# ECU32 SOFTWARE OPERATING MANUAL
# FOR FC1000 FUEL CONTROL UNITS

**TECHNICAL TERMS GLOSSARY:**

**Open Loop**: Using an engine controller **without** the use of a feedback device such as an EGO sensor. This mode of operation is typically used in non-emissions applications, or used during the tuning for the controller to maximize its open loop calibration accuracy.

**Closed Loop**: Using an engine controller **with** the use of a feedback device such as an EGO sensor. This mode of operation is typically best for emissions and for best fuel economy, but often not used for making peak engine power.

**EGO:** Sometime known as "O2" sensor, this sensor is used to determine the current lean/rich state of the engine, and used as an element in closed loop operation.

**TPS:** The throttle position sensor, actually an electronic potentiometer connected to the throttle shaft. Often used for fast throttle response and for idle mixture stabilization.

**CLT:** Sensor used to measure the coolant temperature. Actually a NTC thermister.

MAT: Sensor used to measure the manifold air temperature. Actually a NTC thermister.

**AUX:** Auxiliary voltage input. Used as a general purpose mapping input where anything that can output a voltage can effectively alter the controller behavior.

**Controller:** Also ECU or Engine Control Unit. Electronic device that takes sensory input, and in turn controls the engine operation.

**Mapping:** The process of setting gain parameters across a wide operating range in the engine controller, that results in a favorable operation of both engine and controller.

**Gain:** Arbitrary unit of measure to describe a scaler or linear increase in output as a function of a given input. The mapping operations and maps are made up of matrices of gain cells, which are changed to promote proper engine operation.

**ECU**: Engine Control Unit, also Controller. Electronic device that takes sensory input, and in turn controls the engine operation.

**Pulse Width:** The length in time (typically milliseconds) that an injector is driven for in relation to the current needs of the engine.

**Duty Cycle:** The ratio of time that an injector is on or opened in relation to the time it is off. It is never desirable to run fuel injectors to duty cycles beyond 90%, or the injectors may overheat, or the engine will suffer a lean-out condition, and suffer serious engine damage. Always size your fuel injectors so that the provide between 120% and 150% the amount of fuel horsepower needed by your engine.

**GETTING STARTED**

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**HARDWARE INSTALATION**

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**PC REQUIREMENTS**

The ECU system programming software [ECU.EXE] has the following Hardware/Software Requirements in order to operate correctly:

A) IBM PC Compatible using a Pentium 90mhz processor or better.

B) A 32 bit Operating system, [WINDOW 95 OSR 2.0 or greater, WINDOWS 98, NT v3.51+].

note:       Windows 95 Revision 4.00.00A may require some additional files to operate correctly, please contact technical support for more details.

C) At least 4MB of CPU RAM.

D) At Least 4MB available Hard Disk storage.

E) 9 pin serial [RS 232] port.

F) 16550 or compatible UART [one that has at least 16 bytes FIFO memory].

G) 640 X 480 VGA graphics mode [800 x 600 256 color preferred].

**SOFTWARE INSTALATION**

Be certain that the your computer has booted properly is running as normal, and no previously encountered problems exist.  Using the two 3 1/2 floppy disks that were provided with the system, locate disk 1 and install it into your computers floppy drive.

Execute the Start icon in the lower left-hand corner of your computer screen.

Click on the "Run" icon from the Start menu.
Type "A:\INSTALL.EXE" in the text box labeled Open.
Click OK.

Follow the Installation programs instructions carefully.  Installation usually takes less than 3 minutes.

**RUNNING THE SOFTWARE**

Execute the Start icon in the lower left-hand corner of your computer screen.
Click on the "Programs" icon from the Start menu.
Find the name of the program package [ECU 32 is the default], and click the ECU icon.
The program should run without any errors, if not, contact technical support.

**ECU SYSTEM CONSOLE**

The first thing that you should see after running the ECU32 program is the ECU system console.



The ECU System console allows the user to traverse quickly between different functional screens, so that the system can be monitored and programmed as quickly and efficiently as possible. Since laptop computers typically have poor visibility and poor mouse control, it is advised to use menu commands instead of buttons, although the functions are identical. No communications takes place whine the ECU System Console is visible, so it is possible to leave the computer in this mode while the ECU engine controller is not powered/OFF.

The ECU System Console is provided to ALL users, who have purchased the ECUXXXX Engine controller but all programming features require a purchased license to operate.

**SETTING COMMUNICATIONS PORT**

The programming software "ECU.EXE" communicates with the engine controller through a medium speed RS-232 link between your computer and the engine controller. In order to communicate, the engine controller must be properly installed/wired, and power must be provided to the engine controller. Power is usually provided by turning the ignition switch ON. When the engine controller power is turned off, or falls below 5.7 VDC, communications will halt, as will engine control.

The Programming software needs to know which communications "COMM" port that it must use to communicate with the engine controller. The default is COMM 1, as this is typically the available port on most laptop computer systems. If COMM 1 is not available, another COMM port must be selected. If another COMM port is selected, you must totally exit the ECU32 program before the selection can be used.

**REAL TIME MONITOR:**

This feature is ideal for monitoring the data channels on the engine controller, to look for sensor failure, or to monitor performance. All internal sensors can be monitored from this screen.

**DASHBOARD:**

This feature is a graphical representation of many of the sensor based inputs to the engine controller. It is a great way to get a relative feel for the sensory information instead of plain numerical information.

**CONFIGURATION:**

This feature is used to setup the basics of engine control. This feature effects the heart of the engine controller, and most other programming screens are dependant upon data that is entered in the Configuration screen, to be correct and appropriate.

**BASIC MAPPING:**

This feature allows the engines specific operation to be characterized so that the engine operates as needed across the entire engine map. It incorporates a 32x8 3 dimensional table that allows the user to compensate for engine volumetric efficiency as well as other issues that make simple non-mapped systems inappropriate for many engine applications. This interface allows for subtle changes to be put into a specific engine setup to allow for minor to major engine modifications, while still giving great drivability and performance. A "Crosshair" graphical device is provided to show the user where the controlled engine is currently operating, thus making the mapping operation easier.

**ADDITIONAL MAPPING:**

This feature is used to setup a series of sensor based fuel enrichment maps, as well as setting up the closed loop setpoint map. A "Crosshair" graphical device is provided for each of the map entries for this feature, to make programming the maps a simple operation.

**SUPPLIMENTAL DRIVER MAPPING:**

This feature is provided to setup the optional Supplemental Driver Output. A "Crosshair" graphical device is provided for the map to make programming a simple operation.

**DATA PLOTTER:**

This feature allows the sensor data to be plotted on a digital chart recorder. Individual sensor channels can be turned off and on, the plotter interval time can be changed, and plotted data can be logged into a file that can be imported into any spreadsheet package.

**ABOUT ECU:**

This feature allows a quick verification of the controller's serial number, the ECU 32 software revision number and the controllers internal firmware revision. This information is provided for troubleshooting purposes, or to allow the user to get the serial number so that a software license can be obtained. This feature also provides contact information for obtaining service or technical support.

**EXIT:**
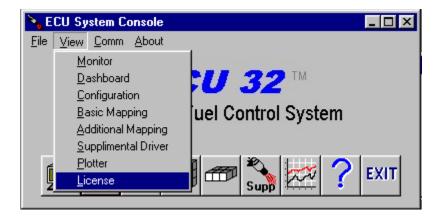
Allows user to exit the console application (ECU.EXE).

**SOFTWARE LICENSING:**

Although the ECU32 PC programming software is provided free of charge, the use of some of its features require the purchase of a user license. Specifically, only the ability to monitor the system sensors and basic performance are provided without the license requirement, and thus all programming options are disabled. It is intended that the user can use the free features within the software to verify that the system is correctly wired, and operable prior to initial startup. These features may also be used for limited troubleshooting as some non-sensory data is also displayed.
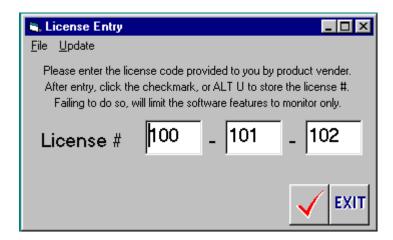
Since some users will purchase ready to run kits, and others may pay a third party to install and tune the users controller system, it is apparent that not all users will require a software license to operate the engine controller successfully. Charging for the full use of the PC software allows us to continue to provide a quality user interface between the tuner and the controller, and to pay for software development costs that should not effect the cost of the controller hardware, since not every user will require its use.

License access codes are matched to a specific controller, and are not transferable to other ECU units. In order to receive a license code which will allow full feature access, you must either purchase the license at the time of the controller purchase, or you may contact us, and we will sell you the license and provide to you a license access code. In order for us to provide an access code, we will need the specific serial number that the license will be used with.

Once the license access code is known, it must be entered into the ECU System Console by clicking the "View" then "License" menus. Enter your 3 license number codes into the text boxes, and click the checkmark button. You will receive a confirmation that you have entered the correct license code, and your license information will be stored in your computer.
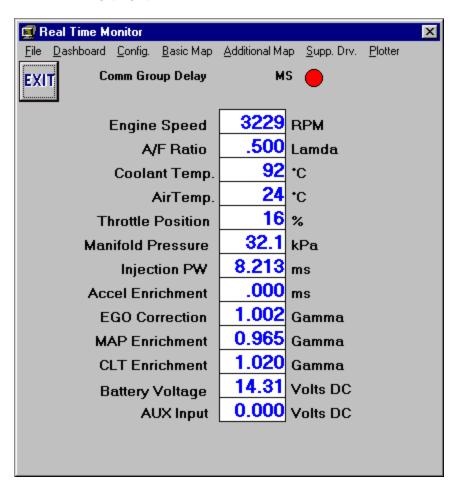
If the provided user license code were 100-101-102, the user would enter the following information into the license entry screen.

**License Entry**

File  Update

Please enter the license code provided to you by product vender. After entry, click the checkmark, or ALT U to store the license #. Failing to do so, will limit the software features to monitor only.
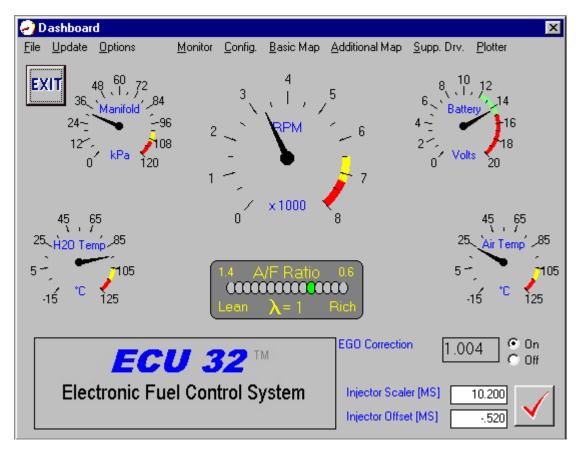
License #  [100] - [101] - [102]

✓ EXIT

If additional engine controllers are to be used from the same PC, a separate license will be needed for each ECU, and the correct license code for the specific ECU will have to be entered before attempting use the software.

**REAL TIME MONITOR:**



The real Time Monitor allows the user to view the operation of the controller while the controller is operating. This allows the user to gauge the level of tuning required, and to troubleshoot the system after installation, or if a problem arises later.

**DASHBOARD:**



This is another monitor only feature that allows a graphical representation of the engine tachometer, air and coolant temperature sensors, battery voltage and manifold pressure. Also provided is a simulated LED Lambda meter for monitoring the air fuel mixture.

The dashboard screen also provides the user the ability to adjust the Fuel Offset and Gain parameter [with optional license], which will allow course tuning of the main fuel parameters from within this screen. Also provided is the ability to temporarily turn off or on closed loop operation, which allows the user to set fuel and mapping parameters without having to deal with the engine controller trying to correct the mixture that the user is setting. The user may also monitor the EGO correction gain, which can tell the user if the mapping parameters are set well.

note: A well mapped engine should have EGO correction gain figures close to 1.000 across the portions of the map that it has been tuned for.

*[Injector Scaler]*
This is the main fuel parameter across the entire map.
Increasing this parameter will cause a richer mixture.

*[Injector Offset]*
This is the fuel offset parameter, and adds or subtracts from the calculated injection pulse width.

**NOTE:   Clicking the checkmark will store this screens parameters to the ECU memory.**

**CONFIGURATION**                              ***This feature requires a user software license.**



*[Accel Sensitivity]*
Sets the amount of throttle opening enrichment.
Higher numbers gives more fuel when the throttle is opened rapidly.

*[Accel Rate]*
Sets the length of time that the acceleration enrichment will operate.
Lower numbers will give longer enrichment times.

*[Accel Min PW]*
Sets the minimum calculated acceleration pulse width that will be used.
This prevents small throttle changes from causing unwanted enrichments.
Larger numbers will give lower emissions, but poorer response.

*[Accel Max PW]*
Sets a limit on the amount of acceleration enrichment that can be used.
Larger numbers will allow higher enrichments.

*[Accel EGO Reset]*
Sets the amount of enrichment that will disable, then reset the closed loop (EGO operation.
Lower numbers will reset the EGO algorithm and prevent closed loop operation during transients.
Setting this value too low can cause problems with normal or static closed loop operation.

*[Rev Limiter]*
The RPM at which the fuel will be cut.

*[Engine Decel]*
The Vacuum/Pressure at which the fuel will be cut during engine deceleration.

*[Number of Cylinders]*
Enter the number of Engine Cylinders.

*[Number of Injection Phases]*
The number of phases before the phase is reset to phase 1.
This is usually set to [but not always] the number of drivers that are installed on the PCB.
IE: a 4 phase controller drives phases 1 to 4, then cycles back to phase 1.

*[Tach Full Scale [RPM]]*
This is the max range for which to calculate and display engine RPM.
Requires that the Number of Cylinders be set correctly, and that each cylinder receives a trigger every 720 engine degrees.

*[Cold Priming Duration]*
Sets the pulse width given to a cold engine when the ignition is turned on.

*[Cold Number of Pulses]*
Sets the number of pulses given to a cold engine when the ignition is turned on.

*[Hot Priming Duration]*
Sets the pulse width given to a hot engine when the ignition is turned on.

*[Hot Number of Pulses]*
Sets the number of pulses given to a hot engine when the ignition is turned on.

*[Cold/Hot Threshold]*
The Air temperature in degrees, that differentiates a cold versus hot priming event.

*[EGO Loop Rate]*
The rate at which the EGO algorithm is applied for closed loop operation.
Sometimes known as Integral Gain.
Higher numbers cause slower, but more stabile closed loop operation.

*[EGO Prop. Gain]*
Sets the instantaneous fuel correction from the EGO sensor.
Setting this too high causes rapid lean/rich oscillations.
Setting this too low can cause higher emissions, and slow closed loop response time.

*[EGO Loop Activation]*
Sets the number of seconds after power up before the EGO sensor is used for closed loop operation.
Set to 0 for no EGO/closed loop operation, or a long enough period that the EGO sensor is heated to its required temperature. Also set to zero during fuel parameter changes and mapping to eliminate the closed loop operation from altering the parameters that you are setting.

*[Min EGO Gain]*
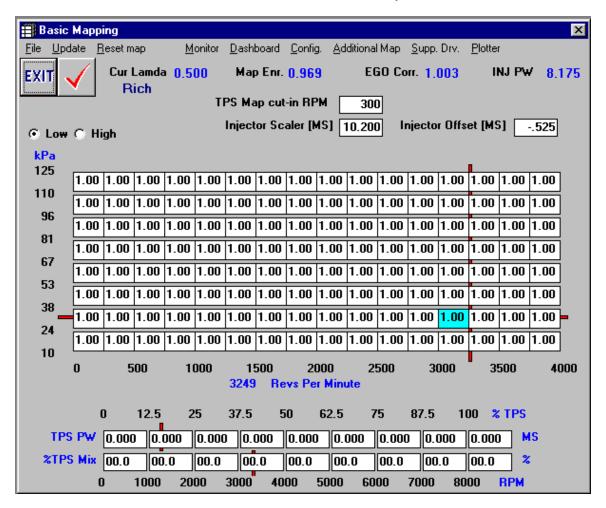Lower limit that the closed loop operation can set the gain to a lower authority limit.

*[Max EGO Gain]*
Upper limit that the closed loop operation can set the gain to a higher authority limit.

*[TPS/MAP mapping]*
Sets if the internal MAP sensor or the TPS becomes the "Y " axis entry into the basic map matrix.


**NOTE:   Clicking the checkmark will store this screens parameters to the ECU memory.**

**BASIC MAPPING**                                **\*This feature requires a user software license.**



*[TPS MAP cut-in RPM]*
Sets the minimum RPM that the %TPS mix mapping will be used.  For instance by setting this feature to 300 RPM,  the engine controller will use ONLY the normal mapping parameters from 0 to 300 RPM.  This feature is useful for allowing proper starting injection pulse widths, will allowing a sharp transition to a mixed TPS stabilized injection pulse width.

*[Injector Scaler [MS]]*
This is the main fuel parameter, similar to the function of main jets on a carburretted  engine.  This number equates to the basic "unmapped" pulse width that the controller would calculate at the maximum manifold pressure.  Increasing this number will generally give more fuel at a give pressure/engine load.  Be careful to correctly select your fuel injector rates, as if the injection pulse width gets too long, the injectors can be opened for 100% of their duty, at which point the engine will lean out, and likely become damaged.  For more information of injector selection, please call technical support.

*[Injector Offset [MS]]*
This parameter is usually considered a trim adjustment, similar to the idle and progression circuit in a carburretted engine.  This parameter is typically near zero, or even slightly negative in many medium performance applications.  In higher performance applications, where the idle manifold vacuum is low, this parameter can be somewhat more negative, where the calculated pulse width at idle is too high due to higher manifold pressure (poor vacuum).  The negative Injector Offset parameter subtracts "if negative" from the basic pulse width so that the resultant pulse width is what is needed to control the engine.

*[Basic Mapping Matrix]*
In the middle of this screen is a 16 by 9 matrix of cells,  These cells form the basis for setting the mapping gains at various locations in the engines operation.  Actually the matrix is 32 by 9 cells, but not all cells can be displayed at a time.  The matrix is effectively split in half, where the lower RPM matrix is viewable by clicking the Low selector, and the second half of the map is viewable by clicking the High selector. The default values for the entire matrix "map" is 1.00, which signifies that the Injector Scaler and Injector Offset ONLY are used to set the basic injection pulse width calculation.  By setting a given cell or range of cells to different values other than 1.00, the engine operation across the region of the map can be made richer "more fuel" or leaner "less fuel" in order to make the engine run and operate properly.  Values in these field greater than 1.00 signify more fuel to be used in this cell, and values less than 1.00 signify a need for less fuel in this cell.  As the RPM or pressure moves between cells, an interpolated mapping gain is calculated between this cell, and the next cell up and next cell to the right.  In this way value differences between cells are smoothed out as you go across a cell, and into the adjacent cell.  In general, simple engines "engines with no or light modifications" require little or no mapping from the default matrix of 1.00 values.  Larger engine modifications and higher performance engines may require substantial mapping changes in order to obtain suitable operation. Mapping an engine can be a very tricky task, if this is your first time, take it slowly and change only 1 thing at a time, and make small sensible changes. You may also consider having a professional assist you in this task to establish a reasonable running engine that can be fine tuned by you later.

*[TPS PW]*
These parameters set the desired pulse width from the this cell TPS position to the next cell TPS position.  This acts as the TPS independent contribution to the pulse width calculation.  The TPS PW series of cells forms a 2 dimensional pulse width curve that can be mixed into the normal pulse width calculations.  These parameters along with the %TPS MIX parameters can assist is stabilizing the idle and light load pulse widths in heavily cammed or with very low volume induction systems.  Reducing the parameters in these fields will reduce the TPS based contribution to the pulse width when the %TPS MIX values are not zero.

*[%TPS Mix]*
These parameters set the amount of mixture between the normal mapping based pulse width, and the TPS based contribution.  The %TPS Mix parameters allows a tapered mix function based upon engine RPM, where the engine can transition from a higher TPS based mixture at low RPMs to a lower or even zero TPS based mixture at higher RPMs.  This feature allows a controlled transfer from a primarily throttle based idle, to a pressure based control at higher RPMs, where perhaps the volumetric efficiency is better, or manifold pressure stabilizes.  Setting these parameters to zero will fully disable (default) the TPS based mixture, and numbers up to 100% will run primarily off of the throttle position sensor.

*Cur Lamda* is the output of the EGO sensor expressed as Lamda, where numbers less than 1.00 mean rich, and numbers greater than 1.00 mean lean.  This value can be used (if EGO sensor equipped) for tuning the fuel parameters and mapping.
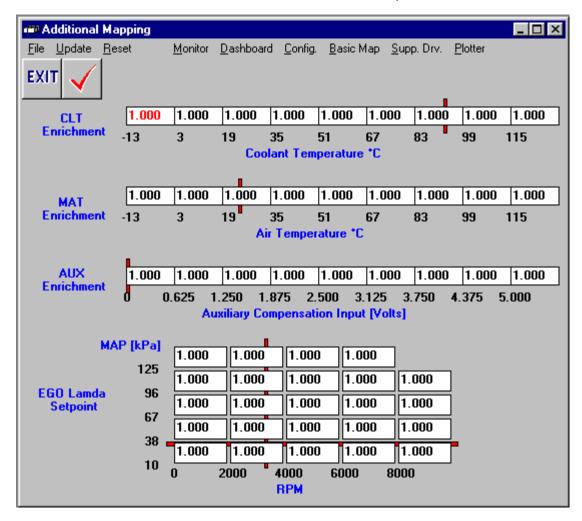
*Map Enr* is the current calculated gain from the mapping matrix.  This useful to see the effect of your mapping values while the engine is operating.

*EGO Corr* is the current gain established by the closed loop operation using the EGO sensor.  If the controller is not running closed loop, this value should be 1.00.  If  the number is not 1.00 then the controller has altered the closed loop gain to attempt to maintain a desired air fuel mixture.  If the number doesn't usually stay between .90 and 1.1, then this indicates that the engine is not properly mapped open loop, and than the closed loop operation has taken unusual means to correct the  tuning problem.

*INJ PW* is the final current calculated pulse width that the injectors will use.

*Crosshairs* indicate the current operating points within each of the maps.

**Clicking the checkmark will store this screens parameters to the ECU memory.**

**ADDITIONAL MAPPING**                                   ***This feature requires a user software license.**



*[CLT Enrichment]*
This series of cells forms the gain as a function of coolant temperature.  This allows more or less fuel to be used at different temperature sort of like a "choke" function on carburretted engines.  Higher values will yield more fuel across this temperature range.

*[MAT Enrichment]*
This series of cells forms the gain as a function of manifold air temperature.  This allows more or less fuel to be used at different air densities.  This is most useful across wider air temperature ranges, or when using a blower or compressor to compensate for compressive air heating.  Higher values will yield more fuel across this temperature range.

*[AUX Enrichment]*
This series of cells forms the gain as a function of an external input voltage. Higher values will yield more fuel across this voltage range.
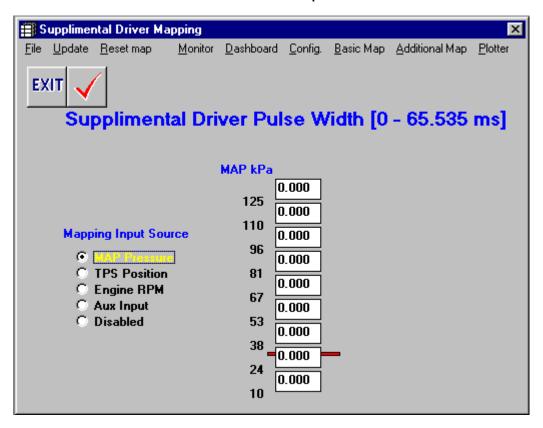
*[EGO Lamda Setpoint]*
This matrix forms an RPM vs. MAP pressure closed loop lamda setpoint map.  Setting these values lower than 1.00 will yield a richer closed loop operation, and values greater than 1.00 will yield leaner closed loop operation.  Don't move these values too far from 1.00 or stability problems will arise due to the rather narrow band of useful range that an EGO sensor can be used.

*Crosshairs* indicate the current operating points within each of the maps.
**Clicking the checkmark will store this screens parameters to the ECU memory.**

**SUPPLIMENTAL DRIVER MAPPING**          **\*This feature requires a user software license.**
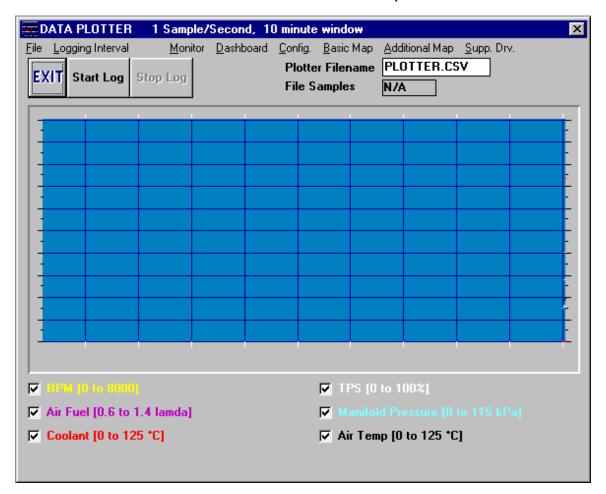


*[Mapping Input Source]*
This allows the selection of the MAP, TPS, RPM, AUX input or none of the above to become the basis for the supplemental driver map. Clicking any of these signals will automatically alter the range of the mapping cells. Use this feature to control supplemental fuel driver, EGR solenoids or even idle air solenoids for whatever purpose seems appropriate.

*[Supplemental Driver Pulse Width]*
These cells form a pulse width function using the Mapping Input Source as the input to this simple table.
Values between cells are interpolated to smooth the transition from one cell to the next.

*Crosshairs* indicate the current operating points within each of the maps.
**Clicking the checkmark will store this screens parameters to the ECU memory.**

**DATA PLOTTER**                                          **\*This feature requires a user software license.**



The Data Plotter is a tool to monitor performance trends and to plot or log sensor data into a spreadsheet file for later evaluation.

Each of 6 listed sensory inputs may be selected or deselected of the graph.

The plotter file name allows the user to type in the name of a file that this program will log to each log interval.
Keep the file extension ".CSV" so that any spreadsheet program can successfully import the data from this feature.

Clicking the Logging Interval menu item will allow the user to select a logging interval from 100ms per log entry to 10 seconds per log entry depending on how often the log needs to be performed.

**Note that faster logging intervals may not be accurate on older or slower computers.**

To start a log, enter the desire logging filename, set the desire logging interval, then click "**START LOG**".
To stop the started log, click "**STOP LOG**".

The log file will the then name that was specified, and will be stored in the ECU32 installation subdirectory.

**ABOUT ECU:**



This screen gives the user our company information. This screen also allows the user to find out what version of ECU software is installed, and what version of firmware is installed in the engine controller. If technical support is needed on either the ECU System Console, or the engine controller, please reference the two printed revisions and have that information available for technical support.

Clicking **EXIT** will return to the system console.

**SAVING/RESTORING CONFIGURATION DATA:**

The internal control parameters may be stored to a file on the PC, as well as a configuration file may be restored to the controller. This feature allows the user to create a benchmark, or a reference configuration that can be reverted to in the event that programming proves to have done more harm than good. To access these features use the File, Upload/Download menu.



If the user is happy with a given configuration stored within the engine controller, or if the user wishes to save a reference "snapshot" of the data in the engine controller, the entire controller data-set can be stored off to a calibration file on the PC. The file may then be read, and restored into the engine controller at a later time. This can be useful to maintain a set of configurations that go with different engine modifications, or even different engines.

**To save a configuration to a calibration file:**

From the ECU System Console, click "File", then "Download ECU to calibration file". A dialog box will ask you to enter a filename. Enter a filename, and click "Save".

**To restore a controller configuration from a calibration file:**

From the ECU System Console, click "File", then "Upload calibration file to ECU". A dialog box will ask you to enter a filename. Select the file of your choice, then click "Open".

While tuning an engine (particularly when the user experience level is low), it is recommended that the user save a reference calibration file so that if something really gets messed up in the calibration. The user can revert to a calibration that operates properly . This serves as an "undo" to a major oops.

**ADVANCED TOPICS:**

**PROBLEM SOLVER:**