WOODWARD

REVISION PENDING

ProAct™ Digital Plus Electric Actuator with Integral Driver

Installation and Operation Manual

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**	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.

⚠	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.

⚠	This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website: **www.woodward.com/searchpublications.aspx** The current revision of all publications is shown in file "***current.pdf***". The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

⚠	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.

NOTICE	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.

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.*

▌**Revisions—Text changes are indicated by a black line alongside the text.**

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Regulatory Compliance

European Compliance for CE Mark:

EMC Directive: Declared to 2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.

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

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

North American Compliance:
This listing is limited only to those units identified for use in hazardous locations and bearing the CSA logo. This product is certified as a component for use in other equipment. The final combination is subject to acceptance by CSA International or local inspection.

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, & D, T4 at 85 °C Ambient for use in Canada and the United States
Certificate 1167451

This listing is limited only to those units identified for use in ordinary locations and bearing the CSA logo.

CSA: CSA Certified for Ordinary Locations at 85 °C Ambient for use in Canada and the United States
Certificate 1167451
This listing is applicable to those units identified for use in ordinary locations and bearing the CSA logo.

Marine Compliance:

Lloyd's: Marine propulsion and auxiliary products in categories ENV1, ENV2, ENV3, and ENV4 as defined in LR Type Approval Test Specification No. 1, 1996.
Type Approval Certificate 01/60006

Peripheral equipment must be suitable for the location in which it is used.

General Installation and Operation Notes and Requirements:
The ProAct Digital Plus is suitable for use in Class I, Division 2, Groups A, B, C, and D per CSA for Canada and US, Ordinary Locations per CSA for Canada and US, or non-hazardous locations only, depending on the individual unit labeling. Specifically marked units are suitable for use in Ordinary Locations per UL for US and Canada.

For units marked for use in hazardous locations, wiring must be in accordance with North American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction. For ordinary locations and non-hazardous location uses, wiring must be in accordance with the authority having jurisdiction.

Field wiring must be suitable for at least 85 °C.

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

⚠ **WARNING**	**EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.**
	Substitution of components may impair suitability for Class I, Division 2.

⚠ **AVERTISSEMENT**	**RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.**
	La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

IMPORTANT	**Jumpers should not be moved or changed unless power has been switched off.**

Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. 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.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.

4. 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.

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.***

Chapter 1.
General Information

Introduction

This manual describes the Woodward ProAct™ Digital Plus Actuator for engine applications. This manual provides installation instructions, describes the control, and explains the configuration (programming), adjustments (service mode), and hardware specifications. This manual does not contain instructions for the operation of the complete engine system. For engine or plant operating instructions, contact the plant-equipment manufacturer.

This revision of the manual applies to all ProAct Digital Plus models with software version 2.00 or newer.

How to Use This Manual

The following summarizes how to install a ProAct actuator into a new or existing system.
- Unbox and inspect the hardware for any visible damage caused during shipping.
- Mount the actuator and linkages following the procedures and recommendations in Chapter 2.
- Wire the actuator—see Chapter 3.
- Refer to Chapter 4 for guidelines on calibration and setup.

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

NOTICE	**The inertia setting must be properly adjusted using the Service Tool prior to engine operation. An improper inertia setting will result in undesirable performance.**

IMPORTANT	**The Service Tool is not included, but can be download from the Woodward Internet website (www.woodward.com) or by ordering the Watch Window Standard CD-ROM (1796-065).**

Description

The ProAct Digital Plus is a family of electric actuators with integral drivers intended to be mounted on-engine to control varying functions including (but not limited to): fuel rack positioning, timing control, and throttle valve and wastegate positioning. The device is effectively a positioner which will accept a desired position signal from another device in the system, such as a speed control, and drive to that position. Each unit includes a digital driver capable of controlling the actuator, communicating with the outside control system, and containing on-board software and intelligence to realize monitoring and customizing functions.

The ProAct Digital Plus actuator can be commanded to a position via 4–20 mA, 0–200 mA, PWM, or CAN interfaces. In addition, given an on board position feedback device, the actual position is available to the system through a position output signal.

Each member of the ProAct Digital Plus family has a different bi-directional torque output capability as described in Chapter 11 (Specifications). In addition, each actuator has a nominal rotation of 75° at the output shaft. It can be mounted in either a base mount or flange mount configuration, with the exception of the ProAct Digital Plus Model IV which can only be base mounted. The units are designed to operate in an on-engine environment and can therefore withstand high levels of vibration and temperature extremes. The details of these environmental limits can be found in the Environmental Specifications section in Chapter 11.

As described in the Regulatory Compliance section, the ProAct Digital Plus family of actuators meets CSA requirements for Class I, Division 2 or Ordinary Locations for North America, and CE Marking requirements.

Controller Overview

The position controller software is executed on a 20 MHz 68376 32-bit microcontroller onboard the ProAct Driver. Internal current and position sensors provide feedback for closed-loop position control. The driver interfaces with an external speed control via a position demand. The position demand can be an analog signal (0–20 mA or 0–200 mA), a PWM signal, or optional CAN. The driver can also be configured to accept redundant demand signals. The ProAct control monitors all available signals, internal and external, and annunciates any detected faults through the discrete output. An analog output provides actual position indication, and a discrete input is available to remotely shut down the actuator.

Features of the driver include model-based position and current control loops, on-line and off-line diagnostics, current limiting based on electronics temperature, CAN communications, and service port communications.

The ProAct control is field programmable, which allows a single design to be used in many different applications. The driver must be configured and field calibrated to the specific engine using the Service Tool software. The Service Tool software is loaded on a PC and communicates serially to the driver via RS-232 using Woodward's DDE Servlink protocol. Refer to Chapter 8 (Service Tool) for installation instructions. Figure 1-2 provides an overview of the ProAct Digital Plus driver I/O (inputs/outputs).
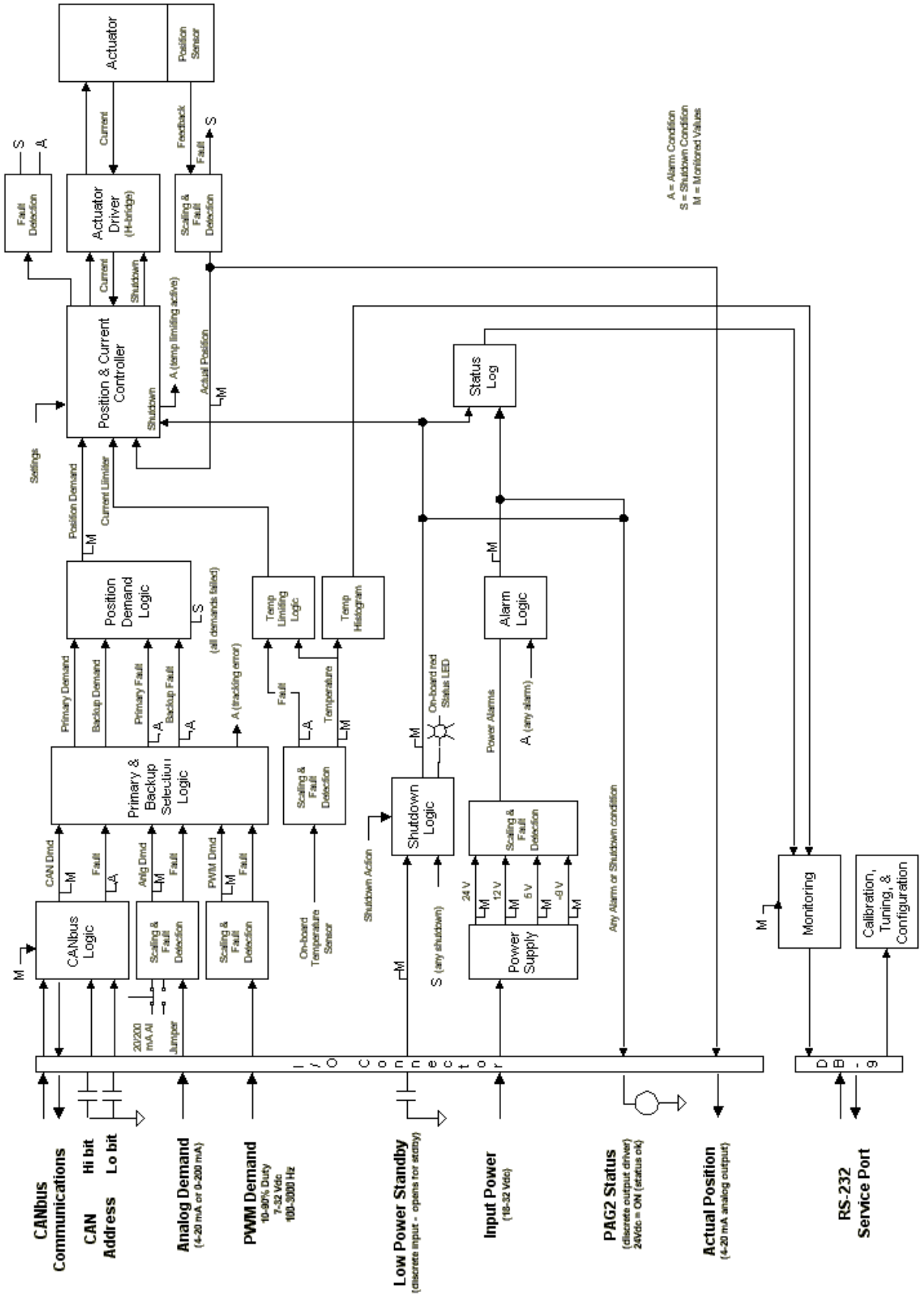
Figure 1-1. ProAct Digital Plus Functional Overview
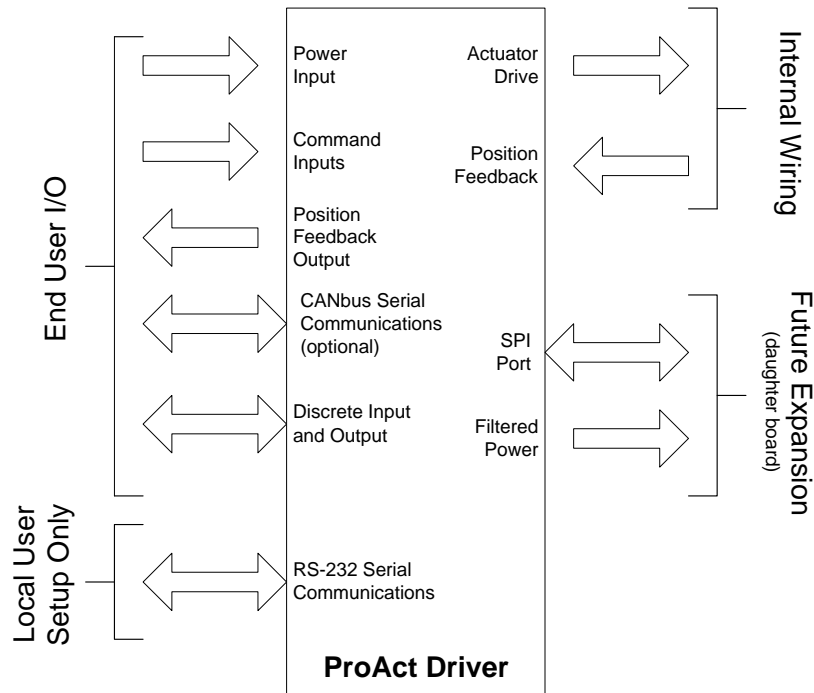
Figure 1-2. Driver Overview

Mechanical Setup

Mounting

The ProAct Digital Plus platform is base mounted to tapped holes on the bottom of the actuator containing through-holes (see Figure 2-5). In addition, the models I, II, and III have the capability of being flange mounted. The unit can be mounted in any orientation. All exterior and mounting dimensions and exterior fasteners are metric. See Chapter 2 (Installation) for details on mounting and installation.

Output Shaft

The ProAct Digital Plus family output shafts are standard US-customary sizes with toothed serrations. A rotation scale and indicator are available as an optional kit for visible detection of travel (for reference only).

Rotation

All ProAct Digital Plus actuators have 73–77° of available travel. The max fuel direction of this travel is software configurable in the clockwise or counterclockwise direction through the Service Tool.

Mechanical Stops

Internal mechanical actuator stops will only survive a maximum kinetic energy of 0.011 J (0.097 in-lb). If the actuator internal stops are used, the load inertia should not exceed 3.76E-3 in-lb-s² (4.25E-4 kg-m²). See Chapter 2 (Linkage) for details on actuator inertia and internal stops. In service, electrical and engine stops should be set inside the actuator stops. Electrical stops are set via the Service Tool.

Electrical Connections

There are three interfaces on the circuit board. Refer to Chapter 3 for details on ProAct actuator wiring.

Interface	Type	Use
Service Port	9-pin sub-D male	Located beneath the customer entry plate.
Power Taps	Insulated Spade or Ring Lug	For 24 Vdc connection.
Terminal Strip	Terminal Block	All other functions.

Table 1-1. Board Connections

IMPORTANT	An optional M37 blanking plug is available to make connections to the 9-pin sub-D male service port. This port should be used only for configuration and setup. Thread lock should be used to secure the blanking plug.

Position Command Input

There are four possible position command signals. See the table below for an overview of the signals and corresponding input signal to actuator position. All adjustments are done via the Service Tool software. All circuits are protected against short circuit to battery negative. These short circuits will not cause damage to the control.

Input Signal	Nominal Range	Adjustment Range	Actuator Output for Input Range
PWM: 7 to 32 V 100 to 3000 kHz	20% to 80% Duty Cycle	10% to 90% Duty Cycle	0% to 100% Actuator Position
Analog: 0 to 200 mA	20 to 180 mA	0.0 to 200 mA	0% to 100% Actuator Position
Analog: 4 to 20 mA	4 to 20 mA	0.0 to 25 mA	0% to 100% Actuator Position
CAN Command	n/a	n/a	0% to 100% Actuator Position

Table 1-2. Positioning Command Input

Inputs/ Outputs (I/O)

The following Inputs/Outputs (I/O) are available in the ProAct Digital Plus:

- power input
- 1 analog input
- 1 PWM input
- 3 discrete inputs

- 1 discrete output
- 1 analog output
- 1 RS-232 communications port
- 1 CAN (Controller Area Network) port (optional)

Refer to the control wiring diagram (Figure 3-1) for wiring overview. Refer to Chapter 3 for wiring details.

Power Input

The input power has an operational range of 18–32 Vdc, nominal 24 Vdc. Input power out of range diagnostics are provided.

Analog Input for Position Demand

The analog input is configurable for either 20–180 mA (200 mA range) or 4–20 mA (25 mA range). The range is selected using the jumper on the terminal board—JPR1 for 200 mA range and JPR2 for 20 mA range. Range and failure diagnostics are provided based on software configuration and settings.

PWM Input for Position Demand

The PWM input accepts a 100 to 3000 Hz input signal of 7 to 32 volts peak voltage (referenced to unit battery ground). The PWM input duty cycle minimum and maximum are field adjustable to match the controller sending the demand. Range and failure diagnostics are provided based on software configuration and settings.

Discrete Input—Low Power Standby Mode
(option may not be available on current-input models)

When opened, the driver goes into a Low Power Standby Mode. The Low Power Standby Mode causes the current driver and the analog output to be de-activated, to minimize the power consumption of the driver. This input is connected to ground, preferably Discrete Common, for a logic 'true'.

The Status Output can also be configured to de-activate when the unit is put into Low Power Standby Mode. See Chapter 9 for Configure Mode Parameters to set Discrete Out Includes Runenable [Run/Enable].

IMPORTANT	**If using firmware version 2.20 Woodward part number 5418-2590, it is possible to configure this input for Run Enable – Closed to Run = False. With this configuration, the contacts are open to run, and closed to enter Low Power Standby Mode.**

⚠ WARNING	**This input must be closed to operate the unit. When open, the unit is forced into a non-operational shutdown state.**

Alternatively, if it is desired to completely reduce the power consumption of the driver to zero, power can be completely disengaged from the unit with a customer installed switch on the input power. We recommend that the Low Power Standby Mode be activated before opening the power lines to minimize the unit's current draw and to store internal parameters.

Discrete Inputs—CAN Address Identification

The CAN Hi and Lo discrete inputs provide an address based on input open/closed status on initialization. Four CAN address combinations (1–4) are available. For example, both contacts open means that the unit address is '1', and both closed means unit '4'. These inputs are connected to ground, preferably Discrete Common, for a logic 'true'.

Discrete Output—Driver Status Indication

The discrete output is normally ON (24 V provided to the load), and turns off/opens to indicate any detected fault (alarm or shutdown) condition within the ProAct Digital Plus. Fault conditions are non-latching, which means a reset command is not required when the condition clears. The Service Tool program can be used to interrogate the cause of the alarm or shutdown as well as provide a historical log of events (see Event Log). The optional CAN communications can also be used to determine alarm and shutdown causes.

The ProAct Digital Plus will continue to operate with an alarm condition (for example, failure of the primary demand signal). However, the unit will cease to operate on a shutdown condition (for example, failure of both primary and backup demand signals).

4–20 mA Analog Output for Indication of Actual Position to an External Device

An analog output of 4 mA and 20 mA corresponds to 0% and 100% actuator travel, respectively. Offset and gain adjustments are provided.

RS-232 Communications Port

An RS-232 communications service port is provided with a 9-pin sub-D male connector for connection to a PC service tool. This connection is a typical three-wire null modem RS-232 communication which is limited to 15 m (50 feet; RS-232 limitation). The port supports Woodward Servlink (DDE) protocol and has fixed communications settings of 19.2 K baud rate, 8 data bits, no parity, and 1 stop bit.

CAN Communications Port (optional)

The driver has CAN communications, version 2.0B, with 29-bit identifiers. The protocol complies with SAE J1939, but uses proprietary group extensions. The CAN port supports positioning (position demand from CAN) of the driver. It also supports ProAct Digital Plus monitoring of all shutdown and alarm conditions as well as some system variables. The address is determined by the CAN address discrete inputs. The data rate may be chosen from 250 kbps, 500 kbps, and 1 Mbps.

Chapter 2.
Hardware Installation

This chapter provides instructions on how to mount and connect the ProAct™ Digital Plus actuator into a system. Hardware dimensions are provided for mounting the ProAct package to a specific application.

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

⚠️CAUTION	**Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the ProAct Actuator.**

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

Unpacking

Be careful when unpacking the actuator. Check the unit for signs of damage, such as bent or dented panels, scratches, and loose or broken parts. Notify the carrier and Woodward if damage is found.

Mounting Location

The ProAct Digital Plus actuator is designed to operate within a temperature range of –40 to +85 °C (–40 to +185 °F). Mount the driver close enough to the battery to meet the wire-length requirements (see wiring instructions in Chapter 3).

The ProAct actuator is designed for installation on the engine. The ProAct actuator will generate heat, especially when stalled or during other conditions requiring maximum torque output. The installer must consider the heat conductivity of the installation bracket, and the operating temperature of the ultimate heat sink to which the bracket will be attached. Generally the heat transfer abilities of aluminum and low-carbon steel are better than those of high-carbon steel or stainless steel.

NOTICE	**A minimum gap of 0.5 mm must be maintained between the support bracket and electronics enclosure (see Figure 2-1). This is necessary because the enclosure is supported on vibration isolators to filter out high-frequency vibrations from reaching the electronics. If the enclosure contacts the bracket, the isolation is defeated and may reduce the electronics operating life.**
	If spacers are used to achieve the necessary gap, Woodward recommends maximizing the surface contact area of the spacers to maximize heat transfer between the ProAct and mounting bracket.

Actuator Application Guidelines

The following sections include environmental guidelines for applying the ProAct Digital Plus. By adhering to the limitations and recommendations set forth in these sections, the customer will realize the full functionality of the actuator and improve its overall reliability.

Mounting

Models I through IV actuators may be installed on a bracket in either base or flange mount configuration with the exception of the model IV. The mass of the model IV requires that it be mounted only in the base mount configuration. The base mount configuration requires the use of four M8x1.25 screws with a minimum engagement of 16 mm. The flange mount configuration requires the use of four M8 screws through the flange. Whether base mounting or flange mounting the actuator, torque the four M8 screws to 22.6 N·m (200 lb-in). The actuator may be mounted in any attitude.

The ProAct Digital Plus weighs approximately:
Model I	11 kg (25 lbs)	Model II	11 kg (25 lbs)
Model III	15 kg (32 lbs)	Model IV	24 kg (52 lbs)

The bracket and attaching hardware must be designed to hold the weight and to withstand the vibration associated with engine mounting. Additionally, the bracket must be designed to provide a heat sink (heat transfer) from the actuator to the engine block as described in the following section.

As shown in Chapter 11, ProAct Digital Plus Specifications, the ProAct actuators have been designed for and verified to a given accelerated life vibration test level at the mounting surface of the actuator. The user should be aware that in any application, bracket design can significantly change the vibration levels at the actuator. Therefore, every effort should be made to make the bracket as stiff as possible so that engine vibrations are not amplified, creating an even more severe environment at the actuator. Additionally, when possible, orienting the actuator shaft parallel to the crankshaft of the engine will often reduce the vibration load on the actuator's rotor system in reciprocating engine applications.

Actuator Selection and Temperature Monitoring Guidelines

The thermal design of the ProAct Digital Plus is based on the cooling of critical electrical components coupled to the aluminum frame of the actuator. In this manner, by maintaining a certain temperature at a specified location on the actuator frame, the temperature of the electronics will be maintained within acceptable limits. Therefore, when applying the ProAct Digital Plus actuator, the area shown in the following diagram (Figure 2-1) must not exceed 90 °C regardless of the surrounding thermal conditions. If the temperature of this zone does exceed 90 °C, thermal based actuator output limiting may begin depending on user-configurable options. The limiting area shown in Figure 2-1 is referred to as the temperature monitoring zone.

IMPORTANT	**CSA hazardous or CSA and UL ordinary location certification of the ProAct Digital Plus is not applicable if the ambient temperature exceeds 85 °C.**

ELECTRONICS
PACKAGE

261-009
08-4-3

(0.5 mm)
MOUNTING GAP

TEMPERATURE
MONITORING ZONE
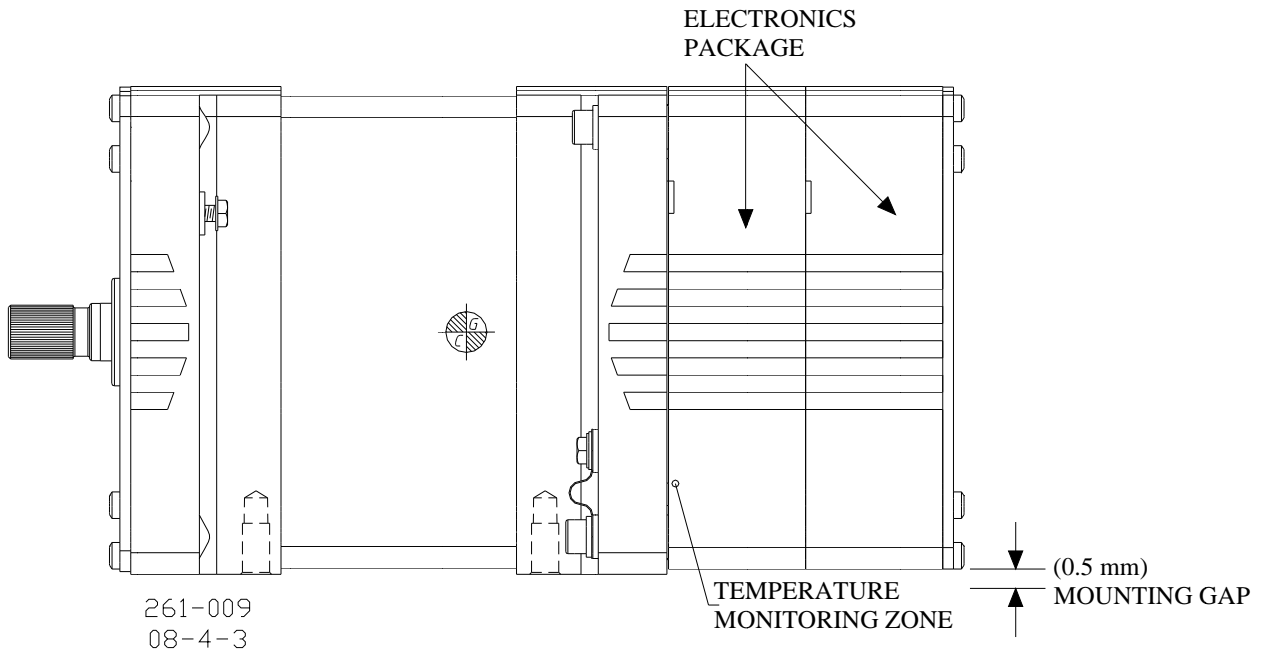
Figure 2-1. Temperature Monitoring Zone (model III shown)

Figure 2-2. Base Mount Actuator Selection Guidelines

IMPORTANT   CSA hazardous and CSA and UL ordinary location certification of the ProAct Digital Plus is not applicable if the ambient temperature exceeds 85 °C.

ProAct Digital Plus Flange Mount Actuator Selection Guidelines
Choose curve which represents torque output utilized in specific application.
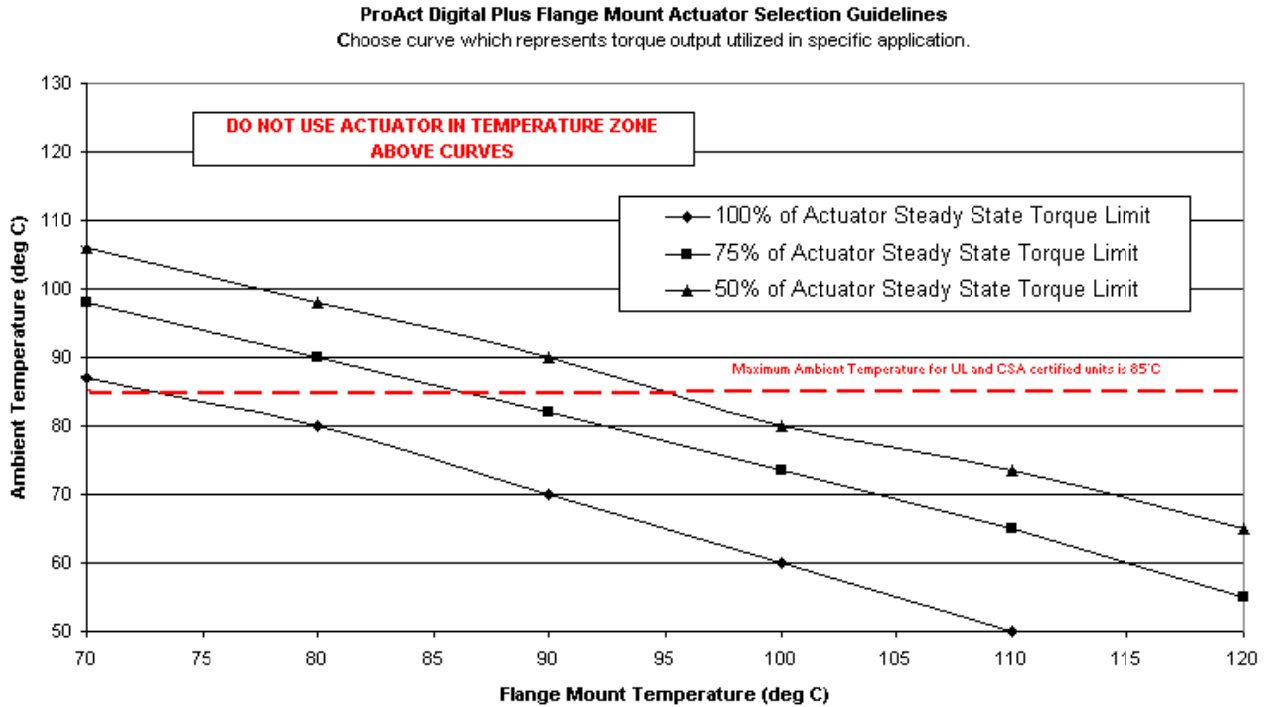
Figure 2-3. Flange Mount Actuator Selection Guidelines

In order to determine whether a customer-specific application will meet this temperature limitation, the following charts are included (Figures 2-2 and 2-3). For each mounting condition the chart gives a general guideline for the surrounding environment. In each case, if the measured temperatures of the environment fall under the limiting curve, the temperature monitoring zone should be under the acceptable 90 °C limit. Note that these curves are guidelines based on actuator testing and modeling. After installation, the true thermal condition must be determined by testing the temperature monitoring zone. Each chart contains three curves representing different actuator output levels. These output levels, and the loading they represent on the actuator, affect the temperature limits. Regardless of the measured temperature in the temperature monitoring zone, CSA hazardous and CSA and UL ordinary locations listings are not applicable if the surrounding air ambient temperature exceeds 85 °C.

Both charts assume a smooth mounting surface with good heat transfer characteristics. In addition, the ambient temperatures shown are based on the air velocities present in a test oven. Therefore, if significant air flow is present, these temperatures can potentially be increased. Similarly, if the surrounding air is highly stagnant, these temperatures my need to be decreased. The specific environment must be verified by checking the temperature monitoring zone given that these curves are only guidelines and many factors can effect the actual thermal conditions on an engine.

Fuel Position Stops

Diesel Stops—Diesel installations will generally use the fuel system minimum and maximum position stops. Diesel engine racks are normally designed to provide the minimum and maximum stops without binding. The actuator's stops must not prevent the actuator from driving the fuel linkage to the minimum and maximum positions. The linkage should be designed to use as much actuator travel as possible, without preventing minimum and maximum fuel positions (see Figure 2-4).

Gas Engine Stops—Butterfly valves in carburetors will often bind if rotated too far toward minimum or maximum. For this reason, the stops in the actuator should be used at both minimum and maximum positions. Note that the actuator internal stops will allow up to 1.5 degrees of additional rotation in both directions during impact (see Figure 2-4).

The engine must always shut down when the actuator is at the minimum stop.
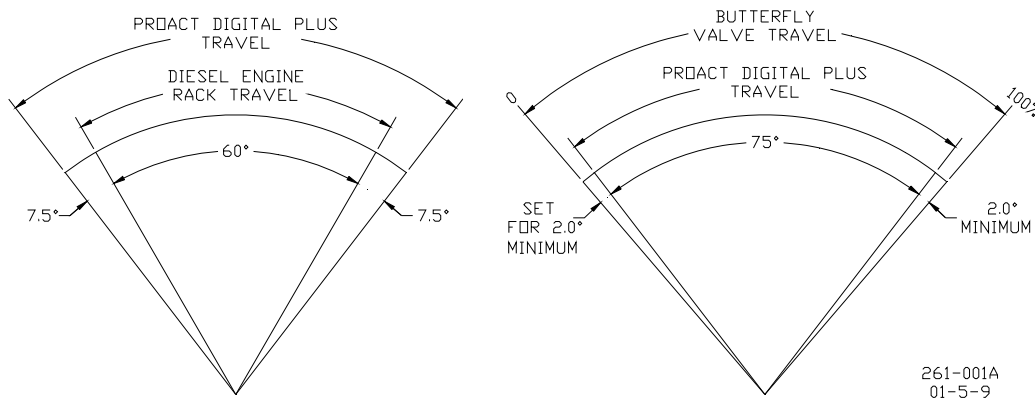
Figure 2-4. Fuel Stops

Linkage

Proper design and installation of the linkage from the actuator to the engine is necessary for the unit to provide the best control possible.

Certain applications with low inertia may be unstable with high impulse loads and may require additional system inertia. See troubleshooting guidelines or contact Woodward for more information.

Ensure that the actuator has ample work capacity to control the fuel supply under maximum load conditions.

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

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

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

The Mass Moment of Inertia (MMOI) for the ProAct Digital Plus actuators are:

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

The fuel system stops must be adequate to absorb the actuator MMOI in addition to the linkage inertia without damage.

ProAct actuator internal stops are designed to absorb 0.011 J (0.097 in-lb) of kinetic energy with 1.5 degrees of over travel. If the actuator stops are used, the load inertia must not exceed 3.76E-3 in-lb-s² (4.25E-4 kg-m²), and the linkage must be designed to allow the 1.5 degrees of over travel on each end.

Use of good rod-end connectors with as little free play as possible is essential. Select rod ends which will remain tight and wear well during the nearly constant movement associated with precise speed control. Low-friction, long-wearing rod ends are available from Woodward.

The link connecting the actuator lever to the fuel-control lever must be short and stiff enough to prevent flexing while the engine is running.

Typically, in a linkage system, there may be links and levers which are supported by customer-supplied bearings. Additionally, there will typically be a section of the linkage where the mass is supported fully by the actuator output shaft. Please note when designing these systems that each ProAct Digital Plus actuator is designed to accept 1.2 kg (2.6 lb) of additional mass at a maximum vibration level of 10 Gs. Exceeding this mass or vibration level may damage the actuator's rotor system and shorten the life of the actuator.

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

Adjust the location of the rod end on the lever to achieve the desired actuator rotation between minimum and maximum positions. The linkage should be set to use as much of the 75 degrees as possible (at least 60 degrees minimum). To increase the amount of actuator rotation, move the rod end closer to the actuator shaft or farther away from the shaft controlling the fuel flow. To decrease the amount of actuator rotation, move the rod end farther from the actuator shaft or closer to the shaft controlling the fuel flow.

⚠WARNING   **The actuator must be stroked using the Service Tool procedure any time the valve stops or linkage is adjusted.**

IMPORTANT   **Follow the procedure in Chapter 9 on Adjusting User Stops and Dynamics.**
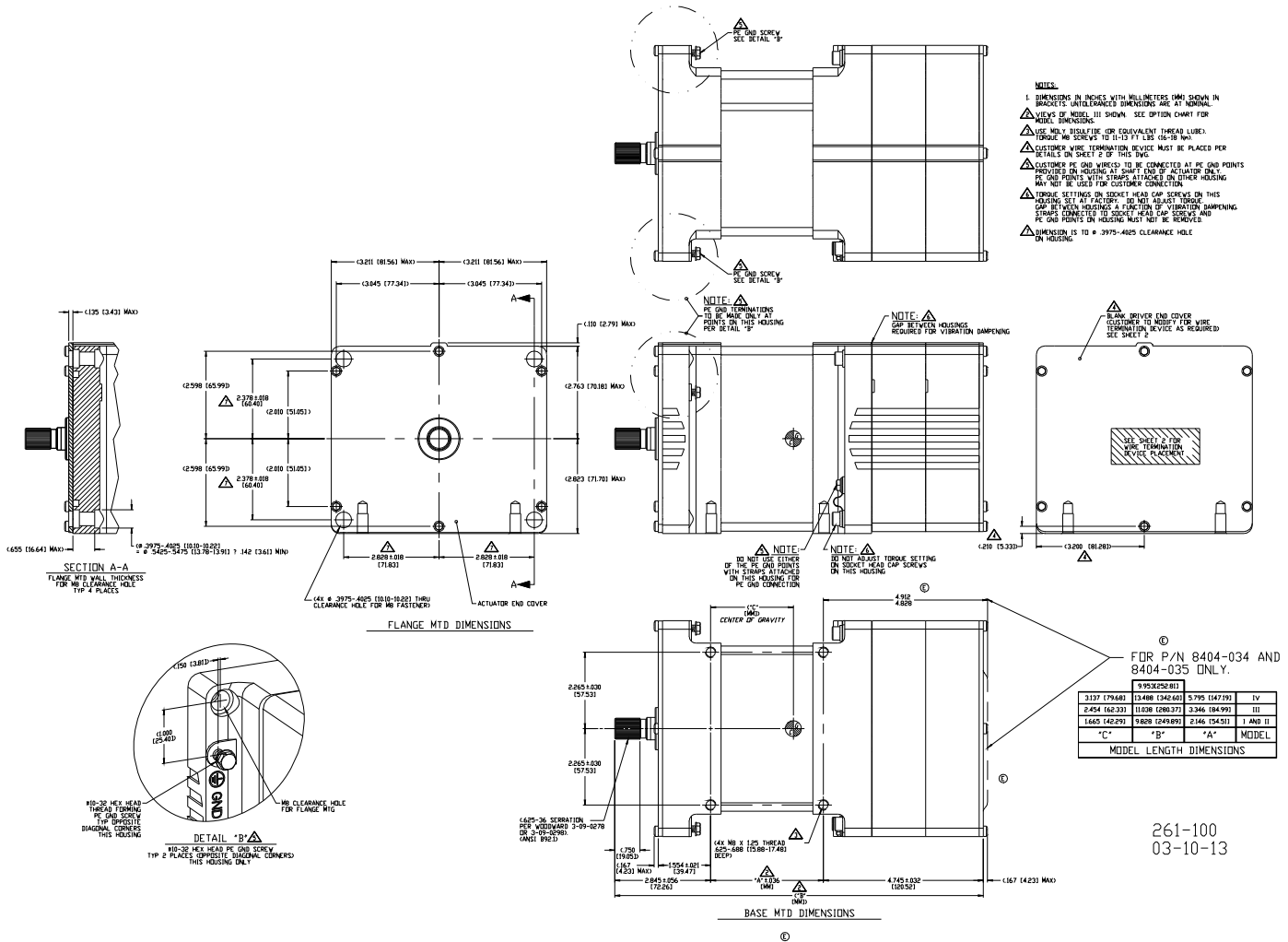
Figure 2-5a. ProAct Digital Plus Actuator Outline Drawing

Figure 2-5b. ProAct Digital Plus Actuator Outline Drawing
(Pilot Adaptor Version)

BLANK DRIVER END COVER
(MODIFY TO ADD CUSTOMER
CONNECTIONS AS REQUIRED)
(WOODWARD P/N: 4250-031)

MAXIMUM ALLOWABLE AREA
FOR CUSTOMER WIRING
TERMINATION DEVICE
(MODIFIED BY CUSTOMER)

(1.062)

(1.840)

(.980)

(2.625)

(.750 MAX)
ALLOWABLE DEPTH
FOR CUSTOMER WIRE
TERMINATION DEVICE

DETAIL "D"
BLANK DRIVER END COVER MODIFICATION
WOODWARD P/N 4250-031

DRIVER END COVER
WITH MS-3102R24-7P TYPE
CONNECTOR SUPPLIED
(WODWARD P/N: 6070-115)

2.530 ±.062
Ⓔ

1.000 [25.40] MAX

4.348 ±.062
Ⓔ

261-006
03-10-2

DETAIL "E"
MS STYLE CONNECTOR DRIVER END COVER
WOODWARD P/N'S 6070-115 AND 6070-1009

Figure 2-5c. ProAct Digital Plus Actuator Outline Drawing

NOTE:
(GASKET MUST REMAIN
INSIDE GASKET GROOVE)

POWER INPUT TERMINALS
2X M4 X 5.8 MM LONG
SLOTED HEAD SCREW

SPRING CLAMP TYPE
TERMINAL BLOCK
(NO. OF POSITIONS OPTIONAL)

RS-232
CONNECTOR
(PINS)

PE GND CONNECTION
M4 X 6MM LONG PH PAN HD
THREAD FORMING SCREW
SUPPLIED IN HOUSING

OPTIONAL PE GND CONNECTION
NONTHREADED .290 (7.37) DEEP
HOLE SIZED FOR M4 X 6MM LONG
THREAD FORMING SCREW
(WOODWARD P/N: 1029-525)

GND

GND
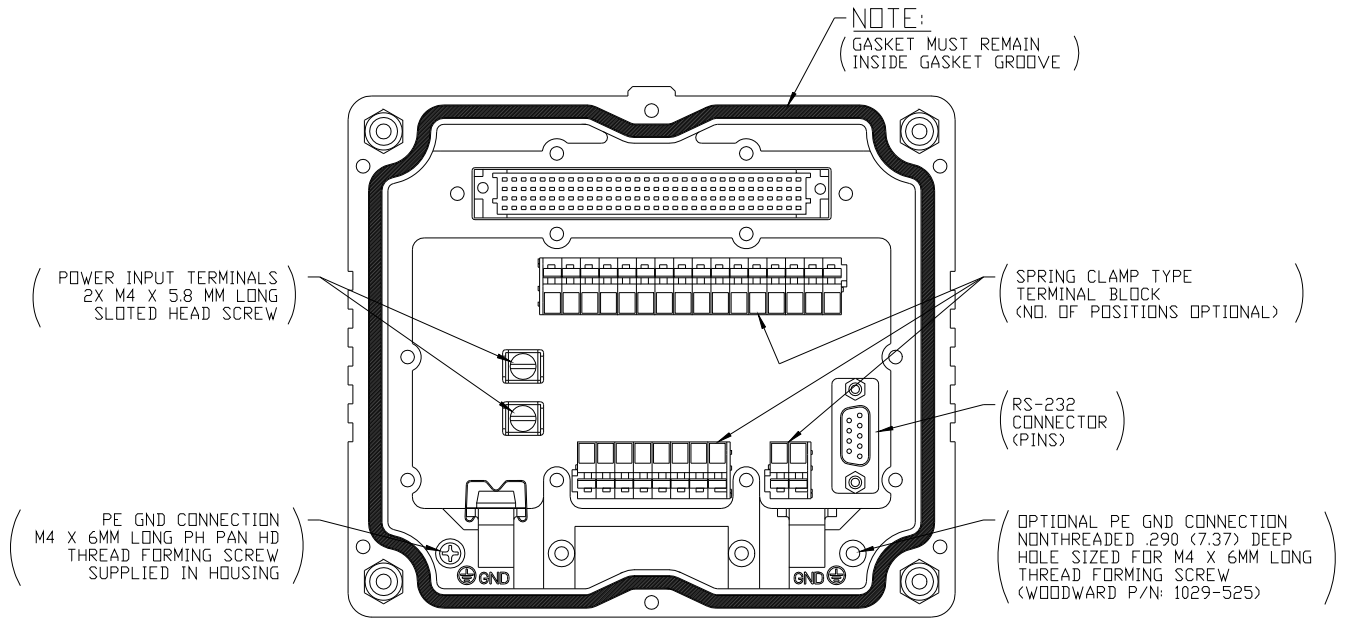
DETAIL "C" △2
DRIVER END OF ACTUATOR WITH   261-007
END COVER REMOVED SHOWING   03-10-2
CUSTOMER TERMINATION PC BOARD

NOTE: DETAIL C VIEW ONLY APPLIES
        DETAILS D,E & G

Figure 2-5d. ProAct Digital Plus Actuator Outline Drawing

Chapter 3.
Wiring

This chapter provides instructions on how to connect the ProAct™ actuator into a system. Ratings and jumper configurations are given to allow wiring and configuration of the ProAct package to a specific application.

Electrical ratings, wiring requirements, and options are provided to allow full installation the ProAct actuator into a new or existing application.

IMPORTANT	**Jumpers should not be moved or changed unless power has been switched off.**

Electrical Connections

⚠ WARNING	**If you are replacing an earlier ProAct series actuator with the ProAct Digital Plus model, be sure to remove the original driver, since the ProAct Digital Plus actuator has an integrated driver.**

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

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

Refer to the control wiring diagram (Figure 3-1), the representative I/O interface schematic (Figure 3-2), and the Specification section of the manual for the hardware I/O specifications.

All inputs and outputs to the ProAct actuator are accessed beneath the end cover which is fastened with 6 M4x10 mm, screws (see the outline drawing, Figure 2-1).

IMPORTANT	**An optional M37 blanking plug is available to make connections to the 9-pin sub-D male service port. This port should be used only for configuration and setup. Thread lock should be used to secure the blanking plug.**

Input power is connected to size M4 screws. The wires must be terminated with insulated spade or ring lugs. Wires for the fixed mounted power terminals should be stripped 5–6 mm (0.2 inch).

The I/O terminal blocks are screwless cage clamp style blocks. The spring clamp can be actuated by pressing down on the thumb levers integral to the block. The terminal blocks accept wires from 0.20 – 3.3 mm² (24 -12 AWG) wire. Two 0.82 mm² (18 AWG) or three 0.5 mm² (20 AWG) wires can easily be installed in each terminal. Wire for the I/O terminals should be stripped 8–9 mm (0.3 inch).

IMPORTANT	**To ensure electromagnetic compliance, cables attached permanently to the unit must be limited to 30 meters.**

TERMINAL PCB ASSY │ DRIVER END COVER
UNDER DRIVER │ TO BE MODIFIED AS
END COVER │ REQUIRED BY
CUSTOMER

⚠ WHEN USED IN HAZARDOUS LOCATIONS, ONLY
UL/CSA APPROVED WOODWARD CONTROLS MAY BE
CONNECTED TO THE 20-180 MA ANALOG COMMAND INPUT.

JPR1   JPR2

T B
1 +⎤ ANLG
2 −⎦ INPUT ⚠   RS-232

3 +⎤ PWM
4 −⎦ INPUT

5 +⎤ POSITION
6 −⎦ OUTPUT
        (4-20mA)   T B

7 RUN
   ENBL   CLOSE   CAN ⎡HI 10
8 STAT   TO   IN ⎣LO 11
   OUT   RUN
9 DIS   CAN ⎡HI 12
   COM   OUT ⎣LO 13

                         TERM⎡ 14
                         (JPR   15
                         FOR ⎦
                          IN)⎣
                         CAN ⎡HI 16
                          ID ⎣LO 17

CANBUS COMMUNICATIONS

24 VDC
INPUT POWER
+   COM

M4 X 5.8MM LONG
CYLINDER SCREW
TYP 2 PLACES
INPUT POWER
TERMINALS

GND

261-003
06-9-14

M4 X 6MM LONG
THREAD FORMING SCREW
SUPPLIED ON HOUSING
FOR PE GND CONNECTION

Figure 3-1a. Control Wiring Diagram (blank cover)

NOTES:

⚠ 1   MATING CONNECTOR TYPE MIL-C-5015:
    SHELL STYLE: 3106 (STRAIGHT) OR 3108 (90° ANGLE).
    SHELL SIZE: 24.
    CONTACT ARRANGEMENT: 7.
    CONTACT TYPE: S (SOCKET).

⚠ 2   WHEN USED IN HAZARDOUS LOCATIONS, ONLY
    UL/CSA APPROVED WOODWARD CONTROLS MAY BE
    CONNECTED TO THE 20-180 MA ANALOG COMMAND INPUT.

Figure 3-1b. Control Wiring Diagram (CAN only)

NOTES:

⚠1 WHEN USED IN HAZARDOUS LOCATIONS, ONLY
    UL/CSA APPROVED WOODWARD CONTROLS MAY BE
    CONNECTED TO THE 20-180mA ANALOG COMMAND INPUT.

⚠2 MATING CONNECTOR TYPE MIL-C-5015:
    SHELL STYLE: 3106 (STRAIGHT) OR 3108 (90° ANGLE)
    SHELL SIZE: 24
    CONTACT ARRANGEMENT: 7
    CONTACT TYPE: S (SOCKET)

TERMINAL PCB ASSY
UNDER DRIVER
END COVER

DRIVER END COVER
WITH MS TYPE
CONNECTOR

⚠2 MS-3102R24-7P TYPE
    CONNECTOR ON DRIVER
    END COVER

261-037A
06-9-14

M4 X 5.8MM LONG
CYLINDER SCREW
TYP 2 PLACES
INPUT POWER
TERMINALS

M4 X 6MM LONG
THREAD FORMING SCREW
SUPPLIED ON HOUSING
FOR PE GND CONNECTION
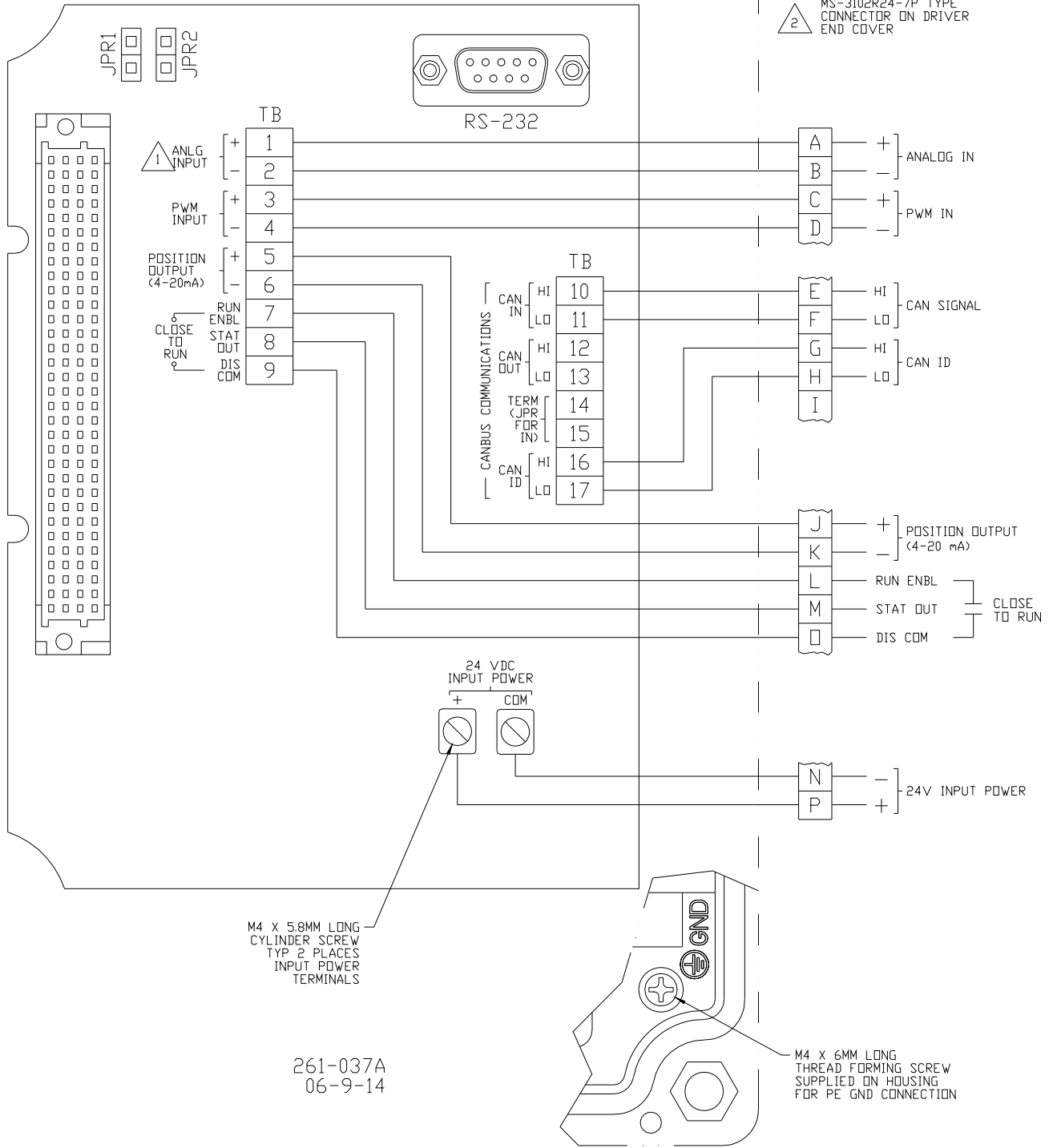
Figure 3-1c. Control Wiring Diagram (Digital Plus)

NOTES:

⚠1 MATING CONNECTOR TYPE MIL-C-5015:
 SHELL STYLE: 3106 (STRAIGHT) OR 3108 (90° ANGLE).
 SHELL SIZE: 24.
 CONTACT ARRANGEMENT: 7.
 CONTACT TYPE: S (SOCKET).

⚠2 WHEN USED IN HAZARDOUS LOCATIONS, ONLY
 UL/CSA APPROVED WOODWARD CONTROLS MAY BE
 CONNECTED TO THE 20-180mA ANALOG COMMAND INPUT.

Figure 3-1d. Control Wiring Diagram (CAN only with External Run Enable)
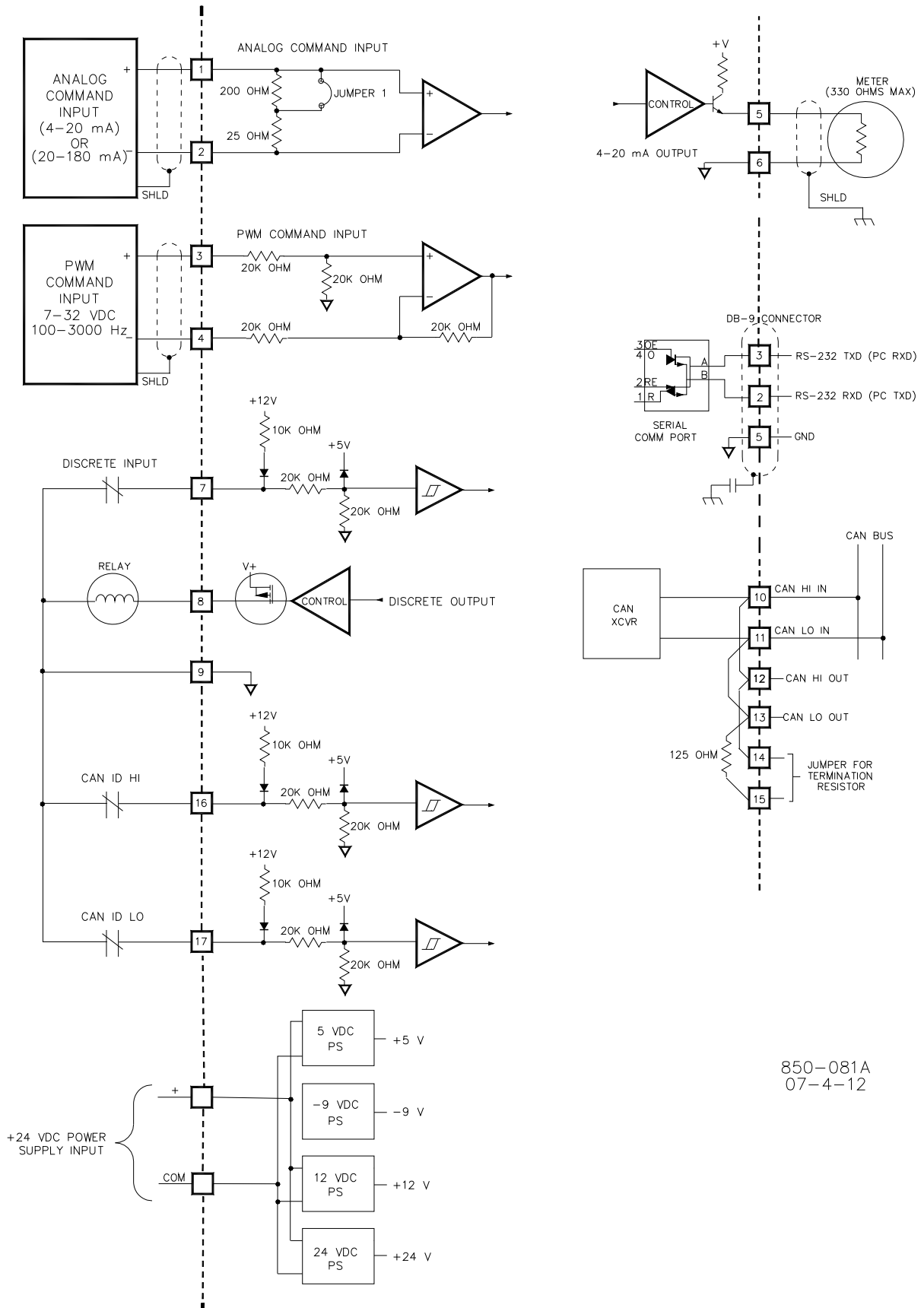
Figure 3-2. Representative I/O Schematic

Cable Shield Termination

The ProAct control is designed for operation without shielded cables. When shielded cables are provided, terminate the shield to the optional termination point shown in Figure 2-5d.

Hardware Jumpers

The analog input has a range jumper to select either a 20 mA range (JPR2) or a 200 mA range (JPR1). Refer to Figure 3-1 for jumper locations. Jumpers must only be moved with input power removed from the ProAct control.

⚠ **WARNING**	**The power must be removed from the ProAct Driver in order to move any jumpers.**

Grounding and Ground Connections

The multiple ground connections are provided for variations in local wiring codes. An internal power ground connection (see Figure 3-1a) and an external ground connection (other than the mounting) are both provided. Refer to the external PE Ground connection identified in Figure 2-5.

IMPORTANT	**Customers must use the grounding point that meets local authority approval requirements.**

Power Source

Power source output must be low impedance (for example, directly from batteries). Run an insulated wire directly from the positive (+) battery terminal and negative (–) battery terminal to the correct connection on the driver (see Figure 3-3). Run a second insulated wire directly from the negative (–) terminal of the battery to the driver. Neither of these connections needs to be shielded.

Run the power leads directly from the power source to the control. DO NOT POWER OTHER DEVICES WITH LEADS COMMON TO THE CONTROL (see Figures 3-3 and 3-4). If the power source is a battery, be sure the system includes an alternator or other battery-charging device.

When the engine is shut down, the driver powers the actuator into the minimum stop. If the battery charging system is off when the engine is shut down, this will cause the battery to be drained. In this case, the power to the ProAct must be turned off with a switch or relay. Any such switch or relay must be interlocking to prevent starting the engine when power to the actuator is shut off.

⚠ **WARNING**	**Do not remove power from the driver for normal shutdown procedures. All actuator position commands should come from the control unit, through the driver, to the actuator. Engine overspeed is possible if power is removed from the driver while the engine is running.**

NOTICE	**To prevent possible damage to the control, or poor control performance resulting from ground loop problems, follow these instructions.**

BATTERY
CHARGER

STARTER

RELAY

OIL SWITCH   LAMP

TYPICAL

BATTERY

WOODWARD
CONTROL

⚠ 1

⚠ 1

RIGHT
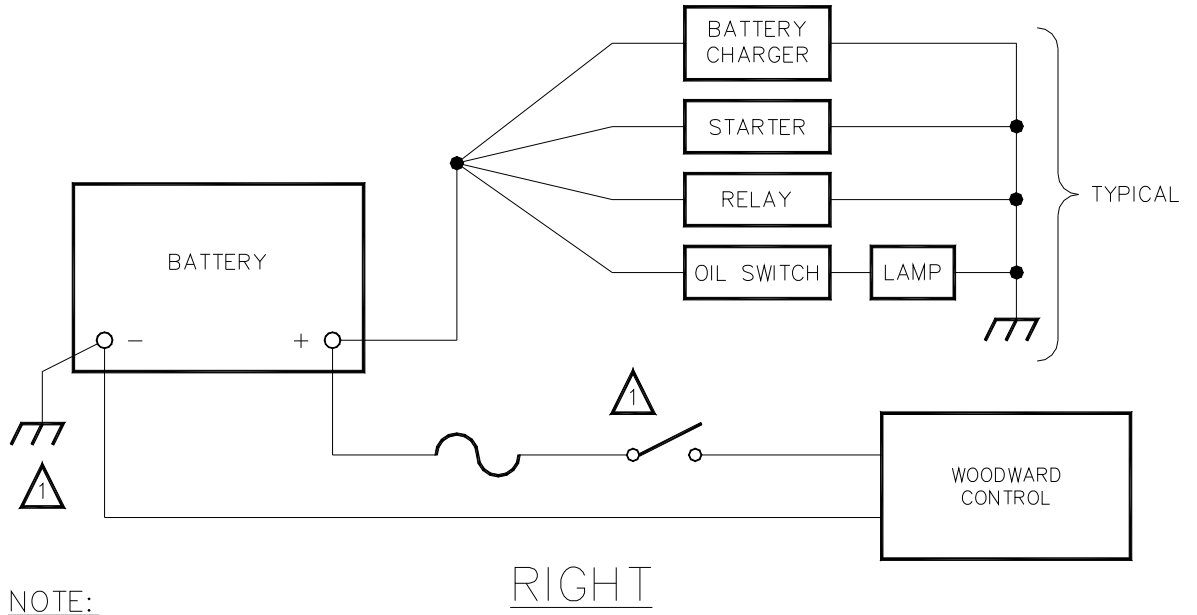
NOTE:

⚠ 1 A NEGATIVE GROUND SYSTEM IS SHOWN. IF A POSITIVE GROUND SYSTEM IS USED, THE SWITCH
AND FUSE MUST BE LOCATED IN SERIES WITH BATTERY (−) AND TERMINAL (TB1−2) ON THE
WOODWARD CONTROL. THE POSITIVE TERMINAL BECOMES CHASSIS GROUND.

Figure 3-3. Correct Wiring to Power Supply

BATTERY
CHARGER

STARTER

RELAY

OIL SWITCH   LAMP

TYPICAL

BATTERY

WOODWARD
CONTROL

WRONG
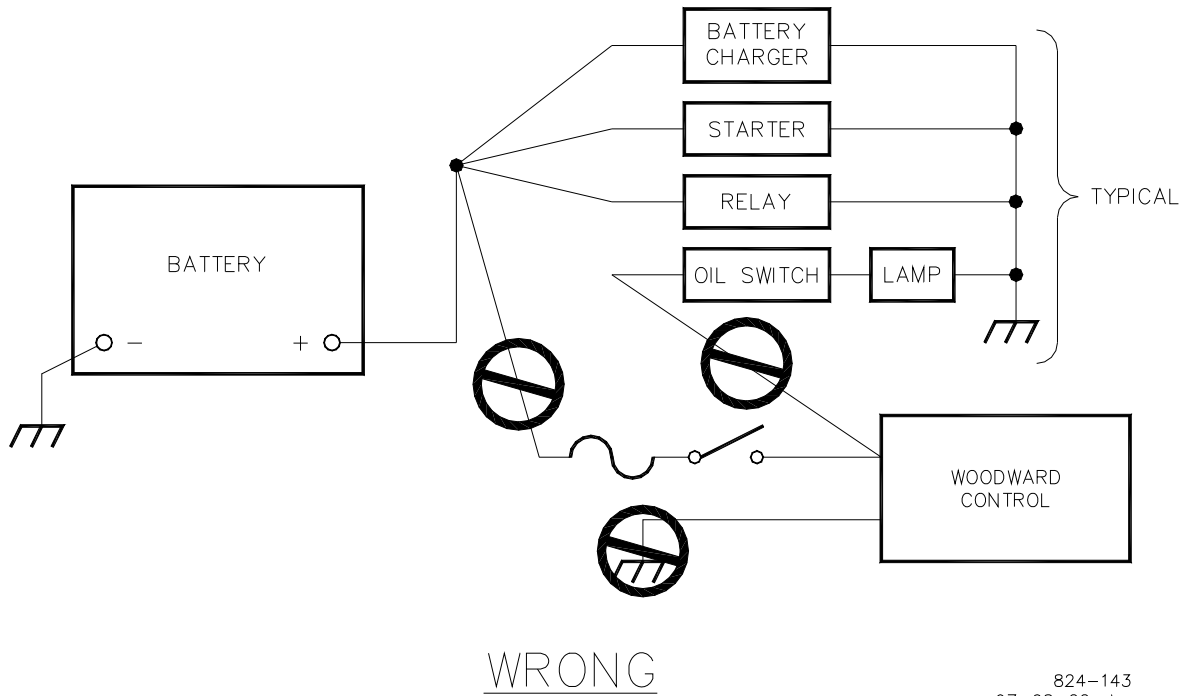
824−143
97−08−22 skw

Figure 3-4. Incorrect Power Supply Wiring

ProAct Inputs/Outputs

Actuator Input Power

The following table summarizes the driver power input requirements. The input voltage operational range is 18–32 Vdc, 24 Vdc nominal. The power input provides protection against reverse voltage connection. Refer to Tables 3-1 and 3-2 for maximum cable lengths and wire sizes. Size M4 screws are provided for power connection requiring either insulated spade- or ring-lug connectors for termination.

ProAct Digital Plus Model	Transient Power–max (Watts)	Continuous Power–max (Watts)
I	67	19
II	251	65
III	282	73
IV	371	101

Table 3-1. Driver Power Input

Input Power Fusing

NOTICE	The input power must be fused. Failure to fuse the ProAct could, under exceptional circumstances, lead to personal injury, damage to the control valve, and/or explosion.

Recommended fuse ratings are listed below.

Model I: 5 Amp Fast Acting Fuse
Model II: 15 Amp Fast Acting Fuse
Model III: 20 Amp Fast Acting Fuse
Model IV: 25 Amp Fast Acting Fuse

All fuses should have a voltage rating of at least 100 V and the I^2t (current^2 * time) rating should be at least 2. A typical fast acting fuse will meet these ratings.

IMPORTANT	The controller can produce transients on the power supply lines which may interfere with certain regulated power supplies. If this is the case, the interference may be reduced or eliminated by connecting a 100 V, 1000 µF or larger capacitor across the power supply lines. Correct polarity must be observed when connecting the capacitor.

Input Power Wire Length Considerations

Input power wire lengths should be as short as possible. Maximum wire lengths are shown in Tables 3-1 and 3-2.

⚠ WARNING	If the recommended cable distances between battery and actuator are exceeded, torque output will be reduced.

Recommended maximum wire length from power source to ProAct actuator based on a 24 V power source.

Input Power Wire Size	Max Wire Length (ProAct Model I)	Max Wire Length (ProAct Model II)	Max Wire Length (ProAct Model III)	Max Wire Length (ProAct Model IV)
16 AWG	51 m / 167 ft	13 m / 43 ft	14 m / 46 ft	6 m / 20 ft
14 AWG	81 m / 266 ft	21 m / 69 ft	23 m / 75 ft	9 m / 30 ft
12 AWG	128 m / 420 ft	34 m / 112 ft	37 m / 121 ft	15 m / 49 ft
10 AWG	202 m / 663 ft	54 m / 177 ft	59 m / 194 ft	24 m / 79 ft
8 AWG	320 m / 1050 ft	84 m / 276 ft	94 m / 308 ft	37 m / 121 ft
1.5 mm²	59 m / 194 ft	15 m / 49 ft	16 m / 52 ft	7 m / 23 ft
2.5 mm²	99 m / 325 ft	26 m / 85 ft	28 m / 92 ft	11 m / 36 ft
4 mm²	158 m / 518 ft	42 m / 138 ft	46 m / 151 ft	19 m / 62 ft
6 mm²	236 m / 774 ft	63 m / 207 ft	69 m / 226 ft	28 m / 92 ft
10 mm²	393 m / 1289 ft	103 m / 338 ft	116 m / 381 ft	45 m / 148 ft

Table 3-2. Maximum Distance from 24 V Power Source to ProAct Actuator

Recommended maximum wire length from power source to ProAct actuator based on an 18 V power source.

Input Power Wire Size	Max Wire Length (ProAct Model I)	Max Wire Length (ProAct Model II) Limited torque output*	Max Wire Length (ProAct Model III)	Max Wire Length (ProAct Model IV) Limited torque output*
16 AWG	12 m / 39 ft	8 m / 26 ft	5 m / 16 ft	4 m / 13 ft
14 AWG	54 m / 177 ft	13 m / 43 ft	8 m / 26 ft	6 m / 20 ft
12 AWG	86 m / 282 ft	21 m / 69 ft	13 m / 43 ft	10 m / 33 ft
10 AWG	137 m / 449 ft	33 m / 108 ft	21 m / 69 ft	16 m / 52 ft
8 AWG	217 m / 712 ft	52 m / 171 ft	33 m / 108 ft	26 m / 85 ft
1.5 mm²	14 m / 46 ft	9 m / 30 ft	6 m / 20 ft	5 m / 16 ft
2.5 mm²	66 m / 217 ft	16 m / 52 ft	10 m / 33 ft	7 m / 23 ft
4 mm²	106 m / 348 ft	25 m / 82 ft	16 m / 52 ft	12 m / 39 ft
6 mm²	160 m / 525 ft	39 m / 128 ft	25 m / 82 ft	19 m / 62 ft
10 mm²	267 m / 876 ft	64 m / 210 ft	41 m / 135 ft	32 m / 105 ft

* Note—Rated transient torque is not achievable with an 18 V power source on the Models II and IV. Listed maximum lengths will provide 75% of rated transient torque.

Table 3-3. Maximum Distance from 18 V Power Source to ProAct Actuator

Analog Position Command Signal

The analog input will accept a jumper configurable 0–25 mA or 0–200 mA input signal with a nominally configured operational range of 4–20 mA and 20–180 mA, respectively. The position command input will be capable of providing a common mode input voltage range (unit battery ground referenced) of 0–32 volts for all analog type inputs. The minimum wire size is 0.5 mm² or 20 AWG.

PWM Position Command Signal

The PWM input will accept a 100 to 3000 Hz PWM input signal of 7 to 32 volts peak voltage (referenced to unit battery ground). The position command input will be capable of providing a common mode input voltage range (unit battery ground referenced) of 0 to 4 volts for all PWM type inputs. The PWM circuit will accept a sourcing driver input. The driving circuit must be capable of providing 10 mA of sourcing current at all battery voltages. The minimum wire size is 0.5 mm² or 20 AWG.

Position Feedback Output

The actuator position signal will be output from the driver as a 4–20 mA signal corresponding to 0% to 100% actuator travel. The minimum wire size is 0.5 mm² or 20 AWG.

Run Enable Discrete Input

This discrete input is closed to run and opened for Low Power Standby Mode. The Low Power Standby Mode provides minimal power consumption of the device. When the discrete input is opened, power is removed from the actuator coil, the processor stays active, and the unit consumes less than 200 mA of current. All communications (CAN and RS-232) remain active while in this mode.

When the input is closed and all shutdown conditions are cleared, the actuator will position its output to the demanded setting.

IMPORTANT	**If using firmware version 2.20 Woodward part number 5418-2590, it is possible to configure this input for Run Enable – Closed to Run = False. With this configuration, the contacts are open to run, and closed to enter Low Power Standby Mode.**

This input must be in Run mode for control the actuator.

Discrete Output

A discrete output is provided to serve as a status indicator. If the driver fails or shuts down, the discrete output will open. In addition, the discrete output can optionally open upon any alarm condition. The circuit drives a 48 Ω load at 500 mA at 24 V input.

Communication Hardware Descriptions

Service Port

An RS-232 service port is provided with a 9-pin sub-D male connector beneath the customer entry plate. Functions available through this port include tuning and configuration of the driver and actuator. Detailed driver status information is also available.

Any RS-232 wiring must meet the requirements in the EIA RS-232 Standard document. The RS-232 standard states that the maximum length of the RS-232 cable between the driver and the PC must be 50 feet (15 meters) with a total capacitance less than 2500 pF. The RS-232 data rate is fixed at 19.2 kbps. The communication port is non-isolated and susceptible to both EMI noise and ground loops related to PC connections and typical industrial environments.

IMPORTANT | The service port is not isolated and is not intended to function while the engine is in normal operation. The service port is provided for configuration and setup only.
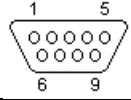
Connector	Signal Mnemonic
DB9M 1 5 ooooo oooo 6 9	Shielded DB9 male connector
2	ProAct Rx
3	ProAct Tx
5	Signal Common
Shield	Chassis GND—capacitively coupled

Table 3-4. RS-232 Port Pinout

CAN Communications

The CAN wiring must meet the requirements in the ISO 11898 specification. The data rate is software configurable between 250 Kbits/sec, 500 Kbits/sec, and 1Mbits/sec. Maximum cable length specifications based on the data rate can be found in Chapter 11 (Specifications).

Up to four ProAct controls can be on the same CAN bus, however, each must have a different device address. The CAN device address is determined by the CAN ID HI and LO discrete inputs upon power-up of the unit (see Table 3-5).

IMPORTANT | The CAN address discrete inputs must be wired prior to power-up to be registered.

ProAct Address	1	2	3	4
CAN ID HI	Open/High	Open/High	Closed/Low	Closed/Low
CAN ID LO	Open/High	Closed/Low	Open/High	Closed/Low

Table 3-5. ProAct CAN Address

A built-in 125 ohm termination resistor is provided. Installing a jumper across terminals 14 and 15 puts the termination resistor across the CAN Hi and Lo terminals—see Figure 3-2. A termination resistor should be installed on the last unit of the CAN bus. The termination resistor will help prevent disturbances and/or reflections of CAN signals.

Chapter 4.
Setup, Calibration, and Adjustments

General Description

Setup, calibration, and adjustments are all provided through software. To use these functions, the Service Tool must be installed. Refer to Chapter 8 (Service Tool) for instructions on installation and operation of the Service Tool.

Setup

The basic setup consists of actuator configuration, actuator stroking, and dynamics (inertial setting) adjustment. Configuration is not required on most OEM-supplied units. Configuration is performed using the Service Tool—details are provided in Chapter 9 (Software Setup). Over 20 Configuration parameters are available—the Appendix provides a Program Summary worksheet which gives an overview of these Configure Mode settings.

Actuator stroking is required to ensure that 0–100% actuator travel provides an equivalent valve position.

The setup, configuration, stroking, and dynamics adjustment must be performed when the engine is shut down. These actions all require a password.

⚠ **WARNING**	**The actuator must be stroked using the Service Tool procedure any time the valve or linkage is adjusted.**

NOTICE	**Actuator dynamics must be set using the Service Tool Inertia Setting parameter prior to engine operation.**

IMPORTANT	**The Service Tool is not included, but can be download from the Woodward Internet website (www.woodward.com) or by ordering the Watch Window Standard CD-ROM (1796-065).**

Calibration

The ProAct™ digital control requires no field calibration, the analog signals are factory calibrated. Adjustments are available in the Service Mode to account for field variations.

Adjustments

Adjustments are provided to optionally fine-tune an application. Over 20 adjustable parameters are available. Adjustments are available through the Service Tool—details are provided in Chapter 9 (Software Setup). The Appendix provides a Program Summary worksheet which gives an overview of these Service Mode Settings available.

Chapter 5.
Description of Operation

Position Control

The ProAct™ Digital Plus provides closed-loop position control based on an internal position sensor and the desired position demand signal. Software model-based position and current controllers are utilized to position the output. Position control is provided using a customer's position demand and an internal driver output while using an internal position feedback sensor. The driver provides a 4–20 mA analog output for indication of actual position. A discrete output is also available to provide a status indication of the driver itself. Field calibration is available through the Service Tool PC program to match the stroke of the driver to that of the field rigging (see User Calibration).
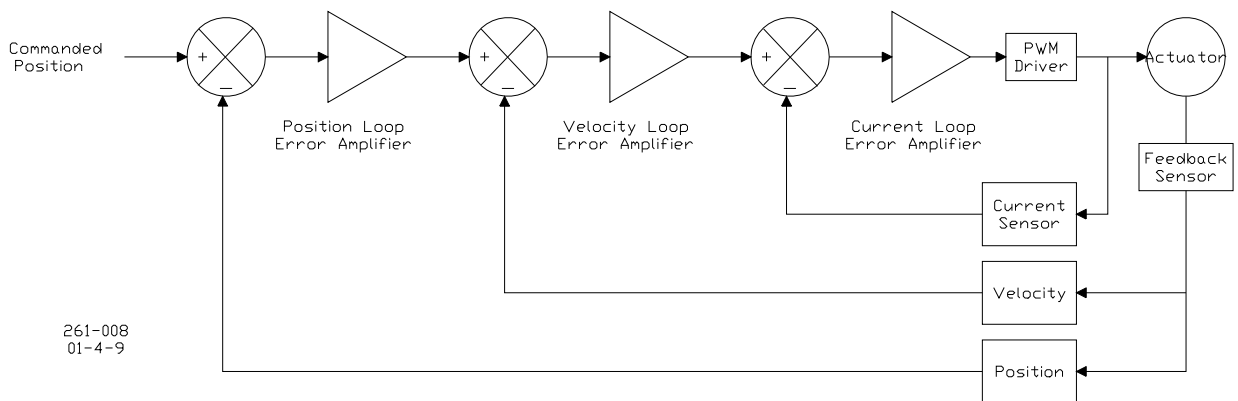
Figure 5-1. Controller Overview

Position Demand

The position demand can be either a single or redundant input; if redundant, the driver provides primary/backup logic to manage the redundancy internally. The position demand can be provided by any one of three configurable signal sources: analog, PWM, or optional CAN. The position demand input signals are internally scalable to match the demand of the signal's source. Failure of any configured position demand signal will issue an alarm (see Alarms section). If all configured signals are faulty, the ProAct Digital Plus is put into the configured shutdown state and remains shut down until a valid signal is received. At least one position demand input must be configured for use for the ProAct actuator to operate. Software adjustments are available for min and max position demands. Since they use the same input circuitry, it is not possible to use the 4–20 mA and 0–200 mA Analog Input simultaneously in a redundant system.

Multiple Demands

If redundant position demand signals are configured, one input is the primary signal and the other is the backup signal. The primary signal and the backup signal must be different signals and must be selected from the configurable sources. The configured inputs are monitored, and any faulty signals are annunciated. Primary and backup demand sources are configured from the available input signals. As long as the primary signal is okay, it is the position demand used by the driver. If the primary signal fails, the backup signal is used. If both primary and backup signals fail, the unit will shut down.

If the backup signal is not tracking the primary signal (tunable magnitude and duration), an alarm is issued. If the primary demand signal fails, the backup signal is used even if the signal had a tracking error. If a failed primary demand signal is restored and tracking within programmed tolerances, control is transferred from the backup demand to the primary demand input. If a failed primary demand signal is restored but not tracking within programmed tolerances, position control remains in the backup demand mode.
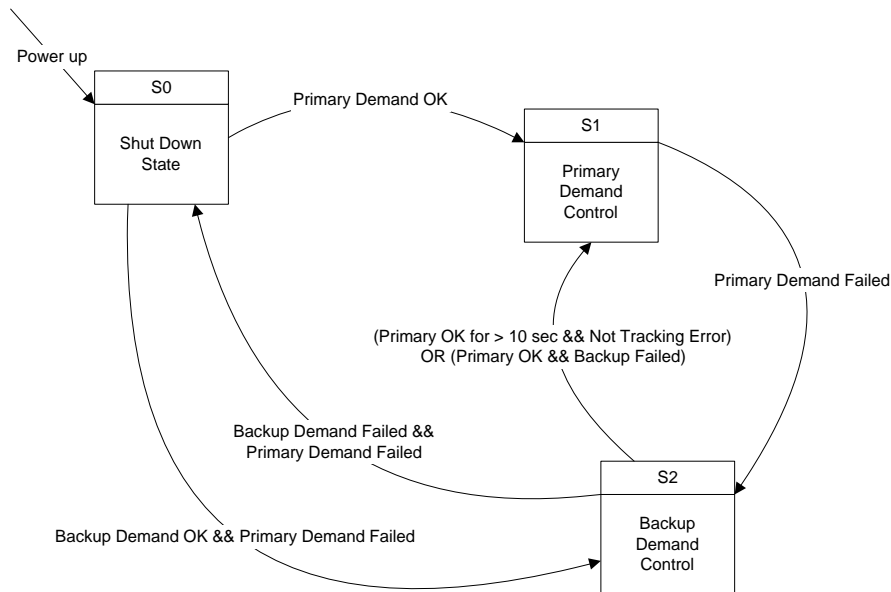
Primary / Backup Position Demand State Machine

Figure 5-2. Primary/Backup Position Demand State Machine

Driver Output and Position Feedback

If the internal position or current sensor is out of range, the actuator is put into the configured shutdown state (see diagnostics). Upon power-up, the unit will stay disabled until the problem is rectified and a position command signal has been received in the proper range.

Drive Current Limitations

The current to the coil is limited to prevent damage. A transient and a steady state limit are used. The transient current limitation is active during a transition in position output. After a short delay (about 3 seconds), the steady state limit is activated if desired position is not reached. The transient and steady state limits are not adjustable, but are based on the actuator type configured. The nominal transient and steady current limits for the ProAct actuators are:

	transient current limit	steady-state current limit
Models I, II	13 A	7 A
Model III, IV	20.6 A	11.3 A

These limits can be biased up/down based on the electronics temperature (see Current Limiting Based on Temperature below).
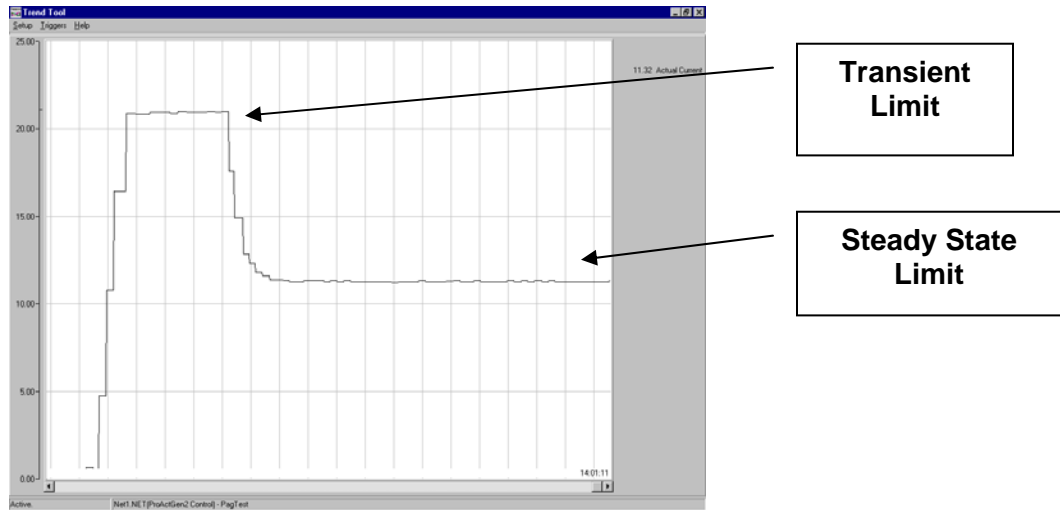
Current Limiting Based on Temperature

An on-board temperature sensor is used to provide temperature monitoring, high temperature alarming, and driver over-temperature protection. It monitors board temperatures which are stored in a historical log. This log contains the electronics temperatures of the unit over the lifetime of the driver. For more detailed explanation, see Temperature Histogram in Chapter 6.

This temperature alarm is flagged if the set point is exceeded. This alarm set point and delay are adjustable in the Configure: Unit Status menu.

The driver optionally provides actuator current limiting based on the electronics temperature. Dependent on board and actuator thermal models, the software reduces current as necessary to avoid conditions that would damage the device due to extreme temperatures. Current limiting based on temperature begins when the combined current and temperature environment exceeds steady state continuous current at steady state mounting and ambient temperature (greater than 105 °C—see temperature-based limits below). Depending on the current and electronics temperatures, the unit may never reach a reduced level. This option can be disabled in the Configure: Unit Status menu.

Models' I and II Current Limits

Models' III and IV Current Limits
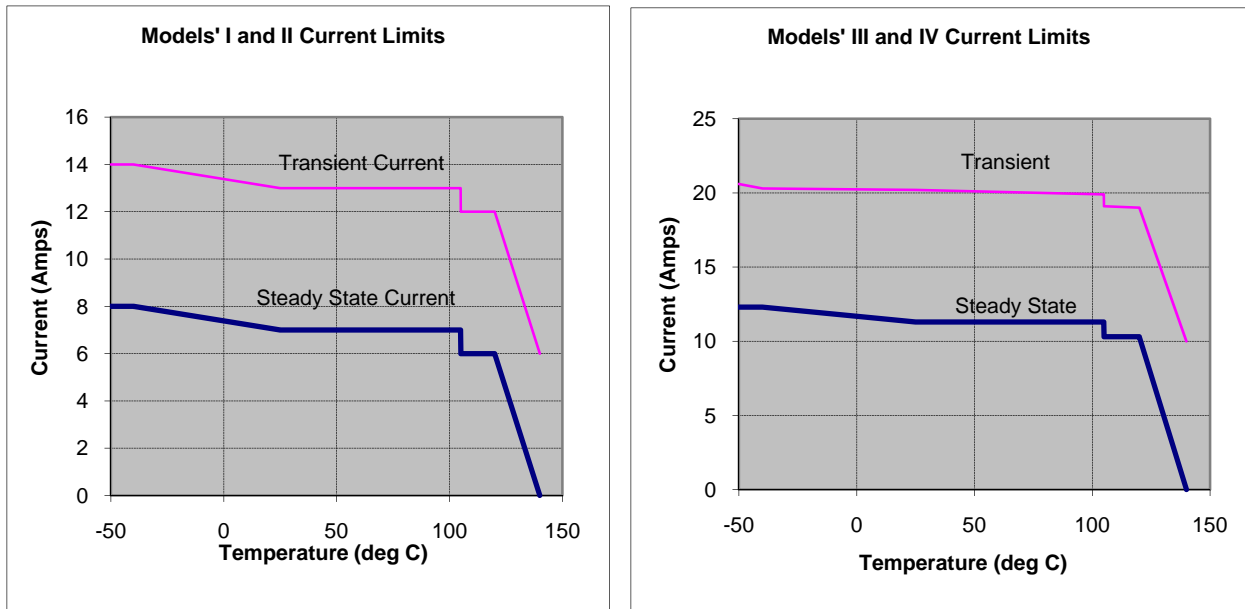
Figure 5-3. Current Limits

Nominal transient and steady current limits between 25 and 105 °C are 13 and 7 A, respectively, for models I and II (20.6 A and 11.3 A for models III and IV).

Communications

The driver has two communications ports; one optional CAN port and one RS-232 service port. The CAN port provides operation, setup, and monitoring capability. The service port provides the capability to perform factory calibration and test, customer/site configuration, tunable parameter and performance tuning, and overall driver monitoring. The PC-based service tool allows the ProAct Digital Plus software to be updated by Woodward factory or field service technicians.

CAN Communications

The optional CAN port supports positioning (position demand from CAN) of the driver. It also supports ProAct Digital Plus monitoring of all shutdown and alarm conditions as well as some system variables. The driver provides communications via CAN, version 2.0B, with 29-bit identifiers. The protocol complies with SAE J1939, but uses proprietary group extensions.

The initial CAN implementation is generic and adaptable to various customer applications. The data rate is configurable from 250 kbps, 500 kbps, and 1 Mbps. CAN communication failure diagnostics are provided and annunciated. Device identification is available, using the CAN address discrete inputs, to facilitate communication to multiple ProAct units on CAN.

The following are examples of parameters that are available on CAN.
Analog parameters including:
      Set Position, Actual Position
Discrete parameters including:
      Alarm Status, Shutdown Status, and all individual alarms and shutdowns

Service Port (RS-232) Communications

The Service Port utilizes RS-232 communications and supports Woodward's Servlink protocol for monitoring and tuning of software variables. The Service Port is used for calibration, troubleshooting, and alarm/shutdown monitoring. Additional functions available through this port include tuning, configuration, and monitoring of the driver and actuator. It also supports configuration upload (send) and download (receive) as well as the capability to install a new application program in flash. If CAN is not used, the Service Port is the only means of identifying/determining specific alarm and shutdown causes.

Service Tool

The Service Tool software resides on a PC (personal computer) and communicates to the driver through the Service Port. The unit is typically in the Normal (Running) mode. However, there are three additional modes available to the customer for setup and monitoring: Configuration, Service, and User Calibration. The Service Tool provided is Woodward Watch Window using the Servlink DDE server. The service tool programs have password protection to prevent inadvertent changes.
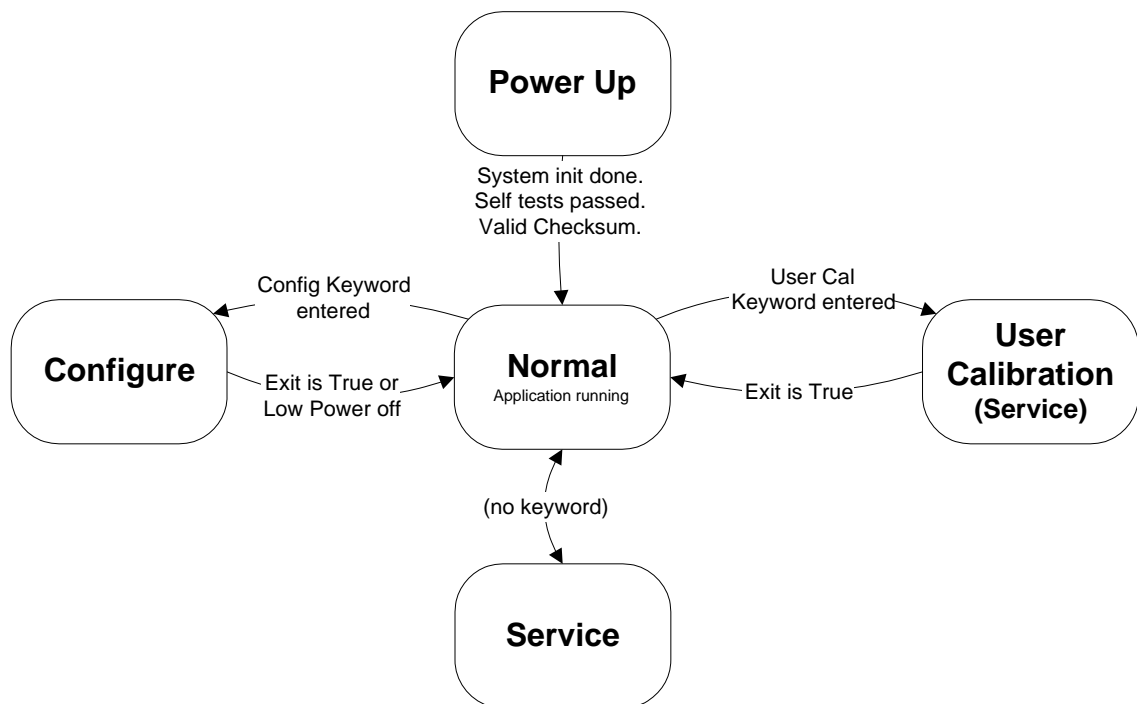
Figure 5-4. Operating Modes

User Operating Modes

User-Calibration (Rigging)

The User Calibration mode of the Service Tool provides the capability to set the min and max position to match the rigging of the actuator and valve. Both automatic and manual procedures are available to perform this setup. This calibration must be done prior to operation of the unit. Once performed, this procedure stores the active min and max positions into non-volatile memory where it is retained until a new calibration is performed (manual or automatic).

Configuration

The Service Tool provides the capability to make Configurable Parameter adjustments when the unit is in a shutdown state. The unit must be in a shutdown state to adjust configuration parameters. Configuration parameters can be monitored at any time. Unit does not need to be shut down for configurable parameter monitoring. The ProAct Digital Plus will do nothing—the current to the actuator controller will remain off—until it has a valid configuration.

Service Mode Tuning

The Service Tool provides the capability to make field-tunable adjustments at any time. A change to these parameters is not limited to a shutdown state (note: the engine most likely is shut down during this time). Tunable adjustments are available for parameters like input failure settings, position error setting, and tracking error settings.

Service Mode Monitoring

The Service Tool provides the capability to monitor control values at any time. Viewing and monitoring these parameters is available at any time and is not limited to a shutdown state.

Monitoring is available for, but not limited to, the following parameters:
Electronics Temperature
Temperature Histogram
Alarms and Shutdowns (individual)
Alarm/Shutdown Event Log
Actual Position Monitor
Demanded Position
Actual Motor Current Monitor
Analog Input Monitor
PWM Input Monitor
CAN Demanded Position
Discrete Input Monitor
Discrete Output Monitor
Input Power Monitoring (24 V)
Internal Power Monitoring (12 V, –9 V, 5 V)

Password Protection for Service Tool

Program changes and tuning/calibration are password protected. The password is a simple 'keyword' password that is fixed and cannot be changed. It is intended only to prevent inadvertent changes to the ProAct Digital Plus. One fixed password is available per mode. This password is required only to make changes (writes), program monitoring does not require a password. Monitoring includes viewing configurable parameters, tunable parameters, alarm and shutdown conditions, and control parameter monitoring.

There are passwords for the Configure Mode, Test Mode, Factory Calibration mode, and User Stops Mode (Configure: Mode screen is shown below). These password are listed in the Appendix.
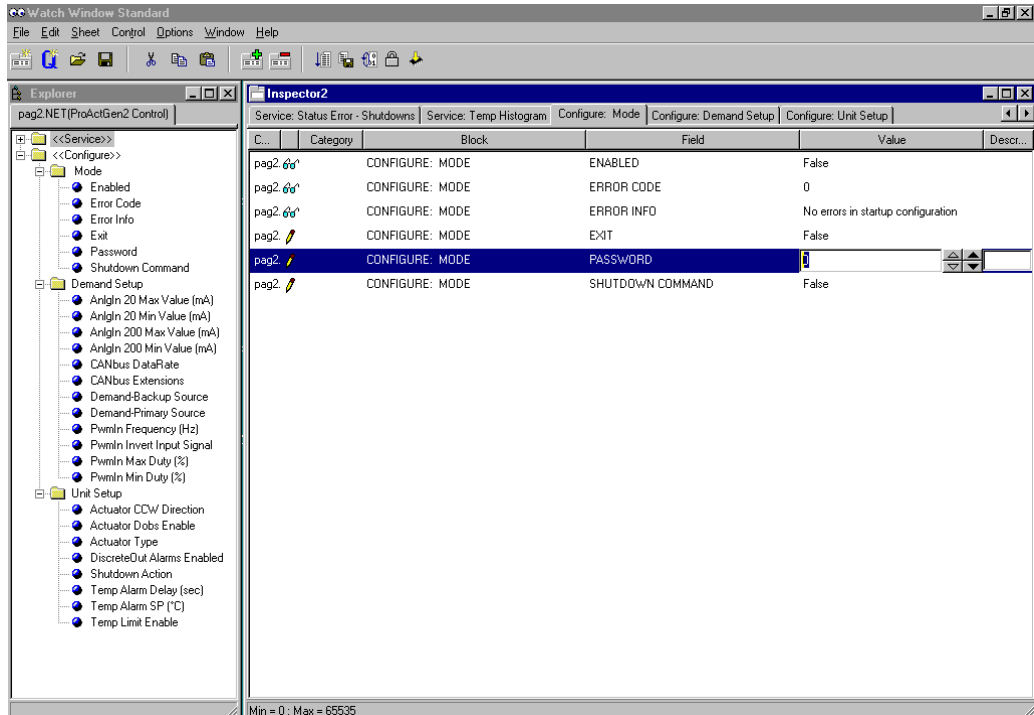
Figure 5-5. Typical Service Tool Screen

Chapter 6.
Diagnostics

General Information

There are a variety of diagnostics available in the ProAct™ Digital Plus, including power-up self-test diagnostics and on-line diagnostics of alarm and shutdown conditions. Driver alarm and shutdown conditions are monitored, logged, and annunciated through the discrete output. The communications ports provide complete fault diagnostic indications (excluding power-up faults).

Power-up Diagnostics

The ProAct Digital Plus provides power up self-test diagnostics. The power-up diagnostics take less than one second to complete. This means the actuator is active within one second of a power-up (when a main program is in flash memory). A diagnostics error found during power-up will keep the output (H-Bridge) disabled. A power down and power-up are the only possible option for clearing this error. During self-test the actuator is un-powered.

On-line Diagnostics

Once power-up tests are completed, the unit starts controlling and provides on-line indication of alarms and shutdowns. The Discrete Output turns off to indicate a shutdown or alarm condition. Individual Shutdown and Alarm conditions can be monitored through the CAN or RS-232 communications links.

Shutdowns Detection and Annunciation

A shutdown condition forces the actuator to a predetermined position regardless of the demanded position. The ProAct Digital Plus can be programmed to go to one of three predetermined states when a shutdown condition is detected. A shutdown condition can be configured to power-down (disable the current driver to the actuator), go to min (0%) position, or go to max (100%) position. When the shutdown condition no longer exists, the driver automatically returns to a non-shutdown state, following the Position Demand input command. The shutdown condition does not require a "reset" command. Refer to the Diagnostics section for a complete listing of shutdowns.

Alarms Detection and Annunciation

An alarm condition is a warning that the driver has determined that something is not operating properly. The driver takes no additional action other than annunciating and logging the alarm condition. When an alarm condition no longer exists, the alarm event automatically returns to a non-alarmed state. The alarm condition is non-latching. Refer to the Diagnostics section for a complete listing of alarms.

Temperature Histogram

The Temperature Histogram will provide historical electronics temperature information based on the on-board temperature sensor. The histogram stores values for over 20 years in non-volatile memory to retain the data on power loss. The histogram logs the operational time of the electronics temperature in seconds. The log is partitioned into 10 degree (Celsius) increment ranges from –40 to +140 °C. The historical data is based on the time within each 10-degree temperature band. The histogram is a permanent record of electronics temperatures and cannot be cleared. The Service Tool is used to view the data in the temperature histogram.

Event Log

The Event Log provides a historical logging of ProAct Digital Plus alarms and shutdowns. It is capable of storing all events, along with the number of times that event occurred and the relative time of the first occurrence. The log will store its information in non-volatile memory to retain the data on power loss. The resolution of the time stored is in hours. The Service Tool is used to view the data in the event log. The log has a Reset/Clear command which clears the log and all history. This command is only available through the Service Tool. The log also stores the hour (time) of the last Reset/Clear command.

Power-up Diagnostics

The ProAct provides power up self-test diagnostics. An internal red LED displays the status of the self-test (see Figure 2-5 for the location of this LED access). When there is a valid main program in flash memory, minimal self-tests are performed (to meet power up time requirement). When there is no main program in the flash, an extensive set of tests is performed. This extensive test will more thoroughly test the memory and hardware. The LED is steady ON red when the unit is powered-up, and the LED turns OFF when all tests are successfully completed. The LED will provide unique flash codes for any "failed" power-up diagnostics. Note that the LED is internal and not visible when the driver is assembled—it is provided for production testing only.

The power-up diagnostic testing takes less than one second to complete. This means the actuator is active within one second of a power-up (when a main program is in flash memory). A diagnostics error found during power-up will keep the H-Bridge disabled. A power down and power-up are the only possible option for clearing this error. During self-test the actuator is un-powered.

CODE: 01: No Application in memory fault
This is caused by the lack of an application program in the flash memory. The application will not be run and the ProAct control will wait in this mode until a valid program is downloaded. In this condition, the ProAct cannot transmit information to the Service Tool or to the CAN link.

A valid application must be downloaded into memory before the unit will run.

This fault indication is not available to Servlink and is only indicated by a flash code on the diagnostic LED. The red LED flash code consists of a continuous on/off flashing sequence (0.1 s on and 0.1 s off).

CODE: 02: EEPROM Error
This is caused by faulty hardware, which is checked during power up. This fault indication is not available to Servlink, only a flash code on the diagnostic LED. The red LED flash code consists of two quick ON (0.25 s) flashes followed by a one second OFF time (see Figure 2-5 for the location of this LED access). This sequence is repeated continuously.

The alarm is enabled when the following conditions are true:
EEPROM Write Fail—This error is set if writes to the main EEPROM fail. When writing to the EEPROM, every byte is checked to ensure it is entered into the EEPROM correctly. If the value read from the EEPROM is different from the value written to the EEPROM, a new write is executed and a retry counter will be incremented. After five retries, the EEPROM Error is set and the ProAct will shut down.
EEPROM Read Fail—This error is set if reads from the EEPROM fail. The EEPROM will always be read twice during operation. If the two values do not match, a retry will be executed and a retry counter will be incremented. After five retries, the EEPROM Error will be set and the ProAct will shut down.
Parameter Error—There is an error detected in the parameter set. Two redundant sets of parameters are stored in non-volatile memory. During a read or write cycle, the parameter values are checked. If either set is incorrect (as indicated by their CRC16 value) the values from the correct set are copied into the incorrect set. If both sets are incorrect the EEPROM Error is set and the ProAct will shut down.
Parameter Checksum Error—The CRC checksum stored with the parameters does not match the checksum of the parameters currently residing in non-volatile memory.

The alarm is disabled when the power is removed and re-applied and the above conditions go false. If cycling the power does not clear this fault, the control will not run and must be returned for repair.

If this error occurs after a program download, this is an indication that the EE structure has changed and the EEPROM must be initialized before the unit will operate.

CODE: 03: RAM failed
Indicates the RAM read/ write is in error. This fault indication is not available to Servlink, only a flash code on the diagnostic LED. The red LED flash code consists of 3 quick ON (0.25 sec) flashes followed by a 1 second OFF time. This sequence is repeated continuously.

This is caused by faulty hardware, which is checked during power up. This will be checked by reading and writing a test pattern into RAM. If the test fails, the ProAct will not start. A flash code on the diagnostic LED will annunciate the RAM failure. In this condition, the ProAct cannot transmit information to the Service Tool or to the CAN link. The unit needs to be returned to the factory to resolve this RAM failure.

On-line Diagnostics

Once power-up tests are completed, unit will start controlling and on-line indication of alarms and shutdowns are provided. The Discrete Output will open, indicating a shutdown or alarm condition. Individual Shutdown and Alarm conditions can be monitored through the CAN or RS-232 communications links. The Servlink Variable listed with each individual diagnostic identifies the parameter to be read in the Service Tool Watch Window program.

Flash Codes

An LED flash code is available to identify the shutdown conditions detected by the ProAct . The LED can only be viewed by removing the wiring access cover. The flash codes for each diagnostic are identified both as the "code" number and in the table at the end of this document (see Figure 2-5 for the location of this LED access).

The diagnostic LED is used to give the user feedback on the error states of the ProAct . The LED will produce a flash code to inform the user of an error. The LED will be on solid when power is applied to ProAct or when the processor is reset. The LED will go off when the ProAct goes to the running state. When shut down, the LED flash code indicates the shutdown condition(s). There can be several conditions that may cause a shutdown. The LED will display all shutdown codes by cycling through all the shutdown flash codes one at a time.

Flash Code Generation

All flash codes will be a two-digit number. The LED will flash out the first digit, pause, flash out the second digit, pause longer, and then continuously repeat the flash code. For example, a code '34' would flash as Figure 6-1 demonstrates.

Figure 6-1. Typical Flash Code

Shutdown Detection and Annunciation

A shutdown condition is a condition that will force the actuator position to a pre-determined known position regardless of the demanded position. The ProAct can be programmed to go to one of three predetermined states when a shutdown condition is detected. A shutdown condition can be configured to power down (disable the current driver to the actuator), go to min (0%) position, or go to max (100%) position. When the shutdown condition no longer exists, the driver automatically returns to a non-shutdown state and follows the Position Demand input command. The shutdown condition does not require a "reset" command.

Individual Shutdown Conditions

CODE: 12: Discrete Input Commanded Low Power Standby Mode
Servlink Variable: Service:Status Error—Shutdowns. DI LowPwr Stdby (12)
The Low Power Standby Mode was commanded by the opening of the Low Power Standby discrete input. The discrete input must be closed to run.

CODE: 13: RS232 (Servlink Service Tool) Commanded Shutdown
Servlink Variable: Service: Status Error—Shutdowns. RS-232 Shutdown (13)
The Shutdown mode is activated over the serial port with a shutdown command
using Watch Window (Configure: Mode). The actuator will perform the Shutdown
Action configured (for example, Min, Max, or Power Down). This can be cleared
by returning the Service Tool Shutdown Command to false or by cycling the
power on the unit.

CODE: 21: All Demands Failed
Servlink Variable: Service:Status Error—Shutdowns. All Demands Failed (21)
This is caused by a failure of all configured Position Demand Inputs. The Primary
and Backup (if used) position demands are both failed. The demand inputs are
determined to be failed and the problem must be corrected. If the inputs seem
proper, monitor the inputs in the Service Mode: Position Control and check the
failure settings in the Service Mode: Hardware Adjustments.

CODE: 22: A/D Converter Error
Servlink Variable: Service:Status Error—Shutdowns. A/D Converter Error (22)
This is caused by a failure of the analog to digital converter. The Queued A/D
Converter (QADC) did not complete all of it's conversions for more than 300 ms.
The alarm is disabled when the power is removed and re-applied and the fault
condition goes false. If cycling the power does not clear this fault, it will not run
and must be returned for repair.

CODE: 23: Position Sensor Failed
Servlink Variable: Service:Status Error—Shutdowns. Position Sensor Failed(23)
This is caused by a failure of the internal position sensor. The internal position
sensor was out of range for more than 20 ms. This fault condition is latching and
remains true until power is removed and re-applied after the fault condition goes
away. If cycling the power doesn't clear the problem, open the Low Power
Standby Mode discrete input and cycle power again and then run the User
Calibration (Adjust User Stops in the Service Mode) again. If this doesn't clear
the fault, the sensor is bad and the unit must be returned for repair.

CODE: 24: Current Sensor Failed
Servlink Variable: Service:Status Error—Shutdowns. Current Fdbk Failed (24)
This is caused by a failure of the internal current sensor. The internal current
sensor was out of range for more than 40 ms. This fault condition is latching and
remains true until power is removed and re-applied after the fault condition goes
away. If cycling the power doesn't clear the problem, open the Low Power
discrete input and cycle power again and then run the User Calibration (Adjust
User Stops in the Service Mode) again. If this doesn't clear the fault, the sensor
is bad and the unit must be returned for repair.

CODE: 25: Configuration Error
Servlink Variable: Service:Status Error—Shutdowns. Config Error (25)
This is caused by an error in the configuration of the ProAct . To correct the error,
re-enter the Configure mode and make the appropriate correction. Refer to the
Configuration Error section in the Service Tools section of the manual for a
complete listing and description of all possible errors.

CODE: 26: Calibration Error
Servlink Variable: Service:Status Error—Shutdowns. Calibration Error (26)
Indicates a problem with the calibration. A step in the calibration was incorrectly
performed or an out of range value used or the precision reference voltage is out
of range. The Calibration mode must be re-entered and unit re-calibrated by a
trained service technician (requires Watch Window Professional).

CODE: 27: Internal Watchdog Timeout
Servlink Variable: Service:Status Error—Shutdowns. Watchdog Timeout (27)
Internal run-time software watchdog timeout error of 1 second. If a watchdog
timeout error is detected the ProAct will shut down and attempt to restart the
ProAct control. If the unit remains in this mode, it must be returned for repair. It is
normal to get this alarm logged when a new version of the software is
downloaded into the ProAct control.

Alarms Detection and Annunciation

An alarm condition is a warning that the driver has determined that something is
not operating properly. The driver takes no additional action other than
annunciating and logging the alarm condition. When an alarm condition no longer
exists, the alarm event automatically returns to a non-alarmed state. The alarm
condition is non-latching.

Individual Alarm Conditions

The following is a detailed description of the ProAct alarm diagnostics.

CODE: 31 : Position Error
Servlink Variable: Service:Status Error—Alarms. Position Error Alert (31)
The Actual Position and Position Demand differ by more than the configured
position error for longer than the configured position error delay. This error is set
if the position command and the position feedback do not track closely enough
during transients. If the valve is able to move but the response becomes too slow
(for example, from contamination buildup), the ProAct actuator can still function
but the accuracy specification may not be met. There is a delay on the error
signal to prevent false errors during position transients. The position error
settings in the service mode may need to be adjusted—see the Service Mode:
Hardware Adjustments 'Position Error Max' and 'Position Error Delay' settings.

CODE: 41 : Primary Position demand signal fault
Servlink Variable: Service:Status Error—Alarms. Primary Demand Fault (41)
The Primary Demand signal is determined to be failed. This is caused by failure
of the input signal or hardware, which is continuously checked. Verify the input
signal. If the input seems proper, monitor the inputs in the Service Mode: Position
Control and check the failure settings in the Service Mode: Hardware
Adjustments.

CODE: 42 : Backup Position demand signal fault
Servlink Variable: Service:Status Error—Alarms. Backup Demand Fault (42)
The Backup Demand signal is determined to be failed. This is caused by failure
of the input signal or hardware, which is continuously checked. Verify the input
signal. If the input seems proper, monitor the inputs in the Service Mode: Position
Control and check the failure settings in the Service Mode: Hardware
Adjustments.

CODE: 43 : Demand Not Tracking signal alert
Servlink Variable: Service:Status Error—Alarms. Tracking Error (43)
Primary and Backup demands differ by more than the configured tracking error
for longer than the configured tracking error delay and the backup demand signal
is configured for use. This is caused by failure of the input signal or the two
signals are either not tracking or not tracking closely enough. The tracking error
settings in the service mode may need to be adjusted (Demand Track Error (%)
and Demand Track Error Delay). This error can be disabled by setting the error
to 100%. All PWM errors are disabled when PWM is not configured as a demand
source. This alert is only enabled when a backup demand is configured.

CODE: 51 : Analog Position demand input signal fault
Servlink Variable: Service:Status Error—Alarms. Analog Demand Fault (51)
Caused by failure of the input signal—indicates input failure/out of range
(low/high input current). The alarm is enabled when the Analog Input signal is
configured for use and is above or below the service mode failure settings for
longer than the failure delay setting. The analog demand is disabled until the
signal is restored. Verify the input signal. If the input seems proper, monitor the
input in the Service Mode: Position Control:Analog Demand and check the failure
settings (AnalogIn Fail Min and Fail Max) in the Service Mode: Hardware
Adjustments. The analog demand fault is disabled when analog is not configured
as a demand input.

CODE: 52 : PWM Frequency Error
Servlink Variable: Service:Status Error—Alarms. Pwm Freq Error (52)
Indicates a problem with the frequency of the PWM input signal—indicates input
frequency is out of range (low/high). The alarm is enabled when the PWM Input
signal is configured for use and is above or below the service mode failure
settings for longer than the failure delay setting. The PWM demand is disabled
until the signal is restored. Verify the input signal frequency. If the input seems
proper, monitor the input in the Service Mode: Position Control. PWM Demand
and check the failure settings (PwmIn Fail Min Freq and Fail Max Freq) in the
Service Mode: Hardware Adjustments. If Watch Window Professional is
available, can also check the PWM input frequency under the 'Monitor.
Hardware' category. All PWM errors are disabled when PWM is not configured
as a demand source.

CODE: 53 : PWM Duty Cycle Error
Servlink Variable: Service:Status Error—Alarms. Pwm Duty Error (53)
Indicates a problem with the duty cycle of the PWM input signal—indicates input
duty cycle is out of range (low/high). The alarm is enabled when the PWM Input
signal is configured for use and is above or below the service mode failure
settings for longer than the failure delay setting. The PWM demand is disabled
until the signal is restored. Verify the input signal frequency and duty cycle. If the
input seems proper, monitor the input in the Service Mode: Position Control.
PWM Demand and check the failure settings (PwmIn Fail Min Duty and Fail Max
Duty) in the Service Mode: Hardware Adjustments. If Watch Window
Professional is available, can also check the PWM input frequency and duty
cycle under the 'Monitor. Hardware' category. All PWM errors are disabled when
PWM is not configured as a demand source.

CODE: 54 : PWM Signal Failure
Servlink Variable: Service:Status Error—Alarms. Pwm No Signal (54)
This is caused by failure of the input signal or hardware which is continuously
checked. Set if there are no pulses on the PWM input. This is needed because at
zero frequency, the frequency error will not be set. The alarm indicates no input
signal is detected for longer than the failure delay setting and the input signal is
configured. The alarm is disabled when the signal is restored. The PWM demand
is disabled until the signal is restored. Refer to the PWM Duty Cycle and
Frequency Error descriptions above for troubleshooting and possible
adjustments. All PWM errors are disabled when PWM is not configured as a
demand source.

CODE: 61 : CAN "Bus Off" Error
Servlink Variable: Service:Status Error—Alarms. CAN Bus Off Error (61)
This is caused by loss of communications on the CAN port which is checked
continuously. This error code is set if the CAN controller disconnects from the
bus ("bus off" condition) by tri-state drivers. In this condition, the CAN controller
does not monitor the CAN bus. The ProAct detects this "bus off" condition and
attempts to clear the fault condition automatically every 100 ms. Typical causes
for this condition are wiring problems on the CAN link, incorrect or missing
termination resistors, or electrical problems within the controller or driver. The
alarm is disabled once the CAN communications has recovered. The CAN
demand and all CAN commands are disabled until communications is restored.
All CAN errors are disabled when CAN is not configured as a demand source.

CODE: 62 : CAN controller not responding
Servlink Variable: Service:Status Error—Alarms. Can Dmd No Signal (62)
This is caused by loss of communications on the CAN port which is checked
continuously. There are no CAN Demand messages received for a specified
time. Set if there are no Demand messages received on the CAN link. This
detects a different problem than the Can Demand Too Slow error described in
the next section.

The alarm is enabled when CAN is configured for use and No CAN demand
messages are detected for longer than the service mode failure delay setting.
The alarm is disabled once the CAN communications has recovered. The CAN
demand and all CAN commands are disabled until communications is restored.
Verify the CAN Settings in the Configure Mode: Demand Setup (Data Rate and
Extensions) and the Device Address (based on the Can ID discrete inputs). All
CAN errors are disabled when CAN is not configured as a demand source.

CODE: 63 : CAN Demand Signal transmission too slow
Servlink Variable: Service:Status Error—Alarms. Can Dmd Too Slow (63)
This is caused by unacceptably slow communications on the CAN port which is
checked continuously. The frequency of the Demand CAN messages is below
the minimum service mode update rate. The ProAct reads the number of
messages received every 100 ms. If the CAN Fail Min (msg/sec) is set to 30,
during 100 ms ProAct receives 3 (30 divided by 10 samples/sec) or more
messages, there is no error. If there are less than 3 messages received in 100
ms, and if this occurs for the Can Fail Delay setting, the Can Demand Too Slow
error is set.

The alarm is enabled when CAN is configured for use and not enough CAN
demand messages are detected for longer than the service mode failure delay
setting. The alarm is disabled once the update rate on the CAN communications
has recovered. The CAN demand is disabled until communications fault is
cleared. All CAN errors are disabled when CAN is not configured as a demand
source.

CODE: 71 : High Temperature Alert
Servlink Variable: Service:Status Error—Alarms. High Temp Alert (71)
This is caused by high temperature detected in the unit, which is checked continuously. The alarm is enabled when the detected temperature is greater than the configured temperature alarm set point for more than the configured delay and is disabled when the conditions go false.

CODE: 72 : High Temperature Limit Protection Active
Servlink Variable: Service:Status Error—Alarms. Temp Limiting Active (72)
Indication that the temperature of the electronics has reached a point that requires limiting the maximum current output to protect the electronics from failure. The alarm is enabled when temperature limiting is configured for use and the detected temperature is greater than the temperature limit set point of 105 °C. The alarm is disabled when the conditions go false for 300 ms.

CODE: 73 : Temperature Sensor Failure Alert
Servlink Variable: Service:Status Error—Alarms. Temp Sensor Fault (73)
This is caused by a failure in the temperature sensor hardware, which is checked continuously. The alarm is enabled when the temperature signal is failed (sensor counts <10 or >450 for longer than 1.5 seconds) and is disabled when the conditions go false.

CODE: 81 : Supply Voltage (+24V) Low
Servlink Variable: Service:Status Error—Alarms. 24V Supply Low (81)
This is caused by an out of range input power source. The alarm is enabled when the 24 V input voltage is below 11 Volts for more than one second or the voltage is below 17 Volts for more than 40 seconds and is disabled when the conditions go false.

CODE: 82 : Supply Voltage (+24V) High
Servlink Variable: Service:Status Error—Alarms. 24V Supply High (82)
This is caused by an out of range input power source. The alarm is enabled when the 24 V supply voltage reads higher than 33 Vdc for more than 5 seconds and is disabled when the condition goes false.

CODE: 83 : +12V out of range
Servlink Variable: Service:Status Error—Alarms. Supply 12Volt Error (83)
This is caused by faulty hardware. The 12-volt supply voltage is incorrect. An internal +12 V supply voltage must be correct in order for the analog electronics on the PCB to function properly. The CPU monitors this voltage and generates a diagnostic if it is not in tolerance. The alarm is enabled when the 12 V reads less than 10.8 Vdc or higher than 13.2 Vdc for more than 10 seconds and is disabled when the conditions go false.

CODE: 84 : -9V out of range
Servlink Variable: Service:Status Error—Alarms. Supply Neg9Volt Error (84)
This is caused by faulty hardware. The –9 volt supply voltage is incorrect. An internal –9 V supply voltage must be correct in order for the analog electronics on the PCB to function properly. The CPU monitors this voltage and generates a diagnostic if it is not in tolerance. The alarm is enabled when the –9 V reads less than –10 Vdc or higher than –8 Vdc for more than 10 seconds and is disabled when the conditions go false.

CODE: 85 : +5V out of range
Servlink Variable: Service:Status Error—Alarms. Supply 5Volt Error (85)
This is caused by faulty hardware. The 5-volt supply voltage is incorrect. An
internal +5 V supply voltage must be correct in order for the analog electronics on
the PCB to function properly. The CPU monitors this voltage and generates a
diagnostic if it is not in tolerance. If the voltage is outside the operational range of
the processor the CPU will go into a reset state. While the CPU is in the reset
state the ProAct will not function. The alarm is enabled when the 5 V reads less
than 4.5 Vdc or higher than 5.5 Vdc for more than 10 seconds and is disabled
when the conditions go false.

CODE: 86 : A/D Reference Error
Servlink Variable: Service:Status Error – Alarms. A/D Reference Error (86)
This is caused by faulty hardware. The 5.0 V A/D precision reference voltage is
out of range. This is determined to be true if all voltage measurements are off (24
V input power, 12 V, 5 V and –9 V).

CODE: 91 : Control is in a Non-Operating Mode
Servlink Variable: Service:Status Error—Alarms. NonOperating Mode (91)
The ProAct is in a non-operating mode. The alarm is enabled when the unit is in
the Adjust User Stops Mode or Configure Mode or Test Mode or Calibration
Mode and is disabled when the conditions go false.

CODE: 92 : Software Error detected
Servlink Variable: Service:Status Error—Alarms. Software Error (92)
A software error has been detected. The alarm is enabled when an internal
software coding error detected. The installed software application is invalid and
will need to be reinstalled to clear this fault. (It is advisable to return the unit to
the factory to have this new software application installed.)

CODE: 93 : EEPROM Error
Servlink Variable: Service:Status Error—Alarms. EEPROM Error (93)
This alarm is identical to the EEPROM Error (Code 02) detected during
initialization, only this error was detected during run-time. As opposed to holding
the unit in a shutdown state, when this error is detected the unit will remain in a
operational state. EEPROM changes that were attempted will not be made but
the unit will remain running with the changes held in RAM. However, the next
power-up will result in the loss of those changes and/or possibly a EEPROM
Error on power-up resulting in a non-operational state.

Chapter 7.
CAN Details

Overview

This section describes the communication that will take place over the SAE J1939 Data Link when the optional CAN (Controller Area Network) communication link is used.

CAN Bit Timing

The default bit times for the ProAct™ Digital Plus are configured per SAE J1939 /11 section 3.14 (December 1994 version).

Source Address/Harness Code Strategy

There could potentially be four ProAct actuators on the same engine. Each actuator would need to have its own source address. Rather than having separate sets of ProAct software for each source address, a harness code strategy has been implemented. The CAN address is set using the CAN ID Hi and Lo discrete inputs. These switch inputs are pulled-up internally in the ProAct actuator. The input will then either be left floating high, or be pulled down to ground when the ProAct actuator is plugged in to the engine's wiring harness or wired externally. The ProAct actuator will read these switch inputs and assign the appropriate source address on power up. Changes to the discrete inputs after power up will not be acknowledged until the next power up.

ProAct Number	CAN ID Hi Bit (Discrete In #3)	CAN ID Lo Bit (Discrete In #2)	Assumed Source Address of the ProAct valve	
#1	Floating high (open)	Floating high (open)	19	13h
#2	Floating high (open)	Pulled low	20	14h
#3	Pulled low	Floating high (open)	21	15h
#4	Pulled low	Pulled low	22	16h

Configuration Strategy

There are over 25 configuration parameters available in the ProAct actuator. These configuration parameters can either be downloaded as a file or individually configured from the Configure Mode. Either way, configuration requires using a PC connected to the ProAct serial port with a null modem cable. When required, these parameters could be added as CAN PGNs and SPNs. However, at present there are no plans to implement configuration over CAN until requested by a customer.

CAN Extensions

To accommodate the differences in CAN implementation between customers, a Configuration parameter (called CAN Extensions) is used to select the appropriate set of extensions/PGNs/SPNs used.

Extension Set 0

When the extensions setting is zero (0), all CAN transmissions are disabled. When the extensions setting is greater than zero, the appropriate set of data is transmitted/received over the CAN link. If CAN demand is used, CAN is configured as primary or backup demand, then a setting of zero is not permitted and results in a configuration error shutdown. If CAN demand is not used, then a non-zero 'extension' setting will transmit only the data of the selected set.

Extension Set 1

Extension set 1 provides the following information sent over the CAN:
- Actual and Desired Valve Position
- Heart Beat Counter
- ProAct Software Application Version
- Alarms and Shutdowns (some grouping is provided to limit the number of parameters)

Extension set 1 receives the following information from the CAN:
- Position Demand

The following section lists all messages, which will be sent by the ProAct valve to the speed control.

Set 1 Transmitted Parameters
Valve Position

Description	Value	
Transmission repetition rate	100ms	
Data length	8 bytes	
Data page	0	
PDU format	255	FFh
PDU specific	251	FBh
Default priority	7	
Parameter Group Number	65531	FFFBh

Byte: 1   Actual valve position
       2   Desired valve position
      3...8   Reserved

Actual valve position—Measured position. A value of 0% represents min and a value of 100% represents max.
    Data length: 1 byte
    Resolution: 0.4% / bit, 0 offset
    Range: 0 to 100% (scaled from 0 to FF hex)
    Suspect Parameter Number: 1442

Desired valve position—Desired position. A value of 0% represents min and a value of 100% represents max.
    Data length: 1 byte
    Resolution: 0.4% / bit, 0 offset
    Range: 0 to 100% (scaled from 0 to FF hex)
    Suspect Parameter Number: 1442
    Error Indicator set if: None

Heart Beat Counter

Description	Value	
Transmission repetition rate	100 ms	
Data length	2 bytes	
Data page	0	
PDU format	255	FFh
PDU specific	31	1Fh
Default priority	6	
Parameter Group Number	65311	FF1Fh

Byte: 1,2   Heart Beat Counter
        3...8   Reserved

Heart Beat Counter
   Data length: 2 bytes
   Resolution: 1 Count / bits, 0 offset
   Range: 0 to 64255 Counts
   Suspect Parameter Number: 1446-11

The Heart Beat Counter will count up.

> **IMPORTANT** **Special action must be taken for the rollover from 64255 to zero. Values above 64255 are not used, to be compatible with the J1939 specification.**

Software version number
If the speed control needs the software version number it will use the request message below.

Request message

Description	Value	
Transmission repetition rate	On request	
Data length	3 bytes	
Data page	0	
PDU format	234	EAh
PDU specific	ProAct address	
Default priority	6	
Parameter Group Number	x	EAxxh

Byte: 1   requested data PGN lsb
Byte: 2   requested data PGN
Byte: 3   requested data PGN msb

Response message

Description	Value	
Transmission repetition rate	On request	
Data length	8 bytes	
Data page	0	
PDU format	254	FEh
PDU specific	218	DAh
Default priority	6	
Parameter Group Number	65242	FEDAh

Byte: 1   Number of software identification fields
Byte: 2...8   Software version or identifier. Data must be delimited with ASCII
"*".   Pad data with FFh if less than 7 characters.

Identification field
Data length: 1 byte
Range: 1

Software version number
Data length: 7 bytes (maximum of 6 bytes of data plus "*")
Range: ASCII characters, delimited by "*"
Resolution 1 character/byte
Suspect Parameter Number: 234
Version Number Example: "1.01*"

The ASCII data must be displayed without formatting.

Diagnostics from ProAct Actuator

The information communicated is limited to the current status of the diagnostics and events that the ProAct actuator can perform within its scope. The status is bit mapped to indicate the active or in-active state (see Bit Code Legend section). Two bits are used for every fault condition to indicate the status. A proprietary PGN will be used to communicate the faults.

Diagnostics/Events

The following Diagnostics and Events will be sent by the ProAct actuator in a sequence.

Description	Value	
Transmission repetition rate	1 s*	
Data length	8 bytes	
Data page	0	
PDU format	255	FFh
PDU specific	16	10h
Default priority	6	
Parameter Group Number	65296	FF10h

* See Transmission Rate for details.
Diagnostic information must also be available by request from the Speed Control.

Byte: 1..4 Diagnostics
5...8 Events

Bit code legend
The following diagnostics and events status will be sent by the ProAct actuator in a sequence.

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

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

Diagnostic codes

Diagnostics	J-1939 data frame bit position
Shutdown – Commanded Shutdown	0,1
Shutdown—Position Demand Failure	2,3
Shutdown—Internal Failure	4,5
Alarm—Internal Fault	6,7
Alarm—Primary Demand Fault	8,9
Alarm—Backup Demand Fault	10,11
Reserved—sent as "1"	12 to 31

Commanded Shutdown includes the following shutdowns, which are individually identified in the Service Tool:
Shutdown—Discrete In Low Pwr Standby
Shutdown—RS-232 Shutdown

Internal Failure includes the following shutdowns, which are individually identified in the Service Tool:
Shutdown—All Demands Failed
Shutdown—A/D Converter Error
Shutdown—Posn Sensor Failed
Shutdown—Current Fdbk Failed
Shutdown—Configuration Error
Shutdown—Calibration Error
Shutdown—Watchdog Timeout

Primary or Backup Demand Fault includes (individually identified in the Service Tool):
Alarm—Analog Input failure
Alarm—PWM Freq Error
Alarm—PWM Duty Error
Alarm—PWM No Signal
Alarm—Can Bus Off Error
Alarm—Can Dmd No Signal
Alarm—Can Dmd Too Slow
Alarm—Tracking Error

Internal Fault Alarm includes (individually identified in the Service Tool):
Alarm—Temp Sensor Fault
Alarm—12V Fault
Alarm—Neg9V Fault
Alarm—5V Fault
Alarm—Reference Voltage Error
Alarm—Software Error
Alarm—EEPROM Error

Event Codes

Events	J-1939 data frame bit position
Alarm—Position Error	32,33
Alarm—High Temp Alert	34,35
Alarm—Temp Limiting Active	36,37
Alarm—24 Volt Supply High	38,39
Alarm—24 Volt Supply Low	40,41
Reserved—sent as "1"	42 to 63

Transmission Rate

The diagnostics messages are transmitted at a rate of once per second. This message is sent only when there is at least one active fault or in response to a request from the speed control.

All the diagnostic and event bits are set appropriately to indicate their current status. The speed control will decode the bits and display the corresponding diagnostic and event codes. The speed control also logs the diagnostic and event codes as required by the application. The speed control makes the decision to shut down or run depending on the application configuration, unless the ProAct actuator has already shut down. The decision will be based on the diagnostic and event classification made in the diagnostics document.

Set 1 Incoming CAN Commands

This section lists all messages, which will be sent by the speed control to the ProAct actuator. The PGN for commanded position must be different for each ProAct actuator and is determined by the ProAct CAN address harness.

Commanded Actuator Position (Demand to ProAct addresses 1–4)

Description	ProAct address 1 Value	ProAct address 2 Value	ProAct address 3 Value	ProAct address 4 Value
Transmission repetition rate	> 5 ms	> 5 ms	> 5 ms	> 5 ms
Data length	8 bytes	8 bytes	8 bytes	8 bytes
Data page	0	0	0	0
PDU format	255 FFh	255 FFh	255 FFh	255 FFh
PDU specific	22 16h	23 17h	24 18h	25 19h
Default priority	1	1	1	1
Parameter Group Number	65302 FF16h	65303 FF17h	65304 FF18h	65305 FF19h

Byte: 1...4   Actuator Position Demand
       5...8   Reserved

Valve Position Demand
Data length: 4 bytes
Resolution: 2.56E-8 %/bit, 0 offset
Range: –5 to 105 % (scaled from 0 to FFFFFFFF hex)
Suspect Parameter Number: 1442

IMPORTANT	**The resolution and range is a required deviation from the SAE specification to meet application accuracy . Data is transmitted with least significant byte first, per J1939.**

Arbitration

Typical Arbitration field (information only) using 29 bits:

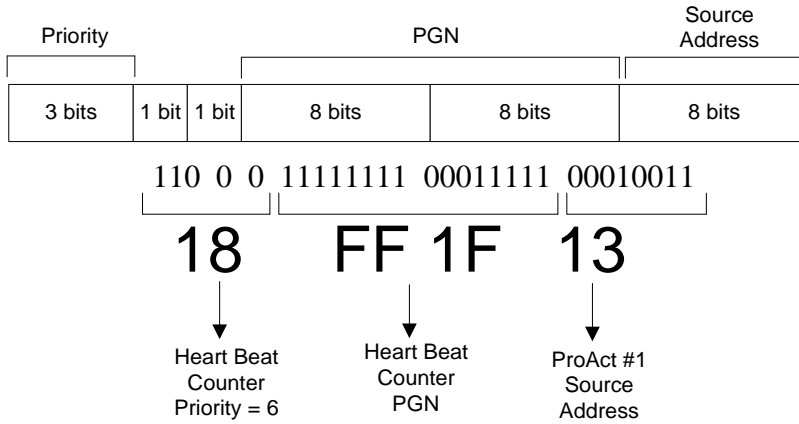Example using Heart Beat Counter in Extension Set 1

Figure 7-1. Typical Arbitration Field Example

Chapter 8.
Service Tool

Description

The Service Tool software is used to configure, tune, and troubleshoot the ProAct™ actuator. This chapter describes installation and use of the Service Tool. It identifies the Servlink parameters available in the ProAct product that can be viewed using the Woodward Watch Window Service Tool. It also provides detailed information on configuring and setting up the ProAct actuator to the customer-specific field application.

The Service Tool software resides on a PC (personal computer) and communicates to the ProAct driver through the driver's 9-pin service port. There are modes available for various users including: Factory Calibration, Test, Configuration, User Calibration, Tune, and Monitor modes (see Operating Mode figure below). Factory Calibration and Test modes are internal Woodward-only options; all else is available to the customer. The service tool modes are password-protected to prevent inadvertent changes to the program. Tune and Monitor capabilities are available at all times and are not password protected. For safety purposes, the password protected modes can be entered only when the unit is shut down. The unit can be shut down with a Service Tool command or by opening the Low Power Standby Mode discrete input.

Configuration

The Configure mode provides general overall application information for the driver. Since this actuator can be used in a variety of field applications, the application-specific details are entered into the unit using the Configure mode. Configurable parameters include actuator direction (CW/CCW) and primary/backup demand sources. The Service Tool provides the capability to make configurable parameter adjustments when the unit is shut down. CAN will provide the capability to make Configurable Parameter adjustments to a limited subset of parameters when the unit is shut down. The unit must be shut down to adjust configuration parameters. Configuration parameters can be monitored at any time. The unit does not need to be shut down for configurable parameter monitoring. The ProAct actuator will do nothing—the current to the actuator controller will remain off—until it has a valid configuration.

User Stops (Service)

The User Stops (also referred to as Rigging or User Calibration) mode of the Service Tool provides the capability to set the min and max position to match the rigging of the actuator and valve. Both automatic and manual procedures are available to perform this setup. This calibration must be done prior to operation of the unit. Once performed, this procedure stores the active min and max positions into non-volatile memory where it is retained until a new calibration is performed (manual or automatic). Also available in this mode is the capability to adjust and test the actuator inertia dynamics setting.

```
                              ┌─────────────┐
                              │    Start    │
                              └──────┬──────┘
                                     │
                                     ▼
                              ┌─────────────┐
                              │   Power Up  │
                              └──────┬──────┘
```

System init done.
Self tests passed.
Valid Checksum.

Config Keyword entered

Factory Cal Keyword entered

Configure

Factory Calibration

Exit is True or Low Power off

Exit is True

Normal
Application running

Test Keyword entered

User Cal Keyword entered

Exit is True

Exit is True

Test

User Calibration (Service)

(no keyword)   (no keyword)

Debug   **Service**
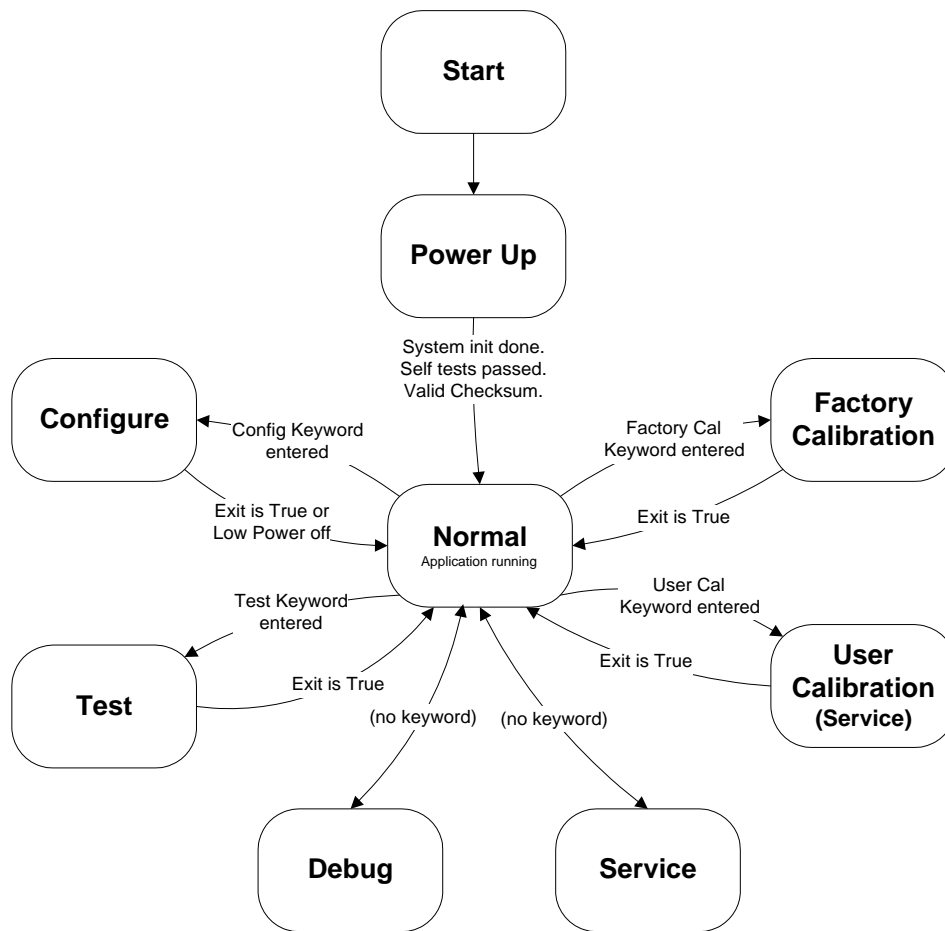
Figure 8-1. Operating Modes

Tuning/Adjustments (Service)

The Service Tool provides the capability to make field tunable adjustments at any
time from the Service Mode. A change to these parameters is not limited to a
shutdown state (Note: the engine most likely is shut down during this time).
Tunable adjustments are available for parameters like input failure settings,
position error setting, and tracking error settings.

Monitor (Service)

The Service Tool will provide the capability to monitor control values at any time
from the Service mode. Viewing and monitoring these parameters is not limited
to a shutdown state, but is available at any time.

Monitoring is available for, but not limited to, the following parameters:
Electronics Temperature and Temperature Histogram
Alarms and Shutdowns (individual)
Alarm/Shutdown Event Log
Position Control information (including actual position, current, demands)
Status and I/O monitoring

Factory Calibration, Test, and Debug Modes

The Factory Calibration, Testing, and Debugging are performed using the Woodward Watch Window Professional tool. The Factory Calibration mode performs analog input and analog output hardware calibration in software (calibrate out resistor tolerances). This includes calibration of Analog I/O (4–20 mA input, 20–180 mA input, 4–20 mA Output, Feedback sensor, Current sensor). The unit will store all hardware calibration parameters in non-volatile memory and retain the calibration independent of the application software. The Test mode reads inputs and provides the capability to exercise the outputs. The Debug mode provides additional parameters for monitoring and troubleshooting.

Password Protection for Service Tool

The Configure, Test, User Stops, and Calibration modes are all provided with password protection. This means that changes to the program and parameter tuning/calibration are password protected. The password is a simple 'keyword' password that is fixed and cannot be changed. This password is intended only to prevent inadvertent changes to the ProAct actuator. This password is only required to make changes (writes), program monitoring does not require a password. Monitoring includes viewing configurable parameters, tunable parameters, alarm and shutdown conditions, and control parameter monitoring.

Program Up-/Downloading

The Service Tool has the capability to save the current application parameter settings to a file. It can also take a previously saved file and load it into the ProAct. If a previously saved program is loaded, configuration and tuning are not necessary. This obviously simplifies the steps required to get a new ProAct actuator up and running.

How Do I Get Started?

The steps required to get started include:
• Install the Service Tool (Watch Window/Servlink) software following the installation steps described later in this chapter.
• Configure the unit (see Chapter 9) or download a previously saved configuration file.
• Calibrate the User Stops and check dynamics adjustment (see Adjust User Stops and Adjusting and Testing Actuator Dynamics in Chapter 9)—after the ProAct actuator is installed, mounted, wired, connected to the valve, and installation and wiring have been properly checked-out (Chapters 2 and 3).
• Optionally, fine-tune application parameters (see Service Mode Parameters in Chapter 9).

⚠️ **WARNING**   **Read this entire procedure before starting the prime mover.**

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.

Getting Started

Installation Procedure

Install the Watch Window and Servlink server software using the setup program on the CD or Disk 1. Alternatively, the Watch Window software can be downloaded and installed from the Woodward internet site at:
    www.woodward.com/software

What to Do Next

After the software is installed, connect a null modem communications cable between the 9-pin connector on the ProAct control and an unused serial port on your computer.
Start the Servlink communications server program on your computer (Programs/Woodward/Watch Window Standard 1.6/Servlink Server). The following is displayed when the program is executed.

IMPORTANT   **Step 2 only needs to be performed one time initially. Once the 'net' file is read-in and saved, this step can be skipped and Watch Window can be opened directly—see step 3.**
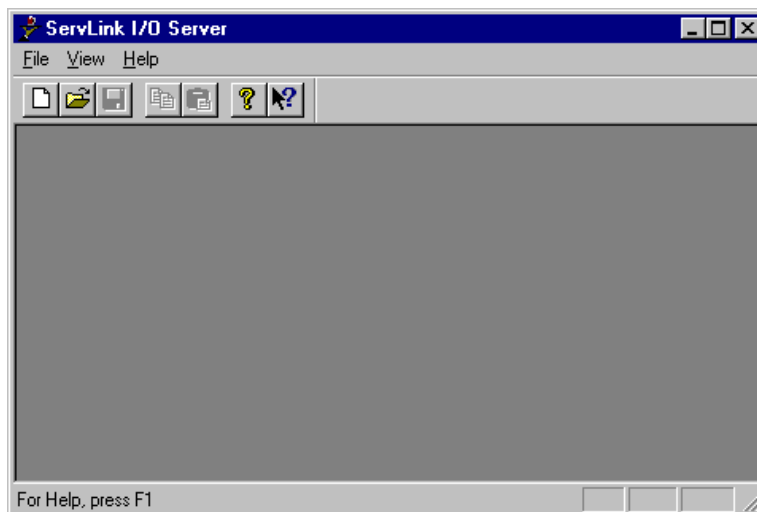
Initiate communications with the Woodward control as follows:
a. From the Servlink menu, select 'File/ New'.
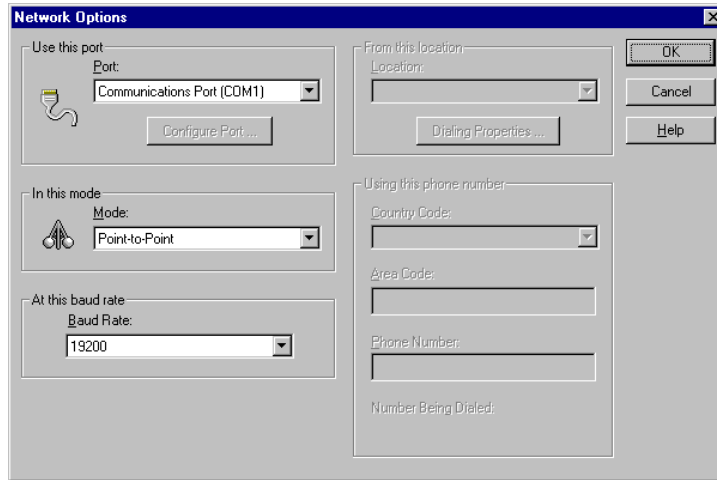
b. Verify the communications settings:
Set the 'Port' to match your serial port connection (e. g., COM1).
'Mode' is set to point- to- point for a single Woodward control.
Set the 'Baud' to 19200.
c. Select 'OK' to initiate communications. If a control is detected, '0's and
'1's will stream across the screen, otherwise a Scan Error message will appear.

When the transfer is completed, the following is displayed.
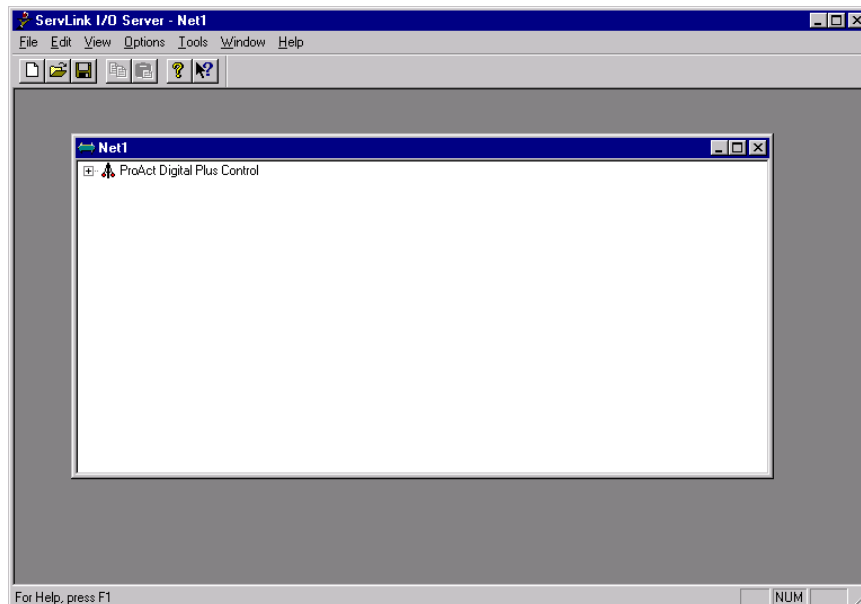
Change the Error settings on the Servlink Server to a 5 second timeout and 3 retries. Select Options / Error from the Servlink menu. Make sure the Save as default is checked and select 'OK'.
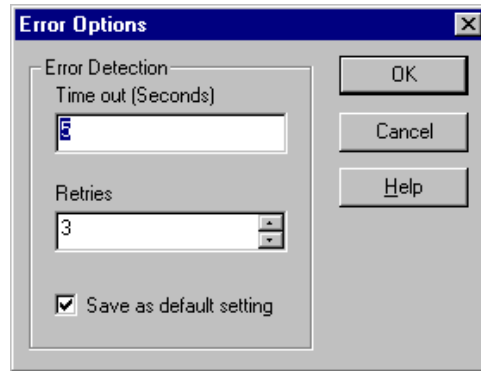
Save the network definition file by selecting 'File/ Save' from the Servlink menu. Set an appropriate name for the file and select 'Save'.

Start the Watch Window program (Programs/ Woodward/ Watch Window Standard 1.6/ Watch Window Standard). The following appears on the screen.

Note: If step 2 was skipped (.net file was saved already), the Watch Window program will first prompt the user for a Network Definition File.
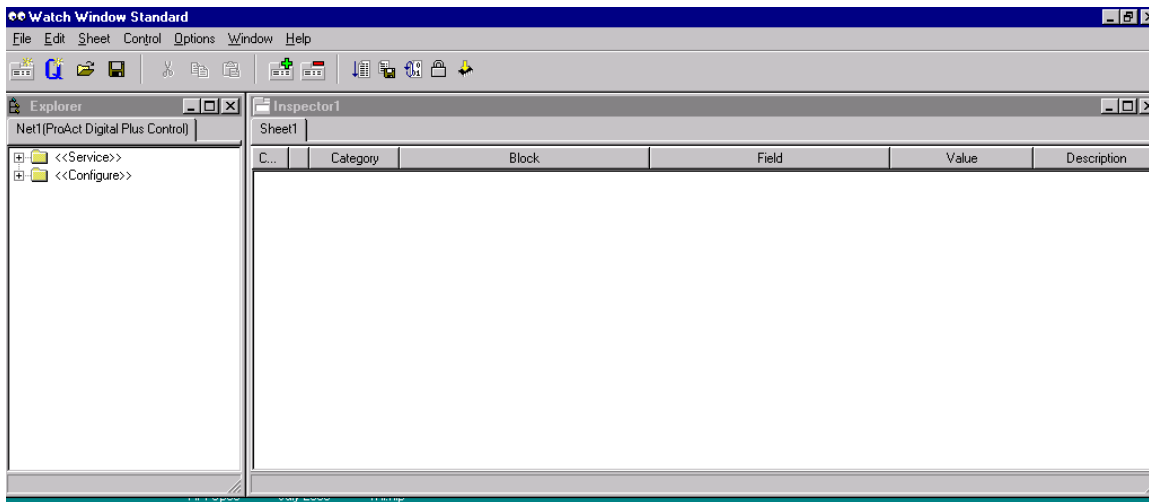
Generate Program Screens using the blue 'Q' icon in the button bar or by selecting 'New Quick Inspector' command from the Watch Window 'File' menu. This will automatically generate Configuration and Service tab sheets in a new Inspector Window. The tab sheet column widths can be adjusted, and the window can be moved, resized, and saved, if desired. Refer to the Watch Window Help for details.

Watch Window Numeric Format

Versions of Watch Window older than 1.05.1 require a specific number format to display values correctly. The required format uses a comma (',') for digit grouping and a decimal point ('.') for the decimal symbol. These settings can be adjusted from the computer's Control Panel / Regional Settings / Number tab sheet. Watch Window 1.05.1 and newer does not require any special numeric formatting.

Using Watch Window

Watch Window was developed by Woodward to be a Servlink client software product that provides a generic PC interface to a Woodward actuator/control, and is a very powerful setup, testing, tuning, and troubleshooting tool. Watch Window provides a means of loading the application software into the unit, shutting down and placing the unit in the configuration mode, saving values in the EEPROM, and resetting the control. Application tunable values can be uploaded, downloaded, and saved to a file.

Purpose

Watch Window is an engineering and troubleshooting tool that provides a window into the control system. Watch Window is the primary troubleshooting tool for Woodward controls that support the Servlink protocol.

Watch Window runs on a PC that is connected to the control system through a serial communications port. The Engineering work station PC may be permanently connected to the control or may be connected only as needed. The communications server, Servlink I/O Server, is included in the same installation with Watch Window.

Watch Window is a typical Microsoft Windows® application that provides a powerful and intuitive interface. The menu structures are familiar to Windows users. Variable navigation is provided through the Explorer window similar to the Explorer in Windows.

Watch Window performs three primary functions:
Monitoring and Tuning of Control Variables—Watch Window presents variables in a tabular format. The user chooses the variables to view at any given time. Multiple pages of variables can be created, each with useful parameters for various troubleshooting or tuning procedures. The user can toggle between pages depending on the task being performed.
Control Configuration and Set Point Management—Watch Window can upload or download all tunable variables from the control system. This feature allows a user (e.g., fleet owner, distributor, packager) to upload (and save) all tunable parameters from one control and download the same settings to other controls for similar engine configurations.
Program Loading—Watch Window provides services to download a new program to the control. This is available in the Professional version only.

Watch Window User Interface

The Watch Window user interface is made up of three types of windows:
the Main Window
the Explorer
the Inspector

All Watch Window applications have only one main window and one Explorer
window. Each application can have as many Inspector windows as the user likes.

Main Window

The Main Window is the application-controlling window. It is used to close the
application. It is also used to control the Explorer's visibility and to create, control,
save and restore Inspectors. The Main Window is composed of a tool bar and a
menu.

Explorer

The Explorer is used to browse the set of variables available through the Servlink
Server, invoke commands on a control and view properties of a control. The
Explorer is composed of a set of tabbed sheets. Each sheet is associated with a
single control from a Servlink network. The sheet's tab is labeled with the
associated control's identifier.

Each sheet contains a tree view. The tree view displays the names of the
categories and blocks in a control's application program in a hierarchical
structure. The names at each level in the tree are listed in alphabetical order.

IMPORTANT	**The standard version of Watch Window will not display Factory Calibration, Test, and Debug values. Only the professional version has this capability. Watch Window Standard only supports Service and Configure modes.**

Selected variables can be used in Copy & Paste or Drag & Drop operations in
order to add a variable to an Inspector. Variables can be selected using the
mouse (left click) or keyboard (arrow keys). Selecting categories or blocks
selects all of the fields underneath them.

Inspector

The Inspector is used to monitor and edit variables available on the control. The
Inspector is composed of a set of tabbed sheets. Each sheet contains a grid.
Each sheet's tab is labeled with a user-definable name. The user has the ability
to add and remove sheets using menu items and/or tool bar buttons in the Main
Window.

One or more variables can be selected using the mouse (left click) or keyboard
(arrow keys). If the user wishes to select multiple variables, they can do so by
performing one of these sequences:

Select a variable, hold down the shift key, and arrow up or down until all of the variables are selected.
Click on a variable, hold down the shift key, and click on the last variable in the series that the user wishes to select.

Selected variables can be used in Cut, Copy & Paste, or Drag & Drop operations in order to add a variable to an Inspector. If the selected variable is tunable or configurable, the status bar will display the minimum and maximum value for that variable. If multiple variables are selected, the minimum and maximum will not be displayed for any of the selected variables.

The Inspector has a pop-up menu that has menu items that apply to the currently selected sheet and/or variable. The Inspector can have its configuration saved and restored. The Inspector can be closed by using the Main Window or by clicking the standard windows close button.

Watch Window Decimal Places

The number of digits displayed after the decimal place displayed in Watch Window can be adjusted from the Precision setting under the Watch Window Options menu.

Watch Window Help

More help on using Watch Window is available and included with the installation of the Watch Window product. Watch Window Help can be accessed from the Watch Window 'Contents' drop-down window selection under the Help menu located on the Main Window.

Software Version Identification

The Watch Window software version can found by selecting 'About' under the Help menu. The ProAct software version information can be found by selecting 'Properties' under the Control menu. Refer to this information in any correspondence with Woodward.

Watch Window Standard and Professional

There are two versions of the Watch Window software, Standard and Professional. Watch Window Standard is provided with the ProAct control as a Service Tool for Configuration, Tuning , and Monitoring. Watch Window Standard supports only Service and Configure modes. The Standard version of Watch Window will not display Factory Calibration, Test, and Debug mode values. Only the professional version has this capability.

Watch Window Professional is available as a purchased upgrade, but is not required for this product. In addition to providing Factory Calibration, Test, and Debug mode access, the Professional version provides software download capabilities for new or revised software versions. Like the Standard version, the Professional version of Watch Window software can be downloaded and installed from the Woodward internet site at:
      www.woodward.com/software
A free trial period is included. This site can also be used to obtain license authorizations.

Chapter 9.
ProAct™ Parameter Setup

ProAct™ software setup consists of four steps: configuration of critical operational parameters, calibration of the linkage between the ProAct control and the actuator (User Calibration), tuning of the actuator dynamics, and optionally, parameter fine-tuning in the Service Mode. No special command is required to save parameters into memory—as soon as the new value is entered into the associated Watch Window field, that value is in memory.

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

IMPORTANT	**Appropriate security permissions are required to perform these functions.**

IMPORTANT	**The Service Tool is not included, but can be download from the Woodward Internet website (www.woodward.com) or by ordering the Watch Window Standard CD-ROM (1796-065).**

Configure Mode

The Configure Mode parameters are found on the right-most tab sheets of the Service Tool inspector created. The Configure mode is divided into three sections: Mode is used to enable and disable the mode, Unit Setup provides general setup information, and Demand Setup configures the primary and backup demand sources.

Use the arrow buttons to view the Configure sheets and select the 'Configure: Mode' tab sheet.

Make all desired Configure mode parameter changes. To change parameters on the Configure tab sheets, the Woodward control must be in a safe state. The following steps identify how to enter and exit the Configuration mode.

Entering Configure Mode

Select the Configure Mode tab sheet and shut down the driver by setting the Shutdown Command value to 'true' or by opening the Low Power Standby Mode discrete input.

Enter the appropriate configure mode Password (1113) and either select 'ENTER' or click on the equals (=) box to the right of the password box. The 'Enabled' field will display 'true' if the Configure Mode has been successfully entered.

Configure the unit by setting the Unit Setup and Demand Setup parameters to the application specific values. Refer to the Configure Mode Details section of the manual for details on these settings.

IMPORTANT	**As changes are made to Configure and Service mode parameters, they are automatically saved into non-volatile memory—no special 'save' command is required.**

Configuring the Unit (Configure Mode parameters)

Refer to the information provided later in this chapter for details on the Configure Mode parameters. A program summary worksheet is provided in the Appendix as an overview of all software settings in the ProAct control.

Exiting Configure Mode

Select the Configure Mode tab sheet and set the EXIT value to 'true'. Return the unit to a running (operational) state by setting the Shutdown Command value back to 'false' or by closing the Low Power Standby Mode discrete input.

The Service Mode / Unit Status will display 'running' if successful (refer to the Service Mode Details section). If an error was made in the unit's configuration, a Config Error shutdown will hold the driver in a shutdown state. The exact cause of the Configuration Error is identified on the Configure Mode tab sheet (see Configuration Error section).
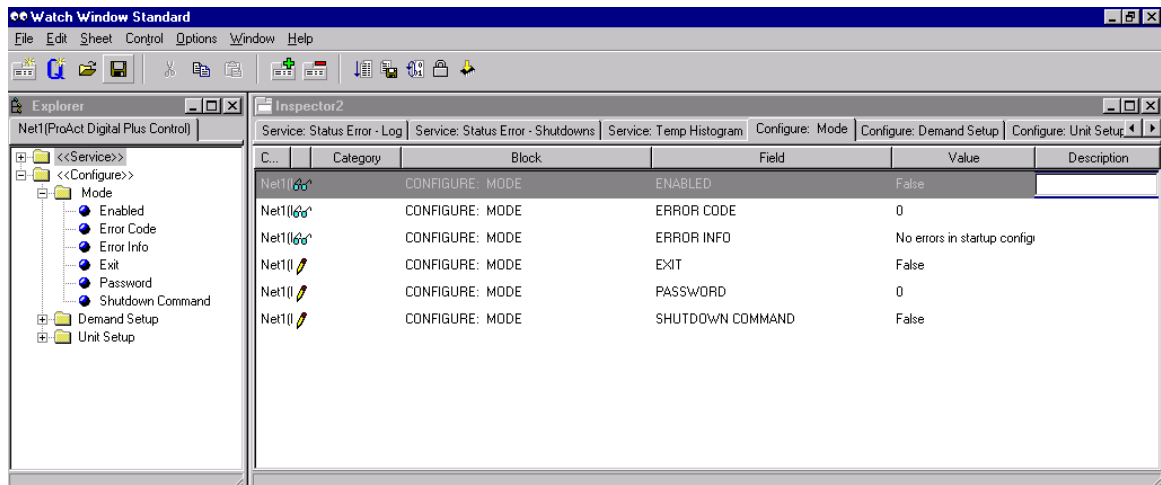
Figure 9-1. Configure Mode

Configuration Error

Upon completion of the configuration, a validity check is performed. If an error is detected, the Config Error shutdown is issued and the unit will not run until it is cleared. The cause of the Configuration Error can be determined from the Error Code and Error Info values on the Configure Mode tab sheet.

Error Code   Error Info (displayed text)
0   No errors in configuration
101   Primary / Backup signal selection same
      (the primary demand and backup demands are configured for the same source)
102   Invalid primary demand signal selection
      (the primary demand selection is configured for an out of range value)
103   Invalid backup demand signal selection
      (the backup demand selection is configured for an out of range value)
104   Actuator Inertia setting value too large
      (the actuator inertia setting selection is configured for an out of range value)
105   Invalid Actuator type selection
      (the actuator type is configured for an out of range value)

106   Invalid PwmIn max/min duty values
        (the PWM demand input setting for min duty cycle must be less than the max value)
107   Invalid AnalogIn max/min values
        (the analog input demand input setting for min must be less than the max value)
108   CAN Extensions must be non-zero
        (the CAN Extensions setting cannot be zero when CAN is configured as a demand
signal. An Extension setting of zero disables the CAN transmissions.)

Configure Mode Parameters

Overview

The Configure Mode is used to set up the parameters for the specific application
of the ProAct control. For example, the direction of shaft rotation, type of
actuator, and primary/backup demand selections are set in the Configure mode.
This mode can be accessed at any time but parameters can only be changed
when the unit is shut down and the password is entered (see Password and
Enabled parameters in the Mode category).

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

IMPORTANT | **Appropriate security permissions are required to perform these functions.**

Configure Mode (Configure Mode Access)

The Mode category provides the access to change parameters in the Configure
Mode. Refer to Figure 9-1. It also provides an exit command, gives mode status,
and identifies any errors made in configuration.

Password   **dflt =0**
Password input command for the Configure mode. To enter a value, highlight or
delete the default value ('0') and use the keypad to enter the numeric password.
The input is accepted when the enter key is pressed or the equals sign to the
right of the input is selected. When entered, the password returns to zero. If
accepted and the unit is shut down, the 'Enabled' indication will be true. Refer to
the Appendix for Service Tool passwords.

Enabled   **(status indication only)**
Configure Mode Enabled Indication (true/false). Parameter is true when the
mode is enabled – this indicates Configure mode parameters can be changed.
When false, parameters can only be viewed – not adjusted.

Exit   **dflt = false (momentary true command only)**
Exit command. Set to true to exit the Configure mode. This disables the ability to
make changes to parameters in this mode. The 'Exit' parameter automatically
returns to false when the exit is completed.

Error Code (status indication only)
Integer Indication of the status of the configuration (see also Error Info). An error in the configuration will not allow the actuator to operate and will result in a Configuration Error Shutdown.

Error Code Interpretation (same as Error Info below)
0   No errors in configuration
101   Primary / Backup signal selection same
102   Invalid primary demand signal selection
103   Invalid backup demand signal selection
104   Actuator Inertia setting value too large
105   Invalid Actuator type selection
106   Invalid PwmIn max/min duty values
107   Invalid AnalogIn max/min values
108   CAN Extensions must be non-zero

Error Info   (status indication only)
String Indication of the status of the configuration (see also Error Code). An error in the configuration will not allow the actuator to operate and will result in a Configuration Error Shutdown (see information on shutdowns).

Shutdown Command   dflt = false (false, true)
RS232 Command to shut the actuator driver down. Refer to shutdowns.

Configure: Unit Setup

The Unit Setup category sets critical actuator and controller information. Refer to Figure 9-2. Additional actuator parameters are available in the Service Mode (see 'Hardware Adjustments').

Actuator Type   dflt = 3 (1=ProAct1, 2=ProAct2, … 4=ProAct4)
ProAct Actuator Type configuration. This is set to the appropriate ProAct actuator (e.g. ProAct Model 4 would be set to '4').

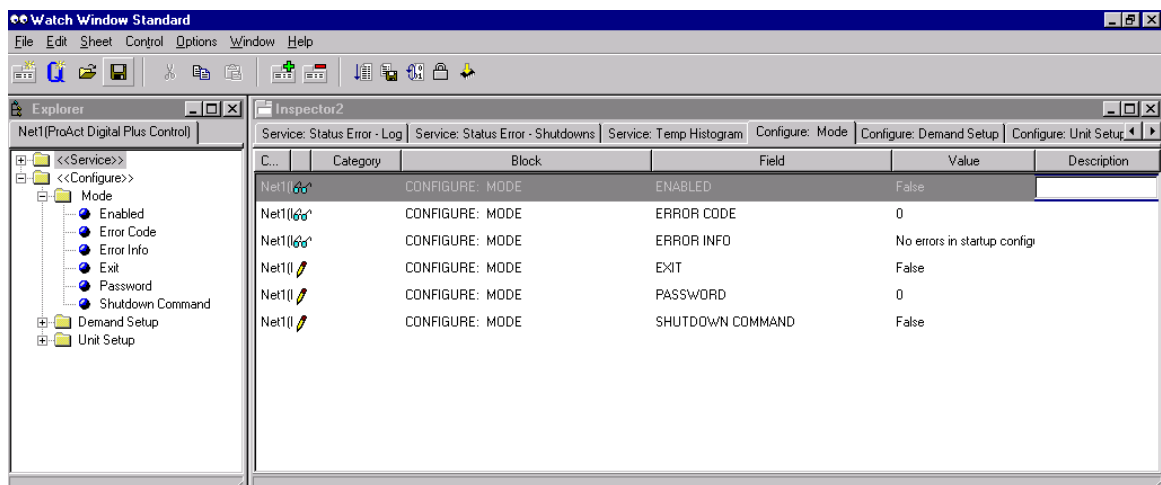
Figure 9-2. Configure Mode: Mode

Actuator CCW Direction   dflt = false (false=CW, true=CCW)
ProAct Actuator Direction configuration—clockwise vs. counter-clockwise—as seen from the shaft end of the actuator.

Actuator Inertia Setting   **dflt =0 (range 0-25)**
Actuator/valve inertia setting. This setting is available for systems with higher or
lower inertia than the default as indicated by excessive shaft movement. A zero
(0) setting is basically for an unconnected shaft, whereas, increasing the setting
implies a higher inertia in the system. This parameter can also be tuned and
tested in the Service Mode—see Adjusting and Testing Actuator Dynamics in the
Adjust User Stops section for details (see Figure 9-9 for more details).

High Friction System   **dflt =false (false, true)**
Internal Disturbance Observer Controller (dobs) Enable command. Normally set
to false, only needed in high friction systems. This parameter can also be tuned
in the Service Mode to determine if it is needed—see Adjusting and Testing
Actuator Dynamics in the Adjust User Stops section for details (see Figure 9-9 for
more details).

DiscreteOut Alarms Enabled   **dflt=true (false, true)**
Discrete Output configuration setting. When false, only Shutdowns will activate
the discrete output. When true, any alarm or shutdown condition will activate the
discrete output.

Discrete Out Includes Runenable [Run/Enable]   **dflt=true (false, true)**
(This parameter only available with ProAct Software Version 2.10 or later)
(Check the version number under Service: Unit Status:)
When set to true, when the Run Enable Discrete Input (Low Power Standby
Mode) contacts are opened, the Status Output will also open. When set to false,
the condition of the Run Enable (Low Power Standby Mode) contacts will not
affect the Status Output.

Run Enable – Closed to Run   **dflt=true (false, true)**
**(This parameter only available with ProAct Software Version 2.20 special
firmware Woodward part number 5418-2590)**
(Check the version number under Service: Unit Status:)
When set to true, the run enable contacts will be **closed** for run mode, and **open**
for Low Power Standby Mode. When set to false, the run enable contacts will be
open for run mode, and **closed** for Low Power Standby Mode.

Shutdown Action   **dflt = 3 (1,3)**
Select the action to be performed when a shutdown condition is detected.
Selection options: 1=Min, 2=Max, 3=Pwr Down. (refer to Shutdown description
TBD).

Temp Alarm SP (°C)   **dflt = 95 °C (50, 150)**
High Temperature Alarm set point in degrees Celsius. This alarm is based on the
internal electronics temperature. Refer to the alarms section for details.

Temp Alarm Delay (sec)   **dflt = 1 sec (0, 10)**
High temperature alarm delay in seconds.

Temp Protect Enable   **dflt =true (false, true)**
Temperature Protection Configuration. This enables current limiting based on
temperature and is a combination of temperature protection and compensation.
When set to true (recommended), protection is provided to limit the drive current
output when the internal actuator temperature exceeds the absolute failure
levels. When set to false, this protection is bypassed. An alarm is logged when
absolute failure protection temperature limiting is active. The same algorithm not
only limits the current at very high temperatures, but allows additional current at
very low temperatures as well (refer to Current Limiting based on Temperature
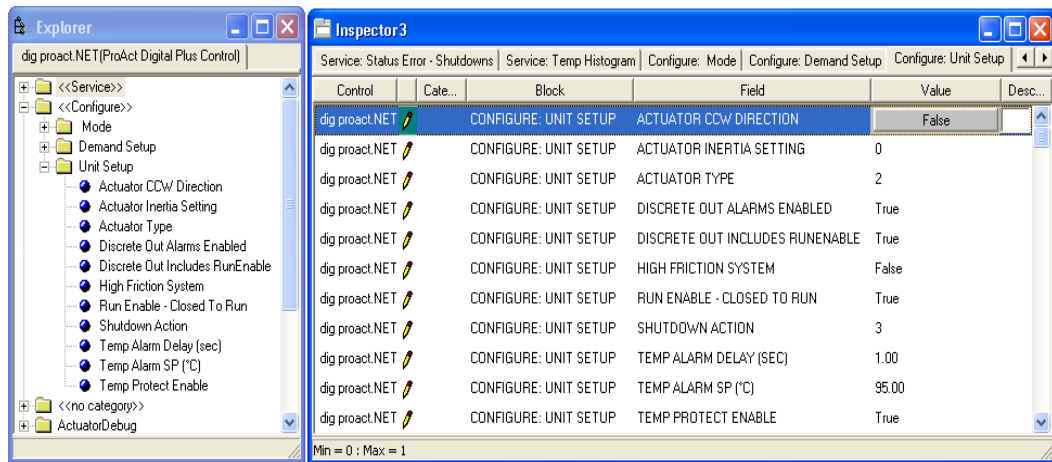description in Chapter 5).

Figure 9-3. Configure Mode: Unit Setup

Configure: Demand Setup

The Demand Setup sets the ProAct control's primary and backup demands. Refer to Figure 9-4. Additional demand parameters are available in the Adjustments Mode.

Demand—Primary Source   **dflt = 3 (1, 3)**
Select the source of the primary demand input. Selection options: 1=CAN, 2=PWM, 3=Analog.

Demand—Backup Source   **dflt = 2 (0, 3)**
Select the source of the backup demand input. Selection options: 0= Not Used, 1=CAN, 2=PWM, 3=Analog (*Primary and Backup demand sources must be different*).

AnlgIn 20 Min Value (mA)   **dflt=4 mA (range 0.0-25)**
Analog Input Minimum Demand Value in mA. This setting corresponds to the milliamp signal that would demand the actuator to be fully closed (0%) (*should be less than the 'AnlgIn 20 Max Value (mA)' setting*).

AnlgIn 20 Max Value (mA)   **dflt=20 mA (range 0.0-25)**
Analog Input Maximum Demand Value in mA. This setting corresponds to the milliamp signal that would demand the actuator to be fully opened (100%) (*should be greater than the 'AnlgIn 20 Min Value (mA)' setting*).

AnlgIn 200 Min Value (mA)   **dflt= 20 mA(range 0.0-200)**
Analog Input Minimum Demand Value in mA. This setting corresponds to the milliamp signal that would demand the actuator to be fully closed (0%) (*should be less than the 'AnlgIn 200 Max Value (mA)' setting*).

AnlgIn 200 Max Value (mA)   **dflt=180 mA (range 0.0-200)**
Analog Input Maximum Demand Value in mA. This setting corresponds to the milliamp signal that would demand the actuator to be fully opened (100%) (*should be greater than the 'AnlgIn 200 Min Value (mA)' setting*).

CAN DataRate   **default = 1(1, 3)**
CAN data rate setting in kbps. Selection options: 1=250, 2=500, 3=1000 kbps.

CAN Extensions   **default = 1 (0, 1)**
CAN Extension Configuration. This determines the messages of the CAN
communications. The ProAct uses J1939 CAN but this setting sets up the actual
Parameter Group Numbers (PGNs) and Suspect Parameter Numbers (SPNs) to
be used over the comm link. Selection options: 0=Disable Can communications,
1=Set#1, 2=Set#2, etc. *(must be greater than zero if CAN demand is configured)*.

PwmIn Min Duty (%)   **default = 10% (range 10-90)**
PWM Minimum actuator position Duty Cycle setting in percent. This setting
corresponds to the duty cycle that would demand the actuator to be fully closed
(0%) (*must be less than the 'PwmIn Max Duty (%)' setting*).

PwmIn Max Duty (%)   **default 90% (range 10-90)**
PWM Maximum actuator position Duty Cycle setting in percent. This setting
corresponds to the duty cycle that would demand the actuator to be fully open
(100%) (*must be greater than the 'PwmIn Min Duty (%)' setting*).

PwmIn Frequency (Hz)   **dflt 1000 hertz (100-3000)**
Nominal PWM signal frequency in hertz.

PwmIn Invert Input Signal   **dflt =false (false, true)**
Invert PWM Signal option. This configuration setting is available for systems that
do not have a pull-up in their PWM output (refer to the hardware PWM section for
details). This setting inverts the PWM input values to read the percentage of the
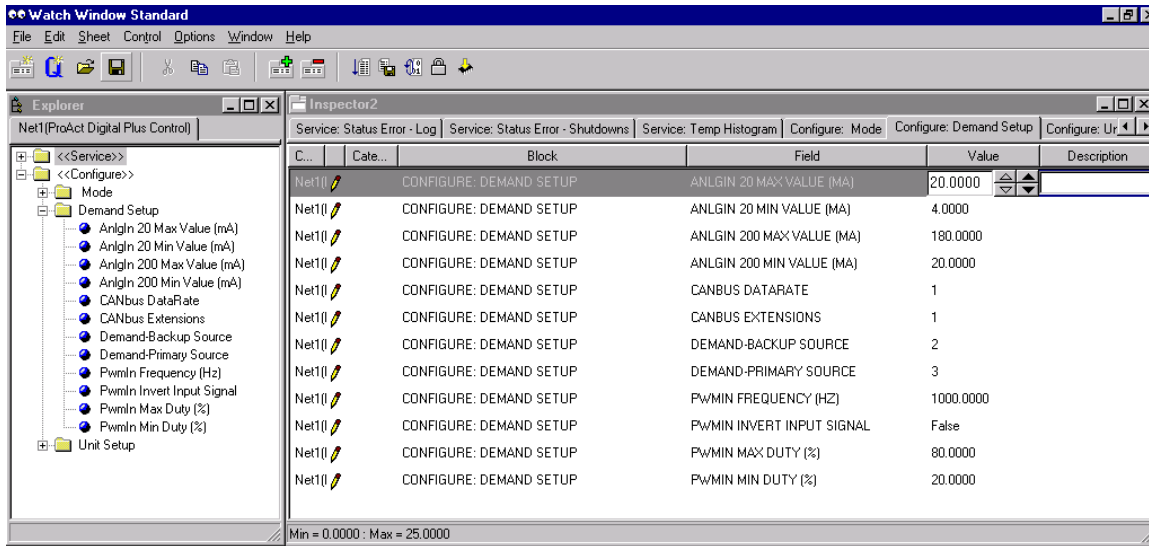time low rather than the percentage of the time high.

Figure 9-4. Configure Mode: Demand Setup

Adjusting User Stops and Dynamics

Introduction

The User Calibration mode of the Service Tool provides the capability to set the min and max position to match the rigging of the actuator and valve. Both automatic and manual procedures are available to perform this setup. This calibration must be done prior to operation of the unit. If this procedure is not done, the actuator will be defaulted such that 0–100% position demand will correspond to 0–75 degrees rotation. Refer to Figure 9-5. Once the user calibration is performed, this procedure stores the active min and max positions into non-volatile memory where it is retained until a new calibration is performed. In addition, this mode can be used to verify the setup/calibration by providing a manual stroking mechanism.

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

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

IMPORTANT	**Appropriate security permissions are required to perform these functions.**

To enter the User Calibration mode, the unit must be shut down and a password must be entered. For an overview of the User Calibration, refer to the attached flowcharts (Figures 9-8 and 9-9). Refer to Figure 9-7 for a visual of the parameters available in the Service Tool.
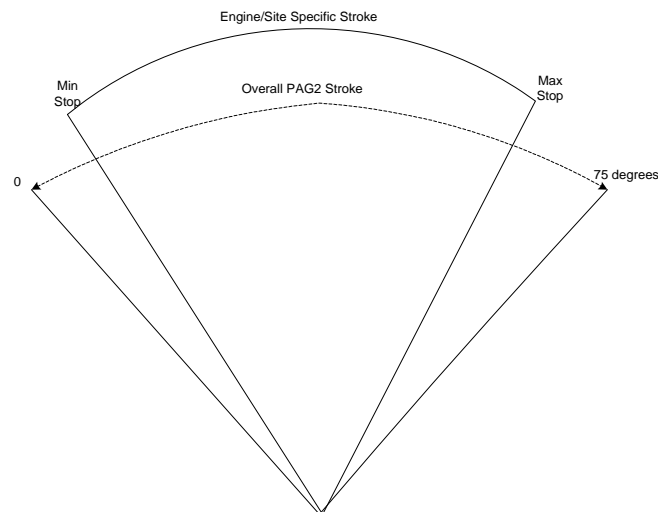

Figure 9-5. Min/Max Stops Relative to the Overall Travel

Procedure to Adjust Stops and Dynamics

1. Connect PC to ProAct using an RS-232 Null Modem cable.
2. Run Servlink on the PC and connect to the ProAct control. Refer to the Service Tool chapter for details on Servlink setting and connection in the Getting Started section.
3. Open Watch Window or alternative programming tool on the PC.
4. Shut down the ProAct by either issuing a Shutdown Command from the PC (on the Unit Status tab sheet) or by opening the ProAct Low Power Standby Mode Discrete Input. Either method puts the unit in a shutdown state, which is a permissive for the Adjust User Stops mode.
5. Enter the Adjust User Stops Password (Mode Password) from the Service: Adjust User Stops tab sheet. The ProAct will provide feedback that the user stops calibration mode has been successfully entered through the Operational Mode and Mode Enabled indications.
6. Select the desired calibration mode. There are 2 modes, a manual stroking mode and an automatic mode. Refer to Figures 9-8 and 9-9. If the Auto mode is selected, steps 7 through 11 will occur automatically without any user input required. Auto Mode is enabled by setting "Auto Execute" to true.
7. There are two methods to manually move the output between min and max position: by hand or by using the Manual Set Position. To use the Manual Set Position, the Manual enable must be set to true. Using the Manual Set Position to position the ProAct, decrease the demand setting until the actuator is positioned at the minimum stop or, by hand, push the output into the min stop.
8. Set the At Min Position parameter to true to allow the Control to record the Min position setting.
9. Increase the Manual Set Position setting until the actuator is positioned at the maximum stop or, by hand, push the output into the max stop.
10. Set the At Max Position parameter to true to allow the Control to record the Max position setting.
11. When both Min and Max have been successfully calibrated, set the Enable Manual Stroke back to false (if a Manual Calibration is enabled). If successful, the Calibration Status will indicate the calibration is complete. The status will indicate 'failed' if the calibration is unsuccessful.
12. **Verify Calibration**. This can be done by hand by moving the rack from min to max and observing the position readout (Service Tool or analog out) or by stetting the Manual Enable to true and positioning the output using the Manual Set Position variable.
13. Adjust Dynamics. Adjust the Actuator Inertia Setting for proper system performance. Increasing the setting implies a higher inertia in the system and results in a higher gain in the actuator. Verify the setting with the Actuator Inertia Test Execute command. Refer to Table 9-1 for an approximate inertia setting based on lever size.
14. Optionally, set the offset (bias) desired at each stop. The Min Stop Bias and Max Stop Bias parameters are available in the Hardware Adjustments to basically provide an electrical stop within the user calibrated stop settings. This offset is in degrees of travel and can be adjusted anytime. Refer to Figure 9-6 and Service Mode: Hardware adjustments later in this chapter.
15. When calibration is complete, set the Mode Exit to true to return to the previous (Shutdown) mode.
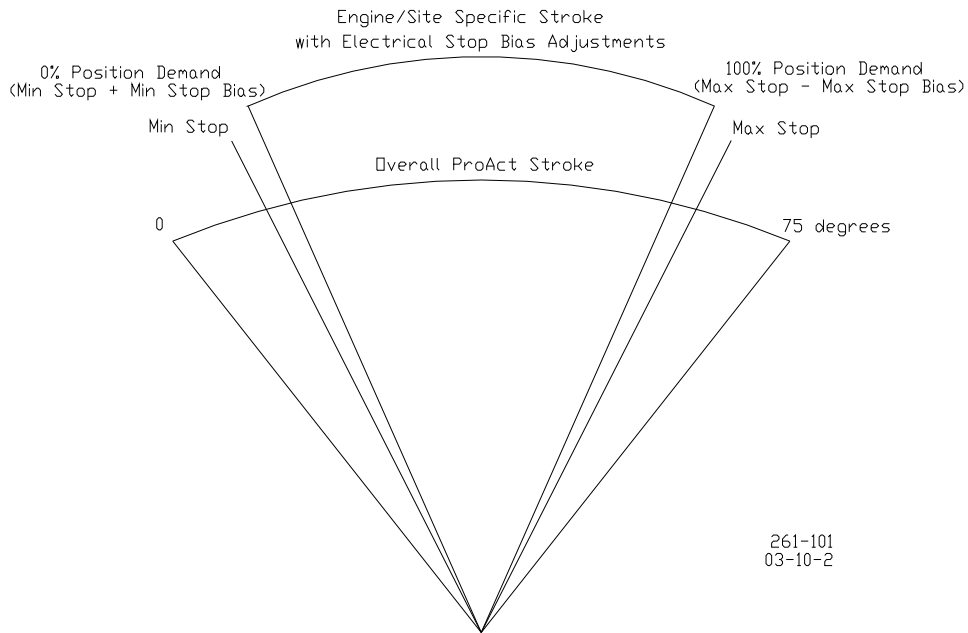
Figure 9-6. Electrical Stop Adjustments Relative to the Mechanical Min and Max Stops

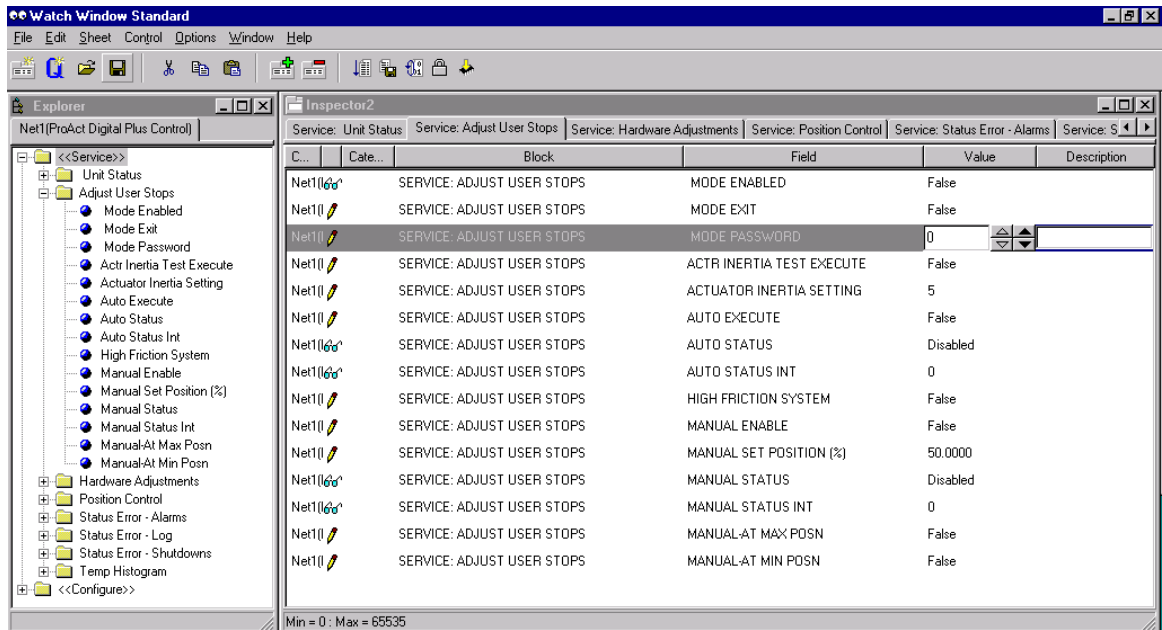Figure 9-7. Service Mode: Adjust User Stops

Service: Adjust User Stops

(must be shut down and password entered)

This category provides the access to change parameters in the Adjust User Stops Mode. Refer to Figure 9-7. It provides both automatic and manual means of setting the stops, inertia setting and testing capability, and exit command, gives mode status, and identifies an errors made in configuration.

Mode Password **dflt =0**
Password input command for the Adjust User Stops mode. To enter a value,
highlight or delete the default value ('0') and use the keypad to enter the numeric
password. The input is accepted when the enter key is pressed or the equals
sign to the right of the input is selected. When entered, the password returns to
zero. If accepted and the unit is shut down, the 'Enabled' indication will be true.
Refer to the Appendix for Service Tool passwords.

Mode Enabled **(status indication only)**
Adjust User Stops Mode Enabled Indication (true/false). Parameter is true when
the mode is enabled—this indicates Adjust User Stops mode parameters can be
changed. When false, parameters can only be viewed—not adjusted.

Mode Exit **dflt = false (momentary true command only)**
Exit command. Set to true to exit the Adjust User Stops mode. This disables the
ability to make changes to parameters in this mode. The 'Exit' parameter
automatically returns to false when the exit is completed.

Auto Execute **dflt = false (momentary true command only)**
Command to Execute the Automatic 'stop finder' procedure. When set to true,
the output moves to both minimum and maximum positions and determines the
stops automatically. The Status string indications the present execution step. The
command is automatically set back to false when the stops are set.

Auto Status—String indication of the automatic user stop procedure.
−1= Failed
0 = Disabled
1 = Enabled
2 = Looking for Min Stop
3 = Looking for Max Stop
4 = Stops Set

Auto Status Int—Integer indication of the Auto Status string (see above).

Manual Enable **dflt = false**
Command to enable the manual user calibration. When true, the Manual Set
Position (%) is actively controlling the driver output to the commanded position.
This mode can also be used to stroke the output.

Manual Set Position (%) **default 50% (−10 to 110)**
Manual position demand. This demand setting is active when the Manual Mode
is enabled. Can be used to both set the stops and to stroke the actuator output.

Manual Status—String indication of the manual user stop procedure.
−1= Failed
0 = Disabled
1 = Enabled
2 = Min Stop Set
3 = Max Stop Set

**Manual Status Int—Integer indication of the Manual Status string (see
above).**

Manual—At Min Posn **dflt = false (momentary true command only)**
Command to indicate minimum position is reached. This sets the 0% (min)
position for all position demand signals.

User Calibration Operator Flow - Auto Mode

PAG2 must be in a shutdown state

Servlink Variables
  Mode Enabled
  Mode Password
  Auto Execute
  Auto Status
  Auto Status Int
  Mode Exit

START

Enter the Mode Password

Password is cleared. ◄─No─ Is Password OK?

Yes

The Control sets OperationalMode = UserCalibration, Status=Enabled, Password is cleared.

The Control saves all User Calibration parameters and exits the UserCal Mode.

Status Definitions
  -1 -- Failed
   0 -- Disabled
   1 -- Enabled
   2 -- Looking foir Min
   3 -- Looking for Max
   4 -- Stops Set

Set Enable Manual Stroke to true.

Set Auto Execute to true.

Exit Calibration Mode is selected.

Enables the Manual stroke functionality.

The Control moves the position demand to maximum. ◄─No─ Actual Position is > 50% ─Yes─► The Control moves the position demand to minimum.

The Control determines the position is at maximum once the feedback stops moving and samples the feedback.

The Control determines the position is at minimum once the feedback stops moving and samples the feedback.

The Control moves the position demand to minimum.

The Control moves the position demand to maximum.

The Control determines the position is at minimum once the feedback stops moving and samples the feedback.

The Control determines the position is at maximum once the feedback stops moving and samples the feedback.

The Control sets the Status=Stops Set if the calibration was successful, otherwise it is set to Failed; ExectureAutoStroke is reset to false.
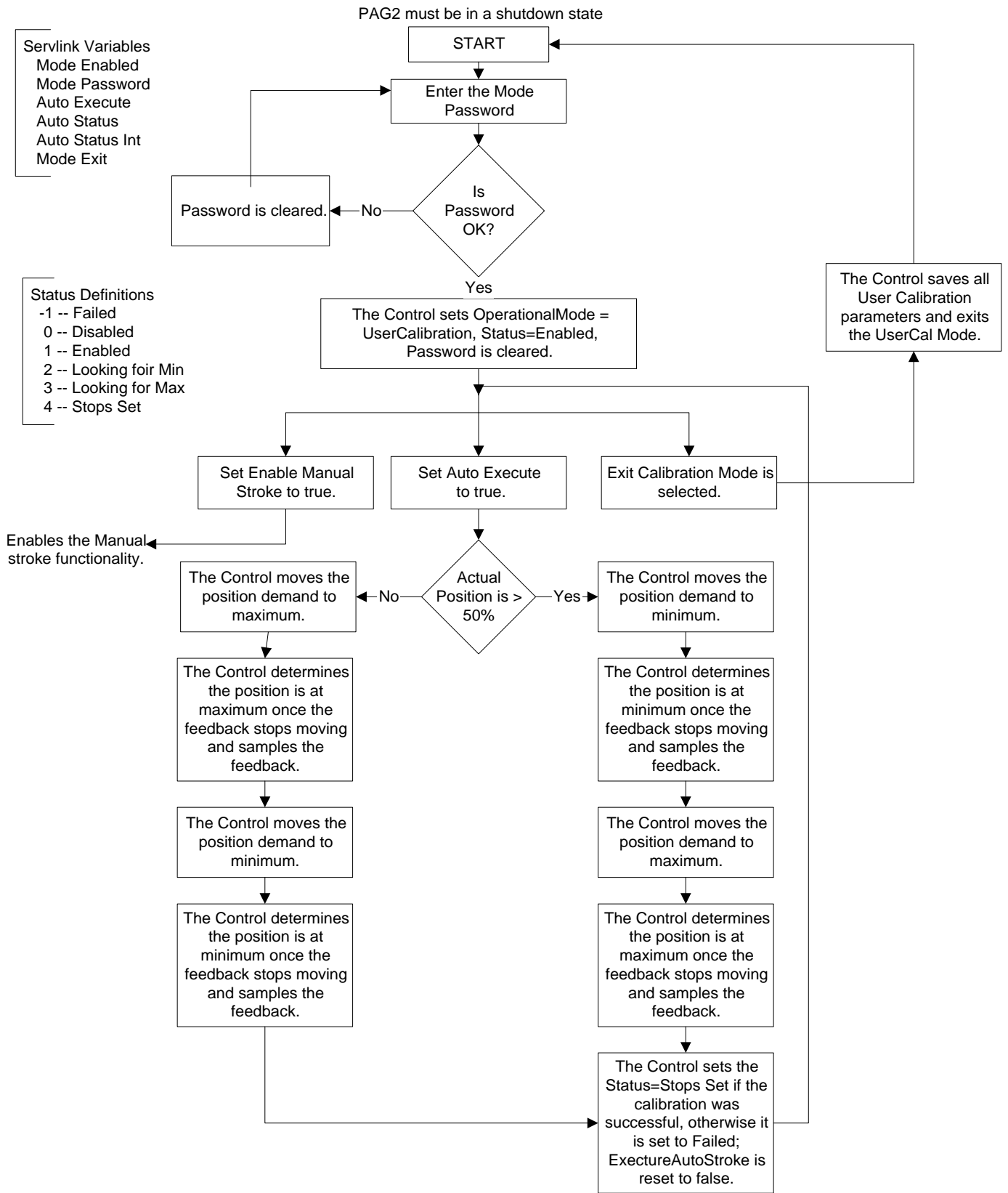
Figure 9-8. Auto Stroke Mode Flowchart

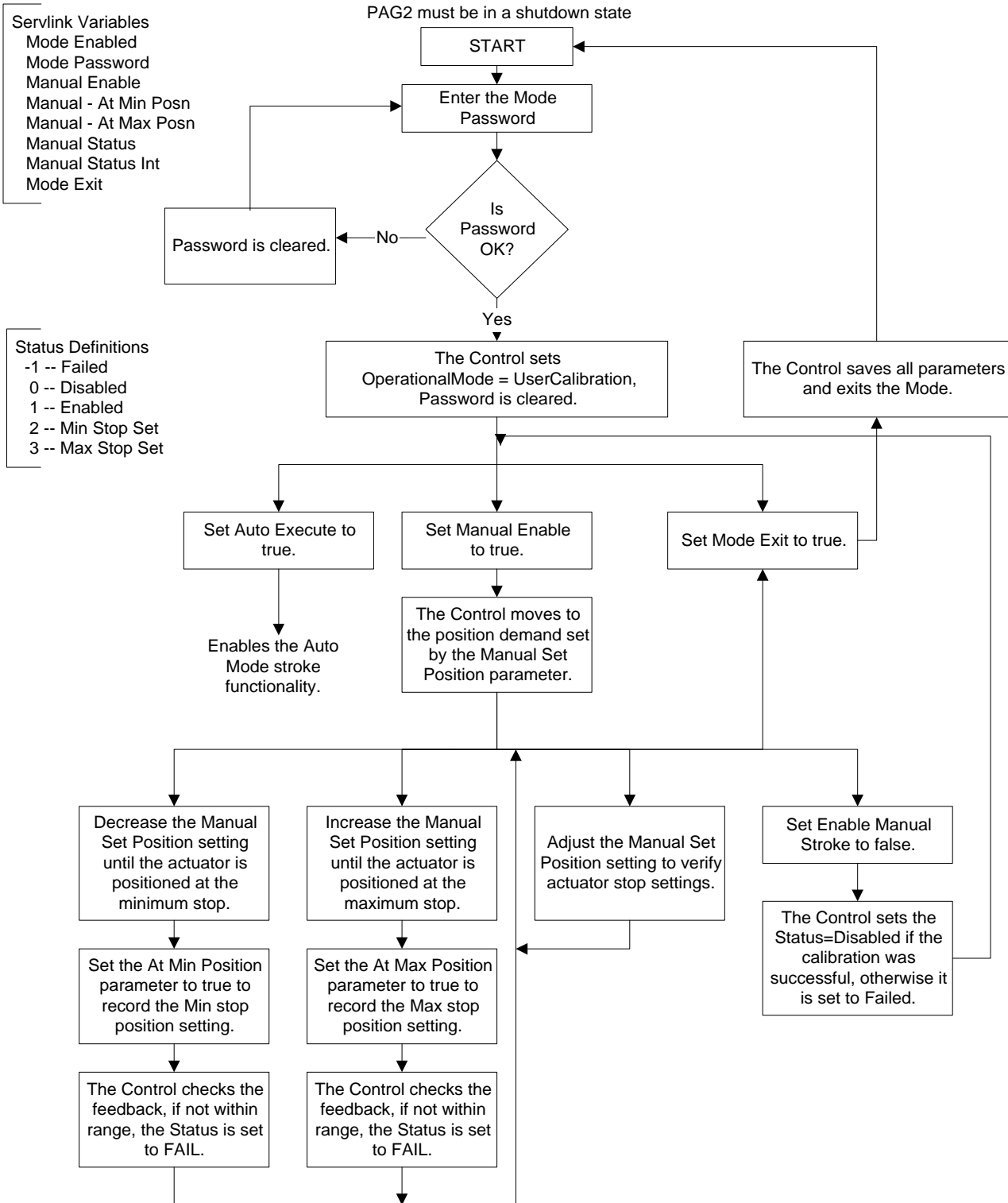**User Calibration Operator Flow - Manual Mode**

Figure 9-9. Manual Stroke Mode Flowchart

Manual—At Max Posn   **dflt = false (momentary true command only)**
Command to indicate maximum position is reached. This sets the 100% (max)
position for all position demand signals.

Adjusting and Testing Actuator Dynamics

Actuator dynamics are set in the Configure Mode, but can also be adjusted in the Adjust User Stop mode. There is only one adjustable dynamics parameter, it is the Actuator Inertia Setting (see Figure 9-7). To change this parameter, the User Stop mode must be enabled.

Actuator Inertia Test Execute
Once changed, it is recommended the setting be tested. A quick stability check can be done by selecting the 'Actr Inertia Test Execute' command. This provides a short actuator positioning sequence and can be used to verify the Inertia Setting. The sequence goes to 30% travel for 3 seconds, then goes to 70% for 3 seconds and back to 30% for 3 seconds, concluding the test. If instability is detected, the test can be aborted by setting the Execute command back to false.

In general, if the Inertia Setting is too high the output will have a high frequency oscillation and too low the frequency of oscillation will be much slower or response will be sluggish.

Actuator Inertia Setting   **dflt =0 (range 0-25)**
Actuator/valve inertia setting. This setting is available for systems with higher or lower inertia than the default as indicated by excessive shaft movement. A zero (0) setting is basically for an unconnected shaft, whereas, increasing the setting implies a higher inertia in the system. Refer to Table 9-1 for an approximate Inertia Setting value based on lever size.

High Friction System   **dflt =false (false, true)**
Internal Disturbance Observer Controller (dobs) Enable command. Normally set to false, only needed in high friction systems. As a general rule-of-thumb, when more than 2 A of current are required to move the actuator then a true setting will help with controllability.

		Width * Thickness (of one lever) [inches; 1 inch = 25.4 mm]					
		0.25	0.50	0.75	1.00	1.50	2.00
Lever Length [inches]	2.00	0	1.00	2.00	2.00	3.00	4.00
	2.50	1.00	2.00	3.00	4.00	5.00	6.00
	3.00	2.00	3.00	5.00	6.00	7.00	8.00
	3.50	3.00	5.00	6.00	7.00	9.00	10.00
	4.00	4.00	6.00	8.00	9.00	11.00	12.00
	4.50	5.00	7.00	9.00	10.00	12.00	13.00
	5.00	6.00	9.00	10.00	12.00	14.00	15.00
	5.50	7.00	10.00	12.00	13.00	15.00	16.00
	6.00	8.00	11.00	13.00	14.00	16.00	18.00
	6.50	9.00	12.00	14.00	15.00	17.00	19.00
	7.00	10.00	13.00	15.00	16.00	18.00	20.00
	8.00	12.00	15.00	17.00	18.00	20.00	22.00
	9.00	13.00	17.00	19.00	20.00	22.00	23.00
	10.00	15.00	18.00	20.00	22.00	24.00	25.00
	12.00	18.00	21.00	23.00	24.00	—	—

Table 9-1. Approximate Inertia Setting for Two Identical Steel Levers

Service Mode Parameters

Overview

The Service Mode is used to Adjust User Stops, tune application parameters, and monitor ProAct actuator status. Parameters in this mode can be accessed and changed at any time (with the exception of Adjusting User Stops).

Tuning Application Parameters

All control parameters in the Service mode that can be tuned are found under the Hardware Adjustments tab sheet.

Service: Hardware Adjustments

The hardware adjustments tab sheet contains all the parameters that can be used to "fine tune" the ProAct control to the specific application. Refer to Figure 9-10.

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

Figure 9-10. Service Mode: Hardware Adjustments

AnalogIn 20 Fail Min (mA)   dflt = –1 mA (–1 to 12.5)
Value at which the analog input will be determined as failed, for the 20 mA
analog input range. A failure is determined if the input is below the 'Fail Min'
milliamp level for the 'AnalogIn Fail Delay' time. A value of '–1' disables the
minimum current failure.

AnalogIn 20 Fail Max (mA)   dflt = 26 mA (12.5 to 26)
Value at which the analog input will be determined as failed, for the 20 mA
analog input range. A failure is determined if the input is above the 'Fail Max'
milliamp level for the 'AnalogIn Fail Delay' time.

AnalogIn 200 Fail Min (mA)   dflt = –5 mA (–5.0 to 100)
Value at which the analog input will be determined as failed, for the 200 mA
analog input range. A failure is determined if the input is below the 'Fail Min'
milliamp level for the 'AnalogIn Fail Delay' time. A value of '–5' disables the
minimum current failure.

AnalogIn 200 Fail Max (mA)   dflt = 250 mA (100 to 250)
Value at which the analog input will be determined as failed, for the 200 mA
analog input range. A failure is determined if the input is above the 'Fail Max'
milliamp level for the 'AnalogIn Fail Delay' time.

AnalogIn Fail Delay (sec)   default = 0.1 sec (0.01 to 10)
Analog input failure delay in seconds.

AnalogIn Filter   default = 0.01 (0.0 to 1.0)
Lag-tau filter adjustment on the analog input.

AnalogOut Offset (mA)   default = 0 mA (–2 to 24)
Offset adjustment, in milliamps, on the analog output current.

AnalogOut Gain   default = 1 (-1.0 to 1.5)
Gain adjustment on the analog output current. The gain is based on the actual
position, at 0% the gain adjustment has no effect. Output in milliamps = (Actual
position in % + 4mA)(Gain) + Offset. Note: The analog output can be reversed
(20-4 mA), if desired, by setting the gain to –1 and offset to 24.

CanIn Fail Min (msg/s)   default = 30 (10 to 100)
Failure adjustment for the CAN demand input. This setting is the minimum
number of messages per second that the ProAct will receive before a failure will
be issued. CAN failure is indicated when the messages drop below the 'Fail Min'
value for the 'Fail Delay' duration. The failure can be a CAN Too Slow or a CAN
No Signal depending on the number of messages received.

CanIn Fail Delay (sec)   default = 0.3 sec (0.1 to 10)
CAN demand signal failure delay in seconds.

This transient current limit and steady state currents are both actively trying to
position the output prior to either min or max stop current limit activation—that is,
prior to this limit engagement the current may reach the transient limit followed by
the steady state limit.

These settings provide integration limits only on the current controller, so the
actual current can exceed this setting. The current error above this setting is
proportional to the demand-to-position error. If the demand continues to increase
(or decrease) once the max (or min) limit is reached, the current will also
increase proportionally. The transient and steady-state current limits are still
active – the current will not exceed these limits.

Demand Track Error (%)   **default = 15% (1.0 to 100)**
Tracking error adjustment for the demand inputs when using redundant demand inputs (both primary and backup). This setting is the maximum difference between the controlling demand and the standby demand in percentage before a tracking alarm will be issued. The difference must exceed the 'Error' percentage value for the 'Error Delay' duration to generate an alarm. A value of '100' will disable the alarm.

Demand Track Error Delay (sec)   **default = 1 sec (0.1 to 10)**
Tracking error delay in seconds—see Demand Tracking Error.

Position Error Max (%)   **default = 10% (1.0 to 110)**
This setting is the maximum difference between the position demand and the actual position in percentage before a position error alarm will be issued. The difference must exceed the 'Error' percentage value for the 'Error Delay' duration to generate an alarm. Note that there is some filtering done internally to model the expected actuator response and minimize nuisance alarms. This setting applies to any Demand source, primary or backup.

Note: The position demand is limited internally between 0 and 100, for position error detection only, to eliminate false position error alarms.

Position Error Delay (sec)   **default = 1 sec (0.1 to 10)**
Position error delay in seconds—see Position Error Max.

PwmIn Fail Min Freq (%)   **default= 85% of nominal freq (50 to 99)**
Value at which the PWM input will be determined as failed. The setting is expressed as a percentage of the nominal frequency set in the Configure Mode (i.e. 85% of a nominal of 1000Hz would equate to a fail level of 850 Hz). A failure is determined if the PWM input frequency is below the 'Fail Min' hertz level for the 'PwmIn Fail Delay' time.

PwmIn Fail Max Freq (%)   **default= 115% of nominal freq (101 to 150)**
Value at which the PWM input will be determined as failed. The setting is expressed as a percentage of the nominal frequency set in the Configure Mode. A failure is determined if the PWM input frequency is above the 'Fail Max' hertz level for the 'PwmIn Fail Delay' time.

PwmIn Fail Min Duty (%)   **default= 5% (1 to 50)**
Duty cycle value at which the PWM input will be determined as failed. A failure is determined if the PWM input duty cycle is below the 'Fail Min' duty cycle level for the 'PwmIn Fail Delay' time.

PwmIn Fail Max Duty (%)   **default= 95% (50 to 99)**
Duty cycle value at which the PWM input will be determined as failed. A failure is determined if the PWM input duty cycle is above the 'Fail Max' duty cycle level for the 'PwmIn Fail Delay' time.

PwmIn Fail Delay (sec)   **default = 0.1 sec (0.01 to 10)**
PWM input failure delay in seconds.

PwmIn Filter   **default = 0.01 (0 to 1)**
Lag-tau filter adjustment on the PWM input.

Stops—Min Stop Bias (deg)   **default = 0.5 degrees (–10 to 10)**
Electrical Stop adjustment in degrees of rotation. This is an actuator range
adjustment setting for an extra "bias" when at the minimum output position. This
value biases the overall 0% demand position. When positive, this setting can
help prevent the ProAct control's current driver from driving the actuator into the
hard stops (mechanical limits) when the stop is reached by effectively moving the
minimum stop position further from the mechanical stops (see also the Current
Limit – Min Stop on the Service Hardware Adjustments tab sheet). Setting this
parameter to a negative value will force the output current to drive into the
mechanical stop harder to ensure the valve is closed. Refer also to the Adjust
User Stops section in the Service Mode.

Stops—Max Stop Bias (deg)   **default = 0.5 degrees (–10 to 10)**
Electrical Stop adjustment in degrees of rotation. This is an actuator range
adjustment setting for an extra "bias" when at the maximum output position. This
value biases the overall 100% demand position. When positive, this setting can
help prevent the ProAct control's current driver from driving the actuator into the
hard stops (mechanical limits) when the stop is reached by effectively moving the
minimum stop position further from the mechanical stops (see also the Current
Limit – Max Stop on the Service Hardware Adjustments tab sheet). Setting this
parameter to a negative value will force the output current to drive into the
mechanical stop harder to ensure the valve is opened. Refer also to the Adjust
User Stops section in the Service Mode.

Monitoring Application Parameters

All pertinent control parameters can be monitored in the Service mode. There are
tab sheets for Unit Status information, Position Control information, Alarm status,
Shutdown status, Error Log, and Temperature Histogram.

Service: Unit Status
The Unit Status tab sheet contains general actuator status information.

Figure 9-11. Service Mode: Unit Status

Mode String—Indication of the current active "mode" of the actuator. Can any one of the following:
>   1 Initialize
>   2 Check Mode
>   3 Shutdown
>   4 Running
>   5 Configure
>   6 Test Mode
>   7 Feedback Sens/Power Fail
>   8 Low Power Standby Mode
>   9 Factory Calib
>   10 User Calibration Mode
>   11 EEPROM Error

Mode Int—Integer indication of the mode string (see above).

ProAct Software Version—Displays the version number of the software installed.

Config ID—Displays the identification of the software system configurables. The default for this parameter is ProAct Digital Plus Configuration, however this string can be edited in the CFG file to a more meaningful name relative to the specific application setup and then downloaded back into the ProAct control.

CAN ProAct Number—Indication of the identification number used in the CAN communication. Based on the status of the CAN ID Hi and Lo discrete inputs at power-up.

Elect Temp (°C)—Indication of the detected electronics temperature in degrees Celsius.

RunTime–Clear Command—Command to clear the accumulated RunTime.

RunTime–Hours—Accumulated runtime hours since the last Run Time Clear command was issued. Time accumulates whenever the unit is powered up and is stored on an hourly basis or if the Low Power Standby Mode discrete input is enabled.

RunTime–100mSec—Accumulated runtime in units of 100 ms (36 000 in an hour). Resets to zero on a power-up or Clear command. Time accumulates whenever the unit is powered-up and is stored on an hourly basis or if the Low Power Standby Mode discrete input is enabled.

Shutdown Command—Command to force the unit into a shutdown condition using the Service Tool. Helpful for entering into modes that require the unit to be shut down, like Configure or Adjust User Stops. This command can be toggled between true and false. When toggled to true, the unit remains in a shutdown state until this parameter is set back to false or the power is cycled on the ProAct.

Status–Alarm—General indication that an alarm condition exists, refer to the Status Error—Alarms tab sheet for the specific alarm condition.

Status–Shutdown—General indication that a Shutdown condition exists, refer to the Status Error—Shutdowns tab sheet for the specific condition.

Status–Low Pwr Stdby—General indication that the unit is in Low Power Standby Mode, refer to the Status Error—Shutdowns tab sheet for the specific condition.

Service: Position Control
The Position Control tab sheet contains position control information.

Figure 9-12. Service Mode: Position Control

Position Demand (%)—Indication of the actual position demand signal, based on unit configuration, in percentage of the user calibrated range.

Actual Posn (%)—Indication of the actual driver shaft output position, in percentage of the user calibrated range.

Actual Posn (deg)—Indication of the actual driver shaft output position, in degrees rotation, relative to absolute shaft position. For models I through IV, full counterclockwise is zero degrees and full clockwise is 75 degrees.

Actual Current (A)—Indication of the actual current, in amps, from the driver to the actuator.

Position Demand Error (%)—Indication of the difference between the demand position and the actual position in percentage of the user calibrated range. This error is filtered based on the internal model to prevent inadvertent alarm indications (see position error alarm).

Primary Demand (%)—Indication of the primary position demand signal, based on unit configuration, in percentage of the user calibrated range. If the primary demand signal is failed, this parameter stops updating.

Backup Demand (%)—Indication of the backup position demand signal, based on unit configuration, in percentage of the user calibrated range. If the backup demand signal is failed, this parameter stops updating.

Primary Control–Control Indication—True if the primary demand is the selected demand signal.

Primary Fault—Indication of the primary demand signal status. True indicates a failed value. This indication does not include a tracking error. The position demand will not transfer from the backup to the primary if a demand tracking error exists.

Backup Control–Control Indication—true if the backup demand is the selected demand signal. Unit will remain in backup control if the primary signal fails and transfers back to primary when the signal is restored and within the tracking error (see Service: Hardware Adjustments).

Backup Fault—Indication of the backup demand signal status. True is failed and false if not. This indication does not include a tracking error.

Demand–Analog Demand (%)—Continuously updated indication, even when failed, of the analog input position demand signal in percentage of the user calibrated range.

Demand–Can Demand (%)—Continuously updated indication, even when failed, of the CAN position demand signal in percentage of the user calibrated range.

Demand–PWM Demand (%)—Continuously updated indication, even when failed, of the PWM input position demand signal in percentage of the user calibrated range.

Xfer to Backup—When set to true, this user command forces the demand signal from primary to the configured backup signal. The force is not performed if the backup demand is failed or if the 'Xfer to Primary' command is true. Used to test primary/backup transfers and to facilitate the code required with the addition of daughter board commands.

Xfer to Primary—User command to transfer control from backup to the configured primary signal (if it's not failed). Normally this would happen automatically if the primary is properly tracking. This command forces transfer to primary even though it may not be tracking the backup within tolerances set in the Service mode. This command overrides the 'Xfer to Backup' command by transferring the demand to primary control and setting 'Xfer to Backup' to false.

Service: Status Errors—Alarms

The Status Errors—Alarms tab sheet contains status information on all monitored actuator alarms. Values that are TRUE, indicate the alarm condition is active. The Alarm indication is non-latching and returns to false when the condition no longer exists. Refer to the Alarm diagnostics in Chapter 6 for details.
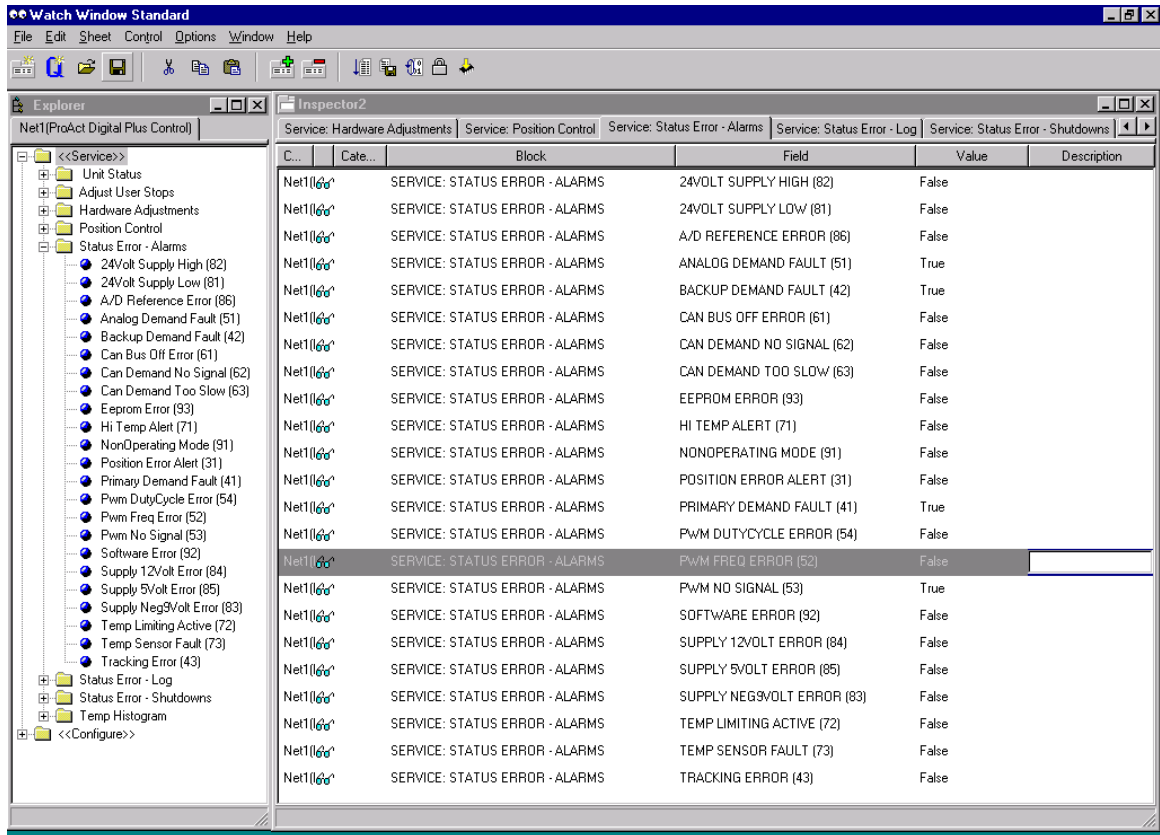
Figure 9-13. Service Mode: Status Error Alarms

Service: Status Errors—Shutdowns
The Status Errors—Shutdowns tab sheet contains status information on all
monitored actuator shutdowns. Values that are TRUE, indicate the shutdown
condition is active—forcing the unit from normal (running) operation into a
shutdown mode. The Shutdown indication is non-latching and returns to false
when the condition no longer exists. Refer to the Shutdown diagnostics in
Chapter 6 for details.
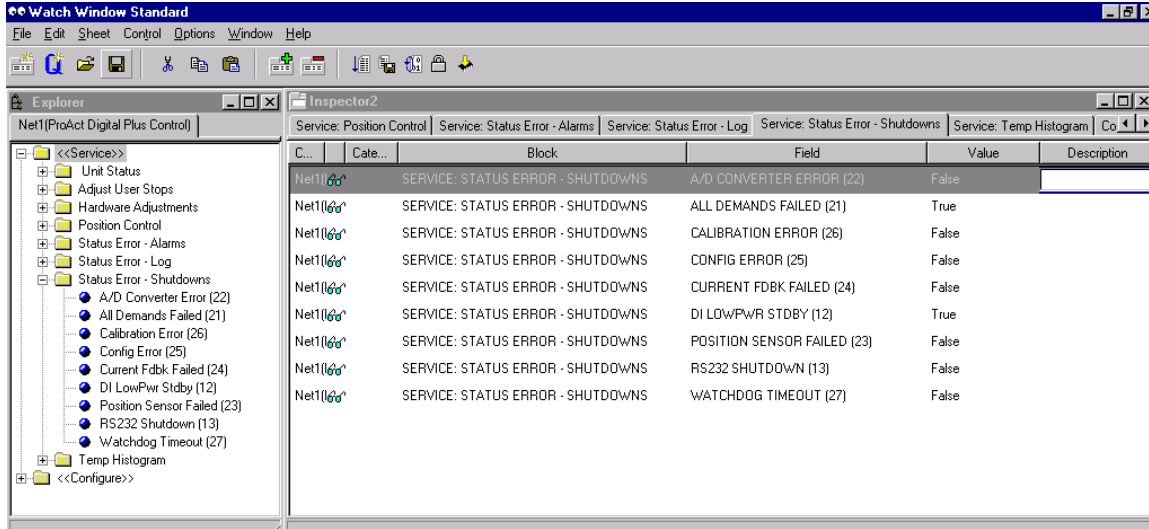
Figure 9-14. Service Mode: Status Error Shutdowns

Service: Status Errors—Log

The Status Errors—Log tab sheet contains the logged status history information. The ErrorLog displays the shutdown and alarm events that occurred since the last "clear" command. It displays the event number, the relative time of the first occurrence, and the number of times this event has been detected. The Error Log changes are saved into non-volatile memory every 100 ms.

Figure 9-15. Service Mode: Status Error Log (1)

Clear ErrorLog—Command to clear the error log of all errors. When issued, all Codes, Counters, and Times are set to zero. When a Clear Error Log is selected, the reset time changes to the present runtime hours (displayed under Unit Status). Errors that exist at the time of the reset are not re-logged, only newly triggered events.

Last Alarm—Event code indication of the last alarm condition.

Last Shutdown—Event code indication of the last shutdown condition.

ErrorLog Reset Time—Time, relative to the Run Time (See Unit Status tab sheet), of the last 'Clear ErrorLog' command.

Entryxx ErrorCode—Integer indication of the detected alarm or shutdown event. The integer corresponds to the number in parentheses listed in the Alarm or Shutdown text, for example 'PWM No Signal (53)' is code 53.

Entryxx Counter—Number of times the entry has been detected since the last time the log was cleared.

Entryxx Time—Time of the first detected occurrence, in hours, relative to how long the unit was running since the last time the log was cleared. The recorded time is based on difference between the RunTime Hours (found under the Unit Status tab sheet) and the ErrorLog Reset Time. For example, if a fault occurs and this is the first occurrence of this fault, the logged time would be 431—assuming RunTime Hours=641 and ErrorLog Reset Time=210. Another example, if the Entryxx Time was 55 and the Reset Time was 200, the time of occurrence was during RunTime hour 255.

If the RunTime is cleared, the runtime is reset to zero. If the run time is less than the reset time, the time in the log will be zero until the runtime exceeds to reset time.
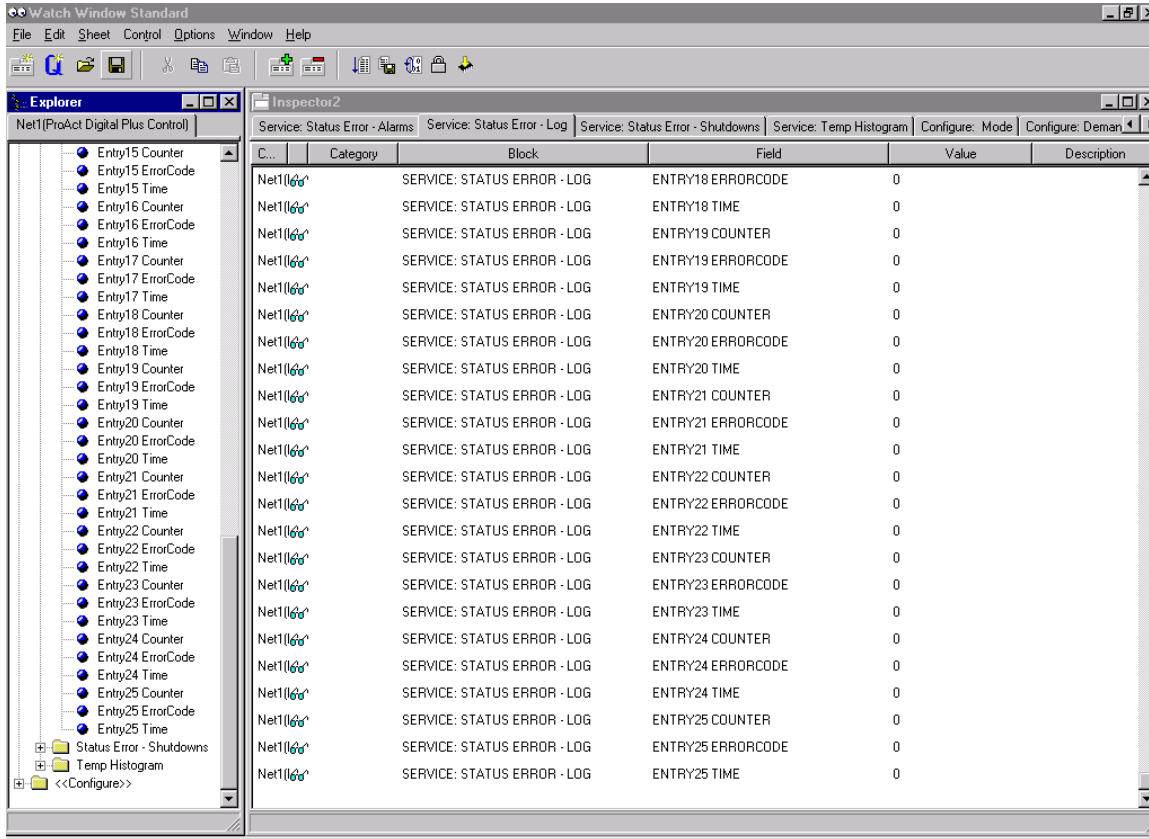
Figure 9-16. Service Mode: Status Error Log (2)

Service: Temp Histogram

The Temp Histogram tab sheet contains the temperature histogram. The temperature histogram provides a historical indication of the electronic temperatures of the unit. The parameter value indicates the number of seconds the unit was within the indicated temperature band. For example, the Field '8 70°C' records the accumulated time the temperature was between 70 and 80 °C. The temperature histogram is saved hourly in EEPROM or if the Low Power Standby Mode discrete input is enabled, and is only cleared if a new software program is downloaded into the unit.
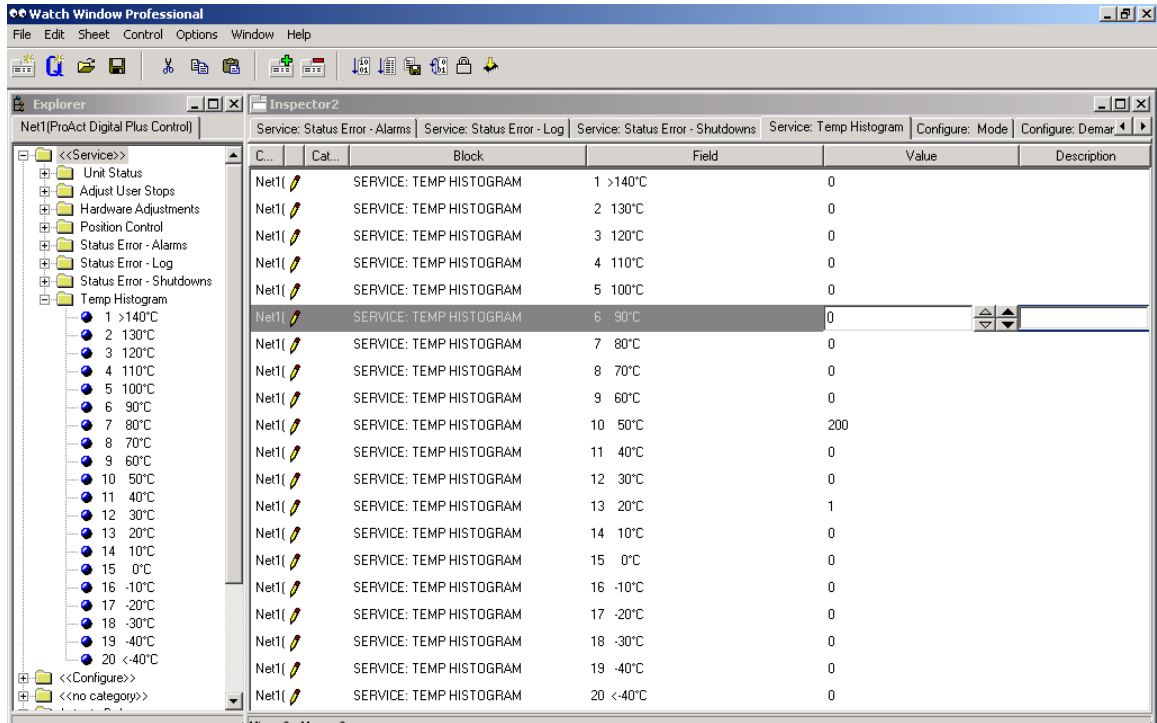
Figure 9-17. Service Mode: Temperature Histogram

Chapter 10.
Troubleshooting

Introduction

Improper engine operation is often the result of factors other than governor operation. This chapter gives tips about engine problems, which can resemble governor problems. Make sure the engine is operating correctly before making any changes in the governor. The following troubleshooting guide is an aid in isolating trouble to the control box, actuator, wiring, or elsewhere. Troubleshooting beyond this level is recommended ONLY when a complete facility for control testing is available.

Attempting to correct engine or load problems with untimely governor adjustment can make problems worse. If possible, isolate the governor from the engine to determine if the problem is with the governor and not with the engine or the load on the engine. Governor faults are usually caused by problems in the installation or the linkage between the actuator and the engine.

Carefully review all the wiring connections, the power supply, and the linkage before making any adjustments to the actuator or driver. Always check the fuel-control linkage from stop to stop as if the actuator were moving it. The linkage must move freely without friction and without backlash. Some fuel controls will present problems at particular fuel or rack positions because of a hesitation or binding in the linkage.

Fuel supply and injector conditions can also present problems, which resemble governor problems. On spark-ignited engines, distributor, coil, points, and timing problems can all cause improper operations, which may resemble faulty governor control.

IMPORTANT	The control can be damaged with the wrong voltage. When replacing a control, check the power supply, battery, etc., for the correct voltage.

Troubleshooting Procedure

This chapter is a general guide for isolating system problems. The guide assumes that the system wiring, soldering connections, switch and relay contacts, and input and output connections are correct and in good working order. Make the checks in the order indicated. Various system checks assume that the prior checks have been properly done.

General System Troubleshooting Guide

The following is a general troubleshooting guide for areas to check which may present potential difficulties. By making these checks appropriate to your engine/turbine before contacting Woodward for technical assistance, your system problems can be more quickly and accurately assessed.

Actuators
Is the actuator wiring correct?
Is the direction of the stroke correct? (This is configured using the Service Tool.)
Has the feedback signal been calibrated? (This is calibrated through the Service Tool.)
Had Load Inertia been set? (This is set using the Service Tool.)

Linkage
Is there slop or lost motion?
Is there misalignment, binding, or side loading?
Is there visible wear or scarring?
Does the linkage move smoothly?

Valves
Does the valve move through its proper stroke smoothly?
Does the valve travel its full stroke?
Can mid-stroke be obtained and held?
Does the valve fully seat (close) before the governor reaches full minimum stroke?
Does the valve fully open before the governor reaches maximum stroke?

Mechanical Troubleshooting Guide

Linkage and Actuator Stroke

Use as much of the 75 degrees of actuator stroke as possible. Carefully follow the guidelines in the Driver Adjustments section of Chapter 2 in making linkage arrangements. Using less than optimum actuator movement will make stability more difficult, and will make the actuator more sensitive to external loading forces and friction.

Actuator exhibits "hunt" or large limit cycle.
Check for loose terminal lever.
Check for loose or worn linkage.
Verify correct mounting hardware.
Verify mounting bolts are tightened to appropriate torque values.
Verify inertia setting.

Unable to rotate stand alone actuator in unpowered condition
Internal mechanical failure—replace actuator.

Electrical Troubleshooting Guide

Analog Input

If the Analog input is not functioning properly, verify the following:
- Measure the input voltage on the terminal block. It should be in the range of 0–5 V.
- Verify that there are no or minimal ac components to the Analog Input signal. AC components can be caused by improper shielding.
- Check the wiring. If the inputs are reading 0 or the engineering units that correspond to 0 mA, look for a loose connection at the terminal blocks and disconnected or misconnected cables. Check for proper jumper installation on the terminal block (JPR1 for 200 mA range and JPR2 for 20 mA range).
- Check for proper jumper installation on the terminal block (JPR1 for 200 mA range and JPR2 for 20 mA range).
- If all of the inputs are reading high, check that the power is not connected across the input directly.
- Check the software configuration to ensure that the input is configured properly as either a primary or backup demand. Verify the Analog In Min and Max Value configurations.
- Check the values seen by the ProAct actuator using the Service Tool in the Service mode under Position Control, Analog Demand. If the input is failed, as indicated by flash code 51, and the milliamp input is in the normal range, check the Service mode settings for Analog In Fail Min and Fail Max.

Analog Output

If the Analog output is not functioning properly, verify the following:
- Check the load resistance, ensure that it is less than the specification limit for the output current.
- Check to ensure that the load wiring is isolated.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- Disconnect the field wiring and connect a resistor across the output. If the output is correct across the resistor, there is a problem with the field wiring.
- If Watch Window Professional is available, the output current can be forced from the Test Mode to verify functionality. In addition, Offset and Gain adjustment are available in the Service Mode.

Discrete Inputs

If a discrete input is not functioning properly, verify the following:
- Measure the input voltage on the terminal block. It should be in the range of 18–28 Vdc.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.

Alarm or Shutdown Conditions

If the ProAct actuator has any alarm or shutdown conditions, refer to Chapter 6 for details on the exact cause of the condition. The LED will indicate a flash code for shutdown conditions. Watch Window or CAN must be used to determine any alarm conditions.

Discrete Output

If the discrete output is not functioning properly, verify the following:
- Measure the output voltage on the terminal block. It should be in the range of 18–28 Vdc when the output is off/false. The voltage will be in this range only if all alarms and shutdowns are false. This can be verified through Watch Window . The output protection circuit will remove this voltage if the output was shorted to ground. This requires a power cycle (off/on) to restore the output once the problem is corrected.
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables.
- If Watch Window Professional is available, the output can be forced on and off from the Test Mode to verify functionality.

Serial (RS-232) Communications

If a serial port is not functioning properly, verify the following:
- Check the wiring, look for a loose connection and disconnected or misconnected cables.
- Check the communication settings, should be set to 19200 baud, 8 data bits, 1 stop bit, and no parity.

Service Tool

If a serial port is not functioning properly, review the installation information in Chapter 8. Verify the following:
- Check the wiring, look for a loose connection and disconnected or misconnected cables. Refer to the Serial (RS-232) Communications troubleshooting above.
- Check that Servlink is running and communicating with the control. Check that Watch Window is running. Verify the Servlink Error settings. If numbers don't appear to be displayed correctly, verify the proper numeric format setting. Refer to Chapter 8 (Service Tool) for details.

CAN Communications

If a CAN port is not functioning properly, verify the following:
- Check the wiring, look for a loose connection at the terminal blocks and disconnected or misconnected cables. Check wiring of termination resistor, if required.
- Check the configured data rate (250, 500, 1000 kbps) in both the ProAct Service Tool and the speed control.
- Verify the appropriate Extension Set is configured.
- Verify the appropriate Device address is utilized. Check the CAN ID discrete inputs—they are only monitored during a power up, so ProAct power may need to be cycled. This parameter can also be verified using the Service Tool and monitor the Service Mode CAN ProAct Number under the Unit Status tab sheet.
- If mis-wired, the CAN driver chip can fail. This could occur when the CAN Hi or Lo connections are inadvertently wired to 30V or more. This failure requires a factory replacement of the CAN driver chip.

Performance Troubleshooting Guide

General Performance Problems

- Verify appropriate Inertia Number is set. Try increasing and testing Inertia Setting to improve performance—refer to the Service Mode: Adjust User Stops tab sheet.
- If Watch Window Professional is available, run the actuator with an internally generated demand (test mode 2) to check for demand signal problems.

If the actuator buzzes, or has a fast limit cycle:
- Set "High Friction Load" = False, found on the Service Mode: Adjust User Stops tab sheet.
- Decrease the Actuator Inertia Setting and re-run the Inertia Test (Service Mode: Adjust User Stops tab sheet).
- Check for loose linkage.

If the actuator overshoots on steps, or is poorly damped:
- Increase the Actuator Inertia Setting and re-run the Inertia Test (Service Mode: Adjust User Stops tab sheet).

If the actuator has a slow limit cycle:
- Set "High Friction Load" = True, found on the Service Mode: Adjust User Stops tab sheet.
- Increase the Actuator Inertia Setting and re-run the Inertia Test (Service Mode: Adjust User Stops tab sheet).
- Free stuck linkage or load.

Actuator has steady state position error:
- Re-run stop position calibration (Service Mode: Adjust User Stops tab sheet).
- Supply voltage too low.
- Actuator load too large or actuator too small.
- Free stuck linkage.
- Actuator fault – replace actuator.

Actuator heats up when against stop:
- Move electrical stops in from mechanical stops by increasing the 'Stops-Min/max Stop Bias' settings found on the Service Mode: Hardware Adjustments tab sheet.
- De-power coil when at min stop.

Actuator has delay when moving off stop:
- Move electrical stops in from mechanical stops by increasing the 'Stops-Min/max Stop Bias' settings found on the Service Mode: Hardware Adjustments tab sheet.
- Increase load inertia and inertia setting.

Actuator maximum stop is inadvertently set lower than the actuator minimum stop:
- Must perform Adjusting User Stops in section 9 (recommend automatic mode)

Chapter 11.
ProAct™ Digital Plus Specifications

Environmental Specifications

Specification Item	Acceptable Range or Qualification Condition	Comments
Operating Temperature	–40 to +85 °C. Under all conditions the Temperature Monitoring Zone must remain below 90 °C.	See Mechanical Installation section of manual for discussion of this specification item.
Storage Temperature	–40 to 125 °C, unpowered.	
Vibration	Sine: 3.2 mm peak-to-peak for 2-39.4 Hz, 10 G for 39.4-300 Hz. Random: 0.01 G²/Hz at 10 Hz, 0.10 at 100 Hz, 0.10 at 1000 Hz, 0.05 at 2000 Hz (12.79 Grms) 3 hours per axis.	
Shock	MS1—40G 11ms sawtooth.	
Ingress Protection	IP56 per IEC60529.	
Humidity	60 °C, 95% RH for five days at one cycle per day.	
Chemical Resistance	The ProAct Digital Plus uses materials proven capable of withstanding normal engine environment chemicals per SAE J1455, such as diesel fuel, engine oil, and antifreeze.	

Hardware Specifications

Feature	Specification	Comments
Shaft	0.625-36 serrations.	
Mass Moment of Inertia (lb-in-sec² / kg-m²)	Model I,II—4.9E-3 / 5.50E-4 Model III—5.6E-3 / 6.4E-4 Model IV—7.2E-3 / 8.1E-4	
Minimum Steady State Work Output	Model I—1.7 J (1.25 ft-lbs) Model II—3.4 J (2.5 ft-lbs) Model III—7 J (5 ft-lbs) Model IV—14 J (10 ft-lbs)	
Minimum Transient Work Output	Model I—3.4 J (2.5 ft-lbs) Model II—7 J (5 ft-lbs) Model III—14 J (10 ft-lbs) Model IV—27 J (20 ft-lbs)	
Rotation	73–77°	
Weight	Model I—25 lbs (11 kg) Model II—25 lbs (11 kg) Model III—32 lbs (15 kg) Model IV—52 lbs (24 kg)	

Electrical Specifications

Feature	Specification
Input Power—max	Model I—67 W (transient) / 19 W (continuous) Model II—251 W (transient) / 65 W (continuous) Model III—282 W (transient) / 73 W (continuous) Model IV—371 W (transient) / 101 W (continuous)
Max Current—Transient (internal current to the actuator coil)	Model I—13 A (transient) / 7 A (steady state) Model II—13 A (transient) / 7 A (steady state) Model III—20.6 A (transient) / 11.3 A (steady state) Model IV—20.6 A (transient) / 11.3 A (steady state)

I/O Specifications

Analog Input

Input type:	4-20 mA or 0-200 mA, jumper selectable, balanced differential input
Max input current (full scale):	25 mA ± 2% (20mA range) 225 mA ± 2% (200mA range)
Common mode rejection:	–60 dB minimum
Input common mode range:	±50 V minimum
Safe input common mode volt:	±200 V minimum
Input impedance:	225 Ω (±10%) (20mA range) 25 Ω (±10%) (200mA range)
Anti-aliasing filter:	2 anti-aliasing poles at 1 ms (159 Hz)
Resolution:	12 bits (using Gaussian Noise)
Accuracy:	±1.5% of full scale, @ 25 °C
Temp Drift:	300 ppm/°C, maximum (1% of full scale)
I/O Latency:	2 ms
Fault Detection:	Service Mode software setting

PWM Command Input

Input Magnitude:	7–32 V balanced differential input
Frequency Range:	100–3000 Hz
Isolation:	none
Input common mode range:	±50 V minimum
Safe input common mode volt:	±50 V minimum
Input Impedance:	40 kΩ
Input type:	Single ended, ground referenced input
Resolution:	12 bits
Accuracy:	±1.5% of full scale, @ 25 °C
Temperature drift:	300 ppm/°C
I/O Latency:	2 ms
Fault Detection:	Service Mode software settings for both Frequency and Duty Cycle

Analog Output

Output Type:	4–20 mA, non-isolated, high side driver output
PWM frequency:	6 kHz
Current output:	4–20 mA
Max current output:	25 mA ± 5%
Output common mode voltage:	24 Vdc
Min. load resistance:	0 Ω
Max. load resistance:	335 Ω at 22 mA with base power supply
Resolution:	10 bits
Accuracy:	±1.5% of full scale at 25 °C
Temperature Drift:	250 ppm/°C, maximum
I/O Latency:	10 ms

Discrete Inputs

Input type:	Ground referenced discrete input
Input Thresholds:	< 2 Vdc = "ON"
	> 7 Vdc = "OFF"
Input Current:	1.2 mA @ 0 Vdc
Contact Input:	Referenced to battery negative
Max Input Voltage:	32 Vdc

Discrete Output

Output type:	High side discrete output driver
Functionality:	Status indicator, output will energize on failure
Drive current:	500 mA, max (with a 48 Ω load)
Load range:	48 Ω to 100 kΩ
Protection:	Short circuit protection will remove output power, when activated, and requires a power cycle to clear

CAN Communication

Type:	2-wire CAN, version 2.0B, with 29-bit identifiers
Protocol:	Complies with SAE J1939, but uses proprietary group extensions
Configurable data rate of:	250 kbps, 500 kbps and 1 Mbps
CAN termination:	Jumper selectable termination resistor (125 Ω)
Bus length:	

Data Rate (bps)	Maximum Length meters (feet)
250 k	250 (820)
500 k	100 (328)
1 M	40 (131)

Fault Detection:	Service Mode software settings

RS-232 Serial Communication Service Port

Isolation:	None
Baud Rate:	Fixed 19.2 Kbaud
Mechanical Interface:	9-pin sub-D male connector
Pinout:	Tx = pin 2, Rx = pin 3, Gnd = pin 5
Maximum Cable Length:	15 m (50 ft)

Electronics Temperature Sensor

Accuracy:	±1 °C at 25 °C ambient
	±2 °C over full range (–40 to +125 °C)
I/O Latency:	100 ms

Current Feedback Sensing

Input:	±29.9 A
Circuit Output:	0–5 Vdc to analog-to-digital converter
Software Output:	±29.9 A reading
Accuracy:	±1.5% of full scale at 25 °C
Temperature Drift:	400 ppm/°C, maximum
I/O Latency:	1ms

Actuator Model	Coil Resistance @ 22 °C (Ohms)	Coil Inductance @ 5 Hz (mH)	Steady State Current to Coil (Amps)	Transient Current to Coil (Amps)
I	0.254	10	6	12
II	1.02	42	6	12
III	0.420	26	10	20
IV	0.600	50	10	20

Position Feedback Sensing

Input:	~1–4 Vdc from Hall-Effect Sensor
Circuit Output:	~0.5–4.5 Vdc to analog-to-digital converter
Software Output:	0–75 degrees (1.31 radians) rotation (software assumes 75 degrees travel)
Positioning Repeatability:	<±1% of full stroke at 25 °C after calibration
Positioning Linearity:	<±1.5% of full stroke at 25 °C after calibration
Positioning Accuracy:	<±1.0% of full stroke at 25 °C after calibration and ±1.5% linearity
Temperature Drift:	<±350 ppm/°C, maximum after calibration
I/O Latency:	1ms

Software

Microprocessor:	Motorola 68376 Microcontroller 20 MHz
Execution Rates:	

Software Routine	Nominal Software Execution Rate
Position and Current Control Algorithms	1 ms
Analog Output	10 ms
Position Demand Algorithms	2 ms
Analog Input Logic	2 ms
PWM Input Logic	2 ms
CAN Demand Signal	2 ms
CAN Transmissions	100 ms
Temperature Sensing and current limiting	100 ms
Temperature Histogram	1 s
Serial Port	background task
LED	background task
Discrete Inputs: Run Enable (Low Power Standby Mode) Can ID Lo and Hi	5 ms only on power up
Jumper Input (4-20/20-180mA)	only on power up
Discrete Output	1 ms
Diagnostics: Current and Position sensor faults Demand signal faults* Position Error Low Power Standby Mode A/D Converter error Voltage Errors Watchdog Timeout Tracking Fault CAN Faults Temperature Faults RS-232 (Servlink) Shutdown	1 ms 2 ms 10 ms 10 ms 100 ms 100 ms 100 ms 100 ms 100 ms 100 ms background task

* Execution of PWM input faults varies with the sampling frequency of the PWM input. The sampling frequency is based on the lowest detectable frequency and is defined as the (Nominal Freq*Fail Min Freq*0.8).

PWM Sampling Freq (Hz) Fault Execution Rate (ms)

PWM Sampling Freq (Hz)	Fault Execution Rate (ms)
501+	2
251-500	4
126-250	8
63-125	16
31-62	32
15-30	64

Performance

Parameter	Specification
Bandwidth	(measured at -6 db) > second order, 40 rad/s –3 db at >8 Hz with low inertia. See ProAct Transfer Function
Max Slew Rate	> 1000 degrees/second >18.5 rad/s (10% to 90% travel)
Limit Cycle	< 0.25 degrees peak to peak with low friction loads
Steady State Error	<0.1 degree for loads up to 80% of steady state current limit. Integrating control drives steady state error to zero.
Inertia Range	Adjusts to work with 450:1 range of (actuator + load) inertia.
Min Load Inertia	0

Transfer Function

The ProAct transfer function is nominally a rate limit followed by three lags. The rate limit varies with actuator model, and the lags are scheduled with actuator model and inertia (see table, below).
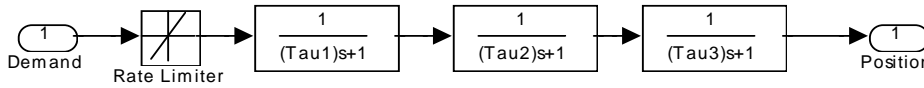

Figure 11-1. Transfer Function

Inertia Number Setting			Time Constants [seconds]		
ProAct I & II	**ProAct III**	**ProAct IV**	**Tau 1**	**Tau 2**	**Tau 3**
> 21	> 23	> 22	0.0333	0.0222	0.0077
18 – 21	20 – 22	19 – 21	0.0286	0.0182	0.0100
15 – 17	17 – 19	16 – 19	0.0222	0.0167	0.0100
9 – 14	12 – 15	11 – 15	0.0200	0.0111	0.0083
6 – 8	9 – 11	8 – 10	0.0167	0.0083	0.0071
3 – 6	6 – 8	5 – 7	0.0133	0.0071	0.0063
< 3	< 6	< 5	0.0118	0.0071	0.0063

Table 11-1. Transfer Function Parameters

Rate Limiter Values:

ProAct I:	3750 deg/sec
ProAct II:	1923 deg/sec
ProAct III:	1595 deg/sec
ProAct IV:	797 deg/sec

Inertia Settings

Inertia=Base_Inertia*1.25^InertiaNumber
The actuator with no load has inertia = Base_Inertia

ProAct Size	**Base_Inertia**
ProAct I	4.3e-4 kg-m^2 (or N-m-sec^2)
ProAct II	4.3e-4 kg-m^2
ProAct III	5.1e-4 kg-m^2
ProAct IV	6.5e-4 kg-m^2

Chapter 12.
Service Options

Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and 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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available by searching on "*25225*" or "*worldwide directory*" at:
www.woodward.com/searchpublications.aspx

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:
- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in "like-new" condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

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

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.
- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems	Engine Systems	Turbine Systems
Facility---------------Phone Number	**Facility---------------Phone Number**	**Facility---------------Phone Number**
Brazil ------------ +55 (19) 3708 4800	Brazil ------------ +55 (19) 3708 4800	Brazil ------------ +55 (19) 3708 4800
China ----------- +86 (512) 6762 6727	China ----------- +86 (512) 6762 6727	China ----------- +86 (512) 6762 6727
Germany--------- +49 (0) 21 52 14 51	Germany--------- +49 (711) 78954-0	India ---------------+91 (129) 4097100
India ---------------+91 (129) 4097100	India ---------------+91 (129) 4097100	Japan-------------- +81 (43) 213-2191
Japan-------------- +81 (43) 213-2191	Japan-------------- +81 (43) 213-2191	Korea -------------- +82 (51) 636-7080
Korea -------------- +82 (51) 636-7080	Korea -------------- +82 (51) 636-7080	The Netherlands- +31 (23) 5661111
Poland---------------+48 12 295 13 00	The Netherlands- +31 (23) 5661111	Poland---------------+48 12 295 13 00
United States ---- +1 (970) 482-5811	United States ---- +1 (970) 482-5811	United States ---- +1 (970) 482-5811

You can also contact the Woodward Customer Service Department or consult our worldwide directory (search on "**25225**" or "**worldwide directory**" at: **www.woodward.com/searchpublications.aspx**) for the name of your nearest Woodward distributor or service facility.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
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	

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.
ProAct™ Program Summary

APPLICATION _____

ACTUATOR SERIAL NUMBER _____

For details on individual settings refer to chapter 9.

Configure Mode Settings

Unit Setup tab sheet
Actuator
Actuator Type   = _____
Actuator CCW Direction?   Yes _____ No _____
Actuator Inertia Setting   = _____
High Friction System?   Yes _____ No _____
Discrete Out
Discrete Out Alarms Enabled?   Yes _____ No _____
Discrete Out Includes Runenable? Yes _____ No _____
Shutdown
Shutdown Action   = _____
Temp Limit
Temp Protect Enable?   Yes _____ No _____
Temp Alarm SP (°C)   = _____
Temp Alarm Delay (sec)   = _____

Demand Setup tab sheet
Demand
Demand – Primary Source   = _____
Demand – Backup Source   = _____
Analog In
AnlgIn 20 Min Value (mA)   = _____
AnlgIn 20 Max Value (mA)   = _____
AnlgIn 200 Min Value (mA)   = _____
AnlgIn 200 Max Value (mA)   = _____
PwmIn
PwmIn Min Duty (%)   = _____
PwmIn Max Duty (%)   = _____
PwmIn Frequency (Hz)   = _____
PwmIn Invert Input Signal?   Yes _____ No _____
CAN
CAN Extensions   = _____
CAN Data Rate   = _____

Service Mode Settings

Hardware Adjustments tab sheet
Analog In
AnalogIn Fail Delay (sec)   = _____
AnalogIn Filter   = _____
AnalogIn 20 Fail Min (mA)   = _____
AnalogIn 20 Fail Max (mA)   = _____
AnalogIn 200 Fail Min (mA)   = _____
AnalogIn 200 Fail Max (mA)   = _____
PwmIn
PwmIn Fail Delay (sec)   = _____
PwmIn Filter   = _____
PwmIn Fail Min Freq (%)   = _____
PwmIn Fail Max Freq (%)   = _____
PwmIn Fail Min Duty (%)   = _____
PwmIn Fail Max Duty (%)   = _____
Demand
Demand Track Error (%)   = _____
Demand Track Error Delay (sec)   = _____
Position Control
Position Error Max (%)   = _____
Position Error Delay (sec)   = _____
Analog Out
Analog Out Offset (mA)   = _____
Analog Out Gain   = _____
Stops
Stops—Min Stop Bias (deg)   = _____
Stops—Max Stop Bias (deg)   = _____
CAN
CanIn Fail Delay (sec)   = _____
CanIn Min (msg/s)   = _____

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Service Tool Passwords

Documentation of the Service Tool passwords is provided here to allow customers a single point of reference as well as a single page to remove for security, if desired.

Mode	Password
Configure Mode	1113
Test Mode	1114
Factory Calibration Mode	1115
User Stops Mode	1116

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Summary of Alarms and Shutdowns

Servlink Variable	Code	Flash	Auto Clear
Service:Status Error—Shutdowns			
DI LowPwr Stdby (12)	12	12	yes
RS232 Shutdown (13)	13	13	yes
All Demands Failed (21)	21	21	yes
A/D Converter Error (22)	22	22	no
Posn Sensor Failed (23)	23	23	no
Current Fdbk Failed (24)	24	24	no
Config Error (25)	25	25	yes
Calibration Error (26)	26	26	yes
Watchdog Timeout (27)	27	27	yes
Service:Status Error—Alarms			
Position ErrorAlert (31)	31		yes
Primary Demand Fault (41)	41		yes
Backup Demand Fault (42)	42		yes
Tracking Error (43)	43		yes
Analog Dmd Fault (51)	51		yes
Pwm Freq Error (52)	52		yes
Pwm Duty Error (53)	53		yes
Pwm No Signal (54)	54		yes
Can Bus Off Error (61)	61		yes
Can Dmd No Signal (62)	62		yes
Can Dmd Too Slow (63)	63		yes
Hi Temp Alert (71)	71		yes
Temp Limiting Active (72)	72		yes
Temp Sensor Fault (73)	73		yes
24V Supply Low (81)	81		yes
24V Supply High (82)	82		yes
Supply 12Volt Error (83)	83		yes
Supply Neg9Volt Error (84)	84		yes
Supply 5Volt Error (85)	85		yes
Reference Voltage Error (86)	86		yes
NonOperating Mode (91)	91		yes
Software Error (92)	92		no
EEPROM Error (93)	93		no

Revision History

Changes in Revision R—

- Updated Regulatory Compliance information
- New Declaration of Conformity & Declaration of Incorproation
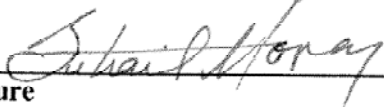
DECLARATION OF CONFORMITY

Manufacturer's Name:	WOODWARD, INC
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	ProAct Digital Plus Actuator 8404-001 and similar
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.
Marking(s):	C E
Applicable Standards:	EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61000-6-4, 2007: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Suhail Horan

Signature

Suhail Horan

Full Name

Quality Manager

Position

Woodward, Inc, Fort Collins, CO, USA

Place

08 - July - 2011

Date

Declaration of Incorporation

Woodward, Inc
1000 E. Drake Road
Fort Collins, Colorado 80525
United States of America
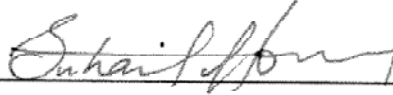
Product: ProAct Digital Plus Actuator
Part Number: 8404-001, 8404-002, 8404-003, 8404-004 and similar

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado, that the above-referenced product is in conformity with the following EU Directives as they apply to a component:

2006/42/EC (Machinery)

This product is intended to be put into service only upon incorporation into an apparatus/system that itself will meet the requirements of the above Directives and bears the CE mark.

MANUFACTURER

_____
Signature

Suhail Horan
_____
Full Name

Engineering Manager
_____
Position

Woodward, Inc, Fort Collins, CO, USA
_____
Place

08-July-2011
_____
Date

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26112R.

WOODWARD