ENGINE
GOVERNING
SYSTEMS

SmartVU EC
Engine Controls
Configuration Software

PRODUCT USER GUIDE

SmartVU EC

Software Number:

GOVERNORS **A**MERICA **C**ORP.

Version 3.X

Governors America Corp. ©2002-2010
Engine Control Utility

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1 Introduction

SmartVU is GAC's configuration software for the AFR, ICM, and EDG series controllers. It incorporates a simple user interface for initial configuration as well as added functionality for diagnostic and troubleshooting purposes.

Important Note: Subsections that are numbered imply a step-by-step procedure whereas sections which have bullets are intended for user information.

2 SmartVU Software Installation & Communication Hardware

2.1 Download Location

SmartVU is available as a download from the GAC website (www.governors-america.com). It can be found under each of the associated product pages which require the configuration utility. If the latest version is not available on the web contact your GAC representative for the installation files.

2.2 Installation

To install, unzip the downloaded package to a directory and execute **SmartVuECsetup.exe**. Once executed, the installer will guide you through the remainder of the process.

Important Note: If SmartVU has been previously installed on the computer being used, the previous version must be uninstalled using Windows Control Panel.

2.3 Communication Hardware

Typically a DB-9 female connector is included on the harnessing for communication with SmartVU. If there is no connection point available, an adapter harness may also be used.

2.3.1 RS232 Pinout

Refer to the product user guide or product information bulletin to determine the type of cable / interface needed to communicate with the controller being configured.

- For the AFR, ICM, and EDG typically, a standard pass-through (not null modem) DB-9 F/M cable is required.

2.3.2 USB Interface

Most modern computers do not have an RS-232 port. If an RS-232 port is not present on the computer, use of a USB-to-RS-232 converter will be required. GAC recommends GAC part number EAM204. If an alternate USB adapter is to be used there may be interconnect issues and timeouts.

3   Main Screen Setup Checklist

The following checklists categorize the sections and parameters located under the main startup screens for each of the controllers.

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 etc…

3.1   ICM200

✔	Section #	Section	Parameters	Category
☐	5.1.1	Engine Setup Parameters	Overspeed # of Cylinders Timing Wheel Synchronization	Required Required Required Required
☐	5.1.2	Timing Parameters	Offset Angle Timing Angle Fixed Timing Cylinder Trim Global Trim	Required Required Required Optimization Feature
☐	5.1.3	Timing Maps	Map 1 Map 2	Optimization Optimization
☐	5.1.4	Engine Data	Engine Speed Manifold Absolute Pressure MAP Style Average Dwell Time Cylinder Dwell	Read-Only Read-Only Required Read-Only Read-Only
☐	5.1.5	Dynamic Coil Parameters	Coil Current Max Dwell Time	Required Required
☐	5.1.6	System Info	Build Date Software Ver.	Read-Only Read-Only

3.2 AFR2XX

| ✓	Section #	Section	Parameters	Category
☐	5.2.1	Setup and Safety Parameters	Overspeed Teeth Ramp Up Ramp Down	Required Required Optimization Optimization
☐	5.2.2	Starting Parameters	Crank Termination Crank Steps Throttle Ramp Time Throttle Begin Point	Required Required Optimization Required
☐	5.2.3.1	Fixed Speed Parameters	Speed (1, 2, 3) Droop (1, 2, 3)	Required Required
☐	5.2.3.2	Variable Speed Parameters	Droop Speed min Speed max Pot min Pot max	Required Required Required Read-Only Read-Only
☐	5.2.4	Engine Data	Actual Speed Requested Speed Magnetic Pickup Actuator Duty Cycle Horsepower Torque	Read-Only Read-Only Read-Only Read-Only Read-Only Read-Only
☐	5.2.5	Engine Response Parameters	Gain (P), Stability (I), Derivative (D) Dither Fuel Limit Governor System Tuning	Required Feature Feature Optimization
☐	5.2.5.2	Fuel	Gain (P) Stability (I) PTune, ITune	Read-Only Read-Only Optimization
☐	5.2.5.3	Valve	Request Actual Offset STune	Required Read Only Read Only Optimization
☐	5.2.6	Sensors	MAP (Volt, kPa) MAP Style Coolant Temp Oil Press PRE - Oxygen OTune POST - Oxygen	Read-Only Required Read-Only Read-Only Read-Only Optimization Read-Only
☐	5.2.7	System Info	Build Date Software Ver.	Read-Only Read-Only
☐	5.2.8	Governor Advanced Settings	PID Update Rate PID Scale Special Functions Speed Increment / Decrement AUX Droop Function	Required Required Required Feature Feature Feature
☐	5.2.9	Advanced Settings	Fuel Control Settings Sensors	Advanced Feature
☐	5.2.10	Device Monitor	Speed O2 Fuel Valve	Read-Only Read-Only Read-Only

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3.3 EDG6000

✓	Section #	Section	Parameters	Category
☐	5.2.1	Setup and Safety Parameters	Overspeed Teeth Ramp Up Ramp Down	Required Required Optimization Optimization
☐	5.2.2	Starting Parameters	Crank Termination Throttle Ramp Time Throttle Begin Point	Required Optimization Required
☐	5.2.3.1	Fixed Speed Parameters	Speed (1, 2, 3) Droop (1, 2, 3)	Required Required
☐	5.2.3.2	Variable Speed Parameters	Droop Speed min Speed max Pot min Pot max	Required Required Required Read-Only Read-Only
☐	5.2.4	Engine Data	Actual Speed Requested Speed Actuator Duty Cycle Magnetic Pickup	Read-Only Read-Only Read-Only Read-Only
☐	5.2.5	Engine Response Parameters	Gain (P), Stability (I), Derivative (D) Dither Fuel Limit Governor System Tuning	Required Feature Feature Optimization
☐	5.2.7	System Info	Build Date Software Ver.	Read-Only Read-Only
☐	5.2.8	Governor Advanced Settings	PID Update Rate PID Scale Special Functions Speed Increment / Decrement AUX Droop Function	Required Required Required Feature Feature Feature
☐	5.2.10	Device Monitor	Speed	Read-Only

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4   Starting SmartVU EC and Connecting to a Device

1. Open SmartVU EC by double-clicking on the desktop icon or by navigating to *All Programs* → *Governors America Corp* → *SmartVUEC* → *SmartVU EC* under the Windows Start Menu.

2. If this is <u>not</u> the first time running SmartVU; go to *Configure* → *Setup Connection* on the top menu bar.

SmartVU Product Selection Page
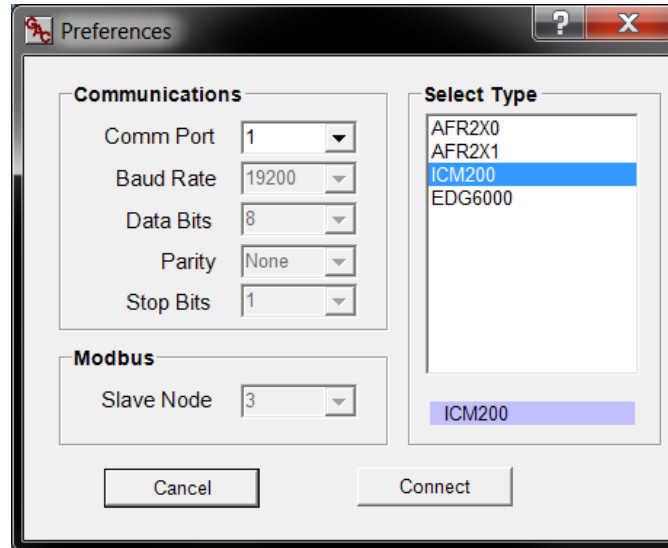
3. Select the device model that matches the device you are trying to configure in the Select Type Window.

4. Set the Comm Port to the port that the serial cable (or USB adapter) is identified as.

⚠️ **WARNING**

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.

---
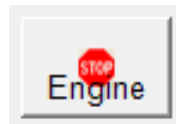
5. Turn ON the ignition / battery switch to provide power to the controller.

6. Press the OK button and the main setup screen will appear for the product you selected.

7. Proceed to the next section within this manual for first time startup instructions or refer to the appropriate section in the table of contents otherwise.

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5   Configuration & Calibration Procedures

5.1   ICM Main Setup Screen

⚠ **WARNING**

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.

[Stop Engine button]
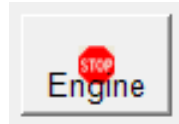
Each of the following sections is contained under the main setup screen after the product selection is made. A representation of the main setup screen is shown below:

Typical ICM Main Setup Screen (Default Values Shown)

The instructions below are meant to provide a quick reference guide as to what is required to configure and calibrate an ICM once installed.

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5.1.1   Engine Setup Parameters

Editing Procedure:

1. On the main screen, set **Overspeed** and **# of Cylinders** under the "Engine Setup Parameters" section:

    • 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.

    • # 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.

2. On the main screen, set the **Timing Wheel** parameters under the "Engine Setup Parameters" section:

    • Timing Wheel: Set this value to CAM or CRANK depending on whether the trigger wheel is mounted to the camshaft or the crankshaft.

    • # 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.

3. On the main screen, set the **Synchronization** parameters under the "Engine Setup Parameters" section:

    • # 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.

    • Extra / Missing: Select the appropriate button for either extra or missing teeth.

        • For example, a 24-1 trigger wheel will use "Missing".

    • 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.

4. Cycle the power to the ICM.

    • This is required to store the changes which will not take effect until the ICM has been power cycled.

5.1.2   Timing Parameters

This section on the display is specific to the 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 the section labeled "Timing Maps".

Editing Procedure:

1. Enable the Fixed Timing option by pressing the appropriate checkbox.

2. Ensure the Global Trim enable option is unchecked.

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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 ±3°, 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 Product User Guide.

9. Once the engine is at rated speed, verify proper ignition timing angle is within ±1° and adjust accordingly.

5.1.2.1 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.

Editing Procedure:

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 will also blink to indicate the offset in-field. The following table details the LED indication for the timing trim functionality.

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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 ¾ 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 ¾ of a second on then off. The angle is repeated every 10 seconds.

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

5.1.2.2 Individual Cylinder Timing Trim

In some cases the individual cylinders may need a small timing offset to account for mechanical variations in the engine design, triggering arrangement, or other factors which result in firing inconsistencies. 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.

Editing Procedure:

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 will appear:

Cylinder Trim Window
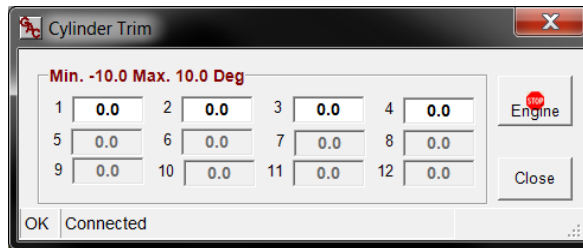
2. Adjust the angles as necessary and check the individual coil timing angles with a timing light until the desired result is attained.

3. Close the window once complete using the 'X' button in the upper right hand corner.

5.1.3 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.

Editing Procedure:

1. Ensure the Fixed Timing box is NOT checked under the Timing Parameters section.

2. Locate the Map 1 and 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*. The screen will appear similar to that shown following:

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Timing Maps – System Tuning
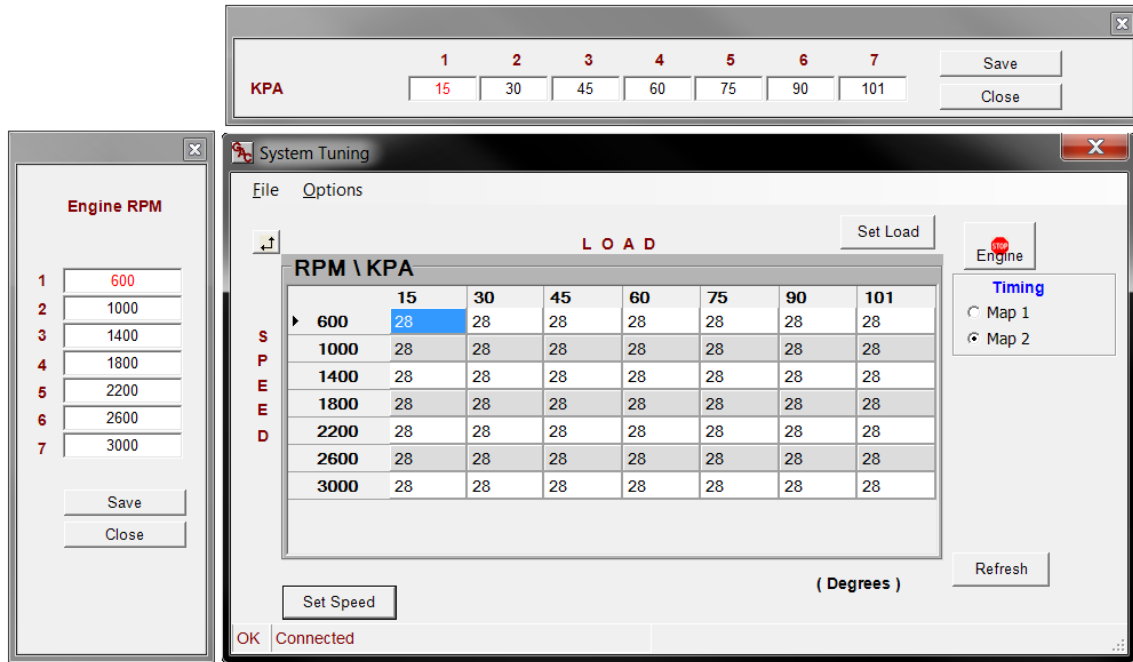
3. Adjust the speed and load scales by selecting the "Set Load" or "Set Speed" buttons and entering the required values.

   • 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 that 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 screen, 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.

5.1.4 Engine Data

The "Engine Data" section of the main screen 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. Pressure: 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 Style:* 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.

- Average Dwell Time: is calculated by the ICM by averaging all of the cylinders for the most recent, complete, combustion cycle. The average dwell time is measured in milliseconds.

  - *Cyl. Dwell:* 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 appear similar to that shown in the following figure:

Individual Cylinder Dwell Times
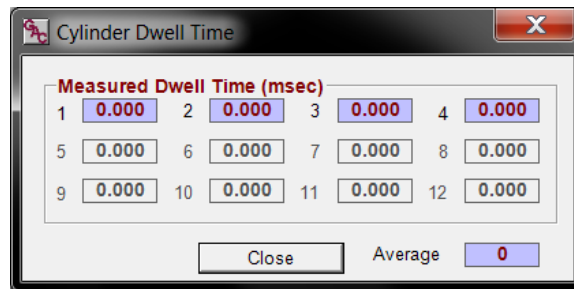
5.1.5 Dynamic Coil Parameters

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.

Editing Procedure:

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 Amps.

   - 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 in msec that is above each of these individual dwell times but not more than 25% more in 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.

5.1.6   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.

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5.2 AFR2XX & EDG6000 Main Setup Screens

⚠️ **WARNING**

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.
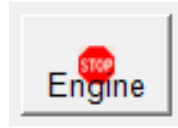
Each of the following sections is contained under the main setup screen after the product selection is made. A representation of each of the main setup screens is shown following:

Typical AFR Main Setup Screen (Default Values Shown)

Typical EDG6000 Main Setup Screen (Default Values Shown)
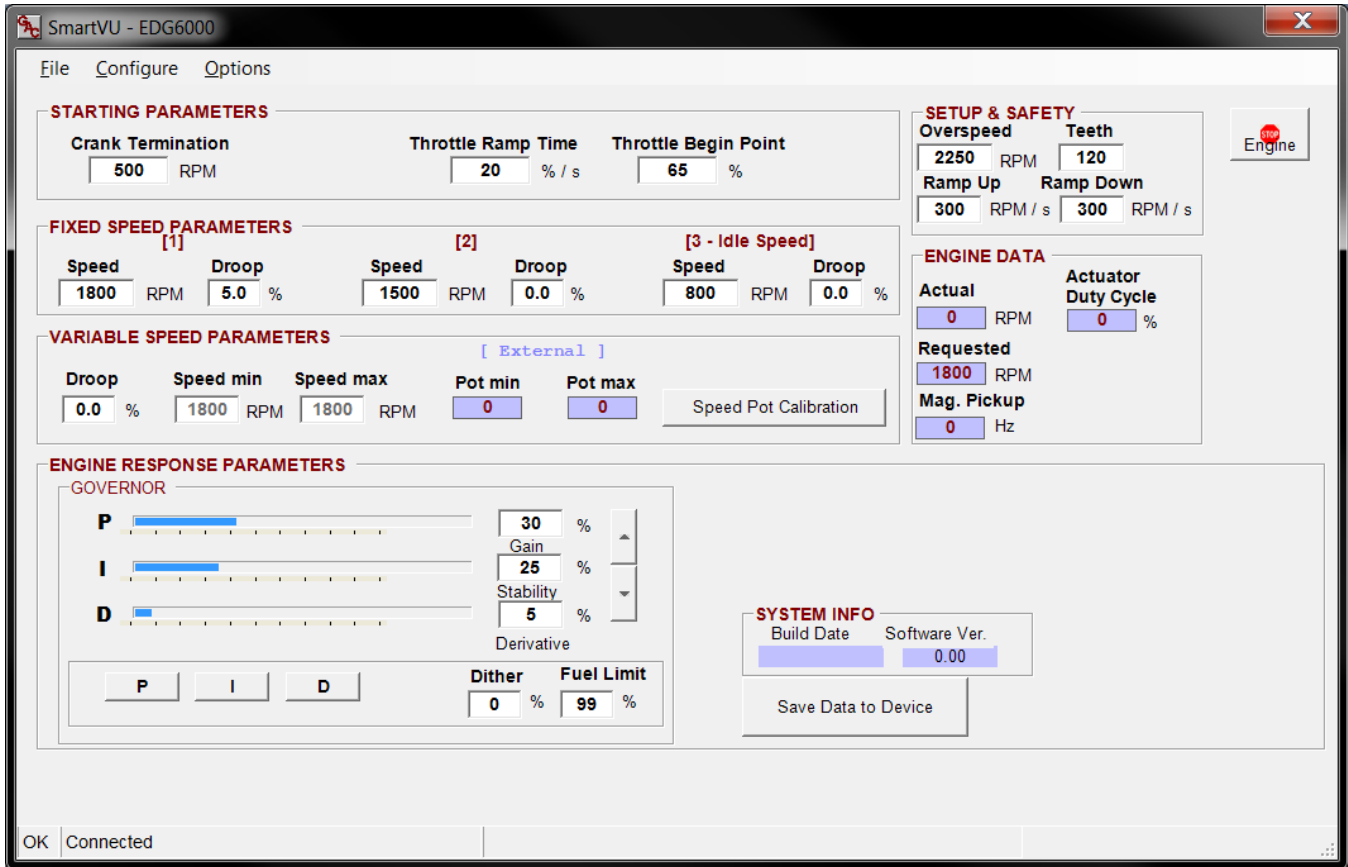
IMPORTANT NOTE

For the AFR and 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.

Save Data to Device

5.2.1 Setup & Safety Parameters

Editing Procedure:

1. On the main screen, 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.

2. On the main screen, set the **Ramp Up** and **Ramp Down** parameters located under the "Setup & Safety Parameters" section (note that these parameters may need to be revisited after the engine is started for proper tuning):

   - 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.

5.2.2 Starting Parameters

Editing Procedure:

1. On the main screen, 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.

2. On the main screen, set the **Throttle Ramp Time** and **Throttle Begin Point** parameters under the "Starting Parameters" section (note that these parameters may need to be revisited after the engine is started for proper tuning):

- 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.

5.2.3 Fixed Speed Parameters / Variable Speed Parameters

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

Editing Procedure:

5.2.3.1 Fixed Speed Parameters

1. On the main screen, 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 the AFR or EDG Product User Guides.

  - *Important 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 <u>must</u> 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.

5.2.3.2 Variable Speed Parameters

1. On the main screen, 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.

  - *Important 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.

    - *Important 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.

5.2.4 Engine Data

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

- 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.

- Horsepower *(AFR Only)*: Displays the estimated horsepower value at the current engine speed and load based upon the user definable torque map. This is not a dynamometer function and requires tuning and data logging for accurate power representation.

- Torque *(AFR Only)*: Displays the estimated torque value based at the current engine speed and load based upon the user definable torque map.

5.2.5 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 screen. Note that certain product selections will only have a subset of the following items.

5.2.5.1 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.

5.2.5.1.1 Governor PID Tuning Guidelines

Editing 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.

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5.2.5.1.2 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 Representation
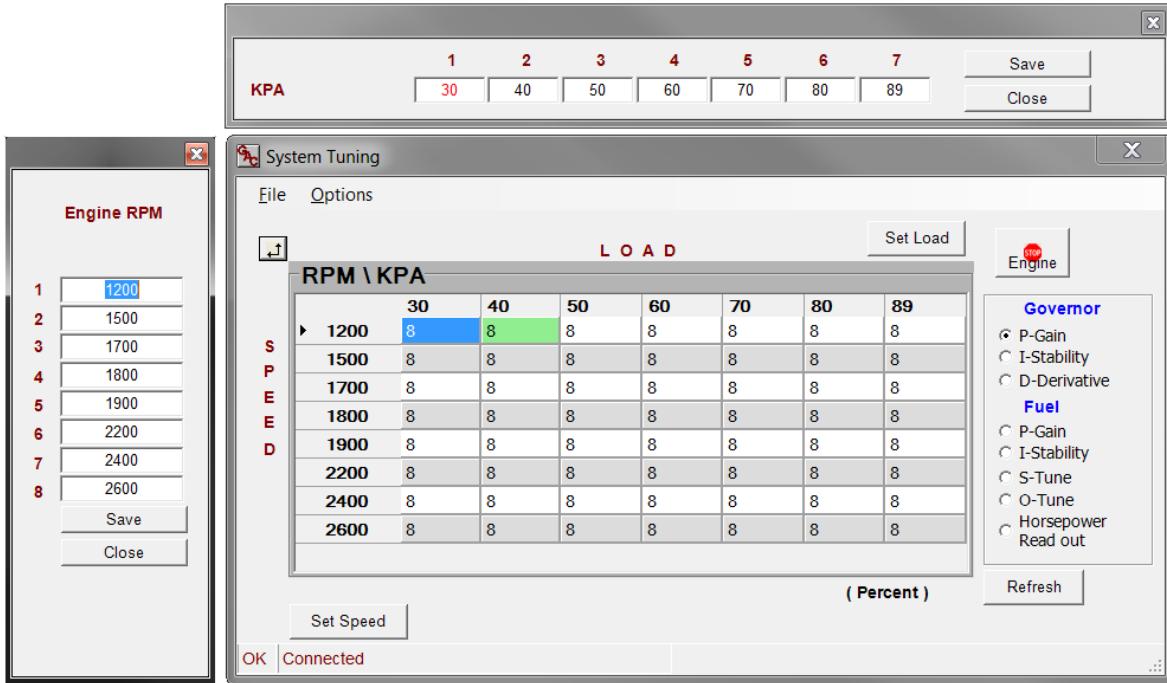
System Tuning Window Basics:

- 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 screen.

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

Editing Procedure:

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.

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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.

5.2.5.2 Fuel *(AFR Only)*

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, ITune: The fuel gain and stability can be adjusted over the engine speed and load range. This procedure is covered in the following section.

5.2.5.2.1 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 screen.

*Note that this window has the same features and similar appearance to that discussed in the Governor System Tuning → System Tuning Window Basics section.

Editing Procedure:

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.

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- 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. 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.

5.2.5.3 Valve *(AFR Only)*

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

- Requested (Req.): This 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 Position (Actual): This 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.

5.2.5.3.1 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 you can select the STune buttons on the main screen.

*Note that this window has the same features and similar appearance to that discussed in the Governor System Tuning → System Tuning Window Basics section.

Editing Procedure:

1. Go to Options → Advanced Settings in the menu bar to enter the "Advanced Settings" window (detailed later in the document).

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. Refresh the map by pressing the Refresh button to assure that all values have been accepted by 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 that 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).

5.2.5.3.2 Horsepower Read Out

The horsepower readout 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.

*   *Important 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.

Editing Procedure:

1. Open the system tuning window using the information provided previously and select the radio button for Horsepower Read Out 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. 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.

5.2.6   Sensors *(AFR Only)*

On the bottom of the main setup screen 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).

    - *Important Note:* This value is irequired to set when editing any of the System Tuning tables covered in following sections to correctly scale the load (kPa) values.

- Coolant Temp: This parameter 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 screen when a controller variety with the post-catalytic O2 sensor enabled is selected.

        - A voltage closer to 999mV would indicate a rich fuel mixture, where a value closer to 001mV would indicate a lean fuel mixture.

            - There is an indication of the state; Lean, Rich, Stoic of the mixture as well.

5.2.6.1 Oxygen Sensor System Tuning (OTune)

The oxygen sensor request 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 **Request** or press **F8.** Alternatively you can select the OTune buttons on the main screen in the Sensors section.

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

Editing Procedure:

1. To enter the "Advanced Settings" window (detailed later in the document) go to **Options → Advanced Settings** in the top menu bar.

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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 and Close 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. Under the Configuration drop down menu on the menu bar select "Save Data to Device".

    • Allow some time for the map to be flashed to the device memory. This can also be done on the main screen 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 screen.

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 screen 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 400mV.

    • These are the maximum and minimum values that should be used when editing this table where the majority of the values are set to 500mV.

12. Once complete with preliminary tuning, 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.

5.2.7   System Info

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

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5.2.8 Governor Advanced Settings

The next section covers the details behind the Governor Advanced Settings window which 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 will appear similar to that shown in the following figure:

Typical Governor Advanced Settings Window
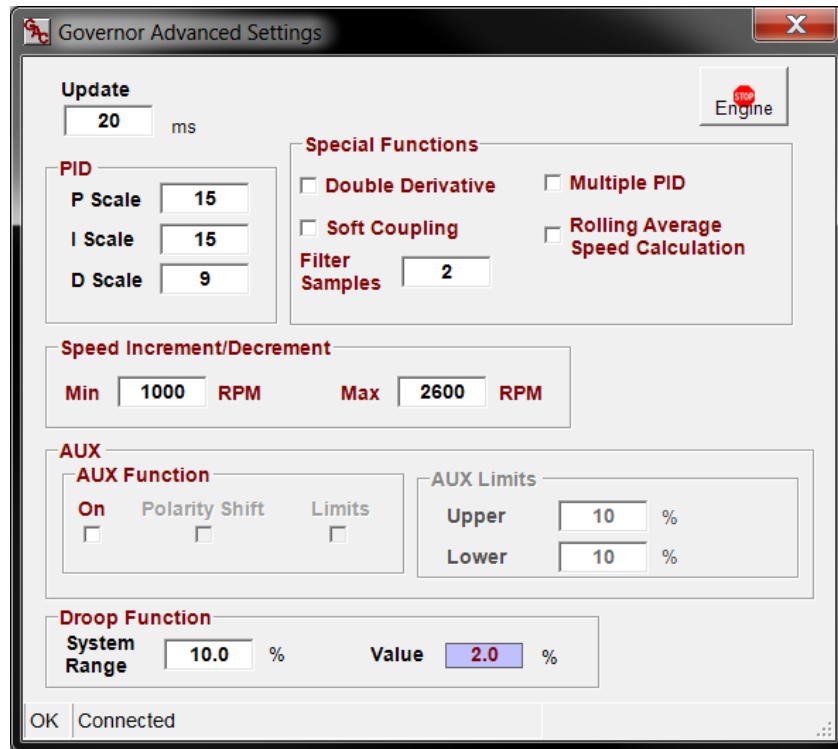
5.2.8.1 PID, Special Functions, and Governor Flags

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.

5.2.8.1.1 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.

5.2.8.1.2 Special Functions

The special functions section is intended for engineering purposes and used for advanced diagnostics. Note that not all of the functions shown below are available with both the AFR and the EDG.

- 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 (*EDG Only*): Enables the active high output for overspeed indication. When this checkbox is not enabled, the output is set to active low.

- Rolling Average Speed Calculation (*AFR Only*): 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.

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

5.2.8.2 Speed Increment / Decrement *(AFR Only)*

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.

5.2.8.3 AUX

This section applies to the Load Sensing and Synchronization input available on certain GAC products. Note that all of the AUX features are not available on all products.

- AUX Function: This section allows the user to customize and enable the load synchronizing input functionality which requires a 0 – 10V input signal.

  - On: Enables or Disables the load sync input.

  - Polarity Shift (EDG Only): 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 10V.

  - Limits *(EDG Only)*: 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 *(EDG Only)*: 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.

### 5.2.8.4 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.

5.2.9 Advanced Settings *(AFR Only)*

The next section covers the details behind 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 will appear similar to that shown in the following figure:

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Typical Advanced Settings Window
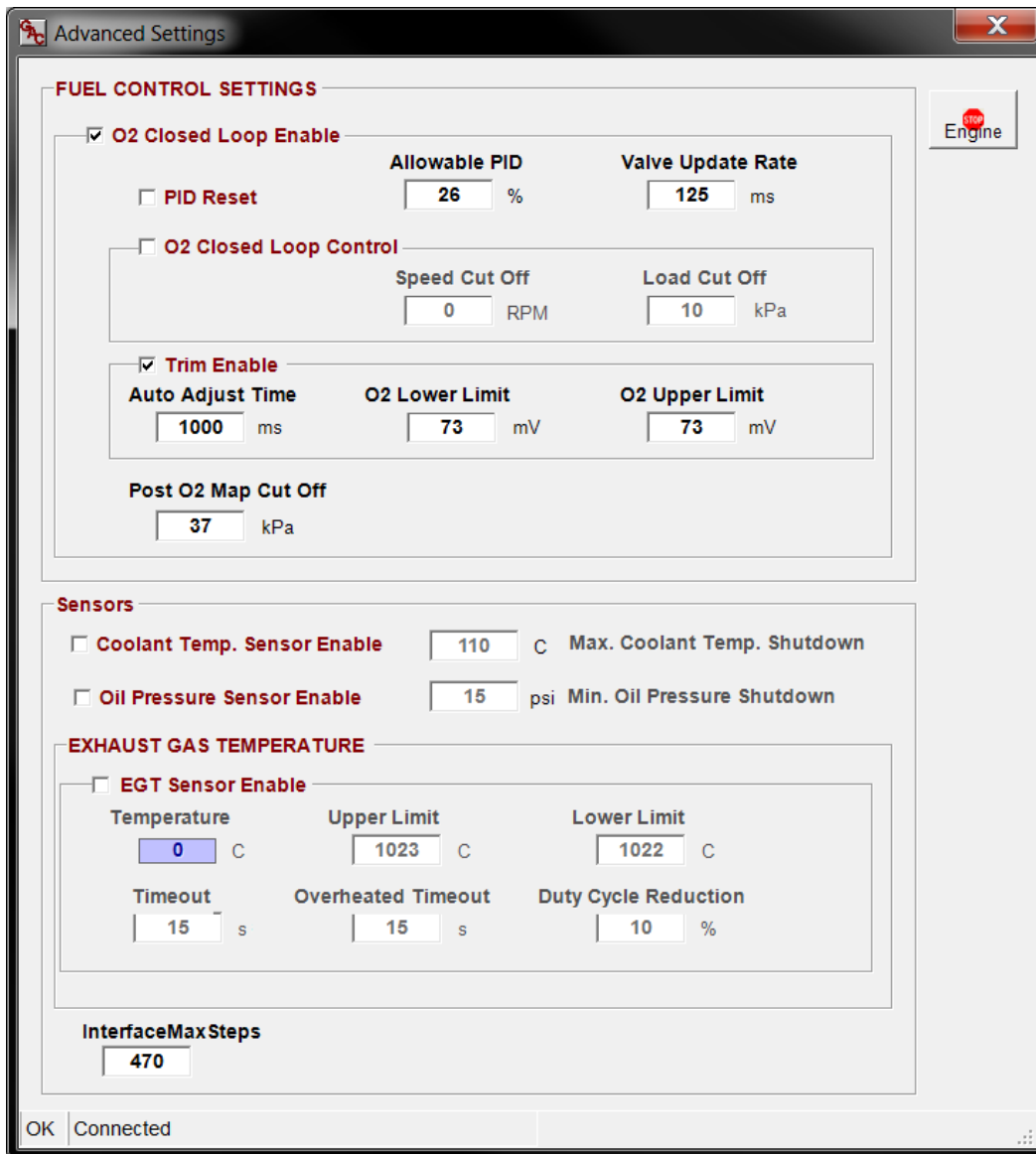
5.2.9.1 Fuel Control Settings

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.

5.2.9.2 Sensors

The sensors section of the screen 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.

5.2.9.2.1 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.

5.2.10 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 screen is shown in the following figure (AFR shown, EDG will only have the speed section)**:**

Typical Device Monitor Screen
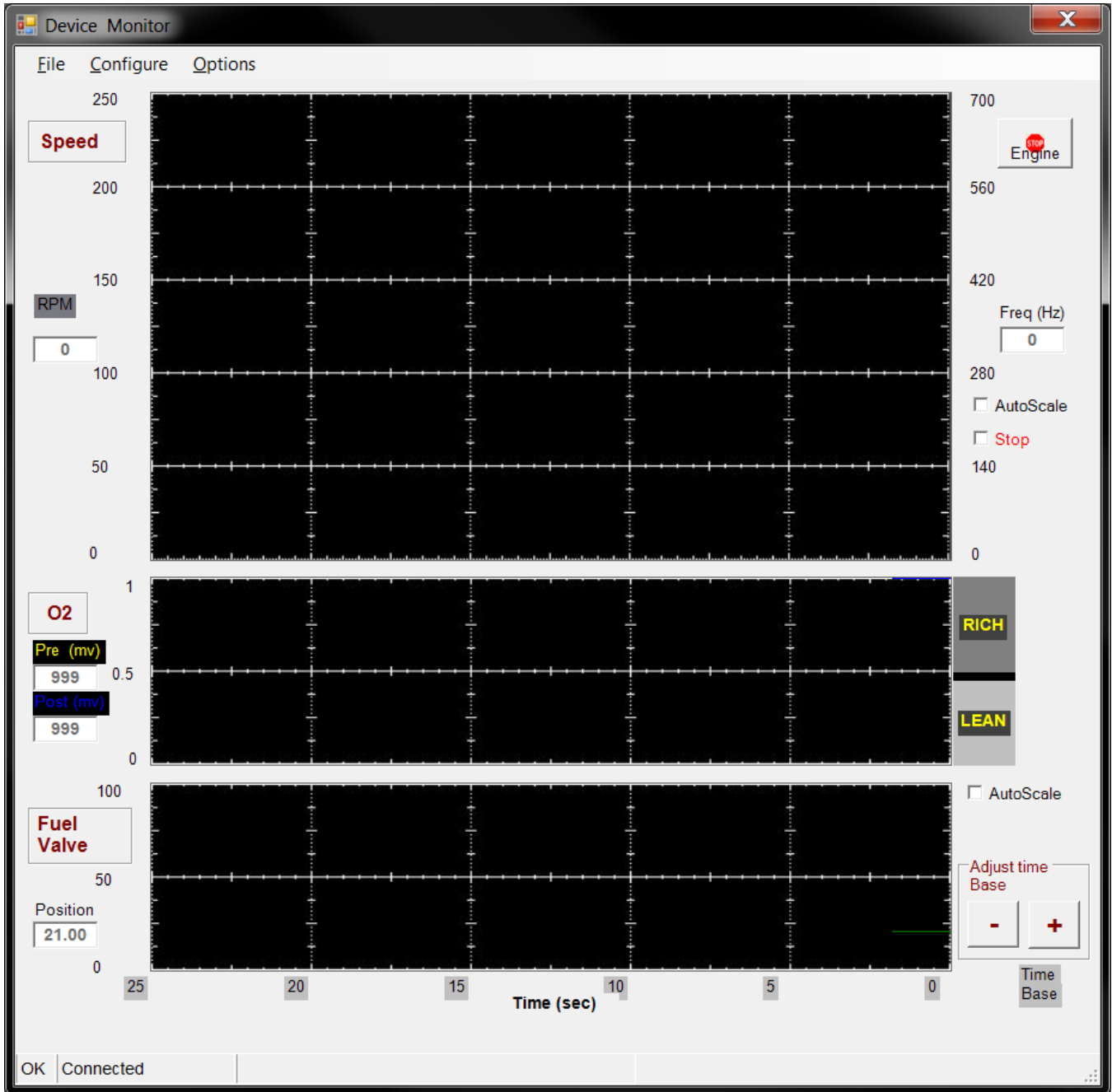
- The speed monitor displays engine speed (rpm) based upon the measured magnetic pickup frequency (Hz).

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- 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.

AFR Only:

- 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   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.

6.1   To Save a Configuration File

1. On the main screen 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.

6.2   To Load a Configuration File

1. On the main screen 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.

7   SmartVU Diagnostic Information

7.1   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 screen 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
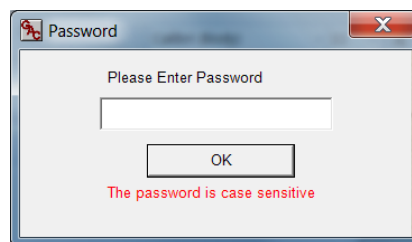
7.2   Timers

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 Screens
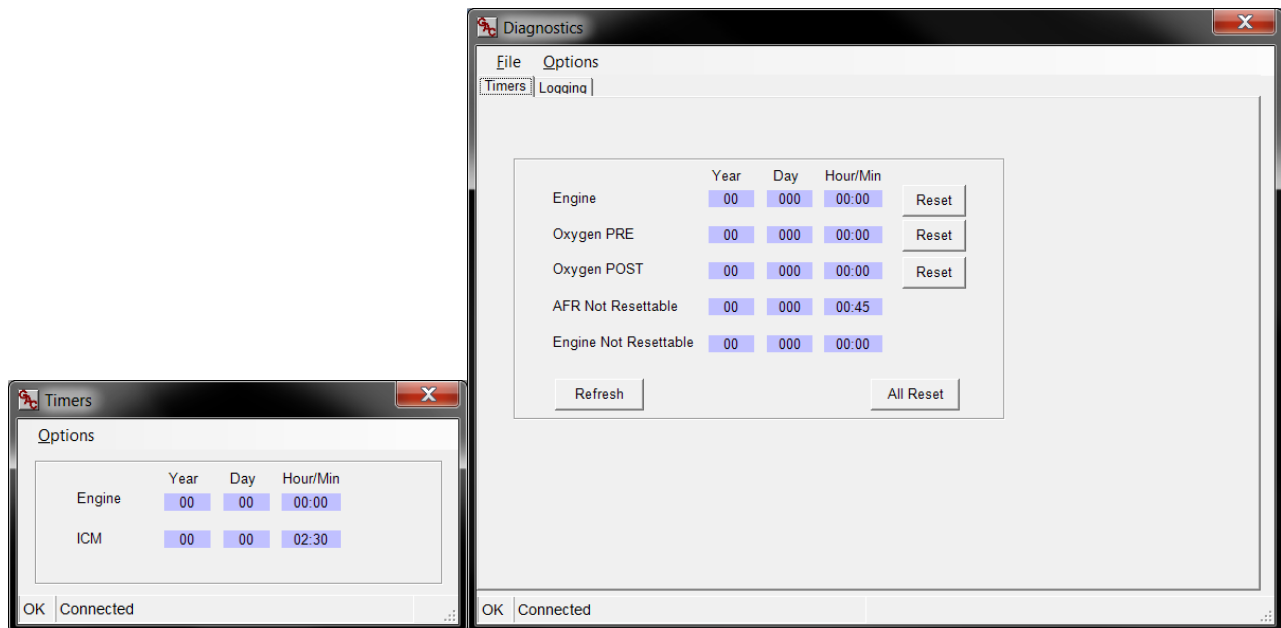
7.3 Diagnostic Troubleshooting Codes

The diagnostic window is a chronological list of accumulated trouble codes. 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.

- For a list of the G and P-codes available refer to the Product User Guides for the ICM, AFR, or EDG.

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 screen is shown in the following figure**:**

Example Diagnostic Trouble Code Logging Screen
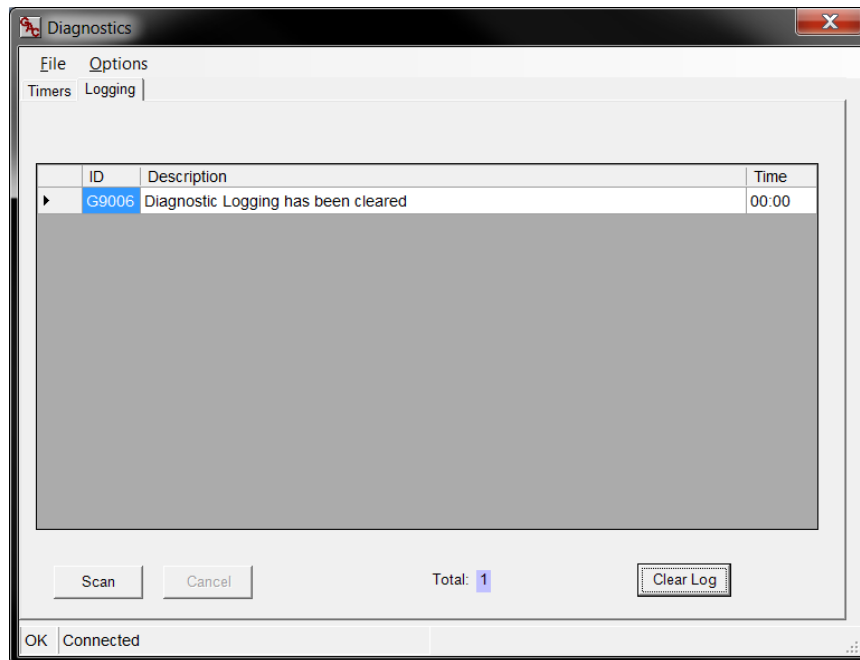
7.4 Reload System Default

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.

7.5 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 screen when SmartVU EC is starting up.

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8   Troubleshooting

Problem	Actions / Possible Solutions
Cannot communicate to the module	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 screen	1. Verify the correct device is selected since certain fields are populated based on the device ID.

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