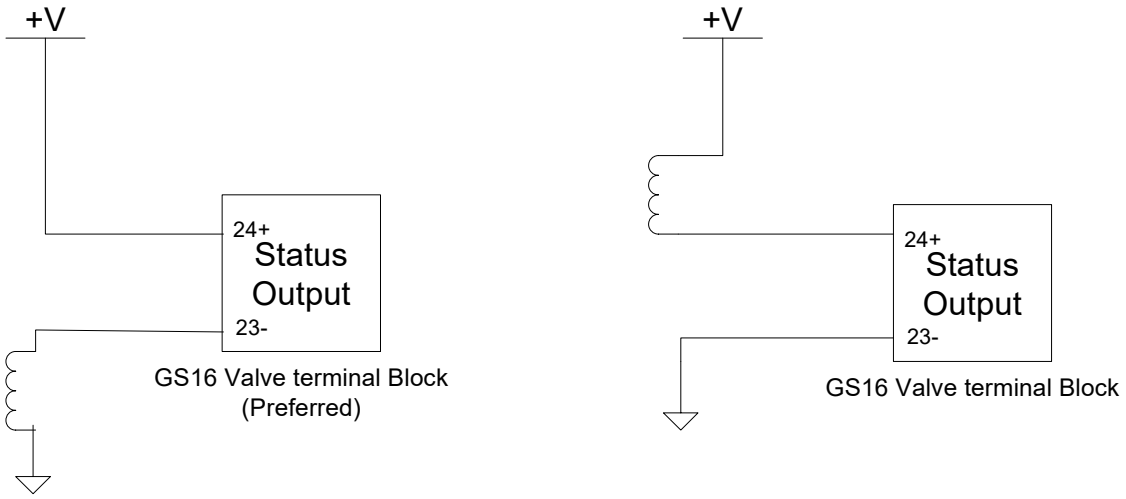


Figure 2-6. Status Output Wiring Examples

The two methods for wiring the Status Output are shown in Figure 2-6. The Status Output indicates if the GS16 is shut down or running. There are two ways for the GS16 to be shut down—if the Shutdown/Reset input is in shutdown, or if a diagnostic has been triggered. If the GS16 is in a shutdown situation, the status output is open (no current).

Maximum Switch Current: 500 mA
Maximum Output Voltage at 500 mA: 1 V
Maximum Output Voltage (Open): 32 V
Default at Power Up: Open Contact
Error Condition: High Impedance
Normal Operating Condition: Low Impedance
Common Mode Range: 40 V
Implementation Types: Relay or Solid-State Relay
Load Configuration Types: High Side or Low Side (see diagram above)

⚠WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed, misfire, and detonation detection shutdown device(s), that operates completely independent 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 2-5) provides an RS-232 connection for troubleshooting and program upgrades. Make a connection to the service port only when the area is known to be non-hazardous. When replacing the cover, torque the cover to 47 N·m (35 lb-ft). A 9-pin straight RS-232 serial cable is required when

using this service port. To configure the RS-232 Service Port for RS-232 communication, set Jumper (JPR3) to RS-232 position, and set Jumper (JPR5) to RS232EN.

Disabling the RS-232 Service Port is recommended when the valve is in normal service. To disable the RS-232 Service Port, set Jumper (JPR3) to RS-485 position, and set Jumper (JPR5) to RS232DIS.

WARNING **Proper torque is critical to ensure that the unit is sealed properly.**

Figure 2-7a. Service Port

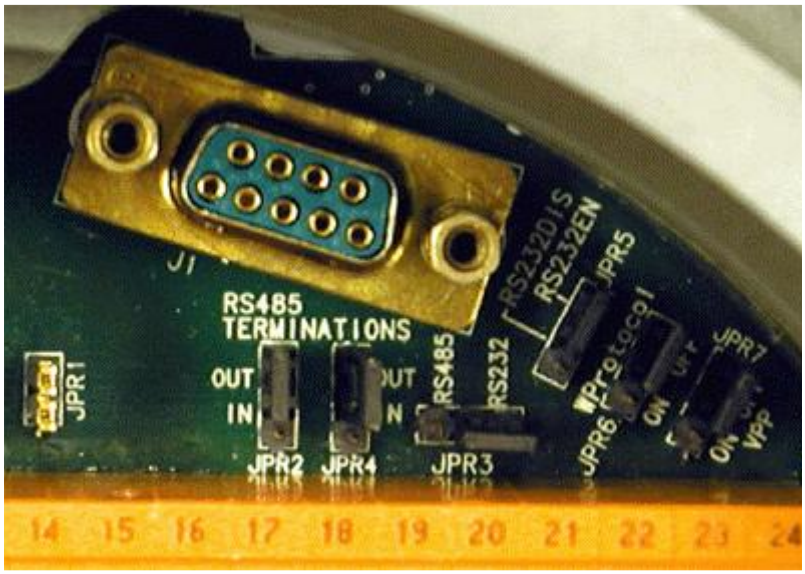


Figure 2-7b. Service Port (close-up)

Chapter 3.
Description of Operation

Description

GS16 Operating Modes

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 4–20 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 zero%. The 4–20 mA output will be set to zero 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. If the GS16 valve is a digital version, also see the next section on Redundancy for situations that will force the valve into shutdown.

Shutdown Position:

If the valve is in shutdown position mode, the valve will no longer control the position. The driver will try to close the valve in current control mode. The 4–20 mA output will be set to zero mA, and the status output will be in shutdown.

⚠WARNING

Repeated use of the "Shutdown Position" command from an external source (i.e., Service Tool, Digital Communication, or Discrete Input) as a method of closing the valve should not be done. This will cause damage to the actuator travel stop.

Shutdown System:

If the valve is in 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 4–20 mA output will be set to zero 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.

Redundancy

This valve has the following redundancy features:

- DeviceNet position control with Analog backup (digital version only)
- CANopen position control with Analog backup (digital version only)

Position Control:

The following table shows the operating states for the GS16 digital version. Configuration for Backup Used and Analog Primary are done over the Digital Interface (DeviceNet / CANopen). See Chapter 6 for a description of Shutdown Input, Tracking Error, DigitalCom Error, and Analog Error. The Digital and Analog states indicate if the valve is controlled via the Digital Interface or the Analog Input.

Table 3-1. GS16 Digital Version Operating States

GS16 valve State	Shutdown Input	Backup Used	Tracking Error	DigitalCom Error	Analog Error	Analog Primary
DeviceNet / CANopen	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 / CANopen	False	True	Don't Care	False	True	Don't Care
Analog	False	True	Don't Care	True	False	Don't Care
DeviceNet / CANopen	False	True	False	False	False	False
Analog	False	True	False	False	False	True
DeviceNet / CANopen	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

Position Feedback (Dual Resolver Option Not Available for GS16):
The valve can be configured to use the average, the higher, or the lower of the two resolvers by setting the Difference Error Mode accordingly. The following table shows when the valve will use the average, the higher, or the lower of the two resolvers for different configurations and valve states.

Table 3-2. GS16 Valve States and Difference Error Modes

	Difference Error Mode		
GS16 valve State	Use Average	Use Higher	Use Lower
No Difference Errors	Average	Average	Average
Difference Error 1	Average	Higher	Lower
Difference Error 2	Average	Higher	Lower

CANopen Communications

The GS16 valve supports CAN communications in the CIA CANopen Protocol format complying with DS301 version 4.02. Obtain further detailed information regarding CANopen at **www.can-cia.org**. Information about CAN is available at **www.semiconductors.bosch.de**. Specific information regarding GS16 behavior is detailed below.

All GS16 CANopen messages use the CAN 2.0 11-bit Standard Data Frame Format. All data in CANopen is formatted as "Little Endian" also known as "Intel Format".

Baud Rate
The baud rate is configurable in the service tool for 125, 250, 500 kbps. The default is 500 kbps.

The GS16 will allow a change in the CAN baud rate if:

The proper CANopen Parameters value is changed, i.e. "BaudRate",
--AND--

The GS16 is then power cycled
-- OR --

The GS16 is set to a different "Input Type" and then returned to the "CANopen with Analog Backup" selection. (This action Closes/Opens the CAN device, thus providing the opportunity to change the CAN device's baud rate.)

The GS16 valve will operate on a CAN Network that has the following "valves-per-baud rate-setting" restrictions:

- At 500 kbps, there shall be no more than 15 valves operating simultaneously
- At 250 kbps, there shall be no more than 7 valves operating simultaneously
- At 125 kbps, there shall be no more than three valves operating simultaneously

Table 3-3. CANopen Cable Limitation for GS16

Baud Rate	Distance (meters)	Distance (feet)
125 kbps	500 m	1640 ft
250 kbps	250 m	820 ft
500 kbps	100 m	328 ft

It is recommended that the CANbus Load should not exceed 90% in order to achieve the best performance.

CAN parameters that need to be configured in Service Tool:

Node ID

The Node is Configurable in the Service Tool.
1..31 if TxPDO 5 and 6 are enabled.
1..255 if TxPDO 5 and 6 are disabled.
The Default value is 1 and 0 should not be used.

CAN Timeout

Description: Timeout or Maximum Sync rate time in ms.
Range/Type: 0 – 1000, unsigned 16 bit.
Default Value: 40

Enable PDO5 and PDO6

Description: Enable/Disable Transmission of TxPDO5 and TxPDO6
Range/Type: 0=disabled, 1=enabled
Default Value: 0 (= disabled)

Heartbeat

The Heartbeat message is not supported.

CANopen State

The GS16 valve starts in boot-up mode, sends the required Boot Message, and then goes to the pre-operational state. An operational command needs to be received on the CAN bus to enter the Operational mode.

Once in operational mode, the GS16 will remain in normal functioning if it receives a SYNC message (COB-ID=0x80) and a FAST REQUEST message
(COB-ID=0x20x) within “CAN Timeout” ms. “CAN Timeout” is configurable in the Service Tool.

Another way of stating this is: if EITHER a Sync or Fast message is NOT seen within the timeout, the DigitalComErr bit/alarm is set.

The alarm/bit may be cleared with a "RESET DIAGNOSTICS" command from the MicroNet/NMT controller via the proper FAST REQUEST message command bit, in combination with a subsequent SYNC message.

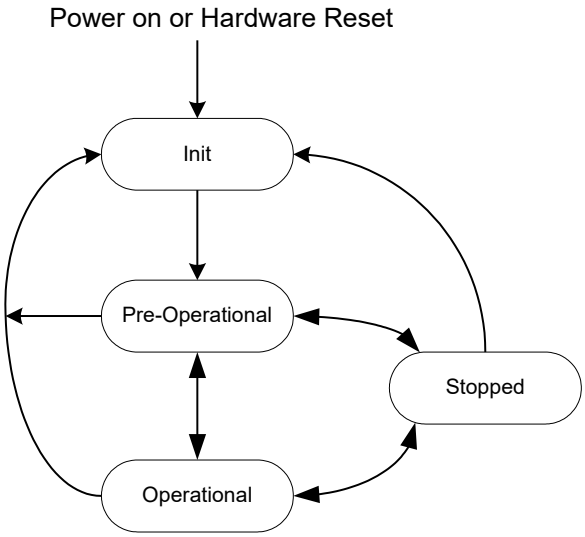


Figure 3-1. CANopen State Chart

The "DigitalCom Slow-Data Not Received" bit will be initially SET when CANopen digital communications begins. It is CLEARED when at least one "Slow Request #1" (RxPDO2) AND at least one "Slow Request #2" (RxPDO3) have been received. It will stay cleared unless digital communications is lost. Diagnostic Word 2, Bit 4 in PDO 6: DigitalNotAllSlowDataReceived.

Table 3-4. Transmit PDO Table

Name	TxPDO	COB_ID	Type	Rate
Actual Position and Status from Valve	1	384 (0x180) +NodeId	SYNC	Sync/Timeout ms
Input Voltage and Temperature	2	640 (0x280) +NodeId	ASYNC	Rx PDO 2 rate
Efficiency and Analog Position In	3	896 (0x380) +NodeId	ASYNC	Rx PDO 2 rate
Actual current and Filtered current	4	1152 (0x480) +NodeId	ASYNC	Rx PDO 2 rate
Actual Position 1 and Actual Position 2	5	480 (0x1E0) +NodeId	ASYNC	Rx PDO 2 rate
Error Status Bits	6	736 (0x2E0) +NodeId	ASYNC	Rx PDO 2 rate

Table 3-5. Receive PDO Table

Name	RxPDO	COB_ID	Timeout
Fast Request: Demand and Bit Command	1	512 (0x200) +NodeId	Sync Rate
Slow Request #1 and Tracking	2	768 (0x300) +NodeId	N/A
Slow Request #2: and Dual Max Diff	3	1024 (0x400) +NodeId	N/A

Receive (Rx) PDO Definitions

Receive PDO 1 – Fast Request with Demand and Command Bits
This and a sync message need to be received within the timeout milliseconds.

Message type: “SYNC” (requires SYNC message)
COB Id: 512+Node Id (0x200+NodeId)
Data length: 3 bytes

Data:
Byte 1-2: Position Demand
Data length: 2 bytes, byte 1 is LSB, byte 2 MSB.
Resolution: 16 bits
Units: %
Scaling: 2,500 = 0% to 62,500 = 100%.

Byte 3: Command Bits
Data length: 1 byte

Bit 0: **Shutdown**. If this bit is "1", the GS16 will shutdown and set the shutdown bit.
Bit 1: **Reset diagnostics bits**. On a "0" to "1" transition (Edge triggered), the GS16 will reset from a shutdown or alarm condition and reset all the diagnostic bits.
Bit 2: **Resolver check enabled**. The GS16 will do a resolver check. The Demand must be <= 0 on DeviceNet.
Bit 3: **AnalogPrimaryDemand**. If set, the analog input is the primary demand. If analog and DeviceNet inputs are OK, the analog is used. If the bit = “0" the DeviceNet input is used.
Bit 4: **UseAnalogBackup**. Set this to “0” so the analog input will be ignored and no reading or diagnostics will be triggered.

Bit 5 to Bit 7 are reserved, must always be "0".

Bytes 4-8 are unused

Receive PDO 2 – Slow Request #1 with Tracking Command

Message type: “ASYNC”
COB Id: 768+Node Id (0x300+NodeId)
Data length: 8 bytes

Data:
Byte 1-4: TrackingMaxDiff
Data length: 4 bytes, Float
Units: % (0..1 = 0%..100%)
Range: 0 to 100%
Default: 1%.

Byte 5-6: TrackingTime
Data length: 2 bytes, unsigned 16
Units: millisecond
Range: 50-5,000

Byte 7-8: DualResolverDiffErrMode
Data length: 2 bytes, unsigned 16
Units: ENUM
Range: 0-2

0 = UseMaxResolver
1 = UseMinResolver
2 = UseAverage

Receive PDO 3 – Slow Request #2 with Dual Resolver Max Diff 1 & 2

Message type: “ASYNC”
COB Id: 1024+Node Id (0x400+NodeId)
Data length: 8 bytes

Data:
Byte 1-4: DualResolverMaxDiff1
Data Length: 4 bytes, Float
Units: % (0..1 = 0%..100%)
Range: 0 to 100%

Byte 5-8: DualResolverMaxDiff2
Data Length: 4 bytes, Float
Units: % (0..1 = 0%..100%)
Range: 0 to 100%

Transmit (Tx) PDO Definitions

Transmit PDO 1 – Actual Position and Status from Valve

Message type: Transmitted in Response to Receipt of Receive PDO 1
COB Id: 384+Node Id (0x180+NodeId)
Data length: 3 bytes

Data:
Byte 1-2: Position Feedback
Data length: 2 bytes, byte 1 is LSB, byte 2 MSB
Resolution: 16 bits
Units: %
Scaling: 2,500 = 0% to 62,500 = 100%

Byte 3: Status Bits
Data length: 1 byte
Bit 0: **Alarm**. This is a copy of the alarm bit.
Bit 1: **Shutdown System**. This is a copy of the shutdown system bit.
Bit 2: **Shutdown Position**. This is a copy of the shutdown position bit.
Bit 3: **Shutdown**. If this bit is "1", the GS16 is shutdown. This bit will follow the status output. If all shutdown conditions are not true and the start-up position is not true, this bit will be set to zero.
Bit 4: **ManualResolverTestInprogress**. This bit will be "1" if the manual resolver test is in progress. If the resolver test is not performed (Demand is not <= 0.0) this bit will not go to "1".
Bit 5-7 are sent as 0.

Transmit PDO 2 – Input Voltage and Electronics Temperature

Message Type: Transmitted in Response to Receipt of Receive PDO 2
COB Id: 640+Node Id (0x280+NodeId)
Data Length: 8 bytes

Data:
Byte 1-4: Input Voltage
Data length: 4 bytes, Float
Units: Volt

Byte 5-8: Electronics Temperature
Data length: 4 bytes, Float
Units: Kelvin

Transmit PDO 3 – Efficiency and Analog Position In

Message type: Transmitted 2 ms after Transmit PDO 2
COB Id: 896+Node Id (0x380+NodeId)
Data length: 8 bytes

Data:
Byte 1-4: Efficiency
Data length: 4 bytes, Float
Units: None

Byte 5-8: Analog Input
Data length: 4 bytes, Float
Units: % (0..1 = 0%..100%)

Transmit PDO 4 – Actual current and Actual Current Filtered

Message type: Transmitted 2 ms after Transmit PDO 3
COB Id: 1152+Node Id (0x480+NodeId)
Data length: 8 bytes

Data:
Byte 1-4: Current Feedback
Data length: 4 bytes, Float
Units: Amp

Byte 5-8: Current Feedback Filtered
Data length: 4 bytes, Float
Units: Amp

Transmit PDO 5 – Actual Position 1 and Actual Position 2

Message type: Transmitted 2 ms after Transmit PDO 4
COB Id: 480+Node Id (0x1E0+NodeId)
Data length: 8 bytes

Data:
Byte 1-4: Actual Position 1
Data length: 4 bytes, Float
Units: % (0..1 = 0%..100%)

Byte 5-8: Actual Position 2
Data length: 4 bytes, Float
Units: % (0..1 = 0%..100%)

Transmit PDO 6 – Error Status Bits

Message type: Transmitted 2 ms after Transmit PDO 5
COB Id: 736+Node Id (0x2E0+NodeId)
Data length: 8 bytes

Data:

Byte 1-2: Diagnostic Word 1 (Error will result in valve shutdown)

Data length: 2 bytes

Bit 0: MainEepromWriteFail.
Bit 1: MainEepromReadFail.
Bit 2: ParameterErr.
Bit 3: ParameterVersionErr.
Bit 4: Adc5VoltErr.
Bit 5: AdcRefErr.
Bit 6: Plus15VoltErr.
Bit 7: Min15VoltErr.
Bit 8: AdcErr.
Bit 9: SpiAdcErr.
Bit 10: FactoryCalibrationErr.
Bit 11 to 15: Reserved.

Byte 3-4: Diagnostic Word 2 (The Alarm(ALM) and Shutdown (SD) setting can vary depending on the valve configuration purchased)

Data length: 2 bytes

Bit0: StartupPositionSensorErr.
Bit1: PositionSensorErr.
Bit2: PositionErr.
Bit3: CurrentControlErr.
Bit4: DigitalNotAllSlowDataReceived.
Bit5: AnalogInputHighErr.
Bit6: AnalogInputLowErr.
Bit7: PowerupReset.
Bit8: WatchdogReset.
Bit9: ShutdownInputActive.
Bit10: DigitalComErr.
Bit11: Reserved.
Bit12: DigitalAnalogTrackingErr.
Bit13: InputVoltageLowErr.
Bit14: InputVoltageHighErr.
Bit15: PositionSensor2Err.

Byte 5-6: Diagnostic Word 3

Data length: 2 bytes

Bit 0: DualResolverDiff1Err. (ALM)
Bit 1: StartupPositionSensor2Err (ALM)
Bit 2: DualResolverDiff2Err (SD)
Bit 3 to 15: Reserved (SD)

On the CAN bus the Diagnostic words will appear in the following order:
(Diagnostic word 1)
b7, b6, b5, b4, b3, b2, b1, b0, b15, b14, b13, b12, b11, b10, b9, b8
(Diagnostic word 2)
b7, b6, b5, b4, b3, b2, b1, b0, b15, b14, b13, b12, b11, b10, b9, b8
(Diagnostic word 3)
b7, b6, b5, b4, b3, b2, b1, b0, b15, b14, b13, b12, b11, b10, b9, b8
Everything else 0x00

Shutdown(SD) and Alarm (ALM) Glossary

Actual Position 1 (Output)	Feedback of the resolver 1 position.
Actual Position 2 (Output)	Feedback of the resolver 2 position.
AdcErr (Output – Internal Driver/Electronics Error)	Failure of the Analog to Digital Converter.
AdcRefErr (Output – Internal Driver/Electronics Error)	This bit will be a “1” if a reference error was detected in the Analog to Digital Converter.
Adc5VoltErr (Output – Internal Driver/Electronics Error)	This is an Analog to Digital Converter (on the driver) voltage error.
Alarm (Output)	This is a general alarm bit. If any parameters are out of range, this bit will send a “1”.
Analog Input (Output)	This is readback of the analog signal input to the valve.
AnalogInputHighErr (Output)	If the analog input is misconnected or driven with more than the normal current, an analog high error will shut down the valve (>22 mA).
AnalogInputLowErr (Output)	If the analog input is not connected, an analog input low error (< 2 mA) will shut down the valve.
AnalogPrimaryDemand (Input)	If set to “1” by the control system the analog input is the primary demand. If analog and CANopen inputs are OK the analog is used. If the bit = “0" the CANopen input is used.
CurrentControlErr (Output – Internal Driver/Electronics Error)	This bit will become a “1” if a fault is detected with the current feedback driver.
Current Feedback (Output)	This is the feedback of the current being consumed by the driver.
Current Feedback Filtered (Output)	This is a filtered feedback of the current being consumed by the driver. The filter being used is: Value(n+1) = (Value(n) - Value(n-1)) * Coeff + Value(n-1) CoEff = 0.002
DigitalAnalogTrackingErr (Output)	This bit will be a “1” if the difference between the digital demand and the analog demand is greater than the “TRACKMAXDIFF” input.
DigitalComErr (Output)	This is a breakdown of the digital network. This error is caused by one of the following conditions: • Incorrect or zero length message • Duplicate MAC ID • Bus Off • No messages received
DigitalNotAllSlowDataReceived (Output – Internal Driver/Electronics Error)	This error occurs when not all of the digital information/messages were received from the control system.
Electronics Temperature (Output)	This is feedback of the temperature of the on board driver.
Efficiency (Output)	This is a multiplier to the position demand to correct the position to a calibrated flow point.
FactoryCalibrationErr (Output – Internal Driver/Electronics Error)	Error in reading the factory calibration file.
Input Voltage (Output)	This is feedback of the input voltage being supplied to the onboard driver.
InputVoltageLowErr (Output)	This is bit will be a “1” if the input voltage to the driver goes below 17 V.
InputVoltageHighErr (Output)	This is bit will be a “1” if the input voltage to the driver goes above 33 V.
MainEepromWriteFail (Output – Internal Driver/Electronics Error)	Failure of the EEPROM on the driver.
MainEepromReadFail (Output – Internal Driver/Electronics Error)	Failure of the EEPROM on the driver.
Min15VoltErr (Output – Internal Driver/Electronics Error)	This bit will become a “1” if the on-board driver -15 supply has an error.

ManualResolverTestInprogress (Output)	This bit will be "1" if the “Resolver Check Enabled” is set to “1” and the check is in progress.
ParameterErr (Output – Internal Driver/Electronics Error)	During a read or write cycle, the parameter values are checked. If either set is incorrect, the values from the correct set is copied into the incorrect set. If both sets are incorrect, this bit is set “1”.
ParameterVersionErr (Output – Internal Driver/Electronics Error)	During the operation, if the block number in the parameter set does not match the block number used when retrieving the parameter, a version mismatch is detected and the ParameterVersionErr is set “1”.
Plus15VoltErr (Output – Internal Driver/Electronics Error)	This bit will become a “1” if the on-board driver +15 supply has an error.
Position Demand (Input)	The position input being demanded from the control system.
Position Feedback (Output)	This is the actual position of the valve being sent to the control system.
PositionSensorErr (Output)	The valve is continuously checking if the signals for resolver 1 are correct. If the resolver signals are missing or incorrect, a Position Sensor Error 1 is set and the valve will continue running on resolver 2 if the valve has dual resolvers.
PositionErr (Output)	During run time, the valve will check if the position feedback and the demanded position are the same. If not, a position error will be flagged, and the valve will be shut down.
PositionSensor2Err (Output)	The valve is continuously checking if the signals for resolver 2 are correct. If the resolver signals are missing or incorrect, a Position Sensor Error 2 is set and the valve will continue running on resolver 1 if the valve has dual resolvers.
PowerupReset (Output)	After power up, the valve will go into shutdown until the valve is reset by the shutdown-reset input.
Reset diagnostics bits (Input)	On a "0" to "1" transition (Edge triggered) from the control system, the GS16 will reset from a shutdown or alarm condition and reset all the diagnostic bits.
Resolver check enabled (Input)	During normal running conditions the valve is continuously checking that the signals of the resolvers are correct. You can manually run a resolver check when the valve is in shutdown and at 0% by making this bit a “1”.
SpiAdcErr (Output – Internal Driver/Electronics Error)	Failure of the “SPI” Analog to Digital Converter.
Shutdown (Output)	If this bit is "1" the GS16 is shutdown. This bit will follow the status output. If all shutdown conditions are not true and the start-up position is not true, this bit will be set to zero.
ShutdownInputActive (Output)	If the shutdown input is active (open), the valve will be in shutdown.
Shutdown Position (Output)	If the valve is into the shutdown position mode, the valve will no longer control the position.. The driver will try to close the valve in current control mode. The 4–20 mA output will be set to zero mA, and the status output will be in shutdown. This shutdown will typically occur with positional errors.
Shutdown System (Output)	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 4–20 mA output will be set to zero mA, and the status output will be in shut down. This shutdown will typically occur with internal errors.
StartupPositionSensorErr (Output)	Failure of resolver 1 on start-up.
StartupPositionSensor2Err (Output)	Failure of resolver 2 on start-up

Shutdown (Input)	If this bit is "1" from the control system, the GS16 will shut down and set the shutdown bit.
TrackingMaxDiff (Input)	This is the maximum difference allowed between the analog command and digital command, if digital demand is used with analog backup.
TrackingTime (Input)	This is the amount of time that must elapse after the limits of the “TrackingMaxDiff” have been exceed for the driver to shutdown the valve.
UseAnalogBackup (Input)	If set to “1” by the control system the valve will switch to the analog signal in the event of the CANopen network fails. If set to “0” the analog input will be ignored and no reading or diagnostics will be triggered.
WatchdogReset (Output – Internal Driver/Electronics Error)	The driver will check if the processes that are running in the software are still running. If not, a watchdog reset will be given and the system will restart.

GS16 Pressure Drop Operational Limits

The pressure drop across the GS16 valve for each port size must be less than the maximum allowable delta pressure across the valve as outlined in the charts below. Pressure drop across the valve is shown as a function of valve position.

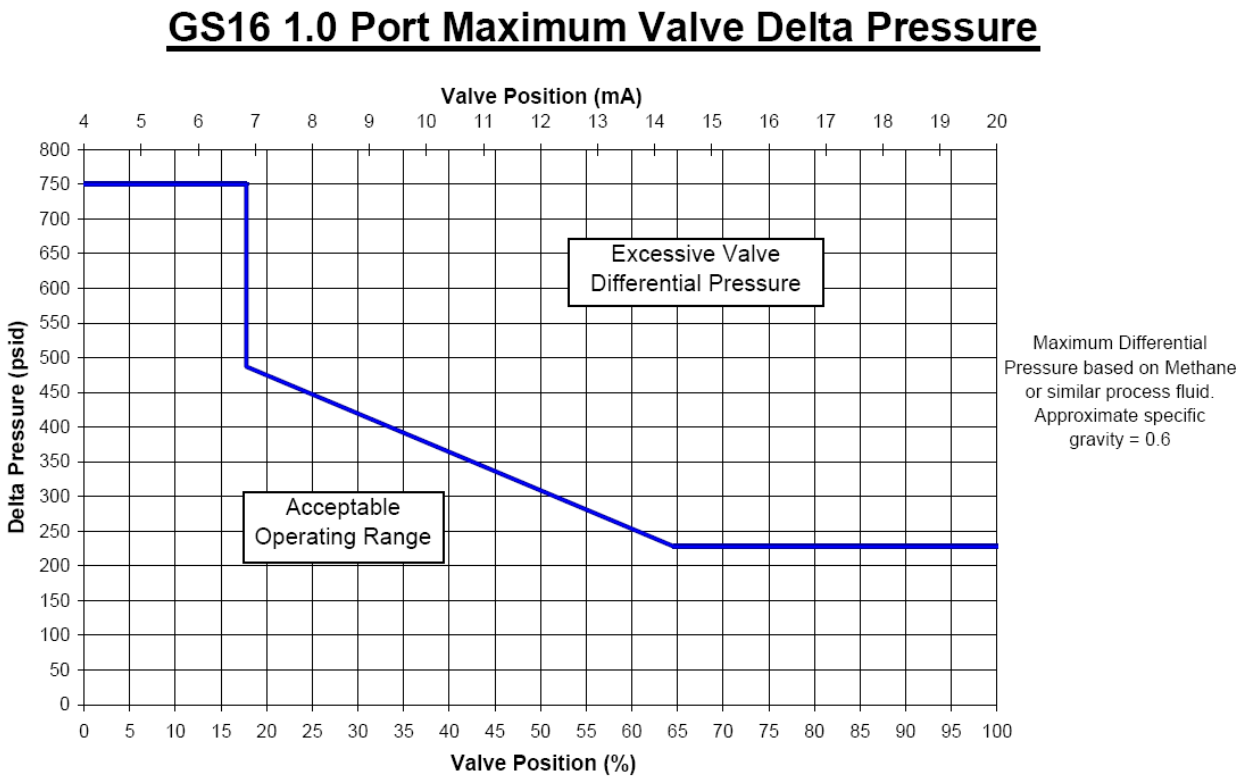


Figure 3-2. GS16 1.0 Port Maximum Valve Delta Pressure

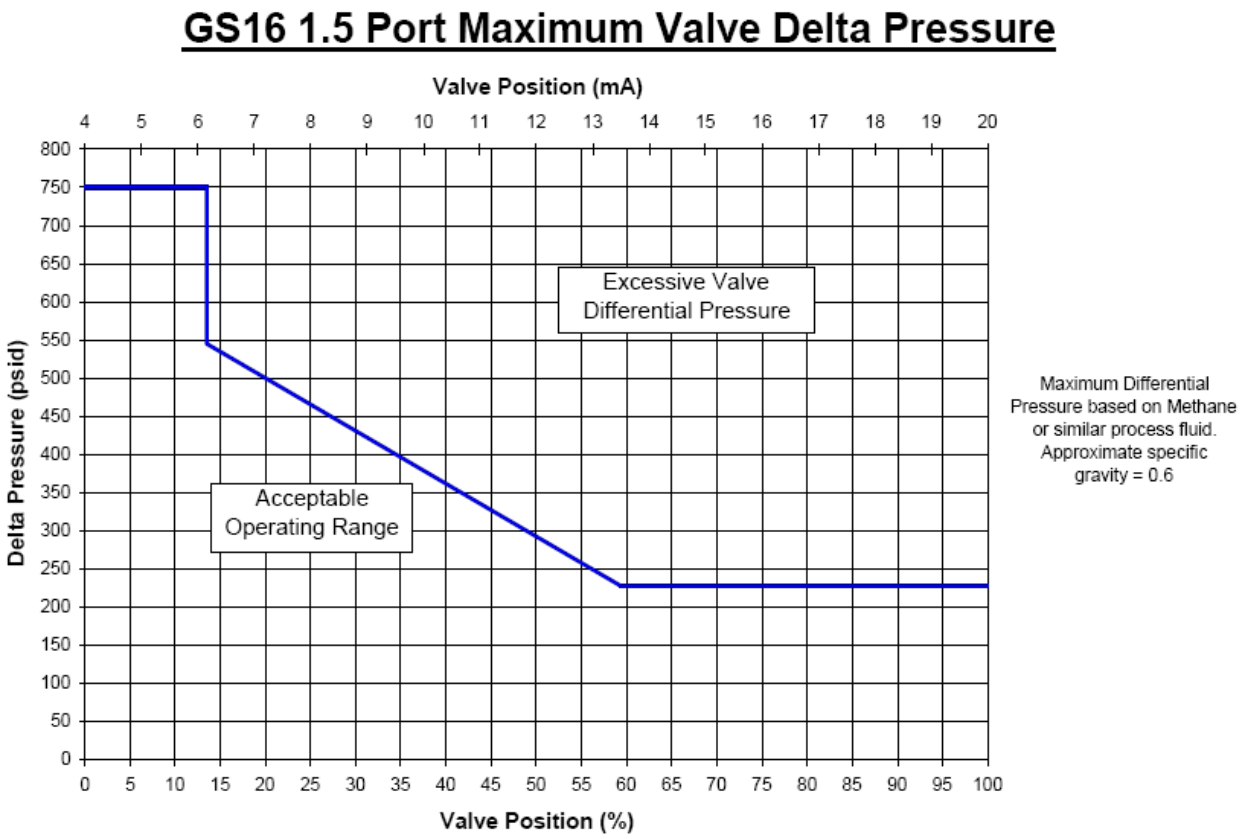


Figure 3-3. GS16 1.5 Port Maximum Valve Delta Pressure

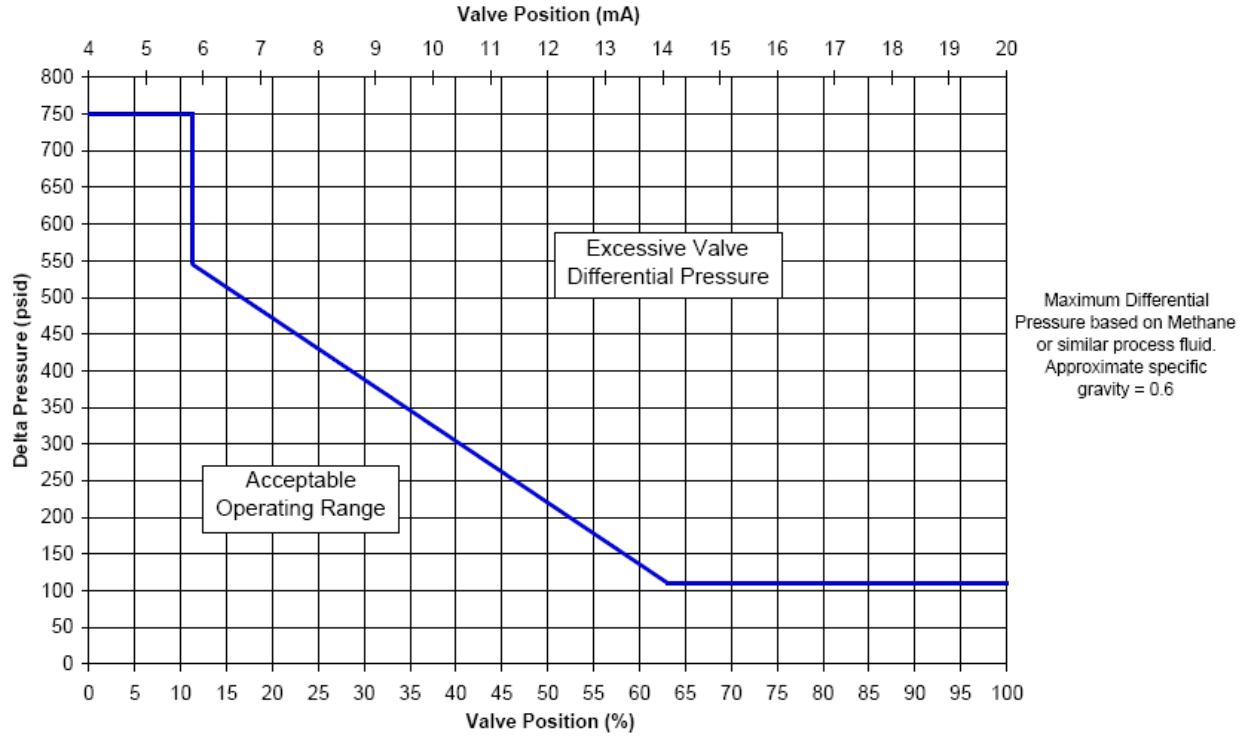


Figure 3-4. GS16 2.0 Port Maximum Valve Delta Pressure

Chapter 4.
Service Tool

Introduction

The VPC Service Tool is used to monitor, manipulate, view, and configure the configuration settings on a valve equipped with an onboard valve position controller (VPC). The service tool runs on a personal computer and communicates with the valve through a serial connection.

The VPC Service Tool is available for use with the analog version or digital versions of the GS16 valve. The Service Tool for this product can be found on the web at **www.woodward.com/software**. Select software product “VPC Tools” for Valve Position Controller Service Tool.

Obtaining the Service Tool

The VPC service Tool software is based on the Woodward Toolkit software standard version included with the VPC Service Tool installation software package. The VPC Service Tool and the appropriate settings files can be obtained from Woodward via e-mail or download from Woodward software download website.

Installation Procedure

After obtaining the VPC Service Tool software installation package from Woodward, run the included installation program and follow the instructions on the screen.

Using the Service Tool

The VPC Service Tool communicates with the GS16 Driver via RS-232 connection. The PC (personal computer), running the VPC Service Tool is connected to the GS16 using a 9-pin straight-through serial cable. Connect the serial cable to the RS-232 Service Port in Figure 2-4.

VPC Service Tool Title Page

The VPC title page is displayed as the tool is launched from a PC. The title page of the VPC Service Tool contains important information about the version of the Service Tool and the Firmware suitable to be controlled and monitored using the Service Tool. It also provides information to contact Woodward Technical Support for assistance (Figure 4-1).

NOTICE

Before modifying any settings of the VPC, ensure the valve is shut down. Modifying settings with the unit in operation may result in unexpected behavior.

⚠WARNING

The SHUTDOWN button will move the valve to 0% position. This will potentially shut down the Prime Mover.

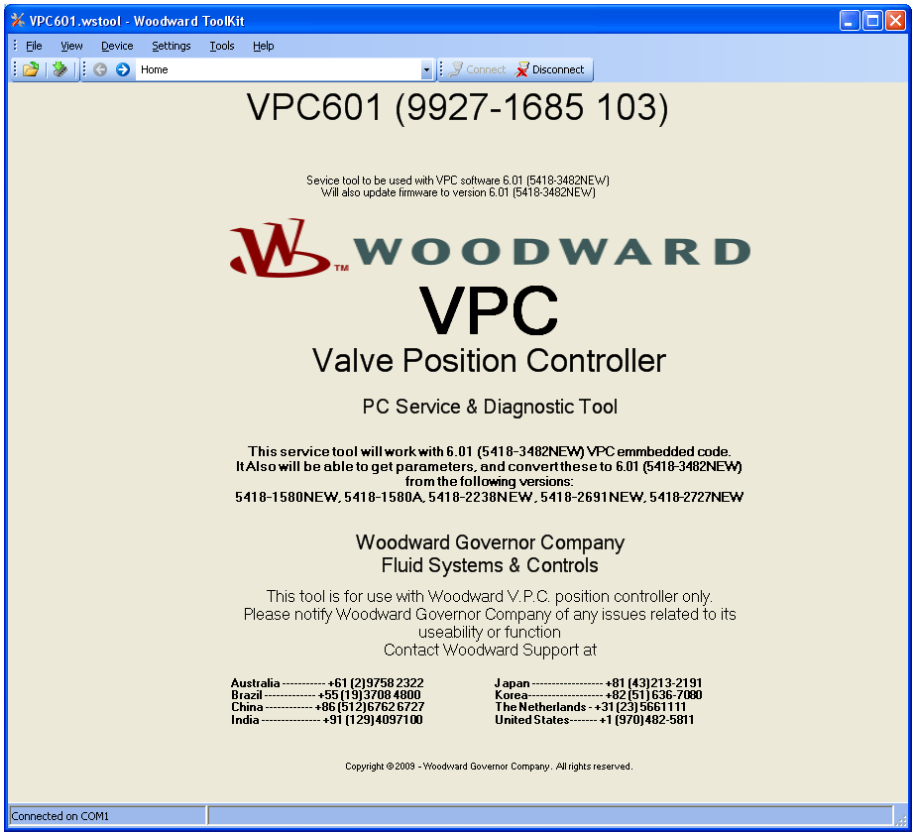


Figure 4-1. VPC Title Page

Connecting & Disconnecting the VPC Service Tool

Connection to the VPC Service Tool is made by clicking the connect button on the main tool bar (Figure 4-2).

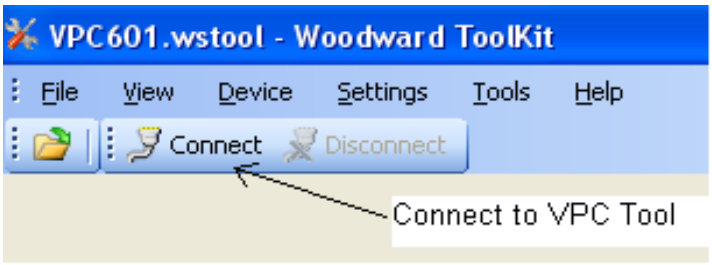


Figure 4-2. Service Tool Connection

Disconnecting the service tool from the GS16 is done by either pressing the disconnect button or selecting ‘Device’ and ‘Disconnect All Devices’ from the pulldown menu (Figure 4-3).

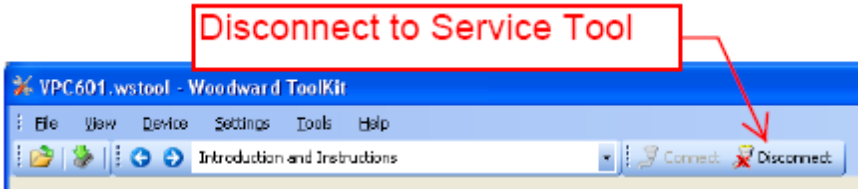


Figure 4-3. Service Tool Disconnection

Selecting a Communication Port

When trying to connect the tool for the first time, the VPC Service Tool will show a pull-down menu and query to select a suitable communication (COM) port for communication between the PC and the GS16. In most cases, the port of choice defaults to COM1. A check mark on the checkbox near the bottom of the dialog screen indicates that the selected port will be used as default in the future (Figure 4-4).

If a default port is selected, the service tool will always establish the connection to the GS16 immediately after pressing the connect button without asking for a communication port again.

If the “Always Connect to my last Selected networks” box is not checked then the tool will prompt the user to select the desired COM port on next run of the tool.

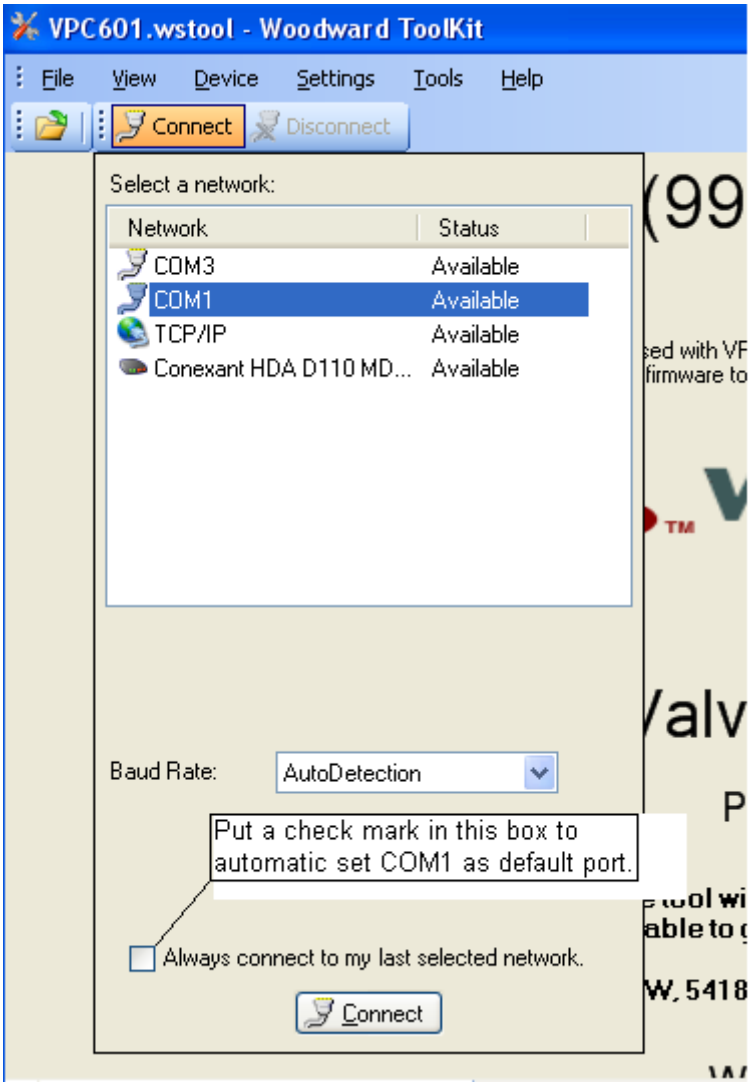


Figure 4-4. VPC Tool Communication Port Selection

If the communication connection between the GS16 and PC is lost, the service tool attempts to re-establish the connection. While the service tool is re-establishing the connection, the communication status displays "Unidentified Device " message shows on the pop-up window at the bottom of the display window (Figure 4-5). A “Reconnecting” message will be displayed at the Status if RS-232 is disconnected or GS16 loses power.

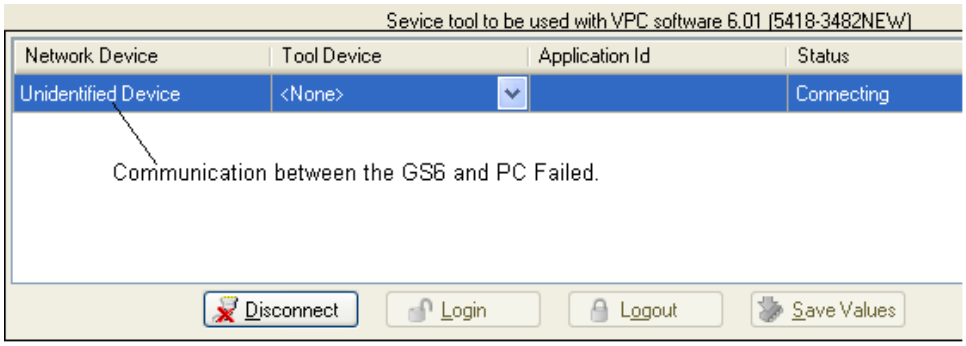


Figure 4-5. Communication Lost

If communication has not been established, disconnect the service tool from the GS16 by selecting the “Disconnect” button from the main tool bar (Figure 4-3). Check the serial connection between the GS16 Driver and PC and make sure the straight-through serial cable is connected correctly on the PC and GS16 RS-232 Port.

Introduction and Instruction Screen

This VPC Service Tool introduction page contains important information of the tool version and GS16 firmware. It provides information to contact Woodward technical support for assistance. Status LEDs and Shutdown button are also provided on this page (Figure 4-6).

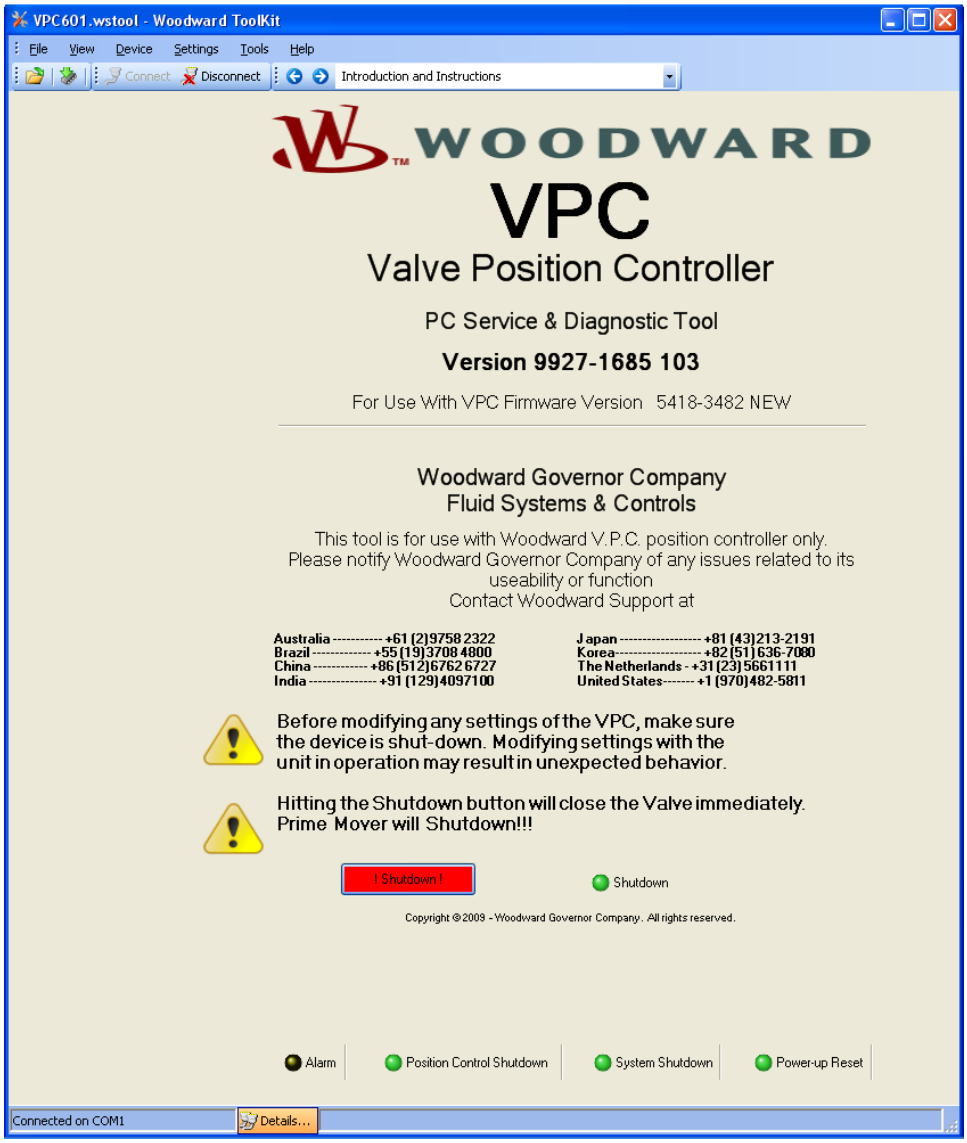


Figure 4-6. Introduction and Instruction Screen

There is one active button on the Introduction and Instruction Display the Shutdown Button.

Shutdown Button
Pressing the shutdown button will close the valve immediately and Primer mover will be shutdown.

Status LEDs
There are five status Common LEDs components on this page of the VPC Service Tool that depict the overall status of the GS16 driver. These components are also integrated into the top of each active service tool pages.

VPC Service Tool Screen Navigation

The VPC Service Tool has display screens that can be selected by using the Navigation Buttons to go forward or back page-by-page or using a Pull-Down menu to select the desired page (Figure 4-7).

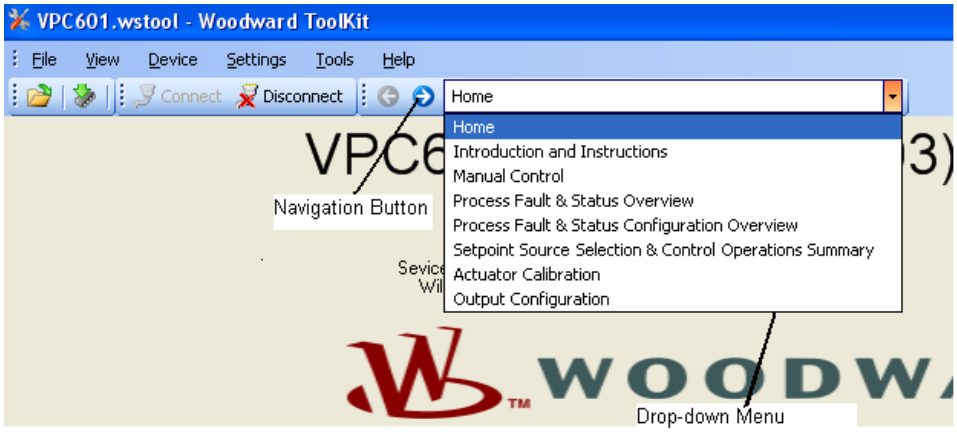


Figure 4-7. VPC Display Screen

The navigation page contains the following menu:

Home - Displays the service tool and its supported software (Figure 4-1).
Introduction and Instructions - Displays the status of tool and support information (Figure 4-6).
Manual Control - Displays manual valve stroking mode (Figure 4-9).
Process Fault & Status Overview - Displays the diagnostic page.
Process Fault & Status Configuration Overview - Displays the diagnostic configuration page.
Setpoint Source Selection & Control Operation Summary - Displays the operation status.
Actuator Calibration - Displays the calibration of the position sensors.
Output Configuration - Displays the output status.

Fault Status and Control Buttons

The top portion of every display screen of the VPC Service Tool contains common components that depict the overall status of the GS16 driver. It also shows control buttons can be used to shutdown and reset the control at any time (Figure 4-8).

The fault status is displayed at the top of each page of the service to tool by LED indicators. The alarm or fault condition alerts the user that the GS16 has detected a diagnostic condition that can be viewed through the service tool screen navigation page.

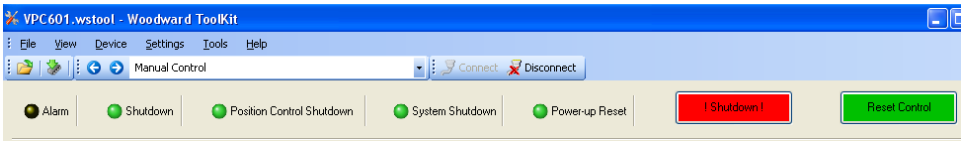


Figure 4-8. Fault Status and Control Button

Alarm
An alarm allows the GS16 to maintain operation in the presence of a detected diagnostic condition.

Shutdown
The valve moves to a 0% position, and it potentially shuts down the prime mover.

Position Control Shutdown
A diagnostic condition has occurred that require the GS16 to shut down. The driver will try to close the valve using current control.

System Shutdown
A diagnostic condition has occurred that requires a shutdown of the position and current control. The driver will try to close the valve using fixed voltage.

Power-up Reset
The GS16 has experienced a power cycle.

Shutdown Button
The driver will move the valve to a 0% position. The Shutdown LED will be illuminated.

Reset Control Button
The button will reset the GS16. All diagnostic flags will be cleared if the diagnostic condition is no longer present.

Manual Control Screen

The Manual Control screen is used during initial commissioning or when troubleshooting to confirm the operation of the GS16. This screen can also used to monitor the ability of the system to respond to a change in position setpoint, valve position, motor current level and valve identification (Figure 4-9).

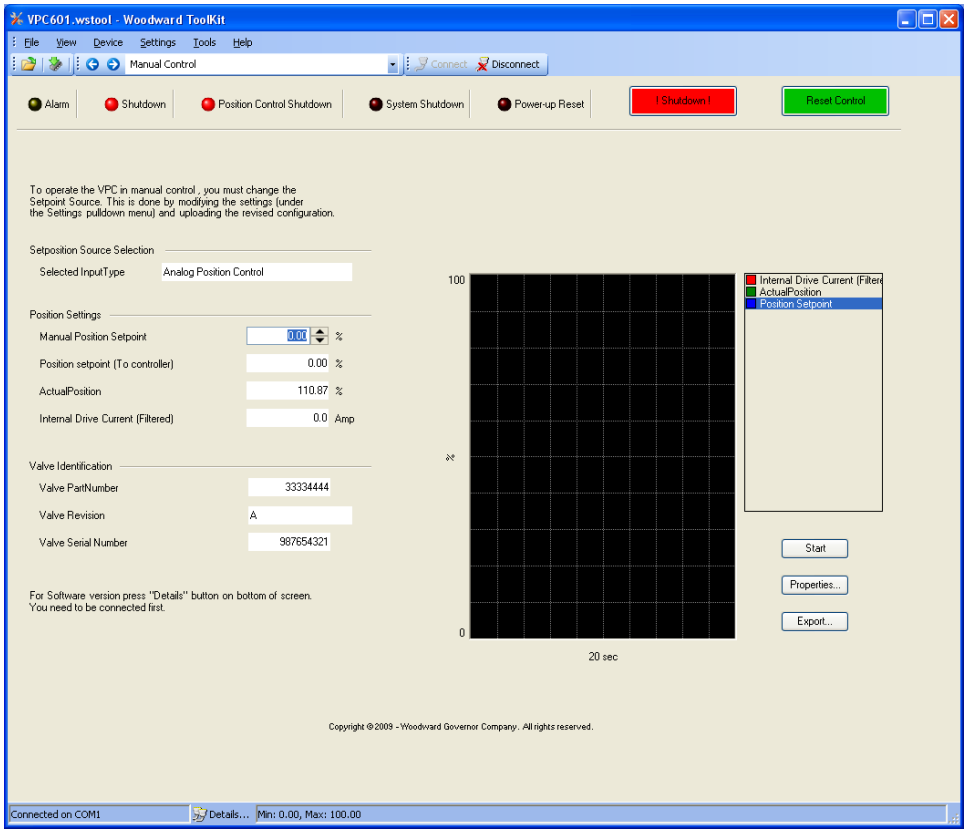


Figure 4-9. Manual Control Screen

Setpoint Source Selection
The displayed source on the selected input field indicates the communication source in the manual control active mode. Possible sources for input type selection are: Analog Position Control mode, Manual Position Control mode, CANopen Position Control mode, DeviceNet Position Control mode, and Function Generator Position Control mode. This selected input type sources can be changed using the VPC Service Tool settings editor.

Position Settings
The VPC can be configured to position the valve based on a set point generated from the service tool. To configure the VPC for this operation, the input source must be set to Manual Input using the service tool settings editor. After the manual checkout, the driver can be put into normal operation mode by using the setting editor. The edited file can be saved into a file for reuse by selecting the File, then Save, from the main menu of the Settings Editor Tool.

Trend Chart
A trend chart displays the time varying positions, the set point, actual position, and filtered motor drive current (Figure 4-10).

Pressing the Start button starts the trending process. Pressing the Stop button freezes the currently displayed values. Pressing the Start button again erases the last traces and restarts the trending process.

Pressing the properties button opens the Trending Properties window. From this window trend screen properties such as trending time span, sample rate and Y-axis scaling can be modified.

Pressing the Export button during or after the trending process allows to export the data collected during the trending process to a file of Comma Separated Values (*.csv) or Web Page (*.htm). This file can be opened in a spreadsheet or math analysis software package for post-processing of the data and further analysis.

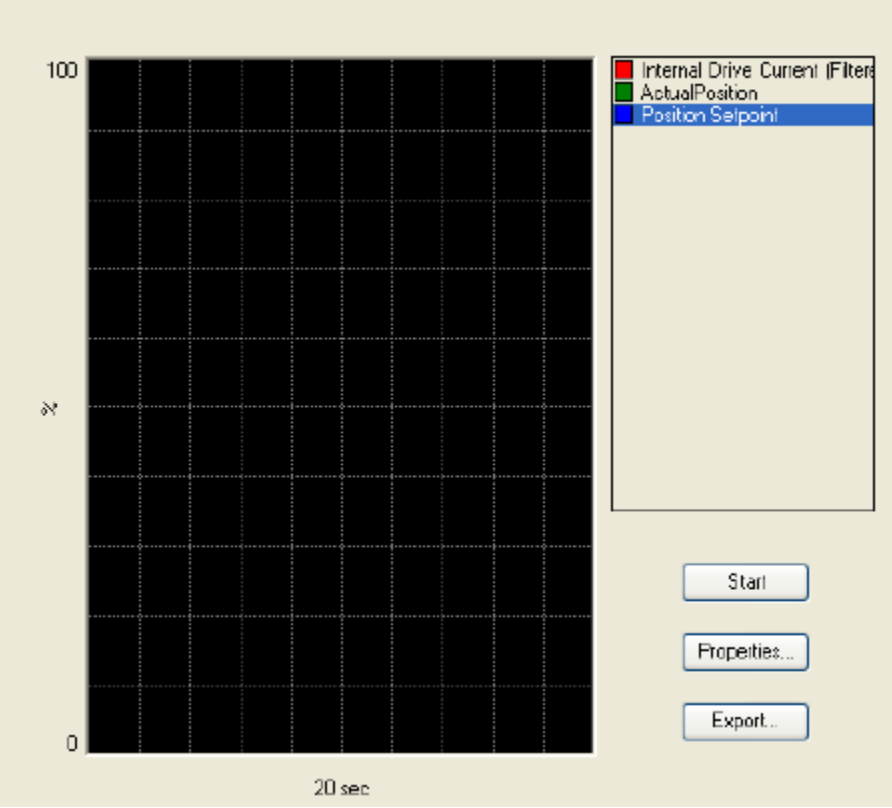


Figure 4-10. Trend Chart

Creating a Custom Trend Chart

Point the cursor to a control parameter to be monitored and right clicking. The new ‘Add to trend’ button will pop up (Figure 4-11).

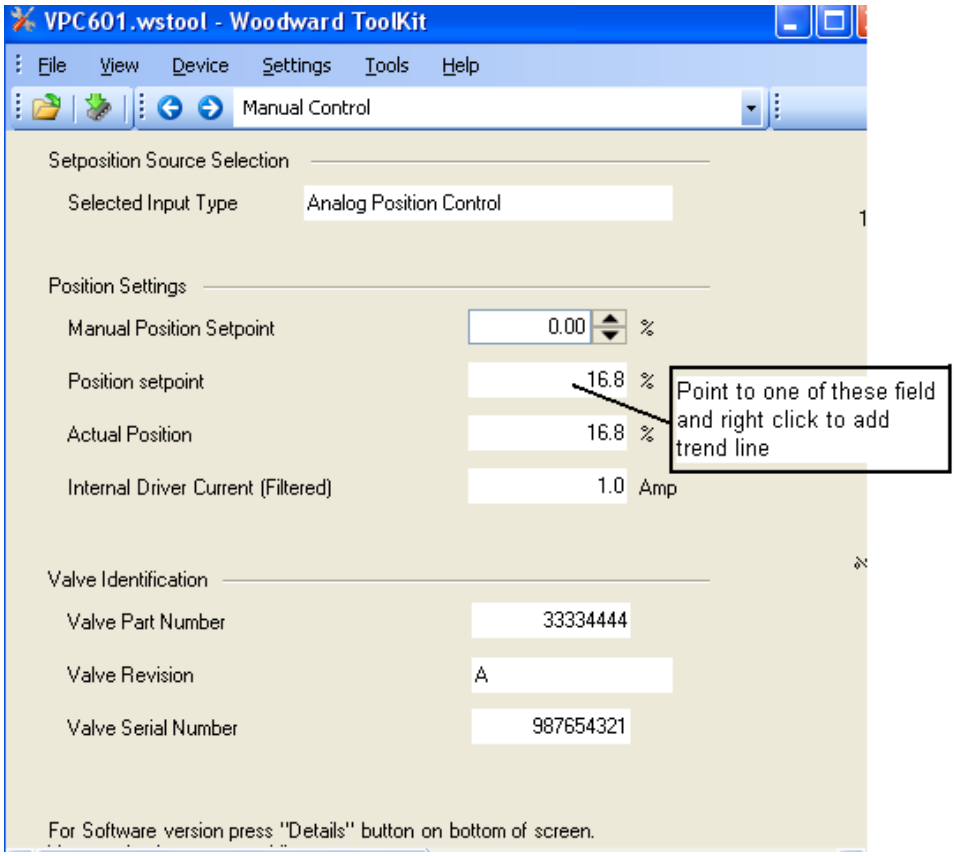


Figure 4-11. Creating a Custom Trend Chart

Selecting the “Add to trend” button a new trending window will open showing a trending chart for the selected control variable. Pressing the Start button starts the trending process for the selected variables. Pressing the Stop button freezes the currently displayed values. Pressing the Start button again erases the last traces and restarts the trending process.

The trend chart can be modified by pressing the properties button. From this window trend screen properties such as trending time span, sample rate and variable scaling can be modified (Figure 4-12).

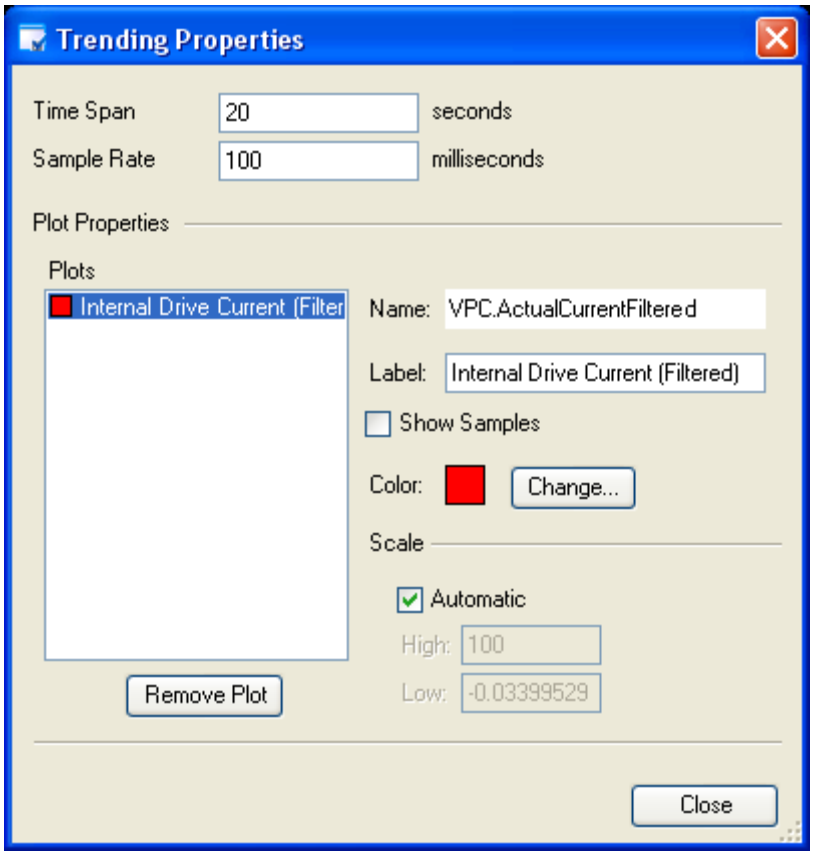


Figure 4-12. Trending Properties

Exporting and Saving Trend Values

Custom trend values can be exported and saved to a file of Comma Separated Values (*.csv file) or Web Page (*.htm) file by pressing the export button. Open this file in a spreadsheet or math analysis software package for post-processing of the data and further analysis.

Process Fault & Status Overview

The Process Fault & Status Overview screen gives an overview of the entire range of process fault and status flags and their individual status. A red LED indicates the process is at fault. In the case of the Power Reset or Analog input error, the GS16 will be in a shutdown mode. If the LED indicator is green, the process fault or status flag indicates no error detected and GS16 is ready for operation (Figure 4-13). The process fault and status flags are grouped according to their function.

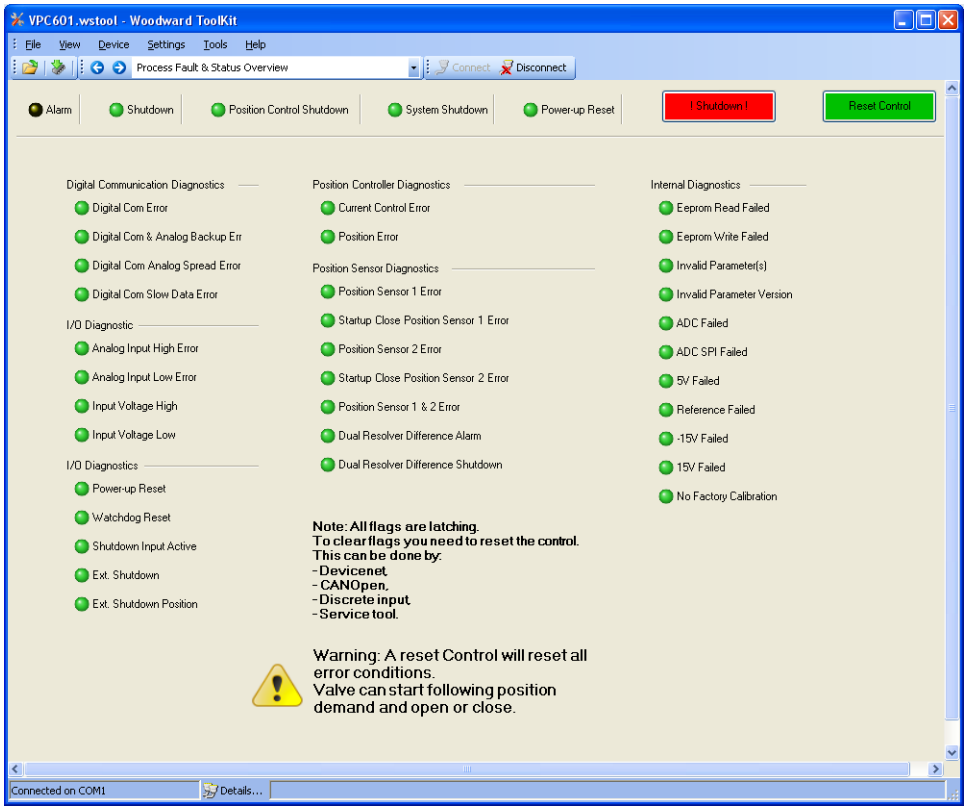


Figure 4-13. Process Fault & Status Overview

Process Fault & Status Configuration Overview

This screen gives an overview of the configuration of the process fault and status flags. Two LED indicators depict the configuration of each individual process fault or status flag.

The flags appear on the Process Fault & Status Configuration Overview is in the same order as on the previous Process Fault & Status Overview screen
(Figure 4-14).

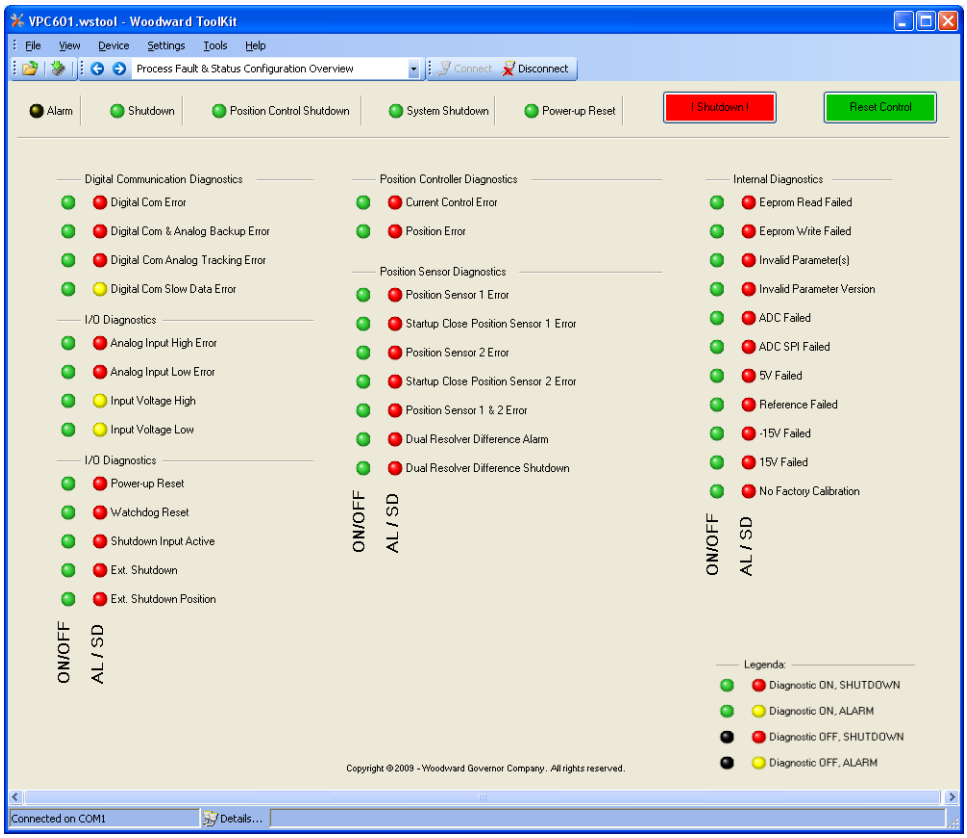


Figure 4-14. Process Fault & Status Configuration Overview

An illuminated green LED indicator on the left indicates that the flag is enabled. If not illuminated, the flag is disabled. A yellow LED indicator on the right indicates that the process fault or status flag is configured as an alarm. This means that if there is a process fault, the driver will not shut down as a result of the occurrence. If red, the process fault and status flag is configured as a shutdown. A fault under this configuration will force the GS16 to shutdown (Figure 4-15).

Figure 4-15. Diagnostic Configuration LED

WARNING

Modification to these settings could affect the operation and plant diagnostic enunciation.

Disabling diagnostic flags or changing their function from Shutdown to Alarm could result in dangerous condition.

An appropriate review of the settings is recommended prior to making any settings modifications.

The configuration of the user-configurable flags is done with the VPC Service Tool settings editor. Some of these flags are changed depending on the configuration of the valve. In the case of a dual resolver valve, the resolver 1 and 2 error will be set to alarm: if one of the resolvers fails, the unit will automatically switch to use the other resolver. The resolver 1 and 2 fault flag will be set to a shutdown. If two resolvers fail, the unit will shut down the valve.

The same rule is also applied to the digital communication. In the case of using Analog input as backup, the analog input high and low error are alarms and not shutdowns.

Setpoint Source Selection & Control Operations Summary

The GS16 can be operated using different sources to demand the setpoint signal. The Setpoint Source Selection page provides an overview on which setpoint source is currently selected and the current setpoint settings for the selected source. Figure 4-16 shows Analog input as the selected source for the GS16.

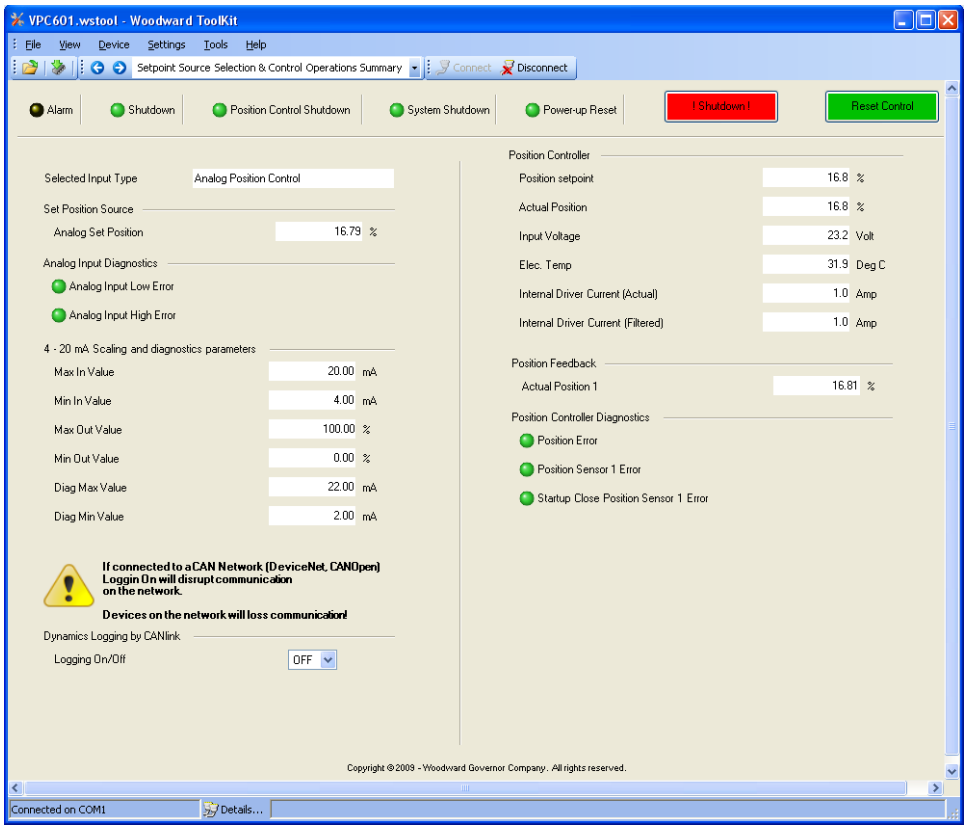


Figure 4-16. Setpoint Source Selection Screen

Setpoint sources available on the GS16 are shown in Table 4-1.

Table 4-1. Setpoint Sources

Selected Input Source	Setpoint Signal Type
Analog Position Control	4–20 mA
Manual Position Control	Internally generated setpoint, user-configurable from the Manual Control page.
CANopen Position Control	CANopen base protocol using CAN Port. Optional use Analog back-up.
DeviceNet Position Control	DeviceNet based protocol. Using CAN port. Optional use Analog back-up.
Function Generator Position Control	Built-in function generator mode.

Selected Input Type
This indicator shows the currently selected active setpoint source.

Set Position Source
The indicator shows the actual set position in percent of position (%) resulting from the currently active analog configuration.

Analog Input Diagnostics
Two LEDs are provided in front of the Analog Input Low Error and Analog Input High Error. An illuminated red LED on the Analog Input Low Error indicates the Analog input signal is too low or it is not presented. An illuminated red LED on the Analog Input High Error indicates the Analog input signal is too high or has not been correctly calibrated.

4–20 mA Scaling and Diagnostics Parameters
This section displays the scaling of the 4–20 mA input signal and the scale valve position. Configure the 4–20 mA setting using the Edit Settings File.

Position Controller
This section shows the position setpoint to the controller and the actual valve position (in %), the controller's internal input voltage (volts), driver internal electronic temperature (°C), and Driver drive current (amps).

Position Feedback
Position feedback is the actual position of the valve. The position feedback is displayed as percent of electrical revolution of the resolver (% Elec Rev).

Position Controller Diagnostic
This section displays the status of the position controller. There are three possible position errors were identified Position Error, Position Sensor 1 Error, and Startup Close Position Sensor 1 Error. An illuminated red LED on the indicator indicates the position controller encounters an error.

Manual Position Control Setpoint Source

Configure the GS16 for Manual Control operation mode when the Manual Position Control is set on the Selected Input Type (Figure 4-17). In this mode, the user can stroke the valve by changing the position on the Manual Control page.

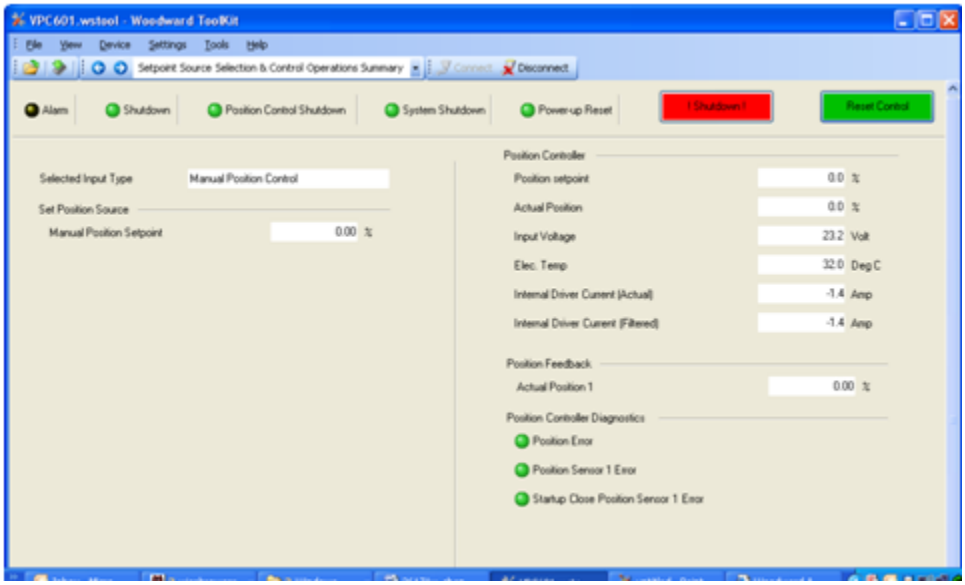


Figure 4-17. Manual Position Control

Selected Input Type

This indicator shows the currently selected active setpoint source.

Set Position Source

The indicator shows the actual set position in percent of position (%) resulting from the currently active of the manual position set point.

Position Controller

This section shows the position setpoint to the controller and the actual valve position (in %), the controller's internal input voltage (volts), driver internal electronic temperature (°C), and Driver drive current (amps).

Position Feedback

Position feedback is the actual position of the valve. The position feedback is displayed as percent of electrical revolution of the resolver (% Elec Rev).

Position Controller Diagnostic

This section displays the status of the position controller. There are three possible position error were identified Position Error, Position Sensor 1 Error, and Startup Close Position Sensor 1 Error. An illuminated red LED on the indicator indicates the position controller encounters an error.

CANopen/DeviceNet Position Control Setpoint Source

CANopen Position Control in the Selected Input Type settings indicates the GS16 is configured for CANopen operation. The CANopen Position Control screen displays the Selected Input Type, Set Position Source, CAN Open Diagnostics, Analog Set Position, CAN Open Parameters, Position Controller, Position Feedback and Position Controller Diagnostics (Figure 4-18).

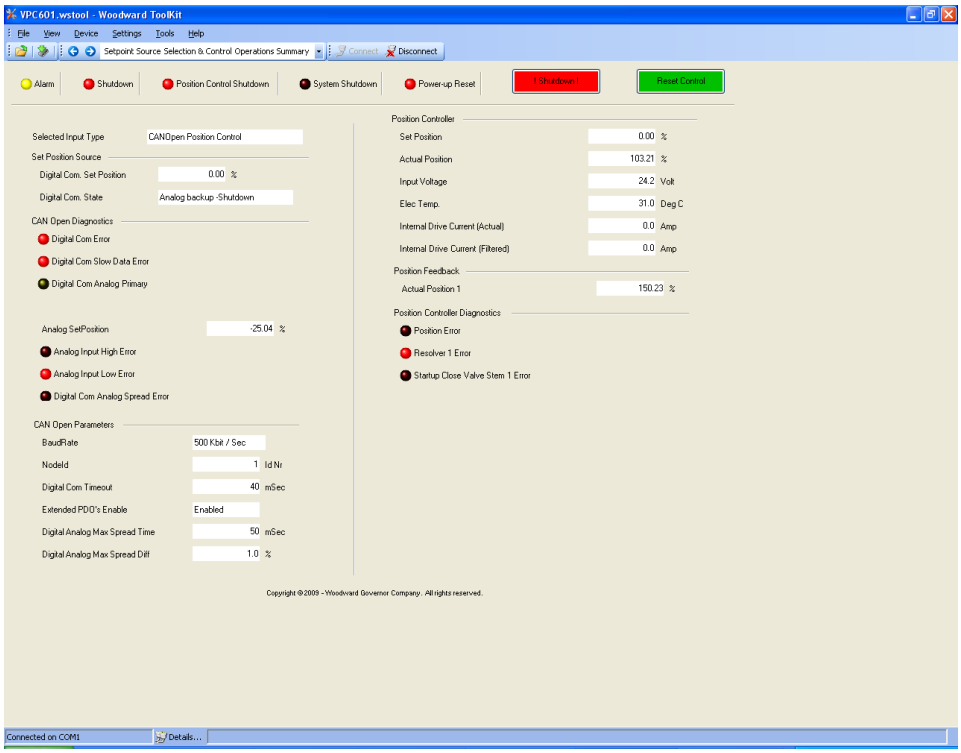


Figure 4-18. CANopen Position Control

Selected Input Type

This indicator shows the currently selected active setpoint source.

Set Position Source

The indicator shows the actual Digital Com. set position in percent of position (%) and the state of Digital Com. Analog backup configuration. The analog backup is used and the setting limit can be configured by using the Edit Settings File tool.

CAN Open Diagnostics

The three possible errors on this group are Digital Com Error, Digital Com Slow Data Error and Digital Com Analog Primary. An illuminated red LED any of the identified errors indicates the controller may has experienced the error.

Analog Setpoint

The indicator shows the actual Analog Set Position in percent of position (%) with three possible error flag. These error flags are Analog Input High Error, Analog Input Low Error, and Digital Com Analog Spread Error. An illuminated red LED any of the identified errors indicates the controller may has experienced the error.

CAN Open Parameters

This section displays the setting status of the CAN protocol and can be configured using the Edit Settings file tool. Refer to CANOpen communication section for proper setting.

Position Controller

This section shows the position setpoint to the controller and the actual valve position (in %), the controller's internal input voltage (volts), driver internal electronic temperature (°C), and Driver drive current (amps).

Position Feedback

Position feedback is the actual position of the valve. The position feedback is displayed as percent of electrical revolution of the resolver (% Elec Rev).

Position Controller Diagnostic

This section displays the status of the position controller. There are three possible position error were identified Position Error, Resolver Error, and Startup Close Valve Stem 1 Error. An illuminated red LED on the indicator indicates the position controller encounters an error.

Function Generator Position Control Setpoint Source

Configure the GS16 to operate in Function Generator Position Control Mode. The Function Generator Position Control screen displays the Selected Input Type, Set Position Source, Function Generator Settings, Position Controller, Position Feedback, and Position Controller Diagnostics (Figure 4-19).

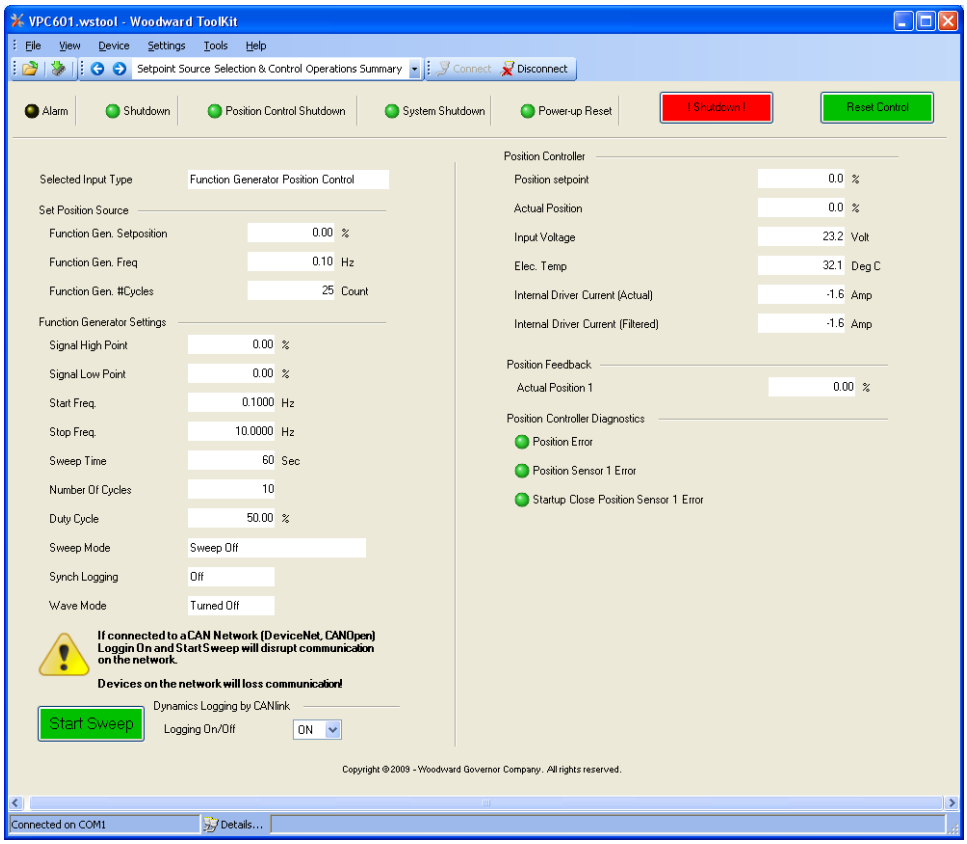


Figure 4-19. Function Generator Position Control

Selected Input Type

This indicator shows the currently selected active setpoint source.

Set Position Source

The indicator show the actual Function Gen. Set Position in percent of position (%), Function Gen. Frequency (Hz), and Function Gen. #Cycles (count).

Function Generator Settings

The indicators show the function generator setting parameters. Reconfigure these parameters by using the Edit Settings File tool.

Position Controller

This section shows the position setpoint to the controller and the actual valve position (in %), the controller's internal input voltage (volts), driver internal electronic temperature (°C), and Driver drive current (amps).

Position Feedback

Position feedback is the actual position of the valve. The position feedback is displayed as percent of electrical revolution of the resolver (% Elec Rev).

Position Controller Diagnostic

This section displays the status of the position controller. There are three possible position error were identified Position Error, Resolver Error, and Startup Close Valve Stem 1 Error. An illuminated red LED on the indicator indicates the position controller encounters an error.

Actuator Calibration

The GS16 product is manufacture configured to a single or dual resolver depends on the application. The VPC actuator calibration page of the VPC Service Tool provides an overview of the actuator position. The single resolver actuator display is shown in Figure 4-20. The tool automatically displays the resolver configuration in Single or Dual resolver. The resolver is pre-configured from the factory.

Single Resolver Actuator

The single resolver actuator screen shows the Position Scaling and Diagnostic Settings, Raw Position Sensor Data, and Position Sensor Mode (Figure 4-20).

Position Sensor 1 Scaling and Diagnostic Settings

This indicator displays the GS16 resolver factory calibrated value in digital count. The resolver min and max count represent the GS16 actuator position 0–100% scale.

Raw Position Sensor Data

This section shows the raw data in Position 1 and Position 2 in counts. Three digital graphic meters are provided to display the set position and actual position.

Position Sensor Mode

The indicator shows the GS16 is in either a Single Resolver Mode or Dual Resolver Mode.

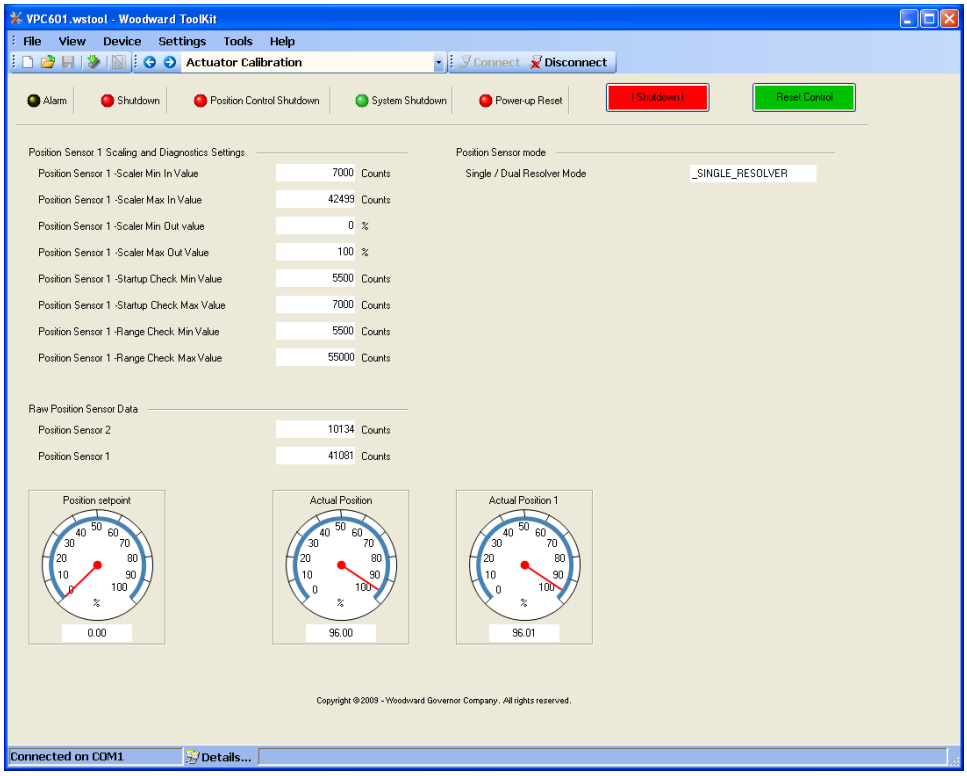


Figure 4-20. Single Resolver Screen

Position Sensor 1 Scaling and Diagnostic Settings

This indicator displays the GS16 resolver factory calibrated value in digital count. The resolver min and max count represent the GS16 actuator position 0–100% scale.

Raw Position Sensor Data

This section shows Position Sensor 1 and 2 resolver raw data. Unlike the single resolver mode, the digital graphic meters are expanded to four and they are position setpoint, actual position, actual position 1, and actual position 2.

Position Sensor Mode

The indicator shows the GS16 is set for Dual Resolver Mode.

Position Sensor 2 Scaling and Diagnostic Settings

This indicator displays the GS16 resolver 2 factory calibrated value and position sensor check value.

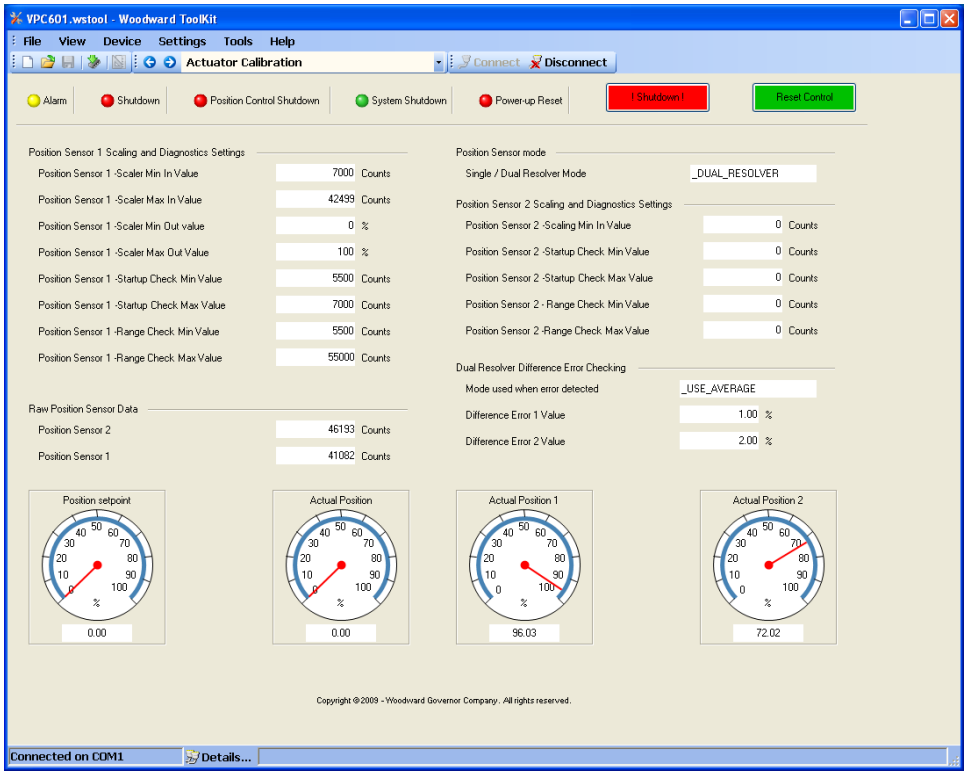


Figure 4-21. Dual Resolver Actuator

Output Configuration

The Output Configuration page displays the analog output configuration of the GS16 (Figure 4-22). The output page provides two output modes: the Discrete Output state and the Analog Output settings. These outputs can be configured for shutdown, internal shutdown, or not shutdown. The analog output scaling is configurable through the VPC Edit Settings tool (see Settings Editor Tool Section).

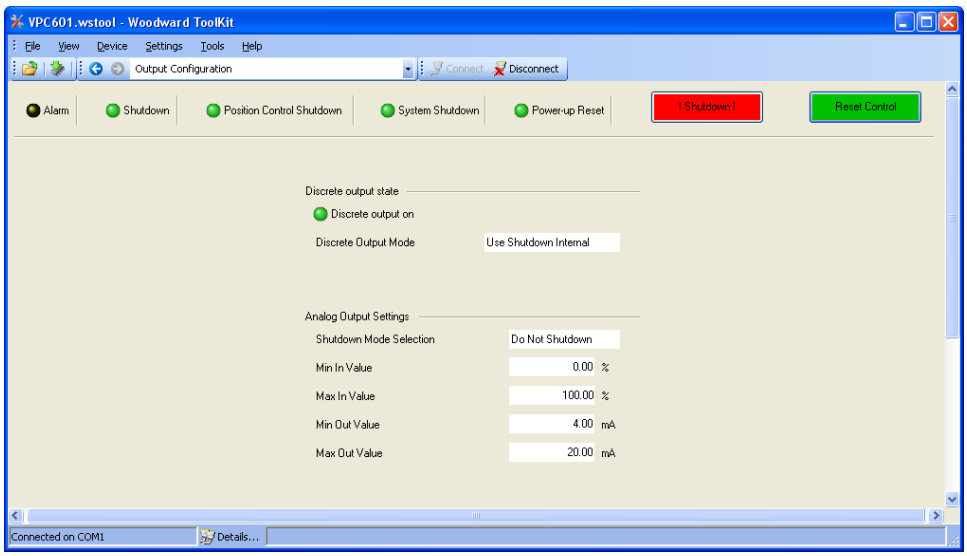


Figure 4-22. Output Configuration

Settings Editor Tool

The VPC Service Tool is designed within the Woodward Toolkit to allow the user to configure the GS16 *.wset file to fit the preferred application. The Toolkit settings utilities provides many options for the user to create, edit, and save *.wset file (Figure 4-23).

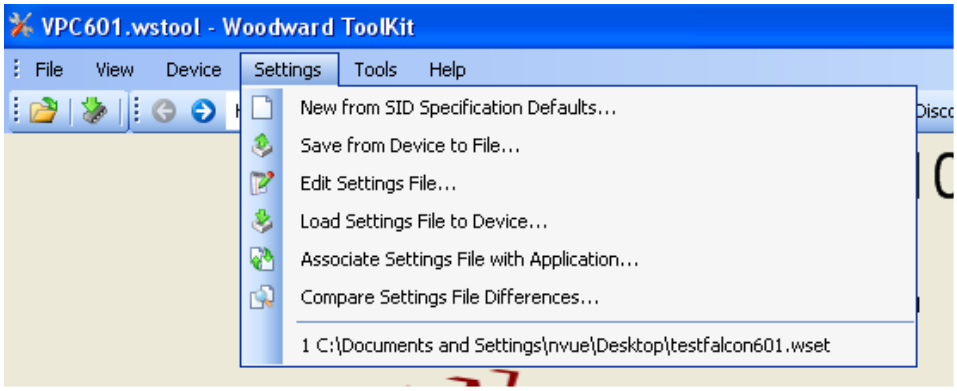


Figure 4-23. Woodward ToolKit Settings Menu

New From SID Specification Defaults
(Creating new *.wset File)

This option allows the user to create a *.wset file from the main application software SID file. To create the new *.WSET file, select the “New From SID Specification Defaults” and the tool will prompt to another window as shown in Figure 4-24. Select the appropriate VPC Service tool firmware version and click on “OK” to continue.

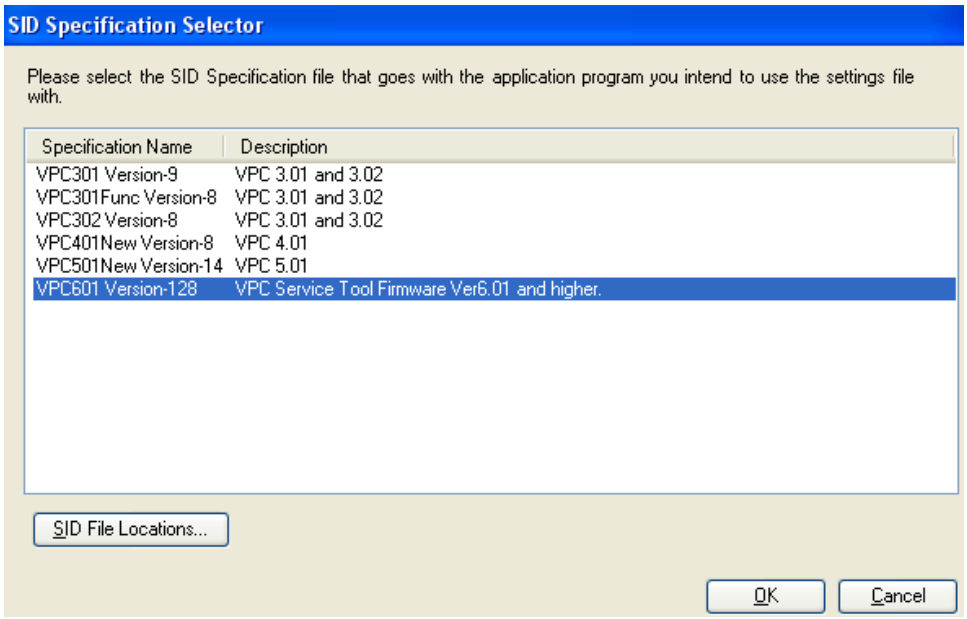


Figure 4-24. SID File Selector

Another window will prompt for a Valve Settings or User Settings (Figure 4-25). It is recommended that "User Settings" will be used for field modification. Select OK to continue.

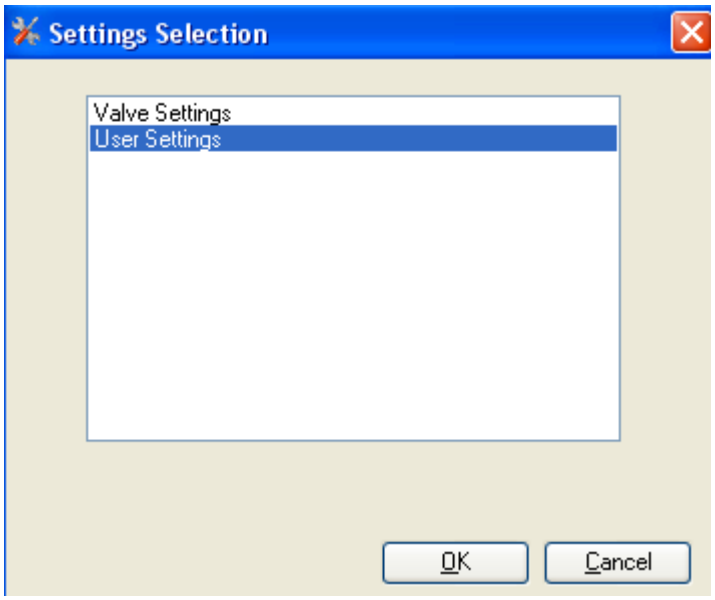


Figure 4-25. SID File Selector

The Settings Editor window will pop up for tool *.WSET file configuration. The available configurable options of the *.WSET are Input Type Selection, Input Modifications, Position Error/Resolvers, Output Selections, and Alarm Shutdown Selections (Figure 4-26).

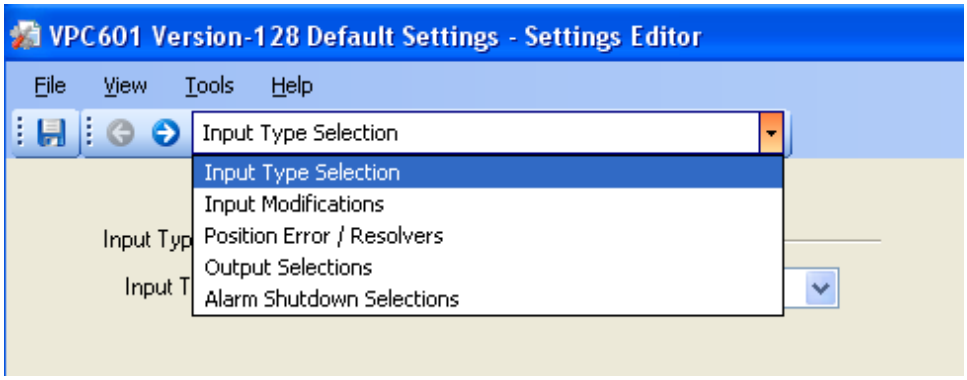


Figure 4-26. Available Configurable Options

Input Type Selection

On a typical GS16 product, the valve is factory configured to Analog Position Control as default input type. Configure this input type to meet the use's need. The Input Type Selection includes Analog Position Control, Manual Position Control, CANopen Position Control, DeviceNet Position Control, and Function Generator Position Control (Figure 4-27).

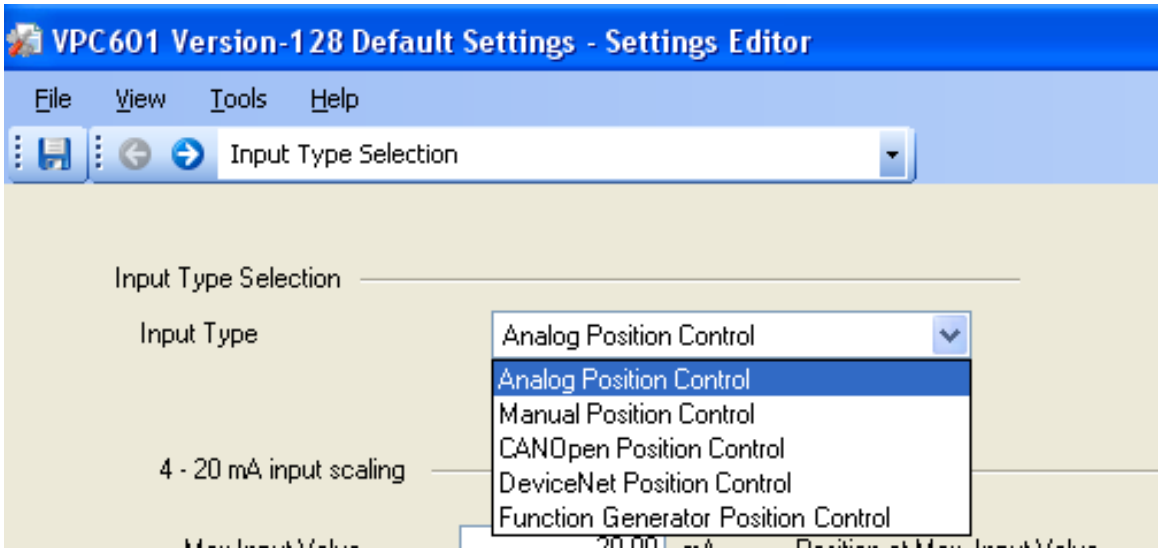


Figure 4-27. Input Type

Analog Position Control Setup

This section shows the Analog Input Position Control mode and the actual position value derived from the applied analog input signal. Signal ranges below or above the specified limits result in a fault (Figure 4-28).

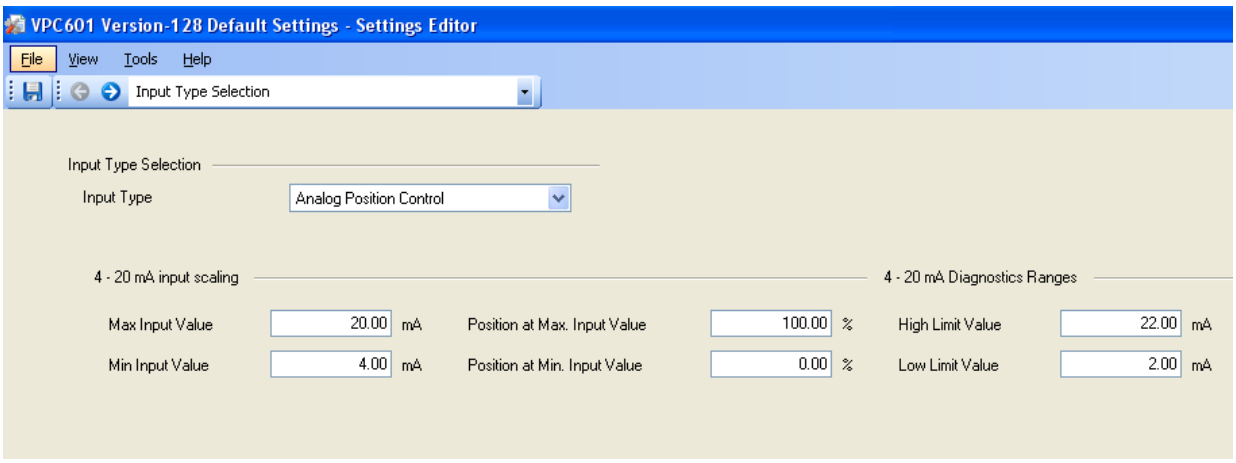


Figure 4-28. Analog Position Control

4–20 mA Analog Input Scaling

The 4–20 mA input-scaling group displays the calibration settings used to convert the analog input current level to the setpoint position in percent of position (%). The unit of the input current is milliamps (mA).

4–20 mA Diagnostic Range

The diagnostic ranges for the 4–20 mA input configuration are displayed in this section. The unit of the limit settings is milliamps (mA). Low limit is the minimum input current input that the GS16 considers as a valid input. Any the input signal drops below this limit, the software will trigger an error flag. A high limit is the maximum input current limitation on the high end.

Manual Position Control Setup

There is no parameter setting for this control page (Figure 4-29). Control parameters are hardcoded into the tool.

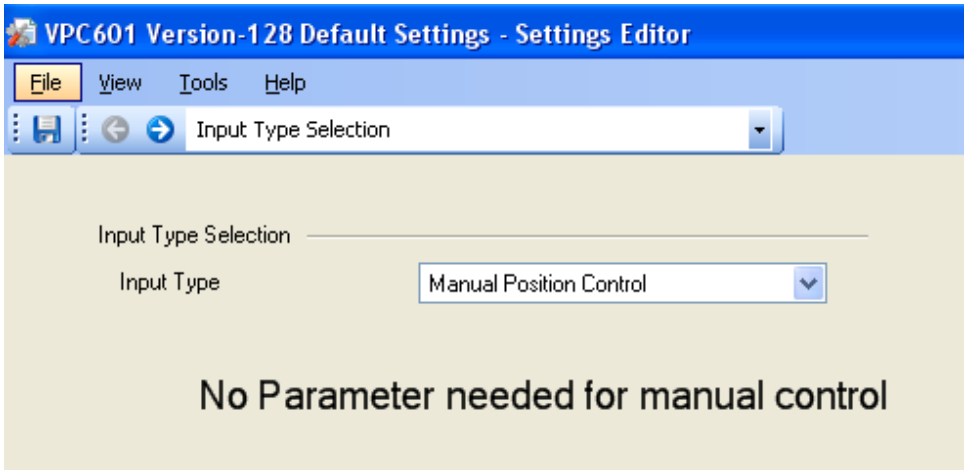


Figure 4-29. Manual Position Control

CANopen Position Control Setup

CANopen is a non-proprietary CAN-based command protocol (CAN = ‘Controller Area Network’). Refer to these protocol controllers as “NMT” controlled devices. CANopen, then, conforms to a traditional Master/Slave hierarchy.

The CANopen Input Configuration screen shows the configuration settings for the CANopen communication input of the GS16. The CANopen protocol on the GS16 is set to operate in single mode with an analog input as backup
(Figure 4-30).

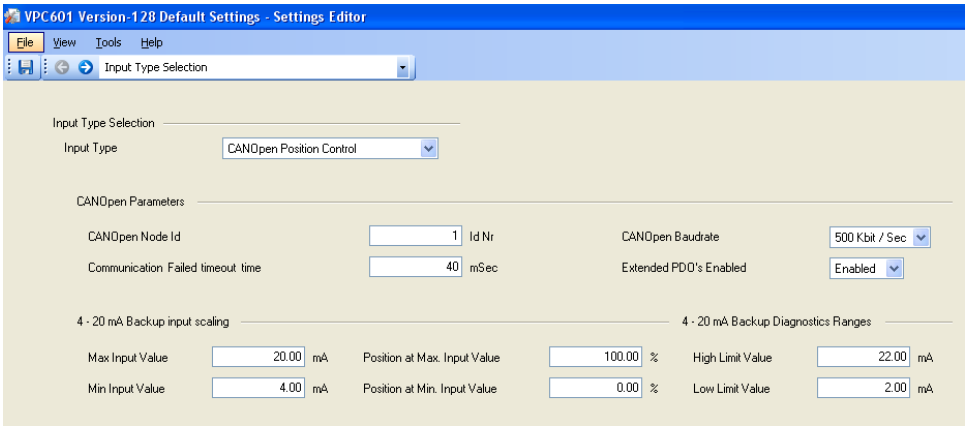


Figure 4-30. CANopen Position Control

CANopen Parameter Settings

This section shows the communication parameter settings of the CANopen communication input. The Baud Rate and port-specific Node IDs are shown as well as the Timeout parameter that determines the quality of the CAN communication link. The GS16 normally uses a non-standard implementation of the CANopen protocol. The number of PDOs has been increased over the standard setting to allow more data transfer between NMT and the GS16. This can be disabled in order to communicate with other customer's products that might require a true implementation of the CANopen protocol compliant to the standard.

The drop-down menu on the baud rate field allows changing the rate. The CANopen Communication section in this manual provides useful information regarding the CAN open Baud rate.

Analog Backup Parameter Settings on CANopen

This section shows the analog input scaling and diagnostic range. The max and min value of the input is converted to an equivalent valve position with a diagnostic fault ranges. Enter the scaling and diagnostic value for the new setting configuration.

DeviceNet Position Control Setup

DeviceNet is a non-proprietary CAN-layer protocol. The DeviceNet Input Configuration screen shows the configuration settings for DeviceNet Digital Input of the GS16. The DeviceNet protocol on the GS16 is set to operate in single mode with an analog input as backup (Figure 4-31). In this setting, the analog input can be configured as backup.

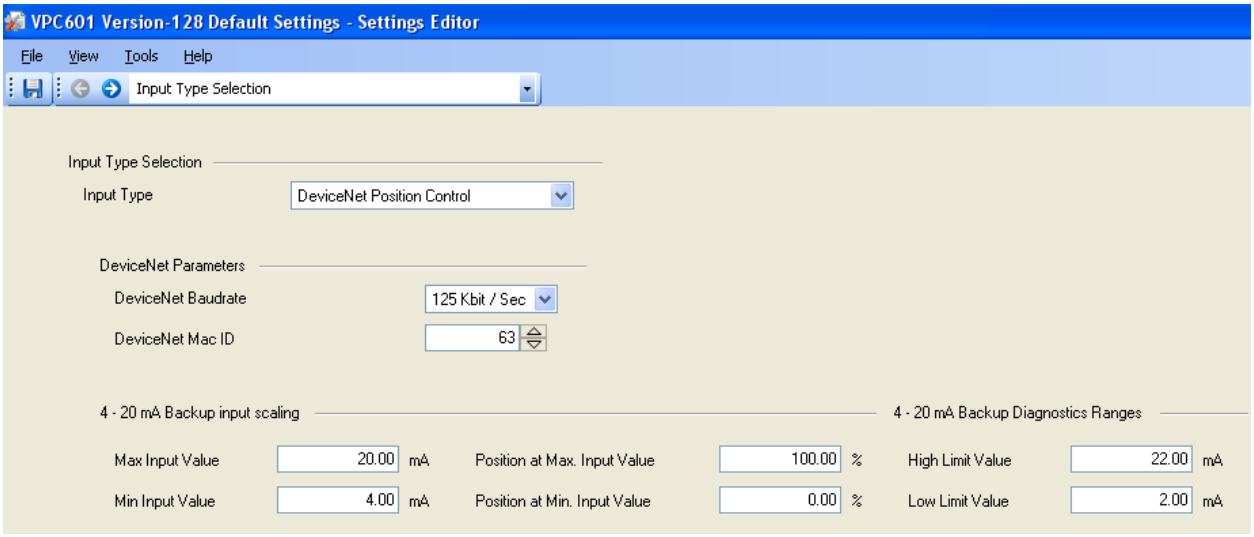


Figure 4-31. DeviceNet Position Control

DeviceNet Parameter Settings

This section shows the communication parameter settings of the DeviceNet Digital Input. The Baud Rate and port-specific Mac IDs are shown as well as the Timeout. Change the baud rate can through the drop-down menu.

Analog Backup Parameter Settings of DeviceNet

This section shows the analog input scaling and diagnostic range. Convert the Max and Min value of the input to an equivalent valve position with a diagnostic fault ranges. Enter the scaling and diagnostic value for the new setting configuration.

Function Generator Position Control Setup

The function generator is an internal Position Control function that simulates the valve. The Function Generator Configuration screen shows the configuration settings in Figure 4-32.

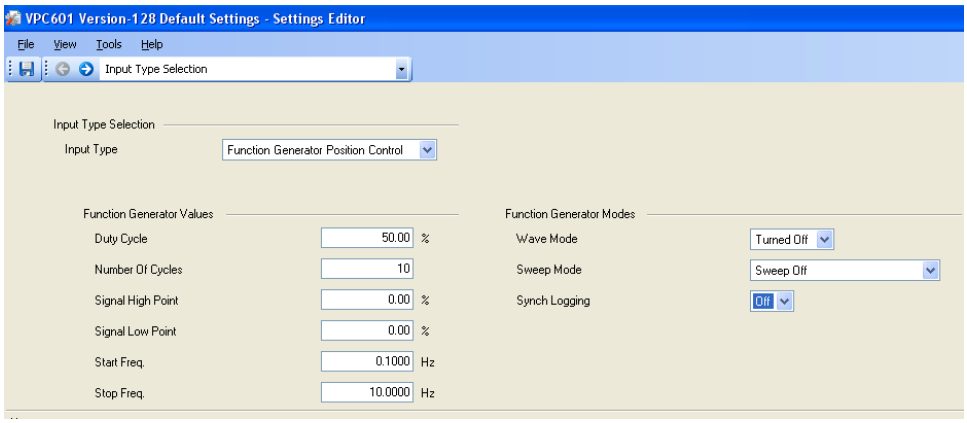


Figure 4-32. Function Generator Position Control

Function Generator Value

This section shows the duty cycle, number of cycles, hi-low point, start-stop frequency, and sweep time of the generator value.

Function Generator Modes

The function generator mode defines the sweep type of frequency and allows for turning ON/Off the Synchlogging.

Input Modification

Use this screen to configure or set to filter a noisy signal. The frequency range in the filter bandwidth can entered to the available space. This range is from 0.8 to 6 Hz with a filter of threshold 0.00% to 2.10% (Figure 4-33).

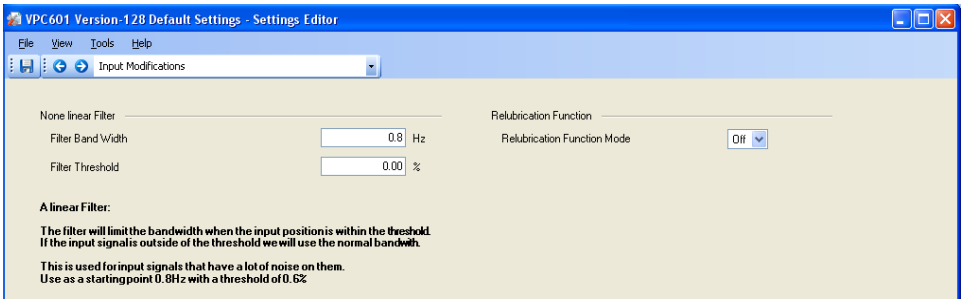


Figure 4-33. Input Modifications

Relubrication Function Mode

The Relubrication Function Mode is an advanced feature of the GS16 that triggers a position pulse at periodic points in time to redistribute the lubrication in the actuator. This function is ON/OFF selectable by using the Settings Editor Tool (Figure 4-34). An “OFF” option indicates that GS16 will not use the function. A pop-up configurable parameter menu populates on the screen when the “ON” option is selected. Modify the following parameters Time Between Pulses, Impulse Half Duration, Position Step Size using the Settings Editor Tool.

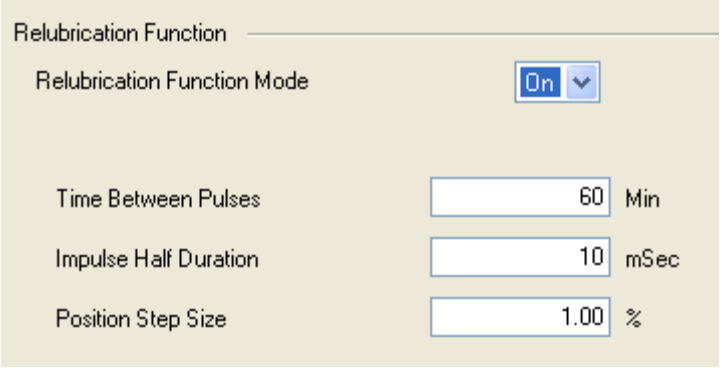


Figure 4-34. Relubrication Function

Position Error/Resolvers

The Position Error/Resolvers setting page is used to set the allowed position error of the feedback resolver. The position error function will compare the actual position and the set position (Figure 4-35).

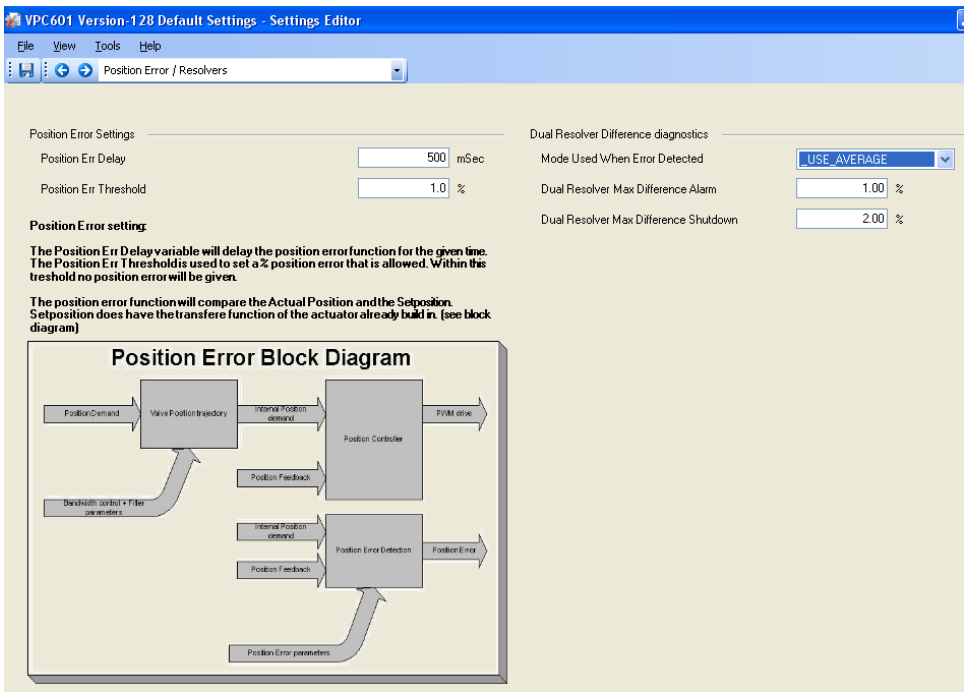


Figure 4-35. Position Error/Resolver Setting Screen

Position Error Settings

This section is the variable set to flag the resolver error mode. The Position Err Delay variable will delay the position error function for a given time. The PositionErr Threshold is used to set the allowed % of position error.

Dual Resolver Difference Diagnostics

This field is used for Dual resolver GS16 and for Position Feedback Redundancy purpose. The mode of operation can be selected from the pull-down menu.

Available options are:

- _Use_Max_Resolver
- _Use_Min_Resolver
- _Use_Average

The redundancy issues a diagnostic event when the difference between the two resolvers exceeds a specified limit. The limit is specified in percent of position (%), i.e., for example if the difference between the two resolvers is bigger than 50% and the alarm limit is set to 50% an alarm will be issued. If the difference between the resolvers keeps increasing and exceeds the shutdown limit, the redundancy manager will issue a shutdown command to GS16.

Output Selections

This Output Selections setting page contains the Analog Output Scaling, 4–20 mA Output Shutdown Mode, and Discrete Output Shutdown Mode (Figure 4-36).

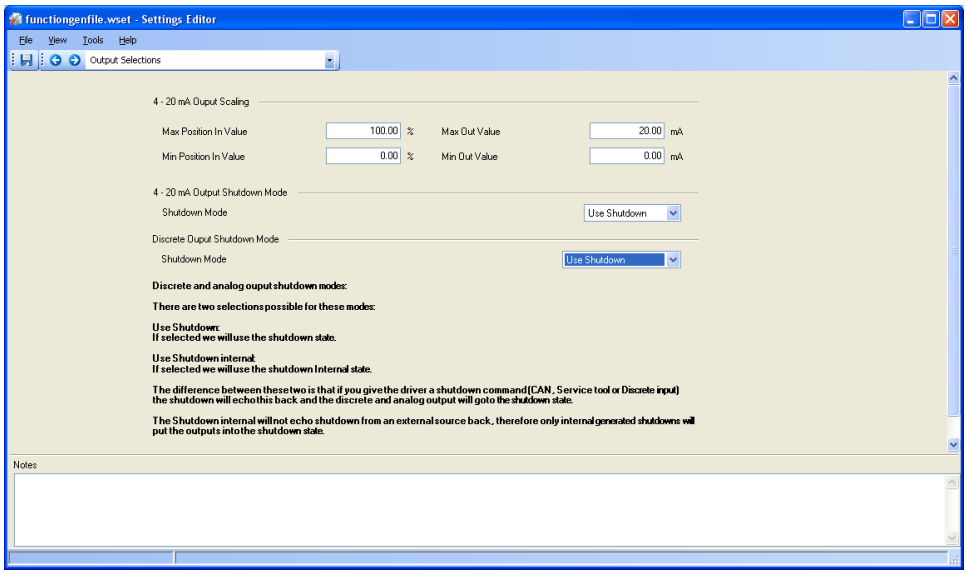


Figure 4-36. Output Selections Setting Screen

4–20 mA Output Scaling

The variable can be entered to the Analog scaling field via PC keyboard. The % of Max Position Value is corresponding to the Max out value (mA) of the Analog output.

4–20 mA Output Shutdown Mode

Configure the 4–20 mA output to trigger a shutdown mode upon detection of a diagnostic event or command from other interface sources. Use the pull-down menu to set the appropriate selectable setting.

- Use Shutdown
- Do Not Shutdown

Discrete Output Shutdown Mode

Configure the Discrete output to trigger a shutdown mode upon detection of a diagnostic event or shutdown command from other interface sources. Use the pull-down menu to set the appropriate selectable setting.

Alarm Shutdown Selections

The Alarm Shutdown Selections page can be configured to generate an Alarm or Alarm/Shutdown (Figure 4-37).

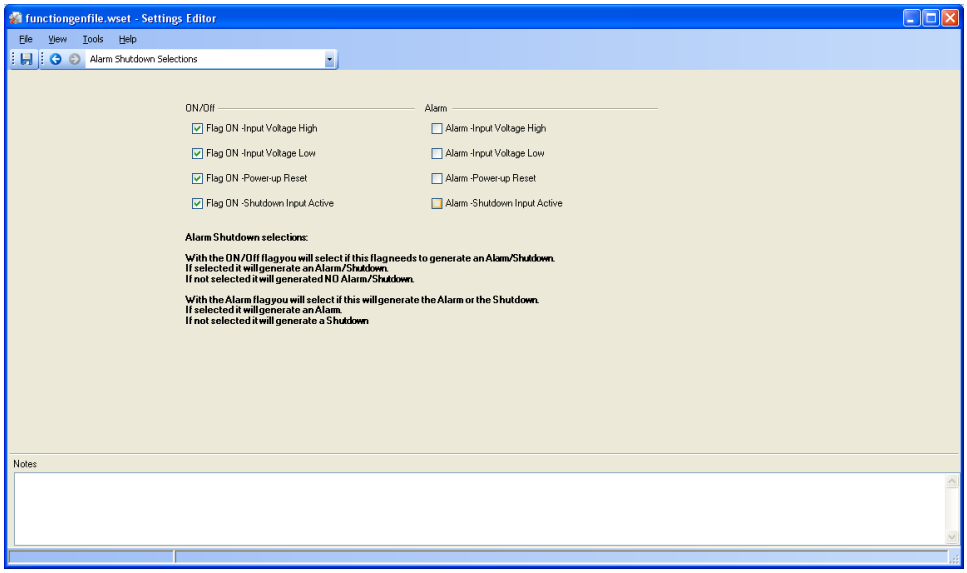


Figure 4-37. Alarm Shutdown Selection Screen

ON/OFF

With a " √ " mark on the box of the ON/Off flag, an Alarm/Shutdown will be triggered upon detection of a diagnostic event. If the box is not checked, it will generate NO Alarm/Shutdown upon detection of a diagnostic event.

Alarm

With a " √ " mark on box of the ON/Off flag, an Alarm will be triggered upon detection of a diagnostic event. If the box is not checked, it will generate a Shutdown upon detection of a diagnostic event.

Upon completion of the configuration, the *.wset file can be saved by using the file save from the main ToolKit menu (Figure 4-38). The window will prompt for file save location.

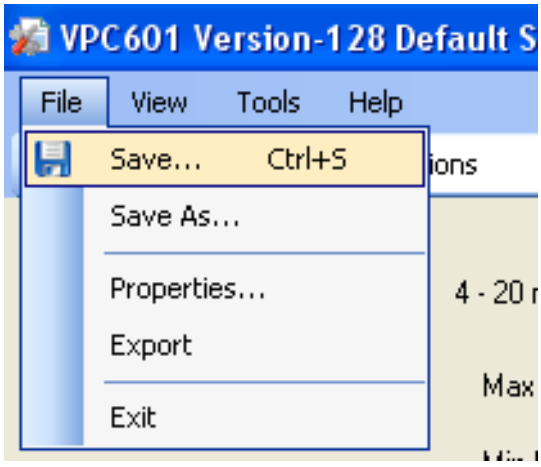


Figure 4-38. Save *.wset file

Save From Device to File

This option is to save the current setting from the GS16 to a file on the PC. First, connect the VPC Service Tool to the GS16 by pressing the Connect button or selecting 'Connect' from the main toolbar. Create GS16 settings files using the VPC Service Tool Settings Editor Wizard.

Procedure to create and save new GS16 Settings File

1. Select "Settings" from the main VPC tool bar menu.
2. Select "Save from device to File" from the pull-down menu. A Settings File Selection window is prompted for a file name to be entered.
3. Press "Browse" to enter the new file name to be saved. Leave the type extension to be .wset.
4. Press "Save' to continue. The save window is prompted for file location review.
5. If the file name and file location is the desired target, select "next" button to continue.
6. A "Valve Settings/User Settings" option window will pop up. For a new save to file, it is recommended that "User Settings " is used. Select the "User Setting" and press "Next" to continue.
7. An option note window will pop up for entering any associated information with the file.
8. Select "Next" to continue. A "Device settings saved successfully" message will appear on the screen. Select "Close" to get back to the VPC Service Tool menu.

⚠WARNING

Modification of the Valve Setting File(ValveSetting.wset) will result in loss of factory calibration settings and valve function. Only modify the User Setting File (UserSetting.wset) when needed.

Edit Settings File

This option allows the user to edit the pre-existing *.wset file. Connect the VPC Service Tool to GS16 by pressing the connect button. Once the communication has been established, select the Settings from main menu bar and choose "Edit Settings File."

Procedure to Edit GS16 Settings File

1. Select "Settings" from the main VPC tool bar menu.
2. Select "Edit Settings File " from the pull-down menu. A Settings File Selection window is prompted for a file name to be entered.
3. Press "Browse" to locate the file to be edited.
4. Press "Open" to continue. The tool will prompt the file in Setting Editor Window.
5. Modify the file to meet the need and save to location where can be loaded back to the GS16.

⚠WARNING

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. Consult with the local safety authority as necessary.

Load Settings File to Device

This option allows the user to download the *.wset file to GS16. Connect the VPC Service Tool to the GS16 by pressing the connect button or selecting 'Connect' main tool bar. A new GS16 settings file can be loaded into GS16 driver by using the Settings Editor tool.

Procedure to load the *.wset file to GS16:

1. Select "Settings" on the main VPC Service Tool bar.
2. Select "Load Settings File to Device" from the pull-down menu. A "Browse" window will prompt to locate the file.
3. Locate and select the file to be loaded and click "Open" button to open the file.
4. A file name and location window is prompted for a review. If the file is the desired file, press "Next" to continue.
5. Upon completion of file loading, a "Device settings loaded successfully" message is displayed. Click "Close" to get back to the VPC Service Tool menu and the file is loaded.

Associate Settings File with Application

This tool allows the user to associate an *.wset file with specific main software application.

Compare Settings File Difference

This tool allows the user to two different *.wset files. The tool will return difference between the files in a report form.

WARNING

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. Consult with the local safety authority as necessary.

Chapter 5.
VPC Software Upgrade

This chapter addresses the options for upgrading the GS16 Software to the latest released version using the VPC Service Tool

The following procedure must be followed to upgrade the VPC to the latest version of software:

⚠WARNING

Woodward recommends performing the software upgrade when the GS16 is operating OFFLINE. In the process of upgrading the software, the GS16 will stop its operation and the valve will be in shutdown.

⚠WARNING

Check system to ensure it is safe to upgrade before proceeding with the software upgrade.

⚠WARNING

Make sure to review the upgraded setting on VPC Service Pages before resetting the GS16. Do NOT reset the DVP without reviewing the settings.

1. Before you start, please read the part number, revision, and serial number of the product identification plate on the valve. You will need these numbers later during the software update process.

2. Make sure to shut down the VPC. Shut down the VPC by cycling power, disconnecting control signals using the shutdown input, or using the control system to shut down the valve.

3. Connect to the driver using the service tool. Click on the "**Connect**" button. A drop-down window will appear. Choose the desired network and connect. Once a connection is established, select "**Details**" at the bottom of the screen. This will give you the serial number and application ID. The application ID is the software part number.

   Note: A typical selection is COM1; Baud rate 38400.

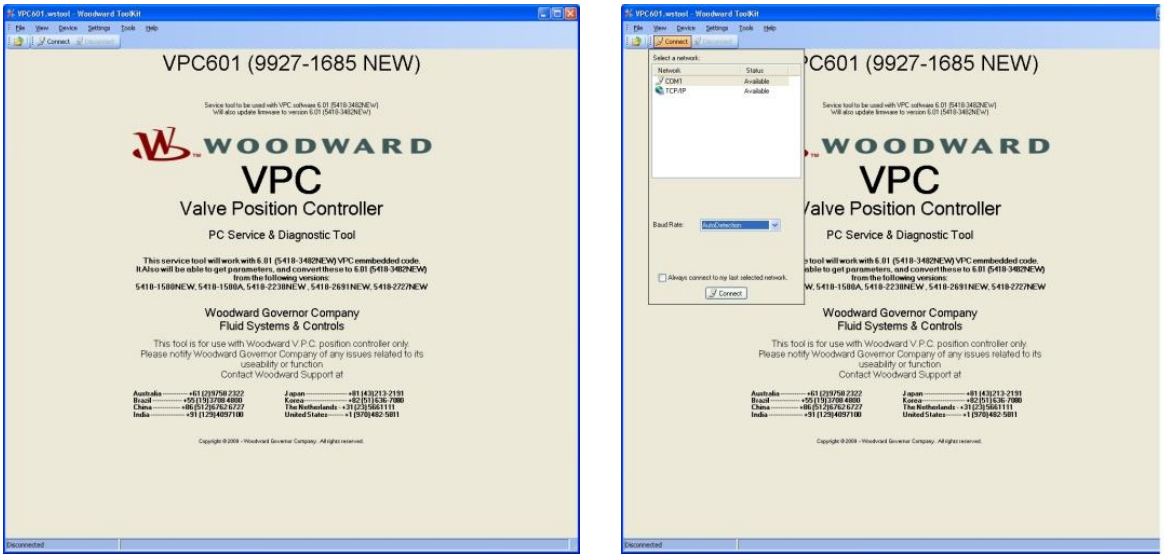


Figure 5-1. Connecting Service Tool (Screen 1 and 2)

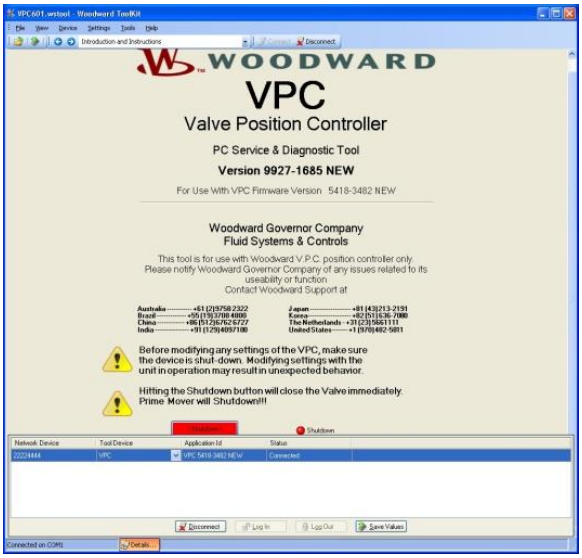


Figure 5-2. Service Tool Successfully Connected

4. Make sure the software part number is one of the following:

5418-1580New	(Ver. 3.01)
5418-1580A	(Ver. 3.02)
5418-2238New	(Ver. 3.01 Functional)
5418-2691New	(Ver. 4.01)
5418-2727New	(ver. 5.01)

5. If the part number of the software is different from the part numbers in step 4, do not update the software, Disconnect the service tool and contact Woodward. The service tool will not be able to update the software, and the valve will be loaded with software but the conversion will fail, making it impossible for the valve to operate.

6. To Load the New Application: Connect the service tool.

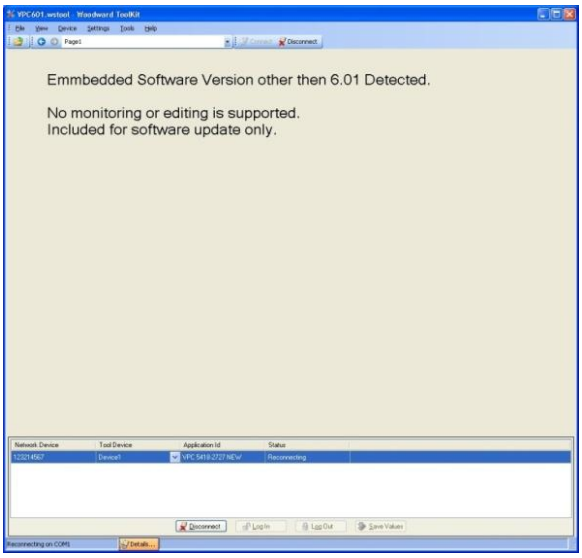


Figure 5-3. Software Version Message

7. Load the new application-using menu “File”, then “Load application”. A wizard screen will pop up. Follow the direction given. Press the **Next** button.

IMPORTANT **Shut down the control must before loading the application.**

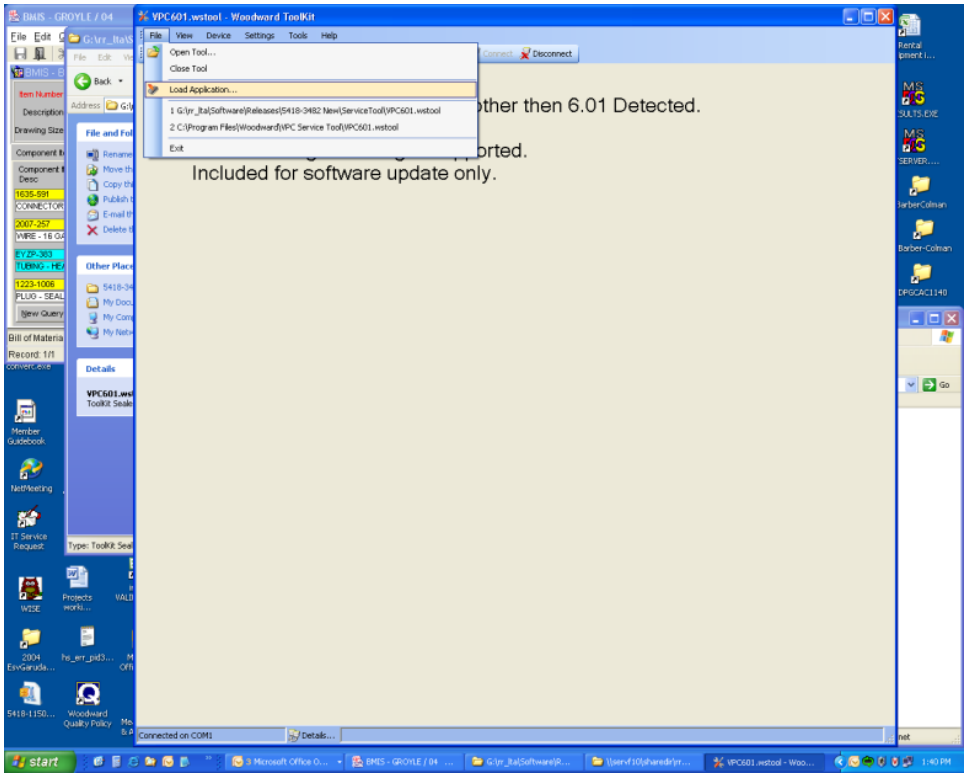


Figure 5-4. Software Load Wizard

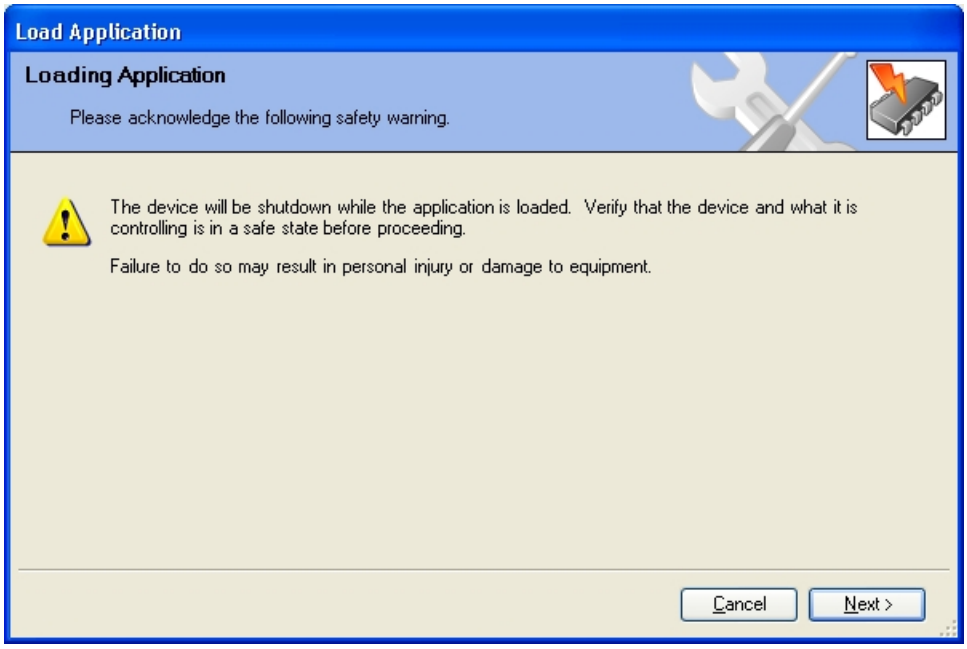


Figure 5-5. Warning Acknowledgement Screen

8. Select the file with the new application filename: VPC5418-3482.scpwapp, then click the **Next** button.

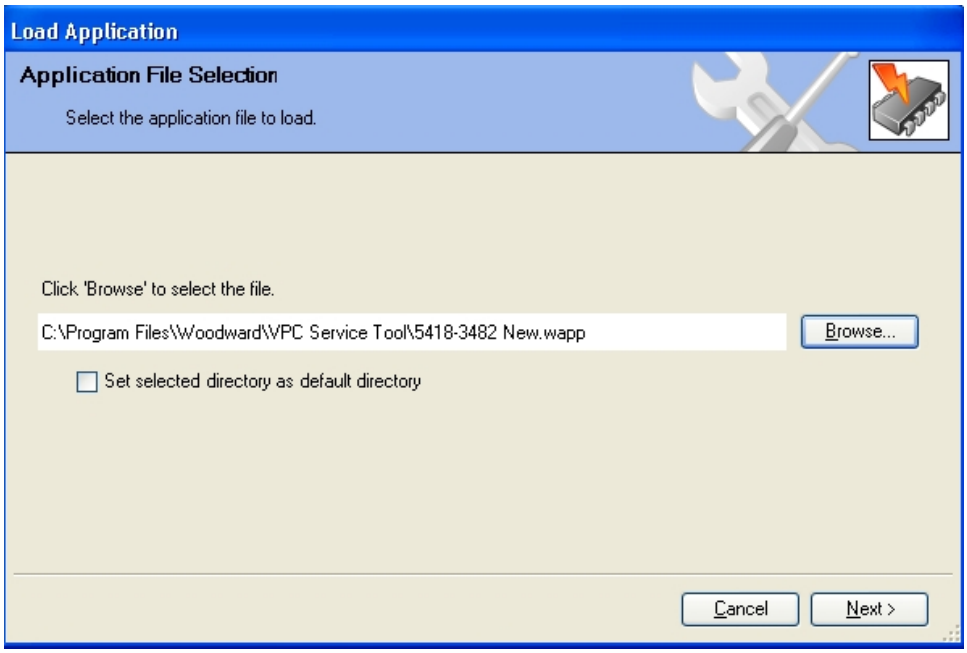


Figure 5-6. Application File Selection Screen

9. Make sure you select “Restore the device’s current setting after loading the application”

NOTICE

If you do not select this option, you will no longer be able to operate the valve after the software is loaded. Note that the first screen below is shown with the *incorrect* selection. Check the box and click Next.

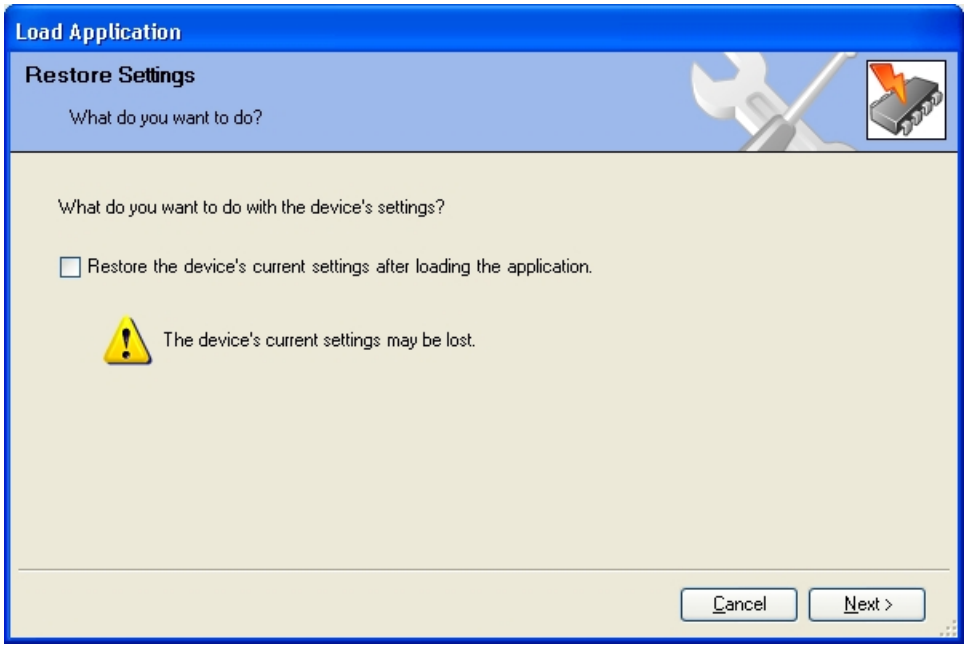


Figure 5-7. Restore Settings Screen

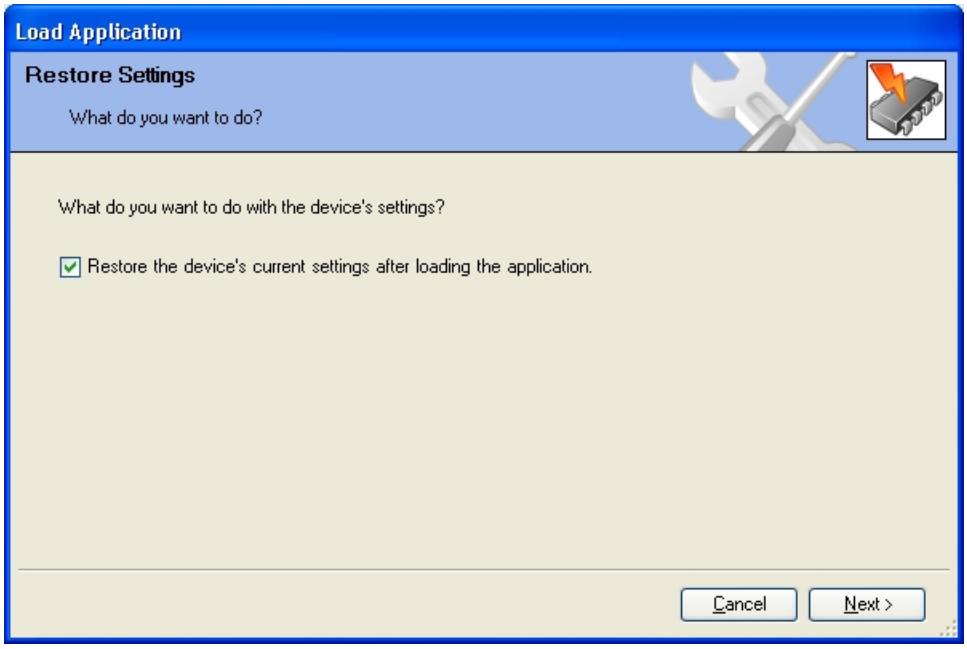


Figure 5-8. Restore Settings Screen (Checkbox Checked)

10. Depending on the version of software you are converting from, the conversion library has populated the fields it can find. Check the part number, serial numbers, and revision, and make sure that all the numbers are the same as the name plate number on the valve.

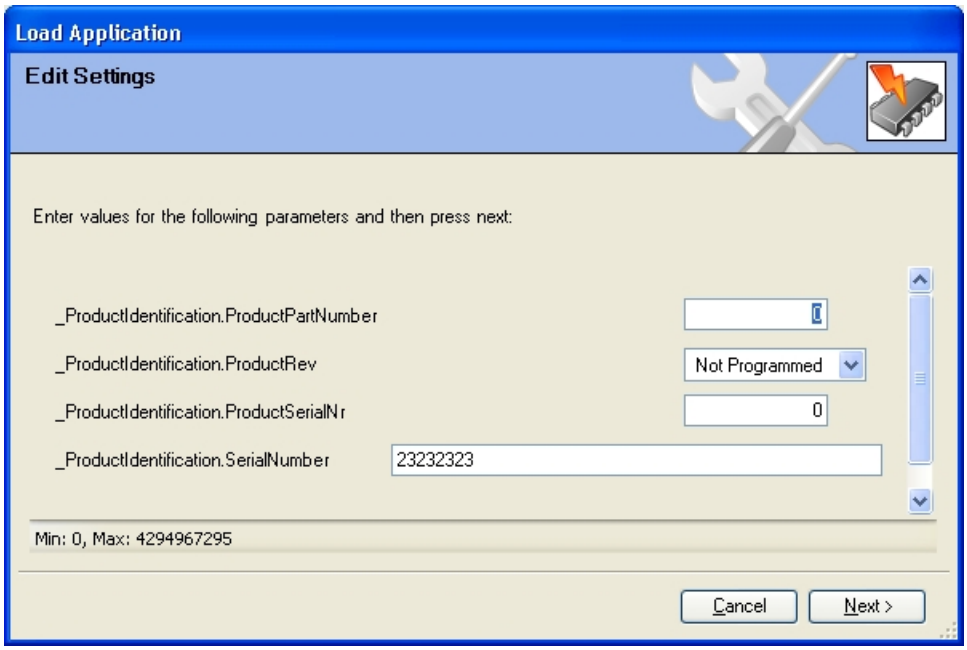


Figure 5-9. Edit Settings Screen (Defaults)

11. **ProductPartNumber** is the control part number on the outside of the valve (9907-661 in the example).

12. **ProductRev**—The “Rev” is New if no other letter is present.

13. **ProductIdentification.ProductSerailNr**—Add the serial number if not found.

14. **ProductIdentification.SerialNumber**—Repeat the serial number one more time if not present. The screen must look something like this. You can now click the next button.

NOTICE

Some control systems will use the part number to determine if the correct valve is connected.

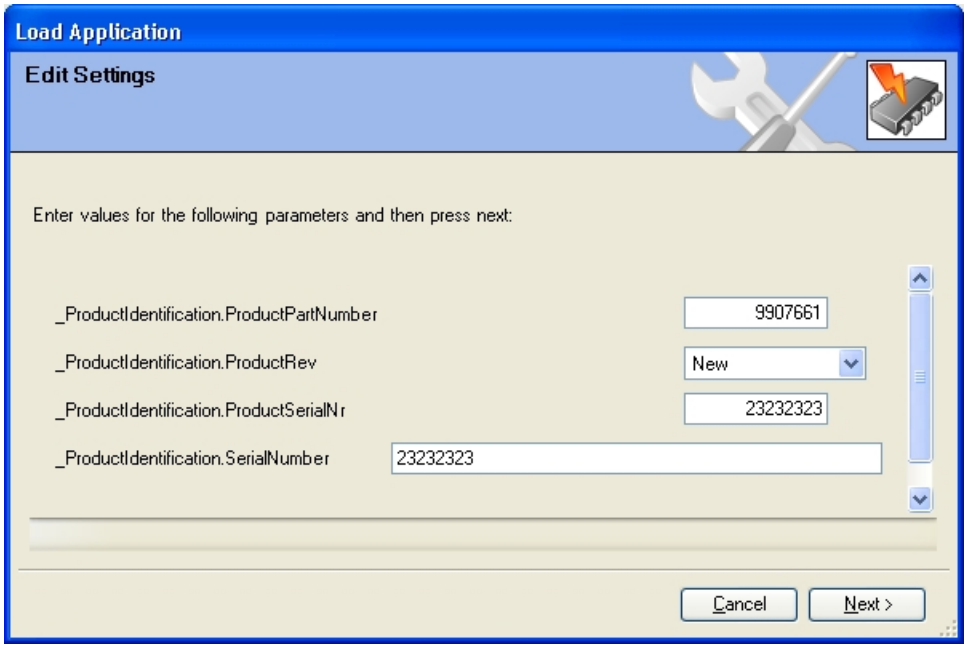


Figure 5-10. Edit Setting Screen (Values Entered)

15. If this screen is shown, the conversion worked correctly. Follow the instruction and click the **Next** button.

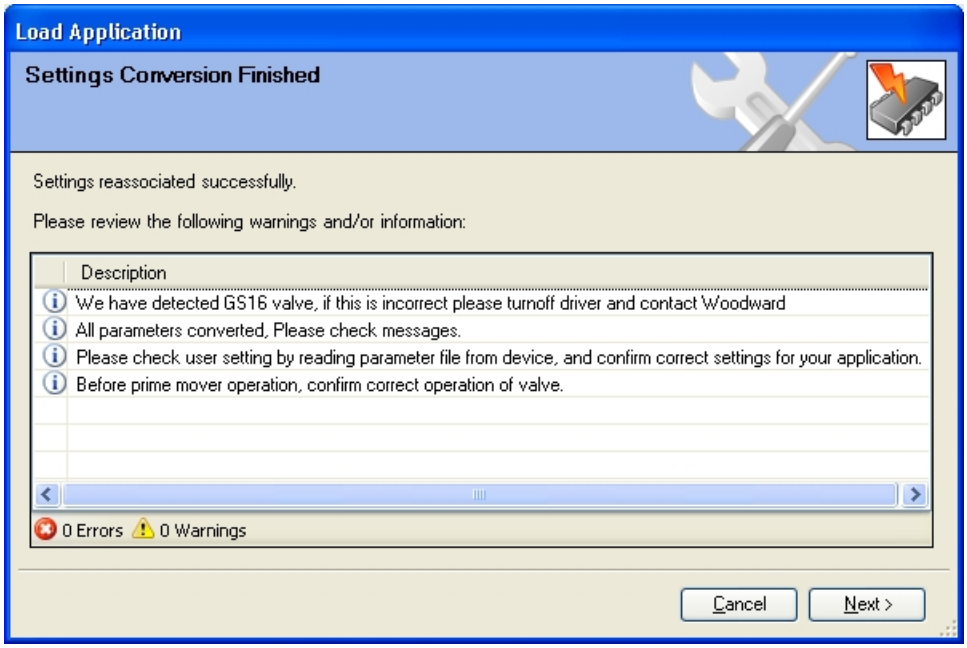


Figure 5-11. Settings Conversion Finished Screen

16. The converted setting will be loaded into the control. Wait until all settings are saved. The last screen will show the message “Application loaded successfully”. Click **Close**.

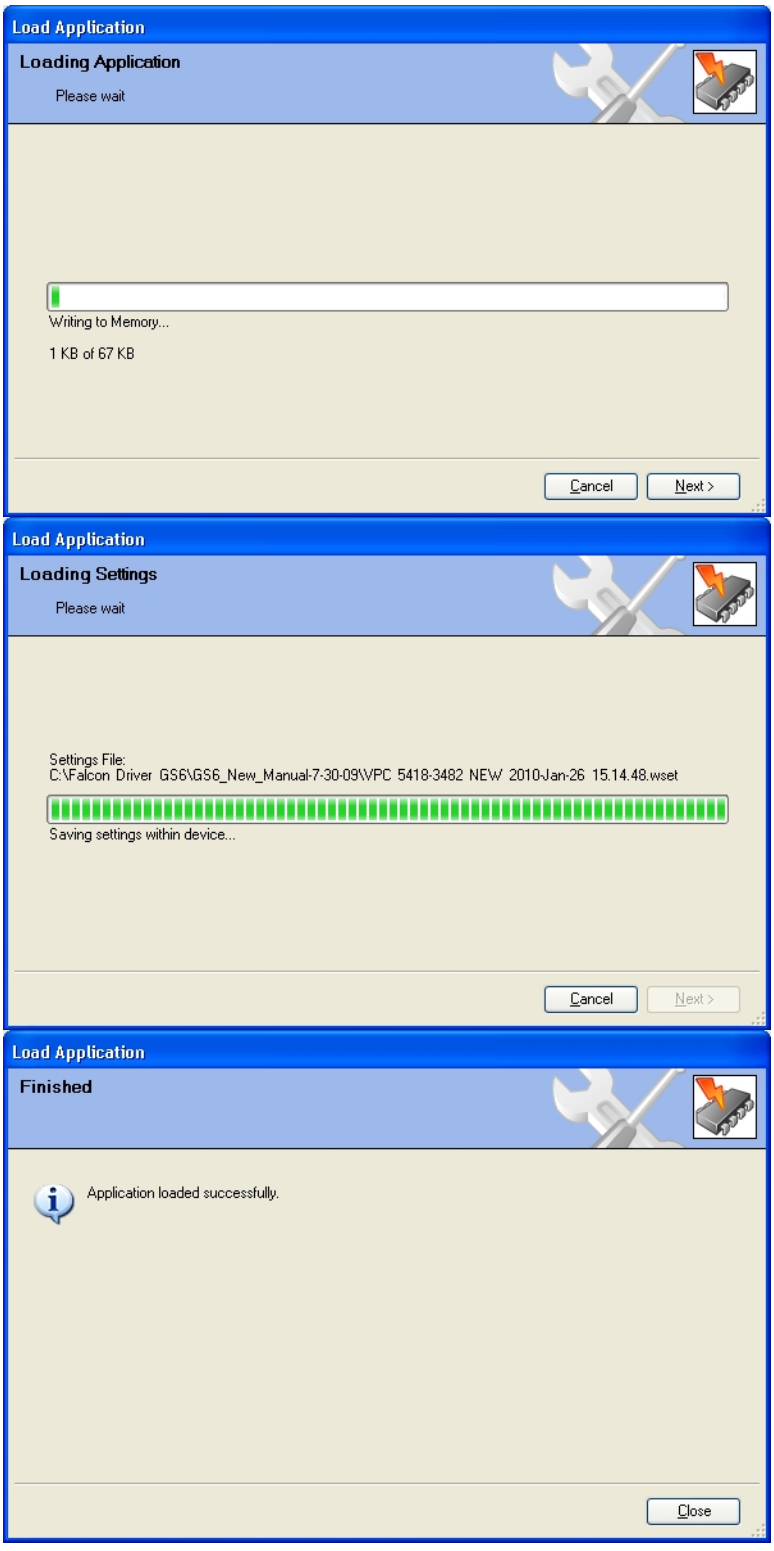


Figure 5-12. Application Load Progress and Finish Screens

17. Now cycle power on the valve.

18. Connect to the valve by clicking the Connect button—you must see the new application ID and serial number you have supplied. Go to the “Manual Control” screen and you can see the part number, serial number, and revision.

Note: You may see only the warning if the Selected Input Type does not match the Default Parameter. If so, select **OK**.

Figure 5-13. Selected Input Type, Default Parameter Mismatch Warning

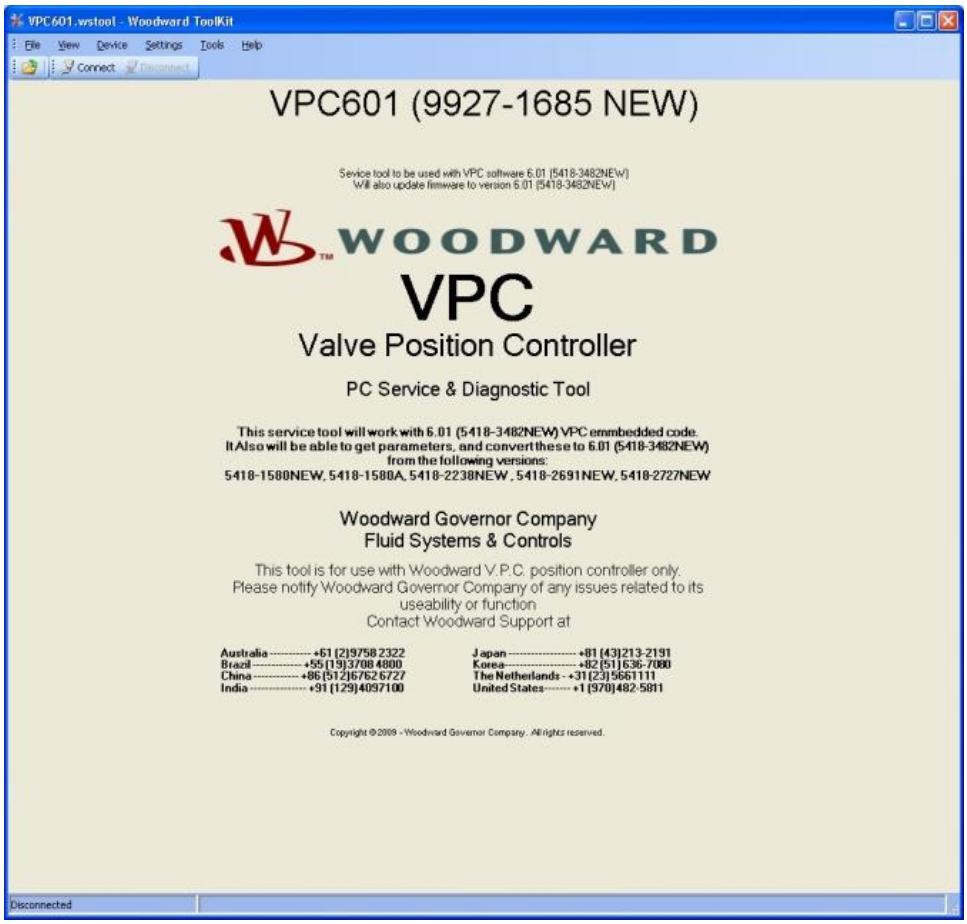


Figure 5-14. Part Number, Serial Number, and Software Revision

19. To validate the new Application ID and Serial Number you have supplied, go to the “Manual Control” screen, where you can see the part number, serial number, and revision.

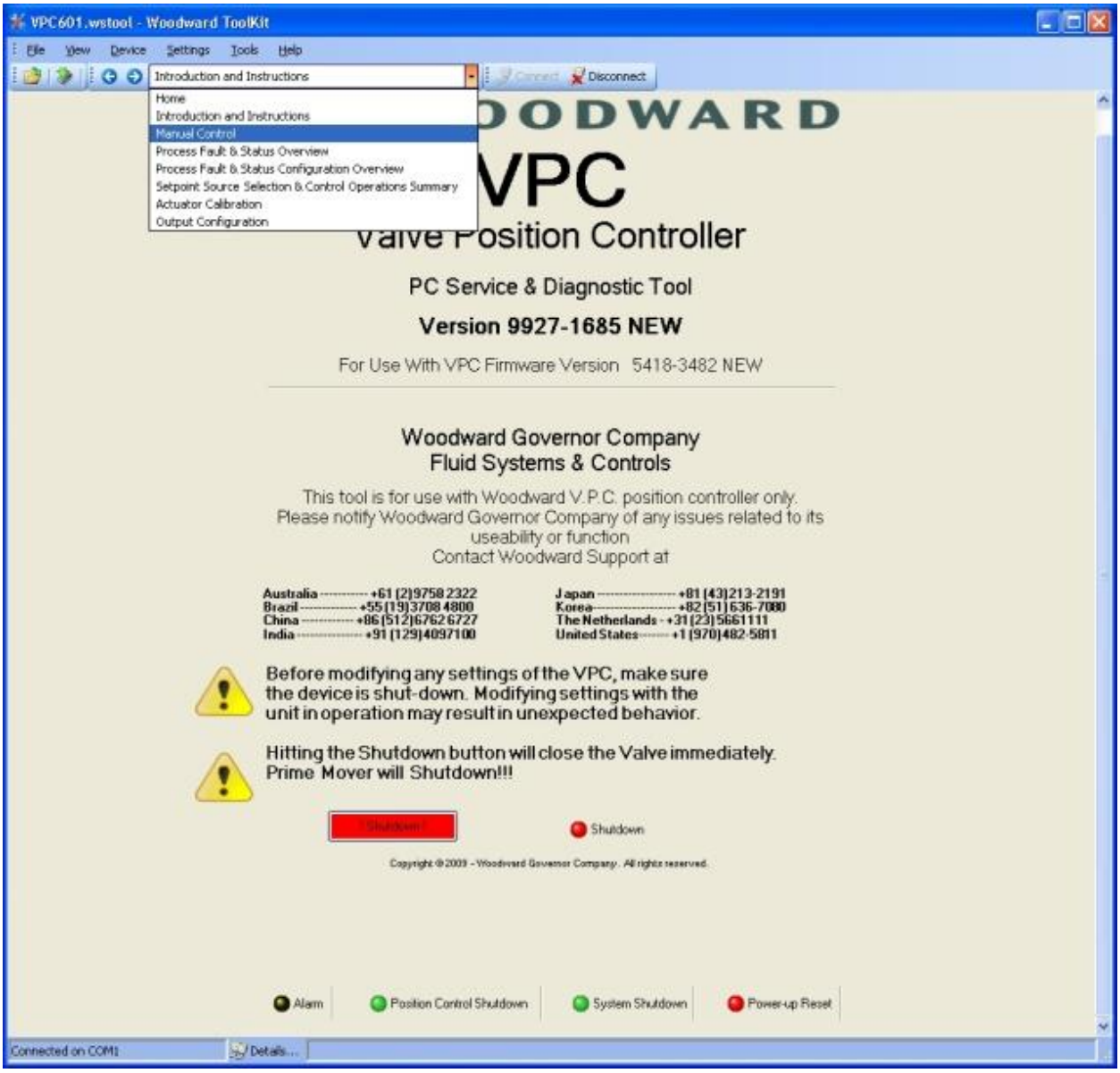


Figure 5-15. Application ID and Serial Number Validation

20. Verify the Valve Identification.

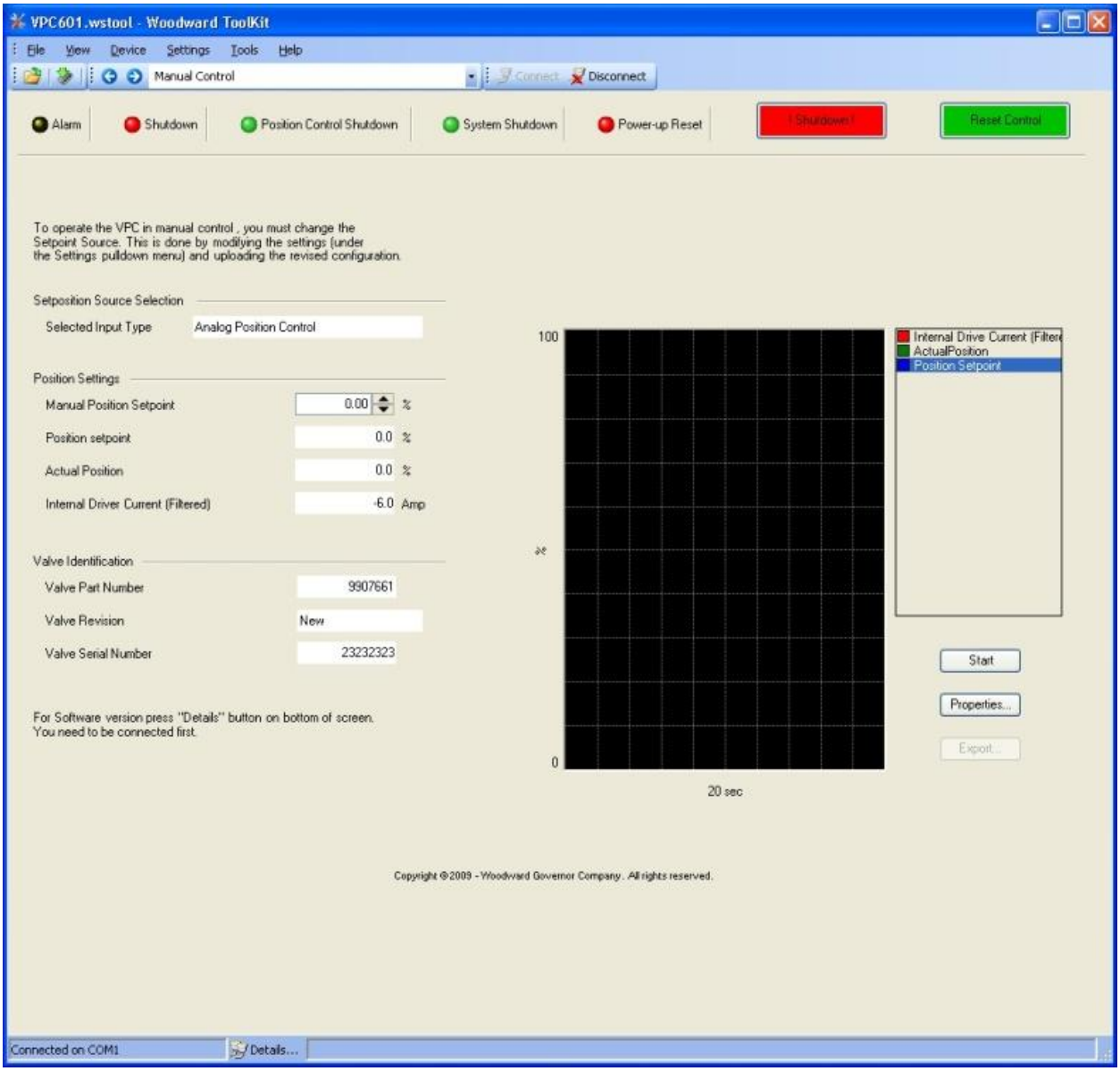


Figure 5-16. Valve ID Verification

Chapter 6.
Valve Sizing

Standard Valve Flow Calculations

Determination of Effective Area

In order to choose the proper size of valve for an application, the effective area needed to meet the maximum flow requirement must first be determined. The effective area is determined using the following equations:

Critical Pressure Ratio: $$R7 = \left(\frac{2}{1+K}\right)^{\frac{K}{K-1}}$$

If $\frac{P2}{P1} \geq R7$ then the Effective Area is calculated as follows:

$$ACd = \frac{Wf}{3955.289 \cdot P1 \cdot \sqrt{\left[\frac{K \cdot SG}{(K-1) \cdot T \cdot Z}\right] \cdot \left[\left(\frac{P2}{P1}\right)^{\frac{2}{K}} - \left(\frac{P2}{P1}\right)^{\frac{1+K}{K}}\right]}}$$

If $\frac{P2}{P1} < R7$ then the Effective Area is calculated as follows:

$$ACd = \frac{Wf}{3955.289 \cdot P1 \cdot \sqrt{\left[\frac{K \cdot SG}{(K-1) \cdot T \cdot Z}\right] \cdot \left[R7^{\frac{2}{K}} - R7^{\frac{1+K}{K}}\right]}}$$

Where:

ACd =	Effective Area (square inches)
Wf =	Mass Flow Rate (pph)
R7 =	Critical Pressure Ratio
P1 =	Valve Inlet Pressure (psia)
P2 =	Valve Discharge Pressure (psia)
K =	Ratio of Specific Heats (1.300 typical for standard natural gas at 60 °F)
SG =	Specific Gravity relative to air (0.60 typical for standard natural gas)
T =	Absolute Gas Temperature (degrees Rankine) (Deg R = Deg F + 459.7)
Z =	Gas Compressibility Factor (see note)

IMPORTANT

For sizing purposes, Z (Gas Compressibility Factor) is approximately 1.0 since its effect on the equation is relatively small.

It is recommended that the effective area for the chosen port be at least 10% larger than the calculated value from the equations previously described in order to have margin.

The valve size selected should be adequate (with at least 10% margin) for worst-case flow conditions. This would be minimum P1, maximum P2, maximum flow and maximum temperature.

Determination of Metering Port Size

Once the effective area has been determined and 10% margin has been added, determine the correct metering port size using the following graph.

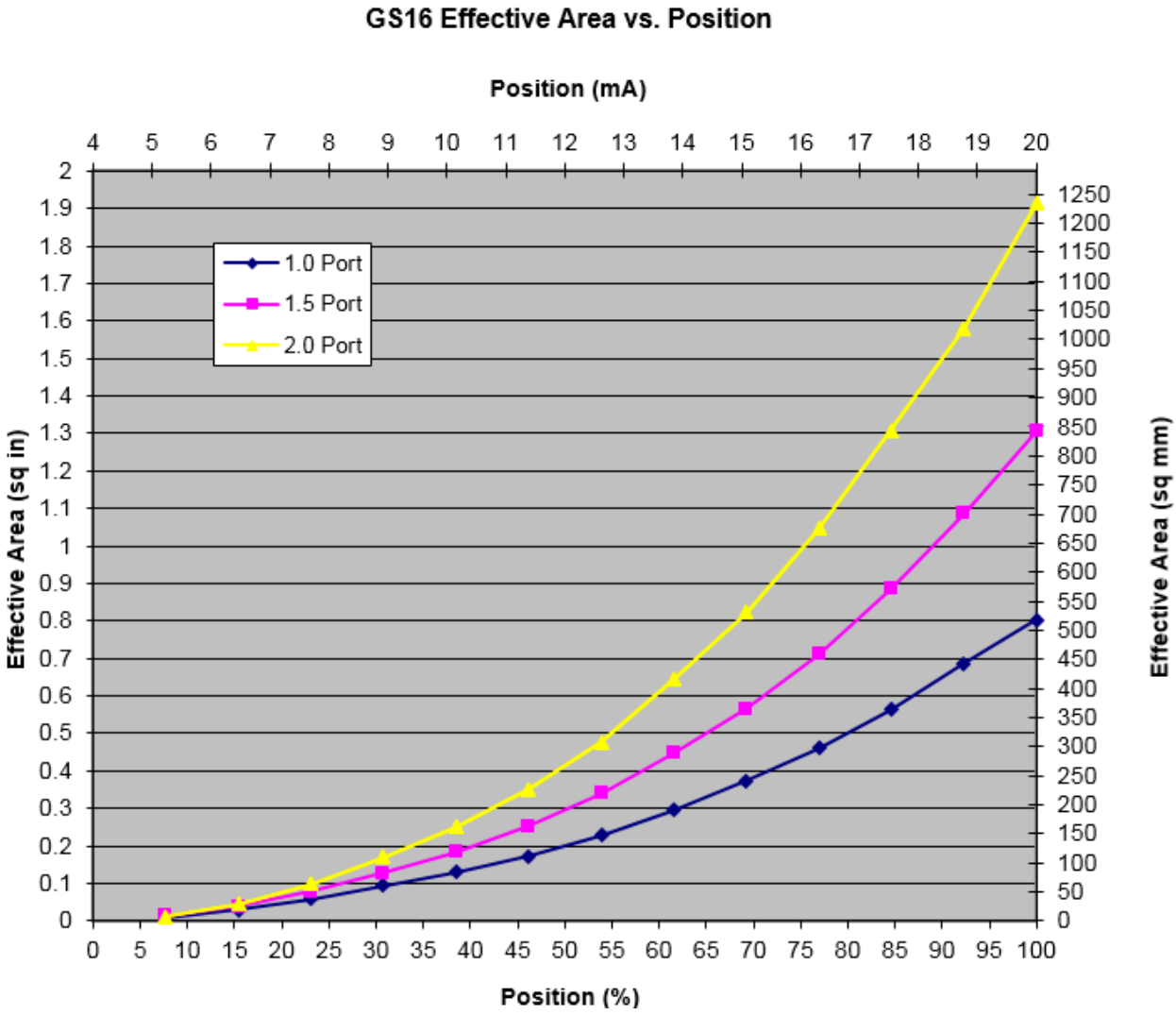


Figure 6-1. GS16 Metering Port Sizing Diagram

Chapter 7. Troubleshooting

For troubleshooting using the VPC Service Tool, reference Figure 4-2 “Valve Overview Status”. Other troubleshooting methods using the VPC Service Tool may be found in the Help section of the service tool.

Possible Reason	Explanation	Action
Power up Reset (Shutdown)	After power up, the valve will go into shutdown until the valve is reset by the shutdown reset input.	Reset the valve after power up.
Shutdown Input Active (Shutdown)	If the shutdown input is active (open), the valve will be in shutdown.	Check wiring and/or control system.
Analog Low Error (Shutdown or switch to DeviceNet / CANopen)	If the analog input is not connected, an analog input low error (< 2 mA) will shut down the valve.	Check the wiring and the control system.
Analog High Error (Shutdown or switch to DeviceNet / CANopen)	If the analog input is mis-connected or driven with more than the normal current, an analog high error will shut down the valve (> 22 mA).	Check the wiring and the control system.
DigitalCom Error (Shutdown or switch to Analog)	This error is caused by one of the following conditions. • Incorrect or zero length message • Duplicate MAC ID • Bus Off • No messages received	Check the wiring and the control system.
Startup Position Error 1 (Shutdown Position or run with other resolver)	During the start-up of the valve, the valve is closed to detect if resolver 1 is at the programmed position. If not, the valve will shut down (Single Resolver) or run using Resolver 2 only (Dual Resolver).	Reset the valve, and the test will be performed again if the valve is Shutdown. Check if there is an obstruction in the valve. Check if the valve needs cleaning. Check pressure rating.
Startup Position Error 2 (Shutdown Position or run with other resolver) (Dual Resolver Only)	During the start-up of the valve, the valve is closed to detect if resolver 2 is at the programmed position. If not, the valve will run using Resolver 1 only. If both resolvers are not at the programmed position, the valve will shut down.	Reset the valve, and the test will be performed again if the valve is Shutdown. Check if there is an obstruction in the valve. Check if the valve needs cleaning. Check pressure rating.
Position Error (Shutdown Position)	During run time, the valve will check if the position feedback and the demanded position are the same. If not, a position error will be flagged, and the valve will be shut down.	Check if there is an obstruction in the valve. Check if the valve needs cleaning. Check pressure ratings.
Tracking Error	The difference between the DeviceNet / CANopen position demand and the Analog position demand is greater than the configured limit (1% default).	Check the control system analog output and the valve analog input.

Possible Reason	Explanation	Action
Position Sensor Error 1 (Shutdown Position or run with other resolver)	The valve is continuously checking if the signals for resolver 1 are correct. If the resolver signals are missing or incorrect, a Position Sensor Error 1 is set and the valve will continue running on resolver 2 if the valve has dual resolvers.	Check wiring in the valve. Replace valve.
Position Sensor Error 2 (Shutdown Position or run with other resolver) (Dual Resolver Only)	The valve is continuously checking if the signals for resolver 2 are correct. If the resolver signals are missing or incorrect, a Position Sensor Error 2 is set and the valve will continue running on resolver 1 if the valve has dual resolvers. If both resolvers have errors, the valve will shut down.	Check wiring in the valve. Replace valve.
Resolver Difference Error 1 (Dual Resolver Only)	The difference between Resolver 1 and Resolver 2 is greater than the configured limit for Resolver Difference Error 1.	Check wiring in the valve. Replace valve.
Resolver Difference Error 2 (Dual Resolver Only)	The difference between Resolver 1 and Resolver 2 is greater than the configured limit for Resolver Difference Error 2.	Check wiring in the valve. Replace valve.
Internal Error	There are different internal errors that can be detected. • Supply voltage errors • AD converter errors • Software errors (Watchdog) • Factory calibration and parameter errors All of these errors will make the valve shut down in one of the three modes (Typical Shutdown System).	There is an internal error detected. Replace the valve.

⚠WARNING

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. Consult with the local safety authority as necessary.

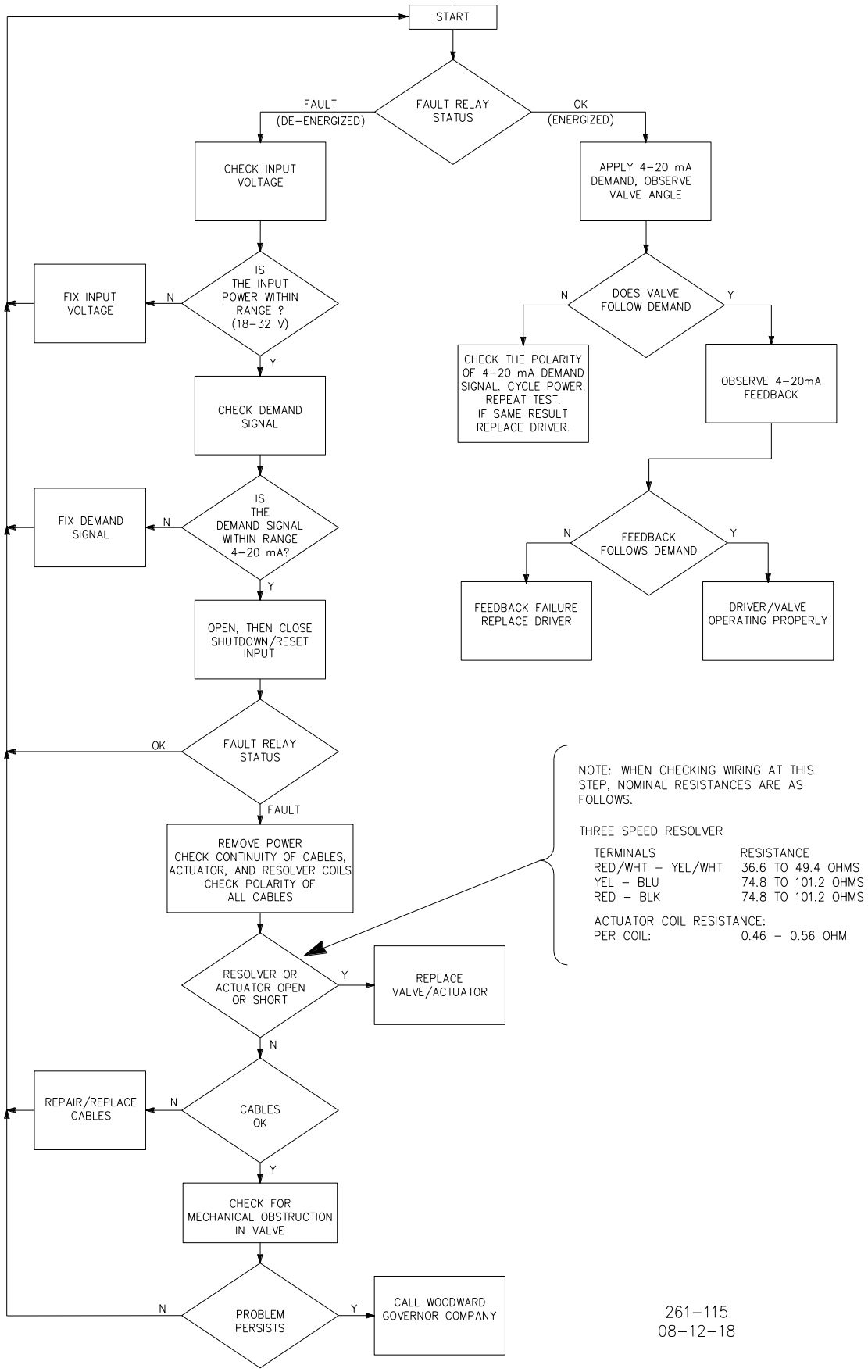


Figure 7-1. Troubleshooting Flowchart

Chapter 8.
Maintenance

No maintenance is required for the GS16 valve; however, performing periodic cleaning is recommended. A petrochemical solvent is recommended to clean (wash and brush) the valve. Do not use high-pressure power washing. 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.

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

⚠WARNING

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

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

⚠WARNING

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

⚠WARNING

Do not lift or handle the valve by any conduit.

⚠WARNING

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the GS16 valve.

⚠WARNING

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.

⚠WARNING

Proper torque is critical to ensure that the unit is sealed properly.

Chapter 9.
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 current list of Woodward Business Partners is available at:
https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

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 (Woodward North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690).

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 North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690). 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

NOTICE

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 one of the Full-Service Distributors listed at: **https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner**

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **https://www.woodward.com/support**, 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 receive information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (51) 636-7080
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.) _____

Control/Governor Information

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.

GS16 Control Specifications

Electrical Characteristics	
Input voltage range:	18–32 VDC
Normal input current range (steady-state, maximum):	< 2.0 A typical; 5.0 A maximum
Maximum continuous input current:	5 A
Maximum transient input current:	12 A for 100 ms maximum to the controller
Mechanical Characteristics	
Valve Geometric Area's Available	645 mm² (1.0 in²) 968 mm² (1.5 in²) 1290 mm² (2.0 in²)
Weight:	48 kg (105 lb)
Mounting:	See installation drawings
Fuel connections:	Recommend Gas Filtration: 25 µm See installation drawings
Environmental	
Fuel Type:	Natural gas
Ingress Protection:	IP66 per IEC EN 60529
Pressure	
Operating inlet fuel pressure range:	690 to 5171 kPa (100 to 750 psig, 6.9 to 51.7 bar)
Proof pressure:	7757 kPa (1125 psig)
Burst pressure:	25 856 kPa (3750 psig)
Nominal piping size (DN):	50.8 mm
Maximum Overboard Drain Port (OBVD) Backpressure:	69 kPa (10 psig)
Temperature	
Ambient:	–40 to +93 °C (–40 to +200 °F)
Fuel temperature:	–40 to +93 °C (–40 to +200 °F)
Unpowered Heat Soak:	125 °C, 2 hours
Vibration and Shock	
Swept sine vibration:	Per US MIL-STD-810C, Method 514.2, Procedure I, Figure 514.2-2, Curve AR (2g)
Shock:	Per US MIL-STD-810C, Method 516.2, Procedure I, (10g)
Flow Characteristics	
Non-characterized Accuracy:	The accuracy of the port scheduling is better than 5% of point or 2% of full scale flow rate from a nominal calibration schedule at room temperature, whichever is the most stringent at any point in the flow schedule from 2% to 100% of full scale flow rate.
Temperature Drift:	The maximum temperature drift for analog positional accuracy will be 0.05% of full-scale input demand (4–20 mA) per degree F. Digital accuracy is not affected.
Common Mode Rejection:	Maximum common mode error for analog positional accuracy will be 0.025% of full-scale input demand per volt common mode. Common mode voltage being the average voltage at 4–20 mA inputs with respect to power supply ground. Digital accuracy is not affected.

Revision History

Changes in Revision AA—
- Replaced EU DoC

Changes in Revision Y—
- Added GS definitions and Chinese translations to the Regulatory Compliance section
- Added Installation Instructions Requirement page

Changes in Revision W—
- Chapter 2: Changed low temperature range of -29 °C to -40 °C

Changes in Revision V—
- Added China Compulsory Certification

Changes in Revision U—
- Chapter 3: Added warning note to not use the “shutdown position” command repeatedly.

Changes in Revision T—
- Updated Pressure Equipment Directive (Valve Assembly) in Regulatory Compliance section
- Updated EU Declaration of Conformity

Changes in Revision R—
- Updated Regulatory and Compliance section
- Replaced Declarations

Changes in Revision P—
- Revised Ingress Protection certification in the GS16 Control Specifications Table

Changes in Revision N—
- Revised PED (Valve Assembly) and ATEX Directives in Regulatory Compliance section
- Added RoHS Directive in Regulatory Compliance section
- Replaced Declarations

Changes in Revision M—
- Added Warning box to pg. 62

Changes in Revision L—
- Updated Regulatory Compliance information and Declarations

Changes in Revision K—
- Expanded information on use of electrolytic capacitor (page 17)

Changes in Revision J—
- Updated Regulatory Compliance information
- Updated Declaration

Changes in Revision H—
- Updated Regulatory Compliance information
- Updated Declaration

Changes in Revision G—
- Changed supply voltage current peak from 7 A to 12 A (page 9)
- Added power wiring recommendation (page 10)
- Updated current information on Control Specifications page
- Updated Declaration of Conformity

Changes in Revision F—

- Removed restricted temperature rating for CE Marking

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00143-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	Gas Fuel Metering Valves: GS6, GS6DR, GS6FS, GS16, GS16DR, GS16DR HP Liquid Fuel Metering Valves: LQ6, LQ6T, LQ6BP
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 2014/68/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment Gas Fuel Metering Valves: PED Category II ; All others: SEP 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: *Note: See Appendix*	All Except GS16DR, GS16DR HP: Ⓔx II 2 G, Ex db IIB T3 Gb All: Ⓔx II 3 G, Ex ec IIC T3 Gc
Applicable Standards:	ASME Boiler and Pressure Vessel Code VIII, Div. 1, 2015. EN IEC 60079-0:2018: Explosive atmospheres – Part 0: Equipment - General requirements EN IEC 60079-1:2014: Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d" EN IEC 60079-7:2015/A1:2018 Explosive atmospheres – Part 7: Type of protection by increased safety "e" 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:	Category 2: TUV 13ATEX7404X Category 3: TUV 13ATEX7409X TUV Rheinland Industrie Service GmbH (0035) Am Grauen Stein, D51105 Cologne
Conformity Assessment:	PED Module H – Full Quality Assurance CE-0062-PED-H-WDI 001-25-USA-rev-A Bureau Veritas SAS (0062) 4 Place des Saisons, 92400 COURBEVOIE, FRANCE ATEX Annex IV - Production Quality Assessment, 01 220 113542 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	Annette Lynch
Full Name	Annette Lynch
Position	Engineering Manager
Place	Woodward, Fort Collins, CO, USA
Date	14 April 2025

5-09-1183 Rev 43

Appendix – Limitations on compliance vs. models

Valve Type	Model	CE Marking				
		EMC	Machinery	ATEX Zone 1	ATEX Zone 2	PED
Gas Fuel	GS6	C	C (DoI)	C	C	C
	GS6DR	C	C (DoI)	C	C	C
	GS6FS	C	C (DoI)	C	C	C
	GS16	C	C (DoI)	C	C	C
	GS16DR	C	C (DoI)	N	C	C
	GS16DR HP	C	C (DoI)	N	C	C
Liquid Fuel	LQ6	C	C (DoI)	C	C	C (SEP)
	LQ6T	C	C (DoI)	C	C	C (SEP)
	LQ6BP	C	C (DoI)	C	C	C (SEP)
C - Compliant ; N - Not Compliant						

DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File name:	00143-04-EU-02-03
Manufacturer's Name:	WOODWARD INC.
Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Names:	GS6, GS6DR, GS6FS, GS16, GS16DR, LQ6, LQ6T, LQ6BP 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 documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

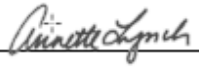
The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Inc. of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER



Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

February 1, 2022
Date

Document: 5-09-1182 (rev. 18)

安装使用要求

Installation Instructions Requirements

认证编号 CN2023C2307-000776

Certification No.

本产品经认证符合 CNCA-C23-01: 2019《强制性产品认证实施规则 防爆电气》的要求。

The product(s) is verified and certified according to CNCA-C23-01: 2019 China Compulsory Certification Implementation Rule on Explosion Protected Electrical Product.

#	**产品名称 Product** **型号 Type**	**防爆标志** **Ex Marking**
1	气体计量阀 GS6, GS6DR, GS16, LQ6, LQ6T, LQ6BP, GS16DR, GS16DR HP, S6FS	Ex ec IIC T3 Gc, Ex db IIB T3 Gb

依据标准 GB/T3836.1-2021, GB/T3836.2-2021, GB/T3836.3-2021

Series standards

安全使用条件

Specific conditions of safety use:

- 阀门的接地端子必须接地。
- 应配用经 CCC 认证且适合使用条件的电缆夹紧密封接头、堵头或导管密封装置，并正确安装。
- 当存在爆炸性环境时，不得使用 RS 232/485 接口。
- GS6 阀门电源输入现场布线的温度应至少为 103°C，GS6FS、GS16DR 和 GS16DR HP 现场布线的温度应至少为 125°C。
- 其他见产品使用说明书。
- Connect the ground terminal of the valve to earth ground.
- Only CCC certified cable glands, plugs or conduit entries, which are sufficient for the use in Ex db resp. Ex ec equipment, shall be used.
- The RS 232 / 485 interface shall not be used when an explosive atmosphere is present.
- Field wiring for power input at the GS6 valve must be suitable for at least 103 °C, and 125 °C for the GS6FS, GS16DR and GS16DR HP.
- See instruction for other information.

Woodward, Inc.

产品上的符合性标志:

Compliance marks on product:

中国强制性认证

China Compulsory Certification

CCC:

Doc No.:

Approved:

Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 26514.

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WOODWARD

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Phone +1 (970) 482-5811

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.