

# **The ECU+ Fuel/Timing/Datalogging Piggyback Engine Computer**

## **Installation/Users Manual**

Manual Revision 2.04 - 11/20/05

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# 1 Introduction

Thanks for purchasing the ECU+ fuel and timing computer. The ECU+ is an inexpensive, full-featured piggyback computer that modifies the MAS airflow and the cam and crank angle sensor signals on your 1990-1999 4G63-equipped turbo Eclipse, Talon, Laser or Galant VR-4, or 2003-2005 Lancer Evolution, giving you complete control over fuel delivery and timing of your vehicle. The ECU+ is typically used on high-performance vehicles with larger turbos, upgraded exhausts and higher-flow injectors to fine-tune your vehicle's performance.

The ECU+ can modify the fuel and timing of your engine at some 129 "points," depending on the engine's air flow, RPM and throttle position. In addition, the ECU+ supports full datalogging of most engine sensors at 25 samples per second as well as complete OBD-II functionality. Datalogged information can be viewed and analyzed with the included Palm OS or Windows software.

## 2 Warning

The ECU+ system is an sophisticated device intended for off-road use, and is not in any way certified for use on public streets. The ECU+ provides you with the ability to adjust the air/fuel and timing mixture of the engine in your car. If used improperly, the ECU+ **can destroy your engine**. Neither the dealer nor the manufacturer of the ECU+ may be held responsible for any damage to your vehicle as a result of the installation, use or misuse of this product. Additionally, you should never adjust your engine's settings or attempt to "run" either the ECU+ Win or ECU+ Palm software while the vehicle is in motion.

## 3 System Requirements

The ECU+ supports the following vehicles:

- 1990-1991 Mitsubishi Galant VR-4
- 1990-1994 Plymouth Laser, Mitsubishi Eclipse or Eagle Talon, AWD or FWD, turbo only
- 1995-1999 Mitsubishi Eclipse or Eagle Talon, AWD or FWD, turbo only
- 2003-2005 Mitsubishi Lancer Evolution VIII

The ECU+ head unit connects via a serial port to a Palm organizer and/or a laptop PC for data display, logging and analysis.

The ECU+ Palm software, which runs on the Palm Organizer, requires Palm OS 3.5.1 or later. The Palm organizer itself must have a serial connection ("HotSync cable") to connect to the head unit.

The ECU+ Win software requires a Intel, AMD or compatible PC running Windows 98, 98SE, ME, 2000, or XP. A Pentium II/366 Mhz or faster CPU is recommended. If the PC is a laptop, it can be used directly with the ECU+ head unit via a serial connection (be that a true serial port, or a pseudo-serial port, like a USB-to-serial adapter).

If you have a laptop, you don't necessarily need the Palm organizer. If not, you'll need a separate PC to run the ECU+ Win analysis software.

## 4 Packing List

When you purchased the ECU+, you should have received the following items:

- ECU+ head unit – this is the “silver and black box.” When shipped in the plug-n-play (PnP) version, the head unit is pre-wired into a adapter harness.
- A software CD-ROM containing the ECU+ Windows and Palm software, as well as this manual and other documentation.
- Two wiring harnesses for connection to the car – one for high-current I/O and one for low-current I/O. For the plug-n-play (PnP) version of the ECU+, these will be pre-wired into a PnP harness.
- Wire ties.
- A 9-pin straight-through serial cable. Male to female. This is used to interface between the ECU+ head unit and the laptop
- A null modem adapter, female to female. This adapts the Palm organizer to the serial cable.

## 5 Head Unit Hardware Installation

The ECU+ “head unit” is the black and silver box of the ECU+ system. This device connects into your car's wiring harness and intercepts various engine sensor signals. The head unit modifies these signals based on your inputs, and passes them on to the stock ECU. This section will explain how to install the ECU+ head unit in your car.

### 5.1 Tools Required

The ECU+ head unit can be installed by anyone with some basic electrical experience. If you can hook up a new car stereo, the ECU+ head unit installation will be a breeze. To complete the installation, you'll need the following tools:

- A set of common screwdrivers and a socket set (for removing the stock ECU).
- Wire cutters and a small knife.
- Electrical tape.
- A pencil-type soldering iron and solder.
- A digital multimeter for measuring voltages.
- Lots of patience.

### 5.2 Wiring Basics

To install the non-PnP ECU+, you'll be splicing into the stock wiring harness that connects the engine sensors to the stock ECU. You'll make one of two types of connections: tapping or splicing into the stock wiring harness.

#### 5.2.1 Tapping Wires

For most of the signals that the ECU+ head unit needs to see, you'll be strictly tapping into the stock wiring harness. That is, you won't be cutting the wires at all, but just stripping back enough insulation so that you can “tap” the wire. Here's what you'll do:

1. Strip about an inch of insulation from the stock ECU wire.
2. Strip an inch and a half of insulation from the end of the corresponding ECU+ wire.
3. Twist the bare ECU+ wire around the bare stock wire, then solder the two together to make a solid connection.
4. Wrap this exposed connection with electrical tape.

### **5.2.2 Splicing Wires**

A few of the ECU+ head unit connections require that you actually splice into the stock wiring harness. This involves cutting a wire in the stock harness and connecting a ECU+ wire to either end. To splice an end, follow these steps:

1. Cut the stock ECU wire with wire cutters.
2. Strip about an inch of insulation from the stock ECU wire.
3. Strip an inch of insulation from the end of the corresponding ECU+ wire.
4. Twist the two wires together and solder the connection. The two wires will be an inverted 'V' shape.
5. Bend the ECU+ wire backwards and wrap the exposed connection with electrical tape.

### **5.2.3 Wiring Tips**

- The stock wiring harness generally only exposes a few inches of wire from the stock ECU. Try to make your connections about half-way between the stock ECU connector and where it disappears under the dash.
- Make sure your hands are clean before wrapping the connection – even the slightest bit of oil will foul the adhesive on the electrical tape.
- Check and double-check that you're connecting the right wires before soldering. It's much easier to re-do a connection before soldering than after.
- A good online resource, including photos, for how to make these connections is at <http://www.mmxpress.com/technical/connections.htm>

## **5.3 Locating and Removing the Stock ECU**

The procedure for removing the stock ECU depends on the type of car you're installing the ECU+ in.

For the Talon, Eclipse and Laser vehicles (all years), the stock ECU is mounted vertically and is located behind the radio in the center console. Remove both the driver and passenger kick panels, and you'll find the ECU bolted in with three bolts. Remove the bolts and the stock ECU will slide out. On the 1990-1994 cars, the stock ECU slides out on the passenger side. On the 1995-1999 cars, it slides out on the driver's side.

For the Galant VR-4, the stock ECU is bolted underneath the dash on the far right side. Remove the two bolts holding it in place, and it'll drop out.

For the Evolution VIII, the stock ECU is behind the glove box. Remove the glove box (there's a tab on the left side that'll free the glove box and allow it to drop out) and unbolt the two bolts holding the stock ECU in place. The stock ECU will drop straight down into the passenger side floor.

## 5.4 Making the Connections

With the stock ECU removed from your vehicle, it's time to do the hookup to the ECU+ wiring harnesses. All of the cars that the ECU+ supports have similar wiring, but the wire locations on the stock ECU are different.

### 5.4.1 1990-1994 Galant VR-4, Laser Talon and Eclipse

On the 1990-1994 Talon, Eclipse, Laser and Galant VR-4, the stock ECU contains three connectors, numbered as shown in Illustration 1. This view shows the stock ECU as you'll view it, facing the connectors in the end of the metal enclosure.

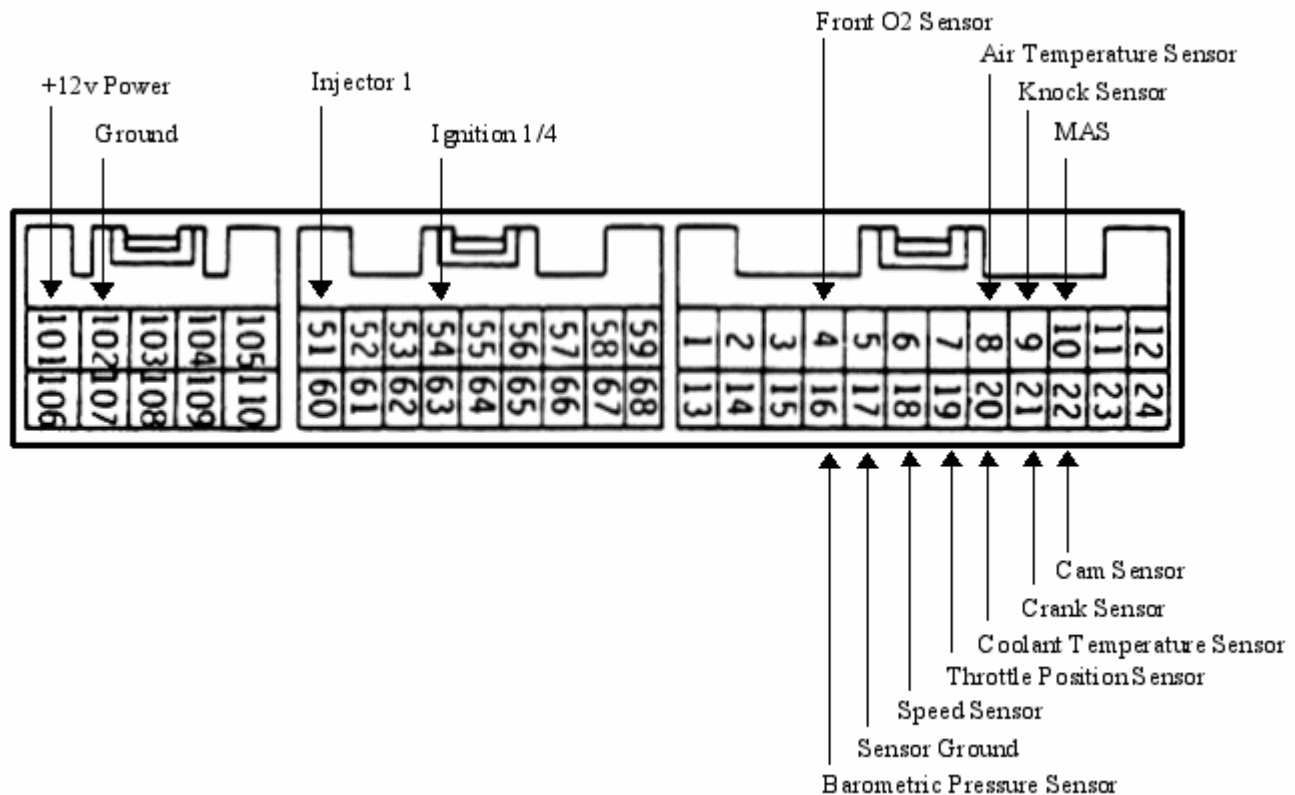


Illustration 1- The first generation DSM ECU pinout

To hook up the ECU+ head unit, you'll be wiring between the stock ECU and one of the two ECU+ harnesses. There are two ECU+ harnesses – one for “low current” connections (this is the main harness, containing 34 pins, terminated at the black connector on the head unit) and one for “high current” connections (terminates at the white connector on the head unit). The high current harness also includes the power connections.





Illustration 2 - The low (left) and high (right) current harnesses.

The low current harness connector contains 34 positions arranged in groups of ten. The groups are labeled “Group A” through “Group D,” and within a group, wires are color-coded in the following sequence: brown, black, red, orange, yellow, green, blue, violet, gray, white. In the above illustration, the Group A wires are on the left, then Group B, Group C and Group D. The leftmost brown wire in Group A is pin 1. Underneath pin 1 is the unused pin 2. The red wire beside the brown wire is pin 3, and so on. The table below lists all of the connections on the low current harness, and where they'll connect to on the stock ECU. Note that some positions on this connector are unused (like pin 2), and there is no wire in that position.

ECU+ Pin #	ECU+ Wire Color	Wiring Group	ECU+ Function	Stock ECU Pin #
1	Brown	A	Sensor Ground	17
2	(Black)	A	<i>Not Used</i>	
3	Red	A	Cam Sensor Out (to stock ECU)	22
4	Orange	A	MAS In (from sensor)	Was 10
5	Yellow	A	Crank Sensor In (from sensor)	Was 21
6	Green	A	Speed Sensor In	18
7	Blue	A	Cam Sensor In (from sensor)	Was 22

ECU+ Pin #	ECU+ Wire Color	Wiring Group	ECU+ Function	Stock ECU Pin #
8	Violet	A	Ignition 1/4 In	54
9	Grey	A	Injector 1 In	51
10	(White)	A	<i>Not Used</i>	
11	(Brown)	B	<i>Not Used</i>	
12	(Black)	B	<i>Not Used</i>	
13	Red	B	MAS Out (to stock ECU)	10
14	Orange	B	Crank Sensor Out (to stock ECU)	21
15	Yellow	B	Analog Output 0	
16	Green	B	Analog Output 1	
17	Blue	B	Knock Sensor In	9
18	Violet	B	Analog Output 2	
19	Grey	B	Analog Output 3	
20	(White)	B	<i>Not Used</i>	
21	Brown	C	Rear O2 Sensor In	N/A
22	Black	C	<i>Reserved</i>	
23	Red	C	Spare Analog Input 1/EGT Adapter In	
24	Orange	C	<i>Reserved</i>	
25	Yellow	C	External MAP Sensor In	
26	Green	C	Simulated Rear O2 Sensor Out	N/A
27	Blue	C	Spare Analog Input 2/Wideband O2 Sensor Kit In	
28	Violet	C	Spare Analog Input 0	
29	Grey	C	Coolant Temperature Sensor In	20
30	White	C	<i>Reserved</i>	
31	Brown	D	<i>Reserved</i>	
32	Black	D	Front O2 Sensor In	4
33	Red	D	Air Temperature Sensor In	8
34	Orange	D	Throttle Position Sensor In	19

Table 1- The low current harness connections

With the exception of the MAS, crank and cam sensor connections, all of the above connections are tap connections – you “tap” the signal and feed it to the ECU+ input. For the MAS, crank and cam sensor connections, you'll split the stock ECU's wire and connect the vehicle sensor's output to the ECU+, and the corresponding ECU+ output to the stock ECU.

The high current harness connector contains 18 positions. Of this, only 6 positions are used.

The table below lists the connections on the high current harness, and where they'll connect to on the stock ECU. Note that the connections on the high current harness are numbered from right to left rather than from left to right, as on the low current harness.

ECU+ Pin #	ECU+ Wire Color	ECU+ Function	Stock ECU Pin #
1	Red	+12v Power	101
2	Black	Ground	102
8	Grey	<i>Reserved</i>	
9	White	<i>Reserved</i>	
17	Violet	<i>Reserved</i>	
18	Green	<i>Reserved</i>	

Table 2- The high current harness connections

ECU+ pins 1 and 2 are tap connections.

4 other connections are reserved for future use, and will be used in the next software release. The rest of the connections are not used.

Some notes:

- The 1990-1994 cars don't include a rear O2 sensor, so these connections are marked N/A in the low current table. The input marked Rear O2 Sensor In can be used as an additional 0 to 5 volt analog input, if desired.
- Some connections on both harnesses are marked *reserved*. These will be used in a future ECU+ software release.
- Any ECU+ harness connections that aren't wired up to the stock ECU or another device should be securely bundled together with electrical tape on the end to ensure that these don't accidentally short-circuit to a in-car ground.

With the basic ECU+ installation completed, you may want to consider hooking up the simulated rear O2 sensor signal, an external MAP sensor (for boost datalogging), an external wideband O2 sensor, or any of the ECU+'s analog inputs or outputs. See the section Using the Auxiliary ECU+ Inputs and Outputs on page 16 for more information.

Now skip to the section Finishing Up the Hardware Installation, on page 20.

### 5.4.2 1995 and Up Talon, Eclipse and Evolution VIII, PnP ECU+

On the 1995-1999 Talon and Eclipses, and the Evolution VIII, the stock ECU contains four connectors, numbered as shown in Illustration 3. This view shows the stock ECU as you'll view it, facing the connectors, facing the connectors in the end of the metal enclosure.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

*Illustration 3 - The second generation stock ECU pinout*

To install the plug-n-play (PnP) version of the ECU+, simply unplug the stock connectors from the stock ECU, and plug them into the mating connector on the ECU+ wiring harness. The ECU+ wiring harness contains a similar set of connectors – plug these into the stock ECU. Each of the connectors are different sizes and keyed for orientation – it's not possible to mix them up.

Note: any ECU+ harness connections that aren't wired up to the stock ECU or another device should be securely bundled together with electrical tape on the end to ensure that these don't accidentally short-circuit to a in-car ground.

With the basic ECU+ installation completed, you may want to consider hooking up the simulated rear O2 sensor signal, an external MAP sensor (for boost datalogging), an external wideband O2 sensor, or any of the ECU+'s analog inputs or outputs. See the section Using the Auxiliary ECU+ Inputs and Outputs on page 16 for more information.

Now skip to the next section, Finishing Up the Hardware Installation, on page 20.

### **5.4.3 1995 and Up Talon, Eclipse and Evolution VIII, non-PnP ECU+**

On the 1995-1999 Talon and Eclipses, and the Evolution VIII, the stock ECU contains four connectors, numbered as shown in Illustration 4. This shows the stock ECU as you'll view it, facing the connectors in the end of the metal enclosure .

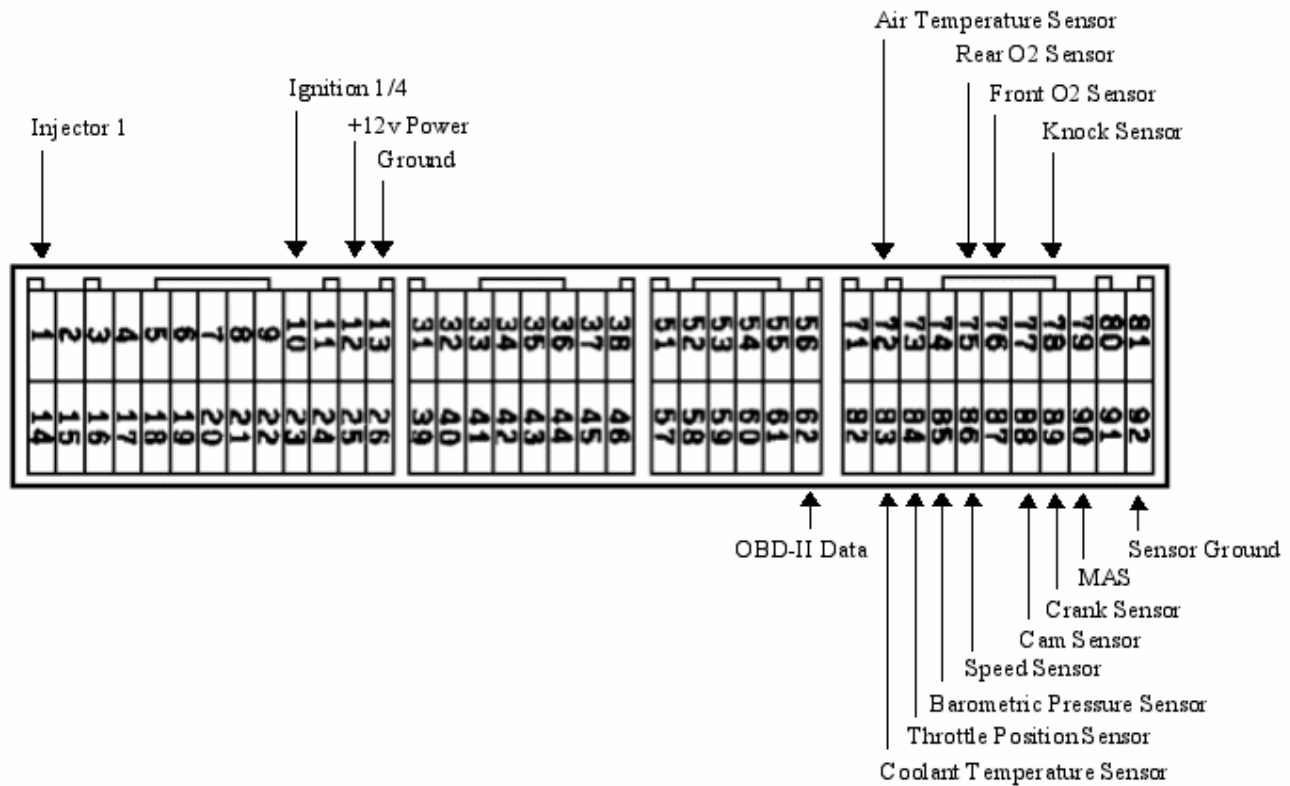


Illustration 4- The second generation DSM and EVO VIII ECU pinout

To hook up the ECU+ head unit, you'll be wiring between the stock ECU and one of the two ECU+ harnesses. There are two ECU+ harnesses – one for “low current” connections (this is the main harness, containing 34 pins, terminated at the black connector on the head unit) and one for “high current” connections (terminates at the white connector on the head unit). The high current harness also includes the power connections.



Illustration 5 - The low (left) and high (right) current harnesses.

The low current harness connector contains 34 positions arranged in groups of ten. The groups are labeled “Group A” through “Group D,” and within a group, wires are color-coded in the following sequence: brown, black, red, orange, yellow, green, blue, violet, gray, white. In the above illustration, the Group A wires are on the left, then Group B, Group C and Group D. The leftmost brown wire in Group A is pin 1. Underneath pin 1 is the unused pin 2. The red wire beside the brown wire is pin 3, and so on. The table below lists all of the connections on the low current harness, and where they'll connect to on the stock ECU. Note that some positions on this connector are unused (like pin 2), and there is no wire in that position.

ECU+ Pin #	ECU+ Wire Color	Wiring Group	ECU+ Function	Stock ECU Pin #
1	Brown	A	Sensor Ground	92
2	(Black)	A	<i>Not Used</i>	
3	Red	A	Cam Sensor Out (to stock ECU)	88
4	Orange	A	MAS In (from sensor)	Was 90
5	Yellow	A	Crank Sensor In (from sensor)	Was 89
6	Green	A	Speed Sensor In	86
7	Blue	A	Cam Sensor In (from sensor)	Was 88



ECU+ Pin #	ECU+ Wire Color	Wiring Group	ECU+ Function	Stock ECU Pin #
8	Violet	A	Ignition 1/4 In	10
9	Grey	A	Injector 1 In	1
10	(White)	A	<i>Not Used</i>	
11	(Brown)	B	<i>Not Used</i>	
12	(Black)	B	<i>Not Used</i>	
13	Red	B	MAS Out (to stock ECU)	90
14	Orange	B	Crank Sensor Out (to stock ECU)	89
15	Yellow	B	Analog Output 0	
16	Green	B	Analog Output 1	
17	Blue	B	Knock Sensor In	78
18	Violet	B	Analog Output 2	
19	Grey	B	Analog Output 3	
20	(White)	B	<i>Not Used</i>	
21	Brown	C	Rear O2 Sensor In	75
22	Black	C	OBD-II Data In	62
23	Red	C	Spare Analog Input 1/EGT Adapter In	
24	Orange	C	<i>Reserved</i>	
25	Yellow	C	External MAP Sensor In	
26	Green	C	Simulated Rear O2 Sensor Out	
27	Blue	C	Spare Analog Input 2/Wideband O2 Sensor Kit In	
28	Violet	C	Spare Analog Input 0	
29	Grey	C	Coolant Temperature Sensor In	83
30	White	C	<i>Reserved</i>	
31	Brown	D	<i>Reserved</i>	
32	Black	D	Front O2 Sensor In	76
33	Red	D	Air Temperature Sensor In	72
34	Orange	D	Throttle Position Sensor In	84

Table 3- The low current harness connections

With the exception of the MAS, crank and cam sensor connections, all of the above connections are tap connections – you “tap” the signal and feed it to the ECU+ input. For the MAS, crank and cam sensor connections, you'll split the stock ECU's wire and connect the vehicle sensor's output to the ECU+, and the corresponding ECU+ output to the stock ECU.

The high current harness connector contains 18 positions. Of this, only 6 positions are used.

The table below lists the connections on the high current harness, and where they'll connect to on the stock ECU. Note that the connections on the high current harness are numbered from right to left rather than from left to right, as on the low current harness.

ECU+ Pin #	ECU+ Wire Color	ECU+ Function	Stock ECU Pin #
1	Red	+12v Power	12
2	Black	Ground	13
8	Grey	<i>Reserved</i>	
9	White	<i>Reserved</i>	
17	Violet	<i>Reserved</i>	
18	Green	<i>Reserved</i>	

Table 4- The high current harness connections

ECU+ pins 1 and 2 are tap connections.

4 other connections are reserved for future use, and will be used in the next software release. The rest of the connections are not used.

Some notes:

- Some connections on both harnesses are marked *reserved*. These will be used in a future ECU+ software release.
- Any ECU+ harness connections that aren't wired up to the stock ECU or another device should be securely bundled together with electrical tape on the end to ensure that these don't accidentally short-circuit to a in-car ground.

With the basic ECU+ in stallion completed, you may want to consider hooking up the simulated rear O2 sensor signal, an external MAP sensor (for boost datalogging), an external wideband O2 sensor, or any of the ECU+'s analog inputs or outputs. See the section Using the Auxiliary ECU+ Inputs and Outputs on page 16 for more information.

Now skip to the section Finishing Up the Hardware Installation, on page 20.

## 5.5 Using the Auxiliary ECU+ Inputs and Outputs

The ECU+ contains a number of additional inputs and outputs that add value to a standard installation. Included are a simulated rear O2 sensor output and several analog inputs and outputs. These are covered below.

### 5.5.1 The Simulated Rear O2 Sensor Output

Note: This section is not applicable to 1990-1994 DSMs, as those vehicles only include a front O2 sensor.

The 1995 and up Talons, Eclipses and Evolution VIII vehicles include a rear O2 sensor on the far side of the catalytic converter. The stock ECU checks this signal to verify that the



vehicle has a functional catalytic converter. If the cat is removed for race purposes, the rear O2 sensor signal won't respond as the stock ECU expects, and will often trigger a "check engine" light to flag the problem. The ECU+ head unit includes a simulated rear O2 output (for off-road use only) that can eliminate this problem. The signal simulates the signal that the stock ECU will see from a functional rear O2 sensor, and thus avoids the check engine light.

To connect the simulated rear O2 signal, locate pin 26 (green, Group C – see Table 3) on the ECU+'s low current harness. Then locate pin 75 on the stock ECU (see Illustration 4) which should be tapped with a brown wire to the ECU+ head unit's rear O2 sensor input. Cut the stock ECU wire between the stock ECU's male connector and where it splices into the brown wire, and solder in the simulated rear O2 signal to the wire containing the splice. This feeds the ECU+'s simulated rear O2 sensor output to the stock ECU, and eliminates the check engine light.

Note: in the previous paragraph, if you've purchased a PnP ECU+, the connection should be made in the ECU+'s PnP harness, not in the stock ECU wiring.

### 5.5.2 Analog Inputs

The ECU+ includes three uncommitted analog inputs whose voltage is logged along with all of the other ECU+ inputs. These are high impedance (2M ohm resistance) inputs that can accept any signal between 0 and 5 volts. Many aftermarket vehicle sensors can be configured to produce a "5 volt" output, and you can datalog these values with the ECU+.

*Warning: before connecting a sensor input to an ECU+ analog input, verify (using a digital multimeter) that the sensor doesn't generate less than zero or greater than 5 volts.*

*Connecting an out-of-range sensor can damage or destroy your ECU+ head unit.*

To connect up a 5 volt input, simply wire it directly to the appropriate ECU+ input. Spare input 0 is pin 28 (violet wire, Group C) on the ECU+, spare input 1 is pin 23 (red wire, Group C) and spare input 2 is pin 27 (blue wire, Group C).

Spare input 2 includes an additional function. The ECU+ software is pre-calibrated to display air-fuel ratio when a supported wideband O2 sensor kit is connected to this input. See Using a Wideband O2 Sensor Kit on page 18 for more information.

### 5.5.3 Analog Outputs

The ECU+ includes four uncommitted analog outputs that can generate any fixed voltage between 0 and 5 volts under software control. Two of the four outputs are used when the ECU+ is used with a GM MAF device, but otherwise these outputs are unused and can be used to control some other device that needs a fixed voltage. Note that these analog outputs aren't fully buffered on the ECU+, and connecting them directly to ground may damage your ECU+ head unit. It's recommended that any device that connects to these outputs have an input impedance of 10k ohms or greater.

### 5.5.4 Using a MAP Sensor

The ECU+ directly supports several aftermarket MAP sensors using a dedicated input. A MAP (Manifold Absolute Pressure) sensor allows the ECU+ to directly datalog and read out your car's boost level.

The ECU+ currently supports three different MAP sensors:

- The “GM 3-Bar” map sensor (part number 12223861), available from any GM dealer or GM Parts Direct (<http://www.gmpartsdirect.com>).
- The SenSym ASCX30 two-bar map sensor, available from DigiKey (<http://www.digikey.com>).
- The AEM 3.5 Bar map sensor, available from many AEM dealers.

Each of the sensors has a port for pressure, and at least three electrical connections, with one terminal for a +5 volt power source, one for ground, and one for the output voltage. Install the sensor's pressure input just like you would a boost gauge, and then connect a long wire from the sensor output in the engine bay, through the firewall, and to your ECU+'s MAP sensor input pin (pin 25, yellow wire, Group C). You'll need to locate a +5 volt source under-hood for the sensor, which is available by tapping any of several of the stock engine sensors.

For the GM sensor, make the electrical connections as follows:

- 'A' terminal to ground
- 'B' terminal is the sensor output
- 'C' terminal to a +5v voltage source

The SenSym sensor has six electrical pins. With the sensor laying flat on a table (pressure port facing up, electrical pins at the bottom), the pins are numbered 1-6 from left to right. Make the electrical connections as follows:

- Pin 2 to a +5v voltage source
- Pin 3 is the sensor output
- Pin 4 to ground

The AEM sensor has three electrical connections. Looking into the end of the sensor, with the tab at the top, the connections are as follows:

- Upper left pin to a +5v voltage source
- Upper right pin to ground
- Bottom pin is the sensor output

Be very careful when installing a MAP sensor. Use a digital multimeter to verify your +5 volt source, and under no circumstances connect the MAP sensor to +12 volts. Doing so may damage the sensor and/or your ECU+ head unit.

### **5.5.5 Using a Wideband O2 Sensor Kit**

The ECU+ supports a number of wideband O2 sensor kits. An O2 sensor “kit” uses an off-the-shelf wideband oxygen sensor along with some electronics to control the sensor heater and to condition and linearize the output of the sensor. When a supported kit is connected to the ECU+, the ECU+ can capture and display a real-time graph of your engine's air/fuel ratio. This is very useful when adjusting fuel with the ECU+.

The ECU+ Palm and Windows software supports the following wideband kits:

- PLX Devices M-Series (M-200, M-250, M-300, M-400 and M-500) Wideband Oxygen Sensor Controllers, with or without the M-Series gauges. See <http://www.plxdevices.com> for more information.
- FJO Racing Wide Band Oxygen Sensor kits using controller CWC0002 or CWC0001. See <http://www.fjoracing.com>.

- Innovative Motorsports LM-1 Air/Fuel Gauge. See <http://www.innovativemotorsports.com>.
- Tech Edge WB02 Lambda Meters (WBo2 version 2A0 and TE-WB Wideband Unit (v1.5)). See <http://www.techedge.com.au>.
- Zeitronix Zt-2 Wideband Air/Fuel Ratio Meter. See <http://www.zeitronix.com>.
- AEM Wideband UEGO Controller and Gauge-Type Wideband UEGO Controller. See <http://www.aempower.com>.

To use a wideband kit with the ECU+, first install the device as described by the manufacturer, to include any calibration sequences. Next, connect the output of the wideband controller to the spare 2 analog input on the ECU+. This is pin 27 (blue wire, Group C) on the ECU+ head unit. Then configure the software so that the ECU+ knows which wideband kit you're using (see the section Miscellaneous Configuration on page 44 for the ECU+ Win software, and the section The ECU+ Palm Setup Screen on page 29 for the ECU+ Palm software).

Connecting up a wideband is usually pretty straightforward. The main difference between the the supported kits lie in which wideband output you should connect to the ECU+ head unit:

- For the PLX M-Series, use the WB output (white wire).
- For the FJO kits, use the red analog output wire on the black 4-pin square connector.
- For the Innovative LM-1, a 3.5mm stereo connector provides the output that the ECU+ needs. Pin 1, the connector tip, is analog output 1. Connect this to the ECU+ head unit.
- For the Tech Edge 2A0, use the WBlin output, which is pin 4 on the unit's RJ45 connector. Facing the RJ45 connector, the pins are numbered 1-8 from left to right.
- For the Tech Edge TE-WB 1.5, use the WBlin output, which is pin 4 on the unit's male DB-9 connector. Facing the DB-9, the top row of pins are numbered 1-5 from left to right.
- For the Zt-2, use the Wideband Analog Output. This is the white wire on pin 2.
- For the AEM Wideband UEGO Controller, use the orange wire, pin 1 (Sensor #1, 0-5v).
- For the AEM Gauge-Type Wideband UEGO Controller, use the white wire, 0-5v output.

For any of the widebands, be sure that the ground for the controller is identical to the ground on the ECU+ head unit.

When your wideband is configured, be sure to not modify any of the factory settings on it with respect to the output "curve." The ECU+ is pre-configured to work with the factory output voltages on all of the supported widebands.

### 5.5.6 Using a EGT Sensor and Adapter

The ECU+ supports datalogging of engine exhaust gas temperature (EGT) using a external EGT probe and the "5V K-type EGT adapter" from o2simulator.com. (See <http://www.o2simulator.com/AEMEGTADAPTER.html>). This adapter converts the signal from a K-Type thermocouple EGT probe into a 0-5v signal which the ECU+ can datalog as actual exhaust gas temperature.

To use this adapter, first install the adapter and EGT probe according to the manufacturers instructions. EGT probes typically are screwed into the exhaust manifold. Next, connect the white wire from the adapter to the spare 1 input on the ECU+ head unit. This is pin 23, red, group C on the ECU+ wiring harness. Finally, configure the ECU+ Win and/or ECU+ Palm software to display actual EGT temperature from the spare 1 input rather than the default voltage. The ECU+ is pre-configured to work with this adapter to display actual exhaust

temperatures.

## ***5.6 Finishing Up the Hardware Installation***

When you're all done making the ECU+ connections, you'll have some unused wires in both the analog and digital connectors. Tie these wires together with wire ties and wrap them in electrical tape. Next, secure all of the ECU+ harness wire bundles by applying wire ties to each bundle. In particular, be sure to use a wire tie very near each of the connectors at the head unit – this will ensure that there's no stress on the pins in the cables.

For the non-PnP ECU+, you'll want to verify that you've wired the ECU+ power correctly. Using a multimeter, hook up to the ECU+ two-pin power connection and turn your car's ignition to the on position. Your multimeter should read between **positive** 12 and 15 volts. If not, double-check your connections. With the wiring completed, you should plug the ECU+ head unit into the newly-wired harnesses.

Next, connect the included 9-pin serial cable to the appropriate connector on the ECU+ head unit.

Before starting your car for the first time, install the ECU+ software and follow the instructions in the next few sections to use either the Palm or the Windows software to setup the ECU+ head unit. In particular, be sure that the cam and crank angle sensor types are set appropriately for your car. Once everything is configured correctly, turn off your ignition and leave it off for a few seconds, then start your vehicle. The vehicle should run normally, just like it did before you installed the ECU+. If not, see the next section for troubleshooting information.

## ***5.7 Troubleshooting the Hardware Installation***

In the previous section, you installed your ECU+ head unit. Here are some things to check if your car doesn't run normally after the install.

- For all problems, double- and triple-check the wiring. Un-tape the connections and look at them. Is a good solder joint being made? Are the wires connected according to the tables?
- If your car won't start, chances are that either the cam or crank angle sensor signals aren't working. Verify that the head unit is using the proper signal type. As a last resort, remove the ECU+ head unit from its connectors and manually jumper together the cam and crank sensor signals.
- If the car idles very fast and seems to be running rich, the MAS signal is probably not being regenerated. Again, check the wiring. Does the software indicate that the input MAS signal is 0 Hz? If so, the MAS input may be disconnected. If not, the MAS output may be disconnected.

As a last resort, contact your ECU+ dealer and see what suggestions they might have. The ECU+ is tested at the factory, and should work for your car.

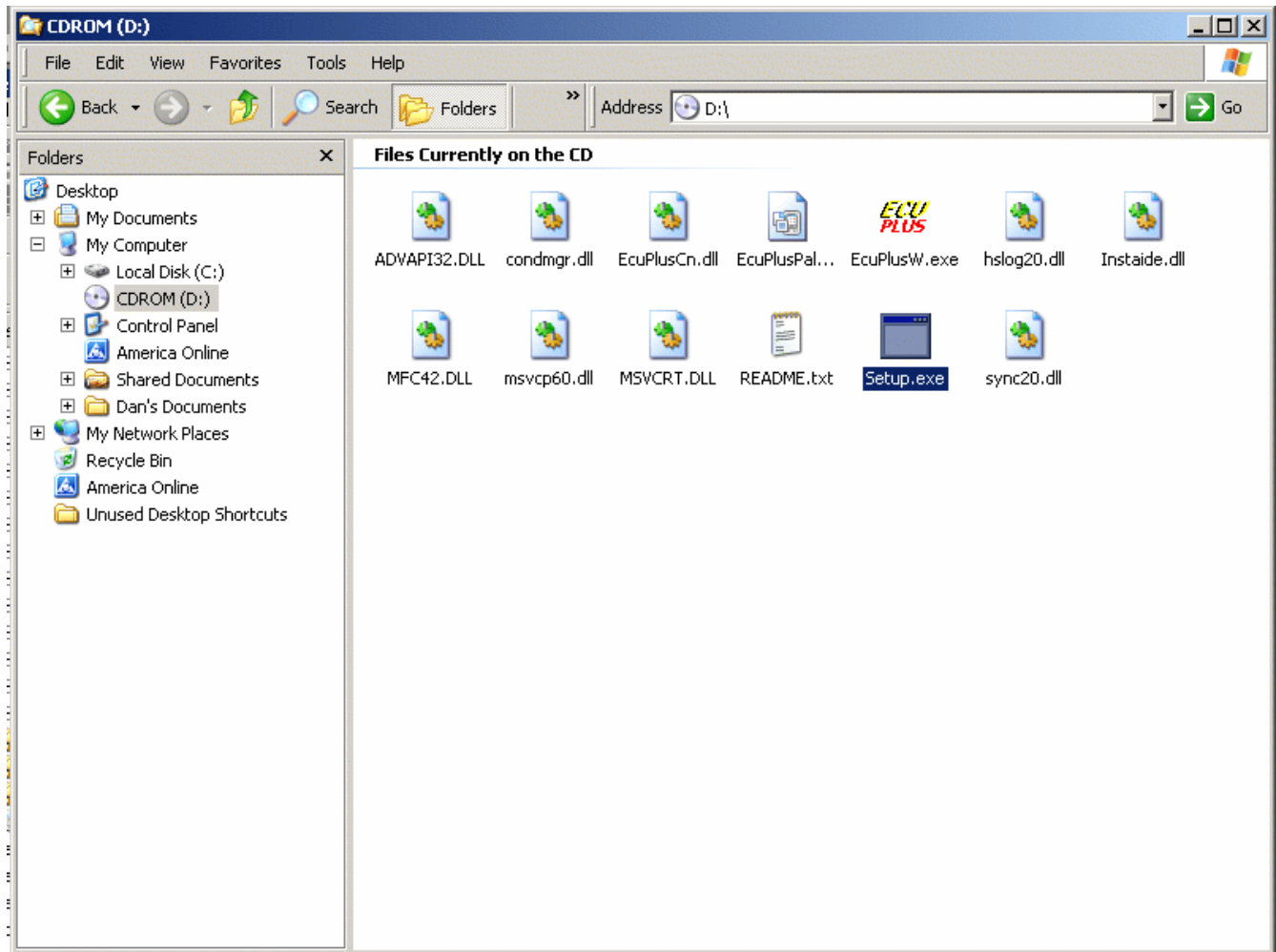
## **6 Software Installation**

The ECU+ system contains three pieces of software which need to be installed:

- The ECU+ Win software, which is a graphical Microsoft Windows-based display, tuning and analysis tool.

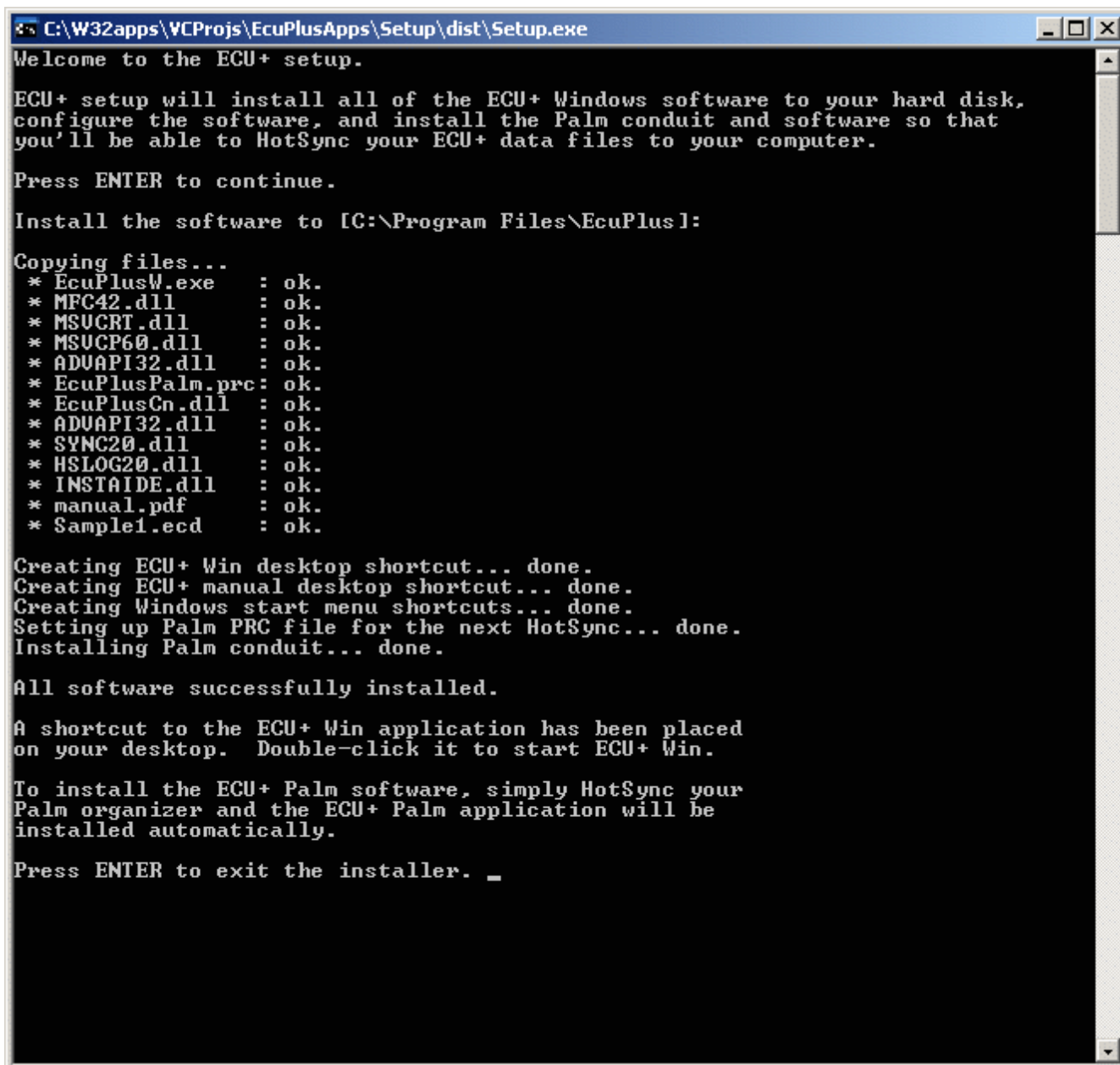
- The ECU+ Palm software, which provides a graphical interface on your Palm device for display and tuning of the ECU+ head unit.
- The ECU+ Palm conduit, which allows the Palm organizer to HotSync data between it and your PC/laptop running ECU+ Win.

To install the software, insert the CD-ROM supplied with the system into your CD-ROM drive. Then use the Windows Explorer tool to navigate to the CD-ROM, and double-click the Setup.exe program.



*Illustration 6 - Installing from CD*

The ECU+'s text-based install will begin, and you'll be prompted for a directory to install the software to. Enter a suitable directory, and the installer will install the software for you. You should see a screen something like:



*Illustration 7 - A successful install*

The installer will install the Windows software (ECU+ Win) as well as the Palm conduit. To install the Palm software (ECU+ Palm), simply HotSync your palm with this computer and the Palm software will be automatically installed on your Palm organizer. Note: you may need to restart the Palm Desktop software before starting the HotSync.

## **7 Using the ECU+ Palm Software**

### **7.1 Introduction**

The ECU+ Palm software interfaces to your ECU+ head unit and allows you to tune the ECU+, perform a capture, or just monitor your engine's sensors.

## 7.2 Starting the ECU+ Palm Software

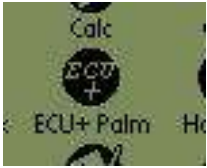


Illustration 8 - The ECU+ Palm icon

To start the ECU+ Palm software, tap its icon (see Illustration 8) on your Palm organizer. This will start up the ECU+ Palm software, and display its initial screen (see Illustration 9).



Illustration 9 - The ECU+ Palm initial screen

## 7.3 Changing Screens - The Button Bar

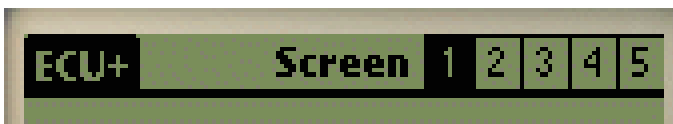


Illustration 10- The button bar

Using the ECU+ Palm software is simple. The software includes four different screens which allow you to display the engine's sensor values or tune the fuel and timing maps. To switch between screens, simply tap one of the four buttons along the top button bar (see Illustration 10). Selecting '2' will select screen 2, selecting '3' will select screen 3, and so on. Each screen serves a particular function:

## 7.4 Screen 1



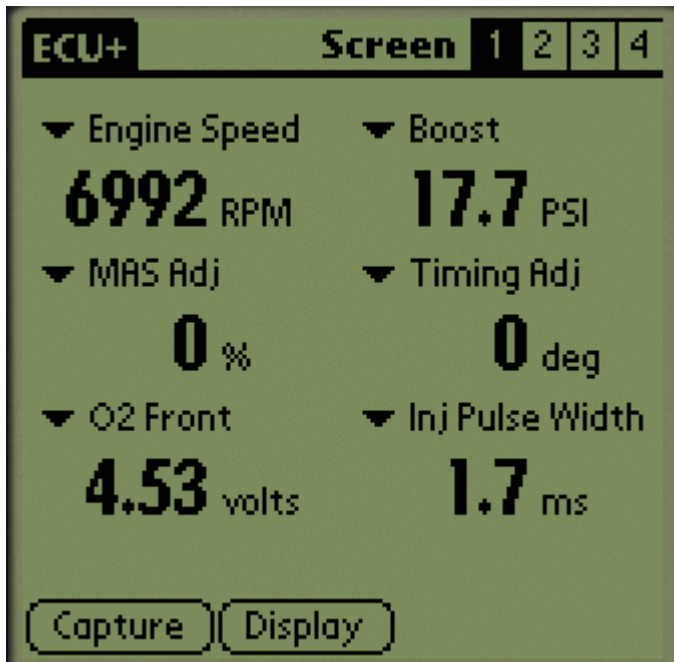


Illustration 11- Screen 1

Screen 1 is a general-purpose sensor display screen with large text. Six sensor values are displayed here, and the values shown are updated continuously.

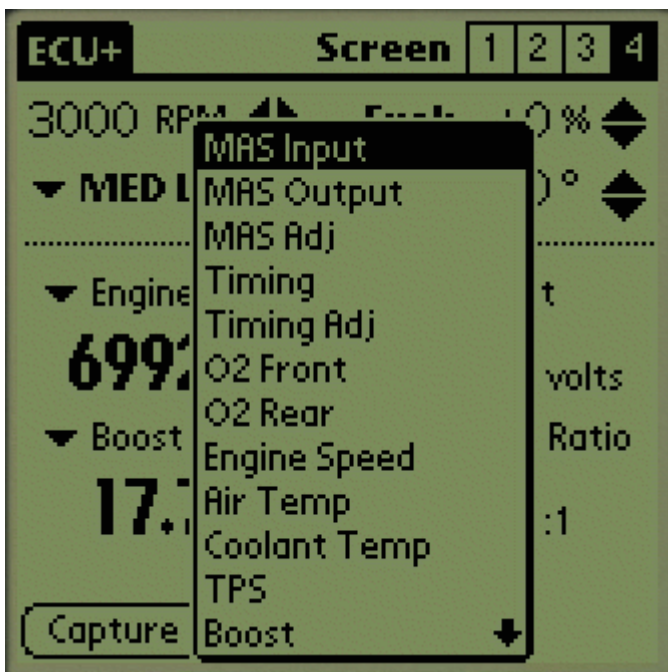


Illustration 12- Selecting a sensor

To change which sensors are displayed here, tap the down-arrow button above a given value, and select a new sensor (see Illustration 12). The ECU+ Palm software will remember how you've configured this (and other) screens between sessions.

The sensors that you can display are:

- **MAS Input** - This is the frequency of your MAS (mass-air sensor), as seen by the ECU+ head unit, in Hz. The MAS measures the amount of air entering your engine, where higher



frequencies indicate more air.

- **MAS Output** - The frequency of the MAS sensor that the ECU+ sends on to your stock ECU. The stock ECU uses this value to determine how long to hold open the injectors, and thus, how much fuel to supply to the engine. Higher output frequencies tell the stock ECU to supply more fuel. The MAS output frequency is a function of the MAS input frequency, the current fuel adjustment, the injector scaling value, and the various "MAS tweaks."
- **MAS Adjustment** - The current adjustment to the MAS output frequency, as a percentage. You configure the fuel maps that the ECU+ head unit uses, and the head unit changes the MAS output frequency as you requested. The MAS adjustment shows the current adjustment that's in effect. Note that the MAS adjustment doesn't include any inherent change in the MAS output frequency caused by the injector scaling value – that is, if you've got injector scaling (say 550/660 cc) in effect, and your current fuel map value is -10%, the MAS adjustment will show -10% even though the MAS output frequency is also affected by the injector scaling.
- **Timing** - The current engine timing, as a number of degrees. The engine timing determines where in the piston revolution that the spark plug fires, and is measured in degrees before or after top-dead-center (TDC) of the piston. This value is positive if the spark fires before TDC, and negative if after.
- **Timing Adjustment** - As with the MAS Adjustment, this is the current timing adjustment (in degrees) that the ECU+ head unit is using. To adjust the engine timing, the ECU+ head unit slides the cam and crank angle sensor signals of your engine forward or backward by a specified number of degrees, and passes these modified signals on to the stock ECU.
- **O2 Front** - This is the reading of the front oxygen (O2) sensor in your car, in volts. The front oxygen sensor, normally located just beyond the turbocharger in the exhaust downpipe, outputs a voltage roughly corresponding to how rich your engine is running. Higher voltages indicate a richer mixture (more fuel for every molecule of air) while lower voltages indicate a leaner mixture (less fuel for every molecule of air). This signal is typically between zero and 1 volt, and will switch back and forth between rich and lean when your car is idling or at part throttle in normal driving situations. Note: when O2 sensors get old or are failing, they often have little or no output voltage, or are very "slow" to react to changes in fuel mixture. Also, a lack of voltage can indicate that the heater inside the O2 sensor is defective.
- **O2 Rear** - The voltage from the rear O2 sensor, if applicable. The rear O2 sensor, when installed, is on the far side of the catalytic converter (cat), and is often used by the stock ECU to detect when the cat has been removed or is defective. Removal of the cat will often trigger a "check engine" light from the stock ECU. Note that the ECU+ head unit can generate a simulated version of this rear O2 sensor signal, which can be fed to the stock ECU to avoid the check engine light. This capability is for off-road situations only.
- **Engine Speed** - Your engine's speed, as a number of revolutions per minute (RPM).
- **Air Temp** - The temperature of the air entering your engine, in degrees fahrenheit, as measured by the air temperature sensor. The air temperature sensor is located in the air intake, and is generally an integral part of the MAS. This temperature readout here will generally be a bit hotter than the true air temperature outside of your car.
- **Coolant Temp** - The temperature of the coolant in your engine, as measured by the coolant temperature sensor.
- **TPS** - The voltage from your engine's throttle position sensor. The TPS measures how far you've pressed on the accelerator, as a voltage between zero and 5 volts. The ECU+ head unit considers a voltage above 4 volts to be wide-open-throttle (WOT), or below 0.75 volts to

be closed throttle.

- **Boost** - Your turbocharger boost level, in pounds per square inch (PSI). Note that this reading requires an optional MAP sensor. If you haven't installed a MAP sensor, this reading will be zero. Typically readings for a car at WOT will be 12-25 PSI, though this value varies widely depending on your turbocharger.
- **Inj Pulse Width** - This is the pulse width, or on-time, of your engine's injectors, measured in milliseconds (ms, or thousandths of a second). To squirt fuel into your engine, the stock ECU turns on the injectors for a fraction of a second - the longer the injectors are on, the more fuel is squirted. This value will typically read out around 2 ms at idle, and much more at WOT.
- **Inj Duty Cycle** - The "duty cycle," or ratio of on-time to total-time, for your engine's injectors. This is displayed as a percentage. The stock ECU has a fixed amount of time available to it in which it can squirt the injectors. This fixed time is inversely proportional to the engine RPM (higher RPMs - less time). The injector duty cycle measures what percentage of the total time available that the injectors were on. 72% would indicate that the injectors were on 72% of the time that was available.
- **Vehicle Speed** - This is the car's approximate speed, as measured by the vehicle's speed sensor. Note that this is an approximate value that is pretty close for stock vehicles. However, changing tire or wheel size on your vehicle will affect the accuracy of this read-out.
- **Knock Voltage** - This is a specially-conditioned version of the output of your vehicle's knock sensor. The ECU+ head unit uses specialized input and conditioning hardware and software to monitor the knock sensor, and displays this value as the knock voltage. When your engine is knocking, you'll see "spikes" on the knock voltage display.
- **Spare 0, 1 and 2**. These are spare analog inputs to the ECU+ head unit that can be used for any signal that ranges between zero and 5 volts. The voltage displayed here is the voltage of these spare inputs, and can be used for things like a wideband O2 sensor or EGT (exhaust gas temperature) probe adapter. If you've hooked up a wideband O2 sensor to spare 2, this value can instead display the engine's air/fuel ratio, where 10:1 is very rich, and 20:1 is very lean. If you've hooked up an EGT probe and adapter to spare 1, this value can instead display the engine's exhaust gas temperature.

## **7.5 Screen 2**

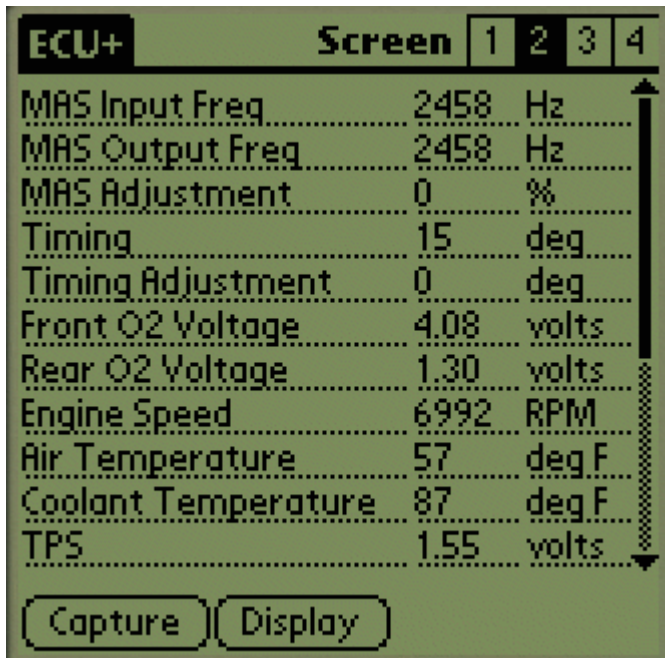


Illustration 13- Screen 2

Screen 2 is the catch-all sensor display screen. This screen displays as many of the sensor values as possible on one screen. As with screen 1, the displayed values are updated continuously. Tap the scroll bar on the right side to see the rest of sensor values.

## 7.6 Screen 3

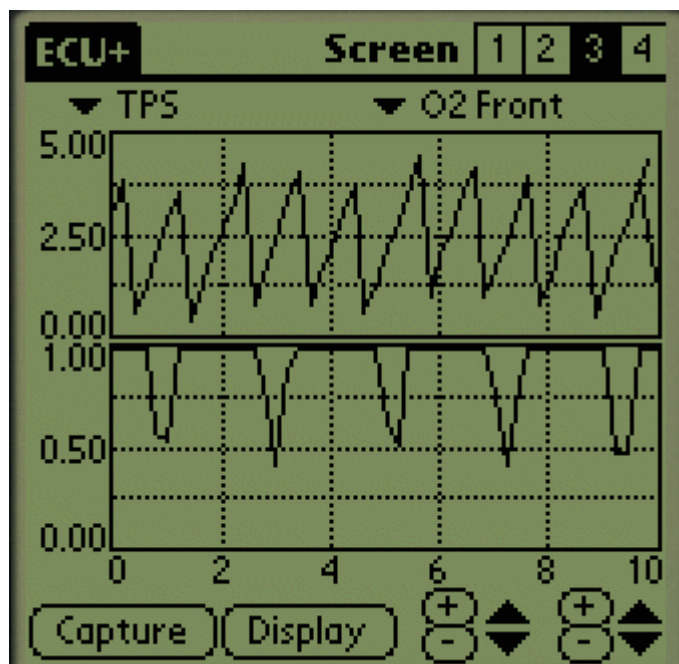


Illustration 14- Screen 3

Screen 3 is the graphing screen. Two sensor values will be graphed here in real time. As with screen 1, which two sensors you'd like to graph can be selected by tapping the down-arrow button on the text fields at the top. At the bottom, two sets of buttons are available to zoom in and out on a graph. The first set of buttons is for the top graph, and the second set of buttons is for the bottom graph. For each, tap the '+' button to zoom in, and the '-' button to

zoom out. Tap the up button to scroll the graph upward, or the down button to scroll the graph downward. Note that the ECU+ Palm software displays exactly 10 seconds worth of data here in real-time - it's not possible to scroll backwards to see old data.

## 7.7 Screen 4

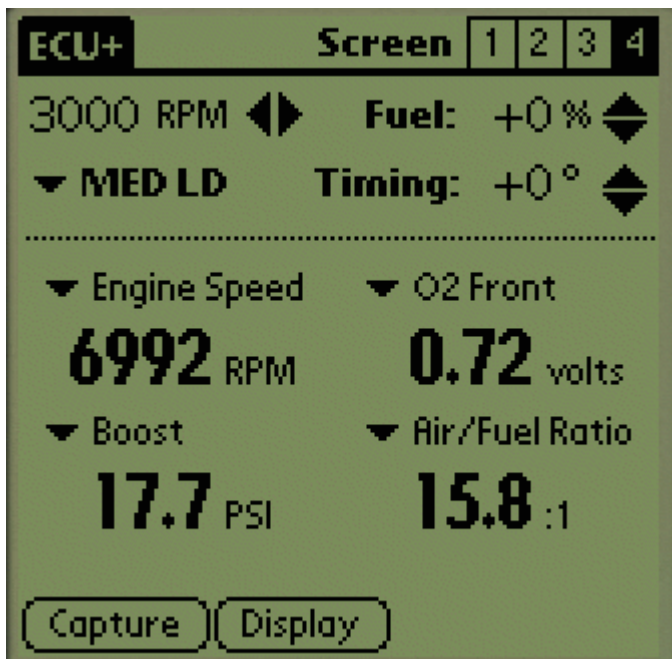


Illustration 15- Screen 4

Screen 4 is the tuning screen. Four sensor values are displayed and updated continuously. In addition, you can use the top section of the screen to display and modify the fuel and timing maps for your ECU+ head unit. The head unit contains 129 fuel and 129 timing map “cells” which allow you control your engine's behavior. The fuel and timing map cells are arranged as follows:

<i><b>RPM</b></i>	<i><b>Low</b></i>	<i><b>Medium</b></i>	<i><b>High</b></i>	<i><b>WOT</b></i>
Idle	0	Not used	Not used	Not used
1000	0	0	0	0
1250	0	0	0	0
1500	0	0	0	0
2000	0	0	0	0
...	0	0	0	0
7500	0	0	0	0
7750	0	0	0	0
8000	0	0	0	0

Table 1 - The fuel table

There are 129 cells for both the fuel and timing maps - one for idle, and one each for low, medium, and high loads, and one for wide-open-throttle (WOT) conditions. Each of these can be set individually - the fuel maps cell values can range from -50% to +50%, and the timing map cell values can vary between -15 degrees and +15 degrees.

To configure a given load and RPM combination, tap the down arrow above the load value to select a load, and tap the right or left buttons next to the RPM display to select the combination you want. Then tap the up or down buttons for the fuel or timing table entry you want to change. Note that the left and right buttons next to the RPM display will cycle through all of the load and RPM values in order - that is, keep tapping the right button to cycle through all of the low load RPMs, then the medium load RPMs, and so on.

Screen 4 is particularly useful when tuning your car on a vehicle dyno. You can set the sensor displays to things that are useful for a dyno run, like RPM, front O2 voltage, air/fuel ratio, knock and engine timing, and then rev your engine to match a given RPM/load setting. Then adjust the fuel and timing settings to achieve the air/fuel ratio and engine timing that you desire.

## 7.8 The Menu Bar



Illustration 16- The Palm menu bar

The menu bar (see Illustration 16) provides access to the less common screens available in the ECU+ Palm application. To bring up the menu bar, tap the Palm's menu key. From the menu bar, various setup, OBD and help screens are available.

### 7.8.1 The ECU+ Palm Setup Screen

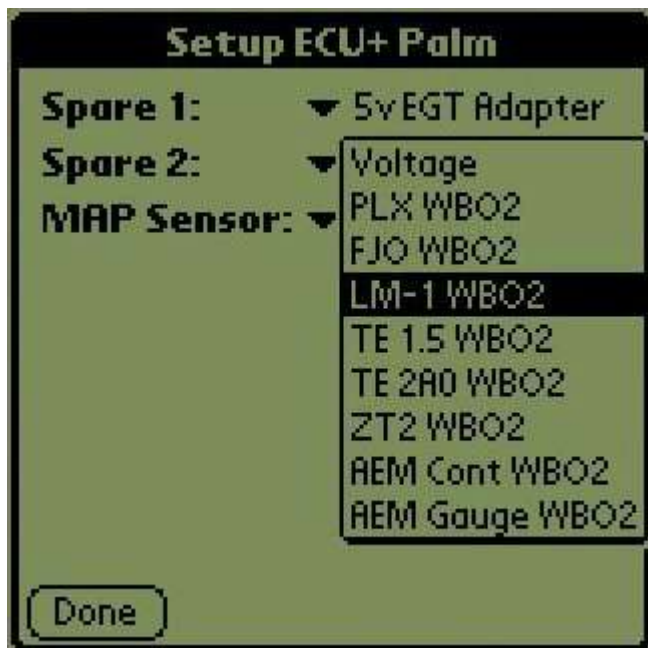


Illustration 17- The ECU+ Palm setup screen

The ECU+ Palm setup screen lets you configure several parameters related to the ECU+ Palm application:

- *Spare 1 Function* – The spare 1 analog input can be used as a general-purpose 5 volt input, or it can be hooked to a EGT adapter which converts the signal from an EGT probe into a 5v signal. Select Voltage here to use spare 1 as a general-purpose input, or select 5v EGT Adapter to use this input with an adapter.
- *Spare 2 Function* – The spare 2 analog input can be used as a general-purpose 5 volt input, or it can be hooked to a variety of supported wideband O2 sensors. Select Voltage here to use spare 2 as a general-purpose input, or select the wideband sensor kit if you're using this input for air/fuel ratio display.
- *MAP Sensor Type* – To display and capture boost, the ECU+ requires an external MAP sensor. Three map sensors are currently supported:
  - The “GM 3-Bar” map sensor.
  - The SenSym ASCX30 two-bar map sensor,.
  - The AEM 3.5 bar map sensor.

To change any of these parameters, tap the down arrow next to the value. Tap the *Done* button when you're finished.

Note that each of these parameters change how the ECU+ Palm application interprets the spare 1, spare 2 and boost voltages, respectively. You'll need to make matching changes to the ECU+ Win software.

### **7.8.2 The Head Unit Setup Screens**

The other setup screens available from the menu bar will be discussed in the section Configuring the ECU+ Head Unit on page 56.

### **7.8.3 The OBD Screens**

The OBD-related screens available from the menu bar will be discussed in the section On

Board Diagnostics (OBD) on page 67.

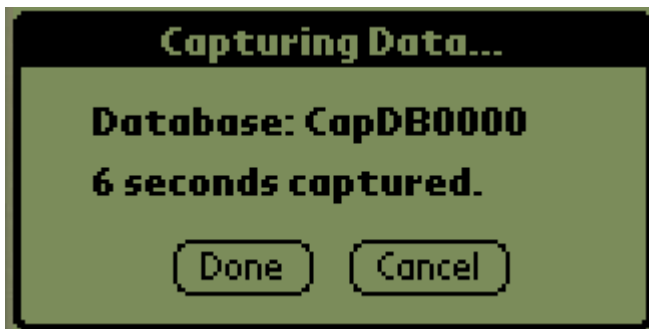
#### **7.8.4 The About Screen**

The about screen displays the version number of the ECU+ Palm software.

### **7.9 Capturing Data**

The ECU+ Palm software can capture and store away "datalogging" information from the ECU+ head unit. These captures grab all of the engine sensor values 25 times per second and store them away in a Palm "database" which can be viewed, or more importantly, HotSync'd to a PC for use with the ECU+ Win software.

To start capturing data, tap the *Capture* button located at the bottom of each screen. The ECU+ Palm software will begin capturing data and display a status box that shows how many seconds of data have been captured so far.



*Illustration 18- The capture dialog*

Tap the *Done* button to save the captured data, or *Cancel* to discard it. Note that the Palm software saves captured data to a one-up database filename, which will match the filename (with a .ecd extension) when this data is HotSync'd to a PC.

### **7.10 Displaying Captured Data**

The ECU+ Palm software contains a simple viewer for displaying captured data. To invoke the viewer, tap the *Display* button at the bottom of each screen. This will invoke a display data dialog in which you can display the contents of a capture.



RPM	Bst	MasA	TimA	O2F	MPH
6992	17.7	0	0	1.43	54
6992	17.8	0	0	1.03	54
6992	17.8	0	0	1.03	54
6992	17.7	0	0	0.71	54
6992	17.7	0	0	0.71	54
6992	17.7	0	0	0.51	54
6992	17.7	0	0	0.51	54
6992	17.7	0	0	0.42	54
6992	17.7	0	0	0.42	54
6992	17.7	0	0	0.46	54

Done Columns ▼ CapDB0000

*Illustration 19- The data display dialog*

Tap the down arrow next to *Select a File*, and then select the Palm “database” you'd like to display. This will display the captured data in a simple columnar format, with a scroll bar that can be used to move up and down in the data. The viewer can display six sensor values (plus elapsed time) at once, and you can select which columns you'd like to see by tapping the *Columns* button and selecting the appropriate sensors. As with all of the other ECU+ Palm screens, your column selections will be remembered between sessions.

Tap the *Done* button when you've finished viewing a database.

### **7.11 Upgrading the ECU+ Palm Software**

Occasionally, there will be updates to the ECU+ Palm software posted on the ECU+ web site. To take advantage of these updates, download the software and extract the .zip file to a temporary location on your laptop. You'll find a file called EcuPlusPalm.prc. Drag and drop this file into the Palm Desktop's Quick Install tool, and next time you HotSync your Palm with your laptop, the new ECU+ Palm software will be automatically installed on your Palm.



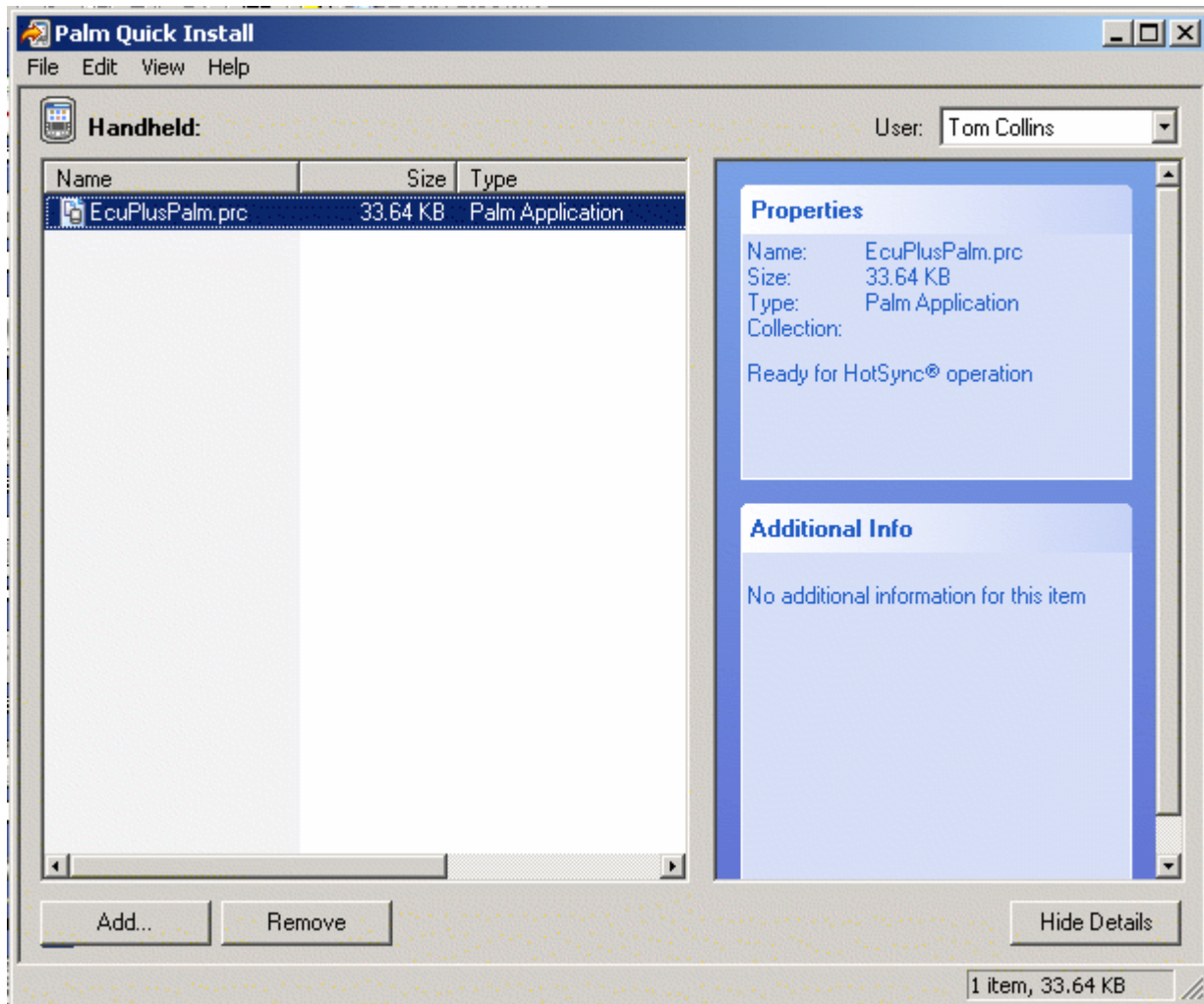


Illustration 20- The Palm Quick Install tool

## 7.12 HotSync'ing Captured Files to Your PC

When you do a capture via the ECU+ Palm software, the captured data is stored in your Palm as a Palm database. These databases will be automatically transferred from the Palm to your laptop whenever you do a HotSync operation. If you've installed the Palm Desktop software in the standard place on your laptop, you'll find these captured data files in the directory:

***C:\Program Files\Palm\LastnameF***

where LastnameF is your last name and first initial.

## 8 Using the ECU+ Win Software

### 8.1 Introduction

The ECU+ Win software, like the ECU+ Palm software, interfaces to your ECU+ head unit and allows you to tune the ECU+, perform a capture, or just monitor your engine's sensors. Unlike the Palm software, though, the ECU+ Win software also includes advanced data analysis and display capabilities that allows you to easily and accurately configure the ECU+

head unit to make your car perform at peak levels.

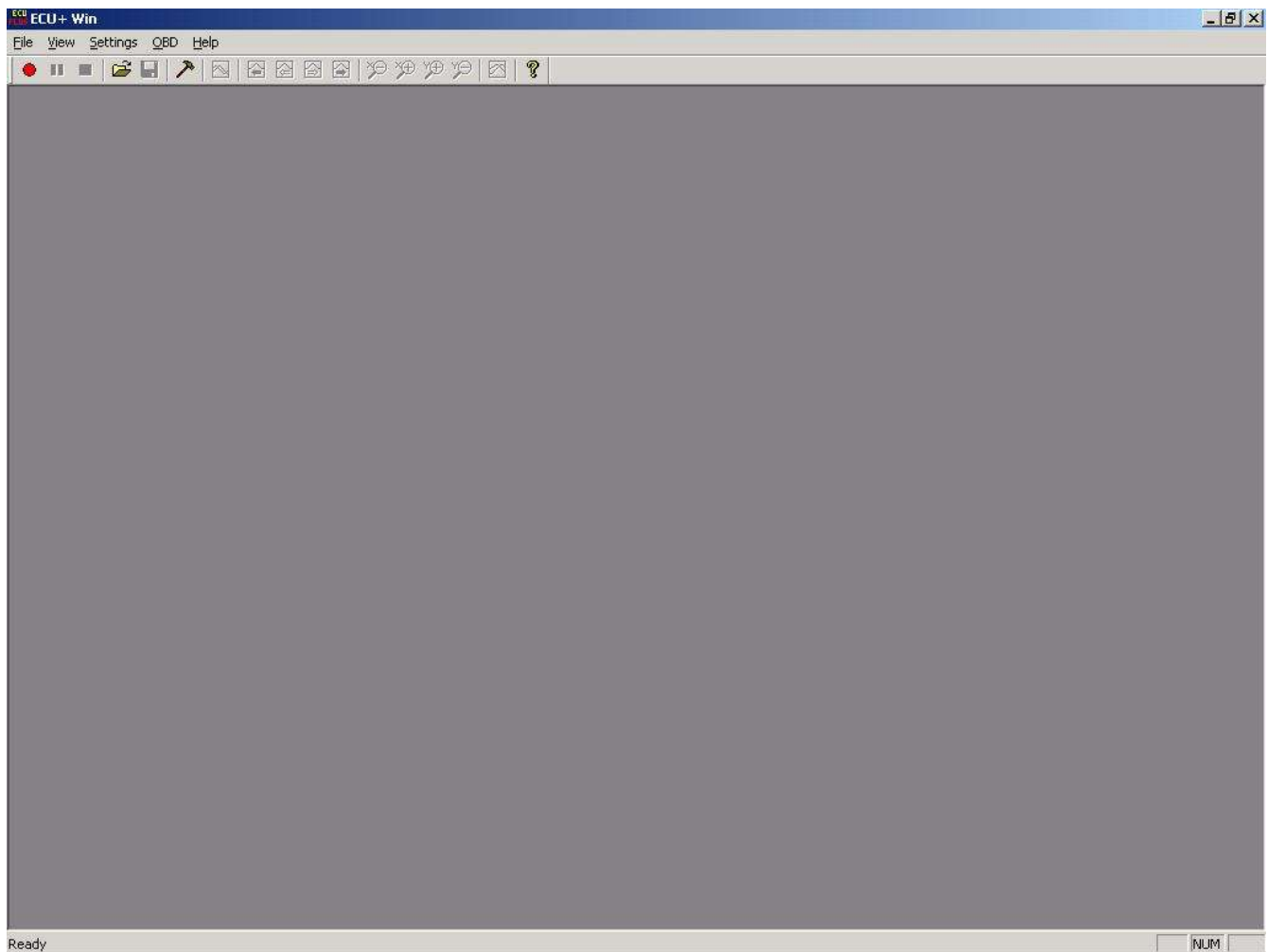
## **8.2 Starting the ECU+ Win Software**

To start the ECU+ Win software, double-click the icon on your desktop.



*Illustration 21- The ECU+ Win icon*

The ECU+ Win software should start up and display its main screen (see Illustration 22).



*Illustration 22- The ECU+ Win main screen*

Because of the amount of information that the ECU+ Win software can display, you might want to maximize the application.

## 8.3 A Guided Tour of the Software

The ECU+ Win application is a relatively complex piece of software. Let's take a look at it one section at a time.

### 8.3.1 The Menu Bar



Illustration 23 - The menu bar

The menu bar (see Illustration 23) is at the top of the screen, and includes the usual Windows *File*, *View*, *Help* and other menu items. The menu bar will change slightly depending on what you are doing, but will always include *File*, *View* and *Help*. The sub-menus that are available on the menu bar are as follows:

#### 8.3.1.1 The File Menu



Illustration 24- The file menu

The file menu (see Illustration 24) is used to Open, Save, Close or Export a capture file, to start a New capture, or to exit the ECU+ Win application. You can also print the contents of a graph (discussed later in this manual) from the file menu. Depending upon what you're doing with the ECU+ Win software, one or more of the items on the file menu may be grayed out or not available.

The items on the file menu are as follows:

- **New Capture** - This connects to the ECU+ head unit and begins capturing data from it, while displaying the data in real time. This is equivalent to the Palm software's *Capture* button. Use this menu item to capture new data from your car.
- **Open Existing Capture** - This opens up an existing file on disk containing captured data, and displays the data for viewing or analysis. Use this menu item to display previously-captured data.
- **Close Capture** - When doing a new capture, this finishes the capture and prompts to save the data to disk. When viewing an existing capture, this closes the capture file and prompts to save the data if it's changed.
- **Save Capture** - This saves any changes you've made to an open capture file, but doesn't close the file.
- **Export Capture** - This allows you to export the currently open capture to a new file, in

comma-separated value (CSV) format. You'll be prompted for the name of the new file. CSV is a common format that can be read by many applications. Most often, you'll use a spreadsheet program (like Microsoft Excel) to read a CSV file for complex analysis and processing.

- *Print* - This prints the current graph view.
- *Print Preview* – Previews the graph view before printing.
- *Print Setup* - Lets you to configure your printer margins and other settings.
- *Numbered files* - The ECU+ Win software remembers the names of several recent capture files that you've opened, and displays them with a number next to them. Selecting a numbered file opens that file quickly, without going through the Open Existing Capture menu item.
- *Exit* - This exits the ECU+ Win application, and prompts to save any unsaved capture files.

### 8.3.1.2 The View Menu



Illustration 25- The view menu

The view menu (see Illustration 25) allows you to toggle on and off the toolbar and status bars for more on-screen real estate. Simply select a menu item to toggle it on and off.

### 8.3.1.3 The Window Menu



Illustration 26 - The window menu

The window menu (see Illustration 26) allows you to arrange the windows in the display area. *Cascade*, *Tile* and *Arrange Icons* work as in other Windows software, but *Auto Arrange* is

unique, tiling the visible view windows in a sensible manner. The numbered windows on this menu makes the selected window current (in front) and un-minimizes it if necessary. The *More Windows* dialog does the same thing, but is used when more than 9 windows are shown in the display area.

Note that the *Window* menu will only be available when displaying an existing capture file or capturing data to a new file.

#### 8.3.1.4 The Settings Menu



Illustration 27 - The settings menu

The *Settings* menu (see Illustration 27) allows you to configure the ECU+ Win software as well as the ECU+ head unit. Select either from the menu, and then follow the instructions below for setting each up.

#### 8.3.1.5 The OBD Menu



Illustration 28 - The OBD menu

The *OBD* menu (see illustration Illustration 28) invokes the OBD functionality of the ECU+. This functionality will be discussed in the section On Board Diagnostics (OBD) on page 67.

#### 8.3.1.6 The Help Menu

The *Help* menu has a single menu item which displays the *About* dialog for the ECU+ Win application. The about dialog just displays the software version and copyright information.

### 8.3.2 The Toolbar



Illustration 29- The toolbar

The toolbar (see Illustration 29) is a quick way to access various ECU+ Win menu items with just a single click. The items on the toolbar, and the menu item equivalences are (from left to right):

- **New Capture** - The record icon. This begins capturing data from the ECU+ head unit. This is equivalent to *File->New Capture*.
- **Pause Capture** - The pause icon. This button temporarily pauses the current capture so that you can scroll back and look at old data. Click this button once to pause the capture, and then again to restart the capture. Any data received from the ECU+ head unit while the capture is paused is lost. There is no menu item equivalent to this button.
- **Close Capture** - The stop icon. This closes a new capture or existing capture file, and prompts to save the data if it's changed. This is equivalent to *File->Close Capture*.
- **Open Existing Capture** - The open folder icon. This opens an existing capture file for analysis. This is equivalent to *File->Open Existing Capture*.
- **Save Capture** - The floppy disk icon. This manually saves the current capture if it's changed. This is equivalent to *File->Save Capture*.
- **Setup Head Unit** - The hammer icon. This brings up the dialog box to configure the ECU+ head unit's fuel and timing maps and other parameters. This is equivalent to *Settings->ECU+ Head Unit*.
- **Add Overlay** - The two-graph icon next to the hammer icon. This adds a new overlay to the current capture file for comparison purposes. This is equivalent to *Graph Context Menu->Overlaid Plots->Add New*.
- **Overlay Shifting** - The next four icons (which show a graph and an arrow) are shortcuts used for shifting the most recent overlay to the left or right. The icons represent shifting left 1/4 page, left by one, shift right by one, and right by 1/4 page, respectively. These are equivalent to *Graph Context Menu->Overlaid Plots->Shift Last*.
- **Graph Zooming** - The next four icons (magnifying glass-like) are used to zoom a graph's X or Y axis in or out, and are equivalent to *Graph Context Menu->Zoom X(Y) Axis->In(Out)*. They zoom the current graph out on the X axis, in on the X axis, out on the Y axis and in on the Y axis, respectively.
- **Dyno Analysis** - The dyno icon. This brings up the dyno analysis dialog. This is equivalent to *Graph Context Menu->Analyze->Dyno Analysis*.
- **Help** - The question mark icon. Displays the current ECU+ Win "About" dialog. This is equivalent to *Help->About ECU+ Win*.

Note that the toolbar can be toggled on and off with the *View->Toolbar* menu item. If you never use the toolbar, you may want to turn it off.

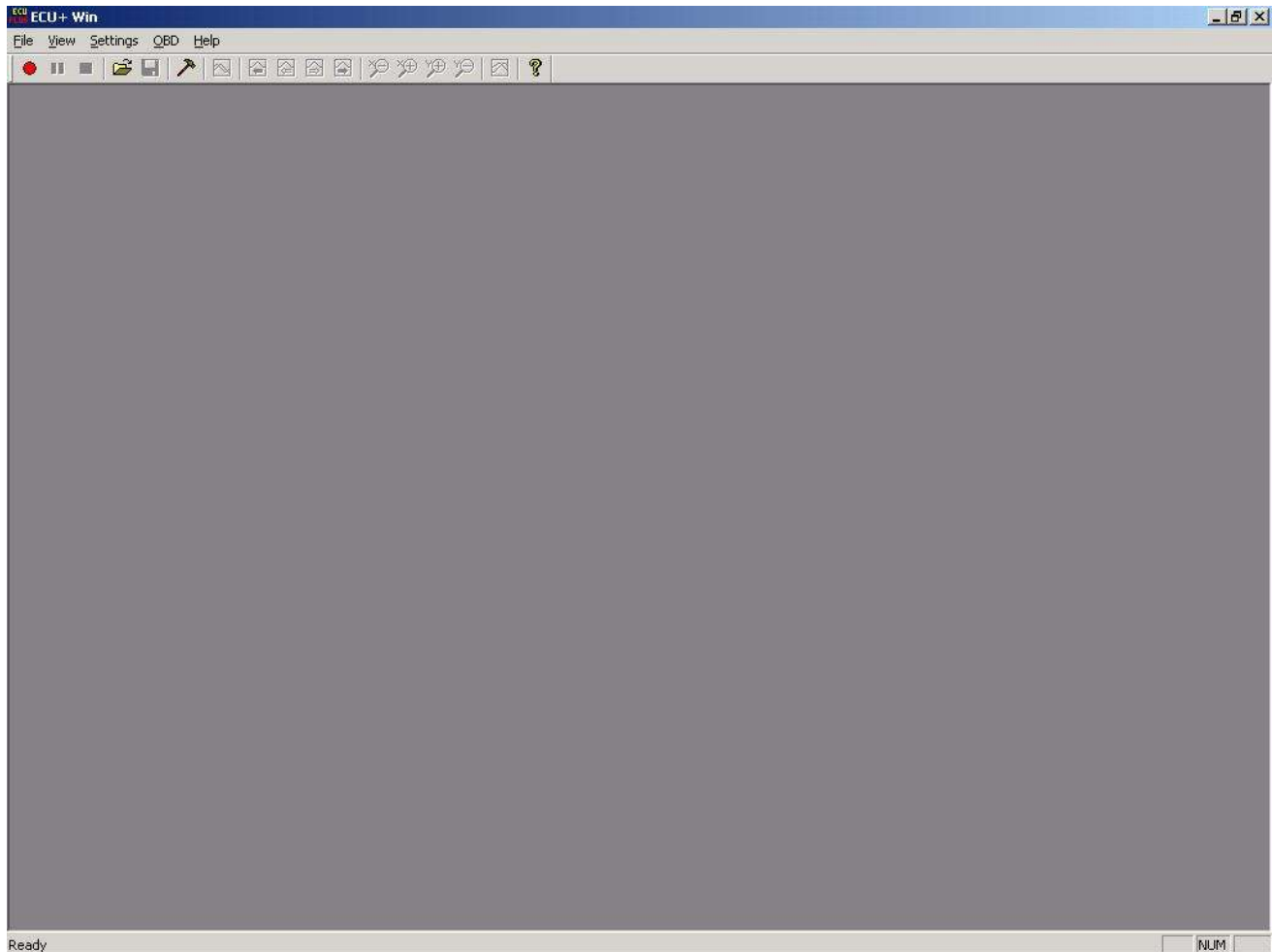
### 8.3.3 The Status Bar



Illustration 30- The status bar

The status bar (see Illustration 30) is used to display the settings of the keyboard caps-lock (CAP), num-lock (NUM) and scroll lock (SCRL) keys, as well as longer descriptions of menu items. The status line can be safely turned off with the *View->Status Bar* menu item.

### 8.3.4 The Display Area



*Illustration 31- The display area*

The display area makes up the bulk of the ECU+ Win's screen space. Inside the display area, the software will display “views” of a live or captured data file. A view is just a sub-window in which data is displayed. Views will either be text boxes, containing data values numerically, or graphs showing data in graph form. More information on views is available in section Setting Up Views on page 49.

## **8.4 Creating a New Capture**



*Illustration 32 - The new capture menu item*



The ECU+ Win software can capture and store away "datalogging" information from the ECU+ head unit. These captures grab all of the engine sensor values 25 times per second and store them away in a file on your computer's hard disk. This captured data contains a permanent record of your engine's operation, and can be later loaded back into the ECU+ Win software for analysis or comparison to other captures.

To create a new capture file, use the *File->New Capture* menu item, or click on the record icon in the toolbar. The ECU+ Win software will then open up the serial port and try to connect to the ECU+ head unit. Once the connection is established, the software will open up the views that you've configured and begin capturing data from the head unit. While the capture is going on, you can open, close or resize any of the views in the display area. At any point during the capture, you can use *File->Close* or click the stop icon in the toolbar to stop capturing. When you stop capturing, ECU+ Win will prompt for you to save the file, and display the standard Windows file-save dialog. At any point during the capture, you can also pause the capture by clicking the pause icon in the toolbar. Any data accumulated from the head unit while paused will be lost.

## 8.5 Opening an Existing Capture File



Illustration 33 - The open existing capture menu item

Captures that you've acquired with either the ECU+ Win or the ECU+ Palm software can be loaded into ECU+ Win by "opening" an existing capture file. To do this, use either the *File->Open Existing Capture* menu item, or click the open folder icon on the toolbar and select the capture file you'd like to view. ECU+ Win will open this file and display its contents within the views you've configured. When you're done with this capture, use *File->Close* capture to close it out.

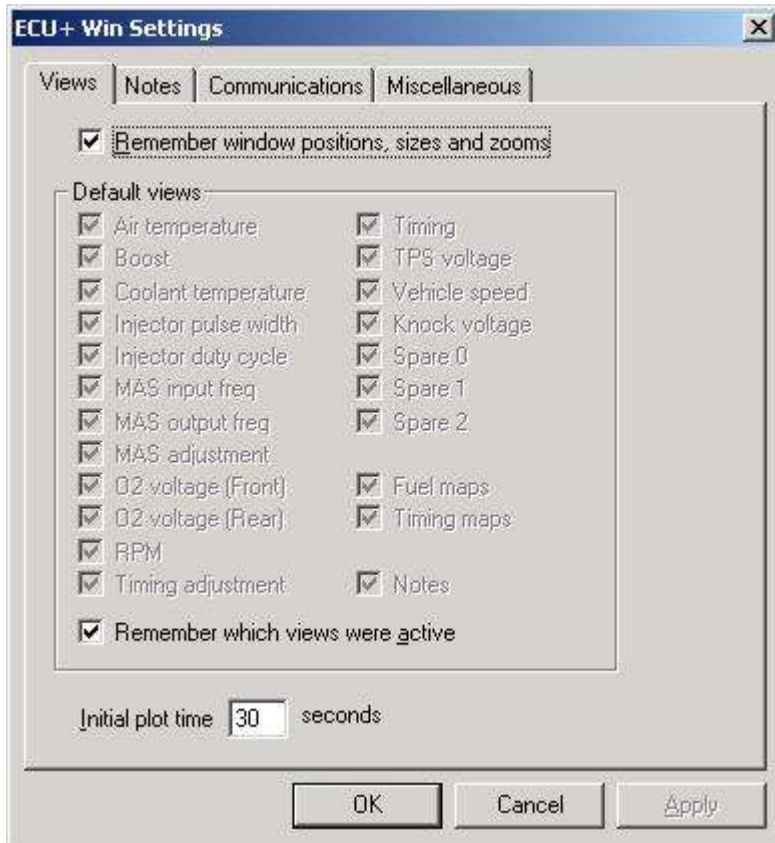
Note: Only one capture file can be open at a time. You can, however, overlay one capture on top of another. See the section *Overlaying Multiple Capture Files* on page 50 to see how this powerful technique works.

## 8.6 Configuring the ECU+ Win Software

To configure the ECU+ Win software, use the *Settings->ECU+ Win* menu item. This opens the ECU+ Win configuration dialog. This has four tabs:

### 8.6.1 View Configuration





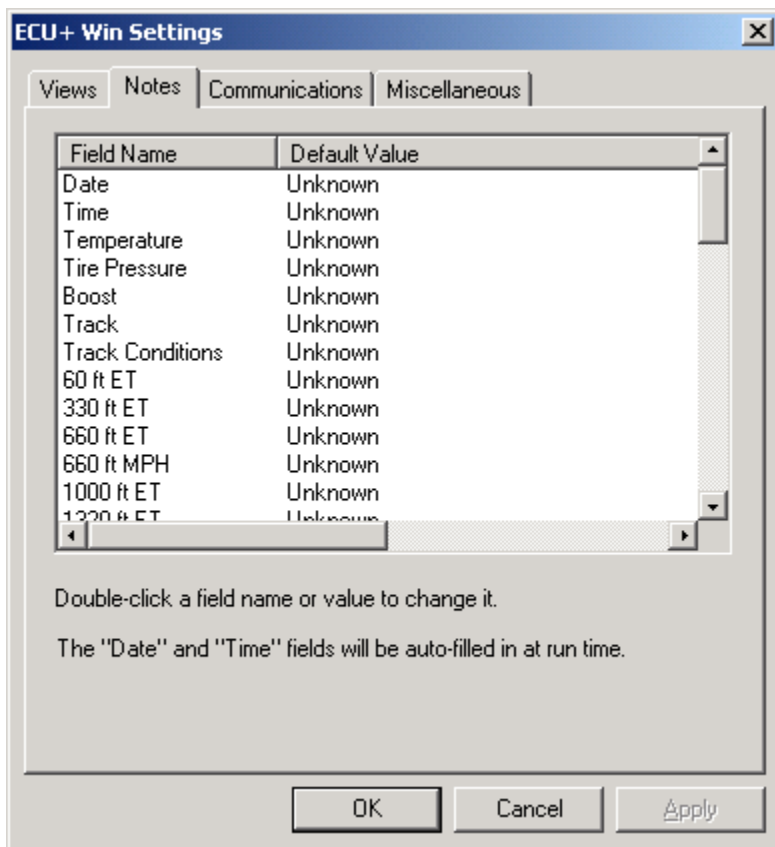
*Illustration 34- The view configuration tab*

The view configuration tab tells the ECU+ Win software what views you'd like to see by default. When you start a new capture or open an existing capture file, the ECU+ Win software starts up and displays one or more views of the data associated with this capture. If *Remember which views were active* is checked, the ECU+ Win software will display the same set of views that were active the last time you showed a capture. If this is un-checked, the checked views will be shown instead,

The checkbox *Remember window positions, sizes and zooms* determines whether the ECU+ Win software will restore the views in the same window position, minimized status, and overlap as before.

Lastly, the *Initial plot time* text field sets how many seconds the X axis of the graph views will display by default.

## 8.6.2 Notes Configuration

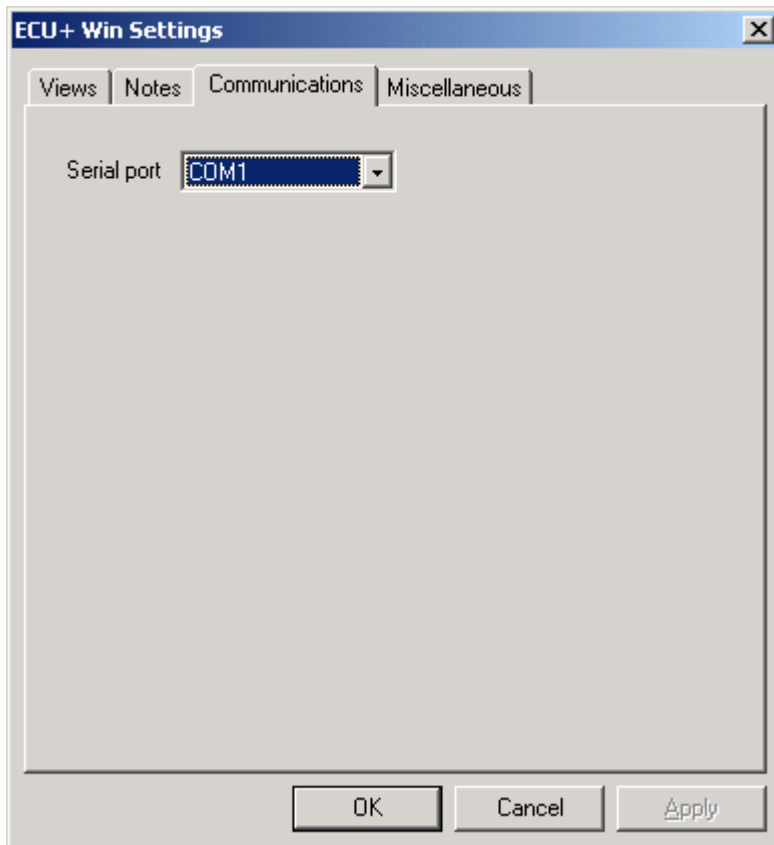


*Illustration 35- The notes configuration tab*

The Notes configuration tab allows you to configure which notes get added to new captures by default. When you start a new capture, the ECU+ Win software automatically copies the values defined here into the notes view for that capture. You can add or delete values from this dialog to configure what notes are used by default. If a field named "Date" and/or a field named "Time" is defined here, it's filled in by the ECU+ Win software when the new capture is started.

Double-click a field name or value to change it, and then press ENTER.

### 8.6.3 Communications Configuration



*Illustration 36- The communications configuration tab*

The communications configuration tab sets up what serial port your laptop will use when talking to the ECU+ head unit. Typical values used are COM1 (with a laptop that has a “real” serial port), or COM5 (with a laptop using a USB-to-serial adapter). Click the dropdown arrow to change this value.

## 8.6.4 Miscellaneous Configuration

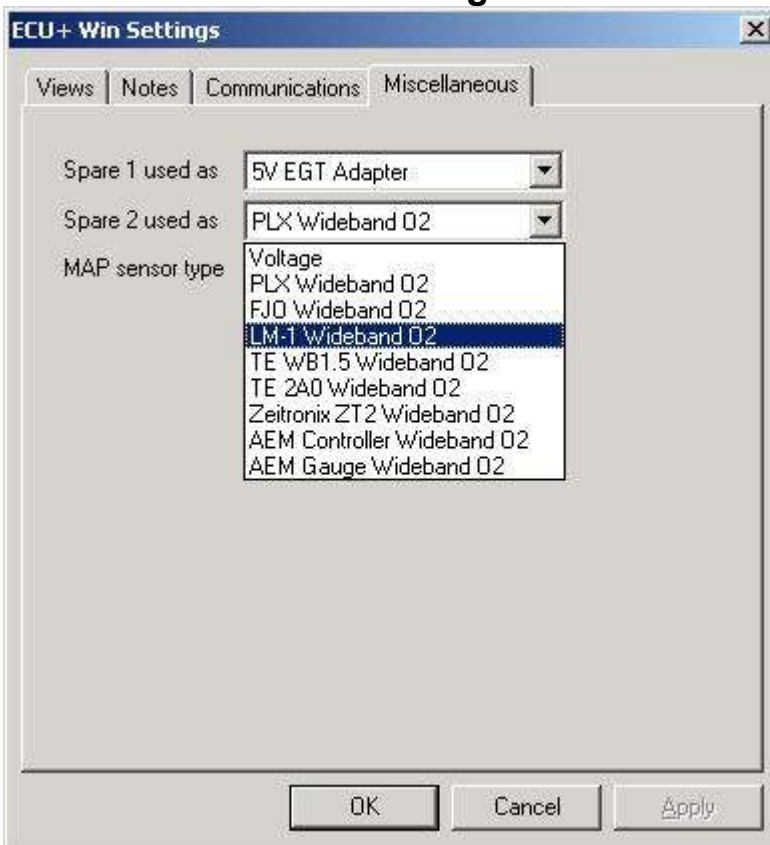


Illustration 37- The miscellaneous configuration tab

The miscellaneous configuration tab lets you configure several miscellaneous parameters:

- **Spare 1 Function** – The spare 1 analog input can be used as a general-purpose 5 volt input, or it can be hooked to a EGT adapter which converts the signal from an EGT probe into a 5v signal. Select Voltage here to use spare 1 as a general-purpose input, or select 5v EGT Adapter to use this input with an adapter.
- **Spare 2 Function** – The spare 2 analog input can be used as a general-purpose 5 volt input, or it can be hooked to a variety of supported wideband O2 sensors. Select Voltage here to use spare 2 as a general-purpose input, or select the wideband sensor kit if you're using this input for air/fuel ratio display.
- **MAP Sensor Type** – To display and capture boost, the ECU+ requires an external MAP sensor. Three map sensors are currently supported:
  - The “GM 3-Bar” map sensor.
  - The SenSym ASCX30 two-bar map sensor,.
  - The AEM 3.5 bar map sensor.

Click the dropdown for one of these to change the current values..

Note that each of these parameters change how the ECU+ Win software interprets the spare 1, spare 2 and boost voltages, respectively. You'll need to make matching changes to the ECU+ Palm software.

## 8.7 The About Dialog

The About dialog, accessible from the menu item Help->About ECU+ Win, displays the version of the ECU+ Win software and a copyright notice.

## 8.8 The Views

When displaying the contents of a captured data file, the ECU+ Win software opens up multiple views of the data in the display section of the software. There are several types of views that the software can display. Some views display several values, some are graphs that can be scrolled around in, and some are just simple text displays. Let's take a look at them:

### 8.8.1 The Engine Monitor View

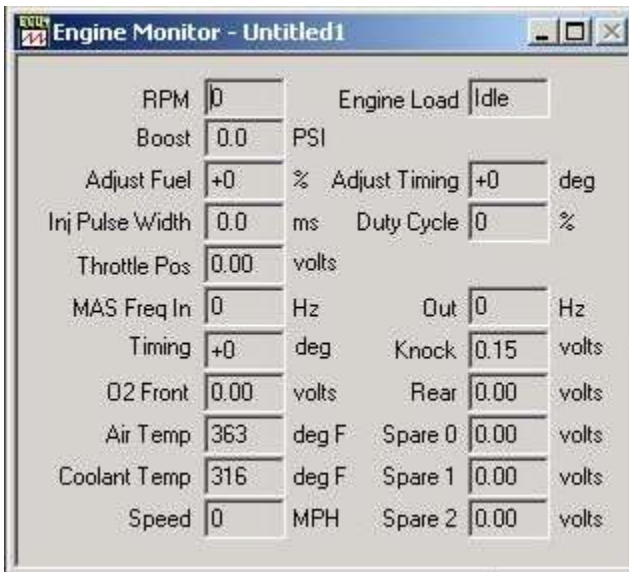


Illustration 38- The engine monitor view

The engine monitor view (see Illustration 38) is your one-stop shop for everything that the ECU+ head unit knows about your engine's sensors. It displays a variety of information about the engine's sensors and what the head unit is doing. When doing a new capture of live data, the engine monitor displays the current data from the engine sensors in real time. When viewing a capture file from disk, the contents of the engine monitor reflect the cursor position on the current graph view. Thus, the engine monitor displays the current engine data at all times as a "snapshot" of what's going on.

Note: the engine monitor is the only view that can't be closed by clicking the 'X' in the upper right of the window.

### 8.8.2 The Notes View

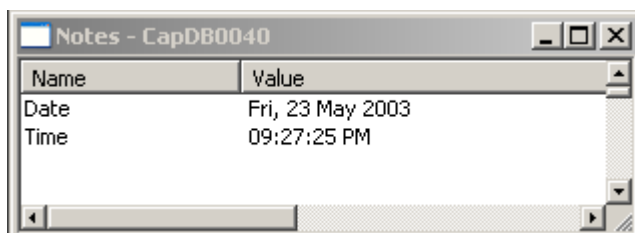


Illustration 39- The notes view

The notes view displays any notes associated with the current capture. You can edit a note's name or value by double-clicking on the field, making your change, and then pressing ENTER.

### 8.8.3 The Plot Color Legend View

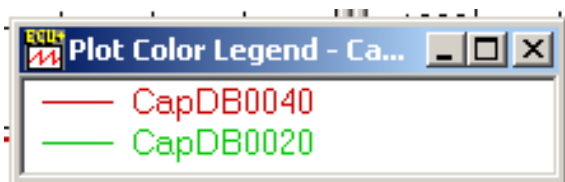


Illustration 40- The plot color legend view

The plot color legend view (see Illustration 45) is a simple box that shows what colors are being used in the graph views when multiple files are overlaid.

### 8.8.4 The Fuel Maps and Timing Maps Views

RPM	Low	Med	High	WOT
Idle	+0%			
1000	+0%	+0%	+0%	+0%
1250	+0%	+0%	+0%	+0%
1500	+0%	+0%	+0%	+0%
1750	+0%	+0%	+0%	+0%
2000	+0%	+0%	+0%	+0%
2250	+0%	+0%	+0%	+0%
2500	+0%	+0%	+0%	+0%
2750	+0%	+0%	+0%	+0%

Illustration 41 - The fuel maps view

The fuel and timing maps can also be displayed in the ECU+ Win software's display area. These views show the fuel and timing maps as they existed when the current capture was made. Additionally, the fuel or timing map value that corresponds to the current (new capture) or cursor (existing capture file) data value is shown highlighted in this view, and this view will auto-scroll so that the current value is on-screen. Remember that the ECU+ head unit interpolates between fuel or timing map cell values, so this highlighted value doesn't necessarily reflect the exact fuel or timing offset that the ECU+ head unit is using – rather, it's

the closest one. So, for example, if your engine RPM is 3125 RPM, the 3000 RPM map cell will be highlighted, when in fact the ECU+ head unit is actually using the value about half-way between 3000 and 3250 RPM.

## 8.8.5 The Graph Views

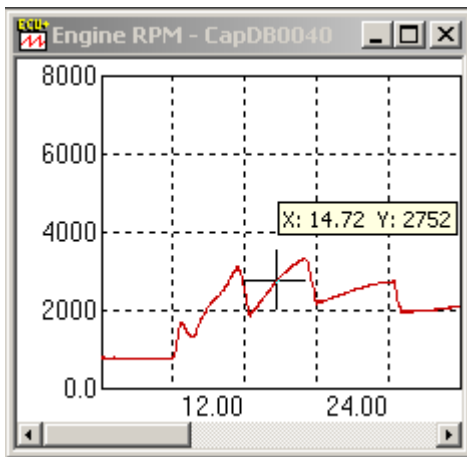


Illustration 42 - A graph view

The graph views are the most complex and powerful of the views to use. A graph view shows a single value from a capture in an X-Y plot, where the X axis is time, in seconds, and the Y axis is the single value. Graph views can be moved around, resized and zoomed. Let's see how these features work:

### 8.8.5.1 The Cursor and Moving Around

The cursor in a graph view (shown as a small cross that tracks the graph) represents the “current” spot on a graph. When you hover your mouse over a graph view, the cursor tracks the horizontal position of the mouse, and pops up a Windows tooltip showing you the current X and Y axis values of the cursor on that graph. If there are any other graph views displayed, a similar tracking cursor is displayed which follows the mouse on all of the graphs at the same time. If you have a engine monitor view active, the values in the engine monitor reflect the current cursor position.

To move the cursor around on a graph view, simply move the mouse. If you'd like to see other parts of the graph, you can use the X and Y scroll bars. Note that the X axis of each graph view is synchronized with the X axis of all of the other graph views.

### 8.8.5.2 Zooming In And Out

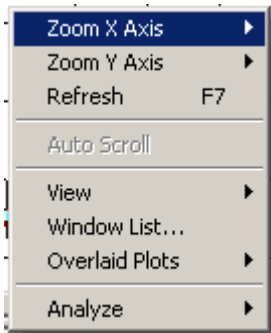
Sometimes a graph view won't reflect exactly the X and Y ranges you'd like to see. The ECU+ Win software gives you multiple ways of zooming in and out:

- The keyboard shortcuts F8, Shift+F8 and Ctrl+F8 are configured to zoom the X axis in, out, and to “full size” (as large as it can go), respectively.
- Similarly, F9, Shift+F9 and Ctrl+F9 zoom the Y axis.
- Other zoom options are available in the graph view Context menu (more on this in the next section).
- And last but not least, you can use the left mouse button to manually zoom to a specific

range – first, select the upper left corner, and press the left mouse button, then while holding down the mouse, drag the dotted box to the lower right corner and release the mouse.

### **8.8.5.3 Using the Graph Context (RMB) Menu**

Each graph view has what's called a “Context” or right-mouse-button menu, which you can access by right-clicking on the graph. This invokes a new menu:



*Illustration 43 - The graph view context menu*

The context menu has several items. The first three items apply to the current graph only, while the remaining options apply to the ECU+ Win software. The menu items are as follows:

#### **8.8.5.3.1 Zoom X Axis and Zoom Y Axis**

Use these menu items to zoom the X or Y axis of the graphs. Any X axis changes apply to all graphs, while any Y axis changes apply to the current graph only. You can zoom each axis in, out or to full size, or you can set the X and Y axis values to a specific size. The Y axis zoom has an additional option, “Fit Visible,” which will scale the Y axis to match the visible data in that graph.

#### **8.8.5.3.2 Undo Last Zoom**

This un-zooms the last zoom. The five most recent zooms are remembered, and can be undone. Note: this item isn't shown in Illustration 43.

#### **8.8.5.3.3 Refresh**

This menu item redraws the current graph.

#### **8.8.5.3.4 Auto Scroll**

When capturing new data, this option is enabled. With the option checked, new data will cause all of the graph views to scroll rightward. If you un-check the option, the graph will not scroll with new data. Compare this option to the pause icon – pause throws away new data while keeping the graph stationary, while Auto Scroll keeps the graph stationary while continuing to acquire new data.

#### **8.8.5.3.5 View and Window List**

These menu items will be described in the section Setting Up Views on page 49.



#### **8.8.5.3.6 Overlaid Plots**

This menu item will be discussed in the section *Overlaying Multiple Capture Files* on page 50.

#### **8.8.5.3.7 Analyze**

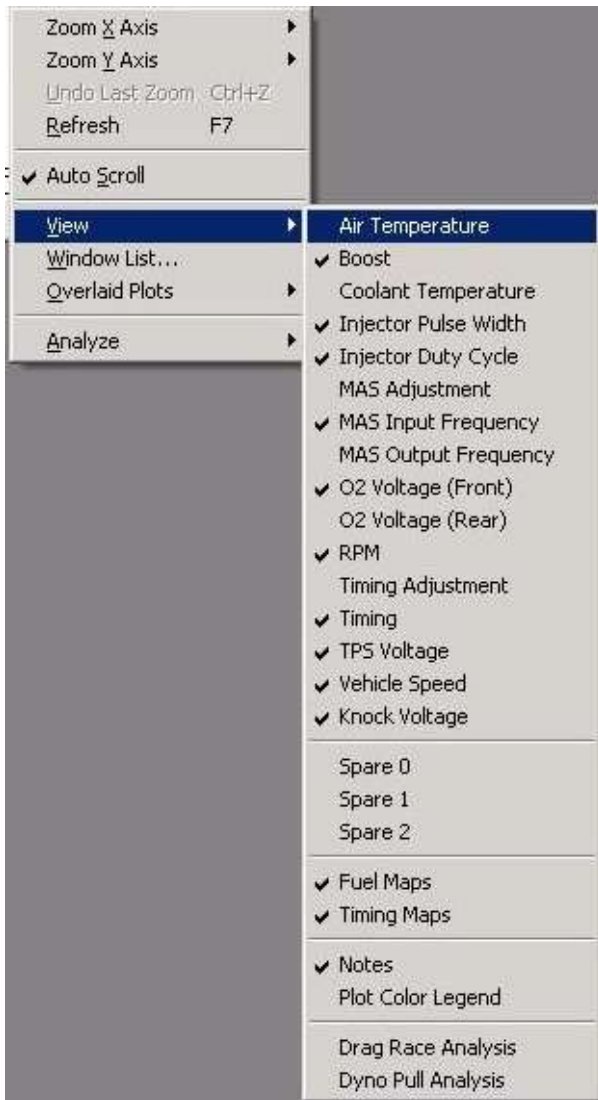
This menu item will be described in the section *Analysis Tools* on page 52.

### **8.8.6 Setting Up Views**

After starting a new capture or opening an existing capture file, the ECU+ Win software will open a collection of views to show you the data associated with the capture. Each view will open in a window in the display area of the software. You can then use the mouse or the Windows minimize and maximize buttons to resize each window. Your best bet, though, is to display the views you're interested in, and then use the *Window->Auto Arrange* menu item to tile the windows.

If you've minimized a view window, or it's underneath another window and you can't see it, you can use either the Window menu, and then select a window by number to show it, or right-click on another window, and select *Window List*.

To close out a view window, click the 'X' in the window's upper right corner. To display a new view window, use the right-click context menu, and select *View*. This will display a sub-menu that looks like this:



*Illustration 44 - The context view menu*

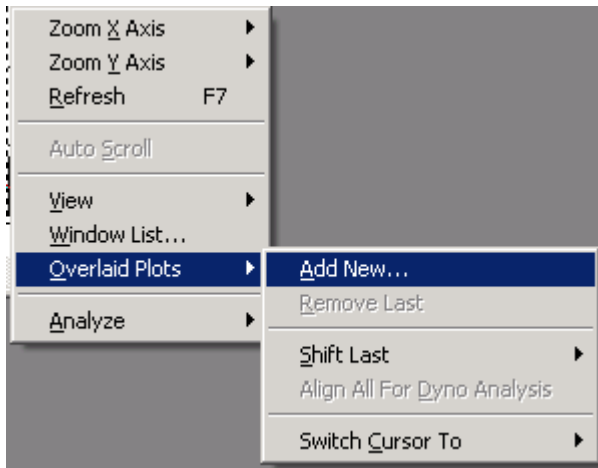
Click an item on this menu to activate or de-activate that view. Views that are checked are currently displayed, though they may be displayed in minimized view windows.

The key points to remember are:

- Use *Context Menu->View* to activate a view, or
- Use *Window->Window List* to un-minimize a view window or display it in front of the other windows

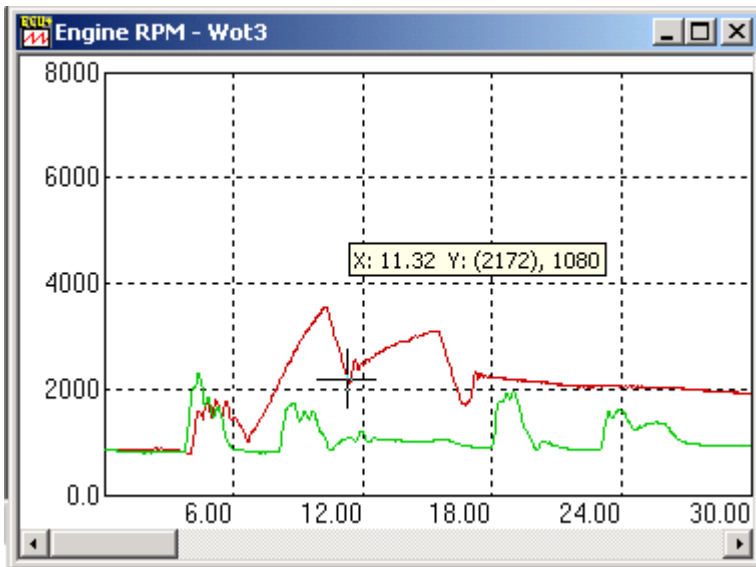
### 8.8.7 Overlaying Multiple Capture Files

When displaying a capture file, it's often handy to be able to view several capture files at the same time for comparison. The ECU+ Win software lets you do just that with the concept of "overlaid plots." Here's how it works:



*Illustration 45- The overlaid plots menu*

1. Open up an existing capture file, and arrange the view windows the way you like them.
2. Use the right-click context menu on one of the graphs, then select Overlaid Plots->Add New. The standard Windows file-open dialog will appear. Select another capture file.
3. The ECU+ Win software will overlay this new capture directly on top of the original capture file, using a different color for each capture on the graph.



*Illustration 46- Two overlaid captures*

4. When you hover the mouse over the graph, the Windows tooltip will display the Y axis values for all of the overlaid captures. The current capture's value is in parenthesis. You can switch which capture is current with the TAB and shift-TAB keys.
5. Next use the "Shift Last" menu item (or the more-convenient "Align All for Dyno Analysis" menu item) to align the two plots in time:

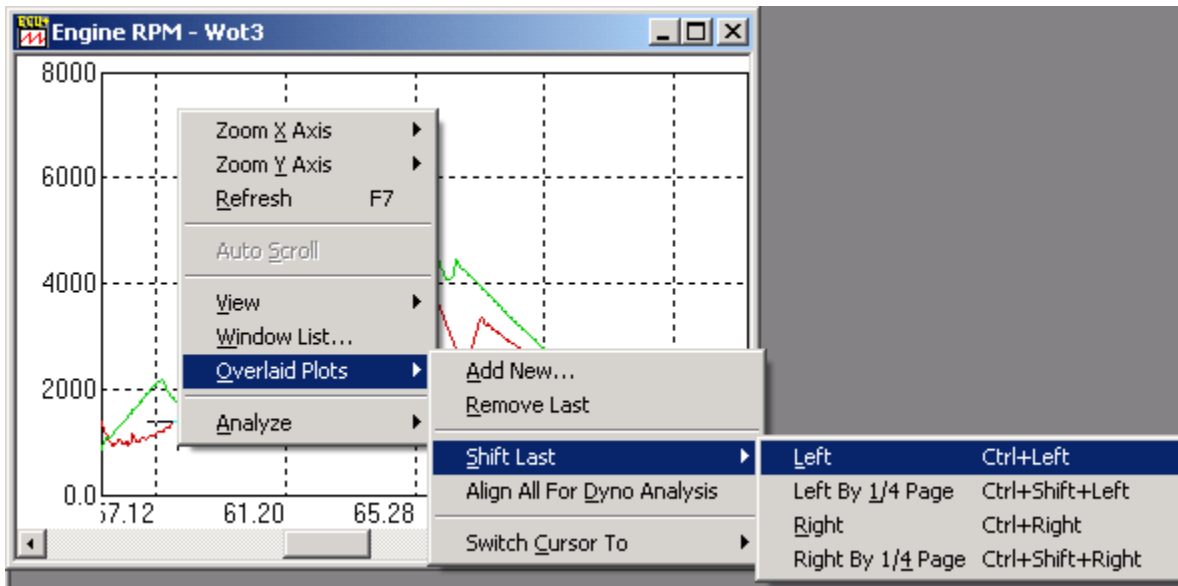


Illustration 47- Aligning two captures

6. When you're all done, use the "Remove Last" menu item to remove the last capture from the graph views.

Being able to overlay multiple captures is a very powerful technique to compare your vehicle's performance before and after a hardware modification or when tuning your car's fuel and timing via the ECU+ head unit. In the next section, we'll see some more powerful techniques with the Analysis Tools of the ECU+ Win software.

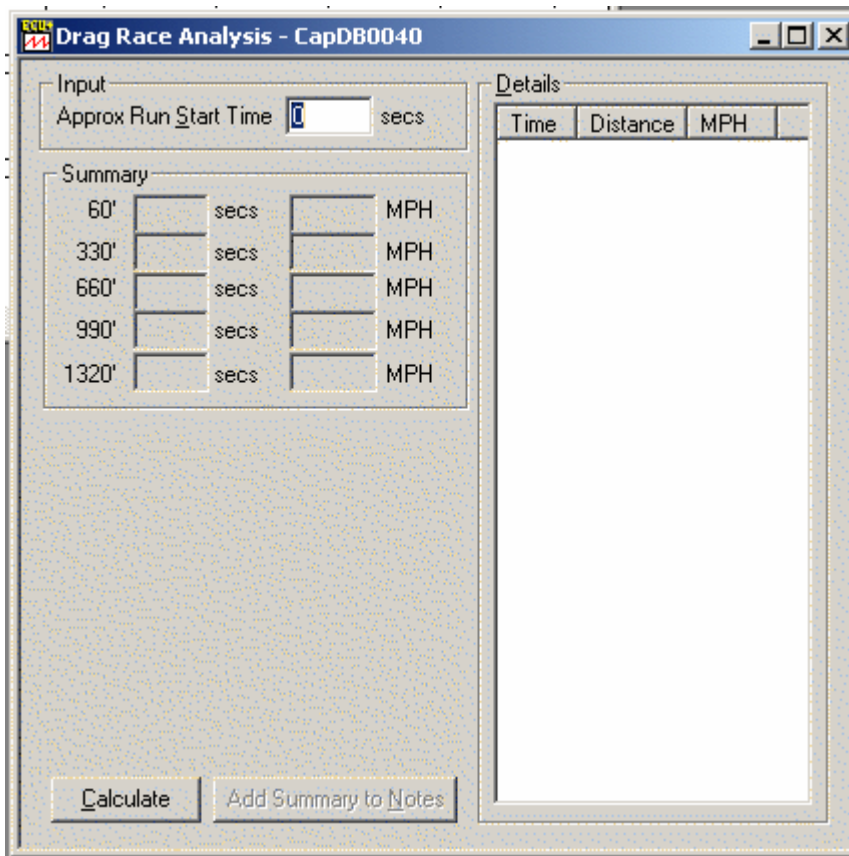
## 8.9 Analysis Tools

The ECU+ Win software offers two powerful analysis tools that will help you to tune your car for best performance. They are the Drag Race Analysis and the Dyno Analysis.

### 8.9.1 Drag Race Analysis

You can access the drag race analysis from the graph view context menu as *Analyze->As a Drag Race*. What this analysis tool does is to treat the capture as though it was a run down a 1/4 mile dragstrip, and calculates the elapsed time, vehicle MPH and distance 25 times a second. Additionally, it'll display typical drag race statistics, like 60' time and 1/4 mile trap speed.

To use this tool, select *Analyze->As a Drag Race* from the graph view context menu. You'll see a dialog like Illustration 48:



*Illustration 48 - The drag race analysis dialog*

With the dialog visible, enter in the approximate start time of the drag race and click the *Calculate* button. The ECU+ Win software will try to find a spot past the start time in which the car was over 60 MPH, and then search backwards to find the time when the car was stopped. It'll treat the stopped time as the start of the drag race and compute the vehicle's 1/4 mile performance.

You can use the drag race analysis on a real dragstrip (or a deserted road) to see how your car was doing at various points in the run, and to compare the car's performance before and after a modification.

Use the *Add Summary to Notes* button to remember the values calculated here. This adds the summary values to the notes view for this capture file.

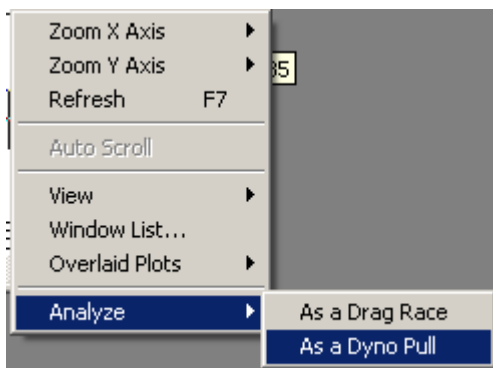
Some considerations when using the drag analysis:

- The calculations use the vehicle's speed sensor, so if you've got non-stock gearing or tires, the analysis may not match exactly what you'd get from a real dragstrip run.
- The calculations assume no tire spin, which is fairly accurate for AWD cars. FWD cars will be less accurate.

### 8.9.2 Dyno Analysis

The dyno analysis tool, accessible from the graph context menu (*Analyze->As a Dyno Pull*) or from the dyno icon on the toolbar, is perhaps the most useful tool in the ECU+ Win software. What the dyno analysis tool does is to treat a short, single-gear acceleration as a dyno pass. From the data in the capture file, ECU+ Win will calculate your engine's horsepower and torque and plot it in an X-Y graph that can be zoomed or printed just like the other graph views. Here's how to use it:

1. Find a deserted back road where you can do some test runs. The road should be flat and straight. You'll use a road sign or marker on the road as a "launch" spot.
2. Start a new capture on the ECU+ Win software.
3. Drive your car along the back road in 2<sup>nd</sup> (or 3<sup>rd</sup>, if you have access to a drag strip) gear, and "lug" the car at the lowest possible RPM. As soon as you pass the launch spot, floor the accelerator and let the car accelerate to redline. Then coast back down and pull off of the road.
4. Stop the capture and save the file. It may be useful to name the file so that you can easily recognize it later ("20040301 Run3 – Boost at 19 PSI.ecd").
5. Later at home, or after stopping the vehicle, open this new capture in the ECU+ Win software, and manually zoom the X axis so that just the acceleration time is visible. This will be easy to find, as the TPS sensor will show the car at WOT, and pretty much everything will be increasing with time.



*Illustration 49 - The dyno analysis menu item*

6. Open the dyno analysis as shown in Illustration 49. ECU+ Win will have filled in the start and stop times from your zoomed graph. Update the other inputs on the left side, and press the *Calculate* button. The ECU+ Win software will now display your car's horsepower and torque graph, just as though you had done a run on a real dyno. See Illustration 50 for a sample graph.

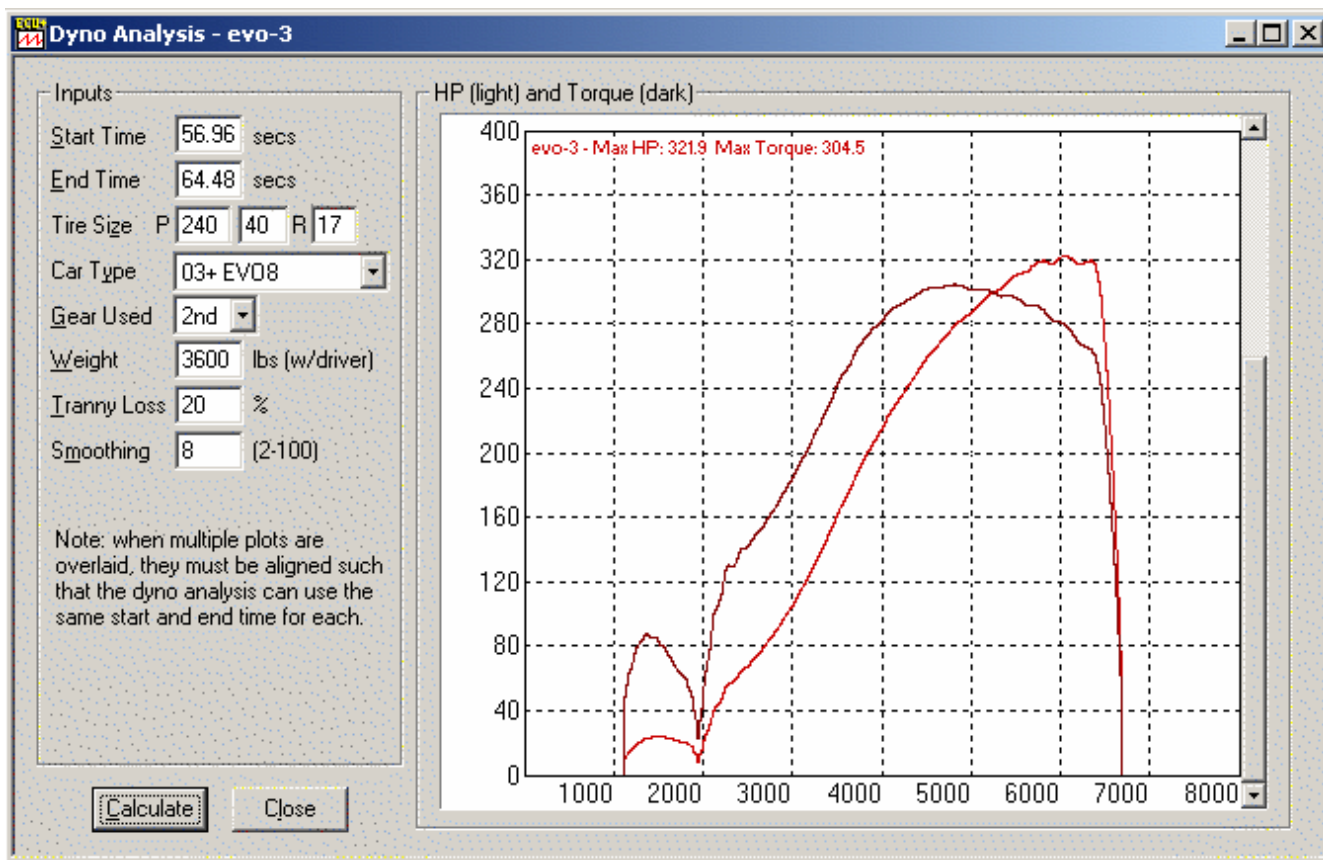


Illustration 50 - A dyno analysis

With the dyno analysis done, you can zoom the dyno graph with the mouse, or right-click for a context menu that has the usual zoom capabilities. You can also print the dyno analysis with the *File->Print* menu item. Use the *Close* button to close the dyno analysis.

The dyno analysis uses the engine's RPM to compute all of its results. Because the vehicle's speed (and thus acceleration, and thus torque and horsepower) is calculated based on the car type, car weight, gear used, and tire size, it's important to set these parameters consistently from one dyno run to the next in order to see reliable plots.

Some things to consider when doing a dyno analysis:

- The dyno analysis uses the *Tranny Loss* parameter to compute the engine's crank horsepower from the measured (wheel) horsepower. If you'd like to plot wheel horsepower, put zero in this field.
- The *Smoothing* parameter smooths the engine RPM before doing the dyno calculation. Larger numbers give smoother plots. Generally, values in the 8-12 range work best.
- The ECU+ Win software will remember your dyno analysis parameters from one session to the next, so it makes sense to put in the correct values for tire size and weight.
- When testing the effects of a performance modification (like a new air filter, or a change in the fuel maps), it's important to do your "dyno runs" in similar weather, and always use the same launch point on the road.
- You can overlay two or more captures, and then do a dyno analysis. The dyno analysis will show you the dyno results from each of the captures, all overlaid on the same dyno plot. This is incredibly useful when tuning your car. The only caveat is that you must align the two overlaid graphs such that the dyno analysis time is the same for each. As an example, if graph 1 did a second gear acceleration starting at 32 seconds, and graph 2



started at 28 seconds, you'll need to move the second overlay to the right by 4 seconds. Use the graph context menu item *Overlaid Plots->Shift Last->Align For Dyno Analysis* to do this automatically.

- The dyno numbers are mathematically correct, but may not exactly reflect the numbers that you'll get on a true vehicle dyno. Nonetheless, what's important is not the absolute horsepower and torque numbers, but instead that you can see whether changes you make to your vehicle increase or decrease its performance.

## 9 Configuring the ECU+ Head Unit

You can use either the ECU+ Win or ECU+ Palm software to configure your ECU+ head unit's settings. ECU+ Win uses a tabbed dialog box to display or edit all of your settings, while ECU+ Palm uses separate screens with a menu item for navigation.

To start the ECU+ Win configuration dialog, either click the hammer icon in the toolbar, or use the *Settings->ECU+ Head Unit* menu item. To start the ECU+ Palm configuration, tap the Palm menu button, then *Setup* and select the screen you'd like to work with.

Let's take a look at the configuration screens in turn:

### 9.1 The Fuel Maps

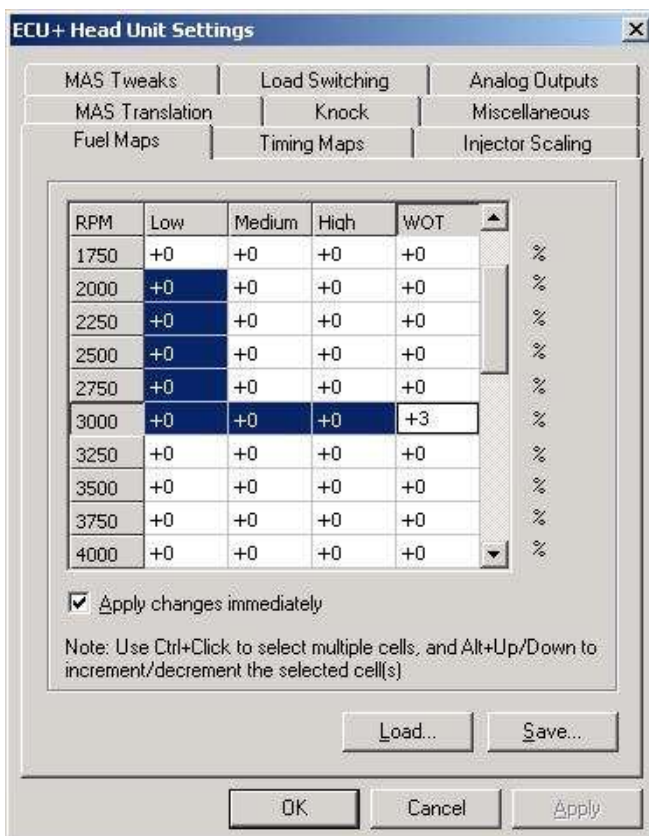


Illustration 51- The fuel maps tab

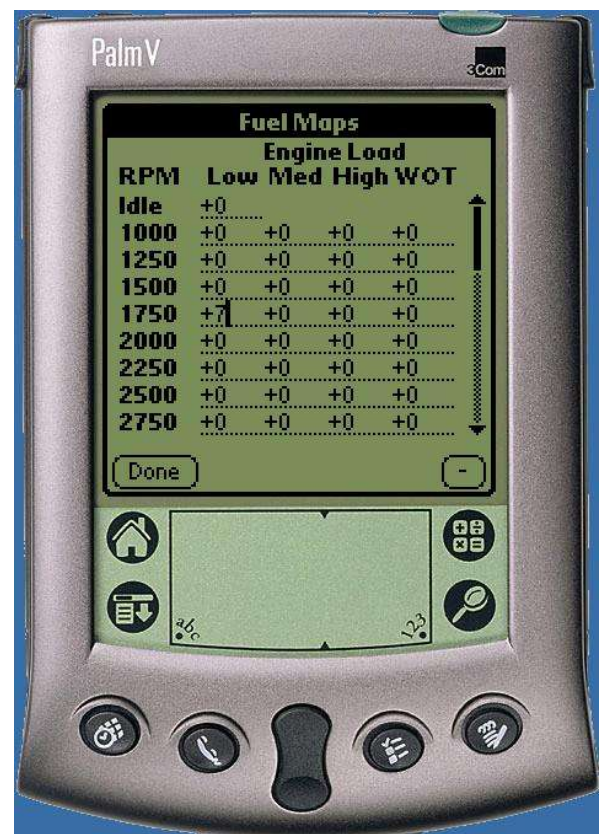


Illustration 52- The fuel maps screen

The fuel maps tab lets you configure the ECU+ head unit's fuel maps. The fuel maps tell the ECU+ head unit how to modify the engine's mass air sensor (MAS) signal. To increase or decrease the fuel flow to your engine, the ECU+ head unit modifies this MAS signal. The MAS (in the car) produces a frequency proportional to the amount of air entering the engine.



By modifying the MAS signal, the ECU+ head unit “lies” to the stock ECU about how much air is entering the engine, which causes the stock ECU to change its fuel flow proportionally – less air means less fuel.

The fuel maps contain 129 different “cells” - one for idle, and 32 cells for low, medium, and high engine “loads,” as well as 32 cells for wide-open throttle conditions. Each cell represents how the ECU+ head unit should modify the MAS frequency when the engine is running at that particular load and RPM combination.

An example: let's say your car is accelerating at wide open throttle, and the engine is at 4000 RPM, and the cell value for 4000 RPM/WOT is -10%. If the engine's MAS frequency is 2200 Hz (representing some fixed amount of air flow), the ECU+ head unit will change this frequency to 90% of 2200 Hz, or 1980 Hz, and pass this new frequency on to the stock ECU. The stock ECU will then reduce the corresponding fuel flow by 10%, thus causing your car to run approximately 10% leaner.

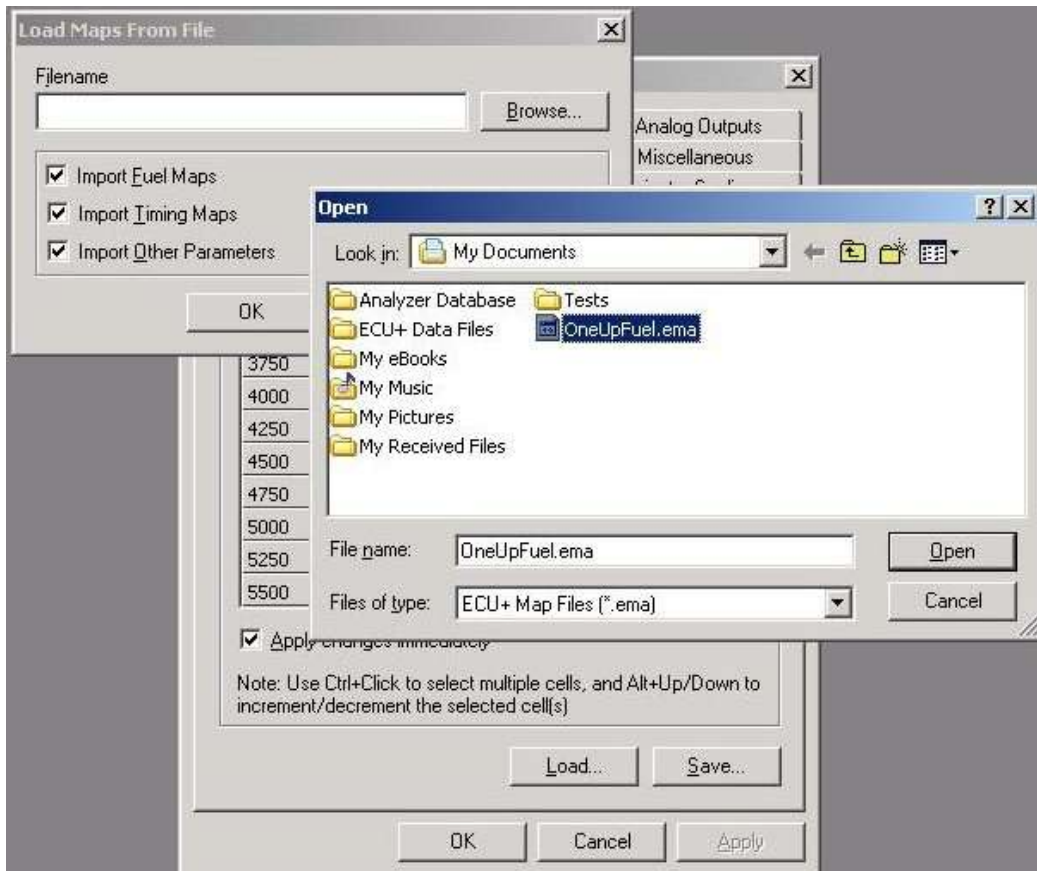
To set a given fuel map cell to a value, type in a number into the appropriate cell. On the ECU+ Win software, you can select multiple cells with a mouse (left-click the first cell, and Ctrl+left-click additional cells to select them), and use Alt+Up (arrow) or Alt+Down (arrow) to easily increment or decrement a range of cells. Selecting a column header selects all of the cells in that column. Similarly, selecting a row header selects all of the cells in that row. On the ECU+ Palm software, use the minus ('-') key to help entering negative values (the Palm Graffiti character set doesn't contain an easy way to enter this character).

Each fuel map cell can take on values from -50% to +50%, where negative numbers decrease your engine's fuel flow (causing the engine to run leaner), and positive numbers increase it (causing the engine to run richer).

Note that the ECU+ head unit interpolates values between the discrete levels in the fuel map table. That is, if your fuel map cell value is -10% at 6000 RPM and -12% at 6250 RPM, and your engine is running at 6125 RPM, the ECU+ head unit will adjust the fuel by -11%.

On the ECU+ Win software, a check box is available that tells the ECU+ Win software to send fuel map changes to the ECU+ head unit immediately. If this isn't checked, values are only sent over when you click “Ok.”

Within this tab on the ECU+ Win software, you can also load or save the maps as well as all of the other configuration values (knock setup, analog outputs, and so on) from the ECU+ head to a file on disk. When saving, you're prompted for a filename only – both the fuel and timing maps as well as the other configuration values are always saved. When loading, you'll be presented with this dialog:



*Illustration 53- Loading maps or configuration values*

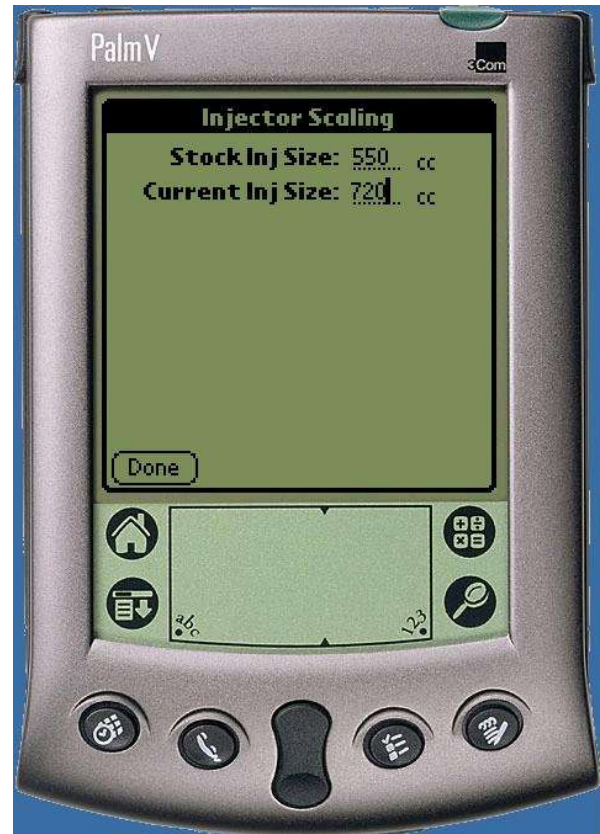
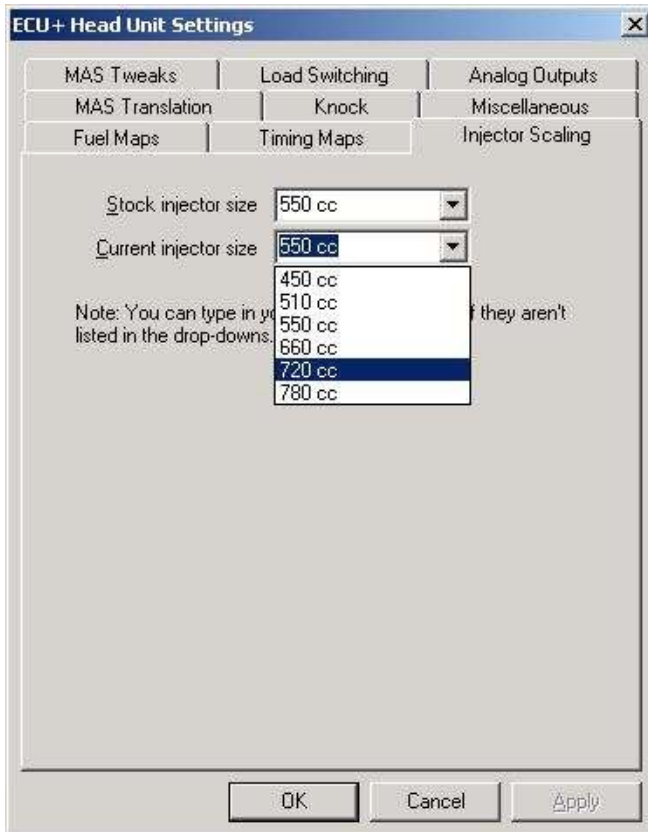
You can select to load just any combination of fuel maps, timing maps, or other configuration values. By default, saved files have the .ema file extension, though you can also load the values used in a previous capture by specifying the .ecd capture file here.

## **9.2 The Timing Maps**

The timing maps tab lets you configure the ECU+ head unit's timing maps. The timing maps tell the ECU+ head unit how to modify the engine's cam and crank angle sensor signals. When the ECU+ head unit modifies the cam and crank angle sensor signals, it causes the stock ECU to fire the spark plugs either sooner or later than stock, thus affecting the engine timing.

The timing maps contain the same 129 cells that the fuel maps do, corresponding to a given engine load and RPM, and are configured exactly like the fuel maps. The timing maps specify a timing offset of between -15 and +15 degrees, where a positive value causes the spark to fire earlier in the engine cycle, and a negative value causes a later spark. Thus, positive values increase the engine's timing advance, and negative values decrease the engine's timing advance.

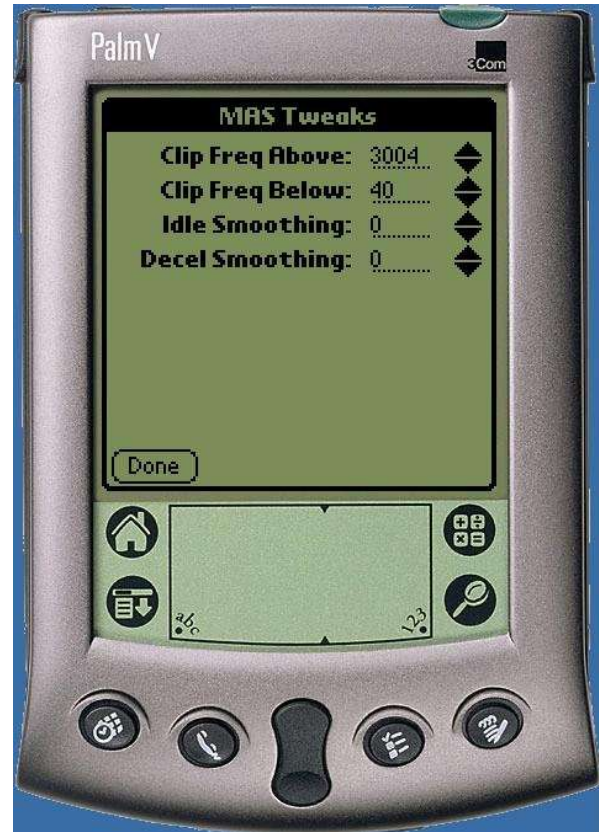
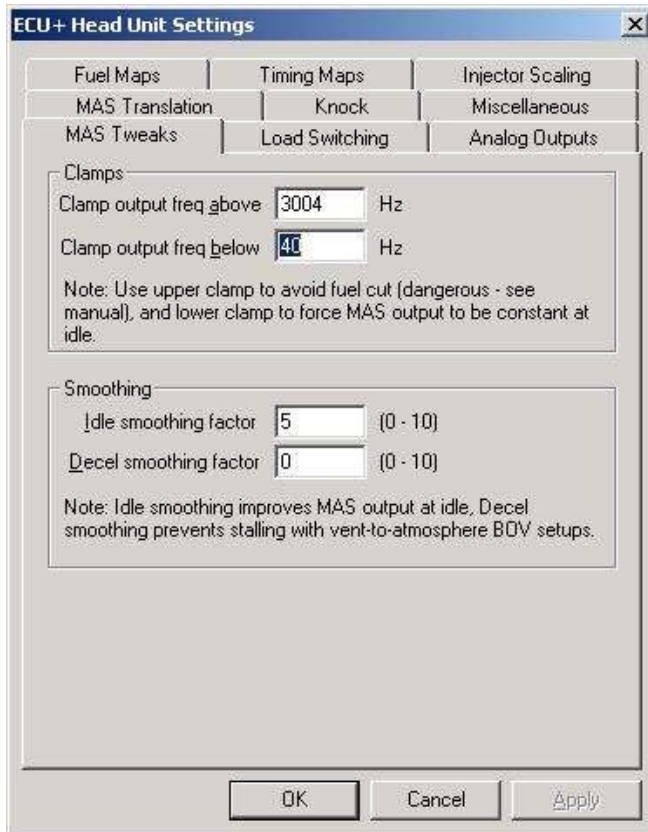
## **9.3 Injector Scaling**



Injector scaling allows the ECU+ to compensate for larger or smaller injectors, while giving you the full -50% to 50% adjustment range in the fuel maps. To use the injector scaling feature, select a new injector size for either the stock or current injectors. From then on, the ECU+ will automatically scale the MAS output to compensate for the injector ratio defined here.

Values between 420 cc and 780 cc can be entered here, and you can pick the values in from the dropdown list (ECU+ Win only), or type them in. Typical stock values are 450 cc on manual-transmission DSMs, 420 cc on automatic-transmission DSMs, and 550 cc on EVOs.

## 9.4 MAS Tweaks



As explained above, the ECU+ modifies the engine's mass air sensor (MAS) signal to make changes to the fuel maps of the engine. This screen allows you to “tweak” the MAS settings in various ways.

- **Clamp Output Frequency Above** - This sets the highest MAS output frequency that the ECU+ will generate on its output. You can use this to limit the output MAS frequency to a given value to avoid fuel cut on your vehicle. You can enter values between 1000 and 4000 Hz here. (The default is 3000 Hz.)

Some background: the stock DSM and EVO ECUs look at the frequency of the signal that the MAS generates to determine when to begin “fuel cutting.” When the MAS frequency is above a pre-programmed limit, fuel cut kicks in and the stock ECU turns off the engine's injectors momentarily, thus causing the engine to stall. As soon as the MAS frequency drops back below the pre-programmed limit, normal engine operation ensues.

By using the MAS frequency clamp, the ECU+ allows you to keep the MAS frequency under the stock ECU's pre-programmed limit and thus avoid fuel cut.

To configure this value, make a series of full-throttle runs in which fuel cut occurs, and save the captures. Make a note of the MAS *output* frequency of the ECU+ at the point where fuel cut occurs. Then set the clamp to just below that fuel cut frequency.

Note: running your car with this upper clamp value activated is dangerous! When the normal ECU+ MAS frequency is limited this way, your engine can easily run lean, which can destroy your engine. This option is rarely used, since most high-horsepower engines use large-enough injectors to make this option unnecessary, but if you need to use this option, do-so only along with a air-fuel ratio meter to ensure your car never goes into a dangerous lean condition.

- **Decel Smoothing Factor** – This is a value between 0 (off) and 10 that controls whether the

ECU+ smooths its MAS output frequency during “decel.” A value of zero turns this feature off, while higher values cause progressively greater smoothing to occur. A “decel” event is when your car is decelerating, with your foot off of the gas pedal, and the clutch pressed in. Under decel conditions, some cars with vent-to-atmosphere (VTA) compressor bypass valve setups will stall because of lean conditions caused by dumping previously “counted” air to atmosphere. By using decel smoothing, the ECU+ can compensate for this dumped air and reduce or eliminate stalling on decel. If you have this stalling problem, try setting this smoothing to a non-zero value and see if it helps. Values of 7-10 usually work best.

- *Idle Smoothing Factor and Clamp Output Frequency Below* – These two (mutually-exclusive) options are used to smooth out idle for cars with large injectors or aftermarket cams. Idle smoothing reduces fluctuations in the MAS frequency at idle, which can reduce or eliminate idle “hunting.” The Clamp Below function sets a lower limit on the MAS frequency that the ECU+ will generate at idle, which can be used to set the ECU+'s MAS output frequency to a fixed value at idle.

Tuning these two along with the idle fuel cell is a bit of an art. Here's the suggested procedure:

- Set Idle Smoothing to zero, and the Clamp Below value to zero.
- With your car fully warmed up and idling normally, adjust the fuel map idle cell. You'll want to monitor your front O2 voltages, and when you're within a good range, your front O2 voltage will cycle every few seconds between approximately zero and approximately one volt. Try to set the idle fuel cell to the center of the range where the front O2 is cycling. (For example, if the front O2 cycles when the idle fuel cell is between -2 and 8, and doesn't cycle when outside of this range, set the idle fuel cell to 3 – the center of the range.)
- Next, turn on Idle Smoothing, and see if your idle improves. Higher values should improve idle more.
- If your idle is still poor, turn off idle smoothing, and monitor the MAS output frequency that the ECU+ is generating. You may find that this value varies quite a bit. Next, set the Clamp Below value to a number that's a bit above the average of the MAS output frequency seen above, and tweak this value until you achieve the best idle. You'll want to verify that the front O2 sensor voltage cycles with your new Clamp Below value. Typical Clamp Below values are in the 40-60 Hz range.



## 9.5 Load Switching

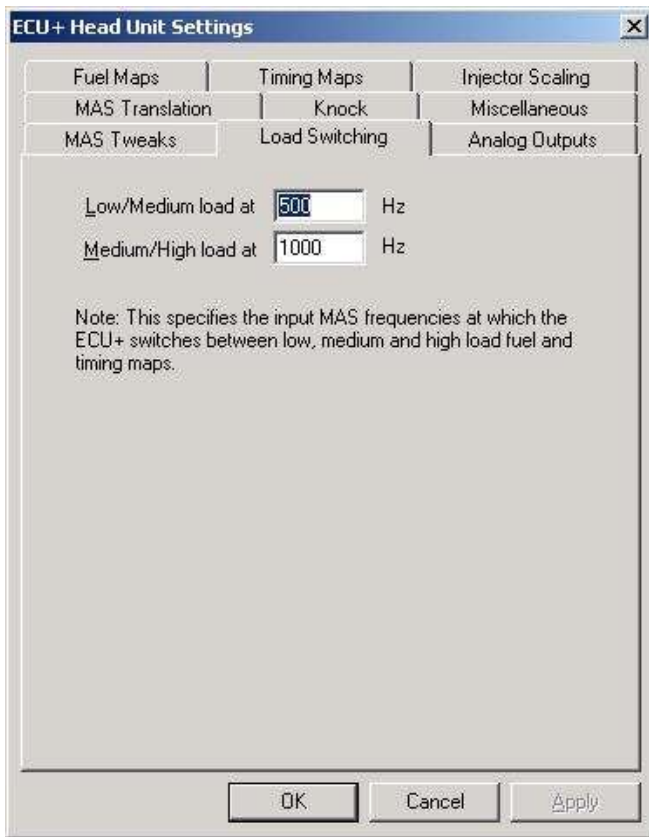


Illustration 58- The load switching tab

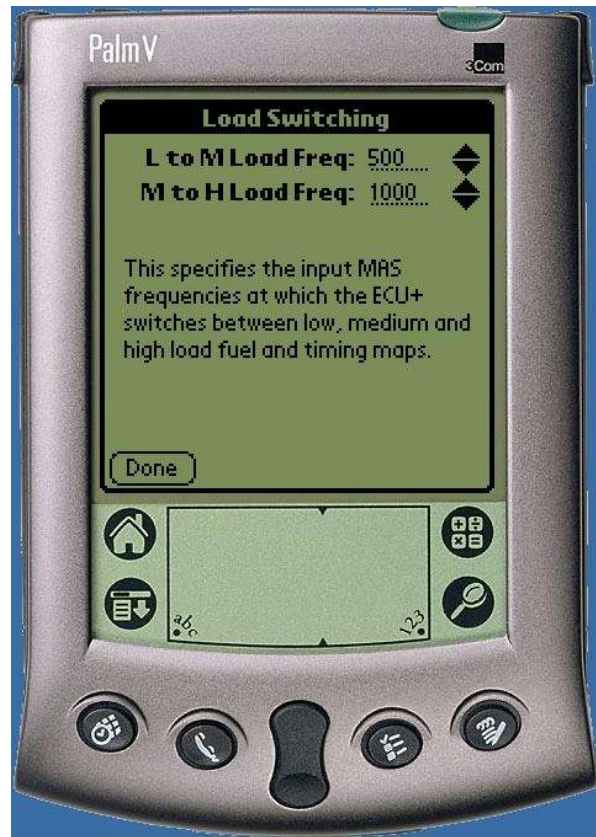


Illustration 59- The load switching screen

As shown on page 56, the ECU+ allows you to tune your engine via two 129-cell tables of fuel and timing maps. The maps are indexed by a combination of engine RPM and "load." There are four load values defined: low, medium, high and WOT (idle is a special case of low load). The WOT column is used when the throttle is fully depressed – Wide Open Throttle. The low, medium and high load columns are used as a function of the *input* MAS frequency that the ECU+ sees. This screen allows you to fine-tune what input MAS frequencies are used as the switchover point between low-to-medium and medium-to-high loads. Enter new frequencies here to fine-tune when the ECU+ switches between its load maps. If you're not sure, use the default values of 500 Hz (low to medium) and 1000 Hz (medium to high).

## 9.6 Analog Outputs

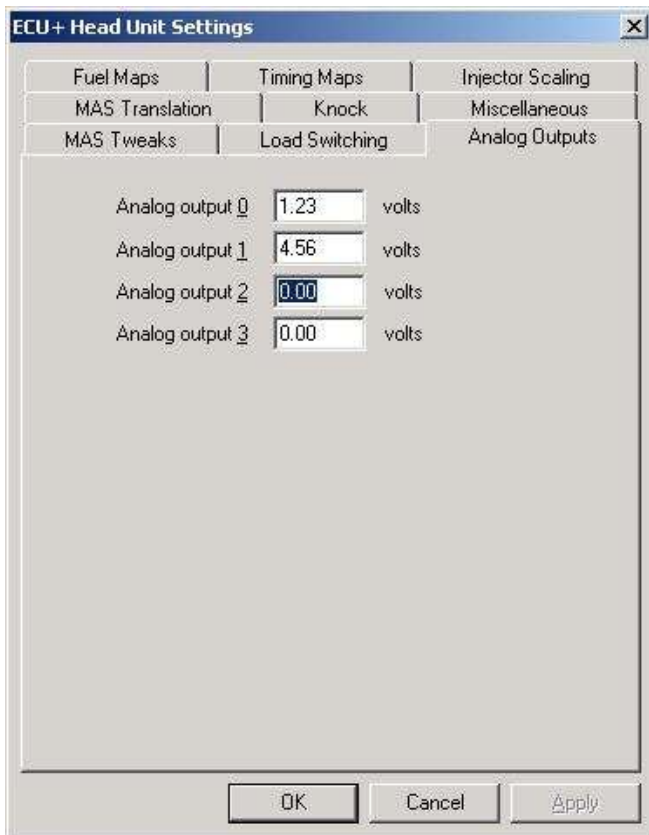


Illustration 60- The analog outputs tab



Illustration 61- The analog outputs screen

The ECU+ has the ability to generate arbitrary analog voltages on four dedicated outputs. This screen configures what analog voltages you'd like to see on the four outputs. For each of the four outputs, enter a voltage between 0 and 5 volts here. This feature is primarily designed for use with the ECU+'s MAS translation feature, but may be useful to generate other signals as well.

## 9.7 MAS Translation

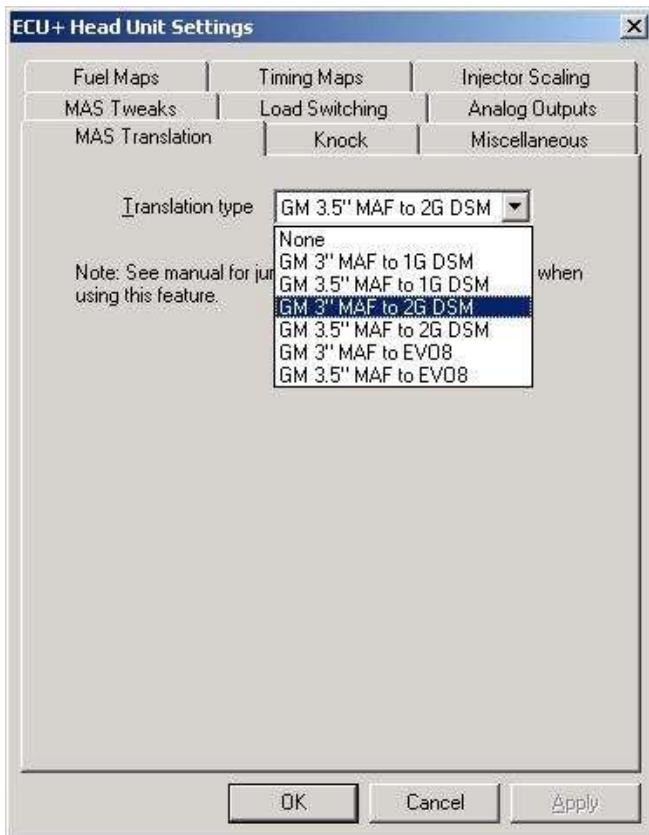


Illustration 62- The MAS translation tab

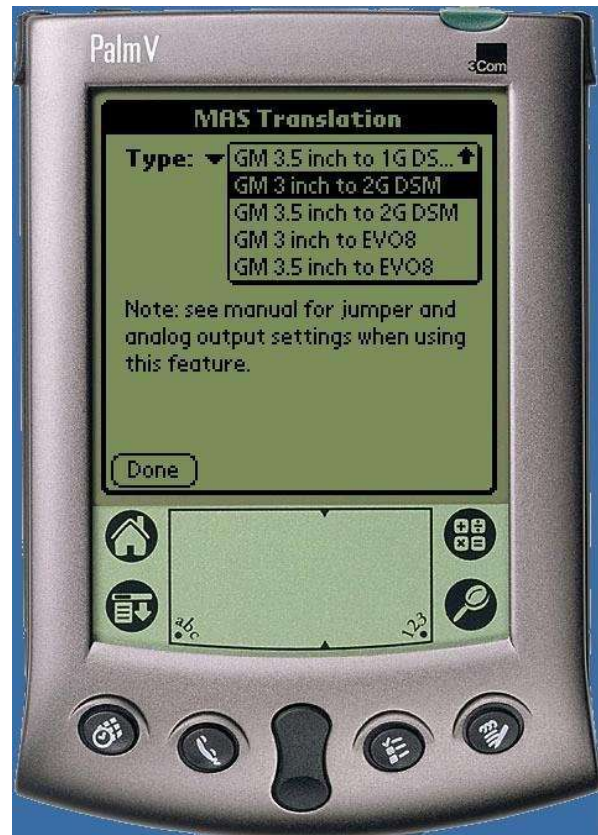


Illustration 63- The MAS translation screen

The ECU+ includes the capability to work directly with a GM hotwire-style MAF (mass air flow) sensor for better airflow. When used this way, the ECU+ will “translate” the sensor frequency to be compatible with the stock ECU, while still giving you the full range of fuel tuning available with the stock MAS.

On this screen, select the translation type you want the ECU+ to do.

Using the MAS translation feature requires special wiring and other configuration (beyond this screen). See the section Using the ECU+ with a GM MAF Meter on page 75 for more information.



## 9.8 Knock

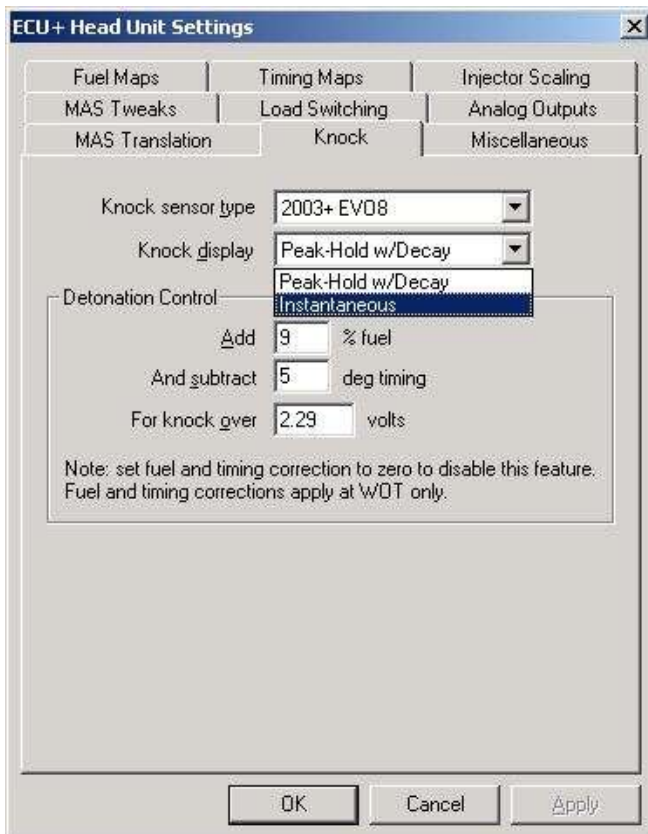


Illustration 64- The knock tab

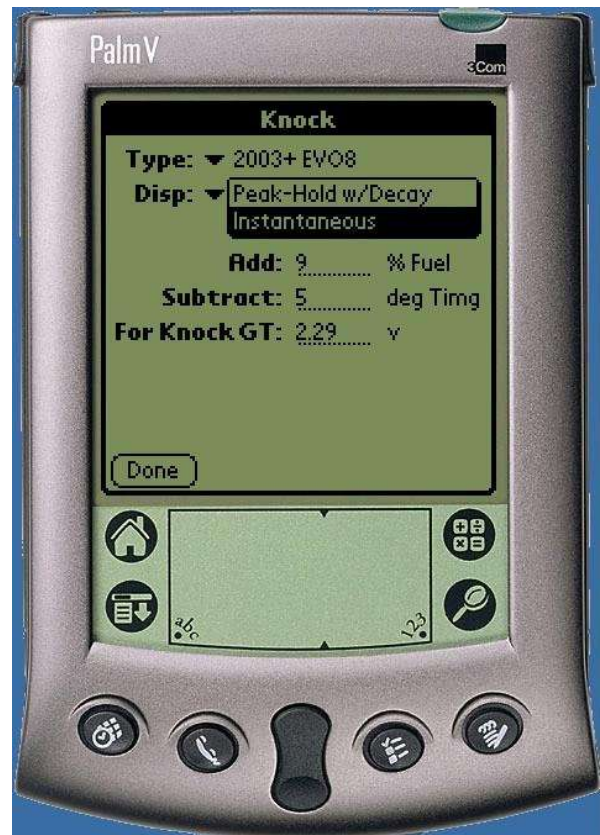


Illustration 65- The knock screen

The ECU+ is able to monitor the knock sensor signal on your car and read out a voltage corresponding to how much the engine is “knocking.” Knock is very harmful to the motor, and should be avoided at all costs. This screen allows you to configure various knock-related parameters:

- **Knock Sensor Type** – Select what type of knock sensor your car has. Only useful for the DSM version of the ECU+.
- **Knock Display** – When the ECU+ records and displays knock, it can show the instantaneous knock “events” (knock will appear as a series of spikes on the knock view), or a smoothed-out version of these, where the ECU+ grabs the most recent instantaneous peak and holds it for a short period of time. This setting selects how you’d like to display the knock signal.
- **Detonation Control** – When the ECU+ sees a large knock signal, it can help you protect your engine against detonation by automatically increasing fuel and retarding timing for a second or two. The detonation control parameters configure this. Here, enter a knock voltage above which the ECU+ will work its magic, and a percentage of fuel and a timing retard. Fuel values can range from 0 to 25%, and timing values can range from 0 to 15 degrees. (Note that a positive timing value here retards timing – this is the opposite of how the timing maps work, where a negative timing value retards timing.)

To use the detonation control feature, you should do some captures to determine what value represents a “normal” knock voltage from your engine (you’ll see residual knock voltages from normal engine noise). Then set the knock voltage threshold about 0.20-0.50 volts higher than this normal knock voltage.

## 9.9 Miscellaneous Settings

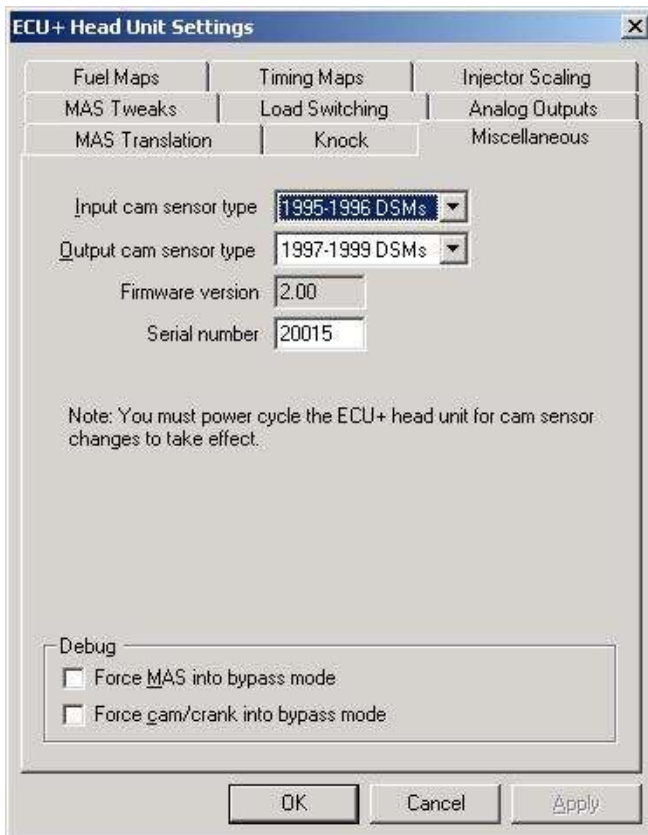


Illustration 66- The miscellaneous tab

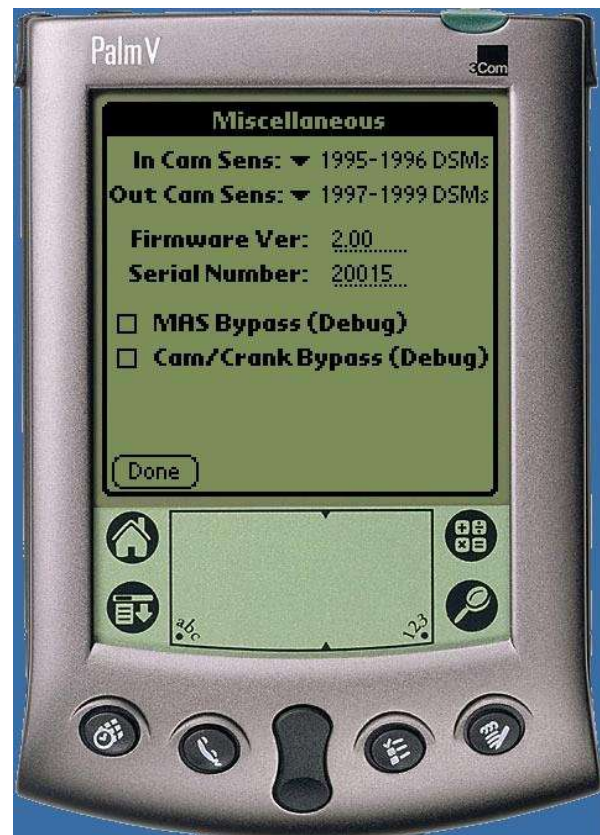


Illustration 67- The miscellaneous screen

The miscellaneous settings tab lets you configure some random values in the ECU+ head unit. These are:

- **Input Cam Sensor Type** - This sets the type of cam sensor used on your car. Click the dropdown button next to the type to set a new value.
- **Output Cam Sensor Type** - This sets the type of cam sensor that the ECU+ head unit should generate. As with the Input Cam Sensor type, click the dropdown arrow to set a new value. Both the input and output cam sensor types should generally match your car - this setting is intended for those people using a different cam sensor than stock on their car. This is most useful for 2G DSM cars with a “6 bolt” motor configuration that has a 1G cam sensor. For that setup, configure the input cam sensor for 1990-1994 DSMs, and the output cam sensor to match your stock ECU.
- **Firmware Version** – This displays the version of the firmware running in the ECU+ head unit. Use this when submitting bug reports.
- **Serial Number** – This displays the serial number of your ECU+ head unit.
- **Force MAS Into Bypass Mode** - This is a debugging option that forces the ECU+ to track your MAS sensor signal with no changes. This effectively causes your car's MAS sensor signal to pass transparently through the ECU+ head unit.
- **Force Cam/Crank Into Bypass Mode** - Similar to the MAS Bypass option, this forces your car's cam and crank sensor signals to pass transparently through the ECU+ head unit. Note that neither the MAS Bypass nor the Cam/Crank Bypass check-boxes are remembered by the ECU+ head unit - these are both switched off when the head unit is powered down, and have to be re-enabled each time you start your car.

## 10 On Board Diagnostics (OBD)

The ECU+ includes a complete OBD-II module that works with the stock ECU on 2G DSMs and the EVO (support for the 1G DSMs will be available in a future software revision). OBD-II is an SAE (Society of Automotive Engineers) standard that specifies that all cars manufactured in 1996 or later must support a common port for diagnostic information. Diagnostic information includes Diagnostic Trouble Codes (DTCs) which indicate the failure of various vehicle systems, as well as real-time and freeze frame ECU data, like RPM and throttle position. This diagnostic information is normally accessible only via expensive dedicated “scan tools,” but the ECU+ now includes a full OBD-II module that can access and display the same information that these expensive scan tools can, and the ECU+ also features real-time display of engine parameters and trouble codes.

You can use either the ECU+ Win or ECU+ Palm software to display the OBD-II information. ECU+ Win uses a tabbed dialog box to display all of the information, while ECU+ Palm uses separate screens with a menu item for navigation. The information presented is identical whether you use ECU+ Win or ECU+ Palm, with the following exceptions:

- The Palm software includes fewer trouble code strings. That is, you may see “Unknown code” more often in the Palm software.
- The freeze frame data is presented on a separate screen in the Palm software, whereas it's integrated into the Stored Trouble Codes tab on the Windows software.
- Some of the descriptive strings displayed on the Palm software are shorter and more verbose.

(The above are generally due to the screen size and memory limitations of the Palm device.)

To start the ECU+ Win OBD-II displays, use the *OBD* menu item. To start the ECU+ Palm OBD-II displays, tap the Palm menu button, then tap *OBD* and select the screen you'd like to see.

The available displays are as follows:

### 10.1 Information

This display is a real-time engine data monitor, and displays all of the information that the stock ECU exports via OBD-II. This information is split into three sub-displays: Basic, Advanced and Tests.

#### 10.1.1 Basic



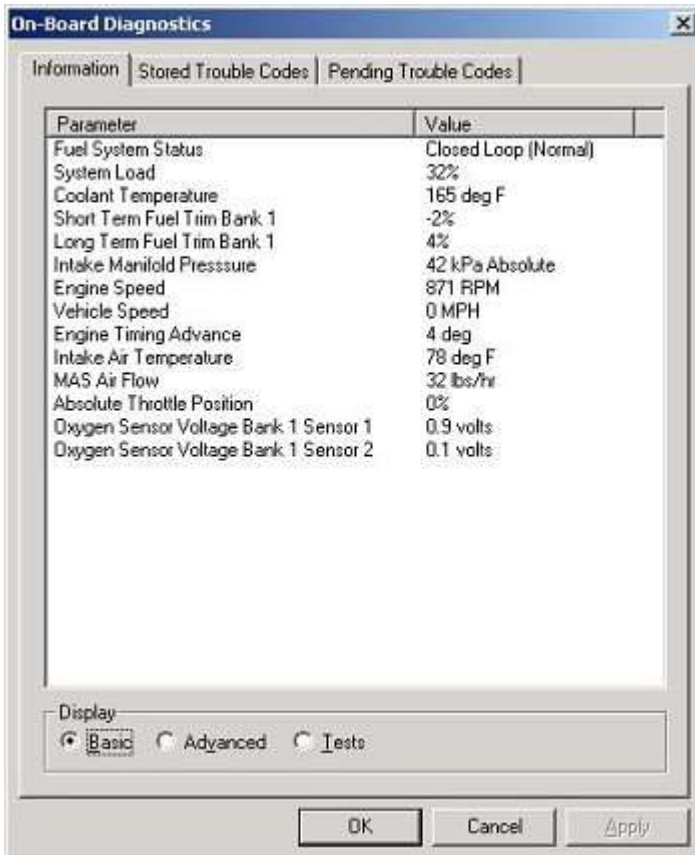


Illustration 68 - The basic information tab

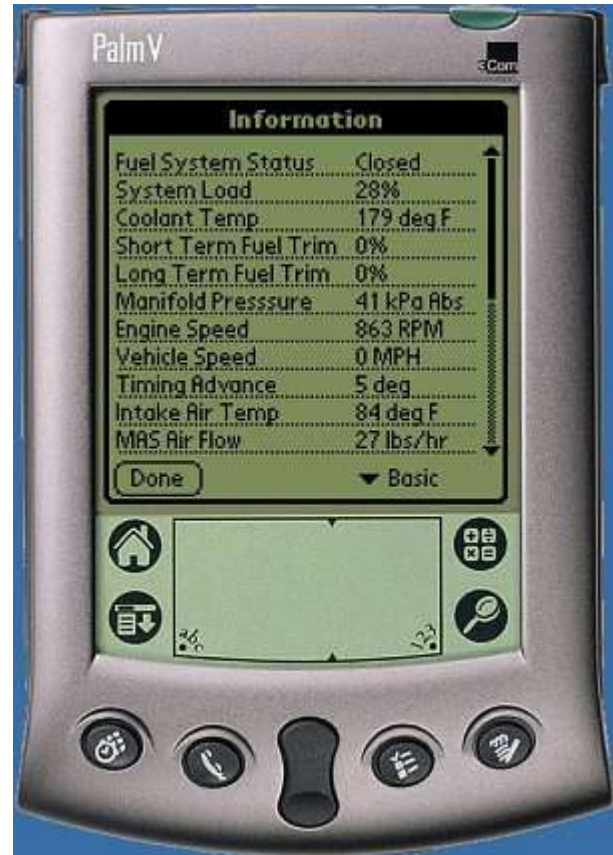


Illustration 69 - The basic information screen

The basic information tab is a real-time display of various vehicle parameters as seen by the stock ECU. Much of the information displayed here duplicates data that is available from the ECU+, but it can still come in handy when debugging problems with your vehicle. An example might be that your cruise control isn't working, and you suspect (or have a trouble code to indicate) that your speed sensor is bad. By looking here, you may find that the stock ECU doesn't ever see a vehicle speed over zero, and yet the ECU+ registers vehicle speed just fine. That may indicate that the speed sensor wire is broken between the ECU+ tap point and the stock ECU.

Other values displayed here are in addition to what the ECU+ can display or datalog. Some of these are:

- **Fuel System Status** – the stock ECU can run in one of two modes when controlling fuel to the engine: open loop or closed loop. In open loop mode (used at WOT or high acceleration conditions), the stock ECU looks up a fuel flow number in a table and turns on the injectors for a fixed amount of time based on air flow, throttle position and the values of the temperature and pressure sensors. In closed loop mode, the stock ECU hunts for a perfect air-fuel ratio by monitoring the front O2 sensor and adjusting fuel flow dynamically. When you see your front O2 sensor voltage cycling up (to around 1 volt) and down (to near zero volts), that's the stock ECU hunting for a perfect (14.7:1) air-fuel ratio by alternately running slightly rich (front O2 voltage around 1 volt) and then slightly lean (front O2 voltage near zero volts). With this display, you can be sure what mode the stock ECU is using. The display will show one of four values:
  - Open Loop (Normal) – either the front O2 sensor or the engine hasn't reached operating temperature yet.

- Open Loop (Accel/Decel) – vehicle is accelerating or decelerating.
- Closed Loop (Normal) – normal operation for low load driving.
- Open/Closed Loop (System Fault) – a sensor problem has been detected.
- *System Load* – this is a percentage of how hard the engine is running. 0-100%.
- *MAS Air Flow* – MAS air flow is a computed number inside the stock ECU that takes into account the MAS frequency (what you see on the ECU+'s display), intake air temperature and barometric pressure. This number is displayed as a flow rate into the engine, in lbs/hr.
- *Absolute Throttle Position* – this is the same information as the ECU+'s throttle position sensor voltage, except that it's displayed as a percentage rather than a voltage. The stock ECU has fixed low and high limits for the voltage corresponding to "0%" and "100%" open throttle, and displays an interpolated value here based on the true throttle position sensor voltage.
- *Oxygen Sensor Voltage* – bank 1, sensors 1 and 2 should correspond exactly to the front and rear O2 sensor voltages as seen by the ECU+. The OBD-II specification allows a vehicle to contain more than two O2 sensors, and so that specification categorizes the O2 sensors according to what engine bank and exhaust position the sensors are placed at. The ECU+'s OBD-II module follows that naming convention rather than displaying the values as front/rear O2 sensor voltages.
- *Short and Long Term Fuel Trims* – these are the most important parameters displayed here. As outlined above, the stock ECU can run in either open or closed loop mode. When in closed loop mode, the stock ECU will adjust its fuel flow based upon feedback from the front O2 sensor. The stock ECU contains a baseline set of fuel tables, pre-programmed at the factory for the stock injectors. It uses these fuel tables as a starting point in calculating the optimum fuel flow for a given air flow (and temperature/pressure readings) in closed loop mode. From that starting point, the stock ECU will continuously (over a few seconds worth of time) add, then subtract fuel in an effort to maintain a perfect (14.7:1) average air-fuel ratio. But the stock ECU needs a mechanism to adapt for injectors that are out-of-spec or clogged, and that is the short term fuel trim. You can think of the short term fuel trim as an offset from the pre-programmed stock ECU fuel table values whose job it is to compensate for imperfect injector flow rates.

With the ECU+, you're modifying the MAS air flow signal to influence fuel flow from the stock ECU. At WOT (in open loop mode), where most tuning is done, the fuel trims don't come into play. Under low and medium loads, though, the stock ECU uses these fuel trims to maintain a perfect air-fuel ratio and thus give you good driveability and gas mileage. The fuel trims have a limited range, and if your car isn't tuned properly under closed loop conditions, the fuel trims will max-out in one direction or the other, thus causing your engine to run consistently lean or rich in closed loop mode.

By monitoring the fuel trim display, you can see how well your engine is tuned in closed loop mode. In general, you'll want to tune the ECU+'s fuel map for idle and low and medium loads such that the fuel trims are near 0% when the car is operating in a given range. If you find that the fuel trim is a negative value for a given range, then your engine is running rich in that range and you should subtract fuel in that range of the ECU+'s fuel maps. Conversely, a positive short term fuel trim number indicates that the engine is running lean in that range, and you should add fuel with the ECU+'s fuel maps.

In general, you'll want to watch the short term fuel trim. The long term fuel trim is, as its name implies, a longer-term average of the short term fuel trim. As with the short term trim, this value should stay around 0%. By occasionally checking the long term fuel trim,

you can be alert to changes in your injector performance that may require re-tuning your car.

You may find fewer, or more, items displayed for your car than is shown in the screen shots. As with all of the OBD-II screens, the ECU+ queries the stock ECU to see what values are supported and displays only the supported data.

### 10.1.2 Advanced

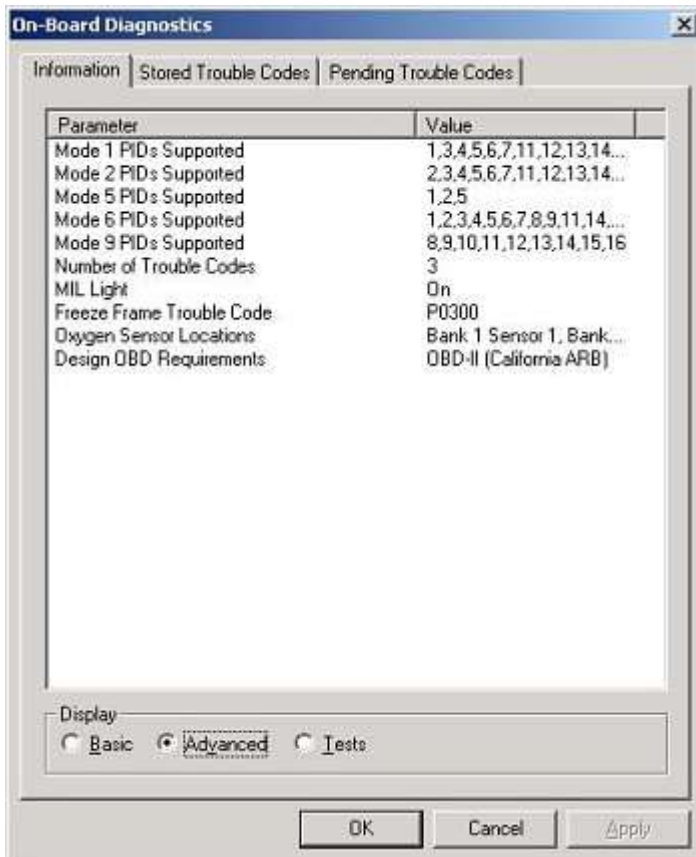


Illustration 70 - The advanced information tab

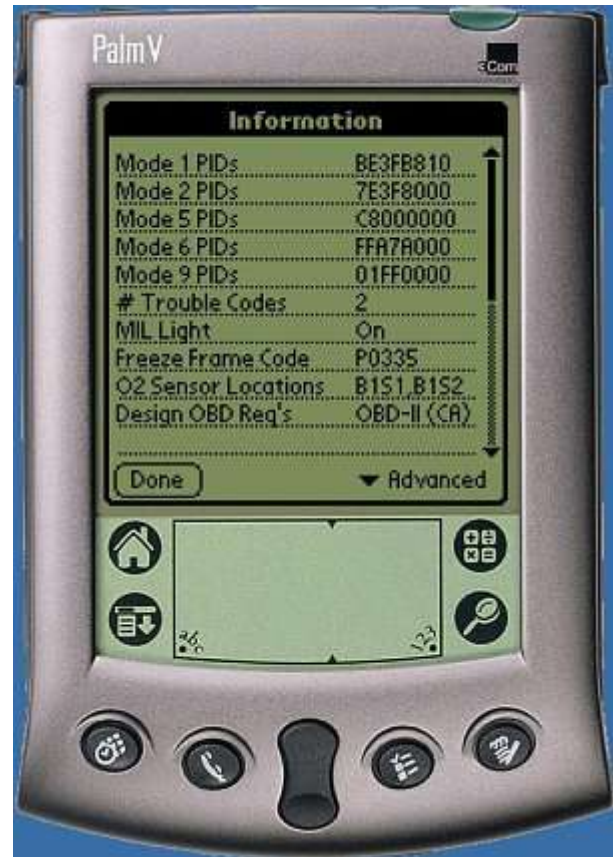


Illustration 71 - The advanced information screen

The advanced information tab is another real-time display which shows advanced OBD-II information that may be useful for debugging software problems with the ECU+'s OBD-II implementation. Here's some of the things you'll see:

- **Mode N PIDs Supported** – this is a cryptic list of “PIDs” (parameter IDs) available in the various OBD-II modes that your stock ECU includes. Different OBD-II modes perform different functions, and the ECU+ needs to know what sub-functions are supported for each mode. The ECU+ Win software displays this as a list of numbers. The ECU+ Palm software displays this as a 32-bit hex number. The most interesting of these is the mode 1 PIDs, which specify which values will display on the basic information screens.
- **Number of Trouble Codes** – this is the number of Diagnostic Trouble Codes (DTCs) currently stored in the stock ECU.
- **MIL Light** – whether or not your MIL (malfunction indicator light, or check engine light) is on due to a stored trouble code.
- **Oxygen Sensor Locations** – which oxygen sensor are supported in this vehicle.

- **Design OBD Requirements** – which OBD specification this stock ECU supports. Potential values include the early-model OBD, OBD-II as well as the European and Japanese OBD specs.

### 10.1.3 Tests

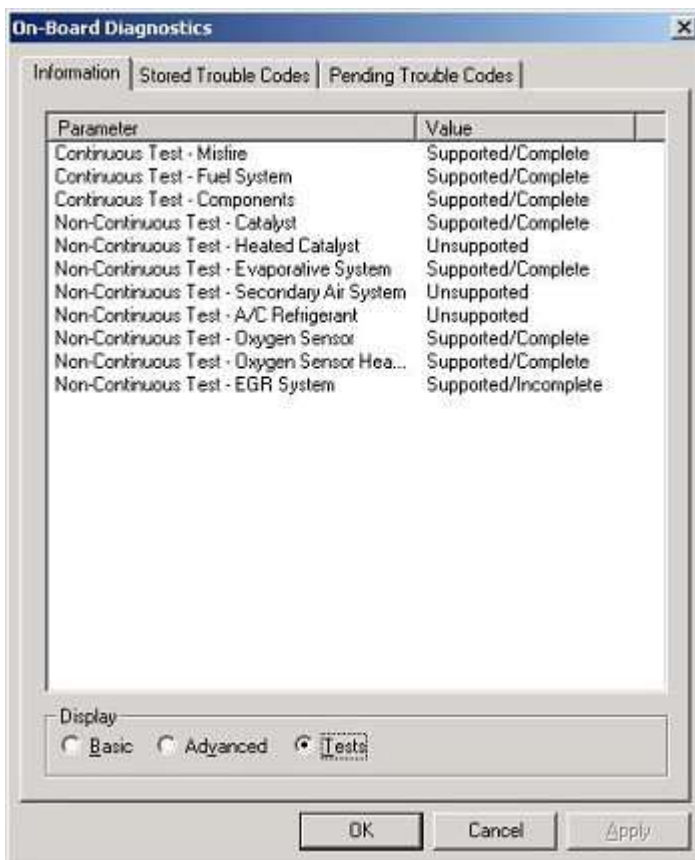


Illustration 72 - The tests information tab

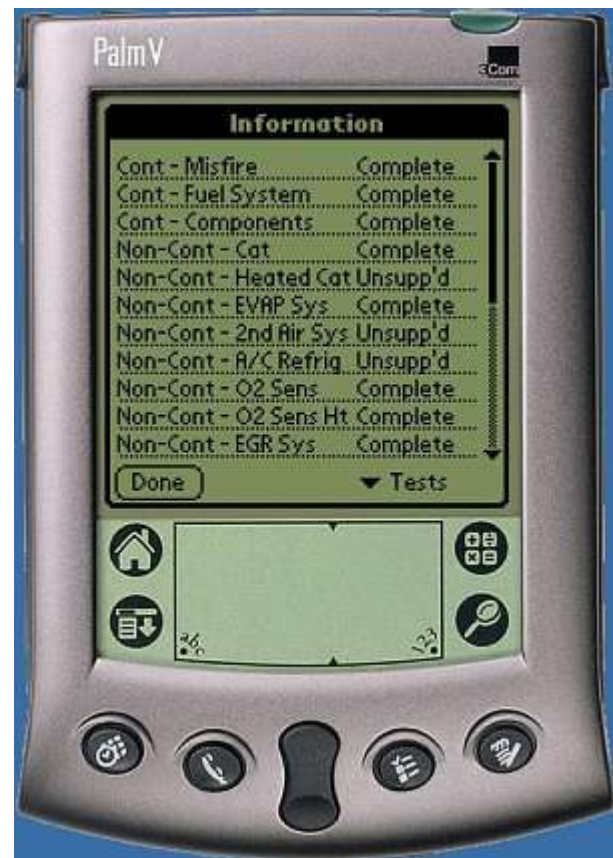


Illustration 73 - The tests information screen

The OBD-II specification requires manufacturers of vehicles to support various internal tests for (generally) emissions-related functions. These tests determine whether the vehicle is operating properly from an emissions point of view. The tests information tab displays the results of these tests. You'll find two types of tests: continuous and non-continuous. Continuous tests run continuously whenever the engine is running, while non-continuous tests must be invoked manually with a scan tool. For each of the tests, the ECU+ will display whether or not the test is supported by the stock ECU, and if the test is supported, whether it has run to completion.

### 10.2 Stored Trouble Codes and Freeze Frame Data



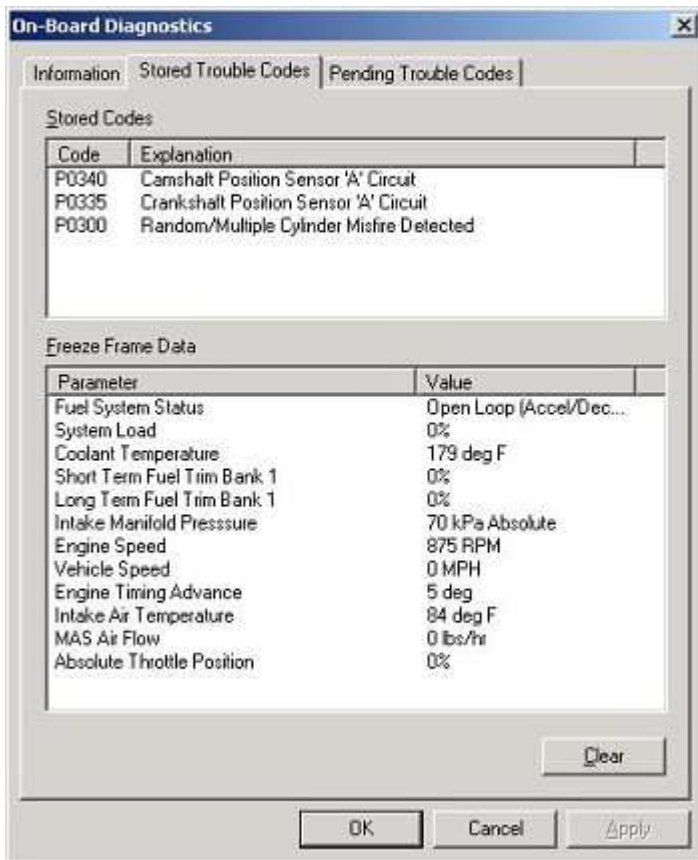


Illustration 74 - The stored codes and freeze frame information tab

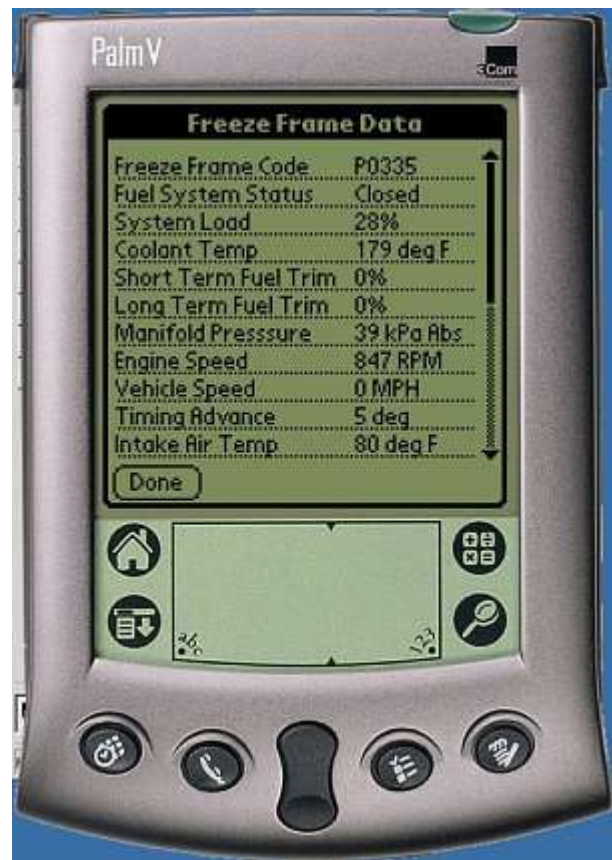


Illustration 75 - The freeze frame data screen

Diagnostic Trouble Codes (DTCs) are how the stock ECU flags problems with your engine. When a problem is detected by the stock ECU, it sets a trouble code and turns on the MIL (malfunction, or check engine light) to indicate that a problem has occurred. Problems can be simple, like no signal from a particular sensor, or complex, like “random misfire detected.” These trouble codes can be displayed and cleared by the ECU+.

Two types of trouble codes exist inside the stock ECU: pending trouble codes and stored trouble codes. Pending codes indicate that a problem was detected, but that the problem is not (yet) considered to be important enough to turn on the check-engine light. Think of the pending codes as an early-warning that something may be wrong. When a pending code occurs frequently, or on multiple drive cycles, the pending code will be “promoted” and become a stored trouble code. Pending codes that only occur infrequently are typically forgotten after one or two additional drive cycles.

On the stored trouble codes tab, the ECU+ displays the stored trouble codes currently in effect. All of the codes are displayed, along with the standard OBD-II trouble code description. Additionally, a set of freeze frame data may also be displayed. Freeze frame data is stored when an emissions-related code is stored. This freeze frame data is a snapshot of what the engine was doing at the time the code was set, and is very useful in tracking down the source of the problem. If multiple stored codes are present, the freeze frame data applies (generally) to the first code that was seen, and the “freeze frame trouble code” indicates which stored code is associated with the freeze frame data.



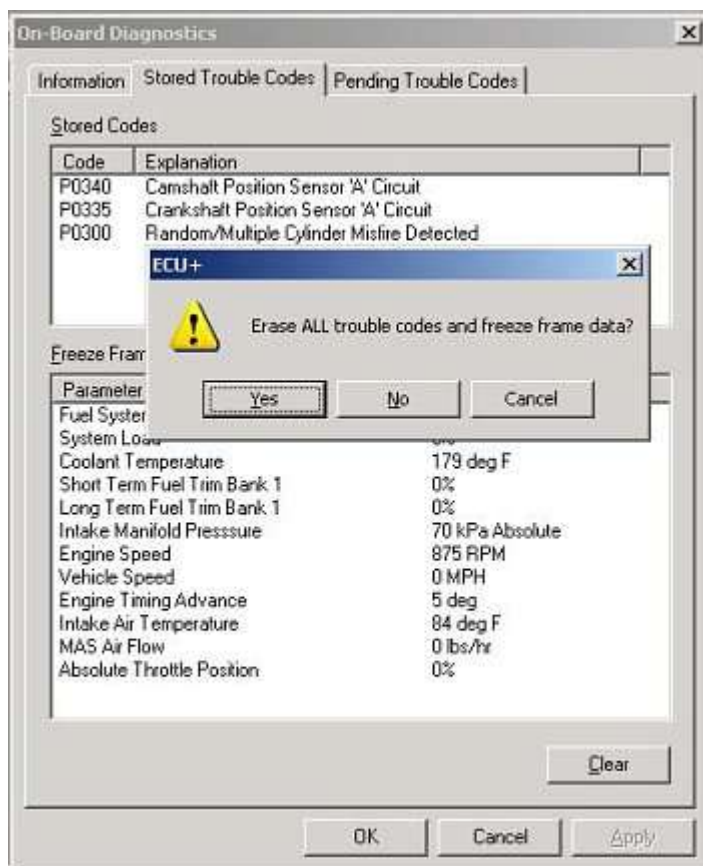


Illustration 76 - The code-clearing confirmation prompt

On this tab, a button is provided that allows the trouble codes to be cleared. When invoked, this will erase all stored and pending trouble codes as well as the freeze frame data. It will also extinguish your MIL light.

## 10.3 Pending Trouble Codes

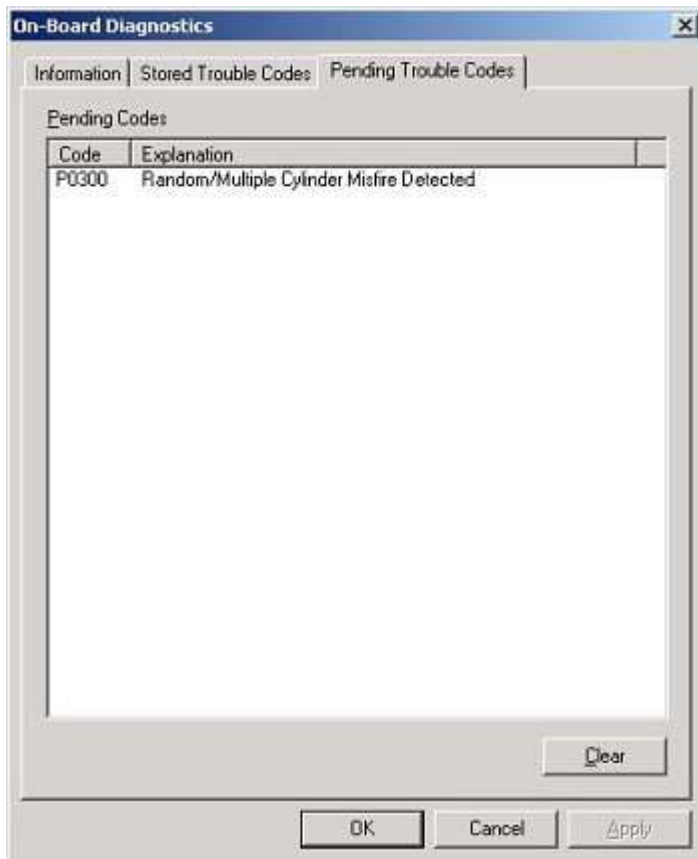


Illustration 77- The pending codes tab

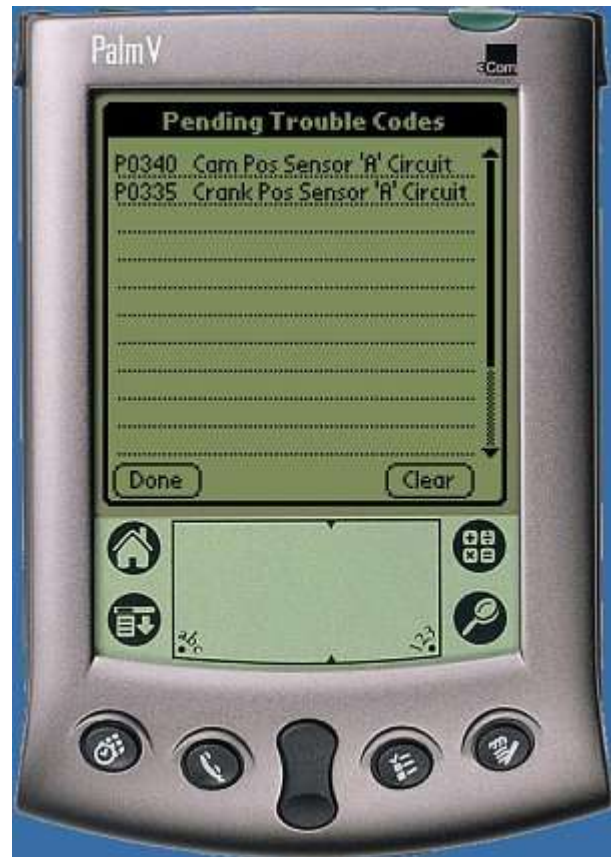


Illustration 78 - The pending codes screen

The pending trouble codes tab shows all of the codes that are currently pending, before they are promoted to stored status. As with the stored trouble codes tab, a clear button is provided to allow these codes to be cleared.

## 10.4 Using the ECU+ With Other Code Scanners

The OBD-II system supported by the ECU+ is normally accessed with a dedicated scan tool. To use a scan tool, you connect the scan tool to the standard OBD-II connector located under the dash of the car, near the steering wheel. OBD-II is a “single master, multiple slave” system which only supports one master device, and as implemented, the ECU+ is the sole master device. The ECU+ connects to the OBD-II port directly at the stock ECU's wiring harness, and doesn't plug into the OBD-II under-dash connector at all. What this means is that with the ECU+ connected to your stock ECU, you'll no longer be able to access the OBD-II functionality with an external scan tool. This can cause problems in two situations:

- If you take your car to the dealer or other repair facility, their scan tool won't work as long as the ECU+ is installed.
- Some states are using the OBD-II port to initiate tests for emissions compliance. With the ECU+ installed, these tests won't run and your vehicle will fail emissions testing.

There are two ways to handle these problems:

1. In the ECU+ wiring harness, locate pin 22 (black wire, group C) on the low current harness and snip the wire in half. Then insert a quick-disconnect in this wire that will allow you to

easily disconnect this wire whenever you need to access the OBD-II functionality with an external scan tool.

2. Inside of the ECU+ head unit, there is an internal jumper that will serve this same purpose. Remove four screws from each end of the ECU+ head unit, and slide out the printed circuit board. Near the high current (white) connector is a jumper, JP8. Simply remove the shorting block from this jumper and reassemble your head unit.

## 11 Using the ECU+ with a GM MAF Meter

The ECU+ has the ability to work directly with a 3" or 3.5" GM hotwire-style MAF meter in place of the stock MAS on the DSMs or EVOs. This capability, which is similar to that provided in the popular MAF Translator device, replaces the stock MAS with the lower-restriction GM unit. The ECU+ will accept the GM MAF's output signal directly, and "translate" it into a signal compatible with the stock ECU.

You can use the GM MAF in place of the stock MAS in the intake (between the air filter and the turbo), or in a "blow through" configuration in which the stock MAS is removed and the GM MAF is placed in the upper intercooler pipe between the compressor bypass valve and the throttle body. The latter configuration has the side benefit of dealing well with compressor bypass valves that are vented to atmosphere (VTA).

Below are the steps required to use this GM MAF setup:

1. Purchase the GM MAF of choice. Both the 3" and 3.5" MAFs are available from Mach V Motorsports as well as other vendors for under \$150.
2. Purchase a "pigtail" wiring adapter from Casper's Electronics, Inc (<http://www.casperselectronics.com>). This item, part #108098, is called a "LT1 MAF splice," and it plugs into the GM MAF and breaks out the three electrical signals on the MAF.
3. Plumb the GM MAF into your intake, in either the normal or blow through mode. Make sure that the GM MAF is facing in the proper direction. The unit has an arrow on the body that indicates the direction of air flow.
4. Make the electrical connections to the pigtail connected to the GM MAF, as follows:

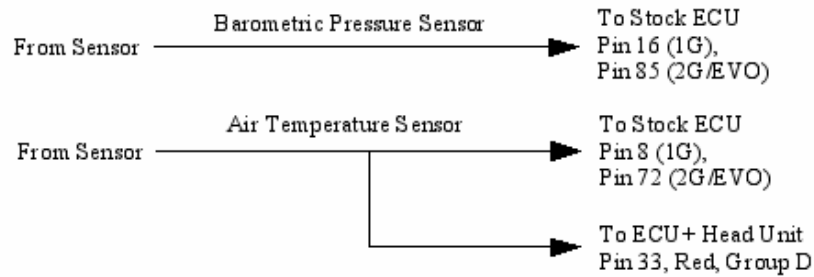


*Illustration 79- The LT1 MAF Splice "pigtail"*

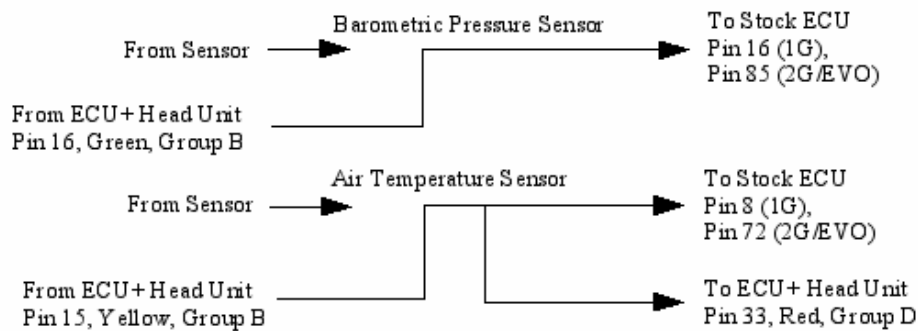
- Pigtail black wire to ground.
- Pigtail pink wire to a +12v source under-hood. Use a digital multimeter to verify the

+12v signal before connecting it up.

- Pigtail yellow wire to the ECU+'s MAS input wire (this is pin 4, orange, Group A on the ECU+). To do this, extend the yellow wire through the firewall and into the passenger compartment. Then, disconnect the ECU+'s pin 4 and connect it to the extended pigtail yellow wire. This is the GM MAF's output, which you're connecting directly to the ECU+.
5. When you remove the stock MAS, you're also removing the stock air temperature and barometric pressure sensors, which are built into the stock DSM or EVO MAS unit. You need to make two more wiring changes that allow the ECU+ to output simulated air temperature and barometric pressure sensor signals:



## Standard Configuration



## MAS Translation Configuration

*Illustration 80- The analog wiring changes for MAS translation*

- Cut the air temperature wire (formerly) between the stock MAS and the stock ECU. This is pin 8 on the 1G DSM ECU or pin 72 on the 2G DSM and EVO ECUs. Solder the ECU+'s analog output 0 (pin 15, yellow wire, Group B) to the stock ECU air temperature input. If you've purchased a PnP ECU+, you can cut the pin 72 wire in the ECU+'s PnP harness.
- Optionally, connect the ECU+'s analog output 0 back into the ECU+'s air temperature datalogging input (pin 33, red wire, group D) as shown in the above illustration. If you cut the air temperature wire to the "left" (in the above illustration) of the tee in the air

temperature wire, you get this connection for free. If you choose to not connect this signal back to the ECU+'s air temperature datalogging input, the ECU+ will display strange values for the air temperature, though this won't affect how your vehicle runs.

- Repeat the first step for the barometric pressure sensor wire. Cut it at the stock ECU (or in the PnP wiring harness) and connect this stock ECU input (pin 16 on the 1G DSM ECU, or pin 85 on the 2G DSM and EVO ECUs) to the ECU+'s analog output 1 (pin 16, green wire, Group B).
6. Double-check your connections. When you're confident that the connections are ok, turn your ignition to the On position (don't start the car yet) and use the ECU+ Win or ECU+ Palm software to navigate to the MAS Translation setup screen. Select the type of translation that you need, based on the type of GM MAF you've purchased, and your car type. Save this setting.
  7. Finally, using the ECU+ Win or ECU+ Palm software, navigate to the Analog Outputs screen, and set analog output 0 to 2.37 volts and analog output 1 to 3.90 volts. Save this setting.

Once all of the above are complete, start your car. The car should start and run normally, just like it did before the installation of the GM MAF. At this point, the ECU+ is doing the MAS translation continuously and fooling the stock ECU into thinking it still has a stock MAS connected. If you look at a capture, you should see MAS input and output frequencies that are very similar to that of the stock MAS for a given RPM and load combination.

With the GM MAF in place, you should drive your car for a while and verify that the car runs normally. Before doing any WOT runs, though, it's recommended that you (slowly) go through the steps of tuning your car again for optimal air-fuel ratio. The MAS translation in the ECU+ should only require minor changes to your fuel maps from the values used before installing the GM MAF, but it never hurts to re-verify your fuel map settings to account for any non-linearities of the stock MAS that have been corrected through the use of the GM MAF. In general, the GM MAF will flow more air before becoming non-linear and introduce much less restriction in the intake than the stock MAS.

Note: when using the GM MAF, you may notice that the input and output MAS frequencies never go to zero. This is because the GM MAF is especially sensitive, and outputs a low frequency signal even when the engine is not running.

## 12 Tuning Your Engine With the ECU+

This section provides some general information on tuning your car with the ECU+. Before starting, please read and heed the following warning:

### **YOU CAN DESTROY YOUR ENGINE WITH THE ECU+!**

**Neither the manufacturer nor the distributor of this device are responsible for any damage done to your vehicle due to the use of this device.**

Always remember the above when tuning your vehicle. If you're conservative when tuning, you'll be able to use the ECU+ to make small, incremental improvements to your vehicle's performance, and most important of all, not destroy your engine in the process. It's sometimes said that engines make maximum horsepower just before they blow up...

To avoid destroying your engine, keep in mind that an excessively lean mixture and timing

that is too-far advanced can lead to detonation. Excessive detonation will destroy your engine's internals. So be very very careful when reducing fuel flow or advancing timing with the ECU+ system.

## **12.1 “Tools” Required**

When tuning your car, you should have the following “tools” available:

1. The ECU+ system (of course), with the ECU+ Win software running on an in-car laptop.
2. A boost gauge, and possibly the ECU+ map sensor, wired into the system.
3. An Exhaust Gas Temperature (EGT) gauge. This allows you to monitor your vehicle's exhaust gas temperature. Rapidly increasing EGT values often indicate detonation, which you can also monitor with the ECU+'s knock logging capability.
4. A wideband O2 sensor. These are moderately-priced, standalone boxes that can display your vehicle's air-fuel ratio very accurately. If this isn't available, the front O2 sensor in your vehicle will make a (poor) substitute.
5. A friend to ride in the car with you. Your friend will pilot the laptop while you pilot the car.  
Note: please don't refer to your friend as a “tool” - he might not appreciate it. :)

## **12.2 Making Runs**

The best way to tune with the ECU+ is to make a series of dyno runs. See the section Dyno Analysis on page 53. You should select a flat, deserted road and make a series of runs, one per capture file, while giving the car a consistent few minutes to cool down between runs. Between each run, make a single change in the fuel, timing or other parameters. Then pull off the road and use the dyno analysis capabilities of the software to compare the most recent run to the previous run and see how the horsepower and torque curves compare. This will tell you whether you're making adjustments in the right direction or not.

You should start out by striving for consistency. The same section of road. Going WOT at exactly the same RPM and launch point on the road. The same dyno numbers and curves when you don't change anything. Once you've got a consistent set of dyno plots, change the fuel, or timing, and make some more runs. See if the car gained horsepower in a portion of the graph, or if it lost horsepower. Continue iterating until you've got the best performance from your engine.

## **12.3 General Tuning Techniques**

- Before beginning tuning, setup the injector scaling values. These establish a baseline fuel offset for the injectors in your car.
- You should start with the injector scaling configured appropriately for your stock vs current injector sizes.
- With the injector scaling values in place, set all of the cells in the fuel and timing maps to all zero.
- Tweak the idle fuel map cell (as well as the values in the MAS tweaks configuration screen) for best idle. You'll probably find that the larger the current injector size, the harder it is to achieve a smooth idle.
- On the road, make several runs with the fuel and timing maps set to zero. Try to launch your car from a roll consistently so that the resultant dyno plots are almost identical.

- Next, make changes to the fuel maps for WOT conditions and do some more runs. Power is generally gained by reducing the fuel map values, thus making the engine run leaner. From the factory, most cars run very rich at WOT, and the ECU+ allows you to compensate for that. For each change you make, make no more than a 2% fuel map change from the last run. Change one or two fuel map cells at a time. When you bring the car to a stop, you'll want to look at the front O2 voltage at WOT, which should be in the range of 0.90-0.92 volts. Also look at the timing view and see how it compares to the previous run. If you find that the timing suddenly drops off at high RPMs, or that the knock display shows "spikes," there's a good chance that the stock ECU heard some knock from the motor. This indicates that you're running too lean – fix that right away. Also, when you're doing the runs, always watch your EGT gauge for rapidly rising temperature. Again, this indicates an overly-lean condition. If you have a wideband O2 sensor hooked up to the ECU+, use that for tuning. Try to get your air/fuel ratios (at WOT) in the 11:1 range on pump gas, and 12:1 on race fuel.
- Once you've optimized the WOT fuel tables, transfer the same values to the high load fuel table cells.
- With the fuel table optimized, try tweaking the timing tables at WOT. Make only 1-2 degree timing changes between runs. Generally, you'll want to advance the engine timing, thus moving the spark time backwards so that it fires earlier before top-dead-center (TDC) of the piston. This means putting positive numbers in the timing map cells. As with the fuel tables, make small changes and see what happens while watching for knock, high EGTs and timing retard.

## 13 Troubleshooting Software Problems

This section provides some tips for diagnosing and fixing common software-related problems.

### 13.1 ECU+ Win Problems

#### 13.1.1 The Software Never Connects

*When I click on the "New Capture" button, a "Connecting" box pops up that says "Connecting to the ECU+ head unit...", but a connection never happens.*

To "connect," the ECU+ Win software looks for a specific stream of data from the head unit. Whenever the head unit is turned on, it transmits this stream of data. If the ECU+ Win software never sees the stream of data, it'll never "connect."

There are several things you'll want to check:

1. Is the ECU+ hooked up to the serial port? You'll use the straight-through DB-9 serial port to connect to your laptop. Double-check the connections, ensuring that the serial cable is secure and tightened down on both the ECU+ head unit and laptop end.
2. Are you connected to the serial port on your laptop. On a laptop, serial ports are male DB-9 connectors.
3. Does Windows recognize your serial port, and is it ok? Bring up the Windows Device Manager (usually under My Computer->Properties->Hardware->Device Manager). You should have a "Ports" entry for your serial port, and if you display its properties, Windows should say "this device is working properly."



4. Make sure the ECU+ Win software is using the correct serial port.
5. Make sure there are no hardware conflicts. Sometimes Windows will "detect" a serial mouse when none exists. Manually disable these in the device manager.
6. Does the Palm software work ok? If so, the head unit is fine.
7. Your car's ignition must be in the on (not accessory) position to power up the ECU+ head unit.

As a last resort, you can use the HyperTerminal application to check to see if the ECU+ head unit data stream is getting into your laptop. Here's how:

1. Make sure your ignition is off.
2. Close down all applications. Start HyperTerminal, which is (on Windows XP) under Start->Programs->Accessories->Communications.
3. The "New Connection" dialog comes up first, type in "ECU+ Comms Test" and then Ok.
4. On the next screen, leave the "Area code" and "Phone number" fields blank, and set the "Connect using" field to COM1 (or whatever serial port you're using) and then Ok. Next a "COM1 Properties" dialog will come up. Set "Bits per second" to 19200, "Data bits" to 8, "Parity" to None, "Stop bits" to 1, and "Flow control" to None. Then Ok.
5. Select File->Properties, then on the Settings tab, set the "Emulation" to TTY.
6. Turn the ignition to the on position. You should now see junk streaming onto your HyperTerminal screen. At the bottom status line, it should say "Connected <time> TTY 19200 8-N-1". See Illustration 81 for an example.

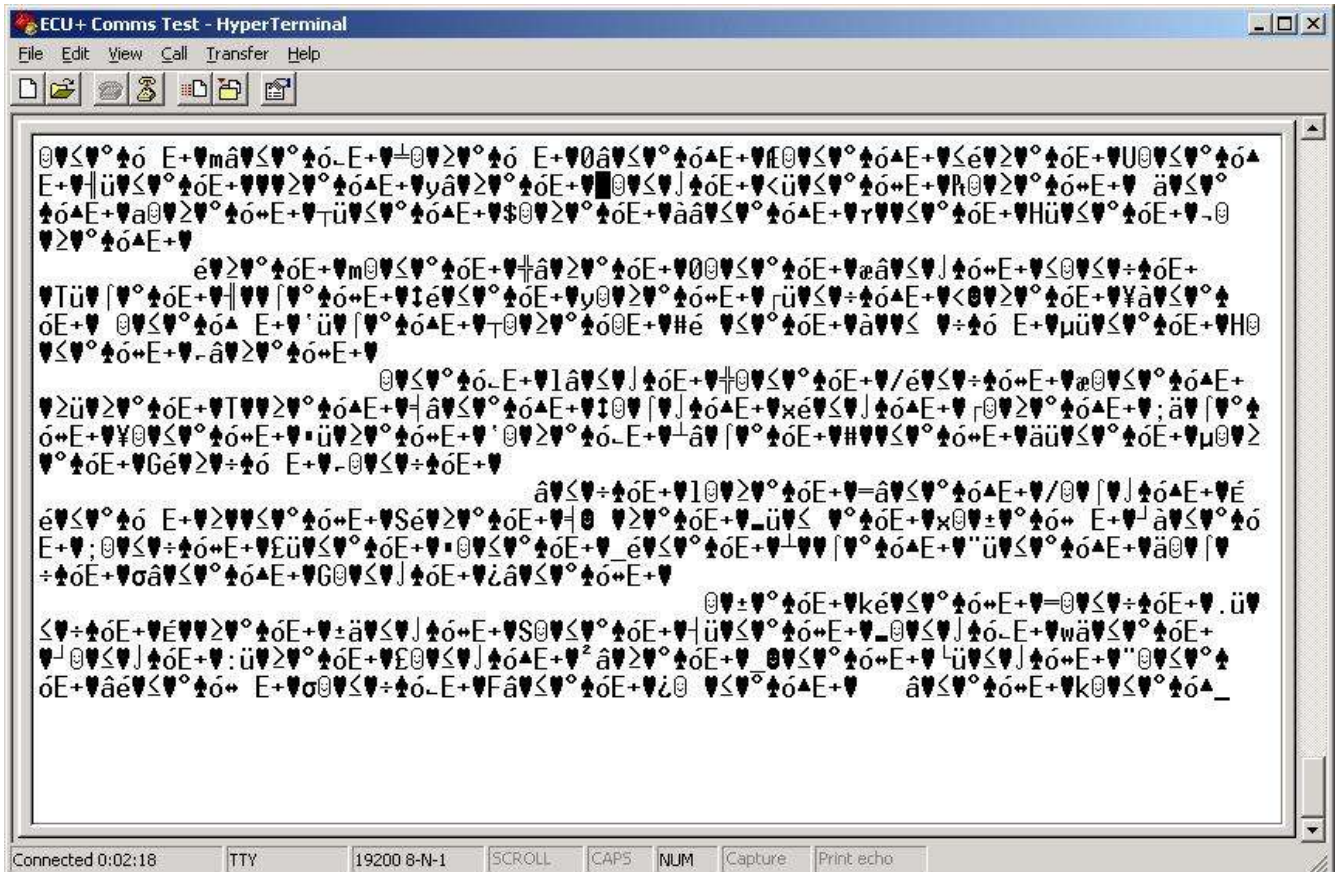


Illustration 81- The ECU+ head unit streaming data



If the HyperTerminal test shows data coming into your laptop, then the ECU+ Win application should work. Note that you *must* configure HyperTerminal before turning on your ignition in order for HyperTerminal to work correctly.

### **13.1.2 Glitches**

*I sometimes get glitches on my capture files when using ECU+ Win, but there are no glitches with the Palm software. What's up?*

The ECU+ Win application is a fairly CPU-intensive piece of software. If your laptop is slow, ECU+ Win may not be able to keep up with the incoming data stream. This causes “glitches” to appear in the captures. There are several things you can do to improve this:

1. Close all other applications when doing a capture.
2. Don't resize or move windows while doing a capture.
3. Within ECU+ Win, try to keep the number of graph views to a minimum. Redrawing the graphs takes the most CPU time of anything in the ECU+ Win application.
4. Minimize the fuel and timing maps, if visible. These also require significant CPU time to redraw in real time.
5. Minimize the ECU+ Win application while doing a capture.
6. Run a minimum of other software when using the ECU+ Win application. Common CPU hogs include applications that show up in your system tray (next to the clock, lower right hand corner of the screen) and anti-virus software.

### **13.1.3 Can't Open Serial Port**

*When I start a capture, ECU+ Win says it can't open the serial port. What could be wrong?*

There are several possible reasons for this error. First, is the ECU+ Win software setup for the correct serial port? Step through the diagnosis in the section “The Software Never Connects” first. Once you've established that you have the correct serial port configuration, check to see if some other device is using the serial port. Often, the Palm desktop and HotSync applications will take over the serial port. Disable these applications and see if the problem goes away.

## **13.2 Setup Problems**

### **13.2.1 Read Error or Open Read Error**

*When installing files, I get “failed (open read error)” or “failed (read error)” on a file, and the install stops.*

This generally occurs when your laptop can't read the CD-ROM shipped with the ECU+, either due to a bad CD-ROM drive or a bad or incompatible disc. Contact your dealer for a

replacement CD-ROM, or if you have a way to transfer files from the Internet to your laptop's hard disk, just download the software from the ECU+ web site at:

<http://www.ecuplus.com/download.htm>

The latest version of the ECU+ software is always available here. There will be a download link for a file called "ecuplus\_software\_yyyymmdd.zip" (yyyymmdd is the date of release). Download this ZIP file and extract it to a directory on your laptop hard disk, and then run the Setup.exe program from there.

### 13.2.1 Write Error or Open Write Error

*When installing files, I get "failed (open write error)" or "failed (write error)" on a file, and the install stops.*

The open write error means that a file couldn't be created in the directory that you specified for the ECU+ software. This could be because the directory is write-only, or (Windows NT, 2000 or XP) you don't have permissions to write to that directory. Try re-running the Setup.exe program and specify a different directory, or perhaps switch to a user that has administrative access to the computer.

The write error generally means your disk is full, since the Setup.exe program couldn't copy a file completely. Check to see how much disk space is free on your laptop hard disk, and free up some space before running the setup program again.

## 14 Support and Getting Help

Because the ECU+ system is a complex device, you may have problems with the software or installation. You have several lines of support open to you:

- For hardware installation problems, contact the dealer that you purchased the ECU+ system from. They're best equipped to handle these type of problems.
- For software support, again your dealer is a good first place to start.
- For tuning help, your best bet is the forums at [forums.ecuplus.com](http://forums.ecuplus.com). The forums are a great place to hang out and learn about how others are using their ECU+. The forums are also used to announce new software or firmware updates, and you can request new features or ask almost any type of question here. If you own an ECU+, you should **definitely** monitor the forums for the latest ECU+ news and information.
- For any type of support, you also have the option of e-mailing the ECU+ developer – just send an e-mail to [support@ecuplus.com](mailto:support@ecuplus.com). E-mails will generally be answered within 24 hours.
- If your ECU+ was working fine, but "breaks," contact your dealer for information about their return and repair policies.