

GAC SmartVU EC and SmartVU Interface Tool

Engine Control Configuration Software

USER GUIDE

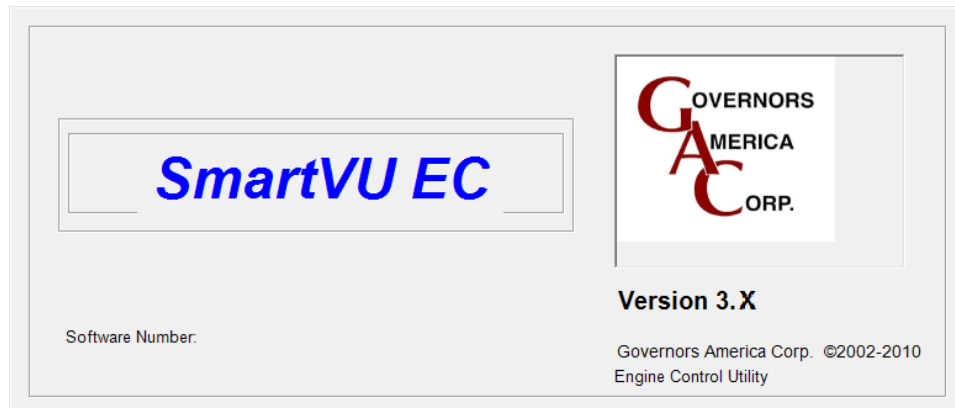


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1 Introduction

SmartVU is GAC's configuration software supporting GAC AFR, ICM, EDG Series, and EEG7000 controllers. GAC's SmartVU provides a simple user interface for initial configuration, engine response and control, diagnostics, and troubleshooting purposes.

2 About This User Guide

This guide is divided into sections by overall information as well as by speed control unit, as each unit has a slightly different user interface offering different functionality.

Numbered items show step-by-step procedures and bulleted items provide general user information.

3 Installation Requirements

3.1 Before You Start

The following hardware is required before installing the SmartVU software:

- PC with internet access running Windows XP or better.
- PC must have the following:
 - A pass-through (not null modem) DB-9 F/M cable is required. A DB-9 female connector is included on the wiring harness for communication with SmartVU. If there is no connection point available an adapter harness may also be used (GAC part number EC07).
 - RS-232 cable as detailed in your speed control installation manual. This cable interfaces with your engine. If an RS-232 port is not present on the computer, use of a USB-to-RS-232 USB adapter cable will be required. GAC recommends GAC part number EAM204. Substandard adapter cables may cause interconnect issues and timeouts.
 - Two or more USB ports.
- The engine should be wired to the speed control unit and any auxiliary products should be connected to the in order for the software to save configuration settings in the SmartVU application.
- Power to the speed control unit is required to communicate with the SmartVU software.

3.2 Download Software

SmartVU can be downloaded to a Windows PC from the GAC website (www.governors-america.com). It can be found under the associated control unit product page or in the software download page. Contact your GAC representative for more information.

3.3 Installation

To install SmartVU, download the file that goes with your product.

1. Once the download link is selected the file will open as Save AS window for a .ZIP file.
 - For EEG7000 the download is EEG7000 Interface Tool.zip. The file to start is EEG7000 IT setup.exe.
 - For all other products the filename will be SmartVuECsetup.

2. Save the file to your existing Governors America Corp folder or other software download location.
3. Double-click the .exe file if presented on the desktop or navigate to the file location and double click. The installer will guide you through the remainder of the process.

NOTE: If the same SmartVU has been previously installed on the computer being used, the previous version may need to be uninstalled using the Windows Control Panel.

4 Setup Checklist

The following checklists can be used to plan the initial setup of your speed controller using SmartVU. These checklists are individualized for each controller: ICM200, AFR2XX, EDG6000, or EEG7000. The category column defines whether the parameter is regarded as:

- **Required:** For engine start, safety, and run-capability.
- **Optimization:** For fine-tuning and system calibration.
- **Read-Only:** Data which is read-only in non-editable fields.
- **Feature:** For optional feature functionality and sensor support.
- **Advanced:** For troubleshooting, advanced diagnostics and similar needs.

4.1 ICM200 Prep List

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
Engine Setup Parameters	Overspeed		Required
	# of Cylinders		Required
	Timing Wheel		Required
	Synchronization		Required
Timing Parameters	Offset Angle		Required
	Timing Angle		Required
	Fixed Timing		Required
	Cylinder Trim		Optimization
	Global Trim		Feature
Timing Maps	Map 1		Optimization
	Map 2		Optimization
Engine Data	Engine Speed		Read-Only
	Manifold Abs Press		Read-Only
	MAP Style		Required
	Avg Dwell Time		Read-Only
	Cylinder Dwells		Read-Only
Dynamic Coil Parameters	Coil Current		Required
	Max Dwell Time		Required
About	Date		Read-Only
	Version.		Read-Only

4.2 AFR2XX Prep List

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
Setup and Safety Parameters	Overspeed		Required
	Teeth		Required
	Ramp Up		Optimization
	Ramp Down		Optimization
Starting Parameters	Crank Cutoff		Required
	Crank Steps		Required

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
	Throttle Ramp Time		Optimization
	Throttle Begin Point		Required
Fixed Speed Parameters	Speed (1, 2, 3)		Required
	Droop (1, 2, 3)		Required
Variable Speed Parameters	Droop		Required
	Speed min		Required
	Speed max		Required
	Pot min		Read-Only
	Pot max		Read-Only
Engine Data	Actual Speed		Read-Only
	Requested Speed		Read-Only
	Mag Pickup		Read-Only
	Actuator Duty Cycle		Read-Only
	Horsepower		Read-Only
	Torque		Read-Only
Engine Response Parameters	Gain (P), Stability (I), Derivative (D)		Required
	Dither		Feature
	Fuel Limit		Feature
	Governor System Tuning		Optimization
Fuel	Gain (P)		Read-Only
	Stability (I)		Read-Only
	P-Tune, I-Tune		Optimization
Valve	Requested		Required
	Actual		Read Only
	Offset		Read Only
	STune		Optimization
Sensors	MAP (Volt, kPa)		Read-Only
	MAP Sensor		Required
	Temperature Coolant / Exhaust		Read-Only
	Oil Pressure		Read-Only
	PRE - Oxygen		Read-Only
	O-Tune		Optimization
	POST Oxygen		Read-Only
System Info	Build Date - Software Ver.		Read-Only
Governor Advanced Settings	PID Update Rate		Required
	PID Scale		Required
	Special Functions		Required
	Speed Increment / Decrement		Feature
	AUX		Feature
	Droop Function		Feature
Advanced Settings	Fuel Control Settings		Advanced
	Sensors		Feature
Device Monitor	Speed		Read-Only
	O2		Read-Only
	Fuel Valve		Read-Only

4.3 EDG6000 Prep List

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
Setup and Safety Parameters	Overspeed		Required
	Teeth		Required
	Ramp Up		Optimization
	Ramp Down		Optimization
Starting Parameters	Crank Termination		Required
	Throttle Ramp Time		Optimization
	Throttle Begin Point		Required
Fixed Speed Parameters	Speed (1, 2, 3)		Required
	Droop (1, 2, 3)		Required
Variable Speed Parameters	Droop		Required
	Speed min		Required
	Speed max		Required
Engine Data	Pot min		Read-Only
	Pot max		Read-Only
	Actual Speed		Read-Only
	Requested Speed		Read-Only
	Actuator Duty Cycle		Read-Only
	Magnetic Pickup		Read-Only
Engine Response Parameters	Gain (P), Stability (I), Derivative (D)		Required
	Dither		Feature
	Fuel Limit		Feature
	Governor System Tuning		Optimization
System Info	Build Date		Read-Only
	Software Ver.		Read-Only
Governor Advanced Settings	PID Update Rate		Required
	PID Scale		Required
	Special Functions		Required
	Speed Increment / Decrement		Feature
	AUX		Feature
	Droop Function		Feature
Device Monitor	Speed		Read-Only

4.4 EEG7000 Prep List

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
Setup & Safety	Overspeed		Required
	Flywheel Teeth		Required
	Speed Ramp Up		Required
	Speed Ramp Down		Required
Starting Parameters	Crank Termination		Required
	Actuator Ramp Rate		Required
	Actuator Begin Point		Required
Fixed Speeds	Speed (1, 2, 3)		Feature
	Gain (1, 2, 3)		
	Droop (1, 2, 3)		Feature
Variable Speed 4	Droop		Feature
	Min Speed		Feature

SECTION	PARAMETERS	INITIAL VALUE ENTERED	CATEGORY
	Max Speed		Feature
	Gain (Min, Max)		Feature
	Droop		Feature
Droop Function	No Load Current		Feature
	Full Load Current		Feature
Faults	Last Fault Code		Read-Only
Engine Data	Actual Speed		Read-Only
	Magnetic Pickup		Read-Only
	Governor Commanded Speed		Read-Only
	Operator Requested Speed		Read-Only
	Actuator Current		Read-Only
	Actuator Duty Cycle		Read-Only
	Battery Voltage		Read-Only
Engine Response Parameters	Active Speed Mode		Read-Only
	Active Gain		Read-Only
	Duty Cycle		Feature
	Stability		Feature
	Dead Time		Feature
J1939	CAN Port Enable		Feature
	CAN Speed Ramp Control Enable		Feature
	J1939 TSC1		Read-Only
System Info	Build Date		Read-Only
	Software Ver.		Read-Only
Special Functions	Lead		Required
	Speed Anticipation		Required
	Light Force Governor		Required
	Resettable Timer Enable		Feature
	AUX		Feature
	Droop Function		Feature
	variable speed		Feature
	auxiliary input		Feature
speed switch		Feature	
Timers			Read-Only
Device Monitor	Duty Cycle		Read-Only

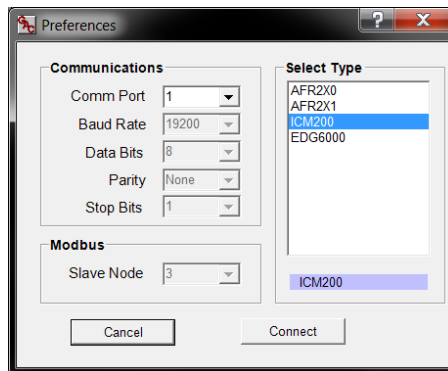
5 Starting SmartVU and Connecting to a Device

SmartVU EC can be started for review prior to setup, however settings cannot be saved and not all functionality is available until after the engine and all related governing equipment is connected to the PC and the engine. Wiring information is available in the installation manual of your speed controller.



SmartVU EEG7000 Interface Tool cannot be started prior to connecting. Power must be connected to the EEG7000 in order to open the software application.

For either version of SmartVU:

1. Double click the SmartVU EC or EEG7000 Interface Tool desktop icon or by locating the software executables the search utility from the Windows Start Menu.
2. Once the application has launched, from the Main menu dropdown select **Configure → Setup Connection**. The Preferences window displays.



3. Select the controller you are configuring in the Select Type window.

	<p>Ensure the fuel supply is disconnected from the engine prior to performing any of the following configuration procedures. The speed controller can be shut down by pressing the Stop Engine button within the SmartVU interface.</p>	
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4. If necessary set the Comm Port to the port where the serial cable (or USB adapter) is connected.
5. Turn on the engine ignition / battery switch to provide power to the controller.
6. Select the Type of controller from the Preferences window and click Connect. Follow the configuration steps detailed for your controller in the next section.

6 Configuration Procedures



This section details configuration and calibration for each type of speed controller.

- [ICM](#)
- [AFR2XX](#)
- [EDG6000](#)
- [EEG7000 with Interface Tool](#)

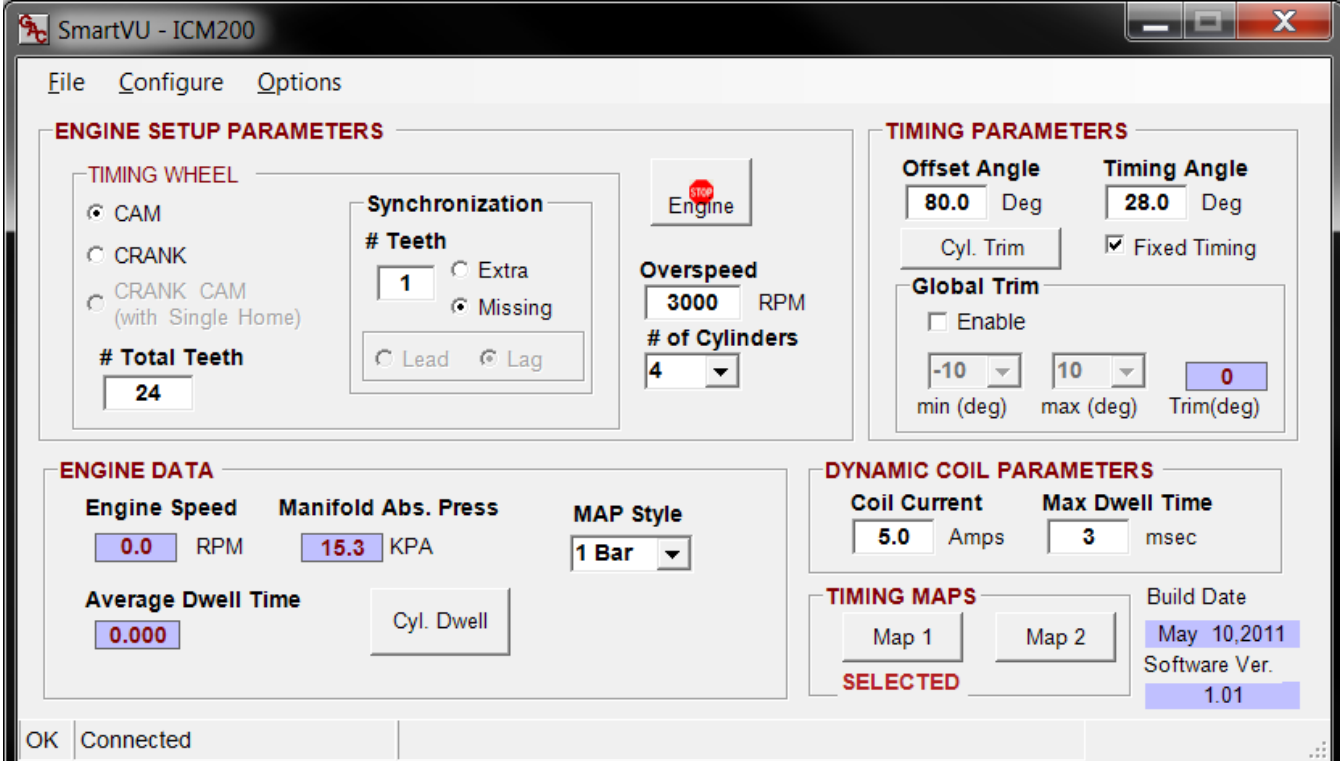
6.1 ICM Setup

Each of the following sections are found on the main setup window (above) after the product selection is made. The following instructions provide a quick reference on the minimum required configuration and calibration settings for the ICM.

NOTE: To save settings, some windows include a SAVE button, however to save main window value settings cycle power to the ICM unit and the system will save the settings.

	<p>Ensure the fuel supply is disconnected from the engine prior to performing any of the following configuration procedures. The speed controller can be shut down by pressing the Stop Engine button within the SmartVU interface.</p>	
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TYPICAL ICM MAIN SETUP WINDOW (DEFAULT VALUES SHOWN)



6.1.1 Engine Setup Parameters

Enter the following parameters while connected to the engine and controller. Connect to the battery but do not start the engine. The following parameters must be set:

1. On the main menu, ENGINE SETUP PARAMETERS, enter the following values.
 - A. Overspeed: Set this value to an engine RPM under the speed where damage may occur.
 - The controller uses this value to de-energize the ignition coils as a safety measure. This value should be set low enough to prevent mechanical damage but high enough to allow realistic load rejection speeds without stopping the engine. As a starting point this should be set to no more than 25% above rated speed.
 - B. # of Cylinders: Set this value to the number of cylinders on the engine. Note that this value does not necessarily equal the number of ignition coils used since some coil varieties are dual output.
 - C. Timing Wheel: Set this value to CAM or CRANK depending on whether the trigger wheel is mounted to the camshaft or the crankshaft.
 - D. # Total Teeth: Set this value to the total number of teeth for the trigger wheel being used. For example, a 24-1 trigger wheel will use 24 as the # total teeth.
 - E. # Teeth: Set this value as the number of missing or extra teeth. For example, a 24-1 trigger wheel will use 1 as the # Teeth under the synchronization section.
 - F. Extra / Missing: Select the appropriate button for either extra or missing teeth. For example, a 24-1 trigger wheel will use Missing.
 - G. Lead / Lag: If an extra tooth trigger wheel (+ X) is being used, select the appropriate button for whether the extra tooth is leading or lagging.
 - For an extra tooth trigger wheel, it is necessary to indicate whether the synchronizing tooth appears before (Lead) or after (Lag) the reference tooth with respect to engine rotation.
2. To save your changes, cycle power to the ICM. Changes which will not take effect until the ICM has been power cycled.

6.1.2 Timing Parameters

Timing Parameters is used to set fixed timing parameters. The fixed timing is accomplished using a set timing angle and offset angle regardless of engine speed. For variable timing based on engine speed and load refer to [TIMING MAPS](#).

1. Enable the Fixed Timing option by pressing the appropriate checkbox.
2. Ensure the Global Trim enable option is unchecked.
3. Set the desired Timing Angle required before TDC at which the spark is to occur.
4. Set the Offset Angle to the same rough angular offset between the reference tooth on the trigger wheel and TDC.
 - Offset Angle is the number of degrees after the sensor detects the synchronizing gap (or tooth) to TDC combustion. This value must be calibrated such that the actual angle of the ignition event occurs at the requested timing angle.
 - This angle is based on how the trigger wheel is mechanically mounted to the engine. Larger angles before TDC allow greater control for accurate timing. 80 degrees is the default value.
5. Crank the engine, with the fuel still disconnected and observe the position of the ignition timing for cylinder 1 with a timing light.

6. If the timing is off from the desired timing, by $\pm 3^\circ$, adjust the Offset Angle parameter.
 - For example, if the specified Timing Angle is 10 degrees before TDC and the observed timing angle is 6 degrees, decrease the offset angle by 4 degrees.
7. Enable the fuel supply and start the engine.
8. Allow the engine to ramp up to the desired speed.
 - If the engine does not start refer to the *Symptom Troubleshooting* section in the ICM controllers Product User Guide.
9. Once the engine is at rated speed, verify proper ignition timing angle is within $\pm 1^\circ$ and adjust accordingly.

6.1.2.1.1 **Global Trim Adjustment**

The global trim adjustment provides the option of offsetting the engine timing in-field up to a maximum of 10 degrees of advance / retard. This is performed after the fixed timing procedure detailed previously is completed as a baseline.

1. Enable the Global Trim feature using the enable checkbox.
2. Set the min (deg) and max (deg) limits for the trim adjustment angle range. This will define the window available for adjustment in-field.
 - The min and max allowable limits are ± 10 crank degrees.
3. Adjust the potentiometer and verify that the limits and desired timing trim range are available using a timing gun.
 - The read-only field under the Global Trim section labeled Trim (deg) provides the current commanded trim angle.
 - The status LED blinks to indicate the offset in-field. The following table details the LED indication for the timing trim functionality.

TIMING TRIM FUNCTIONALITY LED INDICATION

LED State	Functional Description
Solid GREEN	Normal operation; trim pot is currently disabled, or set to zero degrees.
Blinking RED	Normal operation; trim pot is enabled - the LED flashes once for each degree of trim retarded. The blink rate is $\frac{3}{4}$ of a second on then off. The angle is repeated every 10 seconds.
Blinking GREEN	Normal operation; trim pot is enabled - the LED flashes once for each degree of trim advanced. The blink rate is $\frac{3}{4}$ of a second on then off. The angle is repeated every 10 seconds.

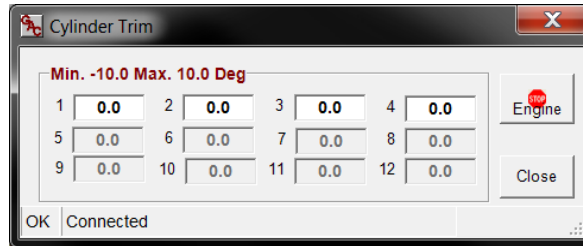
4. If necessary, adjust the window and re-check accordingly.

6.1.2.2 **Individual Cylinder Timing Trim**

If firing inconsistencies exist, the individual cylinders may need a small timing offset to account for mechanical variations in the engine design, triggering arrangement, or other factors. The ICM has the ability to offset the individual cylinder timing by a maximum of ± 10 crank degrees. This adjustment is performed after the fixed timing procedure and startup is completed.

1. Select the Cyl. Trim button under the Timing Parameters sections or go to **Options → Cylinder Trim** on the top menu bar. The following window displays:

CYLINDER TRIM WINDOW



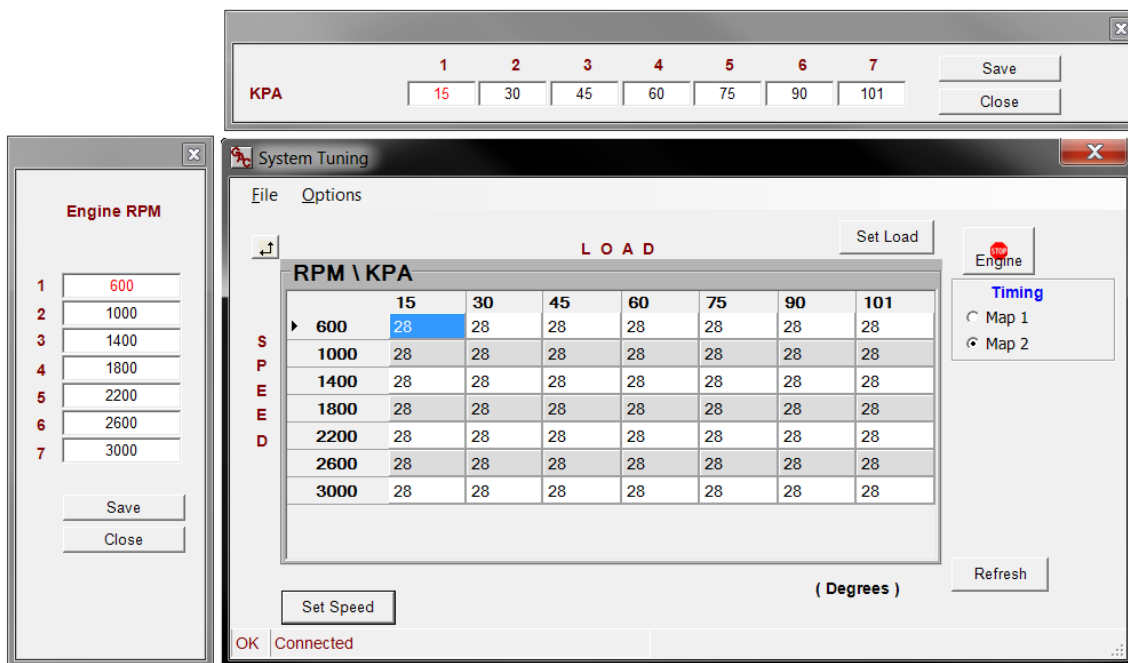
2. Adjust the angles as necessary and check the individual coil timing angles with a timing light until the desired result is attained.
3. Close the window once complete using the 'X' button in the upper right hand corner.

6.1.3 Timing Maps

The TIMING MAPS are used to adjust timing based on real-time engine speed and load. There are two maps available within the ICM typically used for dual-fuel applications, or for a global timing retard/advance.

1. Ensure the Fixed Timing box is NOT checked under the Timing Parameters section.
2. Locate the Map 1 and Map 2 buttons under the Timing Maps section and select Map 1 (default selection). Alternatively, you can go to **Options → System Tuning → Timing Map 1** or **Press F2**. A window similar to the following displays:

TIMING MAPS – SYSTEM TUNING WINDOW



3. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required values.

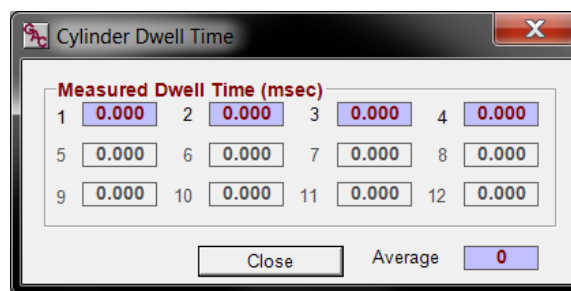
- Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and then Close when complete.
4. Edit each of the cells needed with respect to the number of degrees before TDC for each speed vs. load value.
NOTE: This can be done in real-time with the engine running.
 5. If both timing maps are going to be used:
 - a. Switch over to Map 2 using the timing map select switch.
 - b. Select the radio button for Map 2 under the Timing section on the right side of the System Tuning window.
 - c. Edit the map in a similar manner to that for Map 1.
 - Note that if a global timing offset condition is needed you can use the same values from Map 1 but minus/plus the degrees of retardation/advancement required.
 - If dual fuel operation is required; set up the primary fuel in Map 1 and the secondary in Map 2.
 6. To get back to the main menu, close the window by clicking on the 'X' in the upper right-hand corner, press Ctrl + B, or select **Options → Back to Main Screen** from the top menu bar.

6.1.4 Engine Data

The ENGINE DATA section of the main menu displays the real time information regarding running parameters.

- Engine Speed: Engine speed as read from the cam or crank trigger wheel; displayed in RPM.
- Manifold Abs. Press: This is the absolute pressure reading from the intake manifold and is measured in kPa. You must select the appropriate MAP sensor installed to get an accurate reading. If the sensor is not installed you can ignore the setting.
 - MAP Sensor: Under the Engine Data section drop down the selection box to the correct type of MAP sensor installed (1, 2, or 3 Bar). This value will be saved within the ICM calibration immediately.
- Ave Dwell Time: Calculate average dwell time by the ICM by averaging all of the cylinders for the most recent, complete, combustion cycle. The average dwell time is measured in milliseconds.
- Cylinder Dwell Time: The individual dwell time for each coil can be displayed by pressing the Cyl. Dwell button on the Real Time Data display or by selecting **Options → Show Dwell Time** on the top menu bar. Once selected, a window will display similar to that shown in the following figure:

INDIVIDUAL CYLINDER DWELL TIMES



6.1.5 Dynamic Coil Parameters

The DYNAMIC COIL PARAMETERS, Coil Current and Max Dwell Time, must be configured to run the engine if the default settings are not sufficient, or if alternate coils are used. These parameters can be changed while the engine is running.



1. Set the **Coil Current** to the desired ignition to the desired level for proper ignition.
 - Most coils will operate anywhere from 4 to 8 A.
 - The ICM will calculate the dwell time necessary to achieve the specified current level.
2. Set the **Max Dwell Time** (in ms) as the cutoff for safe engine operation.
 - Use the information provided in the previous section to determine the measured dwell time and choose a value (ms) above each of these individual dwell times but not more than 25% ms.
 - The maximum dwell time parameter is a failsafe in case the current level is not reached in the allotted time. This parameter does NOT represent the actual dwell time for the coils. Set this time as the maximum allowable dwell time for all engine conditions.

6.1.6 System Info

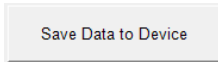
The lower right section of the main window; the system info section provides the Build Date and Software Ver. as read from the controller. The Write Enable button allows you to set up a password for the software.

6.2 AFR2XX Setup

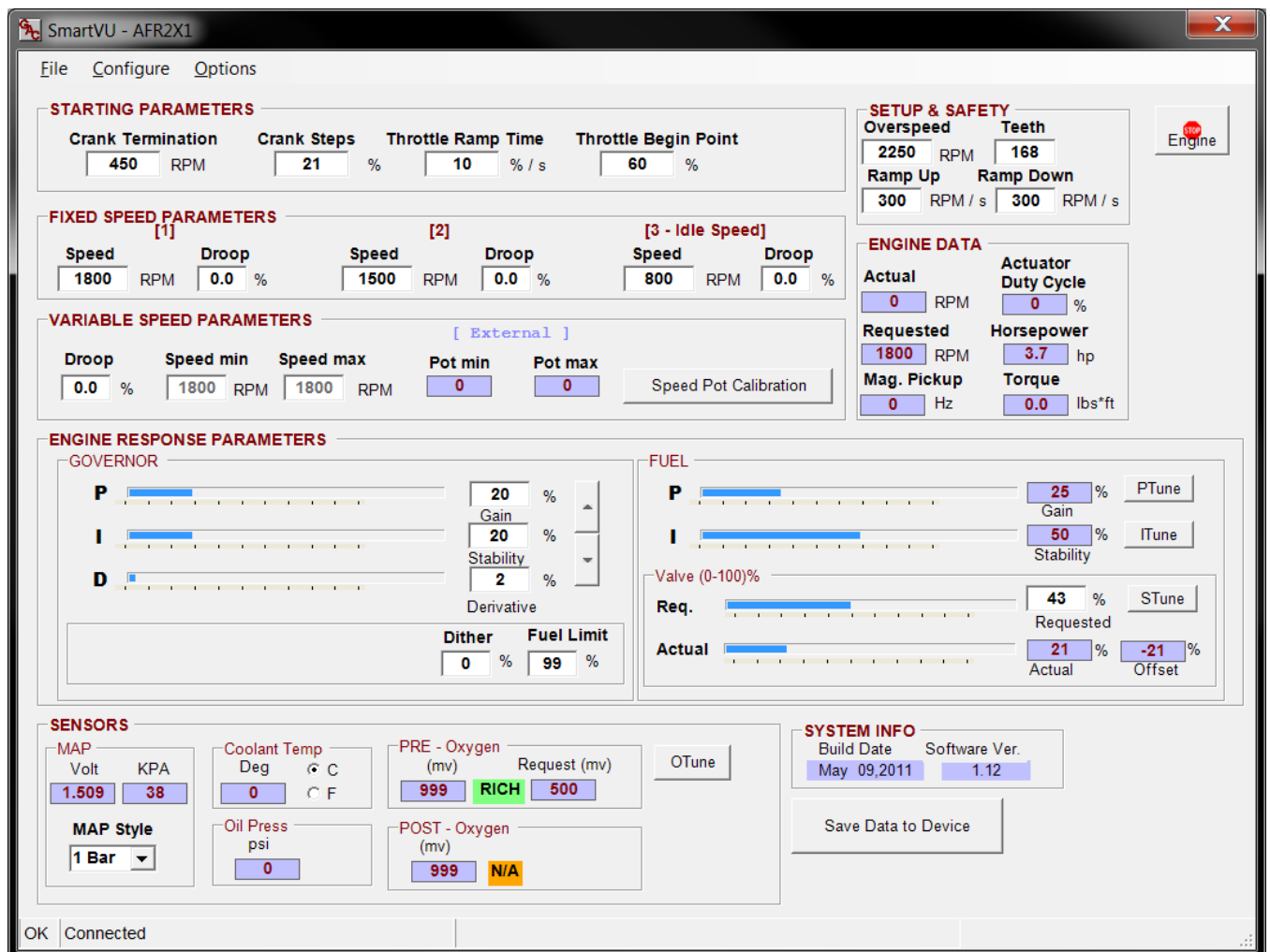
Each of the following sections is contained under the main setup window after the product selection is made. This section details each of the parameters by subsection and defines their use.

	Ensure the fuel supply is disconnected from the engine prior to performing any of the following configuration procedures. The speed controller can be shut down by pressing the Stop Engine button within the SmartVU interface.	
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IMPORTANT NOTE : For the AFR it is important to press the **Save Data to Device** button in order to store any changes made to the calibration. Otherwise, the controller will lose any changes since the previous save in the event the power is cycled to the controller. It is good practice to save often and after any changes which are final.



AFR2X1 MAIN SETUP WINDOW (DEFAULT VALUES SHOWN)



The screenshot shows the SmartVU - AFR2X1 main setup window with the following sections and values:

- STARTING PARAMETERS:** Crank Termination: 450 RPM; Crank Steps: 21 %; Throttle Ramp Time: 10 % / s; Throttle Begin Point: 60 %.
- FIXED SPEED PARAMETERS:**
 - [1] Speed: 1800 RPM; Droop: 0.0 %
 - [2] Speed: 1500 RPM; Droop: 0.0 %
 - [3 - Idle Speed] Speed: 800 RPM; Droop: 0.0 %
- VARIABLE SPEED PARAMETERS:** Droop: 0.0 %; Speed min: 1800 RPM; Speed max: 1800 RPM; Pot min: 0; Pot max: 0. Includes a Speed Pot Calibration button.
- ENGINE RESPONSE PARAMETERS:**
 - GOVERNOR:** P Gain: 20 %; I Stability: 20 %; D Derivative: 2 %.
 - FUEL:** P Gain: 25 %; I Stability: 50 %; Req. Requested: 43 %; Actual: 21 %; Offset: -21 %.
- SENSORS:** MAP: 1.509 Volt, 38 KPA; Coolant Temp: 0 Deg; PRE - Oxygen: 999 (mv), RICH, Request: 500; Oil Press: 0 psi; POST - Oxygen: 999 (mv), N/A.
- SYSTEM INFO:** Build Date: May 09, 2011; Software Ver.: 1.12.
- Buttons:** Stop Engine, Save Data to Device, OTune.
- Status:** OK Connected.

6.2.1 Setup & Safety Parameters

On the main menu SETUP & SAFETY area, set the following values

1. On the main menu, set the **Overspeed** and **Teeth** values under the Setup & Safety Parameters section:
 - **Overspeed:** Set this value to an engine RPM under the speed where damage may occur.
 - The controllers use this value to de-energize the power relay and close the throttle body as an additional safety measure. This value should be set low enough to prevent mechanical damage but high enough to allow realistic load rejection speeds without stopping the engine. As a starting point this should be set to no more than 25% above rated speed.
 - **Teeth:** Set this value as the number of teeth on the flywheel.
 - The governor functionality uses this information to calculate engine speed. You cannot edit this parameter when the engine is running.
 - **Ramp Up:** This value is adjusted in RPM/sec to restrict the rate of acceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual increase in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value will be set at the maximum value that allows for rapid engine speed response with little or minimal overshoot during engine start and acceleration.
 - **Ramp Down:** This value is adjusted in RPM/sec to restrict the rate of deceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual decrease in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value will be set at the maximum value that allows for rapid engine speed response with little or minimal undershoot, or stumbling during engine deceleration.
2. Press the Save Data to Device button to save values.

6.2.2 Starting Parameters

The following STARTING PARAMETERS must be set before starting your engine.

1. On the main menu, set the **Crank Termination** and **Crank Steps** values under the Starting Parameters section:
 - **Crank Termination:** Set the RPM point which tells the control when the engine is in either start/crank or run mode.
 - Once the engine has surpassed the crank termination value the governor will enter closed loop and will transition from start fuel control. The default value is 420 RPM.
 - **Crank Steps:** Set the commanded start position of the fuel valve in %.
 - The fuel valve will move to the crank steps position after the unit has been powered up and the valve has calibrated itself. Once the engine speed passes crank termination the fuel valve will move to the intended open loop position dictated by the fuel table and the load/speed index. The default value is 22% which is usually sufficient.
 - **Throttle Ramp Time:** Set this value to the rate of change desired in throttle position from the throttle begin point to 100% during the start/crank cycle.
 - 100%/s throttle ramp time is the quickest actuator response up to 100% and 1%/s is the slowest. Start with 50% and modify from there for optimal response.

- Throttle Begin Point: Set this value as the starting position of the actuator during the crank cycle.
 - The value of 100% is fully open and 0% is fully closed. The actuator will reach the throttle begin point once the engine begins cranking.
 -
2. Press the Save Data to Device button to save values.

6.2.3 Fixed Speed Parameters / Variable Speed Parameters

The speed governing settings are separated between fixed speed and variable speed parameters on the main setup window. Fixed speed setting 3 (Idle Speed), Speed min, and Speed max must be set regardless of variable or fixed speed operation.

6.2.3.1 FIXED SPEED PARAMETERS

1. On the main window, set the **Speed (1, 2, 3)** and **Droop (1, 2, 3)** parameters under the FIXED SPEED PARAMETERS section:
 - Speed: Set the desired RPM(s) when the fixed speed mode(s) are enabled using the speed select inputs covered in EDG6000 Installation manual.

NOTE: Fixed speed setting 3 is Idle and must be set in order for the ramp functions to operate correctly. If the idle setpoint is not set correctly or set too close to the crank termination setpoint the engine may not start. This value must be under the requested operating engine speed.
 - Droop: Set the percent droop (% RPM decrease at full load) required while running at the associated fixed speed setting.

6.2.3.2 VARIABLE SPEED PARAMETERS

1. On the main window, set the **Droop**, **Speed min** and **Speed max** parameters under the VARIABLE SPEED PARAMETERS section:
 - Droop: Set the percent droop (% RPM decrease at full load) required while running in variable speed mode.
 - Speed min: Set the minimum allowed RPM desired while in variable speed mode. The default is set to 1800 RPM.

NOTE: If the speed pot is not installed, this value must be set to the operating speed of the engine.
 - Speed max: Set the maximum allowed RPM desired while in variable speed mode. The default is set to 50 RPM.

NOTE: If the speed pot is not installed this value must be set to the default value.
2. Run the Speed Pot Calibration which will prompt you through the procedure for setting the Pot min and Pot max values. Once complete, these values will directly correlate to the Speed min and max values.

6.2.4 Engine Data

The following read-only information is displayed under the Engine Parameters section of the SmartVU interface on the main window:

- Actual: Displays the calculated engine speed in RPM based on the magnetic speed pickup sensor.
- Requested: Displays the requested engine speed in RPM.

- Mag. Pickup: Displays the frequency of the Magnetic Speed Pickup sensor in Hz.
- Actuator Duty Cycle: Displays the duty cycle requested to the actuator. This information is identical to actuator position. 0% is fully closed and 100% is fully open.

NOTE: This value does not take into account droop or the load synchronizing input.

6.2.5 Engine Response Parameters

The following engine response parameters are used to fine-tune control of the engine and are contained under the ENGINE RESPONSE PARAMETERS section on the main menu.

6.2.5.1 Governor

Under the GOVERNOR section the current P, I, and D values are shown in addition to advanced features specific to engine governing depending on the GAC product being configured.

- P, I, D: These are the Proportional, Integral, and Derivative control loop terms for Gain, Stability, and Deadtime respectively with respect to governing engine speed which are shown numerically and via bar graph.
 - Gain (Proportional): This parameter changes the general response of the engine. Increasing the gain makes the engine more responsive to load changes while decreasing it makes it less responsive to load changes. Avoid instability due to high gain when adjusting this parameter.
 - Stability (Integral): This parameter changes the steady state response of the engine. Increasing the stability allows the system to come to steady state speed faster while decreasing the stability will result in a more gradual transition to steady state speed.
 - Deadtime (Derivative): This parameter changes the transient response of the engine and affects the stability parameter during transient load changes. Increasing the deadtime (derivative term), decreases both the percent of overshoot and settling time during a transient load change while decreasing the deadtime increases them. Adjusting deadtime value to high can cause random speed instability during steady state since any small speed errors are picked up and amplified by this function.
 - The Up and Down arrows can be used to adjust the values by 1% intervals when the cursor is placed in to the appropriate field for any of the PID values. Adjust the parameters accordingly. There are also customizable maps for the PID values over engine speed and load covered in the following section.
- Dither: This parameter is used to add a high-frequency, low-amplitude signal to the actuator in order to prevent the butterfly valve from sticking in harsh environments. Increase or decrease this value for the desired dithering action but take caution to avoid engine surging.
 - A value of 0% is no dithering action. The maximum allowable dither % varies based on the product family selected.
- Fuel Limit: The fuel limit parameter is the maximum allowable throttle % quantity the system can command. This parameter is used to prevent over fueling after the engine has started. During normal starting cycles and short step loads the function will not engage since there is a 1 second delay. Adjust this parameter accordingly.

6.2.5.1.1 Governor PID Tuning Procedure

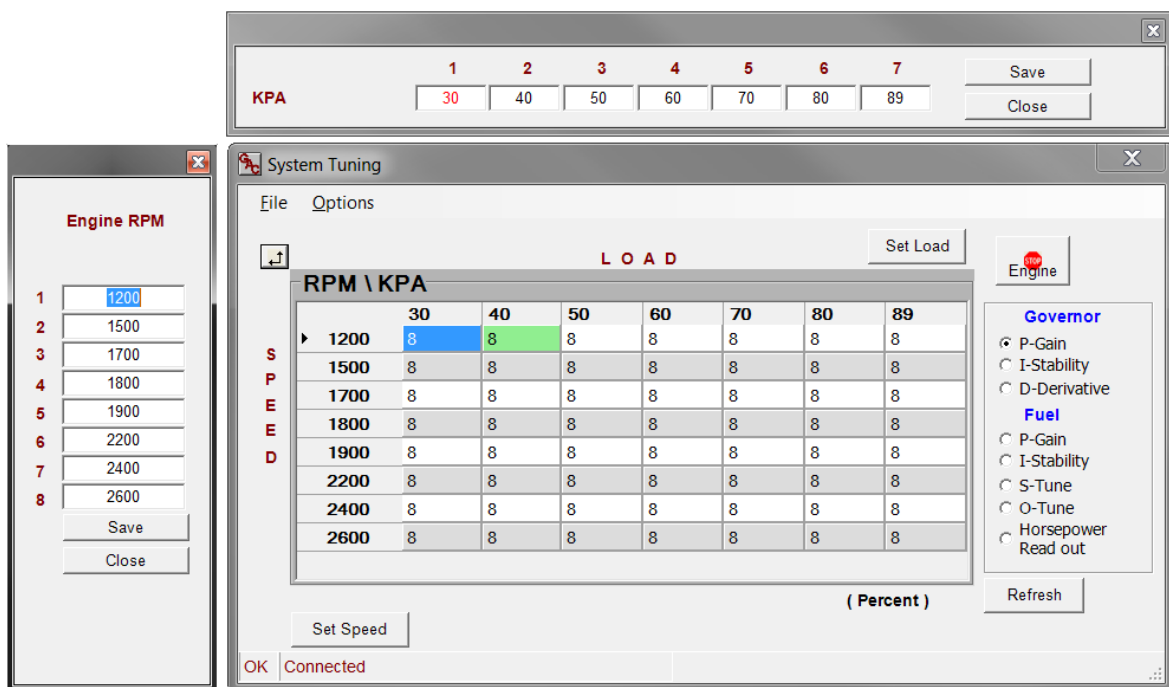
1. Increase the Gain (P) parameter until instability develops.
2. Gradually decrease the Gain (P) until stability returns.
3. Decrease the adjustment one count further to ensure stable performance.
4. Increase the Stability (I) parameter until instability develops.
5. Gradually decrease the Stability (I) until stability returns.
6. Decrease the parameter by one count to insure it is stable. If there is no instability leave the value set at 25.
7. Increase the Deadtime (D) compensation parameter until instability develops.

8. Gradually decrease the Deadtime (D) until stability returns.
9. Decrease the parameter by one count to insure it is stable.
10. The Gain, Stability and Deadtime parameter adjustments may require minor changes after engine load is applied.
 - Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to further optimize the adjustments.

6.2.5.1.2 Governor System Tuning – Multi-PID

The PID values can be adjusted over the engine speed and load range by navigating to the top menu bar and selecting **Options → System Tuning → Governing**. Under this menu you will find a selection for P – Gain, I – Stability, and D – Derivative. For the EDG6000 you can also select the P, I, and D buttons located under the Engine Response Parameters section. An example representation of the window is shown in the following figure:

SYSTEM TUNING WINDOW



6.2.5.2 System Tuning Procedure

- The speed and load axis values can be edited by selecting Set Speed or Set Load buttons on the axis itself in order to adjust the range and resolution of the table.
- The radio buttons on the side panel allow you to switch between any of the tables. Ensure you save the changes whenever possible to avoid data loss.
- The refresh button will update the maps real time; this should be done after making any changes to ensure the values have been entered correctly by the controller.
- The highlighted cell indicates the engines current speed and load value.
- At any time you can press **Ctrl+B** or select **Options → Back to Main Screen**, or close the window to return to the main screen.

- The stop engine icon can be used to shut down the engine at any time.

To tune:

1. Open the system tuning window using the information provided previously and select the radio button for the Governor P, I, or D table. Allow the map to update to the current processor settings.
2. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and Close when complete.
3. Depending on the table being modified enter the information provided below:
 - Enter the values for P, I and D as determined from the Governor PID tuning guidelines section as a baseline value for all speed and load settings.
4. Adjust each of the values as needed for P, I, and D across the speed and load range. Use the information provided in the previous section as a guideline.
5. Refresh the map by pressing the Refresh button to assure that all values have been accepted by the controller.
6. Once complete with preliminary tuning, re-check the response from the system to ensure optimal operation and readjust as necessary.

6.2.5.3 FUEL

Under the FUEL section the current P and I values for Gain and Stability of fuel are shown in % as well as visually using a bar graph.

- **Gain** This parameter changes the fuel response of the engine. Increasing the gain makes the engine more responsive to demand changes while decreasing it makes it less responsive. Avoid instability due to high gain when tuning this value. Ideally the gain needs to be set at a value that allows for effective and quick switching of the O2 sensor reading between states.
- **Stability** This parameter changes the steady state fuel response of the engine. Increasing the stability allows the system to compensate for fuel demands faster while decreasing the stability will result in a more gradual adjustment.
- **PTune** The fuel gain and stability can be adjusted over the engine speed and load range. This procedure is covered in the following section.
- **ITune**

6.2.5.3.1 Fuel System Tuning (PTune, ITune)

The fuel gain and stability can be adjusted over the engine speed and load range by navigating to the top menu bar and selecting **Options → System Tuning → Fuel**. Under this menu you will find a selection for P – Gain (F5), I – Stability (F6), Stepper (F7), and Request (F8). Select **P - Gain** or press **F5** or select **I – Stability** or press **F6**. Alternatively you can select the PTune or ITune buttons on the main menu.

NOTE: This window has the same features and similar appearance to that discussed in the Governor System Tuning → System Tuning Window Basics section.

1. Open the system tuning window using the information provided previously and select the radio button for the Fuel P or I table. Allow the map to update to the current processor settings.
2. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and Close when complete.
3. Depending on the table being modified enter the information provided below:
 - P-Gain: Enter 25 as a baseline value for all speed and load settings.
 - I-Stability: Enter 50 as a baseline value for all speed and load settings.
4. Adjust each of the values as needed for P and I across the speed and load range. Use the information provided as a guideline.
5. Press the Refresh button save all new values to the controller.
6. Once complete with preliminary tuning, re-check the response from the system to ensure optimal operation and readjust as necessary.

6.2.5.4 VALVE

Under the stepper section the current stepper position, offset, and starting point is shown in 0 – 100 % as well as visually using a bar graph.

- Req. : The Requested_parameter represents the setpoint on the STune map for the requested valve position at the current engine speed and load. In the entry field you can edit the starting point on the table real-time if necessary. Editing the entire STune map is covered in the following section. This map is used solely as a starting point during closed loop operation and is adapted from this point.
- Actual : The Actual Position_parameter shows the actual position of the fuel control valve from 0-100%. 100% is fully open or max fuel flow and 0% is fully closed.
- Offset: This parameter displays the difference between the commanded starting position on the STune map based on engine speed and load and the current position as calculated based on the closed loop feedback.

6.2.5.4.1 Fuel Valve Position System Tuning (STune)

The fuel valve position can be adjusted over the engine speed and load range by navigating to the top menu bar and selecting **Options → System Tuning → Fuel**. Under this menu you will find a selection for P – Gain (F5), I – Stability (F6), Stepper (F7), and Request (F8). Select **Stepper** or press **F7**. Alternatively, select the STune buttons on the main menu.

NOTE: This window has the same features and similar appearance to that discussed in the Governor System Tuning → System Tuning Window Basics section.

1. Go to **Options → Advanced Settings** in the menu bar to open the [Advanced Settings](#) window .
2. Disable the O2 Closed Loop Enable by un-checking the box. This will disable the closed-loop feedback on the primary O2 sensor.
3. Return to the STune window using the information provided previously. Allow the map to update to the current processor settings.

4. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and Close when complete.
5. Enter 43% as a baseline value for all speed and load settings.
6. Press the Refresh button save all new values to the controller.
7. Adjust the values as needed for optimal stepper position in open loop mode using the information provided across the speed and load range.
8. Once complete with preliminary tuning, enable the O2 Closed Loop Enable function by returning to the Advanced Settings window and re-checking the box.

NOTE: This step can be skipped if proceeding to the OTune setup covered next since it also requires the closed loop enable to mode unchecked (off).

6.2.5.4.2 **Horsepower Read Out**

The Horsepower Read out table is used to cross-reference the engine speed and manifold absolute pressure (indication of engine load) with an equivalent horsepower reading on the main page of the AFR interface.

NOTE: This map is not an indication of the actual engine horsepower and is merely used as a supplement to dynamometer data so that the user can acknowledge an approximate engine horsepower while using SmartVU for test purposes only.

1. Open the system tuning window using the information provided previously and select the radio button for Horsepower Read out . Allow the map to update to the current processor settings.
2. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and Close when complete.
3. Enter the values required based on the engine speed and manifold absolute pressure as determined by a dynamometer that is calibrated correctly to the current settings.
4. Refresh the map by pressing the Refresh button to assure that all values have been accepted by the controller.
5. Once complete with preliminary tuning, re-check the response from the system to ensure optimal operation and readjust as necessary.

6.2.6 **Sensors**

On the bottom of the main setup menu of the AFR in SmartVU you can find the following parameters related to sensor inputs.

- MAP (Volt, kPa) This section displays the voltage reported by the Manifold Absolute Pressure sensor as well as the corresponding pressure reading in kPa.
 - *MAP Style* Under the sensors section drop down the selection box to the correct type of MAP sensor installed (1, 2, or 3 Bar).

NOTE: This value is required when editing any of the System Tuning tables covered in following sections to correctly scale the load (kPa) values.

- Coolant Temp This value displays the measured engine coolant temperature. The radio buttons allow you to switch between degrees Celsius or Fahrenheit.
- Oil Press This parameter displays the engine oil pressure in PSI.
- PRE - Oxygen (mV) This value displays the reading from the pre-catalyst oxygen sensor in mV. Request (mV): This is the value the AFR is trying to attain with the feedback control loop.
 - 500mV represent a stoichiometric value ideally although due to variation between sensors this value requires tuning.
 - A voltage closer to 999mV would richen the fuel mixture, where a value closer to 001mV would lean the fuel mixture. There is an indication of the state; Lean, Rich, Stoic of the mixture in between the actual and requested O2 voltage.
- POST - Oxygen (mV) This value displays the reading from the post-catalyst oxygen sensor in mV.
 - This section will only be shown on the AFR main menu when a controller variety with the post-catalytic O2 sensor enabled is selected.
 - A voltage closer to 999 mV would indicate a rich fuel mixture, where a value closer to 001 mV would indicate a lean fuel mixture. There is an indication of the state; Lean, Rich, Stoic of the mixture as well.

6.2.6.1 Oxygen Sensor System Tuning (OTune)

Adjust the oxygen sensor over the engine speed and load range by navigating to **Options → System Tuning → Fuel**. Under this menu you will find a selection for P – Gain (F5), I – Stability (F6), Stepper (F7), and Request (F8). Select **Request** or press **F8**. Alternatively, you can select the OTune buttons on the main menu in the Sensors section.

NOTE: This window has the same features and similar appearance to that discussed in the Governor System Tuning → System Tuning Window Basics section.

1. Go to **Options → Advanced Settings** in the top menu bar.
2. Disable the O2 Closed Loop Enable by un-checking the box (if not completed previously). This will disable the closed-loop feedback on the primary O2 sensor.
3. Return to the OTune window using the information provided previously. Allow the map to update to the current processor settings.
4. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save Data to Device button when complete.
5. Enter 500 as a baseline value for all speed and load settings.
6. Refresh the map by pressing the Refresh button to ensure that all values have been accepted to the O2 voltage request map.
7. Click the **Save Data to Device** button.
 - Allow some time for the map to be flashed to the device memory. This can also be done on the main menu via the **Save Data to Device** button. It is good practice to do this often during the following procedures.
8. Close the window to return to the main menu.
9. Start the engine and allow up to a minute for the oxygen sensor to reach operating temperature.

- If the engine does not start refer to the *Symptom Troubleshooting* section in the AFR Product User Guide.
10. In the SENSORS section of the main menu verify that the PRE- oxygen voltage is switching between Lean-Stoic-Rich.
 - If the voltage is static at Lean or Rich, increase the regulator or decrease the regulator output respectively until switching is achieved.
 11. You can richen the mixture at various speed and loads by setting the O-Tune request voltage up to a max of 600mV and lean the mixture by setting the O-Tune request voltage down to a min of 400 mV.
 - These are the maximum and minimum values that should be used when editing this table where the majority of the values are set to 500 mV.
 12. Once preliminary tuning is complete enable the O2 Closed Loop Enable function by returning to the Advanced Settings window and re-checking the box.
 - The AFR will resume control and adjust the fuel flow based on the O2 sensor and the O-Tune request voltage.

6.2.7 System Information

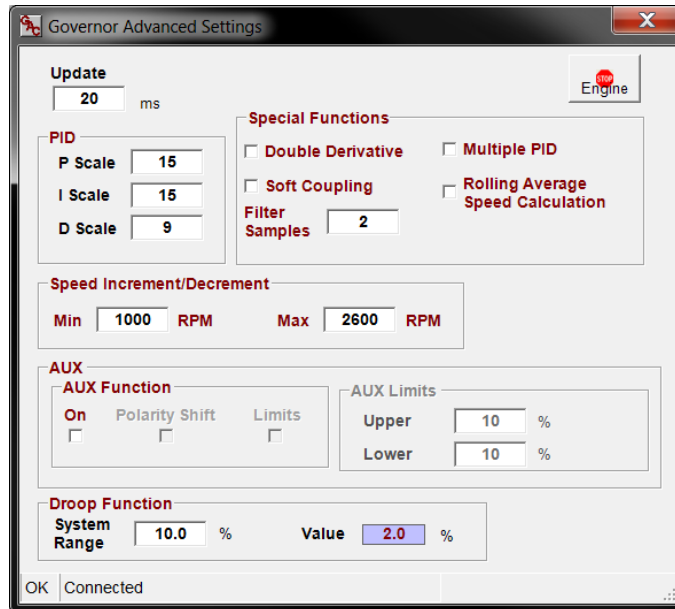
The system info section provides the Build Date and Software Version as read from the controller.

6.3 Governor Advanced Settings

This section details the Governor Advanced Settings window primarily used for the PID adjustments, load sharing / synchronizing, and droop limitation.

On the top menu bar select **Options → Governor Advanced Settings** and the window will appear similar to that shown in the following figure.

TYPICAL GOVERNOR ADVANCED SETTINGS WINDOW



6.3.1.1 PID, Special Functions, and Governor Flags

The PID functionality, special functions, and governor flags are used for advanced engineering and startup purposes.

- **Update:** This changes the rate at which the PID routine is called thus changing the time constant of the overall system.
 - Increasing the time will slightly increase the stability but decrease the response.
 - Decreasing the time will slightly decrease the stability but increase the response.
 - The P, I, D values may need to be retuned when adjusting this parameter.

6.3.1.1.1 PID Scale

The PID Scale will multiply the P, I, and D values respectively by the multiplier entered to increase or decrease PID sensitivity which varies based on engine size and response characteristics.

- **P, I, D:** Set the multiplier values based on the desired engine operational characteristics. This is generally used if the PID values are near the upper or lower limits and require additional adjustment.
 - Note that these scales will only apply while the engine is running.
 - Lower the multipliers for less response and raise them for greater response.
 - A value of 1 (lowest setting) implies that no multiplier is active.
 - When a multiplier is changed the corresponding parameter (Gain, Stability, and Deadtime) will normalize. If the multiplier is decreased by 1, the corresponding value will double in value. Increasing the multiplier halves the corresponding P, I, or D value.
 - I.e., if P scale is changed from 17 to 16, and Gain was 2, Gain will normalize to 4.
 - I.e., if P scale is changed from 10 to 11, and Gain was 16, the Gain will normalize to 8.

6.3.1.1.2 Special Functions

The special functions section is intended for engineering purposes and used for advanced diagnostics.

- **Double Derivative:** Enable or disable the double derivative functionality using this checkbox.
 - This feature increases the PID response by doubling the error term to the control loop thus increasing the reaction rate of the governing routine.

- **Multiple PID:** Enable or disable the multi-PID tables (variable map over full engine speed and load range) using this checkbox.
- **Soft Coupling:** Enable or disable a speed filter before the PID routine using this checkbox.
 - This slows down the engine response and improves steady state performance. It works by averaging out any engine noise or slight instabilities and creates a steady speed reference for the PID routine.
- **Filter Samples:** This is the number of samples the control system will filter out prior to starting the governor PID routine while in soft coupling mode.
 - This parameter effectively changes the cutoff frequency for soft coupling as is only available when soft coupling is enabled. Lower numbers filter out higher frequency noise.
- **Rolling Average Speed Calculation:** This feature enables the rolling average calculation for the magnetic speed pickup input which serves to remove noise from the input by continuously averaging the signal in order to eliminate false occurrences or outliers.

NOTE: This input should be enabled for every 24 V DC application in order to smooth out engine response due to the broader voltage range (resolution).

6.3.1.2 Speed Increment / Decrement

This section applies to the optional speed increment and decrement inputs available on the AFR200 series controllers.

- **Min:** This is the minimum allowable RPM available for the speed decrement input to the AFR. Ensure this value is above the idle speed setpoint.
- **Max:** This is the maximum allowable RPM available for the speed increment input to the AFR. This value must be below the overspeed setpoint otherwise shutdown will occur while adjusting.

6.3.1.3 AUX

This section applies to the Load Sensing and Synchronization input available on certain GAC products.

- **AUX Function:** This section allows the user to customize and enable the load synchronizing input functionality which requires a 0 – 10 V DC input signal.
 - **On:** Enables or Disables the load sync input.
 - The default selection (or if the option is grayed out) is decreasing which means the lowest engine speed will be at 10 V DC.

6.3.1.4 Droop Function

- **System Range:** This parameter represents the actuator current level at full load. Set this value to the desired range for droop functionality.
- **Value:** Displays the current commanded droop percentage.

6.3.2 Advanced Settings

This section details the Advanced Settings window which is primarily used for the oxygen, exhaust gas temperature, coolant temperature, and oil pressure sensor thresholds as well as some advanced feedback and trim functionality.

On the top menu bar select **Options → Advanced Settings** and the window display similar to the following figure.

TYPICAL ADVANCED SETTINGS WINDOW

The screenshot shows the 'Advanced Settings' window with the following sections and values:

- FUEL CONTROL SETTINGS**
 - O2 Closed Loop Enable**
 - PID Reset**: 26 %
 - Valve Update Rate**: 125 ms
 - O2 Closed Loop Control**
 - Speed Cut Off**: 0 RPM
 - Load Cut Off**: 10 kPa
 - Trim Enable**
 - Auto Adjust Time**: 1000 ms
 - O2 Lower Limit**: 73 mV
 - O2 Upper Limit**: 73 mV
 - Post O2 Map Cut Off**: 37 kPa
- Sensors**
 - Coolant Temp. Sensor Enable**: 110 C Max. Coolant Temp. Shutdown
 - Oil Pressure Sensor Enable**: 15 psi Min. Oil Pressure Shutdown
- EXHAUST GAS TEMPERATURE**
 - EGT Sensor Enable**
 - Temperature**: 0 C
 - Upper Limit**: 1023 C
 - Lower Limit**: 1022 C
 - Timeout**: 15 s
 - Overheated Timeout**: 15 s
 - Duty Cycle Reduction**: 10 %
- InterfaceMaxSteps**: 470

At the bottom, there is an 'Engine' status indicator with a red light and 'OK Connected' text.

6.3.2.1 Fuel Control Settings

The fuel control settings section of the window is designed with more experienced users in mind. It features many overrides and advanced controls to help the user calibrate and tune the engine as well as diagnose electrical and performance issues.

- **O2 Closed Loop Enable:** Enable/disable closed loop feedback on pre-catalyst O2 sensor. Removes any adaptation input from the oxygen sensors post and pre catalyst.
- **PID Reset:** This feature allows advanced users the ability to reset the fuel control PID loop when switching between multiple loads and engine speeds.
- **Allowable PID:** This value represents the total allowable % offset available to the control system from the commanded starting position of the stepper motor as dictated by the STune table. The default allows the full range of travel and is typically sufficient.
- **Valve Update Rate:** This value represents the rate at which the control system will register updated position information from the fuel valve in milliseconds. Typically the default value is sufficient.
- **O2 Closed Loop Control:** This feature allows the user to calibrate if and when the closed loop control is enabled. The closed loop system will only apply when the engine is operating above both the speed and load (MAP) cutoffs.

- **Speed Cutoff:** This is the value of engine speed in RPM after which the control system will begin to implement the closed loop fuel control algorithm. The default value is usually acceptable.
- **Load Cutoff:** This is the value of intake manifold pressure (indicator of load) in kPa after which the control system will begin to implement the closed loop fuel control algorithm. The default value is usually acceptable.
- **Trim Enable:** This feature allows advanced users the ability to enable or disable the O2 feedback trim strategy and the associated windows above and below the ideal stoichiometric condition.
 - **Auto Adjust Time:** This is the value in mS for how quickly the control system will respond to changes in the oxygen sensor setpoint for the closed loop control strategy. Typically the default value is sufficient. Reducing the time will increase the stepper motor response and the opposite will occur when decreasing it.
 - **O2 Lower Limit:** This value is the lower limit offset (as a delta from the commanded) in mV for the O2 closed loop feedback strategy. The control will operate in open-loop mode until the AFR detects the oxygen sensor input within this window. Typically the default value is sufficient. Increasing the window will result in a broader range of closed loop control and vice versa for decreasing it.
 - **O2 Upper Limit:** This value is the upper limit offset (as a delta from the commanded) in mV for the O2 closed loop feedback strategy. The control will operate in open-loop mode until the AFR detects the oxygen sensor input within this window.
- **Post O2 Map Cutoff:** This parameter is used to cut off the feedback / diagnostics on the post-catalytic converter oxygen sensor after a calibrated load setpoint. Until the MAP reaches this threshold the control system will ignore the reading from the post-catalytic converter O2 sensor. The default value is usually sufficient.

6.3.2.2 Sensors

The SENSORS section of the window contains the checkboxes to enable each of the optional sensors as well as set the sensor related thresholds and values.

- **Coolant Temp. Sensor Enable:** Check this box if the coolant temperature sensor is installed / used. Set the threshold for engine shutdown in degrees Celsius.
- **Oil Pressure Sensor Enable:** Check this box if the engine oil pressure sensor is installed / used. Set the threshold for engine shutdown (only monitored after the engine is started) in PSI.
- **Interface Max Steps:** This parameter limits the number of steps for the stepper motor valve. It is design protected for future variations of the stepper motor. Leave this value at 470 steps.

6.3.2.2.1 Exhaust Gas Temperature

Take caution when modifying any of the following parameters as they are directly related to the engine protection strategy. They only apply to installations and AFRs equipped with the Type K thermocouple input for Exhaust Gas Temperature (EGT).

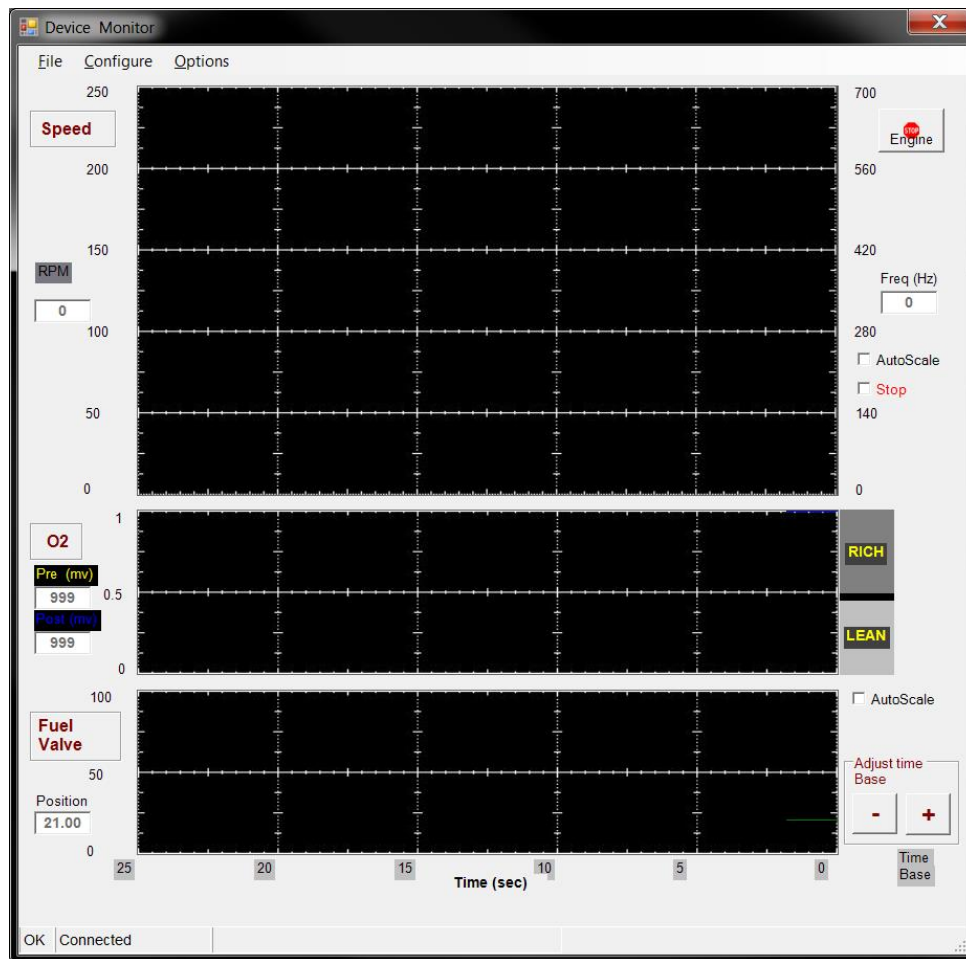
- **EGT Sensor Enable:** Check this box if the exhaust gas temperature sensor is installed / used (only applies to units equipped with an EGT input). **Important Note:** This input must be disabled if the sensor is not installed otherwise the engine will shutdown inadvertently.
 - **Temperature:** Displays the read-only temperature as read from the EGT sensor.
 - **Upper Limit:** Set this value as the upper limit threshold at which the AFR will reduce engine duty cycle in order to lower exhaust gas temperature.
 - This will result in the eventual shutdown of the engine if the temperature remains over the upper limit beyond the overheated timeout duration.

- **Lower Limit:** Set this value as the lower limit threshold after which the AFR will re-allow full duty cycle to the engine if the temperature remains below the limit for the timeout duration.
- **Timeout:** Set this value (in seconds) as the duration after which the AFR will re-allow full duty cycle to the engine if the EGT remains below the Lower Limit threshold.
- **Overheated Timeout:** Set this value (in seconds) as the duration after which the AFR will shutdown the engine if the EGT remains above the Upper Limit.
- **Duty Cycle Reduction:** Set this value as the percent reduction in engine duty cycle the AFR will impose if the exhaust gas temperature rises above the specified Upper Limit.

6.3.3 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**. An example of the device monitor window is shown in the following figure.


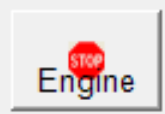
TYPICAL DEVICE MONITOR WINDOW



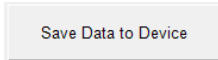
- The speed monitor displays engine speed (rpm) based upon the measured magnetic pickup frequency (Hz).
- The device monitor also features many formatting options for the graphic interface including AutoScale time base adjustment, refresh, and display freezing (stop).
- Make the time scale smaller by pressing the zoom in '+' button and larger by pressing the zoom out '-' button.
- The engine can be stopped at any time by pressing the Stop Engine icon.

- The O2 monitor displays both pre- and post- (AFR201, 202 only) catalyst oxygen sensor voltages (mV) as well as a rich/lean indication and average value.
 - The post-cat O2 sensor will have a separate trace. You can select which O2 trace to view by selecting **Options → Display O2 ...** Pre, Post or Both.
- The fuel valve window displays the commanded fuel valve position from 0-100% (0 = fully closed, 100 = full open) and allows an adjustable time base (in seconds) for all real-time monitor graphs.

6.4 EDG6000 Setup

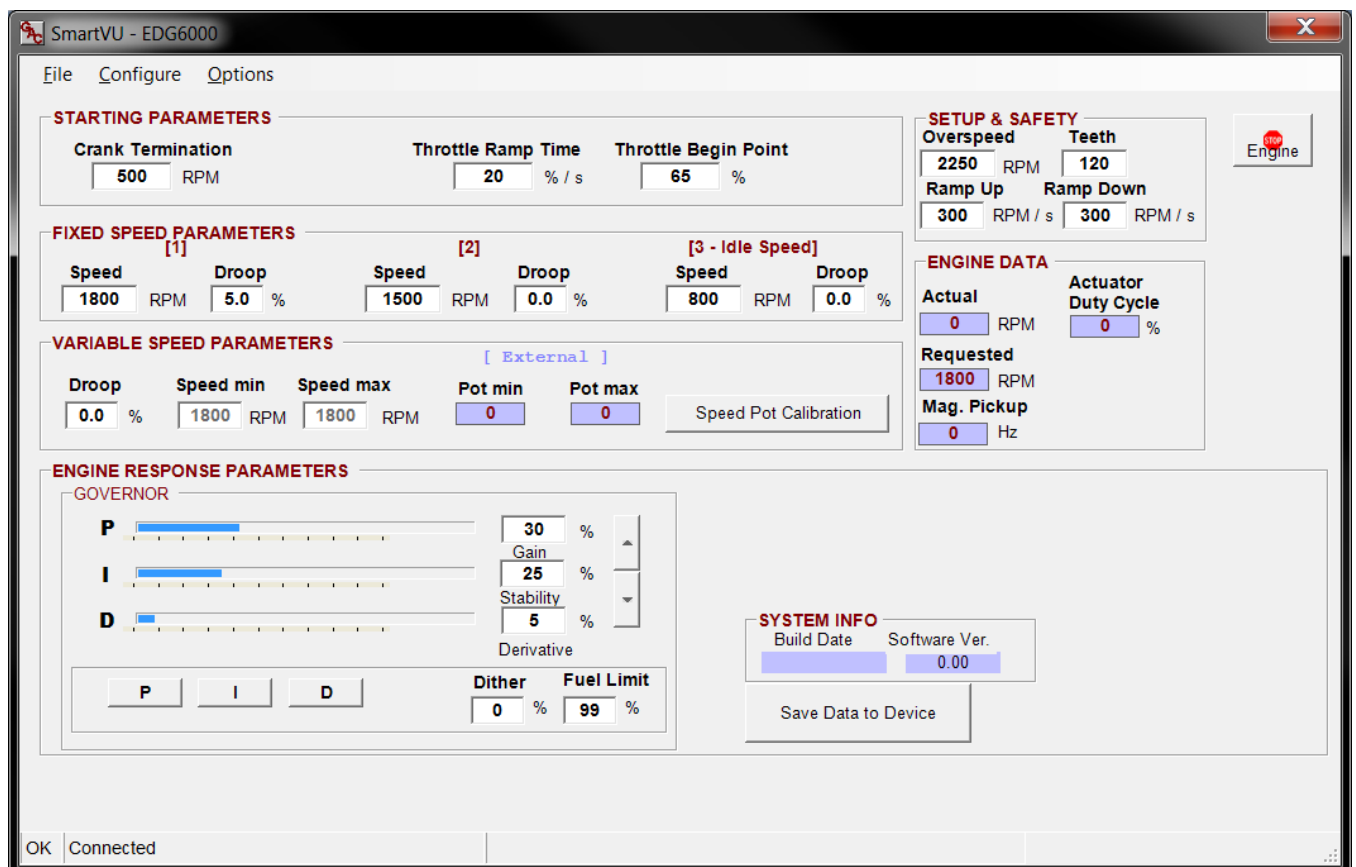
	Ensure the fuel supply is disconnected from the engine prior to performing any of the following configuration procedures. The engine can be shut off by pressing the Stop Engine button within the SmartVU interface.	
---	---	---

IMPORTANT NOTE : For the EDG it is important to press the **Save Data to Device** button in order to store any changes made to the calibration. Otherwise, the controller will lose any changes since the previous save in the event the power is cycled to the controller. It is good practice to save often and after any changes which are final.



Each of the following sections is found on the Main menu after the product selection is made. A representation of each of the main setup is shown following:

TYPICAL EDG6000 MAIN MENU (DEFAULT VALUES SHOWN)



6.4.1 Setup & Safety Parameters

- On the main window, set the **Overspeed** and **Teeth** values under the SETUP & SAFETY section:
 - Overspeed:** Set this value to an engine RPM under the speed where damage may occur.

- The controllers use this value to de-energize the power relay and close the throttle body as an additional safety measure. This value should be set low enough to prevent mechanical damage but high enough to allow realistic load rejection speeds without stopping the engine. As a starting point this should be set to no more than 25% above rated speed.
- Teeth: Set this value as the number of teeth on the flywheel.
 - The governor functionality uses this information to calculate engine speed. You cannot edit this parameter when the engine is running.
- Ramp Up: This value is adjusted in RPM/sec to restrict the rate of acceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual increase in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value will be set at the maximum value that allows for rapid engine speed response with little or minimal overshoot during engine start and acceleration.
- Ramp Down: This value is adjusted in RPM/sec to restrict the rate of deceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual decrease in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value will be set at the maximum value that allows for rapid engine speed response with little or minimal undershoot, or stumbling during engine deceleration.

6.4.2 Starting Parameters

1. On the main window, set the **Crank Termination** and **Crank Steps** values under the STARTING PARAMETERS section:
 - Crank Termination: Set the RPM point which tells the control when the engine is in either start/crank or run mode.
 - Once the engine has surpassed the crank termination value the governor will enter closed loop and will transition from start fuel control. The default value is 420 RPM.
 - Throttle Ramp Time: Set this value to the rate of change desired in throttle position from the throttle begin point to 100% during the start/crank cycle.
 - 100%/s throttle ramp time is the quickest actuator response up to 100% and 1%/s is the slowest. Start with 50% and modify from there for optimal response.
 - Throttle Begin Point: Set this value as the starting position of the actuator during the crank cycle.
 - The value of 100% is fully open and 0% is fully closed. The actuator will reach the throttle begin point once the engine begins cranking.

6.4.3 Fixed Speed Parameters / Variable Speed Parameters

The speed governing settings are separated between fixed speed and variable speed parameters on the main setup window. Fixed speed setting 3 (Idle Speed), Speed min, and Speed max must be set regardless of variable or fixed speed operation.

6.4.3.1 Fixed Speed Parameters

1. On the main window, set the **Speed (1, 2, 3)** and **Droop (1, 2, 3)** parameters under the FIXED SPEED PARAMETERS section:
 - Speed: Set the desired RPM(s) when the fixed speed mode(s) are enabled using the speed select inputs covered in EDG6000 Installation manual.

NOTE: Fixed speed setting 3 is Idle and must be set in order for the ramp functions to operate correctly. If the idle setpoint is not set correctly or set too close to the crank termination setpoint the engine may not start. This value must be under the requested operating engine speed.

- **Droop:** Set the percent droop (% RPM decrease at full load) required while running at the associated fixed speed setting.

6.4.3.2 Variable Speed Parameters

1. On the main window, set the **Droop**, **Speed min** and **Speed max** parameters under the VARIABLE SPEED PARAMETERS section:

- **Droop:** Set the percent droop (% RPM decrease at full load) required while running in variable speed mode.
- **Speed min:** Set the minimum allowed RPM desired while in variable speed mode. The default is set to 1800 RPM.

NOTE: If the speed pot is not installed, this value must be set to the operating speed of the engine.

- **Speed max:** Set the maximum allowed RPM desired while in variable speed mode. The default is set to 50 RPM.

NOTE: If the speed pot is not installed this value must be set to the default value.

2. Run the Speed Pot Calibration which will prompt you through the procedure for setting the Pot min and Pot max values. Once complete, these values will directly correlate to the Speed min and Speed max values.

6.4.4 Engine Data

The following read-only information is displayed under the ENGINE DATA section of the SmartVU interface on the main window:

- **Actual:** Displays the calculated engine speed in RPM based on the magnetic speed pickup sensor.
- **Requested:** Displays the requested engine speed in RPM.
- **Mag. Pickup:** Displays the frequency of the Magnetic Speed Pickup sensor in Hz.
- **Actuator Duty Cycle:** Displays the duty cycle requested to the actuator. This information is identical to actuator position. 0% is fully closed and 100% is fully open. This value does not take into account droop or the load synchronizing input.

6.4.5 Engine Response Parameters

The following engine response parameters are used to fine-tune control of the engine and are contained under the ENGINE RESPONSE PARAMETERS section on the main window.

6.4.5.1 Governor

Under the GOVERNOR section the current P, I, and D values are shown in addition to advanced features specific to engine governing depending on the GAC product being configured.

- **P, I, D:** These are the Proportional, Integral, and Derivative control loop terms for Gain, Stability, and Deadtime respectively with respect to governing engine speed which are shown numerically and via bar graph.

- **P - Gain (Proportional):** This parameter changes the general response of the engine. Increasing the gain makes the engine more responsive to load changes while decreasing it makes it less responsive to load changes. Avoid instability due to high gain when adjusting this parameter.
- **I - Stability (Integral):** This parameter changes the steady state response of the engine. Increasing the stability allows the system to come to steady state speed faster while decreasing the stability will result in a more gradual transition to steady state speed.
- **D - Deadtime (Derivative):** This parameter changes the transient response of the engine and affects the stability parameter during transient load changes. Increasing the deadtime (derivative term), decreases both the percent of overshoot and settling time during a transient load change while decreasing the deadtime increases them. Adjusting deadtime value to high can cause random speed instability during steady state since any small speed errors are picked up and amplified by this function.
 - The Up and Down arrows can be used to adjust the values by 1% intervals when the cursor is placed in to the appropriate field for any of the PID values. Adjust the parameters accordingly. There are also customizable maps for the PID values over engine speed and load covered in the following section.
- **Dither:** This parameter is used to add a high-frequency, low-amplitude signal to the actuator in order to prevent the butterfly valve from sticking in harsh environments. Increase or decrease this value for the desired dithering action but take caution to avoid engine surging.
 - A value of 0% is no dithering action. The maximum allowable dither % varies based on the product family selected.
- **Fuel Limit:** The fuel limit parameter is the maximum allowable throttle % quantity the system can command. This parameter is used to prevent over fueling after the engine has started. During normal starting cycles and short step loads the function will not engage since there is a 1 second delay. Adjust this parameter accordingly.

6.4.5.1.1 **PID Tuning**

1. Increase the Gain (P) parameter until instability develops.
2. Gradually decrease the Gain (P) until stability returns.
3. Decrease the adjustment one count further to ensure stable performance.
4. Increase the Stability (I) parameter until instability develops.
5. Gradually decrease the Stability (I) until stability returns.
6. Decrease the parameter by one count to insure it is stable. If there is no instability leave the value set at 25.
7. Increase the Deadtime (D) compensation parameter until instability develops.
8. Gradually decrease the Deadtime (D) until stability returns.
9. Decrease the parameter by one count to insure it is stable.
10. The Gain, Stability and Deadtime parameter adjustments may require minor changes after engine load is applied.

Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to further optimize the adjustments.

6.4.5.1.2 **Governor System Tuning – Multi-PID**

The PID values can be adjusted over the engine speed and load range by navigating to the top menu bar and selecting **Options → System Tuning → Governing**. Under this menu you will find a selection for P – Gain, I – Stability, and D - Derivative. For the EDG6000 you can also select the P, I, and D buttons located under the ENGINE RESPONSE PARAMETERS section. An example representation of the window is shown in the following figure:

SYSTEM TUNING WINDOW

The screenshot displays the 'System Tuning' window. At the top, there is a 'KPA' scale with values 30, 40, 50, 60, 70, 80, and 89. Below this is a table titled 'RPM \ KPA' with the following data:

	30	40	50	60	70	80	89
1200	8	8	8	8	8	8	8
1500	8	8	8	8	8	8	8
1700	8	8	8	8	8	8	8
1800	8	8	8	8	8	8	8
1900	8	8	8	8	8	8	8
2200	8	8	8	8	8	8	8
2400	8	8	8	8	8	8	8
2600	8	8	8	8	8	8	8

The table is labeled '(Percent)' at the bottom. To the right of the table is a 'Governor' section with radio buttons for P-Gain, I-Stability, and D-Derivative, and a 'Fuel' section with radio buttons for P-Gain, I-Stability, S-Tune, O-Tune, and Horsepower Read out. A 'Refresh' button is located below the Governor section. At the bottom of the window, there is a 'Set Speed' button and a status bar showing 'OK Connected'.

6.4.5.1.2.1 System Tuning Window Basics:

- The speed and load axis values can be edited by selecting Set Speed or Set Load buttons on the axis itself in order to adjust the range and resolution of the table.
 - The radio buttons on the side panel allow you to switch between any of the tables. Ensure you save the changes whenever possible to avoid data loss.
 - The refresh button will update the maps real time; this should be done after making any changes to ensure the values have been entered correctly by the controller.
 - The highlighted cell indicates the engines current speed and load value.
 - At any time you can press **Ctrl+B** or select **Options → Back to Main Screen**, or close the window to return to the main window.
 - The stop engine icon can be used to shut down the engine at any time.
1. Open the system tuning window using the information provided previously and select the radio button for the Governor P, I, or D table. Allow the map to update to the current processor settings.
 2. Adjust the speed and load scales by selecting the Set Load or Set Speed buttons and entering the required (linear) values.
 - Ensure the values are linear so that the transition between cells is gradual for smooth engine response.
 - Press Save and Close when complete.
 3. Depending on the table being modified enter the information provided below:
 - Enter the values for P, I and D as determined from the Governor PID tuning guidelines section as a baseline value for all speed and load settings.
 4. Adjust each of the values as needed for P, I, and D across the speed and load range. Use the information provided in the previous section as a guideline.

5. Refresh the map by pressing the Refresh button to assure that all values have been accepted by the controller.
6. Once complete with preliminary tuning, re-check the response from the system to ensure optimal operation and readjust as necessary.

6.4.6 System Info

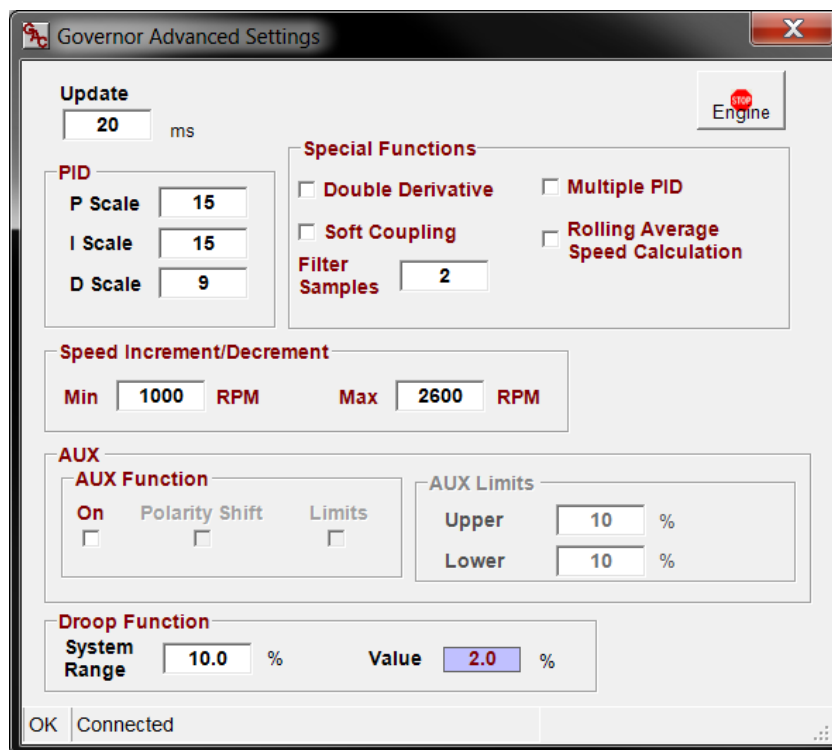
The system info section provides the Build Date and Software Version as read from the controller.

6.4.7 Governor Advanced Settings

This Governor Advanced Settings window is primarily used for the PID adjustments, load sharing / synchronizing, and droop limitation.

On the top menu bar select **Options** → **Governor Advanced Settings** and the window displays similar to the following figure:

TYPICAL GOVERNOR ADVANCED SETTINGS WINDOW



6.4.7.1 PID, Special Functions, and Governor Flags

The PID functionality, special functions, and governor flags are used for advanced engineering and startup purposes.

- **Update:** This changes the rate at which the PID routine is called thus changing the time constant of the overall system.
 - Increasing the time will slightly increase the stability but decrease the response.
 - Decreasing the time will slightly decrease the stability but increase the response.
 - The P, I, D values may need to be retuned when adjusting this parameter.

6.4.7.1.1 PID Scale

The PID Scale will multiply the P, I, and D values respectively by the multiplier entered to increase or decrease PID sensitivity which varies based on engine size and response characteristics.

- **P, I, D:** Set the multiplier values based on the desired engine operational characteristics. This is generally used if the PID values are near the upper or lower limits and require additional adjustment.
 - Note that these scales will only apply while the engine is running.
 - Lower the multipliers for less response and raise them for greater response.
 - A value of 1 (lowest setting) implies that no multiplier is active.
 - When a multiplier is changed the corresponding parameter (Gain, Stability, and Deadtime) will normalize. If the multiplier is decreased by 1, the corresponding value will double in value. Increasing the multiplier halves the corresponding P, I, or D value.
 - I.e., if P scale is changed from 17 to 16, and Gain was 2, Gain will normalize to 4.
 - I.e., if P scale is changed from 10 to 11, and Gain was 16, the Gain will normalize to 8.

6.4.7.1.2 **Special Functions**

The special functions section is intended for engineering purposes and used for advanced diagnostics.

- **Double Derivative:** Enable or disable the double derivative functionality using this checkbox.
 - This feature increases the PID response by doubling the error term to the control loop thus increasing the reaction rate of the governing routine.
- **Multiple PID:** Enable or disable the multi-PID tables (variable map over full engine speed and load range) using this checkbox.
- **Soft Coupling:** Enable or disable a speed filter before the PID routine using this checkbox.
 - This slows down the engine response and improves steady state performance. It works by averaging out any engine noise or slight instabilities and creates a steady speed reference for the PID routine.
- **Filter Samples:** This is the number of samples the control system will filter out prior to starting the governor PID routine while in soft coupling mode.
 - This parameter effectively changes the cutoff frequency for soft coupling as is only available when soft coupling is enabled. Lower numbers filter out higher frequency noise.
- **Overspeed Active High Output:** Enables the active high output for overspeed indication. When this checkbox is not enabled, the output is set to active low.

6.4.7.2 **AUX**

This section applies to the Load Sensing and Synchronization input available on certain GAC products.

- **AUX Function:** This section allows the user to customize and enable the load synchronizing input functionality which requires a 0 – 10 V DC input signal.
 - On: Enables or Disables the load sync input.
 - Polarity Shift: Sets the polarity of the load sync input (increasing vs. decreasing) in voltage.
 - The default selection (or if the option is grayed out) is decreasing which means the lowest engine speed will be at 10 V DC.
 - Limits: Enables or Disables the load sync upper and lower limits.
 - The default selection (or if the option is grayed out) is +/- 10% of commanded engine RPM.
- **AUX Limits:** Here the user can set the upper and lower limits for the percent change in engine speed based on the load sync input. Note that these limits are only available on certain products.
 - Upper: Set the maximum % upper limit.
 - Lower: Set the minimum % lower limit.

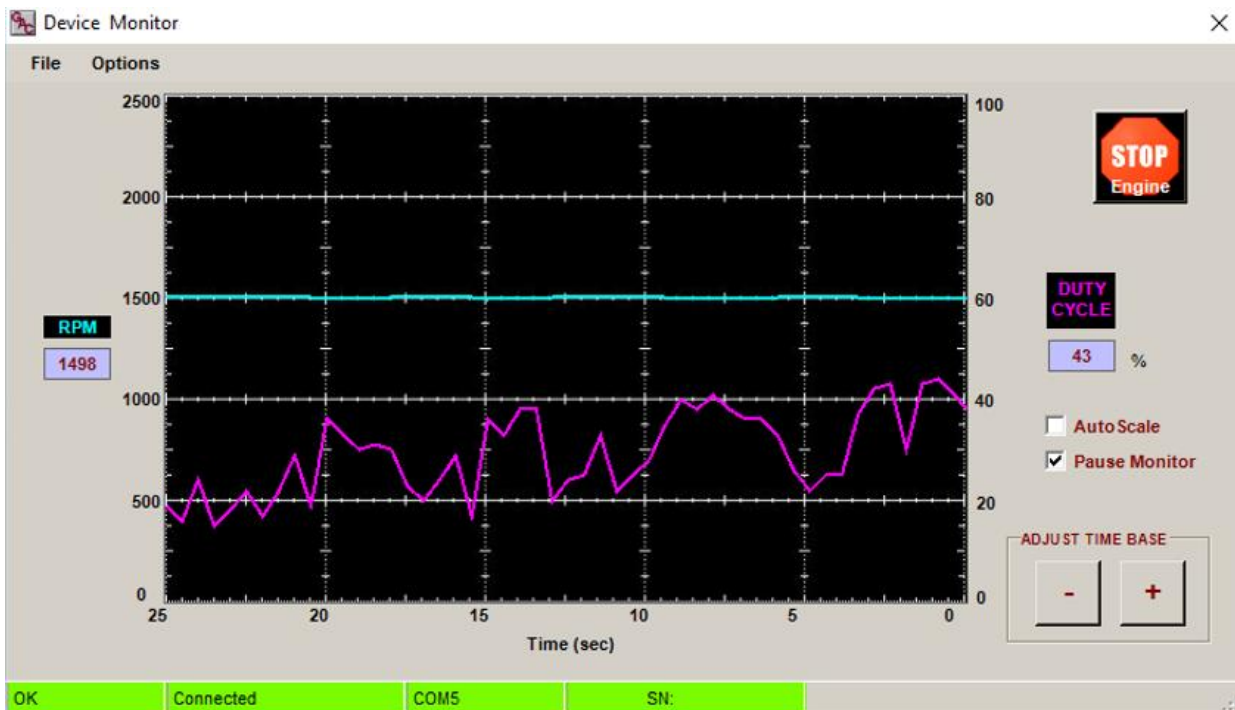
6.4.7.3 Droop Function

- **System Range:** This parameter represents the actuator current level at full load. Set this value to the desired range for droop functionality.
- **Value:** Displays the current commanded droop percentage.

6.4.8 Device Monitor


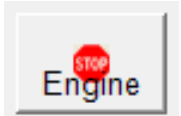
The device monitor is a visual interface which helps you monitor key outputs of the control system. To display the Device Monitor, select **Options → Device Monitor**, from the drop-down menu or press **Ctrl+B**. An example of the device monitor window is shown in the following figure:

TYPICAL DEVICE MONITOR WINDOW



- The speed monitor displays engine speed (rpm) based upon the measured magnetic pickup frequency (Hz).
- The device monitor also features many formatting options for the graphic interface including AutoScale time base adjustment, refresh, and display freezing (stop).
- Make the time scale smaller by pressing the zoom in '+' button and larger by pressing the zoom out '-' button.
- The engine can be stopped at any time by pressing the Stop Engine icon.

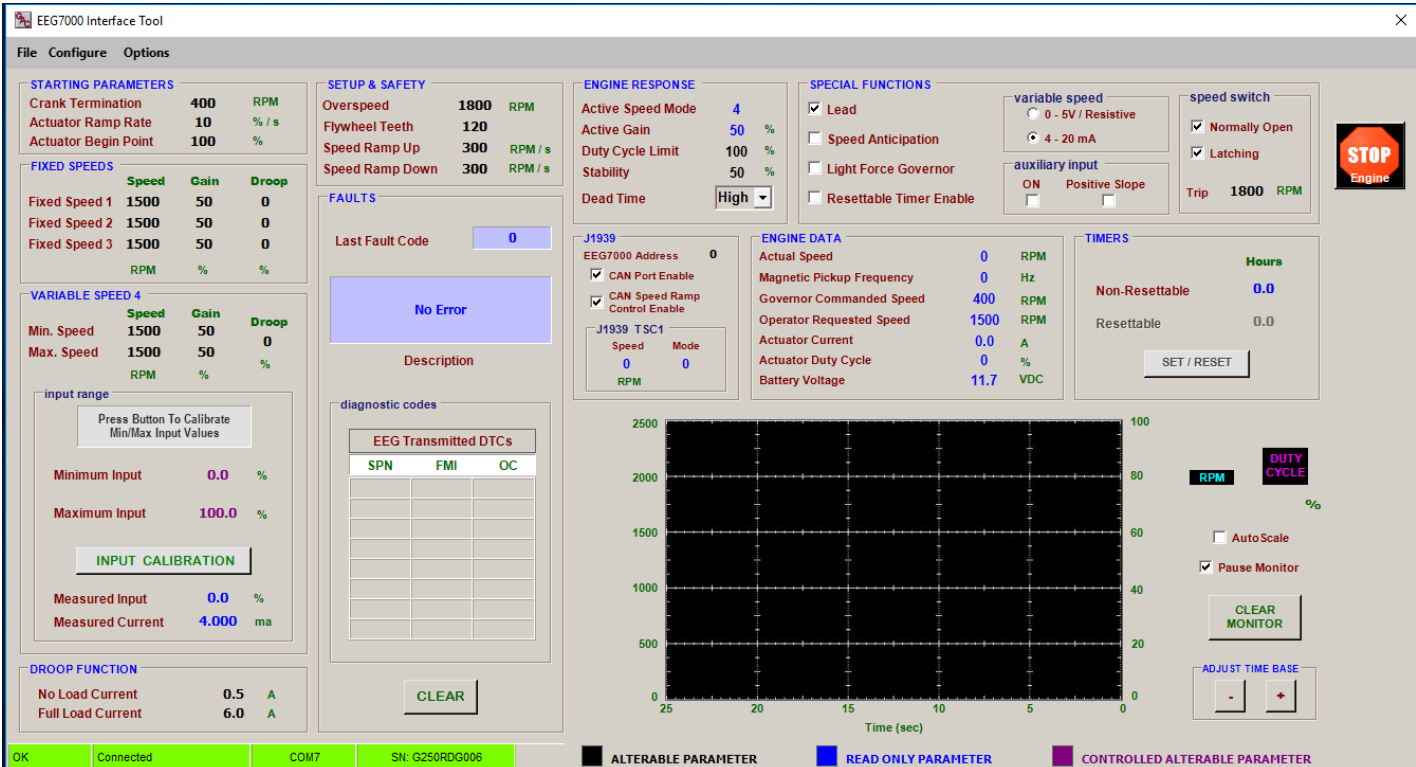
6.5 EEG7000 with SmartVU Interface Tool

	Ensure the fuel supply is disconnected from the engine prior to performing any of the following configuration procedures. The engine can be shut off by pressing the Stop Engine button within the SmartVU interface.	
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NOTE	If you are using the EEG7000 with the GAConfig Tool please see the GAC website for the EEG7000 with GAConfig Tool Installation Manual for details on the software.
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Each of the following sections is contained on the EEG700 Interface Tool main setup window after the product selection is made. A representation of each of the main setup windows is shown following.

TYPICAL EEG7000 MAIN MENU (DEFAULT VALUES SHOWN)



6.5.1 Setup & Safety Parameters

The following parameter values must be set before starting the engine. Values in black text are saved automatically as they are changed. Blue text displays current read-only values and cannot be changed.

SETUP & SAFETY		
Overspeed	1800	RPM
Flywheel Teeth	120	
Speed Ramp Up	300	RPM / s
Speed Ramp Down	300	RPM / s

- On the main window, set the following values for your engine.
 - Overspeed:** Set this value to an engine RPM under the speed where damage may occur.
 - The controllers use this value to de-energize the power relay and close the throttle body as an additional safety measure. This value should be set low enough to prevent mechanical damage but high enough to allow realistic load rejection speeds without stopping the engine. As a starting point this should be set to no more than 25% above rated speed.
 - Flywheel Teeth:** Set this value as the number of teeth on the flywheel.
 - The governor functionality uses this information to calculate engine speed. You cannot edit this parameter when the engine is running.
 - Speed Ramp Up:** This value is adjusted in RPM/sec to restrict the rate of acceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual increase in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value will be set at the maximum value that allows for rapid engine speed response with little or minimal overshoot during engine start and acceleration.
 - Speed Ramp Down:** This value is adjusted in RPM/sec to restrict the rate of deceleration in engine speed.
 - A smaller value of RPM/sec allows for a gradual decrease in response to engine speed demands while a large RPM/sec causes a more abrupt response.
 - Ideally this value is set at the maximum value that allows for rapid engine speed response with little or minimal undershoot, or stumbling, during engine deceleration.

6.5.2 Starting Parameters

STARTING PARAMETERS		
Crank Termination	400	RPM
Actuator Ramp Rate	10	% / s
Actuator Begin Point	100	%

- On the main window, set the following values under the STARTING PARAMETERS section:
 - Crank Termination:** Set the RPM point which tells the control when the engine is in either start/crank or run mode.
 - Once the engine has surpassed the crank termination value the governor will enter closed loop and will transition from start fuel control. The default value is 420 RPM.
 - Actuator Ramp Rate:** Set this value to the rate of change desired in throttle position from the throttle begin point to 100% during the start/crank cycle.
 - 100%/s throttle ramp time is the quickest actuator response up to 100% and 1%/s is the slowest. Start with 50% and modify from there for optimal response.
 - Actuator Begin Point:** Set this value as the starting position of the actuator during the crank cycle.
 - The value of 100% is fully open and 0% is fully closed. The actuator will reach the throttle begin point once the engine begins cranking.

6.5.3 Fixed Speed / Variable Speed Parameters

The speed governing settings are separated between fixed speed and variable speed parameters on the main setup window. Fixed speed setting 3 (Idle Speed), Speed min, and Speed max must be set regardless of variable or fixed speed operation.

6.5.3.1 Fixed Speed Parameters

1. On the main screen FIXED SPEEDS section, set the **Speed (1, 2, 3)**, **Gain (1, 2, 3)** and **Droop (1, 2, 3)**.

FIXED SPEEDS			
	Speed	Gain	Droop
Fixed Speed 1	1500	50	0
Fixed Speed 2	1500	50	0
Fixed Speed 3	1500	50	0
	RPM	%	%

- **Speed:** Set the desired RPM(s) when the fixed speed mode(s) are enabled using the speed select inputs covered in the EEG7000 installation manual.

NOTE: Idle is set with Speed 1 of the speed control settings on the Engine Tuning menu. An additional fixed speed setting can be created using the variable speed setting, when Min Speed and Max Speed are set to the same value. If the idle setpoint is not set correctly or set too close to the crank termination setpoint the engine may not start. This value must be under the requested operating engine speed.

- **Droop:** Set the percent droop (% RPM decrease at full load) required while running at the associated fixed speed setting. Default is 50.
- **Gain:** Set a separate GAIN adjustment for each fixed speed. Default is 0.

6.5.3.2 Variable Speed Parameters

In the VARIABLE SPEED 4 section, both Min Speed and Max Speed settings have a range of 150 to 6000 RPM, the default value is 1500 RPM for both. When Min Speed and Max Speed parameters are set to the same value, with no input on Pin 9, Variable Speed 4 is used as an additional fixed speed setting. If Min Speed setting is higher than the Max Speed, increasing the speed input signal / potentiometer position will decrease RPM.

VARIABLE SPEED 4

	Speed	Gain	Droop
Min. Speed	1500	50	0
Max. Speed	1500	50	0
	RPM	%	%

input range

Press Button To Calibrate Min/Max Input Values

Minimum Input	0.0	%
Maximum Input	100.0	%

INPUT CALIBRATION

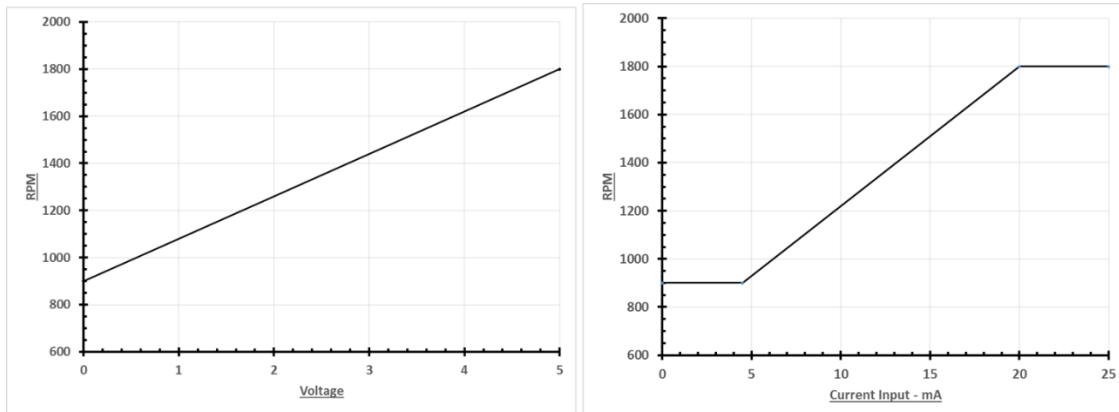
Measured Input	0.0	%
Measured Voltage	0.000	V

variable speed

0 - 5V / Resistive

4 - 20 mA

- **Voltage Input:** (Select 0 – 5 V / Resistive) Voltage to 5.0 V, above 5.0 V DC the variable speed function will be clamped at 100%,RPM response to voltage is linear.
- **Resistive Input:** (Select 0 – 5 V / Resistive) Connect a 5 K potentiometer between Pins 7, 9 and 12 as shown under Variable Speed. Maximum operating voltage is 5.0 V DC, response to this input is linear.
- **Current Input:** (Select 4 - 20 mA) The Min Speed parameter sets the low speed at 4 mA, the Max Speed parameter sets the high speed at 20 mA. If the input current drops below 4 mA, variable speed will be clamped at 0%. If the input current level exceeds 20 mA, variable speed will be clamped at 100%. RPM response to current is linear.



1. Variable Speed, Mode 4, is selected when pins 5 and 6 are open. It is the default Mode when your unit is first powered on.
2. Select the correct variable speed input signal, either 0 - 5V / Resistive or 4 - 20 mA.
3. From Variable Speed 4 click the INPUT CALIBRATION button . The setting sequence will step through each parameter, click Continue after each step.
4. Set Droop with the range: 0.0 to 25%
5. Set Min Speed value with input signal at either 0 volts, 4 mA or with the potentiometer in the full counterclockwise position.
 - Min Speed Gain
 - Min RPM
 - Min Position %
6. Set Max Speed value with input signal at either 5 volts, 20 mA or with the potentiometer in the full clockwise position.
 - Max Speed Gain
 - Max RPM
 - Max Position
7. A window displays confirming the calibration is complete.

6.5.4 Droop Function

After the initial set up is completed and the Flywheel Teeth, Crank Termination Speed and Fixed Speed inputs are set, go to DROOP FUNCTION parameters in the lower left hand corner of the Interface Tool.

DROOP FUNCTION		
No Load Current	0.5	A
Full Load Current	4.0	A

1. Confirm that the LEAD circuit is off. Default position is ON.
2. Set the NLCU (No Load Current) to the measured / displayed current value when operating at no load rated speed (default value is 0.5 amps.)
3. Set the FLCU (Full Load Current) to the measured / displayed current value when operating at full load rated speed (default value is 6.0 amps.)
4. Select and set droop to the desired percentage for each of the three fixed speeds.

The NLCU entered must be less than the FLCU and the difference between the two must be at least 0.5 A. If an invalid combination is entered a warning will be flagged and the values default to 0.5 A and 6.0 A.

6.5.5 Engine Data

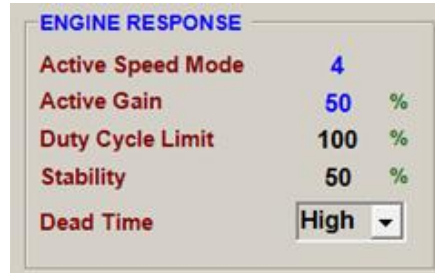
The following read-only information is displayed under the ENGINE DATA section of the SmartVU interface on the main window:

ENGINE DATA		
Actual Speed	0	RPM
Magnetic Pickup Frequency	0	Hz
Governor Commanded Speed	400	RPM
Operator Requested Speed	1500	RPM
Actuator Current	0.0	A
Actuator Duty Cycle	0	%
Battery Voltage	12.1	VDC

- Actual Speed: Displays the calculated engine speed in RPM based on the magnetic speed pickup sensor.
- Governor Commanded Speed:
- Operator Requested Speed: Displays the requested engine speed in RPM.
- Actuator Current: Magnetic Pickup Frequency: Displays the frequency of the Magnetic Speed Pickup sensor in Hz.
- Actuator Duty Cycle: Displays the duty cycle requested to the actuator. This information is identical to actuator position. 0% is fully closed and 100% is fully open. This value does not take into account droop or the load synchronizing input.
- Battery Voltage: Current battery reading in V DC.

6.5.6 Engine Response Parameters

The following engine response parameters are used to fine-tune control of the engine and are contained under the ENGINE RESPONSE PARAMETERS section on the main window.



- Active Speed Mode displays what mode you are in: fixed or variable speed 1, 2, 3, or 4 for PID governor response optimization
- Active Gain: Displays your Gain value
- Duty Cycle Limit: Maximum allowable throttle % the system can command
- Stability : STABILITY is the Integral (I) set point of the PID control
- Dead Time : DEADTIME is the Derivative (D) set point of the PID control

6.5.6.1 PID Tuning Guidelines

1. Increase the Gain (P) parameter until instability develops.
2. Gradually decrease the Gain (P) until stability returns.
3. Decrease the adjustment one count further to ensure stable performance.
4. Increase the Stability (I) parameter until instability develops.
5. Gradually decrease the Stability (I) until stability returns.
6. Decrease the parameter by one count to insure it is stable. If there is no instability leave the value set at 25.
7. Increase the Deadtime (D) compensation parameter until instability develops.
8. Gradually decrease the Deadtime (D) until stability returns.
9. Decrease the parameter by one count to insure it is stable.
10. The Gain, Stability and Deadtime parameter adjustments may require minor changes after engine load is applied.
 - Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to further optimize the adjustments.

6.5.7 J1939

CAN JS1939 bus device communication is supported to receive and display JS1939 messages. See the EEG7000 user manual for details on CAN addresses and information.

6.5.7.1 CAN Address

The CAN ID is 0, and can be configured. Use the Interface Tool to set the J1939 parameters.

1. At the J1939 menu select CAN Port Enable for the Communication mode.
2. Select the CAN Speed Ramp Control Enable.
3. Use the Clear button on the Faults area to clear current faults.

6.5.7.2 CAN Faults

In the unlikely event of a GAC product causing a fault, the numerical fault code and fault code description will be displayed on the main window of the Interface Tool.

If signal is lost to J1939 the EEG7000 reverts to hardwired fixed speed settings (idle).

6.5.8 System Info

The SYSTEM INFO section provides the Build Date and Software Version as read from the controller.

6.5.9 Special Functions

The SPECIAL FUNCTIONS section is intended for engineering purposes and used for advanced diagnostics. The following are available for the EEG.

SPECIAL FUNCTIONS SETTINGS WINDOW

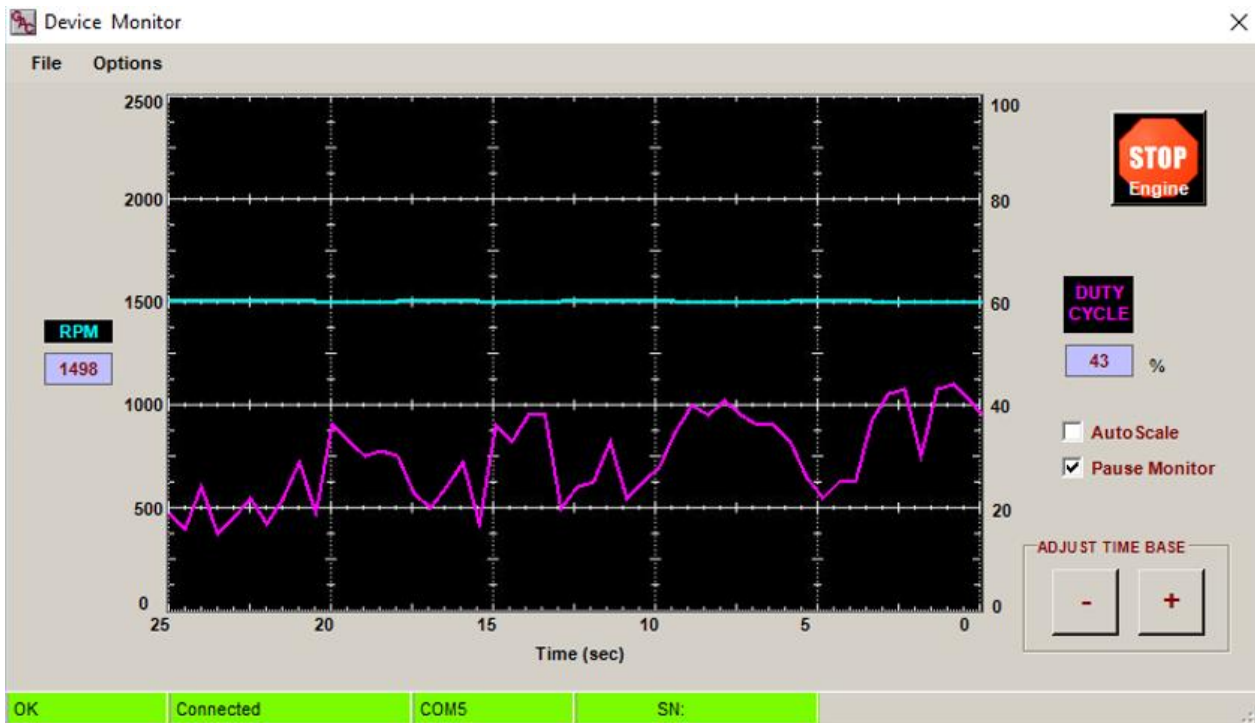
- auxiliary input ON: Enables connections to synchronizing and load sharing equipment. This allows speed adjustments through the auxiliary input voltage, accepting a 1-9 V DC signal, biased at 5 V, and selectable response polarity. In response the EEG can increase or decrease voltage but does not change engine speed. Default Off
- auxiliary input Positive Slope Controls auxiliary / load sharing function On / Off Off speed switch Normally Open NORMALLY OPEN energizes the speed switch output on Pin 8 at the set speed . When the box is not checked (NORMALLY CLOSED) output from Pin 8 will de-energize at the set speed. Default On
- speed switch Latching: When Latching is on the speed switch output state is fixed until power to the unit is cycled. When the box is not checked the output state automatically resets at 0 RPM. Default On
- speed switch Trip: The set speed RPM. Default 1800
- Lead: Improves speed controller responsiveness, typically increasing range of gain adjustment. This function allows for more active control to increase performance in typically slow engines. Default On
- Speed Anticipation: Speed anticipation ON reduces RPM recovery time during high load transients and requires both no load (NLCU) and full load current (FLCU) values are entered. Default Off
- Light Force Governor: Provides finer adjustment resolution for smaller actuators. It is designed to work with low current small actuators, like T1 ATB, ALR/ALN, 100/103/104 series and normally closed Cummins EFC actuators. Select the Light Force Governing block in the PID Tuning block when using small actuators to improve adjustments as they respond very quickly to input changes over a smaller range of operating current, using a fraction of the PID and current output of a normal actuator. Default Off
- Resettable Timer Enable: Service timer used, yes or no. Default Off

6.5.10 Device Monitor

A Device Monitor window is part of the Interface Tool. It optimizes the individual view showing RPM and actuator duty cycle versus time. It has the option of adjusting the Time Base of the 'X' axis and selecting standard or Auto Scaled 'Y' axis.

- Device Monitor can be opened in a separate window from the Options menu.
- Adjust the timing scale for displayed information with the ADJUST TIME BASE + and - buttons.
- Auto Scale and Pause monitor selections are also options.
- Duty Cycle and current RPM are also displayed.

TYPICAL DEVICE MONITOR WINDOW



- The speed monitor displays engine speed (rpm) based upon the measured magnetic pickup frequency (Hz).
- The device monitor also features many formatting options for the graphic interface including AutoScale time base adjustment, refresh, and display freezing (stop).
- Adjust the time scale using the '+' and '-' buttons to increment Time in seconds on Y axis. .
- The actuator (engine) can be stopped at any time by pressing the Stop Engine button.

7 Loading and Saving Configurations

Within SmartVU the user has the ability to save / load each of the tables and settings to or from a file. This allows the user or technician to quickly restore an existing installation or startup a new one once the calibration for the engine has been completed.

The configuration is stored within the module itself; SmartVU merely writes / reads the values to a file so that you do not need to manually enter all of the calibration data individually on subsequent engines.

7.1 To Save a Configuration File

1. On the main window in SmartVU select **File → Save Config To File** from the top menu bar.
2. Choose a directory on your PC to save the file to and name it accordingly.
3. Press the Save button.

7.2 To Load a Configuration File

1. On the main window in SmartVU select **File → Open Config From File** from the top menu bar or press **Ctrl + O**.
2. Locate the configuration file (*.cfg) which matches the engine / application you are working on and press Open.
3. Once complete, verify that the correct values have loaded and that the system is tuned properly.

8 SmartVU Diagnostic Information

8.1 Password Protection

Certain functions require a password interface to enable which include reloading the system default, resetting certain diagnostic timers, and clearing the fault history.

The password entry window is available when trying to perform any of these functions or under the **Options** → **Password** on the top menu bar.

- The password is admin in all lower case letters.

The window will appear similar to that shown in the following figure:

PASSWORD ENTRY WINDOW

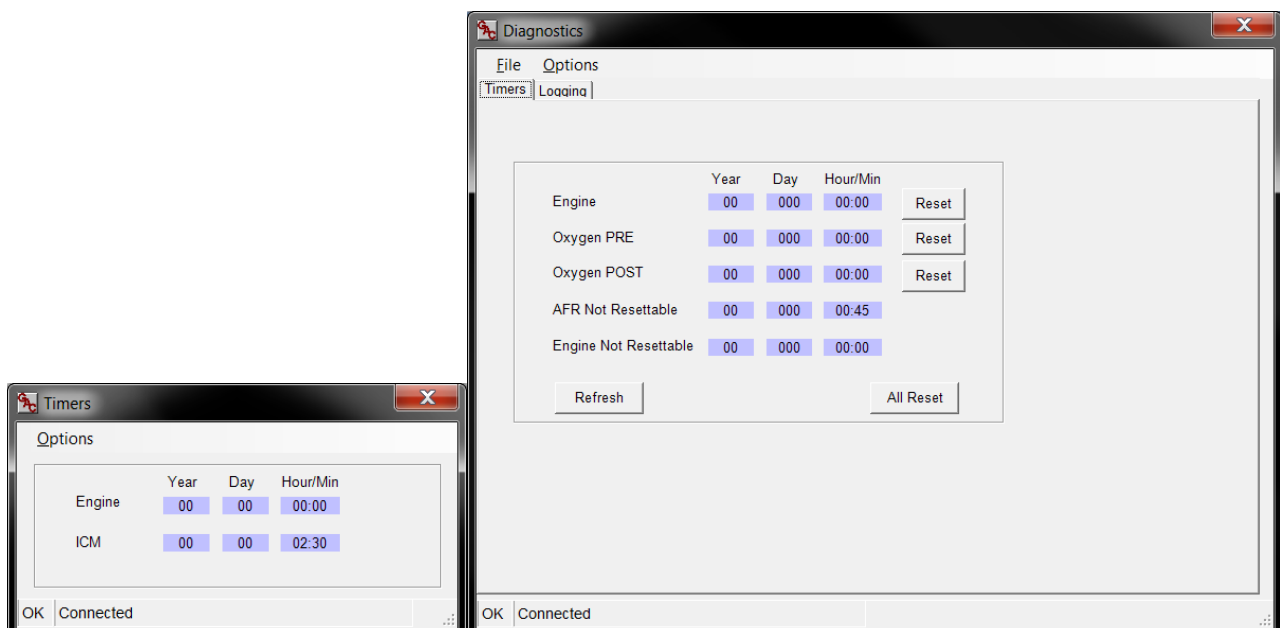


8.2 Timers

Certain GAC controllers feature engine diagnostic timers as well as fault code provisions. To get to this menu select **Options** → **Diagnostics** (or **Timers**) from the top menu bar in SmartVU.

The Timers window logs total run time of the engine and maintenance timers for the applicable sensors. Note that certain controller selections have reset timer capability if a password is entered. Typical representations are shown in the following figures:

TYPICAL DIAGNOSTIC TIMER WINDOWS



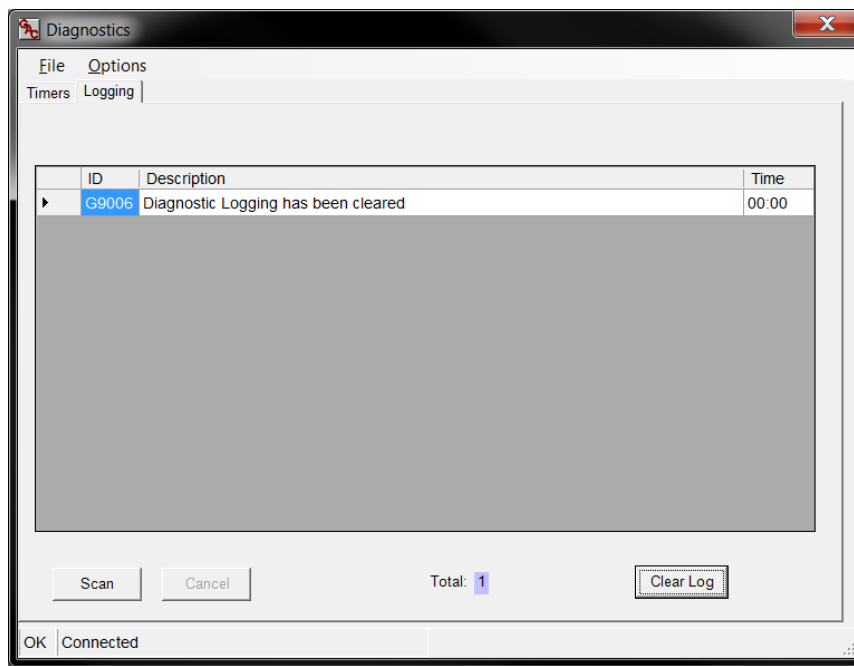
8.3 Diagnostic Troubleshooting Codes

The diagnostic window is a chronological list of accumulated trouble codes (DTCs). Each of the modules communicates malfunctions through this part of the interface with standardized SAE P-codes and governor function G-codes. The P-codes relay engine and sensor malfunctions as well as decreases in performance. These issues may cause poor fuel consumption and excessive emissions output as well as potential engine failure.

See your control units Installation Manual for more on the specific units DTS codes, CAN and available G and P-codes

The G-codes pertain to exceeded safety parameters and general setting changes which log the calibration and run history of the engine and control unit. Codes can be scanned real time while the engine is running. An example of the logging window is shown in the following figure:

EXAMPLE DIAGNOSTIC TROUBLE CODE LOGGING WINDOW



8.4 Reload System Default

The Reload System Default function under **Options → Reload System Default** on the main menu bar is used to restore the ICM to the original confirmation as shipped by the factory (not OEM specific calibration). This reset functionality requires password entry.

8.5 About

The About menu is accessed by going to **Options → About...** on the main menu bar and contains the software version of the SmartVU EC software installed. Press escape to exit this popup window. This information is also available on the splash window when SmartVU EC is starting up.

9 Troubleshooting

More troubleshooting on your specific control unit and involved actuators is available with each product Installation Manual.

Problem	Actions / Possible Solutions
Cannot communicate to the module	<ol style="list-style-type: none"> 1. Verify the correct device was selected in the connection window (AFR, EDG, ICM). 2. Verify correct port number (you may need to check which port a USB to serial adapter is identified to). 3. Verify cable harness to the serial connector. TX and RX may need to be reversed or a null-modem cable may need to be used depending on the controller selected.
Some parameters are missing or not responding on main window	<ol style="list-style-type: none"> 1. Verify the correct device is selected since certain fields are populated based on the device ID.