WOODWARD

Product Manual 26777
(Revision B, 7/2016)

Original Instructions

ACTIVGEN™

Engine Speed Control

Installation and Operation Manual

General Precautions

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

Practice all plant and safety instructions and precautions.

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

Revisions

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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.

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

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Manual 26777

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

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

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

⚠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

Automotive Applications

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

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

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.

Regulatory Compliance

European Compliance for CE Marking

These listings are limited only to those units bearing CE Marking

EMC Directive: 2014/30/EU COUNCIL DIRECTIVE of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.

IMPORTANT **This unit is not qualified for use in residential installations due to EMC compliance. It is only allowed in non-residential applications.**

General Compliance

The actiVgen family of products is not intended for direct sale to general consumers. This product is intended for industrial fixed installations and direct sale to OEM system integrators, not general consumers.

Due to regulatory requirements listed in regulatory compliance section, these guidelines are necessary:

1. Wiring/cabling requirements must be followed.
2. Wiring/cabling should be grouped into bundles as possible or segregated by I/O type.
3. Wiring/cabling I/O types or bundles should be routed against chassis/frame ground potential (the engine) for the maximum length of the cable present, where possible. Cabling and wire routing should only allow small sections of wiring and cabling to be more than 5 cm (2 inches) from chassis/frame ground potential. Wires should preferably be routed directly against chassis/frame.
    a. Cabling may be more than 5cm (2 inches) from chassis/frame ground potential for items like strain relief and cable routing bends. The length of cabling allowed to be more than 5cm (2 inches) from chassis/frame ground potential, must be:
        i. Less than ~0.5m (~20 inch) sections at the cabling ends.
        - or -
        ii. Less than ~0.5m (~20 inch) sections at points along the cabling & wire routing where cabling or wiring greater than ~1.5m (~60 inch) of length on each side of it is less than ~5cm (~2inch) from chassis/frame ground potential.
        - or -
        iii. Cables shorter than ~3.0m (~120 inch) should have at least ~1.5m (~60 inch) of cable wiring less than ~5cm (~2inch) from chassis/frame ground potential. Route as much length as possible against chassis/frame ground potential.

Chapter 1.
General Information

Scope of Manual

This manual provides the information necessary to apply the actiVgen speed control to diesel engines. Topics covered include mechanical installation, electrical wiring, software programming, and troubleshooting.

actiVgen Speed Control System Description

Woodward's actiVgen speed control is a microprocessor-based engine control for diesel engine applications. The basic system components are:

- Magnetic pickup that sends engine speed signal to the controller.
- actiVgen speed control processes the signal received from a speed sensor and compares it to the desired speed setting.
- The output of the controller is a pulse-width modulated (PWM) signal that is connected directly to the Caterpillar ADEM control in the Direct Fuel Control (DFC) mode. This provides a very responsive speed control and an independent way of tuning the dynamics and response of the engine.
- PC service tool that allows configuration of controller's software programmable features as well as servicing the system.

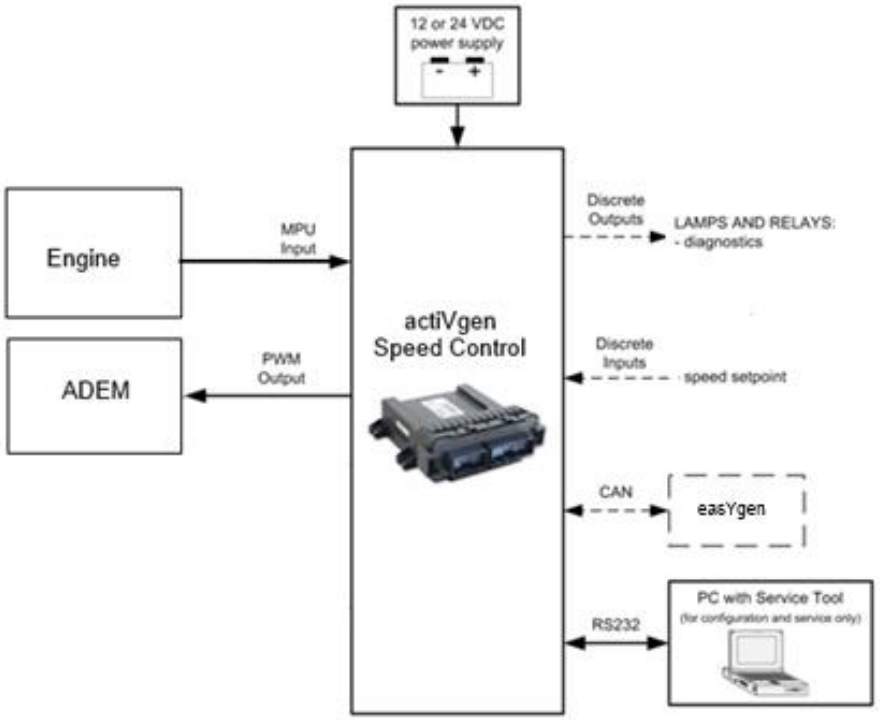


Figure 1-1. actiVgen Speed Control System Components

Programmable Features

The actiVgen speed control is fully configurable through the PC service tool. The controller's programmable features are listed below.

actiVgen Speed Control Programmable Features:

- Engine Speed Governing
  - Isochronous operation
- Emissions Control
  - Engine start-up ramp
- Flexible Diagnostics System
  - Diagnostic lamp with configurable fault codes
  - Up to four configurable warning lamp outputs
- Additional Engine Monitoring Inputs and Outputs
  - Speed trip outputs
  - System voltage monitoring
  - Speed sensor fault detection
- CAN Communication using J1939 Protocol
  - Directly connect to the easYgen for load control functions
  - Monitoring of multiple values including diagnostics is available
- Password Controlled Access through Software Tool
  - Three separate tool access levels, each with configurable passwords

Chapter 2. Specifications

Physical

Height x Width x Depth	Approx. 58 x 152 x 147 mm / 2.3 x 6.0 x 5.8 inches
Weight	Approx. 0.5 kg / 1.2 lb
Mounting	Off-engine and away from exhaust manifold and pipes

Electrical

Power Supply	
Power Supply	9–32 V (dc) (12 or 24 V (dc) nominal) reverse polarity protection
Power Consumption	1.1 W maximum (not including driven loads)
Input Voltage Monitor	
Maximum Voltage Measured	40 V (dc)
Resolution	10 bits
Accuracy	±5%
Speed Signal Input	
Sensors Supported	MPU – Magnetic Pickup (passive variable reluctance)
Voltage Sensitivity at 180 Hz	3.0 V peak-to-peak
Voltage Sensitivity at 1530 Hz	4.0 V peak-to-peak
Maximum Input Voltage	60.0 V peak-to-peak
VR Input Frequency	25–6000 Hz
Switching Hysteresis	0.4 V (dc)
Isolation Voltage	None
Input Common Mode Range	0 V (dc)
Diagnostics	Detect loss of signal
Discrete Inputs (DI) (7 inputs)	
***Input Low and High Voltage Thresholds*:**	
Inputs Switched to Battery Voltage (DI2-DI5)	VIL (min) = 1.0 V (dc)
	VIH (max) = 6.3 V (dc)
Input Switched to Battery Voltage (DI1)	VIL (min) = 2.0 V (dc)
	VIH (max) = 3.6 V (dc)
Inputs Switched to Ground (DI6, DI7)	VIL (min) = 0.7 V (dc)
	VIH (max) = 4.3 V (dc)
Input Current (DI1-DI5)	(min) 0.4 mA @ 9 V power supply
	(max) 2.7 mA @ 32 V power supply
Input Current (DI6, DI7)	(min) -0.8 mA @ 9 V power supply
	(max) -3.2 mA @ 32 V power supply
Anti-aliasing Filter	1 pole at 100 µs (fc = 1600 Hz)

Isolation Voltage	None
Diagnostics	None
Sensor Power Supply	
Output Voltage	5.0 ± 0.5 V (dc)
Output Current	15 mA maximum
Protection	Output is protected from short circuit
Power Supply	
Output Voltage	5.0 ± 0.5 V (dc)
Output Current	15 mA maximum
Protection	Output is protected from short circuit
Discrete Outputs (DO) (9 outputs)	
Output Type	Low side driver
Typical Load	3 W automotive lamp or relay
Control Type	On / Off
Maximum Output Current	250 mA
Leakage Current	170 µA in 12 V system / 315 µA in 24 V system
Diagnostics	Short circuit detection (350 mA max detection threshold) Open load detection
CAN Port	
Isolation Voltage	None
Channel Configuration	CAN 2.0B
Wiring	High, Low
Baud Rate	250 kBaud
Termination	Provided in the controller (120 Ω)
Protocols Supported	SAE J1939
Diagnostics	Protocol specific
RS-232 Serial Communication Service Port	
Isolation	None
Baud Rate	38400 kBaud
Electrical Interface	External transceiver for conversion to RS-232 levels not required
Driver Diagnostics	Protocol specific
Protocols Supported	Woodward Servlink

Environmental

Ambient Operating Temperature	–40 to +85 °C / –40 to +185 °F
Storage Temperature	–40 to +105 °C / –40 to +221 °F
Humidity	95% RH
Water Spray	JIS D 0203-1994 S1
Dust	JIS Z 8901 1995, Method F2
Random Vibration	0.04 G^2/Hz, 10-2000 Hz, 8.2 Grms
Drop	SAE J1455, paragraph 4.11.3.1
Thermal Shock	3 hours 125 °C to 3 hours at –40 °C, 200 cycles
Ingress Protection	IP67 per IEC 60529

Environmental (continued)

EMC **Electro-Magnetic Compatibility has been tested and demonstrated to meet the following requirements:**	
ISO 13766:2006 ESA / CISPR 25:2002 ESA	30–1000 MHz radiated emissions limit –6 dB & 30–1000 Class 3, respectively
CISPR 25:2002, ESA Class 3 Conducted Emissions 0.15 to 108 MHz	~10% CAN bus utilization passed. ~60% CAN bus utilization 1.1 to 2.0 MHz and 5.9-6.2 MHz the class 3 limit was exceeded, Class 1 was met
ISO 7637-2 Pulse Conducted Emissions	Pulse emissions conducted back to the power source only, 28.6 V_{peak}
IEC 61000-4-2:2001, Operational ESD	±8 kV contact ±15 kV air
ISO 10605:2001(E), Handling ESD	±8 kV contact to control pins ±6 kV contact to actuator pins
SAE J1113-24:2000-5 section 5&6, G-TEM Radio Frequency Interference Immunity/Susceptibility	1 to 1000 MHz range: 150 V/m CW & 75 V/m 80% depth 1 kHz AM no degradation, 100 V/m 80% depth 1 kHz AM, self-recovery. Demonstrates will meet EN 61000-4-3 10 V/m requirement
ISO 11452-2:2004 Radio Frequency Interference Immunity/Susceptibility	100 V_{RMS}/m (peak envelope), 200 MHz to 1000 MHz 80% depth 1 kHz AM. 30 V_{RMS}/m (peak envelope), 800 MHz to 2400 MHz pulse modulated 577 µs on time, 4600 µs period. Demonstrates will meet EN 61000-6-2 10 V/m requirement
ISO 11452-4:2005 Bulk Current Injection (BCI)	1–200 MHz, 100 mA_{RMS} (peak envelop), No modulation and 80% AM at 1 kHz. Demonstrates will meet EN 61000-6-2 10 V_{RMS} requirement
IEC 61000-4-4:2004 Electrical Fast Transients (EFT)	±2.2 kV to power inputs, cables are <3 m long
ISO 7637-3:1995 Pulse a & b Electrical Fast Transients (EFT)	±400 V common mode to all I/O cable types
ISO 7637-2:2004 Pulse 3a & 3b Electrical Fast Transients (EFT)	±600 V differential mode to power input
ISO 7637-2:2004 Pulse 1	–600 V to power input
JASO D001-94 Pulse E & B-2	–250/–320 V to power input
JASO D001-94 Pulse A-2 & D-2	+110 / +170 V to power input
JASO D001-94 Pulse A-1 & D-1, ISO 7637-2 Pulse 5a	+70 & +105 V / +130 & +165 V to power input
ISO 7637-2:2004 Battery Droop During Engine Start	12 V & 24 V profiles

Environmental (continued)

JASO D001 94 Section 5.2	12 V & 24 V profiles
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2010	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Dimensions

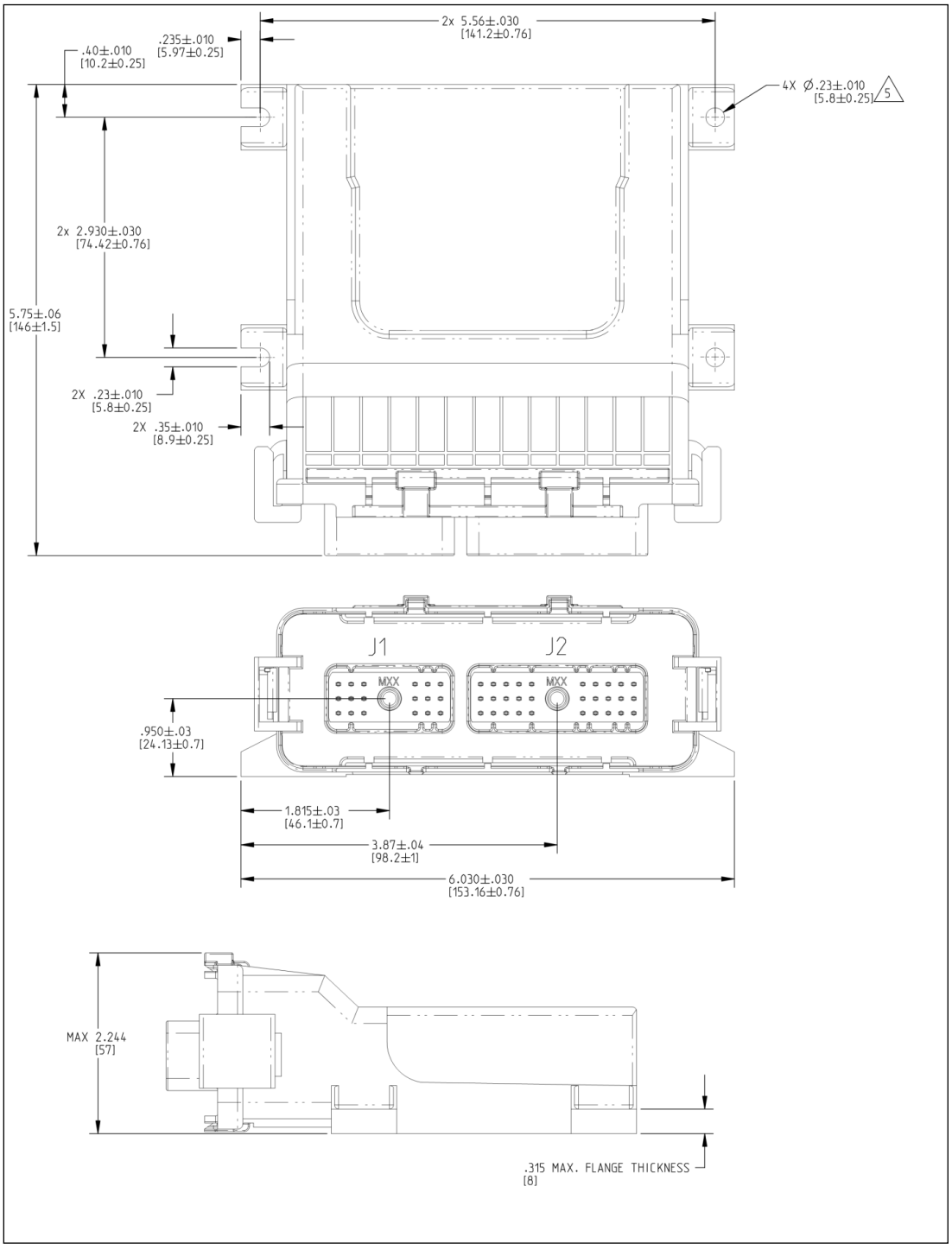


Figure 2-1. actiVgen Speed Control Dimensions

Chapter 3.
Installation and Wiring

Introduction

This chapter provides general information on selection of a mounting location for the actiVgen speed control controller, as well as installation and wiring guidelines.

Unpacking

Before handling the control, refer to the inside front cover and page vii of this manual for Warnings and Cautions, including the Electrostatic Discharge Awareness.

Be careful when unpacking the electronic control. Check the control for signs of damage such as bent panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

The actiVgen speed control is shipped from the factory in an anti-static bag and carton. This bag and carton should always be used for transport of the actiVgen speed control before its installation.

Remove all manuals, connectors, mounting screws, and other items before storing the shipping box. The original shipping material or equivalent should be used when sending the unit back for service.

Mounting

Location Considerations

Consider these requirements when selecting the mounting location:

- Adequate ventilation for cooling and an operating temperature range of –40 to +85 °C / –40 to +185 °F
- Avoidance of excessive vibration levels, or adequate vibration isolation
- Distance from high-voltage or high-current devices or devices that produce excessive electromagnetic interference
- Protection from direct exposure to water or to a condensation-prone environment
- Space needed for harness wires to be laid without excessive bending
- Protection from direct exposure to exhaust manifolds and pipes
- Space for servicing and repair

The actiVgen speed control was designed for off-engine engine bay or skid mount installation. It is suitably protected against water and dust entry, thermal cycles, and exposure to oils, coolant, and fuels. The mating wiring harnesses must be installed to complete the moisture seal.

Figure 3-1 shows the mounting hold pattern and dimensions for use when designing a mounting plate. Mounting fasteners should be torqued to maximum value of 1.1–1.4 N·m / 10–12 lb-in.

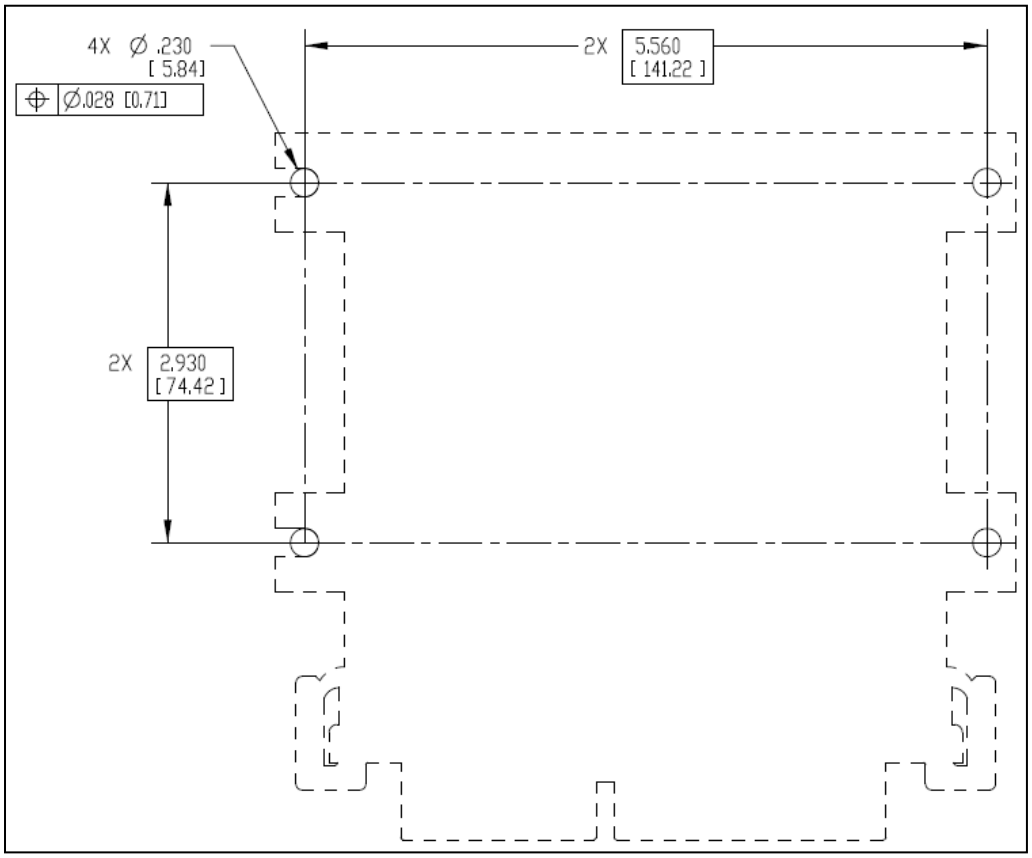


Figure 3-1. Mounting Hole Layout

To ensure proper water ingress protection, the actiVgen speed control should be installed with connectors downward.

Figures 3-2 and 3-3 show mounting orientation requirements.

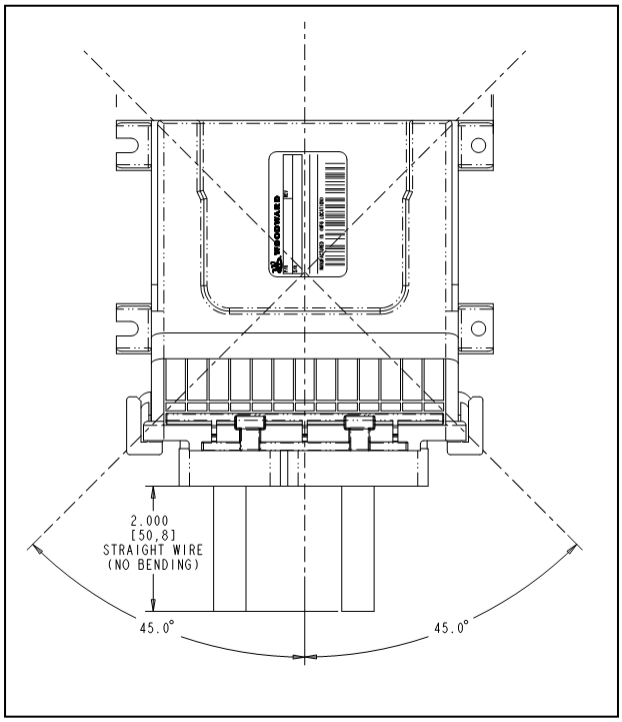


Figure 3-2. Mounting Orientation (Front View)

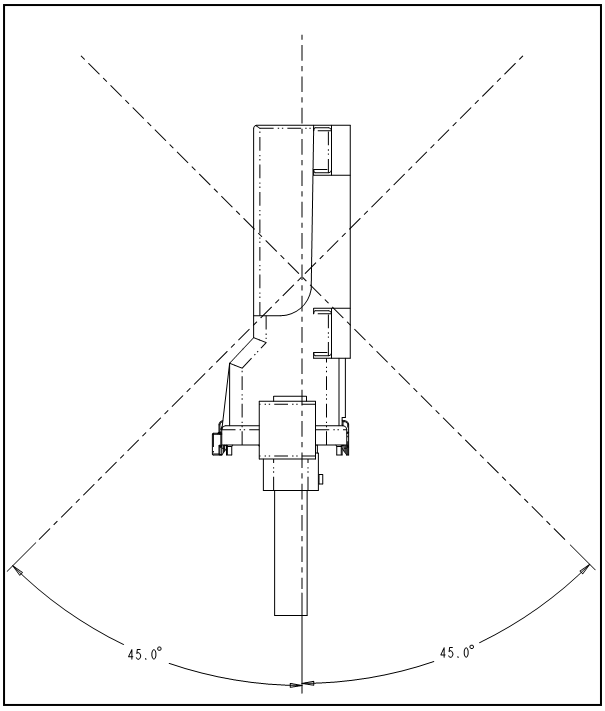


Figure 3-3. Mounting Orientation (Side View)

NOTICE

To prevent damage to the wiring cables, make sure that the bend radius of the harness has been accurately estimated.

Wiring

Connectors Description

The actiVgen speed control is not shipped with mating connectors since many applications may have a standard wiring harness or it is desirable to have the mating connectors in advance to use when wiring. However, for service and convenience, Woodward also carries actiVgen speed control connector kits containing all the mating terminal blocks used on the actiVgen speed control. See the Appendix for mating connector instructions.

The sealed connectors on the actiVgen speed control are not designed for removal by hand. After input power is disconnected, the connectors can be removed using a 1/4 inch hex-head driver. When reinstalling the connectors, use 1.7–2.3 N·m / 15–20 lb-in torque for the jackscrew. Using the correct torque is required to avoid damage and provide proper force on the gasket for a moisture seal. Too little force will allow the connector to leak. See the Appendix for instructions.

A hand crimp tool is necessary for use with the hand crimp terminals included in the connector kit. The tool can be purchased from Woodward or directly from Cinch. See the Appendix for part numbers.

Each wire seals individually within the connector body to protect against dust and water intrusion into the connector. In order to make a proper seal, the wire insulation diameter on the 18-pin and 30-pin connectors must be between 1.96–2.64 mm / 0.077–0.104 inch. All unused pins must be sealed with plug. See the Appendix for part number.

Pinout

All connections are located on the front face of the actiVgen speed control. There are two connectors: J1 and J2. Both connectors must be used because there are required signals on both of them. The connectors are not marked on the enclosure but can be identified by size and position according to Figure 3-4. The drawing also identifies the individual connector pins (A1, B1, etc.) which are additionally marked on mating connectors.

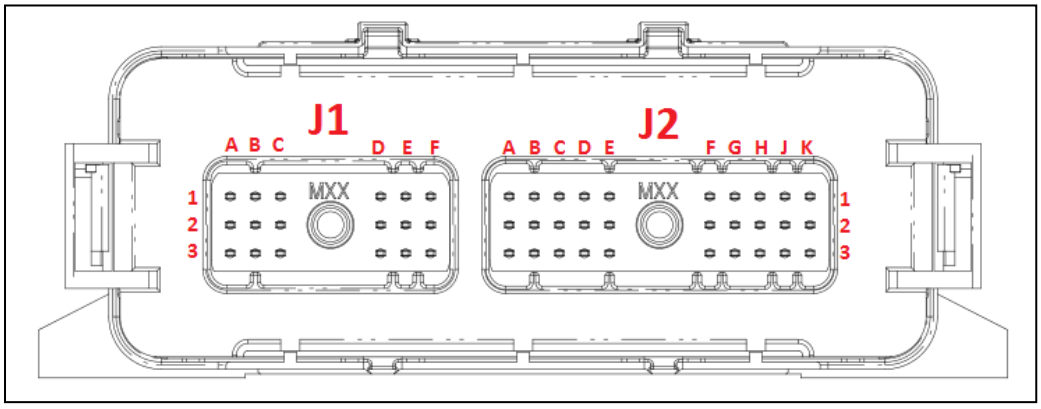


Figure 3-4. Connector and Pin Identification

Signals are separated logically so that J1 signals are high voltage and J2 signals are low voltage, thus simplifying the harness design and minimizing the risk in case of mis-wiring or wire breaks. The J1 connector pinout is shown in Figure 3-5 and J2 connector pinout is shown in Figure 3-6.

IMPORTANT

Unused controller pins should be left electrically unconnected.

Seal plug should be placed in the corresponding connector sockets to assure ingress protection.

Power Input

Battery +	J1-A1, B1
Battery -	J1-C1, B2, B3

PWM Output

Power Supply	J1-A2
PWM Output	J1-A3

CAN Communiactions

CAN High	J1-F2
CAN Low	J1-F3

Discrete Outputs

Discrete Output 1 (DO-1)	J1-D3
Discrete Output 2 (DO-2)	J1-E1
Discrete Output 3 (DO-3)	J1-E3
Discrete Output 4 (DO-4)	J1-C3
Discrete Output 5 (DO-5)	J1-D1
Discrete Output 6 (DO-6)	J1-E2
Discrete Output 7 (DO-7)	J1-C2
Discrete Output 8 (DO-8)	J1-D2
Discrete Output 9 (DO-9)	J1-F1

Figure 3-5. J1 (Smaller Connector) Pinout

Speed Input

MPU +	J2-A1
MPU -	J2-A2
Shield	J2-A3

Unused Pins

Do Not Connect	J2-B1
Do Not Connect	J2-B2
Do Not Connect	J2-B3

Unused Pins

Do Not Connect	J2-H1
Do Not Connect	J2-H2
Do Not Connect	J2-H3

RS-232 Communications

RS-232 Tx (TXD)	J2-C1
RS-232 Rx (RXD)	J2-C2
RS-232 Common (DGND)	J2-C3

Unused Pins

Unused (Do Not Connect)	J2-J1
Unused (Do Not Connect)	J2-J2

Discrete Inputs

Discrete Input 1 (DI-1)	J2-K3
Discrete Input 2 (DI-2)	J2-D1
Discrete Input 3 (DI-3)	J2-D2
Discrete Input 4 (DI-4)	J2-D3
Discrete Input 5 (DI-5)	J2-E3
Discrete Input 6 (DI-6)	J2-E2
Discrete Input 7 (DI-7)	J2-E1

Unused Pins

Do Not Connect	J2-F1
Do Not Connect	J2-F2
Do Not Connect	J2-F3
Do Not Connect	J2-J3

Unused Pins

Do Not Connect	J2-G1
Do Not Connect	J2-G2
Do Not Connect	J2-G3

Unused Pins

Do Not Connect	J2-K1
Do Not Connect	J2-K2

Figure 3-6. J2 (Larger Connector) Pinout

Wiring Diagram

The general wiring diagram shown in Figure 3-7 should be used as a guideline for preparing your application's wiring scheme. Not all presented connections are used for all systems. Detailed information on each electrical connection is given in this chapter's "Description of Electrical I/O" section.

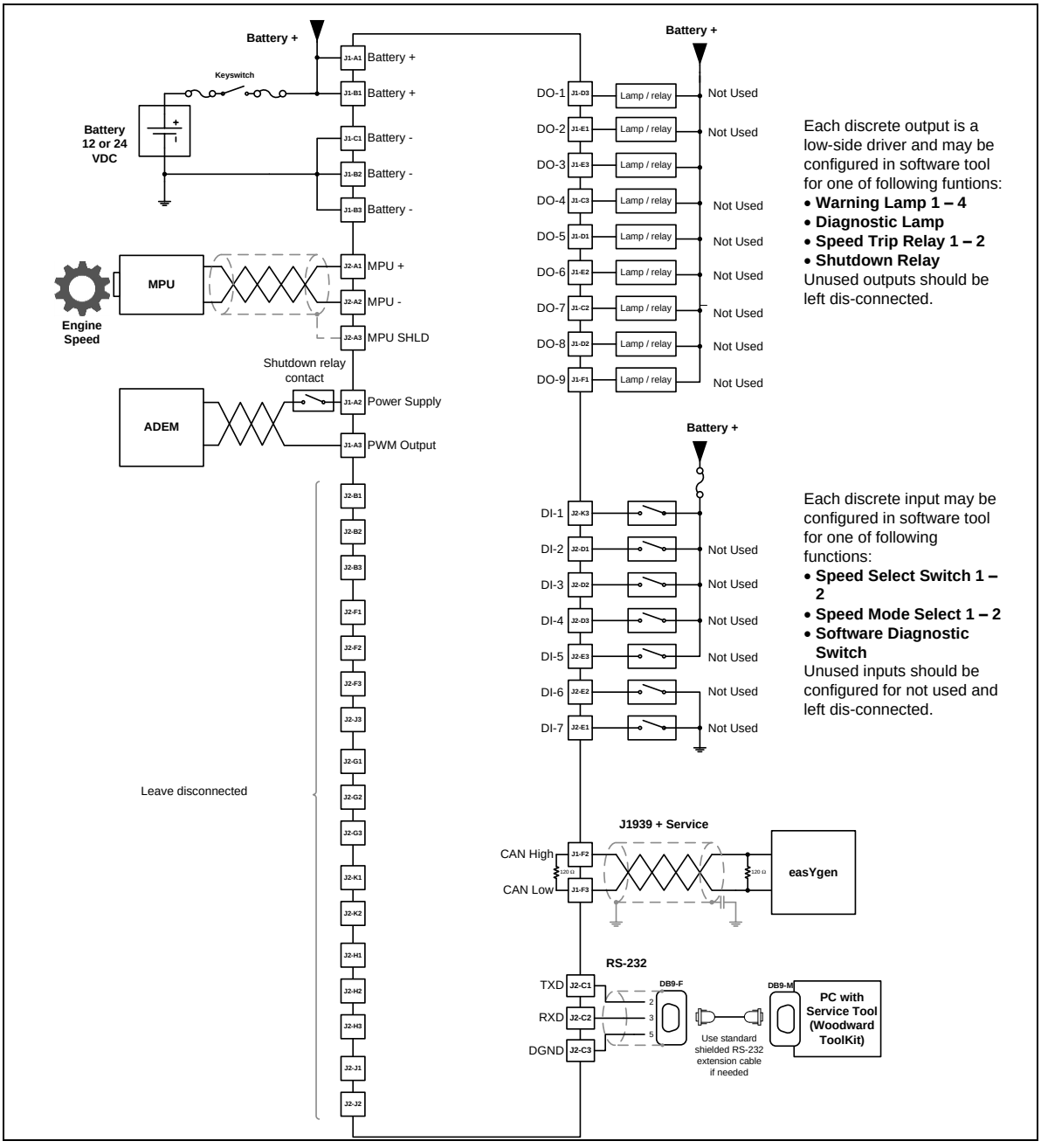


Figure 3-7. General actiVgen Speed Control Wiring Diagram

Wire Type Requirements

The table below shows wiring types for each signal type.

Signal Type	Wiring Type	Gauge	Max Length
Battery Input	May be twisted	1.0 mm^2 / 18 AWG	6.7 m / 22 ft
		1.5 mm^2 / 16 AWG	10 m / 33 ft
		2.0 mm^2 / 14 AWG	20 m / 66 ft
Actuator PWM Output	Twisted pair	1.0 mm^2 / 18 AWG	6.7 m / 22 ft
		1.5 mm^2 / 16 AWG	10 m / 33 ft
		2.0 mm^2 / 14 AWG	20 m / 66 ft
MPU Input	Shielded, twisted pair	1.0 mm^2 / 18 AWG 1.5 mm^2 / 16 AWG	10 m / 33 ft
Discrete Input	No requirement/ Individual wires	1.0 mm^2 / 18 AWG 1.5 mm^2 / 16 AWG	Less than 30m / 100 ft
Discrete Output	No requirement/ Individual wires	1.0 mm^2 / 18 AWG 1.5 mm^2 / 16 AWG	Less than 30m / 100 ft
RS-232	Shielded if longer than 15 mm / 6 inches	Must use serial cable	Less than 3m / 10 ft
CAN	Shielded, twisted pair	Must use CAN cable (see CAN section for details)	Less than 30 m / 100 ft

Wire Routing

Noise interactions can affect the accuracy of the control. To facilitate noise confinement, it is recommended that:

- All low-current wires should be separated from all high-current wires when routing from the actiVgen speed control to the engine components.
- Discrete wiring (such as relay outputs or discrete inputs) may be routed separately or with the analog wiring.

Splicing

Individual returns are not provided for each signal. Some signals share a common return pin. In these cases, harness splicing will be necessary.

Regardless of how the splicing is accomplished, signal routing is still very important. A signal should always be routed together with its return. Signals using twisted pair must have wires in close proximity and separations through the splice should be minimized to the greatest extent possible.

Wiring for discrete signals must be done so that the signal wire and the return are always in the same cable bundle. They should never take different paths between the actiVgen speed control and the sensor. This requirement is for signal integrity and EMI/EMC purposes.

Harness splicing should always be done using hot solder-crimp splices. The solder is necessary for good signal conductivity at all frequencies. The crimp is necessary for strength and protection in the on-engine environment. Cold crimp joints alone are not sufficient signal joints and are unreliable in a high vibration environment.

Splicing of shielded, twisted pair wiring is not recommended. These signals should have a single origin and destination. Breaking the signal path or shield is not desirable, as it provides an opportunity for EMI or EMC interference and reduced signal integrity.

Shielded Wiring

The use of cable with individually shielded-twisted pairs is required where indicated by the control wiring diagram (Figure 3-7). Discrete outputs, discrete inputs, actuator PWM output, and power supply wiring does not normally require shielding but can be shielded if desired. All shielded cable must be a twisted conductor pair. DO NOT attempt to tin (solder) the braided shield prior to crimping it into the socket or splice. The solder will affect the crimp strength and create vibration susceptibility. DO NOT attempt to directly ground the shield at both ends or an undesired ground loop condition may occur.

Shield terminations are provided through the actiVgen speed control connectors for speed input, remote set speed input and RS-232 communication port. CAN communication link does not have separate termination on the connector.

Failure to provide shielding can produce future failure or interference conditions which are difficult to diagnose. Proper shielding at the time of installation is required to assure satisfactory operation of the product.

Description of Electrical I/O

Power Supply Input

Pin	Function
J1-A1 and J1-B1	+12/24 V (dc) Battery Input
J1-C1, J1-B2 and J1-B3	Ground

The actiVgen speed control will handle a voltage range of 9 to 32 V (dc). Power supply output must be low impedance (for example from large batteries such as used for engine cranking). An alternator or other battery-charging device is necessary to maintain a stable supply voltage.

⚠ CAUTION

To prevent damage to the control, do not power a low-voltage control from high-voltage sources, do not exceed 32 V (dc) on the power inputs for more than 60 minutes, and do not power the control from high-voltage sources with resistors and Zener diodes in series with the power input.

The power supply terminals are reverse polarity protected in case a reverse polarity condition exists. Connecting power supply voltage in reverse will not damage the controller, although it will not operate nor alarm in any way.

The controller provides two terminals for redundant connection of the battery positive. Multiple connections help assure low power supply path resistance.

It also has three terminals for redundant connection of the battery negative. Multiple connections help assure low return path resistance.

Woodward recommends using a 10 A slow-blow fuse on the line feeding power supply input of the actiVgen speed control control. Run the power leads directly from the power source to the control. DO NOT power other devices with leads common to the control. Avoid long wire lengths. Connect the battery positive (power source positive) to the BATTERY(+) input and battery negative (power source common) to BATTERY(-). See Figure 3-8 for details.

The input voltage level is monitored for the purpose of application diagnostics and actuator duty cycle compensation.

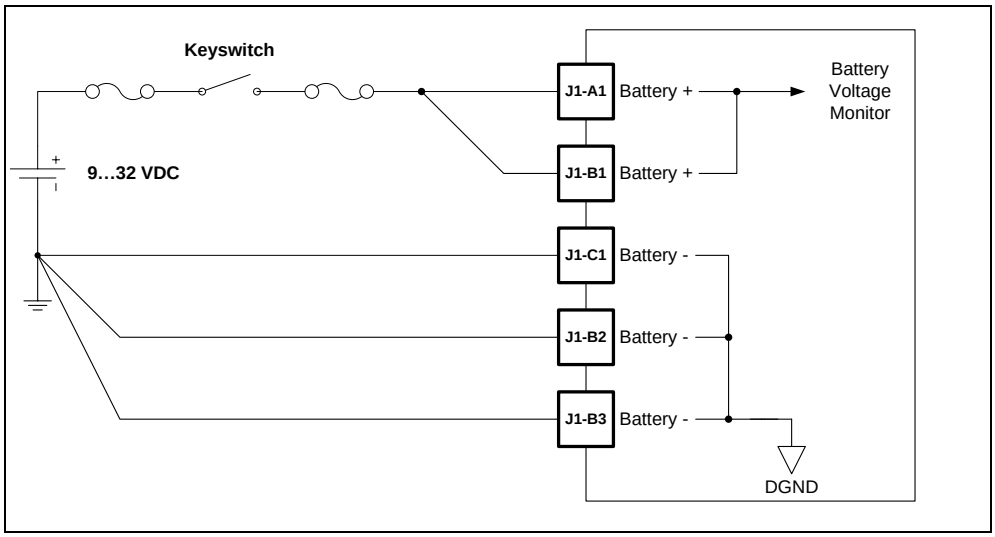


Figure 3-8. Power Supply Wiring

The single wire from the battery to the fuses and key switch should be equivalent gauge or larger gauge than the two wires from the fuse to the control to keep impedance low.

⚠CAUTION

Proper fusing of the control is highly recommended to prevent damage to the control in case of shorts that may occur in the field wiring. Fuses should be wired in series with all the power inputs to the control.

PWM Output

Pin	Function
J1-A2	Power Supply
J1-A3	PWM Output

The controller closes the loop on speed in order to maintain the speed set point. The PWM drive output provides a 5% to 95 % duty cycle at a fixed frequency of 500 Hz. Increasing the duty cycle “on-time” causes an increase in actuator position, which causes an increase in fuel delivery. The controller responds by increasing the duty cycle in response to an increasing engine load or decreasing duty cycle to adjust for decreasing engine load.

The following diagram shows how to connect the PWM to the control. With the large variations in Caterpillar gen sets, different terminal locations of the PWM signal connections are possible. Please consult Caterpillar documentation to verify connection location.

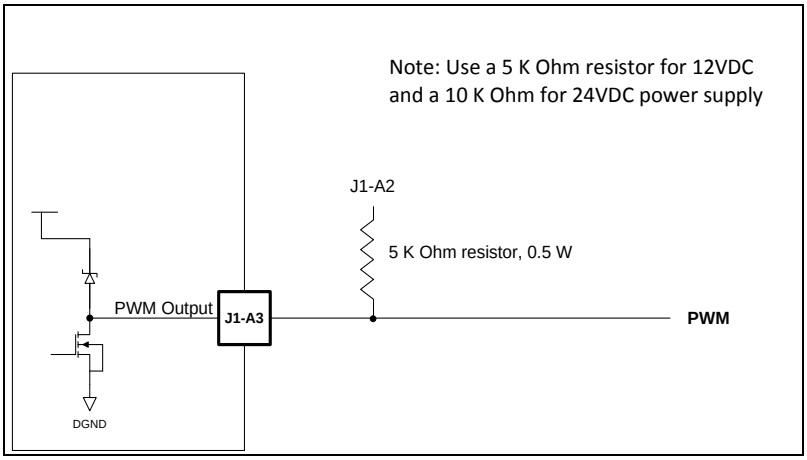


Figure 3-9. PWM Output

CAN Communication

Pin	Function
J1-F2	CAN High
J1-F3	CAN Low

There is one CAN port for service purposes. The actiVgen speed control supports SAE J1939 protocol.

It is necessary to terminate the network to prevent interference caused by signal reflections. Depending on network length, most CAN networks will not operate without proper termination. One of the two required CAN termination is included inside the actiVgen speed control. As a rule, no matter how many units are on a network, there should never be more than two network terminations installed. Termination resistors must be installed only for the two units that are at the physical ends of the network. Terminating more than two units can overload the network and stop all communications. External termination may be a simple 121 Ω, 1 W, 1% metal film resistor placed between CAN high and CAN low terminals at the two end units, as a differential termination. Do not connect the termination resistor to anything besides the CAN high and CAN low wires.

IMPORTANT

SAE J1939 protocol is restricted to 250 kbps and the SAE J1939 standard limits wiring distances to 40 meters, when un-isolated controls are connected on the link.

Shielded CAN cable is recommended between the actiVgen speed control and any other devices. Unshielded or improperly shielded cables are likely to cause communication problems and unreliable control operation. Improper shield termination to ground can also cause communication problems and unreliable control operation. The standard for CAN networks is that each device will have an ac-coupled shield connection (connected through a capacitor—typically 0,01 µF). A single direct network shield ground location should be provided. Typically the direct shield grounding location does not have to be at a unit connector, it can be any convenient place in the system.

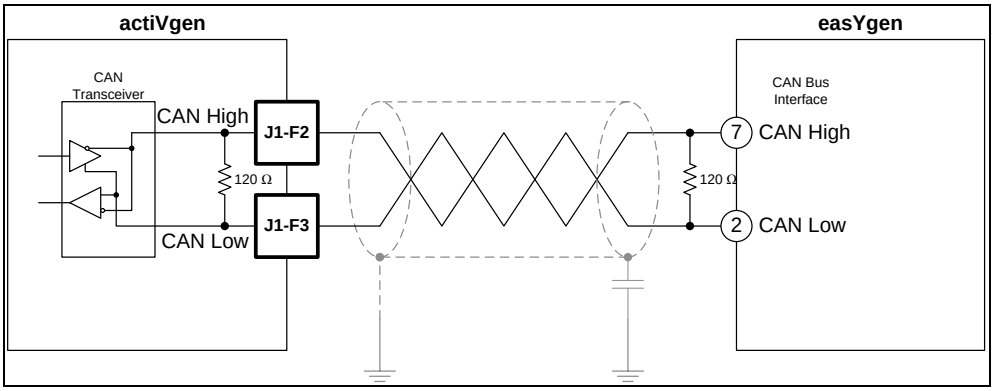
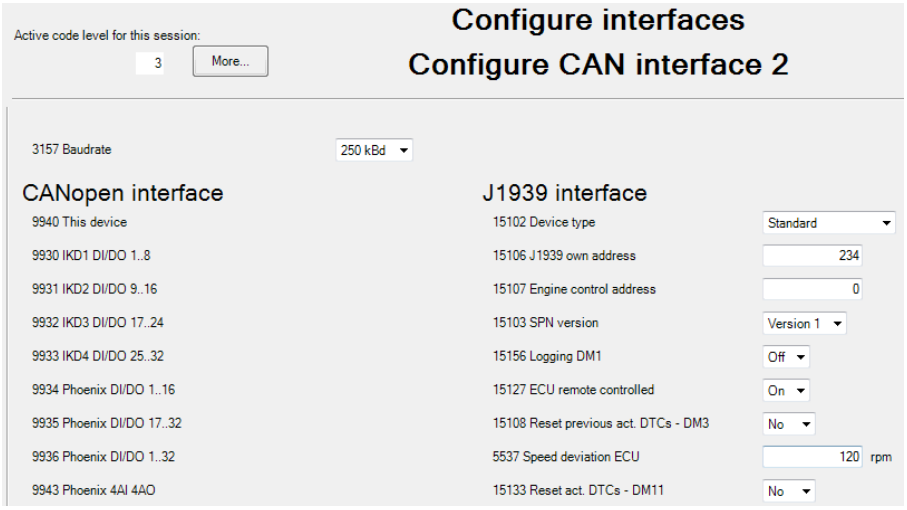


Figure 3-10. CAN Wiring

1. **Setup of the easYgen Controller**. In the “CAN interface 2 config.” menu, adjust the J1939 interface settings to the values shown in the screenshot. The speed deviation ECU setting depends on the engine.



Discrete Outputs

Pin	Function
J1-C2, J1-C3, J1-D1, J1-D2, J1-D3, J1-E1, J1-E2, J1-E3, J1-F1	Low Side Discrete Output

There are nine discrete outputs on the actiVgen speed control, but only one of them is being used in this application. Each of them can be used to control a lamp or relay coil. The function of each output is configured in the software tool and stored in controller settings. If less than nine discrete inputs are needed by an application, remaining outputs should be left unconnected and configured as “not used” in software tool (default value).

Current rating is suitable for direct control of a typical automotive lamp or relays (250 mA max). The electrical circuit is a low-side switch with the return current going to input power minus. The output load must be connected to the discrete output pin and to the Battery (+) of the system. Each output uses a diagnostics that will protect the actiVgen speed control if a short circuit is detected (trip current 350 mA max).

Open circuit diagnostics is available allowing to detect unconnected load (e.g. due to wire break). This causes trickle current of 170 µA in 12 V systems and 315 µA in 24 V systems.

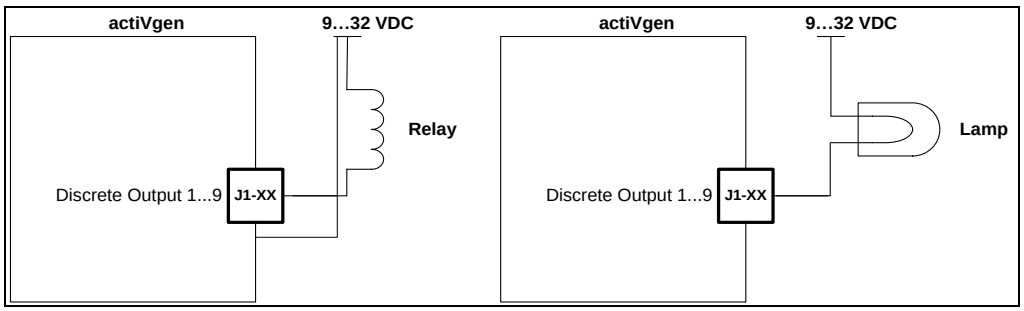


Figure 3-11. Discrete Outputs Wiring

Speed Input

Pin	Function
J2-A1	MPU
J2-A2	MPU
J2-A3	MPU Shield

The actiVgen speed control accepts a passive magnetic pickup (MPU) sensor. The speed input is used for detecting engine speed.

Wiring for speed sensors must be shielded cable with wire size of 16 or 18 AWG. Smaller wire diameters may not provide a strong crimp at the actiVgen speed control connector. Also, smaller wire diameters have been shown to be unreliable in on-engine wiring due to fatigue from vibration. No wire length greater than 10 meters is allowed.

There are multiple techniques in use for shield connections of speed sensors. Each technique has varying results depending on the noise present in the area. The recommended practice is to tie the cable shield to the designated shield pin on the control and leave the opposite end of the shield un-terminated and insulated.

The following diagram shows how to wire a speed sensor.

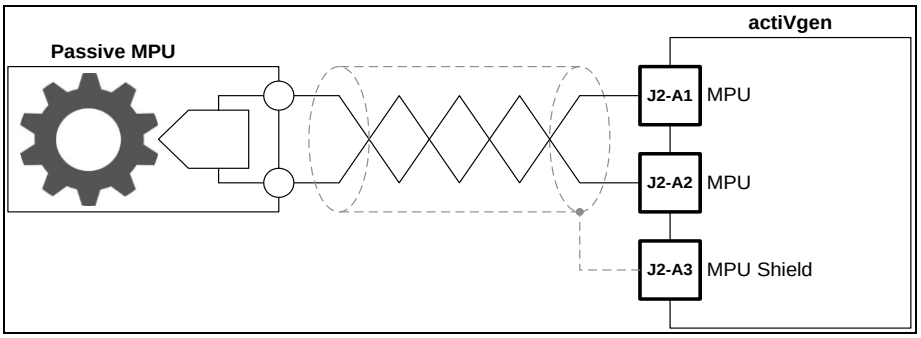


Figure 3-12. Speed Sensor Wiring

RS-232 Communications

Pin	Function
J2-C1	RS-232 Tx
J2-C2	RS-232 Rx
J2-C3	RS-232 Common

The actiVgen speed control has one RS-232 serial port that is used to download new application software or to provide communications between the control and a PC service tool using Woodward's Service Tool software.

⚠ CAUTION

There is a potential for serial port damage when communicating with the actiVgen speed control. This is caused by a difference in AC voltage between neutral and earth ground. If the PC RS-232 port ground is referenced to AC neutral, and the actiVgen speed control is referenced to battery ground (AC earth ground), a large amount of current can be experienced. To avoid this situation, we strongly recommend placing an isolation transformer between the AC outlet and the PC.

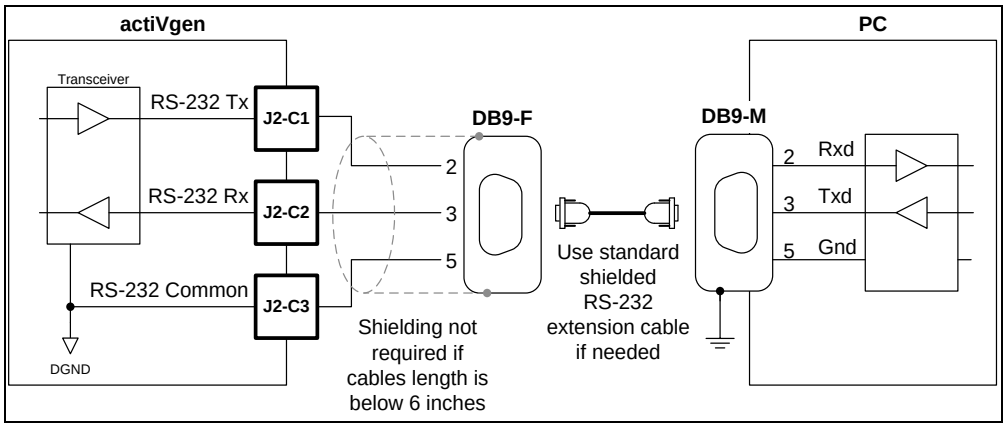


Figure 3-13. RS-232 Interface Wiring

IMPORTANT

Serial communication port is intended as service and monitoring ports; no critical functions should be attributed to them. Data is sent in a free-run mode such that the port is serviced when the microprocessor has extra time.

Discrete Input

Pin	Function
J2-K3	Discrete Input, switched to battery positive.

There are seven discrete inputs on the actiVgen speed control, only one is used for this application. The function of Discrete Input #1 is to switch the speed input from an internal speed reference to receiving the speed setpoint from the CANbus. If less than seven discrete inputs are needed by application, the remaining inputs should be left unconnected.

The electrical connection of each input is fixed. Five inputs are connected in relation to battery voltage and two inputs are to be connected in relation to ground. Each discrete input logic may be configured with software; therefore the contacts may be either normally open or normally closed.

Discrete inputs have identical hardware filtering characteristics. See the Appendix for details.

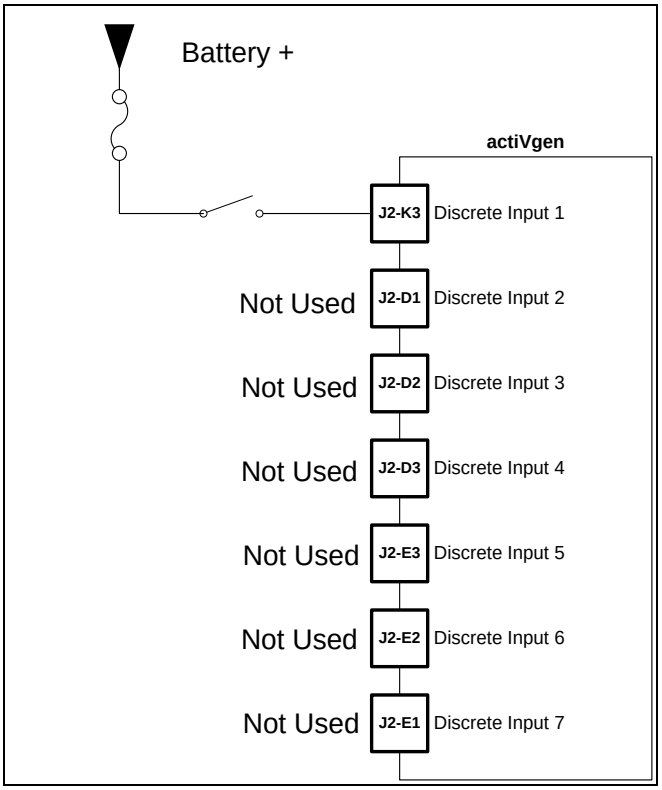


Figure 3-14. Discrete Input Wiring

Chapter 4.
Description of Operation

Introduction

This chapter describes the basic operating principles of the actiVgen speed control. Detailed information about configuring the controller for the operations described is provided in Chapter 6.

Engine Speed Control

The actiVgen speed control uses a PID (Proportional, Integral, and Derivative) type control loop in order to achieve precise engine speed governing. The speed control loop accepts an engine speed signal calculated from a MPU (magnetic pickup) frequency input. This signal is compared with the desired speed. The output of the speed control loop is a desired actuator position which is converted to a PWM (Pulse Width Modulated) signal output.

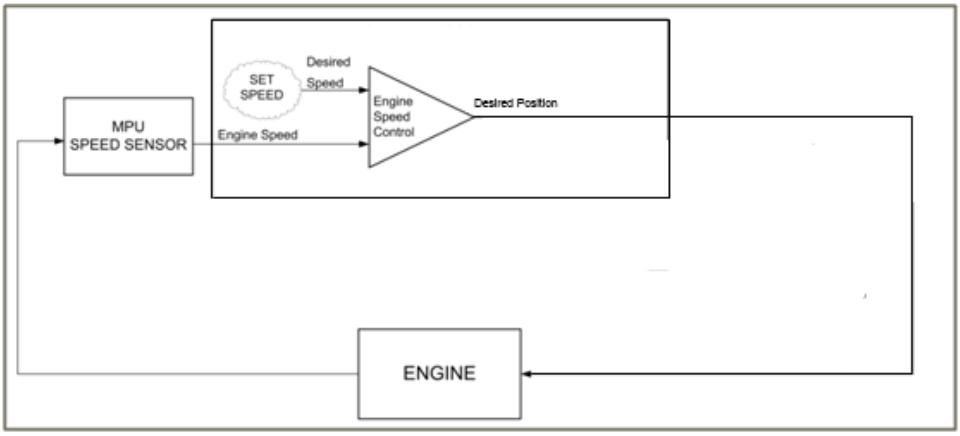


Figure 4-1. actiVgen Speed Control General Control Diagram

Engine Starting

Engine speed input is continuously monitored and the engine is assumed to be in one of the three states:

- Stopped: No speed input signal detected or signal frequency is below 50 rpm.
- Cranking: Engine speed is detected but did not pass CRANK_TO_RUN value.
- Running: Engine speed passed CRANK_TO_RUN value.

When the engine is stopped, 0% actuator position is commanded. During engine cranking, the actiVgen speed control opens the actuator to allow enough fuelling to start the engine. The actuator position during engine crank is limited in order to reduce over fuelling the engine. The actuator position limit can either is fixed. The controller assumes that engine is cranking when speed input signal is measured at the control.

After engine speed has passed CRANK_TO_RUN value, actuator position is commanded by the PID (Proportional, Integral, Derivative) engine speed governor, based on the desired speed value and the measured engine speed. Engine desired speed is ramped from SET_SPEED_START to the desired speed following RAMP_UP_START_RATE value. After this first ramp is finished, RAMP_UP_RATE and RAMP_DOWN_RATE are used for any speed setpoint changes.

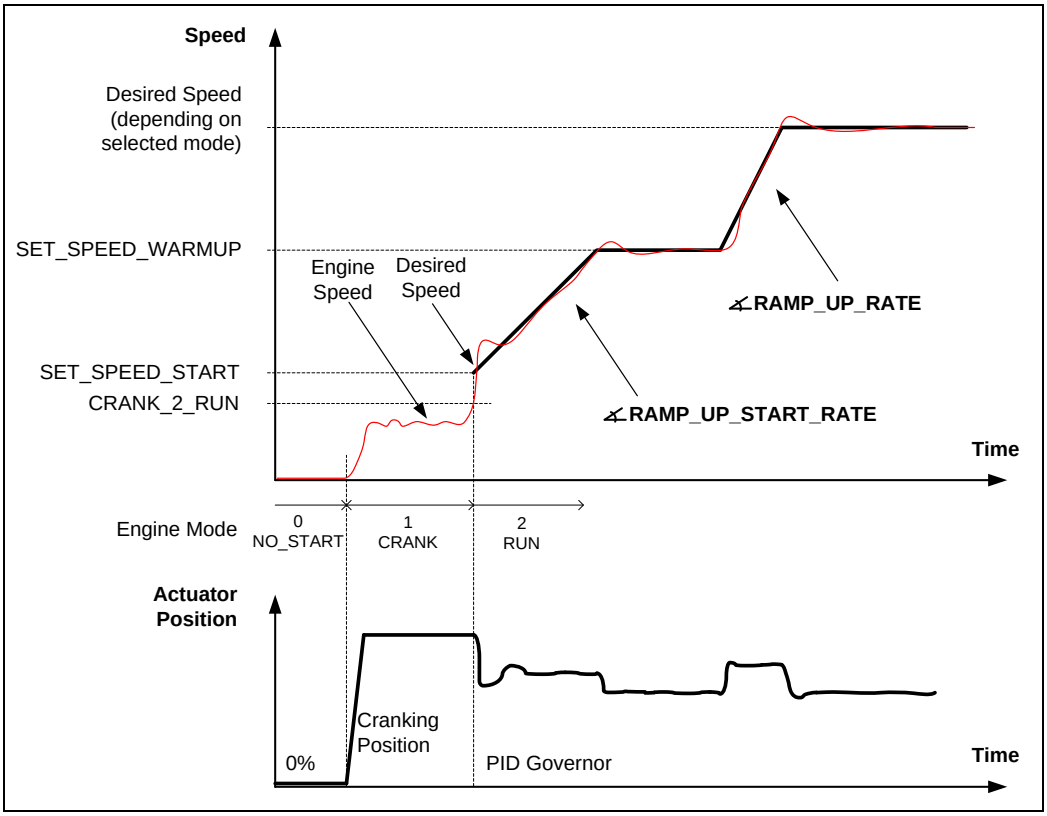


Figure 4-2. Engine Starting Overview

Speed Governor Operation

After the engine is started, the actiVgen speed control algorithm will perform the following functions:

- Desired speed is calculated according to currently active speed mode.
- The Engine Speed Control PID governor commands the desired actuator position.

The Speed governor output working range is limited by configurable desired position low and high limits. The default is a full working range (0–100%).

Speed Setpoint Options

Speed setpoint mode defines the algorithm that is used to calculate the desired engine speed. The actiVgen speed control provides the following speed setpoint modes:

- Speed setpoint controlled with switches for fixed speeds
- Speed setpoint controlled CAN J1939 commanded speed

Switched Speed Operation

In this mode, speed setpoint is controlled with a discrete input. CAN Enable will switch the internal speed reference from the Crank to Run Speed to the CAN bus.

CAN J1939 Speed Setpoint

In CAN J1939 mode, speed is commanded with SPN 898 sent in Torque/Speed Control 1 (TSC1) PGN. CAN module must be enabled. If TSC1 frame is not received within configurable PGN_TSC1_TIMEOUT, configurable CAN_DEFAULT_SPEED will be commanded. Warm up speed feature is not used in CAN speed mode.

Diagnostics

The APECS controller detects a number of abnormal conditions, called “faults”. A fault is considered “active” if the condition defined for this fault is present.

The table below gives a list of detected faults with a brief description. A detailed list of fault actions is given later in this chapter.

Fault Name	Short Description	Engine Shutdown	Limp Home Available
ACTUATOR_OVERCURRENT	Actuator output overcurrent	•	
ACTUATOR_OPEN_CIRCUIT	Actuator output dis-connected		
APS_POWER_SUPPLY	J1-A2 pin short to ground	•	•
CAN_COMMUNICATION	CAN bus error		
CAN_RECEIVE_TIMEOUT	TSC1 frame receive timeout		
CONFIGURATION	Device configuration corrupted	•	
CPU_FAILURE	Internal hardware failure	•	
CPU_POWER_SUPPLY	Controller internal supply dropout		
DOUT_x_OVERCURRENT	Discrete output overcurrent		
DOUT_x_OPEN_CIRCUIT	Discrete output unconnected		
EEPROM_RW_FAILURE	Internal hardware failure		
HIGH_BATTERY_VOLTAGE	Battery voltage over high threshold		
LOW_BATTERY_VOLTAGE	Battery voltage below low threshold		
LOSS_OF_SPEED	MPU sensor failure	•	•
OVERSPEED	Engine speed limit exceeded	•	
PROTECTION_FAULT	External protection device shutdown	•	

Each fault may be configured for latching or non-latching operation. During a non-latching operation, the controller will return to normal operation as soon as the fault condition is removed. During fault latching operation, the controller keeps the fault activated until the controller's power is cycled or all the faults are cleared (see below). Note that some faults don't allow recovery without resetting power to the controller. For those faults, setting latching operation has no effect.

If a fault is latched, the controller operates the same way as if the fault were active.

Similarly to a latching fault, each fault may be configured to activate a lamp that latches on. When a latching lamp is not used, the controller disables the fault annunciation as soon as fault condition is removed. When a latching lamp is used, the controller keeps the fault annunciation on until the controller's power is cycled or the faults are cleared.

Each time a fault is activated, a logged count for this fault is increased. This allows for troubleshooting intermediate fault conditions that may appear in the system. The logged count value stops at value 126.

Diagnostic Lamps and Switches

The actiVgen speed control controller provides the following ways for accessing diagnostic information:

- Diagnostic lamps and switched interface
- ToolKit interface—fault state may be read by service technicians using actiVgen speed control PC Service Tool. See Chapter 7 (Troubleshooting). Note that PC interface is diagnostic only and is not intended for use in normal system operation.
- CAN J1939 interface. This is described in CAN J1939 DM-1 and DM-2 message descriptions.

Detected Faults Description

The full list of faults detected by the APECS controller is given below.

CAN_COMMUNICATION
Activated when CAN bus off, CAN transmitter/receiver error or CAN synchronization error condition is detected for at least CAN_LOST_DELAY (configurable parameter).
Fault actions: none (indication only)

CAN_RECEIVE_TIMEOUT
Activated when TSC1 frame with correct SPN898 data is not received within period defined in PGN_TSC1_TIMEOUT. Setting PGN_TSC1_TIMEOUT to zero disables this fault detection.
Fault actions: setpoint in CAN speed mode is switched to CAN_DEFAULT_SPEED

HIGH_BATTERY_VOLTAGE
Activated when battery voltage exceeding the 135% of nominal voltage is detected for at least 60 seconds (default value, may be changed). Nominal voltage is 14.5 V for 12 volts system or 28.5 V for 24 volts system.
Fault actions: none (indication only)

LOW_BATTERY_VOLTAGE
Activated when battery voltage below 9 V is detected for at least 60 seconds. Both threshold value and delay time default values may be changed.
Fault actions: none (indication only)

LOSS_OF_SPEED
Indicates that MPU speed sensor malfunction has been detected. Activated in two situations:

- When sudden drop of engine speed input frequency is detected
- When starter motor is working (autocrank or autostart enable input) for at least AUTOCRANK_NO_START_TIME and speed is not sensed

If the speed signal drops from least 500 rpm (default value, reconfigurable in parameter FAIL_SPEED_CHANGE) to zero, it is assumed that the speed sensor is malfunctioning. In this situation, calculated speed value is maintained at the last seen value for 100 ms (default value, configurable). If speed input frequency does not re-appear during this time, LOSS_OF_SPEED fault is activated. Refer to Figure 4-25.

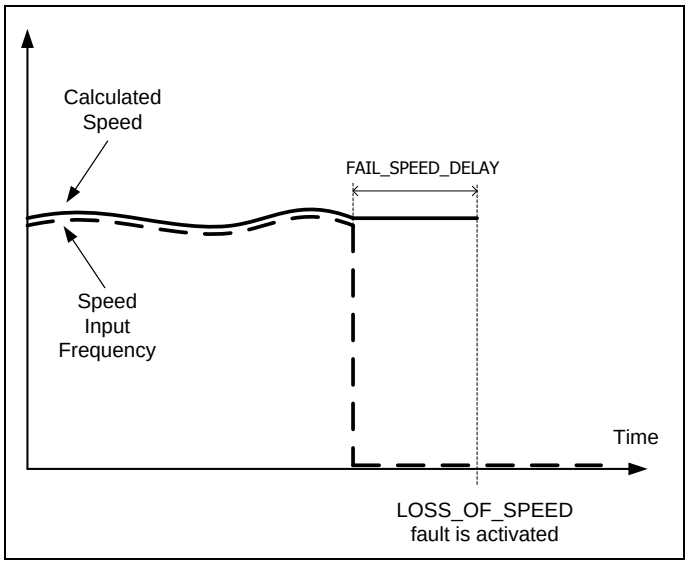


Figure 4-3. LOSS_OF_SPEED Fault Activation Diagram

If not set to latching operation, this fault will be cleared if speed input frequency is observed again. By default, cycling power to the controller will also clear this fault.
Fault actions: engine shutdown, limp home mode available

OVERSPEED
Activated when configured engine speed limit was reached for at least OVERSPEED_DELAY time. Speed limit is configured in two ways:

- As an absolute speed value configured in SPEED_LIMIT_ABSOLUTE
- As a percentage of maximum currently commanded speed. For fixed speeds this is calculated in relation to speed setpoint value. For variable speeds this is calculated in relation to SET_SPEED_MAX.

At any moment, the lower of these two limits is used.
Fault actions: engine shutdown

Engine Monitoring Functions

Battery Voltage Monitoring

The actiVgen speed control controller measures battery voltage and uses that information for:

- Battery voltage low/high diagnostics- see Diagnostics for description of faults: CPU_POWER_SUPPLY, LOW_BATTERY_VOLTAGE, HIGH_BATTERY_VOLTAGE
- Battery voltage compensation for actuator PWM generation—if enabled, at every moment PWM output values is multiplied by a battery voltage dependent factor. This reduces actuator position fluctuations during battery voltage transients.

CAN J1939

General CAN Information

The actiVgen speed control controller 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 may be found in ISO 11898. A subset of the SAE J1939 standard messages defined in J1939-21, J1939-71, J1939-73, and J1939- 81 is supported with further details indicated here.

All actiVgen speed control J1939 messages use the CAN 2.0B 29-bit Extended Data Frame Format. Little-Endian format is used when handling multiple-byte parameters (i.e., a position demand of 50% is $FF0F, not $0FFF). All parameters shall use this format unless otherwise specified.

The actiVgen speed control bit timing is limited to provide a data rate of 250 kbps only.

The available J1939 frames (PGN—Parameter Group Number) are listed further in this chapter. For each PGN only selected data fields (SPN—Suspect Parameter Number) are used.

Broadcasted Messages

actiVgen speed control broadcasts the J1939 messages listed below. Only SPNs mentioned in the tables signals are used, remaining bytes are filled with 0xFF. If SPN value is not available due to active fault, error indicator (0xFE for byte values, 0xFEFF for word values) is sent.

Transmission repetition rate is configurable for all broadcasted messages.

Electronic Engine Controller 1 (EEC1)

Description	Value	
Transmission Repetition Rate	Configurable PGN_EEC1_DELAY – default 10 ms	
Transmitter	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	240	
PDU Specific	4	
Default Priority	3	
Parameter Group Number	61444 (0xF004)	
Byte	3	SPN 513 – Actual Engine – Percent Torque
	4-5	SPN 190 – Engine Speed

SPN 513 Actual Engine – Percent Torque
The calculated engine load. Error indicator sent if POSITION_SENSOR_HI or POSITION_SENSOR_LO fault active.
Data Length: 1 byte
Resolution: 1 %/bit, –125 % offset
Data Range: –125 to +125 % Operational Range: 0 to 125%
Type: Measured

SPN 190 Engine Speed
Actual engine speed. Error indicator sent if LOSS_OF_SPEED fault active.
Data Length: 2 bytes
Resolution: 0.125 rpm/bit, 0 offset

Data Range: 0 to 8,031.875 rpm Operational Range: same as data range
Type: Measured

Electronic Engine Controller 2 (EEC2)

Description	Value	
Transmission Repetition Rate	Configurable PGN_EEC2_DELAY – default 50 ms	
Transmitter	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	240	
PDU Specific	3	
Default Priority	3	
Parameter Group Number	61443 (0xF003)	
Byte	4	SPN 974 – Remote Accelerator Pedal Position

SPN 974 Remote Accelerator Pedal Position
Speed Setpoint Potentiometer value. Error indicator sent if SET_SPEED_POT_HI or SET_SPEED_POT_LO fault active.
Data Length: 1 byte
Resolution: 0.4 %/bit, 0 offset
Data Range: 0 to 100 % Operational Range: same as data range
Type: Measured

Electronic Engine Controller 3 (EEC3)

Description	Value	
Transmission Repetition Rate	Configurable PGN_EEC3_DELAY – default 250 ms	
Transmitter	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	254	
PDU Specific	223	
Default Priority	6	
Parameter Group Number	65247 (0xFEDF)	
Byte	2-3	SPN 515 – Engine's Desired Operating Speed

SPN 515 Engine's Desired Operating Speed
Current Desired Speed used by speed governor.
Data Length: 2 bytes
Resolution: 0.125 rpm/bit, 0 offset
Data Range: 0 to 8,031.875 rpm
Operational Range: (upper byte resolution = 32 rpm/bit)
Type: Status

Requested Messages

Requested messages are sent by the controller when corresponding request PGN frame is received.

Address Claimed

Description	Value	
Transmission Repetition Rate	After power-up, on demand	
Transmitter	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	238	
PDU Specific	255 (global address)	
Default Priority	6	
Parameter Group Number	60928 (0x00EE00)	
Source Address	0 to 253	
Byte	1..8	NAME of Controller Application

NAME of Controller Application
Contains the configurable fields which values are in parameters given in brackets. The default value for Manufacturer Code is set to 153 (Woodward identifier). All the others values are set by default to 0.

Byte: 1 (PGN_NAME_ID)	Bits 8-1	Least significant byte of Identity Number
Byte: 2 (PGN_NAME_ID)	Bits 8-1	Second byte of Identity Number
Byte: 3 (PGN_NAME_MANUF)	Bits 8-6	Least significant 3 bits of Manufacturer Code
	Bits 5-1	Not used (ignore value)
Byte: 4	Bits 8-6	Not used (ignore value)
	Bits 5-1	Most significant 5 bits of Manufacturer Code (PGN_NAME_MANUF)
Byte: 5	Bits 8-4	Function Instance (PGN_NAME_FUN_INST)
	Bits 3-1	ECU Instance (PGN_NAME_ECU_INST)
Byte: 6	Bits 8-1	Function (PGN_NAME_FUNCTION)
Byte: 7	Bits 8-2	Vehicle System (PGN_NAME_SYSTEM)
	Bit 1	Reserved (ignore value)
Byte: 8	Bit 8	Arbitrary Address Capable (always zero because dynamic addressing is not supported)
	Bits 7-5	Industry Group (PGN_NAME_INDUSTRY)
	Bits 4-1	Vehicle System Instance (PGN_NAME_SYS_INST)

CAN Source Address cannot be changed by Address Claim Procedure. The default value is set to 0x00. If it is required (another device uses the same source address) actiVgen speed control CAN Source Address parameter can be modified by Service Tool.

Component Identification

Description	Value	
Transmission Repetition Rate	On demand	
Transmitter	actiVgen speed control	
Data Length	Variable	
Data Page	0	
PDU Format	254	
PDU Specific	235	
Default Priority	6	
Parameter Group Number	65259 (0x00FEFB)	
Source Address	0 to 253	
Byte	1..a	Make – SPN 586
	(a+1)..b	Model – SPN 587
	(b+1)..c	Serial Number – SPN 588
	(c+1)..d	Unit Number – SPN 233

SPN 586 Make
Make of the component corresponding to the codes defined in the American Trucking Association Vehicle Maintenance Reporting Standard (ATA/VMRS). Isn't defined in application. Only delimiter is inserted.
Data Length: 1 character (an "*" delimiter)
Resolution: ASCII

SPN 587 Model
Model of the component. Engine Type, user defined, up to 13 characters long.
Data Length: Variable – 1 to 14 characters ("*" delimited)
Resolution: ASCII

SPN 588 Serial Number
Serial number of the component. Engine Serial Number, user defined, up to 12 characters long.
Data Length: Variable – 1 to 13 characters ("*" delimited)
Resolution: ASCII

SPN 233 Unit Number
Owner assigned unit number for the power unit of the vehicle. Controller Settings Version, user defined, up to 10 characters long.
Data Length: Variable – 1 to 11 characters ("*" delimited)
Resolution: ASCII

Commanded Messages

The actiVgen speed control controller receives and interprets the messages described below.

Torque/Speed Control 1 (TSC1)

Description	Value	
Transmission Repetition Rate	To engine: Control Purpose dependent or 10 ms	
Receiver	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	0	
PDU Specific	APECS Source Address	
Default Priority	3	
Parameter Group Number	0 (0x0000)	
Byte.bit	2-3	SPN 898 – Engine Requested Speed/Speed Limit

SPN 898 Engine Requested Speed/Speed Limit
Desired engine speed that will be used in CAN_J1939 speed mode.
Data Length: 2 bytes
Resolution: 0.125 rpm/bit, 0 offset
Data Range: 0 to 8,031.875 rpm Operational Range: same as data range
Type: Status

Shutdown (SHUTDN)

Description	Value	
Transmission Repetition Rate	1 s	
Receiver	actiVgen speed control	
Data Length	8	
Data Page	0	
PDU Format	254	
PDU Specific	228	
Default Priority	6	
Parameter Group Number	65252 (0xFEE4)	
Byte.bit	5.1-5.2	SPN 1110 – Engine Protection System has Shutdown Engine

SPN 1110 Engine Protection System has Shutdown Engine
This SPN may be used to force immediate shutdown of the engine.
00 – No
01 – Yes (force shutdown)
10 – Ignored
11 – Ignored
Data Length: 2 bits
Resolution: 4 states/2 bit, 0 offset
Data Range: 0 to 3 Operational Range: same as data range
Type: Status

Chapter 5.
Service Tool

Introduction

The actiVgen speed control Service Tool software is used to configure, monitor and troubleshoot an actiVgen speed control controller. It supports the following controller part numbers: 8440-2100 (firmware 5418-XXXX).

This chapter describes the installation and general usage of the Service Tool.

The Service Tool software resides on a PC (Personal Computer) and communicates with the actiVgen speed control through a serial interface. Refer to Chapter 3 for wiring instructions. For newer computers without serial ports, a USB-to-serial converter is required, (Woodward P/N 8928-1151).

System Requirements:

- Microsoft Windows 7, Vista, XP (32- & 64-bit)
- Microsoft .NET Framework ver. 3.5
- 600 MHz Pentium CPU
- 512 MB of RAM
- Minimum 800 by 600 pixel screen with 256 colors
- Recommended screen resolution 1024 x 768 or higher
- 9 pin-D serial port (RS232)
- 9 pin-D straight through serial cable (not a null modem cable)

WARNING

An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.

Obtaining the PC Software Tool

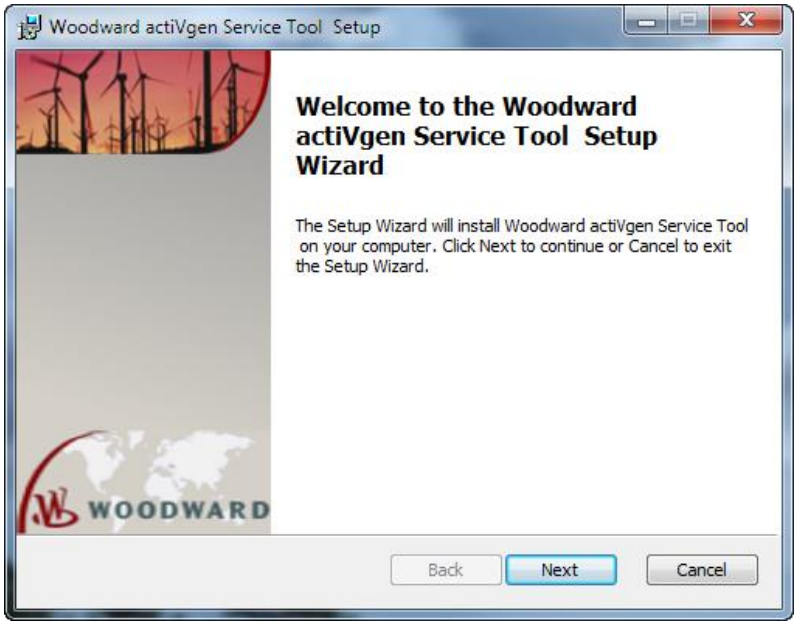
The actiVgen speed control Service Tool can be obtained from Woodward's software products web page. Click on the link or type www.woodward.com/software into your Internet browser.

Type "actiVgen" into the search field. Select Download on the next screen. New users are required to register with an active email address.

Download the software and install it on your PC. Follow the instructions in the installation wizard to load all appropriate application components.

Installation

The actiVgen speed control Service Tool was developed to work in conjunction with Woodward ToolKit. Therefore, the first step in the installation process verifies that ToolKit is already installed. If not (or if the installed version of ToolKit is out-of-date), the user will be notified that ToolKit installation is required (as shown below). Click 'Install' to initiate ToolKit installation.



The user should be aware that ToolKit requires Microsoft .NET Framework 4.0. The ToolKit installer will attempt to install the .NET Framework automatically from the Internet. If this is not possible (e.g. due to lack of Internet connection), user can also obtain the .NET Framework 4.0 Redistributable package from Microsoft's website.

Once loaded, the ToolKit will be accessible via the Start menu (All Programs, Woodward/ToolKit folder).

If the current version of ToolKit is already installed, the installation wizard will proceed directly to installation of the actiVgen speed control Service Tool (as shown below).

During installation, the wizard will not require a user-specified directory in which to save the installation files. Instead, ToolKit is installed to the following default location: C:\Program Files\Woodward\ToolKit

Similarly, the actiVgen speed control Service Tool is installed to the default location: C:\Program Files\Woodward\actiVgen speed control Service Tool.

In order to run the actiVgen speed control Service Tool, from the Start Menu, select All Programs → Woodward → actiVgen speed control Service Tool → actiVgen speed control Service Tool or double-click the shortcut that is automatically created on the Desktop during installation of the actiVgen speed control Service Tool.

Connecting to the actiVgen Speed Control Controller

Connection of a generic PC to the actiVgen speed control is required in order to load application software and view/tune within that software application. The wiring of actiVgen speed control to a PC serial port is described in Chapter 2.

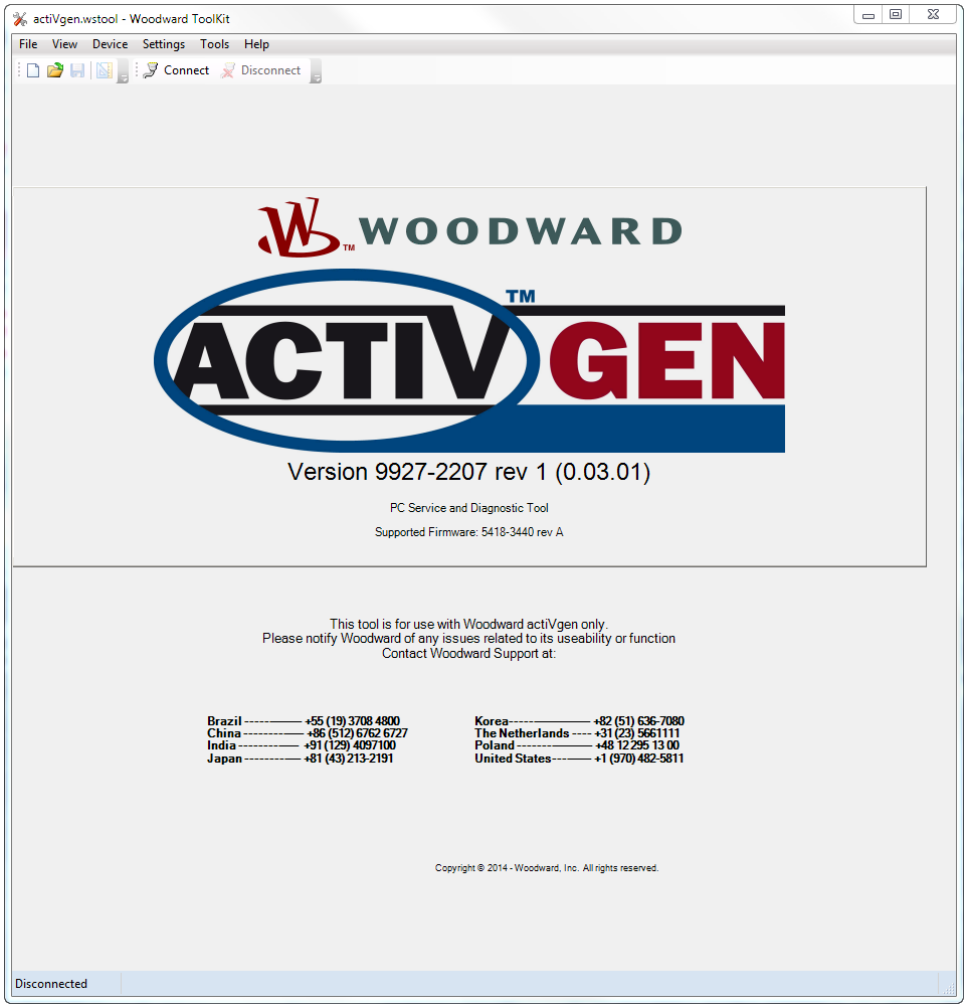


Figure 5-1. Starting the actiVgen Service Tool

At power-up, the actiVgen speed control runs through its boot-up routine and performs a set of initial diagnostics to verify CPU and memory health. When boot-up is complete, the application program will initialize, the control's outputs will be enabled, and system control will begin.

Click on the Connect button to start the connection process.

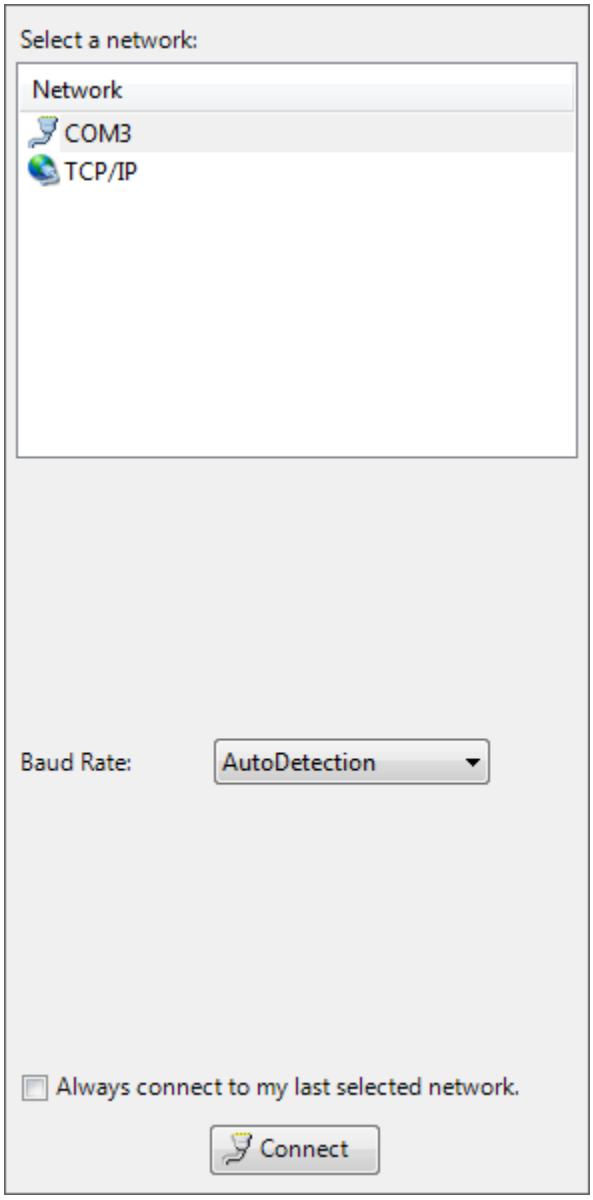


Figure 5-2. ToolKit Connecting Dialog

Make sure that all other programs or devices that may access your computer's communication port are closed or disconnected. Select Connect from the Communication menu in ToolKit. The user must select the COM port to which the controller is connected. Baud Rate parameter should be set to AutoDetection.

If ToolKit successfully connects to the controller, it will display the "Connected on COMx" information in the status bar on the bottom of ToolKit window. Software tool will prompt for password, which is described in the following chapter.

If the connection cannot be established, refer to Chapter 7 (Troubleshooting).

Security Levels and Passwords

The actiVgen speed control controller provides configurable password security with three access levels. It allows an OEM (Original Equipment Manufacturer) to provide partial access to the device or to certain individuals, such as engine resellers. Passwords are not assigned by Woodward. If access to the controller is required, the system OEM should be contacted.

Three access levels are provided:

- Level 3 – Full Access—provides access to all parameters in software tool.
- Level 2 – Partial Write—provides access to all read only controls used to monitor or troubleshoot system performance and to selected configuration parameters that are utilized during system servicing (as described in Chapter 6 “Detailed Configuration Instructions” section). Basic system functions cannot be altered using this access level.
- Level 1 – Read Only—provides access to only to read only controls used to monitor or troubleshoot system performance, with addition of access to clearing faults history.

After connecting to the controller user is presented a “Security Login” dialog.

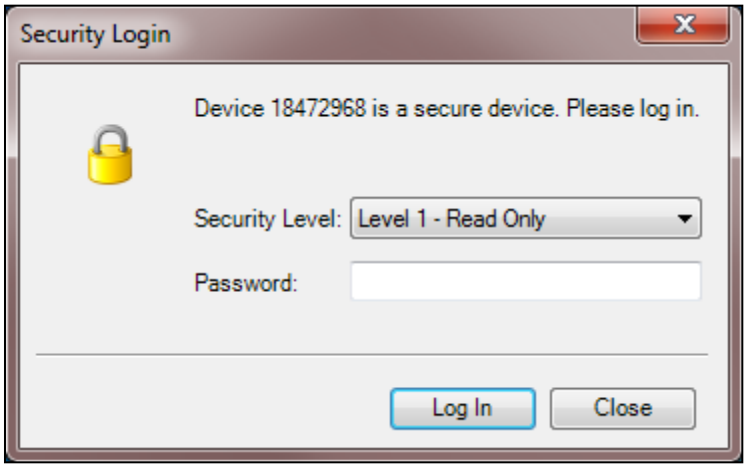


Figure 5-3. Security Login Dialog

User login requires selection of the correct security level with the appropriate password. For brand new units, the password is blank (empty). The passwords for each access level can be updated individually, using the procedure described in Chapter 6: Configuration.

Working with ToolKit Screens

Below are brief instructions for using the ToolKit to view and tune the variables for your actiVgen speed control. These instructions are meant to be introductory. Full on-line help is available in ToolKit.

The two basic types of control parameters within ToolKit are:

- Non-adjustable parameters
- Adjustable parameters

Non-adjustable Parameters
A non-adjustable parameter is shown in a white, frameless box or in a graphic format. See below for an example of non-adjustable parameters.

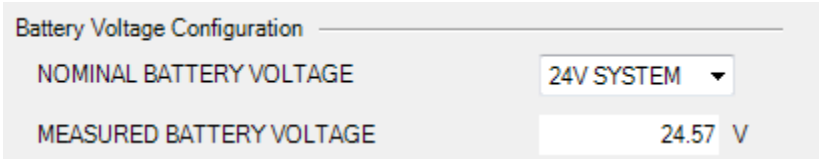


Figure 5-4. Non-Adjustable Parameters Example

Adjustable Parameters
Adjustable control parameters are displayed as shown below, or sometimes as a check box or enumerated list in a drop down.

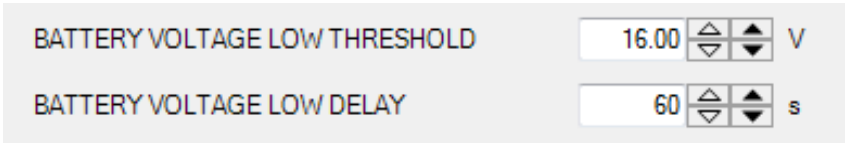


Figure 5-5. Adjustable Parameters Example

To change an adjustable parameter, either click the box for a Boolean, select from a drop down list, use the adjust arrows up and down, or click within the cell for an analog or integer. Every adjustable parameter has limits associated with it. The limit can be found when the cursor is within an adjustable parameter box by looking at the bottom of the screen as shown below.

Figure 5-6. Sample Parameter: Minimum Limit of 0 and Maximum Limit of 1023

Also if the user types a value outside the range allowed, the error prompt will be displayed.

When a value is modified the change immediately takes effect in the control, but is not automatically stored in nonvolatile memory. To save the changes permanently, select ‘Save Values’ from the ‘Device’ menu.

IMPORTANT **After turning the power off, values of unsaved parameters will return to the previous state.**

Monitoring Parameter Trends
Some of the actiVgen speed control Service Tool pages contain trend charts. Additionally, each parameter in the software tool may be added to a temporary trend. This is done by right-clicking the parameter and selecting “Add to trend” option.

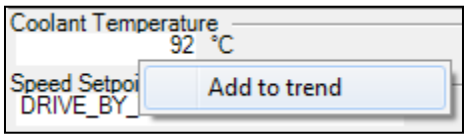


Figure 5-7. Adding the Parameter to a Temporary Trend

A new window with a trend chart will appear. Up to 16 additional parameters may be added to the same chart in this way.

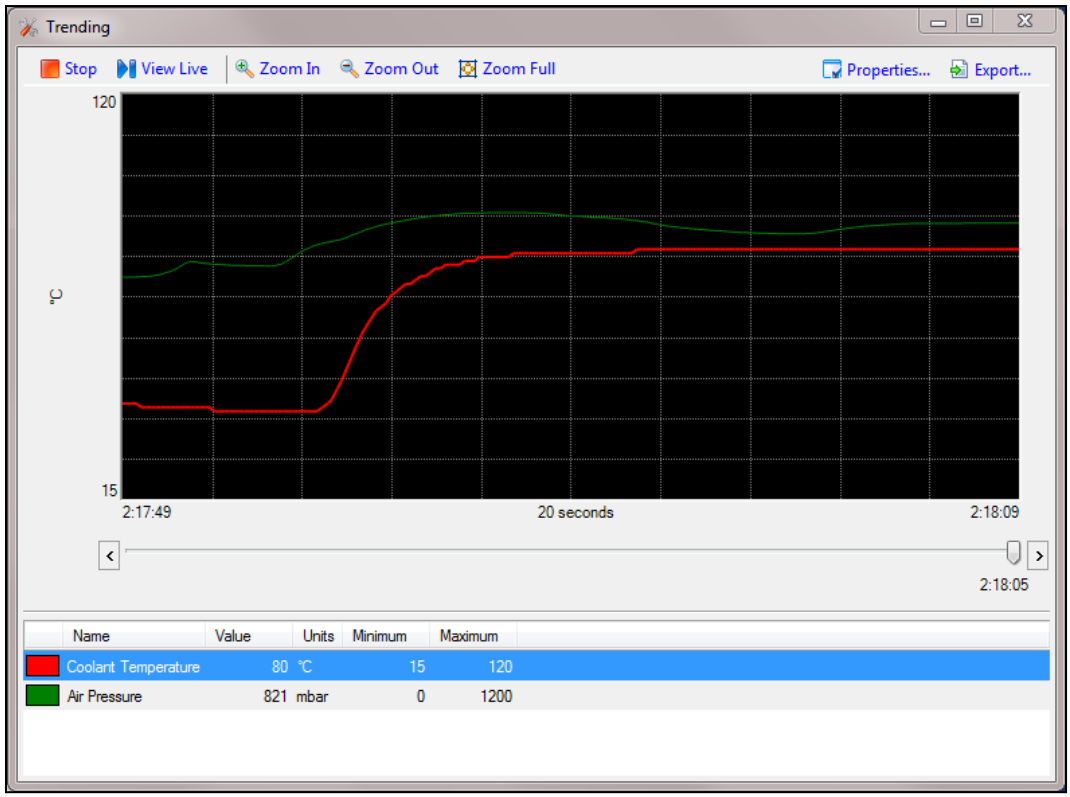


Figure 5-8. Temporary Trend Chart Example

The minimum and maximum values need updating for most parameters added to the trend. These values are configured in the dialog box that is opened by clicking the “Properties…” above the chart. Trending properties allow changing of several other features, including individual trend colors and time span.

Working with Settings Files

All settings from the controller connected to the Service Tool can be stored in settings file using “Save from Device to File…” option from menu “Settings”.

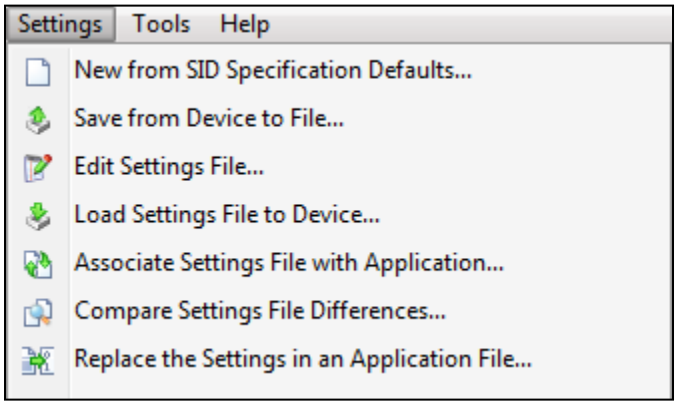


Figure 5-9. Settings Menu Items

This initiates a Save Setting Wizard that saves the APECS configuration to a settings file. You will be prompted for a File name. The ToolKit settings files have the ".wset" extension.

The settings file may be uploaded to controller by using "Load Settings File to Device…" option. This will replace all the settings in the connected controller with the settings from the settings file. User must have write access to the parameter in order to modify it when uploading settings file. Therefore uploading the settings file when logged on security level 1 will have no effect and when logged on security level 2 will only update parameters that are accessible on this level.

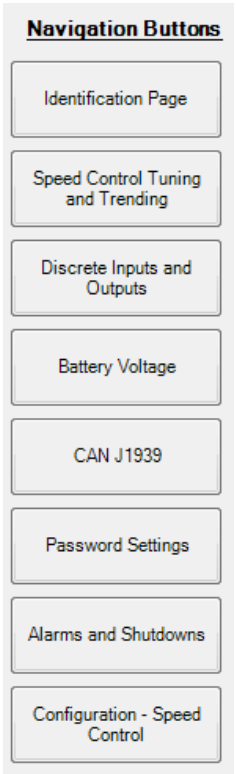
If the settings file has been created for the different controller firmware version, it can be converted to the current version using "Associate Settings File with Application…" option. When using this option user will be presented with a list of incompatibilities between the parameters' lists in setting file and in current firmware version. Parameters that are not present in settings file will be set to its default values. Contact your local Woodward representative regarding the reasons for firmware change before migrating the settings to an updated controller.

Two settings files saved on disk can be compared using the "Compare Settings File Differences…" option. This can be used for example to compare the controller configuration to the existing settings file. Controller configuration must be saved to temporary settings file using "Save from Device to File…" option. This temporary settings file may be then compared to the existing file.

Remaining ToolKit features in "Settings" menu (i.e. "New from Sid Specification Defaults…", "Edit Settings File…", "Replace the Settings in an Application File…") are not supported by the actiVgen speed control controller and should not be used.

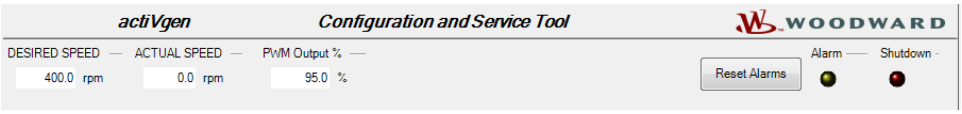
Navigation Buttons

Each Navigation Button will change the page of the Service Tool to that appropriate page. There are eight pages in the Service Tool and the navigation buttons are located on each page.



Data Display Window

The Data Display Window across the top also displays on every page. Shown in the window is Desired Speed, Actual Speed, PWM Output % and Alarm Status:



Chapter 6. Configuration

Introduction

This chapter describes the steps required to configure an actiVgen speed control for operation in a customer's system.

It is assumed that all mechanical and electrical connections are created per the "Installation" section of Chapter 3. Familiarity with the actiVgen speed control operating principles outlined in Chapter 4 is also required.

actiVgen Configuration and Service Tool

The Identification Page is the Part Number, Serial Number and Firmware Version of the controller. It also displays the Work Time, Run Time and the Power Up Cycles from the controller.

Configuration and Calibration Overview

The typical steps for configuring an actiVgen speed control system are:
1. Configure the Configuration – Speed Control page of the actiVgen speed control Service Tool.
2. Configure the Battery Voltage page of the actiVgen speed control Service Tool.
3. Installing actiVgen on the engine.
4. Calibrate and Tune the actiVgen using the Speed Control Tuning and Trending service tool page.
5. Testing and troubleshooting the system if necessary.
6. Saving controller settings to a file that will be used to program units during the production process.

Controller configuration and calibration is performed using the actiVgen speed control Service Tool. Details on installation and use of this service tool are provided in Chapter 5. All changes to the unit settings are done on-line (i.e., with Service Tool connected to the controller).

IMPORTANT **Controllers are shipped with the default configuration, which is not suitable for operations without adjustments. Even for simple applications, a range of basic adjustments are required.**

Default parameters can be used on certain actiVgen speed control parameters if there are no specific application requirements.

The table below lists the parameters that are required for adjustment before the controller is operated. Default values for those parameters are, in general, not intended for use in target application. By adjusting these parameters properly, the APECS controller is prepared to operate in a basic single speed engine governing system with a Caterpillar ADEM control and an engine speed sensor connected to the actiVgen controller.

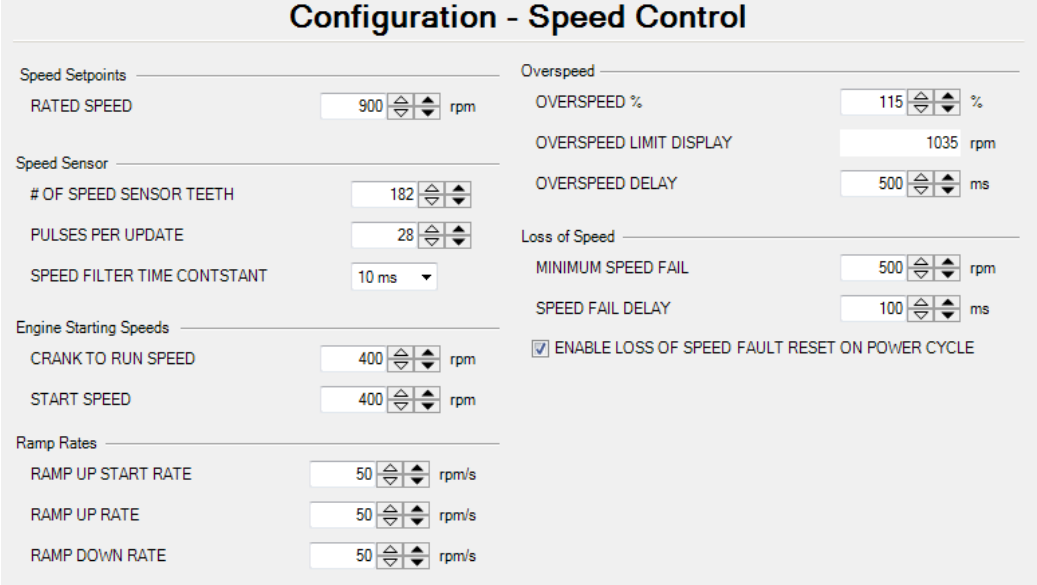


Figure 6-1. Configuration – Speed Control Menu Items

Configure – Speed Control

For proper detection of engine speed, speed sensor parameters must be configured. This step is required for all systems before running the engine.

RATED SPEED—rated synchronous speed of the engine in rpm.

 # OF SPEED SENSOR TEETH—number of speed sensor input pulses per engine revolution. The number of teeth on the engine speed pickup wheel should be entered here.

PULSES PER UPDATE—number of pulses received by the controller between engine speed calculation updates. Proper value for this parameter reduces the number of sensed engine speed fluctuations resulting from engine combustions events. The optimal value should be calculated from PULSES_PER_REV, number of engine cylinders and engine type (two stroke or four stroke) according to the following calculation:

$$\text{PULSES\_PER\_UPDATE} = \frac{\text{no\_of\_strokes} * \text{PULSES\_PER\_REV}}{2 * \text{no\_of\_cylinders}}$$

SPEED FILTER TIME CONSTANT—low-pass filtering time constant. The higher this value, the more filtering is applied. The filtered value is used for:
engine load calculation
speed trip outputs

Note—This setting does not affect speed governing. The only engine speed filtering applied for speed governing is controlled by PULSES PER UPDATE parameter.

CRANK TO RUN SPEED—Idle speed setpoint

START SPEED—The initial speed commanded immediately after engine has started. Speed ramping begins from this value immediately. Normally, this parameter is set to the same value as CRANK TO RUN SPEED.

RAMP UP START RATE—Ramp rate that is used immediately after engine start until the first desired speed is reached.

RAMP UP RATE—Ramp rate that limits accelerating speed when engine is running.

RAMP DOWN RATE—Ramp rate that limits decelerating speed when engine is running.

OVERSPEED %—Relative Overspeed limit percentage.

OVERSPEED DELAY—Defines the amount of time the engine speed must be above the overspeed threshold before OVERSPEED fault is activated.

MINIMUM SPEED FAIL—maximum allowed speed drop without speed sensor fault description. See LOSS_OF_SPEED fault description in Chapter 4 for details.

SPEED FAIL DELAY—the amount of time to keep last seen speed after drop before speed sensor fault is launched. See LOSS_OF_SPEED fault description in Chapter 4 for details.

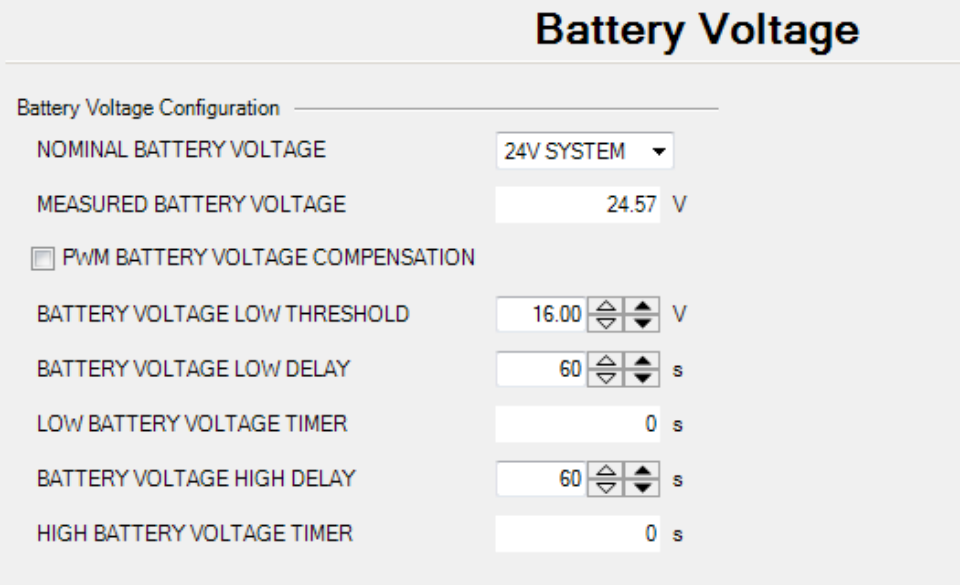


Figure 6-2. Battery Voltage Menu Items

Configure Battery Voltage

Proper system voltage must be selected before operating the controller in order to get proper overvoltage fault detection.

NOMINAL BATTERY VOLTAGE—Select either 12 V or 24 V system. This setting is used for battery voltage compensation adjustment. Nominal battery voltage is 14.4 V for 12 V system and 28.8 V for 24 V system. The default value is 12 V system, therefore this parameter must be updated for 24 V systems.

Note—powering a controller configured for a 12 V system (default value) from a 24 V power supply is allowed in order to change the NOMINAL BATTERY VOLTAGE setting (there is no need to use separate power supply for configuration).

PWM BATTERY VOLTAGE COMPENSATION—if enabled, the generated PWM is multiplied by a compensation factor calculated as a proportion of measured battery voltage to nominal battery voltage. This functionality is disabled by default.

BATTERY VOLTAGE LOW THRESHOLD—battery voltage below which fault is detected. Default value of 9 volts is the minimum supply voltage required by controller and is recommended for most systems.

BATTERY LOW VOLTAGE DELAY—amount of time the device must be detecting voltage below threshold before fault is activated. Low Battery Voltage timer is provided on this page that will count up when low voltage is detected.

BATTERY VOLTAGE HIGH DELAY—amount of time the device must be detecting voltage above 135% of nominal before fault is activated. High Battery Voltage timer is provided on this page that will count up when low voltage is detected.

Configure Passwords

After the device is connected, passwords for each security level can be changed on the page “Password Settings” Changing a password is only allowed at access level 3.

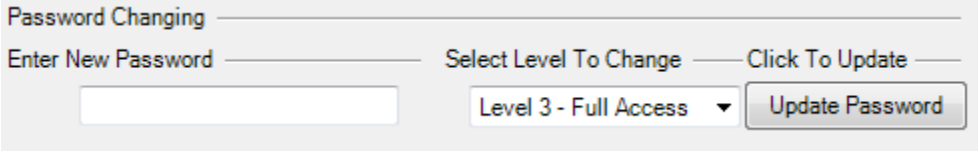


Figure 6-3. Password Updating Interface

To change the password:

1. New password must be entered into “Enter New Password” box.
2. Access level that will use this password should be selected.
3. After clicking “Update Password” button, password for the selected level will be updated.

This should be repeated for each access level.

The new password applies to the connected controller. If the device settings file is created, passwords will be stored in this setting file. If settings are then uploaded to new controller, the same password will be required to log into the controller.

IMPORTANT **Retain password to Level 3 in a secure, readily accessible place. If the Level 3 password is forgotten, it will be impossible to change the basic controller functionalities and passwords.**

Configure Discrete Input

Each Discrete Input is capable of being programmed for multiple functions.

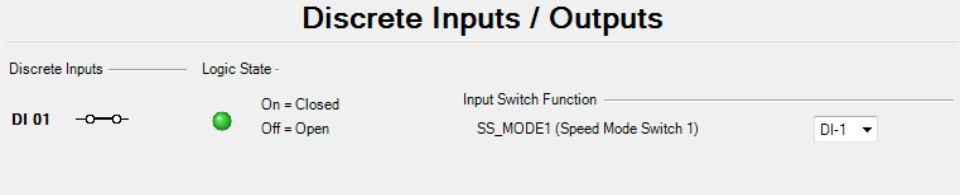


Figure 6-4. Discrete Input Configuration

Each discrete input has a fixed physical connection. Only Discrete Input #1 is used in this application. DI #1 is switched in relation to battery voltage positive. This is discussed in Chapter 3. The exact function of switch being ON or OFF depends on the input functional allocation. Polarity for each input should be configured according to application needs.

Configure Discrete Outputs

Only one Discrete Output is used in this application on the actiVgen speed control controller. The function of Discrete Output #3 is configured in software and is defaulted to Shutdown. Basic speed governing system does not require using of any discrete output. The color of the DO symbol shows the status of DO #3.

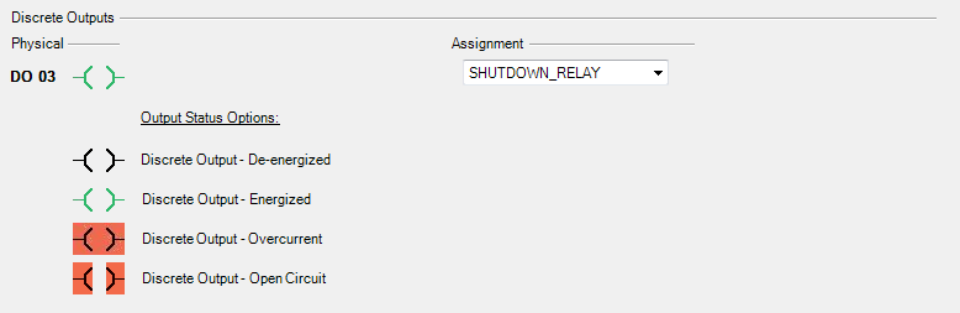


Figure 6-5. Discrete Outputs Configuration

Configure Faults

Faults are configured on the Alarms and Shutdowns, CAN Bus Monitoring page.

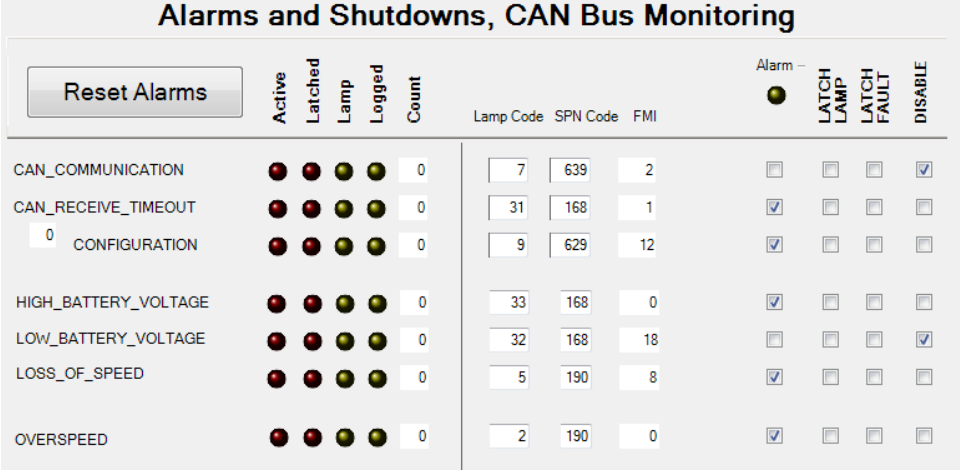


Figure 6-6. Fault Configuration Options

Alarm Lamp—A check mark in the box will configure the indicated Alarm lamp on fault occurrence.
LATCH FAULT—Defines whether the fault operation will persist if fault is cleared. The default is OFF for all faults.
LATCH LAMP—Defines whether the lamp indication for this fault will persist when the fault is cleared. The default is OFF for all faults.
SPN Code—Code used in CAN J1939 diagnostic messages to indicate this fault occurrence. The default values are selected according to J1939 Application Layer. The codes may be modified if this is required.

Configure CAN J1939

Before using CAN communication it has to be enabled in the software by using the **Enable Can Module** option. The changed option takes effect after first controller power cycle.

The content of the **NAME Fields** sent in Address Claimed message can be configured. By default, only the Manufacturer Code is configured to 153 (Woodward), remaining fields are set to zero.

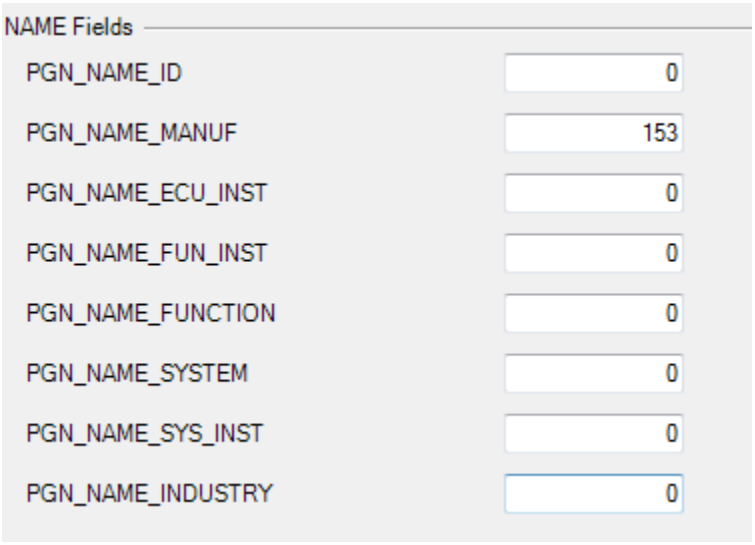


Figure 6-7. NAME Field Content Configuration

CAN_SOURCE_ADDRESS—CAN Source Address is configurable. The actiVgen speed control controller does not support J1939 dynamic addressing. Individual CAN address must be assigned to each unit on the bus that does not support dynamic addressing.

Address Claim Status gives information if address claiming was successful.

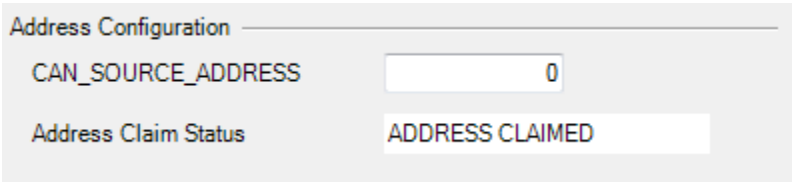


Figure 6-8. CAN Source Address Configuration

Transmitting period for each **broadcasted PGNs** and timeout for **received PGNs** can be configured on this page.

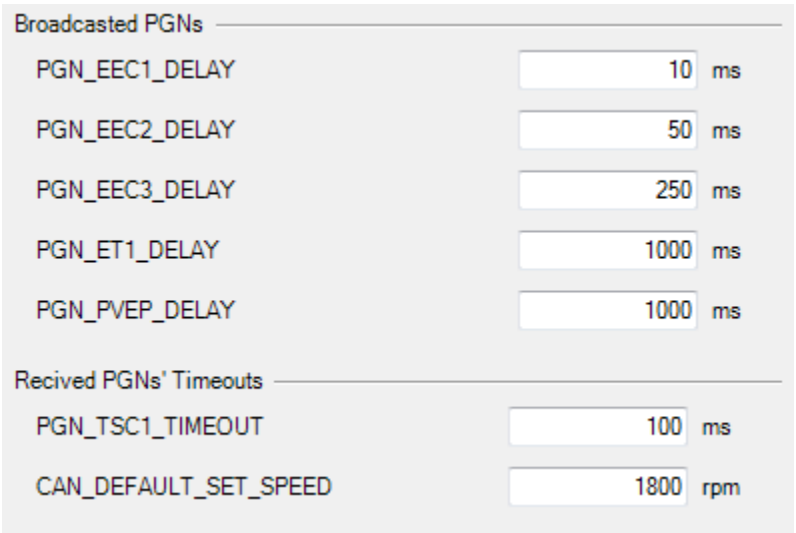


Figure 6-9. PGNs Periods Configuration

PGN_EEC1_DELAY, PGN_EEC2_DELAY, PGN_EEC3_DELAY, PGN_ET1_DELAY, PGN_PVEP_DELAY define the broadcasting period for related PGNs. These parameters can normally be left at default values unless there are specific application requirements.

PGN_TSC1_TIMEOUT—defines the timeout for TSC1 message when using CAN commanded speed. If the TSC1 message is not received within this time, CAN_RECEIVE_TIMEOUT fault will be activated. This parameter should be sent to the value higher than the period of TSC1 message sent by CAN controller commanding speed to APECS.

CAN_DEFAULT_SET_SPEED—this parameter should be set to the speed the APECS should start commanding in CAN mode in case of CAN_RECEIVE_TIMEOUT fault. Can be set to zero or safe speed used in emergency situation.

Calibrate Speed Control Gains

Speed governor gains calibration is required for all systems in order to obtain fast and precise engine speed control. Basic PID gains can be configured on the “Speed Control tuning and Trending” page. This page also contains trend chart displaying desired and actual engine speed as well as the PWM Duty Cycle %.

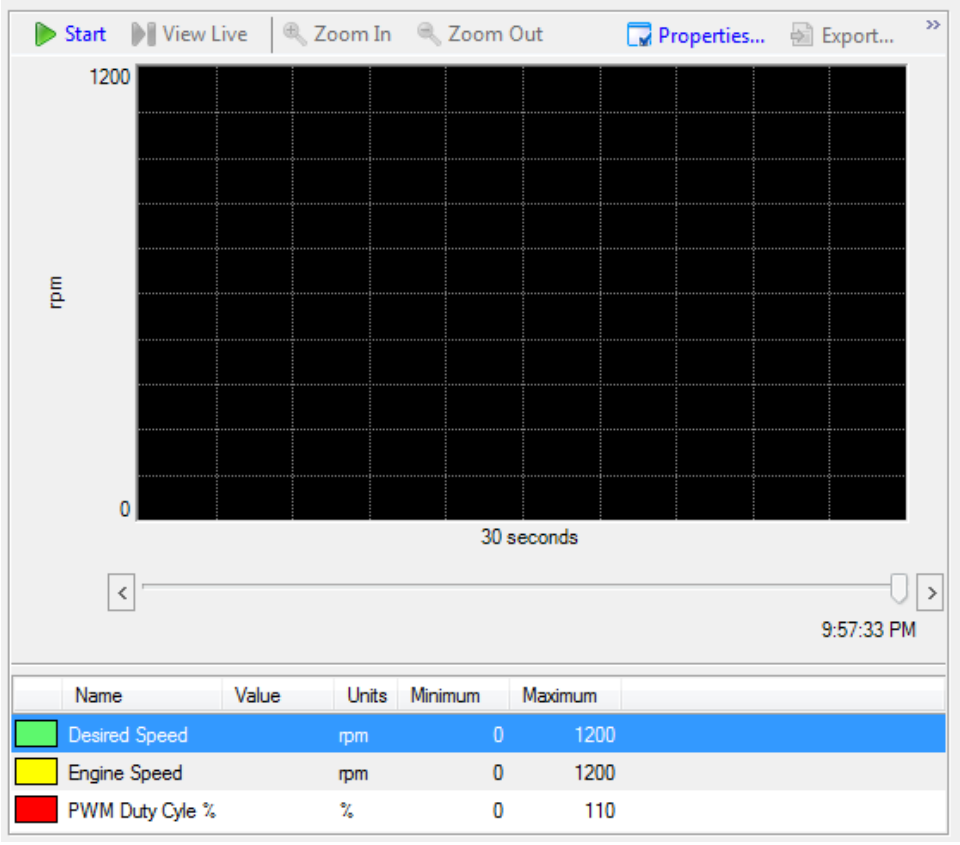


Figure 6-10. Engine Speed Chart

PROPORTIONAL GAIN—speed control proportional gain. Proportional control is required to achieve stability and fast response time. As a general rule, maximum amount of proportional gain should be used while still maintaining stability.

INTEGRAL GAIN—speed control integral gain. Integral gain is required to remove steady state engine speed error. As a general rule, maximum amount of proportional gain should be used while still maintaining stability.

DERIVATIVE—derivative is used to improve stability. Increase derivative gain until response has a slight overshoot on load transients.

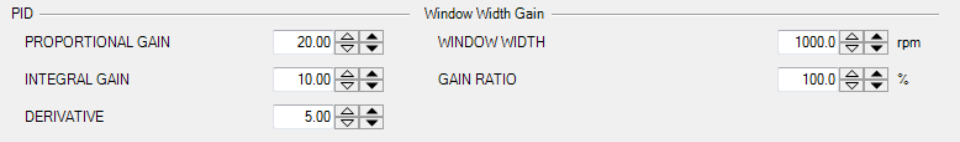


Figure 6-11. Speed Based PID Configuration

WINDOW WIDTH—speed error window width. As long as speed error is lower than this value, proportional gain is not unmodified by the GAIN RATIO. This parameter should be set to a value high enough to make sure that speed error does not exceed the window width in steady state.

Chapter 7. Troubleshooting

Introduction

This chapter presents the application failures typically experienced in the field or during device configuration with possible causes, and suggested solutions.

The troubleshooting scenarios listed below assume that the end user has a digital multi-meter for testing voltages and checking continuity.

Troubleshoot Diagnostic Fault Flags

Diagnostic faults should be checked first in case of system malfunction. The actiVgen speed control controller provides the following ways for accessing diagnostic information:

- actiVgen speed control PC Service Tool
- CAN J1939 interface. This is described in CAN J1939 DM-1 and DM-2 messages description.

Fault states in the Service Tool are displayed on the Alarms and Shutdowns, CAN Bus Monitoring page. Buttons for clearing faults history are also available on those pages. These buttons' operation is identical to using MCS+SDS physical switches (see the Diagnostics description in Chapter 4). Both viewing and clearing the faults is possible on all security levels, including Read Only level. This allows service personnel to troubleshoot the system issues.

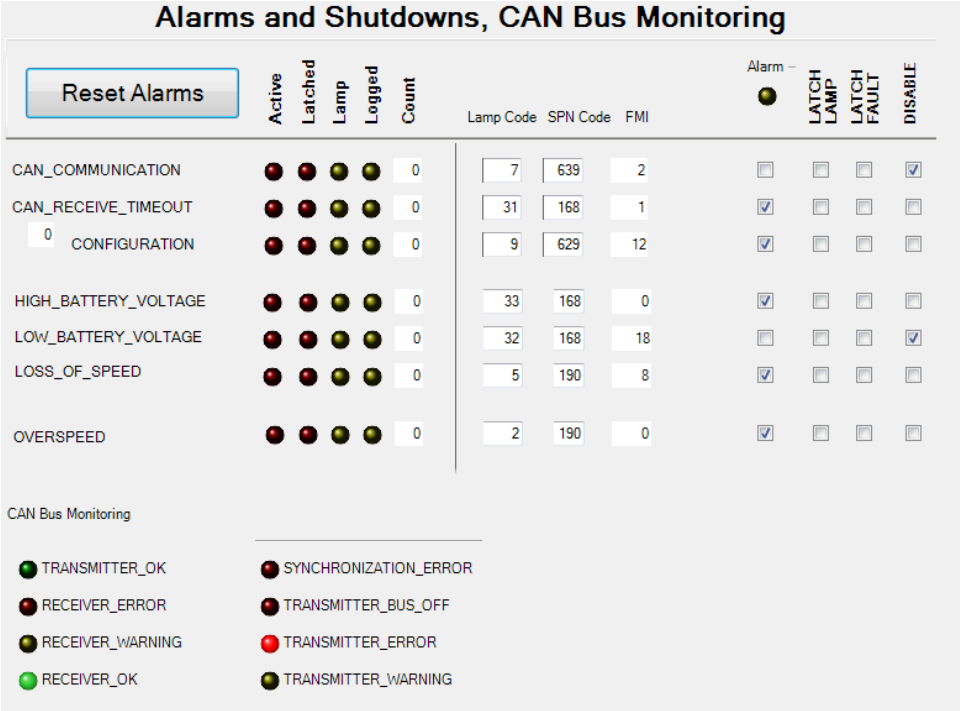


Figure 7-1. Alarms and Shutdowns, CAN Bus Monitoring

Both active and logged faults may provide information regarding the system malfunction cause. For example, a damaged connector may lead to the situation where analog input connection is lost momentarily due to vibration but restored later. This may result in sensor out of range fault being logged (but inactive) at the time of diagnosis.

A detailed description of each fault's meaning is given in the "Diagnostics" section of Chapter 4. If the fault source is not clear, consult the table below for possible solutions.

Table 7-1. Fault Codes

Fault	Possible Cause	Suggested Actions
CAN_COMMUNICATION	CAN wiring issue	Check CAN wiring
CAN_RECEIVE_TIMEOUT CONFIGURATION	CAN controller issue	Verify that CAN controller is transmitting the TSC1 frames within required period.
	Obsolete configuration in memory	If the controller firmware has been updated, upload the configuration in order to update the configuration memory.
CPU_FAILURE	Controller defective	Return the controller to Woodward (see Service Options chapter).
CPU_POWER_SUPPLY	Controller defective	Return the controller to Woodward (see Service Options chapter).
DOUT_x_OVERCURRENT	Excessive battery voltage drop	Verify that power supply voltage does not fall below specification.
DOUT_x_OVERCURRENT	Lamp/relay wiring short to battery voltage	Check the wiring of the device connected to the discrete output.
DOUT_x_OVERCURRENT	Lamp/relay current draw excessive	Check that the current drawn for discrete output does not exceed 250 mA. Note that current draw may vary with temperature.
DOUT_x_OPEN_CIRCUIT	Lamp/relay wiring open circuit	Check the wiring of the device connected to the discrete output.
	Discrete output configuration error	Verify that proper discrete output is configured. Unconnected outputs must be configured to NOT_USED).
HIGH_BATTERY_VOLTAGE	Configuration	If the system is 24 volts, verify that controller battery voltage is properly configured.
	Wiring issue	Verify the voltage at controller supply pins.
LOW_BATTERY_VOLTAGE	Battery discharged	Verify the battery voltage, replace or charge the battery.
	Battery wiring issue	Check the power supply wiring for defects. Verify that wiring is of sufficient thickness and length.
LOSS_OF_SPEED	MPU wiring issue	Check/replace MPU wire.
	MPU damaged	Check/replace MPU sensor.
OVERSPEED	Actuator not capable of closing the fuel throttle	Check the force needed to close the fuel against the actuator force.
	Speed control gains not calibrated properly	Calibrate (increase) gains for better handling of load rejection.
	Overspeed value set too low	Check the overspeed configuration.

General System Troubleshooting Guide

The table below describes issues that may be encountered in the system but are not diagnosed with fault flags.

Issue	Possible Cause	Suggested Actions
Service Tool not communicating— establishing connection on Com x' status indicated	Power not applied to the controller	Check controller's power supply.
	Wiring fault	Check the wiring of power supply and RS232.
	Incorrect cable used	Check that the interconnect cable is selected in accordance to wiring diagram (straight-through).
	The wrong communications port has been selected	Verify the port setting.
Service Tool not communicating— displays message "Unable to locate the correct SID file for device application…"	Improper tool version is being used	Obtain the newest version of actiVgen speed control Service Tool from Woodward website. If the problem persists, contact Woodward for support.
Engine speed not sensed properly	MPU sensor or wiring issue	Check MPU wiring; check or replace the sensor.
	MPU voltage too low	Verify that MPU voltage is within spec. The voltage is lowest at low speed.
Engine unstable	Improperly tuned speed or position PID gains	Recalibrate the position control and then the speed control.
	Intermittent or incorrect speed signal	Check/replace the speed signal wiring and the MPU sensor.

Chapter 8.
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 published at **www.woodward.com/directory**.

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 (129) 4097100
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 (129) 4097100
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 (129) 4097100
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

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

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.
Connector Information

The actiVgen speed control is not shipped with mating connectors because many applications may use a standard wiring harness or because the mating connectors are needed in advance for wiring harness wiring. For service and convenience, Woodward has an actiVgen speed control connector kit that contains all the mating terminal blocks used on the actiVgen speed control.

A single kit provides all the necessary parts for the actiVgen speed control. The kit part number is 8923-1633. Contents of the kit include:

- J1 mating connector
- J2 mating connector
- 48 hand crimp sockets for 14—20 AWG wire
- 35 seal plugs

Those who wish to create standard harnesses may want to purchase the connectors only and get the socket terminals on reels for automated assembly. In support of this need, the manufacturer part numbers are provided below for the parts that are available from Cinch.

Table A-1. Harness Assembly and Application Tooling

Component	Cinch Part Number	Notes
J1 mating connector	581-01-18-023	18-position sealed connector, black
	581-01-18-024	18-position sealed connector, natural
J2 mating connector	581-01-30-029	30-position sealed connector, black
	581-01-30-027	30-position sealed connector, gray
	581-01-30-030	30-position sealed connector, natural
Terminal	425-00-00-872	20 AWG TXL – 18 AWG TXL
Terminal	425-00-00-873	18 AWG GXL – 16 AWG GXL (product not rated for 14 AWG amperage, however can be used for voltage drop only)
Seal Plug	581-00-00-011	For maintaining proper seal
Hand crimping tool	599-11-11-615	For terminals # 425-00-00-872
Hand crimping tool	599-11-11-616	For terminals # 425-00-00-873
Tweezer tool	599-11-11-628	For removing the secondary lock
Terminal removal tool	581-01-18-920	For removing all types of terminals

The sealed connectors on the actiVgen speed control are not designed for removal by hand. After input power is disconnected, the connectors can be removed using a 1/4 inch head driver. When reinstalling the connectors, use 15-20 lb-in (1.69-2.25 N-m) torque for the jackscrew. Using the correct torque is required to avoid damage and provide proper force on the gasket for a moisture seal.

These connectors use a “push-to-seat” design. To use the connectors, it is first necessary to strip the wire, crimp on a terminal, and then push the wire into the connector body from the back to seat it into the connector locking mechanism. Care must be taken to align the terminal correctly with the connector when pushing it into the connector body. If it must be removed, a special tool is necessary to avoid damage to the wire, terminal, and connector.

A crimp tool is necessary for proper field crimping of the mating terminals. Hand crimping tools are available from Woodward; see Table A-1 for selecting proper crimping tool.

If a wire must be removed from the connector, removal tools are necessary to avoid damage to the connector. Individual wires can be removed using extraction tools. Removing the terminal from the sealed connector is a two-step process: (1) removing the secondary lock, and (2) removing the terminal itself. Specific Cinch tools are required for both operations. Tools work for both the 18- and 30-position harness connector. Woodward provides terminal removal tools; see Table A-1 for selecting proper tool.

IMPORTANT **Using the wrong removal tool will very likely result in damage to the internal connector retaining clip.**

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	DOCFORM
Manufacturer's Name:	WOODWARD POLAND SP. Z O.O.
Manufacturer's Contact Address:	Skarbowa 32 32-005 Niepolomice, Poland
Model Name(s)/Number(s):	ACTIVGEN, P/N 8440-2100
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	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)
Applicable Standards:	EN 61000-6-2:2005 - Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments EN 61000-6-4:2007/A1:2011 - Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

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

Dominik Kania

Full Name

Managing Director

Position

Woodward Poland Sp. z o.o., Niepolomice, POLAND

Place

18.05.2016

Date

Doc.: 5-09-1183 Rev26 00379-04-EU-02-02

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

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