Released

Product Manual 26773
(Revision N, 7/2025)
Original Instructions

High Output Digital Valve Positioner (DVP)
DVP5000/DVP10000/DVP12000

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

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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 over-temperature or over-pressure 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 the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

Regulatory Compliance

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

EMC Directive 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) and applicable amendments.

ATEX – Potentially Explosive Atmospheres 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.
Category II 3 G, Ex nA IIC T4; IP-20

Other European and International Compliance:

IECEx: Ex nA IIC T4 Gc Certificate: IECEx CSA 12.0013X
IEC 60079-0: 2018 Explosive Atmospheres – Part 0: General Requirements.
IEC 60079-15: 2010 Explosive Atmospheres – Part 15: Equipment Protection by type of protection "n"

Korean Certification (KC Mark): Ex nA IIC T4 Gc -40°C≤Ta≤+70°C
KCs certificate no. 23-KA4BO-0594X, 23-KA4BO-0595X, and 23-KA4BO-0596X

DVP5000= 23-KA4BO-0594X
DVP10000= 23-KA4BO-0595X
DVP12000= 23-KA4BO-0596X

적용되는 기준의 목록 및 개정 일자 : 방호장치 안전인증 고시 2021-22호
List of applicable standards and date of revision: Safety Certification for Defense Devices Notice No. 2021-22.

방폭기기 설치는 KS C IEC 60079-14를 따라야 한다.
Installation of explosion proof equipment shall be in accordance with KS C IEC 60079-14.

유지 및 보수와 관련하여 그 방법 및 주체 등 사용자와 제조자의 책임 한계가 있다.
There are limitations of the user's and manufacturer's responsibilities, such as methods and entities related to maintenance.

North American Compliance:

EMC: The product is an industrial product exempt from declaring or marking for EMC requirements in North America. It complies with EMC & EMI requirements as detailed under the EMC directive.

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

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, and D, T4 at 70°C ambient for use in USA and Canada Certificate 1682018

This product is certified as a component for use in other equipment. The final combination is subject to acceptance by the authority having jurisdiction or local inspection.

SIL Compliance:

The DVP5000-S, DVP10000-S and DVP12000-S are certified to SIL3 having been evaluated to IEC61508: 2010 parts 1-7. Refer to the instructions of the Installation and Operation Manual, Chapter 9 – Functional Safety Management.

SIL Certificate WOO 1502076 C001

Special Conditions for Safe Use

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

A fixed wiring installation is required. Refer to your local authority having jurisdiction for installation wiring codes.

Field wiring must be suitable for at least 95°C (203°F).

The Communication Module contains a battery to power the real time clock when power to the control is off. This battery is not user replaceable.

The power supply input should be properly fused according to the National Electric Code. The recommended fuse is a European Type Fuse.

Grounding of the control is required by the input PE terminal.
A switch or circuit breaker shall be included in the building installation in close proximity to the equipment and within easy reach of the operator. The switch or circuit breaker shall be clearly marked as the disconnecting device for the equipment. The switch or circuit breaker shall not interrupt the Protective Earth (PE) conductor.

The DVP shall be installed in an enclosure that is coded Ex nA providing an ingress protection of IP54 minimum. The installer shall insure that the maximum ambient surrounding air of the DVP is not exceeded.

The DVP shall not be installed in areas exceeding Pollution Degree 2, as defined in IEC 60664-1.

The user shall ensure that a minimum clearance of 6.4 mm exists between live parts and earthed metal is maintained.

⚠CAUTION

Transporting

The handle installed on the fan assembly should not be used to carry or transport the DVP control. The handle is intended to only be used to remove and reinstall the fan assembly.

⚠WARNING

Explosion Hazard

ENCLOSURE REQUIREMENT
ATEX/IECEx Zone 2, Category 3G applications require the final installation location provide a minimum IP-54 ingress protection enclosure against dust and water per IEC 60529. The enclosure must meet IEC 60079-0 Design & Test Requirements.

⚠WARNING

Explosion Hazard

Do not remove covers or connect/disconnect electrical connectors unless power has been switched off and 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

Explosion Hazard

The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere. Cleaning by hand or water spray must be performed while the area is known to be non-hazardous to prevent an electrostatic discharge in an explosive atmosphere.

⚠WARNING

Explosion Hazard

Do not use any test points on the power supply or control boards unless the area is known to be non-hazardous.

⚠WARNING

Explosion Hazard

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

⚠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.

⚠AVERTISSEMENT

Risque d'explosion

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

⚠AVERTISSEMENT

Risque d'explosion

Ne pas utiliser les bornes d'essai du block d'alimentation ou des cartes de commande à moins de se trouver dans un emplacement non dangereux.

Safety Symbols

 Direct current

 Alternating current

 Both alternating and direct current

 Caution, risk of electrical shock

 Caution, refer to accompanying documents

 Protective conductor terminal

 Frame or chassis terminal

Chapter 1.
General Information

1.1 Introduction

The Digital Valve Positioner (DVP) is a family of purpose-built digital electronic positioners and actuator drivers used to control actuation systems on gas and steam turbines. The DVP is designed to control valves and actuators with brushless DC (BLDC) motor types. The driver controls actuator/valve position based on resolver and LVDT feedback located on the valve and/or actuator. The DVP supports both resolver and LVDT feedback devices. The DVP5000, DVP10000, and DVP12000 use the latest in Woodward control architecture and a robust controller to provide high-speed precise valve control. The DVP5000 provides a nominal 5 kW output, the DVP10000 is capable of a nominal 10 kW output, and the DVP12000 is capable of a nominal 12kW output.

The DVP5000/DVP10000/DVP12000 products are an extension of the existing DVP family. These units are rear-panel mounted and utilize forced air cooling to provide high power output with an extended operating ambient of -40°C to +70°C. The maximum output is 25Adc or 25Apk (17.7Arms) and the driver accepts an input voltage from 90 V to 300 VDC, the output current for the DVP10000 and DVP12000 is derated below an input voltage of 190 VDC. The DVP12000 can provide an increased output current of 28Adc or 28Apk (19.8Arms) when operating with select actuators in ambient temperatures between -40°C to 55°C. For functional safety applications, the DVP5000/DVP10000/DVP12000 has an EXTERNAL SHUTDOWN discrete input that can be used as a remote shutdown command that is independent of the CPU. This feature is optionally available and certified to SIL3 per IEC61508. SIL certified versions are identified by the DVP5000-S, DVP10000-S, and DVP12000-S labels on the front panel. All other I/O and control features are identical to the existing DVP family.

The DVP10000 and DVP12000 have a power module that temporarily boosts output power as necessary to attain the required motor performance. These packages are slightly wider, but otherwise have the same I/O connections as the DVP5000. Some electrical specifications are different. See the Electrical Specifications section for more details.

In this manual, the term DVP is sometimes used to more concisely describe the DVP5000, DVP10000, and DVP12000 products.

IMPORTANT	**The EXTERNAL SHUTDOWN input must be connected to a signal source or strapped to one of the +24 V AUX voltages to enable the driver. The unit is shipped with the connector (provided in the connector kit) pre-wired for operation. If an external source of EXTERNAL SHUTDOWN input is used, the jumpers can be removed. See Figure 3-6 for details.**

The DVP is designed for plug-and-play installations on many Woodward valve and actuator types. Woodward has integrated a smart technology device called an ID (identification) module into our latest valves and actuators. When the DVP is connected to a valve or actuator equipped with an ID module, the DVP will automatically detect the type of valve or actuator and read critical set up and calibration information necessary to configure the driver to the valve or actuator. After the customer interface configuration, the DVP is ready for use.

The DVP is designed to accept many different types of input commands, including Single or Dual CAN, Analog Input (4–20 mA or 0–5 V), or Ethernet (if equipped). Woodward also provided a Service Tool that allows users to manipulate, configure, and monitor the DVP operation status.

The Woodward DVP5000/DVP10000 and DVP12000 are suitable for +125 VDC or 220 VDC nominal input voltage supply operation. Contact Woodward for additional voltage options.

1.2 Purpose and Scope

The purpose of this manual is to provide the necessary background information for installing and operating the Digital Valve Positioner (DVP) appropriately. Topics covered include introduction, basic functional description, mechanical installation, and electrical wiring. Troubleshooting and basic software tool installation and operation is covered in this manual.

IMPORTANT	**Ensure that you have downloaded and are using the latest revision of this manual. Updates are available on the Woodward website at www.woodward.com**

1.3 Intended Applications

The Woodward DVP5000, DVP10000, and DVP12000 are purpose-built, state-of the-art drivers for electric actuation. These versions feature a rugged and compact design. The DVP provides positioning based on a demand signal from the control system and monitors the health of the driver/actuator subsystem. Multiple input type configurations allow use of the DVP with many different turbine controllers. The DVP also supports redundant installations. The DVP provides significant advancements over the earlier generation of the driver, including internal configurability to drive different Woodward products.

Chapter 2.
Installation and Fan Replacement

2.1 Introduction

⚠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	**The engine, turbine, or other type of prime mover should be equipped with an overspeed/misfire/detonation detection shutdown device(s) to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.**

⚠WARNING Explosion Hazard	**The overspeed/misfire/detonation detection shutdown device must be totally independent of the prime mover control system.**

⚠WARNING Explosion Hazard	**ENCLOSURE REQUIREMENT** **ATEX/IECEx Zone 2, Category 3G applications require the final installation location provide a minimum IP-54 ingress protection enclosure against dust and water per IEC 60529. The enclosure must meet IEC 60079-0 Design & Test Requirements.**

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

⚠WARNING	**The DVP must be grounded for safety and EMC compliance (see Mechanical Installation Requirements).** **Make all required electrical connections based on the wiring diagrams (Chapter 3).**

⚠CAUTION

Transporting

The handle installed on the fan assembly should not be used to carry or transport the DVP control. The handle is intended to only be used to remove and reinstall the fan assembly.

NOTICE

ESD Precautions

The DVP5000, DVP10000, and DVP12000 are sensitive to ESD. Always follow the ESD precautions in the Electrostatic Discharge Awareness section to ensure personnel are not electrostatically charged before touching the DVP.

2.2 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.

2.3 Grounding Requirements

The DVP chassis is intended to be grounded using a short, low-impedance strap or cable (typically >12 AWG/3 mm² and <18"/46 cm in length) connected to the designated EMC ground terminal (⏚). Additionally, the PE terminal (⏚) must be connected to PE ground to ensure safety compliance.

⚠WARNING

Explosion Hazard

The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere. Cleaning by hand or water spray must be performed while the area is known to be non-hazardous to prevent an electrostatic discharge in an explosive atmosphere.

2.4 Wiring Installation Notes

NOTICE

Refer to the valve manual for a detailed plant wiring diagram for your wiring installation.

- Connect all wires as shown in the plant-wiring diagram for the appropriate actuator type. Refer to the appropriate valve/actuator manual for wiring diagrams.
- Load terminations should be applied accordingly.
- Apply general practice to ensure cables are checked from point to point. Motor and position feedback transducer impedance are verified from line power to ground.
- 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 where possible the diameter should be maximized.
- 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.

Verify details concerning installation mounting requirements: Ground straps, lock washers, etc.

2.5 Mechanical Installation Requirements

This section provides the general information for mounting location selection, installation, and wiring of the Digital Valve Positioner (DVP).

2.5.1. Unpacking the Shipping Carton

- Before unpacking the control, refer to the inside front cover of this manual and to the Regulatory Compliance page for warnings and cautions. Be careful when unpacking the control. Check for signs of damage such as bent or dented panels, scratches, and loose or broken parts. If any damage is found immediately notify the shipper.
- The DVP is shipped from the factory in an antistatic foam-lined carton. This carton should always be used for transport of the DVP when it is not installed. Read the Electrostatic Discharge Awareness page before handling the DVP.
- Check for and remove all manuals, connectors, mounting screws, and other items before discarding the shipping box.

2.5.2. General Installation and Mounting Considerations

When selecting a location for mounting the DVP consider the following:

- Protect the unit from direct exposure to water or a condensation-prone environment.
- The DVP is designed for installation in a low vibration environment. If installed in vibration levels above normal control room levels, the DVP should be vibration isolated from engine and generator vibrations above 50 Hz. See Grounding Requirements above.
- Install the DVP5000/DVP10000 in an area where the operating temperatures will not exceed -40°C to +70°C (-40°F to +158°F).
- Install the DVP12000 in an area where the operating ambient temperatures will not exceed -40°C to +70°C (-40°F to +158°F) for 25A operation and -40°C to +55°C (-40°F to +131°F) for 28A operation. The Woodward Actuator/Valve determines the DVP12000 operating current.
- The DVP is designed for rear panel mounting to a metal surface and adequate clearance around the air intake and exhaust openings.
- The DVP can be mounted in any orientation with proper clearance provided to allow air flow. For maximum thermal performance, the DVP must be mounted in a vertical orientation.
- Shield the unit from radiant heat sources.
- Allow adequate space around the unit for servicing and cable routing.
- Do not install near high-voltage or high-current devices.
- Install the DVP in an area where there is a protection from outside contamination.
- Installation Clearance: 6 inches on the top and 6 inches on the bottom in addition to proper airflow ventilation in the cabinet for 100 CFM (or 2.8 cubic meters/minute) of unobstructed airflow per unit. No clearance is required on the sides for cooling.
- Verify that cable lengths do not exceed lengths specified in the electrical I/O section of this manual.
- Refer to Technical Specifications for packaging heat load information.

NOTICE

The DVP5000/DVP10000/DVP12000 is a forced air-cooled design. For maximum thermal performance, they must be mounted vertically with at least 150 mm or 6 inches of clearance on the top and bottom of the DVP to allow air to flow through the enclosure. No clearance is required on the sides except as needed for cable routing. Without proper clearance, cooling air will not adequately cool the unit and the unit may overheat.

Proper cabinet ventilation is required for 100 CFM or (or 2.8 cubic meters/minute) of unobstructed airflow per unit.

Do not mount the DVP near sources of excessive radiant heat such as exhaust manifolds or other excessively hot engine components.

IMPORTANT **The EXTERNAL SHUTDOWN input must be connected to a signal source or strapped to one of the +24 V AUX voltages to enable the driver. The unit is shipped with the connector (provided in the connector kit) pre-wired for operation. If an external source of EXTERNAL SHUTDOWN input is used, the jumpers can be removed. See Figure 3-6 for details.**

2.5.3. Wire Preparation and Connector Screw Torque Drive Recommendation

Woodward recommends that the following wire preparation and terminal block screw torque specifications for all DVP input/output terminal blocks.

Note: Stranded wire is recommended.

Table 2-1. Wire Hookup Guideline

Specification	I/O Terminal Block	Power Terminal Blocks
Wire Gauge	20 – 16 AWG (0.5 – 1.0 mm²)	8 to 18 AWG [1] 6 to 18 AWG [2] (0.75 to 6 mm²)
Wire Strip Length	0.25 – 0.300 Inches (6.4–7.6 mm)	0.45 – 0.55 Inches (11.4–14.0 mm)
Recommended Torque drive on the Terminal Block Connector	2.5 – 3.5 lb-in (0.3 – 0.4 N·m)	10 – 12 lb-in (1.1 – 1.4 N·m)

Table Notes
[1] - 8 to 18AWG is for DVP5000 and DVP10000
[2] – 6 to 18 AWG is for DVP12000

2.5.4. Connector Kits

The DVP is shipped with mating connectors for all input and output connectors. However, in some applications where an extra set of connectors is needed, Woodward carries a connector kit as shown on Table 2-2.

2.5.5. DVP 5000 and DVP10000 Configuration Options

The DVP10000 is the same as the DVP5000 with the addition of a boost module to increase power temporarily to meet high performance actuator requirements. The DVP10000 package is slightly wider than the DVP5000 to accommodate the boost module.

The DVP12000 is the same as the DVP10000 with a temperature derating option for higher output current availability and the ability to operate with spring return actuators.

Additional Options:

- EXTERNAL SHUTDOWN feature is optionally certified to a SIL 3 level. The certified versions are indicated on the front panel by DVP5000-S, DVP10000-S and DVP12000-S labels.
- Optional Ethernet Communication capability.

2.5.6. Terminal Locations

All terminals and connectors are located on the front panel of the chassis. Figures 2-2 and 2-3 show the front panel and outline views. For EMC compliance, mount the DVP with low impedance bond to Earth ground.

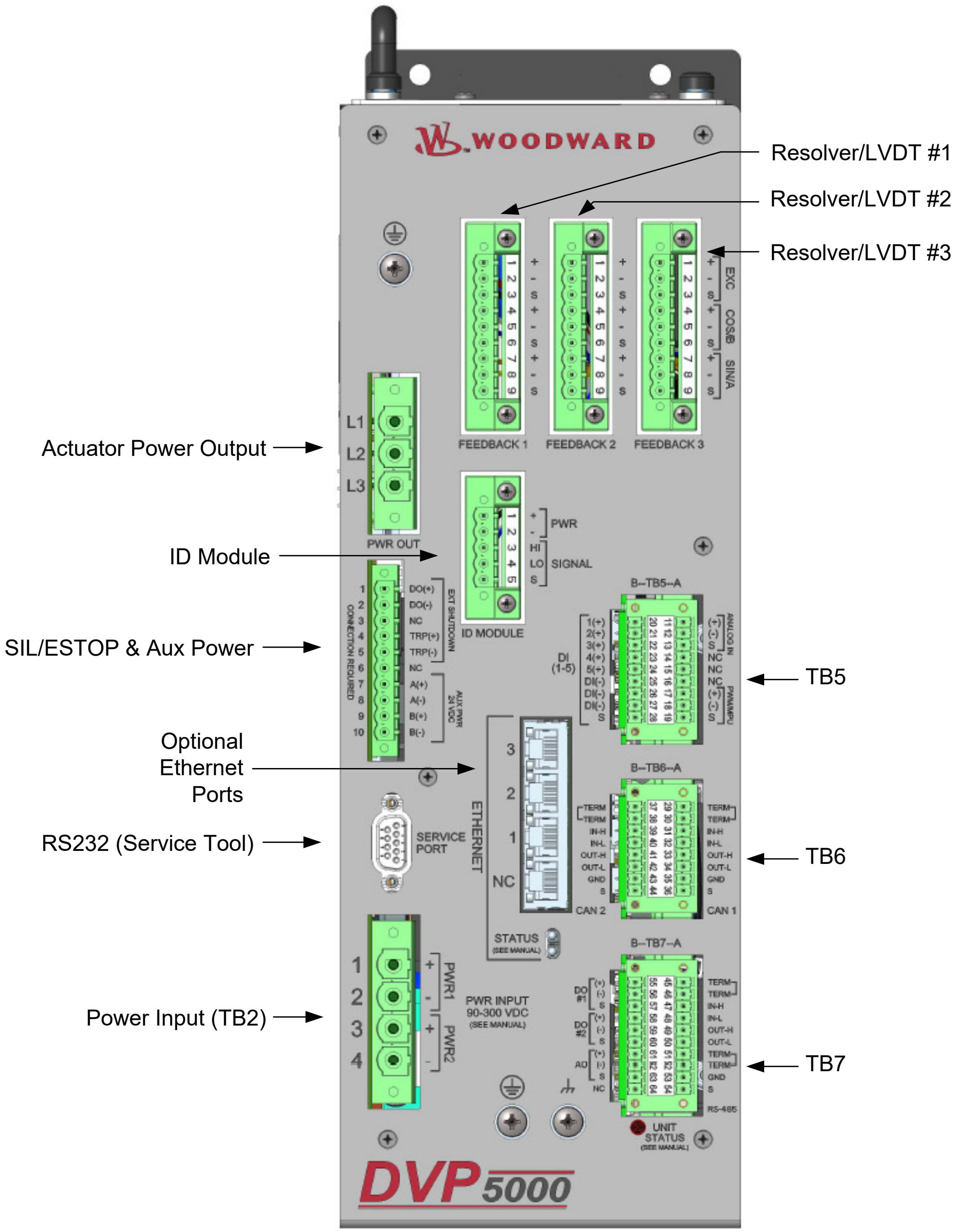


Figure 2-1. DVP Front Panel View & Connector Location

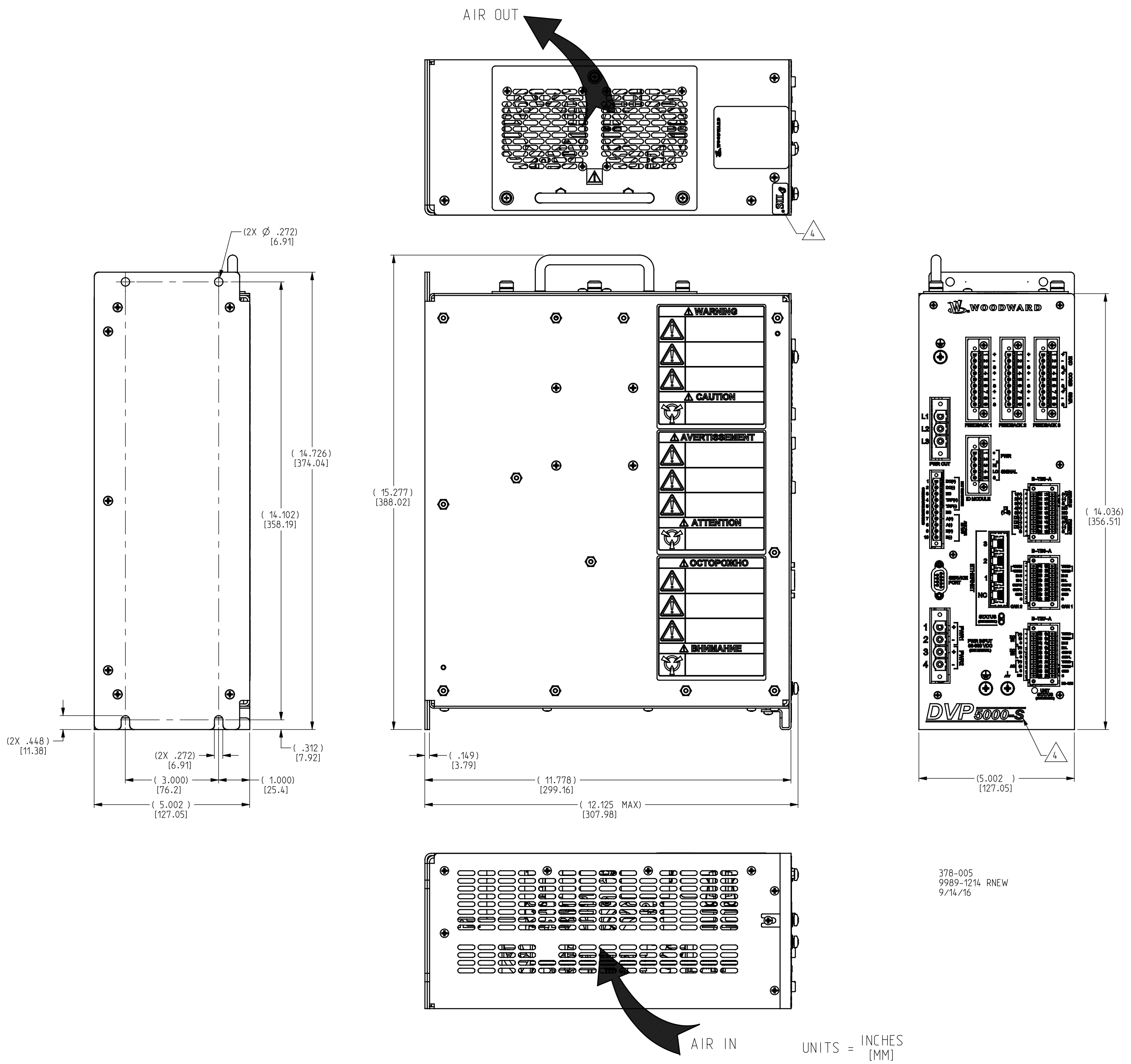


Figure 2-2. DVP5000 Outline

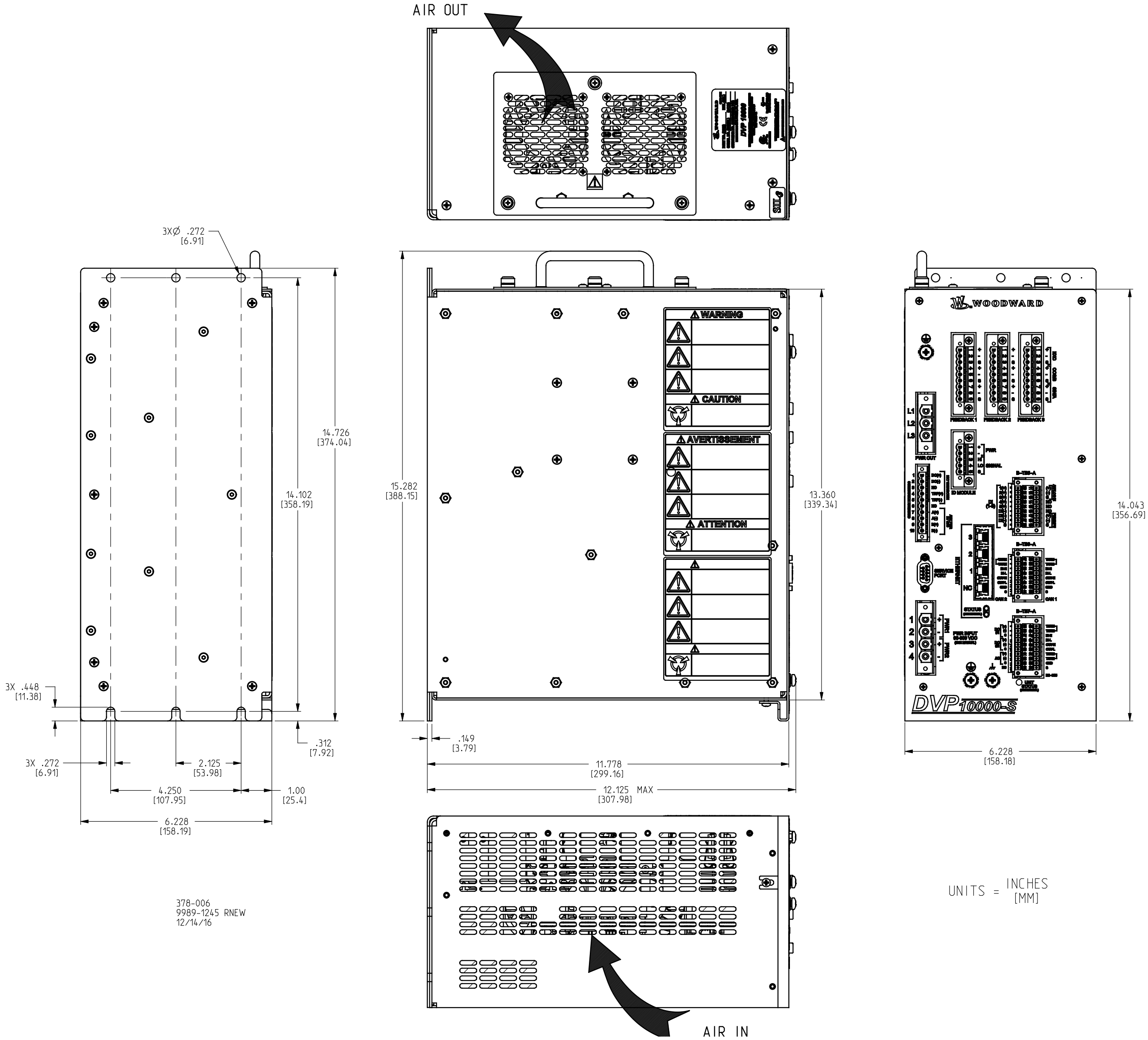


Figure 2-3. DVP10000 and DVP12000 Outline

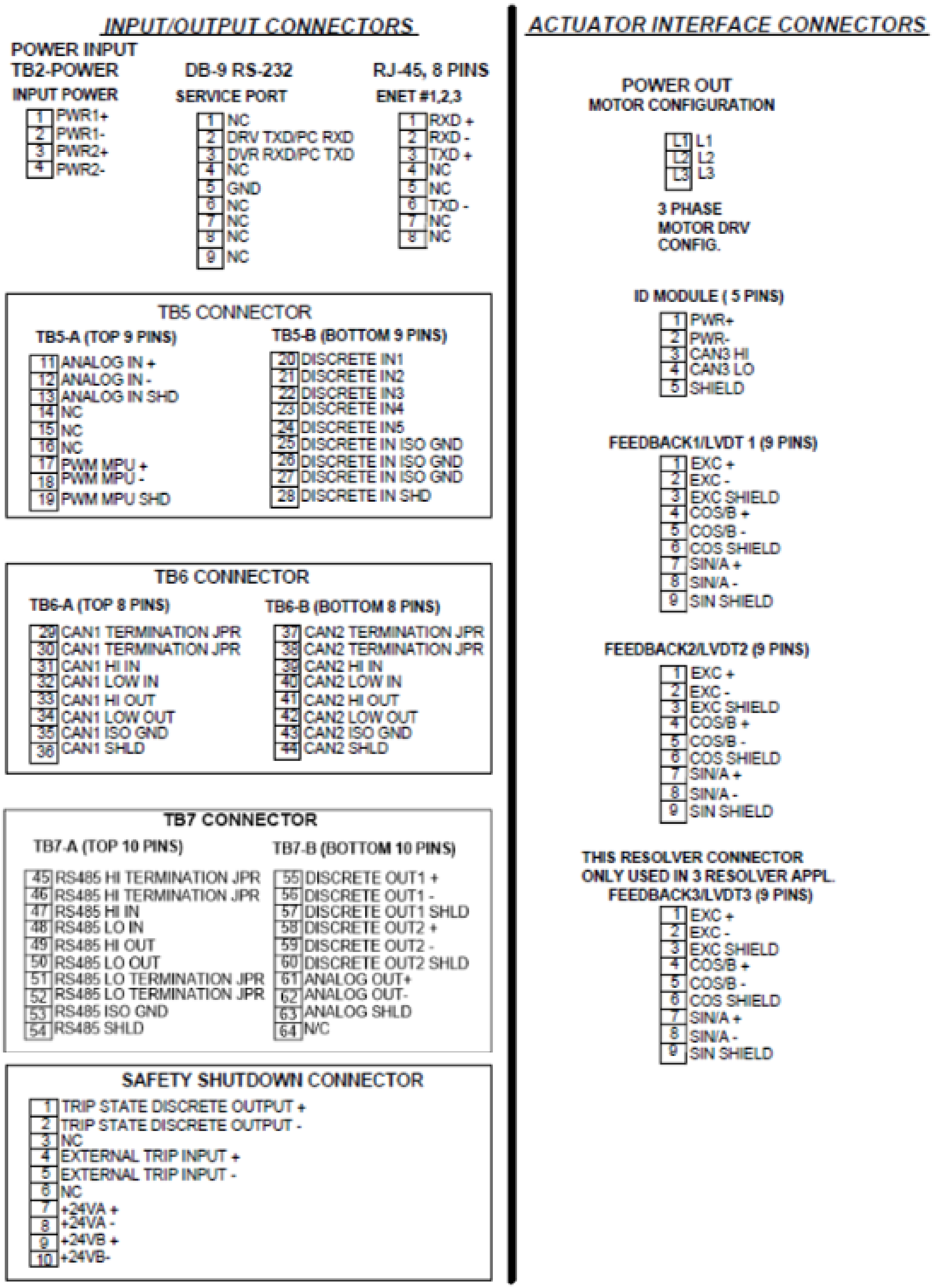


Figure 2-4. Terminal Block Pinout Diagram

2.6 Fan Assembly Replacement

The fan assembly in the DVP is designed for field replacement if necessary. If one or both fans fail, an alarm is generated.

The fans are a ball bearing type with a nominal airflow of 51.97 CFM (1.47m^3/min) each.

A degraded fan can occasionally be identified by audible noise sounding like a low rumbling or roughness from the bearings. In this case, it is advisable to replace the fan assembly at the earliest opportunity.

The fan L10 life is rated at 30,000 hours @ 40C. To extend fan life, the DVP switches fan speed at several internally sensed temperatures to provide optimum balance between cooling and fan life.

Woodward recommends fan assembly replacement every five years of operation.

The fan assembly orderable part number is **8926-1045SPR**.

WARNING

Power to the DVP must be off for fan replacement. Online fan replacement is not approved.

The following procedure is used to replace the fan assembly for the DVP; see Figure 2-5.
1. Place the actuator into a safe state.
2. Ensure that input power is removed from the driver.
3. Unscrew the 3 retention screws. Using the handle, remove the fan assembly from the DVP.
4. Place the new fan assembly into the connector; tighten the three retention screws.
5. Apply power to the DVP and ensure the fan alarms are off.

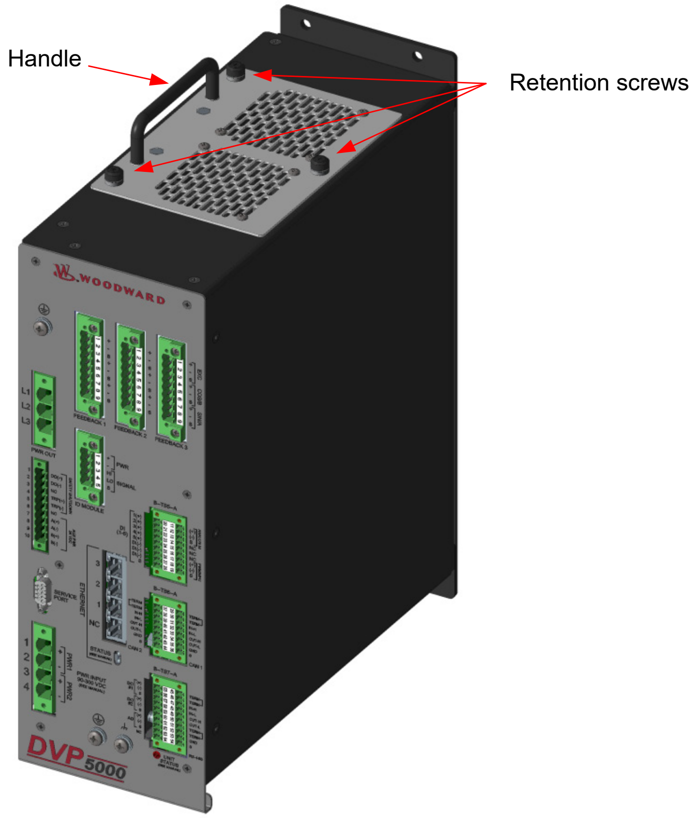


Figure 2-5. Fan Replacement

Chapter 3.
Electrical I/O

3.1 Power Supply Inputs

The DVP is designed with redundant power supply inputs. These inputs share a common ground and are isolated from chassis ground. This option allows for redundancy in wiring, connectors, and power sources if the power sources share a common ground. If one of the inputs is lost, drops low, or experiences temporary power loss, the other power input will take over without being affected by the first input. The user is provided four terminals—two plus and two minus. The DVP requires a power supply capable of the specified voltages and current levels. Please see Table 3-1 for power and fusing information necessary for safe and reliable operation of the DVP.

3.1.1. Inrush Limiting

The DVP has current inrush limiting built into the design. Power to the CPU occurs rapidly after power application, but the internal bulk storage capacitors take about eight seconds to fully charge. Inverter activation is prevented by software until the inrush time has expired. This inrush sequence occurs after BOTH input power is applied AND EXTERNAL SHUTDOWN input is energized.

WARNING

Fire Hazard

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

NOTICE

The DVP is designed to run with a variety of Woodward valves. Power requirement depends on the valve and driver used. See the valve specification for proper power requirements. The valve manual power requirement can be different from the DVP power requirement.

Table 3-1. DVP Input Power Requirements

	DVP5000 (-40°C to +70°C)	DVP10000/12000 (-40°C to +70°C)	DVP12000 (-40°C to +55°C)
Voltage Range [1]	90 VDC to 300 VDC	90 VDC to 300 VDC	90 VDC to 300 VDC
Inrush Current	< 50A	< 50A	< 50A
Continuous Input Current	5A	5A	6A
Transient Input Current [2]	40A for 500 ms, 25A for 30 seconds	40A for 30 seconds	50A for 30 seconds

Notes:

[1] – Transient current for the DVP10000 and DVP12000 is internally derated below input voltage of 190 VDC.

[2] - These numbers represent the maximum possible DVP current draw. See valve/actuator specific manuals for specific power requirements based on individual vale/actuator applications.

3.2 Power Wiring

3.2.1. Recommended Minimum Input Protection:

DVP5000: 15A time delay fuse or 15A breaker
DVP10000 and DVP12000: 30A time delay fuse or 35A breaker (Ambient temperature -40°C to +70°C)
DVP12000: 40A time delay fuse or 45A breaker (Ambient temperature -40°C to +55°C)

High input current transients can be drawn during rapid load movement. The above recommendations include the transient nature of the electrically driven actuator system. The DVP is not equipped with an input power switch or breaker. Correct 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 DVP is crucial to its operation. A circuit breaker meeting the power supply requirement may be used for this purpose. It is important that proper wiring be applied during system installation to avoid an unwanted power trip or ground loop. Figure 3-1 illustrates the correct and incorrect power cable wiring.

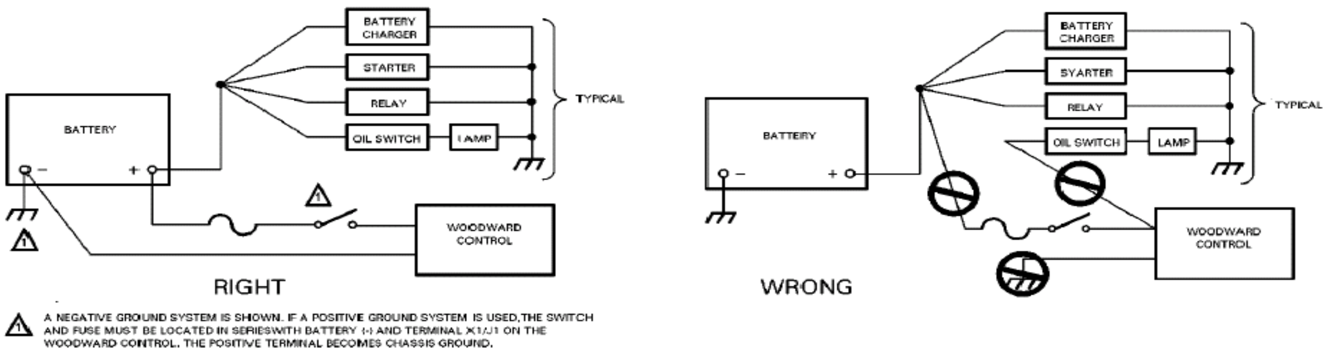


Figure 3-1. Power Wiring Recommendation

3.2.2 Recommendations for Dual and Simplex Power Wiring

The DVP is provided with power terminals suitable for the required voltage and current level. Two positive and two negative pins are each sized for 8 AWG wire for the DVP5000 and DVP10000. The DVP12000 can accommodate up to 6 AWG wire.

Provision for separate redundant power supplies is provided by dual DC inputs. Each of the inputs is diode isolated from the main input bus. If one of the supplies is lost, the other input will take over and the DVP will continue to operate normally. The loss of the input will be annunciated as an alarm.

Woodward recommends that you take advantage of the dual input power wiring configuration; however, the inputs can be tied together for use with a single power supply.

If a single power source is used to supply power to the DVP, 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 DVP inputs. This minimizes the power dissipated in each of the DVP input diodes for reduced heat load and improved reliability. When using the jumpers, insert the positive (+) power input lead from the source into either the #1 or #3 positions, and the negative (-) lead into either the #2 or #4 positions as shown in Figure 3-2a.

Some newer versions of the DVP may include power input plugs with jumpers to connect the two positive and two negative terminals.

In installations where separate dual power sources are connected to the DVP, as shown in Figure 3-2b, the jumpers are not required.

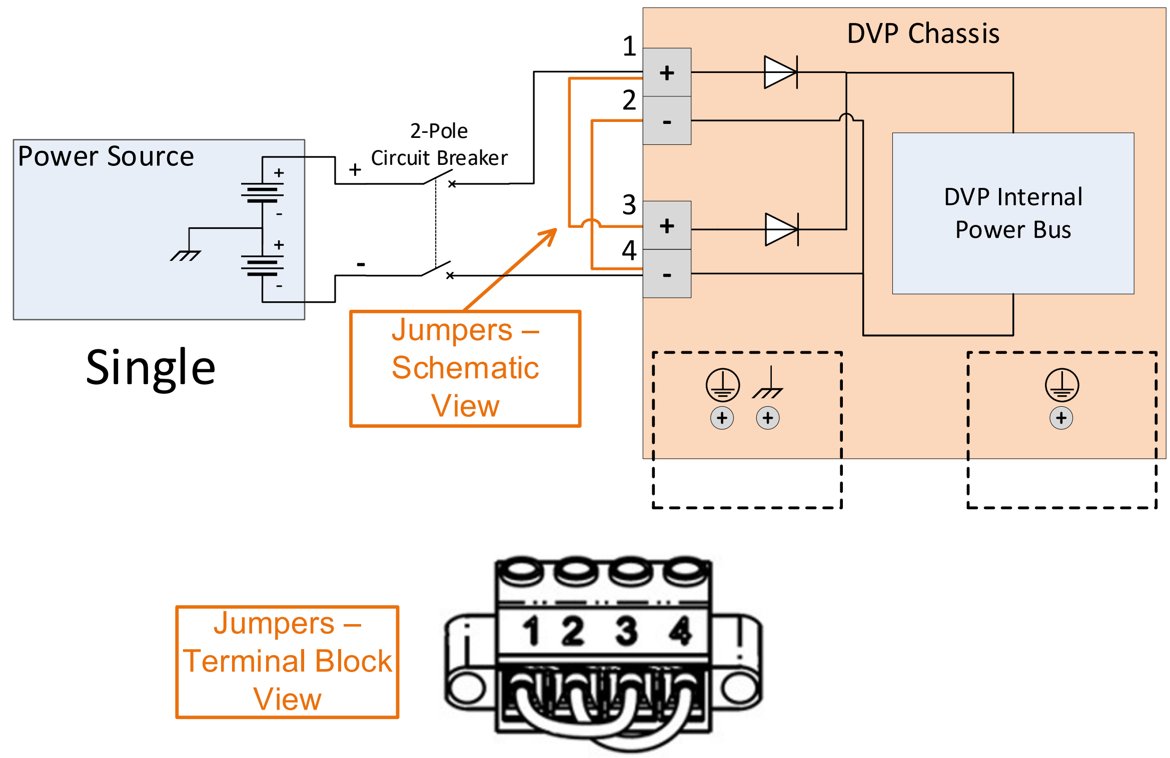


Figure 3-2a. Single Power Source Interface Diagram

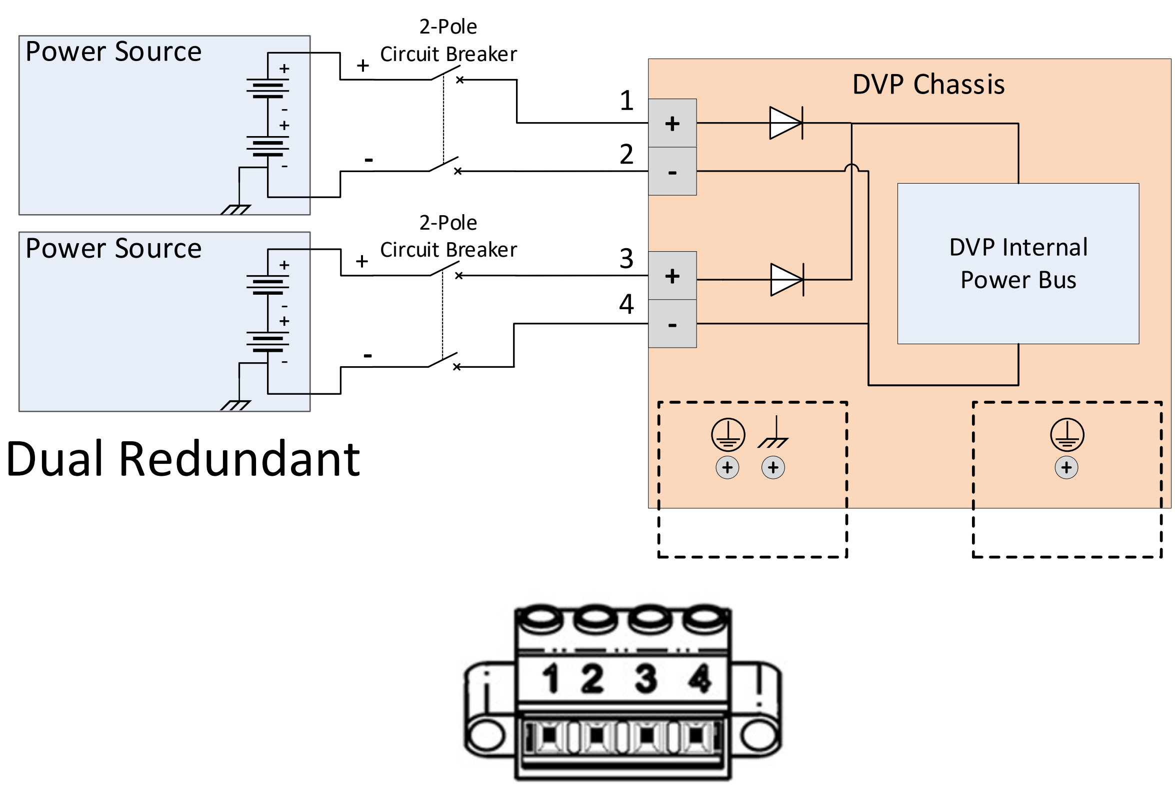


Figure 3-2b. Dual Redundant Power Source Interface Diagram

3.3 Power Input Cable Requirements

Cable selection and sizing are very important to avoid voltage loss during driver operation. **The power supply input at the driver's input terminal must always provide the required nominal voltage for the driver, especially under transient conditions.**

NOTICE

Refer to the valve or actuator manual for a detailed plant wiring diagram for your wiring installation.

⚠CAUTION

Input power must be steady DC. Do not attach energized wires since intermittent connections may allow transient surges to damage internal circuits.

⚠CAUTION

Equipment Damage

The power system must be grounded with a low impedance connection. Otherwise, damaging overvoltage transients can be transmitted to the DVP power input terminals resulting in damage. If this cannot be done, external transient protection systems should be employed to avoid damage.

The input power wire must comply with local code requirements and be of sufficient size such that the power supply voltage minus the voltage loss in the two lead wires to the DVP driver does not drop below the driver input minimum voltage requirement.

3.3.1. American Wire Gauge Voltage Drop

A standard wire gauge voltage drop at maximum ambient temperature is provided in Table 3-2 to assist the cable selection.

A guideline for allowable voltage drop is to size wire for <5% of the nominal voltage under maximum transient conditions. Maximum transient current can be found in Table 3-1.

Table 3-2. Voltage Drop Using American Wire Gauge (AWG)

Wire Gauge (AWG)	Voltage Drop Per Meter @ 20 A Round-Trip (V)	Voltage Drop Per Foot @ 20 A Round-Trip (V)
8	0.100	0.031
10	0.165	0.050
12	0.262	0.080

3.3.2. Voltage Drop Calculation Using American Wire Gauge

Example: 10 AWG wires will drop 0.050 V/ft at 20 A at maximum ambient temperature. Using 100 feet between the DVP driver and the power supply would provide a voltage drop of 100x0.05= 5 V. It is very important to ensure the voltage at the driver's input terminal is within the product power input specification in order to achieve the maximum performance.

3.3.3. Wire Area Voltage Drop

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

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

Wire Gauge (mm^2)	Voltage Drop Per Meter @ 20 A Round-Trip (V)	Voltage Drop Per Foot @ 20 A Round-Trip (V)
10	0.087	0.026
6	0.144	0.044
4	0.216	0.066

Example: 6 mm^2 wires will drop 0.144 V/m at 20 A. Using 50 meters between the DVP driver and the power supply would provide a voltage drop of 50x0.144 = 7.2 V.

NOTICE

The voltage at the DVP input power terminal block must always provide the minimum voltage for the DVP to operate correctly. There is no cable length limitation to the input power of the DVP if the voltage at the DVP power input terminal is within the DVP voltage range specification.

3.4 Resolver Feedback

There are three resolver feedback inputs provided on the DVP for redundancy, or to separately read the position of multiple devices, such as the motor and actuator shaft. There is a 5 kHz excitation signal that is sent out to the resolver from the positioner, and a cosine and sine signal are sent back to the DVP. These signals are then translated through a resolver to digital conversion algorithm, and from the output of that block, the processor calculates the position of the motor. This information is fed into the control model at the appropriate intervals. The resolver feedbacks must be appropriately wired and shielded according to instructions and the length of the wires must be limited to 100 m. Lumped capacitance should be limited to 7 nF (Figure 3-3). If approved prefabricated cables are used, these issues have already been addressed.

3.5 LVDT Feedback

The three feedback connections are each configured as either resolver or LVDT to match the devices installed on the specific actuator or valve type attached to the DVP. This occurs automatically when the ID module is read on DVP power-up and requires no action by the user. The LVDT feedback system operates similarly to the resolvers. The difference in signal demodulation is handled in software.

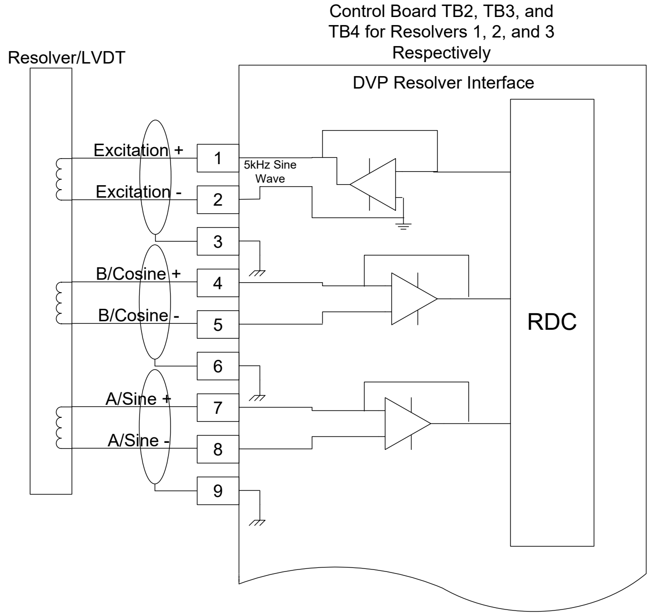


Figure 3-3. Position Feedback Transducer Interface Diagram

3.5.1. Resolver/LVDT Signal Requirement

- **Excitation (Generated from DVP)**
  - Frequency: 5 kHz
  - Voltage: Controlled by DVP
- **Resolver SIN, COS or LVDT A, B signals (Signal returned from the position sensor).**
  - Max Voltage: ±1.5 V

3.5.2. Position Feedback Transducer Wiring Requirements:

1. Shielding: Per drawing above
2. The maximum capacitance of the shielded twisted pair position feedback transducer cables should be less than a total of 7 nF (not including internal capacitance) to meet positioning accuracy and performance specifications
3. Maximum Run Length: 100 m
4. Wire Gauge Range: 16–24 AWG
5. All feedback cables must be run separately from the motor cables to avoid coupling between the high voltage switching drive signals and the lower-level position feedback transducer feedback signals.

3.6 Motor Drive Outputs

The DVP provides three available motor terminal outputs on the motor drive output, Figure 3-4. Each of the three output terminals is sized for 8 AWG wire. The motor drive output is software configured to drive a three-phase BLDC motor.

The safety ground and shield from the motor should be connected to the PE ground terminal provided on the DVP front panel. If approved prefabricated cables are being used, the appropriate grounding is provided via the cable wiring.

For best noise immunity, the motor power cables should be run in separate cable trays or conduits from the motor position feedback transducer cables.

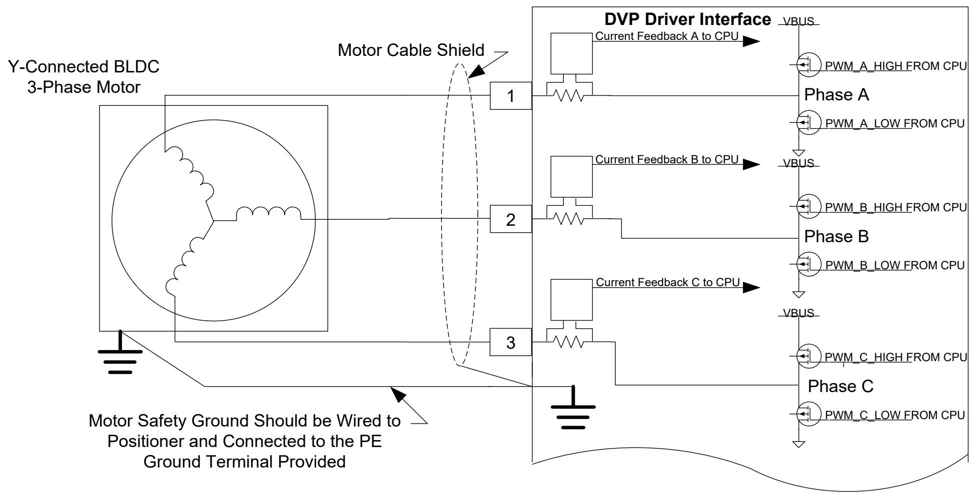


Figure 3-4. 3-Phase Motor Drive Diagram

3.6.1. Motor Drive Specifications

- **3-Phases Motor**
  - Switching Frequency: 10 kHz
  - Software configurable (depending on the valve application)
- **Maximum Motor Current (Motor Currents are dependent on the Load Actuator/Valve)**
  - Steady State Current: See valve manual
  - Transient Current: See valve manual

3.6.2. General Motor Wiring Requirements

- The motor wires should be twisted together to avoid excessive loop area that may radiate or be more susceptible to radiation.
- If separate cables are necessary, then the distance between conductors must be minimal to reduce the previously mentioned loops, as shown in Figure 3-5.
- Motor cable shielding is required for all installations of the DVP. The shield is terminated at the driver end only through the mating cable connector housing for the circular connector version or to an earth ground connection ⏚ for the conduit entry or terminal block version.
- All motor cables should be run separate from the lower-level signals to avoid coupling noise from the high voltage motor drive signals to the lower-level feedback signals.

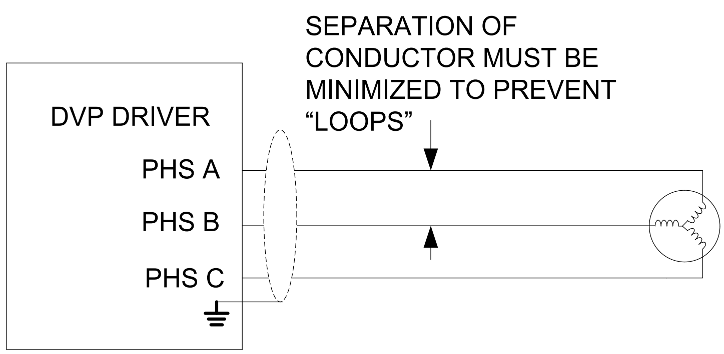


Figure 3-5. Preventing "Loops"

3.6.3. Motor Cable Length

Follow the indications and recommendations on wire gauge for each desired cable length in Table 3-4. For a motor output drive of the circular DVP model, the cable length is limited due to unavailable connector pins. A long distance beyond the recommended cable length will likely degrade the performance of the DVP.

Table 3-4. Motor Minimum Wiring Size Requirements Table

Maximum Cable Length		American Wire Gauge (AWG)	Metric Wire (mm^2)
328 ft	100 m	8	10
206 ft	63 m	10	6
131 ft	40 m	12	4

3.7 External Shutdown Input

The External Shutdown feature is an independent shutdown option for the DVP. It is a single discrete input that accepts a nominal voltage from 24 V or 125 VDC supply. A high level (signal present) will enable the DVP for operation. When the input is left open, the DVP will shut down the power to the motor drive inverter. Alternately, jumper one of the +24 V AUX outputs available on the EXTERNAL SHUTDOWN connector to the EXTERNAL SHUTDOWN input to permanently enable the DVP.

3.7.1. EXTERNAL SHUTDOWN Function

Once the EXTERNAL SHUTDOWN input is energized (high level input), the driver software starts the pre-charge sequence where the main bulk storage capacitors are charged. After a period of about 8 seconds, the inverter is ready to run. This sequence is controlled by software.

When the EXTERNAL SHUTDOWN input is de-energized (low input or open), power is removed from the inverter. When the EXTERNAL SHUTDOWN is energized again, the above pre-charge sequence repeats. See Figure 3-6 for connection information.

IMPORTANT	**The EXTERNAL SHUTDOWN input must be connected to a signal source or strapped to one of the +24 V AUX voltages to enable the driver. The unit is shipped with the connector (provided in the connector kit) pre-wired for operation. If an external source of EXTERNAL SHUTDOWN input is used, the jumpers can be removed. See Figure 3-6 for details.**

IMPORTANT	**For best EXTERNAL SHUTDOWN response time, the input signal transition from high to low should be actively driven low to get the fastest signal edge time.**

A solid-state relay output is provided as a readback that indicates the trip state of the DVP. A closed relay indicates DVP is enabled, an open indicates a tripped or disabled unit.

Table 3-5. External Shutdown Trip Specifications

Characteristics and Conditions	Symbol	Limits Min	Nom	Max	Units
a. Input Voltage Range	V_{IN}	18		150	VDC
b. Input Current Draw	I_{IN}	75		59	mA
c. Turn on Threshold	V_{ONTH}	17.5			VDC
d. Turn off Threshold	V_{OFFTH}	40		14.8	VDC
e. Trip Response Time [1]	T_{TRIP}			10	ms
f. Input Signal Logic Definition	High		DVP Enabled		N/A
	Low		DVP Disabled		N/A

[1] Defined as time from removal of External Shutdown signal to Removal of Actuator Power

Table 3-6. External Shutdown Discrete Output Readback Specifications

Contact Rating:	150 VDC
Maximum Current:	1Adc
Signal Definition:	Open – driver tripped
	Closed – driver enabled
Isolation:	Fully isolated, 1500 VAC (2121 VDC) to power inputs, chassis, and all control circuits

Table 3-7. 24Vdc Aux Power Outputs

Voltage Range:	24 V ± 10%
Maximum Current:	0.25 A/each
Isolation:	Fully isolated, 500 VAC (707 VDC) from each other, chassis, and all control circuits

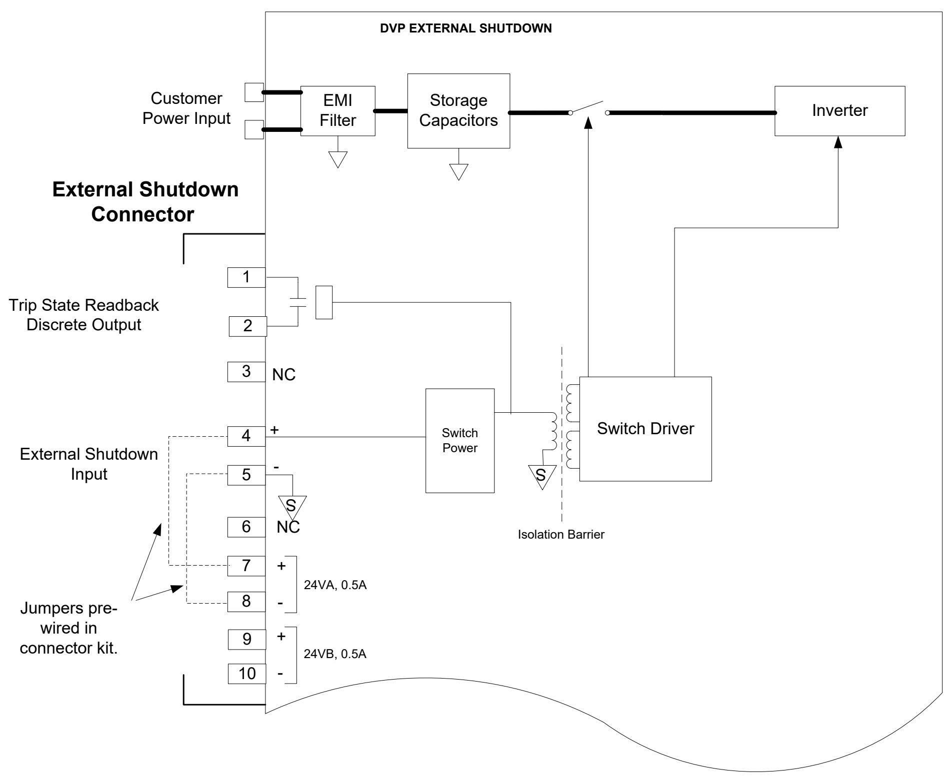


Figure 3-6a. External Shutdown Interface Diagram

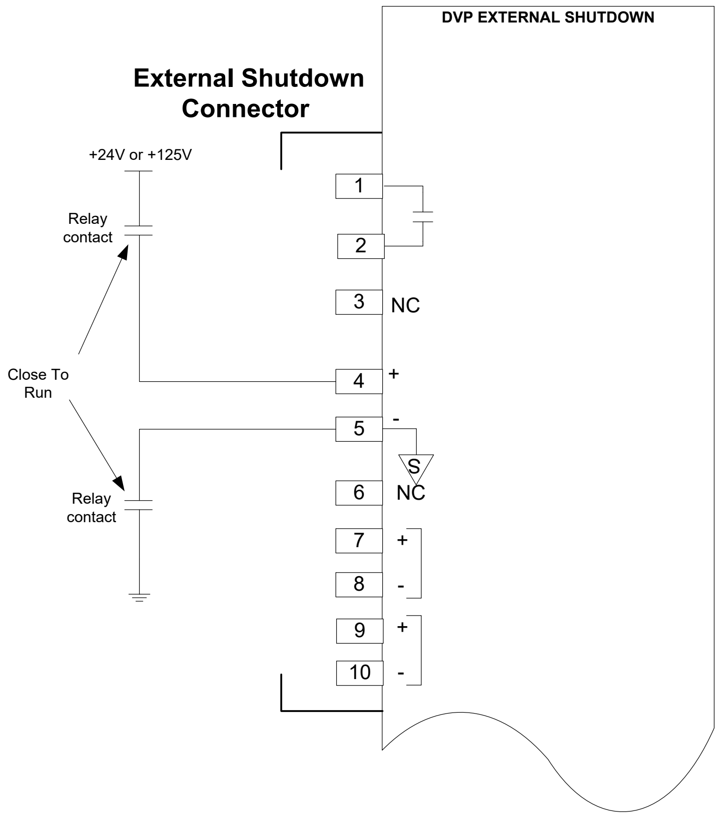


Figure 3-6b. Sample External Shutdown Wiring Example

3.8 Ethernet Communication Ports

DVPs equipped with the optional Ethernet Communications Module support Ethernet communications to the driver from a master controller. The DVP receives command inputs from the master control and will generate a digital response. The wiring requirements and supported EGD protocol is defined below. Please contact your Woodward representative for availability of alternate Ethernet-based protocols.

When the Ethernet module is present, Ethernet communications provides command input for the DVP. This interface currently utilizes the EGD (Ethernet Global Data) protocol. The three Ethernet channels are voted two out of three to ensure operational reliability if one of the channels fails. See Figure 3-7 and Table 3-8 for the pin-out diagram and required Ethernet / EGD settings.

For information related to Cyber-security and the DVP, see manual 35124.

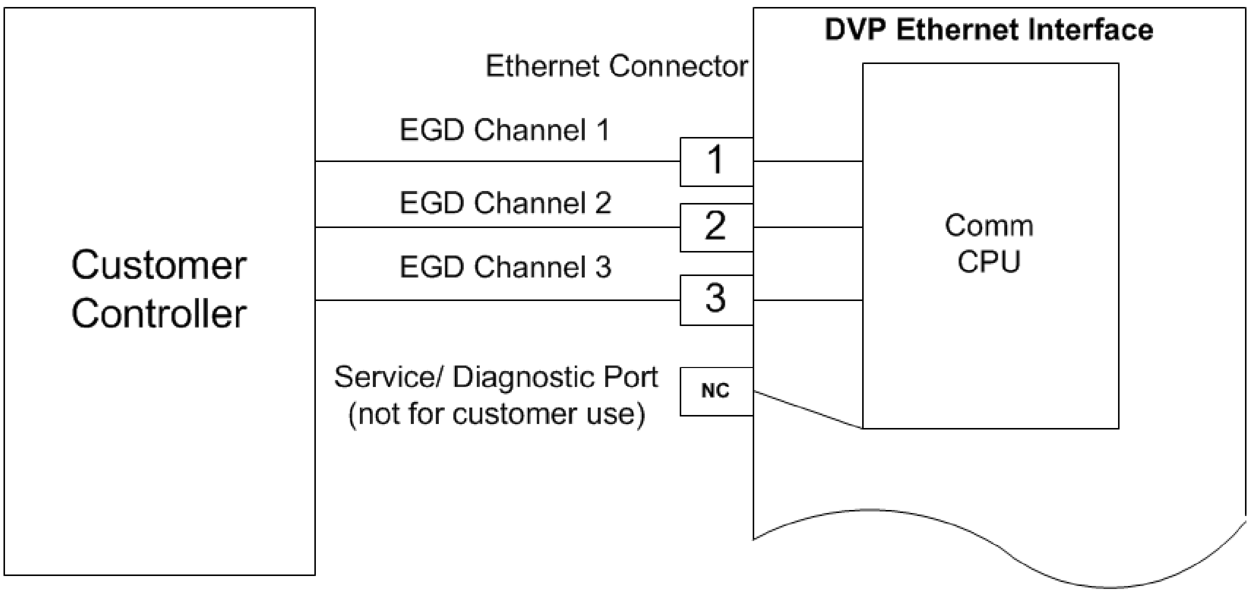


Figure 3-7. Ethernet Interface Diagram

3.8.1. Wiring Requirements:

- Double Shielded (SSTP) cables are required
- CAT-5 Ethernet Cable
- Maximum Run Length: 30 m
- For long Ethernet cables where ground loops are a concern, the shield should be capacitive coupled at one end.

3.8.2. Connection Types (Auto Sensing):

- 10 Base-T
- 10 Base-T Full Duplex
- 100Base-TX
- 100Base-T4
- 100Base-TX Full Duplex

3.8.3. Ethernet Port Configuration Requirements:

All ports configured for different subnets.

Table 3-8. EGD Triplex Communication Configurations

Port	Port Function	DVP Port Configuration IP address Subnet	DVP EGD Producer Configuration Producer ID Exchange Num	Customer Controller IP address Subnet	Customer Controller EGD Producer Configuration Producer ID Exchange Num
1	EGD Chan 1	192.168.128.20 255.255.255.0	192.168.128.20 20	192.168.128.1 255.255.255.0	192.168.128.1 1
2	EGD Chan 2	192.168.129.20 255.255.255.0	192.168.129.20 20	192.168.129.1 255.255.255.0	192.168.129.1 1
3	EGD Chan 3	192.168.130.20 255.255.255.0	192.168.130.20 20	192.168.130.1 255.255.255.0	192.168.130.1 1
4/NC	Service / Test Port	172.16.100.10 255.255.255.0	No Connection	No Connection	No Connection

The above table defines the required configuration of both the Ethernet ports and the EGD protocol. The DVP comes preconfigured for the configuration shown in the table. The IP addresses of the EGD ports are not configurable from the DVP service tool. The DVP will not communicate if the IP address / subnet of the customer controller ports are not configured as shown in the DVP configuration table.

EGD producer interface of the DVP is configured to generate an EGD packet with the Producer ID and exchange number set to the values defined in the DVP EGD Producer Configuration column of the table. The DVP EGD consumer interface is configured to accept EGD packets from the customer controller with the producer ID and exchange number set to the values defined in the Customer Controller EGD Producer Configuration column.

3.9 RS-232 Service Port

Use the RS-232 port (Figure 3-8) only during the DVP configuration or troubleshooting with the Service Tool. See Chapter 5 for initial setup information of this positioner. Perform all normal operation command and monitoring through the Ethernet, CAN, or other command and feedback type depending on the positioner configuration. It is recommended that an RS-232 isolator be applied when using the serial port to avoid any possible communication issues. The reason for this is that the port is not isolated, and it is desired to avoid any potential ground loops or unnecessary EMI noise coupling related to PC connections and typical industrial environments. The RS-232 port requires a straight-through cable.

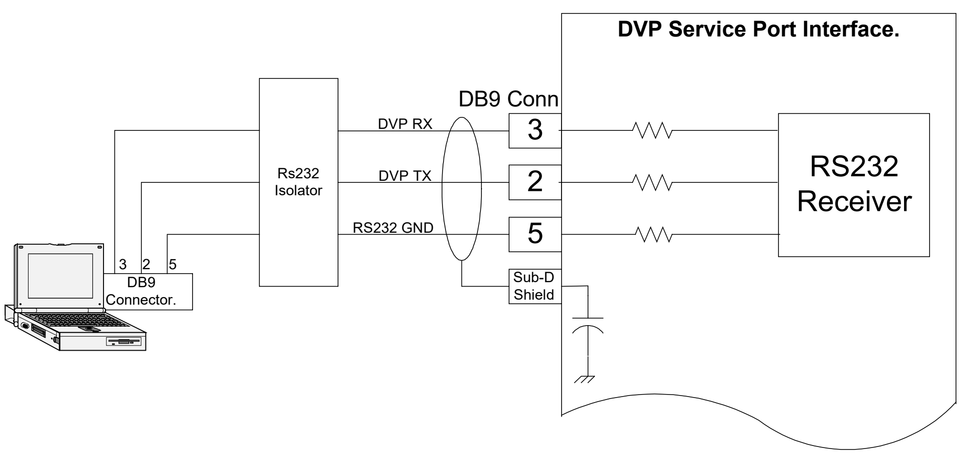


Figure 3-8. RS-232 Interface Diagram

3.9.1. RS-232 Communication Specification

- **Data Rate:**
  - Fixed baud rate at 38.4 kbps
- **Isolation:**
  - 1500 VAC from input power

3.9.2. Wiring Requirements

- External RS-232 isolator is recommended (Phoenix Contact PSM-ME-RS-232/RS-232-P, Woodward P/N 1784-635)
- Straight-through cable type

3.10 Analog Input

The analog input for the DVP is a 4–20 mA or 0–5 V configuration and can be configured through software to be used as the position command input. The input may be used as either a 4–20 mA input or a 0–5 V input, and this configurability is also done through software.

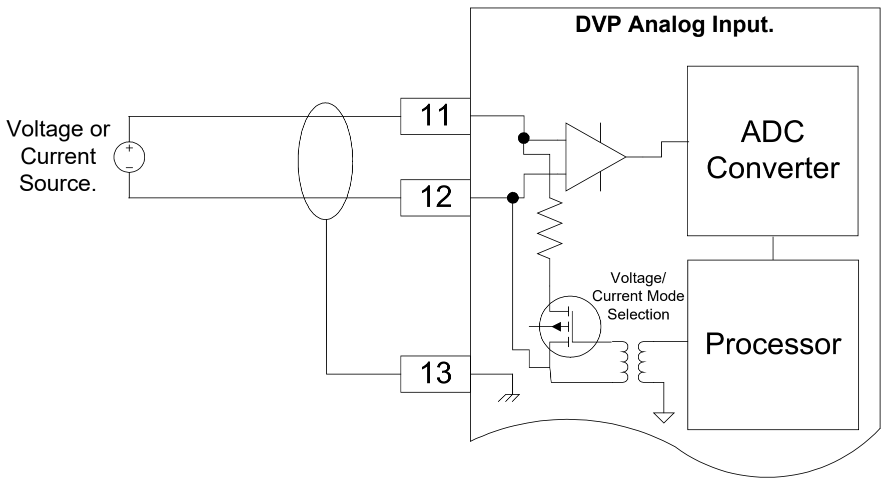


Figure 3-9. Analog Input Interface Diagram TB5-A

Table 3-9. Analog Input Specification

Analog 4–20 mA:	Range is 2 to 22 mA
Analog 0–5 V selection:	Range is 0 to 5 V
Maximum Temperature Drift:	200 ppm/°C
Calibrated Accuracy:	0.1% of FS
Common Mode Voltage:	±100 V
Common Mode Rejection Ratio:	–70 dB @ 500 Hz
Isolation:	400 kΩ from each terminal to Digital Common
	1500 VAC from Input Power

Table 3-10. Wiring Requirements

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)

3.11 Analog Output

The Analog Output of the DVP is in the form of a 4–20 mA output and can drive load resistances up to 500Ω. This output can be configured to perform one of many different tasks, such as reporting actual position, set position, or in the case of a speed control, the output can report speed. This output is designed for monitoring and diagnostic purposes only and is not meant for any type of closed loop feedback.

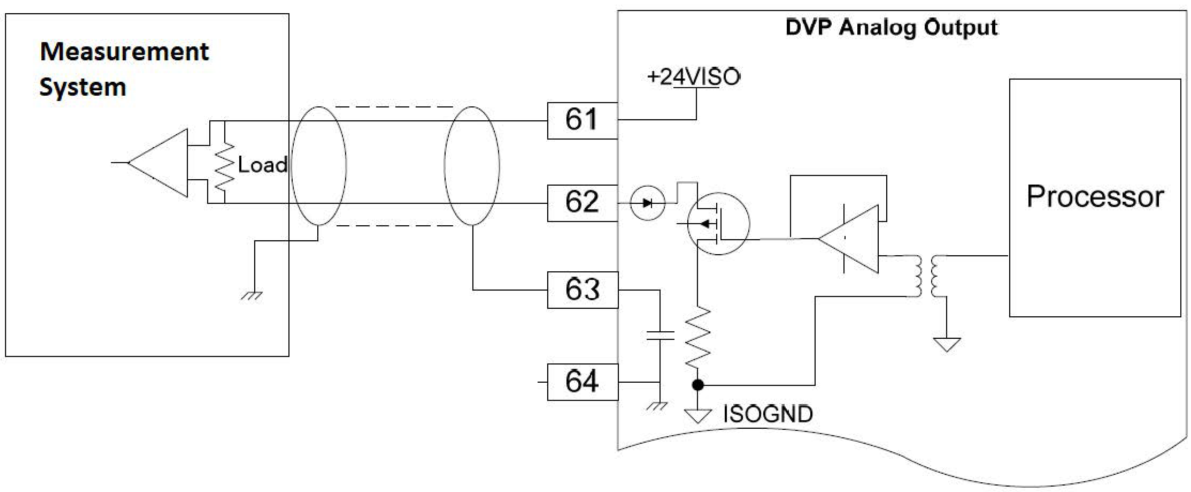


Figure 3-10. Analog Output Interface Diagram TB7-B

Table 3-11. Analog Output Specification

Calibrated Accuracy:	0.5% of full range
Output Rang:	4 to 20 mA
Load Range:	0 Ω up to 500 Ω
Maximum Temperature Drift:	300 ppm/°C
Isolation:	500 VAC from Digital Common 1500 VAC from Input Power

Table 3-12. Wiring Requirements

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 mm^2)

If the measurement system is grounded, terminate ANALOG OUTPUT SHIELD at pin 63 as shown in Figure 3-10.

Only one end of the ANALOG OUTPUT SHIELD should have a direct connection to ground.

3.12 Discrete Inputs

The DVP has five discrete inputs. 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 18 VDC source pulls the sensing signal to the high state. Through the software, 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 as active low to protect against broken wires. A broken wire will look like an open input, which will be the inactive state. 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.

There are five inputs and only three ground terminals provided, so it may be necessary to use one ground for multiple inputs. This is understood and allowable.

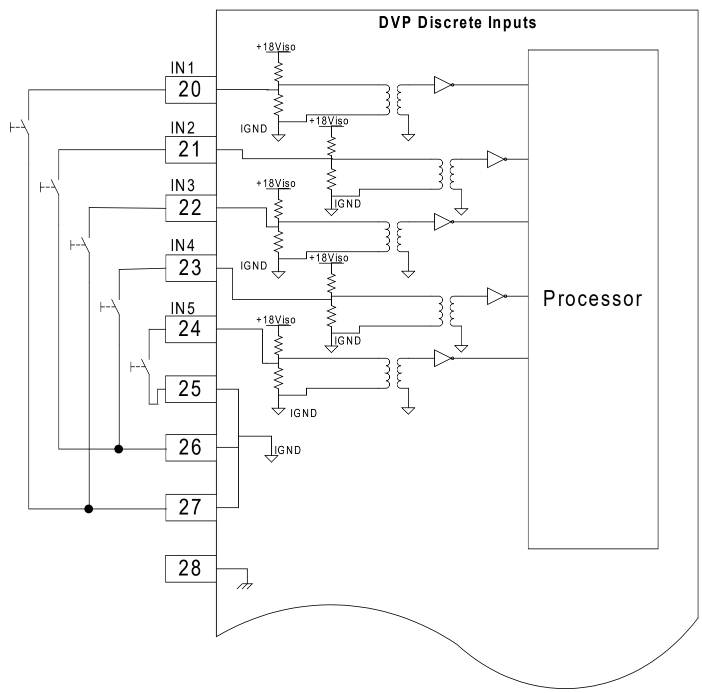


Figure 3-11. Discrete Input Interface Diagram TB5-B

3.12.1. Discrete Input Specification

- **Trip Points**:
  - If the input voltage is less than 3 V the input is guaranteed to detect a low state (input voltage < 3 V = LO).
  - If the input voltage is greater than 7 V the input is guaranteed to detect a high state (input voltage >7 V = HI).
  - The open state will look like a high state to the controller, and therefore the two states of the input are open or tied to ground.
  - The hysteresis between the low trip point and the high trip point will be greater than 1 V.
- **Contact Types:**
  - The inputs will accept either a dry contact from each terminal to ground or an open drain/collector switch to ground.
- **Isolation:**
  - 500 VAC from Digital Common, 1500 VAC from Input Power

3.12.2. Wiring Requirements:

- 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

3.13 Discrete Outputs

There are two Discrete Outputs on the DVP. Either output 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. The outputs can be used as high side or low side drivers depending on user preference. However, Woodward recommends that the output be used as a high side driver as shown in the diagram below. This configuration will make some common wiring faults to ground more detectable.

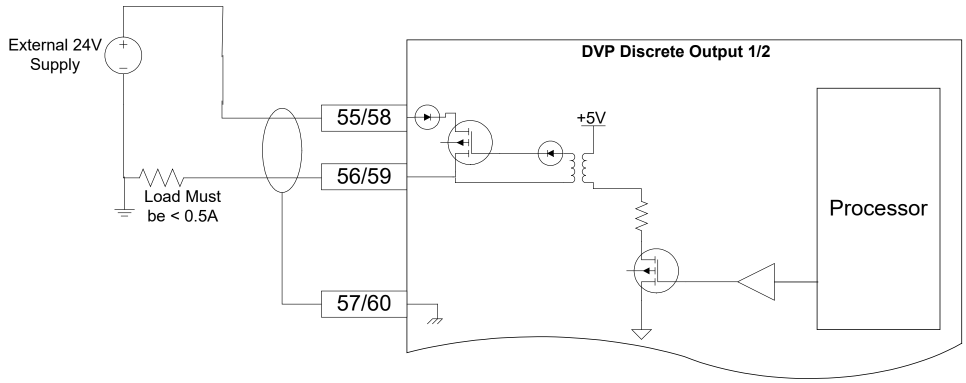


Figure 3-12. Discrete Output Interface Diagram TB7-B

Table 3-13. Discrete Output Specification

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
Hardware Configuration Options:	The outputs can be configured as high-side or low-side drivers, but we recommend that they be used as high side drivers if possible
Isolation:	500 VAC from Digital Common, 1500 VAC from Input Power

Table 3-14. Wiring Requirements

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:	Per Figure 3-12

3.14 CAN Communication Ports 1 and 2

The DVP device may be controlled via CAN communication. There are three possible CAN modes:

1. CANopen single with or without analog backup
2. CANopen dual
3. CANopen virtual

1. The CANopen single with or without backup:
This mode uses CAN port 1 for communication. Optionally, it is possible to configure (by CAN communication) the analog input as a backup signal. By default, the analog input 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 any more (detected by communication time out), CAN port 2 is used for communication.

3. CANopen Virtual:
This mode is used when two DVPs are linked together to control more than one actuator or valve. This is used for Dual Redundant DVP Operation.

The CAN communication baud rate can be selected. The possible options are:

- 125 kbps
- 250 kbps
- 500 kbps

Per CiA DS-102 Standard, the following are the recommended maximum cable lengths. Differences in the baud rate and the cable length affect the number of units that can be put onto a network.

Table 3-15. CAN Communication Recommended Cable Lengths

Baud Rate	Cable Length	Number of DVP on link
500 Kbps	100 m	15
250 Kbps	250 m	7
125 Kbps	500 m	3

NOTICE

For communication wiring, use wires with a temperature rating of at least 5°C above surrounding ambient. All other functions use wires with a temperature rating of at least 10°C above surrounding ambient.

IMPORTANT

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

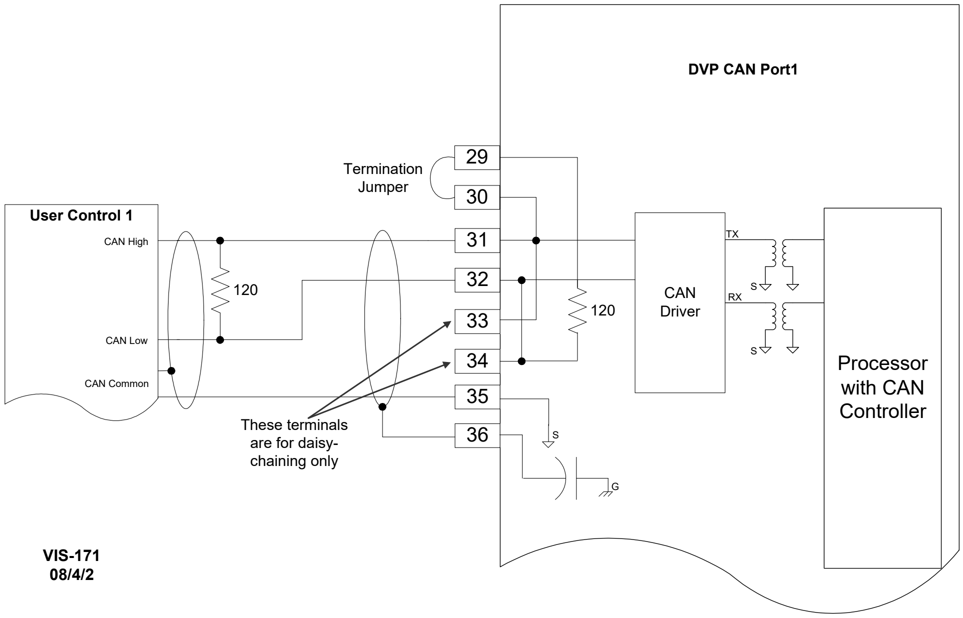


Figure 3-13. CAN Port 1 TB6

If CAN port 1 is used, see Figure 3-13 of the CAN port interface. See the Analog Input section above for the analog interface diagram when CAN is used with an Analog Input backup.

Pins 29 and 30 are the termination jumper. Connecting these two pins with a short wire on the connector will enable an internal 120 Ω resistor between CAN high and CAN low wire.

NOTICE

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

Pins 31 and Pin 32 are the CAN High and CAN low wires typically found on a CAN system.

Pins 33 and 34 are two additional CAN high and CAN low pins. These can be used to daisy chain the CANbus to the next device, without the need for a junction box.

NOTICE

If the daisy chain is used, disconnecting the connector will disconnect the complete CANbus. Other devices communicating on the CANbus will not be able to communicate any more. If this is not desired, do not daisy chain the DVP.

Pin 35 is the CAN ground. The DVP side of the CAN link is galvanically isolated from the DVP, ground, and system common. Therefore, we need to connect the isolated ground to the ground of the user control.

Pin 36 is used to terminate the CAN wiring shield.

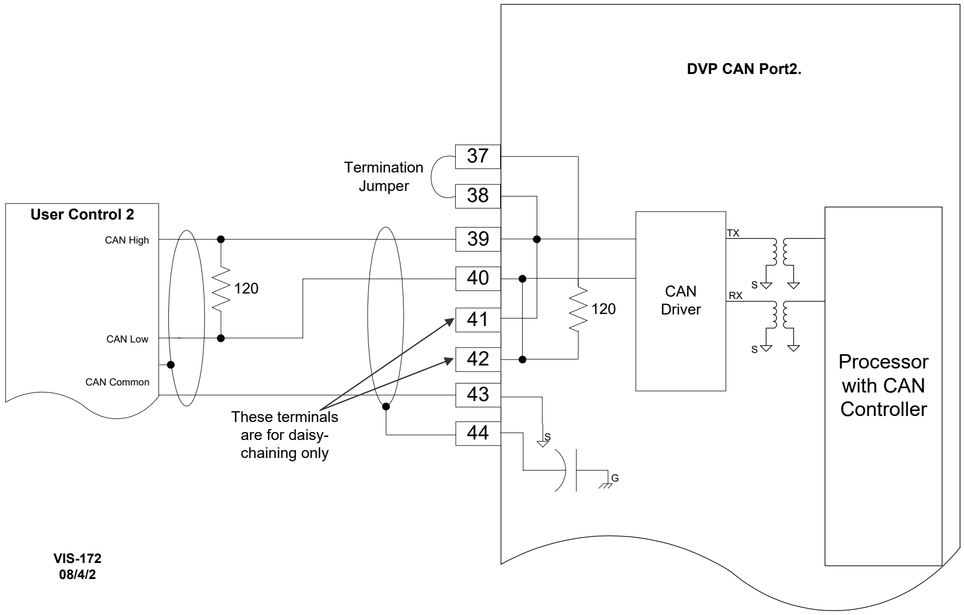


Figure 3-14. CAN Port 2 TB6

When using dual can communication mode, there are two identical communication ports. Port 1 and Port 2 are wired identically. For description, see Port 1.

Table 3-16. Dual CAN Communication Wiring Specifications

Pin Number	Function
29	CAN 1 Termination jumper
30	CAN 1 Termination jumper
31	CAN 1 High in
32	CAN 1 Low in
33	CAN 1 High out
34	CAN 1 Low out
35	CAN 1 ISO GND
36	CAN 1 Shield
37	CAN 2 Termination jumper
38	CAN 2 Termination jumper
39	CAN 2 High in
40	CAN 2 Low in
41	CAN 2 High out
42	CAN 2 Low out
43	CAN 2 ISO GND
44	CAN 2 Shield

See Appendix A for more information on CANopen communications.

3.14.1 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 DVP responds to commands intended for the appropriate device. There are two methods for setting this value— software or hardware/wiring. The method is defaulted to a predetermined configuration based on the DVP part number but can be changed using the Service Tool (see manual 26912). With the software option, the node ID setting is a user-defined value set in software. The hardware/wiring (also referred to as harness coding) option uses discrete inputs to select an index which sets the node ID value. The index is determined by the power-up state of the discrete inputs. Note that the discrete input condition is based on open or closed state at power-up, ignoring the active high/low configuration. Changes to any Node ID-related software settings require a power cycle to take effect.

The discrete input CAN ID selection has three different options. The index can be based on two, three, or four discrete inputs, allowing three, seven, or 15 valid preprogrammed settings. This selection method is set using the Service Tool as part of the CAN demand configuration. Tables 3-17, 3-18, and 3-19 identify the selected index based on the configured selection method.

Definitions:

- Discrete Input 5: connection between terminal 24 and GROUND
- Discrete Input 4: connection between terminal 23 and GROUND
- Discrete Input 3: connection between terminal 22 and GROUND
- Discrete Input 2: connection between terminal 21 and GROUND
- Discrete Input 1: connection between terminal 20 and GROUND
- (GROUND can be any terminal 25, 26 or 27)

Table 3-17. Two Input Index Selection

Index Selected	Discrete Input 5	Discrete Input 4
INVALID	Open	Open
1	Open	Closed
2	Closed	Open
3	Closed	Closed

Table 3-18. Three Input Index Selection

Index Selected	Discrete Input 5	Discrete Input 4	Discrete Input 3
INVALID	Open	Open	Open
1	Open	Open	Closed
2	Open	Closed	Open
3	Open	Closed	Closed
4	Closed	Open	Open
5	Closed	Open	Closed
6	Closed	Closed	Open
7	Closed	Closed	Closed

Table 3-19. Four Input Index Selection

Example Device #	Index Selected	Discrete Input 5	Discrete Input 4	Discrete Input 2	Discrete Input 1
N/A	INVALID	Open	Open	Open	Open
Pressure Control Valve	1	Open	Open	Open	Closed
Metering Valve #1	2	Open	Open	Closed	Open
Metering Valve #2	3	Open	Open	Closed	Closed
Metering Valve #3	4	Open	Closed	Open	Open
Metering Valve #4	5	Open	Closed	Open	Closed
Liquid Metering Valve #1	6	Open	Closed	Closed	Open
Liquid Metering Valve #2	7	Open	Closed	Closed	Closed
Liquid Metering Valve #3	8	Closed	Open	Open	Open
Liquid Metering Valve #4	9	Closed	Open	Open	Closed
Dual Actuator #1a	10	Closed	Open	Closed	Open
Dual Actuator #1b	11	Closed	Open	Closed	Closed
Dual Actuator #2a	12	Closed	Closed	Open	Open
Dual Actuator #2b	13	Closed	Closed	Open	Closed
Dual Actuator #3a	14	Closed	Closed	Closed	Open
Dual Actuator #3b	15	Closed	Closed	Closed	Closed

3.14.2 Instructions for Use of CAN ID Terminal Blocks

When using the harness coding method (as described in Section 3.14.1), it is necessary to install a jumper terminal block within each positioner during initial installation. This terminal block configures each positioner for proper communication with its assigned primary or secondary CAN Open Network. The installation of this terminal block must be performed before attempting power-up or communications across the CAN Open Network. Until this process is complete, the positioners will not communicate with the networks. Install jumpers based on the CAN ID Node Selection and using the information from the appropriate table (3-17, 3-18, and/or 3-19).

Proper installation of the CAN ID Terminal Blocks is performed by the following steps:

1. Ensure that there is no power being applied to the DVPs.
2. Determine which DVP will be connected to the Primary CAN Network, and which will be connected to the Secondary CAN Network.
3. Create the appropriate CAN ID Terminal Block associated with each CAN Network.

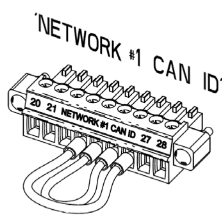


Figure 3-15. Example Index 12
CAN ID Terminal Block

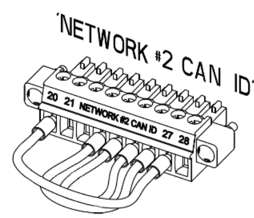


Figure 3-16. Example Index 13
CAN ID Terminal Block

After identifying the appropriate CAN ID Terminal Block, install it into TB5-B as shown in Figure 3-17 with the #20 terminal position on the top.

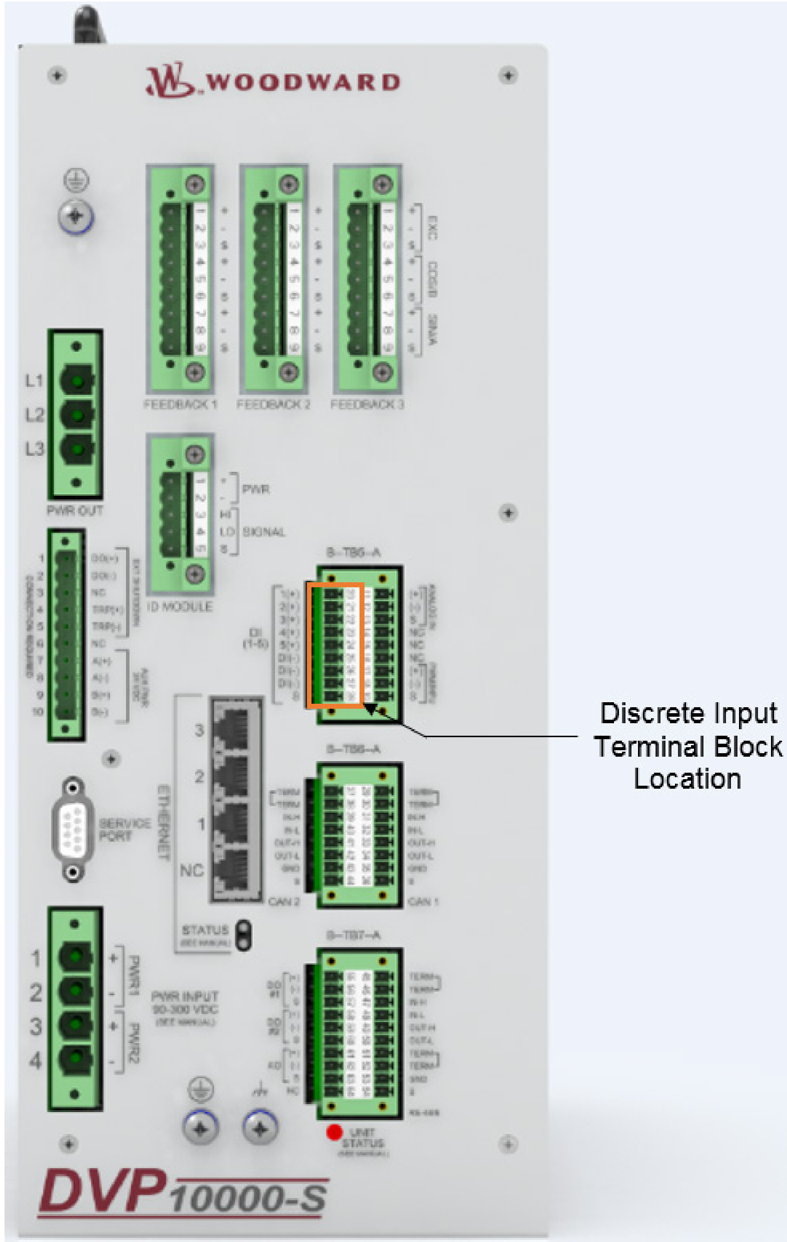


Figure 3-17. Installation Position for CAN ID Jumper

After installation of the jumper terminal blocks, tighten the retaining screws to 2.5 to 3.5 in-lb (0.3 to 0.4 N-m).

3.14.3 Virtual CAN Networks

When two DVPs are used in a dual actuator configuration, the supporting CAN networks are implemented in a somewhat different fashion as compared to operation of a single device. When used in a dual configuration, each DVP is only connected to one network, but still receives a redundant message in the event of a single network fault. Each drive receives its primary CAN message via the network to which it is directly connected as well as a redundant message which is broadcast via the mating positioner across the dual internal link.

For example, as shown in Figure 3-18 below, the positioner connected to IGV-1 is directly connected to CAN network 1, and IGV-2 is directly connected to CAN Network 2. However, Network 1 is considered primary and used by both positioners unless there is a detected fault on that network. The CAN messages destined for both IGV-1 (example address 12) and IGV-2 positioner (example address 14) are normally transmitted across Network 1. The DVP for IGV-1 receives its message directly across Network 1. The DVP for IGV-2 gets its message from DVP-1 across the dual internal link. Conversely, the redundant messages on Network 2 are received directly by the IGV-2 positioner which transmits them across the dual internal link to the IGV-1 positioner. By this method, each drive receives both the primary and redundant message stream. If a fault occurs on the primary network, the system will automatically switch over to the message stream on Network 2. If one of the internal links were to fail, the system will continue transmitting across the second internal link.

By this operation, dual redundant operation and full diagnostics capability is maintained with only two networks. This is critical to maintaining synchronization of the actuators even in the event of a single network fault.

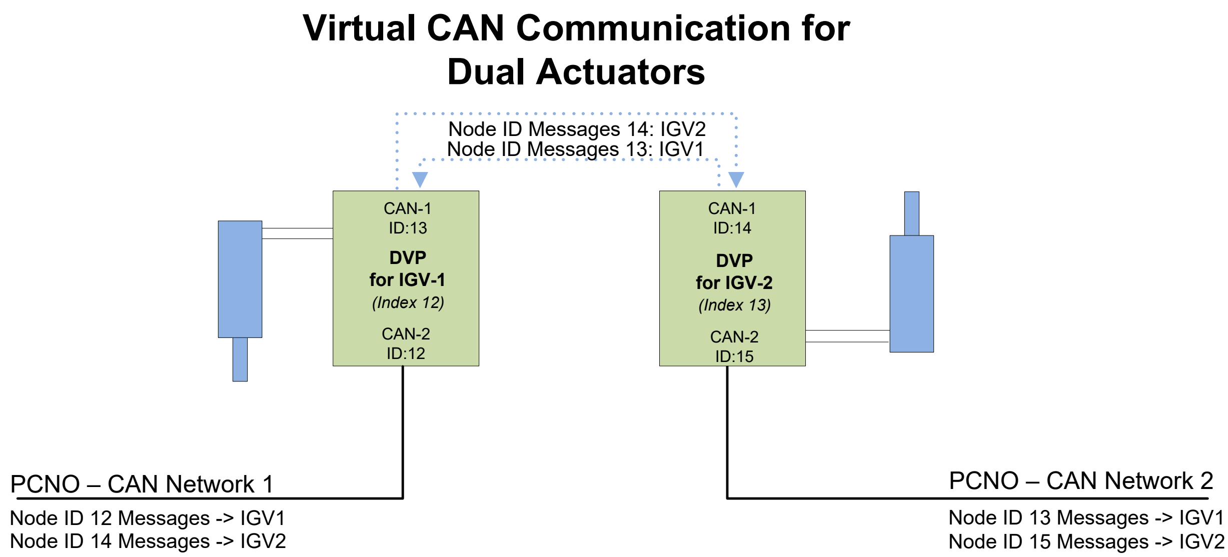


Figure 3-18. Virtual CAN Communication for Dual Actuators

3.14.4 Dual Redundant Communication Setup

The DVP has an option to operate in a dual redundant or virtual mode where two actuators are controlled by DVPs connected in a dual redundant configuration. Connection to the actuator is shown in the specific actuator manual. Figure 3-19 is the diagram for connection between DVPs. The cable length of the DVP-DVP interlink (CAN 1 and RS485) should be kept to < 3m (< 10ft). For more information, see the sections on RS-485 and CAN.

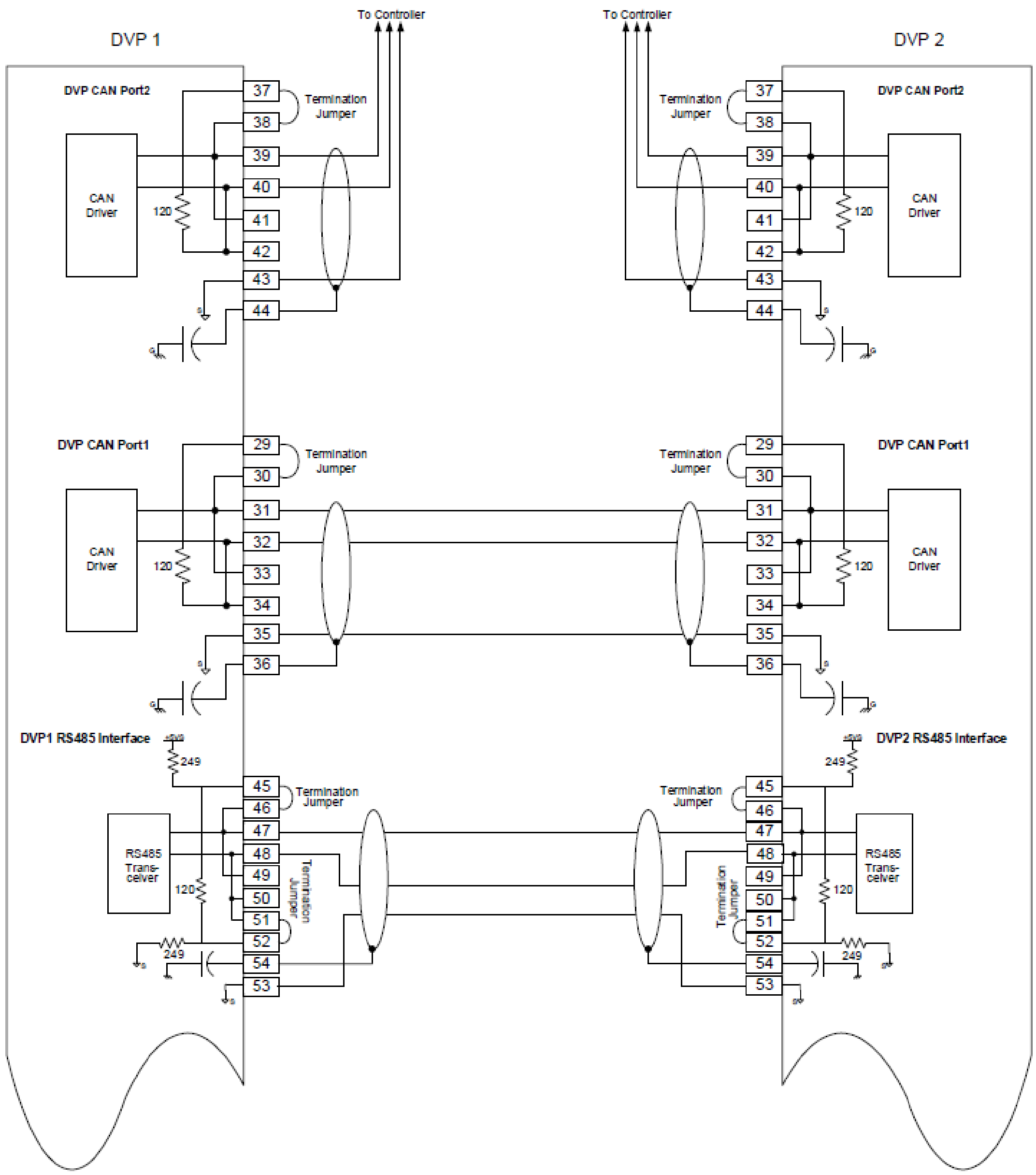


Figure 3-19. Dual Redundant DVP Connection Diagram

3.15 RS-485 Communication Port

The DVP provides an isolated RS-485 communication port (Figure 3-20). This port can be used for a long-distance connection to the control system to utilize the Service Tool or for the dual DVP internal link.

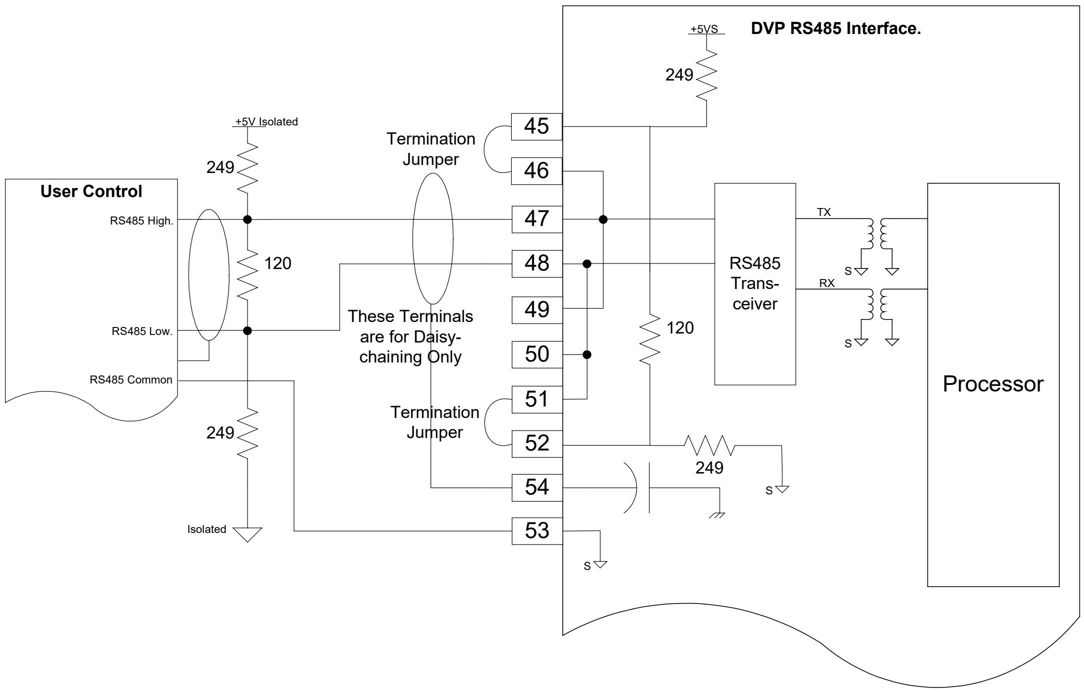


Figure 3-20. RS-485 Interface Diagram TB7-A

3.15.1 RS-485 Port Specification (Service Port)

- **Baud Rate:**
  - Fixed at 38.4 kbps
- **Isolation:**
  - 500 VAC from Digital Common, 1500 VAC from input power

3.15.2. Wiring Requirements:

- 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
- **Shielding**:
  - per drawing above

Chapter 4.
Description of Operation

4.1 Functional Description

The DVP is a digital electronic position controller designed for use with many Woodward actuator/valve combinations that are electrically driven. The positioner allows for three different resolver or LVDT combinations and two independent power supply inputs for redundancy in both feedback and power. Normally, resolvers are used for motor commutation and position control, while LVDTs are used for final shaft sensing. The DVP is capable of driving a three-phase brushless DC motor.

The DVP accepts a position demand signal from the user in the form of Ethernet, 4–20 mA, 0–5 V, RS-485, CAN, or PWM depending on the hardware and software configuration of the DVP.

This position setpoint is processed by a digital, model-based control algorithm, which modulates the motor position (indicated by resolver feedback) to track this setpoint. No controller dynamic tuning is needed. Internal bus voltage, current feedback from the inverter phases, and other information is incorporated into this controller to ensure consistent performance as external conditions vary. These conditions, in conjunction with configuration parameters such as number of motor revolutions per full stroke, coil inductance, zero cutoff settings, and valve specific offsets are used to convert the raw signal data to precision measurements appropriate for the actuator/valve system which the DVP is controlling.

The DVP is shipped in a factory set, auto-detect mode. When connected to a valve or actuator equipped with an integrated “ID Module”, the DVP automatically detects the type of valve to which it is connected and performs a self-configuration process. The content of the ID Module is automatically uploaded into the DVP which is then configured with appropriate configuration settings, including the factory set start-up limits. The objective of the startup checks is that all start up limits are passed prior to entering the normal operating mode.

The DVP is protected against I/O, motor, and grounding faults. The motor output will tolerate a fault condition (like a phase short or earth fault) for a predetermined amount of time before turning off the inverter. The controller protects the DVP against actuator overloads by limiting the output and input currents to the driver. If the overload causes current limiting, full output current is maintained if possible and the actuator will move at a slower speed to prevent motor stall.

The DVP incorporates a suite of monitoring diagnostics which continuously monitor the operation and condition of several different sub-systems. Any sensed diagnostic condition is captured and flagged. For devices controlled via digital communications such as CAN or Ethernet, these diagnostics are transmitted back to the main control system.

For devices controlled via analog signals, discrete outputs can be connected to signal an alarm or shutdown condition. A precise determination of the diagnostic condition can be performed using the PC service tool which supports the DVP product family.

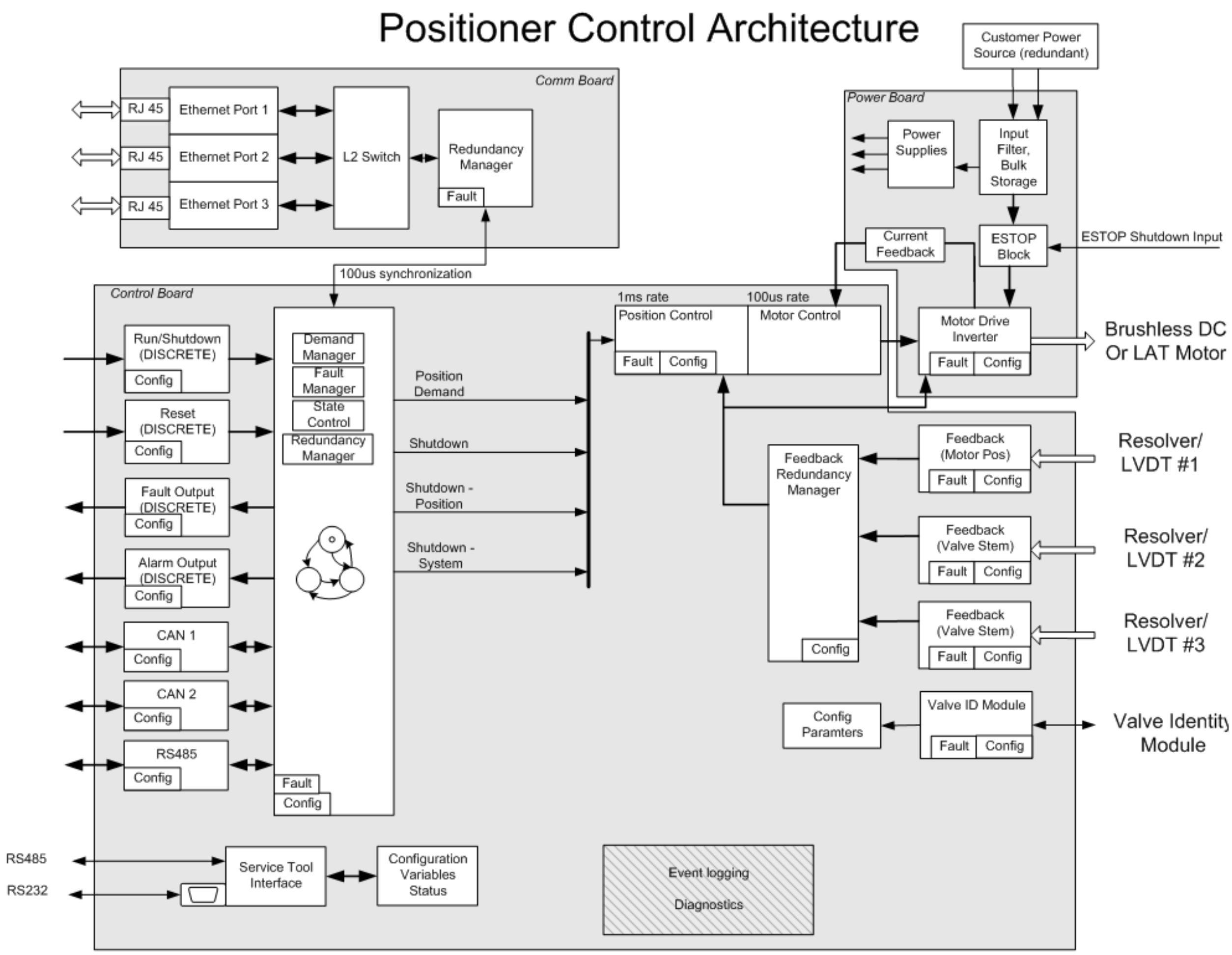


Figure 4-1. Functional Block Diagram

4.2 Startup Checks

Whenever the DVP is reset from a power up or any critical diagnostics shutdown, a series of automatic startup checks is performed and must be successfully completed before the DVP enters the running state. The purpose of the start-up checks is to ensure that correct feedback readings are verified, that the valve or actuator is at the required start-up or "home" position (and confirmed by more than one sensor), and that the actuator moves in the correct direction when commanded before resuming operation. Since many actuators use multi-turn reduction gear trains with multi-turn feedback systems, it is important that the starting point or "zero turn" of the system be confirmed during the startup process. This is particularly important for normally closed control valves, to ensure that the valve is not open at the indicated 0% position, and to prevent a potentially dangerous high flow starting condition. For other actuators controlling externally connected equipment or linkage, verifying the correct zero point during startup can prevent potential collision against the actuator's internal end-stops, or against a hard stop within the driven linkage. This is important to prevent damage of the actuator, driven equipment, or both.

The startup checks are a critical function designed to help ensure system safety. The DVP Valve/Actuator Startup Check sequence includes a Minimum Direction Startup Check, Maximum Direction Startup Check, and Motor Direction Check. Each of these are explained in further detail in the DVP Service Tool Manual 26912. This manual lists how the startup check indications are displayed. The various fault conditions are also referenced in the troubleshooting chapter for explanation and recommended actions.

4.3 General Description of a Dual Positioner System

The DVP provides capability to synchronously operate dual actuators, for example for control of gas turbine variable geometry systems. This dual positioner, dual actuator system also supports control from dual CAN Open networks for precise digital control and diagnostics of the positioners and actuator system. An important feature of the dual drive system is the ability to synchronize operating states of both positioners, as well as the positions of both actuators. Diagnostic information is exchanged between the two drives to manage certain failure modes. A simplified diagram of the dual actuator and positioner system is shown in Figure 4-2 below.

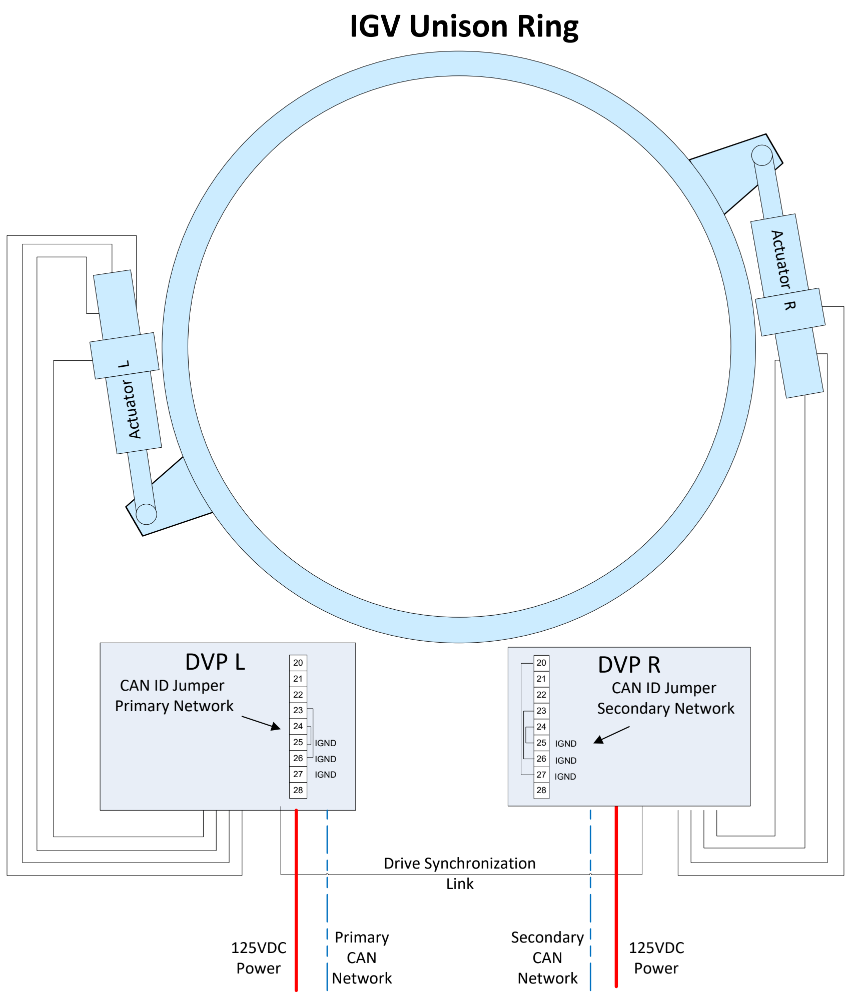


Figure 4-2. Dual Actuator and Positioner System Diagram

4.3.1 Purpose of the CAN ID Jumper Terminal Blocks

To improve the availability of the system, in the event of a failure one of the CAN Open networks, each of the positioners used in the dual actuator system is connected to a separate CAN Open control network. One network is designated as the “Primary Network”, the other is designated as the “Secondary Network”. Under normal circumstances, the operating states (run, shutdown, reset) as well as the control messages (position setpoint, position feedback, diagnostics) are transmitted to both positioners via the primary network. The 2nd positioner receives the primary operating states and control messages across the drive synchronization link such that both positioners operate on the exact same message stream. In the event of primary CAN network failure, both positioners revert to the secondary CAN network data stream. In this case also, the drive synchronization link ensures both positioners operate with consistent information from the secondary network.

4.3.2 Commissioning Checks

After completing all power wiring, actuator wiring, and dual DVP wiring as indicated in Chapter 3, a functional check is recommended to ensure that all aspects of the dual system are performing correctly. The sequence below is provided as a basic set of commissioning checks. Please ensure that all plant level safety procedures are followed in addition to these checks.

1. Continue wiring of the DVP Power, CAN Network Connections, and any discrete I/O as required by the application.

2. Connect all cables between the DVP and the actuator. Ensure that the connector locking rings are snug.

3. Ensure that all personnel are clear from the actuators and driven equipment. Complete any necessary local procedures or checks required by the plant or installation prior to applying power to the DVP’s.

4. Power up the DVP. Wait for the status LED to cycle from fast red/green which indicates device boot up to a steady red flashing indicator. The steady flashing red indicator signals that boot up is complete. A flashing red indicator is normal as the system is awaiting a reset command prior to enabling operation.

5. Reset the DVP’s. Test operation from both primary and secondary CAN Networks. Confirm that both networks are operational. If the status indication does not transition from a steady red flash to a steady green flash, refer to the DVP operating manual for troubleshooting information.

6. Once the status LED flashes a steady green display, the DVP reset has been successful. From the CAN network, send a setpoint value to the DVP. The actuators should begin tracking the setpoint.

7. Test operation from both the primary and secondary networks. Refer to the control system and plant operating instructions for instructions on how to manually position the valves from the turbine control system.

4.4 Operational Limitations

The DVP incorporates a suite of monitoring diagnostics which continuously monitor the operation and condition of several different sub-systems. Any sensed diagnostic condition is captured and flagged. For devices controlled via digital communications such as CAN or Ethernet, these diagnostics are transmitted back to the main control system.

For devices controlled via analog signals, discrete outputs can be connected to signal an alarm or shutdown condition. A precise determination of the diagnostic condition can be performed using the PC service tool which supports the DVP product family.

The information given in this manual represents the maximum DVP5000, DVP10000, or DVP12000 performance. Operational limitations also depend on the specific actuator being driven by the DVP. The controller will maintain limits appropriate for the specific actuator/valve attached. Actuator specific limits may be less than the maximum DVP capability given in this manual. For example, the DVP is capable of 40 A for 500 ms for motor acceleration/deceleration. Some actuator configurations limit the acceleration current to a lower number. Refer to the specific actuator or valve manual for more details on operational limits.

4.5 Mission Profile and Duty Cycle Limitations

NOTICE

DUTY CYCLE

The DVP5000, DVP10000, and DVP12000 are rated for full capability as stated in the specifications for 30 seconds and a cooling duration of 120 seconds. This cycle can be repeated for as long as necessary.

Although Woodward sizes the actuation system (valve/actuator/DVP) to ensure there is sufficient margin for the most critical application requirement, in a lab setting, the DVP can be over-driven if care is not taken to observe the operational duty cycle limits.

Active current limits are enforced by the controller software to prevent damage to the DVP. These current limits control the maximum level and duration of the input and output current, to ensure the reliability and compliance ratings of the DVP and the actuator, and to address various failure modes of the DVP and the installed system. These limits have been established to allow an ample motion profile for prime mover control and for test purposes.

However, in the actual application, the system needs to respond to critical control events at any time. Therefore, the DVP does not enforce any restrictions on the duty cycle or frequency of repetitive movements. The frequency or duty cycle of large, full load motions must be controlled by the user or the supervising control system. The following recommendations are provided as a reference for controlling this duty cycle, particularly during testing.

Frequency sweeps, frequency response testing, or large repetitive step responses performed during testing can result in high power dissipation and potential overheating of the DVP. The amount of power dissipation is dependent upon the amplitude of the test signal, the actuator load, as well as the frequency and duration of the tests. To ensure that the system is not overheated during testing, the duration of high-power test events such as frequency responses and large amplitude step responses should be limited to a maximum test duration of 30 seconds with a minimum 120 second cool down between tests.

IMPORTANT

For lab testing, allow 1 minute cool down after frequency testing with demand amplitude > 5% peak-peak. With this test condition, test duration should be limited to 3 minutes.

4.6 Current Limits

Output current limit graphs represent the maximum performance envelope for the DVP5000, DVP10000, and DVP12000. The valve or actuator may limit the performance below the curves shown below. The sizing of the DVP/actuator system will keep the operational points below the limits.

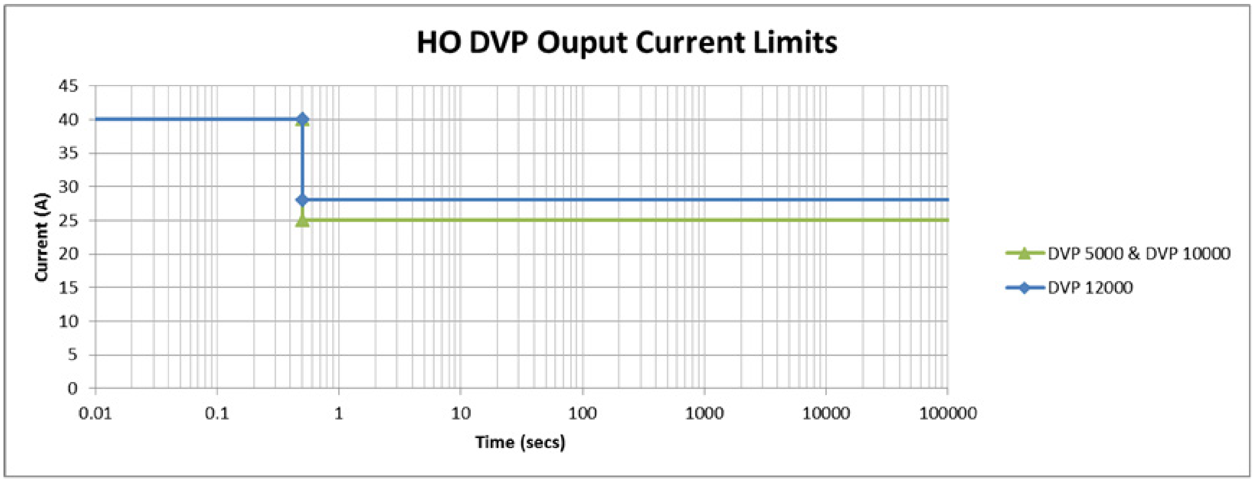


Figure 4-3. DVP5000, DVP10000, and DVP12000 Output Current Limits

Input current limits are needed to prevent exceeding the power capability of the device. Input power and output power are related by the following formulas. Power capability of the device which could cause damage or violate the hazardous locations ratings of the DVP.

Pin = Pout (ignoring efficiency)

Input Power	Output Power
*Pin = (Vin * Iin)*	*Pout = (Vout * Iout)*
	*Pout = (Force * Speed)*
	<-- actuator

Figure 4-4. Input Power and Output Power Relationship Formulas

As an actuator moves rapidly, such as during a full stroke, full load transient, input current draw from the customer power supply system increases. If an input current limit is reached, full output current is still supplied to the motor, but motor voltage is de-rated (reduction of output power), so the actuator still moves, but more slowly.

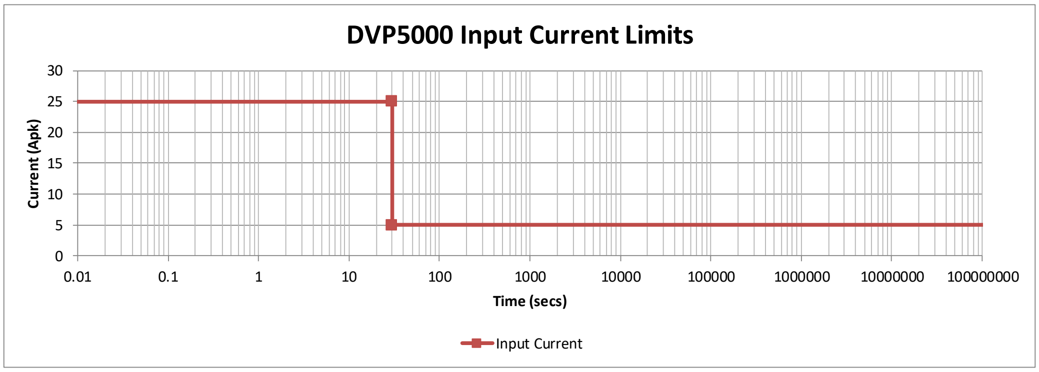


Figure 4-5. DVP5000 Input Current Limits

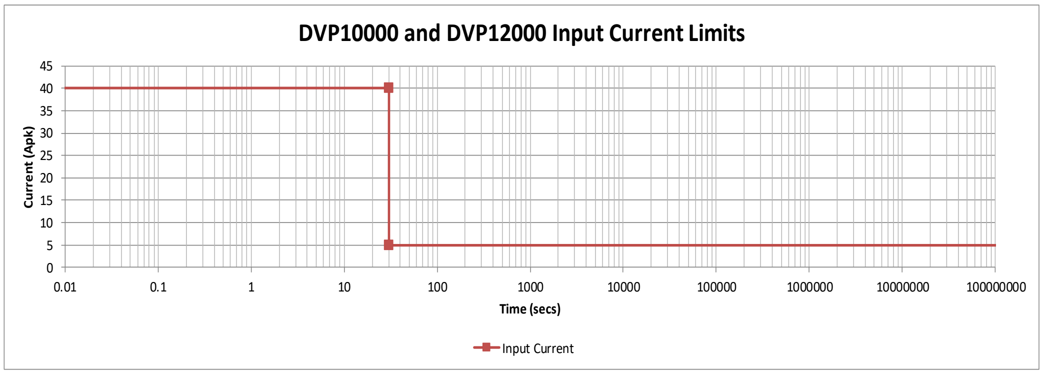


Figure 4-6. DVP10000 and DVP12000 Input Current Limits (Temperature Range -40°C to 70°C)

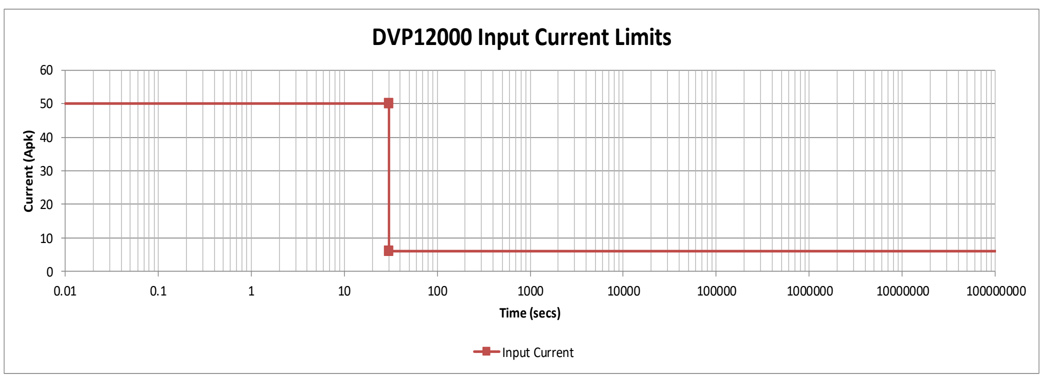


Figure 4-7. DVP12000 Input Current Limits (Temperature Range -40°C to 55°C)

4.7 External User Diagnostics

4.7.1 DVP Diagnostic LED Codes

The diagnostic LEDs are located on the front panel of the DVP. The LED on the bottom right of the front panel is the main diagnostic LED. When equipped with the Ethernet option, there are also two LEDs on the front panel located below the Ethernet connectors. The bottom LED (farthest from the RJ45 connections) is the communication board diagnostic LED, and the upper LED is the communication board Reset/Run LED. Tables 4-1, 4-2 and 4-3 list the flash codes and operating conditions indicated by each of the LEDs.

4.7.2 Main Diagnostic LED (Bottom Right of Front Panel)

Table 4-1. DVP Main Diagnostic LED Codes

Color	On/Off Time (light is on for same time as it is off)	Indicated Condition
Red	500 ms	Internal DVP shutdown fault detected.
Green	500 ms	Normal DVP operation. Indicates Okay, External Shutdown or External Position Shutdown.
Orange (Green and Red at same time)	500 ms	Alert indicating that DVP is not operating in Analog, PWM, EGD or CANopen position demand mode. Indicates either no demand mode is selected, or a test mode is selected (e.g., manual position).
Red and Green alternating	60 ms	DVP Start-up Sequence (Switches to Red, Green, or Orange after successful start-up)

4.7.3 Communication Board Diagnostic LED

The optional communication module includes a diagnostic LED which displays its code through two sequences of blinking. Each sequence shows one digit in the two-digit code. The first digit blinks, and then there is a two second pause. The second digit then blinks and there is a 5-second pause before the pattern repeats. All the diagnostic codes are broadcast in red. The codes are as follows in the table.

Table 4-2. DVP Communication Board Diagnostic LED Codes

1st Digit	2nd Digit	Indicated Condition
1	4	RAM Test Failure
2	2	Real Time Clock Test Failure
2	3	Floating Point Unit Test Failure
2	4	Flash Test Failure
2	5	HD1 Flash Test Failure
2	6	I2C Bus Test Failure

4.7.4 Communication Board Reset/Run LED

The optional communication module includes a Reset/Run LED shows the user what is happening with the communication board processor. The LED will show red or green depending on what is happening. See the table below for the status of the LED under certain modes.

Table 4-3. DVP Communication Board Reset/Run LED Codes

Color	Reason
Solid Red	Processor held in reset by main CPU or for other diagnostic condition
Solid Green	Indicates normal operation, starting operating system (VxWorks), or functioning between Reset and RAM test where RAM is being prepared.
Off After Power Up	RAM test

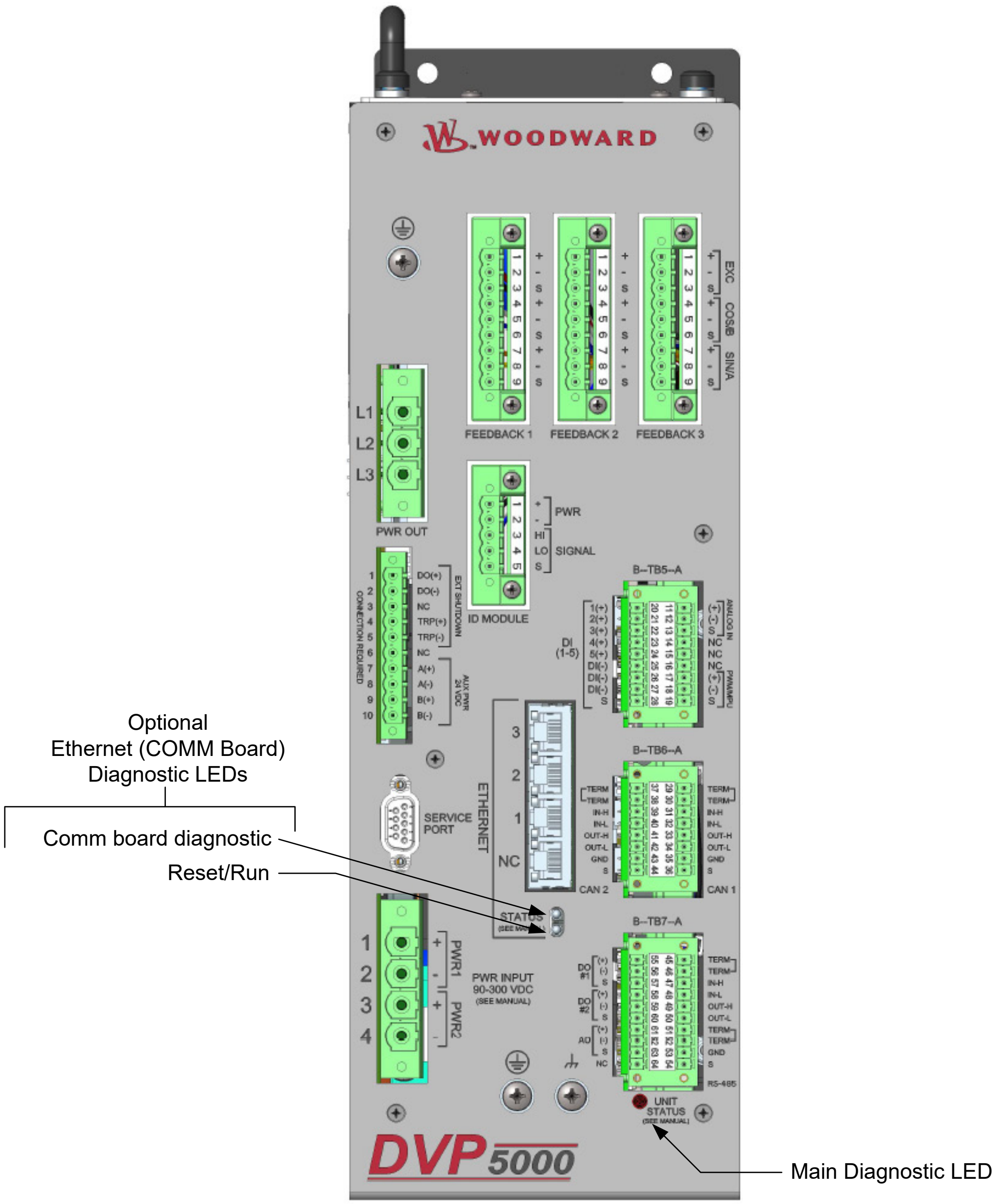


Figure 4-8. DVP Main Diagnostic LED Locations

Chapter 5.
Initial Setup Guide

The DVP5000, DVP10000, and DVP12000 are an extension of the existing DVP family of products and utilize a common service tool and I/O configuration. However, since power levels are higher and additional features are included, initial operation may take extra steps. Notably, the EXTERNAL SHUTDOWN input must be configured to enable the driver.

Refer to Chapter 3 for wire sizing and installation recommendations and for information on wiring the EXTERNAL SHUTDOWN Input. Units are shipped with the EXTERNAL SHUTDOWN feature pre-wired on the connector to enable the driver.

Refer to Manual 26912 “DVP Service Tool” for the initial setup of the DVP5000, DVP10000, or DVP12000. The manual can be downloaded from Woodward website at www.woodward.com

Chapter 6.
DVP Configuration

The DVP5000, DVP10000, and DVP12000 are extensions of the existing DVP family of products and utilize a common service tool and I/O configuration. However, since power levels are higher and additional features are included, initial operation may take extra steps. Notably, the EXTERNAL SHUTDOWN input must be configured to enable the driver.

Refer to Manual “26912 DVP Service Tool” for the initial setup of the DVP5000, DVP10000 or DVP12000.

Chapter 7.
DVP Operation

7.1 Introduction

⚠WARNING Hot Swap Hazard	**Switch off power before removing covers or connect/disconnect electrical connectors or cable interconnection. Failure to do so may result in permanent damage to the DVP.**

The Woodward DVP is designed with control and parameter settings which can be configured using the Woodward DVP Service Tool. There are some valve-specific settings that are read by the DVP from the valve's Identity Module on power-up. Additionally, there are certain parameters which are available for configuration of field settings to satisfy the needs of specific applications.

Refer to Manual “26912 DVP Service Tool” for the initial setup of the DVP5000, DVP10000 or DVP12000.

7.2 Service Tool Introduction

Woodward DVP HO (High Output) Service Tool software is provided to allow end users to monitor the DVP condition, to reconfigure certain driver parameters and to troubleshoot the DVP operation. Detailed information for configuration and setup of the DVP for customer-specific applications using the DVP HO (High Output) Service Tool is provided through the help command.

⚠WARNING Personal Injury	**An unsafe condition could occur with improper use of these software tools. Only qualified personnel should use these tools to modify or monitor the DVP functions.**

7.3 System Requirements

The minimum system requirements for the DVP HO (High Output) Service Tool software are:

- Microsoft Windows® 10, 8.1, 7, Vista (32- & 64-bit) or later
- Microsoft .NET Framework ver. 2.0 (can be downloaded from Woodward software website)
- 600 MHz or faster x86 or x64 CPU
- 96 MB of RAM
- Minimum 800 by 600-pixel screen with 256 colors
- Recommended screen resolution 1024 by 768 pixel or higher
- 9 pin sub-D Serial Port (RS-232)
- Woodward ToolKit Software - latest revision

7.4 Cabling Requirements

A straight through serial cable will be required for RS-232 communication. A null modern connector or cable will not work with DVP RS-232 communication. With today’s advanced technology, many new computers are shipped with multiple USB ports but not with RS-232 serial ports. In that case, a USB to RS232 converter must be fitted. Some USB-RS232 converters may not work correctly with the DVP. Please contact Woodward for recommendations on which serial converters to use.

7.5 Obtaining the Service Tool

The DVP Service Tool software is based on the Woodward ToolKit software standard version included with the DVP Service Tool installation software package. The DVP Service Tool and the appropriate settings files for your specific application can be obtained from Woodward through Woodward website or via e-mail.

7.6 Tool Installation Procedure

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

IMPORTANT	**Check all wirings from point to point, all connections, and terminations to ensure having proper installation before applying the power to the DVP.**

IMPORTANT	**Verify that fuel pressure is not present to the actuator that may open due to actuator motion before applying power to the DVP.**

7.7 General Installation Check Before Applying Power

1. Verify the power source is set to within the input operating voltage range. Always make sure that the power at the driver is within the input power range to insure the operation of the DVP.
2. Verify all DVP and valve cable connections are properly installed, including earth and motor ground and I/O cable shield grounding termination.
3. Verify that the DVP driver is securely installed, and all cover fasteners are tightened.
4. If using analog input as demand source, verify that the input command is between 4 to 20 mA.

⚠WARNING **Overspeed**	**Failure to follow general installation checks prior to applying power to the driver could lead to turbine overspeed if the actuator shuts down in the wrong direction.**

7.8 Getting Started with the DVP Service Tool

The DVP Service Tool communicates with the DVP via RS-232 connection. The PC (personal computer), running the DVP Service Tool is connected to the DVP using a 9-pin straight-through serial cable. Connect the serial cable to the RS-232 service port on the backside of the DVP and an unused RS-232 serial port (COM port) on the PC side.

IMPORTANT	**The serial cable used to connect the DVP to the PC running the DVP HO (high output) Service Tool must be set up as straight-through configuration. Do NOT use a serial cable with Null-Modem configuration to connect the DVP to the PC!**

After the DVP and the PC have been connected via the serial cable, the DVP HO (high output) Service Tool can be started from the Windows Start menu or a shortcut on the desktop (if applicable).

7.8.1 Connecting and Disconnecting the DVP Service Tool

Connection to the DVP is made by clicking the connect button on the tool bar or by selecting 'Device' and 'Connect' from the main tool bar.

Figure 7-1. Service Tool Connection Options

Disconnecting the Service Tool from the DVP is done by either pressing the disconnect button or selecting 'Device' and 'Disconnect' from the main tool bar.

Figure 7-2. Service Tool Disconnect Options

7.8.2 Selecting a Communication Port

When trying to connect for the first time, the DVP Service Tool will show a dialog box and query to select a suitable communication (COM) port for communication between the PC and the DVP. In most cases the port of choice will be COM1. Check the checkbox near the bottom of the dialog screen to use the selected port as default in the future.

If a default port is selected the Service Tool will always establish the connection to the DVP immediately after pressing the connect button without asking for a communication port again.

IMPORTANT	**Before starting the Service Tool, attach the DVP to an available active Serial Port or active USB Serial Port Adapter. The DVP Service Tool will only search for active COM Ports on startup.**

Figure 7-3. Service Tool Communications Port Selection

7.8.3 Establishing a Connection

After selecting the desired communication port, the Service Tool will try to connect to the DVP.

Following successful connection to the DVP, the screen will populate with current values and the status bar will display the connection status.

Figure 7-4. Service Tool Communication Status

Following a successful connection, you may click on the Details button and the following screen appears:

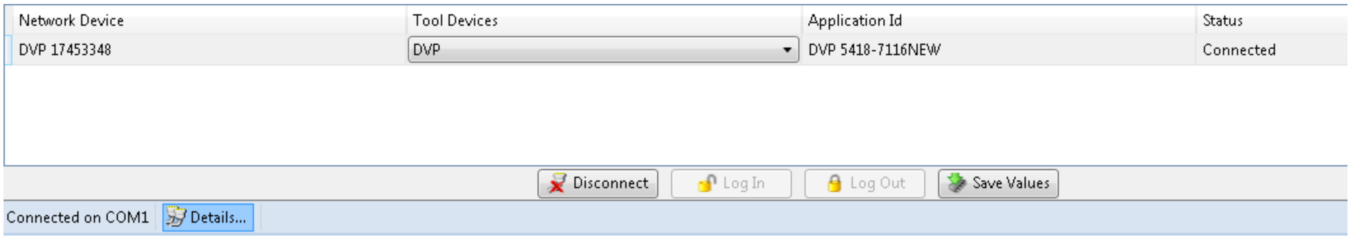


Figure 7-5. Communication Status Details

If the Service Tool does not establish a successful connection to the DVP after approximately 30 seconds, or the DVP Service Tool annunciates that it cannot find the correct SID file, refer to the next section “Connection Troubleshooting” for further information.

Follow the Tool Navigation page to configure and operate the DVP. The tool is designed with self-explanatory and instructions within the active window for the specific command to explain the specific function and setting.

7.8.4 USB to RS-232 Converter

With the widespread adoption of the USB, most of the computers do not have an RS-232 port. Therefore, connecting an RS-232 device to the computer will require a USB to RS-232 adapter.

The USB to RS-232 adapter has some limitations and it is recommended that proper adapter is being selected when use with the DVP. Woodward has some success with off-the-shelf adapter such as Tripp Lite Model U209-000-R USB to RS232 converter cable.

It is very important that the proper USB to RS-232 device driver is installed onto the PC that will be used for your DVP configuration.

Chapter 8. Functional Safety Management

8.1 Product Variations Certified

The SIL3 rated Digital Valve Positioner (DVP) for fuel shutoff is designed and certified to the functional safety standards detailed in IEC61508, Parts 1 through 7. Reference the product FMEDA: WOO 15-02-076 R001 V1R1. The FMEDA was performed by EXIDA.

The functional safety requirement in this manual applies to all DVP5000-S, DVP10000-S and DVP12000-S products. The –S after the product name designates it as a SIL certified product. These SIL rated DVPs will have a Fail Safe Dangerous Undetected (DU) FIT of less than 28 FITS for ESTOP (External Shutdown) function.

The DVP5000-S, DVP10000-S, and DVP12000-S are certified for use in applications up to SIL3 according to IEC61508.

The DVP family is designed and verified to withstand the worst-case (or greater) expected environmental conditions as listed in other sections of this manual.

8.2 Covered DVP Versions

All DVP5000-S, DVP10000-S and DVP12000-S variations are covered.

8.3 SFF (Safe Failure Fraction) for the DVP

The DVP is only one part of a shutoff system that supports an over-speed shutdown SIF (Safety Instrumented Function). This system consists of a speed sensor, a processing unit, and a fuel shutoff actuation sub-system of which the DVP is a component.

The SFF (Safe Failure Fraction) for each subsystem should be calculated. The SFF summarizes the fraction of failures which lead to a safe state plus the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action. This is reflected in the following formulas for SFF:

$$SFF = \lambda_{SD} + \lambda_{SU} + \lambda_{DD} / \lambda_{TOTAL}$$

where $\lambda_{TOTAL} = \lambda_{SD} + \lambda_{SU} + \lambda_{DD} + \lambda_{DU}$

The failure rates listed below, for only the DVP, do not include failures due to wear-out of any components. They reflect random failures and include failures due to external events such as unexpected use. Reference the FMEDA: WOO 17-12-085 R001 V1R1 for detailed information concerning the SFF and PDF.

Table 8-1. Failure Rates According to IEC61508 in FIT

Device	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
Shutdown	95	314	0	34

According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1H approach according to 7.4.4.2 of IEC 61508 or the 2H approach according to 7.4.4.3 of IEC 61508. The 1H approach should be used for the DVP.

8.4 Response Time Data

The response time of the DVP for the described SIF is < 10ms.

The DVP response time is defined as the time from removal of the ESTOP (External Shutdown) signal to the time that power is removed from the actuator. The time to close the actuator depends on the specific actuator and its return mechanism. That information can be found in the specific actuator/valve manual.

8.5 Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the useful life of the DVP is 90000 hours (10.25 years).

8.6 Management of Functional Safety

The DVP is intended for use according to the requirements of a safety lifecycle management process such as IEC61508 or IEC61511. The safety performance numbers in this chapter can be used for the evaluation of the overall safety lifecycle.

8.7 Restrictions

The user must complete a full functional check of the DVP after initial installation and after any modification of the overall safety system. No modification shall be made to the DVP unless directed by Woodward. This functional check should include as much of the safety system as possible, such as sensors, transmitters, actuators, and trip blocks. The results of any functional check shall be recorded for future review.

Operate the DVP within the published specifications in this manual.

8.8 Competence of Personnel

All personnel involved in the installation and maintenance of the DVP must have appropriate training. Training and guidance materials are included in this DVP manual 26773.

These personnel shall report back to Woodward any failures detected during operation that may impact functional safety.

8.9 Operation and Maintenance Practice

A periodic proof (functional) test of the DVP is required to verify that any dangerous faults not detected by safety controller internal run-time diagnostics are detected. More information is in the “Proof Test” section below. The frequency of the proof test is determined by the overall safety system design. The safety numbers are given in the following sections to help the system integrator determine the appropriate test interval.

The DVP does not require special tools for operation or maintenance of the DVP.

8.10 Installation and Site Acceptance Testing

Installation and use of the DVP must conform to the guidelines and restrictions included in this manual. No other information is needed for installation, programming, or maintenance.

8.11 Functional Testing After Initial Installation

A functional test of the DVP is required prior to use in a safety system. This should be done as part of the overall safety system installation check and should include all I/O interfaces to and from the DVP. For guidance on the functional test, see the Proof Test procedure below.

8.12 Functional Testing After Changes

A functional test of the DVP is required after making any changes that affect the safety system. Although there are functions in the DVP that are not directly safety related, it is recommended that a functional test be performed after any change.

8.13 Proof Test (Functional Test)

The DVP must be periodically proof tested to ensure there are no dangerous faults present that are undetected by on-line diagnostics. This proof test should be performed at least once per year. A recommended proof test is described below.

Suggested Proof Test Procedure:

1. Connect Service Tool.
2. Enable actuator output by enabling the External Shutdown Input (input signal is high) and placing the unit into position control mode (either manual or remote from an external demand signal). The safety function is enabled with this action.
3. Use the DVP Service Tool to monitor the Internal Bus Voltage. This should typically be within a few volts of the DVP input voltage.
   Note: The service tool accesses the two input voltages (Input Voltage 1 and Input Voltage 2) and the Internal Bus Voltage. It is important to read the Internal Bus Voltage for this test. The Internal Bus Voltage is interrupted as part of the safety function.

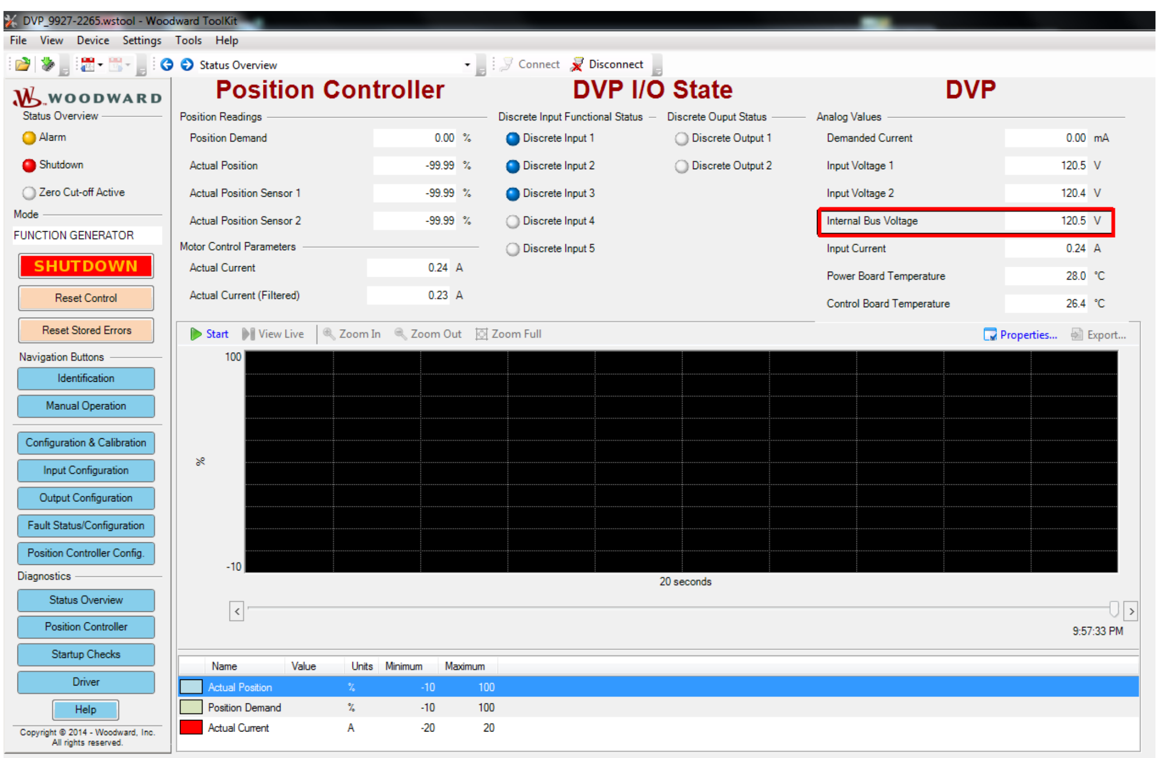


Figure 8-1. Service Tool Status Overview Page – Internal Bus Voltage

4. Open the External Shutdown input, allowing the actuator to move to a fail-safe state. Verify steps "a" and "b". This procedure verifies that the safety function is operational.
   a. On the Status Overview Page, verify the Internal Bus Voltage is decreasing from the value in Input Voltage 1 and 2. It may take several minutes for the voltage to go below 20V.

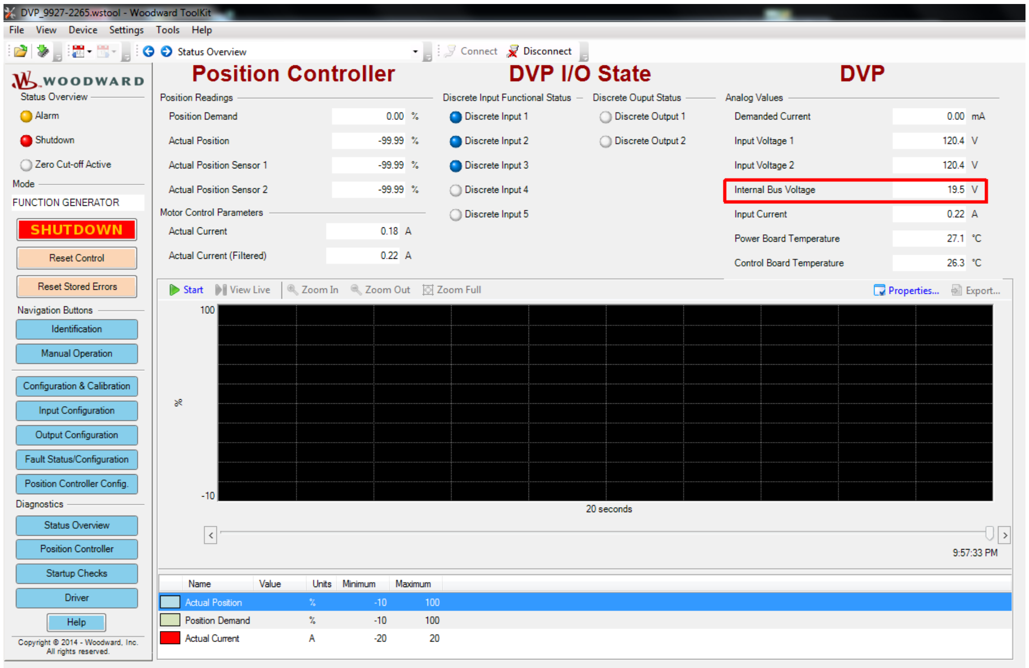


Figure 8-2. Service Tool Status Overview Page – Internal Bus Voltage

   b. On the Fault Status/Configuration Page, verify that the E-STOP 1 Tripped and E-STOP 2 Tripped are active:

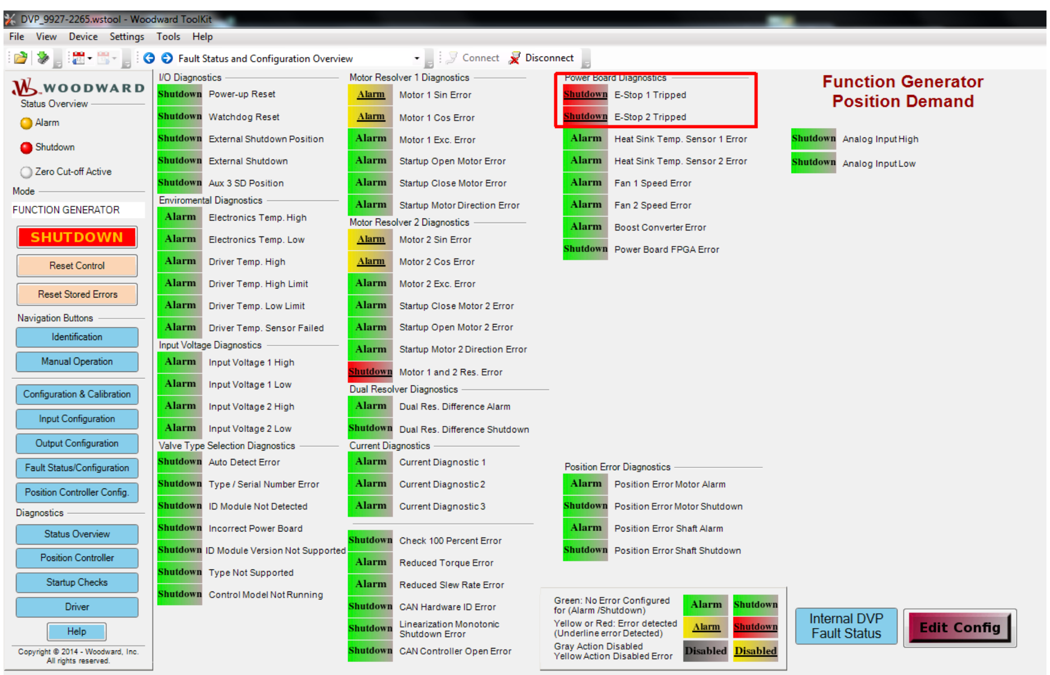


Figure 8-3. Fault Status/Configuration Page, E-STOP 1 and E-STOP 2 Tripped

IMPORTANT **The screen represented in Figure 8-3 is an example. The representation on the screen may differ due to valve/actuator type, DVP and the settings being read by the Service Tool.**

5. The actuator can be returned to normal operation by enabling the External Shutdown input and placing the driver into the normal demand mode.

Chapter 9.
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 DVP Control.**

9.1 Introduction

This chapter addresses several possible causes and recommended actions for many common problems that may be encountered with a system including the DVP, its power source, the actuator/valve assembly, and the wiring interconnect between these components.

⚠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.**

9.2 DVP Troubleshooting Guide

9.2.1 I/O Diagnostics

Table 9-1. DVP 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 DVP.	Issue a reset to the DVP.
	If this occurs while the DVP 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 DVP during a 0-100% position transient, check wire gauge, fuses, or other resistive components in the power supply system.
Watchdog Reset Detection: CPU reset without a power up event.	It is normal for this to occur after the software is updated.	Issue a reset to the DVP.
	A software lockup occurred.	If the cause is not a software update: Contact Woodward Technical Support.
External Shutdown Position Detection: Command sent by Digital communication protocols like EGD, CANopen.	It is normal for this to occur when a shutdown position has been commanded from an external source, i.e., Service Tool, or Digital Communication.	Take away command and reset DVP for normal operation.
	Unexpected command from digital communication.	Take away command and reset DVP for normal operation.
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 DVP for normal operation.
	Unexpected command from digital communication.	Take away command and reset DVP for normal operation.
	Discrete input wiring problem.	Fix wiring problem.
	Discrete input configuration problem.	Ensure the Active/Inactive settings inside the DVP 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.
Aux 3 SD Position Detection: This status flag is set when Discrete Input 3 is set, and the Discrete Input Action Mode is set to Aux3 SD+Reset. When set, indicates the DVP is in Shutdown Position state.	Wiring problem.	Check discrete input wiring. Use Service Tool to confirm the selected input status.
	For actuators supplied with brake, this may indicate that voltage is not detected on the brake supply circuit.	Confirm that the brake supply voltage is present at the Discrete Input 3 terminals.
	DVP settings are incorrect.	Confirm/correct the settings 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.
Shutdown System Detection: Detected driver current fault.	Check Driver Current Fault and Current Phase faults.	Follow troubleshooting for individual faults.
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 short 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 High Detection: The phase A current sensor is at max output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase A Low Detection: The phase A current sensor is at min output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase B High Detection: The phase B current sensor is at max output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Current Phase B Low Detection: The phase B current sensor is at min output.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
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 DVP 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.

Diagnostic Indications	Probable Causes	Recommended Actions
PWM Duty Cycle High Detection: The PWM input duty cycle is above the given setting (User setting).	Incorrect DVP settings.	Correct the duty cycle max setting in the DVP using the Service Tool.
	Incorrect duty cycle scaling in control system.	Correct the scaling in the control system using the Service Tool.
	Noise interference (above specified EMI environment).	Verify ground wire between motor and driver is correct and sufficient gauge. Check wiring, grounding of driver and valve, termination of shields, and EMI levels. Verify stability of the control signal using trending capability in the Service Tool.
PWM Duty Cycle Low Detection: The PWM input duty cycle is below the given setting (user setting).	Incorrect DVP settings.	Correct the duty cycle min setting in the DVP using the Service Tool.
	Incorrect duty cycle scaling in control system.	Correct the scaling in the control system using the Service Tool.
	Noise interference (above specified EMI environment).	Verify ground wire between motor and driver is correct and sufficient gauge. Check wiring, grounding of driver and valve, termination of shields, and EMI levels. Verify stability of the control signal using trending capability in the Service Tool.
PWM Frequency High Detection: The PWM frequency is above the given setting (user setting).	Incorrect frequency max setting in the DVP.	Correct the frequency max setting in the DVP using the Service Tool.
	Incorrect frequency setting in the DVP.	Correct the frequency settings in the Control system using the Service Tool.
	Noise interference (above specified EMI environment).	Verify ground wire between motor and driver is correct and sufficient gauge. Check wiring, grounding of driver and valve, termination of shields, and EMI levels. Verify stability of the control signal using trending capability in the Service Tool.
PWM Frequency Low Detection: The PWM frequency is below the given setting (User Setting).	Incorrect frequency min setting in the DVP.	Correct the frequency min setting in the DVP using the Service Tool.
	Incorrect frequency setting in the DVP.	Correct the frequency settings in the Control system using the Service Tool.
	Noise interference (above specified EMI environment).	Verify ground wire between motor and driver is correct and sufficient gauge. Check wiring, grounding of driver and valve, termination of shields, and EMI levels. Verify stability of the control signal using trending capability in the Service Tool.

Diagnostic Indications	Probable Causes	Recommended Actions
Speed Signal Fault Detection: Only used if speed sensor is active. DVP does not support speed sensor input with present version.	Not applicable.	Not applicable.
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 DVP.
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 DVP.
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.
Digital Com 1 & 2 **and/or** **Analog Backup Error** Detection: When CANopen demand is used, indicates the position setpoint is failed. Either 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.

Diagnostic Indications	Probable Causes	Recommended Actions
Analog Input 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 DVP. 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 DVP Service Tool.
	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.
Analog Input 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 DVP. 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 DVP Service Tool.
	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.
E-Stop 1 Tripped **E-Stop 2 Tripped** Detection: The driver is in a tripped state from the External Shutdown Input.	The External Shutdown Input contact is open. A tripped state is normal when the input is open. To Run, a closed contact must be applied across both SIL inputs.	Check that the External Shutdown Input is wired properly. See wiring and installation section of manual for instructions. Check to make sure the signal level at the External Shutdown Input is at the correct level for operation.
CAN Hardware ID Error Detection: This status flag indicates an incorrect CAN Node ID address has been entered through the Discrete Input connector. This is only true if CAN Hardware ID Mode = CAN HW ID DISCRETE IN-DI5,DI4,DI2,DI1 or CAN HW ID DISCRETE IN-DI5,DI4,DI3 or CAN HW ID DISCRETE INDI5, DI4.	Wiring problem.	Check wiring to ensure the discrete input ID selection is correct. Use Service Tool to confirm the selected ID is correct/expected.
	DVP settings are incorrect.	Confirm the CAN Hardware ID settings using the Service Tool.

9.2.2 Internal Diagnostics

Table 9-2. DVP 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 300VDC for DVP 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 DVP. 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 DVP 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.
Electronics Temp. High Detection: The Control Board temperature sensor indicates a temperature above 140°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.
Electronics Temp. Low Detection: The Control Board temperature sensor indicates a temperature below -45°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 Temp. High Detection: The heat sink temperature is above: 115°C for 24 and 125 VDC Models 70°C for DVP 5000 and 10000 55°C for DVP 12000 Models	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.

Diagnostic Indications	Probable Causes	Recommended Actions
Driver Temp. High Limit Detection: The heat sink temperature is above: 130°C for 24 and 125 VDC Models 80°C for DVP 5000 and 10000 65°C for DVP 12000 Models	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 DVP. Check if the driver is using more current than normal to position the valve.
Driver Temp. 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 Temp. Sensor Failed Detection: The temperature sensor is at min or max.	The temperature sensor has failed.	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.	DVP internal electronics failure or there is no power board connected.	Contact Woodward Technical Support for further assistance.
Power Board Calib. 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.
EEPROM 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.
EEPROM 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.

Diagnostic Indications	Probable Causes	Recommended Actions
Invalid Parameter(s) 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 DVP. NOTE: In DVP firmware prior to 5418-8086, the Invalid Parameter(s) fault indicator on the Internal DVP Fault Status screen can be cleared by Reset Control, but the unit still requires the user to correct the parameters and cycle power. Another indication of this fault being present is when the Input Voltage and Input Current fields are 0.0 on the Status Overview screen.
	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Configuration Process Error Detection: Unexpected settings in ID Module/DVP parameter content.	Valve/actuator configuration content failure.	Serious damage or injury may result if run in this condition. Contact Woodward Technical Support for further assistance.
Invalid Parameter Version Detection: Version information is not correct in the non-volatile memory.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
24V Failed Detection: Internal +24 V is outside acceptable range of 22.1 V to 30.7 V.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
1.8V Failed Detection: Internal 1.8 V is outside acceptable range of 1.818 V to 2.142 V.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
+12V Failed Detection: Internal +12 V is outside acceptable range of 10.6 V to 15.8 V.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
–12V Failed Detection: Internal –12 V is outside acceptable range of –13.7 V to –8.6 V.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
5V Failed Detection: Internal 5 V is outside acceptable range of 4.86 V and 6.14 V.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
5V Reference Failed Detection: Internal 5 V reference is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
5V RDC Reference Failed Detection: Internal 5 V RDC reference is outside acceptable range.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
ADC Failed Detection: Internal ADC in processor core has stopped running.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
RDC DSP Failed Detection: DSP that runs the Resolver-to-digital converter has stopped running.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
ADC SPI Failed Detection: External ADC in processor core has stopped running.	Internal electronics failure.	Contact Woodward Technical Support for further assistance.
Power Board FPGA Error Detection: An error has occurred on the FPGA located on the power board, either an internal error or with the communication to the control board.	There is a problem in the FPGA chip on the power board.	Contact Woodward Technical Support for further assistance.
Fan 1 Speed Error Detection: The fan speed on fan 1 or 2 is below the expected fan speed (applies only to DVP 5000, 10000, and 12000).	Fan 1 or Fan 2 (or both) are running slower than expected, possibly from cooling port blockage or a worn-out fan.	Check for blockage at the inlet or exhaust of the cooling ports of the DVP. Replace Fan assembly, see fan replacement instructions.
Fan 2 Speed Error Detection: The fan speed on fan 1 or 2 is below the expected fan speed (applies only to DVP 5000, 10000, and 12000).	Fan 1 or Fan 2 (or both) are running slower than expected, possibly from cooling port blockage or a worn-out fan.	Check for blockage at the inlet or exhaust of the cooling ports of the DVP. Replace fan assembly, see fan replacement instructions.
Position Controller Not Ready Detection: This status flag indicates the DVP is not controlling position. This occurs during power-up initialization and when in a shutdown position state.	DVP 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.
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	DVP settings are incorrect.	Correct the Linearization settings using the Service Tool.
CAN Controller Open Error Detection: The CAN Controller peripheral was unable to be opened properly. This may occur if the user is changing the CANopen settings (particularly selecting a lower baud rate) while connected to an active CAN network.	Incorrect CANbus settings	Check CAN settings

9.2.3 Position Feedback Transducer Diagnostics

Table 9-3. DVP 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 80% of max ADC. Gain value should be between 10% and 95% of max output. **IMPORTANT** **The gain is continually adjusted by the DVP.**
	The DVP position feedback input circuit has failed.	Contact Woodward Technical Support for further assistance.
Motor 1 Exc. Error **Or** **Motor 2 Exc. 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 Exc. Error, Motor Startup Open Error, Motor Startup Close Error, 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 DVP.**
	The resolver input circuit has failed.	Contact Woodward Technical Support for further assistance.
Valve Shaft 1 Exc. Error **or** **Valve Shaft 2 Exc. 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.

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 Exc. 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 Exc. 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 Valve Shaft 1 Error Start-up-Close Valve Shaft 2 Error Valve Shaft 1 Range Limit Error Valve Shaft 2 Range Limit Error

9.2.4 Valve Type Selection

Table 9-4. DVP Troubleshooting Guide Valve Type Selection

Diagnostic Indications	Probable Causes	Recommended Actions
Auto Detect Error Detection: This diagnostic is only enabled when the DVP has been configured for auto detection (see Auto Detection section). This diagnostic is set when: The DVP 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). The DVP fails to write the calibration records into the non-volatile memory.	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 DVP 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.
	DVP non-volatile memory error.	See Process Fault & Status Overview screen in the DVP Service Tool. If "EEPROM Read/Write Failed" or "Invalid Parameter(s)" is annunciated, contact Woodward Technical Support. **IMPORTANT** **A reset will force the DVP to retry auto detection of the connected valve.**
Control Model Not Running Detection: This status flag indicates the internal DVP Control Model is not Running. The position of the actuator/valve is not controlled by the DVP. If actuator/valve has a return spring, the actuator/valve is be positioned by the return spring.	DVP detected a problem that will not allow the position controller to run.	Using the Service Tool, identify and correct the issues.

Diagnostic Indications	Probable Causes	Recommended Actions
Type / Serial Number Error Detection: If during power up the DVP 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 DVP.	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 DVP.
	User has loaded a parameter set to the DVP that does not match this valve/actuator system serial number.	Use the auto detection function or download the valve specific calibration file into the DVP for the correct serial number. ⚠WARNING **Operation of the DVP with incorrect parameter files can cause personal injury and/or property damage.**
	ID module factory calibration incorrect for this valve type / serial number.	Contact Woodward Technical Support for further assistance.
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 DVP software.	Valve type not supported by the DVP DVP software is not the required revision for this valve.	Contact Woodward Technical Support for potential upgrade to the latest revision of the DVP software.

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 DVP 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 DVP. Any reset command via the DVP 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 DVP to function without an ID module.** **⚠WARNING** **It is the user's responsibility to make sure the correct parameters are stored in the DVP! Operation of the DVP 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 DVP software. **Note**: The Valve Type Auto Detect diagnostic is also set when this condition is detected.	DVP software is not the required revision for this valve.	Contact Woodward Technical Support for a potential upgrade to the latest revision of the DVP software.
	ID module calibration record corrupted.	See Process Fault & Status Overview Screen in the DVP 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 DVP checks the ID module 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 DVP power board.	Contact Woodward Technical Support to determine the correct DVP and valve/actuator system for your application.

9.2.5 Resolver Diagnostic LAT

Table 9-5. DVP Troubleshooting Guide Resolver Diagnostic LAT

Diagnostic Indications	Probable Causes	Recommended Actions
Valve Shaft 1 Range Limit Error or Valve 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 DVP. 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.

Diagnostic Indications	Probable Causes	Recommended Actions
Dual Res. 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 DVP. 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 DVP 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 DVP. See associate valve manual for resistance values. Contact Woodward Technical Support for further assistance if readings are out of valve specifications.
Dual Res. 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 DVP. 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 DVP 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 DVP. See associate valve manual for resistance values. Contact Woodward Technical Support for further assistance if readings are out of valve specifications.

9.2.6 Resolver Diagnostics 3-Phase

Table 9-6. DVP 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 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 DVP 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 DVP	Use the auto detection function or down load the valve specific calibration file into the DVP 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 DVP 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 DVP	Use the auto detection function or down load the valve specific calibration file into the DVP 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 Valve 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 Valve 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 Valve 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 Valve 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 DVP 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 DVP.	Use the auto detection function or down load the valve specific calibration file into the DVP 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 Motor Direction 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.
	DVP electronics failure.	Contact Woodward Technical Support for further assistance.

9.2.7 Position Error

Table 9-7. DVP Troubleshooting Guide Position Error

Diagnostic Indications	Probable Causes	Recommended Actions
Position Error Motor 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 DVP Service Tool.
	Contamination in the valve/actuator system.	At earliest opportunity, perform check out procedure as described in the Position Error Motor Shutdown.
Position Error Motor 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 DVP, 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
Position Error Shaft 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.
Position Error Shaft 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.
	DVP electronics failure.	Contact Woodward Technical Support for assistance.
	CAN wiring or noise problem.	Check CAN wiring.
	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.

9.2.8 Auxiliary Board Status and Diagnostics

Table 9-8. DVP Troubleshooting Guide Auxiliary Board Status and Diagnostics

Diagnostic Indications	Probable Causes	Recommended Actions
Aux Board Not Found Detection: The control board has not detected the aux board.	The selected input type requires an aux board, and no aux board is present.	Contact Woodward to determine how to upgrade you DVP with an aux board.
		Select an input type that does not need an aux board.
Aux Board Type Error Detection: The control board has detected an incorrect Aux Board type.	This occurs when the aux board needed, and the input type selected is not compatible.	Contact Woodward to obtain a DVP with the correct aux board configuration.
		Select an input type that is compatible with the aux board in your DVP system.
M5200 Starting Detection: The control board is waiting until the M5200 aux board is started. Wait time is approximately 2 minutes.	This is a typical situation during a power up or change of input type that will activate the M5200 aux board. This flag will reset automatically.	Wait until the M5200 aux board is started.

Diagnostic Indications	Probable Causes	Recommended Actions
M5200 Detected an Error Detection: One of the five possible errors associated with the M5200 has been set.	DP ram check error: The M5200 has detected a dual ported ram error. If the M5200 program is started or stopped, this error may occur due to the M5200 and the DVP being out of synch.	Reset DVP, which will resynchronize the states of the M5200. If this does not correct the problem, contact Woodward Technical Support for assistance.
	MFT Synch error: The DVP has not been able to provide the synch pulse on time to its M5200.	Reset DVP, which will resynchronize the MFT (minor frame timer) of the M5200. If this does not correct the problem, contact Woodward Technical Support for assistance.
	Version error: DVP and its M5200 do not have compatible software versions.	Load the correct software version on the DVP and/or the M5200 board. If this does not correct the problem, contact Woodward Technical Support for assistance.
	Block count error: The DVP and M5200 software have a different number of interface blocks.	Load the correct software on the DVP and/or the M5200 board. If this does not correct the problem, contact Woodward Technical Support for assistance.
	Heartbeat error: The M5200 has not received a correct heartbeat from the DVP.	Reset DVP, this will reset the M5200 and will synch the two. If this does not correct the problem, contact Woodward Technical Support for assistance.
M5200 DPRAM Error Detection: The DVP has detected a dual port ram error during the RAM check.	Defective dual port Rram or interface.	Contact Woodward Technical Support for assistance.
M5200 Heartbeat Error Detection: The M5200 has not sent the correct heart beat value to its DVP.	The M5200 is not running, or the interface is defective.	Contact Woodward Technical Support for assistance.
M5200 Startup Timeout Detection: After 2 min of waiting for a signal from the M5200 aux board, the control board will timeout.	There is no M5200 program, or it is not running. If the Service/Test Port is configured for DHCP address assignment but cannot get an address (no network connection, no DHCP server).	Contact Woodward Technical Support for assistance.

Diagnostic Indications	Probable Causes	Recommended Actions
Heat Sink Temp. Sensor 1 Error or Heat Sink Temp. Sensor2 Error Detection: This fault status flag indicates power board heat sink sensor (1 or 2) has failed (applies only to DVP 5000, 10000, and 12000).	DVP internal electronics failure or extreme temperature.	If DVP temperature is within specified limits, contact Woodward Technical Support for further assistance.
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 DVP10000 and 12000).	Contact Woodward Technical Support for further assistance.

9.2.9 EGD Diagnostics

Table 9-9. DVP Troubleshooting Guide EGD Diagnostics Status

Diagnostic Indications	Probable Causes	Recommended Actions
EGD Port 1 Link Error Detection: The EGD messages are received slower than the time out time that is a user setting.	Wiring problem on Ethernet port 1.	Check wiring on Ethernet port 1.
	Control system not powered up.	Check if the control system is powered up and running.
	IP addresses incorrect.	Check if the correct IP addresses are given to the DVP and control system.
EGD Port 1 Long Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 1 Short Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 1 Stale Data Error Detection: The Application Level Heart Beat variable has not changed in time greater than the stale data delay time.	Data from the producer is not being updated (stale) in the EGD packet.	Check the Ethernet Port 1 wiring between the DVP and turbine control. Verify the Stale Data Delay setting using the Service Tool.
EGD Port 2 Link Error Detection: The EGD messages are received slower than the time out time that is a user setting.	Wiring problem on Ethernet Port 2.	Check wiring on Ethernet Port 2.
	Control system not powered up.	Check if the control system is powered up and running.
	IP addresses incorrect.	Check if the correct IP addresses are given to the DVP and control system.

Diagnostic Indications	Probable Causes	Recommended Actions
EGD Port 2 Long Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 2 Short Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 2 Stale Data Error Detection: The Application Level Heart Beat variable has not changed its time period greater than the stale data delay time.	Data from the producer is not being updated (stale) in the EGD packet.	Check the Ethernet Port 2 wiring between the DVP and turbine control. Verify the Stale Data Delay setting using the Service Tool.
EGD Port 3 Link Error Detection: The EGD messages are received slower than the time out time that is a user setting.	Wiring problem on Ethernet Port 3.	Check wiring on Ethernet Port 3.
	Control system not powered up.	Check if the control system is powered up and running.
	IP addresses incorrect.	Check if the correct IP addresses are given to the DVP and control system.
EGD Port 3 Long Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 3 Short Message Error Detection: The EGD message length expected is not the same as the one received.	Incorrect protocol definition.	Contact Woodward Technical Support for further assistance.
EGD Port 3 Stale Data Error Detection: The Application Level Heart Beat variable has not changed its time period greater than the stale data delay time.	Data from the producer is not being updated (stale) in the EGD packet.	Check the Ethernet Port 3 wiring between the DVP and turbine control. Verify the Stale Data Delay setting using the Service Tool.

9.2.10 EGD Performance

Table 9-10. DVP Troubleshooting Guide EGD Performance

Diagnostic Indications	Probable Causes	Recommended Action
EGD Data Mismatch Detection: Status indication that one or more of the EGD input channels contains different data for longer than the StateDataDelayTime. Triplex mode only. Will not generate an EGD Fault.	Loss of synchronization of master control.	Verify system data and synchronization. Verify the Stale Data Delay setting using the Service Tool.
EGD Revision Fault Detection: Revision check of external and internal EGD protocol revision.	The revision of the M5200 and the revision from the control system do not match.	Check EGD protocol revision of control system.

Diagnostic Indications	Probable Causes	Recommended Actions
EGD Rate Group Slip Detection: If the M5200 does not have the time to finish the task within the rate group. This will also give a heartbeat error flag.	Internal or processing error.	Check the M5200 CPU Load percentage using the Service Tool.
EGD Fault Detection: Dependent on the EGD mode: For 3 port, 2 port, or 1 port this flag indicates that data required to provide a set position to the DVP is missing.	The EGD mode selection is set to more ports than supported with the control system.	Change the mode or add port(s) from the control system.
	There are other error flags active: See associated troubleshooting steps for each error flag.	Correct the EGD individual port errors.
EGD L2 Port 0 Stat Error	This port is used for internal data logging only.	
EGD L2 Port 1 Stat Error Detection: The Ethernet interface is not communicating status information.	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.
EGD L2 Port 2 Stat Error Detection: The Ethernet interface is not communicating status information.	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.
EGD L2 Port 3 Stat Error Detection: The Ethernet interface is not communicating status information.	DVP internal electronics failure.	Contact Woodward Technical Support for further assistance.

9.3. Dual DVP Troubleshooting

Table 9-11. Dual DVP Troubleshooting

Diagnostic Indications	Probable Causes	Recommended Action
Dual DVP Waiting to Sync Detection: For dual-DVP applications, this is a status indication that the inter-DVP synchronization process is active.	No communication from other the DVP.	Check that the other DVP has power. Check communication cables between DVP units.
	This DVP was in Shutdown Position and then received a Reset, but the other DVP is still operational and controlling its position.	Confirm operational status of the other DVP. Check for any possible causes for this DVP to go into Shutdown Position.
Dual DVP Valve Type Match Error Detection: For dual-DVP applications, indicates the valve types for the two DVPs are not compatible.	The other DVP is incompatible with this DVP.	Check that cabling to the other DVP is connected to correct unit. Confirm the Valve Type Selection Screen in the Service Tool. Verify the "Valve Type" matches the valve/actuator system connected to the DVP. Verify both DVPs, that they match each other or are compatible types. Contact Woodward Technical Support for assistance.
	ID module factory calibration incorrect for this valve type.	

Diagnostic Indications	Probable Causes	Recommended Actions
Dual DVP Inter Com. CAN Error	If Dual DVP Inter Com. Self CAN Error is not shown, then error condition is detected only on the other DVP.	Perform troubleshooting on the other DVP.
Detection: Indicates Dual DVP CAN inter-communication error is detected on this DVP, the other DVP, or both. **Note:** This status is expected after a unit is powered up and before the first Reset is issued.	If Dual DVP Inter Com. Self CAN Error is shown, then error condition is detected on this DVP.	See steps for **Dual DVP Inter Com. Self CAN Error**
Dual DVP Inter Com. Self CAN Error Detection: Indicates Dual DVP Inter Com. CAN Error is being detected on this DVP.	Wiring to CAN 1 port is disconnected or loose.	Check terminals and connections.
	Connection to CAN 1 port is not connected to the other DVP.	Check that cabling to the other DVP is connected correctly.
	Incorrect or missing termination on CAN 1 port.	Confirm that termination is being used on both this DVP and the other DVP.
	CAN 1 cable is too long.	Confirm cable is no longer than maximum specified cable length.
Dual DVP Inter Com. RS485 Error	If Dual DVP Inter Com. Self RS485 Error is not shown, then error condition is detected only on the other DVP.	Perform troubleshooting on the other DVP.
Detection: Indicates Dual DVP RS485 inter-communication error is detected on this DVP, the other DVP, or both. **Note:** This status is expected after a unit is powered up and before the first Reset is issued.	If Dual DVP Inter Com. Self RS485 Error is shown, then error condition is detected on this DVP.	See steps for **Dual DVP Inter Com. Self RS485 Error**
Dual DVP Inter Com. Self RS485 Error Detection: Indicates Dual DVP Inter Com. RS485 Error is being detected on this DVP.	Wiring to RS485 port is disconnected or loose.	Check terminals and connections.
	Connection to RS485 port is not connected to the other DVP.	Check that cabling to the other DVP is connected correctly.
	Incorrect or missing termination on RS485 port.	Confirm that termination is being used on both this DVP and the other DVP.
	RS485 cable is too long.	Confirm cable is no longer than maximum specified cable length.
Dual DVP Inter Com. CAN & RS485 Error Detection: For inter-link communications on dual-DVP applications, indicates both RS485 and CAN are failed.	Dual DVP Inter Com. CAN Error and Dual DVP Inter Com. RS485 Error have both occurred, so all communication to the other DVP has been lost.	Resolve cause for both contributing errors: Dual DVP Inter Com. CAN Error and Dual DVP Inter Com. RS485 Error.
Dual DVP Other Shutdown Position (status is received from the other DVP) Detection: For dual-DVP applications, indicates the other DVP is in a Shutdown Position state.	It is normal for this to occur when a shutdown position has been commanded from an external source. I.E. Service Tool, or Digital Communication.	See entry for **Ext. Shutdown Position**
	The other DVP is in Shutdown Position state.	If an unexpected condition, check status of the other DVP and troubleshoot conditions on that unit.
Dual DVP Other Input Shutdown (status is received from the other DVP) Detection:	Set position input(s) for the other DVP have failed.	If an unexpected condition, check status of the other DVP and troubleshoot conditions on that unit.

For dual-DVP applications, indicates the other DVP is in a shutdown state.

Diagnostic Indications	Probable Causes	Recommended Actions
Dual DVP All Inputs Lost Detection: For dual-DVP applications, indicates there is not valid position setpoint. The local position setting is failed/lost and either the inter-DVP communications is failed or the other DVP has also lost all its set position (command) inputs. **Note:** this status is expected after a unit is powered up and before the first Reset is issued.	All sources of Set Position from both DVP units are invalid.	If an unexpected condition, check status of both DVP units and troubleshoot conditions on each unit if applicable. Check for proper functionality of Set Position sources.
Dual DVP Run Slow	Actuator is running at reduced speed because the other DVP has gone into Shutdown Position.	If an unexpected condition, check status of the other DVP and troubleshoot conditions on that unit.
Dual DVP Other Reduced Slew Rate (status is received from the other DVP)	This DVP is running at reduced speed due to status from the other DVP.	If an unexpected condition, check status of the other DVP and troubleshoot conditions on that unit.
Dual DVP Reset Active	It is normal for Dual DVP Reset Active indicator to sometimes be observed momentarily when unit receives a Reset.	If this indicator stays on continuously, contact Woodward Technical Support for assistance.

9.3.1 InterDVP RS485 Status

Table 9-12. Dual DVP InterDVP RS485 Status

Diagnostic Indications	Probable Causes	Recommended Action
INACTIVE Dual DVP RS485 communication channel is not selected.	This is normal for a unit that is not Dual DVP.	No action needed.
COMM OK Dual DVP RS485 communication channel is working properly.	No issue observed.	No action needed.
SLAVE RX TIMEOUT Dual DVP RS485 communication channel is configured as a Slave, but data is not being received.	Both Dual DVP units are configured as Slaves.	Check CANopen setting of DVP units to make sure one is Master and one is Slave.
	Wiring to RS485 port is disconnected or loose.	Check terminals and connections.
	Connection to RS485 port is not connected to the other DVP.	Check RS485 connection between paired DVP units.
MASTER RX TIMEOUT Dual DVP RS485 communication channel is configured as a Master, but data is not being received.	Wiring to RS485 port is disconnected or loose.	Check terminals and connections.
	Connection to RS485 port is not connected to the other DVP.	Check RS485 connection between paired DVP units.
FRAMING ERROR	Both Dual DVP units are configured as Masters.	Check CANopen setting of DVP units to make sure one is Master and one is Slave.
	Wiring to RS485 port is loose.	Check terminals and connections.

Diagnostic Indications	Probable Causes	Recommended Action
Dual DVP RS485 communication channel is experiencing data framing errors.	Incorrect or missing termination on RS485 port.	Confirm that termination is being used on both this DVP and the other DVP.
	RS485 cable is too long.	Confirm cable is no longer than maximum specified cable length.

9.3.2 InterDVP Rx Channel

Table 9-13. Dual DVP InterDVP Rx Channel

Diagnostic Indications	Probable Causes	Recommended Action
CAN1 ACTIVE CAN 1 port is being used as active channel for communication between Dual DVP units.	Normal condition for a Dual DVP unit.	No action needed.
RS485 ACTIVE RS485 port is being used as active channel for communication between Dual DVP units due to CAN 1 port communication failure.	CAN 1 port communication between Dual DVP units has previously failed.	See entry for **Dual DVP Inter Com. CAN Error.**
CAN1 STANDBY Neither port is active for control data (such as Set Position), but CAN 1 port has functional integrity and will go to ACTIVE after a Reset. **NOTE:** This status is expected after a unit is powered up and before the first Reset is issued.	CAN 1 port and RS485 port communication between Dual DVP units have both previously failed.	See entries for **Dual DVP Inter Com. CAN Error** and **Dual DVP Inter Com. RS485 Error.**
RS485 STANDBY Neither port is active for control data (such as Set Position), but RS485 port has functional integrity and will go to ACTIVE after a Reset.	CAN 1 port and RS485 port communication between Dual DVP units have both previously failed, and CAN 1 port is still failed.	See entries for **Dual DVP Inter Com. CAN Error** and **Dual DVP Inter Com. RS485 Error.**
NONE No receive channel is currently functional.	Normal condition for a unit that is not Dual DVP.	No action needed.
	If a Dual DVP unit, then CAN 1 port and RS485 port communication between Dual DVP units are both currently failed.	See entries for **Dual DVP Inter Com. CAN Error** and **Dual DVP Inter Com. RS485 Error.**

Chapter 10.
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
The Netherlands	+31 (23) 5661111
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
The Netherlands	+31 (23) 5661111
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.

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 DVP 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 DVP behavior is detailed below. The DVP CANopen Electronic Data Sheet (EDS) can be downloaded from www.woodward.com.

A.2 Network Architecture

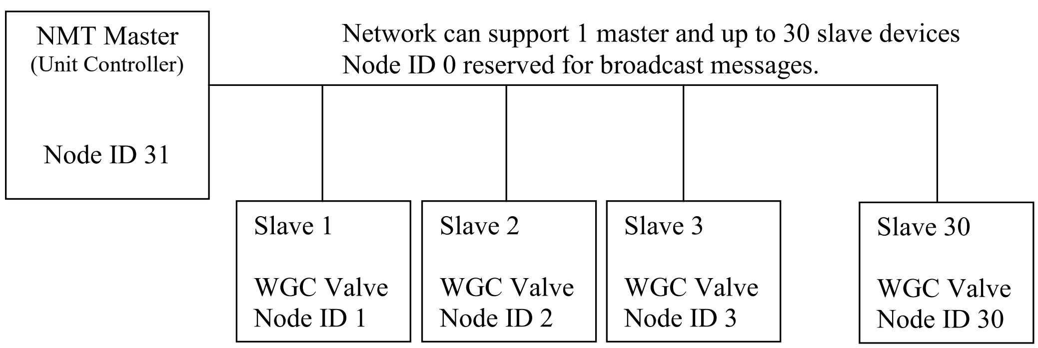


Figure A-1. CANopen Network Architecture

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.

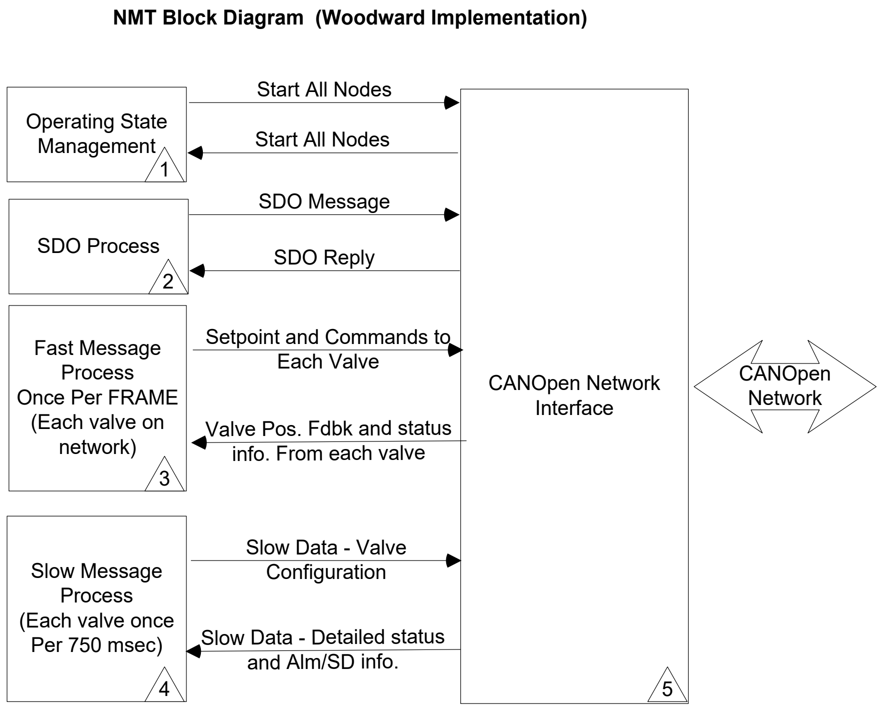


Figure A-2. NMT Master Block Diagram

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 synch 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

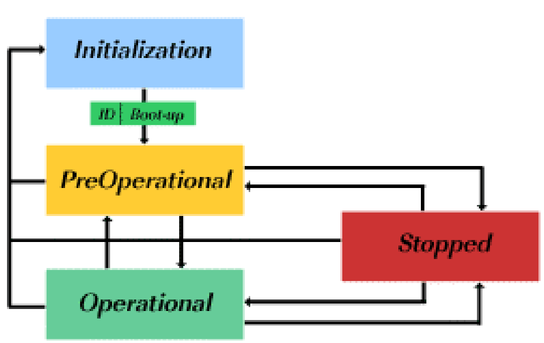


Figure A-3. CANopen Slave State Diagram

The above state diagram is taken from the CANopen specification.

Initialization:
NMT and DVP: The initialization state is used to open the CAN ports and to initialize the CANopen stack. After this is done the DVP 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:
DVP: In this state, the DVP is waiting for the "Start All Nodes" message. When the message is received, the DVP 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:
DVP: In this state the DVP 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 Sec. By sending this message at a periodical cycle we make sure that 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 DVP 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 DVP has time to clear the NMT receive buffer. Symptoms of an insufficient delay include the DVP 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:

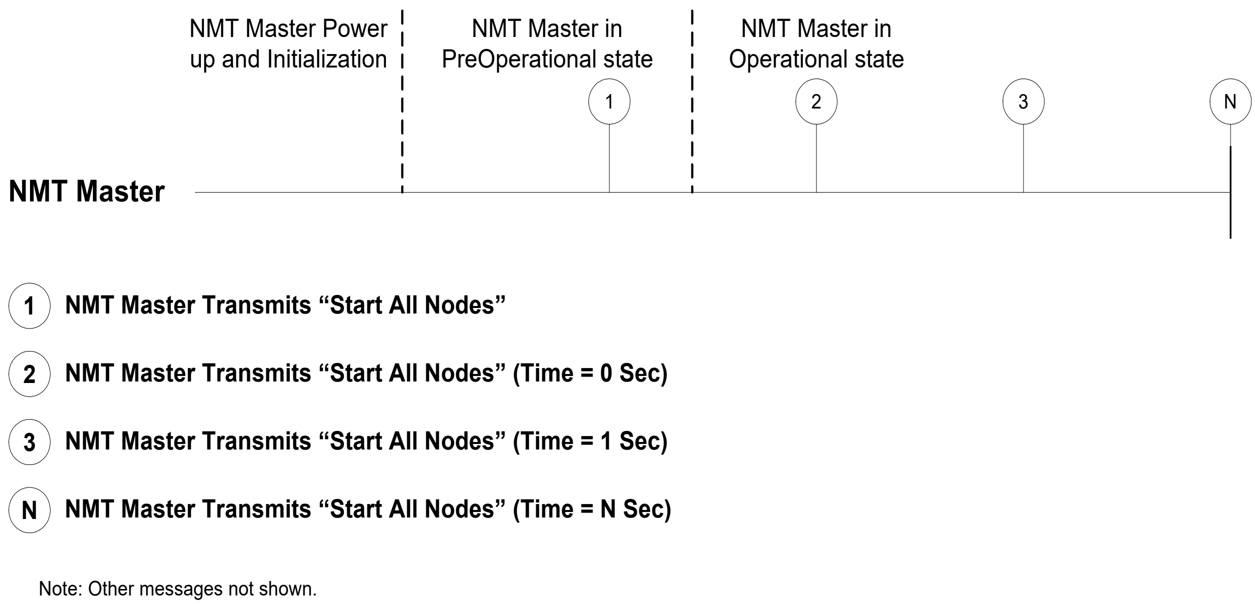


Figure A-4. Sample Operating State Process Timing Diagram

A.4 SDO Process

Master will send SDO messages to each valve to retrieve valve specific information such as 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 this information under application control. This is to make sure 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: 1 second.

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

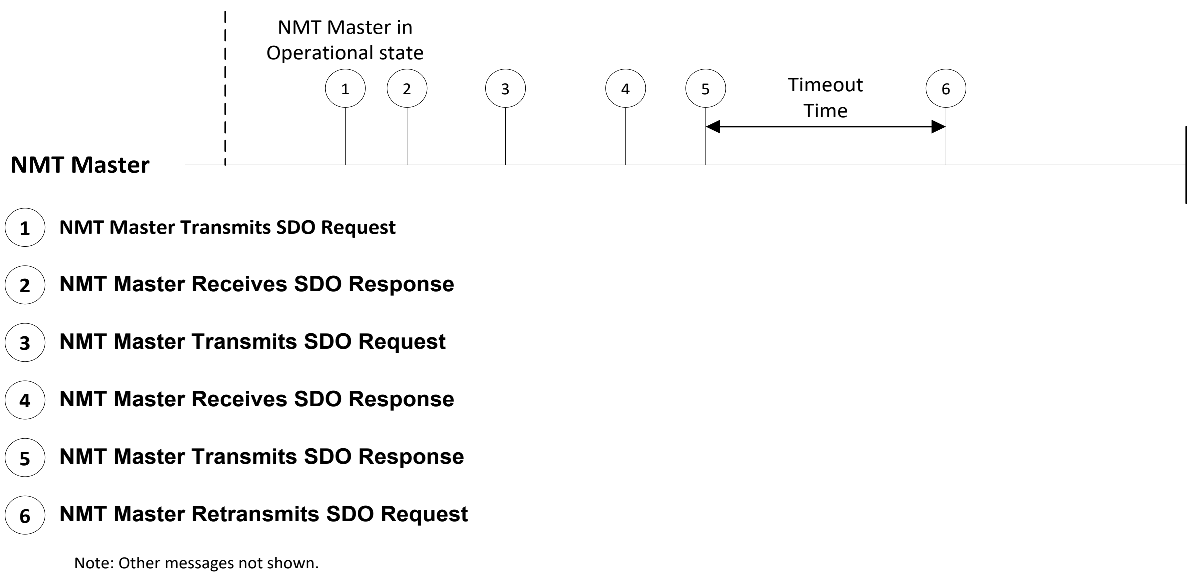


Figure A-5. Sample SDP Process Timing Diagram

Fast Message Process
There are three messages needed to make this process work.

- Fast message to slave
- Fast message from slave
- Synch 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 synch 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 synch message from the master to the slave will do two things.

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

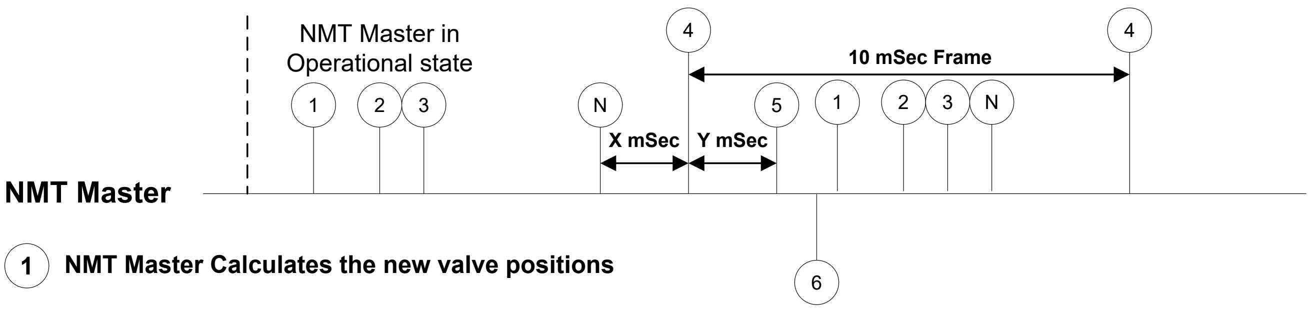
⚠WARNING **CANopen communication link has a timeout value between 1 ms to 1000 ms and it can be specified through Service tool. It is important to ensure the CANopen timeout is set accordingly and use discrete output as shutdown in case of error detection.**

Error Detection:
The slave's error detection is done by checking if the synch 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 <u>Single CANopen</u> or <u>Dual CANopen</u> (single DVP): X ≥ 1 mSec before synch
For <u>Dual DVP CANopen</u> (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 <u>Single CANopen</u> or <u>Dual CANopen</u> (single DVP): Y ≤ 1 mSec
For <u>Dual DVP CANopen</u> (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.

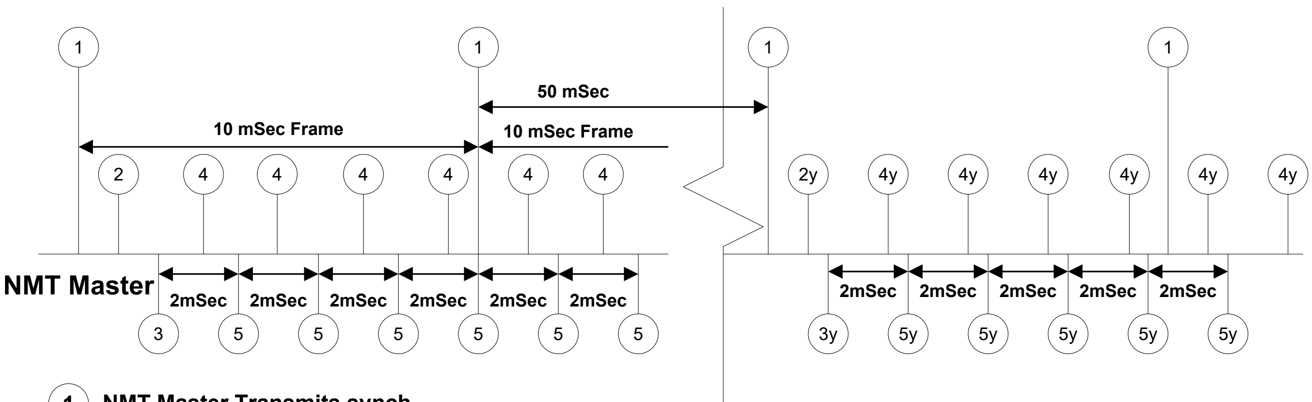
The control will send a slow message every 2 ms, then wait 50 ms after the first slow message is sent before the control starts sending to the next valve. Thus, each valve will receive and transmit slow messages within 50 ms. Max number of valves in the network is 15.

So, 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 DVP:	4
# of bytes in fast Messages from DVP:	5
# of bytes in synch message:	1
# of slow messages to DVP:	7
# of slow messages from DVP:	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 DVPs:	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 synch message.

Total Fast message time = Valve's * (((Overhead + (TxBytes * 8)) * Tperbit) + ((Overhead + (RxBytes * 8)) * Tperbit))
15 * (((51 + (5 * 8)) * 2 μs) + ((51 + (4 * 8)) * 2 μs)) = 5.22 ms

Total Synch message time is = ((Overhead + (SynchDatabytes * 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.

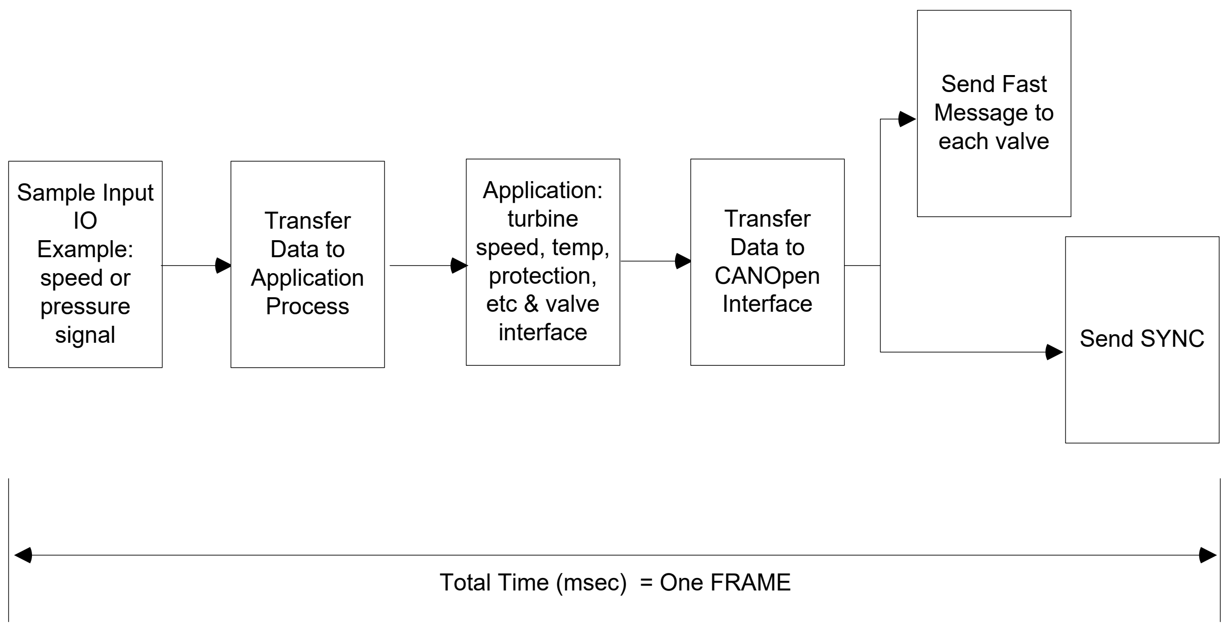


Figure A-8. Frame Time Definition Block Diagram

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 0-3		Async	
		Status Error Register Flag 0	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 4-7		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 13	4,5	Array[16] Boolean	2044
		Unused	6,7	Blank	2045
0x4E0	PDO8	Status Error Register Flags 8-10		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 10	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. 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', DVP will go to a normal shutdown state. The normal shutdown state is to command the valve to 0 or 100 % position depending on valve type.

Bit 1: **Shutdown Position**. If this bit is "1", DVP will perform Shutdown Position by setting the Manual Shutdown Position flag. Care must be taken when using this command. Mechanical stop damage can be incurred on some valves after several hundred cycles from high positions.

Bit 2: **Reset diagnostics bits**. On a "0" to "1" transition (Edge triggered,) the DVP 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 DVP 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 DVP 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 DVP 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 DVP 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 DVP will use these parameters. The exception is if the ENABLE bits are not set, then the DVP will continue using the RAM parameters.

The specified range is enforced with internal DVP 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 DVP.
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 0 through 3
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 0 (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 0)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 1-2	Bit 0	Reserved	Not Used	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	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	Speed Sensor OK	Not Used	See Speed Signal Fault
Byte 1-2	Bit 9	Low MPU Voltage Fault	Not Used	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. The Driver is in Shutdown System mode due to a detected failure with current drive capability of the driver. 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 Active	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 Active	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 EEPROM Write Failed	Failure to write to the EPROM has Occurred.	See EEPROM Write Failed
Byte 3-4	Bit 1	Main EEPROM Read Failed	Failure to read from the EPROM has Occurred.	See EEPROM Read Failed
Byte 3-4	Bit 2	Parameter Error	Parameters do not match the Embedded Firmware version.	See Invalid Parameter(s)
Byte 3-4	Bit 3	Parameter Version Error	Parameter version does not match the Embedded Firmware version.	See Invalid Parameter Version
Byte 3-4	Bit 4	5V Internal Supply Error	Internal 5 V supply is outside acceptable range.	See 5V Failed
Byte 3-4	Bit 5	5V Internal REF Error	Internal 5 V Reference is outside acceptable range.	See 5V Reference Failed
Byte 3-4	Bit 6	12V Internal Supply Error	Internal 12 V supply is outside acceptable range.	See 12V Failed
Byte 3-4	Bit 7	-12V Internal Supply Error	Internal -12 V supply is outside acceptable range.	See -12V Failed
Byte 3-4	Bit 8	ADC Error	The Analog/Digital Converter in the Core processor has stopped running.	See ADC Failed
Byte 3-4	Bit 9	SPI ADC Error	The external Analog/Digital Converter has stopped running.	See ADC SPI Failed
Byte 3-4	Bit 10	5V Internal RDC Error	The RDC 5 V reference is outside acceptable range.	See 5V RDC Reference Failed
Byte 3-4	Bit 11	1.8V Internal Supply Error	Internal 1.8 V supply is outside acceptable range.	See 1.8V Failed
Byte 3-4	Bit 12	24V Internal Supply Error	Internal 24 V supply is outside acceptable range.	See 24V Failed
Byte 3-4	Bit 13	RDC DSP Communication Error	The DSP that computes the feedback positions has stopped running.	See RDC DSP Failed
Byte 3-4	Bit 14	AUX3 Shutdown Position	Annunciates that a Shutdown Position command has been invoked by an external relay or loss of brake power detected via the Aux 3 input.	See Aux 3 SD Position
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 or reset without a power up event.	See Watchdog Reset
Byte 5-6	Bit 2	Analog Input High Fault	Analog input is above the defined threshold - user configurable.	See Analog Input High Error

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 3	Analog Input Low Fault	Analog input is below the defined threshold - user configurable.	See Analog Input Low Error
Byte 5-6	Bit 4	Control Model Not Running	The start-up sequence of the DVP has been interrupted due to a detected fault and the final control state has not been reached.	See Control Model Not Running
Byte 5-6	Bit 5	Manual Shutdown Position	The Shutdown Position mode has been invoked from the service tool.	See Shutdown Position
Byte 5-6	Bit 6	High Elect. Temperature Detected	The control board temperature has exceeded the maximum threshold.	See Electronics Temp. High
Byte 5-6	Bit 7	Low Elect. Temperature Detected	The control board temperature is below the maximum threshold.	See Electronics Temp. Low
Byte 5-6	Bit 8	Speed Sensor Failed	Not Used	See Speed Signal Fault
Byte 5-6	Bit 9	Low PWM Input Fault	The PWM signal duty cycle is lower than the defined threshold.	See PWM Duty Cycle Low
Byte 5-6	Bit 10	High PWM Input Fault	The PWM signal duty cycle is higher than the defined threshold.	See PWM Duty Cycle High
Byte 5-6	Bit 11	Low PWM Frequency Fault	The PWM signal frequency is lower than the defined threshold.	See PWM Frequency Low
Byte 5-6	Bit 12	High PWM Frequency Fault	The PWM signal frequency is higher than the defined threshold.	See PWM Frequency High
Byte 5-6	Bit 13	Manual Shutdown	A Shutdown has been invoked from the service tool.	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 Position Error Motor 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 Position Error Shaft 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	DVP Heat Sink Temp Sensor Fault	The driver heatsink temperature sensor has failed.	See Driver Temp. Sensor Failed
Byte 7-8	Bit 1	High Driver Heat Sink Temp Alarm	The driver heatsink temperature has exceeded the defined warning threshold.	See Driver Temp. High
Byte 7-8	Bit 2	Low Driver Heat Sink Temp Alarm	The driver heatsink temperature is below the defined warning threshold.	See Driver Temp. Low Limit
Byte 7-8	Bit 3	Extreme Driver Heat Sink Temp	The driver heatsink temperature has exceeded the defined critical threshold.	See Driver Temp. 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 Low

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
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 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 Low
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 High

Transmit PDO 7 – Slow Message #6: Status Error Flags 4, 5, 13

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 6 (see table A-9 for bit definition)
Byte 7-8: spare / not used

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 Calib. 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) start up 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) start up 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	Communication CPU Booting	Status indication that the communication processor is booting.	See M5200 Starting
Byte 1-2	Bit 10	Communication CPU Error Detected	Summary Fault – fault detected by the communication processor.	See M5200 Detected an Error
Byte 1-2	Bit 11	Communication CPU not found	The communication processor was not detected for a valve type that requires one.	See Aux Board Not Found
Byte 1-2	Bit 12	Communication CPU Type Fault	The communication processor is not correct for that version of DVP.	See Aux Board Type Error
Byte 1-2	Bit 13	Communication CPU Memory Fault	A Dual port ram error was detected during the RAM check of the communication processor.	See M5200 DPRAM Error
Byte 1-2	Bit 14	Communication CPU Timeout Fault	The communication processor did not start in the required time.	See M5200 Startup Timeout
Byte 1-2	Bit 15	Communication CPU Heartbeat Fault	Loss of the heartbeat signal from the communication processor.	See M5200 Heartbeat 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 Exc. 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 Exc. 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 Exc. 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 Exc. 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 13)

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 0	Heat Sink Temp. Sensor 1 Error (Applies only to DVP 5000, 10000, and 12000)	The #1 temperature sensor on the Heat Sink is out of range/faulted.	None - Replace DVP See Heat Sink Temp. Sensor 1 Error
Byte 5-6	Bit 1	Heat Sink Temp. Sensor 2 Error (Applies only to DVP 5000, 10000, and 12000)	The #2 temperature sensor on the Heat Sink is out of range/faulted.	None - Replace DVP See Heat Sink Temp. Sensor 2 Error

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 5-6	Bit 2	Fan 1 Speed Error	The #1 fan speed is out of range/faulted.	See Fan 1 Speed Error
Byte 5-6	Bit 3	Fan 2 Speed Error	The #2 fan speed is out of range/faulted.	See Fan 2 Speed Error
Byte 5-6	Bit 4	Boost Converter Error (Applies only to DVP 5000, 10000, and 12000)	A fault is detected within the DVP Boost system indicating the Boost Converter board did not reach the proper voltage.	None - Replace DVP. See Boost Converter Error.
Byte 5-6	Bit 5	E-Stop 1 Tripped	The #1 SIL Shutdown contact input is open – Shutdown.	To Run, a closed contact must be applied across both SIL inputs. Check continuity at the input terminal block. Should be low impedance to run. See E-Stop Tripped.
Byte 5-6	Bit 6	E-Stop 2 Tripped	The #2 SIL Shutdown contact input is open – Shutdown.	
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 Error	This status flag indicates an incorrect CAN Node ID address has been selected by the Discrete Inputs.	Correct wiring and power cycle the DVP to re-establish a correct CAN ID address. See CAN Hardware ID Error
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	The CAN transceivers are not functioning, the CAN Controller peripheral was unable to be opened properly.	Power cycle the DVP. If the problem persists, replace the DVP. See CAN Controller Open Error.
Byte 5-6	Bit 13	RESERVED	Reserved message – never active	None
Byte 5-6	Bit 14	RESERVED	Reserved message – never active	None
Byte 5-6	Bit 15	RESERVED	Reserved message – never active	None

Transmit PDO 8 – Slow Message #7: Status Error Flags 8, 9, 10

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-10 for bit definition)
Byte 3-4: Status Error Register 9 (see table A-11 for bit definition)
Byte 5-6: Status Error Register 10 (see table A-12 for bit definition)

Table A-10. 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 DVP 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 DVP and actuator. Power Cycle DVP. 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 DVP and actuator. Power Cycle DVP. 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 DVP. User has connected a different valve to the DVP or has loaded a parameter set to the DVP 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 Type / Serial Number Error.
Byte 1-2	Bit 3	Incorrect Power Board	The actuator connected to the DVP is not compatible with the power board type (i.e., 24 VDC actuator connected to 125 VDC DVP).	Contact Woodward for compatibility information. A different DVP 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 DVP is newer than the firmware loaded on the DVP.	See instructions for software updates. Contact Woodward for support. See Type Not Supported.
Byte 1-2	Bit 5	Dual Res. 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 Res. Difference Alarm.
Byte 1-2	Bit 6	Dual Res. Difference Shutdown	The readings between the two motor commutation resolvers	Contact Woodward for a spare actuator/valve.

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
			differs by an amount larger than the shutdown threshold for a given valve type. Performance is adversely affected; the actuator may not operate reliably.	See Dual Res. Difference Shutdown.
Byte 1-2	Bit 7	Valve 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 DVP. Contact Woodward for a spare actuator/valve. See Valve Shaft 1 Range Limit Error or Valve Shaft 2 Range Limit Error.
Byte 1-2	Bit 8	Valve 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 DVP (as measured by the motor position sensors).	Evaluate the impact on the controlled process. Check for other alarms indicated by the DVP 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 DVP (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 DVP. 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 DVP.	Check thermal conditions at control equipment. When equipment can be brought down for service, check calibration of the analog source and DVP. 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 DVP.	See Digital Com Analog Tracking Shutdown.

Table A-11. 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 Motor 2 Direction Error	This indicates the Motor 2 resolver did not rotate sufficiently or rotated in the incorrect direction.	See Startup Motor Direction Error
Byte 3-4	Bit 3	Startup Max Check 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
Byte 3-4	Bit 4	Startup Max Check Shaft 2 Failed		See Startup Open Valve Shaft 2 Error
Byte 3-4	Bit 5	ID Module Version Not Supported	The version of the ID module is not supported by the DVP to which it is connected.	Contact Woodward for actuator/valve/DVP compatibility. See ID Module Version Not Supported
Byte 3-4	Bit 6	Dual DVP Inter Com CAN Error	In a dual DVP system configuration, the synchronization link over CAN is in-operable	Check the CAN wiring between the DVP's. Ensure that the termination jumper is properly installed. See Dual DVP Inter. Com. CAN Error
Byte 3-4	Bit 7	Dual DVP Inter Com RS485 Error	In a dual DVP system configuration, the synchronization link over RS485 is in-operable.	Check the RS485 wiring between the DVP's. See Dual DVP Inter. Com. RS485 Error
Byte 3-4	Bit 8	Dual DVP Inter Com CAN & RS485 Error	In a dual DVP system configuration, both synchronization link over CAN and RS485 are in-operable.	Check to ensure that both DVP's are powered and there are no other primary electronics faults active. If no other faults are detected, replace DVP. See Dual DVP Inter. Com. CAN & RS485 Error
Byte 3-4	Bit 9	Dual DVP All Inputs Lost	In a dual DVP system configuration, there are no valid control setpoint signals being received by either device.	Check interface wiring and devices connected to the DVP. Ensure they are operational. This is likely not a DVP problem. See Dual DVP All Inputs Lost
Byte 3-4	Bit 10	Dual DVP Valve Type Match Error	In a dual DVP system configuration, the actuator valve types controlled by the DVP's do not match or are otherwise incompatible.	Check the control wiring between the DVP and the actuator. Ensure that the connected devices match. See Dual DVP Valve Type Match Error
Byte 3-4	Bit 11	RESERVED	Reserved message – never active	None

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
Byte 3-4	Bit 12	Power Board FPGA Error	On High Output DVP's, the FPGA interface between the control electronics assembly and power electronics assembly is in-operable. This indicates there has been problem in the FPGA chip on the Power board.	None - Replace DVP See Power Board FPGA 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-12. PDO8 Byte 5-6 (Status Error Register 10)

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 DVP definition to which it is connected.	Contact Woodward for compatibility information. A different DVP 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 DVP 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 DVP 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 the other DVP 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

Status Byte	Bit	Status Name	Description	Troubleshooting Guide
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)	DVP using settings from CAN. DVP 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)	DVP using settings from CAN. DVP 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)	DVP using settings from CAN. DVP 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 dis-abled in normal service.
Byte 5-6	Bit 13	Dual DVP slow mode active	In a dual DVP installation, a single DVP has faulted, or fault condition has been detected requiring a reduced velocity to minimize unbalanced load on the driven system.	This condition is intended to be for short term operation only. At the earliest available opportunity, shutdown the system, troubleshoot the failed DVP/actuator based on the displayed diagnostics and restore normal operation
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	RESERVED	Reserved message – never active	None

A.7 CANopen Objects

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

Table A-13. 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 DVP 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 ‘DVP1’. 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, xxxx-xxxx is represented as xxxxxxxx (no dash)
> 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 DVP part number revision. The DVP 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 DVP 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 through 2048 are mapped and are shown in tTables A-1 and A-2. These are internal data objects (IDOs) accessible by SDO services.

Table A-14. 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. Glossary of Terms

Numerical Terms

Term	Definition/Description
+12V Failed	Internal +12 V is outside acceptable range of 10.6 V to 15.8 V. Internal electronics failure.
–12V Failed	Internal –12 V is outside acceptable range of –13.7 V to –8.6 V. Internal electronics failure.
1.8V Failed	Internal 1.8 V is outside acceptable range of 1.818 V to 2.142 V. Internal electronics failure.
24V Failed	Internal +24 V is outside acceptable range of 22.1 V to 30.7 V. Internal electronics failure.
5V Failed	Internal 5 V is outside acceptable range of 4.86 V and 6.14 V. Internal electronics failure.
5V RDC Reference Failed	Internal 5 V RDC reference is outside acceptable range. Internal electronics failure.
5V Reference Failed	Internal 5 V reference is outside acceptable range. Internal electronics failure.

A

Term	Definition/Description
Actuator Type Selection Diagnostics	In case of a process fault during the Valve Type Selection Process this group shows the appropriate process fault flags
Actuator Type Selection Diagnostics ID Module Not Detected	During power up, the control model the ID Module cannot be read. Failure to read the ID module on the valve/actuator system. ID module calibration record corrupted. The valve does not have an ID module.
Actuator Type Selection Diagnostics ID Module Version Not Supported	During power up, the ID Module version was detected as incompatible with the current version of DVP firmware.
Actuator Type Selection Process	This indicator group gives an overview of the current status of the Valve Type Selection Process. The progress of the auto-detection process is displayed as a percent value.
ADC Failed	Internal ADC in processor core has stopped running. Internal electronics failure.
ADC SPI Failed	External ADC in processor core has stopped running. Internal electronics failure.
Analog Input Configuration	A section within the Input Configuration and Setpoint Source Configuration screens that contains several readable and user configurable fields including Mode Selection Analog Input Scaling and Diagnostic Ranges.
Analog Input Configuration Mode Selection	User configurable setting that may be turned off or select voltage input or milliamp input.
Analog Input Demand	This indicator group gives an overview of the Analog Input signal and valve position information. The analog input demand signal from the control system scaled 0 to 100%.
Analog Input Demand Analog Position Demand	This displays the position that is being demanded by the Analog Input.
Analog Input Demand Analog Input High	The analog input is above the diagnostic threshold. This is a user configurable parameter.
Analog Input Demand Analog Input Low	The analog input is below the diagnostic threshold. This is a user configurable parameter.

Analog Input Scaling	This group gives the input scaling information for 4-20 mA or 0-5V analog inputs.
Analog Output	*Driver Output Data-Demanded Current*
Analog Output Configuration	A section within the Analog Output Configuration screen that contains several readable and user configurable fields including mode selection and analog output scaling ranges.
Analog Output Configuration Mode	This displays the current Analog Output Mode; Off, Actual Position (valve position), Echo Setpoint (demanded position) or Motor Current The user may select from any of these configuration modes.
Analog Output Position Scaling Max. Current Value	This allows setting of the maximum current that will represent the maximum position value (Position at Maximum Current Value) or maximum motor current (Motor Current at Maximum Current Value).
Analog Output Position Scaling Min. Current Value	This allows setting of the minimum current that will represent the Minimum position value (Position at Max. Current Value)
Analog Output Motor Current, Motor Current at Max. Current Value	This allows setting of the maximum motor current value that is correlated to the Analog Output Position Scaling Maximum Current Value
Analog Output Motor Current, Motor Current at Min. Current Value	This allows setting of the minimum motor current value that is correlated to the Analog Output Position Scaling Minimum Current Value
Analog Output Position Scaling Position at Max. Current Value	This allows setting of the maximum position that is correlated to the Analog Output Position Scaling Maximum Current Value
Analog Output Position Scaling Position at Min. Current Value	This allows setting of the minimum position that is correlated to the Analog Output Position Scaling Minimum Current Value
Analog Output Status Demanded Current	This displays the actual analog output current value from the DVP in mA.
Analog Values	The DVP section of the Status Overview Service Tool screen which displays the real time status of the DVP current, voltages, and temperatures.
Auto Detect Error	This diagnostic is only enabled when the DVP has been configured for auto detection (See Auto Detection Section). This diagnostic is set when: The DVP 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). The DVP fails to write the calibration records into the non-volatile memory. Failure to read the ID module on the valve/actuator system. ID module calibration record corrupted. DVP non-volatile memory error.
Auto Detection Control	This indicator group contains Type/Serial Number Error and Type Not Supported status flags and the Auto Detection Request button.
Aux Board Not Found	The Control board has not detected the Aux Board. The selected input type requires an Aux board, and no Aux board is present.
Aux Board Type Error	The Control board has detected an incorrect Aux Board type. This occurs when the aux board needed, and the input type selected are not compatible.
AUX 3 SD Position	This status flag is set when Discrete Input 3 is set, and the Discrete Input Action Mode is set to Aux3 SD+Reset. When this Status Flag is set the DVP is in Shutdown Position

B

Term	Definition/Description
Baud Rate	The number of times per second a signal makes a transition between states and indicates the number of bits per second that are transmitted.
BLDC2 State	This indicates whether the BLDC2 control model is Running or Not Running. When in Running the DVP is controlling the position of the valve based on the Position Demand

Boost Converter Error	This status flag indicates the Boost Converter board did not reach the proper voltage (Applies only to DVP 5000, 10000, and 12000).

C

Term	Definition/Description
CAN Controller Open Error	The CAN Controller peripheral was unable to be opened properly. This may occur if the user is changing the CANopen settings (particularly selecting a lower baud rate) while connected to an active CAN network.
CAN Hardware ID Error	This status flag indicates an incorrect CAN Node ID address has been entered through the Discrete Input connector. This is only true if CAN Hardware ID Mode = CAN HW ID DISCRETE IN-DI5,DI4,DI2,DI1 or CAN HW ID DISCRETE IN-DI5,DI4,DI3 or CAN HW ID DISCRETE IN-DI5,DI4
CAN Hardware ID Mode	A user configurable menu where Disabled and three combinations of communications settings which may be selected by hardware ID.
CANopen	A setpoint source which sets the setpoint signal type of CANopen based protocol using 1 or 2 CAN Ports. Optional use Analog back-up (available if using 1 CAN port).
CANopen Dual Configuration	A section of the Input Configuration screen that is enabled when CAN Open Digital Input is the selected Input Source and CANopen Dual is the communications option. Baud Rate, Port 1 and 2 Node IDs, Timeout interval, and Extended PDO status are displayed.
CANopen Dual Configuration Port 1 Node ID	This indicates what Node ID is selected for CAN input 1. It is configurable by the user
CANopen Dual Configuration Port 2 Node ID	This indicates what Node ID is selected for CAN input 2. It is configurable by the user
CANopen Dual Configuration Timeout	Represents the maximum time allowed between CAN messages. If exceeded the affected port alarm will be activated.
CANopen Redundancy Manager Parameters	This is a display only section of the CANopen Demand Configuration section of the Input Configuration screen when CAN Open Digital Input is the selected Demand Input source. It shows the parameters that are associated with difference between CAN 1 and CAN 2 demand signals.
Check 100 Percent Error	This status flag indicates the 100 % position check has failed.
Configuration and Calibration	Screen within the Service Tool that is used when manual configuration of the DVP to a specific actuator or valve is required.
Control Model Not Running	This status flag indicates the Control Model is not Running. The position of the actuator/valve is not controlled by the DVP. If actuator/valve has a return spring, the actuator/valve is be positioned by the return spring.
Controller Identification	A section of the Service Tool Identification screen which displays information on the controller including Part Number, Revision, and Serial Number.
Current Diagnostic	This feature allows the user to turn the mode on or off and when on will display the limits of three sets of diagnostics.
Current Diagnostic Setting	This shows the operational state of the Current Diagnostic Mode.
Current Phase A High	The phase A current sensor is at max output.
Current Phase A Low	The phase A current sensor is at min output.
Current Phase B High	The phase B current sensor is at max output.
Current Phase B Low	The phase B current sensor is at min output.
Current Setting	Displays motor current demand settings for Valve/Actuator startup checks.

D

Term	Definition/Description
Demand Input Filter Configuration	This group contains the settings for the setpoint filter, and the Mode Selection is user configurable.
Demand Input Filter Settings	These user configurable settings allow selection which input demand filters are enabled; Filter Off, Bandwidth Filter, Noise Filter, Bandwidth and Noise Filter, Slew Rate Filter, Slew Rate Filter and BW Filter, Slew Rate Filter and Noise Filter, Slew Rate Filter, BW and Noise Filter This also displays the break frequency of the Bandwidth filter. The DVP includes a demand signal filter.
Demand Input Filter Settings Bandwidth (Corner Frequency)	This displays the break frequency of the Bandwidth filter and is user configurable to set the Input Filter Bandwidth Corner Frequency (Hz).
Demand Input Filter Settings Damping Factor	This displays the damping factor of the Bandwidth filter, which changes the BW filter from under damped response, to a critically damped response or to an over damped response. This is a user configurable Input Filter Damping Factor Setting.
Demand Input Filter Settings Mode Selection	This displays which input demand filters are enabled; Filter Off, Bandwidth Filter, Noise Filter, Bandwidth and Noise Filter, Slew Rate Filter, Slew Rate Filter and BW Filter, Slew Rate Filter and Noise Filter, Slew Rate Filter, BW and Noise Filter. These are user configurable mode selections.
Demand Input Filter Settings Noise Suppression Threshold	This displays the threshold above which the Noise Filter does not suppress the Input Demand signal.
Demand Input Filter Settings Noise Supp. Gain (Below Threshold)	This displays the gain of the noise filter when below the Noise Suppression Threshold.
Demand Input Filter Settings Slew Rate	This displays the maximum rate the Demand Input will be allowed to change internal to the unit. Demand Input signals exceeding this rate will be internally ramped at the defined rate until achieving the Demand Input.
Demand Input Source	This displays where the position demand originates; Manual Position, Analog Input, EGD Digital Input, PWM Input, Function Generator, or CAN Open Digital Input.
Demand Position Difference Alarm Delay	This is the time delay before an alarm will be set (ratio of 1-to-3).
Demand Position Difference Alarm Limit	This is the maximum allowed difference between Set Position from “Analog Input and CAN Port 1” or “CAN Port 1 and CAN Port 2” depending on the current mode. Alarm will be activated if difference is exceeded for longer than the Demand Position Difference Alarm Delay.
Demand Position Difference Shutdown Limit	This is the maximum allowed difference between Set Position from “Analog Input and CAN Port 1” or “CAN Port 1 and CAN Port 2” depending on the current mode. Shutdown will be activated if difference is exceeded for longer than the Demand Position Difference Shutdown Delay.
Demand Position Difference Shutdown Delay	This is the time delay before a shutdown will be set (ratio of 1-to-3).
Diagnostic Ranges	The diagnostic ranges are those settings used to detect that a Demand Position from the interface is valid (Position Demand Low Point, Position Demand High Point).
Digital Com 1 Error	This status flag indicates when the CAN 1 Input is bad.
Digital Com 2 Error	This status flag indicates when the CAN 2 Input is bad.
Digital Com 1 & 2 And/Or Analog Backup Error	This error occurs if both demand input sources have failed (CAN 1 and 2 if Dual CANopen mode or CAN 1 and Analog Input if CANopen with Analog Backup mode).
Digital Com Analog Tracking Alarm	The CAN demand and Analog Input demand do not match as defined by Demand Position Difference Alarm Limit and Demand Position Difference Alarm Delay.

Digital Com Analog Tracking Shutdown	The CAN demand and Analog Input demand do not match as defined by Demand Position Difference Shutdown Limit and Demand Position Difference Shutdown Delay.
Discrete Inputs Action	This displays the configuration of the Discrete inputs: Off, Shutdown Reset/Reset, Aux 3, Aux3 SD+Reset, Shutdown Reset/Reset FAST.
Discrete Input Functional Status	These status lights indicate whether a Discrete Input has been set.
Discrete Inputs Configuration	This tool provides you the ability to select the behavior of the 5 Discrete Inputs (DI1, DI2, DI3, DI4, and/or DI 5). Each of these options are available with each selection on the dropdown menu except for Turned Off.
Discrete Output Configuration	The main configuration of the discrete outputs is performed on this page. Each of the discrete outputs is configured in the same manner. Each of the two discrete outputs can be configured to activate (or de-activate) upon detection of any of fault conditions monitored by the DVP.
Discrete Output Status	These status lights indicate whether a Discrete Output has been set.
Driver	This Service Tool screen displays I/O State Discrete Input and Output status and Driver Input and Output Data in real time.
Driver Current Fault	The driver fault status flag is detected by monitoring the currents in the driver output stages.
Driver Temp. High	The heat sink temperature is above the high temperature threshold.
Driver Temp. High Limit	The heat sink temperature is above the high limit temperature threshold.
Driver Temp. Low Limit	The heat sink temperature is below the low temperature threshold. The ambient temperature of the driver is below specification.
Driver Temp. Sensor Failed	The temperature sensor is at min or max. The temperature sensor has failed.
Dual Res. Difference Alarm	The difference between the resolver readings is larger than the permissible alarm limit values specific to the valve/actuator serial number. One or both resolvers have moved. There is an electrical problem with the resolver and/or its associated circuits resulting in an incorrect resolver reading.
Dual Res. Difference Shutdown	The difference between the resolver readings is larger than the permissible shutdown limit values specific to the valve/actuator serial number.
Dual DVP Status	The DVP has an option to operate in a dual redundant mode where two actuators are controlled by DVPs connected in a dual redundant configuration. Connection to the actuator is shown in the specific actuator manual. This page displays CANopen Mode, Dual DVP Diagnostics, and Dual DVP Configuration. The status information will only display if the connected valve/actuator is a Dual DVP valve type.
Duty Cycle (Function Generator)	This value defines the ratio of low time to high time when the Wave Pattern is SQUARE WAVE.
DVP Driver Output Information	This displays the driver output current information; real time.
DVP I/O State	A section of the Status Overview Service Tool screen which displays five Discrete Input Functional Status indications and two Discrete Output Status indications.
DVP Temperatures	These real-time measurements display the temperature of DVP Control Board or DVP Power Board in units of Celsius.

E

Term	Definition/Description
EEPROM Read Failed	After multiple retries and data comparison, the software is not able to read from the non-volatile memory. Internal electronics failure.
EEPROM Write Failed	After multiple retries and data comparison the software is not able to write to the non-volatile memory. Internal electronics failure.
EGD	Ethernet Global Data (EGD) is a communications protocol developed by General Electric in 1998. EGD allows a device (the Producer) to transfer data to other devices (the Consumers) on the communications network.
EGD Data Mismatch	A fault which occurs if the corresponding variables from all non-faulted input channels do not match. This function is disabled if the EGD Fault is set to TRUE and is monitored for troubleshooting purposes only.
EGD Diagnostics	Service Tool Screen where up to three EGD ports may be monitored, and error alarms causes may be diagnosed and solutions to extinguish alarms may be determined.
EGD Digital Input	A setpoint source which sets the setpoint signal type which is UDP based Ethernet signal using the EGD protocol;
EGD Fault	Dependent on the EGD mode: 3 port, 2 port, or 1 port this flag indicates the data required to provide a set position to the DVP is missing. The EGD mode selection is set to more ports than supported with the control system. There are other error flags active: See associated troubleshooting steps for each error flag.
EGD L2 Port 0 Stat Error	The Ethernet interface is not communicating status information. DVP internal electronics failure.
EGD L2 Port 1 Stat Error	The Ethernet interface is not communicating status information. DVP internal electronics failure.
EGD L2 Port 2 Stat Error	The Ethernet interface is not communicating status information. DVP internal electronics failure.
EGD L2 Port 3 Stat Error	The Ethernet interface is not communicating status information. DVP internal electronics failure.
EGD Performance	Service Tool Screen which the user may monitor the performance of up to three EDG channels. The screen also contains buttons to open the EGD Diagnostics and Input Configuration screens directly from the EGD Performance screen.
EGD Port 1 Link Error	The EGD messages are received slower than the time out time that is a user setting. Wiring problem on Ethernet port 1. Control system not powered up. IP addresses incorrect.
EGD Port 1 Long Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 1 Short Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 1 Stale Data Error	The Application Level Heart Beat variable has not changed in time period greater than the stale data delay time. Data from the producer is not being updated (stale) in the EGD packet.
EGD Port 2 Link Error	The EGD messages are received slower than the time out time that is a user setting. Wiring problem on Ethernet port 2. Control system not powered up. IP addresses incorrect.
EGD Port 2 Long Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 2 Short Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 2 Stale Data Error	The Application Level Heart Beat variable has not changed in time period greater than the stale data delay time. Data from the producer is not being updated (stale) in the EGD packet.
EGD Port 3 Link Error	The EGD messages are received slower than the time out time that is a user setting. Wiring problem on Ethernet port 3. Control system not powered up. IP addresses incorrect.

EGD Port 3 Long Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 3 Short Message Error	The EGD message length expected is not the same as the one received. Incorrect protocol definition.
EGD Port 3 Stale Data Error	The Application Level Heart Beat variable has not changed in time period greater than the stale data delay time. Data from the producer is not being updated (stale) in the EGD packet.
EGD Rate Group Slip	If the M5200 does not have the time to finish the task within the rate group. This will also give a heartbeat error flag.
EGD Revision Fault	Revision check of external and internal EGD protocol revision. The revision of the M5200 and the revision from the control system do not match.
Electronics Temp. High	The Control Board temperature sensor indicates a temperature above 140° C.
Electronics Temp. Low	The Control Board temperature sensor indicates a temperature below 45° C.
External Shutdown Position	Command sent by Digital communication protocols like: EGD, CANopen. Care must be taken when using this command. Mechanical stop damage can be incurred on some valves after several hundred cycles from high positions.
External Shutdown	Command sent by Service Tool or digital communication protocols like: EGD, CANopen or discrete inputs. See "Shutdown" in Appendix B for functional impact.
E-Stop 1 Tripped	This displays the status of the SIL/External Shutdown status. When this is activated the DVP is in Shutdown Position mode.
E-Stop 2 Tripped	This displays the status of the SIL/External Shutdown status. When this is activated the DVP is in Shutdown Position mode.
Extended PDO	Enables Transmit and Receive PDO's 5-8

F

Term	Definition/Description
Fault Status and Configuration Overview	The Process Fault Status Service Tool screen gives an overview of the entire range of process fault and status flags and their individual status.
Fault Status and Configuration Overview Internals	This Process Fault Status Service Tool screen gives an overview of the internal process fault and status flags and their individual status.
Final Element Feedback Transducer	The final element feedback transducer is the position sensor coupled to or most closely to the final output shaft. This is compared to the motor position sensors which are mounted to the motor.
Force Limiter	This display-only mode is used on specially configured valves/actuators to control an applied force limit during operation. This mode is only available with specially configured valves/actuators (and newer DVP firmware).
Function Generator	A setpoint source which sets the setpoint signal type which is internally generated based on the function generator settings.
Function Generator Configuration	This is a section on the Input Configuration and Setpoint Source Configuration pages and has two options for modifying the information displayed; the Wave Pattern drop down and the Sweep Mode drop down menus.
Function Generator Configuration Start Frequency	This displays the start frequency for a sweep function.
Function Generator Configuration Sweep Stop Frequency	This displays the stop frequency for a sweep function.
Function Generator Configuration Sweep Time	This displays the time that it will take to go from the start frequency to the stop frequency when is sweep mode.

Function Generator Configuration Synch Logging	This setting controls whether data logging will also start when a function generator sweep is started. A non-zero value enables this synchronized behavior.

G

Term	Definition/Description
None Currently	

H

Term	Definition/Description
Home	Screen within Service Tool that contains contact information for assistance and customer service at a variety of Woodward facilities.
Heat Sink Temp. Sensor 1 Error or Heat Sink Temp. Sensor 2 Error	This fault status flag indicates power board heat sink sensor (1 or 2) has failed (Applies only to DVP 5000, 10000, and 12000).

I

Term	Definition/Description
ID Module Not Detected	The DVP is unable to communicate with the ID module or there is no ID module attached to the Actuator or Valve.
ID Module Version Not Supported	Current version of software does not contain the specifications of the ID Module.
Identification	Screen within Service Tool that contains Controller and Valve identification in addition to Service Tool and firmware version information.
Incorrect Power Board	During power up the DVP checks the ID module 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 DVP power board.
Input Configuration	A Service Tool Screen where six different input selections may be made, and the demand configuration may be edited by the user.
Input Current High	The Input current sensor is at maximum output.
Input Current Low	The Input current sensor is at minimum output.
Input Power Information	This displays the input voltage to the DVP (source 1 and source 2), the internal power bus voltage, and the input current to the DVP; real time.
Input Voltage 1 High	The measured voltage at Input 1 is higher than the DVP specification limit.
Input Voltage 1 Low	The measured input voltage on input number 1 is lower than the DVP specification limit.
Input Voltage 2 High	The measured input voltage is higher than the DVP specification limit.
Input Voltage 2 Low	The measured input voltage on input number 2 is lower than the DVP specification limit.
Int. Bus Voltage High	The internal bus voltage sensor is at maximum.
Int. Bus Voltage Low	If the internal bus voltage Sensor is at minimum
Invalid Parameter(s)	CRC16 check failures on both parameter sections. If a new embedded program has been loaded, the parameters have not been updated. NOTE: In DVP firmware prior to 5418-8086, the Invalid Parameter(s) fault indicator on the Internal DVP Fault Status screen can be cleared by Reset Control, but the unit still requires the user to correct the parameters and to cycle power. Another indication of this fault being present is when the Input Voltage and Input Current fields are 0.0 on the Status Overview screen.
Invalid Parameter Version	Version information does not correct in the non-volatile memory. Internal electronics failure.

J

Term	Definition/Description
None Currently	

K

Term	Definition/Description
None Currently	

L

Term	Definition/Description
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.

M

Term	Definition/Description
M5200	Refers to the optional aux board in the DVP that provides Ethernet communications.
M5200 CPU Load	CPU Load of the M5200 in EGD mode.
M5200 Detected an Error	One of the five possible errors associated with the M5200 has been set. *DP ram check error*: The M5200 has detected a dual ported ram error. If the M5200 program is started or stopped this error may occur due to the M5200 and the DVP being out of synch. *MFT Synch error*: The DVP has not been able to provide the synch pulse on time to its M5200. *Version error*: DVP and its M5200 do not have compatible software versions. *Block Count error*: The DVP and M5200 software have a different number of interface blocks. *Heartbeat error*: The M5200 has not received a correct heartbeat from the DVP.
M5200 DPRAM Error	The DVP has detected a Dual port ram error during the RAM check. Defective Dual Port Ram or interface.
M5200 Heartbeat Error	The M5200 has not sent the correct heart beat value to its DVP. The M5200 is not running, or the interface is defective.
M5200 Starting	The control board is waiting until the M5200 aux board is started. Wait time is approximately 2 minutes. This is a typical situation during a power up or change of input type that will activate the M5200 aux board. This flag will reset automatically.
M5200 Startup Timeout	After 2 minutes of waiting for a signal from the M5200 aux board, the control board will timeout. There is no M5200 program, the M5200 program is not running, or the Service/Test Port is configured for DHCP and cannot get an IP address.
Manual Input Manual Position Demand	This is the position setpoint provided while in Manual Operation.
Manual Operation	Service Tool Screen where operating the DVP in manual control is monitored. Capabilities include Position Controller information such as Position Demand, Actual Position and Actual Current.
Manual Position	A setpoint source which sets the setpoint signal type, which is Internally generated setpoint, user-configurable from the Manual Control page
Mode	“Mode” is used to describe a parameter which selects one option to the exclusion of the other available options.
Mode Selection	Allows the user multiple options for input filter configurations. The selected configuration is then displayed in the Mode Selection window of the Position Controller Configuration page.
Motor	This section displays information related to the Motors resolvers

Motor 1 Cos Error **Motor 2 Cos Error**	The Cosine input voltage is out of range on the motor resolver. The wiring to the resolver is disconnected or failed. The resolver failed open or is intermittent.
Motor 1 Exc. Error **Motor 2 Exc. Error**	The Sine and Cosine voltage combined are below the diagnostic threshold. The excitation wiring to the resolver is shorted or intermittent. The resolver excitation coil is shorted. The resolver gain is too low due to resolver wiring problem. Excitation circuit failure.
Motor 1 Sin Error **Motor 2 Sin Error**	The Sine input voltage is higher than the diagnostic limit on the motor resolver. The wiring to the resolver is disconnected or intermittent. The resolver failed open or is intermittent.
Motor 1 and 2 Res. Error	This is a summary indication that an error is detected in both motor 1 and motor 2.
Motor Calibration Point	This value is the factory calibration point for the motor resolver.
Motor Control Parameters	A section of the Service Tool Status Overview screen Position Controller which displays parameters of Actual Current and Actual Current (Filtered).
Motor Control Parameters Actual Current	Real-time current being fed to the actuator; raw current.
Motor Control Parameters Actual Current (Filtered)	This is the actual current driven into the actuator after filtering.
Motor Current	The selection will use the actual current which is the current that the driver is applying to the motor. This signal will have a lot of movement such as the current from the current controller continues moving to keep the position of the valve in the same position as the demanded position.
Motor Max. Direction Startup Direction Settings – Direction Limit	Startup Checks: The maximum allowable motor revolution(s) are displayed during the startup check.
Motor Max. Startup Direction Settings	This section defines the Startup, max direction, current setting, upper and lower limits, and the startup values from the last startup check.
Motor Maximum Startup Limit Settings Actual Avg. Startup Position Motor 1	The last maximum direction startup check value for Motor Res 1 is displayed.
Motor Maximum Startup Limit Settings Actual Avg. Startup Position Motor 2	The last maximum direction startup check value for Motor Res 2 is displayed.
Motor Minimum Startup Limit Settings	This section defines the Startup, min direction, current setting, upper and lower limits, and the startup values from the last startup check.
Motor Position Error Alarm Limit	This is the minimum difference between demanded position and measured position (from the motor resolver) that will trigger a Motor Position Error Alarm.
Motor Position Error Alarm Delay Time	This is the minimum time the Motor Position Error Alarm Limit must be exceeded before an alarm is triggered.
Motor Position Error Shutdown Limit	This is the minimum difference between demanded position and measured position (from the motor resolver) that will trigger a Motor Position Error Shutdown.
Motor Position Error Shutdown Delay Timer	This is the minimum time the Motor Position Error Shutdown Limit must be exceeded before a shutdown is triggered.
Motor Resolver Difference Diagnostics	These diagnostics are for monitoring differences between redundant motor resolvers (Dual Res. Difference Alarm and Dual Res. Difference Shutdown).
MPU/PWM Input	A setpoint source which sets the setpoint signal type of PWM signal.

N

Term	Definition/Description
No Power Board Found	During power up the control board will read the power board. This diagnostic will be set if no Power Board is found. DVP internal electronics failure or there is no power board connected.
Number of Cycles	The number of sweep cycles combined with the number of cycles run.

O

Term	Definition/Description
Output Configuration	A Service Toll screen which provides status information on the DVP's analog and digital output section. Three text indicators show the currently active outputs and which mode they have been configured to.

P

Term	Definition/Description
Position Control State	This displays the controller model that is being used to control the actuator and the state of the controller; Running or Not Running.
Position Controller	A screen in Service Tool which provides Motor and Actuator/Valve Position Readings, Position Sensor Diagnostics, and Position Error Diagnostics. Additionally, Motor Resolver Difference Diagnostics and Motor Position Control State are provided.
Position Controller Configuration	A screen in Service Tool which provides the Position Controller Configuration menu indicates the general overview of the actuator operation. User individual configuration edit options are also available on this screen.
Position Controller Not Ready	This status flag indicates the DVP is not controlling position. This occurs during power-up initialization and when in a shutdown position state.
Position Demand	Position demand signal currently being used by the DVP.
Position Demand High Point	This value specifies the threshold above which the Position Demand is considered to have failed.
Position Demand Low Point	This value specifies the threshold below which the Position Demand is considered to have failed.
Position Error Motor Alarm	The Motor position is not tracking the set point within limitations set by the tracking error alarm parameters. Incorrect Parameter Settings. Contamination in the valve/actuator system.
Position Error Configuration	This only displays the group which includes Motor Position and Shaft Position. The errors are displayed in four categories: Alarm Limit, Alarm Delay Time, Shutdown Limit, and Shutdown Delay Time.
Position Error Motor Shutdown	The Motor position is not tracking the set point within limitations set by the tracking error shutdown parameters.
Position Error Motor Alarm	The motor position sensor is not tracking the set point within limitations set by the tracking error alarm parameters. Contamination in the valve/actuator system, incorrect or damaged motor wiring, and/or motor failure could be a cause for this diagnostic.
Position Error Shaft Alarm	There is an error larger than the shaft (final element) position error alarm parameters between the shaft (final element) position and the demanded position. Excessive Valve/Actuator Wear. Incorrect or damaged motor wiring. Motor Failure. DVP electronics failure.
Position Error Shaft Shutdown	There is an error bigger than the stem position error parameters between the stem position and the demanded position. Excessive Valve/Actuator Wear. Incorrect or damaged motor wiring. Motor Failure. DVP electronics failure.
Position Error Valve Shaft Alarm	There is an error bigger than the stem position error parameters between the stem position and the demanded position. Excessive Valve/Actuator Wear. Incorrect or damaged motor wiring. Motor Failure. DVP electronics failure.

Position Offset	Position offset value – configured during valve factory calibration
Position Readings	A section of the Service Tool Status Overview screen Position Controller which displays readings of Position Demand, Actual Position, and Actual Position Sensors 1 and 2.
Position Readings Actual Position	A value derived by different sensors represented in percentage that is the reported position (real-time position) of the valve or actuator as seen by the DVP.
Position Readings Actual Position Sensor 1	This value shows the actual position according to Position Sensor 1. Note that the physical sensor mapped to Position Sensor 1 is dependent on the specific valve or actuator in use.
Position Readings Actual Position Sensor 2	This value shows the actual position according to Position Sensor 2. Note that the physical sensor mapped to Position Sensor 2 is dependent on the specific valve or actuator in use.
Position Readings Position Demand	This represents the Position Demand value currently seen from the selected Position Demand interface, but subject to the following limitations: 1) The value will be forced into the range of 0.0% to 100.0%, inclusive. 2) When the unit is in the Shutdown state the value will be controlled to the defined demand (0.0% or 100.0% dependent on the specific valve or actuator in use).
Position Sensor Diagnostics	This displays the Fault status flags associated with the Shaft Resolver. Some actuators have one shaft (final element) resolver, and some have two shaft (final element) resolvers.
Position Sensor Diagnostics Motor 1 and 2 Res. Error	Both the Motor 1 and Motor 2 resolvers have active faults detected. This is a summary fault indicator, and the specific causes can be narrowed by reviewing the other specific resolver fault indicators.
Power Board Calib. Error	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.
Power Board Diagnostics Fan 1 Speed Error	This fault status flag indicates Fan 1 is slowing down or has stopped (Applies only to DVP 5000, 10000, and 12000).
Power Board Diagnostics Fan 2 Speed Error	This fault status flag indicates Fan 2 is slowing down or has stopped (Applies only to DVP 5000, 10000, and 12000).
Power Board Diagnostics Heat Sink Temp. Sensor 1 Error	This fault status flag indicates power board heat sink sensors # 1 has failed (Applies only to DVP 5000, 10000, and 12000).
Power Board Diagnostics Heat Sink Temp. Sensor 2 Error	This fault status flag indicates power board heat sink sensors # 2 has failed (Applies only to DVP 5000, 10000, and 12000)
Power Board ID Error	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.
Power–up Reset	CPU reset by a power up event.
PWM Duty Cycle High	The PWM input duty cycle is above the given setting (User setting)
PWM Duty Cycle Low	The PWM input duty cycle is below the given setting (User setting)
PWM Frequency High	The PWM frequency is above the given setting (User Setting)
PWM Frequency Low	The PWM frequency is below the given setting (User Setting)

Q

Term	Definition/Description
None Currently	

R

Term	Definition/Description
Reduced Torque Error	This Fault status flag indicates the system torque has been reduced due a reduction in motor current
Reduced Slew Rate Error	This Fault status flag indicates the system slew speed has been reduced; loss of second actuator in a dual system, input current limiter
Relubrication Function Configuration	This configuration is dependent upon the valve or actuator that is being read by the DVP and the settings are not configurable by the user. This page is a display only and displays relubrication activity which are perturbations (small vibrations) that are introduced into the valve to prevent silt build up.
Resolver	This section displays LVDT information, resolver position, signal amplitude, LVDT drive circuit gain
Resolver Diagnostics	This Service Tool screen displays Resolver, Motor, and Valve diagnostics and displays setting information. There are also Motor and Valve fault indicators that show errors in the diagnostic process.
Resolver Difference	
RDC DSP Failed	DSP that runs the Resolver-to-digital converter has stopped running. Internal electronics failure.

S

Term	Definition/Description
Sample Time	An interval represented in milliseconds which is associated with Sweep Mode of how frequently sample readings are taken.
Servo Position	This selection sends the 4-20mA equivalent of the ServoPosition to the output using scaling defined in the other parameters in this group/
Setpoint Source Selection Configuration	This feature of the Input Configuration screen of Service Tool enables the user to select from six configuration options which include Manual Position, Analog Input, EGD Digital Input, PWM Input, Function Generator, and CANopen Digital Input. These options adjust the settings of the DVP.
Shaft Position Error	The Shaft position is not tracking the set point within limitations set by the position error parameters.
Shaft Position Error Alarm Limit	This is the minimum difference between demanded position and measured position (from the shaft resolver) that will trigger a Shaft Position Error Alarm.
Shaft Position Error Alarm Delay Time	This is the minimum time the Shaft Position Error Shutdown Limit must be exceeded before a shutdown is triggered.
Shaft Position Error Shutdown Limit	This is the minimum difference between demanded position and measured position (from the shaft resolver) that will trigger a Shaft Position Error Shutdown.
Shaft Position Error Shutdown Delay Time	This is the minimum time the Shaft Position Error Alarm Limit must be exceeded before a shutdown is triggered.
Shutdown	This indicates a shutdown condition is detected. The position of the actuator/valve is controlled by the DVP, typically to 0%. On some actuators/valves this may be factory configured to 100% (for example, a special fail open or bypass valve).
Shutdown Position	This indicates a shutdown condition is detected where correct position control is not possible, so driver output is turned off. The position of the actuator/valve is not controlled by the DVP. If the actuator/valve has a return spring, the actuator/valve is positioned by the return spring.
Shutdown System	This indicates a shutdown condition is detected where correct position control is not possible due to a detected driver current fault.
Soft Stop Variant	This display-only value identifies the soft stop configuration that is present within the actuator. This setting is only available with specially configured valves/actuators (and newer DVP firmware).

Speed Signal Fault	Only used if speed sensor is active. DVP does not support speed sensor input with present version.
Start Frequency	This displays the start frequency for a sweep function.
Startup Checks	This Service Tool screen shows DVP Diagnostics Valve/Actuator Startup Checks include Position Offset, Motor Calibration Point, Minimum Direction Startup, Maximum Direction Startup and Motor Direction Check.
Startup Close Motor or Startup Close Shaft Error	**During calibration at the factory, the feedback values at the startup position recorded. The 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 DVP verifies that the valve is at the min stop. This diagnostic occurs if the feedback reading is not within the calibrated range when checking the closing direction.**
Startup Close Valve Shaft 2 Error	This is the same as Startup Close Valve Shaft 1 Error but for the second shaft resolver. Some actuators use 2 shaft resolvers.
Startup Max Check Res 1 Failed **Or** **Startup Max Check Res 2 Failed**	This indicates the primary final element position sensor (“Res 1”) or the secondary final element position sensor (“Res 2) did not fall within the startup max limit range. This is most common with valve/actuators which do not have the ID module and require manual set-up see Appendix D, E, F in Manual 26912 for set-up instructions. For valve/actuators with ID modules, this can occur due to wiring problems or foreign debris which do not allow the device to close properly. See also information on startup checks.
Startup Open Motor or Startup Open Shaft Error	During calibration at the factory, the feedback values during the startup sequence are recorded. The 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 DVP verifies that the valve is at the min stop. This diagnostic occurs if the feedback reading is not within the calibrated range when checking the opening direction.
Startup Motor Direction Error **Or** **Startup Motor 2 Direction Error**	Most commonly a motor wiring problem. Motor not connected, or phases are connected incorrectly. Can also be caused by a resolver wiring problem; resolver moving in the incorrect direction. Less frequently, a motor defect, open or short circuit. If shorted, it is likely that a Driver Current Fault flag is also detected. Least common: DVP electronics failure.
Startup Open Valve Shaft 2 Error	This is the same as Startup Open Valve Shaft 1 Error but for the second shaft resolver. Some actuators use 2 shaft resolvers.
Startup Position Lower Limit	This displays the lower limit of a specific startup check.
Startup Position Upper Limit	This displays the upper limit of a specific startup check.
Status Overview	DVP Service Tool screen which contains Position Controller, DVP I/O State, and DVP Analog Value information. A user customizable trend chart is also included to provide a real-time graphical reference to the performance of the DVP.
Stroke Length	This display-only setting is the programmed stroke length of the actuator. This setting is only for specially configured valves/actuators (and newer DVP firmware).
Sweep Mode	This dropdown menu within the Function Generator Configuration section is a user configurable, multiple option menu to set different sweep modes such as Linear, Linear Repeat, and Number of Cycles Low/High.

T

Term	Definition/Description
Trend Chart	A trend chart displays the time varying position set point, actual position, and filtered motor drive current. Trend charts are a feature in several Service Tool screens such as Manual Operation.
Timeout	A user configurable time interval, typically in milliseconds, which is a buffer.
Type Not Supported	This diagnostic is annunciated if the valve type reported by the valve/actuator system in the ID module is not supported by the DVP software. Valve type not supported by the DVP. DVP software is not the required revision for this valve.
Type / Serial Number Error	If during power up the DVP 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 DVP. User has loaded a parameter set to the DVP that does not match this valve/actuator system serial number.

U

Term	Definition/Description
None Currently	

V

Term	Definition/Description
Valve Identification	A section on the Service Tool Identification screen which displays Valve Type, Part Number, Revision, and Serial Number. This information is provided through communications between the valve and the DVP.
Valve Shaft 1 Cos Error	The Cosine input voltage is out of range on the valve shaft (final element) for Resolver number 1.
Valve Shaft 1 Exc. Error	The Sine and Cosine voltage combined are too low.
Valve Shaft 1 Sin Error	The Sine input voltage is out of range on the valve shaft (final element) Resolver number 1
Valve Shaft 2 Cos Error	The Cosine input voltage is out of range on the valve shaft (final element) for resolver number 2.
Valve Shaft 2 Exc. Error	The Sine and Cosine voltage combined are too low. The excitation wiring to the resolver is shorted or intermittent. The resolver excitation coil is shorted. The resolver gain is too low due to resolver wiring problem. Excitation circuit failure.
Valve Shaft 2 Sin Error	The Sine input voltage is out of range on the valve shaft (final element) resolver number 2.
Valve Shaft 1 and 2 Error	The shaft (final element) resolver redundancy manager has detected a Valve shaft (final element) 1 and Valve shaft (final element) 2 error. Valve shaft (final element) 1 error is true if any of the following errors are detected: • Valve shaft (final element) 1 Sine Error • Valve shaft (final element) 1 Cosine Error • Valve shaft (final element) 1 Exc. Error Valve Stem 2 error is true if any of the following errors are detected: • Valve shaft (final element) 2 Sine Error • Valve shaft (final element) 2 Cosine Error • Valve shaft (final element) 2 Exc. Error
Valve Shaft 1 Range Limit Error or Valve Shaft 2 Range Limit Error	During calibration at the factory, the final element feedback range (difference between minimum and maximum stop) is recorded. This diagnostic occurs if the final element #1 or #2 resolver reading is detected outside the allowable resolver range.

Valve Shaft Max. Startup Range Settings Actual Avg. Startup Position	This value shows the average reading obtained for the shaft resolver during the Max portion of the startup checks. This value is used to determine the status of Startup Open Valve Shaft 1 Error or Startup Open Valve Shaft 2 Error.
Valve Shaft Min. Startup Range Settings Actual Avg. Startup Position	This value shows the average reading obtained for the shaft position feedback transducer during the Min portion of the startup checks. This value is used to determine the status of Startup Close Valve Shaft 1 Error or Startup Close Valve Shaft 2 Error.
Valve Type Selection	Service Tool screen which contains Actuator Type Selection Process, Auto Detection Control, Actuator Type Selection Diagnostics, Selected Valve Type, Valve Specific and Control Module information. The user may invoke a self-configuration process using data acquired from the valve's Identity (ID module).

W

Term	Definition/Description
Watchdog Reset	CPU reset without a power up event.
Wave Pattern	This dropdown menu within the Function Generator Configuration section is a user configurable, multiple option menu to set wave patterns such as DC, Sine Wave, and Square Wave.

X

Term	Definition/Description
None Currently	

Y

Term	Definition/Description
None Currently	

Z

Term	Definition/Description
Zero Cut-off Configuration	This read-only feature ceases closed-loop position control when the position demand and/or actual position meets certain criteria. The DVP and valve remain active and functional but rely on an open-loop method to achieve the desired position. In this state it prevents high frequency noise from wearing the motor gear teeth. The traditional open-loop method is achieved by removing power to the motor and relying on a return spring. An additional open-loop method is available with specially configured valves/actuators (and newer DVP firmware) to use a constant "seating" current.
Zero Cut-off Current Control Mode	This display-only setting is when Zero Cut-off is configured to use constant current to push into the valve seat when Zero Cut-off mode is active. This mode is only available with specially configured valves/actuators (and newer DVP firmware).
Zero Cut-off Seating Current	This display-only setting is the constant current used to push into the valve seat when Zero Cut-off mode is active and is set to Current Control Mode. This mode is only available with specially configured valves/actuators (and newer DVP firmware).

Technical Specifications

Table TS-1. General Specifications

125 VDC Operation	
Description:	Digital Valve Positioner DVP5000, DVP10000 and DVP12000 Models
Power Supply Input:	125 VDC +20%, –28%
Current Draw DVP5000: (-40°C to 70°C)	5 A steady state, 40 A peak for 500 ms, 25 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Current Draw DVP10000/12000: (-40°C to 70°C)	5 A steady state, 40 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Current Draw DVP12000: (-40°C to 55°C)	6 A steady state, 50 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Recommended Input Protection:	DVP5000: 15A time delay fuse or 15A breaker DVP10000: 30A time delay fuse or 35A breaker DVP12000: 40A time delay fuse or 45A breaker
Output Current DVP5000:	25 A DC (17.7 A rms) continuous, 40 A peak for 500 ms Ambient Temperature: -40°C to +70°C
Output Current DVP10000 and DVP12000:	12Adc (8.5Arms) continuous, 40 A peak for 500 ms Ambient Temperature: -40°C to +70°C
Output Current DVP12000:	15Adc (10.6Arms) continuous, 40 A peak for 500 ms Ambient Temperature: -40°C to +55°C
Package Heat Dissipation:	Ethernet Option **For Reference Only** 45W nominal,when the actuator is unpowered. **Cabinet Heat Load Value** 110W Typical with actuator powered (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at typical output current). **For Reference Only** 160W @ Maximum Heat Load (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at full output current). **Non-Ethernet Option** **For Reference Only** 40W Nominal, when the actuator is unpowered. **Cabinet Heat Load Value** 105W Typical with actuator powered (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at typical output current). **For Reference Only**

	155W @ Maximum Heat Load (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at full output current).
Mechanical Dimensions:	Rear Panel Mount DVP5000 388 x 308 x 127 mm (H x D x W) (15.26 x 12.125 x 5.0 inches)
Weight:	DVP5000: 7.9 kg (17.4 lb) DVP10000: 10.7kg (23.6 lb) DVP12000: 10.7kg (23.6 lb)

220 VDC Operation

Description:	Digital Valve Positioner DVP5000, DVP10000 and DVP12000 Models
Power Supply Input:	220 VDC +36%, –15%
Current Draw DVP5000: (-40ºC to 70ºC)	5 A steady state, 40 A peak for 500 ms, 25 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Current Draw DVP10000/12000: (-40ºC to 70ºC)	5 A steady state, 40 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Current Draw DVP12000: (-40ºC to 55ºC)	6 A steady state, 50 A for 30 seconds (during rapid actuator transient) (Current draw includes actuator power)
Recommended Input Protection:	DVP5000: 15A time delay fuse or 15A breaker DVP10000: 30A time delay fuse or 35A breaker DVP12000: 40A time delay fuse or 45A breaker
Output Current All Models:	25 A DC (17.7 A rms) continuous, 40 A peak for 500 ms Ambient Temperature: -40ºC to +70ºC
Output Current DVP12000:	28Adc (19.8Arms) continuous, 40 A peak for 500 ms Ambient Temperature: -40ºC to +55ºC
Package Heat Dissipation:	**Ethernet Option** For Reference Only 45W nominal, when the actuator is unpowered. **Cabinet Heat Load Value** 110W Typical with actuator powered (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at typical output current). **For Reference Only** 160W @ Maximum Heat Load (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at full output current). **Non-Ethernet Option** For Reference Only 40W Nominal, when the actuator is unpowered. **Cabinet Heat Load Value** 105W Typical with actuator powered (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at typical output current).

	For Reference Only 155W @ Maximum Heat Load (This is the heat-load caused by the DVP and occurs when the associated actuator is driven at full output current).
Mechanical Dimensions:	Rear Panel Mount DVP5000 388 x 308 x 127 mm (H x D x W) (15.26 x 12.125 x 5.0 inches)
Weight:	DVP5000: 7.9 kg (17.4 lb) DVP10000: 10.7kg (23.6 lb) DVP12000: 10.7kg (23.6 lb)

Environmental Specifications (Rear Panel Mount)

Ambient Operating Temperature:	-40ºC to +70°C (-40°F to +158°F) -40ºC to +55ºC (-40°F to +131°F)
Storage Temperature:	-40°C to +105°C (-40°F to +221°F) Component life is adversely affected by high temperature and high humidity environments. Room temperature storage is recommended for long life. If the unit is to be stored for a long period of time, operating power must be applied for a few hours at least once every 18-24 months.
Humidity:	0 to 95% non-condensing
Maximum operating Altitude:	3000 m (9842 feet)
Pollution Degree:	Maximum Pollution Degree 2
Mechanical Vibration:	Woodward Specification RV5 (0.04 G²/Hz, 10–500 Hz, 2 hours/axis, 1.04 Grms)
Mechanical Shock:	Woodward Specification MS2 (30 G, 11 ms Half Sine Pulse)
EMC/EMI:	EN 61800-3: EMC Requirements and Test methods for Adjustable Speed Electrical Power Drive Systems (DC Powered Category 3, 2nd Environment). Deviation of EN 61800-3 IEC 61000-4-5 DC power line surge to ±1kV Line to Earth (L-E) and ±0.5kV Line to Line (L-L).Woodward Spec: Conducted Low Frequency Immunity (power line ripple) of 12.5VRMS or 2 Watts sine 50 Hz to 10 kHz.
Environmental Protection	IP20 per IEC 60529. Must be installed in enclosure or cabinet to provide a minimum IP54 level of protection against dust and moisture when used in Hazardous Locations.

Additional Reference

Application Note 51530, “Extended Atmospheric Environment Requirements” contains information and guidelines pertinent to the installation of electronic equipment where it is exposed to atmospheric pollution in the form of particulates and corrosive gases. The note covers corrosion mitigation techniques and provides information on conformal coatings that are employed on Woodward Inc. products for mitigation of corrosion and electrochemical migration. Additionally, the benefits of the conformal coating types used are presented.

Power Down Procedures

The following procedures are used for normal Woodward DVP driver shutdown. This procedure is to power down the Woodward DVP System before performing any maintenance, for example a fan replacement. Follow your local power shutdown procedure to safely turn off the turbine for any maintenance.

⚠WARNING **Power Down**	**Follow your local power shutdown procedure to safely turn off the power to the turbine for any maintenance.**

⚠WARNING **Power Down**	**Follow your plant power lockout/tagout procedures before any employee performs any servicing or maintenance on the DVP where the unexpected energizing, startup or release of stored energy could occur and cause injury.**

⚠WARNING **Power Down**	**The following may occur if you do not observe the danger information given:** • **Damage to material assets** • **Severe personal injury** • **Death**

Normal Power Down

Follow this procedure whenever service engineers perform routine maintenance. The procedure is designed to safely power down the Woodward DVP Driver.

DVP Driver Power Down

Demand the DVP Driver to a shutdown state by following the steps below:

1. Follow your local power shutdown procedure to safely turn off the power to the turbine for any maintenance. Verify that local procedures were completed correctly.
2. Open the main power switch (Breaker) to the DVP. In the case of power redundancy, ensure both main switches (breaker) are open.
3. Measure the voltage at the DVP input power terminal to confirm the voltage read approximately 0 volts.
4. Remove the Input Power Terminal from the DVP.
5. Disconnect the Actuator cable from the DVP.

Revision History

Changes in Revision N—
- Edited EMC Directive with “and applicable amendments”
- Removed Low Voltage Directive
- Edited CSA USA and Canada Certificate
- Removed “+” section 7.3
- Added Important box to section 7.8.2
- Added content to storage temperature in Environmental Specifications
- Updated EU DoC
- Added UKCA DoC

Changes in Revision M—
- Revised Korean Certification in Regulatory Compliance
- Added content to Special Conditions for Safe Use
- Edited section 1.1
- Edited section 2.5.2 and 2.5.5
- Edited Figure 2-4 (TB7 Connector section)
- Added Caution boxes to section 3.3
- New Figure 3-2a and 3-2b
- Edited section 3.8.1
- New Figure 3-10
- Added content to section 3.11
- Added content to Table 9-1, 9-8
- Edited Bit 0 and Bit 1 in section A.5
- Added content to Table A-3
- Added content to Appendix B
- Revised Shutdown Procedures to Power Down Procedures for clarity
- Various edits to manual template and URL links throughout the manual

Changes in Revision L—
- Revised Invalid Parameter(s) in Table 9.2
- Revised Invalid Parameter(s) in Appendix B
- Replaced DoC
- Minor edits to ATEX and IECEx in Regulatory Compliance section

Changes in Revision K—
- Added Korean Certification (KC Mark) to Regulatory Compliance section
- Added Notice box to section 2.1
- Revised section 3.4
- Revised section 3.5.2
- Added shutdown system to Glossary of Terms

Changes in Revision J—
- Added new bullet in section 2.4
- Added Continuous Input Current and Transient Input Current to Table 3-1
- Added section 3.2.2 Recommendations for Dual and Simplex Power Wiring
- Added Figure 3-2
- Changed caption to Figure 3-3
- Changed title to section 3.5.2
- Added new step 2 and step 5 to 3.5.2 Position Feedback Transducer Wiring Requirements
- Added new paragraph to section 3.6
- Added new paragraph to Section 3.8 and updated Figure 3-7 to show correct Ethernet Port 4 wiring and added cyber security reference
- Added new content including new Port 4/NC to Table 3-8

- Edited opening paragraph to section 3.9
- Replaced diagram in Figure 3-10
- Updated description of discrete input circuit in section 3.12.
- Added discrete input number assignments to figure 3-11.
- Added new paragraph below Figure 3-13 and bottom of Page 38
- Added reference to Appendix A to Page 39
- Added new section s 3.14.1, 3.14.3, and 3.14.4 including Figures 3-15, 3-16, 3-17, and 3-18
- Added new opening paragraph to section 3.16
- Added new paragraphs to section 4.1
- Added Sections 4.2 Startup Checks and 4.3 General Description of a Dual Positioner System
- Added new content to Section 4.4
- Added new Duty Cycle Notice box to Section 4.5
- Replaced text content in Section 4.5
- Updated chart in Figure 4-7 and new paragraph to Section 4.6
- Edited Indicated Condition description in red, green, and orange colors in Table 4-1
- Edited Reason descriptions for Solid Red and Solid Green in Table 4-3
- Added new Hot Swap Hazard Warning box and paragraph to Section 7.1
- Updated the software system requirements in section 7.3.
- Edited Aux 3 SD Position content in Table 9-1
- Added Current Diagnostic 1, or Current Diagnostic 2, or Current Diagnostic 3 row to Table 9-1
- Combined Digital Com 1 or Com 2 Errors and Digital Com 1 & 2 or Analog Backup Errors in Table 9-1
- Combined E-Stop 1 and 2 Tripped in Table 9-1
- Added Can Hardware ID Error to Table 9-1
- Added Table 9-8 content to Table 9-2
- Combined Input Voltage 1 High/2 High and 1 Low/2 Low in Table 9-2
- Added Driver Temp. High and Driver Temp. High Limit to Table 9-2
- Corrected spelling of Monotonic in Table 9-2.
- Combined Motor 1 and Motor 2 Sin/Cos Errors; Motor 1 and 2 Exc. Errors; Motor 1 and 2 Res. Errors; Valve Shaft 1 and 2 Sin/Cos Errors; Valve Shaft 1 and 2 Res. Errors in Table 9-3
- Added Control Model Not Running and ID Module Version Not Supported to Table 9-4
- Combined Valve Shaft 1 or 2 Range Limit Error to Table 9-5
- Added Startup Open Motor Error, Startup Open Motor 2 Error, Startup Close Motor Error, Startup Close Motor 2 Error, Startup Open Valve Shaft 1 Error, and Startup Close Valve Shaft 1 Error to Table 9-6
- Added Table 9-7
- Combined Heat Sink Temp Sensor 1/2 Errors and added Boost Converter Error to Table 9-8
- Edited second paragraph in section A.1
- Added note to Stopped reference in section A.3
- Edited content in 0x3E0 Can Bytes 6,7 and 0c4E0 Can Bytes 6,7 in Table A-1
- Edited content in 0x360 Can Bytes 0-7, 0x460 Can Bytes 0-7, and 0x560 Can Bytes 0-7in Table A-2
- Additional content added to Bit 5, Bit 6, and Bit 7 under Byte 3 in Section A.5
- New sentence added to Receive PDOs 2-8 – Parameter Based “Slow Messages” in Section A.5
- New Range numbers installed in Byte 1-2, Byte 3-4 in Receive PDO-4 and Byte 1-4, Byte 5-8 in Receive PDO 6 in Section A.5
- Data updated in Transmit PDO 6, Transmit PDO-7 Transmit PDO-8 and Tables A-3, A-4, A-5, A-6, A-7, A-8, A-9, A-10, A-11, and A-12 in Section A.6
- Added CANopen Objects section after Section A.6 in appendix A
- Definitions for Control Model Not Running, Dual Res. Difference Alarm, Dual Res. Difference Shutdown, Heat Sink Temp. Sensor 1 or 2 Error, M5200, Motor 1 and 2Cos Error, Motor 1 and 2 Cos Error, Motor 1 and 2 Exc. Error, Motor 1 and 2 Sin Error, Motor 1 and 2 Res. Error, Position Controller Not Ready, Position Error Motor Shutdown, Position Error Motor Alarm, Position Error Valve Shaft Alarm, Position Sensor Diagnostics, Shutdown, Shutdown Position, Startup Max Check Res 1 Failed Or Startup Max Check Res 2 Failed, Startup Motor Direction Error Or Startup Motor 2 Direction Error, Valve Shaft 1 Cos Error, Valve Shaft 1 Sin Error, Valve Shaft 2 Cos Error, Valve Shaft 2 Sin Error, Valve Shaft 1 and 2 Error, and Valve Shaft 1 Range Limit Error or Valve Shaft 2 Range Limit Error added to Appendix B Glossary

Changes in Revision H—
- Replaced descriptions of errors Startup Close Motor Error and Startup Close Valve Shaft 1 Error in Appendix B
- Replaced error descriptions Startup Open Motor Error and Startup Open Valve Shaft 1 Error in Appendix B
- Replaced DOC

Changes in Revision G—
- Added references to DVP 12000 to manual
- New cover image
- Added EMC reference to the North American Compliance listing in the Regulatory Compliance section
- Updated content in Technical Specifications table
- Eliminated shading in Table 3-5
- Added Tables 3-6, 3-7, 3-9, 3-10, 3-11, 3-12, 3-13, and 3-14
- Adjusted captions in existing tables to compensate for the new table additions

Changes in Revision F—
- Deleted paragraph from section 3.6.3
- Removed references to HO (High Output) Service Tool
- Added section 7.8.4 – USB to RS-232 Converter
- Moved DVP Software Upgrade chapter content to B26912 DVP Service Tool
- Updated Fast and SDO message specifications within A-3 NMT Master Functions
- Added content to Transmit PDO 6 and Transmit PDO 7 sections of Appendix A
- New DOC and updated ATEX, EAC, and Low Voltage certifications.

Changes in Revision E—
- Updated Declaration of Conformity
- Added Appendix B – Glossary of Terms
- Updated Troubleshooting table
- Added new paragraph to Section 3.1

Changes in Revision D—
- Updated text regarding power supply limits in chapter 3
- Added Notice box at bottom of pg. 25
- Added new images to Figure 2-1

Changes in Revision C—
- Added functional safety management chapter
- Added information on replaceable fan assembly
- Clarifications to motor cable wiring requirements
- Various corrections and DVP10K additions
- Chapters 5 and 6 are references to a new manual
- Added reference to Application Note 51530
- Added chapter and section numbers to the entire manual
- Added new Figure 8-5 and content regarding when old to new firmware is not supported to Chapter 8

Changes in Revision B—
- Updated text to conform to front panel silkscreen changes
- Various corrections and DVP10K additions

Changes in Revision A—
- Updated Regulatory Compliance information and DOC
- Corrected ambient operating temperature range

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00319-04-EU-02-01
Manufacturer's Name:	WOODWARD POLAND SP. Z O.O.
Manufacturer's Contact Address:	SKARBOWA 32 32-005 NIEPOLOMICE, POLAND
Model Name(s)/Number(s):	Digital Valve Positioner (DVP) with IP30 or IP66, Digital Valve Positioner (DVP) Dual Drive with IP66, High Output Digital Valve Positioner (HO DVP), DVP5000, DVP10000, DVP12000 with IP20, High Output Digital Valve Positioner (HO DVP) with Servo Interface Module (SIM) DVP5000 with SIM, DVP10000 with SIM.
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 2014/30/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:	Standard DVP Version and High Output DVP Version: ⟨Ex⟩ II 3 G, Ex nA IIC T4 Gc DVP Dual Drive Version: ⟨Ex⟩ II 3 G, Ex nA IIC T3 Gc HO DVP Version and HO DVP with SIM Version: ⟨Ex⟩ II 3 G, Ex nA IIC T4 Gc
Applicable Standards:	
ATEX:	EN 60079-0:2018 Explosive Atmospheres – Part 0: Equipment – General Requirements EN 60079-15:2010 Explosive Atmospheres – Part 15: Equipment protection by type of protection "n"
EMC:	**For Digital Valve Positioner (DVP) & Dual Drive version:** EN 61000-6-4:2007 + A1:2011: Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments, EN 61000-6-2:2005 + AC:2005: Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments, **For HO DVP version & HO DVP with SIM version:** EN 61800-3:2004/A1:2012, Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods (DC Powered Category 3, 2nd Environment with deviation) Direct ESD per IEC 61000-4-2 is not claimed due to user precautions from touching the unit inside an IP54 enclosure. DC Power Surge per IEC 61000-4-5 is claimed to a deviation of ±1kV Line to Earth (L-E) and ±0.5kV Line to Line (L-L).

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	[signature]
Full Name	**Annette Lynch**
Position	**Engineering Manager**
Place	**Woodward, Fort Collins, CO, USA**
Date	22 April 2025

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UKCA DECLARATION OF CONFORMITY

UKCA DoC No.: **Manufacturer's Name:**	00319-04-EU-UKCA-02-01 WOODWARD POLAND SP. Z O.O.
Manufacturer's Contact Address:	ul. Skarbowa 32, 32-005 Niepolomice, Poland
Model Name(s)/Number(s):	Digital Valve Positioner (DVP) with IP30 or IP66, Digital Valve Positioner (DVP) Dual Drive with IP66, High Output Digital Valve Positioner (HO DVP), DVP5000, DVP10000, DVP12000 with IP20, High Output Digital Valve Positioner (HO DVP) with Servo Interface Module (SIM) DVP5000 with SIM, DVP10000 with SIM.
Markings in addition to UKCA marking:	Standard DVP Version and High Output DVP Version: II 3 G, Ex nA IIC T4 Gc DVP Dual Drive Version: II 3 G, Ex nA IIC T3 Gc HO DVP Version and HO DVP with SIM Version: II 3 G, Ex nA IIC T4 Gc

The object of this Declaration is in full conformity with the following UK Statutory Instruments (and their amendments):

Appropriate S.I.	Description of S.I.
S.I.2016 No. 1107	Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016
S.I.2016 No. 1091	Electromagnetic Compatibility Regulations 2016

The Object of this Declaration is in conformity with the applicable requirements of the following designated standards and technical specifications.

Appropriate Standard	Description of Standard
EN IEC 60079-0:2018	Explosive Atmospheres – Part 0: Equipment – General requirements
EN 60079-15:2010	Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"
For Digital Valve Positioner (DVP) & Dual Drive version:	
EN 61000-6-4:2007/ A1:2011	Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments,
EN 61000-6-2:2005/ AC:2005	Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments,
For HO DVP version & HO DVP with SIM version:	
EN 61800-3:2004/ A1:2012	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods (DC Powered Category 3, 2nd Environment with deviation) Direct ESD per IEC 61000-4-2 is not claimed due to user precautions from touching the unit inside an IP54 enclosure. DC Power Surge per IEC 61000-4-5 is claimed to a deviation of ±1kV Line to Earth (L-E) and ±0.5kV Line to Line (L-L).

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 Regulation(s).

MANUFACTURER

Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

22 April 2025
Date

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