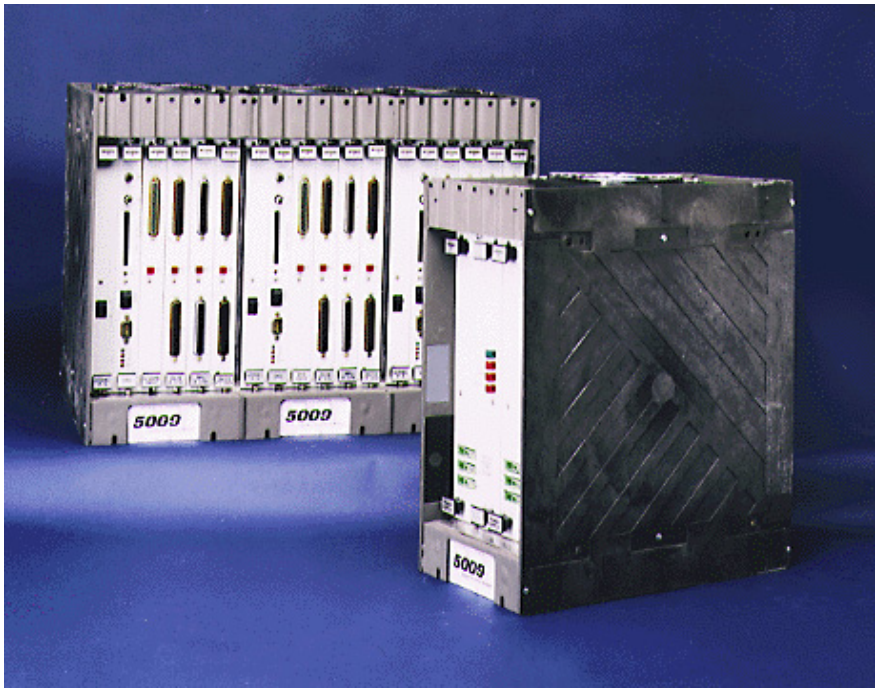
WOODWARD

Product Manual 26320V3
(Revision B)
Original Instructions



MicroNet™ TMR 5009C Digital Control System

Volume 3
PCI Software and Modbus® Interface Manual

Manual 26320 consists of 3 volumes (26320V1, 26320V2, 26320V3).

Software Manual

General Precautions

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

Practice all plant and safety instructions and precautions.

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

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

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

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

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 Out-of-date translations are marked with ⚠.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

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

Contents

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

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

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

⚠WARNING

Overspeed / Overtemperature / Overpressure

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

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

⚠WARNING

Personal Protective Equipment

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

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

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

⚠WARNING

Start-up

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

⚠WARNING

Automotive Applications

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

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

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

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

Follow these precautions when working with or near the control.

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

Chapter 1.
General Information

Introduction

The technical documentation for the 5009C control system consists of the following volumes:

Volume 1—provides information on system application, control functionality, fault tolerant logic, control logic, PID setting instructions, and system operation procedures.

Volume 2—provides hardware descriptions, mechanical and electrical installation instructions, hardware specifications, hardware troubleshooting help, and basic repair procedures.

Volume 3—provides installation procedures for the 5009C control's personal computer based interface software program (PCI), information on all PCI features and modes (Program, Service and Run), and a lists of the control's Modbus® * registers and DDE tag names.

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

Active 5009C part numbers covered in this manual are: 8237-1106.

This volume provides software installation, configuration and troubleshooting information for the 5009C control's PC Interface program.

PCI Software Package

The 5009C control is a field configurable steam turbine control. A software package is included as an installation kit with every 5009C control to allow users to program, service, and operate (Run) their 5009C control. The provided software package must be installed on a capable computer which is connected to the 5009C control to allow users to interact with the 5009C control. The different modes of the PCI program allow it to function as an engineering workstation and or an operator control panel.

Refer to Figure 1-1 of this manual for installed software program relationships. The PCI installation kit includes the following programs:

- PCI—operator interface program
- Watch Window—debug program
- ServLink—DDE communications program
- Print Program—configuration & wiring list print program

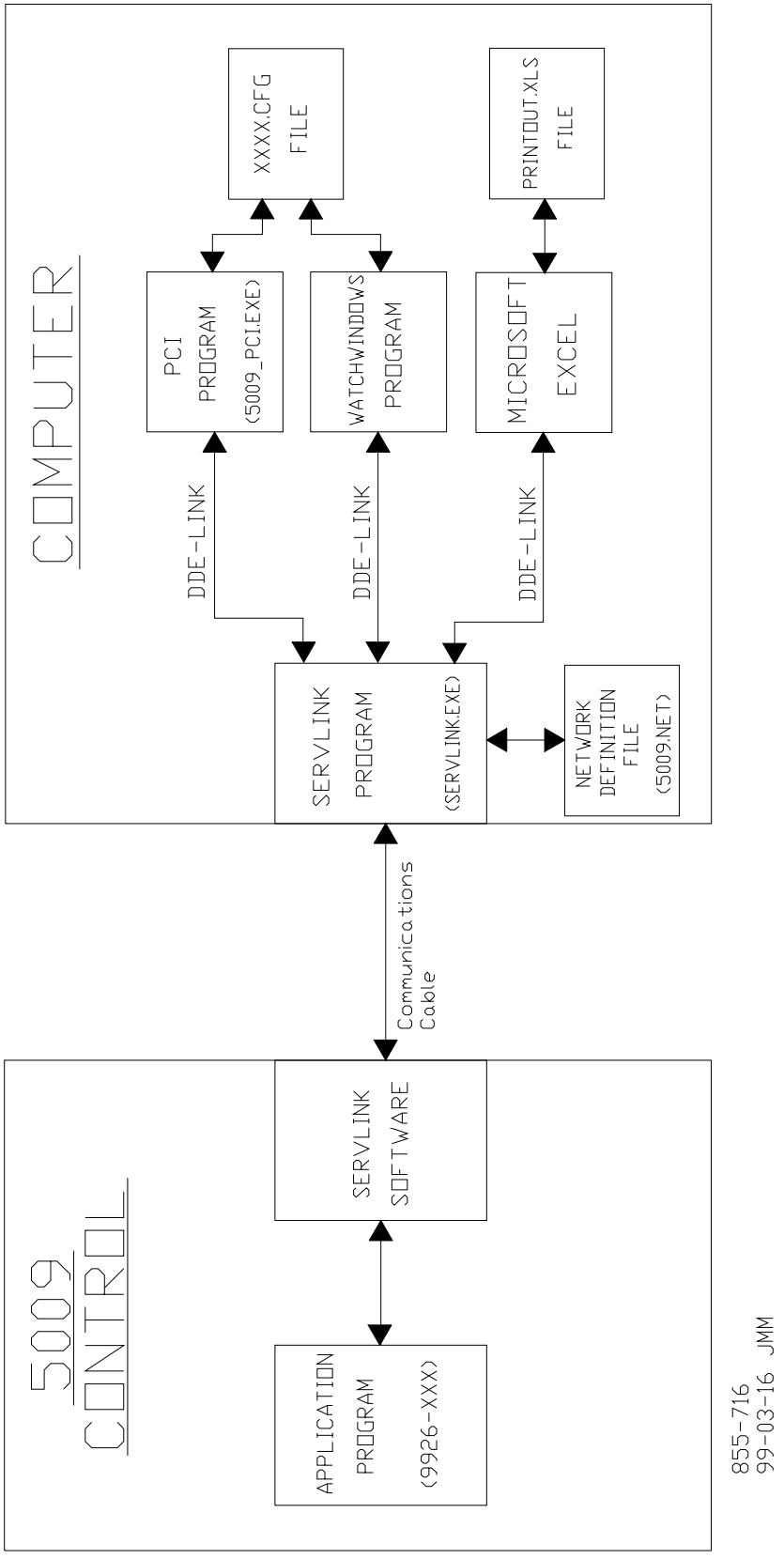


Figure 1-1. 5009C Software Program Relationships

PCI Program

The 5009C_PCI program is the interface program which will be started and used to program, service, and operate the 5009C control. This program's interface modes are as follows:

Program Mode—This mode has password based security and is used when the system is shutdown to:

- Configure the control to an application
- Change control input/output voting logic
- Load a control's configuration from a computer file

Service Mode—This mode has password based security and is used when the system is operating on-line to:

- Calibrate control inputs and outputs
- Tune system settings
- Monitor Control Health
- Change Voting logic
- Test Voting Logic
- Test control and system protection logic

Run Mode—This mode can be used as an operator control panel to:

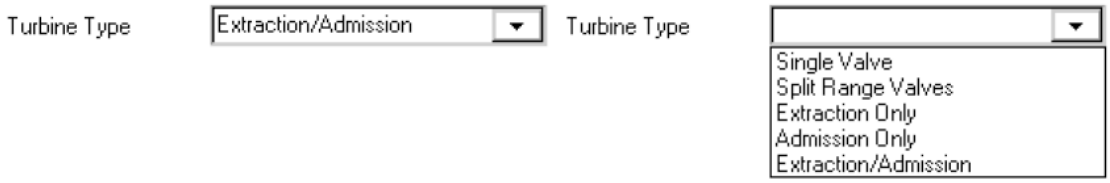
- Start and Stop the turbine
- Enable and Disable all system control modes (Decoupling, Cascade, Ext/Adm, etc.)
- Calibrate valves

This volume applies to all 5009C control systems but may not include information that is unique to your system. It also does not apply to any custom MicroNet TMR applications. This volume and the PCI software described covers only the 5009C application program as generated by Woodward.

5009C PCI Program

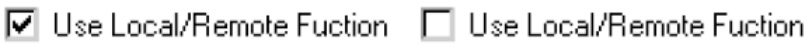
As with any Windows based program, the folders and options inside the folders change radically depending on the input from the user. If certain options of the PCI program are not used, entire folders will disappear and not be shown. For the purpose of this manual, all options and all folders have been displayed in the figures that follow. The folders and screens that you as the user will see on your own PC will be different. Sometimes conflicting options have been shown so that the figure can display all the information necessary to the different types of applications. i.e. Extraction, Admission, and Extraction/Admission folders cannot all appear at the same time on the PC.

The primary way to select options in the 5009C control is the pull-down menu. An option will appear in the appropriate folder with a pull down box shown after it. The selected option will be displayed in the pull-down box. If the user clicks on the arrow in the box with the mouse (placing the mouse cursor over it and clicking the left mouse button), all available options will appear below the pull-down menu. Clicking on any of the options will place that option in the display area of the pull-down box, and make that option the selected one for the 5009C control. At that time additional options may appear or disappear depending on whether they are valid.



Extraction/Admission Option Selected Select Option

The other way to select options in the 5009C control is the check box. An option will appear in the appropriate folder with a small box in front of the text. If the option or the box is clicked on with the mouse (placing the mouse cursor over it and clicking the left mouse button), the box will show a small check mark inside it. If the option is clicked on again, the check mark will disappear. The check mark determines the use or non-use of the option.



Option Selected Option Not Selected

As options are selected (check mark appears) other options or input values appear in the folder and allow the user to further define the 5009C control. If Use Remote Speed Setpoint is “checked”, the necessary input values corresponding to a 4 mA speed setpoint and a 20 mA speed Setpoint need to be entered into the edit boxes that appear only when the option is selected. Some options will not be available for a certain configuration, but will remain visible. These options will be shaded to inform the user that they cannot be selected due to a conflicting option selected elsewhere.

Watch Window Program

The Watch Window program is a troubleshooting and debugging tool that provides a window into the control system. This program is provided with all Woodward ServLink (DDE) based controls to allow internal program calculation and logic monitoring by Woodward technicians and engineers. It is anticipated that a typical 5009C control user will never use this program.

Watch Window presents variables in a tabular format. The user chooses the variables to view at any given time. Multiple pages of variables can be created, each with useful parameters for various trouble shooting or tuning procedures. The user can toggle between screens depending on the work being done.

ServLink Program

The PCI software program runs in parallel with a communications program called ServLink. ServLink is an interface program which directs and manages the transfer of data between the PCI program and the 5009C control. Refer to Figure 1-1.

The setup program that installs the PCI and Watch Windows programs on your computer will also install the ServLink program. All PCI-to-5009C control communications are performed through the ServLink program (designated computer port, baud rate, etc.).

This program can also be used to link Microsoft based programs (Excel, Access, Word) to the control for monitoring or report purposes. This link is performed through DDE communications, thus the program linked-to must be compatible with DDE (Dynamic Data Exchange) servers (communications). Refer to Figure 1-1.

To link a Microsoft based program, close the PCI program and open both the ServLink program and the Microsoft based program at the same time. From the 5009C ServLink program, open the ".net" file then step to the output signal desired by double clicking on the desired program folder to, open it to the next level (category, block output), then select the output desired. Reference this Volume's Modbus list for a list of available application program output signals. At this point perform a Copy command from the ServLink program's Edit menu, open the Microsoft program, and perform a paste special function (selecting the paste link option). After the path has been copied once, any further connections can be made by simply typing in the path name; including the desired output signal name.

Network Definition File

The ServLink program uses a network definition file to communicate with the 5009C control's application software. This file acts as an encoded tag-name look up table so that only encoded tag names are used when communicating with the control. This type of encoding logic allows for faster communications speeds.

This file must be created before the PCI program can communicate with the 5009C control. Once created this file will not have to be recreated unless it is accidentally deleted, the computer port being used is changed, or the 5009C control's application program changes (via an application upgrade). A new network definition file can be created at any time with no affect on the 5009C control's operation.

Printing

Printing control information and configurations can be performed through one of two methods. One method of printing system related information is to issue a "Print Current Page" command from the Tool Bar's File menu. A second method of printing system related information is to use the provided Microsoft Excel based file (PrntoutX.xls) to print the control's Program mode configuration, Service mode configuration, and wiring list.

Print Current Page

The visible folder of the PCI program can be sent to a printer by using the Print Current Page option of the "File" pull-down menu as shown below. The printed pages can be used to record the control's configuration and RUN mode information in a paper format. As an example, most of the figures in this manual resemble the printed output of a folder.

Print Program, Service, & Wiring Lists

The Microsoft Excel based file (PrntoutX.xls) provided with control's PCI software kit allows the control's Program mode configuration, Service mode configuration, and I/O wiring list to be printed out. A Microsoft Excel based file is used for this purpose because of its public acceptance, and DDE interface capabilities. This file allows users to record, save, and printout the control's configuration in a readable format. A set of wiring printout sheets is also created for each of the control's field termination modules, which can be customized with site-specific information before printing.

The PrntoutX.xls print-file can be accessed from Windows Task bar's Start—Programs—Woodward 5009C PCI Group menu. This file can be opened at any time to allow system printing. Once opened this file momentarily establishes a DDE link to the control, reads the control's configuration, then breaks the DDE link. The read configuration data can then be stored, and or printed out. If the control's configuration is changed the print-file's data must be updated again to reflect the control's latest configuration.

If while the print-file is opened a change is made to the control's configuration, the print-file data can also be updated by clicking on the "Read Control Configuration" button located on the Update_Data page.

Once the print-file has completed reading the control's configuration, the user can customize the printout sheets to meet their needs. Site specific information can be added to any and all sheets (i.e. turbine ID numbers, cable numbers, junction box labels, device names, etc.).

Printing Procedure

1. Verify that the Microsoft Excel program is resident on the computer being utilized.

2. If the 5009C_PCI program is running, and communicating with the control (using a network definition file named 5009.net) skip to step #5.

3. Verify that the Network Definition file used is named 5009C.net. If it is not, temporarily rename the file "5009.net".

4. Verify that ServLink is open and communicating with the control using the 5009C.net network definition file. The ServLink program is located in the Woodward 5009C PCI Tools Group. Optionally the 5009C_PCI.exe program can be started to accomplish this task.

5. From the Windows Task bar's Start—Programs—Woodward 5009C PCI Tools Group menu select the "Print Program" file.

6. When prompted to Re-establish links, select "YES". At this point the print- file reads the control's configuration by updating each linked data point. Depending on computer loading, this step may take up to 5 minutes.

7. When prompted that the print-file's update routine is complete, select the desired sheet or sheets by clicking on its TAB, perform any additions or modifications to the sheet(s), and issue an Excel based print command. This will result in the selected sheet/folder being printed to the computer's defaulted printer.

8. At this point the updated print-file can also be saved to a computer directory and or diskette.

9. If at any point the control's configuration changes, the print-file's data can be updated by clicking on the "Read Control Configuration" button.

GOVERNOR SERIAL NUMBER: _____
DATE: _____

APPLICATION FOLDER

Site:		
Turbine:		
ID Tag:		
Turbine Type:	Single Valve	
Application:	Generator Drive	

START SETTINGS FOLDER

Start Routine:	Automatic	
Idle to Rated Routine:	Automatic Start Sequence	
Speed Setpoint Rate to Min Speed:	100.00	rpm/sec
HP Valve Limiter Rate:	2.50	%/sec
Use Critical Speed Avoidance?	Yes	
Critical Rate:	150.00	rpm/sec
Critical Speed Band 1 Minimum:	1100.00	rpm
Critical Speed Band 1 Maximum:	1500.00	rpm
Use Critical Speed Avoidance Band 2?	Yes	
Critical Speed Band 2 Minimum:	2100.00	rpm
Critical Speed Band 2 Maximum:	2500.00	rpm
AUTO SEQUENCE SETTINGS		
Cold Star (> xx hrs):	10.00	hrs
Hot Start (< xx hrs):	1.00	hrs
Low Idle Setpoint:	500.00	rpm
Low Idle Delay (Cold):	0.50	min
Low Idle Delay (Hot):	0.00	min
Low Idle to High Idle Rate (Cold):	75.00	rpm/sec
Low Idle to High Idle Rate (Hot):	100.00	rpm/sec
High Idle Setpoint:	2000.00	rpm
High Idle Delay Time (Cold):	0.50	min
High Idle Delay Time (Hot):	0.00	min
High Idle to Rated Rate (Cold):	75.00	rpm/sec
High Idle to Rated Rate (Hot):	100.00	rpm/sec
Rated Setpoint:	3600.00	rpm

SPEED CONTROL FOLDER

Overspeed Test Limit:	4000.00	rpm
Overspeed Trip Level:	3780.00	rpm
Max Control Setpoint:	3780.00	rpm
Min Control Setpoint:	3420.00	rpm
Setpoint Slow Rate:	6.05	rpm/sec
Use 4-20mA Remote Speed Setpoint?	Yes	
Remote Setpt Max Rate:	49.50	rpm/sec
Off-Line Proportional Gain:	3.53	%
Off-Line Integral Gain:	1.28	rps
Off-Line Derivative Ratio:	5.00	%
On-Line Proportional Gain:	5.86	%
On-Line Integral Gain:	1.60	rps
On-Line Derivative Ratio:	5.00	%

Figure 1-2. Example Program Printout Sheet

ATM-1	TB	CONFIGURED FOR	WIRED TO
Speed Input #1			
A & B Kernel Input (+)	1	MPU #!	
A & B Kernel Input (-)	27	MPU #!	
C Kernel Input (+)	2	Jumper to TB1	
C Kernel Input (+)	28	Jumper to TB27	
Shield	3	Shield	
Speed Input #2			
A & B Kernel Input (+)	31	MPU #2	
A & B Kernel Input (-)	6	MPU #2	
C Kernel Input (+)	32	Jumper to TB31	
C Kernel Input (+)	7	Jumper to TB6	
Shield	33	Shield	
Analog Output #1			
Output (+)	36	Speed Meter (+)	
Output (-)	11	Speed Meter (-)	
Shield	10	Shield	
Actuator Driver #1			
A & B Output (+)	39	Actuator #1 (+)	
A & B Output (-)	14	Actuator #1 (-)	
C Output (+)	40	Jumper to TB39	
C Output (+)	15	Jumper to TB14	
Shield	13	Shield	
Analog In #1 (Loop Pwrd)			
+24Vdc Power	16	Remote Speed Setpoint Input (+)	
Input (+)	18	Remote Speed Setpoint Input (-)	
Shield	17	Shield	
Input (-)	43	Jumper to TB42	
Common	42	Jumper to TB43	
Chassis Ground	52	Earth Ground	

Figure 1-3. Example Wiring List Printout Sheet

General Installation and Operating Notes

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

Wiring must be in accordance with the authority having jurisdiction.

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

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

Chapter 2.
PCI Installation

Introduction

The 5009C control's PCI software installation kit is included with the control on either 3.5" floppy computer diskettes or on a CD-ROM. The diskettes or CD-ROM must be inserted into and used to install the PCI software kit on a computer that meets the below listed requirements. Once installed the PCI program and associated computer function together as an engineering workstation and operator control panel.

IMPORTANT **Woodward recommends deleting previous versions of PCI software prior to installing updated versions.**

Requirements

The PCI software package is installed and runs on any compatible PC hardware platform with the following minimum restrictions:

As a Configuration Only Tool	**As an On-line Operator Interface**
486 50 MHz	Pentium 200 MHz
24 Meg RAM	48 Meg RAM
10 Meg Disk Drive Space	10 Meg Disk Drive Space
Windows 95, Windows NT, or Windows 2000	Windows NT, Windows 2000
3.5" floppy or CD-ROM drive	3.5" floppy or CD-ROM drive

Any PC that has the above list of features will function as a host for the PCI software package. As the speed and memory capabilities of the PC are increased, so will the speed of the PCI software program.

The connection between the PC and the 5009C control consists of a standard Null- modem computer cable with a standard 9 Pin-Sub-D, female connector used to interface with the 5009C control. The control-to-PCI-computer cable provided with the control system, is a 3.05 meter (10') serial cable with 9 Pin-Sub-D, female connectors. If a custom cable is necessary, reference the RS-232 pinout diagram in Figure 2-1. The 5009C control must be connected to the designated computer before the PCI program can be successfully started.

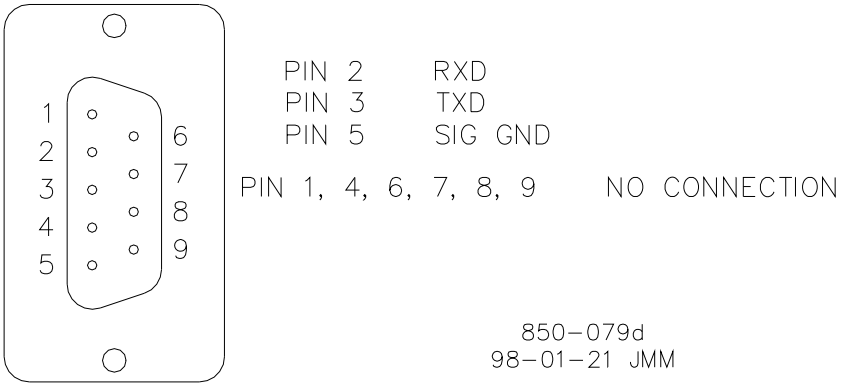
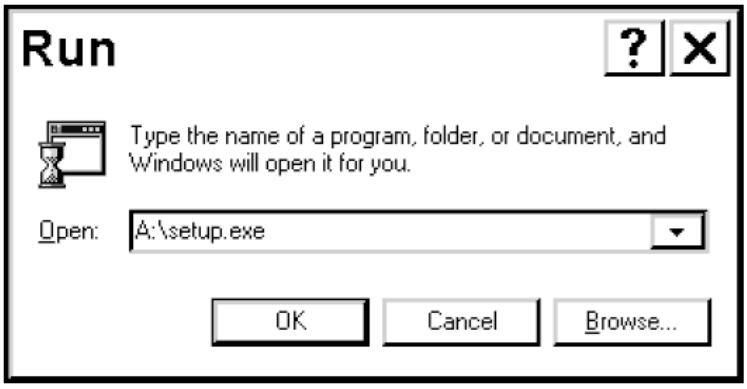


Figure 2-1. CPU RS-232 Pinouts

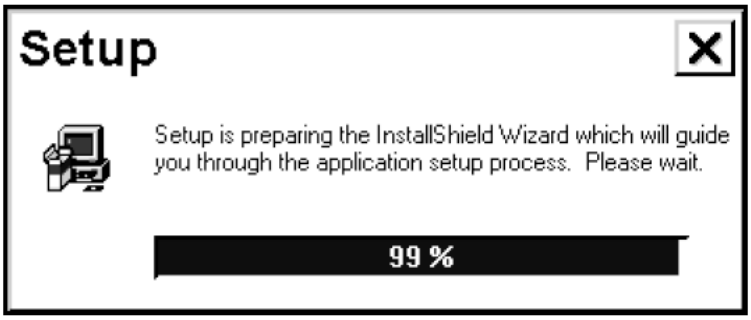
This manual is not intended to teach the user the basics of how to operate a Windows based program. The user should be familiar with how to open and close folders and how to execute pull-down menu options. The PCI program and the ServLink program are both 32 bit operating system programs. This means that Windows 3.1 will NOT work for this application. Windows 95 or Windows NT are the only two operating systems that these programs have been tested with. A Windows compatible 32 bit operating system should work with these programs, but only the Windows 95 and Windows NT have been verified.

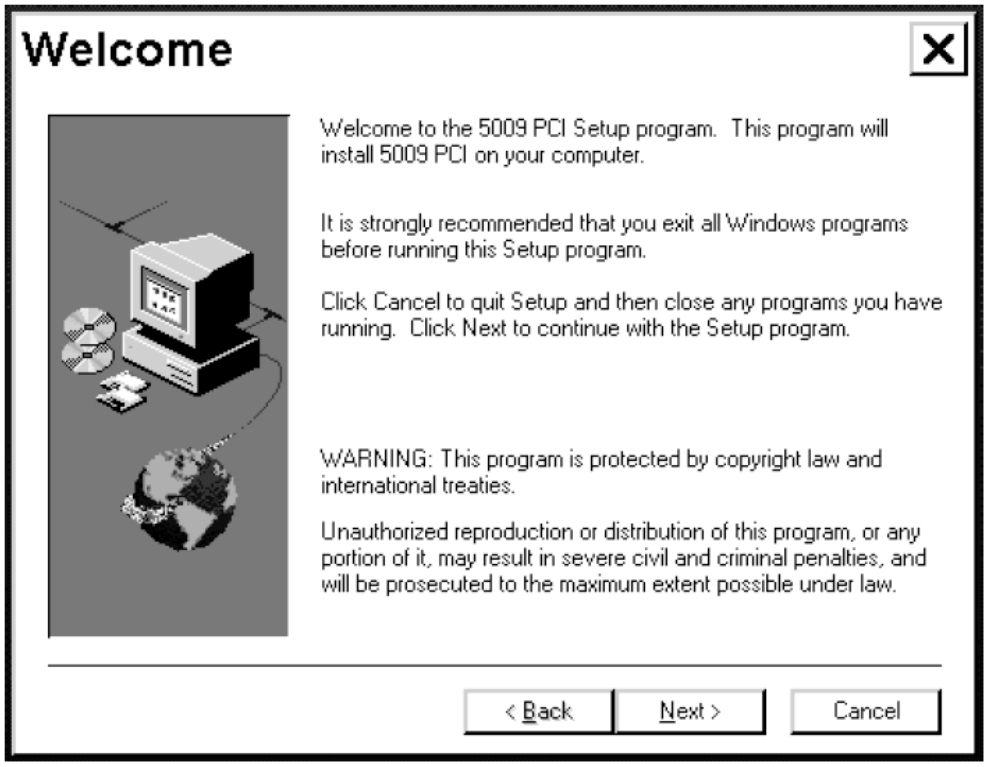
PCI Installation Procedure

STEP 1: Insert Diskette 1 of the installation disks or the CD-ROM provided with the 5009C control into the appropriate drive of your PC. Open the Run folder under Windows 95, Windows NT, or Windows 2000 as shown below.

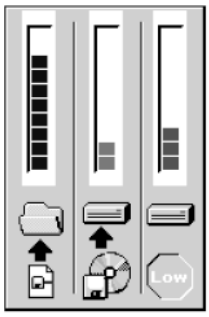


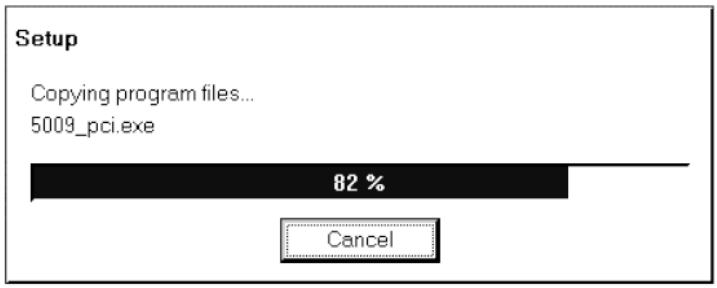
You can use the Browse feature of this folder to find the **Setup.exe** file on the disk or enter it directly on the Open line as **drive letter:\ setup.exe**. In the above figure the drive letter is A. Upon pressing a <CR> or clicking on the “OK” button the setup program will proceed to install the PCI and ServLink programs.



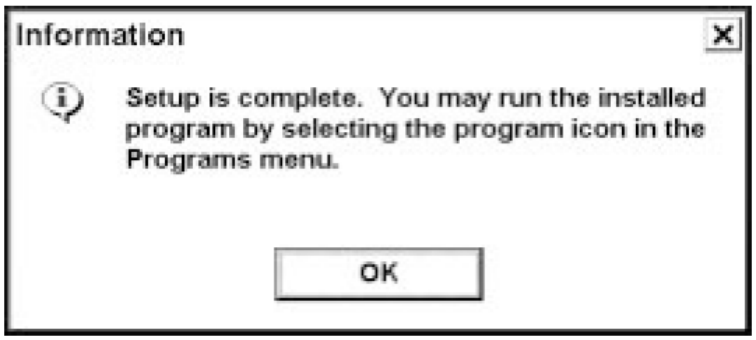


Once the setup program Welcomes you, click on “Next” button to copy all necessary files from the installation disks to your PC. When prompted insert Diskette 2.



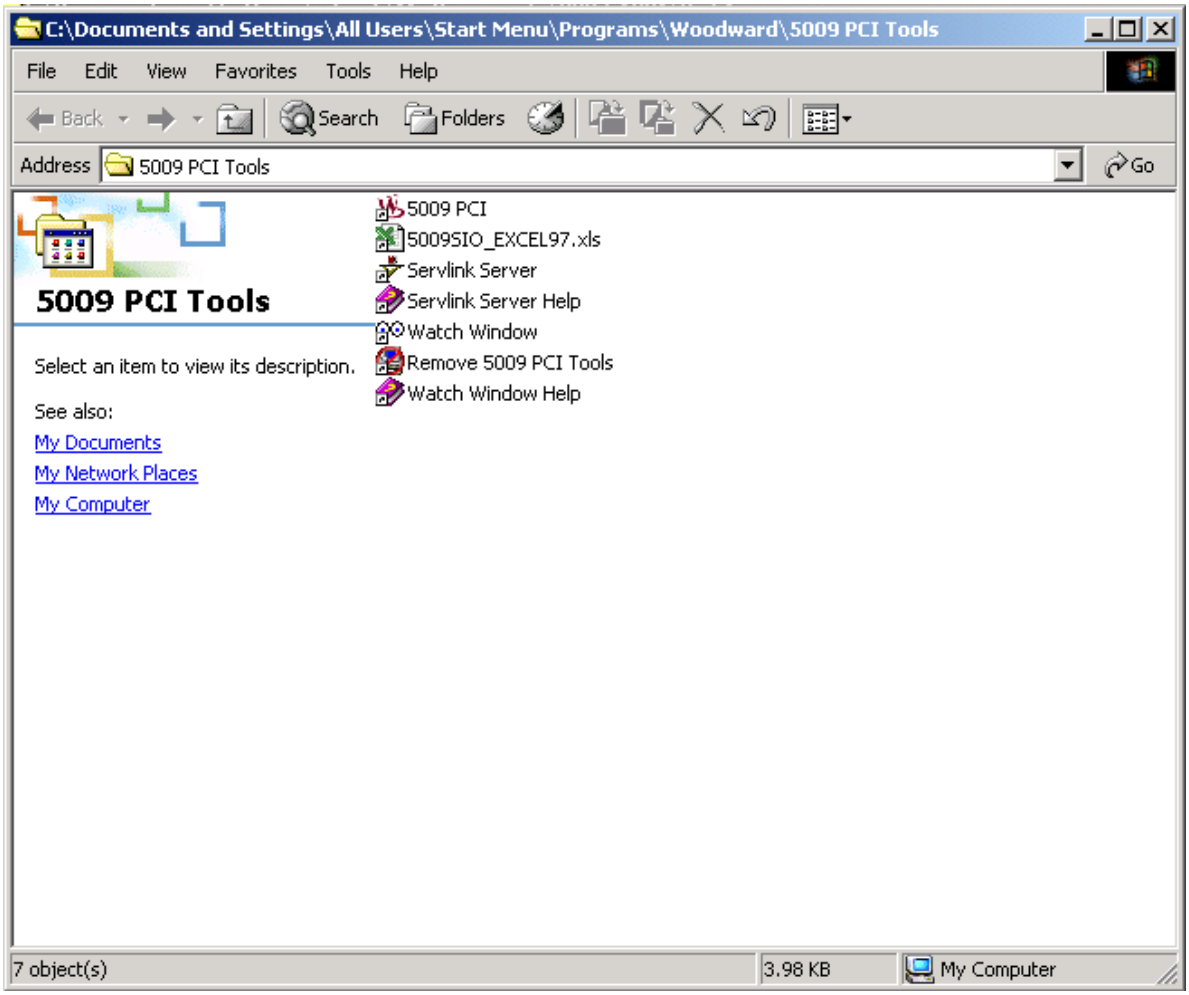


When the setup program has completed the installation, click OK on the screen below.



The setup program will install a Woodward 5009C PCI Tools menu into the Windows Start—Program menu tree. Within this menu the 5000_PCI, Print, ServLink, and Watch Window programs can be accessed. These programs can be initiated run by double-clicking on the icons associated with each program.

The setup program will automatically place all the necessary files for the PCI and ServLink programs in the **C:\Program Files \Woodward** directory. Once the installation is complete, you can verify that the files listed below have been installed on your PC. The size and dates of the files may not be the same as the ones at the time of this publication, and additional files may have been added for future features and upgrades.



STEP 2: Verify that the 5009C control has been properly installed with power applied and that all CPU's are correctly reset (reference Volume 1, CONTROL SYSTEM INSTALLATION PROCEDURE).

STEP 3: Connect the provided RS-232 serial cable (W20) between the 5009C control's CPU-C port and the desired computer port.

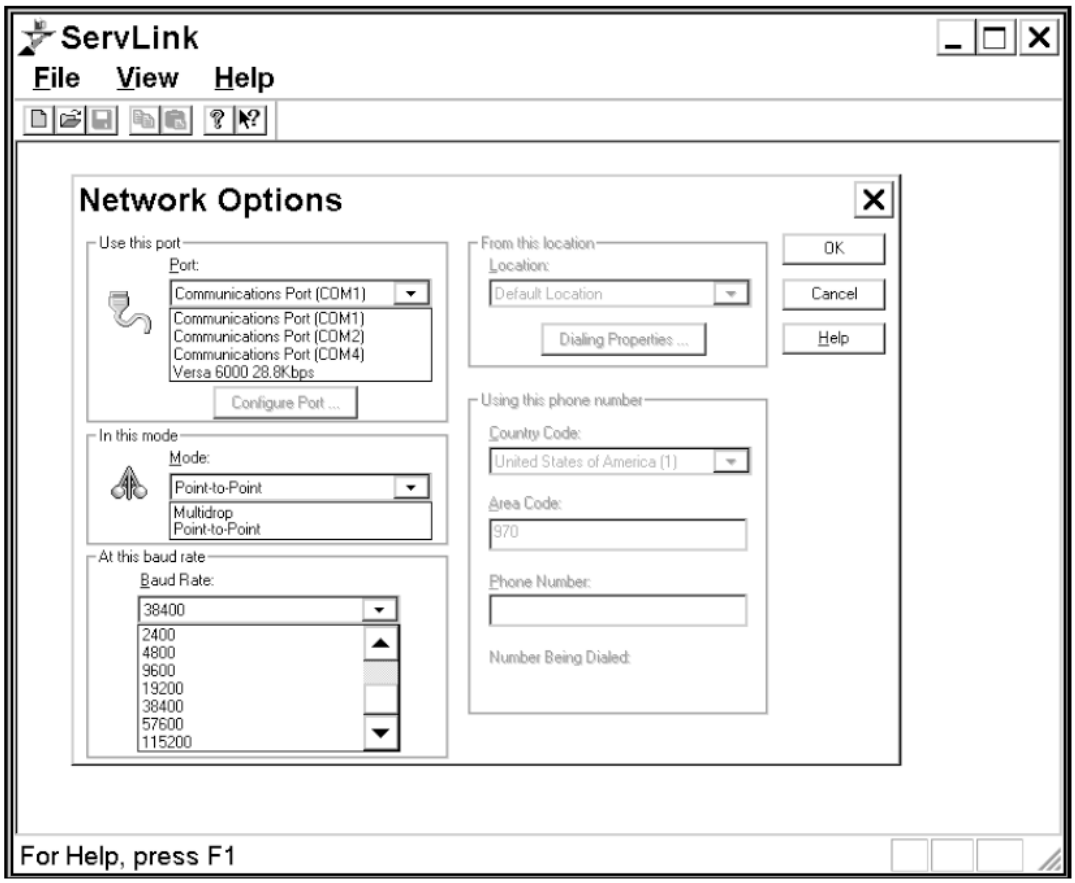
STEP 4: Open the ServLink program by selecting the ServLink Server option from the Windows Task bar's Start—Programs—Woodward 5009C PCI Tools menu or by Windows Explorer with the **C:\Program Files\Woodward\ServLink Server** directory open.

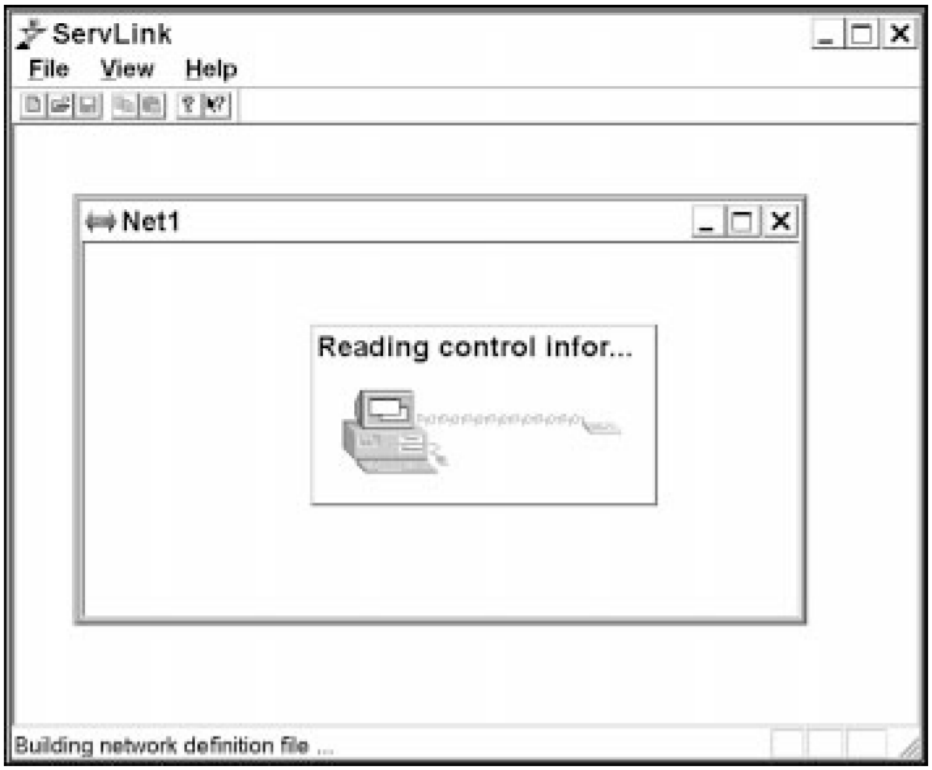
IMPORTANT

If when opening this program a TAPI error is received, install or reinstall the computer's modem drivers. The ServLink program uses one of the computer's modem ".dll" library files which is loaded with the computer's modem drivers.

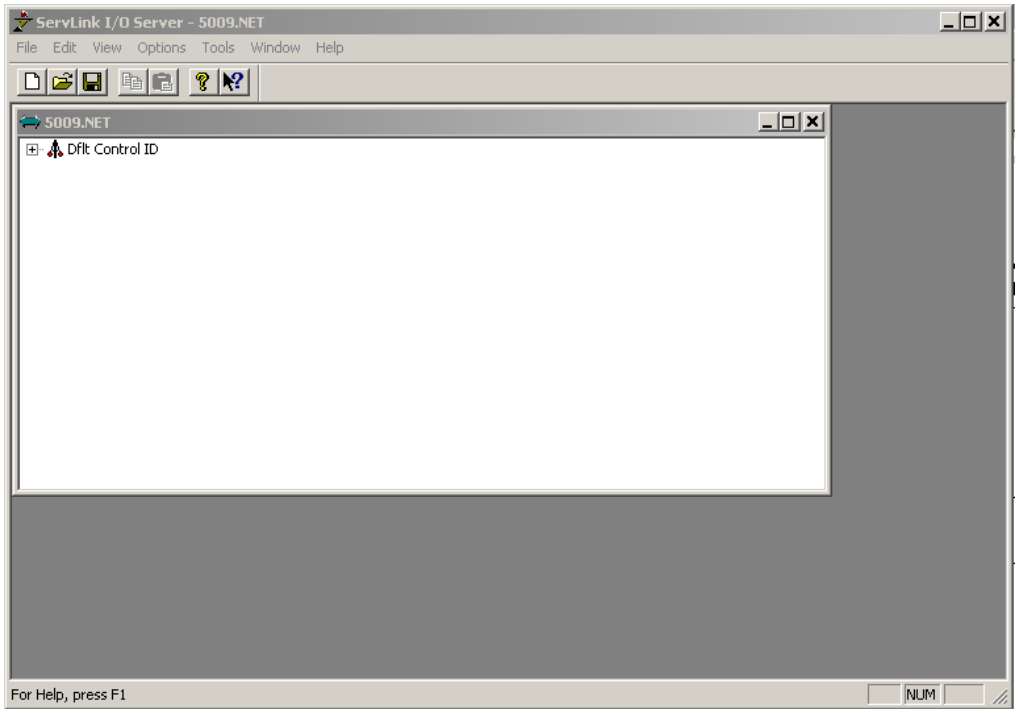
STEP 5: Within the ServLink program click on the New Page icon in the tool bar or select "NEW" under the "File" pull down menu. At this point a menu will appear to set up communications with the control. Select the communication port that the 5009C control is connected to, then click on the "OK" button. Unless otherwise directed by a Woodward representative, do not change any of the other default settings. The Default settings are: Communications Port—COM1, Mode—Point-to-Point, Baud Rate—38400.

Once the "OK" button has been selected, ServLink will access the control and build the network configuration file. The building of the network definition file may take 5 to 10 minutes. The "Reading Control information" folder will remain active until the ServLink program has finished building the configuration file. In the event that communications between the PC and the control are not working, a message will appear to that effect. Check your cable connections and verify your option selections in the above folder until the "Reading Control information" folder appears.


ServLink
File View Help
Network Options
Use this port
Port:
Communications Port (COM1)
Communications Port (COM1)
Communications Port (COM2)
Communications Port (COM4)
Versa 6000 28.8Kbps
Configure Port ...
In this mode
Mode:
Point-to-Point
Multidrop
Point-to-Point
At this baud rate
Baud Rate:
38400
2400
4800
9600
19200
38400
57600
115200
From this location
Location:
Default Location
Dialing Properties ...
Using this phone number
Country Code:
United States of America (1)
Area Code:
970
Phone Number:
Number Being Dialed:
OK
Cancel
Help
For Help, press F1


ServLink
File View Help
Net1
Reading control infor...
Building network definition file ...

STEP 6: Once the program has finished building the file, the new network definition file must be saved. Use the Save As option in the File pull-down menu of the ServLink toolbar to save the new file under the "**C:\Program Files\Woodward\ServLink Server**" directory. The ServLink—Net1 folder shows the new Dflt_Control_ID.NET file that has been created. Because the PCI program is defaulted to look for network definition file "5009.net" it is recommended that the new file be named "5009.net". In cases where multiple controls are being interfaced to with one computer it is recommended that each network definition file be given a unique name.



STEP 7: Close the ServLink Program. At this point the PCI and ServLink programs are fully installed and are ready for communication with the 5009C control. When the PCI program is opened and a network configuration file is requested, select the new file (typically 5009.net). This should guarantee compatibility between the control and the PCI program.

Starting the PCI

The PCI program is the only program that needs to be started to initiate communications with the 5009C control. The ServLink program will be automatically started by the PCI program as soon as a mode of operation is selected. The 5009C control must be connected to the designated computer before the PCI program can be started.

1. Verify that the PCI program has been installed on the designated computer (reference Volume 3, chapter 2, PCI INSTALLATION PROCEDURE).

2. Verify that the 5009C control has been properly installed with power applied and that all CPU's are correctly reset (reference Volume 1, CONTROL SYSTEM INSTALLATION PROCEDURE).

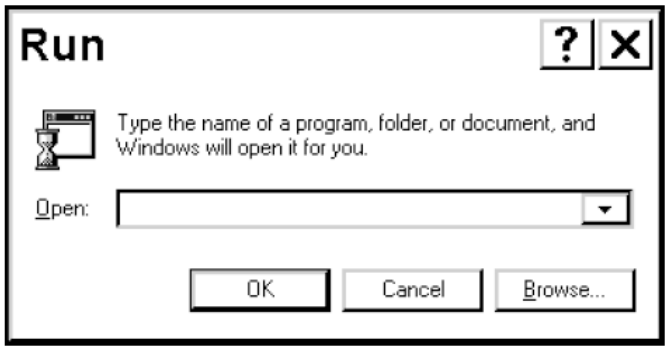
3. Connect the provided RS-232 serial cable between the control's CPU-C serial port and the designated RS-232 port on the computer.

The connection between the PC and the 5009C control consists of an EMI filter pin connector and a standard Null-modem computer cable with a standard 9 Pin-Sub-D, female connector used to interface with the 5009C control. The control-to- PCI-computer cable provided with the control system, is a 3.05 meter (10') serial cable with 9 Pin-Sub-D, female connectors. If a custom cable is necessary, reference the RS-232 Pinout diagram in Figure 2-1. The 5009C control must be connected to the designated computer before the PCI program can be successfully started.

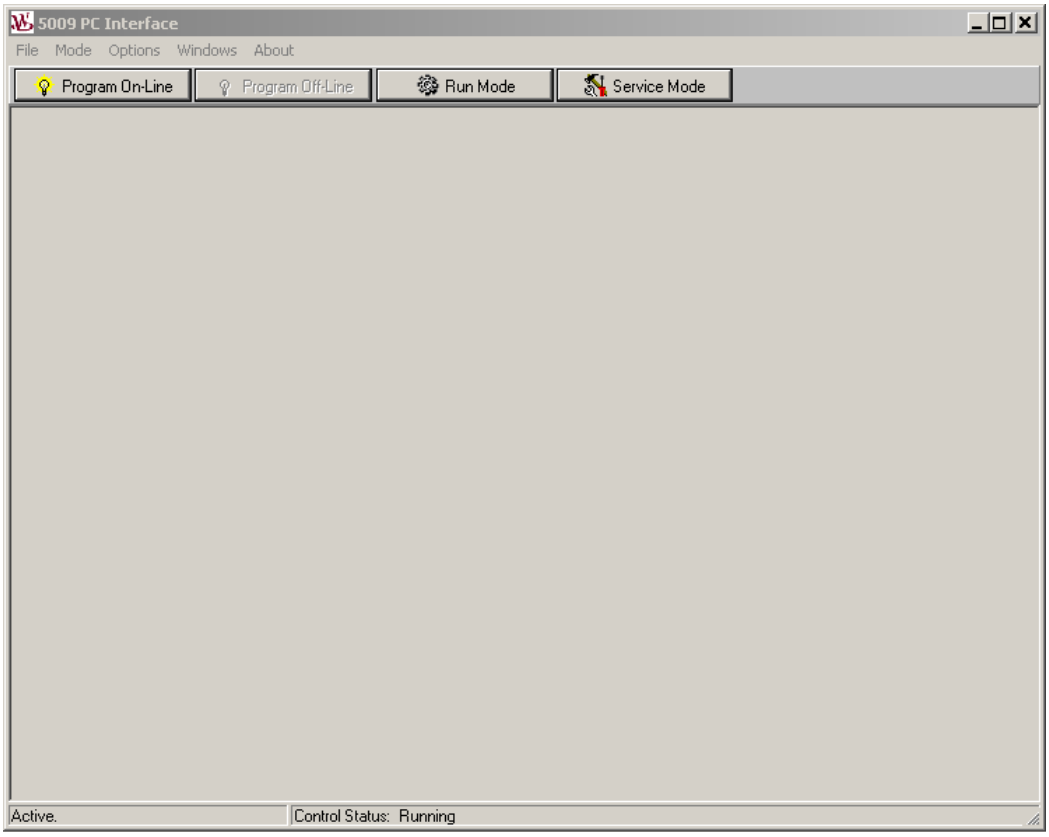
4. Open the 5009C_PCI program from the Windows Task bar's Start—Programs—Woodward 5009C PCI Tools menu or by Windows Explorer with the **C:\Program Files\Woodward\5009C PCI** directory open.

5. Select the Program, Run, or Service mode as desired.

6. When prompted select the Network definition file (5009.net) then select the "Open" button or press enter.



The following screen will appear if the PCI program is started correctly.



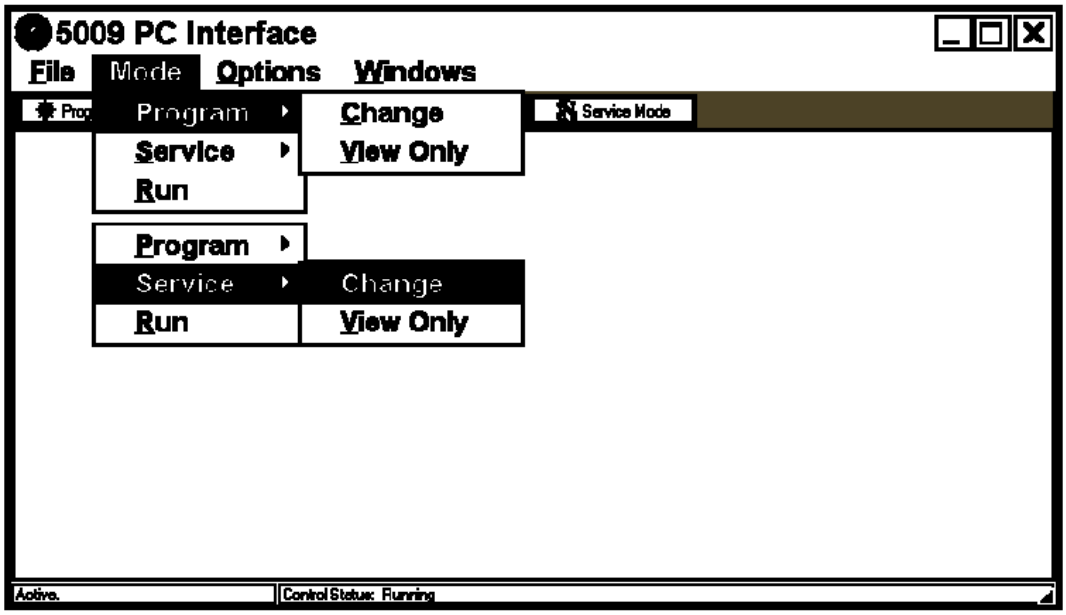
As shown below the control's CPU C's communication port is used to connect to the PCI program. Optionally the control can be configured to switch PCI communications from CPU C's port to CPU B's port if CPU C fails. Refer to Volume 2 of this manual for all possible PCI port options.

Entering Modes

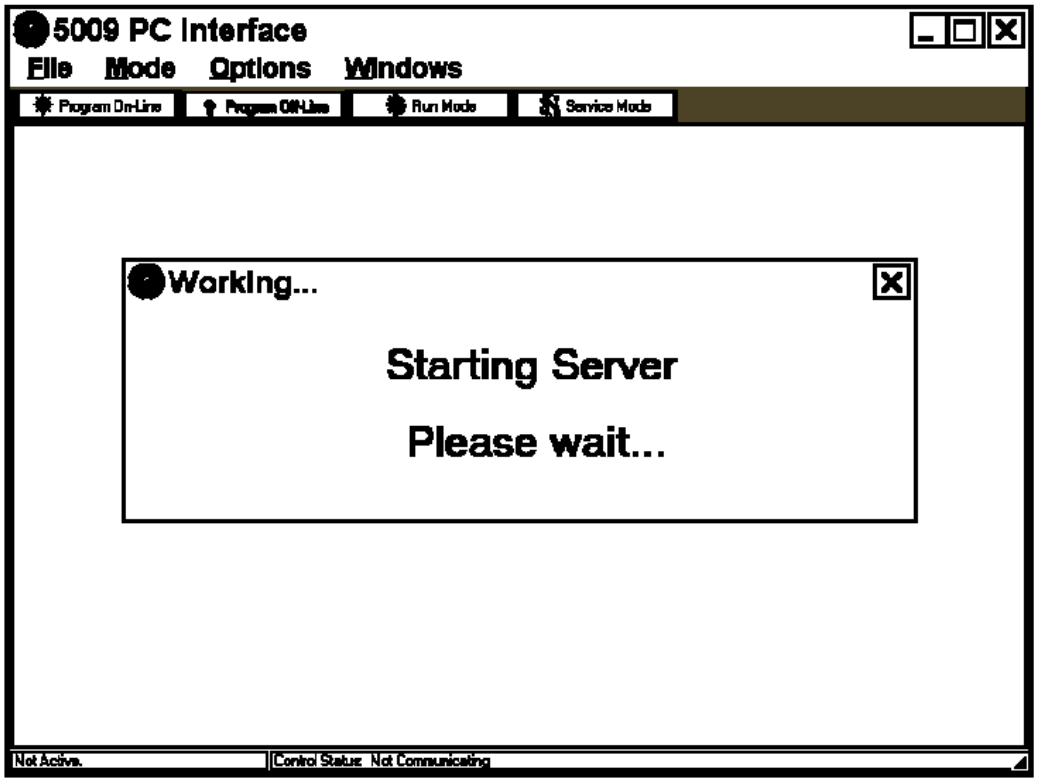
To enter one of the most commonly used modes of the PCI, the tool bar shown below can be used. Simply click on the appropriate button and the PCI will automatically initialize into the selected mode.

Program On-Line Run Service Change

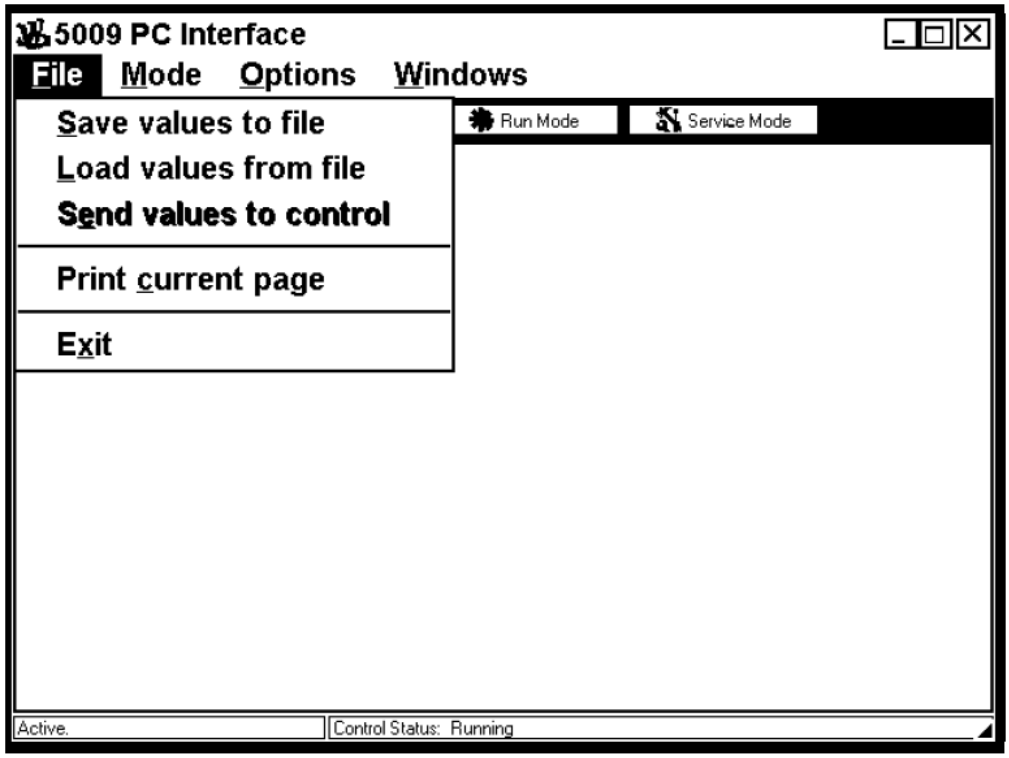
If a user wants to only view the 5009C control settings and not make any changes, both the Program and Service Modes offer View Only modes. The folder below shows all of the available modes of the PCI. Use the Mode pull-down menu of the PCI toolbar to select which mode you wish to use.



Once a mode has been selected, the PCI will open and start the ServLink program as shown below. It may take several seconds before the selected mode is activated and the PCI program begins communicating to the 5009C control.



For further information on the different modes and how each mode effects the 5009C control, see Chapter 3 for the Program Mode, Chapter 4 for the Run Mode, and Chapter 5 for the Service Mode.



Chapter 3.
Program Mode Procedures

Overview

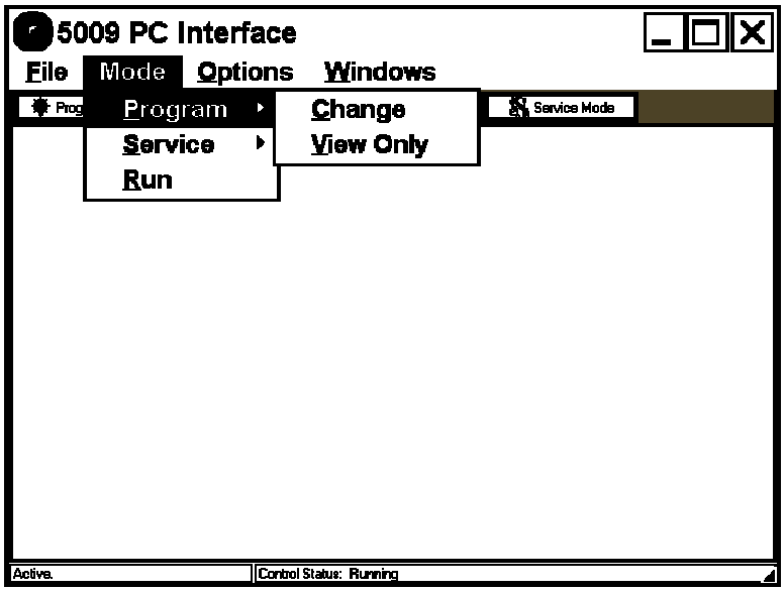
The Program Mode of the PC Interface program is a step by step procedure to program the MicroNet TMR 5009C control. A series of folders are used to allow the user to answer questions to every option the 5009C control contains. The following screens will step a user through all of the programmable features of the control system. For a better feel of the available options, the user can refer to the sample applications and the functional descriptions in Volume 1.

Opening the Program Mode

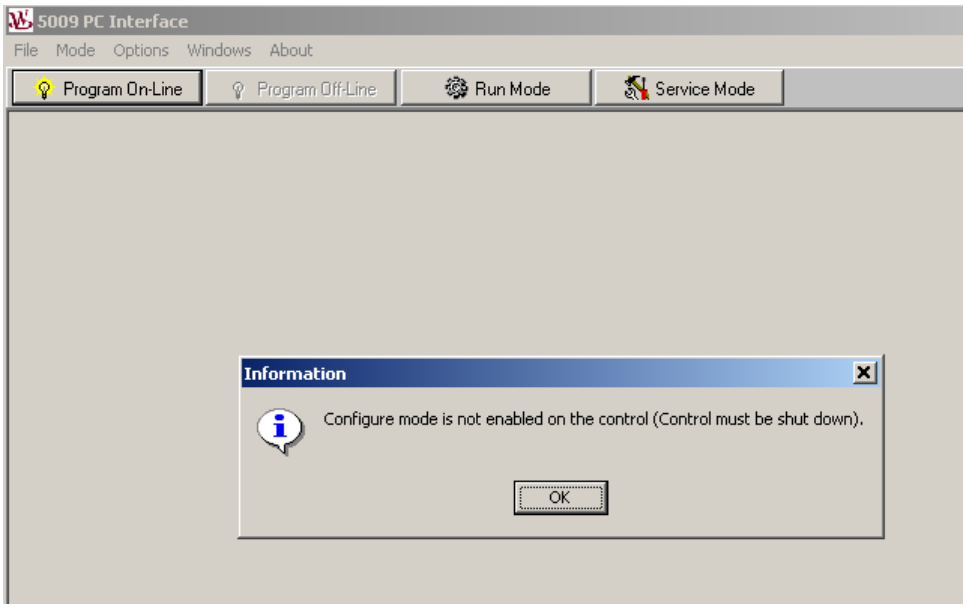
Two Program mode options are offered within the PCI software program (Program-Change, Program-View Only). The Program-Change mode is used to configure the control to the application, and is only accessible when the turbine is shutdown. The Program-View Only mode is used to view control configuration settings, with the turbine running or shutdown, but does not allow any settings to be changed.

The 5009C control and PCI host computer must be connected (via a serial RS-232 cable) before the PCI Program mode can be opened. Trying to open the PCI Program mode without a serial connection will result in a communications error.

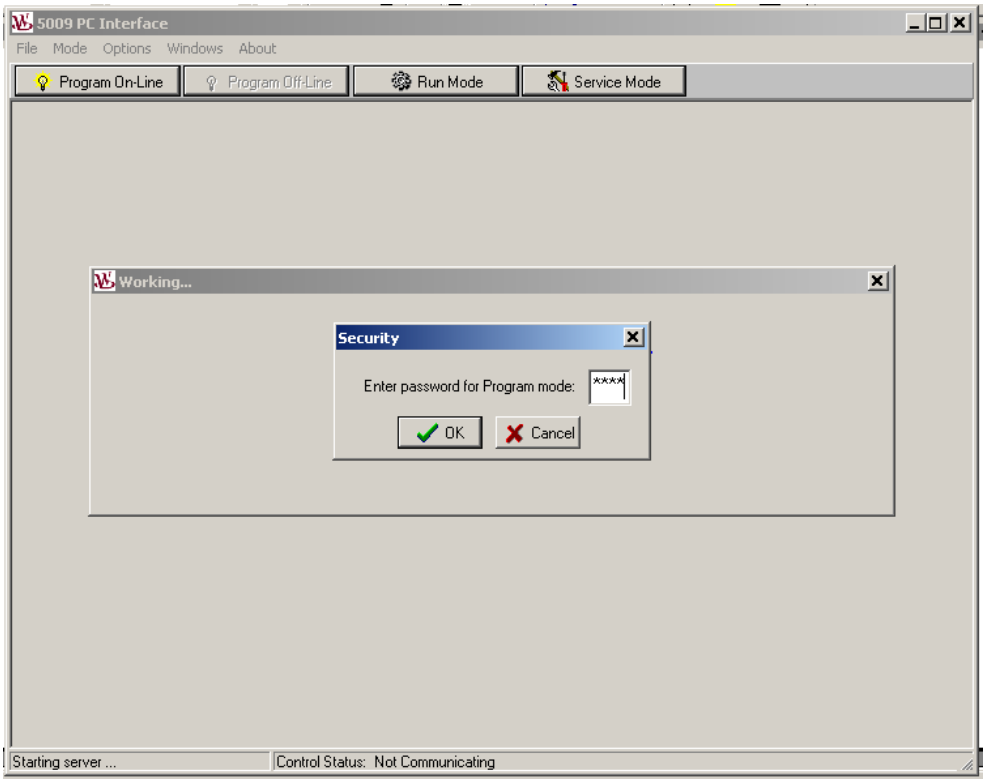
To enter the “Program Change” Mode click on the “Program On-Line” button on the program’s main tool bar in the screen below. If the PCI program has established communications with the control, when an open Program Mode request is made, the Program Mode opens immediately. If the PCI program is not communicating with the control, when an open Program Mode request is made, the program will make communication with the control via the ServLink program, then open the Program Mode. During the time the Server program is establishing communications with the control, a “Starting Server” indication box will appear.



In order to open the Program-Change mode, the 5009C control must be running and the turbine must be shutdown. In the event the turbine is not in a shutdown mode, the following screen will be displayed, and the 5009C control will not accept program changes.



If a program change is necessary, shutdown the turbine and try again. For security purposes, the program-change mode is password protected. The correct password must be entered before the program-change mode can be opened. The password for the program-change mode is located in Appendix A at the back of this manual. This allows Appendix A to be removed from the manual to limit access to the 5009C control.



Program—Change Mode Procedure

1. Verify that the turbine is shutdown.

2. Select the Program-Change mode by double-clicking on the “Program On-Line” button or via the “Mode”—“Program” menus, selecting the “Change” option.

3. Enter the correct password (refer to Appendix A of this volume)

4. Configure the control by stepping through each setting on each folder of the mode, starting with the Application folder (The Application folder settings determine the options and visibility of all other program folders). Refer to this chapter for an explanation on each setting.

5. When all configuration settings are complete, select the “Save to Control” button by clicking on it.
   - At this point if any configuration errors were detected the program will display an error box with a list of the errors detected and a brief explanation of each. By selecting the error (line), then clicking on the branch button the program will step you to the page where the error was detected. (The error box may need to be moved or closed to view/modify the program settings.) When all errors are corrected close the error box and select the “Save to Control” button again.
   - At this point if no configuration errors were detected, a pop-up box displaying “Program Configuration has passed the error check. Re-initialize Control? Yes/Cancel” will appear.

6. Click on the “Yes” button to exit the program mode and initialize the control for system start-up. A pop-up box will then momentarily appear displaying “Performing Control Initialization”.
7. At this point the PCI program can be closed or any PCI mode entered. The “RUN” mode can be entered to start and operate the turbine.

Program-View Mode Procedure

1. At any time select the Program-View Only mode via the “Mode”—“Program” menus, then select the “View Only” option.

2. View any settings desired.

3. This mode can be minimized or closed at any point by using the Window’s option buttons in the screen’s upper right hand corner.

Program Mode Screen

PCI Mode & Folder Panel

This panel is located at the top of the PCI program screen and indicates the PCI mode and folder that is opened and currently being displayed. An indication of “5009C PC Interface—[Program Mode—Speed Control]” indicates that the PCI’s Program mode is opened and the Speed Control folder is currently being viewed.

Control Status Panel

This panel is located in the PCI screen's lower most left corner and displays the status of the control.

Control Mode—Communications Status Panel

This panel is located at the bottom and middle of the PCI screen, and displays the control's current mode of operation, and the status of the ServLink program and communication link.

Option Bar

The screen's Option Bar, can be used like any Window's based program's option bar to select different program functionality through pull-down menus.

File—This menu is used to select, file saving, uploading, and print current page routines.

Mode—This menu allows a user access to open the different PCI program's modes.

Options—The routines associated with this menu are not complete or accessible

Windows—This menu is used to select the window's layout, when multiple modes are open.

Tool Bar

The screen's Tool bar has Program Mode specific command buttons, which are accessible from all folders.

Save To Control Button

This button is used after all Program mode parameters have been configured, to save the configuration settings to the control. Before configuration settings are saved, they are checked to verify that there are no configuration conflicts. Refer to the "Save to Control" section of this chapter, for more information on this button's functionality.

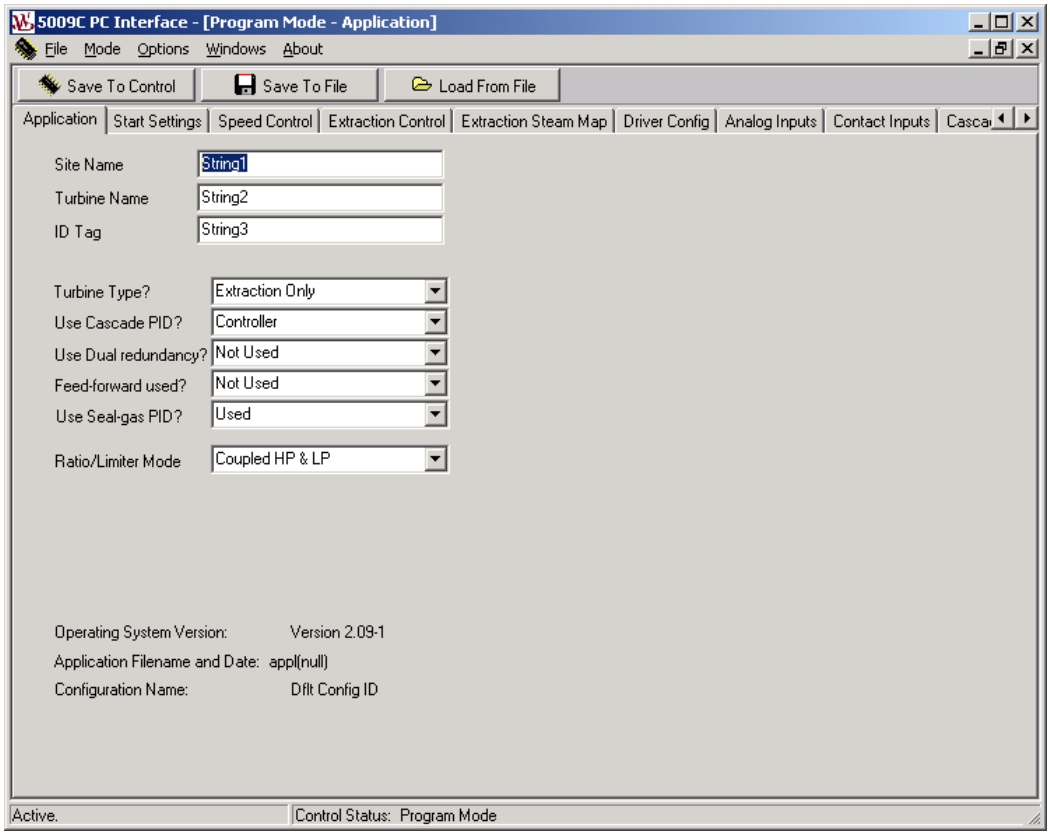
Save To File Button

This button can be used to save the configuration settings to a file, for backup purposes. Refer to the "Saving the Control's Configuration to a File" section of this chapter for more information on this button's functionality.

Load From File Button

This button can be used to upload a previously saved configuration file into the PCI program. Refer to the "Uploading a Configuration File to the Control" section of this chapter for more information on this button's functionality.

Application Page

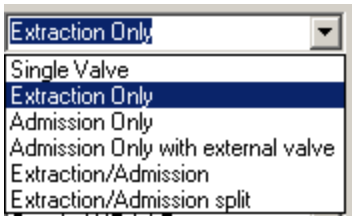


The Applications page is the first page or screen that appears upon entering the program mode and is used to match the control functionality to the application. The Application page settings determine the options and visibility of other program pages. The above screen is shown with all options and drop-down menu options are displayed for explanation reasons only.

Application Definitions—Site, Turbine, and ID Tag fields may be used to distinguish between applications and turbines. This information can help identify a turbine when downloading a program to a turbine or retrieving a program from a turbine. This information is saved in the control and is also saved in the configuration file when the control's configuration is saved to a file. When a file is retrieved, this information can identify which turbine is associated with this file.

Turbine Type

dflt = Single Valve



Single Valve

Select this option if the turbine being controlled is a basic steam turbine with only one steam valve.

Extraction Only
: Select this option if the turbine being controlled is a single controlled extraction turbine (has two modulating control valves; one inlet control valve and one extraction control valve).

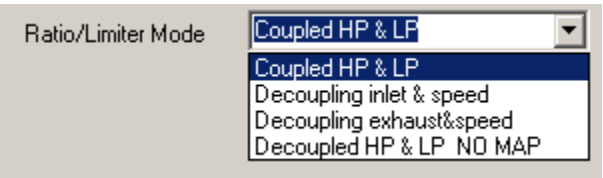
Admission Only
: Select this option if the turbine being controlled is a single controlled admission(induction) turbine (has two modulating control valves; one inlet control valve and one admission control valve)

Admission Only with external valve
: Select this option if the turbine being controlled is a single controlled admission (induction (has two modulating control valves; one inlet control valve and one admission control valve) feeding directly the LP body)

Extraction and Admission
: Select this option if the turbine being controlled is a single controlled extraction/admission turbine (has two modulating control valves; one inlet control valve and one extraction/admission control valve). With this type of application, the turbine can extract or admit steam, depending on system requirements.

Extraction and Admission split
: Select this option if the turbine being controlled is a single controlled extraction/admission turbine (has three modulating control valves; one inlet control valve, one extraction control valve and one admission valve). With this type of application, the turbine can extract or admit steam, depending on system requirements. The opening/closing of extraction and admission valves will be coordinated by the steam Map.

Ratio/Limiter Mode **dflt = Couple HP & LP**



This application option is only visible when configured for extraction, admission, or extraction/admission turbine types. The ratio/limiter logic controls the interaction of both HP and LP valves to control the desired turbine related parameters (i.e. speed, extraction pressure/flow, inlet pressure/flow, exhaust pressure/flow) and minimize the effects of one controlled process on the other controlled process.

When correcting for a system demand change in one process it may be desirable to have the control move both turbine valves at the same time in order to reduce or stop the interaction of one process on the other. For this reason the 5009C's Ratio/ Limiter can be configured in the following operational modes depending on the parameters being controlled and the turbine's function within the system (reference Volume 1, chapter 4 for detailed descriptions).

Coupled HP and LP
: This mode is typically used when the two controlled parameters during normal operation are turbine speed/load and extraction pressure (or flow).

Decoupled Inlet (HP)
: This mode is typically used when the two controlled parameters during normal operation are turbine inlet pressure (or flow) and speed

Decoupled Exhaust (LP)

This mode is typically used when the two controlled parameters during normal operation are turbine exhaust pressure (or flow) and speed.

Decoupled HP and LP

This mode is typically used when the two controlled parameters during normal operation are turbine inlet pressure (or flow) and exhaust pressure (or flow).

When any Inlet or Exhaust decoupled mode are selected, a page will appear in the PCI software, relative to the decoupling parameters.

Cascade Controller **dflt = Not Used**

Controller

Select the Cascade PID's functionality by configuring it as a Controller. The Cascade Control can be configured to control any system process, related to or affected by turbine speed or load. Typically, this controller is configured and used as a turbine inlet or exhaust pressure controller, compressor suction/discharge pressure controller. Cascade Control is a PID controller that is cascaded with the Speed PID.

By cascading these two PIDs, a bumpless transfer between the two controlling parameters can be performed.

Use Dual redundancy? **dflt = Not Used**

The 5009C can to handle up to two valve's redundancy controller.

When this menu is selected, a page will appear in the PCI, to configure the redundancy manager. These managers are capable to control any dual actuator skid such as the dual CPC skid, including alarming an auto switching.

Feed Forward Used? **dflt = Not Used**

In some cases, it is necessary to decouple the speed control and some other device such as anti surge controller.

The feed Forward loop, is a special feature, used to temporary bias the internal speed reference based on an external 4-20 mA signal,

This signal could be for example the Anti-surge valve position.

This feature includes also, the possibility to enable an emergency decoupling in case of surge a compressor.

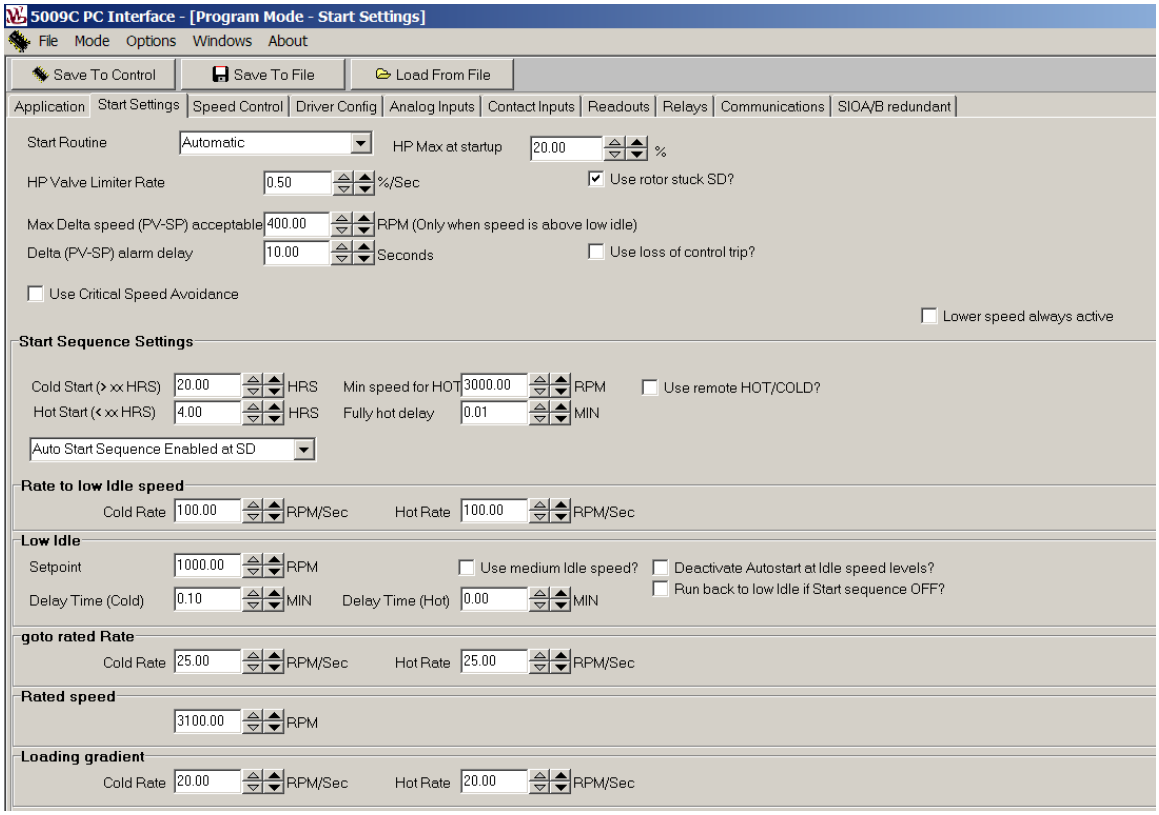
When "Used" is selected, a page in PCI software will appear, for configuration.

Use Seal Gas PID? **dflt = Not Used**

When selected, the 5009C offers the possibility to use an external PID loop. The loop can control the Seal Gas pressure or anything else.
If selected, an analog input must be configured as “Seal Gas Process Value”.

Program Information—Additional program information is displayed on the screen. This information displays the version of the 5009C’s operating software, application software, and what configuration file is being used. The software version information is for Woodward documentation and troubleshooting purposes only. The configuration file information allows the user to verify which configuration file the 5009C is using. Reference the “Saving the control’s configuration to a file” and “Uploading a Configuration File to the Control” sections of this chapter for more information on configuration files.

Start Modes Page



Start Routine **dflt = Automatic**

Manual Start

When configured for a manual start mode, the operator controls the turbine speed from zero up to the minimum control speed using an external trip-throttle valve. The Manual Start Sequence would be: Issue a Start command. The actuators automatically move to HP max position at start-up. Lastly, the operator slowly opens the trip-throttle valve until the governor takes control.

Semiautomatic Start

When configured, the 5009Cs HP limiter must be manually opened by the operator, slowly, to open the control valve and bring the turbine speed from zero up to the minimum control speed. The Semi-automatic Start Sequence would be: Open the T&T valve, then issue a Start Command. The 5009C control's valve limiter must then be raised by the operator until governor takes control.

Automatic Start

When configured for an automatic start mode, the 5009C controls the turbine speed from zero up to the minimum control speed. The Automatic Start Sequence would be: Operator opens the T&T valve, then issue a Start command. The HP valve limiter opens automatically until the governor takes control.

HP max at start-up **dflt = 20% (0, 100)**

This value will determine what percentage the inlet control (HP) valve can be opened when speed is below Low Idle.

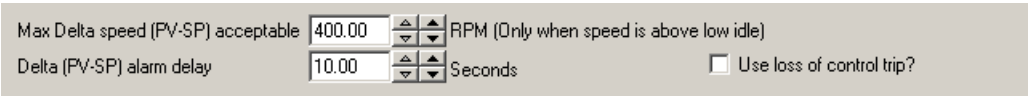
Use rotor stuck SD? **dflt = *TRUE**

Available only when manual start is not selected.
When HP valve reached HP max at start-up, and speed is still below low idle, then, when this option is selected, the engine will trip "rotor stuck Shutdown"

HP Valve Limiter Rate **dflt = 0.5 (0.0, 100)**

Enter the HP Valve Limiter Rate, in percent per second. This is the rate at which the HP valve limiter moves when a RUN command is given or when the limiter setting is changed through Raise/Lower commands. When using a semiautomatic or automatic start, this setting should be very slow—- typically less than 2%/sec. When using a manual start, this setting is less critical and can be left at the default of 5% / sec.

Max delta speed protection



This protection is used to prevent any loss of speed control by the 5009C.
As the 5009C is design for mechanical control, it must be , at all time, in control of the speed.

Max Delta speed (PV-SP) acceptable **dflt 400(0,1000)**

Define the maximum acceptable absolute deviation

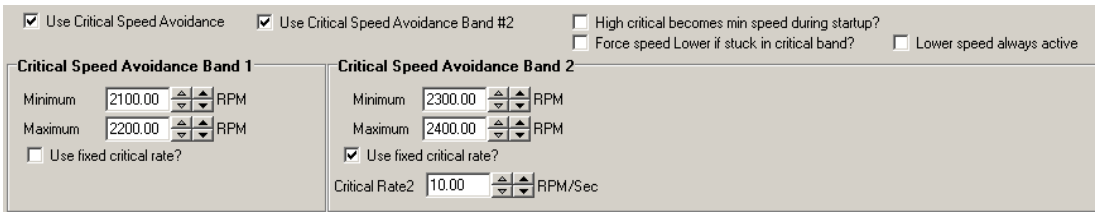
Delta (PV-SP) alarm delay **dflt 10(0,60)**

If the deviation is greater than the acceptable level, during more than this time (in seconds), an alarm will be generated

Use Loss of control trip? **dflt *FALSE**

If selected, instead of an alarm, a trip will be generated if the deviation is greater than the acceptable level, during more than "Delta (PV-SP) alarm delay" (in seconds)

Critical Speed Avoidance(s)
When checked, allows up to two critical speed avoidance bands to be programmed. Within the band, the speed setpoint cannot be stopped. These bands are used to protect the turbine and driven device from speeds that result in inherently high vibration.
The lowest critical speed min has to be greater than low idle.)



High critical becomes min speed during start-up? **dflt= *FALSE**
When selected, is the critical band is passed, then using R/L commands, it is not possible to lower the speed below Max critical band.

Lower speed always active **dflt= *FALSE**
When selected, a lower speed command will be accepted even if the speed is inside the critical band.
If not selected, it is not possible to lower the speed until the speed is not anymore inside the critical band.

Force speed lower if stuck in critical band? **dflt= *FALSE**
When the speed do not accelerate more than 0.2 time the supposed rate during 2 seconds, then an alarm, “stuck in critical will be generated. If the option lower is selected, the speed will be lowered below min critical speed.

Lower speed always active? **dflt= *FALSE**

If True, when inside a critical band, using Lower speed will lower immediately the reference, and the reference will go automatically to min critical.
If false, then lower has no effect until the speed reaches max critical.

Critical Speed Avoidance Bands
Minimum dflt = 2100 (1.0, 25000)
Set the lower limit (in rpm) of the critical speed avoidance band.
(Must be less than the ‘Critical Speed Maximum’ Setting)
Maximum dflt = 2200 (1.0, 25000)
Set the upper limit (in rpm) of the critical speed avoidance band.
(Must be less than the ‘Minimum Governor Speed’ Setting)

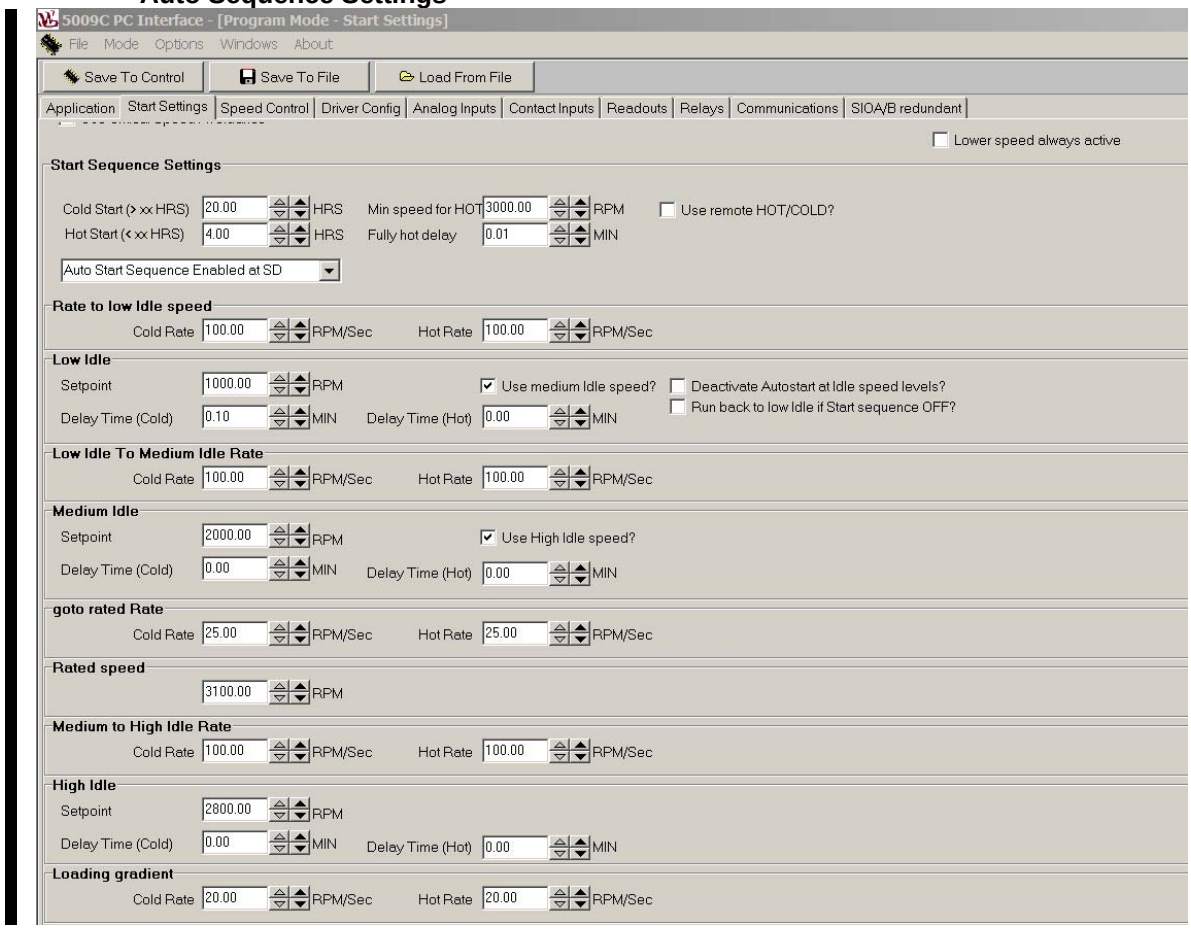
Use fixed critical rate **dflt = FALSE**

When not selected , the speed reference acceleration will depends on the autostart sequence parameters. This will allow Hot/Cold acceleration while speed reference is inside critical band.

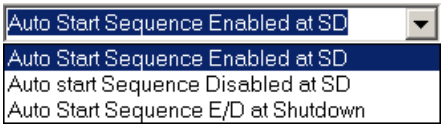
When selected, the speed reference will accelerate at a fixed rate, necessary higher than the rate used for auto start sequence

Critical Rate **dflt = 100.0 (1.0, 2000)**
Set the rate that the speed setpoint will move through the critical speed avoidance ranges (in rpm/second) when fixed rate is selected.
(Must be greater than the ‘fastest rate in auto start sequence’ Setting)

Auto Sequence Settings



Selection Autostart sequence at SD



Select one option (default is Enabled at SD).

When the engine is tripped, if “Autostart Sequence Enabled at SD” is selected, the auto start sequence will remain enabled regardless of the contact input E/D autostart sequence, Modbus commands or PCI commands.

When the engine is tripped, if “Autostart Sequence Disabled at SD” is selected, the auto start sequence will remain disabled regardless of the contact input E/D autostart sequence, Modbus commands or PCI commands.

When the engine is tripped, if “Autostart Sequence E/D at Shutdown” is selected, the auto start sequence can be Enabled/disabled via the contact input E/D autostart sequence, Modbus commands or PCI commands at any time.

Cold Start (Hours) **dflt = 20 (0.0, 500)**

Enter the time in hours allowed after a trip before the 'cold start' sequence curves are to be used. If this much time has expired (or more) after a trip condition, then the control will use the cold start values. If less than this time has expired, the control will interpolate between the hot and cold start values to determine rates and hold times.

Hot Start (Hours) **dflt = 4.0 (0.0, 500)**

Enter the maximum time allowed after a trip for the 'hot start' sequence curves to be used. If less than this time has expired after a trip condition, then the control will use the hot start values.
(Must be less than or equal to the 'Cold Start' Hours)

Min speed for HOT (rpm) **dflt = 3000.0 (0.0, 1500.0)**

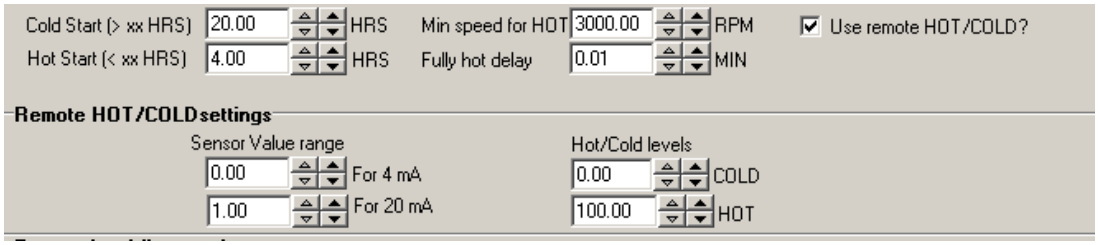
Enter the minimum speed to start to switch from COLD curve to HOT curves

Fully hot delay **dflt = 0.01 (0.0, 500)**

Enter the time to transfer from fully cold to fully HOT parameters when Min speed for hot is reached.

Use Remote HOT/COLD **dflt= FALSE**

Select this option if instead of the internal HOT/COLD timer, an external 4-20 mA signal is used to determine if the engine is HOT or cold



Sensor Value range:

For 4 mA **dflt 0(-20000,20000)**

Set the value of the remote HOT/COLD signal for 4 mA

For 20 mA **dflt 1(-20000,20000)**

Set the value of the remote HOT/COLD signal for 20 mA

Hot/cold levels:

COLD: **dflt 0(-20000,20000)**

Set the value of the remote HOT/COLD in EU when engine is COLD

HOT: **dflt 0(-20000,20000)**

Set the value of the remote HOT/COLD in EU when engine is HOT

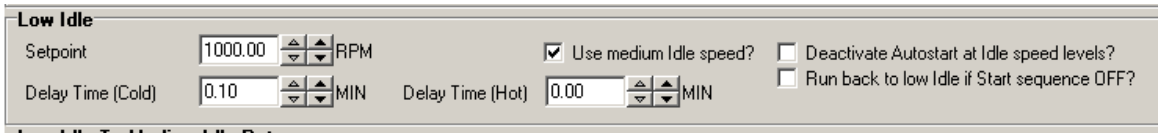
Rate to low-Idle speed:

COLD rate (in rpm/s): **dflt 100(0,1000)**

Set the acceleration value from zero to low-idle speed when engine is cold.

HOT rate (in rpm/s): **dflt 100(0,1000)**

Set the acceleration value from zero to low-idle speed when engine is hot.



Low Idle Setpoint **dflt = 1000 (10.0, 25000)**

Enter the Low Idle Speed Setting. This is the first hold speed. The speed setpoint will remain at this setting until the low idle delay/hold time has expired.

Delay Time (Cold)—Minutes **dflt = 1.0 (0.0, 500)**

Enter the cold start hold time desired at low idle. This is the programmable time, in minutes, that the turbine will wait/hold at the low idle speed when a cold start is determined.

Delay Time (Hot)—Minutes **dflt = 0.10 (0.0, 500)**

Enter the hot start hold time at low idle. This is the programmable time, in minutes, that the turbine will wait/hold at the low idle speed when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold delays to determine the low idle hold time.
(Must be less than or equal to the 'Low Idle Delay Time—Cold' Setting)

Use medium Idle speed? **dflt=*TRUE**

If selected, the auto start sequence will ramp the speed from Low idle to medium idle when Hot/cold delay are passed.
When speed is between Low idle and medium Idle, in manual mode, and continue sequence is selected the auto start sequence will ramp the reference to medium Idle, regardless to the delays.
If not selected, the auto start sequence will ramp the speed from Low idle to rated speed when Hot/cold delay are passed.
When the speed reference is between Low idle and min governor Idle, in manual mode, and continue sequence is selected, it will ramp to Rated speed regardless to the delays.

Deactivate auto start at Idle speed levels? **dflt= *FALSE**

When selected, each time that the speed reference reaches any configured Idle level, the auto start sequence will be halted, and speed reference will be put in manual. Even deactivated, the internal HOT/COLD delays at Idle are activated.
To continue the sequence, the operator must re- select continue, from contact input (open/close contact), Modbus or PCI.
If internal delay is passed, the speed will ramp to the next level, over wise, it will wait for the delay.

Run back to Low Idle if auto start deactivated **dflt= *FALSE**

When this option is selected, during start-up only, the speed reference will go to Low idle, as soon as the auto start sequence is halted using contact input, Modbus command or PCI.
If the auto start sequence is deactivated using R/L speed, then the speed reference won't ramp to low idle, and will stay at its level.
When engine speed is ramping back to low idle, using raise speed will stop this ramp back.

Low Idle To medium Idle Rate

Cold (rpm/sec) **dflt = 100 (0.1, 1000)**

Enter the cold start rate to medium idle. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to medium idle when a cold start is determined.

Hot (rpm/sec) **dflt = 100 (0.1, 1000)**

Enter the hot start rate to medium idle. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to high idle when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold rates to determine the acceleration rate to the hi idle setpoint.
(Must be greater than or equal to the 'Rate to Hi Idle—Cold' Setting)

Medium Idle Setpoint (rpm) **dflt = 2000 (0.0, 25000)**

Enter the medium Idle Speed Setting. This is the second hold speed when using the automatic start sequence. The speed setpoint will remain at this setting until the medium Idle Delay/hold time has expired.
(Must be greater than the 'Low Idle' Setting)

Delay Time(Cold)—Minutes **dflt = 0.0 (0.0, 500)**

Enter the cold start hold time desired at medium idle. This is the programmable time, in minutes, that the turbine will wait/hold at the medium idle speed when a cold start is determined.

Delay Time(Hot)—Minutes **dflt = 0.0 (0.0, 500)**

Enter the hot start hold time desired at medium idle. This is the programmable time, in minutes, that the turbine will wait/hold at the medium idle speed when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold delays to determine the medium idle hold time.
(Must be less than or equal to the 'High Idle Delay Time—Cold' Setting)

Use Hi Idle speed? **dflt=*TRUE**

If selected, the auto start sequence will ramp the speed from medium idle to HI idle when Hot/cold delay are passed.
When speed is between medium idle and Hi Idle, in manual mode, and continue sequence is selected the auto start sequence will ramp the reference to Hi Idle, regardless to the delays.
If not selected, the auto start sequence will ramp the speed from Medium idle to rated speed when Hot/cold delay are passed.
When the speed reference is between Medium idle and min governor Idle, in manual mode, and continue sequence is selected, it will ramp to Rated speed regardless to the delays.

Medium Idle To Hi Idle rate

Cold (rpm/sec) **dflt = 100.0 (0.1, 500)**

Enter the cold start rate to Hi Idle speed setpoint. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to Hi Idle from Medium Idle when a cold start is determined.

Hot (rpm/sec) **dflt = 100.0 (0.1, 500)**

Enter the hot start rate to the Hi Idle speed setpoint. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to HI Idle from Medium Idle when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold rates to determine the acceleration rate to the Hi Idle speed setpoint.
(Must be greater than or equal to the 'Rate to Rated—Cold' Setting)

HI Idle Speed Setpoint (rpm) **dflt = 2800 (0.0, 25000)**

Enter the Hi Idle Speed Setting. This is the third speed setting when using the automatic start sequence. *(Must be greater than medium Idle Setpoint' Setting)*

Delay Time(Cold)—Minutes **dflt = 1.0 (0.0, 500)**

Enter the cold start hold time desired at high idle. This is the programmable time, in minutes, that the turbine will wait/hold at the high idle speed when a cold start is determined.

Delay Time(Hot)—Minutes **dflt = 0.1 (0.0, 500)**

Enter the hot start hold time desired at high idle. This is the programmable time, in minutes, that the turbine will wait/hold at the hi idle speed when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold delays to determine the high idle hold time.
(Must be less than or equal to the 'High Idle Delay Time—Cold' Setting)

High Idle To Rated Rate

Cold (rpm/sec) **dflt = 100.0 (0.1, 500)**

Enter the cold start rate to the rated speed setpoint. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to rated from High Idle when a cold start is determined.

Hot (rpm/sec) **dflt = 25.0 (0.1, 500)**

Enter the hot start rate to the rated speed setpoint. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving to rated speed from High Idle when a hot start is determined. If the turbine has been shutdown for longer than the Hot time but shorter than the Cold time, the control will interpolate between the Hot and Cold rates to determine the acceleration rate to the rated speed setpoint.
(Must be greater than or equal to the 'Rate to Rated—Cold' Setting)

Rated Speed (rpm) **dflt = 3600 (0.0, 25000)**

Setpoint

Enter the Rated Speed Setting. This is the final speed setting when using the automatic start sequence. Once this speed setpoint is reached, the start sequence is complete.
(Must be greater than or equal to the 'Minimum Control Setpoint' Setting)

Loading gradient

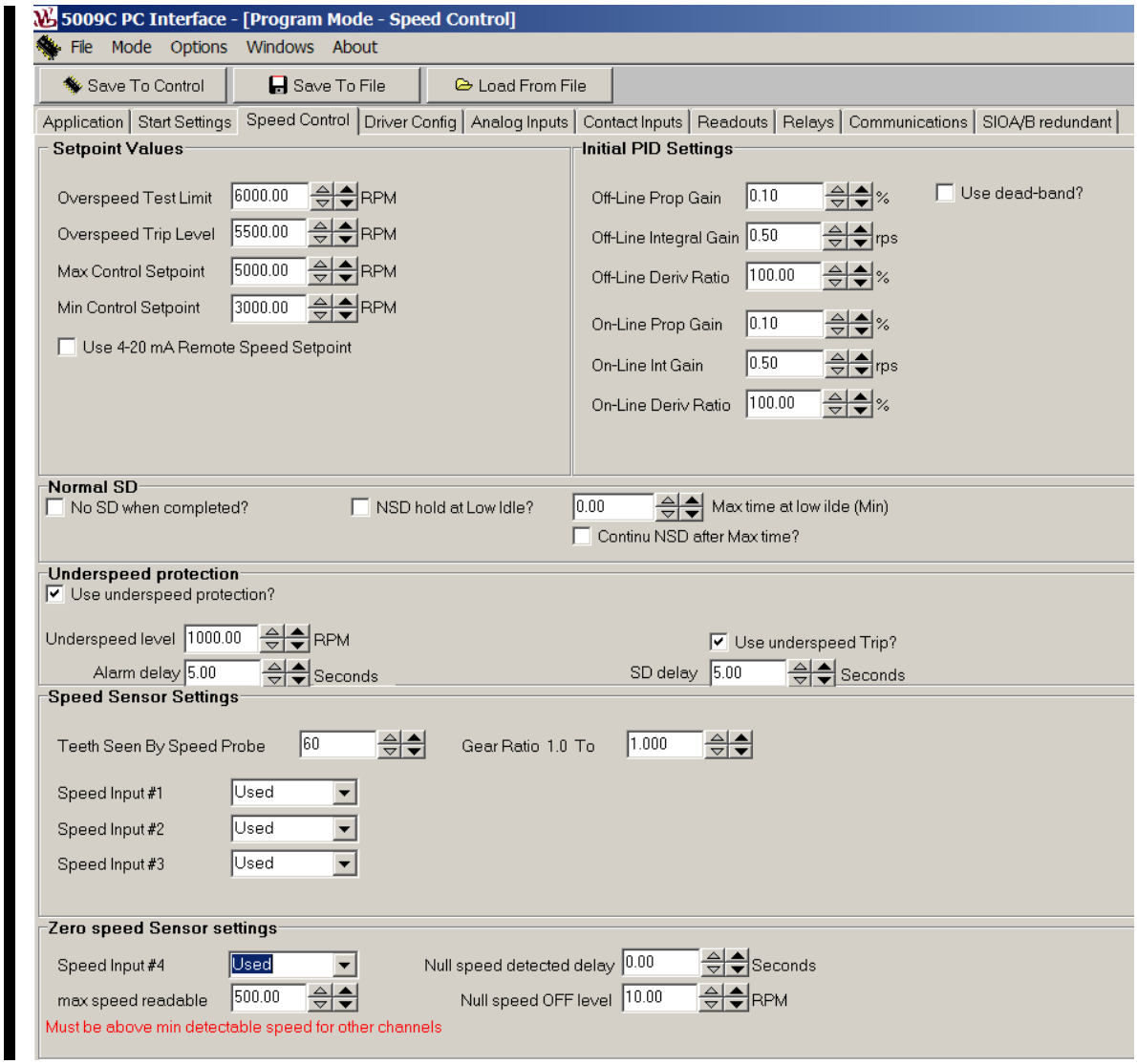
Cold (rpm/sec) **dflt = 20.0 (0.1, 1000)**

Enter the loading gradient. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving from min governor to max governor when a cold start is determined.
If cascade or remote speed setpoint are taking the control of the speed reference, this will remain the maximum rate to move the speed reference, in order to protect the engine against overloading/rotor stress.

Hot (rpm/sec) **dflt = 20.0 (0.1, 1000)**

Enter the loading gradient. This is the programmable rate, in rpm per second, that the speed setpoint will accelerate at when moving from min governor to max governor when a hot start is determined.
If cascade or remote speed setpoint are taking the control of the speed reference, this will remain the maximum rate to move the speed reference, in order to protect the engine against overloading/rotor stress.

Speed Control Page



Setpoint Values

Overspeed Test Limit **dflt = 6000 (0.0, 25000)**

Set the overspeed test limit (in rpm). This is the maximum speed setpoint the control will increase to when overspeed testing the unit. The setpoint can only be raised to this level when the overspeed test function is being performed.

Overspeed Trip Level **dflt = 5500 (0.0, 25000)**

Set the 5009C's overspeed trip level (in rpm). This is the governor overspeed trip setpoint only and is not to be used as ultimate overspeed protection.

(Must be less than the 'Overspeed Test Limit' Setting)

Maximum Control Setpoint **dflt = 5000 (0.0, 25000)**

Set the maximum governor control speed. This is the normal governor operation upper limit. For turbine/generator applications, this value must be at least equal to [Rated Speed + (Droop % x Rated Speed)].

(Must be less than the 'Overspeed Trip Level' Setting)

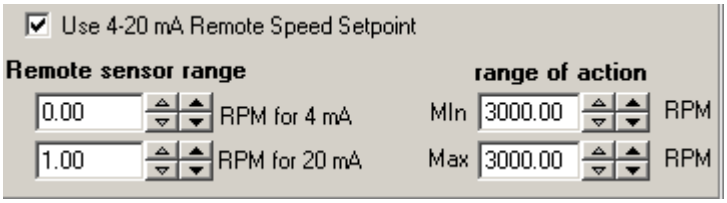
Minimum Control Setpoint **dflt = 3000 (0.0, 25000)**

Set the minimum governor control speed. This is the normal governor operation lower limit.

(Must be less than the 'Maximum In Control Setpoint')

Use 4-20 mA Remote Speed Setpoint **dflt = No (0.0, 25000)**

If checked, allows an external 4—20mA signal to change the speed setpoint.



Remote sensor range

RPM for 4 mA **dflt =0(0,25000)**

Speed reference for a signal of 4 mA

RPM for 20 mA **dflt =1(0,25000)**

Speed reference for a signal of 20 mA

Range of action

Min **dflt =0(0,25000)**

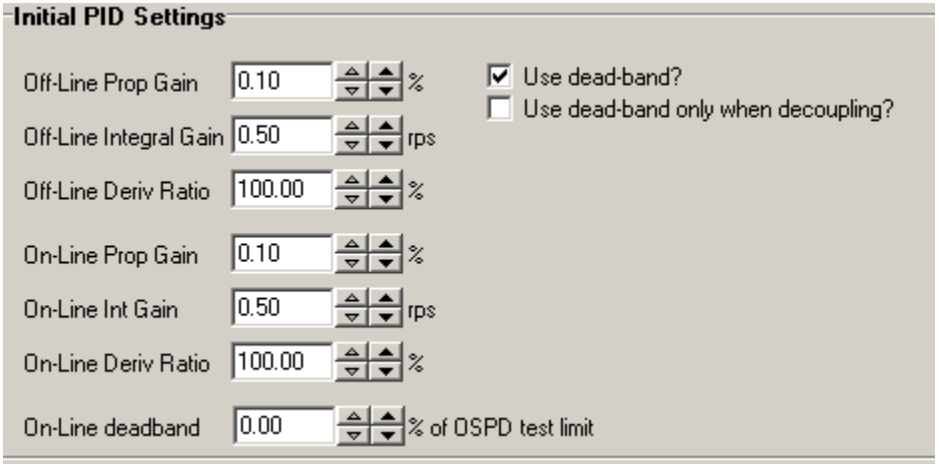
Minimum speed reference possible using the remote speed setpoint. *(Must be inside sensor range, above or equal to min governor and below or equal to maximum governor)*

Max **dflt =1(0,25000)**

Maximum speed reference possible, using the remote speed setpoint. *(Must be inside sensor range, above the min value and below or equal to maximum governor)*

Initial PID Settings

For a description of PID Settings and their effect on turbine operation, see Volume 1.



Off-Line Proportional Gain **dflt = 0.1 (0.005, 100)**

Enter the off-line PID proportional gain percentage. This value is used to set speed/load control response when the turbine speed is below minimum governor speed. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 1%.

Off-Line Integral Gain **dflt = 0.5 (.005, 50)**

Enter the off-line PID integral gain in repeats-per-second (rps). This value is used to set speed/load control response when the turbine speed is below minimum governor speed. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 0.5 rps.

Off-Line Derivative Ratio **dflt 100.0 (0.0, 100)**

Enter the off-line PID derivative ratio. This value is used to set speed/load control response when the turbine speed is below minimum governor speed. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 100%.(disabled)

On-Line Proportional Gain **dflt = 0.1 (0.0, 100)**

Enter the on-line PID proportional gain percentage. This value is used to set speed/load control response when the turbine speed is above minimum governor speed. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 1%.

On-Line Integral Gain **dflt = 0.5 (0.01, 50)**

Enter the on-line PID integral gain, in repeats-per-second (rps). This value is used to set speed/load control response when the turbine speed is above minimum governor. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 0.5 rps.

On-Line Derivative Ratio **dflt = 100.0 (0.0, 100)**

Enter the on-line PID derivative ratio. This value is used to set speed/load control response when the turbine speed is above minimum governor speed. This value can be changed in the Run Mode while the turbine is operating. A recommended starting value is 100%.(disabled)

Use dead-band? **dflt= *FALSE**

Select this option if it is desired to allow a small dead-band in the speed controller.

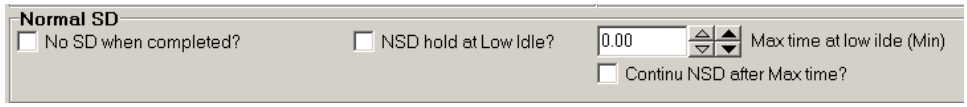
On-line deadband (% of OSPD limit) **dflt= 0(0,1)**

Define the deadband value when speed is above min governor

Use dead-band only when decoupling? **dflt= *FALSE**

Authorize the usage of a speed deadband, only when decoupling mode is active

Normal SD



The normal Shutdown function can be activated at any time.
When activated, it will disable Cascade/remote speed setpoint/extraction. Then, the speed reference will ramp down according the HOT settings of the auto start sequence without any holding point.
Once the speed reference reaches Low Idle setpoint, the valve limiter fully will close the HP valve.
The normal SD can be aborted at any time. In this case, the speed reference will be put in manual mode. R/L speed reference or Auto start sequence can be used to bring back the engine to rated speed. Delay in auto start sequence won't hold the speed reference if already satisfied during first start-up.

No SD when completed? **dflt= *FALSE**

When selected, once the normal shutdown is completed (valve fully closed), the 5009C won't issue a Shutdown. The engine will remain ready to start.
If not selected, once the valve is fully closed, a Shutdown will be issued when normal SD is completed.

NSD to low idle only? **dflt= *FALSE**

When selected, the normal Shutdown function will automatically be aborted when speed reference reaches Low Idle speed.

When selected, the normal shutdown function will hold the speed reference at low idle, for a maximum time set as " Max time at low Idle (Min)"

Once the timer is passed, the Normal SD will stop if "Continu NSD after Max time is not selected, or continu if "Continu NSD after Max time" is selected:

Underspeed protection

This function protects the engine against underspeed. If used, it will remain activated at any time once speed as reached min governor, and as long as no Shutdown is issued.

The Underspeed protection may interact with the normal SD function, generating a Shutdown while normal SD is in progress.

Use Underspeed protection? **dflt= *TRUE**

When selected, the underspeed protection is activated

Underspeed level (rpm) **dflt 1000(500,20000)**

Enter the underspeed level

(Must lower than 99% of min governor)

Alarm delay (seconds) **dflt= 5(0,100)**

Enter the delay before an alarm is generated when speed is below the underspeed level.

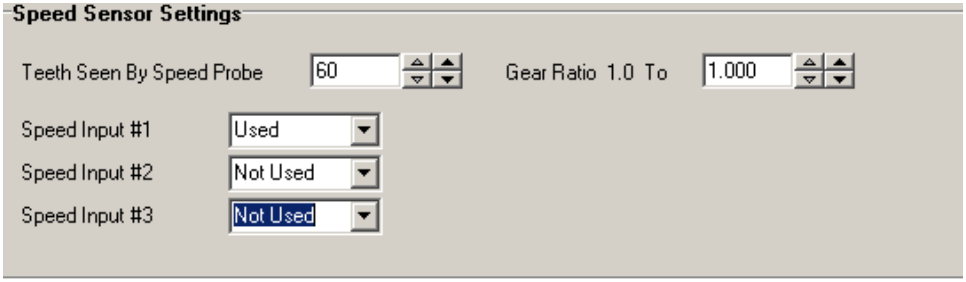
Use underspeed Trip? **dflt= *FALSE**

When selected, the underspeed protection will generate a trip condition when speed is below the underspeed level during more than the authorized delay time.

SD delay (seconds) **dflt 5(0,100)**

Enter the delay before a trip is generated when speed is below the underspeed level.

Speed Sensor Settings



Teeth Seen By Speed Probe **dflt = 60 (1.0, 300)**

Enter the number of teeth on the gear that the speed probe is mounted on. This parameter is also valid for input#4.

Gear Ratio 1 to x.x **dflt = 1.0 (0.1, 10)**

Enter the speed sensor gear ratio. This value is the ratio of the speed sensor gear to the turbine shaft. This gear ratio is the result of dividing the speed of the speed sensor gear by the speed of the turbine shaft. If speed sensor gear is mounted on the turbine shaft, the ratio is 1.
This parameter is also valid for input#4.

Speed Input #1—3 USED/Not used **dflt = USED**

.

Define if the speed probes)MPU or proximity probes is used by the control A minimum of one is mandatory. PCI will refuse the configuration if it is not the case.

Zero speed Sensor Settings

Speed input#4 is specially dedicated for zero speed detection. This channel should be connected to a proximity probe, for proper resolution.

Speed Input#4 **dflt= Not used**

Select USED if null speed detection is desired, and null speed probe used.

Max speed readable: **dflt 500(250,2000)**

This is the maximum speed that this channel can read. The lower this level is, the better the resolution is.
For failure check, it is necessary that this level be above the minimum detectable speed of speed inputs #1-3.

Null speed detected delay (seconds) **dflt 0(0,90)**

This setting is in conjunction with a relay output configured as “null speed relay”. When speed is at zero, the relay will wait during this delay, before it can energize.

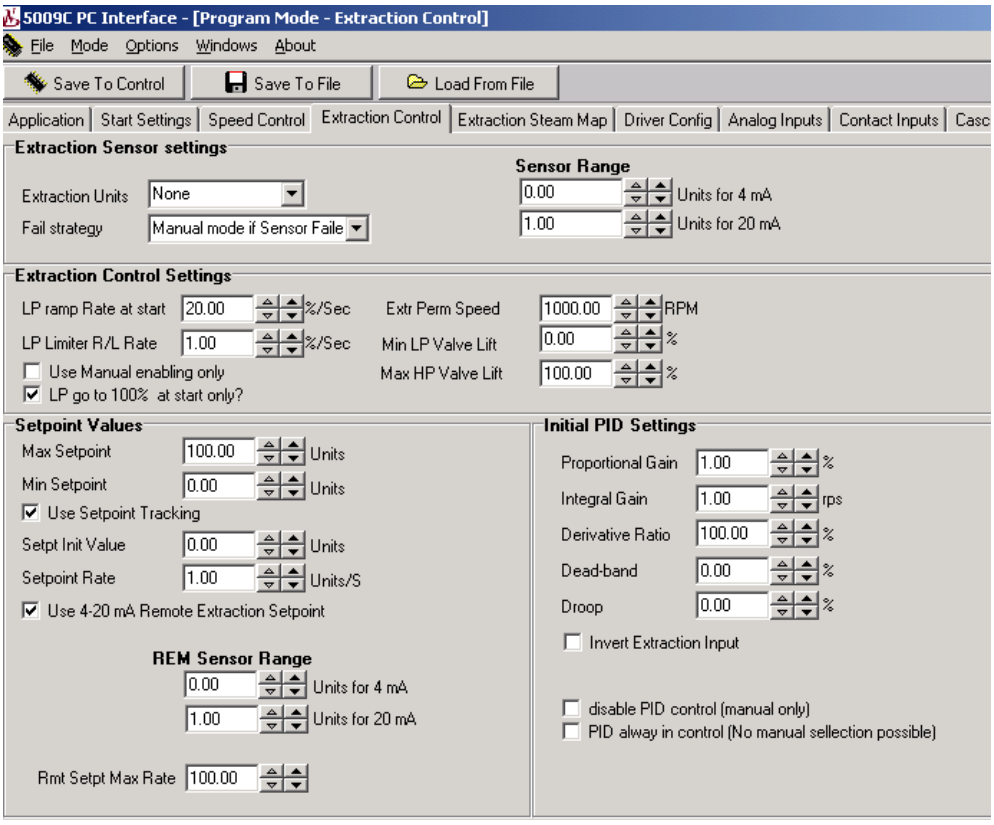
Null speed OFF level (rpm) **dflt 10(0.1,500)**

Because the null speed detection can be used to start a turning gear, the null speed must remain detected, while turning gear is switched ON.
The OFF level is the maximum speed accepted, to hold the configured “null speed” relay switched ON.

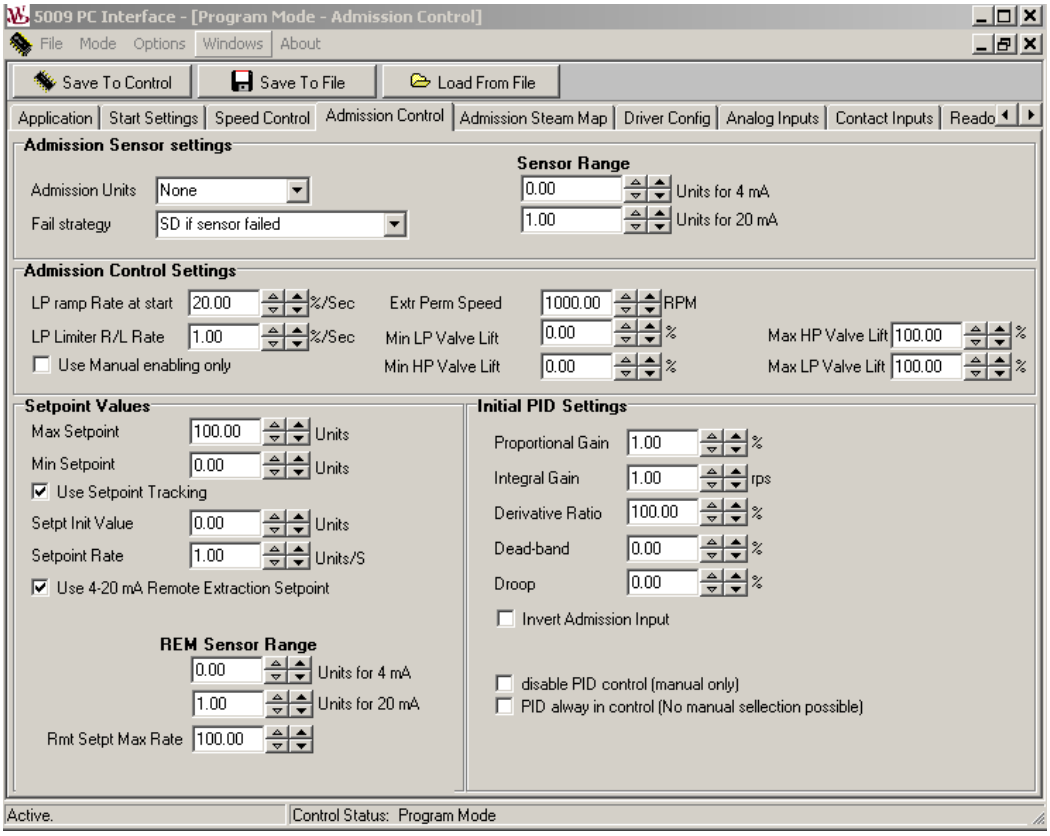
See volume 1 of this manual for more explanations of the protection relative to this function

Extraction/Admission Folders

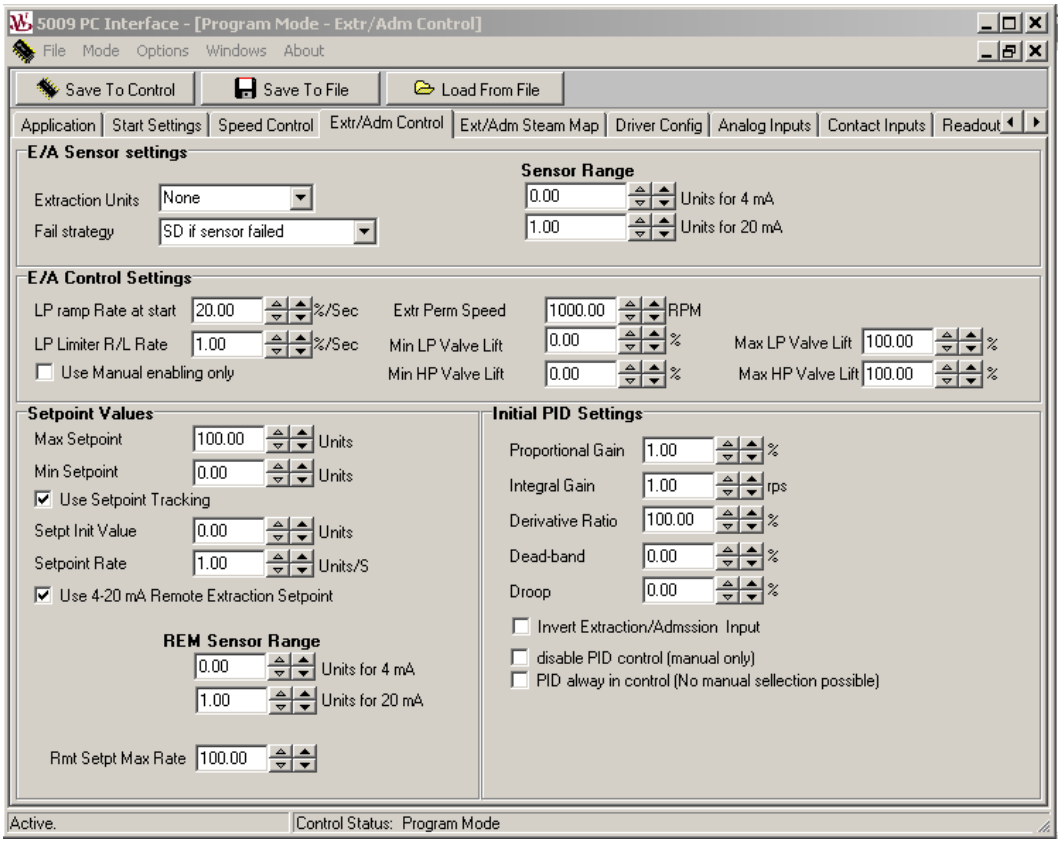
Extraction folder:



Admission folder



Extraction& Admission folder

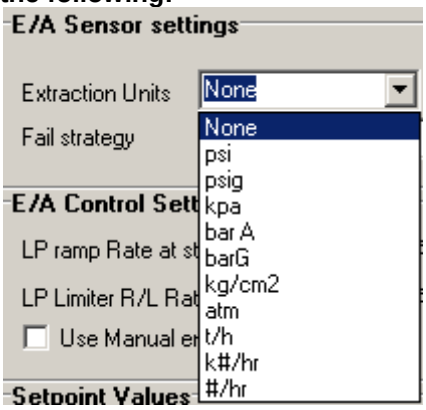


The 5009C can be configured for extraction, admission, or extraction/admission types of steam turbines. Following are examples for each of these configurations. Please proceed to the appropriate configuration for your application.

Due to the similarities in the Extraction, Admission, and Extr/Adm Folders, the separate pages are displayed above, however the folder's option descriptions are combined.

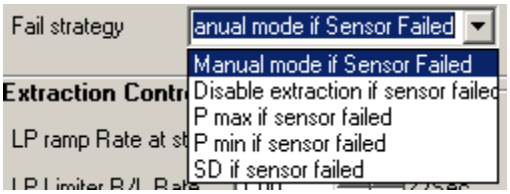
Extraction/admission/E/A sensor settings

Units—Select one of the following: **dflt = None**



these units will be coded and send through Modbus for HMI usage.

Fail strategy—Select one of the following: **dflt = Manual mode**



When an extraction/admission/E/A sensor if detected faulty, then the control will decide the strategy to apply based on this settings
If Manual mode is selected, then the operator can manipulate the Pressure/flow demand in OPEN loop, until the sensor is repaired.

If P max is selected, then the control will ramp P to 100% (minimum position of LP according steam map load)

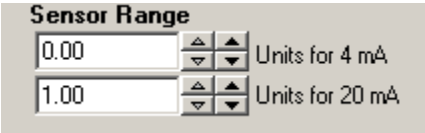
If P min is selected, then the control will ramp P to zero (maximum LP position according steam map load)

If SD is selected, then the turbine will trip as soon as the sensor is detected fault.

Sensor range:

The 5009C request the Analog sensor range in this folder, (not anymore in the analog input folder).

If several transmitter (#1,#2,#3) are used, they must all have the same range



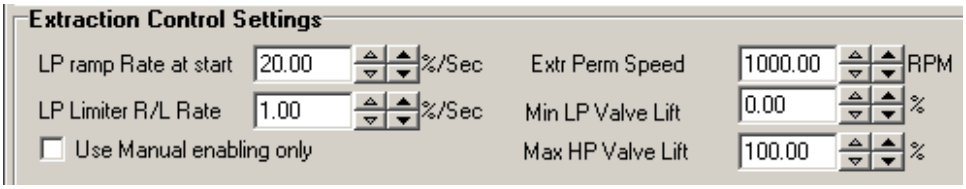
Value 1 (Units for 4 mA) **dflt=0(-20000,20000)**

Set the pressure/flow for 4 mA

Value 2 (Units for 20 mA) **dflt=1(-20000,20000)**

Set the pressure/flow for 20 mA

Extraction/Admission/E/A control settings



LP ramp Rate at start (%/s) **dflt = 20 (1,50)**

Set the LP ramp rate at which the LP valve will ramp from 0% to 100% when start is issued.

LP Limiter R/L rate (%/s) **dflt =1 (0.1,10)**

Set the LP limiter rate at which the ramp limiter will move when extraction/admission is enabled (automatic) or if R/L commands from contact/Modbus/PCI are used.

Use Manual enabling only **dflt=*False**

Select this function if it is not desired to ramp the LP valve limiter automatically (zero for Extraction or Admission with external valve) when extraction/admission is requested.

Extr Perm speed (rpm) **dflt= 1000(0,20000)**

Set the minimum speed to authorize extraction/Admission control (manual or automatic)

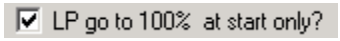
Min LP lift (%) **dflt= 0(0,100)**

Set the minimum position of the LP valve authorized when Extraction/admission is enabled.

Max HP lift (%) **dflt=100(0,100)**

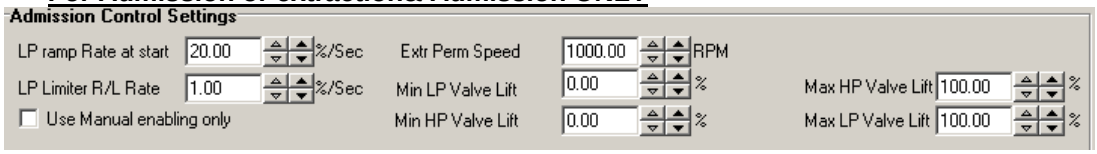
Set the maximum position of the HP valve authorized in any cases.

For extraction ONLY



Select this option if it is desired to open LP valve only when engine is started.
If not selected, the LP valve will open when all trips are cleared.

For Admission or extraction& Admission ONLY



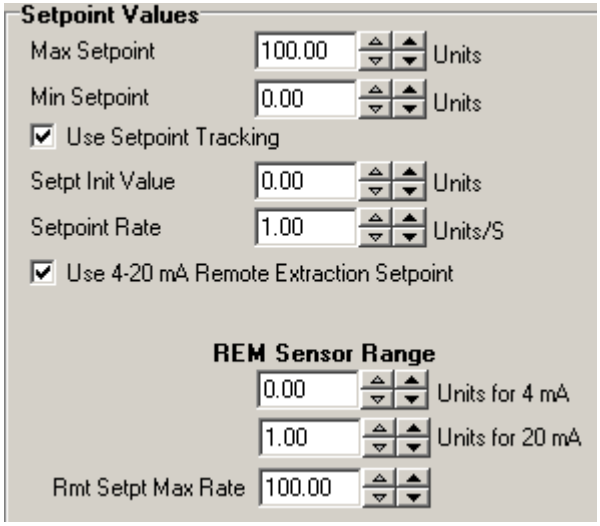
Max LP Valve lift **dflt=100(0,100)**

Set the maximum position of the LP valve authorized

Min HP Valve lift **dflt=100(0,100)**

Set the minimum position of the HP valve authorized when admission or extraction& Admission are enabled.

Setpoint Values



Maximum Setpoint **dflt = 100.0 (-325000, 325000)**

Set the maximum extraction/admission setpoint. This value is the maximum setpoint value that the extraction/admission setpoint can be increased/raised to (upper limit of extraction/admission setpoint).
(Must be greater than the 'Minimum Setpoint' Setting)

Minimum Setpoint **dflt = 0.0 (-325000, 325000)**

Set the minimum extraction/admission setpoint. This value is the minimum setpoint value that the extraction/admission setpoint can be decreased/lowered to (lower limit of extraction/admission setpoint).

Use Setpoint Tracking **dflt = Yes**

If checked, at power up, the setpoint will track the process value when extraction/admission are disabled or in manual mode.
The tracking/Not tracking command can later be changed via Modbus/PCI only.
If tracking is not selected, then the operator can change the setpoint at any time.
However, to avoid any bump while extraction/Admission automatic mode is enabled, an internal (hidden) setpoint of the 5009C will take care of a smooth transfer at the “not match rate” configured in Service mode.

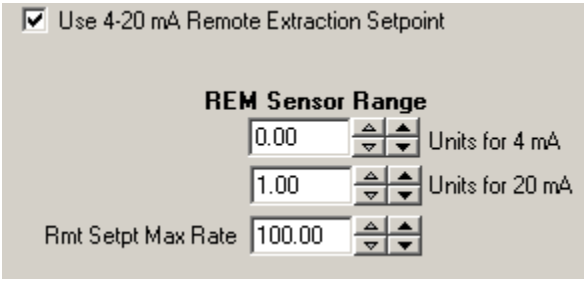
Setpoint Initial Value **dflt = 0.0 (-10000, 10000)**

Enter the setpoint initialization value for the extraction/admission setpoint., this is the value that the setpoint initializes to upon power-up or exiting the program mode.
(Must be less than or equal to the ‘Max admission Setpt’ Setting)

Setpoint Rate—(Slow) **dflt = 5.0 (0.01, 10000)**

Enter the extraction/admission setpoint slow rate (in units per second) at which extraction/admission setpoint moves when adjusted for less than 3 seconds. After 3 seconds, the rate will increase to 3 times this rate. The slow rate, fast rate time delay (defaulted to 3 seconds), and fast rate settings are all adjustable in the PCI’s Service mode.

Use 4–20 mA Remote Extraction/Admission Setpoint **dflt = No**



If checked, an external 4-20mA signal can be used (configure in Analog Input page) to change the extraction/admission setpoint. The extraction/ admission control setpoint will move to this input signal whenever the Remote Extraction/Admission Setpoint is enabled.

REM Sensor Range

Value1 (units for 4 mA) **dflt=0(-20000,20000)**

Set the analog signal value for 4 mA

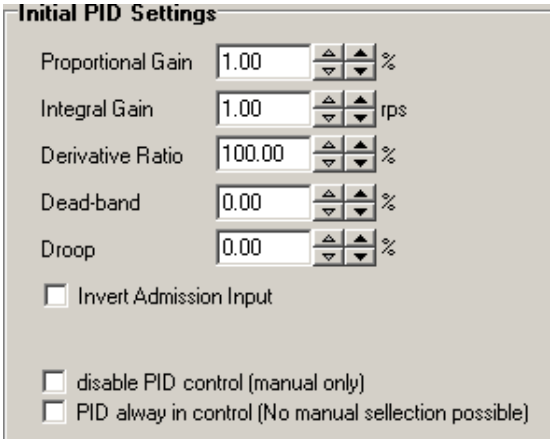
Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Set the analog signal value for 20 mA

Remote Setpoint Maximum Rate **dflt = 100 (0.01, 10000)**

Enter the maximum desired rate that the extraction/admission setpoint will change for a large step change in the Remote Extraction/Admission Setpoint signal.

Initial PID Settings



Proportional Gain **dflt = 1.0 (0.0, 99.99)**

Enter the Extraction/admission PID proportional gain value. This value is used to set extraction/admission control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 1%.

Integral Gain **dflt = 0.3 (0.001, 50)**

Enter the Extraction/admission PID integral gain value, in repeats-per-second (rps). This value is used to set extraction/admission control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 0.3 rps.

Derivative Ratio **dflt = 99.99 (0.01, 99.99)**

Enter the Extraction/Admission PID derivative ratio. This value is used to set extraction/admission control response. This value can be changed in the Service Mode while the turbine is operating. If unknown, a recommended starting value is 99.99%.

Dead-band (% of sensor range) **dflt = 0 (0.0, 100)**

If required, enter the deadband. typically, set between 4-6% and not more than 10%.

Droop **dflt = 0.0 (0.0, 100)**

Enter the droop percentage. If required, typically set between 4-6% and not more than 10%.

Invert Extraction/Admission Input **dflt = No**

Check this box if the extraction/admission control action required is reverse acting. If selected this option will result in the LP valve being opened to increase extraction/admission pressure/flow.

Disable PID control **dflt=*FALSE**

Set to true, if it is desired to control the Pressure/flow always in manual, using R/L P demand commands ONLY.

PID always in control **dflt=*FALSE**

Set to true, if it is desired to control the Pressure/flow always in automatic If selected, “disable PID control” setting is deactivated.

Extraction/Admission Steam Map Information

Before configuring the extraction/admission control folders and steam maps, read the Steam Map description below. This discusses steam maps and how to convert your steam map information into a format usable by the 5009C control.

The steam map is a graphical representation of the operating range and limitations of an extraction and/or admission steam turbine. This map is often called a steam envelope, since normal turbine operation must be contained within the envelope lines.

The 5009C uses the values programmed to calculate the turbine's internal pressure ratios and limits. In order to get these values from your steam map, you must first check the following conditions and, if necessary, modify the map so it meets these conditions:

- The map must be linear (all lines must be straight).
- Lines extraction/admission flow = 0% and extraction/admission flow =100% must be parallel, and lines LP valve = 0% and LP valve = 100% must be parallel.

If your envelope lines are not all straight and parallel (conditions 1 and 2), redraw the envelope so that they are (use graph paper). Make sure your redrawn envelope approximates the old envelope as closely as possible.

The lines on the envelope define the operating characteristics of your turbine. Refer to the example steam maps in this manual. The different lines or limits of a Steam map are:

- The horizontal axis shows turbine power (S).
- The vertical axis shows HP valve position (HP).
- The vertical line called S=100 is the maximum power limiter. This limiter prevents turbine operation beyond the maximum power limit.
- The horizontal line called HP=100 is the maximum HP flow limiter. The HP flow limiter prevents turbine operation beyond the desired maximum HP flow limit.
- The parallel lines called P=0 and P=100 define the extraction/admission flow range (from no flow or maximum admission flow to maximum extraction flow). The "P" term is used to represent pressure demand.
- The parallel lines called LP=0 and LP=100 define the LP valve position range (from closed to 100% open).

The turbine's operating characteristics are programmed into the 5009C as extraction/admission data. This data is taken from the turbine's steam map or envelope. When entering extraction/admission data into the 5009C, it does not matter which units you use, as long as you use the same units throughout for power, and the same units throughout for HP and extraction/admission flow.

The 5009C calculates an extraction and/or admission turbine's ratios and limits from the steam map's Max power, Max HP Flow, point A, point B, and point C values (as shown in the following example figures). The points A, B, and C are entered through programming their horizontal and vertical axis values, as explained below.

Steam maps often show a series of parallel lines representing extraction flow, as do our examples. The bottom line of all the flow lines must be P=0, and the top of the flow lines must be P=100. The "P" term is used to represent pressure demand. The higher the pressure at this point in a turbine the higher the extraction steam flow is, or the lower the admitted steam flow is. Notice, that all the "P" lines in our examples are indeed parallel.

The remaining pair of lines on opposite sides of the envelope must correspond to LP=0 (extraction valve closed) and LP=100 (extraction valve fully open). Note that the LP=0 line is parallel to the LP=100 line (condition 2).

Extraction Only Steam Map—Before a turbine's extraction steam map can be programmed into the control, it must have the intersection points A, B, & C (refer to Figure 3-1).

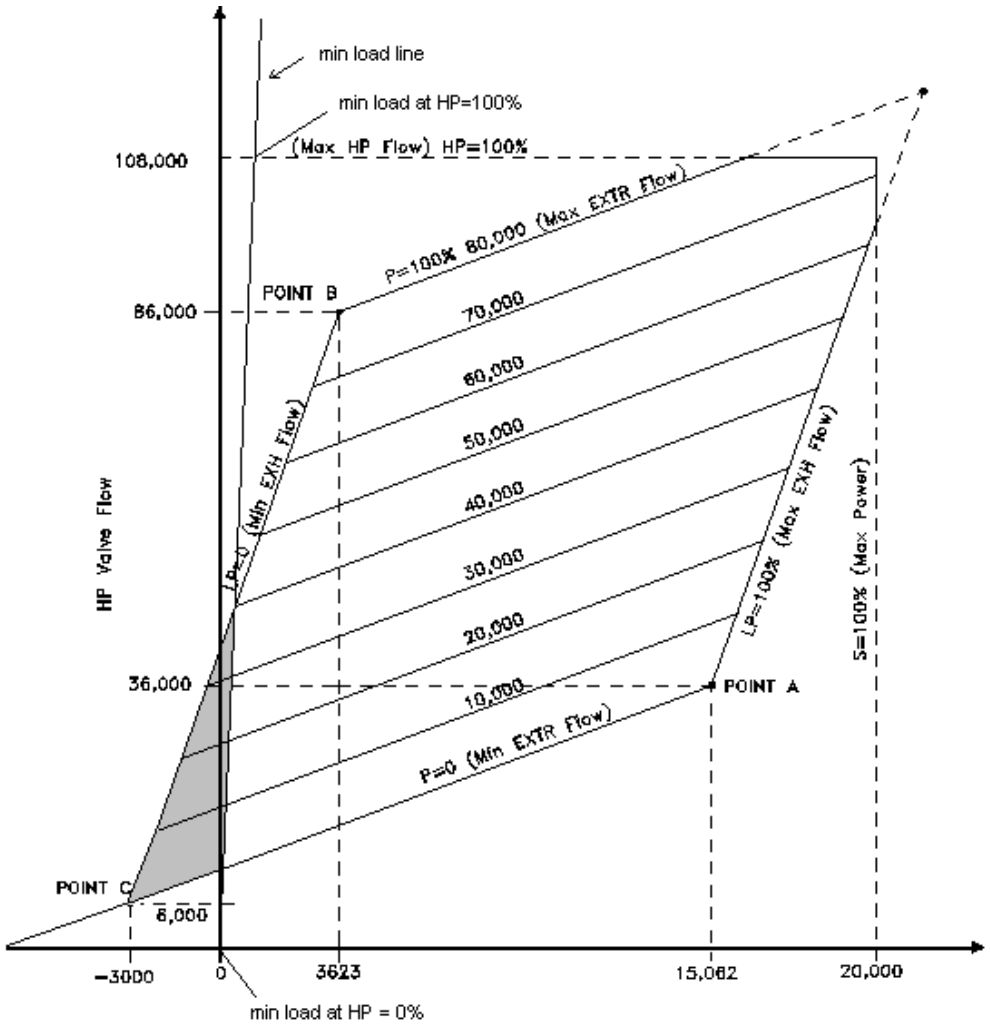


Figure 3-1. Typical Extraction Steam Map

Typically Point C the intersection of the LP=O line and the P=0 line does not exist. If this is the case, it will be necessary to convert your steam map. The only conversion necessary is the extension of the LP=0 line and the P=0 line until they cross or intersect. This point where the LP=0 line intersects the P=0 line is defined as Point C, and is required by the control to calculate the turbine's internal pressure ratios and limits.

The eight values needed can be taken from the converted steam map. As an example, the following data was derived, using the above steam map in Figure 3-1:

The MAX POWER value is the load where the S=100 line crosses the s-axis (about 20,000 KW in our example). The MAX HP FLOW value is the flow where the HP=100 line crosses the HP-axis (about 108,000 lbs/hr).

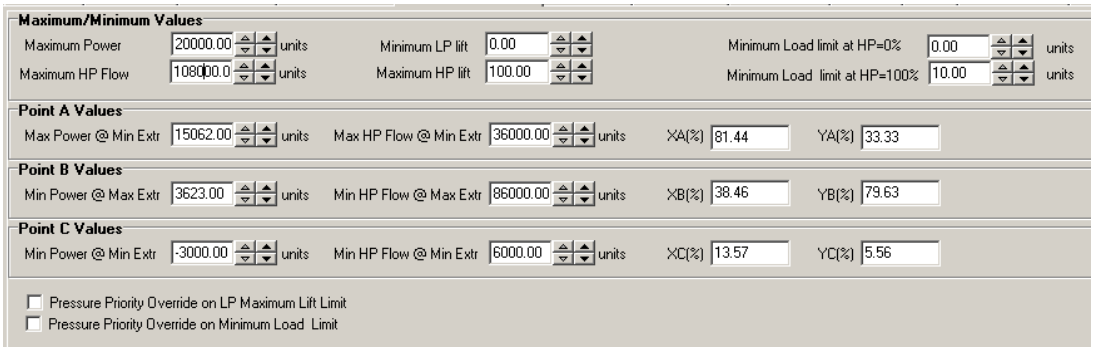
Point A is where the P=0 and LP=100 lines intersect (MAX POWER @ MIN EXTRACTION = about 15,062 KW; HP FLOW @ MIN EXTRACTION = about 36,000 lbs/hr).

Point B is where the LP=0 and P=100 lines intersect (MIN POWER @ MAX EXTRACTION = about 3,623 KW; HP FLOW @ MAX EXTRACTION = about 86,000 lbs/hr).

Point C is where the LP=0 and P=0 lines intersect (MIN POWER @ MIN EXTRACTION = about -3,000 KW; MIN HP FLOW @ MIN EXTRACTION = about 6,000 lbs/hr).

The ratio of one value to another is what is important. It does not matter if values are entered in engineering units, percentages, or values. As long as all values are entered in the same units, the map will ratio correctly.
For monitoring purpose (HMI), the 5009C will convert all the point in percentage, and send the result through Modbus.

Extraction Steam Map Page



Extraction Steam Map Values

Maximum/minimum Values

Maximum Power **dflt = 20000 (0.0, 100000)**

Enter the Maximum Rated turbine Power.

Maximum HP Flow **dflt = 108000 (0.0, 999999)**

Enter the Maximum Rated HP Valve Flow.

Minimum LP lift

Recopy of the parameter set in extraction folder (can be tuned from here also).

Maximum HP lift

Recopy of the parameter set in extraction folder (can be tuned from here also).

Min load limit

The min load limit is the minimum load limit when extraction is in control.
It represents the intersection of the steam MAP and the (Y) axis
This line can be shift (right/Left) and its inclination can be changed
For control reason, this line cannot be vertical. A minimum of 1% load change for HP-0% and HP=100% is required.

Min Load limit at HP=0% **dflt 0(-100000,100000)**
Set the intersection point of the min load line when HP=0%
Min Load limit at HP=100% **dflt 0(-100000,100000)**
Set the intersection point of the min load line when HP=100%

Point A Values
Maximum Power @ Minimum Extraction **dflt = 15062 (0.0, 999999)**
Enter the maximum power attainable at zero extraction flow.
Maximum HP Flow @ Minimum Extraction **dflt = 36000 (1.0, 999999)**
Enter the maximum HP Valve Flow attainable at zero extraction flow.

Point B Values
Minimum Power @ Maximum Extraction **dflt = 3623 (-99999, 999999)**
Enter the minimum power attainable at 100% or maximum extraction flow.
Minimum HP Flow @ Maximum Extraction **dflt = 86000 (-99999, 999999)**
Enter the minimum HP Valve Flow at 100% or maximum extraction flow.

Point C Values
Minimum Power @ Minimum Extraction **dflt = -3000.0 (-99999, 999999)**
Enter the minimum power attainable at zero extraction flow.
Minimum HP Flow @ Minimum Extraction **dflt = 6000.0 (-99999, 999999)**
Enter the minimum HP Valve Flow at zero extraction flow.

Priority On Map Limits
(Due to the similarities in control functionality, the following descriptions include extraction only, admission only, and extr/adm turbine applications.)

With two unlimited valves(HP&LP) the control can control two parameters at a time. However, when the turbine reaches an operating limit (maximum power or one of the valves reaches a mechanical limit), only one parameter can be controlled. This field determines which controlling parameter will be controlled when the turbine reaches an operating limit. Speed/load is the default priority during a start-up, and when extraction is disabled.
Because the 5009C controls only mechanical features, speed as always the highest priority, except for two limits configurable

Pressure Priority Override on LP Maximum Lift Limit **dflt = No**
Check this box to have the control switch to extraction/admission priority whenever the LP valve is on its maximum limit.
In this case, if the limit is reached, speed Raise command is inhibited.
When this limit is reached, the actual speed will be lower than the reference,
Care should be taken that the loss of control setting configure in the speed settings, won't be triggered.
This protection prevent over pressure after the HP stage.

Pressure Priority Override on Minimum load Limit **dflt = No**
Check this box to have the control switch to extraction/admission priority whenever the min load is reached, while extraction is in control.
In this case, if the limit is reached, speed Lower command is inhibited.
When this limit is reached, the actual speed will be higher than the reference,
Care should be taken that the loss of control setting configure in the speed settings, won't be triggered.
This limit prevent an over heating at the exhaust of the HP stage, due to insufficient flow.

Admission Only Steam Map

Before a turbine's admission steam map can be programmed into the control, it must have the intersection points A, B, & C (refer to Figure 3-2).

If points A & B already exist, the only conversion necessary is the extension of the LP=100 line and the P=100 line until they cross or intersect (this is Point C for programming).

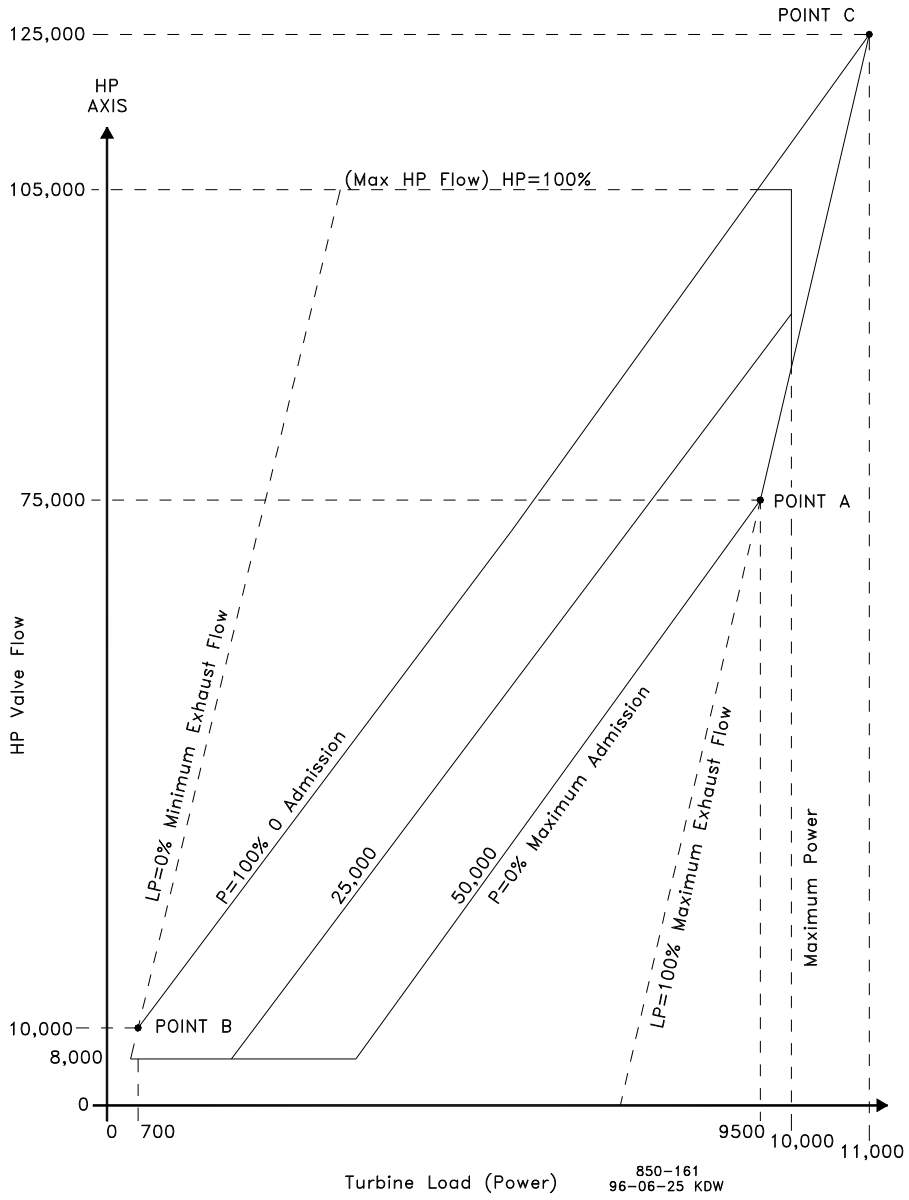


Figure 3-2. Typical Admission Steam Map

If only point A exists, your map will have to be modified to include points B & C. The LP=0 line will need to be created. To create the LP=0 line you must know the minimum required steam flow through the back-end of the turbine. In our example steam map (figure 3-2) the minimum required flow was 10,000 lbs/hr.

1. Extend the zero admission (or induction) line (p=100%). Refer to figure 3-2.

   Find your turbine's minimum back-end steam flow (this will be point B's HP flow).

2. Mark the intersection of the zero admission line and the turbine's minimum back-end (cooling) steam flow. This mark will be Point B for programming.

   Draw a line parallel to the LP=100 line, through the mark created in step 3. This will be your LP=0 line or LP valve closed line.

3. Mark the intersection of the P=100 and the LP=100 line. This will be Point C for programming. Typically Point C the intersection of the LP=100 line and the P=100 line does not exist.

Points A, B, and C are required by the control to calculate the turbine's internal pressure ratios and limits.

The nine values needed can be taken from the converted steam map. An example has been provided using the steam map in Figure 3-2.

The MAX POWER value is the load where the S=100 line crosses the s-axis (about 10,000 KW in our example). The MAX HP FLOW value is the flow where the HP=100 line crosses the HP-axis (about 105,000 lbs/hr).

Point A is where the P=0 and LP=100 lines intersect (MAX POWER @ MAX ADMISSION = about 9,500 KW; HP FLOW @ MAX ADMISSION = about 75,000 lbs/hr).

The ADMISSION FLOW @ MAX ADMISSION = about 50,000 lbs/hr.

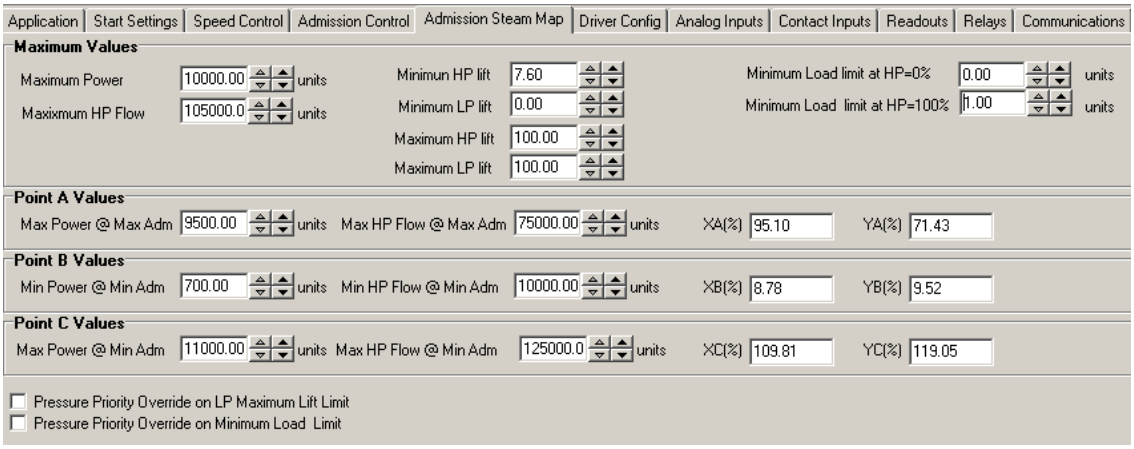
Point B is where the LP=0 and P=100 lines intersect (MIN POWER @ MIN ADMISSION = about 700 kW; HP FLOW @ MIN ADMISSION = about 10,000 lbs/hr). This point was used because 10,000 lbs/hr is the minimum back-end cooling steam flow required by the turbine.

Point C is where the LP=100 and P=100 lines intersect (MAX POWER @ MIN ADMISSION = about 11,000 kW; MAX HP FLOW @ MIN ADMISSION = about 125,000 lbs/hr).

An additional parameter, MIN HP LIFT (%), would also be set to 8000/105,000 = 7.6%.

The ratio of one value to another is what is important. It does not matter if values are entered in engineering units, percentages, or values. As long as all values are entered in the same units, the map will ratio correctly.
For monitoring purpose (HMI), the 5009C will convert all the point in percentage, and send the result through Modbus.

Admission Steam Map Page



Admission Steam Map Values

Maximum Values
Maximum Power
Enter the Maximum Rated Turbine Power.
Maximum HP Flow
Enter the Maximum Rated HP Valve Flow.
.

Point A Values
Maximum Power @ Maximum Admission
Enter the maximum power attainable at 100% or maximum admission flow.
Maximum HP Flow @ Maximum Admission
Enter the maximum HP Valve Flow attainable at 100% or maximum admission flow.

Point B Values
Minimum Power @ Minimum Admission
Enter the minimum power attainable at zero admission flow.
Minimum HP Flow @ Minimum Admission
Enter the minimum HP Valve Flow at zero admission flow.

Point C Values
Maximum Power @ Minimum Admission
Enter the maximum power attainable at zero admission flow.
Maximum HP Flow @ Minimum Admission
Enter the maximum HP Valve Flow at zero admission flow.

Priority On Map Limits—Select the desired control priority when the turbine is operating on a limit. Refer to the “Priority On Map Limits” description under the Extraction Steam Map Folder section of this chapter for a detailed description of each option.

Admission & Admission Steam Map

Extraction & Admission Steam Map—Before a turbine's extraction/ admission steam map can be programmed into the control, it must have the intersection points A, B, & C (refer to figure 3-3).

If points A & B already exist, the only conversion necessary is the extension of the LP=0 line and the zero extraction and admission flow line until they cross or intersect (this is Point C for programming). If point A does not exist, the extension of the LP=100 line and the zero extraction and admission flow line until they cross or intersect is Point A for programming.

If points B & C do not exist, your map will have to be modified to include points B & C. The LP=0 line will need to be created. To create the LP=0 line you must know the minimum required steam flow through the back-end of the turbine. In our example steam map (figure 3-3) the minimum required flow was 8,000 lbs/hr.

1. Extend the maximum extraction line. Refer to figure 3-3.

2. Extend the zero extraction & admission line.

3. Find your turbine's minimum back-end steam flow (this will be point C's HP flow).

   Mark the intersection of the zero extraction & admission flow line and the turbine's minimum back-end steam flow. This mark will be Point C for programming.

4. Draw a line parallel to the LP=100 line, through the mark created in step 4. This will be your LP=0 line or LP valve closed line.

5. Mark the intersection of the maximum extraction line and the created LP=0 line. This will be Point B for programming.

Points A, B, and C are required by the control to calculate the turbine's internal pressure ratios and limits.

An additional parameter, MIN HP LIFT (%), would also be set to 4000/54,000 = 7.4%.

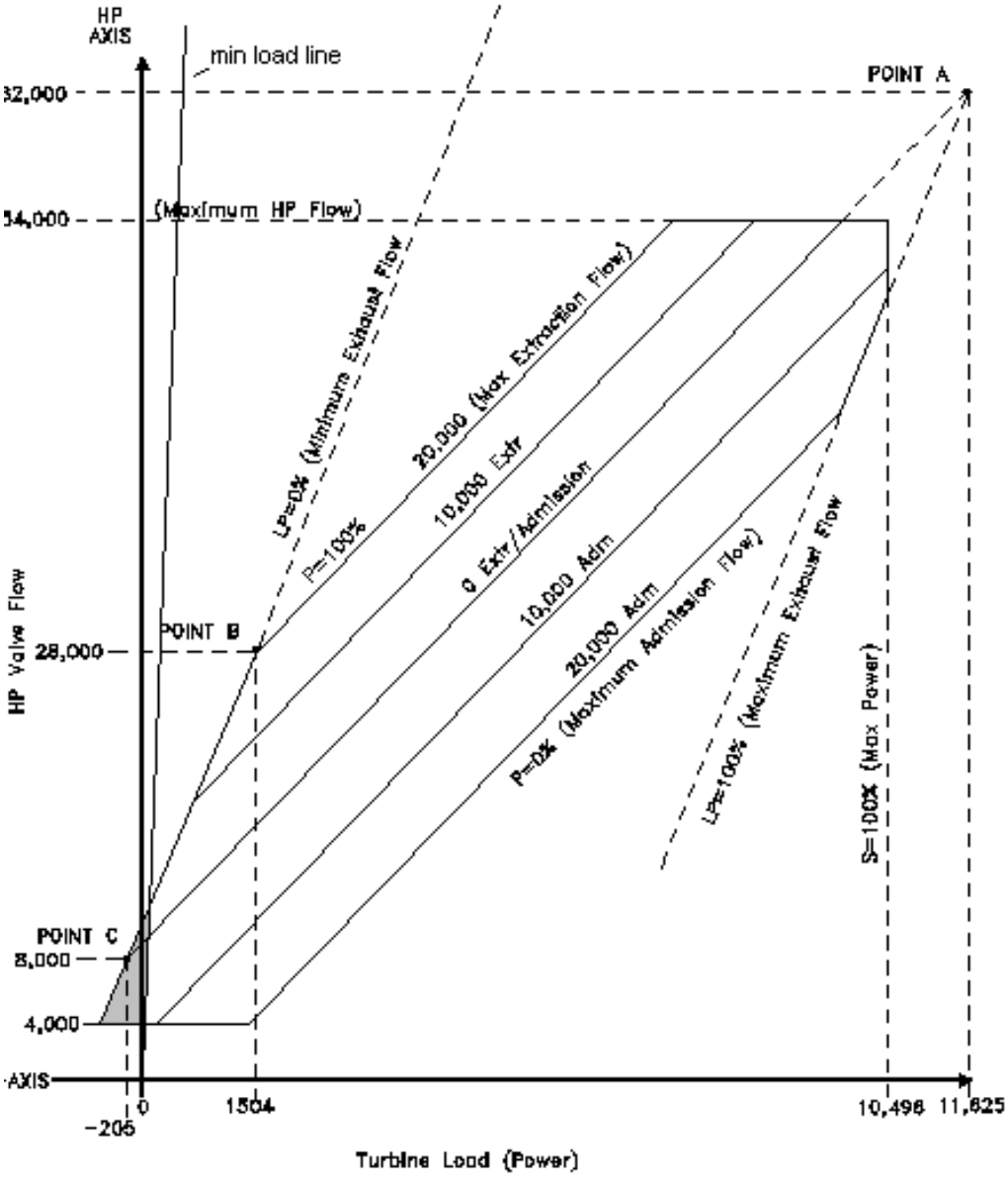


Figure 3-3. Typical Extraction & Admission Steam Map

The ten values needed can be taken from the converted steam map. An example has been provided below, using the steam map in Figure 3-3:

The MAX POWER value is the load where the S=100 line crosses the s-axis (about 10,496 kW in our example). The MAX HP FLOW value is the flow where the HP=100 line crosses the HP-axis (about 54,000 lbs/hr).

Point A is where the P=0 extr/adm and LP=100 lines intersect (MAX POWER @ 0 EXTR/ADM = about 11,625 kW; MAX HP FLOW @ 0 EXTR/ ADM = about 62,000 lbs/hr). MAX ADMISSION = about 20,000 lbs/hr.

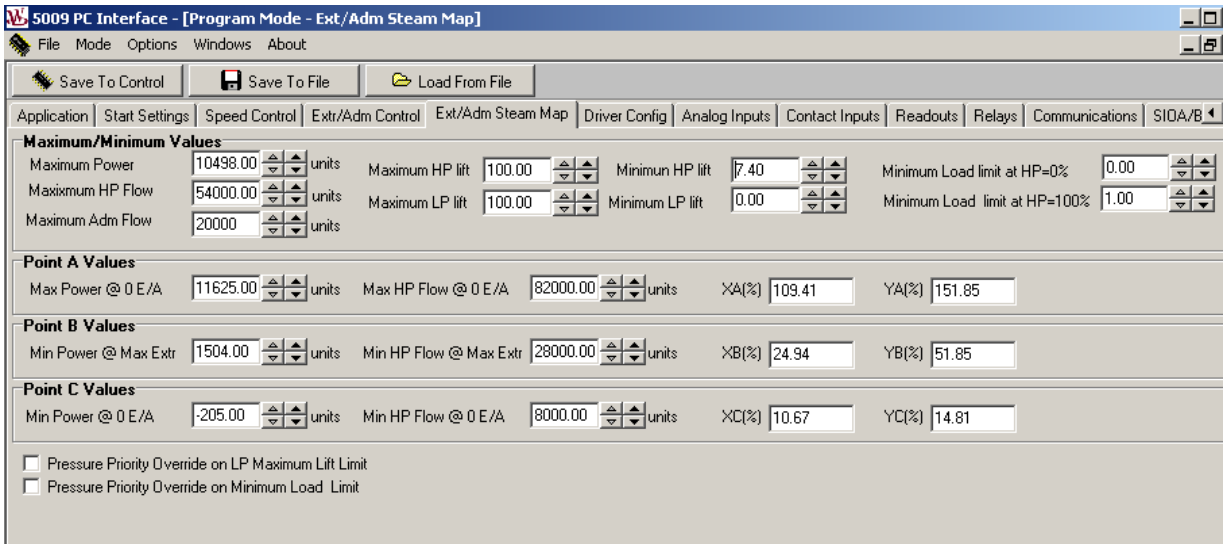
Point B is where the LP=0 and P=100 lines intersect (MIN POWER @ MAX EXTRACTION = about 1504 kW; MIN HP FLOW @ MAX EXTRACTION = about 28,000 lbs/hr).

Point C is where the LP=0 and zero extraction & admission flow lines intersect (MIN POWER @ ZERO EXTRACTION/ADMISSION = about—205 kW; MIN HP FLOW @ ZERO EXTRACTION/ADMISSION = about 8,000 lbs/hr).

An additional parameter, MIN HP LIFT (%), would also be set to 4000/54000 = 7.4%.

The ratio of one value to another is what is important. It does not matter if values are entered in engineering units, percentages, or values. As long as all values are entered in the same units, the map will ratio correctly.
For monitoring purpose (HMI), the 5009C will convert all the point in percentage, and send the result through Modbus.

Extraction/Admission Steam Map Folder



Extraction/ Admission Steam Map Values

Maximum Values
Maximum Power **dflt = 100 (0.0, 999999)**
Enter the Maximum Rated Turbine Power.

Maximum HP Flow **dflt = 100 (0.0, 999999)**
Enter the Maximum Rated HP Valve Flow for the turbine.

Maximum Admission Flow **dflt = 0.0 (0.0, 999999)**
Enter the Maximum Rated Low Pressure Valve Flow (Admission) for the turbine.

Point A Values
Maximum Power @ 0 E/A **dflt = 77.7 (1.0, 999999)**
Enter the maximum power attainable at zero extr/adm flow.
Maximum HP Flow @ 0 E/A **dflt = 28.6 (1.0, 999999)**
Enter the maximum HP Valve Flow attainable at zero extr/adm flow.

Point B Values

Minimum Power @ Maximum Extraction **dflt = 27.4 (-99999, 999999)**

Enter the minimum power attainable at maximum extraction flow.

Minimum HP Flow @ Maximum Extraction **dflt = 80.0 (-99999, 999999)**

Enter the minimum HP Valve Flow at maximum extraction flow.

Point C Values

Minimum Power @ 0 E/A **dflt = 0.0 (-99999, 999999)**

Enter the minimum power attainable at zero extr/adm flow.

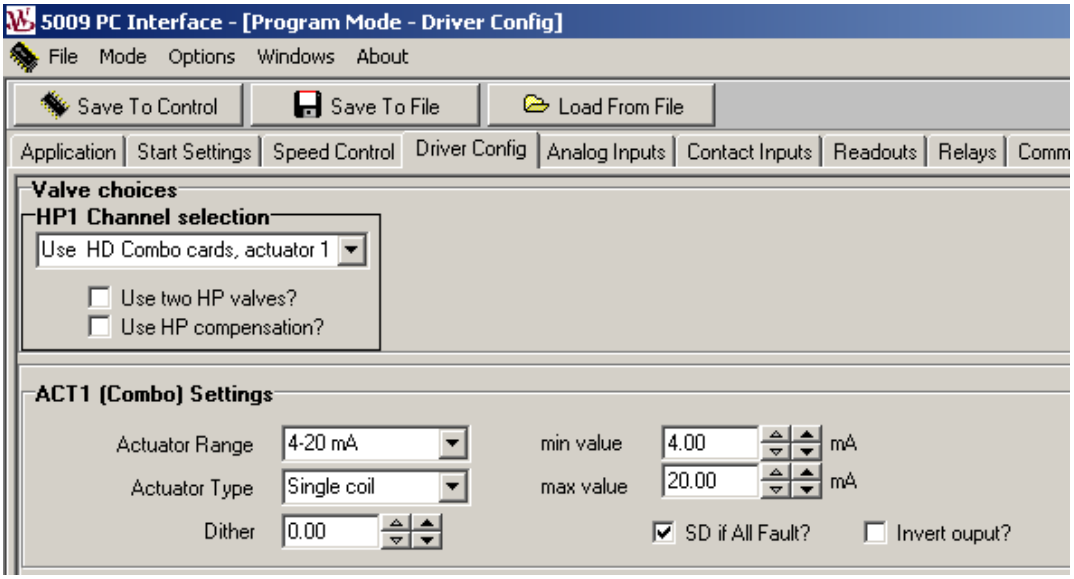
Minimum HP Flow @ 0 E/A **dflt = 0.0 (-99999, 999999)**

Enter the minimum HP Valve Flow at zero extr/adm flow.

Priority On Map Limits

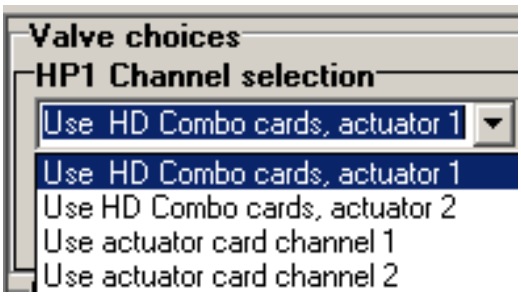
Select the desired control priority when the turbine is operating on a limit. Refer to the “Priority On Map Limits” description under the Extraction Steam Map Folder section of this chapter for a detailed description of each option.

Driver Folder



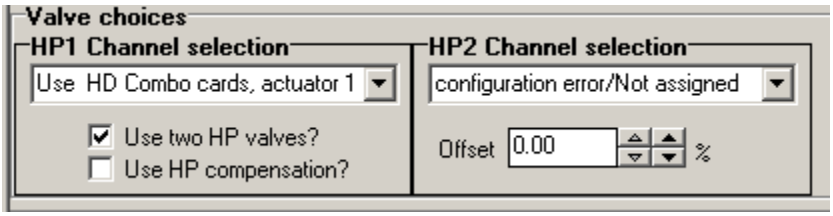
Valve choices

Because the 5009C can be configured for multiple actuator output, the type of Actuator output used for HP valve must be selected from the following menu.



HP1 channel selection **dflt=HD combo card actuator 1**
Select the actuator channel used to drive the HP valve

Use two HP valves? **dflt= *False**



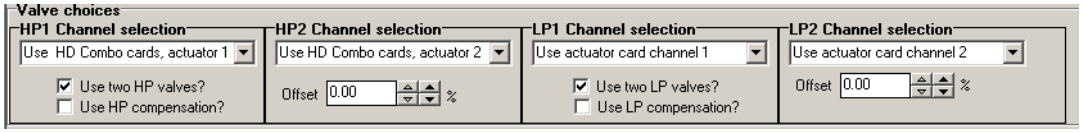
Select this option if a second HP valve is used or if a redundant channel needs to be configured

Offset (%) **dflt=0(0,100)**

When the control must be configured for a split-range, HP2 can be configured to begin opening at an offset value of HP1 position. If this setting is 50%, then Valve HP2 will begin opening when HP1 reaches 50%. The control will continue to open both valves to 100%, with a position difference of 50%.

If HP2 is used for redundancy purpose, this offset should be null, or very small.

<u>If the turbine is set Extraction or admission, then LP valve settings will appear.</u>



LP1 channel selection **dflt=HD combo card actuator 2**

Select the actuator channel used to drive the LP valve

Use two HP valves? **dflt= *False**

Select this option if a second LP valve is used, if admission&extraction split is selected or if a redundant channel needs to be configured

Offset (%) **dflt=0(0,100)**

When the control must be configured for a split-range, LP2 can be configured to begin opening at an offset value of LP1 position. If this setting is 50%, then Valve HP2 will begin opening when HP1 reaches 50%. The control will continue to open both valves to 100%, with a position difference of 50%.

If LP2 is used for redundancy purpose, this offset should be null, or very small.

When engine is configured for extraction&admission with split valve, the offset value is internally calculated, based on the actual load of the turbine.

HP compensation Settings

The HP compensation, when used, will correct the HP valve position, based on an Analog signal called “HP compensation”

When for example, the Inlet Pressure of the turbine differs from its standard settings, Speed PID settings or Steam MAP calculation might not be correct anymore.

The HP compensation curve will use this analog signal and convert it in a gain factor directly multiplied to the HP demand.

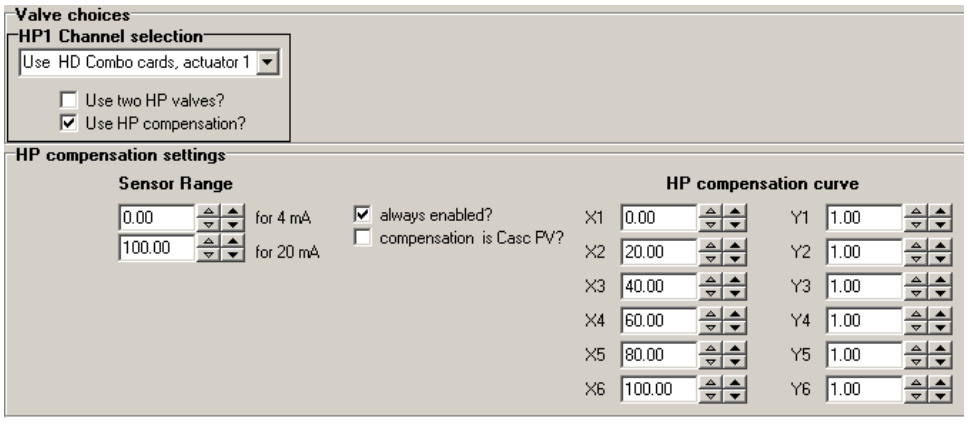
Care should be taken while using this function, not to compensate too strongly the demand. Typical compensation should be the square root of [the standard pressure divided by the pressure]. A Gain factor (output of the curve) of 0.8-.12 should be enough in most of the cases.

As this compensation must be in any case slower than Speed/Pressure PID, a LAG value, available in service mode must be applied to the compensation signal.

In case of signal failure, the compensation will ramp to the safe value of 1.

Use HP compensation? **dflt= *False**

Select this function only if used



Sensor range

Value1 (for 4 mA) **dflt 0(-20000,20000)**

Set the value of the compensation signal for 4 mA.

Value2 (for 20 mA) **dflt 1(-20000,20000)**

Set the value of the compensation signal for 20 mA.

Always enabled? **dflt= *TRUE**

Set to true if this function has to be enabled at any time.
If not, this function can be enabled/disabled using Modbus or PCI software.

Compensation is casc PV? **dflt=*False**

If the Cascade input is the inlet pressure, then the HP compensation can be set to use this signal

HP compensation curve

X1 to X-6 is the HP compensation value
Y1 to Y-6 is the corresponding gain for X1-6 **dflt=1(0.1,2)**
Set these values

LP compensation Settings

The LP compensation, when used, will correct the LP valve position, based on an Analog signal called “LP compensation”

When for example, the extraction Pressure of the turbine differ from its standard settings, Speed PID settings or Steam MAP calculation might not be correct anymore.

The LP compensation curve will use this analog signal and convert it in a gain factor directly multiplied to the LP demand.

When Decoupling Inlet is used, extraction pressure is not controlled anymore.

This will dump possible oscillation when LP controls the speed.

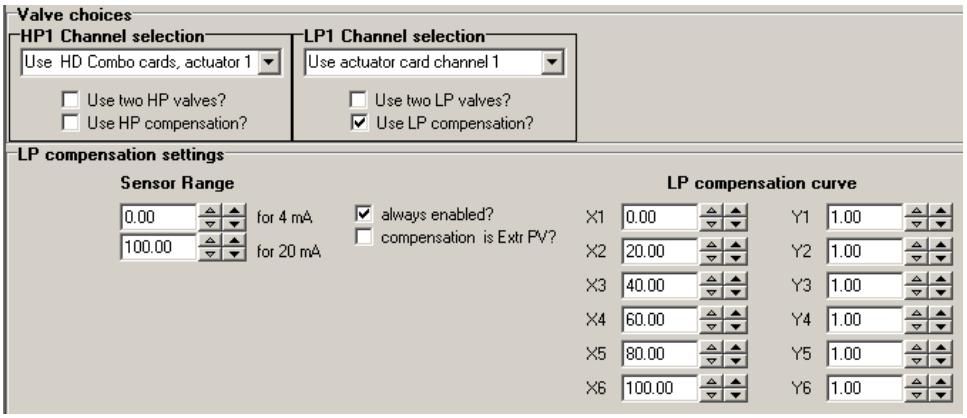
Care should be taken while using this function, not to compensate too strongly the demand. Typical compensation should be the square root of [the standard pressure divided by the pressure]. A Gain factor (output of the curve) of 0.8-.12 should be enough in most of the cases.

As this compensation must be in any case slower than Speed/Pressure PID, a LAG value, available in service mode must be applied to the compensation signal.

In case of signal failure, the compensation will ramp to the safe value of 1.

Use LP compensation? **dflt= *False**

Select this function only if used



Sensor range

Value1 (for 4 mA) **dflt 0(-20000,20000)**

Set the value of the compensation signal for 4 mA.

Value2 (for 20 mA) **dflt 1(-20000,20000)**

Set the value of the compensation signal for 20 mA.

Always enabled? **dflt= *TRUE**

Set to true if this function has to be enabled at any time.
If not, this function can be enabled/disabled using Modbus or PCI software.

Compensation is Extr PV? **dflt=*False**

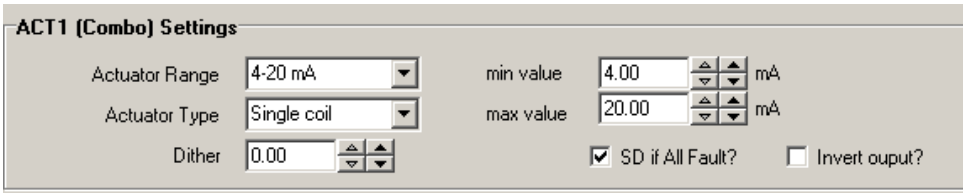
If the Extraction input is to be used, then the HP compensation can be set to use this signal.

LP compensation curve

X1 to X-6 is the LP compensation value
Y1 to Y-6 is the corresponding gain for X1-6 **dflt=1(0.1,2)**
Set these values

ACT1 (combo) Settings or ACT2 (combo) Settings

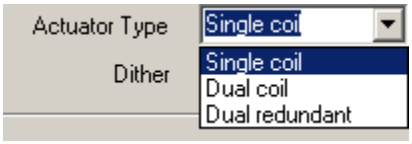
Identical settings are used for both, Act #1 combo and Act #2 combo.
This menu will appear when any valve is selected to use these channels.



Actuator Range **dflt = 20—160 mA**

Select either a 4—20 mA driver range or a 20—160 mA driver range.
Typically, Woodward actuators have a 20—160 mA range.

Actuator type **dflt= Single coil**



Select the type of actuator used.

If Single coil is selected, a jumper between channel A&B and channel C must be installed on the FTM.

If Dual coil is selected, the current output of HD combo cards A&B will be equal to the output of channel C in normal operation.
No jumper must be installed in the FTM.
In case of failure of one coil, then the current output of the second coil will be doubled.

If Dual redundant is selected, the current output of HD combo cards A&B will be equal to the output of channel C in normal operation.
No jumper must be installed in the FTM.
In case of failure of one coil, the current output of the second coil will **NOT** be doubled.
Each output can reach 20 or 160 mA if necessary in normal operation.

Care should be taken, when using the 5009 redundancy managers, that the valves are correctly configured.
If the redundancy manager is set for example to control ACT1-combo A&B and ACT1-combo C, then the ACT1 output must be set for dual redundant.
If the redundancy is set for ACT1-combo/ACT2-combo, then HP2 (LP2) must be used, and single coil selected.

Dither **dflt = 0.0 (0.0, 10)**

Enter the dither, in milliamps, for the actuator. Enter 0.0 if no dither is required. Woodward TM-type actuators typically require dither. This value can be changed in the Run Mode while the turbine is operating.

Calibration Value at 0% **dflt = 4 (1.8,12) or 20 (8, 100)**

Enter the milliamp setting that corresponds to 0% flow. This number can be tuned in Run Mode.

Calibration Value at 100% **dflt = 20 (12,24) or 160 (100, 196)**

Enter the milliamp setting that corresponds to 100% flow. This number can be tuned in Run Mode.

Invert Output **dflt = No**

Check this box if the actuator requires an inverted driver. (Opens on a decrease in current to the actuator).

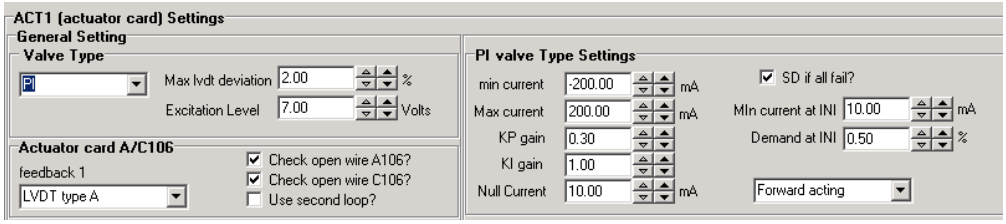
Only in this case, the actuator output will maintain 20 mA(160mA) after SD.

SD On All Failed

Check this box if the 5009C should shutdown and go to a failed safe condition if an actuator failure has been detected. It should be noted that all three legs of the actuator drivers, both coils of a dual coil actuator, or the entire actuators field wiring would have to fail in order to cause a 'Trip on all Failed'.

ACT1 (actuator card) Settings or ACT2 (actuator) Settings

Identical settings are used for both, Act#1(actuator card) channel 1 and Act #2 (actuator card) channel 2.
This menu will appear when any valve is selected to use these channels.



General Settings

Max LVDT Deviation **dflt=*2(0.1,25)%**

When one deviation exceeds this value, the maximum LVDT signal is used by the control. When the two signals values are within this range, the average position is used by the control. Also, after 1 second, an alarm is generated when the difference between LVDT exceeds this value

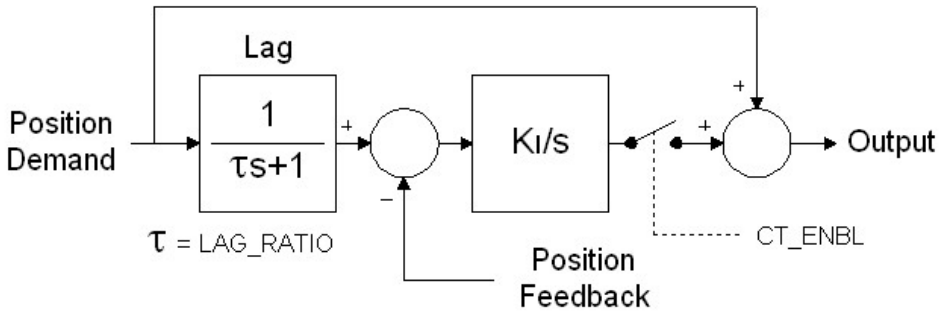
Excitation Level (Volt) **dflt= 7(2,8)**

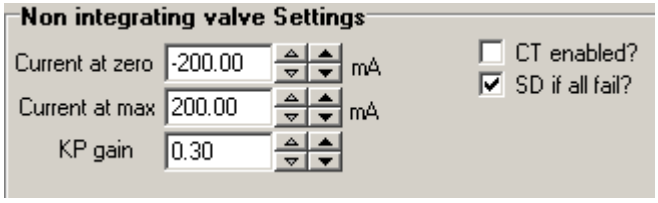
Set the voltage excitation level used for the LVDT.

Valve Type **dflt = P**

Select the type of control desired on this channel from the menu below. For each select, a header will be displayed for specific configuration parameters.
See volume 1 of this manual for explanation of the valve type to be used.

PROP selected
This selection if for proportional valve, and settings are similar of the one used for ACT combo channels.





Calibration Value at 0% **dflt = -200(-250,125)**
Enter the milliamp setting that corresponds to 0% flow. This number can be tuned in Run Mode under valve calibration and Service mode.

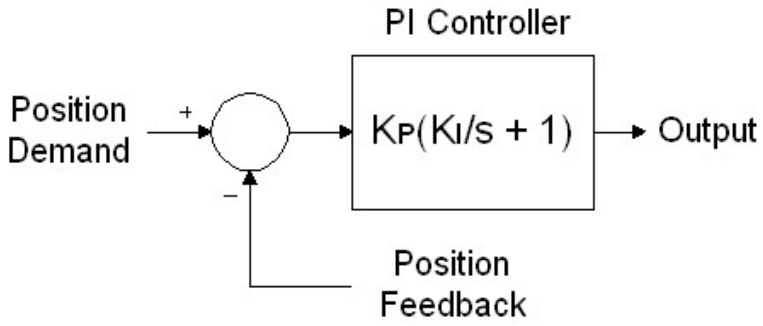
Calibration Value at max% **dflt = 200(0,250)**
Enter the milliamp setting that corresponds to 100% flow. This number can be tuned in Run Mode under valve calibration and Service mode.

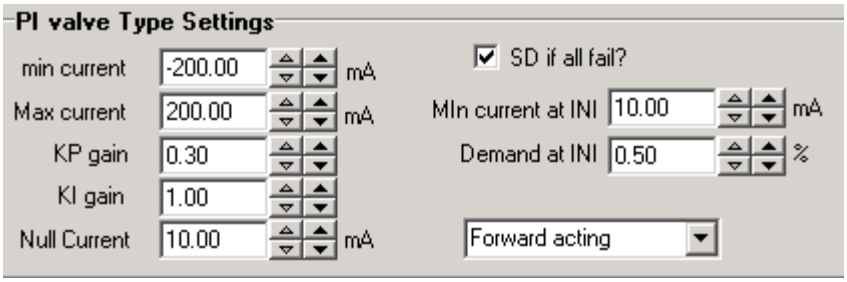
KP gain: **dflt= 0.3 (0.001,20)**
Enter the gain.
This gain is a multiply factor for the difference (Demand - LVDT position)
If the result = 0, then the current output equal current at zero.
If the result =100, then the current output equals current at max.
This number can be tuned in Run Mode under valve calibration and Service mode.

CT enabled? **dflt= *FALSE**
When selected, If the LVDT is considered failed, the card won't use the LVDT signal
See Volume 1 for more explanations.

SD if all fail? **dflt=*TRUE**
Select this option if it is desired to Trip the turbine, if all channels (A106-CHx and C106-CHx) arte fault. In this case, the 5009 cannot control anymore the valve.

PI selected





Min current **dflt = -200(-250,125)**

Enter the milliamp setting that corresponds to the minimum current possible on this channel. This number can be tuned in Run Mode under valve calibration

Max current **dflt = 200(0,250)**

Enter the milliamp setting that corresponds to the maximum current possible on this channel. This number can be tuned in Run Mode under valve calibration and Service mode.

KP gain: **dflt= 0.3 (0.001,20)**

Enter the proportional gain.
This number can be tuned in Run Mode under valve calibration and Service mode

KI gain: **dflt=1(0.001,20)**

Enter the Integrating gain
This number can be tuned in Run Mode under valve calibration and Service mode.

Null I **dflt 0(-250,250)**

Enter the estimated null current.

Not used in normal operation, this parameter is used for redundancy management in case of failure, and during valve calibration in RUN mode.

Min current at INI

To avoid any delay of opening at start command, this level defines the minimum current to be sent to the valve when all trips are cleared, and the engine is reset.

Demand at INI

This level is the temporary valve demand requested when all trips are cleared.
For about 21 seconds, the controller will ask for this level to make sure that the actuator current is at the null current. This setting must be combined with the MIN current at INI, and should be tuned during the first start-up.

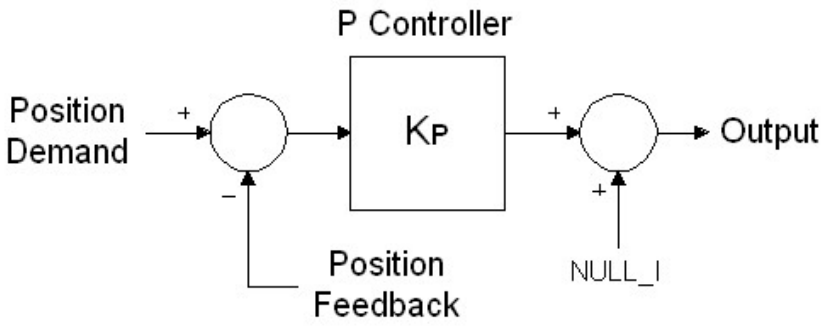
Forward acting? **dflt= Forward**

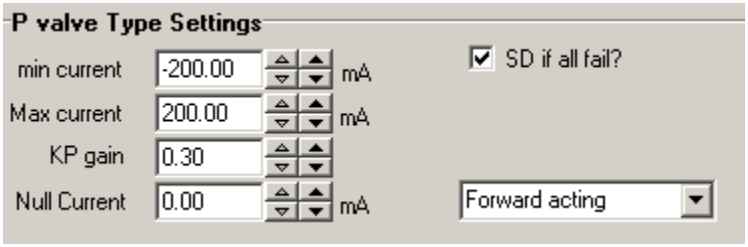
If Forward is selected, the current output will raise proportionally to the difference (Demand – LVDT) the current output will raise depending on the difference (LVDT-Demand)

SD if all fail? **dflt=*TRUE**

Select this option if it is desired to Trip the turbine, if all channels (A106-CHx and C106-CHx) arte fault. In this case, the 5009 cannot control anymore the valve.

P selected





Min current **dflt = -200(-250,125)**

Enter the milliamp setting that corresponds to the minimum current possible on this channel. This number can be tuned in Run Mode under valve calibration and Service mode

Max current **dflt = 200(0,250)**

Enter the milliamp setting that corresponds to the maximum current possible on this channel. This number can be tuned in Run Mode under valve calibration and Service mode.

KP gain: **dflt= 0.3 (0.001,20)**

Enter the proportional gain.
This number can be tuned in Run Mode under valve calibration

Null I **dflt 0(-250,250)**

Enter the estimated null current.

Used in normal operation, this parameter is also used for redundancy management in case of failure, and during valve calibration in RUN mode.
This number can be tuned in Run Mode under valve calibration

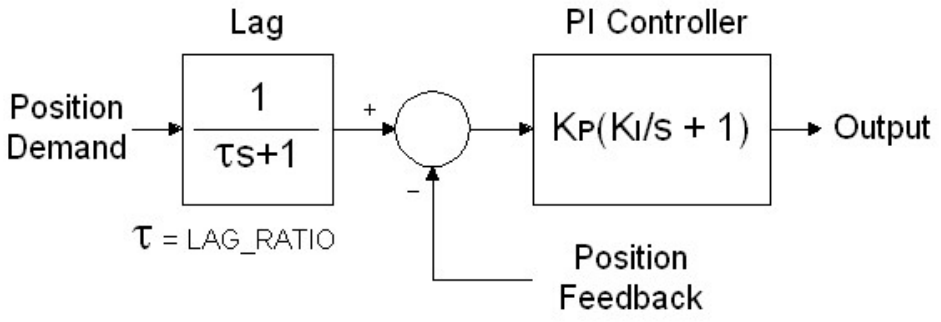
Forward acting? **dflt= Forward**

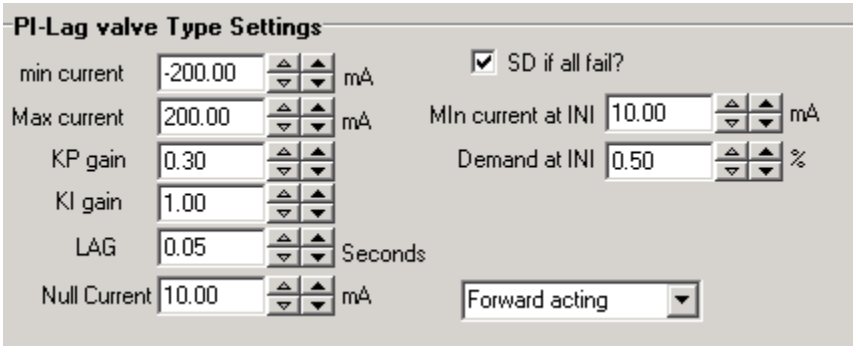
If Forward is selected, the current output will raise proportionally to the difference (Demand – LVDT) the current output will raise depending on the difference (LVDT-Demand)

SD if all fail? **dflt=*TRUE**

Select this option if it is desired to Trip the turbine, if all channels (A106-CHx and C106-CHx) arte fault. In this case, the 5009 cannot control anymore the valve.

PI-LAG selected





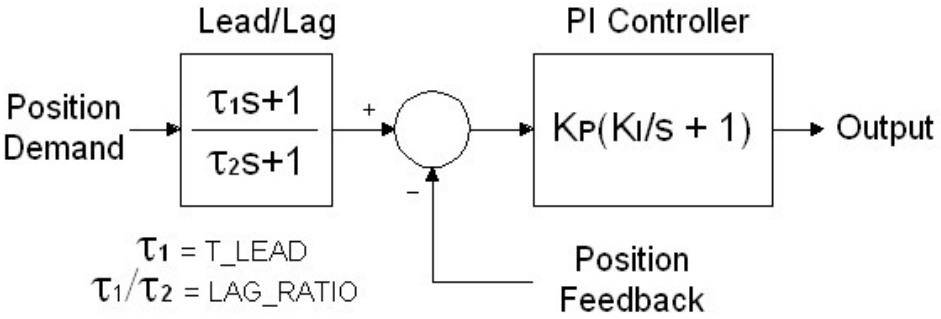
Setting are similar as the one used for PI type (see explanations above)

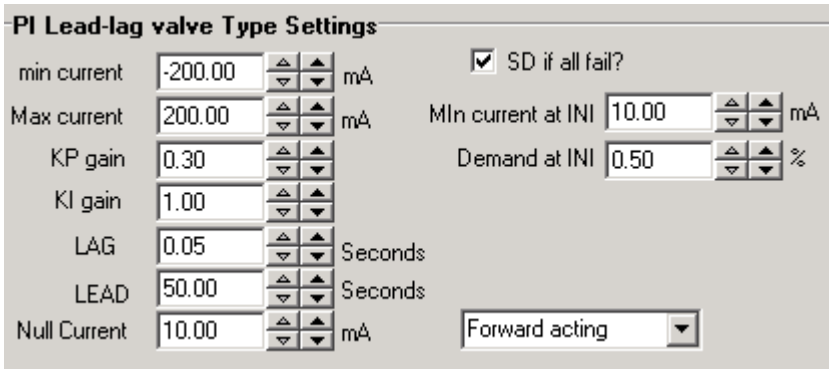
LAG (ms) **dflt=0.05(0.05,50000)**

Set the LAG value

This number can be tuned in Run Mode/ under valve calibration and Service mode .

PI-LEAD/LAG





Setting are similar as the one used for PI type (see explanations above)

LAG (ms) **dflt=0.05(0.05,50000)**

Set the LAG value
This number can be tuned in Run Mode/ under valve calibration and Service mode .

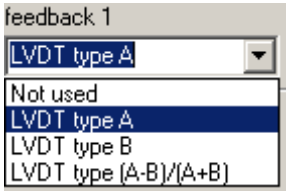
LEAD (ms) **dflt=50(50,50000)**

Set the LAG value
This number can be tuned in Run Mode/ under valve calibration and Service mode .

Actuator card A/C106

Feedback 1 **dflt=type A**

The position transducer must be an LVDT or an RVDT. The Position Feedback Transducer Type field determines how the signals from the transducer are interpreted. In the configuration tool, enter:



- “Not used” if no position feedback will be used.
- "A" for devices with a single pair of return wires,
- "A-B" is for devices with two pairs of return wires that have a simple difference output.
- "(A-B)/(A+B)" is for devices with two pairs of return wires that have a difference/sum (also known as constant sum, or D/S) output.

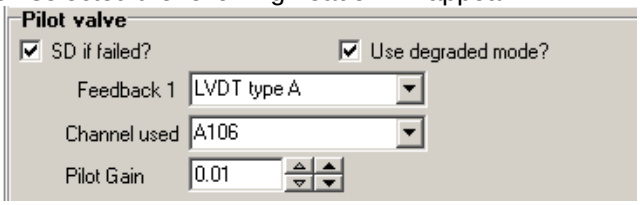
For devices with two pairs of return wires, the device manufacturer's drawing should be consulted to determine if it is a difference type or difference/sum type.
See volume 1 for more explanations.

The type of LVDT used must be similar for each redundant channel.

Pilot valve

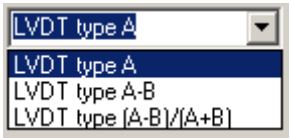
Use Second Loop? **dflt=*FALSE**

Select this option if a second loop (cascade) is necessary to control the valve.
When selected the following header will appear.



Feedback 1 **dflt=LVDT type A**

The position transducer must be an LVDT or an RVDT. The Position Feedback Transducer Type field determines how the signals from the transducer are interpreted. In the configuration tool, enter:



- "A" for devices with a single pair of return wires,
- "A-B" is for devices with two pairs of return wires that have a simple difference output.
- "(A-B)/(A+B)" is for devices with two pairs of return wires that have a difference/sum (also known as constant sum, or D/S) output.

For devices with two pairs of return wires, the device manufacturer's drawing should be consulted to determine if it is a difference type or difference/sum type.

See volume 1 for more explanations.

The type of LVDT used must be similar for each redundant channel.

Channel used **dflt=A106**

Select on which channel the pilot signal is connected.

The pilot signal will be using the LVDT feedback 2 of corresponding channel to control the valve. See volume 1 for more explanation of this loop.

Care should be taken that the cylinder LVDT is only be connected to feedback 1, and pilot to feedback 2

SD if failed **dflt=*true**

Select this option if it is desired to trip the engine when all hardware signal used for Pilot valve are FAULT.

Pilot Gain **dflt =0.01 (0.001,10)**

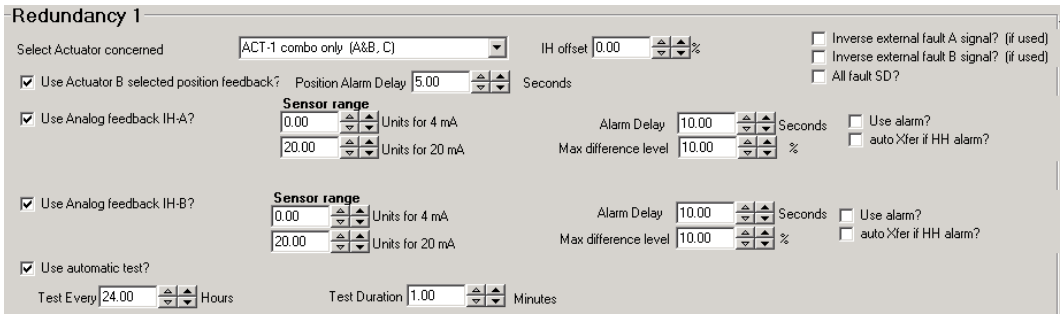
Set the gain used for the pilot deviation (null position – pilot signal). The result will be divided by KP and added to the valve demand.
This number can be tuned in Service mode only .

Use Degraded mode **dflt=*False**

Select this option if it is desired to continue to run the engine when all hardware signal used for Pilot valve are FAULT.
In this case, the 5009 will extrapolate the pilot deviation based on the LVDT cylinder derivative signal.
Table in service mode is available to correct its action.
This mode won't be selected if Sdif failed is selected.

Redundancy Folder

This folder will appear when Redundancy has been selected in the main page



Redundancy 1

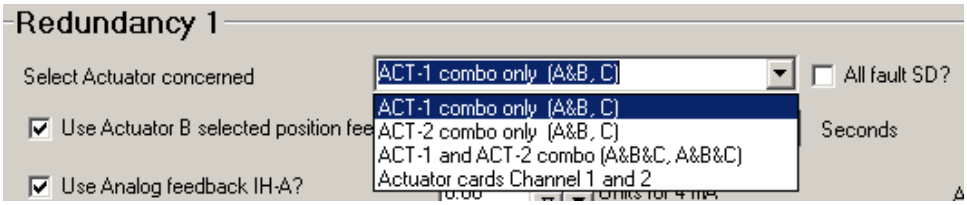
Select Actuator concerned **dflt= Act-1 combo (A&B,C)**

Select the actuators outputs to be used for the redundancy manager 1.

This selection must absolutely match with the actuator type configured under the DRIVER Folder.

Due to multiple selections possible, the redundancy 1 can be used for HP, HP2 or for LP/LP2 valves.

A standard practice should be to use Redundancy 1 for HP only.



The valve selection for redundancy has been explained under the Driver folder.

IH Offset **dflt= 0(-12,0)%**

This value is the difference in the IH demand. When IH-A is in control, IH-B demand will be lowered by this value.

When IH-AB is in control, IH-A demand will be lowered by this value.

This will prevent any possible interference when using shuttle valves.

The offset is immediately suppressed at the transfer request, and ramp down at a rate of 0.5%/s.

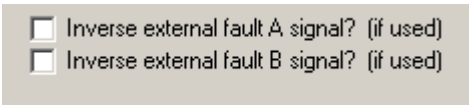
All Fault SD? **dflt=*FALSE**

Select this option if it is desired to trip the engine if both actuators controlled by the redundancy manager are detected FAULT (internal detection or external contact input)

External fault inputs inversion **dflt=*FALSE**

The 5009 will automatically detect if an external Fault input has been configured under the contact input folder. If it is the case, redundancy 1 will use them to detect a failure.

In some cases, it might be necessary to reverse the fault signal.


Inverse external fault A signal? (if used)
Inverse external fault B signal? (if used)

This selection is not relevant if there is no external contact configured.
The two actuators are ,for identification, called A and B for each redundancy manager.

Use Actuator B selected position feedback? **dflt=*TRUE**

Select this option if a contact Input is used to inform the 5009 that Actuator B (of redundancy 1) is in control of the valve

The 5009C, knowing which actuator is supposed to control the valve, will use this signal to generate an alarm, in case of discrepancy.
This alarm could indicate a mechanical/hydraulic failure, independent of the electrical control.
For example, on the dual CPC skid, the transfer valve position can be monitored, It will indicate which CPC is really in control, regardless of the solenoid command.

Position alarm Delay (seconds) **dflt=5(0,100)**

Set the delay before a position alarm is generated in case of discrepancy.
This delay is used to avoid false alarm during normal transfer.

Use analog Feedback IH-A (B) **dflt=*FALSE**

(Settings are similar for feedback B)
Select this option if an analog signal is used to monitor the actuator pressure/position.

Sensor range

Set the range of the analog Pressure/position transmitter.
Value1 (units for 4 mA) **dflt=1(-20000,20000)**
Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Use alarm?

Select this option if the alarm in case of difference demand-IH position is desired.

Auto Xfer if alarm?

Select this option if it is desired to transfer the controlling actuator in case of different IH position demand (only if IH pressure is too high).

Max difference level (%) **dflt=10(0,100)**

Set the maximum deviation tolerated between the actuator demand and the corrected analog feedback.
The corrected analog signal can be set in service mode.
In some case, it is necessary to correct the analog Feedback prior to compare it with the actuator demand. In Service mode, a curve is available to correct it.
The Max difference alarm is used only for monitoring purpose.
It won't proceed to an automatic transfer of valve.

Alarm Delay **dflt=10(0.5,60)**

Set the delay before a “Max difference level” is activated.
This delay might be necessary if some delays exist in the analog actuator feedback, or in case of big transitions.

Use Automatic test? **dflt = *FALSE**

Select this option if it is desired that the 5009C perform in a regular period of time, a temporary valve transfer, in order to verify the second actuator.
This test can only be performed if all Actuator are Healthy.

Internal test Timer is reset at any valve transfer request.

Test Every (hours) **dflt 24(1,48)**

Set the test period

Test duration (minutes) **dflt= 1(0.5,59)**

Set the test duration, before redundancy select the Actuator used before the test.

Redundancy 2

Use redundancy 2 **dflt=*FALSE**

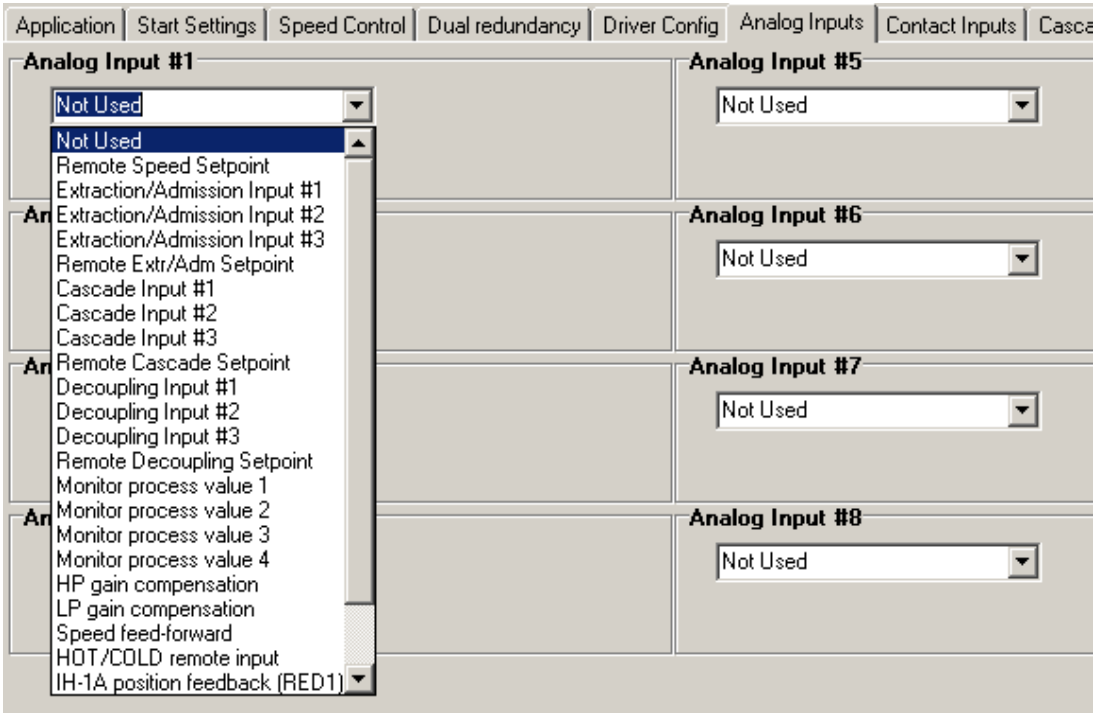
Select this option is a second redundancy manager needs to be used.

All parameters are identical as for redundancy manager 1.

Analog Inputs Folder

Analog Input #X

All Analog Inputs are entered in the same way. As functions are defined in the 5009C control, Analog Inputs are needed to read parameters and close the control loop. If a function is defined, but a needed analog input is not provided, the completeness check at the end of programming will inform the user and bring him back to this page to enter the appropriate analog input. Up to eight analog inputs can be programmed.



Input Option dflt = Not Used

Select one from the following list. If more than one input is needed for one function,(i.e. Cascade Input) use a different numbered selection for each analog function(i.e. Cascade Input #1, Cascade Input #2, Cascade Input #3)

Not Used
Remote Speed Setpoint
Extraction/Admission Input #1
Extraction/Admission Input #2
Extraction/Admission Input #3
Remote Extraction/Admission Setpoint
Cascade Input #1
Cascade Input #2
Cascade Input #3
Remote Cascade Setpoint
Decoupling Input #1
Decoupling Input #2
Decoupling Input #3
Remote Decoupling Setpoint
Monitor Analog Input#1
Monitor Analog Input#2
Monitor Analog Input#3
Monitor Analog Input#4
HP gain compensation
LP gain compensation
Speed Feed-forward
Remote Hot/COLD input
IH-1A position feedback (RED1)
IH-1B position feedback (RED1)
IH-2A position feedback (RED2)
IH-2B position feedback (RED2)
Seal PID process Value

Device Power

Select the power configuration used by the input device (Self Powered or Loop Powered). Select the “Self Powered” setting if the input device has its own power. Select the “Loop Powered” setting if the input device is powered by the 5009C control.

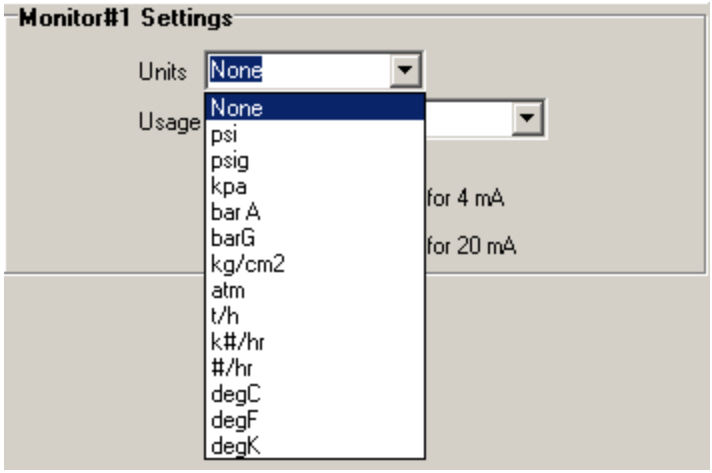
For normal analog input, the range and units will be defined in the corresponding Folder, relative to the selection.
Example: cascade PV range and units will be set in the CASCADE Folder.

Exception is made for the monitor inputs:

If any monitor input is selected, then, the units, the range and usage will appear and will be set in this folder.

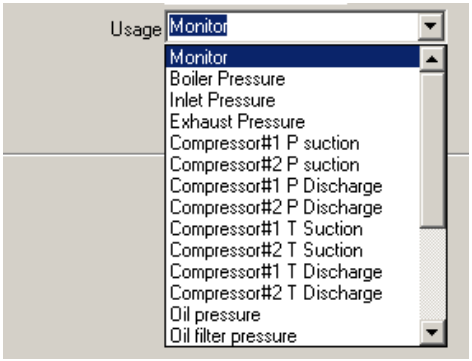
Monitor input#1-4

Units: **dflt=None**



Select the units used from list above. A corresponding number will be send through Modbus, for monitoring Purpose.

Usage:



Select the usage of the channel from the list below:

Monitor
Boiler Pressure
Inlet Pressure
Exhaust Pressure
Compressor#1 P suction
Compressor#2 P suction
Compressor#1 P Discharge
Compressor#2 P Discharge
Compressor#1 T suction
Compressor#2 T suction
Compressor#1 T Discharge
Compressor#2 T Discharge
Oil Pressure
Oil filter pressure
Bearing #1 temperature
Bearing #2 temperature
Bearing #3 temperature
Bearing #4 temperature
Vibration#1
Vibration#2
Vibration#3
Vibration#4

A corresponding number will be send through Modbus, for monitoring Purpose.

Monitor#1-4 Sensor range

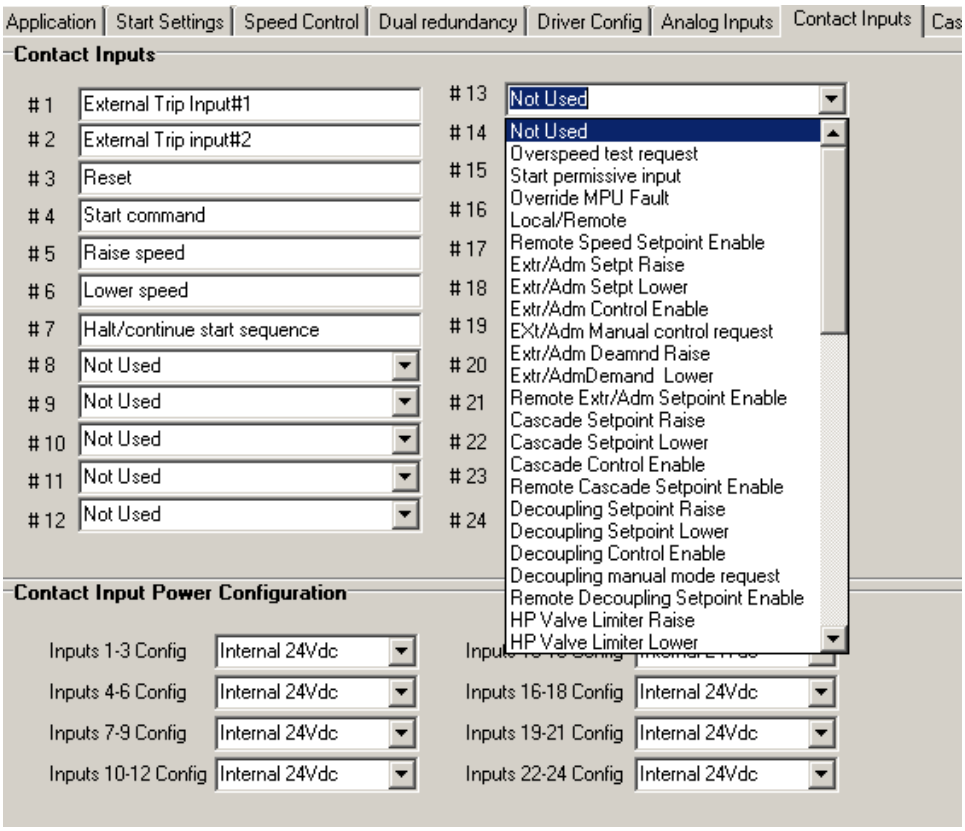
Value at 4 mA **dflt = 0.0 (-20000, 20000)**

Set the value (in engineering units) that corresponds to 4 milliamps (mA) on the analog input.

Value at 20 mA **dflt = 100 (-20000, 20000)**

Set the value (in engineering units) that corresponds to 20 milliamps (mA) on the analog input.

Contact Inputs Folder



Contact Inputs

(Except for the External Trip and External Alarm contacts, each contact input option may be configured only once. In addition, the function that the contact input uses must be programmed or a completeness check error message will occur. For example, to use the Cascade Control Enable contact input, the 'Use Cascade' function must be programmed.)

.

External Trip#1

Contact Input #1 is dedicated as an External Trip input. If the contact is open (power removed) the Control will issue a fail-safe shutdown.

External Trip#2

Contact Input #2 is also dedicated as an External Trip input. If the contact is open (power removed) the Control will issue a fail-safe shutdown.

Reset

Contact Input #3 is dedicated as a Control Reset input. If the contact is closed (power applied) the Control will issue a reset command.

Start Command

Contact Input #4 is dedicated as a Control start input. If the contact is closed (power applied) the Control will issue a start command.

Raise Speed

Contact Input #5 is dedicated as a Raise Speed Setpoint command. If the contact is closed (power applied) the Control will raise the speed setpoint.

Lower Speed

Contact Input #6 is dedicated as a Lower Speed Setpoint command. If the contact is closed (power applied) the Control will lower the speed setpoint.

Halt/continue start sequence

Contact Input #7 is dedicated as a halt/continue start sequence command. If the contact is closed (power applied) the Control will select continue sequence.

If the sequence if halted using R/L speed, PCI or Modbus, and the contact is closed, it must be opened/closed to re-issue a continue command.

Contact Input X

Function

Scroll through the option list and select an option by clicking on it.

CONTACT INPUT

Options	Comments
Not used	
Overspeed TEST	Only external test can be performed with it
Start Permissive	Must be close to authorize start / Not used after start
Override MPU Fault	
Local/remote	Local is local operator panel / Remote is Modbus
Rmt SPD Setpt Enable	
Extr/Adm Setpt Raise	
Extr/Adm Setpt Lower	
Extr/Adm control Enable	Will ramp LP if automatic enabling configured
Extr/Adm control Manual	Close edge will select manual mode open edge select auto
Extr/Adm Demand Raise	Will raise P demand in coupled mode/ P' in decoupled mode
Extr/Adm Demand Lower	Will lower P demand in coupled mode/ P' in decoupled mode
Rmt Ext/Adm Setpt Enable	
Casc Setpt Raise	
Casc Setpt Lower	
Rmt Casc Setpt Enable	
Decoupling Setpt Raise	
Decoupling Setpt Lower	
Decoupling control enable	Extr/adm must be enabled to accept this command
Decoupling control manual	Close edge will select manual mode/ open edge select auto
Rmt DCPL setpt Enable	DCPL is Decoupling
HP valve limiter Open	
HP valve limiter Close	
LP valve limiter Open	
LP valve limiter Close	
Controlled Shutdown	
Set Time of day	
External Trip #3	Each trip number must be different per channel
External Trip #4	//
External Trip #5	//
External Trip #6	//
External Trip #7	//
External Trip #8	//
External Trip #9	//
External Trip #10	//
External Alarm#1	Each external alarm number must be different per channel

External Alarm#2	//
External Alarm#3	//
External Alarm#4	//
External Alarm#5	//
External Alarm#6	//
External Alarm#7	//
External Alarm#8	//
External Alarm#9	//
External Alarm#10	//
Feed-forward enable	
Emergency min gov	If close edge and only if start-up up completed, this contact will jump the speed reference to min governor. This function might be used to protect process/compressor
Null speed arm	Use in conjunction with a relay configured as “null speed detected”. Needed to reset a fault detected on the null speed probe
Null speed permissive	Use in conjunction with a relay configured as “null speed detected”.
Lamp test	Will energize all relay configure for LAMP usage
Redundancy1 select B CMD	Command to switch to B when close/ open switch to A
Redundancy1 B is selected	Feedback signal
Redundancy1 IH-A fault	Used to automatically transfer the valve used
Redundancy1 IH-B fault	Used to automatically transfer the valve used
Redundancy2 select B CMD	Command to switch to B when close/ open switch to A
Redundancy2 B is selected	Feedback signal
Redundancy2 IH-A fault	Used to automatically transfer the valve used
Redundancy2 IH-B fault	Used to automatically transfer the valve used
Hot start-up curve selection	When closed hot curve are selected/when opened cold curves are selected, regardless to the internal timer.
Select manual start	When close, manual start mode will be selected. When open, the start mode set in configuration mode will be selected.
Seal manual command	When closed, seal PID will be in manual mode.
Seal PID Raise demand	Increase Seal PID output when in manual mode.
Seal PID Lower demand	Decrease Seal PID output when in manual mode.
Seal PID Raise Setpoint	Increase Seal PID Setpoint.
Seal PID Lower Setpoint	Decrease Seal PID Setpoint.

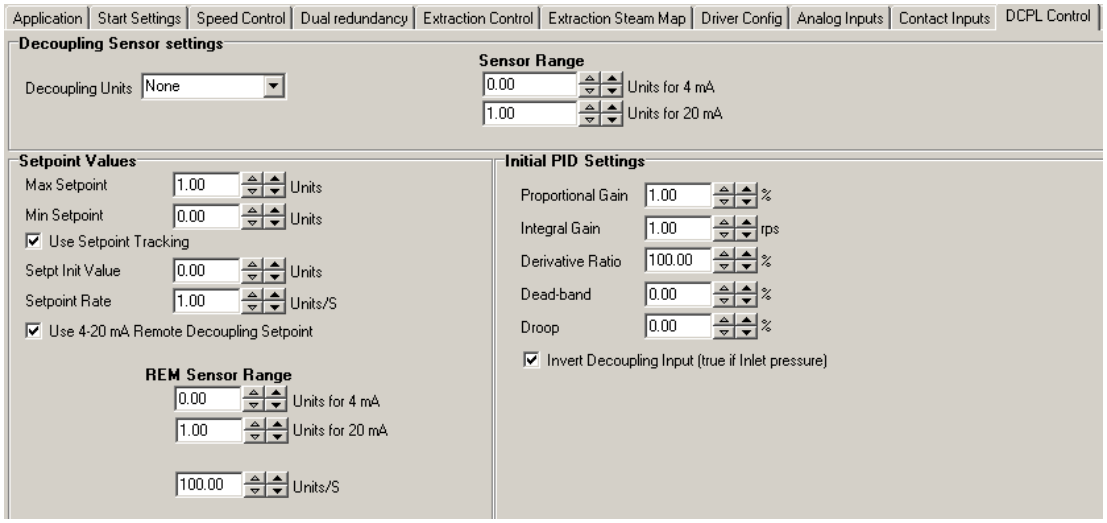
Contact Input Power Configuration

Inputs X-X Config **dflt = Internal 24Vdc**

Select the contact input circuit wetting voltage used by each set of contact inputs. Select the “Internal 24Vdc” setting if the 5009C control is supplying the circuit’s contact input wetting voltage.

DCPL (Decoupling) Folder

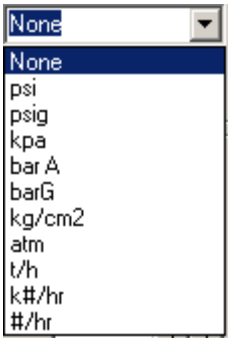
This folder will appear only if decoupling mode has been selected in the main header.



Decoupling Sensor Settings

Decoupling Units:

Select one of the following: **dflt = None**

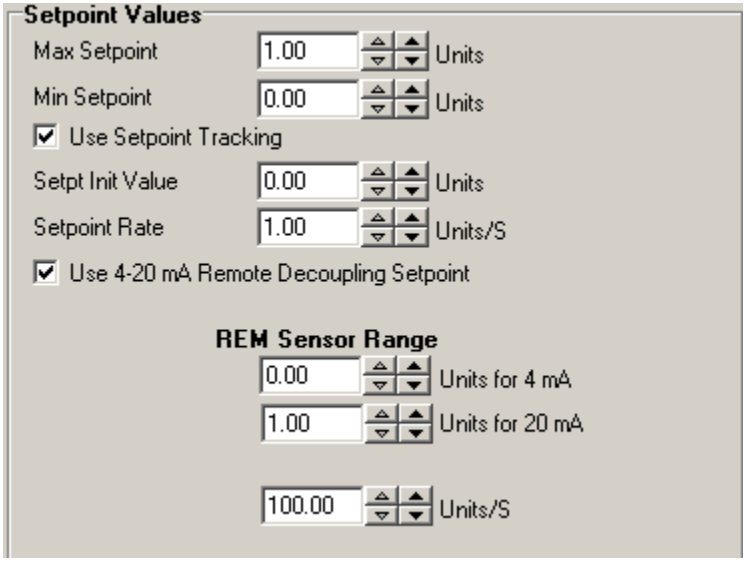


Sensor range:

Set the range of the analog decoupling transmitter.
If several transmitter (#1,#2,#3) are used, they must all have the same range.

Value1 (units for 4 mA) **dflt=1(-20000,20000)**
Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Setpoint Values



Maximum Setpoint **dflt = 0.0 (0, 10000)**

Set the maximum decoupling setpoint. This value is the maximum setpoint value that the decoupling setpoint can be increased/raised to (upper limit of decoupling control).

(Must be greater than the 'Min Setpt' Setting)

Minimum Setpoint **dflt = 0.0 (0, 1000)**

Set the minimum decoupling setpoint. This value is the minimum setpoint value that the decoupling setpoint can be decreased/lowered to (lower limit of decoupling control).

Use Setpoint Tracking **dflt = Yes**

If checked, at power up, the setpoint will track the process value when decoupling mode is disabled or in manual mode.

The tracking/Not tracking command can later be changed via Modbus/PCI only.

If tracking is not selected, then the operator can change the setpoint at any time.

However, to avoid any bump while decoupling automatic mode is enabled, an internal (hidden) setpoint of the 5009C will take care of a smooth transfer at the "not match rate" configured in Service mode.

Setpoint Initial Value **dflt = 0.0 (-10000, 10000)**

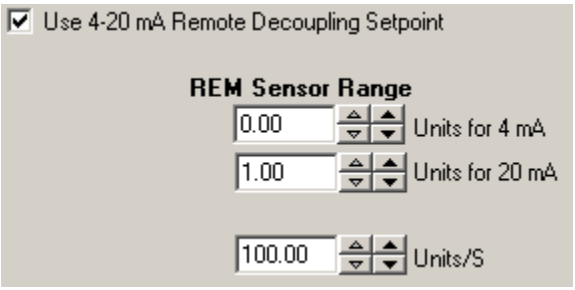
Enter the setpoint initialization value for the decoupling setpoint., this is the value that the setpoint initializes to upon power-up or exiting the program mode.

(Must be less than or equal to the 'Max Setpt' Setting)

Setpoint Rate—(Slow) **dflt = 5.0 (0.01, 10000)**

Enter the decoupling setpoint slow rate (in units per second) at which decoupling setpoint moves when adjusted for less than 3 seconds. After 3 seconds the rate will increase to 3 times this rate. The slow rate, fast rate time delay (defaulted to 3 seconds), and fast rate settings are all adjustable in the PCI's Service mode.

Use 4–20 mA Remote Decoupling Setpoint **dflt = No**



If checked, an external 4-20mA signal can be used (configure in Analog Input page) to change the decoupling setpoint. The decoupling control setpoint will move to this input signal whenever the Remote decoupling Setpoint is enabled.

REM Sensor Range

Value1 (units for 4 mA) **dflt=0(-20000,20000)**

Set the analog signal value for 4 mA

Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Set the analog signal value for 20 mA

Remote Setpoint Maximum Rate **dflt = 100 (0.01, 10000)**

Enter the maximum desired rate that the decoupling setpoint will change for a large step change in the Remote Extraction/Admission Setpoint signal.

Initial PID Settings

Proportional Gain **dflt = 1.0 (0.0, 99.99)**

Enter the DCPL PID proportional gain value. This value is used to set decoupling control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 1%.

Integral Gain **dflt = 1 (0.001, 99.99)**

Enter the DCPL PID integral gain value, in repeats-per-second (rps). This value is used to set decoupling control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 0.3 rps.

Derivative Ratio **dflt = 100 (0.01, 99.99)**

Enter the DCPL PID derivative ratio. This value is used to set decoupling control response. This value can be changed in the Service Mode while the turbine is operating. If unknown, a recommended starting value is 100%.

Dead-band (% of sensor range) **dflt = 0 (0.0, 100)**

If required, enter the deadband. typically, set between 1% and not more than 10%.

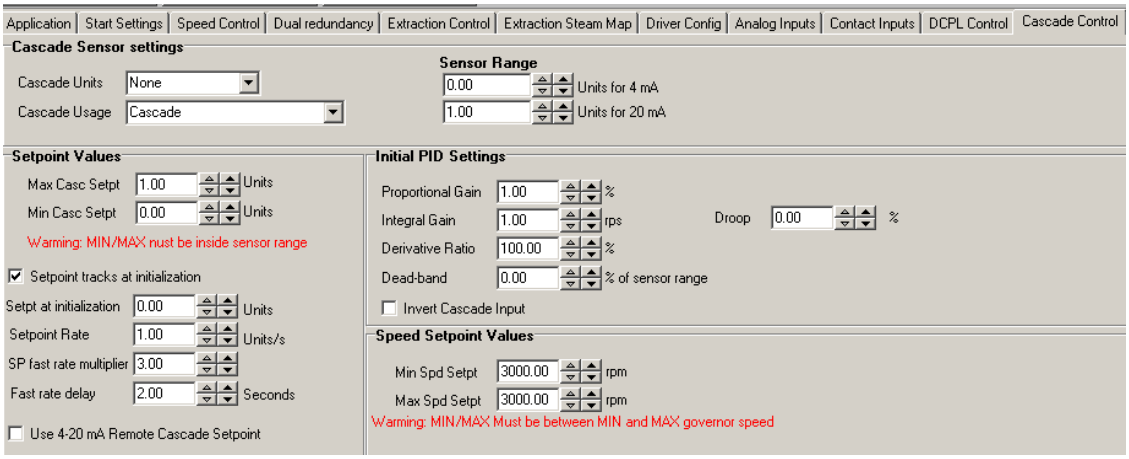
Droop **dflt = 0.0 (0.0, 100)**

Enter the droop percentage. If required, typically set between 4-6% and not more than 100%.

Invert Decoupling **dflt = No**

Check this box if the decoupling control action required is reverse acting. If selected, this option will result in the HP valve (S-term) decreasing to increase the decoupling input parameter if inlet decoupling is used.. An example when the input would be inverted is when DCPL PID is being used for turbine inlet pressure control.

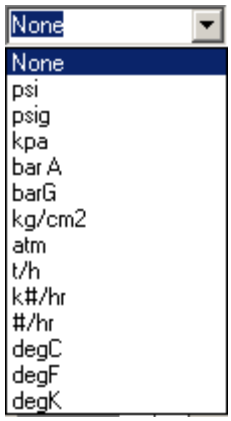
Cascade Folder



Cascade Sensor settings

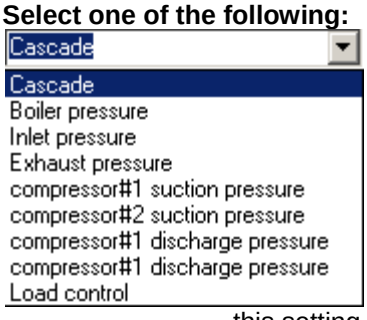
Cascade Units:

Select one of the following: **dflt = None**



Cascade usage

Select one of the following: **dflt = cascade**



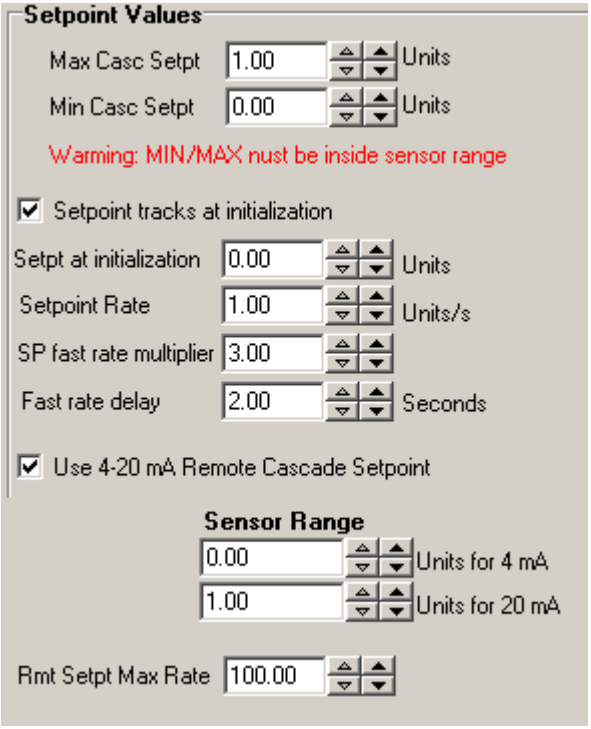
this setting will be converted in a number and send through Modbus for HMI usage.

Sensor range:

Set the range of the analog cascade transmitters.
If several transmitter (#1,#2,#3) are used, they must all have the same range

Value1 (units for 4 mA) **dflt=1(-20000,20000)**
Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Setpoint Values



Maximum Setpoint **dflt = 1.0 (0, 10000)**

Set the maximum cascade setpoint. This value is the maximum setpoint value that the cascade setpoint can be increased/raised to (upper limit of cascade control).

(Must be greater than the 'Min Setpt' Setting)

Minimum Setpoint **dflt = 0.0 (0, 1000)**

Set the minimum cascade setpoint. This value is the minimum setpoint value that the cascade setpoint can be decreased/lowered to (lower limit of cascade control).

Use Setpoint Tracking **dflt = Yes**

If checked, at power up, the setpoint will track the process value when cascade mode is disabled.

The tracking/Not tracking command can later be changed via Modbus/PCI only.

If tracking is not selected, then the operator can change the setpoint at any time.

However, to avoid any bump while cascade is enabled, an internal (hidden) setpoint of the 5009C will take care of a smooth transfer at the "not match rate" configured in Service mode.

Setpoint Initial Value **dflt = 0.0 (-10000, 10000)**

Enter the setpoint initialization value for the cascade setpoint., this is the value that the setpoint initializes to upon power-up or exiting the program mode.

(Must be less than or equal to the 'Max Setpt' Setting)

Setpoint Rate—(Slow) **dflt = 5.0 (0.01, 10000)**

Enter the cascade setpoint slow rate (in units per second) at which cascade setpoint moves when adjusted for less than 2 seconds. After 2 seconds, the rate will increase to 3 times this rate. The slow rate, fast rate time delay (defaulted to 3 seconds), and fast rate settings are all adjustable in the PCI's Service mode and below.

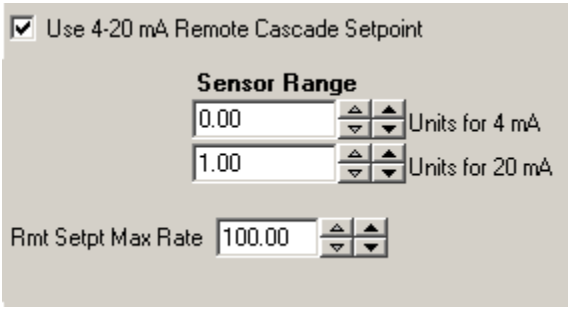
SP fast rate multiply: **dflt=3 (1,10)**

Set this multiply factor used for the setpt rate when fast rate is selected

Fast rate delay (s) **dft2(1,10)**

This is the time to wait when R/L command is send to use the fast rate settings.

Use 4–20 mA Remote Cascade Setpoint **dflt = No**



If checked, an external 4-20mA signal can be used (configure in Analog Input page) to change the cascade setpoint. The cascade control setpoint will move to this input signal whenever the Remote cascade Setpoint be enabled.

REM Sensor Range

Value1 (units for 4 mA) **dflt=0(-20000,20000)**

Set the analog signal value for 4 mA

Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Set the analog signal value for 20 mA

Remote Setpoint Maximum Rate **dflt = 100 (0.01, 10000)**

Enter the maximum desired rate that the cascade setpoint will change for a large step change in the Remote cascade Setpoint signal.

Initial PID Settings

Proportional Gain **dflt = 1.0 (0.0, 99.99)**

Enter the cascade PID proportional gain value. This value is used to set cascade control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 1%.

Integral Gain **dflt = 1 (0.001, 99.99)**

Enter the cascade PID integral gain value, in repeats-per-second (rps). This value is used to set cascade control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 0.3 rps.

Derivative Ratio **dflt = 100 (0.01, 99.99)**

Enter the Cascade PID derivative ratio. This value is used to set cascade control response. This value can be changed in the Service Mode while the turbine is operating. If unknown, a recommended starting value is 100%.

Dead-band (% of sensor range) **dflt = 0 (0.0, 100)**

If required, enter the deadband. typically, set between 1% and not more than 10%.

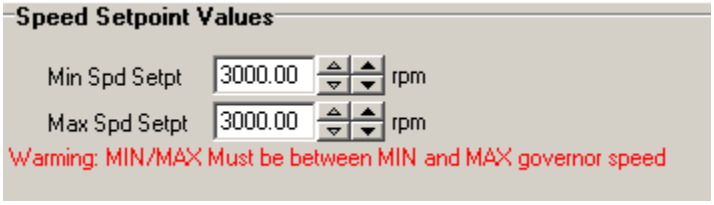
Droop **dflt = 0.0 (0.0, 100)**

Enter the droop percentage. If required, typically set between 4-6% and not more than 100%.

Invert cascade **dflt = No**

Check this box if the cascade control action required is reverse acting. If selected, this option will result in the HP valve (S-term) decreasing to increase the cascade input parameter. An example when the input would be inverted is when cascade PID is being used for turbine inlet pressure control.

Speed Setpoint Values



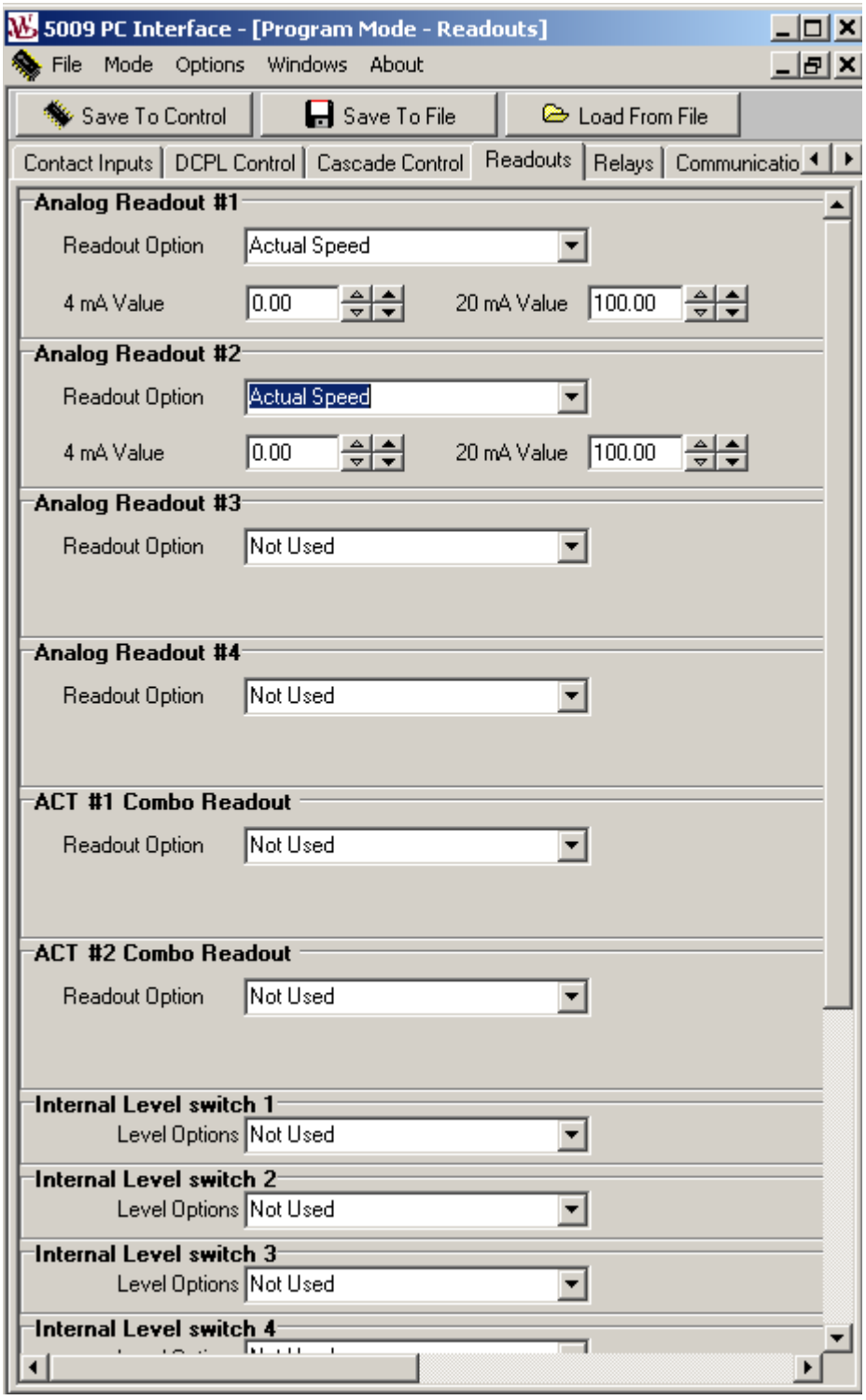
Maximum Speed Setpoint **dflt = 3780 (0.0, 25000)**

Enter the maximum speed setpoint that the Cascade controller can raise the speed setpoint to. This value is used to limit the Cascade PID from over powering the unit. (Must be less than or equal to the 'Maximum Control Speed Setpt' Setting)

Minimum Speed Setpoint **dflt = 3600 (0.0, 25000)**

Enter the minimum speed setpoint that the Cascade controller can lower the speed setpoint to.(Must be greater than or equal to the 'Minimum Control Speed Setpt' Setting)

Analog Readouts Folder



Analog Readout #X

All four 4-20 mA analog readouts may be configured in the same way. The function that the readout uses must be programmed or a completeness check error message will occur. For example, to use the Cascade Setpoint readout, the 'Use Cascade' function must be programmed.

Output Option **dflt = Not Used**

Select one of the following:

(Not Used)	HP1 driver demand
Actual Speed	HP2 driver demand
Remote Speed Setpoint	LP1 driver demand
Extr/Adm Input	LP2 driver demand
Extr/Adm Setpoint	Monitor input #1
Rmt Extr/Adm Setpoint	Monitor input #2
Cascade Input	Monitor input #3
Cascade Setpoint	Monitor input #4
Rmt Cascade Setpoint	IH-1A position feedback (Redundancy 1)
Decoupling Input	IH-1B position feedback (Redundancy1)
Decoupling Setpoint	IH-2A position feedback (Redundancy 2)
Rmt Decoupling Setpoint	IH-2B position feedback (Redundancy 2)
Speed Demand (s)	HP average LVDT position fdbk
Extraction Demand (p)	LP average LVDT position fdbk
HP Valve Limiter Setpoint	Remote IO AO#1-4*
LP Valve Limiter	Setpoint Seal PID process value
HP Demand	Seal PID Setpoint
LP Demand	Seal PID output (%)

* remote IO are available only in customized 5009C version. Using second ring software

Value at 4 mA **dflt = 0.0 (-325000, 325000)**

Enter the value (in engineering units) that corresponds to 4 milliamps (mA) on the analog output.

Value at 20 mA **dflt = 100 (-325000, 325000)**

Enter the value (in engineering units) that corresponds to 20 milliamps (mA) on the analog output.

(Must be greater than the 'Readout 4mA Value' Setting)

ACT1 or ACT2 combo

If any of the actuator combo output is not used to control a valve, then it can be used as a normal analog out (4-20 mA only)

The readout options are the same as the one for regular Analog outputs

Internal level switches (#1-#4)

the 5009C can be configured to use any general signal to generate alarm/SD etc. Four internal levels are available.

Level Option **dflt = Not Used**

Select one of the following:

(Not Used)	HP1 driver demand
Actual Speed	HP2 driver demand
Remote Speed Setpoint	LP1 driver demand
Extr/Adm Input	LP2 driver demand
Extr/Adm Setpoint	Monitor input #1
Rmt Extr/Adm Setpoint	Monitor input #2
Cascade Input	Monitor input #3
Cascade Setpoint	Monitor input #4
Rmt Cascade Setpoint	IH-1A position feedback (Redundancy 1)
Decoupling Input	IH-1B position feedback (Redundancy1)
Decoupling Setpoint	IH-2A position feedback (Redundancy 2)
Rmt Decoupling Setpoint	IH-2B position feedback (Redundancy 2)
Speed Demand (s)	
Extraction Demand (p)	
HP Valve Limiter Setpoint	Remote IO AO#1-4*
LP Valve Limiter	Setpoint Seal PID process value
HP Demand	Seal PID Setpoint
LP Demand	Seal PID output (%)

On Level: **dflt=0(-20000,20000)**

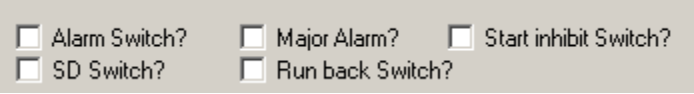
Set the level on the selected option used for TRUE.

Off Level: **dflt=0(-20000,20000)**

Set the level on the selected option used for FALSE

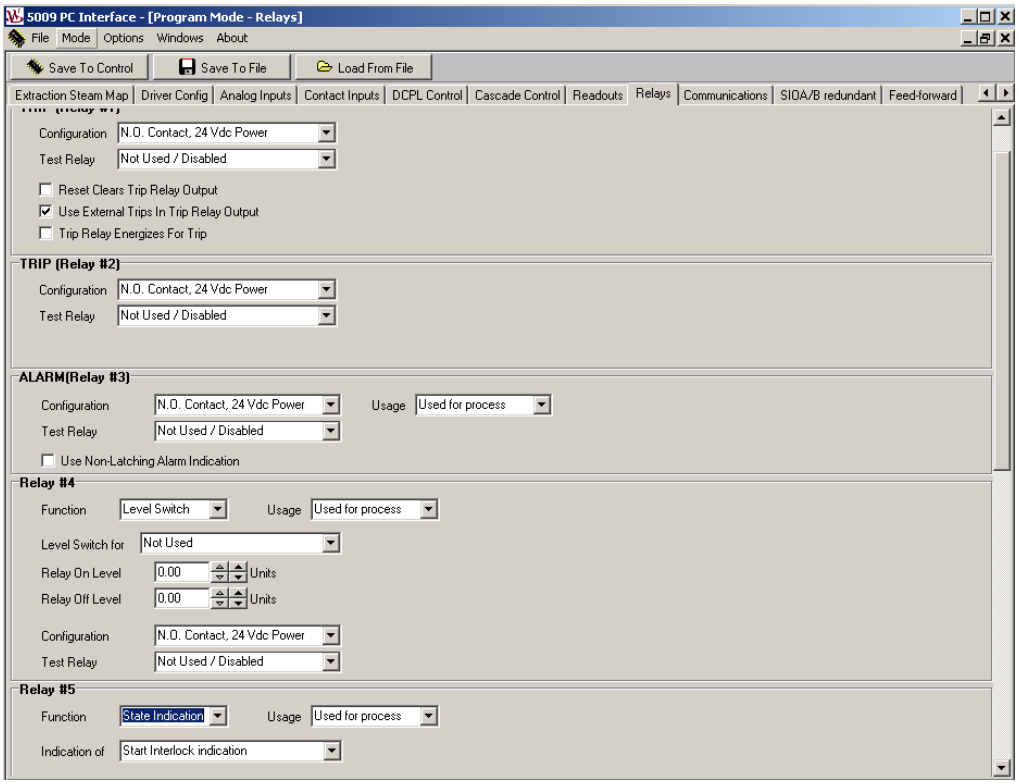
If the ON level if higher than the OFF level then this internal switch will be used a HIGH selector switch (True when signal>on level, FALSE when signal <OFF level.
If the ON level if lower than the OFF level then this internal switch will be used as a LOW selector switch (True when signal <on level, false when signal>OFF level.

The usage of this internal switch when the status is TRUE can be configured according the following options



Select the option(s) desired)
Note:
Run back option will force the lower speed signal, as long as the level status is TRUE

Relay Folder



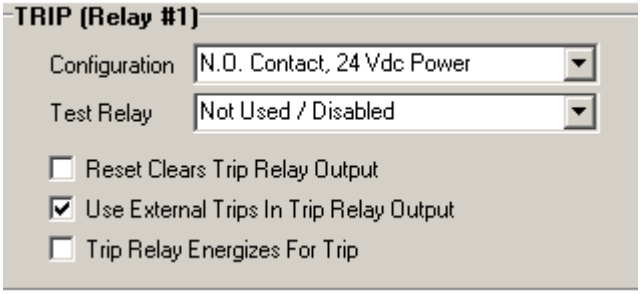
You may configure up to 9 relays in addition to the three pre-assigned relays (Trip#1,trip#2, Alarm). Each relay can be configured to function either as a level switch or as a state indication. An example of a level switch is a Speed Switch (relay changes state above a certain level) and an example of a state indication is Cascade Control Enabled (the relay energizes on the indicated state = true).

Relay Testing

Test Relay(s) Every **dflt = 24 (0.0, 1000)**

Enter the length of time in hours between which the selected relays in each FT relay assembly are to be tested. Each relay output that is configured to be tested (its “Test Relay” option set to When Contacts are open, When Contacts are closed, or When Open or Closed) will be tested when the set time expires. With each test, all relay outputs configured for testing will have their individual relay’s cycled, without affecting the state of the overall relay output. The test relay timer is reset when the program mode is exited, a manual test command is given, and after each timed test.

Trip Relay #1 or #2



This relay is predefined as the control's trip command/indication output. This relay output can be configured to energize or de-energize on a trip condition.

Configuration **dflt = N.O. Contact, 24 Vdc Power**

Select the configuration used for the trip relay (contacts used, power interfaced with). Normally Open (NO) and Normally Closed(NC) options are available for three different power sources (24Volts DC, 125Volts DC, 120 Volts AC). This setting allows the control to correctly test the relay output, and print out the correct wiring-list terminals and jumpers. If the relay is not being tested (the relay's "Test Relay" option set for Not Used/Disabled), and a wiring list is not being utilized this option need not be selected.

Test Relay **dflt = When Open or Closed**

The FT relay assemblies automatically test each relay in the assembly once every time period as entered above. This option allows that test to be disabled or only preformed when the contacts are in a certain state. To determine if the test needs to be disabled for one or both contact settings, see Volume 1 of this manual.

Reset Clears Output **dflt = No**

When this option is checked, the trip relay will change from its shutdown state to its normal operating state when the control is shutdown and a control reset command is issued.

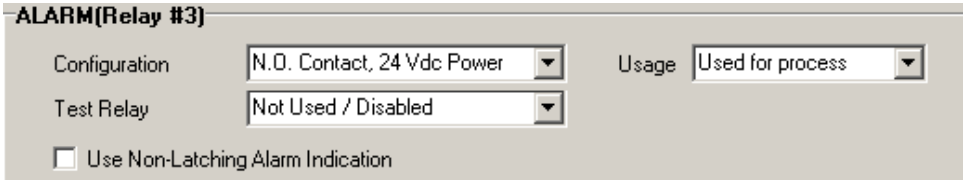
Use External Trips **dflt = Yes**

When this option is selected or checked, the control's trip relay will change to its tripped state when external trip commands (trip contact inputs) have been sensed. When this option is not selected, the control's trip relay will only change state based on internal control shutdown conditions (i.e. Overspeed, all speed inputs failed conditions).

Energize on Trip **dflt = No**

When selected or checked, this option reverses the conditional state of the trip relay. Instead of de-energizing on a trip condition, the Trip relay will energize on a trip condition. Care should be taken in using this option, in the event of a power loss, the Trip relay will not energize.

Alarm Relay #3



This relay is predefined for an alarm indication. When the 5009C control has sensed a control alarm, this relay is energized.

Configuration **dflt = N.O. Contact, 24Vdc Power**
Select the configuration used for the trip relay (contacts used, power interfaced with). Normally Open (NO) and Normally Closed(NC) options are available for three different power sources (24Volts DC, 125Volts DC, 120 Volts AC). This setting allows the control to correctly test the relay output, and print out the correct wiring-list terminals and jumpers. If the relay is not being tested (the relay's "Test Relay" option set for Not Used/Disabled), and a wiring list is not being utilized this option need not be selected.

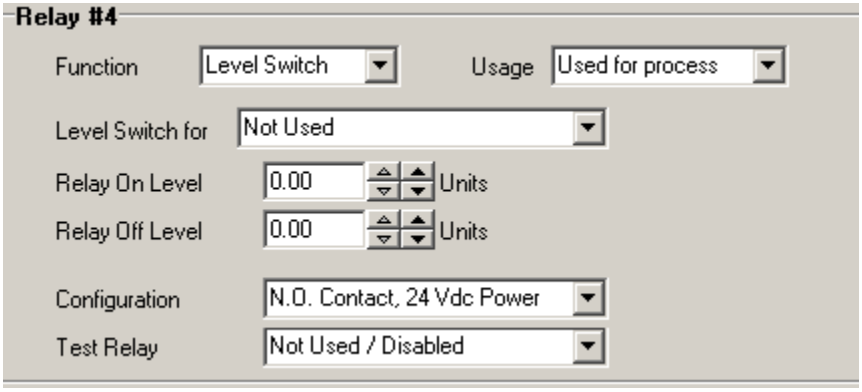
Testing Configuration **dflt = When Open or Closed**
The FT relay assemblies automatically test each relay in the assembly once every time period as entered above. This option allows that test to be disabled or only preformed when the contacts are in a certain state. To determine if the test needs to be disabled for one or both contact settings, see Volume 1 of this manual.

Use Non-Latching Alarm Indication **dflt = No**
When selected or checked, this option will energize the alarm relay when an alarm condition exists. When the alarm condition is removed, the relay will de-energize. If this option is not checked, any alarm indication will energize the alarm relay and the relay will remain "latched" until a control reset command is received.

Usage: **dflt= Process**
This relay can be configured as a process signal or a lamp signal.
If configured as a lamp signal, any lamp test request from contact/Modbus or PCI will energize this relay regardless of the alarm status.

Relay (#4—#12) Level Switch

Function
Level Switch



The level switch option allows the relay to change state above a certain level. For the example above, the relay will energize once the actual sensed turbine speed goes above 3600 RPM. It will remain energized as long as the speed remains above 3590 RPM. Once the speed drops below 3590 RPM the relay will de-energize and remain de-energized until the speed once again reaches above 3600 RPM. This provides a level of hysteresis.

Output Option **dflt = Not Used**

Select one of the following:

(Not Used)	HP1 driver demand
Actual Speed	HP2 driver demand
Remote Speed Setpoint	LP1 driver demand
Extr/Adm Input	LP2 driver demand
Extr/Adm Setpoint	Monitor input #1
Rmt Extr/Adm Setpoint	Monitor input #2
Cascade Input	Monitor input #3
Cascade Setpoint	Monitor input #4
Rmt Cascade Setpoint	
Decoupling Input	
Decoupling Setpoint	
Rmt Decoupling Setpoint	
Speed Demand (s)	
Extraction Demand (p)	
HP Valve Limiter Setpoint	
LP Valve Limiter Setpoint	
HP Demand (before linearization)	
LP Demand (before linearization)	

Relay On Level **dflt = 1.0 (-325000, 325000)**

Enter the level (in the configured parameter's units) at which the relay is to be energized. The relay will energize once the selected parameter's level is at or above this setting.

Relay Off Level **dflt = 0.0 (-325000, 325000)**

Enter the level (in the configured parameter's units) at which the relay will de-energize This setting determines the switch's hysteresis value. The relay will remain energized until the parameter's level lowers to a level at or below this setting.

If the ON level if higher than the OFF level then the relay will be used a HIGH selector switch (energized when signal>on level, de-energized when signal <OFF level.

If the ON level if lower than the OFF level then this internal switch will be used as a LOW selector switch (Energized when signal <on level, DE-Energized when signal>OFF level.

Usage: **dflt= Process**

This relay can be configured as a process signal or a lamp signal.
If configured as a lamp signal, any lamp test request from contact/Modbus or PCI will energize this relay regardless of the alarm status.

Configuration **dflt = N.O. Contact, 24Vdc Power**

Select the configuration used for the trip relay (contacts used, power interfaced with). Normally Open (NO) and Normally Closed(NC) options are available for three different power sources (24Volts DC, 125Volts DC, 120 Volts AC). This setting allows the control to correctly test the relay output, and print out the correct wiring-list terminals and jumpers. If the relay is not being tested (the relay's "Test Relay" option set for Not Used/Disabled), and a wiring list is not being utilized this option need not be selected.

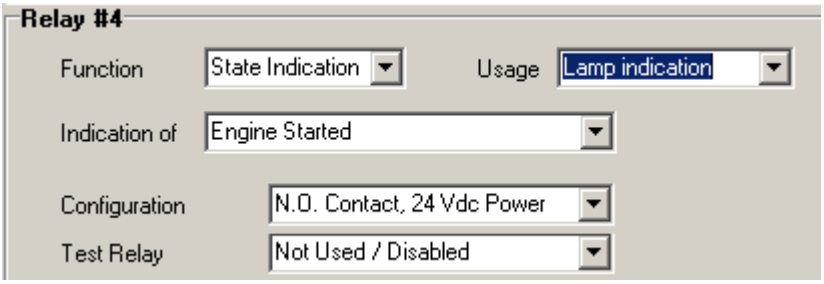
Testing Configuration **dflt = When Open or Closed**

The FT relay assemblies automatically test each relay in the assembly once every time period as entered above. This option allows that test to be disabled or only preformed when the contacts are in a certain state. To determine if the test needs to be disabled for one or both contact settings, see Volume 1 of this manual.

Relay (#4—#12) State Indication

Function

State Indication



The State Indication option provides a True/False indication for any of the options below. In the figure above, the relay will be energized whenever the Control senses an Alarm Condition.

Indication of:

OPTIONS FOR RELAYS IF USED TO INDICATE STATE

Option	Comments
Relay State Indications	
Trip Relay	
Shutdown Indication	
Interlock	Start interlock function is not used in standard 5009C
Alarm Indication	
Major Alarm Indication	
Start permissive	
Engine started	
Overspeed Trip	
Overspeed Test Enabled	
Speed PID in Control	
Start-up completed	
Rmt Spd Setpt Active	
Auto Start Seq Halted	
On-Line PID Dyn Mode	Can be used to determine that min governor speed is reached
Remote (HMI only) Control Mode	
Extr/Adm Control disabled	
Extr/Adm Control enabling	
Extr/Adm PID disabling	
Extr/Adm PID in Manual	
Ext/Adm in semi-auto	
Rmt Extr/Adm Setpt Actv	
Cascade Control Active	
Rmt Casc Setpt Active	
Steam map limit	
DCPL Control Active	DCPL=Decoupling
DCPL Control in manual	
DCPL in semi-auto	

Rmt DCPL Setpt Active	
HP Vlv Lmtr in Control	
LP Vlv Lmtr in Control	
AC1 driver fault	
ACT2 driver fault	
ACT1-FB channel1 driver fault	General fault/not specific to excitation
ACT1-FB channel2 driver fault	General fault/not specific to excitation
Reset pulse (2 sec)	Can be used to Reset Protect 203
stuck in critical	
underspeed	
speed control lost	
feed-forward enabled	
feed-forward active	
Emergency min gov activated	Latching/need a reset
Modbus relay	
Null speed NOT armed	Can be used only if null speed probe configured
Null speed detected	Can be used only if null speed probe configured
Null speed fault	Can be used only if null speed probe configured
redundancy1 select B CMD	
redundancy1 position error	
redundancy2 select B CMD	
redundancy2 position error	
remote IO BO#1	N/A for standard 5009C
remote IO BO#2	N/A for standard 5009C
remote IO BO#3	N/A for standard 5009C
remote IO BO#4	N/A for standard 5009C
remote IO BO#5	N/A for standard 5009C
remote IO BO#6	
fault A106 CH1	Can be used to switch excitation line for LVDT/Pilot if single LVDT is used in site
fault C106 CH1	//
fault A106 CH2	//
fault C106 CH2	//
Seal PID PV or AO fault	
Seal PID in Auto mode	
fault C106 CH2	//

Usage: **dflt= Process**

This relay can be configured as a process signal or a lamp signal.
If configured as a lamp signal, any lamp test request from contact/Modbus or PCI will energize this relay regardless of the alarm status.

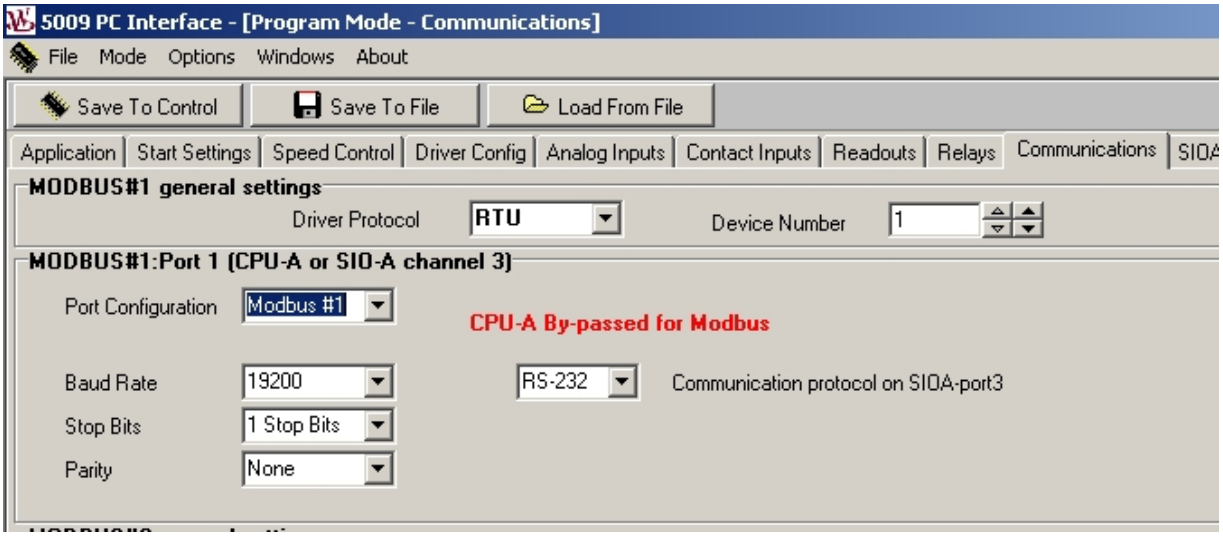
Configuration **dflt = N.O. Contact, 24 Vdc Power**

Select the configuration used for the trip relay (contacts used, power interfaced with). Normally Open (NO) and Normally Closed(NC) options are available for three different power sources (24Volts DC, 125Volts DC, 120 Volts AC). This setting allows the control to correctly test the relay output, and print out the correct wiring-list terminals and jumpers. If the relay is not being tested (the relay's "Test Relay" option set for Not Used/Disabled), and a wiring list is not being utilized this option need not be selected.

Testing Configuration **dflt = When Open or Closed**

The FT relay assemblies automatically test each relay in the assembly once every time period as entered above. This option allows that test to be disabled or only preformed when the contacts are in a certain state. To determine if the test needs to be disabled for one or both contact settings, see Volume 1 of this manual.

Communications Folder



Port 1 (CPU-A) Modbus Settings

Port Configuration **Not Used**

Port 1 or the CPU A communications port is a Modbus port for the 5009C control. If the control is talking to the HMI or to any other Modbus device, it can be connected through this port.

Driver Protocol **dflt = RTU**

ASCII or RTU

Select between ASCII or RTU Modbus. The external device will determine which type of Modbus is necessary. For the HMI RTU is defaulted. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Device Number **dflt = 1.0 ((1.0, 246)**

Enter the integer corresponding to the Modbus device number/address required. For the HMI 1 is defaulted. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Baud Rate **dflt = 19200**

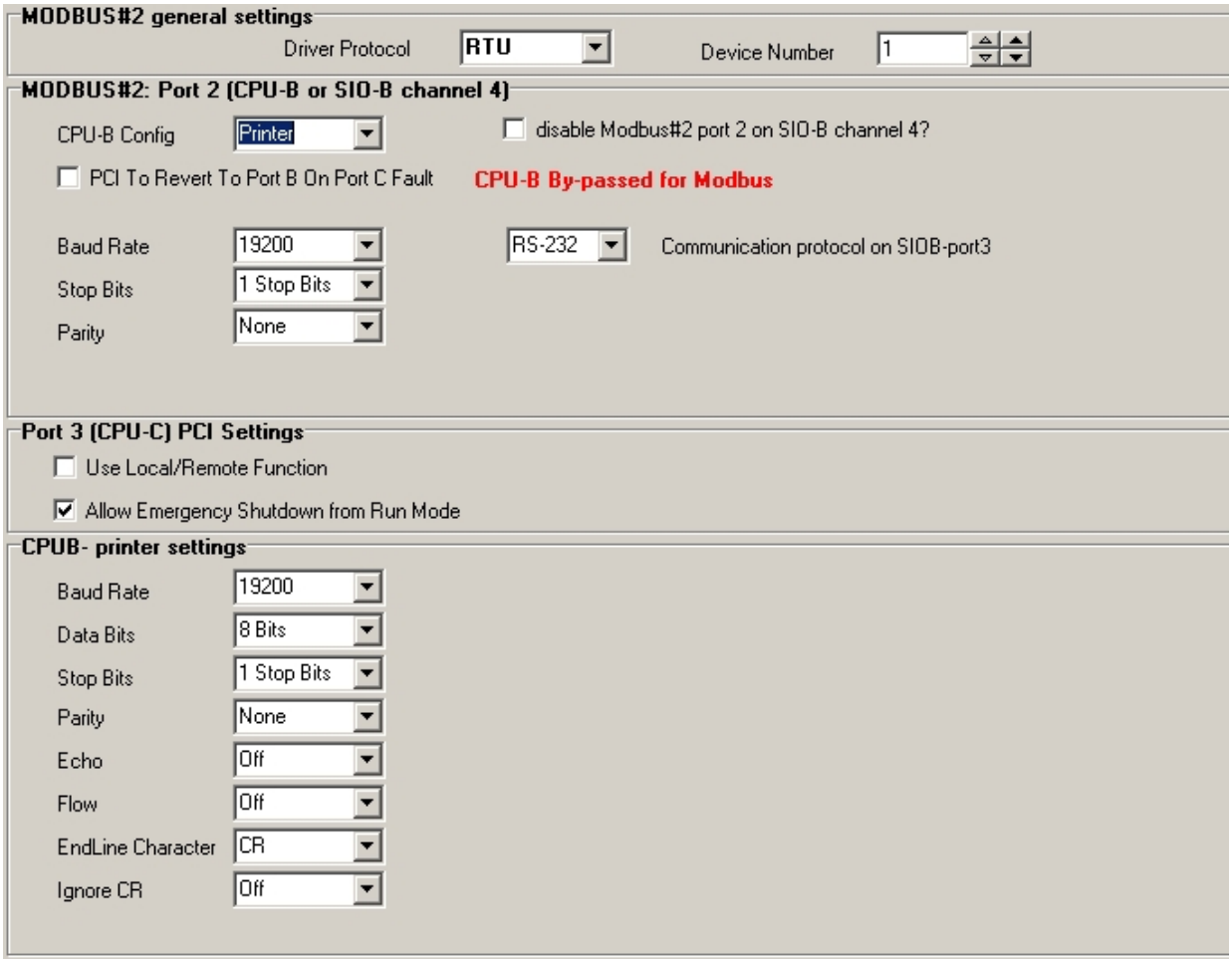
Select the Baud Rate that the external device will be using when communicating with the 5009C control. For the HMI 19200 is defaulted. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Stop Bits **dflt = 1 Stop Bit**

Select the Stop Bit setting that the external device will be using when communicating with the 5009C control. For the HMI 1 Stop Bit is defaulted. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Parity **dflt = None**

Select the Parity setting that the external device will be using when communicating with the 5009C control. For the HMI None is defaulted. In the event it is unknown, this field can be tuned in the Service mode to establish communications.



Port 2 (CPU-B) Settings

Port Type **dflt = Not Used**

Port 2 or the CPU-B communications port can be configured to function as a Modbus Port or a printer port. The CPU-B port is the only port that has the capability to interface with a printer.

Modbus #2

When configured as a Modbus #2 port the control can communicate with the HMI or any other Modbus device connected to this port.

Printer

When configured as a printer port, a line printer can be utilized with the 5009C control to print alarms and trips as they occur. Reference Volume 2 of this manual for printer connection instructions. Once connected match the printer communication settings to the CPU-B port's settings or vice- versa.

A typical Major Alarm line would appear on a line printer as:
Alarm—Casc Input #2 Failed 1997/8/18 10:58:29.724

PCI To revert to Port B On Port C Fault **dflt = No**

In addition to the Port Type options above, port 2 can also be configured to function as a backup PCI port, in the event that the Kernel-C CPU fails. If this option is selected or checked, any fault to the Kernel-C CPU will cause port 2 to stop any Modbus or printer communications and function as a PCI port. This option allows a user to access the 5009C control through the PCI program in the event that the Kernel-C CPU fails.

Once the Kernel-C CPU is restored and reset, the CPU-B port will revert back the its original functionality (Modbus or Printer communications).

Driver Protocol **dflt = RTU**

Select between ASCII or RTU Modbus. The external device will determine which type of Modbus is necessary. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Device Number **dflt = 1.0 (1.0, 246)**

Enter the integer corresponding to the Modbus device number/address required. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Baud Rate **dflt = 38400**

Select the Baud Rate that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Stop Bits **dflt = 1 Stop Bit**

Select the Stop Bit setting that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Parity **dflt = None**

Select the Parity setting that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Port 3 (CPU-C) PCI Settings

Use Local/Remote **dflt = No**

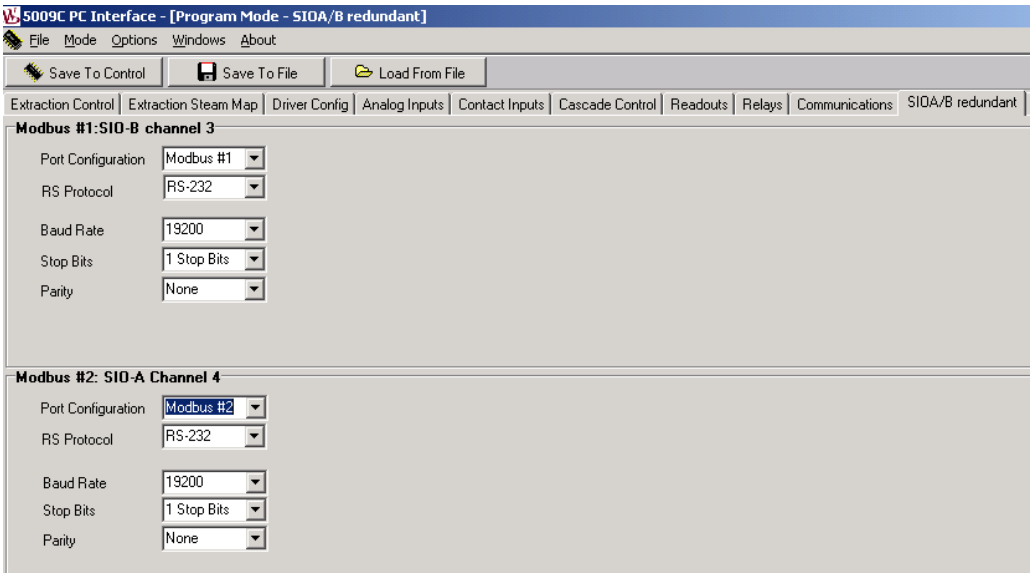
Check this option to select the control's Local/Remote control logic. This logic permits a user to lock out all control commands from one or several of the control's interfaces (Modbus Port 1, Modbus Port 2, contact inputs). If not checked, the commands from all interfaces are active at all times.

When in the REMOTE control mode, the commands from all interfaces are acted upon by the control. When in the LOCAL control mode only commands from the control interfaces, which have been configured to have access are acted upon. Each interface group (Modbus Port 1, Modbus Port 2, contact inputs) can be independently configured for access when LOCAL mode is selected. The PCI program commands are active at all times and can not be locked out. Access configuration prompts for each interface are only visible in the PCI when the "Use Local/Remote" option is selected. Refer to Volume 1 for more information on Local/Remote logic.

Allow Emergency Shutdown from Run Mode **dflt = Yes**

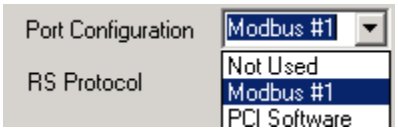
If this option is selected/checked, the user will be able to initiate an emergency stop from the PCI Run Mode. If selected, a two step process is used to avoid unwanted trips. If not selected, only a controlled shutdown is available from the Run Mode.

SIO A/B Redundant Folder



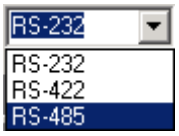
Modbus #1 SIO-B channel 3/Modbus #2 SIO-A Channel 4

Port configuration



Select if on SIO_B channel 3 (SIO-A Channel 4) , Modbus is used or only PCI software.

RS Protocol



Select the communication protocol to be used.

Baud Rate **dflt = 38400**

Select the Baud Rate that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

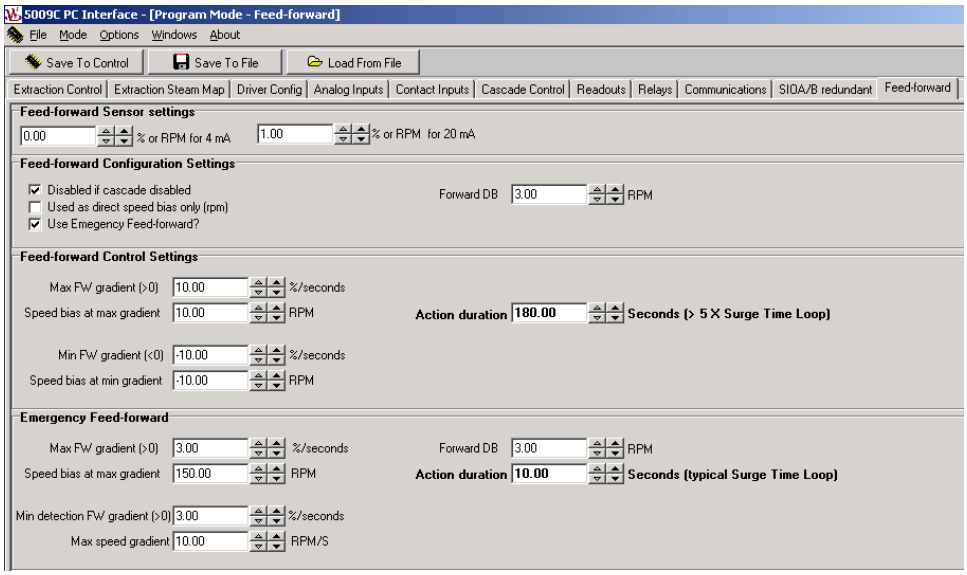
Stop Bits **dflt = 1 Stop Bit**

Select the Stop Bit setting that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Parity **dflt = None**

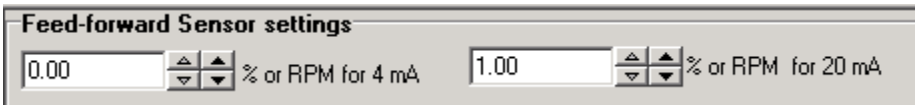
Select the Parity setting that the external device will be using when communicating with the 5009C control. In the event it is unknown, this field can be tuned in the Service mode to establish communications.

Feed-forward Folder



This folder will appear when the feed-forward is selected in the main page.

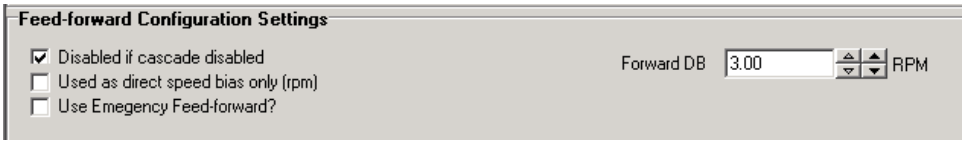
Feed-forward Sensor Settings



Set the sensor values for 4 and 20 mA.

If the Feed-forward loop will be direct action, i.e. bias directly the speed, the units are expressed in RPM.
If the Feed-forward loop is not direct action, i.e. surge valve position send; the units are expressed in percentage.

Feed-forward Configuration Settings



Disabled if cascade disabled **dflt = *TRUE**
If no speed Feed-forward is desired when cascade is disabled, then, select this option.

Used as direct speed bias only (rpm) **dflt = *FALSE**

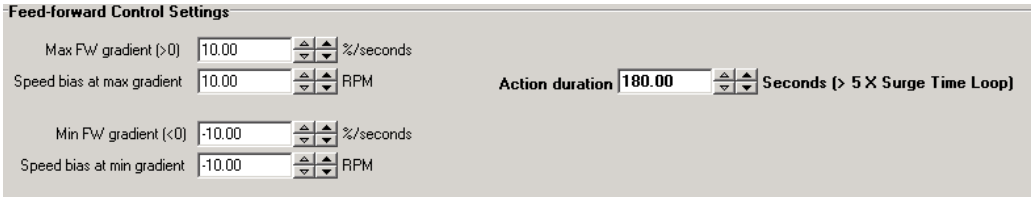
When this option is selected, the speed bias will be directly proportional to the incoming signal.
If not selected, the speed bias will be a temporary action based on the LAG times configured.
Do not select this option if incoming signal is the anti-surge valve position

Used Emergency Feed-forward **dflt = *FALSE**

When the speed bias will be a temporary action based on the Emergency LAG times configured.
The speed bias will act only in case of sudden valve change (opening) due to surge detection. During normal stroke of the valve, this mode should not act on the speed bias.
Care should be taken during calibration of this loop that the emergency bias acts only when necessary.

Forward DB
This is a sliding Dead-band in rpm, use to avoid unnecessary small speed corrections

Feed-forward Control Settings



Max FW gradient (>0) **dflt= *10(0-300)%/s**
This setting is the maximum gradient of the Feed-forward PV (antisurge valve) possible in normal operation.

Speed bias at max gradient **dflt= *10(1,300) rpm**

This is the speed bias requested when Feed-forward demand (valve position minus lagged valve position) reaches the max FW gradient.
In between, zero and Max FW gradient, speed bias will be proportional.

Min FW gradient (<0) **dflt= *-10(-300-0)%/s**
This setting is the minimum gradient of the Feed-forward PV (antisurge valve) possible in normal operation.
Without hysteresis noticed, the absolute value should be equal to Max FW gradient.

Speed bias at min gradient **dflt= *10(-100,-1) rpm**

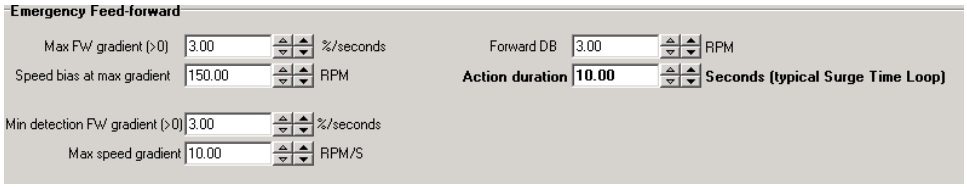
This is the speed bias requested when Feed-forward demand (valve position minus lagged valve position) reaches the min FW gradient.
In between, Min FW gradient and zero, speed bias will be proportional.
Without hysteresis noticed, the absolute value should be equal to speed bias at max gradient.

Action duration **dflt=180(0,1000)**

This time should be at least equal to five times the surge time loop.
When FW signal moves Up/Downs and stays at its position, the speed bias will ramp back to zero in more than 180 s (valve position minus lagged valve position with time constant at 180 s).
This time should be long enough for the cascade PID to control perfectly its PV (example suction/discharge pressure of a compressor).

Emergency Feed-forward

This menu will appear when Emergency feed-forward is selected in Feed-forward configuration Settings.



The emergency loop will be added to the actual speed setpoint. Its action is always positive. It should be activated only in case of sudden FW Process value increase.
This loop should be activated and tuned only after proper tuning of the “normal” one.

Max FW gradient (>0) **dflt=*3(0,100)**
This setting is the max deviation/demand of the valve position minus lagged valve position.

Speed bias at max gradient **dflt= *150(0,300) rpm**

This is the speed bias requested when Feed-forward demand (valve position minus lagged valve position) reaches the max FW gradient.
In between, zero and Max FW gradient, speed bias will be proportional.

Min detection FW gradient (>0) **dflt= *3(0.100)%/s**
This setting is the minimum gradient of the Feed-forward PV (antisurge valve) possible in normal operation.
This setting is used to trigger the Emergency loop. It should be High enough to avoid accidental activation. During normal anti-surge stroke, emergency loop should not be activated.

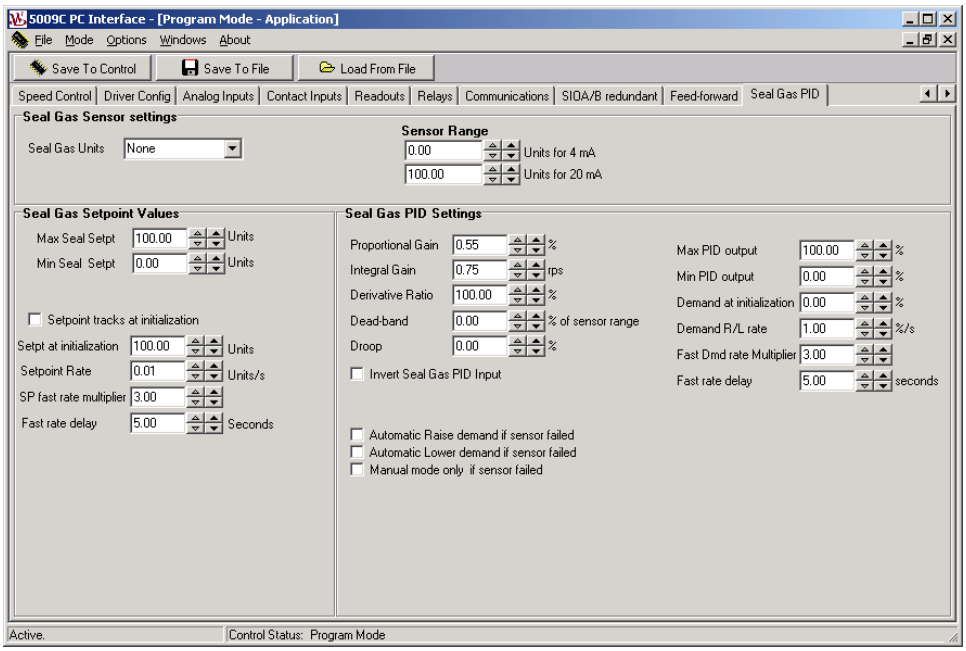
Max speed gradient **dflt=*10(0,300)**
This setting limit the rate of the speed bias when emergency loop is active.

Action duration **dflt=*10(0,100)**

This time should be equal to the surge time loop.
When FW signal moves Up and stays at its position, the speed bias will ramp back to zero in more than 10 s (valve position minus lagged valve position with time constant at 10 s).
This time should be long enough to dump speed oscillation due to surge, but not too long to avoid new instability.

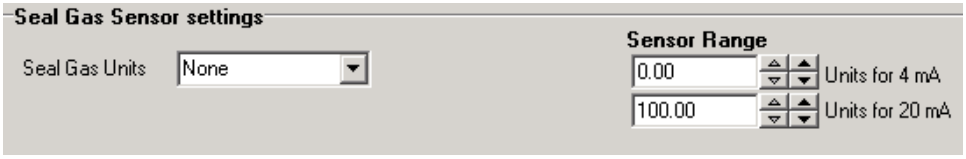
Seal Gas PID Folder

This folder will appear when seal gas PID is selected in the application folder



The seal gas PID, is a PID controller independent from Speed controller and extraction/Admission controller.
Its purpose is to control the seal gas pressure or any other type of process which needs to be controlled.
To be active, an analog output must be configured for this usage. The 5009c won't generate an error message if an AO is configured for Seal gas PID demand or not.

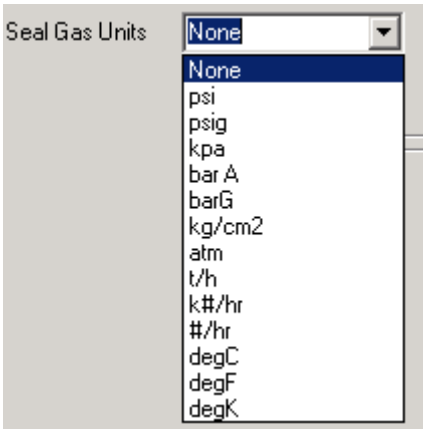
Seal Gas Sensor Settings



This menu define all parameters for the analog input configured as Seal Gas process value.
If seal gas PID is selected and no analog value is configured, an error will appear after the configuration check.

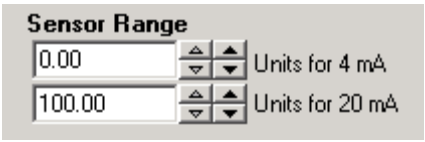
If seal gas PID is not selected and an analog value is configured, an error will appear after the configuration check

Seal Gas Units



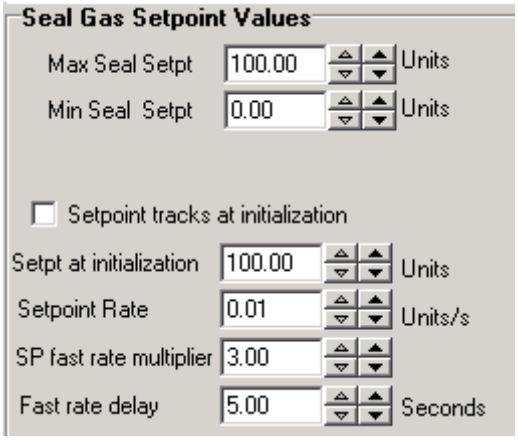
Select the units used for seal gas. This is used for Modbus display only.

Sensor range



Set the range of the analog Seal gas transmitters.
Value1 (units for 4 mA) **dflt=1(-20000,20000)**
Value2 (units for 20 mA) **dflt=1(-20000,20000)**

Seal Gas Setpoint Values



Max seal Setpt **dflt = 100.0 (-100000, 100000)**
Set the maximum Seal PID setpoint. This value is the maximum setpoint value that the Seal PID setpoint can be increased/raised to

Min seal Setpt **dflt = 0.0 (-100000, 100000)**
Set the minimum Seal PID setpoint. This value is the minimum setpoint value that the Seal PID setpoint can be decreased/lowered to

Setpoint Tracks at initialization **dflt = No**

If checked, at power up, the setpoint will track the process value when Seal PID is in manual mode.

The tracking/Not tracking command can later be changed via Modbus/PCI only.

If tracking is not selected, then the operator can change the setpoint at any time.

However, to avoid any bump while Seal PID is enabled, an internal (hidden) setpoint of the 5009C will take care of a smooth transfer at the “not match rate” configured in Service mode.

Setpoint at initialization **dflt = 0.0 (-100000, 100000)**

Enter the setpoint initialization value for the Seal gas PID setpoint., this is the value that the setpoint initializes to upon power-up or exiting the program mode.

Setpoint Rate—(Slow) **dflt = 0.01 (0.01, 10000)**

Enter the Seal PID setpoint slow rate (in units per second) at which Seal PID setpoint moves when adjusted for less than 3 seconds. After 3 seconds, the rate will increase to 3 times this rate. The slow rate, fast rate time delay (defaulted to 3 seconds), and fast rate settings are all adjustable in the PCI’s Service mode and below.

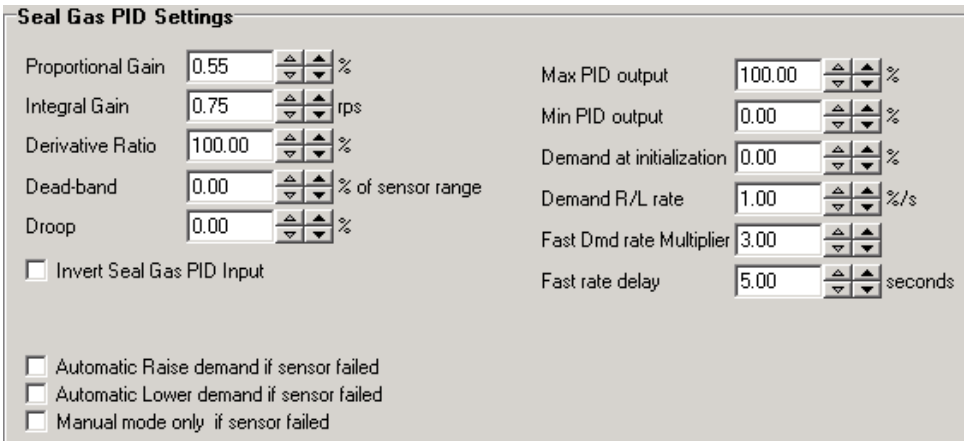
SP fast rate multiply: **dflt=*3 (1,10)**

Set this multiply factor used for the setpt rate when fast rate is selected

Fast rate delay (s) **dflt= *3(1,10)**

This is the time to wait when R/L command is send to use the fast rate settings.

Seal Gas PID Settings



Proportional Gain **dflt = 1.0 (0.0, 99.99)**

Enter the Seal PID proportional gain value. This value is used to set Seal PID control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 1%.

Integral Gain **dflt = 1 (0.001, 99.99)**

Enter the Seal PID integral gain value, in repeats-per-second (rps). This value is used to set Seal PID control response. This value can be changed in the Run Mode while the turbine is operating. If unknown, a recommended starting value is 0.3 rps.

Derivative Ratio **dflt = 100 (0.01, 99.99)**

Enter the Seal PID derivative ratio. This value is used to set Seal PID control response. This value can be changed in the Service Mode while the turbine is operating. If unknown, a recommended starting value is 100%.

Dead-band (% of sensor range) **dflt = 0 (0.0, 100)**

If required, enter the deadband. Typically, set between 1% and not more than 10%. If not needed, set it at zero.

Droop **dflt = 0.0 (0.0, 100)**

Enter the droop percentage. If required, typically set between 4-6% and not more than 100%.If not needed, set it at zero.

Invert Seal PID input **dflt = No**

Check this box if the Seal PID control action required is reverse acting. If selected, this option will result in the PID output decrease decreasing to increase the Seal PID input parameter.

Automatic raise demand if sensor failed. **dflt=*false**

Check this box if it is desired to have the PID output raise to 100% when sensor if detected failed.

Automatic lower demand if sensor failed. **dflt=*false**

Check this box if it is desired to have the PID output lowered to 0% when sensor if detected failed
If automatic raise box is also selected, by accident, then lower has priority.

If no automatic Raise/lower are selected, the PID will automatically goes in manual mode and hold the PID output at the position it had 160 ms before the failure, lagged at maximum 3 seconds (Process value Lag time multiplied by Prop gain)
It is then possible to adjust manually the demand output at any time.

Manual mode only at sensor failed **dflt=false**

Check this box if the manual mode is authorized only in case of sensor failure or analog output failure.
If not selected, it is always possible via contact input/Modbus/PCI to select manual/auto mode.

If several AO are configured as Seal PID output, the Detection of the AO fault will be activated only on the lower AO number configured.
For example if AO#1 and AO#2 are configured like this, the fault will be detected only with AO#1.
If an actuator combo RB is configured as " Seal PID output", the failure detection will be based on this signal.
If two RB are configured, RB#1 will be used to detect the failure.

Max PID Output **dflt=*100(0,100)**

This is the maximum possible demand for the Seal gas PID

Min PID Output **dflt=*0(0,100)**

This is the minimum possible demand for the Seal gas PID

Demand at initialization : **dflt=*0(0,100)**

This is the demand at boot-up

Demand R/L rate: **dflt= *1(0,100)%/s**
This is the normal rate used to raise/lower the PID output when in manual mode.

Fast Demand rate multiplier **dflt=*3(1,10)**
This multiplier factor will apply on the Demand R/L rate when the R/L delay is passed.

Fast rate Delay **dflt=*5(1,30) seconds**
This is the delay when R/L demand is pressed, before the fast rate is activated

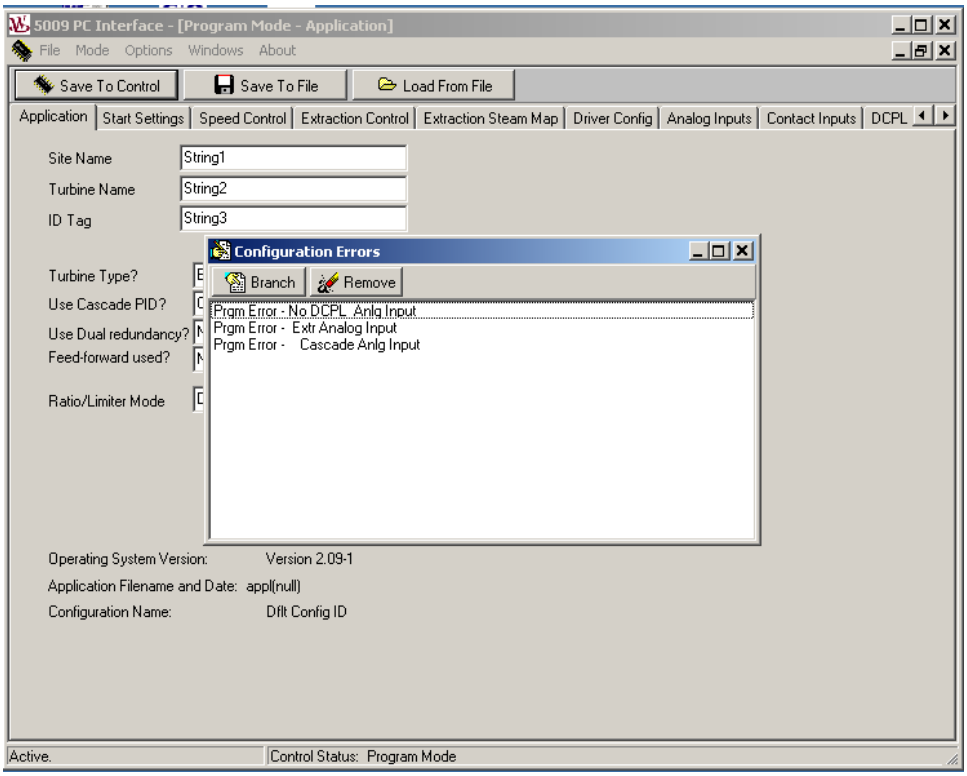
Save to Control

Once all the program settings have been configured, they can be saved to the control. Click on the “Save to Control” button to initiate the save routine. When a Save to Control command is issued, the PCI program performs a configuration error check before any values are saved. If no configuration errors were found, a pop-up box appears and displays “Program Configuration has passed the error check.” and asks if you want to Re-initialize the control. Click on the “Yes” button to exit the Program mode and initialize the control for start-up, or click the “Cancel” button to stay in the Program mode.

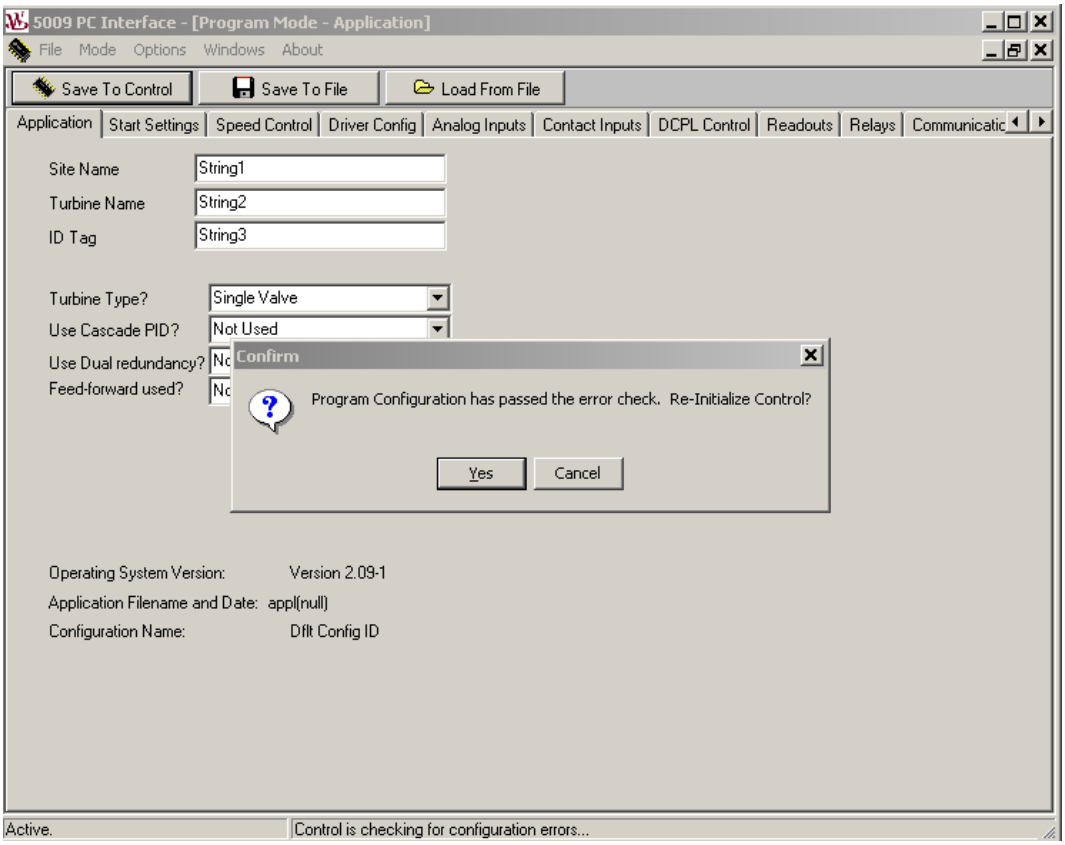
If any configuration errors were detected by the save routine, the program will display a Configuration Error box with a list of the errors detected and a brief explanation of each. By selecting the error (line), then clicking on the “Branch” button the program will step you to the page where the error was detected. Double-clicking on the error will perform the same function. (The error box may need to be moved or closed to view/modify the program settings.)

If desired once an error has been corrected it can be removed from the list by clicking on the “Remove” button. Once all errors have been corrected, close the Configuration Error Box by clicking on the “X” Button then try to save to the control again by clicking the “Save To Control” Button. Continue this process until the program informs you that the “Program Configuration has passed the error check.” and asks if you want to Re-initialize the control. Click on the “Yes” button to exit the Program mode and initialize the control for start-up.

In the example below three configuration errors were detected and displayed by the Error pop-up box. All detected errors will be listed in this folder.



On the Configuration box, being displayed below, the control's program has passed the program's error check routine, and the control can be re-initialized and put into operation. At this point, if Cancel is selected, the PCI program will remain in program mode and the 5009C will remain in a turbine shutdown mode. If a control reset or a control power down is experienced before the Program Mode is exited, all changes will be lost. If Yes is selected, the 5009C control will exit the program mode and be ready to operate the turbine. Once the 5009C control exists the program mode all the above program changes are saved in the control and they will take affect.



After the control leaves the program mode, the original screen reappears. The turbine is now ready to start and any of the PCI modes can be entered, including the program mode again. See Chapter 4 for information on entering the Run Mode and starting the turbine.

Saving the Control's Configuration to a File

At any time when the PCI program is open and communicating with the control, the control's configuration can be saved to a configuration file on the computer or to a disk.

To save the control's configuration settings to a file:

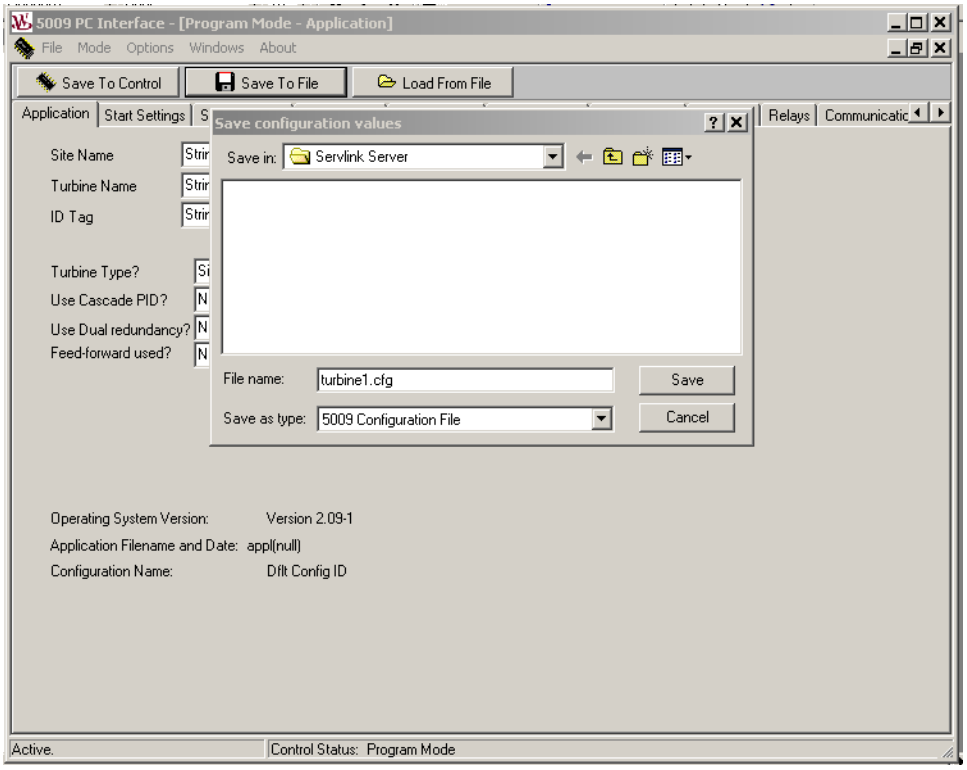
1. Select the "Save values to file" option from the screen's "File" menu, or from the Program mode click on the "Save To File" button.

2. A confirmation box will then appear, asking the user to confirm this action, and informing the user that saving the configuration file may take up to 5 minutes and that during this time exiting/entering the program mode or making configuration changes is not recommended.

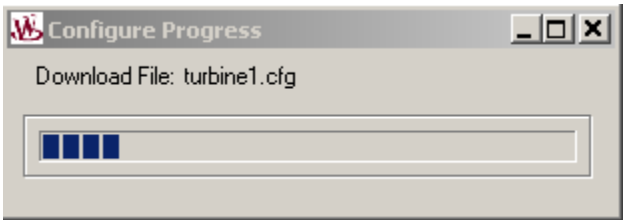
3. Once the Save request is confirmed a “Save Configuration values” box will then appear. At this point if desired, change the save-to file name and location (computer directory or disk), then click on the box’s “Save” button to begin the save routine.

IMPORTANT

The name applied to the “.cfg” file cannot contain more than 5 characters before the “.cfg” (XXXXX.cfg) unless saved to a different directory on the computer.



4. The PCI program’s status panel (located in the screen’s lower left corner) will display the different stages of the Save routine (i.e. Reading File, Reading Configuration Values, etc.). The program will save this configuration file with a “.cfg” extension. During the Save routine, all PCI modes can be monitored, and any Run mode command given. It is recommended that during this routine no Program or Service mode changes be made.



5. When the Save Routine is finished a “XXX.cfg save Complete” message box appears.

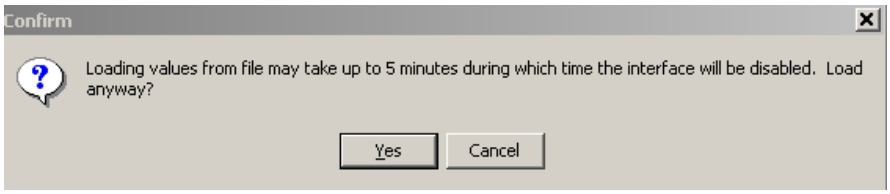
Uploading a Configuration File to the Control

Uploading a configuration file to a control can only be performed if a configuration file has already been created and saved. This procedure may be useful when installing multiple 5009C’s in a plant, to verify that they each have the same configuration. This procedure is not required when replacing any one CPU. If a single CPU is replaced, it will be automatically configured to the settings used by the other two CPUs, during its initialization procedure.

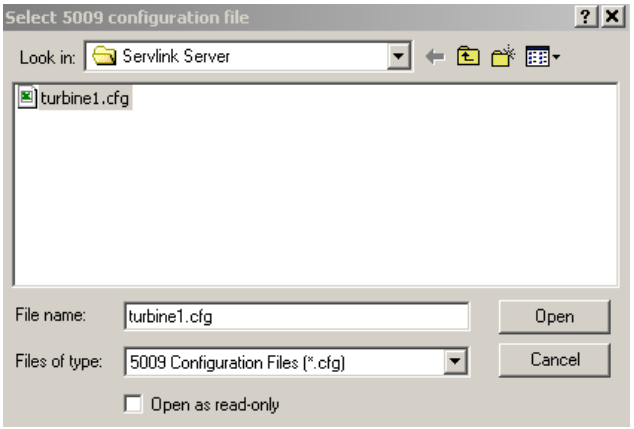
To Upload a stored configuration file into the control:

1. Open the PCI’s Program-Change mode

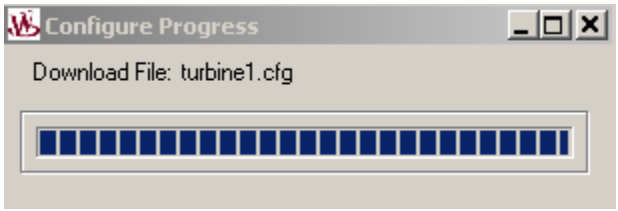
2. Click on the “Load From File” button. A confirmation box will then appear notifying the user that this function may take up to 5 minutes, and asking for confirmation to Load anyway. Confirm the request by clicking on the box’s “Yes” button.



3. At this point a “Select 5009C Configuration file” box appears. Use the box’s directory tools to locate and select the file, then click on the box’s “Open” button to initiate the Upload routine.



4. A “Loading Values to control, Please wait” message box will appear during the load routine’s operation, and the PCI program’s status panel (located in the screen’s lower left corner) will display the different stages of the upload routine (i.e. Reading File, Configuring Control, etc.). This step may take several minutes.



5. When the Upload Routine is finished a “XXX.cfg load Complete” message box appears. The configuration file loaded and used by the control is displayed in the Program mode’s Application Folder.

6. Perform any needed program changes.

7. After any or all configuration changes have been made save the new configuration settings to the control, by clicking on the “Save To Control” button. Refer to the Program-change mode procedure for detailed instructions on saving a configuration to the control.

Chapter 4.
Run Mode Procedures

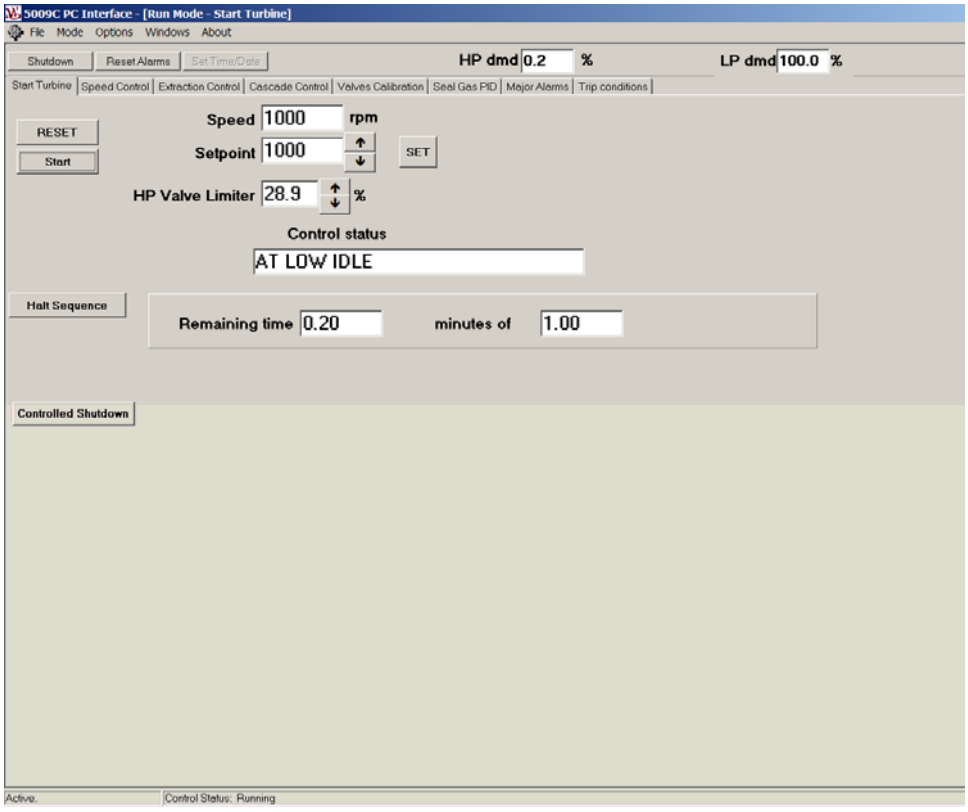
Opening the Run Mode

The PCI program's Run Mode functions as an operator interface to allow a user to start, stop, and operate the turbine. To enter the Run Mode click on the "Run Mode" button on the program's main tool bar in the screen below. If the PCI program has established communications with the control, when an open Run Mode request is made, the Run Mode opens immediately. If the PCI program is not communicating with the control, when an open Run Mode request is made, the program will make communication with the control via the Server program, then open the Run Mode. During the time, the Server program is establishing communications with the control, a "Starting Server" indication box will appear.

The run mode is mainly used during commissioning period or in case of HMI failure. Functions such as Alarming/shutdown conditions are not part of this menu.

Only HMI can be used to monitor precisely all Alarm/SD conditions.

RUN MODE Screen



PCI Mode & Folder Panel

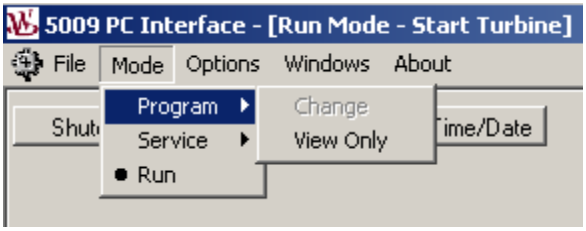
This panel is located at the top of the PCI program screen and indicates the PCI mode and folder that is opened and currently being displayed. An indication of "5009C PC Interface—[Run Mode—Start Turbine]" indicates that the PCI program's RUN mode is opened and the Start Turbine folder is currently being viewed.

Controlling Parameters Panel

The panel is located at the bottom of every folder, just above the Mode and ServLink status panels and displays the control's mode(s) of operation, and reason(s) for shutdown.

Mode Status Panel

This panel is located in the PCI screen's lower most left corner and displays the status of the PCI's PROGRAM, RUN, and SERVICE modes.

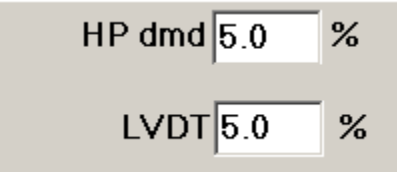


ServLink—Communications Status Panel

This panel is located at the bottom and middle of the PCI screen, and displays the status of the ServLink program and communication link.

Run Mode—Tool Bar

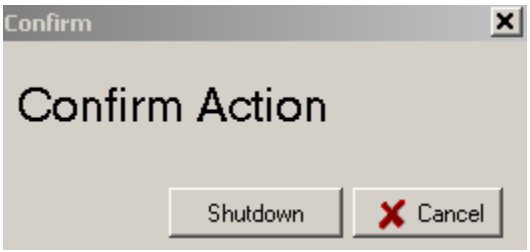
The Run Mode tool bar has Run Mode specific command buttons and valve position information. The Tool Bar is accessible from all Run Mode folders. The valve position information displays position in percent open for one control valve or two depending on the configuration. The number and type of buttons, which appear in this tool bar, also depend on the control's configuration.



The following is a list of all possible tool bar buttons:

Emergency Shutdown Button

If the control is configured to allow an Emergency Shutdown to be performed via the PCI program's Run Mode (set in the Communications Folder in Program or Service Modes) the Emergency Shutdown Button will appear in the tool bar. If configured, this shutdown command uses a two-step approach. When the Emergency Shutdown Button is selected, a confirmation pop-up box will appear (shown below). The user must then confirm the shutdown command by clicking on the "Emergency Shutdown" button in the pop-up confirmation box, or Cancel the command with the "Cancel" button. After an Emergency Shutdown confirmation is given, the control will immediately trip the turbine to a failed-safe condition.



Security Button

The Security button allows users to secure and unsecured critical RUN mode settings (PID, valve calibration, and control time settings). This button is defaulted to its locked (secured) position when the RUN mode is opened, and must be unlocked (unsecured) before any control PID setting, valve calibration setting, or control time adjustment can be performed.

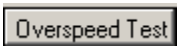
To unlock RUN mode security, click on the Security Button. At this command, a pop-up "Password entry" box then appear. Enter the correct password. (located in Appendix A at the end of this manual), and select the box's "OK" button. This action will allow all critical RUN mode settings to be adjusted.

To lock RUN mode security, click on the Security Button. At this command, a confirmation pop-up box will appear. Confirm the command by selecting the box's "OK" button. This action will secure all PID, valve calibration, and control time settings.

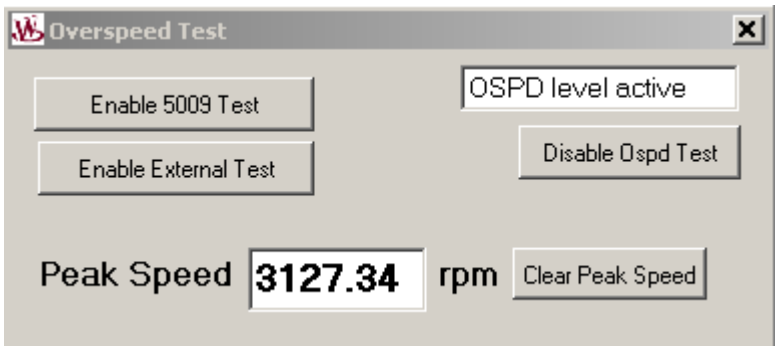
The Security Button changes appearance according to what state the Run Mode security logic is in. If the RUN mode security logic is locked, the "lock" in the picture is closed. If the Run Mode security logic is unlocked, the "lock" in the picture is opened.

LOCKED Mode UNLOCKED Mode

Overspeed Button



This button only appears in the Speed Control folder. The Overspeed Test button is used to display a pop-up Overspeed Test box from which an Overspeed test can be performed. The control's Overspeed Test function allows an operator to periodically increase turbine speed above its rated operating range to test the turbine's electrical and/or mechanical overspeed protection devices, logic and circuitry. Reference Volume 1 Chapter 5 for overspeed testing procedures.

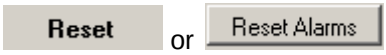


Note: the box "OSPD level active" indicate if the internal overspeed level is used or not.

Set Time/Date Button

This button only appears in the Alarms folder. The Set Time/Date button is used to pop-up a "Set Time and Date" box from which the control's time and date can be set. Reference the Setting Time & Date procedure located in this chapter for time and date setting instructions.

Reset Alarms Button

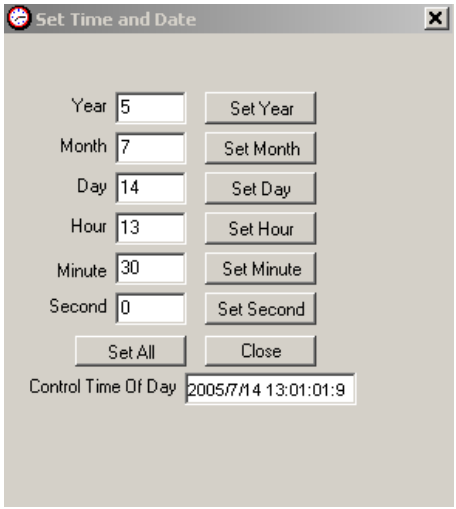


All trip conditions must be reset before the control will allow the unit to be started. Once an alarm condition has been corrected, an Alarm can be reset at any time during operation.

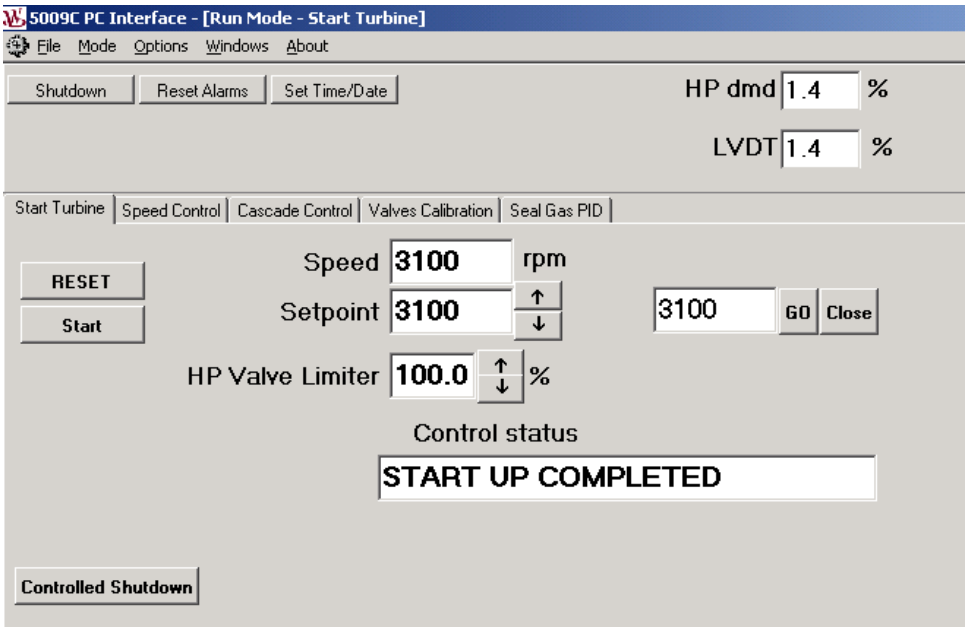
Setting Time & Date

From the Run Mode's Alarms folder, system time and date settings can be changed by selecting the tool bar's "Set Time/Date" button. This button opens a Time & Date edit box, from which all settings can be individually or collectively set. If the RUN mode's Security logic is locked, the "Set Time/Date" button cannot be accessed. If the RUN mode's Security logic is unlocked, the "Set Time/Date" button can be accessed, and all clock settings changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode's Security logic.

From the Set Time & Date edit box, directly enter the time or date setting, and then click the respective parameter's Save button at the exact time (setting) that you have entered. At this point, the control's Real Time clock will be updated, and the edit box's "Control Time of Day" display will reflect the change(s). Click the "Close" or "X" buttons to close the Time and Date display box. The control's Real Time Clock output is also displayed at the top of the folder, after the "Current Alarms" title.



START TURBINE Folder



Start Turbine Features

The Start Turbine folder is used primarily to bring the turbine up to rated speed. Once that has been accomplished, the remaining folders are used to bring other controlling parameters into control. The Start Turbine folder allows the user to change the 5009C control's Speed settings and start parameters from their PC. The Speed input is displayed in the Speed display box at all times. The 5009C control will attempt to control the turbine such that the Speed input matches the Speed Setpoint. The Speed Setpoint can be manually changed by pressing the arrow keys to the right of the Setpoint display box. The status of the Speed controller does not effect whether the setpoint can be adjusted or not.
The rate at which the setpoint can change is set in the Program mode as Loading gradient. The HP Valve Limiter can be manipulated from this screen. The HP Limiter can be raised and lowered by pushing the arrows to the right of the HP Valve Limiter display.

Reset Button

Clicking on, or selecting, the Reset button issues a reset command to the 5009C control. This is identical to the Contact closure or the Modbus run command. This command will reset both alarms and trips, and if all start permissive are met, ready the turbine for the configured start procedure. This command will not start the turbine.

Start Button

Clicking or selecting the Start button is used to issue a start command to the 5009C control. This command is identical to the Contact input or the Modbus RUN commands. This command will initiate the configured start procedure. All start permissives must be met before the start command is accepted.
The start Push button can also be used, when the HP ramp has been manually moved, using R/L HP ramp commands.
If the engine is configured for automatic start, then pressing the start push button, while engine is running, will automatically initiate an automatic raise of the HP ramp limiter.

Continue/Halt Button

Clicking or selecting the Halt button is used to issue a halt command to the 5009C control. This command is identical to the Contact input or Modbus Continue/Halt commands. This is used to stop the auto start procedure at any moment and to keep the turbine at that place in the start procedure. The Continue button is used in the same way, to reinitiate the auto start procedure from the place that it was halted. The status of the Start Sequence is continually displayed in the Start Seq Status display box in this folder.
After Shutdown, the autostart sequence is automatically disabled.
The operator can only request Continue if the engine is not Tripped.

Open/Close HP Limiter Buttons

The Open/close Limiter button is used to initiate the 5009C to open the HP Limiter at the HP Valve Limiter in semi-automatic mode, or to limit the HP valve opening.

Rate as configured in the Program Mode of the Start Turbine folder

Speed Target Buttons

It is possible to write directly a speed Setpoint via Modbus or PCI software.
To be accepted, this target must not set be inside a critical band
For Modbus and PCI, the target will be accepted only when a “Go to target” is send.
Any new target will also have to receive a “Go to target”.
The Target in control is the latest one send from either Modbus#1 or Modbus#2 or PCI
When a target is send, automatically, the autostart sequence is halted.
If ”continue” is re-selected via contact input, Modbus or PCI, then the Target is disabled.
The rate at which the target will move the setpoint will still depends on the auto-start sequence settings.

Start Mode Configurations

There are three basic types of start mode procedures (Manual/semi-automatic/automatic). They are discussed in length in Volume 1 with all of the different options that are available. The control’s Program Mode configuration will determine how the turbine is started.

Only if manual start mode is configured, the speed setpoint can be manipulated when the engine speed is below Low Idle. In any other type of configuration, speed and speed reference must be at low idle to authorize Raise setpoint commands.

Automatic Start Sequence

With this start routine, once a Start command is issued and Speed PID in control of the speed, the control determines whether to use the cold start routine, hot start routine or in-between start routine, based on how long the control was shutdown or a remote HOT/COLD analog signal or a configured contact input..
This routine will:

- Ramp the speed setpoint to a low idle speed setting, verify that turbine speed is at or above the low idle setting.
- Holds for a set delay time,
- Ramp the speed setpoint to a medium Idle (if used) idle speed setting, and verify that turbine speed is at or above the medium idle setting
- Holds for a set delay time
- Ramps the speed setpoint to a high idle speed setting (if configured) and verify that turbine speed is at or above the high idle setting
- Holds for a set delay time
- Then ramps the speed setpoint to the rated speed setting.

This routine can be halted and continued at any point through PCI, Modbus or external contact input commands. Even though configured for an automatic start, and operator can, at any time, choose to raise or lower the speed setpoint manually to complete a system start-up.

If configured, Critical Speed ranges will be avoided and ramped through at the rates configured. Once turbine speed is at or above the Rated Speed setting, the turbine is considered to be started, and other PCI folders can be accessed from which to control turbine operation. The above folder shows the status of the start sequence and the remaining time that the turbine will remain at Low Idle. Once the timer counts down to zero minutes the turbine will ramp to High Idle at the configured rate.

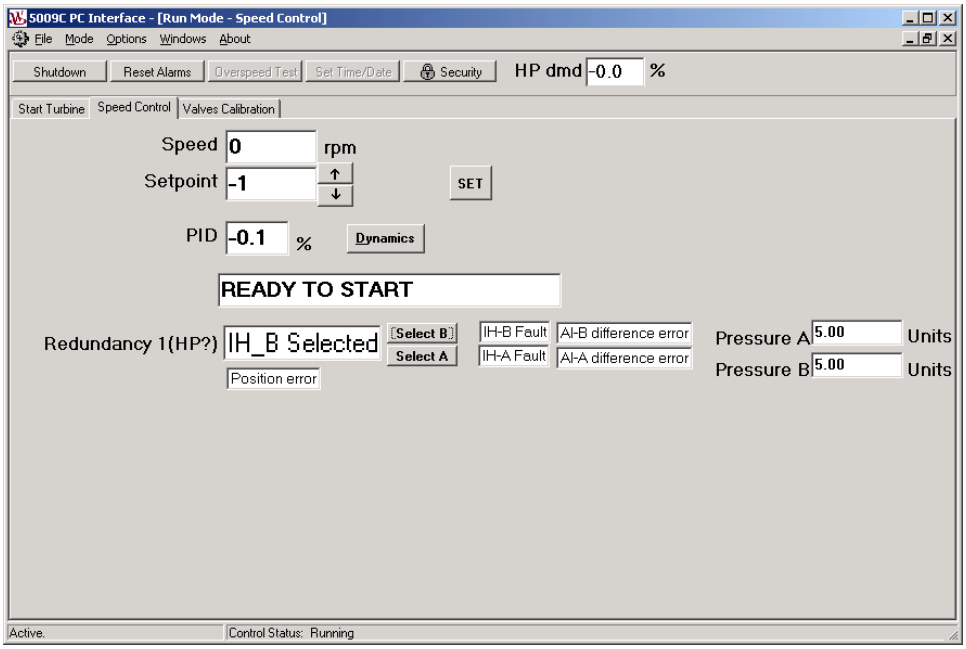
Controlled Shutdown

The Controlled Shutdown button allows a user to stop the turbine in a controlled manner. The 5009C control can be configured to ramp all controlling parameters down to a controlled turbine stop. The 5009C uses a two-step process to initiate the controlled shutdown. When the main Controlled Shutdown button is selected, a separate Confirm display box will appear. The Controlled Shutdown button in the Confirm box must be selected to initiate the controlled shutdown. If at any time during the controlled shutdown, the operator wishes to discontinue the shutdown, the Halt button (not shown) will return the turbine to a run mode.

Depending on the configuration, the normal SD when completed, will

- Trip the turbine
- Let the turbine reset (ready to start)
- Bring the setpoint at low Idle, and switch the control to manual commands.

Speed Control Folder



Speed Control Features

The Speed Control folder is available for viewing under any configuration of the 5009C control. The Speed folder allows the user to change the 5009C control's Speed settings from their PC. The Speed input is displayed in the Speed display box at all times. The 5009C control will attempt to control the turbine such that the Speed input matches the Speed Setpoint.
The Speed Control function is active at all times. Another control function (Decoupling Limiter) can take control of the valves, however, the Speed Control function is still active and will control the speed.

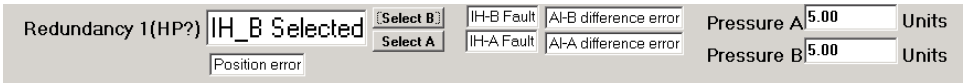
The Speed Setpoint can be manually changed by pressing the arrow keys to the right of the Setpoint display box. The rate at which the setpoint can change is set in the Program mode and adjustable in the Service Mode. The output of the PID controller is displayed in the PID display box. This output can be used to determine if the PID is in control or if there are stability problems.

The Speed setpoint can also be turned over to the Remote Speed Setpoint by enabling that function. The Enable/Disable button to the right of the Remote Setpoint Status display box will enable and disable the remote setpoint function. When the Remote Setpoint function is enabled, the Speed Setpoint will move to the Remote Setpoint at the programmed Rmt Setpt Not Matched Rate. The status of the Remote function is continually displayed in the Remote Status display box if the Remote Speed function is configured in the 5009C control.

Feed-forward
When configured to use Feed-forward loop, them it is possible through Modbus or PCI to enable this loop.

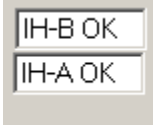
The speed Bias generated by this function will be display in a box.

Redundancy 1 or 1 and 2

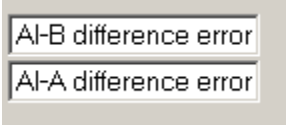


When redundancy 1, or 1 and 2 are configured, then it is possible to select with actuator output must be in control of the valve.
The (HP?) indicates that redundancy 1 should be used for HP, but this is not an obligation.
The actual controlling valve is displayed.

The boxes below indicate the status of the actuators



The box below, indicate the status of the analog feedbacks



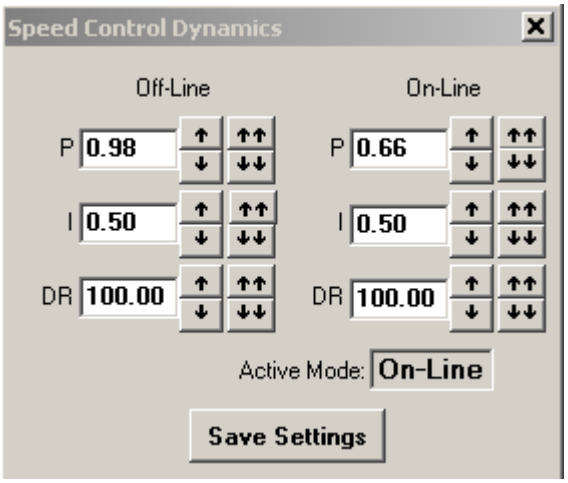
A difference is indicated if the feedback minus demand from PID is higher than difference tolerated, or if the analog signal is deviating form other channel (lower signal generate an alarm).

The box below is used, when the contact “channel-B selected” is configured, and a discrepancy is detected or when the Analog feedback is higher than the other channel while not selected.

Speed Control Dynamics

The Speed Control’s PID settings can be monitored and changed by selecting the Dynamics button. If the RUN mode’s Security logic is locked, the PID’s settings can only be monitored. If the RUN mode’s Security logic is unlocked, the PID’s settings can be monitored and changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode’s Security logic.

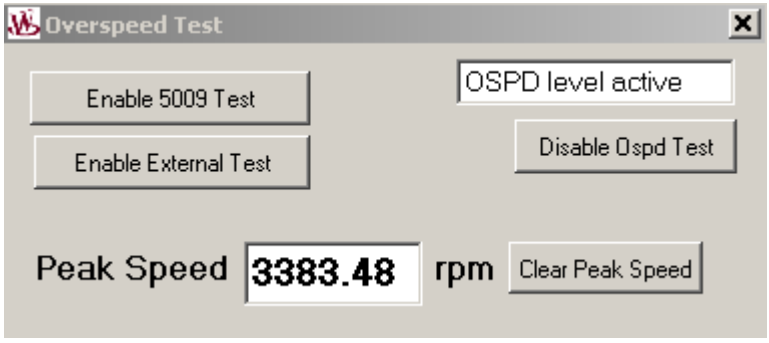
Selecting the “Dynamics button on the Speed Control folder will allow access to the Dynamics display box. This Speed Control Dynamics display box displays the Speed PID dynamic settings. The Controlling Parameter display at the bottom of the folder will inform the user when the Speed PID is in control. The Speed Control’s P, I, and D terms can be adjusted with the arrow buttons to the right of each term.



The Speed PID uses the settings displayed in the Dynamics Display box to determine PID response; any change to these setting will immediately effect PID response (when the Speed PID is in-control). These values are stored in the control’s RAM memory. The box’s “Save Settings” button can be selected to immediately upload the new values to the control’s EEPROM memory. This insures that if all power to the control is lost the PID values will be saved. If the “Save Settings” button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, chapter 5 for detailed information on adjusting PID dynamic settings.

In the case of the Speed Control PID, two sets of PID terms are used. One in normal speed control (Speed off-line) and one when the control is on line and handling a load. Both sets of PID terms can be adjusted independent of whether or not the control is on line. This allows two separate sets of dynamics for the two basic modes of speed control (Dual-Dynamics). Care needs to be taken that the terms changed are the correct terms for the case needed. Adjusting the PID terms for the On-Line selection while the turbine is running Off-Line will not effect the turbines operation, until the turbine is placed On-Line. The active state, On-Line or Off-Line, is displayed at all times in the Active Mode display box. Both sets of PID terms can be adjusted before speed control is in effect. This allows the user, during initial start-up, to adjust dynamic settings before they take effect to insure stable operation. The control can then be fined tuned, once the turbine is up to speed. The same can be done for the Off-Line adjustments.

Overspeed Test



An internal or external overspeed test can be performed from this folder. The above folder shows an example of the Overspeed Test display box. This box is displayed by selecting the “Overspeed Test” button on the Tool Bar. In order to initiate the test, the speed set point must be at the maximum controllable setpoint as configured in the 5009C control. The turbine must be in speed control, and all decoupling control functions must be disabled.

Clicking the Disable Ospd Test button at any time will cause the speed set point to ramp down to the maximum controllable setpoint. Changing the speed setpoint is done by pushing the arrow buttons to the right of the speed and speed setpoint or by a contact input.

Clicking the Enable 5009 Test button will allow the speed setpoint to be raised to the Overspeed Trip Level as configured in the 5009C control. Once the speed reaches the electrical overspeed setpoint, the 5009C will trip the turbine.

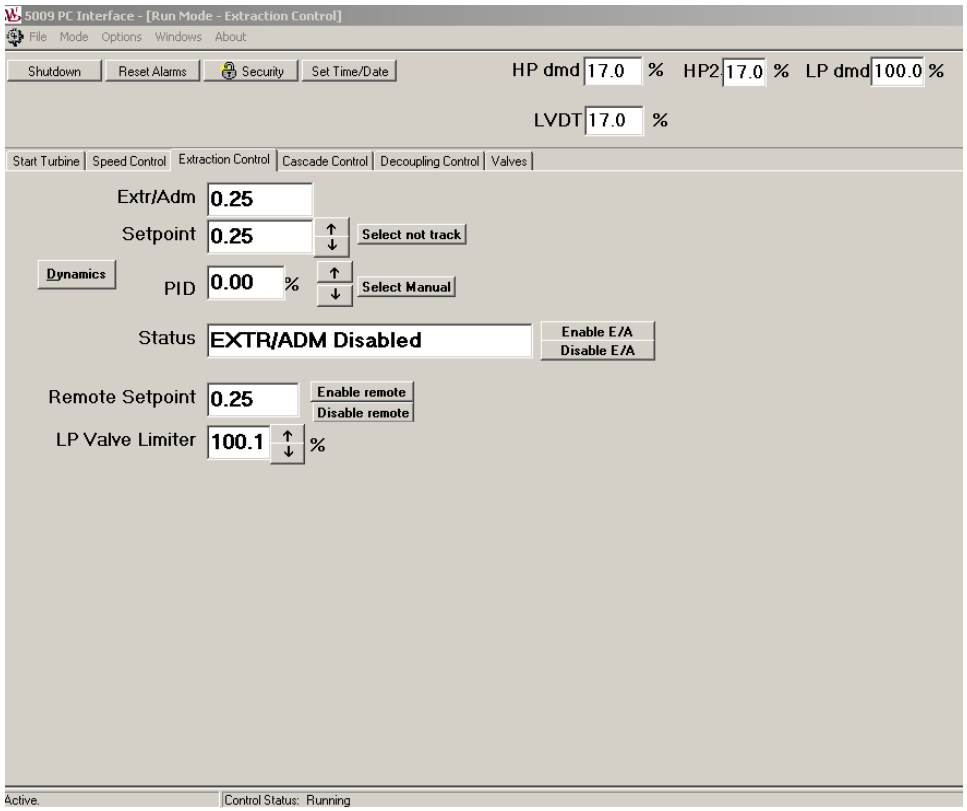
Clicking the Enable External Test button will allow the speed setpoint to be raised to the Overspeed Test Limit as configured in the 5009C control. The mechanical or external overspeed protection of the turbine should trip during this test. The speed of the turbine cannot be increased past the Overspeed Test Limit.

If the speed setpoint is not changed within 60 seconds during either of the tests, the control automatically discontinues the overspeed test. At that time, if the speed of the turbine is above the electrical overspeed setpoint, the turbine will trip. If it is below the electrical trip setpoint, it will ramp down to the maximum controllable setpoint.

A Peak Speed is shown that displays the highest speed the turbine has attained since the Clear Peak Speed button has been selected.

Extraction and Admission Folders

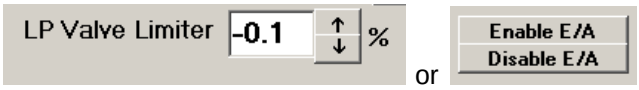
These folders are only visible when the control is configured for Extraction, Admission, or Extr/Adm types of turbines. Because there is very little difference in the options between these folders the, descriptions for all three folders have been combined. Depending on the type of turbine configured, the folder and gauge titles will change from Extraction Control, Admission Control, or Extr/Adm Control. For description purposes the Extr/Adm Folder is displayed below.



Extraction/Admission Control Features

The Extraction/Admission folder allows an operator to start, operate and stop the control's Extraction/Admission control. The Extraction/Admission input is displayed in the Extraction/Admission display box at all times.

When configured for Extraction only turbines, Extraction control can be enabled and disabled manually by lowering and raising the LP valve limiter, respectively, or automatically (if so configured) by selecting the folder's Enable/Disable buttons to the right of the Status gauge.



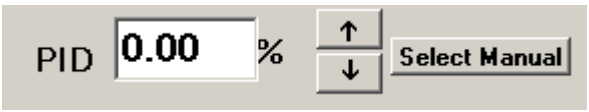
When configured for Admission or Extr/Adm type turbines, Adm or Ext/Adm control is enabled/disabled by selecting the Enable/Disable buttons to the right of the Status display gauge. The status gauge displays the Extraction/Admission Control status at all times. It is recommended with Adm or Extr/Adm turbines that the Demand Setpoint be used to match pressure across the Adm header's T&T valve, and the T&T valve opened, before Extr/Adm control is enabled. Reference Volume 1 for all control enabling/disabling procedures.

The control setpoint will determine what level the Extraction/Admission controller will maintain the turbine at once enabled. The setpoint can also be manually set to a value by using the Set button to the right of the arrow keys as described earlier. The rate at which the setpoint can change is set in the Service mode.

When the Extraction/Admission Controller is disabled, the setpoint will remain at the last valid setpoint and will control at that setpoint when the Extraction/ Admission controller is again enabled. If the control mode's Setpoint Tracking feature is active, the setpoint will track the input whenever the Extraction/ Admission Controller is disabled.

If configured in program mode, the control can be put in manual/automatic mode via Modbus contact or PCI command

when in manual mode the output of the PID will be driven by the R/L command push button on its right

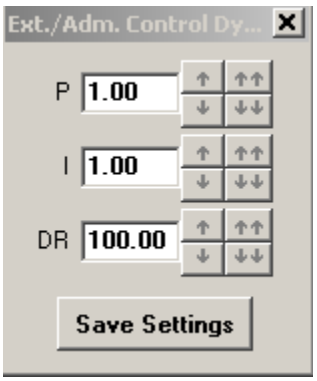


The Extraction/Admission setpoint can also be varied by a 4-20mA Remote Extraction/Admission Setpoint signal. The 4-20mA Remote Extraction/ Admission Setpoint information is only visible if the function is configured in the Program mode. The Enable/Disable buttons to the right of the Remote Setpoint Status display gauge are used to enable and disable the remote setpoint function. If configured, the status of the 4-20mA Remote Ext/Adm function is continually displayed in the Remote Status display gauge.

The output of the PID controller is displayed in the PID display gauge. This output can be used to determine if the PID is in control or if there are stability problems.

The LP Valve Limiter can be manipulated from this screen. The LP Limiter can be raised and lowered by selecting the arrows to the right of the LP Valve Limiter display box or by using the Set button as described earlier.

Extraction/ Admission Control Dynamics

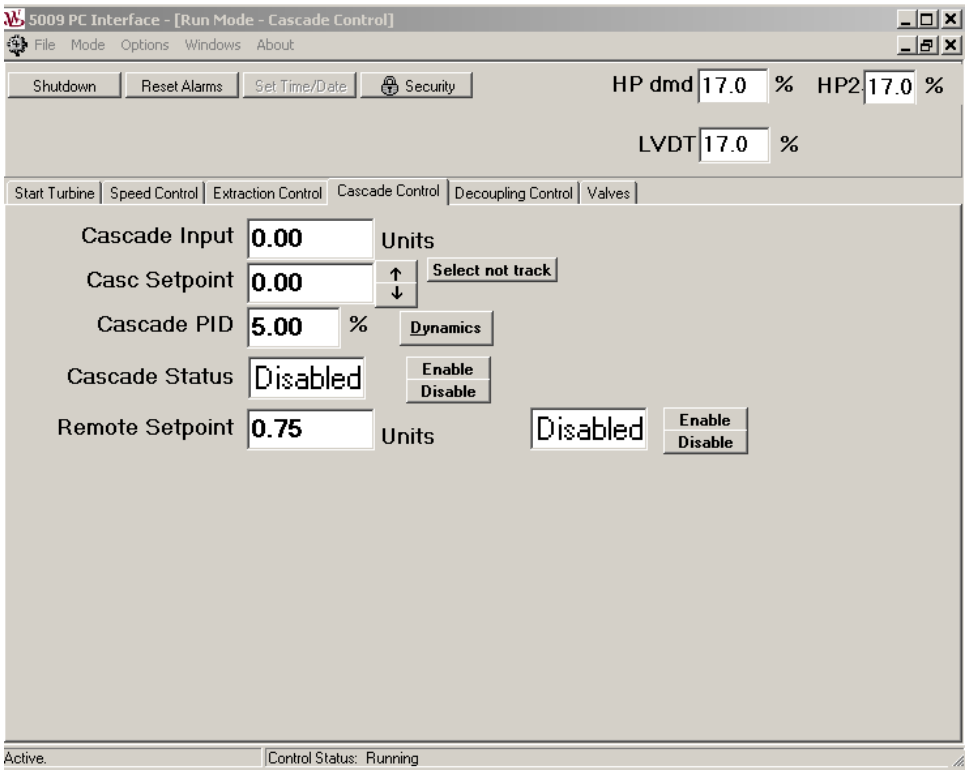


The Extraction/Admission Control's PID settings can be monitored and changed by selecting the Dynamics button. If the RUN mode's Security logic is locked, the PID's settings can only be monitored. If the RUN mode's Security logic is unlocked, the PID's settings can be monitored and changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode's Security logic.

Selecting the "Dynamics button on the Extraction/Admission Control folder will allow access to the Dynamics display box. This Extraction/Admission Control Dynamics display box displays the Extraction/Admission PID dynamic settings. The Controlling Parameter display at the bottom of the folder will inform the user when the Extraction/Admission PID is in control. The Extraction/Admission Control's P, I, and D terms can be adjusted with the arrow buttons to the right of each term.

The Extraction/Admission PID uses the settings displayed in the Dynamics Display box to determine PID response; any change to these setting will immediately effect PID response (when the Extraction/Admission PID is in-control). These values are stored in the control's RAM memory. The box's "Save Settings" button can be selected to immediately upload the new values to the control's EEPROM memory. This insures that if all power to the control is lost the PID values will be saved. If the "Save Settings" button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, chapter 5 for detailed information on adjusting PID dynamic settings.

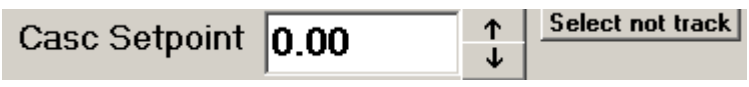
Cascade Control Folder



Cascade Control Features

The Cascade Control folder is visible only when Cascade Control is configured into the 5009C control. The Cascade folder allows the user to change the 5009C control's cascade settings from their PC. The Cascade input is displayed in the Cascade Input display box at all times. The 5009C control will attempt to control the turbine such that the Cascade input matches the Cascade Setpoint whenever the Cascade Controller has been enabled. The Cascade Control function can be enabled and disabled by manually selecting the Enable/Disable buttons to the right of the Cascade Status display box. The status box will display what mode the Cascade Control function is in at all times.

The Cascade Setpoint can be manually changed by pressing the arrow keys to the right of the Casc Setpoint display box. The status of the Cascade controller does not effect whether the setpoint can be adjusted or not. The setpoint will determine what level the Cascade controller will maintain the turbine at once enabled.. The rate at which the setpoint can change is set in the Program mode as Setpoint Rate. The output of the PID controller will be displayed in the Cascade PID display box. This output can be used to determine if the PID is in control or if there are stability problems.

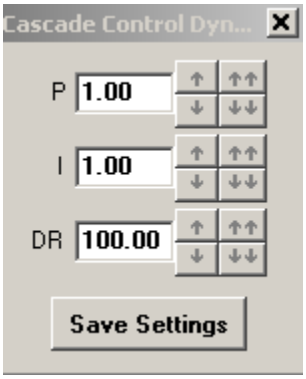


When the Cascade Controller is disabled, the setpoint will remain at the last valid setpoint and will control at that setpoint when the Cascade controller is again enabled. If the Setpoint Tracking feature is, the setpoint will track the input whenever the Cascade Controller is disabled.

The Cascade setpoint can also be varied by a 4-20mA Remote Cascade Setpoint signal. The 4-20mA Remote Cascade Setpoint information is only visible if the function is configured in the Program mode. The Enable/Disable buttons to the right of the Remote Setpoint Status display gauge are used to enable and disable the remote setpoint function. If configured, the status of the 4-20mA Remote

Cascade function is continually displayed in the Remote Status display gauge.

Cascade Control Dynamics

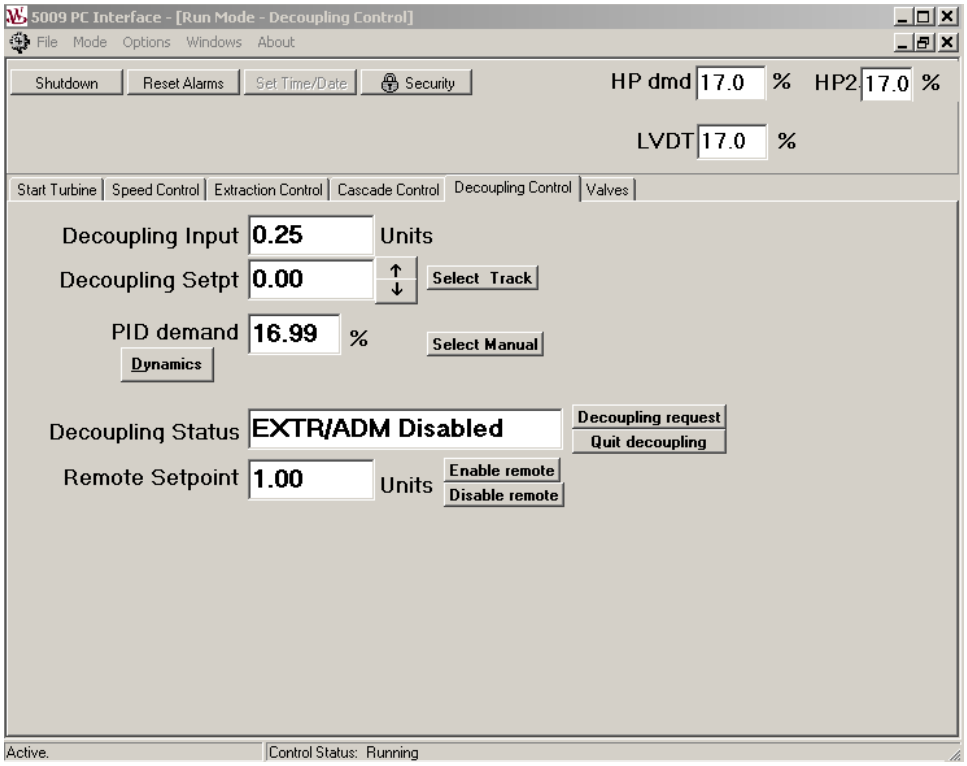


The Cascade Control's PID settings can be monitored and changed by selecting the Dynamics button. If the RUN mode's Security logic is locked, the PID's settings can only be monitored. If the RUN mode's Security logic is unlocked, the PID's settings can be monitored and changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode's Security logic.

Selecting the "Dynamics button on the Cascade Control folder will allow access to the Dynamics display box. This Cascade Control Dynamics display box displays the Cascade PID dynamic settings. The Controlling Parameter display at the bottom of the folder will inform the user when the Cascade PID is in control. The Cascade Control's P, I, and D terms can be adjusted with the arrow buttons to the right of each term.

The Cascade PID uses the settings displayed in the Dynamics Display box to determine PID response; any change to these setting will immediately effect PID response (when the Cascade PID is in-control). These values are stored in the control's RAM memory. The box's "Save Settings" button can be selected to immediately upload the new values to the control's EEPROM memory. This insures that if all power to the control is lost the PID values will be saved. If the "Save Settings" button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, chapter 5 for detailed information on adjusting PID dynamic settings.

Decoupling Control Folder



Decoupling Control Features

The Decoupling folder is visible only when any Decoupling Control is configured into the 5009C control.

The Decoupling Controller will take control of HP or LP the valves any time it is enabled and in control.

To enable it, the extr/Adm control must first be enabled and in control of LP (manual or automatic mode)

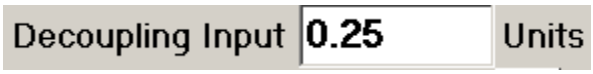
When configure for Inlet & speed, the decoupling PID will control directly the HP valve, and in conjunction with the speed PID, the LP valve.

In this mode, when disabled, the PID will track the HP position as shown in the header above.

When configure for Exhaust & speed, the decoupling PID will control directly the LP valve, and in conjunction with the speed PID, the HP valve.

In this mode, when disabled, the PID will track the LP valve position

The Decoupling folder allows the user to change the 5009C control's decoupling settings from their PC. The Decoupling input is constantly displayed in the DCPL Input display box. Once Decoupling Control is enabled, the 5009C will be attempting to match the input to the setpoint.



The Decoupling Control function can be enabled and disabled by manually selecting the Enable/Disable buttons to the right of the Decoupling Status display box. The status box will display what mode the Decoupling Control function is in at all times. As linked to the extraction status, extraction status is also indicated

Disabling the decoupling will not disable extraction.

Extraction PID control will be re-activated and take control of the pressure/Flow demand (automatic or manual)

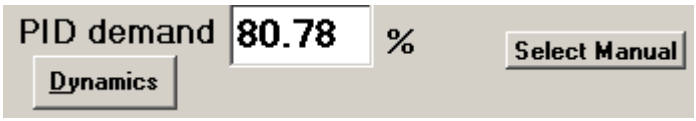
The Decoupling Setpoint can be manually changed by pressing the arrow keys to the right of the DCPL Setpt display box. The status of the Decoupling controller does not effect whether the setpoint can be adjusted or not. The setpoint will determine what level the Decoupling controller will maintain the turbine to once enabled.. The rate at which the setpoint can change is set in the Program mode as Setpoint Rate.

When the Decoupling Controller is disabled, the setpoint will remain at the last valid setpoint and will control at that setpoint when the Decoupling controller is again enabled. If the Setpoint Tracking feature is active

the setpoint will track the input whenever the Decoupling Controller is disabled.

The output of the DCPL PID controller will be displayed in the PID display box. This output can be used to determine if the PID is in control or if there are stability problems. For the DCPL Limiter, the PID will ramp out of he way until the input matches the setpoint.

Like the extraction PID, the Decoupling PID can be put in manual mode.

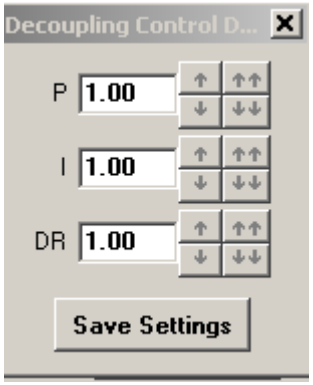


This will allow an easy transfer from letdown station control to Decoupling control.

In case of strong process instabilities, manual mode may also be needed.

The Decoupling setpoint can also be varied by a 4-20mA Remote Decoupling Setpoint signal. The 4-20mA Remote Decoupling Setpoint information is only visible if the function is configured in the Program mode. The Enable/Disable buttons to the right of the Remote Setpoint Status display gauge are used to enable and disable the remote setpoint function. If configured, the status of the 4-20mA Remote Decoupling function is continually displayed in the Remote Status display gauge.

Decoupling Control Dynamics



The Decoupling Control's PID settings can be monitored and changed by selecting the Dynamics button. If the RUN mode's Security logic is locked, the PID's settings can only be monitored. If the RUN mode's Security logic is unlocked, the PID's settings can be monitored and changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode's Security logic.

Selecting the "Dynamics button on the Decoupling Control folder will allow access to the Dynamics display box. This Decoupling Control Dynamics display box displays the Decoupling PID dynamic settings. The Controlling Parameter display at the bottom of the folder will inform the user when the Decoupling PID is in control. The Decoupling Control's P, I, and D terms can be adjusted with the arrow buttons to the right of each term.

The Decoupling PID uses the settings displayed in the Dynamics Display box to determine PID response; any change to these setting will immediately effect PID response (when the Decoupling PID is in-control). These values are stored in the control's RAM memory. The box's "Save Settings" button can be selected to immediately upload the new values to the control's EEPROM memory. This insures that if all power to the control is lost the PID values will be saved. If the "Save Settings" button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, chapter 5 for detailed information on adjusting PID dynamic settings.

Valve Calibration Folder

Before initial operation or after a turbine overhaul where any actuator or valve travel may have been affected, the control must be calibrated or re-calibrated to the turbine valves.

⚠WARNING

The control uses valve position (based off of actuator drive current) to determine turbine operating conditions and limits. The turbine may not function correctly if the control is not correctly calibrated to the turbine valves.

⚠WARNING

For Actuator cards, using LVDTs, it is mandatory to calibrate each card prior to any start. Failure to do so, may result in engine damage and/or injuries.

Valve Calibration is performed via this folder. The above folder shows an example of the Valve Calibration procedure folder.

If the RUN mode's Security is Locked, calibration procedure cannot be requested.

In order for the actuator valves to be calibrated, the turbine must be in shutdown or "RESET" condition and turbine speed must be below 1000 RPM. The valve calibration status gauge displays mode status at all times.

The valve calibration is using sequence steps.

The procedure below indicates how to proceed.

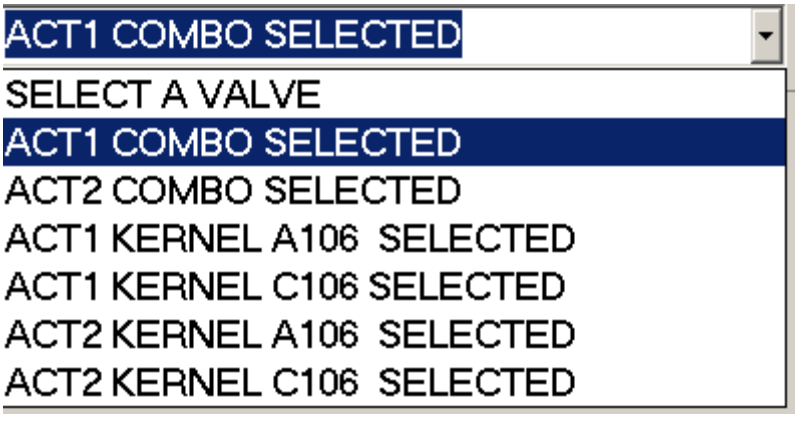
The same procedure applies when calibration is performed via Modbus.

Valve selection

When security is unlock, the actuator channel to be test must be selected.

The operator must know which actuator channel is connected to which valve.

NOTE: In case of communication problems during calibration, the PCI might need must be closed/opened again.

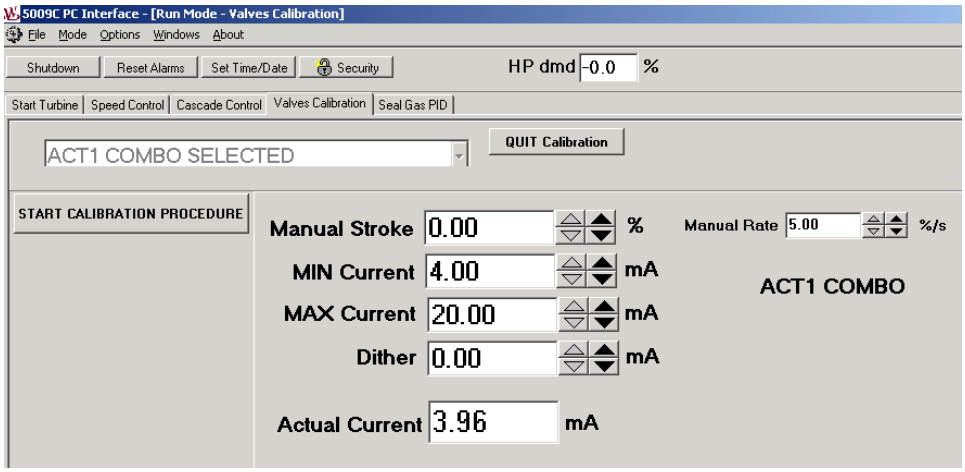


when selected press Enable calibration:

When the calibration is enable different menu will appear depending on the type of actuator calibrated

Ready to calibrate step

For Actuator combo the menu will be as follow



At this stage, and only for actuator combo cards, The output can be manipulated using Manual Stroke commands, and MIN/MAX current adjusted.

MIN Current:

this is the current for 0% demand.

MAX Current:

This is the current for 100% demand

Dither:

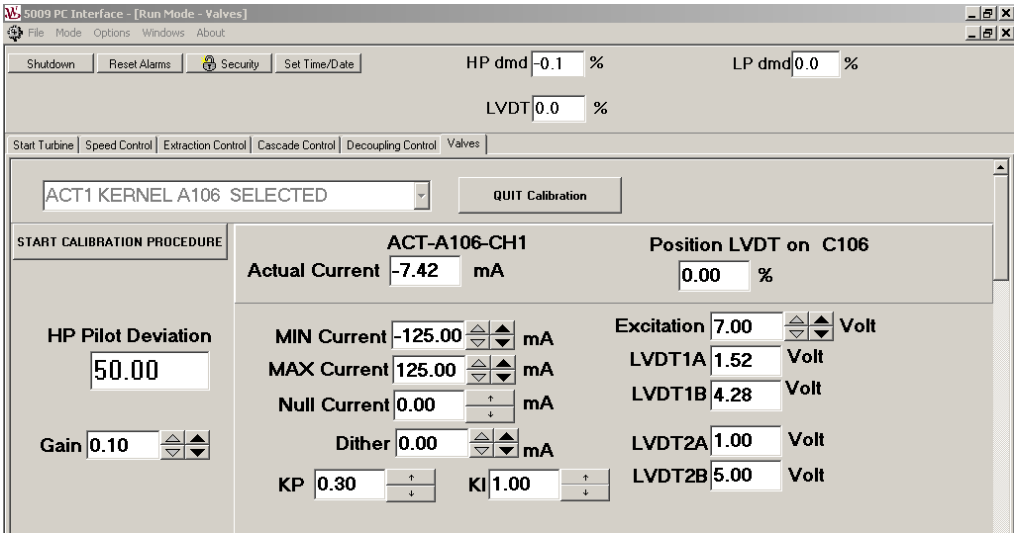
This is a high frequency oscillating signal added to demand, use in case of sticky valves. Its amplitude should be limited.

Manual rate is a settings used to select the rate at which the manual rate will move the demand. It can be tuned for ramp tests or step tests.

The calibration procedure can be aborted by pressing:

later in the sequence, the entire sequence must be completed to quit the calibration procedure.

For actuator cards, the menu will be as follow:



For monitoring purpose, the LVDT signal of the Actuator card, not calibrated will be displayed. This signal is relevant, only if it has been already calibrated.

MIN Current:
This is the minimum current possible for this card. It must match the valve characteristics.

MAX Current:
This is the maximum current possible for this card. It must match the valve characteristics.

Null current
This is the current to be sent when the demand matches the LVDT feedback. At this stage, it can only be estimated.

Dither:
This is a high frequency oscillating signal added to demand, use in case of sticky valves. It amplitude should be limited.

KP:
This is the proportional gain of the card. It is a multiply factor for Demand-LVDT feedback).

KI:
This is the integer Gain. This parameter is relevant only if the valve is PI, PI-LAG or PI LEAD-LAG type (see valve type description in volume 1)

Excitation:
This is the excitation voltage used for LVDT. It can be changed if necessary.

LVDT1A
This is the voltage in the for LVDT1 input A

LVDT1B
This is the voltage in the for LVDT1 input B

LVDT2A
This is the voltage in the for LVDT2 input A. Useful only if Pilot valve is configured

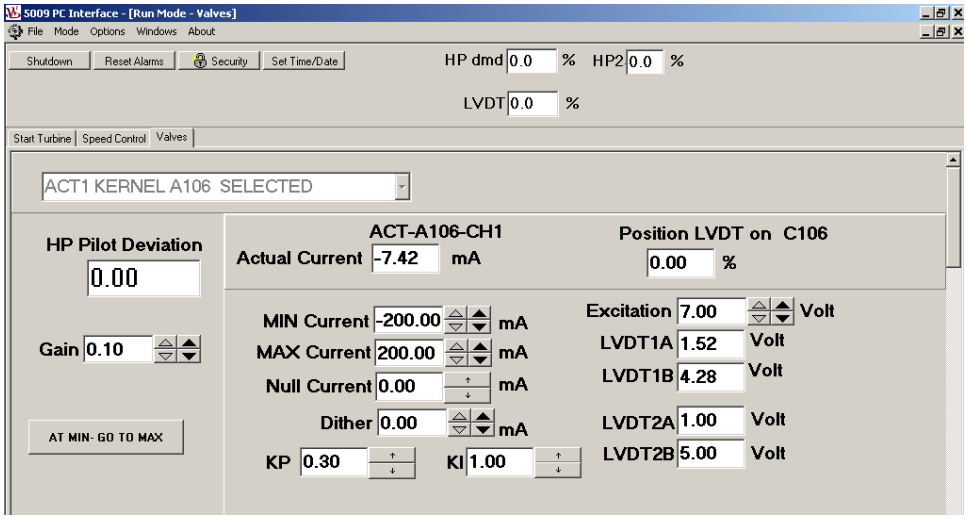
LVDT2B
This is the voltage in the for LVDT2 input B. Useful only if Pilot valve is configured

GOTO MIN STEP

Once the push button

is pressed, the calibration procedure start.
It cannot be stopped, unless it is completed, or if speed is above 1000 RPM.

If during this procedure, a communication failure occurs, generating some failure of the PCI software, close/open the PCI, and continue with the procedure.



Proportional valves:

At this stage, for proportional valve, the control is sending the minimum current (4 mA for 4-20 mA valve/20 mA for 20-160 mA valves, or MIN current for actuator card (PROP only))
Verify physically that the valve is fully closed, adjust if necessary the MIN current or adjust the mechanical valve settings (preferred).

Actuator card. P, PI, PI-LAG or PI-lead_lag

At this step, the current send by the control is NULL CURRENT minus 10 mA (forward acting valve) or NULL Current plus 10 mA (reverse acting valve).
Adjust the null current value if necessary until the valve is fully closed.
Only a visual check of the valve will confirm that it is closed, if the other card hasn't been calibrated yet.
The null current value tuned in this STEP won't be probably the correct one.

When it is certain that the valve is fully closed, then press

The control will memorize this DATA.

GOTO MAX STEP

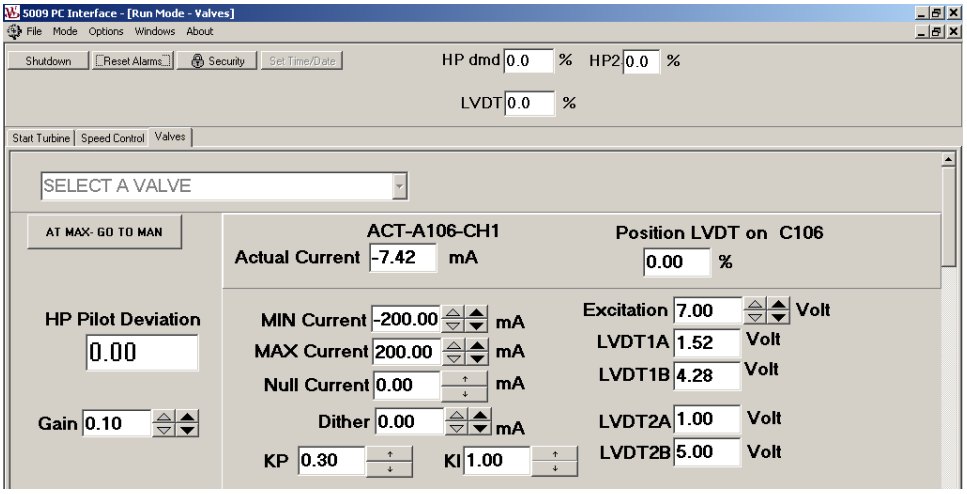
When this Step is activated, the control will ask to fully open the valve.

Proportional valves:

At this stage, for proportional valves, the control is sending the maximum current (20 mA for 4-20 mA valve, 160 mA for 20-160 mA valves, or MAX current for actuator card (PROP only))
Verify physically that the valve is fully opened, and adjust if necessary the Max current, or adjust the mechanical valve settings (preferred)

NOTICE

Leave this step only when the current is at its MAXIMUM. If "at max" is accidentally pressed when the current is not at its maximum, the procedure MUST be performed again or the system MUST be put into program mode (IO lock). Failure to do so will result in a random calibration.



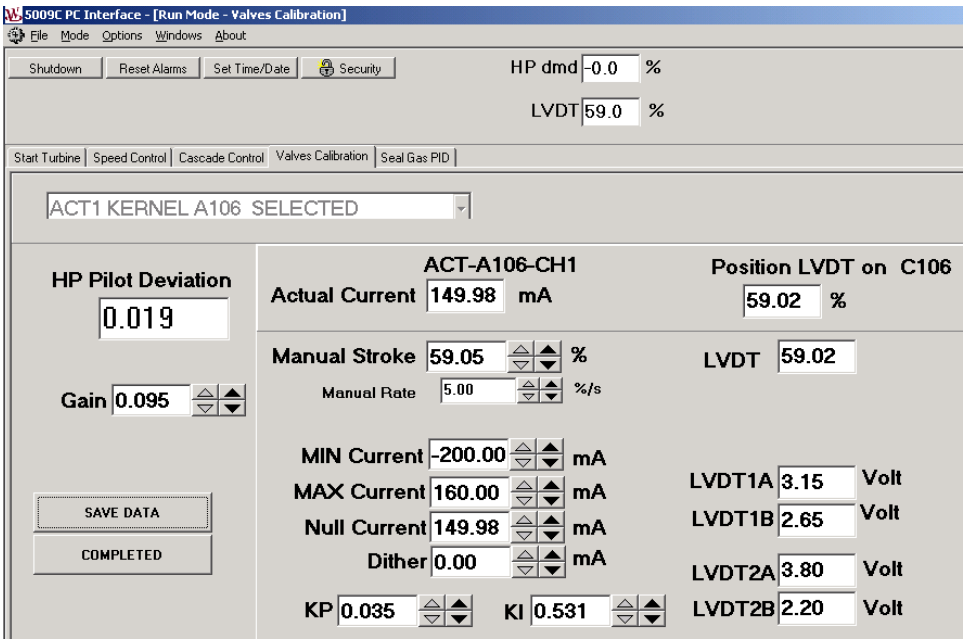
Actuator card. P, PI, PI-LAG or PI-lead lag

At this step, the current send by the control is NULL CURRENT plus 10 mA (forward acting valve) or NULL Current minus 10 mA (reverse acting valve).
Adjust the null current value if necessary until the valve is fully opened.
Only a visual check of the valve will confirm that it is opened, if the other card hasn't been calibrated yet.
The null current value tuned in this STEP won't be probably the correct one.
The voltage of the LVDT (1A,!B) for cylinder and 2A,2B) for pilot (if used) , should have changed compared to the previous step (at min)
If it is not the case, verify LVDT wiring.
A re-calibration might be needed, if wiring failure noticed during calibration procedure.

When it is certain that the valve is fully opened, then press

The control will memorize this DATA.
From now, the LVDT should be calibrated, and it is now possible to use the signal.

MANUAL STROKE



When this step is activated, it is possible to manually stroke the valve using the raise/lower command on the right of “Manual Stroke” display

The rate at which the manual stroke will move can be changed with Manual rate.

<u>Proportional valves</u>

The output can be manipulated using Manual Stroke commands, and MIN/MAX current adjusted.
MIN Current:
this is the current for 0% demand.
MAX Current:
This is the current for 100% demand
Dither:
This is a high frequency oscillating signal added to demand, use in case of sticky valves. Its amplitude should be limited.

<u>Actuator card.(P, PI, PI-LAG or PI-lead lag) without PILOT</u>

Only when this step is activated, KP, and null current can be tuned.
For P type actuator, Set a demand round 50%, and verify that the LVDT position matches with the manual demand. If it is not the case, adjust manually the null current until he valve is stable and demand/LVDT match.

The command

can also be used. This command will sample the actual current read and replace the null current with this value.

When Demand and LVDT position match, stroke UP and DOWN the valve and adjust the gain KP and KI (used by PI, PI-LAG or PI-lead lag only) until the valve response is satisfying.

Actuator card.(P, PI, PI-LAG or PI-lead lag) with PILOT

When the valve is using a PILOT, then, the null position of the pilot and the null current must be determined.

Stroke the valve demand until the valve moves physically.

Verify that it is stable. If not adjust the gain KP or the Pilot gain.

The demand and the pilot LVDT won't probably match when stroking the valve for the first time.

Press the push button "SAVE DATA"

When pressed, the actual current will replace the null current value, and the actual position of the pilot valve will replace the pilot null position value.

Verify that the demand matches with the LVDT feedback.

Tune KP and Pilot gain until valve movement is satisfying.

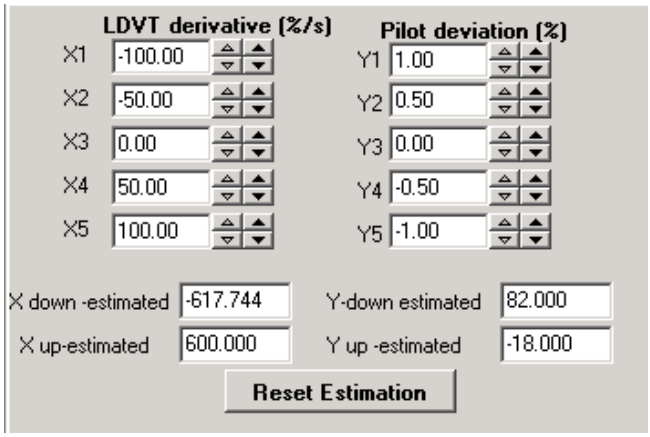
Care should be taken with the Pilot gain, not to put it too strong.

To make sure that the valve will remain stable at all time, big step on the manual demand must be performed.

Only when the valve movement is correct, the degraded can be tested (if used).

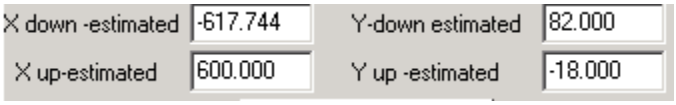
This calibration is quite difficult to achieve. Therefore, in service mode, under valve driver, some estimated parameters are available.

Open the service mode. Under the driver folder, the following menu is available:



Press reset Estimation.
In RUN mode, stroke the demand up and down for a slow Manual rate.

Collect the data.



Reset again the estimation; change the manual rate to stroke, and stroke again UP and down the valve.
Collect the data.
Change the (X1,Y1), (X2,Y2), (X4,Y4), (X5,Y5).

(X3,Y3)should remain at (0,0).

Disconnect the Pilot LVDT signal.

Verify that the message 

appears.

Stroke manually the valve and check it stability when the Degraded mode is active.

If the valve is not stable enough, tune first the pilot gain.
If these parameters have no effects, Tune/Adjust the curve in service mode.

Once the stroke is stable for slow and fast manual rate, then reconnect the pilot, press reset to leave the degraded mode, and verify again the stability.

When valve stroke is correct, then press 

The calibration procedure will go back to the first step “ready to calibrate.

The push button 

will appear again.

If it is desired to perform again the calibration then refer to the beginning of the chapter.
As long as the calibration procedure is activated, the engine is not ready to start.
Press QUIT to quit the calibration procedure.

NOTICE

When using Actuator card channels, each card must be calibrated separately. Do not forget to calibrate the second card, prior to attempt any start-up.

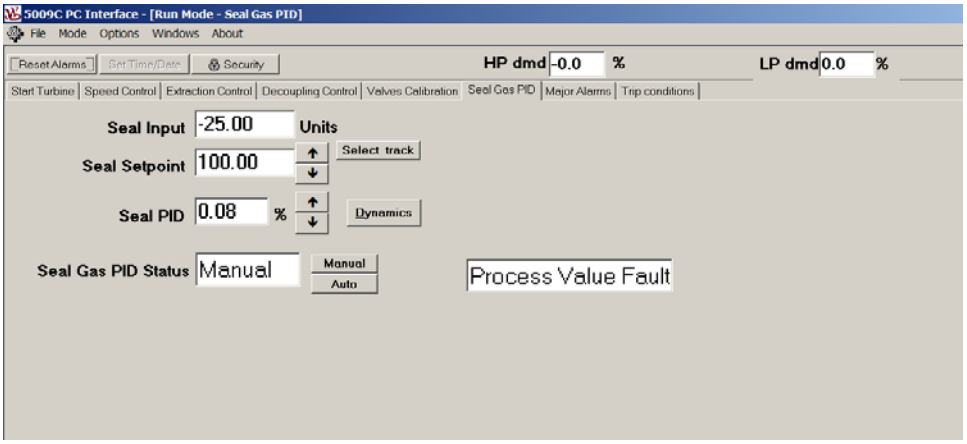
NOTICE

When using Actuator card channels with cascade loop, only one HP valve can be configured like this, and only one LP valve. The software is not designed to handle two HP valves with cascade loop.

The calibration values are stored in the control’s RAM memory. The box’s “Save Settings” button can be selected to immediately upload the new values to the control’s EEPROM memory. This insures that if all power to the control is lost the values will be saved. If the “Save Settings” button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, Chapter 5 for detailed valve stroking instructions.

Seal Gas PID Folder

For description purposes the Seal Gas PID Folder is displayed below.

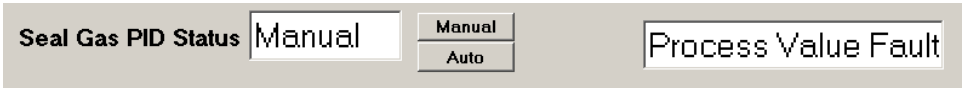


Seal Gas PID Features

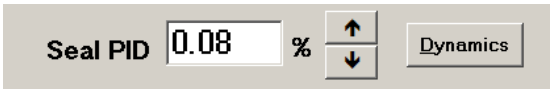
This independent PID can be used for seal Gas or any other type of process, independent from the turbine control.

The Seal Gas PID Control folder is visible only when it is configured into the 5009C control. The Seal gas PID folder allows the user to change the 5009C control's Seal Gas settings from their PC. The Seal gas input is displayed in the Seal Gas Input display box at all times. The 5009C control will control the PID such that the process value input matches the Setpoint whenever the Seal PID Controller has been put in automatic.

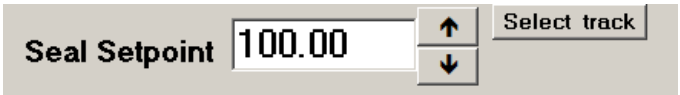
The Seal PID function can be put in manual/automatic selecting the Manual/Auto buttons to the right of the Seal PID Status display box. The status box will display what mode the Control function is in at all times.



When manual mode is selected, the output of the PID can be raised/ lowered using the arrows on the right of the PID output box.



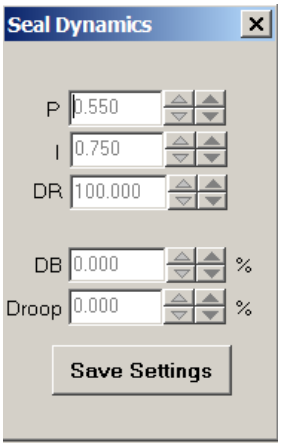
When Manual mode is selected it can be decide to have the setpoint to track or not the process value using the Track/Not track commands



When track is not selected, the Seal Setpoint can be manually changed, by pressing the arrow keys to the right of the Seal.

In any cases, if track is not selected, and the control is in manual, to avoid any bump, when the difference between the SP and PV is too big, the 5009C will internally first ramp the Setpoint from the Process value to the desired Setpoint

Seal PID Control Dynamics



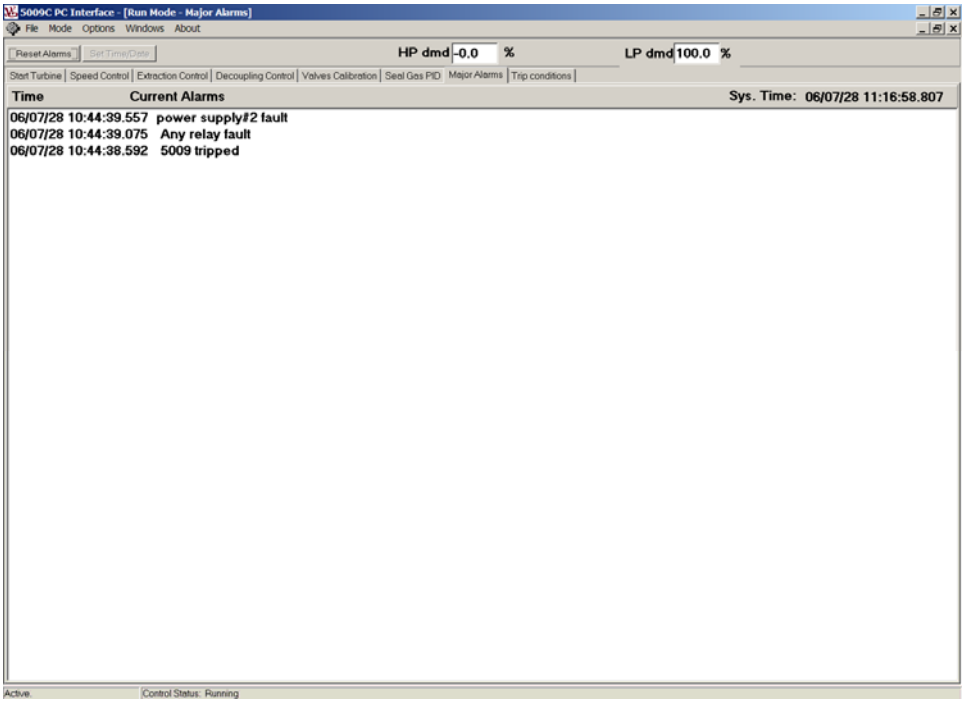
The Seal Gas PID settings can be monitored and changed by selecting the Dynamics button. If the RUN mode's Security logic is locked, the PID's settings can only be monitored. If the RUN mode's Security logic is unlocked, the PID's settings can be monitored and changed. Reference the Security Button section of this chapter for instructions on locking and unlocking the Run Mode's Security logic.

Selecting the "Dynamics button on the Seal Gas Control folder will allow access to the Dynamics display box. This Dynamics display box displays the Seal PID dynamic settings. The Seal Control's P, I, and DR terms can be adjusted with the arrow buttons to the right of each term.

Additional parameters such as DB (dead-band) and Droop are also available.

The Seal PID uses the settings displayed in the Dynamics Display box to determine PID response; any change to these setting will immediately effect PID response (when the PID is in Auto). These values are stored in the control's RAM memory. The box's "Save Settings" button can be selected to immediately upload the new values to the control's EEPROM memory. This insures that if all power to the control is lost the PID values will be saved. If the "Save Settings" button is not selected, the control will automatically save these values within 15 minutes. Reference Volume 1, chapter 5 for detailed information on adjusting PID dynamic settings.

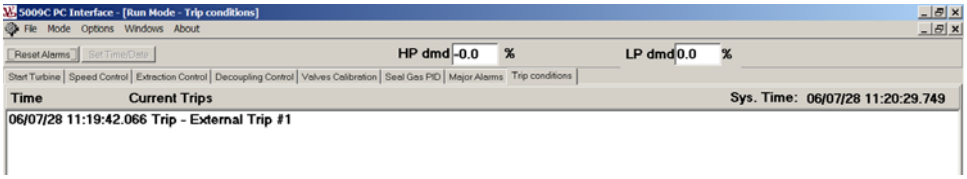
Major Alarms Folder



This folder will indicates only the Major alarms active.
The date and the time of the alarm occurrence are sampled and displayed.

Any “normal” Alarm won’t be displayed in this folder

Trip Conditions Folder



This folder will indicate only the Trip conditions active.

The date and the time of the Trip occurrence are sampled and displayed.

Chapter 5.
Service Mode Procedures

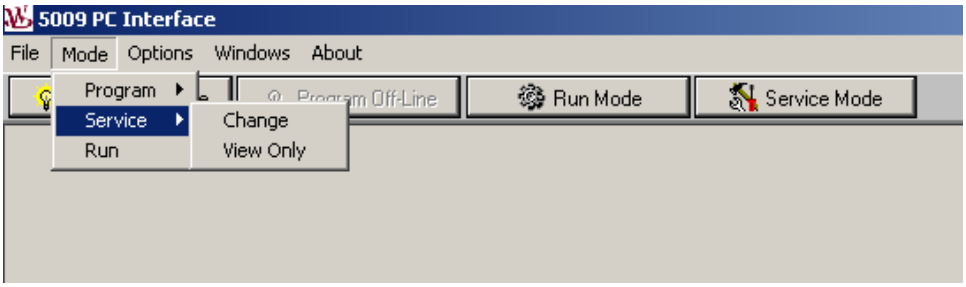
Overview

The Service mode is accessed through the PC interface and has the same easy to follow format as the program mode. The service mode can be used to change control settings, test control hardware, and calibrate control inputs/outputs while the unit is on-line (operating at any load). The parameters that are tuned in the service mode may affect system performance. Caution is advised when tuning any parameter with the turbine not shutdown. The Service Mode cannot be used to operate the turbine or to perform Run Mode functions. The Service Mode is to be used for internal adjustments only.

IMPORTANT

Not all page parameters are referred to or explained in this chapter. This chapter provides descriptions for parameters which only exist in the Service Mode. Refer to this Volume's Program mode chapter for all other page parameter descriptions.

The PCI's service mode can be accessed at any time the control is powered up. In order to enter the Service mode click on the Service Mode button or select the appropriate Service option from the Mode pull down menu as shown below.



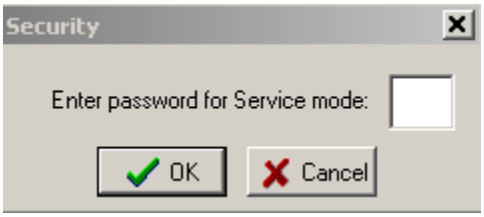
Opening the Service Mode

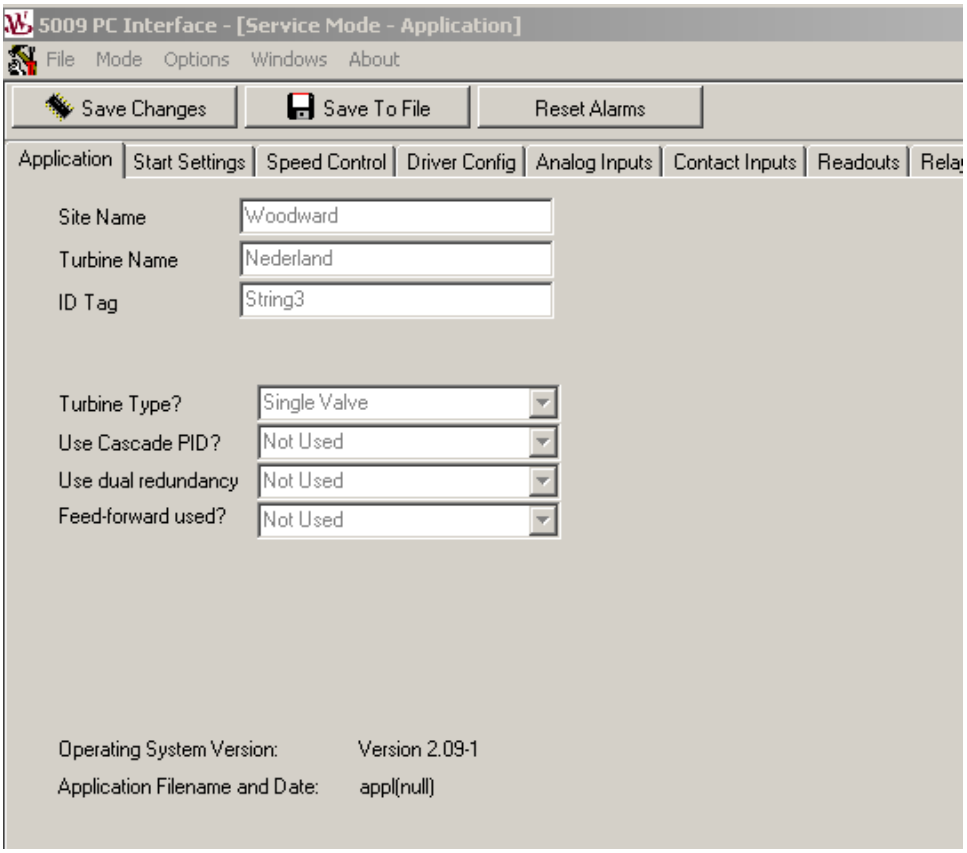
Two Service mode options are offered within the PCI program (Service-Change, Service-View Only). The Service-Change mode is used to change control settings, test control hardware, and calibrate control I/O, while the turbine is in operation or shutdown. For security purposes, the Service-Change mode is password protected. The Service-View Only mode is used to only view Service mode settings, while the turbine is in operation or shutdown. No Service mode settings can be changed via the View Only mode.

The 5009C control and PCI host computer must be connected (via a serial RS-232 cable) before the PCI Program mode can be opened. Trying to open the PCI Program mode without a serial connection will result in a communications error.

To enter the “Service-Change” mode click on the “Mode” button on the program’s main tool bar, or use the program’s Mode—Service menus. Once communications with the control has been established, the mode’s “Security Password entry box” will appear. At this point enter the Service mode password (reference Appendix A of this Volume).

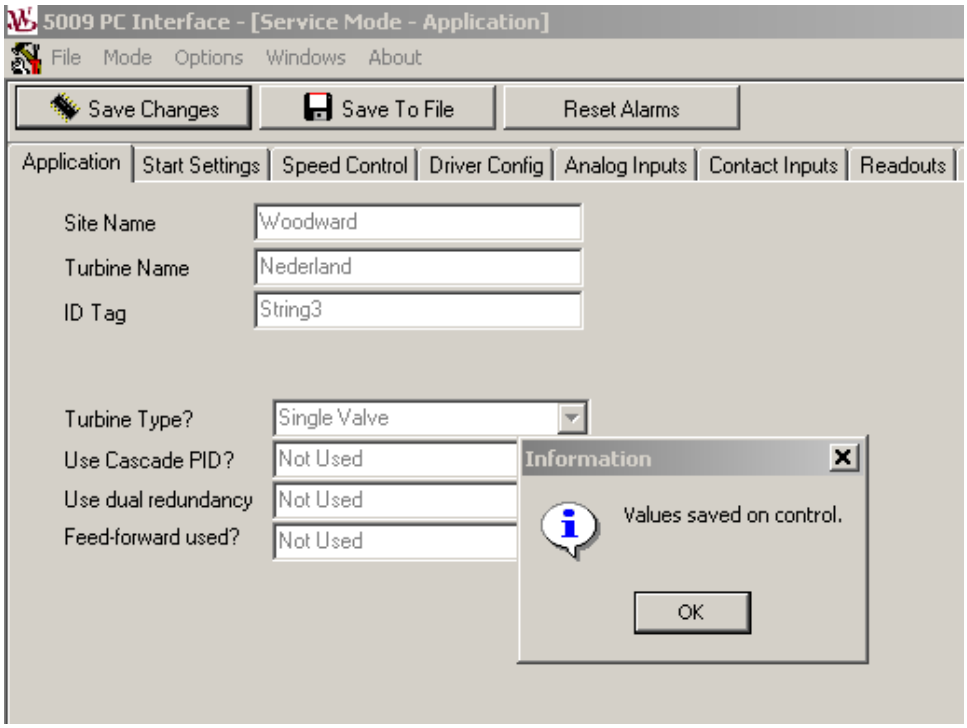
If the PCI program is not communicating with the control, when an open Service mode request is made, the program will make communication with the control via the ServLink program, then open the Service mode and its Security password box. During the time the Server program is establishing communications with the control, a “Starting Server” indication box will appear.





Save Changes

The Service Mode allows the user to change values internal to the 5009C control. The 5009C has two copies of the internal values. One it keeps in SRAM and the other it keeps in Non-volatile EEPROM, both on the CPU modules. When the 5009C control is powered up or reset it transfers the values from EEPROM to the SRAM and uses the values in SRAM. When the user makes changes in the Service Mode, he is making changes to the SRAM values. If the 5009C control is powered down or reset before the new values are stored into the EEPROM on the CPU modules the changes are lost and cannot be retrieved. Clicking the Save Changes button will store the new values into the EEPROM of the 5009C control. When the control has finished the save procedure, the display box shown below will appear. If the “Save Changes” button is not selected, the control will automatically save these values within 15 minutes.



Save To File

Reference the “Saving the Controls Configuration to a file” section in Chapter 3 of this volume.

Reset Alarms

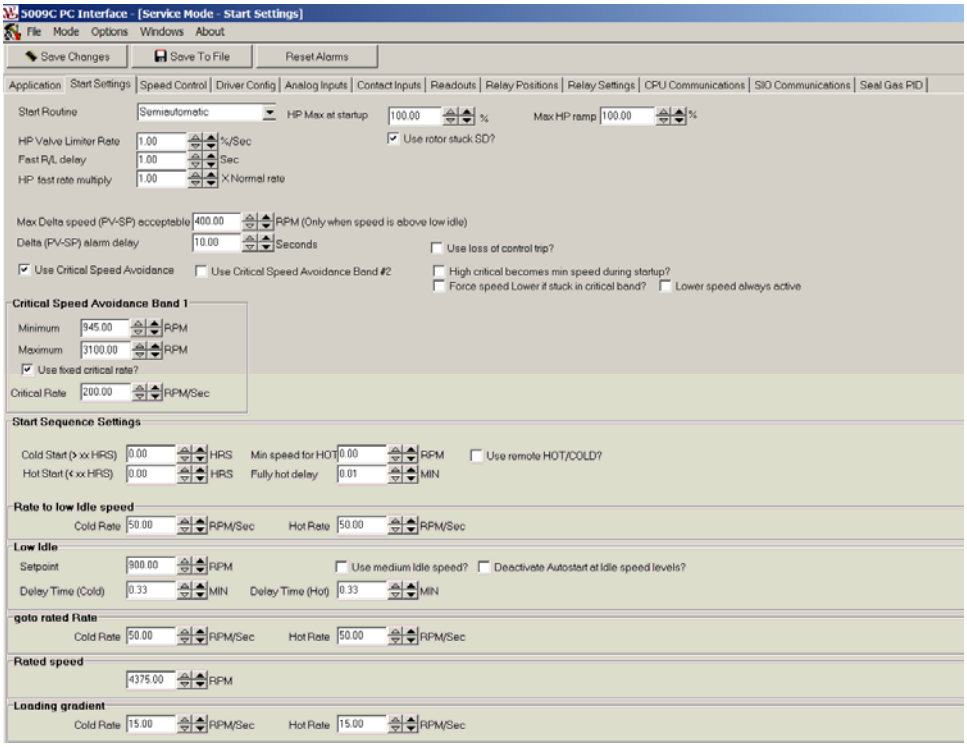
This button allows the user to issue a Reset Alarms command without switching modes on the PCI program. This feature is useful when removing inputs or outputs the reactivating them. a Reset command is required to reactivate an input or output.

Service Mode Folders

The Service Mode consists of a series of folders that allow a user to manipulate the internal control parameters. Each folder is labeled according to it's basic functions. To get a better idea of the functions available and a complete description on their purposes, see Volume 1. To move between folders, click on the folder title. As mentioned in the other modes, only the folders and the options that are relevant will appear visible. i.e. if the application is programmed for a single valve turbine, the extraction or admission folders will not be visible.

The Application folder has no tunable parameters available to the user. All values are entered in the Program Mode and can not be changed. This folder also displays the version of the 5009C's operating software, application software, and what configuration file is being used. The software version information is for Woodward documentation and troubleshooting purposes only. The configuration file information allows the user to verify which configuration file the 5009C is using. Reference the "Saving the control's configuration to a file" and "Uploading a Configuration File to the Control" sections of this chapter for more information on configuration files.

Start Settings Folder



Start Settings

The start settings determine many of the parameters that are available on this folder.. Any of the functions associated with those routines can be adjusted, but they can not be omitted if programmed or used if not programmed. The arrow keys to the right of each parameter will adjust it either up or down.

Common parameters to change during initial start up, is the HP Valve Limiter Rate and the V1 initial Position. They can be adjusted for a smooth and steady transition from zero speed to governor control.

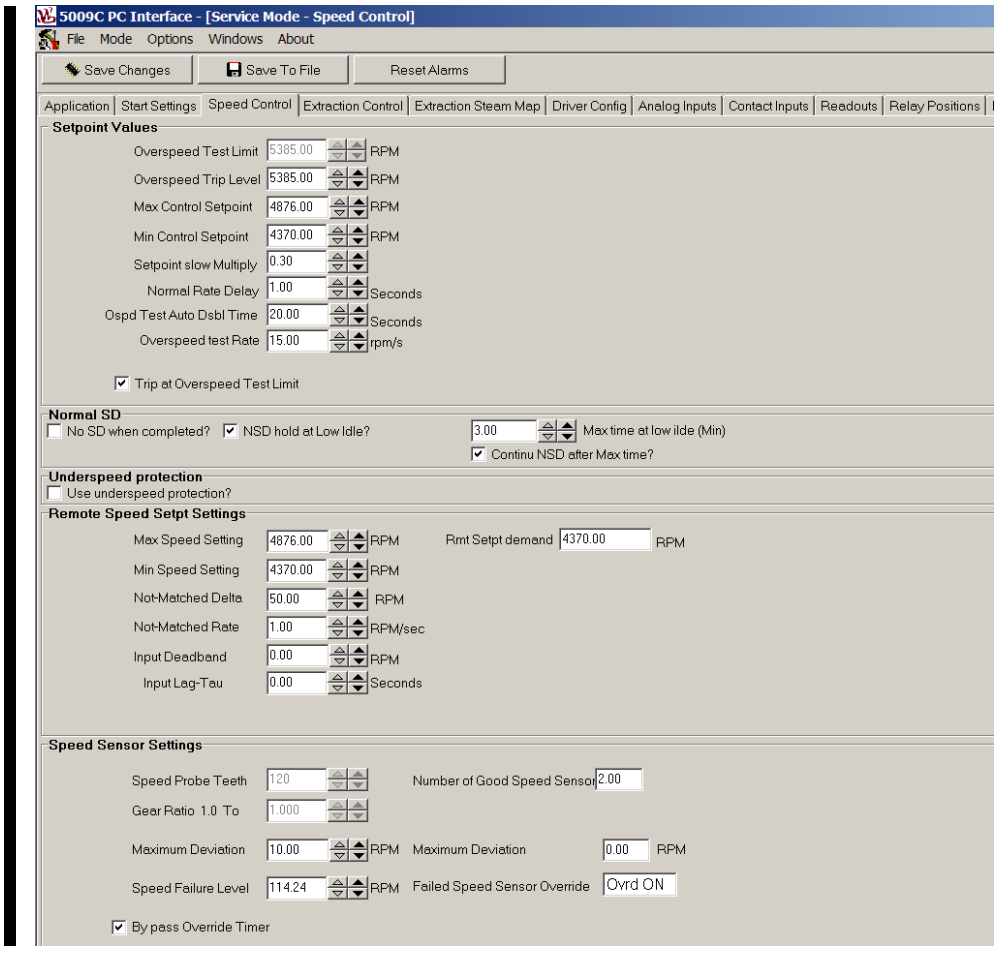
Critical Speed Avoidance Bands

Critical speed avoidance settings can be tuned at all times. If turbine vibrations are such that a smaller or larger critical window is required, the arrow buttons to the right of each setting can be used to adjust the values either up or down.

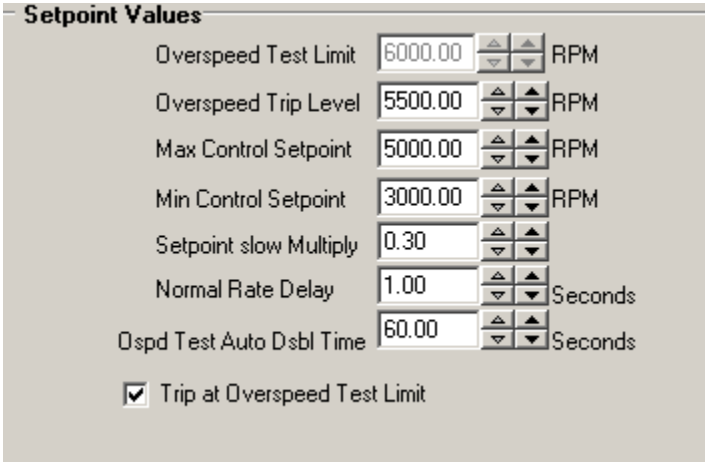
Auto Sequence Settings

The Automatic Start Sequence parameters can be modified at all times with the arrow keys to the right of each parameter, and their functions are the same as described in the Program Mode. The display boxes to the right of the first section shows the status of the entire start procedure. The remaining display boxes show the time that each function of the start up procedure will take. As described in the Program Mode, if the turbine has been shut down longer than the “hot” time and has not been shut down for the full “cold” time, the 5009C control interpolates between the two and displays the calculated times in these display boxes.

Speed Control Folder



Setpoint Values



The Speed Setpoint Values that are configured into the 5009C control are also tunable in the Service Mode except for the Overspeed Test Limit setting. These parameters can be modified at all times with the arrow keys to the right of each parameter. The display boxes to the right of the parameters shows the status of the turbine parameter.

Normal Rate Delay **dflt = 1.0 (0.0, 100)**
This value will determine how long the Setpoint Slow Rate will have to be selected before the Setpoint Normal Rate is engaged.
The normal rate equals the loading gradient. This implies that if a Raise speed setting command is continually given, the speed reference will raise at the slow rate for 1 second and then raise at the normal rate after that.

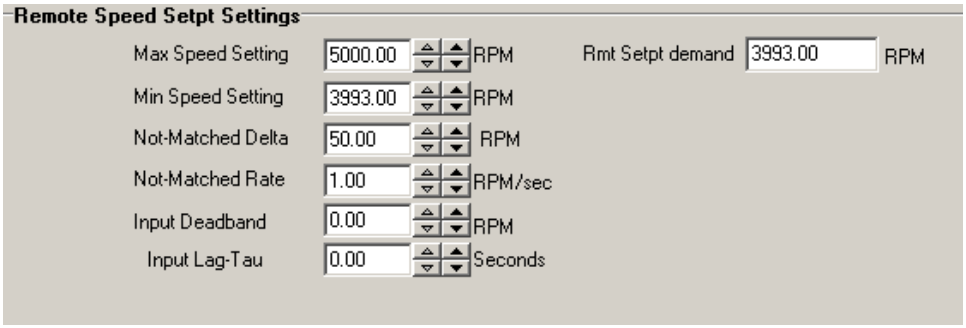
Setpoint slow multiply **dflt = 0.3 (0.1,1)**

This value will determine how slow the speed setpoint will raise or lower when the normal Rate is not yet initiated. This rate is defaulted to 0.3 times the Normal Rate.

Ovsp Test Auto Disable Time **dflt = 60 (0.0, 1000)**
This value will determine how long the user can keep the 5009C Overspeed Tests enabled without making an adjustment to the speed setpoint. This time is defaulted to 60 seconds.

Trip at Overspeed Test Limit **dflt = Yes**
This option will trip the turbine when the turbine speed reaches the Overspeed Test Limit. The 5009C control will trip the turbine at the Overspeed Trip Level at all times unless an External Overspeed Test has been initiated. This option provides a fail-safe condition in case the external device does not trip before the Overspeed Test Limit.

If remote speed is configured, the following menu will appear.



Max Speed Setting **dflt = Max Speed Setpt (0.0, 25000)**
This value will determine the maximum setting the speed setpoint is allowed to be moved to, by the remote input. If the Remote Input is ranged to go from 0 to 4000 RPM by an external device, but the user wishes the speed to be limited to 3500—3700 RPM, this option will allow for it. The default setting is the Max Control Setpoint.

Min Speed Setting **dflt = Min Gov Setpt (0.0, 25000)**
This value will determine the minimum setting the speed setpoint is allowed to be moved to, by the remote input. The default setting is the Min Control Setpoint.

Not-Matched Delta **dflt = 50 (0.1, 500)**
This value determines the max deviation authorized for the remote speed setpoint. When the deviation is above this value, the not Matched rate will be used.

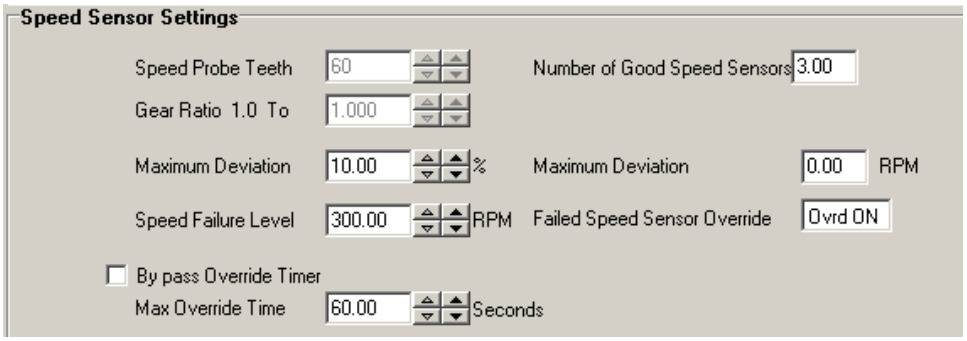
Not-Matched Rate **dflt = 1 (0.1, 500)**
This value determines the rate the setpoint moves when remote is enabled and the remote input doesn't match the actual speed setpoint.

Input Deadband **dflt = 0.0 (0.0, 100)**
This value will determine the deadband in the Remote Speed Input controller. The default value is set to zero. In the event that the input signal is noisy, or drifts, a small deadband value can be added to allow stability during normal operation and still permit movement when needed.

Input Lag-Tau **dflt = 0.0 (0.0, 10)**
This value will determine the Lag delay of the Remote Speed Input. The default value is zero. This value acts as a filter to filter-out noise on the Remote input.

Speed Sensor Settings

The Speed Sensor Settings that are configured into the 5009C control are not tunable in the Service Mode except for the null speed sensor. The options are listed for display purposes only. Their functions are the same as described in the Program Mode. The display boxes to the right of the parameters shows the status of the speed sensor inputs.



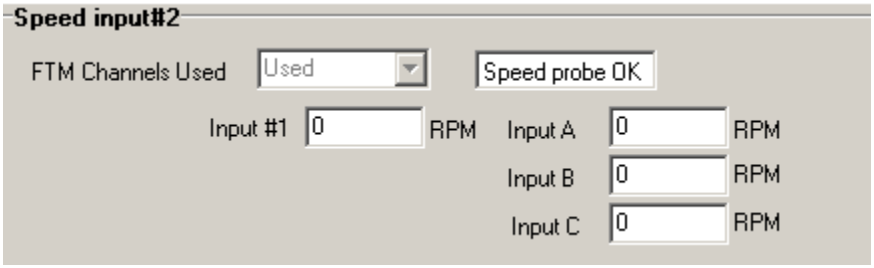
Number of Good Speed Sensors
Displays the number of speed sensors that the 5009C control still views as having a valid input.

Maximum Deviation (rpm) **dflt = 10 (0.0001, 0.2)**
This value will determine the maximum difference between the three inputs before an alarm is given. If one input has a value that is less or greater than the voted-good value by the entered maximum deviation amount, that input will be alarmed.

Speed Failure Level **dflt = 0.0255 x Ovspd Limit (50, 15000)**
This value will determine at what speed a sensor is to be determined as failed. When all four sensors read at or below this value, the turbine will shutdown.

By-pass Override Timer/Max Override Time **dflt = No, dflt = 60 (0.0, 60)**
If a contact input is configured as an Override Speed Sensor Fault input, then this option allows a timer to disable the input after a set amount of time. The override timer function allows the turbine's fail-safe logic to protect the turbine in case the Override Speed Sensor Fault input is left closed for an extended length of time and all turbine speed sensors fail during this time. The override timer begins when a turbine start command is given and is defaulted to 60 Minutes (Max Override time). The status of the Failed Speed Sensor Override is displayed to the right of the Speed Failure Level input box.

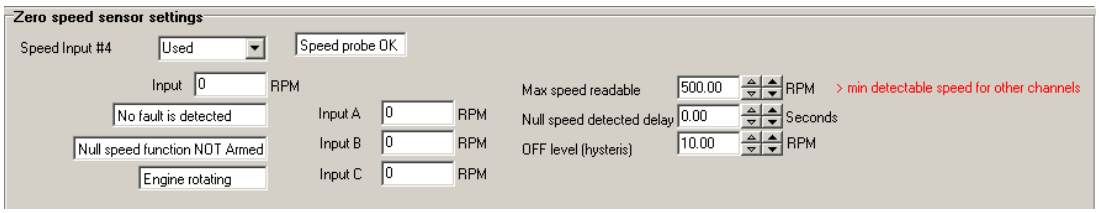
Normal Speed Inputs



For each of the three speed sensor inputs the following information is displayed on this folder.

Value used by 5009C control
Status of Input
Value read by CPU A
Value read by CPU B
Value read by CPU C

Zero Speed Proximity Probe

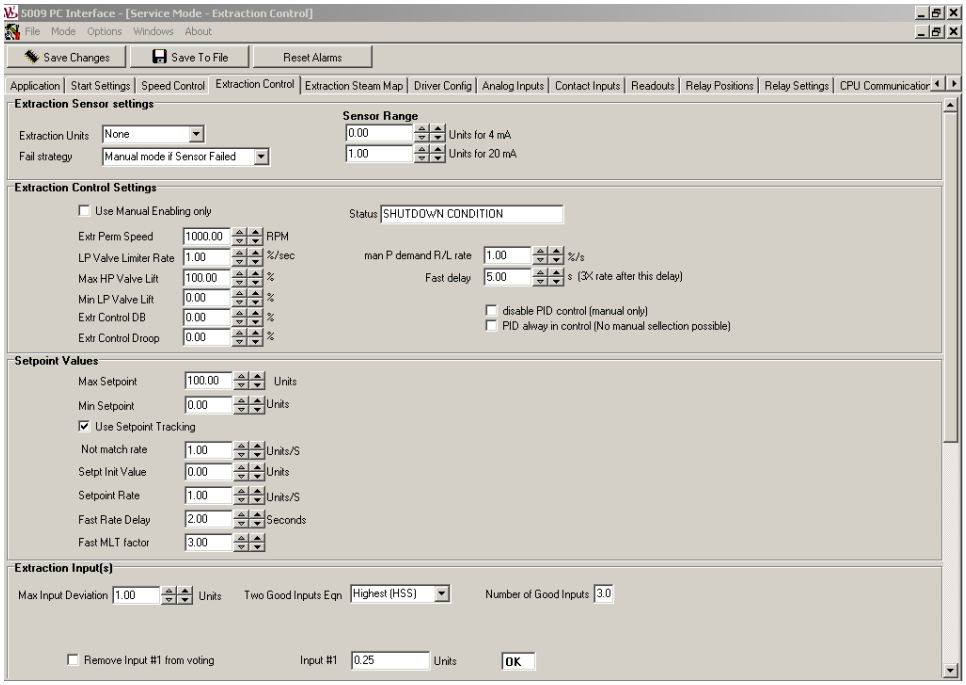


For the zero speed sensor input the following information is displayed on this folder.

Value used by 5009C control
Status of Input
Value read by CPU A
Value read by CPU B
Value read by CPU C
Status of the null speed detection feature
Function ARMED/NOT ARMED feedback
Rotating status
Null speed sensing parameters

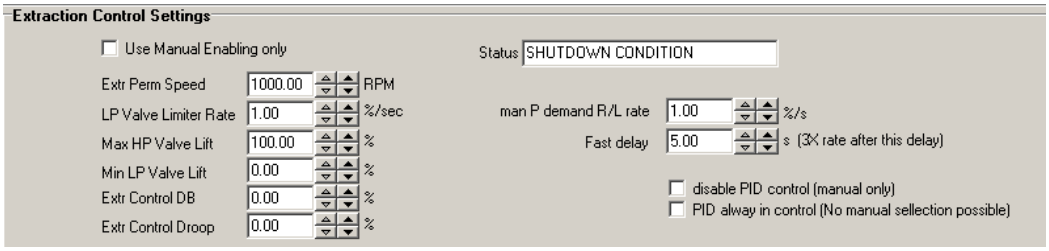
Extraction/Admission Control Folder

These folders are only visible when the control is configured for Extraction, Admission, or Extr/Adm types of turbines. Because there is very little difference between these folders, the descriptions for all three folders have been combined. Depending on the type of turbine configured, the folder and gauge titles will change from Extraction Control, Admission Control, or Extr/Adm Control. For description purposes the Extr/Adm Folder is displayed below.



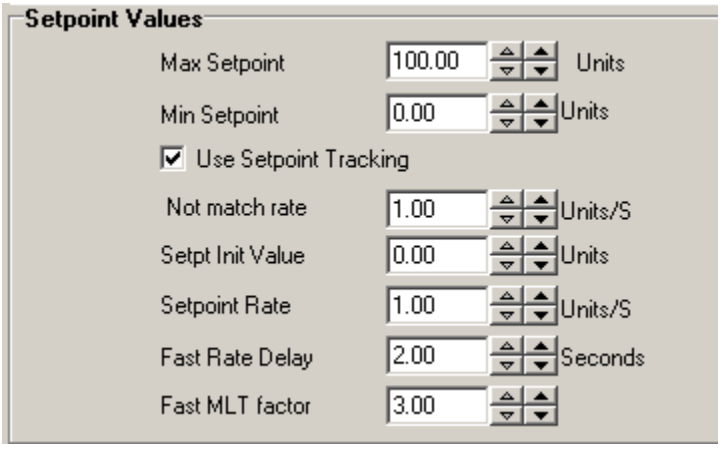
Extraction/Admission Control Settings

Many of the Extr/Adm Control Settings that were Programmed are also tunable in the Service Mode. The parameters can be modified at all times with the arrow keys to the right of each parameter, and their functions are the same as described in the Program Mode of Chapter 3.



Man P demand R/L rate (%/s) **dflt = 1 (0.0, 1000)**
This value will determine the rate of change of the P demand (flow or pressure) when extraction/Admission is in manual mode.

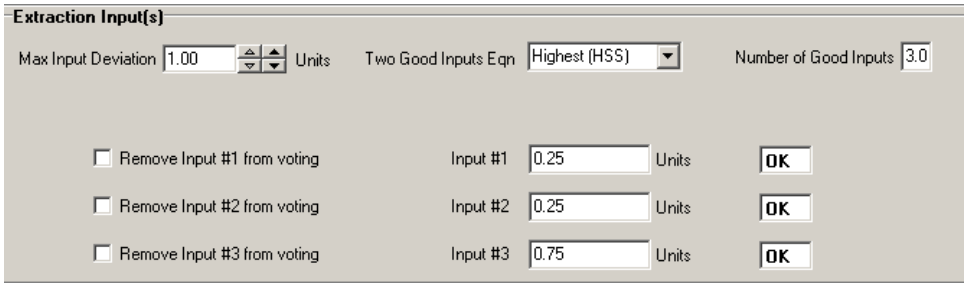
Fast Delay **dflt = 5 (0.0, 100)**
This value will determine how long the demand Slow Rate will have to be selected before the demand Fast Rate will be engaged. It is defaulted for 5 seconds. This implies that if a Raise Extr/Adm demand command is continually given, the Extr/Adm demand will raise at the slow rate for 5 seconds and then raise at the fast rate after that. the fast rate will be three time the normal rate. The fast rate multiplier cannot be changed.



Setpoint Rate **dflt = 1(0.01, 10000)**
This value will determine how fast the Extr/Adm setpoint will raise or lower using raise/lower commands. This rate is defaulted to three times the Setpoint Slow Rate.

Fast Rate Delay **dflt =2 (0.1,10)**
This value will determine how long the Setpoint Slow Rate will have to be selected before the Setpoint Fast Rate will be engaged. It is defaulted for 2 seconds. This implies that if a Raise Extr/Adm Setpoint command is continually given, the Extr/Adm setpoint will raise at the slow rate for 2 seconds and then raise at the fast rate after that. the fast rate will be three time the normal rate.

Fast MLT factor **dflt= 3X Setpoint rate(1,10)**
This value is the multiply factor for the setpoint rate, used when fast rate is selected.



Max Input Deviation **dflt = 1% of Input Range (-325000, 325000)**
This value will determine the maximum difference between the three inputs, before an alarm is given. If one input has a value that is less or greater than the voted-good value by the entered maximum deviation amount, that input will be alarmed.

Number of Good Inputs
Displays the number of Extr/Adm Inputs that the 5009C control still views as having a valid input.

Two Good Inputs Equation **dflt = HSS**
If three good inputs are available, the 5009C control will select the Median Value (the one in the middle). If only one good input is available, the 5009C control will use it . In the instance where one input fails and the 5009C control has two inputs to chose from, the user must select from one of the following options:

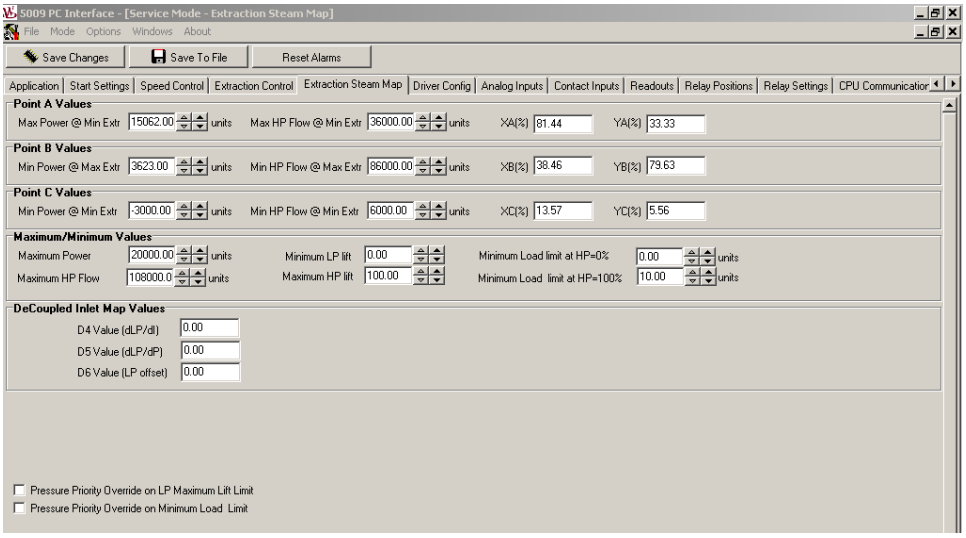
Median	If the failed input fails low the lower value of the two If the failed input fails high the higher value of the two
Highest	Higher value of the two inputs.
Lowest	Lower value of the two input
Average	Average of the two (Input X + Input Y)/2

Remove Input # from Voting **dflt = No**
By clicking or selecting the check box to the left of the text, Inputs 1,2, or 3 can be removed from the input voting logic. This option, allows on-line transducer calibration and maintenance, without the worry of affecting system control. If a sensor has failed or is acting inconsistent, it can be removed from the voting logic, replaced or repaired, have its calibration verified, then placed back into the input's voting logic. To place the input back into the voting logic, click the respective box again, then the "Reset Alarms" button on the screen's tool bar. Use extreme caution when performing this test on-line; removing all three output at once could cause a system trip condition.

IMPORTANT

Don't confuse the three separate inputs with the three separate CPUs. The CPUs read each input and vote them transparent to the application. By removing input #X you are removing Extr/Adm Input #X. You are not eliminating one of the CPUs.

Extraction/Admission Steam Map Folder



Extraction/Admission Steam Map

The Extr/Adm Steam Map settings are fully tunable from the Service Mode. Extreme care must be taken when tuning these parameters while engine in running. Entering a wrong steam MAP will generate an alarm, but might result in stability problems. It is recommended to use the excel file provide with the 5009C to test the new steam MAP prior to any changes on-line.

If decoupling mode is used, D factor are displayed, for indication only.

Decoupled Exhaust Values (for monitoring only)

D1 Value (delta HP/ delta Exhaust Flow) dflt= Calc (0, 4)
D2 Value (delta HP/ delta Ext/Adm Flow) dflt= Calc (0, 4)
D3 Value (HP Offset at 0 Exhaust Flow & 0 E/A Flow) dflt= Calc (-300, 30)

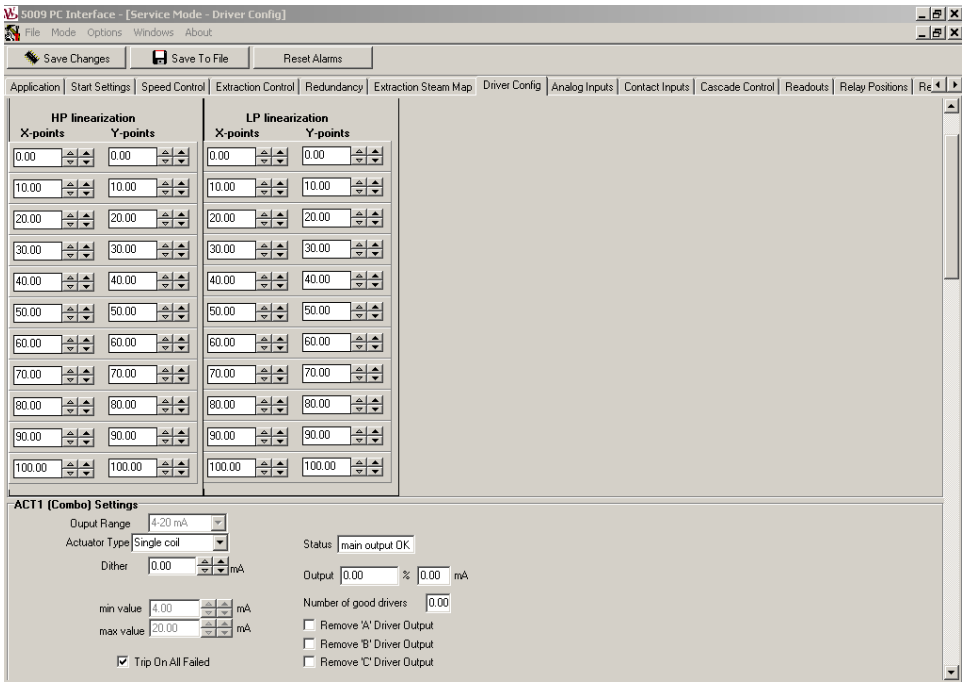
Decoupled Inlet Values (for monitoring only)

D4 Value (delta LP/ delta Inlet Flow) dflt= Calc (0, 4)
D5 Value (delta HP/ delta Ext/Adm Flow) dflt= Calc (-4, 4)
D6 Value (LP offset at 0 Load & 0 E/A Flow) dflt= Calc (-300, 300)

Testing the Extr/Adm Steam Map

Testing the steam MAP can be performed using the excel file provided with the 5009C.
With this file, it is possible to test the real behaving of the valves depending on S/P demand.
When engine is running, using ServLink and a net file named 5009.net, it is possible to monitor the operating point inside the actual steam MAP.

Driver Configuration Folder

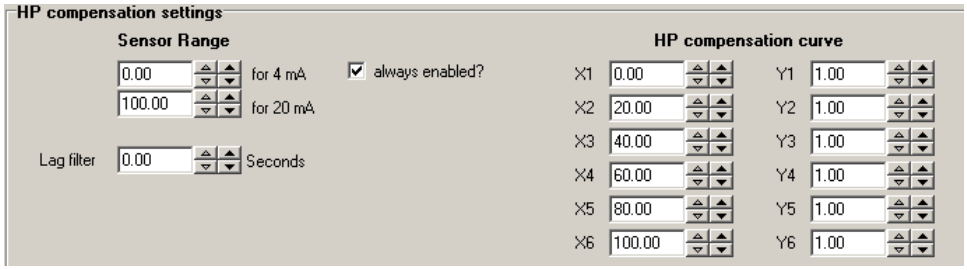


HP/LP linearization **dflt = (Shown in Driver Conf Folder)**

The linearization of the actuators is a vital feature of the 5009C control system. The ratio/limiting that occurs internal to the 5009C is dependent on the valves being linear in nature. Most Woodward Governor Company Actuator/valves are linear in nature and do not need to be adjusted. In order to linearize the valves, a flow meter or some type of measuring device should present to measure flow through the valve. The X—Y values represent an interpolation block that sets up to 11 points on an X-Y graph.

The X values are initially set at 10 % increments but can be adjusted up or down by using the arrows to the right of the Value display box. The X values should be concentrated in areas of known non-linearity. If the valve is known to be linear from 0 to 50 %, X-1 should be 0% and X-2 should be 50%. All higher X values must have a higher %. If X-2 is moved to 50%, then X-3 must be higher and X-4 must be higher than X-3 and so forth.

HP(or LP) Compensation



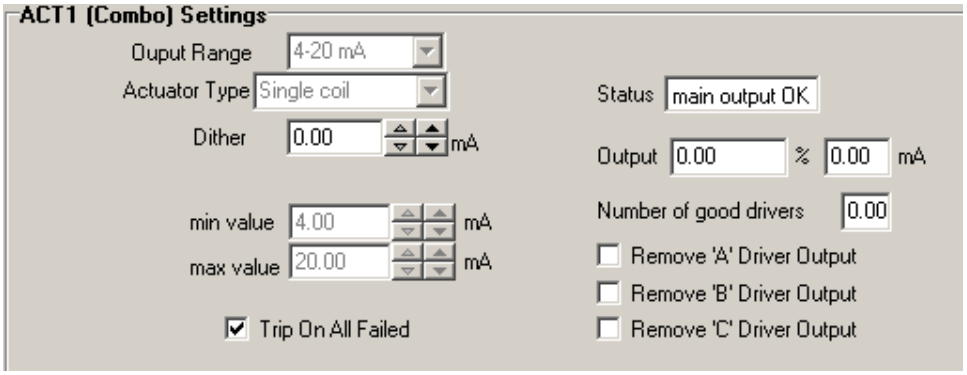
Most of the parameters have been described in Chapter 3.

Lag filter (s) **dflt =0 (90,60)**
Set the filtering value on the sensor used for HP (or LP) compensation.
This filtering should be used to slow down the compensation rat, and to avoid to strong interaction with the speed or extraction controller.

Typically, HP or LP compensation is a valve position compensation and must not act too strongly and fast.

Act #1or 2 Combo Settings

Most of the options that have been configured in the Program Mode are not adjustable in the Service Mode. Once entered by way of the Program Mode into the 5009C control, the system must be shutdown and reprogrammed in order to enter new settings. The parameters shown are the same parameters that are listed and described in the Program Mode. The status of the drivers is displayed to the right of the settings in the driver status display box. The 0–100% output of the driver is also displayed along with the milliamps that the driver output corresponds to.



Dither **dflt = 0.0 (0.0, 10)**
The amount of dither present is the only option that can be adjusted from the Service Mode.

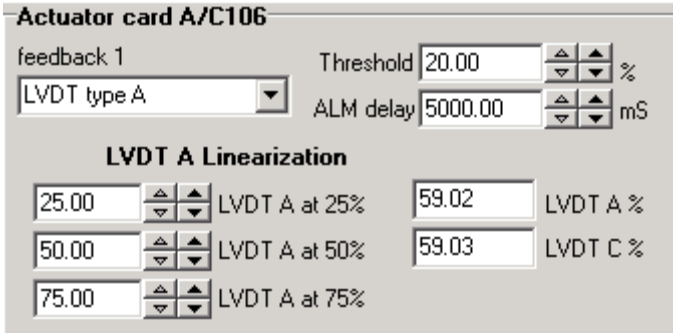
Number of Good Drivers
Displays the number of Driver “legs” that the 5009C control still views as having a valid output.

Remove ‘X’ Driver Output (from Voting) **dflt = No**
If a single leg of the drivers output seams to be disrupting the operation of the 5009C control, the Remove From Voting option can be used to isolate it from the system. By clicking or selecting the check box to the left of the text, Output A, B, or C can be removed from the voting and thereby removed from the 5009C controls output. To place the output back into the voting logic, click on the respective box again, then select the “Reset Alarms” button on the screen’s tool bar. Use extreme caution when performing this test on-line; removing all three output at once could cause a system trip condition.

IMPORTANT

Don’t confuse the three separate inputs option described earlier with the “Legs” of the output driver. The three CPUs each contribute one leg of the drivers output. By removing Driver Output ‘?’ you are eliminating one of the CPUs from the output.

Act #1or 2 Actuator Cards Settings

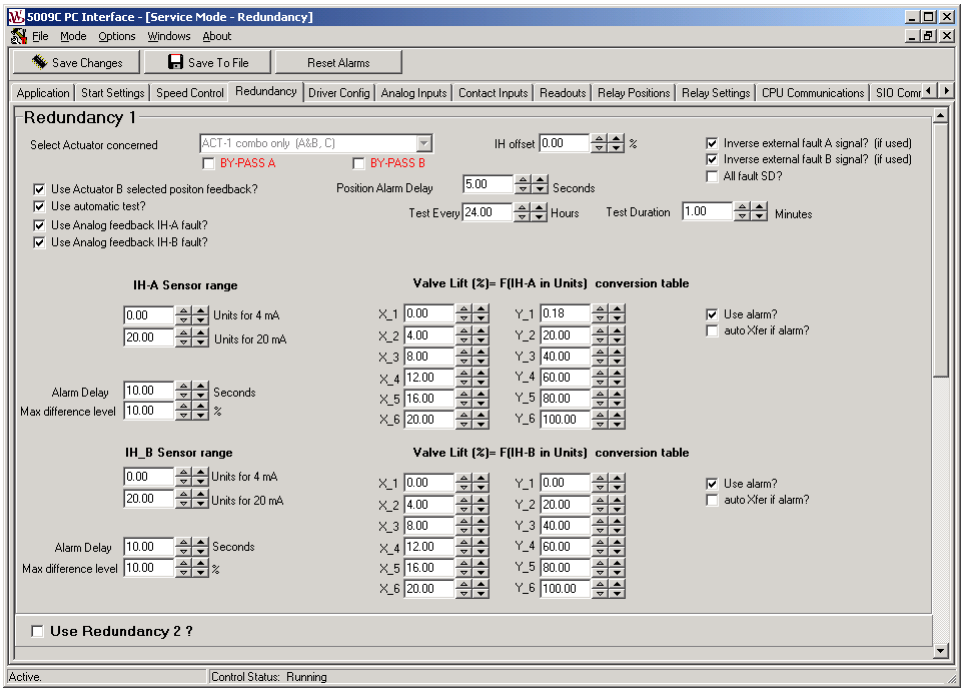


Threshold: **dflt =*20(2,150)**
Error between demand and feedback tolerated

ALM delay **dflt=*5000(0,10000)**
Delay to get an alarm when Threshold is exceeded

LVDT A Linearization
If a difference between LVDT is noticed in normal run, it is possible to tune these value to match the positions.

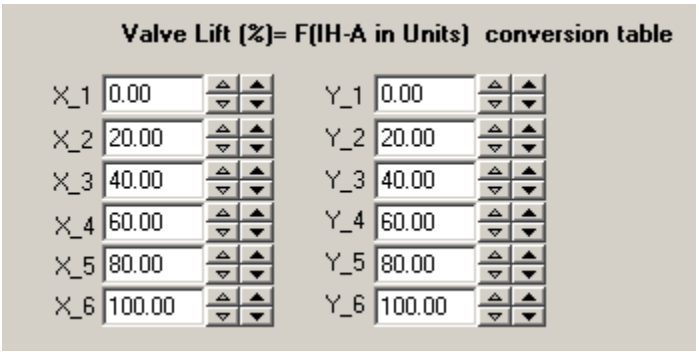
Redundancy Folder



BY_PASS A or BY_PASS B
In some conditions, it may be requested to make sure that an IH cannot be selected.
When BY_PASS is selected, then the IH will not be selected, even in case of failure.
The By-pass solenoid, if used, will be activated.
The IH BY_PASS is mainly used when calibration is performed, and engine is running.

In RUN mode, In red, an indication of the activation of the by-pass will be indicated.

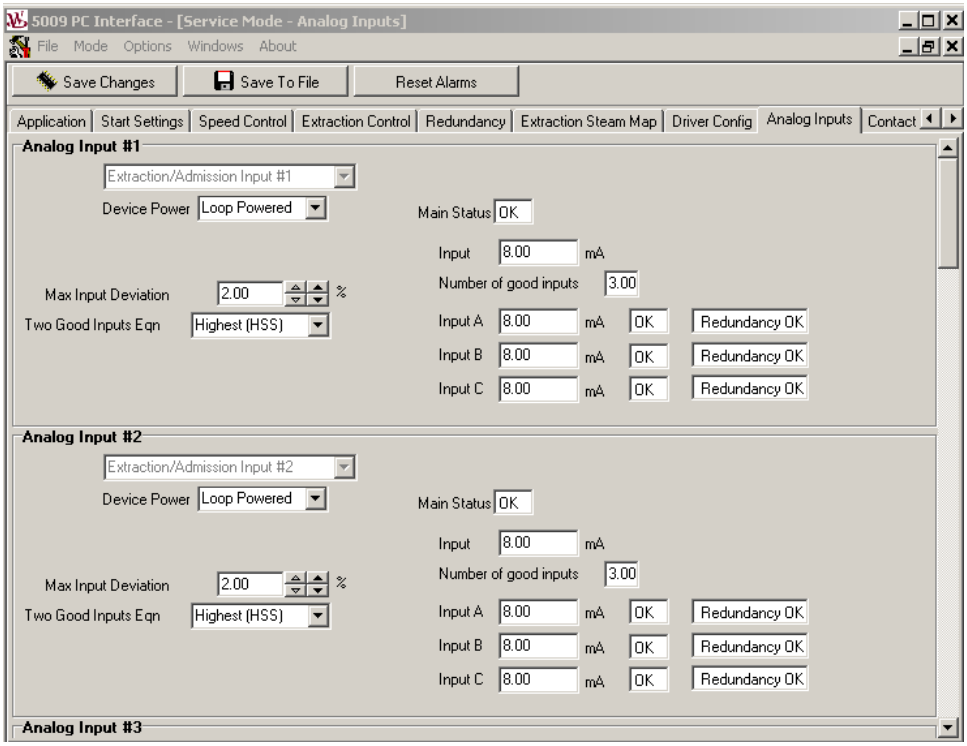
Valve Lift (%)= F(IH_A)



The X—Y values represent an interpolation block that sets up to 6 points on an X-Y graph. This will convert the IH_A position/pressure into valve lift (%). The valve list will then be compared with the valve demand linearized.

The X values are initially set at 10 % increments but can be adjusted up or down by using the arrows to the right of the Value display box. The X values should be concentrated in areas of known non-linearity. The X values must be set such as X1<X2<<X6

Analog Input Folder



Analog Inputs **dflt = Not Used**

The Analog Input function is set in the Program Mode and cannot be changed from the Service Mode. However, the values associated with that function can be adjusted. The arrow keys to the right of each parameter will adjust it either up or down. Each Analog Input #1 through #8 is programmed in the same way. The parameters shown are the same parameters that are listed and described in the Program Mode. The status of the Input is displayed to the right of the folder along with the actual input as seen by the 5009C control. The number of valid inputs as well as the input as seen from all three CPUs A, B, &C is displayed below it.

Fail Low Value correspond to 2mA.
Fail High Value correspond to 22mA.

Number of Good Inputs

Displays how many of the three legs of the Analog Input is a valid input.

Maximum Deviation **dflt = 1% of Input Range (0.1, 10%)**

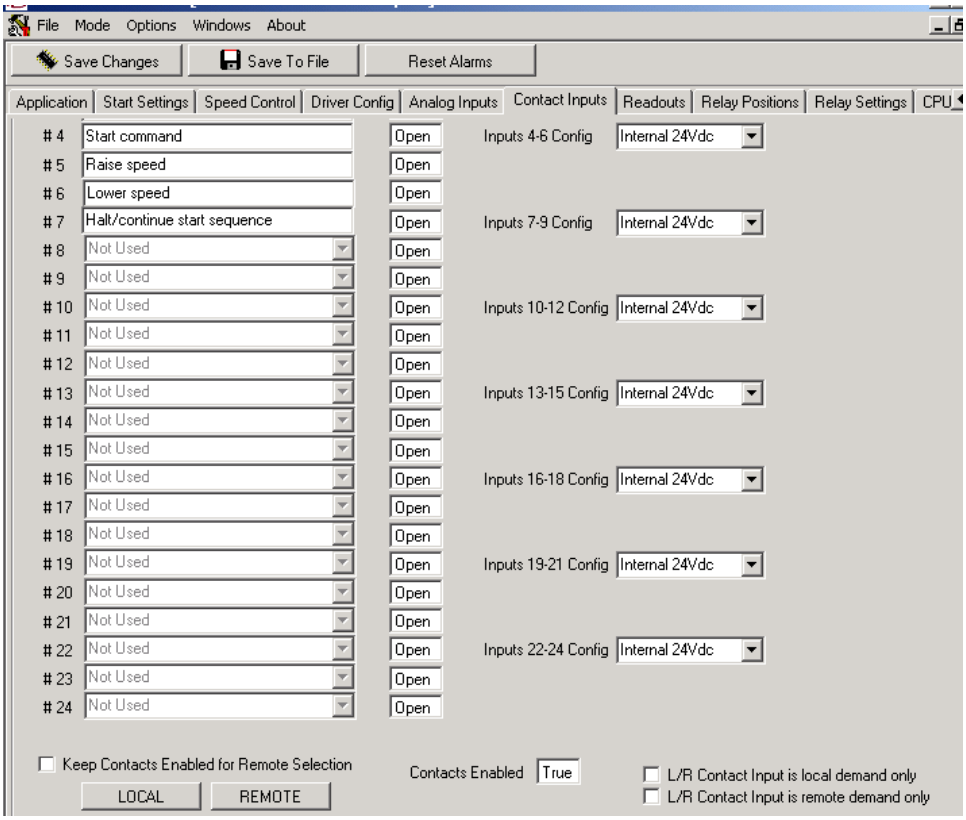
This value will determine the maximum difference between the three inputs. If one input has a value that is less or greater than the voted-good value by the entered maximum deviation amount, that input will be alarmed.

Two Good Inputs Equation **dflt = HSS**

If three good inputs are available, the 5009C control will select the Median Value (the one in the middle). If only one good input is available, the 5009C control will use it . In the instance where one input fails and the 5009C control has two inputs to chose from, the user must select from one of the following options:

Median	If the failed input fails low the lower value of the two If the failed input fails high the higher value of the two
Highest	Higher value of the two inputs.
Lowest	Lower value of the two input
Average	Average of the two (Input X + Input Y)/2

Contact Input Folder



Contact Inputs

The Contact Input functions are set in the Program Mode and cannot be changed from the Service Mode. See Volume 1 and the descriptions in Chapter 3 for a further explanation of functions. This folder is used mainly as an Input Status monitor function except for the following.

Keep Contacts Enabled for Local Selection **dflt = No**
This option is only visible when the Local/Remote function is configured. When selected, the contacts are always active regardless of the Local/Remote selection. When not selected, the contact inputs are disabled when the local mode is selected.

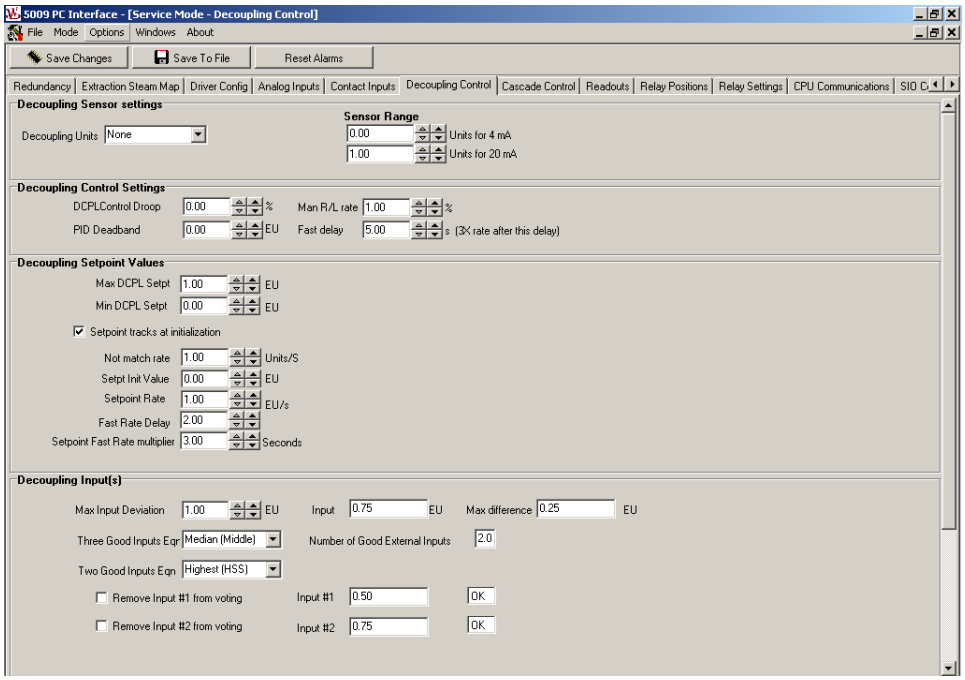
Local/Remote
It is possible from this page to select Local (on the engine) or remote (Modbus**)**

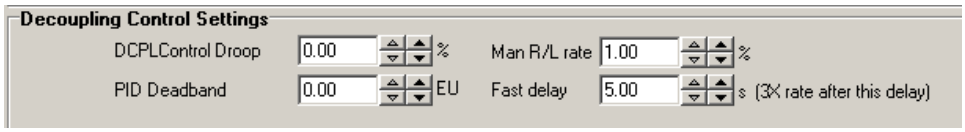
L/R contact input is local demand only
When closed, the contact input will bring and maintain the control in local (HMI) but won't select remote not when opened

L/R contact input is remote demand only
When open, the contact input will bring and maintain the control in remote (contacts) but won't select remote not when closed.

Contacts Enabled
This display box is only visible when the Local/Remote function is configured. It displays the status of the contact inputs in relationship with the Local/Remote function. If Contact Enabled is True, the contact inputs are enabled.

Decoupling Folder

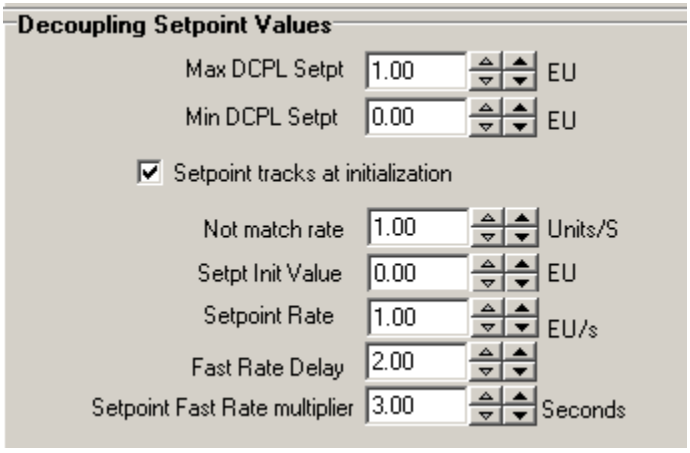




Man P demand R/L rate (%/s) **dflt = 1 (0.0, 1000)**
This value will determine the rate of change of the P demand (flow or pressure) when extraction/Admission is in manual mode.

Fast Delay **dflt = 5 (0.0, 100)**
This value will determine how long the demand Slow Rate will have to be selected before the demand Fast Rate will be engaged. It is defaulted for 5 seconds. This implies that if a Raise Extr/Adm demand command is continually given, the Extr/Adm demand will raise at the slow rate for 5 seconds and then raise at the fast rate after that. the fast rate will be three time the normal rate.

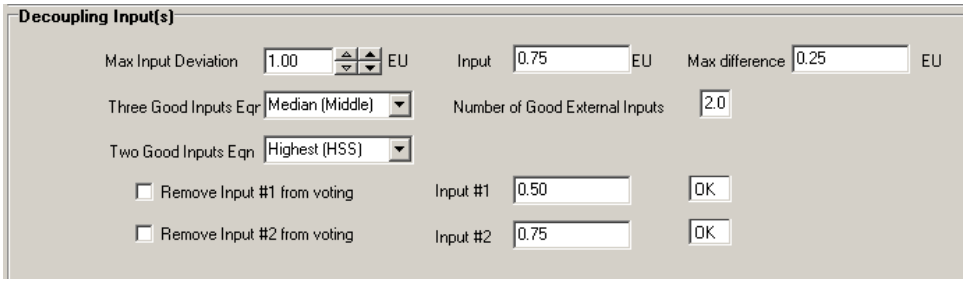
The fast rate multiplier cannot be changed.



Setpoint Rate **dflt = 1(0.01, 10000)**
This value will determine how fast the Decoupling setpoint will raise or lower using raise/lower commands. This rate is defaulted to three times the Setpoint Slow Rate.

Fast Rate Delay **dflt =2 (0.1,10)**
This value will determine how long the Setpoint Slow Rate will have to be selected before the Setpoint Fast Rate will be engaged. It is defaulted for 2 seconds. This implies that if a Raise Decoupling Setpoint command is continually given, the Decoupling setpoint will raise at the slow rate for 2 seconds and then raise at the fast rate after that. the fast rate will be three time the normal rate.

Fast MLT factor **dflt= 3X Setpoint rate(1,10)**
This value is the multiply factor for the setpoint rate, used when fast rate is selected.



Max Input Deviation **dflt = 1% of Input Range (-325000, 325000)**
This value will determine the maximum difference between the three inputs, before an alarm is given. If one input has a value that is less or greater than the voted-good value by the entered maximum deviation amount, that input will be alarmed.

Number of Good Inputs
Displays the number of Extr/Adm Inputs that the 5009C control still views as having a valid input.

Two Good Inputs Equation **dflt = HSS**
If three good inputs are available, the 5009C control will select the Median Value (the one in the middle). If only one good input is available, the 5009C control will use it . In the instance where one input fails and the 5009C control has two inputs to chose from, the user must select from one of the following options:

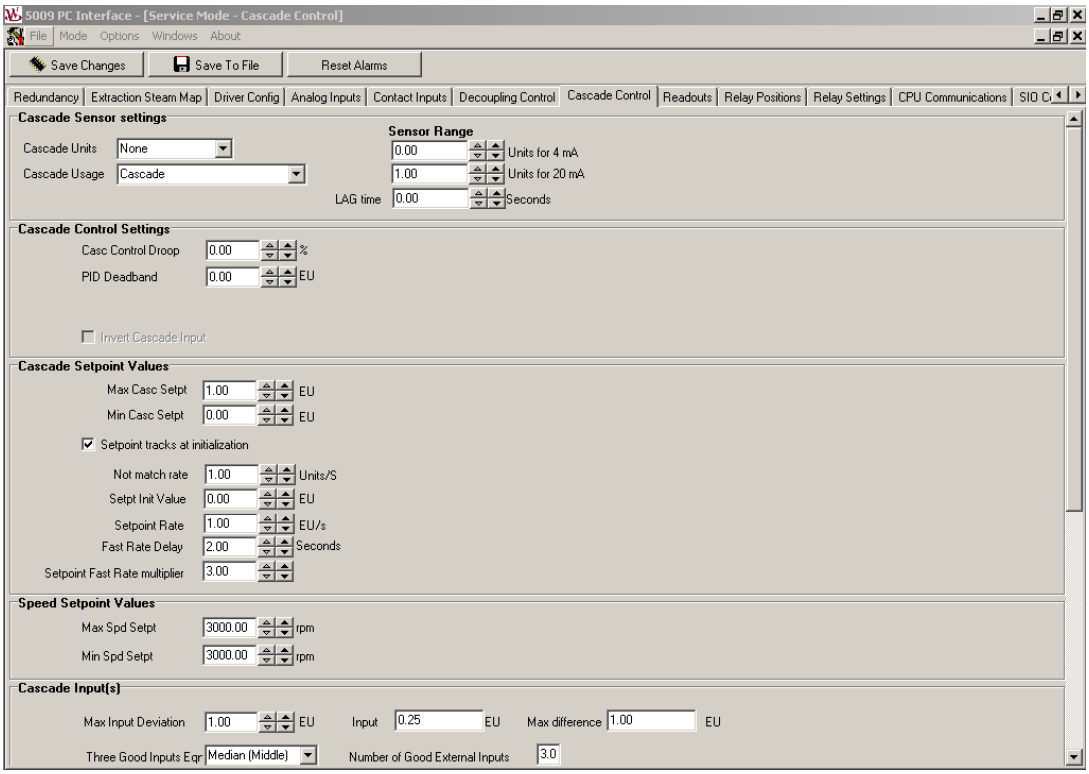
Median	If the failed input fails low the lower value of the two
	If the failed input fails high the higher value of the two
Highest	Higher value of the two inputs.
Lowest	Lower value of the two input
Average	Average of the two (Input X + Input Y)/2

Remove Input # from Voting **dflt = No**
By clicking or selecting the check box to the left of the text, Inputs 1,2, or 3 can be removed from the input voting logic. This option, allows on-line transducer calibration and maintenance, without the worry of affecting system control. If a sensor has failed or is acting inconsistent, it can be removed from the voting logic, replaced or repaired, have its calibration verified, then placed back into the input's voting logic. To place the input back into the voting logic, click the respective box again, then the "Reset Alarms" button on the screen's tool bar. Use extreme caution when performing this test on-line; removing all three output at once could cause a system trip condition.

IMPORTANT

Don't confuse the three separate inputs with the three separate CPUs. The CPUs read each input and vote them transparent to the application. By removing input #X you are removing Extr/Adm Input #X. You are not eliminating one of the CPUs.

Cascade Controller Folder



Cascade Settings

The Cascade Control Settings that are configured into the control are also tunable in the Service Mode. The parameters can be modified at all times with the arrow keys to the right of each parameter, and their functions are the same as described in the Program Mode of Chapter 3. The display boxes to the right of the parameters shows the status of the turbine parameter.

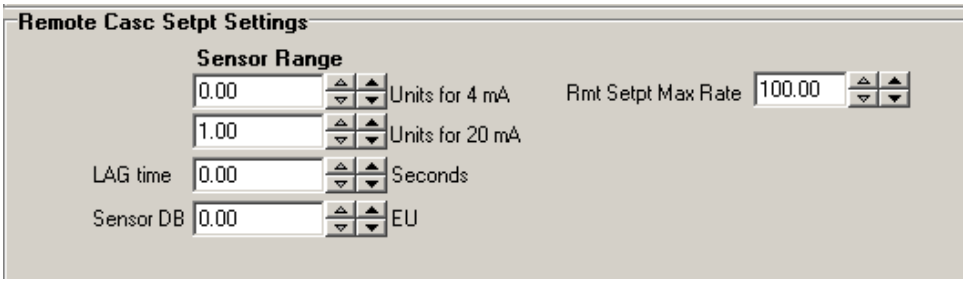
PID Deadband **dflt = 0.0 (0.0, 100)**
This value will determine the deadband in the Cascade controller. The default value is set to zero. In the event that a rapid change is necessary, but stability problems occur with such rapid changes, a deadband can be added to allow stability during normal operation, and still permit fast movement when needed.

PID Minimum **dflt = 0.0 (0.0, 100)**
The Cascade PID cannot output a lower value to the LSS than the value entered here. This can be used to stop the Cascade PID from taking the LSS low enough to take the unit off-line or below min governor. The default setting is zero.

Setpoint Rated Value **dflt = Casc Max Setpt (-325000, 325000)**
This value is used to calculate the Cascade PIDs droop setting. It is defaulted to the Maximum Cascade Setting and should not need to be changed. Unless the resolution of the PID settings or the Droop percentage need to be a higher.

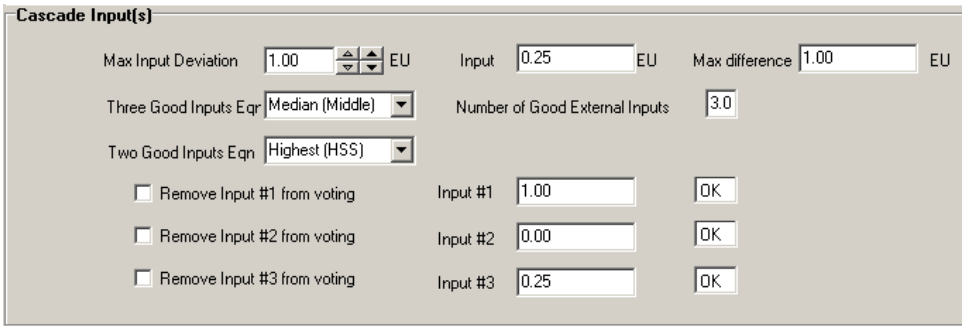
Fast Rate Delay **dflt = 3.0 (0.0, 100)**
This value will determine how long the Setpoint Slow Rate will have to be selected before the Setpoint Fast Rate will be engaged. It is defaulted for 3 seconds. This implies that if a Raise Cascade Setpoint command is continually given, the Cascade Setpoint will raise at the slow rate for 3 seconds and then raise at the fast rate after that.

Setpoint Fast Rate multiply **dflt = 3 x Casc Slow Rate (0.01, 50000)**
This value will determine the multiply factor for the normal rate, when the Fast Rate is initiated. This rate is defaulted to three times the Slow Rate.



LAG time (s): **dflt = 0 (0,60)**
This value determines the signal filtering to use on this signal . In the event that a the input signal is noisy.

Input Deadband (DB) **dflt = 0.0 (0.0, 1000)**
This value will determine the deadband in the Remote Cascade Setpoint input. The default value is set to zero. In the event that a the input signal is noisy or drifts, a small deadband value can be added to allow stability during normal operation, and still permit movement on the Cascade Setpoint when needed.



Max Input Deviation **dflt = 1% of Input Range (-325000, 325000)**
This value will determine the maximum difference between the three inputs before an alarm is given. If one input has a value that is less or greater than the voted-good value by the entered maximum deviation amount, that input will be alarmed.

Number of Good Inputs
Displays the number of Cascade Inputs that the 5009C control still views as having a valid input.

Two Good Inputs Equation **dflt = HSS**

If three good inputs are available, the 5009C control will select the Median Value (the one in the middle). If only one good input is available, the 5009C control will use it . In the instance where one input fails and the 5009C control has two inputs to chose from, the user must select from one of the following options:

Median	If the failed input fails low the lower value of the two If the failed input fails high the higher value of the two
Highest	Higher value of the two inputs.
Lowest	Lower value of the two input
Average	Average of the two (Input X + Input Y)/2

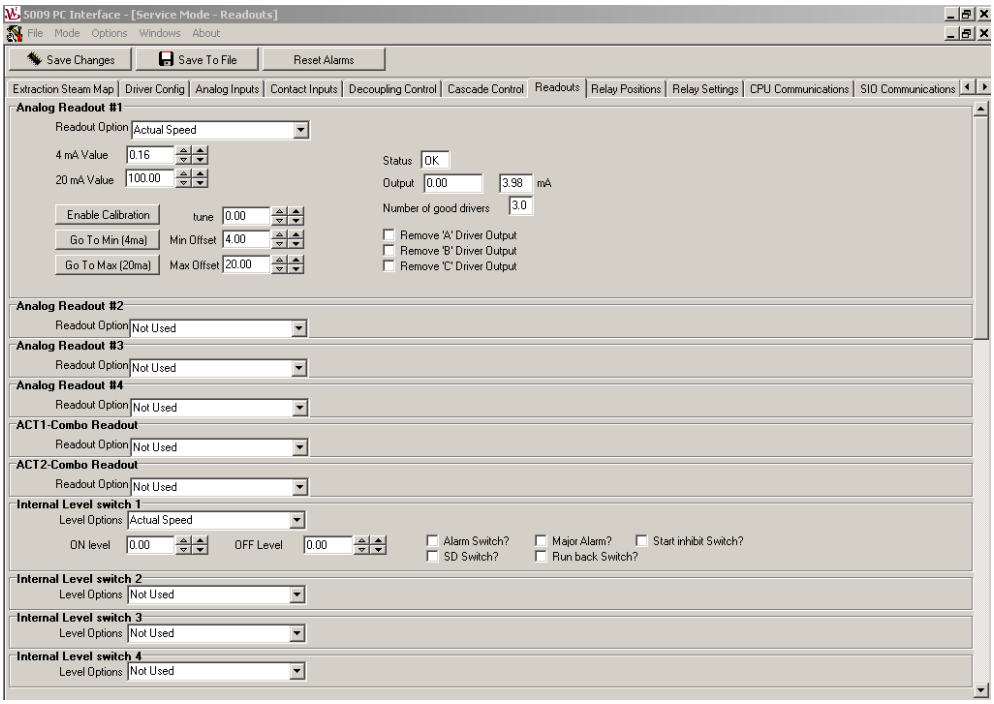
Remove Input 'X' from Voting **dflt = No**

By clicking or selecting the check box to the left of the text, Inputs 1,2, or 3 can be removed from the input voting logic. This option, allows on-line transducer calibration and maintenance, without the worry of affecting system control. If a sensor has failed or is acting inconsistent, it can be removed from the voting logic, replaced or repaired, have its calibration verified, then placed back into the input's voting logic. To place the input back into the voting logic, click the respective box again, then the "Reset Alarms" button on the screen's tool bar. Use extreme caution when performing this test on-line; removing all three output at once could cause a system trip condition.

IMPORTANT

Don't confuse the three separate inputs with the three separate CPUs. The CPUs read each input and vote them transparent to the application. By removing input #X you are removing Cascade Input #X. You are not eliminating one of the CPUs.

Analog Readout Folder



Analog Readouts **dflt = 4 (2.0, 12) or dflt = 20 (12, 24.9)**

Analog Readout functions can be set in the Program or Service Modes. The values associated with a function can also be adjusted. The arrow keys to the right of each parameter will adjust it either up or down. Each Analog Readout #1 through #4 is programmed and calibrated in the same way. The parameters shown are the same parameters that are listed and described in the Program Mode, Chapter 3. The status of the Output is displayed to the right of the folder along with the actual output as seen by the 5009C control in both units and in milliamps. The number of valid output “legs” as well as the value from all three CPUs A, B, &C is displayed below it.

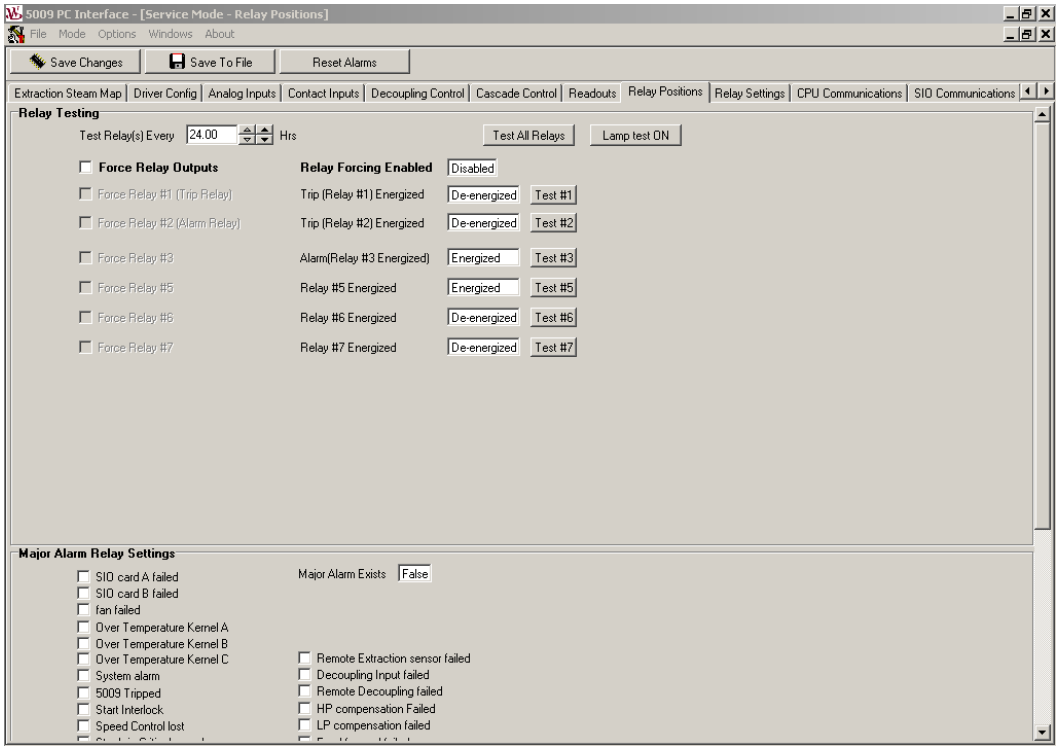
Calibration

The calibration of the Analog Readout is similar to the calibration of the Actuator drivers. The output is put in calibration mode by clicking on the Enable Calibration button. The status display box will show In Calib Mode as shown above and the Enable Calibration button will change to the Disable Calibration button The Go To buttons can then be used to force the driver to output the minimum value and the maximum value. Simply adjust the Min Offset with the arrows to the right of the Min Offset display box for the Minimum current output desired when the readout has been forced to Min, and adjust the Max Offset for the Maximum current desired when the readout has been forced to Max. The defaults are 4mA and 20 mA and they can be adjusted between 0mA and 24mA.

Internal switches

Internal switch can be set in Program mode or service mode (see Chapter 3 for more details).

Relay Position Folder

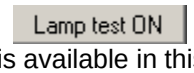


Relay Testing

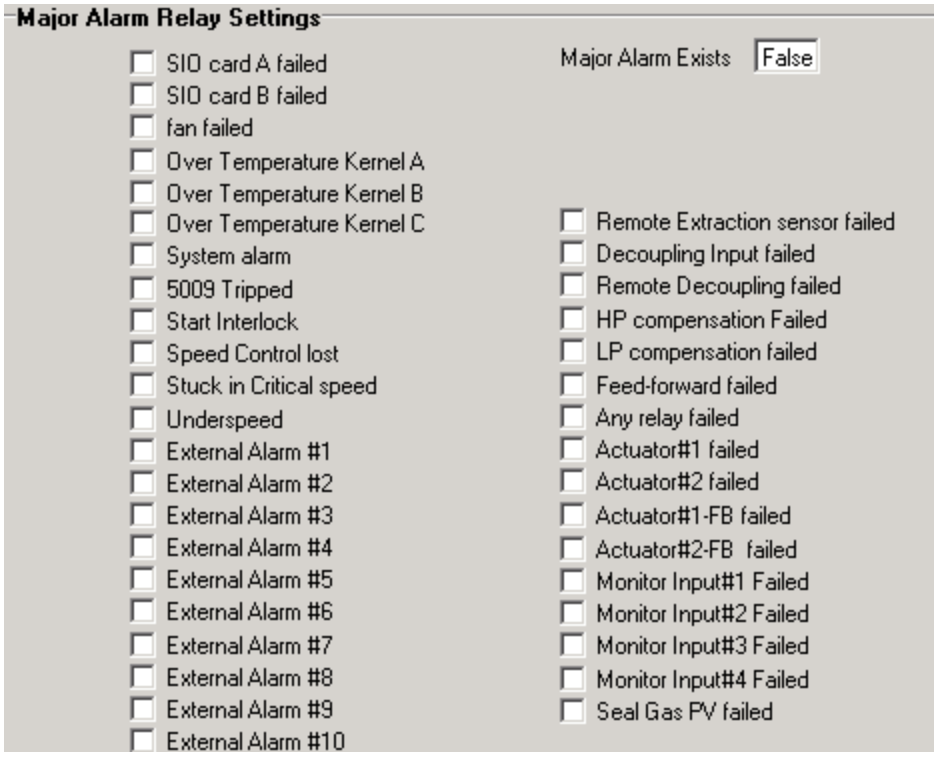
The Relay Position folder is not available in the Program Mode. This folder allows the user to test the FT Relay assemblies in the 5009C control. It also gives access to the tunable parameter of Test Relay(s) Every X Hours found in the Program Mode of Chapter 3. The status display box to the right of each programmed relay will display the Energized/De-energized status of the relay assembly.

There are two types of tests available for every relay assembly. The Force Relay # test can be preformed only when the 5009C control has been shutdown and the turbine speed is less than 1000RPM. With these permissives true, select the Force Relay Outputs function. The Relay Forcing Enabled display box will show Enabled. When the check box to the right of the Force Relay # text is selected, the Relay selected will be forced to an energized state.

The second test will perform a Latent Fault detection test on each relay in the 6 relay FT assembly. By selecting the Test # button, the user will cause the Relay to bypass the Test Relay(s) Every timer and perform the LFD test immediately on that particular relay. For a detailed description of the relay assemblies, see Volume 1. When performing a Relay Test the individual relay timer is reset and will wait the entered period before performing another test.



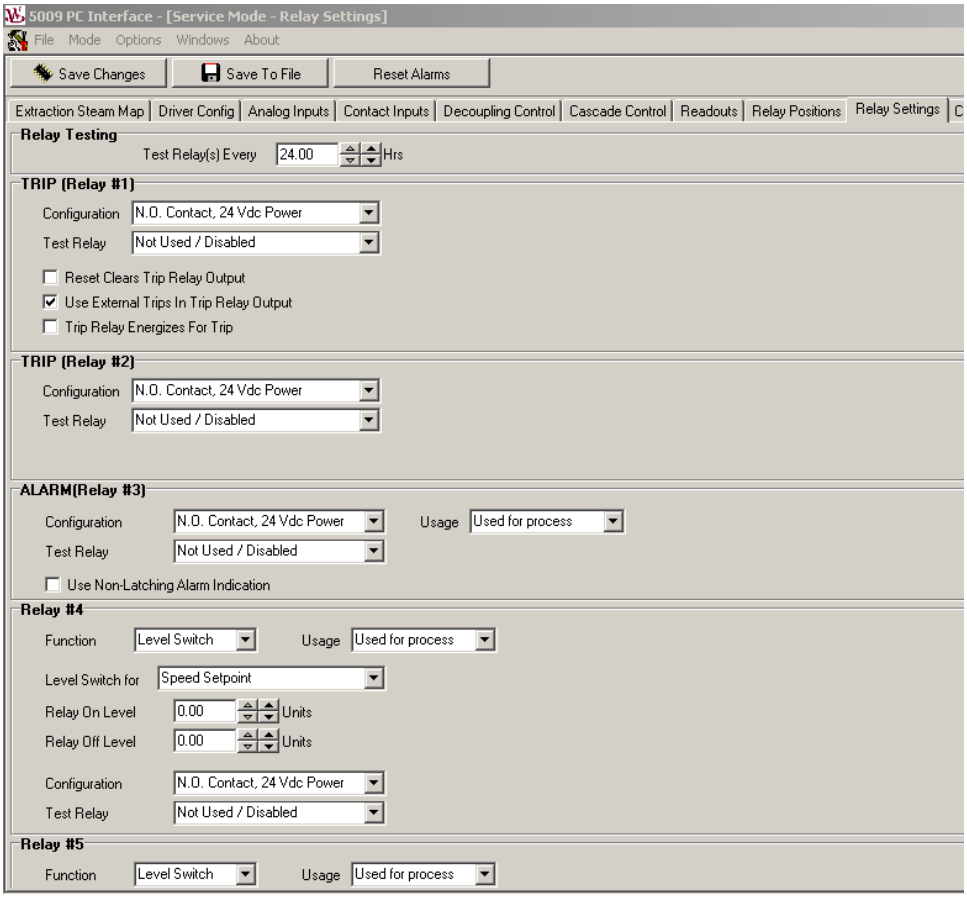
In addition, test lamp command is available in this folder. Any relay configured as a Lamp will energize when Lamp test is requested. Lamp test can be requested through PCI or Contact input only.



Major Alarm Relay Settings **All selection dflts = No**

The 5009C control has a Relay Output option called the Major Alarm Relay. This relay is described in Volume 1 and can be used to externally inform any device of the existence of a Major Alarm inside the control. This folder is used to select which alarm conditions will initiate the Major Alarm. By clicking or selecting the check box to the left of the text in the above folder, that option is added to the list of conditions that will energize the Major Alarm Relay. Whichever Relay Output is configured for the Major Alarm Relay will then be energized. If this relay is fed back into the 5009C control as a trip contact input, this function can be used to shutdown the 5009C control for any of the above conditions.

Relays Settings Folder

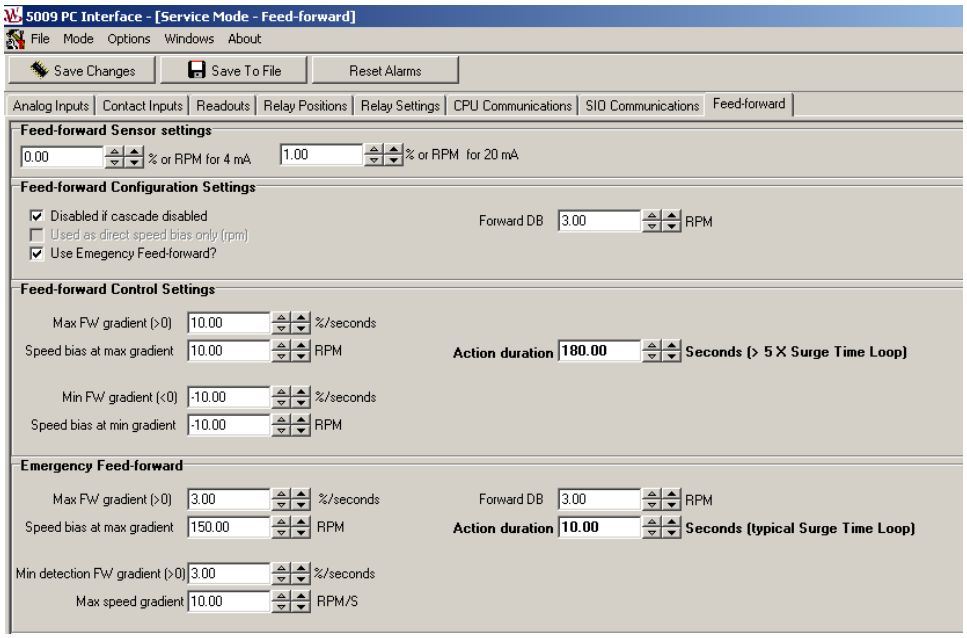


Relays

The relay configurations and functions are also set in the Program Mode and can be changed from the Service Mode. However, the values associated with their function can be adjusted. The arrow keys to the right of each parameter will adjust it either up or down. The parameters shown are the same parameters that are listed and described in the Program Mode, Chapter 3 and in Volume 1. The status of the Relay is displayed to the right of the folder for monitoring purposes.

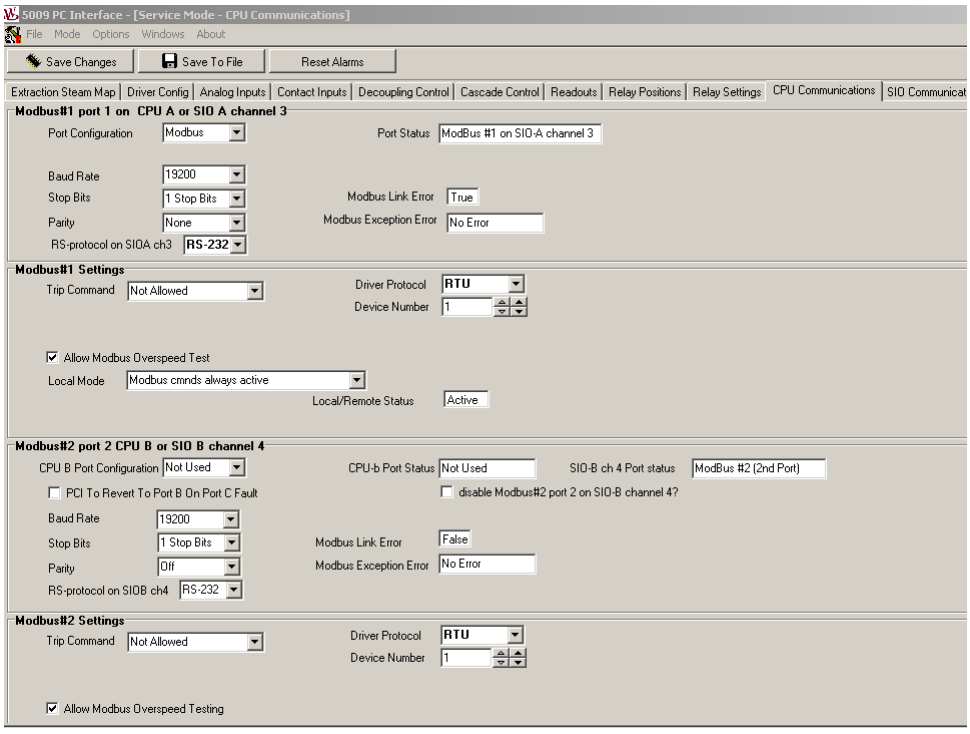
IMPORTANT **The jumpers on the relay boxes must be set to agree with the selections made above.**

FEED-FORWARD Folder



This folder is identical from the one used for program mode. While engine is running, settings can only be adjusted from this Folder.

CPU Communications Folder



Port CPU Settings

The port settings for each of the three CPU communication ports are set in the Program Mode and can be changed or adjusted from the Service Mode. The arrow keys to the right of each parameter will adjust it either up or down. The pull down boxes can be used to change the options for each function. The parameters shown are the same parameters that are listed and described in the Program Mode, Chapter 3 and in Volume 1. The status of the communication port and its function is displayed in the Port Configuration display box.

Port 1, 2 (CPU) Modbus Settings

Trip Command **dflt = Not Used**

The Trip Command is the option that determines how the Modbus Commands can trip the 5009C control. The user must select one of the three options:

Not Used	Cannot initiate a trip from a Modbus port.
One-Step	Will initiate a trip after receiving the Modbus port trip command.
Two-Step	Will initiate a trip after receiving the Modbus port confirm trip command.

Modbus Link Error

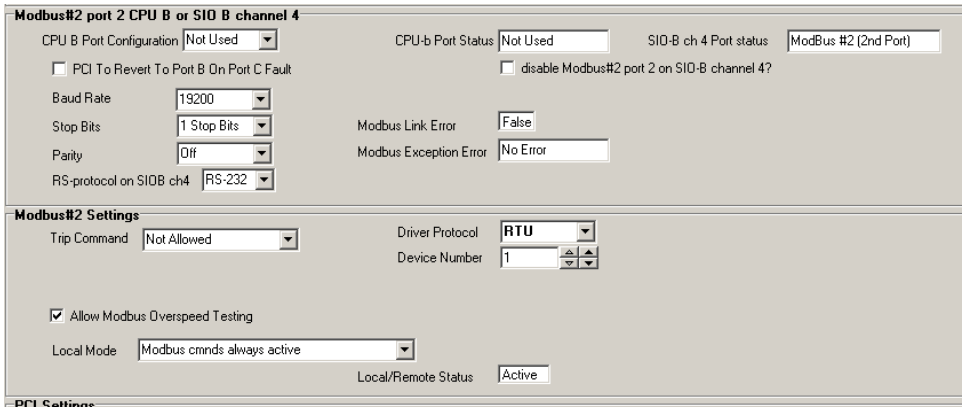
This gauge displays if the Modbus port has sensed a link error. Once the error has been corrected, the display box will show No Error. The alarm will remain until reset by the reset alarms command.

Modbus Exception Error

This gauge displays if the Modbus port has sensed an exception error. The Exception Error display box will display the type of error received. Once the error has been corrected, the display box will show No Error. The alarm will remain until reset by the reset alarms command.

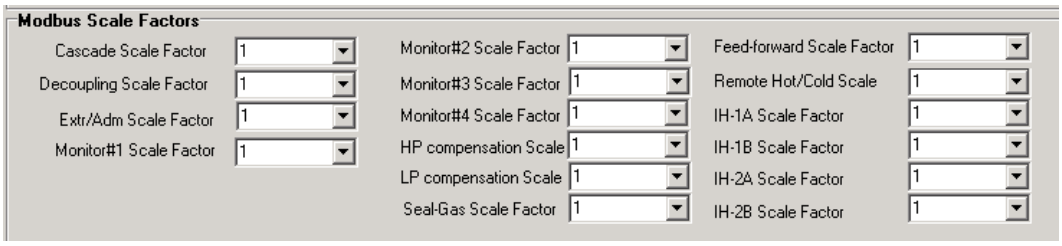
Allow Modbus Overspeed Test **dflt = Yes**

If selected, overspeed tests can be performed via the Modbus port. See Volume1 for a Modbus description and a description of the Overspeed Test procedures.



Modbus Scale Factors **dflt = 1 (0.1, 1.0,10, 100)**

The 5009C control uses scale factors for the Modbus ports. These scale factors are fully described in Volume 1 of this manual. The pulls down menus are operable only in the Service Mode.



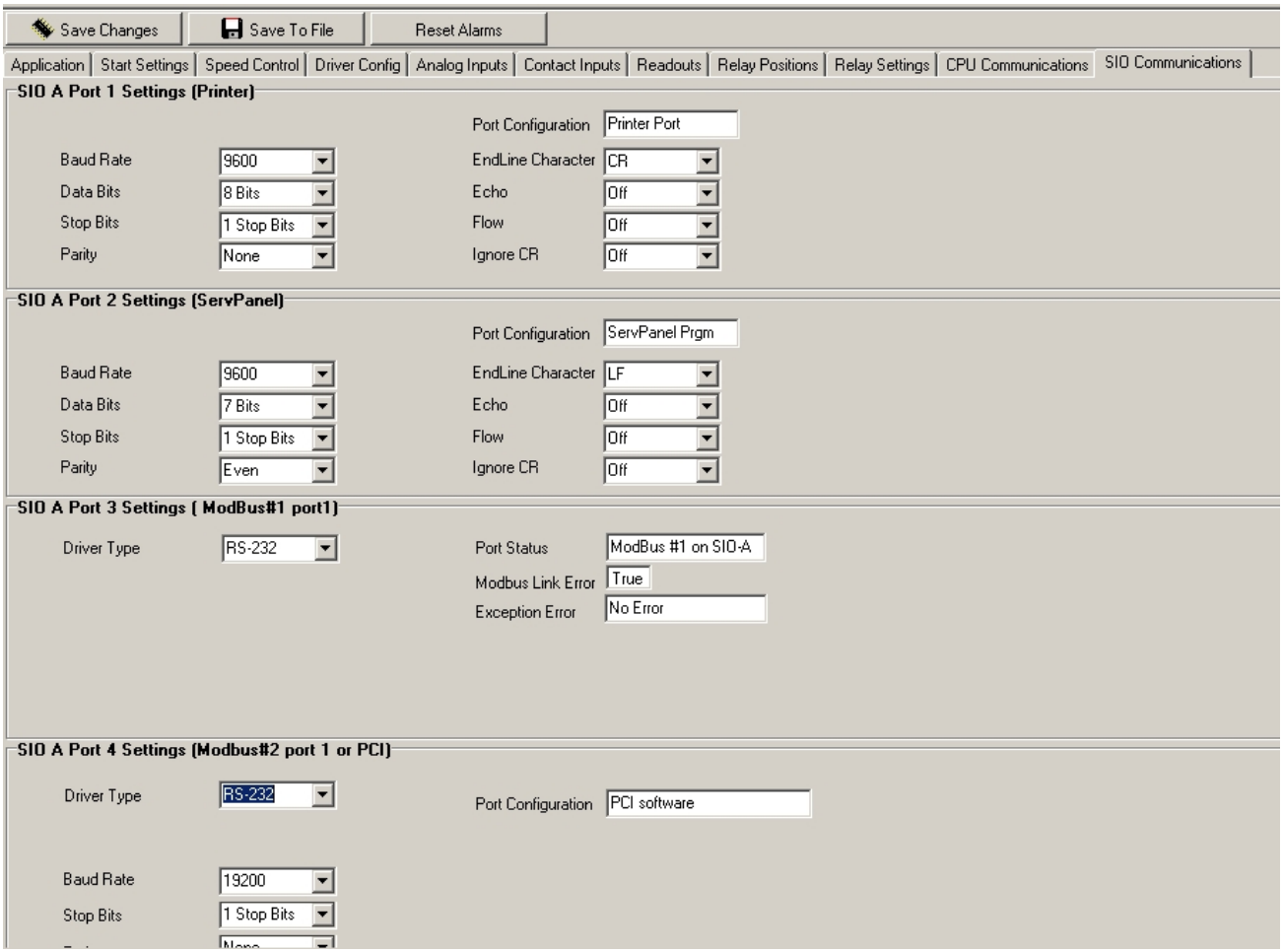
SIO Communications Folder

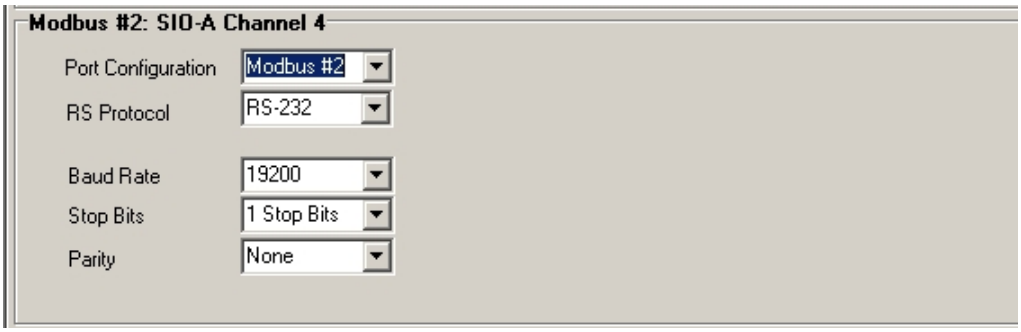
SIO Port Settings

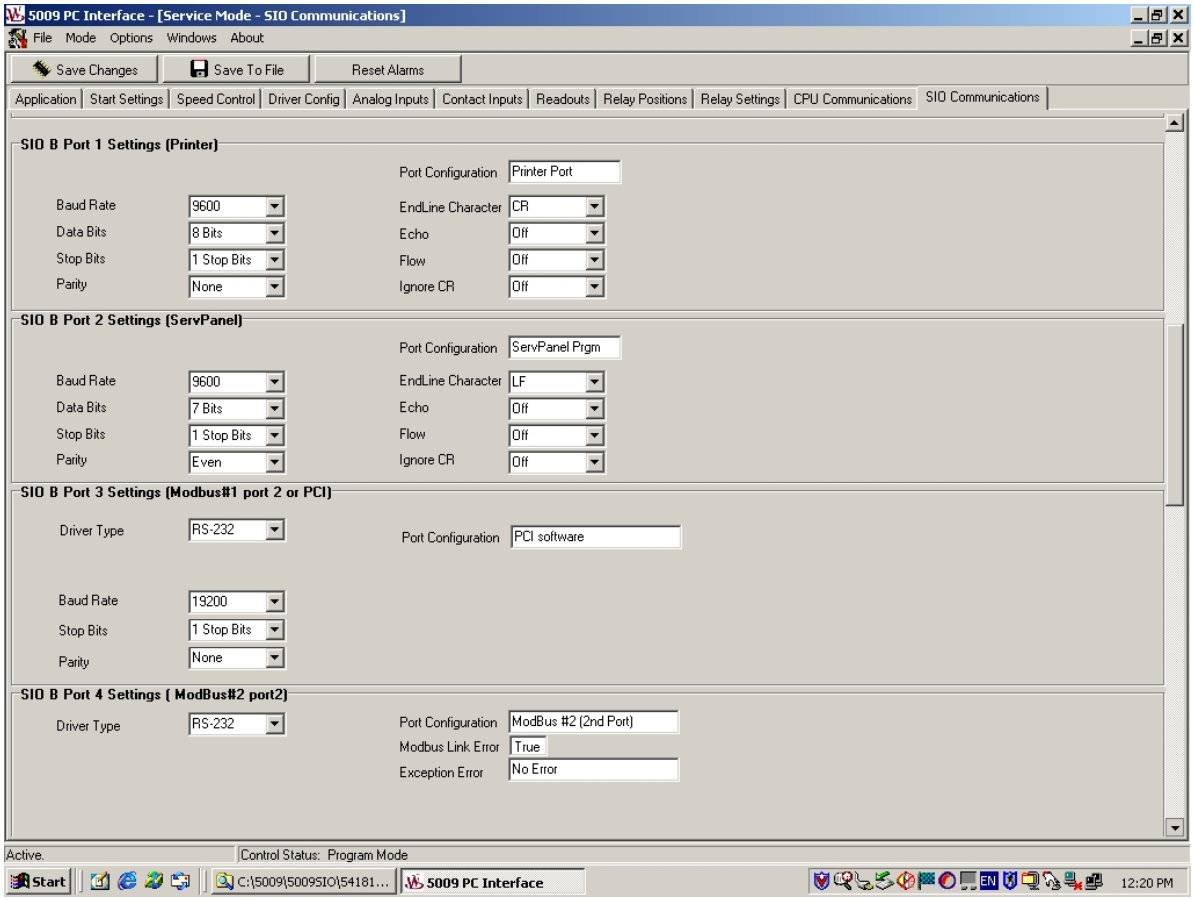
Optionally Serial Input/Output (SIO) modules may be provided in the A and or B kernel sections (Slot A5) to increase communication redundancy and or the number of available communication ports. All SIO module ports are dedicated to a specific communication function. Refer to the list below to determine port functionality. Refer to Volume 1 of this manual for communications redundancy logic.

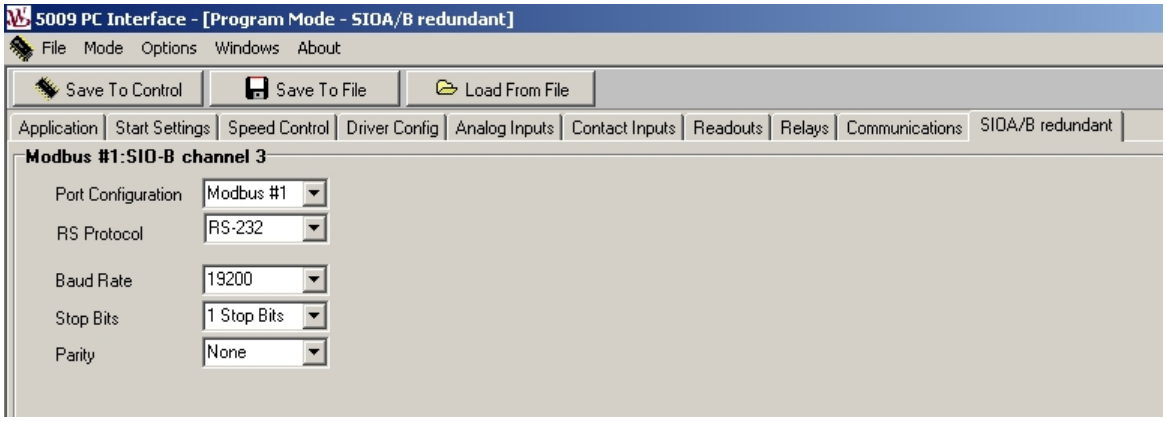
Port Configurations

- SIO Port 1 (RS-232) functions as an Alarm/Trip Printer driver port.
- SIO Port 2 (RS-232) functions as an interface port to Woodward's ServPanel program.
- SIO Port 3 (RS-232, RS-422, RS-485) functions as a redundant Modbus communications port.
- SIO Port 4 (RS-232, RS-422, RS-485) functions as a redundant DDE communications port (PCI).


Save Changes
Save To File
Reset Alarms
Application
Start Settings
Speed Control
Driver Config
Analog Inputs
Contact Inputs
Readouts
Relay Positions
Relay Settings
CPU Communications
SIO Communications
SIO A Port 1 Settings (Printer)
Port Configuration
Printer Port
Baud Rate
9600
EndLine Character
CR
Data Bits
8 Bits
Echo
Off
Stop Bits
1 Stop Bits
Flow
Off
Parity
None
Ignore CR
Off
SIO A Port 2 Settings (ServPanel)
Port Configuration
ServPanel Prgm
Baud Rate
9600
EndLine Character
LF
Data Bits
7 Bits
Echo
Off
Stop Bits
1 Stop Bits
Flow
Off
Parity
Even
Ignore CR
Off
SIO A Port 3 Settings (ModBus#1 port1)
Driver Type
RS-232
Port Status
ModBus #1 on SIO-A
Modbus Link Error
True
Exception Error
No Error
SIO A Port 4 Settings (Modbus#2 port 1 or PCI)
Driver Type
RS-232
Port Configuration
PCI software
Baud Rate
19200
Stop Bits
1 Stop Bits


Modbus #2: SIO-A Channel 4
Port Configuration
Modbus #2
RS Protocol
RS-232
Baud Rate
19200
Stop Bits
1 Stop Bits
Parity
None


5009 PC Interface - [Service Mode - SIO Communications]
File Mode Options Windows About
Save Changes
Save To File
Reset Alarms
Application
Start Settings
Speed Control
Driver Config
Analog Inputs
Contact Inputs
Readouts
Relay Positions
Relay Settings
CPU Communications
SIO Communications
SIO B Port 1 Settings (Printer)
Port Configuration
Printer Port
Baud Rate
9600
EndLine Character
CR
Data Bits
8 Bits
Echo
Off
Stop Bits
1 Stop Bits
Flow
Off
Parity
None
Ignore CR
Off
SIO B Port 2 Settings (ServPanel)
Port Configuration
ServPanel Prgm
Baud Rate
9600
EndLine Character
LF
Data Bits
7 Bits
Echo
Off
Stop Bits
1 Stop Bits
Flow
Off
Parity
Even
Ignore CR
Off
SIO B Port 3 Settings (Modbus#1 port 2 or PCI)
Driver Type
RS-232
Port Configuration
PCI software
Baud Rate
19200
Stop Bits
1 Stop Bits
Parity
None
SIO B Port 4 Settings (ModBus#2 port2)
Driver Type
RS-232
Port Configuration
ModBus #2 (2nd Port)
Modbus Link Error
True
Exception Error
No Error
Active.
Control Status: Program Mode
Start
C:\5009\5009SIO\54181...
5009 PC Interface
12:20 PM


5009 PC Interface - [Program Mode - SIOA/B redundant]
File Mode Options Windows About
Save To Control
Save To File
Load From File
Application
Start Settings
Speed Control
Driver Config
Analog Inputs
Contact Inputs
Readouts
Relays
Communications
SIOA/B redundant
Modbus #1:SIO-B channel 3
Port Configuration
Modbus #1
RS Protocol
RS-232
Baud Rate
19200
Stop Bits
1 Stop Bits
Parity
None

PCI Troubleshooting Guide

This guide is intended to help users troubleshoot typical PCI related problems, and give guidance in correcting them.

TAPI Error

If when attempting to initially open the ServLink program, a TAPI error is received, delete and re-install the computer's modem drivers, then try opening the ServLink program again. The ServLink program uses one of the computer's modem ".dll" library files which is loaded with the computer's modem drivers. A TAPI Error may be experienced, if when installing Windows on the respective computer, all modem drivers were not completely installed.

Access Violation Error

If an Access Violation Error is received during operation, select the message box's "OK" button to continue operation. If the error persists, close and re-open the PCI program. This error was detected and driven by Windows, and is the result of the PCI program trying to access a Window's routine at an incorrect time. This type of error is typically the result of the computer's resources being over utilized (to many programs open at once, for the amount of RAM available). To reduce or stop this type of error, close all other computer programs.

Chapter 6. Alarms/Trips

General

The 5009C Control System monitors all alarms and trips sends them to the Modbus. This chapter includes a list of all alarms and shutdowns and possible causes of the alarm/trip.

Trips (10 ms scan time)

Trip number	Description
1	External trip contact#1
2	External trip contact#2
3	External trip contact#3
4	External trip contact#4
5	External trip contact#5
6	External trip contact#6
7	External trip contact#7
8	External trip contact#8
9	External trip contact#9
10	External trip contact#10
11	Power up SD- Control lost power and CPU was reset or the Program mode was exited.
12	All HD-BIO fault
13	All HDAI fault
14	All actuator cards fault
15	All Speed Sensor Signal failure
16	Overspeed test limit trip
17	OVERSPEED TRIP
18	All extraction PV Fault
19	All cascade PV Fault
20	ACT1 combo Fault
21	ACT2 combo Fault
22	All ACT_06 ch1 fault
23	All ACT_06_ch2 fault
24	Start interlock
25	Speed control lost
26	Underspeed SD
27	Inlet valve No speed / rotor stuck
28	Normal SD completed
29	Modbus Shutdowns SD from Modbus#1
30	Modbus Shutdowns SD from Modbus#2
31	Modbus Shutdowns SD from PCI
32	Trip from Level switch 1
33	Trip from Level switch 2
34	Trip from Level switch 3
35	Trip from Level switch 4
36	Configuration error
37	HP pilot fault
38	LP pilot fault
39	SD01 from remote IO
40	SD02 from remote IO
41	SD03 from remote IO
42	SD04 from remote IO
43	SD05 from remote IO
44	SD06 from remote IO
45	SD07 from remote IO
46	SD08 from remote IO

47 SD09 from remote IO
48 SD10 from remote IO
49 Redundancy1 all fault
50 Redundancy2 all fault

Chassis/Operating System Alarms

Alarm—Kernel x Anlg I/O Module Flt
Explanation—Failure of the Analog I/O module in Kernel x (A, B, C). Verify that the module is inserted and the Fault light is off.

Alarm—Kernel x Discrete I/O Mod Flt
Explanation—Failure of the Discrete I/O module in Kernel x (A, B, C). Verify that the module is inserted and the Fault light is off.

Alarm—Kernel x Fault
Explanation—Kernel x CPU fault. Verify that the CPU is inserted and reset.

Alarm—Kernel x Overtemperature Alarm
Explanation—Kernel overtemperature detected x (A, B, C).

Alarm—Power Supply #x Fault
Explanation—Power supply #x (1,2) fault detected. Check input and output voltages of the supply.

Alarm—Operating System Fault
Explanation—Operating system alarm detected.

Application Alarms

Alarm—Kernel x Comm Link Failed
Explanation—Kernel x (A, B, C) communications link was detected as failed.

Alarm—Turbine Trip
Explanation—Turbine has tripped.
.
Alarm—Overspeed
Explanation—Turbine speed is above trip level.

Alarm—Stuck in Critical Band
Explanation—Turbine speed was stuck or forced into a critical band too long.

Alarm—External Alarm #x
Explanation—External Alarm #x (1-10) contact input was opened.

Alarm—Configuration Error
Explanation—Invalid configuration.

Speed Probe Alarms

Alarm—Spd Probe #x Input Fld
Explanation—All Speed probe #x (1-4) inputs failed.

Alarm—Spd Probe #1 Deviation Alm
Explanation—Speed probe input is out of tolerance with other speed probes.

Alarm—Spd Probe #1 Ospd Alm
Explanation—Speed probe input is above overspeed alarm setting.

Alarm—Spd Probe #x Kernel y Fault
Explanation—Input failure or input is out of tolerance from speed probe x (1,4) in kernel y (A,B,C).

Alarm- Null speed function not armed
Explanation—Input#4 failure or input is out of tolerance from speed probe 1,2, 0r/and 3. Null speed won't be detected until function re-armed.

Analog Input Alarm

Alarm—Anlg Input #x Kernel y Fault
Explanation—Input failure or input is out of tolerance from analog input #x (1-8) in kernel y (A,B,C).

Alarm—Discrete In #x Kernel y Fault
Explanation—Input mismatch from other kernels from input #x (1-24) in kernel y (A,B,C).

Cascade Alarms

Alarm—All Cascade Inputs Failed
Explanation—All Cascade analog inputs failed.

Alarm—Casc Input #x Failed
Explanation—Cascade input #x (1,2,3) failure detected.

Alarm—Casc Input #x Deviation Alm
Explanation—Cascade input #x (1,2,3) is out of tolerance, but not failed.

Alarm—Rmt Casc Setpt Input Failed
Explanation—Remote Cascade Setpoint analog input failed.

Extraction Alarms

Alarm—All Extraction Inputs Failed
Explanation—All Extraction analog inputs failed.

Alarm—Extraction Input #x Failed
Explanation—Extraction input #x (1,2,3) failure detected.

Alarm—Extraction Input #x Deviation Alm
Explanation—Extraction input #x (1,2,3) is out of tolerance, but not failed.

Alarm—Rmt Extr Setpt Input Failed
Explanation—Remote Extraction Setpoint analog input failed.

Decoupling Alarms

Alarm—All DCPL Inputs Failed
Explanation—All DCPL analog inputs failed.

Alarm—DCPL Input #x Failed
Explanation—DCPL input #x (1,2,3) failure detected.

Alarm—DCPL Input #x Deviation Alm
Explanation—DCPL input #x (1,2,3) is out of tolerance, but not failed.

Alarm—Rmt DCPL Setpt Input Failed
Explanation—Remote Decoupling Setpoint analog input failed.

Speed Setpoint Alarms

Alarm—Rmt Spd Setpt Input Failed
Explanation—Remote Speed Setpoint input failure detected.

Feed forward Alarms

Alarm—All feed forward Inputs Failed
Explanation—All Load Share Setpoint analog inputs failed.
Time Stamp—5 ms resolution.

Alarm—feed-Forward Input #x Deviation Alm
Explanation—Load Share Setpoint input #x (1,2,3) is out of tolerance, but not failed.

Monitor Input#(1-4) Alarms

Alarm—Monitor Input#x Failed
Explanation—Monitor input failure detected.

Driver Alarms

Alarm—Act #1 combo Failed
Explanation—All Actuator #1 (open circuit detected).

Alarm—Act #1 combo Load Fault
Explanation—HP (Actuator #1) Load/Coil Fault detected (single coil/load).

Alarm—Act #1 combo Load 'A/B' Fault
Explanation—HP (Act #1) Load/Coil from Kernel A/B Fault detected (dual coil/load).

Alarm—Act #1 combo Load 'C' Fault
Explanation—HP (Act #1) Load/Coil from Kernel C Fault detected (dual coil/load).

Alarm—Act #2 combo Failed
Explanation—All LP (Actuator #2) (open circuit detected).

Alarm—Act #2 Driver x Fault
Explanation—LP (Actuator #2) Kernel x (A,B,C) fault detected.

Alarm—Act #2 combo Load Fault
Explanation—LP (Actuator #2) Load/Coil Fault detected (single coil/load).

Alarm—Act #2 (LP) Load 'A/B' Fault
Explanation—LP (Act #2) Load/Coil from Kernel A/B Fault detected (dual coil/load).

Alarm—Act #2 (LP) Load 'C' Fault
Explanation—LP (Act #2) Load/Coil from Kernel C Fault detected (dual coil/load).

Alarm-All act 06 channel 1 Fault
Explanation—Channel 1 output of A106 and C106 are fault. Line might be opened.

Alarm-Calibration A106 channel 1 not completed.
Explanation—Channel 1 output of A106 calibration is not completed. Calibration is requested.

Alarm— ACT_A106 ch1 fault
Explanation—Channel 1 output of A106 is fault. Line might be opened

Alarm—Position MAX DIFF A106-Ch1.
Explanation—Channel 1 LVDT feedback of A106 is fault is too different from the one on C106. check LVDT/wiring

Alarm—LVDT1 A106 ch1 fault
Explanation—LVDT of A106 is fault.

Alarm-Calibration C106 channel 1 not completed.
Explanation—Channel 1 output of C106 calibration is not completed. Calibration is requested.

Alarm— ACT_C106 ch1 fault
Explanation—Channel 1 output of C106 is fault. Line might be opened

Alarm—Position deviation-Ch1.
Explanation—Channel 1 LVDT feedback different is too big. Check LVDT/wiring or linearize the LVDT.

Alarm—LVDT1 C106 ch1 fault
Explanation—LVDT of C106 is fault

Alarm-All act 06 channel 2 fault
Explanation—Channel 2 output of A106 and C106 are fault. Line might be opened.

Alarm-Calibration A106 channel 2 not completed.
Explanation—Channel 2 output of A106 calibration is not completed. Calibration is requested.

Alarm— ACT_A106 ch2 fault
Explanation—Channel 2 output of A106 is fault. Line might be opened

Alarm—Position MAX DIFF-Ch2.
Explanation—Channel 2 LVDT feedback different is too big. Check LVDT/wiring or linearize valve.

Alarm—LVDT1 A106 ch2 fault
Explanation—LVDT of A106 is fault.

Alarm-Calibration C106 channel 2 not completed.
Explanation—Channel 2 output of C106 calibration is not completed. Calibration is requested.

Alarm— ACT_C106 ch2 fault
Explanation—Channel 2 output of C106 is fault. Line might be opened

Alarm—Position MAX DIFF C106-Ch2.
Explanation—Channel 2 LVDT feedback of C106 is fault is too different from the one on A106. check LVDT/wiring

Alarm—LVDT1 C106 ch2 fault
Explanation—LVDT of C106 channel 2 is fault

Pilot Alarms

Alarm—HP pilot feedback Signal failure A106
Explanation—LVDT Pilot signal used for HP A106 fault

Alarm—HP pilot feedback Signal failure C106
Explanation—LVDT Pilot signal used for HP C106 fault

Alarm—HP pilot feedback HP pilot DF fault
Explanation—LVDT Pilot signal used for HP A106 difference

Alarm—LP pilot feedback Signal failure A106
Explanation—LVDT Pilot used for LP signal on A106 fault

Alarm—LP pilot feedback Signal failure C106
Explanation—LVDT Pilot used for LP signal on C106 fault

Alarm—LP pilot feedback LP pilot DF fault
Explanation—LVDT Pilot used for LP signal difference

Alarm—HP degraded mode activated
Explanation—All LVDT Pilot used for HP signal fault- degraded mode is activated

Alarm—LP degraded mode activated
Explanation—All LVDT Pilot used for LP signal fault- degraded mode is activated

Alarm—HP demand -LVDT too big
Explanation—HP Demand-LVDT feedback too big. Calibration required

Alarm—LP Demand -LVDT too big
Explanation—LP Demand-LVDT feedback too big. Calibration required

Alarm—HP pilot degraded fault
Explanation— Degraded mode cannot drive correctly the HP valve. Tuning is required

Alarm—LP pilot degraded fault
Explanation— Degraded mode cannot drive correctly the HP valve. Tuning is required

Relay Alarms

IMPORTANT **Relays 1-3 are in DTM #1, 4-6 in DTM #2, 7-9 in DTM #3, and 10-12 in DTM #4.**

Alarm—Relay #x y1 Driver Fault
Explanation—Fault in the y (A,B,C)1 driver of Relay #x (1-12).

Alarm—Relay #x y2 Driver Fault
Explanation—- Fault in the y (A,B,C)2 driver of Relay #x (1-12).

Alarm—Relay #x y1 Fault
Explanation—Fault in the y (A,B,C)1 relay of Relay #x (1-12).

Alarm—Relay #x y2 Fault
Explanation—Fault in the y2 relay of Relay #x (1-12).

Alarm—Relay #x A1 or B1 Fault
Explanation—Fault in either A1 or B1 relays of Relay #x (1-12).

Alarm—Relay #x C2 or A2 Fault
Explanation—Fault in either C2 or A2 relays of Relay #x (1-12).

Alarm—Relay #x B2 or C1 Fault
Explanation—Fault in either B2 or C1 relays of Relay #x (1-12).

Analog Output Alarms

Alarm—Analog Out #x Failed
Explanation—All Analog Output #x (1-4) drivers or load has failed.

Alarm—Anlg Out #x Driver y Fault
Explanation—Analog Output #x (1-4) Kernel y (A,B,C) fault detected

Alarm—Anlg Out #x Load Fault
Explanation—Analog Output #x (1-4) Load Fault detected.

Major Alarm Indication

A Major Alarm indication is available to the Modbus communication devices and as a programmable relay option. This major alarm feature is programmable and has both dedicated (fixed) alarms and optional inputs as follows:

Dedicated/Fixed Major Alarms

Kernel x Analog I/O Module Flt	Failure of the Analog I/O module in Kernel x (A,B,C).
Kernel x Discrete I/O Module Flt	Failure of the Discrete I/O module in Kernel x (A,B,C).
Kernel x Fault	Kernel x (A,B,C) CPU Failure.
Power Supply #x Fault	Power Supply #x (1,2) Fault Detected.

Optional/Programmable Major Alarms

5009C Overtemperature	Control's Fan Failure Detected.
Operating System Alarm	Operating System Alarm Detected.
Kernel x Comm Link Failed	Kernel x communications link was detected as failed.
Turbine Trip	Turbine tripped alarm indication.
Stuck In Critical Band	Turbine speed was stuck or forced into the critical band too long.
Speed control lost	Difference speed-speed setpoint too big
Underspeed	Underspeed detected
External Alarm x	External Alarm #x (1-10) contact input was opened.
All Cascade Inputs Failed	All Cascade analog inputs failed.
All Extraction Inputs Failed	All Extraction analog inputs failed.
All DCPL Inputs Failed	All DCPL analog inputs failed.
All KW Inputs Failed	All KW analog inputs failed.
FSP Input Failed	FSP analog input failed.
All Rmt Spd Setpt Inputs Failed	All Rmt Spd Setpt analog inputs failed.
All Rmt Casc Setpt Inputs Failed	All Rmt Casc Setpt analog inputs failed.
All Rmt DCPL Setpt Inputs Failed	All Rmt DCPL Setpt analog inputs failed.
All Rmt Extraction Setpt Inputs Fld	All Rmt Extraction Setpt analog inputs failed.
HP compensation failed	All sensor failed for HP compensation
LP compensation failed	All sensor failed for LP compensation
HP Pilot failed	LVDT pilot signal used for HP fault
LP Pilot failed	LVDT pilot signal used for LP fault
Monitor Analog Input#1-4 Failed	Monitor Analog input#1-4 failed.
LSW#1-4 alarm	Level switch configured for Major alarm activated
Act #1 combo Fault	All Actuator #1 drivers are failed.
Act #2 combo Fault	All Actuator #2 drivers are failed.
Act FB-ch1 Fault	All Actuator card channel1 drivers are failed.
Act FB-ch2 Fault	All Actuator card channel2 drivers are failed
Seal gas PV failed	Process value used for seal gas has failed.

Chapter 7.
Modbus

Modbus® Communications

This control can communicate with plant distributed control systems and/or CRT based operator control panels through up to four Modbus communication ports. These ports support ASCII or RTU MODBUS transmission protocols. The CPU based ports only support RS-232 communications. However, the system's SIO modules (optional) utilize Modbus based ports that can communicate via RS-232, RS-422, or RS-485 communications. Modbus utilizes a master/slave protocol. This protocol determines how a communication network's master and slave devices establish and break contact, how a sender is identified, how messages are exchanged, and how errors are detected. The 5009C control is always the slave device, the DCS or operator interface will act as the master and initiate communication transactions.

Monitor Only

The Modbus communication ports, are defaulted from the factory, to communicate with any device that communicates through Modbus and has the same port settings. Alternatively, each port can be configured to only output data and ignore any input commands. This allows the control to be monitored but not controlled from an external device. By simply connecting a monitoring device, configured to communicate through Modbus, this device can be used to monitor all control parameters, modes, etc. without effecting control of the turbine. To use a Modbus port for monitoring only (Boolean and analog write commands are ignored), program the 'Use Modbus Port' setting to 'Not Used'.

Monitor and Control

Once a Modbus port is configured for Modbus communications, the control will accept Run mode commands from an external network master device (DCS, HMI, etc.). This allows a Modbus compatible device to monitor and perform all 5009C Control Run mode parameters and commands. Modbus ports are independent of each other, and can be used simultaneously. The last command given between the ports has priority. To use a 5009C Modbus port to monitor and operate the 5009C Control, program the desired port(s) 'Use Modbus Port' setting to 'Modbus'.

Modbus Communication

The 5009C Control supports two Modbus transmission modes (ASCII & RTU). A mode defines the individual units of information within a message and the numbering system used to transmit the data. Only one mode per Modbus network is allowed. The supported modes are ASCII (American Standard Code for Information Interchange), and RTU (Remote Terminal Unit). These modes are defined in the following table.

CHARACTERISTIC	ASCII	RTU
Coding System	hexadecimal (uses	8-bit binary
	ASCII printable binary	
	characters: 0-9, A-F)	
Start Bits	1	1
Data Bits per Char	7	8
Parity	even, odd,	even, odd,
	or none	or none
Stop Bits	1, 1.5, or 2	1, 1.5, or 2
Baud Rate	110, 300, 600, 1200,	110,300, 600, 1200,
	1800,2400, 4800, 9600,	1800, 2400, 4800, 9600,
	19200, 38400, or 57600	19200, or 38400
Error Checking	LRC (Longitudinal	CRC (Cyclical
	Redundancy Check)	Redundancy Check)

Table 7-1. ASCII vs. RTU Modbus

In the RTU mode, data is sent in 8-bit binary characters and transmitted in a continuous stream. In the ASCII mode, each binary character is divided into two 4-bit parts (high order and low order), changed to be represented by a hexadecimal equivalent, then transmitted, with breaks of up to 1 second possible. Because of these differences, data transmission with the ASCII mode is typically slower (see Figure 7-1 below).

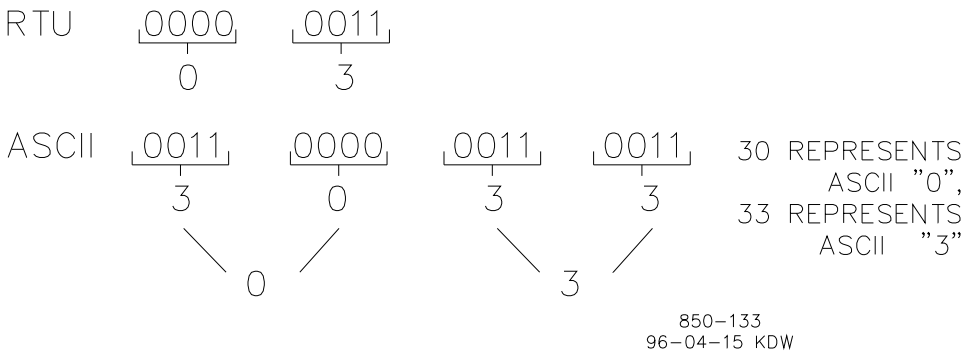


Figure 7-1. ASCII/RTU Representation of 3

The Modbus protocol allows one master and up to 247 slaves on a common network. Each slave is assigned a fixed, unique device address in the range of 1 to 247. With the Modbus protocol, only the network master can initiate a transaction. A transaction consists of a request from the master to a slave unit and the slave's response. The protocol and Modbus device number are set in the Program Mode and can be adjusted in the Service Mode, if required.

The control's CPU module communication ports are configured for RS-232 communications only. RS-232 communications is limited to a distance of 15.24 meters (50 feet). Volume 2 shows the required RS-232 communication connections. The transmit data (TXD), receive data (RXD), and signal ground (SIG GND) must be properly connected as shown. In addition, the shield (SHLD) should be connected in at least one location.

In cases where a device which is being interfaced to is located a distance of greater than 15.24 meters (50 feet) from the control, it is recommended that an RS-232-to-RS-422 converter, RS-232-to-RS-485 converter, or a Woodward SIO Module be used. Each SIO module has four ports, with one port dedicated for Modbus communications and configurable for RS-232, RS-422, or RS-485 communications. With the use of RS-422 or RS-485 communications, the control can interface with a device through serial communications up to 1219.2 meters (4000 feet) from the control. Alternatively, one or two SIO modules may be installed within the control's chassis.

A Model 285 Superverter from Telebyte Technology Inc. of Greenlawn N.Y., or equivalent can be used as an interface converter. RS-422 and RS-485 communications also support multidropping (multiple slaves on a single communications line); RS-232 communications does not.

This control functions as a slave unit only. As a slave unit, the control will only respond to a transaction request by a master device. The control can directly communicate with a DCS or other Modbus supporting device on a single communications link. If multi-dropping is used (via RS-422 or RS-485 communications), up to 246 devices (5009C units or other customer devices) can be connected to one Master device on a single network. The device number for each port can be set in the Program or Service modes.

Each message to or from a master has a defined structure called the message "frame". A frame consists of the slave device address, a code defining the requested data, and error checking information. See Figure 7-2.

	BEGINNING OF FRAME	SLAVE ADDRESS	FUNCTION CODE	DATA	ERROR CHECK CODE	END OF FRAME
ASCII	:	2 CHARS 8 BITS	2 CHARS 8 BITS	4 BITS DATA PER CHAR	2 CHAR 8 BITS	CR LF
RTU	3–CHAR DEAD TIME	1 CHAR 8 BITS	1 CHAR 8 BITS	8 BITS DATA PER CHAR	2 CHAR 16 BITS	3 CHAR DEAD TIME

855–382
93–09–27 DAR

Figure 7-2. Modbus Frame Definition

The Modbus function code tells the addressed slaves what function to perform. The following table lists the function codes supported by this control.

Modbus Function Codes

CODE	DEFINITION	REFERENCE ADDRESS
01	Read Digital Outputs (Raise/Lower and Enable/Disable Commands)	0XXXX
02	Read Digital Inputs (Status Indications / Alarms and Trips)	1XXXX
03	Read Analog Outputs	4XXXX
04	Read Analog Inputs (Speed, Setpt, etc.)	3XXXX
5	Write Single Discrete Output (Raise/Lower and Enable/Disable Commands)	0XXXX
6	Write Single Register (Enter Setpt Directly)	4XXXX
8	Loopback Diagnostic Test (supports subfunction 0 only)	N/A
5	Write Digital Outputs	0XXXX
16	Write Analog Outputs	4XXXX

Table 7-2. Modbus Function Codes

When a Modbus message is received, it is checked for any errors or invalid data. If there is invalid data in the message, an error code is sent back to the master and the control issues an alarm message. The error codes are defined in the following table. The exception error status and respective error codes can be viewed in the Service Mode under PORT # SETTINGS, where # is the number of the port (1 or 2).

If the control has not received a message for the configured time-out period, the control will alarm with an error message, but no message is sent to the master. This time-out is defaulted to 2 seconds and only applies to units using both monitor and control (adjustable in the Service Mode).

Modbus Slave Exception Error Codes

CODE	ERROR MESSAGE	TO MASTER	DESCRIPTION
0	No Error	0	No Error
1	Bad Modbus function	1	The specified function is not supported for this control
2	Bad Modbus data address	2	The Modbus value addressee is not valid for this control
3	Bad Modbus data value	3	Too many values requested or the on/off indicator in function code 5 is invalid.
9	Bad Modbus checksum	None	Message checksum did not match.
10	Bad Modbus message	None	Message could not be decoded.
n/a	Lost Modbus link	None	No messages received for the configured time- out period.

Table 7-3. Modbus Error Codes

Port Adjustments

Before the 5009C Control will communicate with the master device, the communication parameters must be verified. These values are set in the Program Mode and can be adjusted, if required, from the Service Mode.

Modbus Communication Port Adjustments

PARAMETER	ADJUSTMENT RANGE
Baud Rate	110 TO 38400
Parity	NONE, ODD, or EVEN
Stop Bits	1 TO 2

Control Modbus Addresses

The Modbus communication ports in the 5009C Control are programmed for unique Modbus addresses. A complete listing of these addresses for your application is located at the end of this section. The Modbus address listing consists of Boolean Writes, Boolean Reads, Analog Reads, and Analog Writes. The Boolean reads and writes are also referred to as input and holding coils. The analog reads and writes are referred to as input registers and holding registers.

All values that can be addressed by Modbus are considered to be discrete and numeric. The discretes are a 1 bit binary, on or off value and the numerics are 16 bit values. Discretes are sometimes referred to as coils or digitals and numerics are referred to as registers or analogs. All read/write registers are interpreted by the 5009C Control as signed 16 bit integer values. Since Modbus can only handle integers, values that require a decimal point in the Modbus Master Device are multiplied by a scaling constant before being sent by the 5009C Control. See Tables 7-7 &7-8 (Analog Reads and Analog Writes) under the MULTIPLIER column for defaulted communication constants and ranges.

The maximum number of discretes and registers that can be transmitted in one packet is dependent on each implementation of Modbus. The following table defines these limits.

MODE OF TRANSMISSION	MAX DISCRETES	MAX REGISTERS
ASCII	944	59
RTU	1188	118

Table 7-4. Maximum Modbus Discrete and Analog Values

Boolean Writes (Holding Coils)

Holding coils are logical signals that are both readable from and writable to the 5009C Control. An example of a Boolean write value would be raise or lower commands. A logical true denoted by the value 1 will cause the command listed in the description to be executed. For example, if a 1 is written to address 0:0010 and this corresponded to a speed raise command, the speed setpoint will increase until a 0 is written to address 0:0010. The 5009C Control supports function codes 1, 5, and 15. These correspond to reading selected holding coils, writing to a single holding coil, and writing to multiple holding coils, respectively. The holding coils available are listed in Table 8-5, under Boolean Writes.

Boolean Reads (Input Coils)

Input coils are logical signals that are readable from, but not writable to, the 5009C Control. An example of an Boolean read value would be a turbine trip status indication. The input coil will have the value 1 if the statement in the description column is true and a 0 if false. The '1:' term in the address identifies an input coil. The 5009C Control supports Modbus function code 2, which involves reading selected input coils. The input coils available are listed in Table 8-6, under Boolean Reads.

Analog Reads (Input Registers)

Input registers are analog values that are readable from, but not writable to, the 5009C Control. An example of an analog read value would be turbine speed. The values of the input registers are stored internal to the control as floating point numbers representing engineering units (i.e. KPA or RPM). The values that are transmitted are integer values ranging from -32767 to +32767. Since Modbus can only handle integers, values that require a decimal point must be multiplied by a scaling constant in the 5009C Control before being sent across the Modbus link. For example, these input registers may be listed as the Modbus value 'x100' or 'cascade scale factor' under the description heading to denote the value is multiplied by a scaling constant (refer to Modbus Scale Factors later in this section). This will allow transmission of decimal parts of a unit if this is necessary for better resolution.

See the 5009C Control Service Mode for defaulted communication constants and ranges. The control supports Modbus function code 4, which involves reading selected input registers. The input registers available are listed in Table 7-7, under Analog Reads.

Analog Writes (Holding Registers)

Holding registers are analog values that are writable to the 5009C Control. These values can also be read from a device performing error checking. An example of an analog write value would be a direct speed setpoint value as opposed to raise and lower setpoint commands. The value of the holding registers are also stored in the control as numbers representing engineering units (i.e. PSI (kPa) or RPM). Once again, if decimal points are required, a scaling factor must be used (refer to Modbus Scale Factors later in this section). The 5009C Control supports Modbus function codes 3, 6, and 16. These correspond to reading selected holding registers, writing to a single holding register, and writing to multiple holding registers, respectively. The holding registers available are listed in Table 7-8, under Analog Writes. The following tables give the address and description of all Boolean and analog, reads and writes.

Boolean Write Address Overview:

Addr	Point Description	Interface Description
0:0001	Speed logic	Modbus Shutdowns
0:0002	Speed logic	Modbus Shutdowns acknowledge
0:0003	Speed logic	Normal SD
0:0004	Speed logic	Quit normal SD
0:0005	Speed logic	Start permissive
0:0006	Speed logic	RESET
0:0007	Speed logic	START
0:0008	Speed logic	HP ramp limiter UP

Addr	Point Description	Interface Description
0:0009	Speed logic	HP ramp limiter down
0:0010	Speed logic	Lower speed
0:0011	Speed logic	Raise speed
0:0012	Speed logic	Halt sequence
0:0013	Speed logic	Continue autostart
0:0014	Speed logic	Remote speed enable
0:0015	Speed logic	Remote speed disable
0:0016	Speed logic	reset max speed
0:0017	Speed logic	External overspeed test
0:0018	Speed logic	Overspeed request
0:0019	Speed logic	Quit overspeed test
0:0020	HP compensation	HP gain enabled
0:0021	HP compensation	HP gain disabled
0:0022	FW enabling	M1 forward enable
0:0023	FW-forward enabling	M1 forward disable
0:0024	cascade control	Cascade enable
0:0025	cascade control	Cascade disable
0:0026	cascade control	Cascade lower SP
0:0027	Cascade control	Cascade raise SP
0:0028	Cascade control	Enable remote cascade
0:0029	Cascade control	Disable remote cascade
0:0030	decoupling control	Enable decoupling
0:0031	decoupling control	Disable decoupling
0:0032	Decoupling control	Lower decoupling SP
0:0033	Decoupling control	Raise decoupling SP
0:0034	Decoupling control	Enable remote decoupling
0:0035	Decoupling control	Disable remote decoupling
0:0036	Decoupling control	Manual control demand
0:0037	Decoupling control	Decoupling auto demand
0:0038	LOCAL/REMOTE	Remote
0:0039	LOCAL/REMOTE	Local
0:0040	Modbus relays	Activate relay#4
0:0041	Modbus relays	De-activate relay#4
0:0042	Modbus relays	Activate relay#05
0:0043	Modbus relays	De-activate relay#05
0:0044	Modbus relays	Activate relay#06
0:0045	Modbus relays	De-activate relay#06
0:0046	Modbus relays	Activate relay#07
0:0047	Modbus relays	De-activate relay#07
0:0048	Modbus relays	Activate relay#08
0:0049	Modbus relays	De-activate relay#08
0:0050	Modbus relays	Activate relay#09
0:0051	Modbus relays	De-activate relay#09
0:0052	Modbus relays	Activate relay#10
0:0053	Modbus relays	De-activate relay#10
0:0054	Modbus relays	Activate relay#11
0:0055	Modbus relays	De-activate relay#11
0:0056	Modbus relays	Activate relay#12
0:0057	Modbus relays	De-activate relay#12

Addr	Point Description	Interface Description
0:0058	SET TIME	Set time
0:0059	LP compensation	LP gain enabled
0:0060	LP compensation	LP gain disable
0:0061	Extraction control	Enable extraction
0:0062	Extraction control	Disable extraction
0:0063	Extraction control	E/A lower SP
0:0064	Extraction control	E/A raise SP
0:0065	Extraction control	Enable remote extraction
0:0066	Extraction control	Disable remote extraction
0:0067	Extraction control	Raise LP ramp
0:0068	Extraction control	Lower LP ramp
0:0069	Extraction control	Lower flow demand
0:0070	Extraction control	Raise flow demand
0:0071	Extraction control	Extraction manual demand
0:0072	Extraction control	Extraction auto demand
0:0073	Speed PID	Lower Prop Gain off-line
0:0074	Speed PID	Raise Prop Gain off-line
0:0075	Speed PID	Lower Prop Gain on-line
0:0076	Speed PID	Raise Prop Gain on-line
0:0077	Speed PID	Lower Int Gain off-line
0:0078	Speed PID	Raise Int Gain off-line
0:0079	Speed PID	Lower Int Gain on-line
0:0080	Speed PID	Raise Int Gain on-line
0:0081	Speed PID	Lower deriv Gain off-line
0:0082	Speed PID	Raise deriv Gain off-line
0:0083	Speed PID	Lower deriv Gain on-line
0:0084	Speed PID	Raise deriv Gain on-line
0:0085	Speed PID	Lower Deadband online
0:0086	Speed PID	Raise Deadband online
0:0087	Speed PID	fast action for PID adjust
0:0088	Cascade PID	Lower P1
0:0089	Cascade PID	Raise P1
0:0090	Cascade PID	Lower I1
0:0091	Cascade PID	Raise I1
0:0092	Cascade PID	Lower D1
0:0093	Cascade PID	Raise D1
0:0094	Cascade PID	Lower DB
0:0095	Cascade PID	Raise DB
0:0096	Cascade PID	Lower DF
0:0097	Cascade PID	Raise DF
0:0098	Cascade PID	Lower DR
0:0099	Cascade PID	Raise DR
0:0100	Cascade PID	Fast action for PID adjust
0:0101	Cascade PID	Cascade SP track
0:0102	Cascade PID	Cascade SP no track
0:0103	decoupled PID	Lower P1
0:0104	decoupled PID	Raise P1
0:0105	decoupled PID	Lower I1
0:0106	decoupled PID	Raise I1

Addr	Point Description	Interface Description
0:0107	decoupled PID	Lower D1
0:0108	decoupled PID	Raise D1
0:0109	decoupled PID	Lower DB
0:0110	decoupled PID	Raise DB
0:0111	decoupled PID	Lower Droop
0:0112	decoupled PID	Raise Droop
0:0113	decoupled PID	Fast PID tuning
0:0114	decoupled PID	DCPL SP track
0:0115	decoupled PID	DCPL SP no track
0:0116	extraction PID	Lower P1
0:0117	extraction PID	Raise P1
0:0118	extraction PID	Lower I1
0:0119	extraction PID	Raise I1
0:0120	extraction PID	Lower D1
0:0121	extraction PID	Raise D1
0:0122	extraction PID	Lower DB
0:0123	extraction PID	Raise DB
0:0124	extraction PID	Lower Droop
0:0125	extraction PID	Raise Droop
0:0126	extraction PID	Fast action for PID adjust
0:0127	extraction PID	Extraction SP track
0:0128	extraction PID	Extraction SP no track
0:0129	MAIN SYSTEM	Update EEPROM
0:0130	CALIBRATION	Request calibration
0:0131	CALIBRATION	Quit calibration
0:0132	CALIBRATION	Start calibration procedure
0:0133	CALIBRATION	Valve At min
0:0134	CALIBRATION	Valve at max
0:0135	CALIBRATION	Stroke completed
0:0136	CALIBRATION	Raise manual actuator stroke
0:0137	CALIBRATION	Lower manual actuator stroke
0:0138	ACT-FB channel 1 KP	Lower KP
0:0139	ACT-FB channel 1 KP	Raise KP
0:0140	ACT-FB channel 1 KI	Lower KI
0:0141	ACT-FB channel 1 KI	Raise KI
0:0142	ACT-FB ch1 Null current	Lower Null current.
0:0143	ACT-FB ch1 Null current	Raise Null current.
0:0144	ACT-FB ch2 KP	Lower KP
0:0145	ACT-FB ch 2 KP	Raise KP
0:0146	ACT-FB ch2 KI	Lower KI
0:0147	ACT-FB ch 2 KI	Raise KI
0:0148	ACT-FB ch2 Null current	Lower null current
0:0149	ACT-FB ch2 Null current	Raise null current
0:0150	Null speed logic	null speed function armed
0:0151	Modbus relays	Temporary activate relay#4
0:0152	Modbus relays	Temporary activate relay#05
0:0153	Modbus relays	Temporary activate relay#06
0:0154	Modbus relays	Temporary activate relay#07
0:0155	Modbus relays	Temporary activate relay#08

Addr	Point Description	Interface Description
0:0156	Modbus relays	Temporary activate relay#09
0:0157	Modbus relays	Temporary activate relay#10
0:0158	Modbus relays	Temporary activate relay#11
0:0159	Modbus relays	Temporary activate relay#12
0:0160	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0161	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0162	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0163	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0164	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0165	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0166	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0167	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0168	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0169	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0170	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0171	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0172	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0173	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0174	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0175	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0176	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0177	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0178	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0179	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0180	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0181	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0182	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0183	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0184	Mod #1(2) to Mod2(1)	Binary signal Xfer through Modbus
0:0185	Redundancy Manager1	Modbus#1 select RED1-B request
0:0186	Redundancy Manager1	Modbus#1 select RED1-A request
0:0187	Redundancy Manager2	Modbus#1 select RED2-B request
0:0188	Redundancy Manager2	Modbus#1 select RED2-A request
0:0189	ACT Card online calibration	Memorize calibration data.(online)
0:0190	Manual start request	Manual start request
0:0191	NO man Start	Quit Manual start request
0:0192	Raise Setpoint	Seal Gas PID
0:0193	Lower Setpoint	Seal Gas PID
0:0194	Raise Demand	Seal Gas PID
0:0195	Lower Demand	Seal Gas PID
0:0196	Select Manual mode	Seal Gas PID
0:0197	Select Auto mode	Seal Gas PID
0:0198	Select SP track OFF	Seal Gas PID
0:0199	Select SP track ON	Seal Gas PID
0:0200	Go To speed Target	Speed control
0:0201	Actuator A/C106 ch1	Raise pilot gain
0:0202	Actuator A/C106 ch1	Lower pilot gain
0:0203	Actuator A/C106 ch2	Raise pilot gain
0:0204	Actuator A/C106 ch2	Lower pilot gain

Addr	Point Description	Interface Description
0:0191	NO man Start	Quit Manual start request

Table 7-5. Boolean Writes

Boolean Read Address Overview:

Addr	Point Description	Interface Description
1:0001	Trip indication	External trip contact#1
1:0002	Trip indication	External trip contact#2
1:0003	Trip indication	ESD #3
1:0004	Trip indication	ESD #4
1:0005	Trip indication	ESD #5
1:0006	Trip indication	ESD #6
1:0007	Trip indication	ESD #7
1:0008	Trip indication	ESD #8
1:0009	Trip indication	ESD #9
1:0010	Trip indication	ESD #10
1:0011	Trip indication	Power up SD
1:0012	Trip indication	All HD-BIO fault
1:0013	Trip indication	All HDAI fault
1:0014	Trip indication	All actuator cards fault
1:0015	Trip indication	All Sensor Signal failure
1:0016	Trip indication	Overspeed test limit trip
1:0017	Trip indication	OVERSPEED TRIP
1:0018	Trip indication	All extraction PV failure SD
1:0019	Trip indication	All cascade PV failure SD
1:0020	Trip indication	ACT1 fault
1:0021	Trip indication	ACT2 fault
1:0022	Trip indication	All ACT_06 ch1 fault
1:0023	Trip indication	All ACT_06_ch2 fault
1:0024	Trip indication	Start interlock
1:0025	Trip indication	Speed control lost
1:0026	Trip indication	underspeed SD
1:0027	Trip indication	No speed / sticky rotor
1:0028	Trip indication	normal SD completed
1:0029	Trip indication	SD from Modbus#1
1:0030	Trip indication	SD from Modbus#2
1:0031	Trip indication	SD from PCI
1:0032	Trip indication	LSW1 SD
1:0033	Trip indication	LSW2 SD
1:0034	Trip indication	LSW3 SD
1:0035	Trip indication	LSW4 SD
1:0036	Trip indication	TRIP CONF error
1:0037	Trip indication	HP pilot SD
1:0038	Trip indication	LP pilot SD
1:0039	Trip indication	SD01 from remote IO
1:0040	Trip indication	SD02 from remote IO
1:0041	Trip indication	SD03 from remote IO
1:0042	Trip indication	SD04 from remote IO
1:0043	Trip indication	SD05 from remote IO

Addr	Point Description	Interface Description
1:0044	Trip indication	SD06 from remote IO
1:0045	Trip indication	SD07 from remote IO
1:0046	Trip indication	SD08 from remote IO
1:0047	Trip indication	SD09 from remote IO
1:0048	Trip indication	SD10 from remote IO
1:0049	Trip indication	Redundancy1 all fault
1:0050	Trip indication	Redundancy2 all fault
1:0051	Start Interlock indication	ILOCK01 from remote IO
1:0052	Start Interlock indication	ILOCK02 from remote IO
1:0053	Start Interlock indication	ILOCK03 from remote IO
1:0054	Start Interlock indication	ILOCK04 from remote IO
1:0055	Start Interlock indication	ILOCK05 from remote IO
1:0056	Start Interlock indication	ILOCK06 from remote IO
1:0057	Start Interlock indication	ILOCK07 from remote IO
1:0058	Start Interlock indication	ILOCK08 from remote IO
1:0059	Start Interlock indication	ILOCK09 from remote IO
1:0060	Start Interlock indication	ILOCK10 from remote IO
1:0061	Alarm-hardware	SIO-A card fault
1:0062	Alarm-hardware	SIO-B fault
1:0063	Alarm-hardware	all SIO cards fault
1:0064	Alarm-hardware	Kernel A fault
1:0065	Alarm-hardware	Kernel B fault
1:0066	Alarm-hardware	Kernel C fault
1:0067	Alarm-hardware	fan alarm
1:0068	Alarm-hardware	power 1 fault
1:0069	Alarm-hardware	power 2 fault
1:0070	Alarm-hardware	operating system ALM
1:0071	Alarm-hardware	temp A alarm
1:0072	Alarm-hardware	temp A alarm
1:0073	Alarm-hardware	temp A alarm
1:0074	Alarm-Speed sensors	SPD #1 CH A difference
1:0075	Alarm-Speed sensors	SPD #1 CH A fault
1:0076	Alarm-Speed sensors	SPD #1 CH B difference
1:0077	Alarm-Speed sensors	SPD #1 CH B fault
1:0078	Alarm-Speed sensors	SPD #1 CH C difference
1:0079	Alarm-Speed sensors	SPD #1 CH C fault
1:0080	Alarm-Speed sensors	SPD #2 CH A difference
1:0081	Alarm-Speed sensors	SPD #2 CH A fault
1:0082	Alarm-Speed sensors	SPD #2 CH B difference
1:0083	Alarm-Speed sensors	SPD #2 CH B fault
1:0084	Alarm-Speed sensors	SPD #2 CH C difference
1:0085	Alarm-Speed sensors	SPD #2 CH C fault
1:0086	Alarm-Speed sensors	speed sensor #4 fault
1:0087	Alarm-Speed sensors	SPD #3 CH A difference
1:0088	Alarm-Speed sensors	SPD #3 CH A fault
1:0089	Alarm-Speed sensors	SPD #3 CH B difference
1:0090	Alarm-Speed sensors	SPD #3 CH B fault
1:0091	Alarm-Speed sensors	SPD #3 CH C difference
1:0092	Alarm-Speed sensors	SPD #3 CH C fault
1:0093	Alarm-Speed sensors	SPD #4 CH A difference

Addr	Point Description	Interface Description
1:0094	Alarm-Speed sensors	SPD #4 CH A fault
1:0095	Alarm-Speed sensors	SPD #4 CH B difference
1:0096	Alarm-Speed sensors	SPD #4 CH B fault
1:0097	Alarm-Speed sensors	SPD #4 CH C difference
1:0098	Alarm-Speed sensors	SPD #4 CH C fault
1:0099	Alarm-Speed sensors	Signal failure sensor #1
1:0100	Alarm-Speed sensors	Signal failure sensor #2
1:0101	Alarm-Speed sensors	Signal failure sensor #3
1:0102	Alarm-Speed sensors	Difference failure speed sensor
1:0103	Alarm-Speed sensors	null speed function not armed
1:0104	Alarm-Speed sensors	null speed probe fault
1:0105	Alarm-Analog Inputs	Analog Input 01/Ch A difference
1:0106	Alarm-Analog Inputs	Analog Input 01/ Ch A fault
1:0107	Alarm-Analog Inputs	Analog Input 01/Ch B difference
1:0108	Alarm-Analog Inputs	Analog Input 01/Ch B fault
1:0109	Alarm-Analog Inputs	Analog Input 01/Ch C difference
1:0110	Alarm-Analog Inputs	Analog Input 01/Ch C fault
1:0111	Alarm-Analog Inputs	Analog Input 01/ difference detected
1:0112	Alarm-Analog Inputs	Analog Input 02/Ch A difference
1:0113	Alarm-Analog Inputs	Analog Input 02/ Ch A fault
1:0114	Alarm-Analog Inputs	Analog Input 02/Ch B difference
1:0115	Alarm-Analog Inputs	Analog Input 02/Ch B fault
1:0116	Alarm-Analog Inputs	Analog Input 02/Ch C difference
1:0117	Alarm-Analog Inputs	Analog Input 02/Ch C fault
1:0118	Alarm-Analog Inputs	Analog Input 02/ difference detected
1:0119	Alarm-Analog Inputs	Analog Input 03/Ch A difference
1:0120	Alarm-Analog Inputs	Analog Input 03/ Ch A fault
1:0121	Alarm-Analog Inputs	Analog Input 03/Ch B difference
1:0122	Alarm-Analog Inputs	Analog Input 03/Ch B fault
1:0123	Alarm-Analog Inputs	Analog Input 03/Ch C difference
1:0124	Alarm-Analog Inputs	Analog Input 03/Ch C fault
1:0125	Alarm-Analog Inputs	Analog Input 03/ difference detected
1:0126	Alarm-Analog Inputs	Analog Input 04/Ch A difference
1:0127	Alarm-Analog Inputs	Analog Input 04/ Ch A fault
1:0128	Alarm-Analog Inputs	Analog Input 04/Ch B difference
1:0129	Alarm-Analog Inputs	Analog Input 04/Ch B fault
1:0130	Alarm-Analog Inputs	Analog Input 04/Ch C difference
1:0131	Alarm-Analog Inputs	Analog Input 04/Ch C fault
1:0132	Alarm-Analog Inputs	Analog Input 04/ difference detected
1:0133	Alarm-Analog Inputs	Analog Input 05/Ch A difference
1:0134	Alarm-Analog Inputs	Analog Input 05/ Ch A fault
1:0135	Alarm-Analog Inputs	Analog Input 05/Ch B difference
1:0136	Alarm-Analog Inputs	Analog Input 05/Ch B fault
1:0137	Alarm-Analog Inputs	Analog Input 05/Ch C difference
1:0138	Alarm-Analog Inputs	Analog Input 05/Ch C fault
1:0139	Alarm-Analog Inputs	Analog Input 05/ difference detected
1:0140	Alarm-Analog Inputs	Analog Input 06/Ch A difference
1:0141	Alarm-Analog Inputs	Analog Input 06/ Ch A fault
1:0142	Alarm-Analog Inputs	Analog Input 06/Ch B difference
1:0143	Alarm-Analog Inputs	Analog Input 06/Ch B fault

Addr	Point Description	Interface Description
1:0144	Alarm-Analog Inputs	Analog Input 06/Ch C difference
1:0145	Alarm-Analog Inputs	Analog Input 06/Ch C fault
1:0146	Alarm-Analog Inputs	Analog Input 06/ difference detected
1:0147	Alarm-Analog Inputs	Analog Input 07/Ch A difference
1:0148	Alarm-Analog Inputs	Analog Input 07/ Ch A fault
1:0149	Alarm-Analog Inputs	Analog Input 07/Ch B difference
1:0150	Alarm-Analog Inputs	Analog Input 07/Ch B fault
1:0151	Alarm-Analog Inputs	Analog Input 07/Ch C difference
1:0152	Alarm-Analog Inputs	Analog Input 07/Ch C fault
1:0153	Alarm-Analog Inputs	Analog Input 07/ difference detected
1:0154	Alarm-Analog Inputs	Analog Input 08/Ch A difference
1:0155	Alarm-Analog Inputs	Analog Input 08/ Ch A fault
1:0156	Alarm-Analog Inputs	Analog Input 08/Ch B difference
1:0157	Alarm-Analog Inputs	Analog Input 08/Ch B fault
1:0158	Alarm-Analog Inputs	Analog Input 08/Ch C difference
1:0159	Alarm-Analog Inputs	Analog Input 08/Ch C fault
1:0160	Alarm-Analog Inputs	Analog Input 08/ difference detected
1:0161	Alarm-Analog Outputs	Analog Output/CH 01 load fault
1:0162	Alarm-Analog Outputs	Analog Output/CH 01A fault
1:0163	Alarm-Analog Outputs	Analog Output/CH 01B fault
1:0164	Alarm-Analog Outputs	Analog Output/CH 01C fault
1:0165	Alarm-Analog Outputs	Analog Output/ch 01 fault
1:0166	Alarm-Analog Outputs	Analog Output/CH 02 load fault
1:0167	Alarm-Analog Outputs	Analog Output/CH 02A fault
1:0168	Alarm-Analog Outputs	Analog Output/CH 02B fault
1:0169	Alarm-Analog Outputs	Analog Output_/CH 02C fault
1:0170	Alarm-Analog Outputs	Analog Output /ch 02 fault
1:0171	Alarm-Analog Outputs	Analog Output/CH 03 load fault
1:0172	Alarm-Analog Outputs	Analog Output/CH 03A fault
1:0173	Alarm-Analog Outputs	Analog Output/CH 03B fault
1:0174	Alarm-Analog Outputs	Analog Output/CH 03C fault
1:0175	Alarm-Analog Outputs	Analog Output /ch 03 fault
1:0176	Alarm-Analog Outputs	Analog Output/CH 04 load fault
1:0177	Alarm-Analog Outputs	Analog Output/CH 04A fault
1:0178	Alarm-Analog Outputs	Analog Output/CH 04B fault
1:0179	Alarm-Analog Outputs	Analog Output/CH 04C fault
1:0180	Alarm-Analog Outputs	Analog Output/ch 04 fault
1:0181	Alarm-Binary Inputs	Binary Input 01 fault A
1:0182	Alarm-Binary Inputs	Binary Input 01 fault B
1:0183	Alarm-Binary Inputs	Binary Input 01 fault C
1:0184	Alarm-Binary Inputs	Binary Input 02 fault A
1:0185	Alarm-Binary Inputs	Binary Input 02 fault B
1:0186	Alarm-Binary Inputs	Binary Input 02 fault C
1:0187	Alarm-Binary Inputs	Binary Input 03 fault A
1:0188	Alarm-Binary Inputs	Binary Input 03 fault B
1:0189	Alarm-Binary Inputs	Binary Input 03 fault C
1:0190	Alarm-Binary Inputs	Binary Input 04 fault A
1:0191	Alarm-Binary Inputs	Binary Input 04 fault B
1:0192	Alarm-Binary Inputs	Binary Input 04 fault C
1:0193	Alarm-Binary Inputs	Binary Input 05 fault A

Addr	Point Description	Interface Description
1:0194	Alarm-Binary Inputs	Binary Input 05 fault B
1:0195	Alarm-Binary Inputs	Binary Input 05 fault C
1:0196	Alarm-Binary Inputs	Binary Input 06 fault A
1:0197	Alarm-Binary Inputs	Binary Input 06 fault B
1:0198	Alarm-Binary Inputs	Binary Input 06 fault C
1:0199	Alarm-Binary Inputs	Binary Input 07 fault A
1:0200	Alarm-Binary Inputs	Binary Input 07 fault B
1:0201	Alarm-Binary Inputs	Binary Input 07 fault C
1:0202	Alarm-Binary Inputs	Binary Input 08 fault A
1:0203	Alarm-Binary Inputs	Binary Input 08 fault B
1:0204	Alarm-Binary Inputs	Binary Input 08 fault C
1:0205	Alarm-Binary Inputs	Binary Input 09 fault A
1:0206	Alarm-Binary Inputs	Binary Input 09 fault B
1:0207	Alarm-Binary Inputs	Binary Input 09 fault C
1:0208	Alarm-Binary Inputs	Binary Input 10 fault A
1:0209	Alarm-Binary Inputs	Binary Input 10 fault B
1:0210	Alarm-Binary Inputs	Binary Input 10 fault C
1:0211	Alarm-Binary Inputs	Binary Input 11 fault A
1:0212	Alarm-Binary Inputs	Binary Input 11 fault B
1:0213	Alarm-Binary Inputs	Binary Input 11 fault C
1:0214	Alarm-Binary Inputs	Binary Input 12 fault A
1:0215	Alarm-Binary Inputs	Binary Input 12 fault B
1:0216	Alarm-Binary Inputs	Binary Input 12 fault C
1:0217	Alarm-Binary Inputs	Binary Input 13 fault A
1:0218	Alarm-Binary Inputs	Binary Input 13 fault B
1:0219	Alarm-Binary Inputs	Binary Input 13 fault C
1:0220	Alarm-Binary Inputs	Binary Input 14 fault A
1:0221	Alarm-Binary Inputs	Binary Input 14 fault B
1:0222	Alarm-Binary Inputs	Binary Input 14 fault C
1:0223	Alarm-Binary Inputs	Binary Input 15 fault A
1:0224	Alarm-Binary Inputs	Binary Input 15 fault B
1:0225	Alarm-Binary Inputs	Binary Input 15 fault C
1:0226	Alarm-Binary Inputs	Binary Input 16 fault A
1:0227	Alarm-Binary Inputs	Binary Input 16 fault B
1:0228	Alarm-Binary Inputs	Binary Input 16 fault C
1:0229	Alarm-Binary Inputs	Binary Input 17 fault A
1:0230	Alarm-Binary Inputs	Binary Input 17 fault B
1:0231	Alarm-Binary Inputs	Binary Input 17 fault C
1:0232	Alarm-Binary Inputs	Binary Input 18 fault A
1:0233	Alarm-Binary Inputs	Binary Input 18 fault B
1:0234	Alarm-Binary Inputs	Binary Input 18 fault C
1:0235	Alarm-Binary Inputs	Binary Input 19 fault A
1:0236	Alarm-Binary Inputs	Binary Input 19 fault B
1:0237	Alarm-Binary Inputs	Binary Input 19 fault C
1:0238	Alarm-Binary Inputs	Binary Input 20 fault A
1:0239	Alarm-Binary Inputs	Binary Input 20 fault B
1:0240	Alarm-Binary Inputs	Binary Input 20 fault C
1:0241	Alarm-Binary Inputs	Binary Input 21 fault A
1:0242	Alarm-Binary Inputs	Binary Input 21 fault B
1:0243	Alarm-Binary Inputs	Binary Input 21 fault C

Addr	Point Description	Interface Description
1:0244	Alarm-Binary Inputs	Binary Input 22 fault A
1:0245	Alarm-Binary Inputs	Binary Input 22 fault B
1:0246	Alarm-Binary Inputs	Binary Input 22 fault C
1:0247	Alarm-Binary Inputs	Binary Input 23 fault A
1:0248	Alarm-Binary Inputs	Binary Input 23 fault B
1:0249	Alarm-Binary Inputs	Binary Input 23 fault C
1:0250	Alarm-Binary Inputs	Binary Input 24 fault A
1:0251	Alarm-Binary Inputs	Binary Input 24 fault B
1:0252	Alarm-Binary Inputs	Binary Input 24 fault C
1:0253	Alarm-Relay Outputs	Rly01 A1 or B1 Fault
1:0254	Alarm-Relay Outputs	Rly01 B2 or C1 Fault
1:0255	Alarm-Relay Outputs	Rly01 C2 or A2 Fault
1:0256	Alarm-Relay Outputs	Relay 01 A1 fault
1:0257	Alarm-Relay Outputs	Relay 01 A2 fault
1:0258	Alarm-Relay Outputs	Relay 01 B1 fault
1:0259	Alarm-Relay Outputs	Relay 01 B2 fault
1:0260	Alarm-Relay Outputs	Relay 01 C1 fault
1:0261	Alarm-Relay Outputs	Relay 01 C2 fault
1:0262	Alarm-Relay Outputs	Relay#01Customer Power Flt
1:0263	Alarm-Relay Outputs	RLY 01 'A1' Relay Fault
1:0264	Alarm-Relay Outputs	RLY 01 'A2' Relay Fault
1:0265	Alarm-Relay Outputs	RLY 01 'B1' Relay Fault
1:0266	Alarm-Relay Outputs	RLY 01 'B2' Relay Fault
1:0267	Alarm-Relay Outputs	RLY 01 'C1' Relay Fault
1:0268	Alarm-Relay Outputs	RLY 01 'C2' Relay Fault
1:0269	Alarm-Relay Outputs	Relay#01 FAULT
1:0270	Alarm-Relay Outputs	Rly02 A1 or B1 Fault
1:0271	Alarm-Relay Outputs	Rly02 B2 or C1 Fault
1:0272	Alarm-Relay Outputs	Rly02 C2 or A2 Fault
1:0273	Alarm-Relay Outputs	Relay 02 A1 fault
1:0274	Alarm-Relay Outputs	Relay 02 A2 fault
1:0275	Alarm-Relay Outputs	Relay 02 B1 fault
1:0276	Alarm-Relay Outputs	Relay 02 B2 fault
1:0277	Alarm-Relay Outputs	Relay 02 C1 fault
1:0278	Alarm-Relay Outputs	Relay 02 C2 fault
1:0279	Alarm-Relay Outputs	Relay#02 Customer Power Flt
1:0280	Alarm-Relay Outputs	RLY 02 'A1' Relay Fault
1:0281	Alarm-Relay Outputs	RLY 02 'A2' Relay Fault
1:0282	Alarm-Relay Outputs	RLY 02 'B1' Relay Fault
1:0283	Alarm-Relay Outputs	RLY 02 'B2' Relay Fault
1:0284	Alarm-Relay Outputs	RLY 02 'C1' Relay Fault
1:0285	Alarm-Relay Outputs	RLY 02 'C2' Relay Fault
1:0286	Alarm-Relay Outputs	Relay#02 FAULT
1:0287	Alarm-Relay Outputs	Rly03 A1 or B1 Fault
1:0288	Alarm-Relay Outputs	Rly03 B2 or C1 Fault
1:0289	Alarm-Relay Outputs	Rly03 C2 or A2 Fault
1:0290	Alarm-Relay Outputs	Relay 03 A1 fault
1:0291	Alarm-Relay Outputs	Relay 03 A2 fault
1:0292	Alarm-Relay Outputs	Relay 03 B1 fault
1:0293	Alarm-Relay Outputs	Relay 03 B2 fault

Addr	Point Description	Interface Description
1:0294	Alarm-Relay Outputs	Relay 03 C1 fault
1:0295	Alarm-Relay Outputs	Relay 03 C2 fault
1:0296	Alarm-Relay Outputs	Relay#03 Customer Power Flt
1:0297	Alarm-Relay Outputs	RLY 03 'A1' Relay Fault
1:0298	Alarm-Relay Outputs	RLY 03 'A2' Relay Fault
1:0299	Alarm-Relay Outputs	RLY 03 'B1' Relay Fault
1:0300	Alarm-Relay Outputs	RLY 03 'B2' Relay Fault
1:0301	Alarm-Relay Outputs	RLY 03 'C1' Relay Fault
1:0302	Alarm-Relay Outputs	RLY 03 'C2' Relay Fault
1:0303	Alarm-Relay Outputs	Relay#03 FAULT
1:0304	Alarm-Relay Outputs	Rly04 A1 or B1 Fault
1:0305	Alarm-Relay Outputs	Rly04 B2 or C1 Fault
1:0306	Alarm-Relay Outputs	Rly04 C2 or A2 Fault
1:0307	Alarm-Relay Outputs	Relay 04 A1 fault
1:0308	Alarm-Relay Outputs	Relay 04 A2 fault
1:0309	Alarm-Relay Outputs	Relay 04 B1 fault
1:0310	Alarm-Relay Outputs	Relay 04 B2 fault
1:0311	Alarm-Relay Outputs	Relay 04 C1 fault
1:0312	Alarm-Relay Outputs	Relay 04 C2 fault
1:0313	Alarm-Relay Outputs	Relay#04 Customer Power Flt
1:0314	Alarm-Relay Outputs	RLY 04 'A1' Relay Fault
1:0315	Alarm-Relay Outputs	RLY 04 'A2' Relay Fault
1:0316	Alarm-Relay Outputs	RLY 04 'B1' Relay Fault
1:0317	Alarm-Relay Outputs	RLY 04 'B2' Relay Fault
1:0318	Alarm-Relay Outputs	RLY 04 'C1' Relay Fault
1:0319	Alarm-Relay Outputs	RLY 04 'C2' Relay Fault
1:0320	Alarm-Relay Outputs	Relay#04 FAULT
1:0321	Alarm-Relay Outputs	Rly05 A1 or B1 Fault
1:0322	Alarm-Relay Outputs	Rly05 B2 or C1 Fault
1:0323	Alarm-Relay Outputs	Rly05 C2 or A2 Fault
1:0324	Alarm-Relay Outputs	Relay 05 A1 fault
1:0325	Alarm-Relay Outputs	Relay 05 A2 fault
1:0326	Alarm-Relay Outputs	Relay 05 B1 fault
1:0327	Alarm-Relay Outputs	Relay 05 B2 fault
1:0328	Alarm-Relay Outputs	Relay 05 C1 fault
1:0329	Alarm-Relay Outputs	Relay 05 C2 fault
1:0330	Alarm-Relay Outputs	Relay#05 Customer Power Flt
1:0331	Alarm-Relay Outputs	RLY 05 'A1' Relay Fault
1:0332	Alarm-Relay Outputs	RLY 05 'A2' Relay Fault
1:0333	Alarm-Relay Outputs	RLY 05 'B1' Relay Fault
1:0334	Alarm-Relay Outputs	RLY 05 'B2' Relay Fault
1:0335	Alarm-Relay Outputs	RLY 05 'C1' Relay Fault
1:0336	Alarm-Relay Outputs	RLY 05 'C2' Relay Fault
1:0337	Alarm-Relay Outputs	Relay#05 FAULT
1:0338	Alarm-Relay Outputs	Rly06 A1 or B1 Fault
1:0339	Alarm-Relay Outputs	Rly06 B2 or C1 Fault
1:0340	Alarm-Relay Outputs	Rly06 C2 or A2 Fault
1:0341	Alarm-Relay Outputs	Relay 06 A1 fault
1:0342	Alarm-Relay Outputs	Relay 06 A2 fault
1:0343	Alarm-Relay Outputs	Relay 06 B1 fault

Addr	Point Description	Interface Description
1:0344	Alarm-Relay Outputs	Relay 06 B2 fault
1:0345	Alarm-Relay Outputs	Relay 06 C1 fault
1:0346	Alarm-Relay Outputs	Relay 06 C2 fault
1:0347	Alarm-Relay Outputs	Relay#06 Customer Power Flt
1:0348	Alarm-Relay Outputs	RLY 06 'A1' Relay Fault
1:0349	Alarm-Relay Outputs	RLY 06 'A2' Relay Fault
1:0350	Alarm-Relay Outputs	RLY 06 'B1' Relay Fault
1:0351	Alarm-Relay Outputs	RLY 06 'B2' Relay Fault
1:0352	Alarm-Relay Outputs	RLY 06 'C1' Relay Fault
1:0353	Alarm-Relay Outputs	RLY 06 'C2' Relay Fault
1:0354	Alarm-Relay Outputs	Relay#06 FAULT
1:0355	Alarm-Relay Outputs	Rly07 A1 or B1 Fault
1:0356	Alarm-Relay Outputs	Rly07 B2 or C1 Fault
1:0357	Alarm-Relay Outputs	Rly07 C2 or A2 Fault
1:0358	Alarm-Relay Outputs	Relay 07 A1 fault
1:0359	Alarm-Relay Outputs	Relay 07 A2 fault
1:0360	Alarm-Relay Outputs	Relay 07 B1 fault
1:0361	Alarm-Relay Outputs	Relay 07 B2 fault
1:0362	Alarm-Relay Outputs	Relay 07 C1 fault
1:0363	Alarm-Relay Outputs	Relay 07 C2 fault
1:0364	Alarm-Relay Outputs	Relay#07 Customer Power Flt
1:0365	Alarm-Relay Outputs	RLY 07 'A1' Relay Fault
1:0366	Alarm-Relay Outputs	RLY 07 'A2' Relay Fault
1:0367	Alarm-Relay Outputs	RLY 07 'B1' Relay Fault
1:0368	Alarm-Relay Outputs	RLY 07 'B2' Relay Fault
1:0369	Alarm-Relay Outputs	RLY 07 'C1' Relay Fault
1:0370	Alarm-Relay Outputs	RLY 07 'C2' Relay Fault
1:0371	Alarm-Relay Outputs	Relay#07 FAULT
1:0372	Alarm-Relay Outputs	Rly08 A1 or B1 Fault
1:0373	Alarm-Relay Outputs	Rly08 B2 or C1 Fault
1:0374	Alarm-Relay Outputs	Rly08 C2 or A2 Fault
1:0375	Alarm-Relay Outputs	Relay 08 A1 fault
1:0376	Alarm-Relay Outputs	Relay 08 A2 fault
1:0377	Alarm-Relay Outputs	Relay 08 B1 fault
1:0378	Alarm-Relay Outputs	Relay 08 B2 fault
1:0379	Alarm-Relay Outputs	Relay 08 C1 fault
1:0380	Alarm-Relay Outputs	Relay 08 C2 fault
1:0381	Alarm-Relay Outputs	Relay#08 Customer Power Flt
1:0382	Alarm-Relay Outputs	RLY 08 'A1' Relay Fault
1:0383	Alarm-Relay Outputs	RLY 08 'A2' Relay Fault
1:0384	Alarm-Relay Outputs	RLY 08 'B1' Relay Fault
1:0385	Alarm-Relay Outputs	RLY 08 'B2' Relay Fault
1:0386	Alarm-Relay Outputs	RLY 08 'C1' Relay Fault
1:0387	Alarm-Relay Outputs	RLY 08 'C2' Relay Fault
1:0388	Alarm-Relay Outputs	Relay#08 FAULT
1:0389	Alarm-Relay Outputs	Rly09 A1 or B1 Fault
1:0390	Alarm-Relay Outputs	Rly09 B2 or C1 Fault
1:0391	Alarm-Relay Outputs	Rly09 C2 or A2 Fault
1:0392	Alarm-Relay Outputs	Relay 09 A1 fault
1:0393	Alarm-Relay Outputs	Relay 09 A2 fault

Addr	Point Description	Interface Description
1:0394	Alarm-Relay Outputs	Relay 09 B1 fault
1:0395	Alarm-Relay Outputs	Relay 09 B2 fault
1:0396	Alarm-Relay Outputs	Relay 09 C1 fault
1:0397	Alarm-Relay Outputs	Relay 09 C2 fault
1:0398	Alarm-Relay Outputs	Relay#09 Customer Power Flt
1:0399	Alarm-Relay Outputs	RLY 09 'A1' Relay Fault
1:0400	Alarm-Relay Outputs	RLY 09 'A2' Relay Fault
1:0401	Alarm-Relay Outputs	RLY 09 'B1' Relay Fault
1:0402	Alarm-Relay Outputs	RLY 09 'B2' Relay Fault
1:0403	Alarm-Relay Outputs	RLY 09 'C1' Relay Fault
1:0404	Alarm-Relay Outputs	RLY 09 'C2' Relay Fault
1:0405	Alarm-Relay Outputs	Relay#09 FAULT
1:0406	Alarm-Relay Outputs	Rly10 A1 or B1 Fault
1:0407	Alarm-Relay Outputs	Rly10 B2 or C1 Fault
1:0408	Alarm-Relay Outputs	Rly10 C2 or A2 Fault
1:0409	Alarm-Relay Outputs	Relay 10 A1 fault
1:0410	Alarm-Relay Outputs	Relay 10 A2 fault
1:0411	Alarm-Relay Outputs	Relay 10 B1 fault
1:0412	Alarm-Relay Outputs	Relay 10 B2 fault
1:0413	Alarm-Relay Outputs	Relay 10 C1 fault
1:0414	Alarm-Relay Outputs	Relay 10 C2 fault
1:0415	Alarm-Relay Outputs	Relay#10 Customer Power Flt
1:0416	Alarm-Relay Outputs	RLY 10 'A1' Relay Fault
1:0417	Alarm-Relay Outputs	RLY 10 'A2' Relay Fault
1:0418	Alarm-Relay Outputs	RLY 10 'B1' Relay Fault
1:0419	Alarm-Relay Outputs	RLY 10 'B2' Relay Fault
1:0420	Alarm-Relay Outputs	RLY 10 'C1' Relay Fault
1:0421	Alarm-Relay Outputs	RLY 10 'C2' Relay Fault
1:0422	Alarm-Relay Outputs	Relay#10 FAULT
1:0423	Alarm-Relay Outputs	Rly11 A1 or B1 Fault
1:0424	Alarm-Relay Outputs	Rly11 B2 or C1 Fault
1:0425	Alarm-Relay Outputs	Rly11 C2 or A2 Fault
1:0426	Alarm-Relay Outputs	Relay 11 A1 fault
1:0427	Alarm-Relay Outputs	Relay 11 A2 fault
1:0428	Alarm-Relay Outputs	Relay 11 B1 fault
1:0429	Alarm-Relay Outputs	Relay 11 B2 fault
1:0430	Alarm-Relay Outputs	Relay 11 C1 fault
1:0431	Alarm-Relay Outputs	Relay 11 C2 fault
1:0432	Alarm-Relay Outputs	Relay#11 Customer Power Flt
1:0433	Alarm-Relay Outputs	RLY 11 'A1' Relay Fault
1:0434	Alarm-Relay Outputs	RLY 11 'A2' Relay Fault
1:0435	Alarm-Relay Outputs	RLY 11 'B1' Relay Fault
1:0436	Alarm-Relay Outputs	RLY 11 'B2' Relay Fault
1:0437	Alarm-Relay Outputs	RLY 11 'C1' Relay Fault
1:0438	Alarm-Relay Outputs	RLY 11 'C2' Relay Fault
1:0439	Alarm-Relay Outputs	Relay#11 FAULT
1:0440	Alarm-Relay Outputs	Rly12 A1 or B1 Fault
1:0441	Alarm-Relay Outputs	Rly12 B2 or C1 Fault
1:0442	Alarm-Relay Outputs	Rly12 C2 or A2 Fault
1:0443	Alarm-Relay Outputs	Relay 12 A1 fault

Addr	Point Description	Interface Description
1:0444	Alarm-Relay Outputs	Relay 12 A2 fault
1:0445	Alarm-Relay Outputs	Relay 12 B1 fault
1:0446	Alarm-Relay Outputs	Relay 12 B2 fault
1:0447	Alarm-Relay Outputs	Relay 12 C1 fault
1:0448	Alarm-Relay Outputs	Relay 12 C2 fault
1:0449	Alarm-Relay Outputs	Relay#12 Customer Power Flt
1:0450	Alarm-Relay Outputs	RLY 12 'A1' Relay Fault
1:0451	Alarm-Relay Outputs	RLY 12 'A2' Relay Fault
1:0452	Alarm-Relay Outputs	RLY 12 'B1' Relay Fault
1:0453	Alarm-Relay Outputs	RLY 12 'B2' Relay Fault
1:0454	Alarm-Relay Outputs	RLY 12 'C1' Relay Fault
1:0455	Alarm-Relay Outputs	RLY 12 'C2' Relay Fault
1:0456	Alarm-Relay Outputs	Relay#12 FAULT
1:0457	Alarm-Process	remote speed signal failure
1:0458	Alarm-Process	All extraction PV failure
1:0459	Alarm-Process	Extraction failure A
1:0460	Alarm-Process	Extraction failure B
1:0461	Alarm-Process	Extraction failure C
1:0462	Alarm-Process	Extraction sensor Difference failure
1:0463	Alarm-Process	Rem Extr signal failure
1:0464	Alarm-Process	All cascade PV failure
1:0465	Alarm-Process	cascade failure A
1:0466	Alarm-Process	cascade failure B
1:0467	Alarm-Process	cascade failure C
1:0468	Alarm-Process	cascade sensor Difference failure
1:0469	Alarm-Process	Rem Casc signal failure
1:0470	Alarm-Process	'Decoupling input All Signal failure
1:0471	Alarm-Process	'Decoupling input Signal failure A
1:0472	Alarm-Process	'Decoupling input Signal failure B
1:0473	Alarm-Process	'Decoupling input Signal failure C
1:0474	Alarm-Process	'Decoupling input Difference failure
1:0475	Alarm-Process	Rem DCPL signal failure
1:0476	Alarm-Process	monitor1 signal failure
1:0477	Alarm-Process	moniotr2 signal failure
1:0478	Alarm-Process	monitor3 signal failure
1:0479	Alarm-Process	monitor4 signal failure
1:0480	Alarm-LVDT	HP pilot feedback failure A106
1:0481	Alarm-LVDT	'HP pilot feedback failure C106
1:0482	Alarm-LVDT	HP pilot DF fault
1:0483	Alarm-LVDT	LP pilot feedback failure A106
1:0484	Alarm-LVDT	LP pilot feedback failure C106
1:0485	Alarm-LVDT	LP pilot DF fault
1:0486	Alarm-Process	HP degraded mode activated
1:0487	Alarm-Process	LP degraded mode activated
1:0488	Alarm-Process	(HP demand -LVDT) too big
1:0489	Alarm-Process	(LP demand -LVDT) too big
1:0490	Alarm-Process	HP pilot degraded fault
1:0491	Alarm-Process	LP pilot degraded fault
1:0492	Alarm actuator	ACT1 load fault
1:0493	Alarm actuator	ACT1 fault A

Addr	Point Description	Interface Description
1:0494	Alarm actuator	ACT1 fault B
1:0495	Alarm actuator	ACT1 load fault A&B
1:0496	Alarm actuator	ACT1 load fault C
1:0497	Alarm actuator	ACT1 fault C
1:0498	Alarm actuator	ACT1 fault
1:0499	Alarm actuator	ACT2 load fault
1:0500	Alarm actuator	ACT2 fault A
1:0501	Alarm actuator	ACT2 fault B
1:0502	Alarm actuator	ACT2 load fault A&B
1:0503	Alarm actuator	ACT2 load fault C
1:0504	Alarm actuator	ACT2 fault C
1:0505	Alarm actuator	ACT2 fault
1:0506	Alarm actuator	ALM all ACT_06 ch1 fault
1:0507	Alarm actuator	ALM calibration A 106 ch 1 not complete
1:0508	Alarm actuator	ALM act_A106 ch1 fault
1:0509	Alarm actuator	Position MAX DIFF A106-Ch1
1:0510	Alarm actuator	ALM LVDT1 A106 ch1 fault
1:0511	Alarm actuator	ALM calibration C106 ch1 not completed
1:0512	Alarm actuator	ALM act_C106 ch1 fault
1:0513	Alarm actuator	Position MAX DIFF C106-Ch1
1:0514	Alarm actuator	ALM LVDT1 C106 ch1 fault
1:0515	Alarm actuator	ALM all ACT_06 ch2 fault
1:0516	Alarm actuator	ALM calibration A106 ch 2 not complete
1:0517	Alarm actuator	ALM act_A106 ch1 fault
1:0518	Alarm actuator	Position MAX DIFF A106-Ch2
1:0519	Alarm actuator	ALM LVDT1 A106 ch1 fault
1:0520	Alarm actuator	ALM calibration C106 ch 2 not complete
1:0521	Alarm actuator	ALM act_C106 ch1 fault
1:0522	Alarm actuator	Position MAX DIFF C106-Ch2
1:0523	Alarm actuator	ALM LVDT1 C106 ch1 fault
1:0524	Alarm-external	Alarm #1
1:0525	Alarm-external	Alarm #2
1:0526	Alarm-external	Alarm #3
1:0527	Alarm-external	Alarm #4
1:0528	Alarm-external	Alarm #5
1:0529	Alarm-external	Alarm #6
1:0530	Alarm-external	Alarm #7
1:0531	Alarm-external	Alarm #8
1:0532	Alarm-external	Alarm #9
1:0533	Alarm-external	Alarm #10
1:0534	Alarm-control	Normal SD completed
1:0535	Alarm-control	Any relay fault
1:0536	Alarm-control	MAJOR ALARM
1:0537	Alarm-control	Speed control lost
1:0538	Alarm-control	Stuck in critical band
1:0539	Alarm-control	Underspeed alarm
1:0540	Alarm-Redundancy1	Redundancy position error
1:0541	Alarm-Redundancy1	Redundancy1 fault ACT-A
1:0542	Alarm-Redundancy1	Redundancy1 fault ACT-A
1:0543	Alarm-Redundancy1	Fault position IH-1A

Addr	Point Description	Interface Description
1:0544	Alarm-Redundancy1	Fault position IH-1B
1:0545	Alarm-Redundancy2	Redundancy position error
1:0546	Alarm-Redundancy2	Redundancy2 fault ACT-A
1:0547	Alarm-Redundancy2	Redundancy2 fault ACT-A
1:0548	Alarm-Redundancy2	Fault position IH-2A
1:0549	Alarm-Redundancy2	Fault position IH-2B
1:0550	Alarm-Process	Alarm steam map limited SminHP
1:0551	Alarm-Process	Alarm steam map limited SmaxLP
1:0552	Alarm-Process	Alarm steam map limited PminHP
1:0553	Alarm-Process	Alarm steam map limited PminLP
1:0554	Alarm-Process	Alarm steam map limited Pmax HP
1:0555	Alarm-Process	Alarm steam map limited Pmax LP
1:0556	Alarm-Process	ANY steam map reached
1:0557	Alarm-communication	MOD#1 P1 Exception Fault
1:0558	Alarm-communication	Mod#1 P2 Exception Fault
1:0559	Alarm-communication	Mod#1 P1 Link Fault (Timeout)
1:0560	Alarm-communication	Mod#1 P2 Link Fault (Timeout)
1:0561	Alarm-communication	MOD#1 P1 Exception Fault
1:0562	Alarm-communication	Mod#1 P2 Exception Fault
1:0563	Alarm-communication	Mod#1 P1 Link Fault (Timeout)
1:0564	Alarm-communication	Mod#1 P2 Link Fault (Timeout)
1:0565	Alarm-Internal limit switches	LSW1 alarm
1:0566	Alarm-Internal limit switches	unload alarm
1:0567	Alarm-Internal limit switches	LSW2 alarm
1:0568	Alarm-Internal limit switches	unload alarm
1:0569	Alarm-Internal limit switches	LSW3 alarm
1:0570	Alarm-Internal limit switches	unload alarm
1:0571	Alarm-Internal limit switches	LSW4 alarm
1:0572	Alarm-Internal limit switches	unload alarm
1:0573	Alarm-CONFIGURATION	alarm CONF error
1:0574	Alarm-remote IO (if used)	AL01 from remote IO
1:0575	Alarm-remote IO (if used)	AL02 from remote IO
1:0576	Alarm-remote IO (if used)	AL03 from remote IO
1:0577	Alarm-remote IO (if used)	AL04 from remote IO
1:0578	Alarm-remote IO (if used)	AL05 from remote IO
1:0579	Alarm-remote IO (if used)	AL06 from remote IO
1:0580	Alarm-remote IO (if used)	AL07 from remote IO
1:0581	Alarm-remote IO (if used)	AL08 from remote IO
1:0582	Alarm-remote IO (if used)	AL09 from remote IO
1:0583	Alarm-remote IO (if used)	AL10 from remote IO
1:0584	Alarm-remote IO (if used)	AL COM1 from remote IO
1:0585	Alarm-remote IO (if used)	AL COM2 from remote IO
1:0586	Alarm-Actuator	DMD-LVDT MAX DIFF a106-Ch1
1:0587	Alarm-Actuator	LVDT A106 ch1out of range
1:0588	Alarm-Actuator	DMD-LVDT MAX DIFF C106-Ch1
1:0589	Alarm-Actuator	LVDT C106 ch1out of range
1:0590	Alarm-Actuator	DMD-LVDT MAX DIFF C106-Ch2
1:0591	Alarm-Actuator	LVDT A106 ch2out of range
1:0592	Alarm-Actuator	DMD-LVDT MAX DIFF a106-Ch2
1:0593	Alarm-Actuator	LVDT C106 ch2out of range

Addr	Point Description	Interface Description
1:0594	Alarm-Control	Speed limited/no lower
1:0595	Alarm-Control	Speed limited/no raise
1:0596	Alarm-Process	HP gain compensation failure
1:0597	Alarm-Process	LP gain compensation failure
1:0598	Alarm-Process	Feed-forward signal failure
1:0599	Alarm-redundancy1	IH-A-redundancy1 signal failure
1:0600	Alarm-redundancy1	IH-B-redundancy1 signal failure
1:0601	Alarm-redundancy2	IH-A-redundancy2 signal failure
1:0602	Alarm-redundancy2	IH-B-redundancy2 signal failure
1:0603	alarm- Hot/cold time	all signal Fault
1:0604	Major Alarm	CPU A FAULT
1:0605	Major Alarm	CPU B FAULT
1:0606	Major Alarm	CPU C FAULT
1:0607	Major Alarm	HD AIO-A FAULT
1:0608	Major Alarm	HD AIO-B FAULT
1:0609	Major Alarm	HD AIO-C FAULT
1:0610	Major Alarm	Actuator card A fault
1:0611	Major Alarm	Actuator card C fault
1:0612	Major Alarm	BIO card A fault
1:0613	Major Alarm	BIO card B fault
1:0614	Major Alarm	BIO card C fault
1:0615	Major Alarm	power supply#1 fault
1:0616	Major Alarm	power supply#2 fault
1:0617	Major Alarm	SIO card A failed
1:0618	Major Alarm	SIO card B failed
1:0619	Major Alarm	fan failed
1:0620	Major Alarm	Temperature kernel A alarm
1:0621	Major Alarm	Temperature kernel B alarm
1:0622	Major Alarm	Temperature kernel C alarm
1:0623	Major Alarm	system alarm
1:0624	Major Alarm	5009 tripped
1:0625	Major Alarm	start interlock
1:0626	Major Alarm	speed control lost
1:0627	Major Alarm	stuck in critical speed
1:0628	Major Alarm	underspeed
1:0629	Major Alarm	external alarm#1
1:0630	Major Alarm	external alarm#2
1:0631	Major Alarm	external alarm#3
1:0632	Major Alarm	external alarm#4
1:0633	Major Alarm	external alarm#5
1:0634	Major Alarm	external alarm#6
1:0635	Major Alarm	external alarm#7
1:0636	Major Alarm	external alarm#8
1:0637	Major Alarm	external alarm#9
1:0638	Major Alarm	external alarm#10
1:0639	Major Alarm	remote speed failed
1:0640	Major Alarm	all cascade failed
1:0641	Major Alarm	remote cascade failed
1:0642	Major Alarm	all extraction input failed
1:0643	Major Alarm	remote extraction failed

Addr	Point Description	Interface Description
1:0644	Major Alarm	decoupled input failed
1:0645	Major Alarm	remote decoupled failed
1:0646	Major Alarm	HP compensation failed
1:0647	Major Alarm	LP compensation failed
1:0648	Major Alarm	feed-forward failed
1:0649	Major Alarm	Any relay fault
1:0650	Major Alarm	ACT1 failed
1:0651	Major Alarm	ACT2 failed
1:0652	Major Alarm	ACT-FB channel 1 failed
1:0653	Major Alarm	ACT-FB channel 2 failed
1:0654	Major Alarm	monitor#1 failed
1:0655	Major Alarm	monitor#2 failed
1:0656	Major Alarm	monitor#3 failed
1:0657	Major Alarm	monitor#4 failed
1:0658	Major Alarm	HP pilot failed
1:0659	Major Alarm	LP pilot failed
1:0660	Major Alarm	Seal Gas Process value fault
1:0661	Major Alarm	LSW1 alarm
1:0662	Major Alarm	LSW2 alarm
1:0663	Major Alarm	LSW3 alarm
1:0664	Major Alarm	LSW4 alarm
1:0665	Extraction Inhibit condition	no extraction AI configured
1:0666	Extraction Inhibit condition	All Signal failure
1:0667	Decoupling Inhibit condition	function not configured
1:0668	Decoupling Inhibit condition	All Signal failure
1:0669	Cascade Inhibit condition	sensor not configured
1:0670	Cascade Inhibit condition	cascade fault
1:0671	Remote Extraction Inhibit	function not configured
1:0672	Remote Extraction Inhibit	Hardware signal failure
1:0673	Remote decoupling Inhibit	function not configured
1:0674	Remote decoupling Inhibit	Hardware signal failure
1:0675	Remote speed Inhibit	no remote speed AI configured
1:0676	Remote speed setpoint	remote speed signal failure
1:0677	Remote speed setpoint	in calibration mode/start INHIBIT
1:0678	Calibration Steps	CALIBRATION DISABLED
1:0679	Calibration Steps	CALIBRATION ENABLED
1:0680	Calibration Steps	GOTO MIN
1:0681	Calibration Steps	GOTO MAX
1:0682	Calibration Steps	MANUAL STROKE
1:0683	Calibration status	calibration inhibited
1:0684	Control status/configuration	HP gain compensation active
1:0685	Control status/configuration	LP gain compensation active
1:0686	Control status/configuration	HP pilot degraded configured
1:0687	Control status/configuration	HP pilot used
1:0688	Control status/configuration	LP pilot degraded configured
1:0689	Control status/configuration	LP Pilot used
1:0690	Control status/configuration	use ACT_CH1 feedback
1:0691	Control status/configuration	use ACT_CH2 feedback
1:0692	Control status/configuration	use ACT_A ch2 feedback2
1:0693	Control status/configuration	use ACT_C ch2 feedback2

Addr	Point Description	Interface Description
1:0694	Control status/configuration	ACT_A ch1 feedback2 not used
1:0695	Control status/configuration	ACT_C ch1 feedback2 not used
1:0696	Control status/configuration	Actuator channel 1 ready
1:0697	Control status/configuration	Actuator channel 2 ready
1:0698	Control status/configuration	HP open start inhibit
1:0699	Control status/configuration	No cascade AI configured
1:0700	Control status/configuration	Feed-forward not configured
1:0701	Control status/configuration	HP gain compensation not configured
1:0702	Control status/configuration	IH-A-redundancy1 not configured
1:0703	Control status/configuration	IH-A-redundancy2not configured
1:0704	Control status/configuration	IH-A-redundancy2 not configured
1:0705	Control status/configuration	IH-B-redundancy2 not configured
1:0706	Control status/configuration	LPgain compensation not configured
1:0707	Control status/configuration	monitor1 not configured
1:0708	Control status/configuration	monitor2not configured
1:0709	Control status/configuration	monitor3 not configured
1:0710	Control status/configuration	monitor4 not configured
1:0711	Remote cascade setpoint	rem cascade not configured
1:0712	Remote cascade setpoint	signal failed signal failure
1:0713	Remote HOT/COLD timer	remote timer not configured
1:0714	Seal gas PV	Not configured
1:0715	Seal gas PV	Failure detected
1:0716	Monitor contact status	Binary Input 01 process value
1:0717	Monitor contact status	Binary Input 02 process value
1:0718	Monitor contact status	Binary Input 03 process value
1:0719	Monitor contact status	Binary Input 04 process value
1:0720	Monitor contact status	Binary Input 05 process value
1:0721	Monitor contact status	Binary Input 06 process value
1:0722	Monitor contact status	Binary Input 07 process value
1:0723	Monitor contact status	Binary Input 08 process value
1:0724	Monitor contact status	Binary Input 09 process value
1:0725	Monitor contact status	Binary Input 10 process value
1:0726	Monitor contact status	Binary Input 11 process value
1:0727	Monitor contact status	Binary Input 12 process value
1:0728	Monitor contact status	Binary Input 13 process value
1:0729	Monitor contact status	Binary Input 14 process value
1:0730	Monitor contact status	Binary Input 15 process value
1:0731	Monitor contact status	Binary Input 16 process value
1:0732	Monitor contact status	Binary Input 17 process value
1:0733	Monitor contact status	Binary Input 18 process value
1:0734	Monitor contact status	Binary Input 19 process value
1:0735	Monitor contact status	Binary Input 20 process value
1:0736	Monitor contact status	Binary Input 21 process value
1:0737	Monitor contact status	Binary Input 22 process value
1:0738	Monitor contact status	Binary Input 23 process value
1:0739	Monitor contact status	Binary Input 24 process value
1:0740	Monitor relay demand	RL01 DEMAND
1:0741	Monitor relay demand	RL02 DEMAND
1:0742	Monitor relay demand	RL03 DEMAND
1:0743	Monitor relay demand	RL04 DEMAND

Addr	Point Description	Interface Description
1:0744	Monitor relay demand	RL05 DEMAND
1:0745	Monitor relay demand	RL06 DEMAND
1:0746	Monitor relay demand	RL07 DEMAND
1:0747	Monitor relay demand	RL08 DEMAND
1:0748	Monitor relay demand	RL09 DEMAND
1:0749	Monitor relay demand	RL10 DEMAND
1:0750	Monitor relay demand	RL11 DEMAND
1:0751	Monitor relay demand	RL12 DEMAND
1:0752	Alarm BUS status	Trip
1:0753	Alarm BUS status	start interlock
1:0754	Alarm BUS status	HWR alarm
1:0755	Alarm BUS status	MAJOR alarm
1:0756	Alarm BUS status	Disable AUTO EXTRACT
1:0757	Alarm BUS status	disable auto DCPL
1:0758	Alarm BUS status	disable cascade
1:0759	Alarm BUS status	disable remote extr
1:0760	Alarm BUS status	disable remote DCPL
1:0761	Alarm BUS status	disable remote cascade
1:0762	Alarm BUS status	disable remote speed
1:0763	Alarm BUS status	antisurge disable
1:0764	Inhibit Bus status	Start inhibited
1:0765	Inhibit Bus status	cascade inhibited
1:0766	Inhibit Bus status	extraction inhibited
1:0767	Inhibit Bus status	decoupling inhibited
1:0768	Inhibit Bus status	Remote extraction inhibited
1:0769	Inhibit Bus status	remote cascade inhibited
1:0770	Inhibit Bus status	remote decoupling inhibited
1:0771	Inhibit Bus status	Remote speed inhibited
1:0772	Inhibit Bus status	Antisurge1 inhibit
1:0773	Inhibit Bus status	Antisurge2 inhibit
1:0774	Inhibit Bus status	Antisurge3 inhibit
1:0775	Inhibit Bus status	Antisurge4 inhibit
1:0776	Inhibit Bus status	engine tripped start inhibit
1:0777	Spare	SD BUS
1:0778	Spare	start interlock
1:0779	Spare	HWR alarm
1:0780	Spare	MAJOR alarm
1:0781	Spare	Disable AUTO EXTRACT
1:0782	Spare	disable auto DCPL
1:0783	Spare	disable cascade
1:0784	Spare	disable remote extr
1:0785	Spare	disable remote DCPL
1:0786	Spare	disable remote cascade
1:0787	Spare	disable remote speed
1:0788	Spare	antisurge disable
1:0789	Spare	Start inhibited
1:0790	Spare	cascade inhibited
1:0791	Spare	extraction inhibited
1:0792	Spare	decoupling inhibited
1:0793	Spare	Remote extraction inhibited

Addr	Point Description	Interface Description
1:0794	Spare	remote cascade inhibited
1:0795	Spare	remote decoupling inhibited
1:0796	Spare	Remote speed inhibited
1:0797	Spare	Antisurge1 inhibit
1:0798	Spare	Antisurge2 inhibit
1:0799	Spare	Antisurge3 inhibit
1:0800	Spare	Antisurge4 inhibit
1:0801	configuration	use SD mod1
1:0802	configuration	use SD mod2
1:0803	configuration	two step SD mod1
1:0804	configuration	two step SD mod2
1:0805	control status	start inhibit
1:0806	control status	local/remote
1:0807	control status	DCPL manual requested
1:0808	control status	Manual extraction requested
1:0809	control status	Seal PID in Auto
1:0810	control status	remote active/contact locked
1:0811	control status	Cascade SP track enabled
1:0812	control status	start inhibited from Configuration
1:0813	control status	decoupling limiter in control
1:0814	control status	Decoupling SP track enabled
1:0815	control status	alarm E/A limited
1:0816	control status	alarm decoupled limited
1:0817	control status	alarm speed/cascade limited
1:0818	Extraction Steps	extraction disable
1:0819	Extraction Steps	Manual enabling
1:0820	Extraction Steps	extraction manual
1:0821	Extraction Steps	extraction semi-auto
1:0822	Extraction Steps	extraction remote
1:0823	Extraction Steps	disabling
1:0824	Extraction Steps	extraction auto enabling
1:0825	Extraction Steps	decoupled manual
1:0826	Extraction Steps	decoupled semi-auto
1:0827	Extraction Steps	decoupled remote
1:0828	Extraction Steps	All limited
1:0829	Extraction Steps	coupled limited
1:0830	Extraction Steps	decoupled limited
1:0831	Extraction Steps	speed limited
1:0832	Extraction Steps	No limitation
1:0833	extraction PID	Extraction SP track enabled
1:0834	LP valve control Steps	shutdown
1:0835	LP valve control Steps	RAMP LP
1:0836	LP valve control Steps	Driver shutdown
1:0837	LP valve control Steps	Automatic start-up valve ramp to 100%
1:0838	LP valve control Steps	semi automatic start
1:0839	LP valve control Steps	manual start
1:0840	configuration HP valve	SD if HP MX no speed
1:0841	configuration HP valve	Split valve?
1:0842	copy status from Limit SW	start inhibited from Level LSW1
1:0843	copy status from Limit SW	start inhibited from Level LSW2

Addr	Point Description	Interface Description
1:0844	copy status from Limit SW	start inhibited from Level LSW3
1:0845	copy status from Limit SW	start inhibited from Level LSW4
1:0846	copy status from Limit SW	unload demand from level sw
1:0847	copy status from Limit SW	level activated
1:0848	copy status from Limit SW	LSW1 low level switch
1:0849	copy status from Limit SW	level activated
1:0850	copy status from Limit SW	LSW2 low level switch
1:0851	copy status from Limit SW	level activated
1:0852	copy status from Limit SW	LSW3 low level switch
1:0853	copy status from Limit SW	level activated
1:0854	copy status from Limit SW	LSW4 low level switch
1:0855	Level relay configuration	relay RL04 low switch
1:0856	Level relay configuration	relay RL05 low switch
1:0857	Level relay configuration	relay RL06 low switch
1:0858	Level relay configuration	relay RL07 low switch
1:0859	Level relay configuration	relay RL08 low switch
1:0860	Level relay configuration	relay RL09 low switch
1:0861	Level relay configuration	relay RL10 low switch
1:0862	Level relay configuration	relay RL11 low switch
1:0863	Level relay configuration	relay RL12 low switch
1:0864	Save EEPROM	feedback
1:0865	Xfer data inter-Modbus	Binary B01 from M1 to M2
1:0866	Xfer data inter-Modbus	Binary B02 from M1 to M2
1:0867	Xfer data inter-Modbus	Binary B03 from M1 to M2
1:0868	Xfer data inter-Modbus	Binary B04 from M1 to M2
1:0869	Xfer data inter-Modbus	Binary B05 from M1 to M2
1:0870	Xfer data inter-Modbus	Binary B06 from M1 to M2
1:0871	Xfer data inter-Modbus	Binary B07 from M1 to M2
1:0872	Xfer data inter-Modbus	Binary B08 from M1 to M2
1:0873	Xfer data inter-Modbus	Binary B09 from M1 to M2
1:0874	Xfer data inter-Modbus	Binary B10 from M1 to M2
1:0875	Xfer data inter-Modbus	Binary B11 from M1 to M2
1:0876	Xfer data inter-Modbus	Binary B12 from M1 to M2
1:0877	Xfer data inter-Modbus	Binary B13 from M1 to M2
1:0878	Xfer data inter-Modbus	Binary B14 from M1 to M2
1:0879	Xfer data inter-Modbus	Binary B15 from M1 to M2
1:0880	Xfer data inter-Modbus	Binary B16 from M1 to M2
1:0881	Xfer data inter-Modbus	Binary B17 from M1 to M2
1:0882	Xfer data inter-Modbus	Binary B18 from M1 to M2
1:0883	Xfer data inter-Modbus	Binary B19 from M1 to M2
1:0884	Xfer data inter-Modbus	Binary B20 from M1 to M2
1:0885	Xfer data inter-Modbus	Binary B21 from M1 to M2
1:0886	Xfer data inter-Modbus	Binary B22 from M1 to M2
1:0887	Xfer data inter-Modbus	Binary B23 from M1 to M2
1:0888	Xfer data inter-Modbus	Binary B24 from M1 to M2
1:0889	Xfer data inter-Modbus	Binary B25 from M1 to M2
1:0890	Modbus Status	Modbus #1 CMD enabled
1:0891	Modbus Status	Modbus #2 CMD enabled
1:0892	configuration	decoupling not configured
1:0893	configuration	extraction not configured

Addr	Point Description	Interface Description
1:0894	configuration	Red1: actuator B selected
1:0895	configuration	Red2: actuator B selected
1:0896	copy command from remote IO	SD09 from remote IO
1:0897	copy command from remote IO	SD10 from remote IO
1:0898	Setpoint track selected	Seal gas PID
1:0899	Start-up completed	start-up not completed
1:0900	copy	extraction inhibit
1:0901	Speed reference	start inhibit in critical band
1:0902	Speed sequence Steps	RESET position
1:0903	Speed sequence Steps	Restart position
1:0904	Speed sequence Steps	Start-up to warm-up level 1
1:0905	Speed sequence Steps	Automatic warm-up at idle
1:0906	Speed sequence Steps	Manual start-up
1:0907	Speed sequence Steps	Automatic start-up to warm-up level 2
1:0908	Speed sequence Steps	Automatic warm-up at warm-up level 2
1:0909	Speed sequence Steps	Automatic start-up to warm-up level 3
1:0910	Speed sequence Steps	Automatic warm-up at warm-up level 3
1:0911	Speed sequence Steps	Automatic start-up to rated
1:0912	Speed sequence Steps	Start-up completed
1:0913	Speed sequence Steps	Overspeed test
1:0914	Speed sequence Steps	Overspeed test aborted
1:0915	Speed sequence	Automatic start selected
1:0916	Speed Sequence Steps	Remote speed setpoint disabled
1:0917	Speed Sequence Steps	Remote speed setpoint enabled
1:0918	Speed Sequence Steps	Cascade mode selected
1:0919	Speed Sequence Steps	remote cascade
1:0920	speed configuration levels	Critical range 1 active
1:0921	speed configuration levels	Critical range 2 active
1:0922	speed configuration levels	critical speed 1 rate fixed?
1:0923	speed configuration levels	critical speed 2 rate fixed?
1:0924	speed configuration levels	Start-up level 2 active
1:0925	speed configuration levels	Start-up level 3 active
1:0926	speed configuration levels	min speed is High critical?
1:0927	Speed sequence	RUN BACK TO IDLE
1:0928	Speed control	MMI online parameters
1:0929	Speed sequence	use remote timer
1:0930	Speed sequence Steps	shutdown
1:0931	Speed sequence Steps	normal SD in progress
1:0932	Null speed logic	null speed detected
1:0933	Speed sequence	Not enough load
1:0934	configuration	Pressure prior at min load
1:0935	Xfer data inter-Modbus	Binary B01 from M2 to M1
1:0936	Xfer data inter-Modbus	Binary B02 from M2 to M1
1:0937	Xfer data inter-Modbus	Binary B03 from M2 to M1
1:0938	Xfer data inter-Modbus	Binary B04 from M2 to M1
1:0939	Xfer data inter-Modbus	Binary B05 from M2 to M1
1:0940	Xfer data inter-Modbus	Binary B06 from M2 to M1
1:0941	Xfer data inter-Modbus	Binary B07 from M2 to M1
1:0942	Xfer data inter-Modbus	Binary B08 from M2 to M1
1:0943	Xfer data inter-Modbus	Binary B09 from M2 to M1

Addr	Point Description	Interface Description
1:0944	Xfer data inter-Modbus	Binary B10 from M2 to M1
1:0945	Xfer data inter-Modbus	Binary B11 from M2 to M1
1:0946	Xfer data inter-Modbus	Binary B12 from M2 to M1
1:0947	Xfer data inter-Modbus	Binary B13 from M2 to M1
1:0948	Xfer data inter-Modbus	Binary B14 from M2 to M1
1:0949	Xfer data inter-Modbus	Binary B15 from M2 to M1
1:0950	Xfer data inter-Modbus	Binary B16 from M2 to M1
1:0951	Xfer data inter-Modbus	Binary B17 from M2 to M1
1:0952	Xfer data inter-Modbus	Binary B18 from M2 to M1
1:0953	Xfer data inter-Modbus	Binary B19 from M2 to M1
1:0954	Xfer data inter-Modbus	Binary B20 from M2 to M1
1:0955	Xfer data inter-Modbus	Binary B21 from M2 to M1
1:0956	Xfer data inter-Modbus	Binary B22 from M2 to M1
1:0957	Xfer data inter-Modbus	Binary B23 from M2 to M1
1:0958	Xfer data inter-Modbus	Binary B24 from M2 to M1
1:0959	Xfer data inter-Modbus	Binary B25 from M2 to M1
1:0960	Start Inhibit conditions	In calibration mode/start INHIBIT
1:0961	Start Inhibit conditions	ALM calibration A 106 ch 1 not complete
1:0962	Start Inhibit conditions	ALM calibration C106 ch1 not completed
1:0963	Start Inhibit conditions	ALM calibration A106 ch 2 not complete
1:0964	Start Inhibit conditions	ALM calibration C106 ch 2 not complete
1:0965	Start Inhibit conditions	Start inhibit from contact
1:0966	Start Inhibit conditions	Actuator channel 1 not ready
1:0967	Start Inhibit conditions	Actuator channel 2 not ready
1:0968	Start Inhibit conditions	Start inhibit in critical band
1:0969	Start Inhibit conditions	Start inhibited from Level LSW1
1:0970	Start Inhibit conditions	Start inhibited from Level LSW2
1:0971	Start Inhibit conditions	Start inhibited from Level LSW3
1:0972	Start Inhibit conditions	Start inhibited from Level LSW4
1:0973	Start Inhibit conditions	Start inhibited from Configuration
1:0974	Start Inhibit conditions	From remote IO#1
1:0975	Start Inhibit conditions	From remote IO#2
1:0976	Start Inhibit conditions	HP valve opened
1:0977	configure	start-up not completed
1:0978	configure	unload demand from level sw
1:0979	configure	extraction not configured
1:0980	configure	extraction inhibit
1:0981	configure	Not enough load
1:0982	configure	decoupling not configured
1:0983	Spare	
1:0984	Spare	
1:0985	Spare	
1:0986	configure	no remote speed AI configured
1:0987	configure	start-up not completed
1:0988	Start control	Unload demand form level switch

Table 7-6. Boolean Reads

Addr	ServLink TAG	Description	Units	MLT

Addr	ServLink TAG	Description	Units	MLT
3:0001	ABITPACK.M4BA01PACK.A_NAME	BitPack SD 1-16	N/A	N/A
3:0002	ABITPACK.M4BA02PACK.A_NAME	BitPack SD 17-32	N/A	N/A
3:0003	ABITPACK.M4BA03PACK.A_NAME	BitPack SD 33-48	N/A	N/A
3:0004	ABITPACK.M4BA04PACK.A_NAME	BitPack Start interlock 1-16	N/A	N/A
3:0005	ABITPACK.M4BA05PACK.A_NAME	BitPack Alarm 1-16	N/A	N/A
3:0006	ABITPACK.M4BA06PACK.A_NAME	BitPack Alarm 17-32	N/A	N/A
3:0007	ABITPACK.M4BA07PACK.A_NAME	BitPack Alarm 33-48	N/A	N/A
3:0008	ABITPACK.M4BA08PACK.A_NAME	BitPack Alarm 49-64	N/A	N/A
3:0009	ABITPACK.M4BA09PACK.A_NAME	BitPack Alarm 65-80	N/A	N/A
3:0010	ABITPACK.M4BA10PACK.A_NAME	BitPack Alarm 81-96	N/A	N/A
3:0011	ABITPACK.M4BA11PACK.A_NAME	BitPack Alarm 97-112	N/A	N/A
3:0012	ABITPACK.M4BA12PACK.A_NAME	BitPack Alarm 113-128	N/A	N/A
3:0013	ABITPACK.M4BA13PACK.A_NAME	BitPack Alarm 129-144	N/A	N/A
3:0014	ABITPACK.M4BA14PACK.A_NAME	BitPack Alarm 145-160	N/A	N/A
3:0015	ABITPACK.M4BA15PACK.A_NAME	BitPack Alarm 161-176	N/A	N/A
3:0016	ABITPACK.M4BA16PACK.A_NAME	BitPack Alarm 177-192	N/A	N/A
3:0017	ABITPACK.M4BA17PACK.A_NAME	BitPack Alarm 193-208	N/A	N/A
3:0018	ABITPACK.M4BA18PACK.A_NAME	BitPack Alarm 209-224	N/A	N/A
3:0019	ABITPACK.M4BA19PACK.A_NAME	BitPack Alarm 225-240	N/A	N/A
3:0020	ABITPACK.M4BA20PACK.A_NAME	BitPack Alarm 241-256	N/A	N/A
3:0021	ABITPACK.M4BA21PACK.A_NAME	BitPack Alarm 257-272	N/A	N/A
3:0022	ABITPACK.M4BA22PACK.A_NAME	BitPack Alarm 273-288	N/A	N/A
3:0023	ABITPACK.M4BA23PACK.A_NAME	BitPack Alarm 289-304	N/A	N/A
3:0024	ABITPACK.M4BA24PACK.A_NAME	BitPack Alarm 305-320	N/A	N/A
3:0025	ABITPACK.M4BA25PACK.A_NAME	BitPack Alarm 321-336	N/A	N/A
3:0026	ABITPACK.M4BA26PACK.A_NAME	BitPack Alarm 337-352	N/A	N/A
3:0027	ABITPACK.M4BA27PACK.A_NAME	BitPack Alarm 353-368	N/A	N/A
3:0028	ABITPACK.M4BA28PACK.A_NAME	BitPack Alarm 369-384	N/A	N/A
3:0029	ABITPACK.M4BA29PACK.A_NAME	BitPack Alarm 385-400	N/A	N/A
3:0030	ABITPACK.M4BA30PACK.A_NAME	BitPack Alarm 401-416	N/A	N/A
3:0031	ABITPACK.M4BA31PACK.A_NAME	BitPack Alarm 417-432	N/A	N/A
3:0032	ABITPACK.M4BA32PACK.A_NAME	BitPack Alarm 433-448	N/A	N/A
3:0033	ABITPACK.M4BA33PACK.A_NAME	BitPack Alarm 449-464	N/A	N/A
3:0034	ABITPACK.M4BA34PACK.A_NAME	BitPack Alarm 465-480	N/A	N/A
3:0035	ABITPACK.M4BA35PACK.A_NAME	BitPack Alarm 481-496	N/A	N/A
3:0036	ABITPACK.M4BA36PACK.A_NAME	BitPack Alarm 497-512	N/A	N/A
3:0037	ABITPACK.M4BA37PACK.A_NAME	BitPack Alarm 513-528	N/A	N/A
3:0038	ABITPACK.M4BA38PACK.A_NAME	BitPack Alarm 529-544	N/A	N/A
3:0039	ABITPACK.M4BA39PACK.A_NAME	BitPack Major Alarm 1-16	N/A	N/A
3:0040	ABITPACK.M4BA40PACK.A_NAME	BitPack Major Alarm 17-32	N/A	N/A
3:0041	ABITPACK.M4BA41PACK.A_NAME	BitPack Major Alarm 33-48	N/A	N/A
3:0042	ABITPACK.M4BA42PACK.A_NAME	BitPack Major Alarm 49-64	N/A	N/A
3:0043	ABITPACK.M4BA43PACK.A_NAME	BitPack Start Inhibit 1-16	N/A	N/A
3:0044	ACT_.M4ACT1V_A.A_NAME	ACT1-Combo current output A	mA	100
3:0045	ACT_.M4ACT1V_B.A_NAME	ACT1-Combo current output C	mA	100
3:0046	ACT_.M4ACT1V_C.A_NAME	ACT1-Combo current output C	mA	100
3:0047	ACT_.M4ACT1V_T.A_NAME	ACT1-Combo current output total	mA	100
3:0048	ACT_.M4ACT2V_A.A_NAME	ACT2-Combo current output A	mA	100
3:0049	ACT_.M4ACT2V_B.A_NAME	ACT2-Combocurrent output C	mA	100
3:0050	ACT_.M4ACT2V_C.A_NAME	ACT2-Combocurrent output C	mA	100
3:0051	ACT_.M4ACT2V_T.A_NAME	ACT2-Combocurrent output total	mA	100
3:0052	ACT_.M4CF__HP.A_NAME	HP channel number configured	none	1

Addr	ServLink TAG	Description	Units	MLT
3:0053	ACT_.M4CF__HP2.A_NAME	HP2 channel number configured	none	1
3:0054	ACT_.M4CF__LP.A_NAME	LP channel number configured	none	1
3:0055	ACT_.M4CF__LP2.A_NAME	LP2 channel number configured	none	1
3:0056	ACT_.M4HPDR_MN.A_NAME	Min HP pilot deviation	%	100
3:0057	ACT_.M4HPDR_MX.A_NAME	Max HP pilot deviation	%	100
3:0058	ACT_.M4HPDV_MN.A_NAME	Min HP derivative	%/s	100
3:0059	ACT_.M4HPDV_MX.A_NAME	Max HP derivative	%/s	100
3:0060	ACT_.M4HPPIDEG.A_NAME	calculated HP pilot deviation (deg)	%	100
3:0061	ACT_M4HPPIDERV.A_NAME	HP pilot derivative	%/s	100
3:0062	ACT_.M4LPDR_MN.A_NAME	Min LP pilot deviation	%	100
3:0063	ACT_.M4LPDR_MX.A_NAME	Max LP pilot deviation	%	100
3:0064	ACT_.M4LPDV_MN.A_NAME	Min LP derivative	%/s	100
3:0065	ACT_.M4LPDV_MX.A_NAME	Max LP derivative	%/s	100
3:0066	ACT_.M4LPPIDEG.A_NAME	calculated LP pilot deviation (deg)	%	100
3:0067	ACT_M4LPPIDERV.A_NAME	LP pilot derivative	%/s	100
3:0068	ACT_06_CH1.M4CFKI_PV.A_NAME	Actuator1 (A/C106) KI Value	none	100
3:0069	ACT_06_CH1.M4CFKP_PV.A_NAME	Actuator1 (A/C106) KP Value	none	100
3:0070	ACT_06_CH1.M4CFNLP1V.A_NAME	Actuator1 (A/C106) Null Current	none	100
3:0071	ACT_06_CH1.M4CFPG_PV.A_NAME	Actuator 1 (A/C106) Pilot gain	none	100
3:0072	ACT_06_CH2.M4CFKI_PV.A_NAME	I Actuator1 (A/C106) KI Value	none	100
3:0073	ACT_06_CH2.M4CFKP_PV.A_NAME	I Actuator1 (A/C106) KP Value	none	100
3:0074	ACT_06_CH2.M4CFNLP1V.A_NAME	Actuator1 (A/C106) Null Current	mA	100
3:0075	ACT_06_CH2.M4CFPG_PV.A_NAME	Actuator 2 (A/C106) Pilot gain	none	100
3:0076	ACT_A106.M4_AVG_A1.A_NAME	ACT_A106 channel 1 FDBK average readback	%	100
3:0077	ACT_A106.M4_AVG_A2.A_NAME	ACT_A106 channel 2 FDBK average readback	%	100
3:0078	ACT_A106.M4_DMD_A1.A_NAME	ACT_A106 Channel 1 demand	%	100
3:0079	ACT_A106.M4_DMD_A2.A_NAME	ACT_A106 Channel 2 demand	%	100
3:0080	ACT_A106.M4FB1_A1.A_NAME	ACT_A106 channel 1 feedback 1 readback	%	100
3:0081	ACT_A106.M4FB1_A2.A_NAME	ACT_A106 channel 2 feedback 1 readback	%	100
3:0082	ACT_A106.M4FB2_A1.A_NAME	ACT_A106 channel 1 feedback2 readback	%	100
3:0083	ACT_A106.M4FB2_A2.A_NAME	ACT_A106 channel 2 feedback2 readback	%	100
3:0084	ACT_A106.M4MA_A1.A_NAME	ACT_A106 channel 1 mA output	mA	100
3:0085	ACT_A106.M4MA_A2.A_NAME	ACT_A106 channel 2 mA output	mA	100
3:0086	ACT_A106.M4VLT1_1A.A_NAME	LVDT1-A voltage A106 ch1	Vrms	100
3:0087	ACT_A106.M4VLT1_1B.A_NAME	LVDT1-B voltage A106 ch1	Vrms	100
3:0088	ACT_A106.M4VLT1_2A.A_NAME	LVDT2-A voltage A106 ch1	Vrms	100
3:0089	ACT_A106.M4VLT1_2B.A_NAME	LVDT2-B voltage A106 ch1	Vrms	100
3:0090	ACT_A106.M4VLT2_1A.A_NAME	LVDT1-A voltage A106 ch2	Vrms	100
3:0091	ACT_A106.M4VLT2_1B.A_NAME	LVDT1-B voltage A106 ch2	Vrms	100
3:0092	ACT_A106.M4VLT2_2A.A_NAME	LVDT2-A voltage A106 ch2	Vrms	100
3:0093	ACT_A106.M4VLT2_2B.A_NAME	LVDT2-B voltage A106 ch2	Vrms	100
3:0094	ACT_C106.M4_AVG_C1.A_NAME	ACT_C106 channel1 FDBK average readback	%	100
3:0095	ACT_C106.M4_AVG_C2.A_NAME	ACT_C106 Channel 2 FDBK average readback	%	100
3:0096	ACT_C106.M4_DMD_C1.A_NAME	ACT_C106 Channel 1 Channel 1 demand	%	100
3:0097	ACT_C106.M4_DMD_C2.A_NAME	ACT_C106 Channel 2 Channel 1 demand	%	100
3:0098	ACT_C106.M4FB1_C1.A_NAME	ACT_C106 Channel 1 feedback1 readback	%	100
3:0099	ACT_C106.M4FB1_C2.A_NAME	ACT_C106 Channel 2 feedback1	%	100

Addr	ServLink TAG	Description	Units	MLT
		readback		
3:0100	ACT_C106.M4FB2_C1.A_NAME	ACT_C106 Channel 1 feedback2 readback	%	100
3:0101	ACT_C106.M4FB2_C2.A_NAME	ACT_C106 Channel 2 feedback2 readback	%	100
3:0102	ACT_C106.M4MA_C1.A_NAME	ACT_C106 Channel 1 mA output	mA	100
3:0103	ACT_C106.M4MA_C2.A_NAME	ACT_C106 Channel 2 mA output	mA	100
3:0104	ACT_C106.M4VLT1_1A.A_NAME	LVDT1-A voltage C106 ch1	Vrms	100
3:0105	ACT_C106.M4VLT1_1B.A_NAME	LVDT1-B voltage C106 ch1	Vrms	100
3:0106	ACT_C106.M4VLT1_2A.A_NAME	LVDT2-A voltage C106 ch1	Vrms	100
3:0107	ACT_C106.M4VLT1_2B.A_NAME	LVDT2-B voltage C106 ch1	Vrms	100
3:0108	ACT_C106.M4VLT2_1A.A_NAME	LVDT1-A voltage C106 ch2	Vrms	100
3:0109	ACT_C106.M4VLT2_1B.A_NAME	LVDT1-B voltage C106 ch2	Vrms	100
3:0110	ACT_C106.M4VLT2_2A.A_NAME	LVDT2-A voltage C106 ch2	Vrms	100
3:0111	ACT_C106.M4VLT2_2B.A_NAME	LVDT2-B voltage C106 ch2	Vrms	100
3:0112	AI__.M4AI01_MA.A_NAME	mA value Analog Input 01	mA	100
3:0113	AI__.M4AI01A_MA.A_NAME	mA value Analog Input 01A	mA	100
3:0114	AI__.M4AI01B_MA.A_NAME	mA value Analog Input 01B	mA	100
3:0115	AI__.M4AI01C_MA.A_NAME	mA value Analog Input 01C	mA	100
3:0116	AI__.M4AI02_MA.A_NAME	mA value Analog Input 02	mA	100
3:0117	AI__.M4AI02A_MA.A_NAME	mA value Analog Input 02A	mA	100
3:0118	AI__.M4AI02B_MA.A_NAME	mA value Analog Input 02B	mA	100
3:0119	AI__.M4AI02C_MA.A_NAME	mA value Analog Input 02C	mA	100
3:0120	AI__.M4AI03_MA.A_NAME	mA value Analog Input 03	mA	100
3:0121	AI__.M4AI03A_MA.A_NAME	mA value Analog Input 03A	mA	100
3:0122	AI__.M4AI03B_MA.A_NAME	mA value Analog Input 03B	mA	100
3:0123	AI__.M4AI03C_MA.A_NAME	mA value Analog Input 03C	mA	100
3:0124	AI__.M4AI04_MA.A_NAME	mA value Analog Input 04	mA	100
3:0125	AI__.M4AI04A_MA.A_NAME	mA value Analog Input 04A	mA	100
3:0126	AI__.M4AI04B_MA.A_NAME	mA value Analog Input 04B	mA	100
3:0127	AI__.M4AI04C_MA.A_NAME	mA value Analog Input 04C	mA	100
3:0128	AI__.M4AI05_MA.A_NAME	mA value Analog Input 05	mA	100
3:0129	AI__.M4AI05A_MA.A_NAME	mA value Analog Input 05A	mA	100
3:0130	AI__.M4AI05B_MA.A_NAME	mA value Analog Input 05B	mA	100
3:0131	AI__.M4AI05C_MA.A_NAME	mA value Analog Input 05C	mA	100
3:0132	AI__.M4AI06_MA.A_NAME	mA value Analog Input 06	mA	100
3:0133	AI__.M4AI06A_MA.A_NAME	mA value Analog Input 06A	mA	100
3:0134	AI__.M4AI06B_MA.A_NAME	mA value Analog Input 06B	mA	100
3:0135	AI__.M4AI06C_MA.A_NAME	mA value Analog Input 06C	mA	100
3:0136	AI__.M4AI07_MA.A_NAME	mA value Analog Input 07	mA	100
3:0137	AI__.M4AI07A_MA.A_NAME	mA value Analog Input 07A	mA	100
3:0138	AI__.M4AI07B_MA.A_NAME	mA value Analog Input 07B	mA	100
3:0139	AI__.M4AI07C_MA.A_NAME	mA value Analog Input 07C	mA	100
3:0140	AI__.M4AI08_MA.A_NAME	mA value Analog Input 08	mA	100
3:0141	AI__.M4AI08A_MA.A_NAME	mA value Analog Input 08A	mA	100
3:0142	AI__.M4AI08B_MA.A_NAME	mA value Analog Input 08B	mA	100
3:0143	AI__.M4AI08C_MA.A_NAME	mA value Analog Input 08C	mA	100
3:0144	AI__.M4CASC_MLT.A_NAME	cascade PV multiplier factor	none	10
3:0145	AI__.M4CASC_NB.A_NAME	number of casc channel used	none	1
3:0146	AI__.M4CASCDEF.A_NAME	cascade usage	none	1
3:0147	AI__.M4CASCPV.A_NAME	cascade PV	Units	MLT factor
3:0148	AI__.M4CASCPV_A.A_NAME	cascade Value A	Units	MLT factor
3:0149	AI__.M4CASCPV_B.A_NAME	cascade Value B	Units	MLT factor

Addr	ServLink TAG	Description	Units	MLT
3:0150	AI__.M4CASCPV_C.A_NAME	cascade Value C	Units	MLT factor
3:0151	AI__.M4CASCUNIT.A_NAME	unit for cascade	none	1
3:0152	AI__.M4DCPL_MLT.A_NAME	decoupling PV multiply factor	none	10
3:0153	AI__.M4DCPL_NB.A_NAME	number of decoupling channel used	none	1
3:0154	AI__.M4DCPLDEF.A_NAME	decoupling usage	none	1
3:0155	AI__.M4DCPLPV.A_NAME	Process Value	Units	MLT factor
3:0156	AI__.M4DCPLPV_A.A_NAME	Process Value A	Units	MLT factor
3:0157	AI__.M4DCPLPV_B.A_NAME	Process Value B	Units	MLT factor
3:0158	AI__.M4DCPLPV_C.A_NAME	Process Value C	Units	MLT factor
3:0159	AI__.M4DCPLUNIT.A_NAME	unit for decoupling	none	1
3:0160	AI__.M4EXTR_NB.A_NAME	number of EXTR channel used	none	1
3:0161	AI__.M4EXTRMLT.A_NAME	extraction PV multiply factor	none	10
3:0162	AI__.M4EXTRPV.A_NAME	extraction PV	Units	MLT factor
3:0163	AI__.M4EXTRPV_A.A_NAME	extraction Value A	Units	MLT factor
3:0164	AI__.M4EXTRPV_B.A_NAME	extraction Value B	Units	MLT factor
3:0165	AI__.M4EXTRPV_C.A_NAME	extraction Value C	Units	MLT factor
3:0166	AI__.M4EXTRUNIT.A_NAME	unit for extraction	none	1
3:0167	AI__.M4FW___MLT.A_NAME	feed forward multiply factor	none	10
3:0168	AI__.M4FW__PV.A_NAME	feed-forward PV	rpm	MLT factor
3:0169	AI__.M4HPK1_MLT.A_NAME	HP gain compensation multiply factor	none	10
3:0170	AI__.M4HPK1PV.A_NAME	HP gain compensation PV	Units	MLT factor
3:0171	AI__.M4HPK1UNIT.A_NAME	unit for extraction	none	1
3:0172	AI__.M4IH1A_MLT.A_NAME	IH-A-redundancy1 multiply factor	none	10
3:0173	AI__.M4IH1APV.A_NAME	IH-A-redundancy1	none	MLT factor
3:0174	AI__.M4IH1B_MLT.A_NAME	IH-A-redundancy2 multiply factor	none	10
3:0175	AI__.M4IH1BPV.A_NAME	IH-B-redundancy1	none	MLT factor
3:0176	AI__.M4IH2A_MLT.A_NAME	IH-A-redundancy2 multiply factor	none	10
3:0177	AI__.M4IH2APV.A_NAME	IH-A-redundancy2	none	MLT factor
3:0178	AI__.M4IH2B_MLT.A_NAME	IH-B-redundancy2 multiply factor	none	10
3:0179	AI__.M4IH2BPV.A_NAME	IH-B-redundancy2	none	MLT factor
3:0180	AI__.M4LPK1_MLT.A_NAME	LP gain compensation multiply factor	none	10
3:0181	AI__.M4LPK1PV.A_NAME	LP gain compensation	Units	MLT factor
3:0182	AI__.M4LPK1UNIT.A_NAME	unit for LP compensation	none	1
3:0183	AI__.M4MON1_MLT.A_NAME	monitor PV multiply factor	none	10
3:0184	AI__.M4MON1DEF.A_NAME	MON1 usage	none	1
3:0185	AI__.M4MON1PV.A_NAME	monitor1 PV	Units	MLT factor
3:0186	AI__.M4MON1UNIT.A_NAME	unit for monitor#1	none	1
3:0187	AI__.M4MON2_MLT.A_NAME	monitor2 PV multiply factor	none	10
3:0188	AI__.M4MON2DEF.A_NAME	MON2 usage	none	1
3:0189	AI__.M4MON2PV.A_NAME	monitor2 Value	Units	MLT factor
3:0190	AI__.M4MON2UNIT.A_NAME	unit for monitor2	none	1
3:0191	AI__.M4MON3_MLT.A_NAME	monitor3 PV multiply factor	none	10
3:0192	AI__.M4MON3DEF.A_NAME	MON3 usage	none	1
3:0193	AI__.M4MON3PV.A_NAME	monitor3 Value	Units	MLT factor
3:0194	AI__.M4MON3UNIT.A_NAME	unit for monitor3	none	1
3:0195	AI__.M4MON4_MLT.A_NAME	monitor4 PV multiply factor	none	10
3:0196	AI__.M4MON4DEF.A_NAME	MON4 usage	none	1
3:0197	AI__.M4MON4PV.A_NAME	monitor4 Value	Units	MLT factor
3:0198	AI__.M4MON4UNIT.A_NAME	unit for moniotr4	none	1
3:0199	AI__.M4RCASPV.A_NAME	remote cascade	Units	MLT factor
3:0200	AI__.M4RDCLPV.A_NAME	remote decoupling setpoint	Units	MLT factor
3:0201	AI__.M4REXTPV.A_NAME	remote extraction	Units	MLT factor

Addr	ServLink TAG	Description	Units	MLT
3:0202	AI__.M4RSPDPV.A_NAME	remote speed SP	rpm	1
3:0203	AI__.M4RTIM_MLT.A_NAME	remote timer multiply factor	none	10
3:0204	AI__.M4RTIMPV.A_NAME	remote HOT/COLD timer	none	MLT factor
3:0205	AI__.M4SEAL_MLT.A_NAME	Seal PID PV multiplier factor	none	10
3:0206	AI__.M4SEAL_PV.A_NAME	Seal PID Process value	none	MLT factor
3:0207	AI__.M4SEAL_UNIT.A_NAME	Seal Units	none	1
3:0208	AI_CONF_IN.M4A_IN_01F.A_NAME	configuration number AI#1	none	1
3:0209	AI_CONF_IN.M4A_IN_02F.A_NAME	configuration number AI#2	none	1
3:0210	AI_CONF_IN.M4A_IN_03F.A_NAME	configuration number AI#3	none	1
3:0211	AI_CONF_IN.M4A_IN_04F.A_NAME	configuration number AI#4	none	1
3:0212	AI_CONF_IN.M4A_IN_05F.A_NAME	configuration number AI#5	none	1
3:0213	AI_CONF_IN.M4A_IN_06F.A_NAME	configuration number AI#6	none	1
3:0214	AI_CONF_IN.M4A_IN_07F.A_NAME	configuration number AI#7	none	1
3:0215	AI_CONF_IN.M4A_IN_08F.A_NAME	configuration number AI#8	none	1
3:0216	AO__.M4AO01V_A.A_NAME	current output Analog Output 1A	mA	100
3:0217	AO__.M4AO01V_B.A_NAME	current output Analog Output 1B	mA	100
3:0218	AO__.M4AO01V_C.A_NAME	current output Analog Output 1C	mA	100
3:0219	AO__.M4AO01V_T.A_NAME	current output Analog Output 1	mA	100
3:0220	AO__.M4AO02V_A.A_NAME	current output Analog Output 2A	mA	100
3:0221	AO__.M4AO02V_B.A_NAME	current output Analog Output 2B	mA	100
3:0222	AO__.M4AO02V_C.A_NAME	current output Analog Output 2C	mA	100
3:0223	AO__.M4AO02V_T.A_NAME	current output Analog Output 2	mA	100
3:0224	AO__.M4AO03V_A.A_NAME	current output Analog Output 3A	mA	100
3:0225	AO__.M4AO03V_B.A_NAME	current output Analog Output 3B	mA	100
3:0226	AO__.M4AO03V_C.A_NAME	current output Analog Output 3C	mA	100
3:0227	AO__.M4AO03V_T.A_NAME	current output Analog Output 3	mA	100
3:0228	AO__.M4AO04V_A.A_NAME	current output Analog Output 4A	mA	100
3:0229	AO__.M4AO04V_B.A_NAME	current output Analog Output 4B	mA	100
3:0230	AO__.M4AO04V_C.A_NAME	current output Analog Output 4C	mA	100
3:0231	AO__.M4AO04V_T.A_NAME	current output Analog Output 4	mA	100
3:0232	BI_CONF_IN.M4B_IN_08C.A_NAME	configuration number B_IN_08	none	1
3:0233	BI_CONF_IN.M4B_IN_09C.A_NAME	configuration number B_IN_09	none	1
3:0234	BI_CONF_IN.M4B_IN_10C.A_NAME	configuration number B_IN_10	none	1
3:0235	BI_CONF_IN.M4B_IN_11C.A_NAME	configuration number B_IN_11	none	1
3:0236	BI_CONF_IN.M4B_IN_12C.A_NAME	configuration number B_IN_12	none	1
3:0237	BI_CONF_IN.M4B_IN_13C.A_NAME	configuration number B_IN_13	none	1
3:0238	BI_CONF_IN.M4B_IN_14C.A_NAME	configuration number B_IN_14	none	1
3:0239	BI_CONF_IN.M4B_IN_15C.A_NAME	configuration number B_IN_15	none	1
3:0240	BI_CONF_IN.M4B_IN_16C.A_NAME	configuration number B_IN_16	none	1
3:0241	BI_CONF_IN.M4B_IN_17C.A_NAME	configuration number B_IN_17	none	1
3:0242	BI_CONF_IN.M4B_IN_18C.A_NAME	configuration number B_IN_18	none	1
3:0243	BI_CONF_IN.M4B_IN_19C.A_NAME	configuration number B_IN_19	none	1
3:0244	BI_CONF_IN.M4B_IN_20C.A_NAME	configuration number B_IN_20	none	1
3:0245	BI_CONF_IN.M4B_IN_21C.A_NAME	configuration number B_IN_21	none	1
3:0246	BI_CONF_IN.M4B_IN_22C.A_NAME	configuration number B_IN_22	none	1
3:0247	BI_CONF_IN.M4B_IN_23C.A_NAME	configuration number B_IN_23	none	1
3:0248	BI_CONF_IN.M4B_IN_24C.A_NAME	configuration number B_IN_24	none	1
3:0249	BO__.M4RL04_ST.A_NAME	RL04- CF status (used/level/state)	none	1
3:0250	BO__.M4RL04LWST.A_NAME	RL04 CF level number	none	1
3:0251	BO__.M4RL04SWST.A_NAME	RL04 CF switch number	none	1
3:0252	BO__.M4RL05_ST.A_NAME	RL05- CF status (used/level/state)	none	1
3:0253	BO__.M4RL05LWST.A_NAME	RL05 CF level number	none	1

Addr	ServLink TAG	Description	Units	MLT
3:0254	BO__.M4RL05SWST.A_NAME	RL05 CF switch number	none	1
3:0255	BO__.M4RL06_ST.A_NAME	RL06- CF status (used/level/state)	none	1
3:0256	BO__.M4RL06LWST.A_NAME	RL06 CF level number	none	1
3:0257	BO__.M4RL06SWST.A_NAME	RL06 CF switch number	none	1
3:0258	BO__.M4RL07_ST.A_NAME	RL07- CF status (used/level/state)	none	1
3:0259	BO__.M4RL07LWST.A_NAME	RL07 CF level number	none	1
3:0260	BO__.M4RL07SWST.A_NAME	RL07 CF switch number	none	1
3:0261	BO__.M4RL08_ST.A_NAME	RL08- CF status (used/level/state)	none	1
3:0262	BO__.M4RL08LWST.A_NAME	RL08 CF level number	none	1
3:0263	BO__.M4RL08SWST.A_NAME	RL08 CF switch number	none	1
3:0264	BO__.M4RL09_ST.A_NAME	RL09- CF status (used/level/state)	none	1
3:0265	BO__.M4RL09LWST.A_NAME	RL09 CF level number	none	1
3:0266	BO__.M4RL09SWST.A_NAME	RL09 CF switch number	none	1
3:0267	BO__.M4RL10_ST.A_NAME	RL10- CF status (used/level/state)	none	1
3:0268	BO__.M4RL10LWST.A_NAME	RL10 CF level number	none	1
3:0269	BO__.M4RL10SWST.A_NAME	RL10 CF switch number	none	1
3:0270	BO__.M4RL11_ST.A_NAME	RL11- CF status (used/level/state)	none	1
3:0271	BO__.M4RL11LWST.A_NAME	RL11 CF level number	none	1
3:0272	BO__.M4RL11SWST.A_NAME	RL11 CF switch number	none	1
3:0273	BO__.M4RL12_ST.A_NAME	RL12- CF status (used/level/state)	none	1
3:0274	BO__.M4RL12LWST.A_NAME	RL12 CF level number	none	1
3:0275	BO__.M4RL12SWST.A_NAME	RL12 CF switch number	none	1
3:0276	C_READOUT.M4A_OUT01F.A_NAME	configuration number AO#1	none	1
3:0277	C_READOUT.M4A_OUT02F.A_NAME	configuration number AO#2	none	1
3:0278	C_READOUT.M4A_OUT03F.A_NAME	configuration number AO#3	none	1
3:0279	C_READOUT.M4A_OUT04F.A_NAME	configuration number AO#4	none	1
3:0280	C_READOUT.M4RB01F.A_NAME	CF number ACT1-Combo used for Readback	none	1
3:0281	C_READOUT.M4RB02F.A_NAME	CF number ACT2 combo used for Readback	none	1
3:0282	CAS_.M4PID_ASP.A_NAME	remote cascade Setpoint	%	100
3:0283	CAS_.M4PID_D1V.A_NAME	Cascade D1 Value	none	100
3:0284	CAS_.M4PID_DBV.A_NAME	Cascade DB Value	none	100
3:0285	CAS_.M4PID_DFV.A_NAME	Cascade DB forward Value	none	100
3:0286	CAS_.M4PID_DRV.A_NAME	Cascade droop Value	none	100
3:0287	CAS_.M4PID_I1V.A_NAME	Cascade I1 Value	none	100
3:0288	CAS_.M4PID_P1V.A_NAME	Cascade P1 Value	none	100
3:0289	CAS_.M4PID_PV.A_NAME	Cascade Process Value	%	100
3:0290	CAS_.M4PID_SP.A_NAME	Cascade Setpoint	%	100
3:0291	CAS_.M4PID_VP.A_NAME	Implied Valve Position	%	100
3:0292	DCPL.M4PID_ASP.A_NAME	remote DCPL SP	%	100
3:0293	DCPL.M4PID_D1V.A_NAME	Decoupling D1 Value	none	100
3:0294	DCPL.M4PID_DBV.A_NAME	Decoupling DB Value	none	100
3:0295	DCPL.M4PID_DRV.A_NAME	Decoupling droop Value	none	100
3:0296	DCPL.M4PID_I1V.A_NAME	Decoupling I1 Value	none	100
3:0297	DCPL.M4PID_P1V.A_NAME	Decoupling P1 Value	none	100
3:0298	DCPL.M4PID_PV.A_NAME	Decoupling Process Value	%	100
3:0299	DCPL.M4PID_SP.A_NAME	Decoupling Setpoint	%	100
3:0300	DCPL.M4PID_VP.A_NAME	Decoupling demand	%	100
3:0301	EXTC.M4EXTCSEQ.A_NAME	Extraction sequence number	none	1
3:0302	EXTC.M4PID__SP.A_NAME	Extraction SP (EU)	units	MLT Factor
3:0303	EXTC.M4PID_ASP.A_NAME	remote extraction	%	100
3:0304	EXTC.M4PID_D1V.A_NAME	extraction D1 Value	none	100

Addr	ServLink TAG	Description	Units	MLT
3:0305	EXTC.M4PID_DBV.A_NAME	extraction DB Value	none	100
3:0306	EXTC.M4PID_DRV.A_NAME	extraction droop Value	none	100
3:0307	EXTC.M4PID_I1V.A_NAME	extraction I1 Value	none	100
3:0308	EXTC.M4PID_P1V.A_NAME	extraction P1 Value	none	100
3:0309	EXTC.M4PID_PV.A_NAME	Extraction %	%	100
3:0310	EXTC.M4PID_SP.A_NAME	Extr Setpoint %	%	100
3:0311	EXTC.M4PID_VP.A_NAME	EXT demand %	%	100
3:0312	EXTC.M4PIDD_SP.A_NAME	Decoupled SP (EU)	Units	MLT factor
3:0313	FDBK.M4HPPIPV.A_NAME	HP pilot deviation	%	100
3:0314	FDBK.M4HPPIPV_A.A_NAME	HP pilot deviation A106	%	100
3:0315	FDBK.M4HPPIPV_B.A_NAME	HP pilot deviation C106	%	100
3:0316	FDBK.M4LPPIPV.A_NAME	LP pilot deviation	%	100
3:0317	FDBK.M4LPPIPV_A.A_NAME	LP pilot deviation A106	%	100
3:0318	FDBK.M4LPPIPV_B.A_NAME	LP pilot deviation C106	%	100
3:0319	FORWARD.M4FORW_DMD.A_NAME	forward demand	rpm	1
3:0320	HP__.M4CONFSTR.A_NAME	start mode configured	none	1
3:0321	HP__.M4CONFSTRL.A_NAME	Valve ramp start-up limit	%	1
3:0322	HP__.M4HP__DMD.A_NAME	HP demand	%	100
3:0323	HP__.M4HP__HP1.A_NAME	Uncompensated demand HP1	%	100
3:0324	HP__.M4HP__HP1C.A_NAME	compensated HP1	%	100
3:0325	HP__.M4HP__HP2.A_NAME	uncompensated demand HP2	%	100
3:0326	HP__.M4HP__HP2C.A_NAME	compensated demand HP2	%	100
3:0327	HP__.M4HP__HPRP.A_NAME	HP Valve ramp	%	100
3:0328	J_LSW.M4LSW1CF.A_NAME	level switch LSW1 configuration	none	1
3:0329	J_LSW.M4LSW1OFF.A_NAME	LSW1 OFF level	none	MLT Factor
3:0330	J_LSW.M4LSW1ON.A_NAME	LSW1 ON level	none	MLT Factor
3:0331	J_LSW.M4LSW2CF.A_NAME	level switch LSW2 configuration	none	1
3:0332	J_LSW.M4LSW2OFF.A_NAME	LSW2 OFF level	none	MLT Factor
3:0333	J_LSW.M4LSW2ON.A_NAME	LSW2 ON level	none	MLT Factor
3:0334	J_LSW.M4LSW3CF.A_NAME	level switch LSW3 configuration	none	1
3:0335	J_LSW.M4LSW3OFF.A_NAME	LSW3 OFF level	none	MLT Factor
3:0336	J_LSW.M4LSW3ON.A_NAME	LSW3 ON level	none	MLT Factor
3:0337	J_LSW.M4LSW4CF.A_NAME	level switch LSW4 configuration	none	1
3:0338	J_LSW.M4LSW4OFF.A_NAME	LSW4 OFF level	none	MLT Factor
3:0339	J_LSW.M4LSW4ON.A_NAME	LSW4 ON level	none	MLT Factor
3:0340	LP__.M4LP__DMD.A_NAME	LP Valve demand	%	100
3:0341	LP__.M4LP__HP1C.A_NAME	compensated LP1	%	100
3:0342	LP__.M4LP__LP.A_NAME	Uncompensated demand LP1	%	100
3:0343	LP__.M4LP__LP2.A_NAME	uncompensated demand LP2	%	100
3:0344	LP__.M4LP__LP2C.A_NAME	compensated demand LP2	%	100
3:0345	LP__.M4LP__LPRP.A_NAME	LP Valve ramp	%	100
3:0346	MAP_.M4CONFHAN.A_NAME	flow Pt A normalized	%	100
3:0347	MAP_.M4CONFHBN.A_NAME	flow Pt B normalized	%	100
3:0348	MAP_.M4CONFHCN.A_NAME	flow Pt C normalized	%	100
3:0349	MAP_.M4CONFMNFL.A_NAME	Min EXT flow compensated	%	100
3:0350	MAP_.M4CONFMNLD.A_NAME	Min load compensated	%	100
3:0351	MAP_.M4CONFMXLD.A_NAME	Min load compensated at MX	%	100
3:0352	MAP_.M4CONFSAN.A_NAME	S Pt A normalized	%	100
3:0353	MAP_.M4CONFSBN.A_NAME	S Pt B normalized	%	100
3:0354	MAP_.M4CONFSCN.A_NAME	S Pt c normalized	%	100
3:0355	MAP_.M4PLIMITED.A_NAME	P Limited	%	100
3:0356	MAP_.M4SLIMITED.A_NAME	S limited value	%	100

Addr	ServLink TAG	Description	Units	MLT
3:0357	MMI.M4M1T2A01.A_NAME	Analog A01 from M1 to M2	none	1
3:0358	MMI.M4M1T2A02.A_NAME	Analog A02 from M1 to M2	none	1
3:0359	MMI.M4M1T2A03.A_NAME	Analog A03 from M1 to M2	none	1
3:0360	MMI.M4M1T2A04.A_NAME	Analog A04 from M1 to M2	none	1
3:0361	MMI.M4M1T2A05.A_NAME	Analog A05 from M1 to M2	none	1
3:0362	MMI.M4M1T2A06.A_NAME	Analog A06 from M1 to M2	none	1
3:0363	MMI.M4M1T2A07.A_NAME	Analog A07 from M1 to M2	none	1
3:0364	MMI.M4M1T2A08.A_NAME	Analog A08 from M1 to M2	none	1
3:0365	MMI.M4M1T2A09.A_NAME	Analog A09 from M1 to M2	none	1
3:0366	MMI.M4M1T2A10.A_NAME	Analog A10 from M1 to M2	none	1
3:0367	MMI.M4M1T2A11.A_NAME	Analog A11 from M1 to M2	none	1
3:0368	MMI.M4M1T2A12.A_NAME	Analog A12 from M1 to M2	none	1
3:0369	MMI.M4M1T2A13.A_NAME	Analog A13 from M1 to M2	none	1
3:0370	MMI.M4M1T2A14.A_NAME	Analog A14 from M1 to M2	none	1
3:0371	MMI.M4M1T2A15.A_NAME	Analog A15 from M1 to M2	none	1
3:0372	MMI.M4M2T1A01.A_NAME	Analog A01 from M2 to M1	none	1
3:0373	MMI.M4M2T1A02.A_NAME	Analog A02 from M2 to M1	none	1
3:0374	MMI.M4M2T1A03.A_NAME	Analog A03 from M2 to M1	none	1
3:0375	MMI.M4M2T1A04.A_NAME	Analog A04 from M2 to M1	none	1
3:0376	MMI.M4M2T1A05.A_NAME	Analog A05 from M2 to M1	none	1
3:0377	MMI.M4M2T1A06.A_NAME	Analog A06 from M2 to M1	none	1
3:0378	MMI.M4M2T1A07.A_NAME	Analog A07 from M2 to M1	none	1
3:0379	MMI.M4M2T1A08.A_NAME	Analog A08 from M2 to M1	none	1
3:0380	MMI.M4M2T1A09.A_NAME	Analog A09 from M2 to M1	none	1
3:0381	MMI.M4M2T1A10.A_NAME	Analog A10 from M2 to M1	none	1
3:0382	MMI.M4M2T1A11.A_NAME	Analog A11 from M2 to M1	none	1
3:0383	MMI.M4M2T1A12.A_NAME	Analog A12 from M2 to M1	none	1
3:0384	MMI.M4M2T1A13.A_NAME	Analog A13 from M2 to M1	none	1
3:0385	MMI.M4M2T1A14.A_NAME	Analog A14 from M2 to M1	none	1
3:0386	MMI.M4M2T1A15.A_NAME	Analog A15 from M2 to M1	none	1
3:0387	MMI_.M4MB__EPC2.A_NAME	Mod#1 P2 Exception Error Level	none	1
3:0388	MMI_.M4MB__EPCT.A_NAME	Mod#1 P1Exception Error Level	none	1
3:0389	RATL.M4CONFDCL.A_NAME	decoupling type	none	1
3:0390	RATL.M4CONFTYP.A_NAME	turbine type	none	1
3:0391	RATL.M4CONFTYPE.A_NAME	turbine type	none	1
3:0392	RED1.M4CF__TIME.A_NAME	Hours before xfer redundancy1	hours	1
3:0393	RED2.M4CF__TIME.A_NAME	Hours before xfer redundancy2	hours	1
3:0394	REMOTE.M4RAO01_PV.A_NAME	remote IO	n/a	n/a
3:0395	REMOTE.M4RAO02_PV.A_NAME	remote IO	n/a	n/a
3:0396	REMOTE.M4RAO03_PV.A_NAME	remote IO	n/a	n/a
3:0397	REMOTE.M4RAO04_PV.A_NAME	remote IO	n/a	n/a
3:0398	REMOTE.M4RAO05_PV.A_NAME	remote IO	n/a	n/a
3:0399	REMOTE.M4RAO06_PV.A_NAME	remote IO	n/a	n/a
3:0400	REMOTE.M4RAO07_PV.A_NAME	remote IO	n/a	n/a
3:0401	REMOTE.M4RAO08_PV.A_NAME	remote IO	n/a	n/a
3:0402	REMOTE.M4RAO09_PV.A_NAME	remote IO	n/a	n/a
3:0403	REMOTE.M4RAO10_PV.A_NAME	remote IO	n/a	n/a
3:0404	REMOTE.M4RAO11_PV.A_NAME	remote IO	n/a	n/a
3:0405	REMOTE.M4RAO12_PV.A_NAME	remote IO	n/a	n/a
3:0406	REMOTE.M4RAO13_PV.A_NAME	remote IO	n/a	n/a
3:0407	REMOTE.M4RAO14_PV.A_NAME	remote IO	n/a	n/a
3:0408	REMOTE.M4RAO15_PV.A_NAME	remote IO	n/a	n/a

Addr	ServLink TAG	Description	Units	MLT
3:0409	REMOTE.M4RAO16_PV.A_NAME	remote IO	n/a	n/a
3:0410	REMOTE.M4RAO17_PV.A_NAME	remote IO	n/a	n/a
3:0411	REMOTE.M4RAO18_PV.A_NAME	remote IO	n/a	n/a
3:0412	REMOTE.M4RAO19_PV.A_NAME	remote IO	n/a	n/a
3:0413	REMOTE.M4RAO20_PV.A_NAME	remote IO	n/a	n/a
3:0414	REMOTE.M4RAO21_PV.A_NAME	remote IO	n/a	n/a
3:0415	REMOTE.M4RAO22_PV.A_NAME	remote IO	n/a	n/a
3:0416	REMOTE.M4RAO23_PV.A_NAME	remote IO	n/a	n/a
3:0417	REMOTE.M4RAO24_PV.A_NAME	remote IO	n/a	n/a
3:0418	REMOTE.M4RAO25_PV.A_NAME	remote IO	n/a	n/a
3:0419	SEAL.M4PID_PV.A_NAME	Seal normalized process value	%	100
3:0420	SEAL.M4PID_SP.A_NAME	Seal PID Setpoint	Units	MLT factor
3:0421	SEAL.M4PID_SPN.A_NAME	Seal PID normalized SP	%	100
3:0422	SEAL.M4PID_VP.A_NAME	Seal PID output		100
3:0423	SPDC.M4CASC_SP.A_NAME	cascade SP (EU)	Units	MLT factor
3:0424	SPDC.M4CONF_T1.A_NAME	Waiting time at low idle	minutes	1
3:0425	SPDC.M4CONF_T2.A_NAME	Waiting time at H idle	minutes	1
3:0426	SPDC.M4CONF_T3.A_NAME	Waiting time at HH idle	minutes	1
3:0427	SPDC.M4CONFCRR1.A_NAME	critical speed rate1	minutes	1
3:0428	SPDC.M4CONFCRR2.A_NAME	critical speed rate2	minutes	1
3:0429	SPDC.M4CONFL1C1.A_NAME	Warm-up time level 1 COLD	minutes	1
3:0430	SPDC.M4CONFL1C2.A_NAME	Warm-up time level 1 HOT	minutes	1
3:0431	SPDC.M4CONFL2C1.A_NAME	Warm-up time level 2 COLD	minutes	1
3:0432	SPDC.M4CONFL2C2.A_NAME	Warm-up time level 2 HOT	minutes	1
3:0433	SPDC.M4CONFL3C1.A_NAME	Warm-up time level 3 COLD	minutes	1
3:0434	SPDC.M4CONFL3C2.A_NAME	Warm-up time level 3 HOT	minutes	1
3:0435	SPDC.M4CONFLCR1.A_NAME	Lower limit critical range 1	rpm	1
3:0436	SPDC.M4CONFLCR2.A_NAME	Lower limit critical range 2	rpm	1
3:0437	SPDC.M4CONFLRC1.A_NAME	Load rate COLD	rpm/s	1
3:0438	SPDC.M4CONFLRC2.A_NAME	Load rate HOT	rpm/s	1
3:0439	SPDC.M4CONFLVL1.A_NAME	Start-up level low Idle	rpm	1
3:0440	SPDC.M4CONFLVL2.A_NAME	Start-up level medium Idle	rpm	1
3:0441	SPDC.M4CONFLVL3.A_NAME	Start-up level Hi Idle	rpm	1
3:0442	SPDC.M4CONFMNG.A_NAME	Minimum governor speed	rpm	1
3:0443	SPDC.M4CONFMXG.A_NAME	Maximum governor speed	rpm	1
3:0444	SPDC.M4CONFMXR.A_NAME	Maximum speed reference	rpm	1
3:0445	SPDC.M4CONFORTE.A_NAME	Overspeed test rate	rpm	1
3:0446	SPDC.M4CONFOSP.A_NAME	overspeed level	rpm	1
3:0447	SPDC.M4CONFR1C1.A_NAME	Start-up rate to Low Idle COLD	rpm/s	1
3:0448	SPDC.M4CONFR1C2.A_NAME	Start-up rate to low Idle HOT	rpm/s	1
3:0449	SPDC.M4CONFR2C1.A_NAME	Start-up rate to Medium Idle COLD	rpm/s	1
3:0450	SPDC.M4CONFR2C2.A_NAME	Start-up rate to Medium Idle HOT	rpm/s	1
3:0451	SPDC.M4CONFR3C1.A_NAME	Start-up rate to Hi Idle COLD	rpm/s	1
3:0452	SPDC.M4CONFR3C2.A_NAME	Start-up rate to Hi idle HOT	rpm/s	1
3:0453	SPDC.M4CONFR4C1.A_NAME	Start-up rate to min. gov. COLD	rpm/s	1
3:0454	SPDC.M4CONFR4C2.A_NAME	Start-up rate to min. gov. HOT	rpm/s	1
3:0455	SPDC.M4CONFRAT.A_NAME	Rated speed	rpm	1
3:0456	SPDC.M4CONFRTE1.A_NAME	rate to low idle	rpm/s	1
3:0457	SPDC.M4CONFRTE2.A_NAME	rate to Hi idle	rpm/s	1
3:0458	SPDC.M4CONFRTE3.A_NAME	rate to Hi idle	rpm/s	1
3:0459	SPDC.M4CONFRTE4.A_NAME	rate to min GOV	rpm/s	1
3:0460	SPDC.M4CONFRTE5.A_NAME	loading rate	rpm/s	1

Addr	ServLink TAG	Description	Units	MLT
3:0461	SPDC.M4CONFUCR1.A_NAME	Upper limit critical range 1	rpm	1
3:0462	SPDC.M4CONFUCR2.A_NAME	Upper limit critical range 2	rpm	1
3:0463	SPDC.M4SPDCASP.A_NAME	Remote speed SP in %	%	100
3:0464	SPDC.M4SPDCD1V.A_NAME	speed D1 offline	none	100
3:0465	SPDC.M4SPDCD2V.A_NAME	speed D2 online	none	100
3:0466	SPDC.M4SPDCDBV.A_NAME	speed DB Value	none	100
3:0467	SPDC.M4SPDCI1V.A_NAME	I1 offline Value	none	100
3:0468	SPDC.M4SPDCI2V.A_NAME	I2 online Value	none	100
3:0469	SPDC.M4SPDCP1V.A_NAME	speed P1 offline Value	none	100
3:0470	SPDC.M4SPDCP2V.A_NAME	speed P1 online Value	none	100
3:0471	SPDC.M4SPDCPV.A_NAME	speed in %	%	100
3:0472	SPDC.M4SPDCSEQ.A_NAME	Speed Sequence Status NB	none	1
3:0473	SPDC.M4SPDCSP.A_NAME	speed ref in %	%	100
3:0474	SPDC.M4SPDCVP.A_NAME	speed PID output %	%	100
3:0475	SPDC.M4SR__DMD.A_NAME	speed reference	rpm	1
3:0476	SS__.M4MAXSPEED.A_NAME	maximum speed reached	rpm	1
3:0477	SS__.M4SS__PV.A_NAME	speed Process Value	rpm	1
3:0478	SS__.M4SS__PV_A.A_NAME	Process Value#1	rpm	1
3:0479	SS__.M4SS__PV_B.A_NAME	Process Value #2	rpm	1
3:0480	SS__.M4SS__PV_C.A_NAME	Process Value #3	rpm	1
3:0481	SS__.M4SS__V1A.A_NAME	Process Value#1A	rpm	1
3:0482	SS__.M4SS__V1B.A_NAME	Process Value#1B	rpm	1
3:0483	SS__.M4SS__V1C.A_NAME	Process Value#1C	rpm	1
3:0484	SS__.M4SS__V2A.A_NAME	Process Value#2A	rpm	1
3:0485	SS__.M4SS__V2B.A_NAME	Process Value#2B	rpm	1
3:0486	SS__.M4SS__V2C.A_NAME	Process Value#2C	rpm	1
3:0487	SS__.M4SS__V3A.A_NAME	Process Value#3A	rpm	1
3:0488	SS__.M4SS__V3B.A_NAME	Process Value#3B	rpm	1
3:0489	SS__.M4SS__V3C.A_NAME	Process Value#3C	rpm	1
3:0490	SS__.M4SS__V4A.A_NAME	Process Value#4A	rpm	1
3:0491	SS__.M4SS__V4B.A_NAME	Process Value#4B	rpm	1
3:0492	SS__.M4SS__V4C.A_NAME	Process Value#4C	rpm	1
3:0493	Z_MOD.M4MB__EPC2.A_NAME	Mod#1 P2 Exception Error Level	none	1
3:0494	Z_MOD.M4MB__EPCT.A_NAME	Mod#1 P1Exception Error Level	none	1
3:0495	ZACT_CAL.M4ZMANRP.A_NAME	Calibration manual demand	%	100
3:0496	ACT_.M4A00ETM.A_NAME	CALIBRATION ENABLED active time	s	1
3:0497	ACT_.M4A01_TM.A_NAME	Calibration GOTO MIN active time	s	1
3:0498	ACT_.M4A02_TM.A_NAME	Calibration GOTO MAX active time	s	1
3:0499	ACT_.M4A03_TM.A_NAME	Calibration MANUAL STROKE active time	s	1
3:0500	BUS_.M4AL01FO.A_NAME	SD First Out	none	1
3:0501	BUS_.M4AL02FO.A_NAME	Start Interlock First Out	none	1
3:0502	BUS_.M4AL03FO.A_NAME	Alarm First Out	none	1
3:0503	BUS_.M4AL04FO.A_NAME	Major Alarm First Out	none	1
3:0504	BUS_.M4AL05FO.A_NAME	Disable AUTO EXTRACT First Out	none	1
3:0505	BUS_.M4AL06FO.A_NAME	disable auto DCPL First Out	none	1
3:0506	BUS_.M4AL07FO.A_NAME	disable cascade First Out	none	1
3:0507	BUS_.M4AL08FO.A_NAME	disable remote extr First Out	none	1
3:0508	BUS_.M4AL09FO.A_NAME	disable remote DCPL First Out	none	1
3:0509	BUS_.M4AL10FO.A_NAME	disable remote cascade First Out	none	1
3:0510	BUS_.M4AL11FO.A_NAME	disable remote speed First Out	none	1
3:0511	BUS_.M4AL12FO.A_NAME	antisurge disable First Out	none	1
3:0512	EXTC.M4A00_TM.A_NAME	extraction disable active time	s	1

Addr	ServLink TAG	Description	Units	MLT
3:0513	EXTC.M4A01_TM.A_NAME	Manual enabling active time	s	1
3:0514	EXTC.M4A02_TM.A_NAME	extraction manual active time	s	1
3:0515	EXTC.M4A03_TM.A_NAME	extraction semi-auto active time	s	1
3:0516	EXTC.M4A04_TM.A_NAME	extraction remote active time	s	1
3:0517	EXTC.M4A05_TM.A_NAME	disabling active time	s	1
3:0518	EXTC.M4A0A_TM.A_NAME	extraction auto enabling active time	s	1
3:0519	EXTC.M4B02_TM.A_NAME	decoupled manual active time	s	1
3:0520	EXTC.M4B03_TM.A_NAME	decoupled semi-auto active time	s	1
3:0521	EXTC.M4B04_TM.A_NAME	decoupled remote active time	s	1
3:0522	EXTC.M4C00_TM.A_NAME	All limited active time	s	1
3:0523	EXTC.M4C01_TM.A_NAME	coupled limited active time	s	1
3:0524	EXTC.M4C02_TM.A_NAME	decoupled limited active time	s	1
3:0525	EXTC.M4C03_TM.A_NAME	speed limited active time	s	1
3:0526	EXTC.M4C04_TM.A_NAME	No limitation active time	s	1
3:0527	EXTC.M4Z00_TM.A_NAME	shutdown active time	s	1
3:0528	EXTC.M4Z01_TM.A_NAME	RAMP LP active time	s	1
3:0529	HP__.M4A00_TM.A_NAME	Driver shutdown active time	s	1
3:0530	HP__.M4A01_TM.A_NAME	Automatic start-up valve ramp to 100%	s	1
3:0531	HP__.M4A02_TM.A_NAME	semi automatic start active time	s	1
3:0532	HP__.M4A03_TM.A_NAME	manual start active time	s	1
3:0533	SPDC.M4A00_TM.A_NAME	RESET position active time	s	1
3:0534	SPDC.M4A00ATM.A_NAME	Restart position active time	s	1
3:0535	SPDC.M4A01_TM.A_NAME	Start-up to warm-up Low idle active time	s	1
3:0536	SPDC.M4A02_RTMR.A_NAME	Start-up to warm-up at idle Wait Remaining Time	s	1
3:0537	SPDC.M4A02_TM.A_NAME	Start-up to warm-up Low idle active time	s	1
3:0538	SPDC.M4A02ATM.A_NAME	Start-up in manual active time	s	1
3:0539	SPDC.M4A03_TM.A_NAME	Step to medium idle active time	s	1
3:0540	SPDC.M4A04_RTMR.A_NAME	Step to medium idle remaining time	s	1
3:0541	SPDC.M4A04_TM.A_NAME	Step at medium level active time	s	1
3:0542	SPDC.M4A05_TM.A_NAME	Step to HI idle active time	s	1
3:0543	SPDC.M4A06_RTMR.A_NAME	Step to HI idle remaining time	s	1
3:0544	SPDC.M4A06_TM.A_NAME	Step at HI level active time	s	1
3:0545	SPDC.M4A07_TM.A_NAME	step go to rated active time	s	1
3:0546	SPDC.M4A08_TM.A_NAME	Start completed active time	s	1
3:0547	SPDC.M4A09_TM.A_NAME	Step overspeed test active time	s	1
3:0548	SPDC.M4A10_TM.A_NAME	Step quit overspeed active time	s	1
3:0549	SPDC.M4B00_TM.A_NAME	Step remote speed disabled active time	s	1
3:0550	SPDC.M4B01_TM.A_NAME	Step remote speed enabled active time	s	1
3:0551	SPDC.M4B02_TM.A_NAME	Step cascade enabled active time	s	1
3:0552	SPDC.M4B03_TM.A_NAME	Step remote cascade active time	s	1
3:0553	SPDC.M4Z00_TM.A_NAME	Step SHUTDOWN active time	s	1
3:0554	SPDC.M4Z01_TM.A_NAME	Step Normal SD active time	s	1
3:0555	SS__.M4SS__H2.A_NAME	OVERSPEED LEVEL	rpm	1

Table 7-7. Analog Reads

ADDR	DESCRIPTION	UNITS	MULTIPLIER
4:0001	Calibration: valve to test	none	none
4:0002	Xfer data between	none	1

	Modbus#1 and #2		
4:0003	Xfer data between Modbus#1 and #2	none	1
4:0004	Xfer data between Modbus#1 and #2	none	1
4:0004	Xfer data between Modbus#1 and #2	none	1
4:0005	Xfer data between Modbus#1 and #2	none	1
4:0006	Xfer data between Modbus#1 and #2	none	1
4:0007	Xfer data between Modbus#1 and #2	none	1
4:0008	Xfer data between Modbus#1 and #2	none	1
4:0009	Xfer data between Modbus#1 and #2	none	1
4:0010	Xfer data between Modbus#1 and #2	none	1
4:0011	Xfer data between Modbus#1 and #2	none	1
4:0012	Xfer data between Modbus#1 and #2	none	1
4:0013	Xfer data between Modbus#1 and #2	none	1
4:0015	Xfer data between Modbus#1 and #2	none	1
4:0016	Xfer data between Modbus#1 and #2	none	1
4:0017	Speed target	rpm	1

Table 7-8. Analog Writes

Analog Reads Lookup Tables

First Turbine Trip Cause

The cause of the first turbine trip (address 3:0500) is an integer that represents the following cause:

NB	Description	NB	Description
1	External trip contact#1	27	No speed / sticky rotor
2	External trip contact#2	28	normal SD completed
3	ESD #3	29	SD from Modbus#1
4	ESD #4	30	SD from Modbus#2
5	ESD #5	31	SD from PCI
6	ESD #6	32	LSW1 SD
7	ESD #7	33	LSW2 SD
8	ESD #8	34	LSW3 SD
9	ESD #9	35	LSW4 SD
10	ESD #10	36	TRIP CONF error
11	Power up SD	37	HP pilot SD
12	All HD-BIO fault	38	LP pilot SD
13	All HDAI fault	39	SD01 from remote IO
14	All actuator cards fault	40	SD02 from remote IO
15	All Sensor Signal failure	41	SD03 from remote IO
16	Overspeed test limit trip	42	SD04 from remote IO
17	OVERSPEED TRIP	43	SD05 from remote IO
18	All extraction PV Failure SD	44	SD06 from remote IO
19	All cascade PV Failure SD	45	SD07 from remote IO
20	ACT1 fault	46	SD08 from remote IO
21	ACT2 fault	47	SD09 from remote IO
22	All ACT_06 ch1 fault	48	SD10 from remote IO
23	All ACT_06_ch2 fault	49	Redundancy1 all fault
24	Start interlock condition	50	Redundancy2 all fault
25	Speed control lost		
26	Underspeed SD		

Speed control status (based on sequence steps)

The actual Speed control Step (address 3:0472) is an integer that represents the following cause:

NB	Description	NB	Description
1	Shutdown condition	10	Go to Hi Idle
2	Wait for permissive	11	At Hi Idle
3	Ready to start	12	Go to Rated
4	Back to Idle	13	Start-up complete
5	Control in Manual	14	Overspeed Test Active
6	Go to Low Idle	15	Quit Overspeed Test
7	At Low Idle	16	Manual Shutdown Active
8	Go to Medium Idle		
9	At Medium Idle		

Ext/Adm/Decoupling Status (based on sequence Steps)

The Extraction/admission control status (address 3:0301) is an integer that represents the following:

NB	Description	NB	Description
1	Shutdown condition	7	Extr/Adm control in Manual Mode
2	Initial LP Ramp	8	Remote extr/adm SP Active
3	Disabled	9	Disabling Extr/Adm
4	Enabling in automatic	10	Decoupled control in manual
5	Enabling in Manual	11	Decoupled control in Auto
6	Extr/Adm control in Manual Mode	12	Remote decoupling SP active

Analog Input Configuration—The Analog Input Configuration (addresses 3:0208—0215) is an integer that represents the programmed function of each analog input and is defined as follows:

NB	Description	NB	Description
1	NOT USED	**14**	Remote decoupling Setpt
2	Remote Speed Setpt	**15**	Monitor #1
3	Extraction/Admission #1	**16**	Monitor #2
4	Extraction/Admission #2	**17**	Monitor #3
5	Extraction/Admission #3	**18**	Monitor #4
6	Remote Extr/Adm Setpt	**19**	HP pilot fdbk1
7	Cascade Input #1	**20**	LP pilot fdbk2
8	Cascade Input #2	**21**	Feed-forward input
9	Cascade Input #3	**22**	Remote HOT/COLD input
10	Remote Cascade Setpt	**23**	Redundancy 1 IH-A Input
11	Decoupling Input #1	**24**	Redundancy 1 IH-B Input
12	Decoupling Input #2	**25**	Redundancy 2 IH-A Input
13	Decoupling Input #3	**26**	Redundancy 2 IH-A Input
		27	Seal GAS PID Process value Input

Analog Output Configuration—The Analog Output Configuration (addresses 3:0276—0279) is an integer that represents the programmed function of each analog output and is defined as follows:

NB	Description	NB	Description
1	NOT USED	**21**	HP2 driver Demand
2	Actual Speed	**22**	LP1 driver Demand
3	Speed Setpoint	**23**	LP2 driver Demand
4	Remote Speed Setpt	**24**	Monitor Analog Input #1
5	Extr/Adm Input	**25**	Monitor Analog Input #2
6	Extr/Adm Setpoint	**26**	Monitor Analog Input #3
7	Rmt Extr/Adm Setpt	**27**	Monitor Analog Input #4
8	Cascade Input	**28**	IH-1A position feedback
9	Cascade Setpoint	**29**	IH-1B position feedback
10	Rmt Cascade Setpt	**30**	IH-2A position feedback
11	Decoupled Input	**31**	IH-2B position feedback
12	decoupled Setpoint	**32**	HP AVG LVDT position feedback
13	remote decoupled Setpt	**33**	LP AVG LVDT position feedback

NB	Description	NB	Description
14	Speed/Load Demand	34	Remote IO AO #1
15	Extr/Adm Demand	35	Remote IO AO #2
16	HP Valve Limiter Setpt	36	Remote IO AO #3
17	LP Valve Limiter Setpt	37	Remote IO AO #4
18	HP demand	38	Seal PID output
19	LP demand	39	Seal PID setpoint
20	HP1 driver Demand	40	Seal PID process value

Relay Configuration—The Relay Configuration is defined as follows:

	Addr Type	Addr Level	Addr State
Relay #4	3:0249	3:0250	3:0251
Relay #5	3:0252	3:0253	3:0254
Relay #6	3:0255	3:0256	3:0257
Relay #7	3:0258	3:0259	3:0260
Relay #8	3:0261	3:0262	3:0263
Relay #9	3:0264	3:0265	3:0266
Relay #10	3:0267	3:0268	3:0269
Relay #11	3:0270	3:0271	3:0272
Relay #12	3:0273	3:0274	3:0275

DESCRIPTION TYPE

Type	Addr Type
1	Not used
2	Level relay
3	State Relay

DESCRIPTION LEVEL

NB	Description	NB	Description
1	NOT USED	15	Extr/Adm Demand
2	Actual Speed	16	HP Valve Limiter Setpt
3	Speed Setpoint	17	LP Valve Limiter Setpt
4	Remote Speed Setpt	18	HP demand
5	Extr/Adm Input	19	LP demand
6	Extr/Adm Setpoint	20	HP1 driver Demand
7	Rmt Extr/Adm Setpt	21	HP2 driver Demand
8	Cascade Input	22	LP1 driver Demand
9	Cascade Setpoint	23	LP2 driver Demand
10	Rmt Cascade Setpt	24	Monitor Analog Input #1
11	Decoupled Input	25	Monitor Analog Input #2
12	Decoupled Setpoint	26	Monitor Analog Input #3
13	Remote decoupled Setpt	27	Monitor Analog Input #4
14	Speed/Load Demand		

DESCRIPTION STATE

NB	Description	NB	Description
1	Trip Relay	34	ACT1-FB channel2 driver fault
2	Shutdown Indication	35	Reset pulse (2 sec)
3	Interlock	36	Stuck in critical
4	Alarm Indication	37	Underspeed

NB	Description	NB	Description
5	Major Alarm Indication	38	Speed control lost
6	Start permissive	39	Feed-forward enabled
7	Engine started	40	Feed-forward active
8	Overspeed Trip	41	Emergency min gov activated
9	Overspeed Test Enabled	42	Modbus relay
10	Speed PID in Control	43	Null speed NOT armed
11	Start-up completed	44	Null speed detected
12	Rmt Spd Setpt Active	45	Null speed fault
13	Auto Start Seq Halted	46	Redundancy1 select B CMD
14	On-Line PID Dyn Mode	47	Redundancy1 position error
15	Remote (HMI) Control Mode	48	Redundancy2 select B CMD
16	Extr/Adm Control disabled	49	Redundancy2 position error
17	Extr/Adm Control enabling	50	Remote IO BO#1
18	Extr/Adm PID disabling	51	Remote IO BO#2
19	Extr/Adm PID in Manual	52	Remote IO BO#3
20	Ext/Adm in semi-auto	53	Remote IO BO#4
21	Rmt Extr/Adm Setpt Actv	54	Remote IO BO#5
22	Cascade Control Active	55	Remote IO BO#6
23	Rmt Casc Setpt Active	56	Fault A106 CH1
24	Steam map limit	57	Fault C106 CH1
25	DCPL Control Active	58	Fault A106 CH2
26	DCPL Control in manual	59	Fault C106 CH2
27	DCPL in semi-auto	60	Manual start selected
28	Rmt DCPL Setpt Active	61	Seal PID output or PV Fault
29	HP Vlv Lmtr in Control	62	Seal PID in Auto mode
30	LP Vlv Lmtr in Control	63	Redundancy1: IH-A fault
31	AC1 driver fault	64	Redundancy1: IH-B fault
32	ACT2 driver fault	65	Redundancy2: IH-A fault
33	ACT1-FB channel1 driver fault	66	Redundancy2: IH-B fault

Contact Input Configuration—The Contact Input Configuration (addresses 3:0232—0248) is an integer that represents the programmed function of each contact input and is defined as follows:

NB	Description	NB	Description
1	NOT USED	34	External Trip 8
2	Overspeed Test	35	External Trip 9
3	Start Permissive	36	External Trip 10
4	Override MPU Fault	37	External Alarm 1
5	Local / Remote	38	External Alarm 2
6	Rmt Spd Setpt Enable	39	External Alarm 3
7	Extr/Adm Setpt Raise	40	External Alarm 4
8	Extr/Adm Setpt Lower	41	External Alarm 5
9	Extr/Adm Control Enable	42	External Alarm 6
10	Extr/Adm Control manual	43	External Alarm 7
11	Extr/Adm Demand Raise	44	External Alarm 8
12	Extr/Adm Demand Lower	45	External Alarm 9
13	Rmt Ext/Adm Setpt Enable	46	External Alarm 10
14	Casc Setpt Raise	47	Feed-forward enable
15	Casc Setpt Lower	48	Emergency min gov
16	Casc Control Enable	49	Null speed arm pulse
17	Rmt Casc Setpt Enable	50	Null speed permissive
18	Decoupling Setpt Raise	51	Lamp test
19	Decoupling Setpt Lower	52	Redundancy1 select B CMD
20	Decoupling Control Enable	53	Redundancy1 B is selected
21	Decoupling Control manual	54	Redundancy1 IH-A Fault
22	Rmt Aux Setpt Enable	55	Redundancy1 IH-B Fault

NB	Description	NB	Description
23	HP Valve Limiter Open	**56**	Redundancy2 select B CMD
24	HP Valve Limiter Close	**57**	Redundancy2 B is selected
25	LP Valve Limiter Open	**58**	Redundancy2 IH-A Fault
26	LP Valve Limiter Close	**59**	Redundancy2 IH-B Fault
27	Controlled Shutdown	**60**	HOT start-up curve selection
28	Set Time of Day	**61**	Manual start command
29	External Trip 3	**62**	Seal PID manual command
30	External Trip 4	**63**	Seal PID Raise SP
31	External Trip 5	**64**	Seal PID Lower SP
32	External Trip 6	**65**	Seal PID Raise Demand
33	External Trip 7	**66**	Seal PID Lower Demand

Units Address: For monitoring purpose, the Units can be define for the following signal:

Signal	Addr
Extraction	3:0166
Cascade	3:0151
Decoupling	3:0159
Monitor #1	3:0186
Monitor #2	3:0190
Monitor #3	3:0194
Monitor #4	3:0198
HP compensation	3:0171
LP compensation	3:0182
Seal PID	3:0207

Units Configured—integers that represents the following:

NB	Unit	NB	Unit
1	None	**8**	atm
2	psi	**9**	T/h
3	psig	**10**	K#/hr
4	kPa	**11**	#/hr
5	barA	**12**	°C*
6	barG	**13**	°F*
7	kg/cm²	**14**	K*

(*)= Cascade, monitor, HP compensation, LP compensation, seal PID only

Cascade Usage--integers that represents the following (Address 3:0146) used for monitoring purpose

NB	Usage
1	Cascade
2	Boiler pressure
3	Inlet pressure
4	Exhaust pressure
5	Compressor#1 suction pressure
6	Compressor#2 suction pressure
7	Compressor#1 discharge pressure
8	Compressor#2 discharge pressure
9	Turbine load control

Decoupling Usage--integers that represents the following (Address 3:0154) used for monitoring purpose

NB	Usage
1	Decoupling
2	Boiler pressure
3	Inlet pressure
4	Exhaust pressure
5	Compressor#1 suction pressure
6	Compressor#2 suction pressure
7	Compressor#1 discharge pressure
8	Compressor#2 discharge pressure
9	Turbine load control

Monitor#1/2/3/4 Usage--integers that represents the following (Address
#1 = 3:0184
#2 = 3:0188
#3 = 3:0192
#4 = 3:0196

NB	Usage
1	Monitor
2	Boiler pressure
3	Inlet pressure
4	Exhaust pressure
5	Compressor#1 suction pressure
6	Compressor#2 suction pressure
7	Compressor#1 discharge pressure
8	Compressor#2 discharge pressure
9	Compressor#1 suction temperature
10	Compressor#2 suction temperature
11	Compressor#1 discharge temperature
12	Compressor#2 discharge temperature
13	Oil pressure
14	Oil filter pressure
15	Bearing #1 temperature
16	Bearing #2 temperature
17	Bearing #3 temperature
18	Bearing #4 temperature
19	Vibration 1
20	Vibration 2
21	Vibration 3
22	Vibration 4

Turbine Type Configured—The turbine type (address 3:0390) is an integer that represents the following:

1. Single Valve
2. Extraction Only
3. Admission Only
4. Admission Direct Feed
5. Extraction and Admission
6. Extraction and Admission Split

DCPL Control Configured—The decoupling control configured (address 3:0389) is an integer that represents the following:
1. Not Used
2. Inlet & Speed
3. Exhaust & Speed
4. Total Decoupling

Start Mode Configured—The start mode configured (address 3:0320) is an integer that represents the following:
1. Automatic
2. Semi-automatic
3. Manual

Actuator #1/2 Readout—The Act 1 an 2 Readout Configured (address 3:0280 and 281) is an integer that represents the following (relevant if Act is used as readout):

NB	Description	NB	Description
1	NOT USED	**20**	HP1 driver Demand
2	Actual Speed	**21**	HP2 driver Demand
3	Speed Setpoint	**22**	LP1 driver Demand
4	Remote Speed Setpt	**23**	LP2 driver Demand
5	Extr/Adm Input	**24**	Monitor Analog Input #1
6	Extr/Adm Setpoint	**25**	Monitor Analog Input #2
7	Rmt Extr/Adm Setpt	**26**	Monitor Analog Input #3
8	Cascade Input	**27**	Monitor Analog Input #4
9	Cascade Setpoint	**28**	IH-1A position feedback
10	Rmt Cascade Setpt	**29**	IH-1B position feedback
11	Decoupled Input	**30**	IH-2A position feedback
12	decoupled Setpoint	**31**	IH-2B position feedback
13	remote decoupled Setpt	**32**	HP AVG LVDT position feedback
14	Speed/Load Demand	**33**	LP AVG LVDT position feedback
15	Extr/Adm Demand	**34**	Remote IO AO #1
16	HP Valve Limiter Setpt	**35**	Remote IO AO #2
17	LP Valve Limiter Setpt	**36**	Remote IO AO #3
18	HP demand	**37**	Remote IO AO #4
19	LP demand	**37**	Seal gas PID output

Specific Address Information

Modbus Scale Factors

Modbus has two limitations:
- Only integers can be sent across.
- The value is limited between -32767 and 32767.

These limitations can be overcome by scaling the value before it is sent across the Modbus. The default scale factor for the analog values is automatically set by the control based on the scaling of the analog input. If the maximum value of the analog input (Value @ 20 mA) is less than 3200, the scale factor is automatically set to 10. If the maximum value of the analog input (Value @ 20 mA) is less than 320, the scale factor is automatically set to 100. If the maximum value of the analog input (Value @ 20 mA) is greater than 32000, the scale factor is automatically set to 0.1. The scale factor can be changed in the service mode between 0.1, 1.0, 10, and 100, if desired.

The following input and setpoint values that are sent across the Modbus have independent scale factors: Extraction/Admission, Decoupling, Cascade, Monitor#1/2/3/4, Feed forward, HP and LP compensation, IH-A/B for redundancy managers,. These scaled parameters and their scale factor are available through the Modbus.

Values that require a decimal point must be multiplied by the scale factor (10, 100) prior to being sent across the Modbus. The value sent must then be divided by the scale factor in the Master. Values that are larger than the limitation of Modbus can be sent across by multiplying the value by a factor of 0.1, then dividing the value by the same scale factor in the Master.

The Scale Factor adjusts all associated analog reads and writes accordingly. For example, the Cascade Scale Factor adjusts the cascade input and setpoint analog read values as well as the Entered Setpt analog write value.

For example, if the Cascade setpoint of 60000 needs to be sent across the Modbus, the Cascade Scale Factor would automatically be set to 0.1, this will change the value so that it can be sent across the Modbus (60000 * 0.1 = 6000). After the value is sent across the Modbus, it must be rescaled in the Master to the original value (6000 / 0.1 = 60000).

Modbus Percentage

Some of the analog read addresses have percentages sent across. The formula used in the percentage calculation is ((max / actual) * 100). The percentage is multiplied by 100 before being sent across the Modbus.

Modbus Emergency Shutdown

Two different types of shutdown commands (emergency and controlled) can be issued through Modbus. The Emergency Shutdown command instantly takes the speed setpoint to zero and the HP & LP actuator currents to zero. Optionally the 5009C Control System can be configured to ignore this Emergency Shutdown command if it is desired to not allow the unit to be tripped through Modbus.

To avoid an inadvertent trip, the emergency shutdown command from Modbus can be configured to require a two step process before a shutdown command is issued. When the shutdown is a two-step process Boolean write address 0:0001 starts the shutdown process and an acknowledge on address 0:0002 has to be given within five seconds for the control to issue an emergency shutdown command.

For More Modbus Information

Detailed information on the Modbus protocol is presented in “Reference Guide PI-MBUS-300” published by AEC Corp./Modicon Inc., formerly Gould Inc. To implement your own source code, you must register with Modicon. Registration includes purchasing document PI-MBUS-303 and signing a non-disclosure agreement. You can register to use Modbus at your nearest Modicon field office. To find the office nearest you, contact Modicon Technical Support at 1-800-468- 5342.

Appendix A.
Passwords

Program Mode

Default Password : **1113**

If changed, write down the new password here and remove this page and store in a safe place.

_____
NEW PASSWORD

Run Mode

Default Password : **1111**

If changed, write down the new password here and remove this page and store in a safe place.

_____
NEW PASSWORD

Service Mode

Default Password : **1111**

If changed, write down the new password here and remove this page and store in a safe place.

_____
NEW PASSWORD

IMPORTANT **Remove this page to prevent unauthorized access to access to the Program, Run, and Service Modes.**

Appendix B.
5009C Program Mode Worksheet

GOVERNOR SERIAL NUMBER: _____

DATE: _____

APPLICATION: _____

APPLICATION FOLDER

Site	
Turbine	
ID Tag	
Turbine Type	
Ratio/limiter Mode (if extr/Adm)	
Use Cascade?	Y/N
Use Dual Redundancy?	Y/N
Use Feed-forward?	Y/N
Use Seal gas PID?	Y/N

START SETTINGS FOLDER

Start Routine	
V1 Initial Position	%
Use rotor stuck SD?	Y/N
HP Valve Limiter Rate	%/sec
Max Delta speed acceptable rpm	
Delta Speed alarm delay s	
Use loss of control trip? Y/N	
Autostart at shutdown (Enabled/Disabled or E/D	
Use Critical Speed Avoidance?	Y/N
High critical becomes min speed at start-up? Y/N	
Force speed Lower if stuck? Y/N	
Lower speed always active? (even in critical) Y/N	
Use fixed critical rate? Y/N	
Critical Rate for critical 1 (if fixed)	rpm/sec
Critical Speed Band 1 Minimum	rpm
Critical Speed Band 1 Maximum	rpm
Use Critical Speed Avoidance Band 2?	Y/N
Use fixed critical rate? Y/N	
Critical Rate for critical 2 (if fixed)	rpm/sec
Critical Speed Band 2 Minimum	rpm
Critical Speed Band 2 Maximum	rpm

AUTO SEQUENCE SETTINGS (if configured)

Cold Star (> xx hrs)	hrs
Hot Start (< xx hrs)	hrs
Min speed for HOT rpm	
Fully Hot delay min	
Use remote HOT/COLD? Y/N	
Sensor value at 4 mA	
Sensor value at 20 mA	
Cold Level (same units as sensor)	
Hot Level (same units as sensor)	

Rate to low Idle (Cold) rpm/s
Rate to low Idle (Hot) rpm/s

Low Idle Setpoint	rpm
Low Idle Delay (Cold)	min
Low Idle Delay (Hot)	min

Use medium Idle? Y/N
Deactivate autostart at Idle speed Levels Y/N
Run Back to low idle if autostart stopped? Y/N

Use medium Idle? Y/N(If NO go to (a))

Low Idle to Medium Idle Rate (Cold)	rpm/sec
Low Idle to Medium Idle Rate (Hot)	rpm/sec
Medium Idle Setpoint	rpm
Medium Idle Delay Time (Cold)	min
Medium Idle Delay Time (Hot)	min

Use Hi-Idle? Y/N(If NO go to (a))

Medium Idle to Hi-idle Rate (Cold)	rpm/sec
Medium Idle to Hi-idle Rate (Hot)	rpm/sec
High Idle Setpoint	rpm
High Idle Delay Time (Cold)	min
High Idle Delay Time (Hot)	min

(a)

High Idle to Rated Rate (Cold)	rpm/sec
High Idle to Rated Rate (Hot)	rpm/sec
Rated Setpoint	rpm

Loading gradient (cold) rpm/s
Loading gradient (Hot) rpm/s

SPEED CONTROL FOLDER

Overspeed Test Limit	rpm
Overspeed Trip Level	rpm
Max Control Setpoint	rpm
Min Control Setpoint	rpm

Use 4-20mA Remote Speed Setpoint? (Y/N)
Sensor value for 4 mA rpm
Sensor value for 20 mA rpm
Min range of action for control rpm
Max range of action for control rpm

Off-Line Proportional Gain	%
Off-Line Integral Gain	rps
Off-Line Derivative Ratio	%
On-Line Proportional Gain	%
On-Line Integral Gain	rps
On-Line Derivative Ratio	%
Use deadband	(Y/N)
Use deadband on when decoupled	(Y/N)
Deadband	%

Normal SD

No SD when completed	Y/N
Normal SD to low idle only	Y/N
Max delay low idle	min
Continu NSD after Delay?	Y/N

Underspeed	
Use underspeed	Y/N
Underspeed level	rpm
Alarm delay	s
Use Underspeed trip?	Y/N
SD delay	s
Teeth Seen by Speed Probe	
Gear Ratio 1:	
Speed Input #1	
Input 1—FTM Channels Used?	
Speed Input #2	
Input 2—FTM Channels Used?	
Speed Input #3	
Input 3—FTM Channels Used?	
Zero Speed Input #4	
Input 4—FTM Channels Used?	
Max speed readable	rpm
Null speed detected delay	s
Null speed OFF (hysteresis)	rpm

DUAL REDUNDANCY FOLDER (if configured)

Select actuator concerned		
Invert External Fault A (if used)	Y/N	
Invert External Fault B (if used)	Y/N	
Use Actuator B selected position fdbk?		Y/N
Use analog feedback IH-A?	Y/N	
Sensor range for 4 mA		
Sensor range for 20 mA		
Use Alarm?	Y/N	
Au xfer if alarm?	Y/N	
Alarm Delay	s	
Max difference level	%	
Use analog feedback IH-B?	Y/N	
Sensor range for 4 mA		
Sensor range for 20 mA		
Use Alarm?	Y/N	
Au xfer if alarm?	Y/N	
Alarm Delay	s	
Max difference level	%	
Use automatic test	(Y/N)	
Test every	Hours	
Test duration	Minutes	

Use Redundancy2?	**Y/N**	
Select actuator concerned		
Invert External Fault A (if used)	Y/N	
Invert External Fault B (if used)	Y/N	
Use Actuator B selected position fdbk?		Y/N
Use analog feedback IH-A?	Y/N	
Sensor range for 4 mA		
Sensor range for 20 mA		
Use Alarm?	Y/N	

Au xfer if alarm?	Y/N
Alarm Delay	s
Max difference level	%
Use analog feedback IH-B?	Y/N
Sensor range for 4 mA	
Sensor range for 20 mA	
Use Alarm?	Y/N
Au xfer if alarm?	Y/N
Alarm Delay	s
Max difference level	%
Use automatic test	(Y/N)
Test every	Hours
Test duration	Minutes

EXTR / ADM CONTROL FOLDER (if configured)

Extr/Adm Units	
Fail strategy	
Sensor value for 4 mA	
Sensor value for 20 mA	
LP Valve Limiter Rate at start	%/Sec
LP Valve Limiter R/L Rate	%/Sec
Use manual enabling only?	(Y/N)
Extr/Adm Permissive Speed	rpm
Max HP Valve Lift	%
Min LP Valve Lift	%
Min HP Valve Lift	% (not for extraction)
Max LP Valve Lift	%(Not for extraction)
Max Setpoint	units
Min Setpoint	units
Use Setpoint Tracking?	
Setpoint Initial Value	
Setpoint Rate	units/sec
Use 4-20mA Remote Extr/Adm Setpoint?	
Sensor value at 4 mA	
Sensor value at 20 mA	
Rmt Setpoint Max Rate	units/sec
Proportional Gain	%
Integral Gain	rps
Derivative Ratio	%
Droop	%
Deadband	%
Invert Extr/Adm Input?	
Disable PID control?	(Y/N)
No manual mode selection possible	(Y/N)

EXTRACTION STEAM MAP FOLDER

Maximum Power	units
Maximum HP Flow	units
Min Load at HP=0%	units
Min Load at HP=100%	units
Pt A	
Max Power @ Min Extr	units
Max HP Flow @ Min Extr	units
Pt B	
Min Power @ Max Extr	units
Min HP Flow @ Max Extr	units

Pt C
Min Power @ Min Extr units
Min HP Flow @ Min Extr units
Pressure Priority on LP Max Lift Limit?
Priority On min load Limits

ADMISSION STEAM MAP FOLDER
Maximum Power units
Maximum HP Flow units
Min Load at HP=0% units
Min Load at HP=100% units
Pt A
Max Power @ Max Adm units
Max HP Flow @ Max Adm units
Pt B
Min Power @ Min Adm units
Min HP Flow @ Min Adm units
Pt C
Max Power @ Min Adm units
Max HP Flow @ Min Adm units
Pressure Priority on LP Max Lift Limit?
Priority On min load Limits

EXT/ADM STEAM MAP FOLDER
Maximum Power units
Maximum HP Flow units
Maximum Adm Flow units
Min Load at HP=0% units
Min Load at HP=100% units
Pt A
Max Power @ 0 E/A units
Max HP Flow @ 0 E/A units
Pt B
Min Power @ Max Extr units
Min HP Flow @ Max Extr units
Pt C
Min Power @ 0 E/A units
Min HP Flow @ 0 E/A units
Pressure Priority on LP Max Lift Limit?
Priority On min load Limits

DRIVER CONFIG FOLDER
HP1 actuator selected
Use two HP Y/N
Us HP compensation Y/N
HP2 actuator selected
HP2 offset %

LP1 actuator selected
Use two LP Y/N
Us LP compensation Y/N
LP2 actuator selected
LP2 offset %
Depending on the actuator selected
Act 1(combo Settings)
Actuator range 4/20 or 20/160 mA)
Actuator Type
(Single/dual coil/dual redundant)
Min Value mA

Max Value mA
SD if all failed (Y/N)
Invert Output (Y/N)

Act 2(combo Settings)
Actuator range 4/20 or 20/160 mA)
Actuator Type
(Single/dual coil/dual redundant)
Min Value mA
Max Value mA
SD if all failed (Y/N)
Invert Output (Y/N)

Act 1 (actuator card Settings)

Valve Type
(Prop,PI,P,PI-lag,PI-lead-lag)
Prop type
Current at zero mA
Current at max mA
KP gain
CT enabled?
SD if all failed?

Other type
Min current mA
Max current mA
KP gain
KI gain (not for P)
Lag (PI-lag/lead only) ms
Lead (PI-lead only) ms
Null current mA
SD if all failed
Action Forward acting/Reverse acting)

Fail safe (High/Low)
Excitation level Volt
Feedback 1 type type A/A-B/(A-B)/A+B)

Use second Loop? (Y/N)
SD if failed (Y/N)
Use Degraded mode? (Y/N)
Feedback type type A/A-B/(A-B)/A+B)
Channel used (A106/C106/ A and C106)
Pilot gain

Act 2 (actuator card Settings)

Valve Type
(Prop,PI,P,PI-lag,PI-lead-lag)
Prop type
Current at zero mA
Current at max mA
KP gain
CT enabled?
SD if all failed?

Other type
Min current mA

Max current	mA
KP gain	
KI gain (not for P)	
Lag (PI-lag/lead only)	ms
Lead (PI-lead only)	ms
Null current	mA
SD if all failed	
Action Forward acting/Reverse acting)	

Fail safe	(High/Low)
Excitation level	Volt
Feedback 1 type	type A/A-B/(A-B)/A+B)

Use second Loop?	(Y/N)
SD if failed	(Y/N)
Use Degraded mode?	(Y/N)
Feedback type	type A/A-B/(A-B)/A+B)
Channel used	(A106/C106/ A and C106)
Pilot gain	

HP compensation (if used**)**

Sensor value for 4 MA	units
Sensor value for 20 MA	units
Always enabled?	(Y/N)
Compensation on cascade?	(Y/N)

HP curve

X1	units	Y1	%
X2	units	Y2	%
X3	units	Y3	%
X4	units	Y4	%
X5	units	Y5	%
X6	units	Y6	%

LP compensation (if used**)**

Sensor value for 4 MA	units
Sensor value for 20 MA	units
Always enabled?	(Y/N)
Compensation on extr PV?	(Y/N)

LP curve

X1	units	Y1	%
X2	units	Y2	%
X3	units	Y3	%
X4	units	Y4	%
X5	units	Y5	%
X6	units	Y6	%

ANALOG INPUTS FOLDER

Analog Input #1 Function
Device Power
Analog Input #2 Function
Device Power
Analog Input #3 Function
Device Power
Analog Input #4 Function
Device Power
Analog Input #5 Function
Device Power
Analog Input #6 Function

Device Power
Analog Input #7 Function
Device Power
Analog Input #8 Function
Device Power

Monitor#1 (if used)
Units
Usage
Value for 4 mA units
Value for 20 mA units

Monitor#2 (if used)
Units
Usage
Value for 4 mA units
Value for 20 mA units

Monitor#3 (if used)
Units
Usage
Value for 4 mA units
Value for 20 mA units

Monitor#4 (if used)
Units
Usage
Value for 4 mA units
Value for 20 mA units

CONTACT INPUTS FOLDER
Contact Input 8 Function
Contact Input 9 Function
Contact Input 10 Function
Contact Input 11 Function
Contact Input 12 Function
Contact Input 13 Function
Contact Input 14 Function
Contact Input 15 Function
Contact Input 16 Function
Contact Input 17 Function
Contact Input 18 Function
Contact Input 19 Function
Contact Input 20 Function
Contact Input 21 Function
Contact Input 22 Function
Contact Input 23 Function
Contact Input 24 Function

Contact Input Power Configuration
Inputs 1-3 Config
Inputs 4-6 Config
Inputs 7-9 Config
Inputs 10-12 Config
Inputs 13-15 Config
Inputs16-18 Config
Inputs 19-21 Config
Inputs 22-24 Config

DECOUPLING CONTROL/LIMITER FOLDER

Decoupling Units	
Sensor value for 4 mA	
Sensor value for 20 mA	
Max Setpoint	units
Min Setpoint	units
Setpoint Initial Value	units
Setpoint Rate	units/sec
Use 4-20mA Remote Decoupling Setpoint?	
Sensor value for 4 mA	
Sensor value for 20 mA	
Rmt Setpoint Max Rate	units/sec
Proportional Gain	%
Integral Gain	rps
Derivative Ratio	%
Droop	%
Invert Decoupling Input?	

CASCADE CONTROL FOLDER

Cascade Units	
Cascade Usage	
Sensor value for 4 mA	
Sensor value for 20 mA	
Max Casc Setpoint	units
Min Casc Setpoint	units
Use Setpoint Tracking?	
Setpoint Initial Value	units
Setpoint Rate	units/sec
Setpoint fast rate multiplier	
Setpoint fast rate delay	
Use 4-20mA Remote Cascade Setpoint?	
Sensor value for 4 mA?	
Sensor value for 20 mA?	
Rmt Setpoint Max Rate	units/sec
Proportional Gain	%
Integral Gain	rps
Derivative Ratio	%
Droop	%
Deadband	%
Invert Cascade Input?	
Max Speed Setpoint	
Min Speed Setpoint	

ANALOG READOUTS FOLDER

Analog Readout 1	
4mA Value	units
20mA Value	units
Analog Readout 2	
4mA Value	units
20mA Value	units
Analog Readout 3	
4mA Value	units
20mA Value	units
Analog Readout 4	
4mA Value	units

20mA Value	units
Actuator combo 1 (if available)	
4mA Value	units
20mA Value	units
Actuator combo 2 (if available)	
4mA Value	units
20mA Value	units

Level switch 1	
On level	
OFF level	
Alarm switch?	(Y/N)
SD switch?	(Y/N)
Major Alarm switch?	(Y/N)
Run back switch?	(Y/N)
Start inhibit?	(Y/N)

Level switch 2	
On level	
OFF level	
Alarm switch?	(Y/N)
SD switch?	(Y/N)
Major Alarm switch?	(Y/N)
Run back switch?	(Y/N)
Start inhibit?	(Y/N)

Level switch 3	
On level	
OFF level	
Alarm switch?	(Y/N)
SD switch?	(Y/N)
Major Alarm switch?	(Y/N)
Run back switch?	(Y/N)
Start inhibit?	(Y/N)

Level switch 4	
On level	
OFF level	
Alarm switch?	(Y/N)
SD switch?	(Y/N)
Major Alarm switch?	(Y/N)
Run back switch?	(Y/N)
Start inhibit?	(Y/N)

RELAY FOLDER

Test Relays(s) Every	hrs
Trip (Relay #1)	
Configuration	
Test Relay	
Reset Clears Trip Relay output?	
Use external trips in trip relay output?	
Trip Relay Energizes For Trip?	
Trip (Relay #2)	
Configuration	
Test Relay	
Alarm (Relay #3)	
Configuration	
Test Relay	

Use Non-Latching Alarm Indication?
Usage (process/lamp)
Relay #4
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #5
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #6
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #7
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #8
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #9
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration

Test Relay
Usage (process/lamp)

Relay #10
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #11
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

Relay #12
Function
Indication of
Level Switch for
Relay On Level
Relay Off Level
Configuration
Test Relay
Usage (process/lamp)

CPU COMMUNICATIONS FOLDER

MODBUS1
Modbus#1 Driver Protocol
Modbus#1 Device Number

Port 1 (CPU-A or SIO-A-3) Modbus Settings
Port Configuration
Baud Rate
Stop Bits
Parity
RS protocol (for SIO only)

MODBUS#2
Modbus#2 Driver Protocol
Modbus#2 Device Number

Port 2 (CPU-B or SIO B4) Modbus Settings
Port Configuration
PCI To Revert To Port C Fault?
Baud Rate
Stop Bits
Parity

RS protocol (for SIO only)	
Port 3 (CPU-C)	
Allow Emrg Shutdown from Run Mode?	

SIOA/B COMMUNICATIONS FOLDER

SIO-B channel 3 configuration	(PCI/Modbus)
(if Modbus)	
Baud	
Stop bit	
Parity	
RS protocol	
SIO-A channel 4 configuration	(PCI/Modbus)
(if Modbus)	
Baud	
Stop bit	
Parity	
RS protocol	

FEED-FORWARD FOLDER (if configured)

Sensor value for 4 mA	rpm
Sensor value for 20 mA	rpm
Disabled if cascade disabled?	Y/N
Use as direct speed Bias?	Y/N
Forward DB	RPM
Max FW gradient (>0)	%/s
Speed bias at max gradient	rpm
MIN fw gradient	%/s
Speed bias at min gradient	rpm
Use emergency FW?	Y/N
Action duration	s
Use emergency FW?	Y/N
Max FW gradient	%/s
Speed bias at max gradient	rpm
Min detection Fw gradient	%/s
Max speed gradient	RPM/S
Action duration (emergency)	s

Seal Gas PID FOLDER (if configured)

Sensor value for 4 mA	units
Sensor value for 20 mA	Units
Seal gas Units	
Max Seal setpoint	Units
Min Seal setpoint	Units
Setpoint track at initialization	Y/N
Setpoint rate	units/s
Setpoint fast rate multiplier	
SP fast rate delay	s
Proportional gain	
Integer gain	
Derivative ratio	
Dead-band	%
Droop	%
Invert Seal gas input?	Y/N

Automatic raise if sensor failed?	Y/N
Automatic lower if sensor failed?	Y/N
Manual mode only if sensor failed?	Y/N
Max PID output	%
Min PID output	%
Demand at initialization	%
Demand R/L rate	%/s
Demand fast rate multiplier	
fast demand rate delay	s

Appendix C.
5009C Service Mode Worksheet

GOVERNOR SERIAL NUMBER: _____

DATE: _____

APPLICATION: _____

APPLICATION FOLDER
Same as Program Mode

START SETTINGS FOLDER
(Additional parameters only)

HP ramp R/L fast rate delay s
HP ramp R/L multiply factor

SPEED CONTROL FOLDER
(additional parameters only)

Setpoint slow multiply
Normal rate delay s
OSPD Test Auto Dsbl Time s
Trip at overspeed Test limit Y/N

Use 4-20mA Remote Speed Setpoint? (Y/N)
Min range of action for control rpm
Max range of action for control rpm
Not Matched Delta rpm
Not matched Rate rpm/s
Input Deadband rpm
Input lag tau s

Teeth Seen by Speed Probe
Gear Ratio 1:
Maximum deviation rpm
Speed Failure level rpm
By-pass Override Timer Y/N
Max Override Time s

DUAL REDUNDANCY FOLDER (if configured)

Redundancy1

IH-A Valve Lift conversion table

X1	Y1
X2	Y2
X3	Y3
X4	Y4

X5	Y5
X6	Y6

IH-B Valve Lift conversion table

X1	Y1
X2	Y2
X3	Y3
X4	Y4
X5	Y5
X6	Y6

Redundancy2

IH-A Valve Lift conversion table

X1	Y1
X2	Y2
X3	Y3
X4	Y4
X5	Y5
X6	Y6

IH-B Valve Lift conversion table

X1	Y1
X2	Y2
X3	Y3
X4	Y4
X5	Y5
X6	Y6

EXTR / ADM CONTROL FOLDER (if configured)
(Additional parameters only)

demand

Man P demand rate	%/s
Fast delay	s

Setpoint

Setpoint Rate	units/s
Fast rate delay	s
Fast MLT factor	

Remote extraction

Remote extraction sliding DB	units

Inputs

Max Input deviation	units
Two good Input equation	
Remove input#1	Y/N
Remove input#2	Y/N
Remove input#3	Y/N

EXTRACTION STEAM MAP FOLDER
Same as in program mode

ADMISSION STEAM MAP FOLDER
Same as in program mode

EXT/ADM STEAM MAP FOLDER
Same as in program mode

DRIVER CONFIG FOLDER
(Additional parameters only)

HP1 linearization curve

X1	%	Y1	%
X2	%	Y2	%
X3	%	Y3	%
X4	%	Y4	%
X5	%	Y5	%
X6	%	Y6	%
X7	%	Y7	%
X8	%	Y8	%
X9	%	Y9	%
X10	%	Y10	%
X11	%	Y11	%

HP2 linearization curve

X1	%	Y1	%
X2	%	Y2	%
X3	%	Y3	%
X4	%	Y4	%
X5	%	Y5	%
X6	%	Y6	%
X7	%	Y7	%
X8	%	Y8	%
X9	%	Y9	%
X10	%	Y10	%
X11	%	Y11	%

LP1 linearization curve

X1	%	Y1	%
X2	%	Y2	%
X3	%	Y3	%
X4	%	Y4	%
X5	%	Y5	%
X6	%	Y6	%
X7	%	Y7	%
X8	%	Y8	%
X9	%	Y9	%
X10	%	Y10	%
X11	%	Y11	%

LP2 linearization curve

X1	%	Y1	%
X2	%	Y2	%
X3	%	Y3	%

X4	%	Y4	%
X5	%	Y5	%
X6	%	Y6	%
X7	%	Y7	%
X8	%	Y8	%
X9	%	Y9	%
X10	%	Y10	%
X11	%	Y11	%

Act 1 (actuator card Settings)

LVDT A linearization

X1	25%	Y1	%
X2	50%	Y2	%
X3	75%	Y3	%

Use degraded? (Y/N)

Curve Pilot deviation =F(LVDT derivative

X1	%/s	Y1	%
X2	%/s	Y2	%
X3	%/s	Y3	%
X4	%/s	Y4	%
X5	%/s	Y5	%

Act 2 (actuator card Settings)

LVDT A linearization

X1	25%	Y1	%
X2	50%	Y2	%
X3	75%	Y3	%

Use degraded? (Y/N)

Curve Pilot deviation =F(LVDT derivative

X1	%/s	Y1	%
X2	%/s	Y2	%
X3	%/s	Y3	%
X4	%/s	Y4	%
X5	%/s	Y5	%

ANALOG INPUTS FOLDER
(Additional parameters only)

Analog Input #1
Max Input deviation %
Two good equation

Analog Input #2
Max Input deviation %
Two good equation

Analog Input #3
Max Input deviation %
Two good equation

Analog Input #4

Max Input deviation %
Two good equation

Analog Input #5
Max Input deviation %
Two good equation

Analog Input #6
Max Input deviation %
Two good equation

Analog Input #7
Max Input deviation %
Two good equation

Analog Input #8
Max Input deviation %
Two good equation

CONTACT INPUTS FOLDER
(Additional parameters only)

Keep Contact Enabled for remote selection? Y/N

DECOUPLING CONTROL/LIMITER FOLDER
demand
Man R/L rate %/s
Fast delay s

Setpoint
Setpoint rate unit/s
Fast rate delay s
Fast rate multiply

Remote SP
Remote SP LAG s
Sensor DB

Inputs
Max Input deviation units
Two good Input equation
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

CASCADE CONTROL FOLDER

Remote SP
Remote SP LAG s
Sensor DB

Inputs
Max Input deviation units
Two good Input equation
Remove input#1 Y/N
Remove input#2 Y/N

Remove input#3 Y/N

ANALOG READOUTS FOLDER
(Additional parameters only)

Analog Readout 1
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

Analog Readout 2
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

Analog Readout 3
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

Analog Readout 4
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

Actuator combo 1 (if available)
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

Actuator combo 2 (if available)
Remove input#1 Y/N
Remove input#2 Y/N
Remove input#3 Y/N

RELAY FOLDER

Major alarm selection

SIO card A failed
SIO card B failed
Fan failed
Over temperature A
Over temperature B
Over temperature C
System alarm
5009 tripped
Start interlock
Speed control lost
Stuck in critical
Underspeed
Ext alarm#1
Ext alarm#2
Ext alarm#3
Ext alarm#4
Ext alarm#5
Ext alarm#6

Ext alarm#7
Ext alarm#8
Ext alarm#9
Ext alarm#10
Remote speed failed
Cascade PV failed
Remote cascade failed
All extr sensor failed
Remote extr failed
Decoupling Input failed
Remote decoupling failed
HP compensation failed
LP compensation failed
Feed-forward failed
Any relay failed
Actuator#1 failed
Actuator#2 failed
Actuator-FB ch 1 failed
Actuator-FB ch 2 failed
Monitor#1 failed
Monitor#2 failed
Monitor#3 failed
Monitor#4 failed

CPU COMMUNICATIONS FOLDER

MODBUS1
Modbus#1 Driver Protocol
Modbus#1 Device Number

Port 1 (CPU-A or SIO-A-3) Modbus Settings
Port Configuration
Baud Rate
Stop Bits
Parity
RS protocol (for SIO only)
Trip command
Local mode

MODBUS#2
Modbus#2 Driver Protocol
Modbus#2 Device Number

Port 2 (CPU-B or SIO B4) Modbus Settings
Port Configuration
PCI To Revert To Port C Fault?
Baud Rate
Stop Bits
Parity
RS protocol (for SIO only)
Trip command
Local mode

Port 3 (CPU-C)
Allow Emrg Shutdown from Run Mode?

Modbus scale factors
Cascade scale factor

Decoupling scale factor
Ext/Adm scale factor
Monitor#1 scale factor
Monitor#2 scale factor
Monitor#3 scale factor
Monitor#4 scale factor
HP compensation scale factor
LP compensation scale factor
Feed-forward scale factor
Remote Hot/cold scale factor
IH-1A scale factor
IH-1B scale factor
IH-2A scale factor
IH-2B scale factor

SIOA/B COMMUNICATIONS FOLDER

Additional parameters
SIO-A
Port 1
Baud
Data bit
Stop
Parity
Endline
Echo
Flow
Ignore CR

Port 2
Baud
Data bit
Stop
Parity
Endline
Echo
Flow
Ignore CR

SIO-B
Port 1
Baud
Data bit
Stop
Parity
Endline
Echo
Flow
Ignore CR

Port 2
Baud
Data bit
Stop
Parity
Endline
Echo
Flow
Ignore CR

FEED-FORWARD FOLDER (if configured)
Same as for program mode

Seal PID FOLDER (if configured)
Same as for program mode

We appreciate your comments about the content of our publications.

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