

**723PLUS Digital Speed Control with Analog
Load Sharing for Tandem Engines
DSLCTM Compatible**

8280-608

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 Out-of-date translations are marked with .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.

Woodward reserves the right to update any portion of this publication at any time. Information provided by Woodward is believed to be correct and reliable. However, no responsibility is assumed by Woodward unless otherwise expressly undertaken.

Contents

WARNINGS AND NOTICES	IV
ELECTROSTATIC DISCHARGE AWARENESS	V
CHAPTER 1. GENERAL INFORMATION.....	1
Introduction	1
Declaration of Incorporation	1
Application	1
Control Options.....	3
723PLUS Digital Speed Control Accessories.....	3
CHAPTER 2 INSTALLATION.....	11
Introduction	11
Unpacking.....	11
Power Requirements	11
Location Considerations	11
Internal Jumpers.....	12
Electrical Connections	12
Shielded Wiring	12
Power Supply (Terminals 1/2)	13
Relay Outputs (Terminals 3/4, 5/6, 7/8)	14
Speed Signal Inputs (Terminals 11/12 and 13/14).....	15
Analog Output #1 and #2 (Terminals 15/16 and 17/18)	15
Analog Output #3 (Terminals 19/20)	16
Analog Output #4 (Terminals 21/22)	16
LON #1 and LON #2 (Terminals 23—28).....	16
Analog Load Sharing Input 1 (Signal Input #1; Terminals 42/43)	21
DSLCL Input (Signal Input #2; Terminals 45/46).....	21
Remote Speed Reference (Signal Input #3; Terminals 48/49)	22
Analog Load Sharing Input 2 (Signal Input #4; Terminals 51/52)	22
RS-422 Communication Port (J1)	22
Communication Port J2	23
Communication Port J3	23
Installation Checkout Procedure	25
CHAPTER 3. ENTERING CONTROL SET POINTS.....	26
Introduction	26
Watch Window Generic PC Interface.....	26
Hand Held Programmer and Menus.....	27
Configure Menus	27
Service Menus	27
Adjusting Set Points	28
Hand Held Programmer Keys	28
Configuration Menu Descriptions	30
Alarm Setup	34
CFIG Communications	36
CFIG Analog Outputs	36
CFIG DSLCL	37
Service Menu Descriptions.....	38
CHAPTER 4. INITIAL ADJUSTMENTS	67
Introduction	67
Speed Adjustments	70
Conclusion of Setup Procedures.....	72

Contents

CHAPTER 5. DESCRIPTION OF OPERATION.....	74
General	74
Analog Input Load Sharing Operation	76
Speed Input	78
Torsional Filter Function	78
Minimum Fuel Function	79
Maximum Fuel Function	79
Start Limit Function.....	79
Fuel Limiting Function	80
Actuator Function.....	81
Speed Failures.....	81
Alarm Reset.....	82
Speed Reference and Ramps	82
Speed Reference and Ramp Functions	82
Modbus/LON Commands to the DSLC Control.....	84
CHAPTER 6. TROUBLESHOOTING	86
Introduction	86
Troubleshooting Procedure	86
Control Test and Calibration	86
Conclusion of Test and Calibration Procedures	90
CHAPTER 7. PRODUCT SUPPORT AND SERVICE OPTIONS	91
Product Support Options	91
Product Service Options.....	91
Returning Equipment for Repair.....	92
Replacement Parts	92
Engineering Services.....	93
Contacting Woodward's Support Organization	93
Technical Assistance	94
APPENDIX A. SERIAL COMMUNICATIONS PORT WIRING	95
APPENDIX B. LINKNET[®] I/O NETWORK	98
Introduction	98
Network Architecture	98
Hardware	98
I/O Module Specifications.....	98
Individual I/O Module Specifications.....	100
LinkNet I/O Module Descriptions	100
APPENDIX C. MODBUS SLAVE ADDRESS INFORMATION	118
Part Numbers 8280-608	118
APPENDIX D. PROGRAMMING CHECKLIST.....	125
APPENDIX E. MENU SUMMARY	135
Configure Menus	135
Service Menus.....	136
723PLUS/AILS CONTROL SPECIFICATIONS.....	139

Illustrations and Tables

Figure 1-1. Flexible Coupled Generator Set.....	3
Figure 1-2. 723PLUS Digital Speed Control.....	5
Figure 1-3. Watch Window Display	6
Figure 1-4. Hand Held Programmer	7
Figure 1-5. Control Wiring Diagram.....	9
Figure 1-6. Typical 723PLUS Connections	10
Figure 2-1. 723PLUS Control Internal Jumpers	13
Figure 3-1. Hand Held Programmer Functions	29
Figure 3-2. Control Gain as a Function of Speed Error.....	43
Figure 3-3. Control Gain as a Function of Control Output.....	43
Figure 3-4. Typical Transient Response Curves	44
Figure 3-5. Speed Filter.....	45
Figure 3-6. Notch Filter.....	48
Figure 3-7. Start Limit Function	49
Figure 3-8. External Fuel Limit Curve.....	53
Figure 5-1. Simplified Block Diagram	75
Figure 5-2. Start Limit Function	80
Figure 5-3. Fuel Limit Breakpoints	81
Figure 5-4. Remote Speed Reference	84
Figure A-1. 723PLUS RS-232 Connections	95
Figure A-2. 723PLUS RS-422 Connections with Optional Termination at Receiver.....	95
Figure A-3. 723PLUS RS-485 Connections with Optional Termination	96
Figure A-4. RS-422 Terminator Locations.....	96
Figure A-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire.....	97
Figure A-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire.....	97
Figure B-1. LinkNet Relay Contacts	99
Figure B-2. Outline Drawing of I/O Module	101
Figure B-3. Discrete Input Module Block Diagram	102
Figure B-4. Discrete Input Module Wiring Diagram.....	103
Figure B-5. 4–20 mA Input Module Block Diagram	104
Figure B-6. 4–20 mA Input Module Wiring Diagram	105
Figure B-7. Thermocouple Input Module Block Diagram	106
Figure B-8. Thermocouple Input Module Wiring Diagram.....	107
Figure B-9. RTD Input Module Block Diagram	108
Figure B-10. RTD Input Module Wiring Diagram	109
Figure B-11. Relay Output Module Block Diagram	110
Figure B-12. Relay Output Module Wiring Diagram.....	111
Figure B-13. 4–20 mA Output Module Block Diagram	112
Figure B-14. 4–20 mA Output Module Wiring Diagram.....	113
Figure B-15. Troubleshooting Flowchart (1 of 2).....	114
Figure B-15. Troubleshooting Flowchart (2 of 2).....	115
Figure B-16. Direct Wired Network.....	117
Figure B-17. Network Wired Via Stubs.....	117
Table 1-1. LinkNet Modules (Summary).....	4
Table 1-2. LinkNet Modules (Address).....	4

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 Speed Control with Analog Input Load Sharing (AILS) for Tandem Engines and is DSLC™ Compatible, model 8280-608 (low voltage). The control system is designed for installation on Tandem Diesel Engine systems.

Declaration of Incorporation

In accordance with the EMC Directive 89/336/EEC and its amendments, this controlling device, manufactured by the Woodward Governor Company, is applied solely as a component to be incorporated into an engine prime mover system. Woodward Governor declares that this controlling device complies with the requirements of EN50081-2 and EN50082-2 when put into service per the installation and operating instructions outlined in the product manual.

IMPORTANT

This controlling device should be put into service only upon incorporation into an engine prime mover system that itself has met the requirements of the above Directive and bears the CE mark.

Application

The 723PLUS AILS control is a standard low voltage speed control with an analog input (exhaust temperature, manifold air pressure, etc.) for virtual engine load sharing control on a tandem engine driver. The analog input type must be proportional to engine load (virtual load). The control is DSLC compatible for generator load sharing. A backup actuator output engine load-sharing schedule is provided and includes provisions for manual adjustment should the analog load sharing input(s) fail.

The 723PLUS AILS control has provisions for connecting one Digital Synchronizer and Load Control (DSLCTM), one or two magnetic pickups (MPUs), two analog (exh temp, MAP, etc.) engine load transmitters, a remote speed reference transmitter, eight discrete contacts for engine speed control, automatic generator synchronizing and load control, analog input load sharing, and shutdown and alarm protection. The discrete inputs connect to droop, alarm reset, speed fail override, 2nd dynamics, raise speed, lower speed, rated speed and close to run switches. Each discrete input requires 10 mA at 24 Vdc nominal voltage rating.

The control outputs include two actuator outputs (analog outputs #3 and #4), two configurable analog outputs and three relay outputs. Actuator output #1 is connected to the engine 1 actuator and actuator output #2 is connected to the engine 2 actuator to control speed and generator load by adjusting fuel oil rack position. In addition, actuator #2 output is biased (+/-) to provide analog input load sharing of the tandem engines. The relay outputs are switched by Modbus® * BW address, alarm and shutdown events. Two analog outputs are configurable as engine speed, engine speed reference, fuel demand, reverse-acting fuel demand, torsional level, remote speed reference, Modbus AW address, generator real power*, generator reactive power*, generator average voltage*, or generator total amperes* signals.

*—Modbus is a trademark of Schneider Automation Inc.

IMPORTANT

Analog output signals marked by asterisk (*) are only available for output if the DSLC is bound to the 723PLUS using Echelon LonMaker™ ** Profiler and Lon Manager™ ** software.

The 723PLUS AILS control provides three communication 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 AILS control provides two LON® ** channels. LON Channel 1 is dedicated to LinkNet® modules to read in various analog and discrete values. LON Channel 2 is dedicated to communication with the DSLC. The 723PLUS unit is also programmed to port DSLC parameters and LinkNet® parameters over to Modbus.

**—LON, LonMaker, and LonManager are trademarks of Echelon Corporation.

The 723PLUS control system includes:

- 723PLUS Digital Speed Control
- ServLink Watch Window (Figure 1-3) or a handheld terminal (Figure 1-4)
- one proportional actuator per engine to position the fuel metering
- an external power source
- one or two speed-sensing devices (two required for coupling torsional filtering)
- eight optional switch contacts to manage control functions
- a DSLC or other load control device
- two virtual load analog transmitters (one per engine)
- two optional analog readout devices for display
- three optional relay-driven alarms and status indicators
- optional Modbus devices for digital monitoring and control
- optional LinkNet Modules to provide additional I/O paths for the Modbus Devices

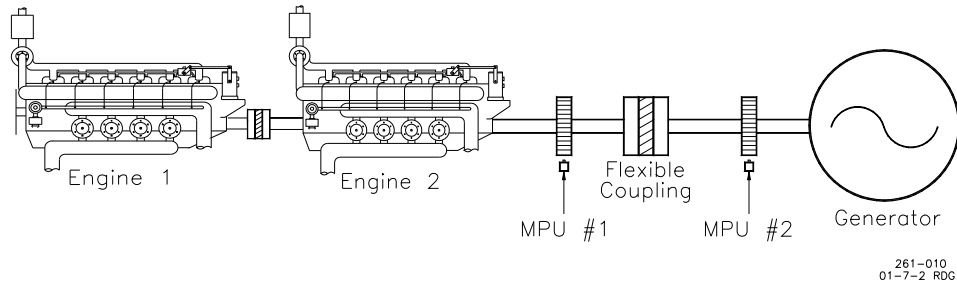


Figure 1-1. Flexible Coupled Generator Set

The 723PLUS control (Figure 1-2) 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.

Control Options

Each 723PLUS control requires 40 W of power. A nominal current in-rush 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 Ω load).

Other control options (on-board jumper configurations):

- proximity switch input for speed signal frequencies below 1000 Hz
- 0–1 or 4–20 mA analog outputs
- 4–20 or 0–200 mA actuator outputs

Magnetic pickup inputs should only be used when operating speeds provide at least 400 Hz magnetic pickup frequency.

723PLUS Digital Speed Control Accessories

PC-based Watch Window Software (part number 8923-932) and a Hand Held Programmer (part number 9907-205) are used for monitoring and adjusting software parameters of the 723PLUS control, including the software options. They plug into communication port J1 of the control. [Hand Held Programmer part number 9905-292 can also be used.] See Figures 1-3 and 1-4.

A DSLC control (Digital Synchronizer and Load Control) for generator load management and load sharing between multiple generator sets can be used with the 723PLUS control. The 723PLUS controls described in this manual are designed to accept load and synchronizing inputs from the DSLC unit through Signal Input # 2.

The 723PLUS control may receive generator parameters from the DSLC through the LON #2 data channel. The generator parameters are used for alarming and output from the 723PLUS control. The generator parameters are also made available to communication port J3. To extract the DSLC information to the 723PLUS, use the LON Binding Kit (part number 9924-863). If the LON hardware is already available, you can order the 723PLUS/DSLC/GATEWAY Standard Database (part number 9924-852). Refer to Woodward manual 02817, *723 Software/DSLC Compatible—Network Binding Procedure*, for detailed binding instructions.

Signal Input # 2 also accepts signals from a Woodward Generator Load Sensor (part number 8290-048) or a Woodward Real Power Sensor (part number 8272-695) when a DSLC control is not used.

The communication port J3 and the LON # 1 data channel allow for digital communications between external Modbus compatible devices and Woodward LinkNet I/O modules. Up to 9 LinkNet modules have been designated for use and can be connected to the LON # 1 channel. The inputs and outputs of these modules can be read and controlled with Modbus compatible devices connected to communication port J3. The number and types of LinkNet modules available:

Description	Nodes Available	Total Channels Available	Network Address	Module Part Numbers
J Thermocouple In–Fail High OR				9905-966
J Thermocouple In–Fail Low	4	24	1, 2, 3, or 4	9905-967
100 Ω Am RTD Input	1	6	5	9905-970
4–20 mA Input	1	6	6	9905-968
Discrete Input	1	16	7	9905-971
Relay Output	1	8	8	9905-973
4–20 mA Output	1	6	9	9905-972
TOTAL	9	66		

Table 1-1. LinkNet Modules (Summary)

Addr.	Description	Channels	Notes
1	J TC–Fail High	6	
2	J TC Input	6	
3	J TC Input	6	
4	J TC Input	6	
5	100 Ω Am RTD Input	6	
6	4–20 mA Input	6	
7	Discrete Input	16	
8	Relay Output	8	
9	Analog Output	6	
Total		66	

Table 1-2. LinkNet Modules (Address)



Figure 1-2. 723PLUS Digital Speed Control

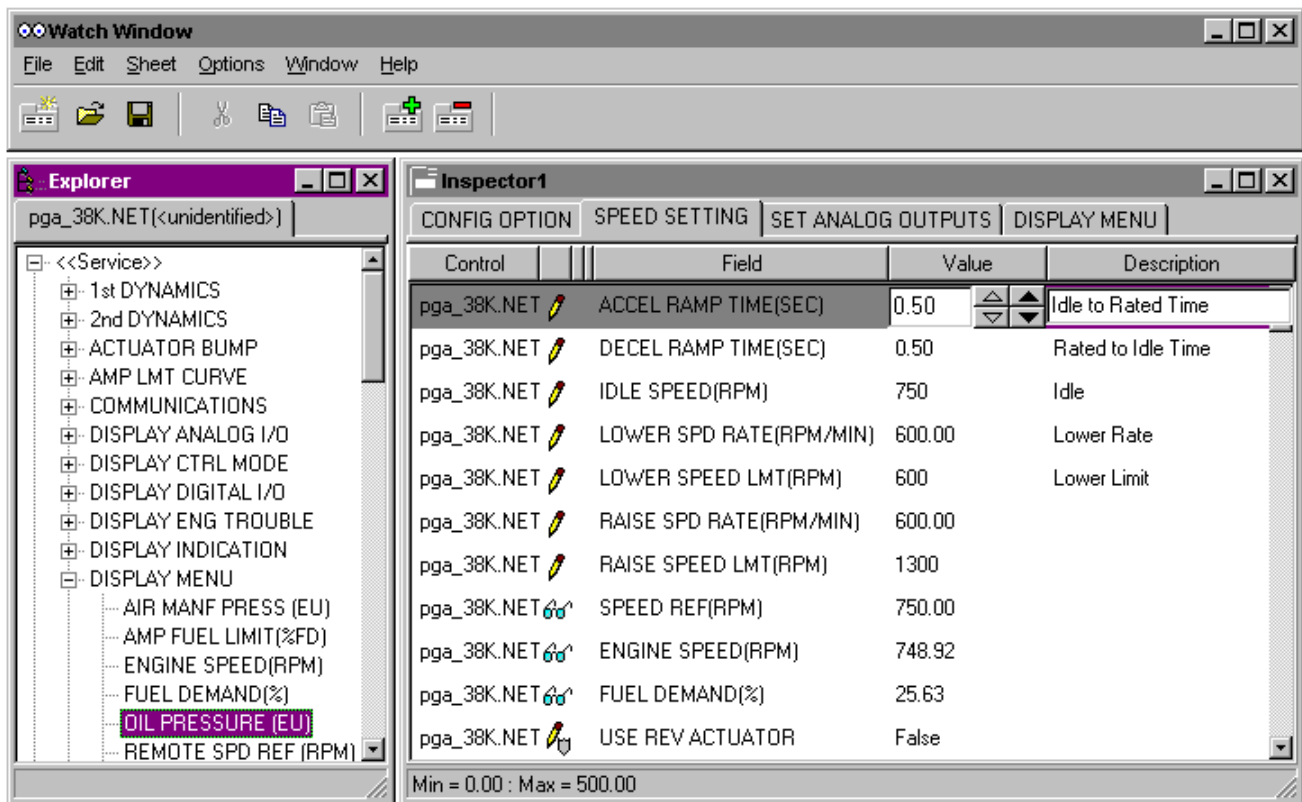


Figure 1-3. Watch Window Display

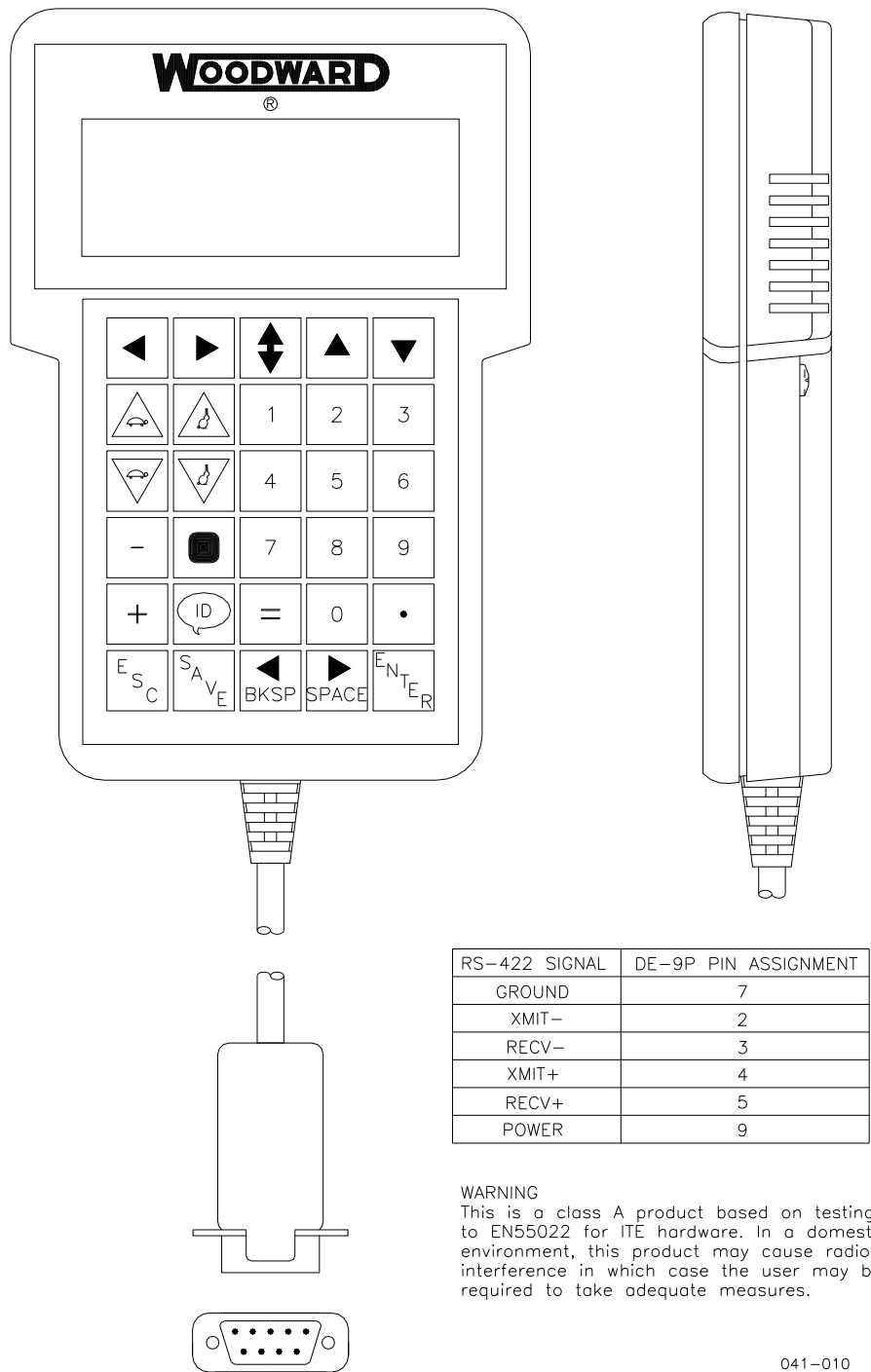


Figure 1-4. Hand Held Programmer

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 TERMINALS 37 AND 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 – REMOVE JUMPER BETWEEN TERMINALS 9 AND 10.
B. PERSONAL COMPUTER – ADD JUMPER BETWEEN TERMINALS 9 AND 10.
1. PERSONAL COMPUTER MUST HAVE WATCH WINDOW SOFTWARE INSTALLED.
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 A RS–232 OR RS–422 SERIAL INTERFACE. COMMUNICATION PORT J3 CAN BE CONFIGURED AS A RS–232, RS–422 OR RS–485 SERIAL INTERFACE. PORT CONFIGURATION CAN BE DONE IN THE APPLICATION SOFTWARE ONLY. FOR THE PIN ASSIGNMENT OF J2 AND J3 SEE APPENDIX A.
16. THE LON MUST BE CONNECTED USING PROPER CABLE AS DESCRIBED IN APPENDIX B. PORT MUST BE BOUND PER APPLICATION NOTE 26031.
17. LON NETWORKS NEED TO BE PROPERLY TERMINATED. THIS CAN BE DONE AT THE 723PLUS BY INSTALLING JUMPERS FROM TERMINALS 24 TO 25 FOR LON #1 AND TERMINALS 27 TO 28 FOR LON #2. REFER TO APPENDIX B FOR FURTHER DETAILS.
18. THE DSLC CONTROL AND OTHER WOODWARD ACCESSORIES PROVIDE ± 5 VDC TO THE 723PLUS. REMOVE THE JUMPER IF USING WOODWARD ACCESSORIES INTO THESE INPUTS.

261–011
01–07–02

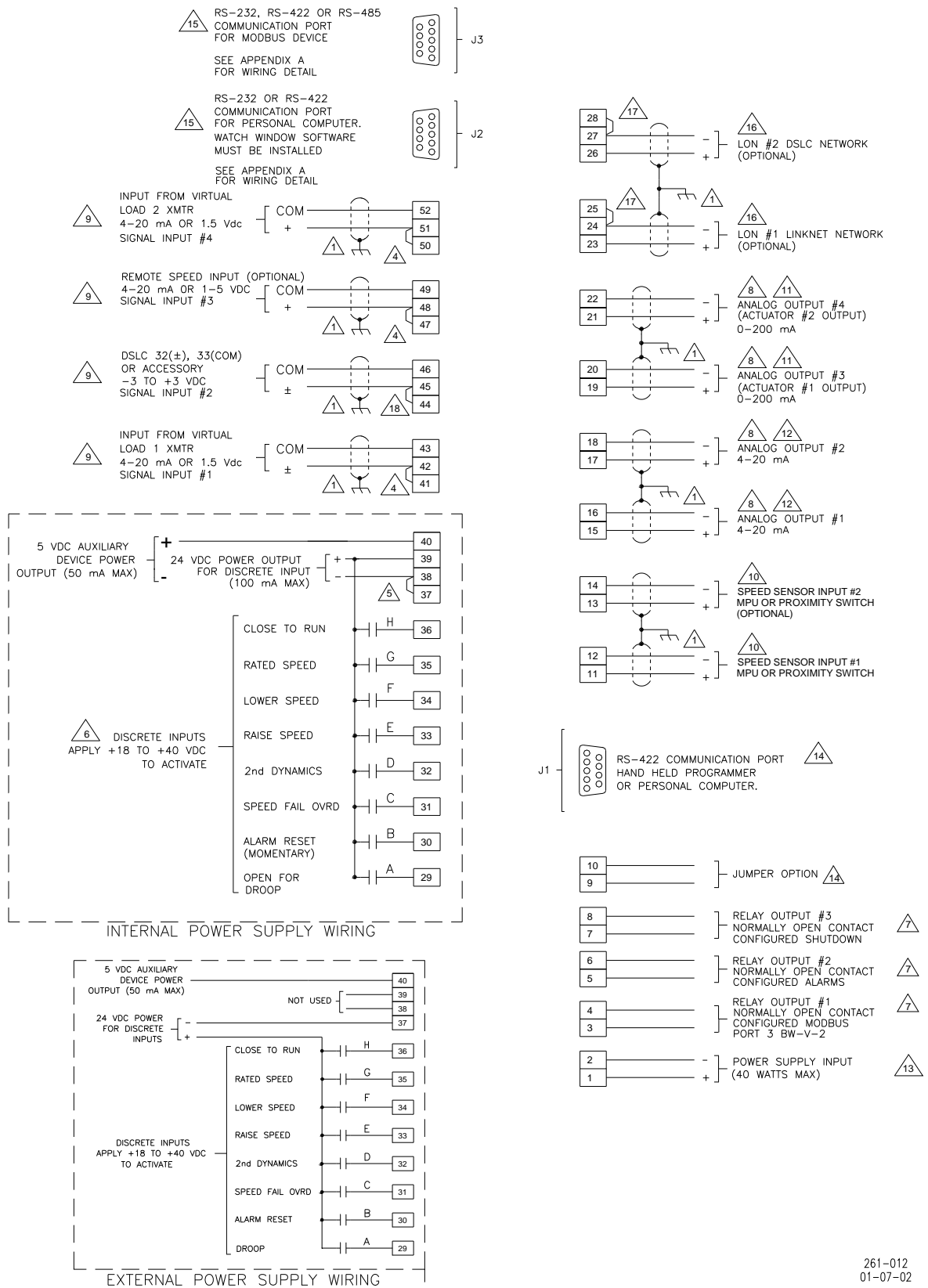


Figure 1-5. Control Wiring Diagram

261-012
01-07-02

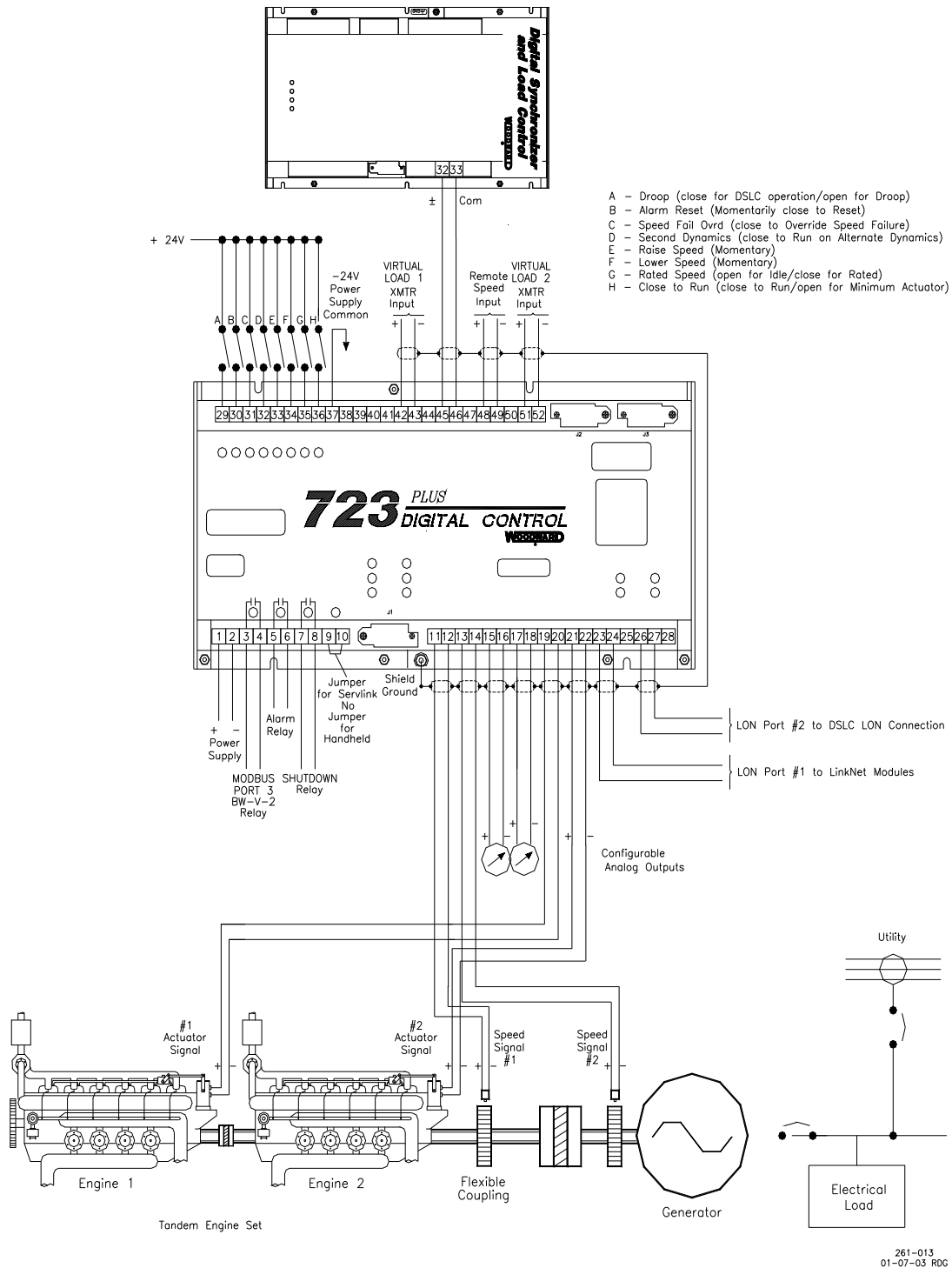


Figure 1-6. Typical 723PLUS Connections

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 Electrostatic Discharge Awareness (p.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 versions require 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 Electrostatic Discharge Awareness (p.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	actuator output #1	0–200 mA, single
	JPR13 & JPR1	actuator output #1	0–20 mA, single
*	JPR15 & JPR3	actuator output #2	0–200 mA, single
	JPR15 & JPR4	actuator output #2	0–20 mA, single
*	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

Electrical Connections

External wiring connections and shielding requirements for a typical 723PLUS control installation are shown in Figure 1-6. The control wiring connections (Figure 1-5) are explained in the rest of this chapter.

Shielded Wiring

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

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

1. Strip outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.
2. Using a sharp, pointed tool, carefully spread the strands of the braided shield.

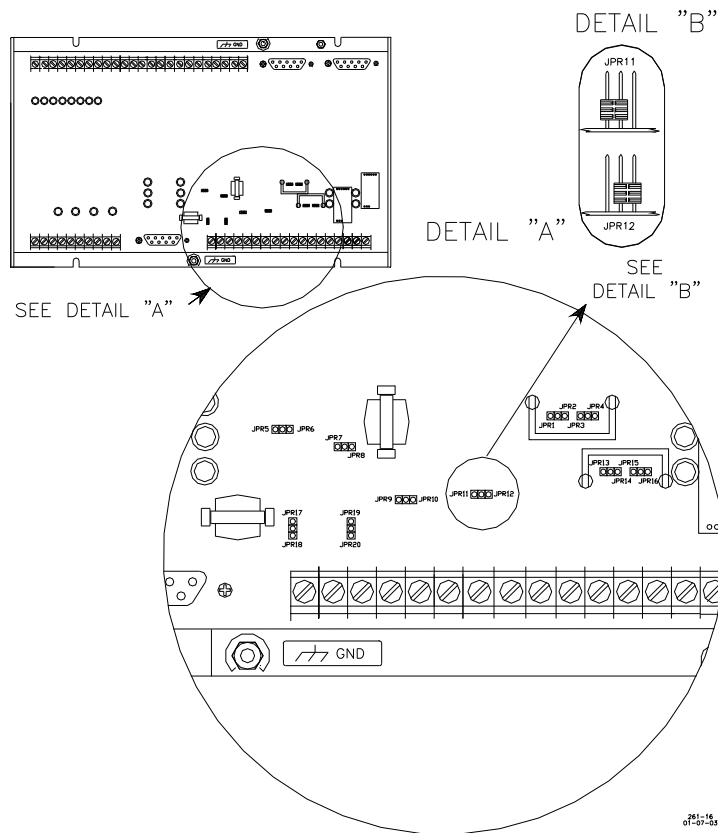


Figure 2-1. 723PLUS Control Internal Jumpers

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 that 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 36) 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.

NOTICE

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 that cause the relays to change state include a Modbus command (BW_V_2), an alarm condition, and a shutdown condition. The contact ratings are shown on the 723PLUS Control Specifications inside the back cover. 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 a Modbus command is intended to drive an external device. Relay Output #1 must be connected to the external device and the Modbus device must be connected to communications port J3. No connections are required if this function is not used in the application. The state of the relay contact will close on a true Modbus command and open on a false Modbus command. 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 alarm conditions are to be used by other devices in the application. No connection is required if the alarm function is not used in the application. The relay changes state if any configured alarm condition has occurred without being cleared or reset. The state of the contact can be configured as either close on alarm or open on alarm. If power to the control is lost, the contact will open.

The relay contact on terminals 7/8 for Relay Output #3 is used when internal shutdown conditions are to be used by other devices in the application. No connection is required if the shutdown function is not used in the application. The relay changes state if any configured shutdown condition has occurred without being cleared or reset. The state of the contact can be configured as either close on shutdown or open on shutdown. If power to the control is lost, the contact will open.

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 generator set, you must connect the first MPU (terminals 11/12) to detect engine speed, and the second MPU (terminals 13/14) to detect generator speed. 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.

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 both be used with non-isolated devices. A number of manufacturers offer 20 mA loop isolators.

Analog Output #1 and #2 (Terminals 15/16 and 17/18)

The two 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. This current signal is supplied to terminals 15(+) and 16(–) for Analog Output #1 and terminals 17(+) and 18(–) for Analog Output #2. 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
- 2– Engine Speed Reference
- 3– Fuel Demand
- 4– Reverse Fuel Demand
- 5– Torsional Level
- 6– Remote Speed Set Point
- 7– J3 Modbus Analog Write Address
 - 4:0002 ANALOG OUTPUT #1
 - 4:0003 ANALOG OUTPUT #2
- 8– Generator Real Power (supplied by the DSLC unit when LON #2 is connected and bound)

- 9– Generator Reactive Power (supplied by the DSLC unit when LON #2 is connected and bound)
- 10– Generator Volts (supplied by the DSLC unit when LON #2 is connected and bound)
- 11– Generator Amps (supplied by the DSLC unit when LON #2 is connected and bound)

IMPORTANT

For generator voltage and amperage, the phase of the generator may be selected by asserting the appropriate Modbus Boolean Write in the table below:

Port J3 Modbus Boolean Write Address Asserted	Voltage Measurement Supplied to Analog Output	Current Measurement Supplied to Analog Output
None Selected	Average 3-phase Voltage	Total 3-phase Current
0:0066	A Phase Voltage	A Phase Current
0:0067	B Phase Voltage	B Phase Current
0:0068	C Phase Voltage	C Phase Current

Analog Output #1 is factory set for 4 to 20 mA, representing the engine speed. Default range is 0 to 1300 rpm. 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 engine speed reference. Default range is 0 to 1300 rpm. Software settings must be changed if the hardware is configured for 0 to 1 mA.

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 #1 wires connect to terminals 19(+) and 20(–). Use shielded wires with the shield connected to chassis at the control. The hardware is factory set for 0 – 200 mA. The unit may be configured for 4 – 20 mA. If the hardware jumper is changed, the software settings must also be changed.

Analog Output #4 (Terminals 21/22)

The actuator #2 wires connect to terminals 21(+) and 22(–). Use shielded wires with the shield connected to chassis at the control. The hardware is factory set for 0 to 200 mA. The unit may be configured for 4–20 mA. If the hardware jumper is changed, the software settings must also be changed.

LON #1 and LON #2 (Terminals 23—28)

The 723PLUS control provides two separate LON communication channels for communicating with Echelon® networks.

LON #1 is used to connect up to nine Woodward LinkNet[®] I/O modules. These modules provide values for temperature, 4 to 20 mA inputs, and discrete inputs for availability to the serial communication port. Additionally, the information can be read on Watch Window when connected to port J1 or J2 or the Hand Held Programmer when connected to J1. Modules can also be used which will provide 4 to 20 mA outputs and relay outputs. These outputs are driven by the Modbus device connected to Communication Port J3.

LON #2 can be connected to the DSLC unit that allows using Modbus port 3 to control loading and synchronizing of the generator. This connection needs to be made if the 723PLUS is using the DSLC information for analog readouts, or monitoring, or control through the Modbus devices.

IMPORTANT

The connection to LON #2 is not required for the DSLC unit to properly perform load control with the 723PLUS. The connection to LON #2 and binding are required to monitor generator parameters at the Modbus device.

If several gensets are connected together with a common LON, the 723PLUS LON #2 channel will connect to this same LON. This connection will require the binding procedure described in Application Note 02817. This connection will allow all parameters described in the DSLC manual 02007C - Chapter 9 to be read by the Modbus device connected to Port J3.

Discrete Inputs (Terminals 29—36)

Discrete inputs are the switch input commands to the 723PLUS control. They interact in such a way as to allow engine control and power management under a variety of conditions.

Voltage is supplied to the discrete input terminal when an input switch or relay contact closes. This will cause the input state for that discrete input to be "TRUE". The input terminal will be open circuited when the input switch or relay contact opens. This will cause the input state for that discrete input to be "FALSE". When the input switch or relay contact is closed, the voltage supplying the discrete inputs 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. The green light above each input terminal will illuminate for a valid "TRUE" state.

In systems that provide an external low voltage source to power the 723PLUS control (or other systems where external low voltage dc power is available), the discrete inputs may be powered by this external low voltage. The voltage source used must be capable of supplying 100 mA at a voltage level of 18 to 40 Vdc. Connect the external low voltage source negative to terminal 37(–). Connect the external low voltage source positive 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.

NOTICE

Remove the factory-installed jumper between terminal 37 and terminal 38 when using external discrete input power.

In systems where the external low voltage dc power is not appropriate, the discrete inputs may be 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. Assure that a connection exists between terminal 37 and terminal 38 when using the internal Discrete Input Power. Do not power other devices with the internal discrete input power source, and assure that the switch or relay contacts used are isolated from any other circuit or system.

Droop/Isochronous (Input A; Terminal 29)

The input switch or relay contact used to de-activate the Droop function connects to terminal 29 (Discrete Input A). This discrete input changes the control state between isochronous and droop control. When the contact is open, the control will operate in droop based on a software-adjusted signal proportional to fuel demand. In this state, the load on the engine will be changed with the RAISE

SPEED and LOWER SPEED contacts described below. Refer to Woodward Application Note 01302 for a further discussion of droop. With the contact closed (discrete input in the "TRUE" state), the DSLC bias will cause the fuel demand to vary according to the analog signal from the DSLC unit or other Woodward accessory connected to Signal Input #2. Note that a "FALSE" state on this input must also de-activate the DSLC unit (by opening the CB Aux input). Otherwise the DSLC unit will erroneously affect other DSLC units in the system.

Alarm Reset (Input B; Terminal 30)

The input switch or relay contact used to activate the Alarm Reset command connects to terminal 30 (Discrete Input B). This discrete input will issue a reset command to all parameters that can latch into an alarm state. Only those parameters that are in the normal state when the discrete input first goes "TRUE" will be reset to the no-alarm condition. When the external switch or relay contacts are closed (discrete input in the "TRUE" state), internal software will limit the command so that the reset condition will apply only for a short time within the control even if the external contact remains closed. With the contacts open (discrete input in the "FALSE" state), the control will again be ready to respond to the external contacts closing. The Alarm Reset command works in parallel with the command from Port J3 and a software switch from the Hand Held Programmer or Watch Window.

Speed Fail Override (Input C; Terminal 31)

The input switch or relay contact used to activate the Speed Fail Override command connects to terminal 31 (Discrete Input C). This discrete input changes the control operation to allow the fuel demand to increase even though the speed signal is not present. This command is normally used to allow the actuator to open for engine starting when the speed signal is too low to be detected. Note that most starting designs will crank the engine fast enough to allow the speed signal to be detected by the control. For these designs, the override command is not needed, and this input can be left disconnected. When the external switch or relay contacts are closed (discrete input in the "TRUE" state), the control will override the shutdown associated with losing the speed sensor. With the contacts open (discrete input in the "FALSE" state), the control will shut down if both speed sensor signals are lost.

For reverse-acting systems where the fuel demand is allowed to increase to the speed setting of a mechanical governor when the electrical system fails, this discrete input should be set to the "TRUE" state. Do by connecting the input directly to the positive Discrete Input Power source. This action will force the fuel demand to increase if the electrical speed signal is lost, and relinquish control to the mechanical governor. Be sure the mechanical governor is properly set up to assume control in the event of an electrical system failure. The mechanical governor must NOT be set up to assume control during normal electrical governor operation. Such interaction produces undesirable instability.



To prevent possible serious injury from an overspeeding engine, the Speed Fail Override command must be "FALSE" during normal operating conditions of direct-acting systems. This is accomplished by open circuiting the discrete input at terminal 31. If switch or relay contacts are used to activate this command, the contacts must be designed to open when the engine is running under normal governor control.

2nd Dynamics (Input D; Terminal 32)

The input switch or relay contact used to activate the 2nd Dynamics command connects to terminal 32 (Discrete Input D). This discrete input changes the control operation to allow a second set of dynamic terms to be used. This command is normally used when the closed loop path needs two independent sets of dynamics such as with circuit breaker open/closed or with dual-fuel engines. When the input switch or relay contacts are closed (discrete input in the "TRUE" state), the control will use the 2nd Dynamics set. When the contacts are open (discrete input in the "FALSE" state), the control will use the 1st Dynamics set. No connection needs to be made to this input if only one set of dynamics is used.

Raise Speed Contact (Input E; Terminal 33)

The input switch or relay contact used to activate the Raise Speed command connects to terminal 33 (Discrete Input E). This discrete input changes the control operation by increasing the speed reference ramp. The ramp can increase only to a software adjusted RAISE SPEED limit. The ramp will increase at a software-adjusted rate. De-selecting the Rated Speed command (described below) will take command control away from Raise Speed and effectively disable the command. This command is normally used to allow raising the engine speed for manually synchronizing and testing high-speed operations such as overspeed. The Raise Speed command will increase the fuel demand and load when the system is run in droop. If the 723PLUS is being used with a DSLC unit, the Raise Speed command should not be used when the generator breaker is closed. When the external switch or relay contacts are closed (discrete input in the "TRUE" state), the control will raise the speed reference. Raise is limited to the maximum speed limit. With the contacts open (discrete input in the "FALSE" state), the control will stop raising the speed reference. Maintained simultaneous closure of this Raise Speed contact along with the Lower Speed contact enables the Remote Speed Input.

Lower Speed Contact (Input F; Terminal 34)

The input switch or relay contact used to activate the Lower Speed command connects to terminal 34 (Discrete Input F). This discrete input changes the control operation by decreasing the speed reference ramp. The ramp can decrease only to a software adjusted LOWER SPEED limit. The ramp will decrease at a software-adjusted rate. De-selecting the Rated Speed command (described below) will take command control away from Lower Speed and effectively disable the command. This command is normally used to allow

lowering the engine speed for manually synchronizing and testing low speed operations such as critical speeds. The Lower Speed command will decrease the fuel demand and load when the system is run in droop. If the 723PLUS is being used with a DSLC unit, the Lower Speed command should not be used when the generator breaker is closed. When the external switch or relay contacts are closed (discrete input in the "TRUE" state), the control will lower the speed reference. Lower is limited to the minimum speed limit. With the contacts open (discrete input in the "FALSE" state), the control will stop lowering the speed reference. Maintained simultaneous closure of this Lower Speed contact along with the Raise Speed contact enables the Remote Speed Input.

Rated Speed (Input G; Terminal 35)

The external contact used to activate the Rated Speed command connects to terminal 35 (Discrete Input G). This discrete input changes the control operation by increasing the speed reference to RATED SPEED and decreasing the speed reference to IDLE SPEED. When the switch or relay contacts are closed (discrete input in the "TRUE" state), the speed reference will ramp for a time set by the Accel Time to the rated speed control point. When the switch or relay contacts are open (discrete input in the "FALSE" state), the speed reference will ramp for a time set by the Decel Time to the idle speed control point. If the 723PLUS is being used with a DSLC unit, the Rated Speed input should be left in the "TRUE" state when the generator breaker is closed. If the application does not require an idle speed setting, the Rated Speed input can be left in the "TRUE" state at all times. Do this by connecting the input directly to the positive Discrete Input Power source.

Close to Run (Input H; Terminal 36)

The external contact used to activate the Close to Run command connects to terminal 36 (Discrete Input H). This discrete input changes the control operation by immediately decreasing the fuel demand to zero. When the switch or relay contacts are closed (discrete input in the "TRUE" state), the control is allowed to control the fuel in an attempt to control the speed/load of the prime mover. When the switch or relay contacts are open (discrete input in the "FALSE" state), the Minimum Fuel Function will immediately pull the fuel demand to zero.

The Close to Run command is the preferred means for a normal shutdown of the engine. The control output to the actuator will be minimum fuel demand when no voltage is applied to terminal 36.



WARNING The Close to Run 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 Close to Run discrete input as the sole means of shutdown in any emergency stop sequence.

Analog Load Sharing Input 1 (Signal Input #1; Terminals 42/43)

Connect an engine 1 load (exhaust temperature, air manifold pressure, etc.) transmitter to Signal Input #1. The input signal must be an isolated high-quality signal.

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 42 and 41. 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.

A failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) and for values exceeding 21 mA (5.25 Vdc). A detected failure will cause a configured alarm or shutdown (or both) to remain until the failure is repaired and an Alarm Reset is issued. Configured alarm conditions actuate Relay Output #2 and configured shutdown conditions actuate Relay Output #3.

DSLCL Input (Signal Input #2; Terminals 45/46)

Use a shielded twisted-pair cable to connect the low-impedance output from DSLCL terminals 32(\pm) and 33(COM) to terminals 45(\pm) and 46(COM). Also remove the factory-installed jumper between terminals 44 and 45. The DSLCL unit is described in Product Specification 02006 and Manual 02007. This input allows a change in speed reference by 3% of Rated speed per volt input to terminals 42 and 43.



IMPORTANT Use only DSLCL bias output option ± 3.0 Vdc.

Remote Speed Reference (Signal Input #3; Terminals 48/49)

Connect a remote speed reference transmitter to Signal Input #3. The input signal must be an isolated high-quality signal. 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 48 and 47. 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. A failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) and for values exceeding 21 mA (5.25 Vdc). A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

Analog Load Sharing Input 2 (Signal Input #4; Terminals 51/52)

Connect an engine 2 load (exhaust temperature, air manifold pressure, etc.) transmitter to Signal Input #4. The input signal must be an isolated high-quality signal.

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 51(+) and 52(-). When using a voltage transmitter, remove the jumper between terminals 50 and 51. 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.

A failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) and for values exceeding 21 mA (5.25 Vdc). A detected failure will cause a configured alarm or shutdown (or both) to remain until the failure is repaired and an Alarm Reset is issued. Configured alarm conditions actuate Relay Output #2 and configured shutdown conditions actuate Relay Output #3.

RS-422 Communication Port (J1)

Port J1 is intended for use with the Woodward ST2000 Hand Held Programmer (part number 9907-205), or Watch Window software (part number 8923-932). The RS-232/RS-422 download cable (part number 5416-870) or Hand Held Programmer plug into communication port J1 of the control. These allow the user to configure software, adjust set points, and display parameters. A jumper switches Port J1 function. See Chapters 3 and 4 for the menu items available. Contact your local distributor for other options.

Communication Port J2

Communication Port J2 is an alternate ServLink connection for use with Watch Window software. Port J2 can be software configured to standard specifications for RS-232 or RS-422. BAUD rates can be set for 100, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, or 38400. Unlike Port J1, an RS-232 null modem cable is used to connect Port J2 to a personal computer. Watch Window can be used to display and modify tunable and configurable values in the control, to shut down the control, restart the control, and upload and download tuning parameters. Multiple values are simultaneously displayed. The ability to link to a control over a network via network DDE is also provided.

Port J2 is a 9-pin subminiature D receptacle connector. See Appendix A for wiring detail.

Communication Port J3

Communication Port J3 is used to connect a separate Modbus device to the 723PLUS control. This device is used to read control parameters and inputs from connected LinkNet nodes and the DSLC if LON binding is performed. The Modbus device can drive LinkNet nodes, the DSLC control parameters and 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, any compatible SCADA system, etc.

Communication Port J3 can be software configured for a wide variety of serial communications. Port J3 can be software configured to standard specifications for RS-232, RS-422, or RS-485. BAUD rates can be independently set for 1200, 1800, 2400, 4800, 9600, 19200, or 38400. The only restrictions are that if Port J2 is set for a BAUD rate of 19200 then Port J3 BAUD rate cannot be 38400 and if Port J2 is set for a BAUD rate of 38400 then Port J3 BAUD rate 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.

Communication Port J3 can read all 723PLUS control parameters, read all connected LinkNet inputs, read all DSLC control parameters, send commands and values to all connected LinkNet outputs, all DSLC outputs and send limited commands and three signals to the 723PLUS control. The three signals, which can be sent to the 723PLUS, are the remote speed reference and a source value for configured analog outputs #1, and #2. The commands which can be sent to the 723PLUS control are Alarm Reset, 723 Relay Output #1, Close for isochronous Control, Close to Override Failsafe, Close for 2nd Dynamics, Raise Speed, Lower Speed, Close for Rated Speed, Close to Run, Use Isoch Remote Command, Use Failsafe Override Remote Command, Use 2nd Dynamics Remote Command, Use Raise Speed Remote Command, Use Lower Speed Remote Command, Use Rated/Idle Remote Command, Use Run Remote Command, and Use Remote Speed Reference. The Alarm Reset command works in parallel with the discrete input Alarm Reset command connected to terminal 30 (B), and a software switch from Watch Window or the Hand Held Programmer. The Raise Speed and Lower Speed commands work independently (by configuration) from the discrete inputs Raise Speed (terminal 33,E) and Lower Speed (terminal 34,F) respectively. See Appendix C for complete listings of port addresses and description of values for Port J3.

To activate the appropriate Discrete input via Modbus Boolean Write, you must assert the '723 Command Close Discrete Input', and you must also assert the 'Use Discrete Input Command'. This method allows you to choose which inputs you would like to have activated by hardware and which inputs you wish to ignore the hardware and use the Modbus Boolean Write command. Also be aware that you can read the hardware state of the Discrete Input using a Boolean Read Modbus command.

The DSLC control can provide a wealth of generator information to the Modbus devices. Over fifteen Analog Read values and fifty Boolean Read values are furnished (e.g., Real Power, Apparent Power, Reactive Power, Volts, Amps, Gen Frequency, Bus Frequency, Synchronizer in Run Mode, Load Control in Parallel Mode, etc.). The Modbus value for power factor is times 1000 and for frequency is times 100 (that is, at 0.8 power factor the Modbus value is 800 and at 60 Hz the Modbus value is 6000). All other Modbus values are in engineering units. Note that the information from the DSLC unit is only available when the DSLC unit is connected to LON #2 and has gone through the binding process (see Application Note 02817). See Appendix C for complete listings of port addresses and description of values for Port J3.

Optional LinkNet nodes provide system parameters that can be sent to and used by the Modbus devices connected to Communication Port J3. The LinkNet nodes can provide temperature signals from 24 (type "J") thermocouples and 6 (3-wire, 100 Ω American curve) RTDs. Nodes can also provide 6 analog inputs in the form of 4 to 20 mA signals and 16 discrete inputs. All signal input values sent to the Modbus device are scaled in milliamps x1000 (that is, a 12 mA signal input to a 4–20 mA input LinkNet node will be read as 12000 on the corresponding address by the Modbus device). LinkNet nodes can also be used to provide system parameters from a Modbus device to the system. This can occur only with the Modbus device connected to Communication Port J3. The LinkNet nodes can provide up to six 4 to 20 mA outputs and 8 Form C relay outputs (contacts are rated 5 A at 28 Vdc). The 4 to 20 mA outputs must be scaled as milliamps x1000 from the Modbus device (that is, to produce 12 mA from a particular output, the Modbus device must send a value 12000). The relay outputs will energize when the state of the correct address is set to "TRUE". A "FALSE" state will cause the relay output to de-energize.

Modbus Analog Write Addresses 0002 and 0003 allow control of configurable analog outputs #1 and #2 respectively. The signed 16-bit integer must be scaled as milliamps x1000 for communication (that is, to produce a 12 mA output from the 723PLUS analog output #1, a value of 12000 must be applied to address 4:0002). Modbus Analog Write Address 0005 allows control of the speed reference. The signed 16-bit integer must be scaled as rpm for communication (that is, to produce a 330 rpm output from the 723PLUS a value of 330 must be applied to address 4:0005).

Port J3 is a 9-pin subminiature D receptacle connector. See Appendix A for wiring detail.

Installation Checkout Procedure

With the installation complete as described in this chapter, do the following checkout procedure before beginning set point entry (Chapter 3) or initial start-up adjustments (Chapter 4).

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, *Electric Governor Installation Guide* for additional information on linkage.



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 valve or fuel rack is at the minimum fuel delivery position.

- B. Check for correct wiring in accordance with the control wiring diagram, Figure 1-5.
 - 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 runout 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.

Entering Control Set Points

Introduction

Because of the variety of installations, plus system and component tolerances, the 723PLUS control must be tuned and configured for each system to obtain optimum performance.

This chapter contains information on how to enter control set points through the control's menu system using the Hand Held Programmer or Watch Window. See the next chapter for prestart-up and start-up settings and adjustments.



WARNING

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

Watch Window Generic PC Interface

Watch Window was developed by Woodward to be a ServLink client software product that provides a generic PC interface to 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, 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. A jumper between terminals 9 and 10 sets port J1 as a ServLink interface port. Removing this jumper sets port J1 as a Hand Held Programmer interface port. As an alternative, Watch Window also communicates with the control through RS-232 null modem cable connection to port J2. Read “Help About” to display the part number and revision level of the software in the control. Refer to this number and revision level in any correspondence with Woodward (write this information in the programming checklist, Appendix D). Read “Getting Started” notepad included with the Watch Window install software.

Hand Held Programmer and Menus

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 (terminal J1). 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. Remove the jumper between terminals 9 and 10 to set port J1 for hand held interface.

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 pertaining to the application. Press the "ID" key to display the part number and revision level of the software in the control. Refer to this number and revision level in any correspondence with Woodward (write this information in the Programming Checklist, Appendix D).

The 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.

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

Configure Menus

To access the Configure menus, the engine must be shutdown. 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. Note: If the engine is running during this process, it will be shutdown due to shutting down the I/O of the control. To move between the menus use the "Right Arrow" and "Left Arrow" keys. To move through the set points within a menu, use the "UP Arrow" and "Down Arrow" 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.

Service Menus

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

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

IMPORTANT

This may be done in CONFIGURE MODE. This may also be done in SERVICE MODE only when the figure is within 10% of the existing value.

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 3-1):

(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).
+ (plus)	Increases set point values by one step at a time.
– (minus)	Decreases set point values by one step at a time. Also used for entering negative exact values.
(solid square)	Not used.
ID	Displays the 723PLUS control part number and software revision level (can only be accessed from the TOP main screen).
ESC	To return to menu header or to main screen, or to exit Configure and save set points.

SAVE
BKSP
SPACE
ENTER

= (equals)
(decimal)

Saves entered values (set points).
Scrolls left through line of display.
Scrolls right through line of display.
Used when entering exact values and
accessing Configure.
For entering exact values (within 10%).
To select Configure. Also used for entering
decimal exact values.

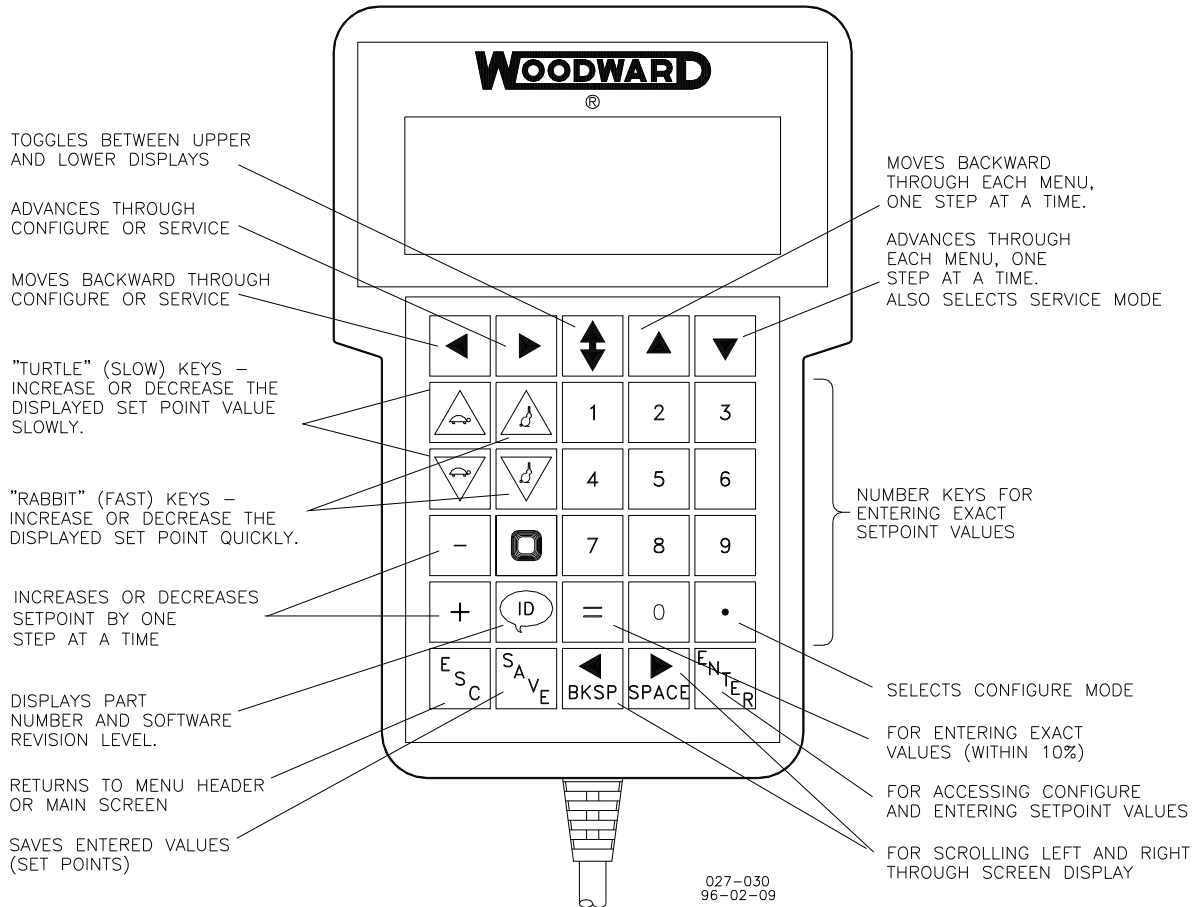


Figure 3-1. Hand Held Programmer Functions

Configuration Menu Descriptions

CFIG Options

1. **USE REVERSE ACTING** should be set to TRUE for reverse acting actuators and FALSE for forward acting actuators (default is FALSE). Forward-acting actuators require increased current to increase fuel. Reverse-acting actuators require decreased current to increase fuel (reverse-acting actuators should always incorporate a mechanical ballhead backup governor, such as the Woodward EGB).
2. **USE 2nd DYNAMICS** should be set TRUE to bring into view the 2nd SPEED DYNAMICS menu when the 2nd Dynamics discrete input is TRUE and permit the use of the 2nd Dynamics function. Set to FALSE to disable the 2nd Dynamics function and conceal the 2nd SPEED DYNAMICS menu.
3. **USE 5-GAIN MAP** should be set TRUE to bring into view the 1st DYNAMICS- 5 GAIN menu and permit the use of a 5-Gain Curve for setting the control gain as a function of fuel demand. If Use 2nd Dynamics is also set TRUE, the 2nd DYNAMICS- 5 GAIN menu will appear when the 2nd Dynamics discrete input is TRUE and permit the use of a second 5-Gain Curve. These two curves each provide 5 tunable gain settings at 5 tunable fuel demand breakpoints. When USE CONST DYNAMICS is also set FALSE, the 5-gain curve settings are varied by the ratio of actual engine speed to rated speed (e.g., at 50% speed the gain setting is also reduced by 50%). Set to FALSE to disable the 5-gain curve function and conceal the DYNAMICS- 5 GAIN menus.
4. **USE CONST DYNAMICS** should be set to TRUE to enable constant dynamics. Set to FALSE to allow variable dynamics which will vary the speed control gain setting by the ratio of actual engine speed to rated speed and the reset setting by the ratio of rated speed to actual engine speed.
5. **USE EXT FUEL LIMIT** should be set to TRUE to bring into view the EXT FUEL LIMIT CURVE menu and permit the use of the External Fuel Limit. The External Fuel Limit function provides five tunable limits of the fuel demand at five tunable external input breakpoints. Normally an air manifold pressure transmitter is used as the Ext Fuel Limit input device. Set to FALSE to disable the Ext Fuel Limit function and conceal the EXT FUEL LIMIT CURVE menu.
6. **USE COMM PORTS** should be set to TRUE to bring into view the configuration and service menus for Communication Ports 2 and 3 and DSLC. Set to FALSE to conceal the Communication Ports 2 and 3 configuration and service menus.
7. **USE REMOTE COMMANDS** is 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.
8. **REMOTE LOCK IN LAST** is used to hold the last speed reference before failure when the Remote Speed or Process Reference inputs fail. Set to FALSE to disable REMOTE LOCK IN LAST. Set to TRUE to enable REMOTE LOCK IN LAST.

9. **RESET ALM ON CLEAR** is set to TRUE to issue an alarm reset whenever engine speed reaches 5% of rated speed during starting. Set to FALSE to block this alarm reset function. A FALSE setting does not block other types of alarm resets.
10. **FORCE DISCRETE OUTPUTS** should be set to TRUE to enable manual control of the discrete outputs and disable automatic control. Set to FALSE to disable manual control and enable automatic control (default is FALSE).
11. **USE AI LOAD SHARE** should be set TRUE to allow analog input (EXHT, MAP, etc.) load sharing control and set FALSE to block analog input load sharing control (default is FALSE).
12. **USE REV AI LD SHARE** should be set TRUE if the analog load sharing input mA level decreases as load increases and set FALSE if analog input mA level increases as load increases (default is FALSE).
13. **USE TORSION FILTER** should be set to TRUE to bring into view the TORSIONAL FILTER menu and permit the use of the Flexible Coupling Torsional Filter or the Notch Filter function. Set to FALSE to disable these functions and conceal the TORSIONAL FILTER menu.
14. **USE NOTCH FILTER** enables/disables a Notch Filter on the speed input(s). Set TRUE to enable the notch filter and disable the torsional filter. Set to FALSE to disable the notch filter and permit the torsional filter to be enabled.
15. **ENABLE TORS LIMITER** should be set to TRUE to enable a tunable Torsional Fuel Limiter. Set FALSE to disable this Fuel Limiter.
16. **USE START SPEED** should be set to TRUE to enable a tunable Start Speed Reference. Set to FALSE to disable the Start Speed Reference.

CFIG Speed Control

1. **RATED SPEED** sets the normal operating speed of the engine. It should be set at the speed at which the engine is operated at full load.
2. **DSPD #1 TEETH** is the number of teeth or holes in the gear or flywheel that speed sensor #1 is on. If the gear is running at camshaft speed (one-half engine speed) then you must enter one-half the number of teeth on the gear. The control requires the number of teeth per engine revolution. If a flexible coupling is being used, DSPD #1 must be on the engine side of the coupling.
3. **DSPD #2 TEETH** is the number of teeth or holes in the gear or flywheel that speed sensor #2 is on. If the gear is running at camshaft speed (one-half engine speed) then you must enter one-half the number of teeth on the gear. The control requires the number of teeth per engine revolution. If a flexible coupling is being used, DSPD #2 must be on the load side of the coupling.

IMPORTANT

Better control performance will be obtained when sensing speed from a gear rotating at full engine speed. Slower-speed gears (such as the camshaft) provide a lower sampling rate that increases control-loop response time and degrades performance.

 **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.

4. **SS CLEAR PERCENTAGE** should be set to a percentage of rated engine speed that will verify a valid MPU signal exists while the engine is cranking (default is 5% of rated).
5. **MPU ALARM ARM TIME** is the time delay to wait before latching armed the MPU failure alarm and shutdown functions once a valid MPU signal is detected. Opening the "Close to Run" contact resets the latch block to prevent MPU failure alarm and shutdown conditions from occurring with normal stops.

CFIG Shutdown/Alarms

1. **SPEED #1 FAIL** sets the condition which will occur when a loss of the speed sensor #1 input signal has been detected. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu. This condition is disarmed when the Run/Stop discrete input is used to stop the engine.
2. **SPEED #2 FAIL** sets the condition which will occur when a loss of the speed sensor #2 input signal has been detected. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu. This condition is disarmed when the Run/Stop discrete input is used to stop the engine.
3. **SPEED #1 AND #2 FAIL** sets the condition which will occur when a loss of both speed sensor #1 and #2 input signals has been detected. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu. This condition is disarmed when the Run/Stop discrete input is used to stop the engine.
4. **AILS 1 INPUT FAIL** sets the condition which will occur when the Analog Load Sharing Input 1 drops below 2 mA or increases above 21 mA. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
5. **REMOTE INPUT FAIL** sets the condition that will occur when the Remote Speed Setting input drops below 2 mA or increases above 21 mA. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
6. **AILS 4 INPUT FAIL** sets the condition that will occur when the Analog Load Sharing Input 4 drops below 2 mA or increases above 21 mA. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
7. **MODBUS PORT3 FAIL** sets the condition that will occur when a Port 3 Link Error occurs. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.

8. **DSLC LON ERROR** sets the condition that will occur when a DSLC LON Error occurs. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
9. **HIGH FUEL DEMND LEVEL** sets the condition that will occur when the fuel demand rises above the HI FUEL DEMND SETPT. This condition may be enabled as a Shutdown, Alarm,, or both, by selecting TRUE in the appropriate menu.
10. **HIGH SPEED LEVEL** sets the condition that will occur when the engine speed rises above the HI SPEED SETPOINT. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
11. **HI TORSIONAL LEVEL** sets the condition that will occur when the TORSION LEVEL SETPT has been exceeded. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
12. **ON MAX LIMIT** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when this fuel limit is in control and to display condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.
13. **ON EXT FUEL LIMIT** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when this fuel limit is in control and to display this condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.
14. **ON TORSION LIMIT** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when this fuel limit is in control and to display this condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.
15. **ACT SHUTDOWN** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when this fuel limit is in control and to display this condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.
16. **SPEED SWITCH** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when this speed switch is triggered and to display this condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.
17. **ON AI LD SH LIMIT** is set to TRUE to actuate Alarm Relay Output #2 or Shutdown Relay Output #3 or both when the analog input load sharing signal is on a high or low level limit and to display this condition on the ALARM MENU or the SHUTDOWN MENU or both by selecting TRUE in the appropriate menu.

Shutdown Setup

1. **HI FUEL DEMND SETPT**—Enter the % Fuel Demand fault level required to trigger the HI FUEL DEMND LEVEL shutdown.
2. **HI FUEL DEMND DELAY**—Enter the delay time (in seconds) to wait before the HI FUEL DEMND LEVEL shutdown is issued after the % Fuel Demand exceeds the HI FUEL DEMND SETPT.

3. **HI SPEED SETPOINT**—Enter the engine speed fault level (rpm) required to trigger the HI SPEED LEVEL shutdown.
4. **HI SPEED DELAY**—Enter the delay time (in seconds) to wait before the HI SPEED LEVEL shutdown is issued after engine speed exceeds the HI SPEED SETPT.
5. **TORSION LEVEL SETPT**—Enter the engine torsional vibration fault level (%RPM) required to trigger the HI TORSIONAL LEVEL shutdown.

IMPORTANT

The torsional vibration fault level is a percentage of the full scale torsional vibration which is scaled using TORS SCALE on the TORSIONAL FILTER service menu. Scaling sets the value of torsional vibration (as a % rated engine rpm) that equals the full scale (100%) torsional vibration level. For example, at a rated rpm of 1200 and a TORS SCALE setting of 1% of rated, the full scale torsional vibration in rpm is 1% of 1200 or 12 rpm. At a TORSION LEVEL SETPT of 50% rpm, a HI TORSIONAL LEVEL shutdown will be triggered when the torsional vibration level is at or above 50% of 12 rpm or 6 rpm torsional vibration.

IMPORTANT

Be sure the TORS SCALE (% RT RPM) is properly set. It can be found on the TORSIONAL FILTER service menu . Default setting is 1% of rated rpm.

6. **HI TORSION DELAY**—Enter the delay time in seconds that the torsional level is above the TORSION LEVEL SETPT before the HIGH TORSION LEVEL shutdown is activated.
7. **ENERGIZE FOR SHTDWN** is set to TRUE to energize Relay Output #3 with any configured shutdown condition. Set to FALSE to de-energize Relay Output #3 with any configured shutdown condition.
8. **SPD SWITCH PICKUP**—Enter the engine speed level (rpm) required to trigger the SPEED SWITCH shutdown.
9. **SPD SWITCH DROPOUT**—Enter the engine speed level (rpm) required to clear the SPEED SWITCH shutdown.
10. **SHUTDOWN ACT ON SD** is set to TRUE to shutdown the speed control fuel actuator with any shutdown condition. Set to FALSE to prevent shutdown of the speed control fuel actuator with any shutdown condition.

Alarm Setup

1. **HI FUEL DEMND SETPT**—Enter the % Fuel Demand fault level required to trigger the HI FUEL DEMND LEVEL alarm.
2. **HI FUEL DEMND DELAY**—Enter the delay time (in seconds) to wait before the HI FUEL DEMND LEVEL alarm is issued after the % Fuel Demand exceeds the HI FUEL DEMND SETPT.
3. **HI SPEED SETPOINT**—Enter the engine speed fault level (rpm) required to trigger the HI SPEED LEVEL alarm.

4. **HI SPEED DELAY**—Enter the delay time (in seconds) to wait before the HI SPEED LEVEL alarm is issued after engine speed exceeds the HI SPEED SETPT.
5. **TORSION LEVEL SETPT**—Enter the engine torsional vibration fault level (%RPM) required to trigger the HI TORSIONAL LEVEL alarm.

IMPORTANT

The torsional vibration fault level is a percentage of the full scale torsional vibration that is scaled using TORS SCALE on the TORSIONAL FILTER service menu. Scaling sets the value of torsional vibration (as a % rated engine rpm) that equals the full scale (100%) torsional vibration level. For example, at a rated rpm of 1200 and a TORS SCALE setting of 1% of rated, the full scale torsional vibration in rpm is 1% of 1200 or 12 rpm. At a TORSION LEVEL SETPT of 25% rpm, a HI TORSIONAL LEVEL alarm will be triggered when the torsional vibration level is at or above 25% of 12 rpm or 3 rpm torsional vibration.

IMPORTANT

Be sure the TORS SCALE (% RT RPM) is properly set. It can be found on the TORSIONAL FILTER service menu . Default setting is 1% of Rated RPM.

6. **HI TORSION DELAY**—Enter the delay time in seconds that the torsional level is above the TORSION LEVEL SETPT before the HIGH TORSION LEVEL alarm is activated.
7. **ENERGIZE FOR ALARM** is set to TRUE to energize Relay Output #2 with any configured alarm condition. Set to FALSE to de-energize Relay Output #2 with any configured alarm condition.
8. **SPD SWITCH PICKUP**—Enter the engine speed level (rpm) required to trigger the SPEED SWITCH alarm.
9. **SPD SWITCH DROPOUT**—Enter the engine speed level (rpm) required to clear the SPEED SWITCH alarm.
10. **SHUTDOWN ACT ON ALM** is set to TRUE to shutdown the speed control fuel actuator with any alarm condition. Set to FALSE to prevent shutdown of the speed control fuel actuator with any alarm condition.

IMPORTANT

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

CFIG Communications

CFIG COMMUNICATION

The 723PLUS has two serial ports. Port 2 is configured as a ServLink port for Watch Window. Port 3 is configured to support the Modbus protocol. These 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 (see the Modbus Register List, Appendix C, for the addresses). USE COMM PORT found in menu CFIG OPTION must be set TRUE to bring this menu into view. This menu is concealed when USE COMM PORT is set FALSE.

1. **PORT 2 ADDRESS** determines the port's multidrop ServLink address from 0 to 15.
2. **PORT 3 ADDRESS** determines the port's multidrop Modbus address from 1 to 247.
3. **PORT 3 MODE** determines if port J3 will use the Modbus ASCII or Modbus RTU mode.
4. 1 = ASCII
5. 2 = RTU

CFIG Analog Outputs

This menu allows configuration of the four analog outputs. This configuration will determine which parameters are in control of the outputs. These menu items are also used along with the Hardware Jumper Configuration to determine the output current range.

1. **AOUT 1 SELECT** determines which parameter controls Analog Output #1. The parameters that can be selected are:
 1. Engine Speed
 2. Engine Speed Reference
 3. Fuel Demand
 4. Reverse Acting Fuel Demand
 5. Torsional Level
 6. Remote Speed Reference
 7. J3 Modbus Address 4:0002
 8. Generator KW
 9. Generator kVAR
 10. Generator Volts
 11. Generator Amps
2. **AOUT 1 4-20 mA** scales Analog Output #1 for 4 to 20 mA or 0 to 1 mA. A value of TRUE will scale the output for 4 to 20 mA. A value of FALSE will scale the output for 0 to 1 mA. Default is TRUE. Note that an internal jumper must be configured if this item is changed.

3. **AOUT 2 SELECT** determines which parameter controls Analog Output #2. The parameters that can be selected are:
 1. Engine Speed
 2. Engine Speed Reference
 3. Fuel Demand
 4. Reverse Acting Fuel Demand
 5. Torsional Level
 6. Remote Speed Reference
 7. J3 Modbus Address 4:0003
 8. Generator KW
 9. Generator kVAR
 10. Generator Volts
 11. Generator Amps
4. **AOUT 2 4-20 mA** scales Analog Output #2 for 4 to 20 mA or 0 to 1 mA. A value of TRUE will scale the output for 4 to 20 mA. A value of FALSE will scale the output for 0 to 1 mA. Default is TRUE. Note that an internal jumper must be configured if this item is changed.
5. **ACT OUT 1 4-20 mA** scales Analog Output #3 for 4 to 20 mA or 0 to 200 mA. A value of FALSE will scale the output for 0 to 200 mA. A value of TRUE will scale the output for 4 to 20 mA. Default is FALSE. Note that an internal jumper must be configured if this item is changed. Analog Output #3 is hard configured as the Engine 1 Speed Control Actuator output and does not offer an output configuration selection.
6. **ACT OUT 2 4-20 mA** scales Analog Output #4 for 4 to 20 mA or 0 to 200 mA. A value of FALSE will scale the output for 0 to 200 mA. A value of TRUE will scale the output for 4 to 20 mA. Default is FALSE. Note that an internal jumper must be configured if this item is changed. Analog Output #4 is hard configured as the Engine 2 Speed Control Actuator output and does not offer an output configuration selection.

CFIG DSLC

This menu is used to configure remote Modbus control of the DSLC. To bring this menu into view, the control must be configured for remote communications by setting USE COMM PORTS to TRUE. This menu is concealed when USE COMM PORTS is set FALSE.

1. **USE CB AUX** determines whether the generator circuit breaker (CB) aux contact used by the DSLC is from Modbus Port 3 *over the LON network connection* or from the CB Aux contact hardware input connected directly to the DSLC. Set FALSE to use the Hardware input. Set TRUE to use the Modbus/LON network input *or* FORCE DSLC input.. DSLC activation will be delayed or blocked if this is set to TRUE. We recommend that this value be set to FALSE.
2. **REM REF THRESH** sets the desired amount of mA change in the present Remote Reference value from the last transmitted Remote Reference value before a new Remote Reference value is propagated onto the LON network.
3. **PROC SIG THRESH** sets the desired amount of mA change in the present Process Signal value from the last transmitted Process Signal value before a new Process Signal value is propagated onto the LON network.

4. **LON TIME OUT** sets the time, in seconds, the 723 PLUS will wait between updates from the DSLC before latching the DSLC LON Fail To Transmit TRUE. A DSLC LON ERROR is initiated by the DSLC LON Fail To Transmit and may be configured as an alarm, a shutdown, both or neither.
5. **LON OUT UPDATE TIME** sets the time, in seconds, between updates of the 723 PLUS LON output to the DSLC.

At this time, we recommend saving the settings by pressing the “SAVE” key on the Hand Held Programmer or save settings using Watch Window (Refer to “help” if you need help). The Programmer will display the message “Saving Changes”. Watch Window has a “Pop-Up” box that says the value have been saved.

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.

Service Menu Descriptions

Shutdown Menu

A shutdown condition must exist to bring into view the SHUTDOWN MENU. This menu displays configured shutdowns that have been triggered. A shutdown may be cleared, if the shutdown condition no longer exists, by activating the Alarm Reset (through the external discrete input, Modbus, Watch Window, or the Hand Held Programmer).

1. **FIRST SHUTDOWN** displays the shutdown that occurred first. The number matches with the number of the shutdown in this menu.
2. **1-SPEED #1 FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
3. **2-SPEED #2 FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
4. **3-SPD #1 AND #2 FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
5. **4-ANLS 1 INPUT FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
6. **5-REMOTE INPUT FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
7. **6-ANLS 4 INPUT FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.

8. **7-MODBUS 3 FAIL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
9. **8-DSLC LON ERROR** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
10. **9-HI FUEL DEMAND** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
11. **10-HI SPEED** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
12. **11-HIGH TORSIONAL** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
13. **ON MAX LIMIT** displays the present condition of the UNLATCHED fuel limiter shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
14. **ON EXT FUEL LIMIT** displays the present condition of the UNLATCHED fuel limiter shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
15. **ON TORSION LIMIT** displays the present condition of the UNLATCHED fuel limiter shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
16. **ACT SHUTDOWN** displays the present condition of the UNLATCHED fuel limiter shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
17. **SPEED SWITCH** displays the present condition of the UNLATCHED speed switch shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
18. **ON AI LD SHARE** displays the present condition of the UNLATCHED on AI load share limit shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
19. **ALARM RESET** is used to reset all latched alarms and shutdowns once the condition that triggered the alarm or shutdown has been cleared. Toggle TRUE then FALSE to activate the reset.

Alarm Menu

An Alarm condition must exist to bring into view the ALARM MENU. This menu displays configured alarms that have been triggered. An alarm may be cleared, if the alarm condition no longer exists, by activating the Alarm Reset (through the external discrete input, Modbus, Watch Window, or the Hand Held Programmer).

1. **FIRST ALARM** displays the alarm that occurred first. The number matches with the number of the alarm in this menu.

2. **1-SPEED #1 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
3. **2-SPEED #2 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
4. **3-SPD #1 AND #2 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
5. **4-ANLS 1 INPUT FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
6. **5-REMOTE INPUT FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
7. **6-ANLS 4 INPUT FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
8. **7-MODBUS 3 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
9. **8-DSLC LON ERROR** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
10. **9-HI FUEL DEMAND** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
11. **10-HI SPEED** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
12. **11-HIGH TORSIONAL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
13. **ON MAX LIMIT** displays the present condition of the UNLATCHED fuel limiter alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
14. **ON EXT FUEL LIMIT** displays the present condition of the UNLATCHED fuel limiter alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
15. **ON TORSION LIMIT** displays the present condition of the UNLATCHED fuel limiter alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
16. **ACT SHUTDOWN** displays the present condition of the UNLATCHED fuel limiter alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.
17. **SPEED SWITCH** displays the present condition of the UNLATCHED speed switch alarm. This alarm will only indicate if it has been activated in the CFGI ALARM menu.

18. **ON AI LD SHARE** displays the present condition of the UNLATCHED on AI load share limit alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
19. **ALARM RESET** is used to reset all latched alarms and shutdowns once the condition that triggered the alarm or shutdown has been cleared. Toggle TRUE then FALSE to activate the reset.

1st Dynamics/2nd Dynamics Menu

Dynamic adjustments are settings that affect the stability and transient performance of the engine. There are two sets of dynamics provided. The set being used is selected by the 2nd Dynamics contact input. The control uses the 1st dynamics when the 2nd Dynamics contact is open, and it uses the 2nd dynamics when the contact is closed.

The following descriptions of each menu item apply to either set. Also see Figures 4-2, 4-3, and 4-4.

1. **GAIN** determines how fast the control responds to an error in engine speed from the speed-reference setting. The Gain is set to provide stable control of the engine at light or unloaded conditions.
2. **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.
3. **COMPENSATION** compensates for the actuator and fuel system time constant. Increasing Compensation increases actuator activity and transient performance.
4. **GAIN RATIO** is the ratio of the Gain setting at steady state to the Gain setting during transient conditions. The Gain Ratio operates in conjunction with the Window Width and Gain adjustments by multiplying the Gain set point by the Gain Ratio when the speed error is greater than the Window Width. This makes the control dynamics fast enough to minimize engine-speed overshoot on start-up and to reduce the magnitude of speed error when loads are changing. This allows a lower gain at steady state for better stability and reduced steady-state actuator linkage movement. (See Figure 3-2.)
5. **WINDOW WIDTH** is the magnitude (in rpm) of a compensated speed error (E_c) at which the control automatically switches to fast response. The control uses the absolute value of compensated speed error (E_c) to make this switch. The absolute value is the difference between the speed reference (N_r) and the compensated speed (N_c). A Window Width too narrow will result in cycling that always factors in the Gain Ratio. (See Figure 3-2.)
6. **GAIN SLOPE BK PNT** sets the percent output above which the Gain Slope becomes effective. It should usually be set just above the minimum load output. (See Figure 3-3.)

7. **GAIN SLOPE** changes Gain as a function of actuator output. Since actuator output is proportional to engine load, this makes Gain a function of engine load. Gain Slope operates in conjunction with the Gain Slope Breakpoint adjustment to increase (or decrease) Gain when percent Actuator Output is greater than the breakpoint. This compensates for systems having high (or low) gain at low load levels. This allows the Gain setting to be lower at light or no load for engine stability, yet provide good control performance under loaded conditions. (See Figure 3-3.)
8. **SPEED FILTER FREQ** adjusts the cutoff frequency of a low pass filter used on the engine speed sensing input (see Figure 3-5). To use this feature set the cutoff frequency below 15.9 Hz. The filter is used to attenuate

engine firing frequencies. To calculate the desired filter cutoff point, use the following formulas:

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

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

Initially set the filter frequency to the firing frequency.

As the filter frequency is reduced, steady state stability improves but transient performance may worsen. As the filter frequency is increased, steady state stability worsens but transient performance may improve.

IMPORTANT

If the calculated firing frequency is greater than 15.9 Hz, then disable the filter by setting the filter cutoff frequency at or above 15.9 Hz.

9. **BUMP ACT** allows you to test your 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. See the ACTUATOR BUMP menu. To initiate an actuator bump, toggle Bump Act 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.

IMPORTANT

BUMP ENABLE must be set TRUE to enable the BUMP ACT function. See the ACTUATOR BUMP menu.

DUAL GAIN DYNAMICS SPEED CONTROL

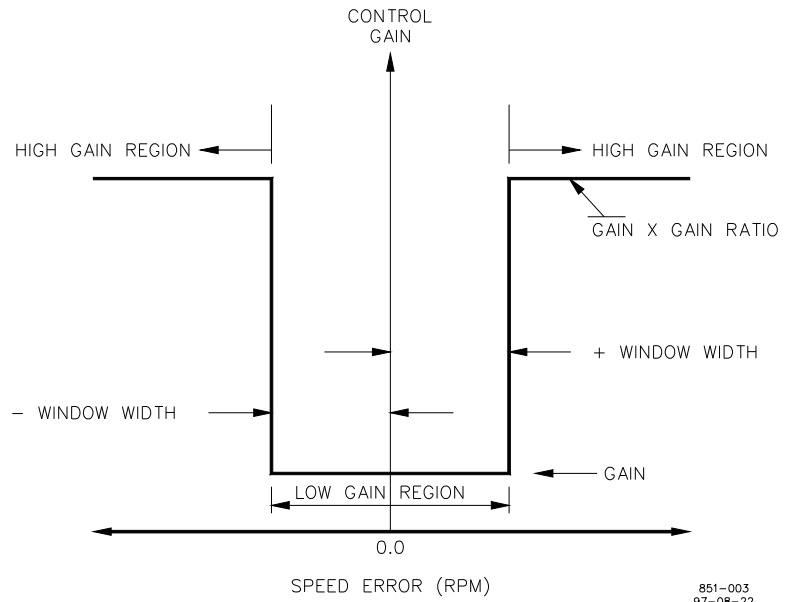


Figure 3-2. Control Gain as a Function of Speed Error

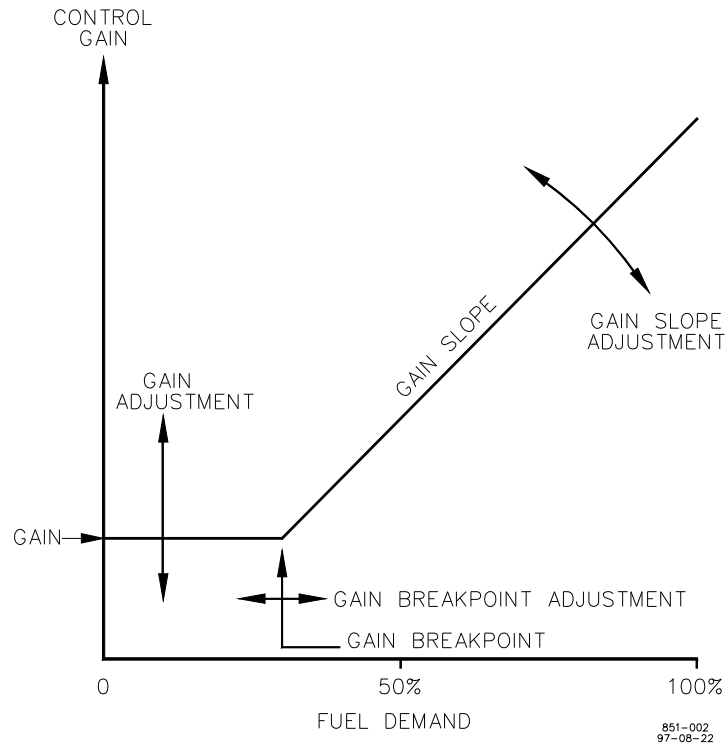
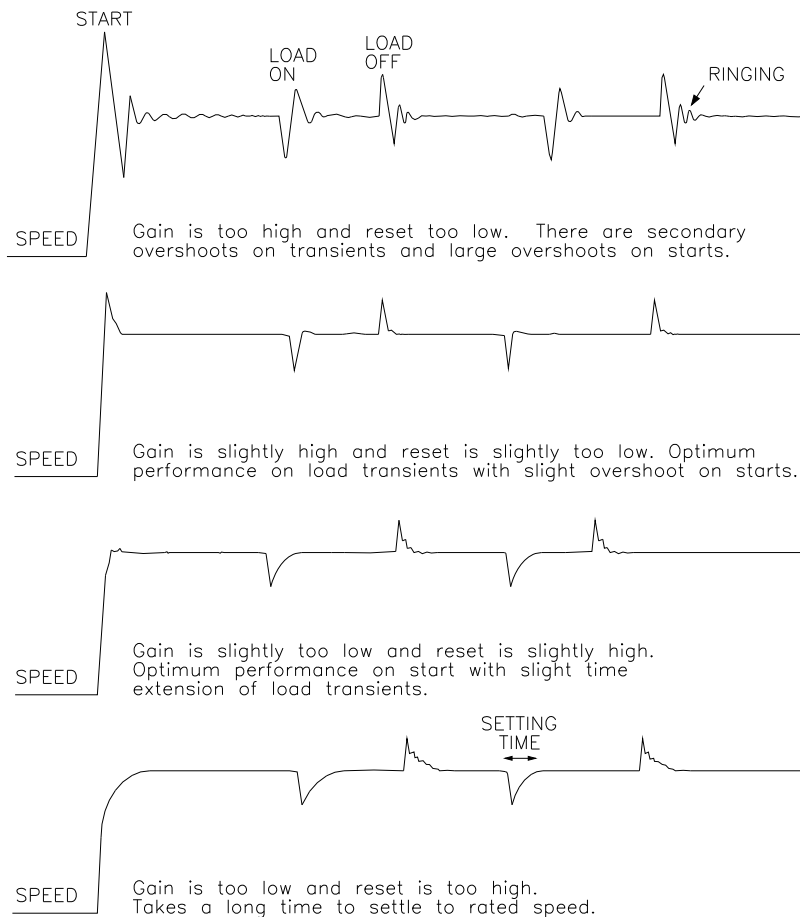
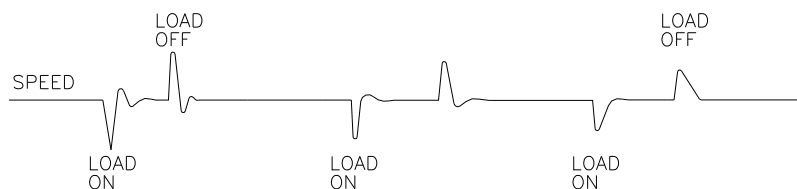


Figure 3-3. Control Gain as a Function of Control Output

RESULTS — GAIN AND RESET ADJUSTMENTS



IDEAL LOAD STEP RESPONSE



RESULTS — COMPENSATION ADJUSTMENT

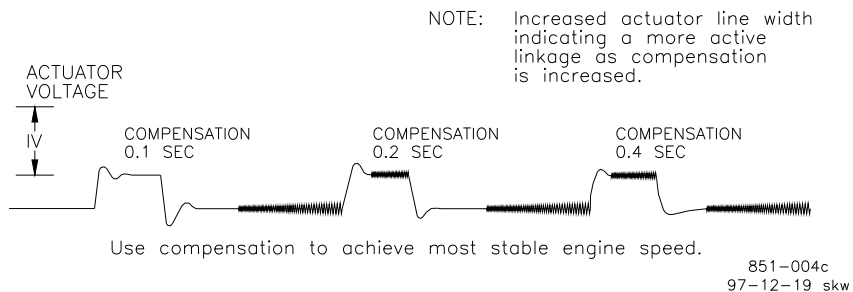


Figure 3-4. Typical Transient Response Curves

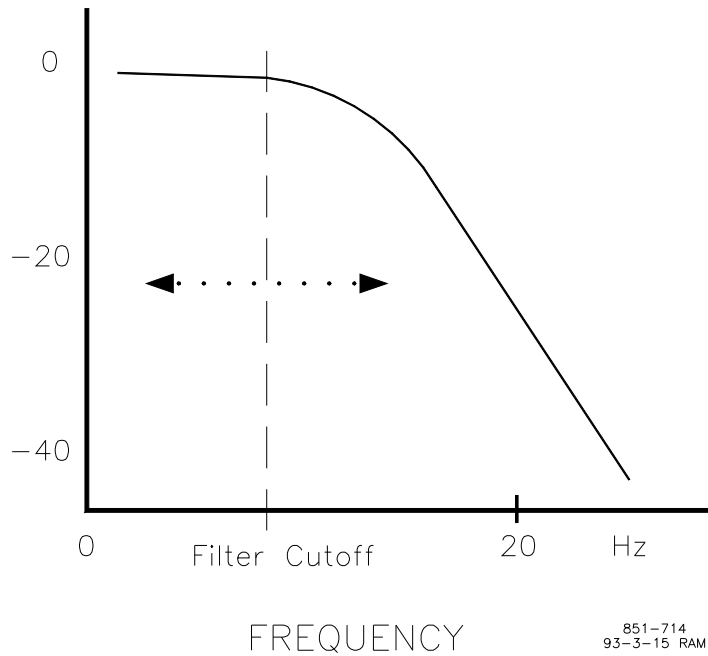


Figure 3-5. Speed Filter

1st Dynamics/2nd Dynamics–5 Gain

This menu and control function is enabled when CFG OPTION 'USE 5-GAIN MAP' is TRUE and provides a 5-point curve as a function of fuel demand for the variable GAIN setpoint. It is useful in applications that have a non-linear fuel valve (such as butterfly valves).

1. **BREAKPOINT A** is set at the no-load actuator 1 output % fuel demand.
2. **GAIN @ BREAKPOINT A** is the no-load GAIN setting.
3. **BREAKPOINT B** is set at the 25 % load actuator 1 output % fuel demand.
4. **GAIN @ BREAKPOINT B** is the 25 % load GAIN setting.
5. **BREAKPOINT C** is set at the 50 % load actuator 1 output % fuel demand.
6. **GAIN @ BREAKPOINT C** is the 50 % load GAIN setting.
7. **BREAKPOINT D** is set at the 75 % load actuator 1 output % fuel demand.
8. **GAIN @ BREAKPOINT D** is the 75 % load GAIN setting.
9. **BREAKPOINT E** is set at the 100 % load actuator 1 output % fuel demand.
10. **GAIN @ BREAKPOINT E** is the 100 % load GAIN setting.
11. **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 following a load disturbance.

12. **COMPENSATION** compensates for the actuator and fuel system time constant. Increasing Compensation increases actuator activity and improves transient performance. Decreasing compensation decreases actuator activity but transient performance may worsen.
13. **GAIN RATIO** is the ratio of the Gain setting at steady state to the Gain setting during transient conditions. The Gain Ratio operates in conjunction with the Window Width and Gain adjustments by multiplying the Gain setpoint by the Gain Ratio when the speed error is greater than the Window Width. This makes the control dynamics fast enough to minimize engine speed overshoot on start-up and to reduce the magnitude of speed errors when loads are changing. This allows a lower gain at steady state for better stability and reduced steady-state actuator linkage movement (see Figure 3-2).
14. **WINDOW WIDTH** is the magnitude (in rpm) of a compensated speed error (E_c) at which the control automatically switches to fast response. The control uses the absolute value of the compensated speed error (E_c) to make this switch. The absolute value is the difference between the speed reference (N_r) and the compensated speed (N_c). A Window Width too narrow will result in cycling that always factors in the Gain Ratio (see Figure 3-2).
15. **SPEED FILTER FREQ** is the cutoff frequency of a low pass filter used on the speed sensing input (see Figure 3-5). To use this feature set the cutoff frequency below 15.9 Hz. The filter is used to attenuate engine firing frequencies. To calculate the desired filter cutoff point, use the following formulas:

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

$$\text{Firing frequency} = \text{Camshaft frequency} \times \text{number of power cylinders}$$

Initially set the filter frequency to the *Firing frequency*.

As the filter frequency is reduced, steady state stability improves but transient performance may worsen. As the filter frequency is increased, steady state stability worsens but transient performance may improve.

IMPORTANT

If the calculated firing frequency is greater than 15.9 Hz, then disable the filter by setting the filter cutoff frequency at or above 15.9 Hz.

16. **BUMP ACTUATOR** allows you to test your dynamics settings by temporarily applying a decrease fuel demand transient to stimulate a control response. Both the magnitude and duration (Act Bump Duration) of the transient may be set. See the ACTUATOR BUMP menu. To initiate an actuator bump, toggle Bump Act 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.

IMPORTANT

BUMP ENABLE must be set to **TRUE** to enable the **BUMP ACT** function. See the **ACTUATOR BUMP** menu.

Actuator Bump

1. **BUMP ENABLED** is set to **TRUE** to enable the actuator bump for 60 minutes. Set to **FALSE** to disable this function.
2. **ACT BUMP LEVEL** is set in % fuel demand for the desired bump level.
3. **ACT BUMP DURATION** is set in seconds for the desired bump duration.

Torsional Filter

Torsional filter adjustments are the settings that affect the control's ability to react to flexible coupling torsionals. A Notch Filter is also provided with this control as an alternate filtering means for single speed sensor applications requiring torsional filtering.

WARNING

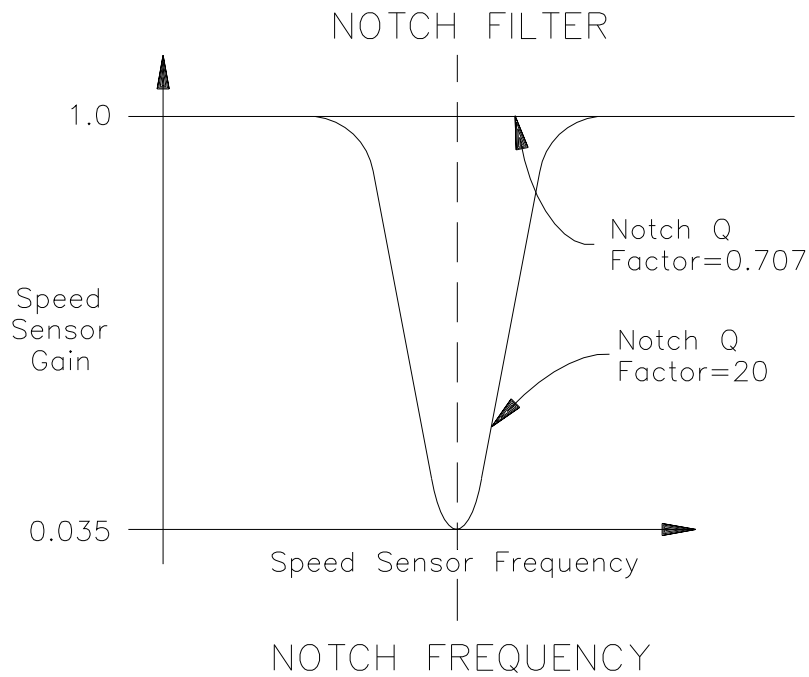
To use the notch filter, make sure that the speed sensor(s) used are only on the engine side of the flexible coupling.

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 driven load inertias and flexible couplings are difficult to control. In the notch filter approach, no attempt is made to map 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.



028-056
98-07-01 skw

Figure 3-6. Notch Filter

1. **ENABLE TORS FILTER** enables the Flexible Coupling filtering function when set to TRUE. When set to FALSE the function is disabled.
2. **ENG SENSOR WEIGHT** is the inertia ratio setting between the engine inertia and the system inertia. Set the value equal to engine inertia divided by (engine inertia + driven load inertia).
3. **TORS SCALE (%RATED)** is the percentage of rated rpm that corresponds to 100% torsional measurement in the 723PLUS. Example: TORS SCALE=1%, RATED=1200 rpm, Torsional RPM=6 rpm, therefore torsional measurement:

$$\frac{6}{(1200 \times 0.01)} = 50\%$$

This only has an effect on the measurement value and has NO effect on the actual dynamic response of the control. Should be left at default value for normal operation.

4. **TORSNL FUEL LIMIT** is the percentage of Fuel Demand the actuator output will be limited to when the torsional measurement level exceeds the TORSNL LEVEL @LIMIT(%).
5. **TORSNL LEVEL @LIMIT(%)** is the torsional level at which the TORSNL FUEL LIMIT is activated.
6. **TORSNL LEVEL @CLEAR(%)** is the torsional level at which the TORSNL FUEL LIMIT is deactivated.
7. **NOTCH FREQUENCY** is set at the center frequency in hertz of a band stop filter (see Figure 3-6).

8. **NOTCH Q FACTOR** will set the filter attenuation and width about the center frequency (see Figure 3-6).
9. **TORSIONAL LEVEL** displays the torsional level as a percentage of the full scale torsional vibration.
10. **TORSNL FILTR ACTIVE** displays whether the torsional filter is enabled and active (TRUE) or disabled (FALSE).
11. **TORSIONAL LIMIT LVL** displays the torsional limit applied to the speed control as a % fuel demand limit.

IMPORTANT

The notch filter is enabled when CFG OPTION menu items **USE TORSION FILTER** and **USE NOTCH FILTER** are set to TRUE, and **TORSIONAL FILTER** menu item **ENABLE TORS FILTER** is set to TRUE. Otherwise the notch filter is disabled.

Fuel Limiters

Fuel limiters restrain the fuel demand from the control to the actuator.

1. **START FUEL LIMIT** limits the percent fuel demand when the engine is started. The limit is usually set at the fuel level required to start the engine. The limiter is disabled when the engine speed exceeds 95% of speed reference (see Figure 3-7).

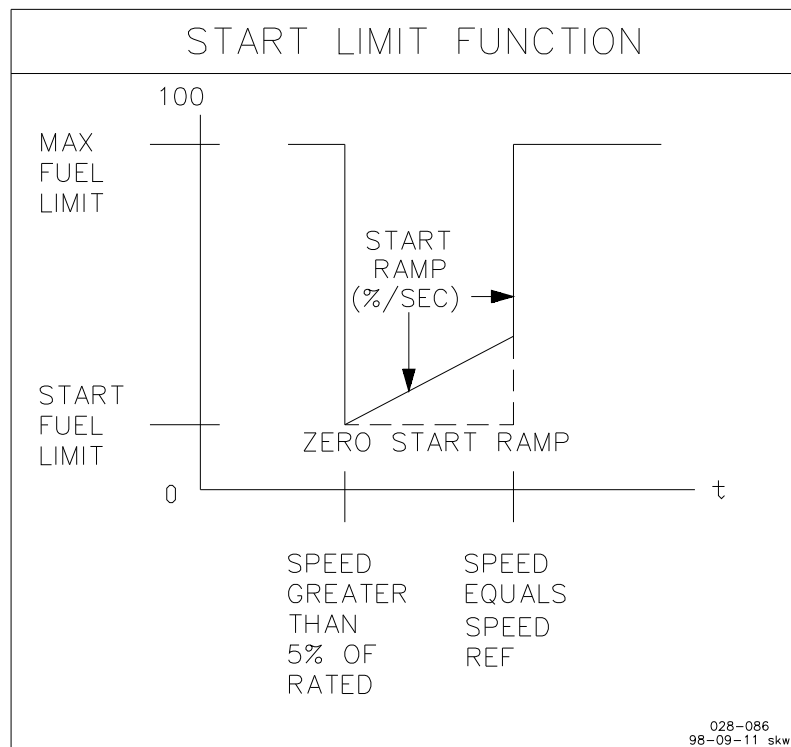


Figure 3-7. Start Limit Function

The limiter begins out of the way at 100% with no speed. Upon speed clear, START FUEL LIMIT immediately limits the fuel to the start fuel limit. The limiter then ramps at START RAMP %/sec until the speed has reached 95% of reference and the Speed Control PID is in control for 1 second.

2. **START RAMP %/sec** establishes the start limiter ramping rate at which the fuel demand increases to assist starting in colder ambient conditions.
3. **MAX FUEL LIMIT** sets the maximum percent fuel demand. Maximum (100%) is based on 200 mA. This is an electronic rack stop that is active in all modes of operation.

Speed Setting Menu

Speed adjustments are the settings that affect the speed reference.

1. **START SPEED** is the initial speed reference for the speed control prior to starting. Start Speed must be set above cranking speed and below the speed achieved with the start fuel limit setting (light-off speed). A ramp from the Start Speed to idle or rated, whichever is selected and permissive, begins when the engine accelerates to Start Speed. The ramp time is the accel ramp time setting or the decel ramp time setting as determined by the idle/rated selection and permissives.
2. **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 normally is set at the speed at which the engine operates at full load.
3. **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 normally is set at the minimum operating speed of the engine.
4. **IDLE SPEED** is the speed that the speed reference ramp goes to when the Close for Rated Discrete Input is OPEN. It is normally the speed at which the engine is operated at start-up. It is also used during cool down.



WARNING To prevent possible death or serious injury from an overspeeding engine, Idle speed must be set the same as or lower than Rated speed.

NOTICE

Be sure to avoid critical speeds when setting idle speed.

5. **ACCEL RAMP TIME** is the time required for the control to ramp the engine speed from Idle speed to Rated speed. The ramp is started whenever the Idle/Rated contact is closed.
6. **DECEL RAMP TIME** 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.

IMPORTANT

Actual engine deceleration may be slower than set by the Decel Ramp Time set point. This occurs when the Decel Ramp Time set point is faster than the amount of time that system inertias allow the engine to slow down. This condition is indicated by the control actuator output going to the minimum fuel position.

7. **RAISE SPEED RATE** is the rate at which the speed reference is ramped when using the Raise Speed input, as well as 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. Instead, it is ramped to the new setting at the Raise Speed Rate.
8. **LOWER SPEED RATE** is the rate at which the speed reference is ramped when using the Lower Speed input, 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. Instead, it is ramped to the new setting at the Lower Speed Rate.

Droop

Droop settings affect parallel operation loading parameters.

1. **LOAD DROOP PERCENT** is the percentage of rated speed the speed reference will droop when the generator load is increased to maximum load. Set to desired droop percent.
2. **FUEL DEMAND @MIN LD** must be set at the percentage of fuel demand when operating at rated speed/no-load. This establishes the 0% internal load measurement for droop.
3. **FUEL DEMAND @MAX LD** must be set at the percentage of fuel demand when operating at rated speed/rated-load. This establishes the 100% internal load measurement for droop.

AI LS Control

These menu items are used to set permissives and dynamically tune the Analog Input Load Sharing (AI LS) control.

NOTICE

Make all speed control dynamic adjustments before enabling and dynamically tuning analog input load sharing.

1. **ENBLE AI LOAD SHR** is set TRUE to enable Analog Input Load Sharing control. Set FALSE to disable AI LS control.
2. **AI LS GAIN** determines how fast the AI LS control responds to an error between the AI LS 1 and the AI LS 2 pressure inputs. The gain is set to provide stable control of the actuator 2 bias while operating at a lightly loaded condition. Load must be sufficient to clear all AI LS permissives. The ACT2 BIASED FUEL DEMND is shown on the DISPLAY MENU for monitoring purposes.
3. **AI LS INTEGRAL** compensates for the lag time of the engine. It adjusts the time required for the control to return the AI LS difference to zero error after a disturbance. Integral is adjusted to prevent slow hunting and to minimize overshoot after a load disturbance.
4. **MAX BIAS** is set to limit the percent fuel demand bias range (+/-) from the AI LS control to Actuator 2. Adjustable range is 0 to 10 % fuel demand.

5. **AI LS PERM LEVEL** is set at the AI LS permissive level desired in engineering units (e.g., °F, inches of mercury, etc.) before permitting AI LS control.
6. **AI LS ENABLE DELAY** is set at the desired delay time in seconds before permitting the AI LS control to be enabled after the engine is started and running (rpm > 95% rated speed and in speed control for 1 second). Adjustable range is 0 to 900 seconds.

Load Share Setting

These menu items are used to set the automatic and manual reference settings for the Analog Input Load Sharing (AI LS) control. When automatic load sharing is permissive and enabled, the manual load sharing is disabled. Conversely when automatic load sharing is not permissive or is disabled, the manual load sharing is enabled. The first manual breakpoint is fixed at 0 and the last breakpoint is fixed at 100. Intermediate breakpoints must be between these two numbers and each succeeding breakpoint must be equal to or higher than the previous breakpoint. Bias values at breakpoints do not have to follow this rule. Succeeding bias values may be higher, lower or equal to previous bias values.

1. **AUTO AI LS REF** is the reference (setpoint) for automatic Analog Input Load Sharing. A value of zero (0) sets the control to share load equally between engines 1 and 2 based on equal Analog Input levels. A positive or negative reference will cause unequal load sharing. A positive reference will cause the load (AI LS 4) of engine 2 to increase and remain greater than the load (AI LS 1) of engine 1. A negative reference will cause the load (AI LS 4) of engine 2 to decrease and remain lower than engine 1. The adjustable range is -50 to +50 that is equal to the MAX BIAS range set in the MAP LS CONTROL Service Header (i.e., -50 to +50 ref = -5 to +5 % fuel demand bias at the default MAX BIAS range setting).
2. **MANUAL LS BRKPT 'X'** is the speed control fuel demand percentage that designates that particular breakpoint.
3. **MANUAL LS SETPT 'X'** is the manually set reference at that respective breakpoint. A value of zero (0) sets the control to share load equally between engines 1 and 2 based on equal actuator outputs. A positive reference will cause the load (Actuator Output) of engine 2 to increase with respect to engine 1. A negative reference will cause the load (Actuator Output) of engine 2 to decrease. The adjustable range is -50 to +50 that is equal to the MAX BIAS range set in the AI LS CONTROL Service Header.

NOTICE

Fuel linkage setting differences between engines may demand some manual offset in order to achieve equal engine load sharing. In other words, if equal actuator outputs does not cause equal engine load sharing, then the offset must be adjusted to produce equal engine load sharing. Check load sharing throughout the entire actuator output range of 0-100%.

Ext Fuel Lmt Curve

The External Fuel Limiter Curve limits the fuel demand based on a two-dimensional curve and an average of two external 4–20 mA devices connected to Analog Inputs #1 and #4.

IMPORTANT

The primary function of Analog Inputs #1 and #4 is Analog Input Load Sharing. Be sure the chosen Analog Input type is suitable for External Fuel Limiting purposes if this function is also needed.

This function is predominantly used to limit fuel demand during a sudden load increase to prevent over fueling due to turbocharger lag as sensed by an average Manifold Air Pressure input (although other inputs may be used). However, exhaust temperature is not recommended for use as a fuel limiter. Limiting fuel demand minimizes smoke on diesel engines, and load transient detonation on gas and dual-fuel engines. In extreme cases, this limit can also prevent flooding of gas and dual-fuel engines. Normally, the load transient performance is not degraded since the lack of combustion air (not fuel) is the transient performance limiting factor. However, setting the fuel demand limit too low can degrade transient performance.

A five-point curve is constructed using the engine manufacturers recommended settings for EXT FUEL LMT versus Fuel Demand. Refer to Figure 3-8. The 'X' values are the Breakpoints and the 'Y' values are the Fuel Limit at the Breakpoints. All values between the designated breakpoints are interpolated.

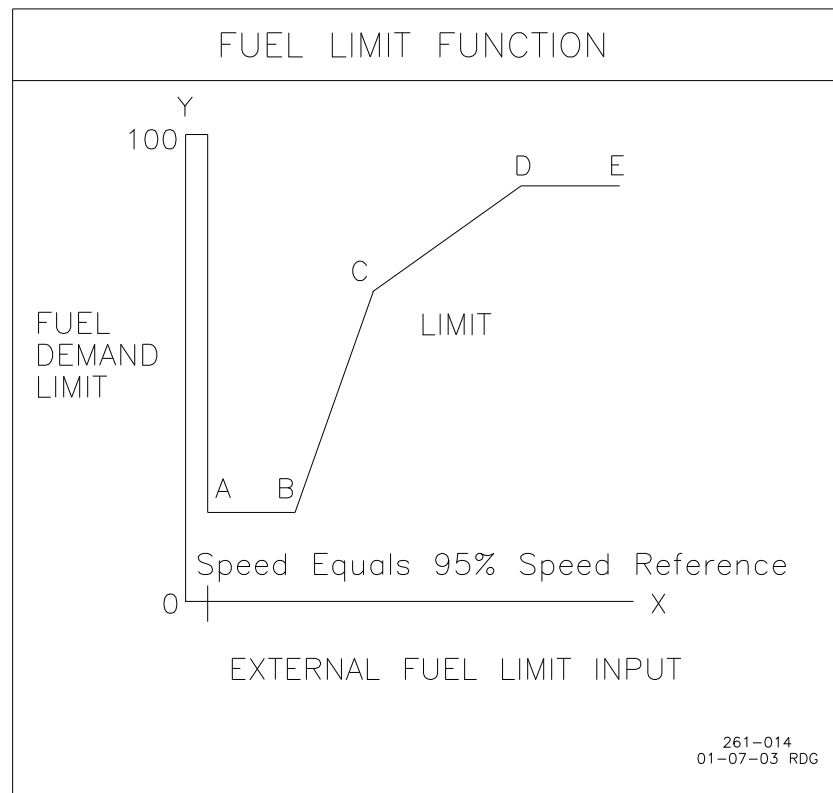


Figure 3-8. External Fuel Limit Curve

1. **ENABLE EXT FUEL LMT** enables and disables the fuel limiter, which uses the External Fuel Limiter input to limit the actuator output. If the fuel limiter is disabled, the fuel limiter breakpoint settings will not be used.

2. **EXT LIMIT BRKPNT X** is the External Fuel Limiter value that designates that particular breakpoint (x-axis input in Figure 3-8).
3. **FUEL LIMIT @ BRKPNT X** is the percent fuel demand allowed when the External Fuel Limiter input is at that respective Breakpoint (y-axis output in Figure 3-8).

Set Analog Inputs

This menu is provided to set the Analog Inputs engineering units. Be sure the units entered match the input sensing device calibration.

1. **AILS 1 LMT @ 4 mA (eu)**—Enter the preferred input engineering units (°F, in hg, etc) for the Analog Load Sharing Input 1 at 4 mA. If a voltage-sensing device is provided, enter the input engineering units at 1 Vdc.
2. **AILS 1 LMT @ 20 mA (eu)**—Enter the preferred input engineering units (°F, in hg, etc) for the Analog Load Sharing Input 1 at 20 mA. If a voltage-sensing device is provided, enter the input engineering units at 5 Vdc.
3. **REMOTE REF @ 4 mA (rpm)**—Enter the preferred engine speed reference setpoint in rpm at 4 mA from the Remote Speed Reference input device. If a voltage-sensing device is provided, enter the input rpm at 1 Vdc.
4. **REMOTE REF @ 20 mA (rpm)**—Enter the preferred engine speed reference setpoint in rpm at 20 mA from the Remote Speed Reference input device. If a voltage-sensing device is provided, enter the input rpm at 5 Vdc.
5. **AILS 2 LMT @ 4 mA (eu)**—Enter the preferred input engineering units (°F, in hg, etc) for the Analog Load Sharing Input 2 at 4 mA. If a voltage-sensing device is provided, enter the input engineering units at 1 Vdc.
6. **AILS 2 LMT @ 20 mA (eu)**—Enter the preferred input engineering units (°F, in hg, etc) for the Analog Load Sharing Input 2 at 20 mA. If a voltage-sensing device is provided, enter the input engineering units at 5 Vdc.

Set Analog Outputs

This menu sets the Analog Outputs to allow the proper scaling of each output based on the engineering units of the software configured input and type of hardware configured output. The items below should be entered so that the MIN entry represents the configured value in engineering units at 4 mA (or 0 mA), and the MAX entry represents the configured value in engineering units at 20 mA (or 1 mA).

1. **ANALOG OUTPUT 1 MIN** is adjusted to the engineering units that will output 4 mA (or 0 mA if so configured) at Analog Output #1.
2. **ANALOG OUTPUT 1 MAX** is adjusted to the engineering units that will output 20 mA (or 1 mA if so configured) at Analog Output #1.
3. **ANALOG OUTPUT 2 MIN** is adjusted to the engineering units that will output 4 mA (or 0 mA if so configured) at Analog Output #2.

4. **ANALOG OUTPUT 2 MAX** is adjusted to the engineering units that will output 20 mA (or 1 mA if so configured) at Analog Output #2.

IMPORTANT

ANALOG OUTPUT 3 and 4 MIN is set for 0 mA output with the fuel demand at 0 percent, and ANALOG OUTPUT 3 and 4 MAX is set for 200 mA output (or 20 mA if configured) with the fuel demand at 100 percent. These settings are fixed and not tunable.

5. **AO FILTER FREQUENCY** adjusts the cutoff frequency of a low pass filter used on Analog outputs 1, 2 and 4 only (see Figure 3-5). The filter is used to attenuate output signal noise. To use this feature, set the cutoff frequency below 15.9 Hz. To disable this filter, set the cutoff frequency at or above 15.9 Hz.

I/O Calibration

This menu allows exact calibration of the analog input and outputs. The offset should be adjusted so that the *minimum input* or *output* produces the correct mA value. The span should be adjusted so that the *maximum input* or *output* produces the correct value. Values are shown on the DISPLAY ANALOG I/O menu. Analog input values displayed are after I/O calibration. Analog output values displayed are before I/O calibration. Monitor inputs with a milliamp meter in series with the source or from the source itself. Monitor outputs with a milliamp meter in series with the output device or at the output itself.

1. **AILS 1 IN OFFSET** adjusts the min displayed AI1 Analog Load Sharing Input.
2. **AILS 1 IN SPAN** adjusts the max displayed AI1 Analog Load Sharing Input mA.
3. **AILS 1 IN READ VOLTS** when TRUE changes the displayed AI1 Analog Load Sharing Input to read Volts instead of mA.
4. **DSLCL OFFSET** adjusts the displayed AI2 DSLC mA.
5. **REM IN OFFSET** adjusts the min displayed AI3 Remote Reference Input.
6. **REM IN SPAN** adjusts the max displayed AI3 Remote Reference Input mA.
7. **REM IN READ VOLTS** when TRUE changes the displayed AI3 Remote Reference Input to read Volts instead of mA.
8. **AILS 4 IN OFFSET** adjusts the min displayed AI4 Analog Load Sharing Input.
9. **AILS 4 IN SPAN** adjusts the max displayed AI4 Analog Load Sharing Input mA.
10. **AILS 4 IN READ VOLTS** when TRUE changes the displayed AI4 Analog Load Sharing Input to read Volts instead of mA.
11. **AO 1 OFFSET** adjusts the Analog Output #1 mA minimum.
12. **AO 1 SPAN** adjusts the Analog Output #1 mA maximum.

13. **AO 2 OFFSET** adjusts the Analog Output #2 mA minimum.
14. **AO 2 SPAN** adjusts the Analog Output #2 mA maximum.
15. **ACT 1 OFFSET** adjusts the Analog Output #3 mA minimum. Provided to precisely set 0 mA with the fuel demand at 0 %. We do not recommend a different setting.
16. **ACT 1 SPAN** adjusts the Analog Output #3 mA maximum. Provided to precisely set 200 mA with the fuel demand at 100 %. We do not recommend a different setting unless the maximum output is configured for 20 mA.
17. **ACT 2 OFFSET** adjusts the Analog Output #4 mA minimum. Provided to precisely set 0 mA with the fuel demand at 0 %. We do not recommend a different setting.
18. **ACT 2 SPAN** adjusts the Analog Output #4 mA maximum. Provided to precisely set 200 mA with the fuel demand at 100 %. We do not recommend a different setting unless the maximum output is configured for 20 mA.

Comm Port Setup

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 for the type of hardware interface and other parameters. 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 supports either Modbus ASCII or RTU. This is selected in the Configure Menu CFG COMMUNICATION. Port 3 also allows commands to be sent from the Modbus master device to the control. (See the Modbus Register List, Appendix C, for the addresses.). USE COMM PORT found in menu CFG OPTION must be set TRUE to bring this menu into view. This menu is concealed when USE COMM PORT is set FALSE.

1. **PORT 2 HARDWARE CFG** determines if the port is set for RS-232, or RS-422 based on:
1 = RS-232
2 = RS-422

IMPORTANT

If RS-422 is selected, the devices can be in a multi-drop configuration.

2. **PORT 2 BAUD RATE** determines the ports baud rate, based on:
1 = 110
2 = 300
3 = 600
4 = 1200
5 = 1800
6 = 2400
7 = 4800
8 = 9600
9 = 19200
10 = 38400

IMPORTANT

If port J2 is set for a 19200 baud rate, then port 3 cannot be 38400. If port J2 is set for a 38400 baud rate, then port 3 cannot be 19200. Also, if port J3 is set for a 19200 baud rate, then port 2 cannot be a 38400. If port J3 is set for a 38400 baud rate, then port 2 cannot be 19200..

3. **PORT 3 HARDWARE CFIG** determines if the port is set for RS-232, RS-422, or RS-485 based on:
 - 1 = RS-232
 - 2 = RS-422
 - 3 = RS-485

IMPORTANT

If RS-422 or RS-485 is selected, the devices can be in a multi-drop configuration.

4. **PORT 3 BAUD RATE** determines the ports baud rate, based on:
 - 1 = 1200
 - 2 = 1800
 - 3 = 2400
 - 4 = 4800
 - 5 = 9600
 - 6 = 19200
 - 7 = 38400

IMPORTANT

If port J2 is set for a 19200 baud rate, then port 3 cannot be 38400. If port J2 is set for a 38400 baud rate, then port 3 cannot be 19200. Also, if port J3 is set for a 19200 baud rate, then port 2 cannot be a 38400. If port J3 is set for a 38400 baud rate, then port 2 cannot be 19200.

5. **PORT 3 STOP BITS** determines the Stop Bits, based on:
 - 1 = 1 stop bit
 - 2 = 1.5 stop bits
 - 3 = 2 stop bits
6. **PORT 3 PARITY** determines what parity the port uses, based on:
 - 1 = no parity
 - 2 = odd parity
 - 3 = even parity
7. **PORT 3 TIMEOUT** sets the time period, in seconds, the Modbus slave will wait for a master to query the 723PLUS. If the master connected to Port 3 does not poll within the timeout period, a configured MODBUS PORT 3 FAIL shutdown and/or alarm will be activated.
8. **PORT 3 LINK ERROR** is a **display only** of the Port 3 link error condition. (True or False).

9. **PORT 3 EXCEPTION ERR** is a **display only** of the Port 3 exception error condition. The following exception error codes will be displayed:

Messages sent by a slave and displayed by Service.

0 No error

1 Illegal function

2 Illegal data address

Messages displayed by Service.

9 Checksum error

10 Message garbled

The Alarm Reset will reset all of the exception errors.

TC Module 1/4

This menu displays and allows calibration of LinkNet Thermocouple input Modules 1 through 4. The offset and span should be adjusted to produces the correct temperature display of the input temperature. The LinkNet Module must be connected and properly addressed for these menus to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. **CH "x" TC DEGREES F** is a **display only** of the Channel "x" thermocouple input temperature, in °F, for the selected TC Module. **This value is sent to Modbus.**
2. **CH "x" TC OFFSET** sets the **minimum value** for the Channel "x" thermocouple input temperature, in °F, of the selected TC module.
3. **CH "x" TC SPAN** sets the **maximum value** of the Channel "x" thermocouple input temperature, in °F, the selected TC module.

RTD Module 1

This menu displays and allows calibration of LinkNet RTD input Module 1. The offset and span should be adjusted to produces the correct temperature display of the input temperature. The LinkNet Module must be connected and properly addressed for this menu to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. **CH "x" RTD DEGREES F** is a **display only** of the Channel "x" RTD input temperature, in °F, for the selected RTD Module. This value is sent to Modbus.
2. **CH "x" RTD OFFSET** sets the **minimum value** for the Channel "x" RTD input temperature, in °F, of the selected RTD module.
3. **CH "x" RTD SPAN** sets the **maximum value** of the Channel "x" RTD input temperature, in °F, of the selected RTD module.

AI Module 1

This menu displays and allows calibration of LinkNet Analog Input Module 1. The offset and span should be adjusted to produces the correct mA display of the input present. The LinkNet Module must be connected and properly addressed for this menu to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. AI "x" CH "x" - mA INPUT is a display only of the Channel "x" mA input current for the selected AI Module. This value times 1000 is sent to Modbus.
2. AI "x" CH "x" - AI OFFSET sets the minimum value for the Channel "x" mA input current of the selected AI module.
3. AI "x" CH "x" - AI SPAN sets the maximum value of the Channel "x" mA input current of the selected AI module.

DI Module 1

This is a **display only** menu that displays the state of LinkNet Discrete Inputs of Module 1. FALSE = Open and TRUE = Closed. The control automatically updates the display. The LinkNet Module must be connected and properly addressed for these menus to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. CH "x" **CONTACT CLOSED** displays the state of the Channel "x" discrete input for the selected DI module. This state value is sent to Modbus.

DO Module 1

This is a display only menu that displays the state of LinkNet Discrete Outputs of Module 1. The LinkNet Module must be connected and properly addressed for this menu to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. CH "x" **ENERGIZED** displays the state of the Channel "x" discrete output for the selected DO module. FALSE = De-energized and TRUE = Energized. This state value is also the value received from Modbus *or* from the FORCE DO 1 menu.

AO Module 1

This menu displays and allows calibration of LinkNet Analog Output Module 1. The offset and span should be adjusted to produces the correct mA output for the input value (scaled in engineering units). The LinkNet Module must be connected and properly addressed for this menu to come into view.

IMPORTANT

LinkNet nodes only reset their hardware switch addresses on power-up.

1. **AO1 CH “x” - mA OUT** is a **display only** of the Channel “x” value, in engineering units, which drives the output current for the AO1 Module. This value times 1000 is also the value received from Modbus.
2. **AO1 CH “x” OFFSET** sets the **minimum** current at the AO1 Module Channel “x” minimum input value, in engineering units.
3. **AO1 CH “x” SPAN** sets maximum current at the AO1 Module Channel “x” maximum input value, in engineering units.

LON and FORCE ENBL

1. **LON SERVICE PIN** tells the LON Neuron Processor to send out its unique ID over the network. This is used in the LON network binding installation procedures.
2. **RESET LON** resets all associated LON software and the NEURON chip in this particular 723PLUS.
3. **FORCE DSLC** should be set to TRUE to enable manual control of the Discrete and Analog commands to the DSLC control. Set to FALSE to disable manual control of the DSLC inputs and use Modbus Boolean Write commands only.

Display DSLC

The menu displays DSLC supplied Generator Parameters. The control automatically updates the display.

1. **DSLCL REAL POWER** displays generator KW load.
2. **DSLCL REACTIVE POWER** displays generator kVAR load.
3. **DSLCL TOTAL AMPS** displays generator total amperes ($I_a + I_b + I_c$).
4. **DSLCL AVERAGE VOLTS** displays generator average voltage $(V_a + V_b + V_c)/3$.
5. **DSLCL PHASE A AMPS** displays generator phase A amperes.
6. **DSLCL PHASE B AMPS** displays generator phase B amperes.
7. **DSLCL PHASE C AMPS** displays generator phase C amperes.
8. **DSLCL PHASE A VOLTS** displays generator phase A voltage.
9. **DSLCL PHASE B VOLTS** displays generator phase B voltage.
10. **DSLCL PHASE C VOLTS** displays generator phase C voltage.

Display Digital I/O

The menu displays Digital input and output states. The control automatically updates the display.

1. **A-DROOP** shows the state of the Isochronous/Droop contact (TRUE = CLOSED = ISOCHRONOUS, FALSE = OPEN = DROOP).
2. **B-ALARM RESET** shows the state of the Alarm Reset contact (TRUE = CLOSED).
3. **C-SPEED FAIL OVRD** shows the state of the Failsafe Override contact (TRUE = CLOSED).
4. **D-2ND DYNAMICS** shows the state of the 2nd Dynamics contact (TRUE = CLOSED).
5. **E-RAISE SPEED** shows the state of the Raise Speed contact (TRUE = CLOSED).
6. **F-LOWER SPEED** shows the state of the Lower Speed contact (TRUE = CLOSED).
7. **G-RATED SPEED** shows the state of the Idle/Rated contact (TRUE = CLOSED).
8. **H-CLOSE TO RUN** shows the state of the Run/Stop contact (TRUE = CLOSED).
9. **DO1-J3 MB BW 0002** shows the state of the Port 3, Modbus Boolean Write 0002, driven Relay Output #1. TRUE indicates the relay is energized.
10. **DO2-ALARM** shows the state of the Alarm Relay Output #2. TRUE indicates the relay is energized.
11. **DO3- SHUTDOWN** shows the state of the Shutdown Relay Output #3. TRUE indicates the relay is energized.

Display Analog I/O

This menu is for display only except for an Alarm Reset function.. It displays the analog inputs and outputs of the 723PLUS control.

1. **DIGITAL SS IN #1** shows the frequency, in hertz, of the Speed Sensor #1 input signal. This value is sent to Modbus.
2. **DIGITAL SS IN #2** shows the frequency, in hertz, of the Speed Sensor #2 input signal. This value is sent to Modbus.
3. **AI1-AIS 1 INPUT** shows the value, in Vdc, of the Analog Load Sharing Input #1 signal. This value times 1000 is sent to Modbus. The Vdc value is after the effect of the offset in the I/O CALIBRATION menu.
4. **AI2-DSLCL** shows the value, in Vdc, of the DSLC Input #2 signal. This value times 1000 is sent to Modbus. The Vdc value is after the effect of the offset in the I/O CALIBRATION menu.

5. **AI3-REMOTE IN** shows the value, in mA, of the Remote Speed Reference Input #3 Signal. This value times 1000 is sent to Modbus. The mA value is after the effect of the offset and span in the I/O CALIBRATION menu.
6. **AI4- AI LS 4 INPUT** shows the value, in mA, of the Analog Load Sharing Input #4 Signal. This value times 1000 is sent to Modbus. The mA value is after the effect of the offset and span in the I/O CALIBRATION menu.
7. **AI1-FAILED** shows the state of the Analog Load Sharing Input #1 Signal. (TRUE = FAILED). This value is sent to Modbus
8. **A13-FAILED** shows the state of the Remote speed Reference Input #3 Signal. (TRUE = FAILED). This value is sent to Modbus.
9. **AI4-FAILED** shows the state of the External Fuel Limit Input #3 Signal. (TRUE = FAILED). This value is sent to Modbus.
10. **ANALOG OUT 1** shows the value, in mA, of the Analog Output #1 Signal. This value times 1000 is sent to Modbus. The mA value is prior to the effect of the offset and span in the I/O CALIBRATION menu.
11. **ANALOG OUT 2** shows the value, in mA, of the Analog Output #2 Signal. This value times 1000 is sent to Modbus. The mA value is prior to the effect of the offset and span in the I/O CALIBRATION menu.
12. **ACTUATOR OUT 1** shows the value, in mA, of the speed control fuel demand signal at Analog Output #3. This value times 1000 is sent to Modbus. The mA value is prior to the calibration effect of the offset and span in the I/O CALIBRATION menu.
13. **ACTUATOR OUT 2** shows the value, in mA, of the Analog Output #4 Signal. This value times 1000 is sent to Modbus. The mA value is prior to the calibration effect of the offset and span in the I/O CALIBRATION menu.
14. **ALARM RESET** provides a means of resetting alarm conditions. Toggle TRUE then FALSE to issue a reset.

Control Mode

This menu is for **display only**. It displays the Control Modes in the 723PLUS control.

- 1) **SPEED IN CONTROL (LSS)** will show TRUE when the fuel demand is controlled by the Speed Control.
- 2) **ON START FUEL LIMIT (LSS)** will show TRUE when the fuel demand is limited by the START FUEL LIMIT.
- 3) **ON MAXIMUM LIMIT (LSS)** will show TRUE when the fuel demand is limited by the MAX FUEL LIMIT.
- 4) **ON EXTERNAL LIMIT (LSS)** will show TRUE when the fuel demand is limited by the EXT FUEL LMT CURVE.
- 5) **ON TORSIONAL LIMIT (LSS)** will show TRUE when the fuel demand is limited by the TORSNL FUEL LIMIT.

- 6) **ACTUATOR SHUTDOWN** will show TRUE when the fuel demand is held off (–1%) by the ACTUATOR SHUTDOWN SIGNAL.
- 7) **REMOTE SPEED ENBLD** will show TRUE when the REMOTE SPEED REFERENCE is enabled (AI3 input device or Modbus AW).
- 8) **SPEED SENSOR 1 ACTIVE** will show TRUE when the speed sensor 1 input is active as the primary input for speed control. The primary input is in control in single speed sensor applications and assumes control if the secondary input fails in a two-speed sensor input application.
- 9) **SPEED SENSOR 2 ACTIVE** will show TRUE when the speed sensor 2 input is active as the primary input for speed control. The primary input is in control in single speed sensor applications and assumes control if the secondary input fails in a two-speed sensor input application.
- 10) **AI LOAD SHARE ENBLD** will show TRUE when analog input load sharing is enabled.

Display Menu

This menu is for display only. It shows several control parameters that are often used to determine the operation of the engine. Refer to Chapter 6 for a complete description of these terms.

1. **ENGINE SPEED** displays the present engine speed in rpm.
2. **BIASED SPD REF** displays the total output of the speed reference ramp, droop bias and DSLC bias. This biased speed reference is the setpoint input to the speed control PID. Note that this may not be the speed the engine is presently running at due to the effect of droop, fuel limiters, etc.
3. **FUEL DEMAND** displays the primary percent fuel demand. This is NOT the same as the actuator output if configured for reverse acting. This is the same if configured for direct acting.
4. **ACT2 BIASED FUEL DMND** displays the combined primary percent fuel demand plus the bias applied to Actuator 2 for load sharing.
5. **SPEED REF** displays the output of the speed reference ramp before any biases are applied.
6. **DROOP BIAS** displays the value, in rpm, that the droop percentage calculation is biasing the speed reference.
7. **DSLC BIAS** displays the value, in rpm, that the DSLC input is biasing the speed reference.
8. **REMOTE SPEED REF** displays the present remote speed reference signal in rpm.
9. **AN LOAD SHARE IN 1** displays the present analog load share input 1 value in engineering units (°F, in hg, etc.).
10. **AN LOAD SHARE IN 4** displays the present analog load share input 4 value in engineering units (°F, in hg, etc.).

11. **EXT FUEL LIMIT IN** displays the present external fuel limit input value in engineering units.
12. **EXT FUEL LIMIT** displays the present percent fuel demand limit of the external fuel limiter.

Force 723 DO

This menu allows the 723PLUS Discrete Outputs to be manually forced on or off during installation to test the output loops. This feature and menu is only available when FORCE DISCRETE OUTS on the CFG OPTION menu is set TRUE.

NOTICE

Before actuating any end device, be sure that forcing the end device to a different state will not cause an unsafe or unwanted condition or event to occur, and take comprehensive safety measures to nullify the effects of forcing the end device to a different state (such as closing manual isolation valves, venting pressurized lines, disconnecting power, independently disabling the device by other means, etc.). Have these measures checked by a separate cognizant person prior to forcing the end device to a different state. **BE AWARE** that incorrect wiring may inadvertently actuate the wrong end device.

- 1) **DO1 FORCE** is set TRUE to force Discrete Output 1 to the energized state. Set value FALSE to force the Discrete Output 1 to the de-energized state.
- 2) **DO2 FORCE** is set TRUE to force Discrete Output 2 to the energized state. Set value FALSE to force the Discrete Output 2 to the de-energized state.
- 3) **DO3 FORCE** is set TRUE to force Discrete Output 3 to the energized state. Set value FALSE to force the Discrete Output 3 to the de-energized state.

IMPORTANT

Be sure to set the 'FORCE DISCRETE OUTS' on the CFG Option menu back to FALSE when discrete output testing is completed. Failure to do so will hold the output in the last forced state.

Force DO 1

This menu allows LinkNet Discrete Outputs 1 to be manually forced on or off during installation to test the output loops. This feature and menu is only available when FORCE DISCRETE OUTS on the CFG OPTION menu is set TRUE.

NOTICE

Before actuating any end device, be sure that forcing the end device to a different state will not cause an unsafe or unwanted condition or event to occur, and take comprehensive safety measures to nullify the effects of forcing the end device to a different state (such as closing manual isolation valves, venting pressurized lines, disconnecting power, independently disabling the device by other means, etc.). Have these measures checked by a separate cognizant person prior to forcing the end device to a different state. **BE AWARE** that incorrect wiring may inadvertently actuate the wrong end device.

- 1) **DO1 CH1 FORCE** is set to TRUE to force Discrete Output 1, Channel 1 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 1 to the de-energized state.
- 2) **DO1 CH2 FORCE** is set to TRUE to force Discrete Output 1, Channel 2 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 2 to the de-energized state.
- 3) **DO1 CH3 FORCE** is set to TRUE to force Discrete Output 1, Channel 3 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 3 to the de-energized state.
- 4) **DO1 CH4 FORCE** is set to TRUE to force Discrete Output 1, Channel 4 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 4 to the de-energized state.
- 5) **DO1 CH5 FORCE** is set to TRUE to force Discrete Output 1, Channel 5 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 5 to the de-energized state.
- 6) **DO1 CH6 FORCE** is set to TRUE to force Discrete Output 1, Channel 6 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 6 to the de-energized state.
- 7) **DO1 CH7 FORCE** is set to TRUE to force Discrete Output 1, Channel 7 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 7 to the de-energized state.
- 8) **DO1 CH8 FORCE** is set to TRUE to force Discrete Output 1, Channel 8 to the energized state. Set value to FALSE to force the Discrete Output 1, Channel 8 to the de-energized state.

IMPORTANT

Be sure to set the 'FORCE DISCRETE OUTS' on the CFG Option menu back to FALSE when discrete output testing is completed. Failure to do so will hold the output in the last forced state.

Force DSLC

This menu allows DSLC Outputs to be manually forced on or off during installation to test the output loops. This feature and menu is available only when FORCE DSLC on the COMM PORT SETUP menu is set TRUE.

NOTICE

Before actuating any end device, be sure that forcing the end device to a different state will not cause an unsafe or unwanted condition or event to occur, and take comprehensive safety measures to nullify the effects of forcing the end device to a different state (such as closing manual isolation valves, venting pressurized lines, disconnecting power, independently disabling the device by other means, etc.). Have these measures checked by a separate cognizant person prior to forcing the end device to a different state. **BE AWARE** that incorrect wiring may inadvertently actuate the wrong end device.

1. **REMOTE REFERENCE** is set to the mA value desired for the forced Remote Reference.

2. **PROCESS SIGNAL** is set to the mA value desired for the forced Process Signal.
3. **USE REMOTE REFERENCE** is set to TRUE to force the DSLC control to use the forced Remote Reference (see item 1 above). Set the value to FALSE to use the DSLC Hardware Remote Reference.
4. **USE PROCESS SIGNAL** is set to TRUE to force the DSLC to use the forced Process Signal (see item 2 above). Set the value to FALSE to use the DSLC Hardware Process Signal.
5. **CB AUX CONTACT** is set to activate the DSLC CB Aux input. This input will not be active unless CFG DSLC - USE CB AUX is TRUE.
6. **USE DISCRETE SIGNALS** is set to TRUE to force the DSLC control to use the forced Discrete Input signals below. Set the value to FALSE to use the DSLC Hardware DI Signals.
7. **SYNCH CHECK INPUT** is set to activate the DSLC Check input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
8. **SYNCH PERM INPUT** is set to activate the DSLC Perm input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
9. **SYNCH RUN INPUT** is set to activate the DSLC Run input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
10. **VOLTAGE RAISE INPUT** is set to activate the DSLC Voltage Raise input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
11. **VOLTAGE LOWER INPUT** is set to activate the DSLC Voltage Lower input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
12. **BASELOAD INPUT** is set to activate the DSLC Baseload input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
13. **LOAD INPUT** is set to activate the DSLC Load/Unload input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
14. **PAUSE INPUT** is set to activate the DSLC Ramp Pause input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
15. **LOAD RAISE INPUT** is set to activate the DSLC Load Raise input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
16. **LOAD LOWER INPUT** is set to activate the DSLC Load Lower input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.
17. **PROCESS INPUT** is set to activate the DSLC Process Control input. This input will not be active unless USE DISCRETE SIGNALS above is TRUE.

IMPORTANT

Be sure to set the 'FORCE DSLC OUTS' on the CFG Option menu back to FALSE when DSLC output testing is completed. Failure to do so will hold the output in the last forced state.

Chapter 4.

Initial Adjustments

Introduction

This chapter contains information on control calibration. It includes initial prestart-up and start-up settings and adjustments.



WARNING

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

Start-up Adjustments

- 1) Complete the installation checkout procedure in Chapter 2 and the prestart menu settings in Chapter 3.
- 2) Close the Run/Stop contact. Be sure the Idle/Rated contact is in idle (open). Apply power to the control. Do NOT proceed unless the green POWER OK and CPU OK indicators on the front of the control are on.
- 3) Check the speed sensor.

Minimum voltage required from the speed sensor to operate the control is 1.0 Vrms, measured at cranking speed or the lowest controlling speed. For this test, measure the voltage while cranking, with the speed sensor connected to the control. Before cranking, be sure to prevent the engine from starting. At 5% of rated speed and 1.0 Vrms, the failed speed sensing circuit function is cleared. If the red FAILED SPD SENSOR #1 indicator remains on, shut down the engine.



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.

4. Start the engine.

If there is insufficient fuel to start the engine, increase the Start Fuel Limit (Fuel Limiters Menu). (The control will reduce fuel as required when the speed setting is reached. It may require extra fuel to accelerate the engine to start speed or idle speed, whichever is configured.) It may take a few start attempts to determine the final setting of the Start Fuel Limit. If the start time is excessive (lightoff speed too slow), increase the Start Fuel Limit. If the start time/lightoff speed is too fast or flooding occurs, decrease the Start Fuel Limit. The start speed reference, if configured, must be set above cranking speed but below the speed achieved with the start fuel limit setting (light-off speed). We recommend trying both hot and cold starts to determine a final setting.

5. Adjust for stable operation.

If the engine is hunting at a rapid rate, slowly decrease the Gain until performance is stable. If the engine is hunting at a slow rate, increase the Reset time. If increasing the Reset time does not stabilize the engine, it also may be necessary to slowly decrease the Gain OR to slowly decrease the Gain and increase the Compensation.

This completes the start-up adjustments. We recommend saving the settings at this time by pressing the "SAVE" key on the Hand Held Programmer or by saving settings with the Watch Window (Refer to "help" if you need help). The Programmer will display the message "Saving Changes". Watch Window has a "pop-up" box that says the value have been saved.

Dynamic Adjustments

The objective of the dynamic adjustments is to obtain the optimum, stable engine speed response from minimum speed/load to full speed and load. All adjustments apply to both 1st dynamics (2nd Dynamics contact open) and 2nd dynamics (2nd Dynamics contact closed).

Do the following adjustments first for 1st dynamics (2nd Dynamics contact open). Use the 1st Dynamics Menu to set the 1st dynamics, if changes are needed.

Then repeat the adjustments for 2nd dynamics (2nd Dynamics contact closed). Use the 2nd Dynamics Menu to set the 2nd dynamics, if changes are needed.

1. No-Load Adjustments

Do this adjustment without load applied.

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.

After acceptable performance at no load, record the Actuator Output as read on the Display Menu. Set the Gain Slope Breakpoint (1st Dynamics Menu) to this reading.

Observe the movement of the actuator. If the activity of the actuator is excessive, reduce the Speed Filter Frequency slightly below 15.9. Additional reduction of the filter frequency may improve actuator stability even more but may worsen transient load response. Keep this in mind when transient load testing is performed and set the filter frequency for optimum stability and transient response. If necessary, 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 0.02, reduce it to 0.01) 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 large 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 zero 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 without excessive rapid actuator movement.

2. Full Load Adjustment

Do these adjustments 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.

If excessive actuator movement again occurs, do procedure 3, then repeat procedure 2. 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. See Figure 3-4.



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.

3. When significant load changes occur, the control should switch automatically to high gain (gain x gain ratio) to 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 more stable operation.

IMPORTANT

When paralleled to the utility, speed error is created when corrective bias signals following load changes are applied to the speed reference by the DSLC control or droop inputs. Speed errors are manifested as load transients instead of speed transients. An actuator bump is recommended to test dynamic settings when operating in parallel with the utility.

4. Verify that performance at all speed and load conditions is satisfactory and repeat the above procedures if necessary. Full load rejection testing is recommended as part of the performance testing.
5. While operating at full load, record the Actuator Output on the Display Menu. Select the Maximum Fuel Limit set point on the Fuel Limiter Menu. Set at approximately 10% over the full load output if desired, otherwise leave at 100%.

We recommend you check the operation from both hot and cold starts to obtain the optimum stability under all conditions.

Map Load Sharing Dynamics

NOTICE

Make all speed control dynamic adjustments before enabling and dynamically tuning map load sharing.

The AI Load Sharing Dynamic tuning parameters AI LS GAIN and AI LS INTEGRAL under the AI LS CONTROL service header govern the dynamic performance of the Analog Input Load Sharing PID control. Start with the initial default tuning settings.

- 1) Be ready to reduce AI LS GAIN when AI Load Sharing is enabled. If instability is experienced when enabled, slowly decrease gain until performance is stable.
- 2) Apply sufficient load and clear all other permissives to enable AI Load Sharing.
- 3) Slowly increase AI LS GAIN until the actuator 2 output or engine speed becomes slightly unstable, and then reduce the AI LS GAIN as necessary to stabilize the actuator output.
- 4) Increase/decrease, as necessary, the AI LS INTEGRAL to further improve stability.

Speed Adjustments

Adjustment of the start, idle, rated, raise, and lower references should not require further setting as they are precisely determined. The Remote Speed Setting input and the Tachometer Output, however, involve analog circuits and may require adjustment. These adjustments can be found on the Set Analog Inputs menu and Set Analog Outputs menu.

1. 4 to 20 mA Remote Speed Setting Input

Apply 4 mA to the Remote Speed Setting Input. Be sure remote operation is selected (Raise Speed and Lower Speed contacts both closed). If the engine rpm is lower or higher than desired, increase or decrease the 4 mA Remote Reference set point to obtain the correct speed. There may be a small difference between the set point and actual speed that compensates for the inaccuracies in the analog circuits.

Now apply 20 mA to the Remote Speed Setting Input. Wait until the ramp stops. Increase or decrease the 20 mA Remote Reference set point to obtain the engine rpm desired.

Repeat the above steps until the speeds at 4 mA and 20 mA are within your required range.

2. 4 to 20 mA Tachometer Output

Set engine speed to the speed desired for 4 mA output. If this is not possible, skip this step or use a signal generator into the speed input with the correct frequency corresponding to the desired rpm. Trim the Tach at 4 mA Output rpm set point for 4 mA set point output.

Set engine speed to the speed desired for 20 mA output. Trim the Tach at 20 mA Output rpm set point for 20 mA set point output.

Repeat the above steps until the speeds at 4 mA and 20 mA are within your required range.

Torsional Adjustments

The Torsional Level is determined by the instantaneous difference in speed between the two speed sensors. The difference in speed is an indication of the energy stored or released by the flexible coupling. There are two separate functions that can occur with the Torsional Level. One function (the Torsional Filter Function) filters the two speed signals and provides a signal to the Speed Filter Function and to the PID that reduces the speed change caused by the flexible coupling. This function is adjusted by the value of item ENG SENSOR WEIGHT in the TORSIONAL FILTER menu. The other function (the Torsional Limit Function) provides a temporary maximum limit to the Fuel Demand. This limit is adjusted with item TORSNL FUEL LIMIT. The temporary limit is set if the Torsional Level exceeds the value adjusted by the item TORSNL LEVEL @LIMIT. The limit is removed when the Torsional Level reduces below the value adjusted by the item TORSNL LEVEL @CLEAR.

1. **Set the ENG SENSOR WEIGHT** with the following procedure. The Torsional Level is the ratio between the engine inertia and the system inertia. If you know these values then set the initial value of Engine Sensor Weight equal to the engine inertia divided by the quantity (engine inertia + generator inertia) and follow the procedure outlined below. If you don't know the system inertia values, then start with the default value and follow the procedure outlined below.

2. It is important to know what speed or load (or combination of speed and load) causes the system to go into torsional instability. This is referred to here as the torsional point. The torsional point can be found by bumping the system using the Actuator Bump function in the dynamics menu. Be prepared to move the system away from the torsional point if it goes unstable. Bump the system at several different speeds and loads. If the system remains stable, slightly increase the dynamic Gain and again bump the system at several different speeds and loads. At some point, a torsional oscillation may begin to occur which can be corrected with the Engine Sensor Weight. Begin by reducing the value a small amount. After each adjustment, approach the torsional point and see if the performance is improving or degrading. If the performance is improving, continue making small reductions until you find the value where no further improvements are seen. If the performance is getting worse, begin increasing the value above

the initial Engine Sensor Weight and determine if any improvement is observed. If the performance is improving, continue making small increases until you find the value where no further improvements are seen.

Be sure to return the Dynamic Gain setting to its proper value.

3. **TORSNL FUEL LIMIT** can be adjusted by finding the torsional point and reducing the limit to a point where the Fuel Demand oscillations are eliminated or reduced to safe levels. Initially set the item TORSNL LEVEL @LIMIT to 0.00 to activate the limit (monitor the item TORSNL FILTER ACTIVE in the Display Ctrl Mode to be sure the limit is active). Monitor the item TORSIONAL LEVEL (%RPM) in the Display Menu and go to the torsional point. Record the value of the TORSIONAL LEVEL. Reduce the value of the TORSNL FUEL LIMIT in the Torsional Filter Menu to reduce or eliminate the Fuel Demand oscillations. Once the oscillations are reduced sufficiently, again record the value of the TORSIONAL LEVEL (%RPM).
4. **TORSNL LEVEL @LIMIT** can be adjusted to the reading recorded above for the TORSIONAL LEVEL before the limit was reduced.
5. **TORSNL LEVEL @CLEAR** can be adjusted to the reading recorded above for the TORSIONAL LEVEL after the limit was reduced.

IMPORTANT

The Torsional Limit Function may not be required if the Torsional Filter function can reduce oscillations sufficiently. This situation is desirable because the load is not affected while operating at the torsion point.

Conclusion of Setup Procedures

This completes the adjustment chapter. Save the set points by pressing the "SAVE" key on the Hand Held Programmer or save settings using the Watch Window (Refer to "help" if you need help). Run through all the set points and record them in Appendix D for future reference. Settings can also be saved to a file using the Watch Window for later download. This can be very useful if a replacement control is necessary or for start-up of another similar unit. Power down the control for about 10 seconds. Restore power and verify that all set points are as recorded.

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.

Disconnect the Hand Held Programmer from the control (if applicable). Watch Window may remain connected or removed from the control at the end user's discretion. Close the cover over J1 and re-tighten the retaining screw if connection is removed.

Chapter 5.

Description of Operation

General

This chapter provides an overview of the features and operation of the 723PLUS Digital Speed Control. Figure 5-1 shows the control block diagram, for reference in the following descriptions.

The 723PLUS Digital Speed Control uses a 32-bit microprocessor for all control functions. All control adjustments are made with a hand-held terminal/display or Watch Window that communicates with the control via a serial port. The terminal/display is disconnected from the control when not in service, to provide security against tampering.

The speed sensors contain a special tracking filter designed for reciprocating engines, which minimizes the effects of firing torsionals. This provides exceptionally smooth steady-state control and allows the control dynamics to be matched to the engine rather than detuned to compensate for firing torsionals. The speed signal itself is usually provided by a magnetic pickup or proximity switch supplying from 1 to 60 Vrms to the control. The control has two red indicators that illuminate if a speed sensor signal is lost.

The control has a switching power supply with excellent spike, ripple, and EMI (electromagnetic interference) rejection. Discrete inputs are optically isolated and capable of rejecting EMI and variable resistance in switch or relay contacts. Analog inputs are differential type with extra filtering for common-mode noise rejection. This protects the control from spurious interference and noise, which can cause speed and load shifts.

The control also provides 4 to 20 mA for configurable outputs. These outputs may be used for an analog meter, recorder, or as input to a computer.

The 723PLUS control provides two separate serial interfaces. Watch Window is available on port J2 for RS-232 or RS-422 communications. An industry-standard Modbus is available on port J3 for RS-232, RS-422, or RS-485 communications in both ASCII and RTU protocols.

The 723PLUS control communicates, using the LonTalk® protocol, with the DSLC control and with optional LinkNet modules. LinkNet modules can be added to provide additional I/O for monitoring and control. The LinkNet Nodes include J-Type Thermocouple, RTD, Analog Input, Analog Output, Discrete Input, and Discrete Output modules. The LinkNet modules are self-binding to the 723PLUS control. The DSLC control is not self-binding to the 723PLUS control. In order to establish communication on the LON channel, the DSLC must be bound to the 723PLUS using LonMaker software and the LON database. See Manual B26031 for detailed 723PLUS/DSLC network binding instructions.

Control Dynamics

The control algorithms used in the 723PLUS Industrial Speed/DSLC Control are designed specifically for reciprocating engine applications. The control offers a powerful set of dynamics to closely match a wide variety of fuel delivery systems and processes.

Constant dynamics remain fixed as entered and do not vary with engine speed. Dynamics may still vary with fuel demand by using the 5-Gain mapped dynamics or the gain slope. Constant dynamics are useful for fuel systems and processes that tend to be equally stable at reduced speed and rated speed.

Variable dynamics vary gain by the ratio of actual engine speed to rated speed, and inversely vary reset by the ratio of rated speed to actual engine speed. The variable dynamics value is multiplied by the gain or the 5-Gain mapped dynamics setting (whichever is elected). Variable dynamics are useful for fuel systems and processes that tend to be less stable at reduced speed operation.

The 5-Gain mapped dynamics is a two-dimensional curve with five breakpoints that vary gain as a function of fuel demand. The 5-Gain mapped dynamics compensate for non-linear fuel systems and are useful for engines or processes whose dynamics change in a non-linear manner with load.

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 (See Figure 3-3). Gain slope and gain breakpoint are available for both constant and variable dynamics choices. It is disabled when 5-Gain mapped dynamics is chosen. Gain slope and gain breakpoint are useful for fuel systems and processes that tend to be less stable at reduced or increased load operation. This function may be disabled by setting the gain slope at zero.

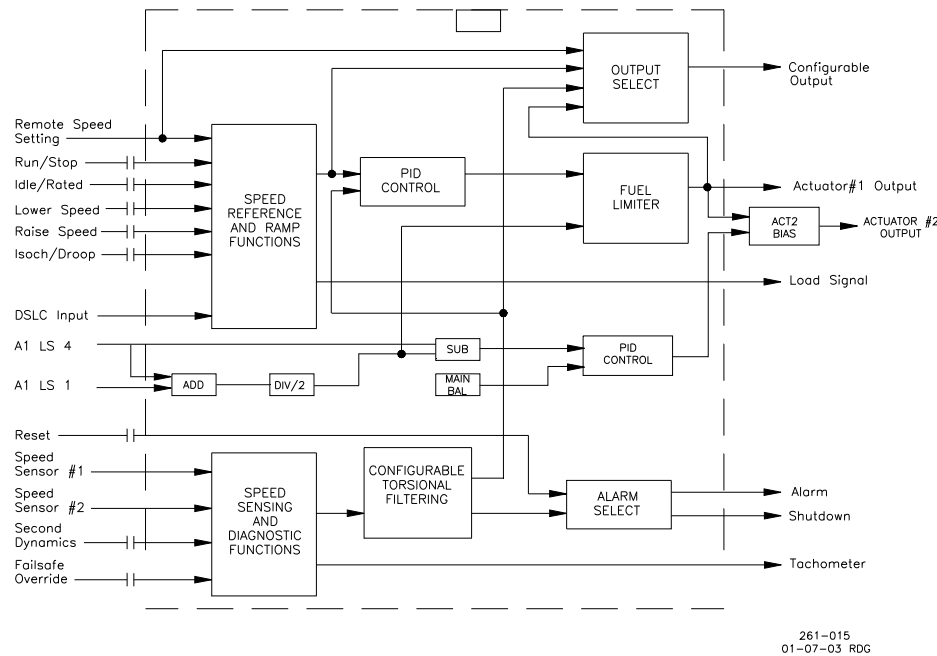


Figure 5-1. Simplified Block Diagram

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. The control automatically increases gain by an adjustable ratio when a speed error exceeding an adjustable window occurs (See Figure 3-2). During steady-state constant-load operation, the control uses the base gain setting. This base gain is adjusted by the user to a value that 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 and quickly restores 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. Furthermore, this feature is active when paralleled to a utility grid. Although actual engine speed does not change, the speed reference is changed when corrective bias signals are applied by the DSLC control or droop during load transients. Large corrective bias signals will produce a large speed error to automatically increase gain.

The control also provides a second complete set of dynamic adjustments that are selected when the 2nd Dynamics discrete input is activated. Two sets of dynamics are useful where engine operating conditions change, such as in dual-fuel engines or in electrical power generation systems where the unit may be operated stand alone or in parallel with an infinite bus.

Analog Input Load Sharing Operation

The purpose of Analog Input Load Sharing is to share load equally between two engines operating in tandem to drive a single load (e.g., generator) based on an analog input from each engine representative of engine load. Analog inputs must be the same type and range. Typically Exhaust Temperature (EXHT) or Manifold Air Pressure (MAP) are the engine parameters that provide the analog input for tandem engine load sharing.

NOTICE

Proper engine load sharing operation depends heavily on identical calibration (within reasonable tolerance) of the AI LS 1 and AI LS 4 input transmitters. Use ample care during transmitter calibration.

Permissives

The following permissives must be met to enable 723PLUS AI Load Sharing:

- Configuration option USE AI LD SHARE must be set TRUE.
- Service option ENABLE AI LOAD SHR must be set TRUE.
- CLOSE TO RUN discrete input must be closed.
- Speed must be greater than 95 % of the speed reference and the speed PID must be in control for 1 second.
- Engine must be running at or above 95 % of rated speed for a tunable delay time.
- Average AI must be greater than a tunable ma level setting (deadband). (Default deadband setting is 1/1600 mA).
- Both AI LS 1 and AI LS 4 transmitter inputs must be good. (> 2 mA, < 21 mA)

Enabled Mode Description

Automatic 723PLUS AI Load Sharing is enabled when all permissives are met. Once enabled, the AI Load Sharing PID (Proportional, Integral, Derivative) control is switched from a tracking mode to an active feedback control mode. In active feedback control mode, load sharing is accomplished by applying the PID output as a bias to the Actuator 2 output to increase or decrease the load of engine 2 to match the load of engine 1 as determined by AI LS 1 and AI LS 4 inputs. A tunable MAX BIAS limit (+/- % fuel demand) is applied to prevent an excessive bias correction signal. The speed control PID output is the primary signal to both Actuator 1 and Actuator 2. It is this signal to which the load sharing bias (Actuator 2 only) is applied. Both actuators respond quickly to step load changes sensed by the speed control. The load sharing bias responds rather slowly to maintain balance between engines.

The AI LS PID process input is AI LS 4 minus the average AI LS $((AI\ LS\ 1 + AI\ LS\ 4) / 2)$. When the two engines are load sharing equally this difference is zero. When engine 2 is carrying more load than engine 1, this difference is a positive value. When engine 2 is carrying less load than engine 1, this difference is a negative value. The difference is measured in the engineering units set for analog inputs AI LS 1 and AI LS 4 under the SET ANALOG INPUTS service header.

The AI LS PID setpoint input is a tunable reference named AUTO AI LS REF under the LOAD SHARING SETTING service header. The default setting is 0. Zero offset produces equal load sharing of engines 1 and 2 based on the analog inputs. This tunable setpoint input may be changed to produce a positive or negative offset in load sharing. A positive value increases the load of engine 2 relative to engine 1. A negative value decreases the load of engine 2 relative to engine 1. Any offset entered will be constant throughout the load range. The units for this reference is % fuel demand.

IMPORTANT

Total tandem engine load is determined by the generator load (KW) under the control of DSLC, load sharing module or droop loading and should not be confused with AI Load Sharing which controls the share of total tandem engine load that each engine carries. In this control equal AI Load Sharing mA levels is presumed to mean equal load on each engine.

The AI LS PID output is a corrective bias signal applied to Actuator 2 to trim the fuel oil rack position of engine 2 until the process input equals the setpoint input. The maximum output bias range is scaled as a percentage of fuel demand and is tunable up to +/- 10 % fuel demand. The default bias range setting is +/- 5 % fuel demand. If a range change is desired, the tunable MAX BIAS setting is found under the AI LS CONTROL service header.

Disabled Mode Operating Description

AI Load Sharing is disabled when any permissive is lost or by setting the ENABLE AI LOAD SHR tunable FALSE under the AI LS CONTROL service header which places the AI Load Sharing PID control in a tracking mode. In this mode the Actuator 2 bias signal will track a setpoint curve that is manually adjusted to add or subtract from the engine 2 speed control fuel demand. This bias provides a means of manual balancing load sharing between engines based on the speed control fuel demand. A series of 5 tunable breakpoints with offsets are provided to manually balance the load sharing of engines 1 and 2 throughout the 0-100 % fuel demand range. Refer to the service menu header LOAD SHARING SETTINGS in the Service Menu Descriptions section for adjustment instructions.

Speed Input

One or two speed sensors provide an engine speed signal to the control. The method used to detect speed is hard configured for digital type detection. The digital detection method senses speed very quickly and can respond to speed changes very quickly.

Torsional Filter Function

When the “Use Torsional Filter” is configured FALSE, the two speed inputs are sent to an HSS (High Signal Selector) that outputs the higher of the two inputs to the speed control function.

When the “Use Torsional Filter” is configured TRUE, the torsional filter function is enabled, which allows the control to effectively filter out the rapid speed changes that are caused by a system with a flexible coupling as shown in Figure 1-1. 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 this would force the closed-loop dynamics 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 fail. A software switch in the Torsional Filter menu can also be used to disable the function and return to the HSS selection of the two speed sensors.

There are two separate actions that can be taken by the torsional filtering function. The first action reduces the dynamic response to the fast speed changes associated with the coupling while still allowing fast response to actual system speed changes. The second action limits the fuel demand at the LSS if the torsional value reaches an unacceptably high value. The Alarm and Shutdown functions can be configured to activate if the torsional value gets too high.

As an alternative filtering means, a Notch Filter is also included for single speed sensor applications that require torsional filtering. In the notch filter approach, no attempt is made to map 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.

Minimum Fuel Function

The Minimum Fuel Function brings the fuel demand to zero. This occurs when the Close to Run discrete input goes FALSE. It also occurs if both speed sensor inputs have failed when the Spd Fail Override discrete input contact is open. The Close to Run command is the preferred means for a normal shutdown of the engine.



The Close to Run 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 Close to Run discrete input as the sole means of shutdown in any emergency stop sequence.

Maximum Fuel Function

The Maximum Fuel Function is a software-adjustable maximum fuel limit on the fuel demand. It is used to set a maximum position of the actuator. This is generally used to prevent engine overloading or other situations where the maximum fuel delivered to the engine should be limited. The function can be disabled by adjusting the Max Fuel Limit to 100 percent.

Start Limit Function

The Start Limit Function provides a limit to the fuel demand that prevents overfuel conditions during starting of the engine (see Figure 5-2). During startup, when engine speed reaches five percent of rated speed, the Start Limit Function is momentarily triggered to immediately limit the fuel demand to a software-adjustable start fuel limit. The start ramp begins increasing the fuel demand at a software-adjustable rate shortly after the start fuel limit is triggered. The rate can be set at zero to eliminate the start ramp function. When engine speed reaches 95% of the speed reference, and the PID is in control of the fuel demand for 1 second, the Start Limit Function will immediately increase to a maximum value of 100 percent. When engine speed decreases below five percent of rated speed from a shutdown, the Start Fuel Limit Function is re-armed for trigger during the next start. The start fuel limit function also works on reverse-acting systems. The function can be disabled by adjusting the Start Fuel Limit to a value of 100.

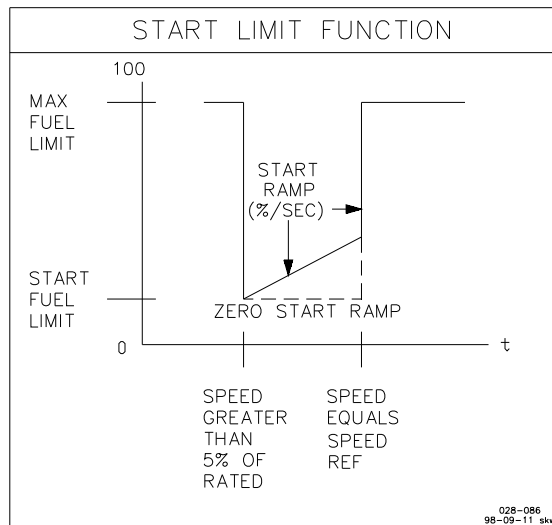


Figure 5-2. Start Limit Function

Fuel Limiting Function

The Fuel Limiting function prevents an over fuel condition by limiting fuel demand. The External Fuel Limiting Function provides one software adjustable five-breakpoint curve based on an average of two external 4-20 mA devices connected to Analog Inputs #1 and #4. The display value of the input signal can be scaled according to the engineering units desired. The output units for fuel demand limiting is in percent. The limiting value is linear from set point to set point as shown in Figure 5-3. The function is enabled when the engine speed first reaches 95 percent of the speed reference. It remains enabled until the engine is shut down. This function is disabled if the input signal is failed. This function can also be enabled or disabled by software at the EXT FUEL Limit Curve menu.

IMPORTANT

The primary function of Analog Inputs #1 and #4 is Analog Input Load Sharing. Be sure the chosen Analog Input type is suitable for External Fuel Limiting purposes if this function is also needed.

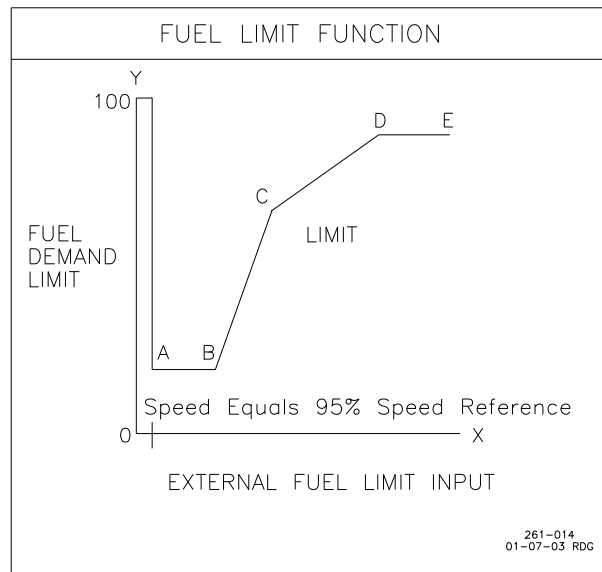


Figure 5-3. Fuel Limit Breakpoints

Actuator Function

The Actuator Function changes the fuel demand into a signal that can be used by Analog Output #3 (Actuator #1) and Analog Output #4 (Actuator #2). This allows for either a direct-acting actuator or a reverse-acting actuator. A direct-acting fuel system is one where the signal to the actuator increases as the fuel demand increases. A reverse-acting fuel system is one where the signal to the actuator decreases as the fuel demand increases. In either system, the fuel to the engine increases as the fuel demand increases. A reverse-acting system allows for using actuators with mechanical governors that can control the engine if the electronic governor fails. Standard actuators use effective signals of 20 to 160 mA to travel from minimum position to maximum position (or 160 to 20 mA to travel from minimum position to maximum position 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 if Reverse Acting is selected). This results in a fuel demand with a value of ten percent when the actuator is effectively at minimum (for either direct-acting or reverse-acting systems) and a fuel demand of 80 percent when the actuator is effectively at maximum (for either direct-acting or reverse-acting systems). An additional load sharing bias is applied to Analog Output #4 (Actuator #2) to provide for load sharing between two tandem engines driving a common load (e.g., generator) when this function is enabled.

Speed Failures

A speed failure is detected any time the input frequency from the speed sensor is less than five percent of rated speed. The failure of either or both speed sensors can be used to activate an Alarm and/or a Shutdown.

The torsional filter will be deactivated but the engine will continue to run if one speed sensor fails. If both speed sensors fail, the control action is determined by the state of the Speed Fail Ovr discrete input. The control will bring the fuel demand to zero if the override is FALSE. The control will allow the fuel demand to maximum if the override is TRUE. A true state is normally used for reverse-acting systems.

Alarm Reset

The Alarm Reset command can be issued from several different points. The command is a momentary true that resets any parameters that were latched in a failed state and are now valid when the reset occurs. The command can be issued from the Shutdown menu, Alarm menu, or the Display Analog I/O menu using Watch Window or the Hand Held programmer. Toggling the Alarm Reset discrete input TRUE, then FALSE, issues the Alarm Reset command. An Alarm Reset is also issued when power is applied to the 723PLUS. And finally, the control issues an Alarm Reset during startup (when configured).

Speed Reference and Ramps

The 723PLUS 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 Reference input and a Modbus analog write (AW) address 4:0005. Input functions are enabled as follows:

- Local Speed Reference Raise/Lower discrete inputs are enabled when remote speed setting is not enabled.
- Remote Speed Reference setting is enabled when the Raise Speed and Lower Speed contacts are both closed, the Rated contact is closed, and Use Remote Commands is FALSE.
- Modbus Speed Reference setting is enabled when the Raise Speed and Lower Speed contacts are both closed, the Rated contact is closed, and Use Remote Commands is TRUE.

Speed Reference and Ramp Functions

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 start, idle, lower limit, raise limit, and rated set points, accel and decel times, and raise and lower rates, for local operation. Accel time determines the time required for the engine to ramp from start to idle speed and from idle to rated speed. 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 and the remote reference input.

The start speed set point provides a speed reference above cranking speed but below the speed achieved with the start fuel limit setting (light-off speed). Achieving start speed begins a ramp to the selected speed reference (usually idle). This function is configurable. The default has this function disabled. It can be enabled for applications that need this function (e.g., spark gas recip engines).

When configured TRUE, the Start reference is selected, at a very fast rate, by control power-up, engine not running, or engine cranking. The Start reference is given first priority over all other references and is the speed reference until the engine starts. The ramp to the reference selected by the Idle/Rated contact input begins after the engine speed exceeds the start speed setting. This may not be the desired mode of operation, so be sure to understand the implications of operating the control in this manner.

The idle speed set point is provided for engine warm-up or cool-down cycles. 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 at a lower speed. Idle speed cannot be changed except through internal software adjustment of the idle speed set point. The idle speed setpoint is selected when the Rated contact is open, if the start reference is removed either by configuration or engine speed above start speed.

Closing the Rated contact ramps the speed set point from idle to rated, if the start reference is removed.

Closing either the Raise or Lower contacts while ramping from idle to rated results in immediate cancellation of the idle to rated ramp. After acceleration to rated speed is completed, the raise and lower commands increase and decrease engine speed based on the raise and lower rate settings. The raise and lower commands will not increase the speed reference above the raise limit or below the lower limit.

If remote operation is selected after the engine reaches rated speed, the control will ramp speed to the reference value set by the Remote Reference milliamp input or the Modbus AW value, as configured, at the raise or lower rate settings. The Remote Reference operates from 4 to 20 mA (1 to 5 Vdc). The rpm values of the 4 mA and 20 mA remote reference set points must be set between the raise and lower limit settings. The 4 mA Remote Reference set point 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.

If the Remote Reference input or the Modbus AW value is present and selected when the Idle/Rated contact is closed or during the idle to rated ramp, the speed reference will ramp to the rpm value set by the Remote Reference milliamp input or the Modbus AW value at the raise or lower rate settings. This may not be the desired mode of operation, so be sure to understand the implications of operating the control in this manner.

Below 2 mA (0.5 Vdc) or above 21 mA (5.25 Vdc), the Remote Reference input is considered failed or out of range. 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 Reference set points (see Figure 5-4). If a difference is detected between the present speed reference and the remote reference rpm value, 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.

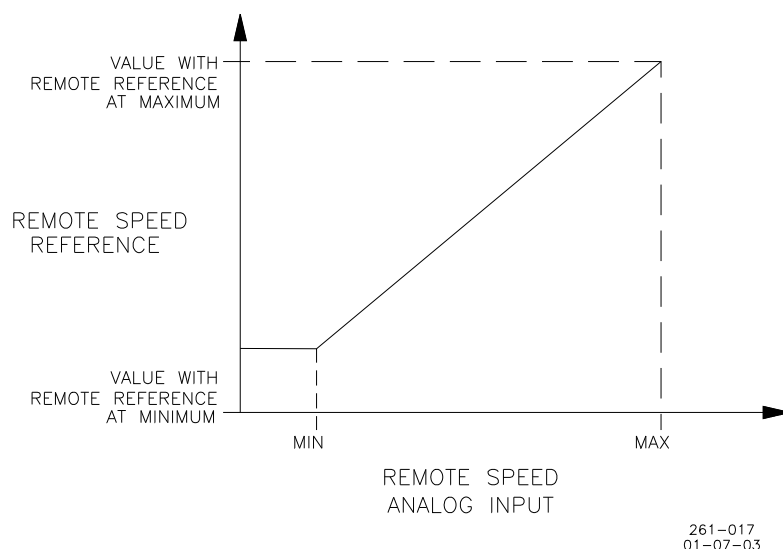


Figure 5-4. Remote Speed Reference

When operating in remote mode, if the remote input goes below 2 mA (0.5 Vdc) or above 21 mA (5.25 Vdc) or a Modbus communication link error occurs, the speed reference remains at the present value if the lock-in-last option is TRUE. Otherwise the reference follows the failed or out-of-range remote input value, or the Modbus default AW value, at the raise or lower rate, until a raise or lower limit is reached.

If the Idle/Rated contact is changed to idle after operating at rated, the control will immediately ramp engine speed to idle based on the decel time set point.

Modbus/LON Commands to the DSLC Control

Once the 723PLUS has been bound to the DSLC control (see Chapter 1, 723PLUS Digital Speed Control Accessories), DSLC inputs may be sent via Modbus to the 723PLUS and then to the DSLC control through the LON.

Modbus

Address Description-Function

- 0:0051 DSLC COMMAND USE REMOTE REFERENCE**—Set to TRUE to force the DSLC control to use the forced Remote Reference Analog Write 4:0021 Register. Set to FALSE to use the DSLC Hardware Remote Reference.
- 0:0052 DSLC COMMAND USE PROCESS SIGNAL**—Set to TRUE to force the DSLC control to use the forced Process Signal Analog Write 4:0022 Register. Set to FALSE to use the DSLC Hardware Process Signal.
- 0:0053 DSLC COMMAND CIRCUIT BKR AUX INPUT**—Set to activate the DSLC CB Aux input. This input will not be active unless CFG DSLC - USE CB AUX is TRUE.
- 0:0054 DSLC COMMAND USE NETWORK DISCRETE IN**—Set to TRUE to force the DSLC control to use the Boolean Write Discrete In signals below. Set the value to FALSE to use the DSLC Hardware DI Signals.
- 0:0055 DSLC COMMAND CHECK INPUT**—Set to activate the DSLC Check input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.

- 0:0056 DS LC COMMAND PERMISSIVE INPUT**—Set to activate the DSLC Perm input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0057 DS LC COMMAND RUN INPUT**—Set to activate the DSLC Run input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0058 DS LC COMMAND RAISE VOLTAGE INPUT**—Set to activate the DSLC Voltage Raise CB Aux input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0059 DS LC COMMAND LOWER VOLTAGE INPUT**—Set to activate the DSLC Voltage Lower CB Aux input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0060 DS LC COMMAND BASELOAD INPUT**—Set to activate the DSLC Baseload input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0061 DS LC COMMAND LOAD INPUT**—Set to activate the DSLC Load/Unload input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0062 DS LC COMMAND PAUSE INPUT**—Set to activate the DSLC Ramp Pause input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0063 DS LC COMMAND RAISE LOAD INPUT**—Set to activate the DSLC Load Raise input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0064 DS LC COMMAND LOWER LOAD INPUT**—Set to activate the DSLC Load Lower input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0065 DS LC COMMAND PROCESS ENABLE INPUT**—Set to activate the DSLC Process Control input. This input will not be active unless USE NETWORK DISCRETE IN above is TRUE.
- 0:0066 SELECT DS LC PHASE A**—Set TRUE to read DSLC Phase A Volts and Amps on Modbus. Set FALSE to read the average Volts and Amps of all phases.
- 0:0067 SELECT DS LC PHASE B**—Set TRUE to read DSLC Phase B Volts and Amps on Modbus. Set FALSE to read the average Volts and Amps of all phases.
- 0:0068 SELECT DS LC PHASE C**—Set TRUE to read DSLC Phase C Volts and Amps on Modbus. Set FALSE to read the average Volts and Amps of all phases.

Power-Up Diagnostics

The power-up diagnostics feature is provided to verify the proper operation of the microprocessor and memory components. The diagnostics take about 20 seconds after the control is powered on. A failure of the test will turn off all outputs from the control. If diagnostic testing is successful, the green CPU OK indicator on the control cover will light.

Chapter 6. Troubleshooting

Introduction

The following troubleshooting guide is an aid in isolating trouble to the control box, actuator, control wiring, or elsewhere. Troubleshooting beyond this level is recommended ONLY when a complete facility for control testing is available.

NOTICE

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

Troubleshooting Procedure

This chapter is a general guide for isolating system problems. Before using this procedure, make sure that the system wiring, soldering connections, switch and relay contacts, and input and output connections are correct and in good working order. Make the checks in the order indicated. Each system check assumes that the prior checks have been properly done.

NOTICE

The engine must be shut down for all system checks.

Control Test and Calibration

General

Do the following checks on the 723PLUS control. Then verify the functioning of set points and adjustments.

1. Connect the Hand Held Programmer or Watch Window to the control in accordance with the instructions in Chapter 3. Verify that correct voltage and polarity are applied to the control. Verify that the programmer does its power-up tests (if applicable). Be sure the jumper between terminals 9 and 10 is removed to use the Hand Held Programmer (do not remove the jumper to use Watch Window). Failure to do the power up test indicates that either the control or the Hand Held Programmer has failed. If so, try this step with another Hand Held Programmer. If the test still fails, replace the 723PLUS control. If the test passes with the second Hand Held Programmer, replace the Hand Held Programmer.
2. Verify the controller ID on the Hand Held Programmer by pressing the "ID" key. Verify the controller ID in Watch Window by clicking "control", then "properties". The Application ID message "5455-052" with the revision

level (new, A, etc) should appear. Failure indicates either the control or Hand Held Programmer (if applicable) has failed. If so, try this step with another Hand Held Programmer. If the test still fails, replace the 723PLUS control. If the test passes with the second Hand Held Programmer, replace the first Hand Held Programmer.

3. Select the 1st Dynamics Menu. Verify that all set points are as recorded during installation. Repeat for the other menus. If any differences are found, change the set point(s) to the correct value. Press the "SAVE" key on the Hand Held Programmer or save settings using the 723PLUS DSLC Control Standard PC Interface or Watch Window (refer to "help" if you need help). The Hand Held Programmer message "Saving Changes" should be displayed. Remove power from the control for at least 10 seconds. Verify correct values were retained during power down. Failure indicates the control has failed and should be replaced.

Discrete Inputs

Do the following test to verify the function of the discrete inputs. Do NOT do these tests with the engine running.

1. Repeat this step for all discrete inputs. Close the appropriate input. The status in DISPLAY DIGITAL I/O should be TRUE. If the value does not change from FALSE to TRUE when the contact is closed, verify the LED is illuminated at the respective control terminal. If the LED is illuminated and correct voltage is verified, the control has failed and should be replaced. If the LED is NOT illuminated and correct voltage is verified at the terminal (common to terminal 37), the control has failed and should be replaced.

Analog Load Sharing Input 1 Xdcr Input

The following tests calibrate and verify the function of the Analog Load Sharing Input 1 Xdcr input (Signal Input #1).

1. Connect a 4 to 20 mA or 1 to 5 Vdc source to terminals 42(+) and 43(-). If a mA source is used, a jumper must be installed across terminals 41 and 42. Connect a dc voltmeter across terminals 42(+) and 43(-). Optionally, a mA meter may be installed in series with the 4 to 20 mA source.
2. Set the source for 5.0 Vdc (20.0 mA) on the meter. Select DISPLAY MENU on the Hand Held Programmer or Watch Window. Select AN LOAD SHARE IN 1.
3. The AN LOAD SHARE IN 1 value should be equal to the AILS 1 LMT @ 20mA value (eu) set previously in the SET ANALOG INPUTS menu.
4. Set the source for 1.0 Vdc (4.0 mA). The AN LOAD SHARE IN 1 value should be equal to the AILS 1 LMT @ 4mA value set previously in the SET
5. ANALOG INPUTS menu. If the meter indicates proper voltages (or currents) are present on Signal Input #1, but readings on the Hand Held Programmer or Watch Window are incorrect, the 723PLUS control is defective and should be replaced

DSLC Input

The following tests calibrate and verify the function of the DSLC input (Signal Input #2).

1. Connect a -5 to +5 Vdc source to terminals 45(+) and 46(-). Connect a dc voltmeter across terminals 45(+) and 46(-).

2. Set the source for +5.0 Vdc on the meter. Select Display Analog IO on the Hand Held Programmer or Watch Window. Select AI2-DSLC Input.
3. Verify that the display reads $+5.0 \pm 0.1$ Vdc.
4. Set the source for -5.0 Vdc. The DSLC Input value should be -5.0 ± 0.1 Vdc. If the meter indicates proper voltages are present on Signal Input #2, but readings on the Hand Held Programmer or Watch Window are incorrect, the 723PLUS control is defective and should be replaced.

Remote Speed Xdcr Input

The following tests calibrate and verify the function of the Remote Speed Xdcr input (Signal Input #3).

1. Connect a 4 to 20 mA or 1 to 5 Vdc source to terminals 48(+) and 49(-). If a mA source is used, a jumper must be installed across terminals 47 and 48. Connect a dc voltmeter across terminals 48(+) and 49(-). Optionally, a mA meter may be installed in series with the 4 to 20 mA source.
2. Set the source for 5.0 Vdc (20.0 mA) on the meter. Select DISPLAY MENU on the Hand Held Programmer or Watch Window. Select REMOTE SPEED REF.
3. The REMOTE SPEED REF value should be equal to the REM SPEED @ 20mA value (usually in rpm) set previously in the SET ANALOG INPUTS menu.
4. Set the source for 1.0 Vdc (4.0 mA). The REMOTE SPEED REF value should be equal to the REM SPEED @ 4mA value set previously in the SET ANALOG INPUTS menu. If the meter indicates proper voltages (or currents) are present on Signal Input #3, but readings on the Hand Held Programmer or Watch Window are incorrect, the 723PLUS control is defective and should be replaced.

Analog Load Sharing Input 4 Xdcr Input

The following tests calibrate and verify the function of the Analog Load Sharing Input 4 Xdcr input (Signal Input #4).

1. Connect a 4 to 20 mA or 1 to 5 Vdc source to terminals 51(+) and 52(-). If a mA source is used, a jumper must be installed across terminals 50 and 51. Connect a dc voltmeter across terminals 51(+) and 52(-). Optionally, a mA meter may be installed in series with the 4 to 20 mA source.
2. Set the source for 5.0 Vdc (20.0 mA) on the meter. Select DISPLAY MENU on the Hand Held Programmer or Watch Window. Select AN LOAD SHARE IN 4.
3. The AN LOAD SHARE IN 4 value should be equal to the AILS 4 LMT @ 20mA value (eu) set previously in the SET ANALOG INPUTS menu.

4. Set the source for 1.0 Vdc (4.0 mA). The AN LOAD SHARE IN 4 value should be equal to the AILS 4 LMT @ 4mA value set previously in the SET ANALOG INPUTS menu. If the meter indicates proper voltages (or currents) are present on Signal Input #1, but readings on the Hand Held Programmer or Watch Window are incorrect, the 723PLUS control is defective and should be replaced.

Actuator Outputs

The following tests verify both actuator outputs of the control.

1. Connect a frequency signal generator to Speed Sensor Input #1 (terminals 11/12). Set the output level above 1.0 Vrms, and the frequency to a value greater than 5% of rated frequency and less than 50% of rated frequency.
2. Close the Run contact (terminal 36). Connect one milliamp meter across terminals 19(+) and 20(–) and a second milliamp meter across terminals 21(+) and 22(–) if no actuator is connected. Connect the milliamp meters in series with each actuator if they are connected to the control. (Alternately, a dc voltmeter may be connected across the output when the actuators are connected. The correct output currents must be computed using the voltage measured and the input resistance of each actuator.)
3. Select the CFG OPTION Menu on the Hand Held Programmer or Watch Window. Set the Use Rev Actuator to Forward Acting (FALSE).
4. Select the FUEL LIMITERS Menu. Set the Start Fuel Limit to 100%. Set the Max Fuel Limit to 20%. The output current of each actuator should be 42 ± 2 mA.
5. Set the Max Fuel Limit to 100%. The output current of each actuator should be 210 ± 10 mA. If with all connections, output settings and hardware jumper positions verified, the output of the control fails to perform as above, replace the control.
6. Return to the CFG OPTION Menu on the Hand Held Programmer or Watch Window. Set the Use Rev Actuator to the value as recorded during installation.
7. Return to the FUEL LIMITERS Menu. Set the Start Fuel Limit and the Max Fuel Limit to the values as recorded during installation.

Speed Inputs

The following tests verify the operation of the speed inputs.

1. Connect a frequency signal generator to Speed Sensor Input #1 (terminal 11/12). Set the output level above 1.0 Vrms. Record the DSPD #1 TEETH set point from the CFG SPEED CONTROL Menu. Temporarily set to 60 (this causes the rpm values and Hertz values to be the same, to make doing the test easier).
2. Set the signal generator to 400 Hz. Read Engine Speed value of 400 rpm on Display Menu. Increase the signal generator frequency to 2000 Hz. The value read should follow the signal generator frequency.

3. Return DSPD #1 TEETH on the CFG Speed Control Menu to the previously recorded values for your engine.
4. Repeat steps 1–3 for Speed Sensor Input #2 (terminal 13/14).

Conclusion of Test and Calibration Procedures

This completes the test and calibration chapter. Save the set points by pressing the “SAVE” key on the Hand Held Programmer, or save settings using the Watch Window (refer to “help” if you need help). Power down the control for about 10 seconds. Restore power and verify that all set points are as recorded.

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.

Disconnect the Hand Held Programmer from the control (if applicable). Watch Window may remain connected or removed from the control as desired. Close the cover over J1 and re-tighten the retaining screw if the connection is removed..



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.

Chapter 7.

Product Support and Service Options

Product Support Options

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

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

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

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

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

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

Product Service Options

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

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

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

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

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

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

Returning Equipment for Repair

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

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

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

Packing a Control

Use the following materials when returning a complete control:

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

NOTICE

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

Replacement Parts

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

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

Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

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

Contacting Woodward's Support Organization

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

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

Products Used In Electrical Power Systems

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

Products Used In Engine Systems

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

Products Used In Industrial Turbomachinery Systems

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

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

Technical Assistance

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

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

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

Power Output Rating _____

Application (power generation, marine,
etc.) _____

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Symptoms

Description _____

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

Appendix A.

Serial Communications Port Wiring

Communication Port J2 can be configured for RS-232 or RS-422 serial communications. Communication Port J3 can be configured for RS-232, RS-422, or RS-485 serial communications. The default setting for both is for RS-232

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).

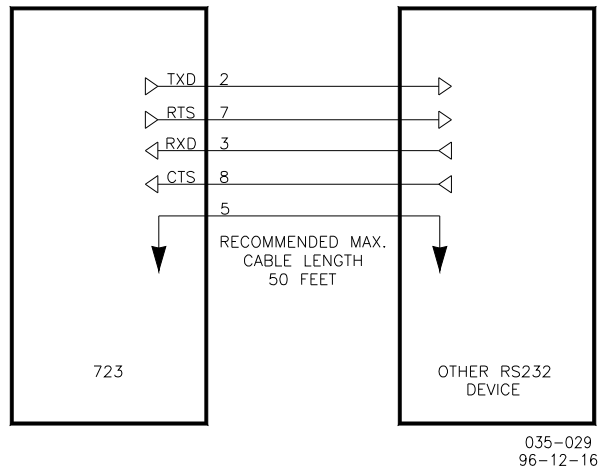


Figure A-1. 723PLUS RS-232 Connections

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).

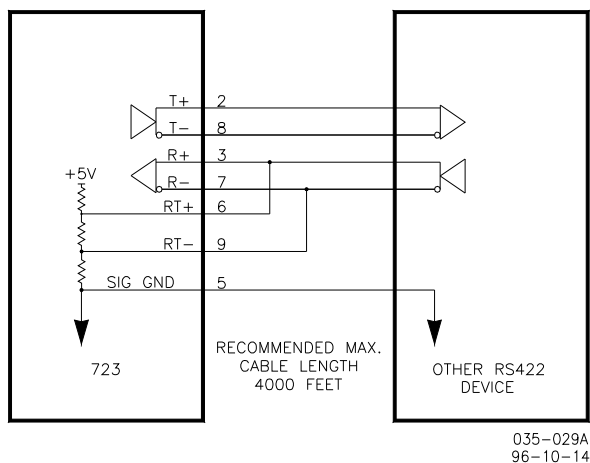


Figure A-2. 723PLUS RS-422 Connections with Optional Termination at Receiver

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).

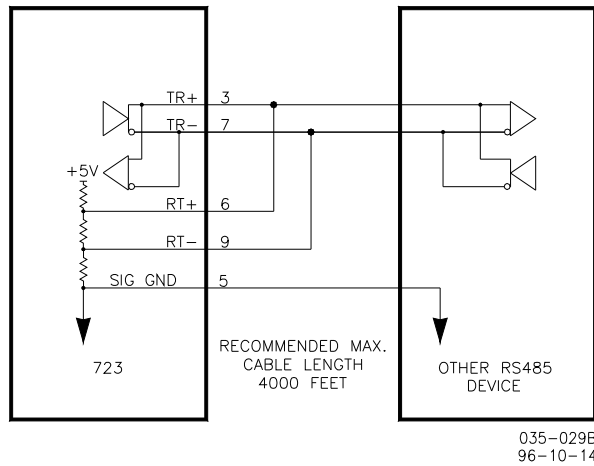


Figure A-3. 723PLUS RS-485 Connections with Optional Termination

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.

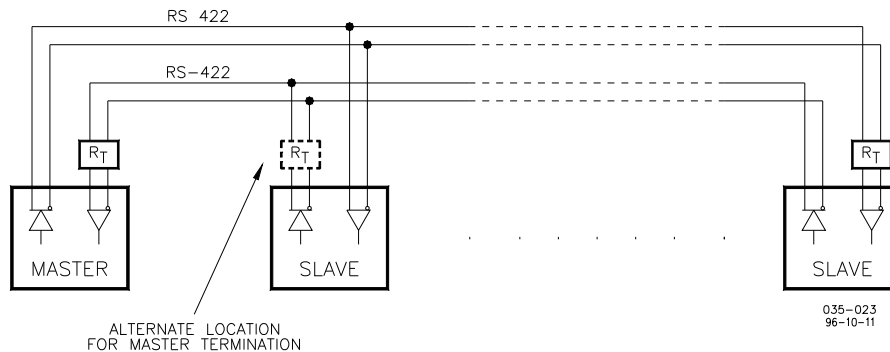


Figure A-4. RS-422 Terminator Locations

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.

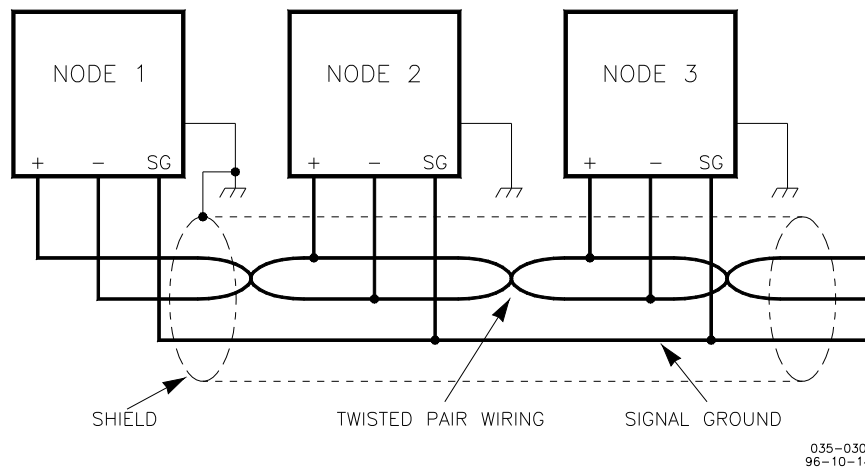


Figure A-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

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

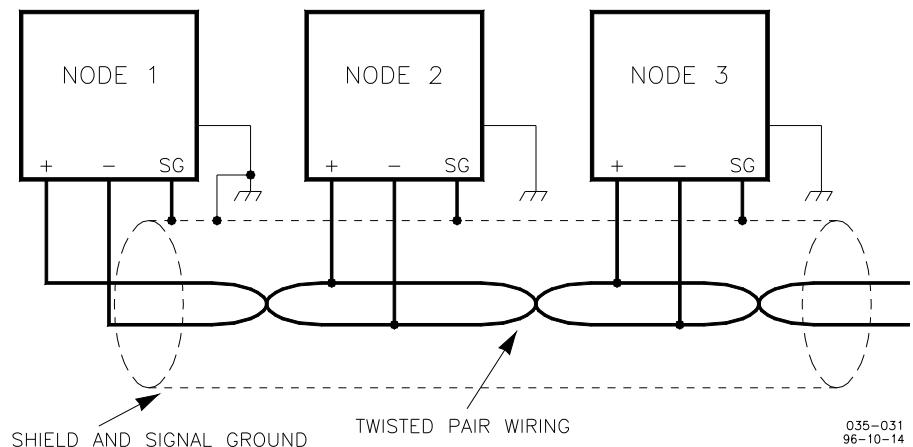


Figure A-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

Appendix B.

LinkNet[®] I/O Network

Introduction

The LinkNet[®] option provides distributed I/O capabilities for the 723PLUS control system through LON #1. The LinkNet I/O modules, while slower and less powerful than on-board I/O, are well suited for functions that are not time-critical, such as sequencing and monitoring.

Network Architecture

An I/O network consists of the 723PLUS LON #1 channel, which provides independent network trunks of up to 9 I/O modules. The LinkNet I/O modules, or nodes, on each trunk are attached to the 723PLUS via a single twisted-pair wire (see end of this Appendix for correct wiring geometry).

Each LinkNet I/O module has two rotary switches that are used to set its network address. On installation, these switches must be dialed so that the I/O module's network address of 1–18 matches the network address defined for this I/O module in the application program. The I/O modules may be placed in any order on the network, and gaps are allowed in the address sequence.

Hardware

Each network consists of one LinkNet channel of a 723PLUS and many I/O modules. The I/O modules include thermocouple inputs, RTD inputs, 4–20 mA inputs, and discrete inputs as well as 4–20 mA and relay outputs. All of the analog modules consist of six channels per module. The Relay Output module contains eight channels, and the Discrete Input module has 16 channels.

Each I/O module is housed in a plastic, field-termination-module-type package for DIN rail mounting. The LinkNet I/O modules can be mounted in the control cabinet or in any convenient location in the vicinity of the engine that meets the temperature and vibration specifications.

I/O Module Specifications

Accuracy

1% at 25 °C without field calibration

Power Supply Input

18 to 32 Vdc

Isolation

Network to I/O channel: 277 Vac

Power supply input to network: 277 Vac

I/O channel to I/O channel: 0 V

Power supply input to I/O channel: 500 Vdc except for discrete inputs, discrete input power comes directly from power supply input

Scan Rate

Less than 7 output modules:

(# of I/O modules x 6 + 75) ms typical

(# of I/O modules x 6 + 100) ms max

7 or more output modules:

(# of I/O modules x 6 + # of output modules x 3 + 55) ms typical

(# of I/O modules x 6 + # of output modules x 3 + 80) ms max

Field Wiring

2 mm² (14 AWG) maximum wire size

Temperature Range

-40 to +55 °C

UL Listed Component

Class 1, Division 2, Groups A, B, C, and D, when wired in accordance with NEC Class 1 Div. 2 wiring methods

Shock and Vibration

US Mil-Std-810, 30 Gs sine wave at 11 ms

US Mil-Std-167, 18-50 Hz

EMC

Emissions: EN 55011, Class A, Group 1

ESD immunity: IEC 801-2 (1991) 8 kV air and 4 kV contact, HCP and VCP tests

Radiated RF immunity: IEC 801-3, 10 V/m +80% 1 kHz AM, 80–1000 MHz

Fast transient immunity: IEC 801-4 (1988) 2 kV directly coupled onto power lines and 2 kV capacitively coupled onto I/O network lines

Discrete Input Current

13.1 mA per channel when "on" (@ 24 V)

Relay Contacts

Ratings: 5.0 A @ 28 Vdc resistive

0.5 A @ 115 Vac resistive

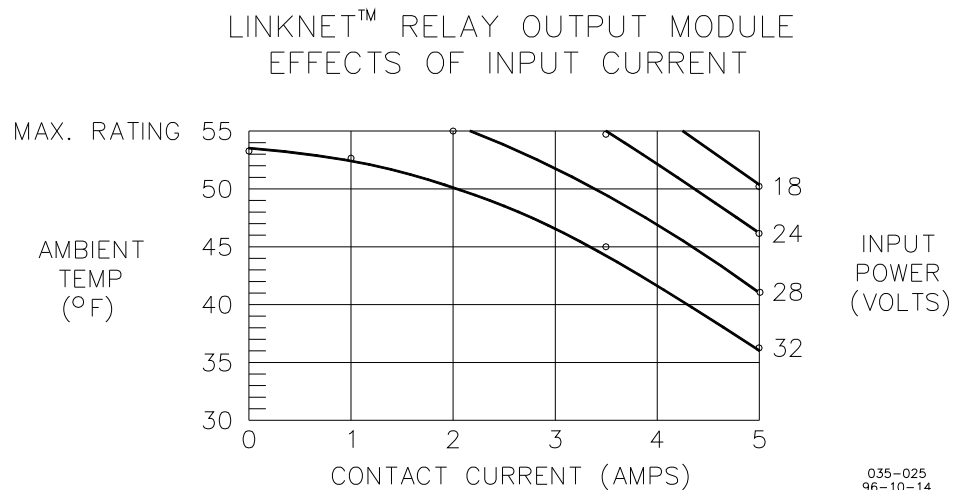


Figure B-1. LinkNet Relay Contacts

Individual I/O Module Specifications

I/O Module Type	Number of Channels	Resolution (bits)	Temp Coefficient (ppm/°C)	Input Impedance	Power Required at 24 V input
Discrete Input	16	N/A	N/A	N/A	6.5 W
Relay Output	8	N/A	N/A	N/A	5.0 W
4-20 mA Input with 24 V	6	12	235	250 Ω	5.3 W
4-20 mA Input	6	12	235	250 Ω	2.4 W
4-20 mA Out	6	12	250	N/A	6.0 W
RTD Input	6	12	290	2.2 M Ω	3.1 W
Thermocouple Input (J or K type +1 AD592)	6 +1 cold junction	12	235	2 M Ω	2.4 W

LinkNet I/O Module Descriptions

The FAULT LED denotes the status of the module processor, and will be off during normal operation. If the FAULT LED is on or is blinking, and cycling power to the module does not change it, then the I/O module should be replaced.

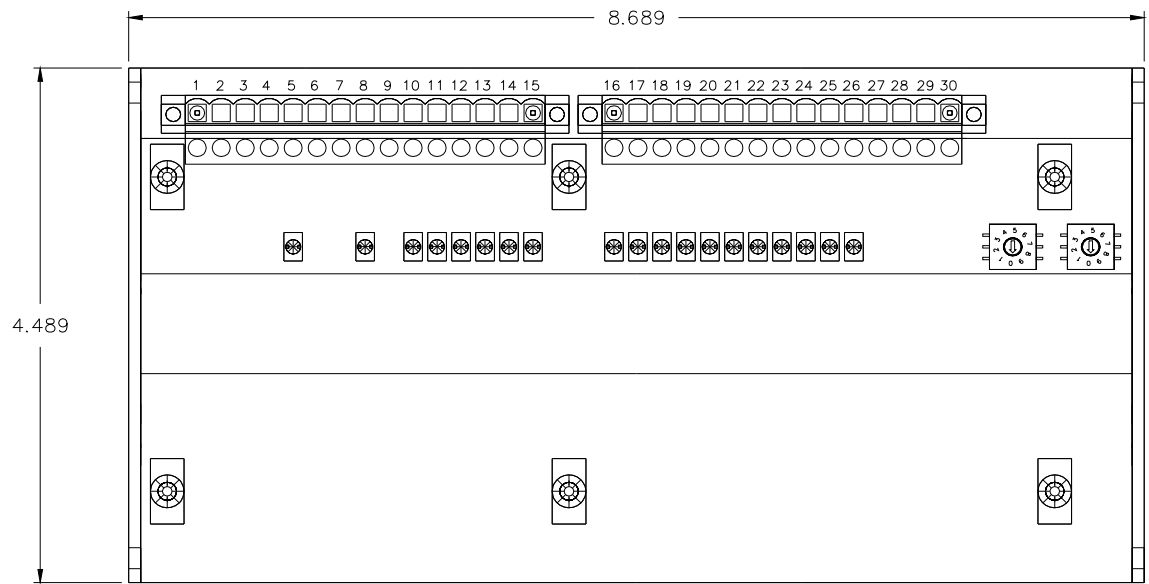
The module address circuit reads the selected module address from the rotary switches on each node. This address should correspond to the address of the I/O module hardware in the application program. If these rotary switches are set incorrectly, the node will not communicate with the 723PLUS, and a “no message” fault will be annunciated through the application program. If two nodes are set to the same address, an “address” fault will be annunciated through the application program, and both nodes will not function. *If the node address switches are changed, power to the module must be cycled before it will read the new module address and change its communication accordingly.*

A “type” fault is annunciated through the application program when the wrong module type is installed at a given address. For example, installing a thermocouple module in place of an RTD module generates a type fault. If an output node receives data intended for a different module type, it will not update its outputs, and will set them to the “off” state when its watchdog timer times out.

No-message faults, address faults, and type faults can be latching or non-latching (selectable within the 723PLUS control). When these faults occur for an input module, the application program can give default values for each channel.

Output modules contain readback circuits to verify proper operation of each output channel. Analog input modules monitor a reference voltage to verify proper operation of the A/D converter. Appropriate faults are annunciated through the application program.

The LinkNet system accommodates hot-replacement of faulty nodes. When replacing a node, the network cable connections must remain intact. A faulty node can be removed from the network by pulling both terminal blocks out of their headers, and removing the node from the DIN rail. The address switches of the replacement node should be set to match those of the faulty node. The replacement node can then be mounted on the DIN rail, and the terminal blocks pushed into the headers. It may be necessary to reset the node through the application program to reinitiate communications with the 723PLUS and to clear the “no message” fault.



MAX. HEIGHT = 2.800

035-026
96-10-14

Figure B-2. Outline Drawing of I/O Module

Discrete Input Module

Figure B-3 is a block diagram and Figure B-4 is a wiring diagram of the Discrete Input module. The module receives information from field switches and relays. Power is provided for these contacts, on four terminal blocks, TB-5 through TB-8. The input power on TB-2 may also be used, but does not have the benefit of an internal fuse and some filtering, therefore external fusing should be provided. The state of each discrete input is passed through an optoisolator and an LED to the shift register. In this manner, the LEDs will light when a contact is closed. The module processor receives this information and transmits it through the transceiver to the 723PLUS.

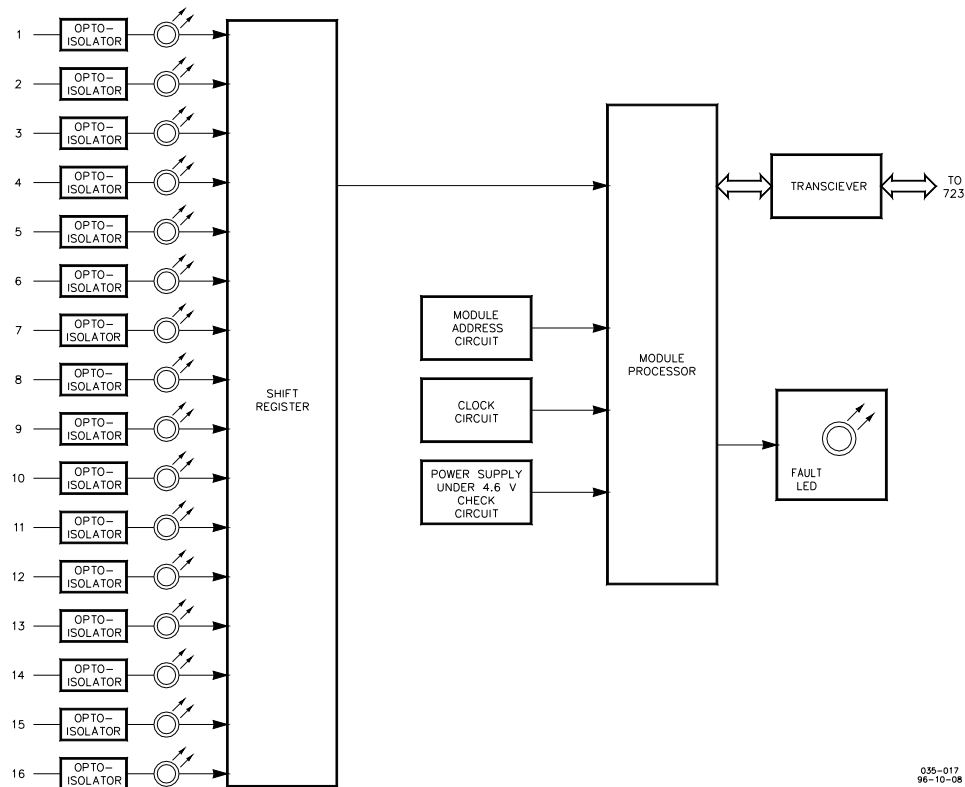


Figure B-3. Discrete Input Module Block Diagram

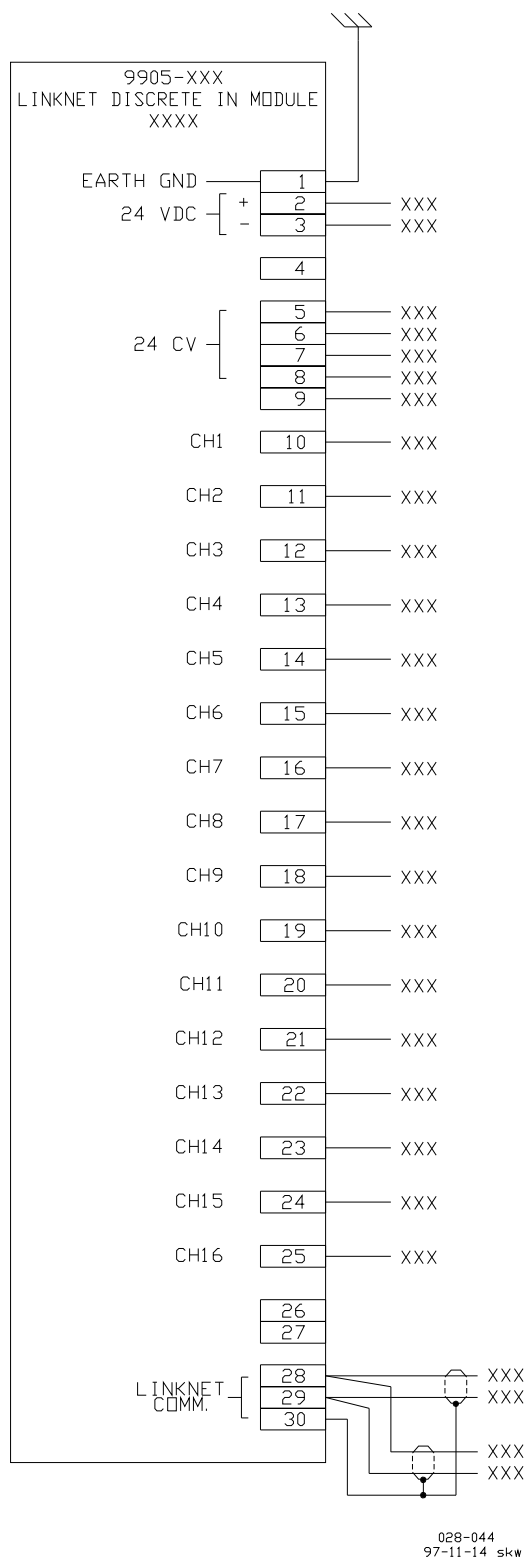


Figure B-4. Discrete Input Module Wiring Diagram

4–20 mA Input Module

Figure B-5 is a block diagram and Figure B-6 is a wiring diagram of the 4–20 mA Input module. The module receives information from 4–20 mA sources, such as transducers. Power is provided for these transducers on one version of the module, but all module inputs must use the power provided. No inputs may use a separate power source, as all of the negatives are tied together and to 24 V common. The advantage of this module version is that it simplifies wiring to devices such as transducers that require external power. Each input is converted to a 0–5 V signal, and then multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the 723PLUS.

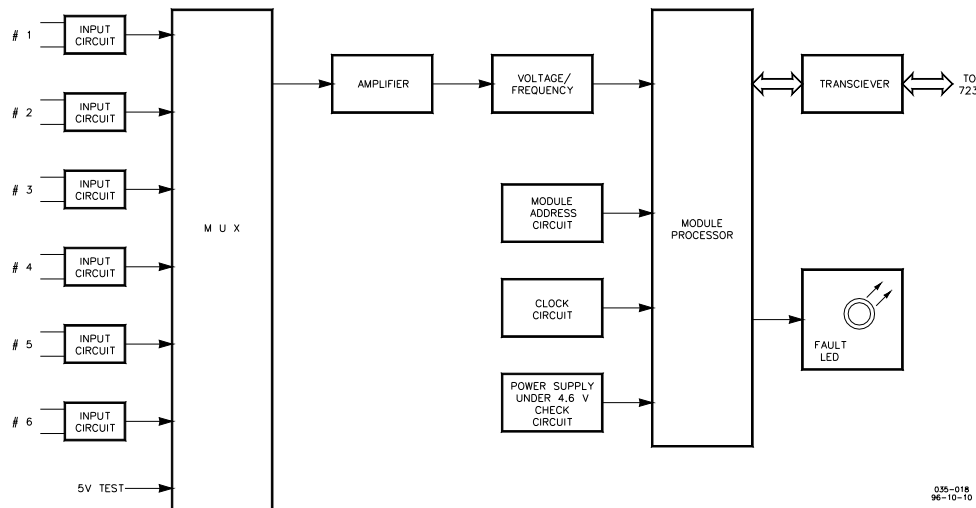


Figure B-5. 4–20 mA Input Module Block Diagram

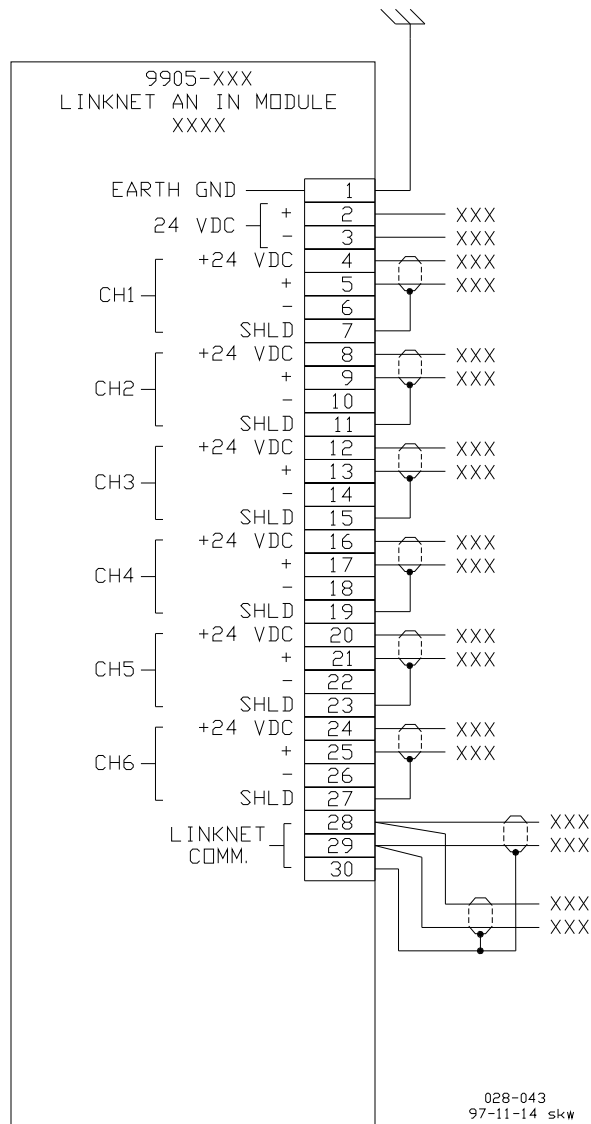


Figure B-6. 4–20 mA Input Module Wiring Diagram

Thermocouple Input Module

Figure B-7 is a block diagram and Figure B-8 is a wiring diagram of the Thermocouple Input module. The module receives information from thermocouples, which can be either J or K type. The type is selected in the application program. It also has an AD592 ambient temperature sensor mounted on the module for cold junction temperature sensing. The cold junction compensation is performed in software. There is a fail high and a fail low version of the module, selected by jumpers on the board, which allow the input channels to be pulled high or low on an open input. Each input is multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the 723PLUS.

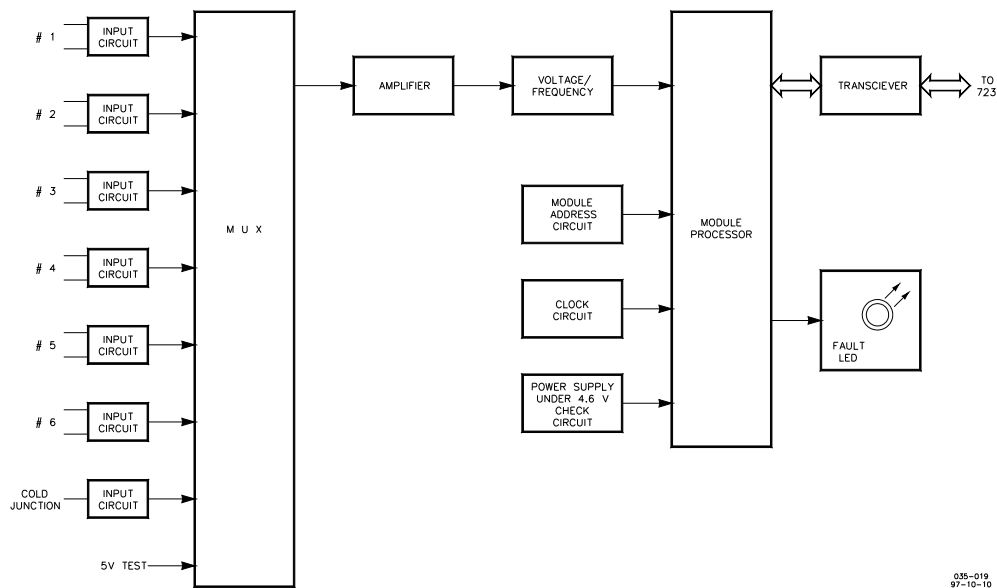


Figure B-7. Thermocouple Input Module Block Diagram

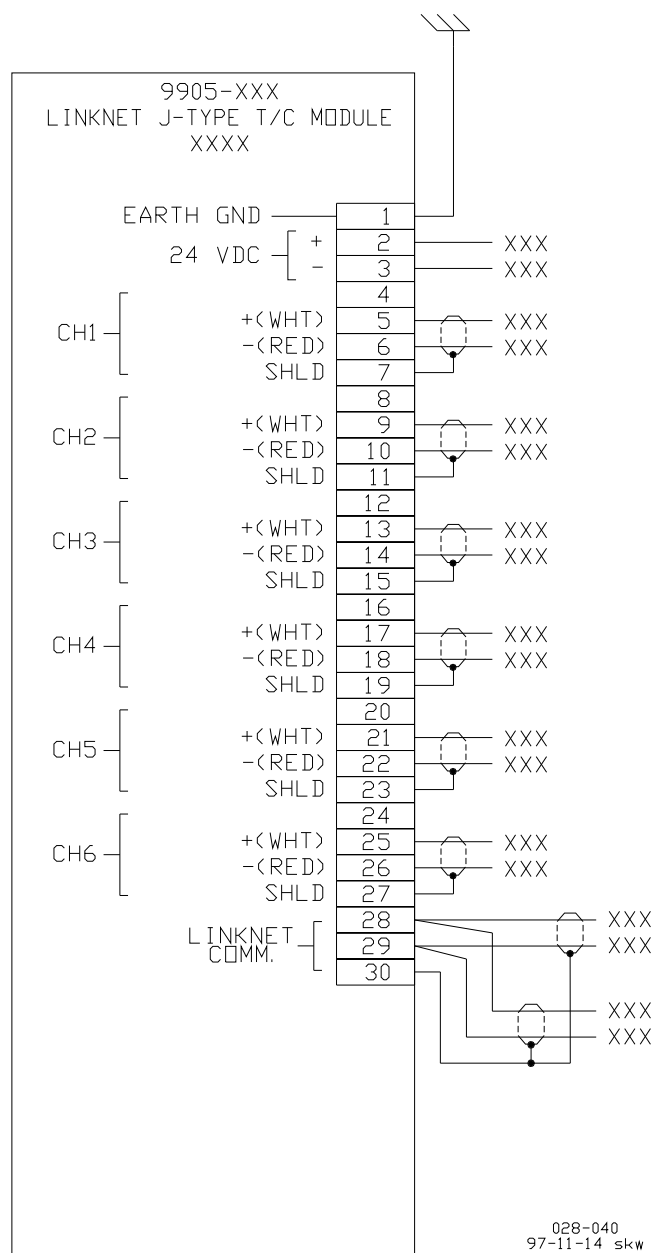


Figure B-8. Thermocouple Input Module Wiring Diagram

RTD Input Module

Figure B-9 is a block diagram and Figure B-10 is a wiring diagram of the RTD Input module. A 1 or 2 mA source is provided for each input. The module receives voltages from six 100 or 200 Ω , 3-wire RTDs. Each voltage is compensated for line resistance, and then is multiplexed to a voltage-to-frequency converter. The module processor reads the period of this signal and converts it to a count, which it transmits through the transceiver to the 723PLUS.

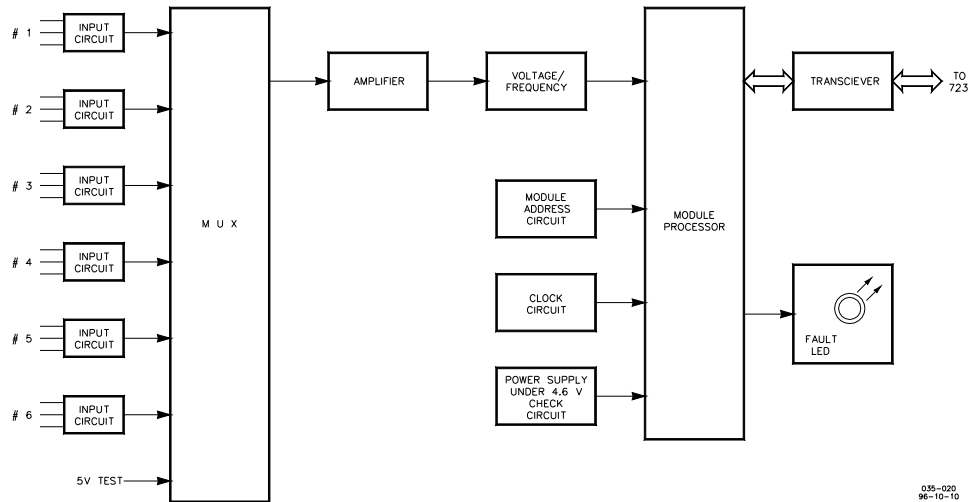


Figure B-9. RTD Input Module Block Diagram



Relay Output Module

Figure B-11 is a block diagram and Figure B-12 is a wiring diagram of the Relay Output module. The module outputs information through eight 5 A form C relays. The relay output module processor receives information through the transceiver, from the 723PLUS. The node then updates the status of the shift register that updates the relays and a status LED. The second set of relay contacts is input back into the module processor through a shift register, for readback status. The readbacks are compared with the desired outputs, and a status annunciated for each relay in the application program. The relay output module has a watchdog that monitors the communications from the module processor to the shift register, and disables the relay drivers upon a loss of communications of more than 1.2 seconds. The node will not function after a watchdog timeout, until its power is cycled or until the 723PLUS is reset.

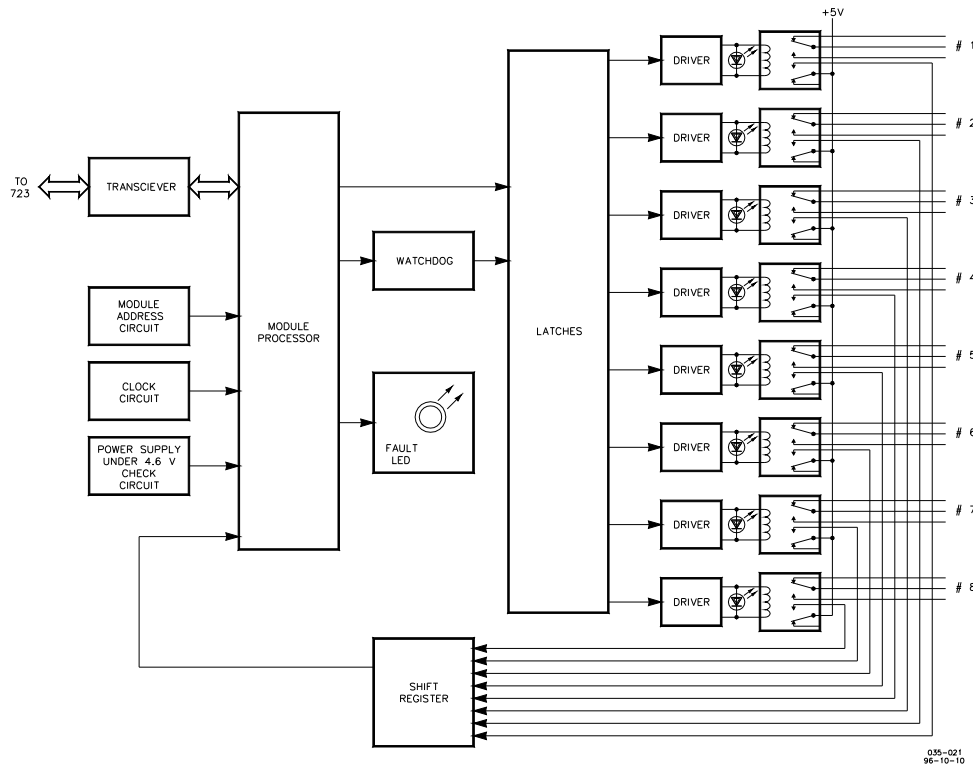


Figure B-11. Relay Output Module Block Diagram

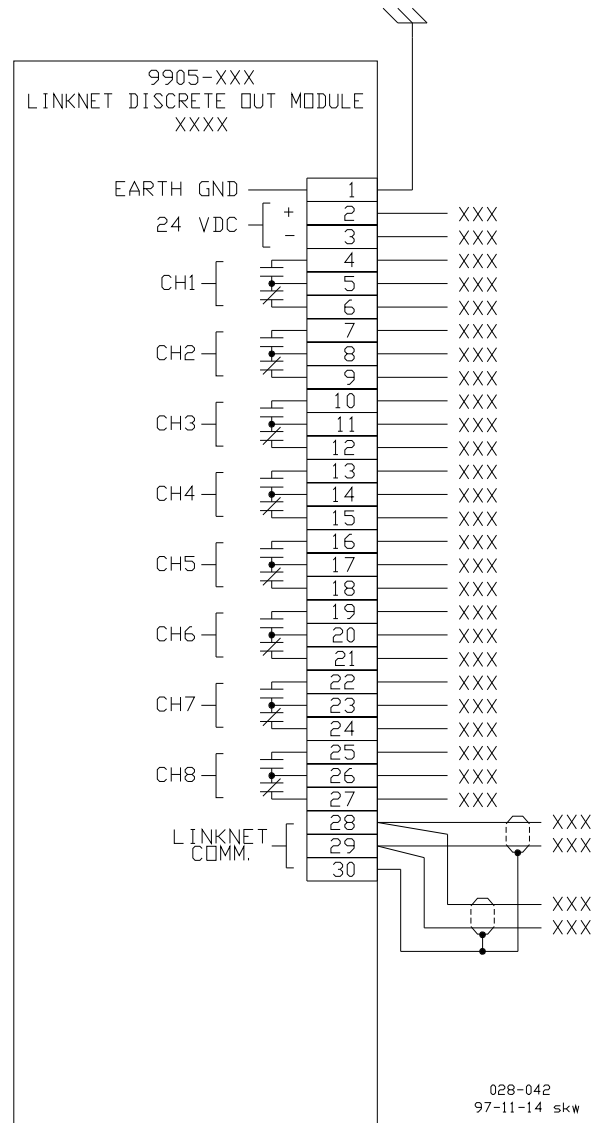


Figure B-12. Relay Output Module Wiring Diagram

4–20 mA Output Module

Figure B-13 is a block diagram and Figure B-14 is a wiring diagram of the 4–20 mA Output module. The 4–20 mA output module processor receives information through the transceiver, from the 723PLUS. The 4–20 mA output module then updates the status of the D/A converter that outputs voltages to the current drivers. The output current is monitored by the module processor through an A/D converter. The readback value and status are available through the application program. The 4–20 mA output module has a watchdog that monitors the communications from the module processor to the D/A converter, and disables the current drivers upon a loss of communications of more than 1.2 seconds. The module will not function after a watchdog timeout until its power is cycled or the 723PLUS is reset.

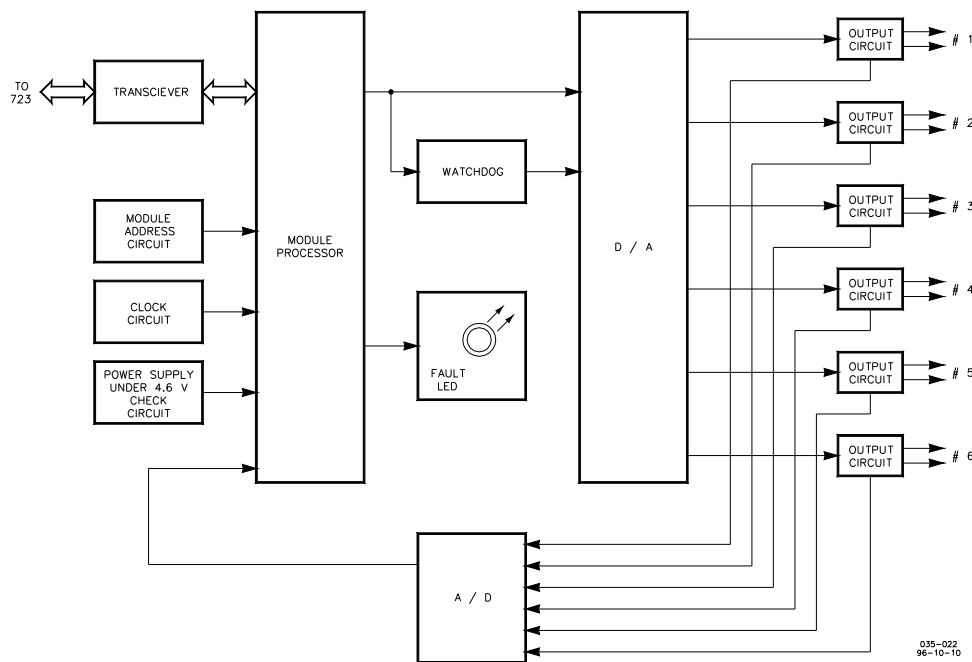


Figure B-13. 4–20 mA Output Module Block Diagram

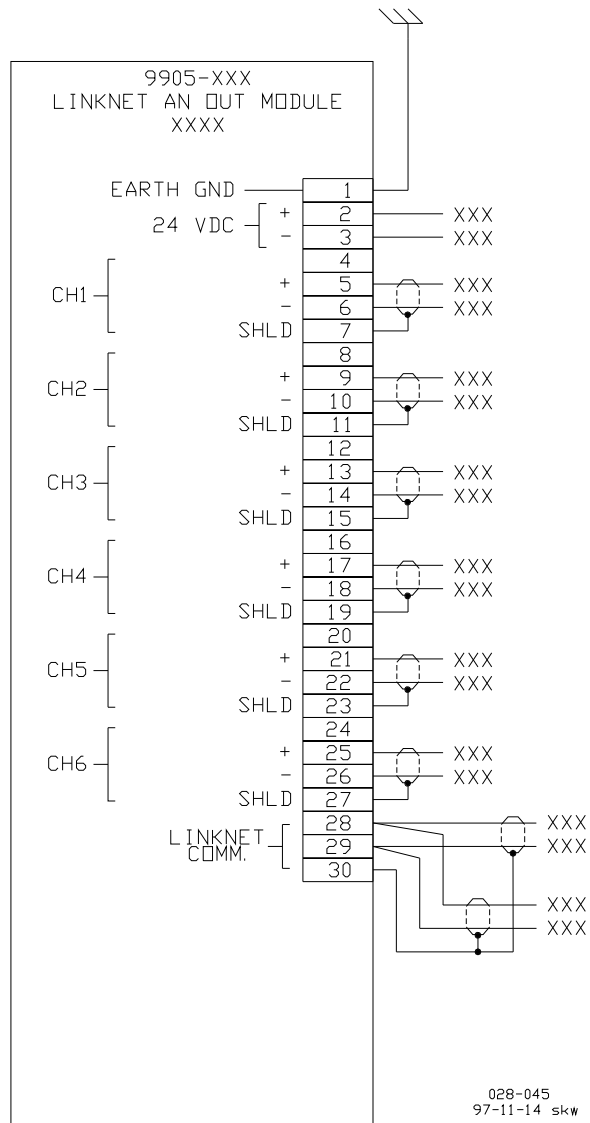


Figure B-14. 4–20 mA Output Module Wiring Diagram

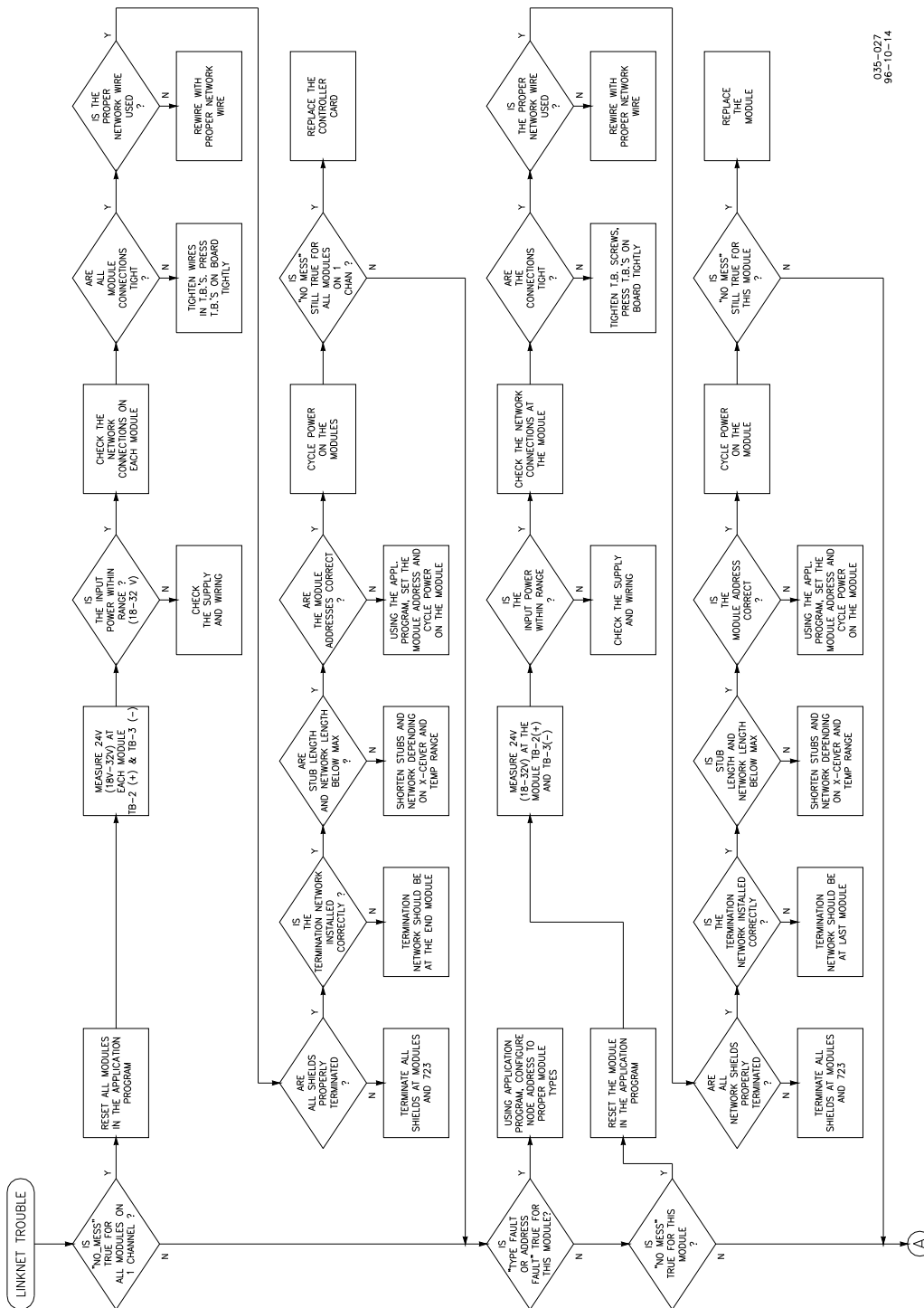


Figure B-15. Troubleshooting Flowchart (1 of 2)

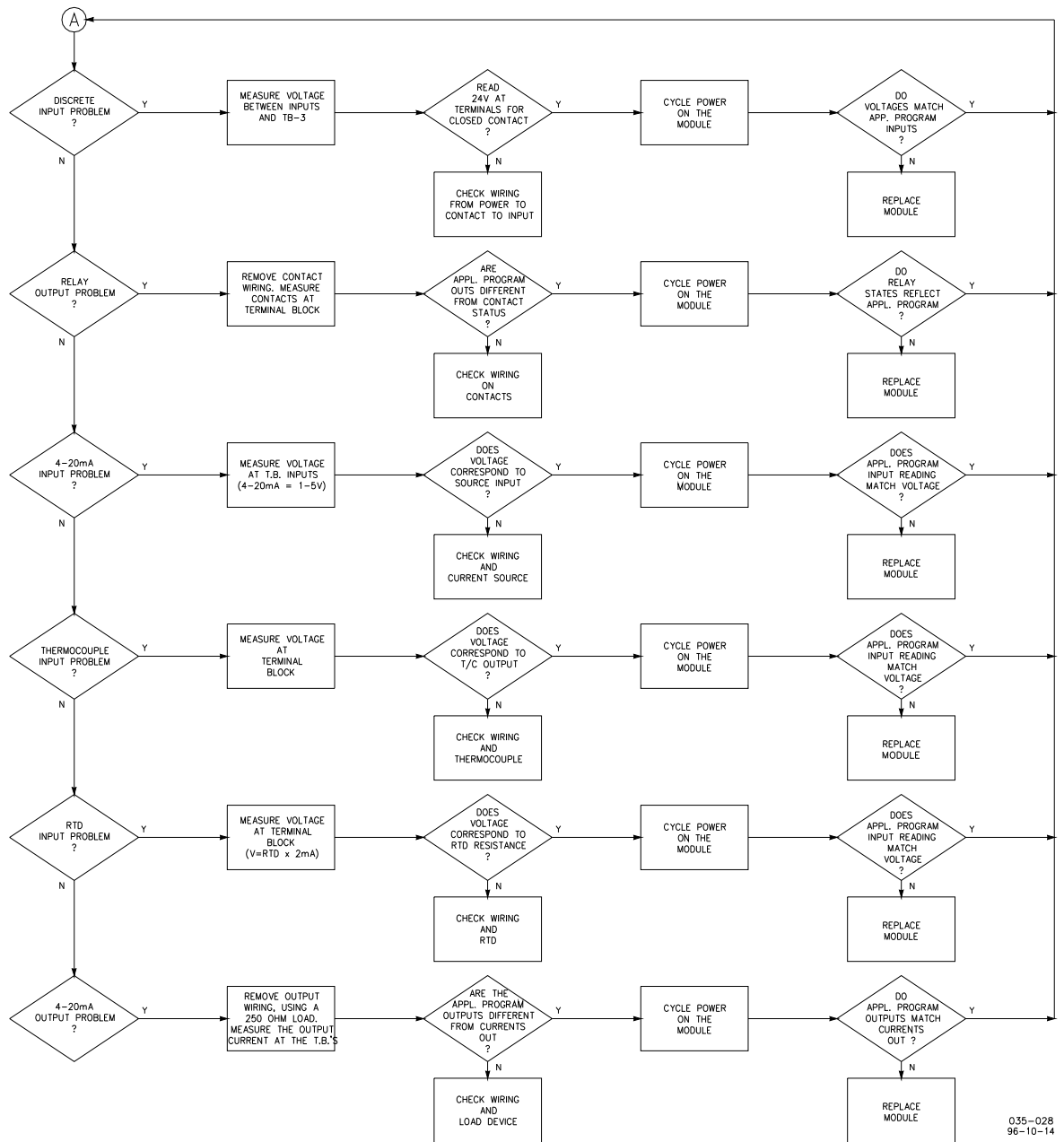


Figure B-15. Troubleshooting Flowchart (2 of 2)

Troubleshooting Flowchart

If a problem occurs with the LinkNet network, use Figure B-15 (Troubleshooting Flowchart) as a guide to find and repair the problem.

Follow the flowchart down from the title block to the next block. This block may be a rectangular suggestion block, or a diamond shaped decision block. When a suggestion block is entered, do the check suggested. A suggestion block may refer you to the control wiring diagram, the application program, or the module field wiring.

If this check does not find the problem, continue down the flowchart.

When a decision block is entered, the question asked inside it must be answered. This answer then determines the proper exit from that block. The exit taken will lead you to another point on the flowchart.

By following the flowchart in this manner, you should be able to determine a course of action for most problems.

Wiring and Proper Cable

All LinkNet I/O modules communicate with the 723PLUS through shielded twisted pair wiring. The specifications for the LinkNet system require that listed level V type cable be used. The network may be wired directly from I/O module to I/O module, as shown in Figure B-16, or the I/O modules may be connected to the network via stubs as in Figure B-17. A termination network must be installed at the last LinkNet I/O module on the network. There is no polarity associated with the network wiring. For optimum EMC performance, the network cable shield should be landed at each I/O module, and the exposed wire length limited to 25 mm (1 inch). At the 723PLUS, the outer insulation should be stripped and the bare shield landed to the chassis.

All field wiring should be shielded. The shield should be landed in the terminal block provided, and the exposed wiring, after the shield is separated, should be limited to one inch.

IMPORTANT

The LinkNet modules should always be mounted in a cabinet, or be otherwise operator inaccessible. The modules should be accessed only for maintenance purposes, in which case, the ESD procedures on page iv should be followed.

Correct 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. FT 4.
YR28867	PVC 22 AWG shielded.
YQ28863	Plenum 22 AWG shielded.

Cable Length and Number of LinkNet I/O Modules

Specification	0 to 55 °C	-20 to +55 °C	-40 to +55 °C
Maximum network cable length	150 m	150 m	50 m
Maximum number of I/O modules	60	32	20
Maximum stub length	300 mm	300 mm	300 mm

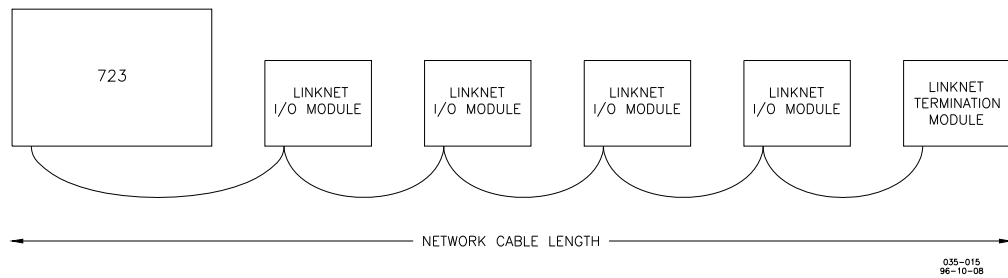


Figure B-16. Direct Wired Network

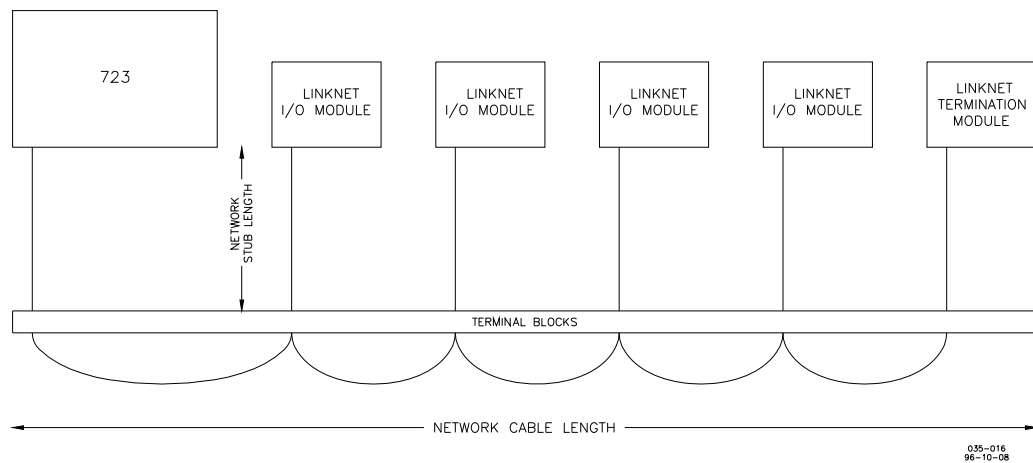


Figure B-17. Network Wired Via Stubs

Appendix C.

Modbus Slave Address Information

Part Numbers 8280-608

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

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

Woodward MODBUS Slave Address Information
File created on 05/17/01
FileName: 5455052.GAP
Project: 77784
P/N: 5455-052
Rev: NEW

723PLUS DIGITAL ENGINE CONTROL
ANALOG INPUT (EXHT OR MAP) LOAD SHARING
FOR TANDEM UNITS AND USE WITH DSLC OR
LOAD SHARING MODULE, MODBUS & LINKNET

MODBUS PORT3

Boolean Writes

Addr	Description
0:0001	ALARM RESET
0:0002	723 RELAY OUTPUT #1
0:0003	
0:0004	
0:0005	
0:0006	
0:0007	
0:0008	
0:0009	
0:0010	
0:0011	USE ISOCH REMOTE COMMAND
0:0012	
0:0013	USE FAILSAFE OVERRIDE REMOTE COMMAND
0:0014	USE SECOND DYNAMICS REMOTE COMMAND
0:0015	USE RAISE SPEED REMOTE COMMAND
0:0016	USE LOWER SPEED REMOTE COMMAND
0:0017	USE RATED/IDLE REMOTE COMMAND
0:0018	USE RUN REMOTE COMMAND
0:0019	USE REMOTE SPEED REFERENCE
0:0020	
0:0021	723 COMMAND CLOSE FOR ISOCHRONOUS
0:0022	
0:0023	723 COMMAND CLOSE TO OVERRIDE FAILSAFE
0:0024	723 COMMAND CLOSE FOR SECOND DYNAMICS
0:0025	723 COMMAND CLOSE TO RAISE SPEED REF
0:0026	723 COMMAND CLOSE TO LOWER SPEED REF
0:0027	723 COMMAND CLOSE FOR RATED SPEED
0:0028	723 COMMAND CLOSE TO RUN
0:0029	
0:0030	

0:0031 CHANNEL 1 DISCRETE OUTPUT MODULE 1
 0:0032 CHANNEL 2 DISCRETE OUTPUT MODULE 1
 0:0033 CHANNEL 3 DISCRETE OUTPUT MODULE 1
 0:0034 CHANNEL 4 DISCRETE OUTPUT MODULE 1
 0:0035 CHANNEL 5 DISCRETE OUTPUT MODULE 1
 0:0036 CHANNEL 6 DISCRETE OUTPUT MODULE 1
 0:0037 CHANNEL 7 DISCRETE OUTPUT MODULE 1
 0:0038 CHANNEL 8 DISCRETE OUTPUT MODULE 1
 0:0039
 0:0040
 0:0041
 0:0042
 0:0043
 0:0044
 0:0045
 0:0046
 0:0047
 0:0048
 0:0049
 0:0050
 0:0051 DSLC COMMAND USE REMOTE REFERENCE
 0:0052 DSLC COMMAND USE PROCESS SIGNAL
 0:0053 DSLC COMMAND CIRCUIT BKR AUX INPUT
 0:0054 DSLC COMMAND USE NETWORK DISCRETE IN
 0:0055 DSLC COMMAND CHECK INPUT
 0:0056 DSLC COMMAND PERMISSIVE INPUT
 0:0057 DSLC COMMAND RUN INPUT
 0:0058 DSLC COMMAND RAISE VOLTAGE INPUT
 0:0059 DSLC COMMAND LOWER VOLTAGE INPUT
 0:0060 DSLC COMMAND BASELOAD INPUT
 0:0061 DSLC COMMAND LOAD INPUT
 0:0062 DSLC COMMAND PAUSE INPUT
 0:0063 DSLC COMMAND RAISE LOAD INPUT
 0:0064 DSLC COMMAND LOWER LOAD INPUT
 0:0065 DSLC COMMAND PROCESS ENABLE INPUT
 0:0066 SELECT DSLC PHASE A
 0:0067 SELECT DSLC PHASE B
 0:0068 SELECT DSLC PHASE C

Boolean Reads

Addr	Description
1:0001	H-CLOSE TO RUN CONTACT
1:0002	G-RATED CONTACT
1:0003	F-LOWER SPEED CONTACT
1:0004	E-RAISE SPEED CONTACT
1:0005	D-2nd DYNAMICS CONTACT
1:0006	C-SPEED FAIL OVERRIDE
1:0007	B-ALARM RESET
1:0008	A-CLOSE FOR ISOCHRONOUS
1:0009	DO1-FROM MODBUS PORT 3 BW 0002
1:0010	DO2-ALARM RELAY
1:0011	DO3-SHUTDOWN RELAY
1:0012	
1:0013	MPU 1 FAILED
1:0014	MPU 2 FAILED
1:0015	LOAD SHARE AI1 FAILED
1:0016	
1:0017	REMOTE SPEED INPUT FAILED
1:0018	LOAD SHARE AI4 FAILED
1:0019	
1:0020	
1:0021	SHUTDOWN IS ACTIVE
1:0022	1-SPEED #1 FAIL SHUTDOWN
1:0023	2-SPEED #2 FAIL SHUTDOWN

1:0024 3-SPD #1 AND #2 FAIL SHUTDOWN
1:0025 4-LD SH INPUT 1 FAIL SHUTDOWN
1:0026 5-REMOTE INPUT FAIL SHUTDOWN
1:0027 6-LD SH INPUT 4 FAIL SHUTDOWN
1:0028 7-MODBUS PORT 3 FAIL SHUTDOWN
1:0029 8DSLCLON ERROR SHUTDOWN
1:0030 9-HIGH FUEL DEMAND SHUTDOWN
1:0031 10-HIGH SPEED SHUTDOWN
1:0032 11-TORSIONAL LEVEL SHUTDOWN
1:0033 ON MAX LIMIT SHUTDOWN
1:0034 ON EXT FUEL LIMIT SHUTDOWN
1:0035 ON TORSION LIMIT SHUTDOWN
1:0036 ACT SHUTDOWN ON SHUTDOWN
1:0037 SPEED SWITCH SHUTDOWN
1:0038 ON AI LS LIMIT SHUTDOWN
1:0039
1:0040
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 ALARM IS ACTIVE
1:0062 1-SPEED #1FAIL ALARM
1:0063 2-SPEED #2 FAIL ALARM
1:0064 3-SPD #1 AND #2 FAIL ALARM
1:0065 4-LD SH INPUT 1 FAIL ALARM
1:0066 5-REMOTE INPUT FAIL ALARM
1:0067 6-LD SH INPUT 4 FAIL ALARM
1:0068 7- MODBUS PORT 3 FAIL ALARM
1:0069 8- DSLCLON ERROR ALARM
1:0070 9- HIGH FUEL DEMAND ALARM
1:0071 10- HIGH SPEED ALARM
1:0072 11- TORSIONAL LEVEL ALARM
1:0073 ON MAX LIMIT ALARM
1:0074 ON EXT FUEL LIMIT ALARM
1:0075 ON TORSION LIMIT ALARM
1:0076 ACT SHUTDOWN ON ALARM
1:0077 SPEED SWITCH ALARM
1:0078 ON AI LS LIMIT ALARM
1:0079
1:0080
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 EXT FUEL LIMIT (LSS)
1:0105 ON TORSIONAL LIMIT (LSS)
1:0106 ACT SHUTDOWN (LSS)
1:0107 TORSIONAL FILTER ACTIVE
1:0108 SPEED SWITCH #1 ACTIVE
1:0109 SPEED SWITCH #2 ACTIVE
1:0110 AI LOAD SHARING ENABLED
1:0111 PRIMARY SPEED INPUT ACTIVE
1:0112 STANDBY SPEED INPUT ACTIVE
1:0113
1:0114
1:0115
1:0116
1:0117
1:0118
1:0119
1:0120
1:0121 DISCRETE IN MOD 1 CHANNEL 1
1:0122 DISCRETE IN MOD 1 CHANNEL 2
1:0123 DISCRETE IN MOD 1 CHANNEL 3
1:0124 DISCRETE IN MOD 1 CHANNEL 4
1:0125 DISCRETE IN MOD 1 CHANNEL 5
1:0126 DISCRETE IN MOD 1 CHANNEL 6
1:0127 DISCRETE IN MOD 1 CHANNEL 7
1:0128 DISCRETE IN MOD 1 CHANNEL 8
1:0129 DISCRETE IN MOD 1 CHANNEL 9
1:0130 DISCRETE IN MOD 1 CHANNEL 10
1:0131 DISCRETE IN MOD 1 CHANNEL 11
1:0132 DISCRETE IN MOD 1 CHANNEL 12
1:0133 DISCRETE IN MOD 1 CHANNEL 13
1:0134 DISCRETE IN MOD 1 CHANNEL 14
1:0135 DISCRETE IN MOD 1 CHANNEL 15
1:0136 DISCRETE IN MOD 1 CHANNEL 16
1:0137
1:0138
1:0139
1:0140
1:0141 ALARM RELAY
1:0142 LOW LIMIT RELAY
1:0143 HIGH LIMIT RELAY
1:0144 LOAD SWITCH RELAY
1:0145 VOLTAGE LOWER RELAY
1:0146 VOLTAGE RAISE RELAY
1:0147 BREAKER OPEN RELAY
1:0148 BREAKER CLOSE RELAY
1:0149 SYNCHRONIZER TIMEOUT ALARM
1:0150 SYNCHRONIZER RECLOSE ALARM
1:0151 LOAD AT HIGH LIMIT ALARM
1:0152 LOAD AT LOW LIMIT ALARM
1:0153 PROCESS AT HIGH LIMIT ALARM
1:0154 PROCESS AT LOW LIMIT ALARM
1:0155 VOLTAGE RANGE ALARM

1:0156	VOLTAGE AT LOW LIMIT ALARM
1:0157	VOLTAGE AT HIGH LIMIT ALARM
1:0158	SYNCHRONIZER IN OFF MODE
1:0159	SYNCHRONIZER IN CHECK MODE
1:0160	SYNCHRONIZER IN PERMISSIVE MODE
1:0161	SYNCHRONIZER IN RUN MODE
1:0162	SYNCHRONIZER IN CLOSE TIMER MODE
1:0163	SYNCHRONIZER IN SYNC TIMER MODE
1:0164	SYNCHRONIZER IN SYNC MODE
1:0165	SYNCHRONIZER IN AUTO OFF MODE
1:0166	LOAD CONTROL IN DROOP MODE
1:0167	LOAD CONTROL IN UNLOAD BASELOAD MODE
1:0168	LOAD CONTROL IN BASE LOAD RAMP MODE
1:0169	LOAD CONTROL IN BASE LOAD MODE
1:0170	LOAD CONTROL IN BASE LOAD LOWER MODE
1:0171	LOAD CONTROL IN BASE LOAD RAISE MODE
1:0172	LOAD CONTROL IN REMOTE RAMP MODE
1:0173	LOAD CONTROL IN BASELOAD REMOTE MODE
1:0174	LOAD CONTROL IN UNLOAD PARALLEL MODE
1:0175	LOAD CONTROL IN PARALLEL RAMP MODE
1:0176	LOAD CONTROL IN PARALLEL MODE
1:0177	LOAD CONTROL IN UNLOAD RAMP MODE
1:0178	LOAD CONTROL IN PROCESS RAMP MODE
1:0179	LOAD CONTROL IN PROCESS LOCAL MODE
1:0180	LOAD CONTROL IN PROCESS LOWER MODE
1:0181	LOAD CONTROL IN PROCESS RAISE MODE
1:0182	LOAD CONTROL IN PROCESS REMOTE MODE
1:0183	CHECK INPUT CLOSED
1:0184	PERMISSIVE INPUT CLOSED
1:0185	RUN INPUT CLOSED
1:0186	CB AUX INPUT CLOSED
1:0187	VOLTAGE RAISE INPUT CLOSED
1:0188	VOLTAGE LOWER INPUT CLOSED
1:0189	BASE LOAD INPUT CLOSED
1:0190	LOAD/UNLOAD INPUT CLOSED
1:0191	RAMP PAUSE INPUT CLOSED
1:0192	LOAD RAISE INPUT CLOSED
1:0193	LOAD LOWER INPUT CLOSED
1:0194	PROCESS ENABLE INPUT CLOSED
1:0195	VOLTAGE REG OUTPUT DRIVER SHUTDOWN
1:0196	DSLC WATCHDOG TIMER
1:0197	DSLC LON FAIL TO TRANSMIT

Analog Reads

Addr	Description
3:0001	AI1-LSAI INPUT 1 (uA)
3:0002	AI2-DSLC INPUT(millivolts)
3:0003	AI3-REMOTE SPEED INPUT (uA)
3:0004	AI4-LSAI INPUT 4 (uA)
3:0005	
3:0006	
3:0007	AO1-CONFIGURED ANALOG OUTPUT(uA)
3:0008	AO2-CONFIGURED ANALOG OUTPUT(uA)
3:0009	ACT1-OUTPUT TO ACTUATOR (uA,mAx100)
3:0010	ACT2-CONFIGURED ACT OUTPUT(uA,mAx100)
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	DROOP BIAS(rpm)
3:0017	DSLC BIAS(rpm)
3:0018	AI LOAD SHARE BIAS(%fd)
3:0019	

3:0020
3:0021
3:0022
3:0023
3:0024
3:0025
3:0026
3:0027
3:0028
3:0029
3:0030
3:0031 FUEL DEMAND (%fd * 10)
3:0032 TORSIONAL FUEL LIMIT (%fd)
3:0033 TORSIONAL LEVEL (% OF RATED)
3:0034 EXT FUEL LIMIT LEVEL (% fd)
3:0035
3:0036
3:0037
3:0038
3:0039
3:0040
3:0041 AI1-LOAD SHARE AI (engr)
3:0042 AI2-DSLC INPUT (rpm)
3:0043 AI3-REMOTE SPEED INPUT (rpm)
3:0044 AI4-LOAD SHARE AI (engr)
3:0045 AO1-CONFIGURED ANALOG OUTPUT(engr)
3:0046 AO2-CONFIGURED ANALOG OUTPUT(engr)
3:0047 ACT1-OUTPUT TO ACTUATOR 1 (%)
3:0048 ACT2-OUTPUT TO ACTUATOR 2 (%)
3:0049
3:0050
3:0051 FIRST OUT SHUTDOWN
3:0052 FIRST OUT ALARM
3:0053
3:0054
3:0055
3:0056
3:0057
3:0058
3:0059
3:0060
3:0061 TC 1 CHANNEL 1 (deg F)
3:0062 TC 1 CHANNEL 2 (deg F)
3:0063 TC 1 CHANNEL 3 (deg F)
3:0064 TC 1 CHANNEL 4 (deg F)
3:0065 TC 1 CHANNEL 5 (deg F)
3:0066 TC 1 CHANNEL 6 (deg F)
3:0067 TC 2 CHANNEL 1 (deg F)
3:0068 TC 2 CHANNEL 2 (deg F)
3:0069 TC 2 CHANNEL 3 (deg F)
3:0070 TC 2 CHANNEL 4 (deg F)
3:0071 TC 2 CHANNEL 5 (deg F)
3:0072 TC 2 CHANNEL 6 (deg F)
3:0073 TC 3 CHANNEL 1 (deg F)
3:0074 TC 3 CHANNEL 2 (deg F)
3:0075 TC 3 CHANNEL 3 (deg F)
3:0076 TC 3 CHANNEL 4 (deg F)
3:0077 TC 3 CHANNEL 5 (deg F)
3:0078 TC 3 CHANNEL 6 (deg F)
3:0079 TC 4 CHANNEL 1 (deg F)
3:0080 TC 4 CHANNEL 2 (deg F)
3:0081 TC 4 CHANNEL 3 (deg F)
3:0082 TC 4 CHANNEL 4 (deg F)
3:0083 TC 4 CHANNEL 5 (deg F)
3:0084 TC 4 CHANNEL 6 (deg F)
3:0085 RTD 1 CHANNEL 1 (deg F)

3:0086 RTD 1 CHANNEL 2 (deg F)
 3:0087 RTD 1 CHANNEL 3 (deg F)
 3:0088 RTD 1 CHANNEL 4 (deg F)
 3:0089 RTD 1 CHANNEL 5 (deg F)
 3:0090 RTD 1 CHANNEL 6 (deg F)
 3:0091 AI 1 CHANNEL 1 (uA)
 3:0092 AI 1 CHANNEL 2 (uA)
 3:0093 AI 1 CHANNEL 3 (uA)
 3:0094 AI 1 CHANNEL 4 (uA)
 3:0095 AI 1 CHANNEL 5 (uA)
 3:0096 AI 1 CHANNEL 6 (uA)
 3:0097
 3:0098
 3:0099
 3:0100
 3:0101 DSLC BLOCK #1 MESSAGE TIME (mSEC)
 3:0102 DSLC BLOCK #2 MESSAGE TIME (mSEC)
 3:0103 DSLC BLOCK #3 MESSAGE TIME (mSEC)
 3:0104 DSLC BLOCK #4 MESSAGE TIME (mSEC)
 3:0105 A PHASE VOLTAGE
 3:0106 B PHASE VOLTAGE
 3:0107 C PHASE VOLTAGE
 3:0108 3-PHASE AVG VOLTAGE
 3:0109 BUS VOLTAGE
 3:0110 GENERATOR POWER FACTOR (p.f. * 1000)
 3:0111 A PHASE CURRENT (AMPS)
 3:0112 B PHASE CURRENT (AMPS)
 3:0113 C PHASE CURRENT (AMPS)
 3:0114 3-PHASE TOTAL CURRENT
 3:0115 LOAD REFERENCE (% RATED)
 3:0116 PROCESS REFERENCE (uA)
 3:0117 GEN ACTIVE POWER OUTPUT (KW)
 3:0118 GEN REACTIVE POWER OUTPUT (KVAR)
 3:0119 GEN APPARENT POWER OUTPUT (KW)
 3:0120 GEN FREQUENCY (Hz * 100)
 3:0121 BUS FREQUENCY (Hz * 100)

Analog Writes

Addr	Description
4:0001	
4:0002	723 ANALOG OUTPUT #1
4:0003	723 ANALOG OUTPUT #2
4:0004	
4:0005	723 REMOTE SPEED REFERENCE
4:0006	
4:0007	
4:0008	
4:0009	
4:0010	
4:0011	ANALOG OUT CHANNEL 1
4:0012	ANALOG OUT CHANNEL 2
4:0013	ANALOG OUT CHANNEL 3
4:0014	ANALOG OUT CHANNEL 4
4:0015	ANALOG OUT CHANNEL 5
4:0016	ANALOG OUT CHANNEL 6
4:0017	
4:0018	
4:0019	
4:0020	
4:0021	DSLC REMOTE REFERENCE (uA)
4:0022	DSLC PROCESS SIGNAL (uA)

Appendix D. 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, select "Control" then "Properties" to get the Software Part Number and revision level.
Record Here _____

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

Configure and Service Menu Items
8280-608 (LV)

723PLUS DIGITAL ENGINE CONTROL
ANALOG INPUT (EXHT OR MAP) LOAD SHARING
FOR TANDEM UNITS AND USE WITH DSLC OR
LOAD SHARING MODULE, MODBUS & LINKNET

Configure Menus

CFIG OPTION	Default	
USE REV ACTUATOR	#FALSE	
USE 2nd DYNAMICS	#FALSE	
USE 5-GAIN MAP	#FALSE	
USE CONST DYNAMICS	#TRUE	
USE EXT FUEL LIMIT	#FALSE	
USE COMM PORTS	#FALSE	
USE REMOTE COMMANDS	#FALSE	
REMOTE LOCK IN LAST	#FALSE	
RESET ALM ON CLEAR	#FALSE	
FORCE DISCRETE OUTS	#FALSE	
USE AI LOAD SHARE	#FALSE	
USE REV AI LD SHARE	#FALSE	
USE TORSION FILTER	#FALSE	
USE NOTCH FILTER	#FALSE	
ENABLE TORS LIMITER	#FALSE	
USE START SPEED	#FALSE	
CFIG SPEED CONTROL	Default (Low, High)	
RATED SPEED(RPM)	#1200 (1, 2100)	
DSPD #1 TEETH	#16 (16, 500)	
DSPD #2 TEETH	#16 (16, 500)	
SS CLEAR PERCENTAGE	#5.0 (1.0, 10.0)	
MPU ALARM ARM TIME (SEC)	#10.0 (0.0, 120.0)	
CFIG SHUTDOWN	Default	
SPEED #1 FAIL	#FALSE	
SPEED #2 FAIL	#FALSE	
SPD #1AND#2 FAIL	#FALSE	
AILS 1 INPUT FAIL	#FALSE	
REMOTE INPUT FAIL	#FALSE	
AILS 4 INPUT FAIL	#FALSE	
MODBUS PORT 3 FAIL	#FALSE	
DSLC LON ERROR	#FALSE	
HI FUEL DEMND LEVEL	#FALSE	
HI SPEED LEVEL	#FALSE	
HI TORSIONAL LEVEL	#FALSE	
ON MAX LIMIT	#FALSE	
ON EXT FUEL LIMIT	#FALSE	
ON TORSION LIMIT	#FALSE	

ACT SHUTDOWN	#FALSE	
SPEED SWITCH	#FALSE	
ON AI LD SH LIMIT	#FALSE	
CFIG ALARM	Default	
SPEED #1 FAIL	#FALSE	
SPEED #2 FAIL	#FALSE	
SPD #1AND#2 FAIL	#FALSE	
AILS 1 INPUT FAIL	#FALSE	
REMOTE INPUT FAIL	#FALSE	
AILS 4 INPUT FAIL	#FALSE	
MODBUS PORT 3 FAIL	#FALSE	
DSLCLON ERROR	#FALSE	
HI FUEL DEMND LEVEL	#FALSE	
HI SPEED LEVEL	#FALSE	
HI TORSIONAL LEVEL	#FALSE	
ON MAX LIMIT	#FALSE	
ON EXT FUEL LIMIT	#FALSE	
ON TORSION LIMIT	#FALSE	
ACT SHUTDOWN	#FALSE	
SPEED SWITCH	#FALSE	
ON AI LD SH LIMIT	#FALSE	
SHUTDOWN SETUP	Default (Low, High)	
HI FUEL DEMND SETPT(%FD)	#100.0 (0.0, 100.0)	
HI FUEL DEMND DELAY(SEC)	#10.0 (0.0, 10800.0)	
HI SPEED SETPOINT (RPM)	#1320.0 (0.0, 2500.0)	
HI SPEED DELAY(SEC)	#0.2 (0.0, 10800.0)	
TORSION LEVEL SETPT(%RPM)	#50.0 (0.0, 100.0)	
HI TORSION DELAY (SECS)	#10.0 (0.0, 10800.0)	
ENERGIZE FOR SHUTDOWN	#TRUE	
SPD SWITCH PICKUP (RPM)	#500.0 (0.0, 2200.0)	
SPD SWITCH DROPOUT (RPM)	#400.0 (0.0, 2200.0)	
SHUTDOWN ACT ON SD	#FALSE	
ALARM SETUP	Default (Low, High)	
HI FUEL DEMND SETPT(%FD)	#100.0 (0.0, 100.0)	
HI FUEL DEMND DELAY(SEC)	#10.0 (0.0, 10800.0)	
HI SPEED SETPOINT (RPM)	#1320.0 (0.0, 2500.0)	
HI SPEED DELAY(SEC)	#0.2 (0.0, 10800.0)	
TORSION LEVEL SETPT(%RPM)	#50.0 (0.0, 100.0)	
HI TORSION DELAY (SECS)	#10.0 (0.0, 10800.0)	
ENERGIZE FOR ALARM	#TRUE	
SPD SWITCH PICKUP (RPM)	#500.0 (0.0, 2200.0)	
SPD SWITCH DROPOUT (RPM)	#400.0 (0.0, 2200.0)	
SHUTDOWN ACT ON ALM	#FALSE	
CFIG COMMUNICATION	Default (Low, High)	
PORT 2 ADDRESS	#0 (0, 15)	
PORT 3 ADDRESS	#1 (1, 247)	
PORT 3 MODE	#2 (1, 2)	
CFIG ANALOG OUTPUTS	Default (Low, High)	
AOUT 1 SELECT	#1 (1, 11)	
AOUT 1 4-20 mA	#TRUE	
AOUT 2 SELECT	#2 (1, 11)	
AOUT 2 4-20 mA	#TRUE	
ACT OUT 1 4-20 mA	#FALSE	
ACT OUT 2 4-20 mA	#FALSE	
CFIG DSLC	Default (Low, High)	
USE CB AUX	#FALSE	
REM REF THRESH(mA)	#1.0 (0.1, 20.0)	
PROC SIG THRESH(mA)	#1.0 (0.1, 20.0)	
LON TIME OUT(SEC)	#5.0 (0.1, 10.0)	
LON OUT UPDATE TIME(SEC)	#1.0 (0.1, 10.0)	

Service Menus

SHUTDOWN MENU	Default	
FIRST SHUTDOWN		
1-SPEED #1 FAIL		
2-SPEED #2 FAIL		
3-SPD #1AND#2 FAIL		
4-ANLS INPUT 1 FAIL		
5-REMOTE INPUT FAIL		
6-ANLS INPUT 4 FAIL		
7-MODBUS 3 FAIL		
8-DSLC LON ERROR		
9-HIGH FUEL DEMAND		
10-HIGH SPEED		
11-HIGH TORSIONAL		
ON MAX LIMIT		
ON EXT FUEL LIMIT		
ON TORSION LIMIT		
ACT SHUTDOWN		
SPEED SWITCH		
ON AI LD SHARE LMT		
ALARM RESET	*FALSE	
ALARM MENU	Default	
FIRST ALARM		
1-SPEED #1 FAIL		
2-SPEED #2 FAIL		
3-SPD #1AND#2 FAIL		
4-ANLS INPUT 1 FAIL		
5-REMOTE INPUT FAIL		
6-ANLS INPUT 4 FAIL		
7-MODBUS 3 FAIL		
8-DSLC LON ERROR		
9-HIGH FUEL DEMAND		
10-HIGH SPEED		
11-HIGH TORSIONAL		
ON MAX LIMIT		
ON EXT FUEL LIMIT		
ON TORSION LIMIT		
ACT SHUTDOWN		
SPEED SWITCH		
ON AI LD SHARE LMT		
ALARM RESET	*FALSE	
1st DYNAMICS	Default (Low, High)	
GAIN 1	*10.0 (0.0015, 1000.0)	
RESET 1	*0.35 (0.01, 50.0)	
COMPENSATION 1	*0.2 (0.01, 1.0)	
GAIN RATIO 1	*1.0 (1.0, 10.0)	
WINDOW WIDTH 1(RPM)	*60.0 (1.0, 2100.0)	
GAIN SLOPE BK PNT 1(%FD)	*20.0 (0.0, 100.0)	
GAIN SLOPE 1	*0.0 (-50.0, 50.0)	
SPEED FILTER FREQ 1(HZ)	*20.0 (0.0, 20.0)	
BUMP ACT	*FALSE	
2nd DYNAMICS	Default (Low, High)	
GAIN 2	*10.0 (0.0015, 1000.0)	
RESET 2	*0.35 (0.01, 50.0)	
COMPENSATION 2	*0.2 (0.01, 1.0)	
GAIN RATIO 2	*1.0 (1.0, 10.0)	
WINDOW WIDTH 2(RPM)	*60.0 (0.0, 2100.0)	
GAIN SLOPE BK PNT 2(%FD)	*20.0 (0.0, 100.0)	
GAIN SLOPE 2	*0.0 (-50.0, 50.0)	
SPEED FILTER FREQ 2(HZ)	*20.0 (0.0, 20.0)	
BUMP ACT	*FALSE	
1st DYNAMICS-5 GAIN	Default (Low, High)	
BREAKPOINT 1A (%FD)	*99.6 (0.00, 100.0)	
GAIN @BREAKPOINT 1A	*10.0 (0.0015, 1000.0)	
BREAKPOINT 1B (%FD)	*99.7 (0.00, 100.0)	
GAIN @BREAKPOINT 1B	*10.0 (0.0015, 1000.0)	

BREAKPOINT 1C (%FD)	*99.8 (0.00, 100.0)	
GAIN @BREAKPOINT 1C	*10.0 (0.0015, 1000.0)	
BREAKPOINT 1D (%FD)	*99.9 (0.00, 100.0)	
GAIN @BREAKPOINT 1D	*10.0 (0.0015, 1000.0)	
BREAKPOINT 1E (%FD)	*100.0 (0.00, 100.0)	
GAIN @BREAKPOINT 1E	*10.0 (0.0015, 1000.0)	
RESET 1	*0.35 (0.01, 50.0)	
COMPENSATION 1	*0.2 (0.01, 1.0)	
GAIN RATIO 1	*1.0 (1.0, 10.0)	
WINDOW WIDTH 1(RPM)	*60.0 (1.0, 2100.0)	
SPEED FILTER FREQ 1(HZ)	*20.0 (0.0, 20.0)	
BUMP ACT	*FALSE	
2nd DYNAMICS-5 GAIN	Default (Low, High)	
BREAKPOINT 2A (%FD)	*99.6 (0.00, 100.0)	
GAIN @BREAKPOINT 2A	*10.0 (0.0015, 1000.0)	
BREAKPOINT 2B (%FD)	*99.7 (0.00, 100.0)	
GAIN @BREAKPOINT 2B	*10.0 (0.0015, 1000.0)	
BREAKPOINT 2C (%FD)	*99.8 (0.00, 100.0)	
GAIN @BREAKPOINT 2C	*10.0 (0.0015, 1000.0)	
BREAKPOINT 2D (%FD)	*99.9 (0.00, 100.0)	
GAIN @BREAKPOINT 2D	*10.0 (0.0015, 1000.0)	
BREAKPOINT 2E (%FD)	*100.0 (0.00, 100.0)	
GAIN @BREAKPOINT 2E	*10.0 (0.0015, 1000.0)	
RESET 2	*0.35 (0.01, 50.0)	
COMPENSATION 2	*0.2 (0.01, 1.0)	
GAIN RATIO 2	*1.0 (1.0, 10.0)	
WINDOW WIDTH 2(RPM)	*60.0 (0.0, 2100.0)	
SPEED FILTER FREQ 2(HZ)	*20.0 (0.0, 20.0)	
BUMP ACT	*FALSE	
ACTUATOR BUMP	Default (Low, High)	
BUMP ENABLE	*FALSE	
ACT BUMP LEVEL(%FD)	*1.0 (0.0, 100.0)	
ACT BUMP DURATION (SEC)	*0.1 (0.01, 2.0)	
TORSIONAL FILTER	Default (Low, High)	
ENABLE TORS FILTER	*FALSE	
ENG SENSOR WEIGHT	*0.5 (0.0, 1.0)	
TORS SCALE (%RATED)	*1.0 (0.0, 100.0)	
TORSNL FUEL LIMIT (%FD)	*100.0 (0.0, 100.0)	
TORSNL LEVEL @LIMIT(%)	*100.0 (0.001, 100.0)	
TORSNL LEVEL @CLEAR(%)	*1.0 (0.0, 100.0)	
NOTCH FREQUENCY (HZ)	*15.9 (0.01, 16.0)	
NOTCH Q FACTOR	*0.707 (0.707, 25.0)	
TORSIONAL LEVEL(%)		
TORSNL FILTR ACTIVE		
TORSIONAL LIMIT LVL(%FD)		
FUEL LIMITERS	Default (Low, High)	
START FUEL LIMIT (%FD)	*100.0 (0.0, 100.0)	
START RAMP RATE (%FD/S)	*2.0 (0.0, 1000.0)	
MAX FUEL LIMIT(%FD)	*100.0 (0.0, 100.0)	
SPEED SETTING	Default (Low, High)	
START SPEED	*125 (1, 2100)	
RAISE SPEED LIMIT (RPM)	*1300 (1, 2100)	
LOWER SPEED LIMIT (RPM)	*1100 (1, 2100)	
IDLE SPEED (RPM)	*750 (1, 2100)	
ACCEL RAMP TIME (SEC)	*8.0 (0.0, 500.0)	
DECEL RAMP TIME (SEC)	*8.0 (0.0, 500.0)	
RAISE SPEED RATE (RPM/MIN)	*120.0 (0.01, 32767.0)	
LOWER SPEED RATE (RPM/MIN)	*120.0 (0.01, 32767.0)	
DROOP	Default (Low, High)	
LOAD DROOP PERCENT	*5.0 (0.0, 100.0)	
FUEL DEMAND @MIN LD(%FD)	*20.0 (0.0, 100.0)	
FUEL DEMAND @MAX LD(%FD)	*80.0 (0.0, 100.0)	

AI LS CONTROL	Default (Low, High)	
ENBLE AI LOAD SHARE	*FALSE	
AI LS GAIN	*1.0 (0.01, 100.0)	
AI LS INTEGRAL	*1.0 (0.01, 50.0)	
MAX BIAS (%FD)	*5.0 (0.0, 10.0)	
AI LS PERM LEVEL (EU)	*1.0 (0.0, 50.0)	
AI LS ENABLE DELAY	*60.0 (0.0, 900.0)	
LOAD SHARE SETTINGS	Default (Low, High)	
AUTO AI LS REF	*0.0 (-50.0, 50.0)	
MANUAL LS BRKPT B	*25.0 (1.0, 99.0)	
MANUAL LS BRKPT C	*50.0 (1.0, 99.0)	
MANUAL LS BRKPT D	*75.0 (1.0, 99.0)	
MANUAL LS SETPT A	*0.0 (-50.0, 50.0)	
MANUAL LS SETPT B	*0.0 (-50.0, 50.0)	
MANUAL LS SETPT C	*0.0 (-50.0, 50.0)	
MANUAL LS SETPT D	*0.0 (-50.0, 50.0)	
MANUAL LS SETPT E	*0.0 (-50.0, 50.0)	
EXT FUEL LMT CURVE	Default (Low, High)	
ENABLE EXT FUEL LMT	*FALSE	
EXT LIMIT BRKPNT A (EU)	*6.0 (-30000.0, 30000.0)	
FUEL LIMIT@BRKPNT A(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT B (EU)	*8.0 (-30000.0, 30000.0)	
FUEL LIMIT@BRKPNT B(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT C (EU)	*10.0 (-30000.0, 30000.0)	
FUEL LIMIT@BRKPNT C(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT D (EU)	*15.0 (-30000.0, 30000.0)	
FUEL LIMIT@BRKPNT D(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT E (EU)	*20.0 (-30000.0, 30000.0)	
FUEL LIMIT@BRKPNT E(%FD)	*100.0 (0.0, 100.0)	
SET ANALOG INPUTS	Default (Low, High)	
AILS 1 LMT@4mA (EU)	*4.0 (-16384.0, 16384.0)	
AILS 1 LMT@20mA (EU)	*20.0 (-16384.0, 16384.0)	
REMOTE REF @4mA (RPM)	*1200.0 (-16384.0, 16384.0)	
REMOTE REF @20mA (RPM)	*1800.0 (-16384.0, 16384.0)	
AILS 4 LMT@4mA (EU)	*4.0 (-16384.0, 16384.0)	
AILS 4 LMT@20mA (EU)	*20.0 (-16384.0, 16384.0)	
SET ANALOG OUTPUTS	Default (Low, High)	
ANALOG OUTPUT 1 MIN(EU)	*0.0 (-32767.0, 32767.0)	
ANALOG OUTPUT 1 MAX(EU)	*1300.0 (-32767.0, 32767.0)	
ANALOG OUTPUT 2 MIN(EU)	*0.0 (-32767.0, 32767.0)	
ANALOG OUTPUT 2 MAX(EU)	*1300.0 (-32767.0, 32767.0)	
AO FILTER FREQUENCY(HZ)	*20.0 (0.01, 20.0)	
I/O CALIBRATION	Default (Low, High)	
AILS 1 IN OFFSET(AI1)	*0.0 (-20.0, 20.0)	
AILS 1 IN SPAN (AI1)	*100.0 (50.0, 200.0)	
AILS 1 IN READ VOLTS (AI1)	*FALSE	
DSLCL OFFSET(AI2)	*0.0 (-5000.0, 5000.0)	
REM IN OFFSET(AI3)	*0.0 (-20.0, 20.0)	
REM IN SPAN(AI3)	*100.0 (50.0, 200.0)	
REM IN READ VOLTS (AI3)	*FALSE	
AILS 4 IN OFFSET(AI4)	*0.0 (-20.0, 20.0)	
AILS 4 IN SPAN(AI4)	*100.0 (50.0, 200.0)	
AILS 4 IN READ VOLTS (AI4)	*FALSE	
AO 1 OFFSET	*0.0 (-4095.0, 4095.0)	
AO 1 SPAN	*100.0 (50.0, 200.0)	
AO 2 OFFSET	*0.0 (-4095.0, 4095.0)	
AO 2 SPAN	*100.0 (50.0, 200.0)	
ACT 1 OFFSET	*0.0 (-4095.0, 4095.0)	
ACT 1 SPAN	*100.0 (50.0, 200.0)	
ACT 2 OFFSET	*0.0 (-4095.0, 4095.0)	
ACT 2 SPAN	*100.0 (50.0, 200.0)	
COMM PORT SETUP	Default (Low, High)	

PORT2 HARDWARE CFG	*1 (1, 2)	
PORT 2 BAUD RATE	*9 (1, 10)	
PORT3 HARDWARE CFG	*1 (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		
TC MODULE 1	Default (Low, High)	
CH1 - TC DEGREES F		
CH2 - TC DEGREES F		
CH3 - TC DEGREES F		
CH4 - TC DEGREES F		
CH5 - TC DEGREES F		
CH6 - TC DEGREES F		
CH1 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH1 - TC SPAN	*100.0 (50.0, 200.0)	
CH2 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH2 - TC SPAN	*100.0 (50.0, 200.0)	
CH3 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH3 - TC SPAN	*100.0 (50.0, 200.0)	
CH4 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH4 - TC SPAN	*100.0 (50.0, 200.0)	
CH5 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH5 - TC SPAN	*100.0 (50.0, 200.0)	
CH6 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH6 - TC SPAN	*100.0 (50.0, 200.0)	
TC MODULE 2	Default (Low, High)	
CH1 - TC DEGREES F		
CH2 - TC DEGREES F		
CH3 - TC DEGREES F		
CH4 - TC DEGREES F		
CH5 - TC DEGREES F		
CH6 - TC DEGREES F		
CH1 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH1 - TC SPAN	*100.0 (50.0, 200.0)	
CH2 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH2 - TC SPAN	*100.0 (50.0, 200.0)	
CH3 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH3 - TC SPAN	*100.0 (50.0, 200.0)	
CH4 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH4 - TC SPAN	*100.0 (50.0, 200.0)	
CH5 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH5 - TC SPAN	*100.0 (50.0, 200.0)	
CH6 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH6 - TC SPAN	*100.0 (50.0, 200.0)	
TC MODULE 3	Default (Low, High)	
CH1 - TC DEGREES F		
CH2 - TC DEGREES F		
CH3 - TC DEGREES F		
CH4 - TC DEGREES F		
CH5 - TC DEGREES F		
CH6 - TC DEGREES F		
CH1 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH1 - TC SPAN	*100.0 (50.0, 200.0)	
CH2 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH2 - TC SPAN	*100.0 (50.0, 200.0)	
CH3 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH3 - TC SPAN	*100.0 (50.0, 200.0)	
CH4 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH4 - TC SPAN	*100.0 (50.0, 200.0)	
CH5 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH5 - TC SPAN	*100.0 (50.0, 200.0)	
CH6 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH6 - TC SPAN	*100.0 (50.0, 200.0)	

TC MODULE 4	Default (Low, High)	
CH1 - TC DEGREES F		
CH2 - TC DEGREES F		
CH3 - TC DEGREES F		
CH4 - TC DEGREES F		
CH5 - TC DEGREES F		
CH6 - TC DEGREES F		
CH1 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH1 - TC SPAN	*100.0 (50.0, 200.0)	
CH2 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH2 - TC SPAN	*100.0 (50.0, 200.0)	
CH3 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH3 - TC SPAN	*100.0 (50.0, 200.0)	
CH4 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH4 - TC SPAN	*100.0 (50.0, 200.0)	
CH5 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH5 - TC SPAN	*100.0 (50.0, 200.0)	
CH6 - TC OFFSET	*0.0 (-500.0, 500.0)	
CH6 - TC SPAN	*100.0 (50.0, 200.0)	
RTD MODULE 1	Default (Low, High)	
CH1 - RTD DEGREES F		
CH2 - RTD DEGREES F		
CH3 - RTD DEGREES F		
CH4 - RTD DEGREES F		
CH5 - RTD DEGREES F		
CH6 - RTD DEGREES F		
CH1 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH1 - RTD SPAN	*100.0 (50.0, 200.0)	
CH2 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH2 - RTD SPAN	*100.0 (50.0, 200.0)	
CH3 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH3 - RTD SPAN	*100.0 (50.0, 200.0)	
CH4 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH4 - RTD SPAN	*100.0 (50.0, 200.0)	
CH5 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH5 - RTD SPAN	*100.0 (50.0, 200.0)	
CH6 - RTD OFFSET	*0.0 (-500.0, 500.0)	
CH6 - RTD SPAN	*100.0 (50.0, 200.0)	
AI MODULE 1	Default (Low, High)	
AI1 CH1 - mA INPUT		
AI1 CH2 - mA INPUT		
AI1 CH3 - mA INPUT		
AI1 CH4 - mA INPUT		
AI1 CH5 - mA INPUT		
AI1 CH6 - mA INPUT		
AI1 CH1 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH1 - AI SPAN	*100.0 (50.0, 200.0)	
AI1 CH2 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH2 - AI SPAN	*100.0 (50.0, 200.0)	
AI1 CH3 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH3 - AI SPAN	*100.0 (50.0, 200.0)	
AI1 CH4 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH4 - AI SPAN	*100.0 (50.0, 200.0)	
AI1 CH5 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH5 - AI SPAN	*100.0 (50.0, 200.0)	
AI1 CH6 - AI OFFSET	*0.0 (-20.0, 20.0)	
AI1 CH6 - AI SPAN	*100.0 (50.0, 200.0)	
DI MODULE 1	Display Only	
CH01 CONTACT CLOSED		
CH02 CONTACT CLOSED		
CH03 CONTACT CLOSED		
CH04 CONTACT CLOSED		
CH05 CONTACT CLOSED		
CH06 CONTACT CLOSED		
CH07 CONTACT CLOSED		

CH08 CONTACT CLOSED		
CH09 CONTACT CLOSED		
CH10 CONTACT CLOSED		
CH11 CONTACT CLOSED		
CH12 CONTACT CLOSED		
CH13 CONTACT CLOSED		
CH14 CONTACT CLOSED		
CH15 CONTACT CLOSED		
CH16 CONTACT CLOSED		
DO MODULE 1	Display Only	
CH1 ENERGIZED		
CH2 ENERGIZED		
CH3 ENERGIZED		
CH4 ENERGIZED		
CH5 ENERGIZED		
CH6 ENERGIZED		
CH7 ENERGIZED		
CH8 ENERGIZED		
AO MODULE 1	Default (Low, High)	
AO1 CH1 mA OUT		
AO1 CH2 mA OUT		
AO1 CH3 mA OUT		
AO1 CH4 mA OUT		
AO1 CH5 mA OUT		
AO1 CH6 mA OUT		
AO1 CH1 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH1 - SPAN	*100.0 (50.0, 200.0)	
AO1 CH2 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH2 - SPAN	*100.0 (50.0, 200.0)	
AO1 CH3 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH3 - SPAN	*100.0 (50.0, 200.0)	
AO1 CH4 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH4 - SPAN	*100.0 (50.0, 200.0)	
AO1 CH5 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH5 - SPAN	*100.0 (50.0, 200.0)	
AO1 CH6 - OFFSET	*0.0 (-20.0, 20.0)	
AO1 CH6 - SPAN	*100.0 (50.0, 200.0)	
LON and FORCE ENBL	Default	
LON SERVICE PIN	*FALSE	
RESET LON	*FALSE	
FORCE DSLC	*FALSE	
DISPLAY DSLC	Display Only	
DSLCL REAL POWER		
DSLCL REACTIVE POWER		
DSLCL TOTAL AMPS		
DSLCL AVERAGE VOLTS		
DSLCL PHASE A AMPS		
DSLCL PHASE B AMPS		
DSLCL PHASE C AMPS		
DSLCL PHASE A VOLTS		
DSLCL PHASE B VOLTS		
DSLCL PHASE C VOLTS		
DISPLAY DIGITAL I/O	Display Only	
A-DROOP		
B-ALARM RESET		
C-SPEED FAIL OVRD		
D-2ND DYNAMICS		
E-RAISE SPEED		
F-LOWER SPEED		
G-RATED SPEED		
H-CLOSE TO RUN		
DO1-J3 MB BW 0002		
DO2-ALARM		
DO3--SHUTDOWN		

DISPLAY ANALOG I/O	Default	
DIGITAL SS IN #1 (HZ)		
DIGITAL SS IN #2 (HZ)		
AI1-AIS 1 INPUT		
AI2-DSLCL(VDC)		
AI3-REMOTE IN		
AI4-AIS 4 INPUT		
AI1 FAILED		
AI3 FAILED		
AI4 FAILED		
ANALOG OUT 1(mA)		
ANALOG OUT 2(mA)		
ACTUATOR OUT 1(mA)		
ACTUATOR OUT 2(mA)		
ALARM RESET	*FALSE	
CONTROL MODE	Display Only	
SPEED IN CONTROL		
ON START FUEL LIMIT		
ON MAXIMUM LIMIT		
ON EXTERNAL LIMIT		
ON TORSIONAL LIMIT		
ACTUATOR SHUTDOWN		
REMOTE SPEED ENBLD		
SPD SENSOR 1 ACTIVE		
SPD SENSOR 2 ACTIVE		
AI LOAD SHARE ENBLD		
DISPLAY MENU	Display Only	
ENGINE SPEED(RPM)		
BIASED SPD REF(RPM)		
FUEL DEMAND(%)		
ACT2 BIASED FUEL DMND(%)		
SPEED REF(RPM)		
DROOP BIAS(RPM)		
DSLCL BIAS(RPM)		
REMOTE SPEED REF (RPM)		
AN LOAD SHARE IN 1 (EU)		
AN LOAD SHARE IN 4 (EU)		
EXT FUEL LIMIT IN (EU)		
EXT FUEL LIMIT(%FD)		
FORCE 723 DO	Default	
DO1 FORCE	*FALSE	
DO2 FORCE	*FALSE	
DO3 FORCE	*FALSE	
FORCE DO 1	Default	
DO1 CH1 FORCE	*FALSE	
DO1 CH2 FORCE	*FALSE	
DO1 CH3 FORCE	*FALSE	
DO1 CH4 FORCE	*FALSE	
DO1 CH5 FORCE	*FALSE	
DO1 CH6 FORCE	*FALSE	
DO1 CH7 FORCE	*FALSE	
DO1 CH8 FORCE	*FALSE	
FORCE DSLCL	Default (Low, High)	
REMOTE REFERENCE	*4.0 (0.0, 20.0)	
PROCESS SIGNAL	*4.0 (0.0, 20.0)	
USE REMOTE REFERENCE	*FALSE	
USE PROCESS SIGNAL	*FALSE	
CB AUX CONTACT	*FALSE	
USE DISCRETE SIGNALS	*FALSE	
SYNCH CHECK INPUT	*FALSE	
SYNCH PERM INPUT	*FALSE	
SYNCH RUN INPUT	*FALSE	
VOLTAGE RAISE INPUT	*FALSE	

VOLTAGE LOWER INPUT	*FALSE	
BASELOAD INPUT	*FALSE	
LOAD INPUT	*FALSE	
PAUSE INPUT	*FALSE	
LOAD RAISE INPUT	*FALSE	
LOAD LOWER INPUT	*FALSE	
PROCESS INPUT	*FALSE	

Appendix E.

Menu Summary

Configure Menus

CFIG OPTION

USE REV ACTUATOR
 USE 2nd DYNAMICS
 USE 5-GAIN MAP
 USE CONST DYNAMICS
 USE EXT FUEL LIMIT
 USE COMM PORTS
 USE REMOTE
 COMMANDS
 REMOTE LOCK IN LAST
 RESET ALM ON CLEAR
 FORCE DISCRETE OUTS
 USE AI LOAD SHARE
 USE REV AI LD SHARE
 USE TORSION FILTER
 USE NOTCH FILTER
 ENABLE TORS LIMITER
 USE START SPEED

CFIG SPEED CONTROL

RATED SPEED(RPM)
 DSPD #1 TEETH
 DSPD #2 TEETH
 SS CLEAR PERCENTAGE
 MPU ALARM ARM TIME
 (SEC)

CFIG SHUTDOWN

SPEED #1 FAIL
 SPEED #2 FAIL
 SPD #1AND#2 FAIL
 AILS 1 INPUT FAIL
 REMOTE INPUT FAIL
 AILS 4 INPUT FAIL
 MODBUS PORT 2 FAIL
 MODBUS PORT 3 FAIL
 DSLC LON ERROR
 HI FUEL DEMND LEVEL
 HI SPEED LEVEL
 HI TORSIONAL LEVEL
 ON MAX LIMIT
 ON EXT FUEL LIMIT
 ON TORSION LIMIT
 ACT SHUTDOWN
 SPEED SWITCH
 ON AI LD SH LIMIT

CFIG ALARM

SPEED #1 FAIL
 SPEED #2 FAIL
 SPD #1AND#2 FAIL
 AILS 1 INPUT FAIL
 REMOTE INPUT FAIL
 AILS 4 INPUT FAIL
 MODBUS PORT 2 FAIL
 MODBUS PORT 3 FAIL
 DSLC LON ERROR
 HI FUEL DEMND LEVEL
 HI SPEED LEVEL
 HI TORSIONAL LEVEL
 ON MAX LIMIT
 ON EXT FUEL LIMIT
 ON TORSION LIMIT
 ACT SHUTDOWN
 SPEED SWITCH
 ON AI LD SH LIMIT

SHUTDOWN SETUP

HI FUEL DEMND
 SETPT(%FD)
 HI FUEL DEMND
 DELAY(SEC)
 HI SPEED SETPOINT
 (RPM)
 HI SPEED DELAY(SEC)
 TORSION LEVEL
 SETPT(%RPM)
 HI TORSION DELAY
 (SECS)
 ENERGIZE FOR
 SHUTDOWN
 SPD SWITCH PICKUP
 (RPM)
 SPD SWITCH DROPOUT
 (RPM)
 SHUTDOWN ACT ON SD

ALARM SETUP

HI FUEL DEMND
 SETPT(%FD)
 HI FUEL DEMND
 DELAY(SEC)
 HI SPEED SETPOINT
 (RPM)
 HI SPEED DELAY(SEC)
 TORSION LEVEL
 SETPT(%RPM)
 HI TORSION DELAY
 (SECS)
 ENERGIZE FOR ALARM
 SPD SWITCH PICKUP
 (RPM)
 SPD SWITCH DROPOUT
 (RPM)
 SHUTDOWN ACT ON ALM

CFIG COMMUNICATION

PORT 2 ADDRESS
 PORT 2 MODE
 PORT 3 ADDRESS
 PORT 3 MODE

CFIG ANALOG OUTPUTS

AOUT 1 SELECT
 AOUT 1 4-20 mA
 AOUT 2 SELECT
 AOUT 2 4-20 mA
 ACT OUT 1 4-20 mA
 ACT OUT 2 4-20 mA

CFIG DSLC

USE CB AUX
 REM REF THRESH(mA)
 PROC SIG THRESH(mA)
 LON TIME OUT(SEC)
 LON OUT UPDATE
 TIME(SEC)

Service Menus

SHUTDOWN MENU

FIRST SHUTDOWN
 1-SPEED #1 FAIL
 2-SPEED #2 FAIL
 3-SPD #1AND#2 FAIL
 4-ANLS INPUT 1 FAIL
 5-REMOTE INPUT FAIL
 6-ANLS INPUT 4 FAIL
 7-MODBUS 2 FAIL
 8-MODBUS 3 FAIL
 9-DSLC LON ERROR
 10-HIGH FUEL DEMAND
 11-HIGH SPEED
 12-HIGH TORSIONAL
 ON MAX LIMIT
 ON EXT FUEL LIMIT
 ON TORSION LIMIT
 ACT SHUTDOWN
 SPEED SWITCH
 ON AI LD SHARE LMT
 ALARM RESET

ALARM MENU

FIRST ALARM
 1-SPEED #1 FAIL
 2-SPEED #2 FAIL
 3-SPD #1AND#2 FAIL
 4-ANLS INPUT 1 FAIL
 5-REMOTE INPUT FAIL
 6-ANLS INPUT 4 FAIL
 7-MODBUS 2 FAIL
 8-MODBUS 3 FAIL
 9-DSLC LON ERROR
 10-HIGH FUEL DEMAND
 11-HIGH SPEED
 12-HIGH TORSIONAL
 ON MAX LIMIT
 ON EXT FUEL LIMIT
 ON TORSION LIMIT
 ACT SHUTDOWN
 SPEED SWITCH
 ON AI LD SHARE LMT
 ALARM RESET

1st DYNAMICS

GAIN 1
 RESET 1
 COMPENSATION 1
 GAIN RATIO 1
 WINDOW WIDTH 1(RPM)
 GAIN SLOPE BK PNT
 1(%FD)
 GAIN SLOPE 1
 SPEED FILTER FREQ
 1(HZ)
 BUMP ACT

2nd DYNAMICS

GAIN 2
 RESET 2
 COMPENSATION 2
 GAIN RATIO 2
 WINDOW WIDTH 2(RPM)
 GAIN SLOPE BK PNT
 2(%FD)
 GAIN SLOPE 2
 SPEED FILTER FREQ
 2(HZ)
 BUMP ACT

1st DYNAMICS-5 GAIN

BREAKPOINT 1A (%FD)
 GAIN @BREAKPOINT 1A
 BREAKPOINT 1B (%FD)
 GAIN @BREAKPOINT 1B
 BREAKPOINT 1C (%FD)
 GAIN @BREAKPOINT 1C
 BREAKPOINT 1D (%FD)
 GAIN @BREAKPOINT 1D
 BREAKPOINT 1E (%FD)
 GAIN @BREAKPOINT 1E
 RESET 1
 COMPENSATION 1
 GAIN RATIO 1
 WINDOW WIDTH 1(RPM)
 SPEED FILTER FREQ
 1(HZ)
 BUMP ACT

2nd DYNAMICS-5 GAIN

BREAKPOINT 2A (%FD)
 GAIN @BREAKPOINT 2A
 BREAKPOINT 2B (%FD)
 GAIN @BREAKPOINT 2B
 BREAKPOINT 2C (%FD)
 GAIN @BREAKPOINT 2C
 BREAKPOINT 2D (%FD)
 GAIN @BREAKPOINT 2D
 BREAKPOINT 2E (%FD)
 GAIN @BREAKPOINT 2E
 RESET 2
 COMPENSATION 2
 GAIN RATIO 2
 WINDOW WIDTH 2(RPM)
 SPEED FILTER FREQ
 2(HZ)
 BUMP ACT

ACTUATOR BUMP

BUMP ENABLE
 ACT BUMP LEVEL(%FD)
 ACT BUMP DURATION
 (SEC)

TORSIONAL FILTER

ENABLE TORS FILTER
 ENG SENSOR WEIGHT
 TORS SCALE (%RATED)
 TORSNL FUEL LIMIT
 (%FD)
 TORSNL LEVEL
 @LIMIT(%)
 TORSNL LEVEL
 @CLEAR(%)
 NOTCH FREQUENCY (HZ)
 NOTCH Q FACTOR
 TORSIONAL LEVEL(%)
 TORSNL FILTR ACTIVE
 TORSIONAL LIMIT
 LVL(%FD)

FUEL LIMITERS

START FUEL LIMIT (%FD)
 START RAMP RATE
 (%FD/S)
 MAX FUEL LIMIT(%FD)

SPEED SETTING

START SPEED
 RAISE SPEED LIMIT (RPM)
 LOWER SPEED LIMIT
 (RPM)
 IDLE SPEED(RPM)
 ACCEL RAMP TIME (SEC)
 DECEL RAMP TIME (SEC)
 RAISE SPEED RATE
 (RPM/MIN)
 LOWER SPEED RATE
 (RPM/MIN)

DROOP

LOAD DROOP PERCENT
 FUEL DEMAND @MIN
 LD(%FD)
 FUEL DEMAND @MAX
 LD(%FD)

AI LS CONTROL

ENBLE AI LOAD SHARE
 AI LS GAIN
 AI LS INTEGRAL
 MAX BIAS (%FD)
 AI LS PERM LEVEL (EU)
 AI LS ENABLE DELAY

LOAD SHARE SETTINGS

AUTO AI LS REF
 MANUAL LS BRKPT B
 MANUAL LS BRKPT C
 MANUAL LS BRKPT D
 MANUAL LS SETPT A
 MANUAL LS SETPT B
 MANUAL LS SETPT C
 MANUAL LS SETPT D
 MANUAL LS SETPT E

EXT FUEL LMT CURVE

ENABLE EXT FUEL LMT
 EXT LIMIT BRKPNT A (EU)
 FUEL LIMIT@BRKPNT
 A(%FD)
 EXT LIMIT BRKPNT B (EU)
 FUEL LIMIT@BRKPNT
 B(%FD)
 EXT LIMIT BRKPNT C (EU)
 FUEL LIMIT@BRKPNT
 C(%FD)
 EXT LIMIT BRKPNT D (EU)
 FUEL LIMIT@BRKPNT
 D(%FD)
 EXT LIMIT BRKPNT E (EU)
 FUEL LIMIT@BRKPNT
 E(%FD)

SET ANALOG INPUTS

AILS 1 LMT@4mA (EU)
 AILS 1 LMT@20mA (EU)
 REMOTE REF @4mA
 (RPM)
 REMOTE REF @20mA
 (RPM)
 AILS 4 LMT@4mA (EU)
 AILS 4 LMT@20mA (EU)

SET ANALOG OUTPUTS

ANALOG OUTPUT 1
MIN(EU)
ANALOG OUTPUT 1
MAX(EU)
ANALOG OUTPUT 2
MIN(EU)
ANALOG OUTPUT 2
MAX(EU)
AO FILTER
FREQUENCY(HZ)

I/O CALIBRATION

AILS 1 IN OFFSET(AI1)
AILS 1 IN SPAN (AI1)
AILS 1 IN READ VOLTS
(AI1)
DSLCOFFSET(AI2)
REM IN OFFSET(AI3)
REM IN SPAN(AI3)
REM IN READ VOLTS (AI3)
AILS 4 IN OFFSET(AI4)
AILS 4 IN SPAN(AI4)
AILS 4 IN READ VOLTS
(AI4)
AO 1 OFFSET
AO 1 SPAN
AO 2 OFFSET
AO 2 SPAN
ACT 1 OFFSET
ACT 1 SPAN
ACT 2 OFFSET
ACT 2 SPAN

COMM PORT SETUP

PORT2 HARDWARE CFG
PORT 2 BAUD RATE
PORT 2 STOP BITS
PORT 2 PARITY
PORT 2 TIMEOUT(SEC)
PORT3 HARDWARE CFG
PORT 3 BAUD RATE
PORT 3 STOP BITS
PORT 3 PARITY
PORT 3 TIMEOUT(SEC)
PORT2 LINK ERROR
PORT2 EXCEPTION ERR
PORT3 LINK ERROR
PORT3 EXCEPTION ERR

TC MODULE 1

CH1 - TC DEGREES F
CH2 - TC DEGREES F
CH3 - TC DEGREES F
CH4 - TC DEGREES F
CH5 - TC DEGREES F
CH6 - TC DEGREES F
CH1 - TC OFFSET
CH1 - TC SPAN
CH2 - TC OFFSET
CH2 - TC SPAN
CH3 - TC OFFSET
CH3 - TC SPAN
CH4 - TC OFFSET
CH4 - TC SPAN
CH5 - TC OFFSET
CH5 - TC SPAN
CH6 - TC OFFSET
CH6 - TC SPAN

TC MODULE 2

CH1 - TC DEGREES F
CH2 - TC DEGREES F
CH3 - TC DEGREES F
CH4 - TC DEGREES F
CH5 - TC DEGREES F
CH6 - TC DEGREES F
CH1 - TC OFFSET
CH1 - TC SPAN
CH2 - TC OFFSET
CH2 - TC SPAN
CH3 - TC OFFSET
CH3 - TC SPAN
CH4 - TC OFFSET
CH4 - TC SPAN
CH5 - TC OFFSET
CH5 - TC SPAN
CH6 - TC OFFSET
CH6 - TC SPAN

TC MODULE 3

CH1 - TC DEGREES F
CH2 - TC DEGREES F
CH3 - TC DEGREES F
CH4 - TC DEGREES F
CH5 - TC DEGREES F
CH6 - TC DEGREES F
CH1 - TC OFFSET
CH1 - TC SPAN
CH2 - TC OFFSET
CH2 - TC SPAN
CH3 - TC OFFSET
CH3 - TC SPAN
CH4 - TC OFFSET
CH4 - TC SPAN
CH5 - TC OFFSET
CH5 - TC SPAN
CH6 - TC OFFSET
CH6 - TC SPAN

TC MODULE 4

CH1 - TC DEGREES F
CH2 - TC DEGREES F
CH3 - TC DEGREES F
CH4 - TC DEGREES F
CH5 - TC DEGREES F
CH6 - TC DEGREES F
CH1 - TC OFFSET
CH1 - TC SPAN
CH2 - TC OFFSET
CH2 - TC SPAN
CH3 - TC OFFSET
CH3 - TC SPAN
CH4 - TC OFFSET
CH4 - TC SPAN
CH5 - TC OFFSET
CH5 - TC SPAN
CH6 - TC OFFSET
CH6 - TC SPAN

RTD MODULE 1

CH1 - RTD DEGREES F
CH2 - RTD DEGREES F
CH3 - RTD DEGREES F
CH4 - RTD DEGREES F
CH5 - RTD DEGREES F
CH6 - RTD DEGREES F
CH1 - RTD OFFSET
CH1 - RTD SPAN
CH2 - RTD OFFSET
CH2 - RTD SPAN
CH3 - RTD OFFSET
CH3 - RTD SPAN
CH4 - RTD OFFSET
CH4 - RTD SPAN
CH5 - RTD OFFSET
CH5 - RTD SPAN
CH6 - RTD OFFSET
CH6 - RTD SPAN

AI MODULE 1

AI1 CH1 - mA INPUT
AI1 CH2 - mA INPUT
AI1 CH3 - mA INPUT
AI1 CH4 - mA INPUT
AI1 CH5 - mA INPUT
AI1 CH6 - mA INPUT
AI1 CH1 - AI OFFSET
AI1 CH1 - AI SPAN
AI1 CH2 - AI OFFSET
AI1 CH2 - AI SPAN
AI1 CH3 - AI OFFSET
AI1 CH3 - AI SPAN
AI1 CH4 - AI OFFSET
AI1 CH4 - AI SPAN
AI1 CH5 - AI OFFSET
AI1 CH5 - AI SPAN
AI1 CH6 - AI OFFSET
AI1 CH6 - AI SPAN

DI MODULE 1

CH01 CONTACT CLOSED
CH02 CONTACT CLOSED
CH03 CONTACT CLOSED
CH04 CONTACT CLOSED
CH05 CONTACT CLOSED
CH06 CONTACT CLOSED
CH07 CONTACT CLOSED
CH08 CONTACT CLOSED
CH09 CONTACT CLOSED
CH10 CONTACT CLOSED
CH11 CONTACT CLOSED
CH12 CONTACT CLOSED
CH13 CONTACT CLOSED
CH14 CONTACT CLOSED
CH15 CONTACT CLOSED
CH16 CONTACT CLOSED

DO MODULE 1

CH1 ENERGIZED
CH2 ENERGIZED
CH3 ENERGIZED
CH4 ENERGIZED
CH5 ENERGIZED
CH6 ENERGIZED
CH7 ENERGIZED
CH8 ENERGIZED

AO MODULE 1

AO1 CH1 mA OUT
 AO1 CH2 mA OUT
 AO1 CH3 mA OUT
 AO1 CH4 mA OUT
 AO1 CH5 mA OUT
 AO1 CH6 mA OUT
 AO1 CH1 - OFFSET
 AO1 CH1 - SPAN
 AO1 CH2 - OFFSET
 AO1 CH2 - SPAN
 AO1 CH3 - OFFSET
 AO1 CH3 - SPAN
 AO1 CH4 - OFFSET
 AO1 CH4 - SPAN
 AO1 CH5 - OFFSET
 AO1 CH5 - SPAN
 AO1 CH6 - OFFSET
 AO1 CH6 - SPAN

LON and FORCE ENBL

LON SERVICE PIN
 RESET LON
 FORCE DSLC

DISPLAY DSLC

DSLCL REAL POWER
 DSLCL REACTIVE POWER
 DSLCL TOTAL AMPS
 DSLCL AVERAGE VOLTS
 DSLCL PHASE A AMPS
 DSLCL PHASE B AMPS
 DSLCL PHASE C AMPS
 DSLCL PHASE A VOLTS
 DSLCL PHASE B VOLTS
 DSLCL PHASE C VOLTS

DISPLAY DIGITAL I/O

A-DROOP
 B-ALARM RESET
 C-SPEED FAIL OVRD
 D-2ND DYNAMICS
 E-RAISE SPEED
 F-LOWER SPEED
 G-RATED SPEED
 H-CLOSE TO RUN
 DO1-J3 MB BW 0002
 DO2-ALARM
 DO3--SHUTDOWN

DISPLAY ANALOG I/O

DIGITAL SS IN #1 (HZ)
 DIGITAL SS IN #2 (HZ)
 AI1-AILS 1 INPUT
 AI2-DSLCL(VDC)
 AI3-REMOTE IN
 AI4-AILS 4 INPUT
 AI1 FAILED
 AI3 FAILED
 AI4 FAILED
 ANALOG OUT 1(mA)
 ANALOG OUT 2(mA)
 ACTUATOR OUT 1(mA)
 ACTUATOR OUT 2(mA)
 ALARM RESET

CONTROL MODE

SPEED IN CONTROL
 ON START FUEL LIMIT
 ON MAXIMUM LIMIT
 ON EXTERNAL LIMIT
 ON TORSIONAL LIMIT
 ACTUATOR SHUTDOWN
 REMOTE SPEED ENBLD
 SPD SENSOR 1 ACTIVE
 SPD SENSOR 2 ACTIVE
 AI LOAD SHARE ENBLD

DISPLAY MENU

ENGINE SPEED(RPM)
 BIASED SPD REF(RPM)
 FUEL DEMAND(%)
 ACT2 BIASED FUEL
 DMND(%)
 SPEED REF(RPM)
 DROOP BIAS(RPM)
 DSLCL BIAS(RPM)
 REMOTE SPEED REF
 (RPM)
 AN LOAD SHARE IN 1 (EU)
 AN LOAD SHARE IN 4 (EU)
 EXT FUEL LIMIT IN (EU)
 EXT FUEL LIMIT(%FD)

FORCE 723 DO

DO1 FORCE
 DO2 FORCE
 DO3 FORCE

FORCE DO 1

DO1 CH1 FORCE
 DO1 CH2 FORCE
 DO1 CH3 FORCE
 DO1 CH4 FORCE
 DO1 CH5 FORCE
 DO1 CH6 FORCE
 DO1 CH7 FORCE
 DO1 CH8 FORCE

FORCE DSLC

REMOTE REFERENCE
 PROCESS SIGNAL
 USE REMOTE
 REFERENCE
 USE PROCESS SIGNAL
 CB AUX CONTACT
 USE DISCRETE SIGNALS
 SYNCH CHECK INPUT
 SYNCH PERM INPUT
 SYNCH RUN INPUT
 VOLTAGE RAISE INPUT
 VOLTAGE LOWER INPUT
 BASELOAD INPUT
 LOAD INPUT
 PAUSE INPUT
 LOAD RAISE INPUT
 LOAD LOWER INPUT
 PROCESS INPUT

723PLUS/AISL Control Specifications

Woodward Part Numbers:	723PLUS with low-voltage power supply
8280-608	Hand Held Programmer
9907-205	Watch Window Installation
8923-932	
Power Supply Rating	18–40 Vdc (24 or 32 Vdc nominal)
Power Consumption	40 W nominal
Inrush Current:	7 A for 0.1 ms (low-voltage model)
Steady State Speed Band	±0.25% of rated speed
Magnetic Pickup	400–15 000 Hz (200–2100 rpm)
Proximity Switch	30–15 000 Hz (200–2100 rpm)
Discrete Inputs (8)	10 mA at 24 Vdc, impedance 2.3 kΩ
Analog Load Sharing Input 1	4–20 mA or 1–5 Vdc, externally powered
DSLC Input	±5 Vdc, externally powered
Remote Reference Input	4–20 mA or 1–5 Vdc, externally powered
Analog Load Sharing Input 4	4–20 mA or 1–5 Vdc, externally powered
Analog Outputs #1 & #2	4–20 or 0–1 mA to meter or computer, internally (configurable) powered
Analog Output #3	0–200 or 4–20 mA to Actuator 1, internally powered
Analog Output #4	0–200 or 4–20 mA to Actuator 2, internally powered
Relay Outputs	Modbus BW 0:0002, Alarm, Shutdown
Relay Contact Ratings	Resistive—2.0 A at 28 Vdc, 0.1 A at 115 Vac 50 to 400 Hz Inductive—0.75 A at 28 Vdc 0.2 Henry, 0.1 A at 28 Vdc Lamp
Programmer Serial Port (J1)	RS-422, 9-pin D connector, 1200 baud, full duplex
Communication Port (J2)	RS-232, RS-422, 9-pin connector, 110 to 38 400 baud, full duplex
Communication Port (J3)	RS-232, RS-422, RS-485, 9-pin connector, 1200 to 38 400 baud, full duplex
Ambient 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
EMI/RFI Susceptibility	Lloyd's Register of Shipping, EN50081-2 and EN50082-2
Mechanical Vibration	Lloyd's Register of Shipping Specification Vibration Test 1
Mechanical Shock	US MIL-STD 810C, Method 516.2, Procedure I (basic design test), Procedure II (transit drop test, packaged), Procedure V (bench handling)

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **26141A.**



PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

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

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