WOODWARD

Product Manual 26914
(Revision -, 3/2020)
Original Instructions

ProAct™ Gen3 Position Controller

Actuator Models II through IV

Installation, Programming, and Troubleshooting Manual

General Precautions	**Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.** **Practice all plant and safety instructions and precautions.** **Failure to follow instructions can cause personal injury and/or property damage.**

Revisions	**This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:** **www.woodward.com/publications** **The latest version of most publications is available on the *publications page*. 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. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

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

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

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

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

WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage.

Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

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

WARNING

Start-up

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

WARNING

On- and Off-Highway Mobile Applications

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

⚠WARNING **Lockout/Tagout LOTO**	**Ensure that personnel are fully trained on LOTO procedures prior to attempting to replace or service a ProAct Gen3 on a "live" running engine. All safety protective systems (overspeed, over temperature, overpressure, etc.) must be in proper operational condition prior to the start or operation of a running engine. Personnel should be equipped with appropriate personal protective equipment to minimize the potential for injury due to release of hot hydraulic fluids, exposure to hot surfaces and/or moving parts, or any moving parts that may be activated and are located in the area of control of the ProAct Gen3.**

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

⚠WARNING **Usage/Maintenance**	**During installation, usage, or maintenance, do NOT use the actuator as a step or climbing mechanism when gaining access to the engine for maintenance or other purposes. Doing so can damage wiring, linkage, or possibly bend the output shaft and cause unexpected behavior on the next engine start-up.**

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. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

IMPORTANT

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

Regulatory Compliance

European Compliance for CE Marking:

EMC Directive: Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC).

ATEX Directive: Declared to Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.

Models II and III:
Zone 2, Category 3, Group II G, Ex ec IIC T4 Gc IP54

Model IV:
Zone 2, Category 3, Group II G, Ex ec IIC T3 Gc IP54

Restriction of Hazardous Substances (RoHS): Declared to 2011/65/EC COUNCIL DIRECTIVE of the European Parliament and the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
Exemption in use: 6 (a), 6 (c), 7 (a), 7(c)-I

Machinery Directive Compliant as partly completed machinery with Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.

North American Compliance:

CSA: *Models II and III*
CSA Certified for Class I, Division 2, Groups A, B, C, & D, T4 at 85 °C ambient. For use in Canada and the United States.

Model IV
CSA Certified for Class I, Division 2, Groups A, B, C, & D, T3 at 85 °C ambient. For use in Canada and the United States.

Models II and III
CSA Certified for Class I, Zone 2, Category 3, Group II G, AEx ec IIC T4 Gc IP54 For use in Canada and the United States.

Model IV
CSA Certified for Class I, Zone 2, Category 3, Group II G, AEx ec IIC T3 Gc IP54 For use in Canada and the United States.
Certificate 160584-70167110

Contact Woodward for Marine Certified Part Numbers:

Det Norske Veritas Det Norske Veritas – Class guideline — DNVGL-CG-0339. Edition November 2016 environmental test specification for electrical, electronic and programmable equipment and systems

Temp. Class	**D**
Humidity Class	**B**
Vibration Class	**B**
EMC Class	**A**
Enclosure Class	**B**

Notes:
See tables 1, 2 and 3 in the standard for environmental class definitions and applicable tests for each environmental class

Special Conditions for Safe Use

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

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

Field wiring must be suitable for at least T_{amb}+10 °C.

All cabling is limited to be less than or equal to 30m in length. Individual IO cabling lengths may be stated as shorter than 30m. Due to the installation of this unit with cabling limited to ≤30m IO Surge is not required for EN61000-6-2.

Connect external safety ground terminal to earth ground.

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

It is the responsibility of the end user to conduct and document a formal systems level Risk Analysis. The Risk Analysis shall evaluate essential health and safety requirements set forth by local jurisdictional authorities.

WARNING **EXPLOSION HAZARD** **Do not connect/disconnect components**	**Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.** **AVERTISSEMENT - Risque d'explosion— Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous situez bien dans une zone non explosive.**

WARNING **EXPLOSION HAZARD** **Do not substitute components**	**Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.** **AVERTISSEMENT - Risque d'explosion - La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.**

Safety Symbols

⎓	Direct Current
∿	Alternating Current
∿ (with bar)	Both Alternating and Direct Current
⚠ (lightning)	Caution, risk of electrical shock
⚠	Caution, refer to accompanying documents
⏚ (circled)	Protective conductor terminal
⏚	Frame or chassis terminal

Chapter 1.
General Information

Purpose and Scope

The purpose of this manual is to provide the necessary background information for applying the ProAct Gen3 control to gaseous and diesel fueled reciprocating engines. Topics covered include mechanical installation, electrical wiring, software programming, and troubleshooting. While this manual is primarily targeted at OEM customers, OEMs themselves may find it useful to copy some of the information from this manual into their application user manuals.

This manual does not contain instructions for the operation of the complete engine system. For engine or plant operating instructions, contact the plant-equipment manufacturer.

This version of the manual applies to all ProAct Gen3 position control models with software 10-005-081A or newer. The software version can be identified on the identification page of the Service Tool.

How to Use This Manual

The following summarizes how to install a ProAct Gen3 actuator into a new or existing system:

- Unpack and inspect the hardware.
- Mount and wire the hardware following the procedures and recommendations outlined in Chapters 2 and 3.
- Description of operation is provided in Chapter 4.
- Details of CAN implementation (J1939) are provided in Chapter 5.
- Use the Service Tool to configure and set up the control following the procedures and recommendations in Chapters 6 and 7.
- Troubleshooting guidelines are provided in Chapter 8.
- Specifications are provided in the Appendix.

Intended Applications

The ProAct Gen3 control is designed for various industrial applications, including but not limited to generator sets, mechanical drives, pumps and compressors. The ProAct Gen3 is generally applicable to engines in the 300 kW to 3000 kW output range. The device is effectively a positioner that accepts a desired position signal from another device in the system, such as a speed control, and drives to that position.

Key environmental characteristics of these applications include extended industrial operating temperatures (–40 °C to +85 °C / –40 °F to +185 °F), Industrial EMC Requirements, and electrical transients.

ProAct Gen3 Overview

The ProAct Gen3 provides a building block approach to total engine management. The modular bi-directional actuator design easily attaches to fuel pumps, fuel valves, or throttle bodies. There are three ProAct Gen3 models (II, III, IV) that provide a wide range of work outputs. Available ITBs (integrated throttle bodies) include 85, 95, 105, 120, 135, 160, and 180 mm versions (see product manual 26916 for details).

Two similar variations of the ProAct Gen3 are available: the standard version and the Flex version. The standard ProAct Gen3, covered by this manual, utilizes a 24-pin circular connector for customer I/O, whereas the Flex version has terminal block connections. The Flex version can be adapted into a variety of existing systems by adding a connector kit or by directly landing wires to terminal blocks. The ProAct Gen3 Flex also provides additional options of (0 to 200) mA Analog Input range and (0 to 5) V (dc) Analog Output range. Refer to manual 26915 for Flex version details.

IMPORTANT

Woodward also offers a non-RoHS compliant ProAct version for speed control applications. Refer to manual 26246, ProAct ISC—Integrated Speed Control. The ProAct ISC is a microprocessor-based speed control incorporated into the actuator, creating a single integrated actuator/speed control. This eliminates the need for an additional driver box and speed control box.

The ProAct Gen3 actuator accepts a position command and drives the output shaft to the commanded position based on an internal shaft position sensor. The high-efficiency torque motor delivers up to 10.4 N-m (92 lb-in), for a Model IV, to operate fuel or air control devices. See specifications in the Appendix for torque performance of all actuator model sizes over the full product temperature range.

The device accepts either a PWM command, a CAN command, or an analog (voltage or milliamp) command for output positioning. The position command input can also be set up with a primary and a backup input, providing redundancy. Automatic failover and failback logic is provided when using redundant position commands.

For status purposes, a relay driver output is available that changes state whenever a fault or error condition is experienced by the controller. A (4 to 20) mA position output signal provides an external position indication after installation and while the unit is operating.

Input power is nominally 24 V (18 to 32) but the device is functional in the range of 10 to 36 V (dc) for short periods (e.g. starting or transients); however accuracy and/or torque can be diminished at the low end of this range.

Product configuration and tuning is performed using a PC-based Service Tool.

More detail on the features of the ProAct Gen3 controller can be found in subsequent sections of this manual.

Programmable Features

Control setup and tuning is accomplished through the use of a PC (personal computer), Woodward Service Tool software, and a programming harness. The features identified below are described in Chapters 2 and 7. Briefly, the programmable features include:

- General Setup
    - Direction (CCW or CW)
    - Shutdown Position
- Position Controller
    - Dynamics (friction and inertia)
    - Position Error magnitude and delay
    - Non-Linear actuator settings
- Position Demand
    - Position Demand Select (Primary/Backup; CAN, PWM or Analog)
    - Tracking options
- PWM Input type, scaling, failure levels, offset
- Analog Input type, scaling, failure levels

- Discrete Output Settings
  - Output's Non-Fault Condition (ON or OFF)
  - Fault Selections as Discrete Output Indications
- Fault Settings
  - Latching or Non-Latching Fault Indications
  - Fault Selections as Alarms or Shutdowns
  - Shutdown actions
- CAN (J1939)
  - CAN Data Rate
  - CAN ID input selections
  - Demand Failure Timeout
  - Data PGN, Command PGN, Source address, Function Field

Service Tool Software

The ProAct Gen3 Service Tool is designed using Woodward's ToolKit software that is a Microsoft Windows based GUI (graphic user interface). The Service Tool Software is compatible with Windows Vista SP1 or greater and provides the ability to:

- Configure product settings based on application requirements
- Tune the control with the engine running during application development
- Create configuration files for downloading into multiple controls
- Download configuration files
- Extract and view fault codes for field diagnosis
- Update control dynamics during field service
- Calibrate the control for user end-stops

Instructions for installing the Service Tool software are in Chapter 6.

⚠WARNING	**The actuator must be properly set up using the Service Tool prior to starting the prime mover.**

⚠WARNING	**The inertia setting and friction setting must be properly adjusted using the Service Tool prior to engine operation. Improper inertia or friction settings can result in unpredictable actuator movement and possible personal injury or damage to equipment.**

IMPORTANT	**The Service Tool is not included, but can be downloaded from the Woodward Internet website (www.woodward.com/software).**

References

The outline drawing is Figure 1-1 below and the control wiring diagram is Figure 3-1 in Chapter 3.

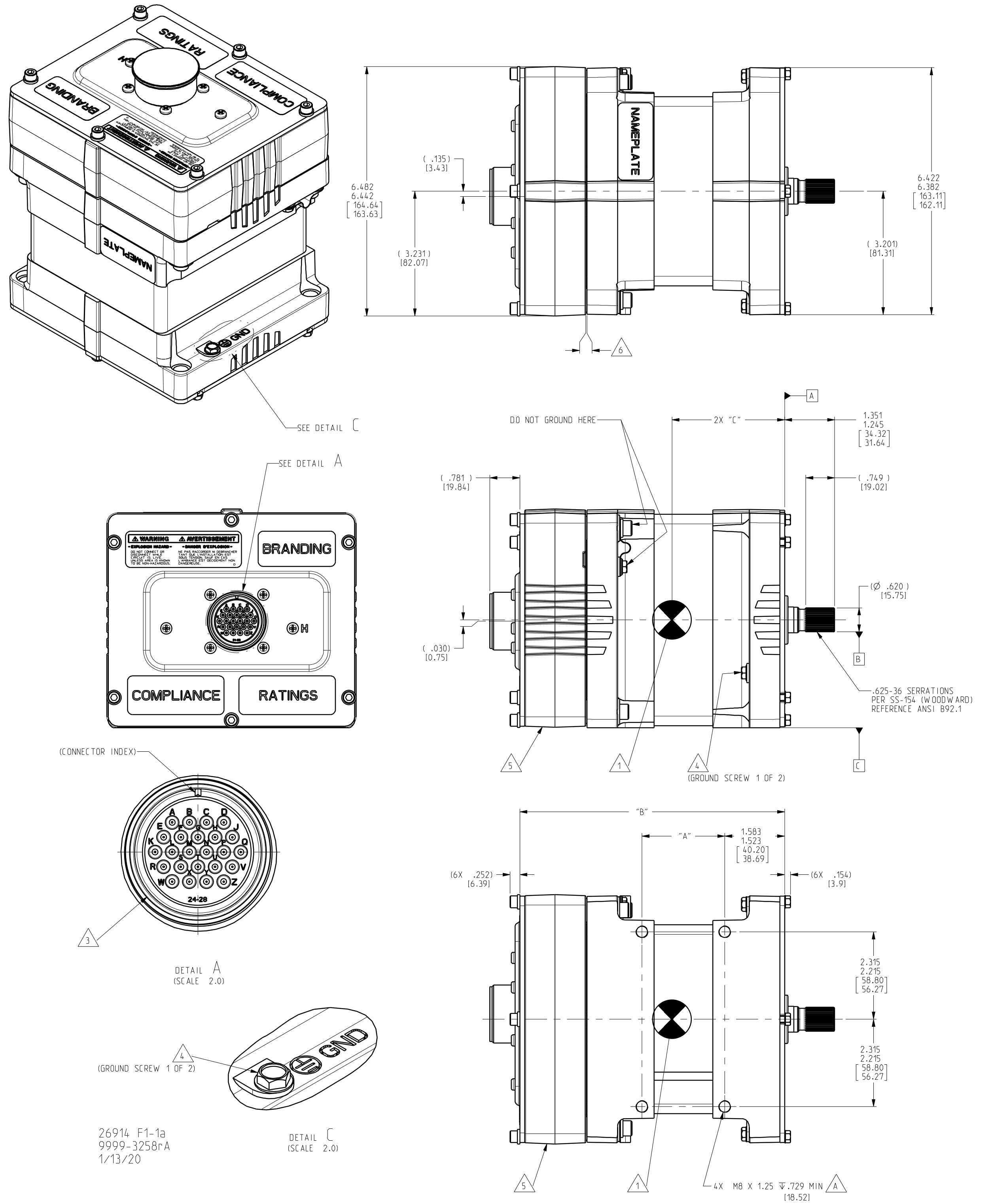
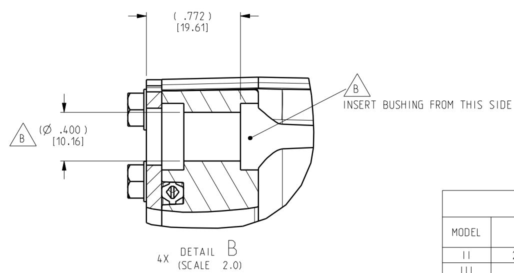


Figure 1-1a. ProAct Outline Drawing - Representation for Reference Only
Review 9999-3258 current revision for all up to date notes and dimensions.

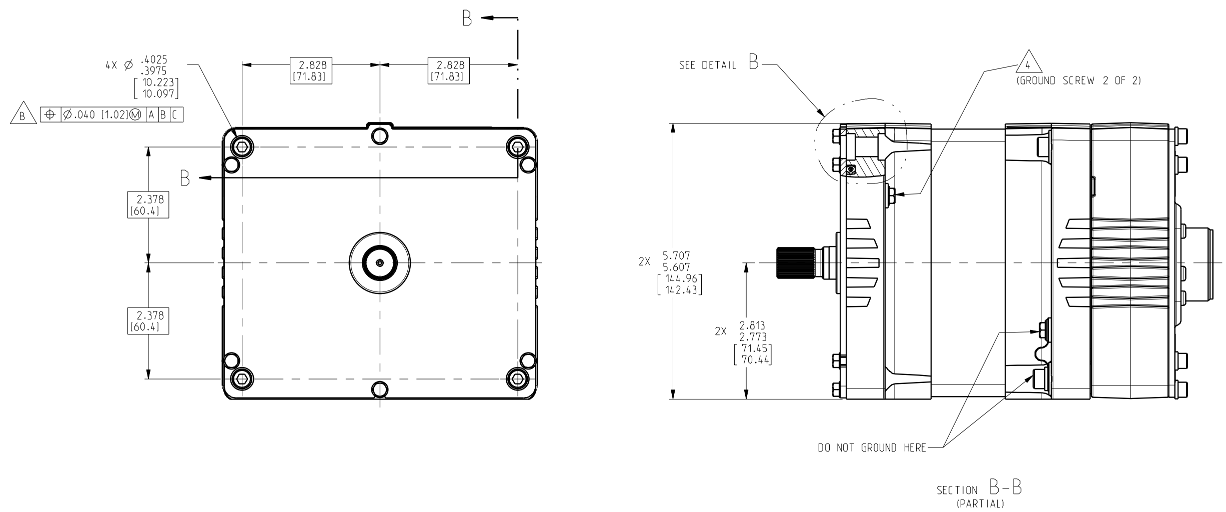
NOTES

1. APPROXIMATE POSITION OF MASS CENTER
2. MOUNTING OPTIONS. SEE MANUAL FOR DETAILS:
   - A. BASE MOUNT:
     4X M8 x 1.25 SCREWS, MINIMUM ENGAGEMENT .630 (16) REQUIRED.
     RECOMMENDED TORQUE: 200 ± 15 LB-IN (22.6 ± 1.7 Nm)
   - B. FLANGE MOUNT:
     4X WOODWARD ITEM NUMBER 1423-037 (BUSHING)
     AND 4X M8 SOCKET HEAD CAP SCREWS REQUIRED
     RECOMMENDED TORQUE: 200 ± 15 LB-IN (22.6 ± 1.7 Nm)
3. RECOMMENDED MATING CONNECTOR (NOT SUPPLIED)
   AMPHENOL P/N: ACS06E24-28S(472) OR
   ITT CANNON P/N: CAR3106E24-28S(A206)
   MAX TORQUE: 105 LB-IN (12 Nm)
4. GROUND SCREWS:
   10-32 HEX HEAD THREAD FORMING
   SEE MANUAL FOR GROUND CONNECTION REQUIREMENTS
5. A MINIMUM GAP OF .020 (0.51) MUST BE MAINTAINED AROUND THE ELECTRONICS ENCLOSURE AND ANY MOUNTING SURFACE AFTER INSTALLATION PER MANUAL.
6. GAP IN ASSEMBLY IS BY DESIGN. DO NOT RETORQUE FASTENERS TO CLOSE GAP.



PRODUCT CONFIGURATION TABLE

MODEL	DIMENSION "A"	DIMENSION "B"	REFERENCE INFORMATION	
			DIMENSION "C"	MASS (LB) [KG]
II	2.110-2.180 [53.59-55.37]	6.725-6.986 [171.82-177.44]	(2.9 [73.6])	22.0 [10.0]
III	3.310-3.380 [84.07-85.85]	7.925-8.186 [201.30-207.92]	(3.5 [88.9])	31.0 [14.1]
IV	5.760-5.830 [146.30-148.08]	10.375-10.636 [263.53-270.15]	(4.7 [119.4])	47.0 [21.3]



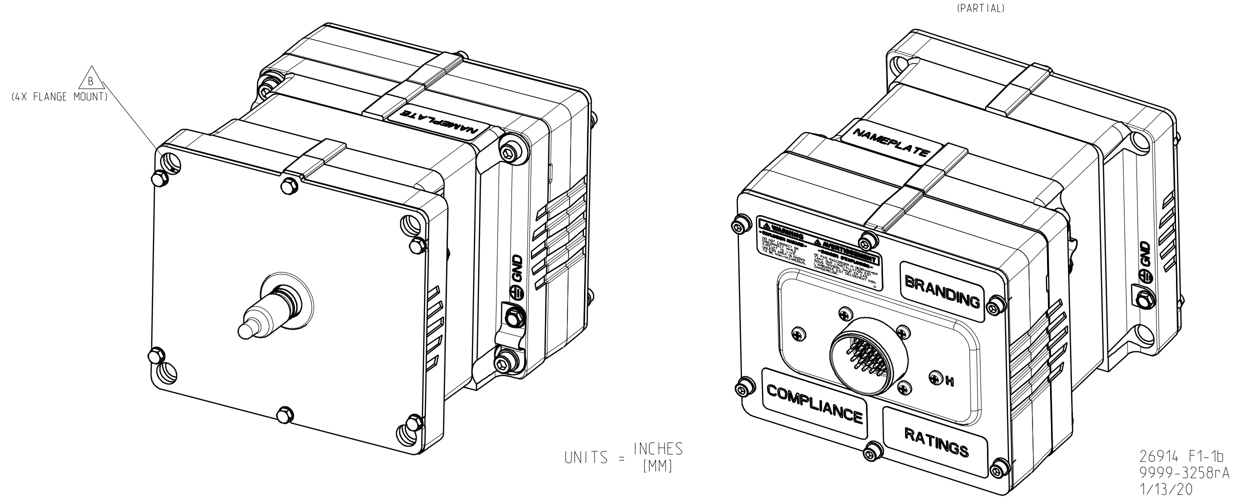


Figure 1-1b. ProAct Outline Drawing - Representation for Reference Only
Review 9999-3258 current revision for all up to date notes and dimensions.

Chapter 2.
Mechanical Installation

Introduction

This chapter provides instructions on how to mount and connect the ProAct Gen3 controller into a system. Hardware dimensions are provided for mounting the device to a specific application.

⚠WARNING **EXPLOSION HAZARD Do not connect/disconnect components**	**Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.** **AVERTISSEMENT - Risque d'explosion— Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous situez bien dans une zone non explosive.**

⚠WARNING **EXPLOSION HAZARD Do not substitute components**	**Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.** **AVERTISSEMENT - Risque d'explosion - La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.**

⚠WARNING **Overspeed / Overtemperature / Overpressure**	**The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.** **The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.**

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

⚠WARNING **Hearing Protection**	**Due to typical noise levels in turbine or engine environments, hearing protection should be worn when working on or around the ProAct Gen3.**

⚠WARNING **Hot Surfaces**	**The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.**

⚠WARNING **Stay Clear of Actuator**	**Stay clear of the actuator output shaft and all attachments as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.**

⚠WARNING **Independent Positive Shutdown Device**	**Use of an independent device for positive shutdown, such as a fuel shut off valve is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage..** **The actuator contains no internal return spring; therefore an external positive shutdown is necessary in the event of a loss of power to the actuator. A separate overspeed trip device is always mandatory.** **Use of a predicted min fuel shutdown procedure is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.**

NOTICE	**Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 3-1).**

General Installation, Operation Notes and Requirements

⚠WARNING	**Do not lift or handle the ProAct Gen3 by any conduit. Lift or handle the actuator only by following proper procedures.**

⚠WARNING	**Use an independent device for positive shutdown, such as a fuel shut-off valve is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.** **Use of an external spring to return to minimum fuel is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.** **Use of a predicted min fuel shutdown procedure is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Unpacking and Handling

Before handling the actuator, read the Electrostatic Discharge Awareness information on page 7. Be careful when unpacking the actuator. Check the unit 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.

⚠CAUTION	**Use both hands to pick up the ProAct Gen3. Do NOT pick up by the connectors or by the terminal shaft, which could damage the actuator or allow it to fall, with the possibility of personal injury.**

Mechanical Installation

Mounting Location

The ProAct Gen3 is designed for installation on the engine. The mounting location on the engine has to provide suitable access to the air throttle, fuel gas control valve, diesel control shaft, etc. Secondary mounting location considerations are temperature, heat sink capability, vibration, and wire length.

NOTICE	**A minimum gap of 0.5 mm must be maintained between the support bracket and electronics enclosure (see Figure 1-1). This is necessary because the enclosure is supported on vibration isolators to filter out high-frequency vibrations from reaching the electronics. If the enclosure contacts the bracket, the isolation is defeated and may reduce the electronics operating life.** **If spacers are used to achieve the necessary gap, Woodward recommends maximizing the surface contact area of the spacers to maximize heat transfer between the ProAct Gen3 and mounting bracket.**

Temperature

The ProAct Gen3 is designed to operate within a temperature range of –40 °C to +85 °C (–40 °F to +185 °F). However, maintaining the actuator operating temperature near normal ambient temperatures (~20 °C) reduces the input and output temperature drift and improves actuator life (MTTF).

Heat Sink Capability

The ProAct Gen3 generates heat, especially when stalled or during other conditions requiring maximum torque output. The installer must consider the heat conductivity of the installation bracket, and the operating temperature of the ultimate heat sink to which the bracket will be attached.

The thermal design of the actuator is based on the cooling of critical electrical components coupled to the aluminum frame of the actuator. If a temperature of 90 °C is maintained at the mounting surfaces, the temperature of the electronics will remain within acceptable limits. Therefore, when applying the actuator, the temperature at the mounting bracket must not exceed 90 °C regardless of the surrounding thermal conditions. If the temperature of this zone exceeds 90 °C, the actuator will limit the available torque to compensate.

IMPORTANT	**The hazardous location listing is not applicable if the surrounding air ambient temperature exceeds 85 °C.**

Mounting the ProAct Gen3

Models II through IV actuators may be installed on a bracket in either base or flange mount configuration with the exception of the model IV. The mass of the model IV requires that it be mounted only in the base mount configuration.

The base mount configuration requires the use of four M8x1.25 screws with a minimum engagement of 16 mm. The flange mount configuration requires the use of four mounting bushings (1423-037) with M8 screws through the flange. Whether base mounting or flange mounting the actuator, torque the four M8 screws to 22.6 N-m (200 lb-in). Both mounting features are shown in Figure 1-1. The unit can be mounted in any attitude. All exterior and mounting dimensions and exterior fasteners are metric.

The brackets and attaching hardware must be designed to hold the weight and to withstand the vibration associated with engine mounting.

ProAct Gen3 approximate weight:
- Model II 10.0 kg (22 lb)
- Model III 14.1 kg (31 lb)
- Model IV 21.3 kg (47 lb)

As shown in Specifications, the ProAct Gen3 actuators have been designed for and verified to a given accelerated life vibration test level at the mounting surface of the actuator. The user should be aware that in any application, bracket design can significantly change the vibration levels at the actuator. Therefore, every effort should be made to make the bracket as stiff as possible so that engine vibrations are not amplified, creating an even more severe environment at the actuator. Additionally, when possible, orienting the actuator shaft parallel to the crankshaft of the engine will often reduce the vibration load on the actuator's rotor system in reciprocating engine applications.

Mounting the ProAct Gen3 with an ITB

The ProAct Gen3 ITBs with model II actuators are designed to be mounted on the valve flange. However, the end-user may also want to support the actuator to minimize the loads on their piping. The ProAct Gen3 ITBs with model III and model IV actuators are designed to be base-mounted due to the higher mass of the actuator and the increased lever arm between the center of the bore and the center of gravity. Flange mounting of model III may be allowed, but the vibration level must be assessed in order to ensure a low level of stress on the component.

Refer to the ITB manual for mounting details.

ProAct Gen3 Grounding

The ProAct Gen3 must be grounded to the engine structure through a low-impedance connection in order to ensure proper EMC performance. This may be accomplished through the mechanical mounting of the actuator/throttle itself (preferred), or through a wired connection to a designated ground screw on the unit. The unit must be grounded by one of the available means. If a wired connection is used as the primary EMC ground, it must be through a low-impedance wire or strap < 30 cm (12 inches) in length, 3 mm² (12 AWG) minimum. See Figure 1-1 for the ground screw location on each model.

Output Shaft

The ProAct Gen3 has mechanical travel of 73.5° to 77° with controlled travel range of 72.5°. This limited travel (soft travel) ensures there is a minimum of 0.5° of allowable overshoot prior to impacting the internal stops. The max fuel direction of this travel is software configurable in the clockwise or counterclockwise direction through the Service Tool.

Mechanical Stops

Internal mechanical actuator stops will only survive a maximum kinetic energy of 0.011 J (0.097 in-lb). If the actuator internal stops are used, the load inertia should not exceed 4.25E-4 kg-m² (3.76E-3 in-lb-s²). In service, electrical and engine stops should be set inside the actuator stops. Electrical stops are set via the Service Tool.

> **⚠WARNING** — **For gas engine applications, the engine MUST ALWAYS shut down when the actuator is at the minimum stop. Improper actuator valve/linkage installations can cause unexpected engine behavior.**

<u>Fuel Position Stops</u>

Diesel Stops

⚠WARNING	**DIESEL ENGINE STOPS— Diesel installations generally use the fuel system minimum and maximum position stops. Diesel engine racks are normally designed to provide the minimum and maximum stops without binding. The actuator's stops must not prevent the actuator from driving the fuel linkage to the minimum and maximum positions. The linkage should be designed to use as much actuator travel as possible, without preventing minimum and maximum fuel positions (see Figure 2-1).**

Gas Engine Stops

⚠WARNING	**GAS ENGINE STOPS—Fuel gas valves and butterfly valves in carburetors often bind if rotated too far toward minimum or maximum. For this reason, the stops in the ProAct Gen3 actuator should be used at both minimum and maximum positions. The engine must always shut down when the actuator is at the minimum stop.**

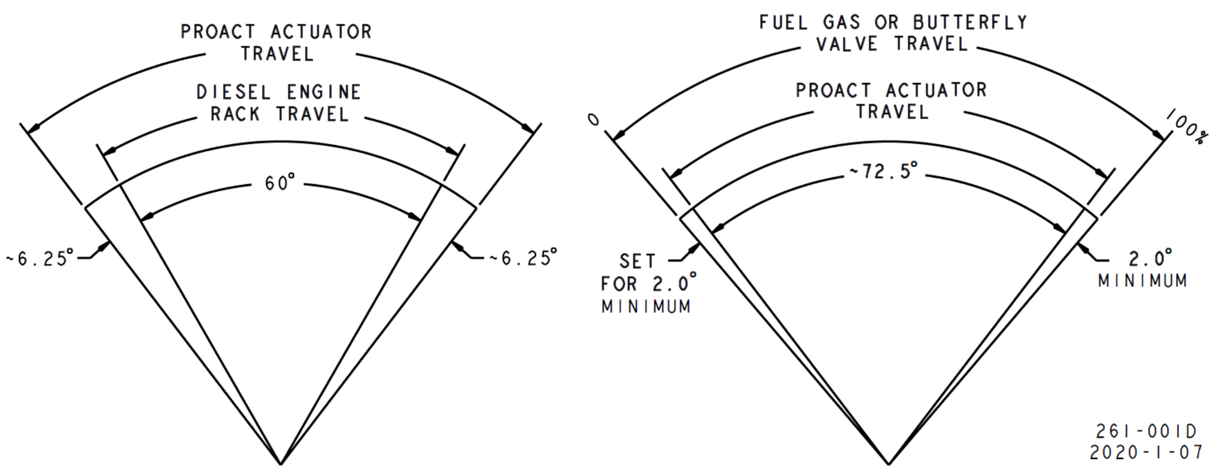


Figure 2-1. Fuel Stops

Linkage

Proper design and installation of the actuator linkage is necessary for the ProAct Gen3 actuator to provide the best possible control. Certain applications with low inertia may be unstable with high impulse loads and may require additional system inertia. See troubleshooting guidelines or contact Woodward for more information. Ensure the actuator has ample work capacity to control the fuel supply under maximum load conditions.

Manually stroke the fuel-control linkage from stop to stop as if the actuator were moving it. The linkage must move freely, without friction and backlash. Lubricate or replace worn linkage or fuel control parts as required.

⚠WARNING **The actuator contains no internal return spring; therefore an external positive shutdown is necessary in the event of a loss of power to the actuator.**

NOTICE **The actuator's maximum slew rate can place stress on the fuel system stops and on the linkage between the actuator and the fuel system. The maximum actuator speed is 1000 degrees per second in both increase and decrease fuel directions.**

The Mass Moment of Inertia (MMOI) for the ProAct Gen3 actuators:

- Model II is 5.5E-4 kg-m² (4.9E-3 lb-in-s²)
- Model III is 6.4E-4 kg-m² (5.6E-3 lb-in-s²)
- Model IV is 8.2E-4 kg-m² (7.2E-3 lb-in-s²)

The fuel system stops must be adequate to absorb the actuator MMOI in addition to the linkage inertia without damage. ProAct Gen3 actuator internal stops are designed to absorb 0.011 J (0.097 in-lb) of kinetic energy with 1.5 degrees of over travel. If the actuator stops are used, the load inertia must not exceed 4.25E-4 kg-m² (3.76E-3 in-lb-s²), and the linkage must be designed to allow the 1.5° of over travel on each end. Use of good rod-end connectors with as little free play as possible is essential. Select rod ends that will remain tight and wear well during the nearly constant movement associated with precise control. The link connecting the actuator lever to the fuel-control lever must be short and stiff enough to prevent flexing while the engine is running.

Typically, in a linkage system, there are links and levers that are supported by customer-supplied bearings. However, there is often a section of the linkage where the mass is supported fully by the actuator output shaft. When designing linkage systems, please note that each ProAct Gen3 actuator output shaft accepts 1.2 kg (2.6 lb) of additional mass at a maximum vibration level of 10 G's. Exceeding the allowable mass or vibration level may damage the actuator rotor system and shorten actuator life.

Actuator levers are available from Woodward, which allow adjustment of the rod end locations with respect to the center of the actuator shaft. The lever used must have a 0.625-36 serration.

Customizable Lever Kit - 5394-181

Adjust the location of the rod end on the lever to achieve the desired actuator rotation between minimum and maximum positions. The linkage should be set to use as much of the 72.5° as possible (60° minimum). To increase the amount of actuator rotation, move the rod end closer to the actuator shaft or farther away from the shaft controlling the fuel flow. To decrease the amount of actuator rotation, move the rod end farther from the actuator shaft or closer to the shaft controlling the fuel flow.

Chapter 3.
Electrical Installation

This chapter provides instructions on how to connect the ProAct Gen3 control into a system.

⚠WARNING **EXPLOSION HAZARD** **Do not connect/disconnect components**	**Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.** **AVERTISSEMENT - Risque d'explosion— Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous situez bien dans une zone non explosive.**

⚠WARNING **EXPLOSION HAZARD** **Do not substitute components**	**Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.** **AVERTISSEMENT - Risque d'explosion - La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.**

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

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

⚠WARNING **Hearing Protection**	**Due to typical noise levels in turbine or engine environments, hearing protection should be worn when working on or around the ProAct Gen3.**

⚠WARNING **Hot Surfaces**	**The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.**

NOTICE	**Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 3-1).**

General Installation, Operation Notes and Requirements

⚠WARNING	**Do not lift or handle the ProAct Gen3 by any conduit. Lift or handle the actuator only by following proper procedures.**

⚠WARNING	**Use an independent device for positive shutdown, such as a fuel shut-off valve is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.** **Use of an external spring to return to minimum fuel is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.** **Use of a predicted min fuel shutdown procedure is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.**

⚠WARNING	**STAY CLEAR OF ACTUATOR** **Stay clear of the actuator output shaft and all attachments as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.** **SUDDEN MOVEMENT** **Stay clear of the actuator output shaft and all equipment that may be actuated by the Discrete or Analog Output, as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.**

⚠WARNING **Overspeed / Overtemperature / Overpressure**	**The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.** **The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.**

NOTICE	**All cabling is limited to be less than or equal to 30m in length. Some specific cabling lengths are given for the individual IO that are shorter than 30m.**

Electrical Installation

A wiring pin-out of the ProAct Gen3 control, as viewed by looking into the control's connector feature, is shown in Figure 3-1. Typical connections to external devices are also shown. Prior to installation, refer to the wiring diagram and the representative I/O interfaces schematic in this chapter. Also, review the hardware I/O specifications in the Appendix.

All input and output signals run through a 24-pin connector. The following section provides a description for every pin and the electrical requirements. For functional descriptions see Chapter 4, Description of Operation.

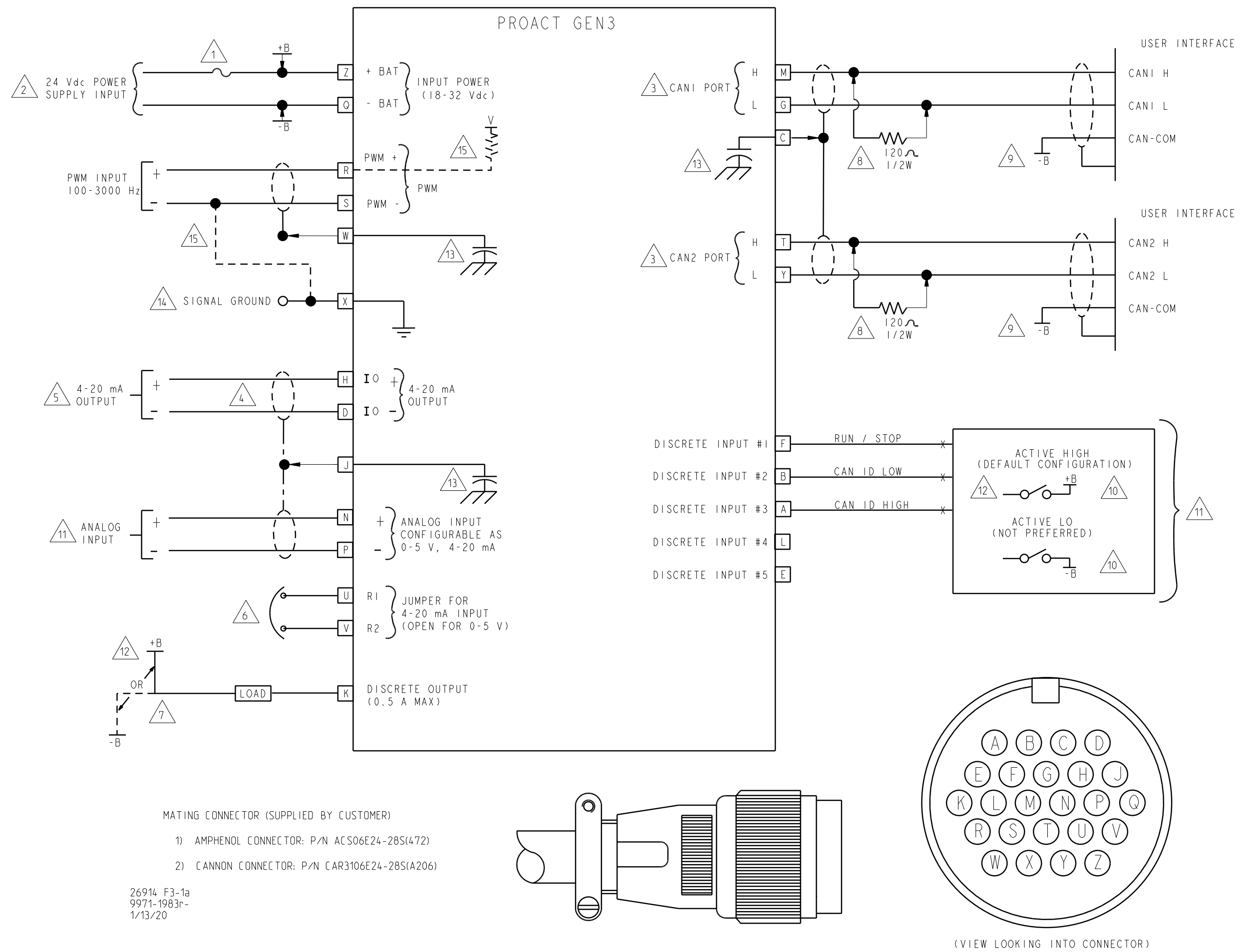
Shielded Wiring

The use of cable with individually shielded-twisted pairs is required where indicated by the control wiring diagram (Figure 3-1). Cable shields must be terminated as indicated in the control wiring diagram, and following the installation notes below. DO NOT attempt to directly ground the shield at both ends by terminating to the cast housing since an undesired ground loop condition may occur.

IMPORTANT	**The actuator CAN shield and Analog Shield connection pins are both established through a high-frequency capacitor (not directly grounded), therefore when using these pins for shield termination, the shield may be grounded directly at the opposite end without fear of a ground loop.**

Installation Notes

- Wires exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches).
- The shield termination wire (or drain wire) should be kept as short as possible, not exceeding 50 mm (2 inches), 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, when provided, at the time of installation is required to ensure satisfactory operation of the product.



NOTES:

1. THE PROACT ISC MUST BE FUSED WITH:
   MODEL II: 15 AMP FAST BLOW
   MODEL III: 20 AMP FAST BLOW
   MODEL IV: 25 AMP FAST BLOW
2. THE SIZING OF THE BATTERY SUPPLY LINES ARE A FUNCTION OF LENGTH:
   MODEL II: FOR DISTANCES UP TO 8 METERS, 16 AWG
   MODEL III: FOR DISTANCES UP TO 5 METERS, 16 AWG
   MODEL IV: FOR DISTANCES UP TO 4 METERS, 16 AWG
   ALL OTHER I/O WIRING:
   1) THE CONNECTOR WILL ACCEPT WIRES IN THE RANGE OF 16-20 AWG
   2) ALL WIRING IS LIMITED TO A MAXIMUM LENGTH OF 30 METERS
3. THERE ARE TWO CAN PORTS, BOTH OF WHICH ARE AVAILABLE FOR USE ACCORDING TO THE FOLLOWING:
   CAN1: USED FOR ACTUATOR CONTROLLING FUNCTIONS OR SERVICE. CAN BIT RATE IS SOFTWARE CONFIGURABLE.
   CAN2: RESERVED FOR SERVICE PORT ONLY. CAN BIT RATE IS NOT CONFIGURABLE.
4. THE ANALOG OUT (Io-) CANNOT BE CONNECTED TO BATTERY RETURN (BATTERY COMMON, -B).
5. THE MAXIMUM LOAD IMPEDANCE IS 385 OHMS.
6. JUMPER AT THE CONNECTOR FOR 4-20 mA ANALOG INPUT.
   LEAVE OPEN FOR 0-5 V.
7. THE DISCRETE OUTPUT CAN BE CONFIGURED AS A SOURCING OR SINKING OUTPUT.
   THE FUNCTIONAL MODE IS CONFIGURABLE IN SOFTWARE.
   USAGE OF THIS OUTPUT MUST COMPLY WITH:
   1) THE DRIVING LOAD MUST BE LESS THAN 0.5A IN BOTH SOURCING OR SINKING MODE
   2) THE DRIVING LOAD IS REFERENCED TO B+ ON THE FUSED SIDE OF THE SUPPLY LINE (IN LOW-SIDE, OR SINKING MODE)
   3) THE DRIVING LOAD IS REFERENCED TO B- (IN HIGH-SIDE, OR SOURCING MODE).
8. THE CAN TERMINATION RESISTOR IS NEEDED IF THE PROACT IS USED AT THE END OF THE COMMUNICATIONS BUS. THIS TERMINATION RESISTOR IS EXTERNAL TO THE PROACT.
9. THE CAN COMMON IS REFERENCED TO THE BATTERY RETURN (BATTERY COMMON, -B).
10. THE DISCRETE INPUT OPERATION LEVELS (OPTIONS):
   1) ACTIVE HIGH, IS TO BATTERY (+), BUT ON THE FUSED SIDE OF THE SUPPLY (+B)
   2) ACTIVE LOW, IS TO BATTERY RETURN (-), NOTE THIS OPERATION IS NOT RECOMMENDED ON APPLICATIONS WHERE THE BATTERY RETURN IS CONNECTED TO THE ENGINE CASE. ACTIVE HIGH OPERATION IS THE FACTORY DEFAULT CONFIGURATION
11. THE DISCRETE INPUT FUNCTIONS CAN BE CONFIGURED FOR ANY INPUT, DEFAULT SETTINGS ARE SHOWN.
12. +B CONNECTION SHOULD BE MADE WITHIN 1 M OF PIN Z. (PIN Z PROVIDES TRANSIENT PROTECTION WHEN USED TO SOURCE THESE INPUTS.)
13. THIS DENOTES A HIGH-FREQUENCY INTERNAL CAPACITIVE CONNECTION TO CHASSIS GROUND. THIS WILL PREVENT A GROUND LOOP AT THE SHIELD CONNECTION. IF USING THIS FEATURE THE SHIELD MUST BE TIED DIRECTLY TO CHASSIS ON THE CUSTOMER END.
14. SIGNAL GROUND CAN BE USED AS A CONVENIENT PIN FOR REFERENCING TO THE INTERNAL CIRCUIT GROUND. THIS PIN CAN BE USED FOR REFERENCING PWM(-) WHEN INTERNAL PULL-UP OPTION IS USED FOR A LOW-SIDE PWM SOURCE. THE SIGNAL GROUND CAN ALSO BE USED AS A LOCAL GROUND REFERENCE FOR THE DISCRETE INPUTS/OUTPUT. IT IS SELF-PROTECTING AGAINST SHORT CIRCUITS TO B+. KEEP ALL CONNECTIONS TO SIGNAL GROUND LESS THAN 0.5A.
15. THE PWM INPUT CAN BE CONFIGURED IN SOFTWARE TO ACCEPT A SIGNAL FROM A LOW-SIDE OR PUSH-PULL SOURCE. IF USING LOW-SIDE PWM SOURCE OPTION AN INTERNAL PULL-UP IS PROVIDED THAT WILL REQUIRE TYING PWM(-) TO A CIRCUIT REFERENCE. THE SIGNAL GROUND AT PIN X IS PROVIDED FOR CONVENIENCE. IF USING PIN X THIS CONNECTION SHOULD BE MADE AT THE MATING CONNECTOR NEAR THE ACTUATOR AND NOT REMOTELY.

26914 F3-1b
9971-1983r-
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Figure 3-1. Control Wiring Diagram - Representation for Reference Only
Review 9971-1983 current revision for all up to date notes and information.

Electrical Connections

The ProAct Gen3 is not supplied with the prime mover harness connector. The following connectors are compatible with the ProAct Gen3.

- **Amphenol**
  Amphenol Connector: P/N ACS06E24-28S(472)
- **Cannon**
  Cannon Connector: P/N CAR3106E24-28S(A206)

Installation torque for mating connector should be 12.0 ± 0.5 Nm (105 ± 5 in-lbs). MS Style connector also has an available lockwire option for use as a secondary retention if desired.

Solder type connector can be ordered from Woodward – 1635-2794

The minimum size for all I/O wiring to the ProAct Gen3 is 0.5 mm² (20 AWG).

I/O cabling for the ProAct Gen3 is limited to 30 m (100 ft) for surge compliance.

Exceptions:
For specifics on power supply and the CAN wiring, see the Supply Power and CAN Port Specification Summary sections later in this chapter.

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

NOTICE **Do not connect any cable grounds to "instrument ground," "control signal ground," or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 3-1).**

IMPORTANT **Ensure the wiring to the actuator is properly dressed and has appropriate strain relief for the intended application. Possibilities of sharp bends in the harness, sharp objects, and areas where hot engine components in close proximity can exceed the temperature ratings of the wiring should be carefully considered and avoided. Good system wiring practices to prevent chafing, abrasion, and strain on the harness will lead to better system reliability and fewer unexpected nuisance events.**

Description of Electrical I/O

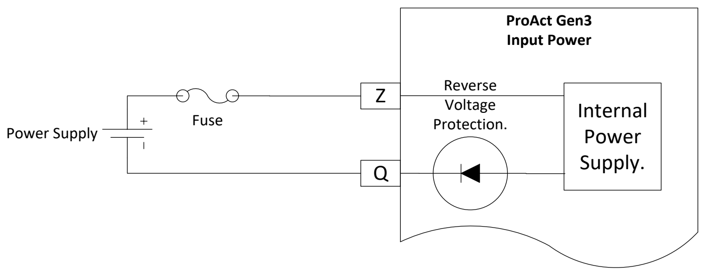
This section provides a schematic representation of each input/output. Additional information can be found in the I/O specifications of the Appendix.

Signal Ground vs. Battery Ground

The ProAct Gen3 actuator provides a signal ground that has internal short-circuit protection. The signal ground will open the circuit upon detecting a mis-wire that effectively shorts the circuit to a power source using the same reference. The signal ground provides a good clean, protected ground for any of the single-ended circuits in the design, including Discrete Inputs, Discrete Output, Analog Output, and PWM input when used in a low-side configuration. All of these circuits can also be used with Battery Ground, but when using in this manner, the short-circuit protection is not used and can lead to wiring damage if unexpectedly shorted to a power source using Battery(-) as a reference. It is up to the system engineer to decide which path is preferred for wiring efficiency, but Woodward recommends using the signal ground when possible to provide for protection and cleaner electrical signal transmission.

> **IMPORTANT** — **Do not tie Signal Ground directly to Battery Ground at the actuator. Doing so may introduce noise into the signals using 'Signal Ground' as a reference, and can also defeat internal over-current protection on the 'Signal Ground' pins.**

Supply Power (Pins: Z, Q)



Pin Z = Supply Power Plus
Pin Q = Supply Power Minus

Figure 3-2. Supply Power Wiring Diagram

The ProAct Gen3 requires a voltage source of 18 to 32 V (dc), with a current capacity of at least:
15 A for the Model II
15 A for the Model III
20 A for the Model IV

If a battery is used for operating power, an alternator or other battery-charging device is necessary to maintain a stable supply voltage.

Special care must be taken when wiring the ProAct Gen3.

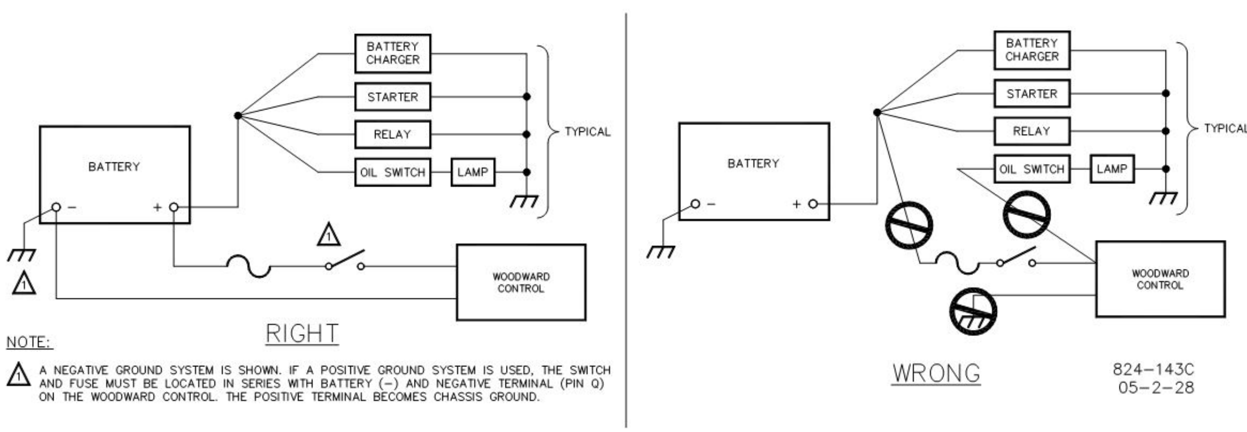


Figure 3-3. Correct and Incorrect Wiring to Power Supply

To withstand an engine start when actuator power is from the starting batteries, the actuator will work with a supply voltage as low as 9 V. However, the actuator will not function completely within specifications. During the low voltage, the ProAct Gen3 will NOT meet the transient response times or the maximum torque output.

Voltage range:

- Normal operation: (18 to 32) V
- Transient/starting: (9 to 40) V for 1 minute

The ProAct Gen3 must be fused:

- Model II: 15 A fast blow
- Model III: 20 A fast blow
- Model IV: 25 A fast blow

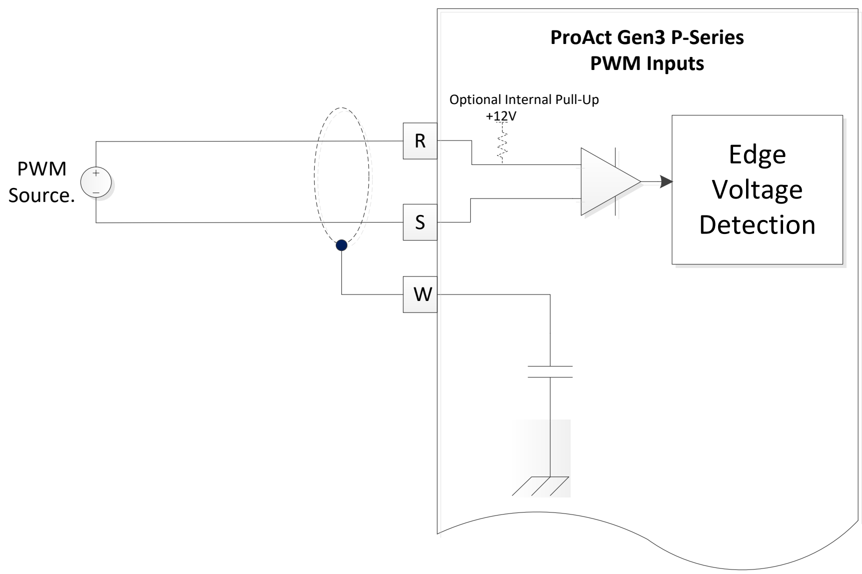
⚠WARNING **The input power must be fused. Failure to fuse the ProAct Gen3 could, under exceptional circumstances, lead to personal injury, damage to the control valve, or explosion.**

Wire Requirements:

For battery connections (+Bat and –Bat):

- Model II: 1.0 mm²/16 AWG for distances up to 8 meters
- Models III and IV: 1.5 mm²/14 AWG for distances up to 8 meters

PWM Input (Pins: R, S, W)



Pin R = PWM + signal
Pin S = PWM - signal
Pin W = Shield (shared)

Figure 3-4. PWM Input Wiring Diagram

This input is optional and is used when a PWM position command is required. The PWM input is a differential type capable of handling low-side and push-pull style PWM sources. Pull-up level is 12 V through 1 kΩ. Using the internal pull-up option requires configuring the software to include it. See 'PWM Input' in Chapter 7 for more information on configuration. When using a low-side source and the internal pull-up option, it is necessary for Pin S to be referenced to the ProAct Gen3 Signal Ground or Battery Ground. This can either be accomplished at the PWM signal source by running a PWM- wire into Pin S, or Pin S can be tied to Pin X locally at the 24-pin mating connector. A high-side source is possible but requires customer-supplied wiring. See suggested push-pull source wiring option in Figure 3-7 below for guidance in applying a high-side PWM source.

The duty cycle is always interpreted as (signal high time)/period at pins R and S, regardless of whether a low-side or push-pull source is used.

This input will handle a PWM frequency range from 100 Hz to 3000 Hz at amplitudes ranging from 4 V to 32 V. Normal operating range is from 10% to 90% duty cycle; however these settings are configurable using the Service Tool.

When configured for a push-pull source, there are two PWM amplitude detection ranges available for use, 0-5V and 0-12V, which allow the user to adjust for a desired source signal. The PWM range is configured in software, and more details on modifying this this setting can be found in Chapter 7. For PWM sources in the 0-5V range, a threshold of approximately 3.5V is provided. If the PWM source is greater than 5V in amplitude, it is better to use the 0-12V range, where the amplitude detection threshold is 7V. In either case, the allowable PWM input amplitude is anywhere from 0V to 32V. Each detection range includes a hysteresis band to avoid inaccuracy caused by detection 'chatter' that can sometimes be a result of a noisy PWM signal source. See Figure 3-5, showing the detection thresholds for each range. When configured for a low-side source, the 0-12V range is always used.

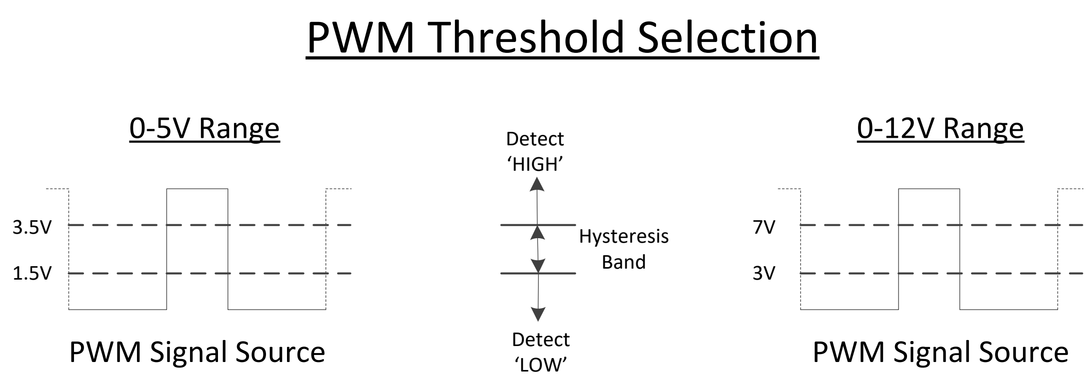
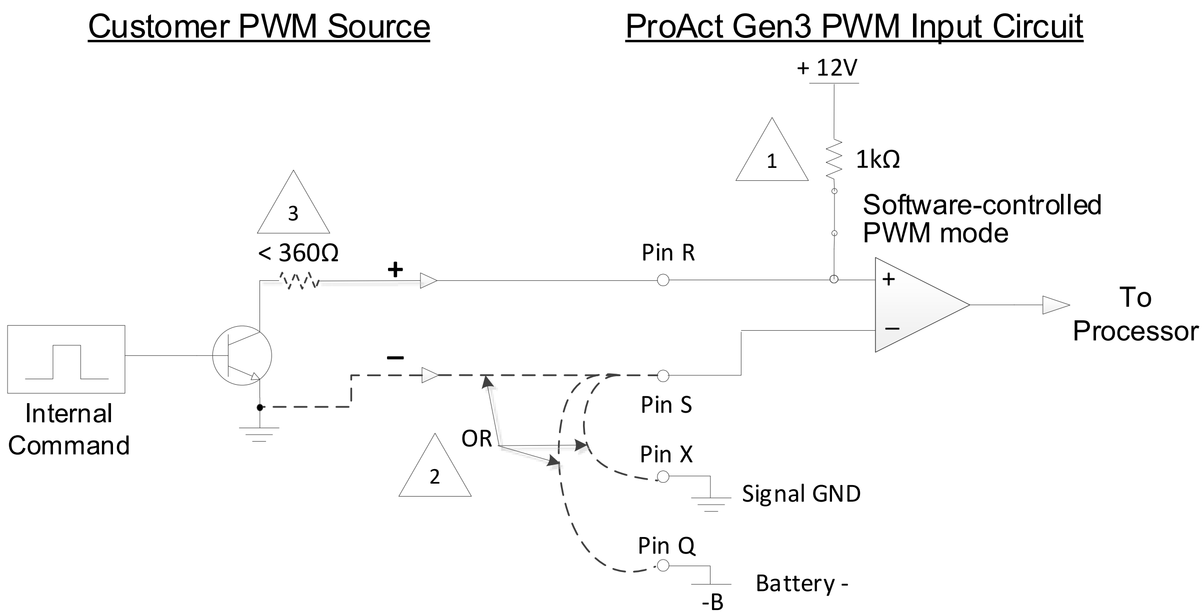


Figure 3-5. Selectable PWM Input Thresholds

PWM input duty cycle failure diagnostics are provided based on software configuration. See Chapter 7 for more details on available diagnostics.

Low-Side PWM Source

(suggested wiring option)



NOTES:

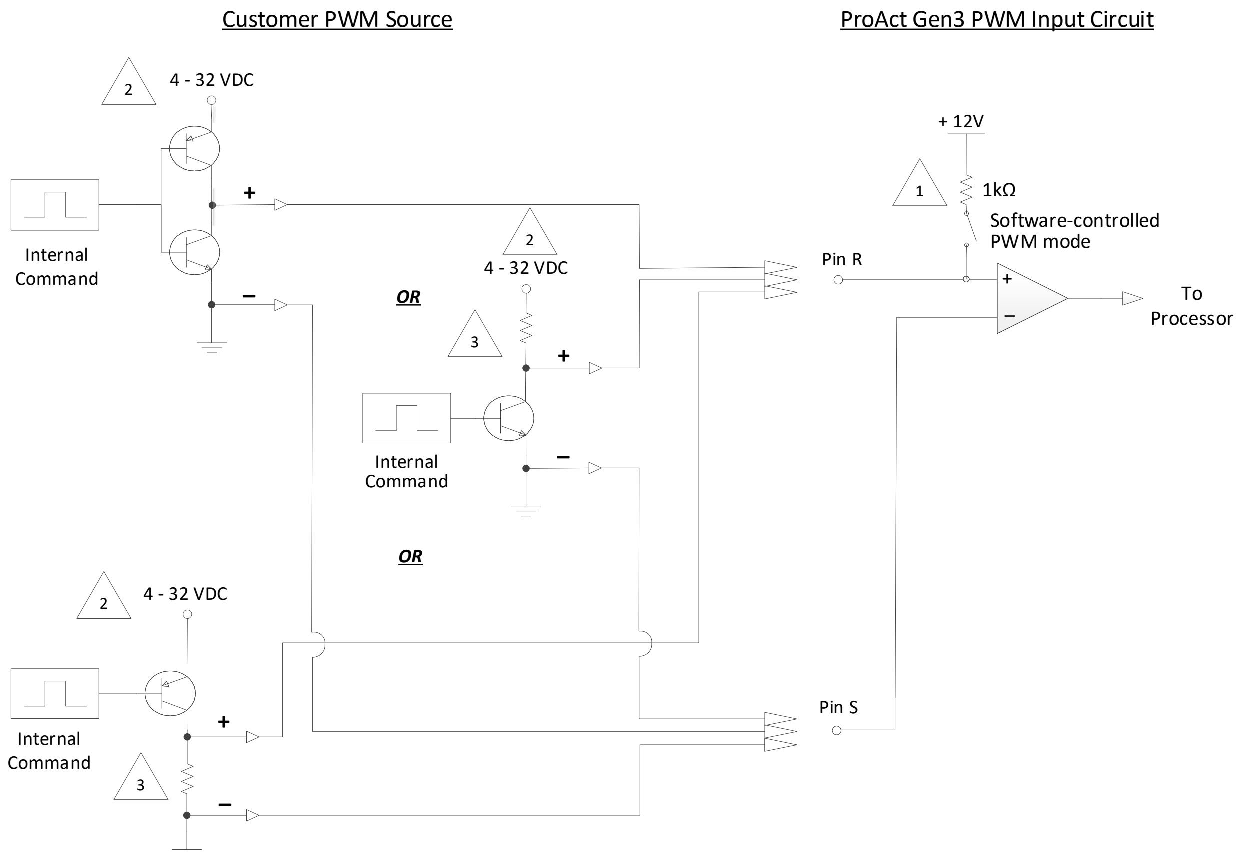
1 — This pull-up resistor is optionally activated using the service tool and is meant to serve as a pull-up for a low-side (open-collector) PWM source. For low-side source applications, the pull-up option should be activated (the input selection should be set to 'Low-Side')

2 — When using low-side PWM source, Pin S must be referenced to either -B or Signal GND at either the customer source or locally at the 24-pin circular connector on the ProAct Gen3 Actuator

3 — When using a low-side source from the supervisory controller to supply a PWM command, to ensure reliable PWM operation, the series or switch impedance must be less than 360Ω.

Figure 3-6. Low-Side PWM Source Wiring

Push-Pull PWM Source (three variations)



NOTES:

1. This resistor is optionally activated using the service tool and is meant to serve as a pull-up for a low-side (open-collector) PWM source. For push-pull sourced applications, the pull-up option should be deactivated (the input selection should be set to 'Push-Pull')

2. The customer's voltage source should be matched with the adjustable input threshold range available for the PWM input circuit

3. There is a 10kΩ line-to-line impedance at the input of the ProAct Gen3 PWM input. Minimize external switch and series impedances for most reliable operation. External pull-up or pull-down resistors can have a voltage division effect with the internal impedance and fail to trip the internal PMW detection thresholds.

Figure 3-7. Push-Pull PWM Source Wiring

Discrete Inputs (Pins: F, B, A, L, E)

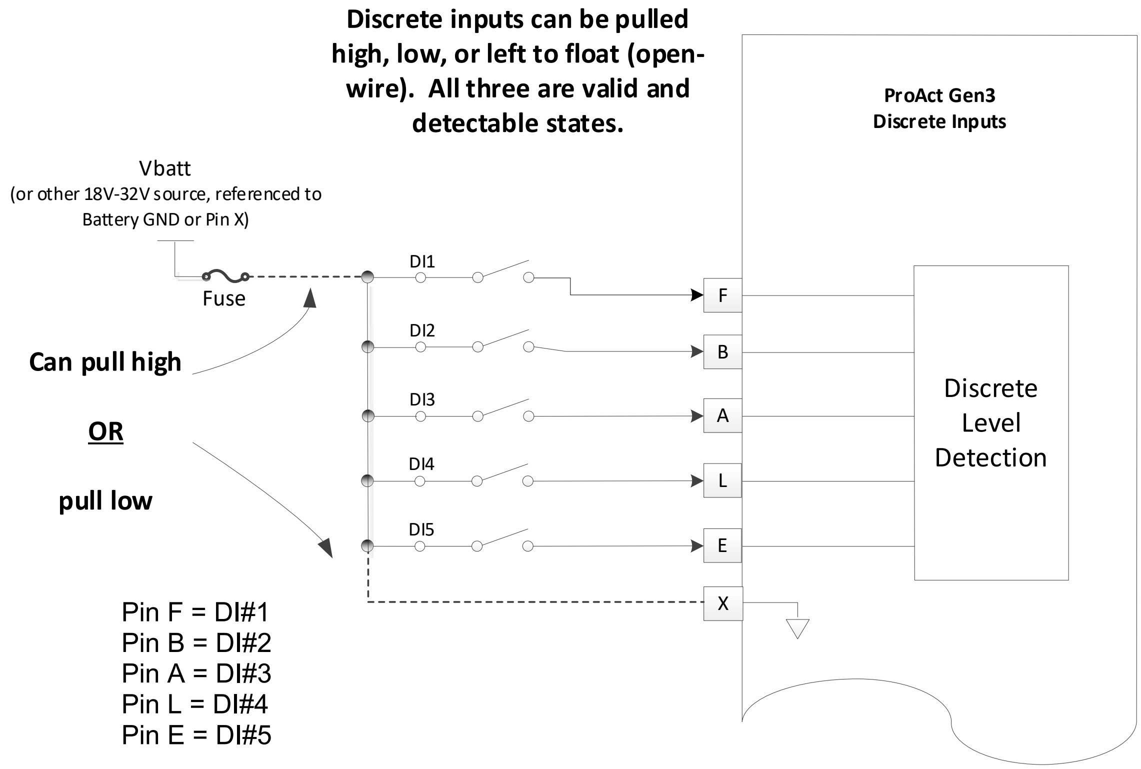


Figure 3-8. Discrete Input Wiring Diagram

There are five discrete inputs on the ProAct Gen3 actuator. The input functions are configurable using the Service Tool (for example, functions such as Run Enable, CAN ID1, and CANID2 can be assigned to any of the five inputs as desired). All five discrete inputs are the same electrical circuits. Each discrete input can be configured in the software for a high side or low side switch and for an active closed contact or an active open contact. Refer to Chapter 7 for discrete input configuration details.

The fuse shown in the diagram can be the same fuse that is used for the power supply of the actuator—there is no need for an additional fuse.

High Side Switch, (default)
If used as a high side switch, the switch contact must be connected to the discrete input pin and to the input power (+) pin of the actuator. The high side switch configuration is preferred.

Low Side Switch
If used as a low side switch, the switch contact must be connected to the discrete input pin and to the Ground pin of the actuator.

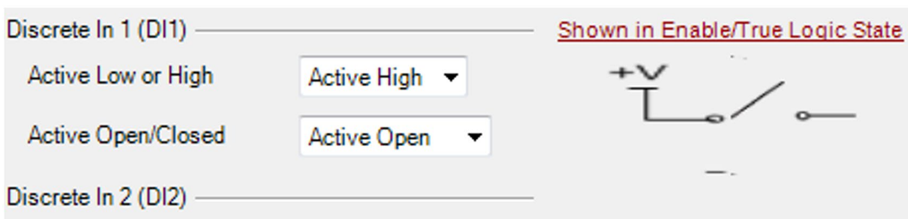
Active Closed, (default)
Active closed can be used for situations where it is safer to make the function inactive if the wire is broken, or disconnected.

Active Open
Active open can be used for situations where it is safer to make the function active if the wire is broken, or disconnected.

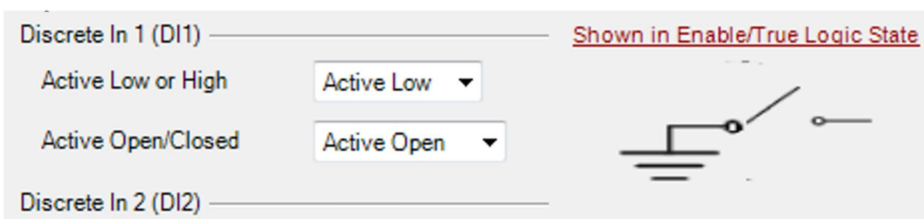
The signal that causes a discrete input to be detected as logic ‘true’ or ‘false’ can be configured independently for each input, using active low/high and active open/closed settings. Figure 3-9, using Discrete Input 1 as an example, illustrates the condition to generate a logic ‘true’ state.

Active High, Active Closed means it will be detected true when pulled high and false when unconnected (or pulled low).

Active Low, Active Closed means it will be detected true when pulled low and false when unconnected (or pulled high).



Active High, Active Open means it will be detected true when unconnected (or pulled low) and false when pulled high.



Active Low, Active Open means it will be detected true when unconnected (or pulled high) and false when pulled low.

Figure 3-9. Discrete Input Assignment

Run/Stop
Any of the five discrete inputs can be optionally used as a Run/Stop (Run Enable) input. When the input is true, a run is commanded and when it is false a stop is commanded.

CAN ID Low and CAN ID High
Up to four ProAct Gen3 controls, designated as Unit 1 – Unit 4, can be on the same CAN bus. Each unit must have a different device address. The CAN device address is determined by the state of the CAN ID HI and LO discrete inputs upon power-up of the unit (see Table 3-1). CAN ID HI and LO discrete inputs are assigned to a particular discrete input with the Service Tool. The state of each input (low, high, unconnected) and the selected address are displayed on the Service Tool to aid in troubleshooting.

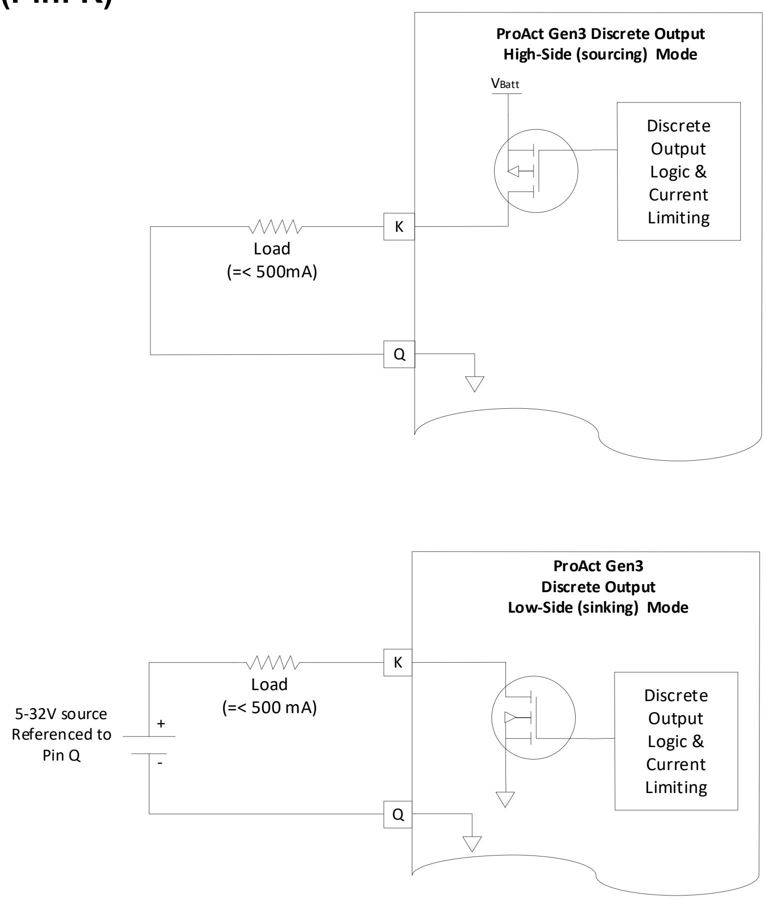
As an example, if CAN ID HI is false and CAN ID LO is true on power-up, the device address for Unit 2 is selected, as well as any other configuration options that are associated with CAN Unit 2.

Table 3-1. ProAct Control CAN Address

ProAct Gen3 Address	Unit 1	Unit 2	Unit 3	Unit 4
CAN ID HI	false	false	true	true
CAN ID LO	false	true	false	true

IMPORTANT — **The CAN ID HI and CAN ID LO pins are only read at power-up.**

Discrete Output (Pin: K)



Pin K = Discrete output

Figure 3-10. Discrete Output Wiring Diagram

The discrete output state can be configured to indicate when a particular condition or conditions are active. Additionally it can be set as normally-energized, de-energize for fault, or vise-versa. Refer to the Service Tool (Chapter 7) for configuration details. The discrete output can provide a status indication to a control system or an operator panel.

The electrical circuit can be either sourcing (high-side) or sinking (low-side) output. This is configured in software using the product Service Tool (configuration detail in Chapter 7). When in high–side mode, the output load must be connected between the discrete output pin (Pin K) and the battery ground connection of the ProAct Gen3 actuator (Pin Q). If the load requires a maximum of 500 mA, it can be driven directly from the output. It is possible to drive a relay with the discrete output if more current is needed for the load.

When used as a low-side output, the load must be tied to either the battery source or independent source that is also referenced to the system ground. Both the low-side and high-side output options are internally current limited to self-protect against short circuit or other over-current situations; however please select the load not to exceed 500 mA.

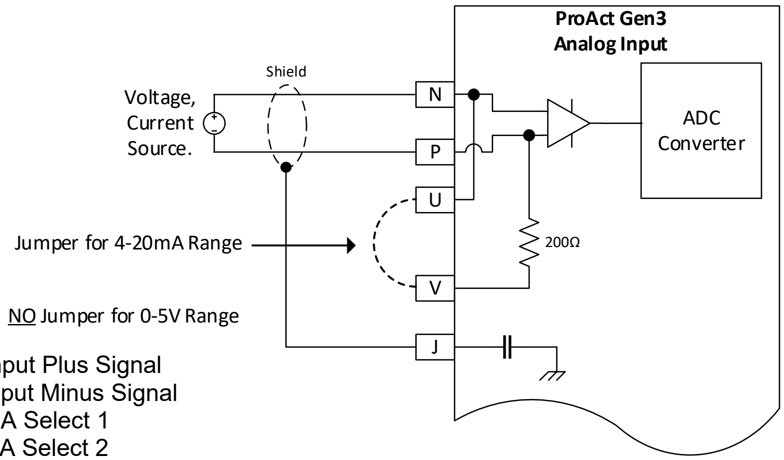
IMPORTANT	**When the discrete output is in over-current mode, there will be slightly different behavior whether the output mode is sourcing (high-side) or sinking (low-side). During an overload condition in sourcing mode, the load will simply be disconnected internally until the current falls below the trip threshold. During an overload condition in sinking mode, the discrete output will oscillate at approximately 21 kHz to help reduce overheating of internal components. This may cause a 'buzzing' of the load if using a relay, or possibly an LED flickering at a low intensity. In both modes, when the source of the over-current fault is cleared, the circuits will automatically resume normal function.**

⚠WARNING **Sudden Movement**	**Stay clear of the actuator output shaft and all equipment that may be actuated by the Discrete Output, as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.**

IMPORTANT	**The high-side discrete output is driven directly from the battery power. Be mindful when attaching the discrete output to a load that the load is capable of handling battery potentials along with all of the various transients that can occur. It may be necessary for the end user to add additional external transient protection to the load if there is a concern of electrical over-stress.**

IMPORTANT	**Choosing between low-side or high-side Discrete Output should be carefully considered by the system engineer of the intended application. There may be situations where using one approach over the other provides a better solution to fault detection, depending on the external system detection circuits (eg. fault 'trip string').**

Analog Input (Pins: N, P, U, V, J)



Pin N = Analog Input Plus Signal
Pin P = Analog Input Minus Signal
Pin U = 4 to 20 mA Select 1
Pin V = 4 to 20 mA Select 2
Pin J = Shield (shared)

Figure 3-11. Analog Input Wiring Diagram

The Analog Input is used when an analog position command is required. The input can be either 4 to 20 mA or 0 to 5 V and is configured by the wiring harness and software.

Connect the Analog Input source between pins N and P. Pin N is the positive input signal and pin P is for the negative input signal. The conductor shield must be connected to pin J and the other end of the Analog Input sensor cable shield is not connected and is isolated. The Analog Input and the Analog Output cables share pin J.

Mode: 0 to 5 V
If the input is used for (0 to 5) V, connect a voltage source between pins N and P. Make sure that there is no connection between pins U and V. The signal at pin N must be more positive than the signal at pin P.

Mode: 4 to 20 mA
If the input is used for (4 to 20) mA, connect a current source between pins N and P. Make sure that pins U and V are connected together as close as possible to the connector. The signal at pin N must be more positive than the signal at pin P.

Analog Input scaling and failure diagnostics are provided based on software configuration.

IMPORTANT	**The mode (4-20 mA or 0-5 V) selected at Pins U and V must agree with that selected in the software configuration for proper operation of the analog input and its diagnostic features.**

Analog Output (Pins: H, D, J)

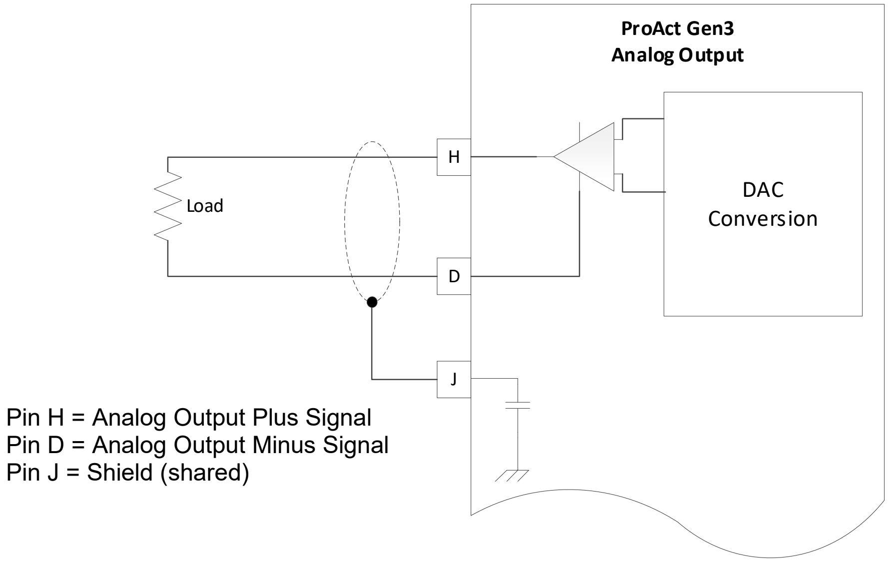


Figure 3-12. Analog Output Wiring Diagram

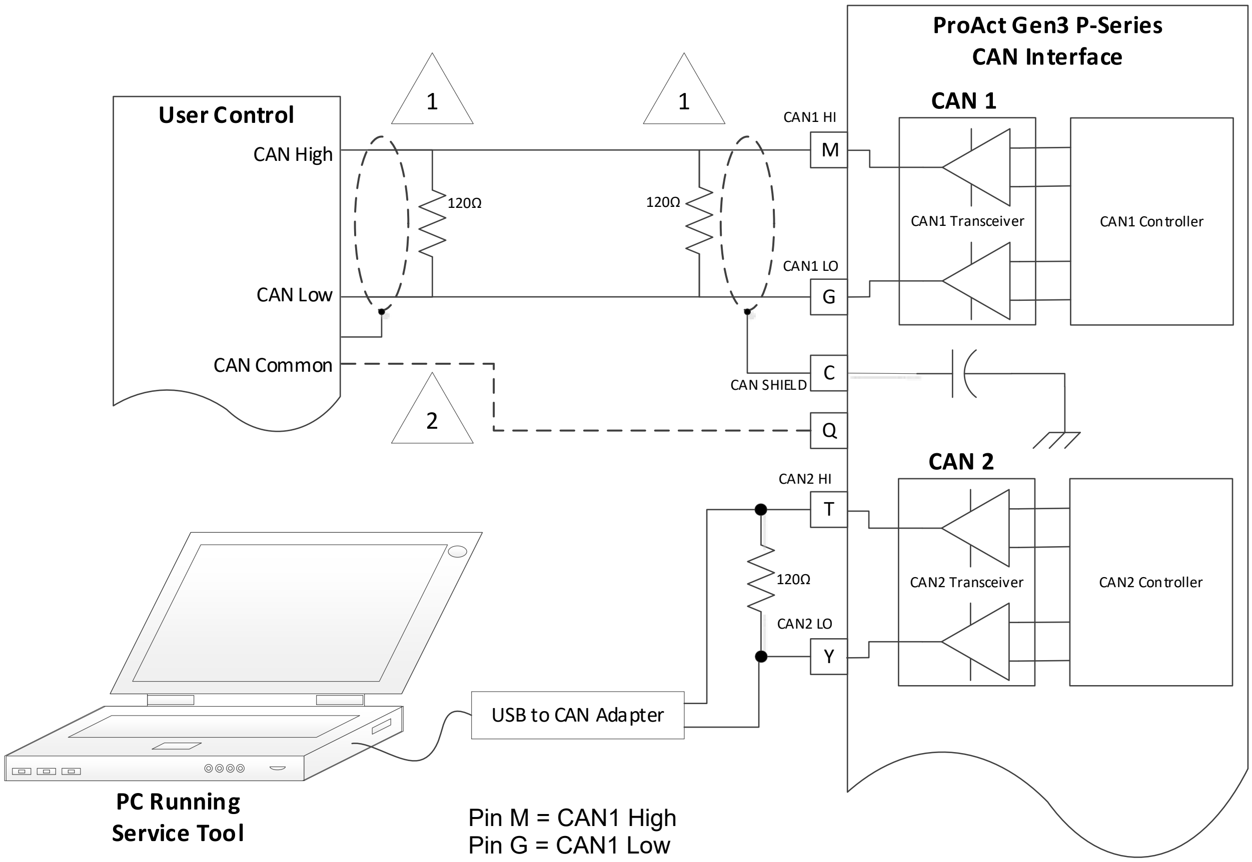
An analog output provides a 4 to 20 mA output signal representing the actual shaft rotational position. Optionally it can be configured in software to represent the position setpoint.

The 4 to 20 mA analog output drives a 0 to 385 Ω load. The high side (pin H) drives current from the internal 12 V (dc) power supply to the load. Connect the return current to pin D. Pin D is internally connected to the power supply ground.

A shielded twisted-pair cable is recommended for the analog output. The output can be setup in the software for scaling and output type.

It is possible to use the analog output with more than one load if the **total** load resistance is not greater than 385 Ω.

CAN Ports (Pins: M, G, C, T, Y)



Pin M = CAN1 High
Pin G = CAN1 Low
Pin C = Shield
Pin T = CAN2 High
Pin Y = CAN2 Low

NOTES:

1. A CAN termination resistor is required if a device is on the END of the CAN bus.

2. CAN common (ground) can be used to reduce signal offset if high common-mode is an issue. This is not required for most installations, as the differential nature of the CAN transceivers normally allow for typical ground offset found in an industrial setting.

Figure 3-13. CAN Wiring Diagram

ProAct Gen3 actuators provide two independent CAN (Control Area Network) ports, CAN1 and CAN2. CAN port 1 is used for supervisory control and monitoring of the actuator using SAE J1939 protocol. Either CAN port can be used for the Service Tool.

The use of CAN bus cable that meets SAE J1939-11 specifications for impedance and shielding properties is required for the CAN communication. The battery minus signal and the shield signal are not connected and therefore the shield cannot be used as a common signal between the controls.

To prevent ground loops, the shield connection is not hard wired to the chassis. The shield is terminated in the ProAct Gen3 control through a high-frequency capacitor. The shield must be connected to the earth ground in the wiring harness to improve EMC performance. See Figure 3-15.

If the actuator is the last device at the end of the CAN bus, install a 120Ω, 1 Watt termination resistor across CAN High and CAN Low, positioned as close as possible to the actuator.

CAN termination resistors are required at the ends of the CAN bus.

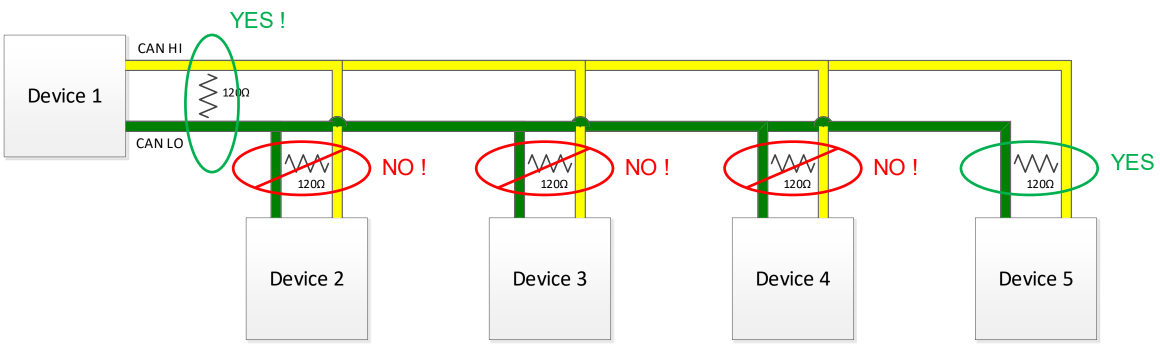


Figure 3-14. CAN Termination Resistors at End of Can Bus

CAN1 has configurable bit rates while CAN2 is fixed at 1Mbps.

CAN Port Specification Summary:

Name	**Value**
Wiring Specification	ISO-11898, SAE J1939-11
Max Wire Length	30 m
CAN Port Isolated	No
Baud Rate	CAN1: Configurable to 125 kbps, 250 kbps, 500 kbps, and 1 Mbps CAN2: 1 Mbps

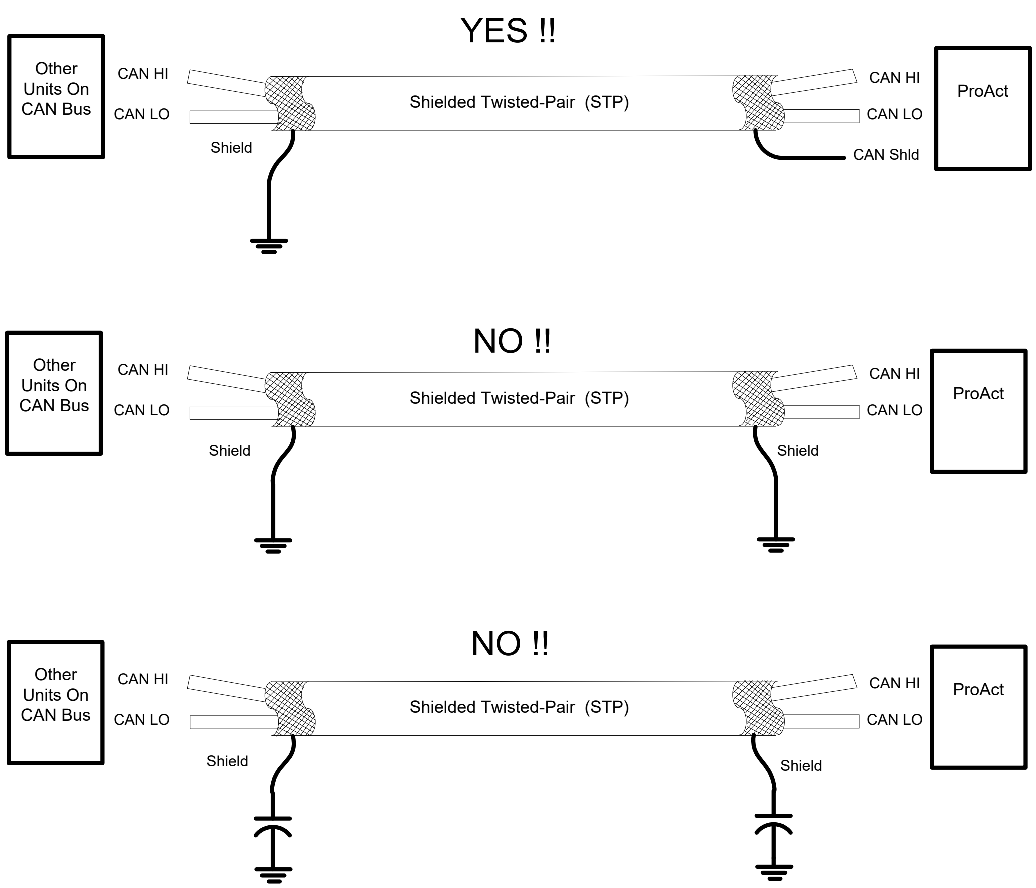


Figure 3-15. CAN Shielding

NOTICE	
Service Tool Usage	**If the CAN bus that is connected to CAN1 is already heavily loaded with other devices and traffic, it is advisable to use CAN2 for connection with the Service Tool to avoid overloading bus traffic. CAN bus traffic overload can lead to communication and functionality problems.**

Service Tool connection to a PC is accomplished through the use of a USB to CAN converter and a breakout adapter. While other options may be available, Woodward has tested functionality with a Kvaser LeafLight HS v.2 (Woodward # 5404-1189) as suitable for use with the ProAct Gen3 actuator. The LeafLight v.2 will require the use of a breakout cable to adapt the 9-pin D-Sub connector to the individual terminals within the ProAct mating connector. Additionally, Woodward can provide an adapter cable for using the Service Tool which provides a CAN breakout, connected to CAN2. This adapter cable (Woodward # 10-010-275) and the CAN termination resistor (Woodward # 1249-1271) are available individually from Woodward, or sold as a kit with the Kvaser LeafLight as 10-010-276.

Figure 3-16 shows how to connect the converter and adaptor between the PC and the ProAct Gen3.

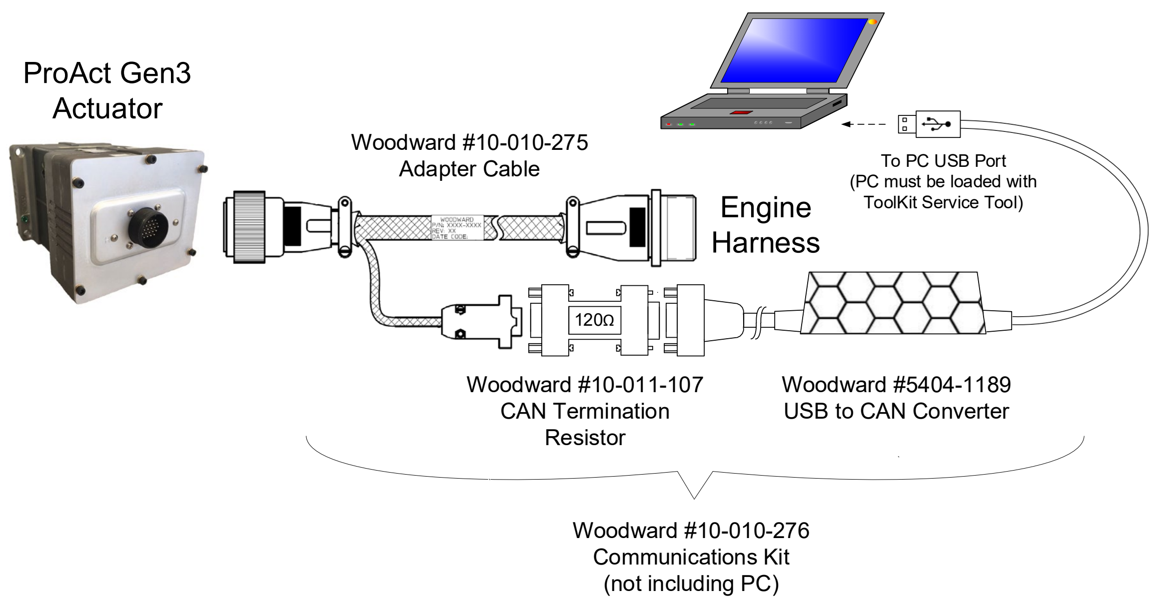


Figure 3-16. CAN Wiring for Service Tool Usage

See Chapter 5 for more information regarding CAN implementation in the ProAct Gen3. Chapter 7 provides details for protocol and configuration of the CAN settings for each ProAct Gen3 actuator on the network.

Chapter 4.
Description of Operation

NOTICE

The non-latching non-redundant position command failure action can lead to a situation where the system is rapidly cycling between two states.

WARNING

Sudden Movement

Configuring some diagnostics as a non-latching shutdown can result in unexpected behavior. In some cases the diagnostic condition may disappear while the unit is in the process of shutting down, allowing the system to resume operation. This can result in wide pressure and speed fluctuations. It is highly recommended that the control system latch any shutdown it detects via the discrete output to prevent unexpected behavior.

External Mechanical Stops:
External mechanical stops must be provided in the linkage system. Do not use the internal actuator stops to limit output shaft travel. The internal actuator stops are provided for actuator setup purposes only

Overview

The ProAct Gen3 is an electric actuator with internal position feedback. The output shaft maximum rotation is 73 to 77 degrees and is configurable for CW or CCW rotation. The actuator accepts a PWM, 4-20 mA analog, 0-5 V analog, or a CAN position command input signal. Command redundancy is possible using two of these signals as a primary/backup pair. An optional correction curve is provided to configure a demanded position versus actual position for non-linear systems. A manual mode is provided to facilitate setting up the actuator system.

Optionally, a Run/Stop input can be used to activate or de-activate the ProAct Gen3 output. It can also be used to reset fault conditions. The actuator has one discrete output, which changes state based on configurable alarms and status conditions. A 4-20 mA analog output is available, providing a position set point or position feedback indication.

Control adjustments are made using the ProAct Gen3 Service Tool. The Service Tool is a Windows based software tool provided at no charge to configure, monitor, adjust, and troubleshoot an actuator. It runs on a personal computer and communicates with the actuator through a CAN connection.

The control provides two CAN communication ports. One port is used for communication using SAE J1939 protocol to an engine control system, while either can be used for connection to the ProAct Gen3 Service Tool. Two discrete inputs (CAN ID High and Low) are provided to support multiple CAN configurations within a single device using harness coding.

As you review the following features, keep in mind that most applications only require a few of the functions to be activated. The choices are made available to provide maximum flexibility in a single package. The user must set up the actuator direction, min and max position calibration, position command input, and desired I/O. The user can choose all or none of the CAN settings, alarm/shutdown functions and logic functions depending on the application.

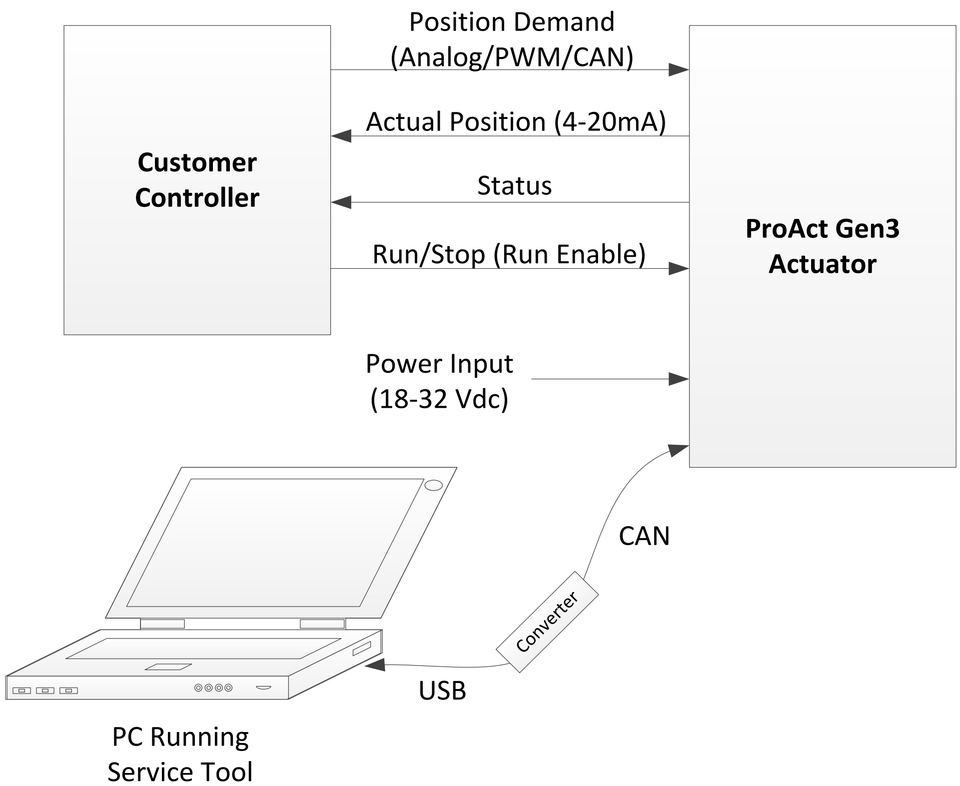


Figure 4-1. Overview

System Operation

The ProAct Gen3 actuator is ready for operation when the power supply is connected. Power may be connected to the control at the same time the engine starter is engaged. The actuator will power up in a stable and predictable manner whether a command signal is present or not. Upon power-up, the actuator will immediately (within 350 milliseconds) begin moving to the commanded position.

Position Control

The ProAct Gen3 actuator provides closed-loop position control based on an internal position sensor and the desired position command signal. The internal motor driver is controlled by software model-based position and current controllers to position the output shaft. The analog output can be configured to provide an indication of actuator output shaft position or position set point.

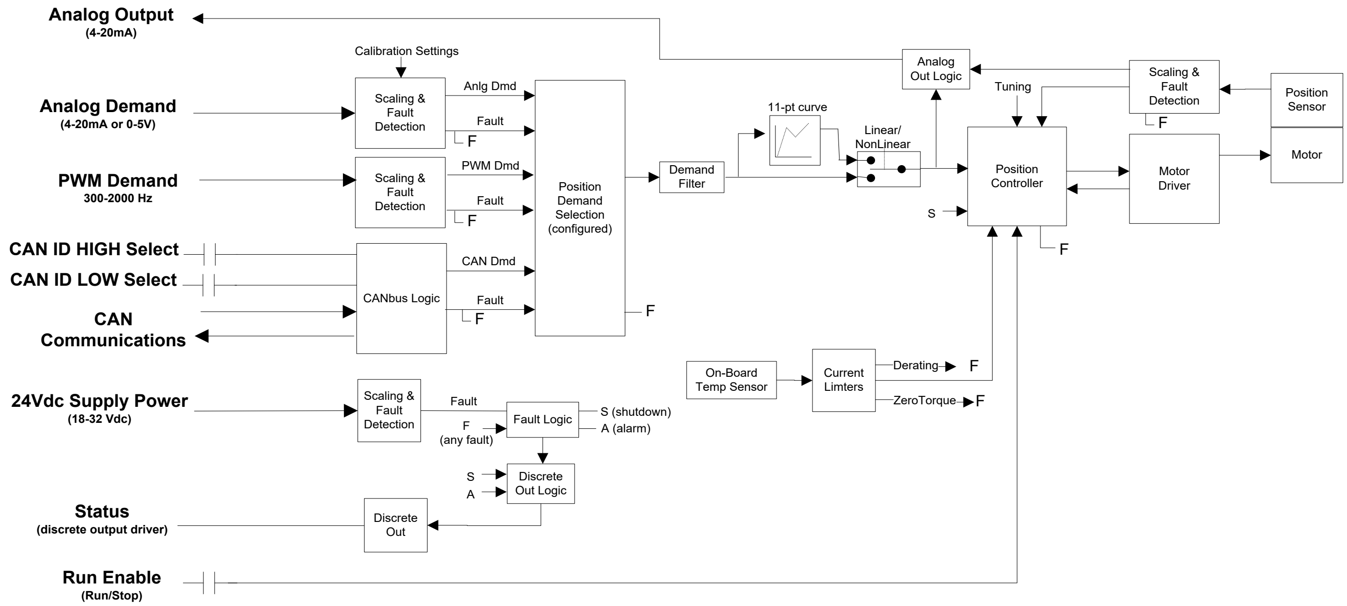


Figure 4-2. Functional Overview

Driver Input Power

The ProAct Gen3 actuator operates at full-specified torque over a voltage range of 18 to 32 VDC. The actuator is functional below 18 VDC and temperatures less than 0 °C, but accuracy and/or torque can be diminished at these conditions. The actuator tolerates input voltages as low as 9 VDC without resetting the internal processor.

The supply voltage low and high diagnostics are provided. High, low, and continuous low thresholds are provided with separate timeouts to avoid nuisance alarms. If the fault is used, it can be configured to either alarm or shut down upon detection of a supply voltage fault.

Position Demand Signal

The ProAct Gen3 can accept either a single position command or redundant position commands. A redundant command uses two position commands, one as the primary command and one as a backup. If the primary should fail, the unit continues to run using the backup command. The command source can be sent over CAN, as a PWM command signal input, or an analog (4–20 mA or 0–5V) command signal input, depending on how the software application and wiring are configured.

A low-pass Position Demand Filter can be configured in the software. The position demand input can be optionally set to use a non-linear mode which provides an 11-point curve relationship between position signal and desired position. The same curve relationship will be used for any demand input type.

The unit can be configured to either alarm or shut down on detection of a position command failure (loss of all position command inputs). Failure of one command source, when redundant commands are used, will result in an alarm and the unit will continue to operate using the remaining healthy command signal.

PWM Input

The PWM input can be configured to function with low-side or push-pull source types. It will handle a PWM frequency range from 100 Hz to 3000 Hz amplitudes ranging from 4 V to 32 V (configurable as either 0 to 5 V or 0 to 12 V nominal for push-pull sources). The duty-cycle-to-position demand scaling and input failure levels for duty cycle and frequency are user-configurable.

IMPORTANT	**Accuracy may degrade 1 to 2% with frequencies above 2 kHz.**

A user-configurable offset is available to adjust the input duty-cycle reading, as needed. This feature is used to compensate duty cycle measurement error resulting from slow signal edge transitions.

CAN Demand

The CAN position demand is configurable in the software as further described in Chapter 7. For hardware configuration options see Chapter 3, CAN ID discrete inputs and CAN Communications.

When used as a position command, a minimum update rate is expected or a CAN fault will be issued. This update rate and a timeout value are both user-configurable.

Analog Input

The analog input type (4 to 20 mA or 0 to 5 V) is configured in the software as further described in Chapter 7.

The input is monitored for out of range condition and the failure levels are user-configurable.

Position Command Redundancy

The position command redundancy determines a commanded position based on the two possible configured inputs - the primary or backup command selection of CAN, PWM, or Analog. It provides failover (primary-to-backup) and failback (backup-to-primary) logic. Indications are provided for monitoring the operating status. These two inputs are expected to track each other such that failure of one signal will not disrupt overall system operation.

The command redundancy utilizes two command inputs; a primary command and a backup command (see Figure 4-3). When both inputs are within normal ranges, as determined by user-configurable failure settings, the primary command is selected and used. A tracking error diagnostic can be utilized to ensure the inputs are tracking each other. If the two input position commands differ by more than the configured maximum difference, then either the primary or backup command is used depending on a user-configurable selection.

Failover logic switches control to a healthy command signal when a failure is detected, either primary-to-backup or backup-to-primary. Failback logic ensures that transfer back to the healthy primary command is not performed until it is within the configured tolerances.

The following operating status indication is provided on the Service Tool:

- **Primary in Control** — Indicates the primary demand is selected and the backup demand is either not used or not failed.
- **Primary Control / Backup Failed** — Indicates the primary demand is selected and the backup demand is failed.
- **Primary Control / Backup Not Tracking** — Indicates the primary demand is selected and the backup demand is not tracking the primary demand per the demand tracking configuration settings.
- **Backup Control / Primary Failed** — Indicates the backup demand is selected and the primary demand is failed.
- **Backup Control / Primary Not Tracking** — Indicates the backup demand is selected and the primary demand is not tracking the backup demand per the demand tracking configuration settings. Note that the chosen input (primary or backup) to use when the difference is exceeded is configurable.
- **Backup Control / Failback is Inhibited** — Indicates the backup demand is selected and the primary demand is healthy but not within the configurable signal healthy tolerance (failback threshold).
- **Backup Control / Failback Pending** — Indicates the backup demand is selected but the primary demand will become active after a configurable signal healthy (failback) delay.
- **All Failed** — Indicates both the primary and backup (if used) demands are failed.

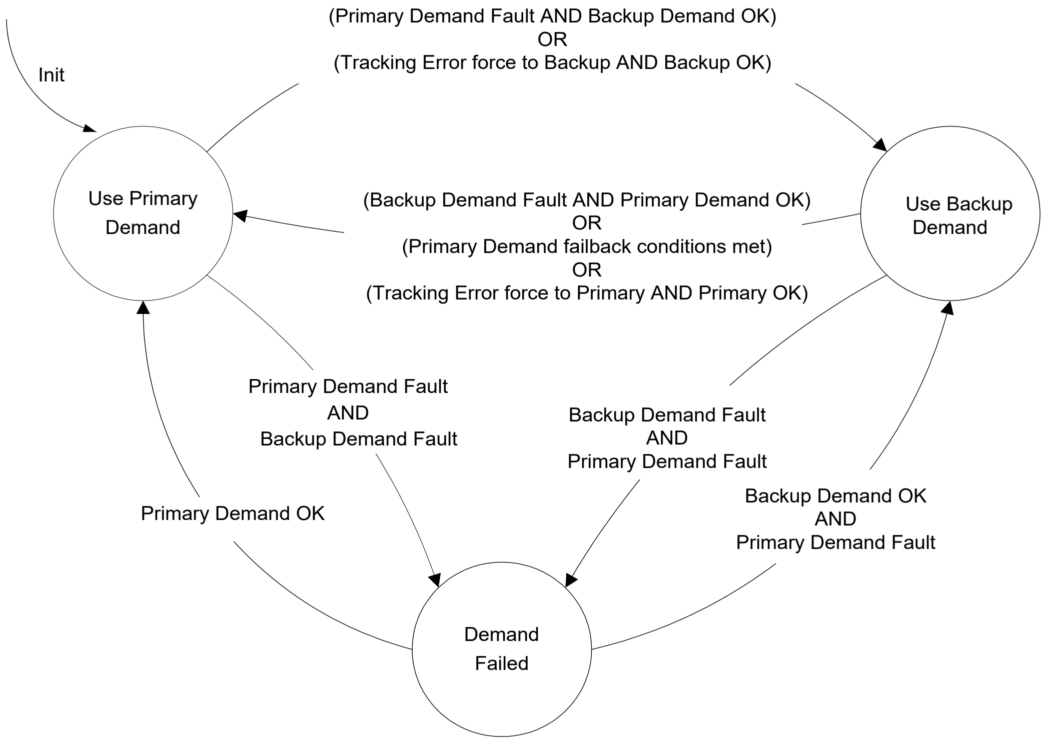


Figure 4-3. Position Demand Logic

Position Lookup Curve

The position lookup curve applies an 11-point look-up function to the position demand signal. The table defines the values at the breakpoints. If the demand is equal to an input breakpoint, the output will be the configured position output value. Between breakpoints the value is interpolated. At the endpoints the value is limited, equal to the last output value. Below the point 1 position input, the output is the point 1 position output. Likewise above the point 11 position input the output is set to the point 11 position output.

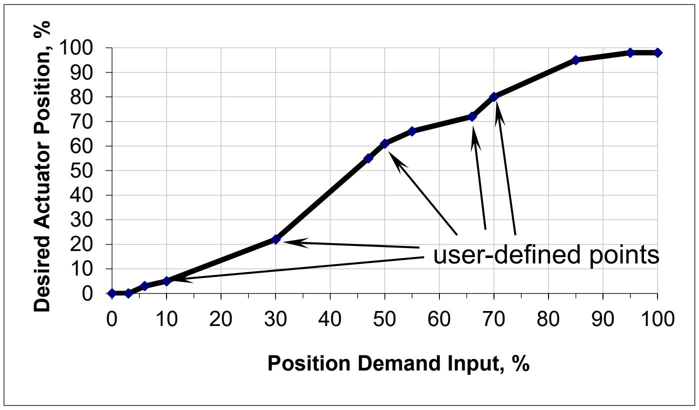


Figure 4-4. Position Lookup Curve

Actuator Travel Range

The Service Tool is used to set the range used by the actuator position control. See Chapter 6 for setting instructions.

The Service Tool provides several methods for scaling the actuator travel (0% to 100%) relative to mechanical end stops that are internal or external to the actuator. An Auto Find Mechanical Stops feature is provided to simplify locating the stop positions at min and max travel. The range of travel can then be manually adjusted by modifying the offset and span values. The automatic method for finding the mechanical stops is preferred and recommended. However, the min position offset may need to be adjusted if sticking of the end device (e.g. butterfly valve) is experienced at the min position.

The control settings for a specific engine system can be used for other duplicate engine builds provided adequate measures are employed to assure the linkage and stop settings are equal to the original engine settings.

NOTICE

Woodward recommends using either CAN, Analog Output, or an external mechanical position indicator (such as a pointer) to indicate position of the actuator output shaft, especially in situations where the output shaft may not be directly visible. Doing so aids in system setup and troubleshooting.

Position Control Tolerances

Command and feedback errors can be determined using the following diagram.

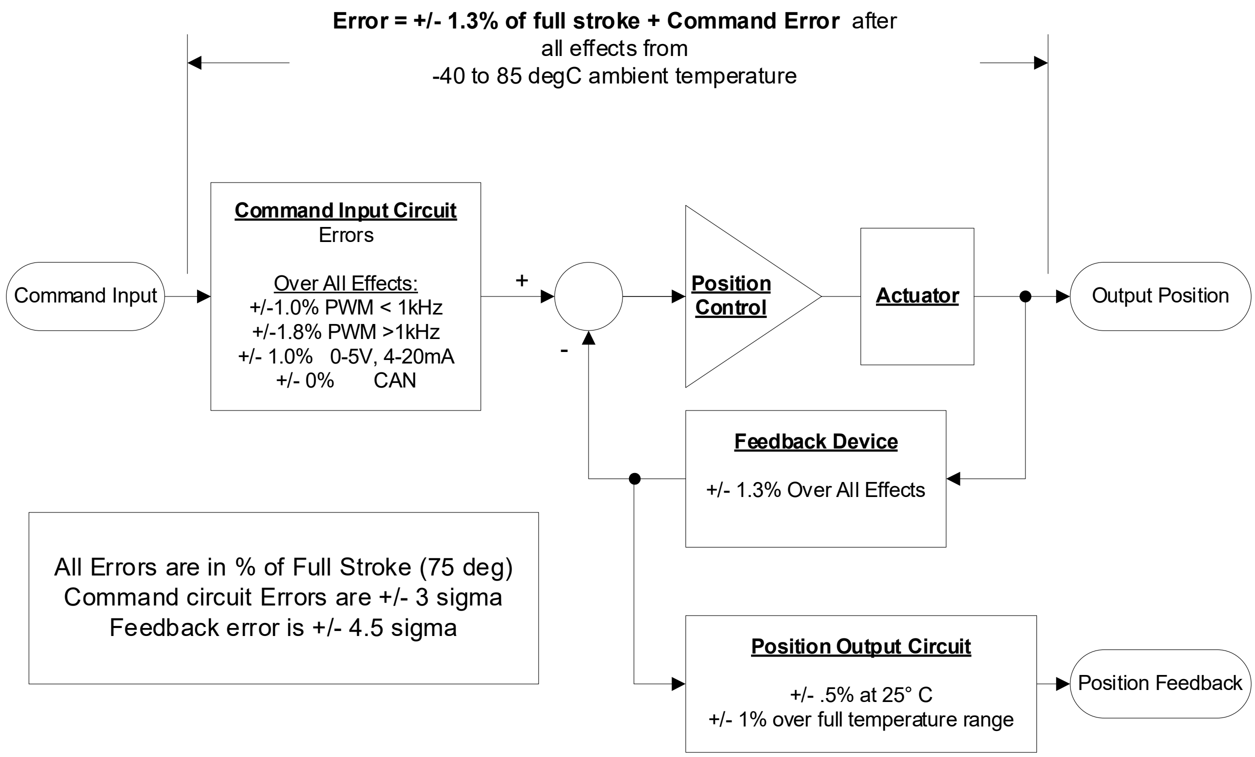


Figure 4-5. Command and Feedback Error Flow

Analog Output

The analog output provides a 4-20 mA signal representing either actual shaft rotational position or position setpoint. The output is 4 mA at 0% and 20 mA at 100% by default, but is user-configurable. Additionally it can be turned off completely (0mA).

Discrete Output

The discrete output can be configured as either a high-side or a low-side driver that changes state upon a detected driver fault. The discrete output can be configured to indicate any number of diagnostic conditions in the actuator. It can also be configured as normally on (preferred failsafe setting) or normally off. This output can provide a useful diagnostic signal for monitoring the engine. It can also be used to shut down the engine by an external means separate from commanding the actuator to a specified position or to a zero current condition.

The discrete output can be configured to be controlled by individually-selected diagnostic conditions, as well as choices for any alarm condition and any shutdown condition.

Run/Stop Discrete Input

An optional Run/Stop function can be configured for use. This function can be performed using a CAN command, a discrete input, or disabled completely. This function will force the actuator output controller into a low current 'limp' state. If the shutdown action is set to 'Position then Limp' then this function will follow the shutdown action of going to a defined position before going limp, otherwise it will go immediately to a limp mode. A stop command can be configured to trigger a common shutdown indication.

The Run/Stop input can also be used to clear a latching shutdown condition. Using this input to command stop for at least 1 second and then command run will issue a reset active faults command.

Temperature Sensing and Self-Protection

The ProAct Gen3 actuator monitors board temperature with on-board temperature sensors to protect the unit from over temperature. A user-configurable high temperature diagnostic is provided, as well as indications when protection becomes active. Additional internal monitoring provides temperature level indications for temperatures exceeding the torque de-rating limit and 140 °C (see self-protection). If the temperature sensor is determined as invalid, a sensor failed diagnostic is annunciated.

Temperature Self-Protection

The controller has a self-protection feature which provides actuator current limiting based on the electronics temperature. Dependent on board and actuator thermal models, the software turns off current when conditions are present that would damage the unit due to **extreme** temperatures. This feature can be disabled in applications where continued functionality is required, however this is not recommended.

⚠WARNING **Sudden Movement**	**When the internal temperature of the ProAct Gen3 returns to 140 °C or lower, there may be a sudden movement to the latest command position.**

Current limiting based on temperature occurs when the combined current and temperature environment causes board temperatures greater than 100 °C. The normal actuator steady-state current limit is de-rated linearly between 100 °C and 140 °C, with zero current at 140 °C. The actuator returns to normal operation when the board temperature is 100 °C or lower. Diagnostic indications are provided for both of these protection levels, Torque Derate Active (>100 °C) and Zero Torque (>140 °C).

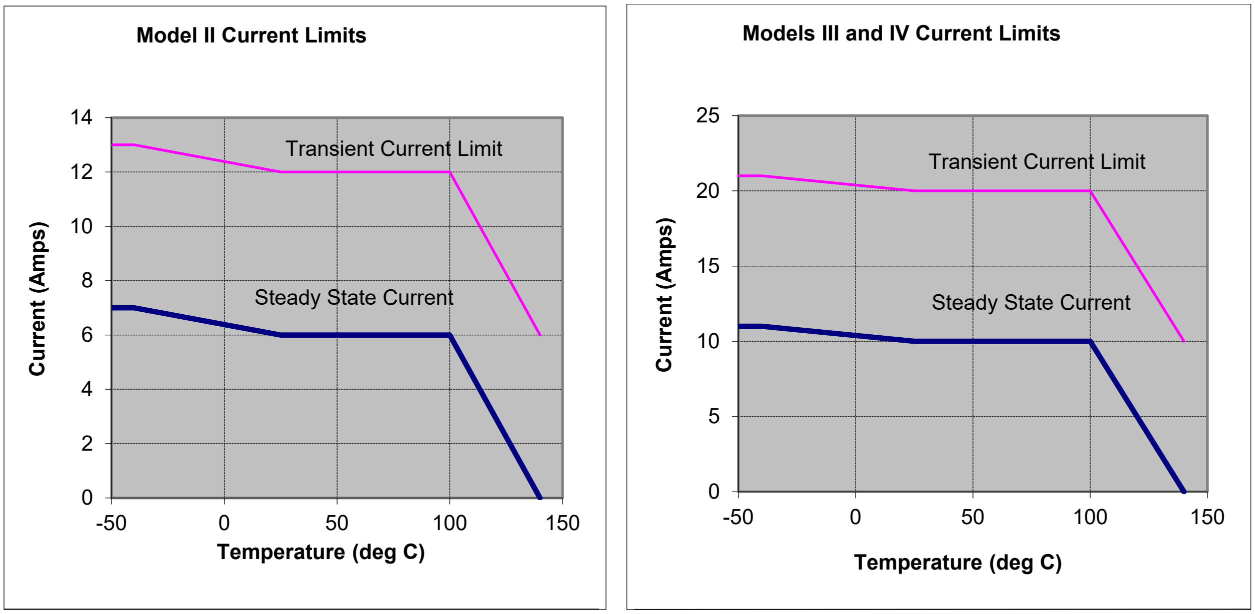


Figure 4-6. Example Temperature vs. Current Limit Curves

Transient Torque Capability

The ProAct Gen3 actuators are capable of rated transient torque for short time periods. The length of time that the unit will provide rated transient torque is a function of the torque load prior to initiation of full-transient-torque demand. The transient output is time-limited to avoid self-damage and the device will fall back to the rated steady-state torque when the limit has been reached.

Position Error Handling

Position Error detection logic will indicate that a difference between actual position and expected position was detected. The 'expected position' is internally determined as the demanded position filtered by the actuator dynamics. This logic is designed to account for normal actuator response times to prevent unwarranted position error indications during transient conditions. The position error, or difference between the expected position and actual position, is run through a low-pass filter. This diagnostic goes true when the filtered error is greater than the error threshold setting. The low-pass filter time constant is set by the error delay setting. The difference threshold, delay, and fault action are configurable (see Position Error on Diagnostic Setup page).

Fault Detection and Annunciation

The diagnostics screens on the ProAct Gen3 Service Tool display the status of both active and stored (i.e., occurred in the past but is possibly no longer active) fault conditions including an occurrence counter and time of first and last occurrence. These indications are stored in non-volatile memory and provide a history of events even after the unit has been power-cycled or run again.

A user-selectable fault action selection is provided for many diagnostics to determine what action should be taken upon detection of the fault. Selecting Shutdown will follow the configured shutdown action, either going limp or forcing the actuator to a predetermined position regardless of the demanded position. Additionally it appears in the fault log and drives a common shutdown indication. When set to Alarm, the diagnostic appears in the fault log and drives a common alarm indication. Diagnostics set to 'Not Used' are ignored. Diagnostics are annunciated in the Service Tool, over the CAN link, and through the Discrete Output, if used.

Faults can be globally set as either latching or non-latching. When set as latching, once the fault is true it remains true until an explicit fault reset operation is performed or power is cycled, even if the source of the fault is remedied. If non-latching, the fault resets as soon as the source of the fault is remedied.

⚠WARNING	**A non-latching shutdown configuration can lead to a situation where the system is rapidly cycling between two states and should be used with caution.**

NOTICE	**With the exception of the individual position demand failures, Woodward recommends using the actuator's fault detection feature with 'shutdown' as the resulting action. This will give the greatest amount of protection in a fault situation. If the severity of the fault does not warrant a shutdown, an 'alarm' setting will still provide the user with annunciation.**

⚠WARNING	**It is recommended that all faults be configured as shutdowns to ensure maximum fault protection.** **Configuring some diagnostics as a non-latching shutdown can result in unexpected behavior. In some cases the diagnostic condition may disappear while the actuator is in the process of shutting down, allowing it to resume operation. This can result in large fluctuations in the engine system. It is highly recommended that the control system latch any shutdown it detects via the discrete output to prevent unexpected behavior.**

Latched active faults can be reset using the Service Tool, by toggling the Run Enable discrete input (if used) Off for greater than 1 second, then back to Run, or by cycling power.

Stored faults are non-volatile and can only be cleared by selecting the 'Clear Stored' or 'Clear All Stored' buttons on the Service Tool.

The diagnostic event manager on the Service Tool displays each fault as it occurs and continues to display the fault until the stored fault is cleared. See Figure 4-7. The event manager displays the time of first occurrence, the time of last occurrence, an occurrence counter, the fault type (alarm/shutdown), and the fault status (active and stored). Faults can be individually or globally cleared, with the Reset Active (selected) and Reset All Active commands. Refer to Diagnostics screen in Chapter 6 for additional details.

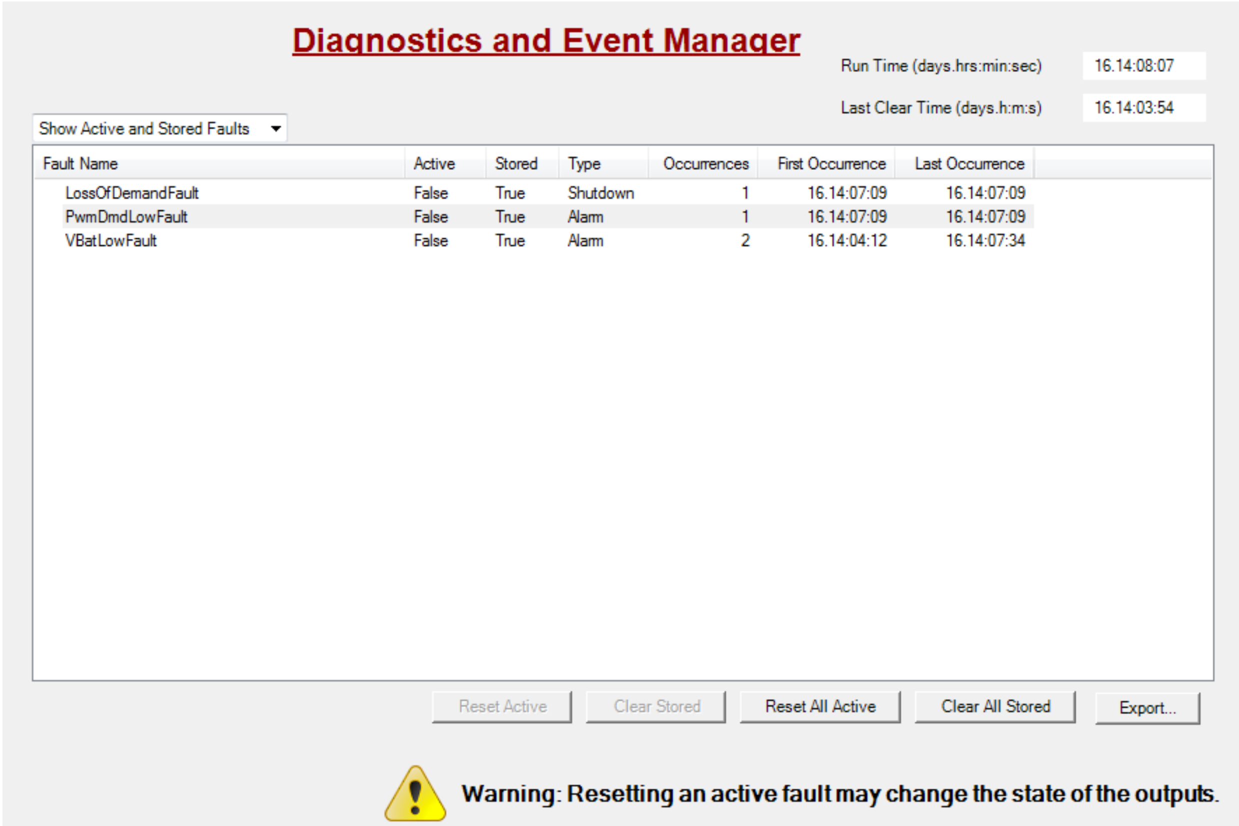


Figure 4-7. Diagnostic Event Manager

Overview of Individual Diagnostics

Diagnostics are either alarms or shutdowns, and are either latching or non-latching. Some have a fixed fault action and/or fixed latching or non-latching behavior – they are identified below. Diagnostics for functions that are not used never become active. For example, if the PWM input is not configured to be a position command source, no diagnostics associated with the PWM inputs can go active.

When redundant position demands are configured, then the selected demand faults are automatically set as Alarms. With a non-redundant (single) demand, the faults can be configured as Not Used, Alarm or Shutdown.

Individual Diagnostic Details

The following section provides details on each diagnostic condition. Note that a fault is enabled or configured for use when the fault type is set to Alarm or Shutdown. It is disabled when set to Not Used.

Input Voltage High

Indicates the input voltage went above the configured high threshold for the configured high delay time. For settings information see Input Voltage High settings on Diagnostics screen in Chapter 7.

Fault Name:	VBatHighFault
Permissive:	Fault enabled
Failure Levels:	user-configurable
Persistence:	user-configurable to set, 3 times that value to clear
Fault Type:	user-configurable (Not Used, Alarm, or Shutdown)

Input Voltage Low

Indicates the input voltage either went below the configured Low Threshold for the configured low delay time or went below the configured Continuous Low Threshold for the configured continuous low delay time. For settings information see Input Voltage Low settings on Diagnostics screen in Chapter 7.

Fault Name: VBatLowFault
Permissive: Fault enabled
Failure Levels: user-configurable
Persistence (Low): user-configurable to set, 3 times that value to clear
Persistence (Continuous Low): user-configurable to set, 1/50 that value to clear
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Stop Commanded (Run/Stop)

Indicates the Run/Stop discrete input commanded a STOP by going to the false state (true=run, false=stop). When a stop is commanded, the actuator will go limp following the configured shutdown action when the shutdown action is to go 'Limp' or to 'Position then Limp'. If the shutdown action is 'Shutdown to Position', then a stop command will immediately go limp. When active, in addition to the run/stop indication, a common alarm or common shutdown will be provided. See 'Include Run Stop in Shutdown Indication' on Discrete Inputs Setup screen in Chapter 7.

This function is disabled when the Run/Stop Function's input is configured as Always Enabled.

Fault Name: RunStopFault
Permissive: Run/Stop input configured
Fault Type: Limp mode with user-configurable indication (Alarm or Shutdown)

Loss of Position Demand

Indicates all configured position demand signals are determined to be failed, both the primary and the backup (when used).

Fault Name: LossOfDemandFault
Permissive: Fault enabled
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Demand Tracking Error

Indicates that the difference between the primary and backup demand signals is not within the configured tolerances, exceeding the Tracking Error Threshold for longer than the Tracking Error Delay. For settings information see Tracking Error on General Setup screen in Chapter 7.

Fault Name: DemandTrackingFault
Permissive: Tracking error fault enabled and backup demand configured for use and neither demand has failed and DM13 message suppression is not in effect when CAN demand is used
Failure Levels: user-configurable
Persistence: user-configurable
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

The control will attempt to continue normal operation using the trusted input. The trusted input is configurable and is based on the 'Demand to Select on Track Error' selection.

Position Error

Indicates the position feedback is not following the position demand. Position Error detection logic is designed to account for normal actuator response times to prevent unwarranted position error indications during transient conditions. The filtered difference must exceed the error threshold. See Position Error Handling above and Position Error settings on the Diagnostics screen in Chapter 7.

Fault Name: PositionErrorFault
Permissive: Position control mode active and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable filter time constant
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Analog Demand High

Indicates the analog input went above the configured analog input high threshold for longer than the delay time. For settings information see Analog Signal Failure Levels on Analog I/O screen in Chapter 7.

Fault Name: AnalogDmdHighFault
Permissive: Analog demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm

Analog Demand Low

Indicates the analog input went below the configured analog input low threshold for longer than the delay time. For settings information see Analog Signal Failure Levels on Analog I/O screen in Chapter 7.

Fault Name: AnalogDmdLowFault
Permissive: Analog demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm

PWM Demand High

Indicates the PWM input duty cycle went above the configured PWM Duty Cycle High Threshold for longer than the delay time. For settings information see PWM Signal Failure Levels on PWM Setup screen in Chapter 7.

Fault Name: PwmDmdHighFault
Permissive: PWM demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm

PWM Demand Low

Indicates the PWM input duty cycle went below the configured PWM Duty Cycle Low Threshold for longer than the delay time. For settings information see PWM Signal Failure Levels on PWM Setup screen in Chapter 7.

Fault Name: PwmDmdLowFault
Permissive: PWM demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm

PWM Frequency High

Indicates the PWM input frequency went above the configured High Threshold for longer than the delay time. For settings information see PWM Signal Failure Levels on PWM Setup screen in Chapter 7.

Fault Name: PwmFreqHighFault
Permissive: PWM demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): user-configurable (Not Used or Alarm; Shutdown is coerced to Alarm)

PWM Frequency Low
Indicates the PWM input frequency went below the configured Low Threshold for longer than the delay time. For settings information see PWM Signal Failure Levels on PWM Setup screen in Chapter 7.

Fault Name: PwmFreqLowFault
Permissive: PWM demand configured for use and fault enabled
Failure Levels: user-configurable
Persistence: user-configurable to set, 3 times that value to clear
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): user-configurable (Not Used or Alarm; Shutdown is coerced to Alarm)

CAN Demand No Signal Fault
This fault is set if the CAN demand is missing for longer than the CAN Signal Failure Delay setting, or if the demand message reception rate falls below the configured Min Update Rate, or if the demand value received is in the "Error" or "Not Supported" range of 64256 to 65535 (FB00h to FFFFh). When the No Signal fault is active, the CAN position demand signal will remain at the last commanded value. A Loss of Position Demand fault can be configured to shut down the actuator when all demand signals are failed.

Fault Name: CanNoSignalFault
Permissive: CAN demand configured for use and fault enabled
Failure Levels: user-configurable (see CAN Demand failure settings in Chapter 7)
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm

CAN Stop Commanded (Run/Stop)
Indicates a STOP command received over CAN. When a stop is commanded, the actuator will go limp following the configured shutdown action when the shutdown action is to go 'Limp' or to 'Position then Limp'. If the shutdown action is 'Shutdown to Position', then a stop command will immediately go limp. When active, in addition to the run/stop indication, a common alarm or common shutdown will be provided. See 'Include Run Stop in Shutdown Indication' on Discrete Inputs Setup screen in Chapter 7.

This function is only available with CAN Demand configured and P-Series Legacy mode selected (See P-Series Legacy information in Chapter 5).

Fault Name: CanRunStopFault
Permissive: CAN demand configured for use and P-Series Legacy mode configured
Fault Type: Limp mode with user-configurable indication (Alarm or Shutdown)

CAN Bus Error
Indicates the CAN bus controller detects a bus error passive condition. This condition can occur if no other devices are on the bus communicating, if the CAN bus is disconnected, shorted, improperly terminated, the baud rate is incorrect, or if bit error rates are high enough to cause hardware failures. Typically caused by wiring problems on the CAN link, incorrect or missing termination resistors, or electrical problems within the controller or driver.

Fault Name: CanBusFault
Permissive: CAN demand configured for use and fault enabled
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm
Note: The CAN position demand signal will remain at last value when this fault is active, regardless of the fault type setting. If this fault goes away and non-latching faults are configured, CAN will return to normal operation.

J1939 Address Claim Error

This J1939 fault is set if the control's address cannot be claimed on the CAN bus. Typically a result of another device on the bus with the same source address.

Fault Name: J1939AddrClaimFault
Permissive: CAN demand configured for use, J1939 protocol selected and fault enabled
Fault Type (single demand): user-configurable (Not Used, Alarm, or Shutdown)
Fault Type (redundant demands): Alarm
Note: The CAN position demand signal is forced to zero when this fault is active, regardless of the fault type setting. A re-try of address claim will occur if the device name settings are modified or if the device is power-cycled.

Stop Commanded (Run/Stop Discrete Input)

Indicates the run/stop discrete input is commanding a Stop. When a stop is commanded, the actuator will go limp following the configured shutdown action when the shutdown action is to go 'Limp' or to 'Position then Limp'. If the shutdown action is 'Shutdown to Position', then a stop command will immediately go limp. When active, in addition to the run/stop indication a common alarm or common shutdown will be provided. See 'Include Run Stop in Shutdown Indication' on Discrete Inputs Setup screen in Chapter 7.

Fault Name: RunStopIndication
Permissive: Run/Stop Discrete Input configured for use
Fault Type: user-configurable (Alarm or Shutdown)

Electronics Temperature High Alert

Indicates internal electronics temperature exceeded the high temperature threshold for longer than the delay time. For settings information see High Temperature Diagnostic settings on Diagnostics screen in Chapter 7.

Fault Name: ElecTempHighFault
Permissive: Fault enabled
Failure Levels: user-configurable (see High Temperature Diagnostic settings in Chapter 7)
Persistence: user-configurable to set, 3 times that value to clear
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Torque Derating Active

This indicates the internally sensed temperature of the ProAct Gen3 has exceeded the torque de-rating limit and the maximum drive current allowed has been decreased (see the temperature-based current limiting in Chapter 4). Maximum drive current operation will resume when this condition clears. Setting the fault type to Not Used is not recommended for most applications, as the self-protection provided by torque derating is then disabled.

Fault Name: TorqueDerateFault
Permissive: Fault enabled
Failure Levels: > 100 °C
Persistence: 5 sec on delay, 5 sec off delay
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Zero Torque Fault

This indicates the internally sensed temperature of the ProAct Gen3 has exceeded 140 °C and the actuator torque is reduced to zero (see temperature self-protection). This is a hard-coded unlatched shutdown, but only when torque derating is used. The control will go limp if this condition is detected. Operation will resume when condition clears (< 140 °C for 5 seconds), using limited current until temperature drops below the torque de-rating limit.

Fault Name: ZeroTorqueFault
Permissive: Torque Derating fault is enabled
Failure Levels: > 140 °C
Persistence: 5 sec on delay, 5 sec off delay
Fault Type: Shutdown (limp)

⚠WARNING

Sudden Movement

The controller protects the internal electronics by going to limp mode "zero torque" when the internal temperature exceeds 140 °C. When this happens, the position of the output shaft is not controlled by the actuator. When the internal temperature of the ProAct Gen3 returns to below 140 °C, there may be a sudden movement to the latest command position.

Temperature Sensor Fault
Indicates the internal electronics temperature signal is faulty. Two internal temperature sensors are used. This fault indicates that both signals are out of range (<-45C or >140 °C) and they have gone out of range in the opposite direction (one high and one low). When this fault is active, the used temperature will default to 25 °C.

Fault Name: TemperatureSensorFault
Permissive: Fault enabled
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Position Sensor Failed (Internal Fault Shutdown condition)
An internal diagnostic check has determined the actuator position sensor has failed. This is a critical hard-coded latched shutdown as the actuator cannot perform its primary function without this signal. This fault always latches and requires a reset command or power cycle to clear.

Fault Name: PositionSensorFault
Permissive: TemperatureSensorFault is not active
Persistence: 10 ms to set
Fault Type: If Shutdown mode is not SD to Position, then the motor current goes to zero (limp shutdown); otherwise current is applied to the motor to cause it to move to the internal min hard stop (Shutdown position is < 50%) or the internal max hard stop (Shutdown Position is > 50%). See Shutdown Mode description in the General Setup page section of Chapter 7.

NV Memory Fail (Internal Fault Shutdown condition)
Indicates that there is a problem with the data read from internal non-volatile memory. This may also set when a new software version is loaded into the unit. This is a hard-coded latched shutdown. The control will go limp if this condition is detected. This fault always latches and requires a reset command or power cycle to clear.

Fault Name: NvMemoryFault
Fault Type: Shutdown (limp)

Internal Voltage Fault (Internal Fault condition)
Indicates an out of range value on an internally monitored voltage (e.g. 3.3V, 5V, 12V). While this fault is present, the PWM (low-side mode only) input accuracy may be affected, the analog output may not be able to deliver full current, and positioning accuracy and/or stability could be degraded. A persistent Internal Voltage Fault condition indicates an internal problem with the actuator that could lead to eventual loss of primary function. The actuator should be returned for service at the customer's earliest convenience. This fault always latches and requires a reset command or power cycle to clear.

Fault Name: InternalVoltageFault
Permissive: Fault enabled
Persistence: 50 ms to set
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Watchdog Reset Fault (Internal Fault condition)
Indicates that an abnormal processor reset condition has occurred. This fault always latches and requires a reset command or power cycle to clear.

Fault Name: WatchdogResetFault
Permissive: Fault enabled
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

Power Up Reset
Indicates a power up condition has occurred.

Fault Name: PowerUpReset
Permissive: Fault enabled
Fault Type: user-configurable (Not Used, Alarm, or Shutdown)

CAN Communications

The ProAct Gen3 supports J1939 communications on CAN port 1. Bit timing is 250 kbits/s by default, but configurable as 125 k, 250 k, 500 k, and 1 M bits/s. CAN communications can be used for monitoring only or for monitoring and control or it can be turned off completely. Diagnostic faults are provided to annunciate a Bus error passive fault condition as well as for J1939 address claim (cannot claim). The CAN demand input is monitored and a CAN demand fault is provided when the input is missing, invalid, or sent too slowly.

Harness coding is provided to facilitate multiple ProAct Gen3 units on a common bus. The CAN ID Low and High discrete inputs select the ProAct Unit number (1-4) at power up. For details, see CAN ID inputs in Chapter 3 and Harness Coding in Chapter 5.

CAN port 1 or CAN port 2 can be used to communicate with the Service Tool. If CAN port 1 is used for control or monitoring and is heavily loaded, it is recommended to use CAN port 2 for the Service Tool to prevent overloading the bus. The bit rate of CAN port 2 is fixed at 1 M bits/s. The Service Tool communications use XCP protocol, which has an identifier format that is compatible with ISO15765 and SAE J1939.

Chapter 5
J1939 Protocol

Overview

The ProAct Gen3 Actuator supports CAN communications in the SAE J1939 Higher Layer Protocol format. Further detailed information regarding the J1939 Standards Collection can be purchased at www.sae.org. Information about CAN is included in ISO 11898. Specific information regarding actuator behavior is detailed below.

All ProAct Gen3 J1939 messages use the CAN 2.0B 29-bit Extended Data Frame Format.

The software provides four legacy mode options for backwards compatibility with existing products:
ProAct Legacy - Messages are the same as in the ProAct Gen 2 product.
P-Series Legacy - Messages are the same as in the P-Series and P-Series FL (Flex) product.
P-Series PISC - Messages are the same as in the P-Series and P-Series FL (Flex) product when it is configured for its “Legacy Message Mode”, which provides messages that are similar to, but not identical to, the ProAct Gen 2 product.
Digital Plus - Messages are the same as in the ProAct Digital Plus product.

An optional heart beat message is available in any mode. Details on each message are provided below.

Harness Coding

The ProAct Gen3 has the optional capability to provide four different J1939 messaging schemes within a single device through a harness code selection. Two discrete inputs, typically hard-wired within the wiring harness, are used for this selection. This provides the ability to have up to four different actuators on an engine, each performing different functions, all within a single part number.

When configured for use, the ProAct Gen3 provides 4 possible source addresses that are set through harness coding based on the state of the configured Discrete Inputs (CAN ID High and CAN ID Low). The source address is determined on power-up when the discrete inputs are initially read. If ProAct Legacy, P-Series PISC, or Digital Plus modes are configured, the Source Addresses are 19, 20, 21, and 22, otherwise they are set to the user-configured value. The active unit number and claimed source address can be viewed in the Overview screen of the Service Tool. See Chapter 6 for Service Tool details.

Table 5-1. Source Address by Harness Code

Unit #	CAN ID High	CAN ID Low	Source Address (P-Series Legacy)	Source Address (ProAct Legacy, P-Series PISC, Digital Plus)
1	Off	Off	Configurable	19 (13h)
2	Off	On	Configurable	20 (14h)
3	On	Off	Configurable	21 (15h)
4	On	On	Configurable	22 (16h)

CAN Messages Overview

The following information will be sent via CAN:
- Actual Valve Position
- Desired Valve Position
- Internal Electronics Temperature*
- Diagnostics (Alarms and Shutdowns)
- Heart Beat Counter (optional)

The following information will be sent via CAN upon request:
- Software Version Number (SOFT)
- ECU Identification information (ECUID)
- Address Claimed (ACL)

The ProAct Gen3 controller receives the following information via CAN:
- Position Demand
- Stop command*
- Reset command*
- Reset Stored faults command*
- DM13

(*) Only available in certain modes

ProAct Legacy, P-Series PISC, and Digital Plus Modes

ProAct Legacy, P-Series PISC, and Digital Plus modes support a 32-bit position command, which can be optionally received (if CAN Demand is configured), and two transmitted data messages. Note: For the outgoing diagnostic data message, there are differences in the data between these three modes. The messages below apply when either of the three modes are selected. The source address is fixed as 19, 20, 21, or 22 based on the CAN ID selected unit number (1-4) as described in Table 5-1.

Command Message (Rx)

This message is received by the actuator when CAN position command is used:

Transmission rate:	receipt checked every 1 ms (set the message timeout to an appropriate value)
Data length:	4 bytes
Data page:	0
PDU format:	255
PDU specific:	22, 23, 24, 25—for unit number 1-4
Suggested priority:	1 (high)
PGN:	65302 (0xFF16), 65303 (0xFF17), 65304 (0xFF18), 65305 (0xFF19)—for unit number 1-4

Data:

Bytes 1-4: Position command

Data length: 4 bytes
Resolution: 2.56E-8 %/bit, -5 offset (note: 2.56e-8 ≈ $110/2^{32}$)
Range: (–5 to +105) % (scaled from 0x00 to 0xFFFFFFFF)

Note: The position demand setpoint is limited internally between 0 % and 100 %.

Data Message (Tx)

This message is available when the J1939 protocol is active.

Transmission rate:	100 ms
Data length:	8 bytes
Data Page:	0
PDU format:	255 (0xFF)
PDU specific:	251 (0xFB)
Default priority:	7
PGN:	65531 (0x00FFFB)

Data:

Byte 1: Actual Valve Position

Data length:	1 byte
Resolution:	1 / 2.55 %/bit, 0 offset
Range:	(0 to 100) % (0x00 to 0xFF)

Error Indicator not used.

Byte 2: Desired Valve Position

Data length:	1 byte
Resolution:	1 / 2.55 %/bit, 0 offset
Range:	(0 to 100) % (0x00 to 0xFF)

Error Indicator not used.

Byte 3-8: Not Used (sent as 0xFF in each byte)

Diagnostics Message (Tx)

This message is available when the J1939 protocol is active.

Transmission rate:	100 ms when configured as P-Series Legacy or P-Series PISC; otherwise 1 s
Data length:	8 bytes
Data Page:	0
PDU format:	255 (0xFF)
PDU specific:	16 (0x10)
Default priority:	6
PGN:	65296 (0x00FF10)

Bit code legend

The following diagnostics status codes will be transmitted.

Bit code	Description
00	Inactive
01	Active
10	Reserved
11	Not Available

Bit position in a byte is “8 7 6 5 4 3 2 1”
Bit position 1 is the least significant bit.
Example: Bit position 3 is “1” and all others bits are “0”, byte value is 4.

Data:

The message data depends on the message mode that has been configured. See the description for Message Mode in the J1939 Setup Page section of chapter 7.

Data for the **ProAct Legacy** message mode

Byte 1:
- Bits 1-2: Stop commanded (Run/Stop)
- Bits 3-4: CAN Position Demand Failure
- Bits 5-6: Internal Fault[1]
- Bits 7-8: Not used, set to Inactive code

Byte 2:
- Bits 1-2: Not used, set to Inactive code
- Bits 3-4: Not used, set to Inactive code
- Bits 5-6: General Alarm indication
- Bits 7-8: General Shutdown indication

Byte 3:
- Not Used (sent as 0xFF in each byte)

Byte 4:
- Not Used (sent as 0xFF in each byte)

Byte 5:
- Bits 1-2: Position Error
- Bits 3-4: High Temp Alarm or Temperature Sensor Failure
- Bits 5-6: Not used, set to Inactive code
- Bits 7-8: 24 V Supply High

Byte 6:
- Bits 1-2: 24 V Supply Low
- Bits 3-4: Not used, set to Inactive code
- Bits 5-6: Power up reset
- Bits 7-8: Not used, set to Not Available code

Byte 7:
- Not Used (sent as 0xFF in each byte)

Byte 8:
- Not Used (sent as 0xFF in each byte)

[1] Internal Fault includes Nonvolatile Memory Failure, Internal Voltage Faults, Watchdog Reset, Position Sensor Error

Data for the **P-Series PISC** message mode

Byte 1:
- Bits 1-2: Stop commanded (Run/Stop)
- Bits 3-4: CAN Position Demand Failure
- Bits 5-6: Internal Fault[2]
- Bits 7-8: Analog Position Demand Failure

Byte 2:
- Bits 1-2: PWM Position Demand Failure
- Bits 3-4: Not used, set to Not Available code
- Bits 5-6: General Alarm indication
- Bits 7-8: General Shutdown indication

Byte 3:
- Not Used (sent as 0xFF in each byte)

Byte 4:
- Not Used (sent as 0xFF in each byte)

Byte 5:
- Bits 1-2: Position Error
- Bits 3-4: Temperature Sensor Failure
- Bits 5-6: Not used, set to Not Available code
- Bits 7-8: 24 V Supply Out of Range (High or Low)

Byte 6:
- Bits 1-2: 24 V Supply Out of Range (High or Low)
- Bits 3-4: Temperature Sensor Failure
- Bits 5-6: Power up reset
- Bits 7-8: Temperature > 100 deg C (derated)

Byte 7:
- Bits 1-2: Temperature >140 deg C (no torque)
- Bits 3-8: Not used, set to Not Available code

Byte 8:
- Not Used (sent as 0xFF in each byte)

[2] Internal Fault includes Nonvolatile Memory Failure, Internal Voltage Faults, Watchdog Reset, Position Sensor Error

Data for the **ProAct Digital Plus** message mode

Byte 1:

Bits 1-2: Stop commanded (Run/Stop)
Bits 3-4: Position Demand Failure
Bits 5-6: Internal Failure[3]
Bits 7-8: Internal Fault[4]

Byte 2:

Bits 1-2: Primary Demand Failure
Bits 3-4: Backup Demand Failure
Bits 5-6: Not used, set to Not Available code
Bits 7-8: Not used, set to Not Available code

Byte 3:

Not Used (sent as 0xFF in each byte)

Byte 4:

Not Used (sent as 0xFF in each byte)

Byte 5:

Bits 1-2: Position Error
Bits 3-4: High Temperature Alert
Bits 5-6: Temperature > 100 deg C (derated)
Bits 7-8: 24 V Supply Out of Range High

Byte 6:

Bits 1-2: 24 V Supply Out of Range Low
Bits 3-4: Not used, set to Not Available code
Bits 5-6: Not used, set to Not Available code
Bits 7-8: Not used, set to Not Available code

Byte 7:

Not Used (sent as 0xFF in each byte)

Byte 8:

Not Used (sent as 0xFF in each byte)

[3] Includes position sensor, watchdog reset
[4] Includes NV memory, temperature sensor, internal voltage, watchdog reset

Note: All units report using the same PGN when set to ProAct Legacy, P-Series PISC, or Digital Plus modes. If more than one unit is present on the same CAN network, the receiving ECU must use source address filtering to identify which actuator transmitted the message.

P-Series Legacy Mode

The messages below apply when the P-Series Legacy Mode is selected.

Command Message (Rx)

This message is received by the actuator when CAN position command is used:

Rate:	receipt checked every 1 ms (set the message timeout to an appropriate value)
Data length:	8 bytes
Data page:	0
PDU format:	configurable PGN
PDU specific:	configurable PGN
Suggested priority:	1 (high)
PGN:	4 configurable PGNs provided, one for each unit number

Data:

Bytes 1-2: Position command

Data length:	2 bytes
Resolution:	0.0025 %/bit, 0 offset
Range:	(0 to 160.6375) % (0x00 to 0xFAFF)

Note: The position demand setpoint is limited internally between 0 % and 100 %.
Values between 100 % (0x9C40) and 160.6375 % (0xFAFF) will be limited to 100 % and continue to use the position demand as 100 %. However, above 0xFAFF, a CAN Demand Failed Signal (out-of-range) will be annunciated by the actuator.

Byte 3: Command bits

Data length: 1 byte

Bits 1-2: Reset Active Diagnostics
- 00 No action
- 01 Reset action *
- 10 Reserved
- 11 Not supported

Bits 3-4: Clear Stored Diagnostics
- 00 No action
- 01 Reset action *
- 10 Reserved
- 11 Not supported

Bits 5-6: Operation Control (Run/Stop)
- 00 No action
- 01 Shutdown
- 10 Reserved
- 11 Not supported

Bits 7-8: RESERVED/NOT USED

* A reset action must be preceded by a no action command ('00') or the actuator will not perform the requested action - the bits cannot remain in a '01' state. The reset action occurs only upon the transition from 00 to 01.

Bytes 4-8: RESERVED/NOT USED (Send as 0xFF in each byte)

Data Message (Tx)

This message is available when the J1939 protocol is active.

Transmission rate: 100 ms
Data length: 8 bytes
Data Page: 0
PDU format: configurable PGN
PDU specific: configurable PGN
Default priority: 6
PGN: 4 configurable PGNs provided, one for each unit number

Data:

Byte 1: Actual Valve Position

Data length: 1 byte
Resolution: 0.4 %/bit, 0 offset
Range: (0 to 100) % (0x00 to 0xFA)
Error Indicator set (0xFE) if position sensor is failed.

Byte 2: Desired Valve Position

Data length: 1 byte
Resolution: 0.4 %/bit, 0 offset
Range: (0 to 100) % (0x00 to 0xFA)
Error Indicator set (0xFE) if all position demands are failed.

Byte 3: Electronics Temperature

Data length: 1 byte
Resolution: 1 °C/bit gain, -40 °C offset
(Subtract 40 from received value to recover °C value)
Range: -40 to +210 °C (0x00 to 0xFA)
Error Indicator set (0xFE) if temperature sensor is failed.

Byte 4: Status Bits

Data length: 1 byte
Bits 1-4: Operation Status (see definition below)
Bits 5-7: Control Mode (see definition below)
Bit 8: Discrete Output ON indication (0=off, 1=on)

Operation Status

0000 Normal
0001 Alarm
0010 Position Error Fault or Loss of Demand Fault
0011 Derate active or Temperature Sensor Fault
0100 Controlled Shutdown active *(Driving to the default position—usually this means closed)*
0101 Uncontrolled Shutdown active *(Actuator is limp)*
0110-1101 Reserved for future assignment
1110 Error
1111 Not available

Control Mode

000 Primary Demand in Control
001 Primary Demand in Control, Backup Failed
010 Backup Demand in Control, Primary Failed
011 All Demand Signals Failed, actuator in default position
100 Primary Demand enabled but inactive, delay from backup control
101 Reserved for future assignment
110 Error
111 Not available

Byte 5: Active Diagnostic Indications 1

Data length: 1 byte
Bit 1: Internal Fault Trip[1]
Bit 2: Stop commanded (Run/Stop discrete in)
Bit 3: Input (Supply) Voltage Fault
Bit 4: Position Error
Bit 5: Temperature Sensor Fault
Bit 6: Torque Derating Active (high temperature)
Bit 7: Zero Torque Indication (extremely high temperature)
Bit 8: Not Used (always reports 0)

Byte 6: Active Diagnostic Indications 2

Data length: 1 byte
Bit 1: Not Used (always reports 0)
Bit 2: Loss of Position Demand
Bit 3: Demand Tracking Fault
Bit 4: Analog Position Demand Failed
Bit 5: PWM Position Demand Failed
Bit 6: CAN Position Demand Failed
Bit 7: CAN Fault (CAN Bus Fault, J1939 Address Claim Error)
Bit 8: CAN Stop Command

Byte 7: Stored Diagnostic Indications 1 (same format as byte 5)

Byte 8: Stored Diagnostic Indications 2 (same format as byte 6)

FOOTNOTES

[1] Internal Fault Trip includes: NV Memory Fault, Position Sensor Fault, Internal Voltage Fault, Watchdog Reset Fault.

Additional Messages

This section identifies the additional messages that are supported in all modes when J1939 is used. These include: Heartbeat, ACL, SOFT, ECUID, ACK, RQST and DM13.

PGN 65311 Heart Beat Counter

The message can be optionally enabled. When enabled, the actuator transmits a continuously updated counter value available for monitoring.

Transmission rate:	100 ms
Data length:	2 bytes
Data Page:	0
Resolution:	1 count/bit, 0 offset
Range:	0 to 64255 counts (0x00 – 0xFAFF)
PDU format:	255
PDU specific:	31
Default priority:	6
PGN:	65311 (0x00FF1F)

Data:
Byte 1-2: Heart Beat Count
Byte 3-8: Reserved

The heart beat counter value will count up continuously every 100ms, rolling over to zero after 64255 (0xFAFF). Values above 64255 are not used, to be compatible with the J1939 specification. If disabled, the counter will restart at 0.

PGN 57088 CAN Start/Stop Broadcast (DM13)

The message can be optionally enabled. It provides the ability to turn off CAN message broadcasts in the actuator, allowing a temporary (timed) stoppage of transmitted messages to minimize network traffic. This feature is referred to as DM13 in the J1939 specification (see J1939-73).

The actuator will respond to DM13 directed to either our specific node (our source address) or globally (0xFF). The following is a summary of the Start/Stop broadcast implementation. If DM13 commands a Stop, then the actuator will stop sending all broadcast messages for 6 seconds. During this time, if a Start is received (on byte 1.7) then message transmission will resume; if a Hold is received (on byte 4.5) then the 6 second timer is restarted. When the timer expires, or if power is cycled on the device, broadcasted messages will be restarted.

The actuator only monitors the ‘Current Data Link’ bits of DM13 (bits 7-8 in byte 1) for Start/Stop commands and support for the DM13 ‘Suspend’ feature is not provided. A 'Start' command is a value of 01 on bits 7-8 of byte 1, a 'Stop' command is a value of 00 on bits 7-8 of byte 1, and a 'Hold' command is a value of 0000 or 0001 on bits 5-8 of byte 4.

While a DM13 commanded 'stop' is active, the CAN demand is internally set to zero and the CAN demand timeout fault is inhibited. To initiate a Stop, data in byte 4 must be 0xFF (Hold and Suspend Signals). When not in QUIET/Stop mode, Start and Hold commands are ignored.

DM13 Message

Transmission rate: As needed
Data length: 8 bytes
Data page: 0
PDU format: 223 (DF)
PDU specific: DA (responds to specific SA or global)
Default priority: 6
PGN: 57088 (0x00DF00)

Responds to DM13 directed to specific node (our SA) or globally (FF).

Data:

Byte 1:
Bits 1-2: (ignored)
Bits 3-4: (ignored)
Bits 5-6: (ignored)
Bits 7-8: **Current Data Link** (see bit code legend 1 below)
Byte 2: (ignored)
Byte 3: (ignored)
Byte 4:
Bits 1-4: Suspend Signal (not supported, must be 0xF)
Bits 5-8: **Hold Signal** (see bit code legend 2 below)
Byte 5-6: Suspend Duration (not supported)
Byte 7-8: SAE Reserved (not used)

Bit code legend 1

Bit Code	Description
00	Stop Broadcast
01	Start Broadcast
10	Reserved
11	Don't care/take no action

Bit code legend 2

Bit Code	Description
0000	All Devices
0001	Stopped Devices
0010-1110	Reserved
1111	Not available

PGN 60928 Address Claimed (ACL)

Address Claimed / Cannot Claim Message

Transmission rate: on start-up, on request, on NAME change, response to Address Claimed
Data length: 8 bytes
Data Page: 0
PDU format: 238
PDU specific: 255
Default priority: 6
PGN: 60928 (0x00EE00)

Bytes 1.1 - 3.5: (21 bits) Identity Number, SPN 2837
Bytes 3.6 - 4.8: (11 bits) Manufacturer Code, SPN 2838
Byte 5.1: (3 bits) ECU Instance, SPN 2840
Byte 5.4: (5 bits) Function Instance, SPN 2839
Byte 6.1: (8 bits) Function, SPN 2841
Byte 7.1: (1 bit) Reserved
Byte 7.2: (7 bits) Vehicle System, SPN 2842
Byte 8.1: (4 bits) Vehicle System Instance, SPN 2843
Byte 8.5: (3 bits) Industry Group, SPN 2846
Byte 8.8: (1 bit) Arbitrary Address Capable, SPN 2844

A byte.bit format is used above. Byte is a value from 1-8, corresponding to the byte number within the message. Bit is a value from 1-8, where bit 1 is the least significant bit within a byte, bit 8 is the most significant bit within a byte. For example, a 4-bit data field with a start bit of 2.5 would occupy the most significant 4 bits of byte 2 within the CAN message.

The Address Claimed message will be sent out shortly after power has been applied to the actuator. The Address Claimed message will also be sent out in response to a Request for Address Claimed. The Request for Address Claimed can be sent to a specific Address or to the Global Destination Address, 255. The actuator will respond to a specific query, or one to the Global Destination Address, 255.

The Source Address for the actuator is configurable uniquely for each Unit Number using the Service Tool. The actuator will only try to claim the configured address. If a higher priority device claims the configured address, the actuator will stop communicating as defined per SAE J1939.

The Address Claimed Message will also be sent out if the actuator receives an Address Claimed message from the same Address as the receiving node and a lower priority (higher value) NAME. The entire 8-byte value of the NAME is used for arbitration with the Arbitrary Address Capable Field as the Most Significant Bit.

The Cannot Claim Address message will be sent out if the actuator receives an Address Claimed message with the same Source Address as the receiving node and with a higher priority (lower value) NAME. The entire 8-byte value of the NAME is used for arbitration with the Arbitrary Address Capable Field as the Most Significant Bit. The Cannot Claim Address will also be sent out in response to a Request for Address Claimed if the address was unsuccessfully claimed.

The Cannot Claim Address message is identical to the Address Claimed message in all aspects except that the Source Address of the actuator is replaced with 254. The Cannot Claim Address message will be sent out with a 0–153 millisecond pseudo-random delay between the reception of the triggering message and the transmission of the Cannot Claim Address message.

If the actuator cannot claim an Address, a CAN Demand Failed status bit will be set and any position demand value from CAN will be forced to zero (this may cause a shutdown depending on fault action settings).

Table 5-2. J1939 NAME

Component	Setting	Value	Configurable?
Arbitrary Address Capable Field	Not Supported	0	No
Industry Group Field	Global	0	No
Vehicle System Instance Field	First Instance	0	No
Vehicle System Field	Non-specific system	0	No
Function Field	Unspecified	255	Yes
Function Instance Field	First	0	Yes
ECU Instance Field	Unit 1 Unit 2 Unit 3 Unit 4	0 1 2 3	Yes
Manufacturer Code Field	Woodward	153	No
Identity Number Field	Unique	Unique	No

See J1939-81 Section 4.1.1 for additional details on J1939 NAME.

PGN 59904 Request (RQST)

PGN Request Message. Sent by Engine Control (or Tool) to the actuator to obtain a PGN.

Transmission rate: As needed
Data length: 3 bytes
Data Page: 0
PDU format: 234
PDU specific: Actuator Source Address
Default priority: 6
PGN: 59904 (0x00EA00)

Bytes 1-3: (24 bits) Parameter Group Number requested, SPN 2540

As defined in SAE J1939-21, if the PGN to be requested is a PDU1 type (PDU format field < 240) then the lower byte of the PGN number (the PDU specific byte) shall be set to 0.

To request the Software ID PGN, use this request message with the data equal to 65242.

PGN 65242 Software Identification (SOFT)

Transmission rate: On Request
Data length: Variable
Data Page: 0
PDU format: 254
PDU specific: 218
Default priority: 6
PGN: 65242 (0x00FEDA)

Data:
Byte 1: Number of Software Identification Fields, SPN 965
Data length: 1 byte
Resolution: 1 /bit, 0 offset
Range: 0 to 250 (0x00 to 0xFA)
Actual value: 1 (will always report 1)
Bytes 2 - (N+1): Software Identification, SPN 234
Data length: up to 200 characters
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: Depending on current software version:
<SoftwarePartNumber><Revision>
for example, 10-005-081A

Byte (N+2): Delimiter, SPN 234
Data length: 1 byte
Resolution: ASCII, 0 offset
Range: 0 to 255 (0x00 to 0xFA)
Actual value: 42 (0x2A)
Character: *

PGN 64965 ECU Identification Information (ECUID) message

Transmission rate: On Request
Data length: Variable
Data Page: 0
PDU format: 253
PDU specific: 197
Default priority: 6
PGN: 64965 (0x00FDC5)

Data:

a: ECU Part Number, SPN 2901

Data length: variable, part number followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: Upper-level assembly part number. e.g. 8335-001_A

b: ECU Serial Number, SPN 2902

Data length: variable, serial number followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: Upper-level assembly serial number

c: ECU Location, SPN 2903

Data length: 5 bytes followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: 'unitX' where 'X' is the unit number based on the harness code (1-4)

d: ECU Type, SPN 2904

Data length: 3 bytes followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: 'POS' (80 79 83)

e: ECU Manufacturer Name, SPN 4304

Data length: 8 bytes followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: 'Woodward' (87 111 111 100 119 97 114 100)

f: ECU Hardware ID, SPN 6714

Data length: variable, part number followed by an "*" delimiter
Resolution: ASCII, 0 offset
Range: 0 to 255 per byte
Actual value: Electronics subassembly hardware part number (e.g. 3522-1057_A)

PGN 59392 Acknowledgment (ACK)

This message is sent by the actuator (as a NACK) as needed according to the protocol.

Transmission rate: As needed
Data length: 8 bytes
Data Page: 0
PDU format: 232
PDU specific: Destination Address
Default priority: 6
PGN: 59392 (0x00E800)

Data:

Byte 1: Control Byte

0: Positive Acknowledgement (Reset action was successful)
1: Negative Acknowledgement (Reset action unsuccessful or PGN not available)

Bytes 2-4: Group Function and Reserved

Not Used. Sent as 255.

Byte 5: Source Address of device being acknowledged (or NACK'd)
Bytes 6-8: PGN being acknowledged (or NACK'd)

See J1939-21 for further details on the data.

Chapter 6.
Service Tool

Introduction

This chapter covers the process of installing and servicing the control by using the ProAct Gen3 Service Tool. It is assumed that the control has already been installed on the engine. As you review the following features, keep in mind that most applications only require a few of the functions to be activated. The Service Tool will automatically hide features that are not activated.

An improperly calibrated control could cause an overspeed or other damage to the prime mover. To prevent possible serious injury from an overspeeding prime mover, read and follow this entire procedure before starting the prime mover.

IMPORTANT	**Many ProAct Gen3 actuators are delivered pre-configured and calibrated with OEM specific settings. These units do not require the use of the Service Tool. However, the Service Tool is a valuable troubleshooting aid.**

⚠WARNING	**An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.** **The ProAct Gen3 can be controlled remotely: make sure the area is clear before connecting tool.**

⚠WARNING **Sudden Movement**	**Stay clear of the actuator output shaft and all attachments as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.** **Stay clear of the actuator output shaft and all equipment that may be actuated by the Discrete or Analog Output, as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.** **All outputs are capable of changing states. Any outputs connected to the ProAct Gen3 can suddenly move with this change of state. Use caution when using the Service Tool.** **Entering manual modes and/or changing modes may change the state of device outputs. Stay clear of the actuator output shaft and all attachments. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Service Tool Description

The Service Tool software is used to configure, setup, and troubleshoot the ProAct Gen3 actuator. This chapter describes the installation and use of the Service Tool. It identifies the control parameters available for viewing. Detailed instructions for configuring and setting up the device for the customer-specific application is provided in Chapter 7.

The Service Tool software resides on a PC (personal computer) and communicates to the ProAct Gen3 control via a CAN connection. A USB-to-CAN converter is available for purchase from Woodward, part number 5404-1189. Additional details are provided in Chapter 3.

System Requirements

The following hardware is required to work with the ProAct Gen3 Service Tool:

- PC-compatible laptop or desktop computer
- Woodward Toolkit version 5.6.1 or newer
    - Microsoft Windows 10, 8.1, 8, 7, Vista SP1 or newer
    - Microsoft .NET Framework version 4.5.1
- 1 GHz CPU or faster x86 or x64 processor
- 1 GB of RAM
- Recommended screen resolution 1024 x 768 or higher
- USB Port, USB-to-CAN IXXAT or Kvaser CAN adapter and driver

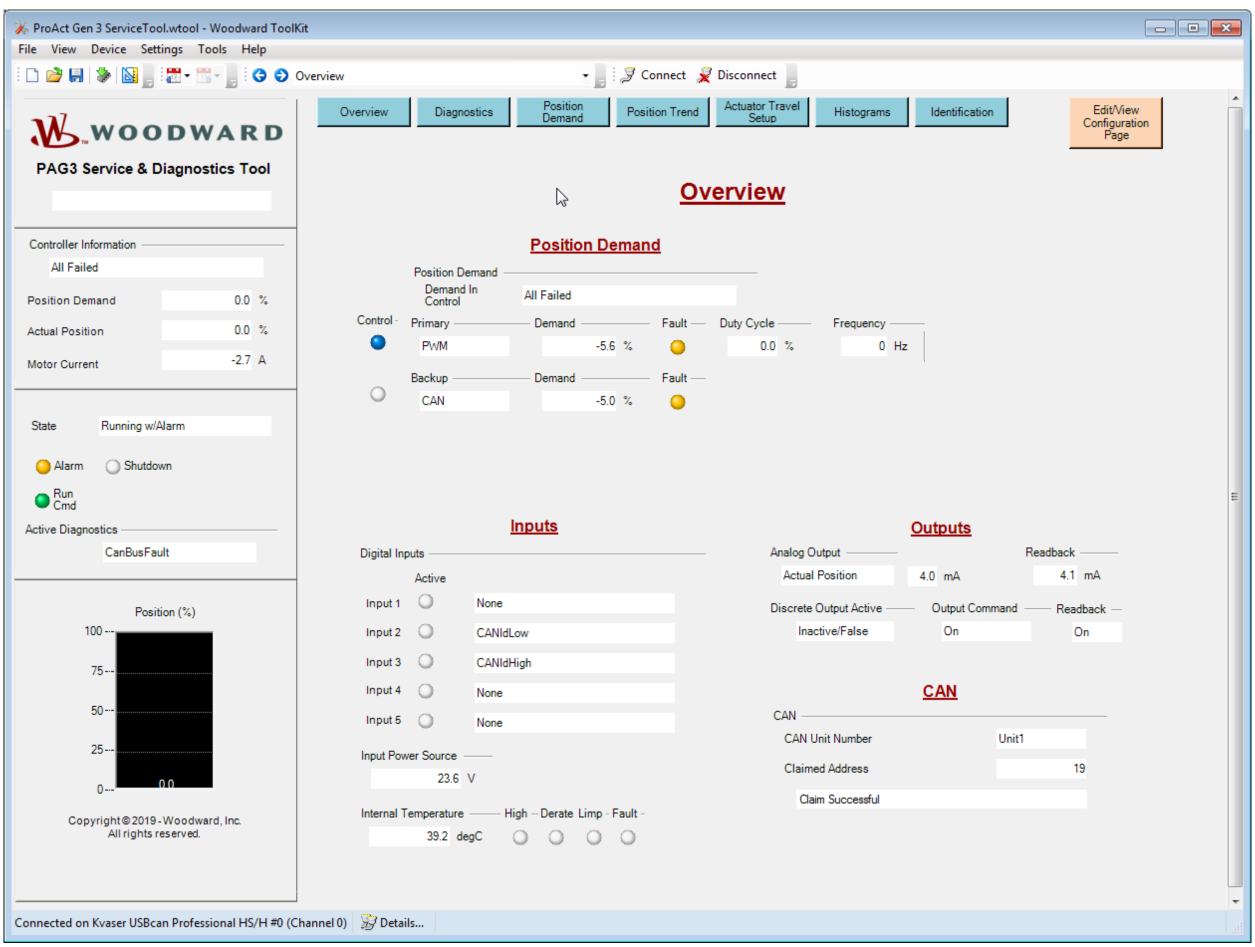


Figure 6-1. Example Service Tool Screen

Getting Started

Installation Procedure

The ProAct Gen3 Service Tool software can be downloaded and installed from the Woodward website (www.woodward.com/software). The Service Tool is based on Woodward Toolkit which is also available for download on the website. Woodward Toolkit version 5.6 or newer is required.

IMPORTANT	**The ProAct Gen3 Service Tool is a Windows-based installer and will automatically install or upgrade the Woodward ToolKit software if required.**

NOTICE **Service Tool Usage**	**If the CAN bus that is connected to CAN1 is already heavily loaded with other devices and traffic, it is advisable to use CAN2 for connection with the Service Tool to avoid overloading bus traffic. CAN bus traffic overload can lead to communication and functionality problems.**

Next Steps

After the software is installed, connect an approved USB-to-CAN interface to an unused USB port on the PC. The CAN connection on the ProAct Gen3 is supported on pins M and G (CAN1 Hi and Lo) or on pins T and Y (CAN2 Hi and Lo). See Chapter 3 for details. Power must be applied to the ProAct Gen3 control for the Service Tool to connect.

Run the appropriate Service Tool program and select an available communication port. Connect to the ProAct Gen3 control by clicking the connect button on the tool bar (see Figure 6-3). Communication settings must be properly set to allow communications between these devices. If the communication settings do not appear, click Tools, Options…, and un-check the "Always connect to my last selected network." option. The connection settings required are listed below. The CAN connection information is also provided on the Service Tool Home screen as a convenient reminder (see Figure 6-5). Two instance identifier command/response pairs are provided, either of which can be used for the Service Tool connection.

Network: choose an available network, the ProAct Gen3 requires CAN communication
Protocol: XCP
Baud Rate: 250k for CAN1*, 1000k for CAN2
Instance 1:
- Command: 188C22F1 (extended)
- Response: 188BF122 (extended)

Instance 2:
- Command: 1B8C22F1 (extended)
- Response: 1B8BF122 (extended)

IMPORTANT	***CAN1 data rate is configurable as 125k, 250k, 500k and 1000k. Baud rate selection must match device configuration. AutoDetection should not be used as it is not applicable. CAN2 data rate is fixed at 1000k and is a suggested 'backdoor' option if unsuccessful with CAN1 connection attempts.**

Future connections can automatically use these same settings, if desired, by selecting the 'Always connect to my last selected network'.

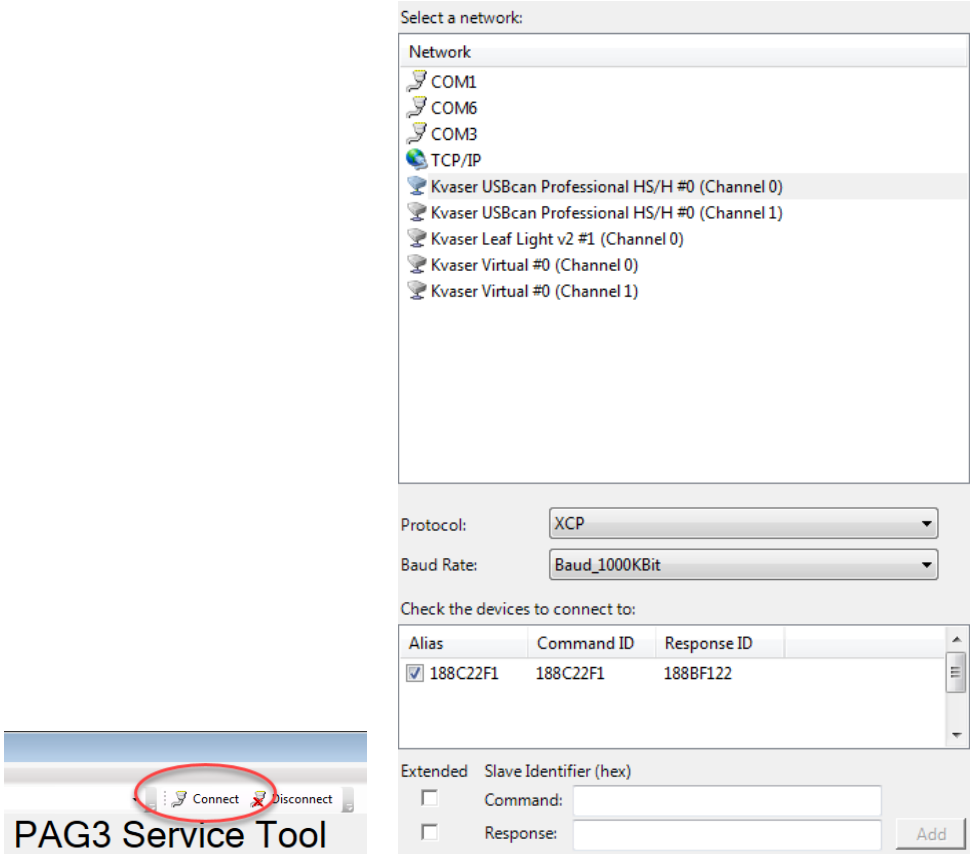


Figure 6-2. Connection Settings

Once connected to the control, the screen view will populate with current values and the status bar will display 'Connected on …' (lower left corner of tool).

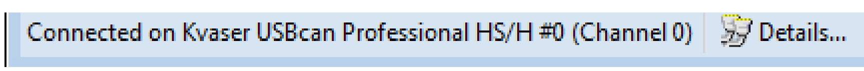


Figure 6-3. Connected Status Indication

The Application firmware version can be verified by clicking on the Details button on the bottom of the screen. The Application Id is the firmware version of the connected device. This window is closed by clicking on the Details button again.

Refer to the troubleshooting section if the connection status remains at Connecting, and a connection with the device cannot be established.

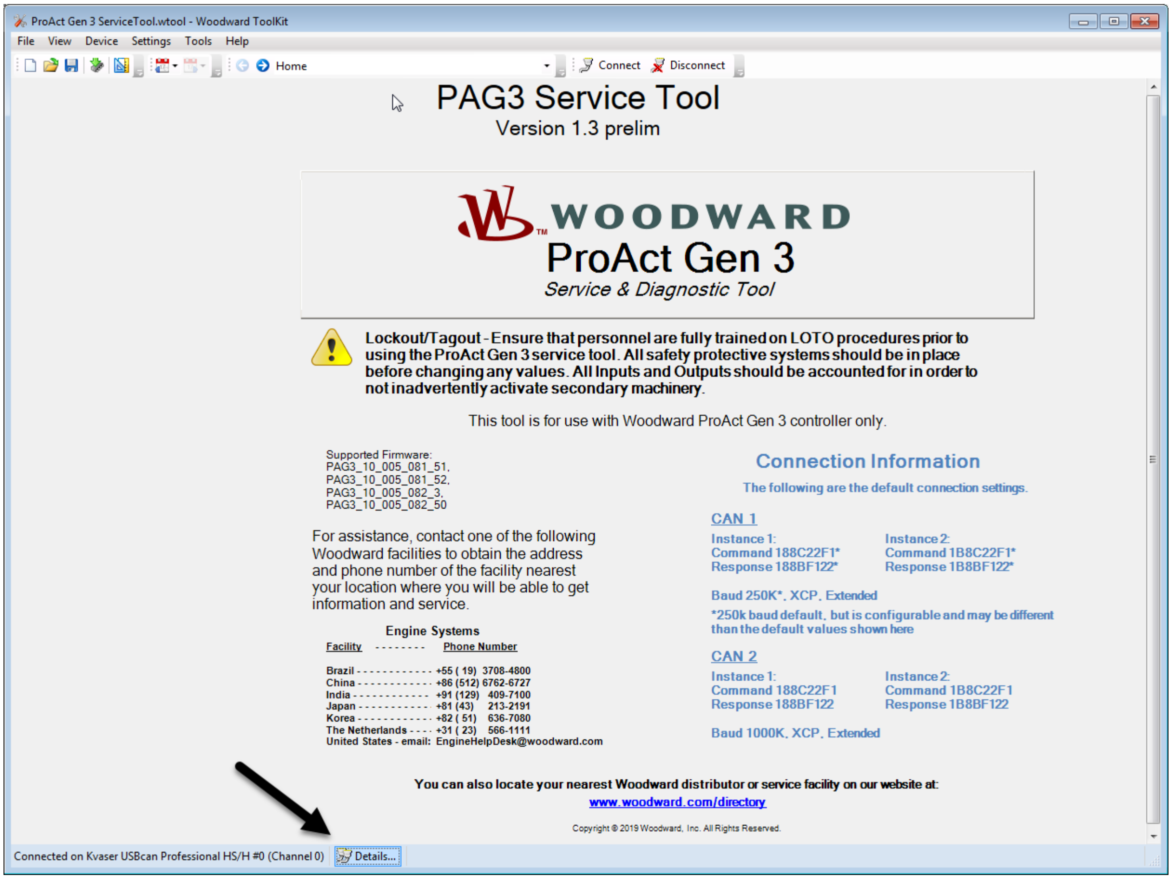


Figure 6-4. Communications Window

The following window appears if the Service Tool cannot find the correct service interface definition (SID) file to communicate with the device. If this occurs, the device is not compatible with the Service Tool version. The latest versions can be downloaded at www.woodward.com.

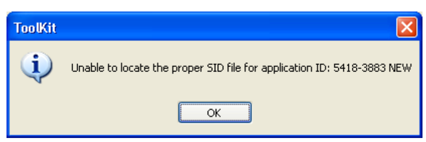


Figure 6-5. Improper SID Window

Service Tool Security

There are no password security levels provided by the ProAct Gen3 Service Tool.

Monitoring and Troubleshooting the Actuator

The Service Tool has the following screens for monitoring and troubleshooting the actuator:

- Overview (Figure 6-8)
- Diagnostics (Figure 6-10)
- Position Demand (Figure 6-12)
- Position Trend (Figure 6-13)
- Actuator Travel/Setup (Figures 6-22,23,24)
- Histograms (Figure 6-25)
- Identification (Figure 6-26)

Screen Navigation

Service Tool screens can be selected for viewing in a variety of ways:

- Pull Down Box on the tool bar
- Next/Previous Page buttons on the tool bar
- Page Up/Page Down keyboard keys.
- Navigation buttons

Dashboard

The Dashboard provides a section of information to be displayed on the left-hand side of all normal operating pages. This section provides common device information and quick navigation to specific screens.

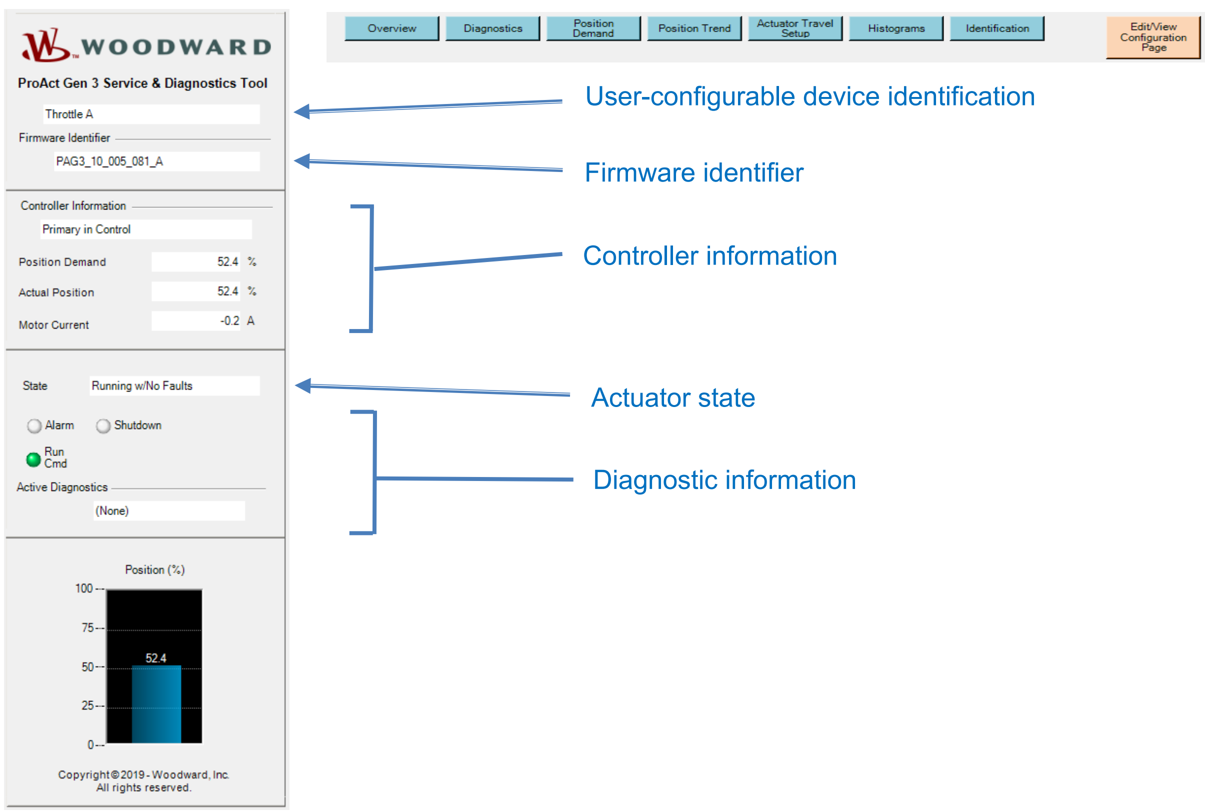


Figure 6-6. Dashboard Section

Indications provided in the dashboard section

Device Identification

Displays the identification data for the device as configured by the user (Device Identifying Name).

Controller Information

Displays the controller demand status. The configured primary and backup demand sources (CAN, Analog, PWM) are displayed on the Overview screen.

Table 6-1. Demand In Control Indication

Indication	Meaning
Primary in Control	The primary demand is in control of the position setpoint.
Primary Control/Backup Failed	The primary demand is in control and the backup demand is failed.
Primary Control/Backup Not Tracking	The primary demand is in control and the backup demand is okay but not tracking the primary demand within the tracking error limits.
Backup Control/Primary Failed	The backup demand is in control and the primary demand is failed.
Backup Control/Primary Not Tracking	Backup demand is in control and the primary demand is okay but not tracking the backup demand within the tracking error limits.
Backup Control/Failback is Inhibited	Backup demand is in control and the primary demand is okay but not within the failback limits.
Backup Control/Failback Pending	Backup demand is in control and the primary demand is okay. This mode occurs during the failback transition time.
All Failed	Indicates both the primary and the backup demands are failed.

Position Demand
Displayed value of the active Position Demand Setpoint in percent.

Actual Position
Displayed value of the Actual Position in percent.

Motor Current
Displayed value of the current commanded to the actuator motor in amps.

State
Displays the overall status of the unit. See Table 6-2 below.

Table 6-2. State Indication

Indication	Meaning
Running w/No Faults	No faults are detected.
Running w/Alarm	An alarm is active.
Stopped (Run/Stop)	A STOP is commanded using the Run/Stop feature.
Shutdown to Position	The device is in shutdown condition, positioning at the configured shutdown position.
Shutdown to Position (timed)	The device is in shutdown condition, positioning at the configured shutdown position. It will maintain this mode until the configured delay time expires at which time it will go to the limp mode. This is displayed when the configured shutdown mode is 'shutdown to position then limp'.
Shutdown Limp	The device is in shutdown condition, the shaft output is limp (no drive current).
Test/Setup Mode	Indicates the unit is in a test or setup mode instead of following the position command, such as when the user is manually controlling the actuator motor to configure the travel range.

Diagnostic Information

Alarm LED
Indicates an active alarm condition when illuminated (orange).

Shutdown LED
Indicates an active shutdown condition when illuminated (red). The dashboard's Active Diagnostics box will display all active faults. Additional details are provided on the Diagnostics screen.

Run/Stop LED
When the Run/Stop (Run Enable) function is used, illuminates red when in the Stop state and green when in the Run state.

Motor is Turned Off LED
Appears when the driver output is turned off. This is typically when in manual (test) mode and the mode is set to 'disabled'. It can also indicate an internal fault shutdown (limp) is active.

Test Mode LED
Appears when the driver is in manual control mode (red).

Active Diagnostics
The window displays all active faults in a scrolling manner, meaning it displays each active fault and repeats continuously. Displays '(None)' when no faults are active. Select the Diagnostics screen to see additional details.

Overview Screen

To view general ProAct Gen3 control parameters, go to the Overview screen. Content on this screen is auto-generated, based on the configured features.

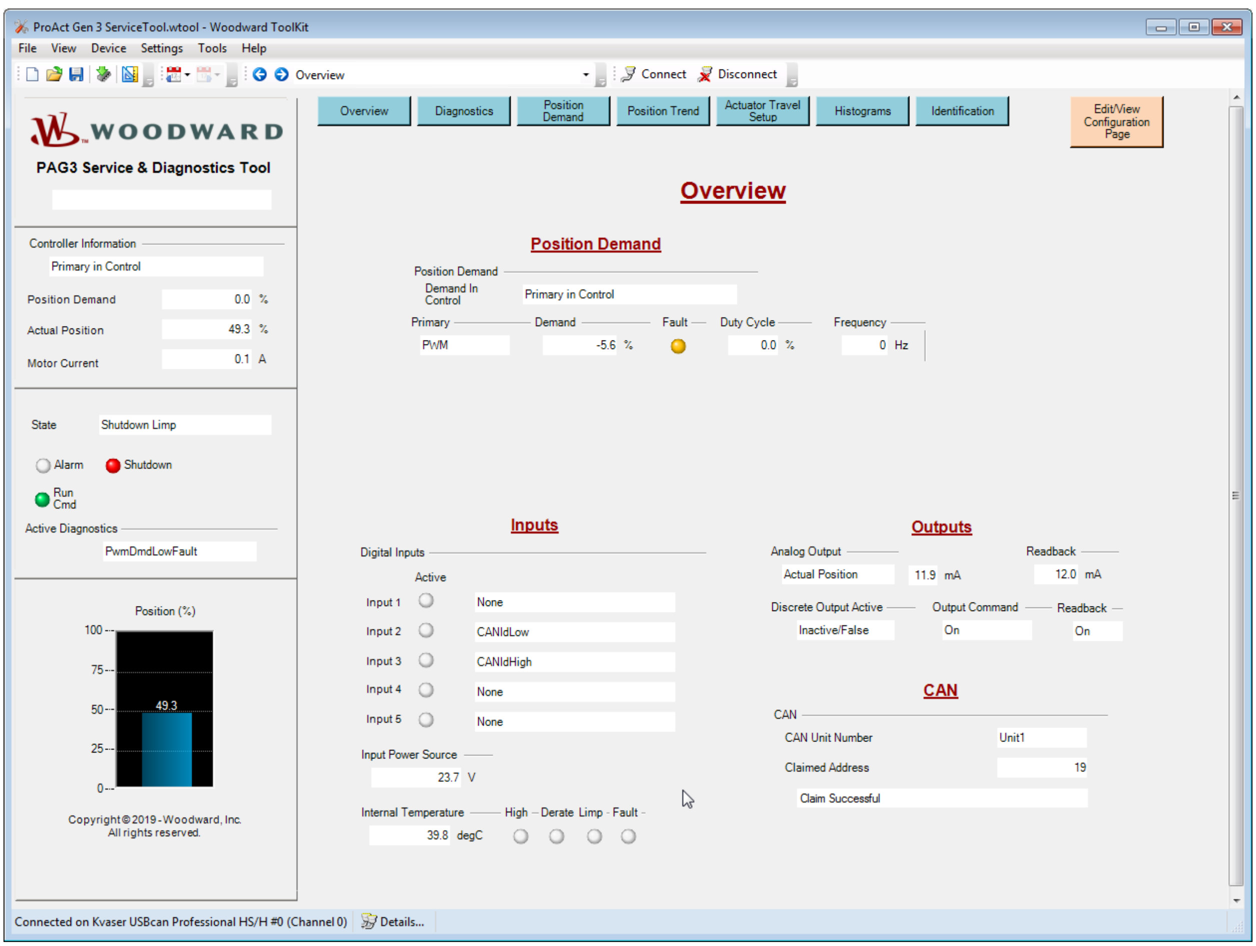


Figure 6-7. Overview Screen

Position Demand

Demand In Control
Displays the controller demand status. See Table 6-1 for definitions. Additional information is displayed for the following cases:

Condition: Primary Control/Backup Not Tracking, or
Condition: Backup Control/Primary Not Tracking
When the difference between the primary and backup demands exceeds the configured tracking error threshold, the tracking error threshold (Max Difference) is displayed. To clear a tracking error, the difference between the primary and backup demands must be within this Max Difference window.

Condition: Backup Control/Failback is Inhibited
When this condition is active, the primary demand is not within the allowed tolerance of the controlling (backup) demand to allow a transfer back to primary demand. The Failback Max Difference is displayed indicating the configured failback inhibit tolerance. To return to primary demand control, the primary demand must be within the Failback Max Difference window.

Condition: Backup Control/Failback Pending
When this condition is active, it indicates the primary demand is tracking the backup demand within the allowed tolerance, but waiting for a delay time prior to transfer control. The configured Failback Delay time is displayed as a reference.

Primary Demand Source
Displayed value of the configured primary demand source (Analog, CAN, or PWM). The corresponding demand percentage, the value of the input, and a fault status LED are displayed. The input voltage or current is displayed when configured for Analog. The input frequency and duty cycle are displayed when configured for PWM. A blue LED indication is provided to indicate which demand is currently in control (off/white indicates not selected).

Backup Demand Source
If used, the value of the configured backup demand source (Analog, CAN, or PWM) is displayed in a format similar to the primary demand.

Lookup Table Output
Provides the output value of the 11-point position lookup table, only displayed when lookup table is configured as used.

Inputs Section

Digital Input 1-5: the configuration of each discrete input is displayed as well as the status of the input (Blue indicates ON / active). The functional mappings for each discrete input are also displayed, indicating each discrete input's function(s).

Input Power Source
Displayed value of the input voltage. When diagnostics are configured for use, failed low and failed high LED indications are provided to indicate if the respective thresholds have been exceeded.

Internal Temperature
Displayed value of the electronics temperature sensor, in degrees Celsius. Indications are provided for temperature-related diagnostics: high temperature alert (High LED), temperature derating active (Derate LED), temperature exceeding the actuator operating threshold (Limp LED), and temperature sense failure (Fault LED).

Outputs

Analog Output
Displays the configured output source and the value of the analog output commanded, in milliamps. Additionally a current read back signal is provided, indicating the measured output.

Discrete Output
Provides an indication of the logic value of the discrete output command, based on the configured options. When Inactive/False, indicates all configured indications are false. When Active/True, indicates a configured indication is true and the output is to be asserted. This could be either to turn off or turn on the output, depending on the normally on/normally off setting.

Output Command
Indicates the output is commanded to be on or off. This indication takes into account the possible output inversion setting (Normally On or Normally Off).

Output Readback
Hardware measured read-back indication of the discrete output. This value should match the output command. If not, refer to the troubleshooting guide in Chapter 8.

CAN *(this section displayed when CAN is used)*

CAN Unit Number
Displayed value of the active CAN Unit number (1-4) based on the state of the CAN ID Low and High Discrete inputs read at power-up. If harness coding is not used this will always display Unit1.

Claimed Address
Displayed value of the last successfully claimed CAN source address.

Address Claim State
Indicates the status (pending, successful, unsuccessful) of the address claim function.

DM13 Suppression Status
When J1939 DM13 is configured for use, indicates the broadcast message suppression status of the DM13 function (Stopped, Not Stopped), and whether the shutdown action is being forced due to a DM13 Stop command.

Diagnostics Screen

This screen displays the status of active and stored fault conditions. Each diagnostic also displays a type, occurrence counter, time of first occurrence, and time last occurred. Details on each diagnostic is provided in Chapter 4. The data displayed in the event manager can be adjusted at any time to show all faults, show only active faults, or show active and stored faults.

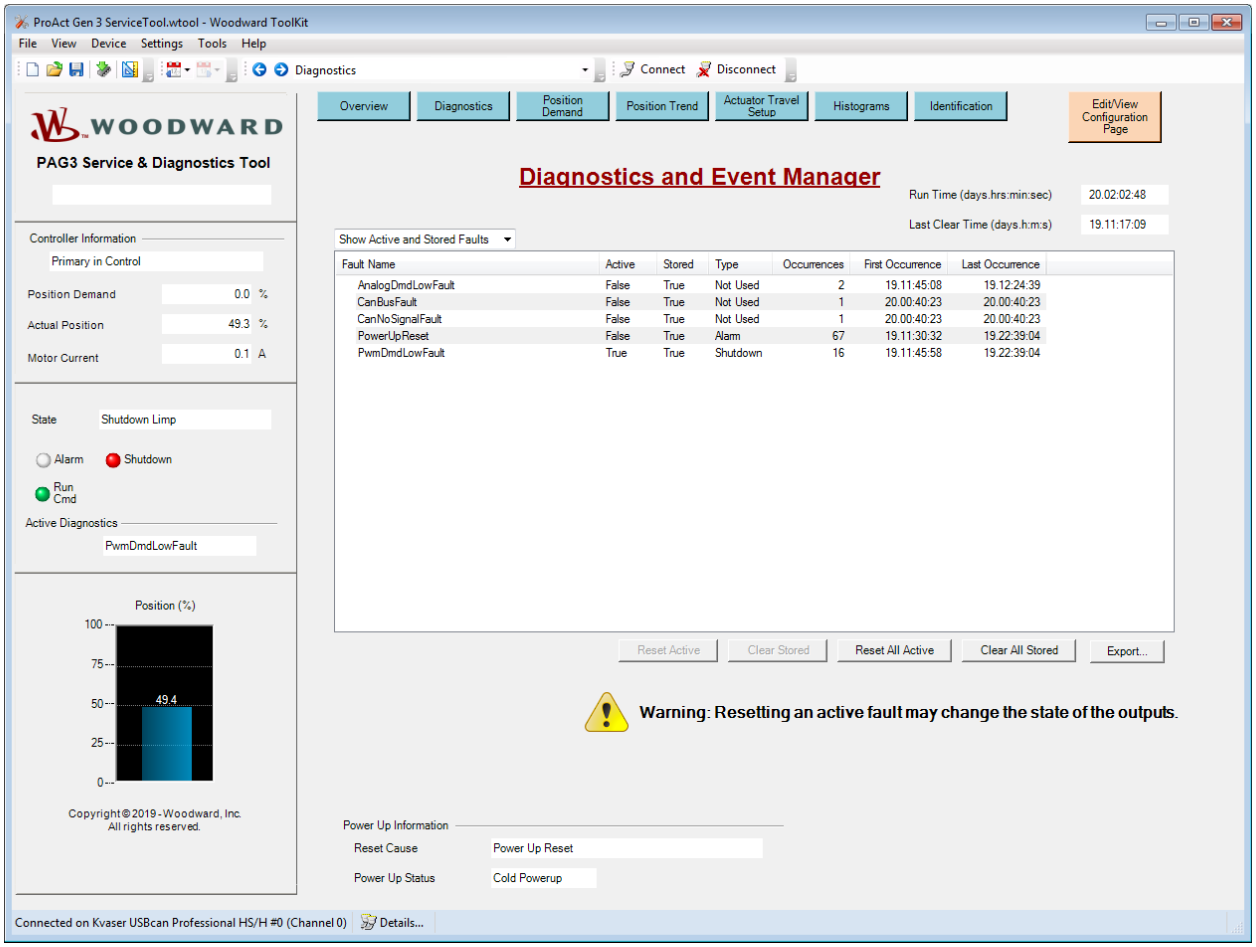


Figure 6-8. Diagnostics Screen

⚠WARNING	**Resetting diagnostics may change the state of device outputs. Stay clear of the actuator output shaft and all attachments. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Run Time

Indicates the accumulated time the ProAct Gen3 device has been powered-up. This value is captured as the occurrence time in the event manager. Run time format is *days.hours:minutes:seconds*.

Last Clear Time

Indicates the run time of the last log clear command (Clear All Stored). Data format is *days.hours:minutes:seconds*.

Reset Cause
Indicates the reason for the most recent reset of the device's microprocessor. Possible values are:
Power Up Reset – this is the "normal" value indicating that the processor started running at power-up.
User Initiated Reset – this indication is given when firmware is loaded into the device.
Any other reset cause indicates that an abnormal condition has occurred and will trigger a Watchdog Reset fault, if it is enabled.

Power Up Status
Indicates the power-up status as either Cold Powerup (power was off, then on) or Warm Powerup (processor was restarted due to a firmware load or abnormal reset condition).

Event Manager Fault Information

Each fault has a unique identifier (**Fault Name**). See chapter 4 for details on each diagnostic fault. Not all faults are used in every application. Selecting the data display to 'Show All Faults' will provide a listing of all possible diagnostic faults, whether they are in use or not.

Each fault has an **Active** state and a **Stored** state. The **Type** attribute indicates the action taken by the controller if the indicated fault goes active. The type is determined by configuration settings and can be values of Shutdown, Alarm, or Not Used. Faults that are not used are inhibited and will never go to an active state.

In non-latching fault mode, active faults indicate those that are currently active. These will automatically go inactive when the fault condition is removed. In latching fault mode, a reset command is required to clear any active fault. Each fault has an associated **Occurrences** count that is incremented and the **Last Occurrence** time is set to the run time whenever the fault transitions from being inactive to active. When latching fault mode is configured, occurrences are not incremented until a reset has been applied to return the fault to inactive. The **First Occurrence** time indicates the run time of the first occurrence since stored faults have been cleared.

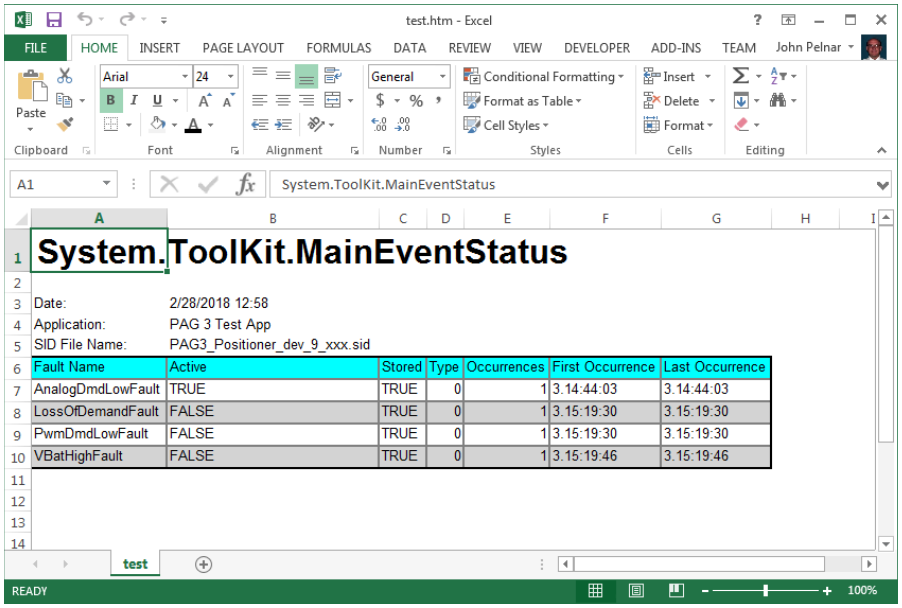
Reset Active or Reset All Active buttons
Active faults are those presently detected, or previously detected but latched and not reset (when latching behavior is configured). To clear active faults that are latched on, click the 'Reset All Active' button. If configured as non-latching, active faults self-clear when the fault condition no longer exists. When a single fault is selected/highlighted, it can be individually cleared with the 'Clear Active' button.

These buttons only change the Active state and only if the condition is no longer active. The Stored state and all occurrence values/times remain unchanged.

Clear Stored or Clear All Stored buttons
A Stored fault is one that is active or was active in the past. Stored faults are non-volatile and can only be cleared by clicking the 'Clear All Stored' button. When a single fault is selected/highlighted, it can be individually cleared with the 'Clear Stored' button.

The Clear All function clears the stored fault latch and sets the overall 'last clear time' to the run time. Occurrence counts are cleared for faults that are not currently active, or set to 1 if they are currently active. Additionally each of the first and last occurrence times are set to the run time. Active faults are not cleared but the First Occurrence Time is set to the Last Occurrence Time. Faults that were not stored remain unchanged.

Export Button
Click the Export button to save the event manager values to a file. The format of the file is html but it can be opened for analysis using other programs (example Microsoft Excel® Figure 6-9).



System.ToolKit.MainEventStatus

Date: 2/28/2018 12:58
Application: PAG 3 Test App
SID File Name: PAG3_Positioner_dev_9_xxx.sid

Fault Name	Active	Stored	Type	Occurrences	First Occurrence	Last Occurrence
AnalogDmdLowFault	TRUE	TRUE	0	1	3.14:44:03	3.14:44:03
LossOfDemandFault	FALSE	TRUE	0	1	3.15:19:30	3.15:19:30
PwmDmdLowFault	FALSE	TRUE	0	1	3.15:19:30	3.15:19:30
VBatHighFault	FALSE	TRUE	0	1	3.15:19:46	3.15:19:46

Figure 6-9. Diagnostic Event Export Example

IMPORTANT — **Refer to Chapter 4 for a complete listing and description of all the fault conditions.**

Position Demand Screen

This screen provides monitoring of the position demands.

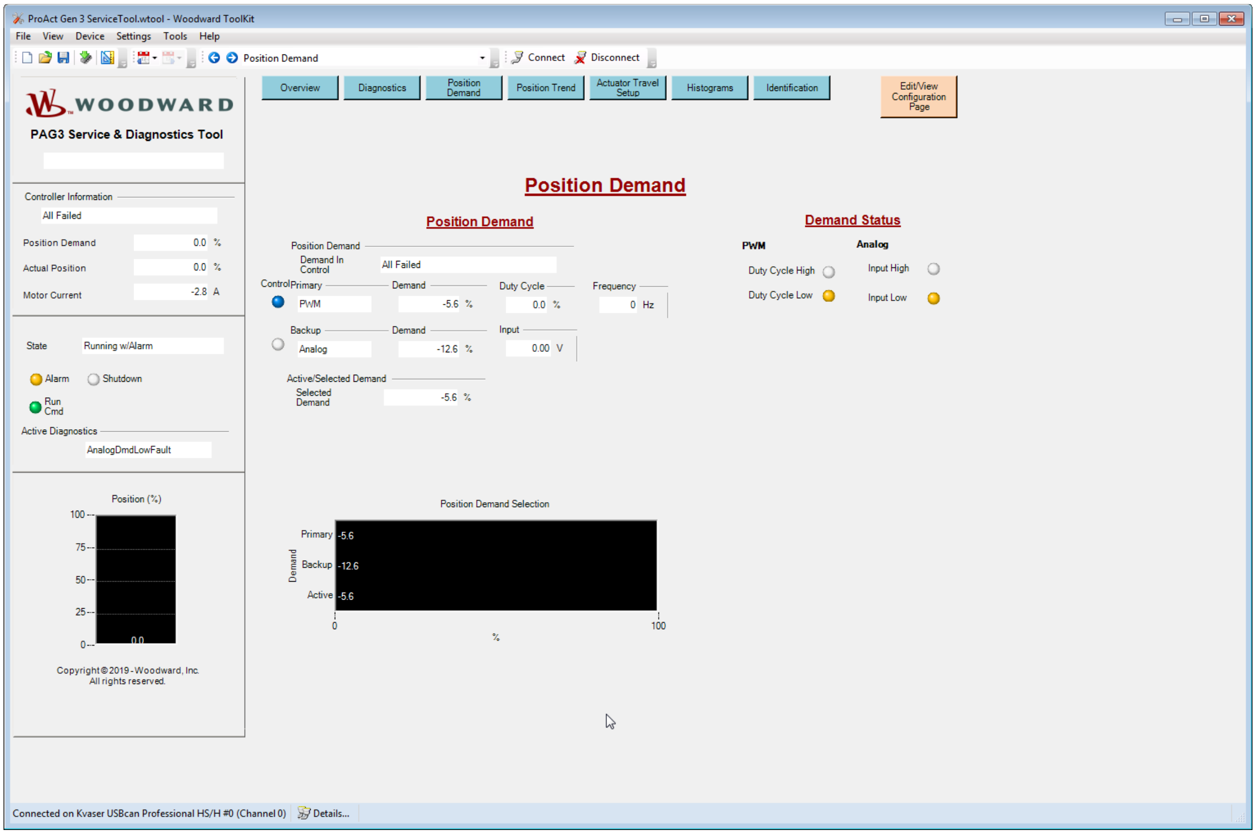


Figure 6-10. Position Demand Screen

Position Demand

Demand In Control
Displays the controller demand status. See table 6-1 for definitions. Additional information is displayed for the following cases:

Condition: Primary Control/Backup Not Tracking, or
Condition: Backup Control/Primary Not Tracking
When the difference between the primary and backup demands exceeds the configured tracking error threshold, the tracking error threshold (Max Difference) is displayed. To clear a tracking error, the difference between the primary and backup demands must be within this Max Difference window.

Condition: Backup Control/Failback is Inhibited
When this condition is active, the primary demand is not within the allowed tolerance of the controlling (backup) demand to allow a transfer back to primary demand. The Failback Max Difference is displayed indicating the configured failback inhibit tolerance. To return to primary demand control, the primary demand must be within the Failback Max Difference window.

Condition: Backup Control/Failback Pending
When this condition is active, it indicates the primary demand is tracking the backup demand within the allowed tolerance, but waiting for a delay time prior to transfer control. The configured Failback Delay time is displayed as a reference.

Primary Demand Source
Displayed value of the configured primary demand source (Analog, CAN, or PWM). The corresponding demand percentage and the value of the input are displayed. The input voltage or current is displayed when configured for Analog. The input frequency and duty cycle are displayed when configured for PWM. A blue LED indication is provided to indicate which demand is currently in control (off/white indicates not selected).

Backup Demand Source
If used, the value of the configured backup demand source (Analog, CAN, or PWM) is displayed in a format similar to the primary demand. Only displayed if backup demand is used.

Active/Selected Demand
Displays the value of the selected demand, when demand redundancy is used.

Filtered Demand
Provides the filtered value of the selected position demand. Only displayed when filtering is configured for use.

Lookup Table Output
Provides the output value of the 11-point position lookup table, only displayed when lookup table is configured as used.

Demand Status

The diagnostic indications for the configured inputs are displayed in this section. When PWM is configured, duty cycle high/low and frequency high/low indications are provided. When Analog is configured, input signal high/low indications are provided. When CAN is configured, input signal failed, address claim and bus fault indications are provided. If tracking error is configured, it is displayed in this section as well. For details on these diagnostics refer to chapter 4.

Position Demand Selection

This bar chart shows the primary, backup and selected demand signals in percentage. It provides a quick visual and can be handy to monitor demand tracking. Only displayed if backup demand is used.

Position Trend Screen

This screen offers a trend screen as well as the ability to manually control the shaft position and adjust controller dynamics settings.

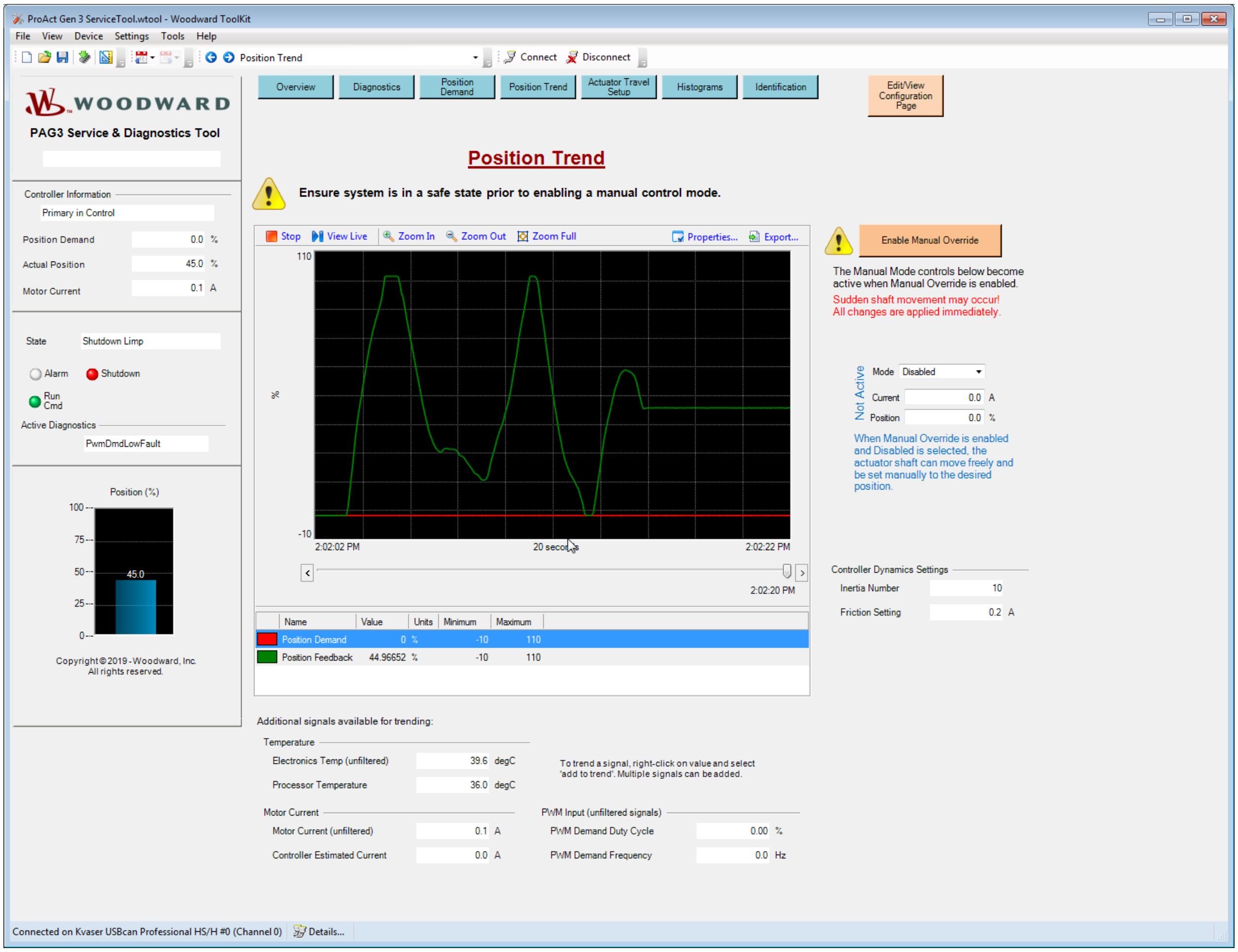


Figure 6-11. Position Trend Screen

The following are the preset trend parameters. These can be modified by selecting 'properties', instructions are provided later in this chapter.

- Actual Position (Default range is -10% to 110%)
- Position Setpoint (Default range is -10% to 110%)

Start/Stop
Click the Start button to begin a position trend. Click the Stop button to freeze the currently displayed values. Clicking the Start button again erases the frozen values and begins trending current values again.

IMPORTANT	Sample rate is not deterministic. While you can get very useful information from these plots, the sample rate is approximate, and the time between samples is only as good as the Windows OS can provide under the current PC operating conditions.

Manual Control Mode

While in manual control mode, the actuator no longer follows the normal position demand. The actuator can be made to drive to a position specified by the user, or to apply a constant torque to rotate the output shaft in either direction. The motor can also be turned off completely to allow the shaft to be moved freely.

Manual position control is useful for stroking the actuator from the min and max positions to verify the actuator travel is correct, that the linkage moves freely, and the stops are properly set.

Manual position control is also useful for stroking the actuator to view the dynamic response. Step changes can be made by setting the manual position demand (position setpoint).

⚠WARNING **Stay clear of the actuator output shaft and all attachments as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Enable/Disable Manual Override Button

Enables or disables manual mode. When manual mode is enabled, the Mode, Manual Current Demand, and Manual Position Demand values take effect immediately. Pre-set these values appropriately. Likewise, when manual mode is disabled, the actuator immediately resumes following the position demand.

Mode

The mode selection determines whether the actuator is turned off, producing a constant torque, or driving to a constant position. The selected mode is active when the manual mode is enabled.

Disabled:

In disabled mode the actuator drive output is turned off, allowing external adjustment/movement of the shaft.

Current Control:

In manual current control mode, the motor current is controlled to the 'Current Demand' value, producing a constant torque. Positive values apply torque in the CW direction (looking into the output shaft), and negative values apply torque in the CCW direction. Begin with small values, for example, 1 A, in order to prevent impacting mechanical stops at high velocity.

Position Control:

In manual position control mode, the shaft position is set by the 'Position Demand' value.

Current Demand

Sets the motor current when the manual current mode is active. Allow range is –12 A to 12 A.

Position Demand

Sets the commanded position when the manual position mode is active. Allowed range is 0 to 100%.

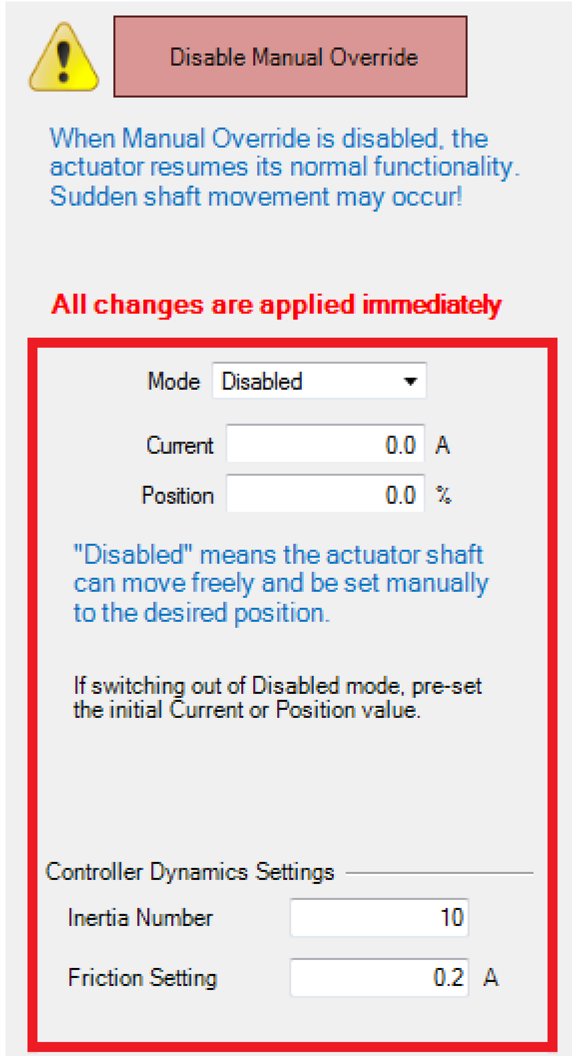


Figure 6-12. Position Trend Screen – Manual Control

Manual Mode Instructions

Manual position control and manual current control modes are provided on the trend screen to facilitate testing the actuator travel, linkage, valve setup, and dynamic response.

1) Prior to enabling manual mode, it is advised to preset the manual mode settings.
2) Click the Enable Manual Override button. Changes to Mode, Manual Current Demand, and Manual Position Demand values take effect immediately.
3) To change the current or position setpoint, highlight the present value, type in a new value, and press Enter on the keyboard.
4) When done, click the Disable Manual Override button.

⚠WARNING	**Entering manual modes and/or changing modes may change the state of device outputs. Stay clear of the actuator output shaft and all attachments. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Controller Dynamics Adjustment

There are two controller settings in the ProAct Gen3: friction and inertia. Adjustment of these settings is described below.

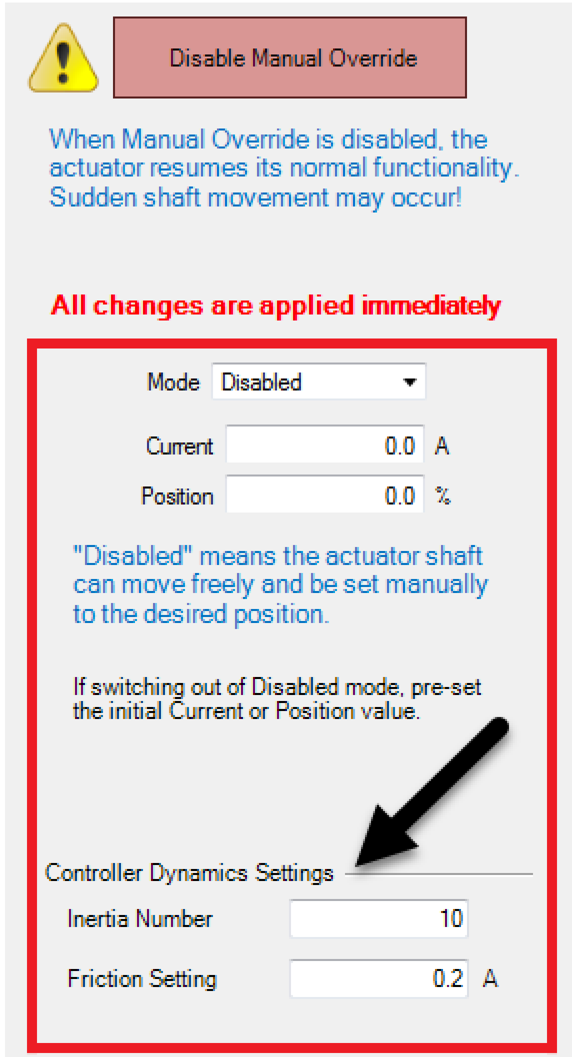


Figure 6-13. Position Trend– Controller Dynamics

Adjusting the Friction Setting

The friction setting represents the actuator current required to overcome static load friction.

The friction setting can be determined using the manual current mode. Where no spring return is present, the current value should be increased until the actuator just begins to move. That value of current should then be entered as the Friction Setting. Ideally, this should be done in the middle of the travel range, and not at either end.

When a return spring is present, the input current should be gradually increased until the actuator begins to move against the spring, then gradually decreased until it moves in the opposite direction. The Friction Setting should be one-half of the difference between these two values. For example, if it takes 0.7 A to begin moving against the spring, and at 0.5 A the actuator moves with the spring in the opposite direction, set the Friction Setting at (0.7 – 0.5) / 2 = 0.1 A.

If the friction setting is too low, the actuator may not respond well to small changes in the position demand. If the friction setting is too high, a high frequency oscillation or limit cycle will be seen.

Adjusting the Inertia Setting
The inertia setting calibrates the position controller to the load inertia. A setting of zero represents the actuator shaft with no load attached. The higher the load inertia, the higher the required inertia setting.

The inertia setting can be tested using manual position mode described above. Perform steps in position (for example, from 30% to 70% and back) and observe the behavior. If the inertia setting is too low, there may be a slow oscillation when the actuator should be steady, or the step response may show excessive overshoot and ringing. If the inertia setting is too high, a high frequency oscillation or limit cycle may be seen. If a range of values is seen to provide adequate response, the lowest value that does not produce overshoot should be chosen.

Trend Properties
Trend properties can be changed. Click the Properties button to open the Trending Properties window (Figure 6-14). From this window the trend time span, sample rate, pen colors and high and low range scaling can be changed.

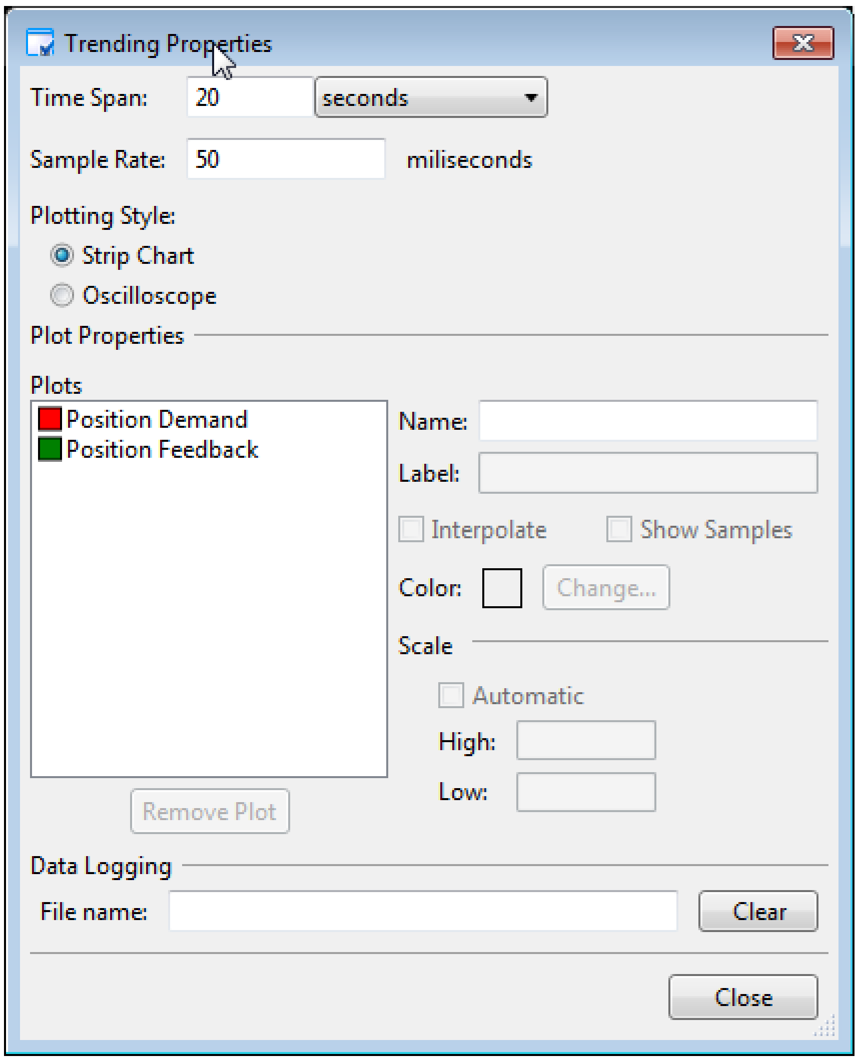


Figure 6-14. Trending Properties Window

Plot Properties

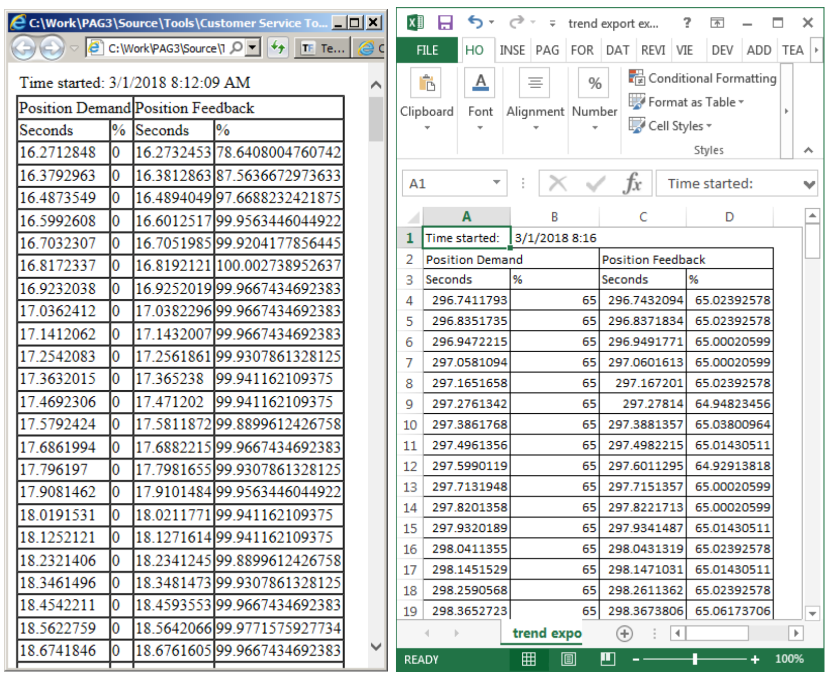
To change plot properties, a plot must be selected. Click on any of the available plots in the plot window. Checking the ‘show samples’ option causes the trend plot points to be displayed as enclosed points on the displayed trend.

Click Color Change to select a different plot color for the highlighted plot.

Checking the automatic scale option dynamically sets the range at the maximum and minimum values measured during a trend run. Checking the automatic scale check box overrides the high and low range scaling settings. Un-checking uses the high and low settings. Click ‘X’ to close the Trend Properties pop up window.

Export

Click the Export button to save file the values of the trend data points taken during the time period just prior to clicking the stop button. The format of the file is html but it can be opened for analysis using other programs (examples in web browser and Microsoft Excel® Figure 6-15).



Time started: 3/1/2018 8:12:09 AM

Position Demand		Position Feedback	
Seconds	%	Seconds	%
16.2712848	0	16.2732453	78.6408004760742
16.3792963	0	16.3812863	87.5636672973633
16.4873549	0	16.4894049	97.6688232421875
16.5992608	0	16.6012517	99.9563446044922
16.7032307	0	16.7051985	99.9204177856445
16.8172337	0	16.8192121	100.002738952637
16.9232038	0	16.9252019	99.9667434692383
17.0362412	0	17.0382296	99.9667434692383
17.1412062	0	17.1432007	99.9667434692383
17.2542083	0	17.2561861	99.9307861328125
17.3632015	0	17.365238	99.941162109375
17.4692306	0	17.471202	99.941162109375
17.5792424	0	17.5811872	99.8899612426758
17.6861994	0	17.6882215	99.9667434692383
17.796197	0	17.7981655	99.9307861328125
17.9081462	0	17.9101484	99.9563446044922
18.0191531	0	18.0211771	99.941162109375
18.1252121	0	18.1271614	99.941162109375
18.2321406	0	18.2341245	99.8899612426758
18.3461496	0	18.3481473	99.9307861328125
18.4542211	0	18.4593553	99.9667434692383
18.5622759	0	18.5642066	99.9771575927734
18.6741846	0	18.6761605	99.9667434692383

	A	B	C	D
1	Time started:	3/1/2018 8:16		
2	Position Demand		Position Feedback	
3	Seconds	%	Seconds	%
4	296.7411793	65	296.7432094	65.02392578
5	296.8351735	65	296.8371834	65.02392578
6	296.9472215	65	296.9491771	65.00020599
7	297.0581094	65	297.0601613	65.00020599
8	297.1651658	65	297.167201	65.02392578
9	297.2761342	65	297.27814	64.94823456
10	297.3861768	65	297.3881357	65.03800964
11	297.4961356	65	297.4982215	65.01430511
12	297.5990119	65	297.6011295	64.92913818
13	297.7131948	65	297.7151357	65.00020599
14	297.8201358	65	297.8221713	65.00020599
15	297.9320189	65	297.9341487	65.01430511
16	298.0411355	65	298.0431319	65.02392578
17	298.1451529	65	298.1471031	65.01430511
18	298.2590568	65	298.2611362	65.02392578
19	298.3652723	65	298.3673806	65.06173706

Figure 6-15. Trend Data Points (in Web Browser and Excel)

Creating a Custom Trend

Any control parameter can be trended by merely right clicking the value and selecting 'Add to trend'. Additional values are added to the same trend using the same process.

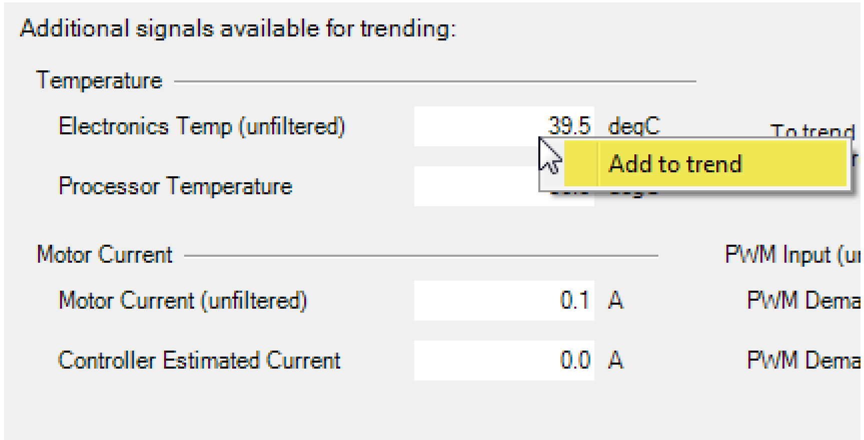


Figure 6-16. Custom Trend

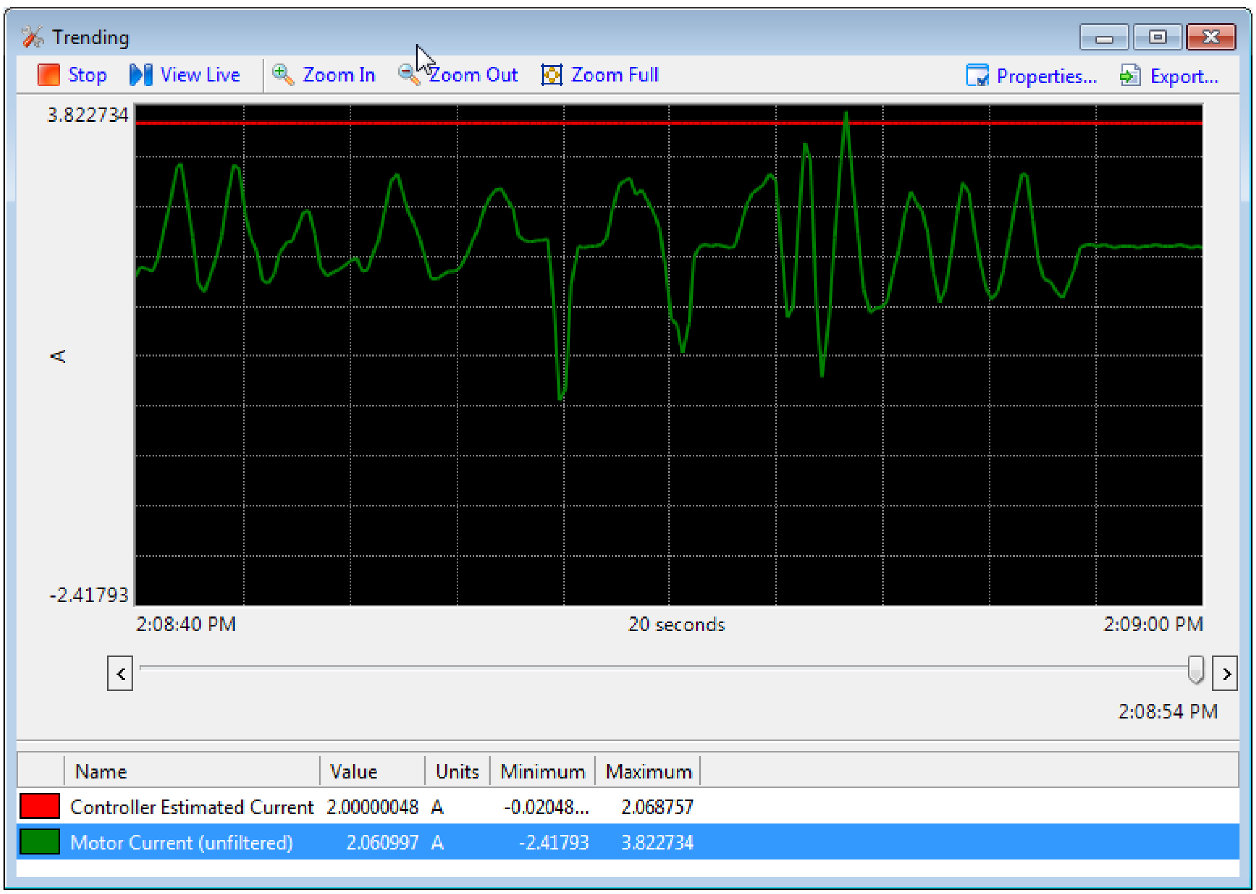


Figure 6-17. Custom Trend Example

The properties default range is automatic and the time span is 20 sec. Use the properties button to make any desired changes. Additional values can be added to this trend as desired by right-clicking other values. Custom trend values can be exported to a file. Zoom in, zoom out, and zoom full change the displayed time window while keeping the same data scaling.

Actuator Travel / Setup Screen

To set up and view the actuator stops settings, go to the Actuator Travel/Setup screen.

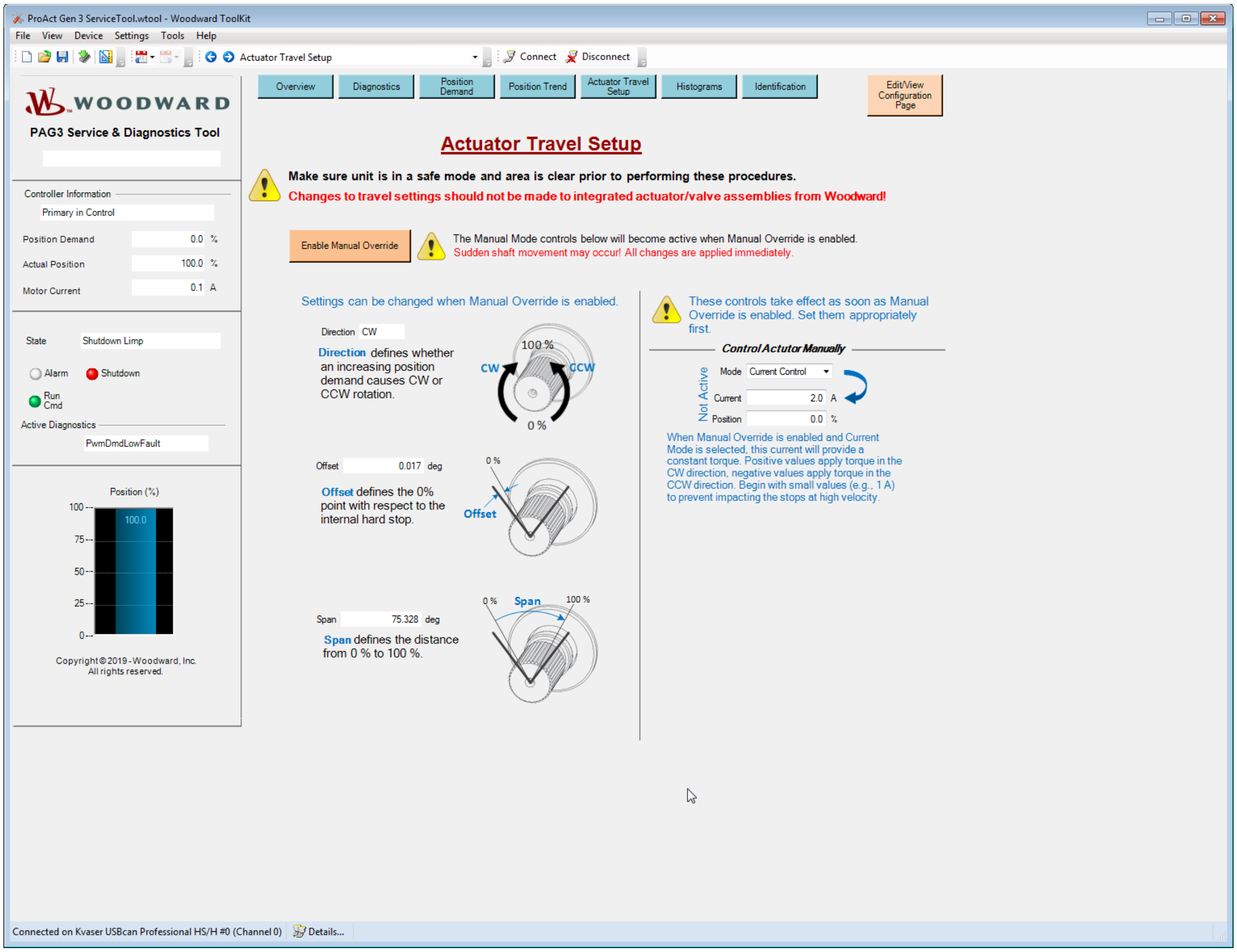


Figure 6-18. Actuator Travel/Setup Screen

Position Calibration and Verification

The Service Tool is used to calibrate end-user stops (physical or soft) and to verify the position calibration. The actuator stroke and direction must be set to the 0% and 100% positions of the driven device to achieve the intended control function.

The position calibration procedures are described below in the actuator travel setup. The position verification procedures are provided in the Manual Mode sections on the Position Trend screen and on the Actuator Travel/Setup screen. To perform calibration and/or verification, the ProAct Gen3 must be connected to the driven device.

⚠WARNING	**An improperly calibrated control could cause an overspeed or other damage to the prime mover. To prevent possible serious injury from an overspeeding prime mover, read and follow this entire procedure before starting the prime mover.**

IMPORTANT **It is highly recommended that the minimum fuel position setting stop the engine. This is essential for any configured shutdowns in the ProAct Gen3 control to be directly effective. If this is not possible, the discrete output should be configured to actuate an external shutdown device.**

⚠WARNING **Make sure unit is in a safe mode and area is clear prior to setting actuator travel. Stay clear of the actuator output shaft and all attachments as sudden movement can occur at any time. Failure to comply with this recommendation can cause personal injury and/or property damage.**

Actuator Travel Setup - Overview

Actuator travel setup refers to changing the settings that determine the angle of the actuator output shaft, relative to the internal mechanical hard stops, when the position command is at 0% and 100%. The settings are Offset, Span, and Direction. The two examples shown in Figures 6-19a and 6-19b illustrate a situation where there are no mechanical stops external to the actuator.

IMPORTANT **There are situations where the travel settings should not be disturbed. For example, Woodward actuators and integrated throttle body assemblies are configured with the proper travel settings at the factory.**

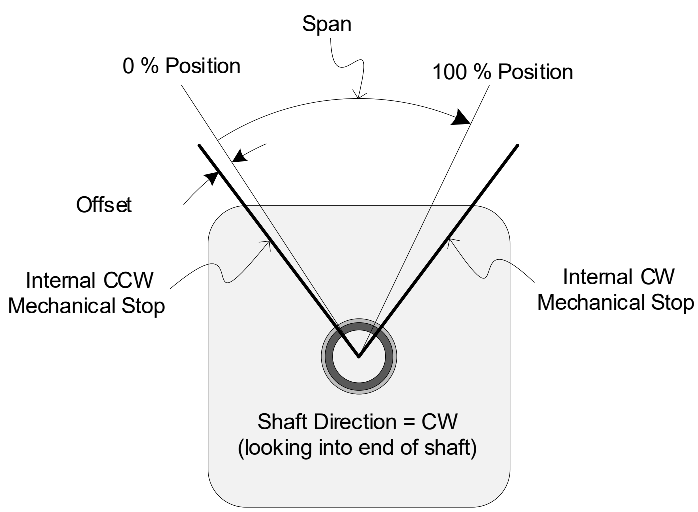


Figure 6-19a. Stops Setup for CW Operation

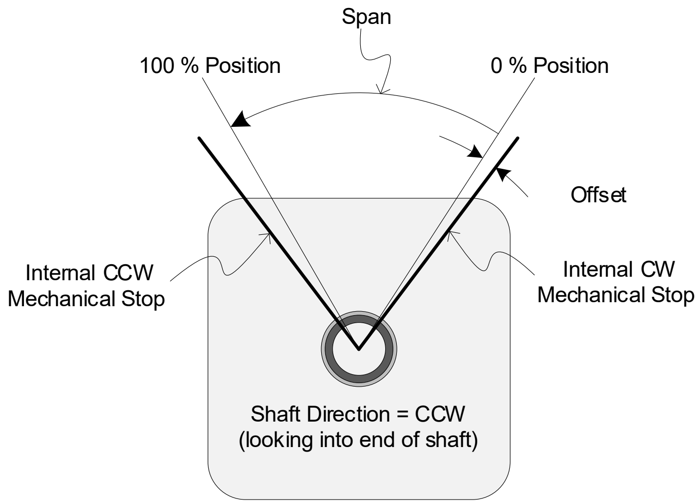


Figure 6-19b. Stops Setup for CCW Operation

See Figure 6-20 below. The travel setup settings are:
Offset - defines the 0% command point with respect to the internal hard stop.
Span - defines the change in output shaft angle as the position command goes from 0% to 100%.
Direction - defines whether an increasing position demand causes CW or CCW rotation.

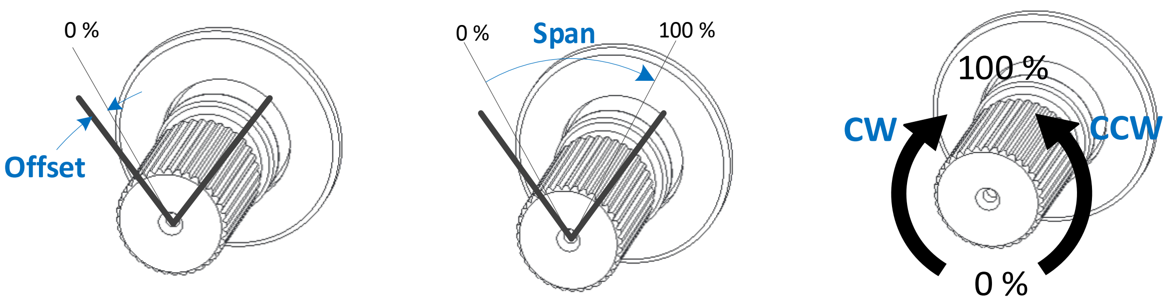


Figure 6-20. Travel Setup Settings

These settings can be entered directly. For example, if it is known that the minimum commanded actuator position needs to be 2° away from the internal actuator stop, the travel span needs to be 68°, and the output shaft should rotate in the counter-clockwise direction as the command signal increases, then the settings should be:
Offset = 2°, Span = 68°, Direction = CCW.

For other situations, the following additional features are available to assist setting the travel. Examples of using each one follow this overview.

Manual Controls:
Then actuator can be placed in a manual control mode where the user has direct control over either the position setpoint or output torque (via a current command to the motor). The user can, for example, move the actuator to a particular position, or apply torque in order to locate a mechanical stop position, or verify that the travel settings produce the desired travel.

Auto-Stroke function:
When the Auto Stroke function is run, the actuator applies torque in both directions while monitoring shaft movement in order to find mechanical stops. The Offset and Span parameters are automatically updated

to match the stops. The parameters can then be adjusted further, if desired, to set the travel range inside the mechanical stops.

Set 0% or 100% buttons:
Buttons are available that tell the actuator that the angle it is currently at should be either the 0% or the 100% command position. The Offset, Span, and Direction parameters are automatically updated when either button is pressed.

Using Manual Control Mode

To change the settings, the device must be in manual control mode. Observe the warnings regarding sudden shaft movement when entering or exiting manual control mode. After manual control mode is entered by clicking the Enable Manual Override button, the controls shown in Figure 6-21 become active. All changes are applied immediately.

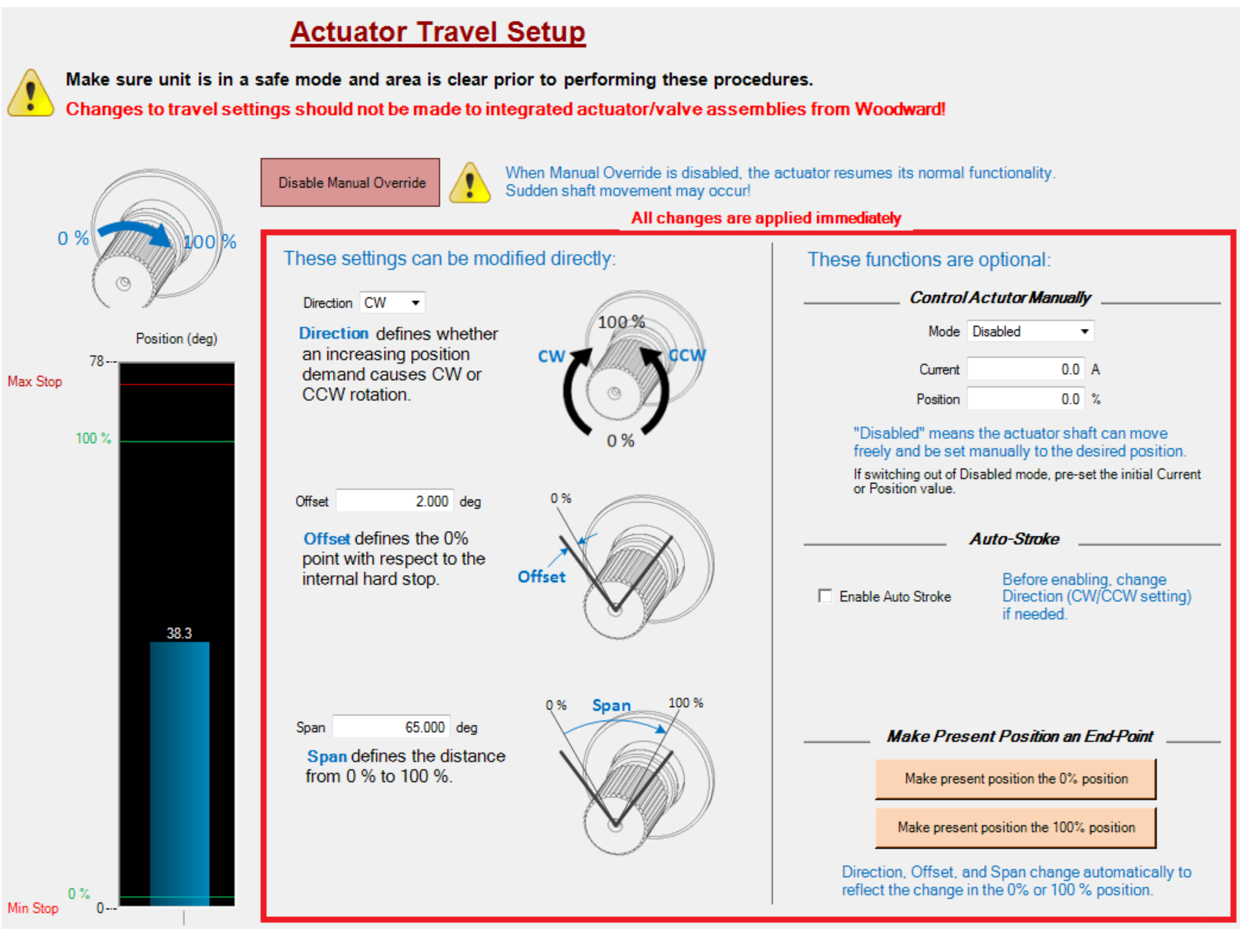


Figure 6-21. Manual Control is Active

Modifying the Travel Settings Directly

The travel settings can be changed while Manual Control is enabled. They also appear in the configuration editor; see the Travel Settings Page section in Chapter 7.

The display on the left side of the page shows the travel scaling as shown in Figure 6-22.

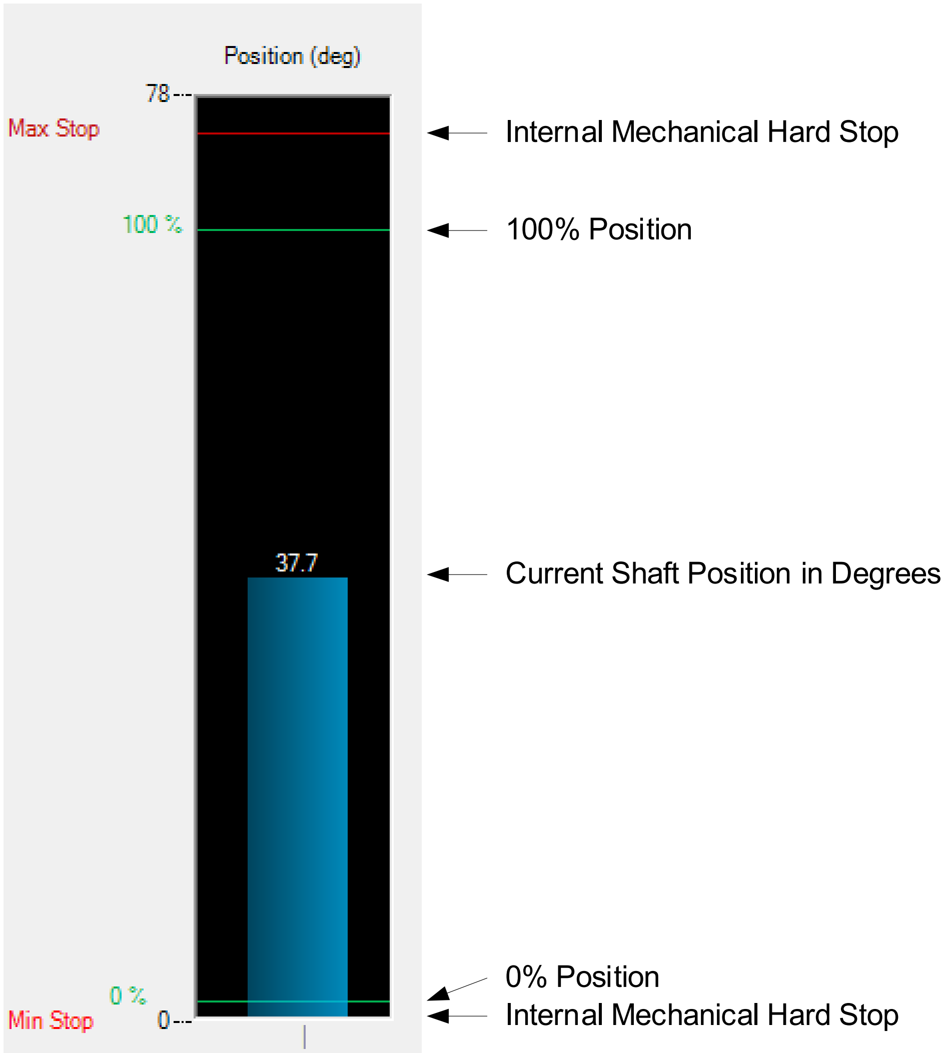


Figure 6-22. Travel Scaling Display

Changes to Direction, Offset, and Span are applied immediately and reflected in this display. If the combination of Offset and Span values exceeds the available travel in the actuator, the warning in Figure 6-23 is displayed, and the travel range is scaled so that a 100% command corresponds to the internal mechanical hard stop.

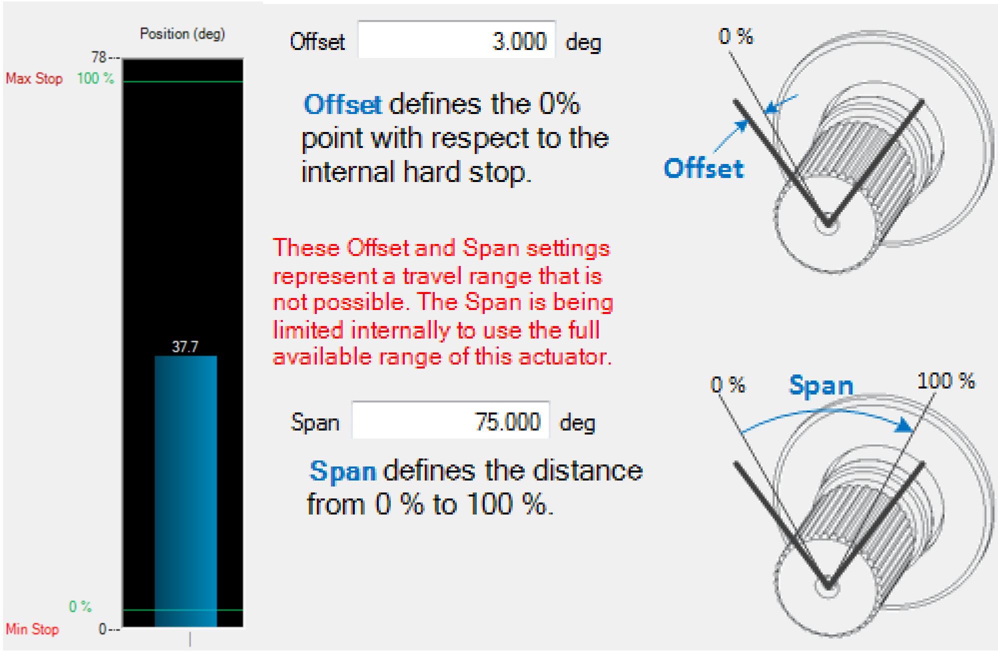


Figure 6-23. Travel Settings Limited to Available Travel

Using the Manual Controls

While in manual control mode, the actuator no longer follows the normal position demand. The actuator can be made to drive to a specific position, or to apply a constant torque to rotate the output shaft in either direction. The motor can also be turned off completely to allow the shaft to be moved freely. The manual controls are shown in Figure 6-24.

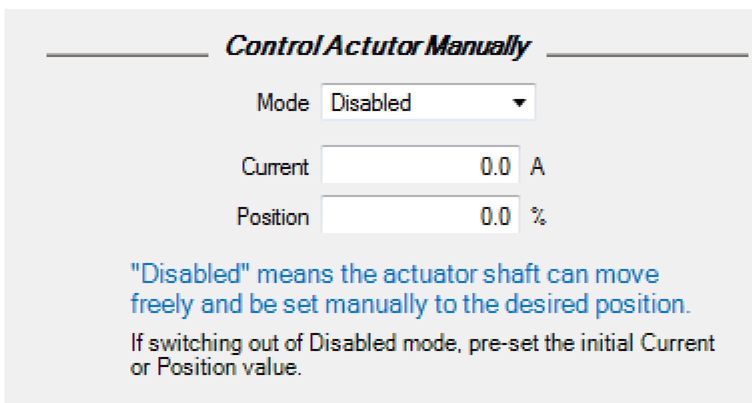


Figure 6-24. Manual Controls

Mode

The mode selection determines whether the actuator is turned off, producing a constant torque, or driving to a constant position. The selected mode is active when manual mode is enabled.

Disabled:
In disabled mode the actuator drive output is turned off, allowing external adjustment/movement of the shaft.

Current Control:
In manual current control mode, the motor current is controlled to the 'Current Demand' value, producing a constant torque. Positive values apply torque in the CW direction (looking into the output shaft), and

negative values apply torque in the CCW direction. Begin with small values, for example, 1 A, in order to prevent impacting mechanical stops at high velocity.

Position Control:
In manual position control mode, the shaft position is set by the 'Position Demand' value.

Current demand
Sets the motor current when the manual current mode is active. Allow range is –12 A to 12 A.

Position demand
Sets the commanded position when the manual position mode is active. Allowed range is 0 to 100%.

While in manual control mode, the State in the Dashboard is Test/Setup Mode, and the Test Mode indicator is on as shown in Figure 6-25.

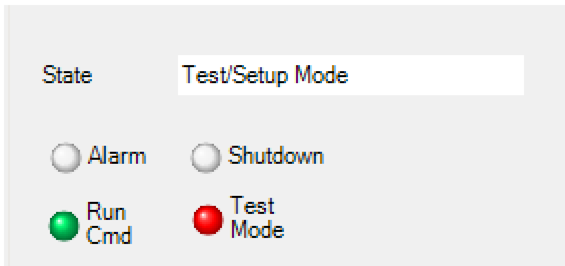


Figure 6-25. Test Mode indications

While in manual control mode, when the Mode is set to Disabled, the Motor Is Turned Off indicator is on as shown in Figure 6-26.

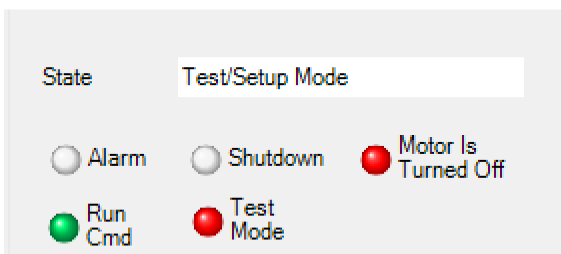


Figure 6-26. Motor Off indicator

Using the Auto-Stroke Function

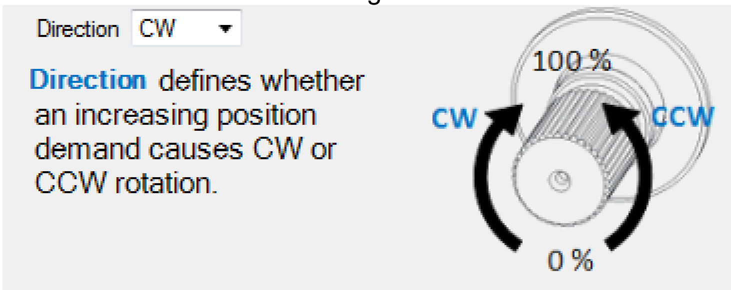
The Auto-Stroke function determines the mechanical travel range of the actuator and sets the Offset and Span settings to that range. The mechanical travel range could be set by the internal hard stops or by hard stops external to the actuator that limit its travel range.

When the Auto-Stroke function is initiated, it performs the following steps:

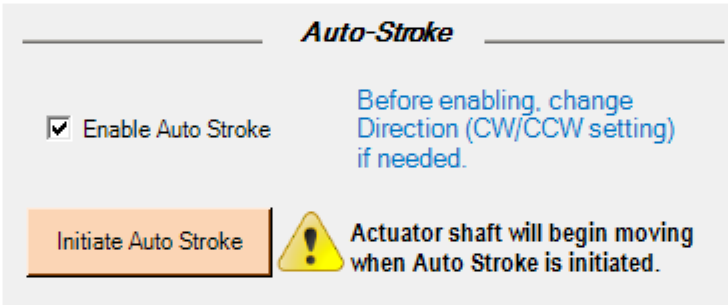
- Constant current is applied to the motor to force it towards the min stop. The Direction setting determines which stop is the min (0%) stop and which is the max (100%) stop.
- Position is monitored to see when the output shaft has stopped rotating, indicating a mechanical stop has been found.
- Constant current is applied to the motor to force it towards the max stop.
- Position is monitored to see when the output shaft has stopped rotating, indicating a mechanical stop has been found.
- The Offset and Span values are adjusted so that a 0% command corresponds to the min stop position and a 100% command corresponds to the max stop position.

Manual Control must be enabled in order to see the Auto Stroke controls in the tool. See the "Using Manual Control Mode" section above. After enabling Manual Control mode, perform the following steps:

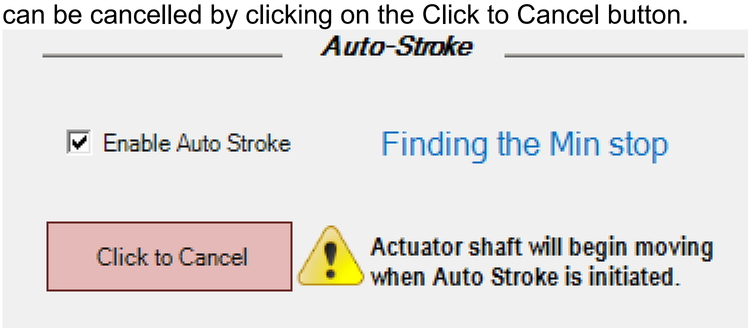
1. Ensure that the Direction setting is correct for the desired direction of rotation.



2. Click on the Enable Auto Stroke checkbox. The Initiate Auto Stroke button appears.



3. Click the Initiate Auto Stroke button. The actuator starts the Auto Stroke procedure. The procedure can be cancelled by clicking on the Click to Cancel button.



4. The status is displayed next to the Enable Auto Stroke checkbox. The possible status values are:

   Finding the Min stop:
   Finding the Max stop:
   The actuator is applying torque in the min or max direction and waiting for the position to remain stationary.

   Auto Stroke Complete:
   The procedure is complete and the Offset and Span have been updated.

   Auto Stroke Aborted: Unable to find min stop:
   Auto Stroke Aborted: Unable to find max stop:
   The actuator position did not become stationary and the procedure timed out.

   Auto Stroke Aborted: Travel range is too small:
   The actuator did not appear to move during the procedure.

   Auto Stroke Aborted:
   Either the "Click to Cancel" button was clicked, or the Enable Auto Stroke checkbox was un-checked, or Manual Control mode was disabled by clicking the Disable Manual Override button.

When the Auto Stroke Complete status appears, the Offset and Span values are updated as in Figure 6-27. In this example, it can be seen from the travel setup display that there was a mechanical stop external to the actuator that limits travel in the max direction, while an Offset of zero indicates that the actuator reached its internal min stop.

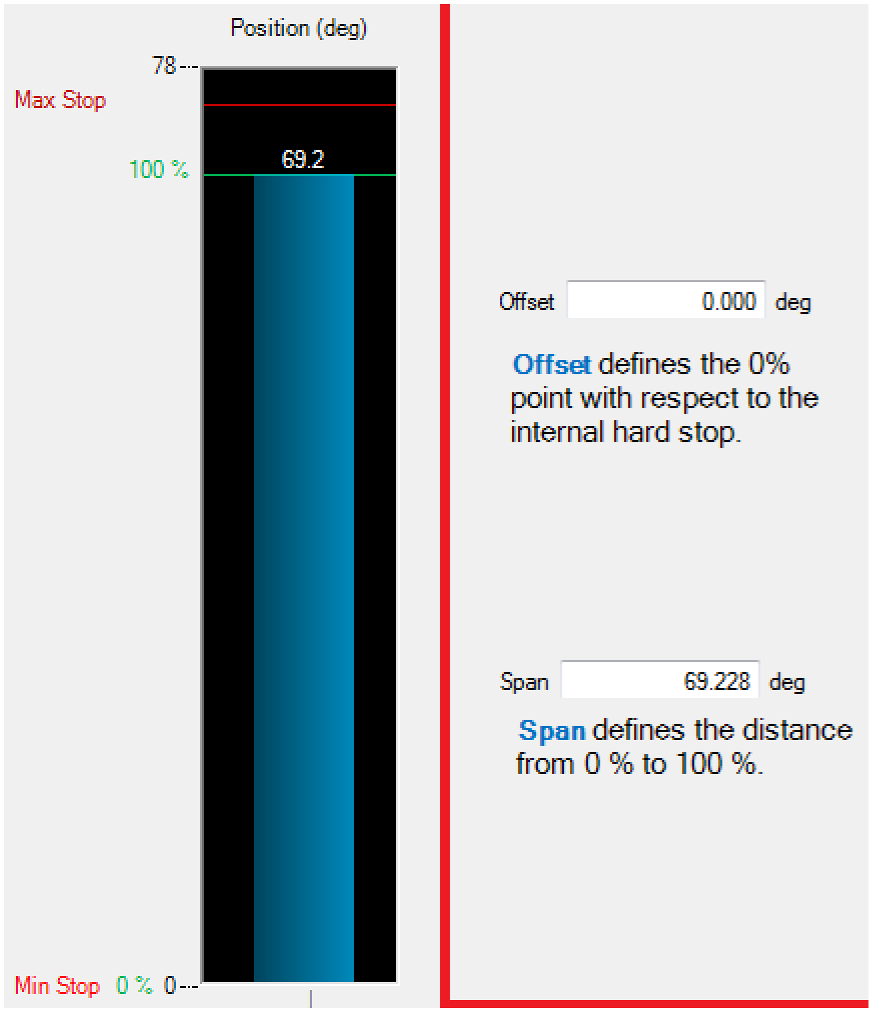


Figure 6-27. Auto Stroke Result When External Max Stop is Present

If desired, the Offset can be *increased* to move the 0% position away from the mechanical min stop, and the Span *decreased* to move the 100% position away from the mechanical max stop. The travel settings should never be set in a way that would cause the 0% or 100% positions to be outside the range of any mechanical stops.

Using the Set 0% and 100% buttons

When using the manual controls, the buttons shown in Figure 6-28 can be used to adjust the travel setup so that the current actuator position is the new 0% position or 100% position.

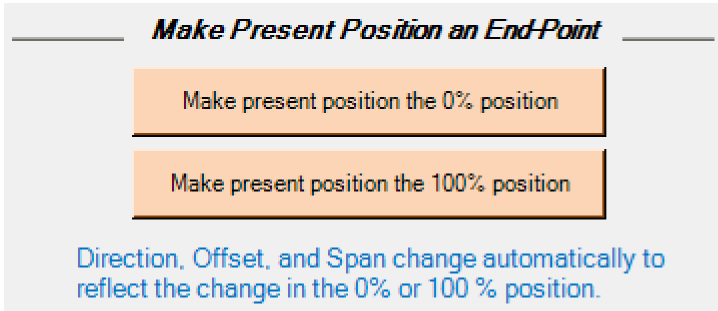


Figure 6-28. Set 0% and Set 100% Position Buttons

The direction, Offset, and Span are automatically adjusted when the button is clicked. These buttons are active in all manual modes: Disabled, Current Control, and Position Control.

Histograms Screen

The Histograms screen displays two histograms, one for position demand and another for electronics temperature. These are provided for historical operation purposes only. The position demand and temperature are sampled once per second. Each data element represents seconds within the range. Histogram data is saved at 1 minute intervals.

Operating Time
Provides an indication of the time the device is in a positioning mode (not limp). Examples when not in positioning mode include: run/stop stopped mode, test mode disabled, or test mode current control. Data format is *days.hours:minutes:seconds*.

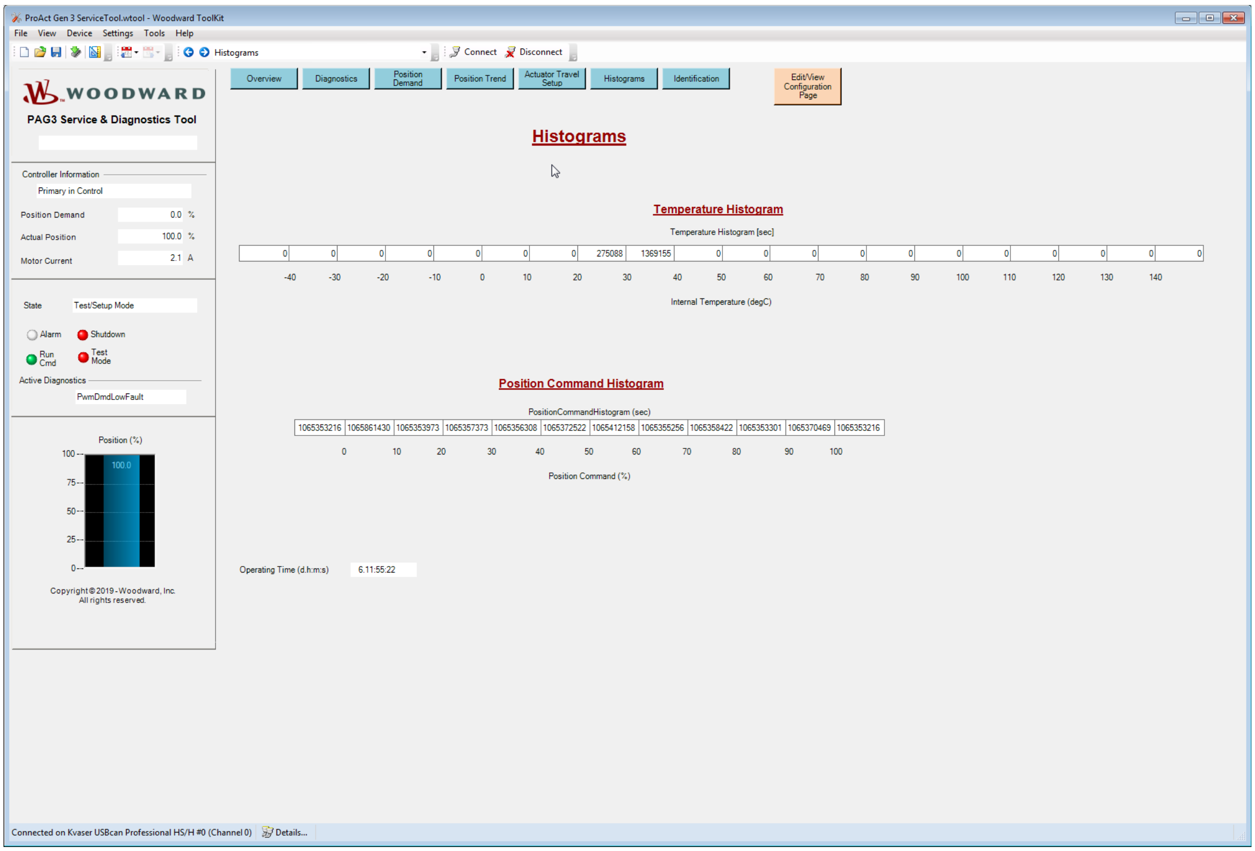


Figure 6-29. Histograms Screen

Identification Screen

The Identification screen provides part-number and serial number information.

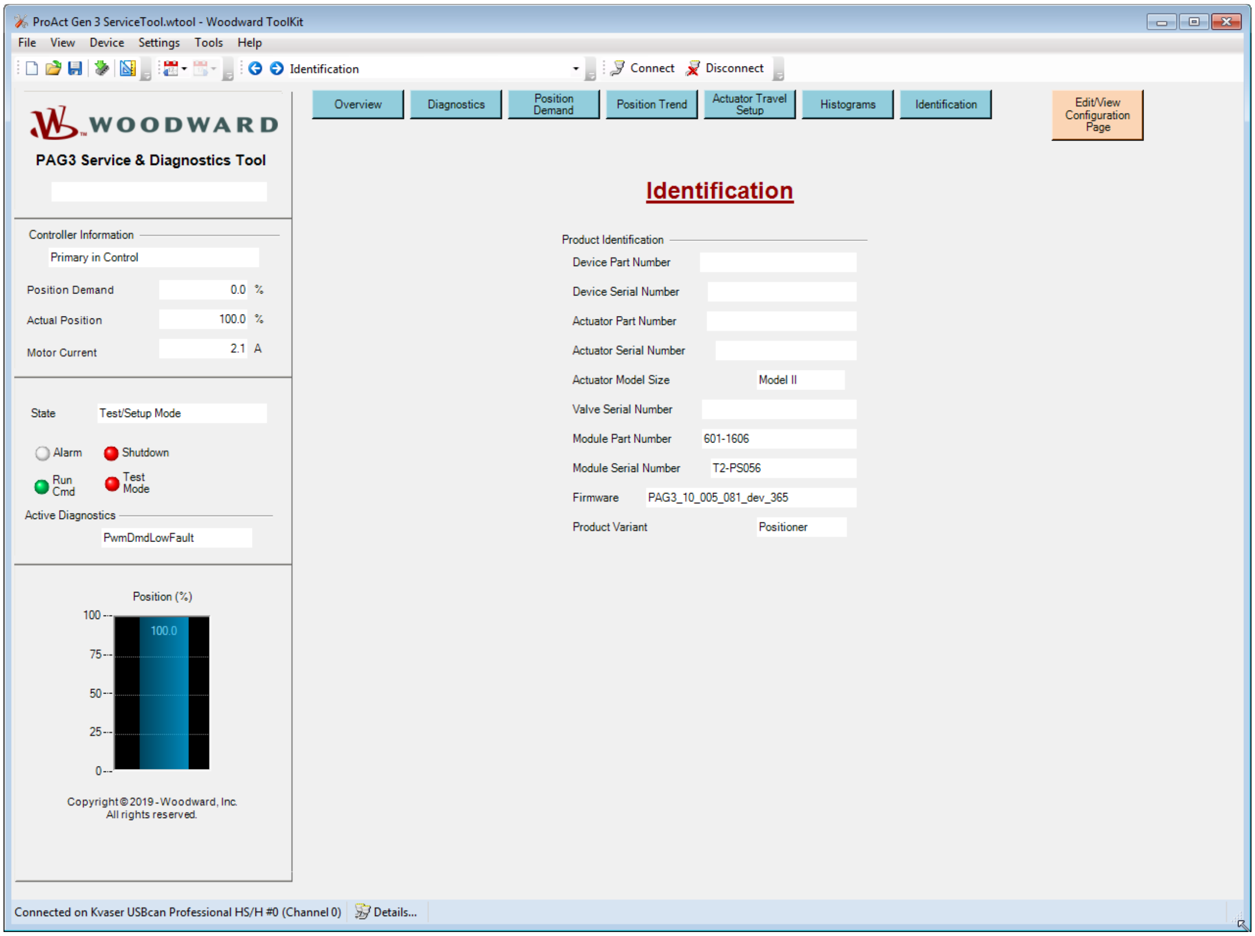


Figure 6-30. Identification Screen

Product Identification

Device Part Number
Displays the device upper level part number. For a stand-alone actuator, it is the actuator part number. For an integrated valve and actuator assembly, it is the part number of the entire assembly.

Device Serial Number
Displays the device upper level serial number. For a stand-alone actuator, it is the actuator serial number. For an integrated valve and actuator assembly, it is the serial number of the entire assembly.

Actuator Part Number
Displays the actuator part number.

Actuator Serial Number
Displays the actuator serial number.

Actuator Model Size
Displays the actuator model version/size (Model II, III or IV).

Valve Serial Number
Displays the valve serial number, if applicable.

Module Part Number
Displays part number of the installed control board.

Module Serial Number
Displays serial number of the installed control board.

Firmware
Displays the firmware identifier.

Product Variant
Displays the product build variant (Positioner).

Chapter 7. Configuration

Overview

The ProAct Gen3 control is configured using the Service Tool. Refer to Chapter 6 for Service Tool installation and connection instructions.

The device can be configured either on-line or off-line. Online configuration can only be performed when the Service Tool is connected to device. Offline configuration can be done at any time. Online and Offline configuration settings do not take effect until they are loaded into the control.

IMPORTANT	**Many ProAct Gen3 actuators are delivered pre-configured and calibrated with OEM specific settings. These units do not require the use of the Service Tool. However, the Service Tool is a valuable troubleshooting aid.**

⚠WARNING	**An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.** **It is recommended that the Discrete Output be configured for the 'Normally Energized' mode to ensure maximum fault protection and annunciation. Failure to follow these guidelines could, under exceptional circumstances, lead to personal injury and/or property damage.** **It is recommended that all faults be used and configured as shutdowns to ensure maximum fault protection.**

OEM Configuration File Data

The OEM can save configuration file specific data with the Service Tool. A notes text field (see Figure 7-6) is provided on each configuration screen that can be used to store data for each configuration such as:

- Customer
- Engine Type
- Application Type
- Notes

Configuring the Unit—Online

Unit Online configuration is summarized as follows:

1. Connect to the ProAct Gen3 device using the associated Service Tool.
2. From the Edit/View Configuration page select the "Edit/View Configuration" button. Allow time for the PC Service Tool to read the parameter values (typically a few seconds).
3. Navigate to the parameters using the buttons displayed on the screen and modify as needed.
4. Load the parameters to the device by selecting either the "Apply" or the "OK" button located at the bottom right corner of the screen (see Figure 7-1).

Configuring the Unit using Edit/View Configuration Button

Pressing Edit/View Configuration Button when Service Tool is connected to the control opens Settings Editor with currently used settings. From this window, the user can monitor settings or modify them.

- to apply changes and exit editor

- to apply changes and keep the editor open

- to exit editor with no changes

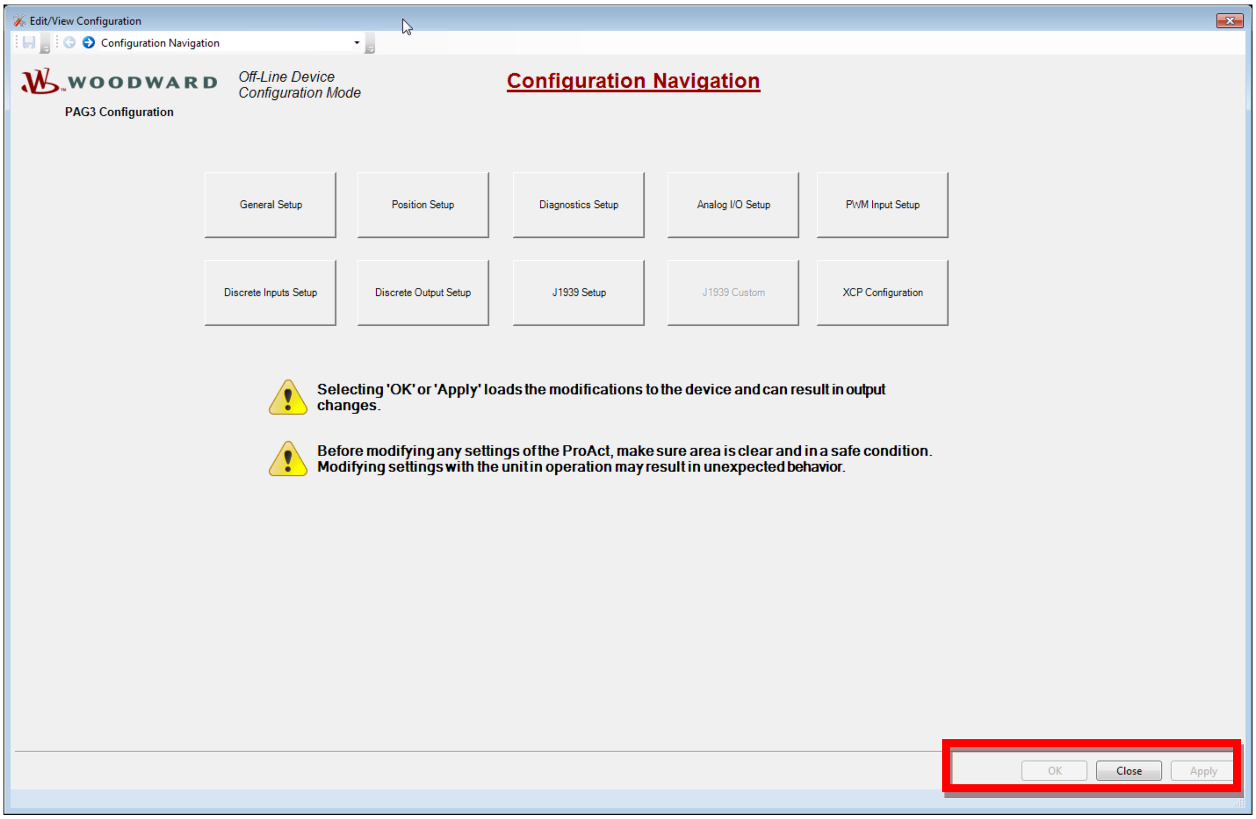


Figure 7-1. Online Configuration

Configuring the Unit—Offline

Unit Off-line configuration is summarized as follows:

1. Open an existing settings file or read the settings from the device and save them to a file for editing.
2. Edit the configuration settings.
3. Do a 'Save' to keep the same configuration filename OR do a 'Save As' to create a new configuration file.
4. When convenient, connect to the device and Load the configuration settings to the control.

IMPORTANT	**New controls are supplied with a configuration. These configurations may consist of default settings or OEM specific settings. Creating a 'New Settings from SID Defaults' is not recommended. Modifying, saving, and loading an existing configuration is preferred.**

Creating a Configuration Settings File

The current configuration settings in a device can be captured by connecting the Service Tool to the device, reading the settings, saving the settings to a file then opening the saved file. For instructions on connecting to the device with the Service Tool, see Chapter 6.

ToolKit allows creation of a new settings file using default values from a particular version of firmware (the "New from SID Specification Defaults" item in the Settings menu), but this is not recommended. To create a settings file based on the control's current values, click 'Settings' on the Service Tool menu bar then 'Save from Device to File...'.

This starts a Save Setting Wizard to save the device settings to a configuration settings file. You will be prompted for a File name. These settings can be saved to an existing file or to a new file.

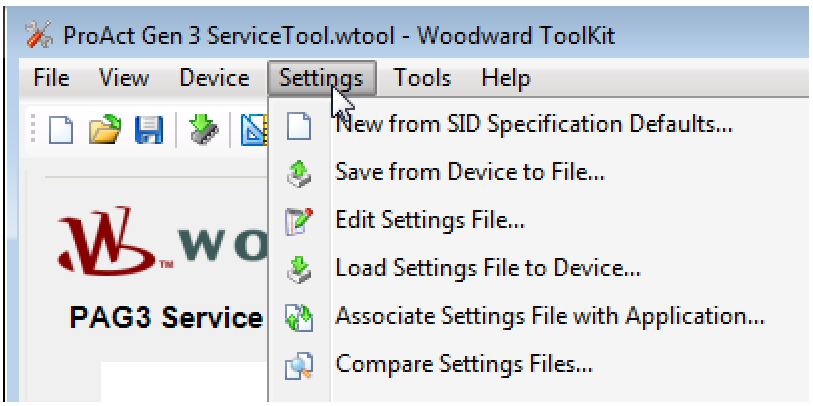


Figure 7-2. Settings Menu Options

Opening Configuration Settings Files for Editing

Settings Files can be opened to view configuration settings, edit settings, 'save' (or 'save as') settings and download settings to the control.

To open the Settings Files, click 'Settings' on the ProAct Gen3 Service Tool menu bar then select 'Edit Settings File...'. Using the file select dialog, simply double click the desired file name. This opens a Settings Editor screen for viewing or editing the configuration settings. See the Configuration Screens section below for descriptions of all the settings.

Save the Configuration Settings File

Once all configuration setting have been made in the Settings Editor, click 'File' on the Settings Editor menu bar and select 'Save' to overwrite the existing Settings File or select 'Save As' to create a new configuration Settings File. You will be prompted for a new file name.

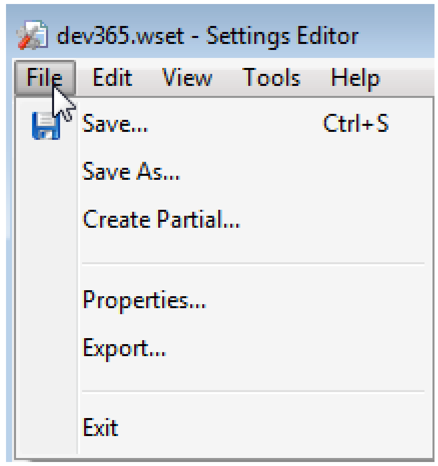


Figure 7-3. Settings Save

Load the Configuration Settings to the Control

Once all configuration settings have been saved to a Settings File, the settings can be loaded to the device. From the main tool, select 'settings' then 'Load Settings File to Device' on the ProAct Gen3 Service Tool menu bar. This will start a wizard to assist in the loading process.

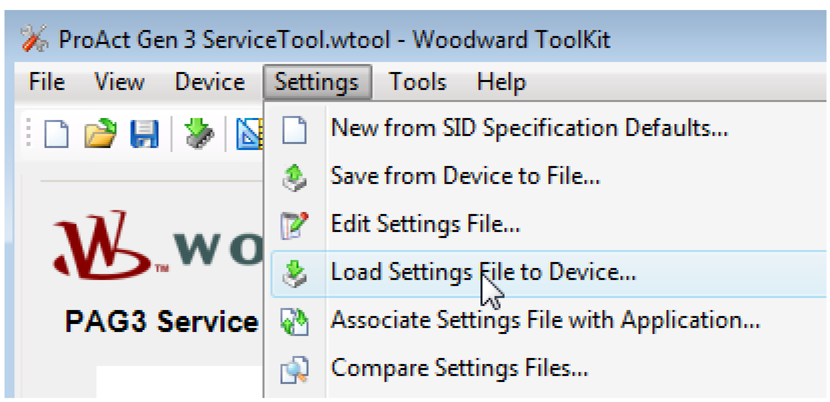


Figure 7-4. Settings Load

A Loading Settings window opens (Figure 7-5). After the settings have been loaded into the control and saved, they are checked. When completed, a successful load message is displayed (Figure 7-18).

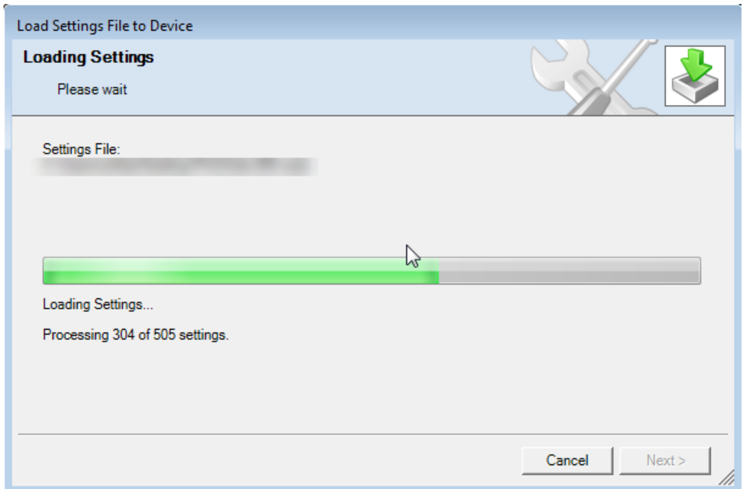


Figure 7-5. Loading Settings Window

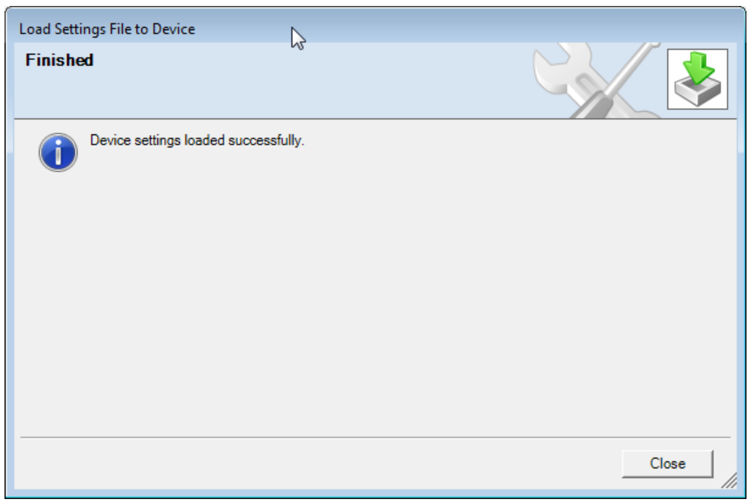


Figure 7-6. Load Settings Finished

Exporting the Settings File Configuration

A Settings File configuration can be exported to an *.htm document file. This provides for listing the configuration settings, printing a hard copy of the settings or e-mailing the control settings.

To select settings file to be exported, from the main tool, select ‘Settings’ then ‘Edit Settings File’ on the ProAct Gen3 Service Tool menu bar and choose proper settings file.

Once the Settings Editor screen opens, select ‘’File, Export’ on the menu bar. The export format can be selected as either hierarchical or tabular. Select Browse for the file name and location selection window. Select Close to cancel.

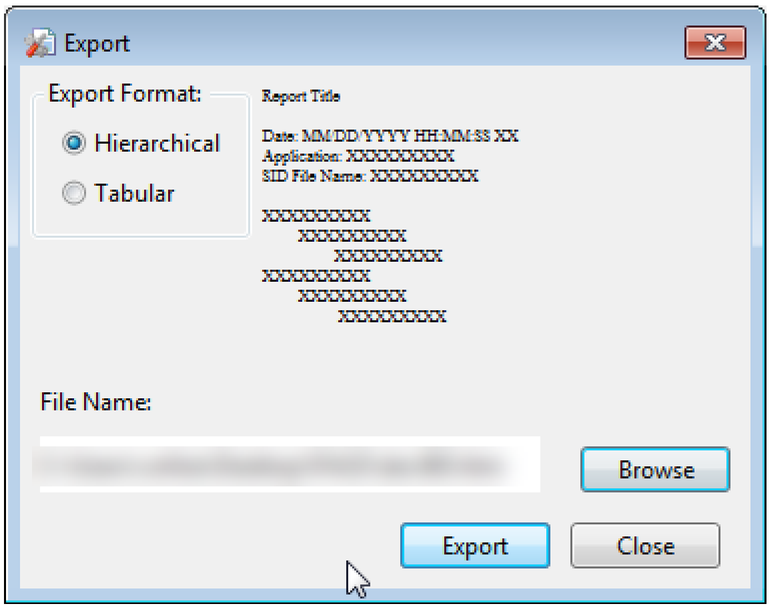
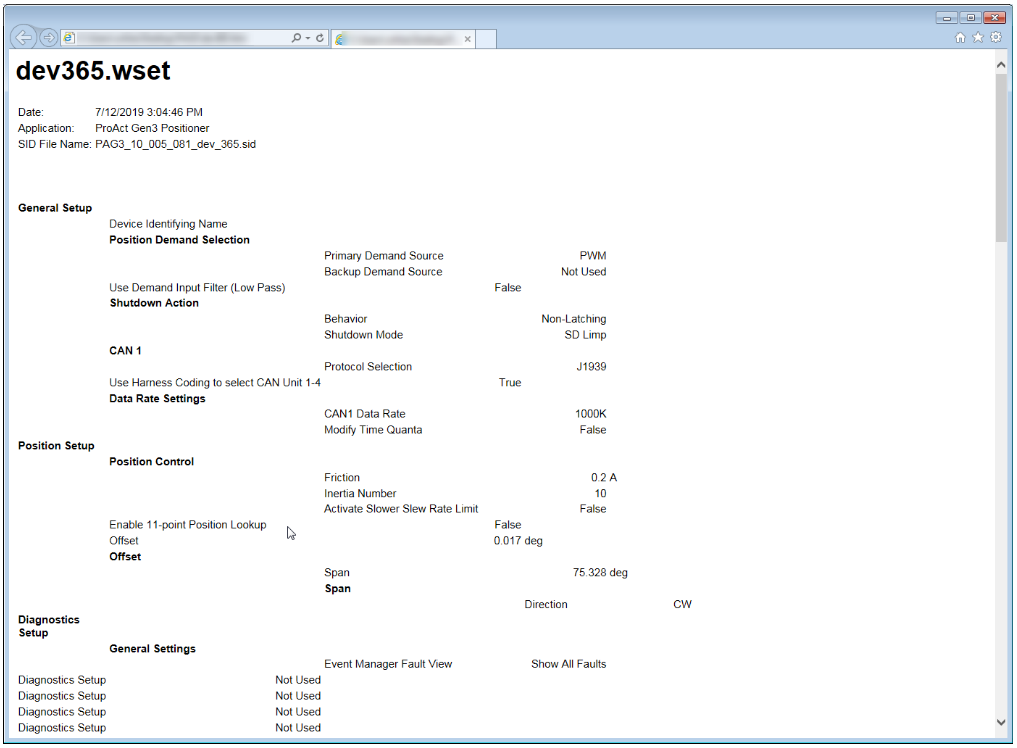


Figure 7-7 Export Format Selection

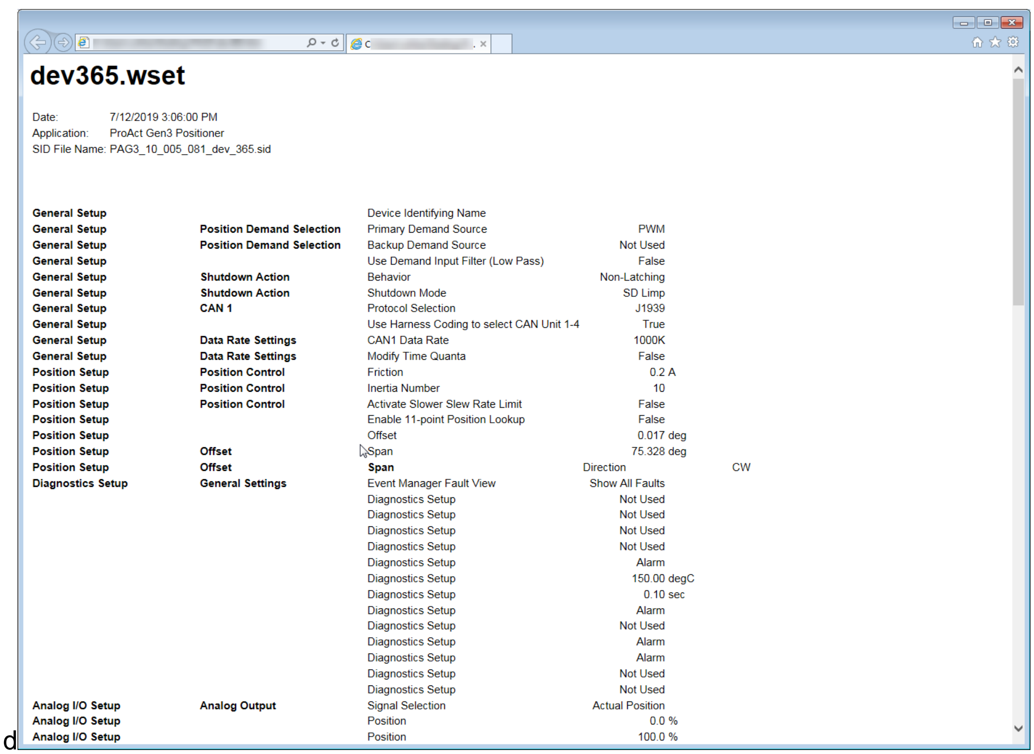


dev365.wset

Date: 7/12/2019 3:04:46 PM
Application: ProAct Gen3 Positioner
SID File Name: PAG3_10_005_081_dev_365.sid

General Setup
Device Identifying Name
Position Demand Selection
Primary Demand Source PWM
Backup Demand Source Not Used
Use Demand Input Filter (Low Pass) False
Shutdown Action
Behavior Non-Latching
Shutdown Mode SD Limp
CAN 1
Protocol Selection J1939
Use Harness Coding to select CAN Unit 1-4 True
Data Rate Settings
CAN1 Data Rate 1000K
Modify Time Quanta False
Position Setup
Position Control
Friction 0.2 A
Inertia Number 10
Activate Slower Slew Rate Limit False
Enable 11-point Position Lookup False
Offset 0.017 deg
Offset
Span 75.328 deg
Span
Direction CW
Diagnostics Setup
General Settings
Event Manager Fault View Show All Faults
Diagnostics Setup Not Used
Diagnostics Setup Not Used
Diagnostics Setup Not Used
Diagnostics Setup Not Used

Figure 7-8. Hierarchical Example



dev365.wset

Date: 7/12/2019 3:06:00 PM
Application: ProAct Gen3 Positioner
SID File Name: PAG3_10_005_081_dev_365.sid

General Setup		Device Identifying Name		
General Setup	**Position Demand Selection**	Primary Demand Source	PWM	
General Setup	**Position Demand Selection**	Backup Demand Source	Not Used	
General Setup		Use Demand Input Filter (Low Pass)	False	
General Setup	**Shutdown Action**	Behavior	Non-Latching	
General Setup	**Shutdown Action**	Shutdown Mode	SD Limp	
General Setup	**CAN 1**	Protocol Selection	J1939	
General Setup		Use Harness Coding to select CAN Unit 1-4	True	
General Setup	**Data Rate Settings**	CAN1 Data Rate	1000K	
General Setup	**Data Rate Settings**	Modify Time Quanta	False	
Position Setup	**Position Control**	Friction	0.2 A	
Position Setup	**Position Control**	Inertia Number	10	
Position Setup	**Position Control**	Activate Slower Slew Rate Limit	False	
Position Setup		Enable 11-point Position Lookup	False	
Position Setup		Offset	0.017 deg	
Position Setup	**Offset**	Span	75.328 deg	
Position Setup	**Offset**	**Span**	Direction	CW
Diagnostics Setup	**General Settings**	Event Manager Fault View	Show All Faults	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Alarm	
		Diagnostics Setup	150.00 degC	
		Diagnostics Setup	0.10 sec	
		Diagnostics Setup	Alarm	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Alarm	
		Diagnostics Setup	Alarm	
		Diagnostics Setup	Not Used	
		Diagnostics Setup	Not Used	
Analog I/O Setup	**Analog Output**	Signal Selection	Actual Position	
Analog I/O Setup		Position	0.0 %	
Analog I/O Setup		Position	100.0 %	

d

Figure 7-9. Tabular Example

Configuration Screens

The settings editor screens are used to set the configuration parameters.

The following screens may be displayed. Screens, content, and available functionality vary with firmware version. Configuration should be performed in the order displayed because settings in the first 3 setup pages drives visibility in the other pages.

- Configuration Navigation
- General Setup
- Position Setup
- Diagnostics Setup
- Analog I/O Setup
- PWM Input Setup
- Discrete Inputs Setup
- Discrete Output Setup
- J1939 Setup
- XCP Configuration

IMPORTANT	**To prevent missed configuration values, configure the General Setup page first, followed by Position Setup and Diagnostics Setup. Settings on these 3 screens controls the visibility of items on other pages.**

Screen navigation can be performed using the on-screen left- and right-arrow icons, the screen drop-down, or by selecting the screen name pushbutton (see Figure 7-10).

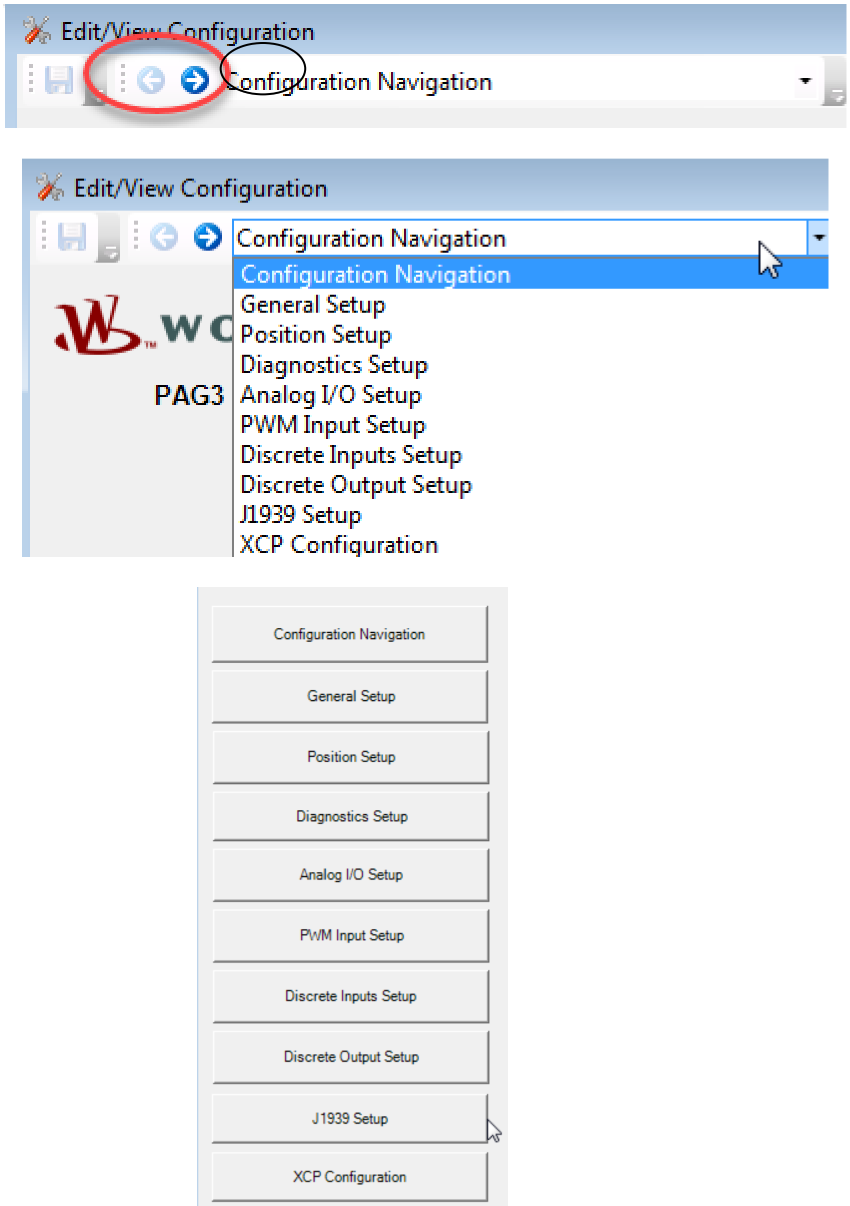


Figure 7-10. Screen Navigation Options

The tuning range of a selected parameter is displayed on the screen status bar (bottom of screen of the main tool, see example Figure 7-11). Attempts to enter values outside the parameter minimum and maximum range will not be accepted and an error message is displayed (see Figure 7-12).

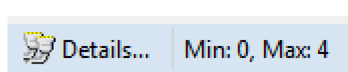


Figure 7-11. Setting Range Indication

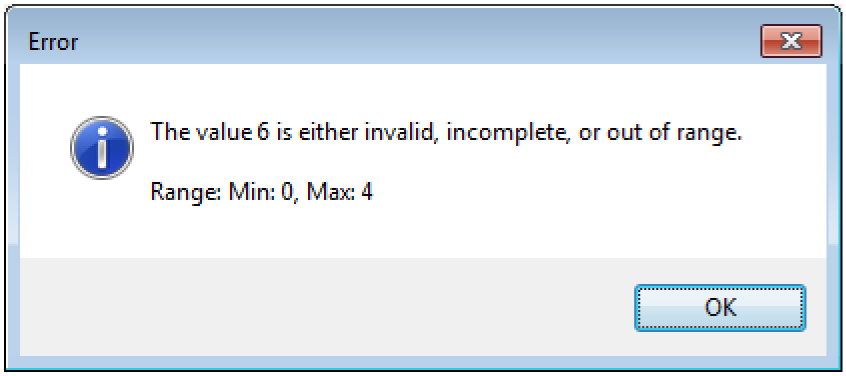


Figure 7-12. Setting Error Message

General Setup Page

The General Setup screen provides device identification, demand input setup, shutdown action, and CAN settings (figure 7-13). Demand setup includes settings for selection, filtering and redundancy.

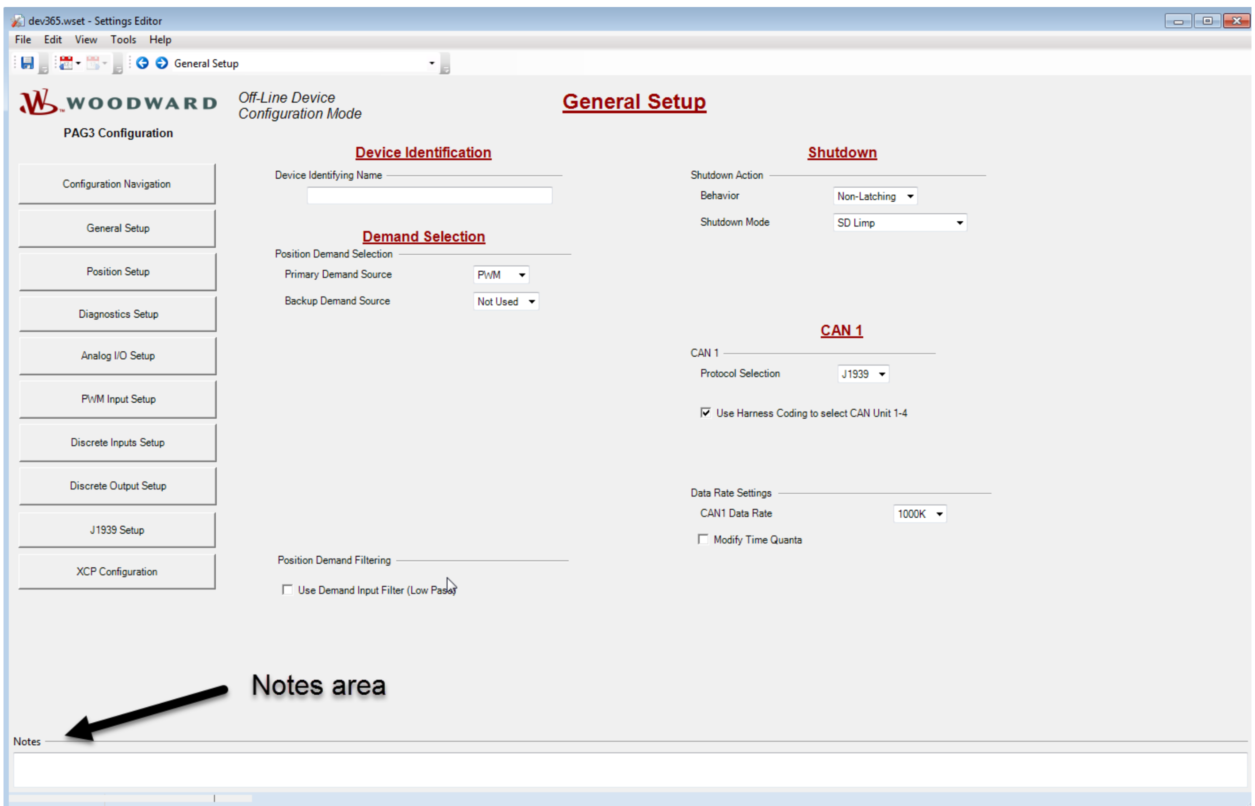


Figure 7-13. Configure General Setup

Device Identification

Device Identifying Name

This is a text field provided to allow customized description of the specific ProAct Gen3 device. This is displayed on the Dashboard to help identify the unit (see Figure 6-8).
Allowed values: free form text, 40 characters max. Default: blank

Demand Selection

Primary Demand Source

The Primary Position Demand input source can be set to one of the following:

Analog	Selects an analog (4-20 mA or 0-5V) position demand input.
PWM	Selects PWM position demand input.
CAN	Selects CAN position demand input.

Allowed values: Analog, PWM, CAN   Default: Analog

Backup Demand Source

The Backup Position Demand input source can be set to one of the following:

Not Used	Removes backup demand operation.
Analog	Selects an analog (4-20 mA or 0-5V) position demand input.
PWM	Selects PWM position demand input.
CAN	Selects CAN position demand input.

Allowed values: Not Used, Analog, PWM, CAN   Default: Not Used

Redundancy Settings

Note: only displayed if backup demand is used

Failback Inhibit

When the backup demand is in control (after primary has failed and is restored), this setting determines the max difference between the primary and the backup demands before transferring back into primary demand control. Allowed values: 0.0 to 100 % Default: 4 %

Failback Delay

Delay on the failback permissive before for allowing a transfer back to the primary demand. Allowed values: 0–100 seconds. Default: 10 seconds

Demand Tracking Fault

Function enable/disable for the Demand Tracking Fault. This function monitors the two demand inputs and verifies they are tracking each other within the defined window settings. Set to Not Used to disable. When set to Shutdown, detection of a tracking error will trigger a shutdown. When set to Alarm, detection of a tracking error will trigger an alarm and the configured 'Demand to Select on Error' will be forced into control. Allowed values: Not Used, Alarm, Shutdown. Default: Alarm

Tracking Error Settings

Note: only displayed if Demand Tracking Fault is Alarm or Shutdown

Tracking Error Threshold (%)

Maximum deviation between the primary position demand and the backup position demand. If the Error is exceeded for longer than the Tracking Error Delay, then a Tracking Error Fault occurs.
Allowed values: 0 % to 100 % (should be set greater than the Failback Inhibit setting). Default: 10 %

Tracking Error Delay (sec)

Delay for tracking error fault. Allowed values: 0–100 seconds. Default: 2 seconds

Demand to select on Track Error – *(Only displayed if configured as Alarm)*

Determines which demand input to select when the demands differ as determined by the tracking error detection, primary or backup. When primary is selected and a tracking error is detected, the primary demand remains in control. When backup is selected and a tracking error is detected, selects the backup demand as the position setpoint.
Allowed values: Primary, Backup. Default: Primary

Position Demand Filtering

Use Demand Input Filter (Low Pass)
Check this box to use a low pass filter on the position demand input. Potentially used for a noisy command signal. Uncheck this box to disable the filter. Default: not used.

Filter Time Constant – *(only displayed if filter is used)*
Sets the time constant of the low pass filter applied to the position command signal.
Adjustable range: 0 to 10 seconds. Default: 0.01

Shutdown Action

Behavior
Global selection of latching vs non-latching faults. When latching, diagnostics fault conditions remain latched until a reset command is issued whereas non-latching fault conditions do not require a reset and will automatically clear once the fault condition is removed.
Options: Non-Latching, Latching. Default: Non-Latching.

⚠WARNING	**A non-latching shutdown configuration can lead to a situation where the system is rapidly cycling between two states and should be used with caution.**

Shutdown Mode
Sets the action to take when a shutdown condition is detected. When set to 'SD Limp', the actuator drive current is turned off. When set to 'SD to position' the actuator drives to the Shutdown Position, over-riding the position command signal during a shutdown condition. When set to 'SD to Position then Limp' the actuator drives to the Shutdown Position for the configured time duration (delay before limp) and then goes limp.
Options: SD Limp, SD to Position, SD to Position then Limp. default= SD Limp.

Shutdown Position – *(only displayed if shutdown to position is used)*
Sets the position command when a shutdown condition is detected. This is used when the mode is set to either 'SD to Position' or 'SD to Position then Limp'. Adjustable range for 0-100 %. Default 0%.

Delay before Limp – *(only displayed if 'shutdown to position then limp' is used)*
Delay time the actuator controls at the Shutdown Position prior to transitioning to a limp (zero actuator drive current) mode. Adjustable range for 0-100 sec. Default 10.

CAN 1

CAN Protocol
Sets the CAN protocol. Set to None to completely disable CAN J1939 communications. Note: This will not affect the Service Tool communications.
Adjustable range: None, J1939. Default: J1939.

Use Harness Coding to select CAN Unit 1-4 – *(only displayed if J1939 is used)*
Check this box to allow up to 4 CAN modes (Unit 1 thru 4), selected on power up using harness coding. Refer to Harness Code information in Chapter 4 for details. Uncheck if this device is to only perform one application function. Default: used/checked.

Data Rate Settings

CAN1 Data Rate
Sets the CAN data rate for CAN1. Changes to this setting are only applied after a power cycle to the device. Note that CAN2 has a fixed data rate of 1000K bps. Adjustable range: 125K, 250K, 500K, or 1000K bps. Default 250K.

IMPORTANT	CAN Data Rate changes could result in loss of communication on CAN1. The Service Tool connection may be established on CAN2 as an alternative of unsuccessful attempts to connect on CAN1.

Modify Time Quanta Settings Selection
When checked, allows direct data setting of the CAN communication bit timing values. When unchecked, default values are used. Note that bit timing changes are only applied when the device is powered on. These settings should only be changed by advanced users who understand how the CAN bit timing values affect operation on the bus. Default: unchecked.

CAN1 Time Quanta Settings

Note: Only displayed if Modify Time Quanta is checked.

Total Time Quanta
Sets the total time quanta. Adjustable range: 8 to 25. Default 14.

Sample Point Time Quanta
Sets the sample point time quanta. Adjustable range: 6 to 17. Default 12.

Sync Jump Width
Sets the synchronization jump width. Adjustable range: 1 to 4. Default 2.

Position Setup Page

The Position Setup screen provides settings for actuator travel, controller settings, and the position lookup curve.

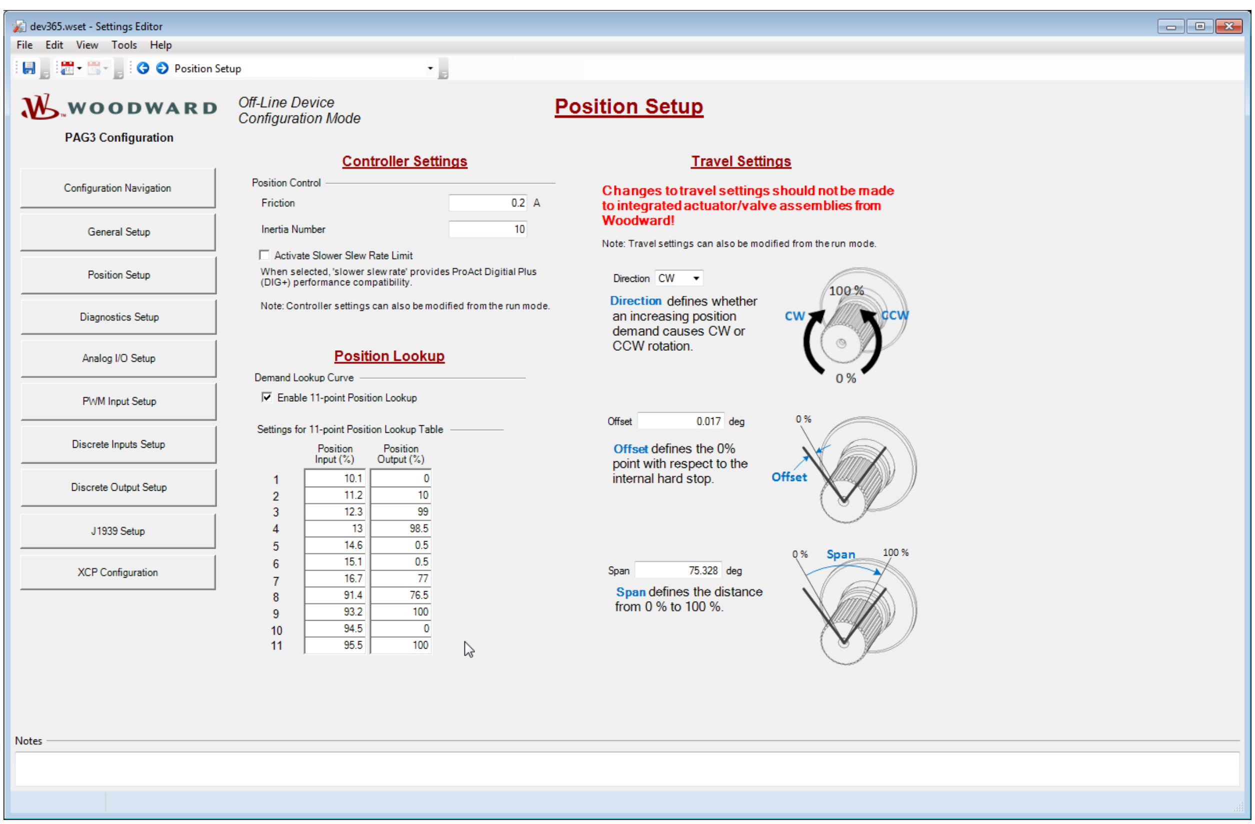


Figure 7-14. Configure Position Setup

Travel Settings

See Actuator Travel/Setup section in Chapter 6 for more details on calibrating the actuator travel.

Direction

Defines whether an increasing position demand causes **CW** or **CCW** rotation, as viewed looking into the output shaft.
Default = CW.

Offset

Sets the 0% command point with respect to the internal hard stop.
Adjustable range: 0-77°, default: 0.0

Span

Defines the change in output shaft angle as the position command goes from 0 % to 100 %. If a span is entered that would cause the actuator to try to move beyond the internal mechanical stop, it is automatically limited internally to keep the 0 to 100% stroke range within the mechanical stops.
Adjustable range: 0-77°, default: 70°

Controller Settings

Friction Setting

The friction setting represents the actuator current required to overcome static load friction.
Adjustable range: 0-4 Amps. Default: 0.1

See Controller Dynamics Adjustment section in Chapter 6 for more details and a tuning procedure.

Inertia Number

The inertia setting calibrates the position controller to the load inertia. A setting of zero represents the actuator shaft with no load attached. Higher load inertia requires a higher inertia setting.

If the inertia setting is too low, there may be a slow oscillation when the actuator should be steady, or the step response may show excessive overshoot and ringing. If the inertia setting is too high, a high frequency oscillation or limit cycle may be seen. If a range of values is seen to provide adequate response, the lowest value that does not produce overshoot should be chosen.

Adjustable range: 0-20. Default: 0

See Controller Dynamics Adjustment section in Chapter 6 for more details and a tuning procedure.

Activate Slower Slew Rate Limit

This setting is provided to emulate ProAct Digital Plus performance, which is slower than newer product versions. Checking this box slows the performance by applying a reduced slew rate limit on the position demand signal. When unchecked, performance is not reduced. Default: unchecked.

Position Lookup

The position lookup curve applies an 11-point look-up function to the position demand signal. The table defines the values at the breakpoints. If the demand is equal to an input breakpoint, the output will be the configured position output value. Between breakpoints the value is interpolated. At the endpoints the value is limited, equal to the last output value. Below the point 1 position input, the output is the point 1 position output. Likewise above the point 11 position input the output is set to the point 11 position output.

Enable 11-point Position Lookup

Check this box to use the position demand curve settings. Uncheck this box to ignore the position demand curve settings. Default: not used.

Position Input (%) – *(only displayed if position lookup is used)*
Sets position demand input breakpoints (%) for the demand curve. Each of the 11 breakpoint values must be larger than the previous and less than the next value. Adjustable range: 0 % to 100 %, must be monotonically increasing. Defaults 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.

Position Output (%) – *(only displayed if position lookup is used)*
Sets the position demand output percentage [11 points] for the configured position demand input breakpoint (%). Adjustable range: 0 % to 100 %, Defaults 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.

Diagnostics Setup Page

The Diagnostics Setup screen provides settings for the individually selectable diagnostics.

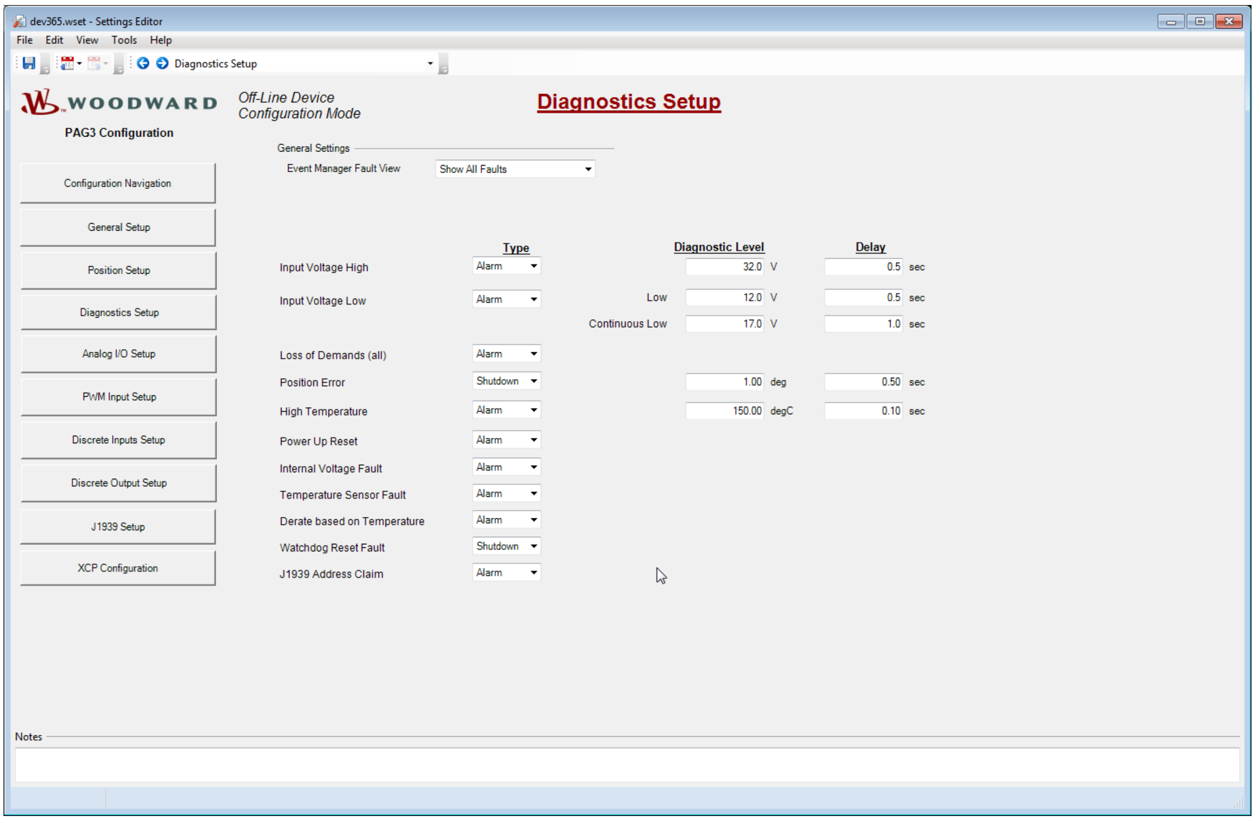


Figure 7-15. Diagnostics Setup

WARNING **It is recommended that all safety-related faults be configured as shutdowns to ensure maximum fault protection.**

NOTICE **With the exception of the individual position demand failures and power up reset, Woodward recommends using the actuator's fault detection feature with 'shutdown' as the resulting action. This will give the greatest amount of protection in a fault situation. If the severity of the fault does not warrant a shutdown, an 'alarm' setting will still provide the user with annunciation.**

Information on Diagnostic Fault Action Selection

- When diagnostic condition is set as '**Not Used'**, the condition will be ignored and will not be triggered as a diagnostic event. It will not provide any indications (i.e. not included in common alarm or shutdown).
- When diagnostic condition is set as an '**Alarm'**, it provides a common alarm indication and logs the event but allows the unit to attempt to continue running.
- If diagnostic condition is set as a '**Shutdown'**, upon detection, the configured shutdown action will be executed (e.g. shutdown to position). Additionally a common shutdown indication is provided and the event is logged in the event manager.

For details on each fault condition, refer to the Diagnostics section of the Description of Operation, Chapter 4.

Input Voltage High Settings

Input Voltage High Fault Action
Selects the action for input voltage high diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Input Voltage High Threshold
Sets the voltage, in V (dc), which triggers an input voltage high diagnostic indication.
Adjustable range: 0 to 40 V (dc). Default 33.

Input Voltage High Delay
Sets the high voltage diagnostic delay time, in seconds, before triggering an input voltage high diagnostic indication. Adjustable range: 0.1 to 120 seconds. Default 0.5

Input Voltage Low Settings

Input Voltage Low Fault Action
Selects the diagnostic action for input voltage low diagnostic condition, which includes both low and continuous low conditions. Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Input Voltage Low Threshold
Sets the voltage, in V (dc), which triggers an input voltage low diagnostic indication.
Adjustable range: 0 to 32 V (dc). Default 9.

Input Voltage Low Delay
Sets the low voltage diagnostic delay time, in seconds, before triggering an input voltage low diagnostic indication. Adjustable range: 0.1 to 120 seconds. Default 0.5

Input Voltage Low Continuous Threshold
Sets the voltage, in V (dc), which triggers an input voltage low diagnostic indication. This value is typically set to a higher value than the Input Voltage Low Threshold.
Adjustable range: 0 to 32 V (dc). Default 12.

Input Voltage Low Continuous Delay
Sets the low voltage diagnostic delay time, in seconds, before triggering an input voltage low diagnostic indication. This value is typically set to a longer time than the Input Voltage Low Delay. Adjustable range: 0.1 to 120 seconds. Default 70

Position Demand Settings

Loss of All Position Demands
Selects the action for the loss of all (primary and backup) position demands diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Shutdown.

Position Error Settings

Position Error Fault Action
Selects the diagnostic action for the position error diagnostic condition. This indicates a deviation is detected between the expected position and actual position.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Position Error Limit
Sets the difference, in degrees, which triggers a diagnostic indication.
Adjustable range: 1 to 50°. Default 2.

Position Error Time Constant
Sets the time constant, in seconds, of a filter that is applied to the difference between expected and actual positions, which is then compared to the Position Error Limit. Adjustable range: 0 to 100 seconds. Default 1.

High Temperature Diagnostic Settings

High Temperature Fault Action
Selects the action for the Temperature High diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

High Temperature Diagnostic Threshold
Sets the temperature, in degree Celsius, which triggers a high temperature diagnostic indication.
Adjustable range: 25 to 150 °C. Default 95.

High Temperature Delay
Sets the Temperature High diagnostic delay time, in seconds, before triggering a diagnostic indication.
Adjustable range: 0 to 100 seconds. Default 0.5.

Fault Action Settings

Power Up Reset
Selects the diagnostic action when a device power up has been detected.
Adjustable range: Not Used, Alarm, Shutdown. Default Not Used.

Internal Voltage Fault
Selects the action for the monitored internal voltage signals out-of-range diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Temperature Sensor Fault
Selects the action for internal temperature sensor fault diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Derate based on Temperature (self-protection)
Enable the self-protection function which limits current to the actuator drive when internal temperature exceeds 100 degC. This action reduces additional heat rise preventing the device from catastrophic and irreparable failure due to overheating. A selection of Not Used is not recommended except in very specific cases such as specific marine or military applications.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

⚠WARNING	**It is recommended that all safety-related faults be configured as shutdowns to ensure maximum fault protection.**

Watchdog Reset Fault
Selects the diagnostic action upon detection of a watchdog reset diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

J1939 Address Claim Fault – *(only displayed if J1939 is used)*
Selects the diagnostic action for the J1939 address claim fault condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

CAN Demand Faults

Note: only displayed if CAN demand is used.

CAN Demand Fault – *(only displayed if non-redundant CAN Demand is used)*
Selects the diagnostic action for the CAN demand failed (no signal or too slow) fault condition. When redundancy is used, this fault is automatically set as an alarm.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Too Slow
Sets the maximum time between received CAN position messages for loss of CAN demand detection. If the message reception rate drops below this threshold a CAN No Signal fault will be annunciated.
Adjustable range: 5 to 100. Default 30.

No Signal
Sets the timeout for loss of CAN demand messages. Exceeding this timeout will trigger a CAN No Signal fault. Adjustable range: 10 to 10000 ms. Default 30.

CAN Bus Fault – *(Only displayed if CAN is the only position demand source.)*
Selects the diagnostic action for the CAN bus error passive fault condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Analog I/O Setup Page

The Analog I/O Setup screen provides settings for the position demand analog input (type, scaling, diagnostics) and the settings for the analog output.

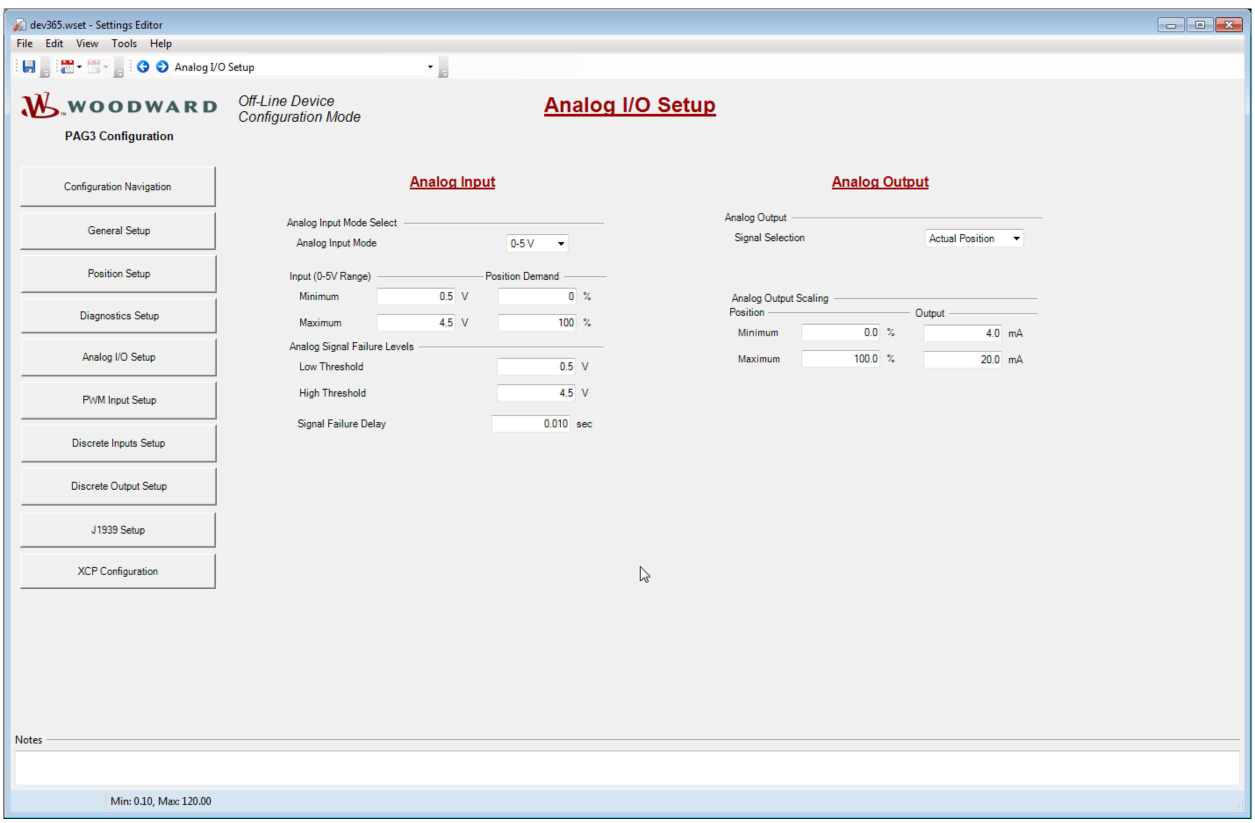


Figure 7-16. Configure Analog I/O Setup

Analog Input Section

Note: (only displayed if Analog demand is used)

The analog input section provides settings for the analog input mode, analog position demand scaling and fault thresholds.

Analog Input Mode
Sets the position demand analog input type as either a 4-20 mA input or a 0-5 V input.
Adjustable range: 4-20 mA, 0-5V. Default 0-5V.

Analog Input Signal Scaling

Minimum Input
Sets the input value corresponding to the minimum Position Demand setting (typically 0%). Setting the minimum higher than the maximum is allowed to provide for a reverse acting signal as needed.
Adjustable range for 4-20 mA input: 0 to 25 mA. Default 4 mA.
Adjustable range for 0-5 V input: 0 to 5 V. Default 0.5 V

Maximum Input
Sets the input value that corresponds to the maximum Position Demand setting (typically 100%).
Adjustable range for 4-20 mA input: 0 to 25 mA. Default 20 mA.
Adjustable range for 0-5 V input: 0 to 5 V. Default 4.5 V

Position Demand at Min Input
Scales the position demand, in percent, for the configured Min Input setting.
Adjustable range: 0 to 100 %. Default 0

Position Demand at Max Input
Scales the position demand, in percent, for the configured Max Input setting.
Adjustable range: 0 to 100 %. Default 100

Analog Signal Failure Settings

Analog Input Low Fault Action – *(only displayed if non-redundant Analog Demand is used)*
Selects the action for the analog demand low diagnostic condition. When redundancy is used, this fault is automatically set as an alarm. Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Analog Input Low Threshold
Sets the threshold value, in milliamps or volts, which triggers an analog input low fault indication.
Adjustable range for 4-20 mA input: -1.0 to 23.8 mA. Default 2 mA
Adjustable range for 0-5 V input: -0.2 V to 5 V. Default 0.25 V

Analog Input High Fault Action – *(only displayed if non-redundant Analog Demand is used)*
Selects the action for the analog demand high diagnostic condition. When redundancy is used, this fault is automatically set as an alarm. Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Analog Input High Threshold
Sets the threshold value, in milliamps or volts, which triggers an analog input high fault indication.
Adjustable range for 4-20 mA input: 0.3 to 23.8 mA. Default 22 mA
Adjustable range for 0-5 V input: 0 V to 5 V. Default 4.75 V

Signal Failure Delay
Sets the delay time for exceeding a low or high threshold prior to triggering an analog input fault. A shorter time is recommended when demand redundancy is used, to minimize failure transitions and facilitate faster switchover. A longer, more forgiving time is generally configured when only a single demand is used. Two delay values are stored, one for the single demand case and one for the redundant demand case. Only the applicable one is shown.
Adjustable range for single demand: 0.01 to 5 seconds. Default 0.1
Adjustable range for redundant demands: 0.01 to 5 seconds. Default 0.01.

Analog Output

Analog Output Signal Selection

Selects the source of the analog output. Set to Not Used to completely turn the output off.
Allowed Values: Not Used, Actual Position, Position Setpoint. Default: Actual Position.

Analog Output Min Position

Sets the actuator position, in percent, that corresponds to the output mA at Min Position setting. Adjustable range: 0 to 100 %. Default 0

Analog Output Max Position

Sets the actuator position, in percent, that corresponds to the output mA at Max Position setting.
Adjustable range: 0 to 100 %. Default 100

Output mA at Min Position

Scales the output current for the configured analog output Min Position setting.
Adjustable range: 0 mA to 25 mA. Default 4

Output mA at Max Position

Scales the output current for the configured analog output Max Position setting.
Adjustable range: 0 mA to 25 mA. Default 20

PWM Input Setup Page

The PWM Input Setup screen provides the PWM position demand input settings including input type, input scaling and input diagnostics.

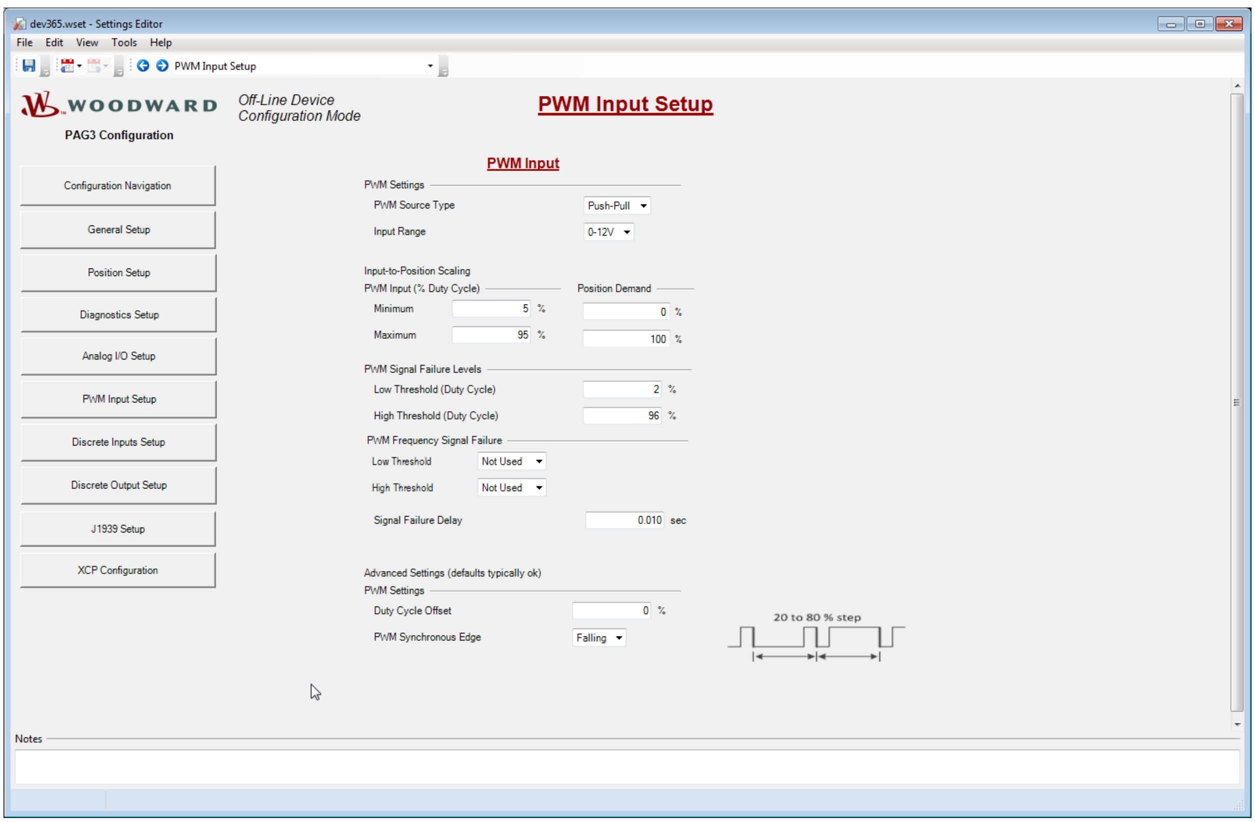


Figure 7-17. Configure PWM Input Setup

PWM Input

Note: only displayed if PWM demand is used

PWM Source Type
Sets the PWM source type that is driving the PWM input as Low-Side or Push-Pull. Default Push-Pull.

Input Range
Selects either 0-5V or 0-12V range for the PWM input signal when the PWM source type is Push-Pull. When the PWM source type is Low-Side, this setting is ignored and the 0-12V range is used. Default 0-12V.

For additional details see PWM Input section in Chapter 3.

PWM Input-to-Position Scaling

PWM Duty Cycle Min Input
Sets the PWM Duty Cycle, in percent that corresponds to the Position Demand at Min Input setting. Setting the minimum duty cycle higher than the maximum is allowed to provide for a reverse acting signal as needed. Adjustable range: 5 to 95 %. Default 10

PWM Duty Cycle Max Input
Sets the PWM Duty Cycle, in percent that corresponds to the Position Demand at Max Input setting. Adjustable range: 5 to 95 %. Default 90

Position Demand at Min Input
Scales the position demand, in percent, for the configured PWM Duty Cycle Min Input setting. Adjustable range: 0 to 100 %. Default 0

Position Demand at Max Input
Scales the position demand, in percent, for the configured PWM Duty Cycle Max Input setting. Adjustable range: 0 to 100 %. Default 100

PWM Input Signal Failure Levels

PWM Demand Low Duty Cycle Fault Action – *(only displayed if non-redundant PWM Demand is used)*
Selects the action for the PWM demand duty cycle low diagnostic condition. When redundancy is used, this fault is automatically set as an alarm. Adjustable range: Not Used, Alarm, Shutdown. Default Alarm.

Low Threshold (Duty Cycle)
Sets the PWM duty cycle, in percent, which triggers a PWM Duty Cycle Low fault indication. Adjustable range: 0 to 100 %. Default 2

PWM Demand High Duty Cycle Fault Action – *(only displayed if non-redundant PWM Demand is used)*
Selects the action for the PWM demand duty cycle low high diagnostic condition. When redundancy is used, this fault is automatically set as an alarm.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm

High Threshold (Duty Cycle)
Sets the PWM duty cycle, in percent, which triggers a PWM Duty Cycle High fault indication. Adjustable range: 0 to 100 %. Default 98

PWM Demand Low Frequency Fault Action – *(only displayed if PWM frequency diagnostic is used)*
Selects the action for the PWM demand frequency low diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm

Low Threshold (Frequency)
Sets the PWM frequency, in Hz, which triggers a PWM Frequency Low fault indication.
Adjustable range: 0 to 10000 Hz. Default 90

PWM Demand High Frequency Fault Action – *(only displayed if PWM frequency diagnostic is used)*
Selects the action for the pwm demand frequency low high diagnostic condition.
Adjustable range: Not Used, Alarm, Shutdown. Default Alarm

High Threshold (Frequency)
Sets the PWM frequency, in hertz, which triggers a PWM Frequency High fault indication.
Adjustable range: 0 to 10000 Hz. Default 3300

Signal Failure Delay
Sets the delay time for exceeding a low or high threshold prior to triggering a PWM input fault. The same delay applies to both frequency and duty cycle diagnostics. A shorter time is recommended when demand redundancy is used, to minimize failure transitions and facilitate faster switchover. A longer, more forgiving time is generally configured when only a single demand is used. Two delay values are stored, one for the single demand case and one for the redundant demand case. Only the applicable one is shown.
Adjustable range for single demand: 0.01 to 5 seconds. Default 0.2
Adjustable range for redundant demands: 0.01 to 5 seconds. Default 0.01

PWM Duty Cycle Offset
Duty Cycle offset that is added to the input to compensate for duty cycle measurement error caused by slow signal edge transitions that create a constant offset error. Adjustable range: –3 % to +3 %. Default 0

PWM Synchronous Edge
Specifies which edge of the PWM occurs at a constant frequency as the duty cycle changes. This is the edge that will be used for the frequency measurement. Setting this to the correct value prevents changes in duty cycle from being interpreted as a frequency change. This setting can be disregarded if PWM demand low and high frequency faults are configured as Not Used and the PWM de-glitch filter is disabled.
Allowed values: Falling or Rising. Default Rising.

Enable De-glitch Filter
When checked, enables a de-glitch filter that rejects false edges due to electrical noise on the PWM signal. Enabling the glitch filter can also cause extra delay in the detection time for PWM diagnostics, however, so it is recommended to only enable the filter if needed.

Discrete Inputs Setup Page

The Discrete Inputs Setup screen provides settings for mapping of discrete input functions and configuration of the discrete inputs (pull up/down, active open/closed).

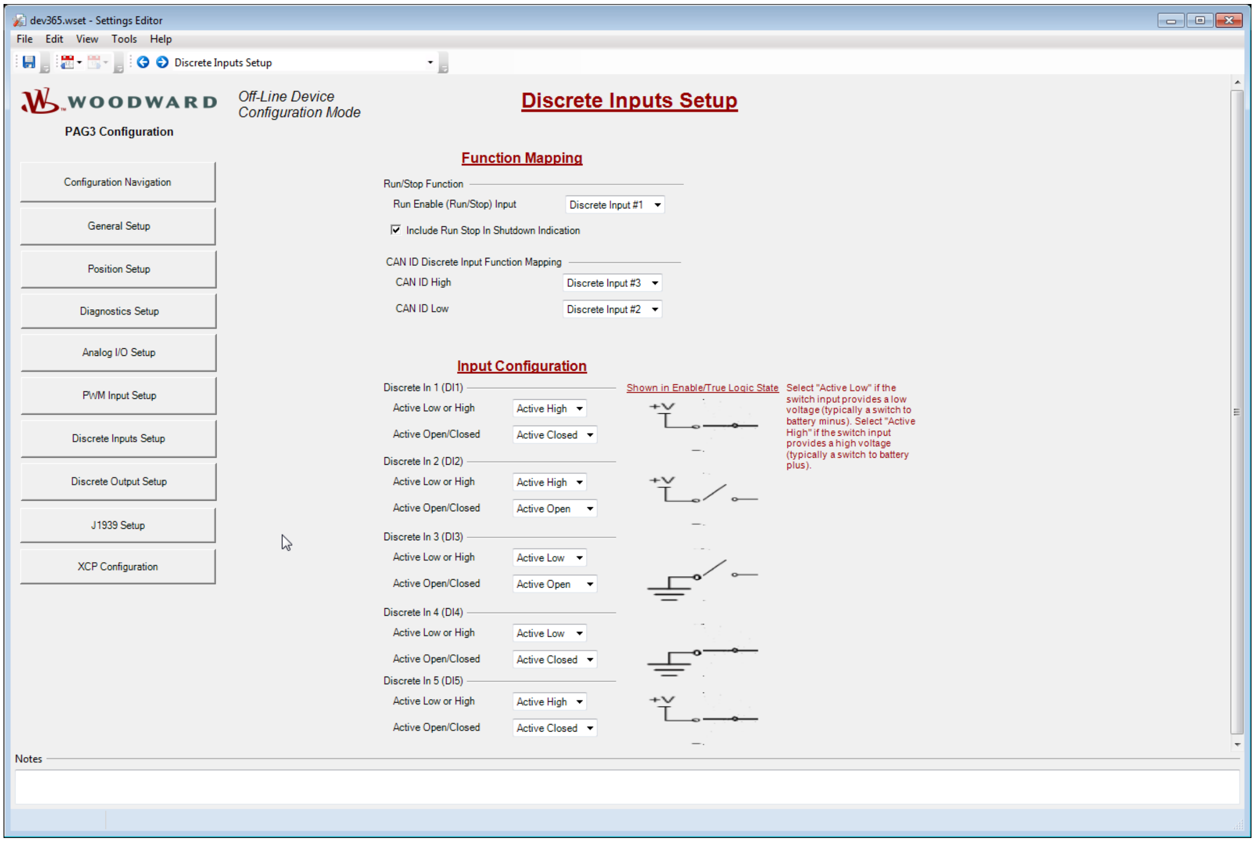


Figure 7-18. Configure Discrete Inputs Setup

Function Mapping

Run Enable

Selection of the discrete input to be used for the Run/Stop function. Set to Always Enabled if the Run Enable function isn't needed. Options: Always Enabled, Discrete Input #1, Discrete Input #2, Discrete Input #3, Discrete Input #4, Discrete Input #5. Default: Discrete Input #1

Include Run Stop In Shutdown Indication

The Run Stop active indication, for reporting purposes, can be included in (or excluded from) the common shutdown indication using this selection. A Stop command will force a limp mode regardless of this setting. When checked, the Stop will be included in the common shutdown indication and when unchecked it will be a common alarm indication. Default: included/checked.

CAN ID Discrete Input Mapping

Note: only displayed if harness coding is used, see the General Setup page section.

CAN ID High

Select the CAN ID High input. Options: Discrete Input #1, Discrete Input #2, Discrete Input #3, Discrete Input #4, Discrete Input #5. Default: Discrete Input #3

CAN ID Low

Select the CAN ID Low input. Options: Discrete Input #1, Discrete Input #2, Discrete Input #3, Discrete Input #4, Discrete Input #5. Default: Discrete Input #2

CAN ID Determination
The CAN unit number is determined on power-up by reading discrete inputs and determining the selected unit number (see chart below) based on the configuration of the CAN ID HIGH and LOW. The active/selected CAN unit number is displayed on the Overview screen.

Table 7-1. Unit # to CanId State

Unit Number	CanIdHigh	CanIdLow
1	Off	Off
2	Off	On
3	On	Off
4	On	On

IMPORTANT **The CAN ID discrete inputs are read at power up. Changes to configuration settings or input state will not take effect until the next power cycle.**

Input Configuration

Active Low or High
Select active high if the switch input provides a high voltage (typically a switch to battery positive) or active low if the switch input provides a low voltage (typically a switch to battery minus).
Adjustable range: Active High or Active Low. Default: Active Low.

Active Open/Closed
Select active closed to activate the condition with a closed switch contact (closed=on, open=off) or select active open to activate with an open contact (open=on, closed=off).
Adjustable range: Active Closed or Active Open. Default: Active Closed.

For examples and additional detail see Discrete Inputs section in Chapter 3.

Discrete Output Setup Page

The Discrete Output Setup screen provides settings for the discrete output.

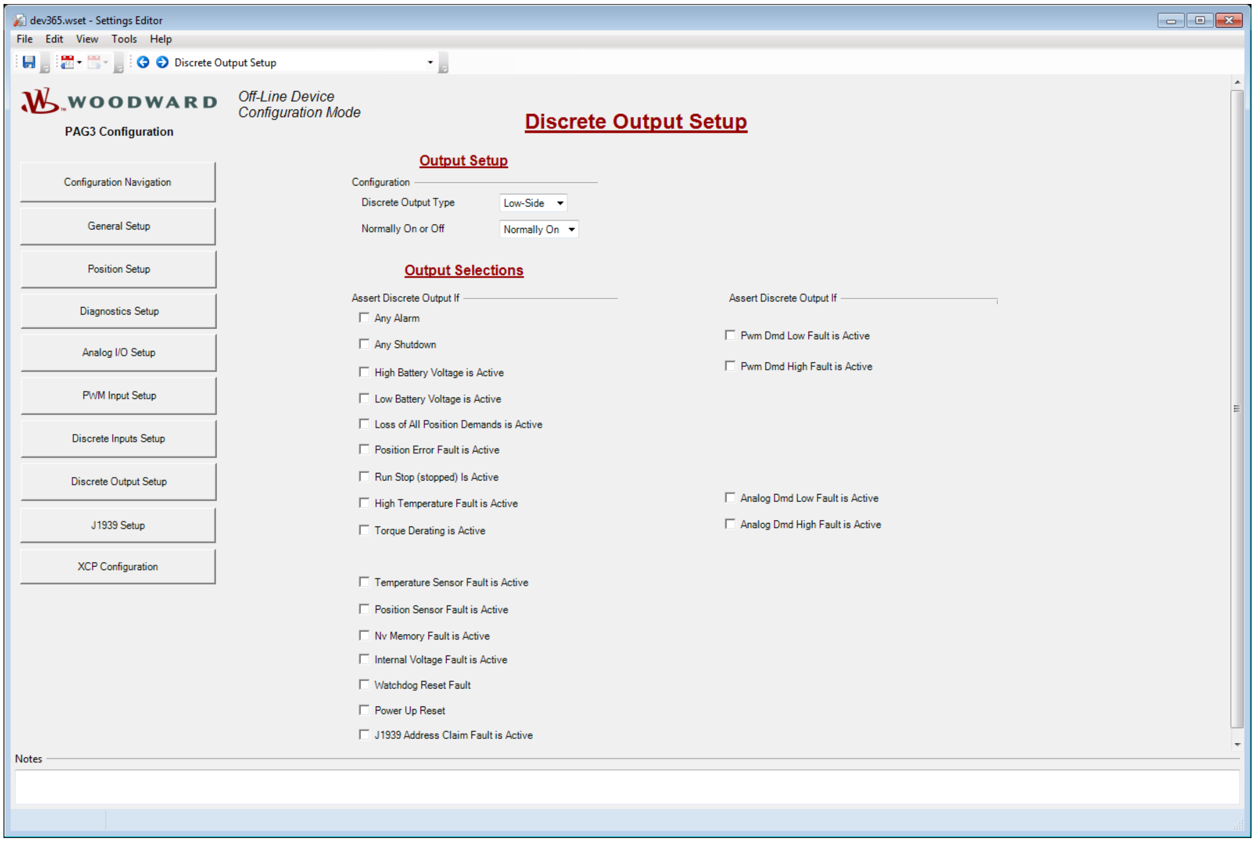


Figure 7-19. Configure Discrete Output Setup

Discrete Out

Type

Sets the drive output type for the discrete output signal as either low-side or high-side. Adjustable range: Low-Side or High-Side default: Low-Side.

Normally On or Off Selection

Sets the output as normally on or normally off. When checked and the Source condition is false, the discrete output will be turned on (normally energized). Adjustable range: Normally On or Normally Off. Default: Normally On.

Output Selections Section

Selects the condition or conditions that control the discrete output signal. Only valid selections appear. These diagnostics are not available if their individual fault action setting is Not Used.

For example, if the Position Error diagnostic is configured to be an alarm, the discrete output is configured to be Normally On, and Any Shutdown and Position Error conditions are selected, then the discrete output will be on unless a shutdown or position error fault occurs.

Output options:
Any Alarm
Any Shutdown
High Battery Voltage
Low Battery Voltage
Run/Stop Active
Loss of All Demands
Position Error Fault
Demand Tracking Fault
Analog Demand High Fault
Analog Demand Low Fault
PWM Demand High Fault
PWM Demand Low Fault
PWM Frequency High Fault
PWM Frequency Low Fault
CAN Bus Fault
J1939 Address Claim Fault
CAN Demand Failed
CAN Stop Commanded (CAN Run/Stop)
High Temperature Fault
Torque Derating Active
Zero Torque Fault
Temperature Sensor Fault
Power Up Reset
Watchdog Reset
Position Sensor Fault
NV Memory Fault
Internal Voltage Fault

WARNING — **It is recommended that the Discrete Output be configured for the 'Normally Energized' mode, to ensure maximum fault protection and annunciation. Failure to follow these guidelines could, under exceptional circumstances, lead to personal injury and/or property damage.**

J1939 Setup Page

The J1939 Setup screen provides settings for the message mode, J1939 NAME, optional message enabling and PGN settings. The screen displayed varies with the Use Harness Coding setting (provided on the General Setup screen). When harness coding is used, settings for units 1-4 are displayed (Figure 7-20b) otherwise only one set is provided (Figure 7-20a).

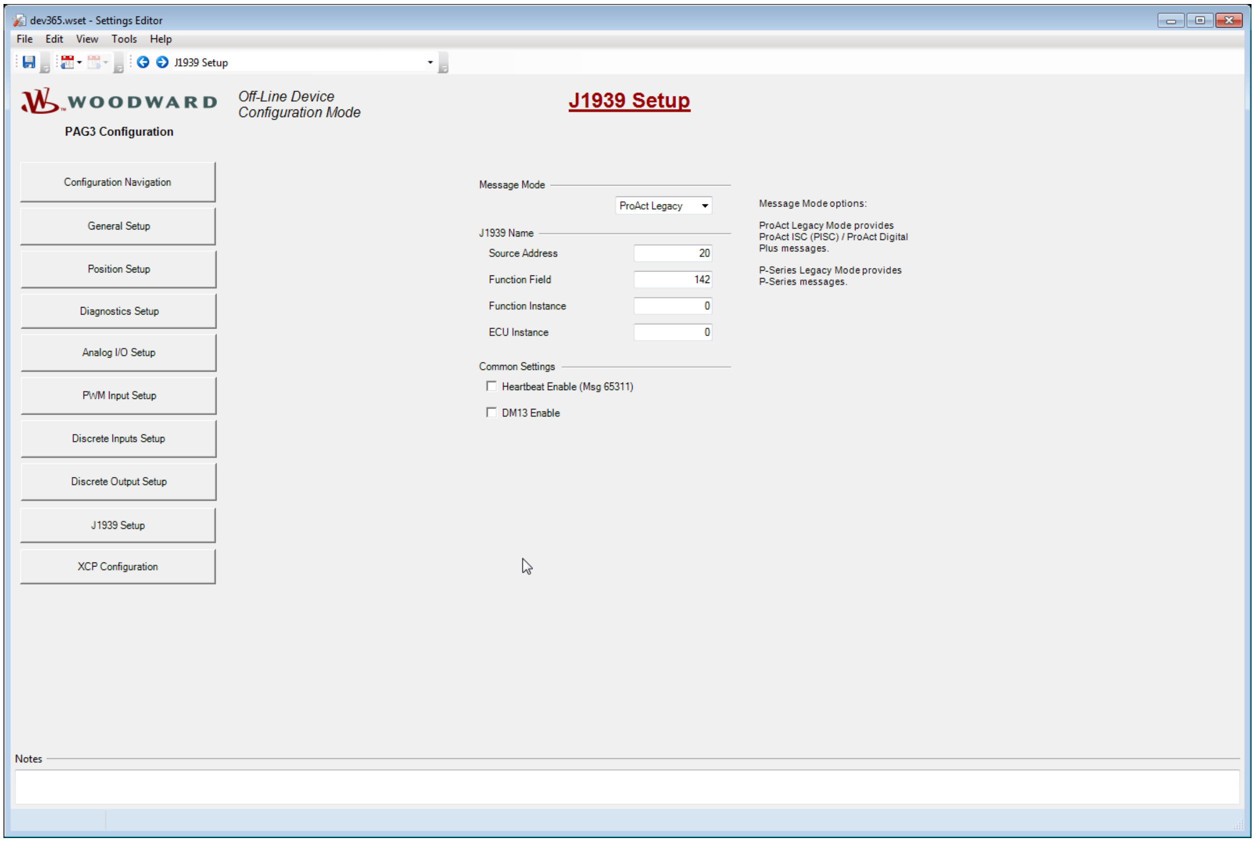


Figure 7-20a. J1939 Settings without Harness Coding

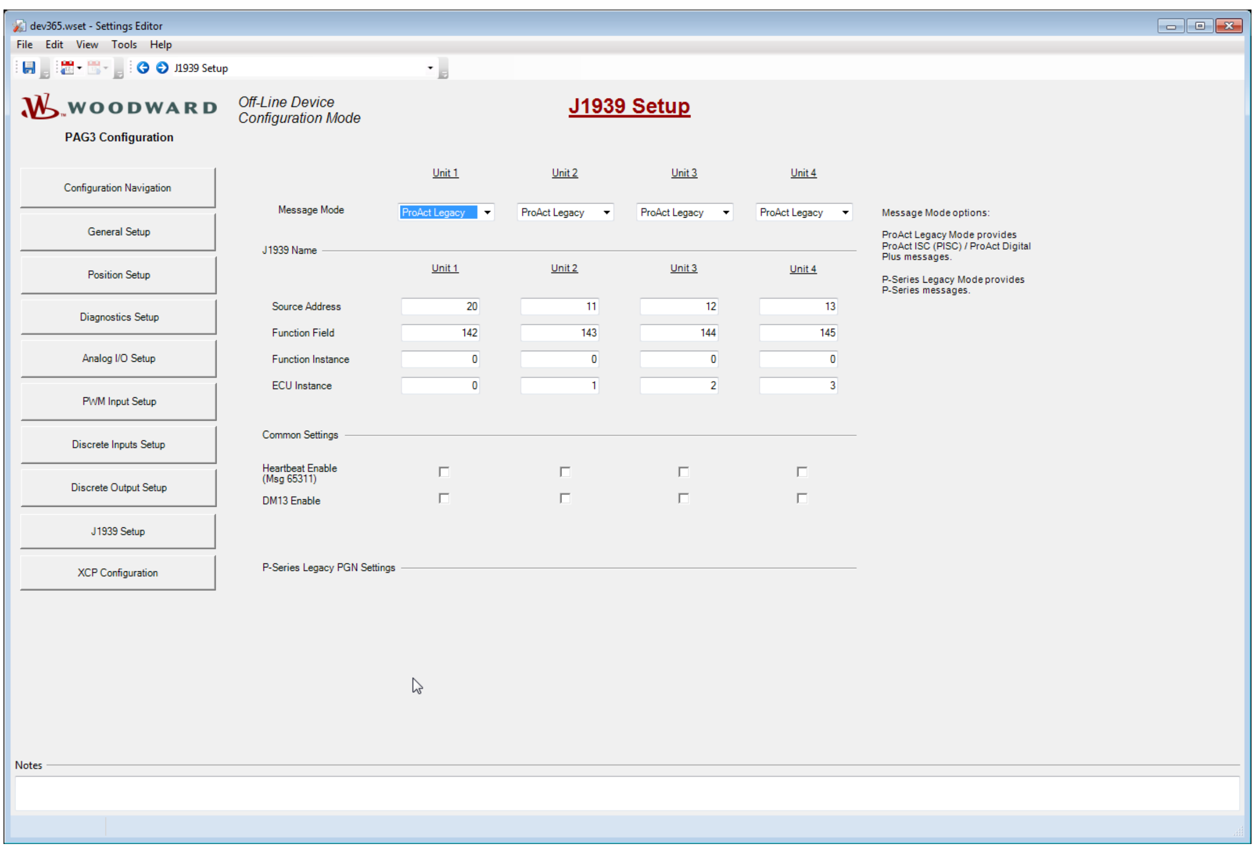


Figure 7-20b. J1939 Settings with Harness Coding Used

Message Mode
Select the J1939 messaging mode. Four legacy mode selections are available, which provide messages that are preconfigured to be the same as previous (legacy) versions of the ProAct actuator family. With P-Series Legacy, the data and position command PGNs are configurable (see Legacy PGN Settings). With ProAct Legacy, P-Series PISC, or Digital Plus, all messaging is preconfigured. No additional settings are provided with exception to the J1939 Name and optional messages.

Message Mode options are:
ProAct Legacy
Messages are the same as in the ProAct Gen 2 product.

P-Series Legacy
Messages are the same as in the P-Series and P-Series FL (Flex) product.

P-Series PISC
Messages are the same as in the P-Series and P-Series FL (Flex) product when it is configured for its “Legacy Message Mode”, which provides messages that are similar to, but not identical to, the ProAct Gen 2 product.

Digital Plus
Messages are the same as in the ProAct Digital Plus product.

Default: P-Series Legacy.

J1939 NAME

Source Address
Sets the J1939 source address for each harness code address (Unit 1-4).
Allowed values: 0-253 Defaults: 34, 34, 34, 34

Function Field
Sets the J1939 Name function field for each harness code address (Unit 1-4).
Allowed values: 0-255 Default: 144, 147, 143, 142

Function Instance
Sets the J1939 Name function instance for each harness code address (Unit 1-4).
Allowed values: 0-31 Default: 0 (First Instance)

ECU Instance
Sets the J1939 Name ECU instance field for each harness code address (Unit 1-4).
Allowed values: 0-7 Defaults: 0, 1, 2, 3

Common Legacy Settings

Heartbeat Enable (Msg 65311)
Select if the heartbeat counter message shall be sent by the ProAct Gen3, PGN 65311. Defaults: unchecked

DM13 Enable
Select if DM13 shall be supported by the ProAct Gen3. Defaults: unchecked

P-Series Legacy PGN Settings
Note: only displayed for P-Series Legacy message mode

Data Message PGN
Sets the PGN for the data message (Tx) when P-Series legacy mode is selected. Allowed values: 0-131071. Defaults: 65266, 64916, 65174, 64931

Position Command PGN *(Only displayed if CAN is used for position command)*
Sets the PGN for the position command (Rx) message when P-Series legacy mode is selected. Allowed values: 0-131071. Defaults: 61466, 64981, 61486, 64931

XCP Configuration Page
The XCP Configuration screen provides access to set the first and second XCP instances on CAN1 command and response identifiers based on presets using a node identifier enumeration or optionally user-defined identifiers. XCP is the protocol used by the Service Tool to communicate with the ProAct Gen3. Note that CAN2 has fixed identifiers that are not affected by these settings.

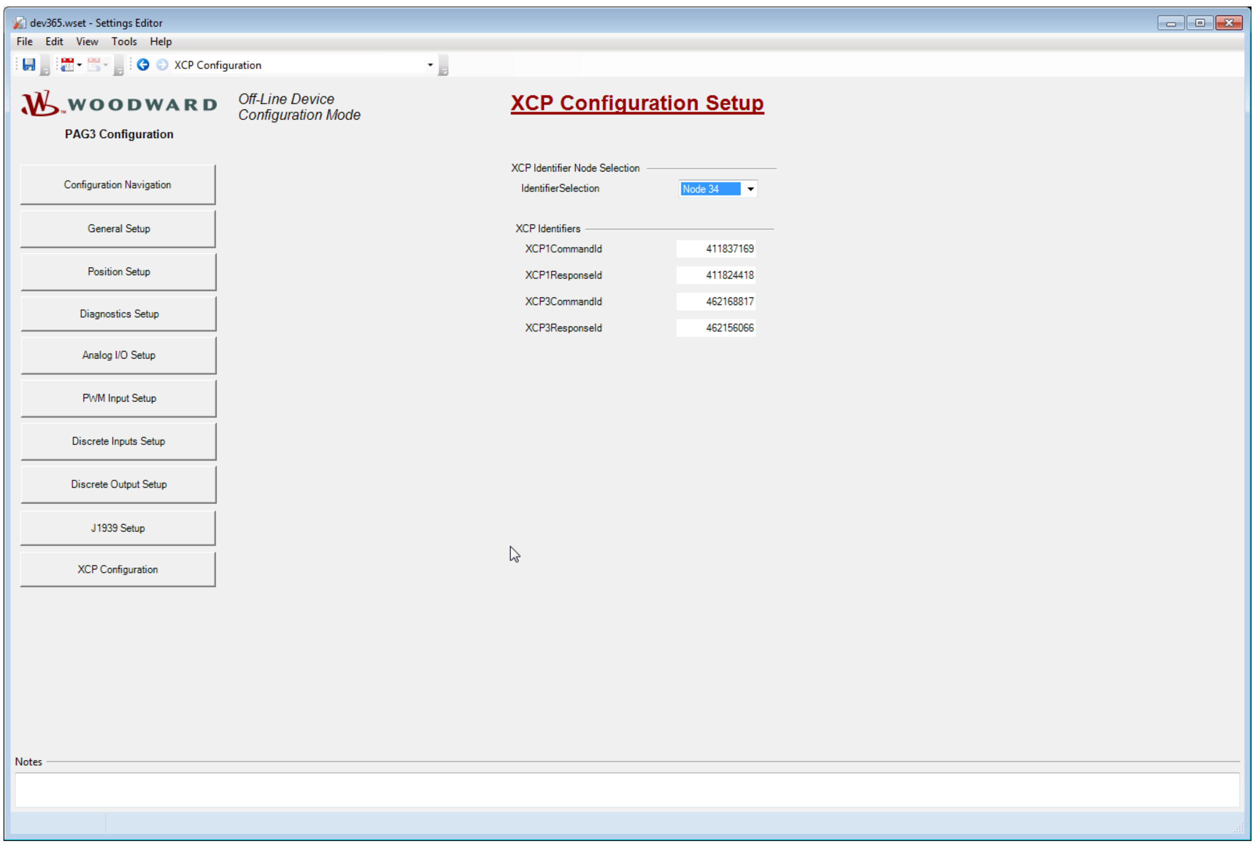


Figure 7-21. XCP Configuration Page

IMPORTANT	The CAN identifiers are only displayed/edited with base 10 (decimal) representation; however, the identifier must be entered as base 16 (hexadecimal) on the Service Tool connect dialog.

Identifier Selection
Select a default node identifier from a list of presets which automatically set the CAN1 XCP instance command and response identifiers as outlined in Table 7-2 or select UserDefined for custom configurations. Default Node 34.

XCP1 Command Id – *only editable when Identifier Selection is set to UserDefined*
Set the first instance (CAN1) command identifier. Default 411837169.

XCP1 Response Id – *only editable when Identifier Selection is set to UserDefined*
Set the first instance (CAN1) response identifier. Default 411824418.

XCP3 Command Id – *only editable when Identifier Selection is set to UserDefined*
Set the second instance (CAN1) command identifier. Default 462168817.

XCP3 Response Id – *only editable when Identifier Selection is set to UserDefined*
Set the second instance (CAN1) response identifier. Default 462156066.

IMPORTANT	**CAN identifier changes will only take effect after a save and power-cycle of the module. After changing identifiers, be sure to explicitly disconnect the Service Tool and reconnect using the updated identifiers (if connected on CAN1).**

Table 7-2. XCP on CAN1 Command/Response Identifiers

Identifier Selection	1st Instance on CAN1 (XCP1)		2nd Instance on CAN1 (XCP3)	
	Command Id	Response Id	Command Id	Response Id
Node 34	0x188C22F1 (411837169)	0x188BF122 (411824418)	0x1B8C22F1 (462168817)	0x1B8BF122 (462156066)
Node 128	0x188C80F1 (411861233)	0x188BF180 (411824512)	0x1B8C80F1 (462192881)	0x1B8BF180 (462156160)
Node 129	0x188C81F1 (411861489)	0x188BF181 (411824513)	0x1B8C81F1 (462193137)	0x1B8BF181 (462156161)
Node 130	0x188C82F1 (411861745)	0x188BF182 (411824514)	0x1B8C82F1 (462193393)	0x1B8BF182 (462156162)
Node 131	0x188C83F1 (411862001)	0x188BF183 (411824515)	0x1B8C83F1 (462193649)	0x1B8BF183 (462156163)
Node 132	0x188C84F1 (411862257)	0x188BF184 (411824516)	0x1B8C84F1 (462193905)	0x1B8BF184 (462156164)
Node 133	0x188C85F1 (411862513)	0x188BF185 (411824517)	0x1B8C85F1 (462194161)	0x1B8BF185 (462156165)
Node 134	0x188C86F1 (411862769)	0x188BF186 (411824518)	0x1B8C86F1 (462194417)	0x1B8BF186 (462156166)
Node 135	0x188C87F1 (411863025)	0x188BF187 (411824519)	0x1B8C87F1 (462194673)	0x1B8BF187 (462156167)
Node 136	0x188C88F1 (411863281)	0x188BF188 (411824520)	0x1B8C88F1 (462194929)	0x1B8BF188 (462156168)
Node 137	0x188C89F1 (411863537)	0x188BF189 (411824521)	0x1B8C89F1 (462195185)	0x1B8BF189 (462156169)

IMPORTANT

CAN1 and CAN2 use the same default IDs. The two CAN ports are not intended to be tied together.

ID format is compatible with ISO15765 and SAE J1939 as both protocols are frequently used on the same network.

Priority field is 6 in all cases. This puts it above multi-package messages but no higher than other low frequency messages on the bus.

The data page is 00b for instance 1 and 11b (ISO reserved range) for instance 2.

In the XCP Id selector, "Node" is referring to the source address (for responses) and DA field (for commands). 0xF1 (241) is used for the ToolKit address.

Chapter 8.
Troubleshooting

Introduction

This chapter presents several broad categories of application failures typically experienced in the field, possible causes, and some tests used to verify the causes. Because the exact failure experienced in the field is the product of the mechanical/electrical failure combined with the configuration file resident in the control, it is left as the OEM's responsibility to create a more detailed troubleshooting chart for the end user. Ideally, this end-user troubleshooting chart will contain information about mechanical, electrical, engine, and load failures in addition to the possible governor failures. For more detailed information about governor system failure modes and effects, contact Woodward for a copy of the system IAFMEA.

The troubleshooting scenarios listed below assume that the end user has a digital multi-meter at their disposal for testing voltages and checking continuity, and assume that the application has been engineered and tested thoroughly.

General System Troubleshooting Guide

The following is a general troubleshooting guide for areas to check which may present potential difficulties. By making these checks appropriate to your engine/turbine before contacting Woodward for technical assistance, your system problems can be more quickly and accurately assessed.

- Is the wiring correct?
- Is the direction of the stroke correct?
- Is the direction of the failsafe shutdown correct?
- Does the valve move through its proper stroke smoothly?
- Does the valve travel its full stroke?
- Can mid-stroke be obtained and held?
- Does the valve fully seat (close)?
- Does the valve fully open?

⚠WARNING	**The actions described in this troubleshooting section are not always appropriate in every situation. Always make sure that any action taken will not result in loss of equipment, personal injury, or loss of life.**

⚠WARNING **Overspeed / Overtemperature / Overpressure**	**The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.** **The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.**

⚠WARNING	**The ProAct Gen3 wiring must be in accordance with North American Class I, Division 2 or Zone 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.**

CAUTION **The ProAct Gen3 is used on prime movers that typically have a high noise level. Always use appropriate hearing protection while working around the ProAct Gen3.**

NOTICE **No maintenance is allowed on the actuator.**

There are three parts to the troubleshooting section:
- Troubleshooting system problems
- Troubleshooting ProAct Gen3 Diagnostic Flags (for specific faults)
- Electrical Troubleshooting Guide (for general I/O issues)

The first section is used for situations where the system is not acting correctly, but the ProAct Gen3 is not giving any diagnostic flags. The second section is used if the ProAct Gen3 has diagnostic flags active. The third section provides a guide for general input/output issues.

Engine/Generator Troubleshooting

Table 8-1. Engine/Generator Troubleshooting

Problem	Possible Cause	Suggested Test/Correction
Engine does not start.	Power not applied to actuator	Test for +24 V between power input and ground on terminal block.
	Incorrect configuration in actuator	Verify the configuration using the Service Tool.
	Stuck throttle/frozen shaft	Move throttle by hand. Assess smoothness, friction, and return spring force.
	Incorrect configuration in actuator	Using Service Tool, read configuration from control and evaluate parameters for correction.
	Fault detected in actuator	Using Service Tool, read faults from control. Verify/correct any shutdown conditions.
The actuator is not opening the control valve during engine cranking.	No command input is present at the actuator	Verify Command input from controller.
	The actuator is configured for the wrong opening direction	Check linkage setup. Check device configuration.
	The actuator has detected a shutdown situation and has not been reset	Execute a 'reset command' to clear the faults. Verify configuration selection, latching vs non-latching faults.
	There is no power supplied to the actuator	Check fuse, wiring, and battery voltage.
	Fault detected in actuator	Using Service Tool, read faults from control. Verify/correct any shutdown conditions.

Table 8-1. Engine/Generator Troubleshooting (cont'd.)

Problem	Possible Cause	Suggested Test/Correction
The engine overspeeds on start-up.	The actuator is setup for the wrong opening direction	Check linkage setup and device configuration.
	Improperly configured valve position relative to command input	Verify valve command configuration. Verify position calibration.
	An overshoot in speed is caused by speed control	Speed control dynamic settings or acceleration ramp rate are overly responsive. Tune the speed control settings in the ECM or the independent speed controller.
	The overspeed trip level is set incorrectly	Verify the overspeed trip setting in the ECM or the independent speed controller.
Engine starts, but shuts down on error.	Error detected by control.	Verify the exact cause of the error using the Service Tool.
Unable to develop full power.	Non-indexed linkage slipped on shaft	Manually verify full travel of throttle plate.
	Improper configured valve position relative to command input	Verify position if possible.
	Fault detected in control	Using Service Tool, view status of fault codes. Take appropriate action for active faults.
Not controlling at desired position setpoint.	Incorrect configuration	Verify the demand source selection and scaling using the Service Tool.
	Actuator is shut down or in test mode	Verify the state indication of the device using the Service Tool or by monitoring the discrete output (if configured for shutdown). Verify the diagnostics and event manager for active faults.
	Running on backup demand	Verify the demand source using the Service Tool.
	Scaling mismatch	Verify the value of the position setpoint using the Service Tool. Verify the configured scaling of the demand inputs.
	Incorrect dynamics; Incorrect position calibration	Follow the procedures in Chapter 6 for verifying both the dynamics (inertia and friction settings) and the position calibration.
	PWM input signal inaccuracy	Measure input duty cycle and convert to percentage. Verify controller signal using Service Tool. If different, adjust the PWM Offset value in the Configuration Editor.
	Wiring fault or ground loop	Measure input duty cycle and convert to percentage. Verify controller signal.

	Analog input signal inaccuracy	Check the wiring. Look for loose connections and disconnected or misconnected cables and connections. Remove all wiring except the position command and power input and verify operation/functionality. As applicable, measure the analog command voltage to verify that it is at the expected value. Use the Service Tool to verify that input is being read correctly.
	Output shaft is bound or sticking	Move output shaft by hand. Assess smoothness, friction, and return spring force. Manually verify full shaft movement. Use the "verify position" function of the Service Tool (Chapter 4).
	PWM input frequency is too high	As applicable, measure PWM command frequency. Verify it is within frequency range.
	Incorrect scaling or unexpected value on CAN demand signal	Verify controller signal using Service Tool.
Discrete output not working.	Wiring fault	Check the wiring leading to the pin for open, ground, or input power connections, or for a misconnection to an incorrect terminal. The true output state can be compared with expected output state shown in the Service Tool.
	Configuration	Using the Service Tool, verify configuration of the discrete output, both type and source. Verify the fault actions are selected properly and that the output is configured for expected operation (either normally "on" or normally "off").
Power supply fluctuation (if using a switching power supply instead of battery power).	Flyback energy on the Batt(+) input can interfere with some switching power sources.	Add a forward-biased power diode in series with the Batt(+) input of the ProAct Gen3. Use at least a 6 A, 100V fast recovery diode.
Actuator is oscillating positions.	Intermittent fault	Check the Service Tool for diagnostic fault indications.
	Incorrect actuator controller dynamics	Check and adjust the dynamics settings as needed using the Service Tool.
Service Tool not communicating–Error message displayed on PC when trying to connect.	Old version of Service Tool or file corruption or bad install.	Re-install Service Tool. Get the latest version from the Woodward web site (www.woodward.com/software).
Service Tool – text is not displayed properly on PC (cut off, not fully visible.	PC Settings are improper for this application.	Update to the latest version of ToolKit. Versions of ToolKit prior to 6.0 required the default system font to be set to a smaller setting.

Table 8-1. Engine/Generator Troubleshooting (cont'd.)

Problem	Possible Cause	Suggested Test/Correction
Service Tool not communicating–'connecting' status indicated	Power not applied to control	Disconnect harness from actuator. Test for +24 V between power input and ground on terminal block.
	Wiring fault	Check for loose or misconnected wiring connections. Verify harness setup and connections.
	Incorrect cable used or converter missing	USB-to-CAN converter and interconnect cable required. See Chapters 3 & 6 for details.
		Check that Service Tool is running.
	The Service Tool is disconnected	Check fuse, wiring, and battery voltage.
		Connect the Service Tool by using the connect icon or 'Device Connect' menu selection.
	Incorrect communication port settings	Verify the port setting is correct. Verify data rate and command/response IDs are correct.
	Device CAN port settings or hardware issue	Try using CAN2 (see Chapter 6 for details).

Troubleshooting Diagnostic Flags

Table 8-2. Troubleshooting Diagnostic Flags

Error Flag	Description	Possible Source	Possible Action
Run Stop Fault (Stop Commanded)	The Run/Stop input is in the 'Stop' state.	Incorrect voltage at the Run/Stop input.	Verify voltage level at connector.
		Incorrect discrete input configuration.	Check configuration of input including active high/low, and active open/closed settings.
		Input is incorrectly wired.	Verify reading of input using Service Tool. Check wiring.
		The actuator's input is damaged.	Return unit to Woodward for repair.
Loss of Position Demand	All configured position demand signals have been detected as out of range or failed.	Incorrect configuration.	Check configuration of demand selection.
		Inputs invalid or failed.	Check troubleshooting of each input below (e.g., PWM Fault).
Demand Tracking Fault	The configured demand signals are not tracking each other within the configured tolerances.	Incorrect configuration. Inputs invalid or failed.	Check configuration of demand tracking.
		Demand signals not matching, incorrectly sent or scaling problem.	Verify demand inputs in Service Tool. Make sure the values are correct and tracking each other.
		Device not sending demand signals that track each other.	Correct signals to ensure they track within configured limits.
		Incorrect configuration.	Verify configuration. Check Demand Tracking settings.
PWM Demand High or Low Fault	This error flag will be set if the PWM input duty cycle is higher or lower than the configured limits.	PWM input is outside of the diagnostic limits. PWM voltage levels out of specification range.	Check signal and fix incorrect signal level. Verify reading of input on the Service Tool.
		Diagnostic limit is setup incorrectly.	Verify correct duty cycle diagnostic limits.
		Input is incorrectly wired.	Correct wiring problem.
PWM Frequency High or Low Fault	This error flag will be set if the PWM input frequency is higher or lower than the configured limits.	PWM input is outside of the diagnostic limits. PWM voltage levels out of specification range.	Check signal and fix incorrect signal level. Verify reading of input on the Service Tool.
		Diagnostic limit is setup incorrectly.	Verify correct frequency diagnostic limits.
		Input is incorrectly wired.	Correct wiring problem.
Supply Voltage (Vbat) High or Low Fault	The power supply voltage is higher than the diagnostic limits.	Bad or damaged battery.	Replace battery.
		Defective battery charging system.	Fix battery charging system.
	The Power supply voltage is lower than the diagnostic limits.	Incorrect setting of power supply voltage level.	Set correct voltage levels on power supply.
		Power supply wiring too long or too thin. Control will flag low voltage during higher power uses.	Make sure wiring is of the correct thickness and length according to manual.
		The control's input is damaged.	Verify input power reading using the Service Tool. If bad, return unit to Woodward for repair.

Table 8-2. Troubleshooting Diagnostic Flags (cont'd.)

Error Flag	Description	Possible Source	Possible Action
Electrical Temperature High Fault	High internal temperature. The temperature inside the actuator is higher than the configured limits.	Actuator has been placed in an environment that is too hot.	Monitor temperature using the Service Tool. Verify reasonable value as compared to ambient temperature of the device. Lower temperature by adding cooling, heat shielding, moving the unit, etc.
		Incorrect setting of high temperature diagnostic.	Verify/set high temperature settings using the Service Tool.
Torque Derate Fault or Zero Torque Fault	Very high internal temperature. The temperature inside the actuator is higher than the allowed programmed limits.	Actuator has been placed in an environment that is too hot.	Monitor temperature using the Service Tool. Verify reasonable value as compared to ambient temperature of the device. Lower temperature by adding cooling, heat shielding, moving the unit, etc.
Temperature Sensor Fault	This error is set if the plausibility check performed on the internal temperature sensors has determined that both have failed.	The internal temperature sensors are defective.	Verify internal electrical temperature reading using the Service Tool. Return unit to Woodward for repair.
Position Error	If the difference between the demanded position and the actual position are outside the configured limits.	Incorrect inertia or friction settings.	Check friction and inertia settings using the Service Tool.
		Incorrect position error settings.	Check position error settings using the Service Tool.
		Binding or excessive friction in the actuator linkage, or stops are set inside the desired range of travel.	Check all mechanical linkages and stops. Verify valve / ITB moves freely and is not blocked or binding.
CAN Bus Fault	The CAN port is detected in the error passive condition or Bus Off condition.	Incorrect or intermittent wiring problem.	Check wiring for broken or loose connection.
		Incorrect or missing termination resistors.	Verify configured data rate. Check wiring for broken or loose connection.
		Electrical problems within the controller or unit.	Verify proper termination resistors at the ends of the CAN network.
		Mismatch of bit rate settings for devices on the bus.	Verify that the bit rate setting is correct for all devices on the bus.
		No other devices are on the bus.	An error passive condition will exist if there are no other devices on the CAN bus to acknowledge transmitted messages. Possible problem with the actuator, although additional testing recommended before returning to Woodward.

Table 8-2. Troubleshooting Diagnostic Flags (cont'd.)

Error Flag	Description	Possible Source	Possible Action
J1939 Address Claim Fault	This J1939 fault is set if the control's address cannot be claimed on the CANbus.	Another unit on the bus with the same id with a higher priority.	Verify correct CAN ID discrete input state, and unit number selection. Verify Source Addresses of units communicating on the bus, resolve conflict.
		CAN wiring problem.	Check the CAN wiring for shorts, open connections, interchanged connections, and intermittent contacts.
CAN Run Stop Fault (Run/Stop)	A STOP command was received over CAN.	CAN data incorrect, CAN PGN incorrect.	Verify PGN configuration settings. Verify device sending J1939 messages. A specific bit pattern is required within the specified PGN to trigger this STOP command.
Analog Demand High or Low Fault	This error flag will be set if the analog input is higher or lower than the configured limits.	Analog input is driven outside of the diagnostic limit.	Check signal and fix incorrect signal level. Verify reading of input on the Service Tool.
		Diagnostic limit is setup incorrectly.	Verify correct diagnostic limits.
		Input configuration (4-20 mA vs 0-5V) mismatch.	Verify input configuration.
		Input is incorrectly wired - open or short or connected to the wrong input (4-20 mA vs 0-5V).	Correct wiring problem.
CAN No Signal Fault	This error is set if the CAN is not communicating or messages received are slower than the configured update rate, or the value received is above 0xFAFF.	Incorrect value sent from ECM.	Verify ECM values are limited below 0xFAFF.
		Incorrect or intermittent wiring problem.	Check wiring for bad or lost connection.
		ECM is not sending updates fast enough or regularly (bursts).	Verify ECM messages and update rates. Verify configuration of CAN Fail timeout.
		CAN demand is missing (no signal).	Verify CANbus communication and connections.
		Incorrect Unit Number / source address.	Check the CAN ID inputs to the valve.
		ECM is not sending Demand messages, or is not sending to the correct unit number.	Verify that the ECM is powered up and sending valid demand messages, and that the correct unit number is selected.
		CAN termination problem.	Check if the CANbus has the right termination resistor connected at both ends of the bus.

		CAN wiring problem.	Check the CAN wiring for shorts, open connections, interchanged connections, and intermittent contacts.
		CAN noise problem.	Verify that the CAN wiring is installed according to the installation instruction
		CANbus incompatibility with ECM, e.g., baud rate.	Verify ECM CANbus compatibility. Verify configured data rate.
		CAN traffic overload.	Verify that there is not excessive CAN traffic that has higher priority than the actuator demand message.
Watchdog Reset Fault	Indicates the ProAct microprocessor experienced a watchdog reset.	Electrical or software problems within the controller or unit.	Clear fault with reset command. Cycle power. Return unit to Woodward for repair.
Power up Reset	Indicates the ProAct experienced a power cycle.	No problem, just a normal indication.	This will be indicated on every power up of the actuator.
		Wiring problem	Check the power wiring for shorts, open connections, interchanged connections, and intermittent contacts. Clear fault with reset command.
		Electrical problems within the controller or unit.	Return unit to Woodward for repair.
Position Sensor Fault	Indicates the internal position sensor output plausibility check failed.	Internal failure of position sensor.	Return unit to Woodward for repair.
NV Memory Fault	Problem with the data read from internal non-volatile memory.	New software loaded into device.	Clear fault with reset command. Cycle power.
		Defective actuator.	Return unit to Woodward for repair.
Internal Voltage Fault	One of the internally monitored voltage signal is out of range.	Defective actuator.	Clear fault with reset command. Cycle power. Return unit to Woodward for repair.

Electrical Troubleshooting Guide

Analog Input
If the Analog Input is not functioning properly, verify the following:
- Measure the input voltage. It should be in the correct range based on configuration and wiring (e.g. 0 V to 5 V or 4 mA to 20 mA).
- Check the values seen by the ProAct Gen3 using the Service Tool and verify that it matches the input signal.
- Verify that there are no or minimal ac components to the Analog Input signal. AC components can be caused by improper shielding.
- Check the wiring. If the inputs are reading 0 or the engineering units that correspond to 0 V, look for loose connections and disconnected / misconnected cables/connections. While checking the wiring, verify the proper jumper is present if using the analog input in 4-20mA mode. See wiring instructions for more information.
- Check the software configuration to ensure that the input is configured properly as the Demand Source.
- Calibration could be incorrect. Return to Woodward.

PWM Input
If the PWM input is not functioning properly, verify the following:
- Measure the input voltage, frequency, and duty cycle.
- Check the values seen by the ProAct Gen3 using the Service Tool and verify that they match the input signal.
- Check the wiring. Look for loose connections and disconnected / misconnected cables/connections.
- Check the software configuration to ensure that the input is configured properly as the demand source.

CAN Input
If the CAN position command is not functioning properly, verify the following:
- Check faults indicated on Service Tool.
- Check the values seen by the ProAct Gen3, if any, using the Service Tool and verify that it matches the sent signal and/or received signal.
- Check the wiring. Look for loose connections and disconnected / misconnected cables/connections. Verify 120 Ohm resistor at ends of transmission lines.
- Check the software configuration to ensure that the signal is configured properly (Device ID, fail timeout, etc).
- Check active device number. This is the CAN Unit Number displayed on the Overview screen. When harness coding is used, based on the CAN ID Hi and Low inputs (read at power-up) and their configurations. If incorrect, could indicate a configuration issue or discrete input wiring issue.

Run / Stop Discrete Input
If the run enable (run/stop) discrete input is not functioning properly, verify the following:
- Measure the input voltage at the connector.
- Check the status of the input from the Overview screen of the Service Tool.
- Check the wiring, looking for loose connections or misconnected cables.
- Verify the input is properly configured (Discrete Inputs Setup page). Check the input selection and input configuration (active low/high, active open/closed).

Alarm or Shutdown Conditions
If the ProAct Gen3 control has any alarm or shutdown conditions, refer to Chapter 4 for details on the exact cause of the condition. The Service Tool must be used to determine the cause of any shutdown or alarm condition. Refer also to the ‘Troubleshooting Diagnostics Flags’ section above.

Discrete Output

If the discrete output is not functioning properly, verify the following:

- Measure the output voltage on the terminal block. If configured as a low-side output, it should be in the range of 10 to 28 Vdc when the output is off/false. If configured as a high-side output, the reading at the pin should be near 0V when off/false. The status can be verified through the Service Tool and compared with the measured output.
- Check the wiring, looking for loose connections or disconnected / misconnected cables.
- Verify the configuration of the output (Discrete Output Setup page).
- Verify the output command and the read-back indications (Overview page).

Analog Output

If the analog output is not reading properly, verify the following:

- Measure the output.
- Check the wiring, looking for loose connections or disconnected / misconnected cables.
- Check the output impedance. Verify it is within the specified limits.
- Verify the configuration of the output (Analog I/O Setup page).
- Verify the commanded output and read-back values (Overview page).
- Calibration could be incorrect. Return to Woodward.

Service Tool

If the Service Tool is not functioning properly, review the installation information in Chapter 6. Verify the following:

- Check the wiring, looking for loose connections or disconnected / misconnected cables.
- Check the USB-to-CAN converter.
- Check that Service Tool is running. Verify the communication settings are correct.
- Follow on-screen error messages. Re-install software as needed. The latest version of software is available for download from the Woodward web site (www.woodward.com/software).

Chapter 9.
Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

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

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

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

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

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- 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 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.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic 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.

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. 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 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's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- 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.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor 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 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 www.woodward.com/directory.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at www.woodward.com/directory, 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) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+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) 6762 6727
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) 6762 6727
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 ______________________

Engine Model Number ______________________

Number of Cylinders ______________________

Type of Fuel (gas, gaseous, diesel, dual-fuel, 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. Acronyms/Abbreviations

ACK	Acknowledgment
AUX	Auxiliary
CAN	Controller Area Network
CAN ID	CAN Identifier. Used to define and select multiple product applications within a single device.
CW	Clockwise
CCW	Counterclockwise
DA	Destination Address
DM	Diagnostic Message
ECM	Engine Control Module
ECU	Electronic Control Unit
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
FL or FLEX	ProAct Gen3 version with customer I/O terminated on terminal blocks as opposed to a 24-pin circular connector on the standard version
FMI	Failure Mode Identification
GUI	Graphic User Interface
J1939	CAN high-level protocol format defined by SAE
I/O	Inputs/Outputs
ID	Identifier
ISC	Integrated Speed Control. ProAct version capable of speed control
ITB	Integrated Throttle Body
LSB	Least Significant Bit or Least Significant Byte
MPU	Magnetic Pickup
NACK	Negative Acknowledgment
OEM	Original Equipment Manufacturer
P-Series	Woodward electronic engine governor that contains both a rotary actuator and a controller circuit board
PDU	Protocol Data Unit
PGN	Programmable Group Number
PWM	Pulse-Width Modulated
RO	Read-Only
RPM or rpm	Revolutions per Minute
RS-232	a communications standard
SA	Source Address
SPN	Suspect Parameter Number
TPS	Throttle Position Sensor
USB	Universal Serial Bus
U32	Un-signed 32-bit value
WO	Write-Only

Appendix B. Determining Device Vibration Levels

Introduction

Determining Vibration Levels for ProAct Gen3

When collecting vibration measurements on an engine, ensure the following is done:

1. Take measurements at each point in three orthogonal axes: X, Y, and Z.
2. Ideally, orient X along the axis of the engine's crankshaft, Y normal to the crankshaft in the horizontal plane, and Z in the vertical direction. If this orientation is not achievable, orient axes as close as possible. Document axis and accelerometer locations with pictures for future reference.
3. Take at least one measurement as close as possible to the mounting point (i.e., the mounting bolt) on the actuator. The mounting bolt locations at the actuator body are shown in blue in Figure B-2. If the actuator is flange mounted, take at least one measurement in close proximity to the mounting areas shown in green Figure B-2. Ensure the location has high stiffness (i.e., not on a thin bracket a distance away from the mounting bolt). Install the accelerometer on the engine's mounting bracket/surface. The accelerometer can be located on the engine's mounting bracket/surface. Ensure the accelerometer is located on a large, stiff structure immediately next to the actuator's mounting bolt.
4. Take at least one measurement on the electronics housing of the actuator. The areas shown in red on the casting surface in Figure B-1 are preferred.
5. At a minimum, measure vibration at one mounting point and at a point on the actuator where a high response, or vibration amplification, is expected. It is critical to document accelerometer locations and provide this information to Woodward with the collected vibration data.
6. If the actuator is mounted to a bracket, ensure measurements are taken where the actuator mounts to the bracket (as explained in 3 above) and at the base of the bracket where the bracket connects to the engine.
7. If possible, take measurements at multiple engine conditions. At a minimum, measurements should be taken at a maximum or rated engine output condition. Also, consider other output conditions that may create different vibration levels. It is recommended to take measurements at 75% and 100% load. If available, a schedule or typical mission profile of time at each loading condition over the expected life of the engine can help Woodward more accurately assess the vibration data for the specific actuator under evaluation.
8. Where there is no concern for damaging parts, it is recommended that the accelerometer be screwed into a drilled and tapped hole when possible. This is normally done on the mounting bracket/surface near the actuator mounting feet. Apply Loctite 243 or equivalent to the accelerometer's thread before installing in a tapped hole. It is recommended to use high-strength, high-temperature adhesive when attaching accelerometers to the actuator to avoid damage to internal parts.
9. Use the following settings in the vibration measurement device.
    a. Windowing: Hanning
    b. Number of Averages: 100 or 200 lines
    c. Record Grms measurements
    d. Bandwidth: 20 Hz
    e. Frequency Span: 2 kHz
    f. High Pass Filter: 3 Hz
    g. Low Pass Filter: 5 kHz

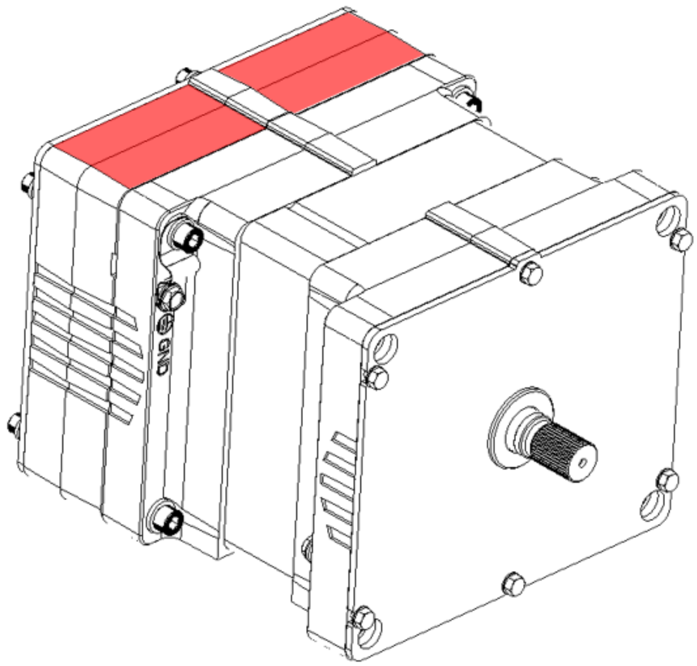


Figure B-1. ProAct Gen3 Accelerometer Locations (red) for Determining Vibration Levels On the Electronics Housing

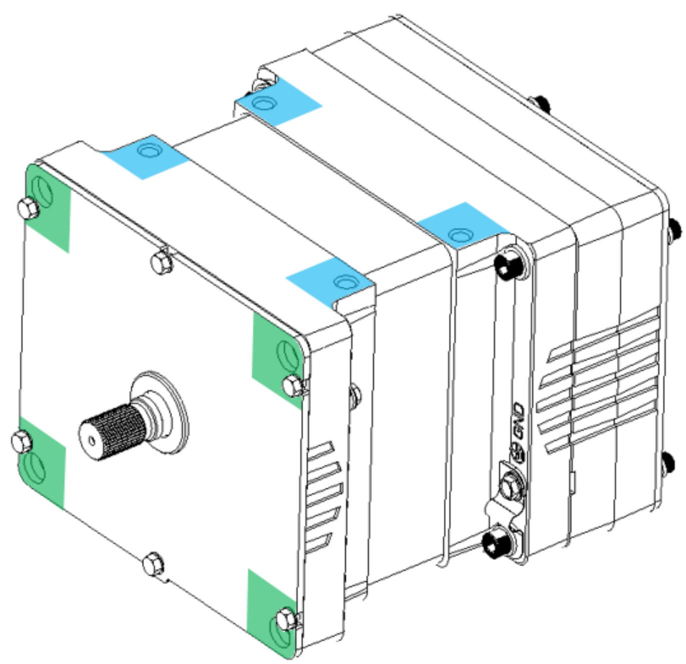


Figure B-2. ProAct Gen3 Accelerometer Locations for Determining Vibration Levels at the Actuator Base Mounting Locations (blue), and at the Flange Mount Locations (green).

Appendix C. ProAct Gen3 Control Specifications

Performance

Table C-1. Performance Specifications

Parameter	Value
Positioning Accuracy	±1% of full travel at 25 °C
Positioning Repeatability	±1% of full travel at 25 °C
Accuracy at Temperature	±1.3% of full travel from -40 °C to 105 °C
Bandwidth	(measured at -6 db) > second order, 40 rad/s –3 db at 8 Hz with low inertia
Max Slew Rate	> 1000 degrees/second > 18.5 rad/s (10% to 90% travel)
Overshoot	< 4% of full scale
1% Settling Time	240 ms
2.5% Setting Time	150 ms
Limit Cycle	< 0.25° peak to peak with low friction loads
Steady State Error	<0.1° for loads up to 80% of steady state current limit. Integrating control drives steady state error to zero.
Min Load Inertia	0

Environmental

Table C-2. Environmental Specifications

Parameter	Value
Ambient Operation Temperature	–40 to +85 °C (–40 to +185 °F)
Storage Temperature	–40 to +125 °C (–40 to +257 °F)
Humidity	95% Relative Humidity –12 hours at 60 °C and 7 hours at 25 °C with 5 hours of transition for 5 complete cycles
Mechanical Vibration	US MIL-STD-202F, procedure 214A: 0.1 G² /Hz, 10 Hz to 2000 Hz, 3 hr/axis, 12.8 Grms
Mechanical Shock	US MIL-STD-810C, Method 516.3, 516.4 procedure 1
Ingress Protection	IP66 per IEC 60529 and Type 3R for North America
Mechanical Vibration	Power Spectral Density (PSD) must not exceed the level or frequency as shown in Figure C-1 while the actuator is running, as measured at the actuator's mounting surface
EMC Emissions	EN 61000-6-4:2011, IACS UR E10 Rev 6 General Zone
EMC Immunity	EN 61000-6-2:2005, IACS UR E10 Rev 6, ISO 7637-2 Pulse 5a Alternator Load Dump

Reliability

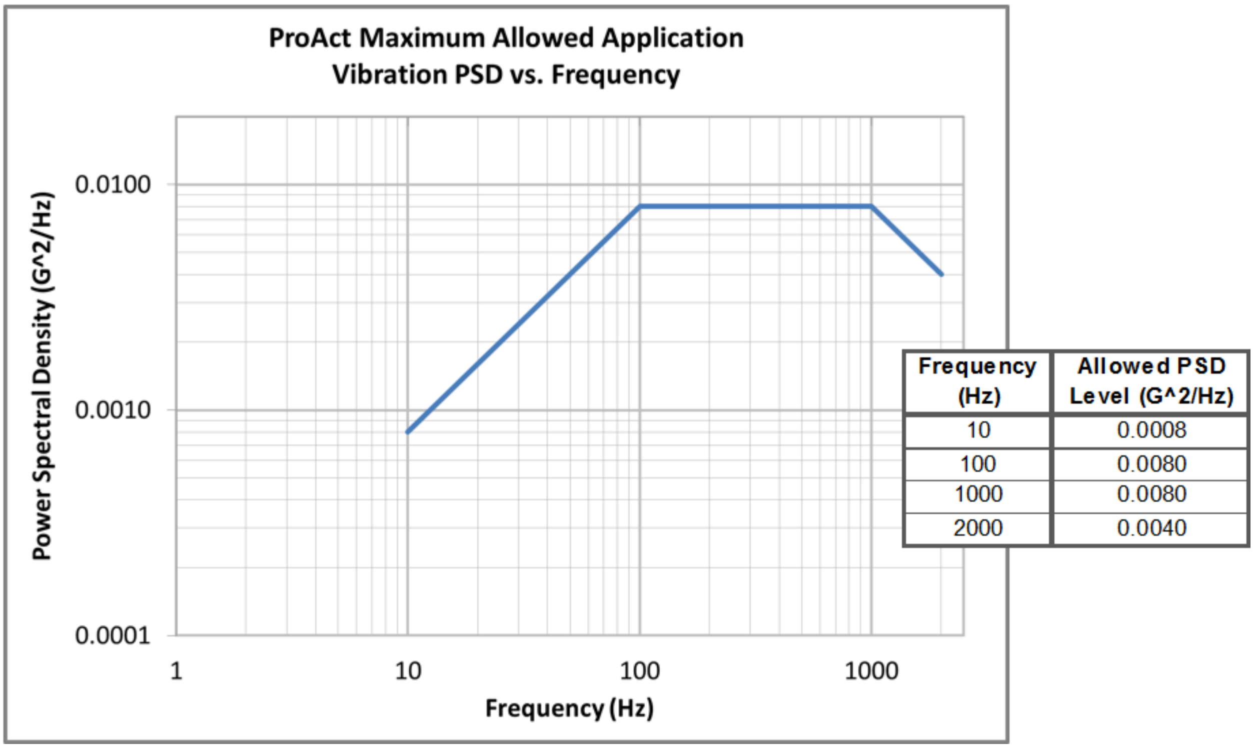
Table C-3. Reliability Specifications

Parameter	Value
Mechanical	B10 life is 60,000 prime mover service hours B10 life prior to a rebuild is 30,000 prime mover service hours
Electrical	B5 life is 50,000 prime mover service hours

Torque Output

Table C-4. Torque Output Specifications

Parameter	Value
Model II Transient	5.2 N·m (46 lb-in)
Model II Continuous	2.6 N·m (23 lb-in)
Model III Transient	10.4 N·m (92 lb-in)
Model III Continuous	5.2 N·m (46 lb-in)
Model IV Transient	20.8 N·m (184 lb-in)
Model IV Continuous	10.4 N·m (92 lb-in)



Frequency (Hz)	Allowed PSD Level (G^2/Hz)
10	0.0008
100	0.0080
1000	0.0080
2000	0.0040

Figure C-1. Maximum Allowed Vibration PSD vs Frequency

Mechanical

Table C-5. Mechanical Specifications

Parameter	Value
Hard Travel	73.5° to 77°
Weight	Model II: 10.0 kg (22 lb) Model III: 14.1 kg (31 lb) Model IV: 21.3 kg (47 lb)
Mass Moment of Inertia	Model II MMOI: 5.5E-4 kg-m² (4.9E-3 lb-in-s²) Model III MMOI: 6.4E-4 kg-m² (5.6E-3 lb-in-s²) Model IV MMOI: 8.2E-4 kg-m² (7.2E-3 lb-in-s²)

Power Supply Input

Table C-6. Power Supply Input Specifications

Parameter	Value
Normal Operation	18 to 32 V
Transient/Starting	9 to 36 V for 1 minute
Max Extended Voltage	36 V for 1 minute 9 V limited performance
Min Extended Voltage	Model II < 13 A @ 18 V
Max Current Transient	Model II < 3.5 A @ 18 V Model III < 15 A @ 18 V Model IV < 20 A @ 18 V
Max Current Continuous	Model II < 3.5 A @ 18 V Models III & IV < 6.5 A @ 18 V
Max Power Steady Continuous	Model II - 65 W Model III - 73 W Model IV - 101 W
Max Power Transient	Model II - 251 W Model III - 282 W Model IV - 371 W
Hold Up Time	**NOTE**: Depends on operating conditions. 1.1 ms at 24 V (dc) with max load
Out of Range Detection	Action is configurable in software

Analog Demand Input

Table C-7. Analog Demand Input Specifications

Parameter	Value
Input Type	0 to 5 V or 0 to 25 mA
Input Scaling	Configurable in software and wiring
Accuracy @ 20 °C	0. 5% / FS
Linearity @ 20 °C	0. 5% / FS
Resolution	12 bits
Temperature Drift	200 ppm/°C
Sample Rate	1 ms
CCM @ 60 Hz or lower	60 dB
Input Impedance	100 kΩ (0 V to 5 V mode), 200 Ω (0 mA to 25 mA mode)
Isolation	None
Overvoltage Protection	Input protected against 32 Vdc steady state
Out of Range Detection	Configurable in software

PWM Demand Input

Table C-8. PWM Demand Input Specifications

Parameter	Value
PWM Input Type	Low-Side and Push-Pull (differential input, software configurable pull-up)
PWM Amplitude Range	4 to 32 V with two software configurable ranges
Specified Frequency Range	100 Hz to 3000 Hz
PWM Compare Point	3.5V in 0-5V amplitude range 7V in 0-12V amplitude range
PWM Hysteresis	2V in 0-5V amplitude range 4V in 0-12V amplitude range
Duty Cycle Scaling	Configurable in software
Isolation	None
Input Impedance	1 kΩ in Low-Side mode with internal pull-up 10 kΩ in Push-Pull mode
Resolution	12 bits up to 1953 Hz
	The duty cycle and frequency are read with reduced resolution at higher frequencies
Accuracy	±1% at 32 V and frequencies < 1000 Hz
	±1.8% at 32 V and frequencies > 1000 Hz
	NOTE: PWM detection accuracy could depend on integrity of signal source.
Pull-Up Level	12 V through 1 kΩ
I/O Execution Rate	1 ms
Calibration	Duty cycle offset adjustment is available in Service Tool. This will tailor the input to the signal source
Loss of Signal	<80 Hz. Sets duty cycle and frequency to zero
Out of Range Duty Cycle	Configurable in software

Discrete Inputs

Table C-9. Discrete Inputs Specifications

Parameter	Value
Input Function	Software Selectable
Low Level	< 1.4 V
High Level	> 4.1 V
Open Wire Detection Range	1.6V – 3.9V
Hysteresis	> 0.2 V (between High or Low, and open-wire range)
Min Current Input @24 V	> 0.7 mA
Max Current	< 10 mA
Min Hardware Delay	> 2 ms
I/O Execution Rate	1 ms
High / Low Side Switch	Software Selectable
Active Open / Close	Software Selectable
Protection	Can tolerate being wired to 32 Vdc

Discrete Output

Table C-10. Discrete Output Specifications

Parameter	Value
Output Type	Status output, software selectable. Low-side and High-side driver, software selectable
Max Voltage at Output Pin	40 Vdc
Max Short Circuit Current	500 mA
Max On-State Saturation Voltage at Max Current (Max Voltage Drop)	1.0 V (dc)
Max Off-State Leakage Current at 24 Vdc if using high-side switch	<4 µA
Max Off-State Leakage Current at 24 Vdc if using low-side switch	< 20 uA
Inductive Load Protection	Yes, internally protected circuitry
Over-Current Protection	Utilizes circuitry that will be disabled when output contacts are short-circuited. Self-resetting when fault is removed
Activating Latency	< 100 ms
I/O Execution Rate	10 ms
Output Action	Configurable ON/OFF in software

Analog Output

Table C-11. Analog Output Specifications

Parameter	Value
Output Type	0 to 25 mA
Output Scaling	Software configurable
Output Function	Software configurable
Isolation	None
I/O Execution Rate	10 ms
Accuracy @ 20 °C	0.5% / FS
Linearity @ 20 °C	1% / FS
Resolution	12 bits
Temperature Drift	< 100 ppm / °C
Reverse Voltage Protection	Yes
Overvoltage Protection	Output protected against 32 Vdc, steady-state. Also protected from direct short to ground
Minimum Load Impedance	0 Ω
Maximum Load Impedance	385 Ω at 25 mA

CAN Communication Ports (for command and service)

Table C-12. CAN Communication Ports Specifications

Parameter	Value
Wiring Specification	ISO-11898, SAE J1939-11
Isolation	None
Baud Rate	Software configurable from 125 kbps to 1 Mbps
Electrical Interface	CAN Hi and CAN Lo differential transmit/receive
Type	Supports CAN2.0B and SAE J1939-11
Maximum Cable Length	30 m
Cable Type	Two-conductor shielded cable according to SAE J1939-11
Fault Detection	Software selectable. CAN Fault (Bus Off, Address Claim) and Loss of CAN Demand provided

Electronics Temperature (internal sensor)

Table C-13. Electronics Temperature Specifications

Parameter	Value
Accuracy	±1 °C at 25 °C ambient ±2 °C over temperature range (–40 °C to +125 °C)
Out of Range	< –45 °C, >140 °C. Action is configurable in software

Transfer Function (Positioner)

The transfer function of the position controller is nominally four lags and a rate limiter (see Figure C-2 below). The first lag is an input filter is set at 0.020 seconds, with a model-dependent slew rate limit. The second lag is set at 0.0033 seconds. The remaining two lags are scheduled with Inertia Number as shown in the following tables.

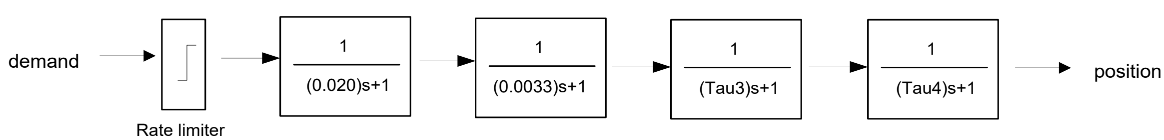


Figure C-2. Transfer Function

Table C-14 Rate Limiter Values

Size	Rate Limiter
Model II	2285°/s
Model III	1882°/s
Model IV	941°/s

Table C-15 Transfer Function Parameters

Tau_3	Tau_4	Model II Inertia Number	Model III Inertia Number	Model IV Inertia Number
0.0040	0.0050	>= 16	>= 17	>= 17
0.0044	0.0063	< 16	< 17	< 17
0.0053	0.0125	< 12	< 13	< 13
0.0063	0.0250	< 7	< 8	< 8

Inertia Settings
Inertia=Base_Inertia*1.25^InertiaNumber
The actuator with no load has inertia = Base_Inertia

Size	Base_Inertia
Model II	5.5e-4 Kg-m^2
Model III	6.4e-4 Kg-m^2
Model IV	8.2e-4 Kg-m^2

Revision History

New Manual—

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.: 00596-EU-02-01

Manufacturer's Name: WOODWARD INC.

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

Model Name(s)/Number(s): ProAct Gen3 Flex, ProAct Gen3, and ProAct TecJet 110 or TecJet 85

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)

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
Exemption in use: 6(a), 6(c), 7(a), 7(c)-I

Markings in addition to CE marking:

Ex Category 3, Group II G, Ex ec IIC, T4 Gc IP54 for Model II and III
Ex Category 3, Group II G, Ex ec IIC, T3 Gc IP54 for Model IV

Applicable Standards:

EN61000-6-4, (2011): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments

EN61000-6-2, (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

EN60079-0: (2017) - Explosive Atmospheres - Part 0: Equipment – General requirements

EN60079-7: (2015) - Explosive Atmospheres - Part 7: Equipment protection by increased safety "e"

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

Mike Row
Full Name

Engineering Supervisor
Position

Woodward, Fort Collins, CO, USA
Place

9-Jan-2020
Date

Page 1 of 1

5-09-1183 Rev 33

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

File name: 00596-EU-02-02
Manufacturer's Name: WOODWARD INC.
Manufacturer's Address: 3800 Wilson Ave.
Loveland, CO 80538 USA

Model Names: ProAct Gen3 Flex, ProAct Gen3, and ProAct TecJet 110 or TecJet 85

This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

The person authorized to compile the technical documentation:

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

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

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

MANUFACTURER

Signature

Mike Row
Full Name

Engineering Supervisor
Position

Woodward Inc., Fort Collins, CO, USA
Place

9-Jan-2020
Date

Document: 5-09-1182 (rev. 18) **PAGE** 1 of 1

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26914.

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