WOODWARD

Product Manual 35136
(Revision P, 8/2025)
Original Instructions

GS Series

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 35136

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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 because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from its enclosure. There are components that will be damaged if the PCB is removed.

IMPORTANT

External wiring connections for reverse-acting controls are identical to those for direct-acting controls.

Tampering Notice

NOTICE

Under no circumstances should the fasteners shown in the picture below be loosened or removed by anyone other than an authorized Woodward service provider. Loosening or removing the screws will result in the loss of position calibration, potentially resulting in unsafe operation of the valve. Warranty of the product may be voided if these screws are tampered with.

Regulatory Compliance

European Compliance for CE Marking
These listings are limited only to units bearing the 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).

ATEX Directive: Directive 2014/34/EU on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Conduit (without flying leads) Versions:
Zone 1: II 2 G Ex db IIB T3 Gb, CSANe 20ATEX1196X
All Versions:
Zone 2: II 3 G Ex ec IIC T3 Gc

Note:
ATEX EU-Type Certificate is limited to Category 2 (Zone 1) and only for conduit entry versions.
See Declaration of Conformity for clarification.

Pressure Equipment Directive: Directive 2014/68/EU on the harmonization of the laws of the Member States relating to making pressure equipment available on the market.
Product Type/Size: PED Category II
PED Module H – Full Quality Assurance

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

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

ATEX Directive: 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.

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.

Other International Compliance
These certifications are limited only to those units bearing the appropriate marking.

IECEx: Certified for use in explosive atmospheres per Certificate: IECEx CSA 19.0038X.

Conduit (without flying leads) Versions:
Zone 1: Ex db IIB T3 Gb
All Versions:
Zone 2: Ex ec IIC T3 Gc

China Certification (CCCEx): Compliance is limited only to those units with labels, marking, and manuals in Chinese language to comply with their certificates and declaration.

CCC Ex Certificate: No 2025312307001077 Zone 1: Ex db IIB T3 Gb, Zone 2: Ex ec IIC T3 Gc
GB/T 3836.1-2021,GB/T 3836.2-2021,GB/T 3836.3-2021

Japanese Ex (JPEx): Certified for use in explosive atmospheres per issued Certificate:

Connector Versions Only (GS40/50):
Zone 2: ec IIC T3 G
Applicable Standard:
JNIOSH-TR-46-1:2020
JNIOSH-TR-46-5:2018

Special Conditions for Safe Use for Japan Ex
See numbered notes 7, 8, 9, and 10 below in the "Special Conditions for Safe use (ATEX, IECEx, and CSA)" section. These notes are applicable for Japan Ex marked units.

INMETRO Certification: **INMETRO Brazil:**

NCC Certificate: BRA 23.GE0019X
Connector and Conduit Versions: Ex ec IIC T3 Gc
Conduit Versions: Ex db IIB T3 Gb

North American Compliance
These listings are limited only to units bearing the CSA identification.

CSA **All Versions:**
Class I, Div 2, Groups A, B, C & D T3 for North America
Ex ec IIC T3 Gc for Canada
Class I, Zone 2, AEx ec IIC T3 Gc for United States
Certificate 70218547

NOTICE

Some models in the GS Series family have a limited CSA certification under UL 429 and CSA C22.2 No. 139. The limitation corresponds to which valve configurations have been tested and certified to meet the full requirements of these standards (for example, 100,000 endurance cycle). For valve configurations that have not been tested and certified, only the GS Series Actuator with Onboard Driver is covered by the certificate as a "valve-actuator". Consult Woodward for support if your application may have special requirements for these standards. Details:
- GS40 or GS50, aluminum valve housings or SST valve for Hydrogen (H2) Service: Certified to UL 429 and C22.2 No. 139 as Electrically Operated Valve-Actuator for Flammable Fluids (limited assembly certification)
- GS40 or GS50, SST valve for Standard Gas: Certified to UL 429 and C22.2 No. 139 as Electrically Operated Valve for Flammable Fluids (full assembly certification)

Special-order Conduit Versions:
Class I, Div 1, Groups C, D T3 for North America
Class I, Div 2, Groups A, B, C & D T3 for North America

Ex ec IIC T3 Gc for Canada
Class I, Zone 2, AEx ec IIC T3 Gc for United States
Certificate 70218547

NOTICE

Conduit versions certified for Class I, Div 1 have tighter tolerance flamepath joints than the standard version which is ATEX and IECEx Zone 1 certified. Consult Woodward for the appropriate part number when ordering.

Canadian Registration Number (CRN): Models are available that are suitable for CRN applications. Contact your sales representative for more information.
The stainless steel and aluminum GS Series Valves have been accepted for registration under the CRN 0C21650.2.

Special Conditions for Safe Use (ATEX, IECEx, and CSA):

1. Wiring must be in accordance with North American Class/Division, or European, or other international Zone wiring methods as applicable, and in accordance with the authority having jurisdiction.

2. 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.

3. Conduit barriers are not required for Zone 2 or Class I, Division 2 installation. A conduit seal must be installed within 457 mm (18 inches) of the conduit entry when the valve is used in Zone 1 or Class I, Division 1 hazardous locations.

4. On-board driver connector version must retain IP66 ratings.

5. The conduit, when installed, must retain the IP66 rating by way of use of a suitably rated conduit adapter.

6. Conduit plugs, when installed, must retain the IP66 rating. Unused entries must be blanked in accordance with special condition to retain the IP66 rating.

7. Internal field wiring is to be installed in accordance with instructions detailed in this user manual. Field wiring for the GS Series valves must be suitable for at least 105C for installations using ATEX or IECEx. 115C required for installations using North American (CSA) certification.

8. The interface temperature between the actuator and valve must not exceed 112C. Equipment for processing fluid temperature is to be used in accordance with instructions in this user manual. This has been satisfied by Woodward when selecting the mating valve and process fluid temperature ratings. Equipment shall only be used with Woodward specified valve type. GS50 SST and GS40 SST valves for Standard Gas: the maximum temperature flowing across the valve should not exceed 177C.

9. Equipment must be protected from direct UV light and shall be installed in low sun exposure environments.

10. Upon installation, equipment ground terminal is to be connected to earth and continuity confirmed.

For ATEX and IECEx Zone 1 marked units:

- The maximum constructional gap ic of flamepath D, E, F as specified in the manufacturer's drawings are less than the maximum required gap per IEC 60079-1-2014-ED7, Table 2. Flameproof joints are not intended to be repaired.

- Driver cover captive screws:
  - Class 12.9, M8x1.25x30 mm socket head shall be used on cover to carrier
  - Class 12.9, M8x1.25x35 mm socket head shall be used on cover to driver
  - Class 12.9, M8x1.25x100 mm socket head shall be used on housing to carrier

Note: Refer to the installation chapter for required torque values.

⚠WARNING

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

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

General EMC Compliance – Special Conditions for Use

To meet EMC regulatory compliance, shielded twisted cable shall be used according to specification as described in the user manual. Shields at both sides shall be connected to earth ground. An AC coupling (shield connected to earth ground via R||C components) shall be ensured on at least one side (at GS Series valves or opposite cable end). Connect the ground terminal of the GS Series valve to earth ground.

Chapter 1.
General Information

The GS Series is an electrically actuated fuel valve with an on-board electronic driver (DVPII). The self-cleaning, shear-type metering action keeps the metering port free from performance-limiting deposits of gas condensates, contaminants, and system debris. Standard versions are compatible with most gaseous fuels, including natural gas, propane, ethane, methane, and up to 50% hydrogen by volume. An optional model is available that is compatible with pure gaseous hydrogen and must be used for any blends with more than 50% hydrogen by volume. This optional version may also be suitable for unusually corrosive applications. All versions are designed to be ISO15156/NACE MR0175 compliant, as well as compliant to ASME B31.3-2024, Chapter VIII for inclusion in a Category M Fluid Service piping system. Contact your Woodward sales associate for more information. Note: Woodward defines pure hydrogen as 99.999% by volume.

The valve minimizes the moving parts within the fuel metering element, actuator rotor, and redundant position feedback resolvers to maximize accuracy over the entire operating range. Available actuator torque has been increased to provide more robust performance in the harshest conditions. Accurate flow versus input signal characteristics is achieved on each valve version by precision forming of the valve metering port, the use of extended valve travels, and high precision resolvers for valve position feedback. The GS valves can achieve a flow turn-down ratio of more than 100 to 1. The shut-off rating meets the requirements of ANSI B16.5 Class IV across all valve sizes and ports.

The valve driver and wiring terminal box are integral with the valve assembly, eliminating interconnecting wiring, reducing package size requirements, and as a result, lowering the installed cost. The on-board driver can be interfaced to the turbine control via redundant 4–20 mA input and feedback signals or through redundant CANopen control networks. The GS Series can be configured to accept both the 4–20 mA signal and CANopen command in a redundant configuration. With this arrangement, if either demand signal fails, the driver will switch to the healthy input demand signal. Valve drivers are available for use with a 90-150 VDC, or an 18-32 VDC power supply.

Chapter 2.
Technical Specifications

Valve Characteristics

Standard Version:	Natural gas
Optional H2 Service Version:	99.999% gaseous hydrogen
Maximum Gas Supply Pressure:	750 psig (5170 kPa) - aluminum body 1440 psig (9928 kPa) - stainless steel body
Minimum Pressure Differential:	20 psid (138 kPa) recommended for accurate flow characteristics
Maximum Pressure Differential:	Matches valve ratings
Proof Pressure:	1125 psia (7757 kPa) – aluminum body 2160 psia (14893 kPa) – stainless steel body
Burst Pressure:	3750 psia (25855 kPa) – aluminum body 7200 psia (49642 kPa) – stainless steel body
Gas Filtration Recommendations:	25 µm Absolute
Metering Port Effective Area (ACd):	0.30 in² (194 mm²), 0.75 in² (484 mm²), 1.0 in² (645 mm²), 1.5 in² (968 mm²), and 2.0 in² (1290 mm²)
Metering Valve Leakage:	ANSI/FCI 70-2 Class IV Seat Leakage – Forward Direction ANSI/FCI 70-2 Class IV Seat Leakage – Reverse Direction

Weight:	GS40 aluminum	Approx. 110lbs (59kg)
	GS50 aluminum	Approx. 120lbs (59kg)
	GS40 stainless steel	Approx. 150lbs (68kg)
	GS50 stainless steel	Approx. 156lbs (71kg)

Materials: Base Model: ASME B26 356-T6 aluminum housing with stainless steel (SST) wetted parts

Base Model: ASME A351 CF8M stainless steel housing with SST wetted parts

H2 Version: ASME A351 CF8M stainless steel housing with H2 compatible wetted parts

NACE MR0103-2012 compliant

NACE MR0175-2015 compliant (see below)

ISO 15156/NACE MR0175-2015 Limits

H2S Partial Pressure:	Base Model: 3.45 kPa (0.5 psia) maximum H2 Model: 3500 kPa (500 psi) maximum with gas temperature of 135°C (275°F) maximum
Acidity (pH):	pH ≥ 4.5
Chloride Concentration:	50 mg/L maximum – stainless steel body No Limits – aluminum body

Temperature

Ambient:	-40 to +200°F (-40 to +93°C)
Fuel Temperature:	-40 to +200°F (-40 to +93°C) – aluminum body -40 to +350°F (-40 to +177°C) – stainless steel body

Gas Connections

Inlet and Discharge Flanges:	Alum. body GS40: 1.5 inch (Size -16) SAE J518-1 (Code 61) Alum. body GS50: 2.0 inch (Size -32) SAE J518-1 (Code 61) SST body GS40: NPS 1½ inch ASME B16.5 Class 600 RF SST body GS50: NPS 2 inch ASME B16.5 Class 600 RF
Overboard Vent:	Per MS 16142 (-04) except threads have a modified minor diameter to accept J threads.

Flow Accuracy

0.30 ACD GS40:	The greater of ±20pph (Air) or 2.5% of point
0.75 ACD GS40:	The greater of ±34pph (Air) or 2.5% of point
1.0 ACD GS50:	The greater of ±40pph (Air) or 2.5% of point
1.5 ACD GS50:	The greater of ±50pph (Air) or 2.5% of point
2.0 ACD GS50:	The greater of ±60pph (Air) or 2.5% of point

Repeatability

Digital Input:	±0.1% of full scale

Dynamic Performance (125V)

Slew Rate:	<100 ms (1s unpowered in the closing direction)
Position Loop Bandwidth:	High bandwidth (10 Hz @ -3db, room temperature, +/-2%) Normal bandwidth (40 rad/sec at -6db)

Dynamic Performance (24V)

Slew Rate:	10-90 time on a 0-100% step is < 0.250 seconds, 90-10 time on a 100-0% step is < 0.150 seconds (1s unpowered in the closing direction)
Position Loop Bandwidth:	High bandwidth (10 Hz @ -3db, room temperature, +/-2%) Normal bandwidth (40 rad/sec at -6db)

Maximum Transient Current:	7.5 A for 250 ms (125V version) 8 A for 400 ms (24V version)

Electrical Connections

Field Wire Connections (see installation chapter):	**Conduit Openings:** Four 1.000-11.5 NPT threaded conduit openings in enclosure and terminal blocks inside enclosure. **Flying Leads:** Wires attached to terminal blocks inside enclosure, extending out through conduit openings in enclosure. **Circular Connectors**: Power: MS3452LS18-11P; Multi-Function: M83723/83G1624N; Dual CAN: M83723/83G1610N **Ground Connections:** External threaded terminals provided for PE and EMC Ground connections
Valve Position Demand Signal:	4–20 mA current signal into 249 Ω impedance
Valve Position Feedback Signal:	4–20 mA current signal into < 500 Ω impedance CANopen
Shut-down/Reset Command:	Close contact to run, open to shut down
System Fault Output:	Isolated FET for direct control connection with or without interposing relays
Maximum Current:	500 mA (10 µA leakage)
Discrete Inputs:	3x inputs for run/shutdown, reset, security lockout 1ms delay, 5mA wetting current provided, 1500 VAC isolation from input power, 500V AC isolation from chassis
Discrete Outputs:	2x outputs for Alarm and Fault signals

	0.5A max current rating, 32V max contact rating, inductive load rated, 1500 VAC isolation from input power, 500 VAC isolation from chassis

Environmental Specifications

Electromagnetic Compatibility (EMC):	EN 61000-6-2:2005: Immunity for Industrial Environments EN 61000-6-4:2007: Emissions for Industrial Environments
Shock:	US MIL-STD-810C method 516.2, procedure 1 (10 G Peak, 11 ms duration, sawtooth waveform)
Vibration:	US MIL-STD-810C, Method 514.2, Procedure I, Figure 514.2-2, Curve AR (2 G test from 10 to 2000 Hz)
Humidity:	MIL-STD 810D, M507.2, PIII (60ºC, 95% RH)
Salt Fog:	600hr Salt Spray Test per ASTM B117
Ingress Protection: (per IEC 60529 and IEC 60079)	IP66
Pollution Degree:	2
Overvoltage Category	II
Altitude:	2000 m

Security Specifications

Achilles Testing:	Passed Achilles Level 1 Testing

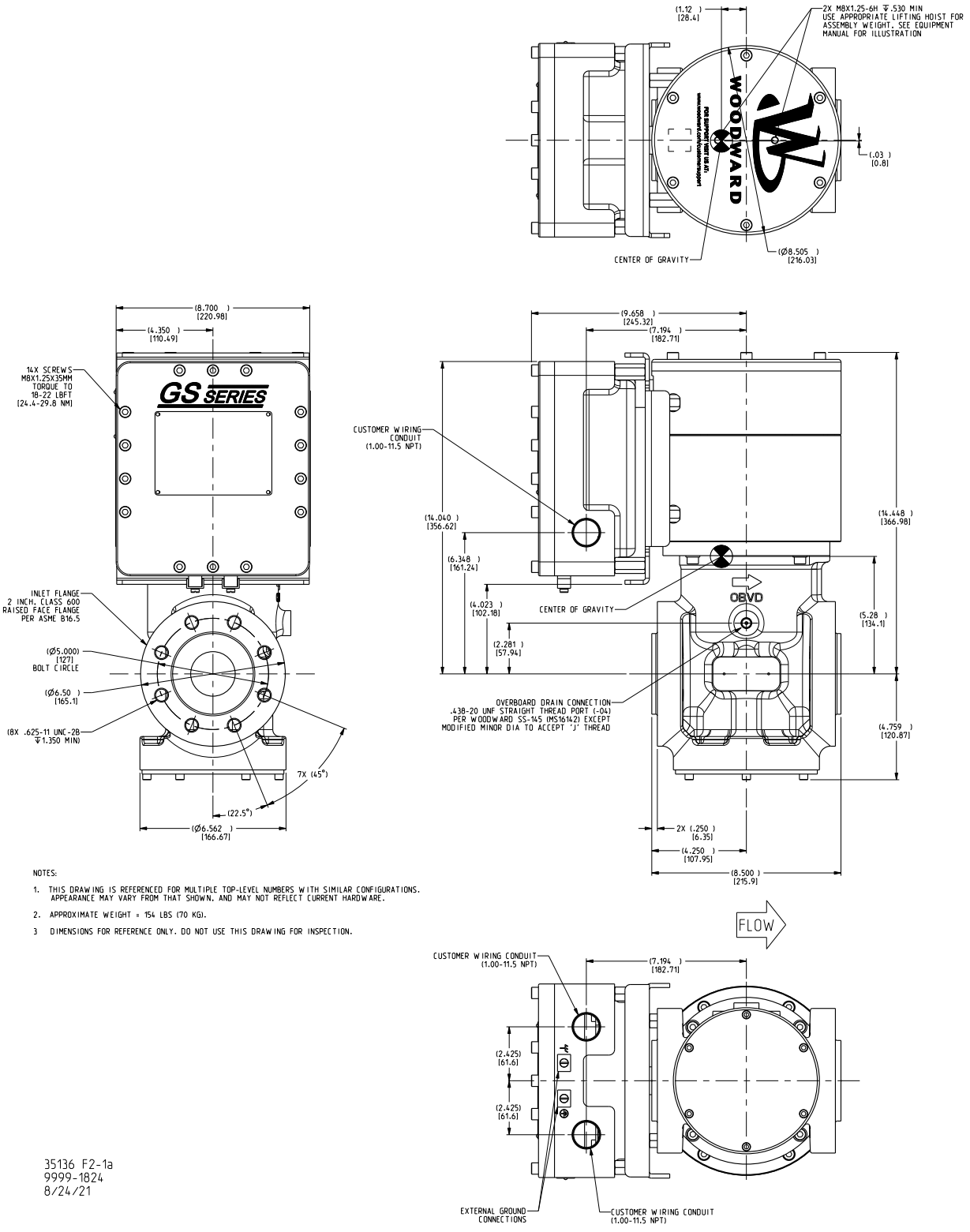


Figure 2-1a. Outline Drawing Stainless Steel GS50 with Conduit Entries

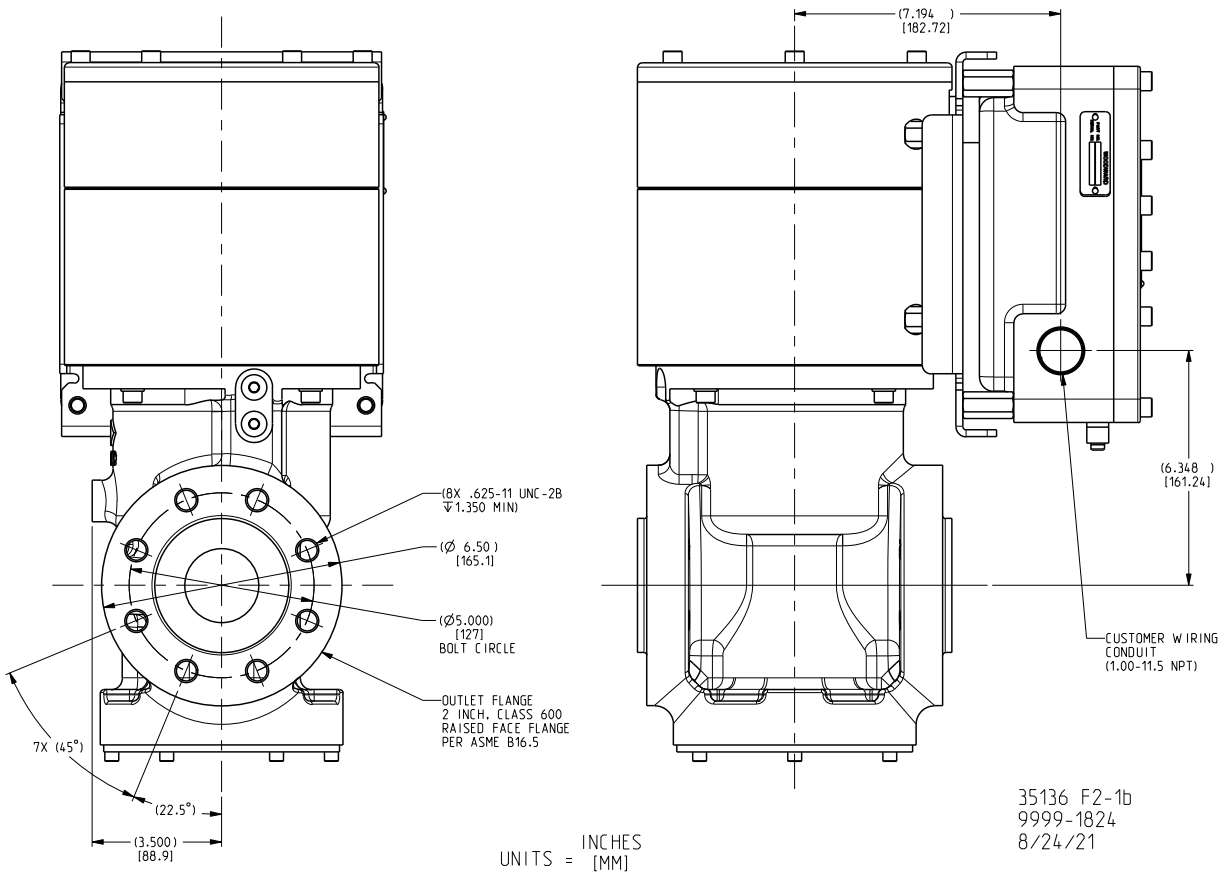


Figure 2-1b. Outline Drawing Stainless Steel GS50 with Conduit Entries

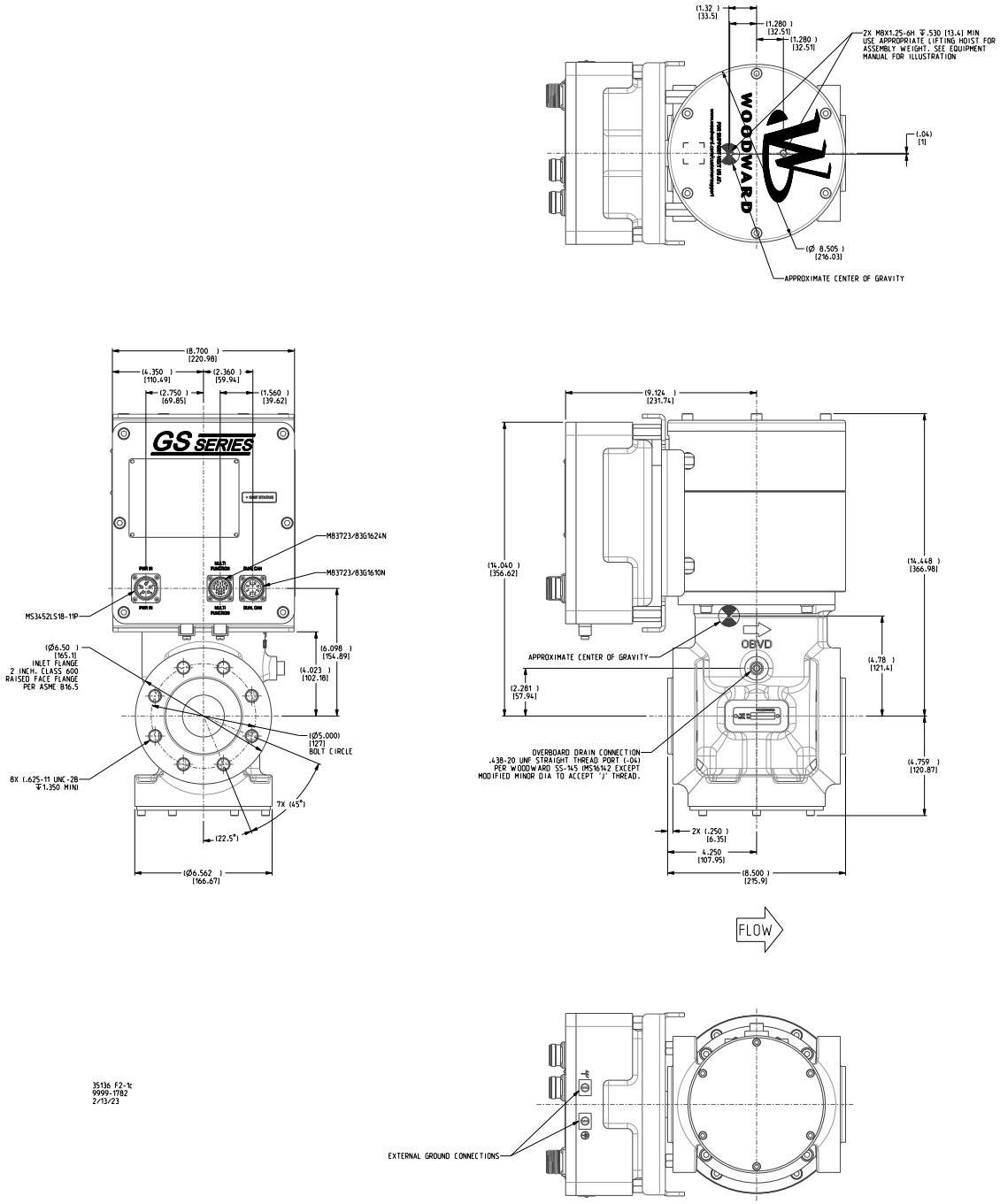


Figure 2-1c. Outline Drawing Stainless Steel GS50 with Connectors

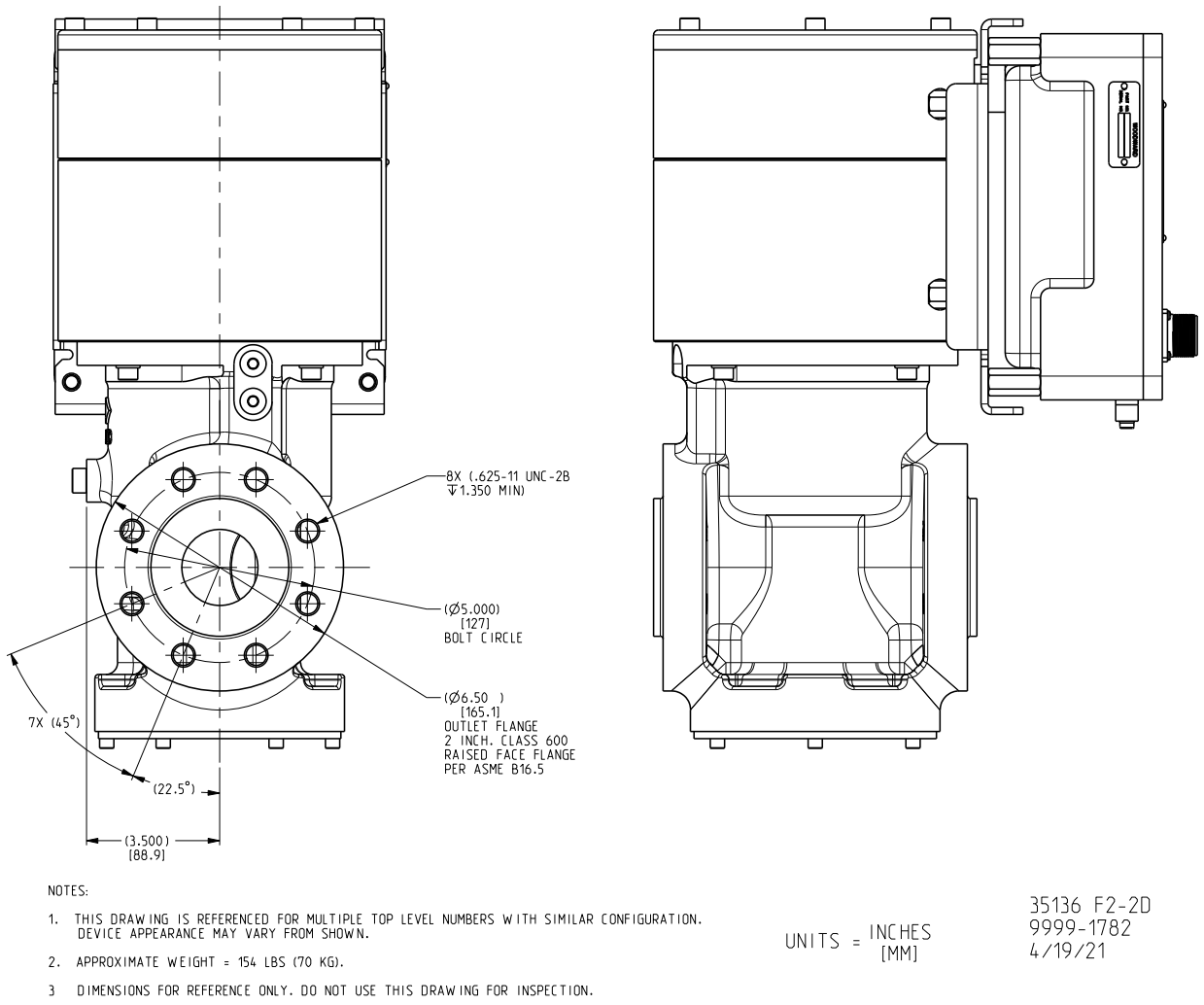


Figure 2-1d. Outline Drawing Stainless Steel GS50 with Connectors

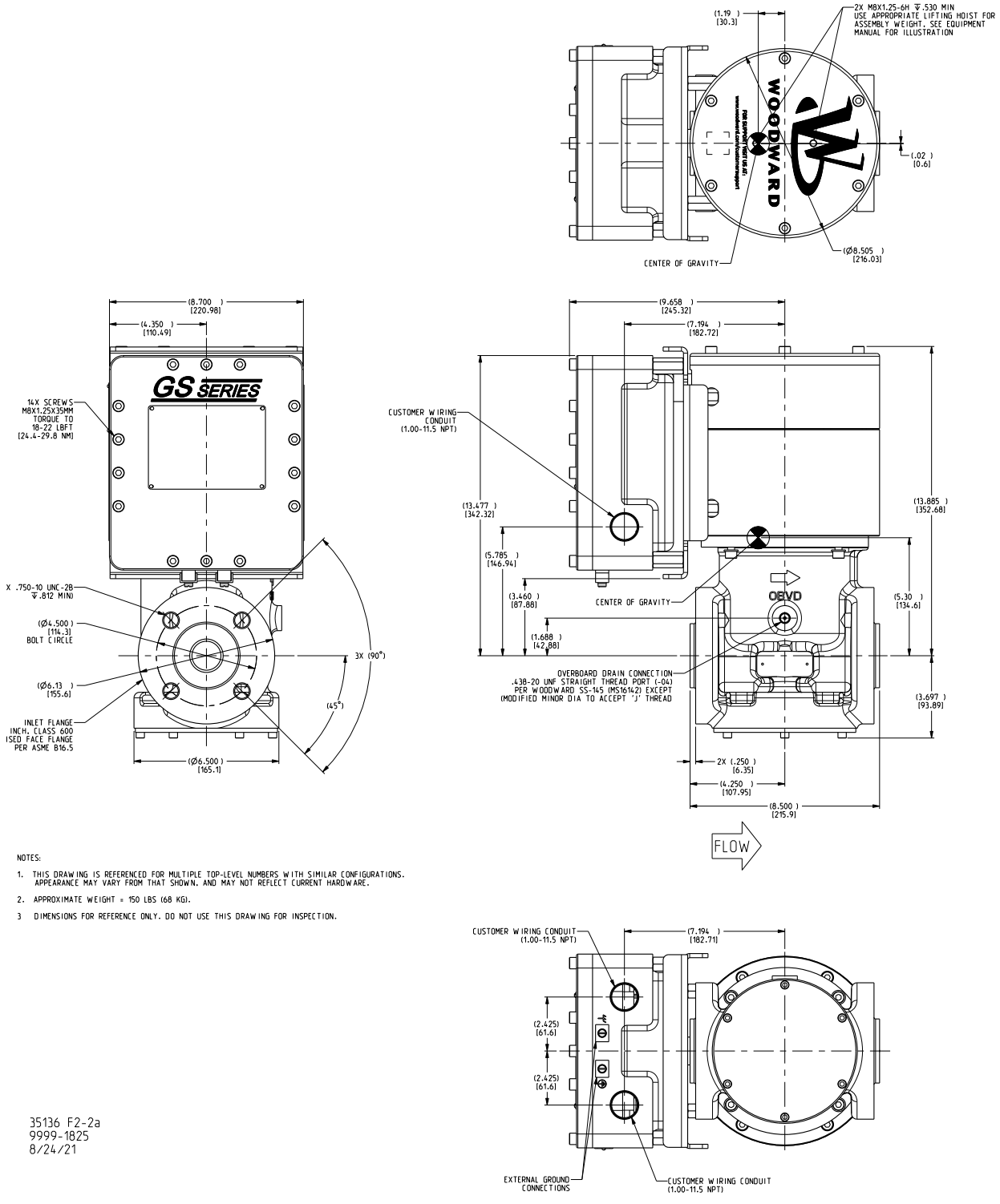


Figure 2-2a. Outline Drawing Stainless Steel GS40 with Conduit Entries

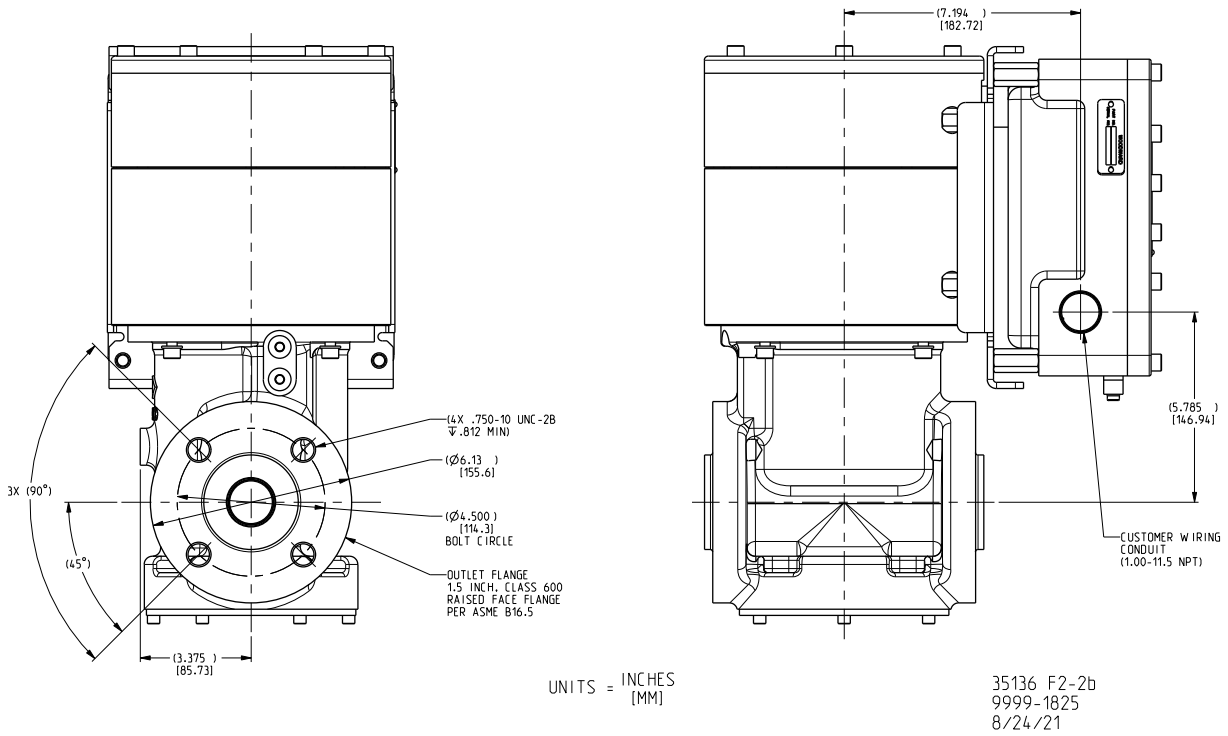


Figure 2-2b. Outline Drawing Stainless Steel GS40 with Conduit Entries

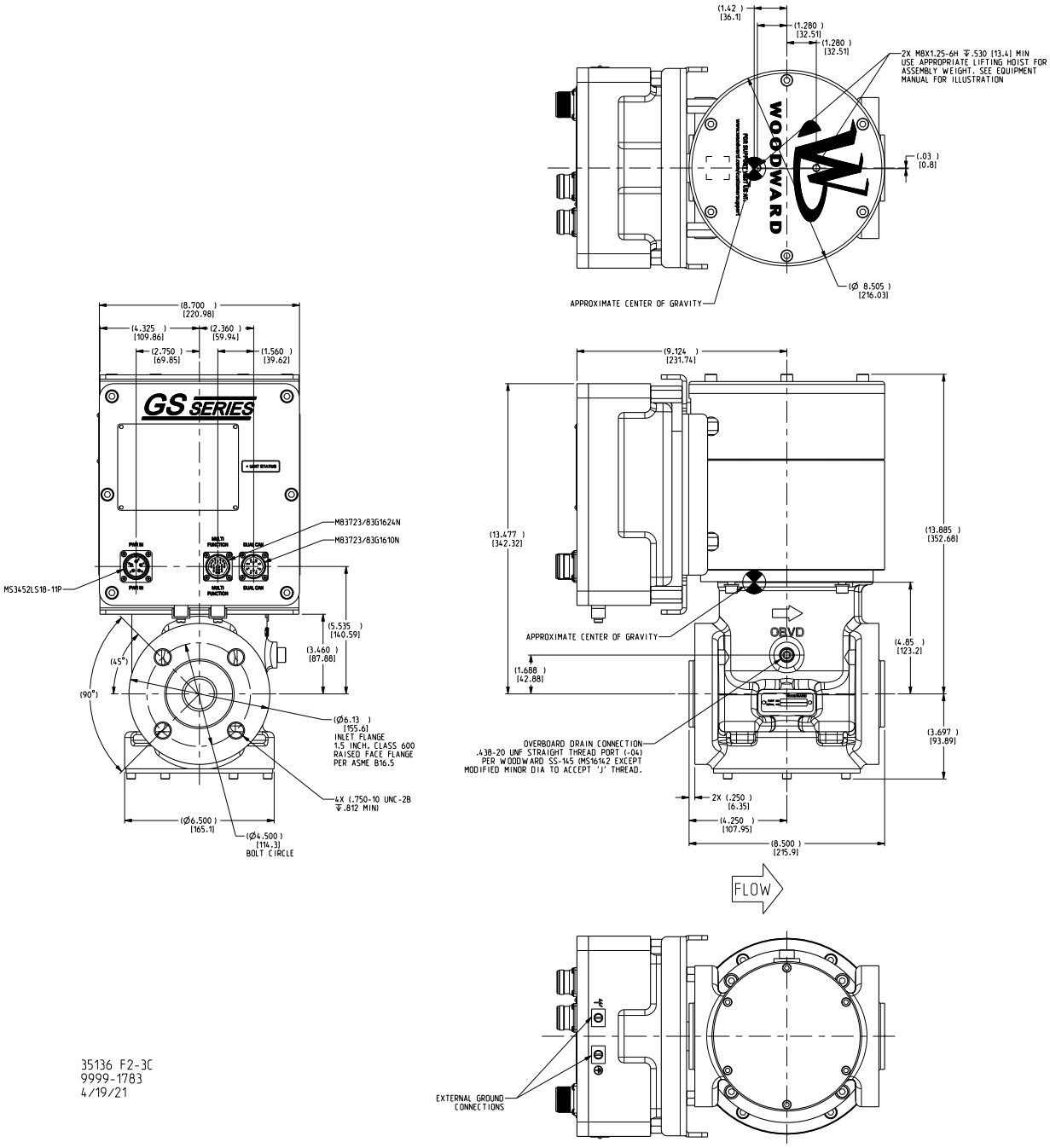


Figure 2-2c. Outline Drawing Stainless Steel GS40 with Connectors

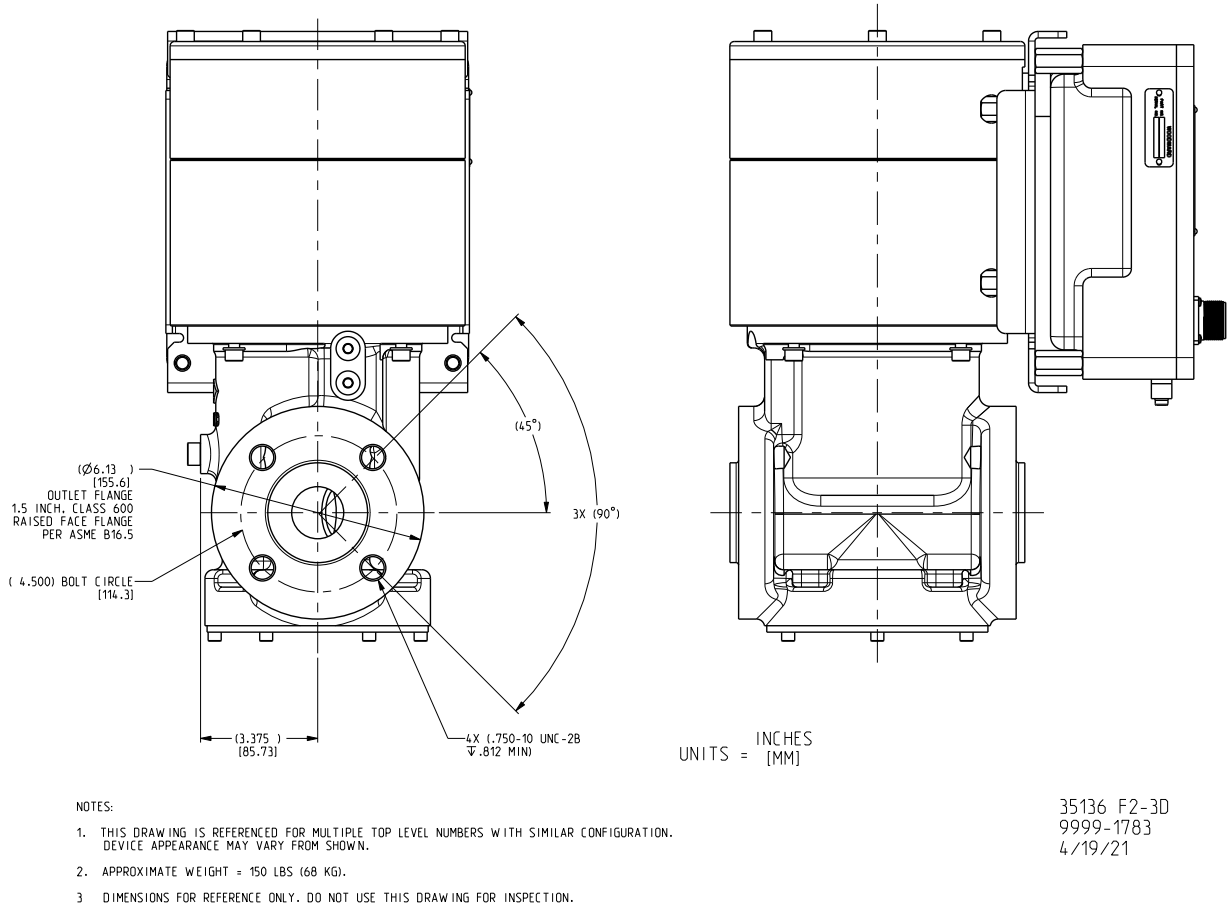


Figure 2-2d. Outline Drawing Stainless Steel GS40 with Connectors

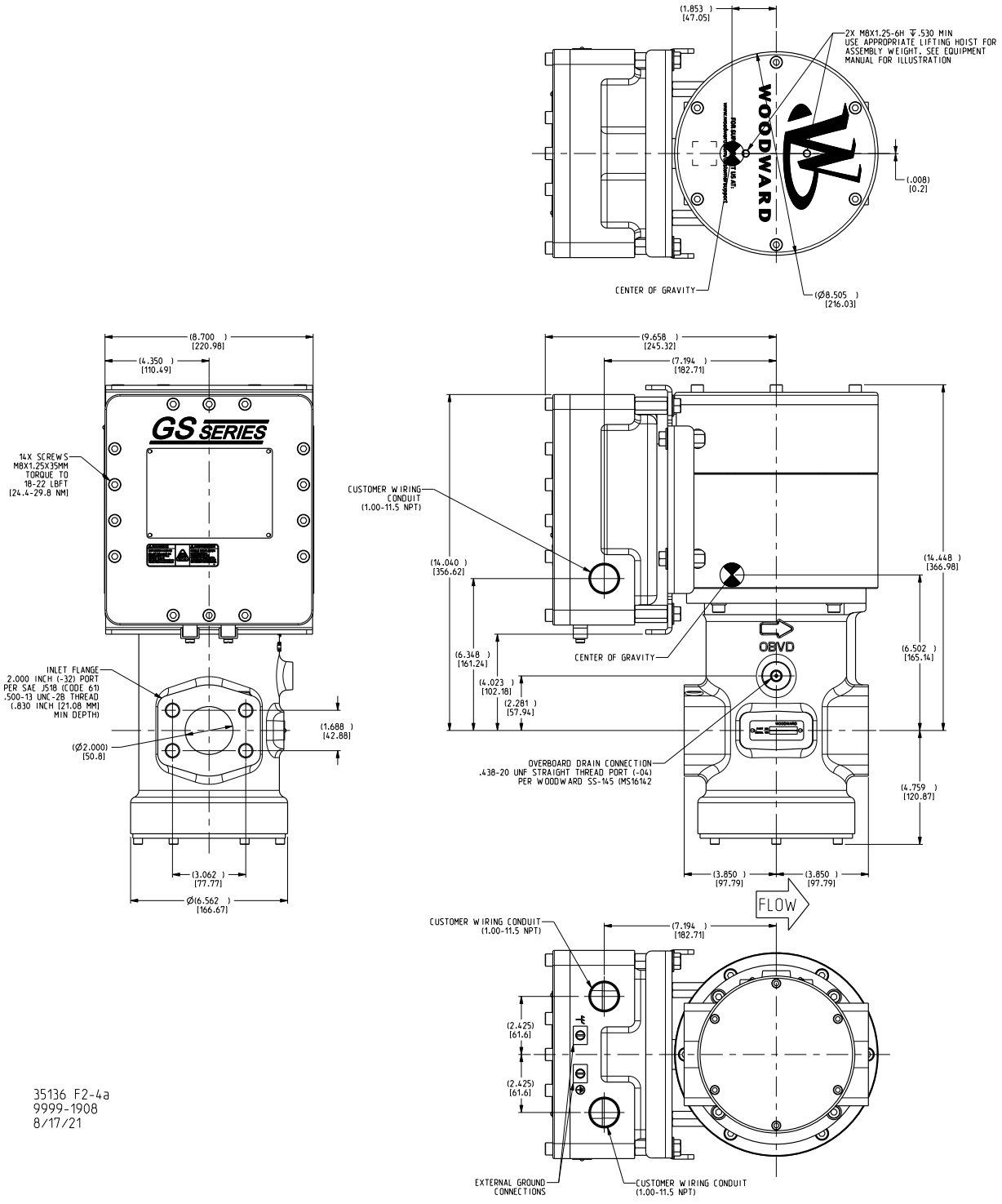


Figure 2-3a. Outline Drawing Aluminum GS50 with Conduit Entries

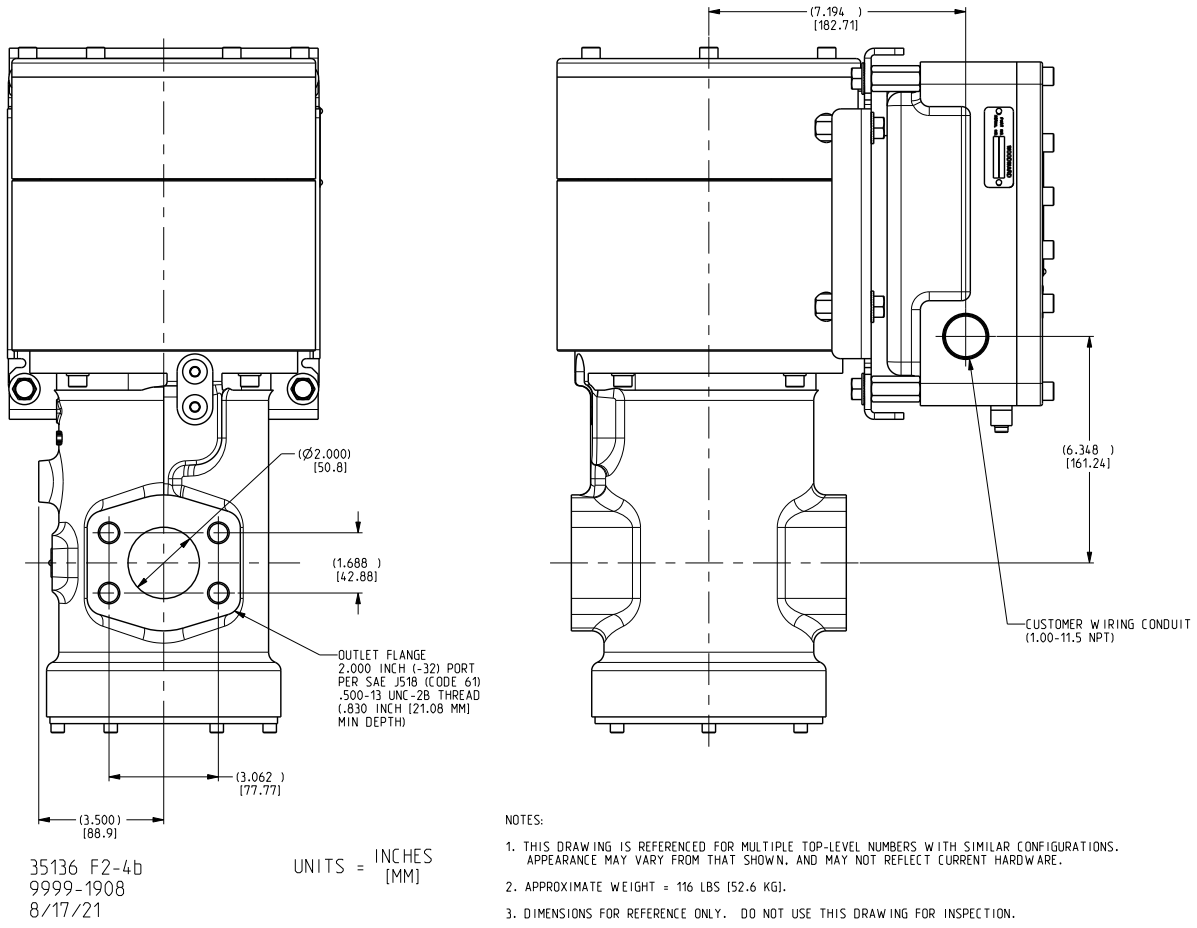


Figure 2-3b. Outline Drawing Aluminum GS50 with Conduit Entries

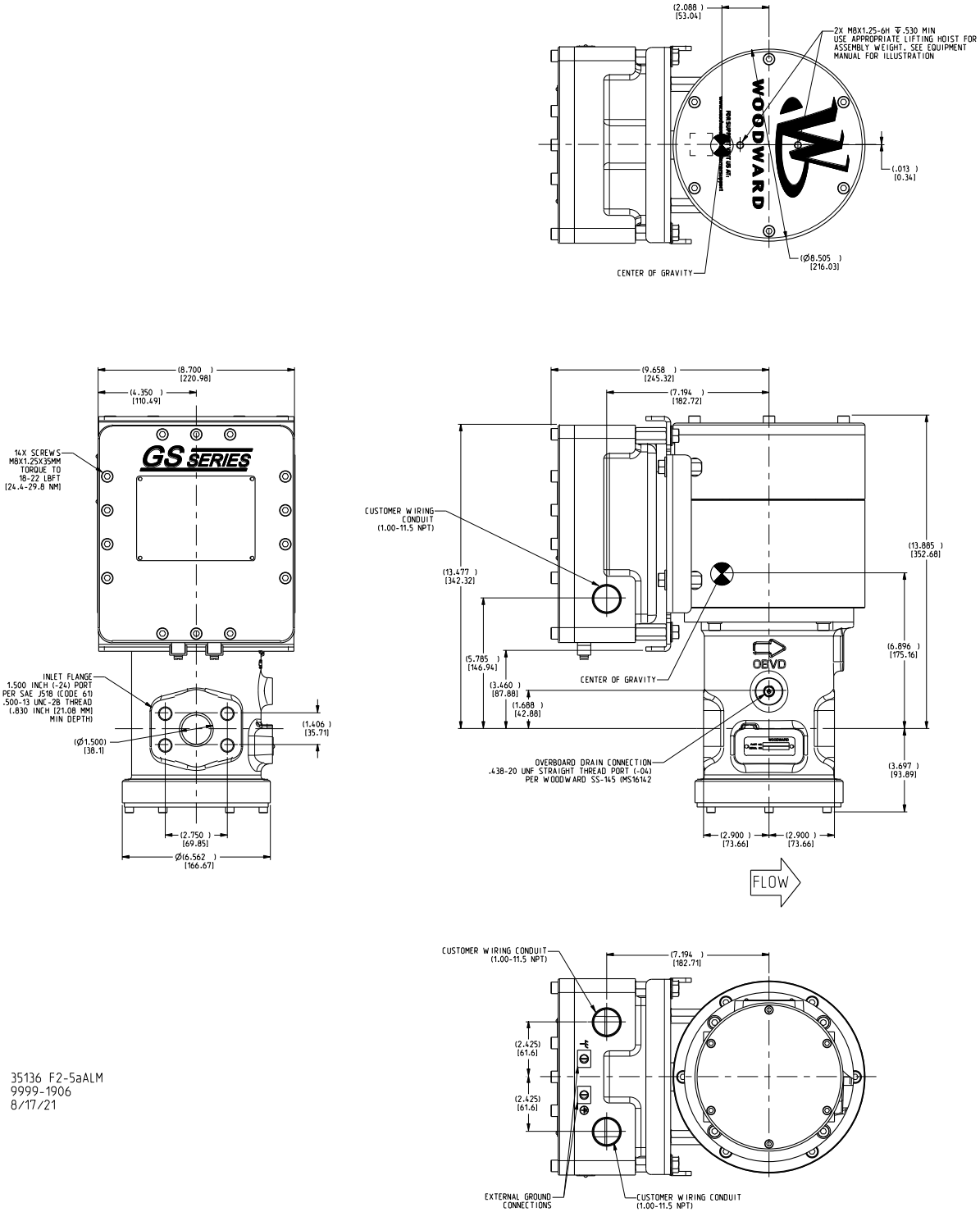


Figure 2-4a. Outline Drawing Aluminum GS40 with Conduit Entries

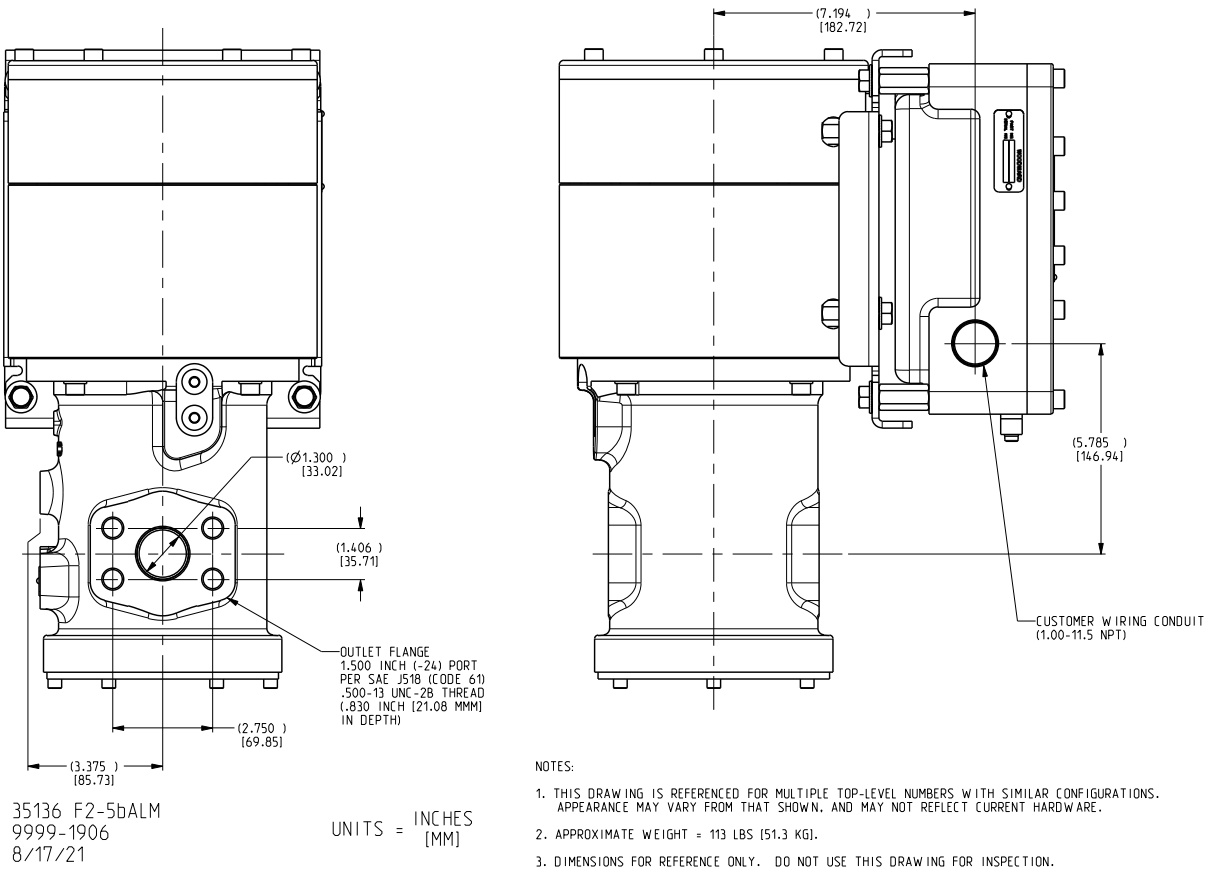


Figure 2-4b. Outline Drawing Aluminum GS40 with Conduit Entries

Chapter 3.
Installation

⚠WARNING

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

⚠WARNING

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

⚠WARNING

The surface temperature of the GS Series valves approaches the maximum temperature of the applied process media. It is the responsibility of the user to ensure that the external environment does not contain hazardous gases capable of ignition in the range of the process media temperatures.

⚠WARNING

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.

Take care when unpacking the GS Series valves. 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.

Lifting

WARNING

The GS Series valves weigh approximately 68kg (150 lb). To prevent injury, use a lifting eye that is appropriately rated for the weight of the valve for lifting assistance.

There are two, M8 x 1.25 threaded holes located on the top of all GS Series valves to be used with lifting eyes. Ensure that the lifting eyes are rated for the full weight of the valve. The threaded hole closest to the on-board driver is near the valve's center of gravity. An example of how to properly lift the GS Series valves is shown below.

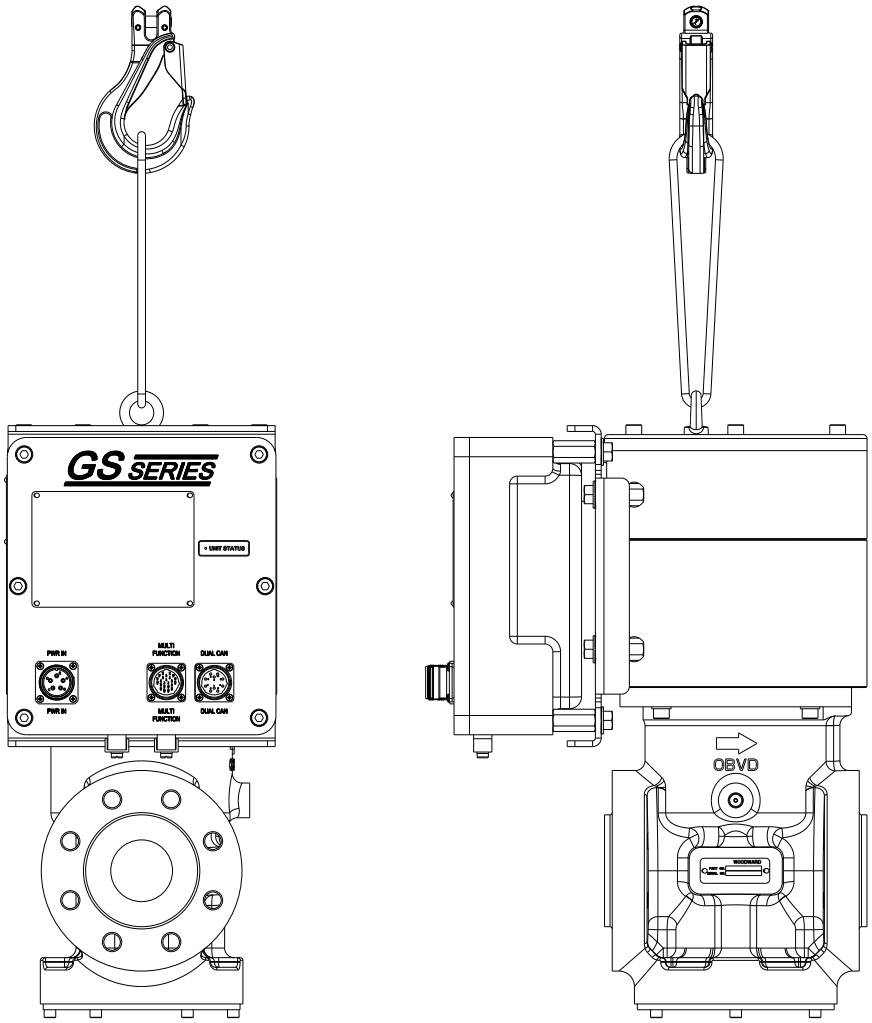


Figure 3-1. Proper GS Series Lift Configuration

Mounting

It is recommended that the GS Series valves be mounted directly to the piping system using the ANSI or SAE flanges. Consider the strength of the piping system to support the weight of the valves. If the valves are supported by the separate mounting points available on some versions, additional care should be taken not to exceed the flange loads specified below.

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

For ANSI flanged valves, refer to ASME B16.5 for details of flange, gasket, and bolt types and dimensions. Verify that the piping flange-to-flange dimensions meet the requirements of the outline drawings Figures 2-1 and 2-6 within standard piping tolerances. The valve should mount between the piping interfaces such that the flange bolts can be installed with only manual pressure applied to align the flanges. Mechanical devices such as hydraulic or mechanical jacks, pulleys, chain-falls, or similar should never be used to force the piping system to align with the valve flanges.

Use ASTM/ASME grade bolts or studs to install the valve into the process piping. Flange gasket material should conform to ASME B16.20. The user should select a gasket material which will withstand the expected bolt loading without injurious crushing, and which is suitable for the service conditions.

When installing the valve into the process piping, properly torque the stud/bolts in the appropriate sequence to keep the flanges of the mating hardware parallel to each other. The two-step torque method is recommended. Once the studs/bolts are hand-tightened, torque the studs/bolts in a crossing pattern to half the required torque. Once all studs/bolts have been torqued to half the appropriate value, repeat the pattern until the rated torque value is obtained.

The overboard vent drain (OVBD) 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 backpressure in excess of 689 kPa (100 psig).

NOTICE

Pressures exceeding 100 psid (690 kPa) on the OBVD port may result in internal seal damage to the valve, resulting in excessive OBVD leakage. This leakage may change the flow accuracy of the valve.

NOTICE

Do not plug the OBVD port. This can cause pressure to build up in the vent cavity, potentially damaging the valve and/or causing external gas leakage.

Allowable Flange Loads

Allowable flange loads are provided for each GS Series valve flange size. It is the customer's responsibility to ensure that the predicted and actual flange loads are within the specified limits over all possible application pressures and temperatures.

Table 3-1. 2-Inch & 1.5-Inch ANSI Flange Valves

Flange Load (Tension):	3600 N (809 lbf) maximum
Flange Load (Shear):	3600 N (809 lbf) maximum
Flange Moment:	2200 Nm (1623 ft-lbf) maximum

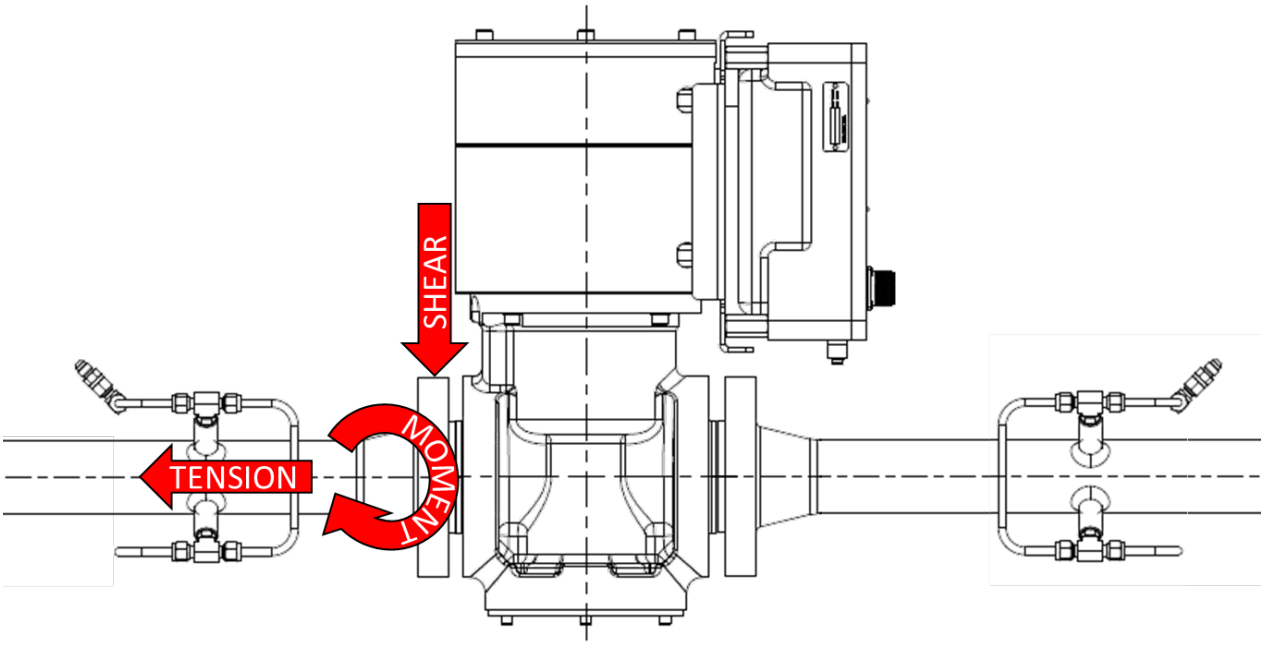


Figure 3-2. Flange Force/Moment Illustration

SAE Flange Valves

For SAE flanged valves, the allowable loads were resolved about the axes of a local coordinate system defined at each flange (Figure 3-1). The loads are considered as the combination of a tensile force along the specified axis and a moment about the same axis.

Coordinate axes were defined as follows. This local coordinate system can be utilized to determine if predicted flange loads are acceptable for use with the SAE flanged GS Series valves.

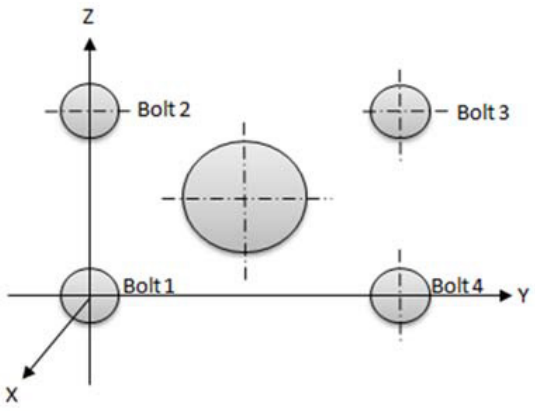


Figure 3-3. Local Coordinate System for SAE Flange Load Calculations

It is the customer's responsibility to ensure that the predicted and actual flange loads are within the specified limits.

For flange loads to be acceptable, the force and the moment when plotted must lie beneath the limiting force-moment line. This must be true for each axis of the flange.

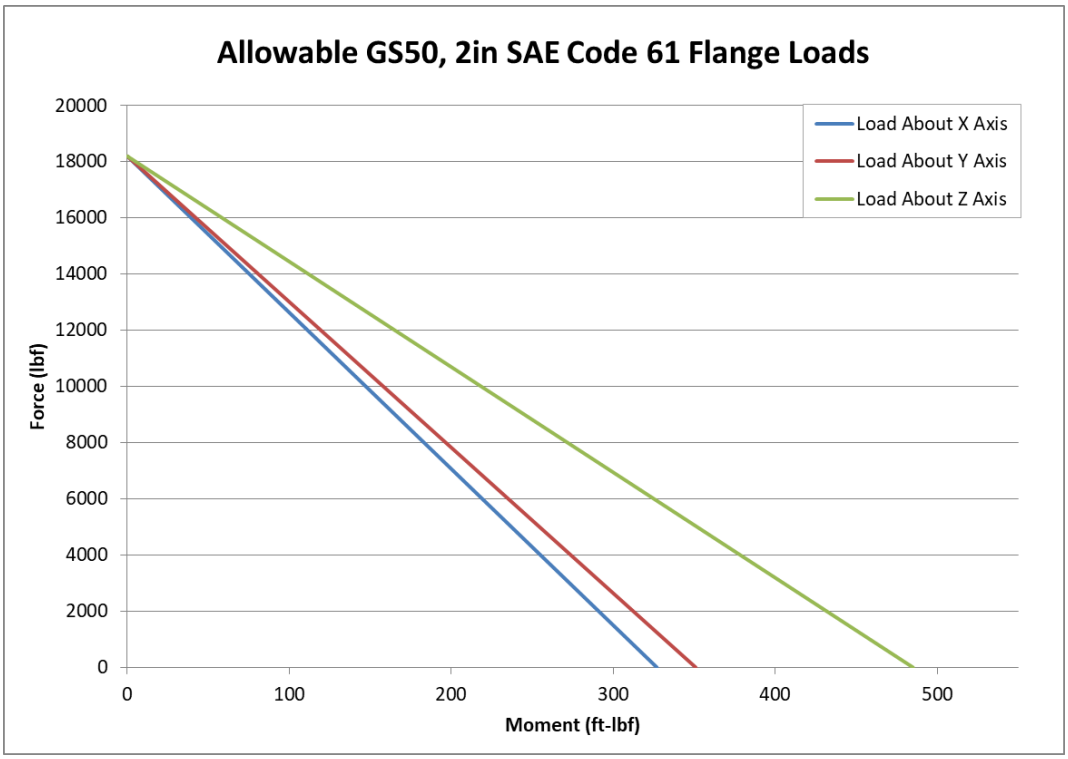


Figure 3-4. Allowable Flange Loads for 2-Inch SAE Code 61 Flange

Pressure Transducer Locations

The inlet piping of the GS40 and GS50 valves must be in accordance with ANSI/ISA-S75.02 as required for flow metering accuracy. Figure 3-5 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.

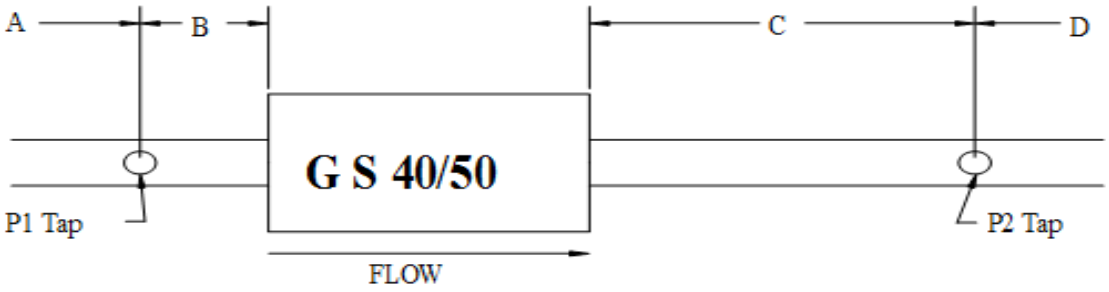


Figure 3-5. Piping Requirements

Dimensions should be:

A At least 18 nominal pipe diameters of straight pipe [may be reduced to 8 nominal pipe diameters if straightening vanes are used]
B Two nominal pipe diameters of straight pipe
C Six nominal pipe diameters of straight pipe
D At least 1 nominal pipe diameter of straight pipe

Electrical Connections

⚠WARNING

The turbine should be equipped with an overspeed shutdown device that operates completely independent of the GS Series valve to protect against runaway or damage to the turbine, with possible personal injury or loss of life should the system fail.

⚠WARNING

Protect Driver Cover

Take care not to damage the GS Series driver cover seal or flamepath surfaces while removing or replacing the cover on conduit versions.

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

When reinstalling the GS Series driver cover, torque all (14x) M8 fasteners to 18-22 lb-ft (24.4-29.8 Nm). See installation drawing figure(s) in Chapter 2 for clarity.

⚠WARNING

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

⚠WARNING

Conduit Installation

Conduit adapters and the front cover of the GS Series driver must be properly installed to ensure the enclosure meets IP66 in accordance with IEC 60079-0 Construction & Test Requirements.

The conduit, when installed, must retain the IP66 rating using a suitably rated conduit adapter. Conduit plugs, when installed, must retain the IP66 rating. Unused entries must be blanked in accordance with special condition to retain the IP66 rating.

Conduit seals must be installed within 18 inches (450 mm) of the conduit entry when the GS Series is used in Zone 1 or Class I, Div. 1 locations.

⚠WARNING

The GS Series valve must be grounded for safety and EMC compliance (see Grounding Requirements below).

Make all required electrical connections based on the wiring diagrams in Chapter 3.

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.

Conduit (Directly Wired) Version

The GS Series valve is connected to the engine control system via the terminal blocks located inside the GS Series on board driver, through 1”-11.5 NPT conduit entries in the driver housing. Field wiring for the GS Series valves must be suitable for at least 115 °C. Input power cable shall be rated to 600V; signal and communication cabling shall be rated at 300V.

With regards to spread of fire or combustible products, all wires, cables, wiring methods, and materials shall be selected per NFPA 70 (National Electrical Code) for the US, the Canadian Electrical Code for Canada, and the applicable electric codes for the rest of the world.

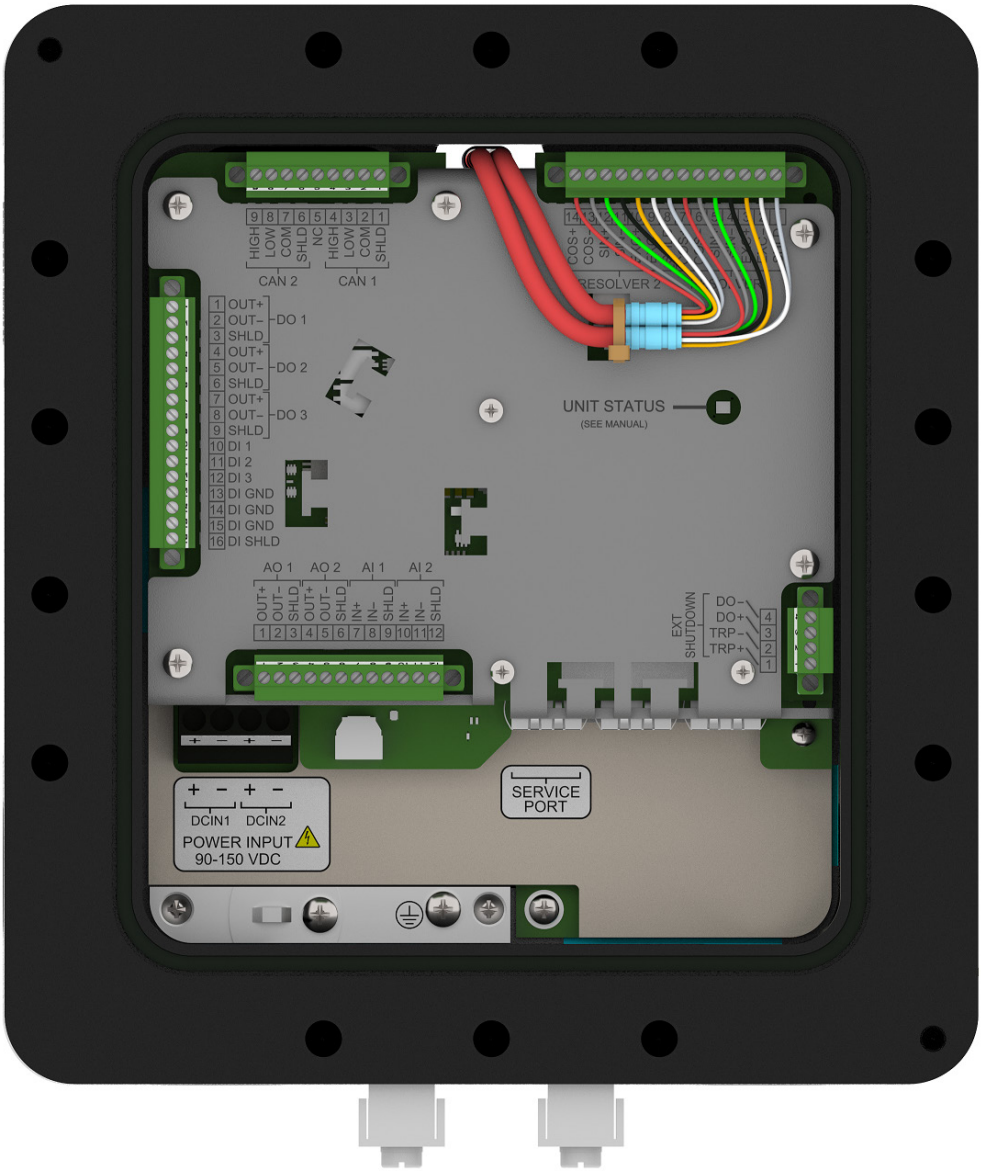


Figure 3-6. GS Series Driver - Conduit Version

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. For European Zone 2 installations, the plug must provide a minimum ingress protection value of IP66 and may only be removed with the aid of a tool. In addition, for IECEx and European Zone 2 installations, conduit barriers are not required. Ensure that any plugs or glands are properly torqued during installation. Care should be taken not to damage any of the sealing surfaces on the enclosure. Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the cover and driver housing mating surfaces for damage or contamination.

Table 3-2. GS Series Valve Electrical Connections.

Driver with Conduit Entries:

Earth Ground:	Provided through ground lugs on housing
Power Input:	90–150, or 18-32 VDC depending on model number (voltage as measured at the driver input terminals)
CAN Network:	CANOpen CAN ports (2)
Analog Input:	4–20 mA signal (2 inputs)
Analog Output:	4–20 mA signal (2 outputs)
Discrete Input:	Sinking - Internal pull-up (3 inputs)
Discrete Output:	Open Collector Low-Side (3 outputs)
Ethernet Service Port:	10/100 Mbps RJ45

Wiring Installation

- Connect all wires as shown in the Control Wiring Diagram(s) for the appropriate GS valve type (Figures 3-7a-d and Figure 3.8).
- Apply load terminations accordingly.
- Apply general practice to ensure cables are checked from point to point.
- Wires exposed beyond the shield should be as short as possible, not exceeding 2 inches (51 mm).
- The shield termination wire (or drain wire) should be kept as short as possible, not exceeding 2 inches (51 mm), and the diameter should be maximized where possible.
- 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 assure satisfactory operation of the product.

I/O terminal plugs utilize a screw connection with tension sleeve, accepting wire sizes from 0.14 to 1.5 mm² (26 to 16 AWG). Recommended wire size is 0.5 – 1.3 mm² (20 - 16 AWG), with a wire end ferrule. Recommended tightening torque for the terminals is 0.22 - 0.25 N·m (1.9 – 2.2 lbf·in). Recommended tightening torque for interlock screws is 0.3 N·m (2.65 lbf·in).

Power input terminal block TB1 on the power board accepts wire sizes up to 6mm² (10 AWG). Recommended wire size is 4 mm² (11 AWG) with a wire end ferrule. Tightening torque for the terminals is 0.5 - 0.6 N·m (4.3 – 5.3 lbf·in). See section below for wiring details and selection of wire gage for long cable lengths.

Required torque for the protective earth terminal is 1.7 Nm (15 lbf·in).

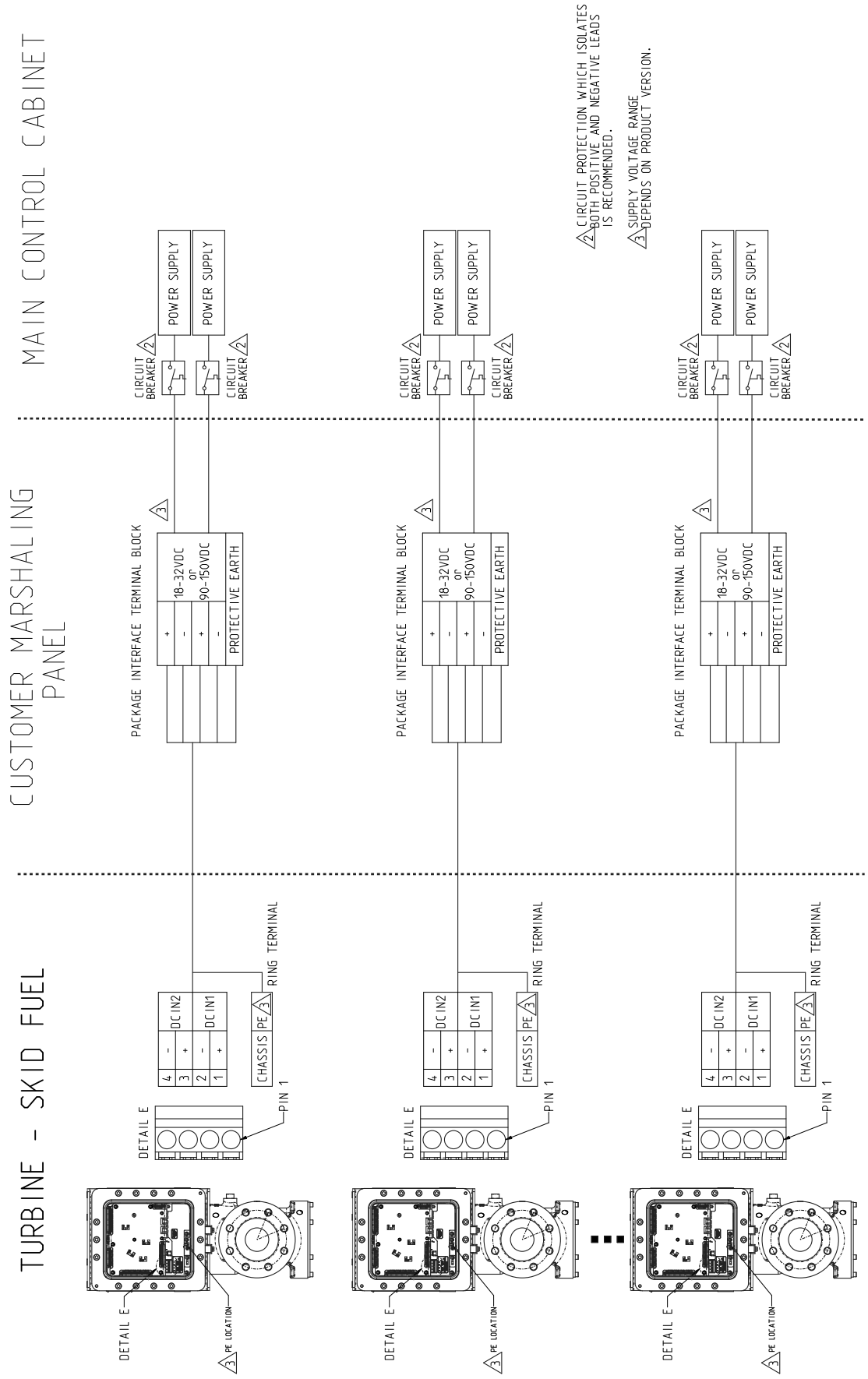


Figure 3-7a. GS Series Conduit Version System Wiring Diagram – Power Input

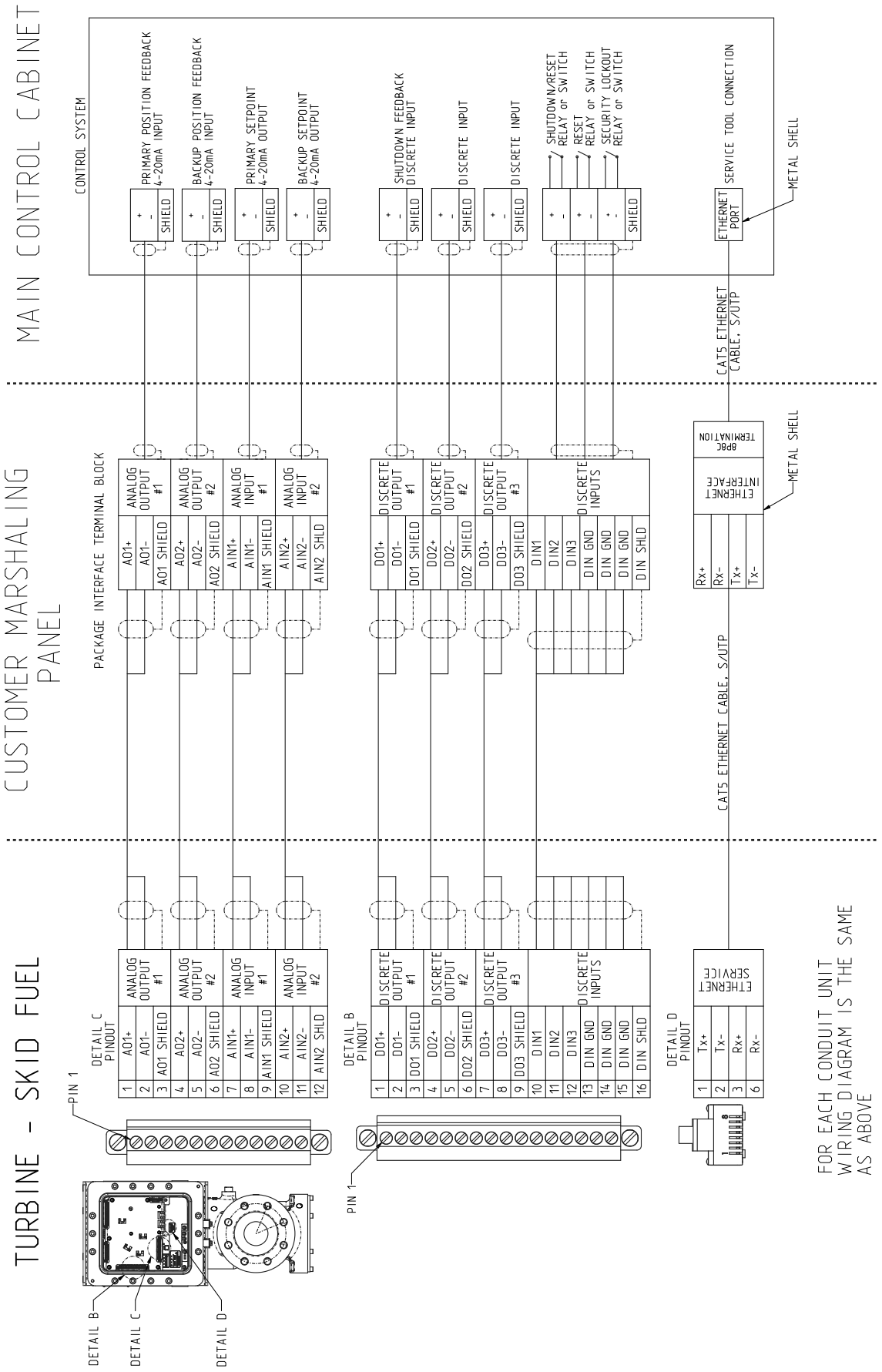


Figure 3-7b. GS Series Conduit Version System Wiring Diagram – IO

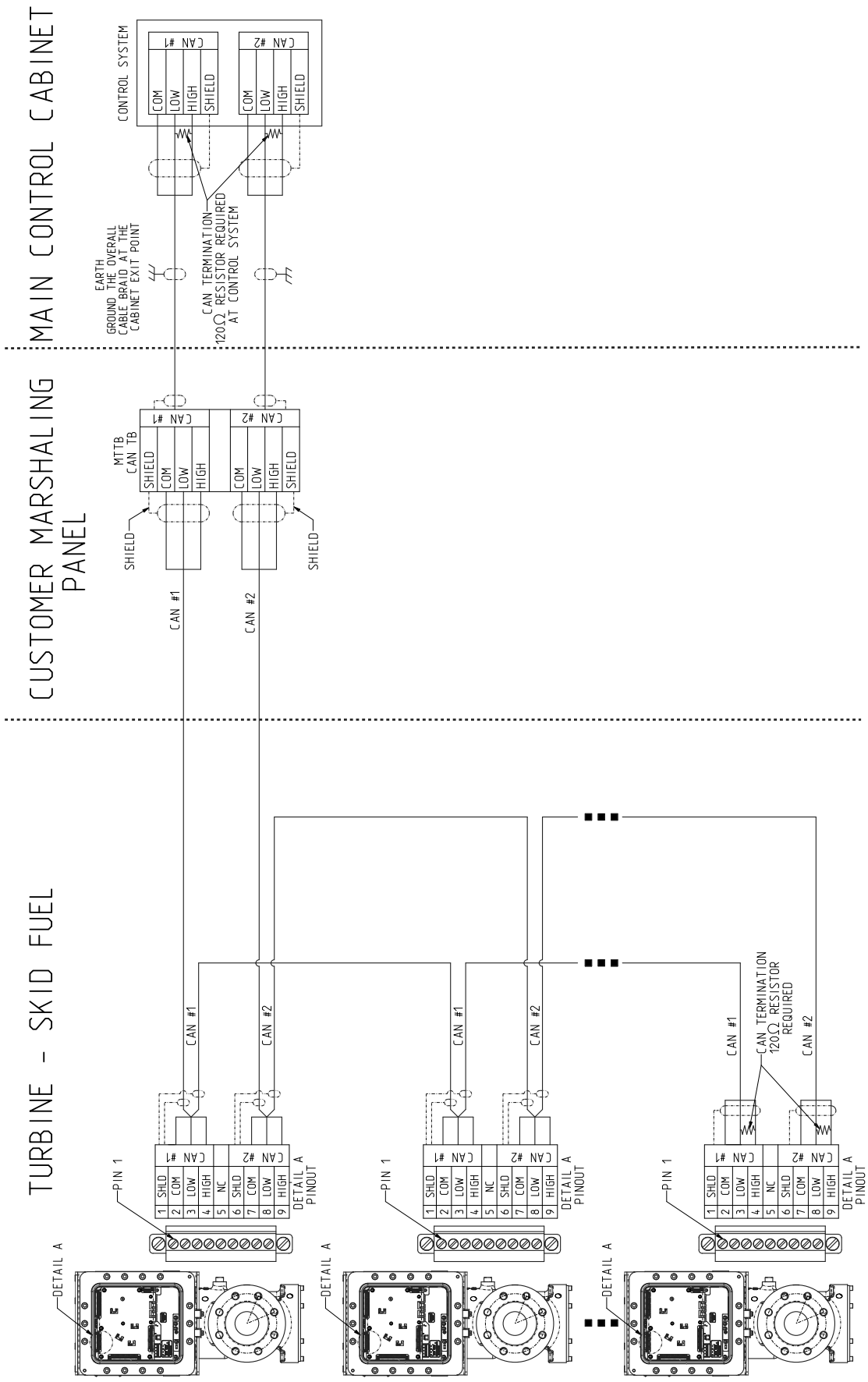


Figure 3-7c. GS Series Conduit Version System Wiring Diagram – Dual CAN.

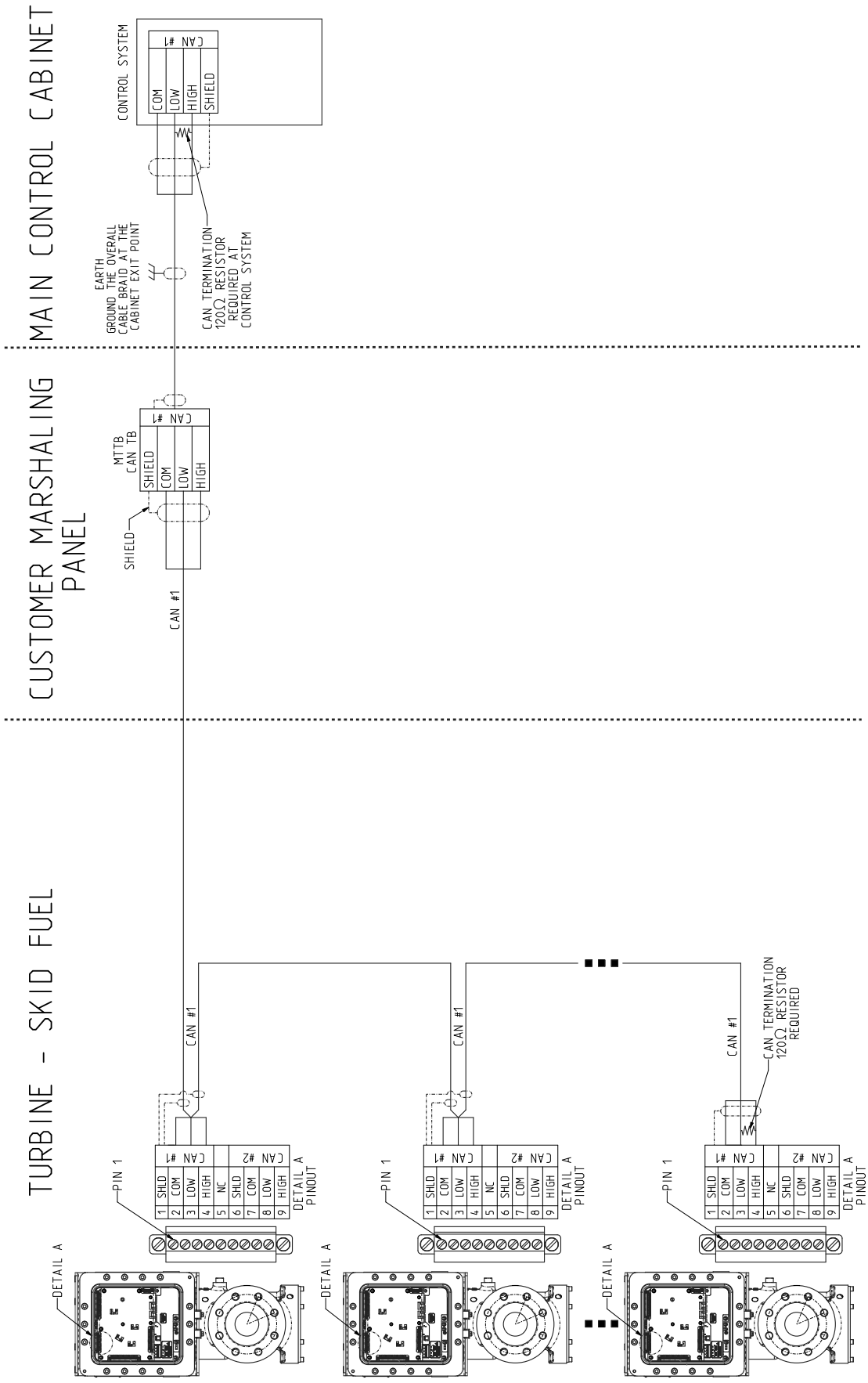


Figure 3-7d. GS Series Conduit Version System Wiring Diagram – Single CAN.

Wiring Strain Relief

Tie down points and ratcheting tie wraps are provided to secure the wiring to the top of the circuit board cover. This helps prevent wire strain from being transmitted to the connection at the terminal block and to keep the wiring from chafing on the cover when tightening and under vibration. Failure to secure the wiring could result in intermittent connections resulting in alarm or shut down conditions. Care should be taken not to stack the field wiring such that the wiring will be put under pressure when the driver enclosure cover is re-installed.

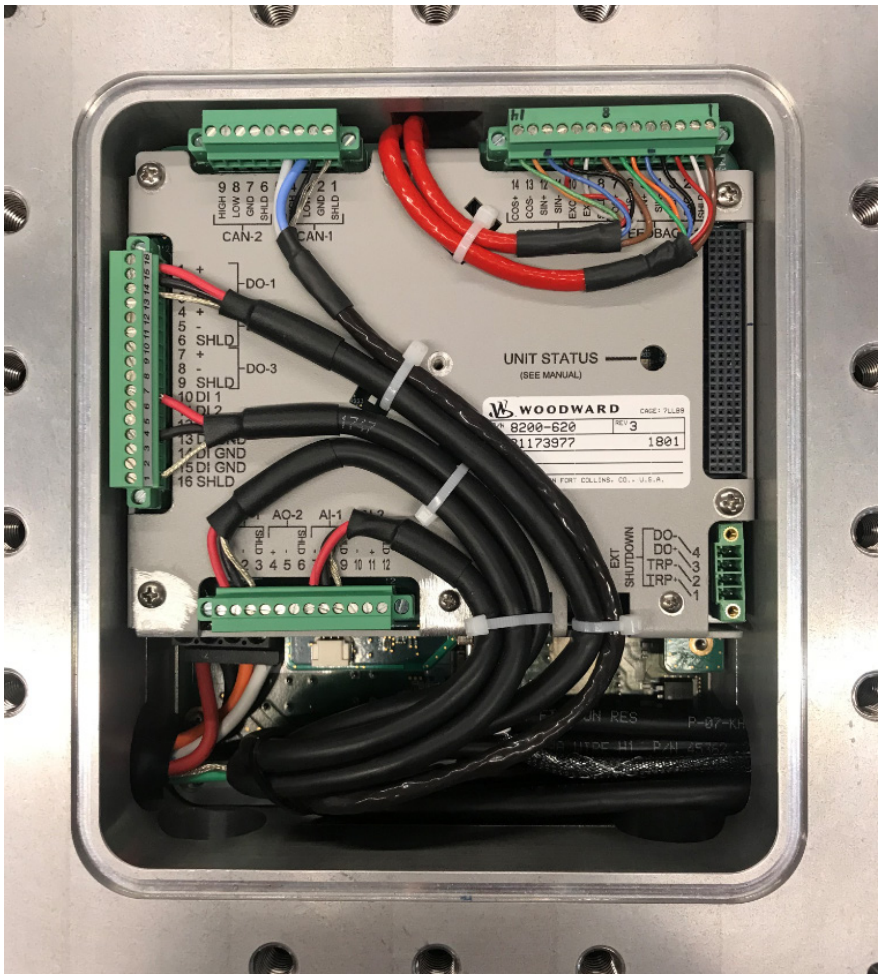


Figure 3-8. Wiring Tie Down Points Example

Shielding Requirements

The use of shielded-twisted cabling is required where indicated by the control-wiring diagram to ensure EMC compliance. Terminate the cable shield as indicated by control wiring diagram using the installation notes described below.

Grounding Requirements

The GS Series driver chassis is intended to be grounded using a short, low-impedance strap or cable (typically >12 AWG/4 mm² and <18”/46 cm in length) connected to the designated EMC ground terminal (⏚). Green/yellow insulation and green insulation shall not be used for the EMC ground connection. Additionally, the PE terminal (⏚) must be connected to PE ground, using wire size ≥12 AWG/4 mm² or at least as large as the power input leads, to ensure safety compliance. Green/yellow insulation and green insulation shall not be used for the EMC ground connection.

Power Supply Requirements

⚠WARNING

Fire Hazard

Overcurrent protection devices recommended in this manual are intended to provide protection against faults in the wiring or GS Series driver which result in increased current flow, and therefore, increased heating and the probability of the start and spread of fire.

The GS Series valve driver is designed to accept redundant power supply inputs. These inputs share a common ground and are isolated from chassis ground. This option allows for redundancy in wiring, terminal connections, and power sources if the power sources share a common ground. The user is provided with four terminals, two positive terminals and two negative terminals.

See Table 3-3 for required power and fusing information.

Table 3-3. GS Series Input Power Requirements

		(-40°C to +93°C)
Voltage Range	90 VDC to 150 VDC	18 VDC to 32 VDC
Inrush Current	< 30A, 10ms	<7A, 80ms
Continuous Input Current [1]	0.7 A	2.75A
Transient Input Current [1]	7.5A, 250ms	8A, 400ms
Input Current at Stall Condition [2]	2.1A	8.4A
Fuse	10A, 250V Slow Blow, Minimum I^2t rating 500 A^2s	10A, 250V Slow Blow, Minimum I^2t rating 500 A^2s
Circuit Breaker	10A, 250V minimum	10A, 250V minimum

Notes:
[1] - These numbers represent the maximum possible GS driver current draw in normal operation.
[2] - Defined by required compliance ratings tests.

High input current transients can be drawn during rapid movement. The above recommendations include the transient nature of the electrically driven actuator system. The GS Series driver is not equipped with an input power switch or breaker. Correct power supply sizing depends on factors such as cable sizing, environment, and local regulatory requirements. It is recommended that a safety input power switch be provided for installation and servicing.

Proper input power wiring to the GS Series driver is crucial to its operation. A circuit breaker meeting the power supply requirement may be used for this purpose. Figure 3-9 illustrates the correct and incorrect power cable wiring.

⚠CAUTION

The circuit breaker must be suitably located and easily reached and must be marked as the disconnecting device for the equipment.

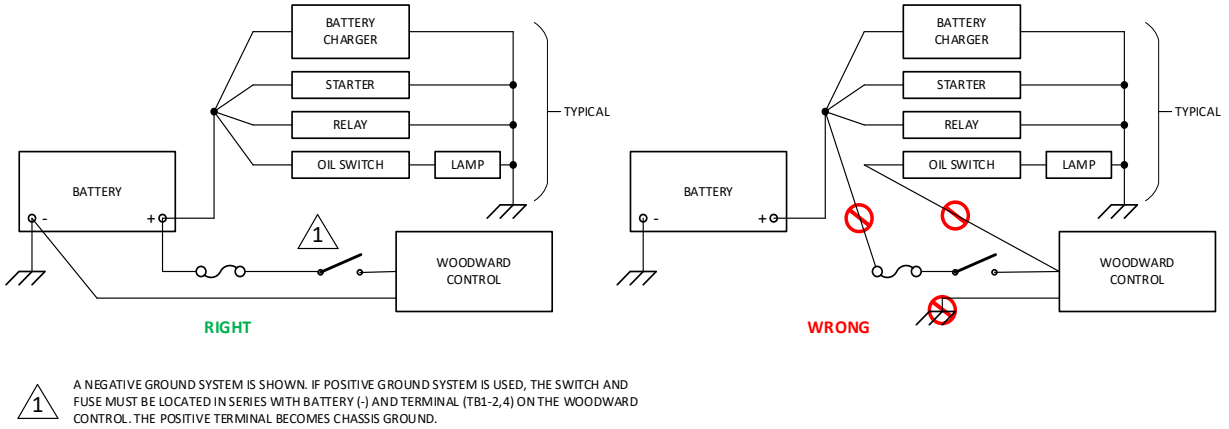


Figure 3-9. GS Series Driver Power Wiring Recommendation

Supply Voltage:

The supply voltage during normal operation must be 90-150 VDC for the 125 VDC versions, or 18-32 VDC for the 24 VDC versions, as measured by the GS Series driver.

Table 3-4. Supply Voltage and Earth Ground

Power Supply #1 Inputs:	DCIN1+ / DCIN1-
Power Supply #2 Inputs:	DCIN2+ / DCIN2-

American Wire Gauge Voltage Drop

A standard wire gauge voltage drop at maximum ambient temperature is provided in Table 3-5 to assist the cable selection.

Table 3-5. Voltage Drop Using American Wire Gauge (AWG)

Wire Gauge (AWG)	Voltage Drop per Meter @ 10 A Round-Trip (V)	Voltage Drop Per Foot @ 10 A Round-Trip (V)
8	0.053	0.016
10	0.085	0.026
12	0.134	0.041

Voltage Drop Calculation Using American Wire Gauge

Example: A 10 AWG wires will drop 0.026 V/ft at 10 A at maximum ambient temperature. Using 100 feet between the driver and the power supply would provide a voltage drop of 100x0.026 = 2.6V. It is very important to ensure the voltage at the driver's input terminal is within the product power input specification to achieve the maximum performance.

Wire Area Voltage Drop

A standard wire area voltage drop at maximum ambient temperature is provided in Table 3-6 to assist the cable selection.

Table 3-6. Voltage Drop Using Wire Area (mm^2)

Wire Gauge (mm^2)	Voltage Drop per Meter @ 10 A Round-Trip (V)	Voltage Drop Per Foot @ 10 A Round-Trip (V)
10	0.044	0.014
6	0.074	0.023
4	0.111	0.034

Example of Voltage Drop Calculation Using Wire Area

A 6mm^2 wire will drop 0.074 V/m at 10 A at maximum ambient temperature. Using 50m between the driver and the power supply would provide a voltage drop of 50 x 0.074 = 3.7V.

It is very important to ensure the voltage at the driver's input terminal is within the product power input specification to achieve the maximum performance.

A guideline for allowable voltage drop is to size wire for <10% of the nominal voltage under maximum transient conditions.

Recommendations for Dual and Simplex Power Wiring:

The GS Series driver is provided with power terminals suitable for the required voltage and current level. Two positive and two negative pins are each sized for up to 10 AWG.

Provisions for separate, redundant power supplies are provided by dual inputs. Each of the inputs is diode isolated from the main input bus. If one of the power supplies fails, the GS Series driver will continue to operate normally using the functioning power supply. The failure of one power supply will annunciate as an alarm.

If a single power source is used to supply power to the GS Series driver, jumpers should be used to apply power to both sets of input power terminals. The purpose of these jumpers is to ensure that the power supplied from the source is distributed equally to the two driver inputs. This minimizes the power dissipated in each of the driver input diodes for reduced heat load and improved reliability. When using jumpers, insert the positive (+) power input lead from the power source into either the #1 or #3 positions, and the negative (-) lead into either the #2 or #4 positions as shown in the left panel of Figure 3-10.

In installations where separate dual power sources are connected to the GS Series driver, as shown on the right panel of Figure 3-10, jumpers should not be used.

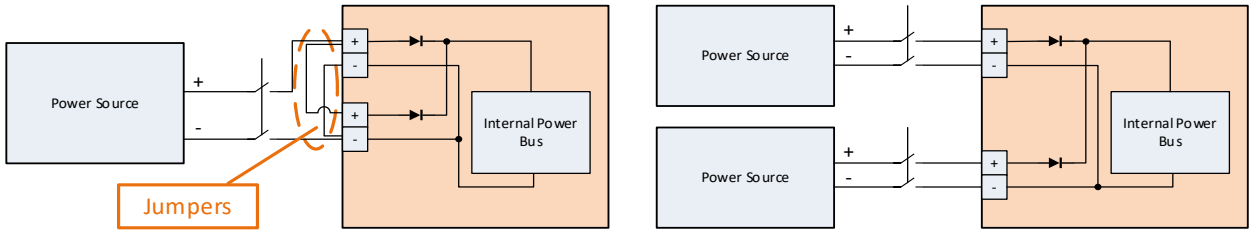


Figure 3-10. GS Series Drivers Installation Examples (Single/Dual Power Sources)

CAN Communications

IMPORTANT **The use of controlled impedance (120 ohm) cable is recommended for proper CANbus operation. See ISO 11898 series standards and CAN in Automation (CiA) recommendations for further information.**

The GS Series valve may be controlled via CAN communication. There are two possible CAN modes:

1. **The CANopen Single (with or without analog backup):**
   This mode uses CAN port 1 for digital communication. Optionally it is possible to configure (by CAN communication) an analog input as a backup signal. By default, only Analog Input #1 is a backup signal (see analog input section for how to interface and setup an analog input).

2. **CANopen Dual:**
   This mode uses CAN port 1 and CAN port 2. If the two ports are working correctly, information received from CAN port 1 is used. If communication by CAN port 1 is not possible anymore (detected by communication time out), CAN port 2 is used for communication.

CAN Node ID Selection:

When using CANopen communications, it is necessary to set the CAN Node ID to a unique value to ensure that the appropriate device responds to commands intended for it. The node ID setting is a user-defined value set in software using the PC Service Tool. Changes to any Node ID-related software settings require a power cycle for the change to take effect.

The CAN communication baud rate can also be configured using the PC Service Tool. The following are the recommended maximum cable lengths for the various baud rates. Differences in the baud rate and the cable length affect the number of units that can be put onto a network.

Table 3-7. CAN Communication Recommended Cable Lengths

Baud Rate	Trunk Cable Length (thick cable)	Max Trunk Length (thin cable)	Max Drop Length	Max Cumulative Drop Length
1 Mbps	30 m	30 m	1 m	6 m
500 Kbps	100 m	100 m	6 m	39 m
250 Kbps	250 m	100 m	6 m	78 m
125 Kbps	500 m	100 m	6 m	156 m

Note: Cable drops shall be kept as short as possible.

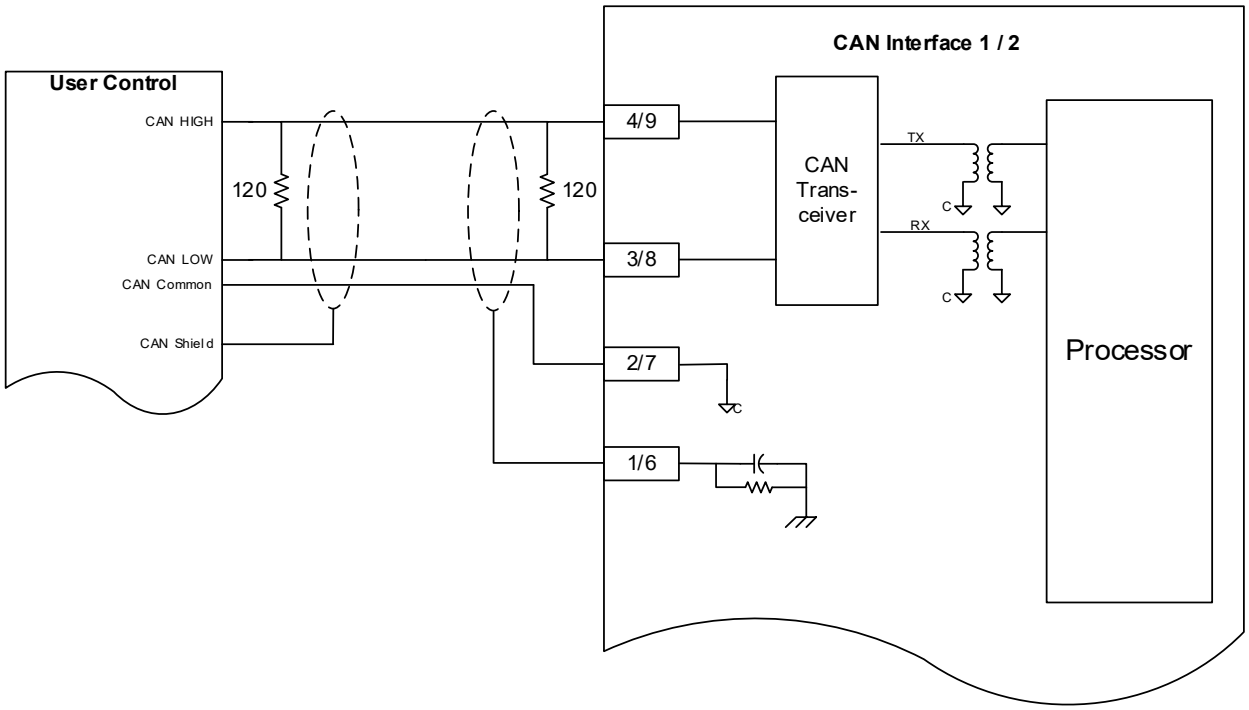


Figure 3-11. CAN Interface Diagram

Figure 3-11 shows CAN interface structure. Refer to Figures 3-7c and 3-7d for dual / single CAN wiring recommendations at system level.

See the Analog Input section below for the analog interface diagram when CAN is used with an Analog Input backup.

IMPORTANT

It is recommended that the system controller continuously monitors position feedback, either by CAN or Analog output. This allows the user to compare the actual position to the commanded position.

Each end of the CAN bus must have a 120 Ω termination resistor. If multiple valves are connected to the same bus, a termination resistor should be installed at the control end of the bus and at the valve furthest from the control. A drop line, 3ft (1m) max length, can be used with a tee connector to install the 120 Ω termination resistors at each end of the bus. For the GS Series conduit version, the termination resistor may be installed internally.

NOTICE

If internal termination is used, disconnecting the GS Series valve will result in communication disruption of all CAN devices on the network, not just the GS Series valve. If this is not desired, do not use the internal termination—use external termination.

Table 3-8. CAN Port Connections

CAN Port #1 Connections:	
Conduit Versions:	CAN Terminal Block Pin 4 (CAN1_High) and Pin 3 (CAN1_Low) CAN Terminal Block Pin 2 (CAN1_Com) CAN Terminal Block Pin 1 (CAN1_Shld)
CAN Port #2 Connections:	
Conduit Version:	CAN Terminal Block Pin 9 (CAN2_High) and Pin 8 (CAN2_Low) CAN Terminal Block Pin 7 (CAN2_Com) CAN Terminal Block Pin 6 (CAN2_Shld)

Table 3-9. CAN Specification

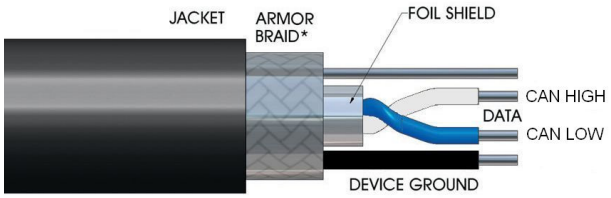
Network Standard:	CAN 2.0B, CANopen
Network Speed:	125kbps, 250kbps, 500kbps, 1Mbps
Network Isolation:	500 V AC from other CAN port & all other I/O, 1500 V AC from Input Power
Network Termination:	120±10Ω is required at each end of the network trunk line. ** The termination resistor is NOT built into the hardware.
CAN Address:	Software Configurable

Table 3-10. Wiring Requirements

Required Cable Type:	Individually shielded twisted pair cable
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	See Table 3.7
Wire Gauge Range:	16–22 AWG (0.3 to 1.3 mm²)
DC Resistance:	17.5Ω per 1000 ft. or less for long trunk cable lengths
Cable Capacitance:	11pF/ft. at 1kHz
Shielding:	Refer to Figures 3-7c, 3-7d, and 3-11

Table 3-11. Recommended CAN Cable Specifications

Belden YR58684, bulk cable (Woodward PN 2008-1512)



Impedance:	120 Ω ±10 % at 1 MHz
DC Resistance:	17.5 Ω per 1000 ft
Cable Capacitance:	11 pF/ft at 1 kHz
Data Pair:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLUE, WHITE twisted pair)
Ground:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLACK)
Drain / Shield Wire:	0.3 mm² / 22 AWG, 7 strands, individually tinned
Shielding:	Foil 100 % with outer Braid 65 %
Jacket:	FEP Insulation, BLACK
Cable Type:	1.5 pair, twisted shielded
Outer Diameter:	0.244 inch
Bend Radius:	2.5 inches
Temperature:	–70 °C to +125 °C
Similar Cable:	Belden 3106A (has different colors & lower temperature specs)

CAN Wiring / Shield Terminations & Limitations

The CAN wiring shields must be terminated at their respective CAN_Shld pins at the GS Series driver, and at the user's control(s) end for EMC compliance purposes.

For robust communications performance, the CAN cabling needs to minimize the exposed, non-shielded cable section that occurs at terminal blocks or connectors. The exposed length of CAN wiring must be limited to less than 3.8 cm / 1.5 inches from the end of the shield to the terminal block.

CAN shields are terminated to chassis (EARTH) through a parallel capacitor-resistor network. This is designed into the GS Series driver. However, the shield must also be directly terminated to chassis (Earth) at one point in the network. In the case of Woodward equipment, the direct ground is meant to be located at the user's control end, as it exits the user's control enclosure.

Since the driver CAN links are galvanically isolated from the GS Series driver's digital core, the CAN COM ground(s) must be connected to the ground of the user's control(s).

IMPORTANT

Always use shielded cables for improved communications in industrial environments. Wire termination should expose as little unshielded cable as possible (less than 3.8 cm / 1.5 inches).

IMPORTANT

It is recommended that the system controller continuously monitors position feedback, either by CAN or Analog output. This allows the user to compare the actual position to the commanded position.

Analog Inputs

The analog inputs on the GS Series driver are 4–20 mA input that may be used as the position command input. The redundancy settings to determine which input(s) is used, and whether it is the primary or secondary position command is configured using the PC Service Tool.

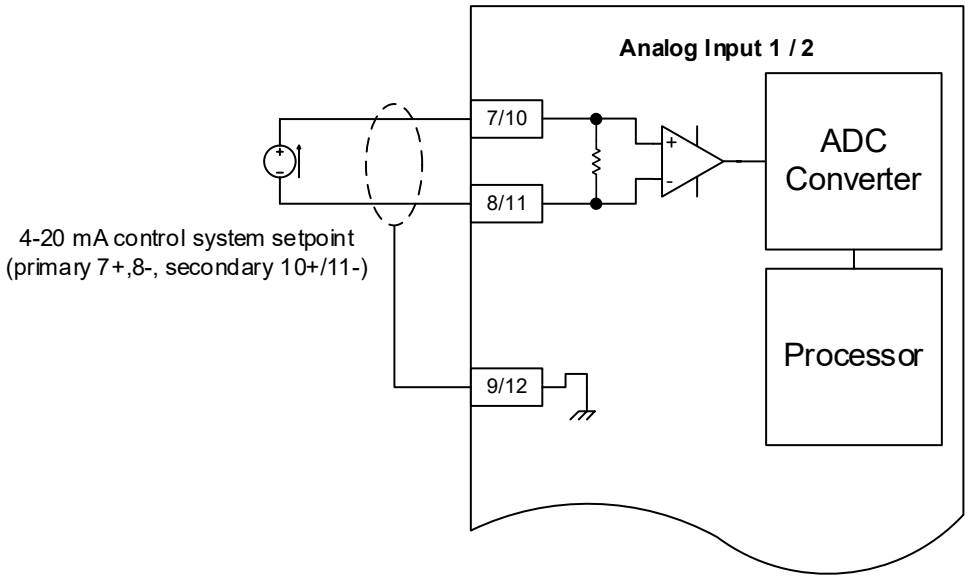


Figure 3-12. Analog Input Interface Diagram

Figure 3-12 shows AIN interface structure. Refer to Figures 3-7b for analog input wiring recommendations at the system level.

Table 3-12. Analog Input Connections

Analog Input #1 Connections:	
Conduit Version:	Analog I/O Terminal Block Pin 7 (AIN1 IN+) and Pin 8 (AIN1 IN-) Analog I/O Terminal Block Pin 9 (AIN1_Shld)
Analog Input #2 Connections:	
Conduit Version:	Analog I/O Terminal Block Pin 10 (AIN2 IN+) and Pin 11 (AIN2 IN-) Analog I/O Terminal Block Pin 12 (AIN2_Shld)

Table 3-13. Analog Input Specification

Analog 4–20 mA:	Range is 0 to 25 mA
Input Impedance:	200±20Ω
Maximum Temperature Drift:	200 ppm/°C
Calibrated Accuracy:	±0.025mA (±0.1% of 25mA Full Scale at 25°C) ±0.063mA (±0.25% of 25mA Full Scale, -40°C - 110°C)
Common Mode Voltage:	±100 V
Common Mode Rejection Ratio:	–70 dB @ 500 Hz
Isolation:	> 1 MΩ from each terminal to Digital Common
Isolation:	1500 VAC from Input Power

Table 3-14. Wiring Requirements

Required Cable Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16–20 AWG (0.5 to 1.3 mm²)
Shielding:	Refer to Figures 3-7b, 3-12

Analog inputs can be used as primary/backup position demand source. Inputs can work in single or redundant mode.

Analog Input 1 can also be configured as a backup source for CANOpen Digital Input With Analog Backup mode. In this case, CAN1 is the primary and Analog Input 1 is the backup demand source.

The turbine system control must also provide appropriate values of Bit3 and Bit4 in “PDO1 – Realtime Fast Message with Demand Selector and Command Bits” (see Appendix A.5. for details) to enable analog backup.

Follow the setup below to configure Analog Input(s) as the position demand source.

Configure Position Demand Selector:

Demand Mode	Selects the position demand source. Analog inputs can be used as the position demand source when one of below options is selected: **Analog Input** Will use the analog input(s) as the position demand (One or two in a redundant configuration) **CANopen Digital Input** in ***Single CAN with analog backup*** mode.

Configure Analog Input(s):

Analog Input Mode	Enable/disable analog input signal. To enable the analog input, this field must be set to the 4 to 20mA mode.

The input is scaled using a linear scaler where:
“Max. Input setting (mA)” will scale to “Position at Max. Input Setting (%)”
“Min. Input setting (mA)” will scale to “Position at Min. Input Setting (%)”

Analog min. mA Input Setting	Scaler for the 4 to 20 mA input. This is the lower input value in mA that will be scaled to the lower position value.
Analog max. mA Input Setting	Scaler for the 4 to 20 mA input. This is the higher input value in mA that will be scaled to the higher position value.
Position at min. mA Input Setting	Scaler for the 4 to 20 mA input. This is the lower position value corresponding to the min input value in mA.
Position at max. mA Input Setting	Scaler for the 4 to 20 mA input. This is the higher position value corresponding to the max input value in mA.
Low Limit Diagnostic Setting	Analog input low diagnostic setting. If the input value is below this setting an error flag is set. When the value goes back above the setting the error flag will no longer be set and a reset will clear this flag.
High Limit Diagnostic Setting	Analog input high diagnostic setting. If the input value is above this setting an error flag will be set. When the value goes back below the setting the error flag will no longer be set and a reset will clear this flag.
	A reset can be given from different sources including the analog input itself (if enabled).

Configure Analog Input Redundancy Manager:

Diff Alarm Threshold	Determines when the position tracking Diff Alarm shall be reported. If difference between Input 1 and Input 2 is greater than or equal to the threshold then the Diff Alarm diagnostic is set.
Diff Shutdown Threshold	Determines when the position tracking Diff Shutdown shall be reported. If difference between Input 1 and Input 2 is greater than or equal to the threshold then the Diff Shutdown diagnostic is set. The Analog Set Position Diff calculation will be used when set in the diff fail mode.
Analog Input Redundancy Calculation	Determines how Analog Set Position is calculated. Applicable only in Dual mode. Average - Analog set position is average of Input 1 and Input 2 Minimum - Analog set position is minimum of Input 1 and Input 2 Maximum - Analog set position is maximum of Input 1 and Input 2
Analog Input Redundancy Diff Fail Calculation	Determines how Analog Set Position is calculated in the Diff Fail mode. This is applicable only in Dual mode and only when the Diff Shutdown diagnostic is active. Diff Shutdown alarm is reported when difference between inputs is higher than configured threshold. Average - Analog set position is average of Input 1 and Input 2 Minimum - Analog set position is minimum of Input 1 and Input 2 Maximum - Analog set position is maximum of Input 1 and Input 2
Analog Input Redundancy Mode	Redundancy mode. The redundancy manager is dependent on Analog Input configuration. Inputs that are used must be enabled (configured to 4-20mA Mode), otherwise an Error will be reported. Dual mode Input 1 and Input 2 are used to calculate Analog Set Position. Single mode Selected input is assigned to Analog Set Position.
Analog Input Reset Mode	Enables Reset of diagnostic flags. Used in systems when there is no other way to perform reset. When inputs are pulled below the low limit and then back into the normal range after 1 second, a reset will be triggered. If Dual mode is used, both inputs must be pulled below low limit and then restored back into the normal range. In the Single mode, only the selected input must be pulled below limit and restored back into the normal range. The other input is ignored.

Analog Outputs

The Analog Outputs from the GS Series driver are 4–20 mA outputs which can be configured to perform one of many different tasks, such as reporting actual position or the demand position. The configuration is done through the PC Service Tool. These outputs are designed for monitoring and diagnostic purposes only and are not meant for any type of closed loop feedback. The outputs are capable of interfacing with instrument load resistances up to 500Ω.

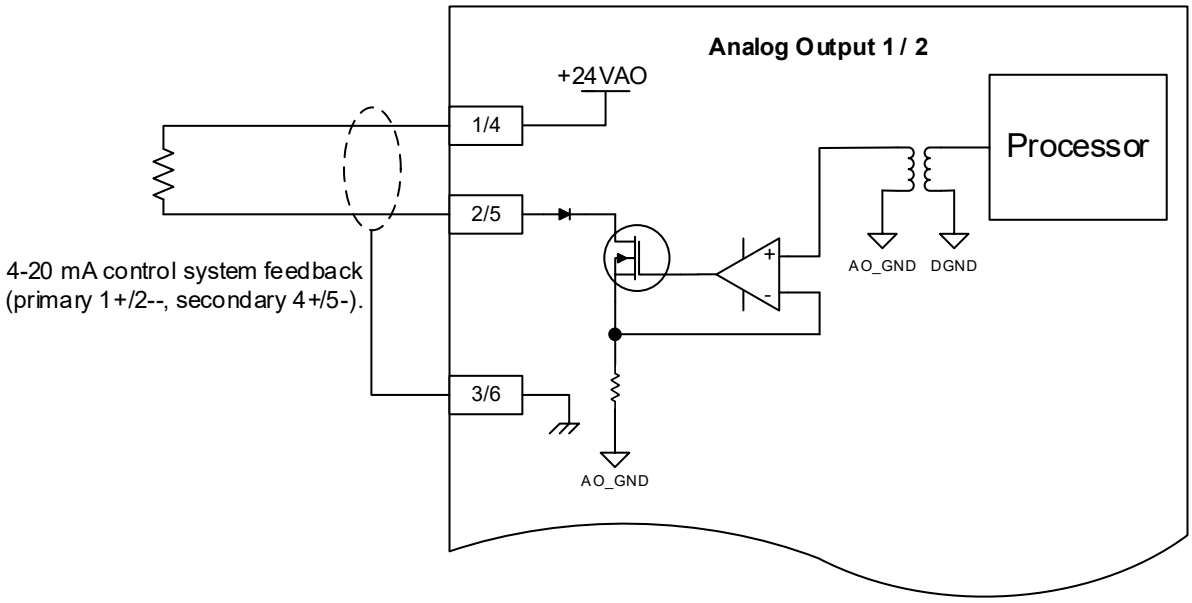


Figure 3-13. Analog Output Interface Diagram

Figure 3-13 shows AOUT interface structure. Refer to Figures 3-7b for analog output wiring recommendations at system level.

Table 3-15. Analog Output Connections

Analog Output #1 Connections:	
Conduit Version:	Analog I/O Terminal Block Pin 1 (AO1 OUT+) and Pin 2 (AO1 OUT-) Analog I/O Terminal Block Pin 3 (AO1_Shld)
Analog Output #2 Connections:	
Conduit Version:	Analog I/O Terminal Block Pin 4 (AO2 OUT+) and Pin 5 (AO2 OUT-) Analog I/O Terminal Block Pin 6 (AO2_Shld)

Table 3-16. Analog Output Specification

Output Range:	0.1 to 25 mA
Calibrated Output Range:	2 to 22 mA
Load Range:	0 Ω up to 500 Ω
Calibrated Accuracy:	±0.025mA (±0.1% of 25mA Full Scale at 25°C) ±0.125mA (±0.5% of 25mA Full Scale, -40°C - 110°C)
Maximum Temperature Drift:	300 ppm/°C
Isolation:	500 V AC from Digital Common, 1500 V AC from Input Power

IMPORTANT

It is recommended that the system controller continuously monitors position feedback, either by CAN or Analog output. This allows the control system to compare the actual position to the commanded position.

Table 3-17. Analog Output Wiring Requirements

Required Cable Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16–20 AWG (0.5 to 1.3 mm²)
Shielding:	Refer to Figures 3-7b, 3-13

Analog output(s) can be used to provide scaled feedback for actual position, set position, or motor current.

Analog Output Configuration Options:

Analog Output Mode	**Turned Off** In this mode the analog output will be turned off, with an output of 0 mA. **Actual Position** This mode will put the actual position (real-time position of the valve) onto the output. **Echo Setpoint** This mode will put the set position (real-time position demand to the position controller) onto the output. This is typically used for system testing. **Motor Current** This selection will use the actual current. This is the current that the driver is producing to control the motor. This signal can be quite active. The current from the position controller is continuously moving to maintain the position of the valve at the demand position. The actual current is a measure of the torque needed to move and control the valve. This mode is typically used for system testing or troubleshooting purposes.

The Analog Out Position Scaling values are applicable to ACTUAL POSITION and ECHO SETPOINT modes:

Position at Min Current Scaling	Min position value for scaling from percent position to mA.
Position at Max Current Scaling	Max position value for scaling from percent position to mA.
Min Current Scaler	The lower value in mA corresponding to the lower position value in percent.
Max Current Scaler	The higher value in mA corresponding to the higher position value in percent.

Analog Out Position Scaling values applicable to the MOTOR CURRENT mode:

Motor current at Min Current Scaling	Min motor current value for scaling from motor current to mA
Motor current at Max Current Scaling	Max motor current value for scaling from motor current to mA
Min Current Scaler	Min analog output value for scaling from motor current to mA
Max Current Scaler	Max analog output value for scaling from motor current to mA

Discrete Inputs

There are three discrete inputs available. These are designed as pull-down circuits which create a configurable logic level state when an external contact is closed. If the external contact is closed, this pulls the sensing signal down to the low state. If the contact is open, the internal +24VISO source pulls the sensing signal to the high state. With the PC Service Tool, the user can configure these inputs as active high (open) or active low (ground) depending on the wiring preference. It is recommended that the discrete inputs be configured with a polarity that enables detection of broken wires. A broken wire will look like an open input, so the polarity should be set where closed is the desired customer condition. This is especially important in the case of a shutdown input. External power is not necessary for these inputs as the isolation is provided internally.

Discrete Input #3 is reserved for the security lockout function. This input is not configurable. If the DI #3 contact is open the security function is in the "lockout" state and the valve configuration cannot be modified, but information from the controller is still displayed on the service tool. If DI #3 contact is closed the security function is in the "disabled" state and valve configuration may be modified based on user access controls.

The conduit version of the driver has three inputs and three ground terminals provided. Only one shield is provided, so if shielding is used it will be necessary run all the inputs in a single shielded group.

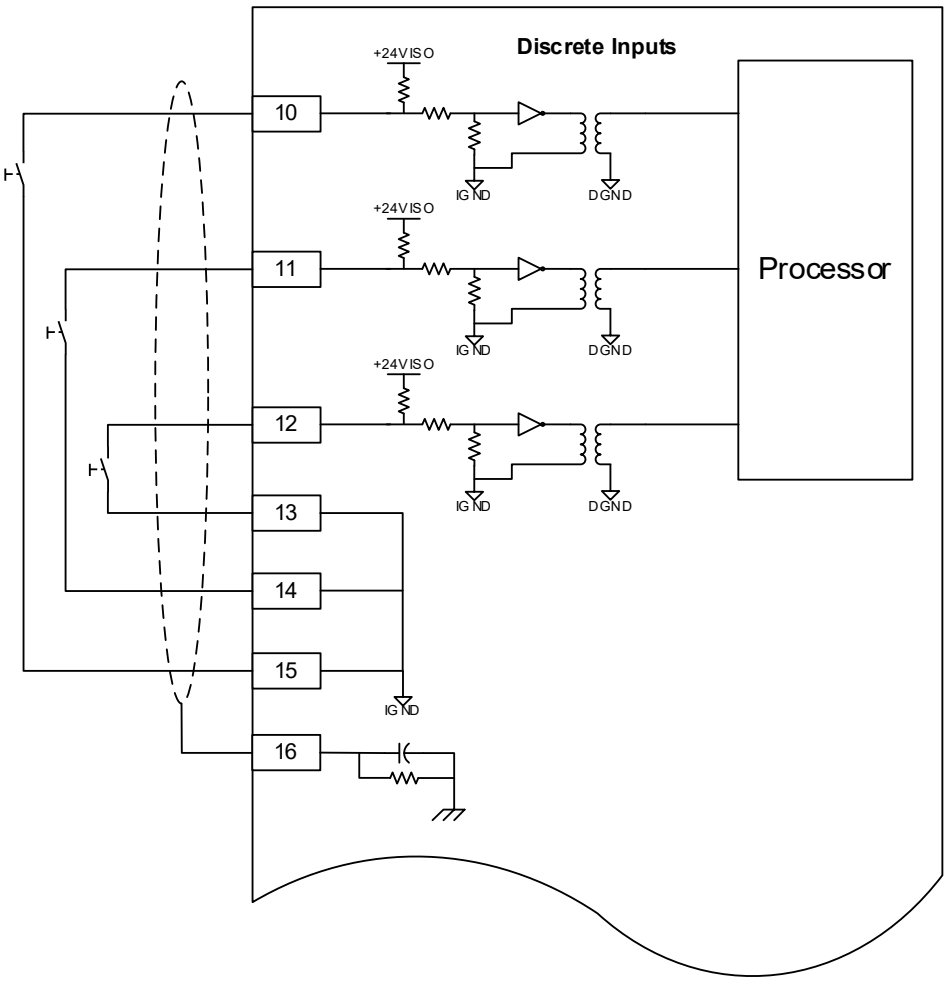


Figure 3-14. Discrete Input Interface Diagram

Figure 3-14 shows the DIN interface structure. Refer to Figures 3-7b for discrete input wiring recommendations at system level.

Table 3-18. Discrete Input Connections

Discrete Input #1 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 10 (DI 1) to DI GND (Pin 13-15)
Discrete Input #2 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 11 (DI 2) to DI GND (Pin 13-15)
Discrete Input #3 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 12 (DI 3) to DI GND (Pin 13-15)

Table 3-19. Discrete Input Specification

High Input Threshold:	> 7 VDC
Low Input Threshold:	< 3 VDC
Hysteresis:	> 1 VDC
Wetting Current:	5 mA
Contact Type:	Dry contact or open drain/collector switch to ground
Isolation:	500 V AC from Digital Common, 1500 V AC from Input Power

Table 3-20. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them
Maximum Run Length: 100 m
Wire Gauge Range: 16–20 AWG (0.5 to 1.3 mm²)

Discrete Input 1 and 2 can be used for shutdown/reset functionality.
Shutdown action is triggered when Input is active (True). Reset action is triggered when input transitions from active (True) to inactive (False) level.

Discrete Inputs 1 & 2 Configuration Options:

Discrete Input Actions	**Disabled:** Discrete inputs will not trigger Shutdown/Reset action. **Shutdown/Reset Input 1 and 2:** Discrete Input 1 allows Shutdown and Reset functions. Discrete Input 2 allows Reset function. Reset is delayed by 1 second. **Fast Shutdown/Reset Input 1 and 2:** Discrete Input 1 allows Shutdown and Reset function. Discrete Input 2 allows Reset function. Reset is delayed by 100 milliseconds.
Discrete Input Polarity [1]	If this option is set to 0 (not ticked), input is active (TRUE) when the voltage at the input terminal is above High Input Threshold. If this option is set to 1 (ticked), input is active (TRUE) when the voltage at the input terminal is below Low Input Threshold.

[1] Polarity settings are aligned with other products in the DVP family. Firmware revision DVPII1_00 and earlier feature opposite polarity selection option. If firmware upgrade is performed in the field, these settings are adjusted automatically, so no user input is required. Firmware revision can be identified using the Web Service Tool, in field *Real-time Software Version* on *Dashboard* tab.

Discrete Outputs

There are three discrete outputs for the conduit version of the GS Series driver. These outputs can be configured to react to any or all the Alarms/Shutdowns in the positioner. The outputs can also be configured as active on or active off. These outputs are low side open-drain drivers requiring an external supply for energizing the external relay or load.

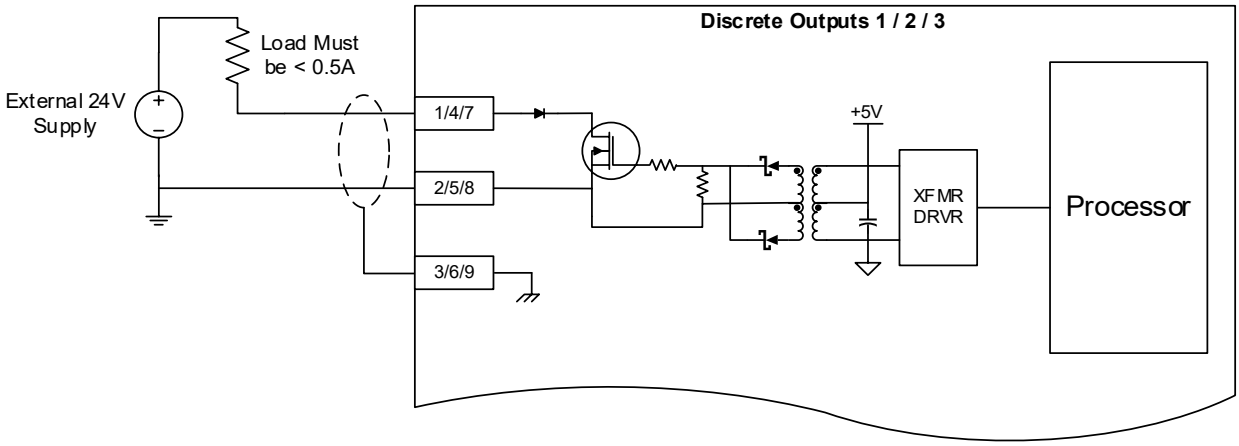


Figure 3-15. Discrete Output Interface Diagram

Figure 3-15 shows DOUT interface structure. Refer to Figure 3-6b for discrete output wiring recommendations at the system level.

Table 3-21. Discrete Output Connections

Discrete Output #1 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 1 (DOUT1+) to Pin 2 (DOUT1-), Pin 3 (DOUT1_SHLD)
Discrete Output #2 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 4 (DOUT2+) to Pin 5 (DOUT2-), Pin 6 (DOUT2_SHLD)
Discrete Output #3 Connections:	
Conduit Version:	Discrete I/O Terminal Block Pin 7 (DOUT3+) to Pin 8 (DOUT3-), Pin 9 (DOUT3_SHLD)

Table 3-22. Discrete Output Specification

Topology:	Open-drain low-side drive
External Power Supply Voltage Range:	18–32 V
Maximum Load Current:	500 mA
Protection:	The outputs are short circuit protected
	The outputs are recoverable after short circuit is removed
Response Time:	Less than 2 ms
On-state Saturation Voltage:	Less than 1 V @ 500 mA
Off-state Leakage Current:	Less than 10 µA @ 32 V
Isolation:	500 V AC from Digital Common, 1500 V AC from Input Power

Table 3-23. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16-20 AWG (0.5 to 1.3 mm²)
Shielding:	Refer to Figures 3-7b, 3-15

American Wire Gauge Voltage Drop

A standard wire gauge voltage drop at maximum ambient temperature is provided in Table 3-24 to assist the cable selection.

Table 3-24. Voltage Drop Using American Wire Gauge (AWG)

Wire Gauge (AWG)	Voltage Drop per Meter @ 0.5 A Round-Trip (V)	Voltage Drop per Foot @ 0.5 A Round-Trip (V)
16	0.017	0.0052
18	0.027	0.0082
20	0.043	0.0131

Voltage Drop Calculation Using American Wire Gauge

Example: A 20 AWG wires will drop 0.013 V/ft at 0.5 A at maximum ambient temperature. Using 100 feet between the driver and the power supply would provide a voltage drop of 100x0.013 = 1.3V.

Wire Area Voltage Drop

A standard wire area voltage drop at maximum ambient temperature is provided in Table 3-25 to assist the cable selection.

Table 3-25. Voltage Drop Using Wire Area (mm^2)

Wire Gauge (mm^2)	Voltage Drop per Meter @ 0.5 A Round-Trip (V)	Voltage Drop per Foot @ 0.5 A Round-Trip (V)
1.3	0.0171	0.0052
1.0	0.0222	0.0068
0.5	0.0444	0.0135

Example of Voltage Drop Calculation Using Wire Area

A 0.5mm^2 wires will drop 0.044 V/m at 0.5 A at maximum ambient temperature. Using 50m between the driver and the power supply would provide a voltage drop of 50 x 0.044 = 2.2V.

It is important to select the appropriate DOUT cable gage to meet system specifications at long cable lengths.

Discrete outputs can be used to provide feedback on unit alarm/shutdown status.

Discrete Output Configuration Options:

Discrete Output Mode	**Turned off:** Discrete output is not used (disabled). **Active when diagnostic is detected:** Output activated when any of the conditions described below is detected. **Inactive when diagnostic is detected:** Output inactivated when any of the conditions described below is detected **Limit Switch*:** Output changes state based on actual position value
Discrete Out Status Error Combined Alarm	This option is applicable for **Active / Inactive when diagnostic is detected** modes. Discrete output state is the combined status of: Alarm Shutdown Shutdown Position Shutdown System Shutdown Not External
Discrete Out Limit Switch On Threshold *	The actual position value at which the Discrete Output will transition from OFF/Open to ON/Closed state when Limit Switch mode is selected.
Discrete Out Limit Switch Off Threshold *	The actual position value at which the Discrete Output will transition from ON/Closed to OFF/Open state when Limit Switch mode is selected
Discrete Out Limit Switch Invalid State *	Setting for DiscreteOutput when Limit Switch mode is selected to determine the output state if the Actual Position value is invalid. If the setting is 0, then it sets it to OFF/Open. If the setting is not 0, then it sets it to ON/Closed

* Not all product versions provide Limit Switch functionality.

Ethernet Service Port

The GS Series driver has an Ethernet service communications port to support operation of the PC Service Tool. This tool is essential for configuration, service support, and firmware updates. The wiring requirements are defined below.

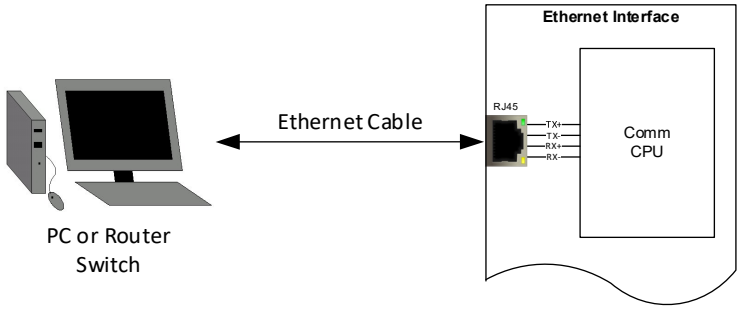


Figure 3-16. Ethernet Service Port Interface Diagram

Table 3-26. Ethernet Service Port Connections

Conduit version: CPU module ‘Service Port’ connector (RJ45)

Wiring Requirements:

- Double Shielded (SSTP) cables are required
- CAT-5 Ethernet Cable
- Maximum Run Length: 100 m
- For long Ethernet cables where ground loops are a concern, the shield should be capacitively coupled at one end.

The RJ45 Ethernet service port follows the EIA 568-B pinout convention:

Table 3-27. Ethernet Service Port

Pin 1 – TX+
Pin 2 – TX-
Pin 3 – RX+
Pin 4 – not used
Pin 5 – not used
Pin 6 – RX-
Pin 7 – not used
Pin 8 – not used
SHIELD = Chassis GND

Driver Version with Circular Connectors

A version of the GS Series valve is available to permit marshaling to the control system via circular connectors which are integrated into the driver housing. Connection can be easily made using the Power, CAN, and Multifunction signal cables. The connections from the marshaling panel to the engine control system are typically implemented via user supplied field wiring.

Field wiring for the GS Series valves must be suitable for at least 115 °C.

Figure 3-17. GS Series Driver – Connector Version

Table 3-28. GS Series Valve Electrical Connections

Driver with Connectors:

Earth Ground:	Provided through ground lugs on housing
Power Input:	90–150 VDC measured at the GS Series valve
CAN Network:	CANOpen CAN ports (2)
Analog Input:	4–20 mA signal (1 input)
Analog Output:	4–20 mA signal (1 output)
Discrete Input:	Sinking - Internal pull-up (2 inputs)
Discrete Output:	Open Collector Low-Side (1 output)
Ethernet	10/100 Mbps Service Port

Wiring Installation

- Connect all wires as shown in the Control Wiring Diagram(s) for the appropriate GS valve type (Figures 3-20a-d).
- Load terminations should be applied accordingly.
- Apply general practice to ensure cables are checked from point to point.
- Wires exposed beyond the shield should be as short as possible, not exceeding 2 inches (51 mm).
- The shield termination wire (or drain wire) should be kept as short as possible, not exceeding 2 inches (51 mm), and the diameter should be maximized where possible.
- 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 assure satisfactory operation of the product.

Cable Assemblies - General Information

The Woodward designed cable assemblies are water and oil resistant to type MIL-23699 synthetic oil, splashing rating, and comply with low smoke requirements per NFPA 262 (UL 910). The construction of the cables assemblies prevents gas and vapor migration. The general characteristics of these cables is listed below:

Table 3-29. Power Cable General Specifications

Cable Rated:	600V UL TC RATING
Wires:	12 AWG, 19 strands minimum, copper individually tinned conductors, FEP insulation
Ground:	12 AWG, 19 strands minimum, copper individually tinned conductors, FEP insulation (GREEN)
Shielding:	Stainless steel outer braid, terminated to 16 AWG jumper wire
Jacket:	FEP Insulation, BLACK
Outer Diameter:	0.500 inch
Min. Bending Radius:	5 inches
Operating Temperature:	–40 °C to +125 °C
Cable Maximum Surface Temperature:	+150 °C

Table 3-30. Power Cable Orderable Part Numbers

Woodward PN	Cable Length
5450-2205.10	10 ft
5450-2205.20	20 ft
5450-2205.30	30 ft
5450-2205.40	40 ft
5450-2205.50	50 ft
5450-2205.60	60 ft
5450-2205.70	70 ft
5450-2205.80	80 ft
5450-2205.90	90 ft
5450-2205.100	100 ft
5450-2205.110	110 ft
5450-2205.120	120 ft
5450-2205.130	130 ft
5450-2205.140	140 ft
5450-2205.150	150 ft

The CAN cable set consists of trunk, jumper, single & dual drop cables, as well as CAN-T and CAN terminators.

Alternatively, if a single GS Series valve is used in the application, the CAN cable with integrated termination resistor (5450-2295) can be used.

Table 3-31. CAN Cable General Specification

Cable Rating:	300V UL PLTC RATING
Impedance:	120 Ω ±10 % at 1 MHz
DC Resistance:	10.5 Ω per 1000 ft
Cable Capacitance:	12 pF/ft at 1 kHz
Data Pair:	20 AWG, 19 strands, individually tinned, FEP insulation (BLUE, WHITE twisted pair)
Ground:	20 AWG, 19 strands, individually tinned, FEP insulation (BLACK)

Drain / Shield Wire:	20 AWG, 19 strands, individually tinned
Shielding:	Stainless steel outer braid, terminated to 16 AWG jumper wire
Jacket:	FEP Insulation, BLACK
Outer Diameter:	Single CAN 0.310 inch Dual CAN 0.30 inch (height) X 0.630 inch (width)
Min Bending Radius:	2.1 inches
Operating Temperature:	–40 °C to +125 °C
Cable Maximum Surface Temperature:	+150 °C

Table 3-32. CAN Drop Cable Orderable Part Numbers

Single CAN Drop Cable		**Dual CAN Drop Cable**	
Woodward PN	**Cable Length**	**Woodward PN**	**Cable Length**
5450-2219.2	2 ft	5450-2245.2	2 ft
5450-2219.3	3 ft	5450-2245.3	3 ft
5450-2219.4	4 ft	5450-2245.4	4 ft
5450-2219.5	5 ft	5450-2245.5	5 ft
5450-2219.10	10 ft	5450-2245.10	10 ft
5450-2219.15	15 ft	5450-2245.15	15 ft
5450-2219.20	20 ft	5450-2245.20	20 ft

Table 3-33. CAN Jumper Cable Orderable Part Numbers

Woodward PN	**Cable Length**
5450-2217.2	2 ft
5450-2217.3	3 ft
5450-2217.4	4 ft
5450-2217.5	5 ft
5450-2217.10	10 ft
5450-2217.20	20 ft
5450-2217.30	30 ft

Table 3-34. CAN Trunk Cable Orderable Part Numbers

CAN Trunk Cable – Female

Woodward PN	**Cable Length**
5450-2218.10	10 ft
5450-2218.20	20 ft
5450-2218.30	30 ft
5450-2218.40	40 ft
5450-2218.50	50 ft
5450-2218.60	60 ft
5450-2218.70	70 ft
5450-2218.80	80 ft
5450-2218.90	90 ft
5450-2218.100	100 ft
5450-2218.110	110 ft
5450-2218.120	120 ft
5450-2218.130	130 ft
5450-2218.140	140 ft
5450-2218.150	150 ft

Table 3-35. CAN-T and Terminators Orderable Part Numbers

Woodward PN	Description
5450-2246	CAN, NETWORK TEE, M/F BUS, F DROP
5450-2247	CAN, NETWORK TERMINATORS, MALE 120 Ω

For applications using just a single GS50 fuel metering valve, a connectorized CAN cable with integrated termination resistor can be used.

Table 3-36. CAN Trunk Cable (with Integrated Termination Resistor) Orderable Part Numbers

Woodward PN	Description
5450-2295.10	10 ft
5450-2295.20	20 ft
5450-2295.30	30 ft
5450-2295.40	40 ft
5450-2295.50	50 ft
5450-2295.60	60 ft
5450-2295.70	70 ft
5450-2295.80	80 ft
5450-2295.90	90 ft
5450-2295.100	100 ft
5450-2295.110	110 ft
5450-2295.120	120 ft
5450-2295.130	130 ft
5450-2295.140	140 ft
5450-2295.150	150 ft

Input and output connections to the analog and discrete signals plus connectivity to the ethernet service port are available via the multifunction cable.

Table 3-37. Multifunction Cable General Specification

Cable Rating:	300V UL PLTC RATING
Ethernet Pairs:	CAT5e 24 AWG, 2 pair per ANSI/TIA/EIA-568.
I/O Data Pairs:	20 AWG, 19 strands, individually tinned
Drain / Shield Wire (overall):	20 AWG, 19 strands, individually tinned
Shielding:	Stainless steel outer braid, terminated to 16 AWG jumper wire
Jacket:	FEP Insulation, BLACK
Outer Diameter:	0.500 inch
Min. Bending Radius:	5 inches
Operating Temperature:	–40 °C to +125 °C
Cable Maximum Surface Temperature:	+150 °C

Table 3-38. Multifunction Cable Orderable Part Numbers

Woodward PN	Cable Length
5450-2250.10	10 ft
5450-2250.20	20 ft
5450-2250.30	30 ft
5450-2250.40	40 ft
5450-2250.50	50 ft
5450-2250.60	60 ft
5450-2250.70	70 ft
5450-2250.80	80 ft
5450-2250.90	90 ft
5450-2250.100	100 ft
5450-2250.110	110 ft
5450-2250.120	120 ft
5450-2250.130	130 ft
5450-2250.140	140 ft
5450-2250.150	150 ft

Front Panel Connectors Installation

Follow the instructions below to ensure the front panel connectors are properly mated.

The multifunction cable should be installed first, then the CAN cable, and finally the power cable.

CAN and I/O Signal Connectors

Install threaded MIL connectors cables in accordance with Figure 3-18. Fully tighten (around 10 full turns) by hand both connectors on the on-board driver. Loose or cross-threaded connectors may lead to poor electrical connection and impair the IP rating listed in the specification section.

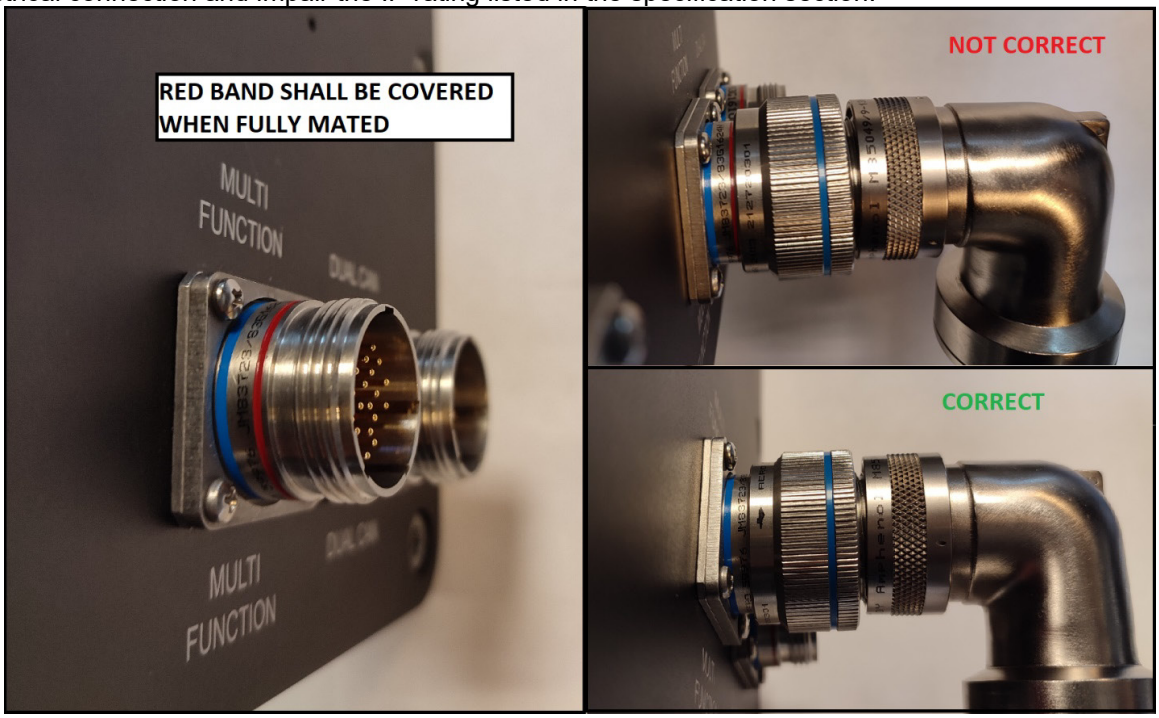


Figure 3-18. CAN and I/O Signal Connectors

Power Supply Connector

Install threaded MIL connector cables in accordance with Figure 3-19. Fully tighten the connector (around 10 full turns) by hand. Loose or cross-threaded connectors may lead to poor electrical connection and impair the IP rating listed in the specification section.

NOTICE

It may be necessary to use a tool to tighten the connector the last 2-3 turns. Make sure not to go any further than the blue band.

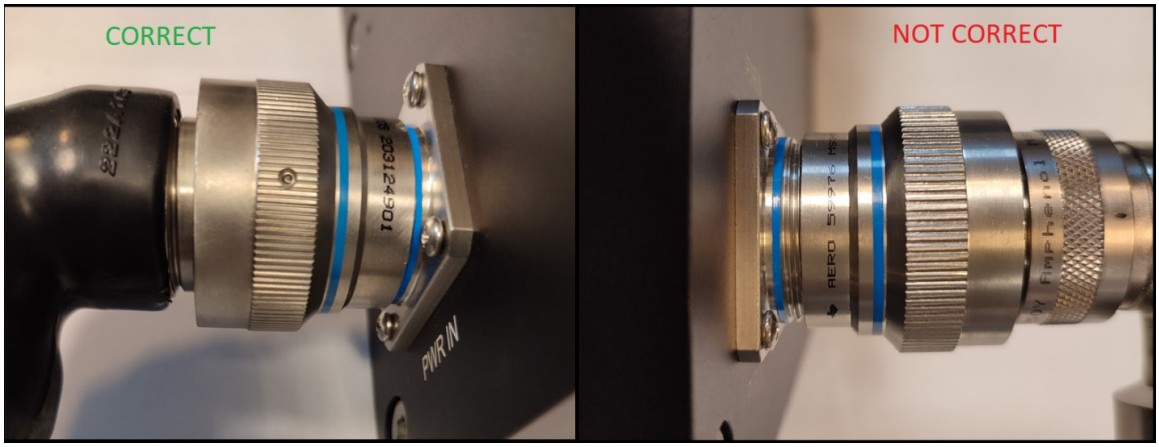


Figure 3-19. Power Supply Connector

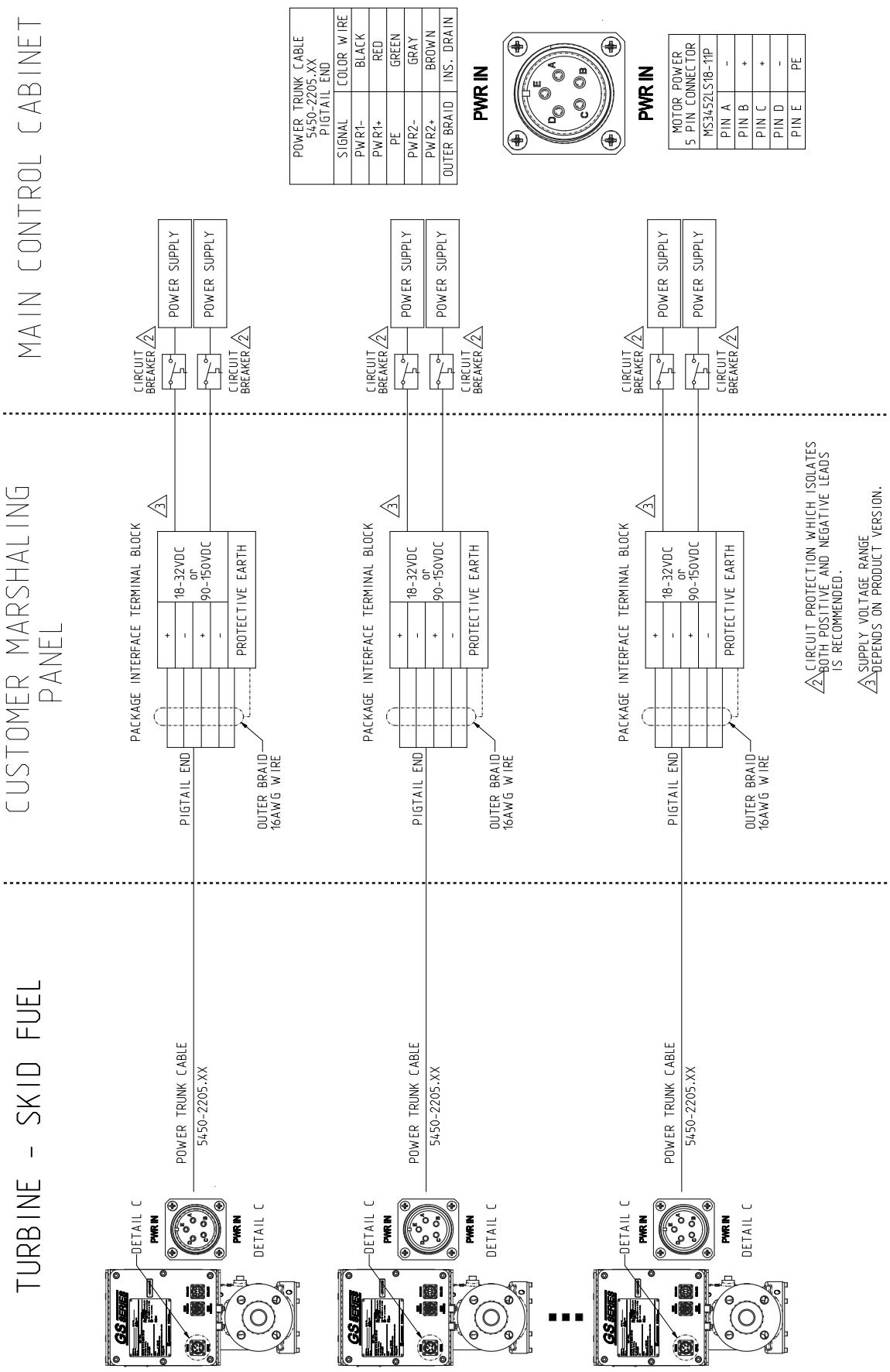


Figure 3-20a. GS Series Connector Version System Wiring Diagram – Power Input

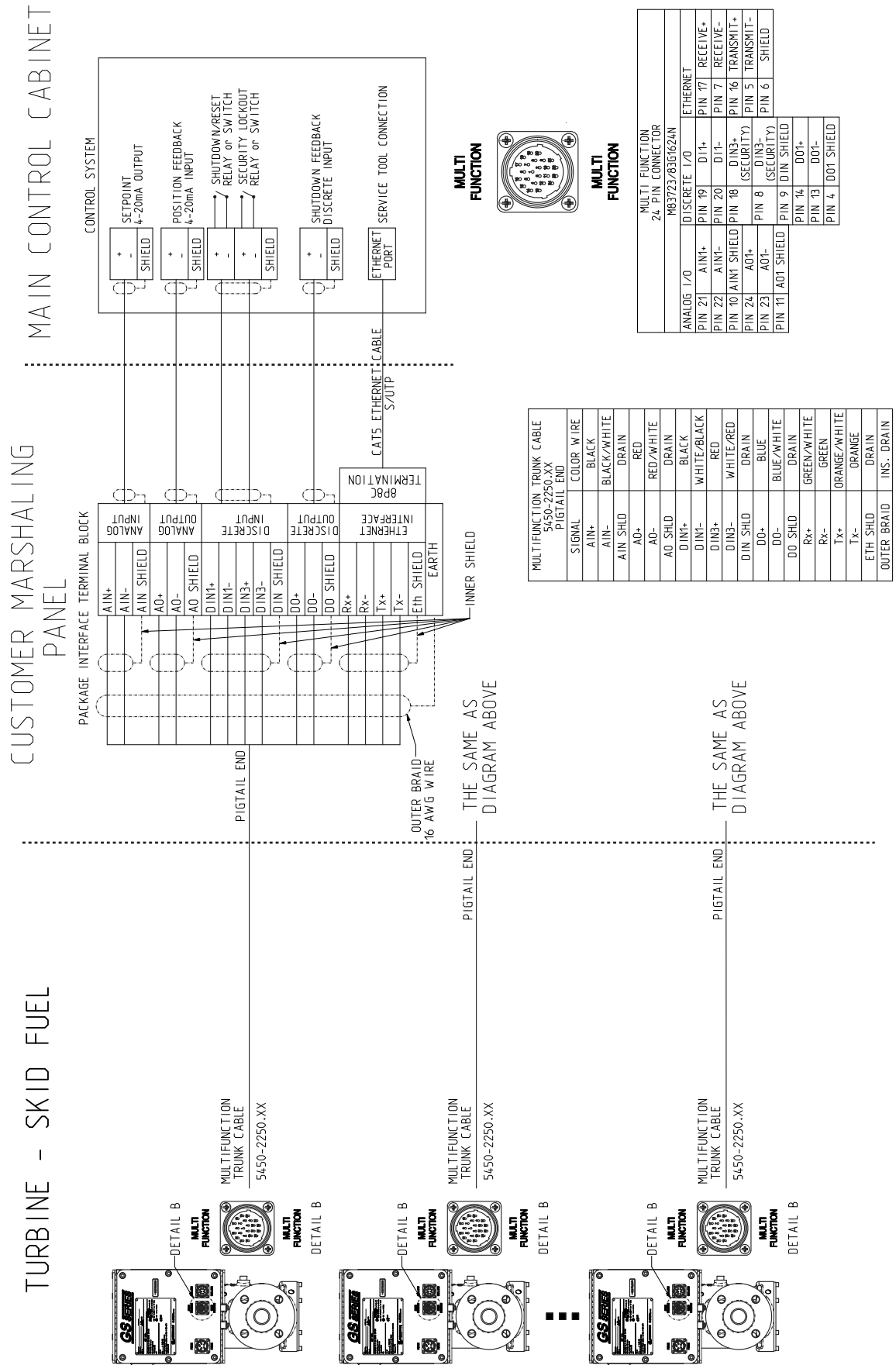


Figure 3-20b. GS Series Connector Version System Wiring Diagram – IO

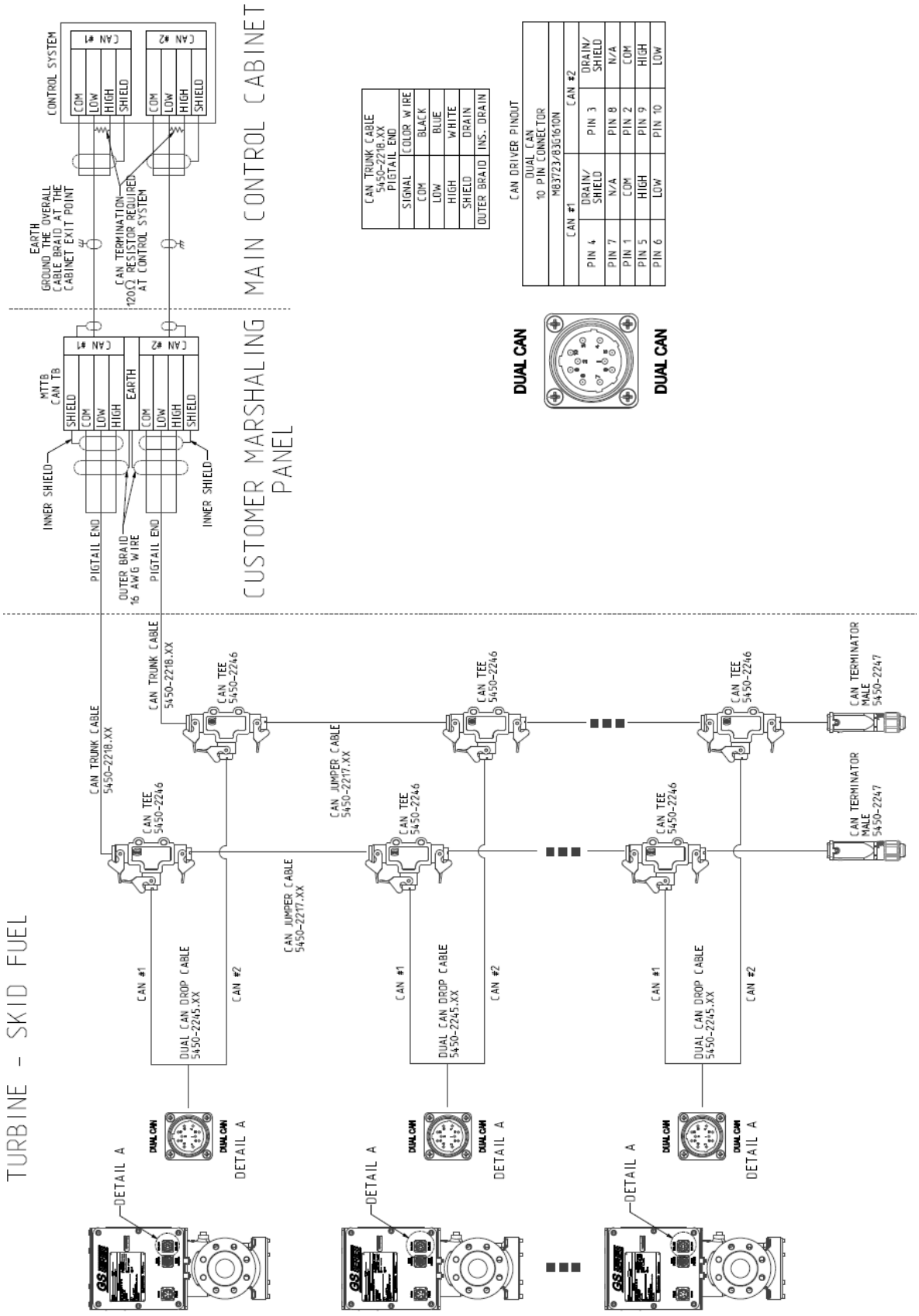


Figure 3-20c. GS Series Connector Version System Wiring Diagram – Dual CAN

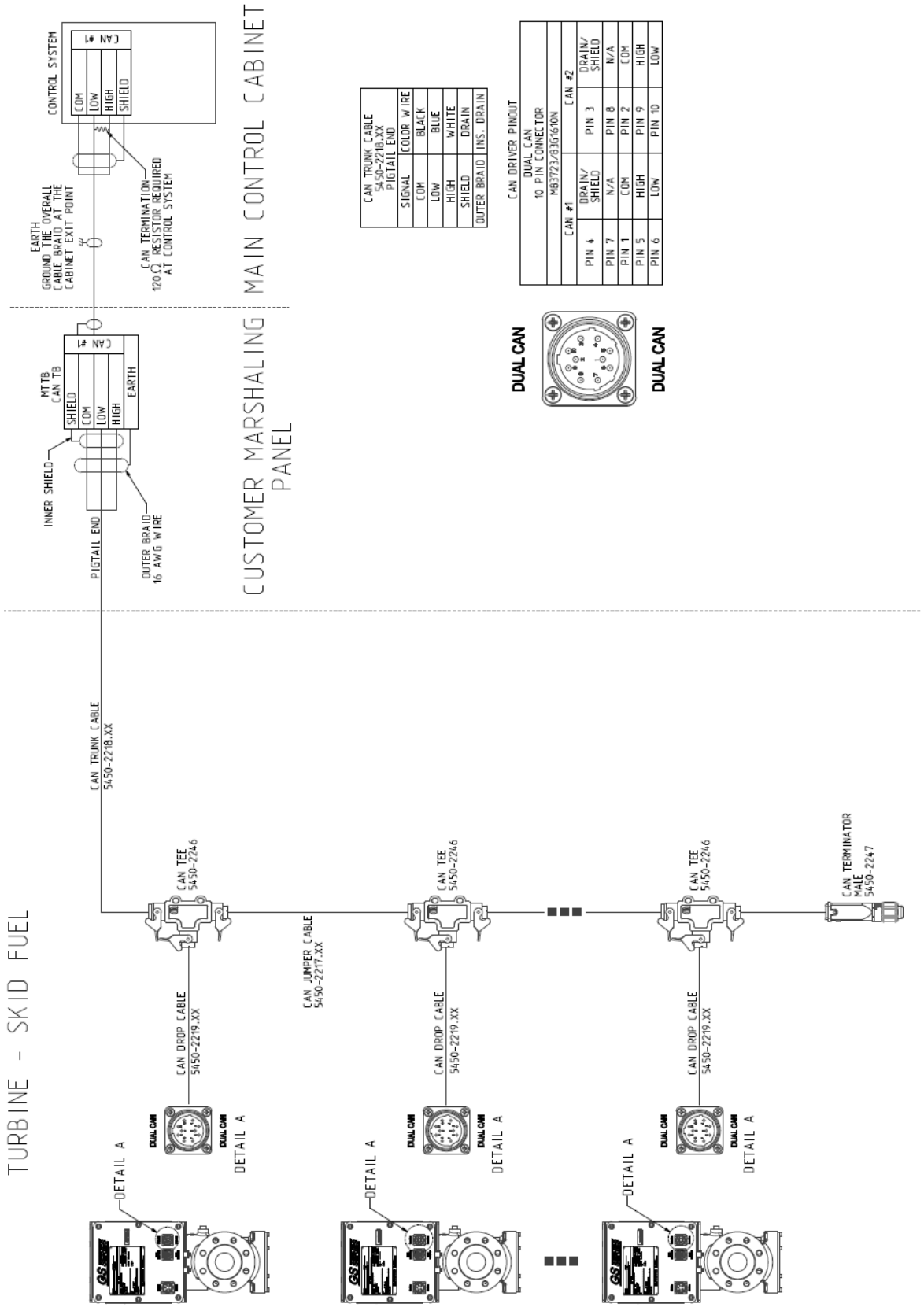


Figure 3-20d. GS Series Connector Version System Wiring Diagram – Single CAN

Shielding Requirements

The use of shielded-twisted cabling is required where indicated by the control-wiring diagram to ensure EMC compliance. The cable shield can be terminated as indicated by the control wiring diagram using the installation notes described below.

Grounding Requirements

The GS Series driver chassis is intended to be grounded using a short, low-impedance strap or cable (typically >12 AWG/4 mm² and <18”/46 cm in length) connected to the designated EMC ground terminal (⏚). Green/yellow insulation and green insulation shall not be used for the EMC ground connection.

Additionally, the PE terminal (⏚) must be connected to PE ground, using wire size ≥12 AWG/4 mm^2 or at least as large as the power input leads, to ensure safety compliance. Green/yellow insulation and green insulation shall not be used for the EMC ground connection.

Power Supply Requirements

⚠WARNING

Fire Hazard

Overcurrent protection devices recommended in this manual are intended to provide protection against faults in the wiring or GS Series driver that could result in increased current flow, and therefore, increased heating and the probability of the start and spread of fire.

The GS Series valve driver is designed to accept redundant power supply inputs. These inputs share a common ground and are isolated from chassis ground. This option allows for redundancy in wiring, terminal connections, and power sources if the power sources share a common ground. The user is provided with four terminals, two positive terminals and two negatives at the front panel connector or power leads when using a Woodward designed power cable.

See Table 3-38 for required power and fusing information.

Table 3-39. GS Series Input Power Requirements

		(-40°C to +93°C)
Voltage Range	90 VDC to 150 VDC	18 VDC to 32 VDC
Inrush Current	< 30A, 10ms	<7A, 80ms
Continuous Input Current	0.7 A	2.75A
Transient Input Current [1]	7.5A, 250ms	8A, 400ms
Input Current at Stall Condition [2]	2.1A	8.4A
Fuse	10A, 250V Slow Blow, Minimum I^2t rating 500 A^2s	10A, 250V Slow Blow, Minimum I^2t rating 500 A^2s
Circuit Breaker	10A, 250V minimum	10A, 250V minimum

Notes:

[1] - These numbers represent the maximum possible GS driver current draw in normal operation.

[2] - Defined by required compliance ratings tests.

High input current transients can be drawn during rapid movement. The above recommendations include the transient nature of the electrically driven actuator system. The GS Series driver is not equipped with an input power switch or breaker. Correct power supply sizing depends on factors such as cable sizing, environment, and local regulatory requirements. It is recommended that a safety input power switch be provided for installation and servicing.

Proper input power wiring to the GS Series driver is crucial to its operation. A circuit breaker meeting the power supply requirement may be used for this purpose. Figure 3-21 illustrates the correct and incorrect power cable wiring.

⚠CAUTION

The circuit breaker must be suitably located and easily reached and must be marked as the disconnecting device for the equipment.

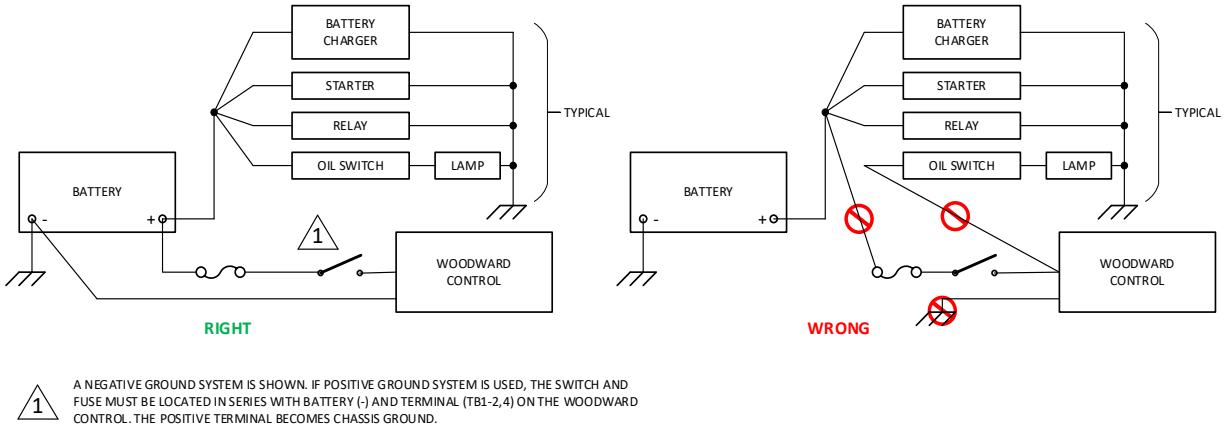


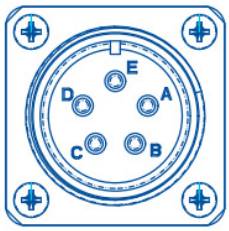
Figure 3-21. GS Series Driver Power Wiring Recommendation

Supply Voltage:

The supply voltage during normal operation must be 90-150 VDC for the 125 VDC versions, or 18-32 VDC for the 24 VDC versions, as measured by the GS Series driver.

Table 3-40. Input Power Connector Pinout

MS3452LS18-11P



Power Supply #1 Inputs:	PWR1(+) Pin B / PWR1(-) Pin A
Power Supply #2 Inputs:	PWR2(+) Pin C / PWR2(-) Pin D
Safety ground:	Pin E

Table 3-41. Power Cable Wire Colors

Label	Color	Function
PWR1+	RED	Power Input 1 (+) lead
PWR1-	BLACK	Power Input 1 (-) lead
PWR2+	BROWN	Power Input 2 (+) lead
PWR2-	GRAY	Power Input 2 (-) lead
SAFETY GROUND	GREEN	Safety ground
OUTER BRAID	-	Outer braid (shield) drain wire

American Wire Gauge Voltage Drop

A standard wire gauge voltage drop at maximum ambient temperature is provided in Table 3-41 to assist the cable selection.

Table 3-42. Voltage Drop Using American Wire Gauge (AWG)

Wire Gauge (AWG)	Voltage Drop per Meter @ 10 A Round-Trip (V)	Voltage Drop Per Foot @ 10 A Round-Trip (V)
8	0.053	0.016
10	0.085	0.026
12	0.134	0.041

Voltage Drop Calculation Using American Wire Gauge

Example: A 10 AWG wire will drop 0.026 V/ft at 10 A at maximum ambient temperature. Using 100 feet between the driver and the power supply would provide a voltage drop of 100x0.026 = 2.6V. It is very important to ensure the voltage at the driver's input terminal is within the product power input specification to achieve the maximum performance.

Wire Area Voltage Drop

A standard wire area voltage drop at maximum ambient temperature is provided in Table 3-42 to assist the cable selection.

Table 3-43. Voltage Drop Using Wire Area (mm^2)

Wire Gauge (mm^2)	Voltage Drop per Meter @ 10 A Round-Trip (V)	Voltage Drop Per Foot @ 10 A Round-Trip (V)
10	0.044	0.014
6	0.074	0.023
4	0.111	0.034

Example of Voltage Drop Calculation Using Wire Area

A 6mm^2 wire will drop 0.074 V/m at 10 A at maximum ambient temperature. Using 50m between the driver and the power supply would provide a voltage drop of 50 x 0.074 = 3.7V.

It is very important to ensure the voltage at the driver's input terminal is within the product power input specification to achieve the maximum performance.

A guideline for allowable voltage drop is to size the wire for <10% of the nominal voltage under maximum transient conditions.

NOTICE

The power input cable provided by Woodward for the connector version of the driver is made of 12 AWG wires. Total voltage drop is the sum of the voltage drops across the power cable and extension cable. Ensure the wire gage of the extension cable is selected to comply with power input voltage range requirements.

Recommendations for Dual and Simplex Power Wiring:

The GS Series driver is provided with power terminals suitable for the required voltage and current level.

Provisions for separate, redundant power supplies are provided by dual inputs. Each of the inputs is diode isolated from the main input bus. If one of the power supplies fails, the GS Series driver will continue to operate normally using the functioning power supply. The failure of one power supply will be annunciated as an alarm.

If a single power source is used to supply power to the GS Series driver, connect both positive leads (PWR1+ and PWR2+) to the positive lead of the power supply, and both negative leads (PWR1- and PWR2-) to the negative lead of the power supply at the marshaling panel, as shown in the left panel of Figure 3-22.

The purpose of this wiring arrangement is to ensure that the power supplied from the source is distributed equally to the two driver inputs. This minimizes the power dissipated in each of the driver input diodes for reduced heat load and improved reliability.

In installations where separate dual power sources are connected to the GS Series driver, as shown on the right panel of Figure 3-22, this connection arrangement should not be used, and each power input shall be connected to its designed source only.

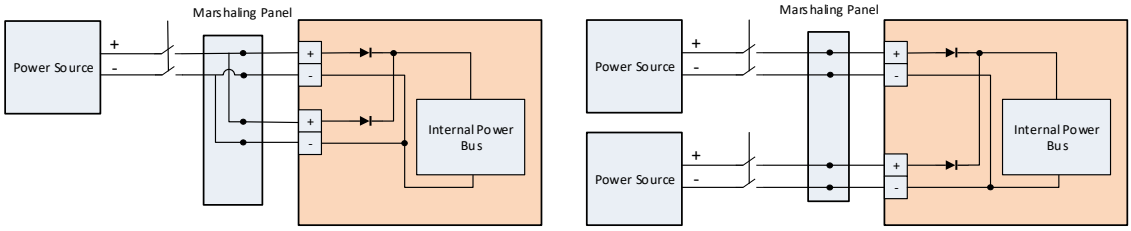


Figure 3-22. GS Series Drivers Installation Examples (Single/Dual Power Sources)

CAN Communications

IMPORTANT

The use of controlled impedance (120 ohm) cable is recommended for proper CANbus operation. See ISO 11898 series standards and CAN in Automation (CiA) recommendations for further information.

The GS Series valve may be controlled via CAN communication. There are two possible CAN modes:

3. **The CANopen Single (with or without analog backup):**
   This mode uses CAN port 1 for digital communication. Optionally, it is possible to configure (by CAN communication) an analog input as a backup signal. By default, only Analog Input #1 is a backup signal (see analog input section for how to interface and setup an analog input).

4. **CANopen Dual:**
   This mode uses CAN port 1 and CAN port 2. If the two ports are working correctly, information received from CAN port 1 is used. If communication by CAN port 1 is not possible anymore (detected by communication time out), CAN port 2 is used for communication.

CAN Node ID Selection:

When using CANopen communications, it is necessary to set the CAN Node ID to a unique value to ensure that the appropriate device responds to commands intended for it. The node ID setting is a user-defined value set in software using the PC Service Tool. Changes to any Node ID-related software settings require a power cycle for the change to take effect.

The CAN communication baud rate can also be configured using the PC Service Tool. The following are the recommended maximum cable lengths for the various baud rates. Differences in the baud rate and the cable length affect the number of units that can be put onto a network.

Table 3-44. CAN Communication Recommended Cable Lengths

Baud Rate	Trunk Cable Length (thick cable)	Max Trunk Length (thin cable)	Max Drop Length	Max Cumulative Drop Length
1 Mbps	30 m	30 m	1 m	6 m
500 Kbps	100 m	100 m	6 m	39 m
250 Kbps	250 m	100 m	6 m	78 m
125 Kbps	500 m	100 m	6 m	156 m

Note: Cable drops shall be kept as short as possible.

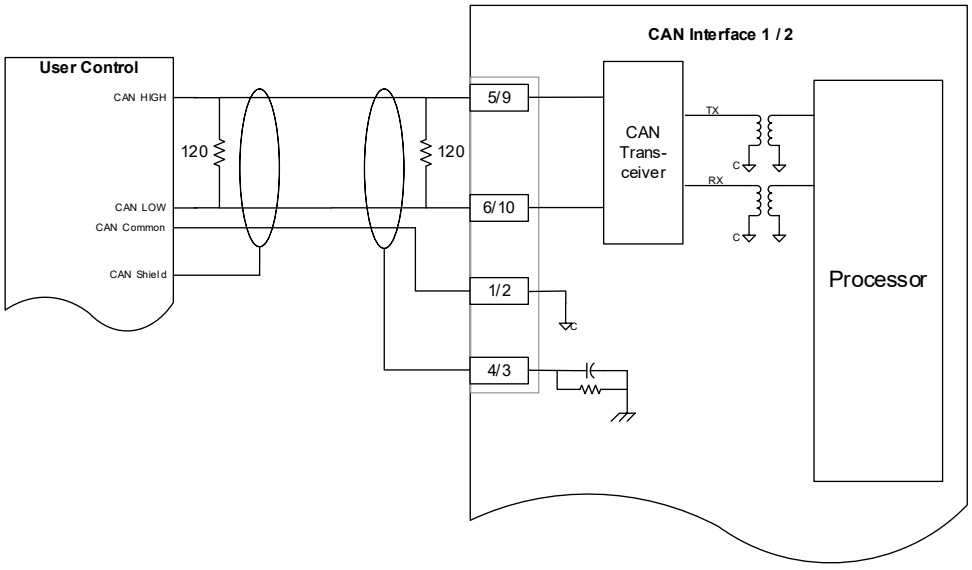


Figure 3-23. CAN Interface Diagram

Figure 3-23 shows the CAN interface structure. Refer to Figures 3-20c and 3-20d for dual / single CAN wiring recommendations at the system level.

See the Analog Input section below for the analog interface diagram when the CAN is used with an Analog Input backup.

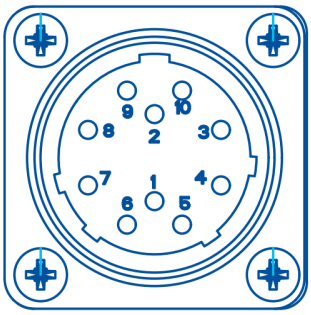
IMPORTANT

It is recommended that the system controller continuously monitors position feedback, either by CAN or analog output. This allows the user to compare the actual position to the commanded position.

Each end of the CAN bus must have a 120 Ω termination resistor. If multiple valves are connected to the same bus, a termination resistor should be installed at the control end of the bus and at the valve furthest from the control. A drop line, 3ft (1m) max length, can be used with a tee connector to install the 120 Ω termination resistors at each end of the bus.

Table 3-45. Dual / Single CAN Port Connections

M83723/83G1610N



CAN Port #1 Connections:

CAN Front Connector Pin 5 (CAN1_High) and Pin 6 (CAN1_Low)
CAN Front Connector Pin 1 (CAN1_Com)
CAN Front Connector Pin 4 (CAN1_Shld)

CAN Port #2 Connections:

CAN Front Connector Pin 9 (CAN2_High) and Pin 10 (CAN2_Low)
CAN Front Connector Pin 2 (CAN2_Com)
CAN Front Connector Pin 3 (CAN2_Shld)

Table 3-46. CAN Trunk Cable Wire Colors

Label	Color	Function
CAN HIGH	WHITE	CAN high
CAN LOW	BLUE	CAN low
GROUND	BLACK	CAN common
SHIELD	-	Signal shield
OUTER BRAID	-	Outer braid drain wire

Table 3-47. CAN Specification

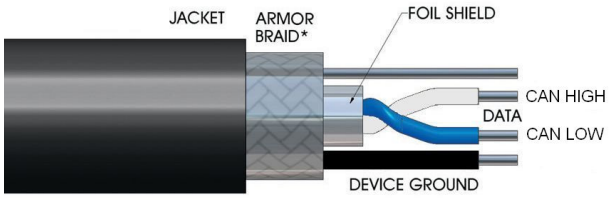
Network Standard:	CAN 2.0B, CANopen
Network Speed:	125kbps, 250kbps, 500kbps, 1Mbps
Network Isolation:	500 V AC from other CAN port & all other I/O, 1500 V AC from input power
Network Termination:	120±10Ω is required at each end of the network trunk line. ** The termination resistor is NOT built into the hardware.
CAN Address:	Software configurable

Table 3-48. Wiring Requirements

Required Wire Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	See Table 3.34
Wire Gauge Range:	16–22 AWG (0.3 to 1.3 mm²)
DC resistance:	17.5Ω per 1000 ft. or less for long trunk cable lengths
Cable capacitance:	11pF/ft. at 1kHz
Shielding:	Refer to Figures 3-20c, 3-20d, and 3-23

Table 3-49. CAN Cable Specifications

Belden YR58684, bulk cable (Woodward PN 2008-1512)



Impedance:	120 Ω ±10 % at 1 MHz
DC Resistance:	17.5 Ω per 1000 ft
Cable Capacitance:	11 pF/ft at 1 kHz
Data Pair:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLUE, WHITE twisted pair)
Ground:	0.3 mm² / 22 AWG, 7 strands, individually tinned, FEP insulation (BLACK)
Drain / Shield Wire:	0.3 mm² / 22 AWG, 7 strands, individually tinned
Shielding:	Foil 100 % with outer Braid 65%
Jacket:	FEP Insulation, BLACK
Cable Type:	1.5 pair, twisted shielded
Outer Diameter:	0.244 inch
Bend Radius:	2.5 inches
Temperature:	–70 °C to +125 °C
Similar Cable:	Belden 3106A (has different colors & lower temperature specs)

CAN Wiring / Shield Terminations & Limitations

The CAN wiring shields must be terminated at their respective CAN_Shld pins at the GS Series driver, and at the user's control(s) end for EMC compliance purposes.

For robust communications performance, the CAN cabling needs to minimize the exposed, non-shielded cable section that occurs at terminal blocks or connectors. The exposed length of CAN wiring must be limited to less than 3.8 cm / 1.5 inches from the end of the shield to the terminal block.

CAN shields are terminated to chassis (EARTH) through a parallel capacitor-resistor network. This is designed into the GS Series driver. However, the shield must also be directly terminated to chassis (Earth) at one point in the network. In the case of Woodward equipment, the direct ground is meant to be located at the user's control end, as it exits the user's control enclosure.

Since the driver CAN links are galvanically isolated from the GS Series driver's digital core, the CAN COM ground(s) must be connected to the ground of the user's control(s).

IMPORTANT

Always use shielded cables for improved communications in industrial environments. Wire termination should expose as little unshielded cable as possible (less than 3.8 cm / 1.5 inches).

IMPORTANT

It is recommended that the system controller continuously monitors position feedback, either by CAN or analog output. This allows the user to compare the actual position to the commanded position.

Analog Input

The analog input on the GS Series driver is 4–20 mA that may be used as the position command input. The configurability for if the input is used and determining whether it is the primary or secondary position command is done through the PC Service Tool.

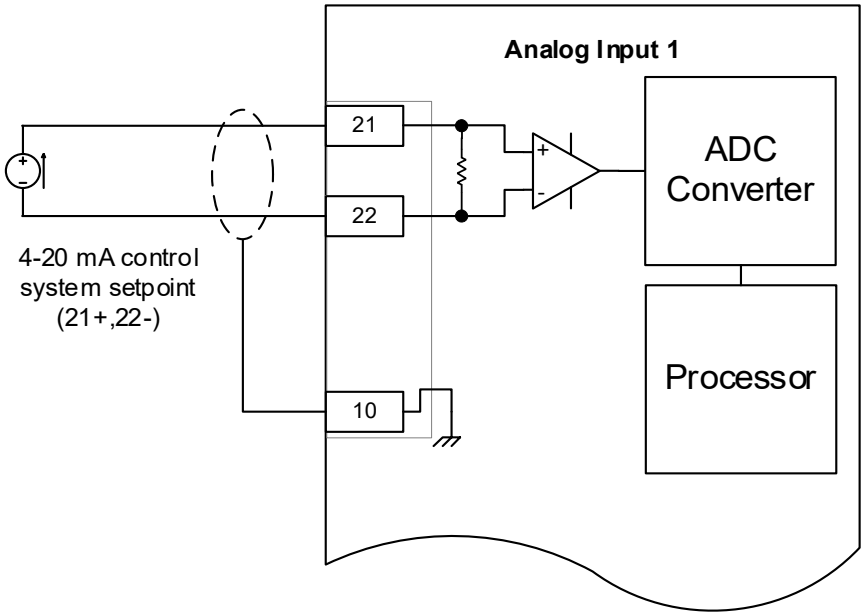
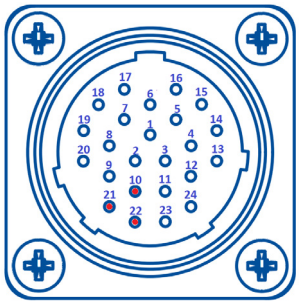


Figure 3-24. Analog Input Interface Diagram

Figure 3-24 shows AIN interface structure. Refer to Figures 3-20b for analog input wiring recommendations at the system level.

Table 3-50. Analog Input Connections

M83723/83G1624N



Analog Input #1 Connections:

Multifunction Front Connector Pin 21 (AIN1 IN+) and Pin 22 (AIN1 IN-)
Multifunction Front Connector Pin 10 (AIN1 Shld)

Analog Input #2 Connections: Not Available

Table 3-51. Analog Input Wire Colors (Multifunction Cable)

Label	Color	Function
AIN+	BLACK	Analog input signal
AIN-	BLACK/WHITE	Analog input signal return
AIN SHLD	-	Analog input shield

Table 3-52. Analog Input Specification

Analog 4–20 mA:	Range is 0 to 25 mA
Input Impedance:	200± 20Ω
Maximum Temperature Drift:	200 ppm/°C
Calibrated Accuracy:	±0.025mA (±0.1% of 25mA Full Scale at 25°C) ±0.063mA (±0.25% of 25mA Full Scale, -40°C - 110°C)
Common Mode Voltage:	±100 V
Common Mode Rejection Ratio:	–70 dB @ 500 Hz
Isolation:	> 1 MΩ from each terminal to Digital Common
Isolation:	1500 V AC from Input Power

Table 3-53. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16–20 AWG (0.5 to 1.3 mm²)
Shielding:	Refer to Figures 3-20b, 3-24

Analog Input 1 can be used as primary position demand source.

Analog Input 1 can also be configured as a backup source for CANOpen Digital Input With Analog Backup mode. In this case, CAN1 is the primary and Analog Input 1 is the backup demand source.

The system controller must also provide appropriate values of Bit3 and Bit4 in “PDO1 – Realtime Fast Message with Demand Selector and Command Bits” (see Appendix A.5. for details) to enable analog backup.

Follow the setup below to configure Analog Input as the position demand source.

Configure Position Demand Selector:

Demand Mode	Selects the position demand source. Analog input can be used as the source when one of below options is selected: **Analog Input** Will use the analog input as the position demand **CANopen Digital Input** in ***Single CAN with analog backup*** mode.

Configure Analog Input:

Analog Input Mode	Enable /disable analog input signal. To enable the analog input, this field must be set to the 4 to 20mA mode.

The input is scaled using a linear scaler where:
“Max. Input setting (mA)” will scale to “Position at Max. Input Setting (%)”
“Min. Input setting (mA)” will scale to “Position at Min. Input Setting (%)”

Analog min. mA Input Setting	Scaler for the 4 to 20 mA input. This is the lower input value in mA that will be scaled to the lower position value.
Analog max. mA Input Setting	Scaler for the 4 to 20 mA input. This is the higher input value in mA that will be scaled to the higher position value.
Position at min. mA Input Setting	Scaler for the 4 to 20 mA input. This is the lower position value corresponding to the min input value in mA.

Position at max. mA Input Setting	Scaler for the 4 to 20 mA input. This is the higher position value corresponding to the max input value in mA.
Low Limit Diagnostic Setting	Analog input low diagnostic setting. If the input value is below this setting an error flag is set. When the value goes back above the setting, the error flag will no longer be set, and a reset will clear this flag.
High Limit Diagnostic Setting	Analog input high diagnostic setting. If the input value is above this setting an error flag will be set. When the value goes back below the setting the error flag will no longer be set and a reset will clear this flag.
	A reset can be given from different sources including the analog input itself (if enabled).

Analog Output

The Analog Output from the GS Series driver is a 4–20 mA output that can drive load resistances up to 500Ω. This output can be configured to perform one of many different tasks, such as reporting the actual position or command set-point position. This output is designed for monitoring and diagnostic purposes only and is not meant for any type of closed loop feedback. The configurability is done through the PC Service Tool.

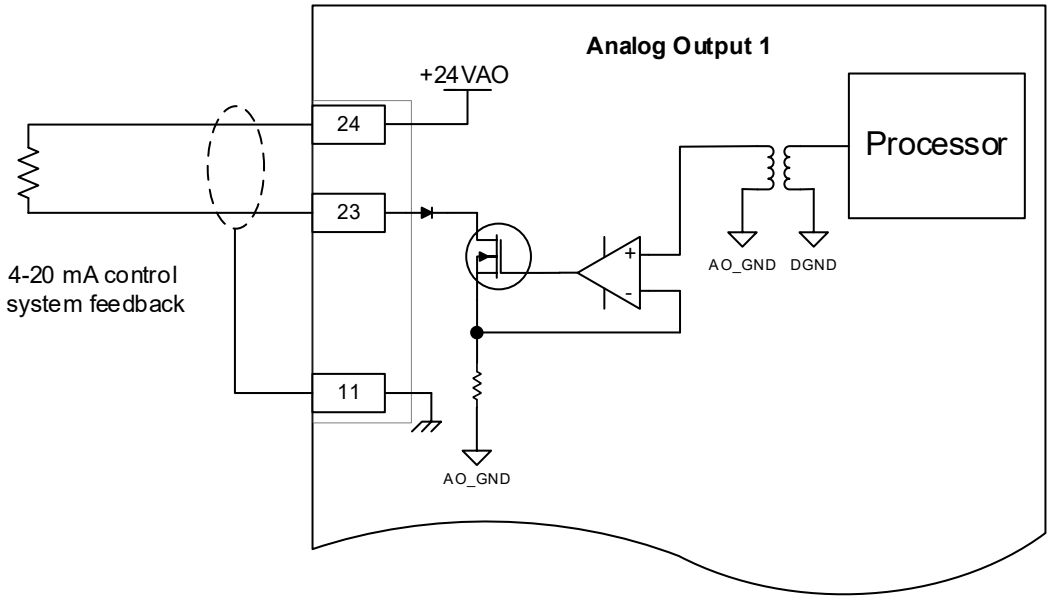
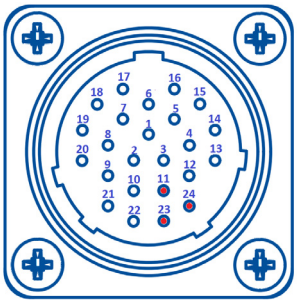


Figure 3-25. Analog Output Interface Diagram

Figure 3-25 shows AOUT interface structure. Refer to Figures 3-20b for analog output wiring recommendations at the system level.

Table 3-54. Analog Output Connections

M83723/83G1624N



Analog Output #1 Connections:
Multifunction Front Connector Pin 24 (AOUT1+) and Pin 23 (AOUT1-) Multifunction Front Connector Pin 11 (AOUT1 Shld)
Analog Output #2 Connections: Not Available

Table 3-55. Analog Output Wire Colors (Multifunction Cable)

Label	Color	Function
AO+	RED	Analog output signal
AO-	RED/WHITE	Analog output signal return
AO SHLD	-	Analog output shield

Table 3-56. Analog Output Specification

Output Range:	0.1 to 25 mA
Calibrated Output Range:	2 to 22 mA
Load Range:	0 Ω up to 500 Ω
Calibrated Accuracy:	±0.025mA (±0.1% of 25mA full scale at 25°C) ±0.125mA (±0.5% of 25mA full scale, -40°C - 110°C)
Maximum Temperature Drift:	300 ppm/°C
Isolation:	500 VAC from Digital Common, 1500 VAC from Input Power

IMPORTANT **It is recommended that the system controller continuously monitors position feedback, either by CAN or analog output. This allows the user to compare the actual position to the commanded position.**

Table 3-57. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16–20 AWG (0.5 to 1.3 mm²)
Shielding:	Refer to Figures 3-20b, 3-25

Analog Output can be used to provide scaled feedback for actual position, set position or motor current.

Analog Output Configuration Options:

Analog Output Mode	**Turned off:** In this mode the analog output will be turned off, with an output of 0 mA. **Actual position** This mode will put the actual position (real-time position of the valve) onto the output. **Echo setpoint** This mode will put the set position (real-time position demand to the position controller) onto the output. This is typically used for system testing. **Motor current** This selection will use the actual current. This is the current that the driver is putting to the motor. This signal will have a lot of movement. The current from the current controller is continuously moving to keep the position of the valve the same as the demanded position. This is typically used for system testing. The actual current is a measure of the torque needed to move and control the valve.
Analog Out Position Scaling values applicable to ACTUAL POSITION and ECHO SETPOINT modes:	
Position at Min Current Scaling	Min position value for scaling from percent position to mA.
Position at Max Current Scaling	Max position value for scaling from percent position to mA.
Min Current Scaler	The lower value in mA corresponding to the lower position value in percent.
Max Current Scaler	The higher value in mA corresponding to the higher position value in percent.
Analog Out Position Scaling values applicable to MOTOR CURRENT mode:	

Motor current at Min Current Scaling	Min motor current value for scaling from motor current to mA
Motor current at Max Current Scaling	Max motor current value for scaling from motor current to mA
Min Current Scaler	Min analog output value for scaling from motor current to mA
Max Current Scaler	Max analog output value for scaling from motor current to mA

Discrete Inputs

There are two discrete inputs available for connector versions of the driver. These are designed as pull-down circuits which create a configurable logic level condition when an external contact is closed. If the external contact is closed, this pulls the sensing signal down to the low state. If the contact is open, the internal +24VISO source pulls the sensing signal to the high state. With the PC Service Tool, the user can configure these inputs as active high (open) or active low (ground) depending on the wiring preference. It is recommended that the discrete inputs be configured with a polarity that enables detection of broken wires. A broken wire will look like an open input, so the polarity should be set where closed is the desired customer condition. This is especially important in the case of a shutdown input. External power is not necessary for these inputs as the isolation is provided internally.

Discrete Input #3 is reserved for security lockout function. This input is not configurable. If DI #3 contact is open, the security function is in the "lockout" state and valve configuration cannot be modified, but information from the controller is still displayed on the Service Tool. If DI #3 contact is closed the security function is in the "disabled" state and valve configuration may be modified based on user access controls.

The connector version provides two inputs and two ground terminals. Only one shield is provided in both cases, so if shielding is used it will be necessary to run all the inputs in a single shielded group.

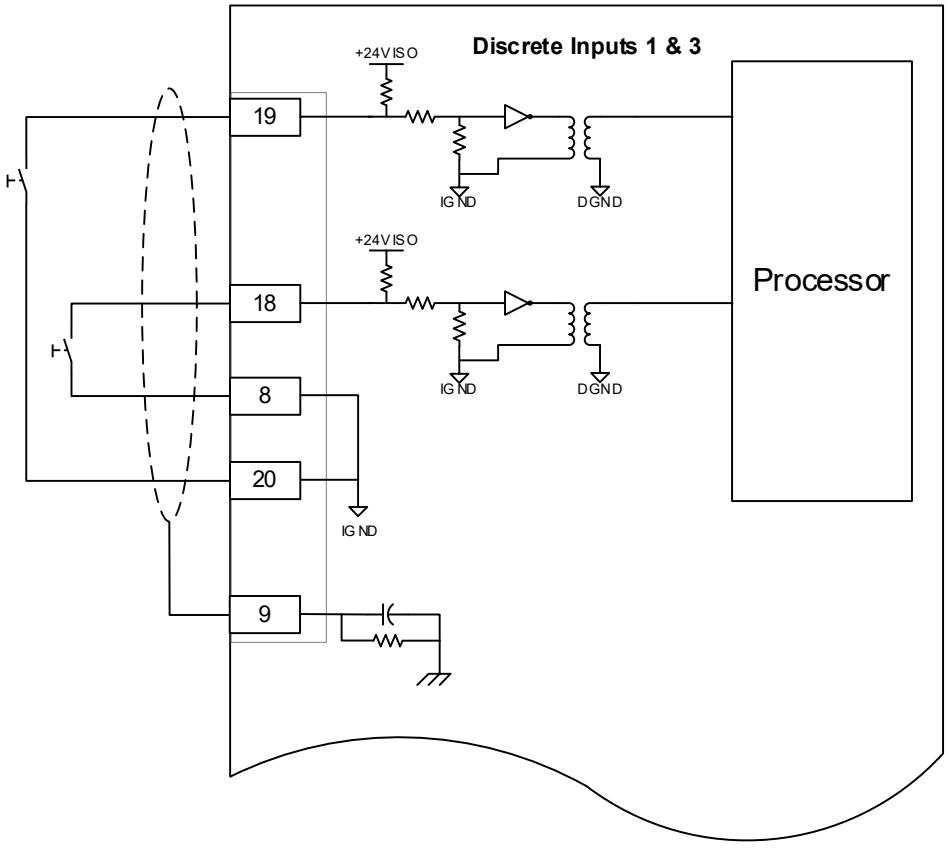
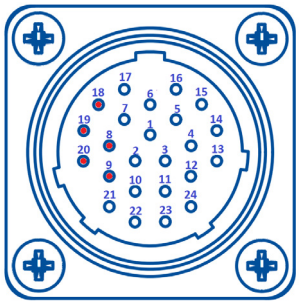


Figure 3-26. Discrete Input Interface Diagram

Figure 3-26 shows DIN interface structure. Refer to Figure 3-20b for discrete input wiring recommendations at the system level.

Table 3-58. Discrete Input Connections

M83723/83G1624N



Discrete Input #1 Connections:
Multifunction Front Connector Pin 19 (DIN1+) and Pin 20 (DIN1-) Multifunction Front Connector Pin 9 (DIN Shld)
Discrete Input #2 Connections: Not Available
Discrete Input #3 (Security Lockout) Connections:
Multifunction Front Connector Pin 18 (DIN3+) and Pin 8 (DIN3-) Multifunction Front Connector Pin 9 (DIN Shld)

Table 3-59. Discrete Input Wire Colors (Multifunction Cable)

Label	Color	Function
DIN1+	BLACK	Discrete input #1 signal
DIN1-	BLACK/WHITE	Discrete input #1 return
DIN3+	RED	Discrete input #3 (security lockout) signal
DIN3-	RED/WHITE	Discrete input #3 (security lockout) return
DIN SHLD	-	Discrete input shield

Table 3-60. Discrete Input Specification

High Input Threshold:	> 7 VDC
Low Input Threshold:	< 3 VDC
Hysteresis:	> 1 VDC
Wetting Current:	5 mA
Contact Type:	Dry contact or open drain/collector switch to ground
Isolation:	500 V AC from Digital Common, 1500 V AC from Input Power

Table 3-61. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them
Maximum Run Length: 100 m
Wire Gauge Range: 16–20 AWG (0.5 to 1.3 mm²)

Discrete Input 1 can be used for shutdown/reset functionality.
Shutdown action is triggered when Input is active (True). Reset action is triggered when input transitions from active (True) to inactive (False) level.

Discrete Inputs 1 Configuration Options:

Discrete Input Actions	**Disabled:** Discrete inputs will not trigger Shutdown/Reset action. **Shutdown/Reset Input 1 and 2:** Discrete Input 1 allows Shutdown and Reset functions. Reset is delayed by 1 second. **Fast Shutdown/Reset Input 1 and 2:** Discrete Input 1 allows Shutdown and Reset function. Reset is delayed by 100 milliseconds.
Discrete Input Polarity [1]	If this option is set to 0 (not ticked), input is active (TRUE) when the voltage at the input terminal is above High Input Threshold. If this option is set to 1 (ticked), input is active (TRUE) when the voltage at the input terminal is below Low Input Threshold.

[1] Polarity settings are aligned with other products in DVP family. Firmware revision DVPII1_00 and earlier feature opposite polarity selection option. If a firmware upgrade is performed in the field, these settings are adjusted automatically, and no user input is required. Firmware revision can be identified using the web Service Tool, in field *Real-time Software Version* on *Dashboard* tab.

Discrete Output

There is one Discrete Output for the connector version of the GS Series driver. This output can be configured to react to any or all the Alarms/Shutdowns in the positioner. The output can also be configured as active on or active off. Discrete output is a low side open-drain driver requiring an external supply for energizing the external relay or load.

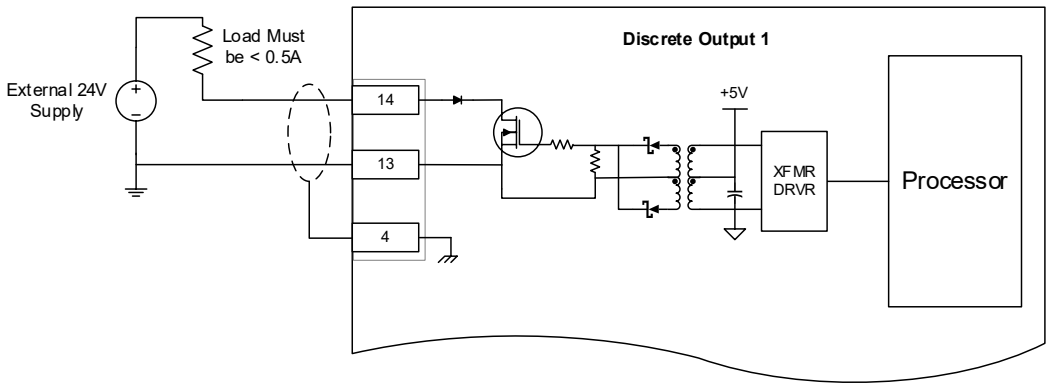
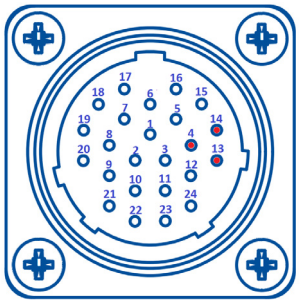


Figure 3-27. Discrete Output Interface Diagram

Figure 3-27 shows DOUT interface structure. Refer to Figure 3-20b for discrete output wiring recommendations at the system level.

Table 3-62. Discrete Output Connections

M83723/83G1624N



Discrete Output #1 Connections:
Multifunction Front Connector Pin 14 (DOUT1+) and Pin 13 (DOUT1-) Multifunction Front Connector Pin 4 (DOUT Shld)
Discrete Output #2 Connections: Not Available
Discrete Output #3 Connections: Not Available

Table 3-63. Discrete Output Wire Colors (Multifunction Cable)

Label	Color	Function
DO+	BLUE	Discrete output signal
DO-	BLUE/WHITE	Discrete output signal return
DO SHLD	-	Discrete output shield

Table 3-64. Discrete Output Specification

Topology:	Open-drain Low-side drive
External Power Supply Voltage Range:	18–32 V
Maximum Load Current:	500 mA
Protection:	The outputs are short circuit protected The outputs are recoverable after short circuit is removed
Response Time:	Less than 2 ms
On-state Saturation Voltage:	Less than 1 V @ 500 mA
Off-state Leakage Current:	Less than 10 µA @ 32 V
Isolation:	500 VAC from Digital Common, 1500 VAC from Input Power

Table 3-65. Wiring Requirements

Recommended Wire Type: Individually shielded twisted pair cable	
Keep this and all other low-level signal cables separated from motor cables and input power cables to avoid unnecessary coupling (noise) between them	
Maximum Run Length:	100 m
Wire Gauge Range:	16-20 AWG (0.5 to 1.3 mm²). Consider using a heavier gage for long cable runs at higher current levels. See selection tables below.
Shielding:	Refer to Figures 3-20b, 3-27

American Wire Gauge Voltage Drop

A standard wire gauge voltage drop at maximum ambient temperature is provided in Table 3-65 to assist with cable selection.

Table 3-66. Voltage Drop Using American Wire Gauge (AWG)

Wire Gauge (AWG)	Voltage Drop per Meter @ 0.5 A Round-Trip (V)	Voltage Drop Per Foot @ 0.5 A Round-Trip (V)
16	0.017	0.0052
18	0.027	0.0082
20	0.043	0.0131

Voltage Drop Calculation Using American Wire Gauge
Example: A 20 AWG wire will drop 0.013 V/ft at 0.5 A at maximum ambient temperature. Using 100 feet between the driver and the power supply would provide a voltage drop of 100x0.013 = 1.3V.

Wire Area Voltage Drop

A standard wire area voltage drop at maximum ambient temperature is provided in Table 3-66 to assist with cable selection.

Table 3-67. Voltage Drop Using Wire Area (mm^2)

Wire Gauge (mm^2)	Voltage Drop per Meter @ 0.5 A Round-Trip (V)	Voltage Drop Per Foot @ 0.5 A Round-Trip (V)
1.3	0.0171	0.0052
1.0	0.0222	0.0068
0.5	0.0444	0.0135

Example of Voltage Drop Calculation Using Wire Area
A 0.5mm^2 wire will drop 0.044 V/m at 0.5 A at maximum ambient temperature. Using 50m between the driver and the power supply would provide a voltage drop of 50 x 0.044 = 2.2V.
It is important to select appropriate DOUT cable gage to meet system specifications for long cable lengths.

NOTICE

DOUT lines within multifunction cables provided by Woodward for the connector version of the driver is made of 20 AWG wires. Total voltage drop is the sum of the voltage drops across multifunction cable and extension cable. Ensure wire gage of the extension cable is selected to comply with system specifications.

Discrete Output can be used to provide feedback on unit alarm/shutdown status.

Discrete Output Configuration Options:

Discrete Output Mode	**Turned off:** Discrete output is not used (disabled). **Active when diagnostic is detected:** Output activated when any of the conditions described below is detected. **Inactive when diagnostic is detected:** Output inactivated when any of the conditions described below is detected **Limit Switch*:** Output changes state based on actual position value
Discrete Out Status Error Combined Alarm	This option is applicable for **Active / Inactive when diagnostic is detected** modes. Discrete output state is combined status of: Alarm Shutdown Shutdown Position Shutdown System Shutdown Not External
Discrete Out Limit Switch On Threshold *	The actual position value at which the Discrete Output will transition from OFF/Open to ON/Closed state when Limit Switch mode is selected.
Discrete Out Limit Switch Off Threshold *	The actual position value at which the Discrete Output will transition from ON/Closed to OFF/Open state when Limit Switch mode is selected
Discrete Out Limit Switch Invalid State *	Setting for DiscreteOutput when Limit Switch mode is selected to determine the output state if the Actual Position value is invalid. If the setting is 0, then it sets it to OFF/Open. If the setting is not 0, then it sets it to ON/Closed

* Not all product versions provide Limit Switch functionality.

Ethernet Service Port

The GS Series driver has an Ethernet service communications port required for product configuration, service support, and firmware updates. The wiring requirements are defined below.

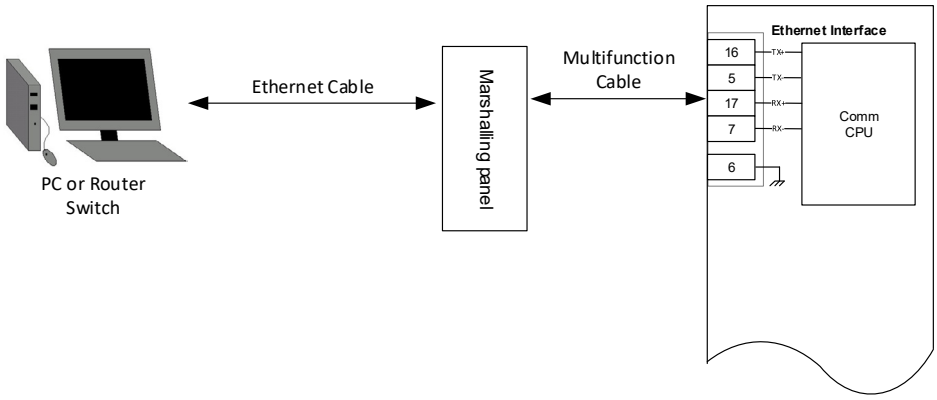
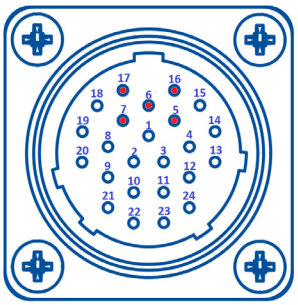


Figure 3-28. Ethernet Service Port Interface Diagram

Table 3-68. Ethernet Service Port Connections

M83723/83G1624N



Ethernet Connections:

Multifunction Front Connector Pin 16 (TX+) and Pin 5 (TX-)
Multifunction Front Connector Pin 17 (RX+) and Pin 7 (RX-)
Multifunction Front Connector Pin 6 (ETH Shld) = Chassis Ground

Table 3-69. Ethernet Wire Colors (Multifunction Cable)

Label	Color	Function
RX+	GREEN/WHITE	Ethernet RX+
RX-	GREEN	Ethernet RX-
TX+	ORANGE/WHITE	Ethernet TX+
TX-	ORANGE	Ethernet TX-
SHLD	-	Ethernet shield

Wiring Requirements:

- Double Shielded (SSTP) cables are required
- CAT-5 Ethernet Cable
- Maximum Run Length: 100 m
- For long Ethernet cables where ground loops are a concern, the shield should be capacitive coupled at one end.

NOTICE

Ethernet lines in the multifunction cable are not terminated into EIA 568-B compliant plug (RJ45). It is the end user's responsibility to provide appropriate means of terminating / extending Ethernet lines.

Chapter 4.
Description of Operation

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.

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 %.

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

Shutdown Position:
If the valve is into shutdown position mode, the driver will cease to modulate power to the actuator and the return spring provided on the valve will drive it to the closed position.

Shutdown System:
If the valve is into shutdown system mode, the driver will cease to modulate power to the actuator and the return spring provided on the valve will drive it to the closed position.

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

Position Control:
In position control, a set point is defined based on demand from external sources.

Unit Status

The general status of the unit can be seen visually via the Unit Status indicator (see Figures 3-8 and 3-17). The indicator consists of a Red LED and Green LED controlled in distinct patterns to provide status information. Note that for the conduit version of the driver, the LED indicator is visible when front cover is removed.

The following flashing patterns can be observed during normal stages of operation:
- Red/green alternating (red and green LEDs alternate back-and-forth approximately 8 times per second) – this is the typical start-up pattern while the system is initializing after power-up. This pattern should be replaced by one of the other normal operational modes shown below.
- Red flashing (red LED on-and-off 1 time per second) – this indicates the unit is in a shutdown state based on an internal diagnostic source. Note that this is the expected condition following power-up of the unit or immediately after a software update.
- Green flashing (green LED on-and-off 1 time per second) – this indicates normal operation and control of the unit via an expected user interface for demand mode (Analog, CANopen). Note that a shutdown condition initiated from an external control interface will still result in green flashing.

- Orange flashing (red/green LEDs together on-and-off 1 time per second) – this indicates normal operation, but that control of the unit is not via an expected user interface demand mode (Analog, CANopen). This will occur when the unit is running in another demand mode such as Manual Position.

The following flashing patterns are associated with special modes of operation or low-level initialization errors:

- Red flashing (red LED on-and-off 2 times per second) – this indicates the boot code is executing with no errors. The boot code should only be in this state while the unit software is undergoing programming by user request. If the unit remains in this state and is not currently being programmed, then contact Woodward technical support.
- Red flashing (red LED on-and-off 3 times per second or faster) – this indicates a low-level self-test failure during initialization. Contact Woodward technical support.

Chapter 5.
Service Tool & Configuration

Driver Configuration

Overview

The GS Series actuator utilizes an ethernet network to support the PC Service Tool, so it is important to understand some networking principals. For successful operation, please read this chapter in detail. Consult with your Network System Administrator for any limitations on the networking allowances in your facility. In addition, networking information can be found on your local Windows PC in, Start\Help – Contents\Networking.

Videos are available to provide guidance and examples on how to connect and configure the GS Series valve and actuator.

These videos are available on the internet at the URLs listed below:

https://www.youtube.com/channel/UC0Ogv5ntWU2OXxshcYYt6Mg

Go to Playlists -> “Woodward DVPII Configuration Training Overview

The training videos list includes:

- DVPII Discovery – Automated discovery process for DVPII devices available on local network
- DVPII Login – Log in methods to selected device
- DVPII Monitoring – Basic monitoring functionality
- DVPII Name Your Valve – Asset information set up and description
- DVPII SW Update – Online software update

Table 5-1. Internet Vocabulary

IP	Internet Protocol—Designed to link networks together.
IP Address	32-bit number made up of four 8-bit segments (“octets”) separated by periods (the protocol for this type of addressing is named “IPv4”).
TCP	Transmission Control Protocol—Designed to link networks together.
UDP	User Datagram Protocol—Connectionless/ Host-to-Host protocol in the Transport Layer of IP.
DHCP	Dynamic Host Configuration Protocol—Automates IP address assignment.
Gateway	A device or computer that forwards data to a destination on another domain.
Subnet Mask	The binary 1’s mark which bits of the IP address are used for the network. The 0’s mark which bits are for your station’s ID#.
Octet	The 32-bit IP address is grouped 8 bits at a time, each group of 8 bits is an **octet**. Each of the four **octets** are separated by a dot and represented in decimal format; this is known as dotted decimal notation. Each bit in an **octet** has a binary weight (128, 64, 32, 16, 8, 4, 2, and 1).
Port	A logical number that increases the number of devices that can talk without increasing IP addresses.
MAC	Media Access Control—A unique 48-bit number burned into the hardware of the device. Uniquely identifies the device.
Address Mapping	When a host broadcasts to all MACs and associates each responding MAC address with its IP Address.

Internet Protocol

The Internet Protocol (“IP”) is a network layer internet protocol. IP facilitates communication from the two transport layer protocols— Transmission Control Protocol (TCP), and User Datagram Protocol (UDP). They run on top of the IP layer and are identified by port numbers.

IP Addresses

Woodward uses IPv4 IP addresses. The IPv4 address is a 32-bit number made up of four 8-bit segments separated by periods. The Subnet Mask controls which bits are the network identifier and which bits are the station identifier (the binary 1’s mark which bits of the IP address represent the network identifier. The binary 0’s indicate which bits of the IP address is your device ID# - for example, a Subnet Mask of 255.255.0.0 = 11111111.11111111.00000000.00000000). The first 16 bits of the IP address identify the network, and the last 16 bits identify the device.

There are three classes (sizes) of IP networks: A, B, and C. Classes are determined by how many unique devices and sub networks are possible based on how many of the IP address bits are used for designating the network number and how many bits identify the device number. A network identifier between 192 and 223 is class C size; the first three bits of the IP address is used to identify the network.

IMPORTANT **Some IP address ranges are reserved. Consult your Network System Administrator if you want a “fixed/static” IP address for a device.**

Driver Networking & Connections

Getting Started

The GS Series driver utilizes an embedded web-based service tool. Access to the service tool is made through the Ethernet/Service port using a web browser. The following sections describe the IP addressing options for the driver. Once the IP address is identified, a web browser can be launched and directed to the address for connection to the driver.

DHCP Addressing

The GS Series driver is shipped from the factory in Dynamic Host Configuration Protocol (DHCP) mode, whereby a DHCP server can dynamically assign an IP address. When the driver logs onto the network, it sends out a DHCP discover message. The DHCP server receives the message and sends out an IP address with the subnet mask and a lease time to the hardware or MAC address of the device. A typical lease is 30 days. The device broadcasts a message of acceptance, implements the new identity, and is ready for TCP/IP sessions. The DHCP server will address map the device and associate its MAC address with its IP address. Utilize the system DHCP server utility to locate the assigned IP address for the driver.

Link Local Addressing (APIPA)

The GS Series driver also supports a link local address if a DHCP server is not available. Link local addressing is also referred to as Automatic Private IP Addressing (APIPA). Link local addressing for the GS Series driver starts at 169.254.100.100. The following diagrams illustrate the different networking options. If the GS Series driver is power cycled it may request a new link local address, typically with the new address going back to 169.254.100.100. However, this number can dynamically increment to 169.254.100.101 and upward depending on network activity, so the user may need to check additional address locations to access the GS Series driver.

Initial Connection to the GS Series Valves

The most straightforward way to connect to the product is set the IP address of the PC to the default network designation which is set at the factory. Set the service tool Host PC adapter to use a fixed IP address as shown in Figure 5-1 below. Launch a browser on the service tool PC and enter the default GS series IP address (169.254.100.100) into the browser search line. If the device does not connect, remove, and re-apply power to the driver. This should re-initialize the initial address to 169.254.100.100.

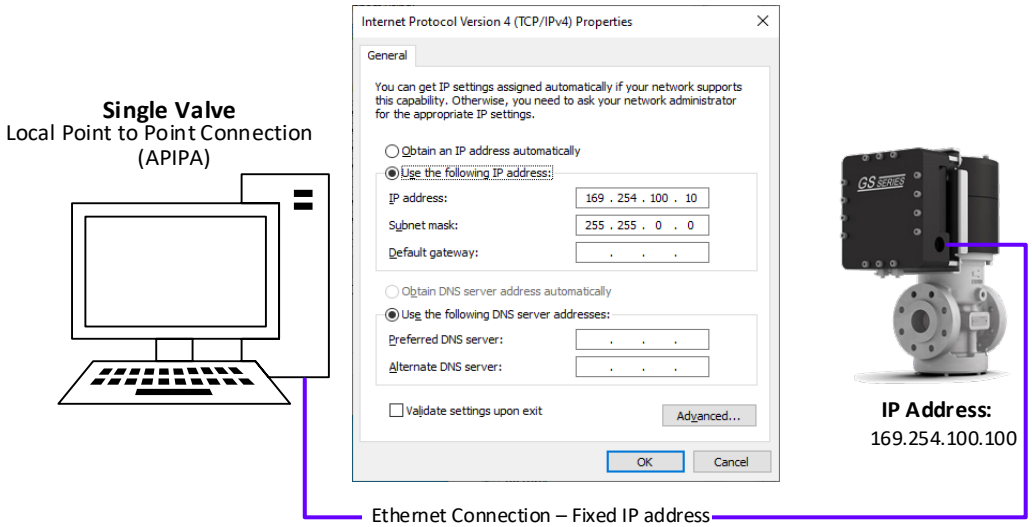


Figure 5-1. Single Valve Link Local

For a system with multiple valves, a router can be used. A secure router configuration that is recommended by Woodward for initial connection and configuration is shown in Figure 5-2.

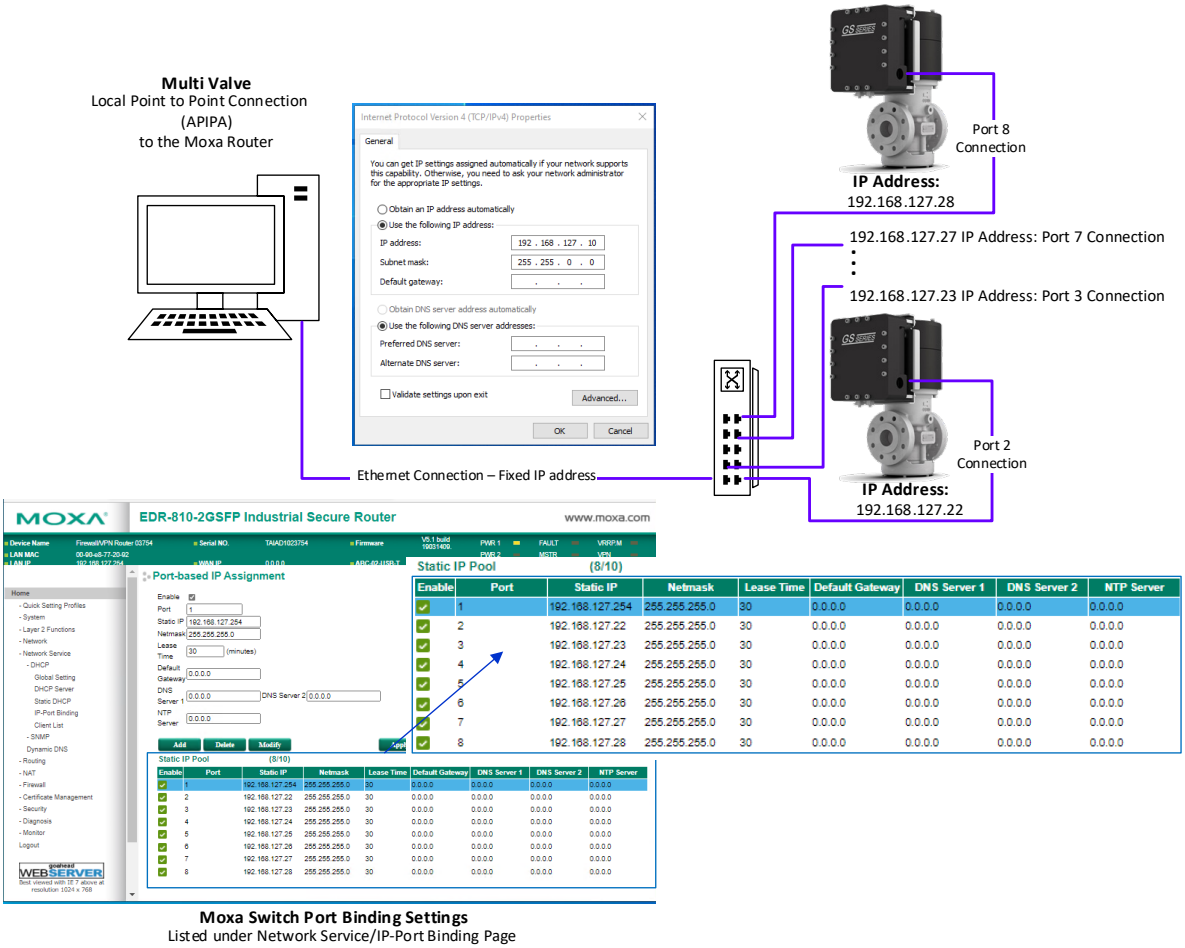


Figure 5-2. Multiple Valve Link Local

The GS40/50 valve is also configurable for use in a variety of partitioned industrial control networks. The specific implementations must be determined by the user in accordance with their specific network allowances and policies. The following diagrams show other possible arrangements that the GS40/50 will support. Please contact your IT department for assistance with permissible plant network topologies.

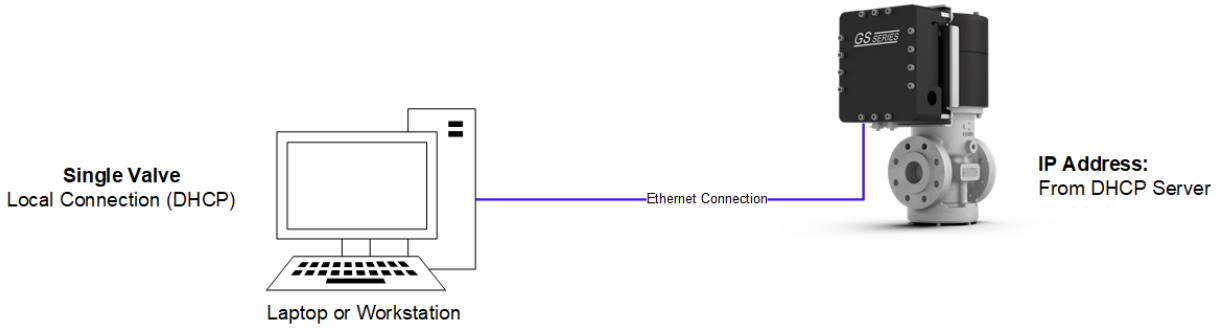


Figure 5-3. Local DHCP Defined by User Network Assignments

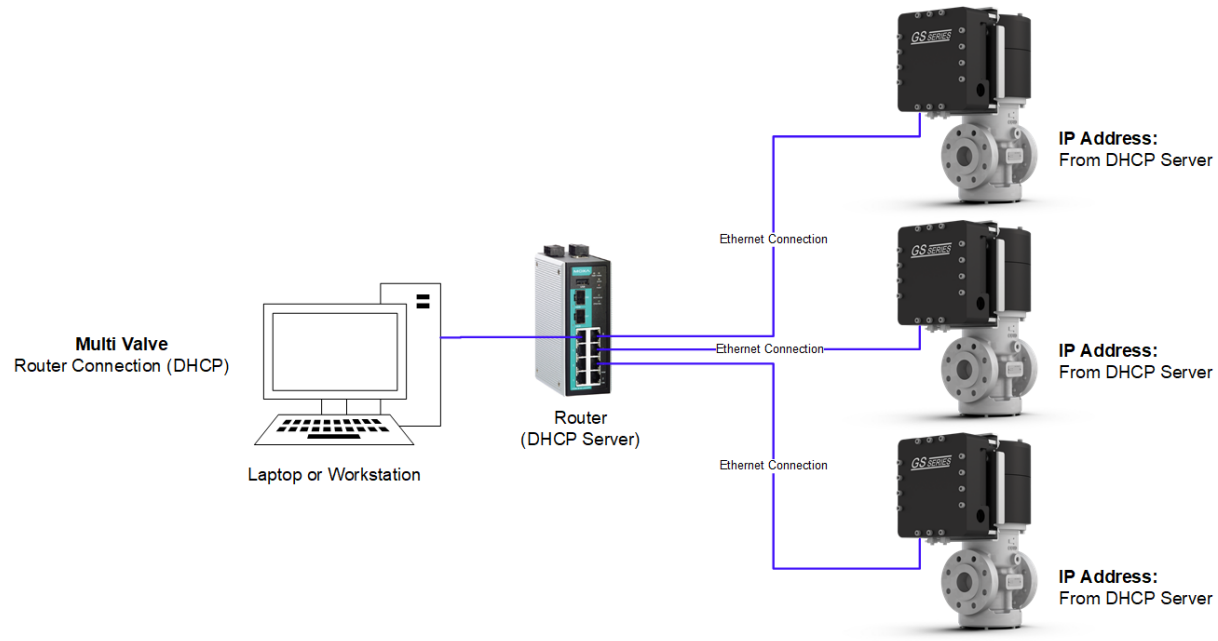


Figure 5-4. Router DHCP Defined by User Network Assignments

Static IP Addressing

The GS Series driver also supports static IP addressing. IP addressing configuration is managed through the Service Tool “Functions” menu.

IMPORTANT

Special care must be taken when addressing GS Series drivers using static IP. Static IP address assignment must be well documented by the user. If a GS Series driver is configured for static IP and the address is lost, it may not be possible to re-establish communications with the GS Series driver.

Cyber Security

The GS Series driver was developed from the ground up with a critical focus on cyber security. This section details the security features of the driver and how it can be used securely within an overall Defense-in-Depth (DiD) framework.

IMPORTANT

An overall DiD strategy is strongly recommended. This includes effective site access control, employee awareness training, governance policies & procedures, and multi-layered security provisions that minimize attack surfaces.

Hardware

The GS Series driver includes a built-in hardware level firewall for interfacing the real-time control functions with the web-based interface. This effectively controls read/write access to the real-time controller (running the critical valve positioning functions) from a hardwired Discrete Input #3.

IMPORTANT

It is strongly recommended that the Security Discrete Input (#3) is interfaced with the turbine control system such that GS Series driver configuration changes can only be made with the prime mover in an offline mode.

Software

The GS Series driver includes functionality to verify the boot program and software packages are verified before operation. Additionally, attack surfaces have been minimized as much as possible by including only necessary software packages and port access.

User Account Management

The GS Series driver comes pre-configured with the following user accounts. You need to change the default user account passwords to have security.

Table 5-2. User Account Examples

Account Name	Default Password	Permissions	Permissions
userconfig	UserConfig@1	Modify driver user I/O configuration Modify driver user fault settings User management	Modify driver user I/O configuration Modify driver user fault settings User management
softwareupdate	SoftwareUpdate@1	Software Update Capability	Software Update Capability

Additional accounts may be created depending on the access or role required. The following roles have been assigned for the purposes as described:

- **Monitoring** – This is the basic user level with read access only. This user is **not** able to shutdown or reset the GS Series driver. Service Tool screen access always starts with the Monitoring role level.
- **MonitoringPlus** – This is the same as the Monitoring user role with the additional capability to shutdown and/or reset the GS Series driver.
- **UserConfig** – This is the same as the MonitoringPlus user role with the additional capability to configure GS Series driver I/O, fault settings, and user management.
- **SoftwareUpdate** – this user is the same as the MonitoringPlus user role with the additional capability to update system software.

IMPORTANT

User access control and account administration governance are the responsibility of the System Administrator. Best practice is to change default passwords and regularly monitor & update user access controls.

Secure Router

An optional secure router is available from Woodward specifically configured for the GS Series driver, part number 1711-1397. The industrial router provides the capability to securely interface and address multiple GS Series drivers. The router incorporates a pre-configured firewall policy, enhancing an overall Defense-in-Depth cyber security strategy. The diagram below illustrates the complimentary security functions and the addition of the secure router.

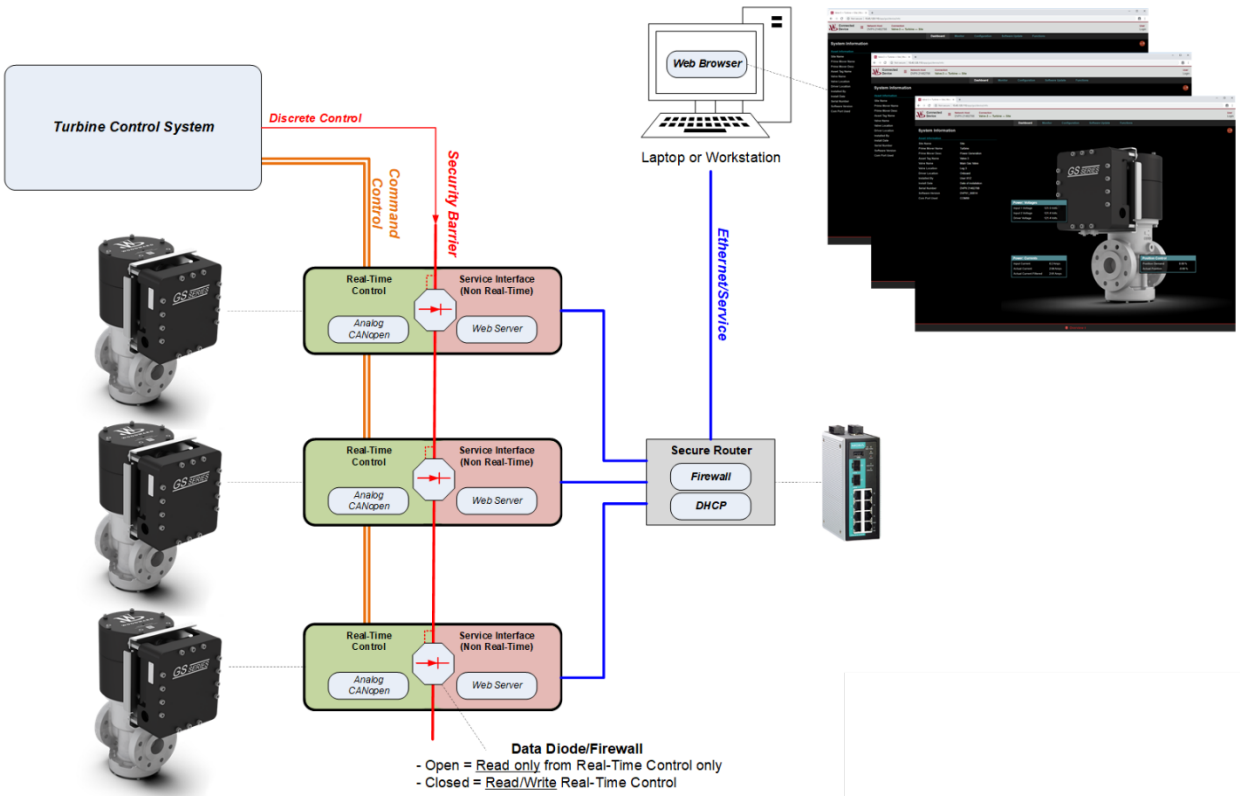


Figure 5-5. Security Architecture with Secure Router

Service Tool

Overview

The GS Series Driver Service Tool can be accessed through a standard web-browser. It is recommended to use Google Chrome or Microsoft Edge using a PC for GS Series driver connections. Internet Explorer is not supported.

Once the IP address of the GS Series driver is determined, as described in the “Driver Networking & Connections” manual section, its IP address can be entered into the web browser. Connection to the specific GS Series driver of interest must be verified by ensuring the network “Host Name” located on the top of the Service Tool screen matches the “Host Name” of the driver as listed on the product nameplate. This view of the Service Tool is termed “Connected Device”. During the first connection to the driver there may be a slight delay loading the page as information is sent to the browser to be cached.

Shutdown and reset commands are available through the Device - Commands menu, located at the top of the screen. Access to this functionality is reserved for the "MonitoringPlus" or "UserConfig" user roles.

Additional information and demonstrations for use of the GS Series driver Service Tool is available on Woodward’s Product Training YouTube® site. These can be accessed at the following URL:

https://youtube.com/playlist?list=PLW55kmXY0fHBEiZn_yzGz2GLa24OvRxB1

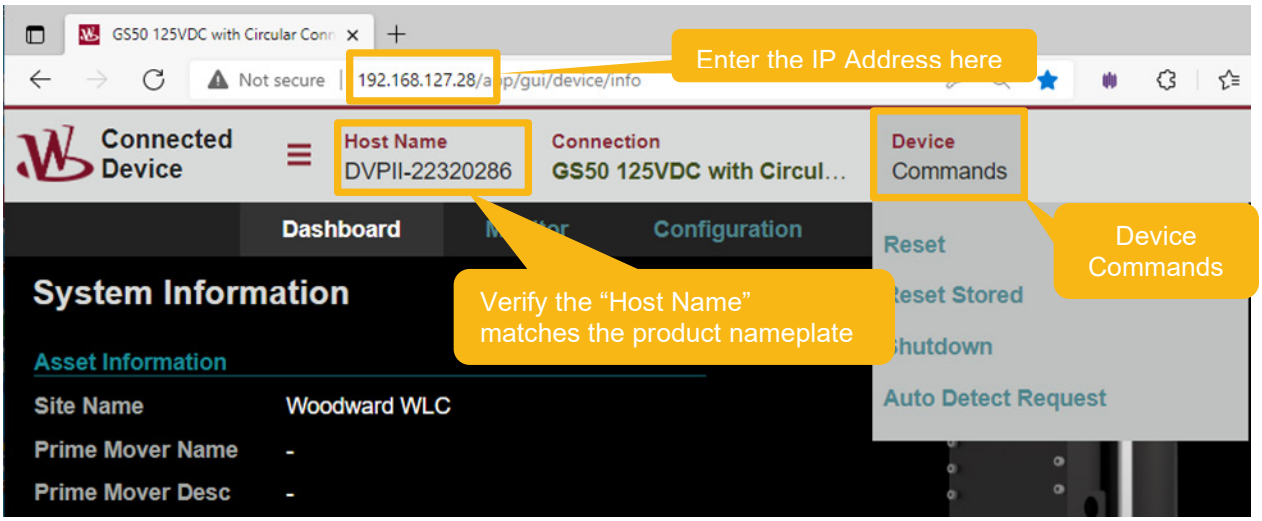


Figure 5-6. Service Tool IP Navigation

User Login Assignments

Configuration of the GS Series driver, user management, and software updates requires login to the driver. The login window is accessed by selecting the “User” login button in the top right corner of the Service Tool screen. Follow the “User Account Management” section of the manual and the video for account assignment information.

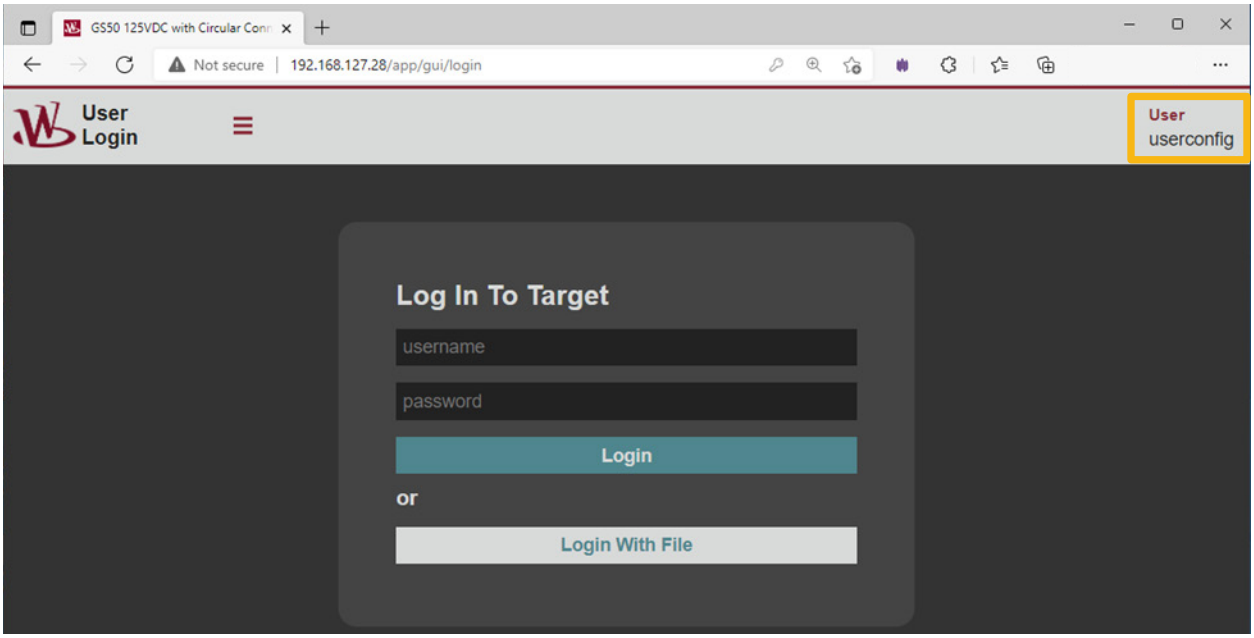


Figure 5-7. Driver Log-in Screen

Driver Utilities

The GS Series driver provides several utilities and enables various features. These options can be accessed through the collapsed menu icon in the upper left corner of the screen.

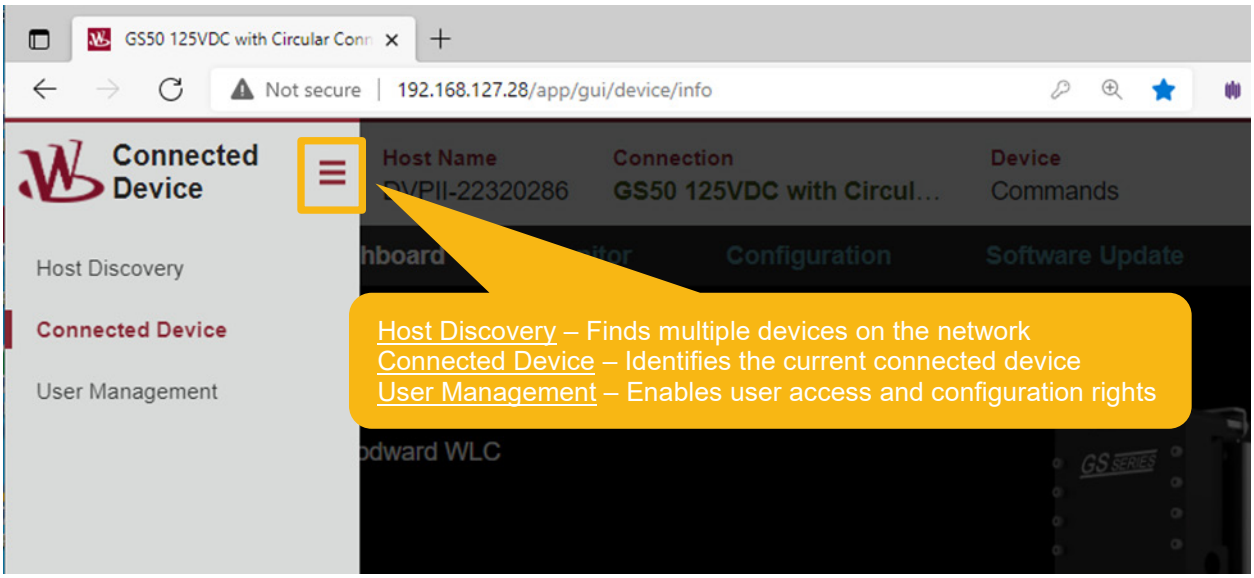


Figure 5-8. Driver Utilities Defined

Host Discovery

Host discovery is a utility that can be used to find multiple networked drivers. Navigation to this utility is managed by selecting the side menu by pressing the collapsed menu icon.

The utility will scan for drivers between the ‘begin’ and ‘end’ IP addresses.

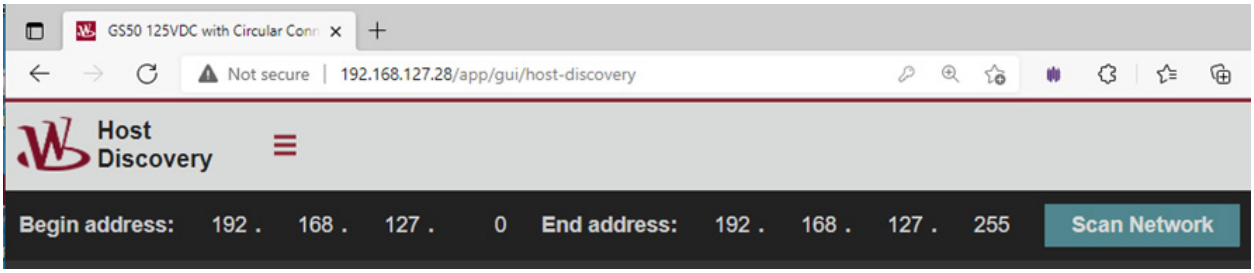


Figure 5-9. Utility Scans for Drivers

User Management

Configuration and management of user access and roles is managed through the User Management utility. The update user screen allows for a setting of a “Require(d) Signed Password”. This feature will be supported in a future software release and should not be used at this time, leave this setting unchecked.

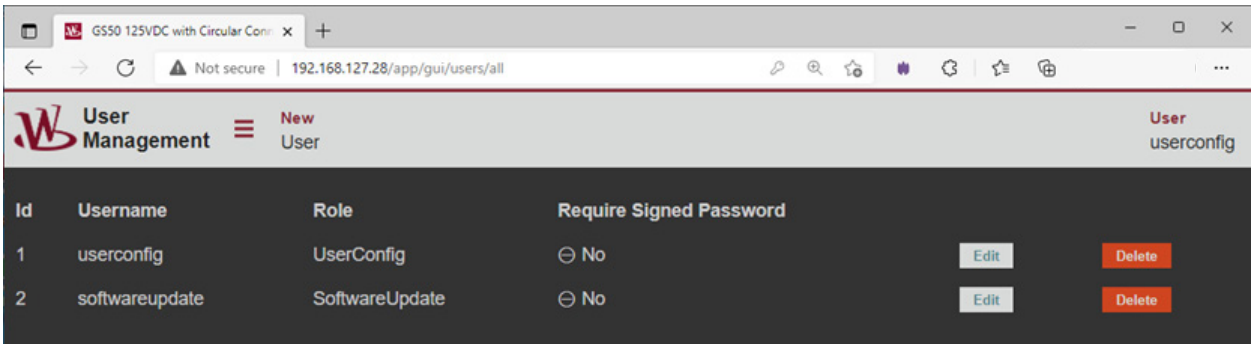


Figure 5-10. Update User Screen

Confirming Correct Operation

After connecting and setting up the necessary user roles and passwords, verify that the device is operating normally. Review the dashboard tab and the bottom panel where the word “Overview” appears. If the field is green, the unit is operating normally. If there are any detected alarms or faults, they will be displayed in the lower panel. Any diagnostics listed as shutdowns must be corrected before continuing.

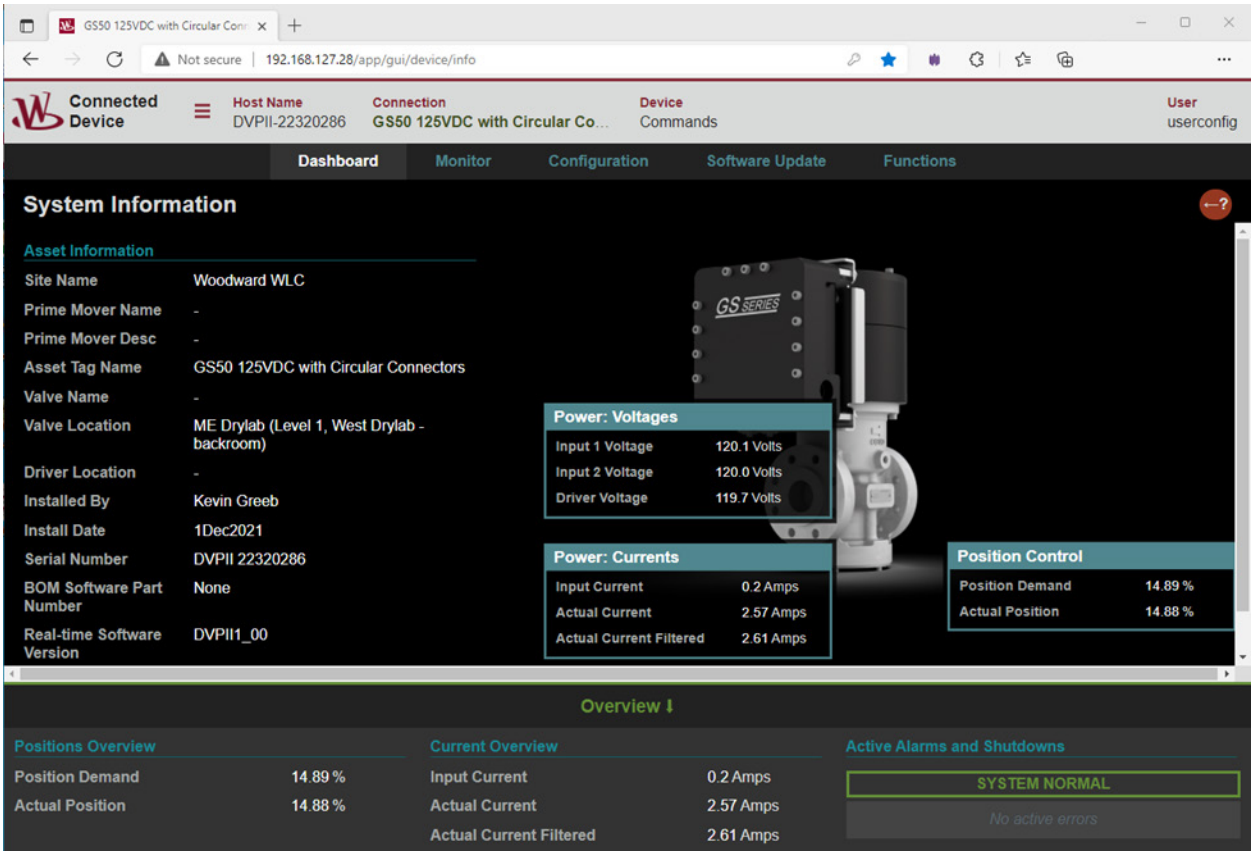


Figure 5-11. Dashboard Page

Once all diagnostics have been resolved, which can be confirmed when the System Normal status is displayed, login with userconfig permissions and select the Position Demand Settings panel as shown in Figure 5-12, then select the Manual Position setting source or one of the other options from the pull-down window. Press the SET button to save the selected input source.

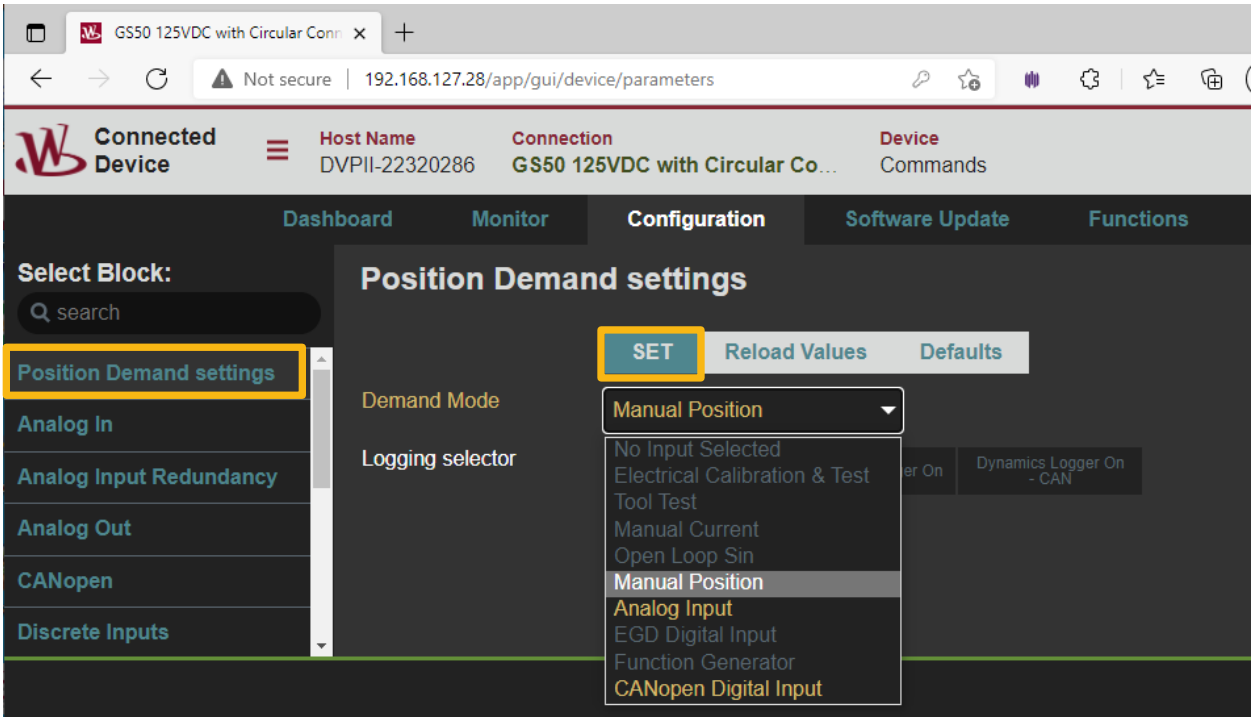


Figure 5-12. Demand Selector

To change the manual position setpoint, select the Monitor tab. Then select the Position Demand panel and input the desired value in the Manual Position Demand Input Field. The pencil symbol indicates this is an input field.

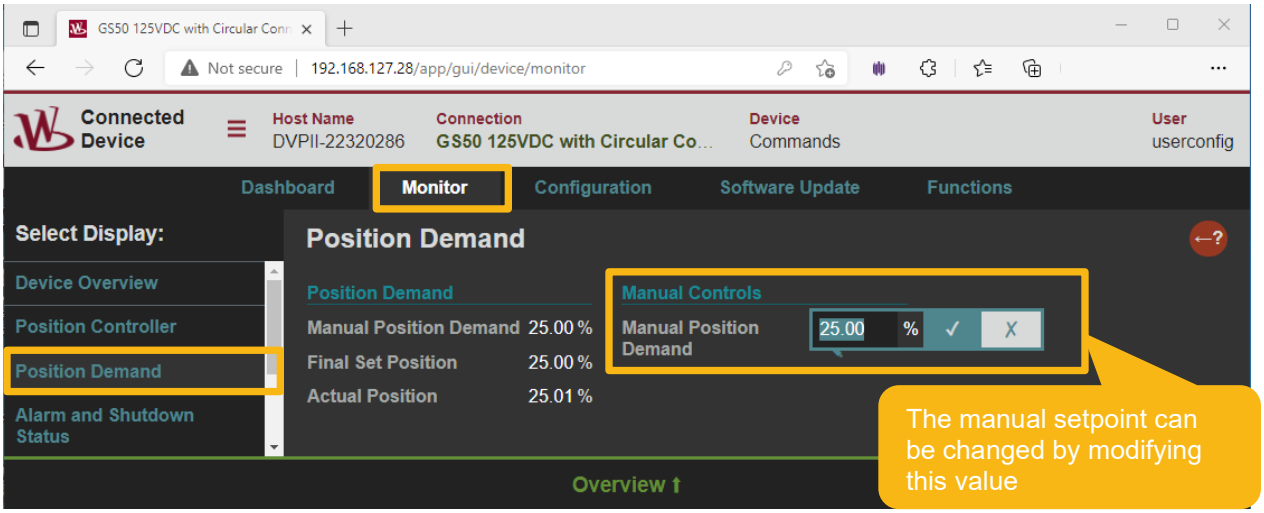


Figure 5-13. Manual Operating Screen

IMPORTANT **Be sure to put the demand selector back into the normal operating mode after verifying operation manually. See Figure 5-12 and related instructions above.**

Quick Start Guide

The GS Series driver includes built-in documentation to guide the user through the device configuration process. The quick-start guide can be accessed by opening the left menu and selecting “Quick Start Guide”.

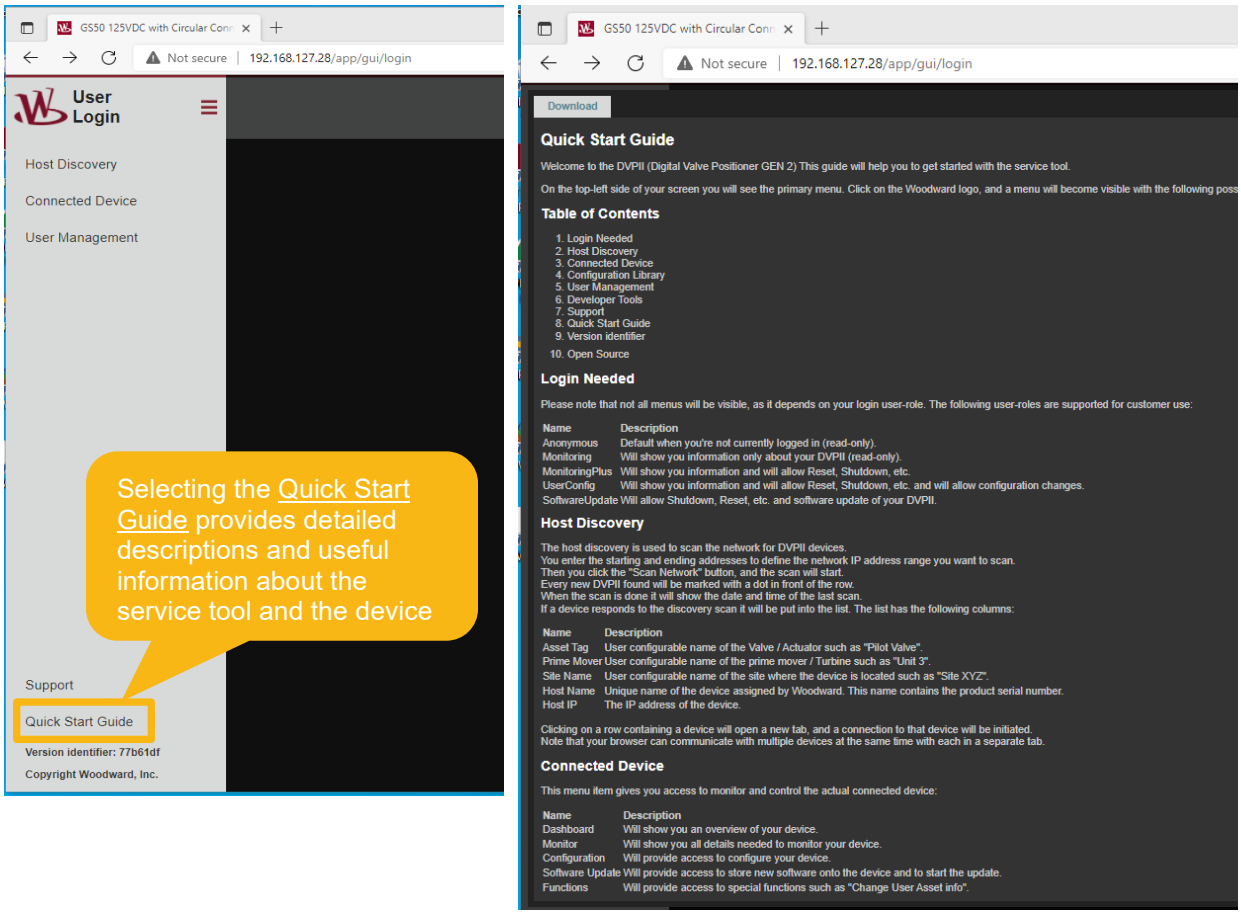


Figure 5-14. Quick Start Guide

Chapter 6.
Valve Sizing

Determination of Effective Area

To confirm that the sizes of the GS valves are appropriate for the application, the effective area required to meet the maximum flow requirement must first be determined. The flow rate attainable under a given set of process fluid conditions are constrained by the values of inlet pressure, inlet temperature, discharge pressure, and gas properties. Using these values, the flow rate can be determined for any given value of the valve capacity coefficient (ACd) using the following equations.

First, the critical pressure ratio must be determined.
The critical pressure ratio (R7) is defined as the point where flow becomes choked because the fluid reaches sonic velocity through the controlling orifice.

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

If $\frac{P2}{P1} \geq R7$ then the pressure ratio is not choked, and the resulting mass flow rate is dependent upon both inlet pressure and discharge pressure. The resulting mass flow rate is computed as follows:

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

If $\frac{P2}{P1} < R7$ then the pressure ratio will result in choked flow conditions. The resulting flow rate is not dependent on discharge pressure. The resulting mass flow rate is calculated as follows:

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

Where:

Wf =	Mass Flow Rate (pph)
ACd =	Effective Area (square inches)
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

Notes

It is recommended that the effective area for the chosen port be at least 10% larger than the highest required mass flow using the equations shown 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 at the maximum expected fuel temperature.

For general sizing purposes, a value for Z (Gas Compressibility Factor) of 1.0 can be used since its effect on the result is relatively small.

Determination of Metering Port Size

To determine if the metering port size is appropriate for the application and to identify where the valve may be operating at any desired flow rate, use the following graphs. For applications requiring high accuracy control, high density numeric tables can also be provided, along with guidance for use with Woodward's proprietary control algorithms by contacting your Woodward sales associate.

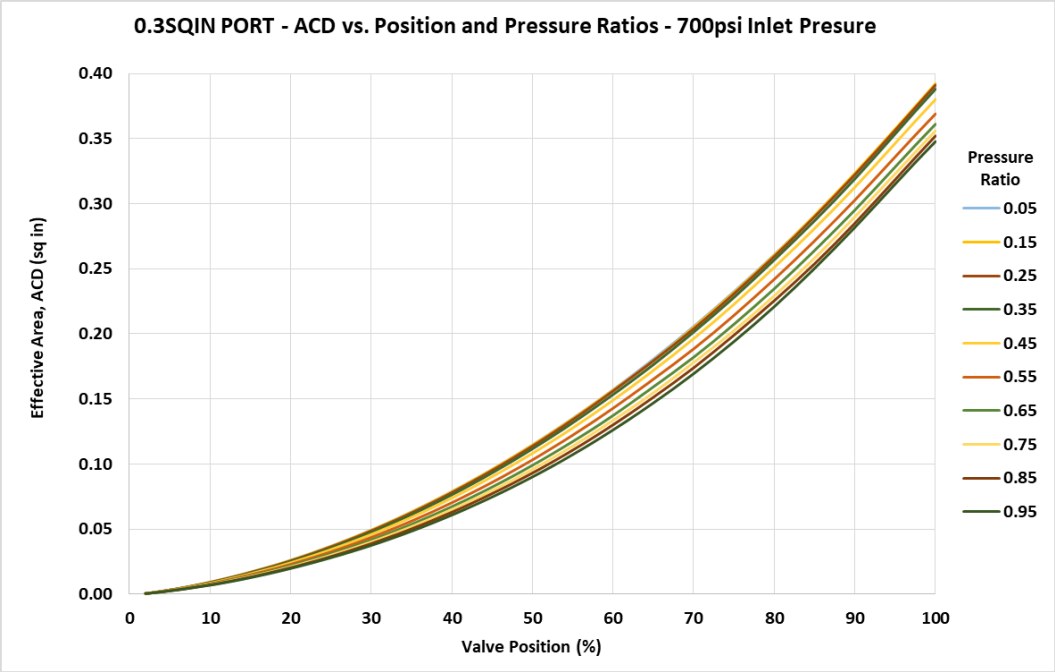


Figure 6-1. GS40 Position vs. Effective Area– 0.3SQIN Port

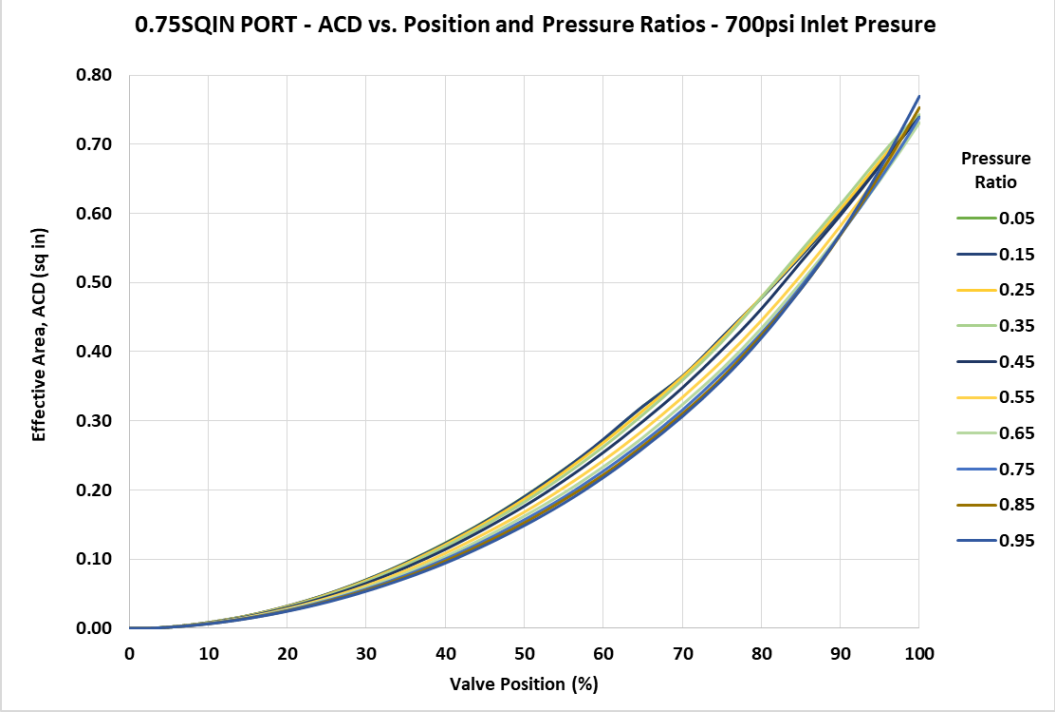


Figure 6-2. GS40 Position vs. Effective Area – 0.75SQIN Port

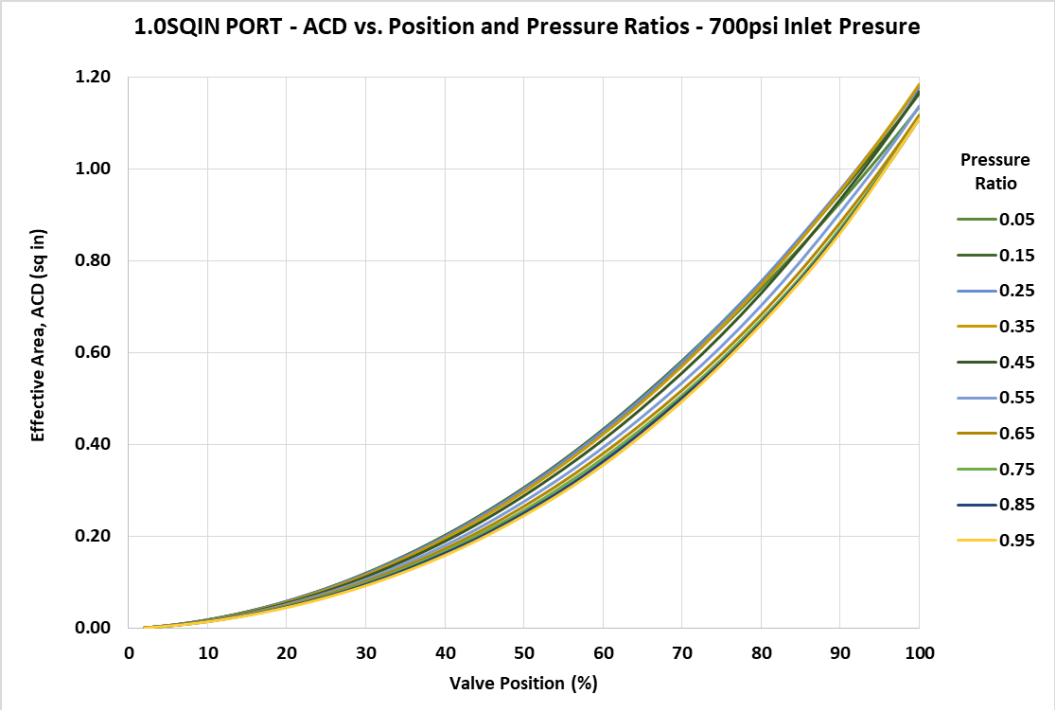


Figure 6-3. GS50 Position vs. Effective Area – 1.0SQIN Port

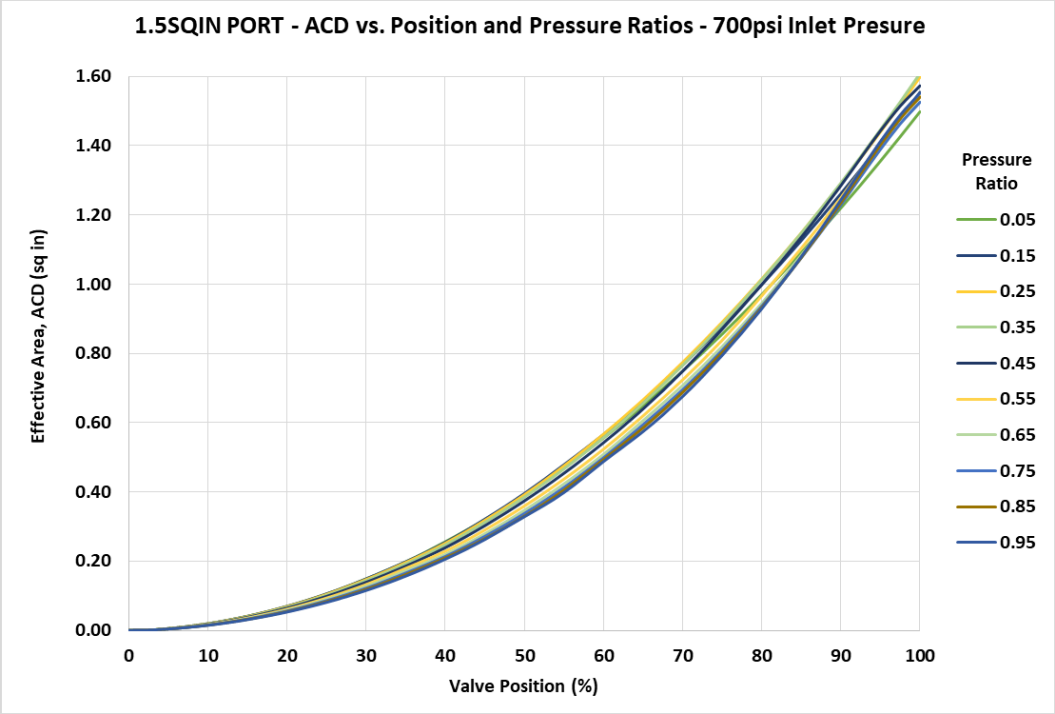


Figure 6-4. GS50 Position vs. Effective Area – 1.5SQIN Port

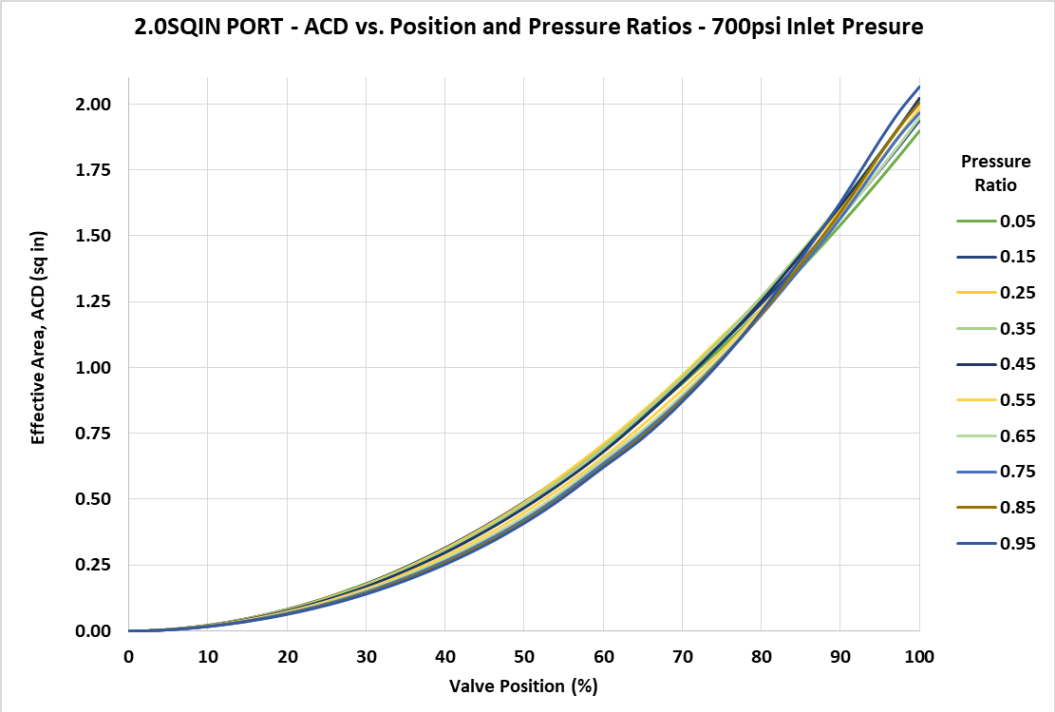


Figure 6-5. Position vs. GS50 Effective Area – 2.0SQIN Port

Seat Leakage

All GS Series valves meet ANSI/FCI 70-2 Class IV seat leakage. At elevated pressure differentials, the seat leakage will increase as shown in the graph below.

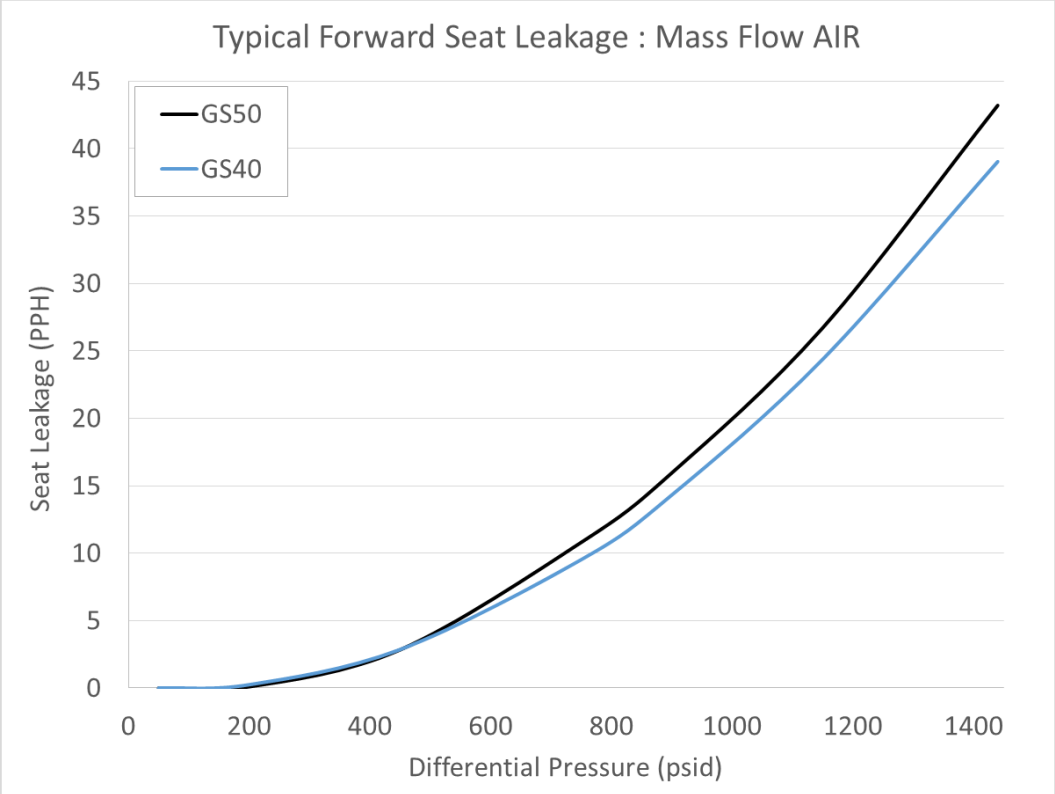


Figure 6-6. High Differential Pressure Seat Leakage for GS40 and GS50

Overboard Vent Leakage

NOTICE

Pressures exceeding 100 psid (690 kPa) on the OBVD port may result in internal seal damage to the valve, resulting in excessive OBVD leakage. This leakage may change the flow accuracy of the valve.

NOTICE

Do not plug the OBVD port. This can cause pressure to build up in the vent cavity, potentially damaging the valve and/or causing external gas leakage.

The overboard vent drain (OBVD) on all GS valves provides a connection where all leakage from the valve stem seals can be routed to a safe area or flare. The stem seals of the GS Series valves are exposed to the downstream pressure (P2) of the metering valve. All GS Series valves are factory tested to ensure the stem seals do lot leak more than 13.5 SCCM when new, although vast majority of new GS Series valves leak <1 SCCM.

Seal performance at cold temperatures can vary based on site conditions. In general, the stem seals of the GS40 and GS50 will perform as shown in the graph below.

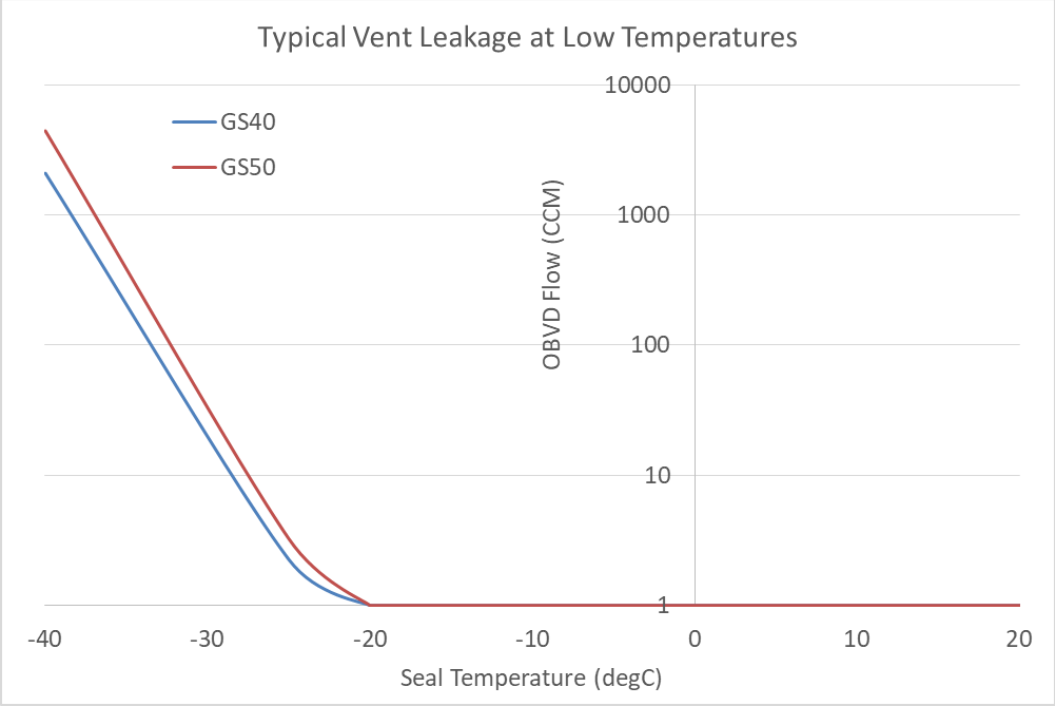


Figure 6-7. Expected Vent Leakage for GS40 and GS50 at Low Temperatures

The overboard vent lines should be sized such that the pressure on the OBVD port never exceeds 100psia. Valves leaking more than 1000 SCCM out of the OBVD port should be sent to an authorized service facility for overhaul. Note: Both the upstream and downstream sides of the valve should be pressurized when making any OBVD flow measurements.

Chapter 7.
Troubleshooting

⚠WARNING

Explosion Hazard

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

⚠WARNING

Explosion Hazard

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

⚠WARNING

Electrocution Hazard

Follow all local plant and safety instructions/precautions before proceeding with troubleshooting the DVPII Control.

Introduction

This chapter addresses several possible causes and recommended actions for many common problems that may be encountered with a system including the GS Series valve, GS Series driver, power source and interconnect wiring.

⚠WARNING

Personal Injury

Incorrect settings may adversely affect the performance, accuracy, behavior, and safety of the valve/actuator/positioner system. Do not make changes to the control per the recommended action without thoroughly reviewing the section of this manual regarding configuration. Injury to personnel or equipment may result.

IMPORTANT

The following troubleshooting guide contains information on diagnostic indications seen on the Service Tool. The Service Tool contains more diagnostics than shown in the troubleshooting guide. The guide will be updated in a later release of the manual.

DVPII Troubleshooting Guide

I/O Diagnostics

Table 7-1. DVPII Troubleshooting Guide I/O Diagnostics

Diagnostic Indications	Probable Causes	Recommended Action
Power–up Reset Detection: CPU reset by a power up event.	It is normal for the Power Up Reset diagnostic to occur upon power up of the DVPII.	Issue a reset to the DVPII.
	If this occurs while the DVPII is powered, and the diagnostic is set during a fast position transient, most likely the power infrastructure is not delivering the power needed.	During transient: Check terminal voltage at the DVPII during a 0-100% position transient, check wire gauge, fuses, or other resistive components in the power supply system.
Watchdog Reset Detection: CPU reset due to critical watchdog event.	A critical software lockup occurred.	Contact Woodward Technical Support.
Software Warm Reset Detection: CPU reset intentionally under software control.	It is normal for this to occur after the software is updated.	Issue a reset to the DVPII.
External Shutdown Position Detection: Command sent by Digital communication protocols like: CANopen.	An external interface has set the system to shutdown position.	Take away command and reset DVPII for normal operation.
Shutdown Position Detection: Runtime diagnostics detected a critical issue.	A critical failure with the driver or actuator occurred.	Check for other active errors to determine cause.
External Shutdown Detection: Command sent by Service Tool or digital communication protocols like: EGD, CANopen or discrete inputs.	It is normal for this to occur when a shutdown has been commanded from an external source. I.E. Service Tool, Digital Communication or Discrete Input.	Take away command and reset DVPII for normal operation.
	Unexpected command from digital communication.	Take away command and reset DVPII for normal operation.
	Discrete input wiring problem.	Fix wiring problem.
	Discrete input configuration problem.	Ensure the Active/Inactive settings inside the DVPII match the Active/Inactive settings of the controller. Settings can be modified using the Service Tool. If the Discrete Input is not used, disable this function using the Service Tool.

Diagnostic Indications	Probable Causes	Recommended Actions
Int. Bus Voltage High Detection: The internal bus voltage sensor is at max.	Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Int. Bus Voltage Low Detection: If the internal bus voltage sensor is at min.	Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
GS Series Driver IGBT Short Error Detection: If one of the driver IGBT's is in a short circuit condition.	Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Driver GND Fault Error Detection: If the driver senses a ground fault within the motor drive circuitry or the motor.	Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Driver Current Fault Detection: The driver fault is detected by monitoring the currents in the driver output stages.	A short exists between phases of the motor or wiring.	Check for phase-to-phase shorts in the wiring. Check for phase-to-phase shorts in the motor.
	A short exists between a phase and the ground (wiring or motor).	Check for phase to ground shorts in the wiring. Check for phase to ground (earth ground, motor housing) short in the motor.
	A short exists between phase and power supply positive (wiring problem).	Check for phase to power supply positive short in wiring.
	Internal electronics problem (this is unlikely, the Driver Current Fault is designed to protect the driver from damage).	Contact Woodward Technical Support for further assistance.
Current Phase A Sensor High Detection: The phase A current sensor is at max output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase A Sensor Low Detection: The phase A current sensor is at min output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase B Sensor High Detection: The phase B current sensor is at max output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase B Sensor Low Detection: The phase B current sensor is at min output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase C Sensor High Detection: The phase C current sensor is at max output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase C Sensor Low Detection: The phase C current sensor is at min output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Current Diagnostic 1 or Current Diagnostic 2 or Current Diagnostic 3 Detection: When enabled, indicates actual current exceeds configured threshold for longer than the configured delay time.	Electrical or wiring problem	Determine if wiring is correct, see Chapter 3.
	The DVPII current sense circuit has failed (electronics failure).	Contact Woodward Technical Support for further assistance.
	Incorrect settings for the current diagnostic detection.	Verify settings are appropriate for application.
Digital Com Analog Tracking Alarm Detection: When the difference between the demanded position on the CANopen port 1 and the demanded position on the analog backup is larger than the difference parameter and for a greater time span than the time parameter setting allows this flag will be set. In Dual CANopen mode, the difference is calculated between demanded position from port 1 and port 2.	The analog system has an error that has not resulted in a high or low error flag being set.	Correct the analog system.
	The control system does not keep the two redundant signals the same. The values are scaled differently, from a different source program, or timing is incorrect.	Debug and correct control system.
	If the analog backup is used, the analog system accuracy is worse than the alarm value set.	Make alarm value larger if acceptable for this application or make analog system accuracy better.
	The delay is too long between analog and CANopen values which have identical settings.	Determine the delay and if acceptable for the application, correct the difference time delay time in the DVPII.
Digital Com Analog Tracking Shutdown Detection: When the difference between the demanded position on the CANopen port 1 and the demanded position on the analog backup is larger than the difference parameter and for a greater time span than the time parameter setting allows this flag will be set. In Dual CANopen mode, the difference is calculated between demanded position from port 1 and port 2.	The analog system has an error that has not resulted in a high or low error flag being set.	Correct the analog system.
	The control system does not keep the two redundant signals the same. The values are scaled differently, from a different source program, or timing is incorrect.	Debug and correct control system.
	If the analog backup is used, the analog system accuracy is worse than the alarm value set.	Make alarm value larger if acceptable for this application or make analog system accuracy better.
	The delay is too long between analog and CANopen values which have identical settings.	Determine the delay and if acceptable for the application, correct the difference time delay time in the DVPII.
Digital Com 1 Error or Digital Com 2 Error Detection: When CANopen demand is used, indicates that the CAN communications (CAN 1 or CAN 2) are not functioning. This can be caused by a communication timeout or a failure to open the CAN port.	CAN wiring or noise problem.	Check CAN wiring.
	Incorrect CANopen messaging.	Refer to CANopen communication implementation details in Appendix A.

Diagnostic Indications	Probable Causes	Recommended Actions
Digital Com 1 & 2 and/or Analog Backup Error Detection: When CANopen demand is used, indicates the position setpoint is failed. That the CAN communications (CAN 1 and CAN 2) are not functioning or both analog input and CAN 1 have failed.	Lost signals or wiring problem.	Check wiring. Verify signals in Service Tool.
Analog Input 1 Low **Analog Input 2 Low** Detection: The analog input is below the diagnostic threshold. This is a user configurable parameter. Typically, 2 mA.	Wiring is disconnected or loose.	Check terminals and connections.
	Control system is turned off.	Check if the control system is turned on and providing the 4 to 20 mA current to the driver.
	Short in wiring to ground or between the plus and minus wires.	Check for short between analog input wiring and any other wiring.
	Control system 4 to 20 mA output has failed low.	Check the current in the input to the DVPII. Fix control system.
	Incorrect user configurable parameter in the driver for the min input diagnostic.	Verify the 4–20 mA Diagnostic Range: Low Limit Value using the DVPII Service Tool.
	DVPII internal electronics failure.	Contact Woodward Technical Support for further assistance.
Analog Input 1 High **Analog Input 2 High** Detection: The analog input is above the diagnostic threshold. This is a user configurable parameter. Typically, 22 mA.	Short in wiring to external voltage.	Check wiring for shorts to positive voltages.
	Control system 4 to 20 mA output has failed high.	Check the current to the analog input of the DVPII. Fix control system.
	Incorrect user configurable parameter in the driver for the max input diagnostic.	Verify the 4–20 mA Diagnostic Range: High Limit Value using the DVPII Service Tool.
	DVPII internal electronics failure.	Contact Woodward Technical Support for further assistance.
Analog Set Position Invalid Detection: None of the configured analog inputs is providing a valid set position value.	Active fault(s) on the configured analog input(s).	Check individual error conditions and resolve the active error(s).
	Incorrectly configured analog input(s).	Check the configuration of the intended analog input(s).
Analog Input 1 and 2 Diff Alarm Detection: The difference between the two analog input values exceeds the user-configured diff alarm threshold.	Active fault on one of the analog inputs.	Check individual error conditions and resolve the active error(s).
	Incorrectly configured analog input(s).	Check the configuration of the intended analog inputs.
Analog Input 1 and 2 Diff Shutdown Detection: The difference between the two analog input values exceeds the user-configured diff shutdown threshold.	Active fault on one of the analog inputs.	Check individual error conditions and resolve the active error(s).
	Incorrectly configured analog input(s).	Check the configuration of the intended analog inputs.

Internal Diagnostics

Table 7-2. DVPII Troubleshooting Guide Internal Diagnostics

Diagnostic Indications	Probable Causes	Recommended Actions
Input Voltage 1 High or Input Voltage 2 High Detection: The measured input voltage is higher than the specification limit: 33 VDC for 24 VDC Models 150 VDC for 125 VDC Models 300 VDC for DVPII 5000, 10000, and 12000 Models	Power supply and/or setting incorrect for application.	Check input voltage and correct voltage to within specification limits.
	Excessive charging voltage and/or battery failure.	
	Power supply has problem regulating the voltage at the input terminals during high current transients.	Determine if the power supply is of the correct type to be used with the DVPII. See power supply section in this manual.
Input Voltage 1 Low or Input Voltage 2 Low Detection: The measured input voltage is lower than the specification limit: 17 VDC for 24 VDC Models 90 VDC for 125 VDC Models 90 VDC for DVPII 5000, 10000, and 12000 Models	Power is not connected to this input. (Dual inputs are provided for redundancy)	If redundancy is not required, jumper power to both inputs.
	The power supply is not capable of delivering the transient current.	Determine if the power supply is capable of delivering the transient current. See power supply section in this manual.
	The power supply wiring is incorrectly sized for the required transient current.	Determine if the wiring is according to the manual.
	Excessive resistance in the wiring due to fuses, connectors, etc. that limits the max transient current to the driver.	Determine if there is excessive resistance in the power supply wiring and correct. Contact Woodward Technical support for appropriate procedure to evaluate the power infrastructure.
Input Current High Detection: The Input current sensor is at max output.	The current sense circuit has failed.	Contact Woodward Technical Support for further assistance.
Input Current Low Detection: The Input current sensor is at min output.	The current sense circuit has failed.	Contact Woodward Technical Support for further assistance.
RealTime CPU Temperature Low Detection: The heat sink temperature is below –40 °C.	The ambient temperature of the CPU is below specification.	Increase ambient temperature to within specification limits.
RealTime CPU Temperature High Detection: The heat sink temperature is above 150 °C.	The ambient temperature of the CPU is above specification.	Reduce ambient temperature to within specification limits.
Electronics Temperature High Detection: The control board temperature sensor indicates a temperature above 125 °C.	The ambient temperature of the driver is higher than allowed by specification.	Reduce ambient temperature to within specification limits.
	The temperature sensor is defective.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Electronics Temperature Low Detection: The Control Board temperature sensor indicates a temperature below –40 °C.	The ambient temperature of the driver is lower than allowed by specification.	Increase ambient temperature to within specification limits.
	The temperature sensor is defective.	Contact Woodward Technical Support for further assistance.
Driver Temperature High Detection: The heat sink temperature is above 150°C	The ambient temperature of the driver is above specification.	Reduce ambient temperature to within specification limits.
	The temperature sensor is defective.	Contact Woodward Technical Support for further assistance.
Driver Temperature High Limit Detection: The heat sink temperature is above 155°C	The ambient temperature of the driver is far above specification.	Reduce ambient temperature to within specification limits.
		Check if there are other heat sources on the mounting surface heating up the temperature around the DVPII.
		Check if the driver is using more current than normal to position the valve.
Driver Temperature Low Limit Detection: The heat sink temperature is below –45 °C.	The ambient temperature of the driver is below specification.	Increase ambient temperature to within specification limits.
Driver Temperature Sensor Error Detection: The temperature sensor is at min or max.	The temperature sensor has failed.	Contact Woodward Technical Support for further assistance.
Driver Brake Resistor Temperature High Detection: The driver brake resistor temperature is at max.	The temperature of the driver brake resistor is above specification.	Contact Woodward Technical Support for further assistance.
No Power Board Found Detection: During power up the control board will read the power board. This diagnostic will be set if no Power Board is found.	DVPII internal electronics failure or there is no power board connected.	Contact Woodward Technical Support for further assistance.
Power Board Calibration Error Detection: During power up the calibration record in the control is set to “No Power Board” this diagnostic will be set.	The control board has not been calibrated during electrical production.	Contact Woodward Technical Support for further assistance.
Power Board ID Error Detection: During power up, the power board ID and the stored ID in the calibration record do not match.	The power board has been changed to a different type after calibration.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
No IO Board Found Detection: During power up the control board will read the I/O board. This diagnostic will be set if no I/O Board is found.	DVPII internal electronics failure or there is no I/O board connected.	Contact Woodward Technical Support for further assistance.
IO Board Calibration Error Detection: During power up the calibration record in the control is set to “No I/O Board” this diagnostic will be set.	The control board has not been calibrated during electrical production.	Contact Woodward Technical Support for further assistance.
IO Board ID Error Detection: During power up, the I/O board ID and the stored ID in the calibration record do not match.	The I/O board has been changed to a different type after calibration.	Contact Woodward Technical Support for further assistance.
Control Board ID Error Detection: The software checks for a valid control board ID during power up.	The control board ID cannot be read correctly, or the software is too old to recognize a newer control board revision.	Contact Woodward Technical Support for further assistance.
Non-Volatile Memory Read Failed Detection: After multiple retries and data comparison the software is not able to read from the non-volatile memory.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Non-Volatile Memory Write Failed Detection: After multiple retries and data comparison the software is not able to write to the non-volatile memory.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Parameters Failed Detection: CRC16 check failures on both parameter sections.	If a new embedded program has been loaded, the parameters have not been updated.	Refer to the embedded software update procedure to update the parameters. Cycle power to restart the DVPII.
	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Parameters Version Failed Detection: Version information does not correct in the non-volatile memory.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
1.1 Volt Supply Failed Detection: Internal 1.1 V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
1.3 Volt Supply Failed Detection: Internal 1.3 V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
1.35 Volt Supply Failed Detection: Internal 1.35 V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
2.5 Volt Supply Failed Detection: Internal 2.5 V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU VDD Supply Failed Detection: Internal CPU VDD is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU VDDP3 Supply Failed Detection: Internal CPU VDDP is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU External Voltage Supply Failed Detection: Internal CPU external supply is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Power Board 5 Volt Supply Failed Detection: Internal power board 5V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
IO Board 5 Volt Supply Failed Detection: Internal I/O board 5V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
1.8 Volt Supply Failed - FPGA Detection: Internal FPGA 1.8 V is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Driver Isolated Power Failed Detection: Internal Driver isolated voltage supply is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
3.3 Volt Supply Failed Detection: Internal 3.3 V is outside acceptable range as measured by all ADC groups.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
RealTime CPU GroupX ADC 3V3 Failed (**X** can be 0, 1, 2, 3, 4, 5, or 7) Detection: Internal 3.3 V is not being converted to the proper value by ADC identified by group "X".	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
1.8 Volt Supply Failed Detection: Internal 1.8 V is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
+15 Volt Supply Failed Detection: Internal +15 V is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
–15 Volt Supply Failed Detection: Internal –15 V is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
5 Volt Supply Failed Detection: Internal 5 V is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Ref Volt Failed Detection: Internal reference voltage is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
5 Volt RDC Ref Failed Detection: Internal RDC voltage reference is outside of acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Main ADC Failed Detection: Internal ADC operation in CPU has failed runtime diagnostics.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Alarm and Shutdown Status" screen (of the form): **"RealTime CPU ADC Error – "**.
RDC Error Detection: The acquisition/storage of conversion data for resolver-to-digital conversion has failed runtime diagnostics.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Alarm and Shutdown Status" screen (of the form): **"RealTime CPU RDC Error – "**.

Diagnostic Indications	Probable Causes	Recommended Actions
FPGA Communication Error Detection: The FPGA-to-CPU communication has failed runtime diagnostics.	There is a problem with communication from the FPGA device to the CPU.	Contact Woodward Technical Support for further assistance.
RealTime CPU-to-FPGA Comm Error Detection: The CPU-to-FPGA communication has failed runtime diagnostics.	There is a problem with communication from the CPU to the FPGA device.	Contact Woodward Technical Support for further assistance.
FPGA Runtime CRC Error Detection: The real-time CPU has detected an error in the FPGA.	The content of the FPGA device has unexpectedly changed due to an upset event or an internal electronics failure.	Contact Woodward Technical Support for further assistance.
PWM Inverter Sync Error Detection: The inverter PWM signals have lost synchronization with the real-time CPU control updates.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
FPGA Clock Sync Error Detection: The FPGA and real-time CPU clock frequencies do not match.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU Internal Clock Error Detection: The CPU has detected an internal clock failure.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Comm CPU Initialization Error Detection: The communication CPU was unable to initialize. Note: The cause of this error may also disrupt access into the real-time CPU from the Service Tool, so it may not be possible to view error status.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Comm CPU Application Stopped Error Detection: The communication CPU application has failed and stopped. Note: The cause of this error may also disrupt access into the real-time CPU from the Service Tool, so it may not be possible to view error status.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
RealTime CPU Fatal Initialization Error Detection: The real-time CPU encountered a fatal issue during initialization. Note: The occurrence of this error will result in a watchdog reset, so the presence of this error will only show in the “Stored Alarms and Shutdowns” screen.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU Critical Initialization Error Detection: The real-time CPU encountered a critical issue during initialization. Note: The cause of this error may or may not disrupt access into the real-time CPU from the Service Tool. If access is working, then additional error information may be available.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RealTime CPU Non-critical Initialization Error Detection: The real-time CPU encountered a non-critical issue during initialization. Note: The cause of this error should not affect access into the real-time CPU from the Service Tool, so additional error information may be available.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Position Controller Not Ready Detection: This status flag indicates the DVPII is not controlling position. This occurs during power-up initialization and when in a shutdown position state.	DVPII is initializing (power-up) or has detected a problem that will not allow the position controller to run.	Using the Service Tool, identify and correct the issues.
Check 100 Percent Error Detection: This status flag indicates the max (100 %) position check has failed. The detected range could be wrong, or a timeout could have occurred during the test.	Unable to reach limit.	Unable to reach max position due to internal or external conditions. Verify that there is no jamming or blockage of the linkage attached to the actuator.
	Incorrect min position detection causing an error in the 100% check.	Using the Service Tool, identify and correct the issues.
	ID module factory settings are incorrect for max position limit range.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Reduced Torque Error Detection: This status flag indicates the system torque has been reduced due to a reduction in motor current.	User Force Limiter is active.	This could be proper/expected operation or User Force Limiter settings could be incorrect.
	Current limiter on motor is active.	Internal protection is active, no action required. If condition persists, contact Woodward Technical Support for further assistance.
Reduced Slew-rate Error Detection: This status flag indicates the system torque has been reduced due to a reduction in motor current.	Input current limiter is active.	Internal protection is active, no action required. If condition persists, contact Woodward Technical Support for further assistance.
Linearization Monotonic Shutdown Error Detection: Linearization Monotonic Shutdown Error	DVPII settings are incorrect.	Correct the Linearization settings using the Service Tool.
Driver Precharge Error Detection: The Driver internal bus failed to charge to expected level.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Driver Brake Resistor Error Detection: The Driver brake resistor has failed runtime checks.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Position Feedback Transducer Diagnostics

Table 7-3. DVPII Troubleshooting Guide Position Feedback Transducer Diagnostics

Diagnostic Indications	Probable Causes	Recommended Actions
Motor 1 Sin Error or Motor 1 Cos Error or Motor 2 Sin Error or Motor 2 Cos Error Detection: The detected signal value is out of range.	The wiring to the position feedback transducer is disconnected or intermittent.	Check wiring and connectors leading to the position feedback transducer.
	The position feedback transducer failed open or is intermittent.	See appropriate valve or actuator manual for the appropriate excitation resistance value. Check the gain and amplitude values shown on the Position Resolver Diagnostics page of the service tool. The amplitude value must be approximately 81% of max ADC. Gain value should be between 10% and 95% of max output. ***IMPORTANT*** **The gain is continually adjusted by the DVPII.**
	The DVPII position feedback input circuit has failed.	Contact Woodward Technical Support for further assistance.
Motor 1 Excitation Error Or Motor 2 Excitation Error Detection: The Sin and Cos voltage combined are below the diagnostic threshold.	The excitation wiring to the resolver is shorted or intermittent.	Check the resolver excitation coil resistance. See appropriate valve manual for resistance value.
	The resolver excitation coil is shorted.	
	The resolver gain is too low due to resolver wiring problem.	If the gain is temporarily low, check wiring and resolver. Reset driver for normal operation. Allow the automatic gain control to stabilize.
	Excitation circuit failure.	Contact Woodward Technical Support for further assistance.
Motor 1 and 2 Res. Error Detection: This is a summary indication that an error is detected in both motor 1 and motor 2	A Motor error is true if any of the following errors are detected: Motor Sin Error, Motor Cos Error, Motor Excitation Error, Motor Startup Open Error, Motor Startup Close Error, and Motor Startup Direction Error.	If there is a Motor 1 and a Motor 2 error, use the recommended actions for those errors.
Valve Shaft 1 Sin Error or Valve Shaft 1 Cos Error or Valve Shaft 2 Sin Error or Valve Shaft 2 Cos Error Detection: The detected signal value is out of range.	The wiring to the resolver is disconnected or failed.	Check wiring and connectors leading to the resolver.
	The resolver is failed open or intermittent.	Check the gain and amplitude values for the resolver on the service tool. Amplitude value must be approximately 80% max ADC. Gain value should be between 10% and 95% max Output. ***IMPORTANT*** **The gain is continually adjusted by the DVPII.**
	The resolver input circuit has failed.	Contact Woodward Technical Support for further assistance.
Valve Shaft 1 Excitation Error or Valve Shaft 2 Excitation Error Detection: The Sin and Cos voltage combined are too low.	The excitation wiring to the resolver is shorted or intermittent.	Check the resolver excitation coil resistance. See appropriate valve manual for resistance value.
	The resolver excitation coil is shorted.	
	The resolver gain is too low due to resolver wiring problem.	If the gain is temporarily low, check wiring and resolver. Reset driver for normal operation. Allow the automatic gain control to stabilize.
	Excitation circuit failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Valve Shaft 1 and 2 Res. Error Detection: The Shaft resolver redundancy manager has detected a Valve shaft 1 and Valve shaft 2 error.	Valve Shaft 1 error is true if any of the following errors are detected: Valve Shaft 1 Sin Error Valve Shaft 1 Cos Error Valve Shaft 1 Excitation Error Valve Shaft 2 error is true if any of the following errors are detected: Valve Shaft 2 Sin Error Valve Shaft 2 Cos Error Valve Shaft 2 Excitation Error	If there is a Valve Shaft 1 and 2 error, use the recommended actions for the Valve stem errors.
	Range or Setting of the Resolvers is out of tolerance.	If there is a Start-up or Range error, verify the following values: Start-up Close Shaft 1 Error Start-up Close Shaft 2 Error Shaft 1 Range Limit Error Shaft 2 Range Limit Error

Valve Type Selection

Table 7-4. DVPII Troubleshooting Guide Valve Type Selection

Diagnostic Indications	Probable Causes	Recommended Actions
Auto Detect Error Detection: This diagnostic is only enabled when the DVPII has been configured for auto detection (see Auto Detection section).	Failure to read the ID module on the valve/actuator system.	See associated diagnostics on the Valve Type Selection Screen in the Service Tool. If “ID Module Not Detected” is annunciated, check wiring to the ID module.
This diagnostic is set when: The DVPII fails to communicate with the ID module due to write or read problems or the calibration records in the ID module are corrupted (CRC16 failure).	ID module calibration record corrupted.	See Process Fault & Status Overview Screen in the DVPII Service Tool. If “Invalid Parameter(s)” is annunciated the calibration records are corrupt in the ID module. Contact Woodward Technical Support for a copy of the correct parameter file. Valve Serial Number will need to be provided.
The DVPII fails to write the calibration records into the non-volatile memory.	DVPII non-volatile memory error.	See Process Fault & Status Overview screen in the DVPII Service Tool. If “EEPROM Read/Write Failed” or “Invalid Parameter(s)” is annunciated Contact Woodward Technical Support ***IMPORTANT*** **A reset will force the DVPII to retry auto detection of the connected valve.**

Diagnostic Indications	Probable Causes	Recommended Actions
Control Model Not Running Detection: This status flag indicates the internal DVPII Control Model is not Running. The position of the actuator/valve is not controlled by the DVPII. If actuator/valve has a return spring, the actuator/valve is be positioned by the return spring.	DVPII detected a problem that will not allow the position controller to run.	Using the Service Tool, identify and correct the issues.
Serial Valve Type Error Detection: If during power up the DVPII detects a valve/actuator system with a different serial number or valve type this diagnostic will be annunciated.	User has connected a different valve to the DVPII.	See the Valve Type Selection Screen in the Service Tool. Verify the "Valve Type" and "Valve Serial Number" match the valve/actuator system connected to the DVPII. Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number. **⚠WARNING** **Operation of the DVPII with incorrect parameter files can cause personal injury and/or property damage.**
	User has loaded a parameter set to the DVPII that does not match this valve/actuator system serial number.	
	ID module factory calibration incorrect for this valve type / serial number.	Contact Woodward Technical Support for further assistance.
Valve Type Not Supported Detection: This diagnostic is annunciated if the valve type reported by the valve/actuator system in the ID module is not supported by the DVPII software.	Valve type not supported by the DVPII	Contact Woodward Technical Support for potential upgrade to the latest revision of the DVPII software.
	DVPII software is not the required revision for this valve.	

Diagnostic Indications	Probable Causes	Recommended Actions
ID Module Not Detected Detection: During power up the ID Module cannot be read.	Failure to read the ID module on the valve/actuator system.	See associated diagnostics on the Valve Type Selection Screen in the Service Tool. If “ID Module Not Detected” is annunciated, check wiring to the ID module.
	ID module calibration record corrupted.	See Process Fault & Status Overview Screen in the DVPII Service Tool. If “Invalid Parameter(s)” is annunciated the calibration records are corrupt in the ID module. Contact Woodward Technical Support for a copy of the correct parameter file. Valve Serial Number will need to be provided.
	The valve does not have an ID module.	Contact Woodward Technical Support for a copy of the correct parameter file. Valve Serial Number will need to be provided. ***NOTICE*** **The correct parameter file must be uploaded into the DVPII. Any reset command via the DVPII Service Tool or any other applicable method (e.g., Discrete Input) will force the driver to use the internally stored parameters. This will allow the DVPII to function without an ID module.** **⚠WARNING** **It is the user’s responsibility to make sure the correct parameters are stored in the DVPII! Operation of the DVPII with incorrect parameter files can cause personal injury and/or property damage.**

Diagnostic Indications	Probable Causes	Recommended Actions
ID Module Version Not Supported Detection: This diagnostic is annunciated if the ID module version is not supported by the DVPII software. **Note**: The Valve Type Auto Detect diagnostic is also set when this condition is detected.	DVPII software is not the required revision for this valve.	Contact Woodward Technical Support for potential upgrade to the latest revision of the DVPII software.
	ID module calibration record corrupted.	See Process Fault & Status Overview Screen in the DVPII Service Tool. If “Invalid Parameter(s)” is annunciated the calibration records are corrupt in the ID module. Contact Woodward Technical Support for a copy of the correct parameter file. Valve Serial Number will need to be provided.
Incorrect Power Board Detection: During power up the DVPII checks the parameters to determine the power board needed for the valve/actuator system. If the power board ID required and the power board detected do not match, this diagnostic will be annunciated.	Valve/actuator system does not match the DVPII power board.	Contact Woodward Technical Support to determine the correct DVPII and valve/actuator system for your application.
Incorrect IO Board Detection: During power up the DVPII checks the parameters to determine the I/O board needed for the valve/actuator system. If the I/O board ID required and the I/O board detected do not match, this diagnostic will be annunciated.	Valve/actuator system does not match the DVPII I/O board.	Contact Woodward Technical Support to determine the correct DVPII and valve/actuator system for your application.

Resolver Diagnostic LAT

Table 7-5. DVPII Troubleshooting Guide Resolver Diagnostic LAT

Diagnostic Indications	Probable Causes	Recommended Actions
Shaft 1 Range Limit Error or Shaft 2 Range Limit Error Detection: During calibration at the factory, the resolver range (difference between minimum and maximum stop) is recorded. This diagnostic occurs if the Valve Shaft resolver reading is detected outside the calibrated resolver range.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	There is an electrical problem with the resolver and/or its associated circuits resulting in an incorrect resolver reading.	See Position Resolver Diagnostics screen in the Service Tool. Verify Position, Amplitude and Gain readings. Amplitude should be approximately 80%. Gain should be from 10-90%. Verify appropriate resistance reading on excitation, sine, and cosine after disconnecting leads at the DVPII. See associate valve manual for resistance values. Contact Woodward Technical Support for further assistance if readings are out of valve specifications.
	The resolver has mechanically moved outside of the range.	Review and record the values shown on the LAT Actuator/Valve Configuration Screen. Contact Woodward Technical Support for further assistance.
Dual Resolver Difference Alarm Detection: The difference between the resolver readings is larger than the permissible alarm limit value.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII. This could result in incorrect resolver scaling resulting in a difference error.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	One or both resolvers have moved.	Contact Woodward Technical Support for further assistance.
	There is an electrical problem with the resolver and/or its associated circuits resulting in an incorrect resolver reading.	See Position Resolver Diagnostics screen in the Service Tool. Verify Position, Amplitude and Gain readings. Amplitude should be approximately 80%. Gain should be from 10-90%. Verify appropriate resistance reading on excitation, sine, and cosine after disconnecting leads at the DVPII. See associate valve manual for resistance values. Contact Woodward Technical Support for further assistance if readings are out of valve specifications.

Diagnostic Indications	Probable Causes	Recommended Actions
Dual Resolver Difference Shutdown Detection: The difference between the resolver readings is larger than the permissible shutdown limit value.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII. This could result in incorrect resolver scaling resulting in a difference error.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	One or both resolvers have moved.	Contact Woodward Technical Support for further assistance.
	There is an electrical problem with the resolver and/or its associated circuits resulting in an incorrect resolver reading.	See Position Resolver Diagnostics screen in the Service Tool. Verify Position, Amplitude and Gain readings. Amplitude should be approximately 80%. Gain should be from 10-90%. Verify appropriate resistance reading on excitation, sine, and cosine after disconnecting leads at the DVPII. See associate valve manual for resistance values. Contact Woodward Technical Support for further assistance if readings are out of valve specifications.

Resolver Diagnostics 3-Phase

Table 7-6. DVPII Troubleshooting Guide Resolver Diagnostics 3-Phase

Diagnostic Indications	Probable Causes	Recommended Actions
Startup Open Motor Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the motor resolver is not within the calibrated range when checking the open direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The resolvers are not connected or there is a wiring error. See: Motor 2 Sin Error Motor 2 Cos Error Motor 2 Exc Error	Follow motor resolver procedures.
	The fusible link on the valve has yielded.	Power down and re-check the min and max mechanical stop for correct operation. Record results from multiple power ups. Contact Woodward Technical Support for further assistance.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Startup Open Motor 2 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the motor resolver is not within the calibrated range when checking the open direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The resolvers are not connected or there is a wiring error. See: Motor 2 Sin Error Motor 2 Cos Error Motor 2 Exc Error	Follow motor resolver procedures.
	The fusible link on the valve has yielded.	Power down and re-check the min and max mechanical stop for correct operation. Record results from multiple power ups. Contact Woodward Technical Support for further assistance.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Startup Close Motor Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the motor resolver is not within the calibrated range when checking the closed direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The resolvers are not connected or there is a wiring error. See: Motor 1 Sin Error Motor 1 Cos Error Motor 1 Exc Error	Follow motor resolver procedures.
	The fusible link on the valve is damaged.	Power down and re-check the min and max mechanical stop for correct operation. Record results from multiple power ups. Contact Woodward Technical Support for further assistance.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Startup Close Motor 2 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the motor resolver is not within the calibrated range when checking the closed direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The resolvers are not connected or there is a wiring error. See: Motor 2 Sin Error Motor 2 Cos Error Motor 2 Exc Error	Follow motor resolver procedures.
	Motor 2 Sin Error The fusible link on the valve is damaged.	Power down and re-check the min and max mechanical stop for correct operation. Record results from multiple power ups. Contact Woodward Technical Support for further assistance.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Startup Open Shaft 1 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the valve stem resolver is not within the calibrated range when checking the open direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The fusible link in the valve / actuator is damaged or broken.	Check the fusible link in the valve for any damage. See valve manual.
	The resolver is not connected or there is a wiring error. See: Valve Shaft 1 Sin Error Valve Shaft 1 Cos Error Valve Shaft 1 Exc Error	Follow stem resolver procedures.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Startup Close Shaft 1 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the valve stem resolver is not within the calibrated range when checking the closed direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The fusible link in the valve / actuator is damaged or broken.	Check the fusible link in the valve for any damage. See valve manual.
	The resolver is not connected or there is a wiring error. See: Valve Shaft 1 Sin Error Valve Shaft 1 Cos Error Valve Shaft 1 Exc Error	Follow stem resolver procedures.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Startup Open Shaft 2 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the valve stem resolver is not within the calibrated range when checking the open direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The fusible link in the valve / actuator is damaged or broken.	Check the fusible link in the valve for any damage. See valve manual.
	The resolver is not connected or there is a wiring error. See: Valve Shaft 2 Sin Error Valve Shaft 2 Cos Error Valve Shaft 2 Exc Error	Follow stem resolver procedures.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Startup Close Shaft 2 Error Detection: During calibration at the factory, the resolver values at the min stop are recorded. The resolver readings corresponding to the fully closed position are recorded in both the opening and closing direction at torques sufficient to overcome the backlash in the gear train, but not to open the valve. During power-up and initialization, the DVPII verifies that the valve is at the min stop. This diagnostic occurs if the valve stem resolver is not within the calibrated range when checking the closed direction.	Calibration values specific to the valve/actuator serial number are incorrect as stored in the DVPII.	Use the auto detection function or download the valve specific calibration file into the DVPII for the correct serial number.
	The valve is not closed, debris or mechanical failure has occurred.	Check the valve according to valve manual.
	The fusible link in the valve / actuator is damaged or broken.	Check the fusible link in the valve for any damage. See valve manual.
	The resolver is not connected or there is a wiring error. See: Valve Shaft 2 Sin Error Valve Shaft 2 Cos Error Valve Shaft 2 Exc Error	Follow stem resolver procedures.
	Insufficient bus voltage. Internal problem with the electronics.	Contact Woodward Technical Support for further assistance.
Startup Direction Motor Error Detection: If the motor did not move into the correct direction, more than the factory calibrated setting, this flag is set.	Motor wiring not connected.	Check wiring connections.
	Wiring problem, phases are incorrectly connected.	Check wiring for incorrect phase assignment.
	Resolver wiring problem, resolver moving in the incorrect direction.	Check the resolver wiring. See resolver error flags, gain and amplitude.
	Motor defect: open phases or shorts. If shorts are present, Driver Current Fault should annunciate.	Check the motor for shorts and open phases.
	DVPII electronics failure.	Contact Woodward Technical Support for further assistance.

Position Error

Table 7-7. DVPII Troubleshooting Guide Position Error

Diagnostic Indications	Probable Causes	Recommended Actions
Motor Position Error Alarm Detection: The Motor position is not tracking the set point within limitations set by the tracking error alarm parameters.	Incorrect Parameter Settings	Check parameters settings. See Three Phase Control Operating Summary in the DVPII Service Tool.
	Contamination in the valve/actuator system.	At earliest opportunity perform check out procedure as described in the Position Error Motor Shutdown.
Motor Position Error Shutdown Detection: The Motor position is not tracking the set point within limitations set by the tracking error shutdown parameters.	Motor wiring not connected.	Check wiring terminations at the DVPII, intermediate connections and valve/actuator. Eliminate any intermittent or open circuits.
	Wiring problem, phases are connected incorrectly.	Ensure no open phases or shorts in the wiring. (See associated valve wiring diagram)

Diagnostic Indications	Probable Causes	Recommended Actions
Shaft Position Error Alarm Detection: The Valve Stem position is not tracking the set point within limitations set by the tracking error alarm parameters.	Resolver wiring problem, resolver moving in the incorrect direction.	Check the resolver wiring/connector. See resolver error flags, gain and amplitude.
	Motor defect- open phases or shorts. If shorts are present, Driver Current Fault should annunciate.	Check the motor for shorts and open phases.
Shaft Position Error Shutdown Detection: There is an error bigger than the stem position error parameters between the stem position and the demanded position.	Excessive valve/actuator wear	At earliest opportunity, perform check out procedure as described in the Position Error Motor Shutdown.
	Incorrect or damaged motor wiring	Ensure no open phases or shorts in the wiring. Verify the motor phases are wired correctly. (See associated valve wiring diagram)
	Motor failure	Contact Woodward Technical Support for assistance
	DVPII electronics failure	Contact Woodward Technical Support for assistance
	CAN wiring or noise problem	Check CAN wiring
	DVPII internal electronics failure	Contact Woodward Technical Support for further assistance.

Auxiliary Board Status and Diagnostics

Table 7-8. DVPII Troubleshooting Guide Auxiliary Board Status and Diagnostics

Diagnostic Indications	Probable Causes	Recommended Actions
Heat Sink Temp. Sensor 1 Error **or** **Heat Sink Temp. Sensor 2 Error** Detection: This fault status flag indicates power board heat sink sensor (1 or2) has failed (Applies only to DVPII 5000, 10000, and 12000).	DVPII internal electronics failure or extreme temperature.	If DVPII temperature is within specified limits, contact Woodward Technical Support for further assistance. Note: This fault should not occur on GS40/GS50 products.
Boost Converter Error Detection: This status flag indicates the Boost Converter board did not reach the proper voltage.	Internal problem with the electronics (applies only to DVPII 5000, 10000, and 12000).	Contact Woodward Technical Support for further assistance. Note: This fault should not occur on GS40/GS50 products.

Watchdog Diagnostics

Table 7-9. DVPII Troubleshooting Guide Watchdog Diagnostics

Diagnostic Indications	Probable Causes	Recommended Actions
Watchdog Critical Process Error Detection: The real-time CPU has detected an error in a process considered critical to operation, and the error resulted in this summary error. Note: The occurrence of this error will result in a watchdog reset, so the presence of this error will only show in the "Stored Alarms and Shutdowns" screen.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Stored Alarms and Shutdowns" area of the "Alarm and Shutdown Status" screen: **Watchdog Error - Critical Process 1** **Watchdog Error - Critical Process 2** **Watchdog Error - Critical Process 3** **Watchdog Error - Critical Process 4** **Watchdog Error - Critical Process 5** **Watchdog Error - Critical ADC 1** **Watchdog Error - Critical ADC 2** **Watchdog Error - Critical ADC 3** **Watchdog Error - Critical Resolver 1** **Watchdog Error - Critical Resolver 2**
Watchdog Non-critical Process Error Detection: The real-time CPU has detected an error in a process considered non-critical to operation, and the error resulted in this summary error.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Alarm and Shutdown Status" screen: **Watchdog Error - Non-critical Process 1** **Watchdog Error - Non-critical Process 2**
Watchdog Service Link Comm Error Detection: The real-time CPU has detected an error in a process related to communication on the Service Link, and the error resulted in this summary error. Note: The cause of this error may also disrupt access into the real-time CPU from the Service Tool, so it may not be possible to view error status.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. If communication via the Service Tool is possible, please provide information on the presence of any of the possible source errors in the "Alarm and Shutdown Status" screen: **Watchdog Error - Non-critical Service Link 1** **Watchdog Error - Non-critical Service Link 2** **Watchdog Error - Non-critical Service Link 3** **Watchdog Error - Non-critical Service Link 4**

Diagnostic Indications	Probable Causes	Recommended Actions
ECC Uncorrected Critical Memory Error Detection: The real-time CPU has detected an uncorrected memory error in a process considered critical to operation, and the error resulted in this summary error. Note: The occurrence of this error will result in a watchdog reset, so the presence of this error will only show in the "Stored Alarms and Shutdowns" screen.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Status Flags" screen (of the form): **"ECC Uncorrected Memory Error - "**
ECC Corrected Critical Memory Error Detection: The real-time CPU has detected a corrected memory error in a process considered critical to operation, and the error resulted in this summary error.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Status Flags" screen (of the form): **"ECC Corrected Memory Error - "**
ECC Uncorrected Non-critical Memory Error or ECC Corrected Non-critical Memory Error Detection: The real-time CPU has detected a corrected or uncorrected memory error in a process considered non-critical to operation, and the error resulted in this summary error.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Status Flags" screen (of the form): **"ECC Corrected Memory Error - "**
ECC Corrected Critical Memory Error Detection: The real-time CPU has detected a corrected memory error in a process considered critical to operation, and the error resulted in this summary error.	Internal electronics failure.	Contact Woodward Technical Support for further assistance. Please provide information on the presence of any of the possible source errors in the "Status Flags" screen (of the form): **"ECC Corrected Memory Error - "** **"ECC Uncorrected Memory Error -"**

Chapter 8.
Maintenance

It is recommended that you perform periodic external cleaning with a petrochemical solvent (wash and brush). High-pressure power washing is not recommended. When cleaning the metering element and the inside of the valve body, do not use sharp objects that may scrape or dent the metering element, as this could degrade the accuracy of the valve.

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

⚠WARNING

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

⚠WARNING

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

⚠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.

⚠WARNING

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

⚠WARNING

Exposed valve metering parts are a pinch hazard. Do not insert hands into the valve when it has been removed from the piping.

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 obtain 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.

Chapter 10.
Long-Term Storage Requirements

Units that will not be put into service within twelve months should be packaged for long-term storage as described in Woodward manual 25075, Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls.

Recommended long term storage temperature for longest life: +25°C +/- 10°C.

It is recommended to apply power to spare units every 24-36 months for 3 hours to reform the electrolytic capacitors used in the power module.

Appendix A.
CANopen Communication

A.1 Introduction

IMPORTANT **The CANopen communications described in this manual are a typical Woodward implementation.**

The CAN network that is used for the CANopen communication with the DVPII has one NMT Master (Network Master Management Node). This node is responsible for starting communication and the timing of the CAN messages. There can be up to 30 slave devices (depending on network load and timing).

Further detailed information regarding CANopen can be obtained at www.can-cia.org. Information about CAN is available in ISO 11898. Specific information regarding DVPII behavior is detailed below. The DVPII CANopen Electronic Data Sheet (EDS) can be downloaded from www.woodward.com/software.

A.2 Network Architecture

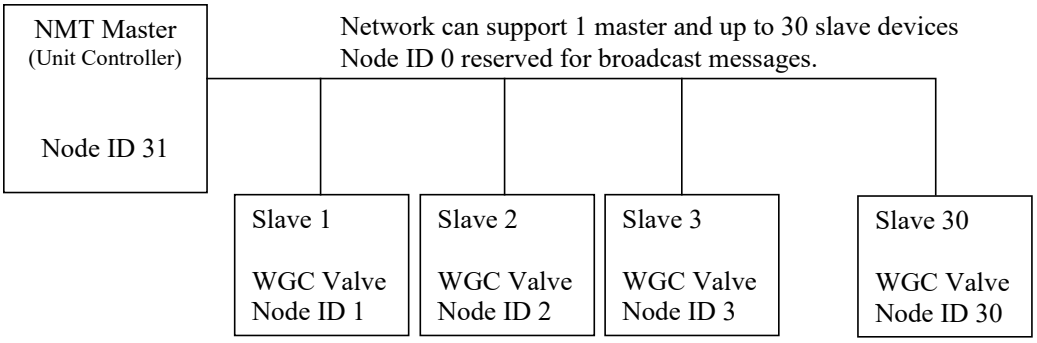


Figure A-1. CANopen Network Architecture

Addressing can support up to 31 devices. To meet the 10 ms timing requirement, only 15 devices can be used at 500 kbaud.

A.3 NMT Master Functions

There are four distinct functions the master can perform. The slave units will respond to these functions.

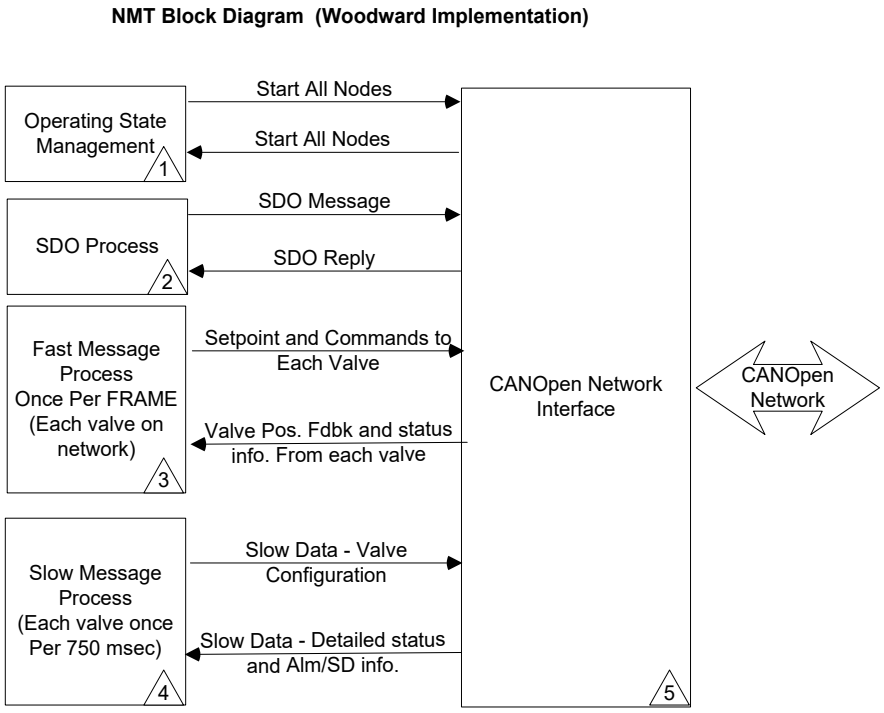


Figure A-2. NMT Master Block Diagram

1) Operating State Management— This function is used to change the operational state of the slave devices.

2) SDO Process—This function is used to read and or write SDO data into or out of the slave devices. SDO data is typically non-time critical data.

3) Fast Message Process— This function will read and write the fast messages (once every frame) to the slave devices. This is time critical data and needs to have priority over the other messages. There is also a sync message supported for timing purposes.

4) Slow Message Process— This function will read and write the slow messages to and from the slaves. Typical update rate is 750 ms.

Operating State Management

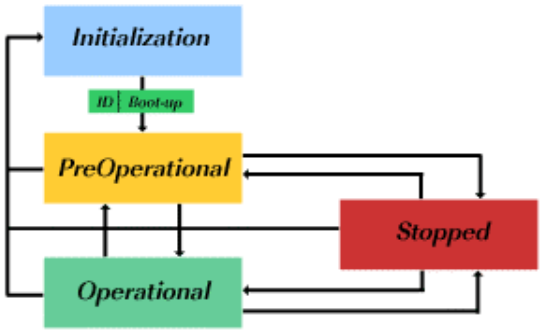


Figure A-3. CANopen Slave State Diagram

The above state diagram is taken from the CANopen specification.

Initialization:

NMT and DVPII: The initialization state is used to open the CAN ports and to initialize the CANopen stack. After this is done the DVPII or NMT will go to the pre-operational state automatically. It will send the boot-up message. The boot-up message is the heartbeat message. Once the boot-up message is sent, the heartbeat message is disabled.

Pre-Operational:

DVPII: In this state, the DVPII is waiting for the "Start All Nodes" message. When the message is received, the DVPII will go to the operational state.

NMT Master: In this state, the NMT will transmit a "Start All Nodes" Message. This message will also be received by the NMT Master and will cause the Master to transition to the operational state.

Operational:

DVPII: In this state the DVPII is in operational mode and will perform all send and receive functions.

NMT Master: In this state NMT will execute all functions.

- Operational state management
- SDO process
- Fast messages
- Slow messages

The NMT master will transmit "Start All Nodes" broadcast message every 1 second. Sending this message at a periodical cycle ensures that any nodes that are added, or power cycles, will go back to the operational state without having to reset the NMT Master.

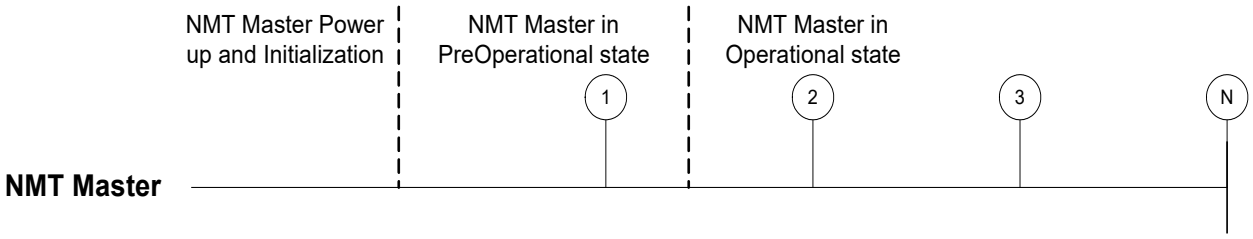
Stopped:

The stopped state is not used.

> **Note**: The DVPII will respond to an individual “go to operational” NMT command. However, due to the broadcast nature of the NMT command, it requires a delay of at least 1.5ms between NMT commands on the CAN bus to ensure the DVPII has time to clear the NMT receive buffer. Symptoms of an insufficient delay include the DVPII node not advancing to the operational state, or the node not being detected in some CANopen scanner programs.

Timing:

In a timing diagram the process will look like this:



1. **NMT Master Transmits "Start All Nodes"**
2. **NMT Master Transmits "Start All Nodes" (Time = 0 Sec)**
3. **NMT Master Transmits "Start All Nodes" (Time = 1 Sec)**
N. **NMT Master Transmits "Start All Nodes" (Time = N Sec)**

Note: Other messages not shown.

Figure A-4. Sample Operating State Process Timing Diagram

A.4 SDO Process

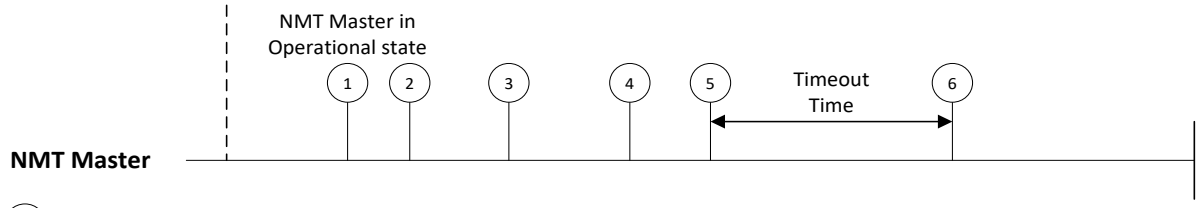
The Master will send SDO messages to each valve to retrieve valve specific information such as the serial number, part number, etc.

All SDO data will be requested when the NMT master goes from Pre-Operational to Operational. Woodward gives the designed application the option to request all information under application control. This is to ensure that when the slave devices are powered, cycled, or added, their information gets updated.

The SDO protocol only allows one request message to be sent. The next message will be sent after a response has been received for the previous message. If no response will be received the NMT master must timeout. The typical timeout time used is one second.

Timing:

In a timing diagram, the process will look like this:



1. NMT Master Transmits SDO Request
2. NMT Master Receives SDO Response
3. NMT Master Transmits SDO Request
4. NMT Master Receives SDO Response
5. NMT Master Transmits SDO Response
6. NMT Master Retransmits SDO Request

Note: Other messages not shown.

Figure A-5. Sample SDP Process Timing Diagram

Fast Message Process

There are three messages needed to make this process work:

- Fast message to slave
- Fast message from slave
- Sync message to slave

Fast message to slave: NMT will send a message to the slave within one frame. This data is processed but not used until the sync message is received. Typical data is the position demand, shutdown flags etc.

Fast message from the slave: Slave will send a message to the NMT. Typical data is the actual position, the shutdown status of the slave, etc.

The sent sync message from the master to the slave will do two things:

- If the slave receives the sync, it will update the fast message information and start using this information.
- If the slave receives the sync, it will send back the fast message from slave.

WARNING

CANopen communication link has a timeout value between 1 ms to 1000 ms which can be specified through Service Tool. It is important to ensure the CANopen timeout is set accordingly and use discrete output as shutdown in case of error detection.

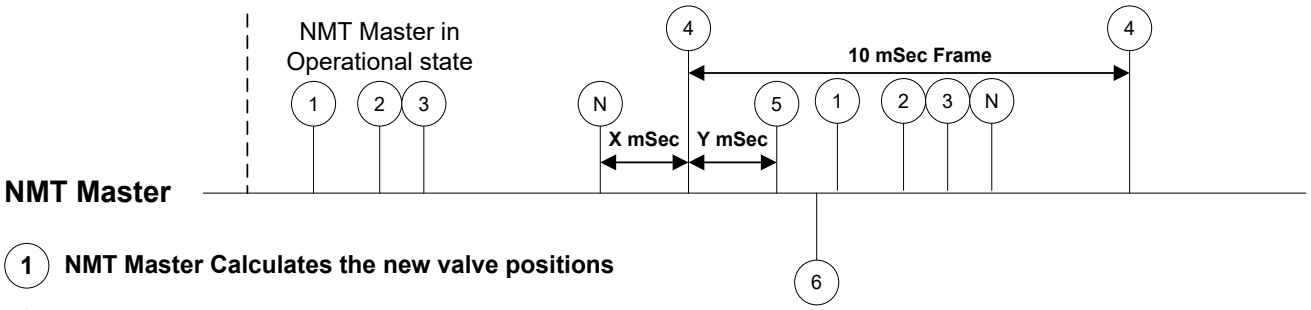
Error Detection:

The slaves error detection is done by checking if the sync message and the fast data message is received within a given timeout time. Typical timeout time is set to 40 ms for a 10 ms rate group and can be changed using the Service Tool. This timeout time is variable depending on the turbine performance and application. It is up to the system integrator to determine this timeout number.

The master error detection is the same as the slave error detection with the exception it will look to the fast message from slave to determine if the communication is failed. Again, the system integrator must determine if the timeout time is acceptable for the system/turbine.

Timing:

In a timing diagram the process will look like this:



1 **NMT Master Calculates the new valve positions**

2 **NMT Master Transmits valve data to valve 1**

3 **NMT Master Transmits valve data to valve 2**

N **NMT Master Transmits valve data to valve N**
Time X referenced to receipt of message by Slave:
For Single CANopen or Dual CANopen (single DVP): X ≥ 1 mSec before synch
For Dual DVP CANopen (dual DVP): X ≥ 2.5 mSec before synch

4 **NMT Master Transmits synch**

5 **Slaves receive synch and will have new data from the CANopen stack within Y mSec**
Time Y referenced to receipt of synch message by Slaves:
For Single CANopen or Dual CANopen (single DVP): Y ≤ 1 mSec
For Dual DVP CANopen (dual DVP): Y ≤ 3 mSec

6 **Slaves will send back the fast message triggered by the synch message**

Note: Other messages not shown.

Figure A-6. Sample Fast Message Process Timing Diagram

Slow Message Process

The slow messages are used to get additional status information and set parameters in the slave device. To make sure the CAN bus is not overloaded, the NMT master must send slow messages at a rate that will allow all messages to be sent and received. Woodward spaces the messages so that all slaves are addressed once every 750 ms.

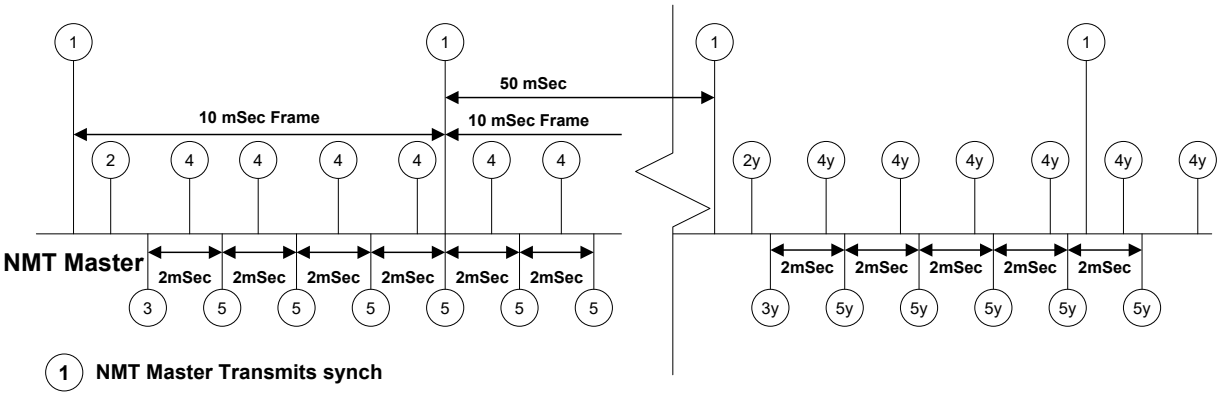
The control will send a slow message every 2 ms, then wait 50 ms after the first slow message is sent before the control starts sending to the next valve. Thus, each valve will receive and transmit slow messages within 50 ms. The max number of valves in the network is 15.

Therefore, the total update time for all valves will be 15 * 50 ms = 750 ms.

The slave will ***not*** send any slow messages until the first slow message (this is RxPDO2, slow message number 1) is received, at which time the slave will initiate a slow response sequence which includes all slow PDO messages (PDO 2 to PDO N). This way the NMT master can control the bus loading by determining which slave will reply with its slow messages. The slave slow message data is sent on a nominal 2 ms tick. The slave will use default data when no slow messages have been received.

Timing:

In a timing diagram, the process will look like this:



1 **NMT Master Transmits synch**

2 **NMT Master Transmits slow data 1 to valve 1**

3 **Valve 1 sends back Slow data 1 in response to incoming slow data 1 (first message in Slow data response sequence)**

4 **NMT Master Transmits slow data N to valve 1 (not required as part of retrieving Slow data, but can be interleaved if desired)**

5 **Valve 1 continues Slow data response sequence by sending back Slow data N until all messages are sent (nominal interval of 2mSec)**

2y **NMT Master Transmits slow data 1 to valve Y**

3y **Valve Y sends back Slow data 1 in response to incoming slow data 1 (first message in Slow data response sequence)**

4y **NMT Master Transmits slow data N to valve Y (not required as part of retrieving Slow data, but can be interleaved if desired)**

5y **Valve Y continues Slow data response sequence by sending back Slow data N until all messages are sent (nominal interval of 2mSec)**

Note: Other messages not shown.

Figure A-7. Sample Slow Message Process Timing Diagram

Putting it all Together

Assumptions for calculations:

# of bytes in fast messages to DVPII:	4
# of bytes in fast messages from DVPII:	5
# of bytes in sync message:	1
# of slow messages to DVPII:	7
# of slow messages from DVPII:	7
# of data byte in slow message:	8
# of SDO messages per 10 ms:	2
# of SDO bytes:	8
CAN link running at:	500 KBits = 2 µs per bit
Frame rate:	10 ms
Max number of DVPIIs:	15
Message overhead is:	51 Bits

All Messages Sent in a Frame

Fast Messages:

If 15 valves are connected to a network, the NMT master will send 15 fast messages and receive 15 fast messages. The control also needs to send a sync message.

Total fast message time = Valves * (((Overhead + (TxBytes * 8)) * Tperbit) + ((Overhead + (RxBytes * 8)) * Tperbit))
15 * (((51 + (5 * 8)) * 2 µs) + ((51 + (4 * 8)) * 2 µs)) = 5.22 ms

Total sync message time is = ((Overhead + (SyncDatabytes * 8)) * Tperbit)
((51 + (1 * 8)) * 2 uSec) = 118 uSec

Total time is: 5.22 mSec + 0.118 mSec = 5.338 mSec
Total load is: (5.338 mSec / 10 mSec) * 100 = 53.38%

Slow Messages:

Number of slow messages sent and received in one frame is 5 + 5 = 10. Slow messages are sent every 2 ms.
Total Slow message time = Number of messages * ((overhead + (RxTxbytes * 8) * Tperbit)
10 * ((51 + (8 * 8)) * 2 µs) = 2.3 ms
Total peak Load is: (2.3 ms / 10) * 100 = 23.0%

SDO Messages:

The control can send and receive one SDO message per frame that is two messages.

SDO message time is = 2 * ((Overhead + (SDO bytes * 8)) * Tperbit)
2 * ((51 + (8 * 8)) * 2 uSec) = 460 uSec
Total load = (0.46 mSec / 10 mSec) * 100 = 4.6%

The CAN link loaded is now:
53.38% + 23.0% + 4.6% = 80.98%

Definitions

Frame

One frame is defined as the time that it takes to process the input IO, transfer this data to the application level, calculate a new valve setpoint, send a fast message to each valve driver, and finally send a SYNC message out on the CANopen Network.

Example: In Woodward controllers, one FRAME is defined by the rate group that is specified in the CANopen interface block. This is typically 10 ms but can also be 5 ms, 20 ms, 40 ms, or 80 ms.

IMPORTANT

The required FRAME time is a function of the application requirements and is the responsibility of the system integrator to define the requirements for FRAME time. Woodward typical values apply to Woodward systems only. In Woodward systems, all controller timing parameters (latency, jitter, execution times, etc.) are known and are considered in the calculation of FRAME times.

Simple Block Diagram to Define Frame Time

Frame time is the time that it takes for the turbine controller to sample the inputs, execute the main application code, and send the SYNC message out on the CANopen network.

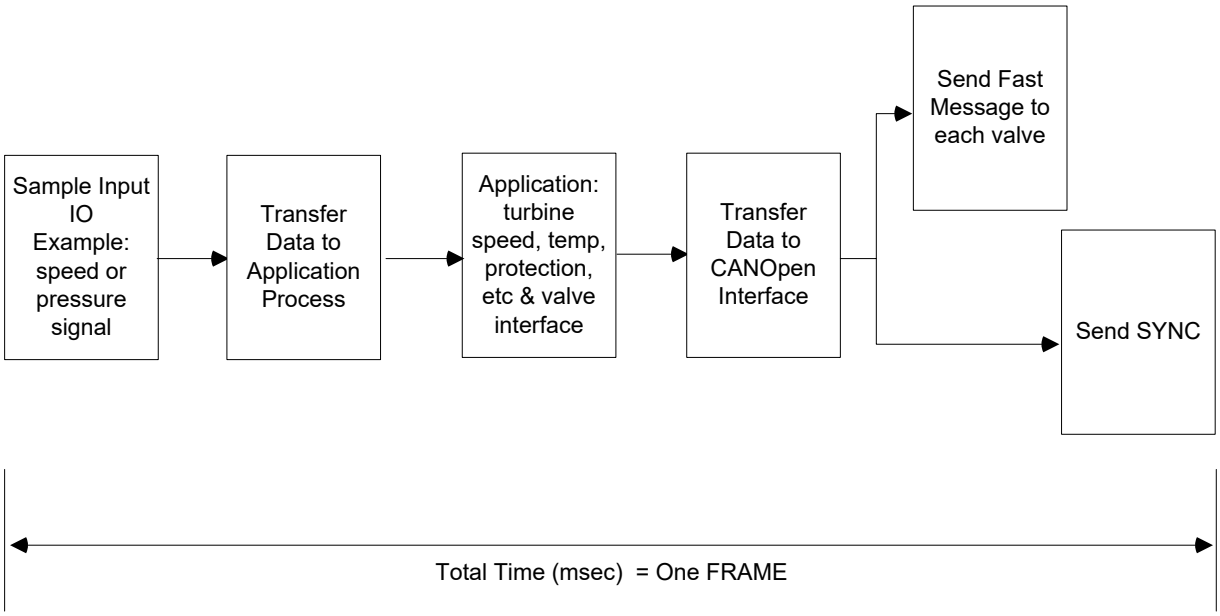


Figure A-8. Frame Time Definition Block Diagram

Table A-1. Transmit PDO Summary

Id base	Tx PDOs	Name	CAN Byte	Message or Data Type	Mfr # hex
0x180	PDO1	Fast Message		Sync	
		Actual Position	0,1	uint16	2034
		Actual Current	2,3	uint16	2035
		Status Bits (0-5 used – 6 &7 unused)	4	Array[8] Boolean	2036
		Unused	5-7		
0x280	PDO2	Temperature/InputCurrent		Async	
		Driver Temperature	0-3	Float	2037
		Driver Input Current	4-7	Float	2038
0x380	PDO3	InputVoltage1/InputVoltage2		Async	
		InputVoltage1	0-3	Float	2039
		InputVoltage2	4-7	Float	203A
0x480	PDO4	ActualPosition1/ActualPosition2		Async	
		ActualPosition1	0-3	Float	203B
		ActualPosition2	4-7	Float	203C
0x1E0	PDO5	ActualCurrentFiltered		Async	
		ActualCurrentFiltered	0-3	Float	203D
		Unused	4-7		
0x2E0	PDO6	Status Error Register Flags Set 1		Async	
		Status Error Register Flag 20	0,1	Array[16] Boolean	203E
		Status Error Register Flag 1	2,3	Array[16] Boolean	203F
		Status Error Register Flag 2	4,5	Array[16] Boolean	2040
		Status Error Register Flag 3	6,7	Array[16] Boolean	2041
0x3E0	PDO7	Status Error Register Flags Set 2		Async	
		Status Error Register Flag 4	0,1	Array[16] Boolean	2042
		Status Error Register Flag 5	2,3	Array[16] Boolean	2043
		Status Error Register Flag 11	4,5	Array[16] Boolean	2044
		Status Error Register Flag 14	6,7	Array[16] Boolean	2045
0x4E0	PDO8	Status Error Register Flags Set 3		Async	
		Status Error Register Flag 8	0,1	Array[16] Boolean	2046
		Status Error Register Flag 9	2,3	Array[16] Boolean	2047
		Status Error Register Flag 21	4,5	Array[16] Boolean	2048
		Unused	6,7	Blank	

Table A-2. Receive PDO Summary

IMPORTANT **The manufacturer numbers given here for SDO access are for reference only. SDO writes aren't supported; the data must be written with the PDOs.**

Id base (hex)	Rx PDOs	Name	CAN Byte	Type	Mfr # (hex)
0x200	PDO1	Fast Message			
		Position Demand	0,1	uint16	2022
		Command Byte 1	2	Array[8] Boolean	2023
		Command Byte2(1 bit used, 7 bits unused)	3	Array[8] Boolean	2024
		Unused	4-7		
0x300	PDO2	Tracking Alarm and Shutdown Difference Errors			
		Tracking Alarm Difference Error Value	0-3	float	2025
		Tracking Shutdown Difference Error Value	4-7	float	2026
0x400	PDO3	Resolver Alarm and Shutdown Difference Errors			
		Resolver Alarm Difference Error Value	0-3	float	2027
		Resolver Shutdown Difference Error Value	4-7	float	2028
0x500	PDO4	Difference Alarm and Shutdown Times			
		Tracking Alarm Difference Error Time Value	0,1	uint16	2029
		Tracking Shutdown Difference Error Time Value	2,3	uint16	202A
		Unused	4-7		
0x260	PDO5	Difference Modes			
		Resolver Difference Mode	0,1	uint16	202B
		Unused	2-7		
0x360	PDO6	Position Error Motor Alarm and Shutdown Limits			
		Position Error Motor Alarm Limit	0-3	float	202C
		Position Error Motor Shutdown Limit	4-7	float	202D
0x460	PDO7	Position Error Shaft Alarm and Shutdown Limits			
		Position Error Shaft Alarm Limit	0-3	float	202E
		Position Error Shaft Shutdown Limit	4-7	float	202F
0x560	PDO8	Position Error Motor and Shaft Times			
		Position Error Motor Alarm Time	0,1	uint16	2030
		Position Error Motor Shutdown Time	2,3	uint16	2031
		Position Error Shaft Alarm Time	4,5	uint16	2032
		Position Error Shaft Shutdown Time	6,7	uint16	2033

A.5 Receive (Rx) PDO Definitions

IMPORTANT **Data length must be sent as specified.**

Receive PDO 1 – Realtime "Fast Message" 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 or 4 bytes

Data:

Byte 1-2: Position Demand
Data length: 2 bytes, byte1 is LSB, byte 2 MSB.
Resolution: 16 bits
Units: %
Scaling: 2,500 = 0% to 62,500 = 100%.

Byte 3: Command Byte 1
Data length: 1 byte

Bit 0: **Shutdown**. If this bit is "1", the DVPII will shut down and set the Shutdown bit.

Bit 1: **Shutdown Position**. If this bit is "1", DVPII will perform Shutdown Position by setting the Manual Position Shutdown flag.

Bit 2: **Reset diagnostics bits**. On a "0" to "1" transition (Edge triggered,) the DVPII will reset from a shutdown or alarm condition and reset all the diagnostic bits.

Bit 3: **Analog Primary Demand**. If set, 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.

Bit 4: **Use Analog Backup**. Set this to "0" so the analog input will be ignored, and no reading or diagnostics will be triggered.

Bit 5: **Enable Tracking**. If this bit is TRUE (=1), then enable the following to be changeable on the DVPII from CANopen:

- Tracking Alarm Difference Error value (float)
- Tracking Shutdown Difference Error value (float)
- Tracking Alarm Difference Error time value (uint16)
- Tracking Shutdown Difference Error time value (uint16)

Bit 6: **Enable Resolver**. If this bit is TRUE (=1), then enable the following to be changeable on the DVPII from CANopen:

- Resolver Alarm Difference Error value (float)
- Resolver Shutdown Difference Error value (float)
- Resolver Difference Mode (uint16)

Bit 7: **Enable Position Error** -- If this bit is TRUE (=1), then enable the following to be changeable on the DVPII from CANopen:

- Position Error Motor Alarm Limit (float)
- Position Error Motor Shutdown Limit (float)
- Position Error Shaft Alarm Limit (float)
- Position Error Shaft Shutdown Limit (float)
- Position Error Motor Alarm Time (uint16)

- Position Error Motor Shutdown Time (uint16)
- Position Error Shaft Alarm Time (uint16)
- Position Error Shaft Shutdown Time (uint16)

Byte 4: Command Byte 2
Data length: 1 byte

Bit 0: **Auto Detect Request**. If this bit is "1", it indicates an auto-detection is requested. This is only honored if the valve type state is set to ValveTypeStateSerialValveTypeFailed.

Unused Bits 1 to Bit 7 are reserved, must always be "0". (Spare Bits)

Bytes 5-8: These bytes are unused. (Spare Bytes)

Receive PDOs 2-8 – Parameter Based "Slow Messages"

If slow messages are not received, the DVPII uses values that are in RAM. During start-up the RAM will be filled with the EEPROM parameters. The variables in RAM will be used when the parameters are updated from the Service Tool.

If the slow messages are received, the DVPII will use these parameters. The exception is if the ENABLE bits are not set, then the DVPII will continue using the RAM parameters.

The specified range is enforced with internal DVPII value limits.

IMPORTANT

If the ENABLE bit is toggled from ENABLE true to ENABLE false, the control will use the RAM and the last value received from the CANopen link.

Receive PDO 2 – Slow Message: #1 Tracking Alarm and Shutdown Difference Errors

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

Data:

Byte 1-4: **Tracking Alarm Difference Error**
Data length: 4 bytes, Float.
Units: %
Range: 0 to 100%

Byte 5-8: **Tracking Shutdown Difference Error value**
Data length: 4 bytes, Float.
Units: %
Range: 0 to 100%

Receive PDO 3 – Slow Message: #2 Resolver Alarm and Shutdown Difference Errors

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

Data:

Byte 1-4: **Resolver Alarm Difference Error value**
Data length: 4 bytes, Float.
Units: %
Range: 0 to 100%

Byte 5-8: **Resolver Shutdown Difference Error value**
Data length: 4 bytes, Float.
Units: %
Range: 0 to 100%

Receive PDO 4 – Slow Message: #3 Difference Alarm and Shutdown Times

Message type: "ASYNC"
COB Id: 1280+Node Id (0x500+NodeId)
Data length: 4 bytes

IMPORTANT **Data length must be sent as 4 bytes.**

Data:

Byte 1-2: **Tracking Alarm Difference Error time value**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0 to 10000 ms

Byte 3-4: **Tracking Shutdown Difference Error time value**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0 to 10000 ms

Bytes 5-8: These bytes are not used. (Spare Bytes)

Receive PDO 5 – Slow Message: #4 Difference Modes

Message type: "ASYNC"
COB Id: 608+Node Id (0x260+NodeId)
Data length: 2 bytes

IMPORTANT **Data length must be sent as 2 bytes.**

Data:

Byte 1-2: **Resolver Difference Mode**
Data length: 2 bytes, unsigned 16
Difference mode used: min = 0, max = 1, avg = 2

Bytes 3-8: These bytes are not used. (Spare Bytes)

Receive PDO 6 – Slow Message: #5 Position Error Motor Alarm and Shutdown Limits

Message type: "ASYNC"
COB Id: 864+Node Id (0x360+NodeId)
Data length: 8 bytes

Data:

Byte 1-4: **Position Error Motor Alarm Limit**
Data length: 4 bytes, Float
Units: %
Range: 0 to 110%

Byte 5-8: **Position Error Motor Shutdown Limit**
Data length: 4 bytes, Float
Units: %
Range: 0 to 110%

Receive PDO 7 – Slow Message: #6 Position Error Shaft Alarm and Shutdown Limits

Message type: "ASYNC"
COB Id: 1120+Node Id (0x460+NodeId)
Data length: 8 bytes

Data:

Byte 1-4: **Position Error Shaft Alarm Limit**
Data length: 4 bytes, Float
Units: %
Range: 0 to 100%

Byte 5-8: **Position Error Shaft Shutdown Limit**
Data length: 4 bytes, Float
Units: %
Range: 0 to 100%

Receive PDO 8 – Slow Message: #7 Position Error Motor and Shaft Times

Message type: "ASYNC"
COB Id: 1376+Node Id (0x560+NodeId)
Data length: 8 bytes

Data:

Byte 1-2: **Position Error Motor Alarm Time**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0-65,535

Byte 3-4: **Position Error Motor Shutdown Time**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0-65,535

Byte 5-6: **Position Error Shaft Alarm Time**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0-65,535

Byte 7-8: **Position Error Shaft Shutdown Time**
Data length: 2 bytes, unsigned 16
Units: milliseconds
Range: 0-65,535

A.6 Transmit (Tx) PDO Definitions

There is only one (1) "Fast Message" sent from the DVPII.
There are additional "Slow Message" sent for monitoring purposes.

Transmit PDO 1 – Actual Position, Current and Status from Valve

Realtime Fast Message

Message type: Transmitted in Response to NMT Sync Message.
COB Id: 384+Node Id (0x180+NodeId)
Data length: 5 bytes

Data:

Byte 1-2: **Actual Position**
Data length: 2 bytes, byte1 is LSB, byte 2 MSB.
Resolution: 16 bits
Units: %
Scaling: 2,500 = 0% to 62,500 = 100%.

Byte 3-4: **Actual Current**
Data length: 2 bytes, byte1 is LSB, byte 2 MSB.
Resolution: 16 bits
Units: Amps
Scaling: –40 A = 2500 counts, 40 A = 62500 counts

Byte 5: **Status Bits**
Data length: 1 byte

Bit 0: **Shutdown**
Bit 1: **Shutdown Position**
Bit 2: **Shutdown System**.
Bit 3: **Shutdown Not External.**
Bit 4: **Alarm**.
Bit 5: **Power Up Reset**.
Bit 6: **Controller Not Ready**
Bit 7 **are sent as 0.** (Spare Bites)

Bytes 6-8 are unused, not sent. (Spare Bytes)

Transmit PDO 2 – Slow Message #1: Temperature / Input Current

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: **Driver Temperature**
Data length: 4 bytes, Float.
Units: Kelvin

Byte 5-8: **Driver Input Current**
Data length: 4 bytes, Float.
Units: Amps

Transmit PDO 3 – Slow Message #2: Input Voltage1 / Input Voltage2

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

Data:

Byte 1-4: **Input Voltage1**
Data length: 4 bytes, Float.
Units: Volts

Byte 5-8: **Input Voltage2**
Data length: 4 bytes, Float.
Units: Volts

Transmit PDO 4 – Slow Message #3: Actual Position 1 / Actual Position 2

Message type: Transmitted 4 ms after receipt of Receive PDO 2.
COB Id: 1152+Node Id (0x480+NodeId)
Data length: 8 bytes

Data:

Byte 1-4: **Actual Position 1**
Data length: 4 bytes, Float.
Units: %

Byte 5-8: **Actual Position 2**
Data length: 4 bytes, Float.
Units: %

Transmit PDO 5 – Slow Message #4: Actual Current Filtered

Message type: Transmitted 6 ms after receipt of Receive PDO 2.
COB Id: 480+Node Id (0x1E0+NodeId)
Data length: 4 bytes

Data:

Byte 1-4: **Actual Current Filtered**
Data length: 4 bytes, Float
Units: Amps

Bytes 5-8: These bytes are not used or sent. (Spare Bytes)

Transmit PDO 6 – Slow Message #5: Status Error Flags Set 1

Message type: Transmitted 8 ms after receipt of Receive PDO 2.
COB Id: 736+Node Id (0x2E0+NodeId)
Data length: 8 bytes

Byte 1-2: Status Error Register 20 (see table A-3 for bit definition)
Byte 3-4: Status Error Register 1 (see table A-4 for bit definition)
Byte 5-6: Status Error Register 2 (see table A-5 for bit definition)
Byte 7-8: Status Error Register 3 (see table A-6 for bit definition)

Table A-3. PDO6 Byte 1-2 (Status Error Register 20)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 0	Security Lockout Active	Write access via service tool is disabled.	None
Byte 1-2	Bit 1	Reading Parameters	Accessing data in internal EEPROM.	None
Byte 1-2	Bit 2	Discrete Input #1 ON	#1 Discrete input state is True.	The True state can be when the contact is open or when closed, depending on User configuration of the discrete input function. See Discrete Inputs Configuration
Byte 1-2	Bit 3	Discrete Input #2 ON	#2 Discrete input state is True.	
Byte 1-2	Bit 4	Discrete Input #3 ON	#3 Discrete input state is True.	
Byte 1-2	Bit 5	Discrete Input #4 ON	#4 Discrete input state is True.	
Byte 1-2	Bit 6	Discrete Input #5 ON	#5 Discrete input state is True.	
Byte 1-2	Bit 7	Manual Control Mode Enabled	Position demand is controlled via the Service Tool manual operation. The normal control setpoint is ignored.	See Manual Position and Manual Operation
Byte 1-2	Bit 8	RESERVED	Reserved message – never active	None
Byte 1-2	Bit 9	RESERVED	Reserved message – never active	None
Byte 1-2	Bit 10	Shutdown Detected	The Driver is in Shutdown mode and is controlling the actuator/valve position at 0% position. This is a summary fault status. Further investigation to the source of the shutdown diagnostic is required.	See Shutdown
Byte 1-2	Bit 11	Shutdown Position	The Driver is in Shutdown Position mode. All power to the actuator is disabled. If so equipped, the actuator is holding the valve on the seat using force provided from the return spring. This is a summary fault status. Further investigation to the source of the shutdown diagnostic is required.	See Shutdown Position
Byte 1-2	Bit 12	Shutdown System	The Driver is in Shutdown System mode. All power to the actuator is disabled. If so equipped, the actuator is holding the valve on the seat using force provided from the return spring. This is a summary fault status. Further investigation to the source of the shutdown diagnostic is required.	See Shutdown System
Byte 1-2	Bit 13	Alarm Condition Detected	A diagnostic condition has been detected which is configured as alarm. This is a summary fault status. Further investigation to the source of the alarm diagnostic is required.	See Alarm

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 14	Discrete Output #1 On	Discrete output #1 state is True.	The True state can occur when the detected contact is closed or open. See Discrete Output Configuration.
Byte 1-2	Bit 15	Discrete Output #2 On	Discrete output #2 state is True.	

Table A-4. PDO6 Byte 3-4 (Status Error Register 1)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 3-4	Bit 0	Main Non-Volatile Memory Write Failed	Failure to write to the non-volatile memory has occurred.	See Non-Volatile Memory Write Failed
Byte 3-4	Bit 1	Main Non-Volatile Memory Read Failed	Failure to read from the non-volatile memory has occurred.	See Non-Volatile Memory Read Failed
Byte 3-4	Bit 2	Parameter Error	Parameters do not match the Embedded Firmware version.	See Parameters Failed
Byte 3-4	Bit 3	Parameter Version Error	Parameter version does not match the Embedded Firmware version.	See Parameters Version Failed
Byte 3-4	Bit 4	5V Internal Supply Error	Internal 5 V supply is outside acceptable range.	See 5 Volt Supply Failed
Byte 3-4	Bit 5	Internal V REF Error	Internal Reference voltage is outside acceptable range.	See Ref Volt Failed
Byte 3-4	Bit 6	15V Volt Supply Error	Internal 15 V supply is outside acceptable range.	See +15 Volt Supply Failed
Byte 3-4	Bit 7	-15V Volt Supply Error	Internal -15 V supply is outside acceptable range.	See -15 Volt Supply Failed
Byte 3-4	Bit 8	Main ADC Error	The Analog/Digital Converters in the Core processor have stopped running.	See Main ADC Failed
Byte 3-4	Bit 9	SPI ADC Error	Not active on DVPII, but bit left for backward compatibility.	None
Byte 3-4	Bit 10	5 Volt RDC Ref Error	The RDC Voltage reference is outside acceptable range.	See 5 Volt RDC Ref Failed
Byte 3-4	Bit 11	1.8 Volt Internal Supply Error	Internal 1.8 V supply is outside acceptable range.	See 1.8 Volt Supply Failed
Byte 3-4	Bit 12	24V Internal Supply Error	Not active on DVPII, but bit left for backward compatibility.	None
Byte 3-4	Bit 13	RDC Error	The acquisition/storage of conversion data for feedback positions has failed.	See RDC Failed
Byte 3-4	Bit 14	AUX3 Shutdown Position	Not active on DVPII, but bit left for backward compatibility.	None
Byte 3-4	Bit 15	Electrical Test Error	Only Used Internally for Production electrical test.	None

Table A-5. PDO6 Byte 5-6 (Status Error Register 2)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 0	Power Up Reset	CPU has been reset by a power up event.	See Power-up Reset
Byte 5-6	Bit 1	Watchdog Reset	CPU has locked up and been reset by the watchdog.	See Watchdog Reset
Byte 5-6	Bit 2	Analog Input 1 High	Analog Input 1 is above the defined threshold - user configurable.	See Analog Input 1 High
Byte 5-6	Bit 3	Analog Input 1 Low	Analog Input 1 is below the defined threshold - user configurable.	See Analog Input 1 Low
Byte 5-6	Bit 4	Control Model Not Running	The start-up sequence of the DVPII has been interrupted due to a detected fault and the final control state has not been reached.	See Control Model Not Running

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 5	Manual/External Shutdown Position	The Shutdown Position mode has been invoked from one of the user interfaces.	See Shutdown Position
Byte 5-6	Bit 6	High Electronics Temperature Detected	The control board temperature has exceeded the maximum threshold.	See Electronics Temperature High
Byte 5-6	Bit 7	Low Electronics Temperature Detected	The control board temperature is below the minimum threshold.	See Electronics Temperature Low
Byte 5-6	Bit 8	Driver Pre-charge Failed	Driver internal bus failed to charge to expected level.	See Driver Precharge Error
Byte 5-6	Bit 9	Driver Brake Resistor Failed	The Driver brake resistor has failed runtime checks.	See Driver Brake Resistor Error
Byte 5-6	Bit 10	RESERVED	Reserved message – never active	None
Byte 5-6	Bit 11	RESERVED	Reserved message – never active	None
Byte 5-6	Bit 12	Software Warm Reset	CPU has intentionally been reset by software.	See Software Warm Reset
Byte 5-6	Bit 13	Manual/External Shutdown	A Shutdown has been invoked from one of the user interfaces.	See Shutdown
Byte 5-6	Bit 14	Position Error Shutdown – Motor Position Induced	Driver is in Shutdown mode due to motor position not tracking the position set point.	See Motor Position Error Shutdown
Byte 5-6	Bit 15	Position Error Shutdown Shaft (final element) Position Induced	Driver is in Shutdown mode due to the shaft (final element) position not tracking the position set point.	See Shaft Position Error Shutdown

Table A-6. PDO6 Byte 7-8 (Status Error Register 3)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 7-8	Bit 0	Driver Heat Sink Temp Sensor Fault	The driver heatsink temperature sensor has failed.	See Driver Temperature Sensor Error
Byte 7-8	Bit 1	High Driver Heat Sink Temp Alarm	The driver heatsink temperature has exceeded the defined warning threshold.	See Driver Temperature High
Byte 7-8	Bit 2	Low Driver Heat Sink Temp Alarm	The driver heatsink temperature is below the defined warning threshold.	See Driver Temperature Low Limit
Byte 7-8	Bit 3	Extreme Driver Heat Sink Temp	The driver heatsink temperature has exceeded the defined critical threshold.	See Driver Temperature High Limit
Byte 7-8	Bit 4	Low Internal Bus Voltage	The internal bus operating voltage sense has failed at low output.	Int. Bus Voltage Low
Byte 7-8	Bit 5	High Internal Bus Voltage	The internal bus operating voltage sense has failed at high output.	Int. Bus Voltage High
Byte 7-8	Bit 6	Input Voltage 1 Low	The Driver input voltage # 1 is less than the defined threshold.	See Input Voltage 1 Low
Byte 7-8	Bit 7	Input Voltage 1 High	The Driver input voltage # 1 is greater than the defined threshold.	See Input Voltage 1 High
Byte 7-8	Bit 8	Input Voltage 2 Low	The Driver input voltage # 2 is less than the defined threshold.	See Input Voltage 2 Low
Byte 7-8	Bit 9	Input Voltage 2 High	The Driver input voltage # 2 is greater than the defined threshold.	See Input Voltage 2 High
Byte 7-8	Bit 10	Low Input Current Sensor Fault	The input current sensor has failed at low output.	See Input Current Low
Byte 7-8	Bit 11	High Input Current Sensor Fault	The input current sensor has failed at high output.	See Input Current High
Byte 7-8	Bit 12	Phase A Input Current Sensor Low Fault	Phase A current sensor has failed at low output.	See Current Phase A Sensor Low
Byte 7-8	Bit 13	Phase A Input Current Sensor High Fault	Phase A current sensor has failed at high output.	See Current Phase A Sensor High
Byte 7-8	Bit 14	Phase B Input Current Sensor Low Fault	Phase B current sensor has failed at low output.	See Current Phase B Sensor Low

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 7-8	Bit 15	Phase B Input Current Sensor High Fault	Phase B current sensor has failed at high output.	See Current Phase B Sensor High

Transmit PDO 7 – Slow Message #6: Status Error Flags Set 2

Message type: Transmitted 10 ms after receipt of Receive PDO 2.
COB Id: 992+Node Id (0x3E0+NodeId)
Data length: 8 bytes

Byte 1-2: Status Error Register 4 (see table A-7 for bit definition)
Byte 3-4: Status Error Register 5 (see table A-8 for bit definition)
Byte 5-6: Status Error Register 11 (see table A-9 for bit definition)
Byte 7-8: Status Error Register 14 (see table A-10 for bit definition)

Table A-7. PDO7 Byte 1-2 (Status Error Register 4)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 0	No Power Board Found	Control board did not locate a power board after power up.	See No Power Board Found
Byte 1-2	Bit 1	Power Board ID Error	Power board was changed after Calibration.	See Power Board ID Error
Byte 1-2	Bit 2	Power Board Calibration Error	The power board was not calibrated correctly.	See Power Board Calibration Error
Byte 1-2	Bit 3	Driver Current Fault	One of the internal current monitors has detected a fault.	See Driver Current Fault
Byte 1-2	Bit 4	Startup Closed Fault Detected by Motor Position	The Motor 1 startup checks did not pass in the closing direction.	See Startup Close Motor Error
Byte 1-2	Bit 5	Startup Closed Fault Detected by Shaft (final element) Position	The Shaft (final element) startup checks did not pass in the closing direction.	See Startup Close Shaft Error
Byte 1-2	Bit 6	Startup Open Fault Detected by Motor Position	The Motor 1 startup checks did not pass in the opening direction.	See Startup Open Motor Error
Byte 1-2	Bit 7	Startup Open Fault Detected by Shaft (final element) Position	The Shaft (final element) startup checks did not pass in the opening direction.	See Startup Open Shaft Error
Byte 1-2	Bit 8	Startup Motor Direction Fault	The motor did not rotate or rotated in the wrong direction.	See Startup Motor Direction Error
Byte 1-2	Bit 9	ECC Uncorrected Critical Memory Fault	An uncorrectable memory error was detected in a critical region.	See ECC Uncorrected Critical Mem Error
Byte 1-2	Bit 10	I/O Board ID Error	I/O board was changed after Calibration.	See IO Board ID Error
Byte 1-2	Bit 11	I/O Board Calibration Error	The I/O board was not calibrated correctly.	See IO Board Calibration Error
Byte 1-2	Bit 12	Control Board ID Error	Control board ID is invalid.	See Control Board ID Error
Byte 1-2	Bit 13	ECC Uncorrected Non-critical Memory Fault	An uncorrectable memory error was detected in a non-critical region.	See ECC Uncorrected Non-critical Mem Error
Byte 1-2	Bit 14	ECC Corrected Critical Memory Fault	A correctable memory error was detected in a critical region.	See ECC Corrected Critical Mem ErrorFaultSee M5200 Startup Timeout
Byte 1-2	Bit 15	ECC Corrected Non-critical Memory Fault	A correctable memory error was detected in a non-critical region.	See ECC Corrected Non-critical Mem Error

Table A-8. PDO7 Byte 3-4 (Status Error Register 5)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 3-4	Bit 0	Motor 1 Sine Error	Detected fault based on the Motor 1 Sine signal value.	See Motor 1 Sin Error
Byte 3-4	Bit 1	Motor 1 Cosine Error	Detected fault based on the Motor 1 Cosine signal value.	See Motor 1 Cos Error
Byte 3-4	Bit 2	Motor 1 Excitation Fault	Detected fault based on the combined values of the Motor 1 Sine and Cosine signals.	See Motor 1 Excitation Error
Byte 3-4	Bit 3	Shaft 1 Sine Error	Detected fault based on the shaft #1(final element) Sine signal value.	See Valve Shaft 1 Sin Error
Byte 3-4	Bit 4	Shaft 1 Cosine Error	Detected fault based on the shaft #1 (final element) Cosine signal value.	See Valve Shaft 1 Cos Error
Byte 3-4	Bit 5	Shaft 1 Excitation Fault	Detected fault based on the combined values of the Shaft #1 (final element) Sine and Cosine signals.	See Valve Shaft 1 Excitation Error
Byte 3-4	Bit 6	Shaft 2 Sine Error	Detected fault based on the shaft #2 (final element) Sine signal value.	See Valve Shaft 2 Sin Error
Byte 3-4	Bit 7	Shaft 2 Cosine Error	Detected fault based on the shaft #2 (final element) Cosine signal value.	See Valve Shaft 2 Cos Error
Byte 3-4	Bit 8	Shaft 2 Excitation Fault	Detected fault based on the combined values of the Shaft #2 (final element) Sine and Cosine signals.	See Valve Shaft 2 Excitation Error
Byte 3-4	Bit 9	Shaft 1 and Shaft 2 Fault	Faults detected in both Shaft 1 and Shaft 2. This is a summary fault, see individual diagnostics.	See Valve Shaft 1 and 2 Res. Error
Byte 3-4	Bit 10	Motor 2 Sine Error	Detected fault based on the Motor 2 Sine signal value.	See Motor 2 Sin Error
Byte 3-4	Bit 11	Motor 2 Cosine Error	Detected fault based on the Motor 2 Cosine signal value.	See Motor 2 Cos Error
Byte 3-4	Bit 12	Motor 2 Excitation Fault	Detected fault based on the combined values of the Motor 2 Sine and Cosine signals.	See Motor 2 Excitation Error
Byte 3-4	Bit 13	Start up Close Fault Detected by Shaft 1 (final element) Position	The Shaft 1 (final element) start up checks did not pass in the closing direction.	See Startup Close Valve Shaft 1 Error
Byte 3-4	Bit 14	Start up Close Fault Detected by Shaft 2 (final element) Position	The Shaft 2 (final element) start up checks did not pass in the closing direction.	See Startup Close Valve Shaft 2 Error
Byte 3-4	Bit 15	Motor 1 and Motor 2 Res Error	Both Motor feedback signals are determined to be faulted. This is a summary fault, see individual diagnostics.	See Position Sensor Diagnostics Motor 1 and 2 Res. Error

Table A-9. PDO7 Byte 5-6 (Status Error Register 11)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 0	Heat Sink Temp. Sensor 1 Error (Applies only to DVPII 5000, 10000, and 12000)	The #1 temperature sensor on the Heat Sink is out of range/faulted.	None - Replace DVPII See Heat Sink Temp. Sensor 1 Error Note: This fault should not occur on GS40/GS50 products.

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 1	Heat Sink Temp. Sensor 2 Error (Applies only to DVPII 5000, 10000, and 12000)	The #2 temperature sensor on the Heat Sink is out of range/faulted.	None - Replace DVPII See Heat Sink Temp. Sensor 2 Error Note: This fault should not occur on GS40/GS50 products.
Byte 5-6	Bit 2	Fan 1 Speed Error (Applies only to DVPII 5000, 10000, and 12000)	The #1 fan speed is out of range/faulted.	See Fan 1 Speed Error Note: This fault should not occur on GS40/GS50 products.
Byte 5-6	Bit 3	Fan 2 Speed Error (Applies only to DVPII 5000, 10000, and 12000)	The #2 fan speed is out of range/faulted.	See Fan 2 Speed Error Note: This fault should not occur on GS40/GS50 products.
Byte 5-6	Bit 4	Boost Converter Error (Applies only to DVPII 5000, 10000, and 12000)	A fault is detected within the DVPII Boost system indicating the Boost Converter board did not reach the proper voltage.	None - Replace DVPII. See Boost Converter Error. Note: This fault should not occur on GS40/GS50 products.
Byte 5-6	Bit 5	E-Stop 1 Tripped	Reserved for future use and backward compatibility with DVPII.	None
Byte 5-6	Bit 6	E-Stop 2 Tripped	Reserved for future use and backward compatibility with DVPII.	
Byte 5-6	Bit 7	Check 100 Percent Error	The Full Stroke start-up check has failed.	Verify that there is no jamming or blockage of the linkage attached to the actuator. See Check 100 Percent Error
Byte 5-6	Bit 8	Reduced Torque Error	This Fault status flag indicates the system torque has been reduced due a reduction in motor current.	See Reduced Torque Error
Byte 5-6	Bit 9	Reduced Slew-rate Error	This status flag indicates the system slew speed has been reduced; current limiter on motor is activated.	See Reduced Slew-rate Error
Byte 5-6	Bit 10	CAN Hardware ID Invalid Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 5-6	Bit 11	Linearization Monotonic Shutdown Error	The Linearization settings stored in the unit are not monotonically increasing and the unit will not begin operation until this fault is resolved by updating the Linearization settings. The X axis values must be continuously increasing.	Reset the values appropriately. See Linearization Monotonic Shutdown Error
Byte 5-6	Bit 12	CAN Controller Open Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 5-6	Bit 13	Watchdog Critical Process Error	A watchdog timeout occurred on a critical software process.	See Watchdog Critical Process Error
Byte 5-6	Bit 14	Watchdog Non-critical Process Error	A watchdog timeout occurred on a non-critical software process.	See Watchdog Non-critical Process Error

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 15	Watchdog Service Link Error	A watchdog timeout occurred on a software process for Service Link communication.	See Watchdog Service Link Error

Table A-10. PDO7 Byte 7-8 (Status Error Register 14)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 7-8	Bit 0	Phase C Input Current Sensor Low Fault	Phase C current sensor has failed at low output.	See Current Phase C Sensor Low
Byte 7-8	Bit 1	Phase C Input Current Sensor High Fault	Phase C current sensor has failed at high output.	See Current Phase C Sensor High
Byte 7-8	Bit 2	No I/O Board Found	Control board did not locate an I/O board after power up.	See No IO Board Found
Byte 7-8	Bit 3	PWM Inverter Sync Error	The driver PWM updates from real-time CPU were disrupted.	See PWM Inverter Sync Error
Byte 7-8	Bit 4	RealTime CPU Temperature Low	The real-time CPU temperature is below the minimum threshold.	RealTime CPU Temperature Low
Byte 7-8	Bit 5	RealTime CPU Temperature High	The real-time CPU temperature is above the maximum threshold.	RealTime CPU Temperature High
Byte 7-8	Bit 6	Analog Input 2 High	Analog Input 2 is above the defined threshold - user configurable.	See Analog Input 2 High
Byte 7-8	Bit 7	Analog Input 2 Low	Analog Input 2 is below the defined threshold - user configurable.	See Analog Input 2 Low
Byte 7-8	Bit 8	Driver Brake Resistor Temperature High	The Driver brake resistor temperature is above maximum threshold.	See Driver Brake Resistor Temperature High
Byte 7-8	Bit 9	RealTime CPU Internal Clock Error	The real-time CPU has detected a clock failure.	See RealTime CPU Internal Clock Error
Byte 7-8	Bit 10	Valvetype Incorrect I/O Board	The actuator connected to the DVPII is not compatible with the I/O board type.	Contact Woodward for compatibility information. A different DVPII or actuator is likely required. See Incorrect IO Board.
Byte 7-8	Bit 11	3.3 Volt Internal Supply Error	Internal 3.3 V supply is outside acceptable range.	See 3.3 Volt Supply Failed
Byte 7-8	Bit 12	Driver IGBT Short Error	The driver IGBT has a short-circuit error.	See Driver IGBT Short Error
Byte 7-8	Bit 13	Driver GND Fault	The driver hardware has a ground fault error.	See Driver GND Fault
Byte 7-8	Bit 14	RealTime CPU-to-FPGA Comm Error	The real-time CPU-to-FPGA communication has failed.	See RealTime CPU-to-FPGA Comm Error
Byte 7-8	Bit 15	FPGA Clock Sync Error	The FPGA and real-time CPU clock frequencies do not match.	See FPGA Clock Sync Error

Transmit PDO 8 – Slow Message #7: Status Error Flags Set 3

Message type: Transmitted 12 ms after receipt of Receive PDO 2.
COB Id: 1248+Node Id (0x4E0+NodeId)
Data length: **6** bytes

Byte 1-2: Status Error Register 8 (see table A-11 for bit definition)
Byte 3-4: Status Error Register 9 (see table A-12 for bit definition)
Byte 5-6: Status Error Register 21 (see table A-13 for bit definition)

Table A-11. PDO8 Byte 1-2 (Status Error Register 8)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 0	Auto Detect Error	The DVPII failed to communicate with the valve/actuator ID module due to write or read problems or the calibration records in the ID module are corrupted.	Check cables between DVPII and actuator. Power Cycle DVPII. See Auto Detect Error.
Byte 1-2	Bit 1	Actuator ID Module Not Detected	During power up, indicates a failure to read the ID module on the valve/actuator system. ID module calibration data corrupted, or the valve does not have an ID module.	Check cables between DVPII and actuator. Power Cycle DVPII. This is normal for some valve types. See ID Module Not Detected.
Byte 1-2	Bit 2	Type / Serial Number Error	The detected serial number of the connected device is not consistent with the valve type currently loaded into the DVPII. User has connected a different valve to the DVPII or has loaded a parameter set to the DVPII that does not match this valve/actuator system serial number.	If a new unit was intentionally replaced, perform an auto-detect request. Manually verify the correct device is operating after completing a new auto detection. See Serial Valve Type Error.
Byte 1-2	Bit 3	Incorrect Power Board	The actuator connected to the DVPII is not compatible with the power board type (i.e. 24 VDC actuator connected to 125 VDC DVPII).	Contact Woodward for compatibility information. A different DVPII or actuator is likely required. See Incorrect Power Board.
Byte 1-2	Bit 4	Valve Type Not Supported	The actuator/valve which is connected to the DVPII is newer than the firmware loaded on the DVPII.	See instructions for software updates. Contact Woodward for support. See Valve Type Not Supported.
Byte 1-2	Bit 5	Dual Resolver Difference Alarm	The readings between the two motor commutation resolvers differs by an amount larger than the alarm threshold for a given valve type. Performance is generally not adversely affected.	Monitor the difference between the two motor resolvers, if the error grows, consider contacting Woodward for a spare actuator/valve. See Dual Resolver Diff Alarm.
Byte 1-2	Bit 6	Dual Resolver Difference Shutdown	The readings between the two motor commutation resolvers differs by an amount larger than the shutdown threshold for a given valve type. Performance is adversely affected; the actuator may not operate reliably.	Contact Woodward for a spare actuator/valve. See Dual Resolver Diff Shutdown.

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 7	Shaft 1 Range Limit Error	The reading of the valve or actuator primary final element position sensor is out of range.	If possible, maintain operation without power cycling the DVPII. Contact Woodward for a spare actuator/valve. See Shaft 1 Range Limit Error or Shaft 2 Range Limit Error.
Byte 1-2	Bit 8	Shaft 2 Range Limit Error	The reading of the valve or actuator secondary final element position sensor is out of range.	
Byte 1-2	Bit 9	Position Error Alarm - Motor	The position of the actuator is not following the demand signal within the control window allowed by the DVPII (as measured by the motor position sensors).	Evaluate the impact on the controlled process. Check for other alarms indicated by the DVPII and at the system level. This indicates a serious problem with the valve/actuator or driven equipment. Serious damage or injury may result. See Position Error Motor Alarm or Position Error Shaft Alarm.
Byte 1-2	Bit 10	Position Error Alarm - Shaft	The position of the actuator is not following the demand signal within the control window allowed by the DVPII (as measured by the final element position sensor(s)). There is an error larger than the position error alarm parameters between the shaft position and the demanded position. Excessive Valve/Actuator Wear.	
Byte 1-2	Bit 11	Digital Comm. Network 1 Error	A communications error is detected on the primary digital communication link (CAN 1).	Check the communication status and operation of the equipment communicating with the DVPII. Check thermal conditions at control equipment. See Digital Com 1 Error or Digital Com 2 Error.
Byte 1-2	Bit 12	Digital Comm. Network 2 Error	A communications error is detected on the secondary digital communication link (CAN 2).	
Byte 1-2	Bit 13	Digital Comm. Error - All	Both primary and secondary communication links are detected as failed.	See Digital Com 1 & 2 And/Or Analog Backup Error
Byte 1-2	Bit 14	Digital Comm. Vs Analog Tracking Alarm	The position demand provided via the analog control signal does not match the digital demand signal within the alarm tracking window allowed by the DVPII.	Check thermal conditions at control equipment. When equipment can be brought down for service, check calibration of the analog source and DVPII. See Digital Com Analog Tracking Alarm.
Byte 1-2	Bit 15	Digital Comm. Vs Analog Tracking Shutdown	The position demand provided via the analog control signal does not match the digital demand signal within the shutdown tracking window allowed by the DVPII.	See Digital Com Analog Tracking Shutdown.

Table A-12. PDO8 Byte 3-4 (Status Error Register 9)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 3-4	Bit 0	Startup Close Motor 2 Error	This indicates the Motor 2 resolver did not fall within the startup min limit range.	See Startup Close Motor Error
Byte 3-4	Bit 1	Startup Open Motor 2 Error	This indicates the Motor 2 resolver did not fall within the startup max limit range.	See Startup Open Motor Error
Byte 3-4	Bit 2	Startup Direction Motor 2 Error	This indicates the Motor 2 resolver did not rotate sufficiently or rotated in the incorrect direction.	See Startup Direction Motor Error
Byte 3-4	Bit 3	Startup Open Shaft 1 Failed	This indicates the primary final element position sensor (shaft 1) or the secondary final element position sensor (shaft 2) did not fall within the startup max limit range.	See Startup Open Valve Shaft 1 Error See Startup Open Valve Shaft 2 Error
Byte 3-4	Bit 4	Startup Open Shaft 2 Failed		
Byte 3-4	Bit 5	ID Module Version Not Supported	The version of the ID module is not supported by the DVPII to which it is connected.	Contact Woodward for actuator/valve/DVPII compatibility. See ID Module Version Not Supported
Byte 3-4	Bit 6	Dual DVPII Inter Com CAN Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 3-4	Bit 7	Dual DVPII Inter Com RS485 Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 3-4	Bit 8	Dual DVPII Inter Com CAN & RS485 Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 3-4	Bit 9	Dual DVPII All Inputs Lost	Reserved for future use and backward compatibility with DVPII.	None
Byte 3-4	Bit 10	Dual DVPII Valve Type Match Error	Reserved for future use and backward compatibility with DVPII.	None
Byte 3-4	Bit 11	FPGA Runtime CRC Error	FPGA runtime CRC error occurred.	See FPGA Runtime CRC Error
Byte 3-4	Bit 12	FPGA Communication Error	The FPGA-to-CPU communication has failed.	See FPGA Communication Error
Byte 3-4	Bit 13	Current Diagnostics 1 Active	The actuator drive current has exceeded the Set 1 alarm level and timeout threshold	Monitor the actuator current as the unit is in operation. At an appropriate service interval, perform a full stroke check. Ensure the driven equipment is not binding. Set the 2nd and 3rd level alarms to monitor further degradation. Contact Woodward for additional information and monitoring advice. See Current Diagnostic 1/2/3
Byte 3-4	Bit 14	Current Diagnostics 2 Active	The actuator drive current has exceeded the Set 2 alarm level and timeout threshold	
Byte 3-4	Bit 15	Current Diagnostics 3 Active	The actuator drive current has exceeded the Set 3 alarm level and timeout threshold	

Table A-13. PDO8 Byte 5-6 (Status Error Register 21)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 0	Zero Cutoff Active	This is a status enunciation only. This bit is active when the actuator is operating in the zero-cutoff mode	Status Only
Byte 5-6	Bit 1	ID Module Parameter Error	The parameter configuration of the ID module is not consistent with the required DVPII definition to which it is connected.	Contact Woodward for compatibility information. A different DVPII or actuator is likely required. See ID Module Version Not Supported
Byte 5-6	Bit 2	ID Module Version Not Supported	The parameter version of the ID module is not consistent with the required DVPII definition to which it is connected.	
Byte 5-6	Bit 3	ID Module Read Failed	A memory read failure was detected during communication with the ID module.	Check the wiring between the DVPII and the actuator. If the problem cannot be corrected, contact Woodward for arrangement of a replacement actuator/valve.
Byte 5-6	Bit 4	ID Module Write Failed	A memory write failure was detected during communication with the ID module.	
Byte 5-6	Bit 5	Internal Critical Fault (shutdown not external)	An internally generated shutdown has occurred	Summary diagnostic only. Check other DVPII diagnostics for shutdown conditions.
Byte 5-6	Bit 6	Valve Type Auto-detect requested	Status indication that a valve type auto-detect sequence was requested.	Status Only
Byte 5-6	Bit 7	Analog Primary – Digital backup	The current operating condition is digital communication with analog demand primary	Status Only
Byte 5-6	Bit 8	Digital primary – Analog Backup	The current operating condition is digital communication with analog demand backup	Status Only
Byte 5-6	Bit 9	CAN demand tracking settings enabled (delta between position command signals)	DVPII using settings from CAN. DVPII received a CAN command to enable a CAN setpoint tracking error settings change (see RPDO1 Command Byte 1, RPDO2 and RPDO4).	Status Only
Byte 5-6	Bit 10	CAN feedback difference error settings enabled (delta between dual feedback signals)	DVPII using settings from CAN. DVPII received a CAN command to enable a resolver difference error settings change (see RPDO1 Command Byte 1, RPDO3 and RPDO5).	Status Only
Byte 5-6	Bit 11	CAN position error settings enabled (delta between commanded and actual position)	DVPII using settings from CAN. DVPII received a CAN command to enable a position error settings change (see RPDO1 Command Byte 1, RPDO6, RPDO7 and RPDO8).	Status Only
Byte 5-6	Bit 12	Dual feedback signal difference error disabled	Status indication that the resolver difference error is disabled.	This indication is for secondary diagnostics and tracking history only. It is not recommended that the resolver difference error be disabled in normal service.
Byte 5-6	Bit 13	Dual DVPII slow mode active	Reserved for future use and backward compatibility with DVPII.	None

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 14	Reduced slew rate active	Status indication that the slew rate has been reduced due to input current limiting.	Status Only
Byte 5-6	Bit 15	Discrete Output #3 On	Discrete output #3 state is True.	The True state can occur when the detected contact is closed or open. See Discrete Output Configuration.

CANopen Objects

The following section provides information on the CANopen objects supported by the DVPII. The product EDS file (Woodward part number 9927-1518) is available for download on the Woodward website (www.woodward.com).

Table A-14. CANopen Standard Objects Supported

Parameter	Object	Access	Type
NMT	**0**	**WO**	**U16**
EMCY	80+NID		
Device Type	1000	RO	uint32
Error Register	1001	RO	uint8
COB-ID SYNC	1005	RO	uint32
Manufacturer Device Name	1008	RO	string
Producer Heartbeat (ms)	1017	RO	uint16
Identity Vendor ID (1) Product Part Number (2) Product Revision (3) Product Serial Number (4) Valve Part Number (5) Valve Revision (6) Valve Serial Number (7) Valve Type (8)	1018	RO	uint32

Object 1000 – Device Type

Requests of the device type always returns a 0, indicating the DVPII does not follow a standardized device profile. Access: read-only.

Object 1001 – Error Register

Error register, part of the Emergency object. Access: read-only.

Object 1005 – COB-ID SYNC

Requests of this object always returns a constant value of 0x80. Access: read-only.

Object 1008 – Manufacturer device name

String indication of the device name. Returns a constant value of ‘DVPII1’. Access: read-only.

Object 1017 – Producer Heartbeat Time

Producer heartbeat time indicates the configured cycle time of the heartbeat. A value of 0 indicates a disabled heartbeat. Access: read-only.

Object 1018 – Identity Object

Provides the following sub-indexes, all are read-only access and data type uint32:

> SubIndex 0: Number of Entries
> SubIndex 1: Vendor Id (0x0170 for Woodward)
> SubIndex 2: Product Code (Woodward product part number, 8410-1234 is represented as 84101234)
> SubIndex 3: Product Revision Number

The higher 2 bytes represent the CAN major revision (e.g. 1, 2, etc) and the lower 2 bytes represent the DVPII part number revision. The DVPII revision level represents the Woodward product part number revision where 1=rev NEW or -, 2=rev A, 3=rev B, etc. Values of 100 or higher indicate a preliminary revision (101=rev 1, 102=rev 2).

> SubIndex 4: Product Serial Number (Woodward DVPII product serial number).
> SubIndex 5: Valve Product Code (Woodward valve product part number).
> SubIndex 6: Valve Revision number (Woodward valve product revision number).

Valve revision level represents the Woodward valve part number revision where 1=rev NEW or -, 2=rev A, 3=rev B, etc. Values of 100 or higher indicate a preliminary revision (101=rev 1, 102=rev 2, etc).

> SubIndex 7: Valve Serial number (Woodward valve product serial number).
> SubIndex 8: Valve Type number (Woodward valve type number).

Manufacturer Objects

The following table lists the available objects that are not mapped to PDOs. Objects 2022 thru 2048 are mapped and are shown in tables A-1 and A-2. These are internal data objects (IDOs) accessible by SDO services.

Table A-15. Unmapped Manufacturer Objects

Parameter	Object	Access	Type	Units	Scaling
Valve Product Code (Part Number)	2049	RO	uint32	none	none
Valve Revision Number	204A	RO	uint32	none	none
Valve Serial Number	204B	RO	uint32	none	none

Appendix B.

B.1 Specific Condition of Safety Use

- On-board driver connector version must retain IP66 ratings.
- The conduit, when installed, must retain the IP66 rating by way of use of a suitably rated conduit adapter.
- Conduit plugs, when installed, must retain the IP66 rating. Unused entries must be blanked in accordance with special condition to retain the IP66 rating.
- Internal field wiring is to be installed according to instructions detailed in this user manual. Field wiring for the GS Series valves must be suitable for at least 105C for installations using ATEX or IECEx. 115C is required for installations using North American (CSA) certification.
- The interface temperature between the actuator and valve must not exceed 112C. Equipment for processing fluid temperature is to be used in accordance with instructions in this user manual. This has been satisfied by Woodward when selecting the mating valve and process fluid temperature ratings. Equipment shall only be used with Woodward specified valve type.
- Equipment must be protected from direct UV light and shall be installed in low sun exposure environments.

Upon installation, equipment ground terminal is to be connected to earth and continuity confirmed.

附录：安全使用条件

- 安装 导管时，必须通过合适的导管适配器来保证IP66防护等级。
- 连接 器型产品在安装时，必须保证IP66的防护等 级。
- 导管插头安装时，必须保证IP66的防护等级。
- 不使用的孔必须用封堵件进行封堵，以保证IP66的防护等 级。
- 内部现场布线应按照用户手册中的制造商说明进行安 装。
- GS系列阀门现场布线的温度应至少为105℃。
- 接口温度不得超过112℃，设备应根据用户手册中的制造 商说明使用，与工艺流体温度和所附阀体的 几何形状有关。
- 该设备只能与Woodward规定的阀门一起使用。
- 应保护设备免受紫外线直射，并应安装在光暴露低的 场所。
- 安装设备后，应将接地端子接地，并保证其连续性。
- 制造商图纸中规定的 最大间隙ic小于GB/T3836.2表2规定的最大要求间 隙。隔爆接合面不能修理。
- 盖与支架固定螺钉为12.9级、M8×1.25×30mm的内六角螺栓；插座 与驱动器盖之间应使用12.9级、M8×1.25×30mm的内六角螺栓 ；外壳与载体之间应使用12.9级、M8×1.25×100mm的内六 角螺栓。注：相关扭矩值，请参阅使用手册。
- 其他见产品使用说明 书。

Revision History

Revision P—
- Updated CCCEx Certificate

Revision N—
- Chapter 1: Added statement regarding compliance to ASME B31.3-2024, Chapter VIII for Category M Fluid Service.
- Updated EU DoC

Revision M—
- Revised tables 3-30, 3-33, 3-34
- Added new content and Table 3-36
- Re-numbered tables 3-37 to end of Chapter 3

Revision L—
- Revised the Regulatory Compliance section and Technical Specifications section to clarify UL 429 valve versions.

Revision K—
- Added China Certification (CCCEx) to Regulatory Compliance section
- Added Specific Condition of Safety Use to Appendix B1

Revision J—
- Removed UKCA compliance section
- Added Japan Ex (JPEx)
- Added INMETRO
- Updated EU DoC

Revision H—
- Edits to CAN cable part numbers in Tables 3-31, 3-32, 3-33, 3-34, and 3-35.
- Updated Figures 3-20c and 3-20d

Revision G—
- Added content to General Information section
- Revisions to Technical Specifications section

Revision F—
- Added subsection “Canadian Registration Number (CRN)” to North American Compliance section
- Replaced EU DOC

Revision E—
- Added United Kingdom Compliance for UKCA Marking to Regulatory Compliance section

Revision D—
- Updated Regulatory Compliance
- Updated Technical Specifications
- Revisions to Chapter 3:
  - New Warning boxes in Electrical Connections
  - Revised Conduit (Directly Wired) Version
  - Revised Supply Voltage
  - Revised CAN Communications
  - Revised Analog Inputs
  - Added footnote on polarity settings
  - Revised Ethernet Service Port
  - Added Driver Version with Circular Connectors

  - Revised Cable Assemblies— General Information
  - Revised Front Panel Connectors Installation
  - Added Important box to CAN Communications
  - Revised Ethernet Service Port
  - Revised Tables 3-2, 3-3, 3-7, 3-9, 3-10, 3-31, 3-38, 3-43, 3-47
- Revised Chapter 4 content
- Revisions to Chapter 5:
  - Revised Driver Configuration Overview in Chapter 5
  - Added Initial Connection to the GS Series Valves
  - Revised Figures 5-1 through 5-4 and 5-11 through 5-14
  - Revised Table 5-2
  - Revised Service Tool Overview, User Login Assignments, Driver Utilities, User Management, Confirming Correct Operation, and Quick Start Guide
- Revised Chapter 6 content
- Added Chapter 10
- Updated DoC/DoI

Revision C—
- Replaced Cover Art
- Renumbered Figure Captions in Chapter 2
- Replaced Figures 2-1a. 2-1b. 2-2a. 2-2b, 2-3a and 2-3b
- Added Figures 2-4a and 2-4b

Revision B—
- Made changes to the following Directives in the Regulatory Compliance Section
  - Both ATEX Directives
  - Added a narrative under Other International Compliance
  - IECEx
  - Changed North American Compliance to PENDING
- Changed content in first paragraph in Special Conditions for Safe Use
- Changed temperature rating for Field Wiring for GS Series in Specific Conditions of Use for IECEx and ATEX
- Change the VDC at the end of the second paragraph of Chapter 1
- Added Figures 2-2C, 2-2D, 2-3C, and 2-3D
- Added content to Table 3-2
- Added Figure 3-6B
- Added content to Tables 3-4, 3-8, 3-12, 3-15, 3-18, 3-21
- Added new section below Table 3-4 that includes Tables 3-5 and 3-6
- Corrected AWG value in Recommendations for Dual and Simplex and Power Wiring
- Replaced first sentence and first sentence, third paragraph in Discrete Inputs section
- Replaced first sentence in Discrete Outputs
- Added new section beneath Table 3-23
- Created Table 3-24
- Replaced DoC

Revision A—
- Updated PED, IECEx, and Special Conditions for Safe Use in Regulatory Compliance section
- Updated Steady State Current value in Technical Specifications table in Chapter 2
- Added text to Explosion Hazard Warning Box in Electrical Connection section in Chapter 3
- Changed temperature rating for Field Wiring in Electrical Connection section in Chapter 3
- Replaced Figure 3-10
- Added Tables 3-9 and 3-22
- Added Important boxes in multiple locations in Chapter 3
- Added Warning Box to Chapter 8
- Added Declarations

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00558-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):	GS Series Valves with ASME B16.5 Class 600 RF flanges or SAE J518.1 (Code 61) flanges; with field connections via conduit openings, flying leads, or circular MIL connectors
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/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 equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment PED Category II 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:	Conduit version without flying leads: Ⓔx II 2 G Ex db IIB T3 Gb All versions: Ⓔx II 3 G Ex ec IIC T3 Gc
Applicable Standards:	
ATEX:	EN IEC 60079-0:2018 - Explosive Atmospheres - Part 0: Equipment – General requirements EN 60079-1:2014 – Explosive Atmospheres – Part 1: Equipment protection by flameproof enclosures "d" EN IEC 60079-7:2015/A1:2018 – Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"
PED:	ASME BPVC.VIII.2 – Rules for Construction of Pressure Vessels – Alternative Rules
EMC:	EN IEC 61000-6-4:2019: Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments. EN 61000-6-4:2007 +A1:2011: Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments EN IEC 61000-6-2:2019: Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments EN 61000-6-2:2005 + AC:2005: Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
Third Party Certification:	Category 2 only: CSANe 20ATEX1196X CSA Group Netherlands B.V. (NB2562), Utrechseweg 310, 6812 AR, Arnhem, NL
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 Category 2 only: ATEX Annex IV - Production Quality Assessment, 01 220 113542 TUV Rheinland Industrie Service GmbH (0035), Am Grauen Stein, D51105 Cologne, DE

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	Engineering Manager
Position	Woodward, Fort Collins, CO, USA
Place	15 April 2025
Date	

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

File name: 00558-EU-02-02
Manufacturer's Name: WOODWARD INC.

Manufacturer's Address: 1041 Woodward Way
Fort Collins, CO 80524 USA

Model Names: **GS Series** Valves with ASME B16.5 Class 600 RF flanges or SAE J518.1 (Code 61) flanges; with field connections via conduit openings, flying leads, or circular MIL connectors.

This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.4, 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

Annette Lynch
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

23-March-2022
Date

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Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 35136.

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Email and Website—www.woodward.com

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

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