



**Product Manual 350108V2**  
**(Revision E, 6/2022)**  
Original Instructions



## **505XT Digital Control for Steam Turbines (Single valve, Extraction and/or Admission)**

Manual 35018 consists of 2 volumes (35018V1 & 35018V2)

**Installation and Operation Manual Volume 2**



### General Precautions

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

Practice all plant and safety instructions and precautions.

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



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# Contents

<b>WARNINGS AND NOTICES .....</b>	<b>6</b>
<b>ELECTROSTATIC DISCHARGE AWARENESS.....</b>	<b>7</b>
<b>INTRODUCTION .....</b>	<b>8</b>
<b>CHAPTER 8. SERVICE TOOLS .....</b>	<b>9</b>
Overview .....	9
Control Assistant (CA).....	9
Servlink-to-OPC-Server (SOS) .....	9
AppManager (AppMan).....	9
505 Remote View .....	10
<b>CHAPTER 9. PERIPHERAL DEVICES .....</b>	<b>11</b>
Overview .....	11
DSL2C-2 (Generator Synchronizer and Load Control).....	11
VariStroke II (Electro-Hydraulic Actuator) .....	14
MFR300 (Multi-function Relay) .....	15
LS-5 (Protection/Breaker Control Relay) .....	17
HighPROTEC (Generator Protection Unit) .....	19
Servo Position Controller (SPC) .....	20
Real Power Sensor .....	21
Engine Generator Control Package/Load Sharing (EGCP-3 LS) .....	22
Applying the 505 with Redundant I/H or I/P Converters .....	26
<b>CHAPTER 10. APPLICATION NOTES .....</b>	<b>28</b>
Overview .....	28
Example Applications.....	30
Example 1—Pump or Compressor Discharge Pressure Control with Turbine Inlet Pressure Limiting .....	31
Example 2—Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting .....	34
Example 3—Exhaust Pressure Control with Generator Power Limiting and Plant Import/Export Limiting ..	38
Example 4—Plant Import/ Export Control with SPC Servo Interface .....	41
Example 5—Inlet Pressure Control with Isochronous Load Sharing Control in Island Mode .....	45
Example 6—Import/Export Control or Exhaust Pressure Control with Isoch Load Sharing in Island Mode ..	49
Example 7—Induction Generator Applications.....	52
Example 8 — Extraction Turbine Mechanical Drive (Pump or Compressor) with Discharge Pressure Control and Turbine Inlet Pressure Limiting.....	53
Example 9 — Extraction Turbine Inlet and Extraction Pressure Control with Automatic Synchronizing & Generator Power Limiting .....	57
<b>CHAPTER 11. OPERATOR INTERFACE.....</b>	<b>62</b>
Introduction .....	62
Graphical Display and Key Inputs.....	62
Service Panel Modes and User Levels .....	63
<b>CHAPTER 12. SERVICE MENU PROCEDURES .....</b>	<b>65</b>
Overview .....	65
Using the Service Menus .....	65
Service Mode Parameters.....	69
<b>CHAPTER 13. UNDERSTANDING PID SETTINGS.....</b>	<b>99</b>
Overview .....	99
Proportional Response.....	100
Proportional + Integral (closed loop).....	101
Derivative Response .....	103
Proportional + Derivative (closed loop).....	104
Proportional + Integral + Derivative (closed loop).....	105
Controller Field Tuning General .....	107

OPTI_PID Automatic Dynamic Optimizer .....	108
<b>CHAPTER 14. HARDWARE/OPERATING SYSTEM FAULTS.....</b>	<b>112</b>
General.....	112
Wiring Problems.....	112
Control Adjustments.....	112
Other Operating Problems .....	113
<b>APPENDIX B. 505 DESIGN SPECIFICATIONS.....</b>	<b>114</b>
Hardware Specifications .....	114
Software Specifications.....	114
<b>APPENDIX C. 505XT SERVICE MODE WORKSHEET .....</b>	<b>116</b>
<b>APPENDIX D. PASSWORD INFORMATION.....</b>	<b>131</b>
General.....	131
Monitor User Level .....	131
“Operator” User Level Password .....	131
“Service” User Level Password.....	131
“Configure” User Level Password .....	131
“ServiceUser” User Level Password .....	131
<b>APPENDIX E. SERVLINK-TO OPC SERVER (SOS) TOOL.....</b>	<b>132</b>
SOS Communication Link .....	132
Installing SOS .....	132
Connecting a PC/Laptop to the Control .....	133
<b>APPENDIX F. CONTROL ASSISTANT—SOFTWARE INTERFACE TOOL.....</b>	<b>136</b>
Features of Control Assistant.....	136
Installing Control Assistant.....	136
Using Control Assistant.....	138
<b>APPENDIX G. APPMANGER SERVICE TOOL .....</b>	<b>143</b>
File Management with App. Manager .....	143
Installing App Manager .....	143
<b>APPENDIX H. CONFIGURING NETWORK TCP/IP ADDRESSES .....</b>	<b>150</b>
Setting SNTP (“Simple Network Time Protocol”).....	152
<b>APPENDIX I. REMOTEVIEW TOOL .....</b>	<b>153</b>
<b>APPENDIX J. USING 505 INTERNAL SIMULATION MODE.....</b>	<b>163</b>
<b>APPENDIX K. CUSTOM TAG NAME PROCEDURE.....</b>	<b>164</b>
<b>APPENDIX L. STARTUP GUIDE.....</b>	<b>165</b>
Commissioning Checklist.....	165
<b>APPENDIX M. DATALOGS.....</b>	<b>167</b>
Overview .....	167
<b>REVISION HISTORY .....</b>	<b>173</b>

## Illustrations and Tables

Figure 9-1. DSLC-2 .....	11
Figure 9-2. Configuration/Woodward Links/DSLC-2 .....	12
Figure 9-3. Service Screen - DSLC-2 Power Parameters .....	12
Figure 9-4. Service Screen - DSLC-2 Status Parameters .....	13
Figure 9-5. VS-II .....	14
Figure 9-6. Configuration/Woodward Links/VS-II .....	14
Figure 9-7. Service/VariStroke II .....	15
Figure 9-8. MFR300 Multi-Function Relay .....	15
Figure 9-9. Configuration/Woodward Links/MFR300 .....	16
Figure 9-10. Service Screen1/Woodward Links/MFR300 .....	16
Figure 9-11. Service Screen2/Woodward Links/MFR300 .....	17
Figure 9-12. LS-5 .....	17
Figure 9-13. Configuration/Woodward Links/LS-5 .....	18
Figure 9-14. Service Screen/Woodward Links/LS-5 .....	19
Figure 9-15. HighPROTEC .....	19
Figure 9-16. Configuration Screen/Woodward Links/HighPROTEC .....	20
Figure 9-17. Service Screen/Woodward Links/HighPROTEC .....	20
Figure 9-18. Servo Position Controller .....	21
Figure 9-19. Interface to Servo Position Controller .....	21
Figure 9-20. Real Power Sensor .....	22
Figure 9-21. EGCP-3 Control .....	23
Figure 9-22. EGCP-3 LS Functional Diagram .....	24
Figure 9-23. EGCP-3 LS Interface Wiring .....	25
Figure 9-24. Typical Redundant I/H System with a Transfer Valve .....	26
Figure 9-25. Typical Redundant I/P System with a Pressure Selecting Relay Valve .....	27
Figure 10-1. Pump or Compressor Discharge Pressure Control with Turbine Inlet Pressure Limiting .....	31
Figure 10-2. Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting .....	34
Figure 10-3. Exhaust Pressure Control with Generator Power Limiting and Plant Import/Export Limiting .....	38
Figure 10-4. Plant Import/Export Control with SPC Servo Interface .....	42
Figure 10-5. Inlet Pressure Control with Isochronous Load Sharing Control in Island Mode .....	46
Figure 10-6. Import/Export Control or Exhaust Pressure Control with Isoch Load Sharing in Island Mode .....	49
Figure 10-7. Pump or Compressor with Discharge Pressure Control and Turbine Inlet Pressure Limiting .....	53
Figure 10-8. Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting .....	57
Figure 11-1 505 Keypad and Display .....	62
Figure 12-1. User Login for Service .....	65
Figure 12-2. Authorized and Unauthorized Components .....	65
Figure 12-3 Service Menu (page 1) .....	66
Figure 12-4 Service Menu (page 2) .....	67
Figure 13-1. Proportional Gain Setting Effects .....	100
Figure 13-2. Open Loop Proportional and Integral Response .....	101
Figure 13-3. Closed Loop Proportional and Integral Response .....	102
Figure 13-4. Integral Gain (Reset) Setting Responses .....	103
Figure 13-5. Closed Loop Proportional and Derivative Action .....	104
Figure 13-6. Derivative Setting Effects .....	105
Figure 13-7. Closed Loop Proportional, Integral and Derivative Action .....	106
Figure 13-8. Typical Response to Load Change .....	107
Figure 13-9. Speed Dynamics for Extraction/Admission type turbine .....	108
Figure 13-10. Speed Dynamics Generator On-Line Gain Curve .....	109
Figure 13-11. Speed Dynamics Optimizer .....	110
Figure 13-12. Configuring settings for OPTI_Tune .....	111
Figure E-1. SOS .....	132
Figure E-2. SOS Install Window .....	133
Figure E-3. SOS Server status dialog box .....	133
Figure E-4. SOS – New Session box .....	134
Figure E-5. SOS - Enter 505 TCP/IP address .....	134

Figure E-6. SOS – Active Links dialog box .....	134
Figure F-1. Control Assistant License Agreement .....	136
Figure F-2. Control Assistant Install Window .....	137
Figure F-3. Control Assistant Folder Selection .....	137
Figure F-4. Control Assistant Install Complete .....	137
Figure F-5. Install Restart Window .....	138
Figure F-6. Control Assistant Window .....	138
Figure F-7. Dialog for Servlink OPC connection .....	139
Figure F-8. WinPanel Session .....	139
Figure F-9. Control Assistant – Retrieve Tunable Dialog box .....	140
Figure F-10. Control Assistant – Send Tunable Dialog box .....	141
Figure F-11. Control Assistant – Speed Control Trend Script .....	142
Figure F-12. Control Assistant – Create Trend Script File .....	142
Figure G-1. App Manager Install Window .....	143
Figure G-2. App Manager License Agreement Window .....	144
Figure G-3. App Manager Installation .....	144
Figure G-4. App Manager Install Complete .....	144
Figure G-5. AppManager Window .....	145
Figure G-6. Dialog for App Manager Connection .....	145
Figure G-7. App Manager Connected to a Control .....	146
Figure G-8. AppManager Control Info Window .....	146
Figure G-9. AppManager Control (GAP) Application Panel .....	147
Figure G-10. AppManager GUI Application Panel .....	147
Figure G-11. Retrieving Files .....	147
Figure H-1. Configuration/Communications Screen .....	150
Figure H-2. Ethernet Port Layout (Ports on Side) .....	150
Figure H-3. Real Time Clock SNTP settings .....	152
Figure I-1. Window Shown when the Time Limit is Exceeded .....	153
Figure I-2. Installation Welcome Window .....	153
Figure I-3. Installation Folder Window .....	154
Figure I-4. Installation License Agreement Window .....	154
Figure I-5. Installation Start Menu Shortcuts Window .....	155
Figure I-6. Installation Ready to Install Window .....	155
Figure I-7. Installation Complete Window .....	156
Figure I-8. Entering an IP Address to be Added to the Control List .....	156
Figure I-9. Control Selected in the Control List .....	157
Figure I-10. Login Window with Fields for User Name and Password .....	157
Figure I-11. An Application Selected in the Application List .....	158
Figure I-12. Default View of the Tool .....	159
Figure I-13. Simple View of the Tool .....	159
Figure I-14. Full View of the Tool .....	160
Figure I-15. Entering a Name for the Current Settings .....	160
Figure I-16. A New Settings File Entered in the Predefined Settings List .....	161
Figure I-17. Remote View Tool (Default Setting) after Opening from the Configuration Window .....	162
Figure J-1. HW Simulation Mode Access .....	163
Figure M-1. The Datalog Service Menu Page .....	168
Figure M-2. DataLog Graph Properties .....	169
Figure M-3. Datalog Plot .....	170
Figure M-4. Automated File Collection Configuration .....	171
Figure M-5. Automated File Collection Active .....	172

Table 9-1. Parameter ID's from DSCLC-2 to 505XT .....	13
Table 9-2. CAN Wiring from 505 to VS-II .....	15
Table 9-3. CAN Wiring from 505XT to MFR300 .....	16
Table 9-4. CAN Wiring from 505XT to LS-5.....	18
Table 10-1. Example Application Summary.....	31
Table 11-1. Mode Access by User Level .....	63
Table 12-1. Current CANOPEN NMT State Values Displayed.....	82
Table 12-2. Current CANOPEN State Values Displayed.....	82
Table 12-3. Time Zones .....	89
Table 13-1. Speed Control Dynamic Settings Options .....	109
Table 13-2. On-Line/Off-Line Dynamics Selection .....	109

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 VxWorks (Wind River Systems, Inc.)

## Warnings and Notices

### Important Definitions



This is the safety alert symbol 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.



## 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, connectors, or 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. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

# Introduction

This volume of the manual contains application-specific notes, details on interfaces to other Woodward products and example configurations of typical steam turbine applications.

This volume gives users an overview of the 505XT Control's capabilities and applications. Typical applications are schematically shown and their functionality explained. Programming and Start/Run mode notes are given for each application to assist application programmers in configuring the 505XT for their application.

## General Installation and Operating Notes and Warnings



Refer to Manual 35018, Volume 1 for required safety instructions, special conditions for safe use and hazardous location requirements to insure the control is used in a safe manner in ordinary, marine, hazardous, ATEX and IECEx locations. Volume 1 must be fully understood and complied with for all applications.

## Chapter 8. Service Tools

### Overview

This chapter provides an overview of the Service Tool interfaces to the 505. Instructions for installing and using these tools are in the Appendices of this volume of the manual. All Service tool interfaces to the 505 are Ethernet connections and can be used on any of the four Ethernet ports. The only requirement is that the PC connecting to the control has an IP address on the same domain (as with any typical network).

Default settings for the Ethernet TCP/IP addresses are in Volume 1, Chapter 2.

### Control Assistant (CA)

This tool is the primary service tool that will provide the following features:

- Uploading and downloading tunables (your complete configuration settings)
- Live trending of any I/O signal or control parameter
- Troubleshooting any system problem by viewing software variables in the system
- Analyzing any datalog files that are collected from the control

The system documentation (BCD-85282) for the 505 contains files that can be used with Control Assistant. The item number of the CD is BCD-85282 and the downloadable install file of this information is item number 5418-7837.

1. Trend script files (.ts) that can be used as a template to view live data.
2. A tunable file (.tc) of the factory default settings of all tunable settings in the control.

The factory default tunables are useful when training personnel on how a spare unit will look when initially powered, and then step through the procedure below to install site specific settings.

Refer to the Appendices of this volume for instruction on using Woodward's Control Assistant Software Service Tool (Version 4.7 or newer).

### Servlink-to-OPC-Server (SOS)

Integrated with control assistant is the Woodward Servlink-to-OPC-Server (SOS) program that provides the communication data link between the 505 and a user PC or system HMI. The SOS program will run on the PC as a service and convert the 505 Woodward proprietary Servlink data to OPC data. The Control Assistant tool will connect as a client to the SOS server. Customers desiring to link to OPC data from the 505 will need to also connect to SOS.

### AppManager (AppMan)

This program is the primary tool for transferring files to and from the control. It will provide the user with the following services:

- Transferring files to and from the control (executable control software, GUI software, datalog files, system log files, control backup information)
- Setting the control Ethernet port IP addresses and the SNTP time synchronization IP address for network time protocol synchronizing
- Installing a software service pack program
- Starting / stopping the control program or GUI program

## 505 Remote View

This program provides a duplicate user interface as found on the front panel of the local 505 control itself. It will allow the user to log into the control from a PC on the same network and provides full access to the control, with the exception of the Emergency Stop (which is a hardwired button directly integrated into the hardware).

Users can log in at any user level with this tool. It will run for up to two hours without a license. For continuous operation of this tool, purchase a runtime license.

## Chapter 9. Peripheral Devices

### Overview

This chapter provides a brief explanation of other Woodward devices, which easily integrate with the 505XT. By understanding the functionality of a peripheral device, a better understanding of the overall control configuration is achieved.

Some of these devices connect to the 505XT by a digital communication link (either Ethernet or CAN depending on the product). Through this link, the 505XT display will allow the user to monitor many signals and status LED's from this external device. In many cases, these connections allow the 505XT to receive required input signals, such as KW Load or a Synchronization or Load Sharing Bias signal. This eliminates the need for wiring these signals to typical I/O channels, or the digital signal can be used as a redundant/backup signal to a hard-wired signal. Devices supported in the 505XT control application is identified with a **"Woodward Link"** identifier.

All the devices covered in this section are manufactured and/or supported by Woodward. Peripheral devices manufactured by other companies can be used with the 505 to perform the functions detailed below; however, the compatibility of them to the 505 and the application should be verified before system operation.

### DSLC-2 (Generator Synchronizer and Load Control)



Figure 9-1. DSLC-2

When connected to the 505XT controller, the DSLC-2 can be used with generators to accurately sense 3-phase RMS generator output power and perform generator breaker synchronization. Other configurable DSLC-2 functions include generator load-sharing, VAR or Power Factor control, process control, and base load control.

This is a **"Woodward Link"** device.

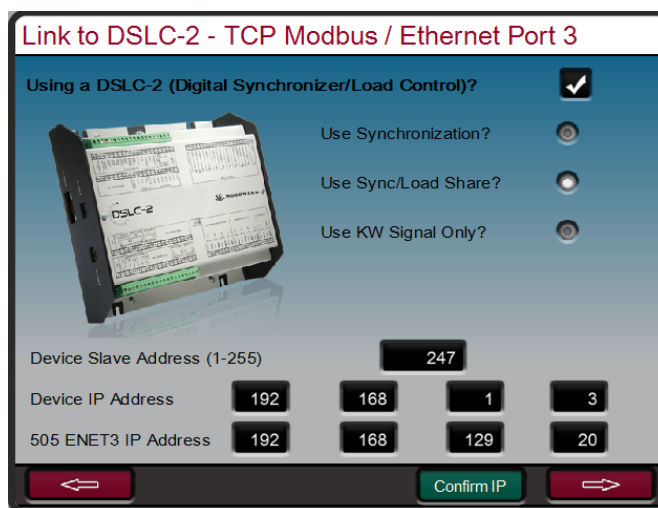


Figure 9-2. Configuration/Woodward Links/DSLC-2

To enable the Woodward Link feature, select the check box on the screen above and enter the slave address and the IP address of the DSLC-2 device. The figure above shows the factory default IP addresses of the DSLC-2 and Ethernet port 3 of the 505XT. These settings will allow these two products to communicate automatically once an RJ45 Ethernet cable is connected between Ethernet Port 3 of the 505XT and Network B port on the DSLC-2.

Once this configuration is complete, the DSLC-2 can provide the synchronization speed bias signal, the sync/load sharing bias signal, and the KW output of the generator. The radio buttons on the screen allow the user to select the desired functions. The KW valued through this link can be used as a secondary KW input signal, and is an analog input channel configured for a KW input.

The screens below show the available service screens that will now be accessible to monitor the DSLC-2.

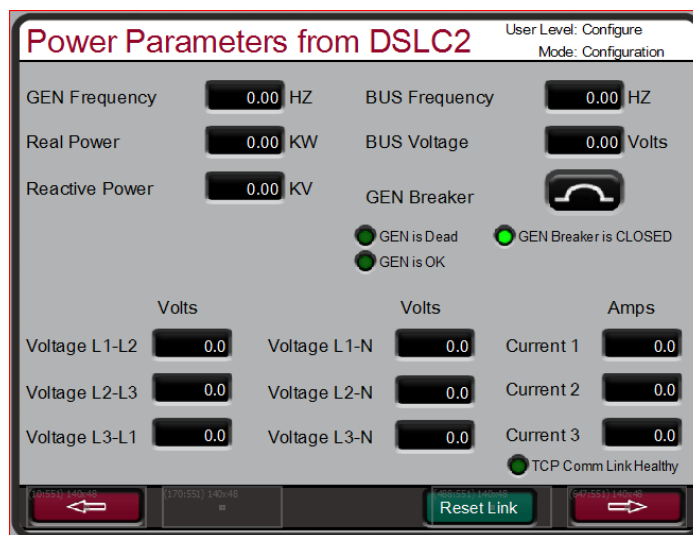


Figure 9-3. Service Screen - DSLC-2 Power Parameters

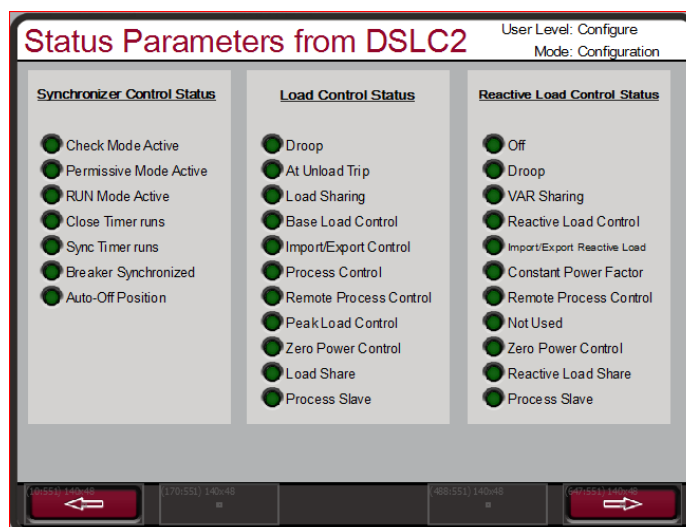


Figure 9-4. Service Screen - DSLC-2 Status Parameters

The following table shows the parameter ID's of the values available in the 505XT from the DSLC-2.

Table 9-1. Parameter ID's from DSCLC-2 to 505XT

Parameter ID	Description
144	Generator Frequency
209	Busbar Frequency
246	Generator Total Active Power
247	Generator Total Reactive Power
248	GEN Voltage L1-L2
249	GEN Voltage L2-L3
250	GEN Voltage L3-L1
251	GEN Voltage L1-N
252	GEN Voltage L2-N
253	GEN Voltage L3-N
254	Busbar Voltage
255	GEN Current 1
256	GEN Current 2
257	GEN Current 3
4151	Conditions Flag 1 (Bit Packed States Decoded to LED's)
4634	Load Control Mode (Bit Packed States Decoded to LED's)
4635	Reactive Load Control Mode (Bit Packed States Decoded to LED's)
4636	Sync Control State (Bit Packed States Decoded to LED's)

## VariStroke II (Electro-Hydraulic Actuator)

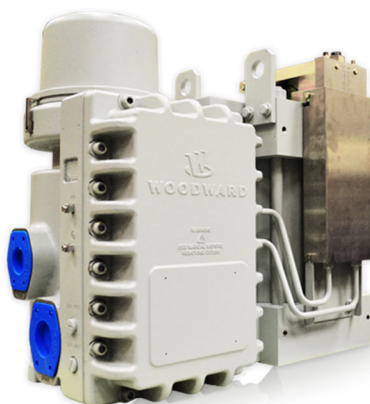


Figure 9-5. VS-II

This is a “**Woodward Link**” device.

The VariStroke-II is a linear electro-hydraulic actuator designed to provide the linear actuation force to operate steam turbine control valves or valve racks. This actuator can be directly networked with the 505 controller to reduce system complexity and wiring requirements.

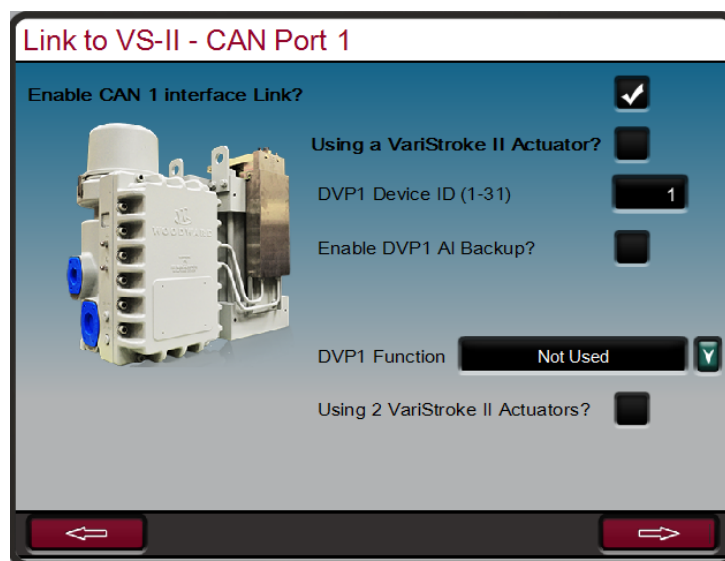


Figure 9-6. Configuration/Woodward Links/VS-II

To enable the Woodward Link feature, select the check boxes on the screen above to enable the CAN1 Link and confirm usage of the VariStroke II actuator, then enter the Device ID. If an analog (4-20 mA) demand signal is going to be connected to the VariStroke in addition to the CAN link, then select the desired function for this signal (AI Backup is recommended). Finally, select the inlet steam valve being controlled (for most applications it is HP Demand).



Table 9-2. CAN Wiring from 505 to VS-II

505	Function	VariStroke II
CAN 1 – terminal 1	COM	TB6-A (Top) – terminal 35
CAN 1 – terminal 2	CAN LO	TB6-A (Top) – terminal 32
CAN 1 – terminal 4	CAN HI	TB6-A (Top) – terminal 31
Connect a termination resistor across CAN 1 – terminals 2 & 4		

Once the configuration is complete, the VariStroke-II digital communication link will provide the actuator demand signal to the steam valve and the screen below will now be available under the Service Menu to monitor driver information.

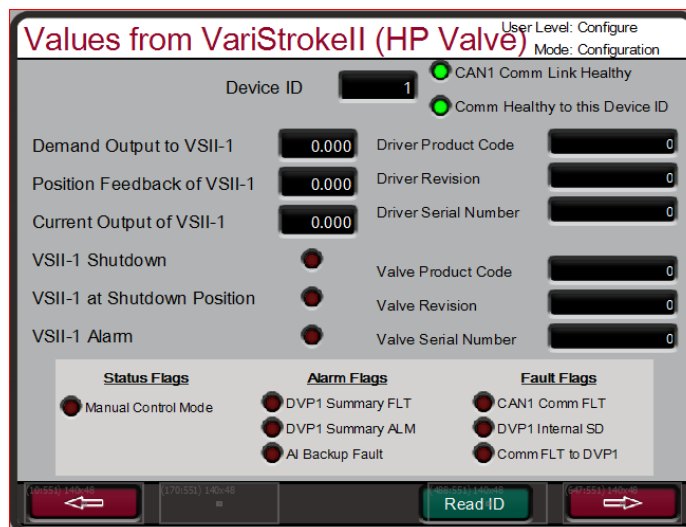


Figure 9-7. Service/VariStroke II

## MFR300 (Multi-function Relay)



Figure 9-8. MFR300 Multi-Function Relay

This is a “**Woodward Link**” device.

The MFR 300 is a multi-function generator protection relay used to sense and protect small generators. This multi-function protection relay integrates all generator protection functions into one common device reducing overall system installation complexity and cost.

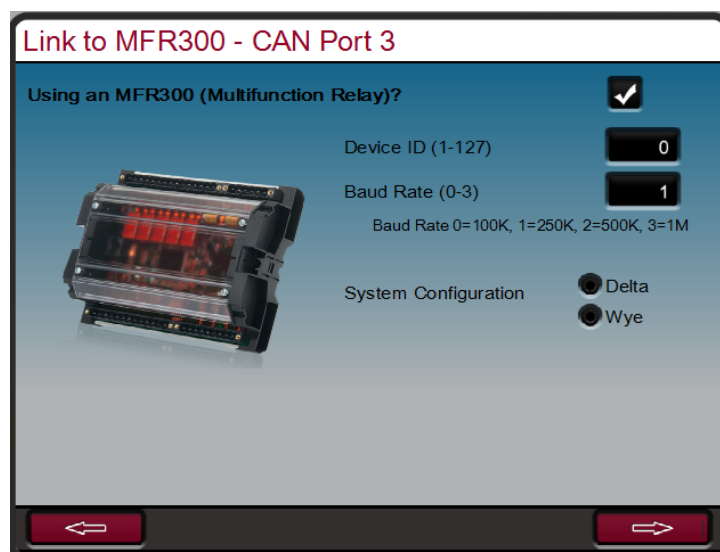


Figure 9-9. Configuration/Woodward Links/MFR300

To enable this Woodward Link feature, select the check box on the screen above to enable the CAN3 Link and confirm usage of the MFR300 multifunction relay, then enter the Device ID, Baud Rate, and system configuration.

Table 9-3. CAN Wiring from 505XT to MFR300

505	Function	MFR300
CAN 1 – terminal 1	COM	
CAN 1 – terminal 2	CAN LO	terminal 03
CAN 1 – terminal 4	CAN HI	terminal 04
Connect a termination resistor across CAN 1 – terminals 2 & 4		

Once selected and configured, the screens below will become available on the Service screens.

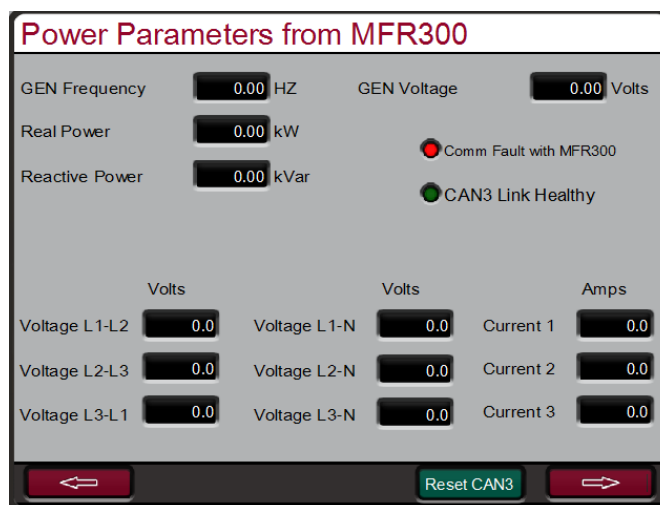


Figure 9-10. Service Screen1/Woodward Links/MFR300

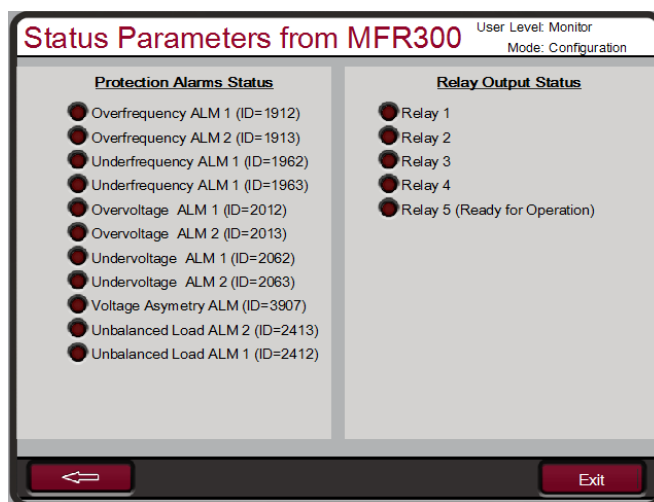


Figure 9-11. Service Screen2/Woodward Links/MFR300

## LS-5 (Protection/Breaker Control Relay)



Figure 9-12. LS-5

This is a “**Woodward Link**” device.

The LS-5 series protection relays integrate generator breaker synchronization, power sense, and protection functions all into one package. This device is designed to function in combination with a prime mover controller like the 505XT to allow accurate generator control, as well as provide required generator protection.

### The LS-5 Series is available in two versions and includes:

- The back panel mounted LS-511 has a rugged aluminum chassis for use in harsh environments or confined spaces.
- The front panel mounted LS-521 has sealed soft keys and an easy to read backlit LCD multilingual graphical display.

### Features Include:

- Up to 16 LS-5 units can be operated in one network with up to 32 easYgen-3400/3500
- Phase match or slip frequency synchronization with voltage matching
- Full protection package (including  $df/dt$  (ROCOF), phase shift and mains voltage increasing protection according to new German grid code requirements in VDE-0126-1-1)
- Segment control for the load sharing
- Event log with up to 300 entries
- Automatic date and time synchronization between the LS-5 units and the connected easYgen-3400/3500 controls

- LS-5 “Stand Alone” mode without the easYgen-3400/3500 is possible
- Preconfigured application modes for the most common applications in the field (MCB or MCB/GGB application)
- Automatic and Manual mode
- Full remote control via CAN or RS-485 interface
- In case transformers are used in the application, vector group adjustment is available
- Breaker open/close failure detection
- Mains decoupling “Test” mode
- Multilingual capability
- Lock Keypad feature
- Eight freely configurable LED's are available on the LS-511 back panel mountable device

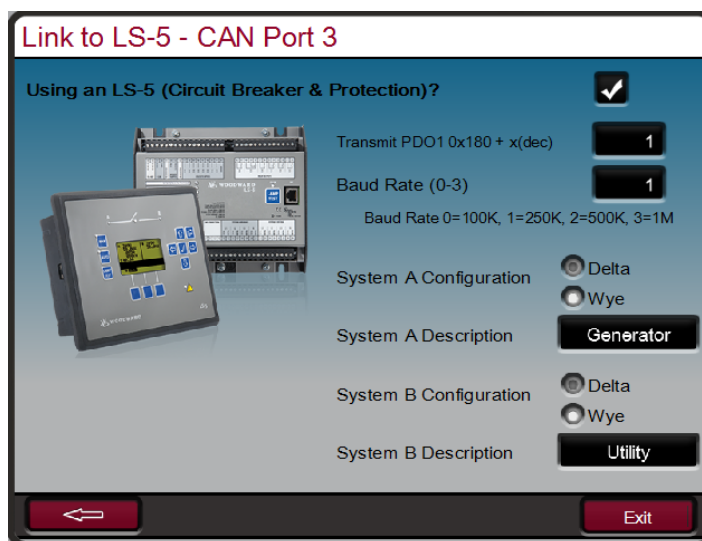


Figure 9-13. Configuration/Woodward Links/LS-5

To enable this Woodward Link feature, select the check box on the screen above to enable the CAN3 Link and confirm usage of the LS-5 Circuit Breaker and Protection device, then enter the PDO number (Device ID), Baud Rate, and system configuration information.

Table 9-4. CAN Wiring from 505XT to LS-5

505	Function	LS-5
CAN 1 – terminal 1	COM	
CAN 1 – terminal 2	CAN LO	terminal 56
CAN 1 – terminal 4	CAN HI	terminal 57
Connect a termination resistor across CAN 1 – terminals 2 & 4		

Once selected and configured, the screen below will become available on the Service screens.

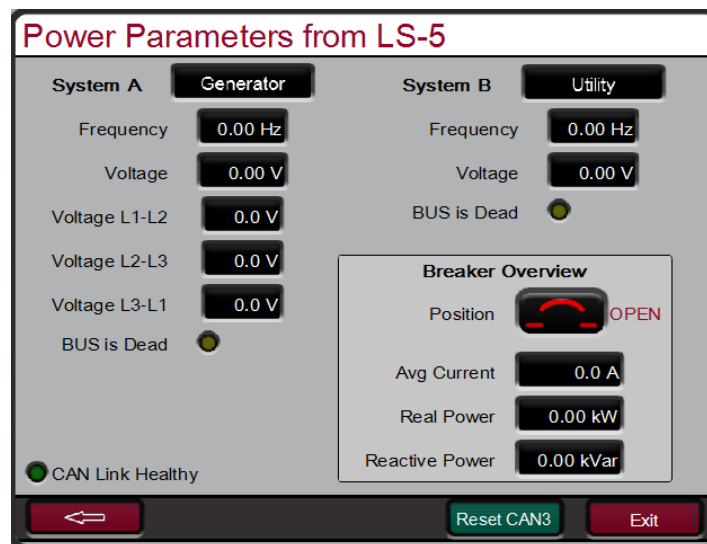


Figure 9-14. Service Screen/Woodward Links/LS-5

## HighPROTEC (Generator Protection Unit)



Figure 9-15. HighPROTEC

This is a “**Woodward Link**” device.

The HighPROTEC is a family of generator protection devices designed to provide complete protection for generators and or power distribution. Various models and configurations exist that provide multiple ANSI standard protection functions.

The 505XT is programmed to communicate only to HighPROTEC model numbers that communicate via Modbus TCP. Check the final letter of the part number to identify the communication protocol that is supported. The letter C indicates it is a unit configurable to use Modbus TCP (for example model MCDGV4-A-0-A-C would work). If the final letter is a “C”, then an RJ45 Ethernet connection jack will exist on terminal X100 on the rear of the unit.

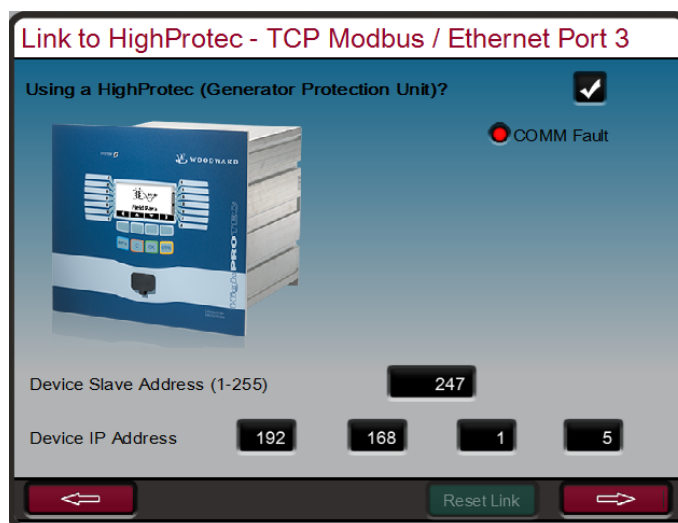


Figure 9-16. Configuration Screen/Woodward Links/HighPROTEC

To enable the Woodward Link feature, select the check box on the screen above and enter the slave address and the IP address of the HighPROTEC device. The figure above shows the factory default IP addresses of the HighPROTEC and Ethernet port 3 of the 505XT. These settings will allow these two products to communicate automatically once an RJ45 Ethernet cable is connected between Ethernet port 3 of the 505XT and Network B port on the HighPROTEC. Note that if a DSLC-2 and a HighPROTEC are both connected to this network, the default slave address of one of these devices will need to be changed.

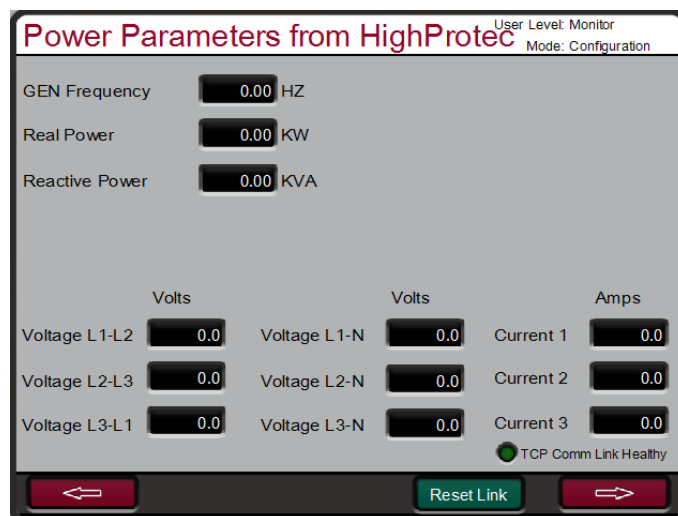


Figure 9-17. Service Screen/Woodward Links/HighPROTEC

## Servo Position Controller (SPC)

Use a Servo Position Controller (SPC) to interface the 505 digital controls to existing valve operators or Woodward actuators that are integrating in action or are not compatible with the 505 directly.

The 505's actuator outputs have the capability of driving a 4–20 mA or 20–160 mA (200 mA max) proportional signal into an actuator coil. These actuator output signals represent a demand signal equal to desired valve position (proportional). If the turbine's actuator or servo assembly requires a different drive signal, or control action (integrating with a null setting), an SPC or equivalent device must be used.

Woodward Servo Position Controller (SPC) accepts a 4–20 mA actuator-drive signal proportional to desired valve position, and positions a servo assembly accordingly. Woodward SPCs have the capability of driving unipolar or bipolar actuator demand signals, up to 0–400 mA or +400 mA respectively, on proportional or integrating servo assemblies.



Figure 9-18. Servo Position Controller

The SPC comes with a user-friendly software interface program that allows the user to configure the unit to the desired settings. Consult the SPC manual for complete details on the types of actuators to which the SPC can interface. Below is one example of how the 505 and SPC are used on integrating servo valves. The SPC can also handle many variations of feedback devices.

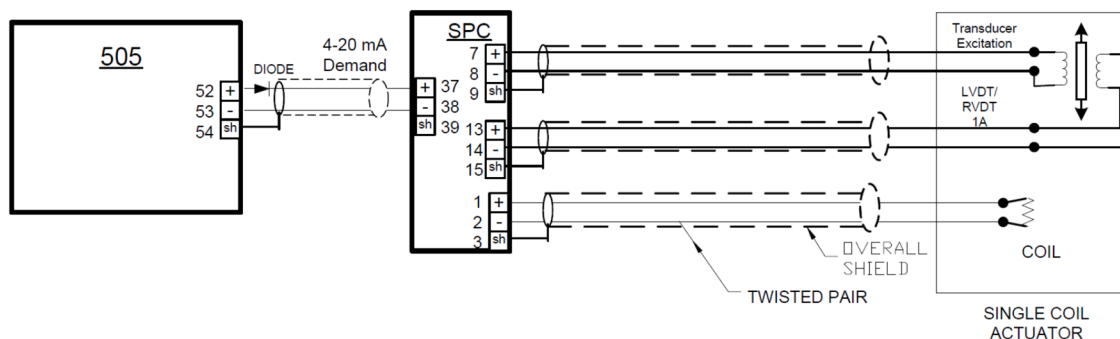


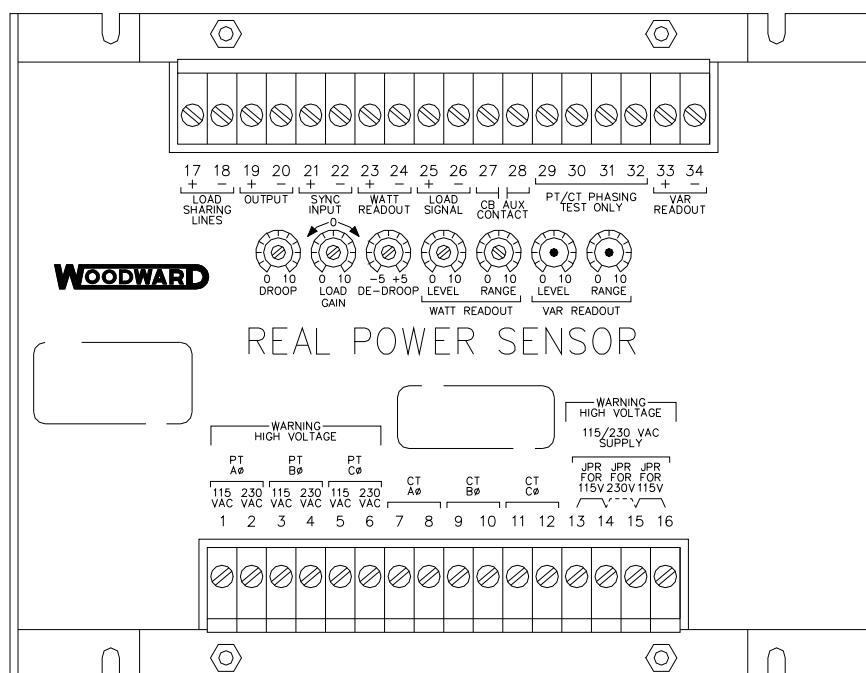
Figure 9-19. Interface to Servo Position Controller  
(Example of Integrating Actuator with a 4-wire Feedback Device)

## Real Power Sensor

A Real Power Sensor (RPS) is used to sense the real power being produced by a generator or flowing through a tie line. Woodward RPS's sense three phase volts, three phase amps, compare each phase's voltage to current relationship, and develop a 4–20 mA output proportional to real power.

Woodward manufactures two types of RPS. The first type of RPS is designed to sense power flow in one direction only (0 to +5 A CT current only), and output a proportional 4–20 mA signal. This type of RPS was designed for and used to sense generator power output. Many different real power sensors of this type exist. Some of the optional RPS features include VAR sensing, load sharing, 0–1 A CT current sensing, and multiple combinations of these. Please consult a Woodward certified distributor or a Woodward factory for the recommended RPS for your application.





820-015 F1  
96-04-11 KDW

Figure 9-20. Real Power Sensor

The second type of RPS manufactured by Woodward is designed to sense power flow through a bus-to-bus tie line. This RPS (8272-726) senses  $-5$  A to  $+5$  A CT current to allow its output to represent power flow in both directions. This RPS provides a  $4$ – $20$  mA power indication output signal where  $12$  mA represents zero power flow. It is recommended that this RPS be used to sense power flow through a tie line only. This RPS or equivalent is required to sense plant import and export power.

Woodward RPS have terminals labeled “Output” and terminals labeled “KW Readout”. The “Watt Readout” terminals provide a  $4$ – $20$  mA signal proportional to real power, which is used by and compatible with the 505 control. Thus, the RPS terminals labeled “Output” are designed and typically compatible only to Woodward’s 2301 type of control.

Woodward manufactured RPS have a  $2.5$  Hz Low pass filter ( $400$  ms lag time) on their output to filter out the high frequency noise typically created in a switch gear type environment. Thus, if another vendor’s watt transducer is used, verification that it has similar filtering criteria should be performed before it is applied with the 505. For more information on Woodward RPS, please refer to Woodward manual 82018.

## Engine Generator Control Package/Load Sharing (EGCP-3 LS)

The Woodward EGCP-3 LS control is a microprocessor based generator load control designed for use on three-phase ac generators with Woodward speed controls and automatic voltage regulators. The EGCP-3 LS is a synchronizer, a load control, a dead bus closing system, a VAR/PF control, a process control, power & energy metering, and protective relays integrated into one package.

The EGCP-3 LS has a keypad and two 4-line display panels on the front cabinet mounted chassis. The display can be used to configure and set up the control for site-specific requirements. The display is also used in normal operating service to monitor operation and view alarm data. All functions performed and parameters monitored by the front panel are also available through the three serial ports. These ports can be configured to use Woodward Watch Window software, an external HMI and Modbus communication, or Servlink DDE software.



The 505 can be programmed to use the EGCP-3 LS as a synchronizer only, or as a synchronizer and load control. The EGCP-3 LS provides either phase match or slip frequency synchronizing, and ties into the unit automatic voltage regulator to match voltages before paralleling. It interfaces with the 505 via a speed bias signal to control generator frequency and phase. When configured to use the EGCP-3 LS as a synchronizer only, the 505 must be programmed to receive the EGCP-3 speed bias signal through an analog input and have this input enabled through a contact input or function key.

When used as a synchronizer and load control, the EGCP-3 LS performs automatic synchronization, and controls unit load based on the EGCP-3's mode of operation. The EGCP-3 LS can be in a base-load, load sharing, remote load setting, or Process Control mode, depending on configuration and system conditions.

The EGCP-3 LS's Load Sharing mode is used to share load with any other units using an EGCP-3 LS and tied to the same isolated bus. This mode is used in conjunction with an EGCP-3 MC when paralleled to a utility to allow the EGCP-3 MC to control plant frequency or load depending on its state of operation.

The EGCP-3 LS's remote load setting mode allows load to be set by a remote 4-20 mA signal. The EGCP-3 LS's Process Control mode allows any process directly related to generator load to be controlled.

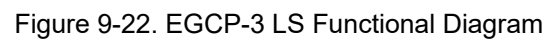
After synchronization, unit load can be controlled by the EGCP-3 LS (through the 505 Sync/Ld input) or by the 505's internal speed/load set point. When the Sync/Ld Share input is programmed, the position of the Utility Tie Breaker Contact selects unit load control through the EGCP-3 LS or through the 505's internal load set point.

Once the generator is synchronized, the EGCP-3 LS soft-loads the unit to the load setting determined by the mode of operation (base load, load sharing, process control). When commanded, the EGCP-3 LS can also soft-unload the unit and issue a breaker-open command at a set power level.

The PowerSense board receives the PT and CT inputs for both the generator and bus for calculation of parameters for the EGCP-3 to use in system control. The algorithms used are based on IEEE 1459-2000. For the generator and bus, the following parameters are provided: Hz, Vac, Amps, W, VA, VAR, PF, phase, voltage harmonics, current harmonics, negative phase sequence voltage, negative phase sequence current. Analog outputs: synchroscope, generator metering, and mains metering are available for selection at the 4–20 mA.



Figure 9-21. EGCP-3 Control



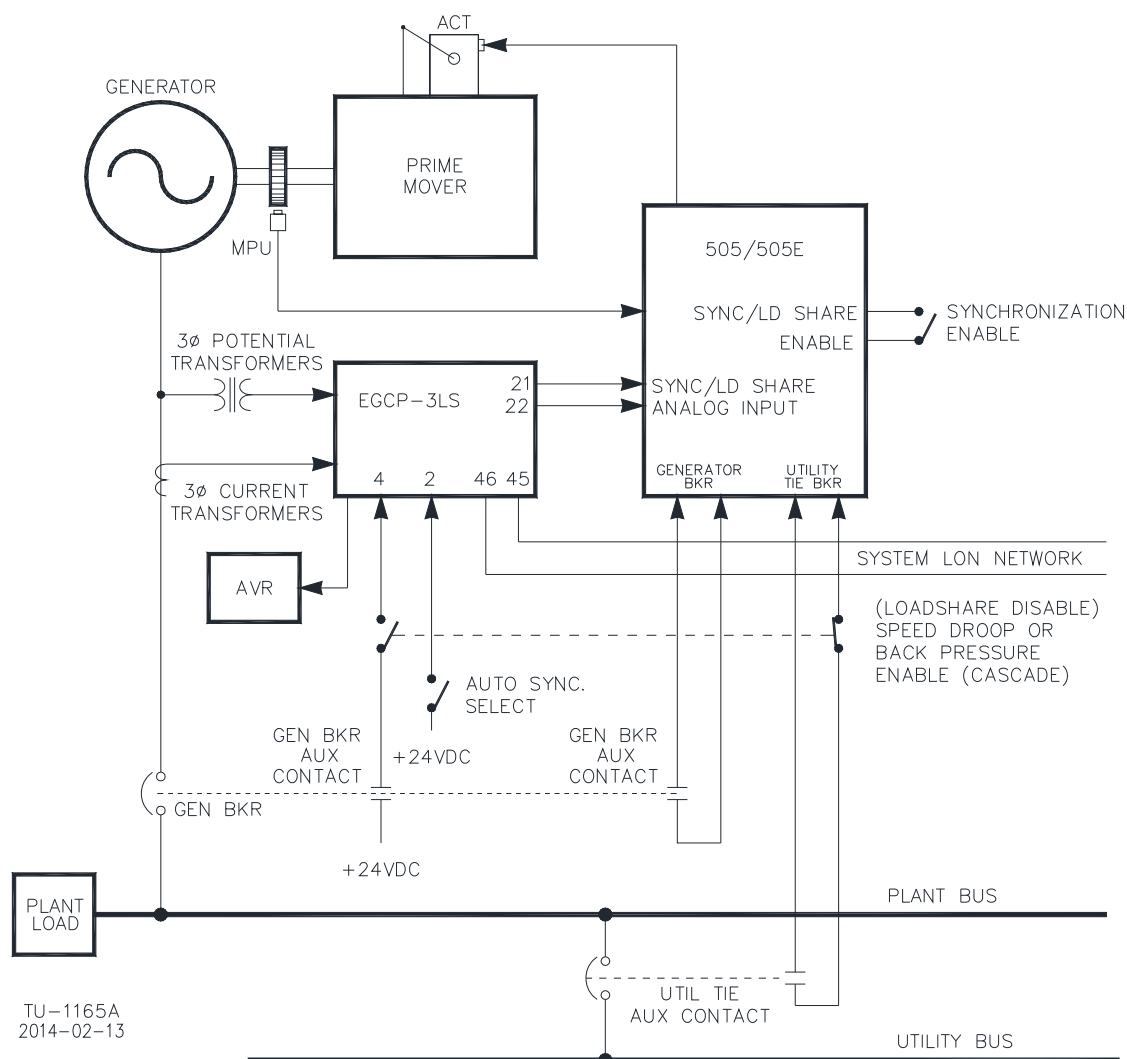


Figure 9-23. EGCP-3 LS Interface Wiring

The following bus protections are available with the EGCP-3 LS:

- Over/Under Voltage (59, 27)
- Over/Under Frequency (81O, 81U)
- Directional (Forward/Reverse) Power (32) \*
- Negative Sequence Phase Overcurrent (46)
- Negative Sequence Phase Overvoltage (47)
- Phase Overcurrent (51) \*
- Voltage Restrained Phase Overcurrent (51V) \*
- Directional VAR
- Phase Current Imbalance (46) \*

The following Generator Protections are available with the EGCP-3 LS:

- Over/Under Voltage (59, 27)
- Over/Under Frequency (81O, 81U)
- Directional (Import/Export) Power (32)\*
- Negative Sequence Phase Overcurrent (46)
- Negative Sequence Phase Overvoltage (47)
- Phase Overcurrent (51) \*
- Directional VAR
- Phase Current Imbalance (46) \*
- Speed/Frequency Mismatch

\*—Inverse Time Protections implemented are according to IEEE C37.112 “very inverse” curves.

For more information on Woodward’s EGCP-3 LS Control, please refer to Woodward manuals 26122 and 26194.

## Applying the 505 with Redundant I/H or I/P Converters

The 505 can be applied in simplex or redundant actuator systems. For redundant actuator applications, Actuator Channel 1 is configured for HP Demand and Channel 2 is configured for HP2 Demand with zero offset. This will supply both actuator driver circuits full current to the driven device.

Selection between converter output signals can be accomplished using either shuttle valves or solenoid transfer valves. Converter status (I/H or I/P) and pressure feedback signals may be optionally programmed into the 505. If required, relay outputs may be programmed to transfer between converter outputs. Manual transfer between converters can be initiated through discrete input, Modbus, or PC interface commands. The 505 based on driver failure, converter status, converter output pressures provide automatic transfer between converters, and servo input pressure feedback signals.

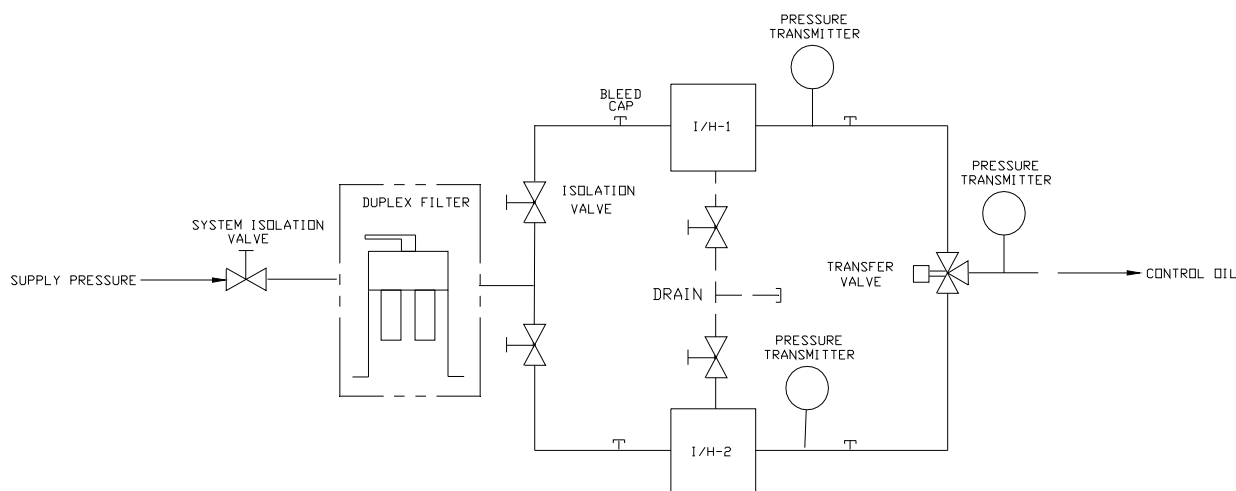


Figure 9-24. Typical Redundant I/H System with a Transfer Valve

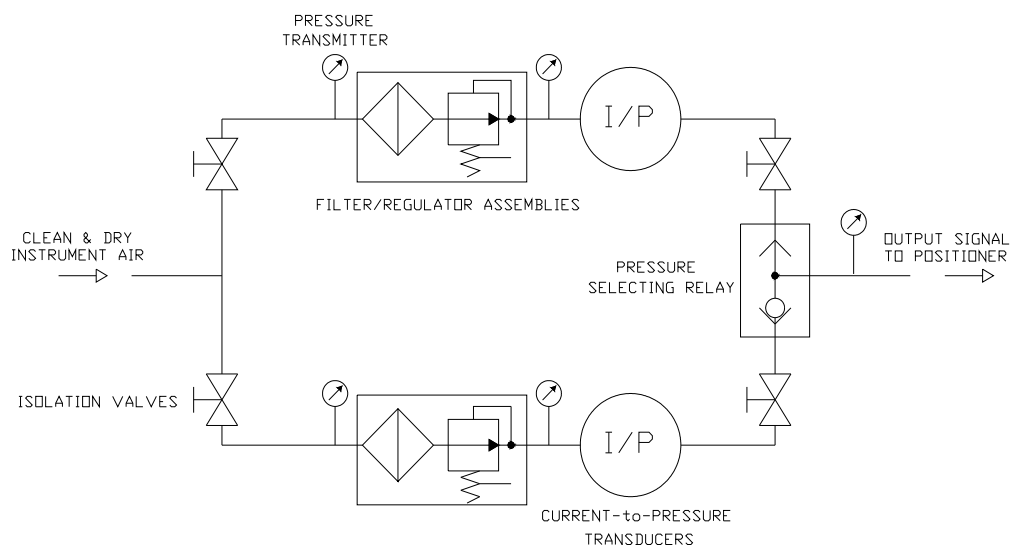


Figure 9-25. Typical Redundant I/P System with a Pressure Selecting Relay Valve

### Functionality Details

Utilizing a two-actuator output configuration provides redundancy all the way to the actuator level. The typical redundant I/H (or I/P) system will convert the 505 actuator milliamp output into a corresponding hydraulic (or pneumatic) pressure positioning the servo-cylinder. Both converters are supplying the appropriate pressure to position the steam valves to the demand requested by the control. One of the converters will be in control of the valve demand and the other will be in a standby mode. Selection between converter output signals is accomplished using either shuttle valves or solenoid transfer valves. The shuttle valve will select the higher pressure output between the two converters whereas the solenoid transfer valve selects one converter output and transfers between converters based on a relay command from the 505 control. Either valve type may be used, refer to the transfer valve section for additional information on advantages/disadvantages of each.

Converter status (I/H or I/P) and pressure feedback signals should be programmed into the 505, since automatic transfer between converters is handled by the status of these signals. If required, a relay output can be programmed (configured as the in-control relay) to transfer between converter outputs.

Automatic transfer is based on the I/O programmed (refer to I/O options available). If a converter malfunction discrete input is programmed, then it is used for malfunction alarming and automatic transfer.

Properly installed valves allow on-line converter replacement.

For more information on Woodward's redundant CPC products, refer to manual 26448 and consult your sales representative about all CPC offerings.

# Chapter 10.

## Application Notes

### Overview

This chapter provides users an overview of the 505XT Digital Control's capabilities and applications. Typical applications are schematically shown and their functionality explained. Programming and Start/Run mode notes for each application assist application programmers in configuring the 505XT for their application. Basic peripheral device connections are shown in each application drawing to allow an understanding of how these devices interface to the 505XT and expand system capabilities.

#### Speed/Load PID

The Speed PID can control and limit:

- Unit Speed/Frequency
- Unit Load

The 505XT's Speed PID can be used to control unit speed/frequency when isolated and unit load when paralleled to an infinite bus (utility). The Speed PID can be programmed to sense unit load via its actuator output signal or a 4–20 mA analog input signal from a generator power sensor. When programmed to sense and control generator load via an analog input true unit load is sensed and controlled. By using the generator, load signal to control from, any turbine inlet or exhaust pressure variation is sensed and compensated for, thus providing true load control.

A combination of the Speed PID and its setpoint limits allow this PID to limit unit load. When used as a unit load limiter, it is recommended that the 505XT be configured to sense and control only true generator load. If applying the 505XT system to a soft grid (utility frequency varies greatly) recommend the Auxiliary PID not the Speed PID perform unit load limiting.

#### Extraction/Admission PID

The 505XT's Extr/Adm PID can be programmed to control:

- Extraction and/or Admission Steam Pressure
- Extraction and/or Admission Steam Flow

The 505XT's Extr/Adm PID can be used to control either of the listed parameters. This PID is enabled and/or disabled by inputs to the 505XT's front panel, contact inputs, or Modbus communications.

Since this PID's output is connected directly to the 505XT ratio/limiter, it directly positions one or both turbine throttle valves, depending on configuration, to control the above listed parameters.

#### Inlet Steam Pressure PID

The 505XT's Inlet PID can be programmed to control or limit:

- Turbine Inlet Steam Pressure
- Turbine Inlet Steam Flow

The 505XT's Inlet PID can be used as a limiter or controller (enabled/disabled on command) on single valve. When programmed as a limiter this PID's output is Low Signal Selected with the Speed PID's output. This configuration allows the Inlet PID to limit the unit's load based on parameter feedback. In Ext/Adm type turbine applications, this PID feeds directly into the Ratio Limiter and is only used as a controller.

When the Inlet PID is configured as a controller, it must be enabled and disabled by commands given through the 505XT's front panel, contact input, or Modbus communications. With this configuration, when the Inlet PID is enabled, the Speed PID is disabled and tracks the Inlet PID's output.

To control or limit any of the listed parameters, the 505XT must be programmed to accept an inlet steam pressure analog input signal representing that parameter's level.

### Exhaust Steam Pressure PID

The 505XT's Exhaust PID can be programmed to control or limit:

- Turbine Exhaust Steam Pressure
- Turbine Exhaust Steam Flow

The 505XT's Exhaust PID can be used as a limiter or controller (enabled/disabled on command) on a single valve. When programmed as a limiter, this PID's output is low signal selected with the Speed PID's output. This configuration allows the Inlet PID to limit the unit's load based on the parameter being sensed. In Ext/Adm type turbine applications, this PID feeds directly into the ratio limiter and is only used as a controller.

When the Exhaust PID is configured as a controller, it must be enabled and disabled by commands given through the 505XT's front panel, contact input, or Modbus communications. With this configuration when the Exhaust PID is enabled, the Speed PID is disabled and tracks the Inlet PID's output.

To control or limit any of the listed parameters, the 505XT must be programmed to accept an exhaust steam pressure analog input signal representing that parameter's level.

### Auxiliary PID

The 505XT's Auxiliary PID's function is dependent on whether the turbine is a single valve control or an Extraction/Admission unit. It can be programmed to control or limit:

- Turbine inlet steam pressure (single valve only)
- Turbine inlet steam flow (single valve only)
- Turbine exhaust steam pressure (single valve only)
- Turbine exhaust steam flow (single valve only)
- Generator power output
- Plant or tie line import/export power
- Process temperature
- Compressor suction pressure
- Compressor suction flow
- Compressor discharge pressure
- Compressor discharge flow
- Any process parameter related to unit load, inlet pressure/flow, or exhaust pressure/flow (depending on configuration)

The 505XT's Auxiliary PID can be used as a limiter or controller (enabled/disabled on command). When programmed as a limiter, this PID's output is low signal selected with the Speed PID's output. This configuration allows the Auxiliary PID to limit the unit's load based on the parameter being sensed.

When the Auxiliary PID is configured as a controller, it must be enabled and disabled by commands given through the 505's front panel, contact input, or Modbus communications. With this configuration, when the Aux PID is enabled, the Speed PID is disabled and tracks the Auxiliary PID's output.

To control or limit any of the listed parameters, the 505 must be programmed to accept an Auxiliary analog input signal representing that parameter's level. The exception to this rule is when controlling or limiting generator load, the Auxiliary PID can be programmed to use and share the KW/Unit load input with the Speed PID.

## Cascade PID

The 505XT's Cascade PID can be programmed to control:

- Turbine inlet steam pressure
- Turbine inlet steam flow
- Turbine exhaust steam pressure
- Turbine exhaust steam flow
- Generator power output
- Plant or tie line import/export power
- Process temperature
- Compressor suction pressure
- Compressor suction flow
- Compressor discharge pressure
- Compressor discharge flow
- Any process parameter related to unit load, inlet pressure, or exhaust pressure (depending on the configuration)

Use the 505XT's Cascade PID to control any of the listed parameters. This PID must be enabled and disabled by commands given through the 505's front panel, contact input, or Modbus communications.

The Cascade PID is cascaded with the Speed PID to vary unit speed/load. By directly positioning the Speed PID's setpoint, the Cascade PID can vary unit speed/load to control its input parameter. This configuration allows for bumpless transfers between the two control modes (Speed/Load and Cascade).

## Example Applications

The example applications in this chapter do not show every possible control configuration or combination. However, these examples can also be used as a reference to apply any of the controlling combinations or parameters not listed or shown. To apply a desired control parameter or combination not shown, refer to one or more of the typical application configurations shown and resemble the control configuration desired, and then substitute the shown control parameters with the required control parameters.

For example, to configure the 505 to perform a turbine exhaust pressure limiting function use Example 1, the "Pump or Compressor Discharge Pressure Control with Turbine Inlet Pressure Limiting" application for reference. With this example, substitute exhaust pressure for inlet pressure and disregard any program settings specified to control pump or compressor discharge pressure.

A summary of the examples shown in this chapter follow:

- Example 1: Pump or Compressor Discharge Pressure Control with Inlet Pressure Limiting
- Example 2: Inlet Pressure Control with Auto Synchronizing and Generator Power Limiting
- Example 3: Exhaust Pressure Control with Plant Import/Export Power Limiting
- Example 4: Plant Import/Export Power Control with DRFD Servo Interface
- Example 5: Inlet Pressure Control with Isochronous Load Share Control in Island Mode
- Example 6: Plant Import/Export Power Control with Isochronous Load Share Control in Island Mode
- Example 7: Induction Generator Control



Table 10-1. Example Application Summary

		Application Examples						
		1	2	3	4	5	6	7
Turbine Type	Mechanical Drive	X						
	Synchronous Generator		X	X	X	X	X	
	Induction Generator							X
Control Functions	Aux, Inlet or Exhaust Limiting	X	X	X		X		
	Auxiliary Control				X			
	Cascade Control	X	X	X			X	X
	Synchronizing		X	X	X	X	X	
	Load Sharing					X	X	
	Frequency Control				X	X		
Control Modes	Inlet Pressure Control		X			X		
	Min Inlet Pressure Limiting	X						
	KW Load Control						X	
	KW Load Limiting		X			X		
	Import/Export Load Control				X		X	
	Import/Export Load Limiting			X				

### Example 1—Pump or Compressor Discharge Pressure Control with Turbine Inlet Pressure Limiting

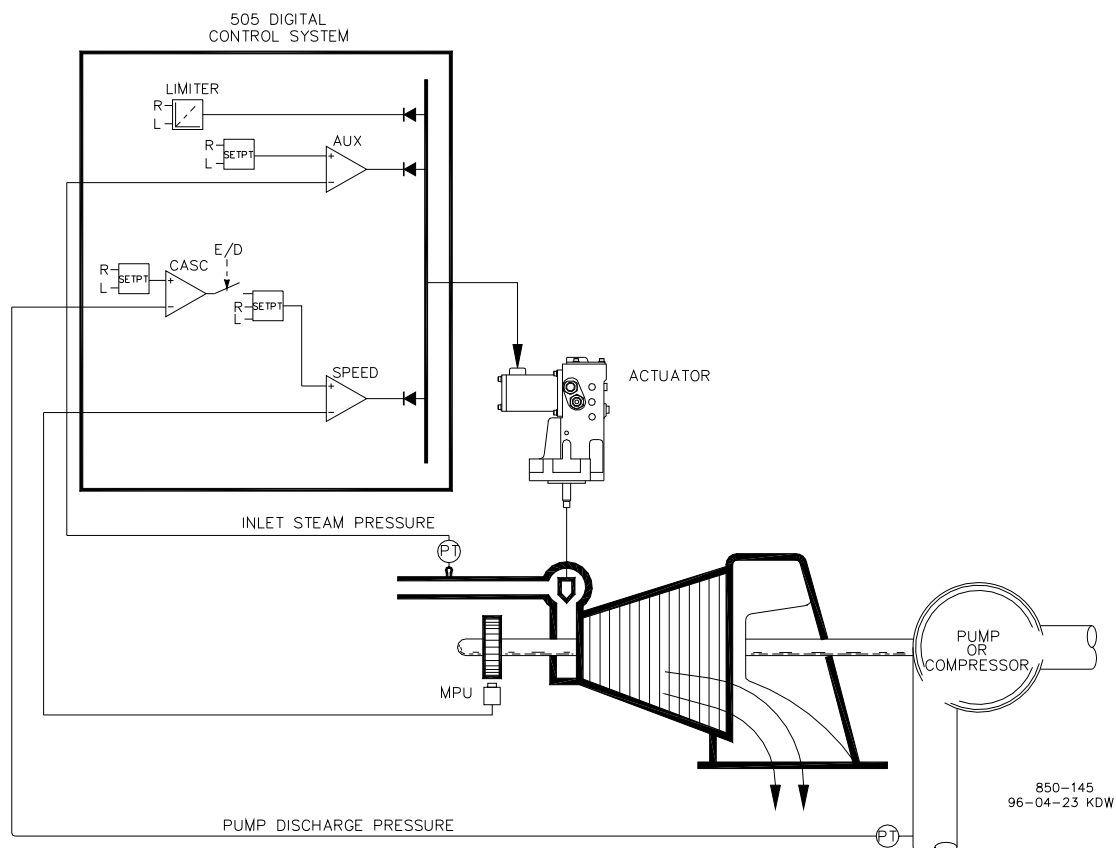


Figure 10-1. Pump or Compressor Discharge Pressure Control with Turbine Inlet Pressure Limiting

This is an example of a typical pump or compressor application. With this application, the 505 is configured to normally control pump/compressor discharge pressure, and limit governor valve position based on low turbine inlet steam pressure. Both the Inlet and Cascade modes were used for this example application. Other applications may or may not use all the functionality shown in Figure 10-1 and described below.

With this application, pump/compressor discharge pressure control is performed within the 505 through the Cascade controller. Because the discharge pressure being controlled typically affects many other plant processes, a plant Distributed Control System (DCS) may be used to monitor plant process conditions and set the Cascade setpoint position. This can be performed through Modbus communications, discrete raise and lower commands, or with an Analog setpoint signal.

For this application, a limiting type of control function was required to help preserve inlet header pressure in case of system header problems. In a single valve application, the Inlet Pressure PID controller can be used as a limiter. It is used to sense turbine inlet pressure and limit governor valve position, based on a low inlet pressure setting.

If a plant Distributed Control System is used to sense and control a process by positioning the load of multiple pumps or compressors (load sharing), the DCS may interface directly to the 505 Speed PID setpoint through a programmed Remote Speed Setpoint analog input. This allows a DCS to monitor and compensate for plant and system conditions by directly changing the speed of multiple pumps or compressors simultaneously.

All 505 PID controller setpoints (Speed, Inlet, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of notes is provided as a reference for application programmers to follow when configuring the 505 to achieve any of the control and limiting actions shown in Figure 10-1.

### 505 Configuration Notes for Example 1

Operating Param:

This is not a generator application. (Generator Application? No)

Cascade Control:

The Cascade control loop is configured to receive a pump/compressor discharge pressure signal through Analog input #1. (Analog Input #5 Function: Cascade Input)

The 505 was configured to accept a contact from a panel mounted switch to externally enable and disable discharge pressure control. (Contact Input 5 Function: Casc Control Enable)

Pump/compressor discharge pressure is directly proportional to turbine inlet valve position, thus input inversion is not required. (Invert Cascade Input? No)

With this application, Setpoint Tracking is not used because the system's pressure setpoint never changes. (Use Setpoint Tracking? No)

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 3% above synchronous speed or 3605.4 rpm (5.4 rpm if rated speed is 3600 rpm and using 5% droop). The 505 will automatically limit the Speed Setpoint Lower Limit to a minimum of 3% (min load). If it is desired to allow the Cascade PID to lower load below this setting, the Service mode's (Cascade Control Settings, Use Min Load) setting must be set to "No".

In this case, because the Cascade PID is not sharing control of discharge pressure with another control, droop is not needed. (Cascade Droop = 0%)

**Inlet Control:**

The Inlet control loop was configured to receive a turbine inlet header pressure signal through Analog input #2. (Analog Input #2 Function: Inlet Pressure Input)

The Inlet Input was inverted to allow the correct control action. To increase turbine inlet header pressure, the governor valve must decrease. This is considered an indirect action and requires the input to be inverted. (Inverted? YES)

The Inlet PID performs as a limiter, since the only option is a single valve configuration.

Because the Inlet PID is used only as a limiter and is not sharing control of inlet pressure with another control, droop is not needed. (Inlet Droop = 0%)

**Trips:**

In this example, the turbine can be tripped by several devices, one of these devices is the 505 Control. To provide feedback to the 505 Control that the turbine is tripped, a contact from the trip string is wired into the External Emergency Shutdown input (DI01). With this application, the 'governor trip' annunciation should only occur if the 505 tripped the turbine and not annunciate when the other external devices shuts down the unit (Turbine Start: Ext Trips in Trip Relay?—No.)

Because the shutdown relay is used in the trip string to shut down the turbine should the 505 initiate a trip, additional relays are required for annunciating any turbine trip and annunciating a 505 initiated trip. Relay #3 was programmed to annunciate any turbine trip in the following sequence. (Relays: Use Relay #3—Yes ; Relay #3 is a Level Switch?—No ; Relay #3 Energizes on—Shutdown Condition) Relay #4 was programmed to indicate a 505 initiated trip as follows: (Relays: Use Relay #4—Yes ; Relay #4 is a Level Switch?—No ; Relay #4 Energizes on—Trip Relay) Note that Relay #4 de-energizes on a trip condition (excluding external trip inputs) and Relay #3 energizes on a trip (shutdown) condition.

**Starting and Run Mode Notes for Example 1**

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position or an operator can give a raise command to manually increase turbine speed.

After the unit starts and is controlling at a minimum/desired speed position, Cascade control (pump/compressor discharge pressure) can be enabled through contacts, Modbus commands, or the 505 service panel. When Cascade control is enabled, if actual discharge pressure does not match the set point, the control will automatically ramp turbine speed at the 'SPEED SET POINT SLOW RATE' setting until the pump/compressor discharge pressure does match the set point.

With this application, the inlet control is used as a limiter, thus it does not need to be enabled. If turbine inlet pressure decreases below the Inlet setpoint at any time the Inlet PID will take control of the governor valve and lower it to help preserve inlet header pressure.

See the Service Mode section of this manual for information on related tunable values and rates.

## Example 2–Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting

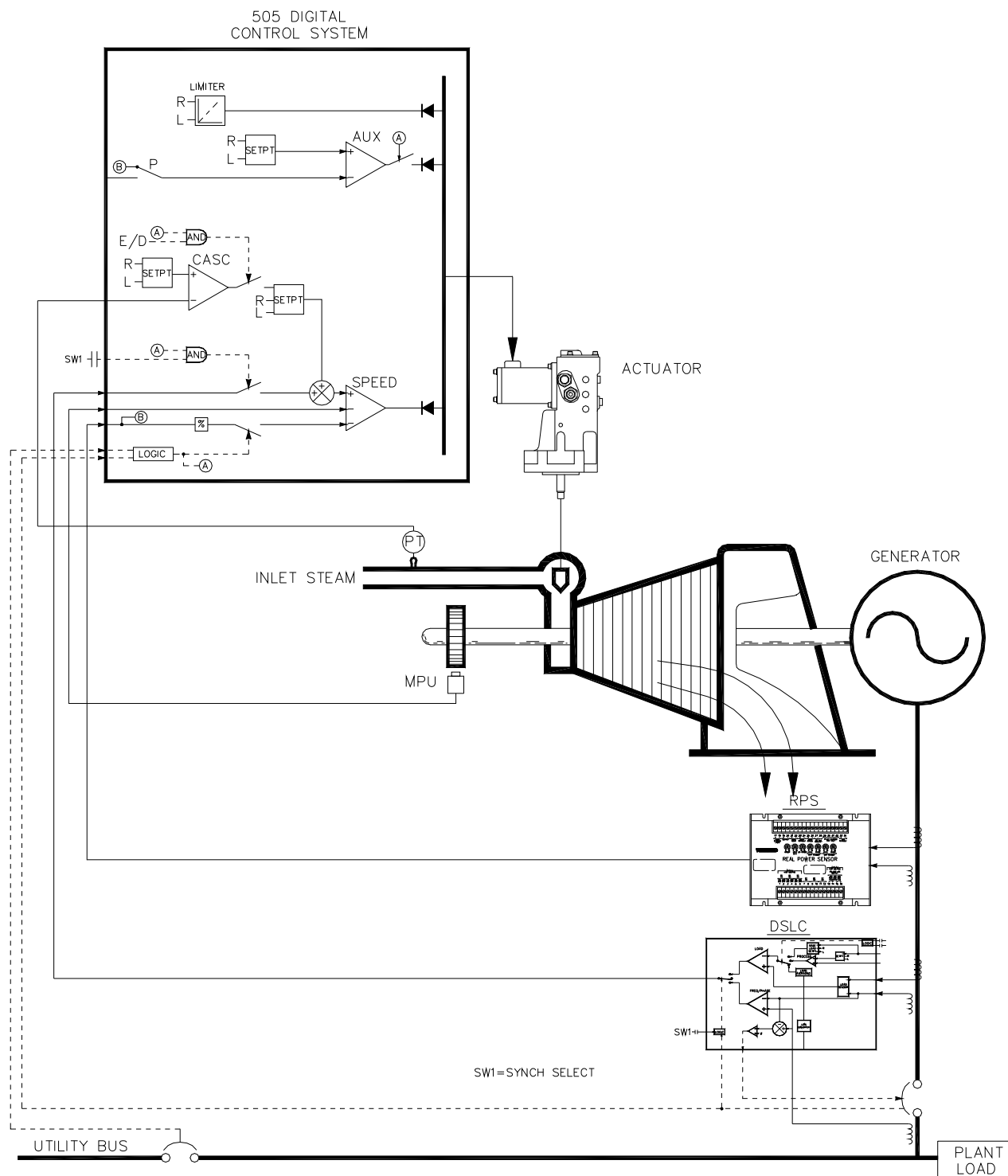


Figure 10-2. Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting

This is an example of a typical turbine generator application where plant process steam (turbine inlet header pressure) is desired to be controlled at a single pressure. With this type of application, turbine load varies based on the plant process steam demand. Both the Auxiliary and Cascade modes were used for this example application. Other applications may or may not utilize all the functionality shown in Figure 10-2 and described below.

With this application, turbine inlet header pressure control is performed within the 505 through the Cascade PID controller. This is an ideal controller for this type of function because it can be enabled and disabled as desired by a system operator. This gives a system operator full authority of when to transfer process pressure control to or from a letdown station or turbine bypass valve.

As shown in Figure 10-2, generator load is being sensed with a Woodward Real Power Sensor and supplied to the 505's KW/unit load input. This allows generator load to be set and controlled by the Speed PID when paralleled to the utility during unit start-up and shutdown.

During normal operation, the Cascade PID controlling inlet header pressure determines unit load. Because turbine load may vary greatly with this application, a limiter is used to protect the generator from being over powered. The Auxiliary PID configured as a limiter performs this protection. By configuring the Auxiliary PID as a limiter and to use the generator load input as the PID's controlling parameter, the maximum load the generator can operate at can be limited.

This application uses an EGCP-3 LS for synchronization only, and interfaces to the 505 through an analog 4-20 mA signal. When a synchronizing input/function is programmed, the input can be enabled through a contact input, function key, Modbus command, or the 505 service panel. As shown in Figure 10-2, a panel-mounted (DPST) switch is used with this application to select automatic synchronization in both the EGCP-3 LS and 505.

All 505 PID controller setpoints (Speed, Auxiliary, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of notes are provided as a reference for application programmers to follow when programming the 505 to achieve any of the control and limiting actions shown in Figure 10-2.

## 505 Configuration Notes for Example 2

### OPERATING PARAM:

This is a generator application. (Generator Application? Yes)

Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #9 Function: Generator Breaker), (Contact Input #10 Function: Utility Tie Breaker).

The 505 was configured to sense the Real Power Sensor's generator load signal through Analog input #1. (Analog Input #3 Function: Generator Load Input)

Because the Real Power Sensor's 'KW readout' is self-powered, configure the analog input as "Loop Powered".

Generator load control (when paralleled to the utility) is controlled through the Speed PID and programmed by selecting KW Droop (Use Load Droop? Yes). For good response and load adjustment resolution, droop was set to 5% of rated speed. (Droop = 5 %)

It was desired to switch to Frequency control at all times, if the plant became isolated from the Utility bus. (Use Freq Arm/Disarm? No)

**CASCADE CONTROL:**

The Cascade control loop was configured to receive an inlet header pressure signal through Analog input #5. (Analog Input #5 Function: Cascade Input)

The 505 was configured to accept a contact from a panel mounted switch to externally enable and disable inlet header pressure control. (Contact Input #5 Function: Casc Control Enable)

The Cascade input was inverted to allow the correct control action. To increase turbine inlet header pressure, the governor valve position must decrease. This is considered an indirect action and requires the input to be inverted. (Invert Cascade Input? Yes)

With this application, Setpoint Tracking is not used because the system's pressure setpoint never changes, thus system start-up is simpler. (Use Setpoint Tracking? No)

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 5 rpm above synchronous speed.

In this case, because the Cascade PID, during normal operation, is not sharing control of inlet header pressure with another controller, droop is not needed. (Cascade Droop = 0%)

**AUXILIARY CONTROL:**

The auxiliary control loop was configured to receive a generator load signal through the KW/unit load input, also being used for load droop. (Use Process Signal = Generator Load Input)

Unit load is directly proportional to turbine inlet valve position, thus no input inversion is required. (Inverted? No)

The Auxiliary PID was programmed to perform as a load limiter. (Use Aux Enable? No)

In this case, because the Auxiliary PID is used only as a limiter, and is not sharing control of generator load with another control, droop is not needed. (Aux Droop = 0%)

With this application, it was desirable to only enable the Auxiliary PID if paralleled to the utility. (Tiebkr Open Aux Dsbl? Yes), (Genbkr Open Aux Dsbl? Yes)

**AUTO SYNCHRONIZING:**

The 505's Analog input #6 was programmed to receive the EGCP-3 LS's speed bias signal for automatic synchronization (Analog Input #6 Function: Synchronizing Input) With this configuration, the analog input's range is defaulted to provide a certain gain factor for best performance, thus the input's 4 mA and 20 mA program settings are not used and do not require programming.

A contact input was programmed to enable the synchronizing analog input (Contact Input #5 Function: Synch Enable).

**Starting and Run Mode Notes for Example 2**

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively an operator can give a manual raise command to increase turbine speed as desired.

After the unit has been started and is controlling at a rated speed position, the turbine generator can be synchronized manually, or automatically. The system operator can select automatic synchronization through the Auto-Synch select switch (switch SW1 in Figure 10-2). When this switch is closed the 505's synchronizing input is enabled and the EGCP-3 LS's automatic synchronizing function is selected.

When the plant-to-utility tie-line breaker is closed, and the unit generator breaker closes, the 505 steps the speed/load set point up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load set point and is defaulted to 3%. The defaulted value is adjustable through the 505's Service mode (Breaker Logic–Min Load Bias = 5).

When the plant-to-utility tie-line breaker is closed, and the unit generator breaker closes, the 505 steps the speed/load set point up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load set point and is defaulted to a "3%5 rpm" step change of the speed/load set point. The defaulted value is adjustable through the 505's Service mode (Breaker Logic–Min Load Bias = 5).

After synchronization, the 505's load setpoint can be positioned through raise and lower Speed/Load setpoint contacts, a programmed 4–20 mA input, Modbus commands, or the 505 service panel. This load control mode may be used to slowly increase turbine load, and take control away from a letdown station or turbine bypass valve.

Cascade control (turbine inlet pressure) can be enabled at any time after the Utility Tie Breaker and Generator breakers are closed, through a contact input, Modbus command or the 505 service panel. With this configuration, when Cascade control is enabled, if actual inlet header pressure does not match the setpoint, the control will increase generator load at the 'SPEED SETPOINT SLOW RATE' setting until the inlet header pressure matches setpoint.

With this application, the Auxiliary control is programmed to be used as a limiter, and be automatically enabled when both the Utility Tie and Generator breakers are closed. When paralleled to the utility, if inlet header pressure demand, and/or other system conditions try to force the generator to operate above its load limit setting, the Auxiliary PID will take control of the governor valve to limit generator load. Once system conditions demand unit load below that of the Auxiliary setpoint, the Cascade/Speed PIDs will again take control of generator load.

505 DIGITAL CONTROL SYSTEM

LIMITER

R L

R L SETPT

AUX (A)

E/D (A) AND

R L SETPT

CASC

R SETPT

SW1 (A) AND

(B) (A)

LOGIC

(A)

SPEED

ACTUATOR

INLET STEAM

MPU

EXHAUST PRESSURE (PT)

GENERATOR

RPS

REAL POWER SENSOR

DSL

SW1=SYNCH SELECT

UTILITY BUS

PLANT LOAD

850-147  
96-04-11 KDW

With this application, turbine exhaust pressure control is performed within the 505 through the Cascade PID controller. This is an ideal controller for this type of function because it can be enabled and disabled as desired by a system operator. This gives a system operator full authority of when to transfer process pressure control to or from a letdown station or turbine bypass valve.



Because turbine load may vary greatly with this application, a limiter is used to protect the generator from being over powered. In order to limit generator load, the 505 control must be able to sense generator load. As shown in Figure 10-3 generator load is being sensed with a Woodward Real Power Sensor and supplied to the 505's KW droop input. With this application generator over-load protection is performed by a combination of the Speed PID and the speed setpoint maximum limit. By programming the speed setpoint maximum limit to that of rated speed plus the % droop value at 100% load, the speed setpoint cannot be taken over 100% load and the Speed PID will limit generator load to 100%.

For this application a limiting type of control function was required to limit the plant export power to zero. The plant does not get reimbursed for any power exported, and it is more economical to make power than purchase it from the utility, thus a zero plant import/export power level is desired. Because the Auxiliary PID is the only 505 controller that has this limiting capability, it was used to sense tie line power and limit turbine/generator output, based on a zero export limit setting.

A second Real Power Sensor (RPS) #8272-726 was used with this application to sense utility tie line power. This RPS is special, in that it senses  $-5$  A to  $+5$  A CT current to allow its output to represent power flow in both the import and export directions. With this, RPS 12 mA represents zero power flow. Because of this feature, the RPS #8272-726 cannot be used with the 505 to sense generator load/power. Please check with a Woodward-certified distributor or factory for the correct RPS to use as a generator load sensor.

This application uses an EGCP-3 LS for synchronization only. Because the EGCP-3 LS interfaces to the 505 through an analog signal, a 505 analog input must be programmed. When a synchronizing input/function is programmed, the input can be enabled, through a contact input, function key, Modbus command, or the 505 service panel. As shown in Figure 10-3, a panel-mounted (DPST) switch is used with this application to select automatic synchronization in both the EGCP-3 LS and 505.

All 505 PID controller setpoints (Speed, Auxiliary, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of configuration notes are a reference for application programmers to follow when programming the 505 to achieve the control and limiting actions shown in Figure 10-3.

### 505 Configuration Notes for Example 3

#### OPERATING PARAM:

This is a generator application. (Generator Application? Yes)

Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #8 Function: Generator Breaker) (Contact Input #9 Function: Utility Tie Breaker)

The 505 was configured to sense a Real Power Sensor's generator load signal through Analog input #1. (Analog Input #1 Function: KW/Unit Load Input)

Because the RPS's KW readout is self-powered, the analog input should be configured as "Loop Powered".

Generator load (when paralleled to the utility) is controlled by the Speed PID and programmed by selecting the KW/Unit load input (Use KW Droop? YES). For good response and load adjustment resolution, droop was set to 5% of rated speed. (Droop = 5 %)

It was desired to switch to frequency control at all times if the plant became isolated from the utility bus. (Use Freq. Arm/Disarm? No)

**CASCADE CONTROL:**

The Cascade control loop was configured to receive an exhaust header pressure signal through Analog input #2. (Analog Input #2 Function: Exhaust Pressure Input)

Because a two wire, loop-powered transducer is used to interface with this signal, 'Loop Powered' is not checked.

The function key F3 was programmed to allow an operator to easily enable and disable Cascade control. (F3 Key Performs: Casc Control Enable)

Exhaust header pressure is directly proportional to turbine inlet valve position, thus no input inversion is required. (Invert Cascade Input? No)

With this application, Setpoint Tracking is used to allow the 505's Cascade control, when disabled, to track exhaust header pressure being controlled by a letdown station. (Use Setpoint Tracking? Yes)

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 5 rpm above synchronous speed.

In this case, because during normal operation the Cascade PID does not control exhaust header pressure with another control, droop is not needed. (Cascade Droop = 0%)

**GEN LOAD LIMITING:**

To limit generator load to 100% the Speed setpoint's maximum limit was set at the 100% load setting. 5% Droop was programmed for this application. (Max Governor Speed Setpoint = Rated speed x 1.05)

**AUXILIARY CONTROL:**

The auxiliary control loop was configured to receive a utility tie line power signal through Analog input #3. (Analog Input #3 Function: Auxiliary Input) the minimum analog input value was programmed for import power based on the tie line power level at -5 A CT current (Input #3 4 mA Value = -XXXX). The maximum analog input value was programmed for export power based on the tie line power level at +5 A CT current (Input #3 20 mA Value = +XXXX).

The utility-tie Real Power Sensor's CT inputs were wired to allow the RPS's 4 mA value to represent full import power and the RPS's 20 mA value to represent full export power. Because this signal is directly proportional to turbine inlet valve position, no input inversion is required. (Invert Aux Input? No)

The Auxiliary PID was programmed to perform as a limiter. (Use Aux Enable? No)

In this case, because the Auxiliary PID is used as a limiter and does not share control of inlet pressure with another control, droop is not needed. (Aux Droop = 0%)

With this application, it was desirable to only enable the Auxiliary PID if paralleled to the utility. (Tiebrk Open Aux Dsbl? Yes), (Genbrk Open Aux Dsbl? Yes)

**AUTO SYNCHRONIZING:**

The 505's Analog input #6 was programmed to receive the EGCP-3 LS's speed bias signal for automatic synchronization (Analog Input #6 Function: Synchronizing Input). With this configuration, the analog input's range is defaulted to a certain gain value, for best performance, thus the input's 4 mA and 20 mA settings are not used and do not require programming.

A contact input was programmed to enable the synchronizing analog input (Contact Input #5 Function: Synch Enable).

## Starting and Run Mode Notes for Example 3

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit starts, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively, an operator can give a manual raise command to increase turbine speed as desired.

After the unit starts and is controlling at a rated speed position, the turbine generator can be synchronized manually or automatically. The system operator can select automatic synchronization through the Auto-Synch select switch (SW1 in Figure 10-3). When this switch is closed, the 505's synchronizing input is enabled and the EGCP-3 LS's automatic synchronizing function selected.

When the plant to utility tie line/breaker is closed, and the unit generator breaker closes, the 505 steps the speed/load setpoint up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load setpoint and is defaulted to 3%. The defaulted value is adjustable through the 505's Service mode (Breaker Logic–Min Load Bias = 5).

After synchronization, the 505's load setpoint can be positioned through raise and lower speed/load setpoint contacts, a programmed 4–20 mA input, Modbus commands, or the 505 service panel.

Cascade control (turbine exhaust pressure) can be enabled at any time after the utility tiebreaker and generator breaker input contacts are closed. Cascade control can be enabled through a programmed contact, Modbus command, or the 505 service panel. Exhaust pressure control can be transferred from a letdown station or turbine bypass valve in one of the following ways; enabling Cascade control, and backing down the letdown station's setpoint, or slowly increasing turbine load with the Speed PID's setpoint, to allow the letdown station to close, then enable Cascade control.

After exhaust pressure control has been transferred to the 505's Cascade PID, the letdown station or turbine bypass valve must be closed or in a manual control mode. This will stop the two controllers (505 Cascade PID and system letdown station) from fighting for control of one parameter and causing system instability.

With this application, the Auxiliary control is programmed to be used as a limiter and be automatically enabled when both the utility tie and generator breakers are closed. When paralleled to the utility this 505 and RPS combination allows the plant to import power from the utility, but not export power. If the utility-to-plant tie line power reaches a zero import/export level the Auxiliary PID will begin limiting generator output, until plant conditions require power to be imported again.

Optionally the Auxiliary PID's setpoint can be varied to limit plant power to a different import or export power level as required.

## Example 4–Plant Import/ Export Control with SPC Servo Interface

This is an example of a typical turbine generator application where plant import/ export control is desired when paralleled with the utility, and frequency control when isolated from the utility. With this type of application, when paralleled to the utility, turbine load varies based on the plant power demand. Other applications may or may not use all the functionality shown in Figure 10-4 and described below.

With this application, plant import/export control is performed within the 505 through the Auxiliary PID controller. Optionally the Cascade PID controller could have been used instead. For this application, the Auxiliary PID is configured to be enabled and disabled on command, instead of performing a limiting action. This gives a system operator full authority of when to enable or disable plant import/export control.

When programmed for this type of control action, the Speed PID is disabled when the Auxiliary PID is enabled, and can only limit the 505's valve output signal if unit load reaches 100%. Also, the Auxiliary setpoint automatically tracks the PID's input value when not in-control.

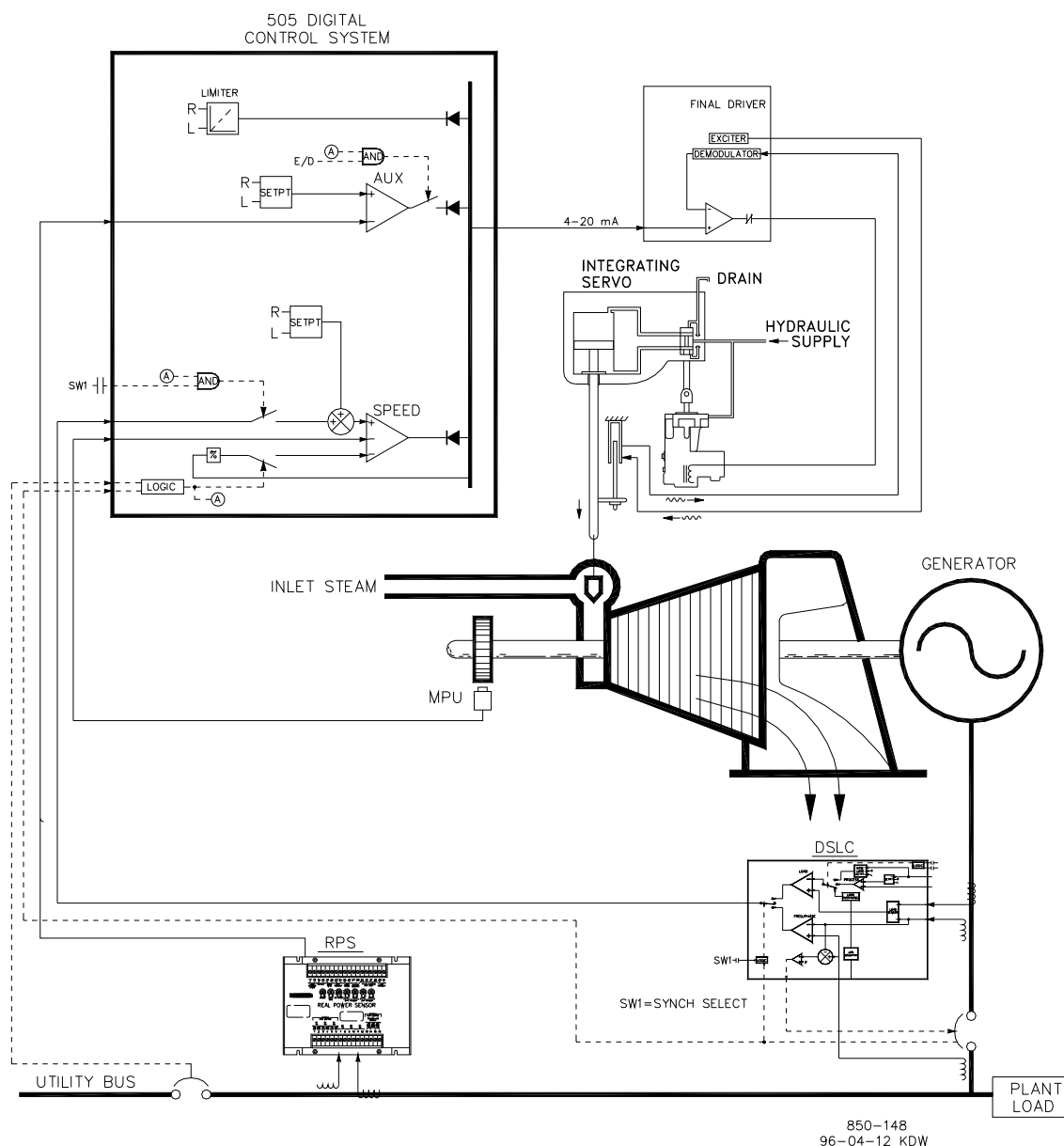


Figure 10-4. Plant Import/Export Control with SPC Servo Interface

A Real Power Sensor (RPS) #8272-726 was used with this application to sense utility tie line power flow. This RPS is special, in that it senses  $-5\text{ A}$  to  $+5\text{ A}$  CT current to allow its output to represent power flow in both the import and export directions. With this RPS  $12\text{ mA}$  represents zero power flow. Because of this feature the RPS #8272-726 cannot be used with the 505 to sense generator load/power.

To save buying a second RPS, with this application unit load is sensed through turbine inlet valve position (505 LSS bus), not a generator load signal. Optionally, another RPS could be used with this application to sense generator power and allow true unit load to be sensed, controlled, and limited. With this configuration, when the generator is paralleled to the utility, the Speed PID controls governor valve position, instead of generator power. Thus, 100% governor valve position is considered 100% unit load, no matter if system conditions are at rated or not.

This application uses an EGCP-3 LS for synchronization only. Because the EGCP-3 LS interfaces to the 505 through an analog signal, a 505 analog input must be programmed. The 505's Analog Input #6 is the only analog input directly compatible with the EGCP-3 LS, thus it is required that this input be programmed to receive the EGCP-3 LS's Speed Bias signal. When a synchronizing input/function is programmed, the input can be enabled, through a contact input, function key, Modbus command, or the 505 service panel. As shown in Figure 10-4, a panel-mounted (DPST) switch is used with this application to select automatic synchronization in both the EGCP-3 LS and 505.

With this application, the existing servo assembly had an actuator which required +50 mA for pilot valve positioning, and a LVDT mounted to the valve rack to feedback actual rack position. Because the 505 does not have a bipolar drive circuit, and cannot perform closed loop servo position control, a Woodward Servo Position Controller (SPC) was used to interface with the existing servo actuator. The SPC used, accepts a 4–20 mA valve demand signal from the 505, monitors actual valve position (through LVDTs, MLDTs, or other dc position feedback devices), compares the two signals, and outputs a drive signal to the servo assembly's actuator accordingly. The SPC interfaces directly with an LVDT (providing excitation, and demodulation) thus no external converter was required or used.

All 505 PID controller setpoints (Speed, Auxiliary, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of notes are provided as a reference for application programmers to follow when programming the 505 to achieve any control and limiting actions shown in Figure 10-4.

## 505 Configuration Notes for Example 4

### OPERATING PARAM:

This is a generator application. (Generator Application? Yes)

Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #8 Function: Generator Breaker), (Contact Input #9 Function: Utility Tie Breaker)

Because no RPS was used to sense unit load, turbine inlet steam valve position, when paralleled to the utility, is controlled by the Speed PID and programmed by not selecting KW droop (Use KW Droop? No). For good response and load adjustment resolution, droop was set to 5% of rated speed. (Droop = 5 %)

It was desired to switch to frequency control at all times, if the plant became isolated from the Utility bus. (Use Freq Arm/Disarm? No)

### DRIVER CONFIGURATION:

Because the SPC used to interface with the servo assembly only accepts a 4–20 mA valve demand signal, the 505 was configured to output a 4–20 mA valve demand signal. (Actuator Is 4–20 mA? Yes)

Dither is a low frequency ac current modulated on to the 505's dc actuator–drive current to reduce stiction in linear type actuators. Because the 505's actuator output is connected to the SPC, dither was not required or used with this application. (Actuator #1 Dither = 0.0%)

### AUXILIARY CONTROL:

The Auxiliary control loop was configured to receive a utility tie line power signal through Analog input #3. (Analog Input #3 Function: Auxiliary Input) the minimum analog input value was programmed for import power based on the tie line power level at –5 A CT current (Input #3 4 mA Value = –XXXX). The maximum analog input value was programmed for export power based on the tie line power level at +5 A CT current. (Input #3 20 mA Value = +XXXX)

Because the RPS's KW readout is self-powered, the analog input should be configured as "Loop Powered".

The 505 was configured to accept a contact from a plant distributed control system to enable and disable import/export control. (Contact Input #5 Function: Aux Control Enable)

The utility-tie Real Power Sensor's CT inputs were wired to allow the RPS's 4 mA value to represent full import power and the RPS's 20 mA value to represent full export power. Because this signal is directly proportional to turbine inlet valve position, no input inversion is required. (Invert Aux Input? No)

The Auxiliary PID was programmed to be enabled and disabled on command. (Use Aux Enable? Yes)

In this case, because the Auxiliary PID is the sole import/export controller, droop is not needed. (Aux Droop = 0%)

With this application, it was desirable to only allow the Auxiliary PID to be enabled if paralleled to the utility. (Tiebkr Open Aux Dsbl? Yes), (Genbkr Open Aux Dsbl? Yes)

#### **AUTO SYNCHRONIZING:**

The 505's Analog input #6 was programmed to receive the EGCP-3 LS's speed bias signal for automatic synchronization (Analog Input #6 Function: Synchronizing Input). With this configuration, the analog input's range is defaulted to a certain gain value for best performance, thus input's 4 mA and 20 mA settings are not used and do not require programming.

A contact input was programmed to enable the synchronizing analog input. (Contact Input #6 Function: Sync Enable)

#### **Starting and Run Mode Notes for Example 4**

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively, an operator can give a manual raise command to increase turbine speed as desired.

After the unit has been started and is controlling at a rated speed position, the turbine generator can be synchronized manually, or automatically. The system operator can select automatic synchronization through the Auto-Synch select switch (SW1 in Figure 10-4). When this switch is closed, the 505's Synchronizing input is enabled and the EGCP-3 LS's automatic synchronizing function selected.

The EGCP-3 LS provides either phase matching or slip frequency synchronizing, and ties into the unit automatic voltage regulator to match voltages before paralleling. It communicates over a LAN using a digital Echelon network with other plant EGCP-3 LSs to perform safe dead bus closing.

When the plant-to-utility tie line/breaker is closed, and the unit generator breaker closes, the 505 steps the speed/load setpoint up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load setpoint and is to 3%. The defaulted value is adjustable through the 505's Service mode (Breaker Logic–Min Load Bias = 5).

After synchronization, the 505's load setpoint can be positioned through raise and lower speed/load setpoint contacts, a programmed 4–20 mA input, Modbus commands, or the 505 service panel.

With this configuration, Import/Export control (Auxiliary PID) can be enabled at any time after the utility tiebreaker and generator breaker input contacts are closed. Auxiliary control can be enabled through the programmed contact, a Modbus command, or the 505 service panel. Because the Auxiliary Setpoint tracks plant Import/Export power before being enabled, the transfer to Auxiliary control is bumpless. Once enabled, the Auxiliary PID's setpoint can then be positioned to the desired import or export level.

Because of the 505's configuration, this unit will automatically switch to frequency control upon the opening of the plant-to-utility tiebreaker.

## **Example 5–Inlet Pressure Control with Isochronous Load Sharing Control in Island Mode**

For this application, it is desired to control inlet pressure when paralleled to the utility, and frequency while load sharing with three other units when isolated from the utility. With this type of application, when paralleled to the utility, load varies based on plant process steam demand, and when isolated, load varies based on plant power demand. Other applications may or may not utilize all the functionality shown in Figure 10-5 and described below.

With this application, turbine inlet header pressure control is performed within the 505 through the Cascade PID controller. This is an ideal controller for this type of function because it can be enabled and disabled as desired by a system operator. This gives a system operator full authority of when to transfer process pressure control to or from a letdown station or turbine bypass valve.

To prevent having to buy a Real Power Sensor for this application, unit load is sensed through turbine inlet valve position (505 LSS bus), not a generator load signal. Optionally, another Real Power Sensor could be used with this application to sense generator power, and allow true unit load to be sensed and controlled. With this configuration, 100% governor valve position is considered to be 100% unit load, no matter what system conditions are.



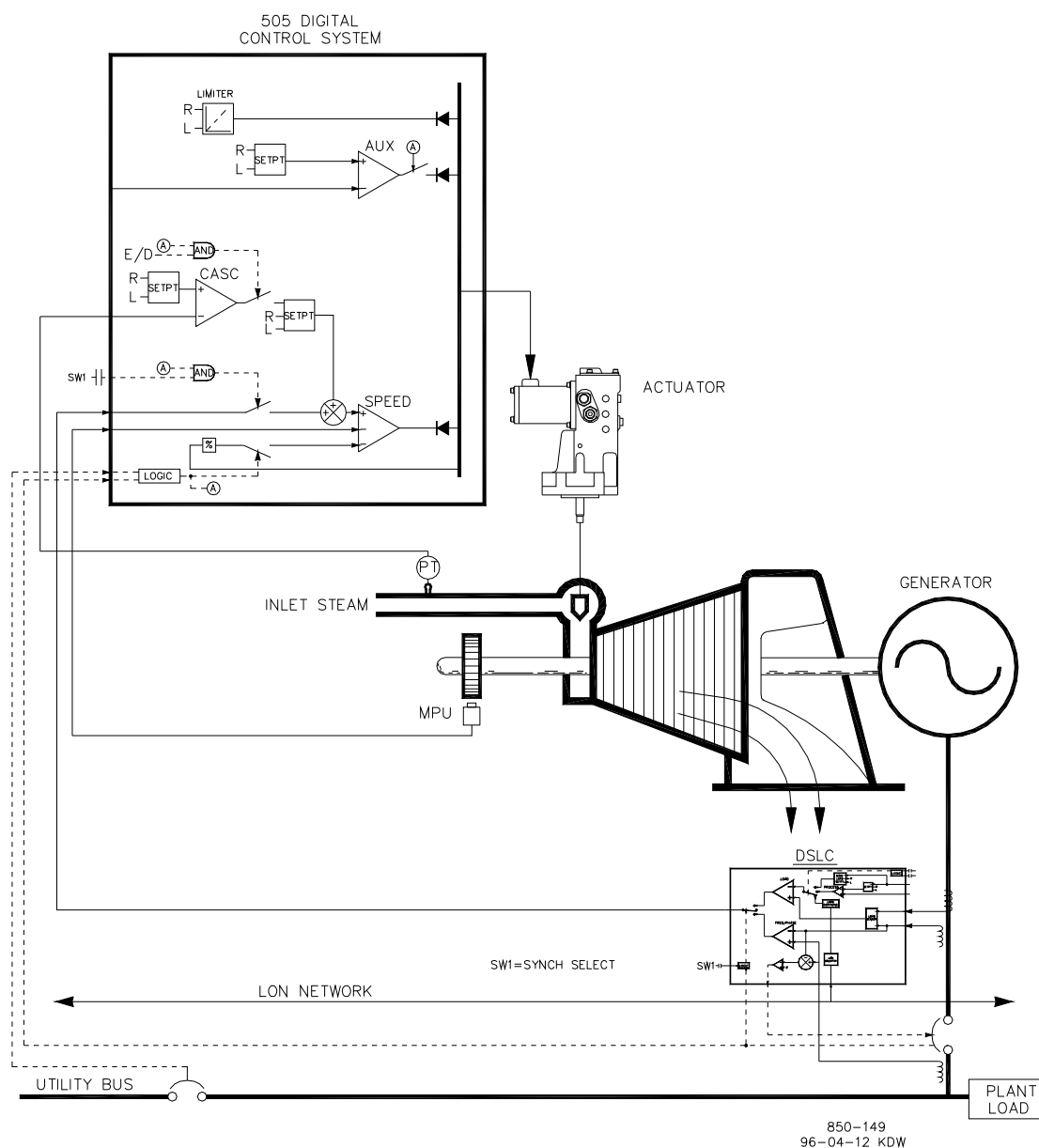


Figure 10-5. Inlet Pressure Control with Isochronous Load Sharing Control in Island Mode

This application uses an EGCP-3 LS for synchronization and isochronous load sharing. With this configuration, the EGCP-3 LS is disabled when the generator is paralleled to the utility, and enabled when isolated from the utility. When the unit is paralleled to the utility, the EGCP-3 LS is disabled and the 505's internal load setpoint or Cascade PID (plant import/export power) is used to control/set unit load. When the plant becomes isolated from the utility, (utility tiebreaker opens), the EGCP-3 LS is enabled. Cascade control is disabled, and the 505 is switched to a Frequency control/load sharing mode.

An EGCP-3 LS can only interface to a 505 through an analog input signal. When a Sync/LD Share analog input is programmed, the input is automatically enabled if the generator breaker input is closed and the utility tiebreaker input is open.

Before the generator breaker is closed, the Synch/Ld Share input can be enabled, to allow automatic synchronization by the EGCP-3 LS. This synchronizing function/ input can be enabled, through a contact input, function key, Modbus command, or the 505 service panel. As shown in Figure 10-5 a panel mounted (DPST) switch is used with this application to select automatic synchronization in both the EGCP-3 LS and 505.



All 505 PID controller setpoints (Speed, Auxiliary, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of notes are provided as a reference for application programmers to follow when programming the 505 to achieve any control and limiting actions shown in Figure 10-5.

## 505 Programming Notes for Example 5

### OPERATING PARAM:

This is a generator application. (Generator Application? Yes)

Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #8 Function: Generator Breaker), (Contact Input #9 Function: Utility Tie Breaker)

Because no RPS was used to sense unit load, turbine inlet steam valve position, when paralleled to the utility, is controlled by the Speed PID and programmed by not selecting KW Droop (Use KW Droop? No). For good response and load adjustment resolution, droop was set to 5% of rated speed. (Droop = 5 %)

It was desired to switch to Frequency control at all times, if the plant became isolated from the Utility bus. (Use Freq. Arm/Disarm? No)

### CASCADE CONTROL:

The Cascade control loop was configured to receive an inlet header pressure signal through Analog input #2. (Analog Input #2 Function: Cascade Input).

Because a two wire, loop powered transducer is used to interface with this signal, 'Loop Powered' is not checked.

The 505 was configured to accept a contact from a panel mounted switch to externally enable and disable inlet header pressure control. (Contact Input #5 Function: Casc Control Enable)

The Cascade Input was inverted to allow the correct control action. To increase turbine inlet header pressure, the governor valve must decrease. This is considered an indirect action and requires the input to be inverted. (Invert Cascade Input? Yes)

With this application, Setpoint Tracking is not used because the desired system pressure level never changes, thus system start-up is simpler. (Use Setpoint Tracking? No)

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 5 rpm above synchronous speed.

In this case, because the Cascade PID is sharing control of inlet header pressure with the boiler control, droop default is 5%. This allows the Cascade PID to assist the boiler control with inlet header pressure control, without having the two fight over the same parameter. (Cascade Droop = 5%).

### SYNCH/LD SHARING:

The 505's Analog Input #6 was programmed to receive the EGCP-3 LS's speed bias signal for automatic synchronization, and load sharing. (Analog Input #6 Function: Synch/Load Share Input) With this configuration, the analog input's range is defaulted to a certain gain value, for best performance, thus input's 4 mA and 20 mA settings are not used and do not require programming.

A contact input was programmed to enable the Synch/Load Share analog input to allow synchronization through the EGCP-3 LS before the generator breaker is closed. (Contact Input #6 Function: Synch/Ld Share Enable).

## Starting and Run Mode Notes for Example 5

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively, an operator can give a manual raise command to increase turbine speed as desired.

When the unit has been started and is controlling at a rated speed position, the turbine generator can be synchronized manually, or automatically. The system operator can select automatic synchronization through the Auto-Synch select switch (SW1 in Figure 10-5). When this switch is closed, the 505's Synch/Load Sharing input is enabled and the EGCP-3 LS's automatic synchronizing function is selected.

After synchronization, generator load is determined by the mode of operation selected, (the position of the utility tiebreaker contact input). If the utility tiebreaker contact is closed, generator load is determined by the 505's internal load setpoint, or when enabled, inlet header pressure control (Cascade control). If the utility tiebreaker contact is open generator load is determined by the EGCP-3 LS. The EGCP-3 LS can be configured to operate in several different load control modes. For this application the EGCP-3 LS is only used for isochronous load sharing, when the plant is isolated from the utility.

In this plant, four generating units use EGCP-3 LSs, and upon the plant-to-utility tie breaker opening they all switch to Frequency control and communicate with each other via a digital LON network to share load. Thus plant frequency is controlled by all units, and plant load is shared proportionally by all four units. With this configuration, plant frequency will be the average frequency of all units. The 505, has a feature that resets its frequency setpoint to the 'RATED SPEED SETPOINT' setting upon the utility tie breaker opening, thus assuring that all units will be at synchronous speed. An EGCP-3 LS's Frequency Trimmer function may be programmed to hold frequency within  $\pm 0.1\%$  of the desired frequency.

Inlet header pressure (Cascade control) can be enabled any time after the utility tie and generator breaker contacts are closed. Cascade control can be enabled through a programmed contact, a Modbus command, or the 505's service panel.

[illegible]

For this application one unit at a time, based on system, health is used to control plant process steam. The other units are used to control a plant export power level of five MW. Because the plant is contractually obligated to provide this level of power to the utility, and because it is more economical to make power than purchase it from the utility, a five MW plant export power level is desired.

Each unit control panel has a mode selection switch, which allows an operator to place a unit in one of three different modes of operation. The three modes of operation are Manual Load (used to manually load and unload a unit), Plant Process Steam Control (turbine exhaust pressure), and Load Sharing (used for plant import/export control or unit load sharing).

When a unit is switched to a Manual Load Control mode, its 505's internal load setpoint determines unit load. This allows an operator to manually load or unload a unit to a set level if desired.

With this application when a unit is switched to the Plant Process Control mode, turbine exhaust pressure control is performed within the 505 through the Cascade PID controller. This is an ideal controller for this type of function because it can be enabled and disabled as desired by a system operator. This gives a system operator full authority of when to transfer process pressure control to or from a letdown station or turbine bypass valve.

To save buying a Real Power Sensor, turbine inlet valve position (505 LSS bus) is used to sense unit load, not a generator load signal. With this configuration, 100% governor valve position, is considered to be 100% unit load, no matter what the system conditions. Thus, unit overload protection is only performed by limiting the 505's output to 100%. Optionally, a Real Power Sensor could be used with this application to sense generator power, and allow true unit load to be sensed, controlled, and limited.

This application uses Woodward EGCP-3 LSs and a MSLC to allow all units to communicate, share plant load, and control plant export power. The EGCP-3 LS is used on each unit, for synchronization and load sharing. One Master Synchronizer & Load Control is used for plant synchronization and import/export power control. When a unit is in the Load Sharing mode, the MSLC determines its load with the plant-to-utility tie line is closed, and the EGCP-3 LS's load sharing circuitry when the plant-to-utility tie line is open. The MSLC, when enabled, sets the load setpoint of each unit EGCP-3 LS (in the Load Sharing mode) to control a plant export level. When the plant-to-utility tiebreaker is open, the MSLC is disabled, and each unit communicates with the other units in the Load Sharing mode via the EGCP-3 LS's LON network to share plant load.

An EGCP-3 LS interfaces to a 505 through an analog input signal. When a Sync/LD Share analog input is programmed, the input is automatically enabled if the generator breaker input is closed and the utility tie breaker input is open.

Before the generator breaker is closed, the 505's Sync/Ld Share analog input can be enabled, to allow automatic synchronization by the EGCP-3 LS. This synchronizing function/input can be enabled, through a contact input, function key, Modbus command, or the 505 service panel. As shown in Figure 10-6 a panel mounted (DPST) switch is used, with this application, to select automatic synchronization in both the EGCP-3 LS and 505.

All 505 PID controller setpoints (Speed, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505 service panel.

The following list of notes are provided as a reference for application programmers to follow when programming the 505 to achieve any control and limiting actions shown in Figure 10-6.

## 505 Configuration Notes for Example 6

### OPERATING PARAM:

This is a Generator application. (Generator Application? Yes)

Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #8 Function: Generator Breaker), (Contact Input #9 Function: Utility Tie Breaker).

Generator load is limited by the Speed PID sensing governor valve position through its LSS bus, and programmed by not selecting KW Droop. (Use KW Droop? No)

For good response and load adjustment resolution, Droop (LSS bus position) was set to 5% of rated speed. (Droop = 5 %)

It was desired to switch to Frequency/Load Sharing control at all times, if the plant becomes isolated from the Utility bus. (Use Freq. Arm/Disarm? No)

### **CASCADE CONTROL:**

The Cascade control loop was configured to receive an exhaust header pressure signal through Analog input #1. (Analog Input #1 Function: Cascade Input)

Because a two wire, loop powered transducer is used to interface with this signal, 'Loop Powered' is not checked.

A contact input was programmed to allow an operator to easily enable and disable Cascade control via a control panel switch. (Contact Input #5 Function: Casc Control Enable).

Exhaust header pressure is directly proportional to turbine inlet valve position, thus no input inversion is required. (Inverted? No)

With this application, Setpoint Tracking is used to allow the 505's Cascade control, when disabled, to track exhaust header pressure being controlled by a letdown station. (Use Setpoint Tracking? Yes)

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 5 rpm above synchronous speed.

In this case, because the Cascade PID, during normal operation, is not sharing control of the exhaust header pressure with another control, droop is not needed. (Cascade Droop = 0%)

### **GEN LOAD LIMITING:**

To limit generator load to 100% the Speed setpoint maximum limit was set at the 100% load setting. 5% droop was programmed for this application. (Max Governor Speed Setpoint = Rated Speed X 1.05)

### **SYNC & LOAD SHARING:**

The 505's Analog input #6 was programmed to receive the EGCP-3 LS's speed bias signal for automatic synchronization and load sharing (Analog Input #6 Function: Sync/Load Share input). or best performance, the analog input's range is defaulted to a certain gain value, thus the input's 4 mA and 20 mA settings are not used and do not require programming.

A contact input is programmed to enable the Sync/Load Share analog input before the generator breaker is closed to enable synchronizing through the EGCP-3 LS (Contact Input #6 Function: Sync/Ld Share Enable).

## **Starting and Run Mode Notes for Example 6**

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively, an operator can give a manual raise command to increase turbine speed as desired.

After the unit has been started and is controlling at a rated speed position, the turbine generator can be synchronized manually, or automatically. The system operator can select automatic synchronization through the Auto-Synch select switch (SW1 in Figure 10-6). When this switch is closed, the 505's Synchronizing input is enabled and the EGCP-3 LS's automatic synchronizing function selected.

With this configuration, the mode of operation the system operates in is dependent on SW2's position. When SW2 is not selecting the Load Sharing mode, and the generator breaker is closed, unit load is set by the 505's internal Speed/load setpoint, or the Cascade PID if enabled. Upon the generator breaker closing, the 505 steps the speed/load setpoint up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load setpoint and is defaulted to 3%. The defaulted value is adjustable through the 505's Service mode (Breaker Logic—Min Load Bias = 5).

After synchronization, the 505's load setpoint can be positioned through raise and lower speed/load setpoint contacts, a programmed 4–20 mA input, Modbus commands, or the 505 service panel.

Cascade control (turbine exhaust pressure) can be enabled at any time after the utility tiebreaker and generator breaker input contacts are closed. The Cascade control can be enabled through a programmed contact, Modbus command, or the 505 service panel.

When SW2 is switched to select Load Sharing, the EGCP-3 LS bumplessly ramps load to match the MSLC's load setpoint, or to a load setting determined by the EGCP-3 LS's load sharing circuitry, depending on utility-to-tie breaker position. The MSLC can be used to set all the units in the Load Sharing mode to a base load setting, or vary their load based on a plant import/export demand setting.

With this application, during normal operation, one unit is switched to control plant process steam and the other units are switched to the Load Sharing mode and are loaded based on the MSLC plant load demand. If the plant should become isolated from the utility, the MSLC will become disabled and all units in the Load Sharing mode will share plant load. When desired the MSLC can be enabled to re-synchronize the plant bus to the utility bus and close the plant-to-utility tie breaker. After synchronization the MSLC will either ramp plant power to a five MW export power level, or ramp plant load to a base load setting, depending on the mode of operation selected.

Woodward EGCP-3 LSs can interface directly with a unit's automatic voltage regulator. This allows units with EGCP-3 LSs to share reactive power as well as real power. This configuration also allows the MSLC to control plant power factor when the utility to tie breaker is closed.

## Example 7–Induction Generator Applications

When the 505 is configured for induction generator applications, typically there are only two differences in the programming of the 505 verses programming for synchronous generator applications.

The induction generator's slip frequency must be taken into account. This is achieved by compensating for the slip frequency with the 505's maximum Speed Setpoint setting. The 'MAX GOVERNOR SPEED SETPOINT' setting must be equal to synchronous speed and the droop percentage plus the full load slip frequency percentage.

1. MAX GOVERNOR SPEED SETPOINT = SYNC SPEED + (SYNC SPEED \* DROOP) + MAX SLIP rpm.
2. The USE TIE BREAKER OPEN TRIP setting must be set to "Yes" if a synchronous generator is not sharing the same plant bus. This will cause the generator to trip when the utility tiebreaker opens.

## Example 8 — Extraction Turbine Mechanical Drive (Pump or Compressor) with Discharge Pressure Control and Turbine Inlet Pressure Limiting

(Extraction Turbine, Coupled HP & LP – Mode 0)

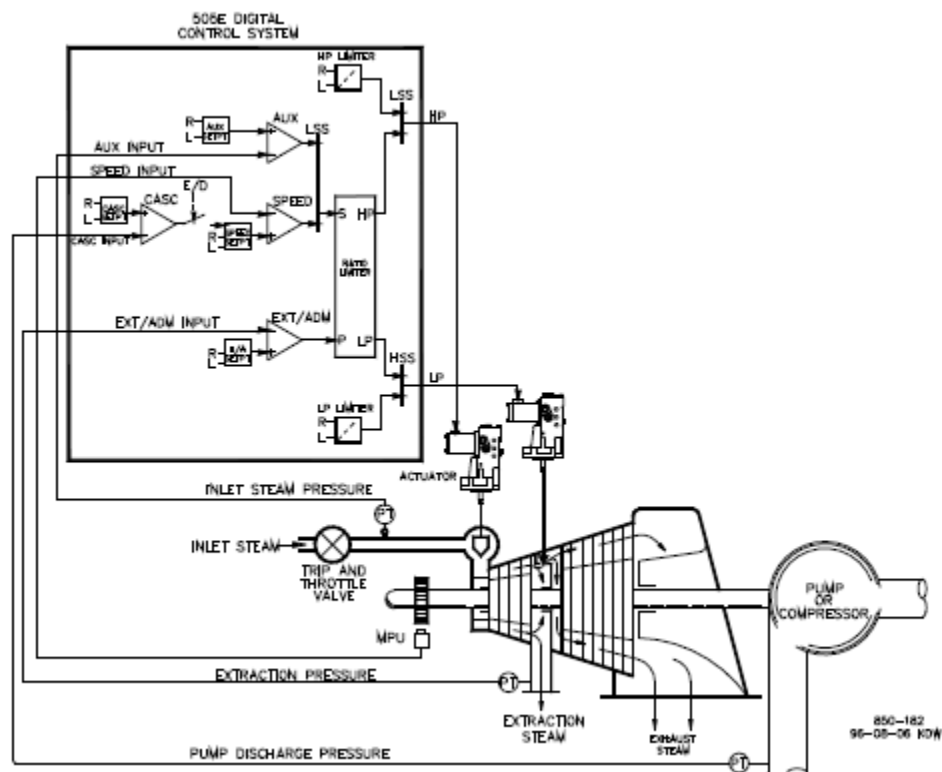


Figure 10-7. Pump or Compressor with Discharge Pressure Control and Turbine Inlet Pressure Limiting

This is an example of a typical pump or compressor application. With this application, the 505XT is configured to normally control pump/compressor discharge pressure, extraction pressure, and limit governor valve position based on low turbine inlet steam pressure. Both the Inlet and Cascade modes were used for this example application. Other applications may or may not use all the functionality shown in Figure 10-7 and described below.

Extraction pressure is controlled by the Extr/Adm PID. This PID controller can be enabled automatically or manually depending on configuration. In all cases, the 505XT starts up with the Extr/Adm PID disabled and the LP valve at its maximum open position. This allows a turbine to warm-up in a uniform manner. With this application, the Extr/Adm setpoint is only varied through the 505XT's front panel. Optionally the 505XT could be programmed to have the Extr/Adm setpoint varied through discrete inputs, a 4–20 mA signal, or Modbus communications.

With this application pump/compressor discharge pressure control is performed within the 505XT through the Cascade controller. Because the discharge pressure being controlled, typically affects many other plant processes, a plant Distributed Control System (DCS) may be used to monitor plant process conditions and set the Cascade setpoint position. This can be performed through Modbus communications, discrete raise and lower commands, or with an Analog setpoint signal.

For this application a limiting type of control function was required to help preserve inlet header pressure in case of system header problems. The Inlet Pressure PID can be setup as a limiter (not a controller) to perform this function. It will sense turbine inlet pressure and limit governor valve position, based on a low inlet pressure setting.



If a plant Distributed Control System is used to sense and control a process by positioning the load of multiple pumps or compressors (load sharing), the DCS may interface directly to the 505XT Speed PID setpoint through a programmed Remote Speed Setpoint analog input. This allows a DCS to monitor and compensate for plant and system conditions by directly changing the speed of multiple pumps or compressors simultaneously.

All 505XT PID controller setpoints (Speed, Extr/Adm, Inlet, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505XT service panel.

The following list of notes is provided as a reference for application programmers to follow when configuring the 505XT to achieve any of the control and limiting actions shown in Figure 10-7:

### 505XT Configuration Notes for Example 8:

#### OPERATING PARAMETERS:

This is not a Generator application. (Generator Application?—No)

#### EXTR / ADM CONTROL:

The Extr/Adm control loop is defaulted to receive an extraction pressure or flow signal through Analog Input #1 (Analog Input #1 Function: Extr/Adm Input). The input's 4 mA and 20 mA values were programmed based on what the pressure transducer was ranged/calibrated for.

Because of where the extraction transducer was placed with respect to the LP valve (refer to Figure 10-7) no input inversion was required. To increase turbine extraction header pressure, the HP valve must increase and the LP valve must decrease. This is considered a direct action and does not require the input to inverted (Invert Extr/Adm Input?—No).

In this application, because the Extr/Adm PID is not sharing control of the extraction pressure with another controller, droop is not required. (Extr/Adm Droop = 0%)

#### TURBINE PERFORMANCE VALUES:

Because it is desired to hold Pump Discharge Pressure constant for a changing extraction flow demand, and because Pump Discharge pressure is directly related to turbine load, the "Coupled HP & LP" Ratio/Limiter mode is used with this application. (Use Decoupling?—No)

From the turbine's steam map or performance envelope (provided with the turbine from the turbine manufacturer), the turbine's operating data/limits were entered as described in Volume #1 of this manual.

This application's turbine can only extract steam. (Extraction Only?—Yes) Automatic enabling/disabling was selected with this application to allow an operator to automatically or manually enable/disable Extraction control (lower the LP valve limiter to its minimum position / raise the LP valve limiter to maximum position). The automatic enable/disable routine may be stopped at any time, and continued manually, or restarted as desired (Use Automatic Enable?—Yes).

When the turbine is on an operating limit and only one valve is available to control with, Pump Discharge pressure is the desired parameter to be controlled (extraction pressure control will be sacrificed). Since Pump Discharge pressure is being controlled with the Cascade PID (the ratio limiter's "S" term) Speed priority is selected. (Speed Control Priority?—Yes)

When the turbine is on the LP Maximum Limiter (100% open), Pump Discharge pressure is the desired parameter to be controlled (extraction pressure control will be sacrificed). Since Pump Discharge pressure is being controlled with the Cascade PID (the ratio limiter's "S" term) Speed priority is selected. (LP Max Lmt E/A Priority?—No)

#### CASCADE CONTROL:

The Cascade control loop was configured to receive a pump/compressor discharge pressure signal through Analog input #2 (Analog Input #2 Function: Cascade Input). The input's 4 mA and 20 mA values were programmed based on what the pressure transducer was ranged/calibrated for.



The 505XT was configured to accept a contact from a panel mounted switch to externally enable and disable discharge pressure control. (Contact Input 1 Function: Casc Control Enable)

Pump/compressor discharge pressure is directly proportional to turbine inlet valve position, thus input inversion is not required. (Invert Cascade Input?—No)

With this application, Setpoint Tracking is not used because the system's pressure setpoint never changes. (Use Setpoint Tracking?—No)

In this application, because the Cascade PID is not sharing control of discharge pressure with another controller, droop is not required. (Cascade Droop = 0%)

### INLET CONTROL:

The Inlet control loop was configured to receive a turbine inlet header pressure signal through Analog input #3. (Analog Input #3 Function: Inlet Pressure Input) the input's 4 mA and 20 mA values were programmed based on what the pressure transducer was ranged/calibrated for.

The Inlet Pressure Input was inverted to allow the correct control action. To increase turbine inlet header pressure, the governor valve must decrease. This is considered an indirect action and requires the input to be inverted. (Invert Inlet Input?—Yes)

The Inlet PID was programmed to perform as a limiter (Use Inlet Enable? No).

Because the Inlet PID is used only as a limiter and is not sharing control of inlet pressure with another controller, droop is not required. (Inlet Droop = 0%)

### TRIPS

In this example, several devices can trip the turbine; one of these devices is the 505XT control. To provide feedback to the 505XT control that the turbine is tripped, a contact from the trip string is wired into the External Emergency Shutdown input (DI01). With this application, the 'governor trip' annunciation should only occur if the 505XT tripped the turbine and not annunciate when the other external devices shuts down the unit (Turbine Start: Ext Trips in Trip Relay? No).

Because the Shutdown relay is used in the trip string to shut down the turbine should the 505XT initiate a trip, additional relays are required for annunciating any turbine trip and annunciating a 505XT initiated trip. Relay #3 was programmed to annunciate any turbine trip as follows: (Relays: Use Relay #3—Yes; Relay #3 is a Level Switch?—No; Relay #3 Energizes on—Shutdown Condition)

Relay #4 was programmed to indicate a 505XT initiated trip as follows: (Relays: Use Relay #4—Yes ; Relay #4 is a Level Switch?—No ; Relay #4 Energizes on—Trip Relay) Note that Relay #4 de-energizes on a trip condition (excluding external trip inputs) and Relay #3 energizes on a trip (shutdown) condition.

### Starting & Run Mode Notes for Example 8:

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position or an operator can give a raise command to manually increase turbine speed.

After the unit has been started and is controlling at a minimum/desired speed position, and is considered to be running in On-Line condition, Cascade control (pump/compressor discharge pressure) can be enabled through contacts, Modbus commands, or the 505XT service panel. When Cascade control is enabled, if the actual discharge pressure does not match the setpoint, the control will automatically ramp turbine speed at the "Speed Setpoint Slow Rate" setting until the pump/compressor discharge pressure does match the setpoint. This allows the Cascade control to be enabled in a controlled manner.

Because the 505XT was programmed for the capability to automatically enable Extraction Control, the operator may choose to automatically or manually enable Extraction control. To manually enable Extraction control the operator must issue a LP valve limiter lower command from the 505XT service panel, a contact input, or through Modbus communications. The LP valve limiter must be taken to its minimum position to fully enable Extraction control. The control will transition from speed only control onto Ratio Limiter control in Mode 0. In this mode, the unit will be able to control both speed (driven by Cascade) and extraction pressure with the steam performance map.

The enabling routine, which automatically lowers the LP valve limiter, may be issued from the 505XT's service panel, contact input, or through Modbus communications. This routine automatically ramps the LP valve to its minimum position and may be stopped at any time by momentarily issuing a LP valve limiter raise or lower command. Once the automatic enabling routine has been stopped, it may be restarted/enabled at any time by issuing a disable command followed by an Extr/Adm control enable command or, once stopped, the operator may continue the routine manually. (Disabling of Exhaust control can also be performed manually or automatically.)

When a letdown station is used as a backup to the turbine extraction pressure controller, it is required that the letdown station's setpoint be lower than that of the 505XT extraction control's setpoint to prevent fighting and potential instability between the controllers.

With this application the Inlet Pressure control is used as a limiter, thus it does not need to be enabled. If turbine inlet pressure decreases below the Inlet setpoint at any time, the Inlet PID will take control of the HP governor valve and lower it to help preserve inlet header pressure.

See the Service mode section of this manual, for information on related tunable values and rates.

## Example 9 — Extraction Turbine Inlet and Extraction Pressure Control with Automatic Synchronizing & Generator Power Limiting

(Extraction Turbine, Decoupled Inlet mode)

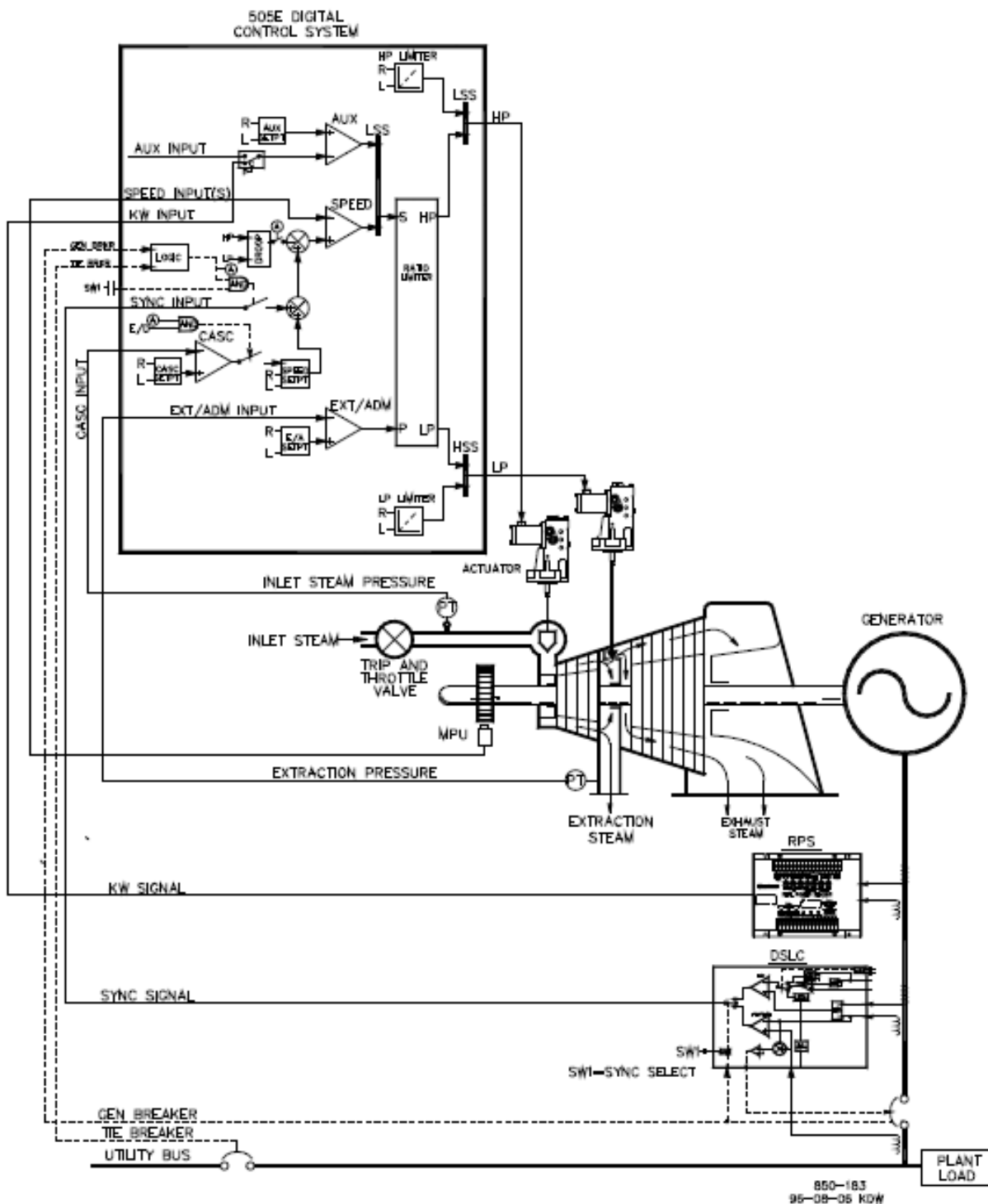


Figure 10-8. Inlet Pressure Control with Automatic Synchronizing & Generator Power Limiting

This is an example of a typical turbine generator application where plant process steam (turbine inlet header pressure) is desired to be controlled at a single pressure. With this type of application, turbine load varies based on the plant process steam demand. Both the Auxiliary and Cascade modes were used for this example application. Other applications may or may not utilize all the functionality shown in Figure 10-8 and described below.

With this application, turbine inlet header pressure control is performed within the 505XT through the Cascade PID controller. This is an ideal controller for this type of function because it can be enabled and disabled as desired by a system operator. This gives a system operator full authority of when to transfer process pressure control to or from a letdown station or turbine bypass valve.

During normal operation, unit load is determined by the Cascade PID, which is controlling inlet header pressure. Because turbine load may vary greatly with this application, a limiter is used to protect the generator from being over powered.

This protection is performed by the Auxiliary PID configured as a limiter. By configuring the Auxiliary PID as a limiter and by using generator load as the PID's controlling parameter, the maximum generator load can be limited.

Extraction pressure is controlled by the Extr/Adm PID. This PID controller can be enabled automatically or manually depending on configuration. In all cases, the 505XT starts up with the Extr/Adm PID disabled and the LP valve at its maximum open position. This allows a turbine to warm-up in a uniform manner. With this application, the Extr/Adm setpoint is only varied through the 505XT's front panel. Optionally the 505XT could be programmed to have the Extr/Adm setpoint varied through discrete inputs, a 4–20 mA signal, or Modbus communications.

This application uses a DSLC-2 for synchronization only. The DSLC-2 can interface to the 505XT through an analog signal or through a high-speed digital communication link. In this case, Analog Input #6 was programmed to receive the DSLC's Speed Bias signal. When a Synchronizing input/function is programmed, the input can be enabled through a contact input, function key, Modbus command, or the 505XT service panel. As shown in Figure 2-2, a panel mounted (DPST) switch is used with this application to select automatic synchronization in both the DSLC-2 and 505XT.

All 505XT PID controller setpoints (Speed, Extr/Adm, Auxiliary, Cascade) may be changed through programmed raise and lower contacts, programmed 4–20 mA inputs, Modbus commands, or the 505XT service panel.

The following list of notes are provided as a reference for application programmers to follow when programming the 505XT to achieve any of the control and limiting actions shown in Figure 10-8.

### 505XT Configuration Notes for Example 9:

#### OPERATING PARAMETERS:

This is a Generator application (Generator Application? Yes). Generator and Utility Tie breaker contact inputs are required to be programmed when a generator application is selected. (Contact Input #8 Function: Generator Breaker), (Contact Input #9 Function: Utility Tie Breaker)

Because the 505XT is configured to control inlet pressure through the Cascade PID, the ratio limiter will run in Mode 0 controlling Speed & Extraction pressure. It is also possible to program the unit to control Inlet pressure directly using the Inlet controller; in this case, the unit would be switched to Mode 2 once the unit was operating in On-line mode. KW droop, however, acts as a form of valve coupling (both valves affect load) and will negate the decoupling action of the ratio limiter if used. For this reason, Speed droop is used with this application. (Use KW Droop?—No)

To achieve good response and load adjustment resolution, droop was set to 5% of rated speed. (Droop = 5 %)

A Real Power Sensor (RPS) was used with this application to sense and display actual unit load. By programming an analog input for KW/unit load, the actual unit's load can be displayed. Without this actual unit load input, a calculated load percentage is displayed. The RPS and associated load input are not required by the 505XT for control, this input is only used for monitor and display purposes. The 505XT was configured to receive a generator load signal from a Real Power Sensor through Analog Input #2. (Analog Input #3 Function: KW / Unit Load Input) The input's 4 mA and 20 mA values were programmed based on what the PTs and CTs used by the Real Power Sensor were ranged for (4 mA = zero, 20 mA = unit power level at 5 A CT current).

Because the Real Power Sensor is self-powered (provides its own loop power), the 505XT input was checked as 'Loop Powered'.

It was desired to switch to Frequency control at all times, if the plant became isolated from the Utility bus (Use Freq. Arm/Disarm? No).

#### **EXTR / ADM CONTROL:**

The Extr/Adm control loop is defaulted to receive an extraction pressure or flow signal through Analog Input #1 (Analog Input #1 Function: Extr/Adm Input). The input's 4 mA and 20 mA values were programmed based on what the pressure transducer was ranged/calibrated for.

Because of where the extraction transducer was placed with respect to the LP valve (refer to Figure 10-8), no input inversion was required. To increase turbine extraction header pressure, the HP valve must increase and the LP valve must decrease. This is considered a direct action and does not require the input to be inverted. (Invert Extr/Adm Input?—No)

In this application, because the Extr/Adm PID is not sharing control of the extraction pressure with another controller, droop is not required. (Extr/Adm Droop = 0%)

#### **TURBINE PERFORMANCE VALUES:**

From the turbine's steam map or performance envelope (provided with the turbine from the turbine manufacturer), the turbine's operating data/limits were entered as described in Volume #1 of this manual. This application's turbine can only extract steam (Extraction Only? Yes).

Automatic enabling/disabling was selected with this application to allow an operator to automatically or manually enable/disable Extraction control (lower the LP valve limiter to minimum / raise the LP valve limiter to maximum). The automatic enable/disable routine may be stopped at any time, and continued manually, or restarted as desired (Use Automatic Enable? Yes).

With this turbine, the turbine manufacture requires that during normal operation the LP valve never be closed less than 5% to allow for adequate cooling steam through the turbine's back stages. (Min LP lift (%) = 5)

When the turbine is on an operating limit and only one valve is available to control with, inlet pressure is the desired parameter to be controlled (extraction pressure control will be sacrificed). Since inlet pressure is being controlled with the Cascade PID (the ratio limiter's "S" term) Speed priority is selected (Speed Control Priority? Yes).

When the turbine is on the LP Maximum Limiter (100% open), inlet pressure is the desired parameter to be controlled (extraction pressure control will be sacrificed). Since inlet pressure is controlled with the Cascade PID (the ratio limiter's "S" term) Speed priority is selected (LP Max Lmt E/A Priority?—No).

#### **CASCADE CONTROL:**

The Cascade control loop was configured to receive an inlet header pressure signal through Analog Input #2. (Analog Input #2 Function: Cascade Input) The input's 4 mA and 20 mA values were programmed based on what the pressure transducer was ranged/calibrated for.

The 505XT was configured to accept a contact from a panel mounted switch to externally enable and disable inlet header pressure control. (Contact Input #3 Function: Casc Control Enable)

The Cascade Input was inverted to allow the correct control action. To increase turbine inlet header pressure, the governor valve position must decrease. This is considered an indirect action and requires the input to be inverted (Invert Cascade Input? Yes).

With this application, Setpoint Tracking is used to allow the 505XT to track inlet header pressure before being enabled, thus allowing a bumpless transfer to inlet header pressure control (Use Setpoint Tracking? Yes).

To protect the generator from being reverse powered by the Cascade PID, the 'Speed Setpoint Lower Limit' value was set to 3% (5.4 rpm if rated speed is 3600 rpm and using 5% droop) above synchronous speed. The 505XT will automatically limit the Speed Setpoint Lower Limit to a minimum of 3% (min load). If it is desired to allow the Cascade PID to lower load below this setting, the Service mode's (Cascade Control Settings, Use Min Load) setting must be set to "No".

In this case, because the Cascade PID, during normal operation, is not sharing control of inlet header pressure with another controller, droop is not required. (Cascade Droop = 0%)

#### **AUXILIARY CONTROL:**

The Auxiliary control loop was configured to receive a generator load signal from a Real Power Sensor, through Analog Input #3 (Use KW Input? Yes).

Unit load is directly proportional to turbine inlet valve position, thus no input inversion is required. (Invert Aux Input?—No)

The Auxiliary PID was programmed to perform as a load limiter. (Use Aux Enable?—No)

In this case, because the Auxiliary PID is used only as a limiter, and is not sharing control of generator load with another control, droop is not required. (Aux Droop = 0%)

With this application, it was desirable to only enable the Auxiliary PID if paralleled to the utility (Tiebrkr Open Aux Dsbl?—Yes), (Genbrkr Open Aux Dsbl?—Yes).

#### **AUTO SYNCHRONIZING:**

The 505XT's Analog input #6 was programmed to receive the DSLC's speed bias signal for automatic synchronization (Analog Input #6 Function: Synchronizing Input)

With this configuration, the analog input's range is defaulted to provide a certain gain factor for best performance, thus the input's 4 mA and 20 mA program settings are not used and do not require programming.

A contact input was programmed to enable the Synchronizing analog input. (Contact Input #6 Function: Sync Enable)

#### **Starting & Run Mode Notes for Example 9:**

Starting and ramping to an idle or minimum speed position can be performed automatically, semi-automatically, or manually. After the unit is started, the Idle/ Rated or Auto Start Sequence functions, if programmed, can be used to assist ramping the control to a rated speed position. Alternatively, an operator can give a manual raise command to increase turbine speed as desired.

After the unit has been started and is controlling at a rated speed position, the turbine generator can be synchronized. This can be done manually or automatically. The system operator can select automatic synchronization through the Auto-Sync select switch (switch SW1 in Figure 10-8). When this switch is closed, the 505XT's Synchronizing input is enabled and the DSLC's automatic synchronizing function is selected.

When the plant-to-utility tie-line breaker is closed and the unit generator breaker closes, the 505XT steps the speed/load setpoint up to a minimum load level to reduce the chance of reverse powering or motoring the generator. This minimum load level is based on the speed/load setpoint and is defaulted to "3%". The

defaulted value (stored as a setpoint “rpm” change) is adjustable through the 505XT’s Service mode (Breaker Logic, Min Load Bias = xxx rpm).

After synchronization, the 505XT’s load setpoint can be positioned through raise and lower Speed/Load setpoint contacts, a programmed 4–20 mA input, Modbus commands, or the 505XT service panel. This Load Control mode may be used to slowly increase turbine load, and take control away from a letdown station or turbine bypass valve. When a letdown station is used as a backup to the turbine pressure controller, it is required that the letdown station’s setpoint be lower than that of the 505XT control’s setpoint to prevent fighting and potential instability between the controllers.

Cascade control (turbine inlet header pressure) can be enabled at any time after the Utility Tie breaker and Generator breakers are closed, through a contact input, Modbus command, or the 505XT service panel. With this configuration, when Cascade control is enabled, its setpoint will match the inlet header pressure level at that time, thus a bumpless transfer to inlet header pressure control is accomplished. After the Cascade controller has been enabled, the operator can increase or decrease the control setpoint as desired. The 505XT’s ratio/limiter uses the Coupled HP & LP mode (Mode 0) regardless of whether Cascade Control is enabled or disabled.

Because the 505XT was programmed for the capability to automatically enable Extraction Control, the operator may choose to automatically or manually enable Extraction control. To manually enable Extraction control the operator must issue a LP valve limiter lower command from the 505XT service panel, a contact input, or through Modbus communications. The LP valve limiter must be taken to its minimum position to fully enable Extraction control.

If an operator chooses to use the automatic enabling routine to lower the LP valve limiter, he may issue an Extraction enable command from the 505XT’s service panel, contact input, or through Modbus communications. This routine automatically ramps the LP valve to its minimum position and may be stopped at any time by momentarily issuing a LP valve limiter raise or lower command. Once the automatic enabling routine has stopped, it may be restarted/enabled at any time by issuing an Extraction control disable command followed by an enable command or, once stopped, the operator may continue the routine manually.

The automatic extraction disabling routine is initiated by issuing an Extraction disable command from the 505XT’s service panel, contact input, or through Modbus communications. This routine instantly moves the LP valve limiter to the current LP valve position setting and automatically continues to move it to its maximum position. This routine may be stopped at any time by momentarily issuing a LP valve limiter raise or lower command. Once the automatic disabling routine stops, it may be restarted at any time by issuing an Extraction control enable followed by a disable command or, once stopped, the operator may continue the routine manually.

With this application, the Auxiliary control is programmed as a limiter and is automatically enabled when both the Utility Tie and Generator breakers are closed. When paralleled to the utility, if inlet header pressure demand, and/or other system conditions try to force the generator to operate above its load limit setting, the Auxiliary PID will take control of the governor valve to limit generator load. Once system conditions demand unit load below that of the Auxiliary setpoint, the Cascade/Speed PIDs will again take control of generator load.



# Chapter 11. Operator Interface

## Introduction

Interface to the control may be performed through the 505's service panel (located on the front of the control), remote switch contacts, analog inputs, meter readouts, relays, or a Modbus communications line to an operator interface device.

### NOTICE

#### Screen Tutorial

The 505 has a detailed Tutorial that is always accessible through the Service Menu. It provides 'On-Screen' help on topics such as navigation, user levels, operating modes, how to adjust parameters and more. The user should familiarize themselves with these screens

## Graphical Display and Key Inputs

The control's service panel consists of hard key command buttons, soft key command buttons, and a Graphical User Interface screen.



Figure 11-1 505 Keypad and Display

The system operator uses the service panel to communicate with the 505 system. The service panel can be used only occasionally to communicate with the system, or it can continuously monitor user interface pages for the operator to view.



## Service Panel Modes and User Levels

The 505 Service Panel operates in several modes and access user levels, each of which has a different purpose. The modes are OPERATION, CALIBRATION, and CONFIGURATION. In order to enter and exit a particular mode, the user must be logged in with an appropriate user level. These user levels are MONITOR, OPERATOR, SERVICE, and CONFIGURE. In addition to granting authority to enter and exit modes, user levels also determine what parameters the user is authorized to adjust. See table 11-1, Mode Access by User Level.

Table 11-1. Mode Access by User Level

		Mode		
		Operation	Calibration	Configuration
User Level	Monitor			
	Operator	X		
	Service	X	X	
	Configure	X	X	X

### Mode Descriptions

The OPERATION mode is the only mode that can be used to run the turbine. This is the default mode. Exiting CALIBRATION or CONFIGURATION mode will return to OPERATION mode. User levels are Operator, Service, or Configure.

The CALIBRATION mode is used to force signal outputs in order to calibrate signals and field devices. In this mode, the actuator, analog, and relay outputs can be manually controlled. To enter this mode the turbine speed must be shutdown with no speed detected. User levels: Service or Configure.

The CONFIGURE mode is used to set up the parameters for a specific application prior to operation of the unit. To enter this mode the turbine speed must be shutdown with no speed detected. When the unit enters CONFIGURE mode the control is placed in IOLOCK, which will disable all Output I/O channels. If the control is not shutdown, navigating through the configuration pages will allow viewing of CONFIGURE, but will not permit any changes to be made.

### User Level Descriptions

The Monitor user level is view-only access. All commands from the front panel are inhibited. All values displayed on each screen are continuously updated.

The Operator user level allows for control of the turbine. Front panel commands to start, change setpoints, enable/disable functions, and stop the turbine are accepted.

The Service user level allows the same commands as the Operator user level plus tuning of Service menu parameters and issuing of additional commands.

The Configure user level allows the same commands and access as the Service user level plus tuning of Configuration menu parameters.

### Adjusting Values

To adjust a value you first navigate the In-Focus highlighter to the correct value – then use the green Adjust Key to raise or lower the value.

The ADJUST arrows will change a selected Service parameter by 1%. Using the ADJUST arrows in combination with the SHIFT key will change the service parameter by 10%. The view of the Adjust button icon next to the value will change to show the up/down arrows as filled when the SHIFT key is pressed.

**NOTICE**

When making adjustments to an analog value that is at 0.00, initial movement will be very small and you may take a few seconds for the display to show the value is moving – be patient.

To make a direct entry, the current displayed value must be within 10% of the value to be entered.

To make direct numeric entries:

1. Bring the displayed value to within 10% of the value to be entered
2. Press the ENTER key
3. Press the numerical keys to input the value
4. Press ENTER again.

If the value entered is less than the value displayed by more than 10% or greater than the value displayed by more than 10%, an appropriate message will be displayed indicating the value entered is too large or too small.

The exception to this 10% adjustment rule is that it is NOT applied if the control is in Configuration mode. In this mode, any direct entry in the appropriate range is accepted.

**NOTICE**

When making a direct entry of a negative number (for example, a sensor range of –50 to 200), enter the value first and then press the +/- key.

When using the SERVICE mode, refer to the Service Mode worksheet in Appendix B.

## Chapter 12.

# Service Menu Procedures

### Overview

The service menu of the 505 control has the same easy to follow format as the Program/Configure mode. The service menus can be used to customize the control to be more application specific. The parameters that are tuned in the service menus may affect system performance, caution is advised.

The service menus of the 505 can be accessed at any time the control is powered up, and with any user level access. The turbine doesn't need to be shutdown. This will allow tuning while the turbine is on-line.

The ability to change these parameters is restricted to service user level and above. The appropriate password is required to protect against both intentional and inadvertent program changes. The password can be changed if desired, refer to Appendix C of this manual for information on changing passwords.

Enter the LOGIN button from the MODE screen to reach the screen below.

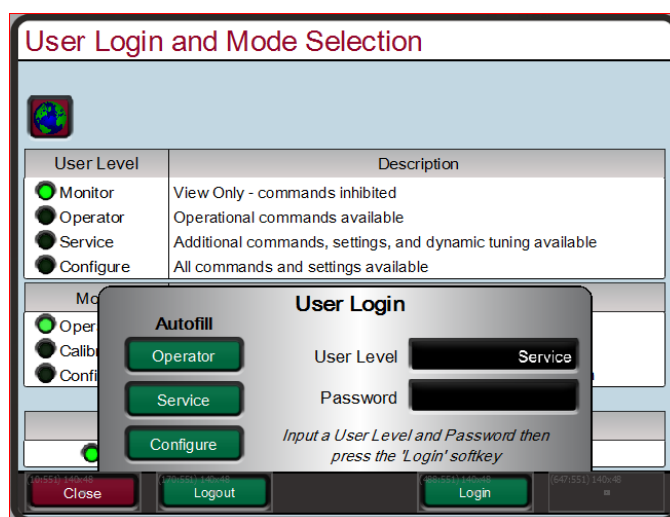


Figure 12-1. User Login for Service

To login to the Service user level, Press the MODE key, press the soft key for LOGIN, and log in as "Service" by entering the password (WG1112). The actual menus that are available may vary with the program configuration.

### Using the Service Menus

Once logged in with an appropriate user level, parameters within the Service menus will become available for adjustment. See Figure 5.2 for an example of how to see that a parameter is authorized, use a work sheet (provided at the end of this manual), to document any changes for future reference.

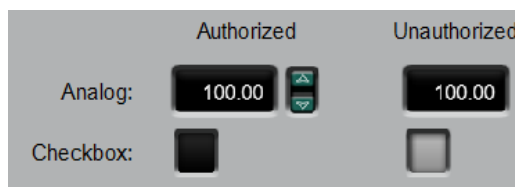


Figure 12-2. Authorized and Unauthorized Components

The arrows keys (STEP LEFT, STEP RIGHT), allow you to move right, or left across the tops of the function the Service mode columns. The STEP UP and STEP DOWN keys allow you to move up or down the columns.

Not all of the service headers listed below will appear at all times. Only the headers that are necessary for the application will appear. Some of the headers will not appear unless the turbine is shutdown.

The Service menu is accessed from the Home screen by pressing the second soft key (from the left). Use the navigation cross allows for navigation of the Service menus. Press ENTER to go into a menu. There are two Service menu selection pages which can be viewed by pressing the arrow soft keys. The available menus depend upon the configuration of the unit. Parameters within the Service menus can be adjusted at any time, independent of the current mode. The user must be logged in with Service user level access or higher to have authorization to change Service parameters.

From within a Service menu, pressing the HOME key once will return to the Service menu screen. To return to the main Home screen, press the HOME key again. To return to the last screen, press the ESC key.

### Service Menus – HOME screen

The following figures show the menu list of pages that are available through the Service Menus. The Tutorial pages and the Save Settings (updating tunable values on the control) are always available on the black Soft Key buttons without any focus or navigation. Features that exist in the control, but are not configured will be shown in reduced opacity so the user is aware of the feature. Pressing Enter while on these pages will not navigate to these pages. This is different from the HOME page, where unused functions are completely removed to avoid confusion and simplify navigation.

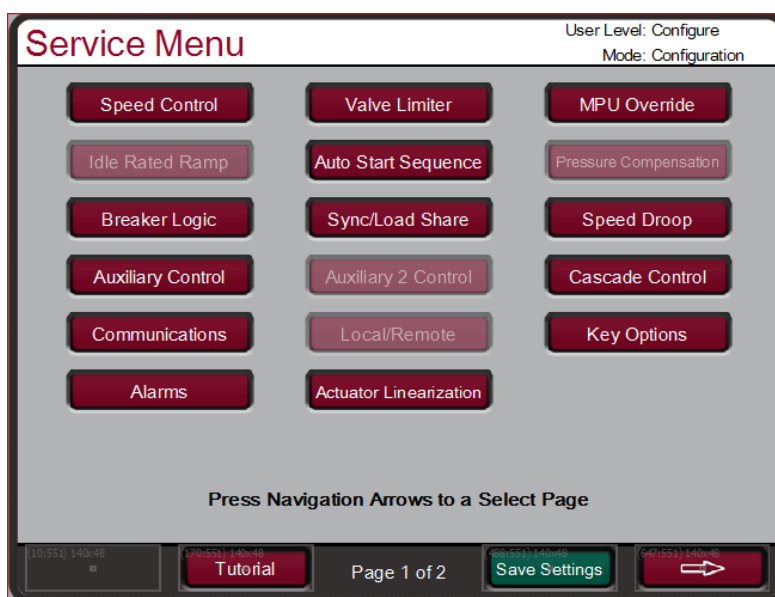


Figure 12-3 Service Menu (page 1)

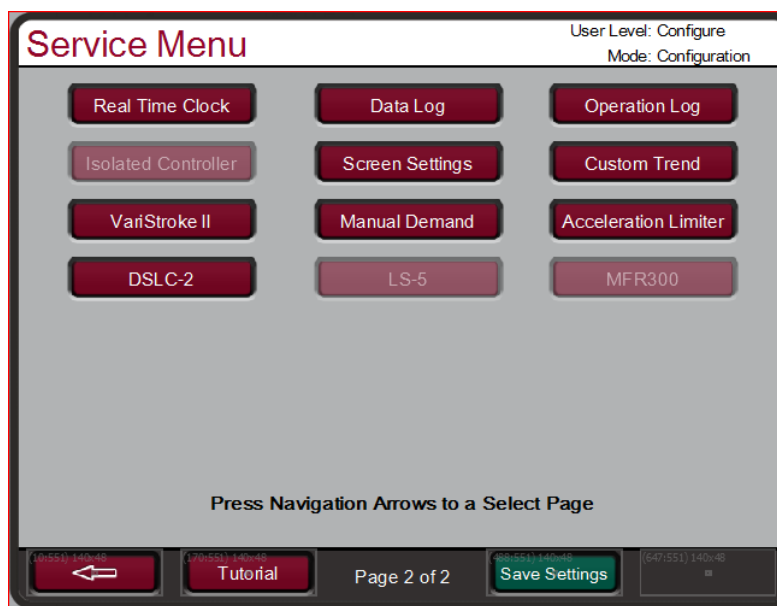


Figure 12-4 Service Menu (page 2)

The service menus can be used while the engine/turbine is running or shut down. Access to the Service menus requires the user to be logged in with a Service user level or higher. The intent of the organization and arrangement of the pages is that page 1 contains the page that directly relate to the previous 505 Service header menus on the two-line display. Page 2 contains features that are new with this product.

This mode can also be used to make direct numeric entries. However, because this mode is intended to be used while the turbine is running, the Service Panel will accept the entry of numeric values for a block only if the proposed change is small.

### Service Menu list:

**Speed Control**—monitor or change the program or default settings of; rate to min; setpoint slow rate; delay for the fast rate; setpoint fast rate; speed setpoint entered rate; underspeed setting; on-line and off-line derivative;

Remote Speed Settings - change the program or default settings of; not matched rate; speed setpoint max rate; min speed setpoint; max speed setpoint; remote deadband value; lag-tau value;

**Valve Limiter Settings** - monitor or change program or default settings of; valve limiter rate; entered rate; limiter max limit;

**MPU Override Settings** - monitor or change program or default settings of; MPU override timer; MPU override time; MPU (s) override timer is on;

**Idle/Rated Ramp Settings** - change the program or default settings of; idle rated rate; use ramp to idle; idle priority;

**Auto Start Sequence** - monitor the status of; low idle delay; rate to hi idle; hi idle delay; rate to rated; hrs. since trip;

**Pressure Compensation** – Set system gain compensation vs inlet pressure points; view current system gain;

**Breaker Logic** - change the program or default settings of; freq cntrl armed; sync window rpm; sync window rate; tie breaker open ramp; tie open rate; gen open setback; gen open setpoint; use min load; min load bias;

**Sync/Load Share** - change the program or default settings of; input bias gain; input bias dead band; lag-tau value;

**Speed Droop** - change the program or default settings of; droop percentage; use KW droop; select gen load units;

**Auxiliary Control** - change the program or default settings of; slow rate; fast rate delay; setpoint fast rate; setpoint entered rate; droop % ; rated aux setpoint; aux derivative ratio; aux threshold;

Remote Auxiliary - change the program or default settings of; remote not matched rate; remote aux max rate; min remote aux setting; max remote aux setting; remote dead band value; lag-tau value;

**Auxiliary 2 Control Settings** - change the program or default settings of; slow rate; fast rate delay; setpoint fast rate; setpoint entered rate; droop % ; rated aux setpoint; aux derivative ratio; aux threshold;

Remote Auxiliary 2 Settings - change the program or default settings of; remote not matched rate; remote aux max rate; min remote aux setting; max remote aux setting; remote dead band value; lag-tau value;

**Cascade Control** - change the program or default settings of; slow rate; fast rate delay; setpoint fast rate; setpoint entered rate; droop %; rated cascade setpoint; cascade not matched rate; max speed rate; max speed setting; min speed setting; cascade dead band; cascade derivative ratio;

Remote Cascade Settings - change the program or default settings of; remote not matched rate; remote cascade max rate; min remote cascade Modbus connections.

**Communications** - change or view the default settings for Ethernet, Serial, and Modbus communication links.

**Local/Remote** - monitor or change the program or default settings of; remote enabled; enable contacts; contacts enabled; enable Modbus 1; Modbus 1 enabled; enable Modbus 2; Modbus 2 enabled;

**Key Options** - allow or disable controlled stop and dynamics adjustments;

**Alarms** - monitor or change the program or default settings of; is trip an alarm indication; blink alarm relay; jump to alarm screen; configurable alarms 1,2, and 3; configurable alarms for inlet pressure, exhaust pressure, and valve demand vs position feedback;

**Actuator Linearization** - provides actuator 1 and actuator 2 output linearization adjustments;

**Real Time Clock** – set date and time settings.

**Custom Trend** – trend display; signal selection; time window for trend display.

**Data Log** – manually start and stop data log collection.

**Operation Values** – view operation log values. Adjust turbine operation values.

**Isolated Process Control** – adjust setpoint; view process value; view demand output; enable manual valve control; enable remote setpoint; adjust Isolated PID gains;

**Screen Settings** – screen saver delay; select auto login as operator;

**Custom Trend** – View control parameters on a graphical display.

**VariStroke II** – CAN communication status; demand; position feedback; alarms; shutdowns;

**Manual Demand** – Select manual valve demand usage; manual demand rate; timeout when inactive;

**Acceleration Limiter** – Select acceleration limiter usage; adjust acceleration limiter PID gains;

**DSL-2** – generator voltages, currents, real power, reactive power; communications link status

**LS-5** – generator voltages, currents, real power, reactive power; CAN communication status

**MFR300** – generator voltages, currents, real power, reactive power; CAN communication status

Each of the Service menu parameters are described in detail below.

## Service Mode Parameters

### Speed Control Settings

#### **RATE TO MIN (RPM/S)**

**dflt= xxx (0.01, 2000)**

Adjusts the rate the set point moves from zero to the minimum controlling speed when the unit is started. The minimum controlling speed will be either 'idle' if idle/rated is used or 'low idle' if the auto start sequence is used. If neither of these startup features is used, the min speed will be the minimum governor speed set point. This value is set in the program mode.

#### **SLOW RATE OFFLINE (RPM/S)**

**dflt= xxx (0.01, 500)**

Normal speed set point rate of change while in the OFFLINE mode of operation. This value is set in the Program mode.

#### **SLOW RATE ONLINE (RPM/S)**

**dflt= xxx (0.01, 500)**

Normal speed set point rate of change while in the ONLINE mode of operation. This value is set in the Program mode.

#### **FAST RATE DELAY (SEC)**

**dflt= 3.0 (0, 100)**

Delay, in seconds, before the Setpt 'Fast Rate' ONLINE/OFFLINE is selected.

#### **FAST RATE OFFLINE (RPM/S)**

**dflt= xxx (0.0099, 500.0)**

This rate is defaulted to three times (3x) the 'Slow Rate OFFLINE'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

#### **FAST RATE ONLINE (RPM/S)**

**dflt= xxx (0.0099, 500.0)**

This rate is defaulted to three times (3x) the 'Slow Rate ONLINE'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

#### **ENTERED RATE OFFLINE (RPM/S)**

**dflt= xxx (0.0099, 500.0)**

This is the rate that the speed set point will move when set point is entered from the front panel of the control or from the communication links while in the OFFLINE mode of operation. This rate is defaulted to the Slow RATE OFFLINE. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

#### **ENTERED RATE ONLINE (RPM/S)**

**dflt= xxx (0.0099, 500.0)**

This is the rate that the speed set point will move when set point is entered from the front panel of the control or from the communication links while in the ONLINE mode of operation. This rate is defaulted to the S RATE ONLINE. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

#### **UNDERSPEED SETTING (RPM)**

**dflt= xxx (0.0, 20000)**

Only used if an underspeed relay is programmed. Speed setting for the underspeed indication. This rate is defaulted to 100 rpm below the 'Minimum Governor Speed Setpt'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

#### **ONLINE SPEED DEADBAND**

**dflt= 0.0 (0.0, 20.0)**

When configured as a mechanical drive unit (not a Generator Application), this is the value of a speed deadband that can be configured in RPM. For a generator application, see 'Frequency Deadband' in the "Breaker Logic" Service menu.

#### **INSTANT MINIMUM LOAD RATE**

**dflt= 50.0 (2.0, 10000.0)**

When Emergency Minimum Load is triggered this is the rate, in RPM/s, that will be used to go to minimum load.

#### **ONLINE SPEED DYNAMICS SPEED LEVEL** **dflt= Min Gov (Low Idle, Max Gov)**

For Mechanical Drive only. When Speed increases above this value, the control switches to Online Dynamics. The value default is Minimum Governor.



**DISPLAY GAUGE MULTIPLIER****dflt= 1.0 (0.01, 1000.0)**

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, use this setting to multiply by a factor of 10.

**HOLD SPEED CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Set Point Fast Rate, the Entered Rate, and Underspeed settings. To permanently save these changes into the 505, set to YES. On the main service page select save settings soft key in the bottom of the menu, or select the "Mode" button, then save settings soft key in the bottom of the menu.

**OVERSPEED RATE (RPM/S)****dflt= xxx (0.0099, 500.0)**

This rate is defaulted to the 'Slow Rate OFFLINE'. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**USE REDUCED OVERSPEED SETPOINT****dflt= NO (Yes/No)**

Set to YES to reduce the Overspeed Trip value within the operating range of the turbine. This can be used to test the Overspeed Trip functionality and systems without increasing speed above Maximum Governor.

**REDUCED OVERSPEED SETPOINT (RPM)****dflt= 1000 (100.0, 20000.0)**

This value will be used as the Overspeed Trip value when 'USE REDUCED OVERSPEED SETPOINT' is YES. If the speed meets or exceeds this value, an Overspeed Trip will be initiated.

**Remote Speed Settings (only displayed if configured)**

**Note:** Available as the last page of the "Speed Control" Service menu.

**NOT MATCHED RATE****dflt= xxx (0.0099, 200.0)**

Rate the set point moves when remote is enabled and the remote input doesn't match the actual set point. This rate is defaulted to the set point slow rate. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SPEED SETPOINT MAXIMUM RATE****dflt= xxx (0.01, 500)**

Rate the setpoint moves once the remote input and actual set point are matched. This is a maximum rate. Normally the setpoint will follow the remote input setting. This value is set in the Configure mode.

**MINIMUM SPEED SETPOINT****dflt= xxx (0.0, 20000)**

Minimum setting allowed by the remote input. This setting is defaulted to the Speed Setpoint Minimum Governor Speed value. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Governor Speed' and the 'Maximum Governor Speed' settings)*

**MAXIMUM SPEED SETPOINT****dflt= xxx (0.0, 20000)**

Maximum setting allowed by the remote input. This setting is defaulted to the Speed Setpoint Maximum Governor Speed value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Governor Speed' and the 'Maximum Governor Speed' settings and greater than Minimum Speed Setting)*

**REMOTE DEADBAND VALUE****dflt= 0.0 (0.0, 100)**

Remote speed setting deadband in RPM.

**REMOTE LAG-TAU VALUE****dflt= 0.0 (0.0, 10)**

Remote Set Point input lag setting.

**USE MINIMUM LOAD?****dflt= YES (Yes/No)**

When set to YES, the speed set point cannot be lowered/decreased by the remote speed set point input below the rated/synchronous speed set point plus the 'Min Load Bias' setting. This is used to prevent a reverse power condition as well as allowing the plant to utilize a minimum load setting for the generator. When NO, the remote speed set point can move the speed set point down to the higher of the minimum governor setting or the RSS 4 mA value.



**HOLD REMOTE CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Speed Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**GENERATOR BREAKER OPEN DISABLE?****dflt=No(Yes/No)**

Set to TRUE to have unit automatically disable remote speed setpoint when generator breaker opens.

**UTILITY BREAKER OPEN DISABLE?****dflt=No(Yes/No)**

Set to TRUE to have unit automatically disable remote speed setpoint when utility tie breaker opens.

**Valve Limiter Settings****HP LIMITER RATE (%/SEC)****dflt= xxx (0.1, 25)**

The rate at which the HP valve limiter will move when a raise or lower command is given from the contact inputs or the Modbus connections. This rate is set in the Program mode.

**HP ENTERED RATE (%/SEC)****dflt= xxx (0.1, 100)**

This is the rate the HP valve limiter will move at when a new position is entered from the front panel of the control. This rate is defaulted to the slow rate. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**HP LIMITER MAXIMUM LIMIT (%)****dflt= 100.0 (0, 101)**

HP Valve Limiter Maximum setting. Normally set to 100%, but this can be set lower to provide a maximum valve lift setting.

**HP MAXIMUM VALUE AT STARTUP (%)****dflt= 100.0 (0, 101)**

During start up this would restrict the opening of the HP valve to the desired value.

**SHUTDOWN AT MAXIMUM?****dflt= NO (Yes/No)**

When set to YES, the control will issue a shutdown whenever the HP ramp exceeds the HP maximum value at startup. When set to NO, this function is disabled.

**HOLD HP LIMITER CHANGES?****dflt= NO (Yes/No)**

Set to YES to hold the changes made to the Entered Rate. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**LP LIMITER RATE (%/SEC)****dflt= xxx (0.1, 25)**

The rate at which the LP valve limiter will move when a raise or lower command is given from the contact inputs or the Modbus connections. This rate is set in the Program mode.

**LP ENTERED RATE (%/SEC)****dflt= xxx (0.1, 100)**

This is the rate the LP valve limiter will move at when a new position is entered from the front panel of the control. This rate is defaulted to the slow rate. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**LP MAXIMUM LIMIT (%)****dflt= 100.0 (0, 100)**

LP Valve Maximum setting. Normally set to 100%, but this can be set lower to provide a maximum valve lift setting.

**LP MINIMUM VALUE (%)****dflt= 0.0 (0, 100)**

LP Valve Minimum Setting. Normally set to 0.0%, but this can be set higher to provide a minimum valve lift setting.

**SHUTDOWN AT MAXIMUM?****dflt= NO (Yes/No)**

When set to YES, the control will issue a shutdown whenever the HP ramp exceeds the HP maximum value at startup. When set to NO, this function is disabled.

**HOLD LP LIMITER CHANGES?****dflt= NO (Yes/No)**

Set to YES to hold the changes made to the Entered Rate. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**MPU Override****USE MPU OVERRIDE TIMER?****dflt= NO (Yes/No)**

When set to YES, the MPU override will go OFF when the MPU Override Time expires after a start is initiated. This provides a maximum time for speed to be sensed on startup before a loss of speed is detected.

**MPU OVERRIDE TIME (SEC)****dflt= 600.0 (0.0, 600)**

Sets the maximum time after a start is initiated for speed to be sensed above the failure level. Only valid if 'Use MPU Override Timer?' is YES.

**MPU #1 OVERRIDE ON STATUS****(status indication only)**

Indicates when the speed probe failure override is on.

**MPU #2 OVERRIDE ON STATUS****(status indication only)**

Indicates when the speed probe failure override is on. This status message only appears if the application is using two speed probes.

**Open Wire Test****Pop-up Menu**

This can be used to run a test to check for an open wire on an MPU. This function is defaulted to automatically run this check when a Start command is given. This 'automatic' open wire test function can be disabled from the pop-up screen.

**Idle/Rated Ramp (only displayed if configured)****HOURS SINCE TRIP (HRS)****(status indication only)**

Indicates the number of hours the unit was tripped, as determined by the control.

**HOT RESET TIMER****dflt= 0 (0.0, 200)**

Use this to adjust the "Hot Reset Timer" value set in Configuration. This is the time needed, when RST Timer level is reached, to transfer the start-up parameters from COLD to HOT.

**IDLE/RATED COLD RATE (RPM/S)****dflt= xxx (0.01, 2000)**

Rate at which the speed set point will ramp from idle to rated speed when the turbine is considered COLD. This value is set in the Program mode.

**IDLE/RATED WARM RATE (RPM/S)****dflt= xxx (0.01, 2000)**

Rate at which the speed set point will ramp from idle to rated speed when the turbine is considered WARM. This value is set in the Program mode.

**IDLE/RATED HOT RATE (RPM/S)****dflt= xxx (0.01, 2000)**

Rate at which the speed set point will ramp from idle to rated speed when the turbine is considered HOT. This value is set in the Program mode.

**USE RAMP TO IDLE?****dflt= YES (Yes/No)**

Set to YES if want to return to idle speed with this function. If set to NO, the Idle/ Rated function acts as a 'Ramp to Rated' function and will not return to idle. When set to NO, closing the Idle/Rated contact accelerates the speed set point towards Rated and opening the contact stops the acceleration.

**IDLE PRIORITY?****dflt= NO (Yes/No)**

If YES, the set point will move to idle whenever Idle is selected. If NO, the set point will move to idle only if remote speed set point is not enabled, Cascade control is not enabled, Auxiliary 'controller' is not enabled, and the generator breaker is open.

**RATED PRIORITY?****dflt= YES (Yes/No)**

If YES, the Rated command will be allowed to move the setpoint to Rated before reaching Idle. If NO, the set point will move to Idle and then the Rated command should be given to move to Rated; the Rated command will not be accepted before reaching Idle.

**TEMPERATURE 1 INPUT****dflt= xxx (-20000, 20000)**

Indication only. This is the current value of the Temperature 1 Analog Input

**OVERRIDE TEMPERATURE 1?****dflt= NO (Yes/No)**

If YES, an Analog Input failure will be overridden and start permissives related to this temperature will be met, allowing for the startup of the turbine.

**TEMPERATURE 2 INPUT****dflt= xxx (-20000, 20000)**

Indication only. This is the current value of the Temperature 2 Analog Input

**OVERRIDE TEMPERATURE 2?****dflt= NO (Yes/No)**

If YES, an Analog Input failure will be overridden and start permissives related to this temperature will be met, allowing for the startup of the turbine.

**Auto Start Sequence (only displayed if configured)**

The following information is provided to display the information useful to the auto start sequence. It allows the operator to check all the times and rates that the 505 is using for the present start sequence.

**HOURS SINCE TRIP (HRS)****(status indication only)**

Indicates the number of hours the unit was tripped, as determined by the control.

**HOT RESET TIMER****dflt= 0 (0.0, 200)**

Use this to adjust the "Hot Reset Timer" value set in Configuration. This is the time needed, when RST Timer level is reached, to transfer the start-up parameters from COLD to HOT.

**HOT RESET TIME REMAINING****(status indication only)**

This shows the remaining time for the Hot Reset Timer. When the time is complete, all turbine start parameters will be using the HOT start values.

**HOT TIME REMAINING** (status indication only)

This shows the time remaining, after the unit is shut down, until the HOT start values begin ramping to the COLD start values.

**TIME UNTIL COLD START** (status indication only)

This shows the time remaining, after the unit is shut down, until the turbine will be considered cold and the COLD start values will be used.

**RATE TO RATED (RPM/S)** (status indication only)

Indicates the acceleration rate, in rpm/s; used by the control from High Idle to Rated.

**IDLE 1 DELAY (MIN)** (status indication only)

Indicates the hold time at Idle 1, in minutes.

**RATE TO IDLE2 (RPM/S)** (status indication only)

Indicates the acceleration rate, in rpm/s; used by the control from Idle to Idle2.

**IDLE2 DELAY (MIN)** (status indication only)

Indicates the hold time at Idle 2, in minutes.

**RATE TO IDLE3 (RPM/S)** (status indication only)

Indicates the acceleration rate, in rpm/s; used by the control from Idle2 to Idle3.

**IDLE3 DELAY (MIN)** (status indication only)

Indicates the hold time at Idle 3, in minutes.

**TEMPERATURE 1 INPUT** dflt= xxx (-20000, 20000)

Indication only. This is the current value of the Temperature 1 Analog Input

**OVERRIDE TEMPERATURE 1?** dflt= NO (Yes/No)

If YES, an Analog Input failure will be overridden and start permissives related to this temperature will be met, allowing for the startup of the turbine.

**TEMPERATURE 2 INPUT** dflt= xxx (-20000, 20000)

Indication only. This is the current value of the Temperature 1 Analog Input

**OVERRIDE TEMPERATURE 2?** dflt= NO (Yes/No)

If YES, an Analog Input failure will be overridden and start permissives related to this temperature will be met, allowing for the startup of the turbine.

**Pressure Compensation (only displayed if configured)**

The pressure compensation settings are used to bias the actuator 1 (V1) position based on inlet pressure.

**Pressure 1** dflt= \*0.0 (0.0, 10000.0)

Input point #1 of the pressure compensation curve, in engineering units.

*(Must be less than the 'Pressure 2' value)*

**Gain 1** dflt= \*1.0 (0.65, 1.54)

Output point #1 of the pressure compensation curve.

**Pressure 2** dflt= \*25.0 (0.0, 10000.0)

Input point #2 of the pressure compensation curve, in engineering units.

*(Must be between the 'Pressure 1' value and the 'Pressure 3' value settings)*

**Gain 2** dflt= \*1.0 (0.65, 1.54)

Output point #2 of the pressure compensation curve.

**Pressure 3** dflt= \*50.0 (0.0, 10000.0)

Input point #3 of the pressure compensation curve, in engineering units.

*(Must be between the 'Pressure 2' value and the 'Pressure 4' value settings)*

**Gain 3** dflt= \*1.0 (0.65, 1.54)

Output point #3 of the pressure compensation curve.

**Pressure 4** dflt= \*75.0 (0.0, 10000.0)

Input point #4 of the pressure compensation curve, in engineering units.

*(Must be between the 'Pressure 3' value and the 'Pressure 5' value settings)*

**Gain 4** dflt= \*1.0 (0.65, 1.54)

Output point #4 of the pressure compensation curve.

**Pressure 5** dflt= \*100.0 (0.0, 10000.0)

Input point #5 of the pressure compensation curve, in engineering units.

*(Must be greater than the 'Pressure 4' value)*

**Gain 5** dflt= \*1.0 (0.65, 1.54)

Output point #5 of the pressure compensation curve.

**Breaker Logic (only displayed if a generator)****FREQUENCY CONTROL ARMED (status indication only)**

Displays when Frequency Control is activated for isochronous control. If not, then the control will be in droop. See Frequency Control description in volume 1 of the manual for details.

**SYNC WINDOW (RPM) dflt= 10.0 (0.0, 200)**

A set point window, in rpm, that the set point moves at a slower rate to accommodate synchronizing to the bus. This rate is only active while within this window and the generator breaker is open.

**SYNC WINDOW RATE (RPM/S) dflt= 2.0 (0.1, 100)**

The rate the speed set point moves at when within the 'Sync Window' and the generator breaker is open. This is normally slower than the slow rate to accommodate synchronizing to the bus.

**TIEBRKR OPEN RAMP? dflt= YES (Yes/No)**

If NO, the speed set point is instantly set to the last utility bus speed setting and holds. When set to YES, the speed set point is instantly set to the last utility bus speed setting and moves to the synchronous (rated) speed set point after the utility tie breaker opens and the generator breaker is still closed.

**TIE OPEN RATE (RPM/S) dflt= 1.0 (0.099, 20000.0)**

Rate the set point moves to rated speed after the utility tie breaker opens (only used if 'Tiebrkr Open Sync Ramp' is YES).

**GEN OPEN SETPOINT (RPM) dflt= xxx (0.0, 20000)**

This set point is defaulted to 50 rpm below the synchronous (rated) speed set point. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Governor' and 'Rated Speed Setpt' settings)*

**ZERO LOAD VALUE (HP Valve %) dflt= xxx (0.0, 100)**

This value is automatically sampled and held at the actuator/load demand value when the generator breaker is closed. When the steam conditions are not at rated conditions when the breaker is closed, this value can be adjusted to a more reasonable value (2–10%). Every time the generator breaker closes, this value is re-sampled.

**USE MINIMUM LOAD? dflt= YES (Yes/No)**

When set to YES, the speed set point automatically increases to the rated/synchronous speed set point plus the 'Min Load Bias' setting when the generator breaker is closed and the unit is on-line (the utility tie breaker is closed). When NO, no automatic set point action occurs.

**REVERSE POWER PROTECTION? dflt= YES (Yes/No)**

When set to YES, the Minimum Load Bias will be used for the lower limit of the Speed Setpoint range. This will prevent the unit from reducing load below the Minimum Load Bias. When set to NO, the lower limit of the Speed Setpoint is Minimum Governor, allowing the setpoint to move below Rated, causing the generator to reverse power. This protection also applies to the Controlled Shutdown sequence; when a Controlled Shutdown is initiated and this setting is YES, the controller will reduce load down to min load and wait for the generator breaker to open.

**MINIMUM LOAD BIAS (RPM above Rated) dflt= xxx (0.0, 500)**

This value is the rpm bias above rated speed and the default is calculated as 3% of full load. This is the value the speed set point will increase to upon the generator breaker closure (when the utility tie is closed).

**FREQ OFFSET (Hz) dflt= 0.0 (-2.5, 2.5)**

This is the deviation, in Hz, from the configured rated speed of 50/60 Hz. It allows the center of the deadband to be adjusted for grid frequencies that are not exactly at 50 or 60 Hz. For example, if rated speed is 3600 rpm = 60 Hz, but the grid is actually running at 60.1 Hz, then this value can be tuned to 0.1 Hz so that the deadband in the 505 will be at 3606 rpm, the actual "speed" of the grid.

**FREQ Deadband (Hz) dflt= 0.0 (0.0, 3.0)**

This is the dead band in Hz used during the droop mode of operation to avoid HP valve oscillations. It will allow frequency to vary a certain amount, plus or minus the configured value, from the configured rated speed before the control reacts by moving the valve.

**TIE OPEN LOAD REJECTION? dflt= YES (YES/NO)**

Setting to YES will allow load rejection recovery logic to activate on a Tie Breaker open event.

**MIN HP VALVE UPON LOAD REJECTION? dflt = 0.0 (0,20)**

Set this value to the minimum demand desired upon a load rejection due to the utility breaker opening. The default of 0 is ideal if there is no significant plant load when this occurs. If there is plant load, this value can be increased to avoid an underspeed trip condition.

**HOLD BREAKER CHANGES? dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Gen Breaker Open Set Point and Min Load Bias. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**FREQUENCY EXCURSION TEST VISIBLE?****dflt= NO (Yes/No)**

If YES, the pop-up menu for the Frequency Excursion Test will be available from the Speed Control run-time page. Allows for Standard NERC and ERCOT tests of logging the control response to utility grid frequency deviations.

**Sync/Load Share Settings (only displayed if configured)****INPUT BIAS GAIN (%)****dflt= xxx (0.0, 100)**

Affects the rpm bias the Sync/Load Sharing input has on the speed setting. This setting is defaulted to the droop (%) value or 3%, whichever is higher. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**IMPORTANT**

Note that the Input Bias Gain affects both the Synchronizing and Load Sharing functions if configured. A feature has been added to make the Synchronizing input 5 times less sensitive than the load sharing input. Therefore, to avoid instability in Load Sharing mode, the Input Bias Gain should be tuned for the Load Sharing mode. If load sharing is not used, this note can be disregarded.

**INPUT BIAS DEADBAND****dflt= 0.0 (0.0, 100)**

Load Share dead band in rpm.

**LAG-TAU VALUE****dflt= 0.0 (0.0, 10)**

Load Sharing input lag setting.

**HOLD CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Load Share Gain (%). To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**Speed Droop (only if generator unit)****ACTUAL DROOP (%)****(status indication only)**

Shows the actual Speed/load control droop being used by the controller.

**MINIMUM DROOP (%)?****dflt= 0.0 (0.0, 4.0)**

When setting the droop from the keypad this defines the minimum droop value that can be set.

**MAXIMUM DROOP (%)?****dflt= 12.0 (2.0, 15.0)**

When setting the droop from the keypad this defines the maximum droop value that can be set.

**USE MW AS LOAD UNITS?****dflt= No (Yes/No)**

When set to Yes, the control will use and display MW as the load units. When set to No, the control will use and display KW as the load units.

**USE LOAD DROOP?****dflt= YES (Yes/No)**

When set to NO, the unit is forced to use speed demand/actuator position droop. This setting is used and relevant if Load Droop was programmed.

**ENTERED DROOP SETPOINT (%)****dflt= 5.0 (min, max)**

When setting the droop from the keypad this sets the desired droop value for control.

**Auxiliary Control Settings (only displayed if configured)****SLOW RATE (UNITS/S)****dflt= xxx (0.01, 1000)**

Normal set point rate of change. This value is set in the Program mode.

**FAST RATE DELAY (SEC)****dflt= 3.0 (0.0, 100)**

Delay, in seconds, before the 'Fast Rate' of change is selected.

**FAST RATE (UNITS/S)****dflt= xxx (0.01, 5000)**

This rate is defaulted to three times (3x) the 'Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SETPT ENTERED RATE (UNITS/S)****dflt= xxx (0.01, 1000)**



This is the rate that the Aux set point will move when set point is entered from the front panel of the control or from the communication links. This rate is defaulted to the Aux set point slow rate. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**DROOP (%)** **dflt= xxx (0.0, 100)**

Aux control droop setting. This value is set in the Program mode.

**RATED AUXILIARY SETPOINT** **dflt= xxx (-20000, 20000)**

Only used to determine the auxiliary control droop. This set point is defaulted to the aux maximum set point limit. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Auxiliary Set Point' and the 'Maximum Auxiliary Set Point' settings)*

**PID THRESHOLD (LIMITER)** **dflt= 10 (0.0, 110)**

Aux PID threshold setting when aux is used as a limiter. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID THRESHOLD (CONTROLLER)** **dflt= 100 (0.0, 110)**

Aux PID threshold setting when aux is used as a controller. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID MINIMUM OUTPUT** **dflt= 0.00 (0.0, 50)**

Auxiliary PID min output setting. The auxiliary PID cannot output a lower value to the LSS. This can be used to stop the aux PID from taking the LSS low enough to take the unit off-line or below min governor.

**DISPLAY GAUGE MULTIPLIER** **dflt= 1.0 (0.01, 1000.0)**

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, use this setting to multiply by a factor of 10.

**HOLD AUXILIARY CHANGES?** **dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Set Point Fast Rate, Entered Rate, and Rated Aux Set Point. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

### Remote Auxiliary Settings (only displayed if configured)

**Note:** Available as the last page of the "Auxiliary Control" Service menu.

**REMOTE NOT MATCHED RATE** **dflt= xxx (0.01, 1000)**

Rate the set point moves when remote is enabled and the remote input doesn't match the actual set point. This rate is defaulted to the 'Aux Set Point Slow Rate'. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**REMOTE AUXILIARY MAXIMUM RATE** **dflt= xxx (0.01, 1000)**

Rate the set point moves once the remote input and actual set point are matched. This is a maximum rate. Normally the set point will follow the remote input setting. This value is set in the Program mode.

**MINIMUM REMOTE AUXILIARY SETPOINT** **dflt= xxx (-20000, 20000)**

Minimum setting allowed by the remote input. This setting is defaulted to the Aux Set Point Minimum Value. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Auxiliary Set Point' and the 'Maximum Auxiliary Set Point' settings)*

**MAXIMUM REMOTE AUXILIARY SETPOINT** **dflt= xxx (-20000, 20000)**

Maximum setting allowed by the remote input. This setting is defaulted to the Aux Set Point Maximum Value. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Auxiliary Set Point' and the 'Maximum Auxiliary Set Point' settings)*

**REMOTE DEADBAND VALUE** **dflt= 0.0 (0.0, 500)**

Remote aux setting input dead band in engineering units.

**REMOTE LAG-TAU VALUE**

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

Remote Set Point input lag setting.

**HOLD REMOTE AUXILIARY CHANGES?**

**dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Aux Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**Extraction/Admission Control Settings (only displayed if configured)****SLOW RATE (UNITS/S)**

**dflt= xxx (0.01, 1000)**

Normal set point rate of change. This value is set in the Program mode.

**FAST RATE DELAY (SEC)**

**dflt= 3.0 (0.0, 100)**

Delay, in seconds, before the 'Fast Rate' of change is selected.

**FAST RATE (UNITS/S)**

**dflt= xxx (0.01, 5000)**

This rate is defaulted to three times (3x) the 'Set Point Slow Rate'. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SETPT ENTERED RATE (UNITS/S)**

**dflt= xxx (0.01, 1000)**

This is the rate that the Ext/Adm set point will move when set point is entered from the front panel of the control or from the communication links. This rate is defaulted to the Ext/Adm set point slow rate.

This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**USE DROOP?**

**dflt= NO (0.0, 100)**

If YES, the droop setting will be used.

**DROOP (%)**

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

Ext/Adm control droop setting. This value is set in the Program mode.

**ACTION ON PV FAILURE**

**dflt= Manual P Demand**

On an Ext/Adm input failure, the control can take one of the following actions

Manual P Demand: Manual Demand will hold the last PID value

LP Limiter to Max: LP Limiter ramps to the Max LP Value

LP Limiter to Min: LP Limiter ramps to the Min LP Value

**RATED SETPOINT**

**dflt= xxx (-20000, 20000)**

Only used to determine the Ext/Adm control droop. This set point is defaulted to the Ext/Adm maximum set point limit. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**PID THRESHOLD**

**dflt= 100 (0.0, 110)**

Ext/Adm PID threshold setting when Ext/Adm is used as a controller. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID MINIMUM OUTPUT**

**dflt= 0.00 (0.0, 50)**

Ext/Adm PID min output setting. The Ext/Adm PID cannot output a lower value to the LSS. This can be used to stop the Ext/Adm PID from taking the LSS low enough to take the unit off-line or below min governor.

**STARTUP DEMAND SETTING (E/A or ADM)**

**dflt= 50.00 (0.0, 100)**

This value sets the initial Ext/Adm Demand for turbine startup. Used mainly for admission or extraction/admission control to balance the pressure across the admission stop valve prior to opening the valve. Using this setting, the default can be programmed to be close to the correct value to minimize adjustments required while starting up. The default value is the 505XTs calculated zero extraction flow based on performance map entries. This value can also be accessed from the Start-up and Ext/Adm run-time screens under the 'Adm Startup' pop-up.

**SPEED ENABLE SETTING**

**dflt= 1000.00 (0.0, 20000)**

Value of speed as a permissive for enabling Extraction/Admission control. The speed must be greater than this setting before control will be active. This value must be greater than Minimum Governor Speed.

**GENERATOR BREAKER OPEN EXT/ADM INHIBIT**

**dflt= YES (Yes/No)**

Select YES if the Ext/Adm pressure control will be inhibited when the generator breaker opens. If NO is selected, then Ext/Adm pressure control will not be inhibited when the generator breaker is open and the control will control on the Ratio Limiter.

**DEADBAND****dflt= 0 (0.0, 50)**

Ext/Adm PID deadband setting in Engineering Units.

**DISPLAY GAUGE MULTIPLIER****dflt= 1.0 (0.01, 1000.0)**

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, us this setting to multiply by a factor of 10.

**MANUAL P DEMAND RATE (%/sec)****dflt= 0.5 (0.0099, 5.0)**

This value controls the rate, in percent per second, which the Manual P Demand ramp moves.

**HOLD EXTRACTION/ADMISSION CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Set Point Fast Rate, Entered Rate, and Rated Aux Set Point. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**GO TO FULL DECOUPLED MODE?****dflt= NO (Yes/No)**

If YES and the 'Permissives to Enable/Disable' are met, the control will run in fully Decoupled mode. In this mode the HP valve demand is directly driven by the Speed PID output and the LP valve demand is directly driven by the Extraction PID output. In this mode, the Ratio Limiting is not used, so no operational map limiters are enforced.

**PERMISSIVES TO ENABLE OR DISABLE FULL DECOUPLED****CONFIGURED TO ALLOW FULL DECOUPLING****(status indication only)**

If LED is ON, 'Allow the use of Full Decoupled Mode' has been selected from the Extraction/Admission Configuration Menu.

**IN SPEED CONTROL ONLY MODE****(status indication only)**

If LED is ON, the control is in Speed Only mode, with the S PID in control of the HP valve, allowing for the Full Decoupled mode to be enabled.

**EXT/ADM CONTROL DISABLED****(status indication only)**

If LED is ON, EXT/ADM control is currently disabled, allowing for Full Decoupled mode to be enabled.

**ENABLE MAP LIMIT REACHED ALARM?****dflt= NO (Yes/No)****DELAY TIME (SEC)****dflt= 10.0 (1.0, 60.0)**

If YES, then the unit will activate an alarm when the turbine is operating on a map limit for the amount of time configured by this delay value. If desired, a corresponding relay can also be configured for this condition.

**Remote Extraction/Admission Settings (only displayed if configured)**

Note: Available as the last page of the "Ext/Adm Control" Service menu.

**REMOTE NOT MATCHED RATE****dflt= xxx (0.01, 1000)**

Rate the set point moves when remote is enabled and the remote input doesn't match the actual set point. This rate is defaulted to the 'Ext/Adm Set Point Slow Rate'. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**REMOTE MAXIMUM RATE****dflt= xxx (0.01, 1000)**

Rate the set point moves once the remote input and actual set point are matched. This is a maximum rate. Normally the set point will follow the remote input setting. This value is set in the Program mode.

**MINIMUM REMOTE SETPOINT****dflt= xxx (-20000, 20000)**

Minimum setting allowed by the remote input. This setting is defaulted to the Ext/Adm Set Point Minimum Value. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.



*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**MAXIMUM REMOTE SETPOINT****dflt= xxx (-20000, 20000)**

Maximum setting allowed by the remote input. This setting is defaulted to the Ext/Adm Set Point Maximum Value. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**REMOTE DEADBAND VALUE****dflt= 0.0 (0.0, 500)**

Remote Ext/Adm setting input dead band in engineering units.

**REMOTE LAG-TAU VALUE****dflt= 0.0 (0.0, 10)**

Remote Set Point input lag setting.

**HOLD REMOTE EXT/ADM CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Ext/Adm Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**Cascade Control Settings (only displayed if configured)****SLOW RATE (UNITS/S)****dflt= xxx (0.01, 1000)**

Normal set point rate of change. This value is set in the Program mode.

**FAST RATE DELAY (SEC)****dflt= 3.0 (0.0, 100)**

Delay, in seconds, before the 'Setpt Fast Rate' is selected.

**SETPOINT FAST RATE (UNITS/S)****dflt= xxx (0.01, 5000)**

This rate is defaulted to three times (3x) the set point 'Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SETPOINT ENTERED RATE (UNITS/S)****dflt= xxx (0.01, 1000)**

This is the rate that the Cascade set point will move when set point is entered from the front panel of the control or from the communication links. This rate is defaulted to the Cascade set point slow rate. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**DROOP (%)****dflt= xxx (0.0, 100)**

Cascade control droop setting. This value is set in the Program mode.

**RATED CASCADE SETPOINT****dflt= xxx (-20000, 20000)**

This setting is only used to determine the cascade control droop. This set point is defaulted to the cascade maximum set point limit. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Cascade Set Point' and the 'Maximum Cascade Set Point' settings)*

**CASCADE NOT MATCHED RATE****dflt= xxx (0.01, 1000)**

This rate is defaulted to the 'Speed Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**MAXIMUM SPEED SETPOINT RATE****dflt= xxx (0.1, 100)**

The maximum rate at which the cascade control can vary the speed set point. This value is set in the Program mode.

**MAXIMUM SPEED SETPOINT****dflt= xxx (0.0, 20000)**

This setting is defaulted to the maximum speed set point value set in the Program mode. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Governor Speed' and the 'Maximum Governor Speed' settings)*

**MINIMUM SPEED SETPOINT****dflt= xxx (0.0, 20000)**

This setting is defaulted to the minimum speed set point value set in the Program mode. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Governor Speed' and the 'Maximum Governor Speed' settings)*

**CASCADE DEADBAND****dflt= 0.1 (0.0, 50)**

Cascade PID controller integrator deadband setting in percent.

**RAISE /LOWER CASCADE SETPOINT ONLY?****dflt= NO (Yes/No)**

When set to NO, the cascade raise/lower commands will adjust the speed set point when cascade control is disabled and adjust the cascade set point when cascade control is enabled. When YES, the cascade raise/lower commands adjust the cascade set point only.

**USE MINIMUM LOAD?****dflt= YES (Yes/No)**

When set to YES, the speed set point cannot be lowered/decreased by the cascade control PID below the rated/synchronous speed set point plus the 'min load bias' setting. This is used to prevent a reverse power condition as well as allowing the plant to utilize a minimum load setting for the generator. When NO, the cascade control PID can move the speed set point down to the cascade minimum speed setting value.

**BREAKER ENABLES CONTROL****dflt= YES (Yes/No)**

Set to TRUE to have unit automatically disable cascade when either the utility or generator breaker opens. If FALSE, then the cascade input will need to be cycled to resume control after the breaker is closed.

**DISPLAY GAUGE MULTIPLIER****dflt= 1.0 (0.01, 1000.0)**

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, use this setting to multiply by a factor of 10.

**HOLD CASCADE CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Fast Rate, Entered Rate, Rated Setpt, Casc Not Matched Rate, Maximum Speed Setting and Minimum Speed Setting. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**Remote Cascade Settings (only displayed if configured)**

Note: Available as the last page of the "Cascade Control" Service menu.

**NOT MATCHED RATE****dflt= xxx (0.01, 1000)**

Rate the set point moves when remote is enabled and the remote input doesn't match the actual set point. This rate is defaulted to the 'Cascade Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**REMOTE CASCADE MAXIMUM RATE****dflt= xxx (0.01, 1000)**

Rate the set point moves once the remote input and actual set point are matched. This is a maximum rate. Normally the set point will follow the remote cascade input setting. This rate is set in the Program mode.

**MINIMUM REMOTE CASCADE SETPOINT****dflt= xxx (-20000, 20000)**

Minimum setting allowed by the remote input. This setting is defaulted to the Minimum Cascade Set Point Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Cascade Set Point' and the 'Maximum Cascade Set Point' settings)*

**MAXIMUM REMOTE CASCADE SETPOINT****dflt= xxx (-20000, 20000)**

Maximum setting allowed by the remote input. This setting is defaulted to the Maximum Cascade Set Point Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Cascade Set Point' and the 'Maximum Cascade Set Point' settings)*

**REMOTE DEADBAND VALUE****dflt= 0.0 (0.0, 500)**

Remote cascade setting input deadband in engineering units.

**REMOTE LAG-TAU VALUE****dflt= 0.0 (0.0, 10)**

Remote Set Point input lag setting.

**HOLD REMOTE CASCADE CHANGES?****dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Casc Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

**Communications (only displayed if configured)**

When this header appears in the display, press the down arrow key to view or change this block or press the left or right arrow key to select another block to change.

**Modbus Settings****USE MODBUS TRIP?****dflt= YES (Yes/No)**

Use trip command through the Modbus link from the Modbus device.

**USE 2-STEP TRIP?****dflt= NO (Yes/No)**

If using a Modbus Trip, is this a two-step trip. If YES, requires both the Trip command and the Trip Acknowledge command to go YES before a trip from the Modbus link will executed.

**IMPORTANT**

“Use Modbus Trip” and “Use 2-Step Trip” now apply to all Modbus links (Serial Port 1, Ethernet Port 2, and Ethernet Port 3). Unlike older 2-line display versions of the 505, these options can no longer be selected individually for each link.

**ENABLE LINK 1 (SERIAL) WRITES?****dflt= NO (Yes/No)**

If YES, the control will accept Boolean and Analog Writes made on this link.

**ENABLE LINK 2 (ETHERNET) WRITES?****dflt= NO (Yes/No)**

If YES, the control will accept Boolean and Analog Writes made on this link.

**ENABLE LINK 3 (ETHERNET) WRITES?****dflt= NO (Yes/No)**

If YES, the control will accept Boolean and Analog Writes made on this link.

**Serial Port 1****LINK STATUS****(status indication only)**

Displays a green LED if the port is healthy. The `Time-out Delay` or port configuration may need to be adjusted.

**EXCEPTION ERROR****(status indication only)**

Displays a red LED if the port has an exception error.

**TIMEOUT DELAY****dflt= 10.0 (0, 100)**

Sets the port timeout. This is the delay, with no communication on the Modbus link, before the link is considered failed and an alarm is issued.

**ERROR CODE****(status indication only)**

Displays the error code related to the communication problem.

0 = No Errors

1 = Illegal Function

2 = Illegal Data Address

3 = Illegal Data Value

9 = Checksum Error

10= Garbled Message

Press RESET to clear the port error.

**Ethernet Port 2****LINK STATUS****(status indication only)**

Displays a green LED if the port is healthy. The `Time-out Delay` or port configuration may need to be adjusted.

**EXCEPTION ERROR****(status indication only)**

Displays a red LED if the port has an exception error.

**TIMEOUT DELAY****dflt= 10.0 (0, 100)**

Sets the port timeout. This is the delay, with no communication on the Modbus link, before the link is considered failed and an alarm is issued.

**ERROR CODE****(status indication only)**

Displays the error code related to the communication problem.

0 = No Errors

1 = Illegal Function

2 = Illegal Data Address

3 = Illegal Data Value

9 = Checksum Error

10= Garbled Message

Press RESET to clear the port error.

**Ethernet Port 3****LINK STATUS****(status indication only)**

Displays a green LED if the port is healthy. The `Time-out Delay` or port configuration may need to be adjusted.

**EXCEPTION ERROR****(status indication only)**

Displays a red LED if the port has an exception error.

**TIMEOUT DELAY****dflt= 10.0 (0, 100)**

Sets the port timeout. This is the delay, with no communication on the Modbus link, before the link is considered failed and an alarm is issued.

#### **ERROR CODE (status indication only)**

Displays the error code related to the communication problem.

- |                          |                        |
|--------------------------|------------------------|
| 0 = No Errors            | 1 = Illegal Function   |
| 2 = Illegal Data Address | 3 = Illegal Data Value |
| 9 = Checksum Error       | 10 = Garbled Message   |

Press RESET to clear the port error.

#### **Servlink**

##### **Socket 1**

#### **IP (status indication only)**

Shows the Ethernet IP address that is connected to this socket. IP address '127.0.0.1' will be identified as the 505 front panel display, which will be used as "Local" for Local/Remote functionality. See volume 1 of the manual for details.

#### **STATUS (status indication only)**

Displays a green LED if the port is healthy. The 'Time-out Delay' or port configuration may need to be adjusted.

#### **LEVEL (status indication only)**

Displays the authority level of this socket. For example, the following at the most common levels a 505 user will encounter:

- 0 = Monitor
- 1 = Operator
- 2 = Service
- 3 = Configure

#### **Socket 2 to 8**

These indications have the same meaning as the indications for Socket 1. See above.

#### **CAN Communications**

##### **CAN PORT 1**

#### **PORT ENABLED (status indication only)**

If LED is ON, PORT 1 has been configured for use.

#### **LINK ERROR (status indication only)**

If LED is ON, PORT 1 has a Link Error indicating no CAN activity for a timeout period.

#### **RX ERROR (status indication only)**

If LED is ON, PORT 1 has accumulated greater than 127 Receive Network errors.

#### **CAN LOAD (%) (status indication only)**

This value displays the current loading of CAN PORT 1 in %. It provides a "real time" monitor of the network load.

#### **NMT STATUS (status indication only)**

Table 12-1. Current CANOPEN NMT State Values Displayed

Status	Meaning
0	Bootup
4	Stopped
5	Operational
127	Pre-Operational

#### **STATE (status indication only)**

Table 12-2. Current CANOPEN State Values Displayed

State	Meaning
0	Preoperational
1	Initializing
2	Operational
3	Faulted

**CAN PORT 2-3**

These indications have the same meaning as the indications for CAN PORT 1. See above.

**Local/Remote Functions (only displayed if configured)**

Normally the Local/Remote function will disable all inputs except the front panel commands when Local is selected. The following questions can customize this feature by allowing the Contacts, Modbus 1, and/or Modbus 2 to be active also when local is selected.

**LOCAL MODE ENABLED?****(status indication only)**

Indicates when the Local mode is enabled. When the indication is NO, Remote mode is enabled. When YES, only "Local" commands are accepted by the control. See "Local/Remote" mode description in Volume 1.

**REMOTE MODE ENABLED?****(status indication only)**

Indicates when the Remote mode is enabled. When the indication is NO, Remote mode is disabled and Local mode only is selected.

**ENABLE CONTACTS?****dflt= NO (Yes/No)**

When set to YES, the contacts are always active regardless of the Local/Remote selection. When set to NO, the contact inputs are disabled when the Local mode is selected.

**CONTACTS ENABLED?****(status indication only)**

Indicates the status of the Contact input commands. When the indication is NO, local control is selected and remote control from the contact inputs is disabled.

**MODBUS SERIAL LINK 1 ENABLE WHEN LOCAL?****dflt= NO (Yes/No)**

If using Local/Remote only. If YES, allows commands from Modbus port 1 to be active even when LOCAL mode is selected. When NO, the Modbus commands from port 1 are disabled when in LOCAL.

**MODBUS ETHERNET LINK 2 ENABLE WHEN LOCAL?****dflt= NO (Yes/No)**

If using Local/Remote only. If YES, allows commands from Modbus port 2 to be active even when LOCAL mode is selected. When NO, the Modbus commands from port 2 are disabled when in LOCAL.

**MODBUS ETHERNET LINK 3 ENABLE WHEN LOCAL?****dflt= NO (Yes/No)**

If using Local/Remote only. If YES, allows commands from Modbus port 3 to be active even when LOCAL mode is selected. When NO, the Modbus commands from port 3 are disabled when in LOCAL.

**WRITES ENABLED?****(status indication only)**

Indicates when the write values are allowed for the link. When the indication is NO, that link may not write values to the control.

**Alarms****IS TRIP AN ALARM?****dflt= YES (Yes/No)**

When set to YES, any trip condition will also be annunciated as an alarm. When NO, a trip condition will not necessarily mean an alarm will be issued.

**BLINK ALARMS?****dflt= NO (Yes/No)**

Set to YES if want an indication if another alarm occurs when an alarm is already present. When set to YES, the alarm relay blinks when an alarm condition occurs until a reset command is issued. If the alarm still exists, the relay will stay energized, but will stop blinking until another alarm occurs. When NO, the alarm relay indicates an alarm continuously whenever an alarm condition exists.

**JUMP TO ALARM SCREEN?****dflt= NO (Yes/No)**

Set to YES to auto launch the alarms screen whenever a new alarm is indicated.

**SHUTDOWN ON POWER-UP?****dflt= YES (Yes/No)**

When set to YES, the control will initially power-up in a Shutdown state requiring an operator reset to start. When set to NO the unit will initialize into a ready to Start mode if all shutdown conditions are clear.

**TEST ALARM (TUNABLE) – EVENT ID 82****dflt= NO (Yes/No)**

Set to YES to trigger Alarm ID 82. This can be used to test communications to external devices. Set to NO and press RESET to clear the alarm.

**CONFIGURABLE ALARM 1**

**ANALOG INPUT SIGNAL** **dflt= Not Used (Analog Input Functions)**

This dropdown selects the signal to be used for triggering alarms. This dropdown list matches the available Analog Input function list such that any 4-20mA input can be used.

**USE ALARM SETPOINT 1?** **dflt= NO (Yes/No)**

Set to YES to enable Level 1 Setpoint. Once enabled, if the signal is greater than the Level 1 Setpoint, an Alarm will be generated.

**USE ALARM SETPOINT 2?** **dflt= NO (Yes/No)**

Set to YES to enable Level 2 Setpoint. Once enabled, if the signal is greater than the Level 2 Setpoint, an Alarm (or trip) will be generated.

**LEVEL 1 SETPOINT?** **dflt= 60.00 (-90000.0, 90000.0)**

Value for the Level 1 Setpoint Alarm in engineering Units.

**INVERT ACTION ON LEVEL 1?** **dflt= NO (Yes/No)**

Set to YES to change alarm to a falling level trigger. If the Signal falls below the Level 1 Setpoint, an Alarm will be generated.

**LEVEL 2 SETPOINT?** **dflt= 70.00 (-90000.0, 90000.0)**

Value for the Level 2 Setpoint Alarm/Trip in engineering Units.

**INVERT ACTION ON LEVEL 2?** **dflt= NO (Yes/No)**

Set to YES to change alarm to a falling level trigger. If the Signal falls below the Level 2 Setpoint, an Alarm/Trip will be generated.

**USE LEVEL 2 AS A TRIP?** **dflt= NO (Yes/No)**

Set to YES to enable the Level 2 Setpoint will generate a trip, shutting down the turbine.

**SETPOINT HYSTERESIS?** **dflt= -3.00 (-100.0, 100.0)**

The hysteresis value determines when the Alarm will be triggered and when it will be cleared again.

For non-inverted action:

If hysteresis is zero, an alarm triggers when the Input Signal becomes greater than or equal to the Level Setpoint and the alarm condition is cleared when the input signal goes less than the Level Setpoint.

If hysteresis is positive, an alarm triggers when the Input Signal becomes greater than or equal to the Level Setpoint *plus* Hysteresis and the alarm condition clears when the input signal goes less than the Level Setpoint.

If hysteresis is negative, an alarm triggers when the Input Signal becomes greater than or equal to the Level Setpoint and the alarm condition is cleared when the input signal goes less than the Level Setpoint *minus* Hysteresis (absolute value).

For inverted action:

If hysteresis is zero, an alarm is triggered when the Input Signal becomes less than or equal to the Level Setpoint and the alarm condition is cleared when the input signal goes greater than the Level Setpoint.

If hysteresis is positive, an alarm is triggered when the Input Signal becomes less than or equal to the Level Setpoint *minus* Hysteresis and the alarm condition is cleared when the input signal goes greater than the Level Setpoint.

If hysteresis is negative, an alarm is triggered when the Input Signal becomes less than or equal to the Level Setpoint *plus* Hysteresis (absolute value) and the alarm condition is cleared when the input signal goes greater than the Level Setpoint.

**DELAY FOR EVENT ACTION (sec)?** **dflt= 2.00 (0, 300.0)**

This value sets the delay in seconds from the time an Alarm condition is met to the time an alarm is generated. The alarm condition must be present for at least this delay time for an alarm to be generated.

**ENABLE SPEED SETPOINT (RPM)?** **dflt= 100 (-1, 10000)**

This value is used as a permissive for the alarm condition. If turbine speed is below this value, an alarm is not generated even if the alarm condition is met.



**ENABLE SPEED SETPOINT HYSTERESIS (RPM)?** **dflt= 10.00 (-100, 100)**

The hysteresis value determines when the Alarm speed permissive will be met and when it will be cleared again.

If hysteresis is zero, the alarm speed permissive is met when the Speed Signal becomes greater than or equal to the Enable Speed Setpoint and the alarm speed permissive is not met when the speed signal goes less than the Enable Speed Setpoint.

If hysteresis is zero, the alarm speed permissive is met when the Speed Signal becomes greater than or equal to the Enable Speed Setpoint *plus* Hysteresis and the alarm speed permissive is not met when the speed signal goes less than the Enable Speed Setpoint.

If hysteresis is zero, the alarm speed permissive is met when the Speed Signal becomes greater than or equal to the Enable Speed Setpoint *plus* Hysteresis and the alarm speed permissive is not met when the speed signal goes less than the Enable Speed Setpoint *minus* Hysteresis (absolute value).

**CONFIGURABLE ALARM 2 and 3**

Please see the descriptions above for Configurable Alarm 1.

**INLET AND EXHAUST PRESSURE ALARMS**

Please see the descriptions above for Configurable Alarm 1.

**VALVE POSITION FEEDBACK ALARM****ENABLE HP DIFFERENCE ALARM?** **dflt= NO (Yes/No)**

Set to YES to enable the HP Difference Alarm. Once enabled, if the HP Demand differs from the Position Feedback for the Position Error Tolerance for the Position Error Delay time, an alarm will be generated.

**POSITION ERROR TOLERANCE (%)** **dflt= 5.00 (0.5, 100.0)**

Amount of difference allowed between the Valve Demand and Position Feedback.

**POSITION ERROR DURATION (sec)** **dflt= 5.00 (1.0, 20.0)**

Amount of time the difference between Valve Demand and Position Feedback can be greater than Position Error Tolerance before an alarm is generated.

**ENABLE HP2 DIFFERENCE ALARM?** **dflt= NO (Yes/No)**

Set to YES to enable the HP2 Difference Alarm. This alarm uses the same Position Tolerance and Duration as above.

**ENABLE LP DIFFERENCE ALARM?** **dflt= NO (Yes/No)**

Set to YES to enable the LP Difference Alarm. This alarm uses the same Position Tolerance and Duration as above.

**HP Linearization (can be configured as actuator output 1 or 2)**

This is configured by default as the Actuator 1 channel output. HP is the same functionality as "Actuator 1" in the older 2-line display non-extraction 505's.

**X-1 VALUE** **dflt= 0.0 (-5, 110)**

Input point #1 of the actuator linearization curve, in percentage.  
(*Must be less than the 'X-2 Value'*)

**Y-1 VALUE** **dflt= 0.0 (-5, 110)**

Output point #1 of the actuator linearization curve, in percentage.

**X-2 VALUE** **dflt= 10.0 (-5, 110)**

Input point #2 of the actuator linearization curve, in percentage.  
(*Must be between the 'X-1 Value' and the 'X-3 Value' settings*)

**Y-2 VALUE** **dflt= 10.0 (-5, 110)**

Output point #2 of the actuator linearization curve, in percentage.

**X-3 VALUE** **dflt= 20.0 (-5, 110)**

Input point #3 of the actuator linearization curve, in percentage.  
(*Must be between the 'X-2 Value' and the 'X-4 Value' settings*)

**Y-3 VALUE** **dflt= 20.0 (-5, 110)**

Output point #3 of the actuator linearization curve, in percentage.

<b>X-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Input point #4 of the actuator linearization curve, in percentage. (Must be between the 'X-3 Value' and the 'X-5 Value' settings)	
<b>Y-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Output point #4 of the actuator linearization curve, in percentage.	
<b>X-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Input point #5 of the actuator linearization curve, in percentage. (Must be between the 'X-4 Value' and the 'X-6 Value' settings)	
<b>Y-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Output point #5 of the actuator linearization curve, in percentage.	
<b>X-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Input point #6 of the actuator linearization curve, in percentage. (Must be between the 'X-5 Value' and the 'X-7 Value' settings)	
<b>Y-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Output point #6 of the actuator linearization curve, in percentage.	
<b>X-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Input point #7 of the actuator linearization curve, in percentage. (Must be between the 'X-6 Value' and the 'X-8 Value' settings)	
<b>Y-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Output point #7 of the actuator linearization curve, in percentage.	
<b>X-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Input point #8 of the actuator linearization curve, in percentage. (Must be between the 'X-7 Value' and the 'X-9 Value' settings)	
<b>Y-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Output point #8 of the actuator linearization curve, in percentage.	
<b>X-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Input point #9 of the actuator linearization curve, in percentage. (Must be between the 'X-8 Value' and the 'X-10 Value' settings)	
<b>Y-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Output point #9 of the actuator linearization curve, in percentage.	
<b>X-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Input point #10 of the actuator linearization curve, in percentage. (Must be between the 'X-9 Value' and the 'X-11 Value' settings)	
<b>Y-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Output point #10 of the actuator linearization curve, in percentage.	
<b>X-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Input point #11 of the actuator linearization curve, in percentage. (Must be greater than the 'X-10 Value')	
<b>Y-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Output point #11 of the actuator linearization curve, in percentage.	
<b>HP DEMAND (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) before the linearization curve.	
<b>HP OUTPUT (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) after the linearization curve.	
<b>TRACK OFFSET (%) =</b>	<b>dflt= 0.0 (0.0, 5.0)</b>
Displays the actuator demand (%) after the linearization curve.	

### HP2 Linearization (only displayed if configured)

HP2 is the same functionality as "Actuator 2" in the older 2-line display non-extraction 505's. HP2 can be used for dual inlet or split range valve applications.

<b>X-1 VALUE</b>	<b>dflt= 0.0 (-5, 110)</b>
Input point #1 of the actuator linearization curve, in percentage. (Must be less than the 'X-2 Value')	
<b>Y-1 VALUE</b>	<b>dflt= 0.0 (-5, 110)</b>
Output point #1 of the actuator linearization curve, in percentage.	
<b>X-2 VALUE</b>	<b>dflt= 10.0 (-5, 110)</b>
Input point #2 of the actuator linearization curve, in percentage. (Must be between the 'X-1 Value' and the 'X-3 Value' settings)	



<b>Y-2 VALUE</b>	<b>dflt= 10.0 (-5, 110)</b>
Output point #2 of the actuator linearization curve, in percentage.	
<b>X-3 VALUE</b>	<b>dflt= 20.0 (-5, 110)</b>
Input point #3 of the actuator linearization curve, in percentage. (Must be between the 'X-2 Value' and the 'X-4 Value' settings)	
<b>Y-3 VALUE</b>	<b>dflt= 20.0 (-5, 110)</b>
Output point #3 of the actuator linearization curve, in percentage.	
<b>X-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Input point #4 of the actuator linearization curve, in percentage. (Must be between the 'X-3 Value' and the 'X-5 Value' settings)	
<b>Y-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Output point #4 of the actuator linearization curve, in percentage.	
<b>X-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Input point #5 of the actuator linearization curve, in percentage. (Must be between the 'X-4 Value' and the 'X-6 Value' settings)	
<b>Y-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Output point #5 of the actuator linearization curve, in percentage.	
<b>X-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Input point #6 of the actuator linearization curve, in percentage. (Must be between the 'X-5 Value' and the 'X-7 Value' settings)	
<b>Y-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Output point #6 of the actuator linearization curve, in percentage.	
<b>X-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Input point #7 of the actuator linearization curve, in percentage. (Must be between the 'X-6 Value' and the 'X-8 Value' settings)	
<b>Y-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Output point #7 of the actuator linearization curve, in percentage.	
<b>X-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Input point #8 of the actuator linearization curve, in percentage. (Must be between the 'X-7 Value' and the 'X-9 Value' settings)	
<b>Y-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Output point #8 of the actuator linearization curve, in percentage.	
<b>X-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Input point #9 of the actuator linearization curve, in percentage. (Must be between the 'X-8 Value' and the 'X-10 Value' settings)	
<b>Y-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Output point #9 of the actuator linearization curve, in percentage.	
<b>X-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Input point #10 of the actuator linearization curve, in percentage. (Must be between the 'X-9 Value' and the 'X-11 Value' settings)	
<b>Y-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Output point #10 of the actuator linearization curve, in percentage.	
<b>X-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Input point #11 of the actuator linearization curve, in percentage. (Must be greater than the 'X-10 Value')	
<b>Y-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Output point #11 of the actuator linearization curve, in percentage.	
<b>HP2 DEMAND (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) before the linearization curve.	
<b>HP2 OUTPUT (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) after the linearization curve.	

### LP Linearization (only displayed if configured)

<b>X-1 VALUE</b>	<b>dflt= 0.0 (-5, 110)</b>
Input point #1 of the actuator linearization curve, in percentage. (Must be less than the 'X-2 Value')	
<b>Y-1 VALUE</b>	<b>dflt= 0.0 (-5, 110)</b>
Output point #1 of the actuator linearization curve, in percentage.	

<b>X-2 VALUE</b>	<b>dflt= 10.0 (-5, 110)</b>
Input point #2 of the actuator linearization curve, in percentage. (Must be between the 'X-1 Value' and the 'X-3 Value' settings)	
<b>Y-2 VALUE</b>	<b>dflt= 10.0 (-5, 110)</b>
Output point #2 of the actuator linearization curve, in percentage.	
<b>X-3 VALUE</b>	<b>dflt= 20.0 (-5, 110)</b>
Input point #3 of the actuator linearization curve, in percentage. (Must be between the 'X-2 Value' and the 'X-4 Value' settings)	
<b>Y-3 VALUE</b>	<b>dflt= 20.0 (-5, 110)</b>
Output point #3 of the actuator linearization curve, in percentage.	
<b>X-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Input point #4 of the actuator linearization curve, in percentage. (Must be between the 'X-3 Value' and the 'X-5 Value' settings)	
<b>Y-4 VALUE</b>	<b>dflt= 30.0 (-5, 110)</b>
Output point #4 of the actuator linearization curve, in percentage.	
<b>X-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Input point #5 of the actuator linearization curve, in percentage. (Must be between the 'X-4 Value' and the 'X-6 Value' settings)	
<b>Y-5 VALUE</b>	<b>dflt= 40.0 (-5, 110)</b>
Output point #5 of the actuator linearization curve, in percentage.	
<b>X-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Input point #6 of the actuator linearization curve, in percentage. (Must be between the 'X-5 Value' and the 'X-7 Value' settings)	
<b>Y-6 VALUE</b>	<b>dflt= 50.0 (-5, 110)</b>
Output point #6 of the actuator linearization curve, in percentage.	
<b>X-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Input point #7 of the actuator linearization curve, in percentage. (Must be between the 'X-6 Value' and the 'X-8 Value' settings)	
<b>Y-7 VALUE</b>	<b>dflt= 60.0 (-5, 110)</b>
Output point #7 of the actuator linearization curve, in percentage.	
<b>X-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Input point #8 of the actuator linearization curve, in percentage. (Must be between the 'X-7 Value' and the 'X-9 Value' settings)	
<b>Y-8 VALUE</b>	<b>dflt= 70.0 (-5, 110)</b>
Output point #8 of the actuator linearization curve, in percentage.	
<b>X-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Input point #9 of the actuator linearization curve, in percentage. (Must be between the 'X-8 Value' and the 'X-10 Value' settings)	
<b>Y-9 VALUE</b>	<b>dflt= 80.0 (-5, 110)</b>
Output point #9 of the actuator linearization curve, in percentage.	
<b>X-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Input point #10 of the actuator linearization curve, in percentage. (Must be between the 'X-9 Value' and the 'X-11 Value' settings)	
<b>Y-10 VALUE</b>	<b>dflt= 90.0 (-5, 110)</b>
Output point #10 of the actuator linearization curve, in percentage.	
<b>X-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Input point #11 of the actuator linearization curve, in percentage. (Must be greater than the 'X-10 Value')	
<b>Y-11 VALUE</b>	<b>dflt= 100.0 (-5, 110)</b>
Output point #11 of the actuator linearization curve, in percentage.	
<b>LP DEMAND (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) before the linearization curve.	
<b>LP OUTPUT (%) =</b>	<b>(status indication only)</b>
Displays the actuator demand (%) after the linearization curve.	

## Real Time Clock

**USE SNTP SYNCHRONIZATION** **dflt= NO (Yes/No)**

Select this option if using an SNTP Server for time synchronization with the 505 internal clock. This will affect alarm and event indication time stamping.

**If SNTP is used:****SNTP IP Address****dflt= xxx.xxx.xxx.xxx**

Enter your network time synchronizing IP

**SNTP Rate (sec)****dflt= 300 (1,9999)****How often the 505 will get the sync pulse from the network****SNTP Timeout (sec)****dflt= 300 (1,9999)****Failure to receive an update from the network within this time will result in an SNTP fault alarm****TIME ZONE****dflt= NO (-12, 13)**

This value will change the local time on the control. The hardware time will be set to GMT. Changing this input will have no effect on the actual hardware keeping track of time. Therefore, if the Time Zone is changed after the hardware time is setup; the Local time will change as it offsets a different Time Zone to the Local Time.

Table 12-3. Time Zones

-12=	-11=	-10=Hawaii
-9=Alaska	-8=Pacific	-7=Mountain
-6=Central	-5=Eastern	-4=Atlantic
-3=	-2=	-1=
0=GMT	1=	2=
3=Moscow	4=	5=
6=	7=	8=Hong Kong
9=Tokyo	10=	11=
12=	13=	

**YEAR****dflt= 15 (0, 99)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value.

**MONTH****dflt= 15 (1, 12)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**DAY****dflt= 15 (1, 31)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**HOURL****dflt= 15 (0, 23)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**MINUTES****dflt= 15 (0, 59)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**SECONDS****dflt= 15 (0, 59)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**Data Log****DATA SAMPLE RATE****dflt= 1000.0 (10, 1000)**

Set the number of milliseconds between each data point in the data log. After changing this value, the Data Log must be stopped and started again for this sample rate to be used.

**ENABLE CONTINUOUS/DISABLE CONTINUOUS****dflt= Disabled**

Enabling Continuous allows continuous datalogs to be collected via AppManager. When Enabled, the control will create 2 log files which get downloaded by AppManager automatically, once configured. This pulls the datalog files onto a PC which can be put together seamlessly via Control Assistant. The Continuous mode will collect 10ms data for 8 hours before automatically disabling. This is intended to be used for commissioning or troubleshooting purposes. When disabled, the Trend Log will automatically re-enable.

**Continuous Mode Active****(status only)**

When the LED is illuminated, Continuous mode is active and files can be collected via AppManager.

**Operation Log****NUMBER OF TURBINE STARTS****dflt= 0 (0, 999999)**

This is the number of times a Start command has been issued. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**NUMBER OF HOT TURBINE STARTS****dflt= 0 (0, 999999)**

This is the number of times a Start command has been issued while the turbine is considered HOT. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**TOTAL TRIPS****dflt= 0 (0, 999999)**

This is the number of times a Trip has occurred. The trip latch must be reset/cleared and then triggered again to increment this counter. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**TRIPS WITH LOAD > 25%****dflt= 0 (0, 999999)**

This is the number of times a Trip has occurred above 25% load. Load is determined by the LSS percentage if configured as a mechanical drive unit. As a generator drive unit the load level is determined by the calculated LSS load percentage or the load analog input if configured. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**TRIPS WITH LOAD > 75%****dflt= 0 (0, 999999)**

This is the number of times a Trip has occurred above 75% load. Load is determined by the LSS percentage if configured as a mechanical drive unit. As a generator drive unit the load level is determined by the calculated LSS load percentage or the load analog input if configured. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**OVERSPEED TRIPS****dflt= 0 (0, 999999)**

This is the number of overspeed trips. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**TOTAL RUN TIME HOURS****dflt= 0.0 (0.0, 1.0e+8)**

This is the total time the turbine has been running. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**RUN TIME HOURS WITH LOAD > 25%****dflt= 0.0 (0.0, 1.0e+8)**

This is the total time the turbine has been running with more than 25% load. Load is determined by the LSS percentage if configured as a mechanical drive unit. As a generator drive unit the load level is determined by the calculated LSS load percentage or the load analog input if configured. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**RUN TIME HOURS WITH LOAD > 75%****dflt= 0.0 (0.0, 1.0e+8)**

This is the total time the turbine has been running with more than 75% load. Load is determined by the LSS percentage if configured as a mechanical drive unit. As a generator drive unit the load level is determined by the calculated LSS load percentage or the load analog input if configured. This number can be reset by pressing the 'Reset Values' soft key to reset all Operation Values to the "Rewrite Value" specified in this menu.

**TOTAL RUN TIME HOURS****(status indication only)**

This is the total time the turbine has been running. This is a repeat of the value on the previous page for ease of comparing the run time with the maintenance alarm time.

**ENABLE MAINTENANCE ALARM****dflt= YES (Yes/No)**

Select this option to turn on the maintenance alarm, which is an alarm based on the number of turbine run hours and reminds the user that the control should be serviced periodically. Unselected this to disable the maintenance alarm.

**MAINTENANCE INTERVAL****dflt= 15000 (10, 100000)**

This sets the number of turbine run hours that will trigger the maintenance alarm. After the turbine has been running for this many hours, the maintenance alarm will activate to remind the user to service the unit.

**MAINTENANCE ALARM****(status indication only)**

This indicates the status of the maintenance alarm. A red LED indication is a reminder that the unit should be serviced. This alarm indication can be reset by pressing the "Reset Alarm" soft key at the bottom of the screen if the appropriate security level is logged in.

**PEAK SPEED REACHED****(status indication only)**

This indicates the maximum turbine speed detected by the 505.

**MAXIMUM ACCELERATION REACHED****(status indication only)**

This indicates the maximum turbine acceleration detected by the 505.

**Isolated Control (only displayed if configured)****SETPOINT****(set by user)**

This is the setpoint in engineering units. It is the target control point for the Isolated Control PID.

**PROCESS****(status indication only)**

This is the process value from the analog input in engineering units. It is the parameter to be controlled by the Isolated Control PID.

**DEMAND****(set by user)**

This is the output of the Isolated Control PID in percent. This can be manually adjusted by a user with the appropriate security login level by enabling Manual mode or in the event of an analog process input fault.

**REMOTE SETPOINT ENABLED****(status indication only)**

This is a status indication that the remote setpoint analog input is driving the Isolated Control setpoint. A green LED indicates the Remote Setpoint is enabled.

**REMOTE SETPOINT FAULT****(status indication only)**

This is a status indication that the remote setpoint analog input is failed. A red LED indicates the Remote Setpoint fault is present.

**AUTO CONTROL****(status indication only)**

This is a status indication that the Isolated Control is controlling the process and attempting to maintain the setpoint automatically. A green LED indicates the PID is controlling.

**PROCESS INPUT FAULT****(status indication only)**

This is a status indication that the process value analog input is failed. A red LED indicates the process analog input fault is present.

**MANUAL DEMAND****(status indication only)**

This is a status indication that the Isolated Control is not controlling the process. The output of the Isolated Control PID is set manually by the operator. A yellow LED indicates the Isolated Control PID is in Manual mode and the PID is not maintaining the setpoint.

**Setpoint Limits****MAXIMUM****(status indication only)**

This is the maximum limit for the Isolated Control setpoint in engineering units.

**MINIMUM****(status indication only)**

This is the minimum limit for the Isolated Control setpoint in engineering units.

**INITIAL****(status indication only)**

This is the value in engineering units at which the Isolated Control setpoint ramp will initialize.

**NORMAL RATE****dflt= 1.0 (0.0, 100000.0)**

This is the rate in engineering units per second at which the Isolated Control setpoint will move when a setpoint Raise/Lower command is issued.

**FAST RATE****dflt= 3.0 (0.0, 100000.0)**

This is the rate in percent per second at which the Isolated Control setpoint will move after the setpoint Raise/Lower command has been active for 5 seconds.

**Output Limits****MAXIMUM****dflt= 100.0 (-10.0, 110.0)**

This is the maximum limit for the Isolated Control PID demand in percent.

**MINIMUM****dflt= 0.0 (-10.0, 110.0)**

This is the minimum limit for the Isolated Control PID demand in percent.

**INITIAL****dflt= 0.0 (-10.0, 110.0)**

This is the value in percent at which the Isolated Control setpoint ramp will initialize.

**NORMAL RATE****dflt= 1.0 (0.0, 1000.0)**

This is the rate in percent per second at which the Isolated Control output will move when a manual demand raise/lower command is issued.

**FAST RATE****dflt= 3.0 (0.0, 1000.0)**

This is the rate in percent per second at which the Isolated Control output will move after the manual demand Raise/Lower command has been active for 5 seconds.

**Commands****Remote Setpoint****REMOTE SETPOINT****(status indication only)**

This is the remote setpoint for the Isolated Control setpoint in engineering units. When enabled, an analog input is used to drive the setpoint for the Isolated Control PID. The Remote Setpoint can be enabled using the soft key at the bottom of the screen.

**REMOTE RATE****dflt= 5.0 (0.1, 100000.0)**

This is the maximum rate at which the remote setpoint can move the Isolated Control setpoint in engineering units per second.

**PID Dynamics****P TERM****(set by user)**

This is the Proportional gain setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**I TERM****(set by user)**

This is the Integral gain setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**DR TERM****(set by user)**

This is the Derivative Ratio setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**Screen/Key Options****SCREEN SAVER DELAY****dflt= 4.0 (0.1, 24.0)**

Set the time before the screen saver will activate. If no front panel keys are pressed in this length of time, the screen saver will turn on.

Note that the current user level will be logged out when the screen saver activates. When the screen saver is deactivated (i.e. waking up the display), either the Operator or Monitor user level will be active.

**AUTO LOGIN AS OPERATOR****dflt= YES (Yes/No)**

Select this option to determine which user level is active when the 505 initializes. With this option selected, the 505 will initialize like the older 2-line display models in Operator mode with operator commands available. If not selected, the 505 will initialize in the Monitor user level with only screen navigation functionality. No operator commands can be issued from the Monitor user level. Note that this will also determine the user level that is logged in any time the user wakes up the display and turns off the screen saver.

**OPERATOR PASSWORD****dflt= wg1111**

If "Auto Login as Operator" is selected, this sets the Operator password. If the user level and password have not been changed, the default input will allow the 505 to login the Operator user level as described above. If the Operator password has been changed, then it must be entered here to authorize the 505 to automatically login to the Operator user level.

**USE 'STOP' COMMAND?****dflt= YES (Yes/No)**

When set to YES, allows the Controlled Stop command to be used. When NO, the Controlled Stop feature is disabled from front panel, Modbus, and contact commands.

**DISABLE SCREEN SAVE?****Dflt= No (Yes/No)**

Use this to disable the screen saver function.

**ENABLE AUTO-DIMMING?****Dflt= YES (Yes/No)**

Uncheck this box to disable the auto-dimming of the display screen

**USE TRIP FROM REMOTE VIEW?****Dflt=No (Yes/No)**



**Check this box to allow a TRIP command to appear on the Normal Stop pop-up screen – this will allow the RemoteView GUI to issue a Trip command**

**SCREEN UPDATE RATE (ms)** (status indication only)

This is the rate that values are being updated on the screen. This time can change from page to page.

**CPU IDLE TIME (%)** (status indication only)

This indicates the amount of available CPU horsepower.

**INTERNAL OPERATING TEMP OF 505 (C)** (status indication only)

This value is measured internally on the 505.

**SCREEN BRIGHTNESS (%)** (status indication only)

Current brightness of the screen. This can be adjusted by holding the Brightness key on the front panel and using the Adjust button.

**SELECT BOOT-UP SCREEN?** HOME (List)

This will configure the display screen to switch to a user-selected page once the boot-up routine is complete (this is helpful if the unit is not accessible to operators – for example if it is in a sealed and/or purged enclosure. If this is the case, there are other options above that may need to be adjusted from defaults).

## Real Time Clock - (Real Time Clock)

**SYSTEM DATE**

**dflt= Display Only**

Displays the current date in the controller.

**SYSTEM TIME (24HR)**

**dflt= Display Only**

Displays the current time in the controller.

**USE SNTP SYNCHRONIZATION**

**dflt= NO (YES/NO)**

Select this option if using an SNTP Server for time synchronization with the Vertex internal clock. This will affect alarm and event indication time stamping.

**TIME ZONE**

**dflt= 0**  
**[-12, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]**

This value will change the local time on the control. The hardware time will be set to GMT. Changing this input will have no effect on the actual hardware keeping track of time. Therefore, if the Time Zone is changed after the hardware time is setup, the Local time will change as it offsets a different Time Zone to the Local Time.

-12= -11= -10=Hawaii

-9=Alaska -8=Pacific -7=Mountain

-6=Central -5=Eastern -4=Atlantic

-3= -2= -1=

0=GMT 1= 2=

3=Moscow 4= 5=

6= 7= 8=Hong Kong

9=Tokyo 10= 11=

12= 13=

**YEAR**

**dflt= 15 (0, 99)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**MONTH**

**dflt= 1 (1, 12)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**DAY**

**dflt= 1 (1, 31)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**HOURL**

**dflt= 0 (0, 23)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**MINUTES****dflt= 0 (0, 59)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**SECONDS****dflt= 0 (0, 59)**

When 'SET CLOCK' is pressed (or the Clock SYNC Pulse Contact Input is closed), the hardware time will be set to this value

**Custom Trend**

Opening Custom Trend page begins the trend, exiting the page will continue to record data in the background. Trends can be paused using the soft-key. While paused, the data continues to record in the background. Once resumed, the trend snaps to real time.

**Settings****TIME WINDOW****dflt= 60 (1, 600)**

Set the amount of time that is shown on the trend. This is the trend window time in seconds. Setting this to '60', for example, will show 60 seconds of data preceding the present time.

**Parameter 1 (Red)****VARIABLE****(set by user)**

Select the parameter to be displayed by this trend line. The color that will appear for this parameter on the trend is indicated to the left of this selection.

**Y MAX****dflt= 100 (-20000, 20000)**

Set the maximum value for the Y axis on the trend for this signal. This sets the maximum vertical limit of the trend display for the signal.

**Y MIN****dflt= 0 (-20000, 20000)**

Set the minimum value for the Y axis on the trend for this signal. This sets the minimum vertical limit of the trend display for the signal.

**WIDTH****dflt= 1 (1, 5)**

Set the width of the line shown on the trend for this signal. To increase thickness of the line, this number should be increased.

**SHOW AXIS****dflt= YES (Yes/No)**

Set the maximum value for the Y axis on the trend for this signal. This sets the maximum vertical limit of the trend display for the signal.

**Parameter 2 (Green)**

The configuration options are similar to that of Parameter 1. See Parameter 1 settings for a description of each option.

**Parameter 3 (Blue)**

The configuration options are similar to that of Parameter 1. See Parameter 1 settings for a description of each option.

**Parameter 4 (Purple)**

The configuration options are similar to that of Parameter 1. See Parameter 1 settings for a description of each option.

**Parameter 5 (Orange)**

The configuration options are similar to that of Parameter 1. See Parameter 1 settings for a description of each option.

**Values from VariStroke II (HP Valve)**

This screen contains status information on the VariStroke II connected as the HP valve driver. See the VariStroke II manual for details.

**Manual Demand****USE MANUAL DEMAND****dflt= NO (Yes/No)**

Select this option to allow the use of the manual valve demand feature. This allows the operator to disable all controllers and hold the valve demand steady for a limited period of time for system troubleshooting purposes.



**NOTICE****Manual Valve Demand**

Using the Manual Valve Demand feature allows the operator to lock the valve demand. This means that closed loop control is not active. In other words, the Speed PID will not be in control of the turbine speed!

**MANUAL DEMAND RATE****dflt= \*0.5 (0.0099, 5.0)**

Set the rate at which the valve demand can be moved when Manual Valve Demand is enabled. This is a value in percent per second.

**TIMEOUT WHEN INACTIVE****dflt= 120.0 (10.0, 300.0)**

Set the maximum length of time, in seconds, that Manual Valve Demand may be enabled. If Manual Valve Demand is enabled for this length of time then it will automatically be disabled and the 505 will return to Speed PID Control.

**Acceleration Limiter****USE ACCELERATION LIMITER****dflt= NO (Yes/No)**

Set to YES to enable the Acceleration Limiter PID during startup.

**PROPORTIONAL GAIN****(set by user)**

This is the Proportional gain setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**INTEGRAL GAIN****(set by user)**

This is the Integral gain setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**DERIVATIVE RATIO****(set by user)**

This is the Derivative Ratio setting for the Isolated Control PID. It can be adjusted by a user with the appropriate user level. The PID algorithm is the same as the other 505 control PID's. See the PID tuning section of the manual for details on the PID parameters.

**Inlet Control Settings (only displayed if configured)****SLOW RATE (UNITS/S)****dflt= xxx (0.01, 1000)**

Normal set point rate of change. This value is set in the Program mode.

**FAST RATE DELAY (SEC)****dflt= 3.0 (0.0, 100)**

Delay, in seconds, before the 'Fast Rate' of change is selected.

**FAST RATE (UNITS/S)****dflt= xxx (0.01, 5000)**

This rate is defaulted to three times (3x) the 'Set Point Slow Rate'. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SETPT ENTERED RATE (UNITS/S)****dflt= xxx (0.01, 1000)**

This is the rate that the set point will move when set point is entered from the front panel of the control or from the communication links. This rate is defaulted to the set point slow rate. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**DROOP (%)****dflt= xxx (0.0, 100)**

Control droop setting. This value is set in the Program mode.

**RATED SETPOINT****dflt= xxx (-20000, 20000)**

Only used to determine the control droop. This set point is defaulted to the aux maximum set point limit. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**PID THRESHOLD (LIMITER)****dflt= 10 (0.0, 110)**

Aux PID threshold setting when Inlet is used as a limiter. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID THRESHOLD (CONTROLLER)****dflt= 100 (0.0, 110)**

Aux PID threshold setting when Inlet is used as a controller. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID MINIMUM OUTPUT** **dflt= 0.00 (0.0, 50)**

PID minimum output setting. The PID cannot output a lower value to the LSS. This can be used to stop the PID from taking the LSS low enough to take the unit off-line or below min governor.

**DISPLAY GAUGE MULTIPLIER** **dflt= 1.0 (0.01, 1000.0)**

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, use this setting to multiply by a factor of 10.

**HOLD INLET CHANGES?** **dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Set Point Fast Rate, Entered Rate, and Rated Set Point. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

### Remote Inlet Settings (only displayed if configured)

Note: Available as the last page of the "Inlet Control" Service menu.

**REMOTE NOT MATCHED RATE** **dflt= xxx (0.01, 1000)**

Rate the set point moves when remote is enabled and the remote input doesn't match the actual set point. This rate is defaulted to the 'Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**REMOTE MAXIMUM RATE** **dflt= xxx (0.01, 1000)**

Rate the set point moves once the remote input and actual set point are matched. This is a maximum rate. Normally the set point will follow the remote input setting. This value is set in the Program mode.

**MINIMUM REMOTE SETPOINT** **dflt= xxx (-20000, 20000)**

Minimum setting allowed by the remote input. This setting is defaulted to the Set Point Minimum Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization. *(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**MAXIMUM REMOTE SETPOINT** **dflt= xxx (-20000, 20000)**

Maximum setting allowed by the remote input. This setting is defaulted to the Set Point Maximum Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization. *(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**REMOTE DEADBAND VALUE** **dflt= 0.0 (0.0, 500)**

Remote setting input dead band in engineering units.

**REMOTE LAG-TAU VALUE** **dflt= 0.0 (0.0, 10)**

Remote Set Point input lag setting.

**HOLD REMOTE INLET CHANGES?** **dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

### Exhaust Control Settings (only displayed if configured)

**SLOW RATE (UNITS/S)** **dflt= xxx (0.01, 1000)**

Normal set point rate of change. This value is set in the Program mode.

**FAST RATE DELAY (SEC)** **dflt= 3.0 (0.0, 100)**

Delay, in seconds, before the 'Fast Rate' of change is selected.

**FAST RATE (UNITS/S)** **dflt= xxx (0.01, 5000)**

This rate is defaulted to three times (3x) the 'Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**SETPT ENTERED RATE (UNITS/S)** **dflt= xxx (0.01, 1000)**

This is the rate that the set point will move when set point is entered from the front panel of the control or from the communication links. This rate is defaulted to the set point slow rate. This value

can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**DROOP (%)** dflt= xxx (0.0, 100)

Control droop setting. This value is set in the Program mode.

**RATED SETPOINT** dflt= xxx (-20000, 20000)

Only used to determine the control droop. This set point is defaulted to the aux maximum set point limit. This value can be changed to a new value, however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**PID THRESHOLD (LIMITER)** dflt= 10 (0.0, 110)

Aux PID threshold setting when Exhaust is used as a limiter. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID THRESHOLD (CONTROLLER)** dflt= 100 (0.0, 110)

Aux PID threshold setting when Exhaust is used as a controller. The value of the Threshold input determines how much error (difference between actual and reference) will be permitted before this block's output goes to 101% (LSS) or -1% (HSS), when this block is not in control of the LSS or HSS bus into which it feeds. It is not advisable to set the Threshold to zero.

**PID MINIMUM OUTPUT** dflt= 0.00 (0.0, 50)

PID minimum output setting. The PID cannot output a lower value to the LSS. This can be used to stop the PID from taking the LSS low enough to take the unit off-line or below min governor.

**DISPLAY GAUGE MULTIPLIER** dflt= 1.0 (0.01, 1000.0)

This allows scaling of the number for display on the gauge on the 505 runtime screen for this controller. If the number is too big or small to be displayed correctly or as desired, us this setting to multiply by a factor of 10.

**HOLD EXHAUST CHANGES?** dflt= NO (Yes/No)

Set to YES to permanently hold the changes made to the Set Point Fast Rate, Entered Rate, and Rated Set Point. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

## Remote Exhaust Settings (only displayed if configured)

Note: Available as the last page of the "Exhaust Control" Service menu.

**REMOTE NOT MATCHED RATE** dflt= xxx (0.01, 1000)

Rate the set point moves when remote is enabled and the remote input does not match the actual set point. This rate is defaulted to the 'Set Point Slow Rate'. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

**REMOTE MAXIMUM RATE** dflt= xxx (0.01, 1000)

Rate the set point moves once the remote input and actual set point are matched. This is a maximum rate. Normally the set point will follow the remote input setting. This value is set in the Program mode.

**MINIMUM REMOTE SETPOINT** dflt= xxx (-20000, 20000)

Minimum setting allowed by the remote input. This setting is defaulted to the Set Point Minimum Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**MAXIMUM REMOTE SETPOINT** dflt= xxx (-20000, 20000)

Maximum setting allowed by the remote input. This setting is defaulted to the Set Point Maximum Value. This value can be changed to a new value; however, the HOLD CHANGES prompt must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

*(Must be between the 'Minimum Set Point' and the 'Maximum Set Point' settings)*

**REMOTE DEADBAND VALUE** dflt= 0.0 (0.0, 500)

Remote setting input dead band in engineering units.

**REMOTE LAG-TAU VALUE** dflt= 0.0 (0.0, 10)

Remote Set Point input lag setting.

**HOLD REMOTE EXHAUST CHANGES?** dflt= NO (Yes/No)

Set to YES to permanently hold the changes made to the Remote Not Matched Rate and the Maximum and Minimum Settings. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

### Steam Map (Only Displayed if Configured)

The below constants are calculated based on the turbine performance parameters entered in the Program mode. These values can be changed to a new value; however, the Retain Service Values must be set to YES to retain the change. If not, the value will return to the default on the next initialization.

<b>K1 (dHP/dS) VALUE</b>	<b>dflt= 0.0 (0.001, 100.0)</b>
<b>K2 (dHP/dP) VALUE</b>	<b>dflt= 0.0 (0.001, 100.0)</b>
<b>K3 HP OFFSET VALUE</b>	<b>dflt= 0.0 (-100.0, 100.0)</b>
<b>K4 (dLP/dS) VALUE</b>	<b>dflt= 0.0 (0.001, 100.0)</b>
<b>K5 (dLP/dS) VALUE</b>	<b>dflt= 0.0 (-100.0, 100.0)</b>
<b>K6 LP OFFSET VALUE</b>	<b>dflt= 0.0 (-100.0, 100.0)</b>
<b>S0 Value</b>	<b>dflt = xxxx (-1e38,1e38)</b>

This value is used to adjust the Steam Map such that 0% Speed PID demand results in zero HP demand. The value is subtracted from the power component of points A, B, C, and Max Load. The effect is to move the map to the right. This value is initially calculated from the Steam Map such that K3 will be equal to Zero, allowing the HP to fully close. Because turbine efficiency can change once the unit is warmed up, this value is available to be adjusted in Service mode. To make an update to the Steam Map, the unit must be operating in Speed Only control (Ext/Adm disabled). Press the 'Update Map' button to apply changes.

### RETAIN SERVICE VALUES? **dflt= NO (Yes/No)**

Set to YES to permanently hold the changes made to the K Value Constants. To permanently save these changes into the 505, set to YES and select the 'Save Settings' key.

### MAP ADJUST (POP-UP OPTION) **dflt= NO (Yes/No)**

This option is available for knowledgeable users to make minor adjustments to the steam map while the turbine is in operation (not requiring a shutdown and the entering of Configuration mode). It is recommended that extraction be disabled (running the unit online in speed/load control only) if large adjustments need to be made.

### STEAM MAP PRIORITY SELECTIONS

In all modes using Ratio Limiter functionality, the user must select which parameter is most important to maintain if a limiter (a performance map or valve limit) is reached. If only 1 parameter can be controlled the user, depending on the configuration, can select which parameter is maintained.

<b>MODE 0</b>	<b>dflt= Speed (Speed/Extraction)</b>
<b>MODE 1</b>	<b>dflt= Speed (Speed/Inlet)</b>
<b>MODE 2</b>	<b>dflt= Inlet (Extraction/Inlet)</b>
<b>MODE 3</b>	<b>dflt= Speed (Speed/Exhaust)</b>
<b>MODE 4</b>	<b>dflt= Exhaust (Extraction/Exhaust)</b>
<b>MODE 5</b>	<b>dflt= Inlet (Inlet/Exhaust)</b>
<b>MODE 6</b>	<b>dflt= Inlet (Inlet/Exhaust)</b>

## Chapter 13.

# Understanding PID Settings

### Overview

The Speed, Cascade, Auxiliary (1 & 2), and Acceleration controls utilize PID controllers. The response of each control loop can be adjusted for optimum response, however it is important to understand what a PID controller is and the effect each controller adjustment has on the controller response. Proportional gain, integral gain (stability), and DR (speed derivative ratio) are the adjustable and interacting parameters used to match the response of the control loop with the response of the system. They correspond to the P (proportional), I (integral), and D (derivative) terms, and are displayed by the 505 as follows:

- P = Proportional gain (%)
- I = Integral gain (%)
- D = Derivative (determined by DR and I)

### Proportional Control

Proportional response is directly proportional to a process change.

Analogy: Setting hand throttle to keep constant speed on straight and level.

Proportional control (using the same analogy) results in a certain speed as long as the car is not subjected to any load change such as a hill. If a throttle is set to any particular setting, the speed of the car will remain constant as long as the car remains straight and level. If the car goes up a hill, it will slow down. Of course, going down a hill the car would gain speed.

### Integral Control

Integral compensates for process and setpoint load changes.

Analogy: Cruise control maintains constant speed regardless of hills.

Integral, (sometimes called reset) provides additional action to the original proportional response as long as the process variable remains away from the setpoint. Integral is a function of the magnitude and duration of the deviation. In this analogy, the reset response would keep the car speed constant regardless of the terrain.

### Derivative

Derivative provides a temporary over-correction to compensate for long transfer lags and reduce stabilization time on process upsets (momentary disturbances).

Analogy: Accelerating into high-speed lane with merging traffic.

Derivative, sometimes called “preact” or “rate”, is very difficult to draw an accurate analogy to, because the action takes place only when the process changes and is directly related to the speed at which the process changes. Merging into high-speed traffic of a freeway from an “on” ramp is no easy task and requires accelerated correction (temporary overcorrection) in both increasing and decreasing directions. The application of brakes to fall behind the car in the first continuous lane or passing gear to get ahead of the car in the first continuous lane is derivative action.

## Proportional Response

The amount of controller change is directly related to the process change and the Proportional gain setting on the controller; Controller output change is Proportional to the process change. If there is no process change, there is no change in output from the controller (or valve change) regardless of the deviation. This results in an undesired offset between the original desired Setpoint and the resulting drop in the Control Point.

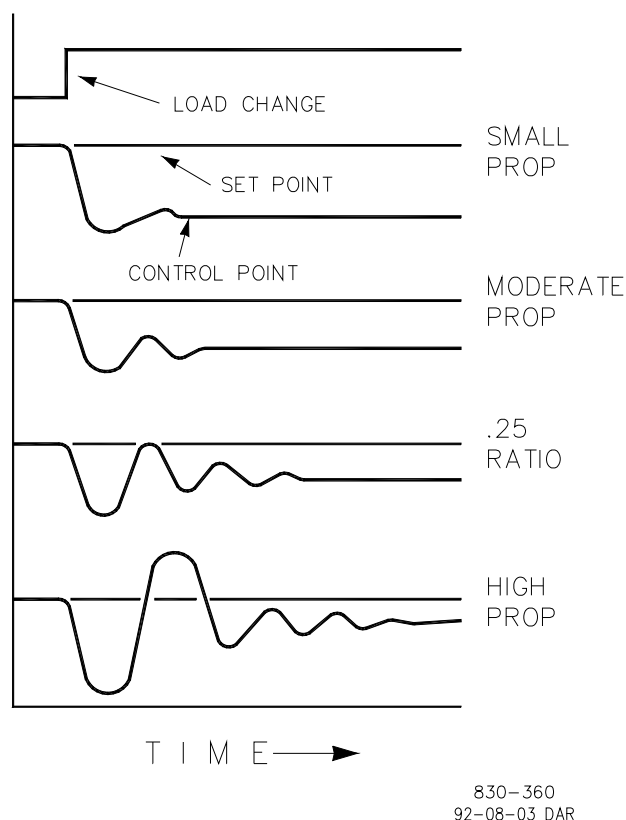


Figure 13-1. Proportional Gain Setting Effects

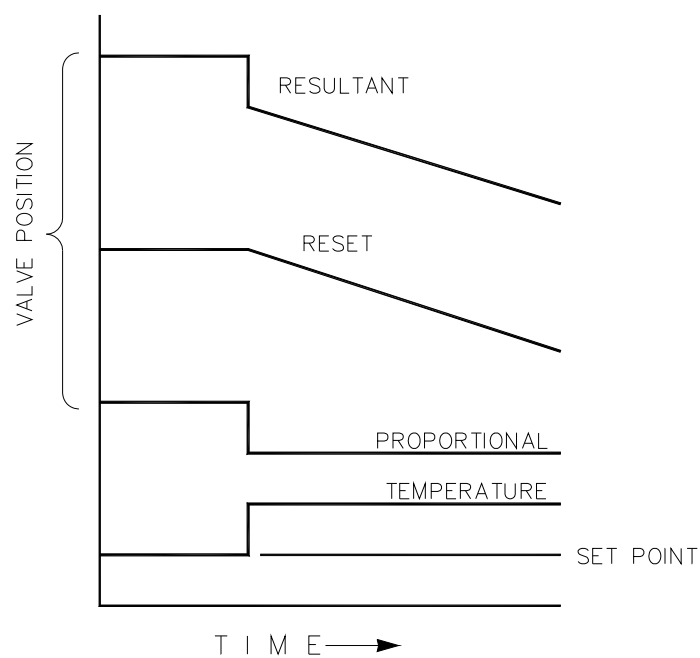
### Proportional Gain (effect of settings)

Figure 13-1 shows the effect of Proportional gain settings on control. Starting at the top of the graph a load change is introduced. With a small Proportional gain (meaning a large process change is required to produce full valve travel), stability is good but offset is very high. With a moderate gain setting (higher number setting) stability is still good—offset is still fairly high. With a high setting, offset is considerably smaller but the stability is poor. The 0.25 ratio effects a minimum area whereby the offset is reduced to a minimum while stability is in a decaying manner at 0.25% ratio. The decay ratio used (0.25%) means that if the second cycle is 1/4 of the first cycle, then each succeeding cycle will be 1/4 of the preceding cycle until the cycle is not visible.

Since Proportional gain is adjusted to produce (only) the proper stability of a process, do not continue increasing its effect to correct offset conditions. The amount of stability and offset is directly related to the setting of the Proportional setting. Stability is of course also affected by the stability of the process. In essence, the amount of output from the controller due to the Proportional setting is from the error. If there is no error, then there is no Proportional effect.

### Integral Response

Integral Gain as stated in the Woodward controls is repeats per minute (or Reset Rate). Therefore, a high amount of Integral gain (high number) would result in a large amount of Reset action. Conversely, a low Integral gain (low number) would result in a slower reset action.



830-361  
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Figure 13-2. Open Loop Proportional and Integral Response

Integral response is provided to eliminate the offset that resulted from straight Proportional control. Figure 13-2 shows how the controller action is Proportional to the measurement change, but as we saw earlier, this results in offset. The Integral (or Reset) action is a function of both time and magnitude of the deviation. As long as an offset condition (due to load changes) exists, Integral action is taking place.

The amount of Integral action is a function of four things:

- The magnitude of the deviation
- The duration of the deviation
- The Proportional gain setting
- The Integral setting

In this Open Loop figure (12-2), the Integral response is shown increasing due to the offset condition existing between the temperature and the setpoint. The resultant action is the top curve showing the step Proportional response that ends as soon as the measurement stops changing. Then the Integral (or reset) action is added to the Proportional action in an amount equal to the Integral of the deviation. In other words, Reset action continues (in either or both directions) as long as there is a difference (deviation) between the setpoint and the process measurement.

In this case, the deviation will never be eliminated (or even reduced) because the system is in Open Loop.

## Proportional + Integral (Closed Loop)

Figure 13-3 shows the closed loop effects of integral action. The bottom curve displays the load change. The next curve up shows the setpoint and the measured variable, temperature. With the load change the temperature drops or deviates from the setpoint.

The next highest curve is the Proportional action and follows the measured variable proportionately. The Integral curve adds to the Proportional curve resulting in a different valve position, thereby returning the process to the Setpoint.



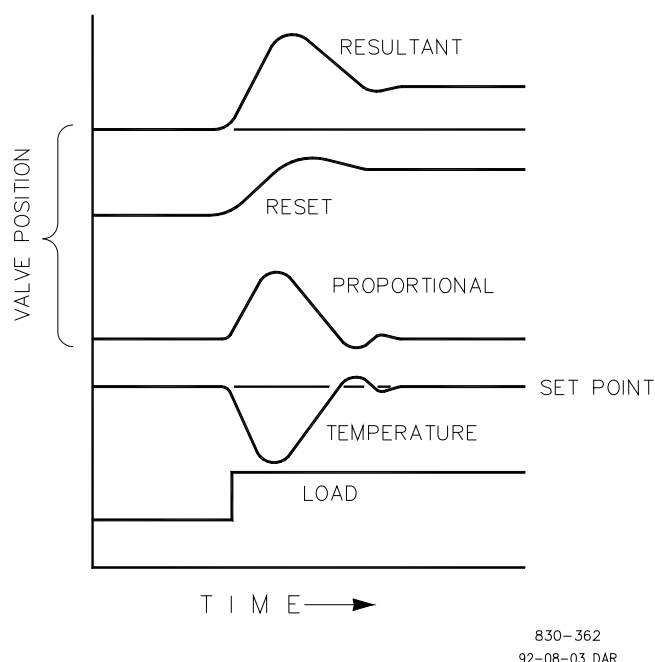


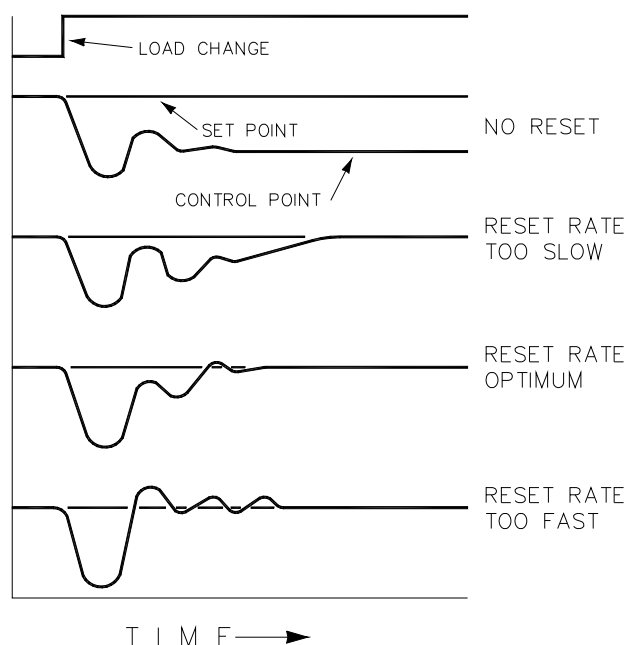
Figure 13-3. Closed Loop Proportional and Integral Response

In Closed Loop, however (as opposed to Open Loop), as the measurement decays toward the Setpoint the Proportional action is taking place Proportionally to the measurement change, and the Integral action is decaying proportionately to the magnitude and duration of the deviation until the measurement reaches the setpoint at which time the Integral action is zero.

### Integral (Effects of Settings)

Figure 13-4 shows the effect of fast or slow Integral action. For a given load change an offset results with Proportional response only. Since recovery time (for a given load change) is important, the Integral setting should remove the offset in minimum time without adding additional cycling. If two cycles are added, then too much Integral Gain has been added. Of course, Proportional only must first establish the 1/4 decay ratio. If increased cycling occurs, the Integral must be turned off or the controller switched to "manual" if allowed to go too far. Ideally, the process should not continue to cycle after the setpoint has been reached as in the second curve from the bottom.





830-363

92-08-03 DAR

Figure 13-4. Integral Gain (Reset) Setting Responses

## Derivative Response

In a process control loop the Derivative action is directly related to how fast the process changes (rate of change). If the process change is slow then the Derivative action is proportional to that rate of change. Derivative acts by advancing the Proportional action. Derivative acts at the start of the process change, when the process changes its rate and when the process stops its change.

Derivative action takes place at only three times:

- When the process starts to change
- When the rate of change takes place in the process
- When the process stops changing

The net result of Derivative action is to oppose any process change and combined with Proportional action to reduce stabilization time in returning the process to the setpoint after an upset. Derivative will not remove offset.

Woodward Derivative is split into two working domains, Input dominant and Feedback dominant. The allowed values for DR range from 0.01 to 100. The most common derivative is Feedback dominant; it is automatically selected with a Derivative Ratio (DR) from one to 100. The Input dominant domain is selected with DR values between 0.01 and 1.

Feedback dominant applies the derivative action to the integrator feedback term of the PID equation and is more stable than input dominant derivative. This will not take corrective action as early and it will be less noise sensitive. When tuning the derivative, the DR will be established in the 1 to 100 range because it is easier to tune and more forgiving of excessive values. Most PIDs will employ feedback dominant derivative.

Input dominant derivative applies the DR term before the integrator term of the PID equation. When the DR is less than one, the derivative is input dominant and reacts very quickly to process upsets. This function is very adapted for PIDs that control the load parameter, such as load shaft turbine speed. Since the input dominant derivative is so sensitive, it should be reserved only for applications without high frequency noise.

Except for input dominant and feedback dominant features, the reciprocal of one domain will appear identical in the other domain. As an example, consider a DR of 5.0, the reciprocal being 1/5. That means that a DR of 5.0 will appear the same as DR of 0.200. The difference in response between these values of 5.0 and 0.2 is in the dominance feature.

If in doubt about the type of derivative to use, then set up for feedback dominant,  $1 < DR < 100$ .

### Proportional + Derivative (Closed Loop)

Figure 13-5 shows how Derivative acts to oppose a change in process in either direction. The dashed line shows the Derivative action going through zero to oppose the process deviation traveling toward zero. Notice offset still exists between the desired setpoint and the drooped control point that resulted from the load change. The top curve is the resultant controller output, Proportional plus Derivative.

If an upset (momentary) had occurred rather than a load change, there would be no offset.

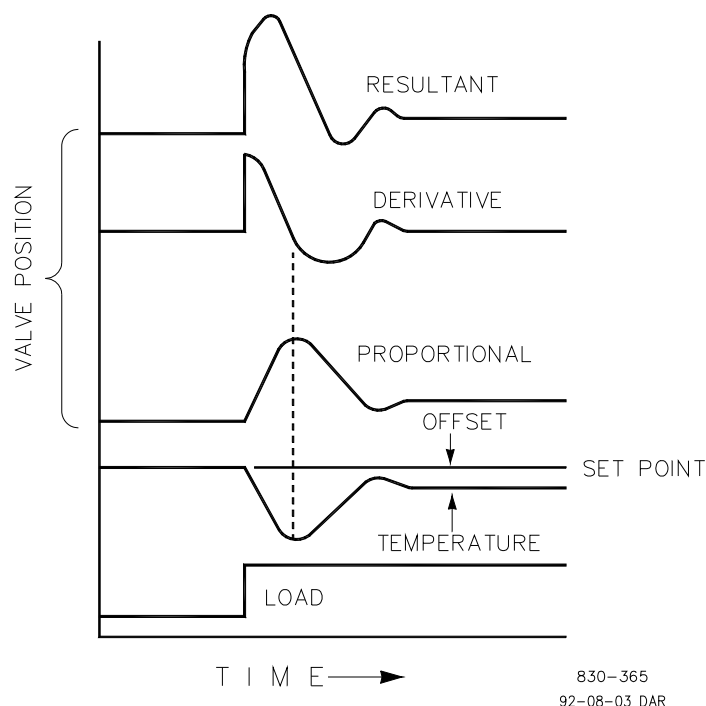


Figure 13-5. Closed Loop Proportional and Derivative Action

## Derivative (Effects of Settings)

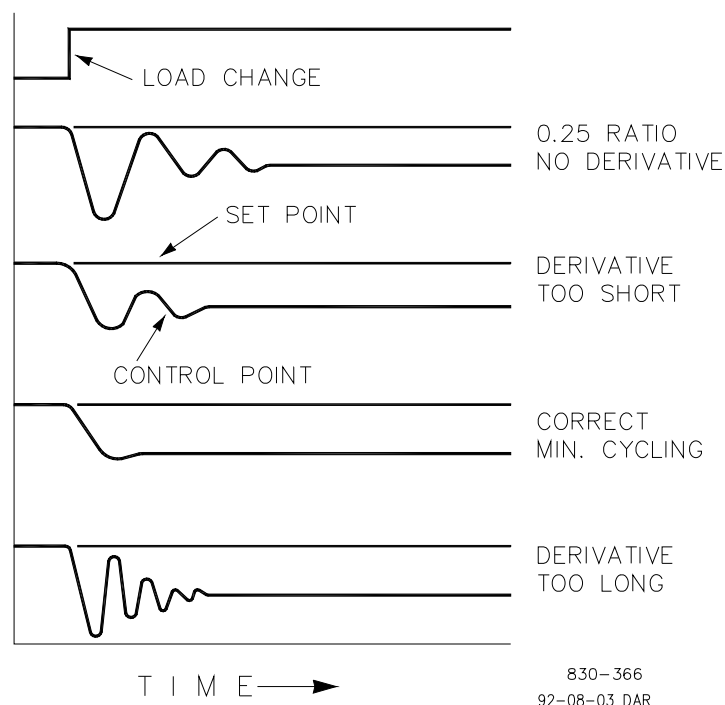


Figure 13-6. Derivative Setting Effects

Figure 13-6 shows the effect of different Derivative settings. The curves are relative since it depends on what type of control is desired in order to properly adjust Derivative time. For example, if minimum cycling is desired (as is shown here) then Derivative is added to the 1/4 decay cycle provided by Proportional until more than one cycle is removed and of course the 1/4 decay is destroyed. However, in most cases it is desirable to retain the 1/4 decay ratio, in which case Derivative is added to the point of removing only one cycle from the 1/4 decay ratio then the gain is increased until the 1/4 decay ratio is restored.

In all the above curves, you will note offset exists since offset is only eliminated by the addition of Integral (or Reset).

## Proportional + Integral + Derivative (Closed Loop)

Figure 13-7 shows the relationship of valve position to the interaction of the PID modes of control whenever a load change takes place in closed loop. As the temperature drops due to the load change, the proportional action moves the control valve proportionately to the measurement (temperature) change. The integral gain/reset adds to the proportional action because of the magnitude and time (duration) of the deviation. In addition, the derivative temporarily over-corrects based on the speed at which the measurement moves in any direction. The resultant curve (at the top) shows a similar over-correction (in this case), but in addition, the valve will stay at the new position required to keep the measurement at the setpoint.

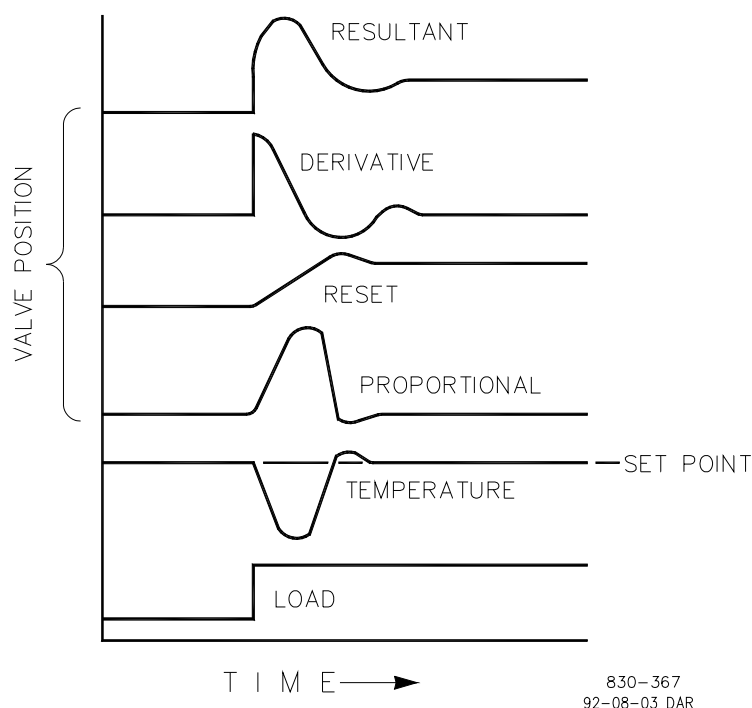


Figure 13-7. Closed Loop Proportional, Integral and Derivative Action

In summary, Derivative provides a temporary over-correction to compensate for long transfer lags and reduce stabilization time on process upsets (momentary disturbances).

## NOTICE

Do not use if high frequency noise is normally in the measured variable or the main lag is dead time. After Proportional is set to 1/4 decay ratio and Derivative is adjusted to remove one cycle as well as decreasing the 1/4 decay ratio, then the Proportional gain can be increased to restore the 1/4 decay ratio.

## Adding Derivative

The value of the Derivative Ratio (DR) term can range from 0.01 to 100. In order to simplify adjustment of the dynamics of the 505, adjusting the integral gain value sets both the I and D terms of the PID controller. The DR term establishes the degree of effect the integral gain value has on the "D" term, and changes the configuration of a controller from input rate sensitive (input dominant) to feedback rate sensitive (feedback dominant) and vice versa.

Another possible use of the DR adjustment is to reconfigure the controller from a PID to a PI controller. This is done by adjusting the DR term to its upper or lower limits, depending on whether an input or feedback dominant controller is desired.

- A DR setting of 1 to 100 selects feedback dominant mode
- A DR setting of .01 to 1 selects input dominant mode
- A DR setting of .01 or 100 selects a PI only controller, input and feedback dominant respectively

The change from one of these configurations to the other may have no effect during normal operation; however, it can cause great differences in response when the governor is coming into control. (i.e. at startup, during a full load change, or during transfer of control from another channel).

An input dominant controller is more sensitive to the change-of-rate of its input (i.e. Speed, Cascade in or Auxiliary in), and can therefore prevent overshoot of the setpoint better than a feedback dominant controller. Although this response is desirable during a startup or full load rejections, it can cause excessive control motions in some systems where a smooth transition response is desired.

A controller configured as feedback dominant is more sensitive to the change-of-rate of its feedback (LSS). A feedback dominant controller has the ability to limit the rate of change of the LSS bus when a controller is near its setpoint but is not yet in control. This limiting of the LSS bus allows a feedback dominant controller to make smoother control transitions than an input dominant controller.

## Controller Field Tuning General

The quality of regulation obtained from an automatic control system depends upon the adjustments that are made to the various controller modes. Best results are obtained when the adjustment (tuning) is done systematically. Prior training and experience in controller tuning are desirable for effective application of this procedure.

This procedure will lead to controller settings, which will provide after a load change:

- Process control without sustained cycling
- Process recovery in a minimum time

Controller settings derived for given operating conditions are valid over a narrow range of load change. The settings made for one operating set of conditions may result in excessive cycling or highly damped response at some other operating condition. This procedure should be applied under the most difficult operating conditions to assure conservative settings over the normal operating range. It is good practice to keep the average of the setpoint changes near the normal setpoint of the process to avoid excessive departure from normal operating level.

After each setpoint change, allow sufficient time to observe the effect of the last adjustment (see Figure 13-8). It is wise to wait until approximately 90% of the change has been completed.

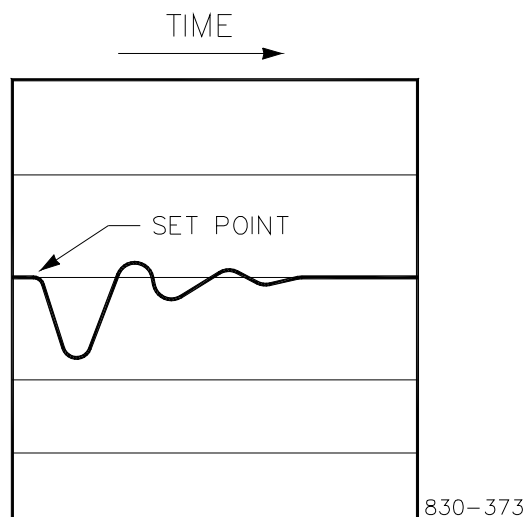


Figure 13-8. Typical Response to Load Change

### Tuning Example

If the system is unstable, make sure the governor is the cause. This can be checked by closing the valve limiter until it has control of the actuator output. If the governor is causing the oscillation, time the oscillation cycle time. A rule-of-thumb is, if the system's oscillation cycle time is less than 1 second reduce the Proportional gain term. A rule-of-thumb is, if the system's oscillation cycle time is greater the one-second reduce the Integral gain term (proportional gain may need to increase).

On an initial startup with the 505, all PID dynamic gain terms will require adjustment to match the respective PID's response to that of its control loop. There are multiple dynamic tuning methods available that can be used with the 505's PIDs to assist in determining the gain terms that provide optimum control loop response times.

The following method can be used to achieve PID gain values that are close to optimum:

1. Increase Derivative Ratio (SDR) to 100 (Service mode adjustment)
2. Reduce integral gain to 0.01 (Run mode adjustment)
3. Increase proportional gain until system just starts to oscillate (Run mode). The optimum gain for this step is when the system just starts to oscillate and maintains a self-sustaining oscillation that does not increase or decrease in magnitude.
4. Record the critical gain ( $K_c$ ) and oscillation period ( $T$ ) in seconds.
5. Set the dynamics as follows:
  - For PI control:  $G = P(I/s + 1)$ 
    - Set: Proportional gain =  $0.45 \cdot K_c$
    - Integral gain =  $1.2/T$
    - Derivative ratio = 100
  - For PID control:  $G = P(I/s + 1 + Ds)$ 
    - Set: Proportional gain =  $0.35 \cdot K_c$
    - Integral gain =  $0.76/T$
    - Deriv ratio =  $(5.2 \cdot T)/\text{Integral Gain for fdbk dominant}$
    - =  $(0.19 \cdot \text{Integral Gain})/T$  for input dominant

This method of tuning will get the gain settings close; they can be fine-tuned from this point.

## OPTI\_PID Automatic Dynamic Optimizer

### Use of the PID\_OPTI features

- User can tune the Manual settings for OFFLINE and ONLINE (same as old 505)
- Can select to use OPTI\_Tune – this will automatically populate the OPTI values with the manual values
- For OPTI\_Tune there is 1 set of dynamics for OFFLINE and a Curve of 1, 2 or 3 points for ONLINE
- Recommend to use the 3-pt curve for ONLINE settings using 20%, 50% and 80% load setpoints

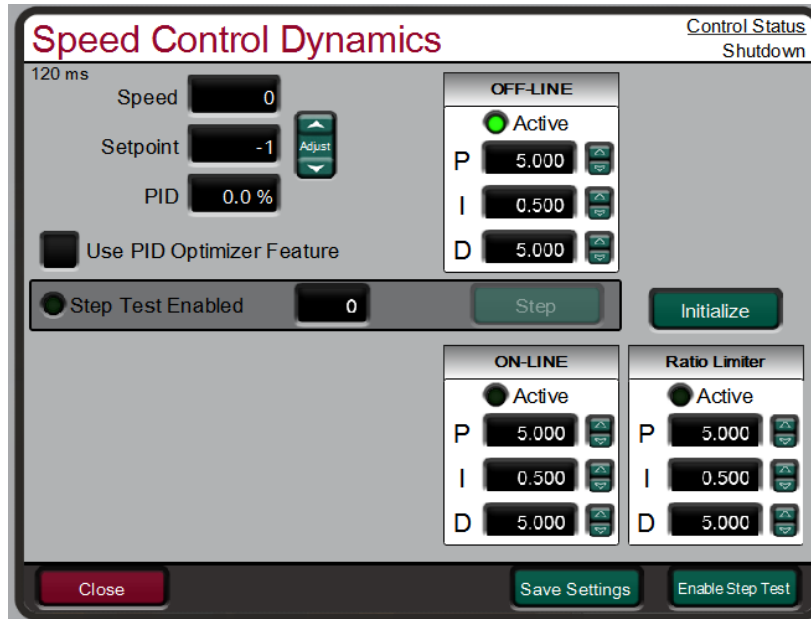


Figure 13-9. Speed Dynamics for Extraction/Admission type turbine

### Multiple Speed Dynamic Settings Features

Recommend the user tune the Manual settings for OFFLINE and ONLINE to settings that provide reasonably stable running conditions (same as old 505). Speed and setpoint are normalized (0-100%) into the speed PID on the 505XT, same as old 505's. This insures that gain settings from the installed units will work nearly identical to the new unit.

For the 505XT – view tables below for available dynamic settings and descriptions of when used

Table 13-1. Speed Control Dynamic Settings Options

Turbine Type	Available Dynamic Settings
Single Valve – mechanical drive	OFFLINE ONLINE
Single Valve – generator drive A Curve of 1, 2 or 3 points for ONLINE is available. if desired, we recommend to use the 3 curve points at 10%, 50% and 80% load setpoints	OFFLINE ONLINE (Curve Point 1) ONLINE (Curve Point 2) - optional ONLINE (Curve Point 3) - optional
Extraction/Admission – mechanical or GEN drive	OFFLINE ONLINE ON Ratio Limiter

Table 13-2. On-Line/Off-Line Dynamics Selection

Mechanical Drive	OFFLINE	=	DI OPEN or Speed < Min Gov
	ONLINE	=	DI CLOSED or Speed > Min Gov
	ONLINE Ratio Limiter	=	ONLINE and Extraction Enabled
Generator Drive	OFFLINE	=	DI OPEN or Either Breaker Open
	ONLINE (1, 2 or 3 pts)	=	DI CLOSED or Both Breakers Closed
	ONLINE Ratio Limiter	=	ONLINE and Extraction Enabled

\*The contact input option has priority, when programmed.

For the generator applications – selecting to use the Gain Curve will allow access to the page below which will allow the operator to run the OPTI\_Tune process at multiple load points and create a gain curve that will adjust the Speed PID gains through the load range of the turbine.

**ON-LINE Dynamics Gain Curve** Control Status  
Shutdown

Speed  Setpoint  ☒ Analysis Active ☐ Analysis Complete

☒ Use Curve Point 2 Speed Setpoint must be higher than PT 1

☒ Use Curve Point 3 Speed Setpoint must be higher than PT 2

Online Curve Setup			Load	PID	HP
Curve PT 1	Curve PT 2	Curve PT 3	<input type="text" value="0.0 %"/>	<input type="text" value="0.0 %"/>	<input type="text" value="0.0 %"/>
Accept	Accept	Accept			
SP <input type="text" value="3600.0"/>	<input type="text" value="3605.0"/>	<input type="text" value="3750.0"/>			
P <input type="text" value="5.000"/>	<input type="text" value="0.010"/>	<input type="text" value="0.010"/>			
I <input type="text" value="0.500"/>	<input type="text" value="0.010"/>	<input type="text" value="0.500"/>			
D <input type="text" value="5.000"/>	<input type="text" value="0.010"/>	<input type="text" value="5.000"/>			

**CALCULATED**

☒ Active

P

I

D

PID Optimizer

Figure 13-10. Speed Dynamics Generator On-Line Gain Curve



## Using the OPTI-Tune feature –

Use of the PID\_OPTI Automated Tune process –

- The OPTI\_Tune can be performed for any of the available dynamic settings
- OPTI\_Tune is operator initiated and will abort if any abnormal
- OPTI\_Tune will calculate new settings – but the user decides to use them or keep previous
- OPTI\_Tune can be adjusted to calculate different response profiles
- Adjustment of the OPTI\_Tune settings are available – but default values typically will work

By checking the option to use the PID Optimizer Feature – a navigation button will appear that will allow you to open the following screen:

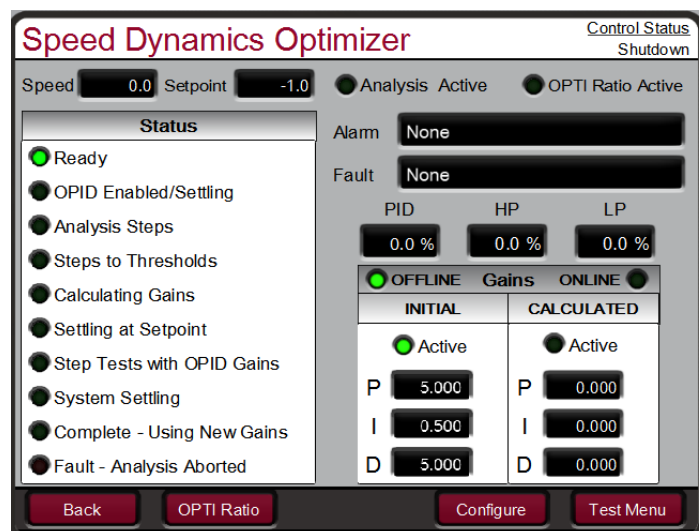


Figure 13-11. Speed Dynamics Optimizer

OPTI\_Tune will step through the process of analyzing the system dynamics, calculate gain values, run a test step, and indicate that it is complete. Once OPTI\_Tune has calculated gains, it will use those gains until they are Accepted or OPTI\_Tune process is Aborted.

**CAUTION** – if the values are not desired to be used – Abort will cause a ‘step’ back to manual settings. There is a 6 minute TIMEOUT from when OPID test starts, if not ACCEPTED it will Abort after this time

## Configuring the OPTI-Tune test limits –

The configuration of the OPTI\_Tune should work with the default values, but if needed, there is a Configure button, which allows the operator to adjust the settings used during the test. The Process and Actuator Limit values are used such that the OPTI\_Tune cannot exceed these values during the test – if they are exceeded the Test will abort, dynamic values will return to the initial values and a Fault status message will be displayed.

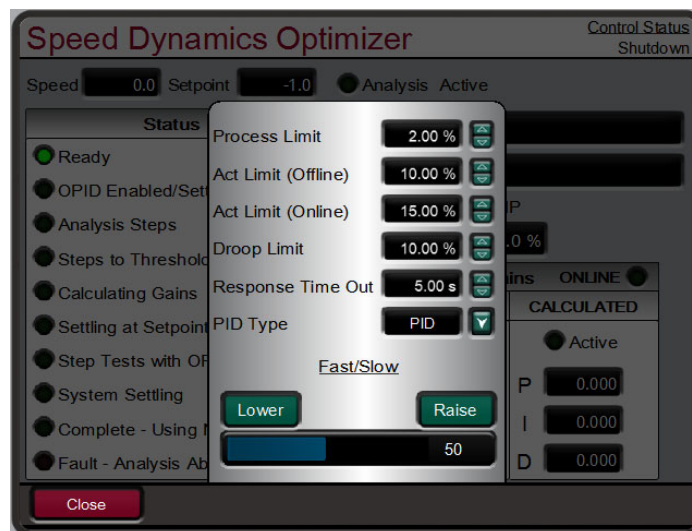


Figure 13-12. Configuring settings for OPTI\_Tune

## Chapter 14.

# Hardware/Operating System Faults

### General

**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.**

### Wiring Problems

Most 505 problems are caused by wiring problems. Carefully and thoroughly check all wiring connections at both ends. Be very careful when installing wires into the 505 control terminal blocks. Check all shields for proper grounding.

All inputs and outputs can be measured directly at the terminal strips. In addition, from the Hardware pages, the display will show what the 505 measures. This comparison can be used to determine if the 505 is interpreting the input signal correctly. The Hardware pages on the display can be used to monitor and adjust analog inputs and outputs, monitor speed inputs, monitor and adjust actuator outputs, monitor contact inputs, and monitor and force relay outputs.

Contact inputs can be verified by measuring the voltage at the terminal blocks. The contact power supply voltage should measure approximately 24 Vdc from any contact (+) terminal to the contact GND terminal (11). If 24 Vdc is not the voltage measured, disconnect all wiring to the 505 except input power, and then re-measure this power supply voltage. If 24 Vdc is not the voltage measured, check for wiring problems. If 24 Vdc is not measured across the contact input (+) and contact GND terminal (11) with input wiring disconnected, replace the 505.

The operation of a contact input to the 505 can be checked by verifying that the voltage from the contact input's (+) terminal measures 24 Vdc with respect to the contact input GND, terminal (11), when the external contact is closed.

Any 4–20 mA input or output can be checked by placing a milliamp meter in series with the input or output.

Refer to Volume 1 Chapter 2 for actuator wiring concerns or questions.

If the serial communications line is not working, check the wiring first. Then check the Program mode entries for matching communications setup.

### Control Adjustments

If, while trying to adjust the Speed Setpoint in the Run mode, the ADJ up and ADJ down keys will not work, check to make sure that CAS (cascade control) and RMT (remote control) are both disabled.

If the system's steam valve is unsteady or hunts, try manually positioning the steam valve by closing the valve limiter. If the steam valve is blocked in this manner and the actuator output is steady but the turbine still hunts, then the problem is outside the governor. If an actuator hunts, or appears sticky, it may need dither (especially TM type).

If the 505 control is not able to fully close or open the governor valves, check to make sure that the actuators are calibrated correctly, and valve linkage is correctly set.

If the 505 control is not able to control speed above or below a certain speed, the steam valve may not be adjusted correctly. Verify that the steam valve position is indeed in the position indicated by the 505 (by pressing the ACT key). If these positions do not match, correct the problem (actuator linkage, or current calibration).

If an overspeed condition is reached on start-up, verify that the governor valve is closed. Next, verify that the governor valve is correctly seated by opening the T&T valve with the governor valve closed. If the T&T valve allows the turbine to turn, then the governor valve is not correctly seated.

## **Other Operating Problems**

If CAS or RMT will not work, check that the generator and tiebreakers are both closed.

From the (MANUAL SHUTDOWN) (PUSH YES OR NO) display, you cannot initiate a shutdown.

If actual speed is less than the speed called for by the speed setpoint, check for droop (kW or speed). Droop causes the actual speed to be less than the speed reference.

## Appendix B.

# 505 Design Specifications

### Hardware Specifications

#### Package

Flush mount package

Approximate physical size of 11" x 14" x 4"

Environmental Category:

Refer to Regulatory Compliance section of Volume 1  
(some listings are dependent on part number)

#### Built-In Graphical User Interface (GUI)

1. 8.4" LCD Display (800x600) and Keypad
2. 34 key multi-function keypad.
3. Emergency stop button (direct to hardware circuits)
4. Alarm, Trip, and Hardware status LED indicators.

#### General I/O, Power Supply, and Environmental Specifications

*REFER To CHAPTER 2 OF Volume 1 of this manual*

#### Microprocessor

Motorola MPC5125 Microprocessor/25 MHz

#### Interfacing to Woodward Service Tools

All interfacing to service tools is done via Ethernet (RJ45) communications and can be accessed from any of the Ethernet ports. See the Appendices for instructions on connecting and using each of the service tools.

### Software Specifications

#### Speed/Load Control

NEMA D or better speed regulation.

#### Nominal Software Execution Rate

Speed/Load Control: 10 ms

Auxiliary Control: 20 ms

Cascade Control: 20 ms

Remote Speed Setpoint: 40 ms

Remote Aux Setpoint: 40 ms

Remote Cascade Setpoint: 40 ms

Sync/Load Share Control: 20 ms

Shutdowns: 10 ms

Alarms: 40 ms

Relays:

- a. Trip Relay: 10 ms
- b. Alarm Relay: 20 ms
- c. Configurable Relays: 40 ms

Readouts: 40 ms

Contact Inputs:

- a. External Trip & Configurable Inputs: 10 ms
- b. Reset: 40 ms
- c. Speed Raise & Lower: 20 ms

***IMPORTANT***

The “nominal rate” listed is the fastest update rate, the worst case response would be twice the nominal rate.

## Appendix C.

# 505XT Service Mode Worksheet

Governor Serial Number \_\_\_\_\_

Application \_\_\_\_\_ Date \_\_\_\_\_

For details on individual settings, refer to Chapter 4.

<b><u>SPEED CONTROL</u></b>	Default	Site Value	
Rate to Min	10.0		rpm/s
Slow Rate Offline	5.0		rpm/s
Slow Rate Online	5.0		rpm/s
Fast Rate Delay	3.0		rpm/s
Fast Rate Offline	15.0		rpm/s
Fast Rate Online	15.0		rpm/s
Entered Rate Offline	5.0		rpm/s
Entered Rate Offline	5.0		rpm/s
Underspeed Setting	0		rpm
Online Speed Deadband (Hz)	0		value
Instant Minimum Load Rate	50		rpm/s
Display Gauge Multiplier	x1		value
Hold Speed Changes	NO		YES/NO
Overspeed Rate	5.0		rpm/s
Use Reduced Overspeed Setpoint	NO		YES/NO
Reduced Overspeed Setpoint	1000		rpm
<b>If Remote Speed Setpoint</b>			
Not Matched Rate	5.0		rpm/s
Speed Setpoint Maximum Rate	5.0		rpm/s
Minimum Speed Setpoint	1.0		rpm
Maximum Speed Setpoint	1.0		rpm
Remote Deadband Value	0.0		rpm
Lag-Tau Value	1.0		value
Use Minimum Load	YES		YES/NO
Hold Remote Speed Changes	NO		YES/NO
Generator Breaker Open Disable	NO		YES/NO
Utility Breaker Open Disable	NO		YES/NO

<b><u>VALVE LIMITER</u></b>	Default	Site Value	
HP Limiter Rate	5.0		rpm/s
HP Entered Rate	5.0		rpm/s
HP Limiter Maximum Limit	101.0		%
HP Maximum at Start	101.0		%
Shutdown at Maximum	NO		YES/NO
Hold Limiter Changes	NO		YES/NO



## Manual 35018V2

## 505XT Digital Control System for Steam Turbines

If Ext/Adm			
LP Limiter Rate	1.0		rpm/s
LP Entered Rate	1.0		rpm/s
LP Maximum Limit	100.0		%
LP Minimum	0.0		%
Hold Limiter Changes	NO		YES/NO

<b>MPU SIGNALS</b>	Default	Site Value	
Use MPU Override Timer?	NO		YES/NO
Override Time (sec)	600		
Override Time Remaining	0		status
MPU 1 Override On	ON		status
MPU 2 Override On	ON		status

<b>IDLE/RATED RAMP</b>	Default	Site Value	
Hours Since Trip	200		status
Hot Reset Timer (minutes)	0.0		min
Idle/Rated Cold Rate	20.0		rpm/s
Idle/Rated Warm Rate	20.0		rpm/s
Idle/Rated Hot Rate	20.0		rpm/s
Use Ramp to Idle	YES		YES/NO
Idle Priority	NO		YES/NO
Rated Priority	YES		YES/NO
<b>If Temp Start used</b>			
Temperature 1 Input			Status (deg)
Override Temp 1	NO		YES/NO
Temperature 2 Input			Status (deg)
Override Temp 2	NO		YES/NO

<b>AUTOMATIC START SEQUENCE</b>	Default	Site Value	
Hours Since Trip	200		status
Hot Reset Timer (minutes)	0.0		min
Hot Reset Time Remaining (minutes)	0.0		status
Hot Time Remaining (Hour)	20.0		status
Time until Cold Start	20.0		status
Rate to Rated	5.0		rpm/s
Idle 1 Delay	0.0		min
Rate to Idle 2	5.0		rpm/s
Idle 2 Delay	0.0		min
Rate to Idle 3	5.0		rpm/s
Idle 3 Delay	0.0		min
<b>If Temp Start used</b>			
Temperature 1 Input			Status (deg)
Override Temp 1	NO		YES/NO
Temperature 1 Input			Status (deg)

Override Temp 1	NO		YES/NO
-----------------	----	--	--------

<b>PRESSURE COMPENSATION</b>	Default	Site Value	
Curve Output (Current Gain)			status
Pressure Point 1	1.0		pressure
Gain 1	1.0		value
Pressure Point 2	2.0		pressure
Gain 2	1.0		value
Pressure Point 3	3.0		pressure
Gain 3	1.0		value
Pressure Point 4	4.0		pressure
Gain 4	1.0		value
Pressure Point 5	5.0		pressure
Gain 5	1.0		value

**Note:** Each pressure point *MUST* be higher than the previous point (points 1-5)

<b>BREAKER LOGIC</b>	Default	Site Value	
Frequency Control Armed			status
Sync Window RPM	10.0		rpm
Sync Window Rate	2.0		rpm/s
Tie Breaker Open Ramp	YES		YES/NO
Tie Open Rate	1.0		rpm/s
Generator Open Setpoint	3600		rpm
Zero Load Value (HP valve %)	0.0		%
Use Minimum Load	YES		YES/NO
Reverse Power Protection?	YES		YES/NO
Minimum Load Bias (RPM above Rated)	5.4		rpm
Frequency Offset (Hz)	0.0		hz
Frequency Deadband (Hz)	0.0		hz
Tie Open Load Rejection?	YES		YES/NO
Hold Breaker Logic Changes	NO		YES/NO
Frequency Excursion Test Visible	NO		YES/NO

<b>SYNC/LOAD SHARE</b>	Default	Site Value	
Input Bias Gain	5.0		value
Input Bias Deadband	0.0		rpm
Lag-Tau Value (sec)	0.0		filter
Hold Changes			

<b><u>SPEED CONTROL DROOP</u></b>	Default	Site Value	
Actual Droop	5.0		value
Minimum Droop	1.0		rpm
Maximum Droop	12.0		filter
Use MW as Load Units?	NO		YES/NO
Use Load Droop?	NO		YES/NO
Entered Droop Setpoint	5.0		value

<b><u>AUXILIARY CONTROL</u></b>	Default	Site Value	
Slow Rate	5.0		Units/s
Fast Rate Delay	3.0		s
Fast Rate	15		Units/s
Entered Rate	5.0		Units/s
Droop (%)	0.0		%
Rated Auxiliary Setpoint	100		Units
Threshold (Limiter)	10.0		%
Threshold (Controller)	100.0		%
PID Minimum Output	0.0		%
Display Gauge Multiplier	x1		Value
Hold Auxiliary Changes	NO		YES/NO
<b>If Remote Auxiliary Setpoint</b>			
Not Matched Rate	5.0		Units/s
Remote Auxiliary Maximum Rate	5.0		Units/s
Minimum Remote Auxiliary Setpoint	0.0		Units
Maximum Remote Auxiliary Setpoint	0.0		Units
Remote Deadband	0.0		Units
Lag-Tau Value	0.0		value
Hold Remote Auxiliary Changes	NO		YES/NO

<b><u>EXTRACTION/ADMISSION CONTROL</u></b>	Default	Site Value	
Slow Rate	5.0		Units/s
Fast Rate Delay	3.0		s
Fast Rate	15.0		Units/s
Entered Rate	5.0		Units/s
Use Droop?	NO		YES/NO
Droop (%)	0.0		%
Rated Setpoint	100.0		Units
Action On PV Failure	Manual P		Manual P LP Limiter Max LP Limiter Min
PID Threshold	100.0		%
PID Minimum Output	0.0		%
Startup Demand Setting (E/A or ADM)	50.0		%
Speed Enable Setting	1000.0		RPM

## Manual 35018V2

## 505XT Digital Control System for Steam Turbines

Generator Breaker Open Extr/Adm Inhibit?	YES		YES/NO
Deadband	0.0		Units
Display Gauge Multiplier	x1		Value
Hold Ext/Adm Changes	NO		YES/NO
Go to Full Decoupled Mode?	NO		YES/NO
<b>If Remote Ext/Adm Setpoint</b>			
Not Matched Rate	5.0		Units/s
Remote Maximum Rate	5.0		Units/s
Minimum Remote Setpoint	0.0		Units
Maximum Remote Setpoint	0.0		Units
Remote Deadband	0.0		Units
Lag-Tau Value	0.0		value
Hold Remote Ext/Adm Changes	NO		YES/NO

<b>CASCADE CONTROL</b>	Default	Site Value	
Slow Rate	5.0		Units/s
Fast Rate Delay	3.0		s
Fast Rate	15		Units/s
Entered Rate	5.0		Units/s
Droop (%)	0.0		%
Rated Cascade Setpoint	100		Units
Cascade Not Matched Rate	5.00		Units/s
Maximum Speed Rate	20		RPM/s
Minimum Speed Setpoint	1.0		RPM
Maximum Speed Setpoint	1.0		RPM
Cascade Deadband	0.1		Units
Raise/Lower Cascade Only	NO		YES/NO
Use Minimum Load	YES		YES/NO
Breaker Enables Control	NO		YES/NO
Display Gauge Multiplier	X1		value
Hold Cascade Changes	NO		YES/NO
<b>If Remote Cascade Setpoint</b>			
Not Matched Rate	5.0		Units/s
Remote Cascade Maximum Rate	5.0		Units/s
Minimum Remote Cascade Setpoint	0.0		Units
Maximum Remote Cascade Setpoint	0.0		Units
Remote Deadband	0.0		Units
Lag-Tau Value	0.0		value
Hold Remote Cascade Changes	NO		YES/NO

<b>COMMUNICATIONS</b>	Default	Site Value	
Use Modbus Trip	Yes		Yes/No
Use 2-Step Trip	No		Yes/No
Enable Link 1 (Serial) Writes?	No		Yes/No
Enable Link 2 (Ethernet) Writes?	No		Yes/No
Enable Link 3 (Ethernet) Writes?	No		Yes/No
<b>If Serial Port 1</b>			
Link Status			Status
Exception Error			Status
Time-out Delay	10.0		s
Error Code			Status
<b>If Ethernet Port 2</b>			
Link Status			Status
Exception Error			Status
Time-out Delay	10.0		s
Error Code			Status
<b>If Ethernet Port 3</b>			
Link Status			Status
Exception Error			Status
Time-out Delay	10.0		s
Error Code			Status
<b>Servlink</b>			
<b>Socket 1</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 2</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 3</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 4</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 5</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 6</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status

<b>COMMUNICATIONS</b>	Default	Site Value	
<b>Socket 7</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>Socket 8</b>			
IP	0.0.0.0		Status
Status	0		Status
Login Level	0		Status
<b>If CAN Communications</b>			
<b>CAN Port 1</b>			
Port Enabled			Status
Link Error			Status
RX Error			Status
CAN Load %			Status
NMT Status			Status
State			Status
<b>CAN Port 2</b>			
Port Enabled			Status
Link Error			Status
RX Error			Status
CAN Load %			Status
NMT Status			Status
State			Status
<b>CAN Port 3</b>			
Port Enabled			Status
Link Error			Status
RX Error			Status
CAN Load %			Status
NMT Status			Status
State			Status

<b>LOCAL/REMOTE</b>	Default	Site Value	
Local Mode Enabled			Status
Remote Mode Enabled			Status
Enable Contacts	NO		YES/NO
Contacts Enabled			Status
Modbus Serial Link 1 Enable When Local	NO		YES/NO
Link 1 Writes Enabled			Status
Modbus Ethernet Link 2 Enable When Local	NO		YES/NO
Link 2 Writes Enabled			Status
Modbus Ethernet Link 3 Enable When Local	NO		YES/NO
Link 3 Writes Enabled			Status

<b>ALARMS</b>	Default	Site Value	
Trip is an Alarm	NO		YES/NO
Blink upon new Alarm	NO		YES/NO
Jump to Alarm Screen	NO		YES/NO
Shutdown on Power Up	YES		YES/NO
Test Alarm (Tunable) – Event ID 82	NO		YES/NO
<b>Configurable Alarm 1</b>			
Analog Input Signal	Not Used		
Use Alarm Setpoint 1	NO		YES/NO
Use Alarm Setpoint 2	NO		YES/NO
Level 1 Setpoint	60.00		Units
Invert Action on Level 1?	NO		YES/NO
Level 2 Setpoint	70.00		Units
Invert Action on Level 2?	NO		YES/NO
Use Level 2 as a Trip?	NO		YES/NO
Setpoint Hysteresis	-3.00		Units
Delay for Event Action	2.00		s
Enable Speed Setpoint	100		RPM
Enable Speed Setpoint Hysteresis	10.00		RPM
<b>Configurable Alarm 2</b>			
Analog Input Signal	Not Used		
Use Alarm Setpoint 1	NO		YES/NO
Use Alarm Setpoint 2	NO		YES/NO
Level 1 Setpoint	60.00		Units
Invert Action on Level 1?	NO		YES/NO
Level 2 Setpoint	70.00		Units
Invert Action on Level 2?	NO		YES/NO
Use Level 2 as a Trip?	NO		YES/NO
Setpoint Hysteresis	-3.00		Units
Delay for Event Action	2.00		s
Enable Speed Setpoint	100		RPM
Enable Speed Setpoint Hysteresis	10.00		RPM
<b>Configurable Alarm 3</b>			
Analog Input Signal	Not Used		
Use Alarm Setpoint 1	NO		YES/NO
Use Alarm Setpoint 2	NO		YES/NO
Level 1 Setpoint	60.00		Units
Invert Action on Level 1?	NO		YES/NO
Level 2 Setpoint	70.00		Units
Invert Action on Level 2?	NO		YES/NO
Use Level 2 as a Trip?	NO		YES/NO
Setpoint Hysteresis	-3.00		Units
Delay for Event Action	2.00		s
Enable Speed Setpoint	100		RPM
Enable Speed Setpoint Hysteresis	10.00		RPM
<b>If Inlet Pressure Signal</b>			
Analog Input Signal	Not Used		
Use Alarm Setpoint 1	NO		YES/NO



## Manual 35018V2

## 505XT Digital Control System for Steam Turbines

Use Alarm Setpoint 2	NO		YES/NO
Level 1 Setpoint	60.00		Units
Invert Action on Level 1?	NO		YES/NO
Level 2 Setpoint	70.00		Units
Invert Action on Level 2?	NO		YES/NO
Use Level 2 as a Trip?	NO		YES/NO
Setpoint Hysteresis	-3.00		Units
Delay for Event Action	2.00		s
Enable Speed Setpoint	100		RPM
Enable Speed Setpoint Hysteresis	10.00		RPM
<b>If Exhaust Pressure Signal</b>			
Analog Input Signal	Not Used		
Use Alarm Setpoint 1	NO		YES/NO
Use Alarm Setpoint 2	NO		YES/NO
Level 1 Setpoint	60.00		Units
Invert Action on Level 1?	NO		YES/NO
Level 2 Setpoint	70.00		Units
Invert Action on Level 2?	NO		YES/NO
Use Level 2 as a Trip?	NO		YES/NO
Setpoint Hysteresis	-3.00		Units
Delay for Event Action	2.00		s
Enable Speed Setpoint	100		RPM
Enable Speed Setpoint Hysteresis	10.00		RPM
<b>If Valve Position Feedback</b>			
Enable HP Difference Alarm	NO		YES/NO
Position Error Tolerance	5.00		%
Position Error Duration	5.00		s
Enable HP2 Difference Alarm?	NO		YES/NO
Enable LP Difference Alarm?	NO		YES/NO

<b>ACTUATOR LINEARIZATION</b>	Default	Site Value	
<b>HP Linearization</b>			
X-1 Value	0.0		%
Y-1 Value	0.0		%
X-2 Value	10.0		%
Y-2 Value	10.0		%
X-3 Value	20.0		%
Y-3 Value	20.0		%
X-4 Value	30.0		%
Y-4 Value	30.0		%
X-5 Value	40.0		%
Y-5 Value	40.0		%
X-6 Value	50.0		%
Y-6 Value	50.0		%
X-7 Value	60.0		%
Y-7 Value	60.0		%
X-8 Value	70.0		%
Y-8 Value	70.0		%
X-9 Value	80.0		%

## Manual 35018V2

## 505XT Digital Control System for Steam Turbines

Y-9 Value	80.0		%
X-10 Value	90.0		%
Y-10 Value	90.0		%
X-11 Value	100.0		%
Y-11 Value	100.0		%
<b>HP2 Linearization</b>			
X-1 Value	0.0		%
Y-1 Value	0.0		%
X-2 Value	10.0		%
Y-2 Value	10.0		%
X-3 Value	20.0		%
Y-3 Value	20.0		%
X-4 Value	30.0		%
Y-4 Value	30.0		%
X-5 Value	40.0		%
Y-5 Value	40.0		%
X-6 Value	50.0		%
Y-6 Value	50.0		%
X-7 Value	60.0		%
Y-7 Value	60.0		%
X-8 Value	70.0		%
Y-8 Value	70.0		%
X-9 Value	80.0		%
Y-9 Value	80.0		%
X-10 Value	90.0		%
Y-10 Value	90.0		%
X-11 Value	100.0		%
Y-11 Value	100.0		%
<b>LP Linearization</b>			
X-1 Value	0.0		%
Y-1 Value	0.0		%
X-2 Value	10.0		%
Y-2 Value	10.0		%
X-3 Value	20.0		%
Y-3 Value	20.0		%
X-4 Value	30.0		%
Y-4 Value	30.0		%
X-5 Value	40.0		%
Y-5 Value	40.0		%
X-6 Value	50.0		%
Y-6 Value	50.0		%
X-7 Value	60.0		%
Y-7 Value	60.0		%
X-8 Value	70.0		%
Y-8 Value	70.0		%
X-9 Value	80.0		%
Y-9 Value	80.0		%
X-10 Value	90.0		%
Y-10 Value	90.0		%
X-11 Value	100.0		%

Y-11 Value	100.0		%
------------	-------	--	---

<b>REAL TIME CLOCK</b>	Default	Site Value	
Use SNTP Synchronization	NO		YES/NO
Time Zone	0		Integer
Year	15		Integer
Month	1		Integer
Day	1		Integer
Hour	0		Integer
Minutes	0		Integer
Seconds	0		Integer

<b>DATALOG</b>	Default	Site Value	
<b>TrendLog Status</b>			
Data Sample Rate	1000		ms

<b>OPERATION LOG</b>	Default	Site Value	
Number of Turbine Starts	0		value
Number of Hot Starts	0		value
Total Trips	0		value
Trips with Load > 25%	0		value
Trips with Load > 75%	0		value
Overspeed Trips	0		value
Total Run Time Hours	0		value
Run Time Hours with Load > 25%	0		value
Run Time Hours with Load > 75%	0		value
Total Run Time Hours	0		value
Enable Maintenance Alarm	NO		YES/NO
Maintenance Alarm Interval	15000		Hours
Maintenance Alarm			Status
Peak Speed Reached			Status
Peak Acceleration Reached			Status

<b>ISOLATED CONTROL</b>	Default	Site Value	
Setpoint	100.0		Units
Process			Status
Demand			Status
Remote Setpoint Enabled			Status
Remote Setpoint Fault			Status
Auto Control			Status
Process Input Fault			Status
Manual Demand			Status
<b>Setpoint Limits</b>			
Maximum	100.00		Units
Minimum	0.00		Units
Initial	100.00		Units
Normal Rate	1.00		Units/s
Fast Rate	3.00		Units/s
<b>Output Limits</b>			
Maximum	100.00		Units
Minimum	0.00		Units
Initial	100.00		Units
Normal Rate	1.00		Units/s
Fast Rate	3.00		Units/s
<b>PID Dynamics</b>			
P Term	0.550		Value
I Term	0.750		Value
D Term	100.00		Value

<b>SCREEN/KEY OPTIONS</b>	Default	Site Value	
Screen Saver Delay	4.0		Hours
Auto Login as Operator	YES		YES/NO
Operator Password	wg1111		string
Use STOP Command	YES		YES/NO
Screen Update Rate			Status (ms)
CPU Idle Time			Status (%)
Internal Operating Temp of 505			Status (C)
Screen Brightness	75		Status (%)

<b>CUSTOM TREND</b>	Default	Site Value	
<b>Settings</b>			
Time Window	60		s
Signal 1 (Red)	Not Used		Selection
Y Maximum	100		Units
Y Minimum	0		Units
Width	1		Value
Show Axis	YES		YES/NO
Signal 1 (Green)	Not Used		Selection
Y Maximum	100		Units
Y Minimum	0		Units
Width	1		Value
Show Axis	YES		YES/NO
Signal 3 (Blue)	Not Used		Selection
Y Maximum	100		Units
Y Minimum	0		Units
Width	1		Value
Show Axis	YES		YES/NO
Signal 4 (Purple)	Not Used		Selection
Y Maximum	100		Units
Y Minimum	0		Units
Width	1		Value
Show Axis	YES		YES/NO
Signal 5 (Orange)	Not Used		Selection
Y Maximum	100		Units
Y Minimum	0		Units
Width	1		Value
Show Axis	YES		YES/NO

<b>FEEDFORWARD</b>	Default	Site Value	
Feed Forward Speed Deadband	0.1		Value
<b>If Direct Feed Forward</b>	NO		YES/NO
Speed Offset at 4mA	-100		RPM
Speed Offset at 20mA	100		RPM
<b>If Emergency Feed Forward</b>			
Emergency Action Delay	10.00		s
Forward Rate to Activate	10.0		%/s
Emergency Max Forward Rate	100.0		%/s
Emergency Max Speed Offset	300.0		RPM
Emergency Max Speed Rate	500.0		RPM/s

<b>MANUAL DEMAND</b>	Default	Site Value	
Enable Use of Manual Demand	NO		YES/NO
Manual Demand Rate	0.25		%/s
Timeout When Inactive	300		s

<b>ACCELERATION LIMITER</b>	Default	Site Value	
Use Acceleration Limiter	NO		YES/NO
Proportional Gain	0.5		Value
Integral Gain	0.5		Value
Derivative Gain	5.0		Value

<b>INLET CONTROL</b>	Default	Site Value	
Slow Rate	5.0		Units/s
Fast Rate Delay	3.0		s
Fast Rate	15		Units/s
Entered Rate	5.0		Units/s
Droop (%)	0.0		%
Rated Setpoint	100		Units
Threshold (Limiter)	10.0		%
Threshold (Controller)	100.0		%
PID Minimum Output	0.0		%
Display Gauge Multiplier	x1		Value
Hold Auxiliary Changes	NO		YES/NO
<b>If Remote Inlet Setpoint</b>			
Not Matched Rate	5.0		Units/s
Remote Maximum Rate	5.0		Units/s
Minimum Auxiliary Setpoint	0.0		Units
Maximum Auxiliary Setpoint	0.0		Units
Remote Deadband	0.0		Units
Lag-Tau Value	0.0		value
Hold Remote Changes	NO		YES/NO

<b>EXHAUST CONTROL</b>	Default	Site Value	
Slow Rate	5.0		Units/s
Fast Rate Delay	3.0		s
Fast Rate	15		Units/s
Entered Rate	5.0		Units/s
Droop (%)	0.0		%
Rated Setpoint	100		Units
Threshold (Limiter)	10.0		%
Threshold (Controller)	100.0		%
PID Minimum Output	0.0		%
Display Gauge Multiplier	x1		Value
Hold Auxiliary Changes	NO		YES/NO
<b>If Remote Inlet Setpoint</b>			
Not Matched Rate	5.0		Units/s
Remote Maximum Rate	5.0		Units/s
Minimum Auxiliary Setpoint	0.0		Units
Maximum Auxiliary Setpoint	0.0		Units
Remote Deadband	0.0		Units
Lag-Tau Value	0.0		value
Hold Remote Changes	NO		YES/NO

<b>STEAM MAP</b>		Default	Site Value
<b>Steam Performance Map</b>			
K1 Map Value	0.36		Value
K1 Service Value	0.36		Value
K2 Map Value	0.59		Value
K2 Service Value	0.59		Value
K3 Map Value	13.05		Value
K3 Service Value	13.05		Value
K4 Map Value	1.14		Value
K4 Service Value	1.14		Value
K5 Map Value	-0.55		Value
K5 Service Value	-0.55		Value
K6 Map Value	4.55		Value
K6 Service Value	4.55		Value
Retain Service Values	NO		YES/NO
<b>Steam Map Priority Selection</b>			
Mode 0	Speed		Speed/Extraction
Mode 1	Speed		Speed/Inlet
Mode 2	Inlet		Extraction/Inlet
Mode 3	Speed		Speed/Exhaust
Mode 4	Exhaust		Extraction/Exhaust
Mode 5	Inlet		Inlet/Exhaust
Mode 6	Inlet		Inlet/Exhaust



## Appendix D. Password Information

### General

The 505 Series control system requires a password to be entered before access can be given to the OPERATOR, SERVICE, CONFIGURE, or Service User modes. These passwords help prevent unauthorized or untrained personnel from accessing these modes and possibly making changes that could cause damage to the turbine or associated process. If only selected people are to know these passwords, remove this appendix and keep it in a separate place, apart from the manual.

#### To enter the login or password on the front panel display:

Navigate so the Login or Password field is highlighted (in-focus)

Press **Enter** on the Navigation Cross

Use the keypad to enter the text field (**hold key down to scroll options**)

Press **Enter** on the Navigation Cross – to accept your entry

### Monitor User Level

There is no password required to monitor values – all navigational commands and display information is available on all screens but no operational commands can be entered from the display. The Emergency Stop button is always available.

#### “Operator” User Level Password

Login as Operator:

Login: Operator

Password: wg1111

#### “Service” User Level Password

Login as Service:

Login: Service

Password: wg1112

#### “Configure” User Level Password

Login as Configure:

Login: Configure

Password: wg1113

#### “ServiceUser” User Level Password

Login as ServiceUser (no autofill key available, must be entered manually):

Login: ServiceUser

Password: ServiceUser@1

## Appendix E.

# Servlink-to OPC Server (SOS) Tool

### SOS Communication Link

The Woodward SOS Servlink OPC server ("SOS") provides an OPC interface for Woodward controls. It runs on a Windows PC that accesses data on controls using the Woodward proprietary Servlink protocol through an Ethernet connection. Woodward OPC client applications, such as Monitor GAP and Control Assistant connect to SOS by selecting a 'Servlink OPC server' connection. SOS implements the OPC Data Access 2.0 standard, so other OPC client applications may also function with it.

The install for this program is included on the system documentation CD, the latest releases and updates are always available on the Woodward.com website.

### Features of SOS

- Establishes communication link between control and a PC
- Can support redundant Ethernet links to a single control
- Can support links to many controls at the same time
- Can create a .CSV file of all alarm and trip events

Prior to installing SOS, you must install the Microsoft .net framework program, which is available on the Woodward website ([www.woodward.com](http://www.woodward.com)). This will install some operating system library files that are used by Control Assistant.

## Installing SOS

### License agreement & Setup

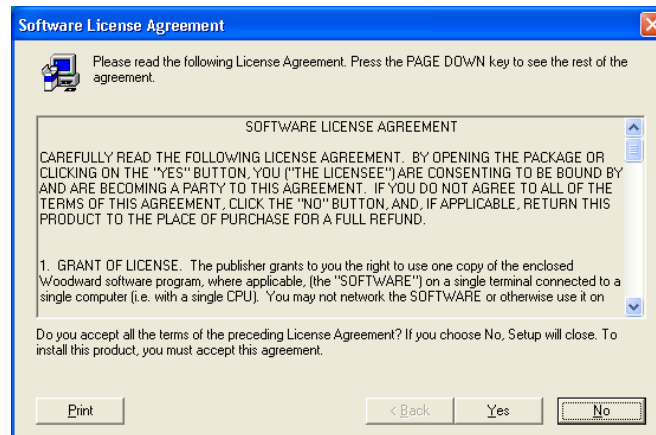


Figure E-1. SOS

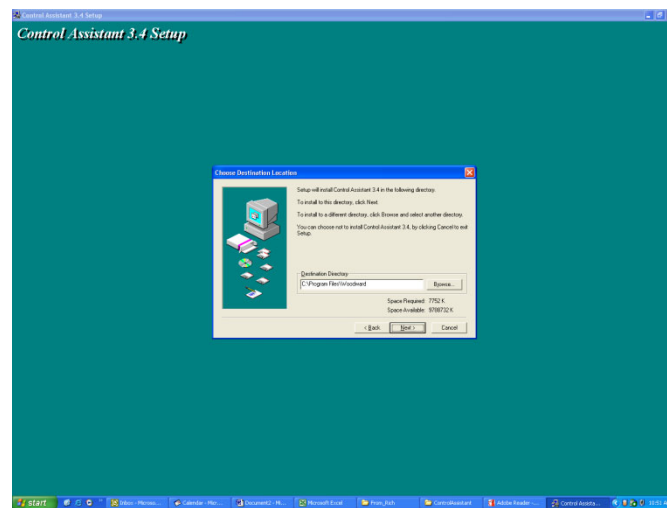


Figure E-2. SOS Install Window

Define the desired directory to save

## Connecting a PC/Laptop to the Control

You will need to connect to the 505 with an RJ45 Ethernet cable. Any Ethernet port can be used, however it is most convenient to use the same network port that handles all LAN communications (if the 505 is connected to a plant network). You will need to know the IP address of the Ethernet port.

**The Default IP for Ethernet 1 = 172.16.100.15 (subnet = 255.255.0.0)**

**All information in the communication link between the 505 and the PC is done via a Woodward Servlink connection (using the SOS tool). It is recommended to initially launch this tool independently to establish a healthy communication link. Once this is done, the PC will cache this information so that future launches will remember 505 controls.**



### Servlink-to-OPC Server (SOS)

The Woodward SOS tool is a sub-component of Control Assistant that handles all of the communications between one or many 505's on a network and the PC. It can be run independently, which is a useful way to clearly establish a connection prior to using the Control Assistant or other programs.

To launch SOS on independently:

Under Start / All Programs / Woodward / SOS Servlink OPC Server



Click on SOS Servlink OPC Server

You should see the following dialog box appear –

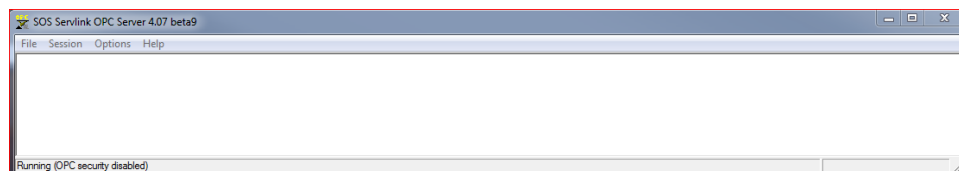


Figure E-3. SOS Server status dialog box

Under Session – scroll down and select New Session and a dialog box similar to the one below will appear. In the top entry box, enter the IP address of the 505.

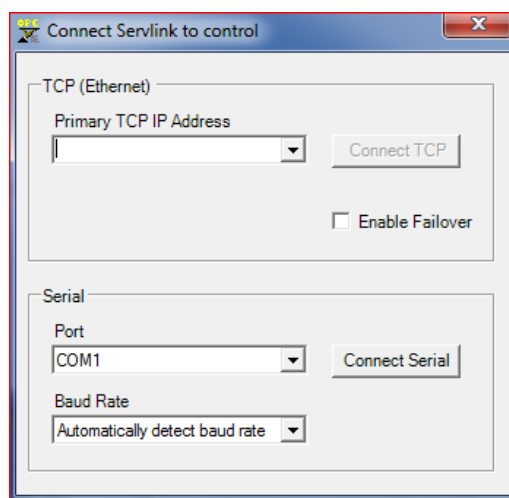


Figure E-4. SOS – New Session box

If you are connected to Ethernet Port 1 of the 505, enter the IP address of this port. The 505 default is shown below or enter the IP for your plant LAN network. Then click on the Connect TCP button

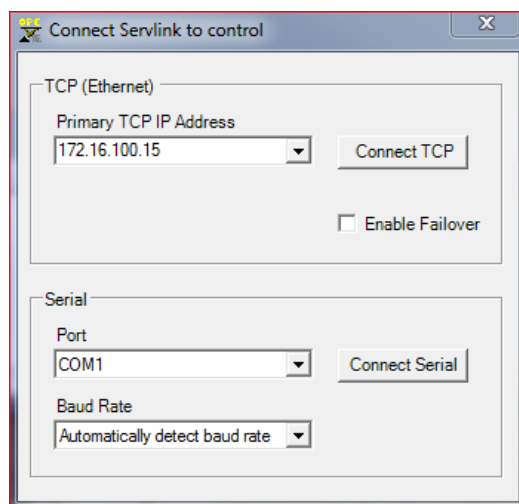


Figure E-5. SOS - Enter 505 TCP/IP address

The SOS program will locate the control and establish a Woodward Servlink connection between the control and your PC. This will take a few seconds to establish, the dialog box should now look like this (with the IP address being equal to what you typed in above).

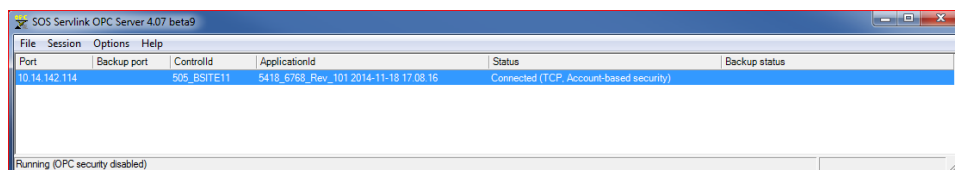


Figure E-6. SOS – Active Links dialog box

## Changing the Control ID

The default Control ID of production units can be found on the back label that includes the default IP. For example

FLEX00042364      172.16.100.15

The Control ID can be changed via SOS by right clicking the session and selecting “Set ControlId” Type in the new Control ID and press ‘Set’ to commit the change. The new Control ID can be used with Control Assistant Trend Scripts, etc.

## Appendix F.

# Control Assistant—Software Interface Tool

### Features of Control Assistant

Control Assistant is an optional software interface tool designed to help experienced users maintain setup and configuration settings and troubleshoot system problems. It provides a flexible window into the application software with multiple features for the user.

The install for this program is included on the system documentation CD, the latest releases and updates are always available on the Woodward.com website.

#### Features

- Using WinPanel (similar to the previous Watch Window products)
- Receiving Control Tunables (Download/Receive Tunables from 505)
- Sending Control Tunables (Upload/Send a Tunable File to the 505)
- Trending Control Parameters

Viewing Datalog files

Prior to installing Control Assistant, you must install the Microsoft .net framework program, which is available on the Woodward website ([www.woodward.com](http://www.woodward.com)). This will install some operating system library files that are used by Control Assistant.

### Installing Control Assistant



### License Agreement & Setup

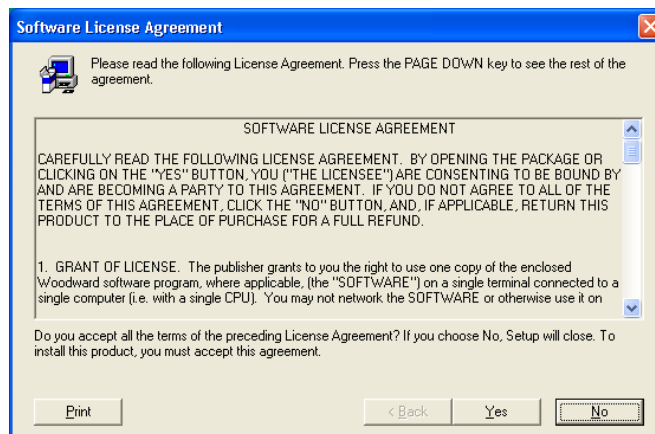


Figure F-1. Control Assistant License Agreement

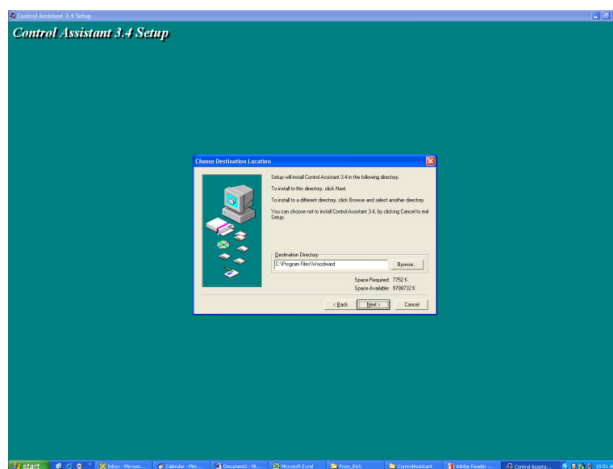


Figure F-2. Control Assistant Install Window

Define the desired directory to save Control Assistant and press 'Next'. It is preferable to use the default, as it will keep all Woodward Software in a common folder. If the program folder field is blank, type in "Woodward" and the install will create a program folder named Woodward.

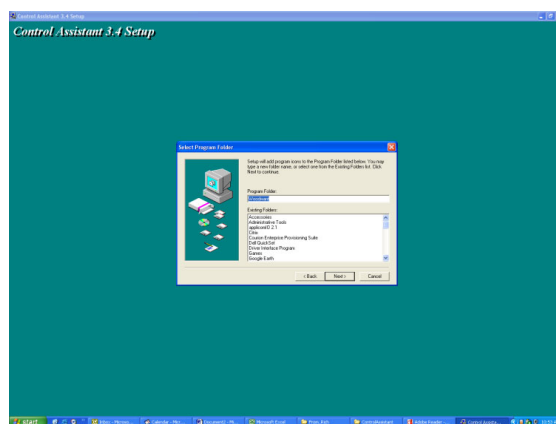


Figure F-3. Control Assistant Folder Selection

Choose the desired folder in the 'Start Menu' to save the shortcuts.

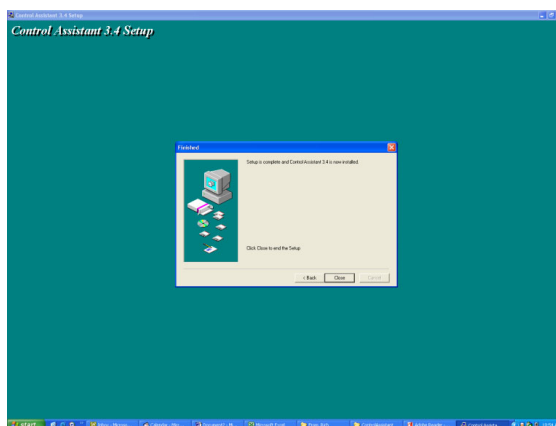


Figure F-4. Control Assistant Install Complete

After Control assistant is installed press 'Close'. You may or may not have to restart your computer depending on whether or not you had a previous version installed.

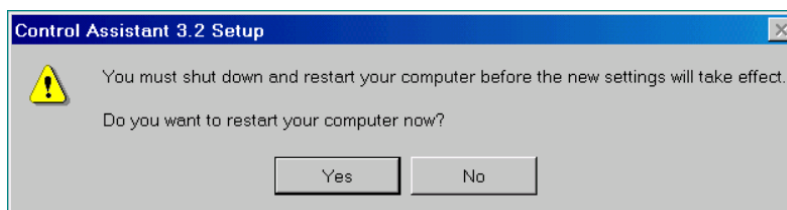


Figure F-5. Install Restart Window

Press 'Yes' to restart your computer now, or press 'No' to restart your computer later. Control Assistant will NOT function properly until the PC is restarted.

## Using Control Assistant

### To launch Control Assistant:

Under Start / All Programs / Woodward / Control Assistant 4

Click on  Control Assistant 4

### NOTICE

Use the Control Assistant HELP in the menu list to get familiar with all features of this product, or for additional information about using the features discussed in this chapter.

You should see the following dialog box appear –

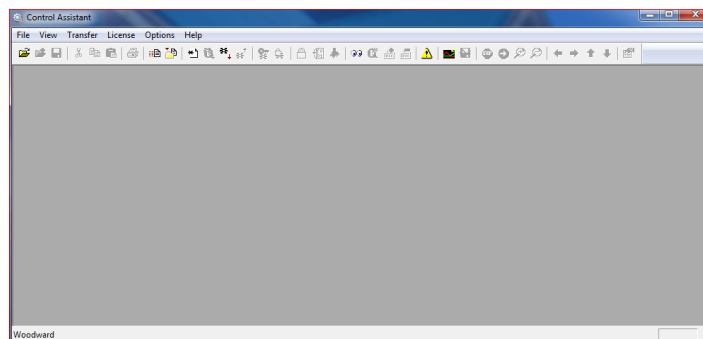



Figure F-6. Control Assistant Window



Next click on the New Winpanel icon  in the toolbar- and the following dialog box will appear.

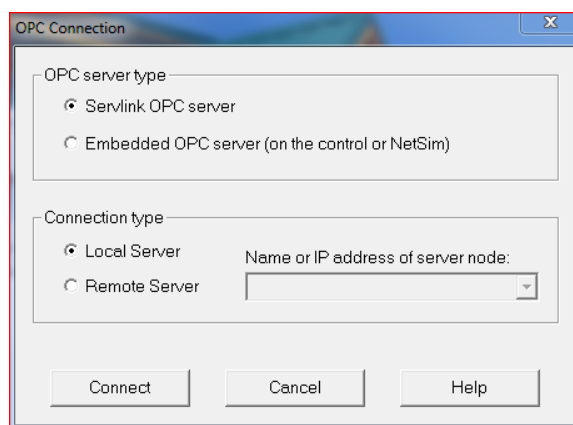


Figure F-7. Dialog for Servlink OPC connection

Clicking on Connect will open a WinPanel window that will look like the figure below.

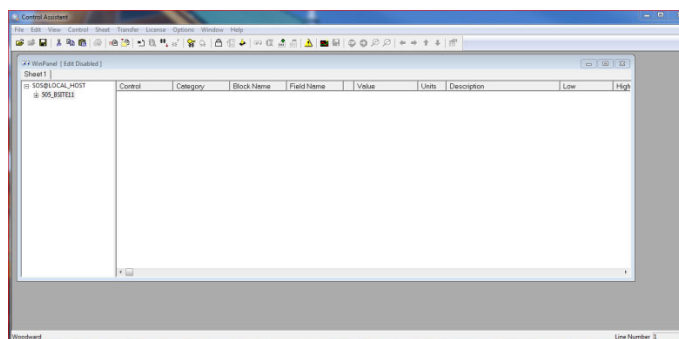


Figure F-8. WinPanel Session

### Using WinPanel (.ws files)

Control Assistant includes a feature called WinPanel that provides a text listing of all the GAP blocks in the application. The WinPanel window allows viewing of any software variable in the system, and is therefore intended to be used by users familiar with the architecture of the control software. WinPanel is a typical Windows application that provides a powerful and intuitive interface. The menu structures are familiar to Windows users. Variable navigation is provided through the Explorer window similar to the Explorer in Windows. This tool will look very familiar to users with experience using Woodward's Watch Windows products.

The WinPanel window acts as an OPC client and establishes the data link with SOS. For this reason, the WinPanel window must be opened and a control selected to enable uploading or downloading the tunables or trending data from the control (next sections). If multiple controls are available in SOS, they will all appear in the WinPanel window.

Typical 505 users are not familiar with the GAP and therefore it is not expected to normally need to create new WinPanel views.

What is valuable for a 505 user is the ability to Open Winpanel View files that have been created by Woodward or by commissioning engineers. These files are identified as *<filename>.ws* files. This is a handy way to be able to gather system information, support tasks such as valve stroking, tuning or system checkout.

## Retrieving Control Tunables (Tunables from 505 to a PC)

### NOTICE

Tunables can be RETRIEVED from the control at any time with no effect on turbine operation.

Once the control is configured and the signals are calibrated, it is recommended that the user save a file containing this information. This is useful for setting up a spare unit, as a replacement or for initially configuring other units of the same type.

1. The first step is to follow the above steps up to the point of having a WinPanel open and the correct control selected
2. Select Transfer/Receive Debug Tunable List from the menus or the Retrieve Icon from the tool bar



(Note the send icon is not available)

The following box should appear

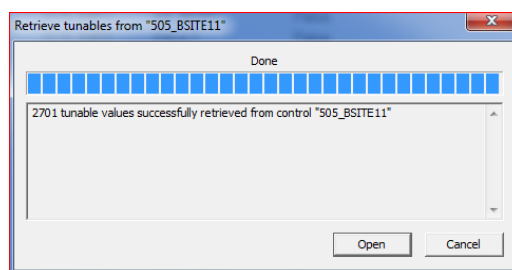


Figure F-9. Control Assistant – Retrieve Tunable Dialog box

3. Click on the Open button and the file will be automatically created with the control ID, time and date in the filename and the extension .tc. Save this file.

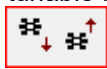
## Sending Control Tunables (Tunables from PC to 505)

### WARNING

To send tunable settings to the control the 505 must be in the IO Lock condition, therefore, the turbine must be shut down and the 505 must be in a TRIPPED state. Entering into I/O Lock mode while the turbine is running will cause an automatic shutdown of the turbine with resulting process stoppage. Do not enter the I/O Lock to upload tunables into the control while the turbine is running.

To load a previously created tunable file (.tc) into a 505, the turbine must be shut down since the control will need to enter Configuration mode to complete this process. Once the turbine is shutdown, follow these steps:

1. From within Control Assistant Open the tunable (.tc) file
2. Follow the steps in the previous section up to the point of having a WinPanel open and the correct control selected
3. From the menu select Control/Lock IO or select the Lock IO icon from the tool bar
4. Once selected a dialog box will appear asking for the Debug password – Enter 1112
5. If the 505 TRIPPED LED was ON (Trip is present) a confirmation box will appear that Lock IO was issued. If the 505 TRIPPED LED was OFF (no trips present) then the confirmation box will state it was not allowed
6. Click on the tunable file and select Transfer/Send Tunable List from the menus or the Send Icon from the tool bar



(Note in this state both retrieve and send are available)

7. The following box should appear

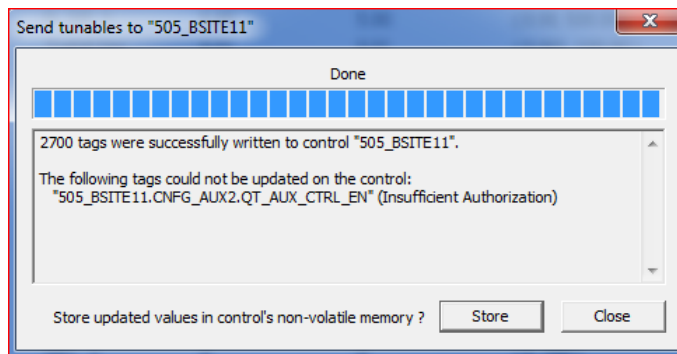
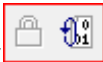


Figure F-10. Control Assistant – Send Tunable Dialog box

8. Click on Store and the control will save these values.
9. Next click back onto the WinPanel window and then select Control/Reset from the menus or the Reset Icon from the tool bar 
10. A dialog confirmation box will appear with some warnings and requires a confirmation check that these have been consider. There is also an option to Save Values again if desired. Checking the warning acknowledge box will allow the Reset button to be selected.
11. Selecting Reset will issue a 'soft' reset to the control and it will perform a soft reboot – similar to when the user exits the Configuration mode. The procedure is now complete.

## IMPORTANT

It is highly recommended that the user keep a current tunable list file available at site. This will make the configuration and setup of a spare unit very simple and assist in troubleshooting system problems.

## Trending Control Parameters

This can be done at any time and will not interfere with any 505 control functions.

The first step is to follow the previous steps that were listed up to the point of having a WinPanel open and the correct control selected

Use File/Open to open a previously saved trend script file (if you have one). To create new trends, the user will need some understanding of how Woodward's GAP software is constructed as well as some specific knowledge of the 505 application software. If the user is not familiar with GAP, they should limit their use to existing trend script files.

## Opening existing Trend Script Files

When you open an existing trend script, the graph will automatically begin trending the control data. The graph will auto scale or the scale can be adjusted to fixed values by the user. There are 2 vertical cursor lines that the user can slide along the X axis – the Y1 and Y2 values below the graph relate to these values and the Total Difference (lower right corner) will show the time difference between the 2 cursers lines at all times.

The control assistant tool bar has Stop/Start/Zoom button and options to save the data buffer of values into a file for later viewing or analysis. Use the Help menu item to learn more.

Below is an example of the Speed Control Trend Script.

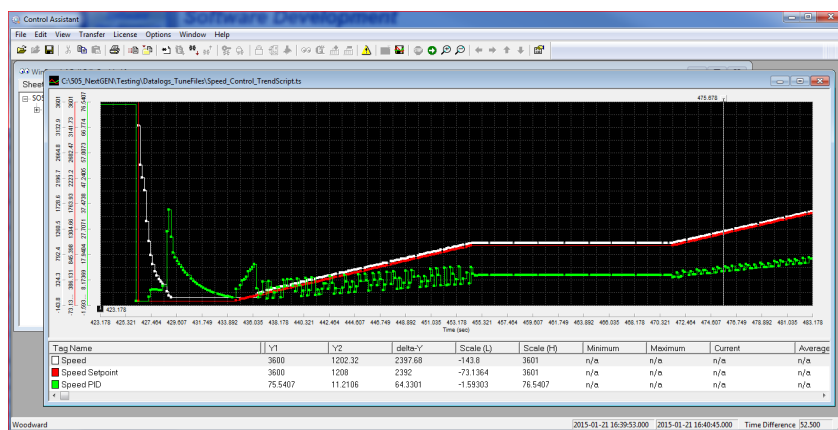



Figure F-11. Control Assistant – Speed Control Trend Script

## Creating a Trend Script File

Click on the New Trend icon  if you want to create a new trend of parameters. A dialog box will appear and the user will be able to build a trend script file for view system parameters by expanding the explorer window on the left and 'drag & drop' GAP block field parameters into the window on the right.

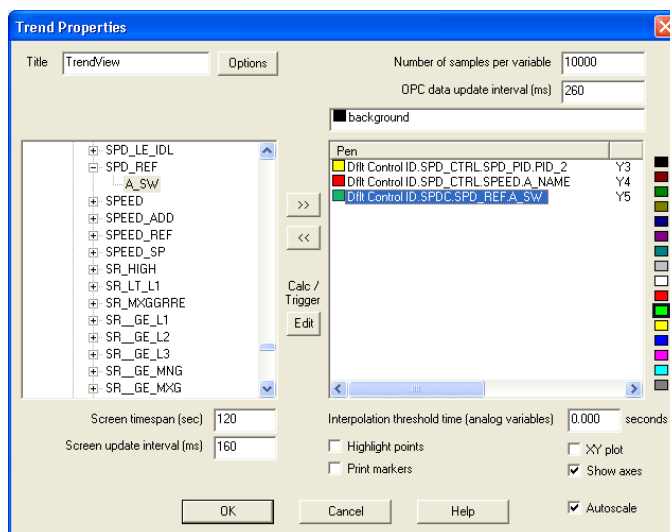


Figure F-12. Control Assistant – Create Trend Script File

Once the script file is complete, clicking on OK will launch the trend file so that live control data can be viewed. For additional information on the trending capabilities, refer to the Control Assistant Help menu.

## Opening a Trend Script File as a Template

Opening a trend script file that was saved for a different control can be opened for a different control (with a different control ID) by opening the trend scrip as a template.

Click File > Open script as a template... > Select the Trend Script

Control Assistant will then pull up a list of all the controls available in SOS. Select the control to which you would like to apply the Trend Script.

## Appendix G.

# AppManger Service Tool

### File Management with App. Manager

AppManager is a Windows based remote access tool for Woodward controls. The 505 is loaded with a service that allows it to interface with AppManager. AppManager is used to manage the applications on the 505 and provide access to operating system information.

The install for this program is included on the system documentation CD, the latest releases and updates are always available on the Woodward.com website.

#### Features of App. Manager

- Send/Retrieve files from the control
- Retrieve datalogs from the control
- Change Ethernet Network addresses
- Start/Stop the GAP or WGUI application that is running on the control
- Load Service Packs

### Installing App Manager



#### License agreement & Setup

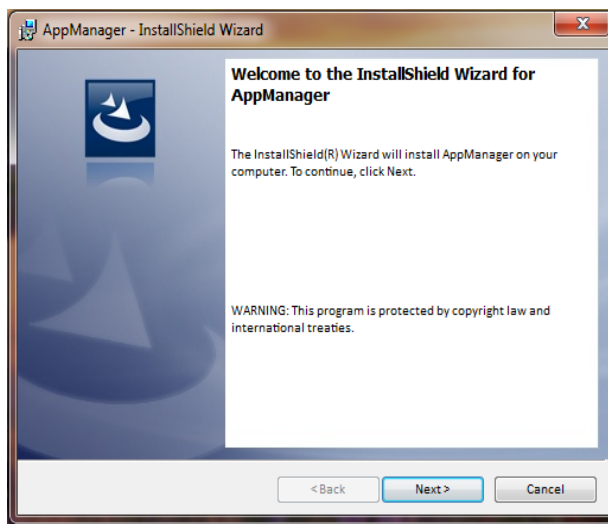


Figure G-1. App Manager Install Window

To continue with App Manager installation, select Next.



Figure G-2. App Manager License Agreement Window

To install App Manager, select “I accept the terms in the license agreement”. Once this has been selected, select “Next” to continue the installation.

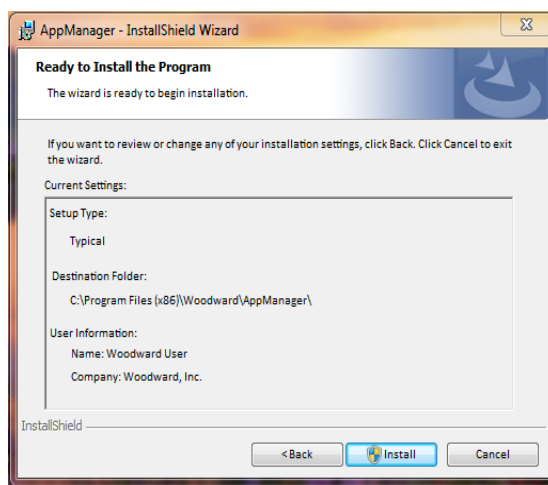


Figure G-3. App Manager Installation

Choose the desired folder in the ‘Start Menu’ to save the shortcuts.

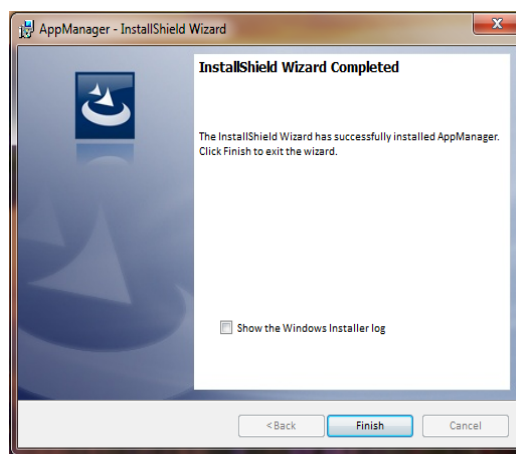


Figure G-4. App Manager Install Complete

After App Manager is installed press 'Finish'. You may to restart your computer depending on whether or not you had a previous version installed.

The topics covered below will highlight the main functions that a 505 user may want to do using this tool. For user already familiar with this tool the only new feature is the ability to access the GUI files. For complete information on this tool, use the help menu

### To launch App Manager:

Under Start / All Programs / Woodward / AppManager



Click on AppManager

You should see the following dialog box appear –

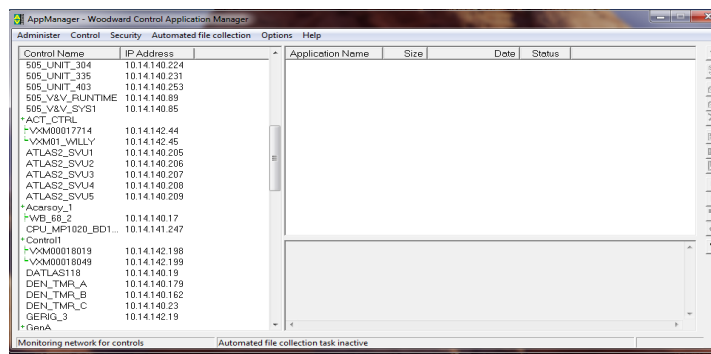


Figure G-5. AppManager Window

AppManager will display three panels; the left side panel will show the Control Name and IP Address for each control available on the network. The right side panels will not show information until you are logged into a specific control. When that is done, the right upper panel will show the list of applications available and the right bottom panel will show control status information.

Next click on the "Control Name" of the 505 you want to connect to. The following dialog box will appear.

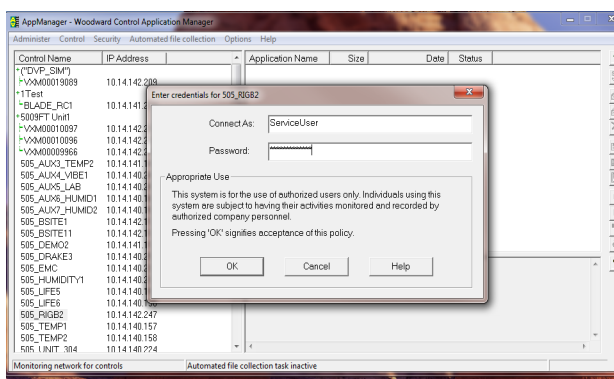


Figure G-6. Dialog for App Manager Connection

To connect to the control use the following

Connect As: ServiceUser  
Password: ServiceUser@1

Click OK and the window should look something like this.

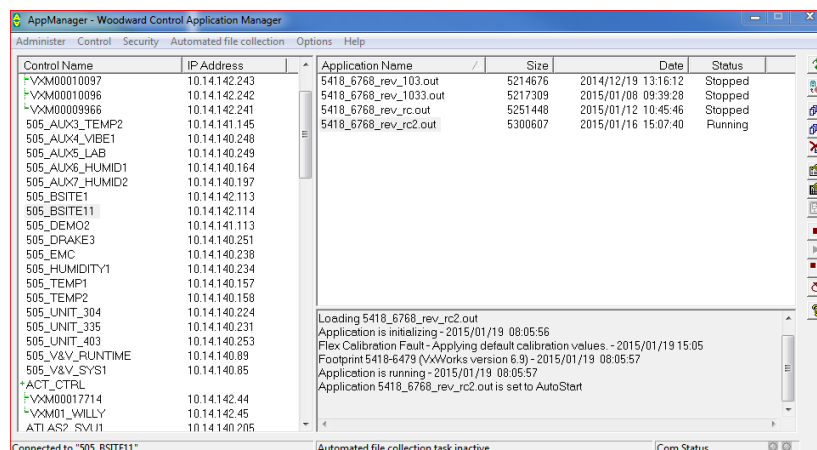


Figure G-7. App Manager Connected to a Control

## Control Information Parameters

From the main screen – click on the Control Name and then from the Control menu pull-down select Control Information. The figure below shows an example of the all the information available here. This is a useful place to obtain embedded software part numbers, memory usage, Ethernet IP assignments, and total hardware run hours (power up time).

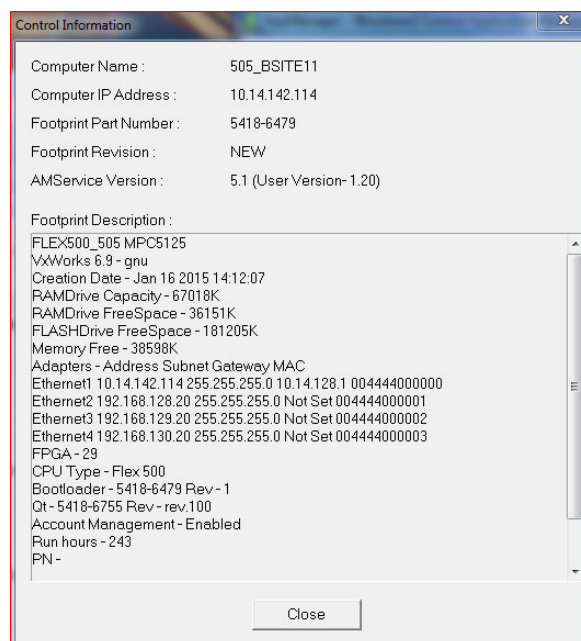



Figure G-8. AppManager Control Info Window

## Switching Application Panel Views

The application panel has two views - the control application panel has a white background while the GUI

application window has a maroon background. To toggle between the panels use the swap  button on the far right side (the second button down from the top).



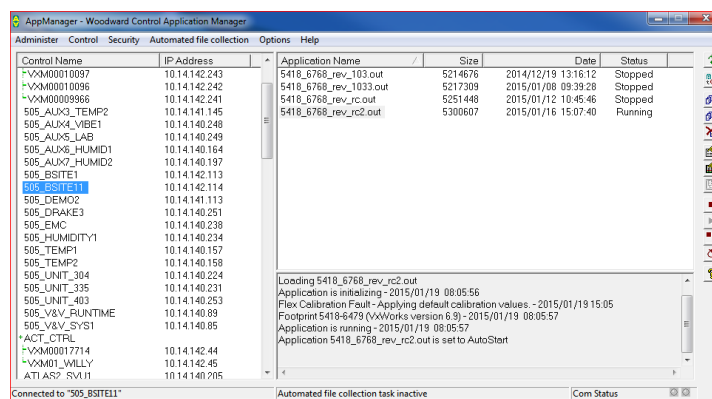


Figure G-9. AppManager Control (GAP) Application Panel

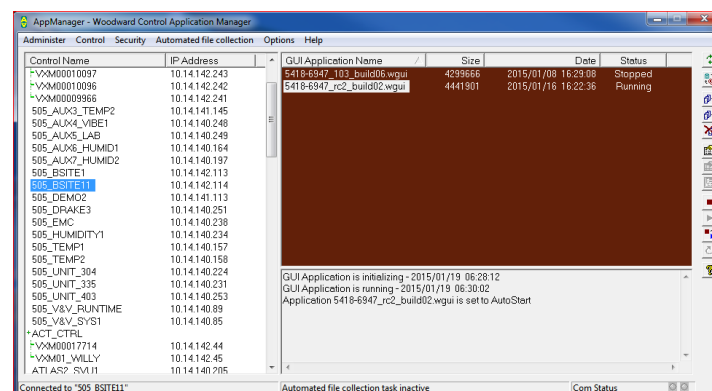


Figure G-10. AppManager GUI Application Panel

## Retrieving Files

The most common use of AppManager is to retrieve data files from the control, specifically Data log and Trend log files. Do this by using the menus and selecting Control/Retrieve Files. A dialog box will open and show the files that are available in that particular application directory.

All Data and Trend log files are located in the control application folder.

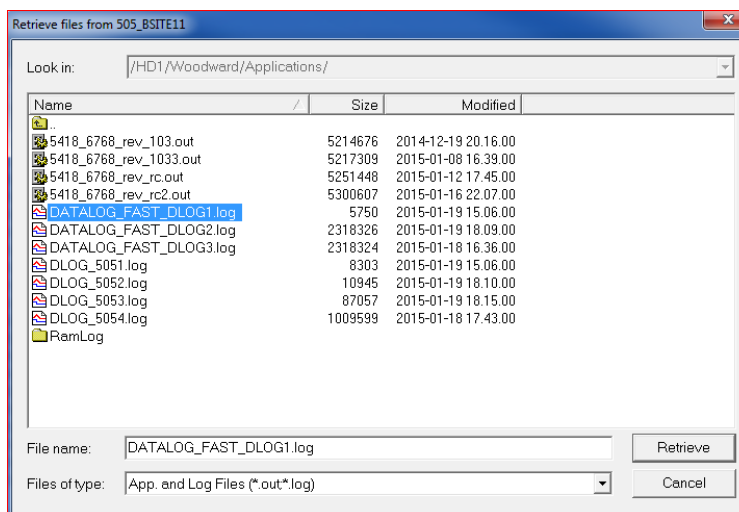


Figure G-11. Retrieving Files

## Transferring Files

For most users there will not be any need to transfer new files to the 505, but if this need arises, AppManager is the tool for doing this. To transfer files to the control, first be sure you are in the correct application window. For example to transfer a customized or updated GUI file – switch to the GUI application file panel before transferring the new file.

Use the menu and select Control/Transfer Application Files. A dialog box will open so that you can browse your PC to find the correct file needing to transfer.

The control will allow any file to be transferred, unless it says an existing file on the control with the same name. If this occurs, the user must first delete the file on the control before the new one can be transferred. Woodward typically adds a revision or a build number to the end of the file name so that any updates can be added to the control and the previous revisions will still be available. All user tunable settings are associated with a specific program revision.

## Changing the Ethernet IP addresses

It is recommended that the user configure the IP addresses and through the GUI in Configuration mode at the same time the control is setup. It is possible to set them up with AppManager – but stop the control applications first. It is best to only have experienced users do this via AppManager. In either method, the turbine must be shutdown to change the IP addresses.

## Start/Stop Applications

AppManager is the tool that is used to Start or Stop the execution of the GAP (control and IO) program and/or the GUI (display) program. The GAP and the GUI are handled very differently and will be explained below.

### GAP applications – Control logic and I/O

The GAP program (*filename.out*) has logic checks to insure that it is never stopped while the turbine is in operation. Stopping the GAP program puts the control in IOLOCK. There is typically no need for the user to stop the GAP program unless an OS service pack is being loaded or the unit is being updated to a newer GAP revision.

### GUI applications – Display Graphics

The GUI program (*filename.wgui*) contains all the pages of information that appear on the front screen. It may be stopped and restarted without any interruption of turbine operation (does not affect the GAP execution).

The typical use of stopping and restarting the GUI program is:

1. Change the program (to a different build revision)
2. Change the default language of the screen

To change the language, go to the MODE Screen, navigate to the Globe Icon, and press Enter. A list of language options will appear – after selecting the desired language the GUI must be restarted. If the turbine is shutdown, you could just power cycle the control. If the turbine is in operation – or it is not desired to stop the GAP application, then the GUI can be selected, stopped, and started from the screen shown in Figure G-10.

**Install a Woodward Service Pack**

AppManager is the tool that is used if a service pack needs to be installed to update the OS or the real-time process that executes the GUI application.

Typically, only Woodward representatives do this or via a service bulletin, that directs the user through the process.

In general, these are the steps:

1. Shutdown the turbine to a complete stop
2. Stop the GAP and GUI applications that are running
3. Under the Control menu click on Install Service Pack
4. Locate and launch the Woodward service pack (may take minutes)
5. At the end there will be a dialog box asking to Reset the control click yes
6. After the control reboots – log into the control again
7. Start the GAP and GUI applications

## Appendix H.

# Configuring Network TCP/IP Addresses



Figure H-1. Configuration/Communications Screen

The ENET 1, ENET 2, and ENET 3 configuration refer to the physical Ethernet connections on the unit. ENET 4 is reserved and is not configurable through the front panel.

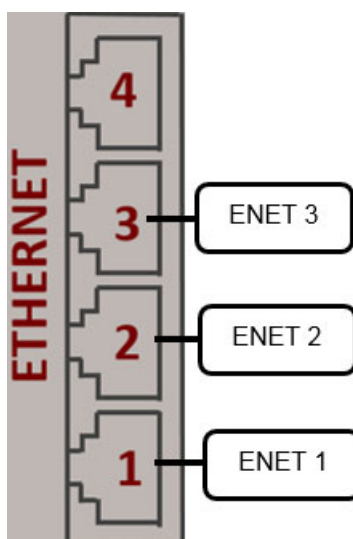


Figure H-2. Ethernet Port Layout (Ports on Side)

The Ethernet IP Configuration screen can be accessed by going to the Configuration Menu and then to Communications. In order to make any changes to the IP settings, the unit must be in Configuration mode and the user must be logged in with User Level Configure.

**IP Conflicts**

It is extremely important to be sure that the control is given a unique IP address on your plant network. Duplicate IP's for multiple 505 units on the same network will cause communication issues that may adversely affect a running unit. Use a standard network command, such as 'ping' to verify the availability of an IP prior to assigning it to a 505 control and placing the control on the network

To set a new IP address to one of the Ethernet connections:

- The current IP and subnet mask being used are displayed at the top of the page
- Once a new IP and subnet have been entered, the "Set IP1", "Set IP2", or "Set IP3" buttons must be pressed in order to send the new IPs to the control.
- Once set, the new IP address and subnet will be displayed at the top of the page.

To set a new device gateway:

- Open the pop-up page by pressing "Gateway" soft key.
- The current device gateway is displayed at the top of the pop-up page.
- Once a new gateway address has been entered, the "Set Gateway" button must be pressed in order to send the new gateway to the control.
- Once set, the new gateway will be displayed at the top of the pop-up page.

## Setting SNTP (“Simple Network Time Protocol”)

SNTP may be used to synchronize the clock on the control to the network time. To configure SNTP, go to the Service Menu Page 2 and then to the Real Time Clock Menu.

- 1) Check the box for “Use SNTP Synchronization?”
- 2) Set the IP Address of the SNTP Server
- 3) Update Rate and Timeout in seconds  
The default update rate (the frequency with which the clocks are synchronized) is 300s (5 minutes).
- 4) Then, push the “Set SNTP” hotkey to send the configuration to the control clock.

To confirm that the changes have been updated.

- 1) Confirm the SNTP IP address readout is correct ①
- 2) Confirm that the SNTP Fault LED remains off ②
- 3) Confirm that the System Time updates to the network time (this may take several minutes) ③

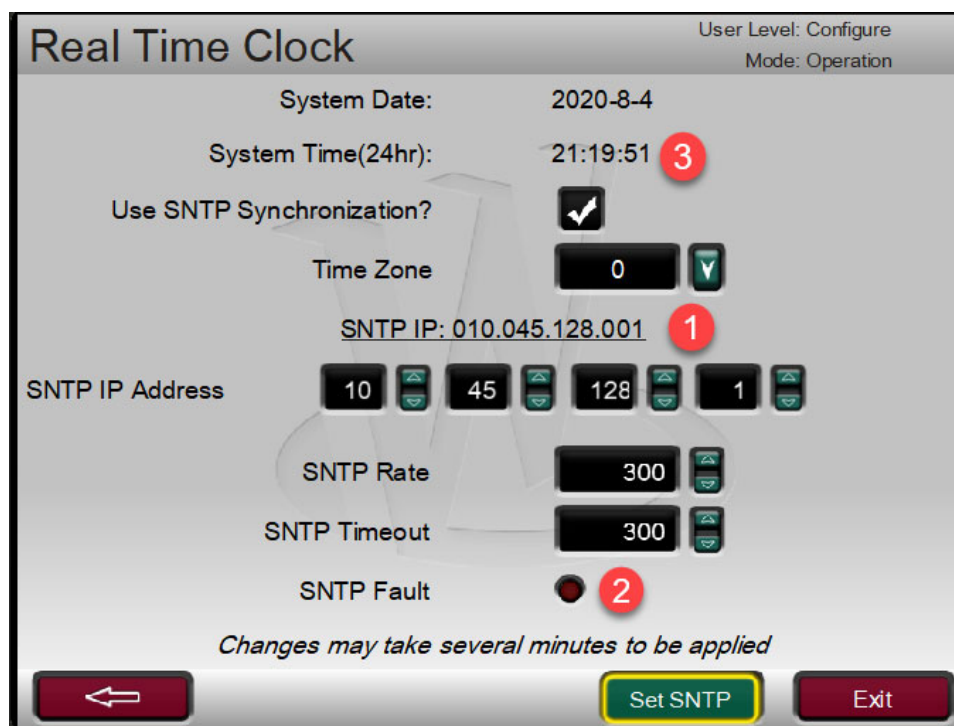


Figure H-3. Real Time Clock SNTP settings

## Appendix I.

# RemoteView Tool

The 505 RemoteView tool is used to connect to the 505 controller via Ethernet and provide an interface that is identical to the front panel display. The Remote View tool connects to the control, downloads the GUI application, and launches it on a PC. This process guarantees that the Remote View tool displays screens that are identical to the front panel screens. The Remote View tool also includes the same front panel physical buttons, except for the ESTOP button. All operation and configuration tasks can be performed remotely using this tool.

The login User Level determines the access capabilities of the Remote View, just as it does at the front panel. The User Level of the Remote View is independent of the front panel User Level, such that different levels of access can be given to the front panel and the Remote View tool.

The Remote View tool is disconnected after two hours and must be launched again to reconnect. The following window will be displayed when the time limit has expired.

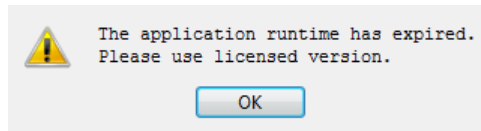


Figure I-1. Window Shown when the Time Limit is Exceeded

### Installation

The installation file is included on the system documentation CD. The name of the installation file will be similar to 9927-2344\_NEW\_Woodward\_505View.exe. The file name may vary slightly as future revisions are released. Execute this file to begin the installation process.

When the installation file is executed, the following welcome window will appear:

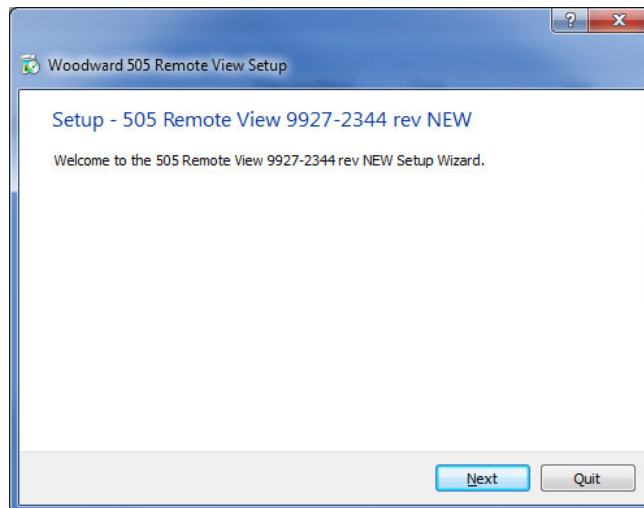


Figure I-2. Installation Welcome Window

Select "Next" to continue.

The Installation Folder window will open. A default installation folder will be shown. If a different installation folder is needed, click the "Browse..." button to select the new folder.

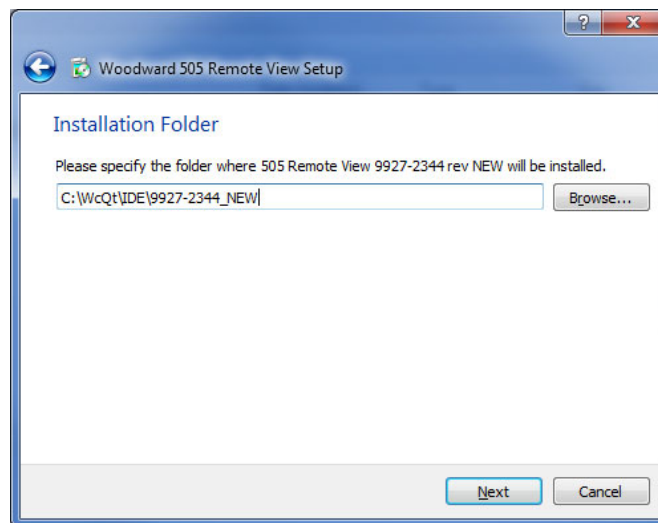


Figure I-3. Installation Folder Window

Select “Next” to continue.

The License Agreement window will open. Review the terms of each license associated with the tool. Installation can only continue if the licenses are accepted. To accept the licenses, select the “I accept the licenses” option.

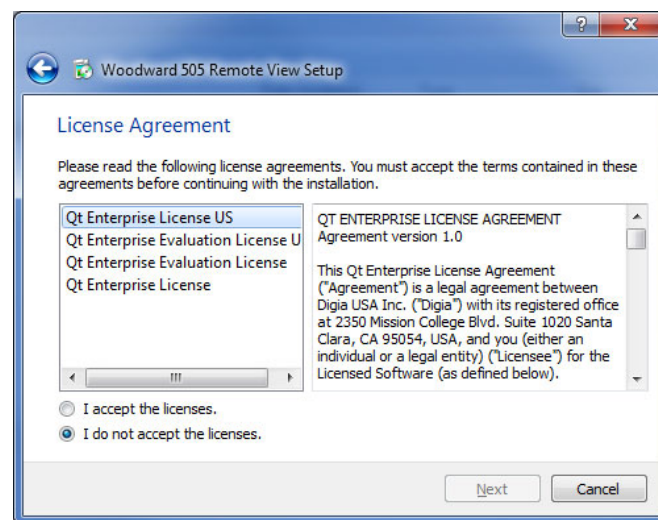


Figure I-4. Installation License Agreement Window

Select “Next” to continue.

The Start Menu shortcuts window will open. A default location in the Woodward program folder will be shown. If a different Start Menu location is needed, type the new location in the window or select one of the locations presented in the list.



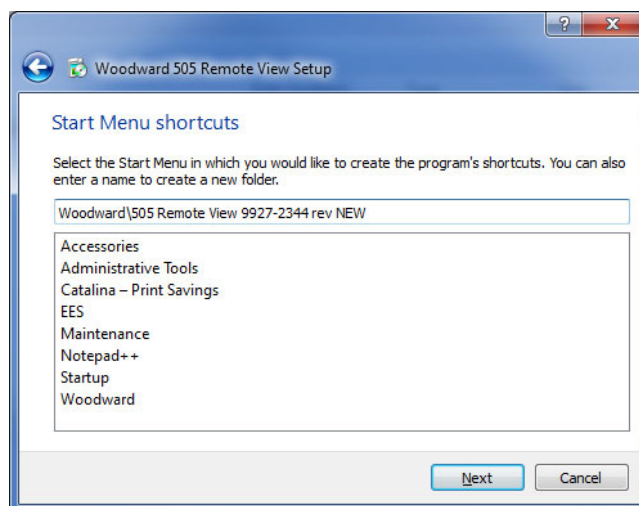


Figure I-5. Installation Start Menu Shortcuts Window

Select “Next” to continue.

The “Ready to Install” window will open.

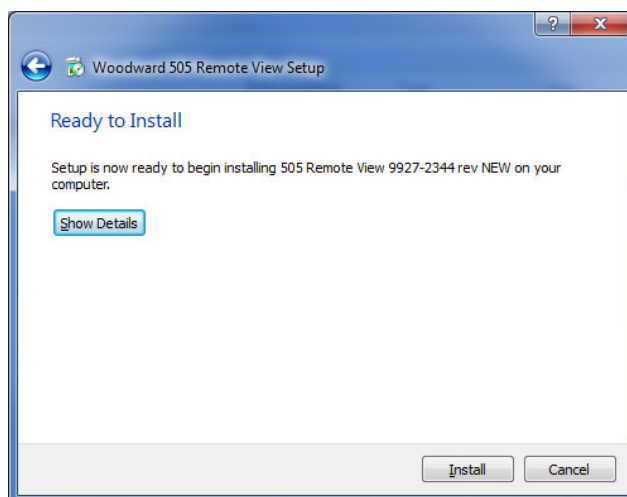


Figure I-6. Installation Ready to Install Window

Select “Install” to continue.

Configuration of the installation is complete and the actual installation process will begin. A window will open showing the progress of the installation. If prompted to do so, give the installation file permission to make changes to the PC. The following window will open when installation is complete.

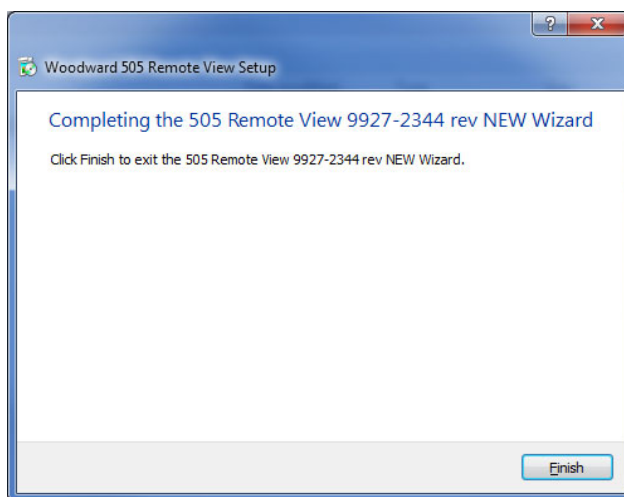


Figure I-7. Installation Complete Window

Click “Finish” to close the window. The Remote View tool is now ready for use.

## Remote View Configuration

To start the Remote View tool, go to the Start Menu and select 505 Remote View from the Woodward folder (or in the alternate folder specified at installation). The configuration window will open. This window has the following sections:

- Control list
- Application list
- Display properties
- Predefined settings
- Log

### Control List

The Control list shows each control that can be connected to the Remote View tool. Identify Controls by their IP address, and manually add each control must to the list. To add a control, put the cursor in the IP address field and type in the address, as shown in the following figure.

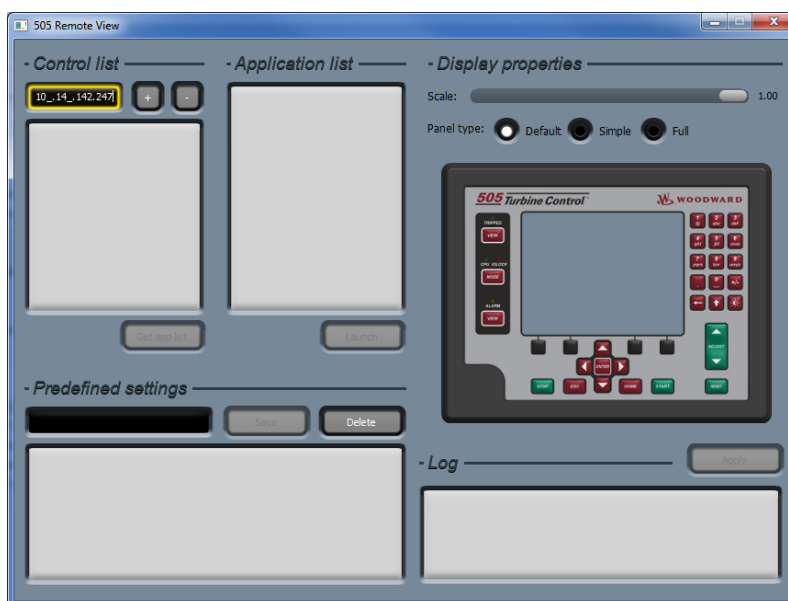


Figure I-8. Entering an IP Address to be Added to the Control List

When the address has been entered, click the “+” button to add the control to the list. When a control is selected in the Control list, the “Get app list” button becomes available, as shown in the following figure.

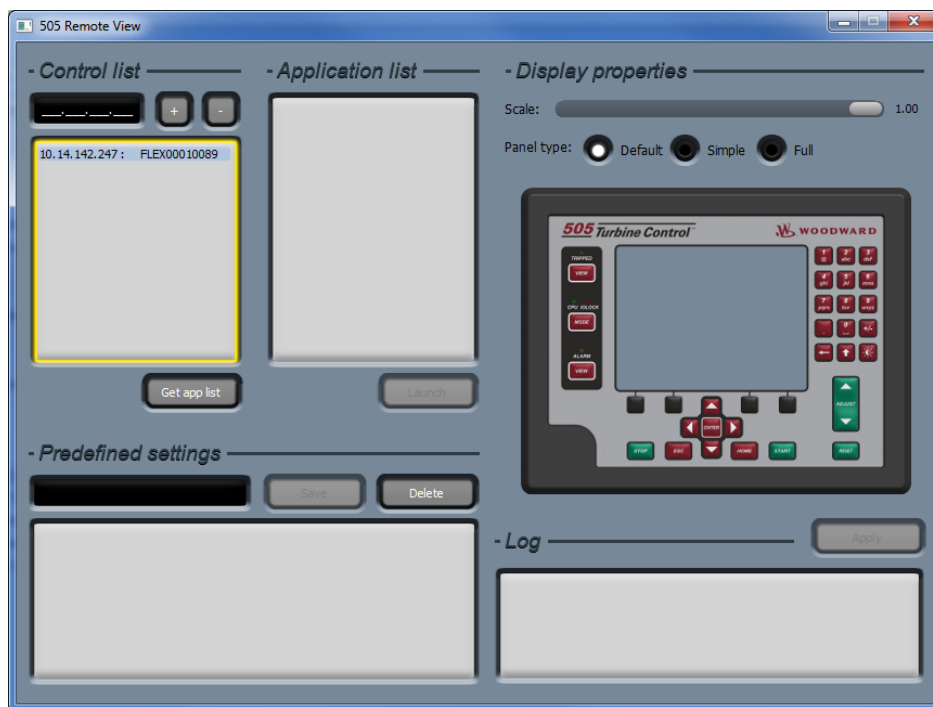


Figure I-9. Control Selected in the Control List

Repeat this process for each control on the network that will be accessed via Remote View. A control can be removed from the list by selecting the control and clicking the “-” button. Click the “Get app list” button to show the applications that are loaded on the selected control. Displaying the applications requires login to the control. When the “Get app list” button is clicked, the login window will open.

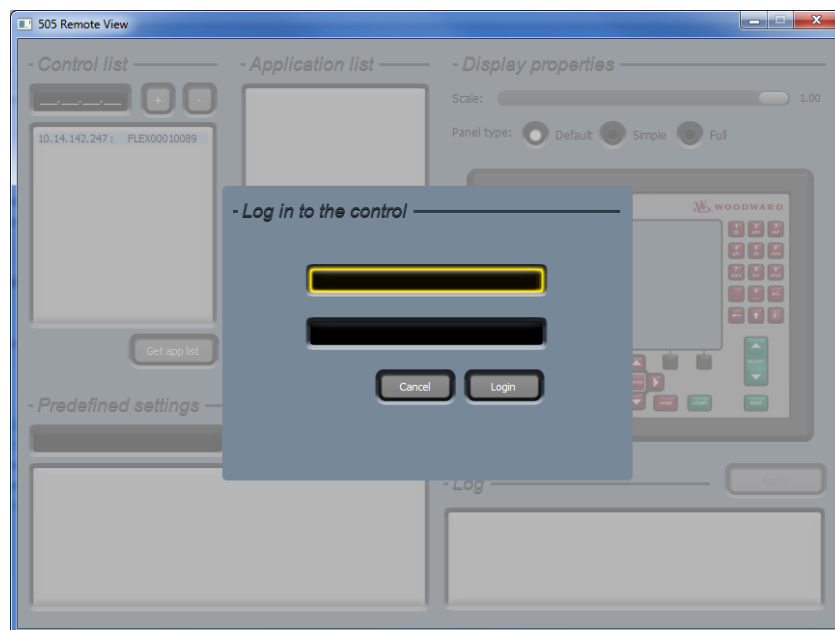


Figure I-10. Login Window with Fields for User Name and Password

The first line in the login window is the user name. The default user name is ServiceUser. The second line is the password. The default password is ServiceUser@1. After entering the login credentials, click “Login”.

### Application list

After a successful login, the application list will show the applications that are loaded on the control. In almost all cases, the 505 control will have a single application loaded. After selecting an application, the “Launch” button will be available. Click the “Launch” button to open the Remote View tool.

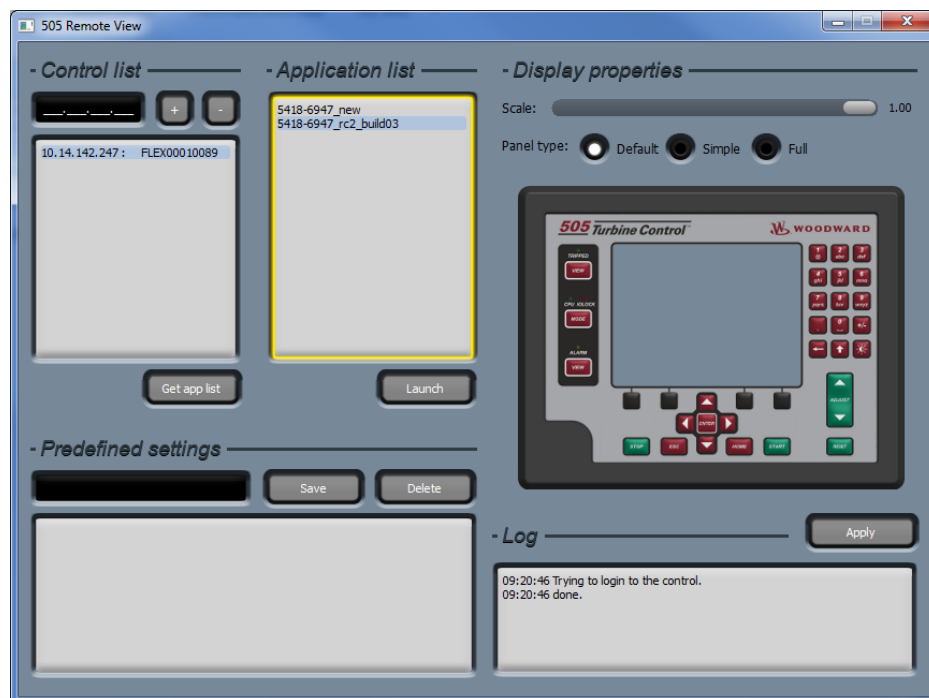


Figure I-11. An Application Selected in the Application List

### Display properties

This section has two options, the Remote View scale and the Remote View panel type. The scale sets the size of the Remote View tool, where 1.00 is full size. If the Remote View tool is too large for the PC monitor, use the slider to reduce the scale.

The Remote View panel type has three choices for the appearance of the tool. The Default setting shows the tool as a replica of the actual 505 front panel. The Simple setting shows the tool as a replica of the actual 505 front panel, but with the right and bottom physical buttons hidden. The Full setting shows the tool as just the screen from the front panel (all physical buttons hidden).

Click the “Apply” button to confirm the scale and panel type.



Figure I-12. Default View of the Tool



Figure I-13. Simple View of the Tool

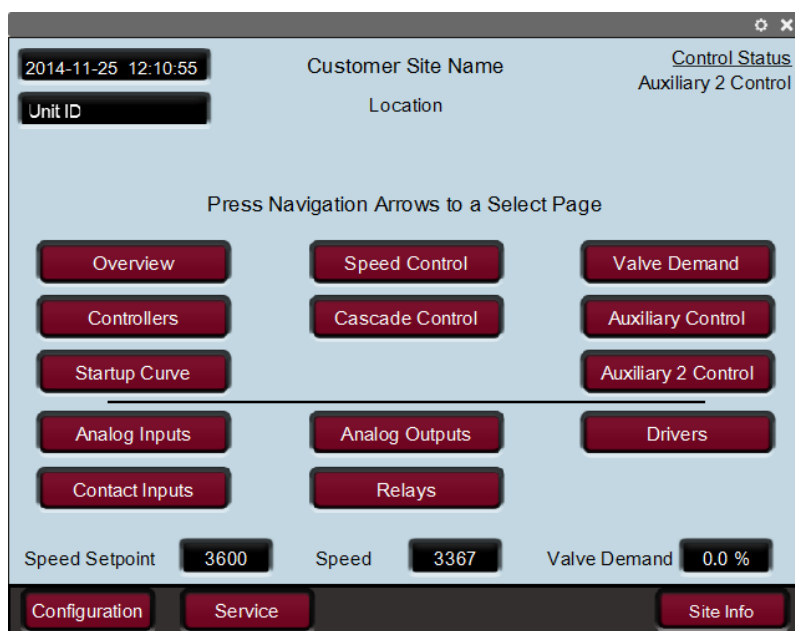


Figure I-14. Full View of the Tool

### Predefined settings

This dialog is used to manage settings for the Remote View tool. To save the current Remote View settings for the control list and the display properties, enter a name for the settings and the click “Save”. The following figure shows “Demo” entered as the name for the current settings.

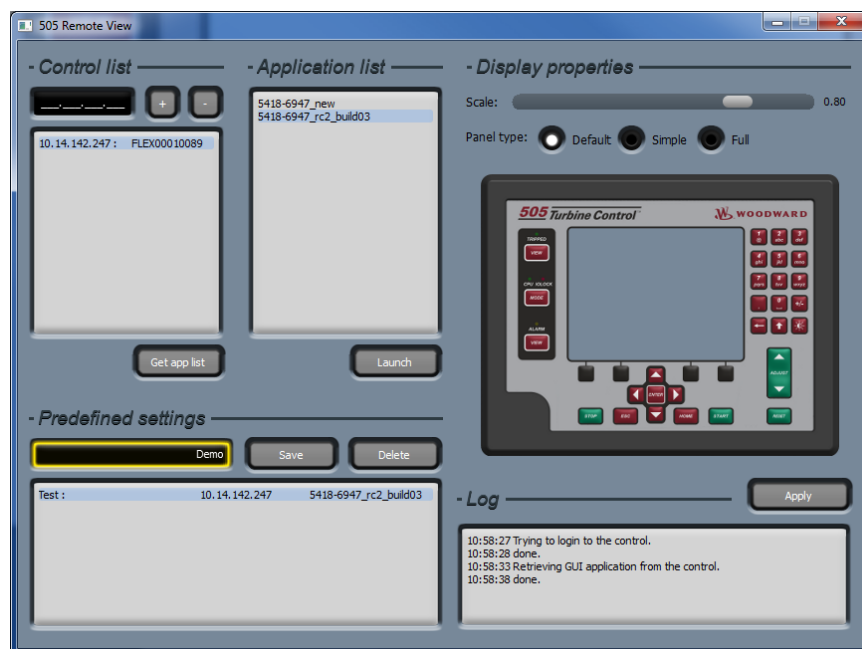


Figure I-15. Entering a Name for the Current Settings

After clicking “Save”, the settings file will be displayed in the list, as shown in the following figure.

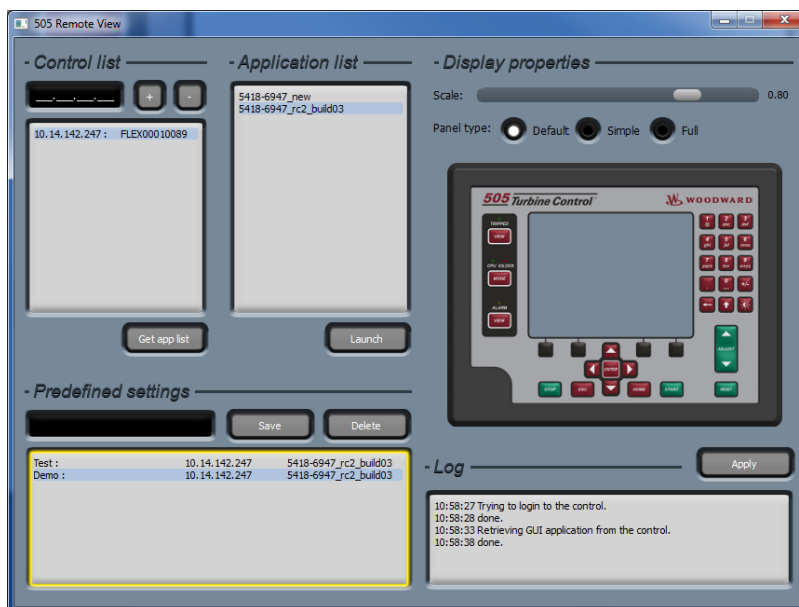


Figure I-16. A New Settings File Entered in the Predefined Settings List

To delete a settings file, select the file from the list and click “Delete”. To load a settings file, double-click on the name of the file. The login window will open. After a success login, the Remote View tool will open.

### Log

The log shows a record of the actions taken by the tool, such as GUI file retrieval from the control and login to the control. The user will generally not need to check the log, but it is useful for troubleshooting.

### Using Remote View

Before using the Remote View tool, complete the follow steps to connect to the 505 control. These steps are described in detail in the Remote View Configuration section.

- Enter the IP address of the control in the configuration window
- Get the application list for the control (requires login)

The Remote View tool is opened by selecting an application in the configuration window and clicking “Launch”. Alternately, open the Remote View tool by selecting a properly configured settings file from the configuration window.



Figure I-17. Remote View Tool (Default Setting) after Opening from the Configuration Window

The Remote View tool serves as an alternate interface to the 505, enabling operation and configuration from a PC. Use the Remote View tool in exactly the same way as the front panel, as described in Volume 1 of the 505 manual. Select the buttons on the Remote View screen with the PC mouse. Use the PC keyboard to enter text. For many users, use of the mouse and keyboard will make configuration through the Remote View tool easier than configuration at the front panel.

## NOTICE

Be aware that once user is logged into the RemoteView – they can issue all the same commands that are available at the 505 Front Panel.

## WARNING

If multiple 505 are available on a network – they can all be accessed through this tool. Be sure that you are connected to the correct unit prior to making operational adjustments.

The configuration window can be opened at any time by clicking the gear button at the top right corner of the tool. The Remote View tool can be closed by clicking the X button at the top right corner of the tool.



## Appendix J.

# Using 505 Internal Simulation Mode

The 505 has an available Speed Simulation mode that is intended to be used as a training tool. Any unit (a spare unit is ideal) can be setup in an office, lab or conference room to use this feature and allow the user to configure and simulate some functions of the 505 prior to using the unit or wiring it to the turbine. This can be extremely valuable. It can be used to:

- Test the operation of the configured start routine
- Explore all the options available on the product
- Train and document startup procedures
- Learn how to connect and use the service tools

To enter this mode, go to the MODE screen and log in as the following:

Login:               Configure  
Password:       wg1113

This will make available two buttons and an LED which will Enable and Disable the H/W Simulation mode. It is possible to disable the H/W Simulation mode from any user level.

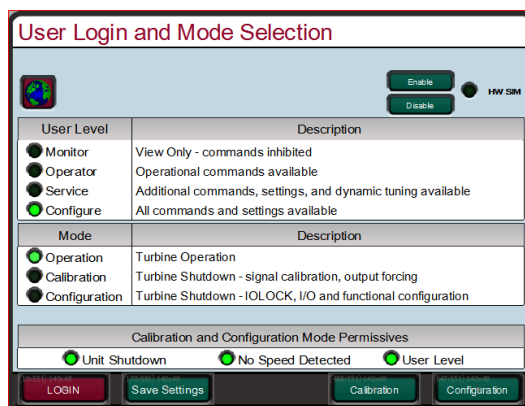


Figure J-1. HW Simulation Mode Access

When this mode is entered, the following actions will take place:

1. The DI01 External Trip will be inverted (so that a FALSE = OK, in normal operation this must be TRUE=OK)
2. If Speed is ever seen on the MPUs
3. Event 102 Alarm will be active stating Simulation is Enabled
4. A simulated speed ramp will produce speed based upon the valve demand increasing

If any of these actions take place, the H/W Simulation mode will be aborted:

1. If DI channel 1 goes TRUE (Normal run mode must be True to Run)
2. Logging out or Lowering User Level
3. If DI channel 1 goes TRUE (Normal run mode must be True to Run)
4. If Speed is ever seen on the MPUs

Typical use would be:

1. Configure the unit for the required steam turbine start routine
2. Configure any start sequence items and critical speeds
3. Configure the ramp rates at rate times as a fraction of what you want (for example for a 4 hour idle delay use 0.24 minutes instead of 240 min)
4. Exit the Configuration mode and re-login as ServiceUser
5. Simulate a start

## Appendix K.

# Custom Tag Name Procedure

Custom tags allow users to input strings for predefined parameters in any characters available in the Arial Unicode MS font family. This allows users to input tag names using a language other than English. The custom tags are input into the “custom\_tags.ini” file that resides on the control. The file contains a list of the available parameters.

If custom tags are not used, the tag name can be edited from the front panel or RemoteView in English only. When a custom tag is defined within the “custom\_tags.ini” file, it will replace the editable tag with a fixed string defined in the file.

Note: When adding custom strings to the “custom\_tags.ini” file, keep in mind the string length and the space available on the screen for that string. If the string is too long, it will automatically shrink it to avoid truncation.




When a new “custom\_tag.ini” file is loaded into the control, the GUI must be restarted in order to load the new strings. The available tags are shown in yellow text on the control.

### Required Tools

- 1) AppManager
- 2) Notepad++ (<http://notepad-plus-plus.org/>)

The “custom\_tag.ini” file is formatted. An advanced text editor, such as Notepad++, is required.

### Creating Custom Tags

- 1) Make a copy of the blank *custom\_tags.ini* file from the System Documentation CD (BCD85282)
- 2) Open the “custom\_tags.ini” file with an advanced text editor, such as Notepad++
- 3) The file contains a list of available tag names. Set the desired tag name to the right of the equals sign.
  - a. If a tag does not contain a string, for example “AI\_01\_Tag =”, where the string to the right of the equals sign is blank, Qt will use the string in control software. In this case, the string is editable from the front panel in English only. If the tag contains a string, for example “AI\_01\_Tag = Custom(习俗)(風習)”, Qt will pull the string from the “custom\_tags.ini” file to be used on the display.
- 4) Save the “custom\_tags.ini” file after changes have been made
- 5) Connect to the control using AppManager
- 6) Change to the GUI Application View 
- 7) Open the appropriate GUI application folder, and download the “custom\_tags.ini” file
- 8) Select “Transfer Files to the Current Control” 
- 9) Select the edited “custom\_tags.ini” file and press Open. The file will get copied to the control.
- 10) Stop and start the appropriate wgui application 

## Appendix L. Startup Guide

If using an Ethernet link from the 505XT onto the plant network be sure to obtain appropriate TCP/IP addresses from the network administrators. Be sure to not place the 505XT onto a plant network with its factory default IP address – as this may cause a conflict with another device in the plant.

### Commissioning Checklist

#### Tests to be done prior to power-up

- ☐ Verify mounting is correct and secure
- ☐ Verify chassis ground connection is appropriately connected to enclosure earth ground
- ☐ Verify Correct Power supply voltage to be used matches part number and color coded connector
- ☐ Verify all required I/O signals and communication cables are available at control

#### Tests to be done prior to turbine operation

- ☐ For specific wiring check details refer to Chapter 2
- ☐ Verify speed signals – type, number of teeth, gear ratio, verify with frequency input
- ☐ Loop Check all analog input signals – verify ranges / calibrate
- ☐ Verify all discrete input signals – verify active state in control
- ☐ Loop Check all ACT signal – calibrate, set range, perform a manual stroke
- ☐ Loop Check all other analog output signals, verify ranges / calibrate / force test
- ☐ Loop Check all Relay output signals, verify active state / force test
- ☐ Verify all Communication links – protocol settings, IP addresses, device numbers
- ☐ Verify Emergency Stop and External Trip (DI 01) from customer
- ☐ Verify Independent Safety systems (External OSPD required) are present with customer
- ☐ Verify configuration on 505 Front Display matches information on Program Worksheets
- ☐ Review appropriate site startup procedures
- ☐ Physically inspect the Steam control valves – verify type, location, position indicators

#### Tests to be done while running

- ☐ Verify start routine is correct and meets customers desired expectations
- ☐ If possible - validate speed shown on the control matches the speed shown on other devices
- ☐ Validate speed control stability at Idle (or lowest desired controllable speed), tune OFFLINE dynamics
- ☐ If turbine is an Extraction/Admission unit verify correct demand for the LP Valve thru the start routine
- ☐ Manually set the ONLINE dynamics to match the OFFLINE settings above

- ☐ Verify stable operation through the rest of the start routine up to MinGov (or to rated speed)
- ☐ Perform internal OSPD trip test to verify 505 setting – perform external OSPD trips if required
- ☐ If Generator application – synchronize the unit, close breaker and tune ONLINE dynamics
- ☐ If Mechanical drive application – raise to a minimum load and tune ONLINE dynamics
- ☐ If turbine is an Extraction/Admission unit – set Ratio Limiter dynamics settings to match ONLINE
- ☐ If turbine is an Extraction/Admission unit – verify set point and enable Ext/Adm control
- ☐ If turbine is an Extraction/Admission unit – adjust Ext/Adm dynamics for stable control
- ☐ Raise the load of the unit and verify stable operation at all loads
- ☐ Verify any configurable control options that are used (Cascade, Auxiliary...)
- ☐ If turbine is an Extraction/Admission unit – verify any site alternate modes use (Speed/Exhaust,...)
- ☐ Verify a normal stop routine – or the site required typical normal stop routine

**What to Leave for site personnel**

- ☐ Tunable settings file for customer (for use on spare unit for training or future replacement)
- ☐ Verify customer has all system documentation – manuals, software tool installs
- ☐ Verify customer knows basic understanding of any Woodward service tools they want to use
- ☐ Appropriate contact numbers for support and/or service

## Appendix M. Datalogs

### Overview

The 505 controller has two internal datalog functions, which collect time series data into a memory buffer. The buffer contains data for the time given in the 'Collection Time' field on the Datalog page within the Service Menu. Only the latest data is stored in the buffer meaning that old data outside of the Collection Time window is overwritten with new data as it comes in. The buffer writes to a file after an event such that it can be retrieved for analysis (using AppManager and Control Assistant).

The Fast DataLog is a fixed configuration which samples and stores data every 10ms and contains approximately 3 minutes of data per file. The TrendLog is configurable down to 10ms sample rates, but is defaulted for one second and is intended to provide historical process data (about five hours of data per file). The data that is stored includes all IO channels, controller inputs and output, limiters, and other pertinent information in order to analyze the system. This is a fixed data set for the Fast DataLog. The TrendLog contains the same base data set but can also have signals added through a configuration file.

The datalog buffer begins collecting data automatically when any of the following occur

1. User command from the Datalog page in the Service Menu
2. The turbine is started
3. A file is stored on the drive

The datalog stops when

1. User command from the Datalog page in the Service Menu
2. A shutdown

A datalog file automatically prints to the Hard Drive for retrieval when the datalog is stopped, which in turn restarts the datalog buffer when the file is printed. The control will store three log files per datalog type and will then overwrite previous datalog files when a new file is generated. The files are indexed with a value from one to three which increments each time a new file is generated.



Figure M-1. The Datalog Service Menu Page

### Datalog File Retrieval

Datalog files can be retrieved from the 505 for analysis using AppManager (see Appendix F).

### Datalog File Analysis

Datalog files can be opened with Control Assistant once it has been downloaded onto your PC from the 505 using AppManager. With Control Assistant open, go to File > Open... and navigate to file location on your PC and select Open.

The Graph Properties page will open with the list of available signals in the left window. Signals plotted are referred to as pens, can be moved from the available signals list to the right window. Once in the right window, the pen color and order can be customized:

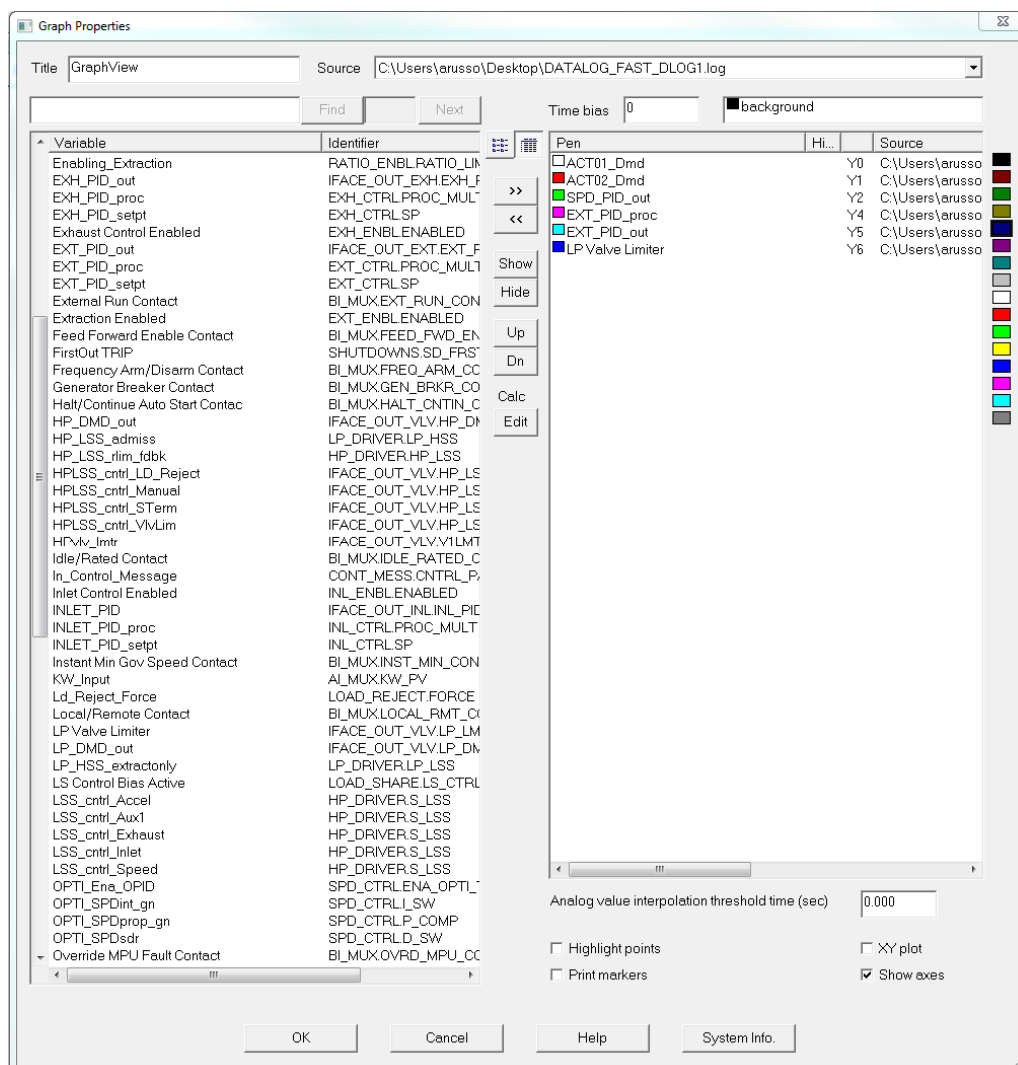


Figure M-2. DataLog Graph Properties

Generate the graph by selecting OK in the Graph Properties Menu. Once generated, the plot is given in the top portion of the screen and the pen details are given on the bottom. The Scale (Low) and Scale (High) are automatically set initially but can also be set manually. Two cursors can be dragged on the plots in order to see exact values and compare data between two time stamps (Y1 column in the Pen details is Cursor 1, Y2 column is Cursor 2, and Delta-Y is the change in the signal value between the two cursors). In the bottom right hand corner of the window, the 'Time Difference' is in seconds and is the amount of time difference between the cursors. Please see the help menu within Control Assistant for detailed information on all menu options.

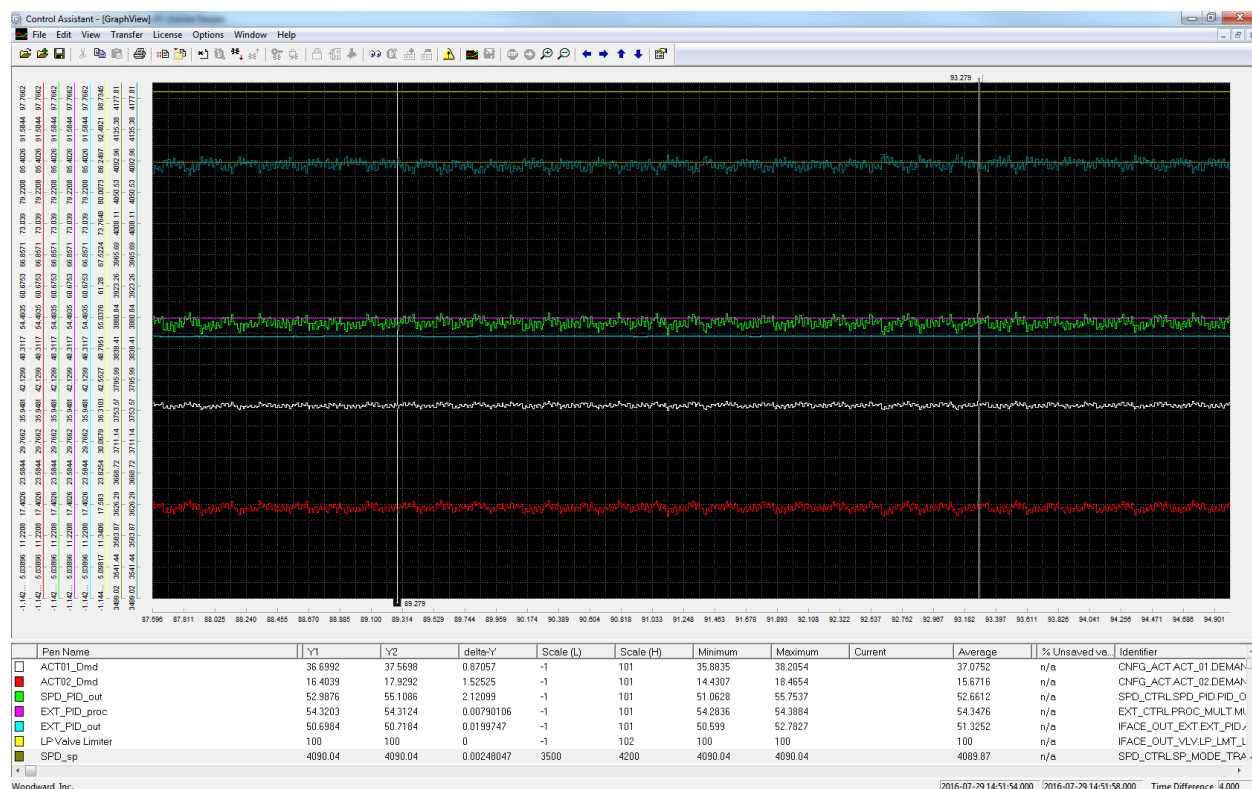


Figure M-3. Datalog Plot

### Continuous DataLog (only on TrendLog)

The Continuous DataLog feature allows for datalog file generations, which merge in Control Assistant to create a plot over very long periods. This mode supports commissioning or troubleshooting efforts. For that reason, the Continuous mode will change the Data Sample Rate to 10ms. Use the Continuous mode with AppManager to automatically collect the datalog files as they are generated.

Press the 'Enable Continuous' button on the Datalog page in the Service Menu to enable Continuous mode. This will stop the TrendLog and restart it in Continuous mode. Next, in AppManager, go to Automated File Collection > Configure Automated File Collection Task. Select the control from the 'Available Control' list and add it to the 'Controls to gather files from' list. Within the 'Datalog retrieval options', set the folder on your PC where files will be stored. Press 'OK' to exit the configuration menu.

Note that, by default, each file is approximately 2.7 megabytes and is stored once every 100 seconds. This means that 97.2 megabytes of data will be stored every hour on your PC.



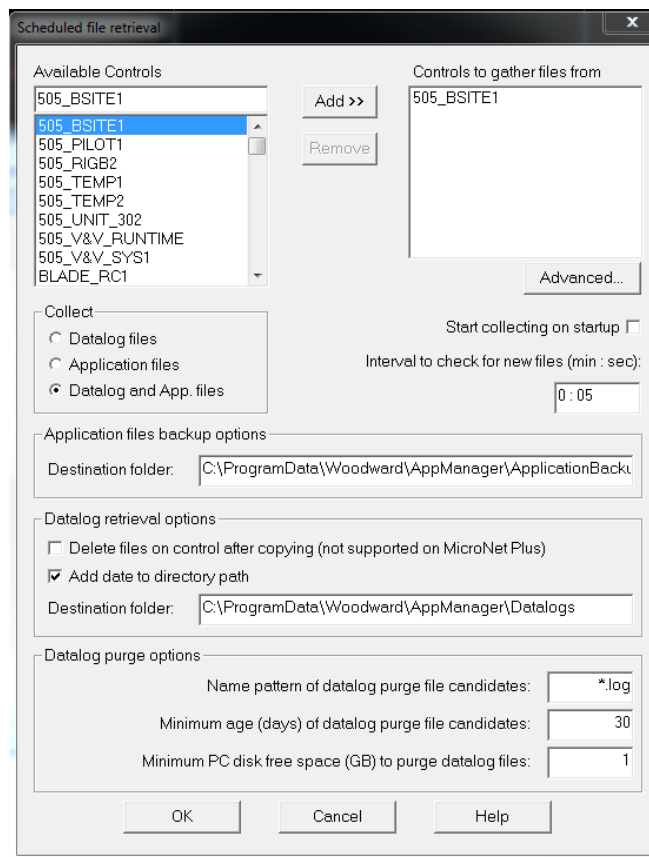


Figure M-4. Automated File Collection Configuration

After clicking OK you will be prompted if you would like to start collecting now – if yes – it will gather all current datalog files on the control (including all existing FAST\_DLOG and TREND\_DLOG files). To begin collecting files you can also go to Automated File Collection > Start Automated File Collection Task. Once started, AppManager will display 'Monitoring Network for New Files' in the bottom window indicating that new files on the control are automatically saved to your PC.

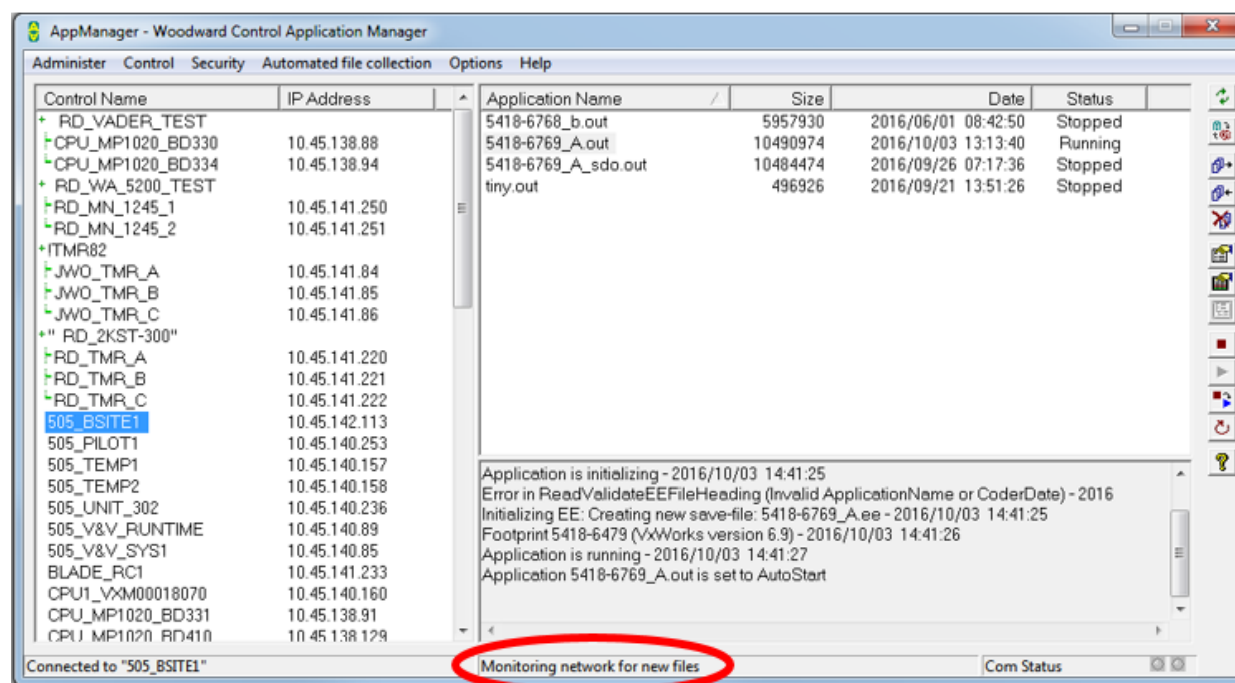


Figure M-5. Automated File Collection Active

**Note:** The Automated File Collection feature of AppManager can be used without placing the control in Continuous DataLog mode. In this case, AppManager will download Fast Datalogs and TrendLogs every time a new file is generated (in the case of a trip or manual datalog).

The Control will remain in Continuous mode for 8 hours or until it is manually disabled from the Datalog page.

To View the continuous datalog, select all of the files (instead of just one) when opening the file and then follow the same steps as above to construct the graph of the desired variables.

### Adding Signals to the TrendLog

If needed – additional parameters can be added to this datalog file at run-time. Using AppManager retrieve the current file from the control (filename = trend\_dlog.logconfig ). Use Control Assistant to modify the file. Increment the revision number at the top for reference (this can be seen in GAP / WinPanel to verify file being used). Then use AppManager to place the file back on the control in the control applications folder.

The datalogging must be stopped and then restarted to use the updated file.

## Revision History

### Changes in Revision E—

- Additional content added to Control Assistant in Chapter 8
- Open Wire Test added to Service Mode Parameters
- Min HP Valve Upon Load Rejection added to Breaker Logic
- Enable Map Limit Reached Alarm added to Extraction/Admission Control Settings
- Additional content added to Use SNTP Synchronization
- Additional content added to Screen/Key Options
- Map Adjust Pop-Up Option added to Steam Map

### Changes in Revision D—

- Added Setting SNTP section to the end of Appendix H

### Changes in Revision C—

- Replaced content in “HOLD SPEED CHANGES?” Listing in Chapter 12.
- Added “Generator Breaker Open Disable?” and “Utility Breaker Open Disable?” to Remote Speed Settings section of Chapter 12
- Removed “only used ‘Gen Breaker Open Setback’ is YES” from GEN OPEN SETPOINT (RPM) listing in Chapter 12
- Added Real Time Clock section to Screen/Key Options in Chapter 12
- Added “Generator Breaker Open Disable” and Utility Breaker Open Disable” in the Speed Control Worksheet in Appendix C

### Changes in Revision A—

- Added NOTICE box in Outline Drawing for Installation section
- Added Changing the Control ID content to Appendix D
- Added Opening a Trend Script File as a Template content to Appendix E
- Added “Online Speed Dynamics Speed Level”, “Reverse Power Protection?”, “Manual P Demand Rate”, “Enable Continuous/Disable Continuous” “Continuous Mode Active”, “Generator Breaker Open Ext/Adm Inhibit”, and “Tie Open Load Rejection?” settings to Chapter 12
- Replaced text in “Use Acceleration Limiter “ setting
- Added two new rows to “Breaker Logic” table in Appendix A
- Added new row to “Extraction/Admission Control” table in Appendix A

We appreciate your comments about the content of our publications.

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