

723PLUS Digital Speed Control for Reciprocating Engines

8280-410, 8280-411

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.



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Warnings and Notices

Important Definitions



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

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

WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

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

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

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

WARNING

Start-up

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

WARNING

Automotive Applications

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

NOTICE**Battery Charging
Device**

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

Electrostatic Discharge Awareness

NOTICE**Electrostatic
Precautions**

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

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

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

Follow these precautions when working with or near the control.

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

Chapter 1.

General Information

Introduction

This manual describes the Woodward 723PLUS Digital Industrial Speed Control, models 8280-410 (low voltage) and 8280-411 (high voltage).

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 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.

NOTICE: This controlling device is intended to 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

This 723PLUS Digital Industrial Speed Control controls the speed of reciprocating engines in variable speed applications, including those with flexible couplings (see Figure 1-1). The control includes inputs for two magnetic pickups (MPUs) or proximity switches for monitoring flexible coupling torsionals, an input for a remote speed setting, an input for output fuel limiting, an internal speed reference for local control of speed, and two spare analog inputs.

One LON[®] * channel can be used to support Woodward LINKnet[™] input/output nodes for monitoring functions. The other LON channel is not used.

The three serial channels provide for various control interfaces. 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.

*—LON is a trademark of Echelon Corporation.

**—Modbus is a trademark of Schneider Automation Inc.

The 723PLUS control system includes:

- a 723PLUS Digital Speed Control
- Servlink Watch Window (Figure 1-3) or a hand held terminal (Figure 1-4) for adjusting control parameters
- one or two proportional actuators 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
- an optional fuel limiting transducer
- three 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

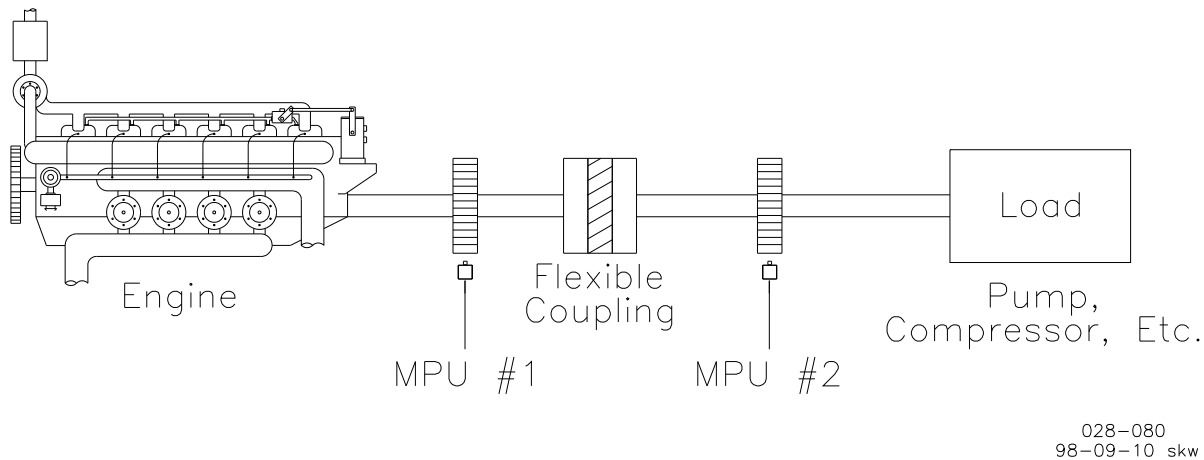


Figure 1-1. Flexible Coupled Driven Load

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 (low voltage) or 22 A (high voltage) is possible. Acceptable input voltage ranges are:

- low voltage—18 to 40 Vdc
- high voltage—90 to 150 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
- tandem actuator outputs
- 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.

Optional PC-based standard Process Control Interface Software (part number 8928-xxx) is a graphical user interface product used for monitoring and adjusting software parameters of the 723PLUS Speed Control.

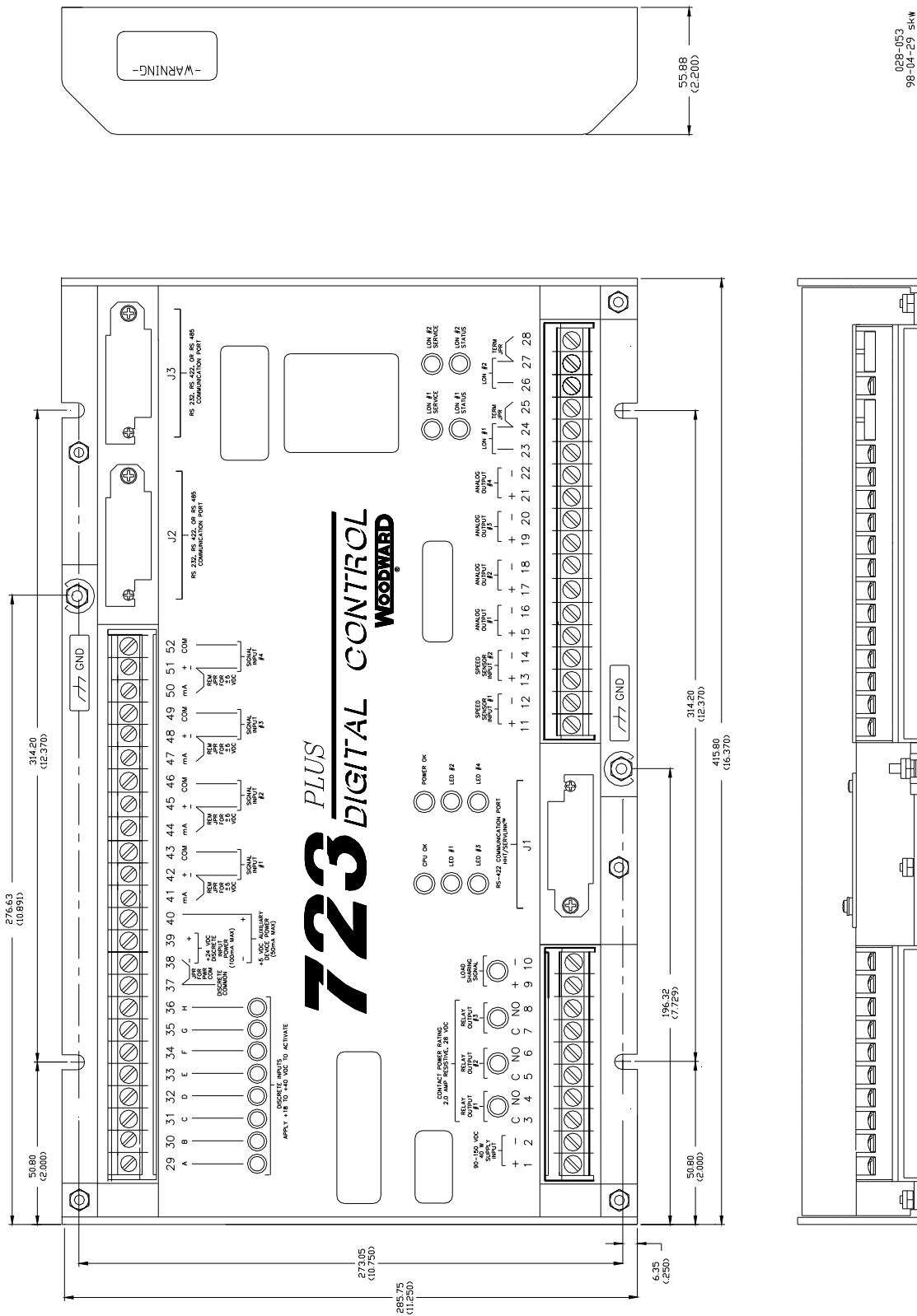
The two communication ports (J2 and J3) and the LON#1 data channel allow for digital communications between external Modbus compatible devices, Servlink devices, and Woodward LINKnet I/O modules. Port J2 is a dedicated port for Servlink clients like Watch Window and Control View. LON#1 channel has been designated for use with up to nine LINKnet modules. 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)



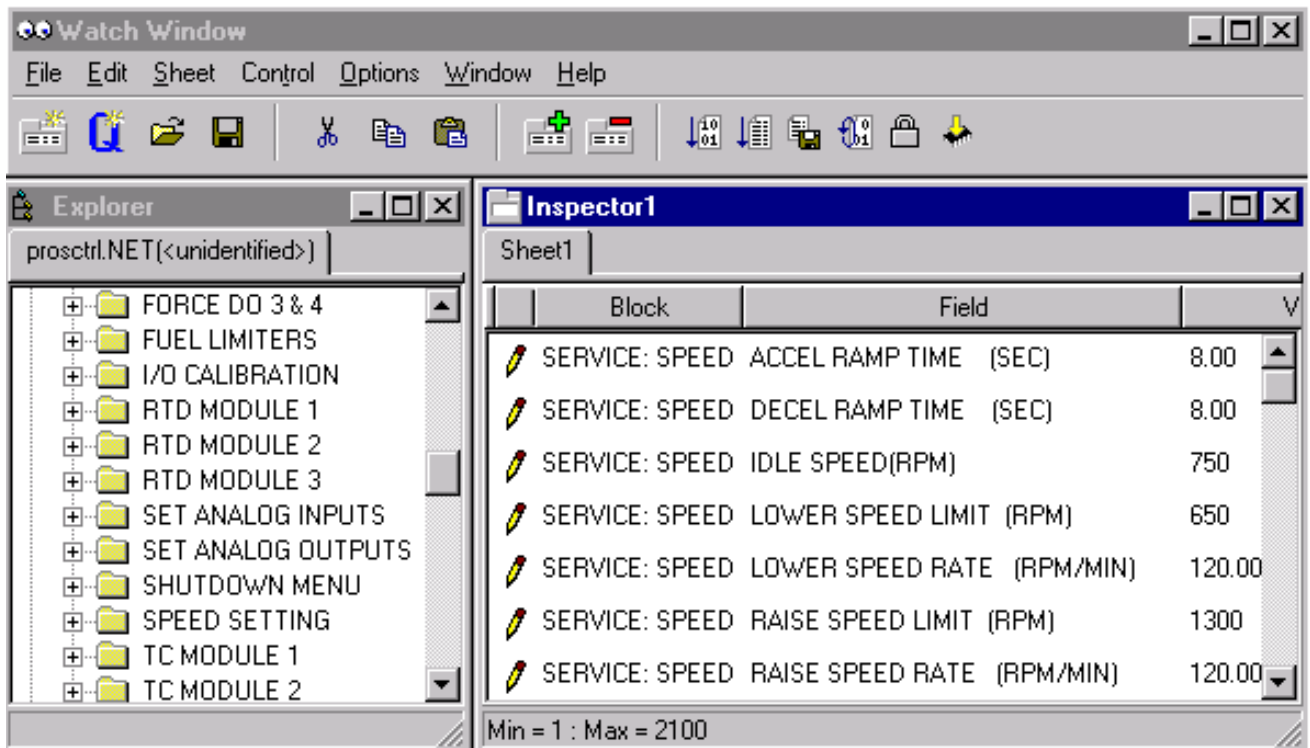


Figure 1-3. Watch Window Display

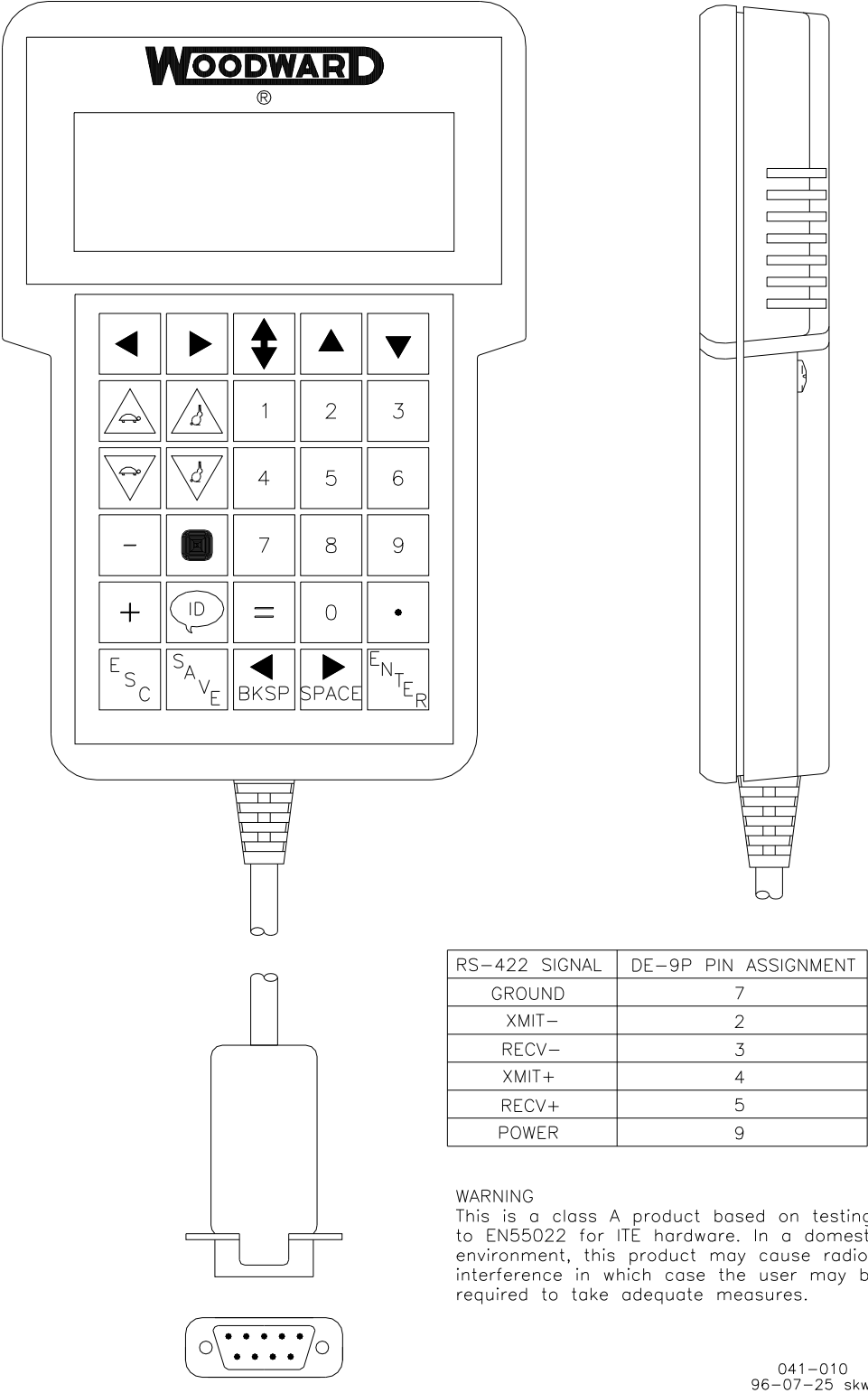


Figure 1-4. Hand Held Programmer

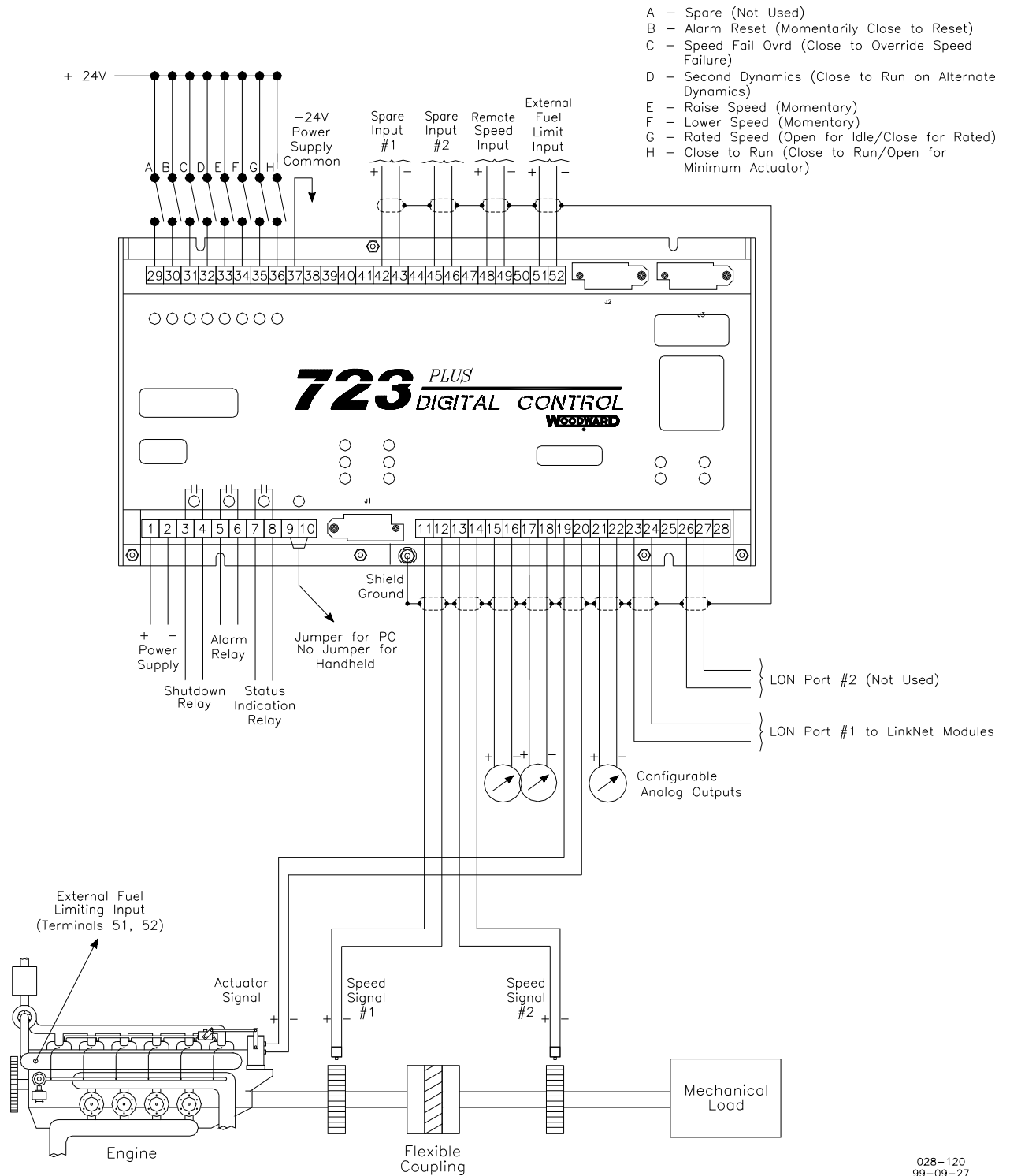
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Figure 1-5. Typical 723PLUS Connections

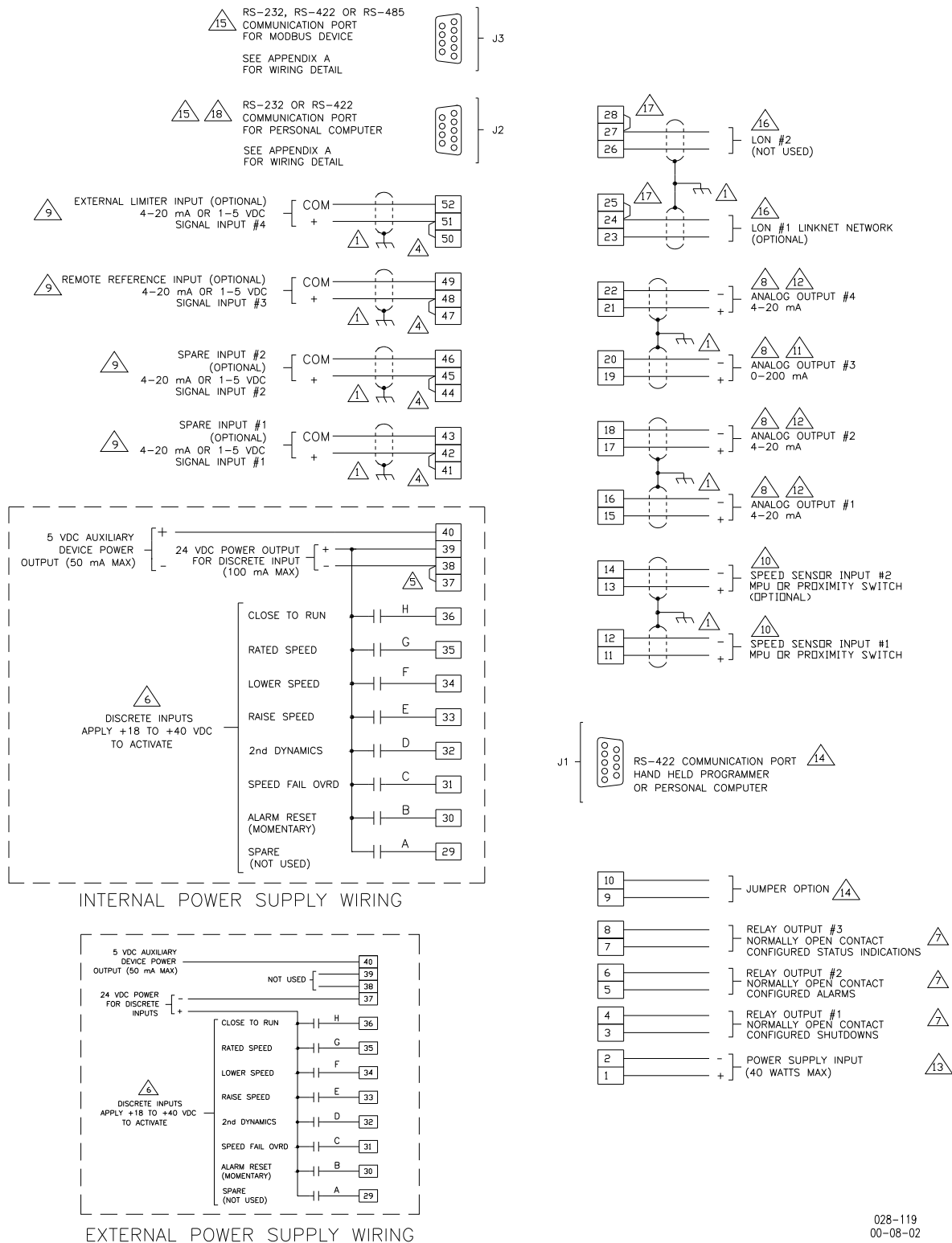


Figure 1-6a. Control Wiring Diagram

NOTES:

1. SHIELDED WIRES ARE TWISTED PAIRS, WITH SHIELD GROUNDED AT ONE END ONLY. WHEN MOUNTING CONTROL TO BULKHEAD, USE THE GROUNDING STUD AND HARDWARE SUPPLIED WITH THE CHASSIS TO ENSURE PROPER GROUNDING.
2. SHIELDS MUST NOT BE GROUNDED AT ANY EXTERNAL POINT UNLESS OTHERWISE NOTED.
3. ALL SHIELDS MUST BE CARRIED CONTINUOUSLY THROUGH ALL TERMINAL BLOCKS AND MUST NOT BE TIED TO OTHER SHIELDS EXCEPT AT THE COMMON GROUND POINT. THE SHIELDS ARE TIED TOGETHER AT THE GROUND STUD
4. REMOVE JUMPER FOR VOLTAGE INPUT.
5. A. INTERNAL POWER SUPPLY--ADD JUMPER FROM TERMINAL 37 TO 38.
B. EXTERNAL POWER SUPPLY--REMOVE JUMPER FROM TERMINAL 37 TO 38.
6. DISCRETE INPUTS ARE ISOLATED FROM OTHER CIRCUITS AND CAN BE POWERED BY TERMINAL 39 (+24 VDC) BY LEAVING THE JUMPER ACROSS 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 OR CONTROL VIEW 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 AN RS–232 OR RS–422 SERIAL INTERFACE. COMMUNICATION PORT J3 CAN BE CONFIGURED AS AN 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 (IF USED) MUST BE CONNECTED USING PROPER CABLE AS DESCRIBED IN APPENDIX B.
17. IF USED, 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. WATCH WINDOW OR CONTROL VIEW SOFTWARE MUST BE INSTALLED ON THE PERSONAL COMPUTER.

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Figure 1-6b. Control Wiring Diagram

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 high-voltage versions of the 723PLUS Digital Industrial Speed Control require a voltage source of 90 to 150 Vdc. 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	analog output #3	0–200 mA, single
	JPR13 & JPR1	analog output #3	0–20 mA, single
&	JPR14 & JPR2	analog output #3	0–160 mA, tandem
	JPR15 & JPR3	analog output #4	0–200 mA, single
*	JPR15 & JPR4	analog output #4	0–20 mA, single
&	JPR16 & JPR3	analog output #4	0–160 mA, tandem
	JPR5 & JPR17	speed sensor #1	proximity switch
*	JPR6 & JPR18	speed sensor #1	magnetic pickup
	JPR7 & JPR20	speed sensor #2	proximity switch
*	JPR8 & JPR19	speed sensor #2	magnetic pickup

*—default jumper settings

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

Electrical Connections

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

Shielded Wiring

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

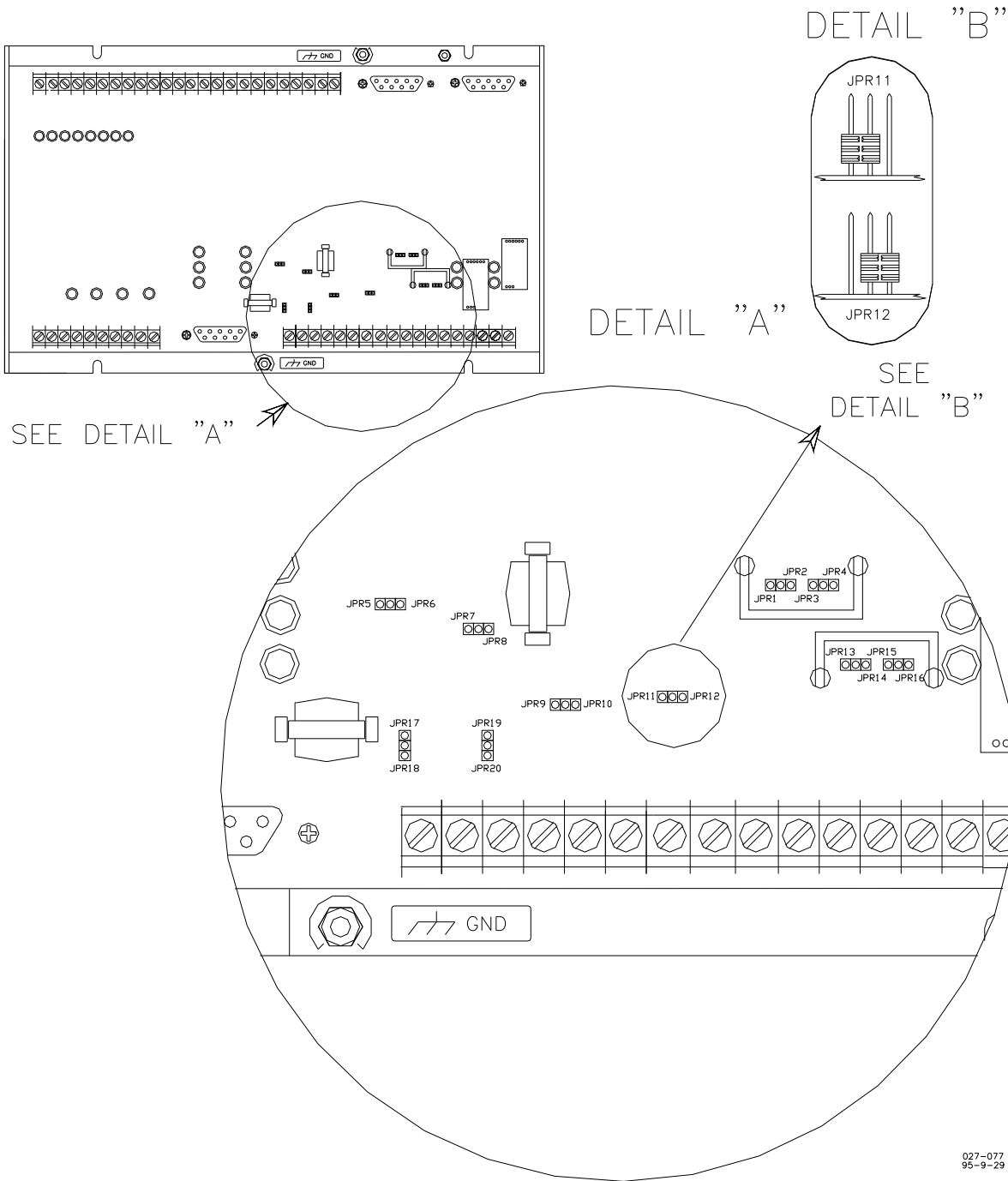


Figure 2-1. 723PLUS Control Internal Jumpers

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

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

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

Power Supply (Terminals 1/2)

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

NOTICE

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

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

If possible, do NOT turn off control power as part of a shutdown procedure. Use the Minimum Fuel (Run/Stop) discrete input (terminal 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.

POWER OK and CPU OK LEDs

The POWER OK and CPU OK are green LEDs (light emitting diodes). These LEDs are illuminated when the internal power supply is functioning and the CPU is operating normally. When the LEDs are not illuminated, do **not** attempt to start or run the engine. The LEDs will turn off if the power supply is turned off or failed, the CPU is failed or a watchdog error exists.

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

The three Relay Outputs provide Form A dry contact closures for controlling three discretely controlled devices. The three conditions which cause the relays to change state include a shutdown condition, an alarm condition, and a status indication condition. The contact ratings are shown on the control wiring diagram in Figure 1-6. Interposing relays should be used if the application exceeds these ratings. Each relay is energized when the green light above the respective terminals is illuminated.

The relay contact on terminals 3/4 for Relay Output #1 is used when internal shutdown conditions are intended to externally shut down the engine. Relay Output #1 must be connected to the engine shutdown system to execute an engine shutdown. 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.

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 status indication conditions are to be used by other devices in the application. No connection is required if the status indication function is not used in the application. The relay changes state if any configured status indication condition has occurred and will self-clear when the condition no longer exists. The state of the contact can be configured as either close on status or open on status. 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 driven load, you must connect the first MPU (terminals 11/12) to detect engine speed, and the second MPU (terminals 13/14) to detect driven load. 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.

LED Outputs #1, #2, #3, and #4 (Control Cover Mounted)

The four LED outputs are hard configured to provide specific status indications.

LED #1 is illuminated if the MPU 1 input is failed.

LED #2 is illuminated if the MPU 2 input is failed.

LED #3 is illuminated if any configured Alarm condition has occurred without being cleared or reset.

LED #4 is illuminated if any configured Shutdown condition has occurred without being cleared or reset.

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

The three analog outputs can be configured several different ways depending on the application needs. The output current is hardware configurable for either 0 to 1 mA or 4 to 20 mA on Analog Outputs #1 and #2 and for either 0 to 200 mA or 4 to 20 mA on Analog Output #4. This current signal is supplied to terminals 15(+) and 16(–) for Analog Output #1, terminals 17(+) and 18(–) for Analog Output #2, and terminals 21(+) and 22(–) for Analog Output #4. Note that the 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
 - 4:0004 ANALOG OUTPUT #4

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.

Analog Output #4 is factory set for 4 to 20 mA, representing the engine fuel demand. Default range is 0 to 100 %. Software settings must be changed if the hardware is configured for 0 to 200 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 wires connect to terminals 19(+) and 20(+). Use shielded wires with the shield connected to chassis at the control. The output current is hardware configurable for either 0–200 mA or 4–20 mA. Factory configuration is set for 0–200 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 two serial communication ports (J2 and J3). Additionally, the information can be read on Watch Window 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 is not used. DO NOT CONNECT.

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 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 which 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 which provide a high voltage source to power the 723PLUS control (or 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.

Spare (Input A; Terminal 29)

This spare input is not used by this control. However, it is assigned a Modbus address and can be used to port a user contact over Modbus.

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 which can latch into an alarm state. Only those parameters which 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 contact open (discrete input in the FALSE state), the control will again be ready to respond to the external contact closing. The Alarm Reset command works in parallel with the command from Port J3, and a software switch from the Hand Held Programmer, Watch Window, or Control View.

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. This can be done 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 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. 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 input contact, along with the Lower input 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. 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 input contact, along with the Raise input 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. Closing the raise contact or the lower contact (or both) will cancel the Rated ramp function initiated by the Rated Speed discrete input. For example, if the accel to rated ramp is in process, the ramp will stop when the raise or lower contact is closed and will then be controlled at the rate set for the Raise or Lower inputs. The remote ramp rate will apply when this input is selected and also cancels the accel ramp.

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.



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.

Spare Input # 1 (Signal Input #1; Terminals 42/43)

Connect an optional Transmitter #1 to Signal Input #1. The input signal must be an isolated high-quality signal. This signal input allows configuration of optional alarms and shutdowns, and the analog value can be sent to the Modbus device connected to Communication Port J3. 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 1 to 5 Vdc voltage transmitter to terminals 42(+) and 43(–). When using a voltage transmitter, remove the jumper between terminals 41 and 42. An input impedance of 255 Ω is present when the jumper is installed. Without the jumper installed, the input impedance will be greater than 10 M Ω . This input is not isolated from the other control inputs and outputs, and an isolation device must be installed if the transmitter output is not isolated. A failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) and for input values exceeding 21 mA (5.25 Vdc). A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

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

Connect an Optional Transmitter #2 to Signal Input #2. The input signal must be an isolated high-quality signal. This signal input allows configuration of optional alarms and shutdowns, and the analog value can be sent to the Modbus device connected to Communication Port J3. 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 1 to 5 Vdc voltage transmitter to terminals 45(+) and 46(–). When using a voltage transmitter, remove the jumper between terminals 44 and 45. An input impedance of 255 Ω is present when the jumper is installed. Without the jumper installed, the input impedance will be greater than 10 M Ω . This input is not isolated from the other control inputs and outputs, and an isolation device must be installed if the transmitter output is not isolated. A failure of the input signal is detected for input values less than 2.0 mA (0.5 Vdc) and for input values exceeding 21 mA (5.25 Vdc). A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

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 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.

Ext Fuel Limit (Signal Input #4; Terminals 51/52)

Connect an External Fuel Limit transmitter to Signal Input #4. The input signal must be an isolated high-quality signal representing the External Fuel Limit signal. This signal input will allow an external signal to limit the fuel demand. It is typically used to set a maximum fuel demand limit based on a parameter such as air manifold pressure. 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 External Fuel Limit current transmitter or 1 to 5 Vdc External Fuel Limit voltage transmitter to terminals 51(+) and 52(–). When using a voltage transmitter, remove the jumper between terminals 51 and 50. 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). A detected failure will remain until the failure is repaired and an Alarm Reset is issued.

RS-422 Communication Port (J1)

Port J1 is intended for use with the Woodward ST2000 Hand Held Programmer (part number 9907-205), Watch Window software (part number 8923-932), or Control View software (part number 8928-222). 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 the 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 or Control View 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 cable may be used to connect Port J2 to a personal computer. Watch Window or Control View can be used to display and modify tunable and configurable values in the control, 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 can read 723PLUS control parameters and inputs from connected LINKnet nodes. The Modbus device can drive LINKnet nodes 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 the Port J3 BAUD rate cannot be 38400, and if Port J2 is set for a BAUD rate of 38400, then the 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, send commands and values to all connected LINKnet outputs, and send limited commands and two signals to the 723PLUS control. The four signals which can be sent to the 723PLUS are the remote speed reference and a source value for configured analog outputs #1, #2, and #4. The commands which can be sent to the 723PLUS control are Alarm Reset, Close to Override Failsafe, Close for 2nd Dynamics, Raise Speed, Lower Speed, Close for Rated Speed, Close to Run, 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/Stop 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, Control View, 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.

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

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 RTDs

(3-wire, 100 Ω American curve). 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 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. 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, 0003, and 0004 allow control of configurable analog outputs #1, #2, and #4 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, 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 1300 rpm output from the 723PLUS, a value of 1300 must be applied to address 4:0005).

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.



WARNING

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

- B. Check for correct wiring in accordance with the control wiring diagram, Figure 1-6.
 - 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, Watch Window, and Control View. 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 PC Interface

Watch Window was developed by Woodward to be a Servlink client software product to provide 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. Tabbed pages can be added within each window for easy grouping and access to sets of parameters and values. 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 723PLUS Process Control through ports J1 or J2. However, only port J1 can be used for loading the application software.

Port J1 is configured for RS-422 as a point-to-point only Servlink Server and requires a special cable to convert from RS-422 to RS-232 (cable part number 5416-870). RS-422 communications are less susceptible to noise than RS-232 and should be used when the control and computer are in noisy environments. When using port J1 with Watch Window or Control View, place a jumper across terminals 9 and 10. This tells the control that a computer is connected to J1. When using the Hand Held Programmer, remove the jumper.

Port J2 is configured by default for RS-232 and requires a widely available 9-pin 'null modem' cable. This cable should be available at almost any computer or electronics store. It does not matter if terminals 9 and 10 are jumpered or not when using port J2. Port J2 configuration may be set for RS-422 as a point-to-point or multidrop Servlink server.

Read 'Control Properties' to display the part number and revision level of the software in the control. Refer to this number and revision level in any correspondence with Woodward (write this information in the Programming Checklist, Appendix C). Read "Getting Started" included in the Watch Window Help file provided with the Watch Window install software.

723PLUS Control View

Woodward has created Control View as a PC Interface for the 723PLUS Speed Control. This custom graphical user interface is a Servlink client that has all 723PLUS Speed control tunable values and monitoring parameters laid out in an intuitive manner.

IMPORTANT

The Control View software is an OPTION and must be ordered separately from the 723PLUS Control. Refer to the inside back cover for the part number.

This interface connects directly to the control values and parameters. Monitoring parameter updates are very fast. Tunable values may be changed directly and saved in the controller's EEPROM or saved to a file to be downloaded or uploaded.

Control View communicates with the 723PLUS Speed Control through ports J1 or J2.

Port J1 is configured for RS-422 and requires a special cable to convert from RS-422 to RS-232. The cable part number is 5416-870. RS-422 communications are less susceptible to noise than RS-232 and should be used when the control and computer are in noisy environments. When using port J1 with Watch Window or Control View, place a jumper across terminals 9 and 10. This tells the control that a computer is connected to J1. When using the Hand Held Programmer, remove the jumper.

Port J2 is configured for RS-232 and requires a widely available 9-pin 'null modem' cable. This cable should be available at most computer or electronics stores. It does not matter if terminals 9 and 10 are jumpered or not when using port J2. Read "Help About" to display the part number and revision letter 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 in the Appendix). Read the "Getting Started" notepad included with the Control View install software.

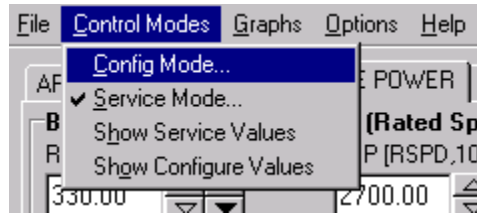
System Requirements

- Operating System: Windows 95 or Windows NT 4.0 *
- Processor: At least a Pentium 166 MHz or equivalent
- RAM: Recommended 32 MB (with Windows 95) and 64 MB (with Windows NT 4.0); Required 8 MB
- Communications: At least 1 free working COMM port

IMPORTANT

*** It is likely that this program would run fine on Windows 98 and Beta Versions Windows NT 5.0, but these have not been tested and will not be supported by Woodward.**

Control Modes

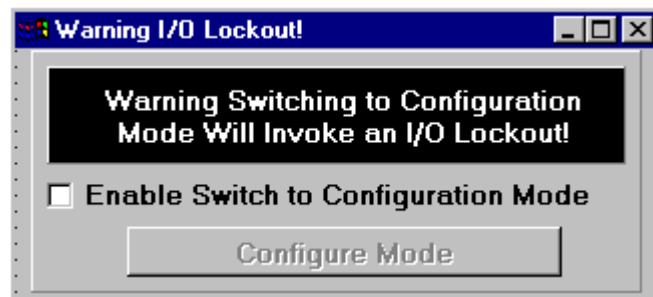



- Service Mode

When the controller is in use, it is in service mode. While in service mode, configuration values cannot be changed, and tunable values can be changed only within 10% of their value per single adjustment.

- Configure Mode

This mode is used to set up options that cannot be changed while the controller is in use (e.g., the number of teeth). Switching to configure mode will cause an I/O lockout. An I/O lockout is a safety precaution to make sure the engine is shut down prior to changing configuration settings. A conformation dialog is in place so that the control is not accidentally placed in configuration mode.



To continue and enter Configuration Mode, check the “Enable Switch to Configuration Mode” box, then press or click Configuration Mode. Close the window (click ) to cancel.

Show Service Values

This will bring the service values to the top so they can be adjusted. If the control is in configure mode, the values can be adjusted by any amount within their allowed maximum and minimum ranges. The “within 10% of their value” rule does not apply in Configure mode.

Show Configure Values

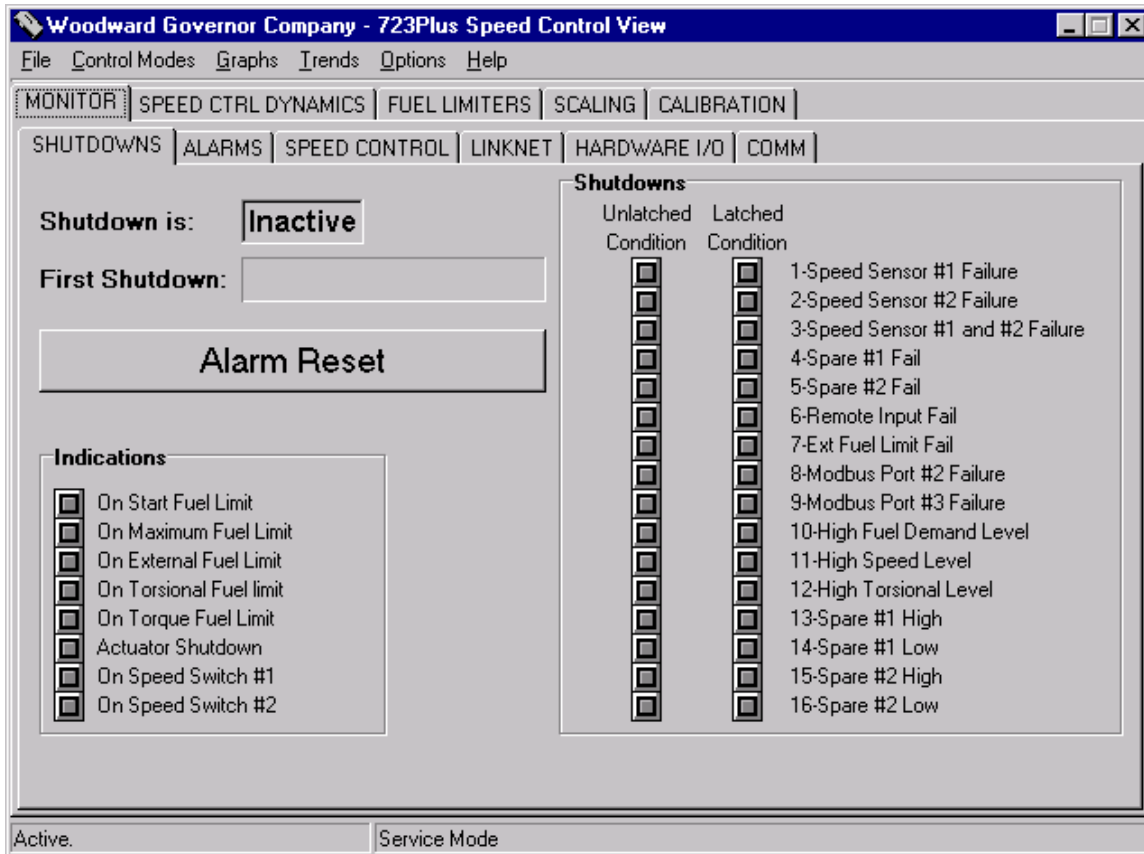
This option will make the configure values visible. Note that if an attempt is made to change a configure value while the control is in service mode, an error will be generated indicating that this is not allowed.

IMPORTANT

While in configure mode, the controller locks out all other input and output processing. This means that if the controller is put in configuration mode while its control device is still active (e.g. the engine is still running) results could be unpredictable.

Startup Screen

This following Startup Screen appears when the 723PLUS Control View interface is opened.

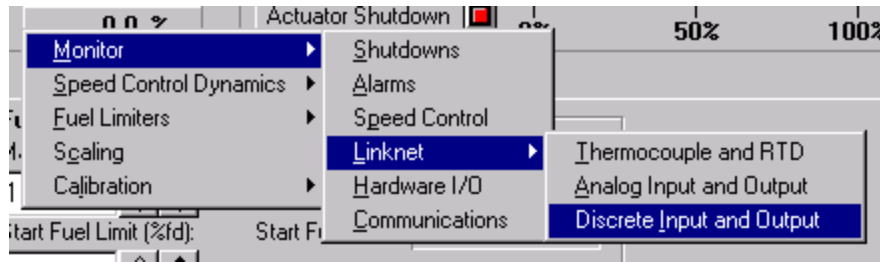


This shows the **Monitor Shutdown** screen and displays current status of all shutdowns. An **Alarm Reset** button is provided to reset any control alarms and shutdowns that have been cleared.

The Tabs across the top provide a word description of main screens and sub-screens of the Monitor screen and are a means of moving to another screen. To move to another screen, Click the appropriate tab. The $\leftarrow \rightarrow$ arrows in the upper right hand corner (if applicable) are used to scroll to other tabs that may be hidden. Some screens when opened (e.g., Monitor), will display additional tabs to sub-screens. Clicking these tabs will move you into the sub-screens.

A quick means of moving directly to another screen or sub-screen from any screen is to right click anywhere on the tab sheet, *except on a gauge panel*. The main tabs list will pop up and an \triangleright symbol will appear at the right edge of main lists which contain a sub-screen list. This facilitates moving to sub-screens. Left click when the cursor is over the desired screen or sub-screen name to move directly to that screen.

The following is an example of right clicking to select and move to the “Discrete Input and Output” screen, which is a sub-screen of “LINKnet” and “Monitor”. It displays the full lists of other LINKnet sub-screens and Monitor sub-screens as well as all Main screens (including those that are hidden).

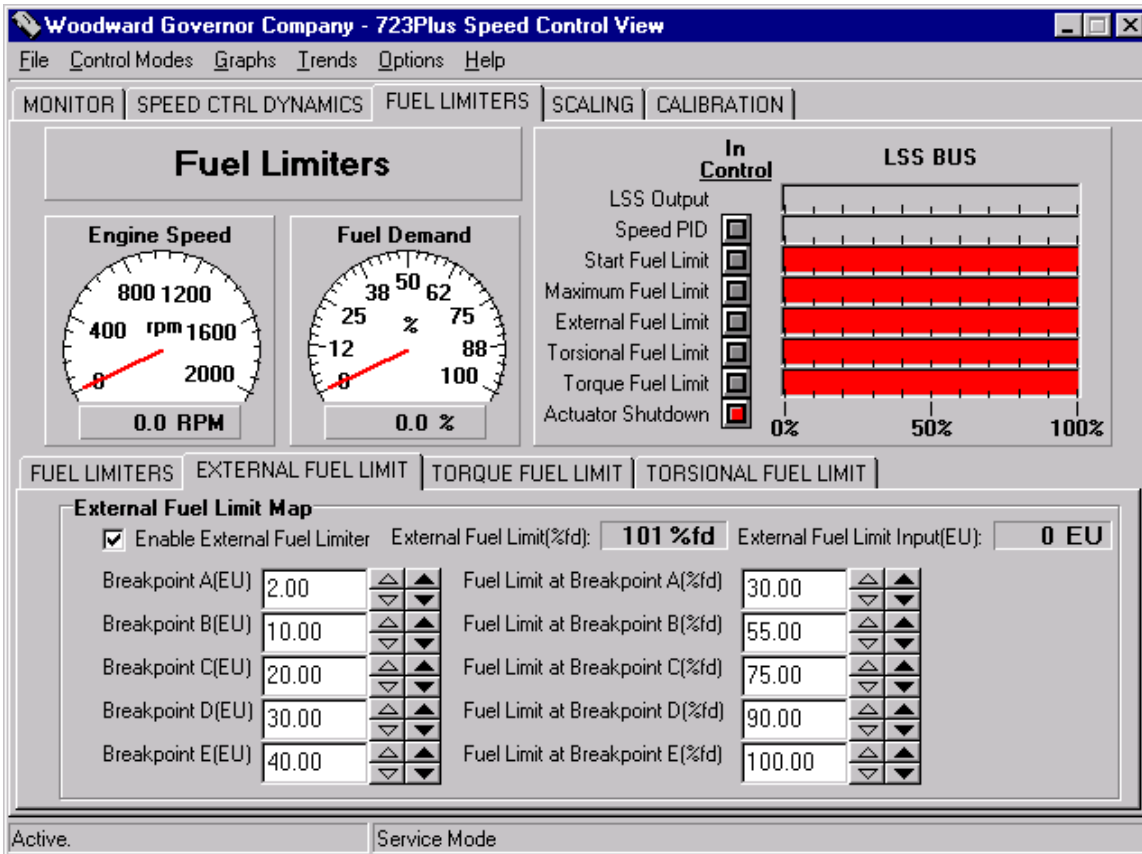


The Fuel Limiter screen, shown below, is typical of all screens except for the curve screens. You can see that the information is presented in various forms:

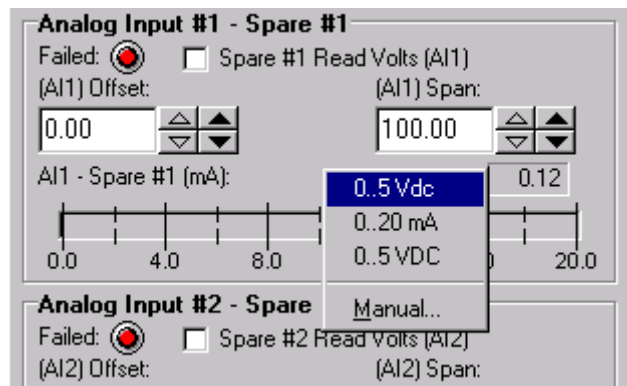
- Analog and digital displays of Engine Speed and Fuel Demand
- LED display of the Fuel Limiter in Control
- Bar graph display of all Fuel Limiters on the Fuel Demand LSS bus
- Sub-tabs for the Fuel Limiter Settings, External Fuel Limit Curve, Torque Fuel Limit Curve, and Torsional Fuel Limit Curve.

Two sets of raise/lower arrows accompany each tunable value. The hollow arrows produce “turtle” (slow) set point changes, and the solid arrows produce “rabbit” (fast) set point changes. Values may also be highlighted and typed in directly. This causes the raise/lower arrows to be replaced by an = sign. Typed values must be within 10% of the previous value to be accepted when in Service Mode. This rule does not apply when in Configuration Mode. Click the = sign or press the enter key to accept newly typed settings. All values in either mode must be within “max” and “min” limits fixed in the control software.

The following is the Fuel Limiter screen with the External Fuel Limit settings sub-tab open. The sub-tabs expose specific fuel limiter setting values with raise/lower arrows for all fuel limiters.



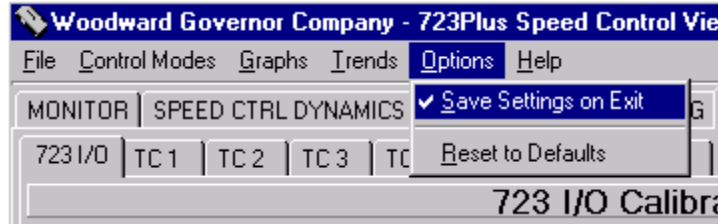
Right clicking on a gauge panel will bring up a different quick menu.



This quick menu will appear when you right click on a gauge (or a group of gauges) that has a changeable range. There are always multiple quick options and a manual option. If the program is set to save settings on close, the new gauge settings will automatically be saved when the program is closed.

Saving Settings

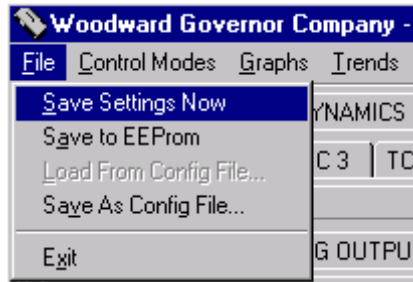
The following shows how to set the program to save (or not save) gauge settings and screen position on exit. Under the Options menu either check or uncheck Save Settings on Exit for the desired action on exit. This save option will only save screen position and gauge settings on exit. To save all configuration and service tunables see File "Save to EEPROM" below.



The other Option is:

- Reset to Default Settings will reset all the user options to their default values.

Control and Program Settings can be saved in various ways at any time from the File menu.



Select File from the menu bar, for the following choices:

- Save Settings Now will save the programs screen position and gauge settings.
- Save to EEPROM will save all configuration and service tunables in the 723PLUS EEPROM.
- Load Config File will load settings from a saved Configuration File into the 723PLUS EEPROM, overwriting all previous values. The control must be in Configure Mode to perform this function.
- Save As Config File will dump all settings from the 723PLUS controller EEPROM into a Configuration File.

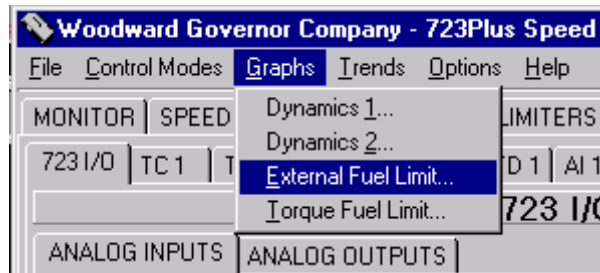
NOTICE

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.

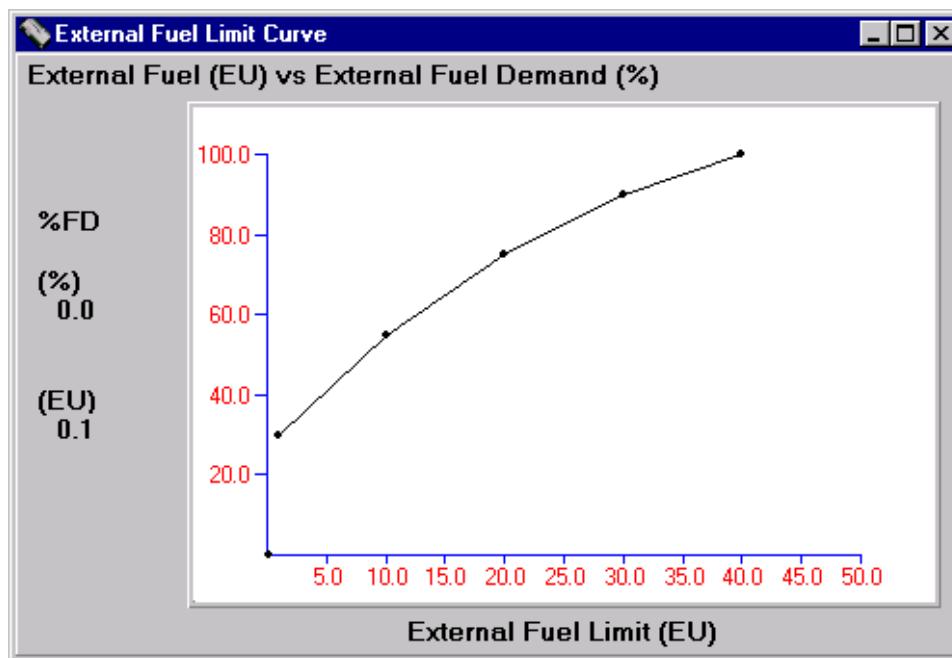
2D Curves

The 2D curve screens are unique. The External Fuel Limit Curve sub-screen with tabulated values and raise/lower arrows was shown earlier on the Fuel Limit screen. The following shows a different way of viewing and changing this same curve as a *graph* instead of as tabulated settings.

To view a curve, select Graphs from the menu bar, and a list of curves will pop-up. Click the desired curve.

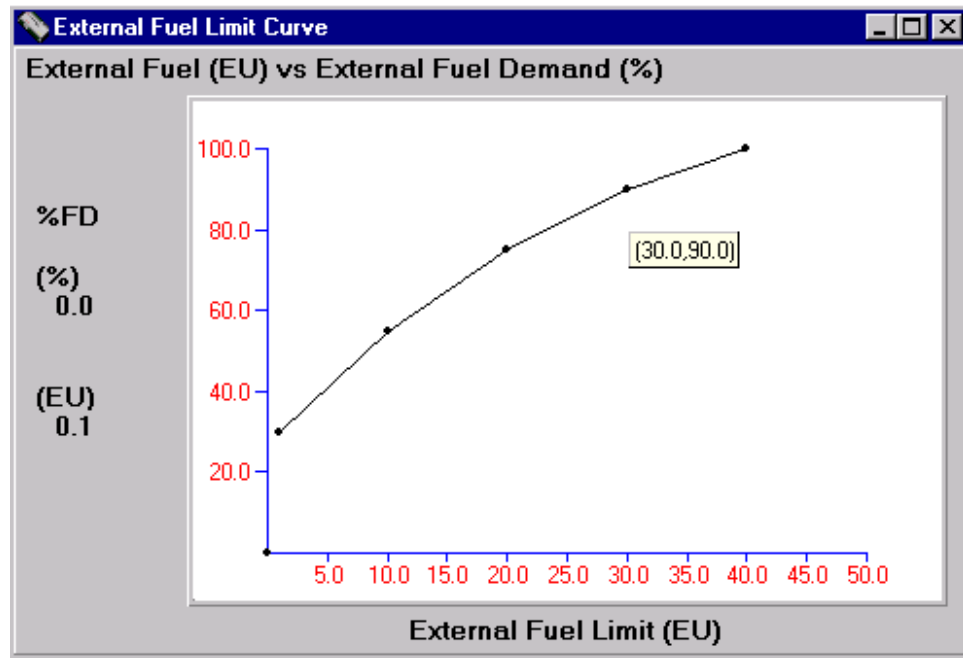


The following External Fuel Limit Curve display, as well as displays for the other listed curves, are available for both viewing the curve graph and changing curve set points.

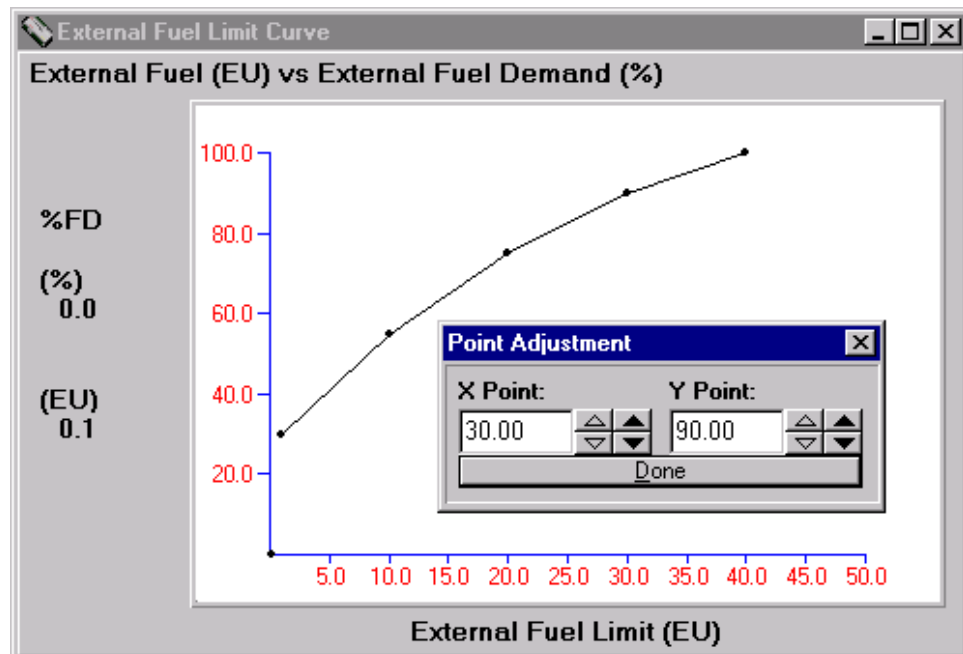


The above screen shows that the External Fuel Limit curve is a 2D curve with five breakpoints. It is set to limit fuel demand at various external analog input values. A digital display of the current x (curve input) and y (curve output) values in engineering units is included. Y in this example is the fuel limit (as a % fuel demand) based on an external analog input. X is the external analog input.

Holding the cursor over a curve breakpoint will display the coordinates, in (x,y) format, for that specific point as shown below.

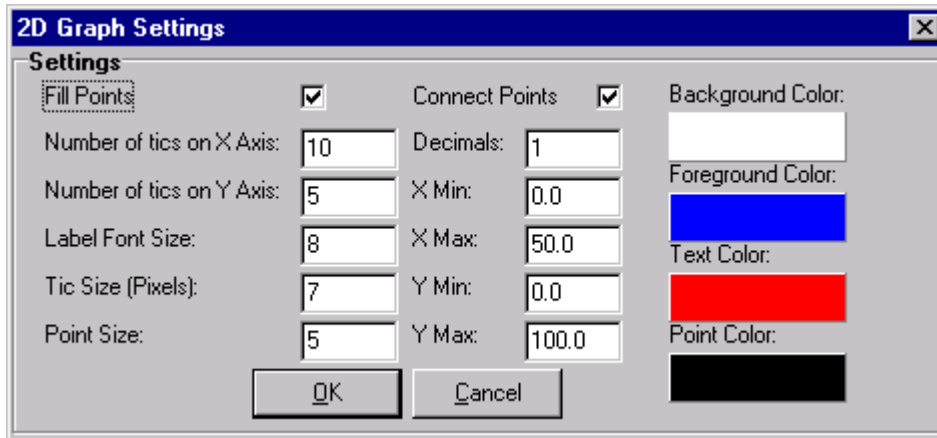


Right clicking on a breakpoint and selecting "properties" will pop-up a "Point Adjustment" window for that point as shown below.

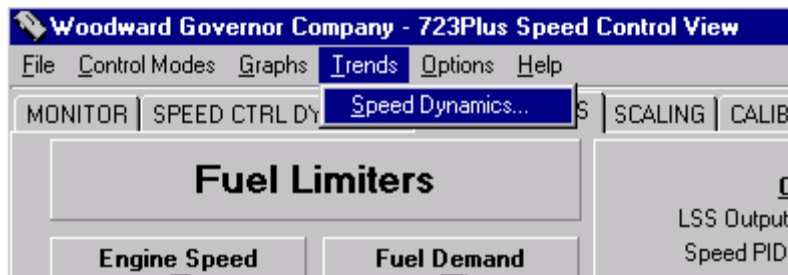


Adjustments to both the x and y breakpoint values can be made, as described earlier, by using the "turtle" and "rabbit" arrows or by typing in values and pressing the = key for the selected point. All breakpoints of all curves can be adjusted in this manner from the curve graph screens.

The setup dialog for a 2D graph axes and colors is shown below.

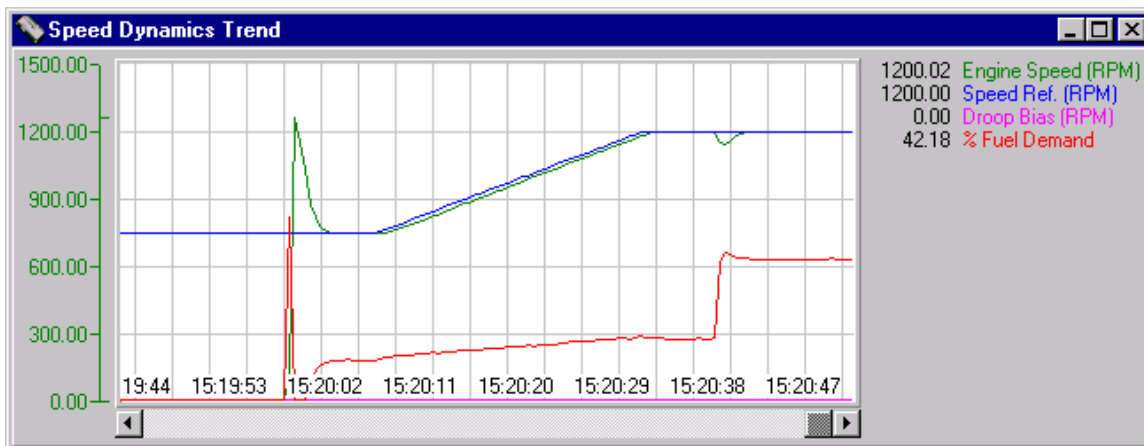


Trends



The purpose of a Trend Graph is to provide a visual relational representation of data as it changes over time. This is especially useful when tuning an engine and different fluctuations need to be seen and dealt with analytically.

Here is an example showing an engine starting trend of speed, fuel demand etc:



The Available Trends are listed below, with the items they contain:

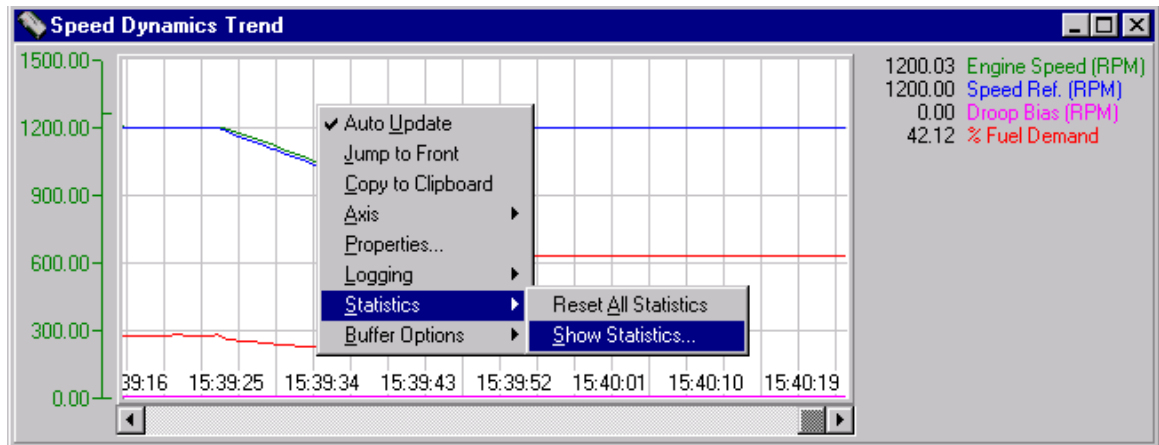
Speed Dynamics

Engine Speed (rpm)
Speed Reference (rpm)
Droop Bias (rpm)
%Fuel Demand

How To Read and Use a Trend Graph

There are two features directly accessible on the Trend Graph

- By right clicking anywhere on the graph a Quick Menu with different options will appear.
- By left clicking on the description of a Trend Pen (e.g. "Engine Speed (rpm)") its axis will be shown on the left. Individual axes are available because different values need to be graphed on different ranges.



The axis provides another piece of information, the maximum and minimum value of its respective pen. This is indicated by two tick marks on the right side of the axis. When the program is first started, it initializes the values to 0, so it might be necessary to reset the Max and Min values once the program is running. This is accomplished by right clicking on the graph and selecting *Statistics* and then selecting *Reset All Statistics*.

Auto Update: Will pause and unpauses the graph motion, as well as pause and unpauses logging.

Copy to Clipboard: Copies the whole graph (axis, graph window, descriptions, and values) to the clipboard so that it can be pasted into any other Windows application capable of receiving a bitmap from the clipboard.

Properties: Will display this dialog.

Pen Status:	Pen# And Name	Color:	Line:	Minimum:	Maximum:
<input checked="" type="checkbox"/> Enabled	1. Engine Speed (RPM)	Green	-----	0.000	1300.00
<input checked="" type="checkbox"/> Enabled	2. Speed Ref. (RPM)	Blue	-----	0.000	1300.00
<input checked="" type="checkbox"/> Enabled	3. Droop Bias (RPM)	Magenta	-----	0.000	1300.00
<input checked="" type="checkbox"/> Enabled	4. % Fuel Demand	Red	-----	0.000	100.000
<input type="checkbox"/> Enabled	5.	Cyan	-----	0.000	100.000
<input type="checkbox"/> Enabled	6.	Black	-----	0.000	100.000
<input type="checkbox"/> Enabled	7.	Orange	-----	0.000	100.000
<input type="checkbox"/> Enabled	8.	Purple	-----	0.000	100.000

Note: Actual timing and scaling is affected by rounding and is not exact.

<input checked="" type="checkbox"/> Show Time	X Grid Tics: 20	Length of Window (sec): 60	Background Color:
<input type="radio"/> Top	Y Grid Tics: 5	Graph Update (msec): 500	Grid Color:
<input checked="" type="radio"/> Bottom	Decimals: 2	Time Update (msec): 9000	Graph Text Color:

Buttons: OK, Cancel

Pen X Enabled: Enables or disables graph of data for that pen. This is useful if pens are overlapping or only certain values need to be monitored or logged.

Pen X Color: Change the color of the trace of the pen. Useful for maintaining contrast.

Pen X Line Style: Is also useful for maintaining contrast. However, if the update time and graph length are such that each update only moves the graph a couple of pixels, the line style appears not to have an effect. This is because each segment drawn is not long enough to show a complete cycle in the line style.

Pen X Minimum: This value is used in conjunction with Pen X Maximum.

Pen X Maximum: These values are used to scale the data in the graph window. Change these values to zoom in or out on a particular region for a given Pen.

Show Time (Top/Bottom): This option toggles if the time passed is written to the graph window, as well as if it is written to the top or bottom of the graph.

Show Grid: Toggles if the grid is drawn or not.

X Grid Tics: This Controls How many lines are drawn parallel to the Y Axis. Note that this value is not exact, but more a value used to generate the grid density. The best way to understand it is to change it to high and low values and see what happens.

Y Grid Tics: This controls how many lines are drawn parallel to the X Axis (Time Line), as well as how many tick marks are placed on the Y Axis.

Decimals: Controls how many decimal places are shown for all data displayed on the graph. This is also used to control how many decimals places are used when data is written to a log file.

Length of Window (sec): Approximate time that it takes a given point to go from the far right side of the graph to the left side.

Graph Update (msec): How often the graph is redrawn. Note that if this value is set too small (such that the graph will not be moved at least one pixel per update), it is automatically set so that the graph will move one pixel per update. This also controls how often data is written to a log file if logging is enabled.

Time Update (msec): Controls how often the time stamp is placed on the graph.

Background Color: Allows the background of the graph window to be changed. Useful for showing contrast.

Grid Color: Changes the grid color if the grid is displayed.

Graph Text Color: Changes the color of the text for the time when it is written to the graph window, if show time is enabled.

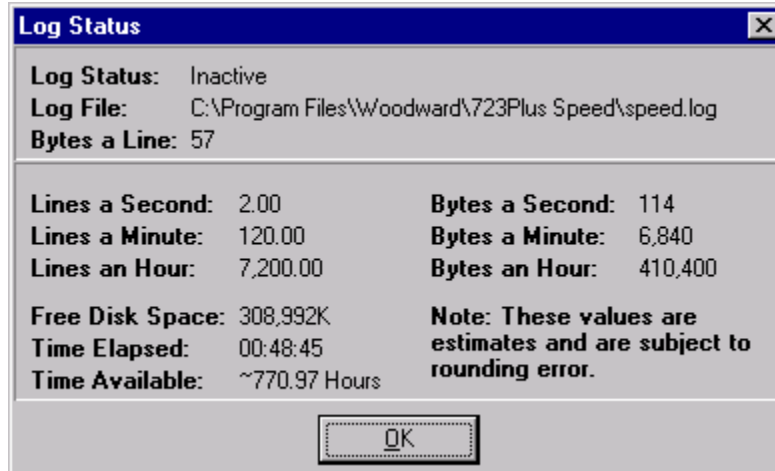
Logging/Log File: Clicking on this will either enable or disable logging. Note that if no log file is specified, trying to start logging has no effect. This feature is provided if a history is needed. Data is logged on every update interval to a standard tab delimited ASCII text file. The log file can be changed in the trend configuration dialog. Note that if the log file exists you can choose to "overwrite", "append", or "create new".

Here is a short sample of a log generated from the above trend. This sample covers ten seconds of time.

Log Creation Time: 3:09:18 PM on 5/11/2000.

Time / Date (RPM)	Engine Speed (RPM) % Fuel Demand	Speed Ref. (RPM)	Droop Bias
05/11/2000 15:19:53.339	0.00	750.00	0.00
05/11/2000 15:19:53.840	0.00	750.00	0.00
05/11/2000 15:19:54.341	0.00	750.00	0.00
05/11/2000 15:19:54.841	114.18	750.00	54.99
05/11/2000 15:19:55.342	1267.00	750.00	0.00
05/11/2000 15:19:55.843	1151.31	750.00	0.00
05/11/2000 15:19:56.344	1035.03	750.00	0.00
05/11/2000 15:19:56.844	878.20	750.00	5.87
05/11/2000 15:19:57.345	818.66	750.00	9.34
05/11/2000 15:19:57.846	771.43	750.00	10.88
05/11/2000 15:19:58.347	758.70	750.00	11.63
05/11/2000 15:19:58.847	750.50	750.00	12.01
05/11/2000 15:19:59.348	749.16	750.00	12.32
05/11/2000 15:19:59.849	748.60	750.00	12.26
05/11/2000 15:20:00.349	748.80	750.00	12.45
05/11/2000 15:20:00.870	749.26	750.00	12.30
05/11/2000 15:20:01.351	749.50	750.00	12.35
05/11/2000 15:20:01.852	749.73	750.00	12.30
05/11/2000 15:20:02.352	749.83	750.00	12.28
05/11/2000 15:20:02.853	749.94	750.00	12.31
05/11/2000 15:20:03.354	750.06	757.56	12.63
05/11/2000 15:20:03.864	752.53	767.27	12.92

Logging/Log Status: This will show a dialog with estimated data rate values indicating how much physical data is being logged per second, per minute, and per hour. This is useful if you wish to have a log file kept for a longer period of time and want to make sure that you won't run out of disk space. The estimate is based on every value being written at its Maximum Axis Value. In most cases the actual data rate should be less. If logging the time is enabled, then every time stamp is evaluated as having three decimal places for estimation purposes.

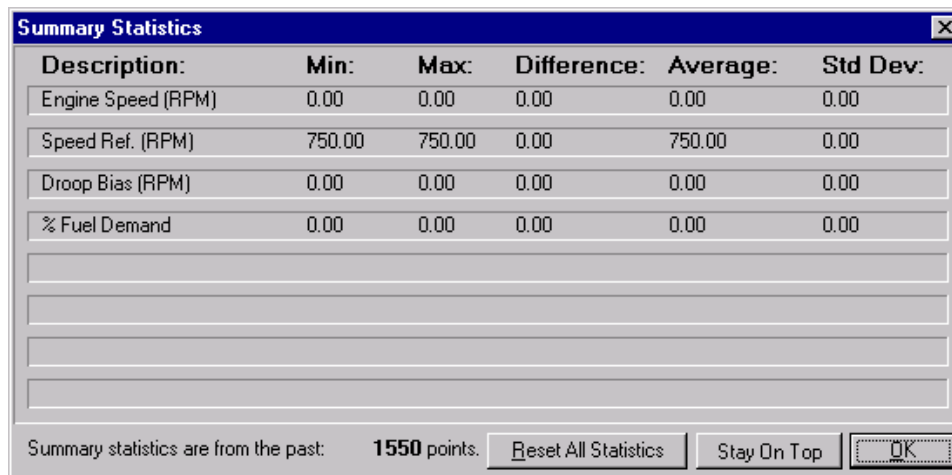


Logging/Convert Logfile Format: This option is used to convert a logfile to CSV format.

Statistics

Reset All Statistics: Will reset all values for the current trend statistics to the current value.

Show Statistics: Displays summary statistics for all pens of the current trend. Reset All Statistics button is included in this display.



Buffer Option

On Screen Buffer Data: Displays current trend buffer data on screen.

Save Buffer to a File: Saves current trend buffer data to a log file.

Buffer Display								
Note: This is only the currently displayed data, to view different ranges of data adjust the settings for the trend then reopen this dialog.								
Date / Time	Engine Speed	Speed Ref.	Droop Bias	% Fuel Deme				
05/12/2000 10:40:37.895	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:38.396	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:38.896	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:39.397	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:39.898	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:40.399	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:40.899	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:41.400	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:41.901	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:42.401	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:42.902	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:43.403	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:43.904	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:44.404	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:44.905	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:45.406	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00
05/12/2000 10:40:45.907	0.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00

On-Line Help

Extensive on-line Help is available. The above instructions are given as an overview only and are not intended to supplant the normal use of the on-line Help. On-line Help is interactive. Just click the Topic to open that Help page and disclose links to related Help Topics.

The Following is the On-line Help Table of Contents (without graphics):

Copyright and Disclaimer

System Requirements

Technical Support

Main Menu

File

Control Modes

Graphs

Trends

Options

Help

Other Menus

Quick Menus

Troubleshooting

Trends

How to Set Up a Trend

723 Plus Setup

Defaults and Ranges

Graph Setup

2D Settings

Glossary

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	Saves entered values (set points).
BKSP	Scrolls left through line of display.

SPACE
ENTER

Scrolls right through line of display.
Used when entering exact values and accessing Configure.

= (equals)
(decimal)

For entering exact values (within 10%).
To select Configure. Also used for entering decimal exact values.

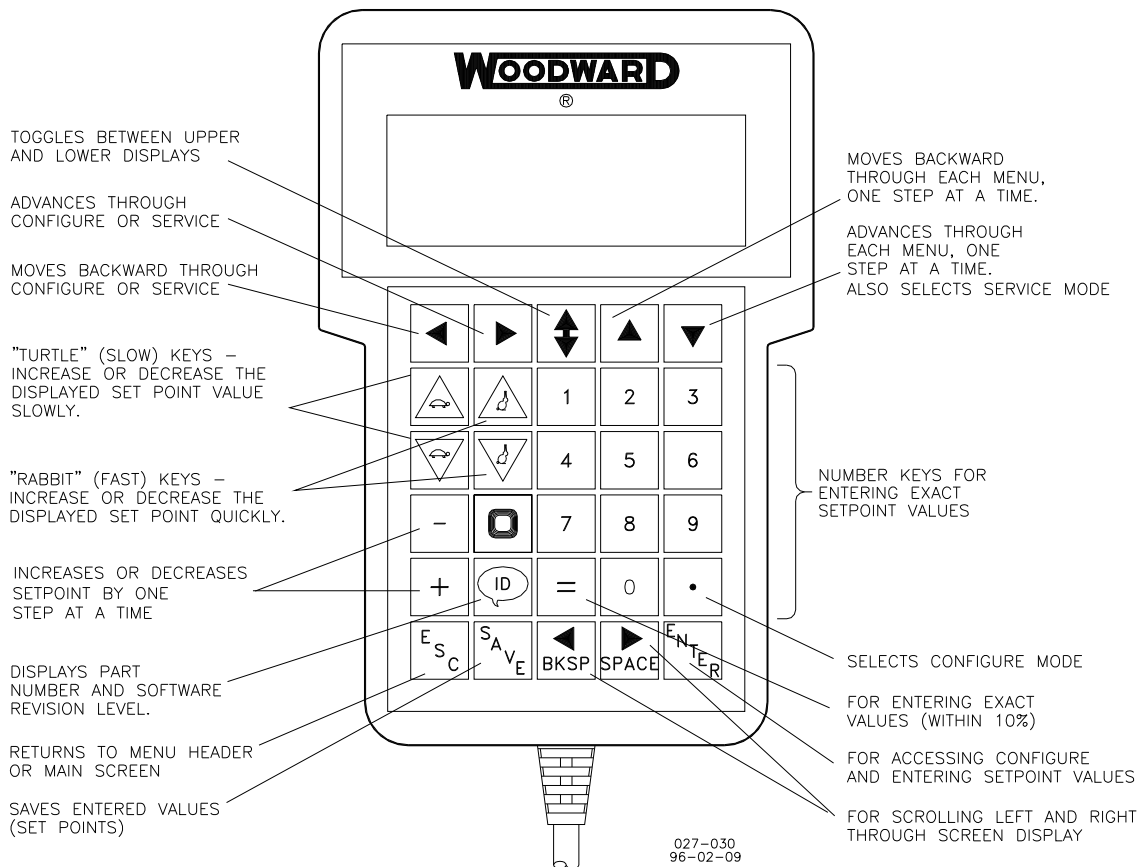


Figure 3-1. Hand Held Programmer Functions

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. 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 TORQUE LIMIT** should be set to TRUE to bring into view the TORQUE LIMIT CURVE menu and permit the use of the Torque Fuel Limit. The Torque Fuel Limit function provides five tunable limits of the fuel demand at five tunable engine speed breakpoints. Set to FALSE to disable the Torque Limit function and conceal the TORQUE LIMIT CURVE menu.

12. **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.
13. **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.
14. **ENABLE TORS LIMITER** should be set to TRUE to enable a tunable Torsional Fuel Limiter. Set FALSE to disable this Fuel Limiter.
15. **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 rated engine speed in rpm. Refer to the engine nameplate for the engine speed rating. This sets the rated speed reference selected when the idle/rated input switch is closed. This setting is used to scale several internal control functions.
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 which 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 (SEC)** is the time delay to wait before latching armed the MPU Failure Alarm & 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.
6. **AI ALARM ARM TIME (SEC)** is the time delay to wait before latching armed the Analog Input #1 & #2 Low Alarm & Shutdown functions once a valid run signal is detected. Speed less than run the running speed blocks these Low Alarm & Shutdown functions. Low Alarm & Shutdown conditions latched while running remain latched in the faulted condition until an Alarm Reset is issued.

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. **SPARE #1 IN FAIL** sets the condition which will occur when the SPARE #1 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.
5. **SPARE #2 IN FAIL** sets the condition which will occur when the SPARE #2 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. **REM INPUT FAIL** sets the condition which 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.
7. **EXT FUEL LIMIT FAIL** sets the condition which will occur when the External Fuel Limit 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.
8. **MODBUS PORT3 FAIL** sets the condition which 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.

9. **HIGH FUEL DEMND LEVEL** sets the condition which will occur when the fuel demand rises above the HIGH ACTUATOR LEVEL. 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 which 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 which 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. **SPARE #1 HIGH** sets the condition which will occur when the SPARE #1 input exceeds the SPARE 1 HI LEVEL set point for the SPARE 1 DELAY time. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
13. **SPARE #1 LOW** sets the condition which will occur when the SPARE #1 input drops below the SPARE 1 LOW LEVEL set point for the SPARE 1 DELAY time. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
14. **SPARE #2 HIGH** sets the condition which will occur when the SPARE #2 input exceeds the SPARE 2 HI LEVEL set point for the SPARE 2 DELAY time. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.
15. **SPARE #2 LOW** sets the condition which will occur when the SPARE #2 input drops below the SPARE 2 LOW LEVEL set point for the SPARE 2 DELAY time. This condition may be enabled as a Shutdown, Alarm, or both, by selecting TRUE in the appropriate menu.

CFIG Indication

1. **ON START FUEL LIMIT** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit status.
2. **ON MAX LIMIT** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit status.
3. **ON EXT FUEL LIMIT** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit status.
4. **ON TORSION LIMIT** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit status.

5. **ON TORQUE LIMIT** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit state.
6. **ACT SHUTDOWN** is set to TRUE to actuate Relay Output #3 when this fuel limit is in control and to display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of limit state.
7. **SPEED SWITCH 1** is set to TRUE to actuate Relay Output #3 when this speed switch is triggered and display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of speed switch state.
8. **SPEED SWITCH 2** is set to TRUE to actuate Relay Output #3 when this speed switch is triggered and display status on the DISPLAY INDICATOR menu. Set to FALSE to prevent Relay Output #3 actuation and display of speed switch state.

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) which 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. **SPARE 1 HI LEVEL**—Enter the SPARE 1 level (EU) required to trigger the SPARE #1 HIGH shutdown.
8. **SPARE 1 LOW LEVEL**—Enter the SPARE 1 level (EU) required to trigger the SPARE #1 LOW shutdown.
9. **SPARE 1 DELAY** is the delay time in seconds that the SPARE #1 level is above the SPARE 1 HI LEVEL or below the SPARE 1 LOW LEVEL set points before the SPARE #1 HIGH and SPARE #1 LOW shutdown conditions are activated.
10. **SPARE 2 HI LEVEL**—Enter the SPARE 2 level (EU) required to trigger the SPARE #2 HIGH shutdown.
11. **SPARE 2 LOW LEVEL**—Enter the SPARE 2 level (EU) required to trigger the SPARE #2 LOW shutdown.
12. **SPARE 2 DELAY** is the delay time in seconds that the SPARE #2 level is above the SPARE 2 HI LEVEL or below the SPARE 2 LOW LEVEL set points before the SPARE #2 HIGH and SPARE #2 LOW shutdown conditions are activated.
13. **ENERGIZE FOR SHTDWN** is set to TRUE to energize Relay Output #1 with any configured shutdown condition. Set to FALSE to de-energize Relay Output #1 with any configured shutdown condition.
14. **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 which is scaled using TORS SCALE on the TORSIONAL FILTER service menu. Scaling sets the value of torsional vibration (as a % rated engine rpm) which 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. **SPARE 1 HI LEVEL**—Enter the SPARE 1 level (EU) required to trigger the SPARE #1 HIGH alarm.
8. **SPARE 1 LOW LEVEL**—Enter the SPARE 1 level (EU) required to trigger the SPARE #1 LOW alarm.
9. **SPARE 1 DELAY** is the delay time in seconds that the SPARE #1 level is above the SPARE 1 HI LEVEL or below the SPARE 1 LOW LEVEL set points before the SPARE #1 HIGH and SPARE #1 LOW alarm conditions are activated.
10. **SPARE 2 HI LEVEL**—Enter the SPARE 2 level (EU) required to trigger the SPARE #2 HIGH alarm.
11. **SPARE 2 LOW LEVEL**—Enter the SPARE 2 level (EU) required to trigger the SPARE #2 LOW alarm.
12. **SPARE 2 DELAY** is the delay time in seconds that the SPARE #2 level is above the SPARE 2 HI LEVEL or below the SPARE 2 LOW LEVEL set points before the SPARE #2 HIGH and SPARE #2 LOW alarm conditions are activated.
13. **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.
14. **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.

Indication Setup

1. **SPD SWITCH 1 PICKUP**—Enter the engine speed level (rpm) required to trigger SPEED SWITCH 1 Indication (Modbus and Service Display).
2. **SPD SWITCH 1 DROPOUT**—Enter the engine speed level (rpm) required to clear SPEED SWITCH 1 Indication.

3. **SPD SWITCH 2 PICKUP**—Enter the engine speed level (rpm) required to trigger SPEED SWITCH 2 Indication (Modbus and Service Display).
4. **SPD SWITCH 2 DROPOUT**—Enter the engine speed level (rpm) required to clear SPEED SWITCH 2 Indication.
5. **ENRGIZE FOR INDICAT** is set to TRUE to energize Relay Output #3 with any configured indication condition. Set to FALSE to de-energize Relay Output #3 with any configured indication 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 COMMUNICATION

The 723PLUS has two serial ports. Port 2 is configured as a Servlink port. 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 1 to 15.
2. **PORT 3 ADDRESS** determines the port's multidrop Modbus address from 1 to 247.
3. **PORT3 MODE** determines if port J3 will use the Modbus ASCII or Modbus RTU mode:
1 = ASCII
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 which 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

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. 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 which 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
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. 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. Note that an internal jumper must be configured if this item is changed. Analog Output #3 is hard configured as the Speed Control Actuator output and does not offer an output configuration selection.
6. **ACT OUT 2 SELECT** determines which parameter controls Analog Output #4. The parameters which 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 4:0004
7. **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. Note that an internal jumper must be configured if this item is changed.

At this time, we recommend saving the settings by pressing the "SAVE" key on the Hand Held Programmer or save settings using Control View or Watch Window (refer to "help" if you need help). The Programmer will display the message "Saving Changes". Control View or Watch Window have 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, Servlink, 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-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.
6. **5-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.
7. **6-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.
8. **7-EXT FUEL LMT 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-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.
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. **12-SPARE #1 HIGH** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
14. **13-SPARE #1 LOW** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
15. **14-SPARE #2 HIGH** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
16. **15-SPARE #2 LOW** displays the present condition of the latched shutdown. This shutdown will only indicate if it has been activated in the CFG SHUTDOWN menu.
17. **ALARM RESET** is used to reset all latched alarms and shutdowns once the condition which 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, Servlink, 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 CFG 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 CFG 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 CFG ALARM menu.
5. **4-SPARE #1 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
6. **5-SPARE #2 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
7. **6-REMOTE INPUT FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
8. **7-EXT FUEL LMT FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
9. **8-MODBUS 3 FAIL** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG 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 CFG 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 CFG 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 CFG ALARM menu.
13. **12-SPARE #1 HIGH** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
14. **13-SPARE #1 LOW** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
15. **14-SPARE #2 HIGH** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
16. **15-SPARE #2 LOW** displays the present condition of the latched alarm. This alarm will only indicate if it has been activated in the CFG ALARM menu.
17. **ALARM RESET** is used to reset all latched alarms and shutdowns once the condition which 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 3-2, 3-3, and 3-4.

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** adjusts the cutoff frequency of a low pass filter used on the speed sensing input (see Figure 3-5). To use this feature set SPEED SETTING MENU - ENABLE SPEED FILTER to TRUE. The filter is used to attenuate engine firing frequencies. To calculate the desired filter cutoff point, use the following formulas:

$$\text{camshaft frequency} = (\text{engine rpm})/60 \text{ [for 2-cycle engines]}$$

$$= (\text{engine rpm})/120 \text{ [for 4-cycle engines]}$$

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

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.
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

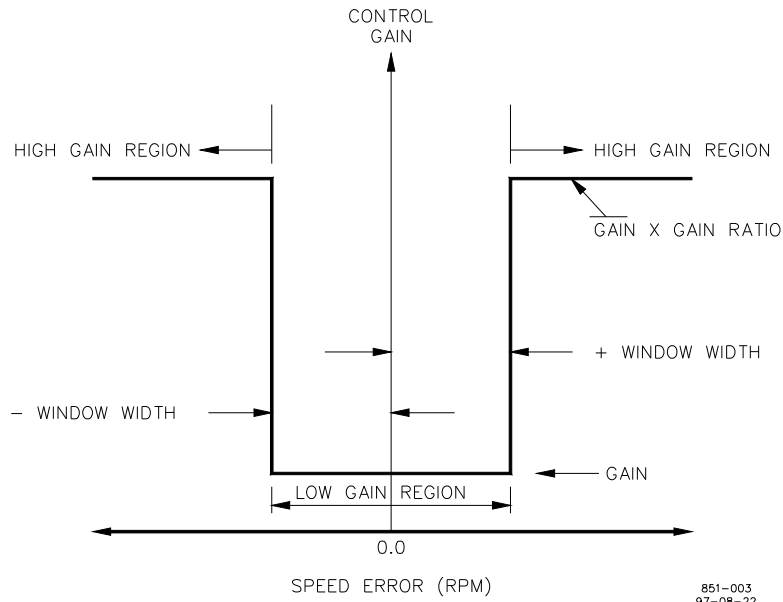


Figure 3-2. Control Gain as a Function of Speed Error

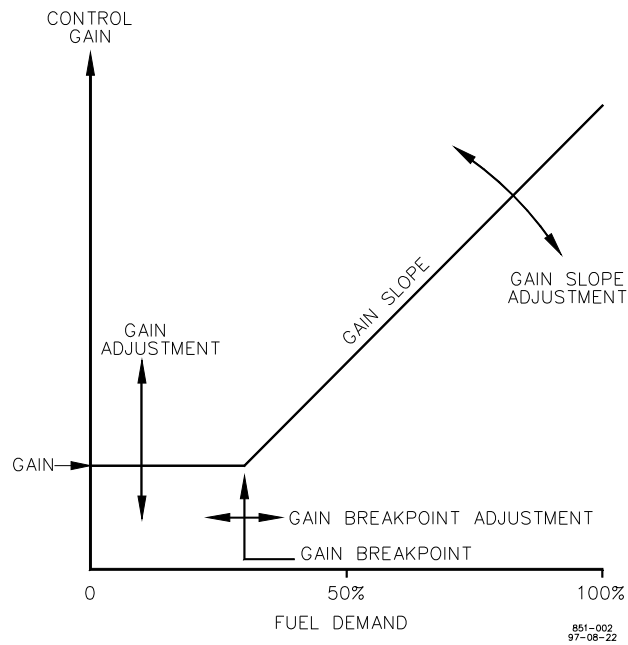
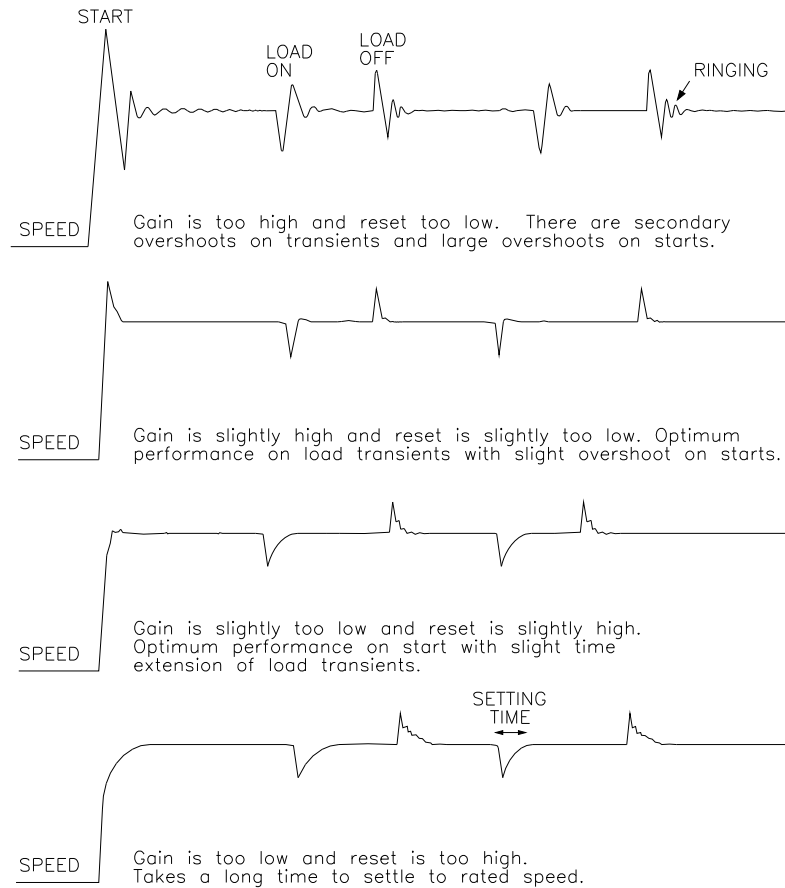
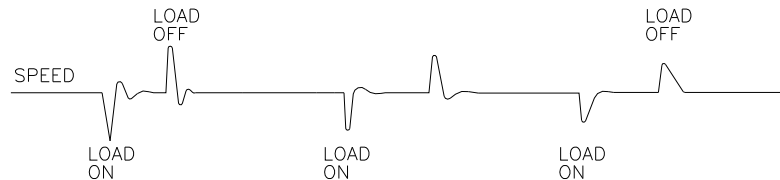


Figure 3-3. Control Gain as a Function of Control Output

RESULTS — GAIN AND RESET ADJUSTMENTS



IDEAL LOAD STEP RESPONSE



RESULTS — COMPENSATION ADJUSTMENT

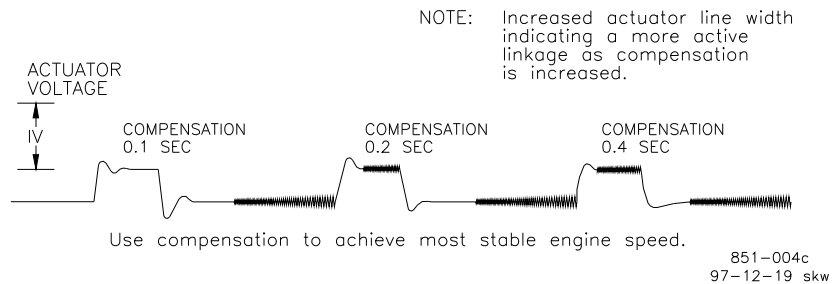


Figure 3-4. Typical Transient Response Curves

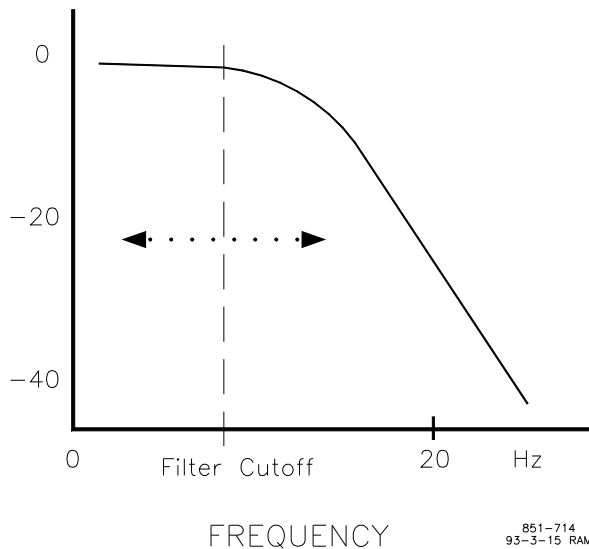


Figure 3-5. Speed Filter

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 set point. 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 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 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 15.915 Hz. The filter is used to attenuate engine firing frequencies. To calculate the desired filter cutoff point, use the following formulas:

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

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.

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.



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

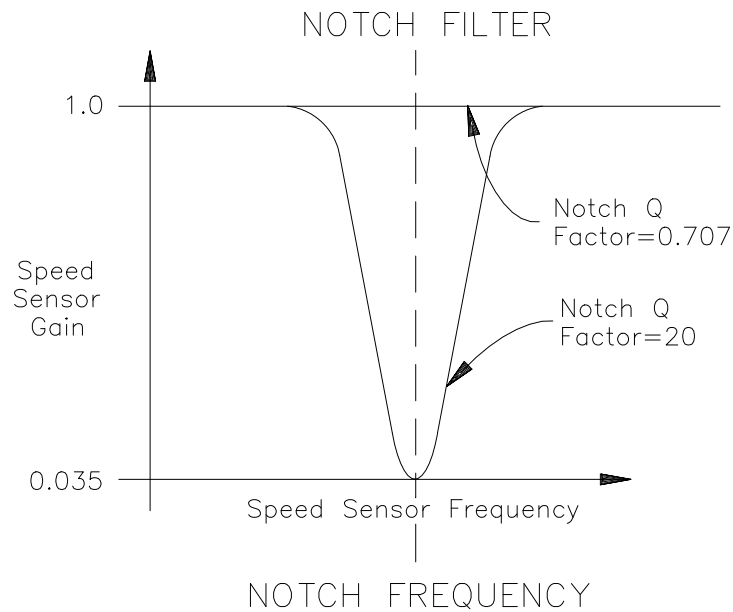
The notch filter is a bandstop filter. It rejects specific frequencies and allows all others to pass. The idea is to reject the torsional (frequency on a frequency) frequencies that the coupling produces, so that the actuator will not respond to speed sensor changes it cannot control with the fuel. Systems 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.

1. **ENABLE TORS FILTER** enables the Flexible Coupling filtering function or allows the notch filter to be enabled when set to TRUE. When set to FALSE these functions are 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).



028-056
98-07-01 skw

Figure 3-6. Notch Filter

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 = $\frac{6}{1200 \times .01} \times 100 = 50\%$. 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). Set at 100% to disable the 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. Set at 0.0 to disable the ramp function.
3. **MAX FUEL LIMIT** sets the maximum percent fuel demand. Maximum (100%) is based on 200 mA. This is an electronic rack stop which is active in all modes of operation.

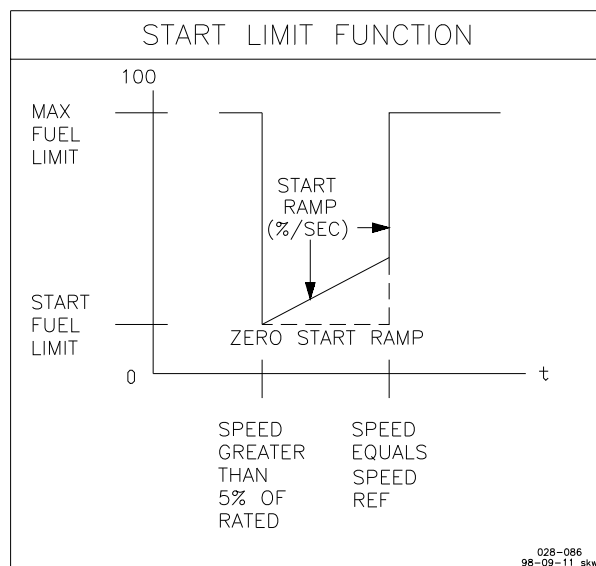


Figure 3-7. Start Limit Function

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 and exceeds Start Speed for 0.5 seconds. 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 command 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.

Torque Limit Curve

Torque Limiter limits the fuel demand based on a two-dimensional curve and an engine speed input. This fuel limit prevents overfueling which limits torque for up to five speed breakpoints. The input breakpoints units are in rpm. The fuel limits are in percent fuel demand. Fuel demand is generally set slightly above the fuel required to carry the allowable load for each specific breakpoint rpm. Too low of a setting can degrade transient load performance.

A five-point curve is constructed for rpm 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.

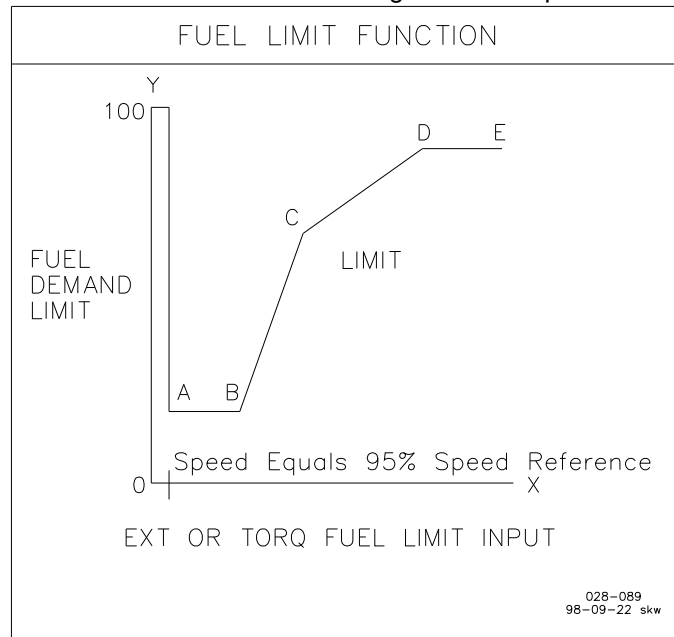


Figure 3-8. Torque Limit Curve

1. **ENABLE TORQUE LIMIT** enables and disables the fuel limiter, which uses the engine speed input to limit the actuator output. If the fuel limiter is disabled, the fuel limiter breakpoint settings will not be used.
2. **TORQUE LMT BRKPT X** is the engine speed (rpm) that designates that particular breakpoint (x-axis input in Figure 3-8).
3. **FUEL LIMIT @ BRKPT X** is the percent fuel demand allowed when the engine speed is at that respective Breakpoint (y-axis output in Figure 3-8).

Droop

Droop adjustments are the settings that affect load parameters. Droop is included to provide a method for paralleling generator sets.

1. **LOAD DROOP PERCENT** is the percentage of speed droop when the engine load is at maximum load. Set at zero to disable the droop function.
2. **FUEL DEMAND @ MIN LD** should be set to the percent fuel demand that the engine is operating at rated-speed/no-load. This establishes the 0% internal load measurement for droop.

3. **FUEL DEMAND @ MAX LD** should be set to the percent fuel demand when the engine is operating at rated-speed/full-load. This establishes the 100% internal load measurement for droop.

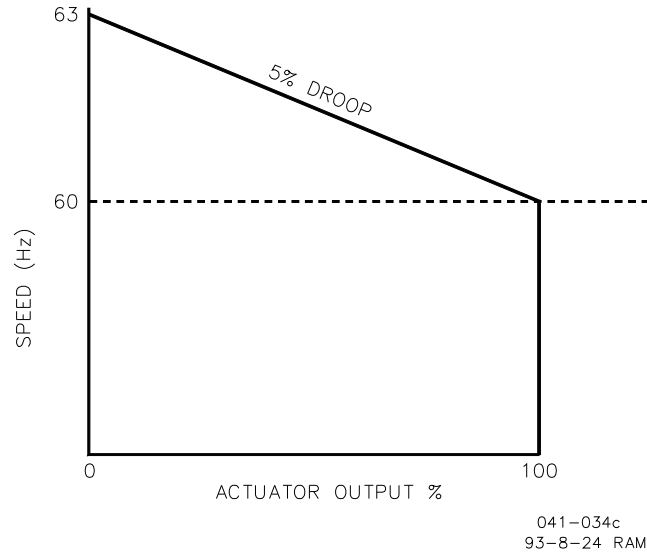


Figure 3-9. Droop Curve

Ext Fuel Lmt Curve

The External Fuel Limiter Curve limits the fuel demand based on a two-dimensional curve and an external 4–20 mA device connected to Analog Input #4. This function is predominantly used to limit fuel demand during a sudden load increase to prevent overfueling due to turbocharger lag as sensed by a Manifold Air Pressure input (although other inputs may be used). 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.

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. **SPARE #1 @ 4 mA (EU)**—Enter the preferred SPARE 1 engineering units (EU) at 4 mA from the SPARE #1 input device. If a voltage sensing device is provided, enter the input EU at 1 Vdc.
2. **SPARE #1 @ 20 mA (EU)**—Enter the preferred SPARE 1 EU at 20 mA from the SPARE #1 input device. If a voltage sensing device is provided, enter the input EU at 5 Vdc.
3. **SPARE #2 @ 4 mA (EU)**—Enter the preferred SPARE 2 EU at 4 mA from the SPARE #2 input device. If a voltage sensing device is provided, enter the input EU at 1 Vdc.
4. **SPARE #2 @ 20 mA (EU)**—Enter the preferred SPARE 2 EU at 20 mA from the SPARE #2 input device. If a voltage sensing device is provided, enter the input EU at 5 Vdc.
5. **REMOTE SPD @ 4 mA (rpm)**—Enter the preferred engine speed reference set point 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.
6. **REMOTE SPD @ 20 mA (rpm)**—Enter the preferred engine speed reference set point 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.
7. **EXT FUEL LMT @ 4 mA (EU)**—Enter the preferred External Fuel Limit set point in EU at 4 mA from the External Fuel Limit input device. If a voltage sensing device is provided, enter the input EU at 1 Vdc.
8. **EXT FUEL LMT @ 20 mA (EU)**—Enter the preferred External Fuel Limit set point in EU at 20 mA from the External Fuel Limit input device. If a voltage sensing device is provided, enter the input EU 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 which 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 which 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 which 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 which will output 20 mA (or 1 mA if so configured) at Analog Output #2.

IMPORTANT

ANALOG OUTPUT 3 MIN is set for 0 mA output with the fuel demand at 0 percent, and ANALOG OUTPUT 3 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. **ACTUATOR OUT 2 MIN** is adjusted to the engineering units which will output 4 mA (or 0 mA if so configured) at Analog Output #4.
6. **ACTUATOR OUT 2 MAX** is adjusted to the engineering units which will output 20 mA (or 200 mA if so configured) at Analog Output #4.
7. **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. Set the cutoff frequency at or above 15.9 Hz to disable this filter.

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. **SPARE #1 OFFSET** adjusts the min displayed AI1 SPARE #1 mA.
2. **SPARE #1 IN SPAN** adjusts the max displayed AI1 SPARE #1 mA.
3. **SPARE #1 READ VOLTS** when TRUE changes the displayed AI1 SPARE #1 mA to read Volts instead of mA.
4. **SPARE #2 OFFSET** adjusts the min displayed AI2 SPARE #2 mA.
5. **SPARE #2 IN SPAN** adjusts the max displayed AI2 SPARE #2 mA.
6. **SPARE #2 READ VOLTS** when TRUE changes the displayed AI1 SPARE #2 to read Volts instead of mA.
7. **REM IN OFFSET** adjusts the min displayed AI3 Remote Reference Input mA.
8. **REM IN SPAN** adjusts the max displayed AI3 Remote Reference Input mA.
9. **REM IN READ VOLTS** when TRUE changes the displayed AI3 Remote Reference Input to read Volts instead of mA.
10. **EXT LMT OFFSET** adjusts the min displayed AI4 External Limiter Input mA.
11. **EXT LIMIT SPAN** adjusts the max displayed AI4 External Limiter Input mA.

12. **EXT LMT READ VOLTS** when TRUE changes the displayed AI4 External Limiter Input mA to read Volts instead.
13. **AO 1 OFFSET** adjusts the Analog Output #1 mA minimum.
14. **AO 1 SPAN** adjusts the Analog Output #1 mA maximum.
15. **AO 2 OFFSET** adjusts the Analog Output #2 mA minimum.
16. **AO 2 SPAN** adjusts the Analog Output #2 mA maximum.
17. **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.
18. **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.
19. **ACT 2 OFFSET** adjusts the Analog Output #4 mA minimum.
20. **ACT 2 SPAN** adjusts the Analog Output #4 mA maximum.

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 addressMessages displayed by Service.
 - 9 Checksum error
 - 10 Message garbledThe 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 these menus 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 these menus 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 which 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 which displays the state of LINKnet Discrete Outputs of Module 1. 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” 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 produce 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.

DISPLAY DIGITAL I/O

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

1. **A-SPARE** shows the state of the SPARE contact (TRUE = CLOSED).
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-SHUTDOWN** shows the state of the Shutdown 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-STAT INDICATOR** shows the state of the Status Indication 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. **SPD SENS IN #1** shows the frequency, in hertz, of the Speed Sensor #1 input signal. This value is sent to Modbus.
2. **SPD SENS IN #2** shows the frequency, in hertz, of the Speed Sensor #2 input signal. This value is sent to Modbus.
3. **AI1-SPARE IN #1** shows the value, in mA, of the SPARE Input #1 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.
4. **AI2-SPARE IN #2** shows the value, in mA, of the SPARE Input #2 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.
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-EXT FUEL LIMIT** shows the value, in mA, of the External Fuel Limit 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 Process Input #1 signal. (TRUE = FAILED). This value is sent to Modbus.
8. **AI2-FAILED** shows the state of the Process Input #2 signal. (TRUE = FAILED). This value is sent to Modbus.
9. **AI3-FAILED** shows the state of the Remote Speed Reference Input #3 Signal. (TRUE = FAILED). This value is sent to Modbus.
10. **AI4-FAILED** shows the state of the External Fuel Limit Input #3 Signal. (TRUE = FAILED). This value is sent to Modbus.
11. **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.
12. **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.
13. **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.
14. **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.
15. **ALARM RESET** provides a means of resetting alarm conditions. Toggle TRUE then FALSE to issue a reset.

DISPLAY INDICATION

This menu is for display only. It displays the configured Status Indications alarms in the 723PLUS control. Any Status Indication alarms which are TRUE will cause Relay Output #3 (Status Indication) to activate. The status condition must be cleared for the Status Indication alarm to show FALSE.

1. **ON START FUEL LIMIT** will show TRUE when the fuel demand is being limited by the Start Fuel Limit.
2. **ON MAX LIMIT** will show TRUE when the fuel demand is being limited by the Max Fuel Limit.
3. **ON EXT FUEL LIMIT** will show TRUE when the fuel demand is being limited by the External Fuel Limit.
4. **ON TORSION LIMIT** will show TRUE when the fuel demand is being limited by the Torsional Fuel Limit.
5. **ON TORQUE LIMIT** will show TRUE when the fuel demand is being limited by the Torque Fuel Limit.
6. **ACT SHUTDOWN** will show TRUE when an Actuator Shutdown has been applied.
7. **SPEED SWITCH 1** will show TRUE when the Speed Switch 1 has been triggered. Display will show FALSE when the Speed Switch 1 is reset.
8. **SPEED SWITCH 2** will show TRUE when the Speed Switch 2 has been triggered. Display will show FALSE when the Speed Switch 2 is 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 being controlled by the Speed Control.
2. **ON START FUEL LIMIT (LSS)** will show TRUE when the fuel demand is being limited by the START FUEL LIMIT.
3. **ON MAXIMUM LIMIT (LSS)** will show TRUE when the fuel demand is being limited by the MAX FUEL LIMIT.
4. **ON EXTERNAL LIMIT (LSS)** will show TRUE when the fuel demand is being limited by the EXT FUEL LMT CURVE.
5. **ON TORSIONAL LIMIT (LSS)** will show TRUE when the fuel demand is being limited by the TORSNL FUEL LIMIT.
6. **ON TORQUE LIMIT** will show TRUE when the fuel demand is being limited by the TORQUE LIMIT CURVE.
7. **ACTUATOR SHUTDOWN** will show TRUE when an Actuator Shutdown has been applied.

8. **REMOTE SPEED ENBLD** will show TRUE when the REMOTE SPEED REFERENCE is enabled (AI3 input device or Modbus AW).
9. **ON 2ND DYNAMICS** will show TRUE when the 2ND DYNAMICS are enabled.
10. **SPD SENSOR 1 ACTIVE** will show TRUE when speed sensor input #1 is actively used by the control.
11. **SPD SENSOR 2 ACTIVE** will show TRUE when speed sensor input #2 is actively used by the control.
12. **PORT 1 ON HANDHELD** will show TRUE when Port 1 is setup to communicate with a handheld programmer.
13. **PORT 1 ON SERVLINK** will show TRUE when Port 1 is setup to communicate by Servlink with a PC.
14. **RESET ALL ALARMS** provides a means of resetting all alarm conditions. Toggle TRUE then FALSE to issue a reset.

DISPLAY MENU

This menu is for display only. It shows several control parameters which 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 SPEED REF** displays the total output of the speed reference ramp plus the droop bias (if any) which is the set point 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 fuel limiters, etc.
3. **FUEL DEMAND** displays the percent fuel demand. This is NOT the same as the actuator output if configured for reverse acting. This is the same if direct acting.
4. **SPEED REF** displays the output of the speed reference ramp in rpm.
5. **DROOP BIAS** displays the value in rpm that the droop percentage calculation is biasing the speed reference.
6. **REMOTE SPEED REF** displays the present remote speed reference signal in rpm.
7. **EXT FUEL LIMIT IN** displays the present external fuel limit input in engineering units.
8. **EXT FUEL LIMIT** displays the present percent fuel demand limit of the external fuel limiter.
9. **SPARE AI1** displays the present SPARE #1 input in engineering units.
10. **SPARE AI2** displays the present SPARE #2 input in engineering units.

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 Output 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.

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 Control View or Watch Window (refer to "help" if you need help). The Programmer will display the message "Saving Changes". Control View or 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 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.



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.
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.

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 which 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.

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 Control View or 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 Control View or 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). Control View or 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 Industrial Speed Control. Figure 5-1 shows the control block diagram for reference in the following descriptions.

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

The speed sensor inputs (8280-410 and 8280-411 controls) contain a special tracking filter designed for reciprocating engines, which minimizes the effects of firing torsionals so that the actuator will not respond to speed sensor changes it cannot control with the fuel. 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 torsional frequencies. 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. Servlink 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 optional LINKnet modules. LINKnet modules can be added to provide additional I/O for monitoring and control. These modules are self-binding to the 723PLUS control. The LINKnet Nodes include J-Type Thermocouple, RTD, Analog Input, Analog Output, Discrete Input, and Discrete Output modules.

Control Dynamics

The control algorithms used in the 723PLUS Industrial Speed 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 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 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 whose dynamics change in a non-linear manner with load (such as butterfly fuel valves).

Gain slope and gain breakpoint vary the gain linearly as a function of fuel demand (load). This provides the flexibility to increase or decrease gain as load increases. Gain slope and gain breakpoint are available for both constant and variable dynamics choices. It is disabled when 5-Gain mapped dynamics is chosen. Gain slope and gain breakpoint are useful for fuel systems that tend to be less stable at reduced or increased load operation. This function may be disabled by setting the gain slope at zero.

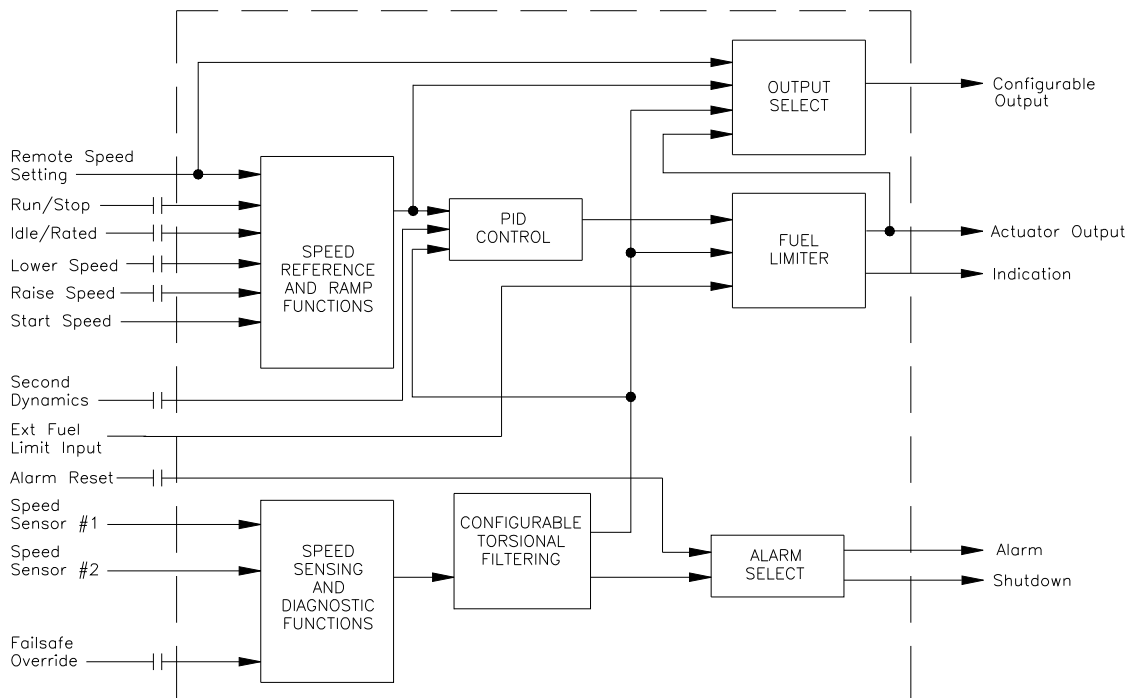
The control can automatically switch between two gain settings, based on engine speed error, to provide improved transient load performance. Speed error is the difference between the speed reference and compensated engine speed. During steady-state constant-load operation, the control uses the base gain setting. This base gain is adjusted by the user to a value which prevents the control from responding to minor speed fluctuations inherent with spark-ignited gas 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.

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

The control also provides a second complete set of dynamic adjustments which 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 systems which demand separate dynamic adjustments.

Speed Input

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



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Figure 5-1. Simplified Block Diagram

Torsional Filter Function

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

When the “Use Torsional Filter” is configured TRUE, the torsional filter function is enabled, which allow the control to effectively filter out the rapid speed changes which are caused by a system with a flexible coupling as shown in Figure 1-1. 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 which 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 Alarms and Shutdowns can be configured to activate if the torsional value gets too high.

Notch Filter Function

When “Use Notch Filter” is configured FALSE, the notch filter function is disabled. When “Use Notch Filter” is configured TRUE, a notch filter is enabled for single speed sensor applications that will benefit from torsional filtering. “Use Torsional Filter” and “Enable Tors Filter” must also be set TRUE to use the notch filter. 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 Ovrdr 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 which 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.

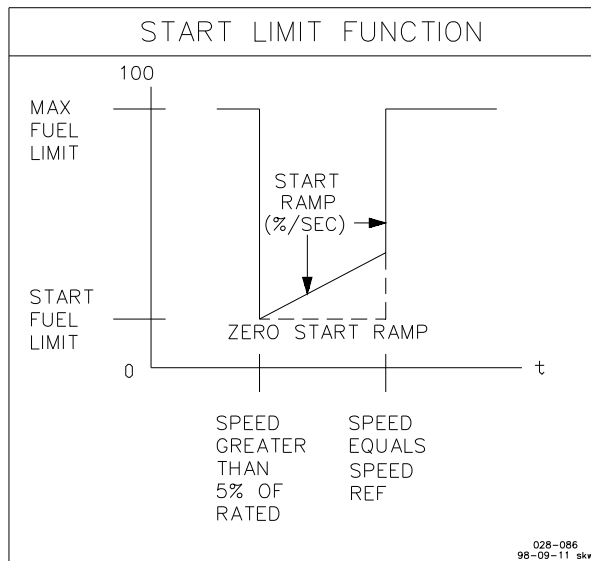


Figure 5-2. Start Limit Function

Fuel Limiting Function

Two separate Fuel Limiting Functions (EXT FUEL LIMIT curve and TORQUE LIMIT curve) provide limits to the fuel demand which prevents overfuel conditions. One function is based on an external transmitter signal provided at Signal Input #4. The other is based on the engine speed provided at the speed inputs. These Fuel Limiting Functions provide two software adjustable five-breakpoint curves based on each signal. The display value of the input signal can be scaled according to the engineering units desired. The output used 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 functions are enabled when the engine speed first reaches 95 percent of the speed reference. They remain enabled until the engine is shut down. These functions are also disabled if the input signal is failed. These functions can also be enabled or disabled by software at the EXT FUEL Limit Curve menu and the Torque Limit Curve menu.

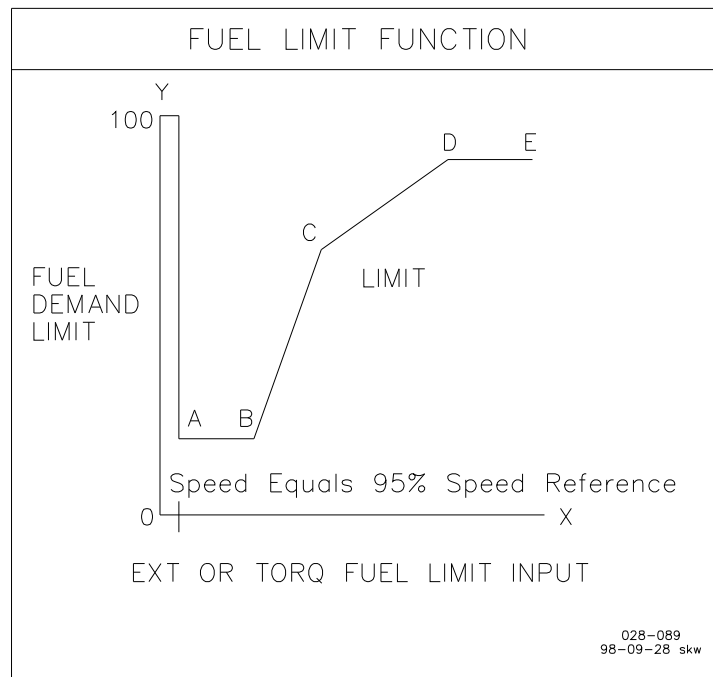


Figure 5-3. Fuel Limit Breakpoints

Actuator Function

The Actuator Function changes the fuel demand into a signal which can be used by Analog Output #3. 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 which 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).

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 Ovrd 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 which resets any parameters which 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, Control View, or with 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 and the rated contact is closed.
- Remote Speed Reference setting is enabled when the Raise Speed and Lower Speed contacts are both closed, the Rated contact is closed and Modbus Reference is configured FALSE.
- Modbus Speed Reference setting is enabled when the Raise Speed and Lower Speed contacts are both closed, the Rated contact is closed and Modbus Reference is configured TRUE.

Speed Reference and Ramp Functions

This section describes the operation of the speed reference and ramp functions and their relation to each other. The idle/rated reference has priority over the raise/lower and remote references. Start reference has the highest priority. 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 by 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 which need this function (e.g., spark gas recip engines). This Start reference is selected, at a very fast rate, by control power-up, engine not running, or engine cranking. When configured TRUE, the Start reference is given first priority over all other references.

Note that the Start Speed reference, when configured, has first priority and is the speed reference until the engine starts. The ramp to the selected reference begins after the engine speed exceeds the start speed setting. Note also that, after starting, engine speed will ramp to the reference selected by the Idle/Rated contact input. 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 adjustment of the idle speed set point. The idle speed set point is selected when the Rated contact is open, and the engine speed exceeds the start speed setting.

Closing the Rated contact ramps the speed set point from idle to rated.

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.

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.

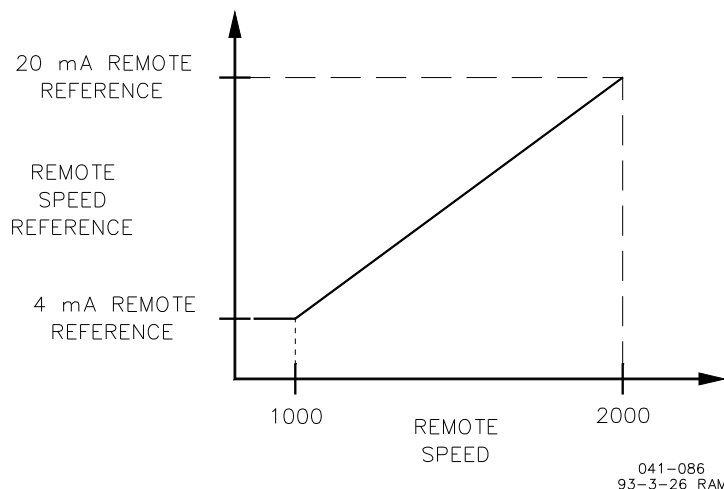


Figure 5-4. Remote Speed Reference

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.

Droop

Droop is a tunable value which decreases the speed reference when load increases as determined by the actuator output. Droop is set as a percentage of rated speed. A setting of 0% disables the Droop function.

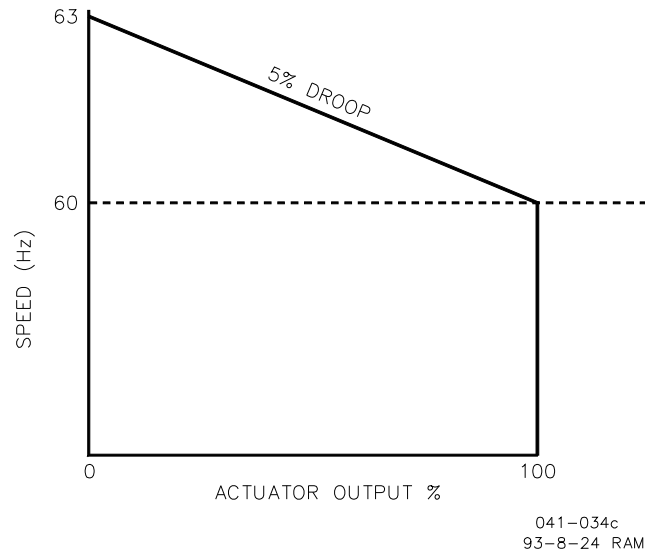


Figure 5-5. Droop Speed Setting

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

General

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, Control View, 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 or Control View). 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 Control View by clicking "help" then "about". Verify the controller ID on the Hand Held Programmer by pressing the "ID" key. Verify the controller ID in Watch Window by reading "Control Properties". The Application ID message "5414-147" 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 Control View 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.

Spare Input #1 Xdcr Input

The following tests calibrate and verify the function of the Spare 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, Control View, or Watch Window. Select SPARE INPUT #1.
3. The SPARE INPUT #1 value should be equal to the SPARE #1 @20mA value set previously in the SET ANALOG INPUTS menu.
4. Set the source for 1.0 Vdc (4.0 mA). The SPARE INPUT #1 value should be equal to the SPARE #1 @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, Control View, or Watch Window are incorrect, the 723PLUS control is defective and should be replaced.

Spare Input #2 Xdcr Input

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

1. Connect a 4 to 20 mA or 1 to 5 Vdc source to terminals 45(+) and 46(-). If a mA source is used, a jumper must be installed across terminals 44 and 45. Connect a dc voltmeter across terminals 45(+) and 46(-). 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, Control View, or Watch Window. Select SPARE INPUT #2.
3. The SPARE INPUT #2 value should be equal to the SPARE #2@20mA value set previously in the SET ANALOG INPUTS menu.
4. Set the source for 1.0 Vdc (4.0 mA). The SPARE INPUT #2 value should be equal to the SPARE #2@4mA value set previously in the SET ANALOG INPUTS menu. If the meter indicates proper voltages (or currents) are present on Signal Input #2, but readings on the Hand Held Programmer, Control View, 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, Control View, or Watch Window. Select REMOTE SPEED REF.
3. The REMOTE SPEED REF value should be equal to the REM SPEED @20mA value 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, Control View, or Watch Window are incorrect, the 723PLUS control is defective and should be replaced.

External Limiter Xdcr Input

The following tests calibrate and verify the function of the External Fuel Limiter 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, Control View, or Watch Window. Select EXT FUEL LIMIT IN.
3. The EXT FUEL LIMIT IN value should be equal to the EXT FUEL LMT @ 20mA value set previously in the SET ANALOG INPUTS menu.

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

Actuator Output

The following tests verify the actuator output 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 a milliamp meter across terminals 19(+) and 20(–) if no actuator is connected. Connect the milliamp meter in series with the actuator if one is connected to the control. (Alternately, a dc voltmeter may be connected across the output when an actuator is connected. The correct output currents must be computed using the voltage measured and the input resistance of the actuator.)
3. Select the CFG Option Menu on the Hand Held Programmer, Control View, or Watch Window. Set the Use Rev Actuator to Forward Acting (FALSE).
4. Select the Fuel Limiters Menu. Set Start Fuel Limit to 100%. Set Max Fuel Limit to 20%. The output current should be 42 ± 2 mA.
5. Set the Max Fuel Limit to 100%. The output current should be 210 ± 10 mA. If with all connections 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, Control View, or Watch Window. Set the Use Rev Actuator to the value 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 both to 60 (this causes the rpm values and Hertz values to be the same, to make doing the tests 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 Control View or 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). Control View or Watch Window may remain connected or removed from the control as desired. Close the cover over J1 and re-tighten the retaining screw if 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 Communication 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).

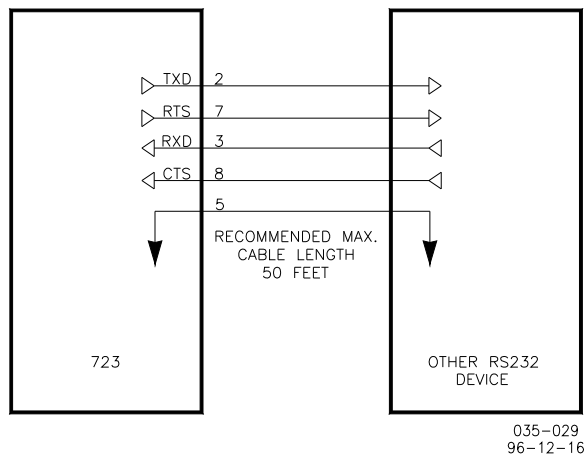


Figure A-1. 723PLUS RS-232 Connections

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).

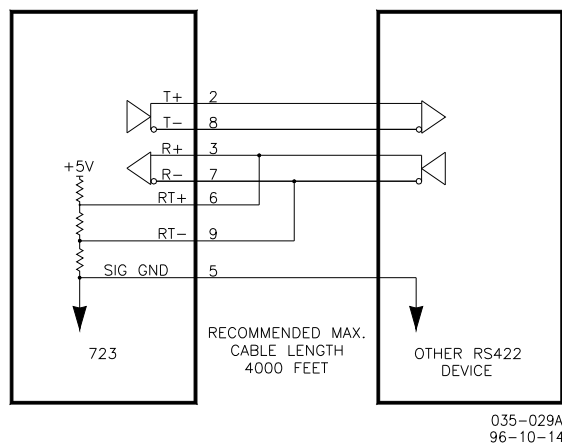


Figure A-2. 723PLUS RS-422 Connections with Optional Termination at Receiver

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).

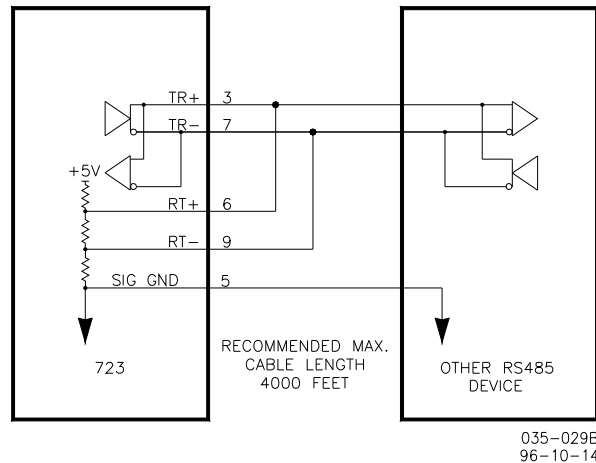


Figure A-3. 723PLUS RS-485 Connections with Optional Termination

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.

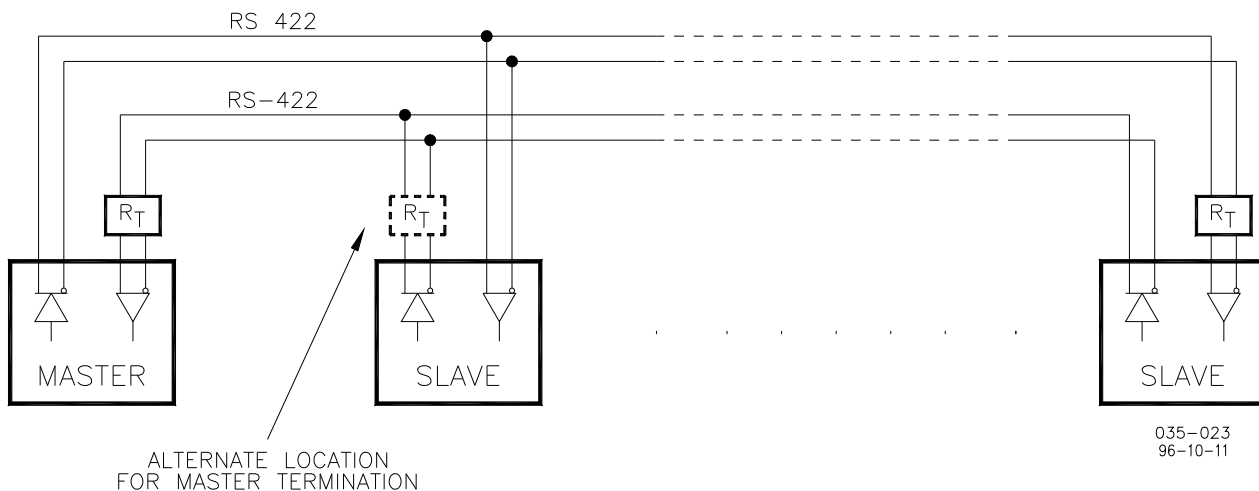


Figure A-4. RS-422 Terminator Locations

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.

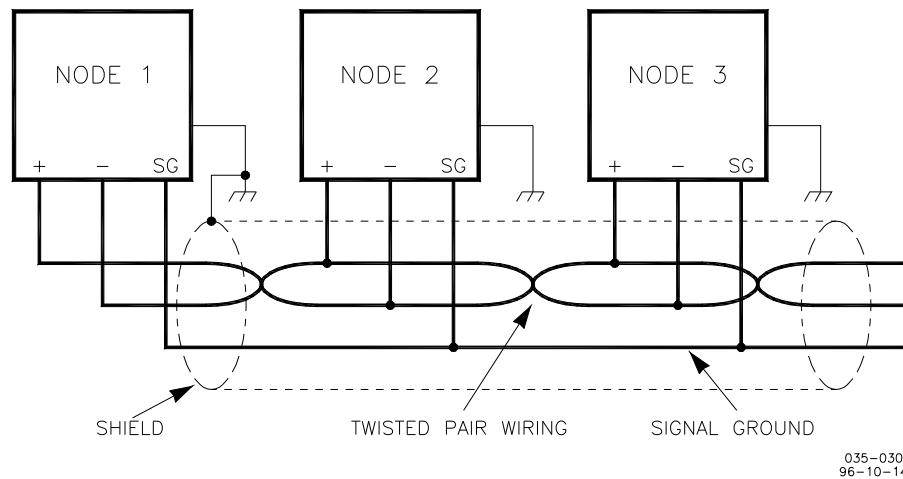


Figure A-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

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

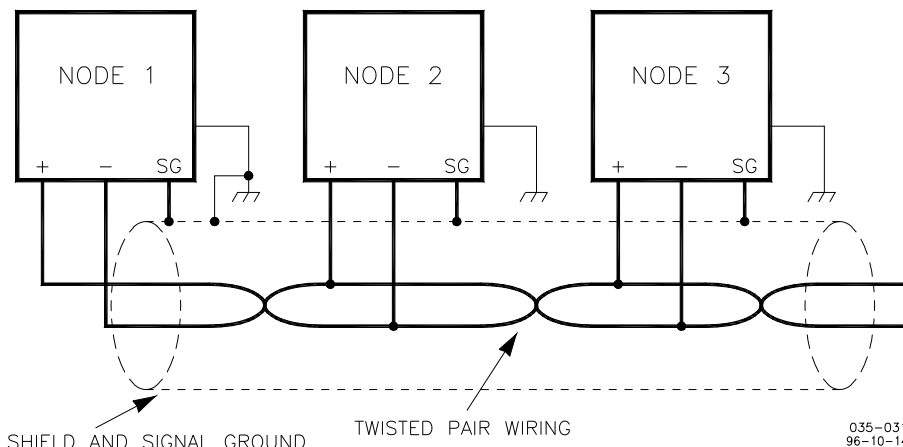


Figure A-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

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 which 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 1–9 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

LINKNET™ RELAY OUTPUT MODULE
EFFECTS OF INPUT CURRENT

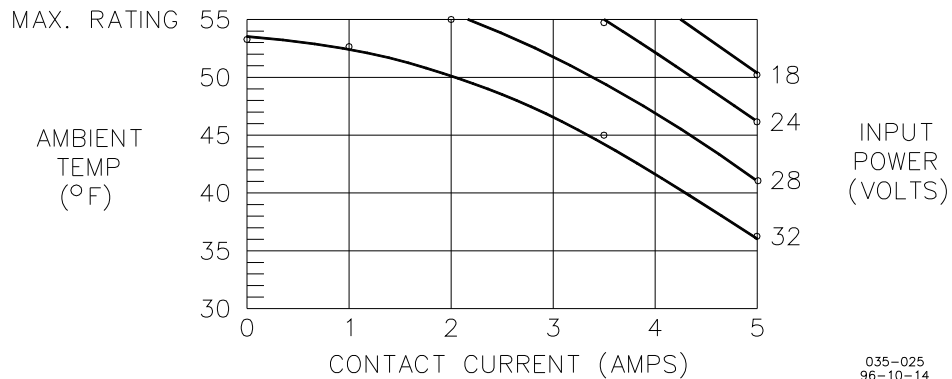


Figure B-1. LINKnet Relay Contacts

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.

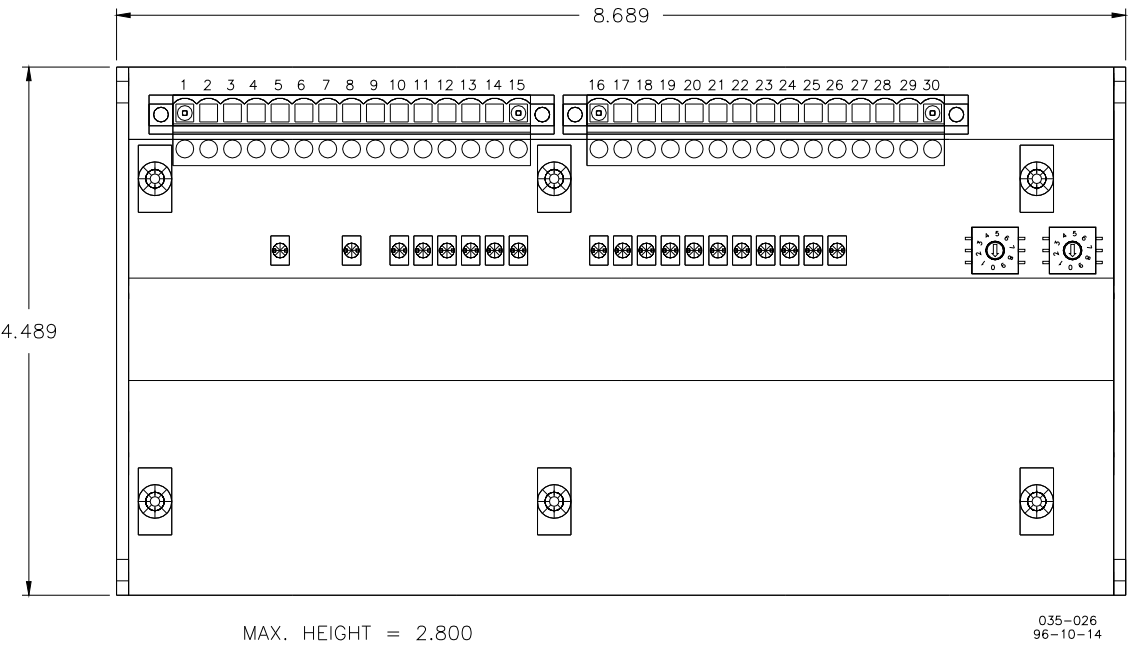


Figure B-2. Outline Drawing of I/O Module

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.

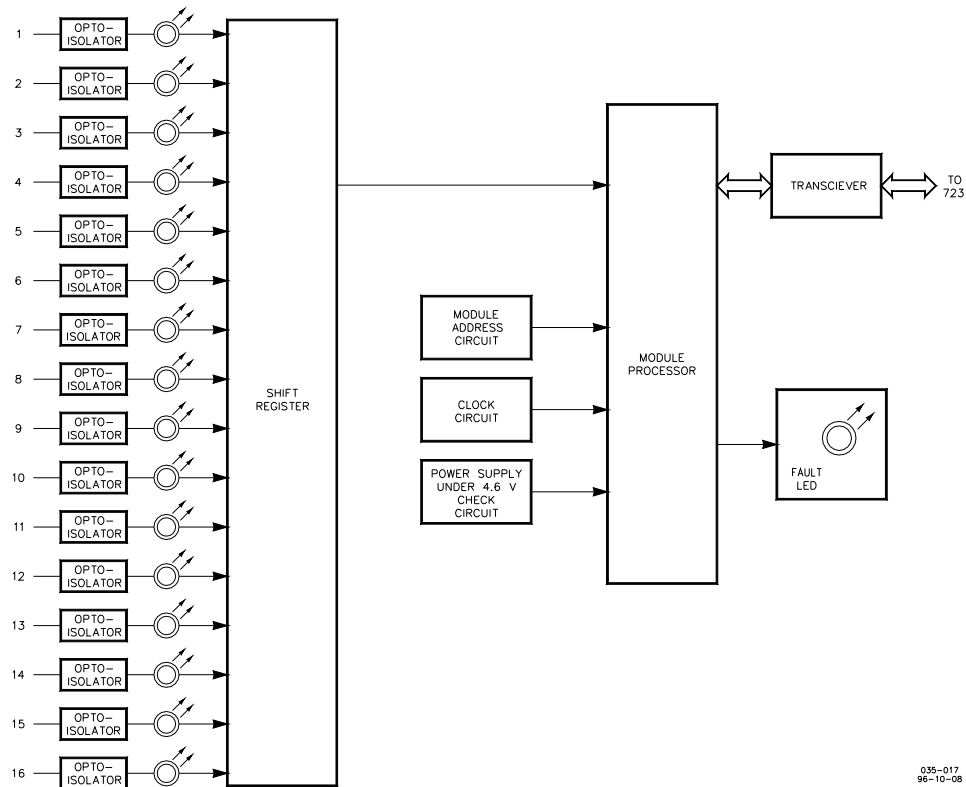


Figure B-3. Discrete Input Module Block Diagram

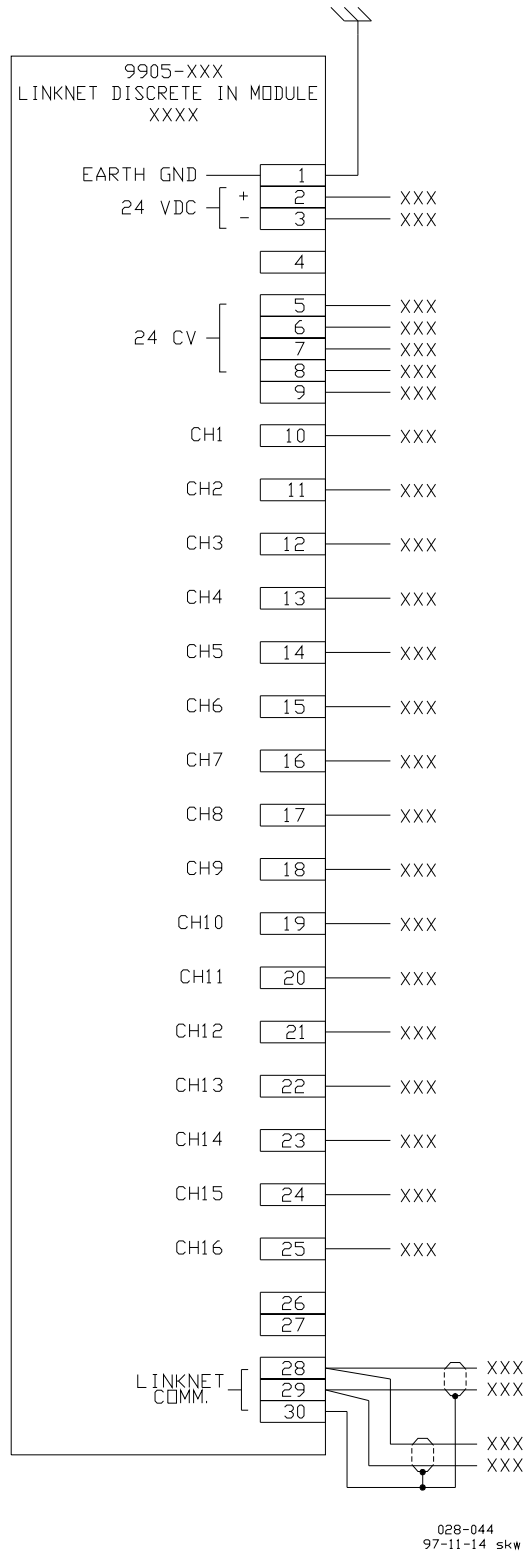


Figure B-4. Discrete Input Module Wiring Diagram

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.

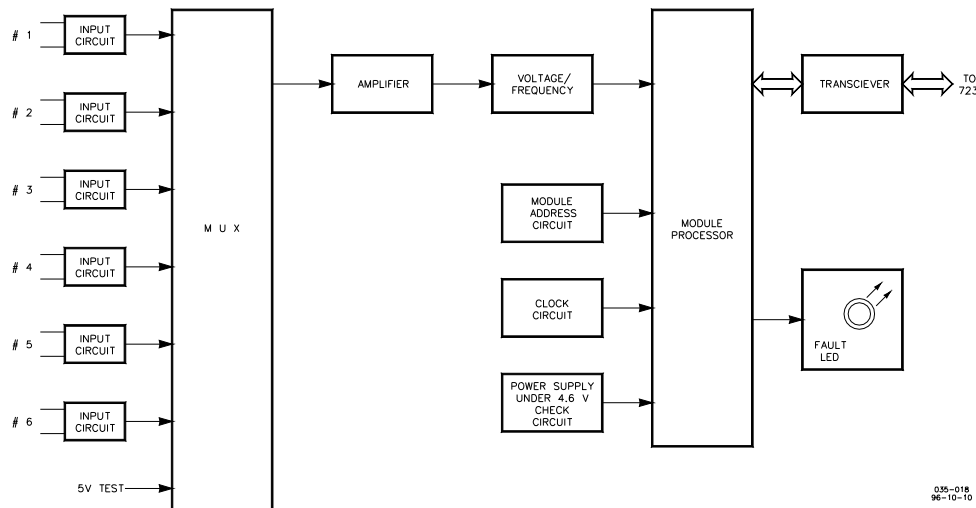


Figure B-5. 4–20 mA Input Module Block Diagram

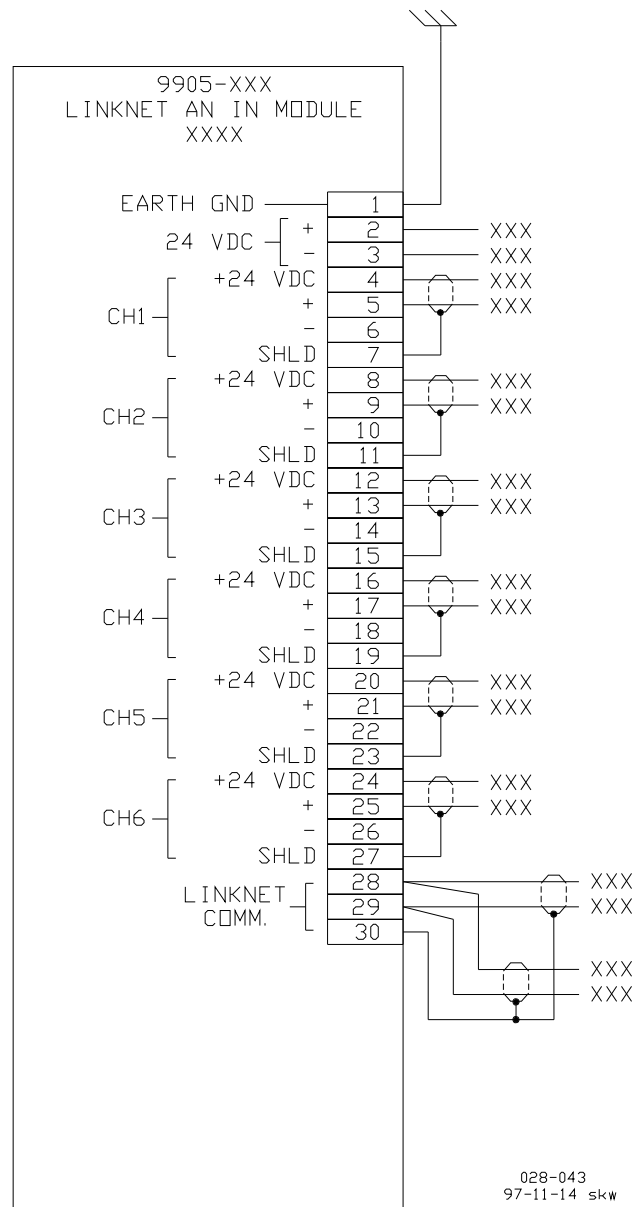


Figure B-6. 4–20 mA Input Module Wiring Diagram

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.

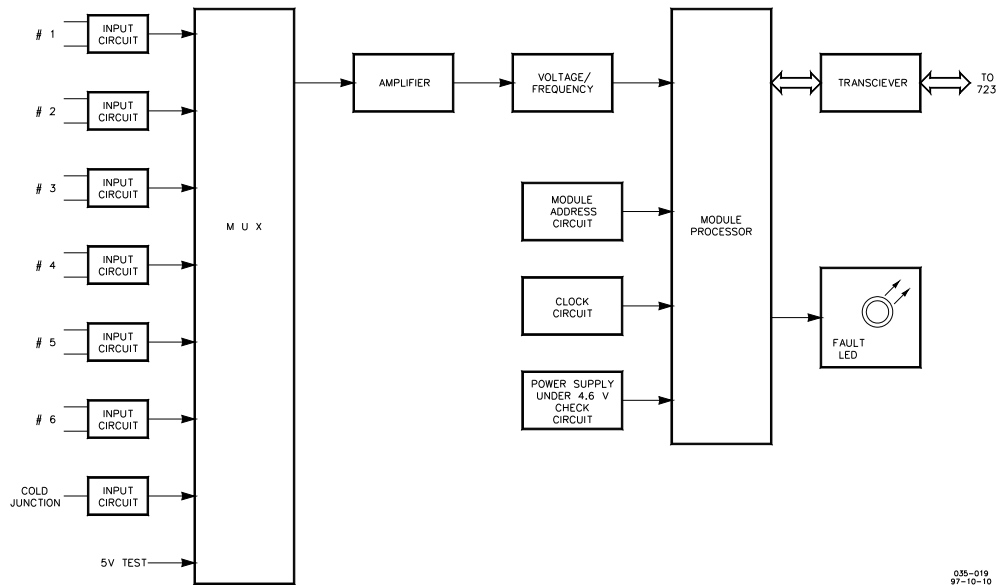


Figure B-7. Thermocouple Input Module Block Diagram

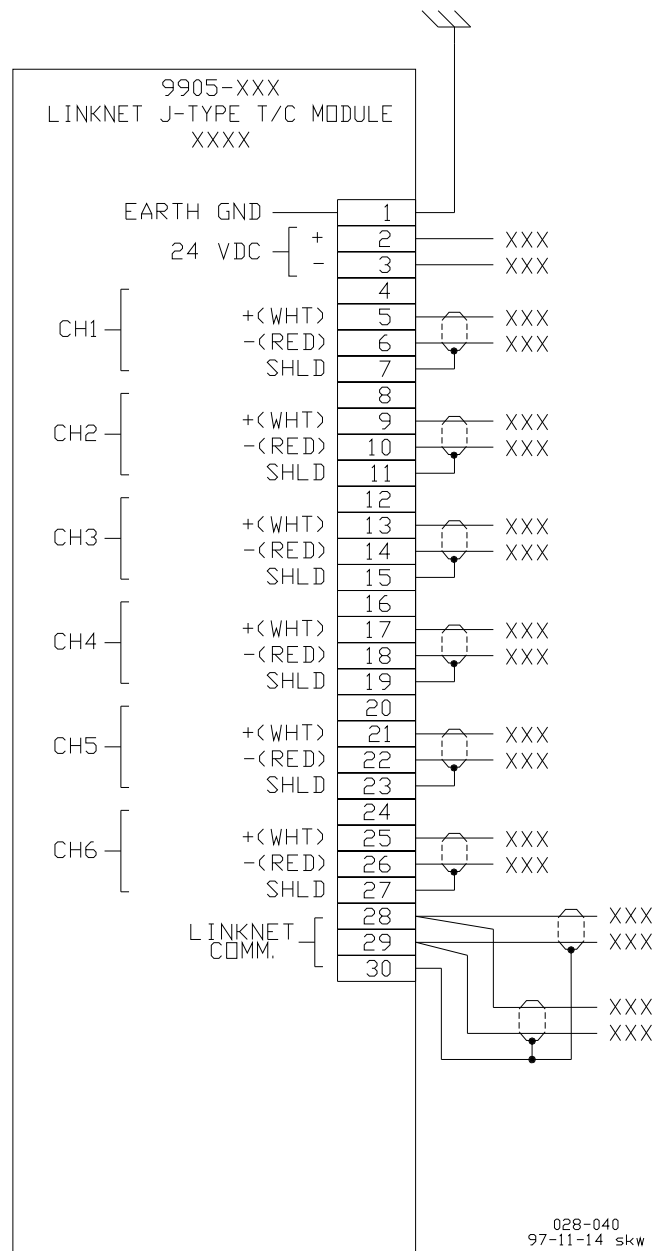


Figure B-8. Thermocouple Input Module Wiring Diagram

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.

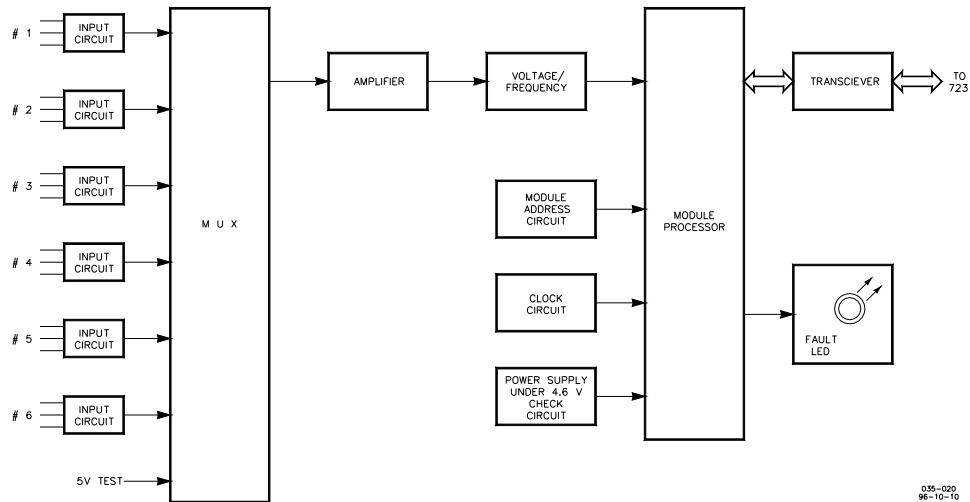


Figure B-9. RTD Input Module Block Diagram

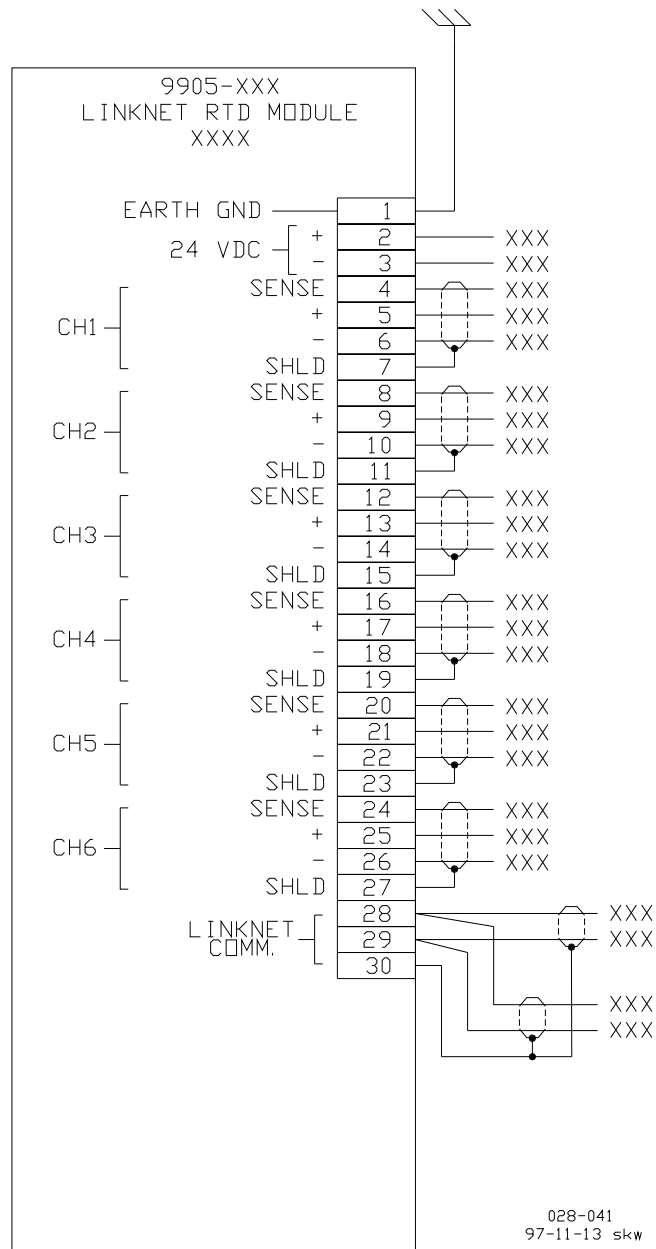


Figure B-10. RTD Input Module Wiring Diagram

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 which 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.

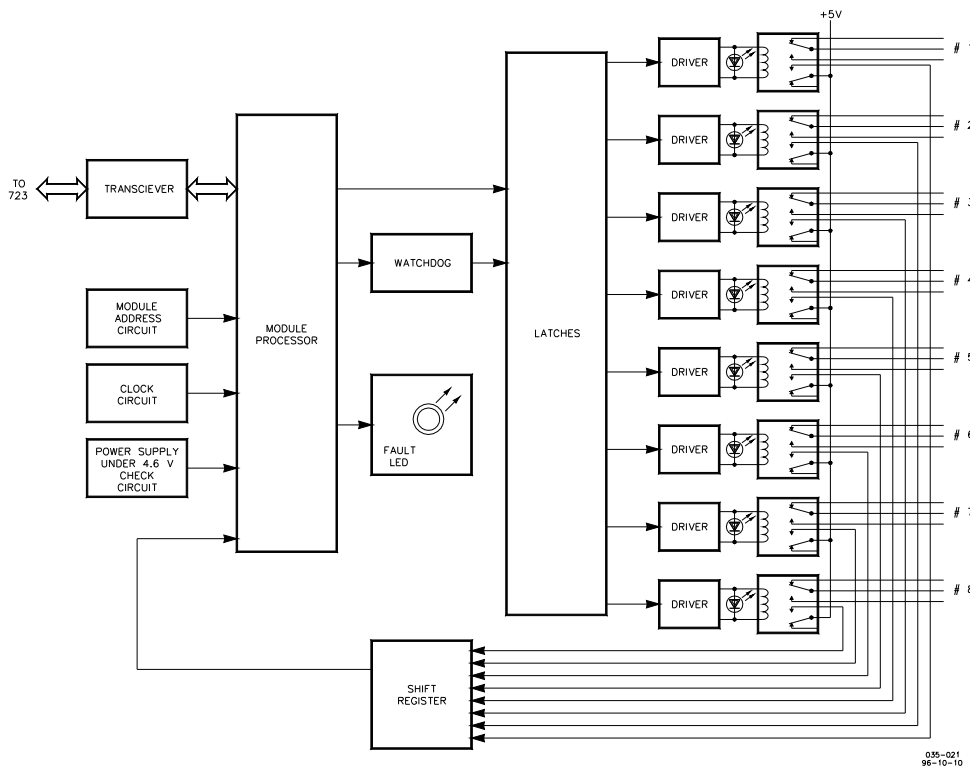


Figure B-11. Relay Output Module Block Diagram

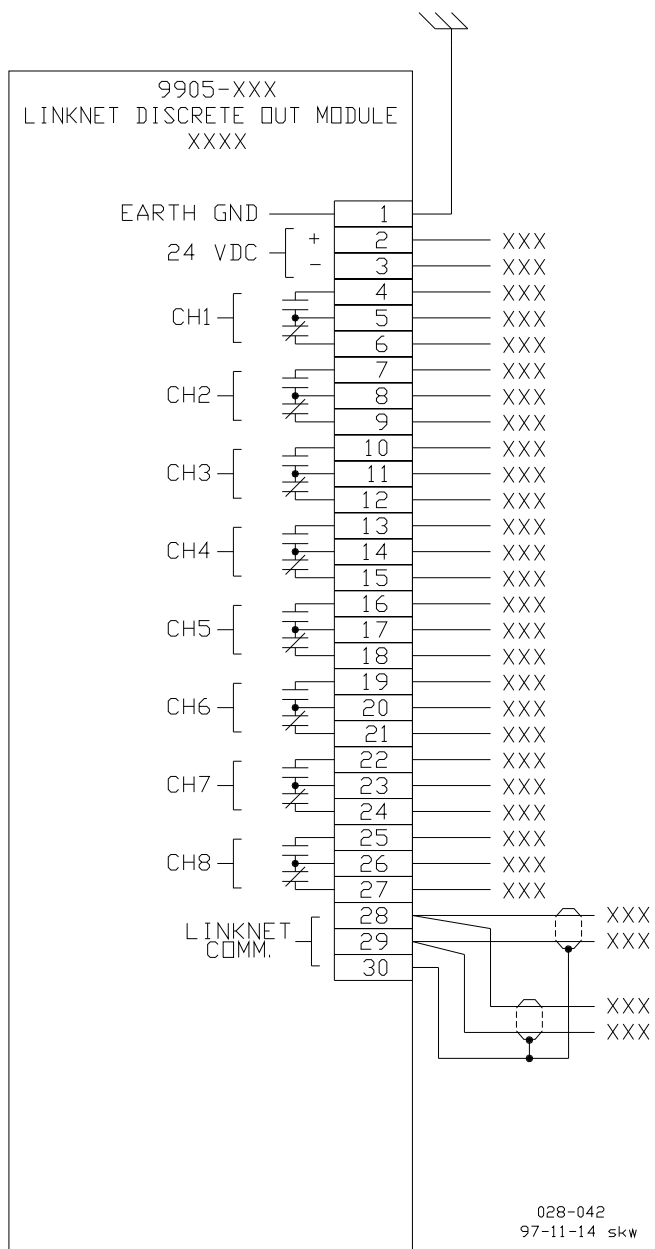


Figure B-12. Relay Output Module Wiring Diagram

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 which 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.

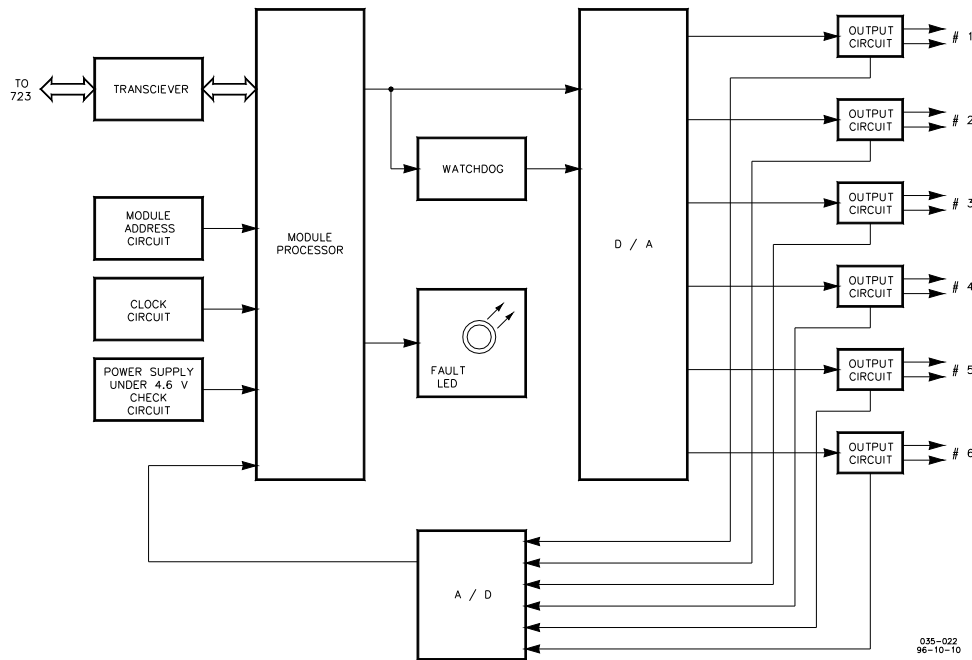


Figure B-13. 4–20 mA Output Module Block Diagram

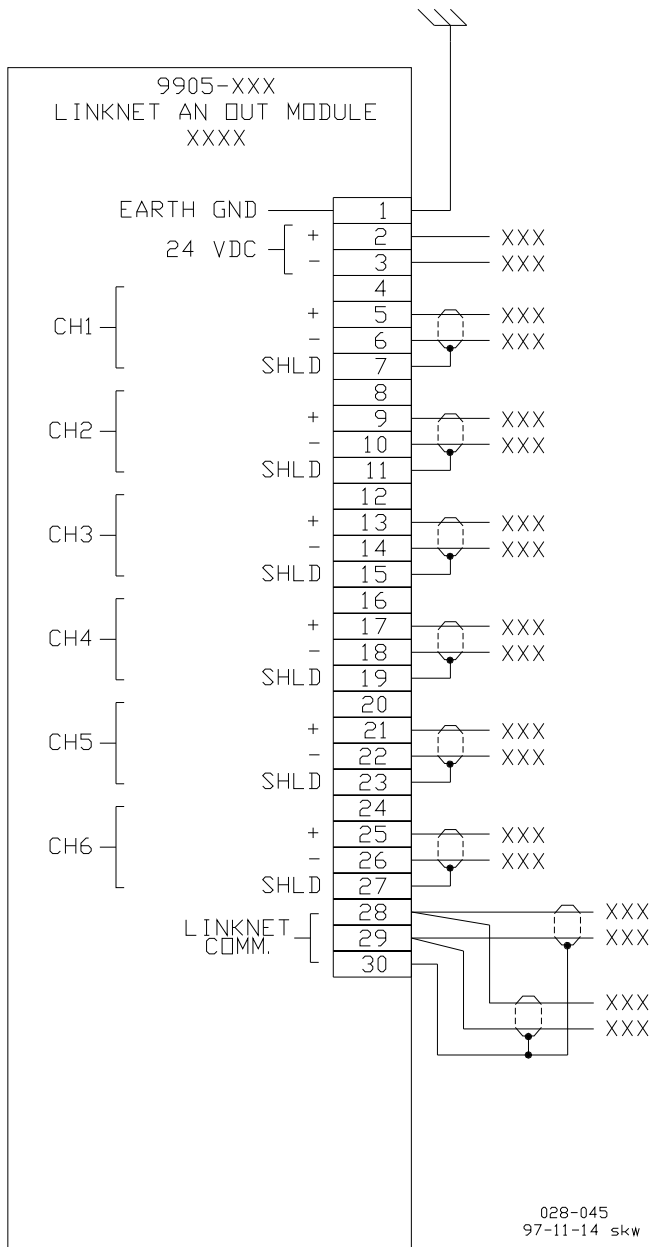


Figure B-14. 4–20 mA Output Module Wiring Diagram

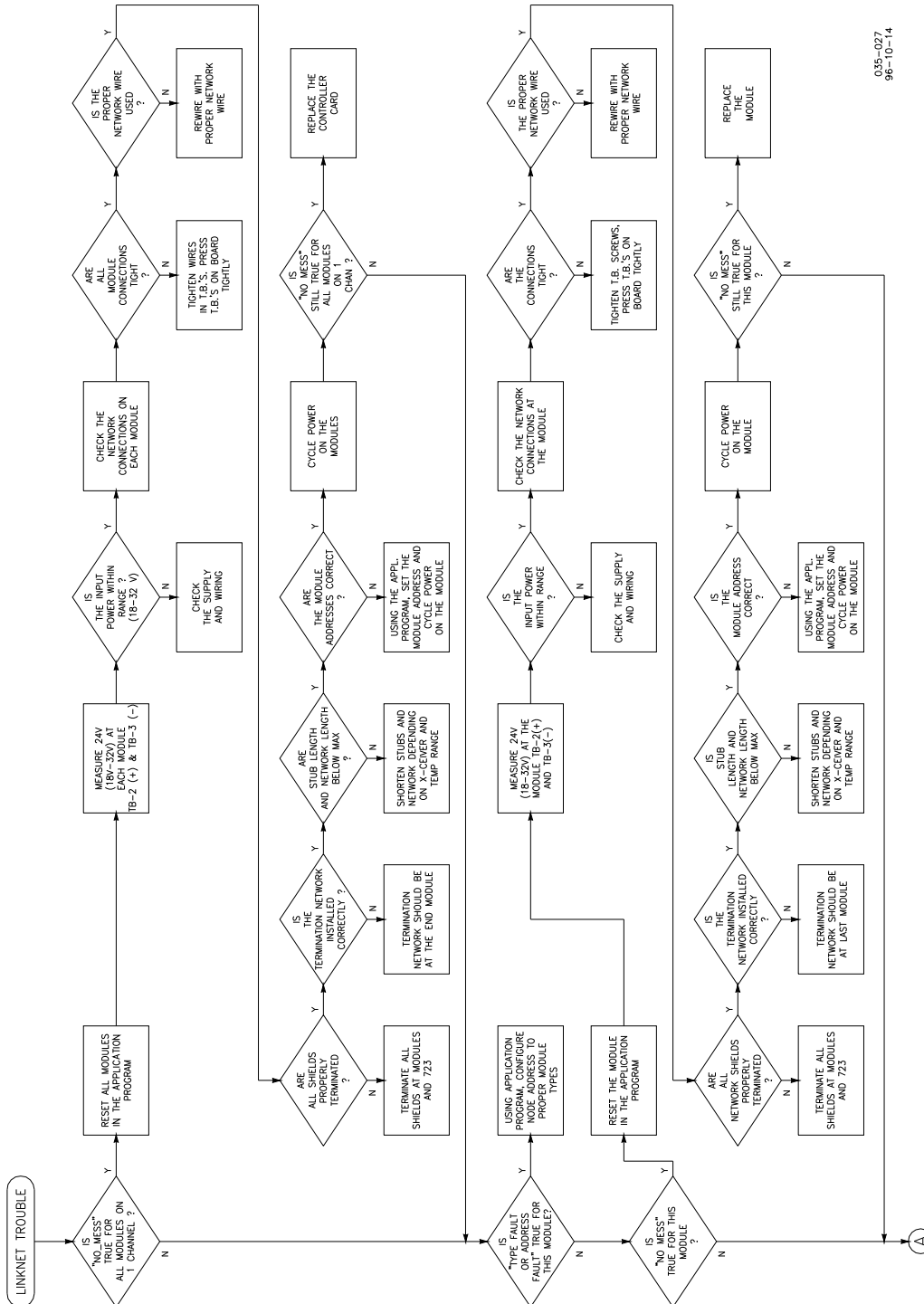
035-027
96-10-14

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

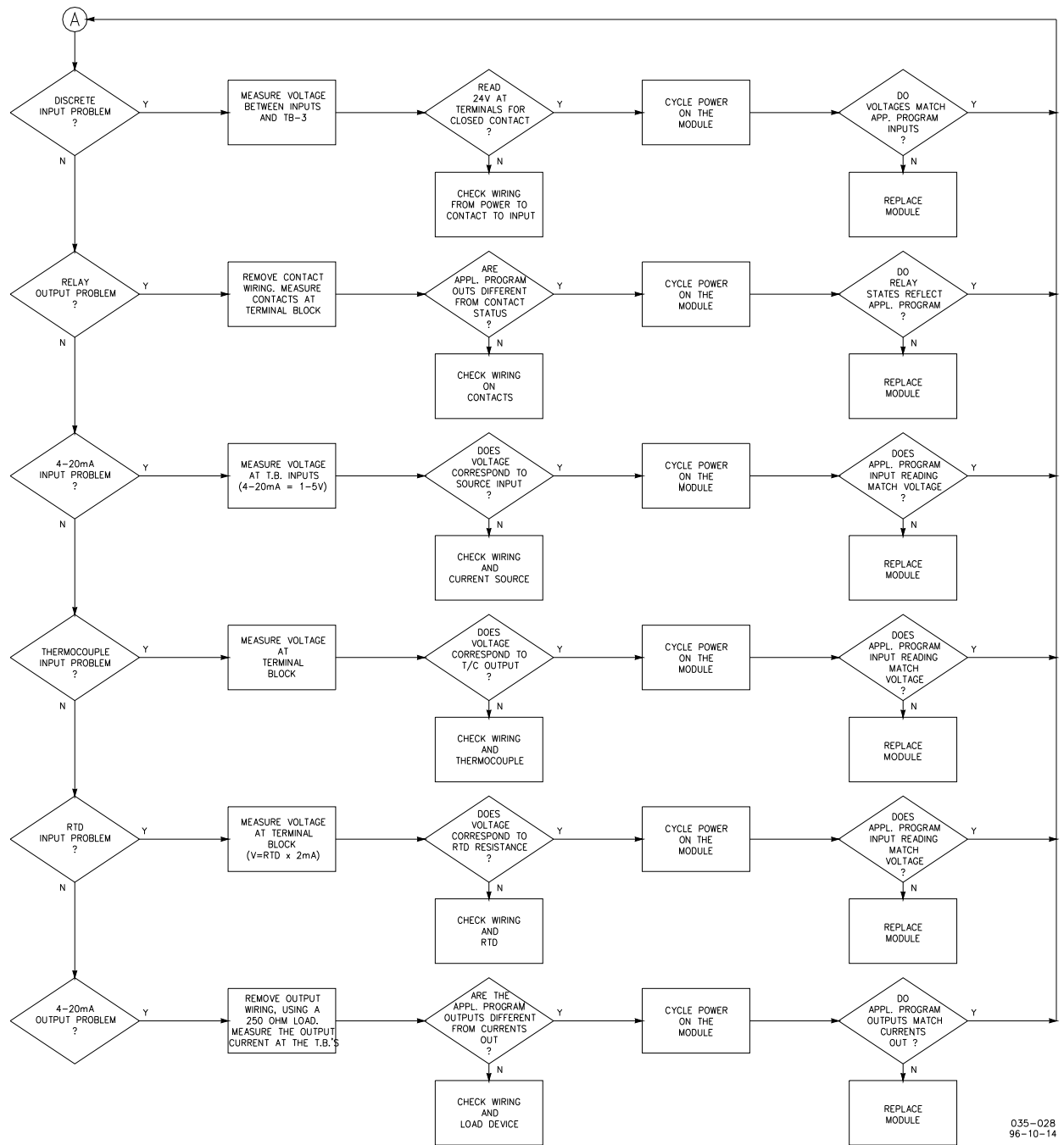


Figure B-15b. Troubleshooting Flowchart (2 of 2)

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

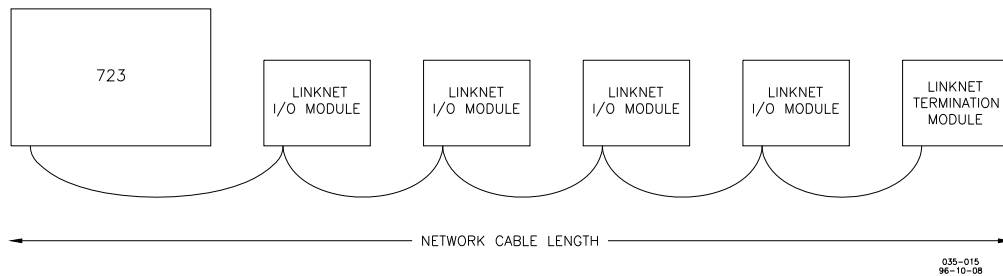


Figure B-16. Direct Wired Network

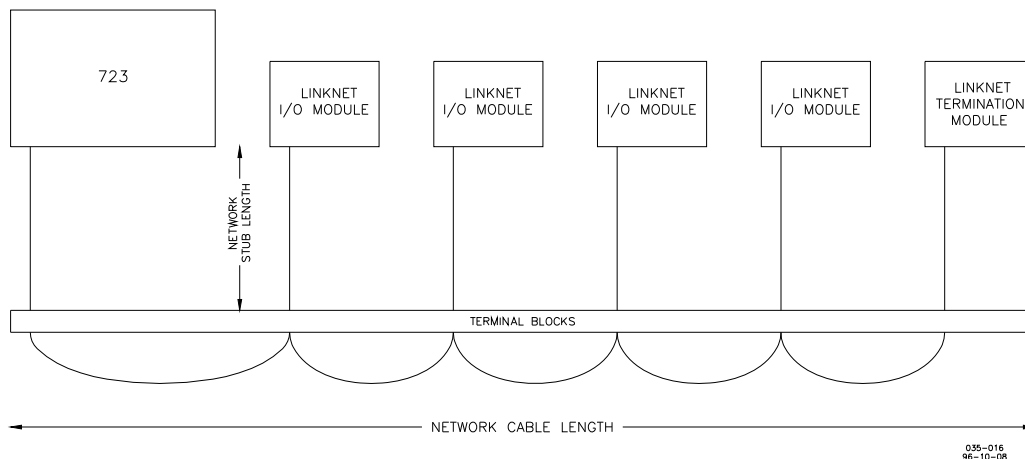


Figure B-17. Network Wired Via Stubs

Appendix C.

Modbus Slave Address Information

Part Numbers 8280-410/-411

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

MODBUS PORT3

Boolean Writes

Addr	Description
0:0001	ALARM RESET
0:0002	
0:0003	
0:0004	
0:0005	
0:0006	
0:0007	
0:0008	
0:0009	
0:0010	
0:0011	
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	
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

Boolean Reads

Addr	Description
1:0001	H-CLOSE TO RUN CONTACT
1:0002	G-RATED CONTACT
1:0003	F-LOWER SPEED/LOAD CONTACT
1:0004	E-RAISE SPEED/LOAD CONTACT
1:0005	D-2nd DYNAMICS CONTACT
1:0006	C-SPEED FAIL OVERRIDE
1:0007	B-ALARM RESET
1:0008	A-SPARE
1:0009	DO1-SHUTDOWN RELAY
1:0010	DO2-ALARM RELAY
1:0011	DO3-STATUS INDICATOR RELAY
1:0012	
1:0013	MPU 1 FAILED
1:0014	MPU 2 FAILED

1:0015	SPARE INPUT #1 FAILED
1:0016	SPARE INPUT #2 FAILED
1:0017	REMOTE SPEED INPUT FAILED
1:0018	EXTERNAL FUEL LIMIT FAILED
1:0019	HANDHELD SELECTED
1:0020	LAPTOP SELECTED
1:0021	SHUTDOWN IS ACTIVE
1:0022	1-SPEED #1FAIL SHUTDOWN
1:0023	2-SPEED #2 FAIL SHUTDOWN
1:0024	3-SPD #1 AND #2 FAIL SHUTDOWN
1:0025	4-SPARE #1 FAIL SHUTDOWN
1:0026	5-SPARE #2 FAIL SHUTDOWN
1:0027	6-EXT FUEL LMT FAIL SHUTDOWN
1:0028	7-EXT FUEL LMT FAIL SHUTDOWN
1:0029	8-MODBUS 3 FAIL SHUTDOWN
1:0030	9-HI FUEL DEMND SHUTDOWN
1:0031	10-HIGH SPEED SHUTDOWN
1:0032	11-TORSIONAL HIGH SHUTDOWN
1:0033	12-SPARE IN #1 HIGH SHUTDOWN
1:0034	13-SPARE IN #1 LOW SHUTDOWN
1:0035	14-SPARE IN #2 HIGH SHUTDOWN
1:0036	15-SPARE IN #2 LOW SHUTDOWN
1:0037	
1:0038	
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-SPARE IN #1 FAIL ALARM
1:0066	5-SPARE IN #2 FAIL ALARM
1:0067	6-EXT FUEL LMT FAIL ALARM
1:0068	7-EXT FUEL LMT FAIL ALARM
1:0069	8-MODBUS 3 FAIL ALARM
1:0070	9-HI FUEL DEMND ALARM
1:0071	10-HIGH SPEED ALARM
1:0072	11-TORSIONAL HIGH ALARM
1:0073	12-SPARE IN #1 HIGH ALARM
1:0074	13-SPARE IN #1 LOW ALARM
1:0075	14-SPARE IN #2 HIGH ALARM
1:0076	15-SPARE IN #2 LOW ALARM
1:0077	
1:0078	
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 ON TORQUE LIMIT (LSS)
 1:0108 TORSIONAL FILTER ACTIVE
 1:0109 SPEED SWITCH #1 ACTIVE
 1:0110 SPEED SWITCH #2 ACTIVE
 1:0111 REMOTE SPEED ENABLED
 1:0112 PRIMARY SPEED INPUT ACTIVE
 1:0113 STANDBY SPEED INPUT ACTIVE
 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

Analog Reads

Addr	Description
3:0001	AI1-SPARE INPUT #1 (uA)
3:0002	AI2-SPARE INPUT #2 (uA)
3:0003	AI3-REMOTE SPEED INPUT (uA)
3:0004	AI4-EXT FUEL LIMIT INPUT (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	
3:0018	
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 LIMIT LEVEL (%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-SPARE INPUT #1 (EU)
3:0042 AI2-SPARE INPUT #2 (EU)
3:0043 AI3-REMOTE SPEED INPUT (rpm)
3:0044 AI4-EXT FUEL LIMIT INPUT (engr)
3:0045 AO1-CONFIGURED ANALOG OUTPUT(engr)
3:0046 AO2-CONFIGURED ANALOG OUTPUT(engr)
3:0047 ACT1-OUTPUT TO ACTUATOR (%)
3:0048 ACT2-CONFIGURED ANALOG OUTPUT(engr)
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
3:0092
3:0093
3:0094
3:0095
3:0096

3:0097
3:0098
3:0099
3:0100
3:0101
3:0102
3:0103 AI 1 CHANNEL 1 (uA)
3:0104 AI 1 CHANNEL 2 (uA)
3:0105 AI 1 CHANNEL 3 (uA)
3:0106 AI 1 CHANNEL 4 (uA)
3:0107 AI 1 CHANNEL 5 (uA)
3:0108 AI 1 CHANNEL 6 (uA)

Analog Writes

Addr	Description
4:0001	
4:0002	723 ANALOG OUTPUT #1
4:0003	723 ANALOG OUTPUT #2
4:0004	723 ANALOG OUTPUT #4
4:0005	723 REMOTE 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

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 Hand Held Main Menu Header press 'ID', or from Watch Window or Control View, select "Help About" to get the Software Part Number and revision level. Record Here _____

Configure Menus

CFG OPTION	Default	Field Settings
USE REV ACTUATOR	#FALSE	
USE 2nd DYNAMICS	#FALSE	
USE 5-GAIN MAP	#FALSE	
USE CONST DYNAMICS	#FALSE	
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 TORQUE LIMIT	#FALSE	
USE TORSION FILTER	#FALSE	
USE NOTCH FILTER	#FALSE	
ENABLE TORS LIMITER	#FALSE	
USE START SPEED	#FALSE	
CFG 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)	
AI ALARM ARM TIME (SEC)	#10.0 (0.0, 10800.0)	
CFG SHUTDOWN	Default	
SPEED #1 FAIL	#FALSE	
SPEED #2 FAIL	#FALSE	
SPD #1AND#2 FAIL	#FALSE	
SPARE #1 IN FAIL	#FALSE	
SPARE #2 IN FAIL	#FALSE	
REMOTE INPUT FAIL	#FALSE	
EXT FUEL LIMIT FAIL	#FALSE	
MODBUS PORT3 FAIL	#FALSE	
HI FUEL DEMND LEVEL	#FALSE	
HIGH SPEED LEVEL	#FALSE	
HI TORSIONAL LEVEL	#FALSE	
SPARE #1 HIGH	#FALSE	
SPARE #1 LOW	#FALSE	
SPARE #2 HIGH	#FALSE	
SPARE #2 LOW	#FALSE	

CFIG ALARM	Default	
SPEED #1 FAIL	#FALSE	
SPEED #2 FAIL	#FALSE	
SPD #1AND#2 FAIL	#FALSE	
SPARE #1 IN FAIL	#FALSE	
SPARE #2 IN FAIL	#FALSE	
REMOTE INPUT FAIL	#FALSE	
EXT FUEL LIMIT FAIL	#FALSE	
MODBUS PORT3 FAIL	#FALSE	
HI FUEL DEMND LEVEL	#FALSE	
HIGH SPEED LEVEL	#FALSE	
HI TORSIONAL LEVEL	#FALSE	
SPARE #1 HIGH	#FALSE	
SPARE #1 LOW	#FALSE	
SPARE #2 HIGH	#FALSE	
SPARE #2 LOW	#FALSE	
CFIG INDICATION	Default	
ON START FUEL LIMIT	#FALSE	
ON MAX LIMIT	#FALSE	
ON EXT FUEL LIMIT	#FALSE	
ON TORSION LIMIT	#FALSE	
ON TORQUE LIMIT	#FALSE	
ACT SHUTDOWN	#FALSE	
SPEED SWITCH 1	#FALSE	
SPEED SWITCH 2	#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)	
SPARE 1 HI LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 1 LOW LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 1 DELAY	#10.0 (0.0, 10800.0)	
SPARE 2 HI LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 2 LOW LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 2 DELAY	#10.0 (0.0, 10800.0)	
ENERGIZE FOR SHTDWN	#TRUE	
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)	
SPARE 1 HI LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 1 LOW LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 1 DELAY	#10.0 (0.0, 10800.0)	
SPARE 2 HI LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 2 LOW LEVEL	#12.0 (-30000.0, 30000.0)	
SPARE 2 DELAY	#10.0 (0.0, 10800.0)	
ENERGIZE FOR ALARM	#TRUE	
SHUTDOWN ACT ON ALM	#FALSE	

INDICATION SETUP	Default (Low, High)	
SPD SWITCH1 PICKUP (RPM)	#500.0 (0.0, 2200.0)	
SPD SWITCH1 DROPOUT(RPM)	#400.0 (0.0, 2200.0)	
SPD SWITCH2 PICKUP (RPM)	#500.0 (0.0, 2200.0)	
SPD SWITCH2 DROPOUT(RPM)	#400.0 (0.0, 2200.0)	
ENRGIZE FOR INDICAT	#TRUE	
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, 10)	
AOUT 1 4-20 mA	#TRUE	
AOUT 2 SELECT	#2 (1, 10)	
AOUT 2 4-20 mA	#TRUE	
ACT OUT 1 4-20 mA	#FALSE	
ACT OUT 2 SELECT	#3 (1, 10)	
ACT OUT 2 4-20 mA	#TRUE	

Service Menus

SHUTDOWN MENU	Default	Field Settings
FIRST SHUTDOWN		
1-SPEED #1FAIL		
2-SPEED #2 FAIL		
3-SPD #1AND#2 FAIL		
4-SPARE #1 FAIL		
5-SPARE #2 FAIL		
6-REMOTE INPUT FAIL		
7-EXT FUEL LMT FAIL		
8-MODBUS 3 FAIL		
9-HI FUEL DEMAND		
10-HIGH SPEED		
11-HIGH TORSIONAL		
12-SPARE #1 HIGH		
13-SPARE #1 LOW		
14-SPARE #2 HIGH		
15-SPARE #2 LOW		
ALARM RESET	*FALSE	

ALARM MENU	Default	
FIRST ALARM		
1-SPEED #1 FAIL		
2-SPEED #2 FAIL		
3-SPD #1AND#2 FAIL		
4-SPARE #1 FAIL		
5-SPARE #2 FAIL		
6-REMOTE INPUT FAIL		
7-EXT FUEL LMT FAIL		
8-MODBUS 3 FAIL		
9-HI FUEL DEMAND		
10-HIGH SPEED		
11-HIGH TORSIONAL		
12-SPARE #1 HIGH		
13-SPARE #1 LOW		
14-SPARE #2 HIGH		
15-SPARE #2 LOW		
ALARM RESET	*FALSE	
1st SPEED 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)	*15.0 (0.5, 20.0)	
BUMP ACT	*FALSE	
2nd SPEED 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)	*15.0 (0.5, 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)	*15.0 (0.5, 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)	*15.0 (0.5, 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 (0.000, 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)	*650 (1, 2100)	
IDLE SPEED(RPM)	*750 (1, 2100)	
ACCEL RAMP TIME (SEC)	*25.0 (0.0, 500.0)	
DECEL RAMP TIME (SEC)	*25.0 (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)	

TORQUE LIMIT CURVE	Default (Low, High)	
ENABLE TORQUE LIMIT	*FALSE	
TORQUE LMT BRKPNT A(RPM)	*600.0 (0.0, 2200.0)	
FUEL LIMIT@BRKPNT A(%FD)	*20.0 (0.0, 100.0)	
TORQUE LMT BRKPNT B(RPM)	*700.0 (0.0, 2200.0)	
FUEL LIMIT@BRKPNT B(%FD)	*40.0 (0.0, 100.0)	
TORQUE LMT BRKPNT C(RPM)	*900.0 (0.0, 2200.0)	
FUEL LIMIT@BRKPNT C(%FD)	*60.0 (0.0, 100.0)	
TORQUE LMT BRKPNT D(RPM)	*1000.0 (0.0, 2200.0)	
FUEL LIMIT@BRKPNT D(%FD)	*80.0 (0.0, 100.0)	
TORQUE LMT BRKPNT E(RPM)	*1200.0 (0.0, 2200.0)	
FUEL LIMIT@BRKPNT E(%FD)	*100.0 (0.0, 100.0)	
DROOP	Default (Low, High)	
LOAD DROOP PERCENT	*0.0 (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)	
EXT FUEL LMT CURVE	Default (Low, High)	
ENABLE EXT FUEL LMT	*FALSE	
EXT LIMIT BRKPNT A (EU)	*6.0 (-16384.0, 16384.0)	
FUEL LIMIT@BRKPNT A(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT B (EU)	*8.0 (-16384.0, 16384.0)	
FUEL LIMIT@BRKPNT B(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT C (EU)	*10.0 (-16384.0, 16384.0)	
FUEL LIMIT@BRKPNT C(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT D (EU)	*15.0 (-16384.0, 16384.0)	
FUEL LIMIT@BRKPNT D(%FD)	*100.0 (0.0, 100.0)	
EXT LIMIT BRKPNT E (EU)	*20.0 (-16384.0, 16384.0)	
FUEL LIMIT@BRKPNT E(%FD)	*100.0 (0.0, 100.0)	
SET ANALOG INPUTS	Default (Low, High)	
SPARE #1@4mA(EU)	*4.0 (-16384.0, 16384.0)	
SPARE #1@20mA(EU)	*20.0 (-16384.0, 16384.0)	
SPARE #2@4mA(EU)	*4.0 (-16384.0, 16384.0)	
SPARE #2@20mA(EU)	*20.0 (-16384.0, 16384.0)	
REMOTE SPD @4mA (RPM)	*600.0 (-16384.0, 16384.0)	
REMOTE SPD @20mA (RPM)	*1300.0 (-16384.0, 16384.0)	
EXT FUEL LMT@4mA (EU)	*4.0 (-16384.0, 16384.0)	
EXT FUEL 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)	
ACTUATOR OUT 2 MIN (EU)	*0.0 (-32767.0, 32767.0)	
ACTUATOR OUT 2 MAX (EU)	*100.0 (-32767.0, 32767.0)	
AO FILTER FREQUENCY(HZ)	*20.0 (0.01, 20.0)	

I/O CALIBRATION	Default (Low, High)	
SPARE#1 OFFSET(AI1)	*0.0 (-20.0, 20.0)	
SPARE#1 IN SPAN(AI1)	*100.0 (50.0, 200.0)	
SPARE#1 READ VOLTS (AI1)	*FALSE	
SPARE#2 OFFSET(AI2)	*0.0 (-20.0, 20.0)	
SPARE#2 IN SPAN(AI2)	*100.0 (50.0, 200.0)	
SPARE#2 READ VOLTS (AI2)	*FALSE	
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	
EXT LMT OFFSET(AI4)	*0.0 (-20.0, 20.0)	
EXT LIMIT SPAN(AI4)	*100.0 (50.0, 200.0)	
EXT LMT 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	*10 (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)	
DISPLAY DIGITAL I/O	Display Only	
A-SPARE		
B-ALARM RESET		
C-SPEED FAIL OVRD		
D-2ND DYNAMICS		
E-RAISE SPEED		
F-LOWER SPEED		
G-RATED SPEED		
H-CLOSE TO RUN		
DO1-SHUTDOWN		
DO2-ALARM		
DO3-STAT INDICATOR		
DISPLAY ANALOG I/O	Default	
SPD SENS IN #1 (HZ)		
SPD SENS IN #2 (HZ)		
AI1-SPARE IN #1		
AI2-SPARE IN #2		
AI3-REMOTE IN		
AI4-EXT FUEL LIMIT		
AI1 FAILED		
AI2 FAILED		
AI3 FAILED		
AI4 FAILED		
ANALOG OUT 1(mA)		
ANALOG OUT 2(mA)		
ACTUATOR OUT 1(mA)		
ACTUATOR OUT 2(mA)		
ALARM RESET	*FALSE	

DISPLAY INDICATOR	Display Only	
ON START FUEL LIMIT		
ON MAX LIMIT		
ON EXT FUEL LIMIT		
ON TORSION LIMIT		
ON TORQUE LIMIT		
ACT SHUTDOWN		
SPEED SWITCH 1		
SPEED SWITCH 2		
CONTROL MODE	Default	
SPEED IN CONTROL		
ON START FUEL LIMIT		
ON MAXIMUM LIMIT		
ON EXTERNAL LIMIT		
ON TORSIONAL LIMIT		
ON TORQUE LIMIT		
ACTUATOR SHUTDOWN		
REMOTE SPEED ENBLD		
ON 2ND DYNAMICS		
SPD SENSOR 1 ACTIVE		
SPD SENSOR 2 ACTIVE		
PORT 1 ON HANDHELD		
PORT 1 ON SERVLINK		
RESET ALL ALARMS	*FALSE	
DISPLAY MENU	Display Only	
ENGINE SPEED(RPM)		
BIASED SPD REF(RPM)		
FUEL DEMAND(%)		
SPEED REF(RPM)		
DROOP BIAS(RPM)		
REMOTE SPEED REF (RPM)		
EXT FUEL LIMIT IN (EU)		
EXT FUEL LIMIT(%FD)		
SPARE AI1 (EU)		
SPARE AI2 (EU)		
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	

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 TORQUE LIMIT
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)
AI ALARM ARM TIME (SEC)

CFIG SHUTDOWN

SPEED #1 FAIL
SPEED #2 FAIL
SPD #1AND#2 FAIL
SPARE #1 IN FAIL
SPARE #2 IN FAIL
REMOTE INPUT FAIL
EXT FUEL LIMIT FAIL
MODBUS PORT3 FAIL
HI FUEL DEMND LEVEL
HIGH SPEED LEVEL
HI TORSIONAL LEVEL
SPARE #1 HIGH
SPARE #1 LOW
SPARE #2 HIGH
SPARE #2 LOW

CFIG ALARM

SPEED #1 FAIL
SPEED #2 FAIL
SPD #1AND#2 FAIL
SPARE #1 IN FAIL
SPARE #2 IN FAIL
REMOTE INPUT FAIL
EXT FUEL LIMIT FAIL
MODBUS PORT3 FAIL
HI FUEL DEMND LEVEL
HIGH SPEED LEVEL
HI TORSIONAL LEVEL
SPARE #1 HIGH
SPARE #1 LOW
SPARE #2 HIGH
SPARE #2 LOW

CFIG INDICATION

ON START FUEL LIMIT
ON MAX LIMIT
ON EXT FUEL LIMIT
ON TORSION LIMIT
ON TORQUE LIMIT
ACT SHUTDOWN
SPEED SWITCH 1
SPEED SWITCH 2

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)
SPARE 1 HI LEVEL
SPARE 1 LOW LEVEL
SPARE 1 DELAY
SPARE 2 HI LEVEL
SPARE 2 LOW LEVEL
SPARE 2 DELAY
ENERGIZE FOR SHTDWN
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)
SPARE 1 HI LEVEL
SPARE 1 LOW LEVEL
SPARE 1 DELAY
SPARE 2 HI LEVEL
SPARE 2 LOW LEVEL
SPARE 2 DELAY
ENERGIZE FOR ALARM
SHUTDOWN ACT ON ALM

INDICATION SETUP

SPD SWITCH1 PICKUP (RPM)
SPD SWITCH1
DROPOUT(RPM)
SPD SWITCH2 PICKUP (RPM)
SPD SWITCH2
DROPOUT(RPM)
ENRGIZE FOR INDICAT

CFIG COMMUNICATION

PORT 2 ADDRESS
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 SELECT
ACT OUT 2 4-20 mA

Service Menus

SHUTDOWN MENU

FIRST SHUTDOWN
 1-SPEED #1 FAIL
 2-SPEED #2 FAIL
 3-SPD #1AND#2 FAIL
 4-SPARE #1 FAIL
 5-SPARE #2 FAIL
 6-REMOTE INPUT FAIL
 7-EXT FUEL LMT FAIL
 8-MODBUS 3 FAIL
 9-HI FUEL DEMAND
 10-HIGH SPEED
 11-HIGH TORSIONAL
 12-SPARE #1 HIGH
 13-SPARE #1 LOW
 14-SPARE #2 HIGH
 15-SPARE #2 LOW
 ALARM RESET

ALARM MENU

FIRST ALARM
 1-SPEED #1 FAIL
 2-SPEED #2 FAIL
 3-SPD #1AND#2 FAIL
 4-SPARE #1 FAIL
 5-SPARE #2 FAIL
 6-REMOTE INPUT FAIL
 7-EXT FUEL LMT FAIL
 8-MODBUS 3 FAIL
 9-HI FUEL DEMAND
 10-HIGH SPEED
 11-HIGH TORSIONAL
 12-SPARE #1 HIGH
 13-SPARE #1 LOW
 14-SPARE #2 HIGH
 15-SPARE #2 LOW
 ALARM RESET

1st SPEED 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 SPEED 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)

TORQUE LIMIT CURVE

ENABLE TORQUE LIMIT
 TORQUE LMT BRKPNT
 A(RPM)
 FUEL LIMIT@BRKPNT A(%FD)
 TORQUE LMT BRKPNT
 B(RPM)
 FUEL LIMIT@BRKPNT B(%FD)
 TORQUE LMT BRKPNT
 C(RPM)
 FUEL LIMIT@BRKPNT C(%FD)
 TORQUE LMT BRKPNT
 D(RPM)
 FUEL LIMIT@BRKPNT D(%FD)
 TORQUE LMT BRKPNT
 E(RPM)
 FUEL LIMIT@BRKPNT E(%FD)

DROOP

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

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

SPARE #1@4mA(EU)
 SPARE #1@20mA(EU)
 SPARE #2@4mA(EU)
 SPARE #2@20mA(EU)
 REMOTE SPD @4mA (RPM)
 REMOTE SPD @20mA (RPM)
 EXT FUEL LMT@4mA (EU)
 EXT FUEL 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)
 ACTUATOR OUT 2 MIN (EU)
 ACTUATOR OUT 2 MAX (EU)
 AO FILTER FREQUENCY(HZ)

I/O CALIBRATION

SPARE#1 OFFSET(AI1)
 SPARE#1 IN SPAN(AI1)
 SPARE#1 READ VOLTS (AI1)
 SPARE#2 OFFSET(AI2)
 SPARE#2 IN SPAN(AI2)
 SPARE#2 READ VOLTS (AI2)
 REM IN OFFSET(AI3)
 REM IN SPAN(AI3)
 REM IN READ VOLTS (AI3)
 EXT LMT OFFSET(AI4)
 EXT LIMIT SPAN(AI4)
 EXT LMT 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
 PORT3 HARDWARE CFG
 PORT 3 BAUD RATE
 PORT 3 STOP BITS
 PORT 3 PARITY
 PORT 3 TIMEOUT(SEC)
 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

DISPLAY DIGITAL I/O

A-SPARE
B-ALARM RESET
C-SPEED FAIL OVRD
D-2ND DYNAMICS
E-RAISE SPEED
F-LOWER SPEED
G-RATED SPEED
H-CLOSE TO RUN
DO1-SHUTDOWN
DO2-ALARM
DO3-STAT INDICATOR

DISPLAY ANALOG I/O

SPD SENS IN #1 (HZ)
SPD SENS IN #2 (HZ)
AI1-SPARE IN #1
AI2-SPARE IN #2
AI3-REMOTE IN
AI4-EXT FUEL LIMIT
AI1 FAILED
AI2 FAILED
AI3 FAILED
AI4 FAILED
ANALOG OUT 1(mA)
ANALOG OUT 2(mA)
ACTUATOR OUT 1(mA)
ACTUATOR OUT 2(mA)
ALARM RESET

DISPLAY INDICATOR

ON START FUEL LIMIT
ON MAX LIMIT
ON EXT FUEL LIMIT
ON TORSION LIMIT
ON TORQUE LIMIT
ACT SHUTDOWN
SPEED SWITCH 1
SPEED SWITCH 2

CONTROL MODE

SPEED IN CONTROL
ON START FUEL LIMIT
ON MAXIMUM LIMIT
ON EXTERNAL LIMIT
ON TORSIONAL LIMIT
ON TORQUE LIMIT
ACTUATOR SHUTDOWN
REMOTE SPEED ENBLD
ON 2ND DYNAMICS
SPD SENSOR 1 ACTIVE
SPD SENSOR 2 ACTIVE
PORT 1 ON HANDHELD
PORT 1 ON SERVLINK
RESET ALL ALARMS

DISPLAY MENU

ENGINE SPEED(RPM)
BIASED SPD REF(RPM)
FUEL DEMAND(%)
SPEED REF(RPM)
DROOP BIAS(RPM)
REMOTE SPEED REF (RPM)
EXT FUEL LIMIT IN (EU)
EXT FUEL LIMIT(%FD)
SPARE AI1 (EU)
SPARE AI2 (EU)

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

723PLUS Control Specifications

Woodward Part Numbers:	
8280-410	723PLUS with low-voltage power supply
8280-411	723PLUS with high-voltage power supply
9907-205	Hand Held Programmer
8923-932	Watch Window Installation
8928-222	Control View Installation
Power Supply Rating	18–40 Vdc (24 or 32 Vdc nominal) 90–150 Vdc (125 Vdc nominal)
Power Consumption	40 W nominal
Inrush Current:	7 A for 0.1 ms (low-voltage model)
Inrush Current:	22 A for 15 ms (high-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 k Ω
Remote Speed Setting Input	4–20 mA or 1–5 Vdc, externally powered
External Limiter Input #1	4–20 mA or 1–5 Vdc, externally powered
Spare Input #1	4–20 mA or 1–5 Vdc, externally powered
Spare Input #2	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, internally powered
Analog Output #4	4–20 or 0–200 mA to meter, computer, or second (configurable) actuator, internally powered
Relay Outputs	Shutdown, Alarm, Status Indicator
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 Ports (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.

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