# SDG500 Series
## Smart Digital Governor

## 1 OVERVIEW

The SDG500 Series (Smart Digital Governor) is designed to regulate engine speed on diesel and gas/gasoline reciprocating engines. The SDG500 Series is a suitable replacement for any mechanical system that needs more flexibility, precision or control in governing speed.

The SDG500 Series is a solid state microprocessor based speed control unit that offers precise (+/- 0.25 %) speed control with fast response to transient load changes in isochronous and droop modes. Designed for high reliability this ruggedly built unit is hard potted to withstand the harsh engine environment and can be mounted directly in the engine compartment.

The SDG500 Series is an integral part of a closed loop control. When connected to an electric actuator and supplied with a magnetic speed sensor signal, the governor will direct the engine to the desired speed setting. The SDG500 Series (Smart Digital Governor) is designed for industrial applications ranging from generators and mechanical drives to pumps and compressors.

- Fast, Compact Digital Engine Speed Governor
- Solid-State Microprocessor-Based Device Designed to
- Control Engine Speed with Precise Response to
- Transient Load Changes
- Easy Configuration using GAC SmartVU Software
- Three Fixed Speeds and One Variable Speed each with Droop Governing Capability
- Overspeed Shutdown Protection
- Speed Ramping from Idle to Operation Speed
- Starting Fuel Control for Lower Engine Exhaust
- Emissions

GACs SmartVU software allows you to configure and tune on the fly or save to download to multiple units.

**SDG514 Resistive (10K Potentiometer) Variable Speed Input**



**SDG524 0-5 V DC Variable Speed Input**

## 2 SPECIFICATIONS

| PERFORMANCE | |
|---|---|
| Isochronous Operation/Steady State Stability | ± 0.25% |
| Speed Range/Governor | 400 - 10 KHz |
| Speed Drift w/ Temp | < ± 1 % MAX |
| Idle Adjust | Full Range |
| Droop Range | 1 - 17 % Regulation |
| Speed Trim Range | ± 5 % of Rated Speed |

| ENVIRONMENTAL | |
|---|---|
| Ambient Operating Temperature Range | -40 to +85°C [-40 to +180°F] |
| Relative Humidity | Up to 95 % |

| RELIABILITY | |
|---|---|
| Vibration | 7 g @ 20-100 Hz |
| Testing | 100 % Functionally Tested |

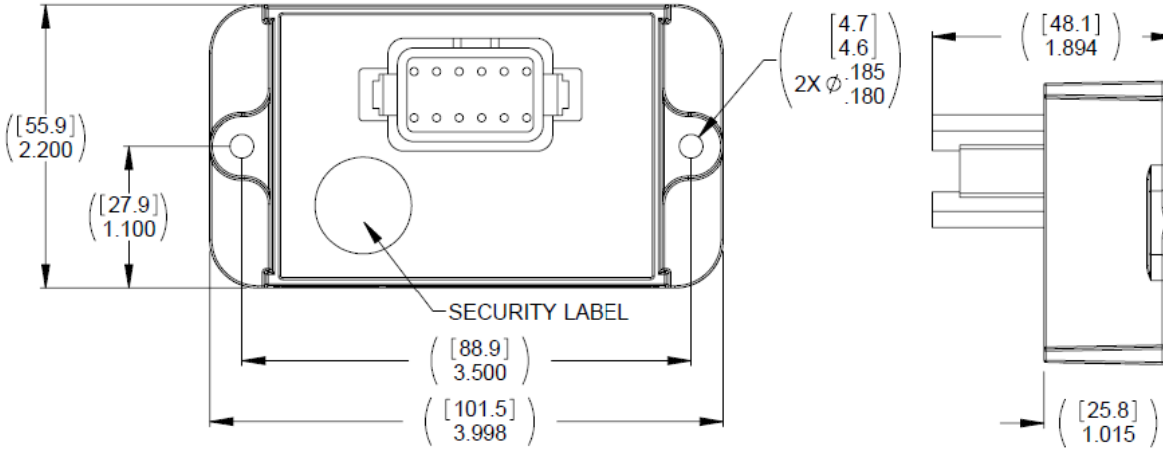
| CONFIGURATION PARAMETERS | |
|---|---|
| Flywheel Teeth | 50 - 250 |
| Range (Gain/Stability multiplier) | 1 - 10 |
| Fixed Speed Settings | 0 - MAX RPM |
| Variable Speed Settings | 0 - MAX RPM |
| Overspeed Setting | 0 - MAX RPM |
| Starting Fuel Preset | 0 - MAX Fuel |

| INPUT/OUTPUT PARAMETERS | |
|---|---|
| Supply | 12 - 24 V DC Battery Systems (6.5 V DC to 33 V DC |
| Polarity | Negative Ground (Case Isolated) |
| Ground Power Consumption | 70 mA MAX Continuous plus actuator current |
| Speed Sensor Signal | 0.5 - 120 V RMS |
| Actuator Current | 7 A continuous |
| Load Share/Synchronizer Input | 0 -10 V DC |

## 3 INSTALLATION

To mount the SDG to a panel, drill 2 ( Ø.181 / .176 [ 4.6 /4.5mm drill size) holes for mounting screws. Place module in front of the panel aligning with the pre-drilled holes. Secure the module in place with two M-4 screws. Locate the SDG Series control a distance from extreme heat, wires or coils. Operating temperature range is from -40 to 85˚ C [-40 to 180˚F].

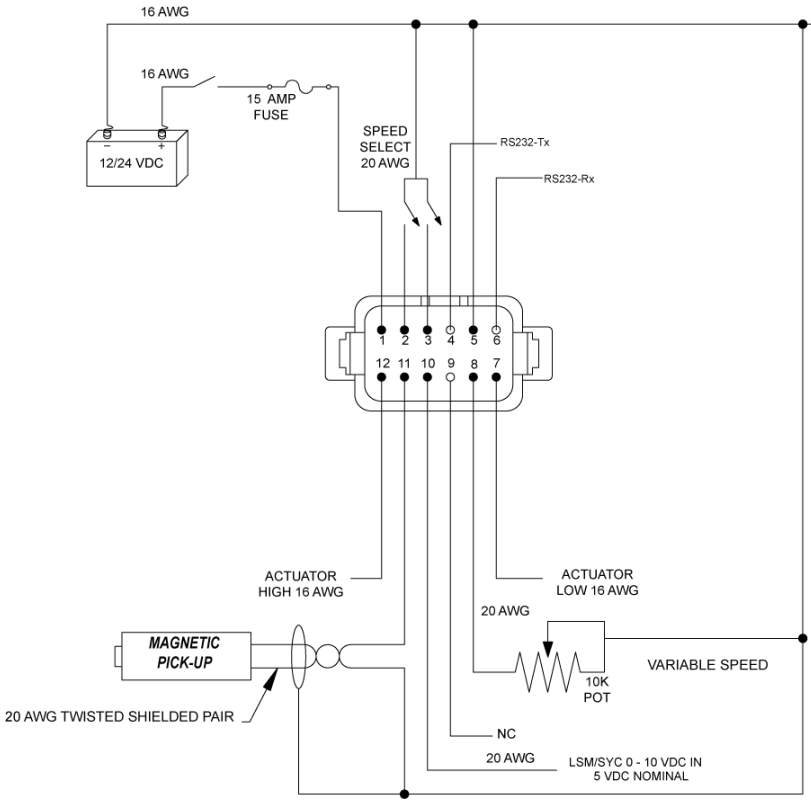
### PHYSICAL DIMENSIONS OF SDG514 and SDG524




## 4 WIRING

Using the GAC CH1330 cable harness or the EC1330 connector and required wiring, connect to the SDG500 Series speed controller using the following wiring diagrams and wiring pin tables. An additional RS-232 to USB connector is required to work with the SmartVU configuration application.

### SDG514 WIRING DIAGRAM



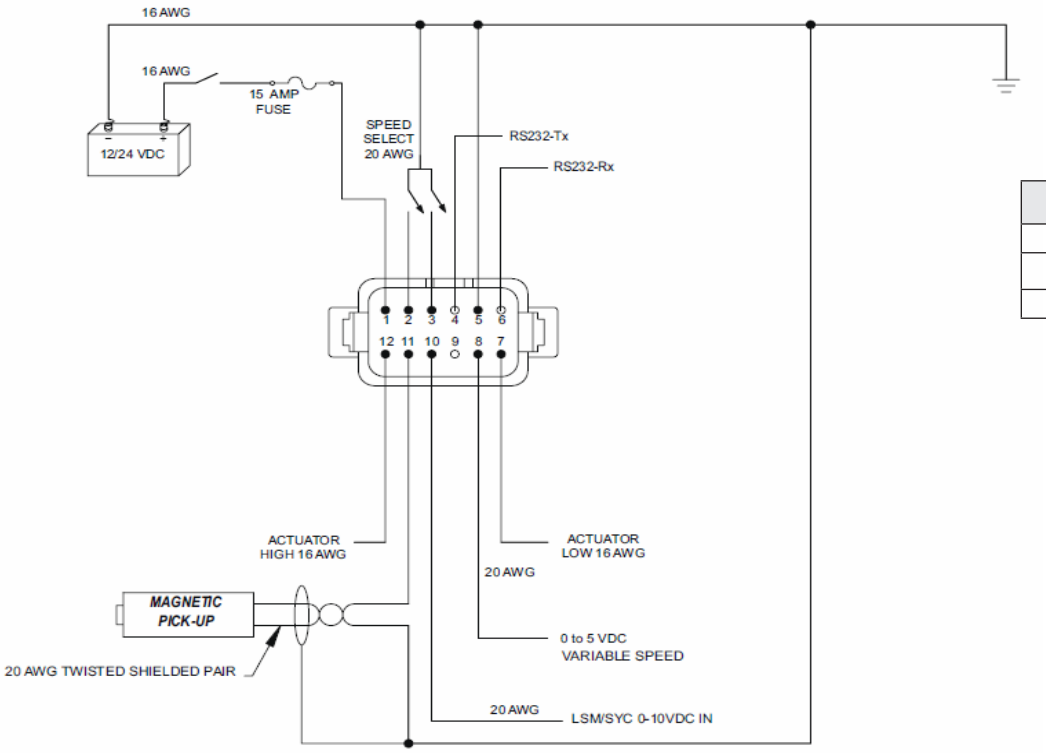

| SPEED SELECT SETTINGS | | |
|---|---|---|
| **Pin 2** | **Pin 3** | **Speed Select** |
| No Connect | No Connect | Variable Speed* |
| Battery - | No Connect | Fixed Speed 1 |
| No Connect | Battery - | Fixed Speed 2 |
| Battery - | Battery - | Fixed Speed 3 |
| *A 10K Variable Speed Potentiometer needs to be connected to activate for an SDG514 | | |

## SDG514 WIRING DIAGRAM (CONTINUED)

### DEUTSCH CONNECTOR SDG514

| PIN # | DESCRIPTION | COMMENT | RECOMMENDED WIRING |
|---|---|---|---|
| 1 | +12 / 24 V DC Input Power | Supplies power. | 16 AWG |
| 2 | Speed Select 2 | See Speed Select Settings table | 20 AWG |
| 3 | Speed Select 1 | See Speed Select Settings table | 20 AWG |
| 4 | RS232 | RS232 | |
| 5 | Input Power Ground | Ground for the 12 / 24 V DC Input Power | 16 AWG |
| 6 | RS232 | RS232 | |
| 7 | Actuator Low | Output to Actuator | 16 AWG |
| 8 | POT Input | Input for 10K Potentiometer for Variable Speed Control | 20 AWG |
| 9 | No Connection | No Connection | NC |
| 10 | 0-10 V DC Input | Input for communication of LSM/SYC | 20 AWG |
| 11 | MPU + | MPU speed signal input | Shielded/Twisted Pair |
| 12 | Actuator High | Output to Actuator | 16 AWG |

## SDG524 WIRING DIAGRAM




| RS232 DB9 PIN | SDG PLUG PIN |
|---|---|
| 2 | 4 |
| 5 | 5 |
| 3 | 6 |

### DEUTSCH CONNECTOR SDG524

| PIN # | DESCRIPTION | COMMENT | RECOMMENDED WIRING |
|---|---|---|---|
| 1 | +12 / 24 V DC Input Power | Supplies power. | 16 AWG |
| 2 | Speed Select 2 | See Speed Select Settings table | 20 AWG |
| 3 | Speed Select 1 | See Speed Select Settings table | 20 AWG |
| 4 | RS232 | RS232 | |
| 5 | Input Power Ground | Ground for the 12 / 24 VDC Input Power | 16 AWG |
| 6 | RS232 | RS232 | |
| 7 | Actuator Low | Output to Actuator | 16 AWG |
| 8 | Variable Speed Input | I0-5 V DC Signal | 20 AWG |
| 9 | No Connection | No Connection | NC |
| 10 | 0-10 V DC Input | Input for communication of AUX | 20 AWG |
| 11 | MPU + | MPU speed signal input | Shielded/Twisted Pair |
| 12 | Actuator High | Output to Actuator | 16 AWG |

# 5 INSTALLING AND USING SMARTVU TO CONFIGURE SDG500 SERIES

The SDG 500 Series are configured using the free PC application SmartVU, available on the GAC web site. SDG uses V2.1.3 of the SmartVU application available for download from GOVERNORS-AMERICA.com and look for the software download link for the SDG500 Series.

### INSTALLING SMARTVU FOR SDG500 SERIES SOFTWARE

The configuration software for the SDG does not affect the registry rights of your operating system and therefore is easy to install.

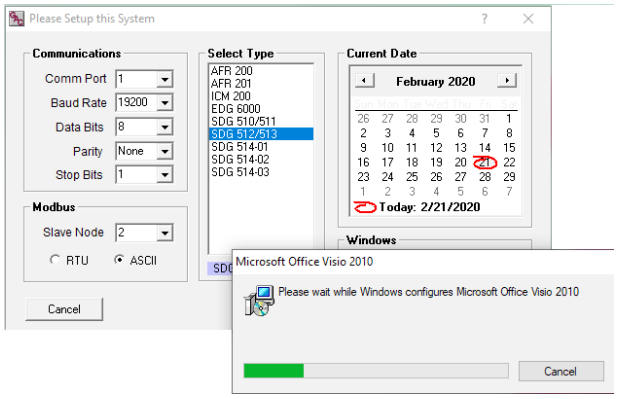
1. Click the link for the software download. You will be taken to a dropbox download area. Click Download.
2. Select the folder you want to install the software into and save the SmartVU SEC 2.1.3 zipped file to that location.
3. Double click the zip folder and open the file folder.
4. Double click the SETUP.exe file. Follow the installation instructions.

### CONNECTING THE SDG TO THE PC FOR CONFIGURATION

1. Connect the CH1330 cable harness or use the EC1330 to build a harness to connect the SDG and the engine's cable harness.
2. Connect your PC and the CH1330 using an USB/Serial Adapter.

### SMARTVU CONNECTION SETTINGS

1. Double click on GAc_SDG51X.exe file to start the SmartVU™ Utility.
2. If the software does not indicate connected on the bottom left section of the screen, select configure from the drop down menu and choose communications.
3. Select the number of the Comm Port used from the drop down list box.
4. Select SDG 514-01 at initial setup, or using the Configure → Preferences drop-down menu. SDG514-01 is also used for the SDG524. If you have an alternate - number (-02 or -03) see your GAC representative for further information.
5. Click OK. Windows will configure the view screen and then display the main screen.
6. You can set up a password at this time, but ensure you do not lose track of it.



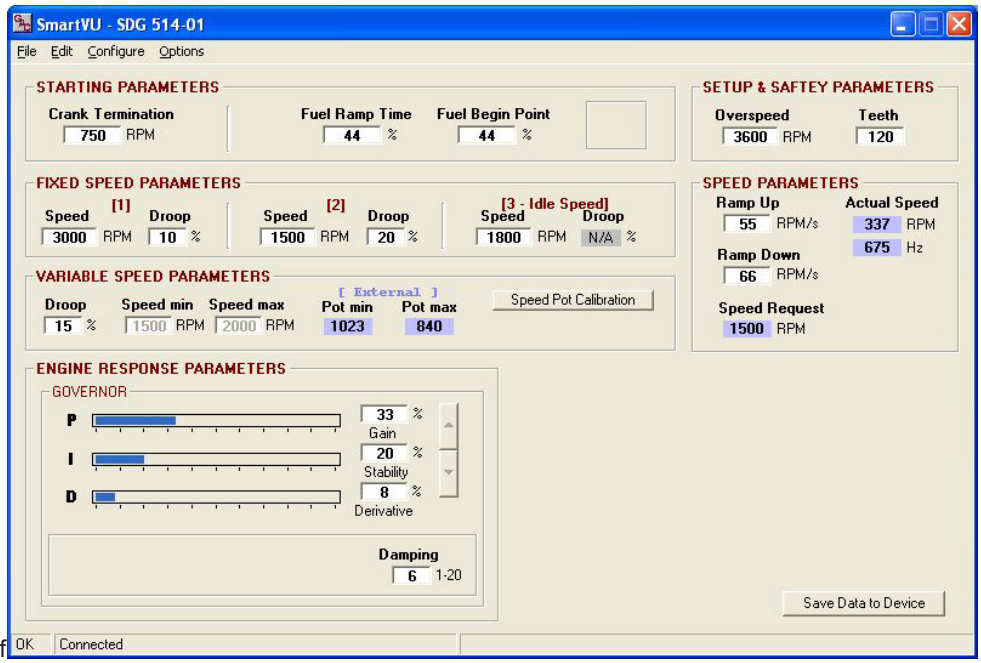

## CONFIGURING WITH SMARTVU

Parameter settings can be made while attached to the engine, or made in OFFLINE mode as described later in this section. These configurations settings can be stored and used on other engines as needed.

### REQUIRED CONFIGURATION SETTINGS

The following parameter settings are required before starting the engine:

- Crank Termination
- Overspeed
- Teeth
- Fixed Speed 1
- Fixed Speed 2
- Fixed Speed 3 (IDLE)
- Speed min
- P - Gain
- I - Stability
- D - Derivative




### SAVING SETTINGS

To save the settings directly to the engine:

- Press the **Save Data to Device** button on the lower right corner of the SmartVU screen.

To save the settings as a configuration file for use on other engines, select:

1. File → Save Config
2. Select a location to save it on the hard drive of your computer

## CONFIGURING WITH SMARTVU (CONTINUED)

### SETTING VARIABLE SPEED

For the SDG524:

- ♦ Make sure the voltage source for variable speed is connected correctly and SmartVU is open.
- ♦ While connected to the engine click on the Speed Pot Calibration button.
  - Set the Minimum value to the lowest controlling voltage and the set the RPM min on the screen.
  - Click on the Continue button.
  - Set the Maximum value to the highest controlling voltage, and then RPM max on the screen and click the Continue button.
  - Click OK on the popup window to calibrate.

### WORKING IN OFFLINE MODE

GAC's configuration software allows you to work offline to input/ change parameters that you can then save to a file and use to load to multiple units. To work in this mode:

1. Select configure from the drop down menu and choose OFFLINE.
2. Enter desired configurations.
3. Choose Save from the file menu to save to file. Choose a location and a filename to save the parameter settings.
4. Select the Save OFFLINE to Device button to save the configurations to the SDG.

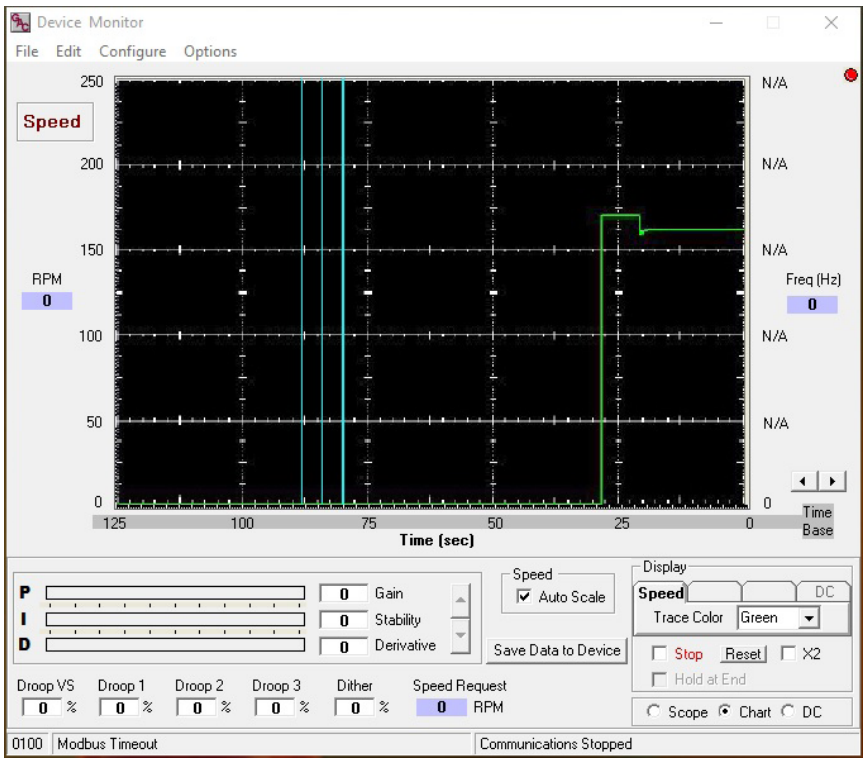
Changes made in offline mode must be saved before switching to Save mode.

## USING SMARTVU DEVICE MONITOR

The device monitor is a visual interface which helps you monitor key outputs of the control system.

To display the Device Monitor, select Options → Device Monitor, from the drop-down menu or press Ctrl+B.

The Speed Monitor screen is an example of the device monitor screen.




- The device displays engine speed (rpm) based upon the measured magnetic pickup frequency (Hz) and using the Display Speed tab.
- The device monitor also features many formatting options for the graphic interface including AutoScale time base adjustment, refresh, and display freezing (stop). Formatting is set up from the Options tab and includes:
  - Auto Scale
  - Trace Colors
  - Trace Width
  - Stop
  - Hold at end
  - Refresh
  - Scope Chart
  - Act duty cycle
- Make the time scale smaller by pressing the zoom in '+' button and larger by pressing the zoom out '–' button.
- File→ Print Screen prints the current view if you have a printer attached to your PC.

## SMARTVU PARAMETER SETTINGS

Items in gray are required.

| PARAMETER [REQUIRED] | DESCRIPTION |
|---|---|
| [**Crank Termination**] | RPM set point for crank termination. When the engine RPM exceeds the crank termination set point, the SDG switches from start up cycle to PID loop control. Set parameter higher than the maximum cranking RPM. |
| [**Derivative**] | PID parameter. Derivative mode is a breaking action to the controller response as the process variable approaches the set point. |
| Damping | Applies a damping variable to the Gain Function. |
| Dither | Imposes a random vibrating on the actuator drive. Only available on some models. |
| Droop 1 | The percent of compensation which reduces the governor's reference speed as fuel position or load increases in reference to Fixed Speed 1. |
| Droop 2 | The percent of compensation which reduces the governor's reference speed as fuel position or load increases in reference to Fixed Speed 2. |
| Droop 3 | The percent of compensation which reduces the governor's reference speed as fuel position or load increases in reference to Fixed Speed 3. |
| Droop Variable Speed | The percent of compensation which reduces the governor's reference speed as fuel position or load increases in reference to Variable Speed. |
| **[Fixed Speed 1]** | Desired RPM set point when the speed select input is set to 1. |
| **[Fixed Speed 2]** | Desired RPM set point when the speed select input is set to 2. |
| **[Fixed Speed 3]** | Desired RPM set point when the speed select input is set to 3. |
| Fuel Limit | The percentage limiter set point on the fuel demands that prevents the over fueling after the engine has started. |
| **[Gain]** | PID parameter. Proportional mode responds to a change in the process variable proportional to the current measured error value. |
| **[Overspeed ]** | RPM Set Point for an Engine Shutdown Signal to the actuator. |
| POT min | Max RPM value from the SDG analog to digital converter. For use with SDG514. |
| POT max | Min RPM value from the SDG analog to digital converter. For use with SDG514. |
| RPM max | Maximum RPM set point for Variable speed. |
| **[RPM min]** | Minimum RPM set point for Variable speed |
| Speed Ramp Down | The % percent set point to decrease engine speed per second when changing speeds. |
| Speed Ramp Up | The % percent set point to increase engine speed per second when changing speeds. |
| Speed Request | Desired speed of engine at the current state. |
| **[Stability]** | PID parameter. In integral mode, the controller output is proportional to the amount and duration of the error signal. |
| Starting Fuel Ramp | Gradually increases the amount of fuel after the engine finishes cranking, which eliminates most unnecessary smoke. The higher the setting the quicker the engine comes to speed. The percent to increase the fuel flow per second until the engine reaches 100% or the governor takes control. |
| Starting Fuel Start Point | Determines how much fuel to begin with before fuel ramping engages. The minimum fuel required for starting the engine. Retards black smoke. The starting position of the actuator at engine start. |
| **[Teeth ]** | Number or teeth on the flywheel. Used to calculate speed settings and values. |
| Variable Speed on SDG514 | Using a potentiometer to set Variable Speed , in SmartVU, click on the Speed Pot Calibration button. Set the Minimum position on the potentiometer and then set the RPM min on the screen. Click on the Continue button. Set the Maximum position on the potentiometer and then RPM max on the screen click on the Continue button. Click OK on the popup window to calibrate. |
| Variable Speed on SDG524 | Using a voltage source as noted in the wiring diagram, using SmartVU, click on the Speed Pot Calibration button. Set the Minimum value to the lowest controlling voltage and set the RPM min on the screen. Click on the Continue button. Set the Maximum value to the highest controlling voltage, and then RPM max on the screen click on the Continue button. Click OK on the popup window to calibrate. |

# 6 TROUBLESHOOTING

| SYMPTOM | CHECK THE FOLLOWING |
|---|---|
| ENGINE NOT STARTING | 1. Check for battery connection, proper polarity, and proper charge.<br>2. Recheck Flywheel Teeth, Overspeed Setting, Variable and Fixed Speed Settings. |
| ENGINE NOT STARTING | While cranking the engine:<br>3. Measure the battery voltage while attempting a crank. If the voltage drops below 8 Volts then the battery is not sufficiently charged.<br>4. Check that the actuator voltage is no less than 2 volts below than battery voltage. If the actuator voltage checks then verify the proper connection of the actuator.<br>5. Check Crank Termination setting. Typically the Crank Termination should be set to at least 50RPM higher than the maximum cranking speed of the engine. If possible measure the cranking RPM of the engine. You can try increasing in 100RPM increments. If engine appears to start but cuts out then the Fuel Limit may be too low. Try increasing the Fuel Limit to 100% initially to disable the Fuel Limiting. If the engine starts, the Fuel Limit will have to be reduced from 100% to more optimum level.<br>6. Verify the Mag Pickup is properly connected. If possible measure the pickup signal while the engine is cranking. The voltage must be a minimum of 0.5VRMS for proper operation.<br>7. If possible through the configuration software check the Starting Fuel Limit and the Starting Fuel Start Point. Via SmartVU, set the Starting Fuel Start Point to 10% and the Starting Fuel Ramp Time to 0%. This will program maximum fuel to the engine at the start. |
| ENGINE STARTS BUT NOT RUNNING AT PROPER SPEED | With engine running:<br>1. Check to see if the Fixed Speed inputs are properly configured. If one or both of the Fixed Speed inputs are not connected to ground the SDG will operate in variable speed mode.<br>2. Make sure the correct number if Flywheel Teeth is set using the configuration software.<br>3. Make sure the proper Fixed Speed is set using the configuration software.<br>4. Check mag pickup signal. |
| ENGINE NOT RUNNING AT THE CORRECT VARIABLE SPEED | With engine running:<br>1. Make sure the Variable Speed Potentiometer is connected properly. Refer to the configuration section for proper setup. Verify, through the configuration software, that the MIN speed setting is less than the MAX speed setting.<br>2. Be sure the proper number of Flywheel Teeth are set. |
| OVERSPEED DURING LOAD TRANSIENT | With engine running:<br>1. Overspeed setting may be too low. Recheck the overspeed setting.<br>2. The SDG is not tuned properly for the application. Try retuning the SDG. |
| OVERSPEED DURING SPEED CHANGES | With engine running:<br>1. Overspeed setting may be too low. Recheck the Overspeed setting.<br>2. Speed Ramp setting is set too low. Increase the Speed Ramp setting. This will cause the engine to accelerate more slowly, reducing overshoot. |