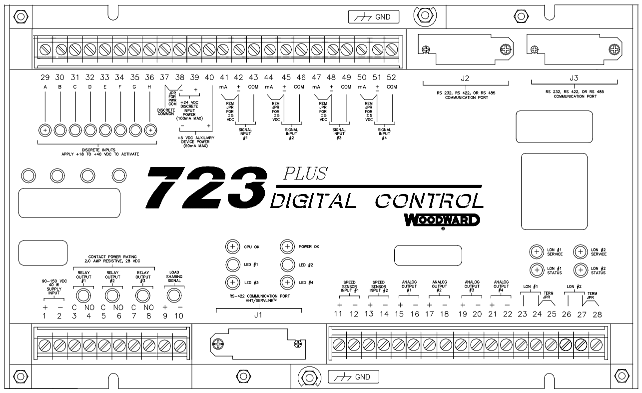
WOODWARD

Product Manual 26227
(Revision B, 1/2016)
Original Instructions



723PLUS Digital Marine Control

Two Engine Mechanical Load Sharing

Installation and Operation Manual

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

Revisions	**This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:** **www.woodward.com/publications** **The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

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

Translated Publications	**If the cover of this publication states "Translation of the Original Instructions" please note:** **The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

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

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol. 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.

Chapter 1.
General Information

Introduction

This manual describes the Woodward 723PLUS Digital Marine Speed Control for two-engine mechanical load 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 load 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 load sharing by matching fuel rack positions
- Advanced speed-sensing algorithms
- Firing torsional filtering
- Flexible coupling torsional filtering
- Torque fuel limiting
- Start fuel limiting
- Manifold or external fuel limiting
- Rack position sensor failure mode which retains load sharing
- Single-throttle operation for both engines during clutched operation
- Redundant control LON® * communication
- Modbus® ** communications port
- Watch Window communications port

*—LON and Lon Works are trademarks of Echelon Corporation
**—Modbus is a trademark of Schneider Automation Inc.

Inputs include:

- Two magnetic pickups (MPUs) or proximity switches for sensing engine speed, capable of filtering torsionals or providing redundant speed signals
- 4–20 mA remote speed-setting input
- 4–20 mA rack position feedback input
- 4–20 mA manifold or external fuel input
- ±5 Vdc auxiliary input
- Eight discrete inputs (contact inputs) for Run/Stop, Clutch Request, Clutch Position, Maneuvering Speed, Raise Speed, Lower Speed, Alarm Reset and Enable Torque Limit.
- Redundant Control LON channels to perform mechanical load sharing and communicate essential control status to the mating control for proper clutching and loading operations.

Outputs include:

- Three 4–20 mA outputs which are configurable for: engine speed, engine load, speed reference, remote speed input, PID output, rack position and torsional level
- 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 17 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. Port J2 is a Watch Window only port. Port J3 can interface to a Modbus master device such as a Human/Machine Interface (HMI) to monitor the control and engine parameters and to issue control commands.

The 723PLUS control provides multiple functions including speed governing, mechanical load 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 load 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 load sharing and utilizing the master speed reference for both engines. The engine clutching/load 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 loads are mechanically balanced (equal fuel-rack positions). The engines will maintain equal loads (load 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.

IMPORTANT

This manual makes references to specific menu items or listings for adjustments or monitoring. Generally, the menu listings will follow the format of the mode you must be in first (Configure or Service), then the name of the Header (in capital letters) while in that mode, and finally the prompt (in capital letters) under that header. For example, in Service mode, under header (*SPD CONTROL*), at prompt ENGINE SPEED. All service headers are denoted by asterisks (*) and all configure headers are denoted by the absence of the (*).

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 Raise Speed, Lower Speed, 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

The LVDT signal conditioner that Woodward recommends for fuel rack position transducer signal conditioning is 8272-824 (4–20 mA output, 24 Vdc input).

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).

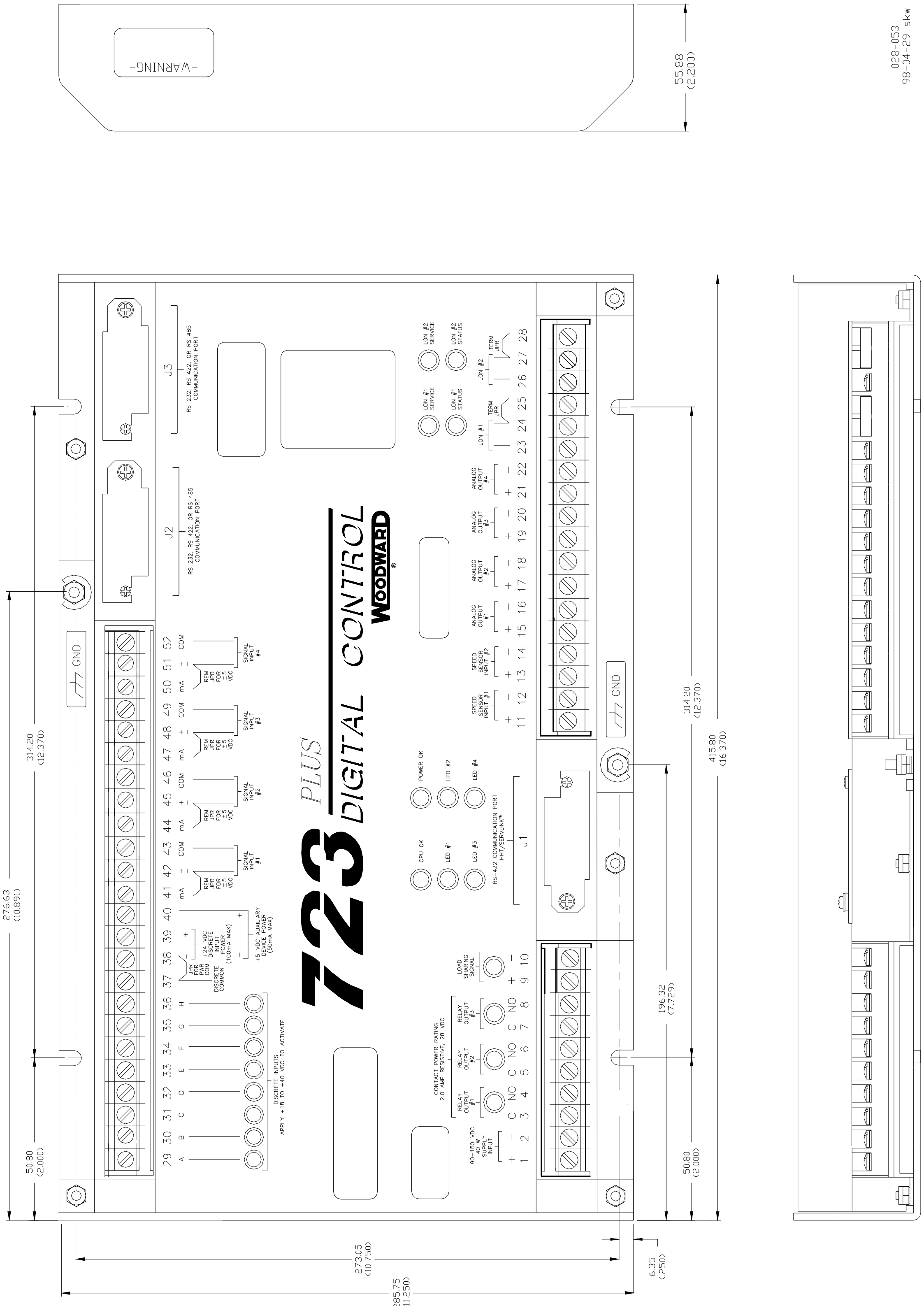


Figure 1-1. 723PLUS Digital Speed Control

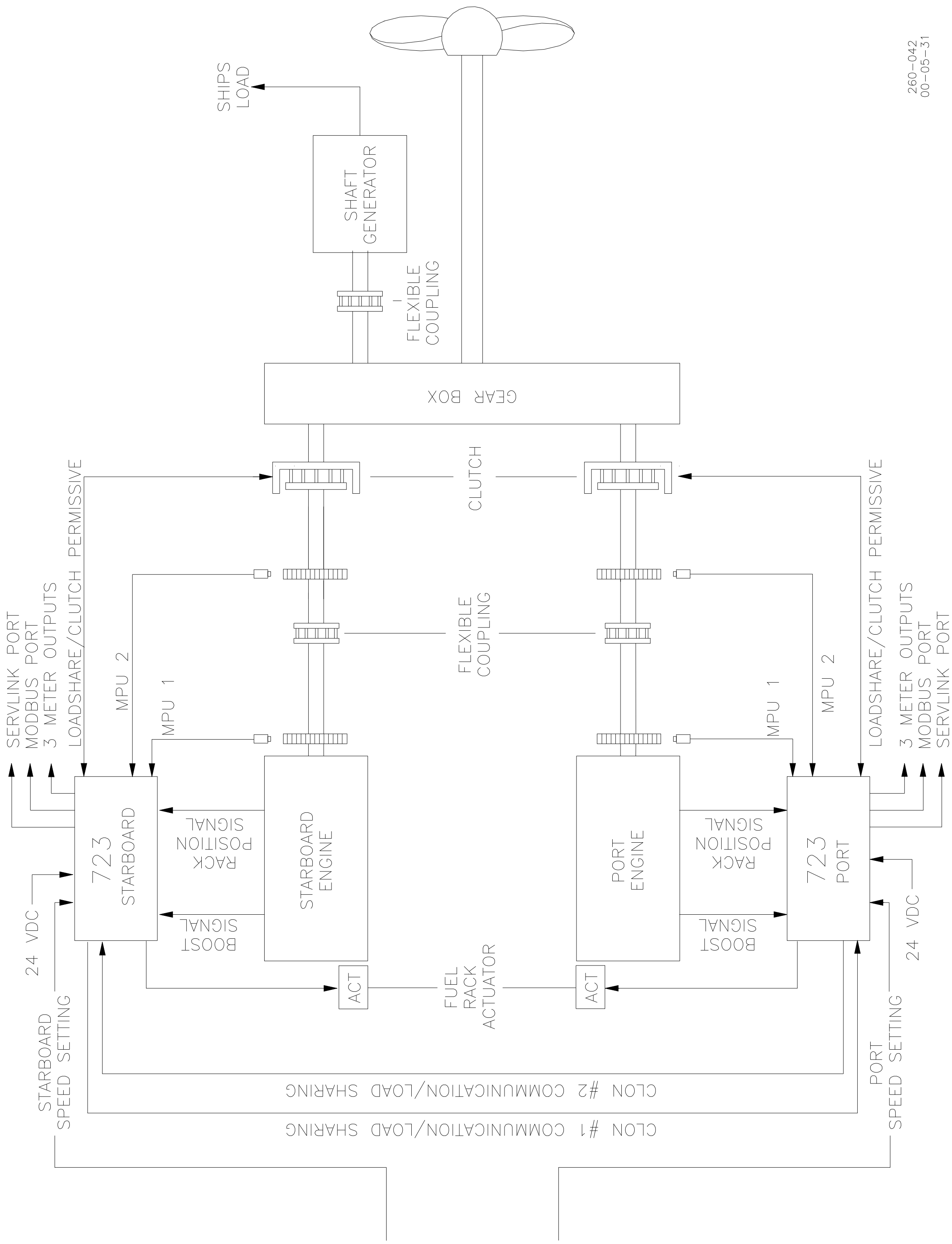
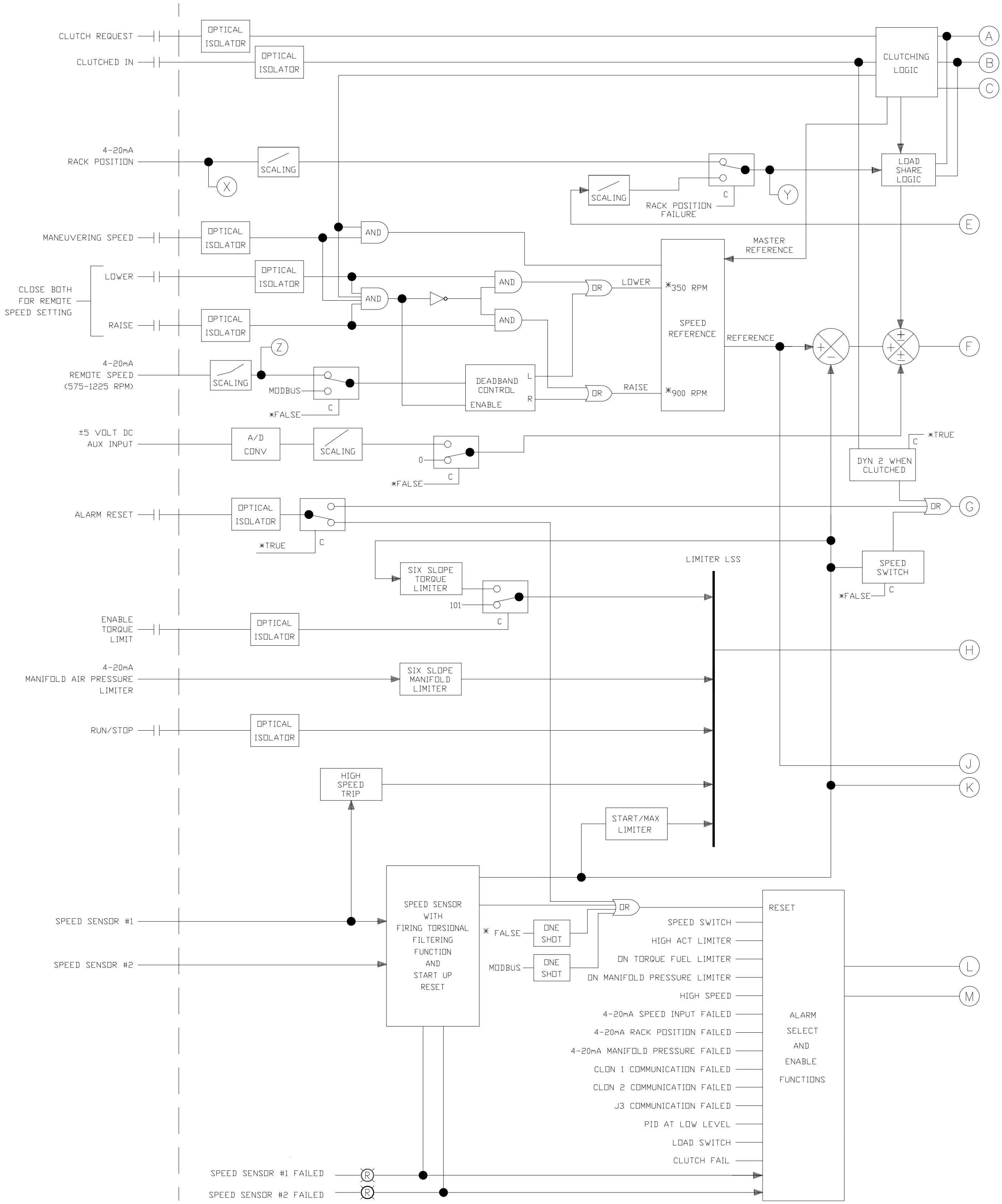


Figure 1-2. 723PLUS Marine Load Sharing System


CLUTCH REQUEST
CLUTCHED IN
OPTICAL ISOLATOR
CLUTCHING LOGIC
A
B
C
4-20mA RACK POSITION
SCALING
X
RACK POSITION FAILURE
Y
LOAD SHARE LOGIC
E
MANEUVERING SPEED
AND
MASTER REFERENCE
CLOSE BOTH FOR REMOTE SPEED SETTING
LOWER
RAISE
OR
*350 RPM
SPEED REFERENCE
*900 RPM
REFERENCE
F
Z
4-20mA REMOTE SPEED (575-1225 RPM)
MODBUS
*FALSE
DEADBAND CONTROL
ENABLE
L
R
±5 VOLT DC AUX INPUT
A/D CONV
0
*TRUE
DYN 2 WHEN CLUTCHED
ALARM RESET
G
LIMITER LSS
SIX SLOPE TORQUE LIMITER
101
SPEED SWITCH
ENABLE TORQUE LIMIT
H
4-20mA MANIFOLD AIR PRESSURE LIMITER
SIX SLOPE MANIFOLD LIMITER
RUN/STOP
HIGH SPEED TRIP
J
K
START/MAX LIMITER
SPEED SENSOR #1
SPEED SENSOR #2
SPEED SENSOR WITH FIRING TORSIONAL FILTERING FUNCTION AND START UP RESET
* FALSE
ONE SHOT
RESET
SPEED SWITCH
HIGH ACT LIMITER
ON TORQUE FUEL LIMITER
ON MANIFOLD PRESSURE LIMITER
HIGH SPEED
4-20mA SPEED INPUT FAILED
4-20mA RACK POSITION FAILED
4-20mA MANIFOLD PRESSURE FAILED
CLON 1 COMMUNICATION FAILED
CLON 2 COMMUNICATION FAILED
J3 COMMUNICATION FAILED
PID AT LOW LEVEL
LOAD SWITCH
CLUTCH FAIL
ALARM SELECT AND ENABLE FUNCTIONS
L
M
SPEED SENSOR #1 FAILED
SPEED SENSOR #2 FAILED
R

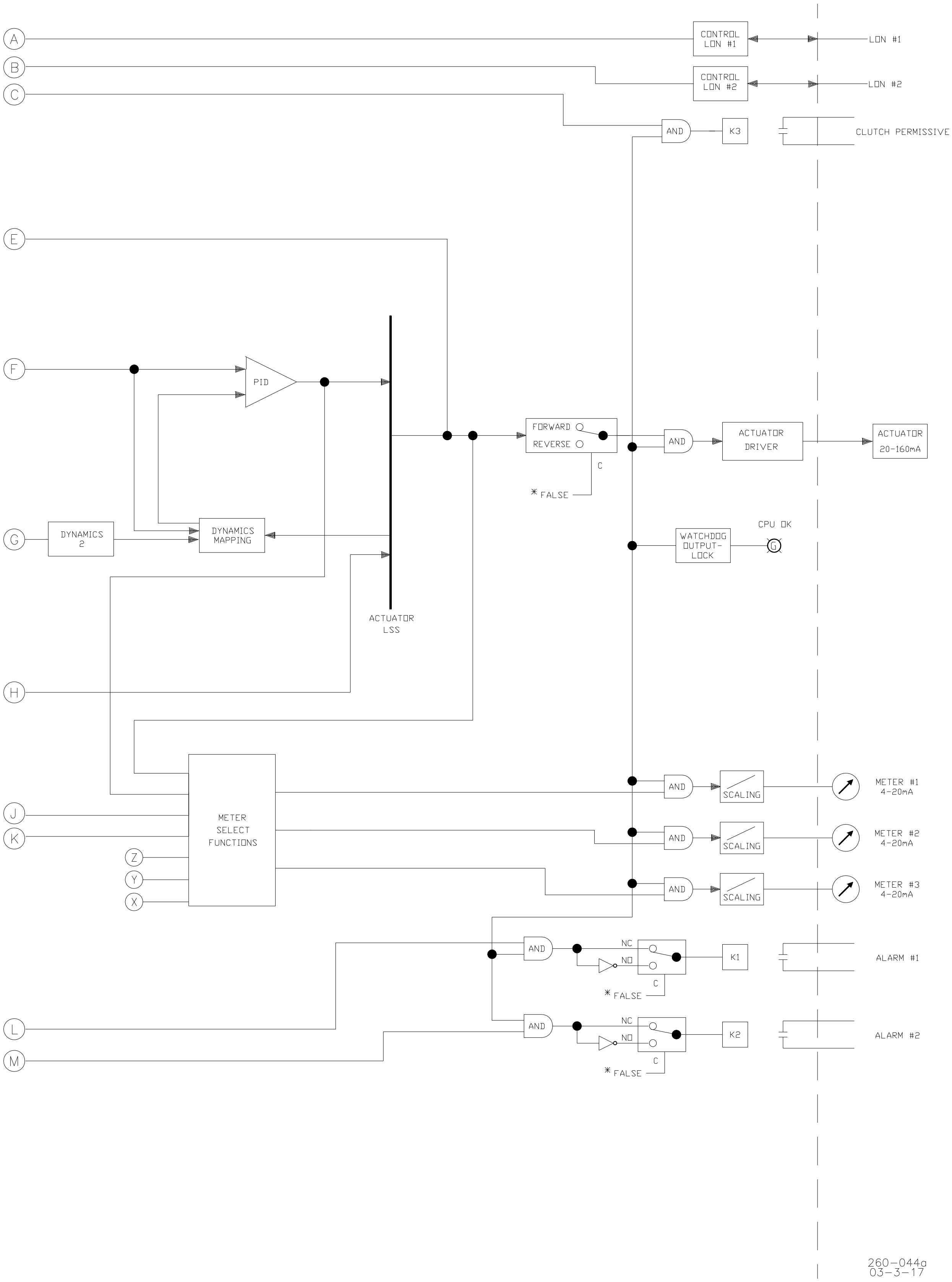


Figure 1-3. Functional Block Diagram

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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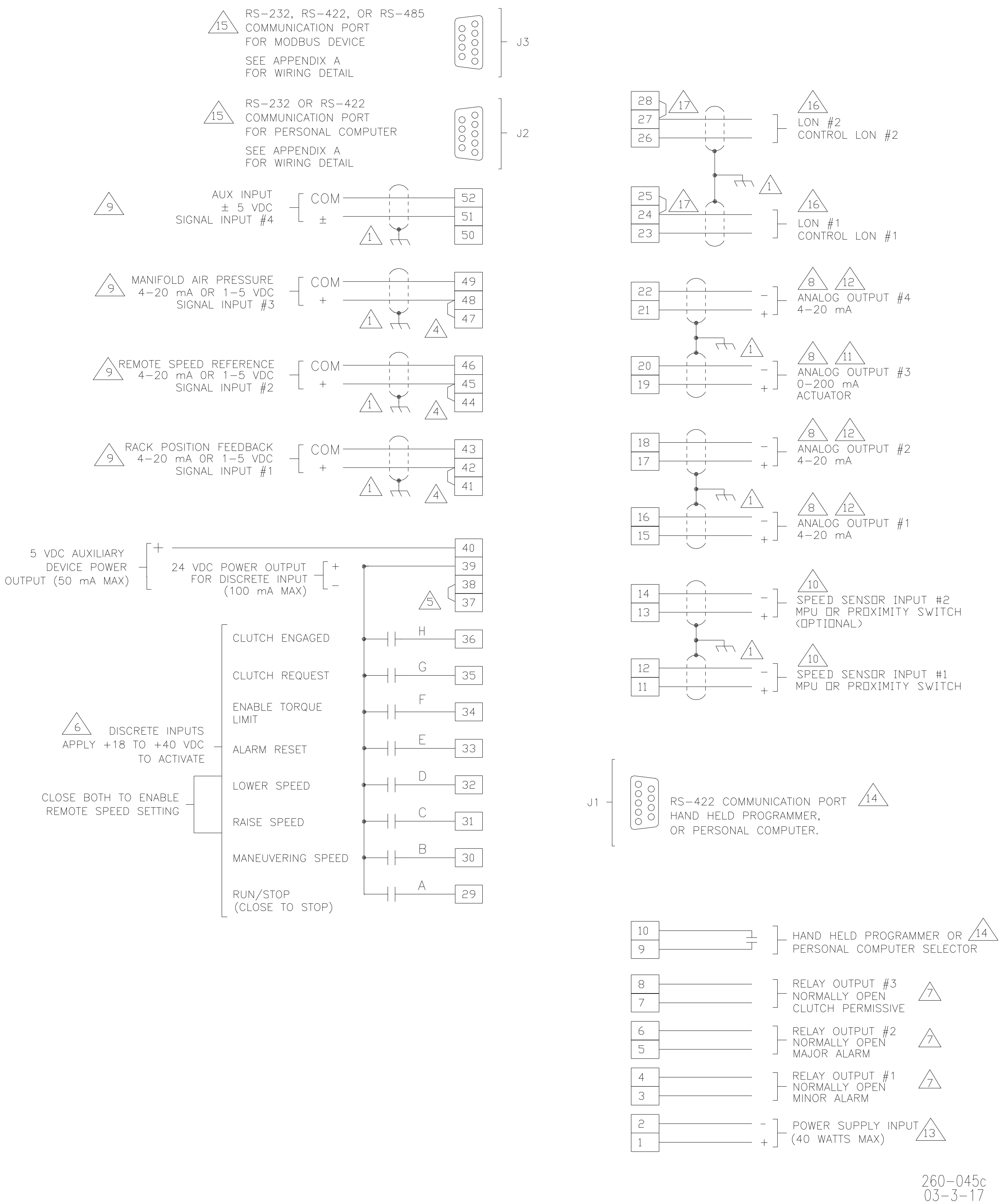

Figure 1-4. Control Wiring Diagram

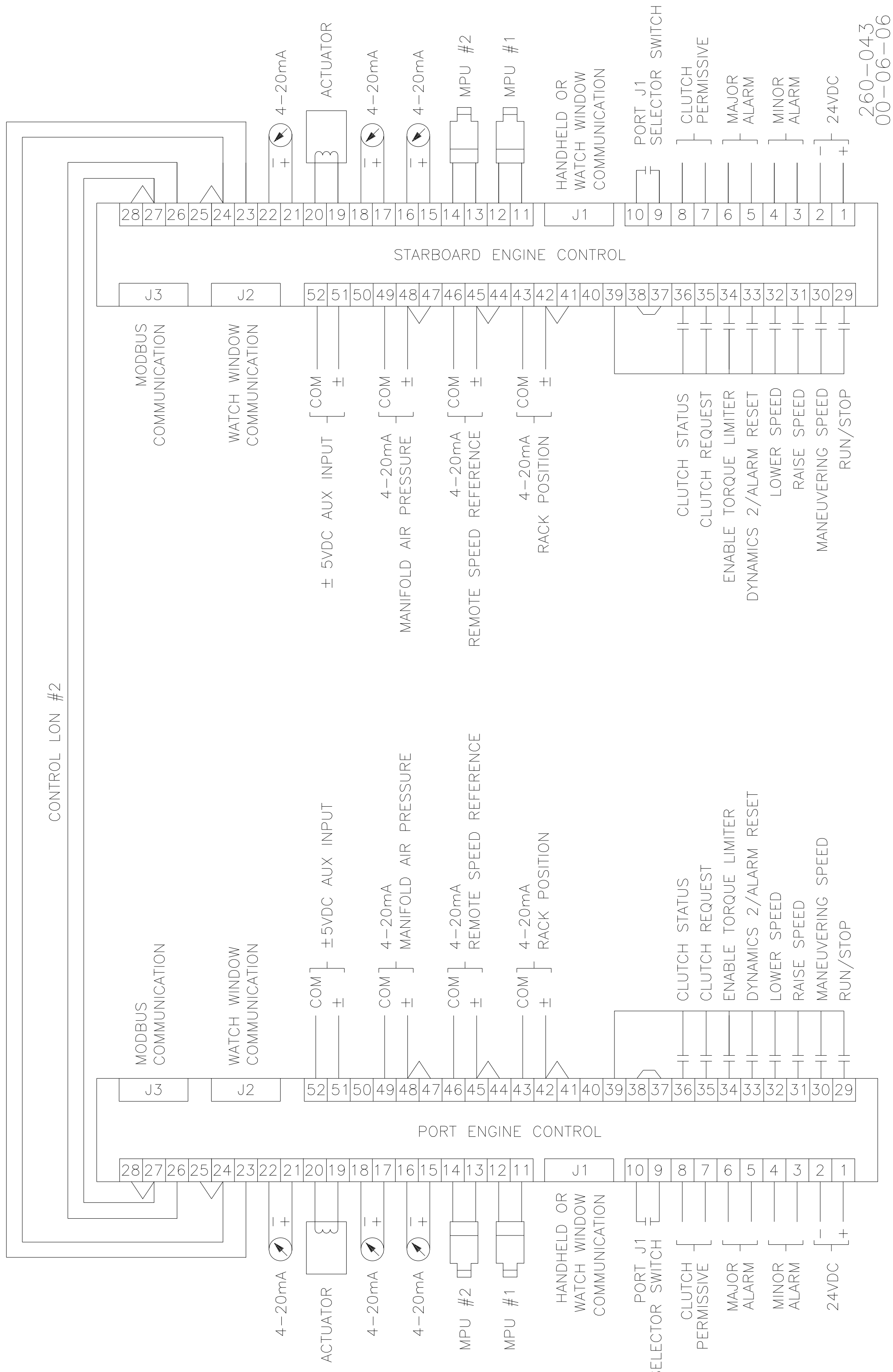

Figure 1-5. System Wiring Overview

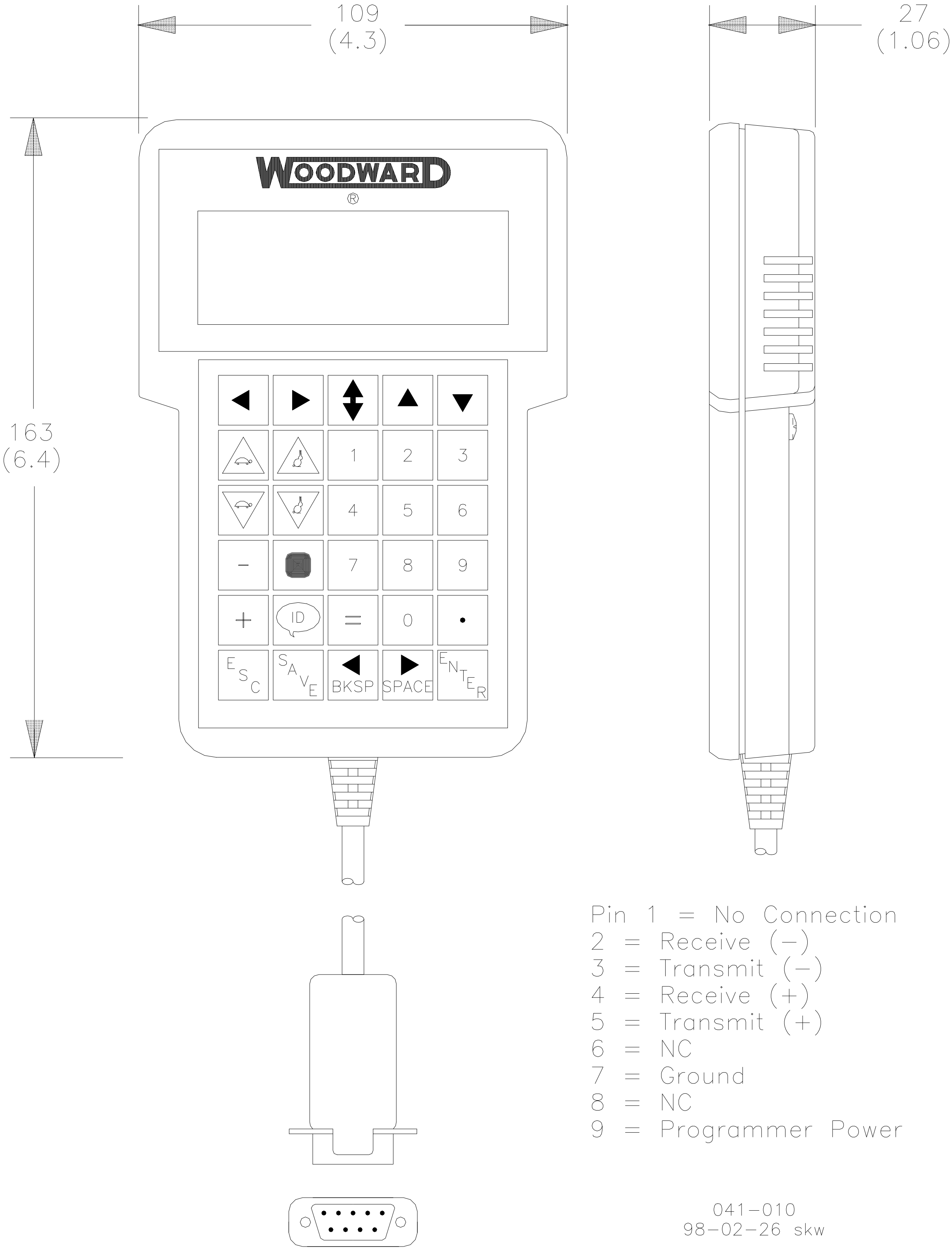

Figure 1-6. Hand Held Programmer

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.

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).

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.

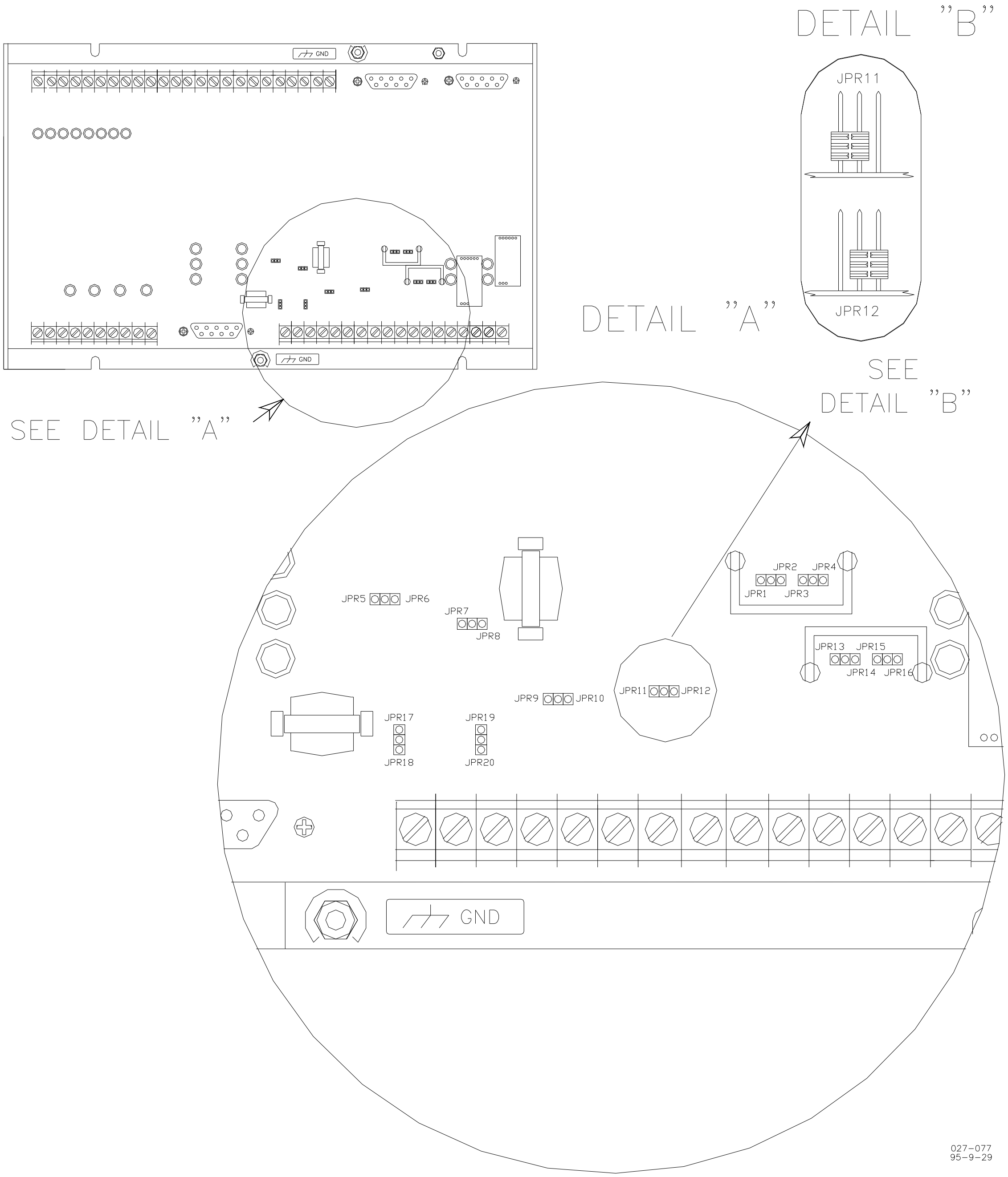

Figure 2-1. 723PLUS Control Internal Jumpers

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 Governor Company 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 and for torsional filtering (if configured). 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.

If you have a flexible coupling between the engine and the clutch, you must connect the first MPU (terminals 11/12) to detect engine speed, and the second MPU (terminals 13/14) to detect the driven shaft speed (See Figure 1-2). The speed sensors must be on shafts rotating at exactly the same speed (not a camshaft, nor on each side of a gearbox, etc). Use shielded wire for all speed sensor connections. Connect the shield to the chassis. Make sure the shield has continuity the entire distance to the speed sensor, and make sure the shield is insulated from all other conducting surfaces.

WARNING

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 #1, #2, and #4 (Terminals 15/16, 17/18, and 21/22)

The three analog outputs can be configured several different ways depending on the application needs. The output current is hardware configurable for either 0 to 1 mA or 4 to 20 mA on Analog Outputs #1 and #2, and for either 0 to 200 mA or 4 to 20 mA on Analog Output #4. This current signal is supplied to terminals 15(+) and 16(–) for Analog Output #1, 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. Any of the three outputs can be software configured to one of several control parameters. These parameters include:
1– Engine Speed (RPM)
2– Engine Speed Reference (RPM)
3– Remote Speed Setting (% mA)
4– Engine Load (% Rated)
5– Fuel Demand (%)
6– Torsional Level (RPM)
7– Rack Position (% mA)
8– PID Output (simulated %)

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 specially set at the factory for 0 to 20 mA, representing the engine speed. Default range is 0 to 1500 rpm. The hardware jumpers are configured for 4-20 mA for this special software setting. Software may be set for 4 to 20 mA output without changing the hardware jumper. Software settings must be changed if the hardware is configured for 0 to 1 mA.

Analog Output #2 is factory set for 4 to 20 mA, representing the rack position. Default range is 0 to 100%. Software settings must be changed if the hardware is configured for 0 to 1 mA.

Analog Output #4 is factory set for 4 to 20 mA, representing the fuel demand signal to the actuator. For actuators that require a 4 to 20 mA signal, Output #4 could be used to drive the actuator in this configuration. Default range is 0 to 100%. Software settings must be changed if the hardware is configured for 0 to 200 mA as well as the internal jumper location.

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). Load sharing is performed entirely with LON communication and negates the need for any separate load 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 load 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 load 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 H). 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 CONT A OPEN TO RUN setpoint in the CFIG 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.

⚠WARNING

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.

Maneuvering Mode (Input B; Terminal 30)

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 B 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. Neither the Raise and Lower contact inputs nor the Remote speed setting input will change the speed of the engine if this contact input is closed.

Raise Speed Contact (Input C; Terminal 31)

The input switch or relay contact used to activate the Raise Speed command connects to terminal 31 (Discrete Input C). This discrete input changes the control operation by increasing the speed reference ramp. The ramp can only increase to a software-adjusted RAISE SPEED limit at a software-adjusted rate. Command control can be configured for Modbus instead of this hardware input. The same raise speed limit and ramp rate apply to the Modbus BW Raise command. The Raise input is disabled if Remote Speed Control is enabled (both Raise and Lower input contacts closed). When the external switch or relay contact is closed (discrete input in the “TRUE” state), the control will raise the speed reference. With the contact open (discrete input in the “FALSE” state), the control stops raising the speed reference and speed remains at its current value.

Lower Speed Contact (Input D; Terminal 32)

The input switch or relay contact used to activate the Lower Speed command connects to terminal 32 (Discrete Input D). This discrete input changes the control operation by decreasing the speed reference ramp. The ramp can only decrease to a software-adjusted LOWER SPEED limit at a software-adjusted rate. Command control can be configured for Modbus instead of this hardware input. The same lower speed limit and ramp rate apply to the Modbus BW Lower command. The Lower input is disabled if Remote Speed Control is enabled (both Raise and Lower input contacts closed). When the external switch or relay contact is closed (discrete input in the "TRUE" state), the control will lower the speed reference. With the contact open (discrete input in the "FALSE" state), the control stops lowering the speed reference and speed remains at its current value.

Alarm Reset (Input E; Terminal 33)

The input switch or relay contact used to activate the Alarm Reset command connects to terminal 33 (Discrete Input E). 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 command from Port J3 and a software switch from Watch Window or the Hand Held Programmer.

As an option, this contact can be configured for DYNAMICS 2. The selection is made in Configure mode, under the header CONFIG OPTION at prompt USE CONT E AS RESET. Default is set for Alarm Reset.

Enable Torque Limiter (Input F; Terminal 34)

The input switch or relay contact used to enable the Torque Limiter connects to terminal 34 (Discrete Input F). This discrete input changes the control operation by placing an adjustable torque limit on the actuator output. When the switch or relay contact is closed (discrete input in the "TRUE" state) and other internal permissive conditions (e.g., clutch closed, etc.) are met, the engine load will be limited by the torque limit curve. When the switch or relay contact is opened (discrete input in the "FALSE" state), the torque limit is removed.

As an option, this contact input can be configured for Emergency De-clutch. The selection is made in Configure mode, under the header CONFIG OPTION, at prompt CT F AS TORQ LIMIT. Default is set to Enable Torque Limiter. If this default value is changed to "FALSE", then Discrete Input F is enabled as an Emergency De-clutch contact. In this configuration, when the switch or relay contact is closed (discrete input in the "TRUE" state), the control immediately issues a command to de-clutch and disables the unload ramp. The switch or relay contact at terminal 34 input must be opened (discrete input in the "FALSE" state) to enable clutching again.

Clutch Request (Input G; Terminal 35)

The input switch or relay contact used to activate the clutching sequence connects to terminal 35 (Discrete Input G). 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 H, Terminal 36) fails to close within the adjustable (1-120 seconds) CLUTCH IN TIME.

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 H, Terminal 36) fails to close within the adjustable (1-120 seconds) 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 load sharing to maintain equal load on both engines. The dwell time, synchronous speed window and soft loading time, are set in Service mode, under the *LOAD CONTROL* header, at prompts CLUTCH SYNC TIME, CLUTCH SPEED WINDOW and LOAD RATE.

When the switch or relay contact is opened (discrete input in the “FALSE” state), and the other engine IS NOT clutched, the clutch permissive Relay #3 output contact (terminals 7 and 8) immediately opens.

When the switch or relay contact is opened (discrete input in the “FALSE” state), and the other engine IS clutched, the engine soft unloads until the load reaches the UNLOAD TRIP POINT where the clutch permissive Relay #3 output contact (terminals 7 and 8) opens. The soft unloading time and unload trip level are set in Service mode, under the header *LOAD CONTROL*, at prompts UNLOAD RATE and UNLOAD TRIP POINT.

Clutch Engaged (Input H; Terminal 36)

The external contact used to activate the Clutch Engaged command connects to terminal 36 (Discrete Input H). This discrete input changes the control operation by providing the clutch status input for the clutching and load 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.

Fuel Rack Position Feedback Input (Signal Input #1; Terminals 42/43)

Connect a fuel rack position feedback transmitter to Signal Input #1. The input signal must be an isolated high-quality signal. By configuration, this input is used for load sharing and fuel rack indication. Fuel rack position is displayed in software adjustable engineering units on Watch Window, on an optional Hand Held Programmer and as a Modbus AR address.

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 MΩ. 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 load sharing and rack position indication. 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 on Watch Window, on an optional Hand Held Programmer and as a Modbus AR address. No connection is required to this input if this function is not needed by the application.

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.

Manifold Air Pressure Input (Signal Input #3; Terminals 48/49)

Connect a manifold air pressure transmitter to Signal Input #3. The input signal must be an isolated high-quality signal. By configuration, this input is used for speed control fuel limiting (external fuel limiting). Manifold air pressure is displayed in software adjustable engineering units on Watch Window, on an optional Hand Held Programmer and as a Modbus AR address. No connection is required to this input if this function is not needed by the application.

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 48(+) and 49(–). When using a voltage transmitter, remove the jumper between terminals 47 and 48. 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 disable the manifold air pressure fuel limit. A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

Aux Input
(Signal Input #4; Terminals 51/52)

This input is provided for the rare occasion that a system might also have a DSLC™ control. This input is designed to work with the Woodward DSLC. No connection is required to this input if the DSLC function is not needed by the 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.

Communication Port J3

Communication Ports J3 is used to connect a separate Modbus device, such as a Human Machine Interface (HMI), to the 723Plus control. These devices are used to read control parameters and can drive certain 723Plus control parameters. The Modbus device can be any master device capable of communicating with Modbus standard protocol. This includes any Modbus compatible PC, compatible SCADA system, etc. Communication Port J3 can be software configured for a wide variety of serial communications. Port can be set to standard specifications for RS-232, RS-422, or RS-485. Additionally the baud rate can be set for 1200, 1800, 2400, 4800, 9600, 19200, or 38400. The only restriction is that if port J3 is set for a baud rate of 19200, then port J2 cannot be 38400, and if port J3 is set for a baud rate of 38400, then port J2 cannot be 19200. Stop bits can be set at 1, 1.5, or 2. Parity can be set for OFF, ODD, or EVEN. The data may be formatted as either ASCII or RTU. See Appendix A for Port Wiring.

Communication Port J3 can read several control parameters, send limited commands and one signal to the 723Plus control. The signal, which can be sent to the 723Plus, is the remote speed reference. The commands which can be sent to the 723Plus control are Alarm Reset, Use Clutch Request Remote Command, Clutch Request, Use Torque Limit Remote Command, Enable Torque Limit, Use Raise Speed Remote Command, Raise Speed, Use Lower Speed Remote Command, Lower Speed, Use Stop Remote Command, Close to Stop and Use Remote Speed Reference. The Alarm Reset command works in parallel with the discrete input Alarm Reset command connected to terminal 33 (E), and a software switch from Watch Window or the Hand Held Programmer. Setting any “Use (*) Remote Command” TRUE disables that hardware discrete input and enables that Modbus Remote Command. These are individually set to allow numerous combinations of hardware/Modbus discrete commands. See Appendix B for complete listings of port addresses and description of values for Port J3.

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 load sharing. These functions will be broken down in this chapter as follows:

Speed Control	Fuel Limiting	Load Sharing
Speed Input	Rack Position	Load Sharing Lines
Speed Reference	Transient Overfuel	Fuel Rack Position
Dynamics	Manifold Air Pressure	
Actuator Output	Torque Fuel Limiting	
	Start Fuel Limiting	
	Maximum Fuel Limiting	

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 allows the application to sense engine speed in one of three ways: single speed sensing input, redundant speed sensing, or torsional filtering for flexible coupling 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 *DYNAMICS 1*, at prompt 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:

camshaft frequency = (engine rpm)/60 [for 2-cycle engines]
= (engine rpm)/120 [for 4-cycle engines]

firing frequency = (*camshaft frequency*) x (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.

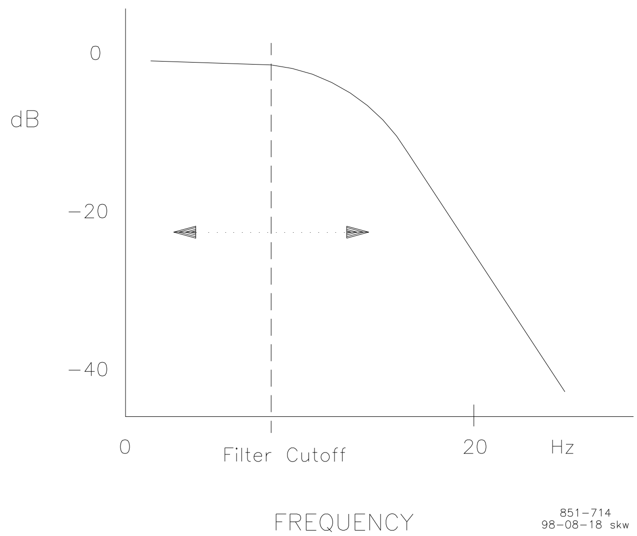

Figure 3-1. Speed Sensor Roll-off Filter

Notch Filter

WARNING **To use the notch filter, make sure that the speed sensor(s) used are only on the engine side of the flexible coupling.**

The notch filter is a bandstop filter. It rejects specific frequencies and allows all others to pass. The idea is to reject the torsional (frequency on a frequency) frequencies that the coupling produces, so that the actuator will not respond to speed sensor changes it cannot control with the fuel. Systems with low frequency oscillatory modes due to engine and generator inertias and flexible couplings are difficult to control. In the notch filter approach, no attempt is made to damp the oscillatory modes, but an effort is made to reduce the signal transmission through the controller by a filter that drastically reduces the signal gain at the resonant frequency.

There are two adjustments—NOTCH FREQUENCY and NOTCH Q FACTOR.

The NOTCH FREQUENCY is the center frequency of rejection, and the units are defined in Hertz. In tuning the notch filter, the resonant frequency must be identified and entered. The allowed frequency range of the notch filter is 0.5 to 16.0 Hz.

The NOTCH Q FACTOR is the width about the NOTCH FREQUENCY that the filter rejects, and is dimensionless. The Q factor has a tuning range of 0.707 to 25.0. At the minimum value 0.707, there is no attenuation of signal gain at the resonant frequency, and the filter gain equals one. At the maximum value 20.0, a maximum attenuation of signal gain occurs at the resonant frequency, and the filter gain equals 0.035. In general, the filter gain at the resonant frequency is 0.707/Q factor.

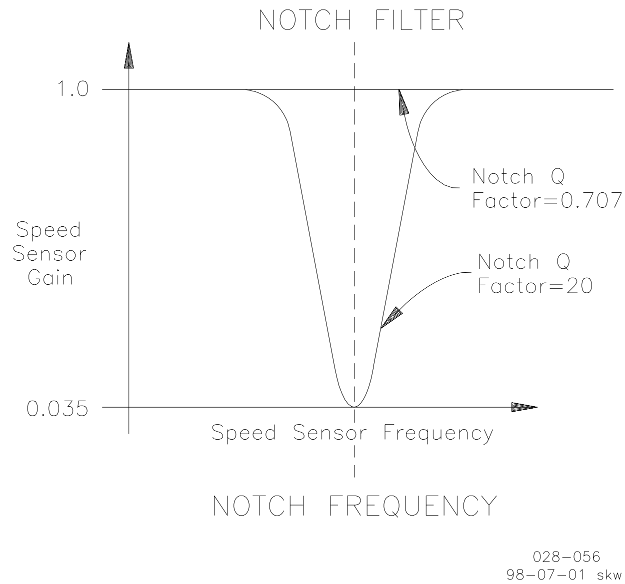

Figure 3-2. Notch Filter

Torsional Filter Function

When the ENBL COUPL TOR FILT, found in Configure Mode under the header CONFIG OPTION, is configured FALSE, the torsional filter is disabled and single or redundant speed sensing is enabled.

When the ENBL COUPL TOR FILT is configured TRUE, the torsional filter function is enabled, which allows the control to effectively filter out the rapid speed changes, which are caused by a system with a flexible coupling as shown in Figure 1-2. A flexible coupling can store energy when the engine is increasing torque to the driven load, and the coupling can also release energy as the engine decreases torque to the driven load. This effect causes the instantaneous change in speed of the driven load to be different from the instantaneous change in speed of the engine. The difference between these two values is referred to as the torsional level. A high torsional level can cause the governor to over-respond to load and speed changes, which can make the entire system unstable. Without torsional filtering, the closed-loop dynamics would have to be “de-tuned” to prevent instability in the system. Worse, as the coupling ages and becomes softer, the closed loop dynamics need to be de-tuned further. At some point the engine will fail to respond aggressively to load changes. The system may also become unstable.

The torsional filtering function requires two speed sensors. The function is disabled if either of the speed sensors fails. A software switch, found in Service mode, under the header *TORSIONAL FILTER*, can also be used to disable the filter function and enable redundant speed sensing operation. The torsional filter factor value, found in Service mode, under the header *TORSIONAL FILTER*, at prompt TORSIONAL FILTER, should be set according to the following formula:
Torsional Filter = Engine Rotating Inertia/Engine and Load Rotating Inertia
OR
Torsional Filter = Rotating Inertia on Engine Side of Coupling/Total Inertia

The torsional filter action reduces the dynamic response to the fast speed changes associated with the coupling while still allowing fast response to actual system speed changes.

More Speed Input

All the speed signal configurations are located in the CONFIG SPD CONTROL configure menu. GEAR #1 TEETH (under header, 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.

Speed Signal (Hz) = Gear Teeth * Engine rpm / 60

GEAR #2 TEETH (under header, 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 HI SPEED SD value. This value is set in Configure mode, under the header ALARM/SD CONFIGURE, at prompt HI SPEED 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 *MINOR ALARMS*, *MAJOR ALARMS*, or *DISPLAY 2* at prompt 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 overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

Speed Reference and Ramps

The 723PLUS Two-Engine Mechanical Load Sharing control provides local control with discrete inputs for raising and lowering speed. For remote speed setting, the control provides a 4 to 20 mA or 1 to 5 Vdc Remote Speed Setting input and a Modbus analog write (AW) address 4:0005.

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 load sharing signal, sent over Control LON, biases the speed reference of each engine to effect load 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 MAN MODE SPD STPT in the CFIG SPEED CONTROL menu.

- Local Raise Speed/Lower Speed discrete inputs are enabled when no other engines are clutched in or this engine is clutched in as the master.

- Remote Speed Setting is enabled when the raise and lower speed contacts are both closed, no other engines are clutched in or this engine is clutched in as the master and USE REMOTE COMMANDS, found in configure mode under the header CONFIG OPTION, is configured FALSE.

- Modbus Speed Reference setting is enabled when the lower and raise contacts are both closed, no other engines are clutched in or this engine is clutched in as the master and USE REMOTE COMMANDS, found in configure mode under the header CONFIG OPTION, is configured TRUE.

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 control provides lower limit, raise limit and idle set points, decel time, and raise and lower rates. Decel time determines the time required for the engine to ramp from rated speed to idle speed. Raise and lower rates determine how fast speed is increased or decreased by the raise and lower command inputs, the remote speed setting input and the Modbus AW value.

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 IDLE REF @ SHUTDOWN found in configure mode under the header 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.

IMPORTANT **The IDLE REF @ SHUTDOWN setting can be overridden after the engine stops by closing one or both of the Raise or Lower speed discrete input contacts. To maintain the idle reference setting Do Not close either contact after the engine is stopped.**

Closing either the raise or lower speed contact increases or decreases the master or unclutched engine speed based on adjustable raise and lower rate set points. The raise and lower limits determine the adjustable range of these commands. The raise and lower contacts are active when the engine is not running. Therefore the speed reference can be set at the raise or lower limit while the engine is stopped. Rate and limit settings are found in service mode, under the header *SPEED REFERENCE*, at the prompts RAISE SPEED RATE, LOWER SPEED RATE, RAISE SPEED LIMIT and LOWER SPEED LIMIT.

Additionally, when the maneuvering mode input is closed, the engine speed reference will ramp from its current value to the maneuvering speed setpoint at the 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 remote operation is selected, the control ramps the master or unclutched engine speed to the reference value set by the Remote Speed Setting milliamp input or the Modbus AW value, as configured, based on the raise or lower rate. This ramp action can occur while the engine is stopped to override the idle reference. This may not be the desired mode of operation, so be sure to understand the implications of operating the control in this manner.

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

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 Remote Speed Reference set points (see Figure 3-3). 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. The 723PLUS control responds to a remote speed setting input failure in one of two ways: ramp to lower limit or Lock-in-Last. When REM LOCK IN LAST is set "TRUE" and the remote speed input is failed or out of range, the speed reference locks in the last position. When REM LOCK IN LAST is set "FALSE", and the remote speed input is failed or out of range, the speed reference will ramp to the lower limit set point. Response is set in configure mode, under the header CONFIG OPTION, at prompt REM LOCK IN LAST. 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 ALARM/SD CONFIGURE, at the prompt ALARM DELAY TIME.

A clutch request ramps the slave engine speed to the master speed reference at the SLV-MST RAMP RATE found in service mode under the header *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 load sharing bias signal is applied to the speed reference to effect load sharing once both engines are clutched in and load sharing is enabled. The load sharing signal biases the speed reference of each engine to distribute the load equally between both engines. The load sharing bias signal is applied after the speed reference ramp rate limiter. This ensures the load sharing response is not restricted by any speed reference ramp rate settings. The PERCENT LOAD used by the control to produce the load sharing bias signal is primarily provided by the rack position analog input and calibration settings found in service mode, under the header * RACK CALIBRATION*, at the prompts RACK OUT @ NO LOAD and RACK OUT @ MAX LOAD. Should the rack position analog input fail, a backup load signal is provided by the ACTUATOR % OUT and calibration settings found in service mode, under the header * RACK CALIBRATION*, at the prompts ACT OUT @ NO LOAD and ACT OUT @ MAX LOAD.

NOTICE

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

In the unlikely event the ENABLE AUX INPUT and USE DSLC AS SYNC, found in configure mode under the header CONFIG OPTION, are configured TRUE, a ±5 Vdc Aux Speed Bias is applied to the speed reference to effect generator synchronizing and load control by signal from a DSLC control.

The combined speed reference ramp plus the load sharing bias and aux speed bias can be monitored in service mode, under the header *DISPLAY 1*, at prompt SPEED REF BIASED.

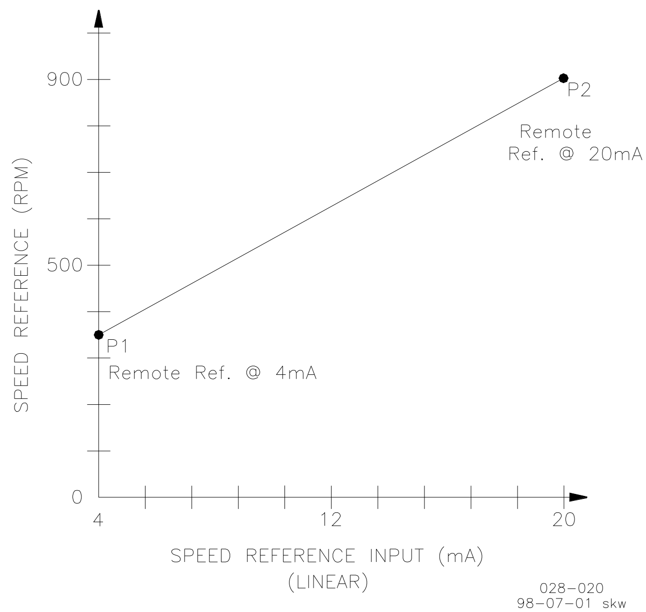

Figure 3-3. Speed Reference

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 (*DYNAMICS 1* and *DYNAMICS 2*). By configuration, the dynamic set selection can be switched with discrete input E, clutch engaged or an internal speed switch setting.

Constant dynamics are used when the LINEAR DYNAMIC MAP is configured FALSE. Constant dynamics remain fixed as entered and do not vary with engine speed. Dynamics may still vary with fuel demand when the gain slope setting is used. Constant dynamics are useful for fuel systems that tend to be equally stable at reduced speed and rated speed.

When the LINEAR DYNAMIC MAP is configured “TRUE”, gain varies linearly by the ratio of real engine speed reference to rated speed, and reset varies inversely by the ratio of rated speed to real engine speed reference. The values used by the speed control are the product of the entered gain and reset values multiplied by these speed ratios. A variable linear dynamic map is useful for fuel systems that tend to be less stable at reduced speed operation.

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.

For applications requiring even more flexibility, the gain value can be programmed according to a five-point curve, to allow a non-linear gain map. The gain value used by the PID will vary as the fuel demand output of the control changes, so that different gain settings can be used at different engine load points.

The control can 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 engine is clutched in at a light load. The percentage of gain reduction and load level are set in service mode, under the header *LOAD CONTROL*, at the prompts GAIN % @ LIGHT LOAD, LITE LD GAIN PU and LITE LD GAIN DO. A setting of 100% disables the light load reduced gain function. If the five-point gain map is selected, this setpoint does not apply.

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, which can be used by 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.

It is also possible to use a 4-20 mA actuator output using Analog Output #4 (TB 21 and TB 22)

WARNING

When using Analog Output #4 to control an actuator, the configurable AOUT 4 SELECTION must be set to option 5, which is the FUEL DEMAND selection.

Actuator type is set in configure mode, under the header CONFIG OPTION, at the prompt 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 Governor 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%. However, special fuel limiter scaling is provided to allow and require setting the air manifold and torque fuel limiters as a PERCENT LOAD rather than as an actuator output %. The PERCENT LOAD outputs from these limiters are re-scaled to actuator output % before applying them to the LSS bus.

Percent Load

PERCENT LOAD 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 rack position input or the actuator output. PERCENT LOAD is primarily provided by the rack position analog input. However, should the rack position analog input fail or not be provided, a default PERCENT LOAD signal is provided by the actuator % out. The no-load and rated load rack position and actuator output settings are found in service mode, under the header *RACK CALIBRATION*, at prompts RACK OUT @ NO LOAD and ACT OUT @ NO LOAD and RACK OUT @ MAX LOAD and ACT OUT @ MAX LOAD respectively.

NOTICE

The fuel limiting and load sharing functions both depend heavily upon accurate *RACK CALIBRATION* settings. Carefully determine and enter the *RACK CALIBRATION* 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 PERCENT LOAD signal exists when the Rack Position analog input is both valid or failed. Failure to do so may result in incorrect fuel limiter operation.

Rack Position

The rack position input is optional and produces the PERCENT LOAD signal used for load sharing and for fuel limiting as described above. Load sharing and fuel limiting automatically switch to the default mode when the rack position input signal is not provided or failed.

The calibration of the rack position input is done at two positions, the minimum (no-load) load rack position and the maximum (rated) load rack position. The no-load rack position is defined, as the rack (or default actuator) position that requires the least amount of fuel rack to run the engine while it is unloaded. The engine speed at no-load may be at either idle speed or rated speed. The no-load point should be determined while the engine is hot. The maximum (rated) load rack position is defined, as the rack (or default actuator) position required to run the engine at rated loaded. Refer to *RACK CALIBRATION* above and in Chapter 4 for more information.

After calibration, the RACK % LOAD and the DEFAULT % LOAD shown on the *DISPLAY 1* service menu should be compared to confirm good correlation at both minimum (no-load) and maximum (rated) load.

Transient Overfuel

Transient overfuel is a function that works in conjunction with both the manifold pressure and torque fuel limiters. The *TRANSIENT OVR FUEL* service header becomes visible in the hand held programmer when either one or both of these fuel limiters are enabled. The transient overfuel function allows the limiters to be exceeded for a short adjustable time by an adjustable amount during an increasing load transient. The limiter settings are enforced if the overfuel condition exceeds the overfuel amount and time settings. The overfuel time has an adjustable range of 0–10 seconds. The overfuel amount has an adjustable range of 0–100% load. These settings are found in service mode, under the header *TRANSIENT OVR FUEL*, at prompts TORQUE OVER FUEL TIME or MAN PRES OVER FUEL TIME and TORQUE OVER FUEL AMOUNT or MAN PRES OVER FUEL AMOUNT.

Manifold Air Pressure/External Fuel Limiter

The manifold air pressure/external fuel limiter is an actuator driver output limit based on a 4–20 mA or 1–5 Vdc manifold air pressure transmitter or some other external transmitter connected to analog input #3. There are six tunable points for this fuel limiter curve. By special scaling the fuel limit is set as a PERCENT LOAD for each manifold air pressure breakpoint. Settings are found in service mode, under the header *MAN PRESS LIMITER*, at prompts FUEL LIMIT BKP 1 through FUEL LMT AT BKPT 6.

To use the manifold air pressure fuel limiter, it must first be enabled in configure mode, under the header CONFIG OPTION, at prompt USE MANIFOLD LIMITR. Set “TRUE” to use. Set “FALSE” to disable. If the limiter function is configured “FALSE”, the service header *MANIFOLD PRESS LMT* will not appear on the hand held programmer. Other permissives (e.g., clutch engaged) must also be satisfied to enable the manifold air pressure fuel limiter.

Torque Fuel Limiting

The torque fuel limiter is an actuator driver limit based on actual engine speed or the engine speed reference inputs. There are six tunable points for this fuel limiter curve. By special scaling the fuel limit is set as a PERCENT LOAD for each RPM breakpoint. Settings are found in service mode, under the header *TORQUE LIMITER*, at prompts TORQ LIMIT BKP 1 through TORQ LMT AT BKPT 6.

To use the torque fuel limiter, it must first be enabled in configure mode, under the header CONFIG OPTION, at prompt USE TORQUE LIMITER. Set "TRUE" to use. Set "FALSE" to disable. If the torque limiter function is configured "FALSE", the service header *TORQUE LIMITER* will not appear on the hand held programmer. Other permissives (e.g., clutch engaged, discrete input 'enable' closed, etc.) must also be satisfied to enable the torque fuel limiter.

To select engine speed or the engine speed reference as the basis for the torque fuel limiter, go to service mode, under the header *TORQUE LIMITER*, at the prompt BASED ON SPD REF. Set "TRUE" to use the speed reference. Set "FALSE" to use actual engine speed.

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 START FUEL LIMIT based on actuator percent. If the engine does not immediately start, the actuator percent will increase at the START FUEL RATE (% FD/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 *START/ MAX LIMITS*, at prompts START FUEL LIMIT and the START FUEL RATE (% FD/S). To disable the start fuel limit function, set the limit at 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 *START/MAX LIMITS*, at prompt MAXIMUM FUEL LIMIT. To disable the maximum fuel limit function, set the limit at 100%.

Load Sharing

The third primary function of this 723PLUS control is to share load equally between two engines mechanically connected through a common gearbox. Load sharing is done electronically. The two 723PLUS controls communicate load, and other information needed for load sharing, over redundant Control LON channels. Load sharing signals, produced within each 723PLUS, are used to maintain equal load on both engines. The load sharing signal is proportional to the total PERCENT LOAD on both engines. Each 723PLUS control compares its specific PERCENT LOAD to the load sharing signal and applies a bias (±) to the speed reference. This bias changes engine load until it matches the load sharing signal. The load 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. Separate load sharing lines are not required since the Control LON connections provide all the information needed to complete the load sharing function.

Percent Load

The PERCENT LOAD used for load sharing is the same as the percentage of rated engine load used by the fuel limiters. Refer to the previous description for more details. PERCENT LOAD is calibrated to be 0% at minimum engine load and 100% at maximum engine load. Load sharing can only be as accurate as the *RACK CALIBRATION* settings for each engine.

NOTICE

The fuel limiting and load sharing functions both depend heavily upon accurate *RACK CALIBRATION* settings. Carefully determine and enter the *RACK CALIBRATION* settings and re-verify these settings following any related mechanical changes (linkage, actuator. etc.). Failure to do so may result in unequal load sharing.

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 PERCENT LOAD of both engines is sent and received over the Control LON lines to do load sharing. A load 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 load sharing signal.

An internal switch isolates the 723PLUS control from the load sharing signal until the unit is ready to begin load sharing. This is done shortly after a clutching operation begins. If this is the first unit being clutched, the load 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 load equals, within 5%, the internal load sharing signal. At this point the internal load sharing switch closes and the two 723PLUS controls begin operating in the load sharing mode. In the load sharing mode, load on each engine is regulated to make the PERCENT LOAD 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 Generic PC Interface

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 Menus

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 Menus

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.

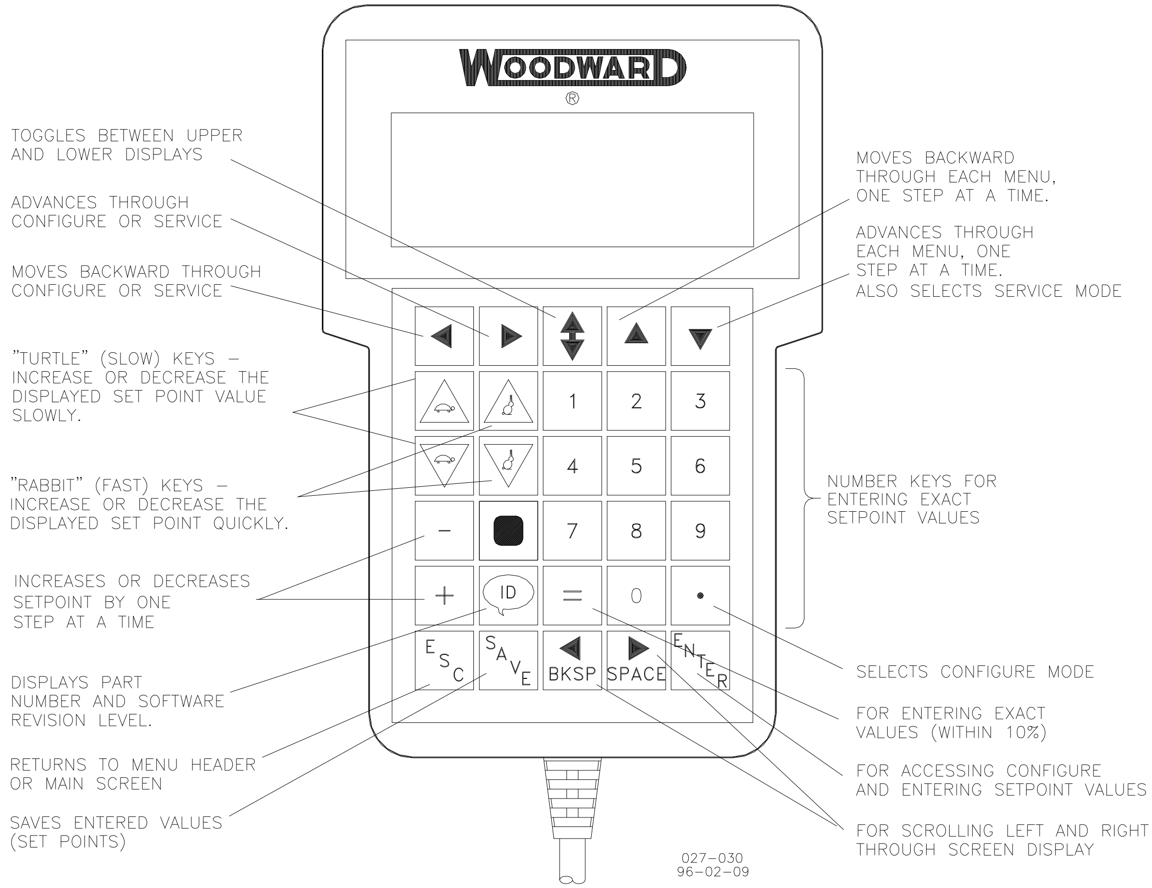

Figure 4-1. Hand Held Programmer Functions

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.

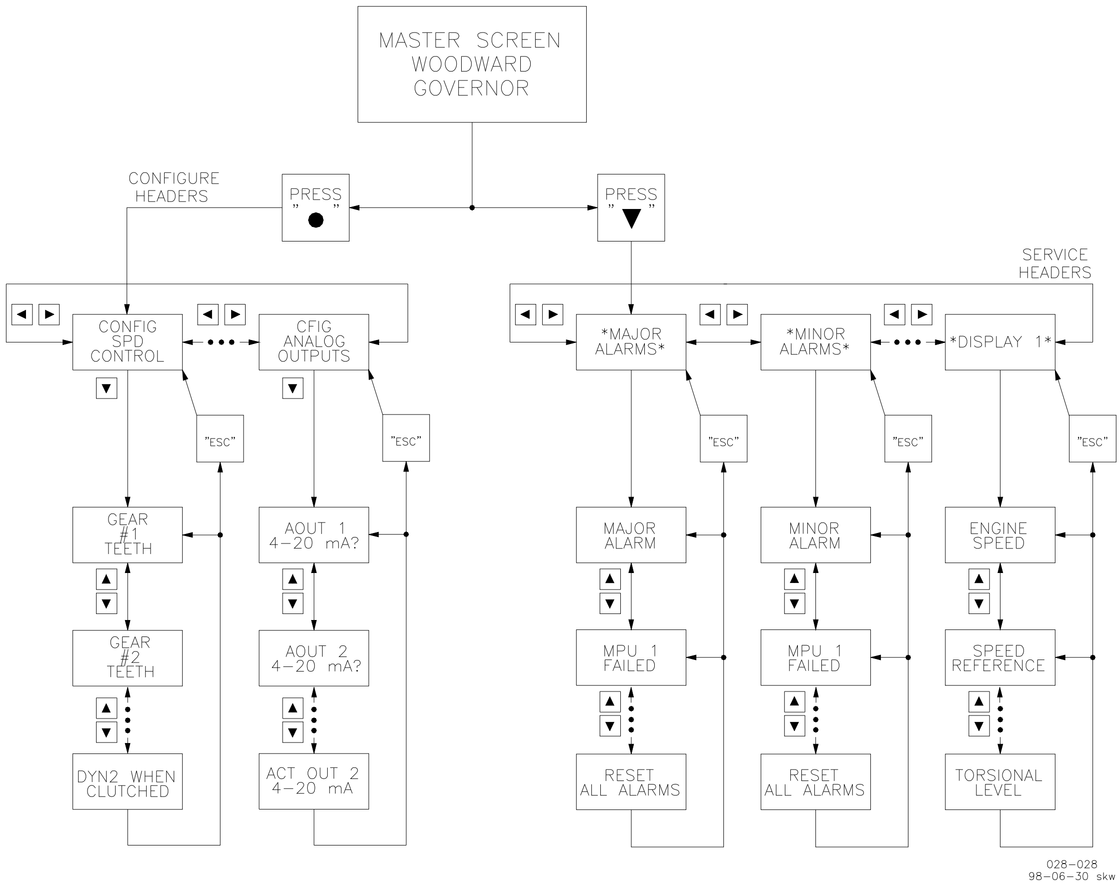

Figure 4-2. Service and Configure Headers

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.

Configure Menus

CONFIG SPD CONTROL

WARNING

All settings in the 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.

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.

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.

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

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.

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.

LINEAR DYNAMIC MAP (*T/F)—Set this value "FALSE" to have constant Gain and Reset values over the entire engine speed reference range. Set this value "TRUE" to have Gain and Reset vary linearly with engine speed reference. See Figure 4-3 for these two dynamic maps.

DYN2 ON SPD SWITCH (*T/F)—If this value is set "TRUE", dynamics 2 will activate when the dynamics 2 contact is closed (contact E, if configured) and the engine speed is above the DYN2 ON SPD SWITCH value.

DYN2 WHEN CLUTCHED (*T/F)—If this value is set "TRUE", dynamics 2 will activate when the dynamics 2 contact is closed (contact E, if configured) and the engine is clutched in.

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

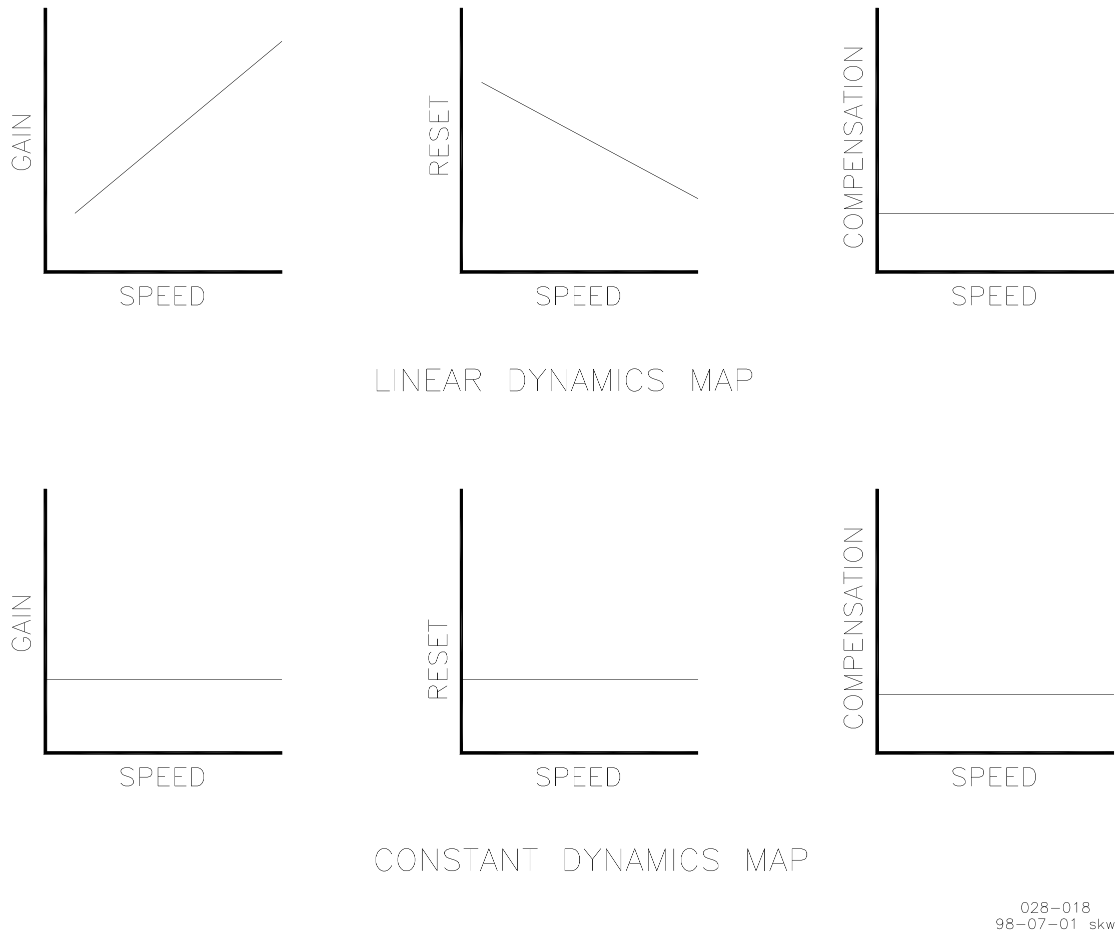

Figure 4-3. Dynamics Maps

CONFIG OPTION

USE TORQUE LIMITER (*T/F)—Set this value “FALSE” if the Torque Limiter function is not required. Set this value “TRUE” if the Torque Limiter function is required. This also activates the *Torque Limiter* menu.

USE MANIFOLD LIMITR (*T/F)—Set this value “FALSE” if the Manifold Limiter function is not required. Set this value “TRUE” and connect a Manifold Pressure Transducer to the 723PLUS if the Manifold Limiter function is required. This also activates the *Manifold Limiter* menu.

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.

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.

ENBL COUPL TOR FILT (*T/F)—Set this value “TRUE” to enable the coupling torsional filter. Set this value “FALSE” to disable the coupling torsional filter. This also activates the *Torsional Filter* menu.

REM LOCK IN LAST (*T/F)—Set this value “TRUE” to enable the Lock-in-Last function of the remote speed setting input. When enabled, on a failed remote speed setting input, the speed reference will “lock” at the last remote speed setting input value. Set this value “FALSE” to disable the Lock-in-Last function of the remote speed setting input. When disabled, on a failed remote speed setting input, the speed reference will ramp to the Lower Limit speed value.

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”.

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

ENABLE AUX INPUT (*T/F)—Set this value “FALSE” if the AUX Input is not being used. Set this value “TRUE” if the AUX Input function is required.

CT F AS TORQUE LIMIT (*T/F)—Set this value “FALSE” for this discrete-in to be used as Emergency Declutch input. Set this value “TRUE” for this discrete-in to be used as Torque Limit input.

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. Load 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.

CONT A OPEN TO RUN (*T/F)—Set this value “TRUE” if this input will be open to run the engine. Set this value to “FALSE”, if this input will be closed to run the engine.

USE CONT E AS RESET (*T/F)—Set this value “TRUE” to use this contact to reset the major and minor alarms. When this value is set “FALSE”, this contact is used to enable Dynamics 2.

USE DSLC AS SYNC (*T/F)—Set this value “TRUE” if a DSLC (3%/volt) is used to synchronize a generator driven by a common gearbox. Set this value to “FALSE” if an SPM-A (0.667%/volt) is used to synchronize.

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.

USE REMOTE COMMANDS(*T/F)—Set to FALSE to block remote Modbus Boolean and Analog write commands and enable the discrete and analog hardware input commands. Set to TRUE to enable Modbus Boolean and Analog write commands. Modbus Boolean writes can also be used to enable specific hardware input commands instead of the Modbus commands.

USE COMM PORTS (*T/F)—Set to TRUE to bring into view the CFIG COMMUNICATION menu for communication Ports 2 and 3. Set to FALSE to conceal the CFIG COMMUNICATION menu for communication Ports 2 and 3.

USE 5PT GAIN MAP (*T/F)—Should be set TRUE to permit the use of a 5-Gain Curve for setting the control gain as a function of prime mover load. If “Use 2nd Dynamics” is also set TRUE, the use of a second 5-Gain Curve is activated. These two curves each provide 5 tunable gain settings at 5 tunable load dependent breakpoints. If ‘Enable 5 Slope Gain Map’ is set FALSE only a single gain value will be used as the dynamic adjustment. When enabled, the DYNAMICS 1 and DYNAMICS 2 menus will change automatically to show the five point gain settings.

MINOR ALARM TRIPS

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.

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.

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.

MANIFOLD AIR FAILED (*T/F)—Set this value “FALSE” if failure of Manifold Air Pressure Transducer input is not to be a minor alarm. Set this value “TRUE” if failure of Manifold Air Pressure Transducer input is to be alarmed as a minor alarm.

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.

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

SPEED SWITCH (*T/F)—Set this value “FALSE” if no minor alarmed is desired once the Speed Switch set point is exceeded. Set this value “TRUE” if a Minor alarm is desired once the Speed Switch set point is exceeded. This alarm is non-latching.

TORQUE LIMITER (*T/F)—Set this value “FALSE” if no minor alarm output is desired when Torque Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a minor alarm output is desired when Torque Limiter is in control (limiting) of the actuator driver output. This alarm is non-latching.

MANIFOLD LIMITER (*T/F)—Set this value “FALSE” if no minor alarm output is desired when Manifold Pressure Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a minor alarm output is desired when Manifold Pressure Limiter is in control (limiting) of the actuator driver output. This alarm is non-latching.

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.

PORT 3 LINK ERROR (*T/F)—Set this value "FALSE" if no minor alarm output is desired when Port 3 detects an link or hardware error. Set this value "TRUE" if a minor alarm output is desired when Port 3 detects a link or hardware error.

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.

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.

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.

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.

HIGH SPEED SW (*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.

LOAD SWITCH (*T/F)—Set this value "FALSE" if no minor alarm output is desired when engine load exceeds LOAD SWITCH pickup (see *LOAD CONTROL*). Set this value "TRUE" if a minor alarm is desired when engine load exceeds LOAD SWITCH pickup. This alarm is non-latching.

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.

MAJOR ALARM TRIPS

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.

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.

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.

MANIFOLD AIR FAILED (*T/F)—Set this value “FALSE” if failure of Manifold Air Pressure Transducer input is not to be a major alarm. Set this value “TRUE” if failure of Manifold Air Pressure Transducer input is to be alarmed as a major alarm.

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.

RACK INPUT FAILED (*T/F)—Set this value “FALSE” if failure of Rack Position Feedback input is not to be a major alarm. Set this value “TRUE” if failure of Rack Position Feedback input is to be alarmed as a major alarm.

SPEED SWITCH (*T/F)—Set this value “FALSE” if no major alarmed is desired once the Speed Switch set point is exceeded. Set this value “TRUE” if a Major alarm is desired once the Speed Switch set point is exceeded. This alarm is non-latching.

TORQUE LIMITER (*T/F)—Set this value “FALSE” if no major alarm output is desired when Torque Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a major alarm output is desired when Torque Limiter is in control (limiting) of the actuator driver output. This alarm is non-latching.

MANIFOLD LIMITER (*T/F)—Set this value “FALSE” if no major alarm output is desired when Manifold Pressure Limiter is in control (limiting) of the actuator driver output. Set this value “TRUE” if a major alarm output is desired when Manifold Pressure Limiter is in control (limiting) of the actuator driver output. This alarm is non-latching.

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.

PORT 3 LINK ERROR (*T/F)—Set this value “FALSE” if no major alarm output is desired when Port 3 detects an link or hardware error. Set this value “TRUE” if a major alarm output is desired when Port 3 detects a link or hardware error.

CLON 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.

CLON 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.

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.

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.

HIGH SPEED SW (*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.

LOAD SWITCH (*T/F)—Set this value “FALSE” if no major alarm output is desired when engine load exceeds LOAD SWITCH pickup (see *LOAD CONTROL*). Set this value “TRUE” if a major alarm is desired when engine load exceeds LOAD SWITCH pickup. This alarm is non-latching.

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.

ALARM/SD CONFIGURE

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.

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 MINOR ALARM TRIPS.

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 MAJOR ALARM TRIPS.

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.

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.

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.

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.

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

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.
CFIG ANALOG OUTPUTS

AOUT 1 SELECTION determines which parameter controls Analog Output #1. The parameters that can be selected are:
1. Engine Speed (rpm) – Default selection.
2. Engine Speed Reference (rpm)
3. Remote Speed Setting (% mA)
4. Engine Load (% rated)
5. Fuel Demand (%)
6. Torsional Level (rpm)
7. Rack Position (% mA)
8. PID Output (%) (simulated PID windup)

AOUT 1 4–20 mA? (*T/F)—Selects which output mA range is desired. TRUE selects 4–20 mA output, and FALSE selects 0–1 mA output. NOTE—The hardware jumpers must also be configured.

AOUT 2 SELECTION determines which parameter controls Analog Output #2. The parameters that can be selected are:
1. Engine Speed (rpm)
2. Engine Speed Reference (rpm)
3. Remote Speed Setting (% mA)
4. Engine Load (% rated)
5. Fuel Demand (%)
6. Torsional Level (rpm)
7. Rack Position (% mA) – Default selection.
8. PID Output (%) (simulated PID windup)

AOUT 2 4–20 mA? (*T/F)—Selects which output mA range is desired. TRUE selects 4–20 mA output, and FALSE selects 0–1 mA output. NOTE—The hardware jumpers must also be configured.

AOUT 4 SELECTION determines which parameter controls Analog Output #4. The parameters that can be selected are:
1. Engine Speed (rpm)
2. Engine Speed Reference (rpm)
3. Remote Speed Setting (% mA)
4. Engine Load (% rated)
5. Fuel Demand (%) – Default selection.
6. Torsional Level (rpm)
7. Rack Position (% mA)
8. PID Output (%) (simulated PID windup)

AOUT 4 4–20 mA? (*T/F)—Selects which output mA range is desired. TRUE selects 4–20 mA output, and FALSE selects 0–200 mA output. NOTE— The hardware jumpers must also be configured.

CFIG COMMUNICATIONS

The 723PLUS has two serial ports. Port 2 is configured as a ServLink port. Port 3 is configured to support the Modbus protocol. The ports are configured in this menu to set the network address that they will use and to set Port 3 to use the Modbus ASCII or RTU mode. Only Port 3 has monitoring information available that can be retrieved by a Modbus master device such as a PC-based Human Machine Interface (HMI). Port 3 allows commands to be sent from the Modbus master device to the control. To bring this menu into view, the control must be configured for remote communications by setting USE COMM PORTS found in configure mode, under the header CONFIG OPTION to TRUE. This menu is concealed when USE COMM PORTS is set FALSE.

PORT 2 ADDRESS determines the port's multidrop ServLink network address. Set between 0 and 15.

PORT 3 ADDRESS determines the port's multidrop Modbus slave address from 1 to 247.

PORT 3 MODE determines if port J3 will use the Modbus ASCII or Modbus RTU mode.
1 = ASCII
2 = RTU

Service Menus

MAJOR ALARMS

IMPORTANT

For any of the major alarms to be displayed, they must first be enabled while in Configure mode under header MAJOR ALARMS. 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).

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.

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.

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.

MANIFOLD AIR FAILED (T/F)—A "TRUE" displayed indicates that the Manifold Air Pressure input (analog input #3) has failed (either below 2 mA or above 22 mA). A "FALSE" displayed indicates that the Manifold Air Pressure input is within the 2–22 mA window.

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.

RACK INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Rack Position Feedback input (analog input #1) has failed (either below 2 mA or above 22 mA). A “FALSE” displayed indicates that Rack Position Feedback input is within the 2–22 mA window.

SPEED SWITCH ON (T/F)—A “TRUE” displayed indicates that the engine speed has exceeded the Speed Switch Pickup point. A “FALSE” displayed indicates that the engine speed has dropped below the Speed Switch Dropout point.

TORQUE LIMITER (T/F)—A “TRUE” displayed indicates that the Torque Fuel Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Torque Fuel Limiter is not in control of the actuator driver output.

MANIFOLD LIMITER (T/F)—A “TRUE” displayed indicates that the Manifold Air Pressure Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Manifold Air Pressure Limiter is not in control of the actuator driver output.

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.

PORT 3 LINK ERROR (T/F)—A “TRUE” displayed indicates that Port 3 has detected a link or hardware error. A “FALSE” displayed indicates Port 3 is functioning properly.

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.

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.

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.

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.

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.

LOAD SWITCH (T/F)—A “TRUE” displayed indicates that the engine load is above the load switch pickup set point. A “FALSE” displayed indicates that the load switch is not activated.

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.

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.

MINOR ALARMS

IMPORTANT **For any of the minor alarms to be displayed, they must first be enabled while in Configure mode under header MINOR ALARMS. 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).**

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.

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.

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.

MANIFOLD AIR FAILED (T/F)—A “TRUE” displayed indicates that the Manifold Air Pressure input (analog input #3) has failed (either below 2 mA or above 22 mA). A “FALSE” displayed indicates that the Manifold Air Pressure input is within the 2–22 mA window.

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.

RACK INPUT FAILED (T/F)—A “TRUE” displayed indicates that the Rack Position Feedback input (analog input #1) has failed (either below 2 mA or above 22 mA). A “FALSE” displayed indicates that Rack Position Feedback input is within the 2–22 mA window.

SPEED SWITCH ON (T/F)—A “TRUE” displayed indicates that the engine speed has exceeded the Speed Switch Pickup point. A “FALSE” displayed indicates that the engine speed has dropped below the Speed Switch Dropout point.

TORQUE LIMITER (T/F)—A “TRUE” displayed indicates that the Torque Fuel Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Torque Fuel Limiter is not in control of the actuator driver output.

MANIFOLD LIMITER (T/F)—A “TRUE” displayed indicates that the Manifold Air Pressure Limiter has control of, and is limiting, the actuator driver output. A “FALSE” displayed indicates that the Manifold Air Pressure Limiter is not in control of the actuator driver output.

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.

PORT 3 LINK ERROR (T/F)—A “TRUE” displayed indicates that Port 3 has detected a link or hardware error. A “FALSE” displayed indicates Port 3 is functioning properly.

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.

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.

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.

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.

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.

LOAD SWITCH (T/F)—A “TRUE” displayed indicates that the engine load is above the load switch pickup set point. A “FALSE” displayed indicates that the load switch is not activated.

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.

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.

DYNAMICS 1

GAIN 1 (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

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.

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.

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.

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

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

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

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.

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.

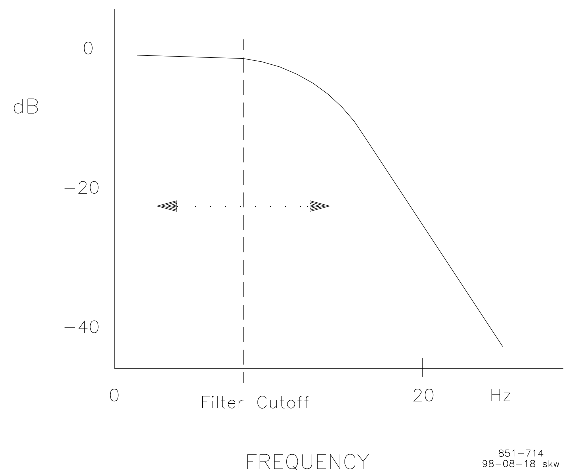

Figure 4-4. Speed Filter

DYNAMICS 1 (with 5-point gain map enabled)

BREAKPNT 1A % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 1A setting.

GAIN @ BRKPT 1A (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 1B % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 1B setting.

GAIN @ BRKPT 1B (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 1C % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 1C setting.

GAIN @ BRKPT 1C (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 1D % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 1D setting.

GAIN @ BRKPT 1D (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 1E % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 1E setting.

GAIN @ BRKPT 1E (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

The following illustration shows how the gain setting of the control can be mapped for a non-linear response.

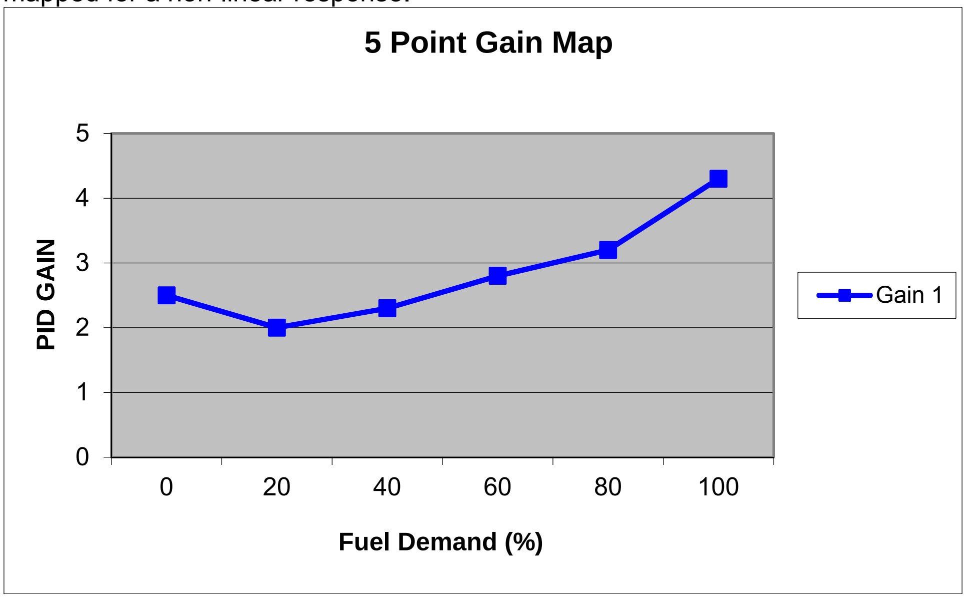

Figure 4-5. 5 Point Gain Map

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.

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.

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.

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

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

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

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.

INITIATE BUMP—Tests the dynamics settings by temporarily applying a decreased fuel demand transient to stimulate a control response.

DYNAMICS 2

These settings are used only when dynamics 2 is selected.

GAIN 2 (*0.01–150.0)—The gain is set to provide stable control of the engine at the light unloaded conditions.

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.

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.

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.

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

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

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

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.

DYN 2 SPD SW PU (*100.0–2200.0 rpm)—Set this to the desired rpm value that dynamics 2 will pick up when DYN2 ON SPD SWITCH under configuration menu CONFIG SPD CONTROL is set TRUE.

DYN 2 SPD SW DO (*1.0–2200.0 rpm)—Set this to the desired rpm value that dynamics 2 will drop out when DYN2 ON SPD SWITCH under configuration menu CONFIG SPD CONTROL is set TRUE. NOTE—If the dropout is lower than the pickup, the switch is active above the pickup. If the dropout is higher than the pickup, the switch action is reversed and is active below the pickup.

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.

DYNAMICS 2 (with 5-point gain map and dynamics 2 enabled)

BREAKPNT 2A % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 2A setting.

GAIN @ BRKPT 2A (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 2B % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 2B setting.

GAIN @ BRKPT 2B (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 2C % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 2C setting.

GAIN @ BRKPT 2C (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 2D % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 2D setting.

GAIN @ BRKPT 2D (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions.

BREAKPNT 2E % (*0.0–100.0)—The fuel demand level that selects the GAIN @ BRKPT 2E setting.

GAIN @ BRKPT 2E (*0.01–150.0)—The gain is set to provide stable control of the engine at light unloaded conditions

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.

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.

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.

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

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

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

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.

DYN 2 SPD SW PU (*100.0–2200.0 rpm)—Set this to the desired rpm value that dynamics 2 will pick up when DYN2 ON SPD SWITCH under configuration menu CONFIG SPD CONTROL is set TRUE.

DYN 2 SPD SW DO (*1.0–2200.0 rpm)—Set this to the desired rpm value that dynamics 2 will drop out when DYN2 ON SPD SWITCH under configuration menu CONFIG SPD CONTROL is set TRUE. NOTE—If the dropout is lower than the pickup, the switch is active above the pickup. If the dropout is higher than the pickup, the switch action is reversed and is active below the pickup.

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.

SPEED REFERENCE

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

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

IDLE SPEED (RPM) (*100–2200 rpm)—Idle Speed Reference sets the speed at which the engine is operated when the Idle/Rated contact (terminal #30) is open. It 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.

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. The ramp is started whenever the Idle/Rated contact is opened.

RAISE SPEED RATE (*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 using the Raise command, 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.

LOWER SPEED RATE (*1.0–10 000.0 rpm/sec)—Lower Speed Rate is the rate at which the speed reference is ramped when using the Lower command as well as 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.

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.

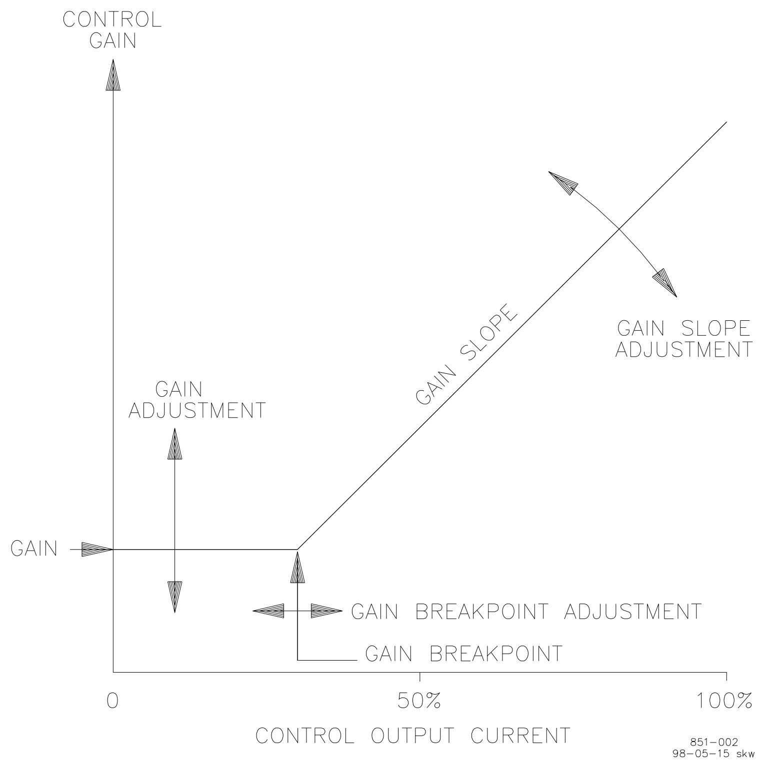

Figure 4-6. Gain Slope

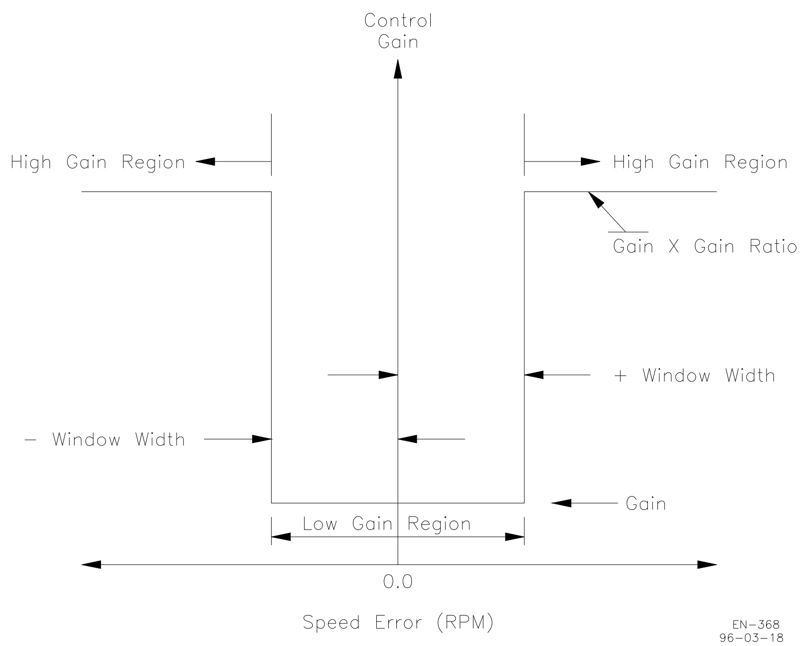

Figure 4-7. Gain Window

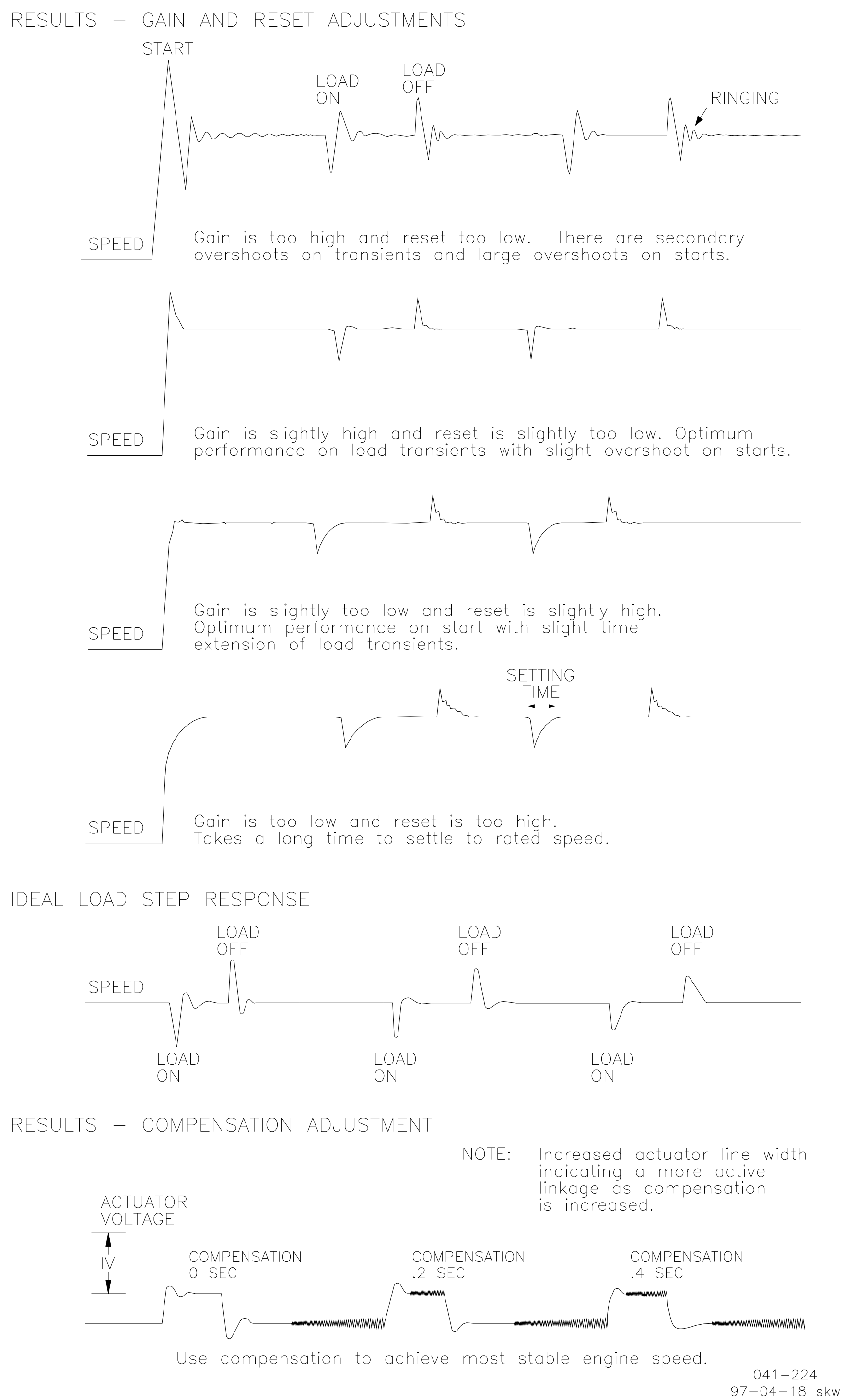

Figure 4-8. Typical Transient Response Curves

REMOTE REF AT 4 mA (*–32 767.0–32 767.0 rpm)—Remote Reference at 4 mA is the engine speed desired when 4 mA is applied to the Remote Speed Setting input.

REMOTE REF AT 20 mA (*–32 767.0–32 767.0 rpm)—Remote Reference at 20 mA is the engine speed desired when 20 mA is applied to the Remote Speed Setting input.

SPD SWITCH PICKUP (*100.0–2200.0 rpm)—Speed Switch Pickup is the engine speed (rpm) at which the minor or major alarm will activate. This speed switch was designed to cause a minor alarm, major alarm, or both. It will cause a minor or major alarm only if enabled in Configure mode.

SPD SWITCH DROPOUT (*1.0–2200.0 rpm)—SPD Switch Dropout is the engine speed (rpm) at which the minor or major alarm will deactivate.

IMPORTANT

If SPD SWITCH PICKUP is greater than SPD SWITCH DROPOUT, the switch will be on above the PICKUP setting, and off below the DROPOUT setting. If SPD SWITCH PICKUP is less than SPD SWITCH DROPOUT, the switch will be on below the PICKUP setting, and off above the DROPOUT setting.

MANEUVER RAMP RATE (*50.0 1.0-10000 rpm/sec) – This ramp rate adjusts the rate at which the speed reference ramps to the Maneuver Speed Setpoint.

START/MAX LIMITS

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.

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.

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.

DISCRETE IN

IMPORTANT

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

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

MAN MODE CONTACT (T/F)—Shows the status of the Maneuvering Mode contact (terminal 30).

RAISE SPEED CONTACT (T/F)—Shows the status of the Raise Speed contact (terminal 31).

LOWER SPEED CONTACT (T/F)—Shows the status of the Lower Speed contact (terminal 32).

ALARM RESET CONTACT (T/F)—Shows the status of the Alarm Reset contact (terminal 33).

TORQUE LIMITER CONTACT (T/F)—Shows the status of the Torque Limiter contact (terminal 34).

CLUTCH REQUEST (T/F)—Shows the status of the Clutch Request contact (terminal 35).

CLUTCH ENGAGED (T/F)—Shows the status of the Clutch Engaged contact (terminal 36).

REMOTE SPD SELECTED (T/F)—Shows the status of the Remote Speed Selected contacts. Raise Speed and Lower Speed contacts must both be closed for this status to display "TRUE".

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

TORQUE LIMITER

IMPORTANT **If Use Torque Limiter is not configured (see CONFIG OPTION header), this header will not appear and the Torque Limiter is not active. The Torque Limiter is a six-point curve.**

BASED ON SPD REF (*T/F)—Set this value "TRUE" to use the engine speed reference as the torque limit reference. Set the value "FALSE" to use actual engine speed as the torque fuel reference.

TORQ LIMIT BKPT 1 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 1.

TORQ LMT AT BKPT 1 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 1.

TORQ LIMIT BKPT 2 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 2.

TORQ LMT AT BKPT 2 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 2.

TORQ LIMIT BKPT 3 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 3.

TORQ LMT AT BKPT 3 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 3.

TORQ LIMIT BKPT 4 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 4.

TORQ LMT AT BKPT 4 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 4.

TORQ LIMIT BKPT 5 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 5.

TORQ LMT AT BKPT 5 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 5.

TORQ LIMIT BKPT 6 (*0.0–2200.0 rpm)—This is the speed input value in rpm for the torque fuel limiter at breakpoint 6.

TORQ LMT AT BKPT 6 (*0.0–101.0%)—This is the torque fuel limit value in percent rated load when the torque fuel limiter speed input is at breakpoint 6.

CLUTCH PERM DELAY (*0.0–30 SEC)—This is the time the torque fuel limiter permissive is delayed once the clutch is engaged. This delay time is also applied to the manifold air pressure fuel limiter permissive. Both limiters are permissive after this delay timer expires and, when all other permissives are satisfied, these limiters are enabled. Both limiters are disabled without delay when the clutch is disengaged.

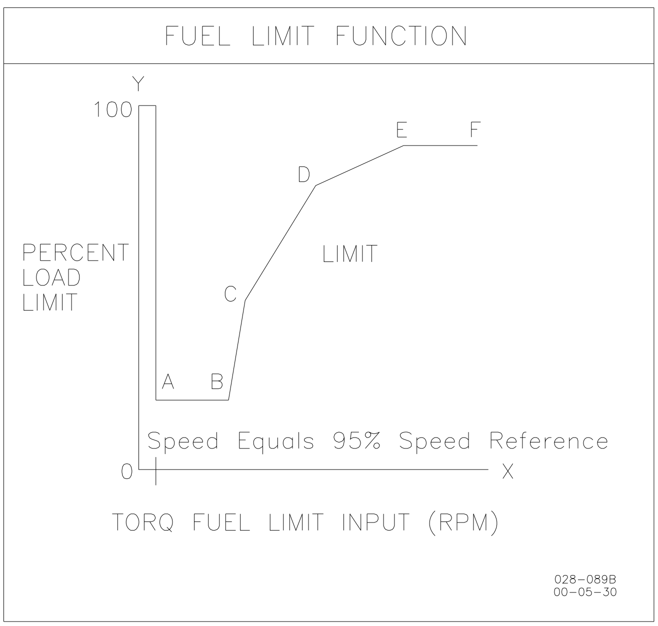

Figure 4-9. Torque Fuel Limit Curve

MAN PRESS LIMITER

IMPORTANT

If the USE MANIFOLD LIMITR is not configured TRUE (See CONFIG OPTION header) this header will not appear and the Manifold Air Pressure Limiter is not active. The Manifold Air Pressure Limiter is a six-point curve.

FUEL LIMIT BKPT 1 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 1.

FUEL LMT AT BKPT 1 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 1.

FUEL LIMIT BKPT 2 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 2.

FUEL LMT AT BKPT 2 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 2.

FUEL LIMIT BKPT 3 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 3.

FUEL LMT AT BKPT 3 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 3.

FUEL LIMIT BKPT 4 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 4.

FUEL LMT AT BKPT 4 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 4.

FUEL LIMIT BKPT 5 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 5.

FUEL LMT AT BKPT 5 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 5.

FUEL LIMIT BKPT 6 (*0.0–20.0 mA)—This is the manifold air pressure input value in mA for the manifold air pressure fuel limiter at breakpoint 6.

FUEL LMT AT BKPT 6 (*0.0–101.0%)—This is the fuel limit value in percent rated load when the manifold air pressure mA input is at breakpoint 6.

TRANSIENT OVR FUEL

IMPORTANT

If NEITHER the Manifold Air Pressure or the Torque Fuel Limiters is configured TRUE (See CONFIG OPTION header) this header will not appear and the Transient Overfuel function is not active. When active, the Transient Overfuel affects the Manifold Air Pressure Limiter and the Torque Limiter during load transients. It does NOT affect the Start Fuel Limiter or the Maximum Fuel Limiter.

TORQUE OVER FUEL TIME (*0.0–10.0 sec)—Sets the time duration that the torque over fuel amount will be added to the torque fuel limiter setting when triggered by a high load transient.

TORQUE OVER FUEL AMOUNT (*0.0–100.0%)—Sets the percent rated load amount added to the torque fuel limiter setting when triggered by a high load transient. This additional torque over fuel amount is removed from the limiter once the torque over fuel timer expires. Load must be reduced slightly below the limiter setting to reset this transient over fuel function.

MAN PRES OVER FUEL TIME (*0.0–10.0 sec)—Sets the time duration that the manifold pressure over fuel amount will be added to the manifold air pressure fuel limiter setting when triggered by a high load transient.

MAN PRES OVER FUEL AMOUNT (*0.0–100.0%)—Sets the percent rated load amount added to the manifold air pressure fuel limiter setting when triggered by a high load transient. This additional manifold pressure over fuel amount is removed from the limiter once the manifold pressure over fuel timer expires.

Load must be reduced slightly below the limiter setting to reset this transient over fuel function.

TORQ ALM DELAY (*0.0–20.0 sec)—Sets the time delay to wait after a torque limiting condition begins before issuing a torque limiter alarm.

BOOST ALM DELAY (*0.0–20.0 sec)—Sets the time delay to wait after a manifold air pressure limiting condition begins before issuing a manifold limiter alarm.

RESPONSE TESTING

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

BUMP ENABLED—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.

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

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.

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

TORSIONAL FILTER

IMPORTANT **If ENBL COUP TORS FILT is not configured TRUE (See CONFIG OPTION header) this header will not appear and the Torsional Filter function is not active.**

ENABLE TORS FILTER (*T/F)—Enables the flexible coupling torsional filter function when set “TRUE”. When set “FALSE”, the function is disabled.

TORS FILTER ACTIVE—Will show “TRUE” when the Torsional Filter is active and “FALSE” when the Torsional Filter is inactive.

TORSIONAL FILTER (*0.0–1.0)—This is the setting for the flexible coupling torsional filter. Set this value to the inertia factor found by using the formula in Chapter 3.

NOTCH FREQUENCY (HZ) (*0.5–16.0 Hz)—This is the center frequency of rejection, and the units are defined in Hertz. In tuning the notch filter, the resonant frequency must be identified and entered.

NOTCH Q FACTOR (*0.707–25.0)—This is the width about the NOTCH FREQUENCY that the filter rejects, and is dimensionless. At the minimum value 0.707, there is no attenuation of signal gain at the resonant frequency, and the filter gain equals one. At the maximum value 20.0, a maximum attenuation of signal gain occurs at the resonant frequency, and the filter gain equals 0.035. In general, the filter gain at the resonant frequency is 0.707/Q factor.

RACK CALIBRATION

NOTICE	**ACT OUT @ NO LOAD and ACT OUT @ MAX LOAD must always be calibrated, regardless of whether the Rack Position Feedback input is used or not. The fuel limiting and load sharing functions both depend heavily upon accurate *RACK CALIBRATION* settings. Carefully determine and enter the *RACK CALIBRATION* 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 PERCENT LOAD signal exists when the Rack Position analog input is both valid or failed. Failure to do so may result in incorrect fuel limiter or load sharing operation. However, if the Rack Position Feedback input is not used, calibration of the RACK OUT @ NO LOAD and RACK OUT @ MAX LOAD values are not required.**

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 ACTUATOR % OUT under *DISPLAY 1*. Final adjust this value until the DEFAULT % LOAD prompt under the *DISPLAY 1* header reads 0.0% ±1.0 when the engine is at this unloaded condition.

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

RACK OUT @ NO LOAD (–150.0–150.0%)—Find the normal no-load rack position, which is defined as the rack position that requires the least amount of fuel rack 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. Adjust this value until the RACK POS % LOAD prompt under the *DISPLAY 1* header reads 0.0% ±1.0 when the engine is at this unloaded condition.

RACK OUT @ MAX LOAD (–150.0–150.0%)—Adjust this value until the RACK POS % LOAD prompt under the *DISPLAY 1* header reads 100% when the engine is operating at full load.

Check rack calibration with the rack position feedback connected (if used) at minimum load and maximum load. At these load points the PERCENT LOAD prompt under the *DISPLAY 1* header should display 0% and 100% respectively. If there are discrepancies, re-calibrate RACK OUT @ NO LOAD, RACK OUT @ MAX LOAD, ACT OUT @ NO LOAD and ACT OUT @ MAX LOAD as needed to meet this requirement.

CALIBRATION

> **IMPORTANT**
>
> **The CONFIG ANALOG OUTPUTS header contains all the output selections for the three configurable analog outputs (Analog Output #1, Analog Output #2, and Analog Output #4). Depending on which one is selected, this can be the engine speed (rpm), engine speed reference (rpm), remote speed setting (% mA), engine load (% rated), fuel demand (%), torsional level (rpm), rack position (% mA), or simulated PID output (%).**

AOUT 1 FILTER (Hz) (*0.1-20.0)—This value adjusts the cutoff frequency of a low pass filter used on Analog Output 1. To use this feature, set the cutoff frequency below 15.9 Hz. To disable this filter, set the cutoff frequency above 15.9 Hz.

ANALOG OUTPUT#1 MIN (*–30 000.0–30 000.0)—This value adjusts the engineering units which will output 4 mA at Analog Output #1.

ANALOG OUTPUT#1 MAX (*–30 000.0–30 000.0)—This value adjusts the engineering units which will output 20 mA at Analog Output #1.

AOUT 2 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.

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

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

AOUT 4 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.

ANALOG OUTPUT#4 MIN (*–30 000.0–30 000.0)—This value adjusts the engineering units which will output 4 mA at Analog Output #4.

ANALOG OUTPUT#4 MAX (*–30 000.0–3 000.0)—This value adjusts the engineering units which will output 20 mA at Analog Output #4.

LOAD CONTROL

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

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

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

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%.

GAIN % @ LIGHT LOAD (*10.0–100.0%)—Gain % @ Light Load is the percent of Gain that is required at light loads to maintain stable paralleled engine operation. This Gain percentage is only active when the engines are paralleled and affects whichever Gain is selected (Gain 1 or Gain 2). This is typically set at 50% and should not need adjusting.

LITE LD GAIN PU (*0.0–101.0%)—Lite Ld Gain PU is the percent of engine load at which the Gain % @ Light Load function becomes active (is turned on). This is typically set at 10% and should not need adjusting.

LITE LD GAIN DO (*0.0–101.0%)—Lite Ld Gain DO is the percent of engine load at which the Gain % @ Light Load function becomes inactive (is turned off). This is typically set at 15% and should not need adjusting.

LOAD SWITCH PU (*0.0–101.0%)—Set this value to the desired engine load that will enable the load switch.

LOAD SWITCH DO (*0.0–101.0%)—Set this value to the desired engine load that will disable the load switch.

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.

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.

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

LOAD SHARE FILTER (*0.1–1.0)—This is a low-pass filter which is set to generate a delay in the load 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.

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.

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.

DISPLAY 2

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.

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.

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).

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).

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).

BOOST LIMIT MODE (T/F)—A “TRUE” displayed indicates that the Manifold Air Pressure Limiter input has control of the actuator driver output. A “FALSE” displayed indicates that the Manifold Air Pressure Limiter input does not have control of the actuator driver output (something else has control).

TORQUE LIMIT MODE (T/F)—A “TRUE” displayed indicates that the Torque Fuel Limiter has control of the actuator driver output. A “FALSE” displayed indicates that the Torque Fuel Limiter does not have control of the actuator driver output (something else has control).

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 “MINOR ALARM” or “MAJOR ALARM” at prompt RESET ALL ALARMS.

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

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

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.

ON LOAD SHARING (*T/F)—A “TRUE” displayed indicates that load 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).

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

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

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

DISPLAY 1

ENGINE SPEED (0–2000 rpm)—This is the sensed engine speed after it has been processed by the flexible coupling and firing torsional filters.

SPEED REFERENCE (0–2000 rpm)—This is the present value of the engine speed reference.

SPEED REF BIASED (0–2000 rpm)—This is the engine speed reference value plus the bias value from either the load sharing bias signal or the AUX input.

ACTUATOR % OUT (0–100%)—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 or 0–20 mA).

PERCENT LOAD (0–100%)—This is either the calibrated rack position input signal (if used and not failed) or the calibrated actuator driver signal, whichever one is actively being used by the control. 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.

RACK POS % LOAD (0–100%)—This is solely the calibrated rack position input signal. The rack position input signal (if used) should be calibrated so that at no-load this reads 0%, and at full (rated) load this reads 100%.

DEFAULT % LOAD (0–100%)—This is solely the calibrated actuator driver signal. The actuator driver signal should be calibrated so that at no-load this reads 0%, and at full (rated) load this reads 100%.

REMOTE SPD REF (RPM) (0–2000 rpm)—This is the remote speed setting rpm value from the Analog Input #2.

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

REMOTE SPD INPUT (mA)—This is the remote speed 4–20 mA input (Analog Input #2) signal value, displayed in milliamps.

MANIFOLD PRESS (mA)—This is the manifold air pressure sensor 4–20 mA input (Analog Input #3) signal value, displayed in milliamps.

AUX INPUT (Volts)—This is the voltage value seen on the aux input terminals (Analog Input #4).

TORSIONAL LEVEL—This is the absolute difference (in rpm) between the two MPUs (when used).

CLON CH 1 ACTIVE—This shows “TRUE” when control LON channel 1 is actively used by the control.

CLON CH 2 ACTIVE—This shows “TRUE” when control LON channel 2 is actively used by the control.

SPD SENSOR 1 ACTIVE—This shows “TRUE” when speed sensor input #1 is actively used by the control.

SPD SENSOR 2 ACTIVE—This shows “TRUE” when speed sensor input #2 is actively used by the control.

	Port Unit	**Starboard Unit**
Hardware P/N:		
Hardware S/N:		
Software P/N:		

Date:
Vessel:

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

⚠WARNING	**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.**

Maneuvering Mode Switch (Discrete Input B)

Place the Maneuvering Mode switch in the closed position. The prompt MAN MODE CONTACT, under the header *DISCRETE IN*, should read “TRUE”. Place the Maneuvering Mode switch in the open position. The MAN MODE CONTACT prompt should read “FALSE”

Raise Speed Switch (Discrete Input C)

Place the Raise Speed switch in the Raise Speed position (closed). The prompt RAISE SPEED CONTACT, under the header *DISCRETE IN*, should read “TRUE”. Place the Raise Speed switch in the open position. The RAISE SPEED CONTACT prompt should read “FALSE”.

Lower Speed Switch (Discrete Input D)

Place the Lower Speed switch in the Lower Speed position (closed). The prompt LOWER SPEED CONTACT, under the header *DISCRETE IN*, should read “TRUE”. Place the Lower Speed switch in the open position. The LOWER SPEED CONTACT prompt should read “FALSE”.

Alarm Reset Switch (Discrete Input E)

Place the Alarm Reset switch in the Reset position (closed). The prompt ALARM RESET, under the header *DISCRETE IN*, should read “TRUE”. Place the Alarm Reset switch in the Non-Reset position (open). The ALARM RESET prompt should read “FALSE”.

Torque Limiter Switch (Discrete Input F)

Place the Torque Limiter switch in the ON position (closed). The prompt TORQUE LIMITER, under the header *DISCRETE IN*, should read “TRUE”. Place the Torque Limiter switch in the OFF position (open). The TORQUE LIMITER prompt should read “FALSE”.

Clutch Request Switch (Discrete Input G)

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

Clutch Engaged Switch (Discrete Input H)

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

Remote Speed Selected

Place the Raise Speed switch in the Raise Speed position (closed) and the Lower Speed switch in the Lower Speed position (closed) to select Remote Speed for the engine that is not the slave. The prompt REMOTE SPD SELECTED, under the header *DISCRETE IN*, should read "TRUE". Place the Raise Speed and/or the Lower Speed switch in the open position. The REMOTE SPD SELECTED 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 SERVLINK SELECTED, under the header *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 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 MINOR ALARM prompt at header *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 ALARM/SD CONFIGURE, at prompt OPEN CNT ON MIN ALM.

If at prompt 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 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 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 *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 ALARM/SD CONFIGURE, at prompt OPEN CNT ON MAJ ALM.

If at prompt 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 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 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. The contacts at terminals 7 & 8 will open immediately if Contact F is configured as an Emergency De-clutch contact and Contact F is closed. Setting prompt CT F AS TORQUE LIMIT under configuration header CONFIG OPTION to "FALSE" sets up Contact F as an Emergency De-clutch contact. 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 if 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, load 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 ±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 ±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.

Rack Position (Analog Input #1)

The fuel Rack Position input signal comes from a transducer located on the engine fuel rack. For best results the input signal should be linear when compared to the actual fuel rack position. The input signal must be direct acting (increase fuel rack position to increase fuel and milliamps). To verify the fuel rack transducer, view the Rack Position input in Service mode, under header *DISPLAY 1*, at prompt RACK INPUT (mA). Release any mechanical stops on the engine fuel rack and take any necessary precautions (shut off fuel, starting air, etc.) to prevent the engine from starting or being started at this time. Install a current meter in the wiring between the transducer and the 723PLUS control. Move the fuel rack from minimum to maximum fuel position and verify the current meter tracks the RACK INPUT within ±10%. Verify the advertised output of the rack position transducer matches the current meter as well. The input will be calibrated later, so the accuracy is not critical at this time. Remove the current meter and return the wiring to its original condition.

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, some applications may require that two or more speed devices be used. Ideally the two 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 transmitter, view the Remote Speed Setting (in rpm), in Service mode, under header *DISPLAY 1*, at prompt REMOTE SPEED REF. Set the remote speed setting device to its idle speed position (4 mA). Verify the REMOTE SPEED REF prompt reads at or near the desired engine idle rpm. Move the remote speed setting device to its rated speed position (20 mA). Verify the REMOTE SPEED REF 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.

Manifold Air Pressure (Analog Input #3)

This is an optional input and can be skipped if the function is disabled. The Manifold Air Pressure input signal is used to limit fuel rack position based on an external sensor (pressure, temperature, etc.). To verify the input, the field sensor or device needs to be monitored. Install a current meter in the wiring. View the Manifold Pressure input (it is displayed in mA), in Service mode, under header *DISPLAY 1*, at prompt MANIFOLD PRESS (mA). Set the MANIFOLD PRESSURE device to its 4 mA position. Verify the MANIFOLD PRESS (mA) matches (±1.0%) the milliamp reading on the current meter. Set the MANIFOLD PRESSURE device to its 20 mA position. Verify the MANIFOLD PRESS (mA) matches (±1.0%) the milliamp reading on the current meter. The input will be calibrated later, so the accuracy is not critical at this time. Also compare the current meter reading with the advertised output for the field sensor or device and verify that they agree. If possible, exercise the field sensor or device and verify that the MANIFOLD PRESS (mA) reading and current meter track each other throughout the range. Remove the current meter and return the wiring to its original state. Verify the shield is connected only to the 723PLUS control and nowhere else in the system.

±5 Vdc Auxiliary Input (Analog Input #4)

The ±5 Vdc Auxiliary input is programmed for use with the Woodward DSLC Digital Synchronizer and Load Control or the SPM-A synchronizer. If used, verify the wiring between the synchronizer unit and the 723PLUS control at this time. Verify the jumper provided on terminals 50 and 51 is removed. Verify the shield is connected at the 723PLUS control only.

Load Sharing Lines

Load sharing is performed over the LON #1 or LON #2 Control LON wiring (whichever is active). No connection is needed between the 723PLUS Load Sharing Signal terminals 9 & 10. Instead these terminals are utilized to enable either the Handheld Programmer or ServLink/Watch Window on comm port 1. 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 load 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 4–20 mA full range for the Manifold Air Pressure, Rack Position, or Remote Speed Setting analog inputs. All of these inputs can be calibrated, or scaled, to use almost any range within the 4 mA and 20 mA limits. If the input signal falls outside of the 4 mA and 20 mA limits, proper fault detection cannot be guaranteed.

At this point the engine still has not been started. Do not attempt the 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 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 (CONFIG OPTION, MINOR ALARM TRIPS, MAJOR ALARM TRIPS, ALARM/SD CONFIGURE, CONFIG ANALOG OUTPUTS, and CFIG COMMUNICATION), 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 needed.

Major Alarm (Discrete Output #2)

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

Clutch Permissive Output (Discrete Output #3)

No configuration needed.

Load Sharing Lines

No calibration available.

Analog Output #1

Analog output #1 is configurable to output one of eight different choices. The selection is made in configure mode, under header CFIG ANALOG OUTPUTS at the prompt AOUT 1 SELECTION. The choices by number are: 1 = Engine Speed (rpm)(default selection), 2 = Engine Speed Reference (rpm), 3 = Remote Speed Setting (% mA), 4 = Engine Load (% rated), 5 = Fuel Demand (%), 6 = Torsional Level (rpm), 7 = Rack Position (% mA) and 8 = PID Output (%) (simulated PID windup). Set for the preferred output selection 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 *CALIBRATION*. At the prompt ANALOG OUTPUT #1 MIN, adjust to the value (in engr units) preferred for 4 mA output. At prompt ANALOG OUTPUT #1 MAX, adjust to the value (in engr units) preferred for 20 mA output (see Figure 5-1). For example, if selection 1 was made (Engine Speed) and the meter being driven by this analog output is designed to display 0 rpm at 4 mA and 1500 rpm at 20 mA, then 0 rpm/4 mA is the first point and 1500 rpm/20 mA is the second point.

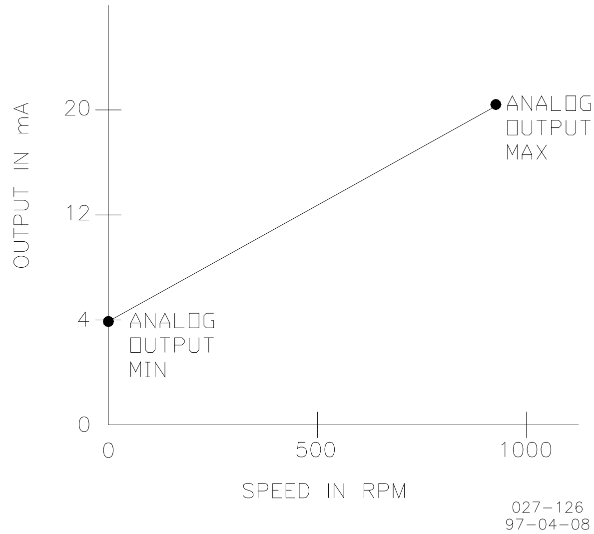

Figure 5-1. Analog Output Calibration Example

The engineering units are not displayed for prompts ANALOG OUTPUT #1 MIN and ANALOG OUTPUT #1 MAX. Remember these when choosing the AOUT 1 SELECTION number. If choices "1", "2", or "6" were selected, the units are engine rpm. If choices "3", "4", "5", "7" or "8" were selected, the units are percent.

Analog Output #2

Analog output #2 is configurable to output one of eight different choices. The selection is made in configure mode, under header CFIG ANALOG OUTPUTS at the prompt AOUT 2 SELECTION. The choices by number are: 1 = Engine Speed (rpm), 2 = Engine Speed Reference (rpm), 3 = Remote Speed Setting (% mA), 4 = Engine Load (% rated), 5 = Fuel Demand (%), 6 = Torsional Level (rpm), 7 = Rack Position (% mA)(default selection) and 8 = PID Output (%) (simulated PID windup). Set for the preferred output selection 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 *CALIBRATION*. At the prompt ANALOG OUTPUT #2 MIN, adjust to the value (in engr units) preferred for 4 mA output. At prompt ANALOG OUTPUT #2 MAX, adjust to the value (in engr units) preferred for 20 mA output. For example, if selection 7 was made (Rack Position) and the meter being driven by this analog output is designed to display 0% rack position at 4 mA and 100% rack position at 20 mA, then 0%/4 mA is the first point and 100%/20 mA is the second point.

The engineering units are not displayed for prompts ANALOG OUTPUT #2 MIN and ANALOG OUTPUT #2 MAX. Remember these when choosing the AOUT 2 SELECTION number. If choices "1", "2", or "6" were selected, the units are engine rpm. If choices "3", "4", "5", "7" or "8" were selected, the units are percent.

Speed Sensor #1 (Speed Sensor Input #1)

No calibration needed.

Speed Sensor #2 (Speed Sensor Input #2)

No calibration needed.

Analog Output #3

No calibration needed.

Analog Output #4

Analog output #4 is configurable to output one of eight different choices. The selection is made in configure mode, under header CFIG ANALOG OUTPUTS at the prompt AOUT 4 SELECTION. The choices by number are: 1 = Engine Speed (rpm), 2 = Engine Speed Reference (rpm), 3 = Remote Speed Setting (% mA), 4 = Engine Load (% rated), 5 = Fuel Demand (%)(default selection), 6 = Torsional Level (rpm), 7 = Rack Position (% mA) and 8 = PID Output (%) (simulated PID windup). Set for the preferred output selection 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 *CALIBRATION*. At the prompt ANALOG OUTPUT #4 MIN, adjust to the value (in engr units) preferred for 4 mA output. At prompt ANALOG OUTPUT #4 MAX, adjust to the value (in engr units) preferred for 20 mA output. For example, if selection 5 was made (Fuel Demand) and the meter being driven by this analog output is designed to display 0% at 4 mA and 100% at 20 mA, then 0%/4 mA is the first point and 100%/20 mA is the second point.

The engineering units are not displayed for prompts ANALOG OUTPUT #4 MIN and ANALOG OUTPUT #4 MAX. Remember these when choosing the AOUT 4 SELECTION number. If choices “1”, “2”, or “6” were selected, the units are engine rpm. If choices “3”, “4”, “5”, “7” or “8” were selected, the units are percent.

Discrete Inputs A–H

No calibration needed.

Rack Position Input (Analog Input #1)

The Rack Position Input is optional. If it is not used or fails, the 723PLUS control will default to using the actuator driver output 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 rack position transducer output, the minimum mechanical stop and the maximum mechanical stop, performs the fuel rack position transducer setup. The input signal must be direct acting (increase fuel rack position to increase both fuel and milliamps). The rack transducer setup is done with the engine shut down. The rack shutdown device(s) must be released so the fuel rack can be moved freely from stop to stop by hand. With a milliamp meter connected in series with the rack position input, and the rack held at its minimum mechanical stop, verify that the meter reads 4.0 Ma (±0.04). Next, move the fuel rack to its maximum mechanical stop and verify that the meter reads 20.0 mA (±0.2). If the calibration of the signal conditioner is not correct, then calibration adjustments are required. See Woodward manual 02024, Rack Position Sensor, for rack position sensor calibration.

IMPORTANT

DO NOT forget to reconnect the rack shutdown device(s) after the rack position input calibration is completed. DO NOT attempt to start the engine until the rack shutdown device(s) are fully operational.

LVDTs may exhibit temperature drift. To ensure accurate load sharing, calibrate sensors after engine is run at operating temperatures.

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 V 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 *DISPLAY 1*, and at prompt REMOTE SPEED REF, 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 REMOTE SPEED REF displayed on one line of the hand held programmer or on a Watch Window inspector, find and display the prompt REMOTE REF @ 1 V (it is under header *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 REMOTE REF @ 1 V value until the REMOTE SPEED REF 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 REMOTE REF @ 5 V value until the REMOTE SPEED REF 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.

The remote speed input is intended for use with only one speed setting device, typically the bridge controller. However, some applications may require two or more speed devices be used. Due to the differences in the output signal from the multiple speed setting devices, the remote speed setting input calibration may have to be compromised to achieve acceptable results. For example, if one speed setting device output signal is 0.95 V to 4.95 V and the other speed device is 1.05 V to 5.05 V, it will only be possible to accurately calibrate one of the devices. If device one is calibrated accurately, then the second device will not function properly. Due to the offset in the second device, it will not be possible to reach the idle speed (1.05 V). The second device may also trigger the high signal fault for the remote speed input at its rated speed position (5.05 V). And conversely if the second speed setting device is calibrated accurately then similar problems may occur when using the first speed setting device. When speed setting device one is at its idle position (0.95 V), the low signal fault for the remote speed input may be triggered, and it will not be possible to reach rated speed (4.95 V).

There are two choices to correct this problem. First, calibrate both speed devices so the output signals match each other very closely. The range and offset of the output signal do not matter as long as they are identical. The second option is to calibrate the remote speed setting using a combination of the two speed setting signals. The device with the lower idle speed signal would be used for the low end calibration (REMOTE REF @ 1 V). The device with the higher rated speed signal would be used for the high end calibration (REMOTE REF @ 5 V). From the above example, use the first speed setting device for the low end (Idle Speed) calibration (0.95 V) and use the second speed setting device for the high end (Rated Speed) calibration (5.05 V). The resulting calibration will not cause any remote speed input faults, however there will be some deadband on the respective speed setting devices. One unit will not be able to reach its idle speed (device two in our example) and the other device will not be able to reach its rated speed (device one in our example). The deadband will be proportional to the error between the two devices. Ideally the two speed setting devices need to be matched very closely.

Manifold Air Pressure Input (Analog Input #3)

The manifold air pressure fuel limit is an optional input, and this section may be skipped if the function is not enabled. The calibration is done with the input scaling and fuel limiting curve. The Manifold Air Pressure fuel limit is a PERCENT LOAD limit based on manifold air pressure. There are six tunable points on the Manifold Air Pressure fuel limit curve. The six tunable points of the Manifold Air Pressure Fuel Limiter are found in Service mode, under the header *MANIFOLD PRESS LMT*, at prompt FUEL LIMIT BKP 1 through and including prompt FUEL LMT AT BKPT 6. Each point has a FUEL LIMIT BKP, which is the milliamp input value. And each point has a FUEL LMT AT BKPT value, which is the PERCENT LOAD at the corresponding milliamp input value. The engine manufacturer generally provides the manifold air pressure fuel limit curve. (See Figure 5-2).

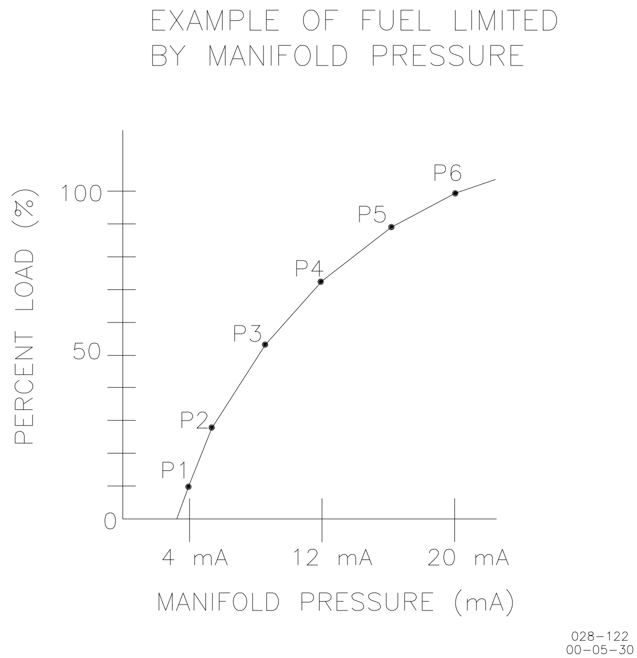

Figure 5-2. External Fuel Limit Calibration and Scaling

±5 Vdc Auxiliary Input (Analog Input #4)

No calibration needed.

J2 and J3

All values are preset. No calibration needed.

Torque Fuel Limit Adjustment

The torque fuel limit is optional and, if it is not enabled, its header will not appear in Service mode. If the torque fuel limit is enabled, the Torque Limiter header will appear in Service mode, called *TORQUE LIMITER*. The torque fuel limiter should be set up using the engine manufacturer’s torque fuel limit curve. The torque fuel limit can be based on either the actual engine speed or the engine speed reference. This selection is made in Service mode, at header *TORQUE LIMITER* at prompt BASED ON SPD REF. By setting the BASED ON SPD REF value to “TRUE”, the torque fuel limiting will be based on the engine speed reference. If the value is “FALSE”, the torque fuel limiting will be based on the actual engine speed. Six adjustable points are available to create the torque fuel limit curve (see Figure 5-3) and are located in the *TORQUE LIMITER* service header. Each point has an rpm (engine speed or engine speed reference) and PERCENT LOAD at that rpm. The engine manufacturer generally provides the torque fuel limit curve.

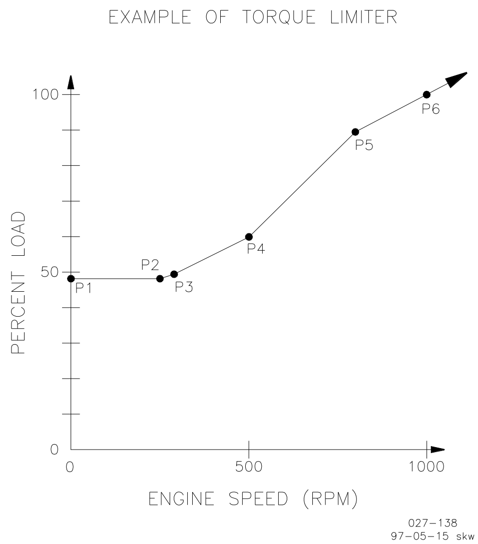

Figure 5-3. Torque Fuel Limit Curve

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 *START/MAX LIMITS*, at prompt START FUEL LIMIT (see Figure 5-4).

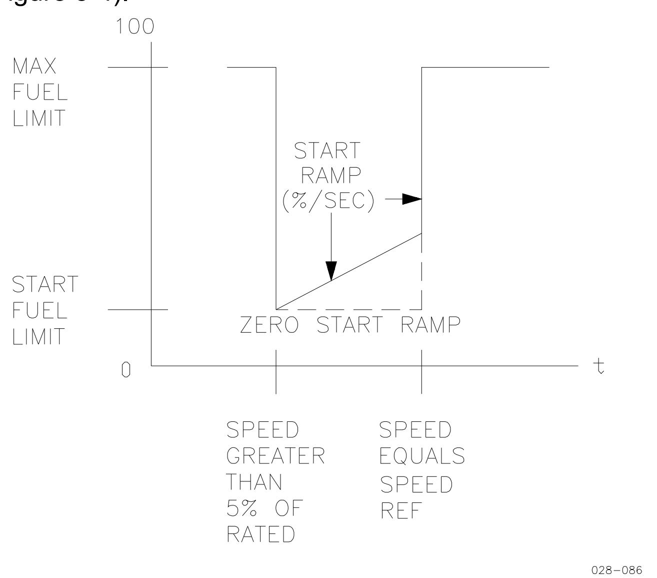

Figure 5-4. Start Fuel Limit

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 0.0 Vdc (forward acting), or 7.0 Vdc (reverse acting). Begin cranking the engine and verify the voltage on terminals 19 & 20 increases, or 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.

For electric actuators, make sure power is applied to the electrical actuator driver module. While the engine is cranking, the speed sensors can be tested also. To test the MPU or proximity probe, disconnect the speed sensor from speed sensor input #2 and crank the engine without starting the engine. Verify speed sensor 1 is mounted on the engine side of any couplings. Verify the fuel is shut off to prevent the engine from running. The value viewed in Service mode under header *DISPLAY 1* at the prompt ENGINE SPEED should increase to the engine cranking rpm. To check speed sensor #1 input signal strength, measure the RMS voltage at terminals 11 & 12. The voltage must be 1.0 Vrms or greater during cranking. Proceed to the next section if the second speed sensor is not used. Reconnect speed sensor #2. To test the second MPU or proximity probe, disconnect the first speed sensor and 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 *DISPLAY 1* at the prompt ENGINE SPEED should increase to the engine cranking rpm. To check speed sensor #2 input signal strength, measure the RMS voltage at terminals 13 & 14. The voltage must be 1.0 Vrms or greater during cranking. Reconnect the speed sensor #1. Speed sensor #2 can be mounted on either side of the coupling.

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 a 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 (*DYNAMICS 1* or *DYNAMICS 2*).

Do the following adjustments first for 1st dynamics. If changes are needed, go to header *DYNAMICS 1* to set the 1st dynamics.

Then repeat the adjustments for 2nd dynamics. If changes are needed, go to header *DYNAMICS 2* to set the 2nd 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 Output % as read on the *DISPLAY 1* menu. Set the Gain Slope Breakpoint, found under the *DYNAMICS 1* header, to this reading.

2. Minimum Load Adjustment

   Do this adjustment at the minimum speed and load conditions at which the engine is operated. Speed may be set either with the Raise and Lower commands in local control or with the 1 to 5 Vdc Remote Speed Setting input in remote mode.

   Observe the movement of the actuator. If movement is excessive, reduce the 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:

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

- 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 Gain set point to minimize the cycling. If actuator movement becomes excessive, reduce the Compensation set point until movement is acceptable. In some cases, Compensation may be reduced to 0.01 and only the Gain and Reset adjustments used. This should be done only if necessary to eliminate excessive actuator response to misfiring or other periodic disturbances. Reduce the Window Width set point until the limit cycle amplitude is acceptable and without excessive rapid actuator movement.

3. 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.

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 5-5.

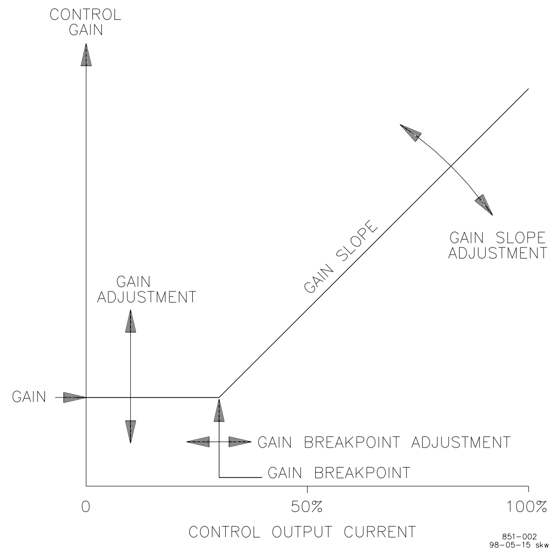

Figure 5-5. Gain Slope

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.**

4. 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.**

5. 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.

6. While operating at minimum speed and load, record the Actuator Output in the *DISPLAY 1* menu. Select the START FUEL LIMIT in the *START/MAX LIMITS* menu. Set at approximately 5% over the recorded value.

7. While operating at full load, record the Actuator Output on the Display Menu. Select the MAXIMUM FUEL LIMIT set point on service menu *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 SPEED FILTER1 HZ found under the *DYNAMICS 1* header to the calculated number. If the speed filter is not needed, adjust SPEED FILTER HZ1 to 20 Hz to disable the speed filter. Always attempt to use the maximum frequency for best response.

If the flexible coupling filter is being used, calculate the inertia factor for the system. Adjust the TORSIONAL FILTER (under *TORSIONAL FILTER* header) to match the calculated inertia factor. If only one speed sensor is being used, the inertia factor has no effect on the speed sensing.

IMPORTANT

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

Load Sharing Calibration

There are no load sharing calibrations available to field personnel.

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 load 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 CLUTCH SPEED WINDOW rpm, for the CLUTCH SYNC TIME. Both prompts are found under service header *LOAD CONTROL*. Close the Clutch Request contact to clutch in the engine by itself. Adjust the dynamics set if necessary. Open the Clutch Request contact to de-clutch the engine. Increase the engine speed above idle speed by more than the 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 CLUTCH SPEED WINDOW for the 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, PERCENT LOAD (*DISPLAY 1*). If two Handheld programmers or the Watch Window PC interface are not available, monitor one engine with the Handheld programmer or the Watch Window PC interface and the other engine by visually watching the actuator terminal shaft. 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 PERCENT LOAD or rack positions. 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 PERCENT LOAD (*DISPLAY 1*) of both engines is close (±5%). The actual engine load may be slightly different. This is due to the differences between engine calibrations, including the fuel racks/ pumps, and fuel rack position transducers.

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 load sharing, but the actual fuel racks are not balanced, the rack transducer calibrations or linkage 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 CLUTCH SPEED WINDOW rpm, for the 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 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 LOAD RATE (*LOAD CONTROL*) and UNLOAD RATE (*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 loads, the slave unit will close its internal load sharing relay and begin isochronous load sharing with the master. View the prompt ON LOAD SHARING (*DISPLAY 2*) to verify the load sharing relays of both units are closed. The load difference between the two units must be 5% or less before the load sharing relay will close and isochronous load sharing can begin. 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 it's unload level, UNLOAD TRIP POINT (*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.

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.

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, ALARM DELAY TIME (ALARM CONFIGURE), can be set to delay the fault from 0.1 to 2.0 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 RESET ALL ALARMS (*MINOR ALARM*, *MAJOR ALARM*, or *DISPLAY 2*) from “FALSE” to “TRUE”. The reset only occurs on the transition from false to true. The third fault reset is with contact E, when it is configured to be ALARM RESET. The fourth fault reset is with Modbus BW address 0:0001.

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 ENGINE OVER SPED? (*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 REMOTE SPEED FAILED in either the *MINOR ALARMS* or *MAJOR ALARMS* header, 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.

Rack Position Input Fault

The Rack Position 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 RACK INPUT FAILED in either the *MINOR ALARMS* or *MAJOR ALARMS* header, if the Rack Position Input Fault has been selected as one of these alarms. If the Rack Position Input is used, we recommend that the Rack Position Fault be configured to activate one of the alarms.

When the rack position fault is latched, the 723PLUS control automatically switches to the default rack calibration based on the percent actuator driver output. The 723PLUS control will function normally (load sharing, fuel limiting, etc.) when using the default rack calibration (if it was set up properly). The accuracy of the default rack calibration will not be as good as the rack position transducer, so the fault should be corrected as soon as practical.

Manifold Air Pressure Input Fault

The Manifold Air Pressure 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 MANIFOLD AIR FAILED in either the *MINOR ALARMS* or *MAJOR ALARMS* header, if the Manifold Air Pressure Input Fault has been selected as one of these alarms. If the Manifold Air Pressure Input is used, we recommend that the Manifold Air Pressure Fault be configured to activate one of the alarms.

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 PID @ ZERO TIME. The minimum fuel level is also adjustable. The PID @ ZERO LEVEL is the actuator LSS percent used to determine where "minimum" fuel is. PID @ ZERO TIME and PID @ ZERO LEVEL are found in ALARM/SD CONFIGURE. Depending on the linkage arrangement, the PID @ ZERO LEVEL should be set near minimum fuel and lower than the lowest actuator LSS command for normal operation. The status of the fault is found at prompt PID @ LOW LEVEL in either the *MINOR ALARMS* or *MAJOR ALARMS* header, 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 (> 1Vrms) 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 rack position transducer calibration may cause the actuator output to minimum fuel. See rack calibration procedure for testing. **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.**
	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.

Symptom	Cause	Test/Remedy
Engine will not start (actuator moving to start fuel position).	1. Actuator linkage not connected. 2. Start fuel limit too low. 3. Engine problem.	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.	1. Actuator and/or linkage problem. 2. Speed control dynamics adjustment.	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.	1. Start fuel limit set too high.	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.	1. Improper linkage adjustment. 2. 723PLUS control problem. 3. Mechanical governor in control.	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. **⚠WARNING** **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.**
	8. Improper wiring and installation. Possible shielding or ground loop problems.	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 a 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 load equally.	1. Improper rack transducer or default percent actuator calibration.	1. The 723PLUS control can only share load as well as the rack transducers, actuator linkages, and engine fuel rack(s) or pump(s) are calibrated. With the hand held programmer, verify the engine fuel rack positions are equal (+/– 2.5%). A small rack position error between units is common and will never be zero. If 723PLUS control indicates balanced load sharing (rack positions on hand held programmer equal), the control is functioning properly and the problem is with the fuel rack transducer calibrations or engine fuel system. If engine fuel rack positions are balanced, the problem exists in the engine (fuel pumps, etc.). See the appropriate engine manufacturer's recommendations for balancing the engine's fuel racks. Verify the fuel racks have been properly calibrated for their full load and no load conditions. Verify the same approximate fuel rack setting corresponds to similar rack position percent between the 723PLUS controls.
	2. Fuel limiter active.	2. An active fuel limit will override the load sharing and de-rate the engine. Verify no fuel limiters are active.
	3. Actuator linkage problem.	3. Verify the actuator linkage is capable of controlling engine fuel rack at that position.
	4. Load sharing line.	4. There is no load sharing line calibrations available to field personnel. Verify ON LOAD SHARING is true. Verify the Control LON #1 and #2 wiring is correct and that node addresses are properly set (see Chapter 5).

Symptom	Cause	Test/Remedy
Engine does not share load with other unit (one unit takes all of the load).	1. Improper rack transducer calibration. 2. Clutch contacts. 3. Control LON lines. 4. LED #3 illuminated and flashing. 5. LED #4 illuminated.	1. Verify the rack position percent increases as the engine fuel rack is moved in the increase fuel direction. 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 load sharing as indicated by a closed internal load sharing switch (*DISPLAY 2* prompt ON LOAD 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

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

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 can be configured for RS-232, RS-422 or RS-485 serial communications (default setting is RS-485).

The RS-232 connections are shown in Figure A-1. The maximum distance from the Master Modbus Device to the 723PLUS control is 15 m (50 ft).

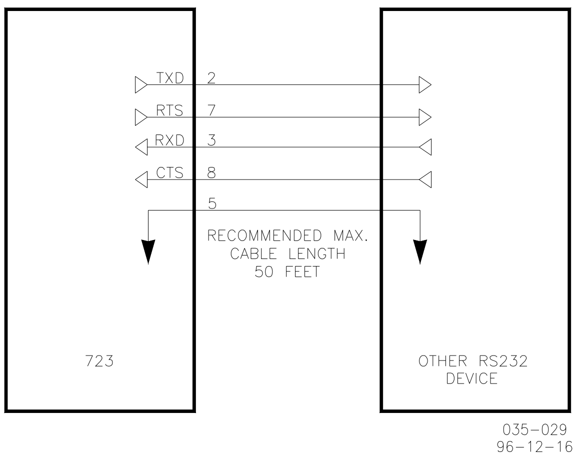

Figure A-1. 723PLUS RS-232 Connections

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).

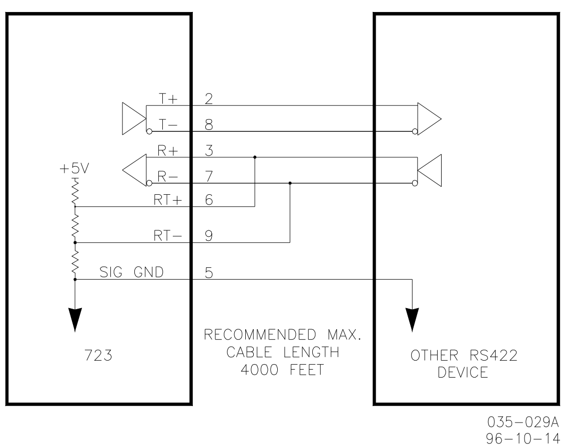

Figure A-2. 723PLUS RS-422 Connections with Optional Termination at Receiver

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).

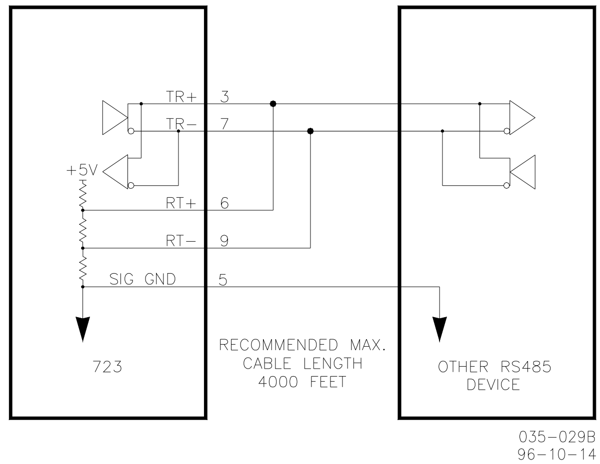

Figure A-3. 723PLUS RS-485 Connections with Optional Termination

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.

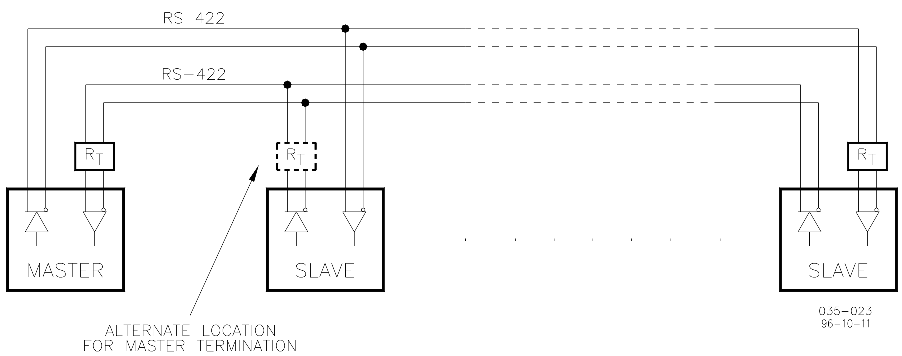

Figure A-4. RS-422 Terminator Locations

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.**

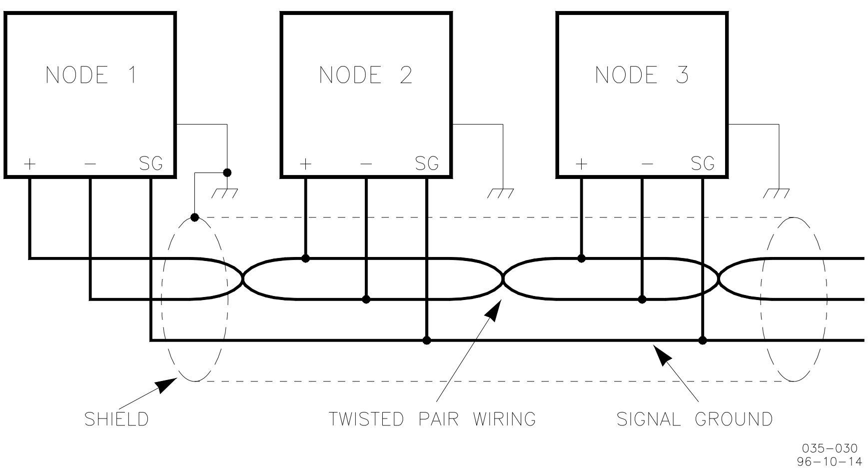

Figure A-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

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

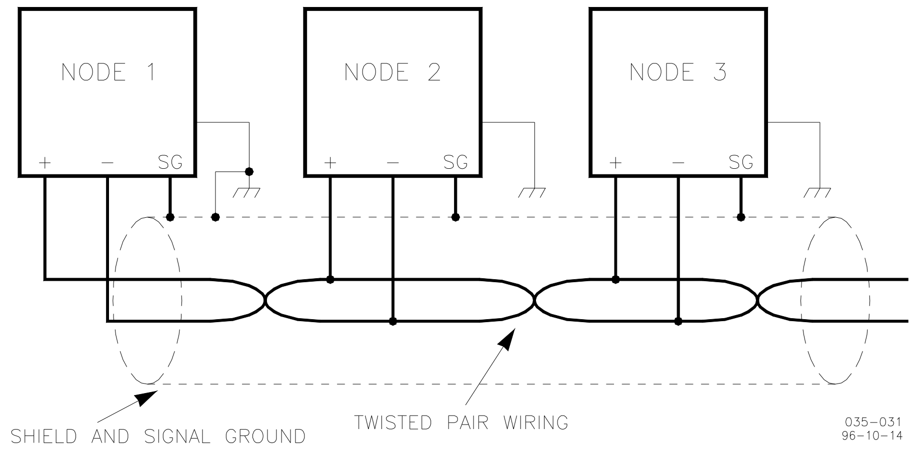

Figure A-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

Appendix B. Modbus Slave Address Information

Part Number 8280-1031

This appendix contains the Modbus slave address information for this 723PLUS part number.

WOODWARD GOVERNOR COMPANY
INDUSTRIAL CONTROLS DIVISION
FORT COLLINS, COLORADO, U.S.A.

Woodward MODBUS Slave Address Information
File created on 03/17/03
FileName: 54141582.GAP
Project: 76634
P/N: 5414-1582
Rev: NEW

723 PLUS DIGITAL ENGINE CONTROL
MARINE SERVICE
MECHANICAL CLON LOAD SHARING
WITH SERVLINK AND MODBUS INTERFACE

MODBUS PORT3

Boolean Writes

Addr	Description
0:0001	ALARM RESET
0:0002	
0:0003	
0:0004	
0:0005	
0:0006	
0:0007	
0:0008	
0:0009	
0:0010	
0:0011	USE CLUTCH REQUEST REMOTE COMMAND
0:0012	
0:0013	USE TORQUE LIMIT REMOTE COMMAND
0:0014	USE ALARM RESET REMOTE COMMAND
0:0015	USE LOWER SPEED REMOTE COMMAND
0:0016	USE RAISE SPEED REMOTE COMMAND
0:0017	USE MANEUVER REMOTE COMMAND
0:0018	USE STOP REMOTE COMMAND
0:0019	USE REMOTE SPEED REFERENCE
0:0020	
0:0021	723 COMMAND CLOSE FOR CLUTCH REQUEST
0:0022	
0:0023	723 COMMAND CLOSE TO ENABLE TORQ LIMIT
0:0024	723 COMMAND CLOSE FOR ALARM RESET
0:0025	723 COMMAND CLOSE TO LOWER SPEED REF
0:0026	723 COMMAND CLOSE TO RAISE SPEED REF
0:0027	723 COMMAND CLOSE FOR MANEUVER
0:0028	723 COMMAND CLOSE TO STOP

Boolean Reads

Addr	Description
1:0001	A-CLOSE TO STOP CONTACT
1:0002	B-MANEUVER MODE CONTACT
1:0003	C-RAISE SPEED CONTACT
1:0004	D-LOWER SPEED CONTACT
1:0005	E-ALARM RESET CONTACT
1:0006	F-ENABLE TORQ LMT CONTACT

1:0007	G-CLUTCH REQUEST
1:0008	H-CLUTCH ENGAGED
1:0009	DO1-MINOR ALARM RELAY
1:0010	DO2-MAJOR ALARM RELAY
1:0011	DO3-CLUTCH PERMISSIVE RELAY
1:0012	
1:0013	MPU 1 FAILED
1:0014	MPU 2 FAILED
1:0015	RACK INPUT FAILED
1:0016	REMOTE SPEED FAILED
1:0017	MANIFOLD AIR INPUT FAILED
1:0018	HANDHELD SELECTED
1:0019	LAPTOP SELECTED
1:0020	
1:0021	MAJOR ALARM IS ACTIVE
1:0022	MPU 1 FAILED MAJOR ALARM
1:0023	MPU 2 FAILED MAJOR ALARM
1:0024	MANIFOLD AIR FAILED MAJOR ALARM
1:0025	REMOTE SPEED FAILED MAJOR ALARM
1:0026	RACK INPUT FAILED MAJOR ALARM
1:0027	SPEED SWITCH ON MAJOR ALARM
1:0028	TORQUE LIMITER MAJOR ALARM
1:0029	MANIFOLD LIMITER MAJOR ALARM
1:0030	HIGH ACT ALARM MAJOR ALARM
1:0031	MODBUS PORT 3 FAILED MAJOR ALARM
1:0032	LON 1 COMM ERROR MAJOR ALARM
1:0033	LON 2 COMM ERROR MAJOR ALARM
1:0034	LON 1&2 COMM ERROR MAJOR ALARM
1:0035	PID @ LOW LEVEL MAJOR ALARM
1:0036	HIGH SPEED SW MAJOR ALARM
1:0037	LOAD SWITCH MAJOR ALARM
1:0038	CLUTCH FAIL MAJOR ALARM
1:0039	SPARE MAJOR ALARM
1:0040	SPARE MAJOR ALARM
1:0041	
1:0042	
1:0043	
1:0044	
1:0045	
1:0046	
1:0047	
1:0048	
1:0049	
1:0050	
1:0051	
1:0052	
1:0053	
1:0054	
1:0055	
1:0056	
1:0057	
1:0058	
1:0059	
1:0060	
1:0061	MINOR ALARM IS ACTIVE
1:0062	MPU 1 FAILED MINOR ALARM
1:0063	MPU 2 FAILED MINOR ALARM
1:0064	MANIFOLD AIR FAILED MINOR ALARM
1:0065	REMOTE SPEED FAILED MINOR ALARM
1:0066	RACK INPUT FAILED MINOR ALARM
1:0067	SPEED SWITCH ON MINOR ALARM
1:0068	TORQUE LIMITER MINOR ALARM
1:0069	MANIFOLD LIMITER MINOR ALARM
1:0070	HIGH ACT ALARM MINOR ALARM
1:0071	MODBUS PORT 3 FAILED MINOR ALARM
1:0072	LON 1 COMM ERROR MINOR ALARM
1:0073	LON 2 COMM ERROR MINOR ALARM
1:0074	LON 1&2 COMM ERROR MINOR ALARM
1:0075	PID @ LOW LEVEL MINOR ALARM
1:0076	HIGH SPEED SW MINOR ALARM
1:0077	LOAD SWITCH MINOR ALARM
1:0078	CLUTCH FAIL MINOR ALARM
1:0079	SPARE MINOR ALARM
1:0080	SPARE MINOR ALARM

1:0081	
1:0082	
1:0083	
1:0084	
1:0085	
1:0086	
1:0087	
1:0088	
1:0089	
1:0090	
1:0091	
1:0092	
1:0093	
1:0094	
1:0095	
1:0096	
1:0097	
1:0098	
1:0099	
1:0100	
1:0101	SPEED IN CONTROL (LSS)
1:0102	ON START LIMIT (LSS)
1:0103	ON MAX LIMIT (LSS)
1:0104	ON BOOST FUEL LIMIT (LSS)
1:0105	ON TORQUE LIMIT (LSS)
1:0106	ACT SHUTDOWN (LSS)
1:0107	ENGINE OVERSPEED
1:0108	TORSIONAL FILTER ACTIVE
1:0109	SPEED SWITCH #1 ACTIVE
1:0110	SPEED SWITCH #2 ACTIVE
1:0111	LOAD SWITCH ACTIVE
1:0112	REMOTE SPEED ENABLED
1:0113	DYNAMICS 1 ACTIVE
1:0114	DYNAMICS 2 ACTIVE
1:0115	LON CHNL 1 ACTIVE
1:0116	LON CHNL 2 ACTIVE
1:0117	SPD SENSOR 1 ACTIVE
1:0118	SPD SENSOR 2 ACTIVE
1:0119	ON LOAD SHARING
1:0120	I AM RUNNING
1:0121	USE MASTER SPEED REF

Analog Reads

Addr	Description
3:0001	
3:0002	
3:0003	
3:0004	
3:0005	
3:0006	
3:0007	
3:0008	
3:0009	
3:0010	
3:0011	SPEED INPUT #1 (rpm)
3:0012	SPEED INPUT #2 (rpm)
3:0013	ENGINE SPEED (rpm)
3:0014	BIASED SPEED REFERENCE (rpm)
3:0015	SPEED REFERENCE (rpm)
3:0016	FUEL DEMAND (%x10)
3:0017	REV FUEL DEMAND (%x10)
3:0018	PERCENT LOAD
3:0019	DEFAULT PERCENT LOAD
3:0020	REMOTE SPD REF(RPM)
3:0021	ANALOG OUT #1 (mAx100)
3:0022	ANALOG OUT #2 (mAx100)
3:0023	ANALOG OUT #4 (mAx100)
3:0024	SPEED PID OUTPUT (%)
3:0025	SPEED PID OUTPUT (SIMULATED %)
3:0026	
3:0027	
3:0028	
3:0029	

3:0030	
3:0031	RACK INPUT (mAx100)
3:0032	REMOTE SPD INPUT(mAx100)
3:0033	MANIFOLD PRESS(mAx100)
3:0034	AUX INPUT (Voltsx100)
3:0035	
3:0036	
3:0037	
3:0038	
3:0039	
3:0040	
3:0041	TORSIONAL LEVEL (%Ratedx100)

Analog Writes

Addr	Description
4:0001	
4:0002	
4:0003	
4:0004	
4:0005	723 REMOTE REFERENCE

Appendix C. 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 GOVERNOR COMPANY
INDUSTRIAL CONTROLS GROUP
FORT COLLINS, COLORADO, U.S.A.

Configure and Service Menu Items
8280-1031, Rev NEW
723PLUS Digital Engine Control
Marine Service
Mechanical CLON Load Sharing
With ServLink and Modbus Interface

Configure Menus

CONFIG SPD CONTROL	**Default (Low, High)**	**Field Settings**
GEAR #1 TEETH	#183 (16, 300)	
GEAR #2 TEETH	#183 (16, 300)	
RATED SPEED	#1225 (100, 2200)	
IDLE REF @ SHUTDOWN	#TRUE	
IDLE WHEN LON FAIL	#FALSE	
LINEAR DYNAMIC MAP	#FALSE	
DYN2 ON SPD SWITCH	#FALSE	
DYN2 WHEN CLUTCHED	#TRUE	
MAN MODE SPD STPT	*720 (100, 2200)	
CONFIG OPTION	**Default**	
USE TORQUE LIMITER	#TRUE	
USE MANIFOLD LIMITR	#FALSE	
LON ADDRESS CH#1	#0 (0, 2)	
LON ADDRESS CH#2	#0 (0, 2)	
ENBL COUPL TOR FILT	#FALSE	
REM LOCK IN LAST	#TRUE	
OVERRIDE FAILSAFE	#FALSE	
REVERSE ACTING ACT	#FALSE	
ENABLE AUX INPUT	#FALSE	
CT F AS TORQ LIMIT	#TRUE	
MANUAL CLUTCH LOGIC	#FALSE	
CONT A OPEN TO RUN	#FALSE	
USE CONT E AS RESET	#TRUE	
USE DSLC AS SYNC	#FALSE	
MAJOR ALM SD ACT	#FALSE	
USE NOTCH FILTER	#FALSE	
USE REMOTE COMMANDS	#FALSE	
USE COMM PORTS	#FALSE	
USE 5-PT GAIN MAP	#FALSE	
MINOR ALARM TRIPS	**Default**	
MPU 1 FAILED	#FALSE	
MPU 2 FAILED	#FALSE	
MANIFOLD AIR FAILED	#FALSE	
REMOTE SPEED FAILED	#FALSE	
RACK INPUT FAILED	#FALSE	
SPEED SWITCH	#FALSE	
TORQUE LIMITER	#TRUE	
MANIFOLD LIMITER	#FALSE	

HIGH ACT ALARM	#FALSE	
PORT 3 LINK ERROR	#FALSE	
CLON CH1 ERROR	#FALSE	
CLON CH2 ERROR	#FALSE	
CLON CH1&2 ERROR	#FALSE	
PID @ LOW LEVEL	#FALSE	
HIGH SPEED SW	#FALSE	
LOAD SWITCH	#FALSE	
CLUTCH FAIL	#FALSE	
MAJOR ALARM TRIPS	**Default**	
MPU 1 FAILED	#FALSE	
MPU 2 FAILED	#FALSE	
MANIFOLD AIR FAILED	#FALSE	
REMOTE SPEED FAILED	#TRUE	
RACK INPUT FAILED	#TRUE	
SPEED SWITCH	#FALSE	
TORQUE LIMITER	#FALSE	
MANIFOLD LIMITER	#FALSE	
HIGH ACT ALARM	#FALSE	
PORT 3 LINK ERROR	#TRUE	
CLON CH1 ERROR	#TRUE	
CLON CH2 ERROR	#TRUE	
CLON CH1&2 ERROR	#FALSE	
PID @ LOW LEVEL	#FALSE	
HIGH SPEED SW	#FALSE	
LOAD SWITCH	#FALSE	
CLUTCH FAIL	#FALSE	
ALARM/SD CONFIGURE	**Default (Low, High)**	
ALARM DELAY TIME	#0.5 (0.01, 60.0)	
OPEN CNT ON MIN ALM	#FALSE	
OPEN CNT ON MAJ ALM	#FALSE	
SHUTDOWN WHEN PID@0	#FALSE	
PID @ ZERO LEVEL	#0.0 (0.0, 100.0)	
PID @ ZERO TIME	#10.0 (0.0, 120.0)	
HIGH ACT ALM LEVEL (%)	#100.0 (0.0, 100.0)	
HIGH SPEED SD	#1400 (1, 2200)	
LON ALM DELAY TIME	#2.0 (0.1, 60.0)	
CFIG ANALOG OUTPUTS	**Default (Low, High)**	
AOUT 1 SELECTION	#1 (1, 8)	
AOUT 1 4-20 mA?	#TRUE	
AOUT 2 SELECTION	#7 (1, 8)	
AOUT 2 4-20 mA?	#TRUE	
AOUT 4 SELECTION	#5 (1, 8)	
AOUT 4 4-20 mA?	#TRUE	
CFIG COMMUNICATION	**Default (Low, High)**	
PORT 2 ADDRESS	#0 (0, 15)	
PORT 3 ADDRESS	#1 (1, 247)	
PORT 3 MODE	#2 (1, 2)	

Service Menus

MAJOR ALARMS	Default	Field Settings
MAJOR ALARM		
MPU 1 FAILED		
MPU 2 FAILED		
MANIFOLD AIR FAILED		
REMOTE SPEED FAILED		
RACK INPUT FAILED		
SPEED SWITCH ON		
TORQUE LIMITER		
MANIFOLD LIMITER		
HIGH ACT ALARM		
PORT 3 LINK ERROR		
CLON CH1 ERROR		
CLON CH2 ERROR		

CLON CH1&2 ERROR		
PID @ LOW LEVEL		
HIGH SPEED SW		
LOAD SWITCH		
CLUTCH FAIL		
RESET ALL ALARMS	*FALSE	
MINOR ALARMS	**Default**	
MINOR ALARM		
MPU 1 FAILED		
MPU 2 FAILED		
MANIFOLD AIR FAILED		
REMOTE SPEED FAILED		
RACK INPUT FAILED		
SPEED SWITCH ON		
TORQUE LIMITER		
MANIFOLD LIMITER		
HIGH ACT ALARM		
PORT 3 LINK ERROR		
CLON CH1 ERROR		
CLON CH2 ERROR		
CLON CH1&2 ERROR		
PID @ LOW LEVEL		
HIGH SPEED SW		
LOAD SWITCH		
CLUTCH FAIL		
RESET ALL ALARMS	*FALSE	
DYNAMICS 1	**Default (Low, High)**	
GAIN 1	*1.3 (0.01, 150.0)	
RESET 1	*1.5 (0.01, 50.0)	
ACT COMP 1	*0.12 (0.01, 1.0)	
GAIN RATIO 1	*1.0 (1.0, 20.0)	
WINDOW WIDTH 1	*25.0 (0.01, 150.0)	
GAIN SLOPE 1	*0.01 (0.01, 20.0)	
GAIN BKPT 1	*50.0 (0.01, 100.0)	
SPEED FILTER 1 HZ	*15.0 (0.5, 20.0)	
INITIATE BUMP	*FALSE	
***DYNAMICS 1* (5 point)**	**Default (Low, High)**	
BREAKPNT 1A %	*20 (0.0,100.0)	
GAIN @ BRKPT 1A	*1.3 (0.01, 150.0)	
BREAKPNT 1B %	*40 (0.0,100.0)	
GAIN @ BRKPT 1B	*1.3 (0.01, 150.0)	
BREAKPNT 1C %	*60 (0.0,100.0)	
GAIN @ BRKPT 1C	*1.3 (0.01, 150.0)	
BREAKPNT 1D %	*80 (0.0,100.0)	
GAIN @ BRKPT 1D	*1.3 (0.01, 150.0)	
BREAKPNT 1E %	*100 (0.0,100.0)	
GAIN @ BRKPT 1E	*1.3 (0.01, 150.0)	
RESET 1	*1.5 (0.01, 50.0)	
ACT COMP 1	*0.12 (0.01, 1.0)	
GAIN RATIO 1	*1.0 (1.0, 20.0)	
WINDOW WIDTH 1	*25.0 (0.01, 150.0)	
GAIN SLOPE 1	*0.01 (0.01, 20.0)	
GAIN BKPT 1	*50.0 (0.01, 100.0)	
SPEED FILTER 1 HZ	*15.0 (0.5, 20.0)	
INITIATE BUMP	*FALSE	
DYNAMICS 2	**Default (Low, High)**	
GAIN 2	*1.2 (0.01, 150.0)	
RESET 2	*1.6 (0.01, 50.0)	
ACT COMP 2	*0.12 (0.01, 1.0)	
GAIN RATIO 2	*1.0 (1.0, 20.0)	
WINDOW WIDTH 2	*50.0 (0.01, 150.0)	
GAIN SLOPE 2	*0.01 (0.01, 20.0)	
GAIN BKPT 2	*50.0 (0.01, 100.0)	
SPEED FILTER 2 HZ	*15.0 (0.5, 20.0)	
DYN 2 SPD SW PU	*500.0 (100.0, 2200.0)	

DYN 2 SPD SW DO	*400.0 (1.0, 2200.0)	
INITIATE BUMP	*FALSE	
***DYNAMICS 2* (5 point)**	**Default (Low, High)**	
BREAKPNT 2A %	*20 (0.0,100.0)	
GAIN @ BRKPT 2A	*1.3 (0.01, 150.0)	
BREAKPNT 2B %	*40 (0.0,100.0)	
GAIN @ BRKPT 2B	*1.3 (0.01, 150.0)	
BREAKPNT 2C %	*60 (0.0,100.0)	
GAIN @ BRKPT 2C	*1.3 (0.01, 150.0)	
BREAKPNT 2D %	*80 (0.0,100.0)	
GAIN @ BRKPT 2D	*1.3 (0.01, 150.0)	
BREAKPNT 2E %	*100 (0.0,100.0)	
GAIN @ BRKPT 2E	*1.3 (0.01, 150.0)	
RESET 2	*1.5 (0.01, 50.0)	
ACT COMP 2	*0.12 (0.01, 1.0)	
GAIN RATIO 2	*1.0 (1.0, 20.0)	
WINDOW WIDTH 2	*25.0 (0.01, 150.0)	
GAIN SLOPE 2	*0.01 (0.01, 20.0)	
GAIN BKPT 2	*50.0 (0.01, 100.0)	
SPEED FILTER 2 HZ	*15.0 (0.5, 20.0)	
INITIATE BUMP	*FALSE	
SPEED REFERENCE	**Default (Low, High)**	
RAISE SPEED LIMIT	*1225 (100, 2200)	
LOWER SPEED LIMIT	*575 (100, 2200)	
IDLE SPEED (RPM)	*575 (100, 2200)	
DECEL RAMP (SEC)	*10.0 (0.0001, 500.0)	
RAISE SPEED RATE	*50.0 (1.0, 10000.0)	
LOWER SPEED RATE	*50.0 (1.0, 10000.0)	
SLV-MST RAMP RATE	*30.0 (1.0, 500.0)	
REMOTE REF AT 1 V	*575.0 (-32767.0, 32767.0)	
REMOTE REF AT 5 V	*1225.0 (-32767.0, 32767.0)	
SPD SWITCH PICKUP	*500.0 (100.0, 2200.0)	
SPD SWITCH DROPOUT	*400.0 (1.0, 2200.0)	
MANEUVER RAMP RATE	*50.0 (1.0, 10000)	
START/MAX LIMITS	**Default (Low, High)**	
START FUEL LIMIT	*65.0 (0.0, 100.0)	
START RAMP RATE (%/SEC)	*6.0 (0.01, 10000.0)	
MAXIMUM FUEL LIMIT	*100.0 (0.0, 101.0)	
DISCRETE IN	**Display Only**	
STOP CONTACT		
MANEUVER CONTACT		
RAISE SPEED CONTACT		
LOWER SPEED CONTACT		
ALARM RESET		
TORQUE LIMITER		
CLUTCH REQUEST		
CLUTCH ENGAGED		
REMOTE SPD SELECTED		
SERVLINK SELECTED		
TORQUE LIMITER	**Default (Low, High)**	
BASED ON SPD REF	*TRUE	
TORQ LIMIT BKPT 1	*575.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 1	*101.0 (0.0, 101.0)	
TORQ LIMIT BKPT 2	*675.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 2	*101.0 (0.0, 101.0)	
TORQ LIMIT BKPT 3	*825.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 3	*101.0 (0.0, 101.0)	
TORQ LIMIT BKPT 4	*975.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 4	*101.0 (0.0, 101.0)	
TORQ LIMIT BKPT 5	*1125.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 5	*101.0 (0.0, 101.0)	
TORQ LIMIT BKPT 6	*1225.0 (0.0, 2200.0)	
TORQ LMT AT BKPT 6	*101.0 (0.0, 101.0)	
CLUTCH PERM DELAY	*5.0 (0.0, 30.0)	

MAN PRESS LIMITER	**Default (Low, High)**	
FUEL LIMIT BKPT 1	*4.0 (0.0, 20.0)	
FUEL LMT AT BKPT 1	*101.0 (0.0, 101.0)	
FUEL LIMIT BKPT 2	*8.0 (0.0, 20.0)	
FUEL LMT AT BKPT 2	*101.0 (0.0, 101.0)	
FUEL LIMIT BKPT 3	*12.0 (0.0, 20.0)	
FUEL LMT AT BKPT 3	*101.0 (0.0, 101.0)	
FUEL LIMIT BKPT 4	*16.0 (0.0, 20.0)	
FUEL LMT AT BKPT 4	*101.0 (0.0, 101.0)	
FUEL LIMIT BKPT 5	*18.0 (0.0, 20.0)	
FUEL LMT AT BKPT 5	*101.0 (0.0, 101.0)	
FUEL LIMIT BKPT 6	*20.0 (0.0, 20.0)	
FUEL LMT AT BKPT 6	*101.0 (0.0, 101.0)	
TRANSIENT OVR FUEL	**Default (Low, High)**	
TORQUE OVER FUEL TIME	*5.0 (0.0, 10.0)	
TORQUE OVER FUEL AMOUNT	*15.0 (0.0, 100.0)	
MAN PRES OVER FUEL TIME	*5.0 (0.0, 10.0)	
MAN PRES OVER FUEL AMOUNT	*15.0 (0.0, 100.0)	
TORQ ALM DELAY	*3.0 (0.0, 20.0)	
BOOST ALM DELAY	*3.0 (0.0, 20.0)	
RESPONSE TESTING	**Default (Low, High)**	
BUMP ENABLE	*FALSE	
ACT BUMP DURATION	*0.1 (0.01, 2.0)	
ACT BUMP LEVEL	*1.0 (0.0, 100.0)	
INITIATE BUMP	*FALSE	
TORSIONAL FILTER	**Default (Low, High)**	
ENABLE TORS FILTER	*FALSE	
TORS FILTER ACTIVE		
TORSIONAL FILTER	*0.5 (0.0, 1.0)	
NOTCH FREQUENCY (HZ)	*15.9 (0.5, 16.0)	
NOTCH Q FACTOR	*0.707 (0.707, 25.0)	
RACK CALIBRATION	**Default (Low, High)**	
ACT OUT @ NO LOAD	*15.0 (0.0, 50.0)	
ACT OUT @ MAX LOAD	*70.0 (50.1, 100.0)	
RACK OUT @ NO LOAD	*-63.0 (-150.0, 150.0)	
RACK OUT @ MAX LOAD	*108.0 (-150.0, 150.0)	
CALIBRATION	**Default (Low, High)**	
AOUT 1 FILTER (Hz)	*20.0 (0.1, 20.0)	
ANALOG OUTPUT#1 MIN	*0.0 (-30000.0, 30000.0)	
ANALOG OUTPUT#1 MAX	*1500.0 (-30000.0, 30000.0)	
AOUT 2 FILTER (Hz)	*20.0 (0.1, 20.0)	
ANALOG OUTPUT#2 MIN	*0.0 (-30000.0, 30000.0)	
ANALOG OUTPUT#2 MAX	*100.0 (-30000.0, 30000.0)	
AOUT 4 FILTER (Hz)	*20.0 (0.1, 20.0)	
ANALOG OUTPUT#4 MIN	*0.0 (-30000.0, 30000.0)	
ANALOG OUTPUT#4 MAX	*100.0 (-30000.0, 30000.0)	
COMM PORT SETUP	**Default (Low, High)**	
PORT2 HARDWARE CFIG	*1 (1, 2)	
PORT 2 BAUD RATE	*9 (1, 10)	
PORT3 HARDWARE CFIG	*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)	
PORT3 LINK ERROR		
PORT3 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)	
GAIN % @ LIGHT LOAD	*50.0 (10.0, 100.0)	
LITE LD GAIN PU	*10.0 (0.0, 101.0)	
LITE LD GAIN DO	*15.0 (0.0, 101.0)	
LOAD SWITCH PU	*101.0 (0.0, 101.0)	
LOAD SWITCH DO	*100.0 (0.0, 101.0)	
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	**Default**	
ACT SHUTDOWN		
ON DYNAMICS 2		
SPEED CONTROL MODE		
ON MAX FUEL LIMIT		
ON START FUEL LIMIT		
BOOST LIMIT MODE		
TORQUE LIMIT MODE		
ENGINE OVER SPED?		
CH1 LON ERROR		
CH2 LON ERROR		
USE MASTER SPD REF		
ON LOAD SHARING		
PORT 1 ON HANDHELD		
PORT 1 ON SERVLINK		
RESET ALL ALARMS	*FALSE	
DISPLAY 1	**Display Only**	
ENGINE SPEED		
SPEED REFERENCE		
SPEED REF BIASED		
ACTUATOR % OUT		
PERCENT LOAD		
RACK POS % LOAD		
DEFAULT % LOAD		
REMOTE SPD REF (RPM)		
RACK INPUT (mA)		
REMOTE SPD INPUT (mA)		
MANIFOLD PRESS (mA)		
AUX INPUT (Volts)		
TORSIONAL LEVEL		
CLON CH 1 ACTIVE		
CLON CH 2 ACTIVE		
SPD SENSOR 1 ACTIVE		
SPD SENSOR 2 ACTIVE		

Appendix D.
Menu Summary

Configure Menus

CONFIG SPD CONTROL
GEAR #1 TEETH
GEAR #2 TEETH
RATED SPEED
IDLE REF @ SHUTDOWN
IDLE WHEN LON FAIL
LINEAR DYNAMIC MAP
DYN2 ON SPD SWITCH
DYN2 WHEN CLUTCHED
MAN MODE SPD STPT

CONFIG OPTION
USE TORQUE LIMITER
USE MANIFOLD LIMITR
LON ADDRESS CH#1
LON ADDRESS CH#2
ENBL COUPL TOR FILT
REM LOCK IN LAST
OVERRIDE FAILSAFE
REVERSE ACTING ACT
ENABLE AUX INPUT
CT F AS TORQ LIMIT
MANUAL CLUTCH LOGIC
CONT A OPEN TO RUN
USE CONT E AS RESET
USE DSLC AS SYNC
MAJOR ALM SD ACT
USE NOTCH FILTER
USE REMOTE COMMANDS
USE COMM PORTS
USE 5-PT GAIN MAP

MINOR ALARM TRIPS
MPU 1 FAILED
MPU 2 FAILED
MANIFOLD AIR FAILED
REMOTE SPEED FAILED
RACK INPUT FAILED
SPEED SWITCH
TORQUE LIMITER
MANIFOLD LIMITER
HIGH ACT ALARM
PORT 3 LINK ERROR
CLON CH1 ERROR
CLON CH2 ERROR
CLON CH1&2 ERROR
PID @ LOW LEVEL
HIGH SPEED SW
LOAD SWITCH
CLUTCH FAIL

MAJOR ALARM TRIPS
MPU 1 FAILED
MPU 2 FAILED
MANIFOLD AIR FAILED
REMOTE SPEED FAILED
RACK INPUT FAILED
SPEED SWITCH
TORQUE LIMITER
MANIFOLD LIMITER
HIGH ACT ALARM
PORT 3 LINK ERROR
CLON CH1 ERROR
CLON CH2 ERROR
CLON CH1&2 ERROR
PID @ LOW LEVEL
HIGH SPEED SW
LOAD SWITCH
CLUTCH FAIL

ALARM/SD CONFIGURE
ALARM DELAY TIME
OPEN CNT ON MIN ALM
OPEN CNT ON MAJ ALM
SHUTDOWN WHEN PID@0
PID @ ZERO LEVEL
PID @ ZERO TIME
HIGH ACT ALM LEVEL (%)
HIGH SPEED SD
LON ALM DELAY TIME

CFIG ANALOG OUTPUTS
AOUT 1 SELECTION
AOUT 1 4-20 mA?
AOUT 2 SELECTION
AOUT 2 4-20 mA?
AOUT 4 SELECTION
AOUT 4 4-20 mA?

CFIG COMMUNICATION
PORT 2 ADDRESS
PORT 3 ADDRESS
PORT 3 MODE

Service Menus

MAJOR ALARMS
MAJOR ALARM
MPU 1 FAILED
MPU 2 FAILED
MANIFOLD AIR FAILED
REMOTE SPEED FAILED
RACK INPUT FAILED
SPEED SWITCH ON
TORQUE LIMITER
MANIFOLD LIMITER
HIGH ACT ALARM
PORT 3 LINK ERROR
CLON CH1 ERROR
CLON CH2 ERROR
CLON CH1&2 ERROR
PID @ LOW LEVEL
HIGH SPEED SW
LOAD SWITCH
CLUTCH FAIL
RESET ALL ALARMS

MINOR ALARMS
MINOR ALARM
MPU 1 FAILED
MPU 2 FAILED
MANIFOLD AIR FAILED
REMOTE SPEED FAILED
RACK INPUT FAILED
SPEED SWITCH ON
TORQUE LIMITER
MANIFOLD LIMITER
HIGH ACT ALARM
PORT 3 LINK ERROR
CLON CH1 ERROR
CLON CH2 ERROR
CLON CH1&2 ERROR
PID @ LOW LEVEL
HIGH SPEED SW
LOAD SWITCH
CLUTCH FAIL
RESET ALL ALARMS,

DYNAMICS 1
GAIN 1
RESET 1
ACT COMP 1
GAIN RATIO 1
WINDOW WIDTH 1
GAIN SLOPE 1
GAIN BKPT 1
SPEED FILTER 1 HZ
INITIATE BUMP

DYNAMICS 2
GAIN 2
RESET 2
ACT COMP 2
GAIN RATIO 2
WINDOW WIDTH 2
GAIN SLOPE 2
GAIN BKPT 2
SPEED FILTER 2 HZ
DYN 2 SPD SW PU
DYN 2 SPD SW DO
INITIATE BUMP

SPEED REFERENCE
RAISE SPEED LIMIT
LOWER SPEED LIMIT
IDLE SPEED (RPM)
DECEL RAMP (SEC)
RAISE SPEED RATE
LOWER SPEED RATE
SLV-MST RAMP RATE
REMOTE REF AT 4 mA
REMOTE REF AT 20 mA
SPD SWITCH PICKUP
SPD SWITCH DROPOUT
MANEUVER RAMP RATE

START/MAX LIMITS
START FUEL LIMIT
START RAMP RATE (%/SEC)
MAXIMUM FUEL LIMIT

DISCRETE IN
STOP CONTACT
SPARE CONTACT
RAISE SPEED CONTACT
LOWER SPEED CONTACT
ALARM RESET
TORQUE LIMITER
CLUTCH REQUEST
CLUTCH ENGAGED
REMOTE SPD SELECTED
SERVLINK SELECTED

TORQUE LIMITER
BASED ON SPD REF
TORQ LIMIT BKPT 1
TORQ LMT AT BKPT 1
TORQ LIMIT BKPT 2
TORQ LMT AT BKPT 2
TORQ LIMIT BKPT 3
TORQ LMT AT BKPT 3
TORQ LIMIT BKPT 4
TORQ LMT AT BKPT 4
TORQ LIMIT BKPT 5
TORQ LMT AT BKPT 5
TORQ LIMIT BKPT 6
TORQ LMT AT BKPT 6
CLUTCH PERM DELAY,

MAN PRESS LIMITER
FUEL LIMIT BKPT 1
FUEL LMT AT BKPT 1
FUEL LIMIT BKPT 2
FUEL LMT AT BKPT 2
FUEL LIMIT BKPT 3
FUEL LMT AT BKPT 3
FUEL LIMIT BKPT 4
FUEL LMT AT BKPT 4
FUEL LIMIT BKPT 5
FUEL LMT AT BKPT 5
FUEL LIMIT BKPT 6
FUEL LMT AT BKPT 6

TRANSIENT OVR FUEL
TORQUE OVER FUEL TIME
TORQUE OVER FUEL
AMOUNT
MAN PRES OVER FUEL TIME
MAN PRES OVER FUEL
AMOUNT
TORQ ALM DELAY
BOOST ALM DELAY

RESPONSE TESTING
BUMP ENABLE
ACT BUMP DURATION
ACT BUMP LEVEL
INITIATE BUMP

TORSIONAL FILTER
ENABLE TORS FILTER
TORS FILTER ACTIVE
TORSIONAL FILTER
NOTCH FREQUENCY (HZ)
NOTCH Q FACTOR

RACK CALIBRATION
ACT OUT @ NO LOAD
ACT OUT @ MAX LOAD
RACK OUT @ NO LOAD
RACK OUT @ MAX LOAD

CALIBRATION
AOUT 1 FILTER (Hz)
ANALOG OUTPUT#1 MIN
ANALOG OUTPUT#1 MAX
AOUT 2 FILTER (Hz)
ANALOG OUTPUT#2 MIN
ANALOG OUTPUT#2 MAX
AOUT 4 FILTER (Hz)
ANALOG OUTPUT#4 MIN
ANALOG OUTPUT#4 MAX

COMM PORT SETUP
PORT2 HARDWARE CFIG
PORT 2 BAUD RATE
PORT3 HARDWARE CFIG
PORT 3 BAUD RATE
PORT 3 STOP BITS
PORT 3 PARITY
PORT 3 TIMEOUT(SEC)
PORT3 LINK ERROR
PORT3 EXCEPTION ERR
PORT 3 EX ERR NUM
PORT 3 EX ERR PCT
CLON 1 & 2 TIMEOUT,

LOAD CONTROL
CLUTCH SYNC TIME
UNLOAD RATE
LOAD RATE
UNLOAD TRIP POINT
GAIN % @ LIGHT LOAD
LITE LD GAIN PU
LITE LD GAIN DO
LOAD SWITCH PU
LOAD SWITCH DO
CLUTCH IN TIME
CLUTCH SPEED WINDOW
LOAD SHARE GAIN
LOAD SHARE FILTER
REF@TRIP LEVEL TIME
INITIATE BUMP

When the 5 point gain map is enabled, the DYANMICS 1 and DYNAMICS 2 appear like this.

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

DYNAMICS1
BREAKPNT 1A %
GAIN @ BRKPT 1A
BREAKPNT 1B %
GAIN @ BRKPT 1B
BREAKPNT 1C %
GAIN @ BRKPT 1C
BREAKPNT 1D %
GAIN @ BRKPT 1D
BREAKPNT 1E %
GAIN @ BRKPT 1E
RESET 1
ACT COMP 1
GAIN RATIO 1
WINDOW WIDTH 1
GAIN SLOPE 1
GAIN BKPT 1
SPEED FILTER 1 HZ
INITIATE BUMP

DISPLAY 1
ENGINE SPEED
SPEED REFERENCE
SPEED REF BIASED
ACTUATOR % OUT
PERCENT LOAD
RACK POS % LOAD
DEFAULT % LOAD
REMOTE SPD REF (RPM)
RACK INPUT (mA)
REMOTE SPD INPUT (mA)
MANIFOLD PRESS (mA)
AUX INPUT (Volts)
TORSIONAL LEVEL
CLON CH 1 ACTIVE
CLON CH 2 ACTIVE
SPD SENSOR 1 ACTIVE
SPD SENSOR 2 ACTIVE

DYNAMICS 2
BREAKPNT 2A %
GAIN @ BRKPT 2A
BREAKPNT 2B %
GAIN @ BRKPT 2B
BREAKPNT 2C %
GAIN @ BRKPT 2C
BREAKPNT 2D %
GAIN @ BRKPT 2D
BREAKPNT 2E %
GAIN @ BRKPT 2ERESET 2
ACT COMP 2
GAIN RATIO 2
WINDOW WIDTH 2
GAIN SLOPE 2
GAIN BKPT 2
SPEED FILTER 2 HZ
DYN 2 SPD SW PU
DYN 2 SPD SW DO
INITIATE BUMP

723PLUS Control Specifications

	Input Power
Low Voltage Model	18–40 Vdc (24 or 32 Vdc nominal)
Power Consumption	40 W nominal
Inrush Current	7 A for 0.1 ms
	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 kΩ ± 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 ±15%
Impedance	2.3 kΩ
Note: For Lloyd's Register applications, use only control-supplied power.	
Analog Inputs (4)	
Analog Input	±5 Vdc or 0–20 mA, transducers externally powered
Common Mode Voltage	±40 Vdc
Common Mode Rejection	0.5% of full scale
Accuracy	0.5% of full scale
Load Sharing Input	
Analog Input	0–4.5 Vdc
Common Mode Voltage	±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 1, Division 2, Groups A, B, C, D
Lloyd's Register of Shipping	Certification Pending
American Bureau of Shipping (ABS)	Certification Pending
European Union (EU)	Compliant with EMC Directive 89/336/EEC (Low Voltage Model Only)

Revision History

Changes in Revision A—

- Added Maneuver Ramp Rate information and menu settings.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

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