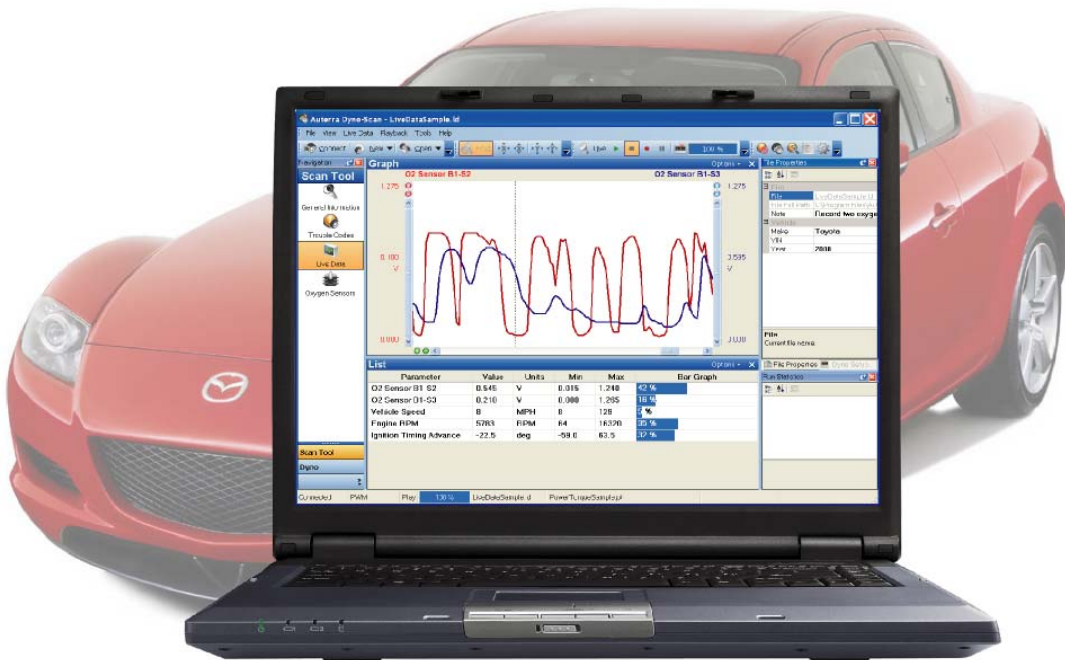




Dyno-Scan™ for Windows User Guide

Warnings

The exclamation point within the triangle is a warning sign alerting you of important instructions accompanying the product. Please observe all warnings.



Do not operate the vehicle indoors. A running engine produces lethal carbon monoxide exhaust fumes that can seriously harm or kill you if inhaled. Only run the vehicle motor outdoors with proper ventilation. Many scan tool operations do not require a running motor.



Do not attempt to operate or observe the scan tool while driving a vehicle. Driving requires the full attention of the driver. Operating or observing the scan tool will cause driver distraction and could cause a fatal accident.



Ensure the PC, cable, and OBD II adapter do not interfere with the vehicle controls. A cable dangling in front of the foot pedals, gear shifter, or steering wheel can interfere with vehicle operation and cause a fatal accident. Always ensure the PC, cable, and OBD II adapter are securely fastened out of the way. If the scan tool and PC cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the OBD II adapter connected to the vehicle.



Never race or exceed the posted speed limit while on public highways. The dynamometer operations require accelerating to high speeds. Always use a closed course raceway when performing dynamometer and acceleration tests.

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The "Product" is the complete Dyno-Scan for Windows product including hardware, software, user manual, and packaging.

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CHAPTER 1

Preface

Congratulations on your purchase of an Auterra's Dyno-Scan™ for Windows. Please take time to read through these operating instructions and become familiar with the operating procedure.

The Auterra Dyno-Scan™ for Windows, in conjunction with your personal computer, enables access to your vehicle's diagnostic information.

The scan tool offers features such as read and clear trouble codes, turn off the "Check Engine" light, and display live sensor data from the vehicle. The Dyno software adds a performance-measuring package that includes a dynamometer, acceleration tests, and fuel economy measurements.

Key Features

Dyno-Scan™ for Windows offers a multitude of diagnostic and performance-measuring features:

- All 1996 and later vehicles supported, including American, Asian, and European
- Read and clear diagnostic trouble codes (DTCs)
- Integrated DTC description databases including enhanced and generic definitions
- Turn off the vehicle's Check Engine or Service Engine Soon light
- Read and clear freeze frame data
- Monitor live sensor data with line graphs, bar graphs, and meters
- Graphically zoom in/out and pan within a virtual trace buffer
- View multiple sensors simultaneously with variable sample rates
- Record and playback live sensor data streams
- Export recording to a spreadsheet for further analysis
- Graphical oxygen sensor monitoring and on-board test results
- I/M readiness. Metric and English units of measure
- Horsepower and torque measurements
- 0-60 time, 1/8 and 1/4 mile time and speed, MPG, and top speed
- Supports Windows 98 and higher

- 1-year warranty

Minimum Platform and Software Requirements

You must have one of the following operating systems with Microsoft Internet Explorer 5.01 or later installed on your computer:

- Microsoft® Windows® 98
- Microsoft® Windows® 98 Second Edition
- Microsoft® Windows® Millennium Edition (Windows Me)
- Microsoft® Windows NT® 4 (Workstation or Server) with Service Pack 6a
- Microsoft® Windows® 2000 (Professional, Server, or Advanced Server) with the latest Windows service pack and critical updates available from the Microsoft Security Web site (www.microsoft.com/security).
- Microsoft® Windows® XP (Home or Professional, 32-bit and 64-bit)
- Microsoft® Windows® XP Media Center Edition
- Microsoft® Windows® XP Tablet PC Edition
- Microsoft® Windows® Server 2003 family
- Microsoft® Windows® Vista (all editions, 32-bit and 64-bit)
- Microsoft® Windows® 7 (all editions, 32-bit and 64-bit)

Minimum hardware requirements:

- Pentium 166MHz or faster
- 64MB of RAM or higher

Auterra Dyno-Scan™ for Windows

The Dyno-Scan™ for Windows is comprised of four components:

- OBD II Adapter and Software
- OBD II Cable
- USB or RS-232 null modem cable
- Windows laptop or desktop PC (purchased separately)



Figure 1: PC, RS-232 cable, OBD II Adapter, and OBD II Vehicle Connect Cable

OBD II

OBD II stands for On-Board Diagnostics second generation. OBD II was incorporated on some 1994 and 1995 model-year vehicles and was required for all 1996-and-later vehicles.

OBD II is a series of government regulations intended to reduce in-use vehicle emissions by continually monitoring for failure and/or deterioration of the powertrain and its emission-control systems. A Malfunction Indicator Light (i.e. Check Engine light or Service Engine Soon light) visible to the vehicle operator will be illuminated and a Diagnostic Trouble Code set when either there is a failure of a monitored component/system or any of the sensed parameters deteriorates such that the vehicle's emissions would exceed the relevant standard by approximately 50 percent.

The OBD II standard makes the Auterra Dyno-Scan™ for Windows universal to all automobiles, since all newer vehicles sold must conform to these government regulations.

OBD II standardizes a vehicle communication protocol and the vehicle's connector to an external diagnostic device called a Scan Tool. Auterra Dyno-Scan™ for Windows uses this connector located under the dash to communicate with the vehicle's on-board computer systems.

OBD II Connector

OBD II compliant vehicles must have a 16-pin connector located in plain sight underneath the dash near the driver's seat (see Figure 2). Alternatively, it may be behind ashtrays or concealed by an easily removed plastic cover, sometimes with the letters "OBD" stamped on the outside. Some 1994 and 1995 vehicles have this connector and are only OBD I compliant. These OBD I vehicles are not supported by the scan tool.

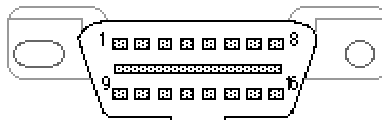


Figure 2: Vehicle OBD II Connector (Front View)

Specifications

The Dyno-Scan OBD II Adapter conforms to these specifications.

Table 1: Hardware Specifications

Vehicle Protocol Input:	VPW, PWM, ISO, Keyword Protocol (KWP) 2000, and CAN bus.
External Power:	None. Draws power from vehicle.
Weight:	4 oz
Dimensions (H x W x D):	3.5" x 1.75" x .875"
Temperature:	32° to 158° F (0° to 70° C) non-condensing

Supported Vehicles

Auterra Dyno-Scan™ for Windows supports all 1996 and newer vehicles, including American, European, and Asian models. Some 1994 and 1995 vehicles are also supported with a sticker under the hood indicating OBD II compliance. All vehicles sold in the US model year 1996 and newer are OBD II compliant and do not require the under hood sticker.

The OBD II Adapter supports the following automotive standard interfaces: VPW, PWM, ISO, Keyword Protocol (KWP) 2000, and CAN bus.

Abbreviations

Some item descriptions are abbreviated within the software.

BX – designates a bank number (e.g. B1 means bank 1)

SX – designates a sensor number (e.g. S1 means sensor 1)

BX-SX – designates a bank-sensor combination (e.g. B1-S2 means bank 1 – sensor 2)

Abbreviations and Definitions

A/F – Air Fuel

A/T – Automatic Transmission

Check Engine Light – also known as a MIL (Malfunction Indicator) light.

CHT – Cylinder Head Temperature

Closed Loop – In closed loop operation the oxygen sensors are used to adjust the fuel mixture. See open loop.

DTC – Diagnostic Trouble Code

Dyno - Dynamometer

EBCM – Electronic Brake Control Module

EBTCM – Electronic Brake Traction Control Module

ECU – Emission Control Unit (i.e. the vehicle's on-board computer)

EGR – Exhaust Gas Recirculation

EFI – Electronic Fuel Injection

EMR – Electronic Module Retard

ESC – Electronic Spark Control

EST – Electronic Spark Timing

EVAP – Evaporative Emission

Fuel Trim – engine computer function that keeps the air/fuel mixture close to ideal.

HC – Hydrocarbons

HEI – High Energy Ignition

HO2S – Heated Oxygen Sensor

Horsepower – a unit of measure to express the rate at which mechanical energy is expended.

HP – Horsepower

M/T – Manual Transmission

MAF – Mass Air Flow

MIL – Malfunction Indicator Light (i.e. “Check Engine” or “Service Engine Soon” light on the vehicle’s instrument panel).

NO_x – Oxides of Nitrogen

O₂ – Oxygen

Open Loop – used to describe the fuel mixture when the oxygen sensors are not being used, usually when the engine is cold or if a malfunction preventing closed loop operation is detected. See closed loop.

PCM – Power Control Module

PID – Parameter ID is a number used to designate a particular vehicle sensor.

PTO – Power Take-Off

RPM – Revolutions per Minute

SAE – Society of Automotive Engineers

Scan Tool – a computer that reads out OBD II values from the vehicle.

Service Engine Soon – also known as a MIL light.

SFI – Sequential Fuel Injection

TBI – Throttle Body Injection

TCM – Transmission Control Module

TCS – Traction Control Switch

TFT – Transmission Fluid Temperature

Torque - Torque is a measure of the force acting on an object causing that object to rotate.

TP – Throttle Position

TPS – Throttle Position Sensor

VAC – Vacuum

VIN – Vehicle Identification Number

VSS – Vehicle Speed Sensor

Installing Windows Software

Loading the Auterra Windows software onto your personal computer is easy. This section shows you how.

Uninstall Previous Dyno-Scan for Windows

Auterra recommends uninstalling all previous versions of the Dyno-Scan for Windows software, if any, before proceeding.

- 1 From the Start menu, select Settings > Control Panel.
- 2 Double-click on Add/Remove Programs.
- 3 Click the Install/Uninstall tab, if your Windows version includes it.
- 4 From the list of programs that you can remove, select Dyno-Scan for Windows.
- 5 Click Add/Remove.
- 6 At the prompt, click Yes to confirm that you want to remove the Dyno-Scan for Windows program.
- 7 When the files are removed, the uninstall program indicates that the process is complete.

Upgrade Internet Explorer

The Dyno-Scan software relies upon Microsoft Internet Explorer version 5.01 or later. The version is located on the Help > About Internet Explorer menu option within Internet Explorer. If you do not have version 5.01 or later, you will need to upgrade using the instructions below. If necessary, update your Internet Explorer for free directly from Microsoft at:

<http://windowsupdate.microsoft.com>

Software Installation (All Windows Versions)

- 1 Close all other programs and windows.
- 2 Insert the CD labeled Dyno-Scan for Windows into your CD-ROM drive.
- 3 The installation should start automatically. If not, from the Start menu select Run.
- 4 Type **D:\setup** (substitute the appropriate letter of your CD-ROM drive for D).
- 5 Follow the instructions on the screen.

USB Driver Installation

The A-302 Windows kit is equipped with a B-301 USB OBD II adapter. This adapter requires installing a USB driver. This section only applies to the USB version of the OBD II adapter, as shown in Figure 3: USB OBD II Adapter.



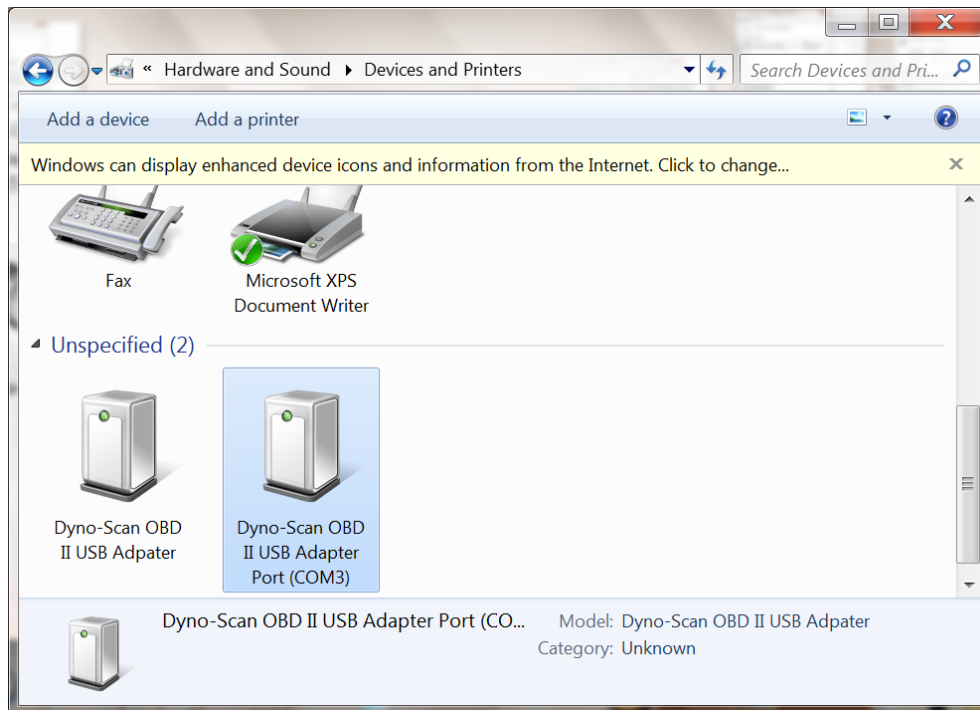
Figure 3: USB OBD II Adapter

Windows Vista/7 Installation

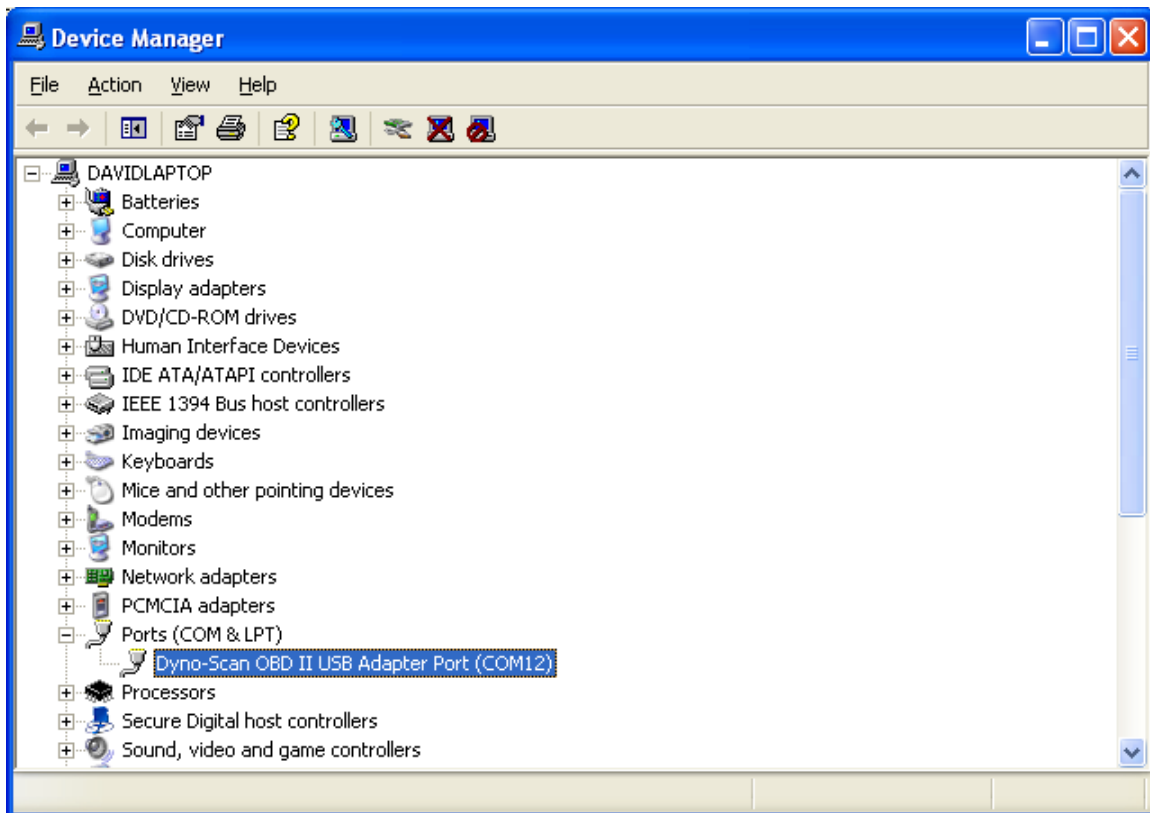
- 1 Do not plug in your Auterra USB OBD Adapter into your PC until after the Auterra Dyno-Scan for Windows software is installed.
- 2 During Dyno-Scan for Windows software installation, the USB driver is installed automatically. Just plug in the USB OBD II adapter and your device is ready for use.

If you experience problems installing the USB driver, see the “**USB Driver Installation.pdf**” manual in the User Guide directory on the Auterra CD ROM.

- 3 **Windows 7:** To locate the COM port number, go to the Windows Start button > Devices and Printers. In the Unspecified section, see the Dyno-Scan OBD II USB Adapter Port (COMX), where COMX is the COM port to select within the Dyno-Scan software on the Tools > Options menu dialog.



Windows Vista: To locate the COM port number, go to the Windows Start button > Control Panel > System and Maintenance and click Device Manager. Expand the Ports (COM & LPT) setting and see the Dyno-Scan OBD II USB Adapter Port (COMX) entry, where COMX is the COM port to select within the Dyno-Scan software on the Tools > Options menu dialog.



Windows 2000/XP Installation

- 1 Do not plug in your Auterra USB OBD Adapter into your PC until after the driver is installed.
- 2 Start **AuterraVCPInstaller.exe** within the USB Driver directory located on the Auterra CD ROM.
- 3 On Windows XP it may display a warning message. Press the Continue Anyway button. With all other versions of Windows no warning dialog is displayed.

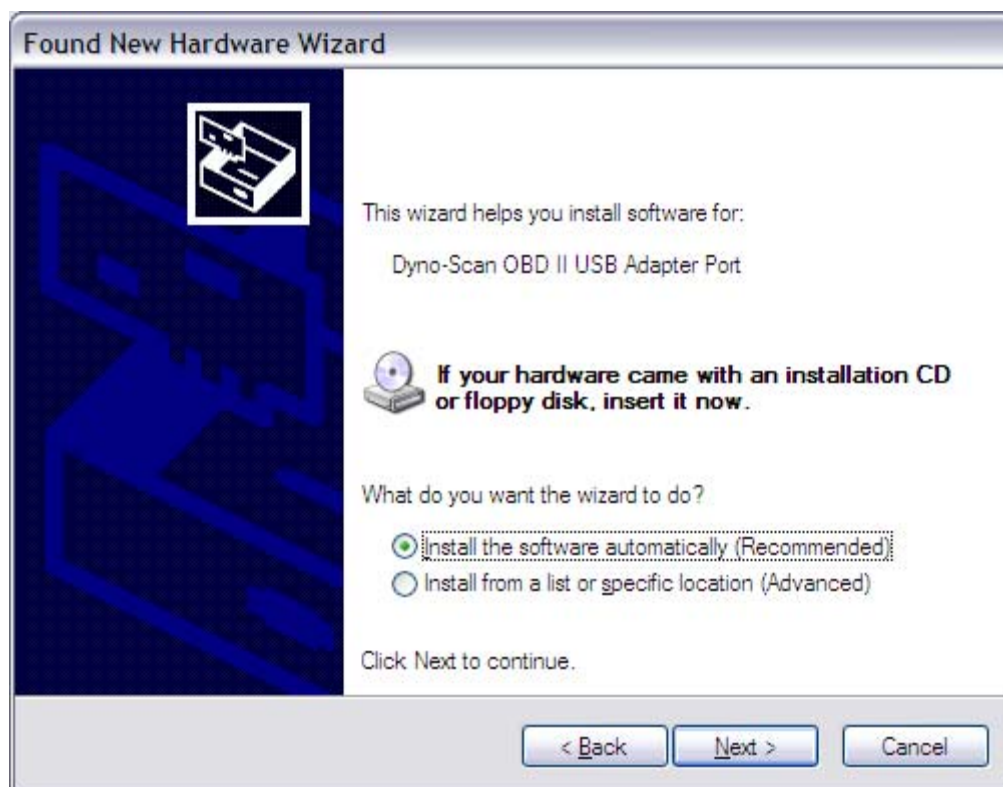


- 4 Please wait a few minutes for the driver installation to complete. There will be no progress dialog during installation.
- 5 Plug in the USB OBD II Adapter to your Windows PC. The Found New Hardware Wizard will display.
- 6 On the Found New Hardware Wizard, select "Yes, this time only" and press Next.



- 7 On the next dialog, select "Install the software automatically (Recommended).

The **AuterraVCPInstaller.exe** pre-installs the driver on your PC. Optionally, if you wanted to install the driver directly from the Auterra CD ROM, select "Install from a list or specific location (Advanced)" and then select a specific location on your computer (for instance d:\USB Driver).



- 8 On Windows XP, a warning dialog will appear. Press Continue Anyway. All other Windows versions will not display a warning message.



- 9 After the first driver installs, steps 7 though 9 will **repeat again**. There are two parts to the driver and both must be installed.

- 10 The driver installation is complete.

If you experience problems installing the USB driver, see the “**USB Driver Installation.pdf**” manual in the User Guide directory on the Auterra CD ROM.

- 11 To locate the COM port number, go to the Windows Start button > Control Panel > System and Maintenance and click Device Manager. Expand the Ports (COM & LPT) setting and see the Dyno-Scan OBD II USB Adapter Port (COMX) entry, where COMX is the COM port to select within the Dyno-Scan software on the Tools > Options menu dialog.

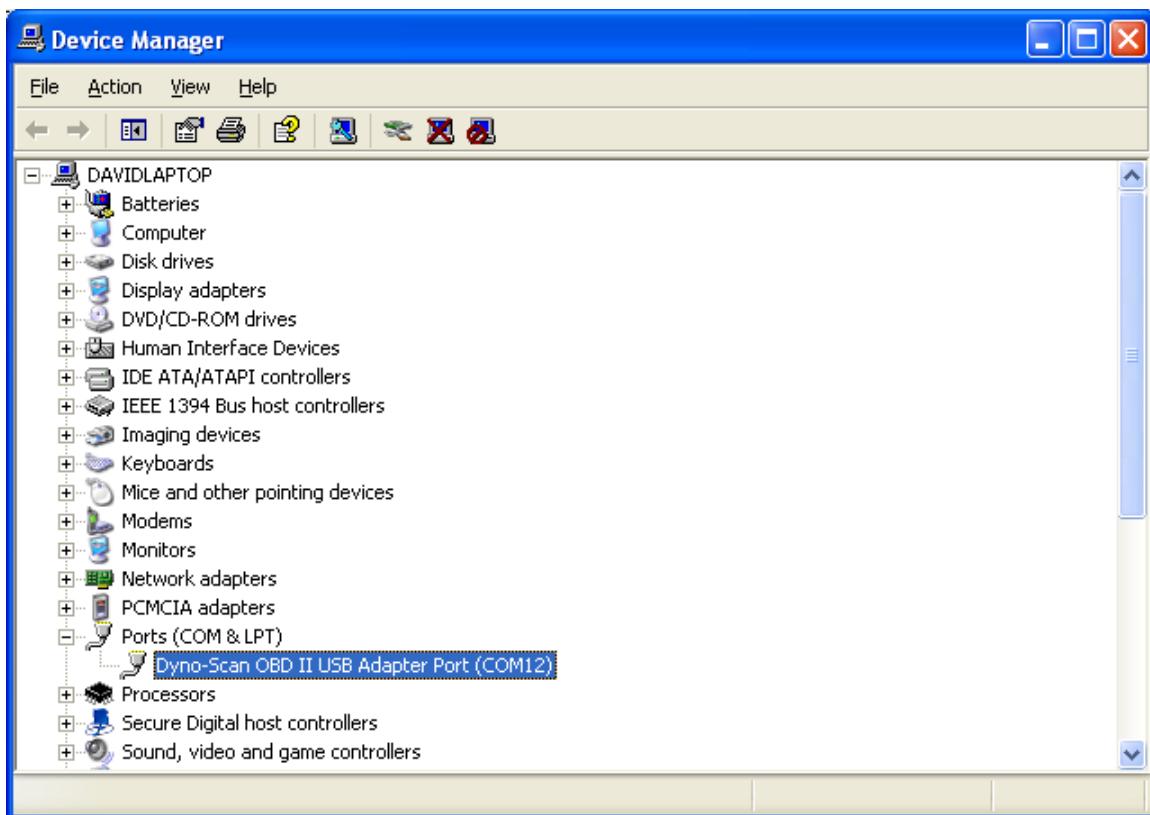


Figure 4: Correct Installation of USB Driver

Windows 98/ME USB Driver Installation

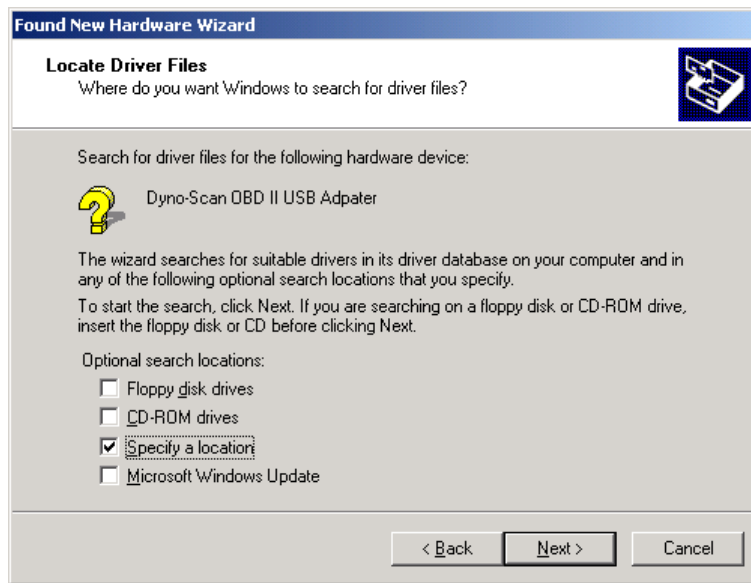
- 1 Plug in the USB OBD II adapter into any USB port on your Windows PC.
- 2 The Welcome to the Found New Hardware Wizard dialog will display. Press Next.



- 3 The Found New Hardware Wizard dialog will display. Select the “Search for a suitable driver for my device (recommended)” option and press Next.



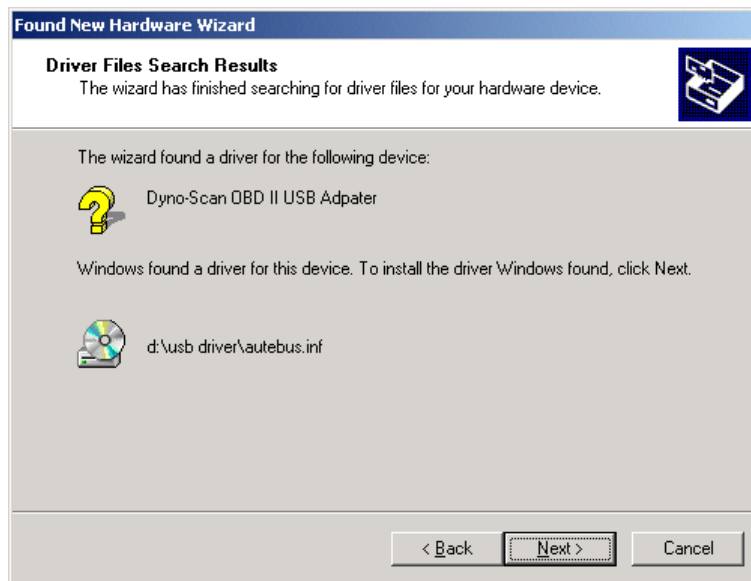
- 4 Check the “Specify a location” option and press Next.



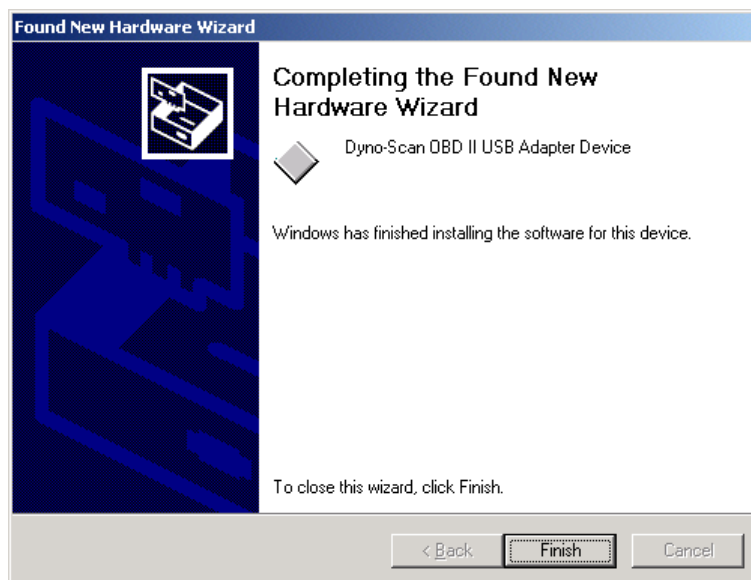
- 5 Press the Browse... button and select the "USB Driver (Win 98)" directory on the Auterra software CD ROM. Press OK.



- 6 Windows will locate the driver on within the USB Driver directory on the Auterra the CD ROM. Press Next.



- 7 The wizard will now complete the installation. Press Finish.



- 8 Once the first driver is installed, the Found New Hardware Wizard will **repeat again** the second driver. Repeat the above steps for the second driver installation.
- 9 After installing both drivers, your OBD II USB Adapter is ready for use.

Virtual COM Port

When the USB OBD II adapter is plugged into the PC, the driver will create a virtual COM port and assign it a number. The Windows Device Manager shows all assigned port numbers. Open Device Manager by doing the following:

- 1 Click on "Start" and then "Control Panel".

- 2 Switch to Classic View (if in Category View).
- 3 Double click on "System".
- 4 Select the Hardware tab.
- 5 Press the "Device Manager" button.
- 6 Click on the "+" next to Port.
- 7 The entry labeled "Auterra USB OBD II Adapter" shows the virtual COM port for the USB OBD II adapter. Physical COM ports are also shown if you are using a serial OBD II adapter.

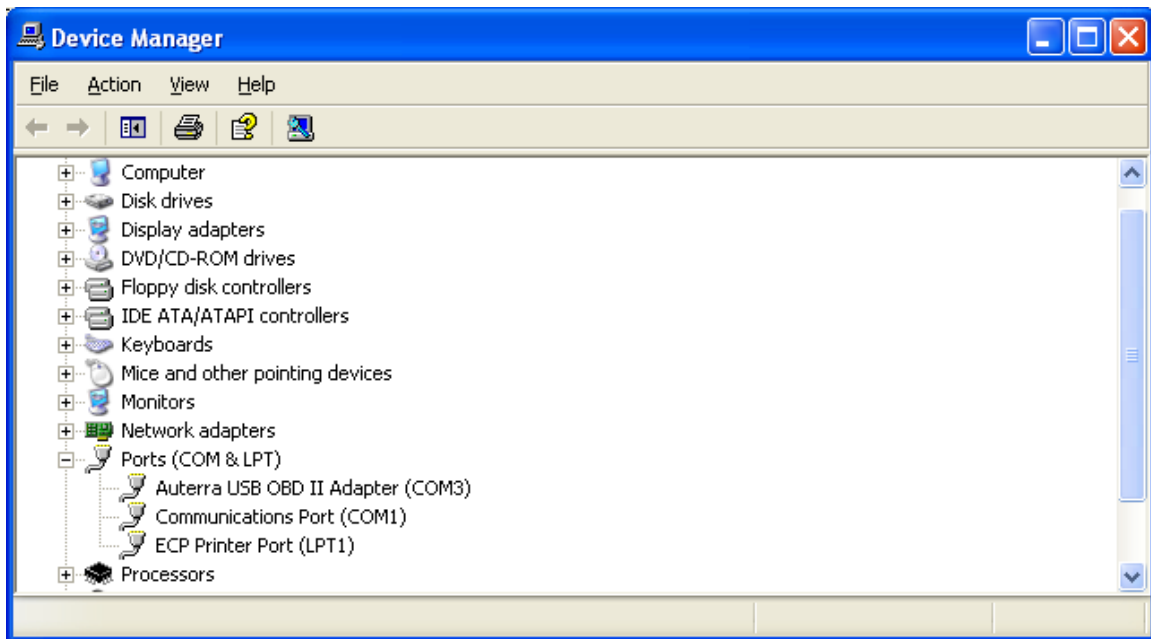


Figure 5: Auterra USB OBD II Adapter COM Port

Software Updates

Check the Auterra website periodically to download software updates at www.auterraweb.com.

Connections

Connecting your Auterra Dyno-Scan™ for Windows to the vehicle is easy. This section shows you how.

Connect your Dyno-Scan™ to the Personal Computer

- A** Plug the USB cable into the personal computer's USB port. If the kit is equipped with a serial cable instead, plug the serial RS-232 cable into the computer's COM port.
- B** Connect the USB or RS-232 cable to the OBD II adapter.
- C** Connect the OBD II cable to the OBD II adapter and tighten the two thumbscrews.

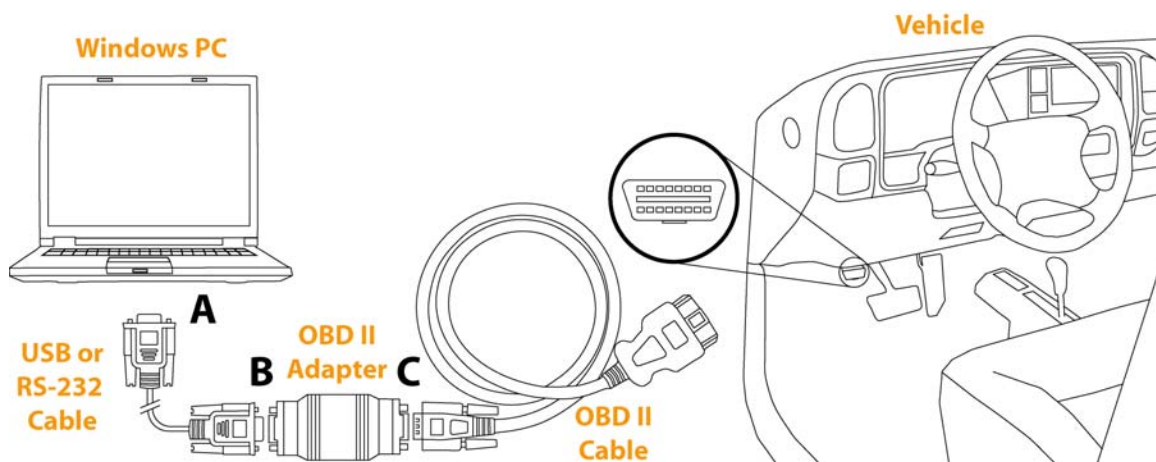


Figure 6: Dyno-Scan™ Connections

Connect the Dyno-Scan™ to your Vehicle

Locate the OBD II connector on the vehicle. OBD II compliant vehicles have the 16-pin connector located in plain sight underneath the dash near the driver's seat (see Figure 2). It may also be behind ashtrays.

Connect the male OBD II Cable connector to the vehicle's female OBD II connector. Ensure the connectors are fully engaged.

Select COM Port

- 1 Start the Dyno-Scan application.
- 2 Select the Tools > Options... menu selection.
- 3 On the Options dialog, select the COM port that the scan tool is connected to. The COM port dropdown list only shows COM ports installed on your computer. Refer to section Virtual COM Port for information on displaying COM port numbers within Windows Device Manager.
- 4 Press the OK button.

Your Dyno-Scan for Windows scan tool is setup and ready for use.

Dyno-Scan Basics

Getting started with your Dyno-Scan for Windows software is easy, and this section shows you how.

To connect to your vehicle, press the Connect button on the toolbar. Then press the “Connect to Vehicle” button on the Connect dialog. After a few seconds the scan tool will be connected to the vehicle. If the scan tool fails to connect, see Troubleshooting on page 90.

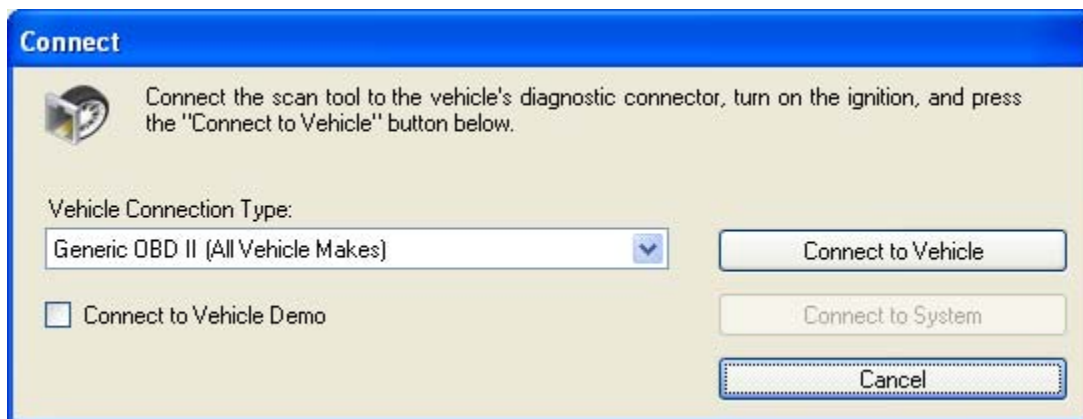


Figure 7: Connect Dialog

The Navigation pane is vertically docked on the far left of the screen. The Navigation pane is used to switch between the main screens. Just click an icon, such as Live Data, to change screens.

The Navigation pane sorts the main screens by category: Scan Tool, Dyno and Analyze. Mouse click a category on the Navigation pane and new category icons are displayed.

A *right* mouse click brings up a shortcut menu on many screen elements. On the Live Data screen, right mouse click in the middle of a Graph or List pane and select “Edit Parameters” to monitor live sensor data. Alternatively, left mouse click the Options dropdown button located on the right side of the pane title bar.

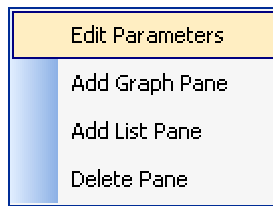


Figure 8: Right Mouse Click Shortcut Menu

If you close all of the Live Data Graph and List panes, the screen is blank. To add panes again, just right mouse click in the middle of the screen and select “Add List Pane” or “Add Graph Pane” and a new pane will be displayed.

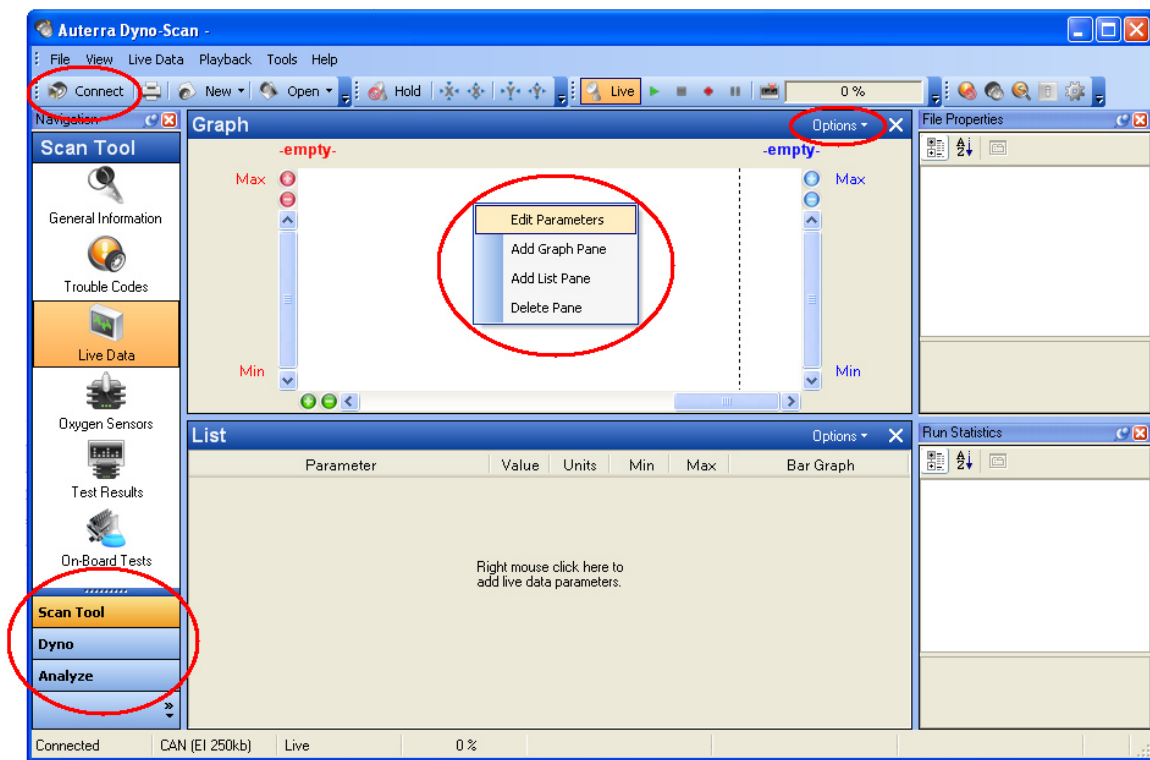


Figure 9: Live Data Screen Highlighted Features

Not every screen is supported by every vehicle. For instance, some vehicles will not support the Oxygen Sensors screen. If a screen is blank or shows no data, then the vehicle doesn't support that particular scan tool feature.

The Analyze Live Data screen only displays data if you either record data or open a previously recorded live data file. For instance, select File > Open > Live Data File... and select a file to open. Data will then be displayed on the Analyze Live Data screen.

Left mouse click the Options button on the Analyze Live Data pane title bar to display a shortcut menu of options. Right mouse click on any graphical element on this screen to display a shortcut menu of options. For instance, right mouse click an x or y axis for options.

Hold the left mouse button down and drag to move the axis data. Hold the Ctrl keyboard key and mouse drag an axis to zoom in and out.

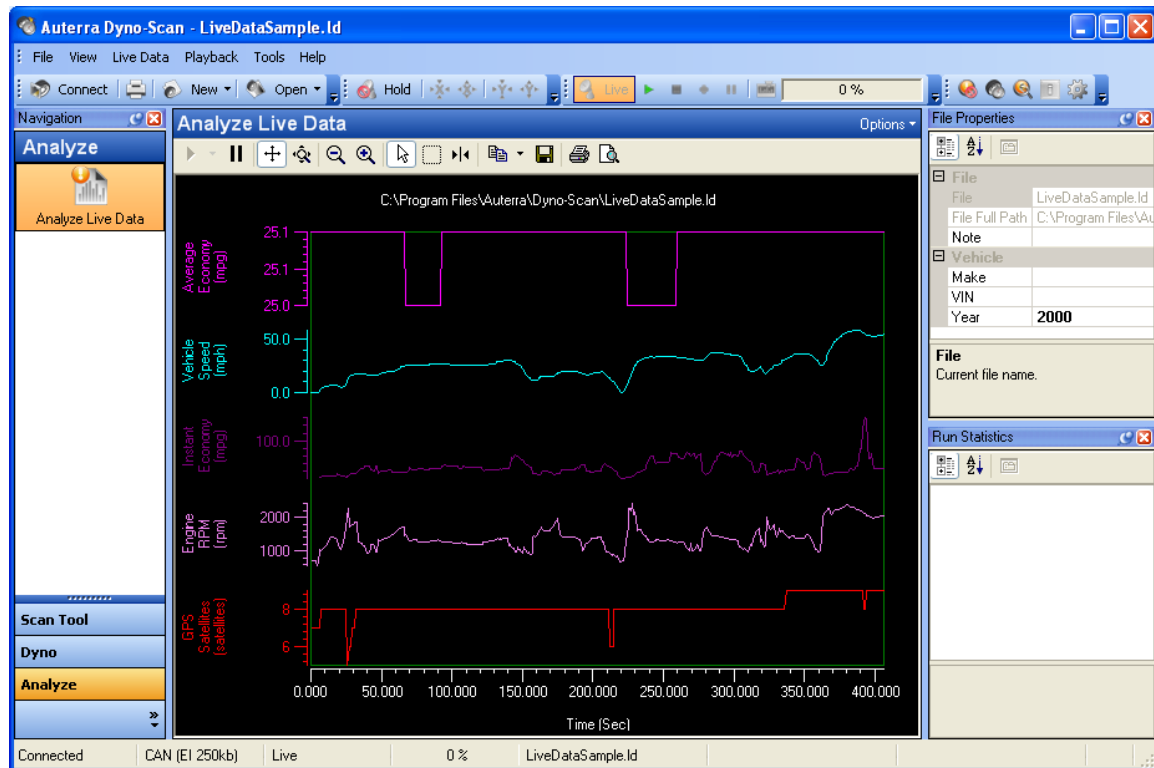


Figure 10: Analyze Live Data Screen

If you close any of the docking windows such as Navigation or File Properties, you can display them again on the View menu (e.g. View > Navigation).

Options Dialog

The **Reload last user parameters when starting program** setting, when checked, restores all user parameters to their last known state. Otherwise, the program's default parameters are used.

The **COM Port** setting on the General tab selects the personal computer COM port to use. Make sure the selected COM port matches the one the OBDII's adapter has been plugged into.

The **Default Units of Measure** setting changes between English or Metric units. Not all sensors use English units of measure, in which case the Metric units are used.

The **Fast Sampling** option on the General tab enables a faster than normal sampling frequency on some vehicles. If you notice on some vehicles that the live sensor monitoring doesn't function or the sensor measurements update sporadically, disable this feature.

The **CAN 6x Communication** options enables or disables the high-speed six-samples-per-query communication mode. Normally, one sensor at a time is polled from the vehicle. If the

vehicle supports CAN bus, then the vehicle may support polling up to six parameters at once speeding the transfer of data.

The **MPG Correction** applies a percent correction factor to all Instant Economy, Average Economy and Fuel Used parameters. This correction is used to fine-tune the fuel economy measurements.

The **Distance Correction** applies a percent correction factor to the Distanced Traveled live data parameter.

The **Vehicle Speed Correction** preference adjusts the vehicle speed sensor readings to accommodate a vehicle with an inaccurate speedometer. This is a global setting and adjusts the vehicle speed measurements on all screens displaying or using live data such as Live Data, Gear Ratio and Acceleration. The vehicle speed correction preference does not adjust the vehicle dashboard speedometer nor does it calibrate the vehicle speedometer.

The **Boost Calibration** value is subtracted from all Boost Pressure readings in order to adjust the Boost Pressure measurements from absolute pressure to a gauge pressure. The Boost Calibration entered is the atmospheric pressure in psi (pounds per square inch). To get atmospheric pressure using your vehicle, enter a Boost Calibration value of 0.0% and view the Boost Pressure parameter on the Live Data screen with the engine off. The Boost Pressure reading with a 0.0% calibration is the value to enter into the Boost Calibration box.

The **Engine Size** preference is used in the following parameters: Instant Economy 2, Average Economy 2, Fuel Used 2 and Air Flow Rate From MAP. Ensure you enter an accurate engine size (in liters) if you use these parameters.

The **Fuel Type** preference is used to adjust the fuel economy-related parameters. Ensure you enter the correct fuel type: gas or diesel.

The **Fuel Cost** preference is used to enter the cost per gallon of fuel currently in the vehicle gas tank. This value is used to compute the Fuel Cost live data parameter. If the Units of Measure is Metric, the value is the cost per liter.

The Reset Defaults button sets all settings back to their default state.

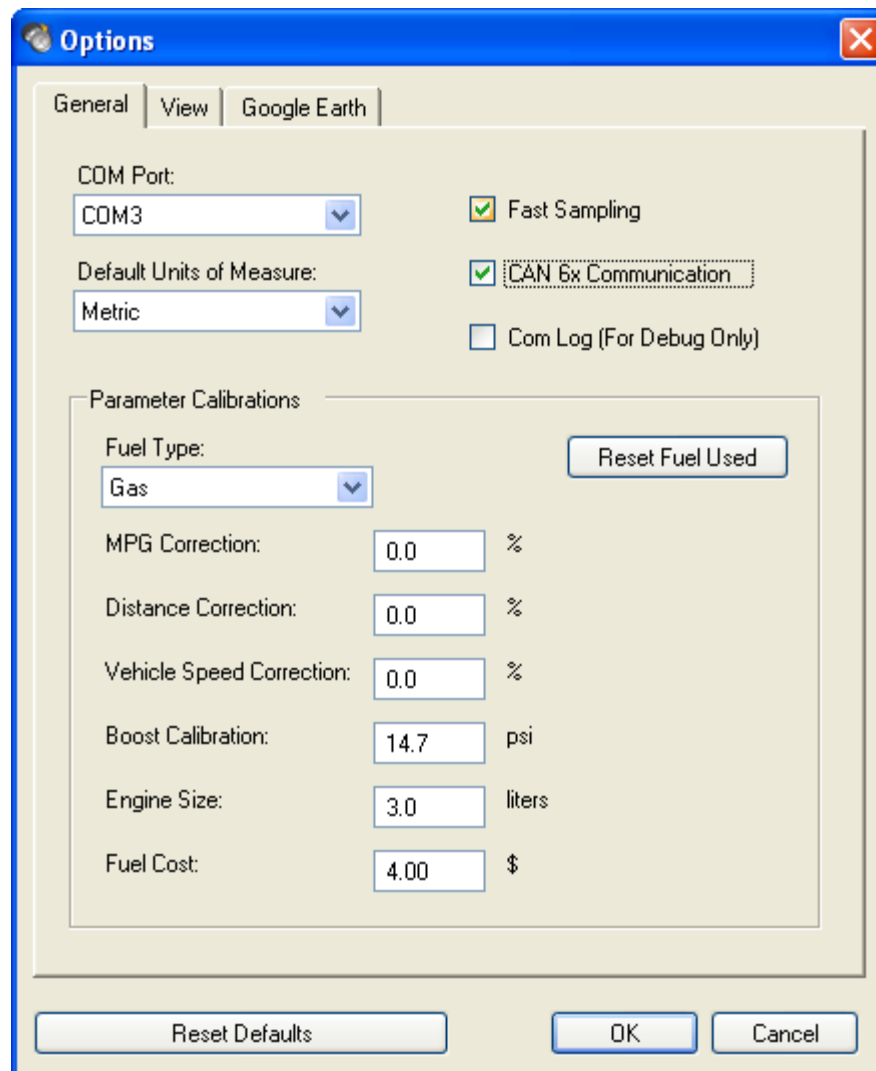


Figure 11: Options Dialog, General Tab

The View tab allows customization of the Font, Font Style, Font Color, and Font Size settings used in all grid displays.

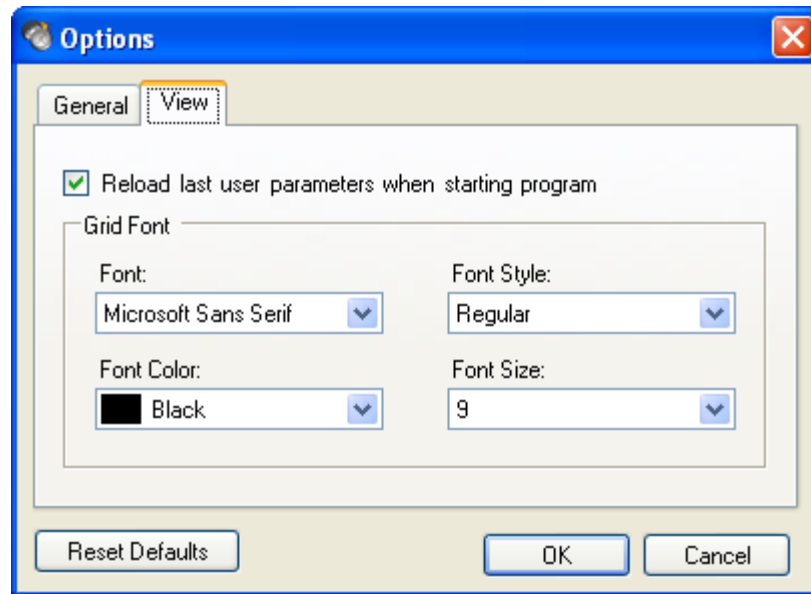


Figure 12: Options Dialog, View Tab

Vehicle Speed Correction

The vehicle speed correction preference adjusts the vehicle speed sensor readings to accommodate a vehicle with an inaccurate speedometer. This is a global setting and adjusts the vehicle speed measurements on all screens displaying of using live data.

The vehicle speed correction preference does not adjust the vehicle dashboard speedometer nor does it calibrate the vehicle speedometer.

If your vehicle is equipped with a stock tire size you leave this setting at 0.0%.

Always compute and adjust the vehicle speed correction first before measuring and adjusting the distance correction or MPG correction.

To compute and adjust the vehicle speed correction factor using is GPS:

- 1 Set Vehicle Speed Correction to 0.
- 2 Select the Live Data screen and monitor the Vehicle Speed parameter.
- 3 Drive the vehicle and keep the vehicle speed steady (e.g. 30 MPH).
- 4 Have a passenger note the Dyno-Scan Vehicle Speed and the GPS speed.
- 5 Compute an error percentage:

$$\text{vehicle speed correction} = ((\text{GPS speed} - \text{Dyno-Scan vehicle speed}) / \text{GPS speed}) \times 100$$

Example:

$$7.3\% = ((30.0 \text{ MPH} - 27.8 \text{ MPH}) / 30.0 \text{ MPH}) \times 100$$

- 6 Set the Vehicle Speed Correction to the computed correction factor.

Distance Correction

The distance correction preference fine-tunes the accuracy of the Distance Traveled parameter, if necessary.

The distance correction preference does not adjust the vehicle odometer nor does it calibrate the vehicle speedometer.

The Distance Traveled parameter is used within the Instant MPG and Average MPG parameter computations. Therefore, an accurate Distance Traveled parameter ensures greatest accuracy of these parameters.

To compute and adjust the distance correction preference using your vehicle odometer:

- 1 Set the Distance Correction to 0.
- 2 Go to the Live Data screen and monitor the Distance Traveled parameter.
- 3 Drive the vehicle for 25 to 50 miles.
- 4 Compare the Dyno-Scan trip computer Distance Traveled value and the vehicle's odometer mileage. Compute an error percentage:

$$\text{distance correction} = ((\text{odometer distance} - \text{Dyno-Scan distance}) / \text{odometer distance}) \times 100$$

Example:

$$3.3\% = ((27.5 \text{ miles} - 26.6 \text{ miles}) / 27.5 \text{ miles}) \times 100$$

- 5 Set the Distance Correction to the computed correction factor.

Alternatively a GPS may be used in place of the odometer in the above procedure if the vehicle speedometer is not accurate.

MPG Correction

The MPG correction preference fine-tunes the accuracy of the Instant MPG, Average MPG and Fuel Used parameters due to different fuels or minor vehicle sensor variances.

The MPG correction preference does not adjust the amount of fuel used by the vehicle.

Always compute and adjust the distance correction first before measuring and adjusting MPG correction.

To compute and adjust the MPG correction preference:

- 1 Set the MPG Correction to 0.
- 2 Fill up your vehicle gas tank.
- 3 On the Tools > Options menu press the Reset Fuel Used button then press OK.
- 4 Go to the Live Data screen and monitor the Fuel Used parameter.
- 5 Drive the vehicle normally until the tank is near empty. Always have the Average Fuel Economy screen displayed when driving the vehicle.
- 6 Fill up the vehicle and note the gallons used to fill up the vehicle.

- 7 Compute the error in the Dyno-Scan Fuel Used parameter and the gallons used to fill up the gas tank.

MPG correction = ((Dyno-Scan fuel used - gas pump gallons) / gas pump gallons) x 100

Example:

-1.2% = ((25.3 gallons – 25.6 gallons) / 25.6 gallons) x 100

- 8 Set the MPG Correction to the computed correction factor.

Boost Calibration

Two different methods are used for expressing pressure: gauge pressure and absolute pressure. Gauge pressure is referenced to atmospheric pressure. The atmospheric pressure at sea level is about 14.7psi and changes slightly with atmospheric conditions. Absolute pressure is referenced to 0psi. The relationship between the pressures can be expressed as follows:

absolute pressure = gauge pressure + atmospheric pressure

The Boost Pressure parameter measures the absolute pressure within the vehicle's intake manifold. To measure gauge pressure, enter a Boost Calibration offset. Gauge pressure can be expressed as follows:

gauge pressure = absolute pressure – atmospheric pressure

The Boost Calibration allows entering the atmospheric pressure, in psi, such that a gauge pressure reading may be obtained.

boost pressure = absolute pressure – Boost Calibration

Two factors affect the Boost Calibration accuracy: weather conditions and elevation changes, the later being more significant. Enter a new Boost Calibration for the most accurate gauge pressure measurements.

The boost calibration does not adjust the turbo boost pressure of the vehicle.

To compute a Boost Calibration correction factor:

- 1 Connect Dyno-Scan to your vehicle.
- 2 Ensure your vehicle is not running.
- 3 Select the Boost Calibration option to 0.
- 4 Go to the Live Data screen and monitor the Boost Pressure parameter.
- 5 The Boost Pressure parameter will display. This is your Boost Calibration correction factor. With the Boost Calibration preference at 0 and the vehicle off, the Boost Pressure value shown is atmospheric pressure.
- 6 Set the Boost Calibration to the value measured above.

Engine Size

The Engine Size preference is used in the following parameters: Instant Economy 2, Average Economy 2, Fuel Used 2 and Air Flow Rate From MAP. Ensure you enter an accurate engine size (in liters) if you use these parameters.

Fuel Type

The Fuel Type preference is used to adjust the fuel economy-related parameters. Ensure you enter the correct fuel type: gas or diesel.

Fuel Cost

The Fuel Cost preference is used to enter the cost per gallon of the fuel currently in the vehicle gas tank. This value is used to correctly display the Fuel Cost live data parameter. If the Units of Measure is set to Metric, the Fuel Cost is the cost per liter.

Dyno-Scan File Types

The software uses four data file types with four different file extensions. Each file type can be created using the File > New menu option.

Table 2: File Types

File Type	File Extension	Description
Live Data File	.ld	Live data files store live parameter recordings.
Power Torque File	.pt	Stores power torque run data.
Acceleration File	.ac	Stores acceleration run data.
Dyno Setup File	.ds	Stores vehicle and environmental setup information.

Docking Windows

The program contains four docking windows: Navigation, File Properties, Run Statistics, and Dyno Setup Properties. Each docking Windows may be resized, hidden, or slide-in or slide-out from a docked position on demand.

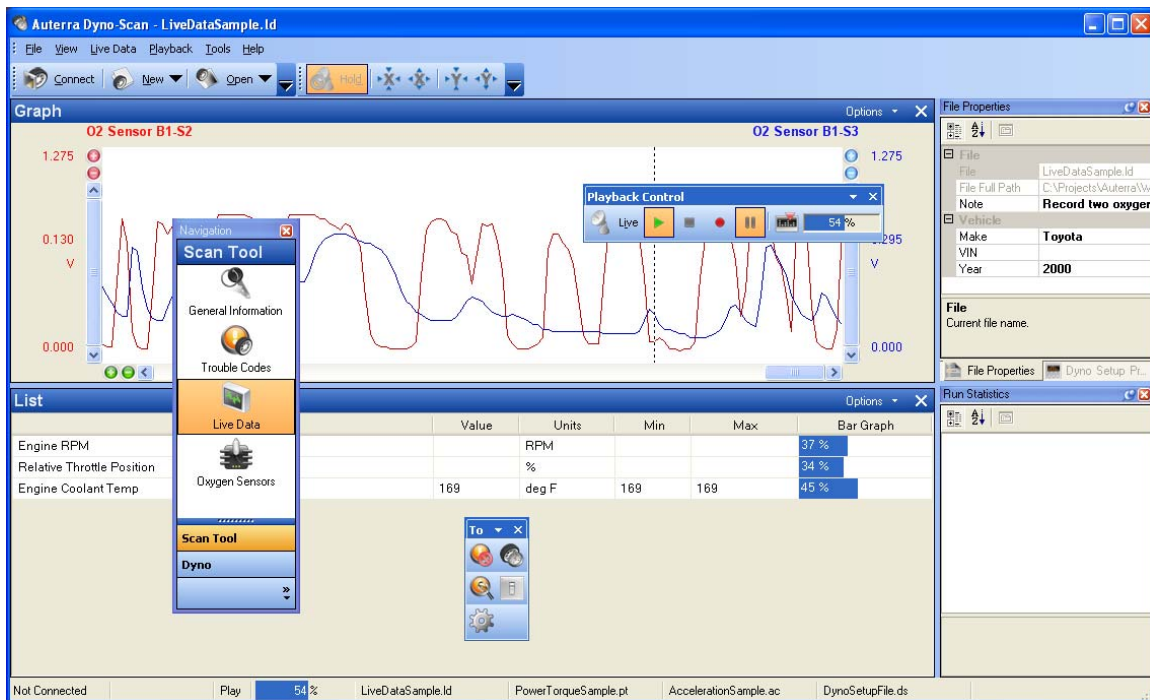


Figure 13: Floating Toolbars and Property Windows

- To hide a docking window, click the red X close button in the upper right corner.
- To hide a docking window with slide-in, press the pushpin icon in the upper right corner. The window will slide in and hide itself.
- To show a hidden docking window, select the View menu option (e.g. View > Navigation).
- To show a docking window with slide-out, hover the mouse button over the docked window name or icon. The window will slide out showing itself.
- If a docking window is not visible, the View menu option will redisplay any of the four windows.
- To move a docking window from dock to float, either drag window title bar to a new location or double click the title bar.
- To move a docking window from float to dock, either drag the window title bar to one of the four window edges (top, bottom, left, right) or double click the title bar.

Properties Windows

Properties values are shown in certain docking windows, such as the Dyno Setup Properties as shown below.

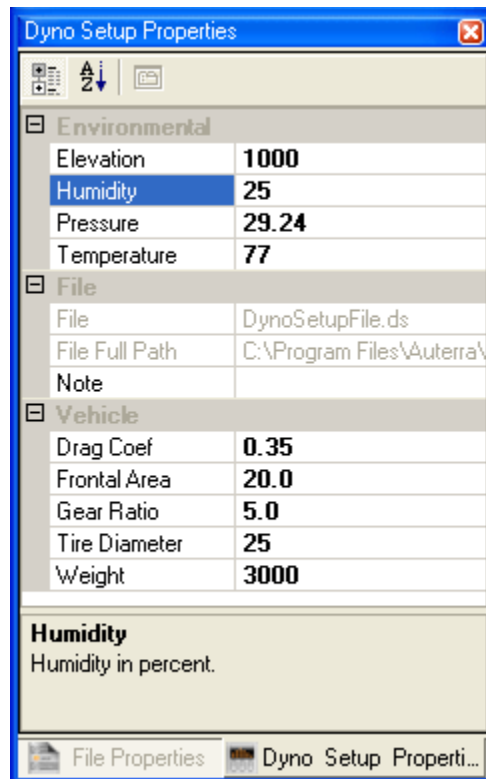


Figure 14: Dyno Setup Properties Docking Window

All property windows share the same behavioral traits, such as:

- Properties displayed in bold font may be modified.
- Properties display in grey font cannot be changed.
- Any property changes are immediately saved to disk.

To change a property value, click the parameter and type in a new value. The change is immediately saved to disk.

Navigation Docking Window

The Navigation docking window is used to switch main screen.

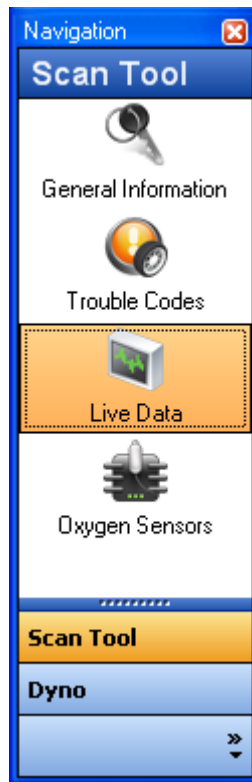


Figure 15: Navigation Docking Window

To switch screens, perform these steps:

- 1 Click one of main group buttons.
- 2 Click an item icon from within that group.

For instance, to select the Acceleration screen, select the Dyno group then click the Acceleration icon.

File Properties Docking Window

Live Data, Power Torque, and Acceleration files properties are viewed and changed from the File Properties docking window.

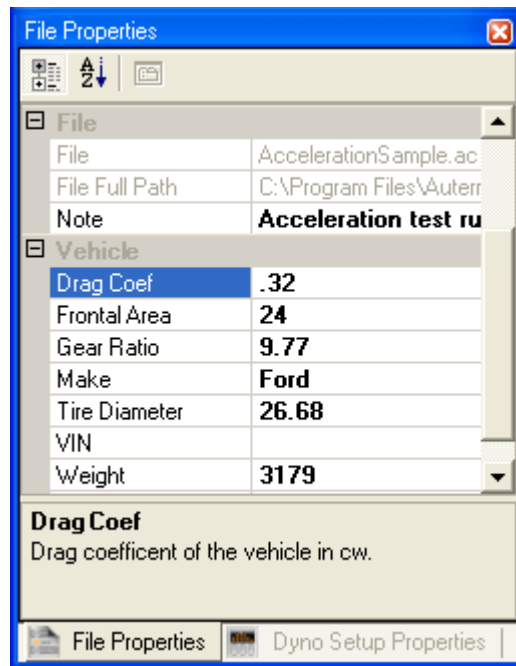


Figure 16: File Properties Docking Window

The File Properties docking window shows different properties depending on the active screen.

Table 3: File Properties Displayed

Active Screen	File Properties Displayed
Live Data	Live Data file
Power Torque	Power Torque file
Acceleration	Acceleration file
All other screens	No properties are displayed

For instance, to view Live Data file properties within the File Properties docking window, select the File > Open > Live Data File... menu option to open a file then switch to the Live Data screen.

Dyno Setup Properties Docking Window

The Dyno Setup file properties are viewed and changed from the Dyno Setup Properties docking window.

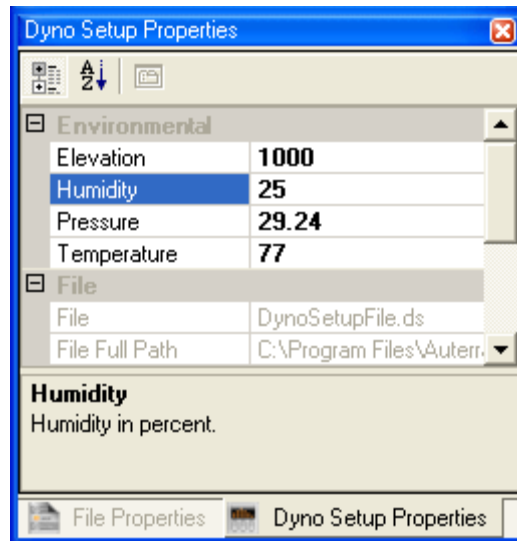


Figure 17: Dyno Setup Properties Docking Window

To view Dyno Setup file within the Dyno Setup Properties docking window, select the File > Open > Dyno Setup File... menu option to open a file.

Run Statistics Docking Window

The Run Statistics docking window shows statistical values for Power Torque and Acceleration curves, such as maximum horsepower or top speed.

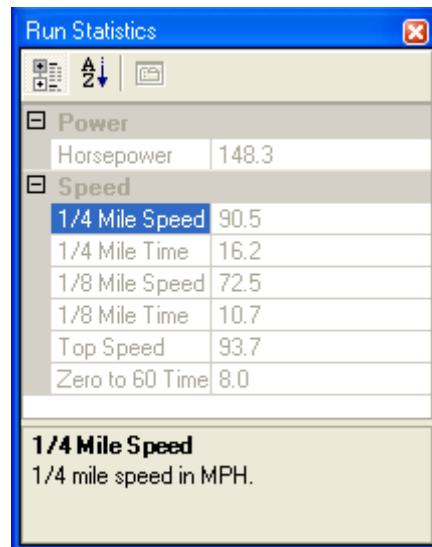


Figure 18: Run Statistics Docking Window

For instance, to view Power Torque statistics within the Run Statistics docking window, select the File > Open > Power Torque File... menu option to open the file then switch to the Power Torque screen.

Toolbars

Toolbar locations, docking position, buttons shown, and sizes are completely user customizable. Each time you start the program; the toolbar settings and position is restored if the "Restore last user parameters when starting program" option is selected (see Options Dialog).

- To move a docked toolbar, left mouse click and drag the vertical dashed line on a toolbar. Alternatively, double click the dashed line to move the toolbar into a floating position.



- To move a floating toolbar, left mouse click the title bar and drag to its new location. Alternatively, double click the title bar to put the toolbar back into its docked position.



- To move toolbar to a new docked location, left mouse click and drag the toolbar to a new edge of the screen. The toolbar can be docked to any of the four application window edges (top, bottom, left, right).
- To customize the buttons shown on the toolbar, click the down arrow located on a docked toolbar to show a toolbar shortcut menu. Alternatively, right mouse click on any blank location within the toolbar area to show the shortcut menu.



- To change to change various toolbar and menu options, such as enable/disable toolbars or change the icons from large to small, select the toolbar shortcut menu then select the Customize... option.

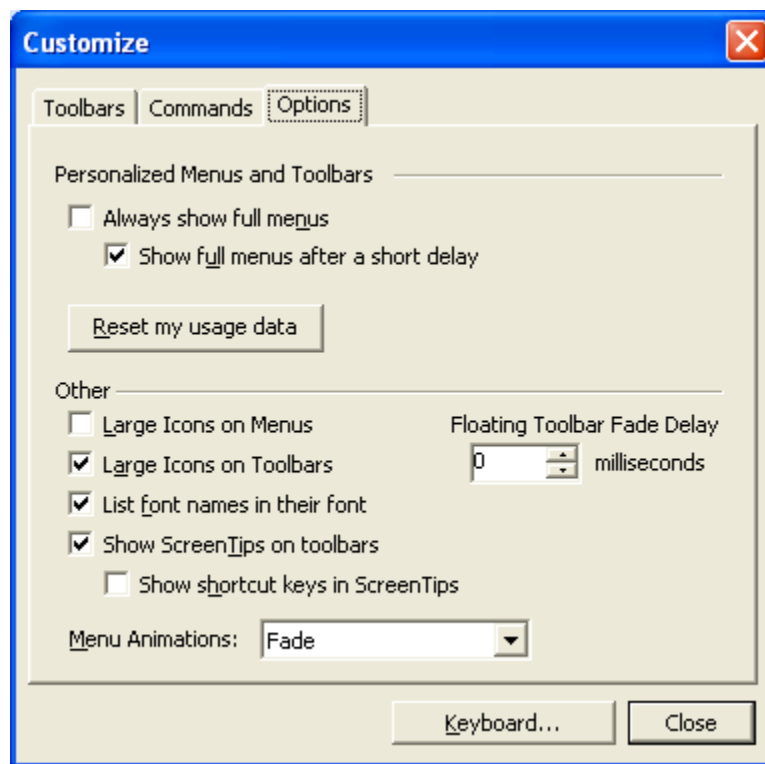


Figure 19: Customize Toolbars and Menus Dialog

Status Bar

The status bar is located at the bottom of the program screen. It displays the following information from left to right:

Vehicle Connection Status – either Connected or Not Connected

Connection Type – the vehicle hardware protocol connection type. For instance, PWM, VPW, CAN, ISO, or KWP.

Data Mode – either Live or Play. Live mode means the data is originating from the vehicle. Play mode means the data is originating or recording to/from a file.

Playback Percentage Bar Graph – the current playback file position as a percent.

Open Live Data File – currently open Live Data file.

Open Power Torque File – currently open Power Torque file.

Open Acceleration File – currently open Acceleration file.

Scan Tool Operation

The Dyno-Scan™ software is designed for easy operation. This section shows how to operate the software and describes the features on each screen.

Not every vehicle is equipped with all sensor types supported by the scan tool. Therefore, the scan tool interrogates the vehicle and creates a custom list of sensors and options unique to the vehicle connected.



Ensure the PC, cable, and OBD II adapter do not Interfere with the vehicle controls. A cable dangling in front of the foot pedals, gear shifter, or steering wheel can interfere with vehicle operation and cause a fatal accident. Always ensure the PC, cable, and OBD II adapter are securely fastened out of the way. If the scan tool and PC cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the OBD II adapter connected to the vehicle.

Connect Scan Tool to Vehicle

The scan tool must be connected to the vehicle's diagnostic connector, except in demonstration mode where the vehicle data is simulated. See Demo Mode for more information about the demo mode.

- 1 Turn the vehicle ignition off.
- 2 Connect the OBD II cable to the vehicle's OBDII connector. Normally the vehicle connector is located under the dash on the driver's side in plain sight.
- 3 Turn the vehicle's ignition on. Vehicle does not have to be running. For engine running tests, the vehicle can be started and idling.



Do not operate the vehicle indoors. A running engine produces lethal carbon monoxide exhaust fumes that can seriously harm or kill you if inhaled. Only run the vehicle motor outdoors with proper ventilation.

Start Dyno-Scan™ Software

- 1 Start the Dyno-Scan™ software on the personal computer by double-clicking Dyno-Scan icon located your desktop. You can also start the software in different languages by selecting the Windows start button > Dyno-Scan > Español > Dyno-Scan.
- 2 Once the software has started, select the File > Connect menu option.

- 3 On the Connect dialog, press the "Connect to Vehicle" button to connect to the vehicle. Selecting the Connect to Vehicle Demo checkbox to enable Demo mode see Demo Mode.

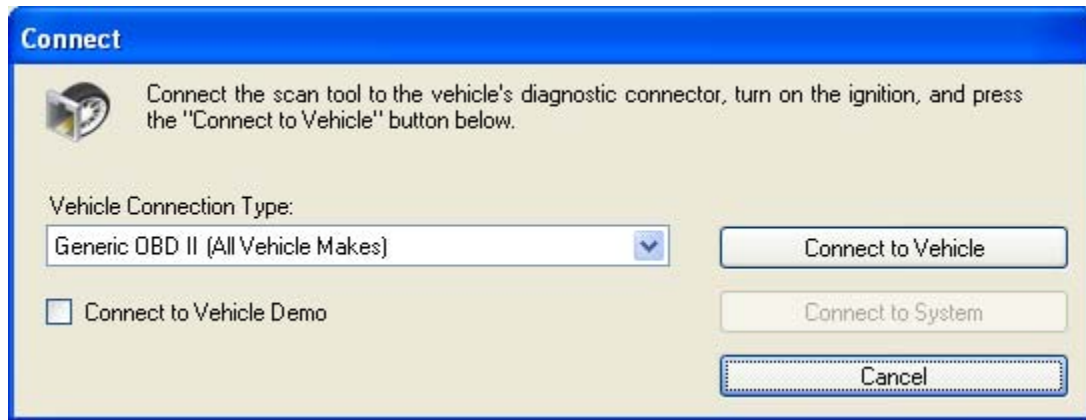


Figure 20: Connect Dialog

- 4 After a few seconds, the scan tool will detect the vehicle.

Enhanced OBD II

The scan tool supports optional enhanced OBD II upgrades. These upgrades can be purchased separately for certain makes of vehicle, like Ford, GM, Toyota and others. The enhanced features allow access to other vehicle systems like ABS, airbag (SRS), and others.

A Product Key is purchased to unlock these features. Once the Product Key is obtained, it is entered into the Help > Product Registration Keys menu option.

If you want to see what enhanced OBD II vehicles systems are supported before purchasing an enhanced upgrade, select a different make on the Vehicle Connection Type dropdown on the Connect dialog, and then press Connect to Vehicle. The software will detect the enhanced systems available on your vehicle such as ABS or airbag.

Note the following when detecting enhanced OBD II vehicle systems:

1. Upgrade to the latest Dyno-Scan for Windows software by download the upgrade from the Auterra web site (www.auterraweb.com).
2. If you have an older OBD II adapter version, an adapter firmware update or new OBD II adapter may be required before all available vehicle systems are detected. Please contact Auterra for upgrade options available.

General Information Screen

The General Information screen contains two panes: Vehicle Monitor Test Status and Vehicle Information.

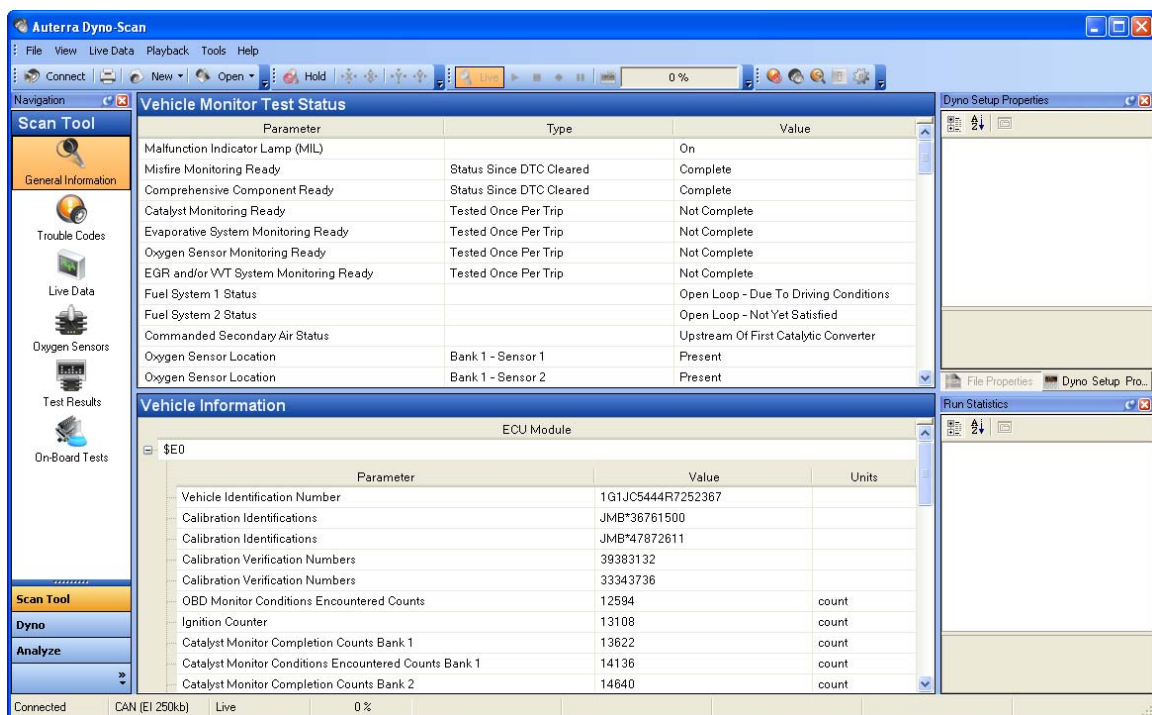


Figure 21: General Systems Screen

The Vehicle Monitor Test Status pane shows the status of the vehicle's built-in readiness monitor tests. Test statuses are either Complete or Incomplete. Other bit-encoded information is also displayed on this screen like fuel system status. Click on a column header to sort the parameters ascending alphabetically. Click the header again and it sorts descending.

The software continually queries the vehicle to display current values on the Vehicle Monitor Test Status pane.

The Vehicle Information pane shows vehicle specific information such as Vehicle Identification Number (VIN), Calibration IDs and Performance Tracking counters.

Diagnostic Trouble Codes Screen

The Diagnostic Trouble Codes screen has three panes: Stored Diagnostic Trouble Codes, Pending Diagnostic Trouble Codes, and Freeze Frame.

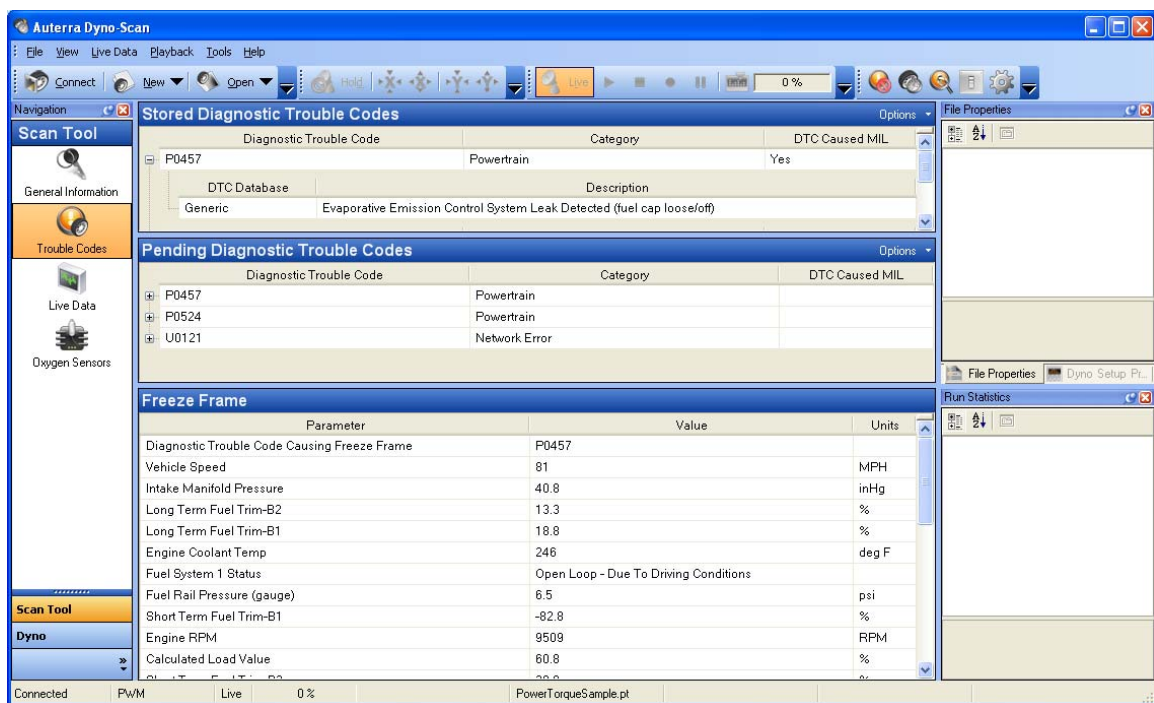


Figure 22: Trouble Codes Screen

Stored and Pending Diagnostic Trouble Codes Pane

The Stored and Pending Diagnostic Trouble Codes panes display the vehicle's pending and stored Diagnostic Trouble Codes (DTC), if any. The Diagnostic Trouble Codes screen continually scans for new DTCs, even if some DTCs are already shown.

All DTCs are displayed within 10 to 20 seconds. If the vehicle's Check Engine or Service Engine Soon light on the instrument panel is illuminated, a stored DTC will be displayed. Pending DTCs do not necessarily indicate a faulty component/system. If the vehicle's test results indicate a failure after additional driving, then the Check Engine light is illuminated and a DTC is set in the stored DTC pane.

Two categories of trouble codes exist: generic and enhanced. Generic codes are standardized and common to all vehicle manufacturers. Enhanced codes are not uniquely defined and may overlap with another manufacture, or even the same manufacturer. For instance, multiple definitions may exist for code P1234. Ford may define it as "Engine Oil Pressure Too Low", but Toyota's definition could mean something different like "System Voltage Unstable". The Diagnostic Trouble Codes screen reads and clears both generic and enhanced codes.

There are four types of trouble codes: P (Powertrain), B (Body), C (Chassis), and U (Network Communication). The scan tool reads and clears all P-codes and, depending on the vehicle, B, C, and U-codes as well¹.

¹ Not all vehicles support retrieving and clearing B, C, and U-codes.

1. Switch to the Diagnostic Trouble Codes screen as described in the section Navigation Docking Window.
2. If the vehicle has detected a Diagnostic Trouble Code(s) (DTC) they are listed in either the Stored or Pending Diagnostic Trouble Codes pane. Not all Diagnostic Trouble Codes cause the MIL light (i.e. Check Engine) to illuminate.
3. If the MIL light is on (Check Engine), the Diagnostic Trouble Code that caused the light to illuminate is marked with a Yes in the "DTC Caused MIL" column. The Freeze Frame pane will contain a snapshot of a variety of sensor values at the time the error occurred (see Freeze Frame). Useful for diagnosing operating parameters of the vehicle at the time the MIL occurred.
4. If you wish to clear the MIL, select the Tools > Clear DTCs... menu option to clear all DTCs from the vehicle's memory. Wait a few seconds after pressing Yes on the Clear Trouble Codes dialog for the scan tool to complete the clear command.
5. Pressing Yes will clear the DTC from vehicle memory. Once cleared, the error codes cannot be recovered. Clearing also extinguishes the vehicle's MIL (i.e. Check Engine) light and erases the vehicle's freeze frame log. Sometimes the vehicle's ignition must be turned off and on again before the Check Engine light turns off.

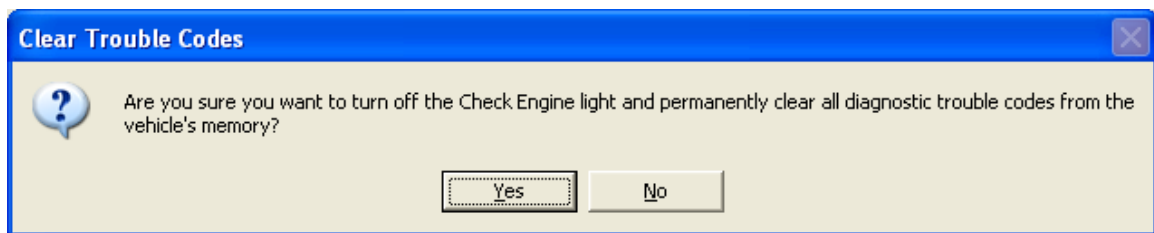


Figure 23: Clear Trouble Codes

6. Tapping the '+' icon next a trouble code number will expand out the possible DTC textual descriptions. The software may not contain a description for every possible trouble code. If the software cannot find a description, please refer to your vehicle's repair manual. See Diagnostic Trouble Codes for more information.

Freeze Frame Pane

The Freeze Frame pane displays the vehicle freeze frame log. Select the sensor units of measure, either English or Metric, using the Preferences screen (see Options Dialog). When a Diagnostic Trouble Code occurs that illuminates the Check Engine light, the vehicle's computer saves the current values of the vehicle's sensors at the instant the error occurred. If a freeze frame exists, it will display within a few seconds. Each vehicle supports a different complement of sensors. The Freeze Frame pane displays only sensors appropriate for the vehicle under test. This pane remains blank if no freeze frame information is available from the vehicle.

Record/Playback

The Live Data screen can record and playback live sensor data. The recording and playback is controlled from the Playback menu option.

The Record/Playback settings are:

Live – display live data as it is occurring.

Play – playback a previously recorded file.

Stop – stop a playing file.

Record – start recording live data.

Pause – pause a file during playback.

The Live Data panes have two modes of operation: Live and Play. When the Playback control is set to Live, all displayed parameters are live from the vehicle. If the Playback control is set to Play, Pause, Stop, or Record the scan tool is in the Play mode (see Status Bar).

The recorded data is saved in a Live Data file. The Live Data files are open and created from the File > New and File > Open menu options.

Once a file is open, selecting Record saves the data into the currently opened file. Similarly, Play plays back the currently opened file.

New vehicle parameters are selected while in Live mode. Once the mode has switched to Play mode, new parameters cannot be added; always switch to Live mode to add/remove parameters via the Parameter Edit dialog.

The playback speed does not use the same time-base as the original recording. Therefore, playback will be faster than when recorded. This makes it easier to review long recorded files.

Playback position is controlled using the Playback > Set Playback Position control. 0% is the beginning of the file and 100% is the end.

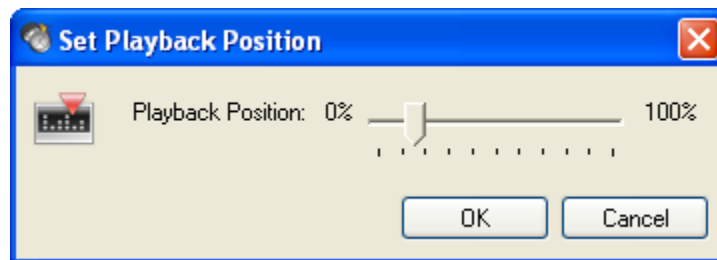


Figure 24: Set Playback Position Dialog

A Live Data file saves a list of parameters recorded. The Parameter Edit dialog shows recorded parameters in the Parameter list box and the word "Play" is displayed as the Module. The Sample Speed control is hidden when in play mode. See Edit Parameters Dialog for more information.

A typical Live Data record session proceeds as follows:

1. Switch to the Live Data screen as described in the section Navigation Docking Window.
2. Ensure the Playback mode is set to Live by selecting the Playback > Live menu option.
3. Create a new Live Data file by selecting File > New > Live Data File...
4. Enter a file name, and press Open.
5. Press the Options label in the upper right corner of the Graph pane. Alternatively, right mouse click anywhere in the Graph pane. Select the Edit Parameters menu option.
6. Press the Add Parameter button.
7. Select a sensor from the ECU Parameter box located on the right side of the dialog.
8. Press OK.
9. Set the Playback mode on the Playback > Record menu to start recording.
10. Select the Playback > Stop menu option after a few seconds of recording.
11. Select the Playback > Play menu option to playback the previously recorded file.

Edit Parameters Dialog

The Edit Parameters dialog selects a parameter to monitor, record, or playback.

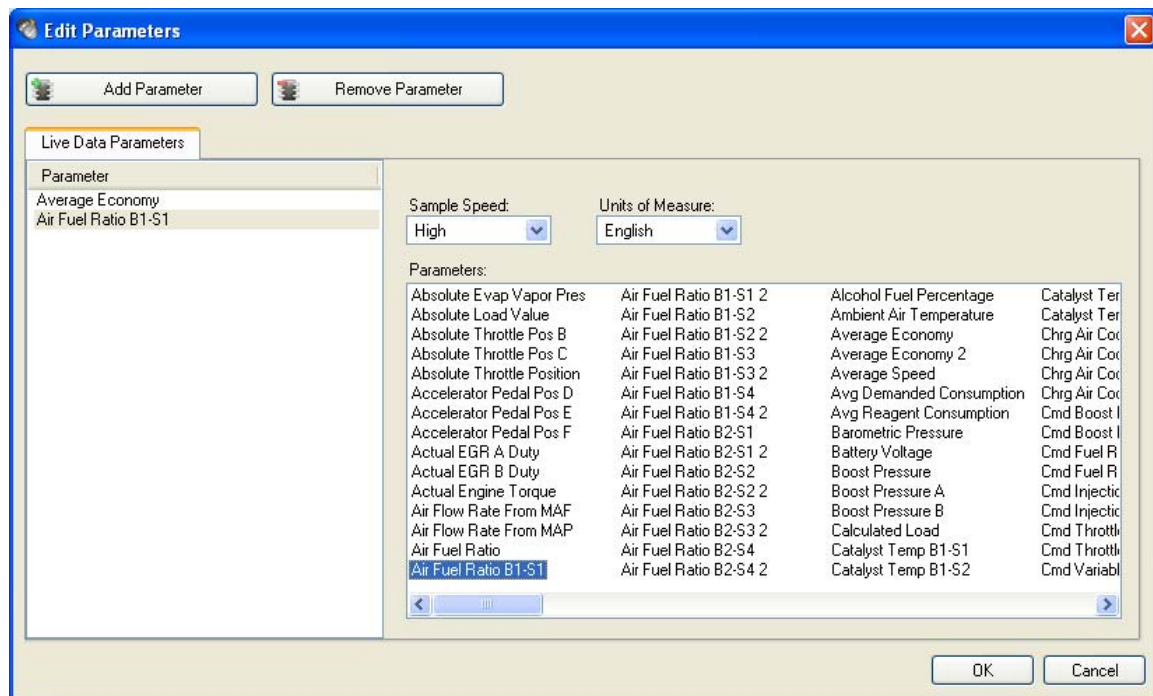


Figure 25: Parameter Edit Dialog

Not every vehicle is equipped with all sensor types and not every vehicle supports every parameter type. Therefore, the software interrogates the vehicle and creates a custom, alphabetical listing of the parameters unique to the vehicle and module selected.

Sample Speed – selects the sampling speed for the sensor. High samples at up to 40mS², Med is about 3 seconds, and Low is about every 10 seconds per sample.

Units of Measure – selects the units of measure for the sensor reading, either English or Metric.

Parameters – selects the vehicle parameter to monitor. The list of sensors is dynamically created depending on the types of sensors supported by the vehicle.

Add and Remove Parameters

To add a Parameter, follow these steps:

- 1 Switch to the Live Data screen as described in the section Navigation Docking Window.
- 2 Press the Options button in the upper right corner of the Graph pane. Alternatively, right mouse click anywhere in the Graph pane. Select the Edit Parameters menu option.
- 3 Press Add Parameter.
- 4 Select the Sampling Speed desired.
- 5 Select the Units of Measure to display.
- 6 Select the parameter to monitor within the ECU Parameters list box.
- 7 Repeat the above process to add more parameters.
- 8 Press OK.

To remove a Parameter, follow these steps:

- 1 Select the parameter to remove in the Parameter list.
- 2 Press the Remove Parameter button.
- 3 Repeat the above process to remove more parameters.
- 4 Press OK.

Supported Parameters

The following is a list of all the live parameters supported by the software and a brief description of each parameter. Other non-live parameters, such as statuses or test results, are not listed here.

Each parameter name ending with a number (e.g. "Average Economy 2") provides the same data value as the non-numeric ending parameter. The distinction is the same parameter is obtained in different ways.

Not every vehicle supports all parameters. A custom list of parameters is created unique to the vehicle connected.

² Actual sampling speed is vehicle dependant.

Parameter	Parameter	Parameter
Average Economy	EGR Temperature B2-S2	O2 B1-S2 Wide Range V
Average Speed	Engine Coolant Temp	O2 B1-S3 Wide Range mA
Battery Voltage	Engine Coolant Temp 1	O2 B1-S3 Wide Range V
Boost Pressure	Engine Coolant Temp 2	O2 B1-S4 Wide Range mA
Digital In 1	Engine Fuel Rate	O2 B1-S4 Wide Range V
Distance Traveled	Engine Oil Temp	O2 B2-S1 Wide Range mA
Drive Time	Engine Reference Torque	O2 B2-S1 Wide Range V
Fuel Cost	Engine RPM	O2 B2-S2 Wide Range mA
Fuel Rate	Engine Torque Idle Point 1	O2 B2-S2 Wide Range V
Fuel Used	Engine Torque Point 2	O2 B2-S3 Wide Range mA
Idle Percent	Engine Torque Point 3	O2 B2-S3 Wide Range V
Idle Time	Engine Torque Point 4	O2 B2-S4 Wide Range mA
Instant Economy	Engine Torque Point 5	O2 B2-S4 Wide Range V
Absolute Evap Vapor Pres	Equivalence Ratio B1-S1	O2 Sensor B1-S1
Absolute Load Value	Equivalence Ratio B1-S1 2	O2 Sensor B1-S2
Absolute Throttle Pos B	Equivalence Ratio B1-S2	O2 Sensor B1-S3
Absolute Throttle Pos C	Equivalence Ratio B1-S2 2	O2 Sensor B1-S4
Absolute Throttle Position	Equivalence Ratio B1-S3	O2 Sensor B2-S1
Accelerator Pedal Pos D	Equivalence Ratio B1-S3 2	O2 Sensor B2-S2
Accelerator Pedal Pos E	Equivalence Ratio B1-S4	O2 Sensor B2-S3
Accelerator Pedal Pos F	Equivalence Ratio B1-S4 2	O2 Sensor B2-S4
Actual EGR A Duty	Equivalence Ratio B2-S1	PM Mass Concentrate B1-S1
Actual EGR B Duty	Equivalence Ratio B2-S1 2	PM Mass Concentrate B2-S1
Actual Engine Torque	Equivalence Ratio B2-S2	Reagent Tank Level
Air Flow Rate From MAF	Equivalence Ratio B2-S2 2	Rel Throttle A Position
Alcohol Fuel Percentage	Equivalence Ratio B2-S3	Rel Throttle B Position
Ambient Air Temperature	Equivalence Ratio B2-S3 2	Relative Accel Pedal Pos
Avg Demanded	Equivalence Ratio B2-S4	Relative Intake Air A
Consumption	Equivalence Ratio B2-S4 2	Relative Intake Air B
Avg Reagent Consumption	Evap System Vapor Pres	Relative Throttle Position
Barometric Pressure	Evap System Vapor Press	Run Time NOx Warn
Boost Pressure A	Exhaust Gas Temp B1-S1	Short Fuel Trim B1-S1
Boost Pressure B	Exhaust Gas Temp B1-S2	Short Fuel Trim B1-S2
Calculated Load	Exhaust Gas Temp B1-S3	Short Fuel Trim B1-S3
Catalyst Temp B1-S1	Exhaust Gas Temp B1-S4	Short Fuel Trim B1-S4
Catalyst Temp B1-S2	Exhaust Gas Temp B2-S1	Short Fuel Trim B2-S1
Catalyst Temp B2-S1	Exhaust Gas Temp B2-S2	Short Fuel Trim B2-S2
Catalyst Temp B2-S2	Exhaust Gas Temp B2-S3	Short Fuel Trim B2-S3
Chrg Air Cooler Temp B1S1	Exhaust Gas Temp B2-S4	Short Fuel Trim B2-S4
Chrg Air Cooler Temp B1S2	Exhaust Pressure B1	Short Term Fuel Trim B1
Chrg Air Cooler Temp B1S2	Exhaust Pressure B2	Short Term Fuel Trim B2
Chrg Air Cooler Temp B2S1	Fuel Injection Timing	Short Term Fuel Trim B3
Cmd Boost Pressure A	Fuel Level Input	Short Term Fuel Trim B4
Cmd Boost Pressure B	Fuel Rail Press Rel Manifold	Shrt Term Sec Fuel Trim B1

Cmd Fuel Rail Pressure A	Fuel Rail Pressure	Shrt Term Sec Fuel TrimB2
Cmd Fuel Rail Pressure B	Fuel Rail Pressure (abs)	Shrt Term Sec Fuel TrimB3
Cmd Injection Pressure A	Fuel Rail Pressure (gauge)	Shrt Term Sec Fuel TrimB4
Cmd Injection Pressure B	Fuel Rail Pressure A	Time Since DTCs Cleared
Cmd Throttle Actuator A	Fuel Rail Pressure B	Time Since Engine Start
Cmd Throttle Actuator B	Fuel Rail Temp A	Total Engine Idle Time
Cmd Variable Turbo A	Fuel Rail Temp B	Total Engine Run Time
Cmd Variable Turbo B	Hybrid Battery Pack Life	Total Engine Run w/PTO
Command Throttle Actuator	Ignition Timing Advance	Total Run w/IE-ACED 1
Commanded EGR	Injection Pressure A	Total Run w/IE-ACED 10
Commanded EGR A Duty	Injection Pressure B	Total Run w/IE-ACED 2
Commanded EGR B Duty	Intake Air Temp B1-S1	Total Run w/IE-ACED 3
Commanded Equival Ratio	Intake Air Temp B1-S2	Total Run w/IE-ACED 4
Commanded Evap Purge	Intake Air Temp B1-S3	Total Run w/IE-ACED 5
Commanded Intake Air A	Intake Air Temp B2-S1	Total Run w/IE-ACED 6
Commanded Intake Air B	Intake Air Temp B2-S2	Total Run w/IE-ACED 7
Commanded Wastegate A	Intake Air Temp B2-S3	Total Run w/IE-ACED 8
Commanded Wastegate B	Intake Air Temperature	Total Run w/IE-ACED 9
Control Module Voltage	Intake Manifold Abs PresA	Turbo A In Compressor
Distance Since DTCs Clrd	Intake Manifold Abs PresB	Turbo A In Turbine Temp
Distance Traveled MIL On	Intake Manifold Pressure	Turbo A Inlet Pressure
DPF Delta Pressure B1	Long Term Fuel Trim B1	Turbo A Out Compressor
DPF Delta Pressure B2	Long Term Fuel Trim B2	Turbo A Out Turbine Temp
DPF Inlet Pressure B1	Long Term Fuel Trim B3	Turbo A RPM
DPF Inlet Pressure B2	Long Term Fuel Trim B4	Turbo B In Compressor
DPF Inlet Temp B1	Long Term Sec Fuel Trim B1	Turbo B In Turbine Temp
DPF Inlet Temp B2	Long Term Sec Fuel TrimB2	Turbo B Inlet Pressure
DPF Outlet Pressure B1	Long Term Sec Fuel TrimB3	Turbo B Out Compressor
DPF Outlet Pressure B2	Long Term Sec Fuel TrimB4	Turbo B Out Turbine Temp
DPF Outlet Temp B1	Manifold Surface Temp	Turbo B RPM
DPF Outlet Temp B2	Mass Air Flow A	Variable Turbo A
Driver Demand Torque	Mass Air Flow B	Variable Turbo B
EGR A Error	Minutes Run with MIL On	Vehicle Speed
EGR B Error	NOx Concentration B1-S1	Warm-ups Since DTCs Clrd
EGR Error	NOx Concentration B2-S1	Wastegate A
EGR Temperature B1-S1	O2 B1-S1 Wide Range mA	Wastegate B
EGR Temperature B1-S2	O2 B1-S1 Wide Range V	
EGR Temperature B2-S1	O2 B1-S2 Wide Range mA	

Air Fuel Ratio – overall air to fuel ratio of the vehicle being commanded by the vehicle ECU.

Air Fuel Ratio BX-SX (up to 8) – air to fuel ratio of the vehicle computed for one bank (i.e. one oxygen sensor).

Average Economy – the average fuel economy of the vehicle over time.

Battery Voltage – the vehicle battery voltage.

Boost Pressure – the pressure measured within the intake manifold.

Distance Traveled – distance traveled by the vehicle. This is not the odometer.

Drive Time – the engine running time.

Fuel Cost – the cost per gallon or liter of fuel.

Fuel Used – amount of fuel used by the vehicle.

Idle Percent – the ratio of Drive Time vs. Idle Time.

Idle Time – the engine idling time defined as the motor running with the vehicle speed at 0.

Instant Economy – is defined as the instantaneous fuel economy of the vehicle (e.g. MPG).

Absolute Evap Vapor Pres – the evaporative system vapor pressure normally obtained from a sensor located in the fuel tank or a sensor in an evaporative system vapor line.

Absolute Load Value – indicates a percentage of peak available torque. The normalized value of air mass per intake stroke displayed as a percent.

Absolute Throttle Position (up to 3) – the absolute throttle position (not the relative or learned) throttle position. Usually above 0% at idle and less than 100% at full throttle.

Accelerator Pedal Pos (up to 4) – the absolute pedal position (not the relative or learned) pedal position.

Actual EGR A Duty (up to 2) – actual EGR displayed as a percent.

Actual Engine Torque – the calculated output torque of the engine.

Air Flow Rate From MAF – indicates the airflow rate as measured by the mass airflow sensor.

Alcohol Fuel Percentage – percentage of alcohol fuel contained in ethanol or methanol fuels.

Ambient Air Temperature – displays the ambient air temperature.

Avg Demanded Consumption – average demanded reagent consumption by the engine system either over the previous complete 48 hour period of engine operation or the period needed for a demanded reagent consumption of at least 15 liters, whichever is longer.

Avg Reagent Consumption – average reagent consumption by the engine system either over the previous complete 48 hour period of engine operation or the period needed for a demanded reagent consumption of at least 15 liters, whichever is longer.

Barometric Pressure – barometric pressure normally obtained from a dedicated barometric sensor. Note some weather services report barometric pressure adjusted to sea level. In these cases, the reported value may not match the displayed value.

Boost Pressure A (up to 2) – the actual turbocharger/supercharger pressure.

Calculated Load Value – indicates a percentage of peak available torque. Reaches 100% at wide open throttle at any altitude or RPM for both naturally aspirated and boosted engines.

Catalyst Temp Bank X – Sensor X (up to 4) – the catalyst substrate temperature.

Chrg Air Cooler Temp BXSX – (up to 4) – the charge air cooler temperature.

Cmd Boost Pressure A (up to 2) – the ECU commanded turbocharger/supercharger pressure.

Cmd Fuel Rail Pressure A (up to 2) – the commanded fuel rail pressure when the reading is referenced to atmosphere (gauge pressure).

Cmd Injection Pressure A (up to 2) – the commanded injection control pressure.

Cmd Throttle Actuator A (up to 2) – the commanded throttle actuator. 0% fully closed and 100% fully open.

Cmd Variable Turbo A (up to 2) – the variable geometry turbocharger commanded vane position as a percent.

Commanded Throttle Actuator – displays 0% when the throttle is commanded closed and 100% when the throttle commanded open.

Commanded EGR (up to 3) – display 0% when the EGR is commanded off, 100% when the EGR system is commanded on, and if the EGR is duty cycled somewhere between 0% and 100%.

Commanded Equival Ratio – the commanded equivalence ratio (also known as lambda) while the fuel system. Fuel systems that use conventional oxygen sensors display the commanded open loop equivalence ratio while the system is in open loop. Should report 100% when in closed loop fuel. Fuel systems that utilize wide-range/linear oxygen sensors shall display the commanded ratio in both open-loop and closed-loop operation.

Commanded Evap Purge – displays 0% when no evaporative purge is commanded and 100% at the maximum commanded purge position/flow.

Commanded Intake Air A (up to 2) – the commanded air intake displayed as a percent. Also known as EGR Throttle on compression ignition engines.

Commanded Wastegate A (up to 2) – the commanded wastegate position as a percent. 0% is fully closed (full boost) and 100% fully open (dump boost).

Control Module Voltage – power input to the control module. Normally the battery voltage, less any voltage drop between the battery and the control module.

Distance Since DTCs Cleared – distance accumulated since DTCs were cleared with a scan tool.

Distance Traveled MIL On – accumulates the vehicle distance traveled while the MIL light is illuminated.

DPF Delta Pressure BX (up to 2) – diesel particulate filter delta pressure.

DPF Inlet Pressure BX (up to 2) – diesel particulate filter inlet pressure.

DPF Inlet Temp BX (up to 2) – diesel particulate filter inlet temperature.

DPF Outlet Pressure BX (up to 2) – diesel particulate filter outlet pressure.

DPF Outlet Temp BX (up to 2) – diesel particulate filter outlet temperature.

Driver Demand Torque – the requested torque output of the engine by the driver.

EGR Error (up to 3) – error as percent of actual commanded EGR. Negative percent is less than commanded and positive is more than commanded.

EGR Temperature BX-SX (up to 4) – the EGR gas temperature.

Engine Coolant Temp (up to 3) – engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor.

Engine Fuel Rate – amount of fuel consumed by the engine per unit of time in liters per hour.

Engine Oil Temp – engine oil temperature.

Engine Reference Torque – display the engine reference torque value. This value does not change.

Engine RPM – displays the current engine revolutions per minute value.

Engine Torque Idle Point – the torque limit that indicates the available engine torque that can be provided by the engine at idle speed.

Engine Torque Point X (up to 4) – the torque limit that indicates the available engine torque that can be provided by the engine point X of the engine map.

Equivalence Ratio BX-SX (up to 16) - is defined as the ratio of the fuel-to-oxidizer ratio to the stoichiometric fuel-to-oxidizer ratio.

Evap System Vapor Press – evaporative system vapor pressure normally obtained from a sensor located in the fuel tank.

Exhaust Gas Temp BX-SX – exhaust gas temperature.

Exhaust Gas Pressure BX – exhaust gas pressure.

Fuel Injection Timing – the start of the fuel injection relative to Top Dead Center (TDC). Positive degrees indicate before TDC. Negative degrees indicate after TDC.

Fuel Level Input – indicates the nominal fuel tank liquid fill capacity as a percent of maximum.

Fuel Rail Press Rel Manifold – displays the fuel rail pressure referenced to the manifold vacuum (relative pressure).

Fuel Rail Pressure – indicates the fuel rail pressure at the engine referenced to atmosphere (gauge pressure).

Fuel Rail Pressure (abs) – fuel rail pressure at the engine when the reading is absolute.

Fuel Rail Pressure (gauge) – displays the fuel injection rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).

Fuel Rail Pressure A (up to 2) – fuel rail pressure when the reading is referenced to atmosphere (gauge pressure).

Fuel Rail Temp A (up to 2) – the fuel rail temperature.

Fuel Rate – the rate at which fuel is consumed by the engine in gallons/hour or liters/hour.

Hybrid Battery Pack Life – the percent remaining life for the hybrid battery pack.

Ignition Timing Advance – ignition timing advance for #1 cylinder (not including any mechanical advance).

Injection Pressure A (up to 2) - the injection control pressure.

Intake Air Temp BX-SX – displays the intake manifold air temperature.

Intake Air Temperature – displays the intake manifold air temperature.

Intake Manifold Abs PresA (up to 2) – intake manifold absolute pressure.

Intake Manifold Pressure – indicates the manifold pressure derived from a Manifold Absolute Pressure sensor.

Long Term Fuel Trim-BX (up to 4) – indicates the correction being used by the fuel control system in both open and closed loop modes of operation.

Long Term Fuel Trim BX-SX (up to 8) - indicates the correction being used by the fuel control system in both open and closed loop modes of operation.

Manifold Surface Temp – intake manifold surface temperature.

Mass Air Flow A (up to 2) – airflow rate as measured by a vehicle MAF sensor or an equivalent source.

Minutes Run with MIL On – accumulated minutes of engine run time while the MIL light is on.

NOx Concentration BX-SX (up to 2) – NOx concentration.

O2 Sensor BX-SX Wide Range mA (up to 8) – shows milliamps for linear or wide-ratio oxygen sensors.

O2 Sensor BX-SX Wide Range V (up to 8) – shows voltage for linear or wide-ratio oxygen sensors.

O2 Sensor BX-SX (up to 8) – indicates the voltage for conventional 0 to 1V oxygen sensors. O2 sensors with a different full-scale voltage shall be normalized to this range or, if a wide range sensor, may use the wide range parameters instead.

PM Mass Concentration BX-SX (up to 2) – particulate matter mass concentration.

Reagent Tank Level – nominal reagent tank liquid fill capacity as a percent of maximum.

Rel Throttle A Position (up to 2) - relative or “learned” throttle position.

Relative Throttle Position – relative or “learned” throttle position.

Relative Accel Pedal Pos - relative or “learned” pedal position.

Relative Intake Air A (up to 2) – actual intake airflow position displayed as a percent. Also known as EGR Throttle Position on compression ignition engines.

Run Time NOx Warn – run time of the engine while NOx warning mode is activated.

Short Term Fuel Trim-BX (up to 4) – indicates the correction being used by the closed loop fuel algorithm. If the fuel system is open loop, 0% correction should be reported.

Short Term Fuel Trim BX-SX (up to 8) - indicates the correction being used by the closed loop fuel algorithm. If the fuel system is open loop, 0% correction should be reported.

Short Term Sec Fuel Trim BX (up to 4) – short term secondary O2 sensor fuel trim shall indicate the correction being utilized by the closed-loop fuel algorithm. If the fuel system is open loop, 0% correction should be reported.

Time Since DTCs Cleared – engine run time accumulated since DTCs were cleared.

Time Since Engine Start – indicates the elapsed time since the engine was started while the engine is running.

Total Engine Idle Time – total engine idle time for the life of vehicle.

Total Engine Run Time – total engine run time for the life of vehicle.

Total Engine Run w/PTO – total engine run time with PTO (power take off) engaged for the life of the vehicle.

Total Run w/IE-ACED X (up to 10) – total engine run time with Emission Increasing Auxiliary Emission Control Device active for the life of the vehicle.

Turbo A In Compressor (up to 2) – turbocharger compressor inlet temperature.

Turbo A In Turbine Temp (up to 2) – turbocharger turbine inlet temperature.

Turbo A Inlet Pressure (up to 2) – turbocharger inlet pressure.

Turbo A Out Compressor (up to 2) – turbocharger compressor outlet temperature.

Turbo A Out Turbine Temp (up to 2) – turbocharger turbine outlet temperature.

Turbo A RPM (up to 2) – turbocharger revolutions per minute.

Variable Turbo A (up to 2) – variable geometry turbocharger actual vane position as a percent. 0% when vanes are fully bypassed and 100% when the vanes are fully utilized.

Vehicle Speed – displays the vehicle road speed.

Warm-ups Since DTCs Cleared – number of warm-up cycles since all DTCs were cleared via a scan tool. A warm-up is defined as the coolant temperature rising by at least 22°C (40°F) and the engine temperature reaches at a minimum 70°C (160°F) (60°C (140°F) for diesels).

Wastegate A (up to 2) – actual wastegate position as a percent. 0% wastegate is off (allow full boost) and 100% fully open (dump boost).

Live Data Screen

The Live Data screen has two panes: List and Graph.

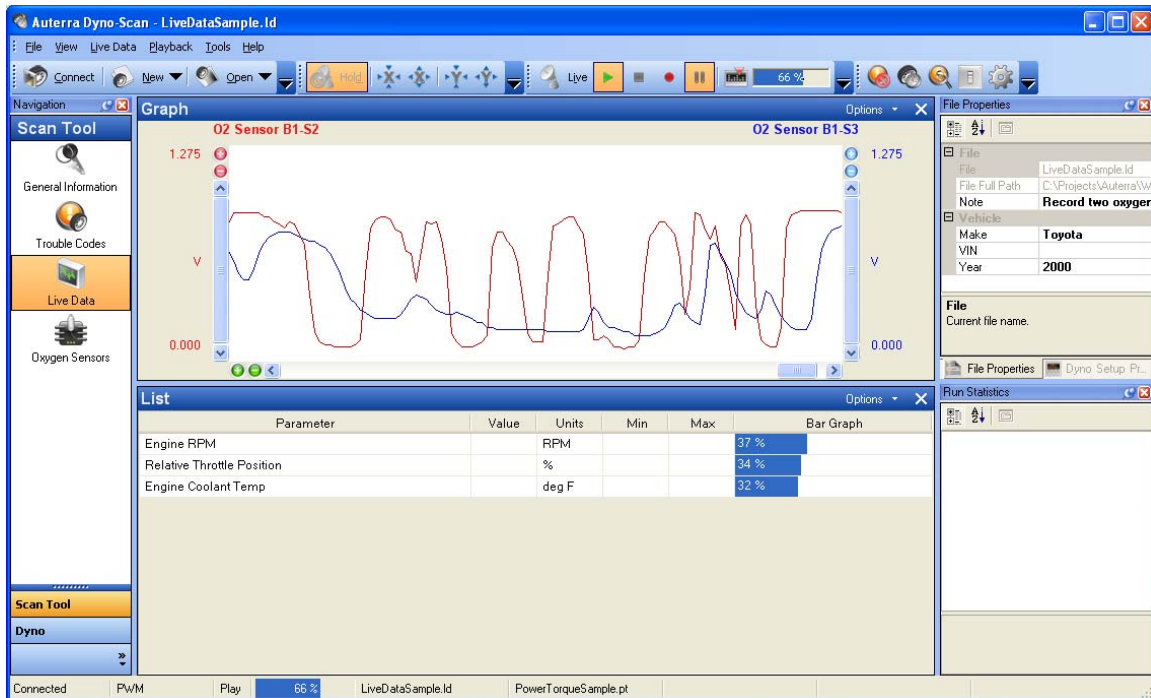


Figure 26: Live Data Screen

The Live Data screen supports recording and playback of live data. See Record/Playback for more information.

The Options button in the upper right corner of each pane provides a menu of options. Alternatively, right mouse clicking inside any pane displays the Options menu.

Panes are added or deleted using the Options menu items Add Graph Pane, Add List Pane, and Delete Pane.

List Pane

The List pane displays real-time sensor readings from the vehicle in a list format. Any number of sensors can be monitored simultaneously. Note the more sensors selected, the slower the update interval of each sensor.

- 1 Switch to the Live Data screen as described in the section Navigation Docking Window.
- 2 Press the Options button in the upper right corner of the List pane. Alternatively, right mouse click anywhere in the List pane. Select the Edit Parameters menu option.
- 3 Press the Add Parameter button.
- 4 Select a sensor from the ECU Parameters list box located on the right side of the dialog.
- 5 Press OK.
- 6 Live data now displays in the List pane.
- 7 Selecting Live Data > Hold temporarily suspends updating the Live data display. Selecting Hold again resumes sensor sampling.

The List pane shows these values:

Parameter – the selected parameter.

Value – the last measured parameter reading.

Units – the units of measurement for the Value.

Min – the minimum Value measured.

Max – the maximum Value measured.

Bar Graph – the current Value reading in relation to the absolute minimum and maximum parameter values.

To reset the Min and Max values, select Options > Reset Min Max.

Graph Pane

The Graph pane displays real-time sensor readings from the vehicle in a line graph format. Two sensors at a time may be monitored simultaneously on one Graph pane. More panes are added using the Options > Add Graph Pane option.

The Live Data menu options Zoom in X, Zoom in Y, Zoom out X, and Zoom out Y zoom the graph - vertically and horizontally. Each trace can be zoomed on the vertical axis independent of the other trace by using the zoom in/out buttons next to the scroll bars. The horizontal axis zooms both traces together.

When changing vertical zoom levels, the minimum and maximum display value labels change to reflect the new range. The current sensor reading will always display the correct value irrespective of the zoom range or graphical clipping.

Data values exceeding the vertical graph limits, either high or low, will be clipped at the vertical maximum/minimum graph value.

The graph control has a virtual trace buffer that stores many pages of graph information. Scroll right and left using the control at the bottom of the graph pane to view all the data within the trace buffer.

Exact measurement values for any data point along the trace can be shown using the marker. The marker is a vertical dashed line within the graphing area. A left mouse click within the graph boundaries sets the marker position. The data point under the marker for each axis will update as the marker is moved about the graphing area.

Pressing zoom in will center the horizontal axis display around the marker. This facilitates selecting a point of interest with the marker, then zooming in the horizontal axis to examine the data point.

The sensor Sample Speed (High, Medium, or Low) for each trace must be the same on the Graph screen. The software enforces identical sample speeds.

- 1 Switch to the Live Data screen as described in the section Navigation Docking Window.
- 2 Press the Options button in the upper right corner of the Graph pane. Alternatively, right mouse click anywhere in the List pane. Select the Edit Parameters menu option.

- 3 Press the Add Parameter button.
- 4 Select a sensor from the ECU Parameters list box located on the right side of the dialog.
- 5 Press OK.
- 6 Live data now displays on the Graph pane.
- 7 Selecting Live Data > Hold temporarily suspends the Live display. Selecting Hold again resumes sensor sampling.

Oxygen Sensors

The Oxygen Sensors screen has two panes: Oxygen Sensor Test Results and Oxygen Sensor Output Legend.

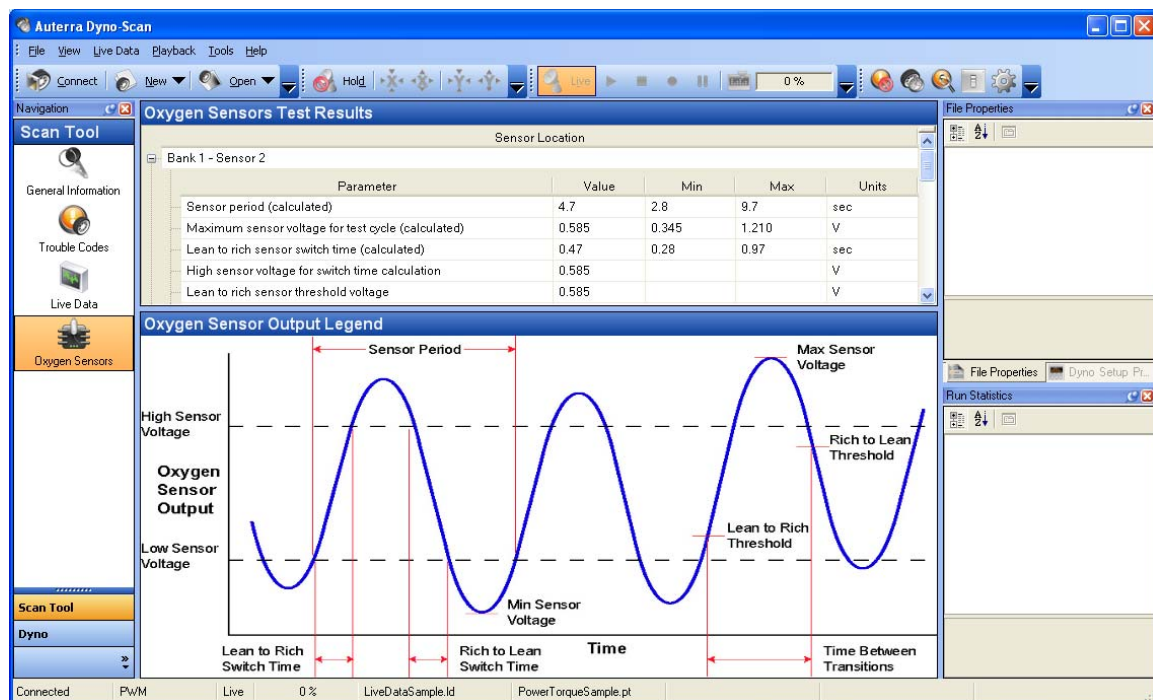


Figure 27: Oxygen Sensors Screen

Oxygen Sensors Test Results Pane

The Oxygen Sensors Test Results pane displays the vehicle's oxygen sensor test results. The results displayed here are computed/measured by the vehicle's on-board computer (ECU) last successful test. These tests are performed internally by the vehicle and are not initiated by the scan tool. These are not live values but instead the results of the ECU's last O2 sensor test. For live O2 sensor readings, refer to any of the live sensor screens such as Graph Pane, selecting the desired O2 sensor parameters

For these test results to be accurate, the Oxygen Sensor test on the in the Vehicle Monitor Status section within the Vehicle Monitor Test Status pane should have a Test Status of Complete.

Not all test values are applicable to all vehicles. Therefore, the list generated will vary depending on the vehicle. In addition, not all vehicles support the Oxygen Sensors screen. If the vehicle or a particular sensor does not support this feature, the screen list will be blank.

The test values measured by the ECU correspond to certain attributes of the O2 sensor voltage over time waveform as shown the Oxygen Sensor Output Legend Pane.

- 1 Switch to the Oxygen Sensors screen as described in the section Navigation Docking Window.
- 2 Press the "+" icon next to the Sensor Location to display the sensor results.

The Oxygen Sensors Test Results displays these values:

Parameter – an oxygen sensor parameter.

Value – the ECU measured test result

Min - the minimum test limit for which the measured test result is compared.

Max - the maximum test limit for which the measured test result is compared.

Units – the units of measure for the Value.

Oxygen Sensor Output Legend Pane

The Oxygen Sensor Output Legend Pane shows an oxygen sensor voltage over time waveform illustration. Each parameter with in the Oxygen Sensors Test Results pane is measured is shown on the illustration.

Test Results Screen

The Test Results screen shows the results for on-board diagnostic monitoring test of specific components / systems that are continuously monitored (e.g. mis-fire monitoring) and non-continuously monitored (e.g. catalyst system).

The Test Results pane displays the vehicle ECU's test results. The results displayed here are computed/measured by the vehicle's on-board computer (ECU) last successful test. These tests are performed internally by the vehicle and are not initiated by the scan tool. These are not live values but instead the results of the ECU's last test.

Not all test values are applicable to all vehicles. Therefore, the list generated will vary depending on the vehicle. In addition, only vehicles using CAN communication protocol are supported on this screen. If the vehicle or a particular sensor does not support this feature, the screen list will be blank.

The Test Results displays these values:

Parameter – a test result parameter.

Value – the ECU measured test result

Min - the minimum test limit for which the measured test result is compared.

Max - the maximum test limit for which the measured test result is compared.

Units – the units of measure for the Value.

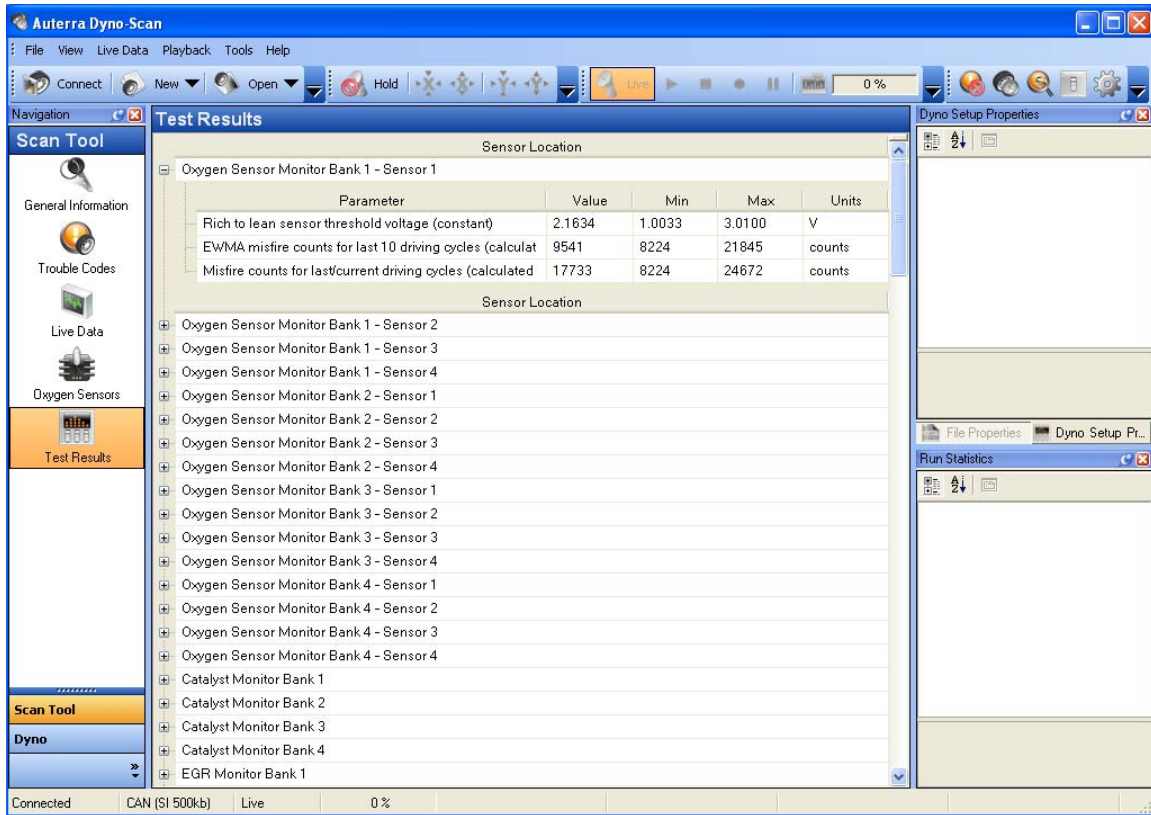


Figure 28: Test Results Screen

On-Board Tests Screen

The On-Board Tests screen shows the bi-directional controls supported by the vehicle. Bi-directional on-board tests are commands sent by the scan tool to the vehicle to perform some action.

The Bi-Directional Control pane shows the tests supported by the vehicle. If the vehicle does not support any bi-directional controls, the screen will remain blank. To run an on-board test, select the test to run then press the Run Selected On-Board Test. The vehicle will respond to the command with a status shown in the Status column.

Table 4: Status Messages

Status	Meaning
Complete	Indicates the vehicle completed the requested action successfully.
General Reject	Indicates that the service requested was rejected but the vehicle ECU did not specify the reason of the rejection.
Service Not Supported	Indicates that the requested action will not be taken because the vehicle ECU does not support the requested service.
Sub Function Not Supported	Indicates that the requested action will not be taken because

– Invalid Format	the vehicle ECU does not support the arguments of the requested message.
Busy – Repeat Request	Indicates the vehicle ECU is temporarily too busy to perform he requested operation.
Conditions Not Correct Or Request Sequence Error	Indicates that the requested action will not be taken because the vehicle ECU prerequisite conditions are not met. May also occur when sequence sensitive requests are issued in the wrong order.

The Bi-Directional Test Description pane provides a description for the currently selected bi-directional control within the Bi-Directional Control pane.

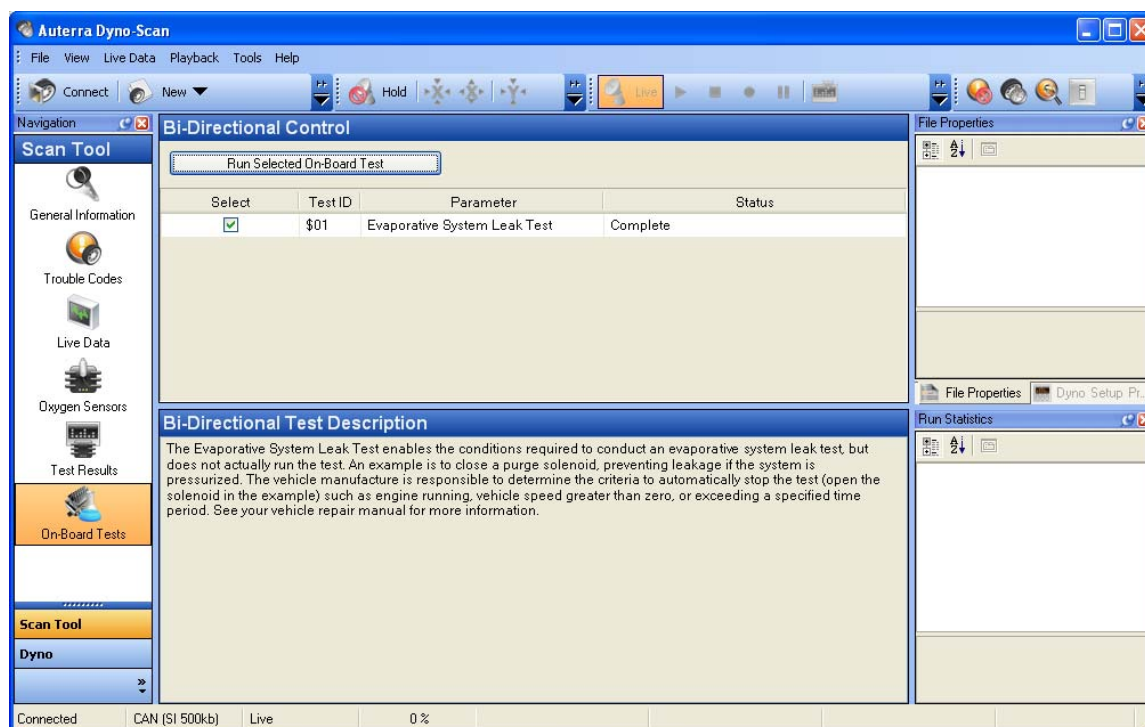


Figure 29: On-Board Tests Screen

Analyze Live Data Screen

The Analyze Live Data screen provides a view of the entire live data recording. Whereas the Live Data screen plays back the recorded data, the Analyze Live Data screen shows the recorded data all at once.

The Analyze Live Data screen is a data analysis tool. Numerous options are available for viewing the data, such as a stacked or side-by-side view, hiding traces, zoom in and out, and markers showing each data point.

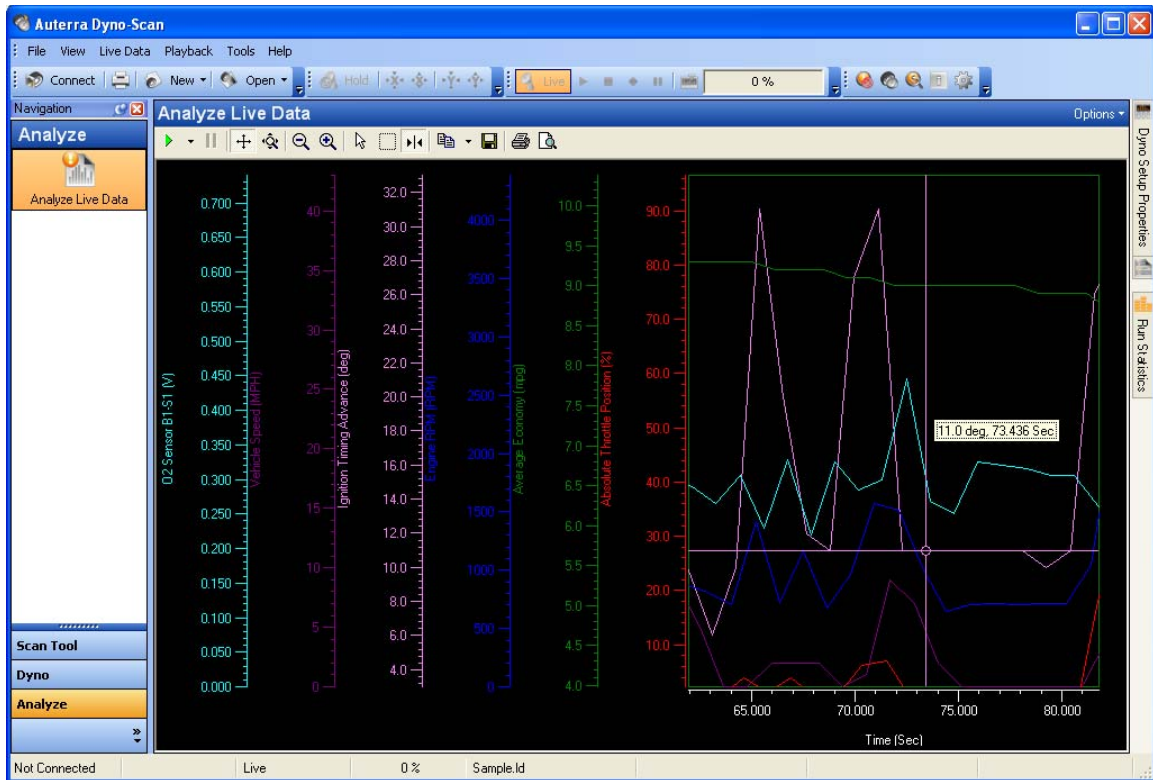


Figure 30: Analyze Live Data Screen (Side-By-Side)

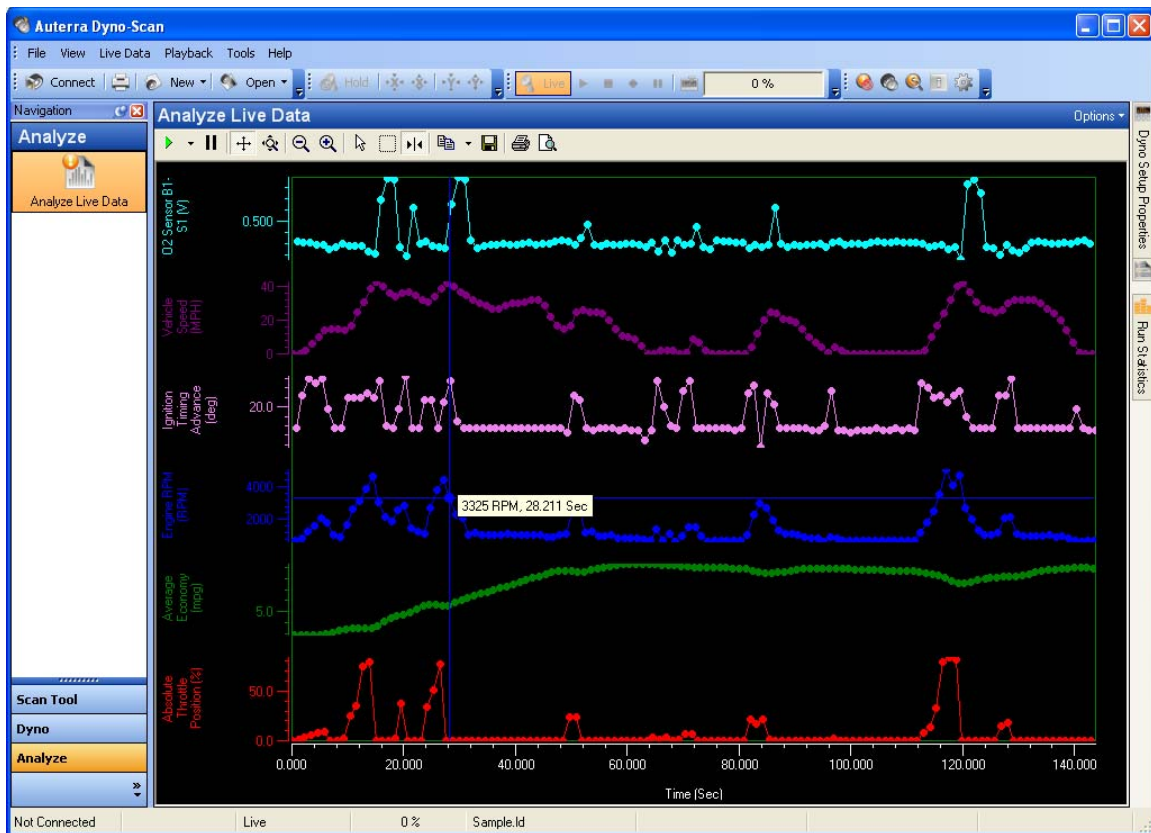


Figure 31: Analyze Live Data Screen (Stacked)

A right mouse button click on these graph elements brings up a shortcut menu for additional options.

- X-Axis
- Y-Axis
- Data-Cursor

Viewing Recorded Live Data

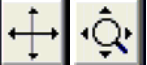
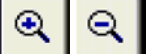
To open on the Analyze Live Data screen, select the File > Open > Live Data File... menu option.

To create a file for analysis, select the File > New > Live Data File... menu option and then go to the Live Data screen to record data into the file. See Live Data Screen for more information.

Analyze Tool Bar

The toolbar provides quick and easy control over the function of the chart.

Button	Meaning
	Resume Button: Shows all data on all axes.

	Pause Button: Pauses tracking for all axes.
	Axes Mode Buttons: Changes the mode that the axes are in when using the mouse. The first icon puts the axes in scroll mode. The second icon puts the axes in zoom mode. TIP: Press the Ctrl keyboard key to toggle between the two modes.
	Zoom In/Out Buttons: Zooms all axes in or out.
	Select Button: Used for selecting items in the data view area.
	Zoom Box Button: Allows the user to draw a "Zoom Box" to zoom ALL axes.
	Data Cursor Button: Show or hide all data cursors. Values for each channel are displayed in a hint window next to the cursor(s).
	Copy Button: Copies the current component image to the clipboard.
	Save Button: Save chart data to an image or data file.
	Print Button: Print image of chart to printer.

Options Button

The Options dropdown button on the upper right corner of the Analyze Live Data graph title bar provides a menu to graph features.

Shortcut Menu	Meaning
Side-By-Side View	Switches between Side-By-Side view and the Stacked view.
Show Markers	Shows a round dot on each data point.
Show File Name	Shows the file name at the top of the graph.
Show Legend	Shows a trace legend on the right side of the graph.
Show All Parameters	Shows every parameter on the screen.
Hide All Parameters	Hides all parameters on the screen.
Parameters	Shows/hides individual parameters on the graph.

Axis Control

The chart has two axes, one x-axis (horizontal) and one or more y-axis (vertical). Each axis shows the name of the parameter, units of measure, and numbers showing the axis scale.

The chart has two main modes, Axis Scroll mode and Axis Zoom mode. The modes are switched using the Axis Scroll or Axis Zoom buttons on the toolbar.

Many options require dragging, which means pressing and holding the left mouse button while moving the mouse in a direction.

Zoom All Axes

Toolbar Zoom: All axes can be zoomed together using the toolbar.

- 1 Left mouse click anywhere inside the line graphing area (a dotted box will surround the entire axes and line graphing area).
- 2 Press the Zoom In or Zoom Out toolbar button.

Zoom-Box Zoom: All axes can be zoomed using the Zoom-Box tool.

- 1 Select the Zoom-Box button on the toolbar.
- 2 Click inside the line graph area and drag a dotted line box around the area to zoom in.

Mouse Zoom: The entire graph area can be dynamically zoomed using the mouse.

- 1 Press the Axes Zoom toolbar button.
- 2 Press the Select toolbar button.
- 3 Drag the line graphing area to dynamically zoom both the x and y-axes. Drag left and right zooms the x-axis, and up and down zooms the y-axis.

Zoom One Axis

Toolbar Zoom: Each axis can be zoomed independent of the other using the toolbar zoom buttons.

- 1 Press the Axis Zoom toolbar button.
- 2 Select an axis to zoom with the left mouse button (a dotted box will surround the axis).
- 3 Press the Zoom In or Zoom Out toolbar button.

Mouse Zoom: Each axis can be dynamically zoomed using the mouse.

- 1 Select the Axis Zoom button on the toolbar.
- 2 Drag an axis to zoom in and out.

Shortcut Menu Zoom: The software can also zoom a parameter to fit the entire graphing area.

- 1 Right mouse click an axis and select from the shortcut menu Zoom To Fit > All or Zoom To Fit > In-View. The All option zooms the line based upon the data points in the entire recorded file. The In-View option only zooms the data points that are visible within the graphing area.

Scroll One Axis

Mouse Scroll: Once an axis is zoomed, it can be scrolled up and down.

- 1 Press the Axis Scroll toolbar button.
- 2 Drag an axis to scroll.

Scroll All Axes

Mouse Scroll: The entire graph area can be scrolled in any axis direction by mouse dragging. The chart must be zoomed on at least 1 axis before you can drag the chart.

- 1 Press the Axis Scroll toolbar button.
- 2 Drag the graph in any direction causes dynamic zooming in and out.

Data-Cursor Control

The Data-Cursor is a red crosshair within the graphing area. Dragging the crosshair vertical line moves the cursor. As the cursor is moved, the tooltip shows the current x/y value. If the Options > Show Markers is on, round markers will mark each individual data point. Tooltip values between actual marker data points are interpolated.

The data cursor can be moved to a data point marker.

- 1 Drag the cursor close to the marker you want to measure.
- 2 Release the left mouse button. The cursor will snap to the closest marker providing an exact value of the data point.

Moving the data-cursor between parameters uses the shortcut menu.

- 1 Right mouse click anywhere on the cursor crosshair lines.
- 2 Select Channel from the shortcut menu, then the parameter to monitor.

The data-cursor has many different measurement modes selected from the Style shortcut menu:

- Value-XY
- Value-X
- Value-Y
- Period
- Peak-Peak
- Frequency

Analyze Data Export

The Analyze Live Data screen can export data into a data file or graphics file.

Save Button

The Save button on the graph toolbar can save the graph as a graphics image file or as a text data file (.dat). The text data file saves a series of X and Y values for each parameter. The file can be opened with any text editor or with a spreadsheet such as Microsoft Excel.

Copy Button

The Copy button on the graph toolbar can copy the data into the Windows clipboard as either a graphics image file or as text data. Once copied, the data can be pasted into another application such as word processor.

Playback

Pressing the Play button on the Playback Control toolbar plays the data on the Analyze Live Data screen. The tooltip on the Data Cursor will continually update as the data plays back. The

Playback Pause or Stop button halts playback. Playback is particularly useful in conjunction with the Google Earth feature. See Google Earth on page 80 for more information.

Code Search Screen

The Code Search dialog provides an interactive search of diagnostic trouble code definitions (DTCs).

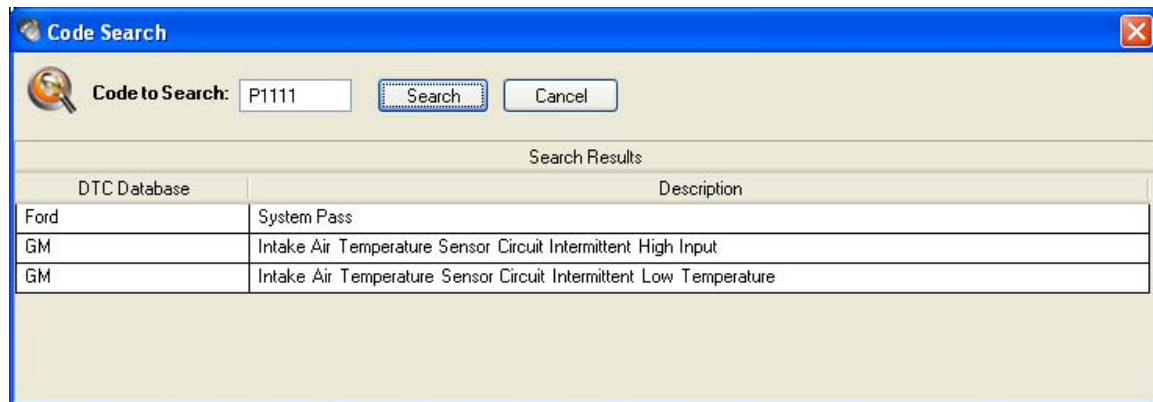


Figure 32: Code Search Dialog

Generic codes and enhanced codes have predefined numeric ranges as shown in Table 5: DTC Groupings.

Table 5: DTC Groupings

ISO/SAE Controlled (Generic)	Manufacturer Controlled (Enhanced)
P0000 to P0999	P1000 to P1999
P2000 to P2999	P3000 to P3399
P3400 to P3999	

- 1 Select the Tools > Code Search... menu option.
- 2 Type a code into the Code to Search field (e.g. P1234). The code must start with a P, B, C or U and end with a 4-digit number.
- 3 Press the Search button. If a definition is found, it will display in the Search Results table.

Import

The Import feature allows users with the Dyno-Scan™ for Palm OS software product to import files recorded on a Palm OS device. Acceleration, Power Torque, and Scan Data files may be imported and viewed within the Dyno-Scan for Windows software.

The Import feature is located on the File > Import > Palm PDB File... menu option.

Export

The Export feature allows files to be exported into a comma separated values (CSV) file format. Acceleration, Power Torque, and Scan Data files may be exported.

The Export feature is located on the File > Export > Comma Separated Values... menu option.

Dyno Operation

The Dyno software is designed for easy operation. This section shows how to operate the Dyno features and describes the features on each screen.

Dyno operations require driving the vehicle while the software records performance data. For increased safety, the software does not require user intervention during the test runs. All data is recorded for later analysis and audible tones are used to convey instructions to the user while driving.



Ensure the PC, cable, and OBD II adapter do not interfere with the vehicle controls. A cable dangling in front of the foot pedals, gear shifter, or steering wheel can interfere with vehicle operation and cause a fatal accident. Always ensure the PC, cable, and OBD II adapter are securely fastened out of the way. If the scan tool cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the OBD II adapter connected to the vehicle.



Never race or exceed the posted speed limit while on public highways. The dynamometer operations require accelerating to high speeds. Always use a closed course raceway when performing dynamometer and acceleration tests.



Do not attempt to operate or observe the scan tool while driving a vehicle. Driving requires the full attention of the driver. Operating or observing the scan tool will cause driver distraction and could cause a fatal accident.

Theory of Operation

A dynamometer, or dyno for short, is used to measure the power produced by an engine. Until now, automotive dynos were either crankshaft dynamometers or chassis dynamometers.

Crankshaft dynos require the motor to be removed from the vehicle. The power is measured directly at the crankshaft, or flywheel, and is not affected by transmission and axle powertrain losses. Vehicle manufacturers spec crankshaft power on new cars and trucks.

Chassis dynos test the entire vehicle. The vehicle is tied down to a large machine and the drive wheels are placed over a rotating drum. The chassis dyno tests the entire powertrain system,

not just the crankshaft power. This is a more realistic test since it measures the power delivered to the wheels, not just the crankshaft. As such, the power figures measured are always less than with a crankshaft dyno since the powertrain robs some power from the vehicle.

Clearly pulling the motor to use a crankshaft dyno is beyond most people, and chassis dynos can run \$150 and hour or more to operate.

Auterra Dyno-Scan™ for Windows

The Auterra Dyno-Scan™ for Windows software is a newly developed device designed expressly for the automotive enthusiast. It uses the OBD II computer port located on all 1996 and newer automobiles to compute engine power, acceleration times, fuel economy, and more.

The Dyno-Scan™ for Windows is the only dyno to test the vehicle in a completely real world situation that includes powertrain losses, drag from disk brakes and wheel bearings, tire rolling resistance, etc. – everything a vehicle sees on the street.

Aerodynamic drag is compensated for within the calculations. So, whether your vehicle has the aerodynamics of a Chevy Suburban or a Porsche 911, the power calculations can correct for losses due to wind drag.

Weather conditions affect the output of an internal combustion motor. A correction factor is applied to compensate the measurements for weather conditions and elevation. The industry standard document for horsepower and torque corrections is SAE J1349. The Dyno-Scan™ for Windows software applies this correction factor to all horsepower and torque measurements.

By applying these correction factors to the dyno results, a vehicle dyno'd in Denver on a hot day will give the same results as a chilly day in San Diego. Using the Dyno-Scan™ for Windows, measurements generated are comparable with one another the world over.

The dyno runs are performed in a single gear. Any gear will work, however increased accuracy is obtained if the software has an increased measurement duration. For instance, the time to accelerate from 1000 RPM to 5000 RPM in 1st gear is a shorter duration than it would be in 3rd gear. Therefore, using 2nd or 3rd gear for dyno runs offers longer test durations for greater accuracy.

Extensive comparison testing on a Dynojet chassis dynamometer has shown the Dyno-Scan™ for Windows to be extremely accurate.

Automatic Transmissions

All automatic transmissions are equipped with a torque converter. The torque converter is designed to slip under certain conditions, such as at low RPM and under heavy load. When the torque converter slips, the gear ratio is artificially lower and the RPM is higher than if the torque converter is locked up in direct drive. At cruising speeds and under low load requirements, the torque converter locks up for increased fuel economy.

Under heavy acceleration, the slippage is greatest below 3000 RPM. Above 3000 RPM the slippage is still evident but to a lesser degree.

A slipping torque converter is perfectly normal. Automatic transmissions are designed to slip, which gives them some advantages when towing a heavy load. However, this causes an anomaly known to all chassis dynos and the Dyno-Scan™ for Windows.

Since the RPM is higher than normal while the torque converter is slipping below 3000 RPM, the power vs. torque graphs may display an unnaturally large swell below 3000 RPM. This swell is the torque converter multiplying the engines available torque. The swell is normal and all dynos exhibit this behavior. The power torque figures above 3000 RPM are the real numbers generally used for evaluation.

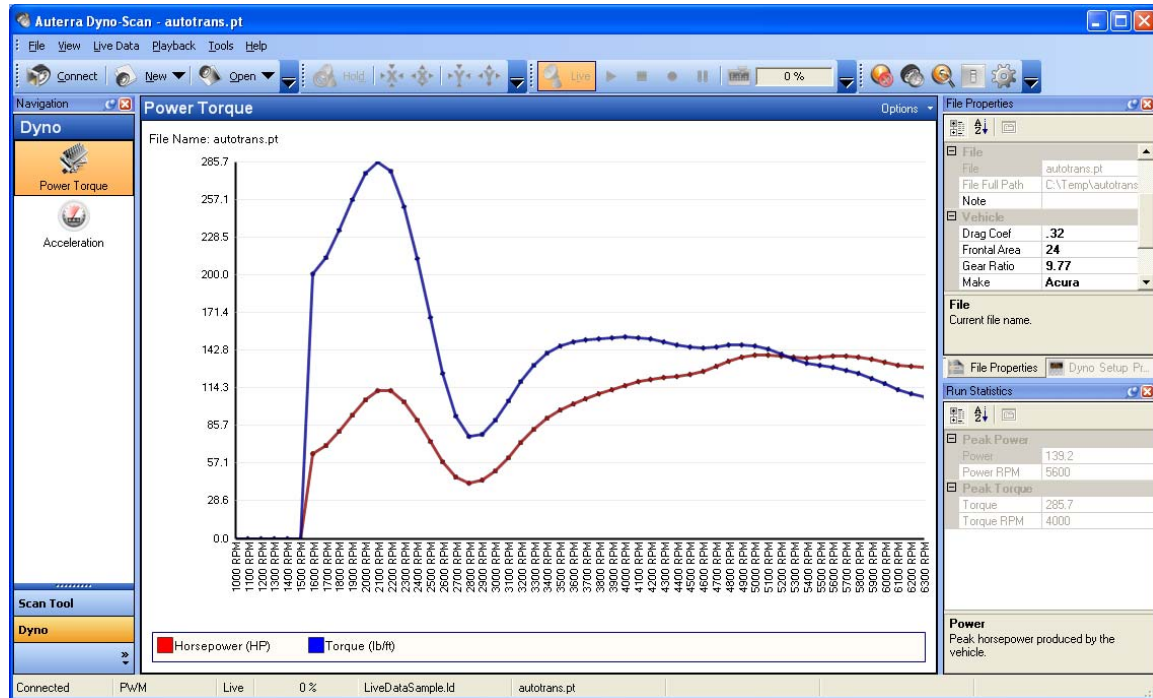


Figure 33: Power Torque Run Automatic Transmission

Fast Sampling

The Fast Sampling preference on the Options dialog must be enabled to achieve accurate dyno operation. Ensure this option is selected whenever using Dyno features.

Dyno Files

The Dyno feature use three storage file types:

Power Torque – stores Power and Torque run data.

Acceleration – stores Acceleration run data.

Dyno Setup – stores Dyno setup variables such as vehicle weight, elevation, humidity, etc.

Each of the files may be opened or created from the File > Open or File > New menu option.

The properties of each file may be viewed and modified in either the File Properties or Dyno Setup Properties docking window. See Properties Windows for more information.

Dyno Setup File Properties

The Dyno Setup file properties are changed on the Dyno Setup Properties Docking Window. The file attributes are:

File – file name.

File Full Path –file name and path.

Weight – weight of the vehicle including passengers during the run.

Gear Ratio – the overall gear ratio of the vehicle, which includes transmission and axle.

Tire Diameter – the vehicle tire diameter.

Temperature – current outside temperature.

Elevation –elevation at the test track.

Humidity – current outside humidity.

Pressure – current outside altimeter pressure available from www.nws.noaa.gov. Altimeter pressure is different than barometric pressure.

Drag Coef – drag coefficient of vehicle.

Frontal Area – the frontal area of the vehicle.

Note – an optional text note.

Make – Vehicle make.

VIN – vehicle identification number.

Year – model year of vehicle.

The software can measure the gear ratio and compute the tire diameter for you. See Compute Gear Ratio for more information.

Drag Coefficient and Frontal Area

Common drag coefficients are usually in the range of 0.25 to 0.45 – the lower the number the less wind drag on the vehicle.

Frontal areas are usually in the range of 17 to 28 sq. ft – the lower the number the less frontal area. Smaller vehicles have lower frontal areas.

To get an understanding for these numbers, Table 6: Drag Coefficients and Frontal Areas list the values for different vehicle types.

Table 6: Drag Coefficients and Frontal Areas

Vehicle	Drag Coefficient	Frontal Area (sq/ft)
2005 BMW 325i	0.30	22.7
2005 Chevrolet Corvette Z06	0.31	22.4
2006 Porsche Cayman	0.29	21.3
1999 Chevy Cavalier	0.36	21.5
2000 Ford Taurus	0.32	23.7
2000 Chevy Silverado 1500 2WD	0.45	28.0
2000 Ford Explorer	0.45	25.8
2002 Honda Insight	0.25	20.5
2002 Honda Civic Hatchback	0.36	20.5
2000 Acura Integra	0.32	20.1
2000 Volvo S40	0.32	20.9
2000 Mercedes E320	0.29	22.3
2000 Chrysler LHS	0.31	23.1

See the Auterra Vehicle Specifications document for more information on your specific vehicle make and model.

An Internet search is another good source of drag coefficients, frontal areas and vehicle weights. The web site www.carfolio.com has specifications for thousands vehicles.

Many frontal areas on the Internet are listed in metric square meter (m²). To convert to square feet (ft²) multiply the metric frontal area by 10.76.

$$2.11 \text{ m}^2 \times 10.76 = 22.71 \text{ ft}^2$$

Calculation of Frontal Area

Frontal area can be calculated for any car. The frontal area represents the front projection area of the vehicle. If one takes a straight-on picture of the front of a vehicle, it is the area included in the outline. Use the following to calculate:

1. Calculate the area of a rectangle, which would encompass the front of the vehicle (multiply width by the height).
2. Adjust the figure obtained above for areas not included, such as top rounded corners, etc. Typical adjusting values are 85 percent for cars, and 100 percent for trucks.

Dyno Setup File Properties Usage

The Dyno Setup file stores vehicle setup variables. When a power torque run is performed, the Dyno Setup file settings are copied into the Power Torque file. Similarly, the current Dyno Setup file is copied into the Acceleration file for acceleration runs.

Once the settings are copied from the Dyno Setup file to the Power Torque or Acceleration file, there is no tie to the original Dyno Setup file. Meaning if you change a Dyno Setup file, it does not affect any stored Power Torque or Acceleration properties.

Compute Gear Ratio Dialog

The Gear Ratio screen measures the overall gear ratio of the vehicle and computes a tire diameter given the tire size. The screen is located on the Tools > Compute Gear Ration menu option.

Compute Gear Ratio

Tire Diameter

Tire Width: 185 Tire Ratio: 50 Rim Diameter: 15

Tire Diameter: 22.28 inches **Compute Tire Diameter**

Gear Ratio

Status: Idle

Gear Ratio: 6.825 **Measure Gear Ratio**

Live Vehicle Data

RPM: **6811** MPH (computed): **66.2** RPM (real): **61**

OK

Figure 34: Compute Gear Ratio Dialog

Tire Diameter

Computing a tire diameter requires entering the tire size. Most passenger car tire sizes are listed as width, ratio, and rim diameter (e.g. 205/65 R15).

Enter the tire size using the Width, Ratio, and Rim Dia drop down lists. Once entered, press the Compute Tire Diameter to calculate the tire diameter in inches.

Many large truck tire sizes are sized differently. These tires are listed as diameter, width, and rim diameter (e.g. 31x10.5 R16). In this case, the first number is used as the tire diameter, in inches (e.g. 31"), and entered directly into the Tire Diameter field.

Manufacturers are usually off very slightly from the indicated tire size. Many manufactures list the exact tire diameter on their website. If available, use the tire diameter listed on the manufacturer's datasheet.

Measuring Overall Gear Ratio

Measuring the vehicle gear ratio involves keeping the vehicle speed steady while the software computes an overall gear ratio. The gear ratio changes with each transmission gear. Therefore, the software computes one overall gear ratio per gear run (e.g. overall gear ratio for 2nd gear). The overall gear ratio is the combination of the transmission gear ratio and the final drive gear ratio.

The Status field lists the status of the gear ratio run, either:

Idle – no data is being gathered.

Countdown to Start – shows the number of seconds until data collection begins.

Collecting Data – vehicle data is being recorded.

A tire diameter must be entered in the Tire Diameter field before performing a gear ratio run. Pressing Measure Gear Ratio will start a gear ratio run.

Once a tire diameter is entered, pressing the Measure Gear Ratio button starts the 10-second countdown. During this time, get the vehicle moving in the gear the run is going to be performed in (e.g. 2nd gear). The vehicle RPM should be between 3000 and 4000 RPM for best results. Once the gear and RPM is achieved, keep the throttle steady and clutch out (if a manual transmission).

At the end of the countdown, the software will beep. After the beep continue to keep the throttle steady until a second beep is heard (about 10 seconds). The second beep indicates the gear ratio run is over.

Bring the vehicle to a complete stop. The measured overall gear ratio is displayed.

Calculating Overall Gear Ratio

The overall gear ratio can also be computed if the tire diameter and RPM at a speed is known. The following formula computes the overall vehicle gear ratio used by the dyno software:

overall gear ratio = RPM x tire diameter / MPH x 336

Example car:

$3.57 = 3000 \text{ RPM} \times 26" / 65 \text{ MPH} \times 336$

The preferred method is to use the Dyno-Scan™ to compute the overall gear ratio. If calculating, always confirm your ratio calculation is correct by performing the procedure in section Confirming Gear Ratio Result.

Confirming Gear Ratio Result

At the bottom of the Gear Ratio screen are three live values:

RPM – current measured RPM.

MPH (computed) – computed MPH using only RPM and the gear ratio.

MPH (real) – real MPH measured via the vehicle's on-board computer.

MPH (computed) will only display if values are entered into the Tire Diameter and Gear Ratio fields. If the computed MPH and real MPH values match throughout the RPM range then the gear ratio and tire diameter values are correct for this vehicle. If they do not match, adjust the Gear Ratio field up or down until the computed and real MPH match.

A computed verses real MPH check in a single gear might be:

1. Keep a steady speed at 2000 RPM.
2. Confirm the computed and real MPH values match.
3. Increase speed to a steady 4000 RPM.
4. Confirm the computed and real MPH values match.



Always have a passenger confirm the computed and real MPH readings match.

Driving requires the full attention of the driver. Operating or observing the scan tool while driving will cause driver distraction and could cause a fatal accident.

Computing a gear ratio requires an accurate speedometer. If the vehicle's tire size is either smaller or larger than stock and the speedometer has not been recalibrated to the new wheel size, then the computed gear ratio will be incorrect. This will make the horsepower and torque figures higher or lower than expected.

Using Tire Diameter and Gear Ratio

After obtaining the tire diameter and gear ratio, the values are entered into the Gear Ratio and Tire Diameter fields within a Dyno Setup file. See [Dyno Setup File](#) for more information.

TIP: To have multiple gear ratio setups for the same car, create a Dyno Setup file for each gear with file names like Ford1stGear, Ford2ndGear, etc.

Automatic Transmissions

The software uses the gear ratio on the power torque run, which is performed under heavy acceleration. The gear ratio run, however, is performed under essentially a no-load condition where the torque converter slippage is negligible. Therefore, for automatic transmissions the measured gear ratio may have to be lowered by 5 to 15% to account for the torque converter slippage. Otherwise, the power and torque curves will show lower than expected results.

Dynamometer Getting Started

Using the dynamometer features requires a few one-time configurations. This section summarizes those steps.

- 1 Obtain the drag coefficient, frontal area and vehicle weight as described in [Drag Coefficient and Frontal Area](#) on page 68.
- 2 Measure gear ratio of your vehicle as described in [Compute Gear Ratio Dialog](#) on page 70.
- 3 Create a Dyno Setup file as described [Dyno Setup File Properties](#) on page 68.

- 4 Create a Power Torque file as described in Dyno Files on page 67.
- 5 Connect the OBD II adapter to your vehicle.
- 6 Turn the vehicle ignition ON.
- 7 Select the File > Connect menu option.
- 8 To measure power and torque, proceed to Dyno Run Dialog (Power Torque) on page 74.

Power Torque Screen

The Power Torque screen analyzes power and torque data gathered from a vehicle run.

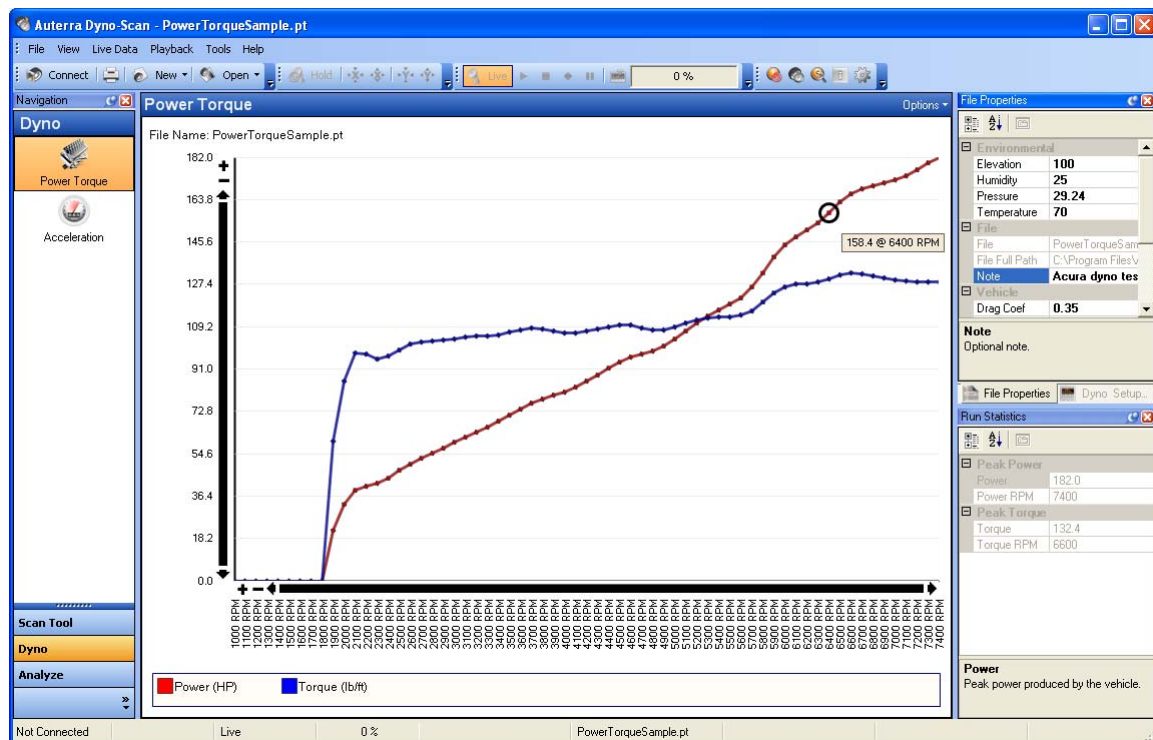


Figure 35: Power Torque Screen

The power torque graph shows the relationship between horsepower/torque and engine RPM. The vertical axis shows the power and torque. The horizontal axis shows the engine RPM.

The value at any point along the curve is obtained by placing the mouse cursor (circle) over a data point.

The File Properties displays the settings used to compute the power torque curve. When the File Properties are modified the graph dynamically updates to show the newly computed curve. See Dynamic Graph Update Using File Properties for more information.

Dynamic Graph Update Using File Properties

The File Properties docking window offers the ability to change parameters stored within the file (see File Properties Docking Window). When the Power Torque screen is displayed,

modifying these File Properties causes the Power Torque graph and Run Statistics to recompute based upon the new values.

Similarly, the Acceleration screen offers file properties. However, only Weight within the File Properties docking window changes the computed Horsepower in the Run Statistics docking window. Unlike power and torque, the acceleration graph is not derived from mathematical computations and therefore the Acceleration File Properties are for informational purposes only.

For instance, if the Power Torque file properties Elevation value is changed from 1000 feet to 9000 feet, the graph will redraw using the new input parameter.

See Properties Windows for more information about changing properties.

Dyno Run Dialog (Power Torque)

The Dyno Run dialog acquires the data from a power torque or acceleration run.

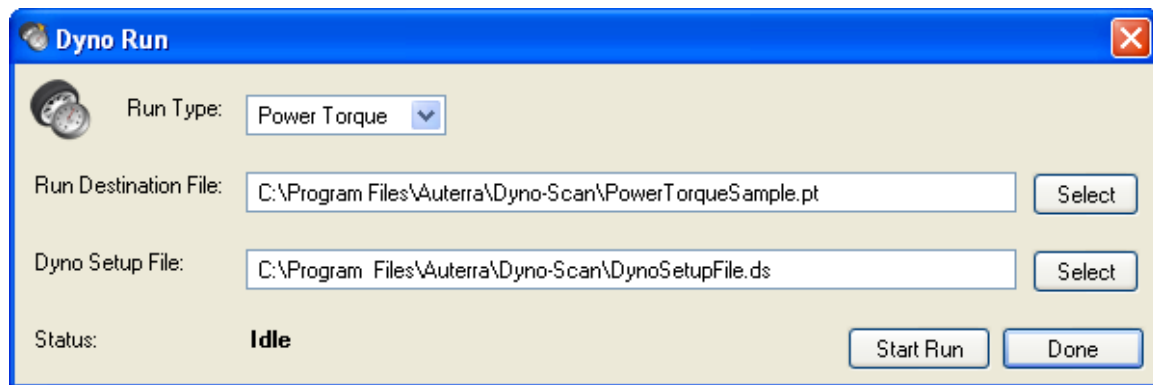


Figure 36: Power Torque Run

Two files are required to perform a power torque run: a Power Torque and a Dyno Setup file. The Power Torque file is the destination for the collected run data. The Dyno Setup file provides the operational parameters used by the software to compute horsepower and torque. Both files types are created from the File > New menu option.

The Status field shows the status of the run, either:

Idle – no data is being gathered.

Countdown to Start – shows the number of seconds until data collection begins.

Collecting Data – vehicle data is being recorded.

Performing a Power Torque Run

Before the run, ensure the laptop, cables and OBD II adapter are securely fastened out of the way and do not interfere with vehicle operation.

Once the Power Torque file and Dyno Setup files are selected, pressing the Start Run button starts the 10-second countdown.

During the countdown, get the vehicle moving in the gear the run is going to be performed in (e.g. 2nd gear). The vehicle RPM during the countdown should be relatively low, under 2000 RPM, the throttle steady, and clutch out (if a manual transmission).

At the end of the countdown, the software will beep. At the beep, floor the accelerator to achieve maximum acceleration.

Once maximum RPM is reached, either shift to the next higher gear or decelerate the vehicle by letting off the accelerator. Bring the vehicle to a complete stop and press Done to stop data collection.

Power Torque Run Do's and Don'ts

For safety and the most accuracy from the Dyno software, please follow the guidelines below.

Keep your attention on driving – the software is designed to require no user intervention when a run is performed. Start the power torque run while the vehicle is stopped. During the countdown, accelerate to the correct gear and starting RPM. Audible tones signal when to accelerate the vehicle.

Consistent vehicle setup – use the same tire pressure, same number of passengers, no A/C, windows rolled up, low beams on, radio and other accessories off.

Automatic transmission – most automatic transmissions will want to downshift under hard acceleration. Experiment with higher starting RPM or roll the throttle on slowly at first to prevent a downshift.

Manual transmission – ensure the clutch is completely out when the data collection starts.

Steady throttle – do not “blip” the throttle during the countdown period. Keep the throttle and RPM steady.

Maximum throttle – keep the throttle fully floored until maximum RPM is achieved. A dip in the RPM will cause the power torque graphs to terminate early³.

Dyno setup – try to obtain current temperature, humidity, elevation, and altimeter pressure before each day of runs.

Head/Tail Wind – a windy day will skew the power/torque results higher or lower depending on the wind direction. A relatively calm day provides the best results.

Level Ground – an uphill climb will make the power/torque lower and conversely a downhill run will have higher than expected values. Level ground provides the best results.

Heat soak – repeated runs will cause the intake manifold temperature to increase. Hot air is less dense and causes a reduction in power/torque. Just note that the first run may have slightly higher values than subsequent runs if performed back-to-back.

³ Use common sense – let off the accelerator if something gets in the way of the vehicle.

Power Torque Run Statistics

The Run Statistics docking window calculates the peak horsepower and torque at RPM values for the currently opened Power Torque file.

Power – peak horsepower output during the run.

Peak RPM – the RPM peak power was achieved.

Torque – peak torque output during the run.

Torque RPM – the RPM peak torque was achieved.

Acceleration Screen

The Acceleration screen analyzes acceleration data gathered from a vehicle run.

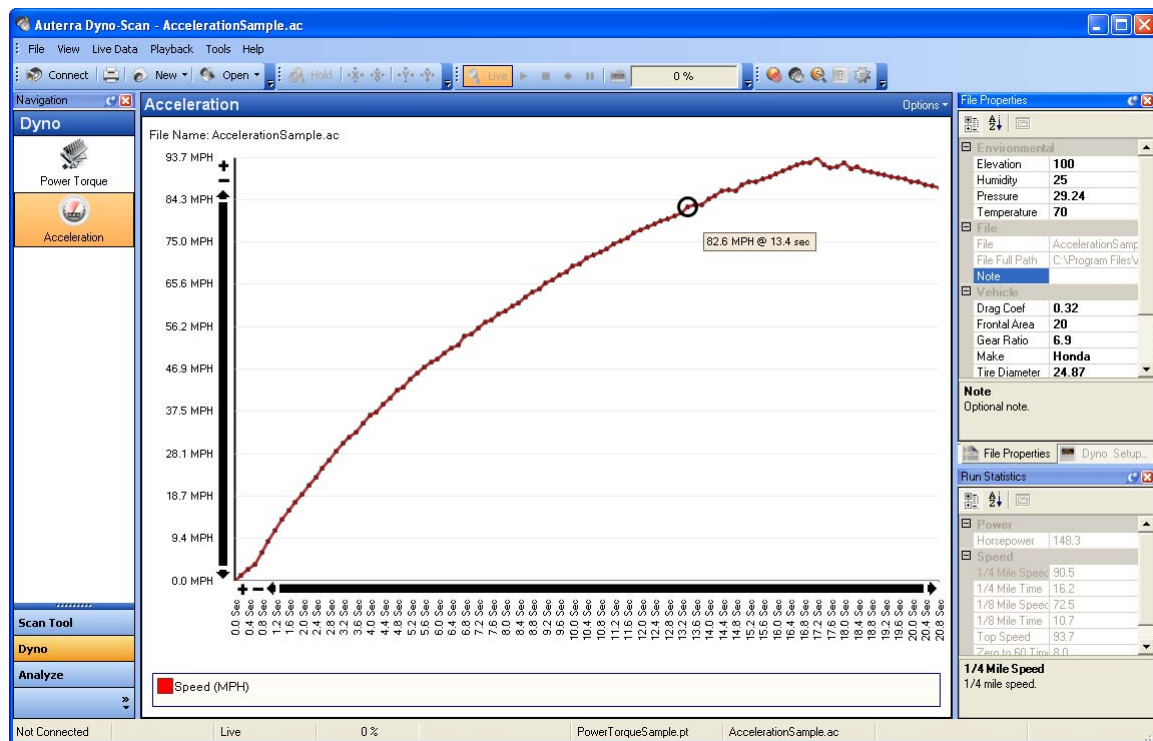


Figure 37: Acceleration Screen

The acceleration graph shows the relationship between vehicle speed over time. The vertical axis shows the vehicle speed in MPH. The horizontal axis shows the time in seconds.

The value at any point along the curve is obtained by placing the mouse cursor over a data point.

Dyno Run Dialog (Acceleration)

The Dyno Run dialog acquires the data from an acceleration run.

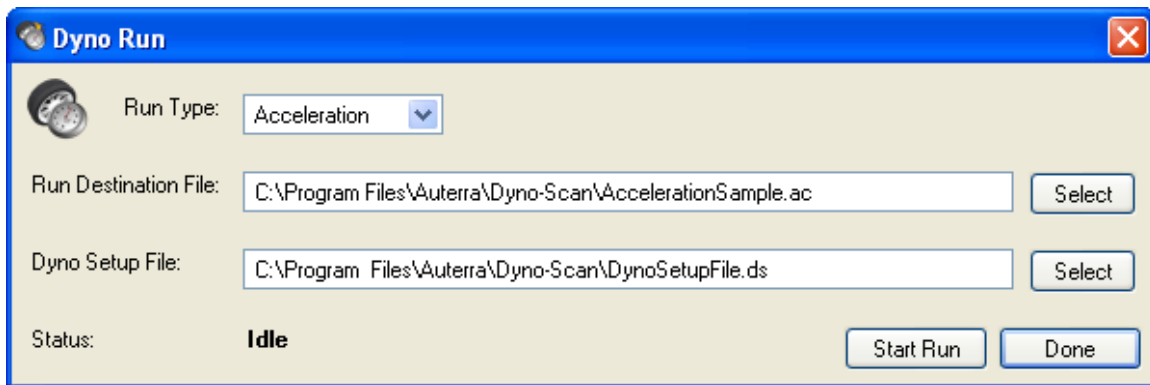


Figure 38: Acceleration Run Dialog

Two files are required to perform an acceleration run: an Acceleration file and a Dyno Setup file. The Acceleration file is the destination for the collected run data. The Dyno Setup file provides the operational parameters used by the software to compute a 1/4-mile horsepower figure. Both file types are created from the File > New menu option.

The Status field shows the current status of the run, either:

Idle – no data is being gathered.

Waiting to Start – waiting for the vehicle to start moving.

Collecting Data – vehicle data is being recorded.

Performing an Acceleration Run

Before the run, ensure the laptop, cables and OBD II adapter are securely fastened out of the way and do not interfere with vehicle operation.

Once the Acceleration file and Dyno Setup files are selected, press the Start Run button.

The acceleration run is performed from a standing start. Once the Status field says “Waiting to Start”, the software is waiting for the vehicle to start accelerating. The acceleration run does not use RPM like a power torque run does. Therefore, while waiting to accelerate you may rev the motor or do whatever else you think will achieve the quickest acceleration time.

As you accelerate down the track, you may stop the acceleration run at different data points depending on the data you’re trying to collect.

60 MPH – if acceleration stops after 60 MPH is reached, the 0-60 time will be computed.

1/8 mile – if acceleration stops after 1/8 mile reached, the 1/8-mile time and speed is computed.

1/4 mile – if acceleration stops after 1/4 mile reached, the 1/4-mile time and speed is computed. In addition, a 1/4-mile horsepower value is computed.

Its best to accelerate slightly beyond a data point to ensure the software captures the vehicle passing through the data point at maximum acceleration. For instance, don’t let off the

accelerator at exactly 60 MPH. Accelerate just beyond 60 for approximately ½ second to achieve the best results.

Bring the vehicle to a complete stop and press the Done button to stop data collection.

Acceleration Run Do's and Don'ts

For safety and the most accuracy from the Dyno software, please follow the guidelines below.

Keep your attention on driving – the software is designed to require no user intervention when a run is performed.

Consistent vehicle setup – use the same tire pressure, same number of passengers, no A/C, windows rolled up, low beams on, radio and other accessories off.

Head/Tail Wind – a windy day will skew the acceleration results higher or lower depending on the wind direction. A relatively calm day provides the best results.

Level Ground – an uphill climb will make the acceleration lower and conversely a downhill run will have higher than expected values. Level ground provides the best results.

Heat soak – repeated runs will cause the intake manifold temperature to increase. Hot air is less dense and causes a reduction in power/torque. Just note that the first run may have slightly faster values than subsequent runs if performed back-to-back.

Accelerate Just Past Data Point - accelerate slightly beyond a data point (e.g. 60 MPH, 1/8 mile, or 1/4 mile) to ensure the software captures the vehicle passing through the data point at maximum acceleration

If the vehicle's tire size is either smaller or larger than stock and the speedometer has not been recalibrated to the new wheel size, then the computed acceleration figures will be incorrect. Acceleration runs require an accurate speedometer.

Acceleration Run Statistics

The Run Statistics screen computes times and horsepower values based upon how fast the vehicle accelerates.

Top Speed – maximum speed achieved during the run.

0 to 60 Time – how fast in seconds the vehicle traveled from 0 to 60 MPH.

1/8 Mile Speed – how fast in MPH the vehicle was traveling at the 1/8-mile mark.

1/8 Mile Time – time in seconds, the vehicle traveled a 1/8-mile.

1/4 Mile Speed – how fast in MPH the vehicle was traveling at the 1/4-mile mark.

1/4 Mile Time – time in seconds, the vehicle traveled a 1/4-mile.

1/4 Mile HP – a rough calculation of horsepower based strictly on 1/4-mile time and vehicle weight.

N/A will be displayed in a column if the vehicle didn't travel far enough to compute the statistic.

Google Earth

Google Earth is a geographic information system (GIS) and provides a 3D software representation of Earth using satellite imagery. It provides you with the ability to move about the Earth and view any location on the planet from any altitude or viewing angle. Google Earth is a free application and may be downloaded from <http://earth.google.com>. Ensure you are running version 4.1 or higher.

DashDyno and Dyno-Scan for Windows utilize Google Earth to correlate recorded vehicle sensor data with the vehicle's georeferenced position on Earth. This is an extremely powerful tool in analyzing vehicle data whether on a racetrack, off road or around town.

DashDyno records OBD II vehicle sensors data, analog voltages and GPS data onto the SD card. Dyno-Scan for Windows then opens the file and if it contains GPS data, Dyno-Scan for Windows interactively sends coordinate information to Google Earth. You do not need to interact with Google Earth –Dyno-Scan for Windows updates the camera position and viewing angles automatically.

The Google Earth feature within the Dyno-Scan for Windows software may only be used in conjunction with an Auterra DashDyno SPD data logger. Dyno-Scan for Windows cannot connect to a GPS and will not record GPS data. The software reads GPS data recorded by an Auterra DashDyno.

- 2 Eject the SD card from DashDyno and insert into your PC card reader connected to your computer.
- 3 Start the Dyno-Scan for Windows software.
- 4 Go to the Tools > Options dialog then select the Google Earth tab.
- 5 Check the Enable Google Earth checkbox. Press OK.
- 6 Select the File > Open > Live Data File menu option.
- 7 Go to the PC card reader drive and open the DashDyno live data file. Live data files are stored on the SD card within the LIVE directory (e.g. f:\LIVE\MY_DATA.Id).
- 8 Google Earth will start automatically when the file is opened. A yellow vehicle path line is drawn and the camera zooms over the entire vehicle path.
- 9 Select the Analyze Live Data icon on the Navigation docking window.
- 10 Press the Data Cursor button on the Analyze Tool Bar.
- 11 Left mouse click the data cursor and drag it to a new location. Google Earth will reposition to the vehicle's georeferenced location as recorded within your data file.
- 12 Press the Play button on the Playback Control toolbar. The line graph will start to move and Google Earth will continually update its position during playback.

See Analyze Live Data Screen on page 57 for more information on how to use Analyze Live Data screen.

Google Earth Options

Dyno-Scan for Windows has settings to control how GPS data is displayed within Google Earth. The user's point of view within Google Earth is called a camera position. The camera position can be adjusted for altitude and viewing angle.

The Google Earth settings with the Dyno-Scan for Windows Tools > Options dialog are:

Enable Google Earth – when checked, Google Earth is used to display GPS position information from within a live data file.

Playback Mode – the Stationary option holds the camera position and attitude steady during playback. The camera position when the Play button is pressed is used as the stationary position. The Follow Vehicle option zooms the camera behind the vehicle position. When the vehicle position is updated, the camera view will follow.

GPS Heading Camera View – uses the heading (i.e. direction of travel) from the GPS to orient the camera view. During playback, the camera point of view always faces the vehicle's direction of travel. Otherwise, the camera points north.

Playback Speed – controls the playback speed.

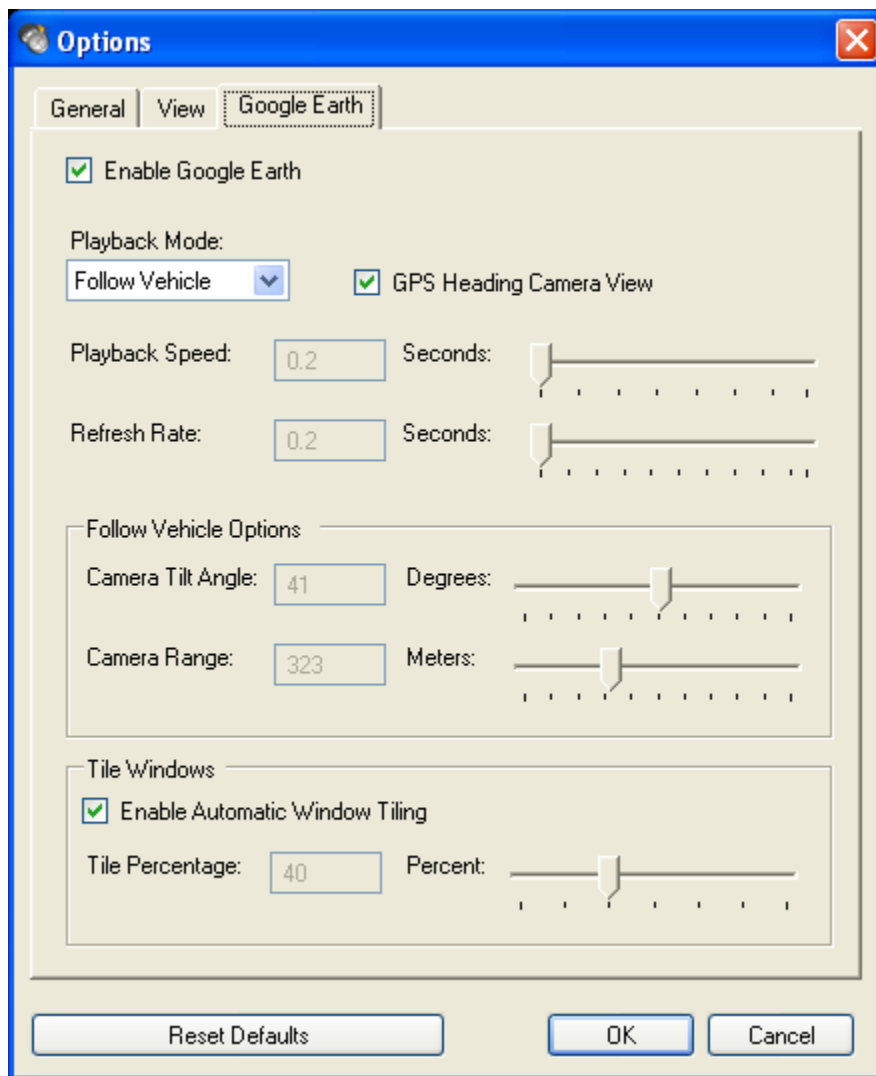
Refresh Rate – controls how often Google Earth is sent GPS positional data.

Camera Tilt Angle – controls the tilt of the camera position. 0 degrees looks straight down and 80 degrees looks toward the horizon.

Camera Range – controls how far from the ground the camera is positioned.

Enable Automatic Window Tiling – when checked, the software vertically tiles Dyno-Scan and Google Earth so both application windows are visible.

Tile Percentage – the horizontal percentage of screen width Google Earth will occupy. The Google Earth toolbar prevents Google Earth from sizing to a small horizontal screen width. To allow a small screen width, uncheck the menu View > Toolbar within Google Earth.



Improving Playback Speed

The Analyze Live Data screen Playback feature can be slow on an older computer. If this is the case, here are some tips:

- 1 On Dyno-Scan, slow the Refresh Rate and/or Playback Speed. For instance, setting a playback speed of 0.2 seconds and a refresh speed of 1.0 second's means every 5th data point Google Earth will receive a new GPS coordinate.
- 2 On Dyno-Scan, turn off the round markers by selecting the Options button pull down on the Analyze Live Data title bar and unchecking Show Markers.
- 3 On Google Earth's Tools > Options... dialog, set the Detail Area to Small and set the Terrain Quality to Lower. Its best to restart Google Earth after making changes.
- 4 On Google Earth's Layers sidebar, uncheck unused options such as Roads, Terrain, Dining, etc...
- 5 On Google Earth, select the View > Sidebar menu option to hide the sidebar. This will prevent needless refreshing of the sidebar during playback.

Working Without an Internet Connection

Google Earth obtains satellite imagery from the Internet. If you want to use Google Earth away from the Internet (e.g. at track day), you'll need to cache the images to your computer disk drive.

To cache satellite imagery, while connected to the Internet move the Google Earth view around the location you want to view when not connected to the Internet. As you fly around, look at the area from different directions and attitudes. This will cause the satellite images to be stored within the Google Earth memory cache for use when offline.

If necessary, the Google Earth cache can be increased by going to the Tools > Options menu then select the Cache tab.

Demo Mode

Demonstration mode simulates all vehicle data. This mode facilitates learning about scan tool features without connecting to a live vehicle.

Enable Demo Mode

Demo mode is enabled from the File > Connect dialog.

- 1 Select the “Connect to Vehicle Demo” checkbox on the Connect screen.

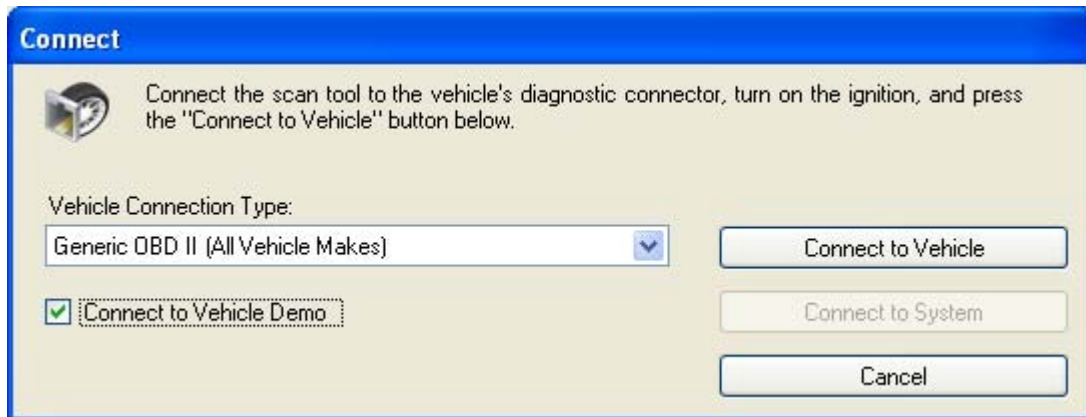


Figure 39: Connect to Vehicle Demo

- 2 Press the “Connect to Vehicle” button. With demo mode enabled, all vehicle data is simulated – even if the scan tool is connected to a vehicle.

Export File Format

Four different export formats available within the software.

- 1 Single-Point Row CSV File
- 2 Multi-Point Row CSV File
- 3 TrackVision File
- 4 Analyze Live Data Save

All file formats may be imported into a spreadsheet application such as Microsoft Excel. Once the data is imported into the spreadsheet, numerous data manipulations are possible such as graphing and analyzing the data.

Single-Point Row CSV File Format

This file format exports the data into a one-data point per row format. Each row within the spreadsheet corresponds to one data sample. The sample time on each row is the exact time the data sample was taken.

The CSV file is a tabular format of data placed into rows and columns. The first row contains basic file information:

File Name – the name of the PDB file.

Make – make of the vehicle.

Year – the year of the vehicle.

VIN – the optional VIN number field.

Note – the optional note field.

Sample	Name	Sample Time	Value Metric	Units Metric	Value English	Units English
0	Vehicle Speed	0	0	km/h	0	MPH
1	Analog In 3 - 24V	0.179	0	V		
2	Average Economy	0.193	9.4	L/100	25.1	mpg
3	Absolute Throttle Position	0.201	0.4	%		
4	Analog In 3 - 24V	0.279	0	V		
5	Analog In 3 - 24V	0.379	0	V		
6	Analog In 3 - 24V	0.479	0	V		
7	Analog In 3 - 24V	0.579	0	V		
8	Analog In 3 - 24V	0.679	0	V		
9	Analog In 3 - 24V	0.779	0	V		
10	Vehicle Speed	0.83	0	km/h	0	MPH
11	Average Economy	0.861	9.4	L/100	25.1	mpg
12	Analog In 3 - 24V	0.879	0	V		
13	GPS Satellites	0.95	7	satellites		
14	Analog In 3 - 24V	0.979	0	V		
15	GPS Latitude	0.987	34.08617333	latitude		
16	GPS Longitude	0.987	-117.507365	longitude		
17	Absolute Throttle Position	1.033	0.4	%		
18	Analog In 3 - 24V	1.079	0	V		
19	Analog In 3 - 24V	1.179	0	V		
20	Engine RPM	1.24	713	RPM		
21	Analog In 3 - 24V	1.279	0	V		

Figure 40: Single-Point Row CSV File in Excel

The second row contains the column headings for the scan data. Metric values are always included in the CSV file, however if there is no corresponding English units of measure for a sensor then no conversion is shown.

Sample – the sample number.

Name– the parameter name.

Sample Time – the time stamp when the data was sampled in seconds.

Value Metric – the sensor value in Metric units.

Units Metric – the Metric units of measure.

Value English – the sensor value in English units.

Units English – the English units of measure.

Multi-Point Row CSV File

This file format exports the data in a multiple data points per row format. Each row within the spreadsheet corresponds to one or more data samples.

The data arrives from the vehicle at different times. A single time stamp cannot accurately identify the exact moment when multiple vehicle samples arrive⁴. Therefore, the sample time used on each row is the time of the last sensor to be sampled on that row. The order of the columns is not important and does not indicate the order in which the sensors were sampled.

All the sampled data within a certain time period is combined into a single row. If a new data sample is not available for a row within the time period, then the last known good data sample is inserted instead.

The multi-point row CSV file format may be easier to use than the single-point row CSV format at the expense of losing the exact time stamp for each data sample point.

Sample Time	Position Latitude	Position Longitude	GPS Satellites	GPS Speed	Vehicle Speed	Distance Traveled	Engine RPM	Instant
0.339	31.98590667	34.74370167	10	46.6	46	19	2127	
0.579	31.98590667	34.74370167	10	46.6	46	19	2129	
0.779	31.98590667	34.74370167	10	46.6	46	19	2109	
0.979	31.985725	34.74362833	10	46.5	46	19	1958	
1.184	31.985725	34.74362833	10	46.5	46	19	1882	
1.476	31.985725	34.74362833	10	46.5	46	19	1889	
1.629	31.985725	34.74362833	10	46.5	46	19	1890	
1.838	31.985545	34.743555	10	46.6	47	19	1891	
2.036	31.985545	34.743555	10	46.6	46	19	1886	
2.229	31.985545	34.743555	10	46.6	47	19	1890	
2.435	31.985545	34.743555	10	46.6	47	19	1892	
2.629	31.985545	34.743555	10	46.6	47	19	1896	
2.865	31.985545	34.743555	10	46.6	47	19	1889	
3.036	31.98536667	34.74348333	10	46.7	47	19	1892	
3.26	31.98536667	34.74348333	10	46.7	47	19	1897	
3.429	31.98536667	34.74348333	10	46.7	47	19	1902	
3.636	31.98536667	34.74348333	10	46.7	47	19	1895	
3.837	31.98518667	34.74341167	10	46.9	47	19	1899	
4.036	31.98518667	34.74341167	10	46.9	47	19	1901	
4.265	31.98518667	34.74341167	10	46.9	47	19	1899	
4.439	31.98518667	34.74341167	10	46.9	47	19	1899	
4.637	31.98518667	34.74341167	10	46.9	47	19	1899	

Figure 41: Multi-Point Row CSV File in Excel

TrackVision CSV File

TrackVision is a 3rd party software package that merges in-car video recorded with a camcorder and vehicle data recorded with DashDyno. The TrackVision software synchronizes the video and data and creates a virtual dashboard overlay within your video. Engine RPM, throttle position, vehicle speed, GPS position and more can be displayed.

The resulting movie is exported to different video file formats or a DVD. TrackVision can be purchased at www.trackvision.net.

⁴ On CAN bus equipped vehicles with CAN 6x mode enabled up to 6 sensors can be simultaneously sampled from the vehicle.

To export a Live Data file into a format suitable for import within TrackVision, select the File > Export > TrackVision File... menu option.

For more information on using TrackVision, refer to Auterra's DashDyno SPD User Guide.

Analyze Live Data Save

The Save icon on the Analyze Live Data Screen toolbar exports a .dat file. This tab delimited file may be imported into a spreadsheet using a spreadsheet import data feature.

See Save Button on page 62 for more information regarding the Analyze Live Data Save button.

CHAPTER 10

Troubleshooting

This section contains solutions for common problems encountered with the scan tool.

Scan Tool Connects but No Sensor Data

If no Live data is displayed in the Live Data screens, try the following remedies:

- 1 Right mouse click in a Graph or List pane and select “Edit Parameters” from the shortcut menu and add the parameters you want to monitor.
- 2 Disable the Fast Sampling option in the Tools > Options dialog.
- 3 Disable the CAN 6x Communication option in the Tools > Options dialog.

Can’t Open COM Port

The COM port is either busy or does not exist, try the following remedies:

- 1 Try selecting another COM port.
- 2 If you use a Palm handheld computer with your computer, disable the Local Serial checkmark on the HotSync icon located on the Windows taskbar by right mouse clicking on the HotSync icon. Alternatively, right mouse click the HotSync icon and select Exit.
- 3 If you have a PocketPC or Windows CE PDA, disable ActiveSync.

No Communication (Scan Tool)

If the No Communication (Scan Tool) dialog appears, this means the software cannot communicate with the vehicle. Try the following remedies:

- 1 Ensure the vehicle ignition is turned on. Vehicle does not have to be running; however, it can be.
- 2 Try pressing the “Connect to Vehicle” button again.
- 3 Ensure the OBD II Adapter is securely plugged into the vehicle’s OBD II connector.
- 4 Ensure the RS-232 cable is securely plugged into the PC.
- 5 Ensure the vehicle is OBD II compliant (see Supported Vehicles).
- 6 Ensure no vehicle fuses are blown. OBD II adapter power is derived from the vehicle and a blown fuse could prevent power from reaching the scan tool.

No Communication (Vehicle)

If the No Communication (Vehicle) dialog appears, see No Communication (Scan Tool).

Lost Communication

If the Lost Communication dialog appears, this means the software initially established communication but subsequently lost it. Try the following remedies:

- 1 Ensure the OBD II Adapter is securely plugged into the vehicle's OBD II connector.
- 2 Ensure the RS-232 cable is securely plugged into the PC.

Live Data Screen Is Blank

Right mouse click in the center of the screen and select "Add List Pane" or "Add Graph Pane" from the shortcut menu to add new panes.

Oxygen Sensors Test Results Pane is Blank

Not all vehicles support the features provided by the Oxygen Sensor screen. If the vehicle does not support this feature, the data for the screen will be blank.

Freeze Frame Pane is Blank

If the vehicle has not detected a failure that caused the Check Engine to illuminate, the data for the Freeze Frame pane will be blank.

Clearing Codes Did Not Work or MIL Didn't Turn Off

There are a few possible causes for the check engine light not to extinguish or the DTCs to reappear on the scan tool. First, if the problem is not fixed the DTC may return immediately for problems such as misfires, open or shorted sensors, etc. Second, some vehicles can't be running when the memory is cleared. In these cases, ensure the key is on but the engine is off before attempting to clear the memory. Last, some vehicles require, after the codes are cleared, for the ignition key to be turned off and then on again before the MIL light actually turns off.

Diagnostic Trouble Codes

A Diagnostic Trouble Code (DTC) is a 5-digit value starting with a letter.

The DTC's codes listed here are generic to all manufacturers. These generic Diagnostic Trouble Codes are those codes where industry uniformity has been achieved. However, each vehicle manufacturer may optionally create new codes beyond the generic ones. The Auterra Dyno-Scan™ for Windows can read these enhanced manufacturer specific codes.

The DTC database files included with the software incorporates thousands of more codes, both generic and enhanced, than those listed here. The following listing simply provides an overview of the types of codes available.

Diagnostic Trouble Code Format Structure

The Diagnostic Trouble Code numbering follows a standardized structure. All Diagnostic Trouble Codes have a letter followed by a 4-digit number (e.g. P1234). The first letter indicates the type of code:

P = Powertrain

C = Chassis

B = Body

U = Network Communication

The remaining 4-digit number specifies the problem within that system.

P00XX Fuel and Air Metering and Auxiliary Emission Controls

P0010	"A" Camshaft Position Actuator Circuit	(Bank 1)
P0011	"A" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 1)
P0012	"A" Camshaft Position - Timing Over-Retarded	(Bank 1)
P0013	"B" Camshaft Position - Actuator Circuit	(Bank 1)
P0014	"B" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 1)
P0015	"B" Camshaft Position -Timing Over-Retarded	(Bank 1)
P0020	"A" Camshaft Position Actuator Circuit	(Bank 2)
P0021	"A" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 2)
P0022	"A" Camshaft Position - Timing Over-Retarded	(Bank 2)
P0023	"B" Camshaft Position - Actuator Circuit	(Bank 2)
P0024	"B" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 2)
P0025	"B" Camshaft Position - Timing Over-Retarded	(Bank 2)
P0030	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 1)
P0031	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 1)
P0032	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 1)
P0033	Turbo Charger Bypass Valve Control Circuit	

P0034	Turbo Charger Bypass Valve Control Circuit Low	
P0035	Turbo Charger Bypass Valve Control Circuit High	
P0036	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 2)
P0037	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 2)
P0038	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 2)
P0042	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 3)
P0043	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 3)
P0044	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 3)
P0050	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 1)
P0051	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 1)
P0052	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 1)
P0056	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 2)
P0057	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 2)
P0058	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 2)
P0062	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 3)
P0063	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 3)
P0064	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 3)
P0065	Air Assisted Injector Control Range/Performance	
P0066	Air Assisted Injector Control Circuit or Circuit Low	
P0067	Air Assisted Injector Control Circuit High	
P0070	Ambient Air Temperature Sensor Circuit	
P0071	Ambient Air Temperature Sensor Range/Performance	
P0072	Ambient Air Temperature Sensor Circuit Low Input	
P0073	Ambient Air Temperature Sensor Circuit High Input	
P0074	Ambient Air Temperature Sensor Circuit Intermittent	
P0075	Intake Valve Control Solenoid Circuit	(Bank 1)
P0076	Intake Valve Control Solenoid Circuit Low	(Bank 1)
P0077	Intake Valve Control Solenoid Circuit High	(Bank 1)
P0078	Exhaust Valve Control Solenoid Circuit	(Bank 1)
P0079	Exhaust Valve Control Solenoid Circuit Low	(Bank 1)
P0080	Exhaust Valve Control Solenoid Circuit High	(Bank 1)
P0081	Intake valve Control Solenoid Circuit	(Bank 2)
P0082	Intake Valve Control Solenoid Circuit Low	(Bank 2)
P0083	Intake Valve Control Solenoid Circuit High	(Bank 2)
P0084	Exhaust Valve Control Solenoid Circuit	(Bank 2)
P0085	Exhaust Valve Control Solenoid Circuit Low	(Bank 2)
P0086	Exhaust Valve Control Solenoid Circuit High	(Bank 2)

P01XX Fuel and Air Metering

P0100	Mass or Volume Air Flow Circuit
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem
P0102	Mass or Volume Air Flow Circuit Low Input
P0103	Mass or Volume Air Flow Circuit High Input
P0104	Mass or Volume Air Flow Circuit Intermittent
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input
P0109	Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent
P0110	Intake Air Temperature Circuit
P0111	Intake Air Temperature Circuit Range/Performance Problem
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0114	Intake Air Temperature Circuit Intermittent
P0115	Engine Coolant Temperature Circuit
P0116	Engine Coolant Temperature Circuit Range/Performance Problem
P0117	Engine Coolant Temperature Circuit Low Input

P0118	Engine Coolant Temperature Circuit High Input	
P0119	Engine Coolant Temperature Circuit Intermittent	
P0120	Throttle/Pedal Position Sensor/Switch A Circuit	
P0121	Throttle/Pedal Position Sensor/Switch A Circuit Range/Performance Problem	
P0122	Throttle/Pedal Position Sensor/Switch A Circuit Low Input	
P0123	Throttle/Pedal Position Sensor/Switch A Circuit High Input	
P0124	Throttle/Pedal Position Sensor/Switch A Circuit Intermittent	
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	
P0126	Insufficient Coolant Temperature for Stable Operation	
P0127	Intake Air Temperature Too High	
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	
P0130	O2 Sensor Circuit	(Bank 1 Sensor 1)
P0131	O2 Sensor Circuit Low Voltage	(Bank 1 Sensor 1)
P0132	O2 Sensor Circuit High Voltage	(Bank 1 Sensor 1)
P0133	O2 Sensor Circuit Slow Response	(Bank 1 Sensor 1)
P0134	O2 Sensor Circuit No Activity Detected	(Bank 1 Sensor 1)
P0135	O2 Sensor Heater Circuit	(Bank 1 Sensor 1)
P0136	O2 Sensor Circuit Malfunction	(Bank 1 Sensor 2)
P0137	O2 Sensor Circuit Low Voltage	(Bank 1 Sensor 2)
P0138	O2 Sensor Circuit High Voltage	(Bank 1 Sensor 2)
P0139	O2 Sensor Circuit Slow Response	(Bank 1 Sensor 2)
P0140	O2 Sensor Circuit No Activity Detected	(Bank 1 Sensor 2)
P0141	O2 Sensor Heater Circuit	(Bank 1 Sensor 2)
P0142	O2 Sensor Circuit Malfunction	(Bank 1 Sensor 3)
P0143	O2 Sensor Circuit Low Voltage	(Bank 1 Sensor 3)
P0144	O2 Sensor Circuit High Voltage	(Bank 1 Sensor 3)
P0145	O2 Sensor Circuit Slow Response	(Bank 1 Sensor 3)
P0146	O2 Sensor Circuit No Activity Detected	(Bank 1 Sensor 3)
P0147	O2 Sensor Heater Circuit	(Bank 1 Sensor 3)
P0148	Fuel Delivery Error	
P0149	Fuel Timing Error	
P0150	O2 Sensor Circuit	(Bank 2 Sensor 1)
P0151	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 1)
P0152	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 1)
P0153	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 1)
P0154	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 1)
P0155	O2 Sensor Heater Circuit	(Bank 2 Sensor 1)
P0156	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 2)
P0157	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 2)
P0158	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 2)
P0159	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 2)
P0160	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 2)
P0161	O2 Sensor Heater Circuit	(Bank 2 Sensor 2)
P0162	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 3)
P0163	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 3)
P0164	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 3)
P0165	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 3)
P0166	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 3)
P0167	O2 Sensor Heater Circuit	(Bank 2 Sensor 3)
P0168	Fuel Temperature Too High	
P0169	Incorrect Fuel Composition	
P0170	Fuel Trim	(Bank 1)
P0171	System too Lean	(Bank 1)
P0172	System too Rich	(Bank 1)
P0173	Fuel Trim Malfunction	(Bank 2)
P0174	System too Lean	(Bank 2)
P0175	System too Rich	(Bank 2)
P0176	Fuel Composition Sensor Circuit	
P0177	Fuel Composition Sensor Circuit Range/Performance	
P0178	Fuel Composition Sensor Circuit Low Input	
P0179	Fuel Composition Sensor Circuit High Input	

P0180	Fuel Temperature Sensor A Circuit
P0181	Fuel Temperature Sensor A Circuit Range/Performance
P0182	Fuel Temperature Sensor A Circuit Low Input
P0183	Fuel Temperature Sensor A Circuit High Input
P0184	Fuel Temperature Sensor A Circuit Intermittent
P0185	Fuel Temperature Sensor B Circuit
P0186	Fuel Temperature Sensor B Circuit Range/Performance
P0187	Fuel Temperature Sensor B Circuit Low Input
P0188	Fuel Temperature Sensor B Circuit High Input
P0189	Fuel Temperature Sensor B Circuit Intermittent
P0190	Fuel Rail Pressure Sensor Circuit
P0191	Fuel Rail Pressure Sensor Circuit Range/Performance
P0192	Fuel Rail Pressure Sensor Circuit Low Input
P0193	Fuel Rail Pressure Sensor Circuit High Input
P0194	Fuel Rail Pressure Sensor Circuit Intermittent
P0195	Engine Oil Temperature Sensor
P0196	Engine Oil Temperature Sensor Range/Performance
P0197	Engine Oil Temperature Sensor Low
P0198	Engine Oil Temperature Sensor High
P0199	Engine Oil Temperature Sensor Intermittent

P02XX Fuel and Air Metering

P0200	Injector Circuit
P0201	Injector Circuit - Cylinder 1
P0202	Injector Circuit - Cylinder 2
P0203	Injector Circuit - Cylinder 3
P0204	Injector Circuit - Cylinder 4
P0205	Injector Circuit - Cylinder 5
P0206	Injector Circuit - Cylinder 6
P0207	Injector Circuit - Cylinder 7
P0208	Injector Circuit - Cylinder 8
P0209	Injector Circuit - Cylinder 9
P0210	Injector Circuit - Cylinder 10
P0211	Injector Circuit - Cylinder 11
P0212	Injector Circuit - Cylinder 12
P0213	Cold Start Injector 1
P0214	Cold Start Injector 2
P0215	Engine Shutoff Solenoid
P0216	Injector/Injection Timing Control Circuit
P0217	Engine Coolant Over Temperature Condition
P0218	Transmission Fluid Over Temperature Condition
P0219	Engine Over Speed Condition
P0220	Throttle/Pedal Position Sensor/Switch "B" Circuit
P0221	Throttle/Pedal Position Sensor/Switch "B" Circuit Range/Performance Problem
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input
P0224	Throttle/Pedal Position Sensor/Switch "B" Circuit Intermittent
P0225	Throttle/Pedal Position Sensor/Switch "C" Circuit
P0226	Throttle/Pedal Position Sensor/Switch "C" Circuit Range/Performance Problem
P0227	Throttle/Pedal Position Sensor/Switch "C" Circuit Low Input
P0228	Throttle/Pedal Position Sensor/Switch "C" Circuit High Input
P0229	Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent
P0230	Fuel Pump Primary Circuit
P0231	Fuel Pump Secondary Circuit Low
P0232	Fuel Pump Secondary Circuit High
P0233	Fuel Pump Secondary Circuit Intermittent
P0234	Turbo/Super Charger Overboost Condition
P0235	Turbo/Super Charger Boost Sensor "A" Circuit
P0236	Turbo/Super Charger Boost Sensor "A" Circuit Range/Performance
P0237	Turbo/Super Charger Boost Sensor "A" Circuit Low
P0238	Turbo/Super Charger Boost Sensor "A" Circuit High
P0239	Turbo/Super Charger Boost Sensor "B" Circuit

P0240	Turbo/Super Charger Boost Sensor "B" Circuit Range/Performance
P0241	Turbo/Super Charger Boost Sensor "B" Circuit Low
P0242	Turbo/Super Charger Boost Sensor "B" Circuit High
P0243	Turbo/Super Charger Wastegate Solenoid "A"
P0244	Turbo/Super Charger Wastegate Solenoid "A" Range/Performance
P0245	Turbo/Super Charger Wastegate Solenoid "A" Low
P0246	Turbo/Super Charger Wastegate Solenoid "A" High
P0247	Turbo/Super Charger Wastegate Solenoid "B"
P0248	Turbo/Super Charger Wastegate Solenoid "B" Range/Performance
P0249	Turbo/Super Charger Wastegate Solenoid "B" Low
P0250	Turbo/Super Charger Wastegate Solenoid "B" High
P0251	Injection Pump Fuel Metering Control "A" (Cam/rotor/Injector)
P0252	Injection Pump Fuel Metering Control "A" Range/Performance (Cam/Rotor/Injector)
P0253	Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)
P0254	Injection Pump Fuel Metering Control "A" High (Cam/Rotor/Injector)
P0255	Injection Pump Fuel Metering Control "A" Intermittent (Cam/Rotor/Injector)
P0256	Injection Pump Fuel Metering Control "B" (Cam/Rotor/Injector)
P0257	Injection Pump Fuel Metering Control "B" Range/Performance (Cam/Rotor/Injector)
P0258	Injection Pump Fuel Metering Control "B" Low (Cam/Rotor/Injector)
P0259	Injection Pump Fuel Metering Control "B" High (Cam/Rotor/Injector)
P0260	Injection Pump Fuel Metering Control "B" Intermittent (Cam/Rotor/Injector)
P0261	Cylinder 1 Injector Circuit Low
P0262	Cylinder 1 Injector Circuit High
P0263	Cylinder 1 Contribution/Balance
P0264	Cylinder 2 Injector Circuit Low
P0265	Cylinder 2 Injector Circuit High
P0266	Cylinder 2 Contribution/Balance
P0267	Cylinder 3 Injector Circuit Low
P0268	Cylinder 3 Injector Circuit High
P0269	Cylinder 4 Contribution/Balance
P0270	Cylinder 4 Injector Circuit Low
P0271	Cylinder 4 Injector Circuit High
P0272	Cylinder 4 Contribution/Balance
P0273	Cylinder 5 Injector Circuit Low
P0274	Cylinder 5 Injector Circuit High
P0275	Cylinder 5 Contribution/Balance
P0276	Cylinder 6 Injector Circuit Low
P0277	Cylinder 6 Injector Circuit High
P0278	Cylinder 6 Contribution/Balance
P0279	Cylinder 7 Injector Circuit Low
P0280	Cylinder 7 Injector Circuit High
P0281	Cylinder 7 Contribution/Balance
P0282	Cylinder 8 Injector Circuit Low
P0283	Cylinder 8 Injector Circuit High
P0284	Cylinder 8 Contribution/Balance
P0285	Cylinder 9 Injector Circuit Low
P0286	Cylinder 9 Injector Circuit High
P0287	Cylinder 9 Contribution/Balance
P0288	Cylinder 10 Injector Circuit Low
P0289	Cylinder 10 Injector Circuit High
P0290	Cylinder 10 Contribution/Balance
P0291	Cylinder 11 Injector Circuit Low
P0292	Cylinder 11 Injector Circuit High
P0293	Cylinder 11 Contribution/Balance
P0294	Cylinder 12 Injector Circuit Low
P0295	Cylinder 12 Injector Circuit High
P0296	Cylinder 12 Contribution/Balance
P0298	Engine Oil Over Temperature

P03XX Ignition System or Misfire

P0300	Random/Multiple Cylinder Misfire Detected
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P0301	Cylinder 1 Misfire Detected	
P0302	Cylinder 2 Misfire Detected	
P0303	Cylinder 3 Misfire Detected	
P0304	Cylinder 4 Misfire Detected	
P0305	Cylinder 5 Misfire Detected	
P0306	Cylinder 6 Misfire Detected	
P0307	Cylinder 7 Misfire Detected	
P0308	Cylinder 8 Misfire Detected	
P0309	Cylinder 9 Misfire Detected	
P0310	Cylinder 10 Misfire Detected	
P0311	Cylinder 11 Misfire Detected	
P0312	Cylinder 12 Misfire Detected	
P0313	Misfire Detected with Low Fuel	
P0314	Single Cylinder Misfire (Cylinder not Specified)	
P0320	Ignition/Distributor Engine Speed Input Circuit	
P0321	Ignition/Distributor Engine Speed Input Circuit Range/Performance	
P0322	Ignition/Distributor Engine Speed Input Circuit No Signal	
P0323	Ignition/Distributor Engine Speed Input Circuit Intermittent	
P0324	Knock Control System Error	
P0325	Knock Sensor 1 Circuit	(Bank 1 or Single Sensor)
P0326	Knock Sensor 1 Circuit Range/Performance	(Bank 1 or Single Sensor)
P0327	Knock Sensor 1 Circuit Low Input	(Bank 1 or Single Sensor)
P0328	Knock Sensor 1 Circuit High Input	(Bank 1 or Single Sensor)
P0329	Knock Sensor 1 Circuit Input Intermittent	(Bank 1 or Single Sensor)
P0330	Knock Sensor 2 Circuit	(Bank 2)
P0331	Knock Sensor 2 Circuit Range/Performance	(Bank 2)
P0332	Knock Sensor 2 Circuit Low Input	(Bank 2)
P0333	Knock Sensor 2 Circuit High Input	(Bank 2)
P0334	Knock Sensor 2 Circuit Input Intermittent	(Bank 2)
P0335	Crankshaft Position Sensor A Circuit	
P0336	Crankshaft Position Sensor A Circuit Range/Performance	
P0337	Crankshaft Position Sensor A Circuit Low Input	
P0338	Crankshaft Position Sensor A Circuit High Input	
P0339	Crankshaft Position Sensor A Circuit Intermittent	
P0340	Camshaft Position Sensor "A" Circuit	(Bank 1 or Single Sensor)
P0341	Camshaft Position Sensor "A" Circuit Range/Performance	(Bank 1 or Single Sensor)
P0342	Camshaft Position Sensor "A" Circuit Low Input	(Bank 1 or Single Sensor)
P0343	Camshaft Position Sensor "A" Circuit High Input	(Bank 1 or Single Sensor)
P0344	Camshaft Position Sensor "A" Circuit Intermittent	(Bank 1 or Single Sensor)
P0345	Camshaft Position Sensor "A" Circuit	(Bank 2)
P0348	Camshaft Position Sensor "A" Circuit Range/Performance	(Bank 2)
P0347	Camshaft Position Sensor "A" Circuit Low Input	(Bank 2)
P0348	Camshaft Position Sensor "A" Circuit High Input	(Bank 2)
P0349	Camshaft Position Sensor "A" Circuit Intermittent	(Bank 2)
P0350	Ignition Coil Primary/Secondary Circuit	
P0351	Ignition Coil "A" Primary/Secondary Circuit	
P0352	Ignition Coil "B" Primary/Secondary Circuit	
P0353	Ignition Coil "C" Primary/Secondary Circuit	
P0354	Ignition Coil "D" Primary/Secondary Circuit	
P0355	Ignition Coil "F" Primary/Secondary Circuit	
P0356	Ignition Coil "F" Primary/Secondary Circuit	
P0357	Ignition Coil "G" Primary/Secondary Circuit	
P0358	Ignition Coil "H" Primary/Secondary Circuit	
P0359	Ignition Coil "I" Primary/Secondary Circuit	
P0360	Ignition Coil "J" Primary/Secondary Circuit	
P0361	Ignition Coil "K" Primary/Secondary Circuit	
P0362	Ignition Coil "L" Primary/Secondary Circuit	
P0365	Camshaft Position Sensor "B" Circuit	(Bank 1)
P0366	Camshaft Position Sensor "B" Circuit Range/Performance	(Bank 1)
P0367	Camshaft Position Sensor "B" Circuit Low Input	(Bank 1)
P0368	Camshaft Position Sensor "B" Circuit High Input	(Bank 1)

P0369	Camshaft Position Sensor "B" Circuit Intermittent	(Bank 1)
P0370	Timing Reference High Resolution Signal "A"	
P0371	Timing Reference High Resolution Signal "A" Too Many Pulses	
P0372	Timing Reference High Resolution Signal "A" Too Few Pulses	
P0373	Timing Reference High Resolution Signal "A" Intermittent/Erratic Pulses	
P0374	Timing Reference High Resolution Signal "A" No Pulse	
P0375	Timing Reference High Resolution Signal "B"	
P0376	Timing Reference High Resolution Signal "B" Too Many Pulses	
P0377	Timing Reference High Resolution Signal "B" Too Few Pulses	
P0378	Timing Reference High Resolution Signal "B" Intermittent/Erratic Pulses	
P0379	Timing Reference High Resolution Signal "B" No Pulses	
P0380	Glow Plug/Heater Circuit "A"	
P0381	Glow Plug/Heater Indicator Circuit	
P0382	Glow Plug/Heater Circuit "B"	
P0385	Crankshaft Position Sensor "B" Circuit	
P0386	Crankshaft Position Sensor "B" Circuit Range/Performance	
P0387	Crankshaft Position Sensor "B" Circuit Low Input	
P0388	Crankshaft Position Sensor "B" Circuit High Input	
P0389	Crankshaft Position Sensor "B" Circuit Intermittent	
P0390	camshaft Position Sensor "B" Circuit	
P0391	Camshaft Position Sensor "B" circuit Range/Performance	(Bank 2)
P0392	Camshaft Position Sensor "B" Circuit Low Input	(Bank 2)
P0393	Camshaft Position Sensor "B" Circuit High Input	(Bank 2)
P0394	Camshaft Position Sensor "B" Circuit Intermittent	(Bank 2)

P04XX Auxiliary Emission Controls

P0400	Exhaust Gas Recirculation Flow	
P0401	Exhaust Gas Recirculation Flow Insufficient Detected	
P0402	Exhaust Gas Recirculation Flow Excessive Detected	
P0403	Exhaust Gas Recirculation Control Circuit	
P0404	Exhaust Gas Recirculation Control Circuit Range/Performance	
P0405	Exhaust Gas Recirculation Sensor "A" Circuit Low	
P0406	Exhaust Gas Recirculation Sensor "A" Circuit High	
P0407	Exhaust Gas Recirculation Sensor "B" Circuit Low	
P0408	Exhaust Gas Recirculation Sensor "B" Circuit High	
P0409	Exhaust Gas Recirculation Sensor "A" Circuit	
P0410	Secondary Air Injection System	
P0411	Secondary Air Injection System Incorrect Flow Detected	
P0412	Secondary Air Injection System Switching Valve "A" Circuit	
P0413	Secondary Air Injection System Switching Valve "A" Circuit Open	
P0414	Secondary Air Injection System Switching Valve "A" Circuit Shorted	
P0415	Secondary Air Injection System Switching Valve "B" Circuit	
P0416	secondary Air Injection System Switching Valve "B" Circuit Open	
P0417	secondary Air Injection System Switching Valve "B" Circuit Shorted	
P0416	Secondary Air Injection System Relay "A" Circuit	
P0419	Secondary Air injection System Relay "B" Circuit	
P0420	Catalyst System Efficiency Below Threshold	(Bank 1)
P0421	Warm Up Catalyst Efficiency Below Threshold	(Bank 1)
P0422	Main Catalyst Efficiency Below Threshold	(Bank 1)
P0423	Heated Catalyst Efficiency Below Threshold	(Bank 1)
P0424	Heated Catalyst Temperature Below Threshold	(Bank 1)
P0425	Catalyst Temperature Sensor	(Bank 1)
P0426	Catalyst Temperature Sensor Range/Performance	(Bank 1)
P0427	Catalyst Temperature Sensor Low Input	(Bank 1)
P0428	Catalyst Temperature Sensor High Input	(Bank 1)
P0429	Catalyst Heater Control Circuit	(Bank 1)
P0430	Catalyst System Efficiency Below Threshold	(Bank 2)
P0431	Warm Up Catalyst Efficiency Below Threshold	(Bank 2)
P0432	Main Catalyst Efficiency Below Threshold	(Bank 2)
P0433	Heated Catalyst Efficiency Below Threshold	(Bank 2)
P0434	Heated Catalyst Temperature Below Threshold	(Bank 2)

P0435	Catalyst Temperature Sensor	(Bank 2)
P0436	Catalyst Temperature Sensor Range/Performance	(Bank 2)
P0437	Catalyst Temperature Sensor Low Input	(Bank 2)
P0438	Catalyst Temperature Sensor High Input	(Bank 2)
P0439	Catalyst Heater Control Circuit	(Bank 2)
P0440	Evaporative Emission Control System	
P0441	Evaporative Emission Control System Incorrect Purge Flow	
P0442	Evaporative Emission Control System Leak Detected (small leak)	
P0443	Evaporative Emission Control System Purge Control Valve Circuit	
P0444	Evaporative Emission Control System Purge Control Valve Circuit Open	
P0445	Evaporative Emission Control System Purge Control Valve Circuit Shorted	
P0446	Evaporative Emission Control System Vent Control Circuit	
P0447	Evaporative Emission Control System Vent Control Circuit Open	
P0448	Evaporative Emission Control System Vent Control Circuit Shorted	
P0449	Evaporative Emission Control System Vent Valve/Solenoid Circuit	
P0450	Evaporative Emission Control System Pressure Sensor	
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance	
P0452	Evaporative Emission Control System Pressure Sensor Low Input	
P0453	Evaporative Emission Control System Pressure Sensor High input	
P0454	Evaporative Emission Control System Pressure Sensor Intermittent	
P0455	Evaporative Emission Control System Leak Detected (gross leak)	
P0456	Evaporative Emission Control System Leak Detected (very small leak)	
P0457	Evaporative Emission Control System Leak Detected (fuel cap loose/off)	
P0460	Fuel Level Sensor Circuit	
P0461	Fuel Level Sensor Circuit Range/Performance	
P0462	Fuel Level Sensor Circuit Low Input	
P0463	Fuel Level Sensor Circuit High Input	
P0464	Fuel Level Sensor Circuit Intermittent	
P0465	EVAP Purge Flow Sensor Circuit	
P0466	EVAP Purge Flow Sensor Circuit Range/Performance	
P0467	EVAP Purge Flow Sensor Circuit Low Input	
P0468	EVAP Purge Flow Sensor Circuit High Input	
P0469	EVAP Purge Flow Sensor Circuit Intermittent	
P0470	Exhaust Pressure Sensor	
P0471	Exhaust Pressure Sensor Range/Performance	
P0472	Exhaust Pressure Sensor Low	
P0473	Exhaust Pressure Sensor High	
P0474	Exhaust Pressure Sensor Intermittent	
P0475	Exhaust Pressure Control Valve	
P0476	Exhaust Pressure Control Valve Range/Performance	
P0477	Exhaust Pressure Control Valve Low	
P0478	Exhaust Pressure Control Valve High	
P0479	Exhaust Pressure Control Valve Intermittent	
P0480	Cooling Fan 1 Control Circuit	
P0481	Cooling Fan 2 Control Circuit	
P0482	Cooling Fan 3 Control Circuit	
P0483	Cooling Fan Rationality Check	
P0484	Cooling Fan Circuit Over Current	
P0485	Cooling Fan Power/Ground Circuit	
P0486	Exhaust Gas Recirculation Sensor "B" Circuit	
P0487	Exhaust Gas Recirculation Throttle Position Control Circuit	
P0488	Exhaust Gas Recirculation Throttle Position Control Range/Performance	
P0491	Secondary Air Injection System	(Bank 1)
P0492	Secondary Air Injection System	(Bank 2)

P05XX Vehicle Speed, Idle Control, and Auxiliary Inputs

P0500	Vehicle Speed Sensor
P0501	Vehicle Speed Sensor Range/Performance
P0502	Vehicle Speed Sensor Circuit Low Input
P0503	Vehicle Speed Sensor Intermittent/Erratic/High
P0505	Idle Control System

P0506	Idle Control System RPM Lower Than Expected	
P0507	Idle Control System RPM Higher Than Expected	
P0508	Idle Control System Circuit Low	
P0509	Idle Control System Circuit High	
P0510	Closed Throttle Position Switch	
P0512	Starter Request Circuit	
P0513	Incorrect Immobilizer Key ("Immobilizer pending SAE J1930 approval)	
P0515	Battery Temperature Sensor Circuit	
P0516	Battery Temperature Sensor Circuit Low	
P0517	Battery Temperature Sensor Circuit High	
P0520	Engine Oil Pressure Sensor/Switch Circuit	
P0521	Engine Oil Pressure Sensor/Switch Range/Performance	
P0522	Engine Oil Pressure Sensor/Switch Low Voltage	
P0523	Engine Oil Pressure Sensor/Switch High Voltage	
P0524	Engine Oil Pressure Too Low	
P0530	A/C Refrigerant Pressure Sensor Circuit	
P0531	A/C Refrigerant Pressure Sensor Circuit Range/Performance	
P0532	A/C Refrigerant Pressure Sensor Circuit Low Input	
P0533	A/C Refrigerant Pressure Sensor Circuit High Input	
P0534	Air Conditioner Refrigerant Charge Loss	
P0540	Intake Air Heater Circuit	
P0541	Intake Air Heater Circuit Low	
P0542	Intake Air Heater Circuit High	
P0544	Exhaust Gas Temperature Sensor Circuit	(Bank 1)
P0545	Exhaust Gas Temperature Sensor Circuit Low	(Bank 1)
P0546	Exhaust Gas Temperature Sensor Circuit High	(Bank 1)
P0547	Exhaust Gas Temperature Sensor Circuit	(Bank 2)
P0548	Exhaust Gas Temperature Sensor Circuit Low	(Bank 2)
P0549	Exhaust Gas Temperature Sensor Circuit High	(Bank 2)
P0550	Power Steering Pressure Sensor Circuit	
P0551	Power Steering Pressure Sensor Circuit Range/Performance	
P0552	Power Steering Pressure Sensor Circuit Low Input	
P0553	Power Steering Pressure Sensor Circuit High Input	
P0554	Power Steering Pressure Sensor Circuit Intermittent	
P0560	System Voltage	
P0561	System Voltage Unstable	
P0562	System Voltage Low	
P0563	System Voltage High	
P0564	Cruise Control Multi-Function Input Signal	
P0565	Cruise Control On Signal	
P0566	Cruise Control Off Signal	
P0567	Cruise Control Resume Signal	
P0568	Cruise Control Set Signal	
P0569	Cruise Control Coast Signal	
P0570	Cruise Control Accel Signal	
P0571	Cruise Control/Brake Switch A Circuit	
P0572	Cruise Control/Brake Switch A Circuit Low	
P0573	Cruise Control/Brake Switch A Circuit High	
P0574	Cruise Control System - Vehicle Speed Too High	
P0575	Cruise Control Input Circuit	
P0576	Cruise Control Input Circuit Low	
P0577	Cruise Control input Circuit High	
P0578 through P0580	Reserved for Cruise Control Codes	

P06XX Computer and Auxiliary Inputs

P0600	Serial Communication Link
P0601	Internal Control Module Memory Check Sum Error

P0602	Control Module Programming Error	
P0603	Internal Control Module Keep Alive Memory (KAM) Error	
P0604	Internal Control Module Random Access Memory (RAM) Error	
P0605	Internal Control Module Read Only Memory (ROM) Error (Module Identification Defined by SAE J1979)	
P0606	ECM/PCM Processor	
P0607	Control Module Performance	
P0608	Control Module VSS Output "A"	
P0609	Control Module VSS Output "B"	
P0610	Control Module Vehicle Options Error	
P0615	Starter Relay Circuit	
P0616	Starter Relay Circuit Low	
P0617	Starter Relay Circuit High	
P0618	Alternative Fuel Control Module KAM Error	
P0619	Alternative Fuel Control Module RAM/ROM Error	
P0620	Generator Control Circuit	
P0621	Generator Lamp "L" Terminal Control Circuit	
P0622	Generator Field "F" Terminal Control Circuit	
P0623	Generator Lamp Control Circuit	
P0624	Fuel Cap Lamp Control Circuit	
P0630	VIN Not Programmed or Mismatch - ECM/PCM	
P0631	VIN Not Programmed or Mismatch - TCM	
P0635	Power Steering Control Circuit	
P0836	Power Steering Control Circuit Low	
P0637	Power Steering Control Circuit High	
P0638	Throttle Actuator Control Range/Performance	(Bank 1)
P0639	Throttle Actuator Control Range/Performance	(Bank 2)
P0640	Intake Air Heater Control Circuit	
P0645	A/C Clutch Relay Control Circuit	
P0646	A/C Clutch Relay Control Circuit Low	
P0647	A/C Clutch Relay Control Circuit High	
P0648	Immobilizer Lamp Control Circuit ("Immobilizer" pending SAE J1930 approval)	
P0649	Speed Control Lamp Control Circuit	
P0650	Malfunction Indicator Lamp (ML) Control Circuit	
P0654	Engine RPM Output Circuit	
P0655	Engine Hot Lamp Output Control Circuit	
P0656	Fuel Level Output Circuit	
P0660	Intake Manifold Tuning Valve Control Circuit	(Bank 1)
P0661	Intake Manifold Tuning Valve Control Circuit Low	(Bank 1)
P0662	Intake Manifold Tuning Valve Control Circuit High	(Bank 1)
P0663	Intake Manifold Tuning Valve Control Circuit	(Bank 2)
P0664	Intake Manifold Tuning Valve Control Circuit Low	(Bank 2)
P0665	Intake Manifold Tuning Valve Control Circuit High	(Bank 2)

P07XX Transmission

P0700	Transmission Control System (MIL Request)
P0701	Transmission Control System Range/Performance
P0702	Transmission Control System Electrical
P0703	Torque Converter/Brake Switch B Circuit
P0704	Clutch Switch In put Circuit Malfunction
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)
P0706	Transmission Range Sensor Circuit Range/Performance
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0709	Transmission Range Sensor Circuit intermittent
P0710	Transmission Fluid Temperature Sensor Circuit

P0711	Transmission Fluid Temperature Sensor Circuit Range/Performance
P0712	Transmission Fluid Temperature Sensor Circuit Low Input
P0713	Transmission Fluid Temperature Sensor Circuit High Input
P0714	Transmission Fluid Temperature Sensor Circuit Intermittent
P0715	Input/Turbine Speed Sensor Circuit
P0716	Input/Turbine Speed Sensor Circuit Range/Performance
P0717	Input/Turbine Speed Sensor Circuit No Signal
P0718	Input/Turbine Speed Sensor Circuit Intermittent
P0719	Torque Converter/Brake Switch B Circuit Low
P0720	Output Speed Sensor Circuit
P0721	Output Speed Sensor Circuit Range/Performance
P0722	Output Speed Sensor Circuit No Signal
P0723	Output Speed Sensor Circuit Intermittent
P0724	Torque Converter/Brake Switch B Circuit High
P0725	Engine Speed Input Circuit
P0726	Engine Speed Input Circuit Range/Performance
P0727	Engine Speed Input Circuit No Signal
P0728	Engine Speed Input Circuit Intermittent
P0730	Incorrect Gear Ratio
P0731	Gear 1 Incorrect Ratio
P0732	Gear 2 Incorrect Ratio
P0733	Gear 3 Incorrect Ratio
P0734	Gear 4 Incorrect Ratio
P0735	Gear 5 Incorrect Ratio
P0736	Reverse Incorrect Ratio
P0737	TCM Engine Speed Output Circuit
P0739	TCM Engine Speed Output Circuit Low
P0739	TCM Engine Speed Output Circuit High
P0740	Torque Converter Clutch Circuit
P0741	Torque Converter Clutch Circuit Performance or Stuck Off
P0742	Torque Converter Clutch Circuit Stuck On
P0743	Torque Converter Clutch Circuit Electrical
P0744	Torque Converter Clutch Circuit Intermittent
P0745	Pressure Control Solenoid "A"
P0746	Pressure Control Solenoid "A" Performance or Stuck Off
P0747	Pressure Control Solenoid "A" Stuck On
P0748	Pressure Control Solenoid "A" Electrical
P0749	Pressure Control Solenoid "A" Intermittent
P0750	Shift Solenoid "A"
P0751	Shift Solenoid "A" Performance or Stuck Off
P0752	Shift Solenoid "A" Stuck On
P0753	Shift Solenoid "A" Electrical
P0754	Shift Solenoid "A" Intermittent
P0765	Shift Solenoid "B"
P0756	Shift Solenoid "B" Performance or Stuck Off
P0757	Shift Solenoid "B" Stuck On
P0758	Shift Solenoid "B" Electrical
P0759	Shift Solenoid "B" Intermittent
P0760	Shift Solenoid "C"
P0761	Shift Solenoid "C" Performance or Stuck Off
P0762	Shift Solenoid "C" Stuck On
P0763	Shift Solenoid "C" Electrical
P0764	Shift Solenoid "C" Intermittent
P0765	Shift Solenoid "C"
P0766	Shift Solenoid "D" Performance or Stuck Off
P0767	Shift Solenoid "D" Stuck On
P0768	Shift Solenoid "D" Electrical
P0769	Shift Solenoid "D" Intermittent
P0770	Shift Solenoid "E"
P0771	Shift Solenoid "E" Performance or Stuck Off
P0772	Shift Solenoid "E" Stuck On
P0773	Shift Solenoid "E" Electrical
P0774	Shift Solenoid "E" Intermittent

P0775	Pressure Control Solenoid "B"
P0776	Pressure Control Solenoid "B" Performance or Stuck Off
P0777	Pressure Control Solenoid "B" Stuck On
P0778	Pressure Control Solenoid "B" Electrical
P0779	Pressure Control Solenoid "B" Intermittent
P0780	Shift
P0781	1-2 Shift
P0782	2-3 Shift
P0783	3-4 Shift
P0784	4-5 Shift
P0785	Shift/Timing Solenoid
P0786	Shift/Timing Solenoid Range/Performance
P0787	Shift/Timing Solenoid Low
P0788	Shift/Timing Solenoid High
P0789	Shift/Timing Solenoid Intermittent
P0790	Normal/Performance Switch Circuit
P0791	Intermediate Shaft Speed Sensor Circuit
P0792	Intermediate Shaft Speed Sensor Circuit Range/Performance
P0793	Intermediate Shaft Speed Sensor Circuit No Signal
P0794	Intermediate Shaft Speed Sensor Circuit Intermittent
P0795	Pressure Control Solenoid "C"
P0796	Pressure Control Solenoid "C" Performance or Stuck off
P0797	Pressure Control Solenoid "C" Stuck On
P0798	Pressure Control Solenoid "C" Electrical
P0799	Pressure Control Solenoid "C" Intermittent

P08XX Transmission

P0801	Reverse Inhibit Control Circuit
P0803	1-4 Upshift (Skip Shift) Solenoid Control Circuit
P0804	1-4 Upshift (Skip Shift) Lamp Control Circuit
P0805	Clutch Position Sensor Circuit
P0806	Clutch Position Sensor Circuit Range/Performance
P0807	Clutch Position Sensor Circuit Low
P0808	Clutch Position Sensor Circuit High
P0809	Clutch Position Sensor Circuit Intermittent
P0810	Clutch Position Control Error
P0811	Excessive Clutch Slippage
P0812	Reverse Input Circuit
P0813	Reverse Output Circuit
P0814	Transmission Range Display Circuit
P0815	Upshift Switch Circuit
P0816	Downshift Switch Circuit
P0817	Starter Disable Circuit
P0818	Driveline Disconnect Switch Input Circuit
P0820	Gear Lever X-Y Position Sensor Circuit
P0821	Gear Lever X Position Circuit
P0822	Gear Lever Y Position Circuit
P0823	Gear Lever X Position Circuit Intermittent
P0824	Gear Lever Y Position Circuit Intermittent
P0825	Gear Lever Push-Pull Switch (Shift Anticipate)
P0830	Clutch Pedal Switch "A" Circuit
P0831	Clutch Pedal Switch "A" Circuit Low
P0832	Clutch Pedal Switch "A" Circuit High
P0833	Clutch Pedal Switch "B" Circuit
P0834	Clutch Pedal Switch "B" Circuit Low
P0835	Clutch Pedal Switch "B" Circuit High
P0836	Four Wheel Drive (4WD) Switch Circuit
P0837	Four Wheel Drive (4WD) Switch Circuit Range/Performance
P0838	Four Wheel Drive (4WD) Switch Circuit Low

P0839	Four Wheel Drive (4WD) Switch Circuit High
P0840	Transmission Fluid Pressure Sensor/Switch "A" Circuit
P0841	Transmission Fluid Pressure Sensor/Switch "A" Circuit Range/Performance
P0842	Transmission Fluid Pressure Sensor/Switch "A" Circuit Low
P0843	Transmission Fluid Pressure Sensor/Switch "A" Circuit High
P0844	Transmission Fluid Pressure Sensor/Switch "A" Circuit Intermittent
P0845	Transmission Fluid Pressure Sensor/Switch "B" Circuit
P0846	Transmission Fluid Pressure Sensor/Switch "B" Circuit Range/Performance
P0847	Transmission Fluid Pressure Sensor/Switch "B" Circuit Low
P0848	Transmission Fluid Pressure Sensor/Switch "B" Circuit High
P0849	Transmission Fluid Pressure Sensor/Switch "B" Circuit Intermittent

Additional Diagnostic Trouble Code Ranges

Other DTC ranges are defined for either manufacturer specific codes or under the control of SAE (Society of Automotive Engineers) and not yet defined. This section documents these additional ranges. Refer to your vehicle's repair manual for manufacturer specific Diagnostic Trouble Codes.

P09XX Transmission

P1XXX Manufacturer Controlled

P10XX Fuel and Air Metering and Auxiliary Emission Controls

P11XX Fuel and Air Metering

P12XX Fuel and Air Metering

P13XX Ignition System or Misfire

P14XX Auxiliary Emission Controls

P15XX Vehicle Speed, Idle Control, and Auxiliary Inputs

P16XX Computer and Auxiliary Outputs

P17XX Transmission

P18XX Transmission

P19XX Transmission

P2XXX SAE Controlled DTCs

P20XX Fuel and Air Metering and Auxiliary Emission Controls

P21XX Fuel and Air Metering and Auxiliary Emission Controls

P22XX Fuel and Air Metering and Auxiliary Emission Controls

P23XX Ignition System or Misfire

P24XX SAE Reserved

P25XX SAE Reserved

P26XX SAE Reserved

P27XX SAE Reserved

P28XX SAE Reserved

P29XX SAE Reserved

P3XX Manufacturer Controlled and SAE Reserved

P30XX Fuel and Air Metering and Auxiliary Emission Controls

P31XX Fuel and Air Metering and Auxiliary Emission Controls

P32XX Fuel and Air Metering and Auxiliary Emission Controls

P33XX Ignition System Misfire

P34XX SAE Reserved

P35XX SAE Reserved

P36XX SAE Reserved

P37XX SAE Reserved

P38XX SAE Reserved

P39XX SAE Reserved

APPENDIX B

Support

Technical support is offered on our products via email. Please note technical support cannot assist you in diagnosing and repairing your vehicle. Support is limited to operation of the scan tool only.

When contacting technical support please provide the following information:

- Year of Vehicle (e.g. 1997)
- Make (e.g. Chevrolet)
- Model (e.g. K1500 Pickup Extended Cab)
- Problem encountered, be specific as possible. List any error messages displayed by the software.
- Version of Auterra software located on the Help Options > About Dyno-Scan... menu.



Figure 42: About Auterra Dyno-Scan Dialog

Technical support is provided at: support@auterraweb.com.

Warranty Information

Auterra warrants the Dyno-Scan™ for Windows hardware for 1 year. Damage caused by misuse or modification is not covered.

Auterra is not responsible for damage to vehicle caused by misuse or otherwise. Auterra's sole liability is limited to the repair or replacement of the scan tool while under warranty.

When contacting Auterra for an RMA please provide the following information:

- Year of Vehicle (e.g. 1997)
- Make (e.g. Chevrolet)
- Model (e.g. K1500 Pickup Extended Cab)
- Problem encountered. Please be as specific as possible.

Contact Auterra technical support via email at: support@auterraweb.com.

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