

723PLUS Digital Marine Control

Woodward Part Number 8280-1109

**Two-Engine Redundant LON Torque Sharing
Marine Propulsion Application**

Installation and Operation Manual



General Precautions

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

Practice all plant and safety instructions and precautions.

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



Revisions

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.



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The original source of this publication may have been updated since this translation was made. Be sure to check manual **26311**, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

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Warnings and Notices

Important Definitions



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

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

WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

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

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

WARNING

Start-up

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

WARNING

Automotive Applications

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

NOTICE**Battery Charging
Device**

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

Electrostatic Discharge Awareness

NOTICE**Electrostatic
Precautions**

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

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

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

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
 - Do not touch any part of the PCB except the edges.
 - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
 - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

European Compliance for CE 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.

This controlling device, manufactured by Woodward, is applied solely as a component to be incorporated into a larger, prime mover, system. Woodward declares that this controlling device complies with the EMC Directive requirements when put into service per the installation and operating instructions outlined the product manual. All wiring must also follow the wiring and shielding requirements given in the specific, separate, software manual.

IMPORTANT

This controlling device is intended to be put into service only upon incorporation into a prime mover system that itself has met the requirements of the above Directive and bears the CE mark.

Low Voltage Directive Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

North American Compliance

UL UL Listed for Class I, Division 2, Groups A, B, C, and D, T4A at 70 °C ambient for use in the United States and Canada: UL File E120143.
These listings are limited to those units bearing the UL or DEMKO agency identifications.

WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

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

AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

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

IMPORTANT

Installation wiring must be in accordance with Class I, Division 2 wiring methods in Article 501–4(b) of the NEC, and in accordance with the authority having jurisdiction.

IMPORTANT

All peripheral equipment must be suitable for the location in which used.

Safety Related Installation Limitations

- Wiring must be in accordance with North American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.
- Field wiring must be suitable for at least 75 °C for operating ambient temperatures expected to exceed 50 °C.
- A fixed wiring installation is required.
- Do not connect more than one main power supply to any one fuse or circuit breaker.
- Connect ground screw to earth ground (see Figures 1-1a, 1-1b).

Marine Type Approval Compliance

American Bureau of Shipping (ABS)	2007 Steel Vessel Rules 1-1-4/7.7, 4-2-1/7.3, 4-2-1/7.5.1, 4-9-3/17, 4-9-7/13, 4-9-2/11.7 & 4-9-4/23 (Low Voltage Models only)
Bureau Veritas (BV)	Certified for Environmental Category EC Code: 33 Certified for use on AUT-UMS, AUT-CSS, AUT-PORT and AUT-IMS Classed Vessels
Det Norske Veritas (DNV)	Certified for Marine Applications, Temperature Class B, Humidity Class A, Vibration Class B, EMC Class A, and Enclosure Class B per DNV Rules for Ships Pt. 4, Ch. 9 Control and Monitoring Systems and Pt. 4, Ch.'s 2 & 3, Rotating Machinery
Germanischer Lloyd (GL)	Environmental Category C; EMC2 per Type Tests Part 2, Edition 2003: Regulations for the Use of Computer and Computer on Board
Lloyd's Register (LR)	LR Type Approval Test Specification No. 1:1996 for Environmental Categories ENV1, ENV2, and ENV3
Nippon Kaiji Kyokai (NKK)	Rules Ch. 1, Part 7, of Guidance for the approval and Type approval of materials and equipment for marine use and relevant Society's Rules (Low Voltage Models only)
Registro Italiano Navale (RINA)	RINA Rules for the Classification of Ships – Part C Machinery, Systems and Fire Protection – Ch. 3, Sect. 6, Tab. 1.

Chapter 1.

General Information

Introduction

This manual describes the Woodward 723PLUS Digital Marine Speed Control for two-engine mechanical torque sharing with using LonWorks® * communications,

Application

The 723PLUS Digital Marine Speed Control is designed to control clutching functions and to regulate the speed and load of diesel engines in dual-engine marine applications that require mechanical torque sharing. The applications include mechanically combined two-engine operation for main propulsion, including those with flexible couplings (see Figure 1-2).

Features include:

- Clutch control and permissive logic
- Soft loading and unloading
- Mechanical torque sharing by matching torque sensor inputs
- Advanced speed-sensing algorithms
- Firing torsional filtering
- Start fuel limiting
- Torque sensor failure mode which retains torque sharing
- Single-throttle operation for both engines during clutched operation
- Redundant control LON® * communication
- Watch Window communications port

*—LON and LonWorks are trademarks of Echelon Corporation

Inputs include:

- Two magnetic pickups (MPUs) or proximity switches for sensing engine speed, capable of providing redundant speed signals
- 1–5 Vdc remote speed-setting input
- 4–20 mA torque sensor input
- 1–5 Vdc remote speed input
- Eight discrete inputs (contact inputs) for Run/Stop, Clutch Request, Clutch Position, Maneuvering Speed, and Alarm Reset.
- Redundant Control LON channels to perform mechanical torque sharing and communicate essential control status to the mating control for proper clutching and loading operations.

Outputs include:

- Two 4–20 mA outputs which are set for: engine speed and rack position.
- One 0–200 mA actuator output compatible with most Woodward actuators
- One relay output for clutch permissive/close contact out
- Two Alarm relay outputs: each is user-configurable for normally open/closed contact output. There are status choices to choose among for these two alarms.
- Three serial ports. Port J1 is switchable to be a Watch Window PC interface or a hand-held programmer port for monitoring and programming the 723PLUS control. Ports J2 and J3 are Watch Window only ports.

The 723PLUS control provides multiple functions including speed governing, mechanical torque sharing, clutching/de-clutching control logic, speed matching during clutching, and soft engine loading/unloading. Each engine requires a 723PLUS control along with the associated I/O connections, transducers, and accessories (see Figure 1-2).

The 723PLUS control uses a master/slave relationship during clutching and torque sharing operations. The master unit is the first unit to close its clutch. The slave unit is the last unit to close its clutch. The primary function of the 723PLUS control is speed control. Once the engines are clutched together, the primary function becomes torque sharing, utilizing the master control's speed reference for both engines. The engine clutching/torque sharing process, which begins with closure of the Clutch Request discrete input, includes matching (synchronizing) the engine speeds and then giving a clutch permissive command. Once clutched, the engine is soft-loaded until the engines' torques are balanced. The engines will maintain equal torques (torque sharing) during clutched operation. During a de-clutching operation, the de-clutching engine is soft unloaded and, a de-clutch-command is given when the engine is at the unload trip level. This is a simplified description. For a more detailed description, see Chapter 3, Description of Operation.

The 723PLUS control (Figure 1-1) consists of a single printed circuit board in a sheet metal chassis. Connections are via three terminal strips and three 9-pin subminiature D connectors. The 723PLUS control should be located in a protected location. See Woodward manual 02877, 723PLUS Digital Control Hardware, for installation details.

Control Options

Each 723PLUS control requires 40 W of power. A nominal in-rush current of 7 A is possible. Acceptable input voltage range is 18 to 40 Vdc.

Discrete input voltages provide on/off command signals to the electronic control, such as Run/Stop, De-Clutch Request, etc. Each discrete input requires 10 mA at its 24 Vdc nominal voltage rating (2210 W load).

Other control options (on-board jumper configurations):

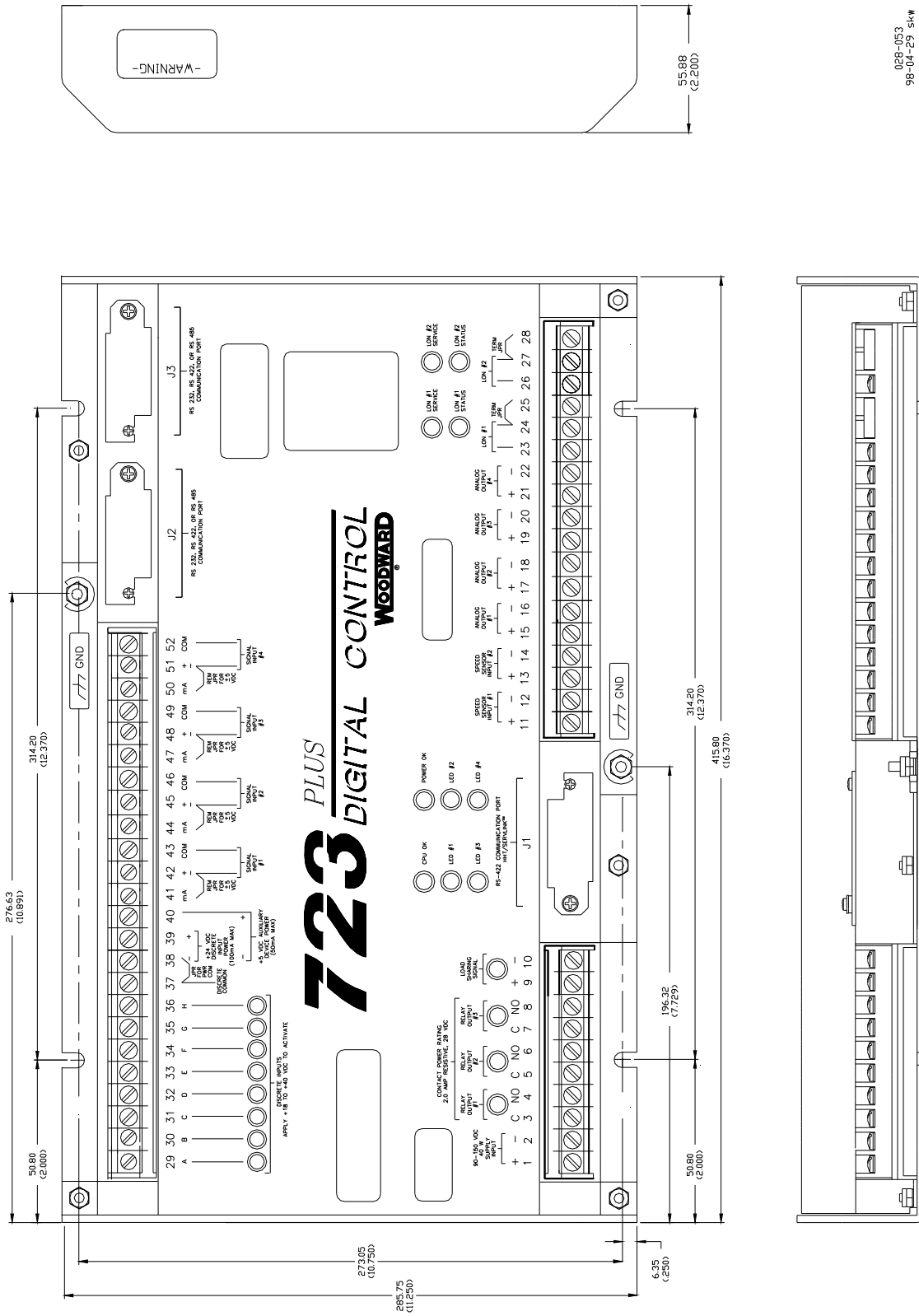
- Proximity switch input for speed signal frequencies below 400 Hz
- 0–1 or 4–20 mA analog outputs
- 4–20 or 0–200 mA actuator outputs

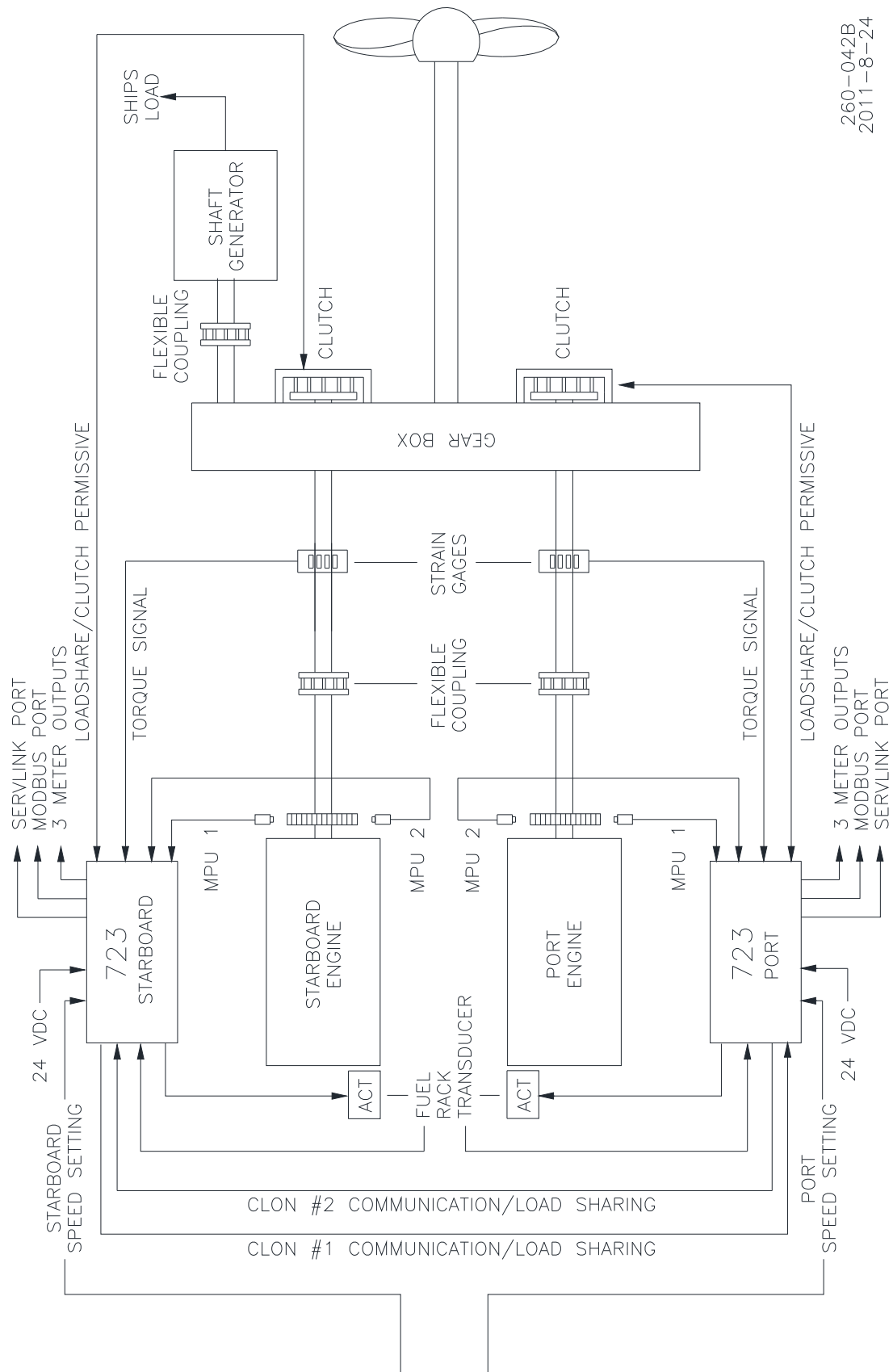
Magnetic pickup inputs should provide at least a 400 Hz frequency at minimum operating speed.

723PLUS Digital Speed Control Accessories

PC based Watch Window software (part number 8923-932) or a Hand Held Programmer (part number 9907-205) are used for adjusting software parameters of the 723PLUS control, including the software options. The RS-232/RS-422 download cable (part number 5416-870) or Hand Held Programmer plug into communication port J1 of the control. Hand Held Programmer part number 9905-292 can also be used. See Figure 1-6.

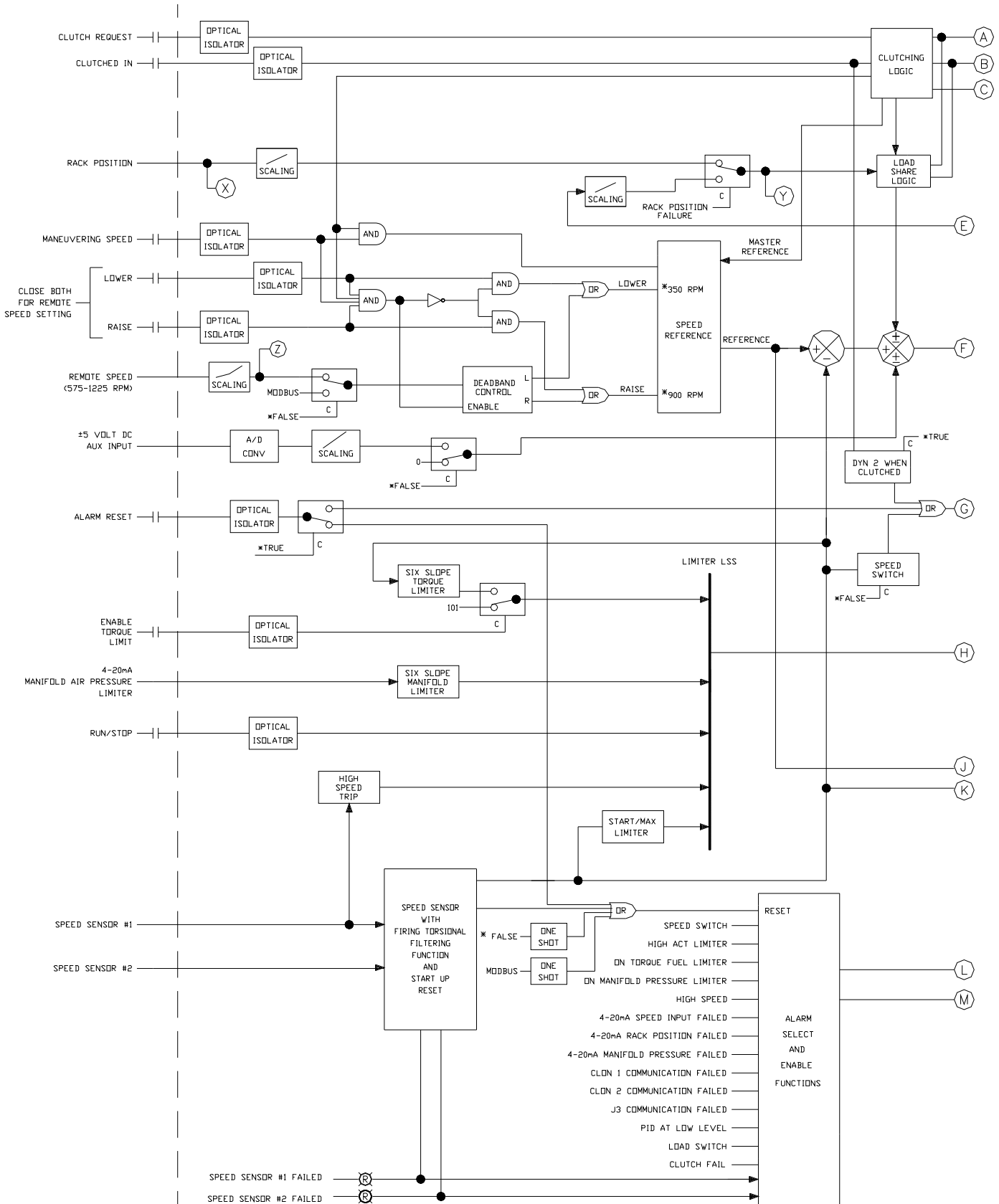
As an alternate, an RS-232 cable (part number 5416-614) may be plugged into communication port J2 of the control to use the PC based Watch Window software (see manual 26007 Getting Started for using the Watch Window software).





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Figure 1-2. 723PLUS Marine Torque Sharing System



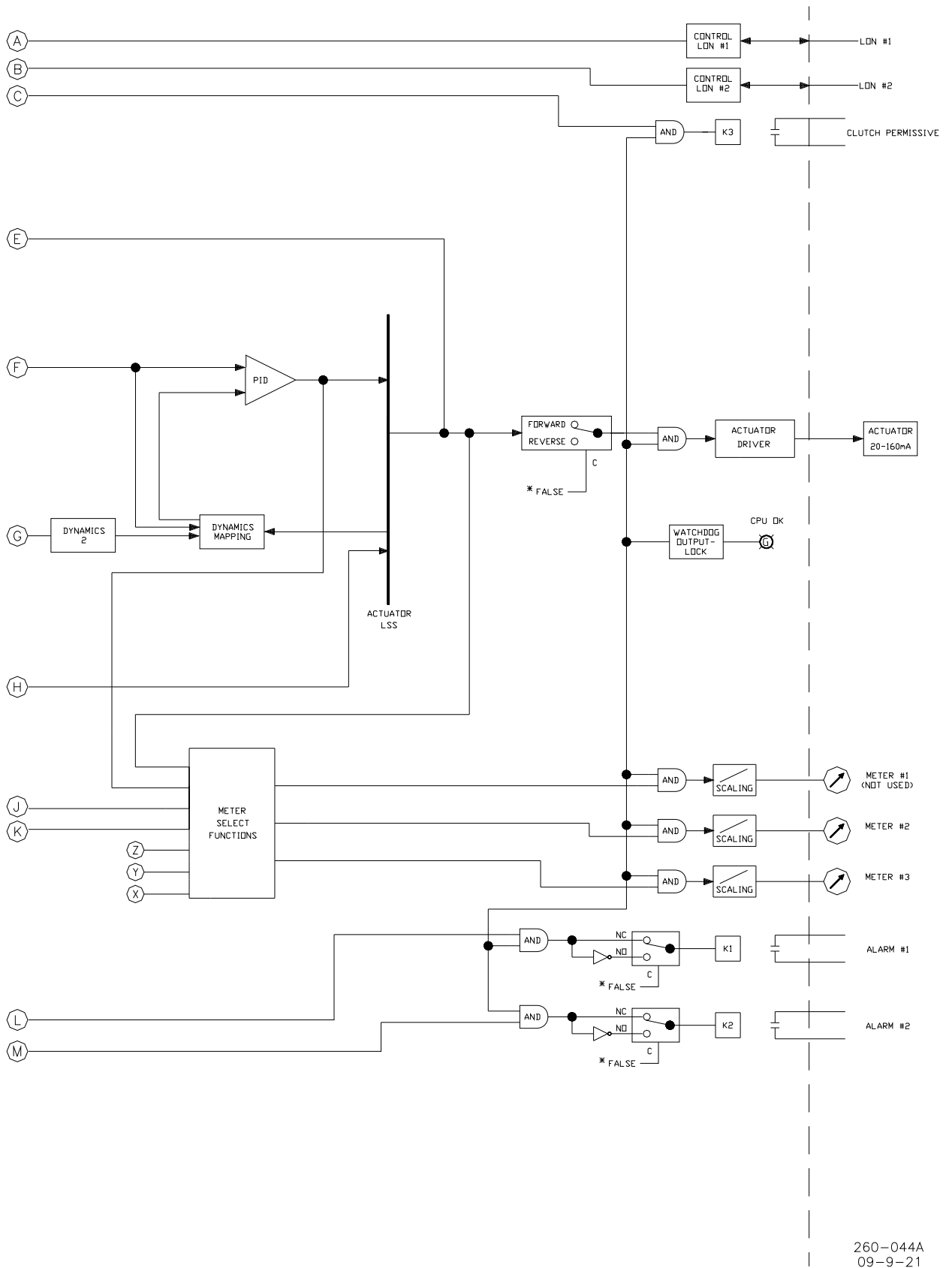


Figure 1-3. Functional Block Diagram

NOTES:

- 1 SHIELDED WIRES ARE TWISTED PAIRS, WITH SHIELD GROUNDED AT ONE END ONLY. WHEN MOUNTING CONTROL TO BULKHEAD, USE THE GROUNDING STUD AND HARDWARE SUPPLIED WITH THE CHASSIS TO ENSURE PROPER GROUNDING.
2. SHIELDS MUST NOT BE GROUNDED AT ANY EXTERNAL POINT UNLESS OTHERWISE NOTED.
3. ALL SHIELDS MUST BE CARRIED CONTINUOUSLY THROUGH ALL TERMINAL BLOCKS AND MUST NOT BE TIED TO OTHER SHIELDS EXCEPT AT THE COMMON GROUND POINT. THE SHIELDS ARE TIED TOGETHER AT THE GROUND STUD.
- 4 REMOVE JUMPER FOR VOLTAGE INPUT.
- 5 A. INTERNAL POWER SUPPLY--ADD JUMPER FROM TERMINAL 37 TO 38.
B. EXTERNAL POWER SUPPLY--REMOVE JUMPER FROM TERMINAL 37 TO 38.
- 6 DISCRETE INPUTS ARE ISOLATED FROM OTHER CIRCUITS AND CAN BE POWERED BY TERMINAL 39 (+24 VDC) BY LEAVING THE JUMPER ACROSS TERMINAL 37 TO 38.
- 7 ALL RELAY OUTPUTS WILL OPEN ON LOSS OF CONTROL POWER.
- 8 ANALOG OUTPUT SIGNALS TO OTHER SYSTEMS MUST BE ISOLATED FROM GROUND EITHER BY DESIGN OR EMPLOYMENT OF ISOLATION AMPLIFIERS.
- 9 ANALOG INPUT SIGNALS FROM OTHER SYSTEMS MUST BE ISOLATED FROM GROUND EITHER BY DESIGN OR EMPLOYMENT OF ISOLATION AMPLIFIERS. INPUTS MUST BE EXTERNALLY POWERED.
- 10 FACTORY SET FOR MPU INPUT.
- 11 FACTORY SET FOR 0–200 mA OUTPUT. OUTPUTS ARE INTERNALLY POWERED. DO NOT PROVIDE EXTERNAL POWER.
- 12 FACTORY SET FOR 4–20 mA OUTPUT. OUTPUTS ARE INTERNALLY POWERED. DO NOT PROVIDE EXTERNAL POWER.
- 13 INTERNAL POWER SUPPLY PROVIDES DC ISOLATION BETWEEN THE POWER SOURCE AND ALL OTHER INPUTS AND OUTPUTS.
- 14 COMMUNICATION PORT J1:
A. HAND HELD PROGRAMMER--OPEN CONTACT ACROSS TERMINALS 9 & 10.
B. PERSONAL COMPUTER--CLOSE CONTACTS ACROSS TERMINALS 9 & 10.
1. PERSONAL COMPUTER MUST HAVE WATCH WINDOW SOFTWARE
2. NEED DOWNLOAD CABLE #5416–870 TO CONNECT FROM J1 (RS–422) TO PERSONAL COMPUTER (RS–232)
- 15 COMMUNICATION PORT J2 CAN BE CONFIGURED AS RS–232 OR RS–422 SERIAL INTERFACE.
COMMUNICATION PORT J3 CAN BE CONFIGURED AS RS–232, RS–422, OR RS–485 SERIAL INTERFACE.
PIN ASSIGNMENT OF J2 AND J3, SEE APPENDIX A.
- 16 THE LON MUST BE CONNECTED USING THE PROPER CABLE, AS DESCRIBED IN CHAPTER 3.
- 17 LON NETWORKS MUST BE PROPERLY TERMINATED. THIS CAN BE DONE BY INSTALLING JUMPERS FROM TERMINALS 24 TO 25 FOR LON #1, AND TERMINALS 27 TO 28 FOR LON #2. REFER TO CHAPTER 3 FOR FURTHER DETAILS.

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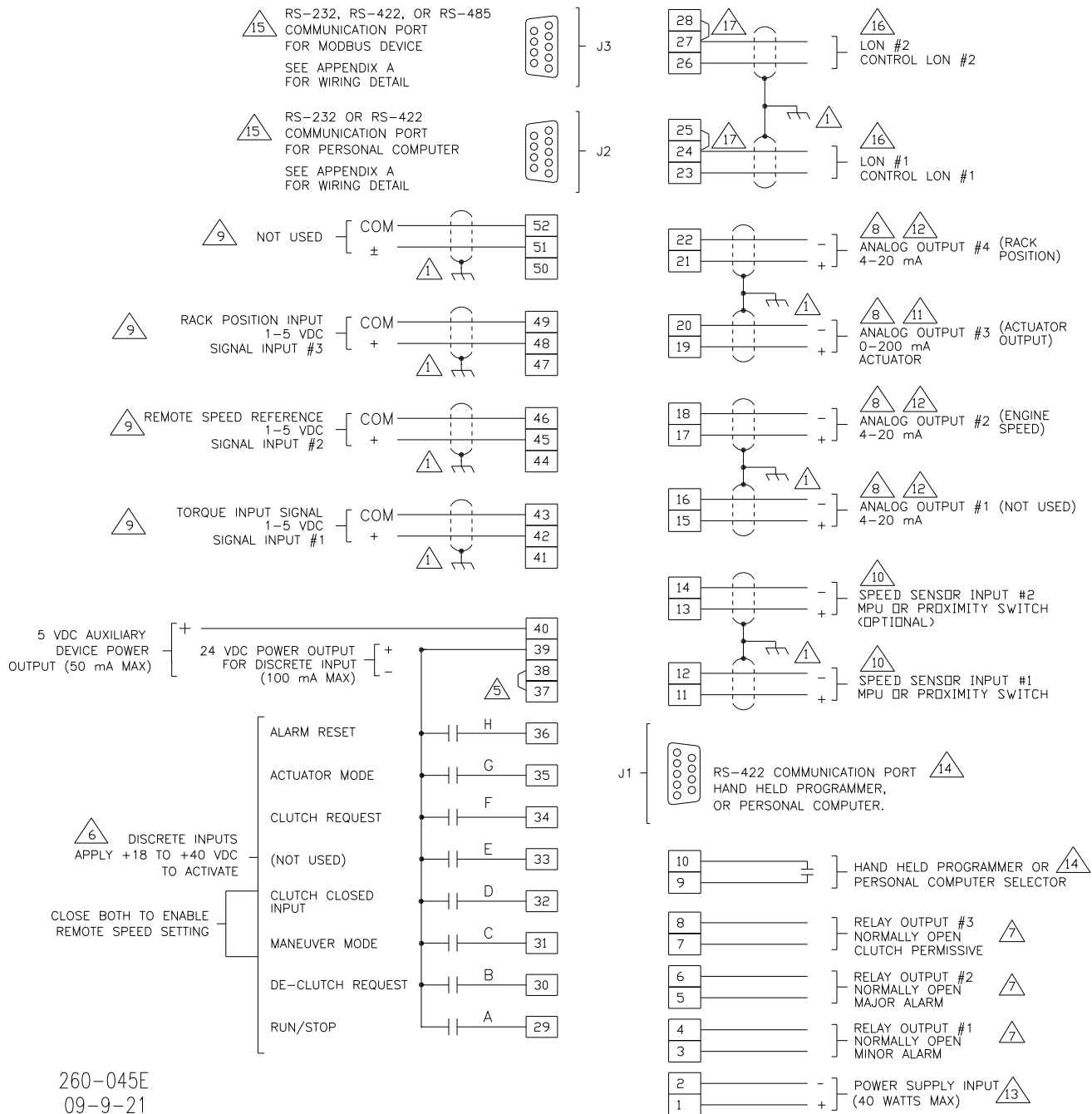


Figure 1-4. Control Wiring Diagram

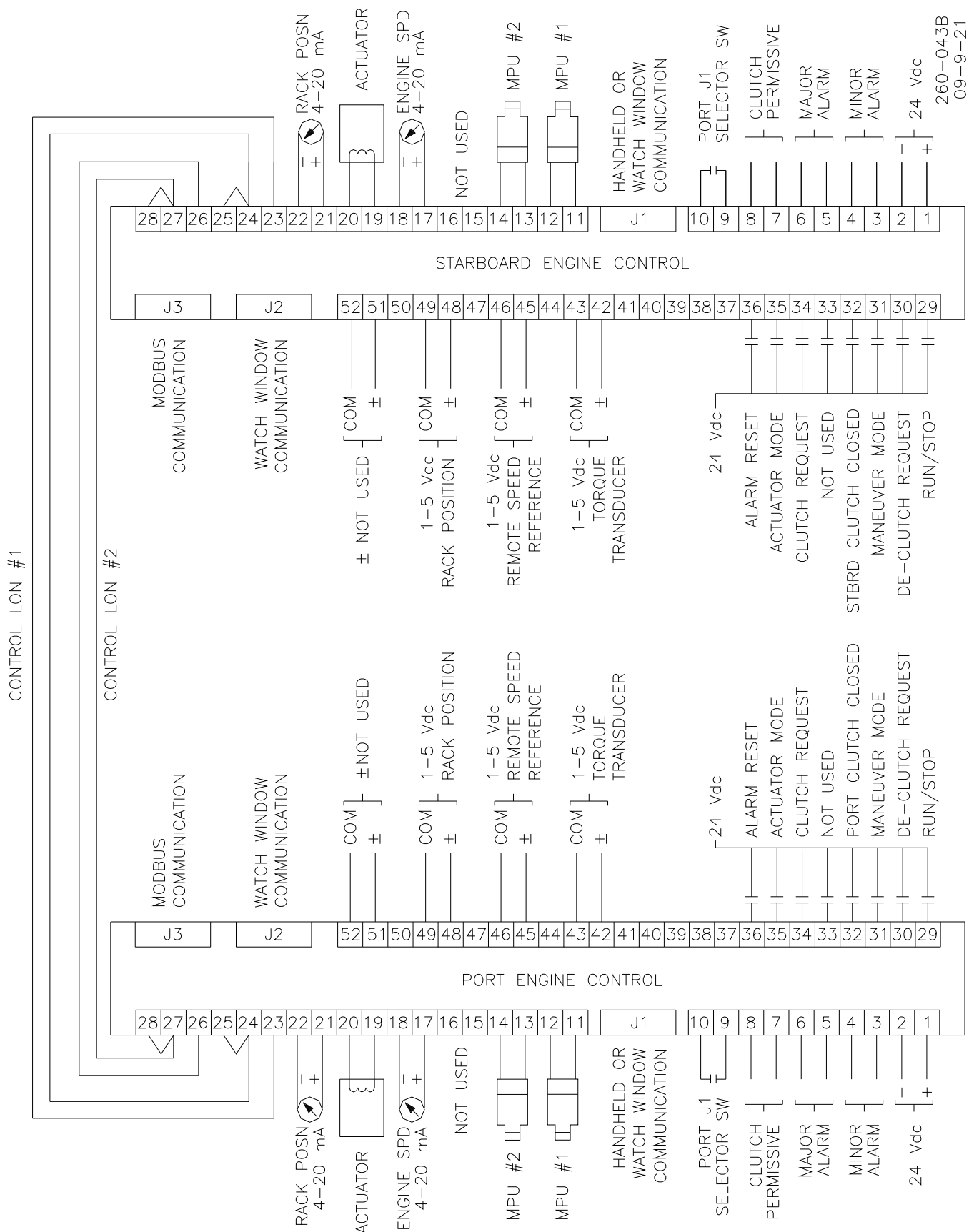


Figure 1-5. System Wiring Overview

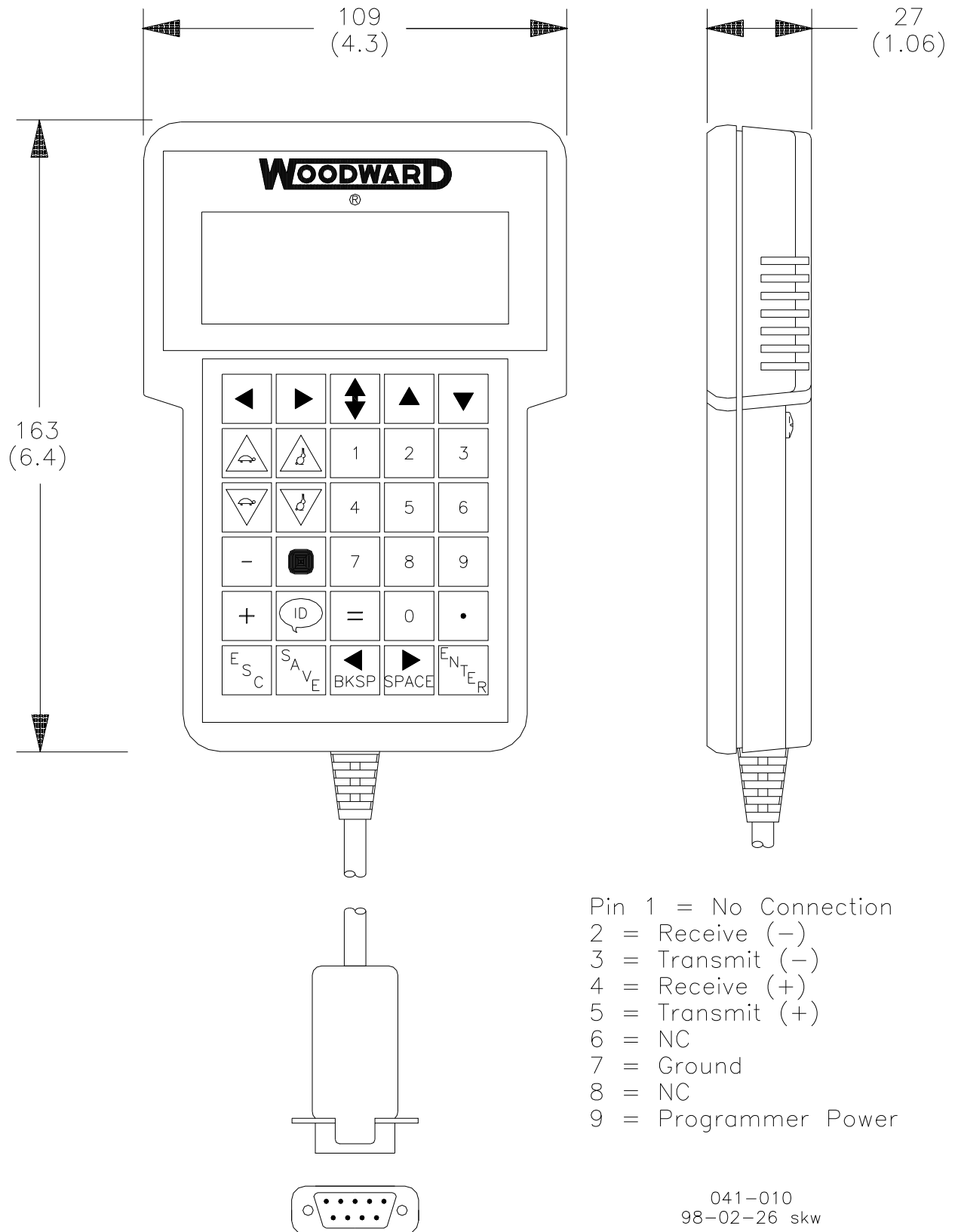


Figure 1-6. Hand Held Programmer

Chapter 2. Installation

Introduction

This chapter contains general installation instructions for the 723PLUS control. Power requirements, environmental precautions, and location considerations are included to help you determine the best location for the control. Additional information includes unpacking instructions, electrical connections, and installation checkout procedures.

Unpacking

Before handling the control, read the Electrostatic Discharge Awareness information on page iv. Be careful when unpacking the electronic control. Check the control for signs of damage such as bent panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

Power Requirements

The low voltage version of the 723PLUS Digital Marine Control requires a voltage source of 18 to 40 Vdc.

NOTICE

To prevent damage to the control, do not exceed the input voltage range.

IMPORTANT

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

NOTICE

To prevent damage to the control, make sure that the alternator or other battery-charging device is turned off or disconnected before disconnecting the battery from the control.

Location Considerations

Consider these requirements when selecting the mounting location:

- adequate ventilation for cooling;
- space for servicing and repair;
- protection from direct exposure to water or to a condensation-prone environment;
- protection from high-voltage or high-current devices, or devices which produce electromagnetic interference;
- avoidance of vibration;
- selection of a location that will provide an operating temperature range of -40 to $+70$ °C (-40 to $+158$ °F).

The control must NOT be mounted on the engine.

Specific Marine Installation Requirements

Marine Type approval requirements change over time. In recent years, there has been at least the addition of a stricter emission limit. A 156–165 MHz band notch has been added and referred to here as the “Marine Notch”. To address the Marine Notch, additional installation limitations are required for new installations under the updated Marine Type approvals.

All wiring, except for the last 12 inches (305 mm) adjacent to the control connection terminals must be inside a metal conduit, metal cable armoring, enclosed metal cable way, or similar metal acting as a secondary shield. The metal acting as the secondary shield must be grounded to the same reference ground as the control chassis. In some cases, the chassis reference ground is also referred to as Protective Earth (PE). All wiring must also follow the wiring and shielding requirements given in the specific, separate software manual.

The control must be mounted on a metal mounting plate that is grounded to the same reference ground potential as the control's chassis.

Alternatively, if the installation is limited to areas of the ship where at least 6 dB attenuation of the RF signals from the control can be guaranteed, no additional special measures are needed. The signals in the 156–165 MHz range must be attenuated by 6 dB before they reach the receiver antenna or receiver (interference point), and the control must be >3 m away from the antenna or receiver. This is a specific installation dependency, and some examples may include:

- A grounded, metal, IP rated cabinet with all cabling staying inside it for more than 2 m length, with any shield terminations at the cabinet exit/entry point and all unshielded cable routed directly against the metal cabinet.
- A below-deck metal engine room where none of the cabling, including power, leaves the engine room.

If using a specific installation location or method as a means to meet the Marine Notch requirements, instead of a secondary metal shield for cabling, consult the ship builder. Acceptability of the installation for obtaining 6 dB of RF attenuation in the 156–165 MHz range must be provided by the ship builder. Woodward will not know the ship installation application or requirements to provide guidance.

Internal Jumpers

The 723PLUS control has ten, two-position internal jumpers (JPR1 through JPR20) located on the top of the printed circuit board. If you need to change any jumper to match your control needs, be sure to read the Electrostatic Discharge Awareness information on page iv before proceeding.

With the power off, remove the control cover. With a small pair of tweezers or needle-nose pliers, carefully remove the appropriate jumper and replace it securely over the proper two connectors (see Figure 2-1).

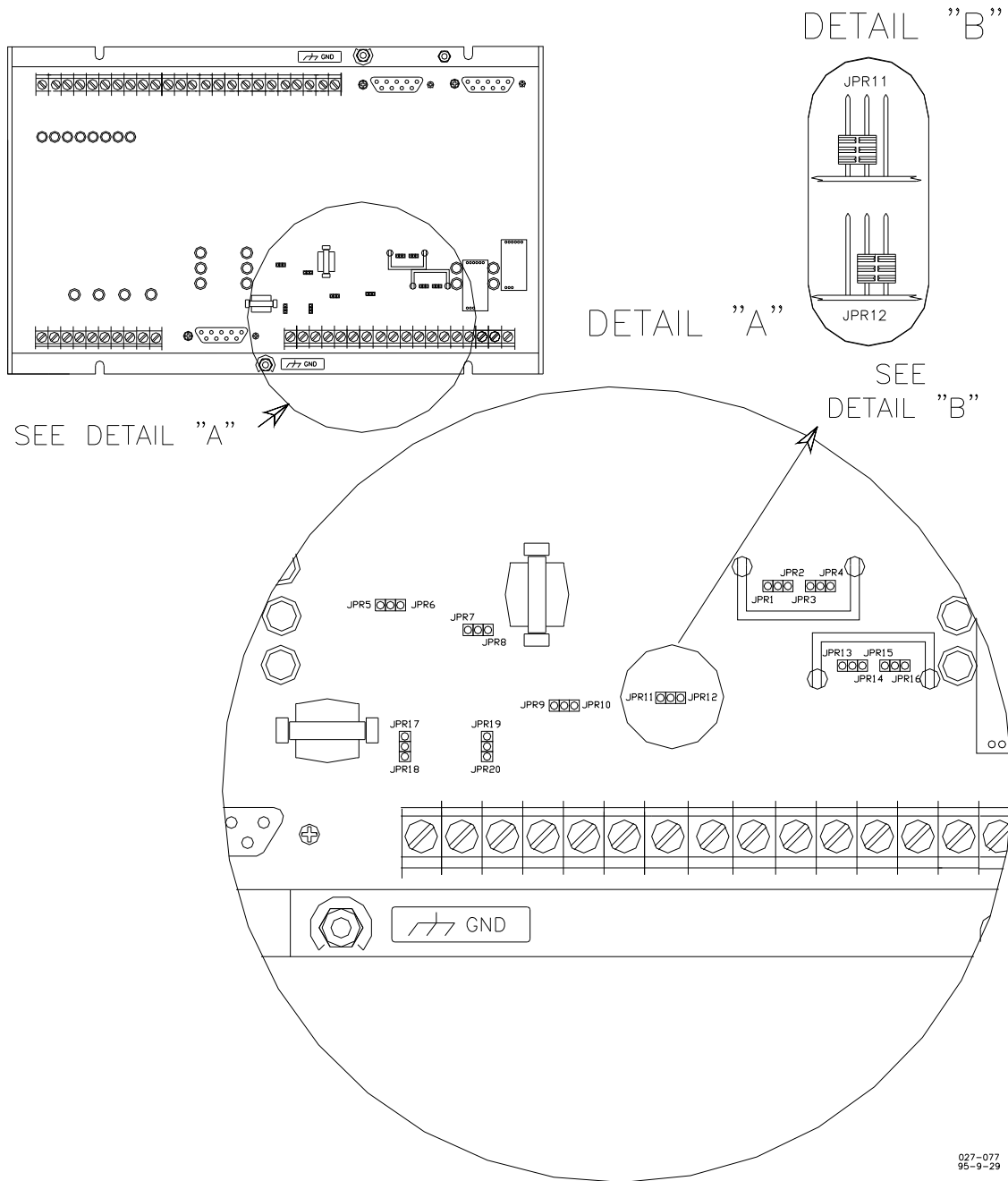


Figure 2-1. 723PLUS Control Internal Jumpers

The following jumper options are available for these 723PLUS controls:

*	JPR10	analog output #1	0–1 mA
	JPR9	analog output #1	0–20 mA
*	JPR12	analog output #2	0–1 mA
	JPR11	analog output #2	0–20 mA
*	JPR13 & JPR2	analog output #3	0–200 mA, single
	JPR13 & JPR1	analog output #3	0–20 mA, single
	& JPR14 & JPR2	analog output #3	0–160 mA, tandem
*	JPR15 & JPR3	analog output #4	0–200 mA, single
	JPR15 & JPR4	analog output #4	0–20 mA, single
	& JPR16 & JPR3	analog output #4	0–160 mA, tandem
*	JPR5 & JPR17	speed sensor #1	proximity switch
	JPR6 & JPR18	speed sensor #1	magnetic pickup
*	JPR7 & JPR20	speed sensor #2	proximity switch
	JPR8 & JPR19	speed sensor #2	magnetic pickup

*—default jumper settings

&—tandem outputs are designed to supply a maximum of 160 mA into two actuators connected in series.

Electrical Connections

External wiring connections for a typical 723PLUS control installation are shown in Figure 1-5. The control wiring connections (Figure 1-4) are explained in the rest of this chapter.

Shielded Wiring

All shielded cable must be twisted conductor pairs. Do not attempt to tin the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields to the nearest chassis ground. Wire exposed beyond the shield should be as short as possible, not exceeding 25 mm (1 inch). The other end of the shields must be left open and insulated from any other conductor. DO NOT run shielded signal wires along with other wires carrying large currents. See Woodward application note 50532, Interference Control in Electronic Governing Systems for more information.

Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below.

1. Strip outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.
2. Using a sharp, pointed tool, carefully spread the strands of the braided shield.
3. Pull inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
4. Remove 6 mm (1/4 inch) of insulation from the inner conductors.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.

Power Supply (Terminals 1/2)

Power supply output must be low impedance (for example, directly from batteries). DO NOT power the control from high-voltage sources with resistors and zener diodes in series with the control power input. The 723PLUS control contains a switching power supply which requires a current surge (7 A) to start properly.

NOTICE

To prevent damage to the control, do not power a low-voltage control from high-voltage sources, and do not power any control from high-voltage sources with resistors and zener diodes in series with the power input.

Run the power leads directly from the power source to the control. DO NOT POWER OTHER DEVICES WITH LEADS COMMON TO THE CONTROL. Avoid long wire lengths. Connect the positive (line) to terminal 1 and negative (common) to terminal 2. If the power source is a battery, be sure the system includes an alternator or other battery-charging device.

If possible, do NOT turn off control power as part of a shutdown procedure. Use the Minimum Fuel (Run/Stop) discrete input (terminal 29) for shutdown. Leave the control powered except for service of the system and extended periods of disuse.

NOTICE

Do NOT apply power to the control at this time. Applying power may damage the control.

To prevent damage to the engine, apply power to the 723PLUS control at least 60 seconds prior to starting the engine. The control must have time to do its power up diagnostics and become operational. Do not start the engine unless the green POWER OK and CPU OK indicators on the 723PLUS control cover come on, because test failure turns off the output of the control.

Relay Outputs (Terminals 3/4, 5/6, 7/8)

The three Relay Outputs provide Form A dry contact closures for controlling three discretely controlled devices. The three conditions which cause the relays to change state include a shutdown condition, an alarm condition, or a clutch enable condition. The contact ratings are shown on the inside back cover of this manual. Interposing relays should be used if the application exceeds these ratings. Each relay is energized when the green light above the respective terminals is illuminated.

The relay contact on terminals 3/4 for Relay Output #1 is used when internal minor alarm conditions are to be used by other devices in the application. No connection is required if the minor alarm function is not used in the application. The relay changes state if any configured minor alarm condition has occurred without being cleared or reset. The state of the contact can be configured as either close on minor alarm or open on minor alarm. If power to the control is lost, the contact will open.

The relay contact on terminals 5/6 for Relay Output #2 is used when internal major alarm conditions are to be used by other devices in the application. No connection is required if the major alarm function is not used in the application. The relay changes state if any configured major alarm condition has occurred without being cleared or reset. The state of the contact can be configured as either close on major alarm or open on major alarm. If power to the control is lost, the contact will open.

The relay contact on terminals 7/8 for Relay Output #3 provides the Clutch Permissive. The relay contact changes state based on control configuration and parameters as described next.

If **CONFIG OPTION** prompt MANUAL CLUTCH LOGIC is set TRUE, the relay contact is held open and a clutch permissive is not issued. Clutch closure with this configuration is solely a Manual operation.

If **CONFIG OPTION** prompt MANUAL CLUTCH LOGIC is set FALSE, the relay contact closes automatically when permissive conditions for clutch closure are met. There are two cases to consider for automatic clutching. One is that no units are clutched in, and the second is that one unit is already clutched in. The permissive conditions differ for these two cases. When the following permissive conditions for each case are met, the Clutch Permissive relay contact closes:

No Units are Clutched In (The first unit clutched is the Master)

- Engine running (speed > 5% rated)
- Run/Stop in 'Run' position (Discrete Input A)
- Clutch Request closed (Discrete Input G)
- If engine speed is not at Idle, ramp to Idle
- Engine speed at Idle for the CLUTCH SYNC TIME

Other Unit Already Clutched In (This second unit clutched is the Slave)

- Engine running (speed > 5% rated)
- Run/Stop in 'Run' position (Discrete Input A)
- Clutch Request closed (Discrete Input G)
- If engine speed is not at Master engine speed, ramp to Master speed.
- Engine speed matches the Master engine speed within the CLUTCH SPEED WINDOW setting for the CLUTCH SYNC TIME.

The Clutch Permissive relay contact will open if a Clutch Engaged contact closure is not received (at discrete input H) within the CLUTCH IN TIME. The clutch request must be toggled to re-close the Clutch Permissive relay contact.

Speed Signal Inputs (Terminals 11/12 and 13/14)

Connect a magnetic pick-up (MPU) or proximity switch to terminals 11 and 12. You may connect a second MPU/proximity switch to terminals 13 and 14. The second speed-sensing device may be used for redundancy. The second device will provide backup speed sensing in the event of a single speed sensor device failure. If two speed sensor devices are used, they must both sense the exact same speed of rotation. The usual location for both devices is on the upper half of the flywheel housing.



The number of gear teeth is used by the control to convert pulses from the speed sensing device to engine rpm. To prevent possible serious injury from an overspeeding engine, make sure the control is properly programmed to convert the gear-tooth count into engine rpm. Improper conversion could cause engine overspeed.

Analog Output #2, and #4 (Terminals 17/18, and 21/22)

These two analog outputs are configured specifically for this application. The output current is configured for 4 to 20 mA on Analog Output #2, and for 4 to 20 mA on Analog Output #4. This current signal is supplied to terminals 17(+) and 18(–) for Analog Output #2, and terminals 21(+) and 22(–) for Analog Output #4. Note that these terminals must be isolated from ground. Analog Output #2 is configured for Engine Speed and Analog Output #4 is configured for Rack Position.

NOTICE

To prevent possible damage to the control or poor control performance resulting from ground loop problems, we recommend using current-loop isolators if the 723PLUS control's analog inputs and outputs must be connected to non-isolated devices. A number of manufacturers offer 20 mA loop isolators.

Analog Output #1 is not used in this application.

Analog Output #2 is specially set at the factory for 0 to 20 mA, representing the engine speed. Default range is 0 to 1200 rpm.

Analog Output #4 is factory set for 4 to 20 mA, representing the 0–100% Rack Position signal.

Use shielded twisted-pair wires. For electrically isolated devices, such as 4 to 20 mA analog meters, the shield should be grounded at the control end of the cable. For input to other devices, use the recommendation of the device manufacturer.

Analog Output #3 (Terminals 19/20)

The actuator wires connect to terminals 19(+) and 20(–).

Analog Output #3 is factory set for 0 to 200 mA and can only be selected as an actuator command.

Use shielded twisted-pair wires with the shield connected to the chassis at the control.

LON #1 and LON #2 (Terminals 23—28)

The 723PLUS control provides two separate LON communication channels for communicating with Echelon networks. Use one of the cable types listed below to make all LON wiring connections. There is no polarity associated with the network wiring. Total network length must not exceed 500 meters (1640 ft). Torque sharing is performed entirely with LON communication and negates the need for any separate torque sharing wiring connections.

LON #1 terminals 23 and 24 connect to LON #1 on a mating 723PLUS Digital Marine control to provide the data and signals needed for correct clutch control and mechanical torque sharing in a two-engine marine propulsion system.

LON #2 terminals 26 and 27 connect to LON #2 on a mating 723PLUS Digital Marine control to provide redundant data and signals needed for backup clutch control and mechanical torque sharing in a two-engine marine propulsion system.

A jumper is needed between terminals 24 and 25 and between terminals 27 and 28 at each control to properly terminate each LON network.

The 723PLUS utilizes Control LON, which does not require any special binding procedure. Communication between controls begins when the LON wires are connected and the communication node addresses have been assigned. LED #3 will flash when the node addresses are improperly set. LED #3 extinguishes when the node addresses are properly set. See CONFIG OPTION menu in Chapter 4 for instructions on setting the node address.

For optimum EMC performance, the network cable shield should be landed on one end only at either 723PLUS chassis, and the exposed wire length limited to 25 mm (1 inch).

Acceptable cable is available from Woodward, Belden, or other suppliers providing an equivalent cable:

Woodward part number 2008-349

Belden
PO Box 1980
Richmond IN 47375
Telephone (317) 983-5200

Belden Part Number	Description
9207	PVC 20 AWG shielded. NEC Type CL2, CSA Cert. PCC FT 1.
89207	Teflon 20 AWG shielded, Plenum version. NEC Type CMP, CSA Cert.t. FT 4.
YR28867	PVC 22 AWG shielded.
YQ28863	Plenum 22 AWG shielded.

Discrete Inputs (Terminals 29—36)

Discrete inputs are the switch commands to the 723PLUS control. These inputs direct engine control through various operating conditions. When an input switch or relay contact closes, voltage is supplied to the discrete input terminal. This sets the input state for that discrete input "TRUE". The input terminal is open circuited when the input switch or relay contact opens. This sets the input state for that discrete input "FALSE". When the input switch or relay contact is closed, the voltage supplying the discrete input should be present from the appropriate discrete input (terminal 29, 30, 31, 32, 33, 34, 35, or 36) to terminal 37 (common). Terminal 37 is the common return path for all of the discrete input channels. A lower voltage indicates that the switch contacts have too high a resistance when closed and should be replaced. These terminals must be isolated from ground. A green light above each input terminal illuminates for a valid "TRUE" state.

The discrete inputs are powered by the internal 24 Vdc Discrete Input Power source at terminal 39(+). This source is capable of supplying 100 mA at a voltage level of 24 Vdc. Connect the internal 24 Vdc voltage source positive from terminal 39 to the appropriate input switch or relay contact, and connect the mated switch or relay contact to the corresponding discrete input terminal on the 723PLUS control. Make certain a connection exists between terminal 37 (discrete common) and terminal 38(-). Do not power other devices with the internal discrete input power source, and make certain the switch or relay contacts are isolated from any other circuit or system.

Run/Stop (Input A; Terminal 29)

The external contact used to activate the Run/Stop command connects to terminal 29 (Discrete Input A). This discrete input changes the control operation by immediately decreasing the fuel demand to zero. The Run/Stop command is the preferred means of signifying a normal engine shutdown. This input can be selected for either "Open to Run" or "Close to Run" operation based on the 06 CONT A OPEN TO RUN setpoint in the B**CFG OPTION** configuration menu. When programmed for "Open to Run", normal speed control function is enabled when the switch or relay contact is open (discrete input in the "FALSE" state). When the switch or relay contact is closed (discrete input in the "TRUE" state), the Minimum Fuel Function will immediately pull the fuel demand to zero. The control output to the actuator will be the minimum fuel demand when voltage is applied to terminal 29. The opposite is true when configured for "Close to Run". The input must have voltage applied to terminal 29 to operate the engine.



The Run/Stop discrete input is not intended for use as the sole means of shutdown in any emergency stop sequence. To prevent possible serious injury and engine damage from an overspeeding engine, do NOT use the Run/Stop discrete input as the sole means of shutdown in any emergency stop sequence.

De-Clutch Request (Input B; Terminal 30)

Close this contact to begin the de-clutching process. The process begins by softly unloading the engine and then de-clutching. Once de-clutched, the engine speed will be forced to idle and then returned to its normal remote speed setting reference.

Maneuvering Mode (Input C; Terminal 31)

For applications where a generator may also be connected to the engine shaft, it is desired to have the engine run at a fixed speed. In many cases the vessel may be using electric thrusters for positioning in this mode, thus the name Maneuvering mode. By closing Discrete Input C on the master unit, the engine speed setpoint will ramp to a fixed programmed value. If both units are clutched in, the slave unit will follow the speed setpoint of the master.

Clutch Engaged Contact (Input D; Terminal 32)

The external contact used to activate the Clutch Engaged command connects to terminal 32 (Discrete Input D). This discrete input changes the control operation by providing the clutch status input for the clutching and torque sharing logic and the speed control dynamics selector. When the switch or relay contact is closed (discrete input in the "TRUE" state), the control expects the clutch to be closed. When the switch or relay contact is opened (discrete input in the "FALSE" state), the control expects the clutch to be opened. This input signal must be present for the engine to load share in either Manual mode or Automatic mode.

(Input E; Terminal 33)

The input switch or relay contact is not used in this application.

Clutch Request (Input F; Terminal 34)

The input switch or relay contact used to activate the clutching sequence connects to terminal 34 (Discrete Input F). This discrete input changes the control operation by initiating an automatic clutch closing sequence or, when already clutched, an unloading and de-clutching sequence. There are two cases to consider for automatic clutching. One is that no units are clutched in, and the second is that one unit is already clutched in. The Clutch Request action differs for these two cases:

When the switch or relay contact is closed (discrete input in the "TRUE" state), and the other engine IS NOT clutched, the speed reference is ramped to Idle. After an adjustable dwell time at idle, the clutch permissive Relay #3 output contact (terminals 7 and 8) closes. The clutch permissive contact will re-open if the Clutch Engaged input switch or relay contact (Discrete Input D, Terminal 32) fails to close within the adjustable (1-120 seconds) 05 CLUTCH IN TIME in the P**LOAD CONTROL** menu.

When the switch or relay contact is closed (discrete input in the "TRUE" state), and the other engine IS clutched, the speed reference is ramped to match (sync) the clutched engines speed. After an adjustable dwell time at synchronous speed, the clutch permissive Relay #3 output contact (terminals 7 and 8) closes. The clutch permissive contact will re-open if the Clutch Engaged input switch or relay contact (Discrete Input D, Terminal 32) fails to close within the adjustable (1-120 seconds) 05 CLUTCH IN TIME. Once the clutch has closed, the engine soft loads until the load on both engines are matched where the control automatically switches into isochronous torque sharing to maintain equal torque on both engines. The dwell time, synchronous speed window and soft loading time, are set in Service mode, under the P**LOAD CONTROL** header, at prompts 05 CLUTCH SYNC TIME, 06 CLUTCH SPEED WINDOW and 03 LOAD RATE.

Actuator Mode Switch (Input G; Terminal 35)

This contact input is an indication from the actuator that it is running on the mechanical ballhead governor. This optional input is used for fault detection (723PLUS not in control) and can only be used with appropriate reverse-acting actuators.

Alarm Reset (Input H; Terminal 36)

The input switch or relay contact used to activate the Alarm Reset command connects to terminal 36 (Discrete Input H). This discrete input issues a reset command to all parameters, which can latch into an alarm state. When the external switch or relay contact is closed (discrete input in the "TRUE" state), the reset condition is applied for a short time even if the external contact remains closed. With the contact open (discrete input in the "FALSE" state), the control will again be ready to respond to the external contact closing. The Alarm Reset command works in parallel with the software switch from Watch Window or the Hand Held Programmer.

Torque Sensor Input (Signal Input #1; Terminals 42/43)

Connect a torque sensor transmitter to Signal Input #1. The input signal must be an isolated high-quality signal. By configuration, this input is used for torque sharing and torque indication. Torque is displayed in software adjustable engineering units on Watch Window, or on the optional Hand Held Programmer.

Use a shielded twisted-pair cable to connect a 4 to 20 mA current transmitter or a 1 to 5 Vdc voltage transmitter to terminals 42(+) and 43(–). When using a voltage transmitter, remove the jumper between terminals 41 and 42. An input impedance of 255 Ω is present when the jumper is installed. Without the jumper installed, the input impedance will be greater than 10 M Ω . This input is not isolated from the other control inputs and outputs, and an isolation device must be installed if the transmitter output is not isolated. An out-of-range or failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) or greater than 22 mA (5.5 Vdc). The control defaults to a scaled actuator output for torque sharing if this input fails. A detected input failure will remain until the failure is repaired and an Alarm Reset is issued.

Remote Speed Reference Input (Signal Input #2; Terminals 45/46)

Connect a remote speed reference transmitter to Signal Input #2. The input signal must be an isolated high-quality signal. The remote speed reference is displayed in rpm and Vdc on Watch Window, or on the optional Hand Held Programmer.

Use a shielded twisted-pair cable to connect a 4 to 20 mA current transmitter or a 1 to 5 Vdc voltage transmitter to terminals 45(+) and 46(–). When using a voltage transmitter, remove the jumper between terminals 44 and 45. An input impedance of 255 Ω is present when the jumper is installed. Without the jumper installed, the input impedance will be greater than 10 M Ω . This input is not isolated from the other control inputs and outputs, and an isolation device must be installed if the transmitter output is not isolated. An out of range or failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) or greater than 22 mA (5.5 Vdc). The control defaults, by configuration, to a 'Lock-in-Last' speed reference. A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

Fuel Rack Position Input (Signal Input #3; Terminals 48/49)

Connect the fuel rack position transmitter to Signal Input #3. The input signal must be an isolated high-quality signal. The fuel rack position input is a signal from a transducer, usually an LVDT or RVDT, that allows the 723PLUS control to accurately measure the amount of fuel given to the engine. The 1–5 Vdc input signal is scaled for 0–100% fuel rack position.

An out of range or failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) or greater than 22 mA (5.5 Vdc). This signal is not being used by the control logic and is only passed from this input to Analog Output #3.

(Signal Input #4; Terminals 51/52)

This input is not used in this application.

Communication Port J2

Communication Port J2 is configured to connect a Servlink device, such as Watch Window, to the 723PLUS control. Watch Window is used to display and modify tunable and configurable values in the control. Multiple values may be viewed simultaneously. Watch Window includes the ability to shut down the control, restart the control, and upload and download tuning parameters. The ability is also provided to link to a control over a network via network DDE.

Port J2 connector is a 9-pin subminiature D receptacle.

Communication Port J2 can be software configured for a wide variety of serial communications. The port can be set to standard specifications for RS-232 or RS-422. The baud rates can be set for 110, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, or 38400. The only restriction is that if port J2 is set for a baud rate of 19200, then port J3 cannot be 38400, and if J2 is set for a baud rate of 38400, then port J3 cannot be 19200. The default baud rate is 19200.

In this application, Port J2 of the Starboard 723PLUS and the Port 723PLUS are connected together and must use the multi-drop feature of Servlink when connecting to the network.

Communication Port J3 (not used in this application)

Communication Port J3 is configured to connect a Servlink device, such as Watch Window, to the 723PLUS control. Watch Window is used to display and modify tunable and configurable values in the control. Multiple values may be viewed simultaneously. Watch Window includes the ability to shut down the control, restart the control, and upload and download tuning parameters. The ability is also provided to link to a control over a network via network DDE.

Port J3 connector is a 9-pin subminiature D receptacle.

Communication Port J3 can be software-configured for a wide variety of serial communications. The port can be set to standard specifications for RS-232 or RS-422. The baud rates can be set for 110, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, or 38400. The only restriction is that if port J2 is set for a baud rate of 19200, then port J3 cannot be 38400, and if J2 is set for a baud rate of 38400, then port J3 cannot be 19200. The default baud rate is 19200.

POWER AND CPU OK LED

The POWER OK and CPU OK are green LEDs (light emitting diode). The LEDs illuminate when the internal power supply is functioning and the CPU is operating normally. Do Not attempt to start or run the engine when either LED is not illuminated. The LEDs turn off if the power supply is turned off or failed and the CPU is failed or has a watchdog error.

FAILED SPD SENSOR #1 and #2 LEDs

The FAILED SPD SENSOR #1 and #2 LEDs are red. The FAILED SPD SENSOR LEDs are programmed to illuminate if a speed sensor fault has been detected. FAILED SPD SENSOR #1 illuminates LED #1 when a speed sensor 1 fault has been detected, and FAILED SPD SENSOR #2 illuminates LED #2 when a speed sensor 2 fault has been detected. The speed sensor fault is activated if the sensed speed is below the failsafe speed setting. See Chapter 6, Faults and Troubleshooting, for additional speed sensing fault details.

LED #3 and LED #4

The LED #3 and LED #4 are yellow. The LED #3 is programmed to illuminate and flash if the Control LON network addresses for channels 1 and 2 are either not set or improperly set. Control LON cannot function until properly addressed. The LED #4 is programmed to illuminate if both Control LON networks 1 and 2 are failed. Alarm conditions must be corrected to extinguish LED #3 and LED #4.

Installation Checkout Procedure

With the installation complete as described in this chapter, do the following checkout procedure before beginning set point entry (Chapter 4) or initial start-up adjustments (Chapter 5).

1. Visual inspection
 - A. Check the linkage between the actuator and fuel-metering device for looseness or binding. Refer to the appropriate actuator manual, and Manual 25070, *Electronic Control Installation Guide*, for additional information on linkage.



WARNING

To prevent possible serious injury from an overspeeding engine, the actuator lever or stroke should be near but not at the minimum position when the fuel rack is at the minimum fuel delivery position.

- B. Check for correct wiring in accordance with the control wiring diagram, Figure 1-4.
 - C. Check for broken terminals and loose terminal screws.
 - D. Check the speed sensor(s) for visible damage. If the sensor is a magnetic pickup, check the clearance between the gear and the sensor, and adjust if necessary. Clearance should be between 0.25 and 1.25 mm (0.010 and 0.050 inch) at the closest point. Make sure the gear run out does not exceed the pickup gap.

IMPORTANT

The smallest practical gap is preferred; typically smaller gaps can be set on smaller gears and larger gaps on larger gears.

2. Check for grounds

Check for grounds by measuring the resistance from all control terminals to chassis. All terminals except terminals 2 and 37 should measure infinite resistance (the resistance of terminals 2 and 37 depends on whether a floating or grounded power source is used). If a resistance less than infinite is obtained, remove the connections from each terminal one at a time until the resistance is infinite. Check the line that was removed last to locate and repair the ground fault.

Chapter 3.

Description of Operation

Introduction

The three primary functions of this 723PLUS control are speed control, fuel limiting, and torque sharing. These functions will be broken down in this chapter as follows:

Speed Control

Speed Input
Speed Reference
Dynamics
Actuator Output

Fuel Limiting

Torque Sensor
Start Fuel Limiting
Maximum Fuel Limiting

Torque Sharing

Torque Sharing Lines
Torque Input

Speed Control

The primary job of this 723PLUS control is to control the engine speed. The control compares the engine speed to the speed reference and then adjusts the actuator output to maintain a zero error between engine speed and the speed reference. This is done with a PID controller. Several tunable variables (dynamics) allow the 723PLUS control to be tuned for optimal performance over a wide range of engine operating conditions.

Speed Input

One or two speed sensors provide the feedback for the speed control PID. These allow the application to sense engine speed in two ways: single speed sensing input, or redundant speed sensing. For redundant speed sensing, the speed control selects MPU #1 for use when both speed inputs are valid. Otherwise the valid input with the higher frequency is used. The method used to detect speed is hard configured for digital type detection. The digital detection method senses and responds to speed changes very quickly.

An adjustable low-pass speed sensor filter is provided, which is adjusted in Service mode, under the header E**DYNAMICS DE-CLUTCHED**, at prompt 09 SPEED FILTER 1 HZ. The filter is used to attenuate engine firing frequencies. This filter is active on both speed signal inputs regardless of the speed sensing mode. The proper roll-off frequency setting can be found using the following formula:

$$\begin{aligned}\text{camshaft frequency} &= (\text{engine rpm})/60 \text{ [for 2-cycle engines]} \\ &= (\text{engine rpm})/120 \text{ [for 4-cycle engines]}\end{aligned}$$

$$\text{firing frequency} = (\text{camshaft frequency}) \times (\text{number of cylinders})$$

Initially set the filter frequency to the firing frequency or 15.9 Hz, whichever is lower. A lower setting increases filtering but slows response. Settings below 10 Hz are not recommended.

For single speed input applications, either input may be used. The unused speed signal input will be failed when the engine is running.

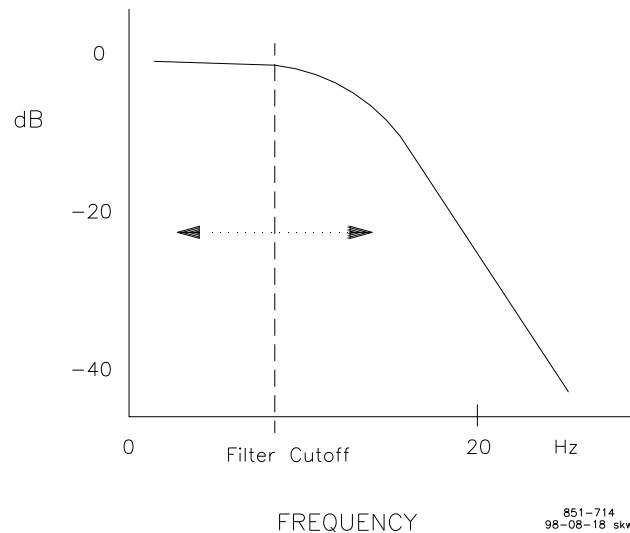


Figure 3-1. Speed Sensor Roll-off Filter

More Speed Inputs

All the speed signal configurations are located in the A**CONFIG SPD CONTROL** configure menu. 01 GEAR #1 TEETH (under header, A**CONFIG SPD CONTROL**) should be set to the number of gear teeth on the gear where speed sensor #1 is installed. If the gear is not rotating at the same speed as the crankshaft, the gear teeth must be adjusted accordingly. In this case, set the gear teeth equal to the number of teeth that will pass the MPU in one complete engine revolution.

$$\text{Speed Signal (Hz)} = \text{Gear Teeth} * \text{Engine rpm} / 60$$

02 GEAR #2 TEETH (under header, A**CONFIG SPD CONTROL**) should be set to the number of gear teeth on the gear where speed sensor #2 is installed. If the gear is not rotating at the same speed as the crankshaft, the gear teeth must be adjusted accordingly. In this case, set the gear teeth equal to the number of teeth that will pass the MPU in one complete engine revolution. This gear must rotate at the same speed as the gear used for speed sensor #1.

WARNING

The number of gear teeth is used by the 723PLUS control to convert the pulses from the speed sensing device to engine rpm. To prevent possible serious injury from an overspeeding engine, make sure the control is properly programmed to convert the gear tooth count into engine rpm. Improper conversion could cause the engine to overspeed.

Should the engine speed fall below the failsafe speed, the 723PLUS will consider the speed sensor failed and shut down the actuator output. The failsafe speed is automatically calculated and set to 5% of the value entered in for rated engine speed. The speed sensors also have a failsafe voltage level. The 723PLUS control must have at least 1 Vrms MPU voltage to operate. An amplitude less than 1 Vrms is considered to be a failed speed signal, and the 723PLUS control will go to minimum fuel.

The 723PLUS control also monitors the engine speed for an overspeed condition. The overspeed fault will latch, and actuator output will go to the minimum fuel position, if the engine speed is greater than the 08 OVERSPEED SD value. This value is set in Configure mode, under the header E**ALARM/SD CONFIGURE**, at prompt 08 OVERSPEED SD. This fault is reset when the engine speed clears the failsafe speed like the other faults. The overspeed can be reset by restarting the engine or using the software reset, which can be found in Service mode, under either the header D**MINOR ALARMS**, C**MAJOR ALARMS**, or B**DISPLAY 2** at prompt 13 RESET ALL ALARMS. Even though the overspeed fault will cause the actuator output to go to the minimum fuel position, ***IT SHOULD NOT BE USED AS THE OVERSPEED PROTECTION FOR THE ENGINE.***



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 over-temperature or over-pressure shutdown device may also be needed for safety, as appropriate.

Speed Reference and Ramps

The 723PLUS Two-Engine LON Torque sharing control provides for remote speed setting, the control provides a 4 to 20 mA or 1 to 5 Vdc Remote Speed Setting input.

The 723PLUS for the first engine clutched in is the master, which responds to the speed reference inputs and uses all internal speed reference ramp rates. The 723PLUS for the second engine clutched in is the slave, which ignores all internal speed reference ramp rates and exclusively follows the master speed reference. The slave receives the master speed reference over Control LON.

The torque sharing signal, sent over Control LON, biases the speed reference of each engine to effect torque sharing after both engines are clutched together.

Input functions are enabled as follows:

- The Maneuvering Mode speed setpoint is selected when this discrete input is closed on the master unit. The speed reference will be the setting of the 06 MAN MODE SPD STPT in the A**CONFIG SPD CONTROL** menu.

This section describes the operation of the speed reference and ramp functions and their relation to each other. Read this section carefully to be sure your sequencing provides the proper operating modes.

The idle speed set point is provided for engine start-up and for clutching in the first engine. The idle reference is selected, at a very fast rate, by control power-up or whenever the engine is not running, if 04 IDLE REF @ SHUTDOWN found in configure mode under the header A**CONFIG SPD CONTROL**, is configured TRUE. The idle reference is also selected by a clutch request, when neither engine is clutched in, to ramp engine speed to the idle reference at the decel ramp rate. Idle speed may be set equal to or less than the rated speed set point. Idle is independent of the lower limit set point and may be set to a lower speed. Idle speed set point cannot be changed except through adjustment of the idle speed set point.

When the maneuvering mode input is closed, the engine speed reference will ramp from its current value to the maneuvering speed setpoint at the 05 RAISE SPEED RATE. This is true even if the engine speed is actually higher than the maneuvering speed setpoint when the maneuvering speed input is closed.

When in remote operation, the control ramps the master or unclutched engine speed to the reference value set by the Remote Speed Setting input as configured, based on the raise or lower rate.

The Remote Speed Setting operates from 4 to 20 mA (1 to 5 Vdc). The values of the remote reference set points must be set between the raise and lower limit set points. The 4 mA (1 Vdc) Remote Speed Setting may be set to a lower or higher speed than the 20 mA (5 Vdc) set point, providing for either direct or reverse-acting remote speed setting. Remote input speed settings are found in service mode, under the header G**SPEED REFERENCE**, at prompts 08 REMOTE REF AT 1 V and 09 REMOTE REF AT 5 V.

Between 4 and 20 mA (1 and 5 Vdc), the control determines the required speed reference based on a straight line between the 4 mA and 20 mA (1 and 5 Vdc) Remote Speed Reference set points (see Figure 3-2). If a difference is detected between the present speed reference and the remote speed reference, the present speed reference is ramped up or down at the raise or lower rate until the present speed reference matches the remote speed reference rpm value. The remote reference will not increase/decrease the speed reference above the raise limit or below the lower limit.

Below 2 mA (0.5 Vdc) or above 22 mA (5.5 Vdc), the Remote Speed Setting input is considered failed or out of range. While the remote speed input is failed or out of range, the master engine speed can be raised or lowered with the raise/lower speed contact inputs. Remote speed input failure or out of range is latched, after a configurable delay time, and must be reset to restore normal operation. Toggling the alarm reset, once the failure is repaired, resets the input failure latch. The delay time setting is found in configure mode, under the header E**ALARM/SD CONFIGURE**, at the prompt 01 ALARM DELAY TIME.

A clutch request ramps the slave engine speed to the master speed reference at the 07 SLV-MST RAMP RATE found in service mode under the header G**SPEED REFERENCE**. Once the slave engine speed matches the master engine speed reference, the ramp switches to a very fast rate to force the slave engine speed to immediately track the master engine speed reference.

A torque sharing bias signal is applied to the speed reference to effect torque sharing once both engines are clutched in and torque sharing is enabled. The torque sharing signal biases the speed reference of each engine to distribute the torque equally between both engines. The torque sharing bias signal is applied after the speed reference ramp rate limiter. This ensures the torque sharing response is not restricted by any speed reference ramp rate settings. The torque sensor analog input and calibration settings are found in service mode, under the header L**ACT / TORQUE CALIB**, at the prompts TORQUE IN @ NO LOAD and TORQUE IN @ MAX LOAD. Should the torque signal analog input fail, the actuator signal fuel demand is provided by the 03 SCALED ACT COMMAND and calibration settings found in service mode, under the header I**ACT / TORQUE CALIB**, at the prompts 01 ACT OUT @ NO LOAD and 02 ACT OUT @ MAX LOAD.

NOTICE

The torque sharing and fuel limiting functions both depend heavily upon accurate L**ACT / TORQUE CALIB** settings. Carefully determine and enter the L**ACT / TORQUE CALIB** settings and re-verify these settings following any related mechanical changes (linkage, actuator, etc.). Failure to do so may result in unequal torque sharing and incorrect fuel limiter operation.

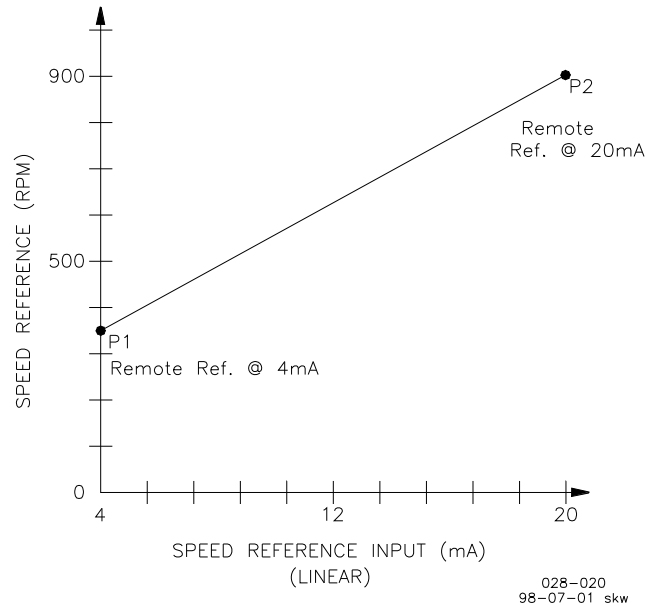


Figure 3-2. Speed Reference

Dynamic Adjustments

Dynamic adjustments are the settings that affect the stability and transient response of the engine. The objective of dynamic adjustments is to obtain an optimum, stable engine speed response from minimum speed/load to rated speed/ load operation. The control provides two complete sets of dynamic adjustments (E**DYNAMICS DE-CLUTCHED** and F**DYNAMICS CLUTCHED**). By configuration, the dynamic set selection is switched when the clutch is engaged.

Gain slope and gain breakpoint vary the gain linearly as a function of fuel demand (load). This provides the flexibility to increase or decrease gain as load increases. Gain slope and gain breakpoint are available for both constant and variable dynamics choices. Gain slope and gain breakpoint are useful for fuel systems that tend to be less stable at reduced load operation. Setting the gain slope at zero disables this function.

The control will automatically switch between two gain settings, based on engine speed error, to provide improved transient load performance. Speed error is the difference between the speed reference and compensated engine speed. During steady-state constant-load operation, the control uses the base gain setting. This base gain is adjusted by the user to a value, which prevents the control from responding to minor speed fluctuations inherent with reciprocating engines. This feature essentially eliminates harmful jiggle of the actuator and fuel system linkage. When the speed error exceeds an adjustable window width (e.g., during a load transient), the control automatically increases gain by an adjustable ratio. This increased gain produces a faster fuel response to quickly restore engine speed at the speed reference. The base gain is restored once the control senses a return to steady-state operation. This feature is available for all gain choices.

An internal load switch selects a multiplier to reduce gain when the engines are clutched in at a light load. The percentage of gain reduction and load level are set in service mode, under the header F**DYNAMICS CLUTCHED**, at the prompt 11 BTH CLTCHED GN FCTR. A setting of 100% disables the light load reduced gain function.

The control provides an actuator bump feature, which can be set (by the bump level and duration) to simulate a load transient and test the window width and gain ratio dynamic settings before actual application of load.

Actuator Output

The actuator output is driven by the fuel demand from the speed control PID. The dynamic settings determine the amount and rate of change for the actuator output. The actuator function changes the fuel demand into a signal on Analog Output #3 (TB 19 and TB 20). This function allows for either a direct-acting or reverse-acting actuator. In a direct-acting fuel system the signal to the actuator increases as the fuel demand increases. In a reverse-acting fuel system the signal to the actuator decreases as the fuel demand increases. In either system, the fuel (i.e., diesel oil) to the engine increases as the fuel demand increases. A reverse-acting system requires the use of an actuator with a mechanical ballhead back up governor, which can control the engine should the electronic governor fail.

Standard actuators use effective signals of 20 to 160 mA to travel from minimum position to maximum position (or 160 to 20 mA on reverse-acting systems). The fuel demand is scaled from 0 to 100 percent for an output of 0 to 200 mA (or 200 to 0 mA on reverse-acting systems). For either direct-acting or reverse-acting systems, the result is a fuel demand with a value of ten percent when the actuator is effectively at minimum and a fuel demand of 80 percent when the actuator is effectively at maximum.

Actuator type is set in configure mode, under the header B**CONFIG OPTION**, at the prompt 04 REVERSE ACTING ACT. Set "FALSE" for direct-acting actuators or "TRUE" for reverse-acting actuators.

For troubleshooting most 723PLUS controls, monitoring actuator voltage is recommended instead of monitoring actuator current. Take extreme care when using a current meter in the actuator wiring. An unexpected engine shutdown or overspeed will occur if a lead falls off. The voltmeter is a safer tool for troubleshooting since an open lead will not cause an unexpected shutdown or overspeed. In general, actuator voltage will be between 0–7 Vdc for a Woodward actuator.

Fuel Limiting Function

The second primary function of this 723PLUS control is to provide fuel rack limiting to protect the engine. All the fuel limiters and the PID output are applied to the actuator LSS (low signal select) bus. The lowest LSS input is "in Control" of the actuator output. All inputs to the LSS bus are scaled from 0% to 100% fuel demand. The output of the LSS bus goes directly to the actuator driver circuit, which is also scaled from 0 to 100%. The PERCENT LOAD outputs from these limiters are re-scaled to actuator output % before applying them to the LSS bus.

Load Sharing (Torque or Actuator Fuel Demand)

06 TORQUE INPUT % and 03 SCALED ACT COMMAND % is the percentage of rated engine load. Proper setting provides a 0% signal at minimum engine load (no-load) and a 100% signal at maximum engine load (rated load) based on either the torque sensor input or the actuator fuel demand output. Load sharing is primarily provided by the torque sensor analog input. However, should the torque sensor analog input fail or not be provided, a scaled actuator command signal is provided by the scaled actuator command %. The no-load and rated load torque input and scaled actuator command settings are found in service mode, under the header L**ACT / TORQUE CALIB**, at prompts 01 ACT OUT % @ NO LOAD, 02 ACT OUT % @ MAX LOAD, and 04 TORQUE IN @ NO LOAD, 05 TORQUE IN @ MAX LOAD.

NOTICE

The fuel limiting and torque sharing functions both depend heavily upon accurate L**ACT / TORQUE CALIB** settings. Carefully determine and enter the L**ACT / TORQUE CALIB** settings and re-verify these settings following any related mechanical changes (linkage, actuator, etc.). Be sure to compare both the 03 SCALED ACT COMMAND % and the 07 TORQUE INPUT % for the full range of loading operations. Failure to do so may result in incorrect load sharing operation.

Torque Input

The torque input produces the TORQUE signal used for torque sharing. The torque signal is produced from a set of strain gauges on the engine drive shaft. Torque sharing automatically switches to using fuel demand (actuator current) when the torque input signal is not provided or failed or if there is a torque deviation between the two engines.

The calibration of the torque input is done at two positions, the minimum torque position and the maximum torque position, or no load to full load.

After calibration, the 06 Torque Input % shown on the A**DISPLAY 1** service menu should be compared to confirm good correlation at both minimum torque (minimum load) and maximum torque (maximum load).

Start Fuel Limiting

The start fuel limit is set to limit actuator driver output during starts to minimize smoke, overfueling, flooding, or cylinder wash down. Upon starting, the actuator will open to the 01 START FUEL LIMIT based on actuator percent. If the engine does not immediately start, the actuator percent will increase at the 02 START RAMP RATE (%/S) until the engine starts or until the max fuel limit is reached. The start fuel limit remains in effect until engine speed reaches 95% of the speed reference set point and the speed PID is in control for 1 second at which time the start fuel limit is removed. The start fuel limit is reactivated once the engine is completely stopped and restarted. The start fuel limit and rate set points are found in service mode, under the header H**START/ MAX LIMITS**, at prompts 01 START FUEL LIMIT and the 02 START RAMP RATE (%/S). To disable the start fuel limit function, set the limit to 100%.

Maximum Fuel Limiting

The maximum fuel limit is an absolute actuator driver output limit and is active at all times. This is the maximum actuator driver output the 723PLUS control will allow under any conditions, and can be used to limit engine horsepower. It can also be used as a troubleshooting tool to block the fuel rack during unstable conditions. The max fuel limit set point is found in service mode, under the header H**START/MAX LIMITS**, at prompt 03 MAXIMUM FUEL LIMIT. To disable the maximum fuel limit function, set the limit at 100%.

Torque Sharing

The third primary function of this 723PLUS control is to share load equally between two engines that are mechanically connected through a common gearbox or reduction gear. Torque sharing is done electronically. The two 723PLUS controls communicate torque, and other information needed for torque sharing, over the redundant Control LON channels. Torque sharing signals, produced within each 723PLUS, are used to maintain equal torque on both engines. Each 723PLUS control compares its specific TORQUE INPUT % to the companion torque sharing signal and applies a bias (\pm) to the speed reference. This bias changes engine load until it matches the torque sharing signal. The torque sharing bias of the speed reference is zero once both engines are clutched in and sharing load equally or when only one engine is clutched in.

Control LON Lines

The Control LON lines provide the link for communicating load and operational status (e.g., running, clutched in, slave, etc.) between the two 723PLUS controls. The TORQUE SIGNALS of both engines are sent and received over the Control LON lines to do torque sharing. A torque sharing signal, proportional to the total load on both units, is independently produced within each 723PLUS control. The 723PLUS control simultaneously biases and uses this internal torque sharing signal.

An internal switch isolates the 723PLUS control from the torque sharing signal until the unit is ready to begin torque sharing. This is done shortly after a clutching operation begins. If this is the first unit being clutched, the torque sharing switch closes immediately after the clutch closes. If this is the second unit being clutched, the engine speeds are matched (synchronized), then the clutch is closed. The 723PLUS control then begins to soft load the second engine until its torque equals, within 5%, the internal torque sharing signal. At this point the internal torque sharing switch closes and the two 723PLUS controls begin operating in the torque sharing mode. In the torque sharing mode, torque on each engine is regulated to make the TORQUE SIGNALS of both engines match each other equally. Both 723PLUS controls now operate as one unit and use only the speed reference of the master (first engine clutched in) 723PLUS control.

Chapter 4.

Service and Configure Menus

Watch Window and Servlink Software

Watch Window was developed by Woodward to be a Servlink client software product to provide a generic PC interface for any 723PLUS control, and is a very powerful setup, testing, and troubleshooting tool. Watch Window provides a means of loading the application software into the 723PLUS control, shutting down and placing the control in the configuration mode, setting configuration and service tunable values, saving values in the control EEPROM, and resetting the control. Application tunable values can be uploaded, downloaded, and saved to a file.

An “inspector” provides a window for real-time monitoring and editing of all control Configuration and Service Menu parameters and values. Custom “inspectors” can easily be created and saved. Each window can display up to 28 lines of monitoring and tuning parameters without scrolling. The number with scrolling is unlimited. Two windows can be open simultaneously to display up to 56 parameters without scrolling. Tunable values can be adjusted at the inspector window. Watch Window communicates with the control through RS-232/RS-422 cable connection to port J1 which is configured as a point-to-point only Servlink Server and through RS-232 or RS-422 null modem cable connection to port J2. A jumper or closed switch between terminals 9 and 10 sets port J1 as a Servlink interface port. Removing this jumper or opening the switch sets port J1 as a Hand Held Programmer interface port. Port 2 is a Servlink interface port only. Read “Control Properties” to display the part number and revision level of the software in the control. Refer to this number and revision level in any correspondence with Woodward (write this information in the Programming Checklist, Appendix C). Read “Getting Started” notepad included with the Watch Window install software.

Hand Held Programmer

The Hand Held Programmer is a hand-held computer terminal that gets its power from the 723PLUS control. The terminal connects to the RS-422 communication serial port on the control (port J1). Remove the jumper or open the switch between terminals 9 and 10 to set port J1 as a Hand Held Programmer interface port. To connect the terminal, slightly loosen the right-hand screw in the cover over J1 and rotate the cover clockwise to expose the 9-pin connector. Then firmly seat the connector on the terminal into J1. The terminal can be connected or disconnected at any time without affecting control operation.

The programmer does a power-up self-test whenever it is plugged into the control. When the self-test is complete, the screen will display two lines of information relating to the application. Pressing the ID key will change the display to show the part number and revision level of the software.

The programmer screen is a four-line, backlit LCD display. The display permits you to look at two separate functions or menu items at the same time. Use the “Up/Down Arrow” key to toggle between the two displayed items. The BKSP and SPACE keys will scroll through the display to show the remainder of a prompt if it is longer than the display screen's 19 characters.

Menus

The 723PLUS has two sets of menus; the Service menus and Configure menus. The Service menus allow easy access and tuning while the engine is running. The Configure menus may only be entered if the I/O is shut down, and hence the engine stopped.

Configure Menu

To access Configure menus, the engine must be shut down. Close the Run/Stop contact. Press the "." key. The display will show "To select configure, press enter". Press the ENTER key and the display will show "To shutdown I/O, press enter". Press the ENTER key and this will allow you into the Configure menus.

IMPORTANT

If the engine is running during this process, it will be shut down due to shutting down the I/O of the control.

To move between the menus, use the "Arrow Left" and "Arrow Right" keys. To move through the set points within a menu, use the "Arrow Up" and "Arrow Down" keys. Once within a menu, to return to the menu header, press the ESC key.

To leave the Configure menus press the ESC key. The set points will be automatically saved when leaving Configure, and the control will automatically reboot itself.

Service Menu

To access the Service menus press the "Arrow Down" key from the master screen. To move between menus, and to move through set points within menus, follow the instructions as for the Configure menus. Also to return to the menu header, or to leave Service, follow the Configure instructions.

Adjusting Set Points

To adjust a set point, use the "Turtle Up" or the "Rabbit Up" keys to increase the value, and the "Turtle Down" or "Rabbit Down" keys to decrease the value. The "Rabbit Up" and "Rabbit Down" keys will make the rate of change faster than the "Turtle Up" and "Turtle Down" keys. This is useful during initial setup where a value may need to be changed significantly. Where necessary, to select TRUE, use either the "Turtle Up" or the "Rabbit Up" keys, and to select FALSE, use the "Turtle Down" or "Rabbit Down" keys. To increase or decrease the value one unit at a time, use the "+" (PLUS) or "-" (MINUS) keys.

To obtain an exact value, press the "=" key. Key in the required figure and press ENTER.

IMPORTANT

This may be done only if the figure is within 10% of the existing value.

Saving Set Points

To save set points at any time, use the SAVE key. This will transfer all new set point values into the EEPROM memory. The EEPROM retains all set points when power is removed from the control.

NOTICE

To prevent possible damage to the engine resulting from improper control settings, make sure you save the set points before removing power from the control. Failure to save the set points before removing power from the control causes them to revert to the previously saved settings.

Hand Held Programmer Keys

The programmer keys do the following functions (see Figure 4-1):

(left arrow)	Moves backward through Configure or Service, one menu at a time.
(right arrow)	Advances through Configure or Service, one menu at a time.
(up/down arrow)	Toggles between the two displayed items.
(up arrow)	Moves backward through each menu, one step at a time.
(down arrow)	Advances through each menu, one step at a time.
	Selects Service from Main Screen.
(turtle up)	Increases the displayed set point value slowly.
(turtle down)	Decreases the displayed set point value slowly.
(rabbit up)	Increases the displayed set point value quickly (about 10 times faster than the turtle keys).
(rabbit down)	Decreases the displayed set point value quickly (about 10 times faster than the turtle keys).
– (minus)	Increases set point values by one step at a time.
+ (plus)	Decreases set point values by one step at a time.
(solid square)	Not used.
ID	Displays the 723PLUS control part number and software revision level.
ESC	To return to menu header or to main screen.
SAVE	Saves entered values (set points).
BKSP	Scrolls left through line of display.
SPACE	Scrolls right through line of display.
ENTER	Used when entering exact values and accessing Configure.
= (equals)	For entering exact values (within 10%).
(decimal)	To select Configure.

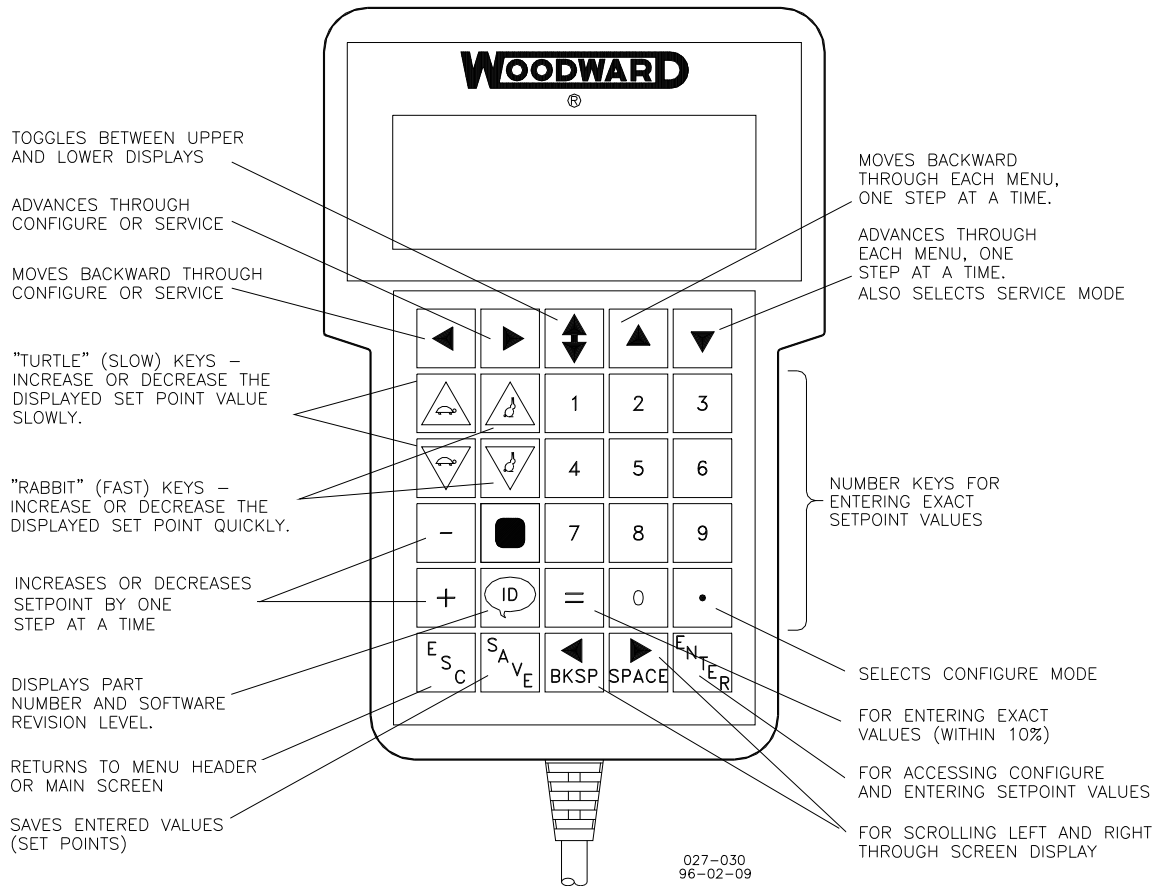


Figure 4-1. Hand Held Programmer Functions

NOTICE

Any values that are adjusted or tuned must be saved prior to removing power to the 723PLUS control, otherwise they will revert back to their original settings. Saving is done by pressing the SAVE key on the hand held programmer.

When the hand held programmer is not being used for extended periods, it is recommended that it be disconnected from the 723PLUS control. The hand held programmer may provide an easier path for radio and other EMI signals to enter the 723PLUS control and cause undesirable conditions. By removing the hand held programmer, undesirable, accidental, or tampered variable changes are avoided.

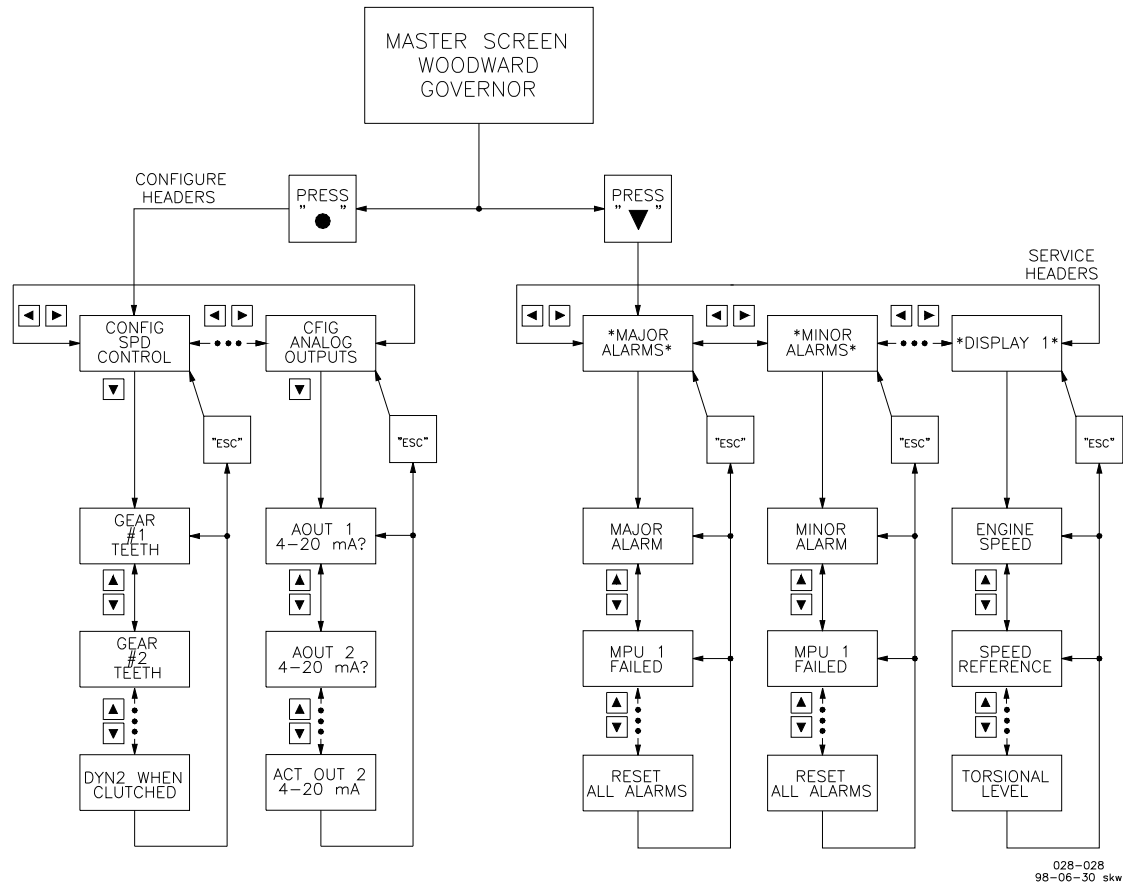


Figure 4-2. Service and Configure Headers

IMPORTANT

To change control port J1 to Servlink/Watch Window mode, install a jumper or close a switch between terminals 9 and 10. Removing this jumper or opening the switch sets port J1 as a Hand Held Programmer interface port.

Servlink / Watch Window PC Interface

The connection of a computer is only required for calibration and setup of the 723PLUS control on a prime mover. The computer and Watch Window software is not required, and not necessary, for normal operation of the prime mover, unless Modbus is being used for monitoring.

Watch Window was developed by Woodward to be a Servlink client software product that provides a generic PC interface to any control, and is a very powerful setup, testing, and troubleshooting tool. Watch Window provides a means of shutting down and placing the control in the I/O Lock mode for Configuration, saving values in the control EEPROM, and resetting the control. Application tunable values can be uploaded, downloaded, and saved to a file.

An “inspector” provides a window for real-time monitoring and editing of all control Configuration and Service Menu parameters and values. Custom “inspectors” can easily be created and saved. Each window can display up to 28 lines of monitoring and tuning parameters without scrolling. The number with scrolling is unlimited. Two windows can be open simultaneously to display up to 56 parameters without scrolling. Tunable values can be adjusted at the inspector window. Watch Window communicates with the control through an RS-232 cable connection to the communication port which is configured as a point-to-point only Servlink Server.

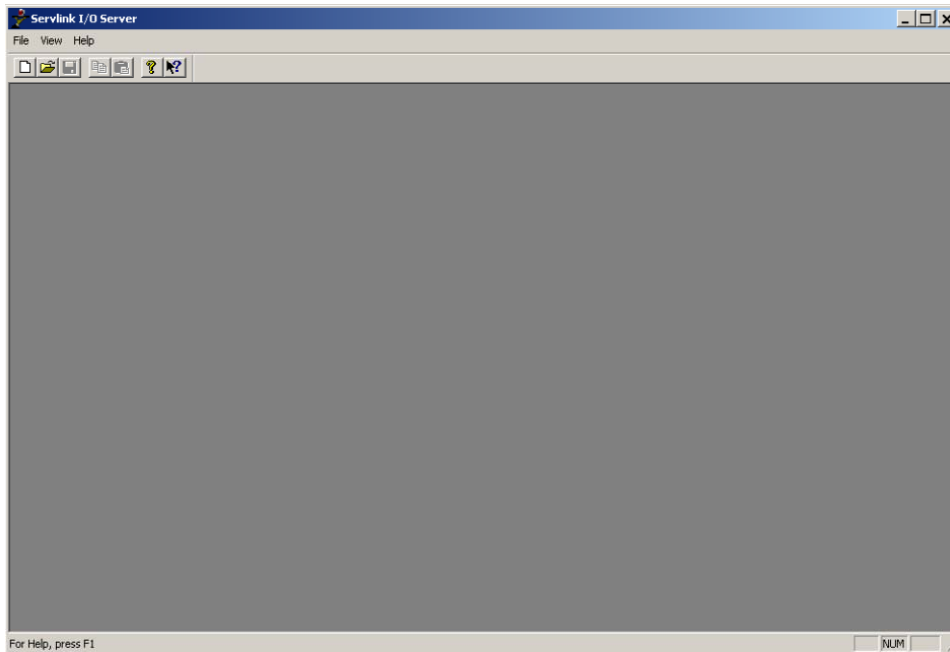
The 723PLUS’s default baud rate is 19200, which needs to be entered in the Servlink Network Options window. Servlink will be initialized correctly for all other port parameters except BAUD rate.

Check the ‘pull-down’ menu CONTROL \ PROPERTIES to display the part number and revision level of the software in the control. Refer to this number and revision level in any correspondence with Woodward (write this information in the programming checklist, Appendix D). The Watch Window software has extensive help assistance through the Help Menu.

Follow these steps to communicate with the control:

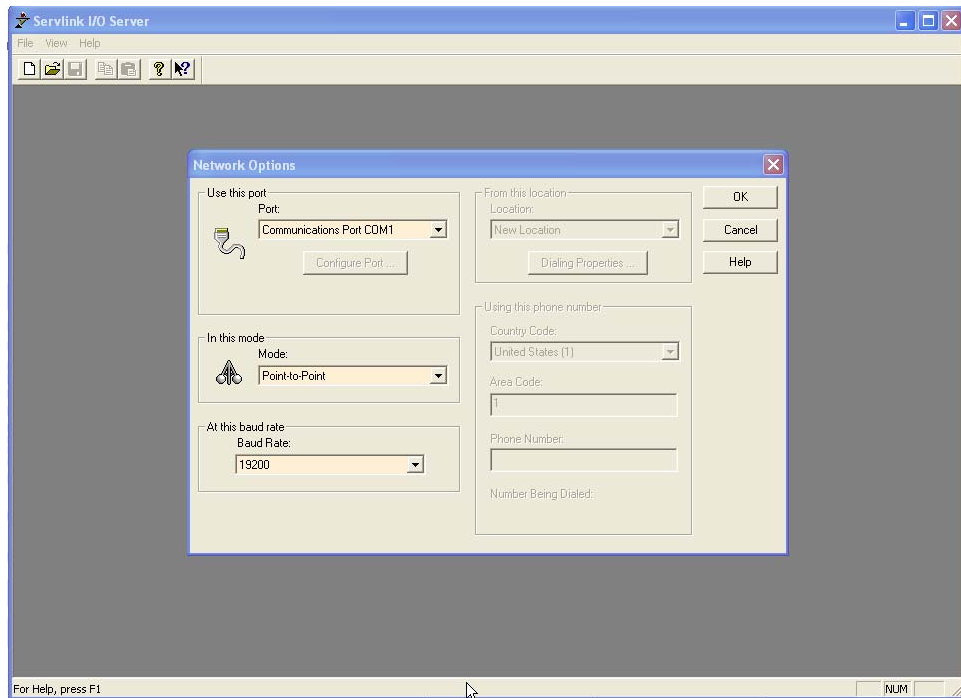
Step 1:

Open a Servlink Window. Go to Start \ Programs \ Woodward \ Servlink Server \ Servlink Server, and click on the Servlink Server to start the software.

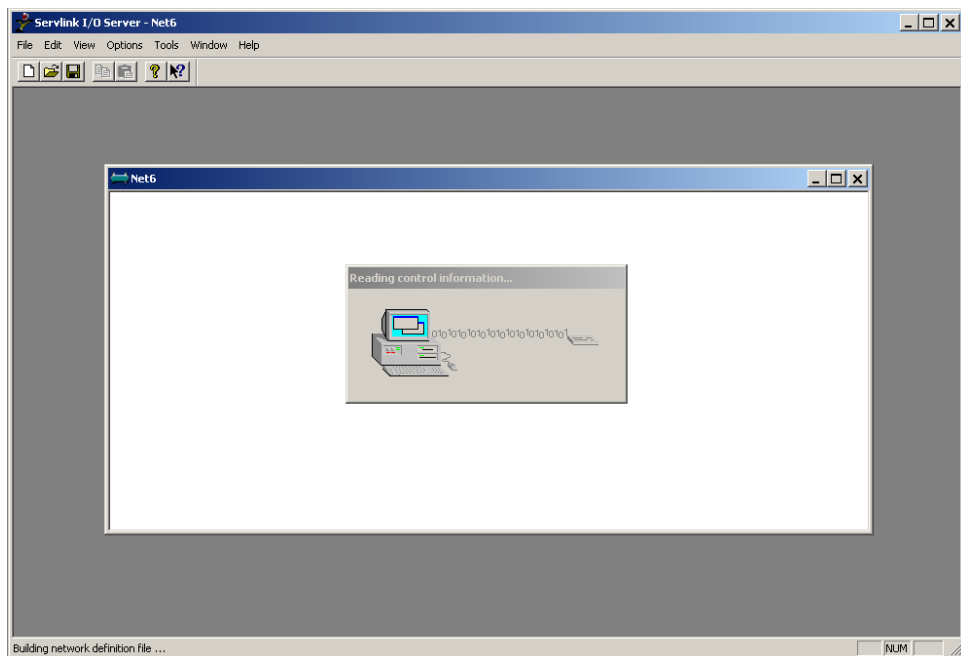


Step 2:

Click on File \ New to open a Network Options menu. Select the correct Port for your computer (Com 1 is default). Select Point-to-Point for the Mode, and select 19200 for the Baud Rate.

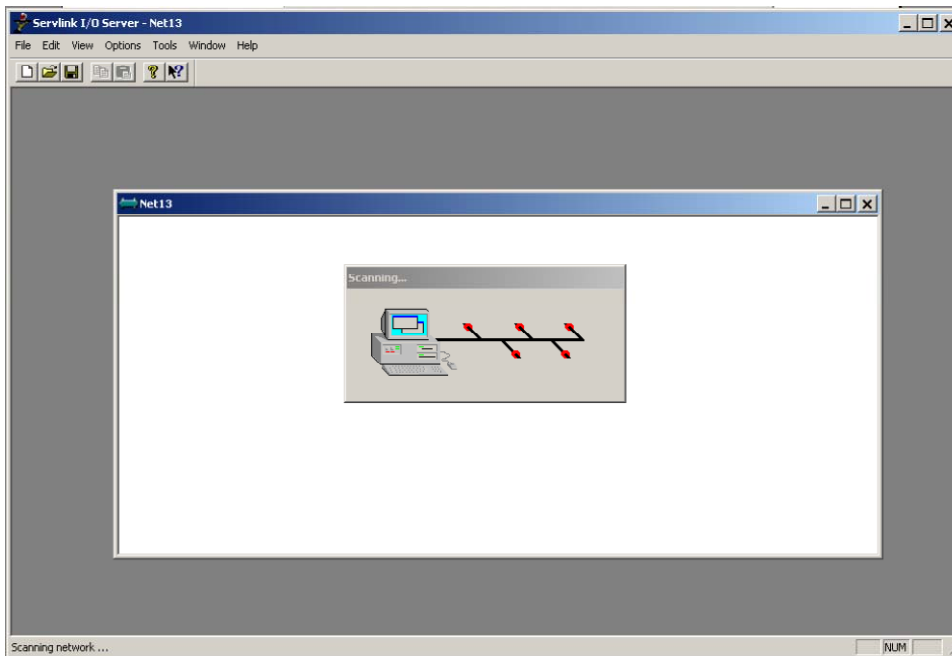
**Step 3:**

Select OK, and the control will start communicating with the computer.

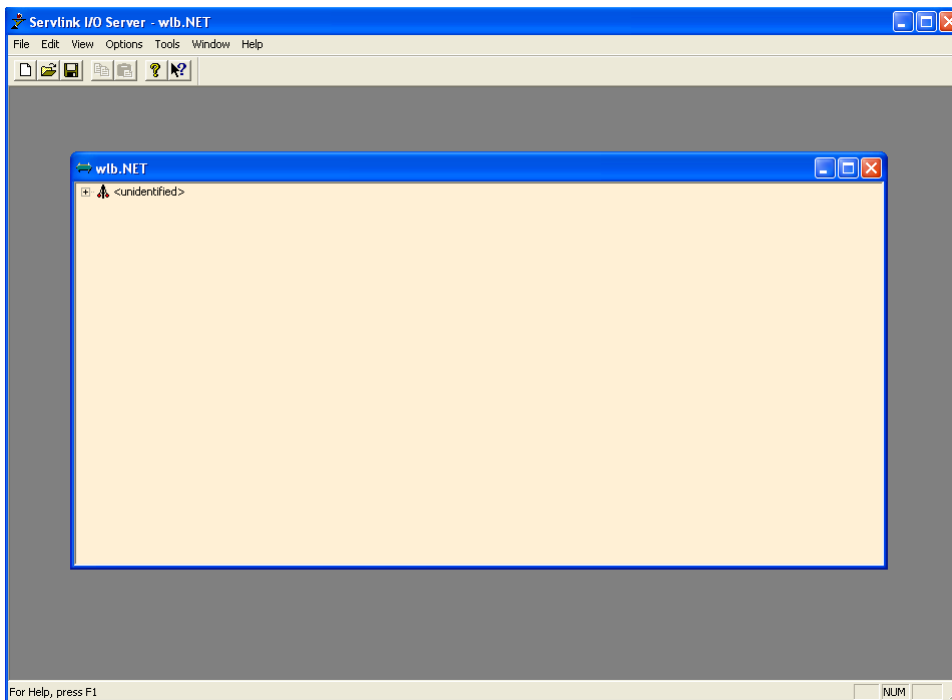


Step 4:

If the red scanner bars cannot locate a control, then check to make sure that there is power on the control, and that a null modem (cross-over) cable is connected to the control.

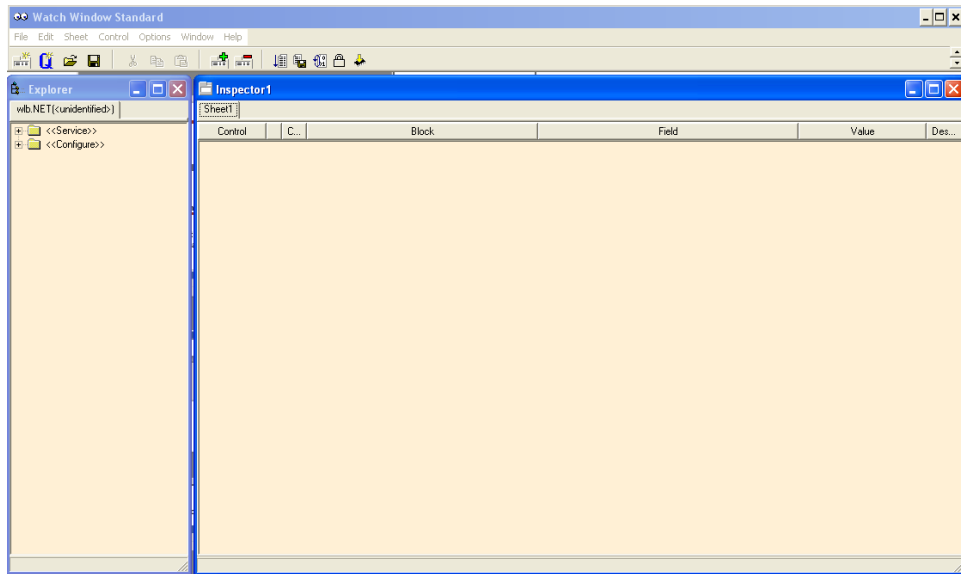
**Step 5:**

When the communication is complete, the window should look as follows:

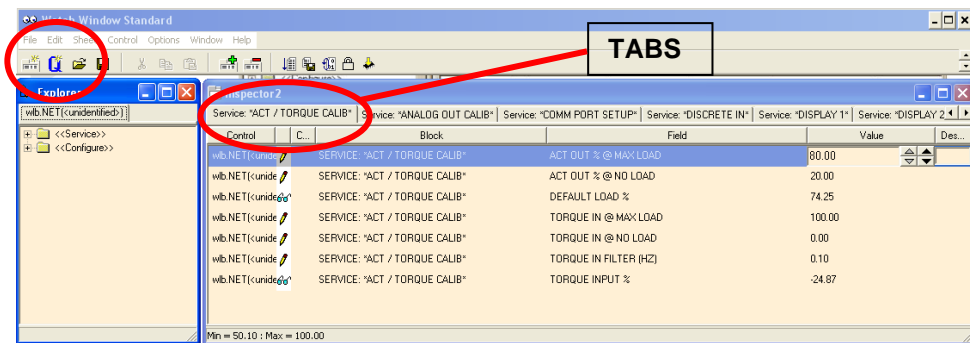


Step 6:

Minimize the Servlink program (don't close it down). Open Watch Window software. Go to Start \ Programs \ Woodward \ Watch Window Standard \ Watch Window Standard, and click on the Watch Window Standard to start the software.

**Step 7:**

Click on the “Q” icon in the Main Window. This will open up a Quick Inspector window, with all of the Service and Configure menu header tabs



Listed below is a description of the icons in the Watch Window software:



Watch Window version 1.05 and above allows for automatic generation of inspector sheets. Click on the Q icon (Quick Inspector) on the tool bar. A Sheet will automatically be created from each Service and Configure Header programmed into the control. Multiple inspectors can be created this way to allow for viewing more than one sheet at a time.



To enter the I/O Lock mode and enable a configure value to be entered, click on the I/O Lock icon on the Tool Bar. Because the values set in Configure are critical to engine operation, it is not safe to operate the prime mover while these parameters are being configured. In the Configure mode the control outputs will be set to their off state, and the microprocessor will stop executing the application code. The control will have to be Reset to continue operation.



The Reset icon allows the microprocessor to store the configure parameters, to return the outputs to their active state, and to resume executing the application software.



When the tuning or setting of parameters is complete, the values must be saved in the control's non-volatile memory. Go to the Tool Bar and click the PROM icon for Save Values. The values will be saved in non-volatile memory and will be unaffected by loss of power to the control.




If an application configuration has been previously saved to a *.CFG file, the saved set of parameters can be loaded into the 723PLUS as a group by selecting the Load Application Settings icon.

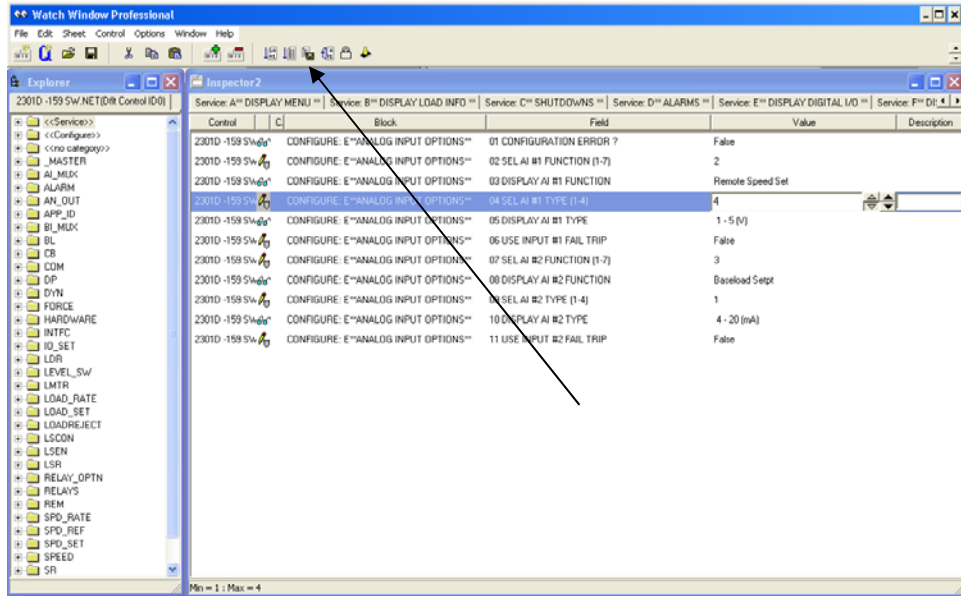


To save the configuration to a file in the external computer for backup or download later into another 723PLUS when a similar system is being set up, select the Save Application Settings icon. All the tunable values presently set in the control will be saved to a file and can be loaded into this 723PLUS, control to reprogram it to the saved values or into another 723PLUS, at a later time.

Follow these steps to save and reload the variables from the control:

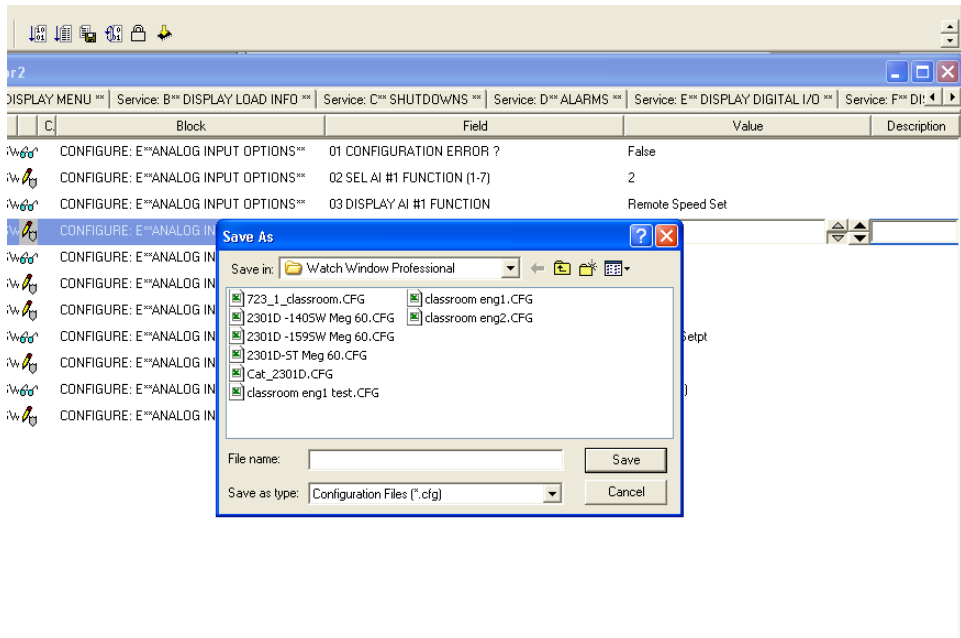
Step 1:

Servlink and Watch Windows must be open to upload or save the variables to your computer. Click on the “Save Application Settings” icon .



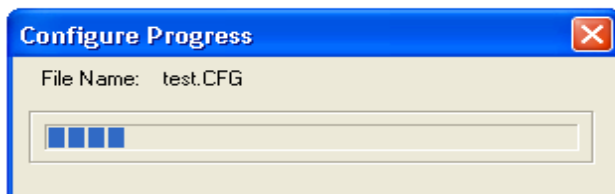
Step 2:

The software will ask you where to save the application settings file. The file extension is .cfg.




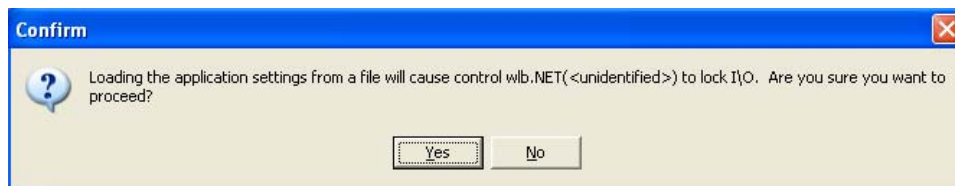
Step 3:

The software will ask you where to save the application settings file. The file extension is .cfg. This process can be executed even while the engine is running. It will not interrupt the 723PLUS. A progress bar will show you when the upload is finished. It should only take about 10-20 seconds.

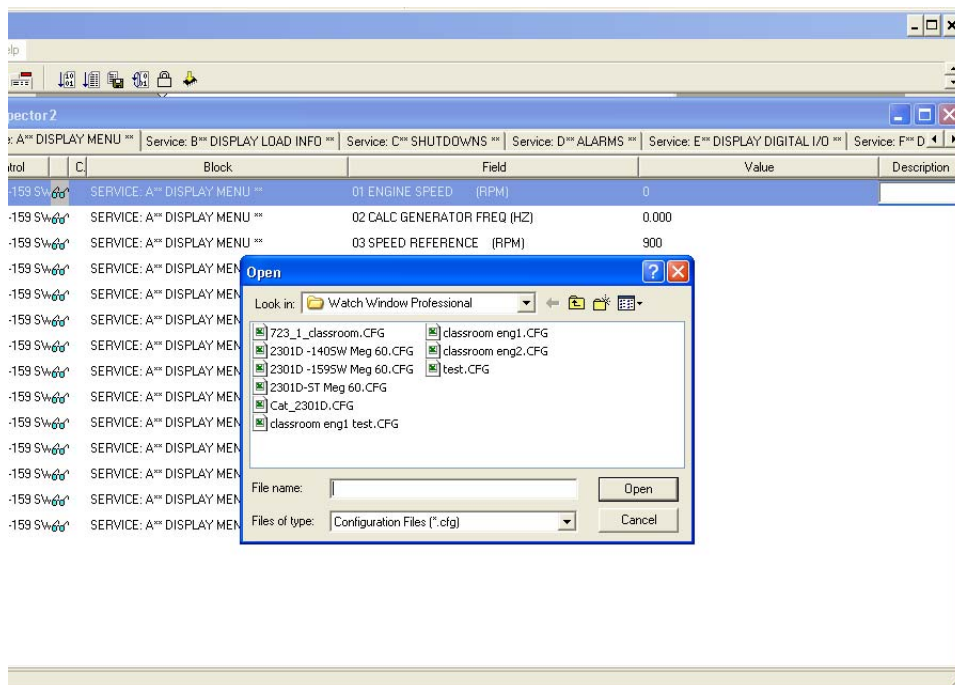
**Step 4:**

To download the configure file (.cfg) back into a control, the engine must be shutdown. Servlink and Watch Windows must be running. Click on the "Load

Application Settings" icon . The software will then tell you that the control is going to be put into an I/O Lock. This will open up all of the inputs and outputs. Make sure that your engine is shutdown. Click on Yes to continue.

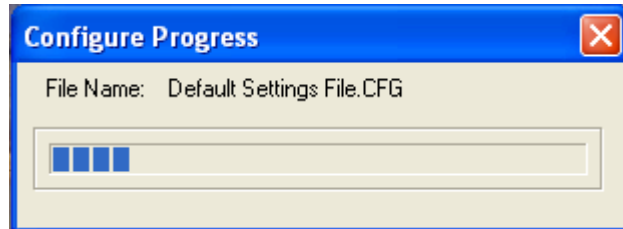
**Step 5:**

The software will then ask you where you saved your .cfg file. Select the file that you saved and click on the Open button.



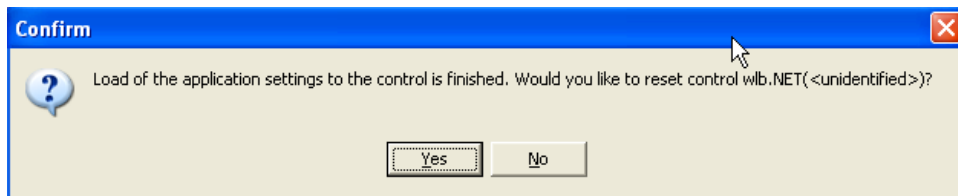
Step 6:

The download will begin and a progress bar will appear. This should only take about 5-10 seconds.



Step 7:

Once the download is finished, a confirmation window will appear. By clicking on the Yes button, the control will reboot.



Step 8:

Verify the settings in the control. This is important to make sure that you downloaded the correct Configure File (.cfg), and to make sure that the most critical settings were loaded.

Configure Menus

A**CONFIG SPD CONTROL**



WARNING All settings in the A**CONFIG SPD CONTROL** configure header are critical engine operating parameters. Incorrectly set values could result in an engine overspeed and resulting injury or property damage.

When accessing the configuration menus the 723PLUS control will activate an I/O lock on the hardware. All outputs will be turned off (zero current/volts, extinguished LEDs) or de-energized (open contacts). Do not attempt to run the engine when a configure menu is active.

01 GEAR #1 TEETH (*16–300 Teeth)—Set this to the number of teeth or holes on the speed sensing gear for speed sensor #1. If the speed sensing gear is not rotating at the same speed as the crankshaft, this is the number of gear teeth that will pass the speed sensor in one complete engine revolution.

02 GEAR #2 TEETH (*16–300 Teeth)—Set this to the number of teeth or holes on the speed sensing gear for speed sensor #2. If the speed sensing gear is not rotating at the same speed as the crankshaft, this is the number of gear teeth that will pass the speed sensor in one complete engine revolution.

03 RATED SPEED (*100–2200)—Set this value to the rated speed of the engine.

04 IDLE REF @ SHUTDOWN (*T/F)—If set to “TRUE”, every time the engine is shut down (engine speed falls below 5% of rated speed) the speed reference will reset to the Idle set point (if remote speed setting is selected, the speed reference is reset to idle and, after one second, it will ramp to the remote speed setting). If set to “FALSE”, the speed reference will stay at its present value when the engine is shut down.

05 IDLE WHEN LON FAIL (*T/F)—If set to “TRUE”, a Control LON communications failure between the two 723PLUS controls will cause the speed reference to reset to idle. Engine speed will remain at idle until communication is restored. If set to “FALSE”, the speed references will lock in last.

06 MAN MODE SPD STPT (*100–2200)—Set this value for the engine speed when the maneuvering mode discrete input is closed.

BCONFIG OPTION****

01 LON ADDRESS CH#1 is the node address for LON Channel #1 and must be set at 1 or 2. The node address must be the same for both LON Channels #1 and #2 within the same 723PLUS control. The mating 723PLUS control must be assigned the remaining node address choice.

02 LON ADDRESS CH#2 is the node address for LON Channel #2 and must be set at 1 or 2. The node address must be the same for both LON Channels #1 and #2 within the same 723PLUS control. The mating 723PLUS control must be assigned the remaining node address choice.

03 OVERRIDE FAILSAFE (*T/F)—Set this value “FALSE” to have the actuator output go to the MINIMUM fuel position on loss of engine speed input signal/ signals. Set this value “TRUE” to have the actuator output go to the MAXIMUM fuel position on loss of engine speed input signal(s). This function will activate only when Reverse Acting Act is also “TRUE”.

04 REVERSE ACTING ACT (*T/F)—Set this value “FALSE” for forward (direct) acting actuators and “TRUE” for reverse (indirect) acting actuators.

05 MANUAL CLUTCH LOGIC (*T/F)—Set this value “TRUE” to enable manual clutch logic. When manual clutch logic is selected, engine synchronizing must be done manually and a clutch permissive output will not be issued by the 723PLUS. Torque sharing is initiated when a clutch engaged contact is sensed. Soft loading operates as normal, however soft unloading is not possible due to the absence of the clutch request function.

06 CONT A OPEN TO RUN (T/F)—Set this value “FALSE” for “Open to Run”, normal speed control function is enabled when this input is open. If this value is closed (discrete input in the “TRUE” state), the Minimum Fuel Function will immediately pull the fuel demand to zero. The control output to the actuator will be the minimum fuel demand when voltage is applied to terminal 29.

07 MAJOR ALM SD ACT (*T/F)—Set this value “TRUE” to have the control return to minimum fuel if a major alarm is detected. USE NOTCH FILTER (*T/F)—Set this value TRUE to enable the notch filter. The notch filter is useful for dampening otherwise uncontrollable system harmonics. It can be used as a flexible coupling torsional frequency filter if two speed sensors are not available.

08 DISABLE TORQUE INPUT (*T/F)—Set this value “TRUE” to disable the torque input signal on Analog Input #1. This feature was added to permanently run on the back up Actuator Fuel Demand load sharing function. Set this value “False” to enable the Torque Load Sharing function and still have the Actuator Fuel Demand load sharing as a backup.

CCONFIG MAJOR ALARMS****

Enabling any one or a combination of the following alarms is acceptable as they are linked together as logical “ORs”. This is relay output #2, 723PLUS control terminals #5 and #6. This is a normally energized contact and will provide a shutdown signal when de-energized.

01 MPU 1 FAILED (*T/F)—Set this value “FALSE” if failure of MPU 1 input is not to be a major alarm. Set this value “TRUE” if failure of MPU 1 input is to be alarmed as a major alarm.

02 MPU 2 FAILED (*T/F)—Set this value “FALSE” if failure of MPU 2 input is not to be a major alarm. Set this value “TRUE” if failure of MPU 2 input is to be alarmed as a major alarm.

03 BOTH MPU FAILED (*T/F)—Set this value “FALSE” if a failure of both MPUs is not to be a major alarm. Set this value “TRUE” if failure of both MPUs is to be alarmed as a major alarm.

04 REMOTE SPEED FAILED (*T/F)—Set this value “FALSE” if failure of Remote Speed Setting input is not to be a major alarm. Set this value “TRUE” if failure of Remote Speed Setting input is to be alarmed as a major alarm.

05 TORQUE INPUT FAILED (*T/F)—Set this value “FALSE” if failure of THE TORQUE input is not to be a major alarm. Set this value “TRUE” if failure of the TORQUE input is to be alarmed as a major alarm.

06 RACK POSN INPUT FAILED (*T/F)—Set this value “FALSE” if failure of the rack position input is not to be a major alarm. Set this value “TRUE” if failure of the rack position input is to be alarmed as a major alarm.

07 HIGH ACT ALARM (*T/F)—Set this value “FALSE” if no major alarm output is desired when Maximum Fuel Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a major alarm output is desired when Maximum Fuel Limiter is in control (limiting) of the actuator driver output.

08 LON CH1 ERROR (*T/F)—Set this value “FALSE” if no major alarm output is desired when a Control LON Channel 1 error is detected. Set this value “TRUE” if a major alarm output is desired when a Control LON Channel 1 error is detected.

09 LON CH2 ERROR (*T/F)—Set this value “FALSE” if no major alarm output is desired when a Control LON Channel 2 error is detected. Set this value “TRUE” if a major alarm output is desired when a Control LON Channel 2 error is detected.

10 CLON CH1&2 ERROR (*T/F)—Set this value “FALSE” if no major alarm output is desired when both Control LON Channel 1 and 2 errors are detected. Set this value “TRUE” if a major alarm output is desired when both Control LON Channel 1 and 2 errors are detected.

11 PID @ LOW LEVEL (*T/F)—Set this value “FALSE” if no major alarm output is desired when PID At Zero Fault occurs. Set this value “TRUE” if a major alarm output is desired when PID At Zero Fault occurs.

12 OVERSPEED (*T/F)—Set this value “FALSE” if no major alarm output is desired when engine overspeed occurs. Set this value “TRUE” if a major alarm output is desired when engine overspeed occurs.

13 CLUTCH FAIL (*T/F)—Set this value “FALSE” if no major alarm output is desired when a clutch engaged contact is not received within the CLUTCH SYNC TIME. Set this value “TRUE” if a major alarm is desired when the clutch engaged contact is not received within the CLUTCH SYNC TIME.

14 ACTUATOR MODE (MECH GOV) (*T/F)—Set this value “FALSE” if no major alarm output is desired when the ACTUATOR MODE discrete input contact is open. Set this value “TRUE” if a major alarm is desired when the ACTUATOR MODE discrete input contact is closed.

15 TORQ DEV ERROR (*T/F)—Set this value “FALSE” if no major alarm output is desired when a TORQUE DEVIATION is sensed. Set the value “TRUE” if a major alarm is desired.

DCONFIG MINOR ALARMS****

Enabling any one or a combination of the following alarms is acceptable as they are linked together as logical “ORs”. This is relay output #1, 723PLUS control terminals #3 and #4. The output goes to the TANO panel and will alarm a Minor Governor Alarm when energized.

01 MPU 1 FAILED (*T/F)—Set this value “FALSE” if failure of MPU 1 input is not to be a minor alarm. Set this value “TRUE” if failure of MPU 1 input is to be alarmed as a minor alarm.

02 MPU 2 FAILED (*T/F)—Set this value “FALSE” if failure of MPU 2 input is not to be a minor alarm. Set this value “TRUE” if failure of MPU 2 input is to be alarmed as a minor alarm.

03 REMOTE SPEED FAILED (*T/F)—Set this value “FALSE” if failure of Remote Speed Setting input is not to be a minor alarm. Set this value “TRUE” if failure of Remote Speed Setting input is to be alarmed as a minor alarm.

04 TORQUE INPUT FAILED (*T/F)—Set this value “FALSE” if failure of the TORQUE input is not to be a minor alarm. Set this value “TRUE” if failure of TORQUE input is to be alarmed as a minor alarm.

05 RACK POSN INPUT FAILED (*T/F)—Set this value “FALSE” if failure of the rack position input is not to be a minor alarm. Set this value “TRUE” if failure of the rack position input is to be alarmed as a minor alarm.

06 HIGH ACT ALARM (*T/F)—Set this value “FALSE” if no minor alarm output is desired when Maximum Fuel Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a minor alarm output is desired when Maximum Fuel Limiter is in control (limiting) of the actuator driver output.

07 CLON CH1 ERROR (*T/F)—Set this value “FALSE” if no minor alarm output is desired when a Control LON Channel 1 error is detected. Set this value “TRUE” if a minor alarm output is desired when a Control LON Channel 1 error is detected.

08 CLON CH2 ERROR (*T/F)—Set this value “FALSE” if no minor alarm output is desired when a Control LON Channel 2 error is detected. Set this value “TRUE” if a minor alarm output is desired when a Control LON Channel 2 error is detected.

09 CLON CH1&2 ERROR (*T/F)—Set this value “FALSE” if no minor alarm output is desired when both Control LON Channel 1 and 2 errors are detected. Set this value “TRUE” if a minor alarm output is desired when both Control LON Channel 1 and 2 errors are detected.

10 PID @ LOW LEVEL (*T/F)—Set this value “FALSE” if no minor alarm output is desired when PID At Zero Fault occurs. Set this value “TRUE” if a minor alarm output is desired when PID At Zero Fault occurs.

11 OVERSPEED (*T/F)—Set this value “FALSE” if no minor alarm output is desired when engine overspeed occurs. Set this value “TRUE” if a minor alarm output is desired when engine overspeed occurs.

12 CLUTCH FAIL (*T/F)—Set this value “FALSE” if no minor alarm output is desired when a clutch engaged contact is not received within the CLUTCH SYNC TIME. Set this value “TRUE” if a minor alarm is desired when the clutch engaged contact is not received within the CLUTCH SYNC TIME.

13 ACTUATOR MODE (MECH GOV) (*T/F)—Set this value “FALSE” if no minor alarm output is desired when the ACTUATOR MODE discrete input contact is open. Set this value “TRUE” if a minor alarm is desired when the ACTUATOR MODE discrete input contact is closed.

14 TORQ DEV ERROR (*T/F)—Set this value “FALSE” if no minor alarm output is desired when a TORQUE DEVIATION is sensed. Set the value “TRUE” if a minor alarm is desired.

15 ACT CUR DEV ERROR (*T/F)—Set this value “FALSE” if no minor alarm output is desired when an ACTUATOR CURRENT DEVIATION is sensed. Set the value “TRUE” if a minor alarm is desired.

EALARM/SD CONFIGURE****

01 ALARM DELAY TIME (*0.01–60.0)—Set this value for the duration that an analog input must be outside the normal operating range (below 2.0 mA for the low side or above 22 mA for the high side) before it is considered failed. The units for this value are seconds.

02 OPEN CNT ON MIN ALM (*T/F)—If this value is set “FALSE”, the minor alarm relay (relay #1) will energize, closing the contacts at terminals #3 and #4 when a minor alarm occurs. If this value is set “TRUE”, the minor alarm relay (relay #1) will de-energize, opening the contacts at terminals #3 and #4 when a minor alarm occurs. Remember that for any of the minor alarms to be annunciated by the minor alarm output, it must first be enabled while under configure header D**CONFIG MINOR ALARMS**.

03 OPEN CNT ON MAJ ALM (*T/F)—If this value is set “FALSE”, the major alarm relay (relay #2) will energize, closing the contacts at terminals #5 and #6 when a major alarm occurs. If this value is set “TRUE”, the major alarm relay (relay #2) will de-energize, opening the contacts at terminals #5 and #6 when a major alarm occurs. Remember that for any of the major alarms to be annunciated by the major alarm output, it must first be enabled while under configure header C**CONFIG MAJOR ALARMS**.

04 SHUTDOWN WHEN PID@0 (*T/F)—Set this value “FALSE” if no action is to be taken when the PID @ ZERO alarm occurs. Set this value “TRUE”, and a PID @ ZERO alarm will cause an Emergency Declutch.

05 PID @ ZERO LEVEL (*0.0–100.0)—The units for this value are percent of the actuator output driver. Set this value for the desired level that the PID output must be below before an alarm will occur.

06 PID @ ZERO TIME (*0.0–120.0)—The units for this value are seconds. Set this value for the duration that the PID output must be below the value set at prompt PID @ ZERO LEVEL before an alarm will occur.

07 HIGH ACT ALM LEVEL (%) (0.0–100.0)—The units for this value are percent of the actuator driver output. Set this value for the desired level that the PID output must be above before the HIGH ACT ALARM is tripped.

08 OVERSPEED SD (1–2200 rpm)—The units for this value are rpm. Set this value to the desired high speed shutdown point.

09 LON ALM DELAY TIME (*SEC)—Set the delay time to wait before latching the CLON CH1 ERROR, CLON CH2 ERROR and PORT 3 LINK ERROR into a minor or major alarm state.

10 ACTUATOR MODE SWITCH DELAY (*SEC)—Set the delay time to wait before latching the ACTUATOR MODE SWITCH DELAY discrete input into a minor or major alarm state.

FCFG COM PORT 2****

The 723PLUS has two serial ports. Port 2 and Port 3 are configured as Servlink ports.

01 PORT 2 ADDRESS determines the port’s multidrop Servlink network address. Set between 0 and 15.

Service Menus

ADISPLAY 1****

01 ENGINE SPEED (RPM)—This is the sensed engine speed.

02 SPEED REFERENCE (RPM)—This is the present value of the engine speed reference.

03 ACTUATOR COMMAND %—This is the actuator output command percentage to the actuator. This value is the output of the final driver and may be forward (direct) or reverse (indirect) acting. The percentage is proportional to the actuator current (0–200 mA).

04 ACTUATOR COMMAND (mA)—This the actuator output command to the actuator in milliamps (0–200 mA)

05 TORQUE INPUT (4–20 mA)—This is the torque sensor 4–20 mA input (Analog Input #1) signal value, displayed in milliamps.

06 TORQUE INPUT %—This is the calibrated torque input signal (if used and not failed. Both the rack position input signal and the actuator driver signal should be calibrated so that at no-load this reads 0%, and at full (rated) load this reads 100% regardless of which one is active.

07 RACK POS INPUT(1–5 Vdc)—This is the rack position input 1–5 Vdc input (Analog Input #3) signal value, displayed in volts.

08 REM SPD INPUT (1–5 Vdc)—This is the remote speed 1–5 Vdc input (Analog Input #2) signal value, displayed in volts.

09 BIASED SPEED REF (RPM)—This is the engine speed reference value plus the bias value from the torque sharing bias signal.

10 ENGINE SPEED MPU#1 RPM—This is the engine speed signal from magnetic pickup #1.

11 ENGINE SPEED MPU#2 RPM—This is the engine speed signal from magnetic pickup #2.

12 TORQUE OUT – FT/LBS—This is the calculated output of the engine torque in foot-pounds coming from the torque sensor input.

BDISPLAY 2****

01 ACT SHUTDOWN (T/F)—A “TRUE” displayed indicates that the 723PLUS is asking the actuator driver output to go to the minimum fuel point. A “FALSE” displayed indicates that the 723PLUS is not asking the actuator driver output to go to the minimum fuel point.

02 ON DYNAMICS 2 (T/F)—A “TRUE” displayed indicates that dynamics #2 is currently being used. A “FALSE” displayed indicates that dynamics #1 is currently being used.

03 SPEED CONTROL MODE (T/F)—A “TRUE” displayed indicates that the 723PLUS speed control PID has control of the actuator driver output. A “FALSE” displayed indicates that the 723PLUS speed control PID does not have control of the actuator driver output (something else has control).

04 ON MAX FUEL LIMIT (T/F)—A “TRUE” displayed indicates that the Maximum Fuel Limiter has control of the actuator driver output. A “FALSE” displayed indicates that the Maximum Fuel Limiter does not have control of the actuator driver output (something else has control).

05 ON START FUEL LIMIT (T/F)—A “TRUE” displayed indicates that the Start Fuel Limiter has control of the actuator driver output. A “FALSE” displayed indicates that the Start Fuel Limiter does not have control of the actuator driver output (something else has control).

06 ENGINE OVER SPED? (T/F)—A “TRUE” displayed indicates that the engine has hit the 723PLUS control overspeed trip point. This will be automatically reset each time the engine speed reaches 5% of rated speed during a start, or it can be reset by the software reset found in Service mode, at either headers C**MAJOR ALARMS** or D**MINOR ALARMS** at prompt RESET ALL ALARMS.

07 CH1 LON ERROR (*T/F)—A “TRUE” displayed indicates that a communications error has occurred on Control LON Channel 1.

08 CH2 LON ERROR (*T/F)—A “TRUE” displayed indicates that a communications error has occurred on Control LON Channel 2.

09 USE MASTER SPD REF (*T/F)—A “TRUE” indicates this control is currently a “slave” and is using the speed reference of the other control.

10 ON TORQUE SHARING (*T/F)—A “TRUE” displayed indicates that torque sharing is currently active for this engine. When ON LOAD SHARING is “TRUE” for both engines, then both engines share load equally (based upon the PERCENT LOAD signal for each engine). This could also mean that the load sharing being used, is the Actuator Fuel Demand load sharing.

11 PORT 1 ON HANDHELD (*T/F)—A “TRUE” displayed indicates Port 1 is setup to communicate with a handheld programmer.

12 PORT 1 ON SERVLINK (*T/F)—A “TRUE” displayed indicates Port 1 is setup to communicate by Servlink with a PC.

13 RESET ALL ALARMS (*T/F)—Changing this value from FALSE to TRUE issues an alarm and transducer failure reset. All cleared conditions will reset.

C**MAJOR ALARMS**

IMPORTANT

Once the desired major alarms are enabled in Configure mode, any one or a combination of the enabled alarms may activate the Major Alarm output (terminals #5 and #6).

01 MAJOR ALARM (T/F)—This is the major alarm indicator. A “TRUE” indicates that a major alarm has occurred or is active, and “FALSE” indicates that there are no major alarms. This will display “TRUE” if only one or any combination of the “enabled” Major alarms occur.

02 MPU 1 FAILED (T/F)—A “TRUE” displayed indicates that speed sensor input #1 (terminals #11 and #12) has failed. A “FALSE” displayed indicates that speed sensor input #1 is OK.

03 MPU 2 FAILED (T/F)—A “TRUE” displayed indicates that speed sensor input #2 (terminals #13 and #14) has failed. A “FALSE” displayed indicates that speed sensor input #2 is OK.

04 MPU1 AND MPU2 FAILED (T/F)—A “TRUE” displayed indicates that both magnetic pickup sensors failed. A “FALSE” displayed indicates that both magnetic pickups are OK.

05 REMOTE SPEED FAILED (T/F)—A “TRUE” displayed indicates that the Remote Speed input (analog input #2) has failed (either below 2 mA or above 22 mA). A “FALSE” displayed indicates that the Remote Speed input is within the 2– 22 mA window.

06 TORQUE INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Torque Signal input (analog input #1) has failed (either below 2 mA [0.5 Vdc] or above 22 mA [5.5 Vdc]). A “FALSE” displayed indicates that Torque input is within the correct 2–22 mA or 0.5–5.5 Vdc window.

07 RACK POSN INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Rack Position Signal input (analog input #3) has failed (either below 2 mA [0.5 Vdc] or above 22 mA [5.5 Vdc]). A “FALSE” displayed indicates that Rack Position Signal input is within the correct 2–22 mA or 0.5–5.5 Vdc window.

08 HIGH ACT ALARM (T/F)—A “TRUE” displayed indicates that the Maximum Fuel Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Maximum Fuel Limiter is not in control of the actuator driver output.

09 CLON CH1 ERROR (*T/F)— A “TRUE” displayed indicates that a Control LON Channel 1 error is detected. A “FALSE” displayed indicates Control LON Channel 1 is functioning properly.

10 CLON CH2 ERROR (*T/F)— A “TRUE” displayed indicates that a Control LON Channel 2 error is detected. A “FALSE” displayed indicates Control LON Channel 2 is functioning properly.

11 CLON CH1&2 ERROR (*T/F)— A “TRUE” displayed indicates that both Control LON Channel 1 and Control LON Channel 2 errors are detected. A “FALSE” displayed indicates either Control LON Channel 1 or Control LON Channel 2 is functioning properly.

12 PID @ LOW LEVEL (T/F)—A “TRUE” displayed indicates that a PID @ Low Level alarm has occurred. A “FALSE” displayed indicates that the PID @ Low Level alarm has not been detected.

13 HIGH SPEED SW (T/F)—A “TRUE” displayed indicates that the engine speed has exceeded the 723PLUS Engine Overspeed Trip point. A “FALSE” displayed indicates that the engine speed has not exceeded the 723PLUS Engine Overspeed Trip point.

14 CLUTCH FAIL (T/F)—A “TRUE” displayed indicates that a clutch engaged contact has not been received within the clutch sync time. A “FALSE” displayed indicates that a clutch engaged contact has been received.

15 TORQ DEVIATION EXCEEDED (T/F)—A “TRUE” displayed indicates that the torque deviation between the engines has exceeded the maximum deviation for the specified time limit.

16 RESET ALL ALARMS (T/F)—Toggle this value from “FALSE” to “TRUE” to reset any of the alarms once they have been cleared. This will also reset any minor alarms.

D**MINOR ALARMS**

IMPORTANT

Once the desired minor alarms are enabled in Configure mode, any one or a combination of the enabled alarms may activate the Minor Alarm output (terminals #3 and #4).

01 MINOR ALARM (T/F)—This is the minor alarm indicator. A “TRUE” indicates that a minor alarm has occurred or is active, and “FALSE” indicates that there are no minor alarms. This will display “TRUE” if only one or any combination of the “enabled” minor alarms occur.

02 MPU 1 FAILED (T/F)—A “TRUE” displayed indicates that speed sensor input #1 (terminals #11 and #12) has failed. A “FALSE” displayed indicates that speed sensor input #1 is OK.

03 MPU 2 FAILED (T/F)—A “TRUE” displayed indicates that speed sensor input #2 (terminals #13 and #14) has failed. A “FALSE” displayed indicates that speed sensor input #2 is OK.

04 REMOTE SPEED FAILED (T/F)—A “TRUE” displayed indicates that the Remote Speed input (analog input #2) has failed (either below 2 mA or above 22 mA). A “FALSE” displayed indicates that the Remote Speed input is within the 2–22 mA window.

05 TORQUE INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Torque Signal input (analog input #1) has failed (either below 2 mA [0.5 Vdc] or above 22 mA [5.5 Vdc]). A “FALSE” displayed indicates that Torque input is within the correct 2–22 mA or 0.5-5.5 Vdc window.

06 RACK POSN INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Rack Position Signal input (analog input #3) has failed (either below 2 mA [0.5 Vdc] or above 22 mA [5.5 Vdc]). A “FALSE” displayed indicates that Rack Position Signal input is within the correct 2–22 mA or 0.5-5.5 Vdc window.

07 HIGH ACT ALARM (T/F)—A “TRUE” displayed indicates that the Maximum Fuel Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Maximum Fuel Limiter is not in control of the actuator driver output.

08 CLON CH1 ERROR (*T/F)— A “TRUE” displayed indicates that a Control LON Channel 1 error is detected. A “FALSE” displayed indicates Control LON Channel 1 is functioning properly.

09 CLON CH2 ERROR (*T/F)— A “TRUE” displayed indicates that a Control LON Channel 2 error is detected. A “FALSE” displayed indicates Control LON Channel 2 is functioning properly.

10 CLON CH1&2 ERROR (*T/F)— A “TRUE” displayed indicates that both Control LON Channel 1 and Control LON Channel 2 errors are detected. A “FALSE” displayed indicates either Control LON Channel 1 or Control LON Channel 2 is functioning properly.

11 PID @ LOW LEVEL (T/F)—A “TRUE” displayed indicates that a PID @ Low Level alarm has occurred. A “FALSE” displayed indicates that the PID @ Low Level alarm has not been detected.

12 HIGH SPEED SW (T/F)—A “TRUE” displayed indicates that the engine speed has exceeded the 723PLUS Engine Overspeed Trip point. A “FALSE” displayed indicates that the engine speed has not exceeded the 723PLUS Engine Overspeed Trip point.

13 CLUTCH FAIL (T/F)—A “TRUE” displayed indicates that a clutch engaged contact has not been received within the clutch sync time. A “FALSE” displayed indicates that a clutch engaged contact has been received.

14 TORQ DEVIATION EXCEEDED (T/F)—A “TRUE” displayed indicates that the torque deviation between the engines has exceeded the maximum deviation for the specified time limit.

15 ACT CUR DEV EXCEEDED (T/F)—A “TRUE” displayed indicates that the actuator current deviation between the engines has exceeded the maximum deviation for the specified time limit.

16 RESET ALL ALARMS (T/F)—Toggle this value from “FALSE” to “TRUE” to reset any of the alarms once they have been cleared. This will also reset any major alarms.

EDYNAMICS DE-CLUTCHED****

01 IDLE GAIN 1 (*0.01–500.0)—The gain is set to provide stable control of the engine at low or idle speed conditions

02 RATED GAIN 1 (*0.01–500.0)—The gain is set to provide stable control of the engine at rated speed conditions.

03 RESET 1 (*0.01–50.0 sec)—Reset compensates for the lag time of the engine. It adjusts the time required for the control to return the speed to zero error after a disturbance. Reset is adjusted to prevent slow hunting and to minimize speed overshoot after a load disturbance.

04 ACT COMP 1 (*0.01–1.0 sec)—Set this value for the time constant of the actuator and fuel system. Typical values are at 20–25% of the reset.

05 GAIN RATIO 1 (*1.0–20.0)—Set this value to the desired gain ratio multiplier when the speed error is outside of the window width.

06 WINDOW WIDTH 1 (*0.01–150.0 rpm)—Set this value for the desired speed error window (\pm) width.

07 GAIN SLOPE 1 (*0.01–20.0)—Set this value for the desired gain slope beyond the gain break point.

08 GAIN BKPT 1 (*0.01–100.0%)—Set this value for the desired percent actuator output above which Gain Slope becomes effective.

09 SPEED FILTER 1 HZ (*0.5–20.0 Hz)—Set this value to the cutoff frequency found by using the formula in Chapter 3. This is the roll-off frequency for the firing torsional filter. This filter is active when dynamics 1 is selected.

10 INITIATE BUMP—Tests the dynamics settings by temporarily applying a decreased fuel demand transient to stimulate a control response. Both the magnitude (ACT BUMP LEVEL) and duration (ACT BUMP DURATION) of the transient may be set under service menu *RESPONSE TESTING*. To initiate an actuator bump, toggle INITIATE BUMP to TRUE then back to FALSE while the engine is operating in a normal steady state loaded or unloaded condition.

IMPORTANT

Be prepared to change the dynamics settings since the actuator bump transient may stimulate instability.

BUMP ENABLE must be set TRUE to enable the BUMP ACT function. See service menu *RESPONSE TESTING.

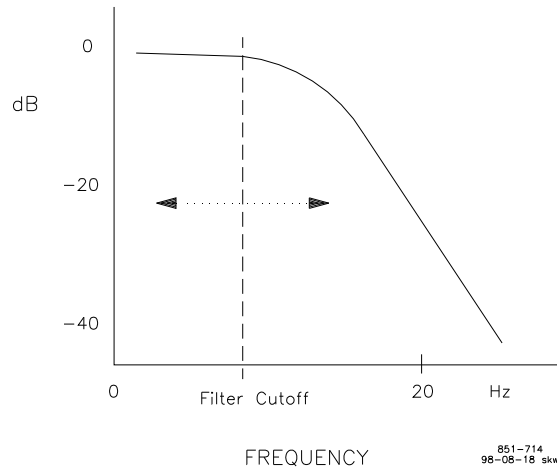


Figure 4-3. Speed Filter

11 MANEUVER GAIN (*0.1–500.0)—The maneuver gain is set to provide stable control of the engine at maneuver speed conditions.

F**DYNAMICS CLUTCHED**

These settings are used only when this engine's clutch is closed.

01 IDLE GAIN 2 (*0.01–500.0)—The gain is set to provide stable control of the engine at low or idle speed conditions and both clutches are closed.

02 RATED GAIN 2 (*0.01–500.0)—The gain is set to provide stable control of the engine at rated speed conditions and both clutches are closed.

03 RESET 2 (*0.01–50.0 sec)—Reset compensates for the lag time of the engine. It adjusts the time required for the control to return the speed to zero error after a disturbance. Reset is adjusted to prevent slow hunting and to minimize speed overshoot after a load disturbance.

04 ACT COMP 2 (*0.01–1.0 sec)—Set this value for the time constant of the actuator and fuel system. Typical values are at 20–25% of the reset.

05 GAIN RATIO 2 (*1.0–20.0)—Set this value to the desired gain ratio multiplier when the speed error is outside of the window width.

06 WINDOW WIDTH 2 (*0.01–150.0 rpm)—Set this value for the desired speed error window (\pm) width.

07 GAIN SLOPE 2 (*0.01–20.0)—Set this value for the desired gain slope beyond the gain break point.

08 GAIN BKPT 2 (*0.01–100.0%)—Set this value for the desired percent actuator output above which Gain Slope becomes effective.

09 SPEED FILTER 2 HZ (*0.5–20.0 Hz)—Set this value to the cutoff frequency found by using the formula in Chapter 3. This is the roll-off frequency for the firing torsional filter. This filter is active when dynamics 2 is selected.

10 INITIATE BUMP—Tests the dynamics settings by temporarily applying a decreased fuel demand transient to stimulate a control response. Both the magnitude (ACT BUMP LEVEL) and duration (ACT BUMP DURATION) of the transient may be set under service menu *RESPONSE TESTING*. To initiate an actuator bump, toggle INITIATE BUMP to TRUE then back to FALSE while the engine is operating in a normal steady state loaded or unloaded condition.

11 BTH CLTCHD GN FCTR – (*0.0-100.0)—Set this value so that the engines are stable under all load conditions while both clutches are closed.

GSPEED REFERENCE****

01 RAISE SPEED LIMIT (*100–2200 rpm)—Raise Speed Limit is the maximum speed reference setting. It is used to limit the Remote Speed Setting inputs to a maximum. It is normally set at the maximum rated engine speed.

02 LOWER SPEED LIMIT (*100–2200 rpm)—Lower Speed Limit is the minimum speed reference setting. It is used to limit the Remote Speed Setting inputs to a minimum. It is normally set at the minimum operating speed of the engine.

03 IDLE SPEED (RPM) (*100–2200 rpm)—Idle Speed Reference is also the Speed Reference set point that the control will go to if either IDLE REF @ SHUTDOWN or POWER UP TO IDLE functions are enabled in Configure mode. Always set the IDLE SPEED lower than rated speed.

04 DECEL RAMP (SEC) (*0.0001–500.0 sec)—Decel Ramp is the time required for the control to ramp the engine speed from rated speed to idle speed.

05 RAISE SPEED RATE (%/S) (*1.0–10 000.0 rpm/sec)—Raise Speed Rate is the rate at which the speed reference is ramped in one of two situations: 1) when the maneuvering mode is selected, and 2) when the Remote Speed Setting input is changed in the increase direction. A step change on the remote input does not cause an immediate change in the reference, which is ramped to the new setting at the Raise Speed Rate.

06 LOWER SPEED RATE (%/S) (*1.0–10 000.0 rpm/sec)—Lower Speed Rate is the rate at which the speed reference is ramped when the Remote Speed Setting input is changed in the decrease direction. A step change on the remote input does not cause an immediate change in the reference, which is ramped to the new setting at the Lower Speed Rate.

07 SLV-MST RAMP RATE (*1.0–500.0 rpm/sec)—Slave-Master Ramp Rate is the rate at which the slave unit will ramp to synchronize with the master when its clutch request is activated.

08 REMOTE REF AT 1 V (*–32 767.0–32 767.0 rpm)—Remote Reference at 1 V is the engine speed desired when 1.0 Volt is applied to the Remote Speed Setting input.

09 REMOTE REF AT 5 V (*–32 767.0–32 767.0 rpm)—Remote Reference at 5 V is the engine speed desired when 5.0 Volts is applied to the Remote Speed Setting input.

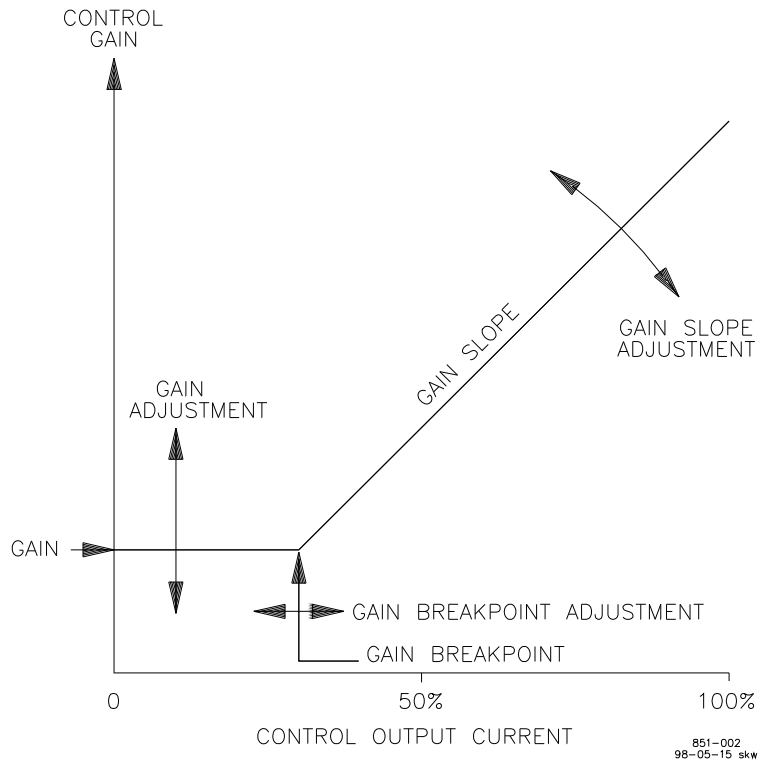


Figure 4-4. Gain Slope

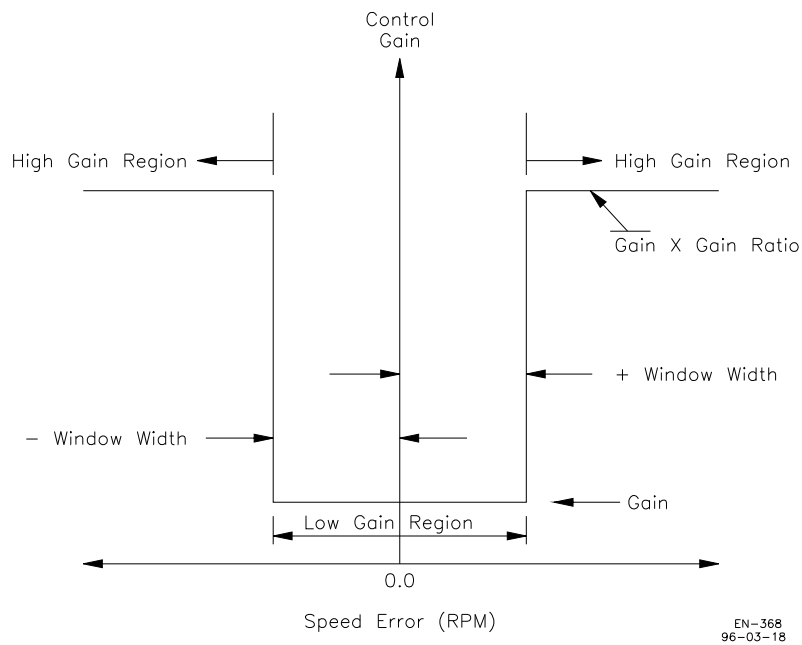
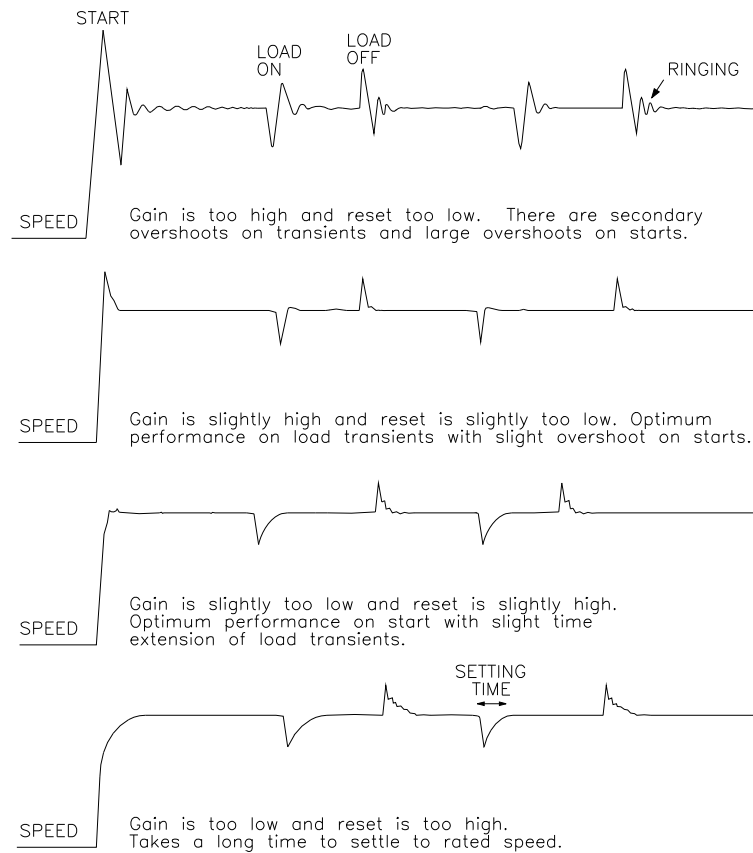
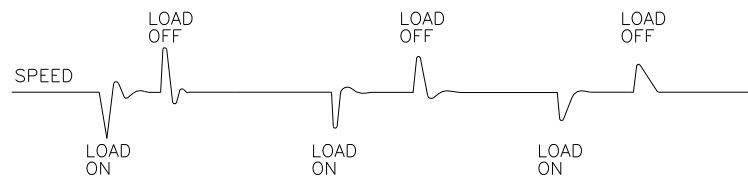


Figure 4-5. Gain Window

RESULTS — GAIN AND RESET ADJUSTMENTS



IDEAL LOAD STEP RESPONSE



RESULTS — COMPENSATION ADJUSTMENT

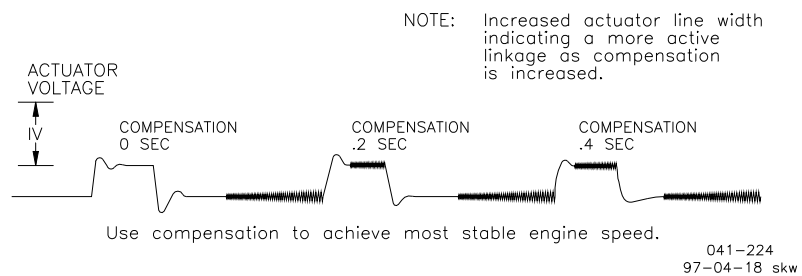


Figure 4-6. Typical Transient Response Curves

HSTART/MAX LIMITS****

01 START FUEL LIMIT (*0.0–100.0%)—Start Fuel Limit sets the maximum percent actuator output current when the engine is starting. Once the engine speed reaches 95% of the current speed reference set point (and the PID is in control for 1 second), the Start Fuel Limit is disabled until the engine is shut down and restarted. The limit is usually set at the fuel level required to start the engine under all normal operating conditions.

02 START RAMP RATE (%/SEC) (*0.01–10 000.0 %/sec)—Start Ramp Rate sets the rate at which the start limiter ramps once it reaches the START FUEL LIMIT.

03 MAXIMUM FUEL LIMIT (*0.0–101.0%)—Maximum Fuel Limit sets the maximum percent actuator output current under any conditions. Maximum (100%) is based on 200 mA. The limit is usually set just above the output at full load. The percent output is displayed in service, under header *DISPLAY 1*, at prompt ACTUATOR % OUT.

JDISCRETE IN******IMPORTANT**

For all discrete inputs, a “TRUE” value indicates the contact input is closed and a “FALSE” indicates the contact input is open.

01 RUN / STOP CONTACT (T/F)—Shows the status of the Stop contact (terminal 29).

02 DE-CLUTCH REQUEST (T/F)—Shows the status of the De-clutch Request contact (terminal 30).

03 MANEUVER MODE (T/F)—Shows the status of the Maneuver Mode contact (terminal 31).

04 CLUTCHED ENGAGED (T/F)—Shows the status of the Clutch Engaged contact (terminal 32).

05 CLUTCH REQUEST (T/F)—Shows the status of the Clutch Request contact (terminal 34).

06 BALL_HEAD GOVERNOR (T/F)—Shows the status of the Actuator Mode contact (terminal 35).

07 RESET INPUT CONTACT (T/F)—Shows the status of the Reset contact (terminal 36).

08 SERVLINK SELECTED (T/F)—Shows the status of the Servlink selector switch contact or jumper (terminals 9 and 10).

KRESPONSE TESTING******IMPORTANT**

Response Testing is used for initial dynamic setup of the 723PLUS governor.

01 ACT BUMP ENABLE—Set TRUE to enable the actuator bump function for 60 minutes. Set to FALSE to disable this function and to reset the actuator bump 60-minute timer.

02 ACT BUMP DURATION (0.1–2.0 sec)—This is the time (in seconds) that the actuator bump will last once initiated.

03 ACT BUMP LEVEL (0.0–100.0%)—This is the amount (in percent) the actuator output current will be reduced from its present level once an actuator bump is initiated. This reduced level is held for the ACT BUMP DURATION.

04 INITIATE BUMP (*T/F)—Toggling this value “FALSE” to “TRUE” initiates the Actuator Bump function. Reset “FALSE” to set up for another bump.

LACT / TORQUE CALIB****

NOTICE

ACT OUT % @ NO LOAD and ACT OUT % @ MAX LOAD must always be calibrated. The torque sharing and the backup actuator fuel demand sharing functions both depend heavily upon accurate *ACT/TORQUE CALIB* settings. Carefully determine and enter the *ACT/TORQUE CALIB* settings and re-verify these settings following any related mechanical changes (linkage, actuator, etc.). Be sure to set ALL menu items to ensure a correct SCALED ACT COMMAND and TORQUE INPUT % signal exists when the Torque analog input is both valid or failed. Failure to do so may result in incorrect torque sharing operation or actuator fuel demand sharing.

01 ACT OUT % @ NO LOAD (0.0–100.0%)—Find the normal no-load actuator percent output, which is defined as the actuator percent output that requires the least amount of fuel demand to run the engine while it is unloaded and hot. The engine speed at no-load may be at either idle speed or rated speed. Initially set this value to match the 03 ACTUATOR COMMAND % under A**DISPLAY 1**. Finally adjust this value until the 03 SCALED ACT COMMAND % reads 0.0% ± 1.0 when the engine is at this unloaded condition.

02 ACT OUT @ % MAX LOAD (0.0–100.0%)—Initially adjust this value to match the 03 ACTUATOR COMMAND % under A**DISPLAY 1** when the engine is at full load. Finally adjust this value until the DEFAULT LOAD % reads 100.0% while the engine is operating at full load.

03 SCALED ACT COMMAND % displays the scaled actuator percent fuel demand. This value is used to set the above settings. When finished calibrating the above two values, this value and the 07 TORQUE INPUT % value will read approximately the same values from no load to full load. This a good way of verifying calibration.

04 TORQUE IN @ NO LOAD (–150.0–150.0%)—Find the normal no-load torque, which is defined as zero torque. Adjust this value until the 07 TORQUE INPUT % prompt reads 0.0% ± 1.0 when the engine is at this zero torque condition.

05 TORQUE IN @ MAX LOAD (–150.0–150.0%)—Adjust this value until the 07 TORQUE INPUT % prompt reads 100% when the engine is operating at full torque.

06 TORQUE IN FILTER (HZ) (0.001–10.0)—This value in hertz is used for filtering the Torque Input signal. Increase this value if a noisy signal is seen.

07 TORQUE INPUT % displays the torque input of 4–20 mA converted to a percentage. When finished calibrating the 03 SCALED ACT COMMAND % and the 07 TORQUE INPUT % settings, this value and the TORQUE INPUT % will read approximately the same values from no load to full load. This a good way of verifying calibration.

Check torque calibration with the torque input at minimum torque and maximum torque. At these torque points, the 03 SCALED ACT COMMAND % prompt and the 07 TORQUE INPUT % should display 0% and 100% respectively. If there are discrepancies, re-calibrate 04 TORQUE IN @ NO LOAD, 05 TORQUE IN @ MAX LOAD, 01 ACT OUT % @ NO LOAD and 02 ACT OUT % @ MAX LOAD as needed to meet this requirement.

M**ANALOG OUT CALIB**

IMPORTANT

The ANALOG OUT CALIB header contains all the output selections for the two analog outputs (Analog Output #2 and Analog Output #4), Tach Output and Rack Position (mA).

01 TACH OUT FILTER (Hz)(*0.1-20.0)—This value adjusts the cutoff frequency of a low pass filter used on Analog Output 2. To use this feature, set the cutoff frequency below 15.9 Hz. To disable this filter, set the cutoff frequency above 15.9 Hz.

02 TACH OUT MIN (*-30 000.0–30 000.0)—This value adjusts the engineering units which will output 4 mA at Analog Output #2.

03 TACH OUT MAX (*-30 000.0–30 000.0)—This value adjusts the engineering units which will output 20 mA at Analog Output #2.

04 TACH OUTPUT (4–20 mA)—This is a display of the current in milliamps of the tachometer output.

05 RACK OUT FILTER (Hz)(*0.1-20.0)—This value adjusts the cutoff frequency of a low pass filter used on Analog Output 4. To use this feature, set the cutoff frequency below 15.9 Hz. To disable this filter, set the cutoff frequency above 15.9 Hz.

06 RACK OUT AT MIN (*-30 000.0–30 000.0)—This value adjusts the engineering units which will output 4 mA at Analog Output #4.

07 RACK OUT AT MAX (*-30 000.0–3 000.0)—This value adjusts the engineering units which will output 20 mA at Analog Output #4.

08 RACK OUTPUT (4–20 mA)—This is a display of the current in milliamps of the rack output.

09 RACK OUTPUT %—This is a display of the percent of the rack output (0–100).

10 TORQUE INPUT OFFSET (*-5000.0, 5000.0)—This value adjusts the engineering units which will output 4.0 mA when the input is at 4.0 mA. The value is read on 12 TORQUE INPUT (4–20 mA) below.

11 TORQUE INPUT GAIN (*0.5, 20)—This value adjusts the engineering units which will output 20.0 mA when the input is at 20.0 mA. The value is read on 12 TORQUE INPUT (4–20 mA) below.

12 TORQUE INPUT (4-20 mA)—This value reads the input value (4–20 mA) of the torque sensor on terminals 42 and 43.

13 TORQUE OUT FT/LB OFFSET (*-200, 200)—This value adjusts the torque readout which converts the incoming torque value of 4.0 mA to an actual torque value in foot-pounds. The value is read on 15 TORQUE OUT – FT/LBS below.

14 TORQUE OUT FT/LB GAIN—(*10000, 22000)—This value adjusts the torque readout which converts the incoming torque value of 20.0 mA to an actual torque value in foot-pounds. The value is read on 15 TORQUE OUT – FT/LBS below.

15 TORQUE OUT – FT/LBS—This value is the converted input torque value converted to foot-pounds.

NCOMM/LON PORTS****

01 PORT2 HARDWARE CFG (*1,2))—Set this value to a “1” for RS-232 on Port 2 or a “2” for RS-422 hardware configuration.

02 PORT 2 BAUD RATE (*1,10)—Set this value to corresponding number for the appropriate baud rate: 1=110, 2=300, 3=600, 4=1200, 5=1800, 6=2400, 7=4800, 8=9600, 9=19200, 10=38400.

03 CLON1 & 2 TIMEOUT (*0.0, 30.0)—This value sets the timeout, in seconds, allowed between updates for a message, before setting the LON communications fault to a TRUE.

04 CLON CH 1 ACTIVE—This value will display true if LON #1 channel is active. It will display false if not using LON #2 channel.

05 CLON CH 2 ACTIVE—This value will display true if the LON #2 channel is active. It will display false if not using LON #2 channel.

PLOAD CONTROL****

01 CLUTCH SYNC TIME (*0.0–120.0 sec)—Set this value for the time it takes to receive the clutch engaged signal.

02 UNLOAD RATE (*0.01–100.0%/sec)—Set this value to the desired engine unload rate in percent load per second.

03 LOAD RATE (*0.01–100.0%/sec)—Set this value to the desired engine load rate in percent load per second.

04 UNLOAD TRIP POINT (*0.0–100.0%)—Set this value to the desired amount of load on the engine at which the clutch open command (clutch permissive contacts TB#7 and #8 open) will be issued when engine unload has been selected by opening the Clutch Request contact. This is typically set near 0%.

05 CLUTCH IN TIME (*1.0–120.0 sec)—Set this value to the maximum time for the Clutch Permissive Contact to remain closed waiting to receive a Clutch Engaged Contact.

06 CLUTCH SPEED WINDOW (*0.1–100.0 rpm)—Set this value to the allowable absolute speed difference between the clutched in engine and the engine to be clutched in.

07 LOAD SHARE GAIN (*0.1–10.0)—This is the gain, expressed as a ratio of rated speed, that is used to scale the torque sharing error bias signal. This bias signal is applied to the speed reference to accomplish equal torque sharing.

08 LOAD SHARE FILTER (*0.1–1.0)—This is a low-pass filter which is set to generate a delay in the torque sharing bias error signal to the speed reference. Default setting is 0.05. A lower setting will be more responsive but may become unstable. A higher setting will be more stable but may become unresponsive.

09 REF@TRIP LEVEL TIME (*0.01–60.0)—This setting is the maximum delay time to wait after an unload command and ramp to the unload trip level is completed before removing the Clutch Permissive signal to Relay Output #3.

RTORQUE DEVIATION****

01 TORQUE DEVIATION (*0.1, 50.0)—Set this value to maximum amount of torque deviation, in percent, allowed between the two engines. Once this amount is exceeded for the TORQUE DEVIATION TIME and both clutches are closed for the LOAD SHARE SETTling TIME, then the load sharing will switch from Torque Load Sharing to Actuator Fuel Demand Load Sharing and a minor or major alarm is set, if enabled.

02 TORQUE DEVIATION TIME (*0.01,30.0)—Set this value to the amount of time, in seconds, that will allow the TORQUE DEVIATION to exceed and the LOAD SHARING SETTling TIME, before switching to the Actuator Fuel Demand Load sharing.

03 LOAD SHARE SETTling TIME.(*0.01, 30.0)—Set this value to the settling time of the load share function. This time is dependent upon how fast the soft load or soft unload feature is.

04 TORQUE DIFFERENTIAL—This value will display the differences in torques, in percentage, between both engines. Typically this number will read close to zero when performing the Torque – Torque Load Sharing function.

SACT CURRENT DEVIATION****

01 ACT CURRENT DEV (*0.1, 50.0)—Set this value to maximum amount of actuator fuel demand deviation, in percent, allowed between the two engines while using the Actuator Fuel Demand Load Sharing. Once this amount is exceeded for the ACT CURRENT DEVIATION TIME and both clutches are closed for the LOAD SHARE SETTling TIME, then the SLAVE unit will issue a de-clutch command and a minor alarm is set, if enabled.

02 ACT CURR DEV TIME (*0.01,30.0)—Set this value to the amount of time, in seconds, that will allow the ACT CURRENT DEVIATION to exceed and the LOAD SHARING SETTling TIME, before initiating a SLAVE DE-CLUTCH command.

03 LOAD SHARE SETTling TIME.(*0.01, 30.0)—Set this value to the settling time of the load share function. This time is dependent upon how fast the soft load or soft unload feature is.

04 LSS DIFFERENTIAL—This value will display the differences in actuator fuel demand, in percentage, between both engines. Typically this number will read a small difference, due to the calibration of the fuel rack linkages.

Chapter 5.

I/O Verification and Calibration

Introduction

Read this chapter entirely before proceeding with the I/O verification and calibration.

For the hardware installation and wiring information, refer to the 723PLUS Hardware Manual, 02877. The hardware manual contains the specific installation information including wire gauge and shielding requirements.

Do not run the engines during the following calibration except where noted.

Should any of the transducers, sensor, companion 723PLUS control, or field devices connected to the 723PLUS control's inputs be changed at a later time, the corresponding input calibration will need to be performed before returning the engine to normal operation.

The "Companion Control" or "Companion 723PLUS Control" refers to the other 723PLUS control. If you are working on the port 723PLUS control, the starboard 723PLUS control is the "companion". If you are working on the starboard 723PLUS control, the port 723PLUS control is the "companion".

The following calibration procedure uses the default hardware settings for the analog I/O. Wherever 4–20 mA is mentioned, the appropriate equivalent 0–1 mA or 1–5 Vdc signal can be substituted instead. For example, if Analog Input #1 has been configured for 0–1 mA, then 0 mA can be used in place of 4 mA, and 1 mA can be used in place of 20 mA. The same applies if the milliamp jumper is removed for 1–5 Vdc input. Then 1 Vdc can be used in place of 4 mA, and 5 Vdc can be used in place of 20 mA.

If the 723PLUS control response or the Watch Window or hand held readout do not agree with the information listed, stop and correct the problem before continuing with the next step. For optional I/O that is not used in the application, the respective installation and calibration can be skipped. Complete the I/O Verification before proceeding to the I/O Calibration and running the engine.

Do NOT start the engine(s) at this point. Lock the engine(s) out so they will not start or attempt to start during the I/O Verification.

I/O Verification

Apply 18–40 Vdc power supply [TB1 (+) and TB2 (–)] to the 723PLUS control. After approximately 20 seconds, the green CPU LED should illuminate. Once the CPU LED is illuminated, plug the hand held programmer into J1. The hand held programmer will be used during the I/O verification and calibration.

Run/Stop Switch (Discrete Input A)

Place the Run/Stop switch in the closed position. The prompt 01 RUN / STOP CONTACT, under the header J**DISCRETE IN**, should read "TRUE". Place the Run/Stop switch in the open position. The 01 RUN / STOP CONTACT prompt should read "FALSE". Do not allow the engine to start during this step.



The Run/Stop switch should be used in conjunction with the normal shutdown devices. The Run/Stop should NOT be used as the emergency shutdown for the engine.

De-Clutch Request Switch (Discrete Input B)

Place the De-Clutch Request switch in the closed position. The prompt 02 DE-CLUTCH REQUEST, under the header J**DISCRETE IN**, should read "TRUE". Place the De-Clutch Request switch in the open position. The 02 DE-CLUTCH REQUEST prompt should read "FALSE"

Maneuvering Mode Switch (Discrete Input C)

Place the Maneuvering Mode switch in the closed position. The prompt 03 MANEUVER MODE, under the header J**DISCRETE IN**, should read "TRUE". Place the Maneuvering Mode switch in the open position. The 03 MANEUVER MODE prompt should read "FALSE"

Clutch Engaged Switch (Discrete Input D)

Place the Clutch Engaged switch in the Clutch Engaged position (closed). The prompt 04 CLUTCH ENGAGED, under the header J**DISCRETE IN**, should read "TRUE". Place the Clutch Engaged switch in the Clutch is NOT Engaged position (open). The 04 CLUTCH ENGAGED prompt should read "FALSE".

Clutch Request Switch (Discrete Input F)

Place the Clutch Request switch in the Clutch Request position (closed). The prompt 05 CLUTCH REQUEST, under the header J**DISCRETE IN**, should read "TRUE". Place the Clutch Request switch in the Declutch position (open). The 05 CLUTCH REQUEST prompt should read "FALSE".

Actuator Mode Switch (Discrete Input G)

Place the Actuator Mode switch in the Mechanical Governor position (closed). The prompt 06 BALL-HEAD GOVERNOR, under the header J**DISCRETE IN**, should read "TRUE". Place the Actuator Mode switch in the Electrical Actuator position (open). The 06 BALL-HEAD GOVERNOR prompt should read "FALSE".

Alarm Reset Switch (Discrete Input H)

Place the Alarm Reset switch in the Reset position (closed). The prompt 07 RESET INPUT, under the header J**DISCRETE IN**, should read "TRUE". Place the Alarm Reset switch in the Non-Reset position (open). The 07 RESET INPUT prompt should read "FALSE".

Servlink Selected (Terminals 9 & 10, labeled "Load Sharing Signal")

Place the Servlink Selector switch (or jumper) in the Servlink position (closed). The handheld programmer should be disabled and the prompt 08 SERVLINK SELECTED, under the header J**DISCRETE IN**, should read "TRUE" on the Watch Window display. Place the Servlink Selector switch (or remove jumper) in the Handheld Programmer position (opened). The handheld programmer should be enabled and the 08 SERVLINK SELECTED prompt should read "FALSE".

Minor Alarm Relay (Relay Output #1)

A minor alarm may or may not be active at this time. The 01 MINOR ALARM prompt at header D**MINOR ALARMS** will be "TRUE" when a minor alarm is active and "FALSE" if there are no minor alarms. The position of the contacts on terminals 3 and 4 (Relay #1 energized or de-energized) when a minor alarm is active depends on the selection made in Configure mode, under header E**ALARM/SD CONFIGURE**, at prompt 02 OPEN CNT ON MIN ALM.

If at prompt 02 OPEN CNT ON MIN ALM, the value is set "FALSE", then closed contacts (Relay #1 energized) on terminals 3 & 4 indicate a minor alarm is active, and open contacts (Relay #1 de-energized) indicate no minor alarm. If at prompt 02 OPEN CNT ON MIN ALM, the value is set "TRUE", then open contacts (Relay #1 de-energized) on terminals 3 & 4 indicate a minor alarm is active, and closed contacts (Relay #1 energized) indicate no minor alarm.

Verify that Relay #1 contacts are configured for the desired logic, closed or open, upon active Minor Alarm. Verify that the current contact status matches the 01 MINOR ALARM prompt and is correctly indicated by the necessary monitoring, shutdown, and alarm equipment.

Major Alarm Relay (Relay Output #2)

A major alarm may or may not be active at this time. The MAJOR ALARM prompt at header C**MAJOR ALARMS** will be "TRUE" when a major alarm is active and "FALSE" if there are no major alarms. The position of the contacts on terminal 5 & 6 (Relay #2 energized or de-energized) when a major alarm is active depends on the selection made in Configure mode, under header E**ALARM/SD CONFIGURE**, at prompt 03 OPEN CNT ON MAJ ALM.

If at prompt 03 OPEN CNT ON MAJ ALM, the value is set "FALSE", then closed contacts (Relay #2 energized) on terminals 5 & 6 indicate a major alarm is active, and open contacts (Relay #2 de-energized) indicate no major alarm. If at prompt 03 OPEN CNT ON MAJ ALM, the value is set "TRUE", then open contacts (Relay #2 de-energized) on terminals 5 & 6 indicate a major alarm is active, and closed contacts (Relay #2 energized) indicate no major alarm.

Verify that Relay #2 contacts are configured for the desired logic, closed or open, upon active Major Alarm. Verify that the current contact status matches the 01 MAJOR ALARM prompt and is correctly indicated by the necessary monitoring, shutdown, and alarm equipment.

Clutch Command Contacts (Relay Output #3)

The contacts at terminals 7 & 8 will be closed when clutched in, or when requested to clutch in and all the clutching permissives have been met. The contacts at terminals 7 & 8 will be open once asked to de-clutch (open Clutch Request input), and the engine load is ramped to the Unload Trip Point. Jumper terminals 7 & 8 and verify that the respective clutch relay picks up. Remove the jumper and verify that the clutch relay drops out.

FAILED SPD SENSOR #1 LED

The failed speed sensor #1 LED is a visual indication that speed sensor 1 has gone below the failsafe speed while the 723PLUS control was in run mode.

FAILED SPD SENSOR #2 LED

The failed speed sensor #2 LED is a visual indication that speed sensor 2 has gone below the failsafe speed while the 723PLUS control was in run mode.

LED #3

This LED will flash on and off when the 723PLUS control LON ADDRESS CH#1 and LON ADDRESS CH#2 are not set or are improperly set. Do not parallel engines until this LED has been extinguished.

LED #4

This LED is programmed to illuminate when both Control LON Channel #1 and Control LON Channel #2 have a communication fault. If this LED is illuminated, the control will not perform its design functions including synchronizing, soft loading, torque sharing, master/slave speed reference, etc. For proper operation this LED must be OFF! Do not parallel engines until this LED has been extinguished.

Speed Sensor 1 (Speed Sensor Input #1)

Verify the MPU shield is tied only to the 723PLUS control ground and nowhere else in the system. If an MPU is used, measure the resistance across terminals 11 & 12. The resistance depends on the MPU used but should be less than 250 Ω . Disconnect the MPU connector at the MPU and the resistance value should be greater than 250 Ω . The typical input resistance for an MPU speed sensor is 250 \pm 50 Ω . Check the resistance of the MPU and verify it is within the manufacturer's specifications. Reconnect the MPU connector.

A proximity probe cannot be tested using this manner. For a proximity probe, verify the wiring to the proximity probe including the power supply wiring. The MPU or proximity probe will be tested prior to running the engine.

Speed Sensor 2 (Speed Sensor Input #2)

Speed Sensor 2 is an optional input. Verify the MPU shield is tied only to the 723PLUS control ground and nowhere else in the system. If an MPU is used for the speed sensor, measure the resistance across terminals 13 & 14. The resistance depends on the MPU used, but should be less than 250 Ω . Disconnect the MPU connector at the MPU and the resistance value should be greater than 250 Ω . The typical input resistance for an MPU speed sensor is 250 \pm 50 Ω . Check the resistance of the MPU and verify it is within the manufacture's specifications. Reconnect the MPU connector.

A proximity probe cannot be tested using this manner. For a proximity probe, verify the wiring to the proximity probe including the power supply wiring. The MPU or proximity probe will be tested prior to running the engine.

Actuator Output (Analog Output #3)

Verify the actuator wiring from the 723PLUS control to the actuator. Verify proper polarity as well as shield continuity. The shield should be connected only at the 723PLUS control and nowhere else in the system. Verify the actuator output current (0–200 mA or 4–20 mA) matches the actuator input. Refer to the actuator manual for proper wiring connections and signal input. The 723PLUS control, actuator, and actuator wiring will be tested prior to starting the engine.

TORQUE INPUT (Analog Input #1)

The torque input signal comes from a torque transducer and strain gauges to measure the engine shafts torque. The input signal must be direct acting (increase torque to increase fuel and milliamps). To verify the torque input, view the Torque input in Service mode, under header A**DISPLAY 1**, at prompt TORQUE INPUT (1–5 Vdc).

Remote Speed Setting (Analog Input #2)

The remote speed input is intended to be used with only one speed setting device, typically the bridge controller. However, in this applications the remote speed setting comes from two or more speed devices. Ideally the multiple speed setting devices need to be matched very closely. The calibration of the remote speed setting input will be covered later. At this point, verify the wiring and any relay logic that may be used to switch between multiple speed setting devices. To verify the remote speed input, view the 02 SPEED REFERENCE (RPM), in Service mode, under header A**DISPLAY 1**. Set the remote speed setting device to its minimum speed position (1 Vdc). Verify the 02 SPEED REFERENCE (RPM) prompt reads at or near the desired engine idle rpm. Move the remote speed setting device to its maximum speed position (5 Vdc). Verify the 02 SPEED REFERENCE (RPM) prompt reads at or near the desired engine rated rpm. If multiple speed devices are used, repeat this process for all devices to verify proper wiring. It may be useful to record the different signal input ranges for all devices for the remote speed calibration. Verify the shield is connected only to the 723PLUS control and nowhere else in the system.

Rack Position Input (Analog Input #3)

The Rack Position input signal is used to indicate a fuel rack position, which comes from a Heinzmann position transducer. To verify the input, view the Rack Position input (displayed in volts) in Service mode under header A**DISPLAY 1** at prompt 07 RACK POS INPUT (1–5 Vdc). Set the RACK POSITION to its 1 Vdc position. Verify the RACK POSITION matches ($\pm 1.0\%$). Set the RACK POSITION to its 5 Vdc position. Verify the RACK POSITION (1–5 Vdc) matches ($\pm 1.0\%$). The input will be calibrated later or is calibrated on the Heinzmann controller, so the accuracy is not critical at this time.

Torque Sharing

Torque sharing is performed over the LON #1 or LON #2 Control LON wiring (whichever is active). Verify the wiring between the 723PLUS controls for the LON #1 and LON #2 Control LON lines. Verify the termination jumper is provided at each end of both the LON #1 and LON #2 networks. The LON #1 and LON #2 line shields must be connected only at one of the 723PLUS controls. The Control LON torque sharing signals will be tested after the engine is running.

I/O Calibration

In some applications, it may not be possible or practical to achieve 1–5 Vdc full range for the Torque Sensor, Rack Position Sensor, or Remote Speed Setting analog inputs. All of these inputs can be calibrated, or scaled, to use almost any range within the 1 Vdc and 5 Vdc limits. If the input signal falls outside of the 1 Vdc and 5 Vdc limits, proper fault detection cannot be guaranteed.

At this point the engine still has not been started. Do not attempt to start the engine until instructed to do so during the I/O calibration. All precautions to keep the engine from starting should remain in place.

Configure and Service Menu Preset

The calibration process starts by going through the applicable configure and service menus and presetting as many menu items as possible. See Chapter 4 for menu item definitions and details. If a preset is unknown for a menu item, leave it at its default setting.

Access the configuration headers with the Handheld programmer or the Watch Window PC interface (see Chapter 4). View the A**CONFIG SPD CONTROL** configure header. Step through the menu items and adjust the values to match the critical engine configurations. After completing the configuring of the items under the CONFIG SPD CONTROL configure header, continue in the same manner with the other six configure headers (B**CONFIG OPTION**, C**CONFIG MAJOR ALARMS**, D**CONFIG MINOR ALARMS**, E**ALARM/SD CONFIGURE**, and F**CONFIG COM PORT 2**), enabling/disabling functions and setting the tunable values until all items are set as desired. After adjusting all configuration menu items, save the settings into the control by pressing the “SAVE” key on the Handheld programmer or save settings using the Watch Window PC interface (Refer to “help” if you need help). Exit the configuration headers and reset the control. The 723PLUS control will reboot before returning to normal operation. Reboot takes about 20 to 30 seconds.

With the Handheld programmer or the Watch Window PC interface, go through the service headers and preset any applicable menu items. Many of the service headers do not have any adjustable menu items available and can be skipped. Some menu items are calibrations that will be fine-tuned later but can be preset at this time. After adjusting all service menu items, save the settings into the control.

Minor Alarm (Discrete Output #1)

Configurable for normally open (relay #1 de-energized) or normally closed contacts (relay #1 energized). No calibration required.

Major Alarm (Discrete Output #2)

Configurable for normally open (relay #2 de-energized) or normally closed contacts (relay #2 energized). No calibration required.

Clutch Permissive Output (Discrete Output #3)

No configuration needed.

Analog Output #1 (not used in this application)

Analog Output #2

Analog output #2 is configured for Engine Speed, and is set to provide a 4–20 mA output signal.

Once this selection is made, the analog output is calibrated in service mode at two points, the minimum point (4 mA) and the maximum point (20 mA). To calibrate these points, enter Service mode and find header M**ANALOG IN/OUT CALIB*. At the prompt 01TACH OUT MIN, adjust to the value (in engr units) preferred for 4 mA output. At prompt 02 TACH OUT MAX, adjust to the value (in engr units) preferred for 20 mA output (see Figure 5-1). In this application the output is Engine Speed and the meter being driven by this analog output is designed to display 0 rpm at 4 mA and 1225 rpm at 20 mA, then 0 rpm/4 mA is the first point and 1500 rpm/20 mA is the second point.

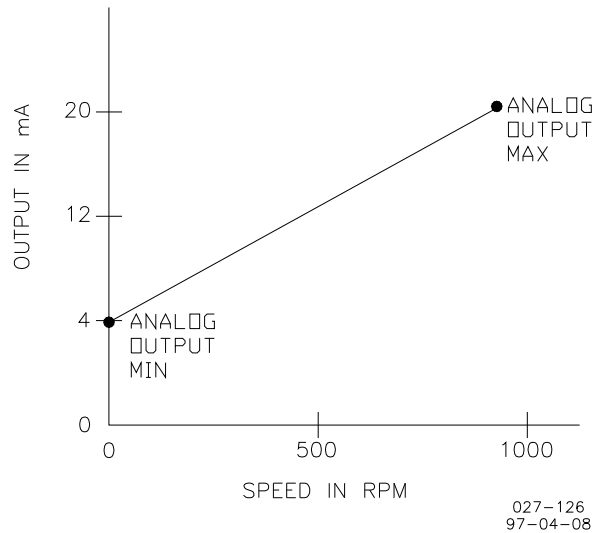


Figure 5-1. Analog Output Calibration Example

Speed Sensor #1 (Speed Sensor Input #1)

No calibration required.

Speed Sensor #2 (Speed Sensor Input #2)

No calibration required.

Analog Output #3

No calibration needed.

Analog Output #4

Analog output #4 is configured for Rack Position and is set for the preferred output selection to provide a 4–20 mA output signal based on the 1–5 Vdc Rack Position Input #4.

Once this selection is made, the analog output is calibrated in service mode at two points, the minimum point (4 mA) and the maximum point (20 mA). To calibrate these points, enter Service mode and find header M**ANALOG IN/OUT CALIB*. At the prompt 06 RACK OUT AT MIN, adjust to the value preferred for 4 mA output. At prompt RACK OUT AT MAX, adjust to the value preferred for 20 mA output.

Discrete Inputs A–H

No calibration required.

Torque Input (Analog Input #1)

If the Torque Input fails, the 723PLUS control will default to using the actuator fuel demand to indicate engine load.

IMPORTANT

Since the percent actuator driver signal is used for the default condition, it must always be calibrated.

Adjusting two known points of the torque transducer output, the minimum torque and the maximum torque, performs the torque transducer setup. The input signal must be direct acting (increase torque to increase both fuel and milliamps).

Remote Speed Setting Input (Analog Input #2)

The remote speed setting voltage input signal must be calibrated for acceptable system performance. Verify with a voltmeter that the remote speed setting device outputs 1 Vdc at the idle or minimum position to the 723PLUS and 5 V to the 723PLUS at the rated or maximum position. With the Handheld programmer or the Watch Window PC interface enter the Service mode, find the header A**DISPLAY 1**, and at prompt 02 SPEED REFERENCE (RPM), view the remote speed setting input (it is displayed in rpm). This is the voltage input signal after it has been converted to engineering units (in this case rpm).

While leaving the 02 SPEED REFERENCE (RPM) displayed on one line of the hand held programmer or on a Watch Window inspector, find and display the prompt 08 REMOTE REF @ 1 V (it is under header G**SPEED REFERENCE**) on the other line of the hand held programmer or a Watch Window inspector. Set the remote speed setting device for its idle speed position. Adjust the 08 REMOTE REF @ 1 V value until the 02 SPEED REFERENCE (RPM) prompt value displays the desired speed reference setting (in rpm) for this position. Set the remote speed setting device for its rated speed position. Adjust the 09 REMOTE REF @ 5 V value until the 02 SPEED REFERENCE (RPM) prompt value displays the desired speed reference setting (rpm) for the rated speed position. Move the remote speed setting device to intermediate positions between its idle speed position and its rated speed position to verify the desired speed settings at each position. The remote speed setting input is now calibrated.

J2 and J3

All values are preset. No calibration required.

Start Fuel Limit Calibration

The start fuel limit is set to provide the desired maximum percent actuator driver output during starts. The start fuel limit should be set to provide consistent starting during hot and cold starts. Once it is felt that the start fuel limit is properly set, it is a good idea to test it under all required starting conditions so that consistent starting can be expected. The Start Fuel Limit set point is found in Service mode, under the header H**START/MAX LIMITS**, at prompt 01 START FUEL LIMIT (see Figure 5-2).

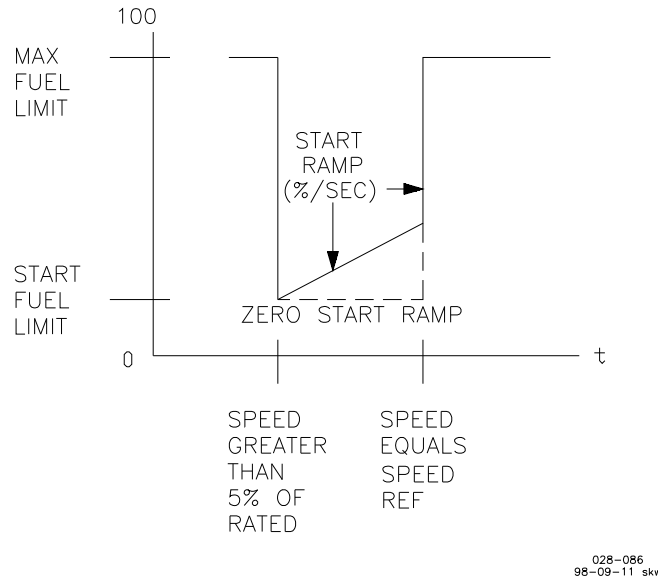


Figure 5-2. Start Fuel Limit

Engine Start-up

The 723PLUS control pre-calibration is now complete and the engine is ready to be started. The first attempt to start the engine should be done with the fuel shut off to prevent the engine from starting. This will allow the 723PLUS control, actuator, and actuator wiring to be checked prior to actually running the engine. Begin by measuring the dc voltage at terminal 19 & 20. With the engine stopped, the voltage should be 7.0 Vdc (reverse acting). Begin cranking the engine and verify the voltage on terminals 19 & 20 decreases for reverse acting, to approximately 3.50 Vdc (assuming 50% start fuel limit). The voltage will vary depending on actuators as well as the start fuel limit setting. The voltage will be proportional to the start fuel limit. While the engine is cranking, verify the actuator movement on the engine is in the increase-fuel direction. This test can be done at the same time the speed sensors are being tested.

While the engine is cranking, the speed sensors can also be tested. To test the MPUs, crank the engine without starting the engine. Verify the fuel is shut off to prevent the engine from running. The value viewed in Service mode under header A**DISPLAY 1** at the prompts 10 ENGINE SPEED MPU#1 and 11 ENGINE SPEED MPU#2 should increase to the engine cranking rpm. To check speed sensor #1 input signal strength, measure the RMS voltage at terminals 11-12 and 13-14. The voltage must be 1.0 Vrms or greater during cranking.

Prepare the engine for a normal start (restore all shut off fuel, start air, etc.). Be prepared to shut down the engine should a problem arise during the start. Verify the proper engine overspeed devices function.



WARNING

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.

Select the idle speed position from the speed setting device. Attempt to start the engine. If the engine does not start or hesitates, increase the start fuel limit. Once the engine has started and is running, the dynamics can be adjusted for optimal performance. If the engine does not start, proceed to Chapter 6 for troubleshooting. If necessary, on new or rebuilt engines, stabilize the engine as soon as possible and allow the engine to run for some break-in period as specified by the engine manufacturer.

Dynamics Adjustments

The objective of dynamic adjustments is to obtain an optimum, stable engine speed response from minimum speed/load to rated speed/ load operation. The control provides two complete sets of dynamic adjustments. All adjustments described apply to both sets (E**DYNAMICS DE-CLUTCHED** or F**DYNAMICS CLUTCHED**).

Do the following adjustments first for de-clutched dynamics. If changes are needed, go to header E**DYNAMICS DE-CLUTCHED** to set the de-clutched dynamics.

Then repeat the adjustments for clutched dynamics. If changes are needed, go to header F**DYNAMICS CLUTCHED** to set the clutched dynamics.

1. No-Load Adjustments

Do this adjustment without load applied.

If speed is stable, slowly increase the Gain set point until the actuator output or engine speed becomes slightly unstable then reduce the Gain as necessary to stabilize the engine. If speed is unstable, reduce the Gain as necessary to stabilize the engine.

After acceptable performance at no load, record the ACTUATOR COMMAND % as read on the A**DISPLAY 1** menu. Set the Gain Slope Breakpoint, found under the E**DYNAMICS DE-CLUTCHED* header, to this reading.

2. Minimum Load Adjustment – Low Speed

Do this adjustment at the minimum speed and load conditions at which the engine is operated.

Observe the movement of the actuator. If movement is excessive, reduce the 01 Idle Gain set point slightly to achieve an acceptable actuator movement level.

If there is a slow periodic cycling of the engine speed above and below the speed setting, there are two possible causes:

- 01 Idle Gain is too high and 03 Reset is too low. Reduce the 01 Idle Gain by 50% (i.e., if the 01 Idle Gain was 2.2, reduce it to 1.1) and increase 03 Reset slightly. Observe the movement of the actuator or actuator output. Continue to increase 03 Reset until the movement is active and acceptable but not rapid or excessive. A final value of 03 Reset should be between 1.0 and 2.0 for most engines. If the 03 Reset value exceeds 2.0, but this procedure continues to improve performance, increase the 04 Actuator Compensation set point 50% and repeat the procedure.

- 01 Idle Gain is too low. If the preceding procedure does not improve the slow periodic cycling of the engine speed, the control may be limiting cycling through the low gain control region set by the Window Width set point. Increase the 01 Idle Gain set point to minimize the cycling. If actuator movement becomes excessive, reduce the 04 Actuator Compensation set point until movement is acceptable. In some cases, 04 Actuator Compensation may be reduced to 0.01 and only the 01 Idle Gain and 03 Reset adjustments used. This should be done only if necessary to eliminate excessive actuator response periodic disturbances. Reduce the Window Width set point until the limit cycle amplitude is acceptable and without excessive rapid actuator movement.

3. Minimum Load Adjustment – High Speed

Do this adjustment at high speed and low load conditions at which the engine is operated.

Observe the movement of the actuator. If movement is excessive, reduce the 02 Rated Gain set point slightly to achieve an acceptable actuator movement level.

If there is a slow periodic cycling of the engine speed above and below the speed setting, there are two possible causes:

- 02 Rated Gain is too high and 03 Reset is too low. Reduce the 02 Rated Gain by 50% and increase 03 Reset slightly. Observe the movement of the actuator or actuator output. Continue to increase 03 Reset until the movement is active and acceptable but not rapid or excessive. A final value of 03 Reset should be between 1.0 and 2.0 for most engines. If the 03 Reset value exceeds 2.0, but this procedure continues to improve performance, increase the 04 Actuator Compensation set point 50% and repeat the procedure.
- 02 Rated Gain is too low. If the preceding procedure does not improve the slow periodic cycling of the engine speed, the control may be limiting cycling through the low gain control region set by the Window Width set point. Increase the 02 Rated Gain set point to minimize the cycling. If actuator movement becomes excessive, reduce the 04 Actuator Compensation set point until movement is acceptable. In some cases, 04 Actuator Compensation may be reduced to 0.01 and only the 02 Rated Gain and 03 Reset adjustments used. This should be done only if necessary to eliminate excessive actuator response periodic disturbances. Reduce the Window Width set point until the limit cycle amplitude is acceptable and without excessive rapid actuator movement.

4. Full Load Adjustment

Do these adjustments at rated speed and load or at the speed and load at which the engine is most often operated.

Once the clutch is engaged, the dynamics being used will be under the F**DYNAMICS CLUTCHED. Start by copying all of the dynamic settings used in the E**DYNAMICS DE-CLUTCHED to the F**DYNAMICS CLUTCHED settings. This gives you a good starting point. Start by tuning the 01 Idle Gain 2, 03 RESET 2 and 04 ACT COMP 2 for stable operation at low speed. Increase the speed and the load and adjust the 02 RATED GAIN 2.

If operation in this range is satisfactory, no further dynamic adjustments are necessary. If during changes in load or an actuator bump, excessive speed errors occur, increase the Gain Slope adjustment until engine performance is satisfactory. See Figure 5-3.

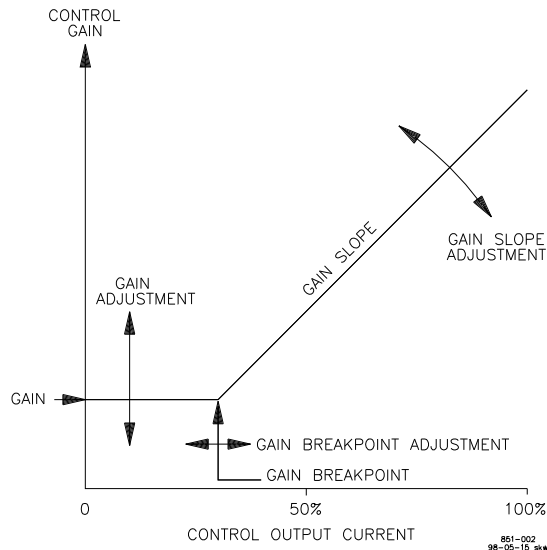


Figure 5-3. Gain Slope

If excessive actuator movement again occurs, do procedure 4 then repeat procedure 3. If the settling time after a load change is too long, reduce the Reset set point slightly and increase the Gain slightly. If slow-speed hunting occurs after a load change but decreases or stops in time, increase the Reset set point slightly and reduce the Gain set point.



WARNING

The use of negative Gain Slope should be considered carefully. Low gain at high fuel levels will result in poor load rejection response or possible overspeed. To prevent possible serious injury from an overspeeding engine, the Maximum Fuel Limit must be set near the full load output current demand to prevent excessive integrator windup and a subsequent low gain condition.

5. When a significant load change occurs, the control should switch automatically to a high gain (gain x gain ratio) and reduce the amplitude of the speed error. Reduce (or increase) the Window Width set point to just greater than the magnitude of acceptable speed error. A value of Gain Ratio too high will cause the control to hunt through the low-gain region. This normally will occur only if the Window Width is too low. If necessary to decrease the Window Width to control limit cycling (identified by the engine speed slowly cycling from below to above the speed setting by the amount of Window Width), the Gain Ratio may be reduced for a more stable operation.

IMPORTANT

An actuator bump is recommended to test dynamic settings.

6. Verify that performance is satisfactory at all speed and load conditions or repeat the above procedures as necessary to achieve acceptable performance. Quick reversal (crash back) testing is recommended as part of the dynamic setting verification.
7. While operating at minimum speed and load, record the 03 Actuator Command % in the A**DISPLAY 1** menu. Select the 01 START FUEL LIMIT in the H**START/MAX LIMITS** menu. Set at approximately 5% over the recorded value.
8. While operating at full load, record the 03 Actuator Command % on the Display Menu. Select the 03 MAXIMUM FUEL LIMIT set point on service menu H**START/MAX LIMITS**. Set the limit approximately 10% over the full load actuator output if desired or leave at 100%.

Checking the operation for both hot and cold starts is recommended to obtain the optimum stability and response under all ambient conditions.

If needed, calculate the roll-off frequency for the firing torsional speed filter and adjust the value at the prompt 09 SPEED FILTER1 HZ found under the E**DYNAMICS DE-CLUTCHED** and F**DYNAMICS CLUTCHED** header to the calculated number. If the speed filter is not needed, adjust SPEED FILTER HZ 1 to 20 Hz to disable the speed filter. Always attempt to use the maximum frequency for best response.

IMPORTANT

See Woodward Application Note 01304, *Dynamic Adjustment Procedure, 700-Series Controls*, for more information on the dynamics adjustments.

Torque Sharing Calibration

Torque Sharing is only as accurate as the Torque Sensor Input signals. During torque load sharing, the engines should put out equal horsepower into the reduction gear. This is usually measured by monitoring Exhaust Temperatures, Cylinder Temperatures, and Manifold Air Pressures using external monitoring devices.

Synchronizing, Clutching, and Loading Adjustments

Prior to testing the clutching and declutching of the 723PLUS control, the I/O calibration, and engine start-up, and torque sharing calibration procedures must be completed.

WARNING

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.

Start one engine and prepare to clutch in the engine by itself. The first engine to close its clutch becomes the master 723PLUS control. Before the master can clutch in, the engine must be running at idle speed, plus or minus the 06 CLUTCH SPEED WINDOW rpm, for the 01 CLUTCH SYNC TIME. Both prompts are found under service header P**LOAD CONTROL**. Close the Clutch Request contact to clutch in the engine by itself. Open the Clutch Request contact to de-clutch the engine. Increase the engine speed above idle speed by more than the 06 CLUTCH SPEED WINDOW setting then close the Clutch Request contact to again clutch in the engine by itself. The engine speed should ramp to idle and, once the engine speed is at idle within the 06 CLUTCH SPEED WINDOW for the 01 CLUTCH SYNC TIME, the clutch permissive contact (Relay Output #3) should close. Repeat this test separately for both engines.

Once clutching operations for both engines have been independently tested, both engines can be tested together. When clutching two engines together, it is useful to have one Handheld programmer or the Watch Window PC interface for each 723PLUS control. When clutching two units together for the first time, monitor the calibrated fuel rack position, 03 ACTUATOR COMMAND % (A**DISPLAY 1**).

Clutch in one engine (this unit becomes the master). Clutch in the other engine (this unit becomes the slave). When the slave unit is clutched in, monitor the 04 TORQUE DIFFERENTIAL, under the R**TORQUE DEVIATION** service menu. Both units should attempt to share load equally. If either unit integrates to maximum fuel or to minimum fuel, de-clutch one engine and troubleshoot the system.

Verify both engine speeds are the same as the master unit's reference. If the Handheld programmers or the Watch Window PC interface indicate good torque sharing, but the actual torques are not balanced, the torque transducer calibration settings need to be re-verified. The actuator commands may be different, but neither unit should be at or near 0% or 100% actuator command. Apply load to the engines and verify that both engines pick up load and load share equally. Unload the engines and de-clutch the master unit. The previous slave unit now becomes the master unit. Increase the master engine load to approximately 50% or as much as is possible or practical. Clutch in the other (slave) unit. First, the slave will match speed with the master. When the slave unit's speed matches the Master's speed, plus or minus the 06 CLUTCH SPEED WINDOW rpm, for the 01 CLUTCH SYNC TIME, the slave 723PLUS control will issue a clutch permissive (Relay Output #3). Once the slave clutch has closed, the slave unit will soft load, and the master unit will unload at the slave's load rate in percent load per second. The rates at which the units load and unload are determined by the 03 LOAD RATE (P**LOAD CONTROL**) and 02 UNLOAD RATE (P**LOAD CONTROL**) values. Adjust these values as necessary to achieve the desired loading and unloading results. Remember the rates used are those of the unit being clutched (slave) or de-clutched (either unit).

Once the units have reached equal torques,, torque sharing will begin. View the prompt 10 ON TORQUE SHARING (B**DISPLAY 2**) to verify the torque sharing function. The load difference between the two units must be 5% or less before the torque function begins.. De-clutch the slave by opening the Clutch Request contact. The slave unit will unload and the master unit will load at the slave's unload rate. When the slave reaches its unload level, 04 UNLOAD TRIP POINT (P**LOAD CONTROL**), the clutch permissive contacts (Relay Output #3) will open and the unit should de-clutch. Different combinations of master and slave units as well as de-clutching combinations can be attempted to verify proper system operation. See Chapter 6, Faults and Troubleshooting, if there are any problems.

Figure 5-4 illustrates how the Torque Load Sharing scheme works. The primary control loop for the engines is speed. It will always try to maintain the speed control loop first. The torque sensors from both engines are sent to each 723PLUS. When both clutches are closed, the speed references are biased up or down, which in turn increases or decreases the fuel a small amount until the torques signals are balanced. The Load Sharing scheme is the secondary control loop and only has about a 10% change over the Speed Control Loop. The normal running condition is when speed is in control and the Speed Bias coming from the Load Sharing is biased to zero. Also illustrated in this figure is the back-up Actuator Fuel Demand load sharing. If the Torque Signals fail or if the deviation between the two torque signals is too large, both units will switch to the back-up load sharing using Actuator Fuel Demand. This is why it is imperative that the calibration of the these two signals is done with care.

Conclusion

The 723PLUS control is now calibrated and adjusted for normal operation. If any problems are experienced during the calibration or adjustments, see Chapter 6 for troubleshooting. We recommend you check the system operation under all conditions to verify proper setup and calibration of the 723PLUS controls. If any accessories, including transducers, are replaced, the respective input needs to be calibrated again for the new accessory.

Quick Calibration Check

Listed below is a quick guide for the calibration:

1. Assure that each engine is stable throughout its load range, both by itself and clutched together. If for some reason the engine is unstable or the actuator is oscillating, this can be fixed by adjusting one of the gain variables in the dynamics menus. Knowing which gain variable to tune can be a little tricky, as the gains are variable with speed, and they switch when both engines are clutched. Assure that you know which Gain term to tune before making an adjustment.
2. Analog Output #2—Engine Speed / Tachometer Output. This 4–20 mA output is used by the TANO System to read engine speed and the local engine speed tachometer by the engines. The adjustments for this output are located in the Service Menu: M**ANALOG IN/OUT CALIB**, under the 02 TACH OUT MIN and 03 TACH OUT MAX. These are listed in rpm, and the default is 0–1225 rpm.
3. Analog Output #4—Rack Position Output. This 4–20 mA output is used by the TANO System to read the fuel rack position on the engine. There is a Heinzmann rotary converter that converts Rack Position to a 1–5 Vdc signal. This signal is sent to the 723PLUS, but is basically passed through to the TANO System. To calibrate this output, manually pull the governor fuel rack to minimum fuel and make sure the output in Service Menu: M**ANALOG IN/OUT CALIB**, under the 08 RACK OUT (4–20 mA) reads 4.0 mA. Pull the governor fuel rack to maximum fuel and make sure the output in Service Menu: M**ANALOG IN/OUT CALIB**, under the 08 RACK OUT (4–20 mA) reads 20.0 mA. Adjust 06 RACK OUT AT MIN and 07 RACK OUT AT MAX if these values are not within specifications. There are other adjustments on the Heinzmann converter box located directly beneath the 723PLUS. These adjustments are usually what is adjusted to provide a 4–20 mA signal to the 723PLUS, out of the 723PLUS and to the TANO system.

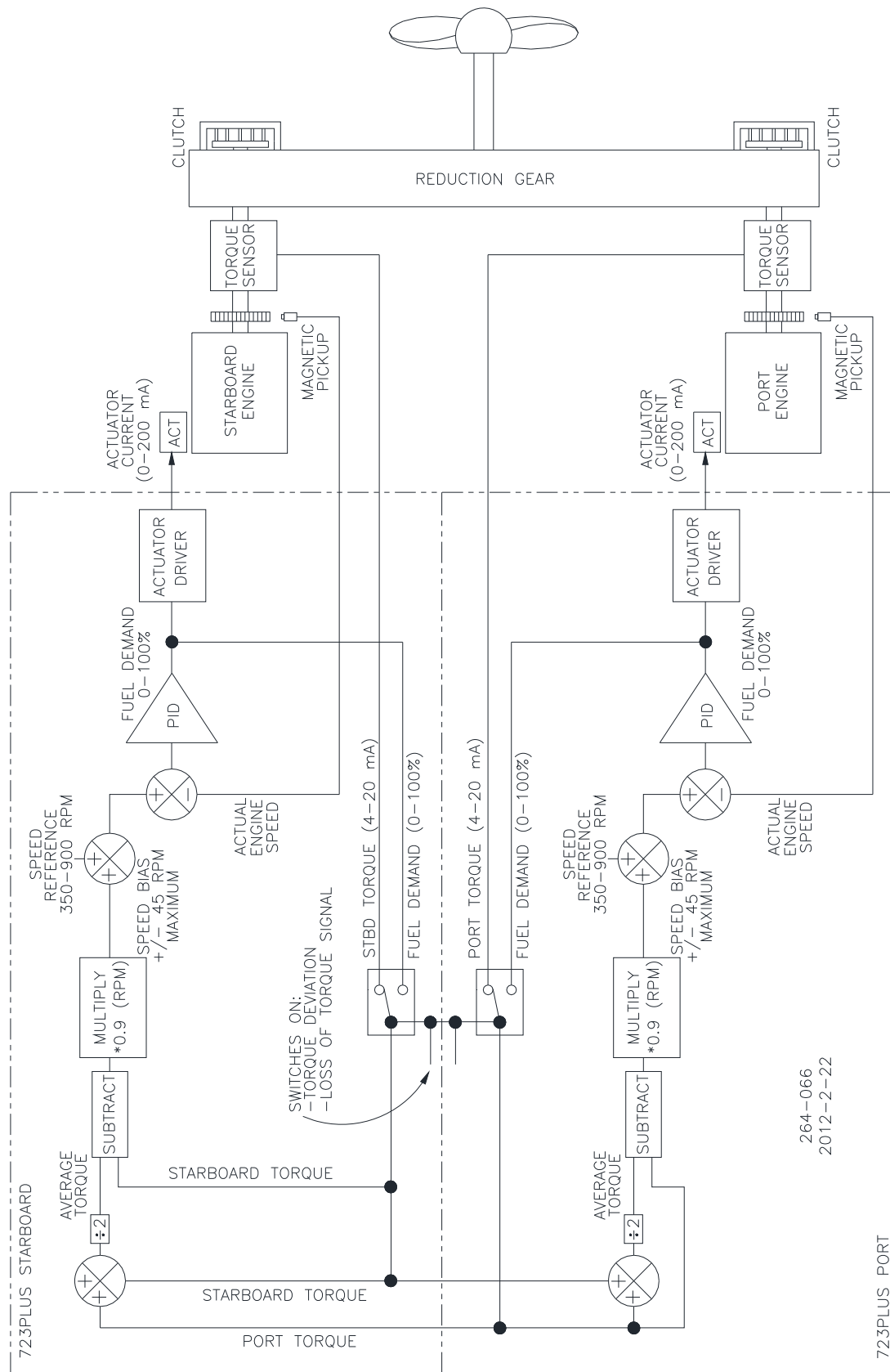


Figure 5-4. Speed and Load-Sharing Control Loops

4. Analog Input #1—Torque Input Signal. This 4–20 mA signal is brought in from the Torque Transducer. This signal is used for sharing the actual torque across both engines while the engines are clutched together. If the torque signal fails, then the 723PLUS uses the actuator fuel demand as a way of determining load on the engine. Therefore it is critical that this input be calibrated accurately. To verify calibration, monitor the two values at SERVICE MENU: L**ACT / TORQUE CALIB** under the values 03 SCALED ACT COMMAND % and 07 TORQUE INPUT %. These two values should be matched throughout the load of the engines while the engines are clutched together. If they are not matched, then the four adjustments are: 04 TORQUE IN @ NO LOAD, 05 TORQUE IN @MAX LOAD, 01 ACT OUT % @ NO LOAD and 02 ACT OUT @ MAX LOAD. Adjust these values until the values 03 SCALED ACT COMMAND % and 07 TORQUE INPUT % are very close during loaded and unloaded conditions.
5. Analog Input #2—Remote Speed Input. This signal is a 1–5 Vdc signal used for setting the engine speed reference. The ship has local control, which is a potentiometer local to the engines and bridge control coming from the bridge and the TANO system. The Speed Reference can be monitored at SERVICE MENU: A**DISPLAY 1 under 02 SPEED REFERENCE. When the input is at 1.0 Vdc the speed reference should be at 350 rpm. When the input is at 5.0 Vdc, the speed reference should be at 900 rpm.
6. Analog Input #3—Rack Input. Please see item #3—Analog Output #4 for calibration.

Chapter 6.

Faults and Troubleshooting

Introduction

This chapter covers the major and minor alarms, CPU OK LED, POWER OK LED, FAILED SPD SENSOR #1 LED, FAILED SPD SENSOR #2 LED, LED #3, LED #4, and the most common problems and their causes. The possible causes of the alarms or faults and common problems will be covered as well as some brief troubleshooting.

Major Alarm and Minor Alarm

The faults or conditions that cause an activation of the major or minor alarm relays are selectable in Configure mode. As shipped, none of the alarms are selected. The selection of which faults or conditions activate the alarm relays is up to the operator. The major and minor alarm selection options are identical. See the description of operation in Chapter 3 for the different selections.

Both Speed Sensors Failed

Both speed sensors faulted at the same time will cause the 723PLUS to go to the minimum fuel position. The speed sensor faults are latching faults (latching means the fault/alarm condition remains in effect even if the problem disappears, until the control is reset—see Alarm/Fault Resets below). Intermittent problems with the speed sensors may cause the speed sensor faults to latch during normal operation and trigger the actuator driver to go to the minimum fuel position. Therefore, both speed sensors do not have to fail at the same time to cause shutdown (actuator driver to the minimum fuel position). As long as one speed sensor is functioning, the engine may still run properly with the 723PLUS control even though it is indicating that one of the speed sensors has failed.

CPU Watchdog Fault

The CPU watchdog fault is caused by a CPU failure. A CPU failure will cause the hardware watchdog monitor to time out. When the watchdog times out, the green CPU OK LED will turn off and the hardware I/O lock will be activated. The I/O lock will de-energize all discrete outputs (and all analog outputs will go to zero current). The hand held programmer may or may not work depending on the type of CPU failure. The CPU failure can be caused by several things including a failed CPU, corrupt memory, intermittent input power supply, or a bad or incorrectly installed program. Generally, if a CPU watchdog fault occurs, the 723PLUS control will need to be replaced.

POWER SUPPLY OK LED

If the power supply fails, the POWER OK LED will not illuminate. The failed power supply can be either an internal or external power supply problem. One cause can be no voltage or improper voltage applied to terminal 1 & 2 (blown fuse, open wire, etc.). If the proper voltage is applied to terminals 1 & 2, and the POWER SUPPLY OK LED is still not illuminated, replace the 723PLUS control.

Alarm Delay Time

The analog input failed alarms are delayed before the actual fault is triggered. The fault must be present for the entire delay time before the fault is activated. This delay time is adjustable and is useful when dealing with intermittent or noisy signals. The alarm delay time, 01 ALARM DELAY TIME (E**ALARMS/SD CONFIGURE**), can be set to delay the fault from 0.01 to 60.0 seconds.

Alarm/Fault Resets

All of the alarms/faults detected by the 723PLUS control are latching faults. Therefore, the alarms/faults may be true even though the alarm/faulted condition has been cleared. Unless otherwise mentioned, there are four ways to reset the latched (inactive) faults. If the faulted condition is still present when the reset is attempted the fault will not clear. A fault reset is triggered when the engine speed clears 5% of the rated speed set point during cranking. Another fault reset is triggered from the hand held programmer or the Watch Window PC interface. The reset is triggered by toggling the 16 RESET ALL ALARMS (C**MAJOR ALARMS**, D**MINOR ALARMS**) from "FALSE" to "TRUE". The reset only occurs on the transition from false to true.

Speed Sensor 1 & 2 Fault

The speed sensor faults are latched when the sensed speed falls below the failsafe speed while the unit has been running (run mode). The FAILED SPD SENSOR #1 LED and #2 LED are used to display the status of the speed sensor faults. The respective LED will illuminate if the corresponding speed sensor fault is latched. There are no delays in the speed sensor fault detection, so an intermittent signal will latch a fault. When the engine is in stop mode, the speed sensor fault is overridden. When the 723PLUS control is powered up or re-booted by exiting Configuration, the speed sensor faults may be active. As soon as the engine attempts to start, the speed sensor faults should clear. If one of the speed sensors inputs is not used, the respective fault will latch once the engine starts. A failed speed sensor will cause the 723PLUS control to disable the flexible coupling filtering and switch to redundant (high signal select) speed sensing mode. If both speed sensors faults are latched at the same time, the control will go to minimum output. Most speed sensor problems are caused by loose wires, improper MPU gap, poor MPU location, or by dirt, oil, or metal filings on the end of the probe.

LED #3

LED #3 is used to indicate that the node addresses for LON ADDRESS CH#1 and LON ADDRESS CH#2 are not set or improperly set within each 723PLUS control. There two conditions that will cause this LED to illuminate and flash are: 1) The configured node addresses of LON Channel #1 and LON Channel #2 within the same 723PLUS control are different. 2) The configured node address for either LON Channel #1 or LON Channel #2 is set at "0".

LED #4

LED #4 is used to indicate that both Control LON Channel #1 and Control LON Channel #2 have a communication fault. The four causes are: 1.) The configured node addresses of both 723PLUS controls for LON Channel #1 and LON Channel #2 are the same. 2.) LON #1 and LON #2 of one control has a hardware fault (replace control). 3.) The communication lines between LON #1 and LON #2 of both controls are broken. 4.) Wire connections between LON #1 and LON #2 of both controls are not correct.

Overspeed Trip

The overspeed fault is latched when either one of the speed sensor signals goes above the adjustable overspeed set point. The status of the overspeed fault is 06 ENGINE OVER SPED? (B**DISPLAY 2**). There are no delays in the overspeed fault, so an intermittent signal will cause the fault to latch. An overspeed trip will cause the actuator output to go to minimum position, which should shut down the engine. The overspeed trip can be reset as described in the Alarm/Fault Resets paragraph.

The minor and major alarms can be configured to alarm when an overspeed trip has occurred.

Remote Speed Input Fault

The remote speed input fault is latched when the sensed input signal goes outside the 2.0 mA (0.5 V) and 22.0 mA (5.5 V) range for more than the configured alarm delay time. The status of the fault is found at prompt 04 REMOTE SPEED FAILED in either the C**MAJOR ALARMS** or D**MINOR ALARMS** headers, if the Remote Speed Input Fault has been selected as one of these alarms. If the Remote Speed Setting Input is used, we recommend that the Remote Speed Input Fault be configured to activate one of the alarms.

Torque Sensor Input Fault

The Torque Sensor input fault is latched when the sensed input signal goes outside of the 2 mA (0.5 V) and 22.0 mA (5.5 V) range for more than the configured alarm delay time. The status of the fault is found at prompt 06 or 05 TORQUE INPUT FAILED in either the C**MAJOR ALARMS** or D**MINOR ALARMS** headers, if the Torque Sensor Input Fault has been selected as one of these alarms. If the Torque Sensor Input is used, we recommend that the Torque Sensor Fault be configured to activate one of the alarms.

When the torque sensor fault is latched, the 723PLUS control automatically switches to the default actuator fuel demand based on the percent actuator driver output. The 723PLUS control will function normally (torque sharing, fuel limiting, etc.) when using the default rack calibration (if it was set up properly).

Another method of switching to the backup actuator fuel demand load sharing is by exceeding the torque deviation. The torque signals from both engines are measured in both 723PLUS controls. If the torque signals are different by a certain percentage and for a certain period of time, both units will switch to using the back up Actuator Fuel Demand load sharing. An alarm reset will switch back to using the Torque Signals for load sharing.

PID at Low Level Fault

The speed control PID at Low Level fault is latched when the speed control PID output has integrated to the minimum fuel level. The PID at Low Level fault is an indication that the engine is being motored by the other unit. The fault has its own fault delay time. The delay time is set at the prompt 06 PID @ ZERO TIME. The minimum fuel level is also adjustable. The 05 PID @ ZERO LEVEL is the actuator command percentage used to determine where "minimum" fuel is. 06 PID @ ZERO TIME and 05 PID @ ZERO LEVEL are found in E**ALARM/SD CONFIGURE**. Depending on the linkage arrangement, the PID @ ZERO LEVEL should be set near minimum fuel and lower than the lowest actuator command for normal operation. The status of the fault is found at prompt 11 or 12 PID @ LOW LEVEL in either the C**MAJOR ALARMS** or D**MINOR ALARMS** headers, if the PID at Low Level fault has been selected as one of these alarms. If the PID at Low Level is used, we recommend that the PID at Low Level fault be configured to activate one of the alarms.

Troubleshooting Procedure

Table 6-1 is a general guideline for isolating system problems. The service personnel should be thoroughly familiar with the contents of this manual as well as governor theory involving precise control of engine speed. This guide assumes 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 check have been properly done.



WARNING

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.

Table 6-1. Troubleshooting Procedure

Symptom	Cause	Test/Remedy
Engine will not start (actuator not moving to start fuel position).	1. CPU OK LED not illuminated.	1a. No or incorrect power supply voltage. Power supply fuse may be open. Power supply may be dropping out, especially if the cranking batteries are being used to power the 723PLUS control. The power supply polarity may be reversed (dc units only). Replace the hardware as necessary. 1b. Watchdog fault caused by hardware faults or software faults. Replace hardware.
	2. Actuator voltage remains at 0 Vdc (forward acting) or 7 Vdc (reverse acting) during cranking.	2a. 723PLUS control in STOP mode. With hand held programmer verify that RUN/STOP contact status is false (Discrete Input A open) during cranking. 2b. Verify actuator voltage output from 723PLUS control during cranking. Voltage should be between 0 Vdc & 7 Vdc. The voltage will be proportional (forward acting actuator), or inversely proportional (reverse acting actuator), to the actuator command percentage viewed on the hand held programmer. Proceed to next section if actuator voltage is correct. If voltage is higher than 7.0 Vdc, check for open actuator circuit (wiring, actuator coil, etc.). If actuator voltage is not proportional to command, check that 723PLUS control hardware is configured for desired actuator output (0–200 mA or 4–20 mA). 2c. Shorted actuator output. Check for actuator wires shorted to ground. 2d. Speed signal not clearing failsafe levels. View the engine speed with the hand held programmer. Engine speed must be greater than 5% of the rated speed set point before actuator is allowed to move from minimum fuel. Check for proper MPU clearance. Check speed signal amplitude (> 1 Vrms) during cranking. Verify proper gear teeth calibration. See Chapter 5, speed sensor. 2e. Start fuel limit set too low. View start fuel limit with hand held programmer. Increase start fuel limit if necessary. 2f. Fuel limiter not functioning properly. Incorrect torque sensor transducer calibration may cause the actuator output to minimum fuel.
	3. Actuator not responding to actuator voltage signal from 723PLUS control.	3a. Verify actuator linkage is not binding. Check for sticking fuel rack, fuel rack shutdown solenoid active, or properly functioning collapsible link. 3b. The actuator does not track the actuator voltage, refer to the specific actuator manual troubleshooting. 3c. Actuator tracks actuator voltage, but engine still does not start. Proceed to next section.


IMPORTANT

Hydraulic actuators must have oil pressure and proper drive rotation to operate. Electric actuators must have power applied to their respective electronic driver module. See the actuator manual for more information.

Symptom	Cause	Test/Remedy
Engine will not start (actuator moving to start fuel position).	<ol style="list-style-type: none"> 1. Actuator linkage not connected. 2. Start fuel limit too low. 3. Engine problem. 	<ol style="list-style-type: none"> 1. Verify the linkage from actuator to fuel rack is properly connected. Verify collapsible link functioning properly, if used. 2. Check the start fuel limit level. Increase start fuel limit as necessary. 3. Engine fuel, air, ignition, etc. problem. Engine fuel and/ or air solenoid(s) may still be shutdown from calibration procedure. Troubleshoot engine as recommended by manufacturer.
Engine overspeeds on start.	<ol style="list-style-type: none"> 1. Actuator and/or linkage problem. 2. Speed control dynamics adjustment. 	<ol style="list-style-type: none"> 1a. Verify that fuel rack is not binding and linkage is properly adjusted. 1b. Actuator drive rotation incorrect. 1c. Verify the actuator and 723PLUS control are the same action (forward or reverse). Verify that as the 723PLUS control actuator command goes to maximum fuel, the fuel rack is moved in the increase fuel direction. Actuator terminal shaft position should be proportional to the actuator command. 2. Speed control PID dynamics may be adjusted for sluggish operation. Attempt to start engine by controlling fuel rack manually or by reducing the speed reference. Adjust dynamics for better response.
Engine overspeeds on start or causes excessive smoke on start.	<ol style="list-style-type: none"> 1. Start fuel limit set too high. 	<ol style="list-style-type: none"> 1. Reduce start fuel limit to some level slightly above (10%–20%) the percent actuator driver level needed to run the engine at idle speed.
Engine speed not regulated.	<ol style="list-style-type: none"> 1. Improper linkage adjustment. 2. 723PLUS control problem. 3. Mechanical governor in control. 	<ol style="list-style-type: none"> 1. Verify actuator is capable of reaching the minimum and maximum fuel rack positions. 2a. 723PLUS control is not powered up. Verify proper power supply operation. 2b. Verify proper CPU status (CPU LED illuminated). 2c. 723PLUS control is STOP or shutdown mode. View actuator shutdown mode with hand held programmer. 2d. Fuel limiter in control. View fuel limiter control status with hand held programmer. 3a. Engine may be running on ballhead back up if used. Verify by attempting to change engine speed with speed setting input for mechanical governor. Manual override device on actuator may be active. 3b. Actuator load limit setting on actuator set too low. Increase load limit so 723PLUS control takes control of engine speed. 3c. Actuator wiring may be open. Check wiring and continuity from 723PLUS control to actuator.

Symptom	Cause	Test/Remedy
Engine does not accelerate and/or decelerate when remote reference moved.	1. Unit is clutched in as slave or appears to be clutched in as slave.	1a. If unit is clutched in last, it becomes the slave unit. The slave unit will use the master speed reference set point. 1b. Unit is attempting to clutch in as the slave unit. The speed reference will be determined by the master unit again.
	2. Remote speed setting input not functioning.	2. Remote speed setting device not functioning. View the remote speed setting input and verify proper operation. See the remote speed setting calibration for troubleshooting. The 723PLUS control will not track the remote above or below the rated and idle speed settings.
	3. Slow speed reference ramp rate.	3. Speed reference ramp rate set too low. Increase the speed reference ramp rate to desired rate for acceleration or deceleration.
	4. Communications with companion failed.	4. Unit will run at idle speed when communications with the companion are lost if CONFIG SPD CONTROL – IDLE WHEN COMM FAIL is set to TRUE.
	5. Mechanical governor in control.	5a. Mechanical governor in control of the engine speed. 723PLUS control not in control of speed. Manual override device may be active. Verify actuator command is at 0% or 100%. See actuator manual for more information. 5b. Actuator wires may be open. Check continuity from 723PLUS control to actuator.

Symptom	Cause	Test/Remedy
Engine will not stabilize. Control may be erratic or vary with load.	1. Speed control dynamics adjustments.	1. A dynamics adjustment problem generally appears as a sinusoidal hunt or oscillation. There are several dynamics adjustments that take effect during loaded or unloaded conditions at different speeds. Verify the proper dynamics are being adjusted at the proper time. Disable gain slope and/or gain ratio functions to isolate problem. See dynamics adjustments to correctly adjust 723PLUS control response.
	2. Improper linkage adjustments.	2a. Make sure the actuator terminal shaft movement is approximately 2/3 of the total actuator movement from no load to full load. For most diesels, turbines, and fuel injected prime movers, the actuator linkage should be linear. For the other prime movers, a non-linear linkage should be used. See the actuator manual regarding linkage arrangements. 2b. Make sure the linkage, ball-ends, and associated fuel rack links are in good condition and not worn. Make sure the fuel rack is not binding.
	3. Faulty dynamics #2 contact.	3. Dynamics #2 contact may be intermittently open or closing, causing the dynamics selection to be intermittent. This is especially true if an oil pressure or speed switch is used to select between the two dynamics.
	4. Erratic speed setting devices.	4. The speed setting device signal may be erratic, causing the speed reference to move around erratically. The 723PLUS control will attempt to follow the changing the speed reference. View the speed setting input in control and verify that the speed reference is stable.
	5. Mechanical governor interference/problem.	5a. Often referred to as ballhead interference. The mechanical ballhead governor and 723PLUS control speed settings are too close to each other. The speed control governors (electrical and mechanical) are attempting to control the engine speed at the same time. Separate the two speed settings, lower 723PLUS control speed setting, or increase the mechanical speed setting. There must be at least a 1.7% difference in speed setting between the 723PLUS and the mechanical governor. 5b. Possible actuator stability problem. Check actuator drive rotation and actuator hydraulic pressure. Check condition of actuator oil and supply system. For electric actuators, check electronic driver module power supply, and associated wiring. See the actuator manual for troubleshooting.

Symptom	Cause	Test/Remedy
Engine will not stabilize. Control may be erratic or vary with load. [continued]	6. Poor engine speed signal.	6a. MPU speed signal problem. Verify MPU probe is in good condition (free of dirt, oil, grease, or metal filings). Verify the gear is in good condition (no missing teeth, gear run out with tolerance, etc.). If possible view speed signal to 723PLUS control with an oscilloscope. MPU speed signal should be a sine wave with a relatively fixed amplitude. There should be no major wave form distortions. 6b. Possible engine firing torsionals or flexible coupling torsionals. Attempt to re-adjust the inertia factor and/or speed filter.
	7. Engine fuel delivery or other mechanical problem.	7. Attempt to isolate engine and governors. If possible, slowly reduce mechanical load limit until actuator terminal shaft is controlled by load limit setting. The fuel rack can also be blocked by using the maximum fuel limiter in the 723PLUS control.
	8. Improper wiring and installation. Possible shielding or ground loop problems.	<div style="text-align: center;">  WARNING </div> <p>Do not lower load limit rapidly or any lower than necessary to prevent unwanted engine shutdowns under severe load conditions. This is especially true at low speed. If the engine is still unstable when the actuator/fuel rack is blocked, the problem is most likely an engine problem.</p> 8a. Verify all shields are grounded at 723PLUS control only and not at any other points. Verify shields are carried continuously through any terminal blocks throughout their length. 8b. If possible begin to remove one input wiring section at a time until stability is corrected. Remove as many inputs as possible until only the minimum connections (power supply, MPU, & actuator) exist. An external current or voltage source may be needed to simulate input signal when the field device wiring is removed to run the engine. Correct the possible ground loop, shield problem. See 8c below. 8c. Verify 723PLUS control wiring (power supply, MPU, actuator, etc.) is not routed through conduit containing high voltages or currents. Route suspect wiring outside of conduit and verify engine instability goes away. 8d. If 723PLUS control wiring is isolated down to power supply, MPU, and actuator, check condition of solder joints at MPU and actuator connectors. Check all terminal connections for tightness.

Symptom	Cause	Test/Remedy
Engines do not share torque equally.	1. Improper torque sensor transducer or default percent actuator calibration. 2. Fuel limiter active. 3. Actuator linkage problem. 4. Torque sharing line.	1. The 723PLUS control can only share load as well as the torque sensor transducers, actuator linkages, and engine torque or pump(s) are calibrated. With the hand held programmer, verify the torque inputs are equal ($\pm 2.5\%$). A small torque error between units is common and will never be zero. If 723PLUS control indicates balanced torque sharing (torque inputs on hand held programmer equal), the control is functioning properly and the problem is with the torque transducer calibrations or engine fuel system. If torques are balanced, the problem exists in the engine (fuel pumps, etc.). 2. An active fuel limit will override the torque sharing and de-rate the engine. Verify no fuel limiters are active. 3. Verify the actuator linkage is capable of controlling engine fuel rack at that position. 4. There is no torque sharing line calibrations available to field personnel. Verify ON TORQUE SHARING is true. Verify the Control LON #1 and #2 wiring is correct and that node addresses are properly set (see Chapter 5).
Engine does not share torque with other unit (one unit takes all of the load).	1. Improper torque transducer calibration. 2. Clutch contacts. 3. Control LON lines. 4. LED #3 illuminated and flashing. 5. LED #4 illuminated.	1. Verify the torque increases as the engine load is increased. 2. Verify that when both engines are clutched together, the clutch contact inputs to both controls are closed. When both contacts are closed, the 723PLUS controls begin torque sharing as indicated by a closed internal torque sharing switch (B**DISPLAY 2** prompt 10 ON TORQUE SHARING is true). 3. Verify that one or both LON ports are connected and terminated. Verify the absence of any configured CLON CH1 ERROR or CLON CH2 ERROR alarms. 4. Verify the LED #3 is not illuminated. If it is, verify the configured node addresses for LON Channel #1 and LON Channel #2 within each 723PLUS control are the same but not "0". 5. Verify the LED #4 is not illuminated. If it is, and both 723PLUS controls are powered up and one or both of the LON ports are connected, verify that the communication line(s) are working. If they are OK, then both units are configured with the same node addresses for LON Channel #1 and LON Channel #2. If this is the case, then one of them needs to be configured with a different (but not "0") node address for LON Channel #1 and LON Channel #2.
Engine does not maintain constant speed (isochronous).	1. Fuel limiter in control. 2. Mechanical governor in control. 3. Actuator linkage.	1. Verify speed control is in control and no fuel limiter becomes erroneously active. 2. Most mechanical governors have some amount of droop built into the governor. Verify engine does not droop using 723PLUS control. 3. Engine speed droops off near rated speed (full load). Verify actuator or fuel rack is not at its maximum fuel position.

Chapter 7.

Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (EngineHelpDesk@Woodward.com) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at www.woodward.com/directory.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

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

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in “like-new” condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

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

When shipping the item(s), attach a tag with the following information:

- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

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

NOTICE

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

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

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

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

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

For information on these services, please contact one of the Full-Service Distributors listed at www.woodward.com/directory.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at www.woodward.com/directory.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

<u>Facility</u> -----	<u>Phone Number</u>
Brazil -----	+55 (19) 3708 4800
China -----	+86 (512) 6762 6727
Germany:	
Kempen----	+49 (0) 21 52 14 51
Stuttgart--	+49 (711) 78954-510
India -----	+91 (129) 4097100
Japan-----	+81 (43) 213-2191
Korea -----	+82 (51) 636-7080
Poland-----	+48 12 295 13 00
United States----	+1 (970) 482-5811

Products Used In Engine Systems

<u>Facility</u> -----	<u>Phone Number</u>
Brazil -----	+55 (19) 3708 4800
China -----	+86 (512) 6762 6727
Germany-----	+49 (711) 78954-510
India -----	+91 (129) 4097100
Japan-----	+81 (43) 213-2191
Korea -----	+82 (51) 636-7080
The Netherlands-	+31 (23) 5661111
United States----	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

<u>Facility</u> -----	<u>Phone Number</u>
Brazil -----	+55 (19) 3708 4800
China -----	+86 (512) 6762 6727
India -----	+91 (129) 4097100
Japan-----	+81 (43) 213-2191
Korea -----	+82 (51) 636-7080
The Netherlands-	+31 (23) 5661111
Poland-----	+48 12 295 13 00
United States----	+1 (970) 482-5811

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

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel,
dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine,
etc.) _____

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Symptoms

Description _____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Appendix A.

Serial Communication Port Wiring

Communication Port J2 can be configured for RS-232 or RS-422 serial communications (default setting is RS-232). Communication Port J3 is configured for RS-232.

The RS-232 connections are shown in Figure A-1.

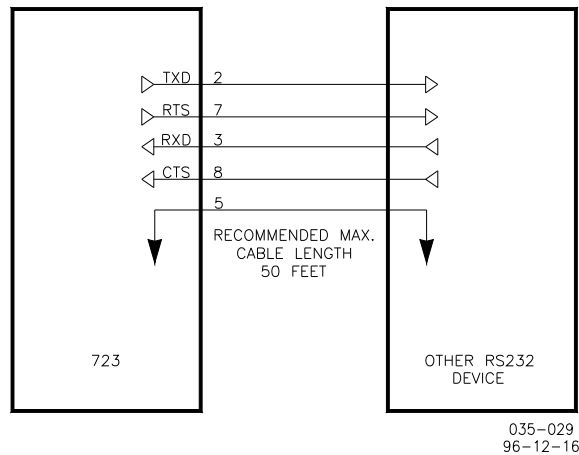


Figure A-1. 723PLUS RS-232 Connections

The RS-422 connections are shown in Figure A-2. The maximum distance from the Master Modbus Device to the 723PLUS control is 1219 m (4000 ft).

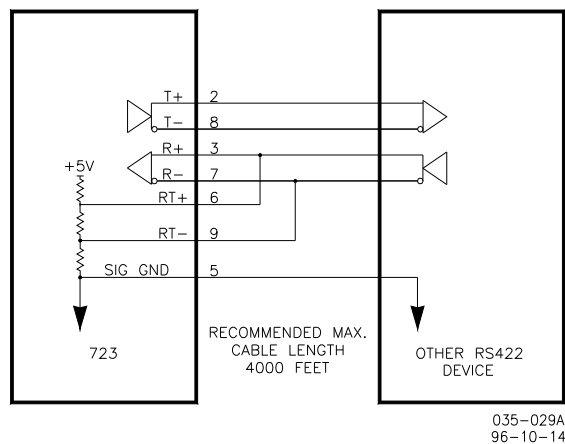


Figure A-2. 723PLUS RS-422 Connections with Optional Termination at Receiver

The RS-485 connections are shown in Figure A-3. The maximum distance from the Master Modbus Device to the 723PLUS control is 1219 m (4000 ft).

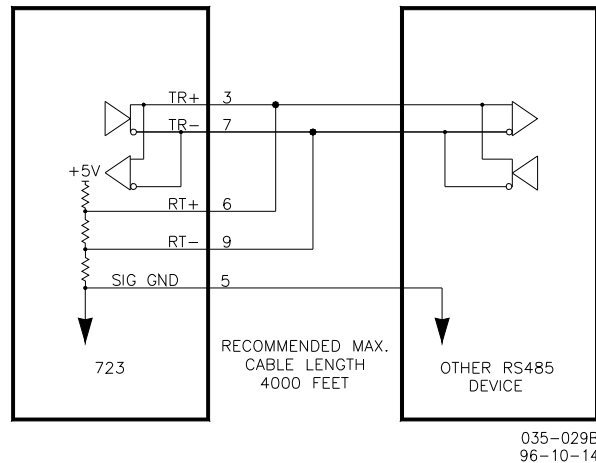


Figure A-3. 723PLUS RS-485 Connections with Optional Termination

RS-422 and RS-485 can use a multi-drop set-up where more than one device is connected to a master device. A termination should be located at the receiver when one or more transmitters are connected to a single receiver. When a single transmitter is connected to one or more receivers, termination should be at the receiver farthest from the transmitter. Figure A-4 is an example.

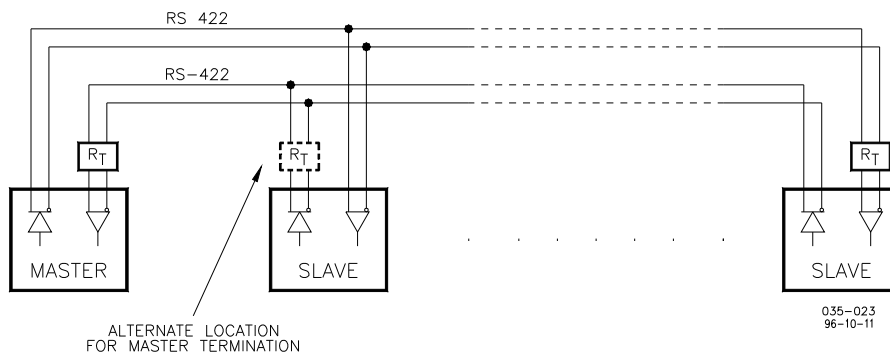


Figure A-4. RS-422 Terminator Locations

Termination is accomplished using a three-resistor voltage divider between a positive voltage and ground. The impedance of the resistor network should be equal to the characteristic impedance of the cable. This is usually about 100 to 120 Ω . The purpose is to maintain a voltage level between the two differential lines so that the receiver will be in a stable condition. The differential voltage can range between 0.2 and 6 V. The maximum voltage between either receiver input and circuit ground must be less than 10 V. There is one termination resistor network for each port located on the 723PLUS board. Connection to this resistor network is made through the 9-pin connectors on pins 6 and 9.

Grounding and Shielding

The RS-422 specifications state that a ground wire is needed if there is no other ground path between units. The preferred method to do this is to include a separate wire in the cable that connects the circuit grounds together. Connect the shield to earth ground at one point only. The alternate way is to connect all circuit grounds to the shield, and then connect the shield to earth ground at one point only. If the latter method is used, and there are non-isolated nodes on the party line, connect the shield to ground at a non-isolated node, not an isolated node. Figures A-5 and A-6 illustrate these cabling approaches.

IMPORTANT

Non-isolated nodes may not have a signal ground available. If signal ground is not available, use the alternate wiring scheme in Figure A-5 with the signal ground connection removed on those nodes only.

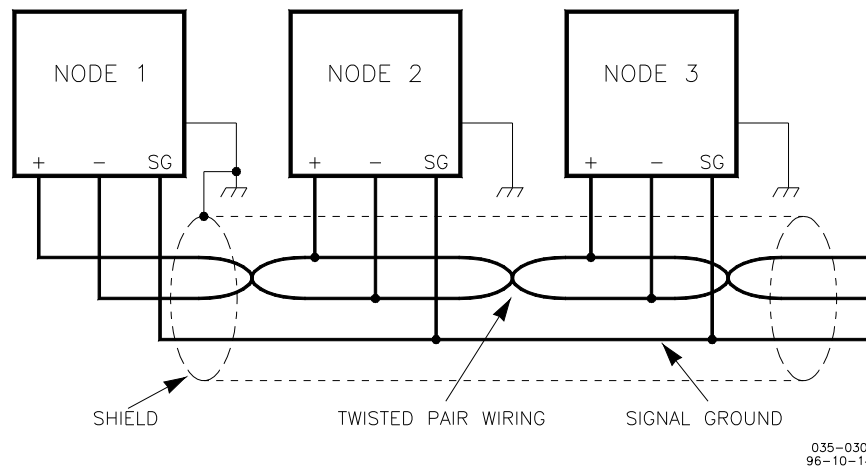


Figure A-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

The SG (signal ground) connection is not required if signal ground is unavailable.

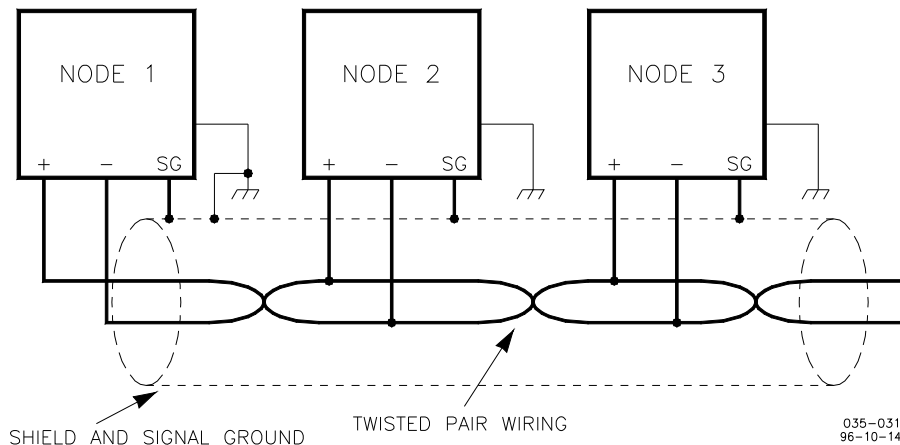


Figure A-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

Appendix B.

Programming Checklist

We recommend you write down the final value of each menu item here so you will have a record if you later need to reprogram or replace the control.

From the Handheld Main Menu Header press 'ID', or from Watch Window or the STD PC interface, select "Control Properties" to get the Software Part Number and revision level.

Record Here _____

WOODWARD INC.
ENGINE CONTROLS
FORT COLLINS, COLORADO, U.S.A.

Configure and Service Menu Items
8280-1031, Rev NEW
723PLUS Digital Engine Control
Marine Service
Mechanical CLON Torque sharing
With Servlink and Modbus Interface

Configure Menus

A**CONFIG SPD CONTROL**	Default (Low, High)	Field Settings
01 GEAR #1 TEETH	#255 (16, 300)	
02 GEAR #2 TEETH	#255 (16, 300)	
03 RATED SPEED	#900 (100, 2200)	
04 IDLE REF @ SHUTDOWN	#TRUE	
05 IDLE WHEN LON FAIL	#FALSE	
06 MAN MODE SPD STPT	*720 (100, 2200)	
B**CONFIG OPTION**	Default	
01 LON ADDRESS CH#1	#0 (0, 2)	
02 LON ADDRESS CH#2	#0 (0, 2)	
03 OVERRIDE FAILSAFE	#FALSE	
04 REVERSE ACTING ACT	#TRUE	
05 MANUAL CLUTCH LOGIC	#FALSE	
06 CONT A OPEN TO RUN	#FALSE	
07 MAJOR ALM SD ACT	#FALSE	
08 DISABLE TORQUE INPUT	#TRUE	
C**CONFIG MAJOR ALARMS**	Default	
01 MPU 1 FAILED	#TRUE	
02 MPU 2 FAILED	#TRUE	
03 REMOTE SPEED FAILED	#TRUE	
04 TORQUE INPUT FAILED	#TRUE	
05 RACK POSN INPUT FAILED	#TRUE	
05 HIGH ACT ALARM	#FALSE	
07 LON CH1 ERROR	#TRUE	
08 LON CH2 ERROR	#TRUE	
09 LON CH1&2 ERROR	#FALSE	
10 PID @ LOW LEVEL	#FALSE	
11 OVERSPEED	#TRUE	
12 CLUTCH FAIL TO CLOSE	#TRUE	
13 ACT MODE (MECH GOV)	#FALSE	
14 TORQ DEV ERROR	#TRUE	
15 ACT CUR DEV ERROR	#TRUE	

D**CONFIG MINOR ALARMS**	Default	
01 MPU 1 FAILED	#FALSE	
02 MPU 2 FAILED	#FALSE	
03 BOTH MPU FAILED	#TRUE	
04 REMOTE SPEED FAILED	#TRUE	
05 TORQUE INPUT FAILED	#FALSE	
06 RACK POSN INPUT FAILED	#TRUE	
07 HIGH ACT ALARM	#FALSE	
08 LON CH1 ERROR	#FALSE	
09 LON CH2 ERROR	#FALSE	
10 LON CH1&2 ERROR	#FALSE	
11 PID @ LOW LEVEL	#TRUE	
12 OVERSPEED	#TRUE	
13 CLUTCH FAIL TO CLOSE	#FALSE	
14 ACT MODE (MECH GOV)	#FALSE	
15 TORQ DEV ERROR	#FALSE	
E**ALARM/SD CONFIGURE**	Default (Low, High)	
01 ALARM DELAY TIME	#0.5 (0.01, 60.0)	
02 OPEN CNT ON MIN ALM	#FALSE	
03 OPEN CNT ON MAJ ALM	#TRUE	
04 SHUTDOWN WHEN PID@0	#FALSE	
05 PID @ ZERO LEVEL	#0.0 (0.0, 100.0)	
06 PID @ ZERO TIME	#10.0 (0.0, 120.0)	
07 HIGH ACT ALM LEVEL (%)	#100.0 (0.0, 100.0)	
08 OVERSPEED SD (RPM)	#1400 (1, 2200)	
09 LON ALM DELAY TIME	#2.0 (0.1, 60.0)	
10 ACT MODE SWITCH DELAY	#4.0 (0.25, 4.0)	
F**CFG COM PORT 2	Default (Low, High)	
01 PORT 2 ADDRESS	#0 (0, 15)	

Service Menus

A**DISPLAY 1**		
01 ENGINE SPEED (RPM)	Display Only	
02 SPEED REFERENCE (RPM)	Display Only	
03 ACTUATOR COMMAND %	Display Only	
04 ACTUATOR COMMAND (mA)	Display Only	
05 TORQUE INPUT (4-20 mA)	Display Only	
06 TORQUE INPUT %	Display Only	
07 RACK POS INPUT (1-5 Vdc)	Display Only	
08 REMOTE SPD INPUT (1-5 Vdc)	Display Only	
09 BIASED SPD REF	Display Only	
10 ENGINE SPEED MPU#1 (RPM)	Display Only	
11 ENGINE SPEED MPU#2 (RPM)	Display Only	
12 TORQUE OUT – FT/LBS	Display Only	
B**DISPLAY 2**		
01 ACT SHUTDOWN	Display Only	
02 ON DYNAMICS 2	Display Only	
03 SPEED CONTROL MODE	Display Only	
04 ON MAX FUEL LIMIT	Display Only	
05 ON START FUEL LIMIT	Display Only	
06 ENGINE OVER SPED?	Display Only	
07 CH1 LON ERROR	Display Only	
08 CH2 LON ERROR	Display Only	
09 USE MASTER SPD REF	Display Only	
10 ON TORQUE SHARING	Display Only	
11 PORT 1 ON HANDHELD	Display Only	
12 PORT 1 ON SERVLINK	Display Only	
13 RESET ALL ALARMS	*FALSE	

C**MAJOR ALARMS**	Default	Field Settings
01 MAJOR ALARM	Display Only	
02 MPU 1 FAILED	Display Only	
03 MPU 2 FAILED	Display Only	
04 MPU1 AND MPU2 FAILED	Display Only	
05 REMOTE SPEED FAILED	Display Only	
06 TORQUE INPUT FAILED	Display Only	
07 RACK POSN INPUT FAILED	Display Only	
08 HIGH ACT ALARM	Display Only	
09 CLON CH1 ERROR	Display Only	
10 CLON CH2 ERROR	Display Only	
11 CLON CH1&2 ERROR	Display Only	
12 PID @ LOW LEVEL	Display Only	
13 HIGH SPEED SW	Display Only	
14 CLUTCH FAIL	Display Only	
15 TORQ DEVIATION EXCEEDED	Display Only	
16 RESET ALL ALARMS	*FALSE	
D**MINOR ALARMS**	Default	
01 MINOR ALARM	Display Only	
02 MPU 1 FAILED	Display Only	
03 MPU 2 FAILED	Display Only	
04 REMOTE SPEED FAILED	Display Only	
05 TORQUE INPUT FAILED	Display Only	
06 RACK POSN INPUT FAILED	Display Only	
07 HIGH ACT ALARM	Display Only	
08 CLON CH1 ERROR	Display Only	
09 CLON CH2 ERROR	Display Only	
10 CLON CH1&2 ERROR	Display Only	
11 PID @ LOW LEVEL	Display Only	
12 HIGH SPEED SW	Display Only	
13 CLUTCH FAIL	Display Only	
14 TORQ DEVIATION EXCEEDED	Display Only	
15 ACT CUR DEV EXCEEDED	Display Only	
16 RESET ALL ALARMS	*FALSE	
E**DYNAMICS DE-CLUTCHED*	Default (Low, High)	
01 IDLE GAIN 1	*1.0 (0.01, 500.0)	
02 RATED GAIN 1	*6.0 (0.01, 500.0)	
03 RESET 1	*0.33 (0.01, 50.0)	
04 ACT COMP 1	*0.25 (0.01, 1.0)	
05 GAIN RATIO 1	*1.8 (1.0, 20.0)	
06 WINDOW WIDTH 1	*15.0 (0.01, 150.0)	
07 GAIN SLOPE 1	*.01 (0.01, 20.0)	
08 GAIN BKPT 1	*50.0 (0.01, 100.0)	
09 SPEED FILTER 1 HZ	*15.0 (0.5, 20.0)	
10 INITIATE BUMP	*FALSE	
11 MANEUVER GAIN	*3.5 (0.01, 500.0)	
F**DYNAMICS CLUTCHED*	Default (Low, High)	
01 IDLE GAIN 2	*3.0 (0.01, 500.0)	
02 RATED GAIN 2	*1.75 (0.01, 500.0)	
03 RESET 2	*0.33 (0.01, 50.0)	
04 ACT COMP 2	*0.25 (0.01, 1.0)	
05 GAIN RATIO 2	*2.0 (1.0, 20.0)	
06 WINDOW WIDTH 2	*20.0 (0.01, 150.0)	
07 GAIN SLOPE 2	*0.01 (0.01, 20.0)	
08 GAIN BKPT 2	*50.0 (0.01, 100.0)	
09 SPEED FILTER 2 HZ	*15.0 (0.5, 20.0)	
10 INITIATE BUMP	*FALSE	
11 BOTH CLTCHED GN FACTR	*81.0 (0.0,100.0)	

G**SPEED REFERENCE**	Default (Low, High)	
01 RAISE SPEED LIMIT	*1225 (100, 2200)	
02 LOWER SPEED LIMIT	*350 (100, 2200)	
03 IDLE SPEED (RPM)	*350 (100, 2200)	
04 DECEL RAMP (SEC)	*10.0 (0.0001, 500.0)	
05 RAISE SPEED RATE (%/sec)	*25.0 (1.0, 10000.0)	
06 LOWER SPEED RATE (%/sec)	*25.0 (1.0, 10000.0)	
07 SLV-MST RAMP RATE	*30.0 (1.0, 500.0)	
08 REMOTE REF AT 1 V	*350.0 (-32767.0, 32767.0)	
08 REMOTE REF AT 5 V	*900.0 (-32767.0, 32767.0)	
H**START/MAX LIMITS**	Default (Low, High)	
01 START FUEL LIMIT	*45.0 (0.0, 100.0)	
02 START RAMP RATE (%/SEC)	*6.0 (0.01, 10000.0)	
03 MAXIMUM FUEL LIMIT	*100.0 (0.0, 101.0)	
J**DISCRETE IN**	Display Only	
01 RUN / STOP CONTACT	Display Only	
02 DE-CLUTCH CONTACT	Display Only	
03 MANEUVER MODE	Display Only	
04 CLUTCH ENGAGED	Display Only	
05 CLUTCH REQUEST	Display Only	
06 BALL-HEAD GOVERNOR	Display Only	
07 RESET INPUT CONTACT	Display Only	
08 SERVLINK SELECTED	Display Only	
	Display Only	
K**RESPONSE TESTING**	Default (Low, High)	
01 ACT BUMP ENABLE	*FALSE	
02 ACT BUMP DURATION	*0.1 (0.01, 2.0)	
03 ACT BUMP LEVEL	*1.0 (0.0, 100.0)	
04 INITIATE BUMP	*FALSE	
L**ACT / TORQUE CALIB*	Default (Low, High)	
01 ACT OUT % @ NO LOAD	*35.0 (-100.0, 110.0)	
02 ACT OUT % @ MAX LOAD	*100.0 (-10.0, 110.0)	
03 SCALED ACT COMMAND %	DISPLAY ONLY	
04 TORQUE IN @ NO LOAD	*0.0 (-150.0, 150.0)	
05 TORQUE IN @ MAX LOAD	*100.0 (-150.0, 150.0)	
06 TORQUE IN FILTER (HZ)	*0.1 (0.010, 10.0)	
07 TORQUE IN PUT %	Display Only	
M**ANALOG IN/OUT CALIB**	Default (Low, High)	
01 TACH OUT FILTER (Hz)	*20.0 (0.1, 20.0)	
02 TACH OUT MIN	*0.0 (-30000.0, 30000.0)	
03 TACH OUT MAX	*1225.0 (-30000.0, 30000.0)	
04 TACH OUT (4–20 mA)	Display Only	
05 RACK OUT FILTER (Hz)	*20.0 (0.1, 20.0)	
06 RACK OUT AT MIN	*0.0 (-30000.0, 30000.0)	
07 RACK OUT AT MAX	*100.0 (-30000.0, 30000.0)	
08 RACK OUT (4–20 mA)	Display Only	
09 RACK OUT %	Display Only	
10 TORQ INPUT OFFSET	*0.0 (-5000.0, 5000.0)	
11 TORQ INPUT GAIN	*1.0 (0.5, 2.0)	
12 TORQUE (4–20 mA)	Display Only	
13 TORQUE OUT FT/LB OFFSET	*0.0 (-200.0, 200.0)	
14 TORQUE OUT FT/LB GAIN	*18093.0 (10000.0, 22000.0)	
15 TORQUE OUT – FT/LBS	Display Only	
N**COMM /LON PORTS*	Default (Low, High)	
01 PORT 2 HARDWARE CFG	*1 (1, 2)	
02 PORT 2 BAUD RATE	*9 (1, 10)	
03 CLON 1 & 2 TIMEOUT	*2 (0.0, 30.0)	
04 CLON CH 1 ACTIVE	Display Only	
05 CLON CH 2 ACTIVE	Display Only	

P**LOAD CONTROL**	Default (Low, High)	
01 CLUTCH SYNC TIME	*2.0 (1.0, 120.0)	
02 UNLOAD RATE	*20.0 (0.01, 100.0)	
03 LOAD RATE	*20.0 (0.01, 100.0)	
04 UNLOAD TRIP POINT	*20.0 (0.0, 100.0)	
05 CLUTCH IN TIME	*5.0 (1.0, 120.0)	
06 CLUTCH SPEED WINDOW	*20.0 (0.1, 100.0)	
07 LOAD SHARE GAIN	*10.0 (0.01, 10.0)	
08 LOAD SHARE FILTER	*0.05 (0.01, 1.0)	
09 REF@TRIP LEVEL TIME	*10.0 (0.01, 60.0)	
R**TORQUE DEVIATION**	Default (Low, High)	
01 TORQUE DEV %	*10.0 (0.1, 50.0)	
02 TORQUE DEV TIME (SEC)	*3.0 (0.01, 30.0)	
03 LOAD SHARE SETTLE TIME	*10.0 (0.01, 30.0)	
04 TORQUE DIFFERENTIAL	Display Only	
S**ACT CURRENT DEVIATION**	Default (Low, High)	
01 ACT CURRENT DEV %	*10.0 (0.1, 50.0)	
02 ACT CURR DEV TIME (SEC)	*2.0 (0.01, 30.0)	
03 LOAD SHARE SETTLE TIME	*10.0 (0.01, 30.0)	
04 ACT CURRENT DIFFERENTIAL	Display Only	
ANALOG OUT CALIB	Default (Low, High)	
TACH OUT FILTER (Hz)	*20.0 (0.1, 20.0)	
TACH OUT MIN	*0.0 (-30000.0, 30000.0)	
TACH OUT MAX	*1225.0 (-30000.0, 30000.0)	
RACK OUT FILTER (Hz)	*20.0 (0.1, 20.0)	
RACK OUT AT MIN	*0.0 (-30000.0, 30000.0)	
RACK OUT AT MAX	*100.0 (-30000.0, 30000.0)	
TACK OUT (4–20 mA)	Display Only	
RACK OUT (4–20 mA)	Display Only	
COMM PORT SETUP	Default (Low, High)	
PORT 2 HARDWARE CFG	*1 (1, 2)	
PORT 2 BAUD RATE	*9 (1, 10)	
PORT 3 HARDWARE CFG	*3 (1, 3)	
PORT 3 BAUD RATE	*6 (1, 7)	
PORT 3 STOP BITS	*1 (1, 3)	
PORT 3 PARITY	*1 (1, 3)	
PORT 3 TIMEOUT(SEC)	*10.0 (0.5, 30.0)	
PORT 3 LINK ERROR		
PORT 3 EXCEPTION ERR		
PORT 3 EX ERR NUM		
PORT 3 EX ERR PCT		
CLON 1 & 2 TIMEOUT	*2.0 (0.0, 30.0)	
LOAD CONTROL	Default (Low, High)	
CLUTCH SYNC TIME	*2.0 (1.0, 120.0)	
UNLOAD RATE	*20.0 (0.01, 100.0)	
LOAD RATE	*20.0 (0.01, 100.0)	
UNLOAD TRIP POINT	*20.0 (0.0, 100.0)	
CLUTCH IN TIME	*5.0 (1.0, 120.0)	
CLUTCH SPEED WINDOW	*20.0 (0.1, 100.0)	
LOAD SHARE GAIN	*10.0 (0.01, 10.0)	
LOAD SHARE FILTER	*0.05 (0.01, 1.0)	
REF@TRIP LEVEL TIME	*10.0 (0.01, 60.0)	
INITIATE BUMP	*FALSE	

DISPLAY 2		
ACT SHUTDOWN	Display Only	
ON DYNAMICS 2	Display Only	
SPEED CONTROL MODE	Display Only	
ON MAX FUEL LIMIT	Display Only	
ON START FUEL LIMIT	Display Only	
ENGINE OVER SPED?	Display Only	
CH1 LON ERROR	Display Only	
CH2 LON ERROR	Display Only	
USE MASTER SPD REF	Display Only	
ON LOAD SHARING	Display Only	
PORT 1 ON HANDHELD	Display Only	
PORT 1 ON SERVLINK	Display Only	
RESET ALL ALARMS	*FALSE	
DISPLAY 1		
ENGINE SPEED (RPM)	Display Only	
SPEED REFERENCE (RPM)	Display Only	
SPEED REF BIASED	Display Only	
ACTUATOR OUT %	Display Only	
ACTUATOR OUT (mA)	Display Only	
TORQUE INPUT %	Display Only	
REMOTE SPD REF (RPM)	Display Only	
TORQUE INPUT (1–5 Vdc)	Display Only	
REMOTE SPD INPUT (1–5 Vdc)	Display Only	
RACK POSITION (1–5 Vdc)	Display Only	
CLON CH 1 ACTIVE	Display Only	
CLON CH 2 ACTIVE	Display Only	
SPD SENSOR 1 ACTIVE	Display Only	
SPD SENSOR 2 ACTIVE	Display Only	

Appendix C. Menu Summary

Configure Menus

ACONFIG SPD CONTROL****

01 GEAR #1 TEETH
02 GEAR #2 TEETH
03 RATED SPEED
04 IDLE REF @ SHUTDOWN
05 IDLE WHEN LON FAIL
06 MAN MODE SPD STPT

BCONFIG OPTION****

01 LON ADDRESS CH#1
02 LON ADDRESS CH#2
03 OVERRIDE FAILSAFE
04 REVERSE ACTING ACT
05 MANUAL CLUTCH LOGIC
06 CONT A OPEN TO RUN
07 MAJOR ALM SD ACT
08 DISABLE TORQUE INPUT

CCONFIG MAJOR ALARMS**

01 MPU 1 FAILED
02 MPU 2 FAILED
03 REMOTE SPEED FAILED
04 TORQUE INPUT FAILED
05 RACK POSN INPUT FAILED
06 HIGH ACT ALARM
07 LON CH1 ERROR
08 LON CH2 ERROR
09 LON CH1&2 ERROR
10 PID @ LOW LEVEL
11 HIGH SPEED SW
12 CLUTCH FAIL TO CLOSE
13 ACT MODE(MECH GOV)
14 TORQ DEV ERROR
15 ACT CUR DEV ERROR

DCONFIG MINOR ALARMS**

01 MPU 1 FAILED
02 MPU 2 FAILED
03 BOTH MPU FAILED
04 REMOTE SPEED FAILED
05 TORQUE INPUT FAILED
06 RACK POSN INPUT FAILED
07 HIGH ACT ALARM
08 LON CH1 ERROR
09 LON CH2 ERROR
10 LON CH1&2 ERROR
11 PID @ LOW LEVEL
12 OVERSPEED
13 CLUTCH FAIL TO CLOSE
14 ACT MODE (MECH GOV)
15 TORQ DEV ERROR

EALARM/SD CONFIGURE****

01 ALARM DELAY TIME
02 OPEN CNT ON MIN ALM
03 OPEN CNT ON MAJ ALM
04 SHUTDOWN WHEN PID@0
05 PID @ ZERO LEVEL
06 PID @ ZERO TIME
07 HIGH ACT ALM LEVEL (%)
08 OVERSPEED SD
09 LON ALM DELAY TIME
10 ACT MODE SWITCH DELAY

FCFIG COM PORT 2****

01 PORT 2 ADDRESS

Service Menus

A**DISPLAY 1**

01 ENGINE SPEED (RPM)
02 SPEED REFERENCE (RPM)
03 ACTUATOR COMMAND %
04 ACTUATOR COMMAND (mA)
05 TORQUE INPUT (mA)
06 TORQUE INPUT %
07 RACK POSITION (1–5 Vdc)
08 REM SPD INPUT (1–5 Vdc)
09 BIASED SPEED REF
10 ENGINE SPEED MPU #1
11 ENGINE SPEED MPU #2
12 TORQUE OUT – FT/LBS

B**DISPLAY 2**

ACT SHUTDOWN
ON DYNAMICS 2
SPEED CONTROL MODE
ON MAX FUEL LIMIT
ON START FUEL LIMIT
ENGINE OVER SPD?
CH1 LON ERROR
CH2 LON ERROR
USE MASTER SPD REF
ON LOAD SHARING
PORT 1 ON HANDHELD
PORT 1 ON SERVLINK
RESET ALL ALARMS

C**MAJOR ALARMS**

01 MAJOR ALARM
02 MPU 1 FAILED
03 MPU 2 FAILED
04 MPU1 AND MPU1 FAILED
05 REMOTE SPEED FAILED
06 TORQUE INPUT FAILED
07 RACK POSN FAILED
08 HIGH ACT ALARM
09 CLON CH1 ERROR
10 CLON CH2 ERROR
11 CLON CH1&2 ERROR
12 PID @ LOW LEVEL
13 HIGH SPEED SW
14 CLUTCH FAIL
15 TORQ DEVIATION EXCEED
16 RESET ALL ALARMS

D**MINOR ALARMS**

01 MINOR ALARM
02 MPU 1 FAILED
03 MPU 2 FAILED
04 REMOTE SPEED FAILED
05 TORQUE INPUT FAILED
06 RACK POSN INPUT FAILED
07 HIGH ACT ALARM
08 CLON CH1 ERROR
09 CLON CH2 ERROR
10 CLON CH1&2 ERROR
11 PID @ LOW LEVEL
12 HIGH SPEED SW
13 CLUTCH FAIL
14 TORQ DEVIATION EXCEED
15 ACT CUR DEV EXCEEDED
16 RESET ALL ALARMS

E**DYNAMICS DE-CLUTCHED**

01 IDLE GAIN 1
02 RATED GAIN 1
03 RESET 1
04 ACT COMP 1
05 GAIN RATIO 1
06 WINDOW WIDTH 1
07 GAIN SLOPE 1
08 GAIN BKPT 1
09 SPEED FILTER 1 HZ
10 INITIATE BUMP
11 MANEUVER GAIN

F**DYNAMICS CLUTCHED**

01 IDLE GAIN 2
02 RATED GAIN 2
03 RESET 2
04 ACT COMP 2
05 GAIN RATIO 2
06 WINDOW WIDTH 2
07 GAIN SLOPE 2
08 GAIN BKPT 2
09 SPEED FILTER 2 HZ
10 INITIATE BUMP
11 BTH CLTCHED GN FCTR

G**SPEED REFERENCE**

01 RAISE SPEED LIMIT
02 LOWER SPEED LIMIT
03 IDLE SPEED (RPM)
04 DECEL RAMP (SEC)
05 RAISE SPEED RATE
06 LOWER SPEED RATE
07 SLV-MST RAMP RATE
08 REMOTE REF AT 1 V
09 REMOTE REF AT 5 V

H**START/MAX LIMITS**

01 START FUEL LIMIT
02 START RAMP RATE (%/SEC)
03 MAXIMUM FUEL LIMIT

J**DISCRETE IN**

01 RUN / STOP CONTACT
02 DE-CLUTCH
03 MANEUVER MODE
04 CLUTCH ENGAGED
05 CLUTCH REQUEST
06 BALL-HEAD GOVERNOR
07 RESET INPUT
08 SERVLINK SELECTED

K**RESPONSE TESTING**

01 ACT BUMP ENABLE
02 ACT BUMP DURATION
03 ACT BUMP LEVEL
04 INITIATE BUMP

L**ACT / TORQUE CALIB*

01 ACT OUT % @ NO LOAD
02 ACT OUT % @ MAX LOAD
03 SCALED ACT COMMAND %
04 TORQUE IN @ NO LOAD
05 TORQUE IN @ MAX LOAD
06 TORQUE IN FILTER (HZ)
07 TORQUE INPUT %

M**ANALOG IN/OUT CALIB**

01 TACH OUT FILTER (Hz)
02 TACH OUT MIN
03 TACH OUT MAX
04 TACH OUT (4–20 mA)
05 RACK OUT FILTER (Hz)
06 RACK OUT AT MIN
07 RACK OUT AT MAX
08 RACK OUT (4–20 mA)
09 RACK OUT %
10 TORQ INPUT OFFSET
11 TORQ INPUT GAIN
12 TORQ INPUT (4–20 mA)
13 TORQUE OUT FT/LB OFFSET
14 TORQUE OUT FT/LB GAIN
15 TORQUE OUT – FT/LBS

N**COMM PORT SETUP**

01 PORT 2 HARDWARE CFG
02 PORT 2 BAUD RATE
03 CLON 1 & 2 TIMEOUT
04 CLON CH1 ACTIVE
05 CLON CH2 ACTIVE

P**LOAD CONTROL**

01 CLUTCH SYNC TIME
02 UNLOAD RATE
03 LOAD RATE
04 UNLOAD TRIP POINT
05 CLUTCH IN TIME
06 CLUTCH SPEED WINDOW
07 LOAD SHARE GAIN
08 LOAD SHARE FILTER
09 REF@TRIP LEVEL TIME

R**TORQUE DEVIATION**

01 TORQUE DEV %
02 TORQUE DEV TIME
03 LOAD SHARE SETTLE TIME
04 TORQUE DEVIATION

S**ACT CURRENT DEVIATION**

01 ACT CURRENT DEV %
02 ACT CURR DEV TIME
03 LOAD SHARE SETTLE TIME
04 ACT CURRENT DEVIATION

723PLUS Control Specifications

Low Voltage Model	18–40 Vdc (24 or 32 Vdc nominal)
Power Consumption	40 W nominal
Inrush Current	7 A for 0.1 ms

Input Power

Inputs

Speed Signal Inputs (2)

Speed Input Voltage	1.0–50.0 Vrms
Speed Input Frequency	Magnetic Pickup: 400 Hz to 15 kHz; Proximity Switch: 30 Hz to 15 kHz
Speed Input Impedance	10 k Ω \pm 15%

Note: EU Directive compliant applications are not currently able to use proximity switches due to the sensitivity of the switches.

Discrete Inputs (8)

Discrete Input	24 Vdc, 10 mA nominal, 18–40 Vdc range
Response Time	10 ms \pm 15%
Impedance	2.3 k Ω

Note: For Lloyd's Register applications, use only control-supplied power.

Analog Inputs (4)

Analog Input	\pm 5 Vdc or 0–20 mA, transducers externally powered
Common Mode Voltage	\pm 40 Vdc
Common Mode Rejection	0.5% of full scale
Accuracy	0.5% of full scale

Torque Sharing Input

Analog Input	0–4.5 Vdc
Common Mode Voltage	\pm 40 Vdc
Common Mode Rejection	1.0% of full scale
Accuracy	1.0% of full scale

Outputs

Analog Outputs 0–1 or 4–20 mA (2)

Analog Output	0–1 mA or 4–20 mA (max. 600 Ω load)
Accuracy	0.5% of full scale

Analog Outputs 0–20 or 0–200 mA (2)

Analog Output	0–20 mA (max. 600 Ω load) or 0–200 mA (max. 70 Ω load)
Accuracy	0.5% of full scale

Relay Contact Outputs (3)

Contact Ratings	2.0 A resistive @ 28 Vdc; 0.5 A resistive @ 125 Vdc
-----------------	-----------------------------------------------------

Environment

Operating Temperature	–40 to +70 °C (–40 to +158 °F)
Storage Temperature	–55 to +105 °C (–67 to +221 °F)
Humidity	95% at +20 to +55 °C (+68 to +131 °F)
	Lloyd's Register of Shipping Specification Humidity Test 1
Mechanical Vibration	Lloyd's Register of Shipping Specification Vibration Test 1
Mechanical Shock	US MIL-STD 801C Method 516.2, Proc. I, II, V
EMI/RFI Specification	Lloyd's Register of Shipping Specification EN 50081–2 and EN 50082–2

Compliance

UL/cUL Listing	Class I, Division 2, Groups A, B, C, & D
Marine Listings	Lloyd's Register of Shipping (LR), Germanischer Lloyd (GL), American Bureau of Shipping (ABS, Low Voltage Models only), Bureau Veritas (BV), Det Norske Veritas (DNV), Nippon Kaiji Kyokai (NKK), Registro Italiano Navale (RINA)
European Union (EU)	Compliant with EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC.

DECLARATION OF CONFORMITY

Manufacturer's Name: WOODWARD GOVERNOR COMPANY (WGC)
Industrial Controls Group

Manufacturer's Address: 1000 E. Drake Rd.
Fort Collins, CO, USA, 80525

Model Name(s)/Number(s): **723, 723 Plus and 828 Digital Control**

P/N: 9906-131, 9906-620 and similar
(90-150Vdc Input)

Conformance to Directive(s): 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.

Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

Applicable Standards: EN61000-6-4, (2007): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
EN61000-6-2, (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

EN50178, January 1997: Electronic Equipment for Use in Power Installations

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

MANUFACTURER



Signature

Sam Coleman

Full Name

Compliance Engineering Supervisor

Position

WIC, Fort Collins, CO, USA

Place

August 12, 2009

Date

5-09-1183
00115-04-CE-02-02

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

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