INSTALLATION INSTRUCTIONS

Original Issue Date: **3/06**
Model: **20–230 kW Generator Sets**
Market: **Industrial and Marine**
Subject: **Digital Isochronous Governor Programming Kit GM39344 (Kohler and Woodward Brand-Labeled)**

Introduction

The digital isochronous governor programming kit includes the programming CD-ROM and cable for connecting the governor controller to the user's PC. This instruction is used in conjunction to the digital isochronous governor kits.

Two brands of governors (Kohler and Woodward) can be programmed with this kit. Kohler-branded governors require the use of KPST v1.0.1 or higher software and Woodward- branded governors require use of UPST v3.0 software.

The programming kit parameter setting tool (PST) software tells the governor controller how to operate the generator set governing system for that application.

The procedure for UPST (universal) and KPST (Kohler) is very similar and where it is the same, the software will simply refer to it as PST. The KPST software is included on the CD-ROM and is available for download from the KOHLERnet TechTools website. Access and download the UPST software by going to the following website.

http://www.woodward.com/software/Download/SWProductDetail.cfm?FileID=201

The digital isochronous governor kits replace discontinued generator set governors. See Figure 1. Replacement governors are shipped unprogrammed. After installing and wiring the new governor service kit, download the PST software and follow the instructions to change the default settings to your specific application.

The PST software overwrites any original programs in the governor controller's nonvolatile memory. Make a backup copy of the files onto a disk and store the disk in a safe place.

The CD-ROM file contents can also be requested through KOHLERnet. Use your SecurID to access the KOHLERnet, click on the TechTools button, and follow the instructions to download the files.

Service Kit	Governor Assembly	Replaces:
GM36253	GM17644-4, DPG-2101-002	A-249922
GM36254	GM17644-4, DPG-2101-002	A-246045
GM38323	GM17644-4, DPG-2101-002	324515, 324704, 326814, 336236, 336396
GM39342*	GM17644-7, DPG-2223-002	227264, 255932, 299933, 324547, 336397, 347840, 347841
GM39343	GM17644-6, DPG-2146-002	GM22742
* Load share governor		

Figure 1 Service Kits and Discontinued Governors

Read the entire procedure before beginning. Install the software onto a PC. Carefully follow these instructions and any additional instructions that appear on the screen during the download procedure. The instructions provided here assume you know how to operate a PC.

Loading incorrect or incomplete files may cause permanent damage to the governor controller's logic circuit board. Verify that the CD-ROM file contains settings for your specific generator set and engine. Do not attempt to modify the data files.

Kit Components

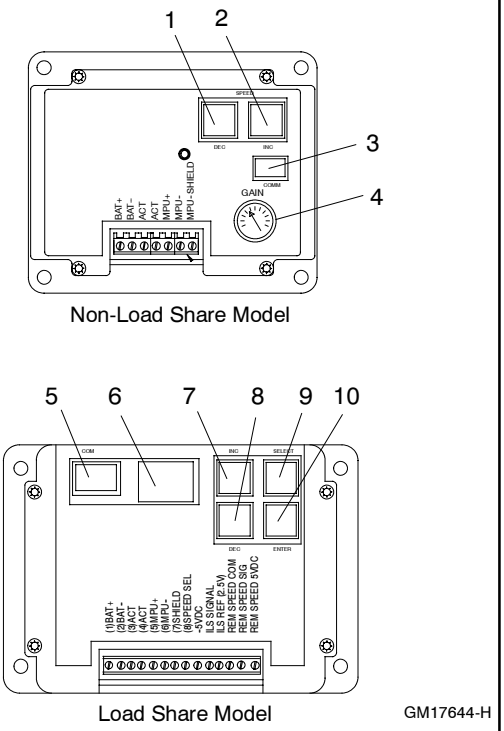
- COMM port cable (9-pin RS-232 DB9F serial port connector to a RJ11M plug)
- CD-ROM includes
  - Governor Parameter Detail Form
  - Governor Parameter Summary Form
  - Parameter Text Files
  - TT-1398 Governor Service Kits
  - TT-1399 Governor Programming Instructions
  - KPST v1.0.1 or higher
  - Link to the UPST software on the Woodward website

Features and Specifications

The microprocessor-based, digital isochronous governor allows adjustment of set speed and gain. Other adjustments include acceleration, deceleration, ramp rates, idle speed set, and hold time. The COMM port provides simple programming when connected to the user's PC. See Figure 2 for specifications and Figure 3 for governor controller illustrations.

Specifications	Value
Maximum controlled output current	7 amps
Maximum current surge	14 amps for 10 seconds
Input signal from magnetic pickup	2.0 VAC RMS min. during cranking
Ambient operating temperature	-40°C to +85°C (-40°F to +185°F)
Environmental protection	Oil, water, dust resistant via conformal coating and die cast enclosure
Electrical connections	Euro-style terminal strip

Figure 2 Specifications



1. Speed decrease
2. Speed increase
3. RJ11 connector
4. Gain potentiometer
5. RJ11 connector
6. LED display
7. Increase
8. Decrease
9. Select
10. Enter

Figure 3 Governor Controller Functions

Other features include:

- 0.25% frequency control.
- Reverse battery protection.
- 9–30 VDC input.
- Smoke control on startup.
- Serial communication port.
- Droop operation with 0%–10% set speed with 0.10% resolution (load share model).
- Parallel input (load share model).
- Speed adjustment and voltage measurement ranges (load share model).

Keypad Functions

The governor controller keypad provides functions as described below. Refer to Figure 3 illustrations.

The Set Speed A and Gain (OVG @ Set Speed A) values can be changed using the governor controller keypad and potentiometer adjustment on non-load share models.

All values can be changed using the governor controller keypad on load share models.

Non-Load Share Model

These models provide speed adjustment for increase/ decrease speed and a gain potentiometer. No other functions are available on the governor controller.

Load Share Model

The user interface operates in two modes—Parameter Select Mode and Parameter Edit Mode.

The Parameter Select Mode provides the user selection of viewing and editing parameters. This mode is active when the 2-digit value display is flashing (blinks). The value is the parameter identification (ID) number. The governor controller label lists each user-adjustable parameter and the corresponding ID number.

The Parameter Edit Mode provides the user with the selected parameter's value and allows the changing of a value. This mode is active when the 2-digit value display is steady on. The value displayed is the selected parameter's current value. The decimal point display has several meanings:

- Decimal point flashing indicates the value can be edited.
- Decimal point not flashing indicates the value cannot be edited. The selected parameter is locked and values are viewable only. This situation occurs when the password protection is active and the unlocking code has not been entered.
- The right digit's decimal point is ON—the lower two digits of a parameter's 4-digit value are displayed.
- The left decimal point is ON—the greater two digits of a parameter's value are displayed. The upper two digits of a parameter are always view only and cannot be modified directly. The upper two digits will change when the lower digits transition from 99 upward or 00 downward.

The keypad consists of four pushbuttons—Enter, Select, INC, and DEC. See Figure 4 for a summary of functions by mode selection.

Parameter Select Mode	
LED Display	The ID number of a parameter listed on the label is flashing.
INC key	Increase the parameter ID number by 1.
DEC key	Decrease the parameter ID number by 1.
Select key	Activate the Parameter Edit Mode on the parameter number flashing.
Enter	Display the version number of the governor's programming.
INC and DEC simultaneously	Turn on all LED segments as a test.
Parameter Edit Mode	
LED Display	The value of the selected parameter is displayed. A flashing decimal point indicates the value can be changed.
INC key	Increase the selected parameter's value.
DEC key	Decrease the selected parameter's value.
Select key	Return to Parameter Select Mode and ignore the changes made to the parameter value.
Enter	Save the parameter's new value and return to the Parameter Select Mode.
INC and DEC simultaneously	Use to display the upper digits of values greater than 99.

Figure 4 Keypad Function Summary

Enter key. Use the Enter key to exit the Parameter Edit Mode and return to the Parameter Select Mode while the new value gets saved to nonvolatile memory. In the Parameter Select Mode, pressing the Enter key displays the version number of the governor's programming.

Select key. Use the Select key to enter the Parameter Edit Mode from the Parameter Select Mode after a particular parameter has been selected for editing.

Also use the Select key to escape the Parameter Edit Mode and return to the Parameter Select Mode without saving a change in the parameter's value. The parameter value reverts back to the value present when the Parameter Edit Mode was entered.

INC (Increase) key. Use the INC key to increase the displayed parameter ID or value depending upon mode selection.

In the Parameter Select Mode, each press of the INC key causes the display of the next higher parameter ID. After the maximum parameter ID is reached, the display loops back to the first display.

In the Parameter Edit Mode, each press of the INC key increases the current value. Holding the INC key down automatically causes the values to rise at an increasing rate until the INC key is released or the parameter's maximum value is reached.

DEC (Decrease) key. Use the DEC key to decrease the displayed parameter ID or value depending upon mode selection.

In the Parameter Select Mode, each press of the DEC key causes the display of the next lower parameter ID. After the minimum parameter ID is reached, the display loops back to the last display.

In the Parameter Edit Mode, each press of the DEC key decreases the current value. Holding the DEC key down automatically causes the values to fall at an increasing rate until the DEC key is released or the parameter's minimum value is reached.

INC and DEC keys together. In the Parameter Select Mode, pressing and holding the two keys at the same time causes the LED segments to go ON. This serves as a test for the LED segments. Release the keys to resume displaying the parameter ID number.

In the Parameter Edit Mode, pressing and holding the two keys at the same time permits viewing the upper two digits of a 4-digit number. The left digit's decimal point is turned on indicating that the thousands and hundreds digits are displayed.

Note: Not all parameters have four digit values, in which case the upper digits will display 0.0 (zero decimal point zero).

Release the keys and the tens and ones digits are again displayed. The right digit's decimal point is flashing when editing is allowed or steady on indicating that editing is not allowed.

LED Display Functions (Load Share Model only)

The governor controller LED display provides two 7-segment LEDs with digit's corresponding decimal point to display values and indicate mode of operation. Refer to Figure 3 illustration for the load share model.

When the LED display value flashes, the Parameter Select Mode is active.

When the LED display value is steady on, the selected parameter's value is displayed and the user interface is in the Parameter Edit Mode. The decimal points also indicate which half of a 4-digit value is displayed and whether editing is allowed.

The right digit's decimal point indicates that the lower 2 digits of a value (tens and ones) are displayed. When the right decimal point flashes, the values can be changed using the INC and DEC keys. When the right digit is steady on, no editing is allowed or is password protected.

The left digit's decimal point indicates that the upper 2 digits of a value (the thousands and hundreds) are displayed. The greater 2 digits are always view only so the right decimal point does not flash.

When values exceed four digits, the LED display uses the hexadecimal numbering system to represent the value of the thousands position. See Figure 5 and the following examples.

Note: For generator set applications, the values will not exceed 9999. This text is for informational purposes only in the event that a value is inadvertently entered above 9999.

Decimal Value	Hexadecimal Equivalent
10	A
11	B
12	C
13	D
14	E
15	F

Figure 5 Decimal to Hexadecimal Conversion Chart

Example A

The desired set value is 10069 Hz. The upper two digits should display A.0 and the lower two digits should display 69.

Example B

The desired set value is 10972 Hz. The upper two digits should display A.9 and the lower two digits should display 72.

PST Software

The PST software enables the user to adjust parameter settings and monitor governor operation when a user-supplied PC is connected to the governor controller via the COMM port. Access and download the PST software using the KOHLERnet or CD-ROM.

Note: Use KPST v1.0 for Kohler-branded governors. Use UPST v3.0 for Woodward-branded governors.

Features

- Automatic configuration to each generator set when communication is established.
- Read/write access to all of a generator set's programmable parameters and features.
- Display of each parameter's default, minimum, and maximum values.
- Diagnostics utilizing automatic refresh of the generator set's status.
- Saving and reloading generator set setup information to and from a file for reuse.
- Single button read for acquiring current parameter values.
- Single button write to program a generator set with previously saved setup values.
- Engine speed monitoring via a chart recorder to aid in governor tuning.
- Saving chart recorder data to a Microsoft® Excel compatible file.
- Help information on each of the governor's parameters.
- Help information on using the PST software.

PC System Requirements

- 100% IBM® PC compatible with a 133 MHz or higher Pentium® compatible CPU.
- Microsoft Windows® 98SE (second edition), Windows NT® Workstation Version 4.0, Windows® 2000, or Windows XP® operating system.
- Display resolution with SVGA (800 x 600) or higher.
- CD-ROM drive and minimum of 4 MB hard drive space for installation.
- One 9-pin RS-232 DB9M serial port.
- PCs using USB ports will require a serial adapter.
- Stable power supply. A laptop system with a fully charged battery or desktop system running with a battery backup system is recommended.

PST Software User Interface Overview

The PST software for generator set applications has two main display modes—Table View and Chart View. Table view is the PST software default setting.

Table View

In the table view, the user can perform the following items:

- View the current values for all user-programmable parameters in the Parameter Setup panel's table.
- Edit a parameter's value by double clicking on a cell in the *Value* column of the table.
- Left click Read All to refresh the values in the table shown on the Parameter Setup panel.
- Left click Write All to transmit setup values to the governor controller.
- Left click View Status to display read only parameters in the View Status panel.
- Left click View Chart to set the display mode to Chart View.

Chart View

In the chart view, the user can perform the following items:

- View the current values for all user-programmable parameters in the Parameter Setup panel's table.
- Edit a parameter value related to governor tuning. These same parameters are also on the main parameter setup table.
- Left click Data File to open a file for saving chart recorder data.
- Left click Data Reset to start data collection to the open file at the beginning.
- Left click Pause Chart to stop the chart recorder, which also stops writing data to the file. Left click Continue to start the chart recorder function.
- Adjust the horizontal and vertical settings for the chart recorder.
- Left click View Table to set the display mode back to Table View.

PST Software Menu Items

Use the following menus as needed:

File Menu

- Open a previously saved setup data file.
- Save the setup data to a file.
- Exit the program.

View Menu

- Select the Parameter Table view (Table View).
- Select the Chart Recorder view (Chart View).

Port Menu

- Select the PC's serial port connected to the governor controller.

Help Menu

- Help on the PST software for generator sets.
- Help on the governor controller that is currently in communication with the PC.
- Information about the PST software for generator set application.

Parameter Setup

The Parameter Setup panel displays a table where each row shows the name of a user-programmable parameter, the current value, and the parameter's (default, minimum, and maximum) values.

To modify a parameter's current value, select the value by double clicking the left mouse button on a cell in the table. The selected cell will be highlighted and the value can be modified. After entering the new value, press the PC Enter key to change the governor controller value.

To get help on a particular parameter, left click the parameter's value, then press <Control> F on the PC.

To see the current values for all of the generator set's parameters, left click Read All.

Left click Write All to transmit all parameter values to the governor controller automatically. The Write All button is very useful when reusing saved setup data to configure a new system the same as a previously created one. Load an existing set of previously saved parameter values into the Parameter Setup table using Open a Setup Data File from the File menu and then left click Write All.

Status View

The Status View panel is displayed only after left clicking View Status. The Status View panel is part of the Table View display mode.

The Status View panel displays a table where each row shows the Name of a read only parameter and its current Value when Auto Read is ON.

Left click Start Monitoring to have the PST software program automatically refresh the values. Left click Stop Monitoring to disable automatic refresh.

Tuning View

The Tuning View panel is displayed only after left clicking View Chart. The Tuning View panel is part of the Chart View display mode.

To modify a tuning parameter's current value, select the value by double clicking the left mouse button on a cell in the table. The selected cell will be highlighted and the value can be modified. After entering the new value, press the PC Enter key to change the governor controller value.

Chart Recorder

The Chart Recorder is part of the Chart View display mode. Each time Chart View is entered, the last Data File is reset, the vertical scale defaults to a preset value, and the horizontal scale defaults to 20 seconds.

The vertical and horizontal scale options control the chart recorder's display characteristics. Use the horizontal scale to provide a chart recorder display at 60-, 30-, 20-, 10-, or 5-second intervals. Larger values compress the display while smaller numbers expand the display.

The Data File button opens a dialog box to name the file and path where chart recorder data is saved.

Use the Data Reset button to start data collection over using the current data file. The progress bar to the right of this button indicates the capacity of the data file. Each data file can hold approximately 10 minutes of data and the data is sampled 100 times per second. The progress bar displays the message The Data File is Full when it can no longer accept chart recorder data.

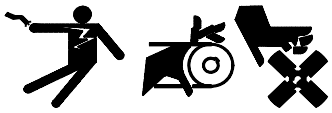
The Pause Chart button stops the chart recorder and data file updates. Left click this button, which is now named Continue, to activate the chart recorder.

Use the View Table button to return to the Table View display mode. Be sure to open a new Data File before returning to Table View if the data already collected needs saving. The active Data File is automatically reset each time the Chart View display mode becomes active.

Safety Precautions

Observe the following safety precautions while installing the kit.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Read the entire installation procedure and compare the kit parts with the parts list in this publication before beginning installation. Perform steps in the order shown.

Installation Procedure

1. Download and install the PST software.

Before going to the generator set jobsite, It is recommended to access and download the PST software to your PC hard drive where an internet connection is available.

The instructions provided here assume you know how to operate a PC.

1.1 Login to the user-supplied PC.

1.2 **For Kohler-branded governors**, login to the internet. Access the KOHLERnet and download the KPST software files (about 25 MB) to a designated folder on your PC hard drive.

For Woodward-branded governors, login to the internet. Go to the website shown on page 1 to access and download the UPST software files.

1.3 Log off the internet.

1.4 Unzip the files to a designated folder on your PC hard drive.

1.5 Open the readme.txt file and review the contents.

1.6 Run the setup.exe file. Use the readme.txt file as needed.

1.7 Follow the prompts as directed.

2. Determine the governor assembly part number and engine model number.

Before beginning the programming procedure, the user must determine the governor assembly part number and engine model number. The selection of the correct Parameter Text File later in this procedure depends on knowing these numbers.

2.1 The **governor assembly part number** is stamped on the replacement governor included in the service kit. Knowing the service kit number and using Figure 1 will also provide the governor assembly part number.

2.2 The **engine model number** may be shown on the engine nameplate attached to the generator set engine block. Other sources for finding the engine model number include the respective generator set spec sheet and documentation included with the generator set sales invoice and/or warranty registration.

3. Connect the governor controller to the user-supplied PC.

3.1 Place the generator set master switch in the OFF/ RESET position.

3.2 Connect the supplied cable included in the kit from the user-supplied PC 9-pin RS-232 serial port to the governor controller RJ11 connector (telephone jack). See Figure 3.

4. Open the CD-ROM files.

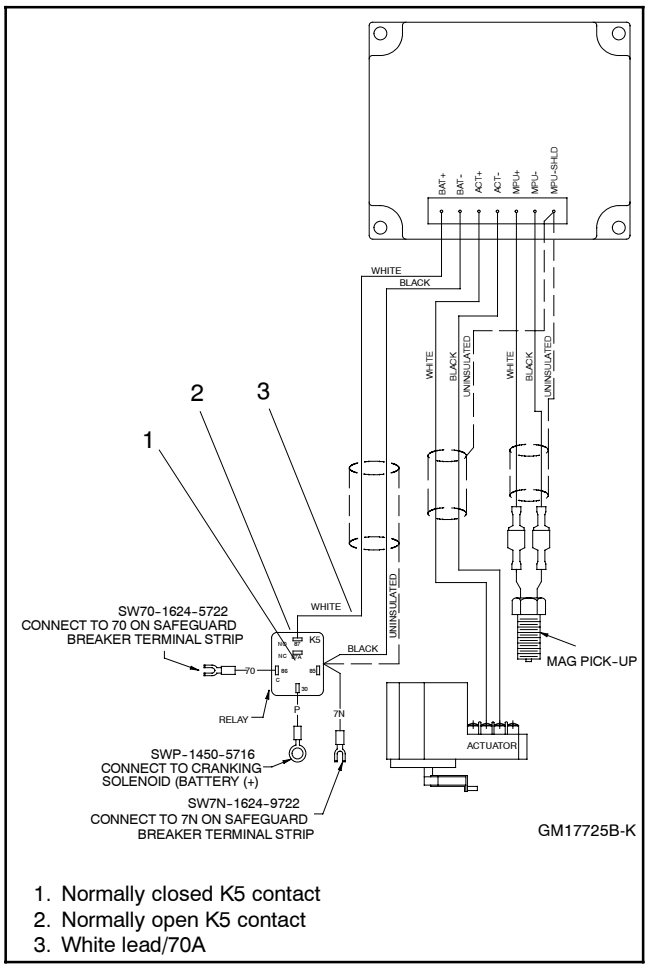
The instructions provided here assume you know how to operate a PC.

4.1 Login to the user-supplied PC.

4.2 Load the supplied CD-ROM from the kit in the PC.

4.3 Copy the Setup and Parameter Text files to your PC hard drive. The default folder is *ProgramFiles\Kohler\KPST or UPST*.

4.4 Energize the governor controller by moving the white lead/70A from the normally open K5 contact to the normally closed K5 contact. See Figure 6. Connecting to the normally closed contact will energize the governor controller without starting/ running the generator set.



1. Normally closed K5 contact
2. Normally open K5 contact
3. White lead/70A

Figure 6 Energizing the Governor Controller (non-load share model shown)

4.5 The supplied CD-ROM from the kit contains a Governor Parameter Summary for each generator set/ engine combination. Print a copy of this summary as it provides the data necessary for programming the parameters for each specific generator set. See **Appendix A, Parameter Definitions,** for detailed explanations of each parameter and **Appendix B, Parameter Defaults Reference**.

4.5.1 If Governor Parameter Summary includes your generator set/engine combination, go to step 5.

4.5.2 If the Governor Parameter Summary DOES NOT include your generator set/ engine combination, go to **Appendix C, Calibration Instructions.**

Note: It is recommended to connect a load bank to the generator set in an effort to provide varying loads.

5. Program the governor controller and save the files.

5.1 Use the part number data determined in step 2 and select the Parameter Text file by clicking *File-Open-"?.Txt"*

Note: For Kohler-branded governors, file will begin with KB.

The Read All values on the PC screen are the values shown on the printed Parameter Summary form.

5.2 Click *Write All*. The selected parameter text file is then sent to the governor controller. Wait until download is complete when the *Write All* button reappears.

5.3 Save and store this parameter text file on your PC hard drive, floppy disk, and/or CD-ROM for future reference.

5.4 Close the PST software.

6. Disconnect the governor controller from the user-supplied PC.

6.1 Check that the generator set master switch is in the OFF position.

6.2 Move the white lead/70A from the normally closed K5 contact back to the normally open K5 contact. See Figure 6.

6.3 Disconnect the supplied cable included in the kit from the user-supplied PC 9-pin RS-232 serial port and the governor controller RJ11 connector (telephone jack).

6.4 Store the cable and CD-ROM together for later use as needed.

Troubleshooting

See **Appendix D, Diagnostics and Troubleshooting,** for help in diagnosing generator set/engine problems relating to the governor controller.

Parts List

Digital Isochronous Governor Programming Kit

Qty.	Description	GM39344
1	Cable (RS11), 3 m (10 ft.)	GM34410
1	Adapter, cable (RS11 to serial port)	GM39345
1	CD-ROM	GM39346

Use this appendix for definitions of each of the calibration values. **Appendix B, Parameter Defaults Reference** lists the default settings.

When changing values using the keypad, the PST software display on the user's PC will not automatically update. To refresh the PST software display, the user must select a different parameter with the PC mouse and then go back to the desired value. The PST software provides *Read All* button that will refresh all of the parameter values.

1. **Number of Flywheel Teeth.** Enter the value from the Governor Parameter Summary. This display is not required. Displayed speeds can be changed between Hz and rpm.

2. **Remote Speed Min. (load share model only).** Remote Speed Min. is the controller's minimum target speed when the remote speed potentiometer is selected. The controller will read the remote speed potentiometer position when the SPEED SEL input is OPEN and the startup sequence is complete.

   The default value is 1000 MPU Hz. The adjustable range extends from 10 Hz to Remote Speed Max.

   When Remote Speed Min. values greater than 9999 are displayed, the left most digit uses the capital letter A to represent 10000 and the lower case letter b to represent 11000.

   Example: If Remote Speed Min. is set to 11000, the controller will display the upper 2 digits as [b.0] and the lower 2 digits as [00.]

3. **Remote Speed Max. (load share model only).** Remote Speed Max. is the controller's maximum target speed when the remote speed potentiometer is selected. The controller will read the speed potentiometer position when the SPEED SEL input is OPEN and the startup sequence is complete.

   The default value is 1000 MPU Hz. The adjustable range extends from Remote Speed Min. to 11000 Hz.

   When Remote Speed Max. values greater than 9999 are displayed, the left most digit uses the capital letter A to represent 10000 and the lower case letter b to represent 11000.

   Example: If Remote Speed Max. is set to 11000, the controller will display the upper 2 digits as [b.0] and the lower 2 digits as [00].

4. **Set Speed A.** Enter the value from the Governor Parameter Summary.

5. **Idle Speed.** Enter the value from the Governor Parameter Summary.

6. **Proportional.** Enter the value from the Governor Parameter Summary.

   A speed change creates a speed error (the difference between the target speed and the actual speed.) The Proportional gain controls the size of the governor output response to a step change in the speed error. See Figure 7.

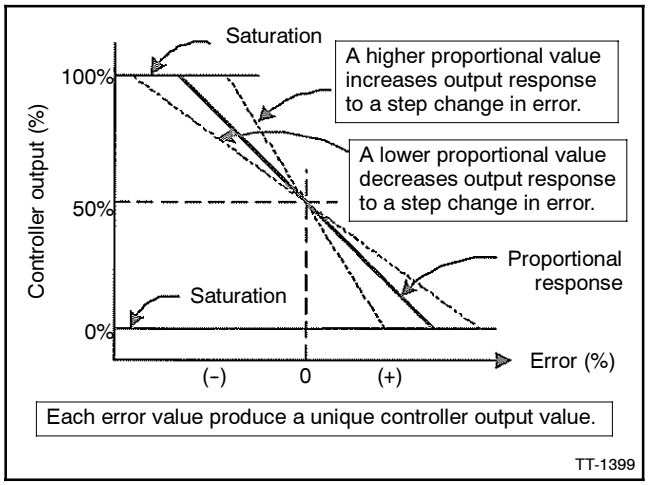


Figure 7 Proportional Value

7. **Integral.** Enter the value from the Governor Parameter Summary.

   The Integral value acts to drive the speed error to zero. In a Proportional only control with constant load, there will be a constant speed error that inversely relates to the Proportional gain of the system.

   The Integral value is key to isochronous speed control. This value eliminates the difference between the programmed set speed and the actual speed. The Integral gain changes the time it takes to drive the error to zero. The Integral value eliminates the speed offsets due to Proportional gain and should not be set to zero. See Figure 8.

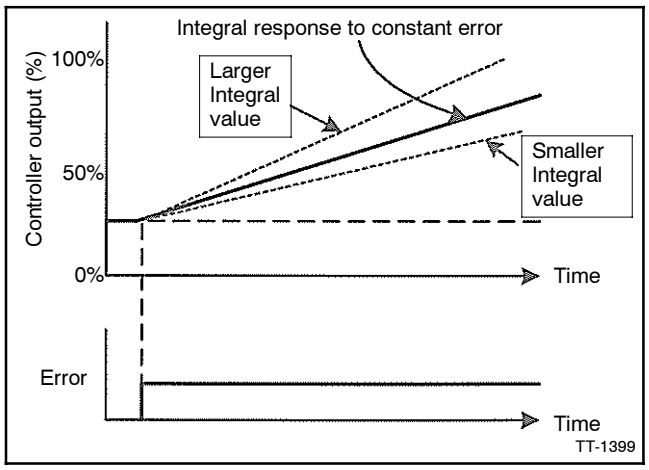


Figure 8 Integral Value

8. **Derivative.** Enter the value from the Governor Parameter Summary. See Figure 9.

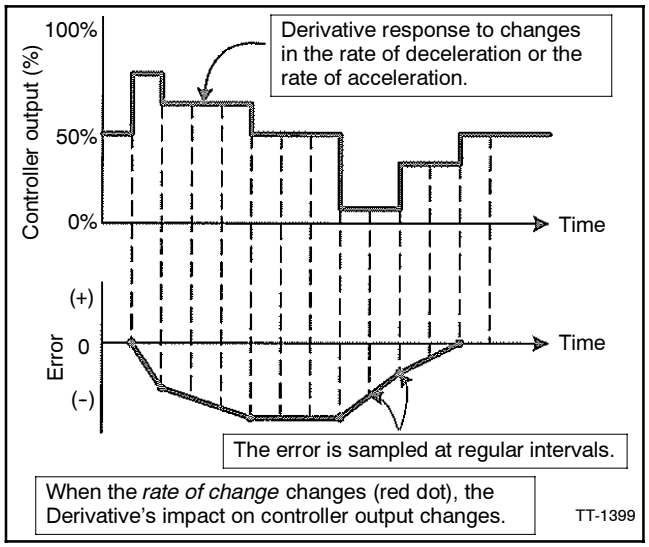


Figure 9 Derivative Value

   The Derivative responds to the rate of change in the speed error. This parameter is primarily used to dampen very rapid oscillations resulting from large speed changes. The Derivative responds to engine acceleration or deceleration. When the engine speed approaches the target speed at a fast rate, the Derivative acts to minimize or eliminate overshoot. A zero value is allowed but systems typically require some Derivative gain to improve overall engine speed control.

9. **Overall Gain (OVG) @ Remote Speed Min. (load share model only).** This overall gain acts as the multiplier on the three PID terms (proportional, integral, and derivative) when the remote speed potentiometer is selected to set the active target speed. This gain term is adjustable from 01 to 99.

   This value along with the OVG @ Remote Speed Max. value is used to select between single point gain vs. dual point gain. When OVG @ Remote Speed Max. is zero, the OVG @ Remote Speed Min. value is used over the full speed range of the remote speed potentiometer.

   When OVG @ Remote Speed Max. is a non-zero value, dual point sloped gain is used and a new gain value is computed based on the current speed.

10. **Overall Gain (OVG) @ Remote Speed Max. (load share model only).** This overall gain acts as the multiplier on the three PID terms (proportional, integral, and derivative) when the remote speed potentiometer is selected as the active target speed. This gain term is adjustable from 00 to 99.

    When a non-zero value is entered, dual point sloped gain is used, and a new gain value is computed based on the current speed.

11. **Overall Gain (OVG) @ Set Speed A (load share model only).** This overall gain acts as the multiplier on the three PID terms (proportional, integral, and derivative) when Set Speed A is selected as the active target speed. This gain term is adjustable from 01 to 99.

12. **Overall Gain (OVG) @ Idle.** Enter the value from the Governor Parameter Summary.

    This gain value acts as a multiplier on the three PID values when the idle speed is the active target speed. The idle speed set point is active only during startup when the Idle Hold Timer is running.

13. **Gain Factor.** Enter the value from the Governor Parameter Summary.

    The Gain Factor permits more range of adjustment from the PID values. When any of the PID reaches their adjustment limit, the Gain Factor can be modified for more range of the PID and OVG values.

14. **Speed Filter.** Enter the value from the Governor Parameter Summary.

    Value indicates the number of speed signal pulses to use when calculating an average engine speed and is used to dampen out speed measurement variations that can make PID tuning difficult.

    Too much filtering slows down the governor's response to speed change and too little filtering can make the governor overly sensitive and tuning difficult. As a general rule, less filtering is needed when the number of engine cylinders increases because there is less time for the engine speed to slow down before the next engine cylinder firing.

    Note: Use 24 for three- or four-cylinder engines and 16 for six- or eight-cylinder engines.

15. **Idle Hold Time.** Use the default value.

    The Idle Hold Time specifies how long after starting the engine stays at idle speed before finishing the ramp to the target speed. The time value has a resolution of one-tenth of a second.

    During the startup sequence, the governor increases the engine speed from the engine's crank speed to the active target speed at the Startup Rate specified. When the Idle Hold Time is nonzero, the initial target speed will be the idle speed. After the Idle Hold Time times out, the governor uses the Startup Rate to ramp the engine to the selected Set Speed (A or B). The startup sequence is complete after the engine speed reaches the specified set speed.

16. **Accel Rate.** Use the default value.

    This value specifies how fast the governor should increase the engine's speed when a new higher speed is made active.

17. **Decel Rate.** Use the default value.

    This value specifies how fast the governor should decrease the engine's speed when a new higher speed is made active.

18. **Startup Rate.** Enter the value from the Governor Parameter Summary.

    This value achieves a smooth controlled engine start. On diesel engines, this value minimizes exhaust smoke at startup. When used in conjunction with the idle speed and Idle Hold Time, a brief warmup cycle can be programmed.

    The Startup Rate specifies how fast the governor should increase the engine speed when the engine is started. The governor increases the engine speed from the engine's crank speed to the active target speed at the rate specified. The governor brings the engine to the idle speed for the Idle Hold Time, then continues increasing the engine speed at this same ramp rate until the engine reaches the selected target speed (Set Speed A or B).

    Note: In cases where the target speed is less than the idle speed and the Idle Hold Time is nonzero, the startup ramp sequence ends when the idle speed is reached. The Decel Rate is then used to ramp the engine speed down to the target speed from the idle speed.

    The ramp up pauses at the Startup Speed until the governor senses an magnetic pickup (MPU) signal greater than the Startup Speed. This prevents the startup ramp from reaching completion before the engine has started.

    The governor treats MPU frequencies below the Startup Speed as an indication that the engine is cranking but has not yet started. The governor treats MPU frequencies above the Startup Speed as an indication that the engine has started and the governor increases the engine speed until the selected set speed is reached.

    Note: In cases where the target speed is less than the Startup Speed, the startup ramp sequence ends when the target speed is reached.

    During the startup sequence, the governor increases the engine speed from the engine's crank speed to the active target speed at the Startup Rate specified. When the Idle Hold Time is nonzero, the initial target speed is the idle speed. After the Idle Hold Time times out, the governor uses the Startup Rate to ramp the engine to the selected set speed (Set Speed A or B). The startup sequence is complete after the engine speed reaches the selected set speed.

19. **Startup Limit (load share model only).** Use the default value.

    The Startup Limit parameter limits the fuel supplied to the engine during startup. This value is useful in reducing smoke when starting diesel engines.

    Note: The engine may not start if the value is set too low.

20. **Torque Limit (load share model only).** Use the default value.

    The Torque Limit parameter limits the fuel supplied to the engine during heavy generator set loads or generator set overloads.

    Note: The engine may not be able to carry its rated load if the value is set too low.

21. **Integral Low Limit.** Use the default value.

    The Integral Low Limit value reduces underspeed duration after a long or sustained overspeed condition was present. The low limit helps reduce the duration and amount of engine underspeed by maintaining a minimum actuator position.

    Note: Setting an improper value can prevent the governor from reaching target speed.

22. **Integral High Limit.** Enter the value from the Governor Parameter Summary.

    The Integral High Limit value reduces overspeed duration after a long or sustained underspeed condition was present. The high limit helps reduce the duration and amount of engine overspeed by maintaining a maximum actuator position.

    Note: Setting an improper value can prevent the governor from reaching target speed.

23. **Percent (%) Droop (load share model only).** Use the default value.

    The percent droop value selects droop mode operation and specifies the percentage of droop required. When the percent droop parameter is set to zero (default setting), droop is not active.

    Note: This value can only be changed during the Droop Calibration Procedure detailed in Appendix C.

24. **No Load Calibration (load share model only).** Use the default value.

    The No Load Calibration value is determined during the Droop Calibration Procedure and should not be set manually.

    Note: This value can only be changed during the Droop Calibration Procedure.

25. **Full Load Calibration (load share model only).** Use the default value.

    The Full Load Calibration value is determined during the Droop Calibration Procedure and should not be set manually.

    Note: This value can only be changed during the Droop Calibration Procedure.

26. **Password.** Use the default value.

    The password feature provides protection against inadvertent parameter changes that can occur when keys are pressed and a parameter modification is not intended. The password parameter has three possible settings: Disabled, Locked, and Unlocked.

    Disabled. This setting turns off any password protection. Use this setting if password protect is not desired. This is the default setting from the factory. Enter a value of 99 to set the password protection parameter to the Disabled mode.

    Load share model only. When the password protect parameter is selected, the governor controller LED display shows *Pd* for 2 seconds, indicating the password-disabled mode; then the value *00.* is displayed. The user can then edit the value.

    Locked. This setting means that password protection is active and only parameter viewing is allowed (parameter editing is disabled). Enter a value of 22 to set password protection to the Locked mode.

    Load share model only. For 2 seconds after selection of the password protection parameter, the LED display shows *PE* for this mode and the rightmost decimal point will be steady ON (not flashing), then the value *00.* is displayed. The user can edit the value.

Unlocked. This setting means that password protection is active but parameter editing is allowed.

Load share model only. Entering a value of *30* in the Locked mode will unlock parameter editing. The user is free to edit parameters. If there is no governor controller keypad activity for 5 minutes, the governor controller returns to the Locked mode. If not already in the Unlocked mode, the user must get into the Unlocked mode in order to enter *99* to disable password protection.

27. **Overspeed limit.** Use the default value.

    This value determines the engine speed that triggers the governor output minimum fuel. The parameter's value is in terms of a percentage over the highest set speed.

    Note: The governor controller must be turned off to clear the overspeed detection before the engine can be restarted.

28. **Set Speed A Min.** Enter the value from the Governor Parameter Summary.

    Use Set Speed A minimum to set the lowest value allowed for adjustments of Set Speed A.

29. **Set Speed A Max.** Enter the value from the Governor Parameter Summary.

    Use Set Speed A maximum to set the highest value allowed for adjustments of Set Speed A.

30. **Idle Speed Min.** Enter the value from the Governor Parameter Summary.

    The idle speed minimum value is the lowest value allowed for adjustments of idle speed.

31. **Idle Speed Max.** Enter the value from the Governor Parameter Summary.

    The idle speed maximum value is the lowest value allowed for adjustments of idle speed.

32. **Duty Cycle Limit.** Enter the value from the Governor Parameter Summary.

    The duty cycle maximum value sets the absolute maximum amount of drive signal to the actuator and serves as a mechanism for fuel limiting. Fuel limiting is achieved by setting the maximum duty-cycle or ontime allowed during one cycle of the pulse width modulation (PWM) signal controlling the actuator drive circuit.

33. **E1 Handler Select (load share model only).** This parameter's value determines how the controller will handle the E1 error generated when a Loss of Remote Set Speed Signal is detected. Upon detecting a Loss of Remote Set Speed Signal, the controller automatically returns to the Remote Speed Min. value.

    When the value entered is zero or one, a Loss of Remote Set Speed Signal is defined when the measured Remote Speed Signal input voltage is less than 0.20 VDC or greater than 4.8 VDC.

    When the E1 Handler Select parameter value is zero, remove power from the controller to clear the E1 error.

    When the E1 Handler Select parameter value is 1, the E1 error is automatically cleared when the Remote Set Speed Signal returns to the Speed Potentiometer Min. or Speed Potentiometer Max. position recorded during calibration.

    When the E1 Handler Select parameter value is 2, the DPG-2223-002 will accept a 0.0 to +5 VDC remote speed signal without detecting a Loss of Remote Set Speed Signal and generating an E1 error.

34. **Startup Speed.** Set the startup speed parameter to an engine speed at least 10% higher than the fastest engine cranking speed but lower than the engine's idle speed. This allows the controller to determine whether the engine is cranking or running whenever an engine speed signal is present.

    If the startup speed value is set too low (less than crank speed), the controller's target speed will be ramped to the active set speed (Idle, Remote Speed, or Set Speed A) before the engine has started. Therefore, when the engine does start, it may overspeed or output excessive smoke because the startup ramp, having already completed, no longer controls the rate of engine speed increase.

    If the Startup Speed value is set too high (above the active set speed), the startup speed becomes the target speed that the controller must reach before controller considers the startup sequence complete. Typically, the startup sequence ends when the engine speed reaches the active set speed. The active set speed is the idle speed if the idle hold time parameter is a non-zero value or the *selected set speed* (either remote speed or set speed A).

    To determine the proper value for this parameter, the crank speed must be known. There are two ways to determine the engine crank speed:

    a. Use a meter to measure the frequency across the MPU+ and MPU- terminals of the controller during cranking.

    or

    b. Use a PC running the Universal PST application and read the value of the Measured Speed in the view status panel when the engine is cranking.

    Note: From the Universal PST's startup screen, press the View Status button, then press the Start Monitoring button to begin reading values.

    Note: When the No. of Flywheel Teeth parameter is used, the startup speed parameter is displayed as an rpm value instead of Hz value.

35. **Startup Duty Cycle.** Enter the value from the Governor Parameter Summary.

    The Startup Duty Cycle value is used to preload the PID values with a PWM duty cycle value that provides an actuator output signal sufficient to allow enough fuel to idle the engine.

    If the Startup Duty Cycle value is too low, the engine crank time may be longer than desired because the governor's actuator output starts from a value much smaller than needed to begin opening the fuel valve.

    If the Startup Duty Cycle value is too high, the engine may overspeed because the actuator opens more that needed to start the engine.

36. **Speed Potentiometer Action (load share model only).** The Speed Potentiometer Action parameter affects how the controller interprets the REMOTE SET SPEED SIG input. When in forward acting mode, as the voltage at the remote set speed signal input increases the engine speed increases. When in reverse acting mode, as the voltage at the remote set speed signal input decreases the engine speed increases. This is shown in Figure 10.

    The DPG-2223-00X defaults to forwarding acting mode.

Pedal Action Setting	Remote Set Speed Input Voltage	Direction
0 = forward acting	Increase	CW
1 = reverse acting	Decrease	CCW

Figure 10 Speed Potentiometer Action

Parameter Minimum/Maximum Values and Default Settings

No.	Parameter Name	Load Share Only	Value Range		Default Settings		
			Minimum	Maximum	GM17644-4	GM17644-6	GM17644-7
1	No. of Flywheel Teeth		0	572	0	0	0
2	Remote Speed Min.	Yes	10	Remote Speed Max.	—	—	1000
3	Remote Speed Max.	Yes	Remote Speed Min.	11000	—	—	5000
4	Set Speed A (Hz)		Set Speed A Min.	Set Speed A Max.	1000	25	1000
5	Idle Speed (Hz)		Idle Speed Min.	Idle Speed Max.	500	20	500
6	Proportional		1	99	1	1	1
7	Integral		0	99	0	0	0
8	Derivative		0	99	0	0	0
9	OVG @ Remote Speed Min.	Yes	1	99	—	—	20
10	OVG @ Remote Speed Max.	Yes	0	99	—	—	0
11	OVG @ Set Speed A (gain potentiometer)	Yes	1	99	—	—	20
12	OVG @ Idle		1	99	20	20	20
13	Gain Factor		1	99	1	1	1
14	Speed Filter		1	24	16	4	16
15	Idle Hold Time (sec.)		0	9999	0	0	0
16	Accel Rate (Hz/sec.)		1	11000	1000	3000	1000
17	Decel Rate (Hz/sec.)		1	11000	1000	3000	1000
18	Startup Rate (Hz/sec.)		1	11000	1000	3000	1000
19	Startup Limit	Yes	0	1000	—	—	1000
20	Torque Limit	Yes	0	1000	—	—	1000
21	Integral Low Limit		0	Integral High Limit	0	0	0
22	Integral High Limit		Integral Low Limit	99	99	99	99
23	% Droop	Yes	0	100	—	—	0
24	No Load Calibration	Yes	0	1000	—	—	0
25	Full Load Calibration	Yes	0	1000	—	—	1000
26	Password		0	99	0	0	0
27	Overspeed Limit (Hz)		0	6000	6000	450	6000
28	Set Speed A Min. (Hz)		10	Set Speed A	1000	25	1000
29	Set Speed A Max. (Hz)		Set Speed A	11000	5000	300	5000
30	Idle Speed Min. (Hz)		10	Idle Speed	500	20	500
31	Idle Speed Max. (Hz)		Idle Speed	11000	5000	300	5000
32	Duty Cycle Limit		10	95	10	10	10
33	E1 Handler Select	Yes	0	2	—	—	2
34	Startup Speed (Hz)		10	11000	1000	25	1000
35	Startup Duty Cycle		5	95	5	5	5
36	Speed Potentiometer Action	Yes	0	1	—	—	0

Appendix C Calibration Instructions

Basic Adjustments

The governor controller is programmed at the factory with default setting parameter settings. These settings allow the controller to operate but usually require some further adjustments to obtain the best system performance. In order to bring the engine up to a single speed for the first time, the user needs to adjust the parameters shown in Figure 11. Use the Calibration Instructions only when the Governor Parameter Summary does **not** include a specific generator set/ engine combination.

The parameters listed in Figure 11 are the primary items to get the governor controller tuned and the engine running smoothly. It is recommended that the default settings in Figure 11 be initially used and then adjusted to satisfy the generator set/engine application. Leave all other parameters at their default settings until the primary parameter settings are determined.

Calibration Techniques

After the engine is running, use the following procedure to determine optimum values for the Proportional, Integral, and Derivative (PID) values and the Overall Gain Parameters (OVG). The goal is to find PID values that allow the governor controller to govern the engine optimally at all loads while only requiring gain adjustment. Use the following steps:

1. Calibration Procedure.

   The governor controller default programming provides the values shown in Figure 11. It is recommended to connect a load bank to the generator set in an effort to provide varying loads.

   Note: Steps 1.f. through 1.j. require varying the generator set load to cause engine speed changes. Start with small load variations and continue with greater load changes to provide a better overall performance test.

   With Integral, a speed error may persist after a load-on load-off transition. During steps 1.c. through 1.i., temporarily increase the Integral to get the engine speed back to the set speed, and then reset the Integral to a lower value again while working to find good Proportional and Derivative values.

   Repeat steps 1.f. through 1.k. as needed to find Proportional, Integral, and Derivative values that work well with a variety of overall gain values and different load transients. See Figure 12.

   a. Open the line circuit breaker to disconnect the load from the generator set.

   b. Place the generator set master switch in the RUN position to start the generator set.

   c. Set the Set Speed A to 1800 rpm for 60 Hz models and 1500 rpm for 50 Hz models.

   d. Set the Integral and Derivative values to 0.

   e. Set the Overall Gain low (less than 20).

   f. Increase the Proportional value until the engine shows continuous oscillations greater than 2 Hz.

   g. Reduce the Proportional value by 25%–50%.

Parameter No.	Parameter Name	Default Value
2	Set Speed A	1000
5	Proportional	25
6	Integral	50
7	Derivative	25
8	OVG @ Set Speed A	20
11	Gain Factor *	20
12	Speed Filter †	18

* Modify the Gain Factor only when the PID or OVG values reach their min./max. parameters.
† The Speed Filter value should be set to 24 for 3- or 4-cylinder engines. Use a value of 16 for 6- or 8-cylinder engines.

Figure 11 Primary Parameter Setup

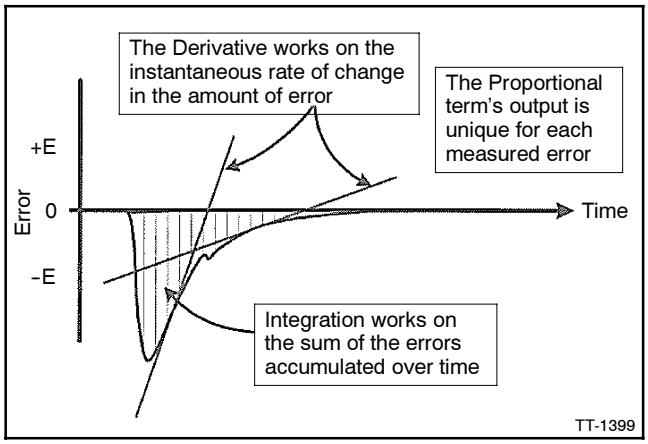


Figure 12 Relationships of DIP

h. Close line circuit breakers to connect load to the generator set.

i. Make small Derivative value changes to dampen out *ringing* in response to load transients.

j. Increase the Integral to eliminate any steady-state error in the engine's speed and help decrease error recovery time.

k. Increase the Overall Gain to improve response time while keeping the ratios of the PID values relative to each other constant.

2. Droop Calibration Procedure (load share model only).

   If droop calibration is required, go to step 2.a.

   If droop calibration is not required, go to step 3.

   Use this calibration procedure when droop is required.

   After droop calibration, the difference between the No Load Cal and the Full Load Cal parameter values should be greater than 100 for best operation of droop. The droop function may still work for smaller differences but with less accuracy.

   a. Open the line circuit breaker to disconnect the load from the generator set.

   b. Place the generator set master switch in the RUN position to start the generator set.

   c. Set the Set Speed A to 1800 rpm for 60 Hz models and 1500 rpm for 50 Hz models if not already completed.

   d. Enter a value of 41 in the Password parameter allowing editing of the droop related parameters.

   e. Select the % Droop parameter and adjust the value to:

      Selected Set Speed / [(1000 - Value of % Droop) / 1000]

   f. Allow the engine to stabilize at the No Load droop speed and then press the governor controller's Enter key to set the percent droop. No Load Calibration is now complete.

   g. Select the Full Load Calibration procedure. The engine speed will return to the selected set speed.

   h. Apply full load to the engine and allow the speed to stabilize.

   i. Wait 5 seconds and then press the governor controller's Enter key to record the calibration value. Full Load Calibration is now complete.

   j. Remove the load from the generator set. The engine speed will increase to the no load droop speed. Droop calibration is now complete.

   k. Place the generator set master switch in the OFF position to stop the generator set.

3. Update the governor controller and save the files.

   a. Select WRITE ALL. The updated program is then sent to the governor controller.

   b. Save and store this modified PST software file on your PC hard drive, floppy disk, and/or CD-ROM for future reference.

   c. In an effort to help us build a more complete data base, we request you share your calibration values by filling out the Governor Parameter Detail form. E-mail or fax the completed form to us and after our review, we will include the data in the Governor Parameter Summary.

      E-mail: generatorfieldservice@Kohler.com

      Fax number: 920-803-4977.

4. Disconnect the governor controller from the user-supplied PC.

   a. Check that the generator set master switch is in the OFF position.

   b. Move the white lead/70A from the normally closed K5 contact back to the normally open K5 contact. See Figure 6.

   c. Disconnect the supplied cable included in the kit from the user-supplied PC 9-pin RS-232 serial port and the governor controller RJ11 connector (telephone jack).

   d. Store the cable and CD-ROM together for later use as needed.

Appendix D Diagnostics and Troubleshooting

Introduction

Use the troubleshooting chart to help diagnose generator set/engine problems relating to the governor controller.

Display Codes (Load Share Model)

Code	Fault
E0	Controller memory failure. Replace governor controller.
E1	Loss of remote speed potentiometer signal.
E2	Overspeed detected. Governor controller must be turned off and reset to allow an engine restart.
E3	Actuator drive overcurrent detected. Check wiring. Check actuator loading and linkage.

LED Indications (Non-Load Share Model)

LED State	Fault
Off	Governor controller is either not currently powered or is being reverse powered. (Check polarity of supplied power.) If correctly powered, governor controller is malfunctioning.
Blinking Slow (1/2 Hz)	Governor controller is powered, but not sensing a speed signal. OK if engine is not running. If the engine is running, this indicates a fault with the speed signal.
Blinking Fast (1 1/2 Hz)	Governor controller is powered and an engine speed signal is being detected. If the engine is not running, this indicates electrical noise on the speed signal wires.
ON and Not Blinking	Governor controller is powered and is malfunctioning. Replace governor controller.

Troubleshooting Chart

Symptom	Possible Cause	Remedy
LED display does not light up when the governor controller is powered	BAT+ and BAT- leads are reversed.	Check and correct wiring.
	Battery voltage is too low. Governor controller supply voltage should be 9-30 VDC.	Charge or replace the battery.
	Governor controller is defective.	Replace governor controller.
Unable to modify parameters	The parameter's value is the maximum value allowed.	Enter acceptable value.
	The parameter's value is the minimum value allowed.	Enter acceptable value.
	A display code is active (load share model).	Refer to the Display Codes section above.
	Password protection is enabled (load share model).	Enter Password.
	PST software not communicating with the controller (non-load share model).	Check cable connection.
	Keypad is defective.	Replace governor controller.
Engine does not start	Actuator leads not connected or shorted.	Check and correct actuator wiring.
	No fuel source.	Check fuel supply, fuel line, and shutoff valves.
	Battery voltage is low.	Charge or replace the battery.
	Set speed is lower than crank speed.	Increase the set speed value.
	Startup rate setting is too low. The target speed ramps up too slow.	Increase the startup rate value.
	Startup limit is too low, limiting the actuator drive signal too much.	Increase the startup limit value.
	No magnetic pickup (MPU) speed signal present. Magnetic pickup should be 2.0 V RMS minimum.	Adjust the MPU gap. Try reversing the MPU leads; otherwise, replace the MPU.
	If a speed signal is present, measure the actuator output duty cycle.	If not greater than 5%, restore all parameter values to factory default settings and crank the engine again.
	Final target speed must be greater than crank speed before the governor will attempt to drive the actuator open (non-load share model).	Increase the final target speed value and/or decrease the crank speed value.
Engine overspeeds at startup	The proportional value is too low.	Increase the proportional value.
	The appropriate overall gain (OVG) value is too low.	Increase the appropriate OVG value.
	The startup limit is incorrect (load share model).	Adjust the startup limit value.
	The startup ramp rate is too high.	Decrease the startup ramp rate value.

Symptom	Possible Cause	Remedy
Engine does not reach set speed	Improper Proportional, Integral, and Derivative (PID) tuning values.	Check and adjust the PID values.
	Integral value is too low or zero.	Increase the integral value.
	Derivative value is too low or zero (load share model).	Increase the derivative value.
	PID values are too low. A tuning that is too soft can prevent the governor from delivering the needed actuator drive signal to reach the set speed.	Check and adjust the PID values.
	PID values are too high. Tuning is too hot or oversensitive to small speed errors causing the governor to make large, rapid changes in actuator drive signal, creating an average signal that is inadequate.	Decrease PID tuning values.
	The integral low limit setting is too high.	Return the integral low limit value to the default setting of zero.
	The integral high limit setting is too low.	Return the integral high limit value to the default setting of 99.
Engine takes too long to reach the set speed	Improper PID tuning values.	Check and adjust the PID values.
	Integral setting is too low.	Increase the integral value.
	Startup rate setting is too low.	Increase the startup rate value.
	Accel rate setting is too low.	Increase the Accel rate value.
	Speed filter setting is too high.	Decrease the speed filter value.
Engine does not track speed setting changes	Is the LED decimal point flashing (load share model)?	If yes, enter password.
	Is the LED flashing fast (3 Hz) (non-load share model)?	If no, check speed sensing circuit.
	Is the selected set speed parameter being modified?	If yes, speed setting display is unavailable during changes.
	A PID value or an OVG value is too high.	Decrease the PID values or OVG value.
	A PID value is too low or zero.	Increase the PID value.
	Accel rate is set too low.	Increase the Accel rate value.
	Decel rate is set too low.	Increase the Decel rate value.
Excessive smoke at startup	Improper PID tuning values.	Check and adjust the PID values.
	The startup rate is too high.	Use a lower startup rate value.
	The startup limit is too high.	Use a lower startup limit value.
	No/low MPU speed signal present. MPU should be 2.0 V RMS minimum.	Adjust the MPU gap. Try reversing the MPU leads; otherwise, replace the MPU.
Slow response to load changes	Gain value set too low.	Decrease the gain value.
	Improper PID tuning values.	Check and adjust the PID values.
	Speed filter setting is too high.	Decrease the speed filter value.
Engine instability with no load	Improper PID tuning values.	Check and adjust the PID values.
	Speed filter setting is too low.	Increase the speed filter value.
	Fuel flow is restricted.	Check actuator linkage.
	Battery voltage is too low.	Charge or replace the battery.
Engine instability with load	Improper PID tuning values.	Check and adjust the PID values.
	Fuel flow is restricted.	Check actuator linkage.
	Battery voltage is too low.	Charge or replace the battery.
Engine unable to carry rated load	PID values may be too high, causing the governor to overreact and make large, rapid changes in PWM duty cycle output to the actuator.	Check and decrease the PID values.
	Improper PID tuning values.	Check and adjust the PID values.
	Torque limit is set too low (load share model).	Increase the torque limit.
	Fuel flow is restricted.	Check actuator linkage.
Load share does not work (load share model)	No/low ILS input signal present. ILS should be 2.375–2.625 VDC.	Check ILS wiring; otherwise, replace the ILS.
	ILS signal wiring having electrical interference problems.	Use shielded wiring.
Droop does not work (load share model)	The no load and full load values are not calibrated.	Perform the droop calibration procedure.
	Difference between no load and full load calibration values is too small. Should be >100 for best performance.	Adjust the no load and/or full load calibration values.
	Actuator linkage range too small.	Modify or adjust actuator linkage to increase range of actuator loading.