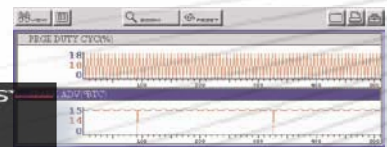


Y SELECTS, N EXITS GRAPHICS MODE.



SOLUS

- SCANNER
- SAVED DATA
- UTILITIES
 - Vehicle Comm
 - US Domestic
 - Asian
 - European
 - Global OBDII

05/05/2005

Press the Thumb Pad left and right arrows to access other toolbar functions.

1 ☐ 2 ☐ 3 ☐ 4 ☐

Global OBD Vehicle Communication Software Manual

February 2007



Trademark Acknowledgments

Snap-on is a registered trademarks of Snap-on Incorporated.

Scanner and MODIS are trademarks of Snap-on Incorporated.

All other marks are trademarks or registered trademarks of their respective holders.

Copyright 2007 Snap-on UK Holdings Ltd.

All Rights Reserved

DISCLAIMER OF WARRANTIES AND LIMITATIONS OF LIABILITIES

Whilst the authors have taken due care in the preparation of this manual, nothing contained herein:

- modifies or alters in any way the standard terms and conditions of the purchase, lease or rental agreement under the terms of which the equipment to which this manual relates was acquired,
- increases in any way the liability to the customer or to third parties.

TO THE READER

Whilst every effort has been made to ensure that the information contained in this manual is correct, complete and up-to date, the right to change any part of this document at any time without prior notice is reserved.

IMPORTANT:

Before installing, maintaining or operating this unit, please read this manual carefully, paying extra attention to the safety warnings and precautions.

Visit our Web site at www.snapondiag.com

For Technical Assistance Call: 1-800-670-3162

SNAP-ON INCORPORATED SOFTWARE LICENSE AGREEMENT

YOU SHOULD CAREFULLY READ THE FOLLOWING TERMS AND CONDITIONS BEFORE INSTALLING THIS SOFTWARE PACKAGE. WHOEVER INSTALLS THIS SOFTWARE PACKAGE MUST EITHER BE THE PERSON WHO ACQUIRED THE SOFTWARE OR A PERSON AUTHORIZED BY THE PERSON OR ENTITY WHO ACQUIRED THE SOFTWARE TO ACCEPT THE FOLLOWING TERMS ON SUCH PERSON'S OR ENTITY'S BEHALF. "YOU" AND "YOUR" SHALL REFER TO THE PERSON OR ENTITY WHO ACQUIRED THIS PRODUCT. INSTALLING THIS SOFTWARE PACKAGE INDICATES YOUR ACCEPTANCE OF THESE TERMS AND CONDITIONS. IF YOU DO NOT AGREE WITH THEM, YOU SHOULD PROMPTLY RETURN THE SOFTWARE PACKAGE, UNINSTALLED, TO THE PLACE OF PURCHASE.

LICENSE Upon your acceptance of this License Agreement (the "Agreement"), Snap-on Incorporated ("Snap-on") grants, subject to the terms and conditions of this Agreement, to the person or business entity who originally acquired the Software Products ("Software") a non-exclusive, non-transferable (except as permitted below), personal license to use the Software ("License"). The Software in this package is a proprietary product of Snap-on and is protected by copyright law, as well as other intellectual property laws. Snap-on retains title and ownership of the Software, and it is being licensed to you and not sold. All rights, not expressly granted to you, are reserved by Snap-on.

CONSENT Each time you use this Software, you consent to the collection, use, disclosure, and processing of Personal Information in accordance with the Privacy Policy attached as *Exhibit A*. In particular, if you are located in a jurisdiction outside the United States, you consent to the transfer of this information to our servers and computer systems in the United States, a country that may not provide an "adequate" level of data protection within the meaning of the laws in your country. You may withdraw your consent at any time, subject to any applicable legal or contractual restrictions and prior written notice to Snap-on. **If you wish to withdraw your consent, please contact Snap-on using our information below.**

You may contact us at:

Snap-on Incorporated
2801 80th Street
P.O. Box 1410
Kenosha, WI 53141-1410

PERMITTED USES YOU MAY: (i) install the Software on a single automotive diagnostic computer provided you keep the original solely for backup or archival purposes; (ii) transfer the Software and License to another party if the other party agrees to accept the terms and conditions of this Agreement, you retain no copies of the Software, and you transfer all of the Software to such other party.

PROHIBITED USES YOU MAY NOT: (i) copy the Software into any machine readable or printed form for backup or archival purposes; (ii) modify, merge, translate, decompile, reverse engineer, disassemble, decode, or otherwise alter or attempt to derive the source code of the Software; (iii) use the Software on more than one computer at the same time; (iv) separate the Software's component parts for use on more than one computer; (v) transfer, assign, rent, lease, sell, or otherwise dispose of the Software on temporary or permanent basis except as expressly provided herein; (vi) use the Software in any outsourcing, timesharing or service bureau arrangement; and/or (vii) provide, disclose, divulge or make available to, or permit use of the Software by any third party without Snap-on's prior written consent. You will not remove any proprietary notices from the Software and will include such notices on any authorized copies of the Software.

TERM The License is effective until terminated. You may terminate it at any time by destroying the Software. The License will also terminate automatically without notice from Snap-on if you fail to comply with any provision of this Agreement. You agree upon such termination to destroy the Software and upon Snap-on's request to certify in writing that you have so destroyed the Software.

LIMITED WARRANTY Snap-on warrants, for a period of sixty (60) days from the date of delivery to you as evidenced by a copy of your sales receipt, that the Software will perform substantially in accordance with the accompanying technical specifications in the documentation, under normal use. THIS LIMITED WARRANTY IS PROVIDED IN LIEU OF ANY OTHER EXPRESS WARRANTIES (IF ANY), ALL OF WHICH ARE DISCLAIMED BELOW. THIS LIMITED WARRANTY IS THE ONLY EXPRESS WARRANTY THAT IS PROVIDED TO YOU AND IS NOT TRANSFERABLE OR ASSIGNABLE.

WARRANTY DISCLAIMER EXCEPT AS SET FORTH IN THE ABOVE LIMITED WARRANTY AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, THE SOFTWARE IS PROVIDED "AS IS", WITH ALL FAULTS AND WITHOUT WARRANTY, EITHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, OF LACK OF

VIRUSES, AND OF LACK OF NEGLIGENCE OR LACK OF WORKMANLIKE EFFORT AND ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED.

SNAP-ON AND ITS AFFILIATED COMPANIES DO NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE OR WRITTEN MATERIALS IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY, CURRENTNESS, OR IN TERMS OF YOUR REQUIREMENTS. ALSO, THERE IS NO WARRANTY OF TITLE OR NONINFRINGEMENT IN THE SOFTWARE. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY SNAP-ON OR ITS AFFILIATED COMPANIES, OR THEIR RESPECTIVE AGENTS, DISTRIBUTORS, DEALERS AND EMPLOYEES, SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY, AND YOU MAY NOT RELY ON ANY SUCH INFORMATION OR ADVICE. SNAP-ON DOES NOT WARRANT THE OPERATION OF THE SOFTWARE TO BE UNINTERRUPTED OR ERROR-FREE, NOR DOES SNAP-ON MAKE ANY WARRANTY OR REPRESENTATION REGARDING THE USE OR OUTPUT OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, COMPLETENESS, TIMELINESS, SEQUENCE, RELIABILITY OR OTHERWISE OR THAT THE SOFTWARE WILL MEET YOUR REQUIREMENTS. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO THE ABOVE EXCLUSIONS MAY NOT APPLY TO YOU TO THE EXTENT SUCH EXCLUSION IS NOT ALLOWED BY APPLICABLE LAW. THE LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU ALSO MAY HAVE OTHER RIGHTS THAT VARY BY JURISDICTION.

YOUR EXCLUSIVE REMEDY If, during the sixty (60) day warranty period, the Software fails to comply with the limited warranty set forth above, provided you notify Snap-on within such sixty (60) day warranty period, Snap-on shall, at Snap-on's sole option, either: (i) the return the price paid (if any) for the Software; or (ii) repair or replace at no charge, the Software not meeting the Limited Warranty, and which is returned to Snap-on at your expense with a copy of the sales receipt. THE FOREGOING IS SNAP-ON'S ENTIRE LIABILITY AND YOUR SOLE AND EXCLUSIVE REMEDY RELATING TO BREACH OF THE LIMITED WARRANTY. If failure of the Software has resulted from accident, abuse, misuse or misapplication, Snap-on shall have no responsibility whatsoever. Any replacement Software will be warranted for the remainder of the original warranty period of sixty (60) days.

EXCLUSION OF CONSEQUENTIAL, INCIDENTAL AND CERTAIN OTHER DAMAGES TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, NEITHER SNAP-ON NOR ANY ONE ELSE WHO HAS BEEN INVOLVED IN THE CREATION, PRODUCTION, OR DELIVERY OF THE SOFTWARE, INCLUDING BUT NOT LIMITED TO SNAP-ON'S AFFILIATED COMPANIES, DISTRIBUTORS OR DEALERS SHALL BE LIABLE TO YOU FOR ANY INDIRECT, CONSEQUENTIAL, EXEMPLARY, SPECIAL, INCIDENTAL OR PUNITIVE DAMAGES WHATSOEVER (INCLUDING BUT NOT LIMITED TO DAMAGES FOR LOSS OF BUSINESS OR PERSONAL PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS OR PERSONAL OR CONFIDENTIAL INFORMATION, OR ANY OTHER PECUNIARY LOSS, DAMAGES FOR LOSS OF PRIVACY, OR FOR FAILURE TO MEET ANY DUTY, INCLUDING ANY DUTY OF GOOD FAITH OR TO EXERCISE COMMERCIALLY REASONABLE CARE OR FOR NEGLIGENCE) ARISING OUT OF OR IN ANY WAY RELATED TO THE USE OR INABILITY TO USE SUCH SOFTWARE, EVEN IF SNAP-ON HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. **IN NO EVENT WILL SNAP-ON'S OR ITS AFFILIATED COMPANIES' TOTAL LIABILITY FOR ANY AND ALL DAMAGES, LOSSES AND CAUSES OF ACTION, WHETHER IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, EXCEED THE AMOUNT PAID BY YOU FOR THE SOFTWARE.** SOME STATES/JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO CERTAIN OF THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

TAXES AND CHARGES You will be responsible for all applicable federal, state or local taxes, tariffs or duties, now or hereafter imposed except for those taxes related to the income of Snap-on.

EXPORT ADMINISTRATION COMPLIANCE This Agreement is made subject to any restrictions concerning the export of the Software from the United States of America or the country in which you are located. You will comply fully with all relevant export laws and regulations of the United States and any local country, and you will not export, directly or indirectly, the Software nor any other technical data received from Snap-on, nor any part thereof, in violation of such laws.

RESTRICTED RIGHTS The Software is provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by or on behalf of any unit or agency of the United States Government (the "Government") is subject to restrictions as set forth in subparagraph (c)(1) of the Rights in Technical Data and Computer Licensed Software clause at DFARS 252.227-7013 or subparagraphs (c)(1) and (2) of the Commercial Computer Licensed Software---Restricted Rights at 48 CFR 52.227-19, as applicable. Manufacturer is Snap-on Incorporated or one of its affiliates, 2801 80th Street, Kenosha, WI 53143.

GOVERNING LAW; EXCLUSIVE JURISDICTION This Agreement will be governed by the laws of the State of Wisconsin (excluding its choice of laws principles). **YOU CONSENT TO EXCLUSIVE JURISDICTION AND VENUE IN THE**

FEDERAL COURTS SITTING IN MILWAUKEE COUNTY, WISCONSIN, UNLESS NO FEDERAL JURISDICTION EXISTS, IN WHICH CASE YOU CONSENT TO EXCLUSIVE JURISDICTION AND VENUE IN ANY STATE COURT LOCATED IN MILWAUKEE COUNTY, WISCONSIN. YOU WAIVE ALL DEFENSES OF LACK OF PERSONAL JURISDICTION AND FORUM NON CONVENIENS. THE PARTIES HEREBY EXPRESSLY AGREE THAT THIS AGREEMENT SHALL NOT BE GOVERNED BY THE UNITED NATIONS CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

GENERAL You agree that this Agreement is the complete and exclusive statement of the Agreement between you and Snap-on which supersedes any proposal or prior agreement, oral or written, and any other communications between you and Snap-on relating to the subject of this Agreement. If for any reason a court of competent jurisdiction finds any provision of this Agreement to be unenforceable, that provision will be enforced to the maximum extent permissible so as to effect the intent of the parties, and the remainder of this Agreement will continue in full force and effect. Any failure by either party to require strict performance by the other of any provision of this Agreement will not constitute a waiver of such provision or thereafter affect the party's full rights to require strict performance. This Agreement may only be amended by specific written amendment signed by authorized representatives of both parties.

YOU ACKNOWLEDGE THAT YOU HAVE READ THIS AGREEMENT, UNDERSTAND IT AND AGREE TO BE BOUND BY ITS TERMS AND CONDITIONS.

EXHIBIT A: SNAP-ON INCORPORATED PRIVACY POLICY

The privacy of your personally identifiable information is important to us. As part of our commitment to the privacy of your personally identifiable information ("Personal Information") that we collect through the Software Product ("Software"), we provide this notice explaining our information practices and the choices you can make about the way your Personal Information is collected and used with the Software. To make this notice easy to find, we make it available with the Software. This revised Privacy Policy is effective as of January 1, 2006.

The privacy practices set forth in this Privacy Policy are for this Software only. Other Snap-on Incorporated ("Snap-on") affiliate Software may have different practices. If you use other Snap-on Software, please review the privacy policies, if any, provided with that Software. Also, if you are an employee of Snap-on or its affiliates, please note that other internal company policies apply to you related to employee use of company computer systems and networks.

CONSENT Please read this policy carefully. Your use of this Software constitutes your consent to the collection, use, disclosure and processing of Personal Information in the United States as described below.

FOREIGN VISITORS The Software maybe used by persons located in jurisdictions worldwide. Please review the Foreign Users Notices section near the end of this Privacy Policy, where we may provide additional notices regarding the collection, use, disclosure, and processing of your Personal Information in accordance with the laws in your country.

ACTIVE COLLECTION OF PERSONAL INFORMATION When you use the Software you provide Personal Information to register, order products or services, contact Snap-on, and conduct other transactions via the Software. The types of Personal Information actively collected in the Software may include any or all of the following, depending on your activities using the Software:

Date of sale, franchisee name, franchisee address, e-mail, invoice number, product number, quantity, device serial number, customer name, customer address, customer phone number, Snap-on customer number (if applicable), Software training requested and received, and other Personal Information that you actively provide to us via the Software.

PURPOSE FOR WHICH WE USE AND DISCLOSE PERSONAL INFORMATION We use and disclose Personal Information obtained when you purchase the product/software and agree to provide this information to the Snap-on Franchise.

We also use Personal Information to communicate with you, for example, to answer the e-mail and correspondence we receive, to confirm your order, to send more information about becoming a dealer, to send renewal notices, and to notify you of important changes in the functionality of the Software or other notices related to the handling of your Personal Information.

We may use Personal Information to make recommendations for additional products or special offers, and to provide you with updates on new products that we believe may be of interest to you, in situations where you expressly request such communications.

From time to time, we may share certain Personal Information with select third parties including other Snap-on affiliates and independent Snap-on dealers in your area to enable them to offer products or services that may be of interest to you. If you do not want us to share such Personal Information in the future, please contact us by using our information below and we will take reasonable measures to avoid sharing such information in the future. Please note that such third parties are usually independent from Snap-on, and if you wish to stop all communications from such parties, you will need to address such issues with the third parties directly.

We may disclose Personal Information in response to legal process or when we believe in good faith that the law requires it, for example, in response to a court order, subpoena or a law enforcement agency's request. We also reserve the right to disclose Personal Information to protect the security of the Software, to protect ourselves and our affiliated companies against liability, and/or in connection with any sale, assignment, or other transfer of all or a part of our business.

We may share Personal Information with our consultants or service providers to help us serve you better. We also contract other companies and individuals (collectively "Suppliers") to perform functions on our behalf, including without limitation, fulfilling and processing orders, handling shipping and returns, sending communications to you, and providing customer services. We require the Suppliers to agree to abide by Snap-on's privacy policy and only use your Personal Information, only until payment for your order is processed, and only to the extent necessary to perform their functions, and may not use it for any other purpose.

We will not use or share the Personal Information provided to us in the Software in ways unrelated to the ones described above without first providing you an opportunity to opt out or otherwise prohibit such unrelated uses.

CUSTOMIZATION AND AGGREGATE DATA We use non-identifying and aggregate information to better design our Software and gather information for product management and development at Snap-on. For example, we may tell our sales and marketing staff that X number of individuals using the Software, or that Y number of software licenses were ordered during a particular time period, but we would not disclose anything that could be used to identify those individuals. This aggregate information may also be shared with Snap-on's affiliates and independent dealers.

CHILDREN'S PRIVACY Snap-on has no intention of collecting personal information from children in this Software.

HOW YOU CAN ACCESS OR CORRECT YOUR INFORMATION If you are a registered user of the Software, you can access and correct certain Personal Data that we collect through the Software and maintain by using the contact information below. You may also contact us using the information below to ask us to remove your Personal Information from our records, electronic or otherwise. However, we will need to maintain certain Personal Information about your product purchases in our records for purposes such as warranty and product information. We will usually be glad to update your information, but we reserve the right to use Personal Information obtained previously to verify your identity, administer our warranty program, or to take other actions that we believe are appropriate.

COLLECTION OF PERSONAL INFORMATION BY THIRD PARTIES Sometimes we may offer promotions or specials that are sponsored by or co-sponsored with identified third parties. By virtue of their sponsorship, these third parties may obtain Personal Information that you submit to participate in the promotion or special. Snap-on has no control over the third-party sponsors' use of this information. We will notify you at the time of requesting Personal Information if third-party sponsors will obtain such information, and obtain your express consent for such disclosures.

CHANGES TO THE POLICY Our privacy practices are subject to change. We reserve the right to change this policy from time to time in our sole discretion. Please review this policy before you submit additional Personal Information via the Software. All revisions to this Privacy Policy will be communicated to you through updates to the License Agreement. Your continued use of the Software constitutes acceptance of such changes in the Privacy Policy, except where further steps are required by applicable law.

FOREIGN USERS NOTICES Please contact us at the address below to obtain Privacy Policy information for your country.

HOW TO CONTACT US Please feel free to contact us with any comments, questions, or suggestions you may have regarding the information practices described in this Privacy Policy. Please also contact us to report any known or suspected privacy or security breaches.

You may contact us at:

Snap-on Incorporated
2801 80th Street
P.O. Box 1410
Kenosha, WI 53141-1410

(Form 8-13963A03 Rev. A)



Safety Information

For your safety, read this manual thoroughly before operating your MODIS™ (Modular Diagnostic Information System) unit.

Your MODIS™ unit is intended for use by properly trained, skilled professional automotive technicians. The safety messages presented below and throughout this user's manual are reminders to the operator to exercise extreme care when using this test instrument.

There are many variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. Because of the vast number of test applications and variations in the products that can be tested with this instrument, we cannot possibly anticipate or provide advice or safety messages to cover every situation. It is the automotive technician's responsibility to be knowledgeable of the system being tested. It is essential to use proper service methods and test procedures and to perform tests in an appropriate and acceptable manner that does not endanger your safety, the safety of others in the work area, or vehicle or equipment being tested.

It is assumed the operator has a thorough understanding of vehicle systems before using the MODIS™ unit. Understanding these system principles and operating theories is necessary for competent, safe and accurate use of this instrument.

Before using the MODIS™ unit, always refer to and follow safety messages and applicable test procedures provided by the manufacturer of the vehicle or equipment being tested. Use equipment only as described in this manual.

Read, understand and follow all safety messages and instructions in this manual and on the test equipment. Safety messages in this section of the manual contain a signal word with a three-part message and an icon. The signal word indicates the level of the hazard in a situation.

Safety Message Conventions

Safety messages are provided to help prevent personal injury and equipment damage. All safety messages are introduced by a signal word indicating the hazard level.



DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury to the operator or to bystanders.



WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to the operator or to bystanders.



CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury to the operator or to bystanders.

Safety messages contain three different type styles.

- Normal type states the hazard.
- Bold type states how to avoid the hazard.
- Italic type states the possible consequences of not avoiding the hazard.

An icon, when present, gives a graphical description of the potential hazard.

Example:



Risk of unexpected vehicle movement.

- **Block drive wheels before performing a test with engine running.**

A moving vehicle can cause injury.

Important Safety Instructions

For a complete list of safety messages, refer to the *Diagnostic Safety Manual*.

SAVE THESE INSTRUCTIONS

Table of Contents

Safety Information.....	ix
Safety Message Conventions	ix
Important Safety Instructions	x
Table of Contents.....	1
Chapter 1: Introduction	3
Global OBD and What it Means	3
OBD-II Start-up Phase.....	3
EOBD Start-up Phase	4
OBD-II/EOBD Limitations.....	4
OBD-II/EOBD Advantages.....	4
Communication Protocols	4
What is CAN?	5
Diagnostic Services Introduction.....	5
Readiness Monitor Test Status	6
MIL Status	7
Diagnostic Service Definitions.....	8
Service \$01: Display Current Data	8
Service \$02: Power train Freeze Frame Data	8
Service \$03: Emission-related DTCs.....	9
Service \$04: Clear/Reset Emission-related Diagnostic Data	10
Service \$05: Oxygen Sensor Monitoring Test Results	11
Service \$06: Specific Monitored Systems	15
Service \$07: Emission-related DTCs detected during Current or Last Completed Drive Cycle (Pending Codes)	16
Service \$08: On-board Activation Tests	17
Service \$09: Vehicle Information.....	17
Service \$09: In-use Performance Tracking	18
Chapter 2: Operations	21
Overview	21
Connecting to the Vehicle	21
Main Menu	22
Select Communication Protocol	23
Start Communication	23
Select Service Menu	24
Readiness Test Status	24
MIL Status	24
Display Current Data (\$01).....	24
Display Freeze Frame Data (\$02)	24
Display Trouble Codes (\$03).....	25
Clear Emissions Related Data (\$04)	25
Display Test Parameters/Results (\$05 to \$07).....	25

Request Control of On-board System (\$08).....	26
Read Vehicle Identification (\$09)	26
In-use Performance Tracking (\$09)	26
Chapter 3: Data Parameters	27
Service \$01 and \$02.....	27
Long Parameter Names	27
Short Parameter Names	27
PID Definitions	27
Appendix A: Troubleshooting	39
Start-up Problems.....	39
Internal Battery Voltage Low	39
Communication Problems	39
Check scan tool operation	39
Testing the Diagnostic Connector — 16-pin DLC	40
Check the Malfunction Indicator Lamp	41
Glossary	43

1.1 Global OBD and What it Means

As a result of increasing emission levels around the world, many countries have enacted strict emission related regulations that will drive increased technology into the modern automobile in order to reduce the exhaust emissions. European and North American countries lead the way by adopting technology that will standardize the way these vehicles can be checked for compliance.

The OBD-I (On-Board Diagnostics I) system was introduced in the early 1980's and by 1988 all new cars and light trucks sold in California had to have OBD-I. The fundamental elements of the OBD-I are the electrical components (which influence exhaust emissions) that are monitored by the engine management system. An optical warning signal is given in the event of an OBD-I relevant failure. This fault can be read out by way of a flashing code.

OBD-II has been compulsory on all vehicles in the US market since January 1996. EOBD (European On-Board Diagnostics) is Europe's equivalent to OBD-II. It was introduced in 2000 and became effective in January 2001. There are a few differences between EOBD and OBD-II but none that will affect the generic scan tool operation. All the communication protocols for both programs are identical. Vehicle emission strategies and certification procedures vary between countries, states and regions. Always use the vehicle factory service information specific to the country and emission certification.

EURO-3 is a continuation of the emission regulations known as EURO-1 and EURO-2. In addition to introducing stricter emission limits, the directive now also covers the monitoring of emission related components and functions during operation, i.e. EOBD.

The OBD-II and EOBD system must show the failure of an emission related component or system to the driver using a MIL (Malfunction Indicator).

What does OBD-II and EOBD mean for the Repair Shop?

A universal or Generic OBD-II/EOBD scan tool can now be used on any OBD-II 1996 and newer and EOBD 2001 and newer vehicle, giving the shop more diagnostic coverage that was not previously possible.

1.1.1 OBD-II Start-up Phase

About 40 % of the vehicles of model year 1995 sold in the USA were OBD-II prepared. Beginning in 1996, all vehicles sold in the USA were supposed to comply with OBD-II standards.

However, some 1996 and 1997 vehicles were not fully OBD-II compliant. This means that some early OBD-II vehicles may:

- Not have the standardized diagnostic connector location or
- Have missing or only partially implemented OBD-II monitors.

1.1.2 EOBD Start-up Phase

The European vehicle manufacturers also needed time to phase in and develop EOBD tests and software in their electronic control modules (ECMs). Some of the manufacturers already had experience with the USA OBD-II. Others may still have to improve their most recent software versions. This means that EOBD is experiencing similar phase in problems as OBD-II, with some 2001 and 2002 vehicles having limited EOBD functionality.

1.2 OBD-II/EOBD Limitations

Generic OBD-II/EOBD data is currently limited to:

- Emission diagnostics or
- Problems related to the Malfunction Indicator.

Access to all available data in the ECM (other systems, other parameters, enhanced diagnostics) will still require a scan tool with manufacturer specific capabilities.

1.3 OBD-II/EOBD Advantages

The advantage of OBD-II and EOBD is the simple “Plug and Play” function:

- Unlike using a manufacturer specific scan tool or vehicle communication software, one does not have to select the vehicle make, year or model.
- The communication protocol can be automatically detected by the scan tool software.
- Depending on the ECM and amount of parameters selected, data update rates may vary. By using functions as CUSTOM DATA LIST and MANUAL SELECT PID in Service \$01, sometimes data update rates may be higher than with manufacturer specific software. This can be helpful in finding intermittent signal gulches.

Data and monitors that are not described in the OBD/EOBD standards are filtered out, although they are selectable.

1.4 Communication Protocols

A communication protocol is a standardized way of data communication between an ECM and a scan tool.

For vehicles that comply with OBD-II and EOBD, the following communication protocols are permitted:

- ISO 9141-2 (K-LINE)
- SAE J1850 PWM (Pulse Width Modulation)
- SAE J1850 VPW (Variable Pulse Width)
- ISO 14230-4 (Keyword Protocol 2000)
- SAE J2284/ISO 15765-4 (CAN)

The scan tool can be setup so it will automatically determine the communication protocol used in the vehicle under test:

- If none of the protocol tests succeeds, the scan tool will show a message with hints to solve the communication problem.
- The test can be redone or the user can choose to abandon the attempt.



NOTE:

The scan tool indicates the number of failed initialization attempts to the user.

1.4.1 What is CAN?

CAN stands for Controller Area Network and means that control units are networked and interchange data. Although some car manufacturers have used CAN for some years for communication between ECUs, it was not directly connected to the diagnostic connector. In approximately 2001/2002 for Europe and 2003 for North America, the first car manufacturers started to connect the CAN communication lines to the diagnostic connector. CAN will be the only required protocol in near future for (E)OBD.

1.5 Diagnostic Services Introduction

The OBD program is divided into several sub programs, called 'Service \$xx'. This complies to the EOBD/OBD-II standards:

Table 1-1 *Diagnostic services*

Service	Description
\$01	System readiness test status display
	MIL (malfunction indicator) Status & Control
	Request current power train diagnostic data
\$02	Request power train freeze frame data
\$03	Request emission-related DTCs (Diagnostic Trouble Codes)
\$04	Clear/reset emission-related diagnostic data
\$05	^a Oxygen sensor monitoring test results
\$06	Specific diagnostic monitored system test results
\$07	Emission related diagnostic trouble codes detected during current or last completed driving cycle (=Pending Codes)
\$08	^b Onboard system activation tests
\$09	Request vehicle information
\$09	In-use Performance Tracking

a. Manual selection of Test IDs is not supported.

b. Service \$08 is currently not supported.

1.5.1 Readiness Monitor Test Status

OBD-II/EOBD stipulates the monitoring (continuous or non-continuous) of the functions of the following emission control related subsystems):

Table 1-2 *Continuous or Non-continuous monitors*

Readiness Monitor	Remark
Misfire monitoring	Continuous
Fuel system monitoring	Continuous
Comprehensive component monitoring	Continuous
Catalyst monitoring	*
Heated catalyst monitoring	*
Evaporative system monitoring	*
Secondary air system monitoring	*
A/C system refrigerant monitoring	*
Oxygen sensor monitoring	*
Oxygen sensor heater monitoring	*
EGR system monitoring	*

* Will only be monitored if the correct conditions are met.



NOTE:

Not all data is applicable or supported by all vehicles.

Each vehicle manufacturer has unique monitor test criteria. The Readiness Test Status indicates whether a particular diagnostic monitor or function passed its specific test criteria and was found to be within specification.

Usually the monitors should run and set the Readiness Test Status during normal vehicle operation. The OBD-II Drive Cycle (see Figure 1-1: 'Typical OBD-II Drive Cycle') can be used to drive the vehicle in a prescribed manner.

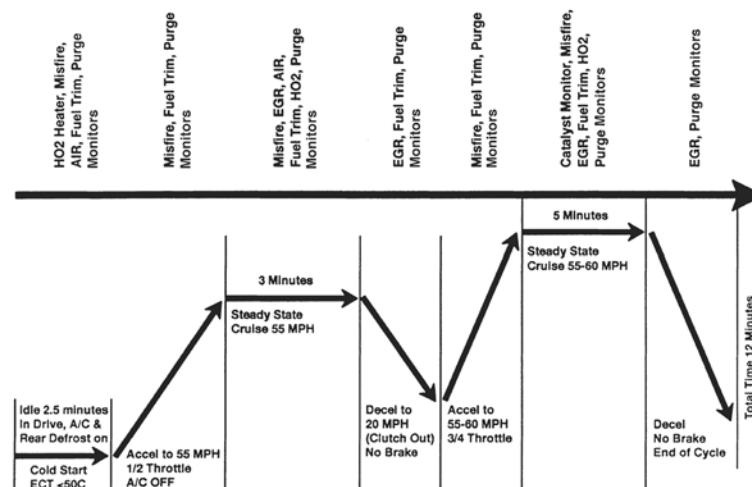


Figure 1-1 *Typical OBD-II Drive Cycle*

As this is a generic drive cycle, it may have limited results on some vehicles. If available, use the drive cycle information as supplied by the vehicle manufacturer.

System malfunctions that occur later and record a DTC (Diagnostic Trouble Code) will not change the Readiness Test Status. When the failure is repaired and the DTC is erased, all Readiness Test Status will be reset to a 'Not Completed' status.

Repair validation

Use the following procedure to validate a repair.

To validate the repair:

- Perform a drive cycle (generic or vehicle specific).
- Check Service \$07 (refer to 1.6.7: 'Service \$07: Emission-related DTCs detected during Current or Last Completed Drive Cycle (Pending Codes)' on page 16) and Service \$03 (refer to 1.6.3: 'Service \$03: Emission-related DTCs' on page 9).

If no DTCs are reported (that relate to the initial failure), it can be assumed that the fault has been repaired correctly.

1.5.2 MIL Status

Emission related malfunctions set failure specific DTC(s). The MIL (Malfunction Indicator Lamp) may light up as soon as the first emission related DTC has been stored and confirmed (stored a second time). Depending on the malfunction, it may take multiple drive cycles before the MIL turns on.

The MIL is located in the instrument panel. The MIL may display a symbol of an engine and should light up as soon as the ignition is switched on. Three different states are possible when the engine is running:

1. OFF: no emission limits exceeded.
2. ON: at least one OBD-II/EOBD emission limit exceeded.
3. Blinking: possibility of damage to the catalytic converter.

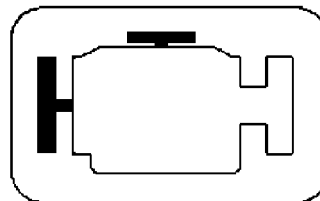


Figure 1-2 Example of Malfunction Indicator Lamp



NOTE:

MIL may also be called "Check Engine".

The ECM will transmit the status of the Malfunction Indicator including the identification of the ECM that commanded 'MIL ON'.

**NOTE:**

The MIL status will indicate "OFF" during the 'ignition key on, engine off' instrument panel bulb check unless the MIL has been commanded "ON" for a detected malfunction.

1.6 Diagnostic Service Definitions

1.6.1 Service \$01: Display Current Data

The ECMs will transmit the data value stored by the system. The data is commonly called PID (Parameter IDentification). All PIDs of sensors will show the actual readings. Not default or substitute values used by the system, because of a fault with that sensor.

Depending on the ECM and amount of parameters selected, data update rates may vary. Use CUSTOM DATA LIST to select the parameters to be displayed in Service \$01. The fewer data parameters were selected, the faster the update rate.

Only OBD/EOBD defined parameters will come up in the Current Data list. To view not supported parameters, select MANUAL SELECT PID (the last item of the CUSTOM DATA LIST).

1.6.2 Service \$02: Power train Freeze Frame Data

Engine conditions are stored by the ECM at the time a Monitor detects an emission-related fault. A 'Freeze Frame' is such a group of captured information.

Using Freeze Frame for diagnostic purposes.

Freeze Frame is useful for determining the exact operating conditions under which the DTC was stored. Please note:

- Freeze Frame is captured and stored when the DTC is stored, not when the problem began.
For example, misfire is evaluated every 1,000 revs. A misfire DTC may be stored 60-90 seconds after the misfire initially occurred, at substantially different rpm and load conditions.

The Technician can duplicate these conditions to verify the complaint or the repair. In some cases the on-board tests for a specific DTC may report no problem found. But when the conditions match the Freeze Frame conditions, that same DTC would set with the MIL on.

**NOTE:**

A Freeze Frame will be erased when codes are cleared.

Does a stored DTC change?

It can be overwritten by higher priority Emission DTCs. Misfire & Fuel System DTCs have the highest priority. A lower rated DTC may be overwritten by a higher priority DTC.

Only PIDs supported by the ECM will come up in the Freeze Frame data list.

1.6.3 Service \$03: Emission-related DTCs

The purpose of this service is to enable the scan tool to obtain stored DTCs from the power train ECMs that are emission-related.

The OBD-I ECM primarily identifies a faulty signal or a faulty sensor using three steps:

- Signal or component shorted to ground
- Signal or component shorted to battery positive
- No signal or component (open circuit)

For each of these tests, a specific trouble code is set.

With OBD-II/EOBD, expanded diagnostics now includes “rationality” testing. One input signal is compared against other input signals to determine if the reading is reasonable, given the current operating conditions.

Table 1-3 *Diagnostic Trouble Code description*

Position	Description
1	P = Power train
	C = Chassis
	B = Body
	U = Network
2	0 = Standardized emission-related trouble code
	1 = Manufacturer-specific trouble code
	2 = Standardized or Manufacturer-specific trouble code
	3 = Standardized or Manufacturer-specific trouble code
3	0 = Overall system
	1 = Secondary air system/Mixture preparation
	2 = Fuel system
	3 = Ignition system/Misfires
	4 = Additional exhaust gas monitoring
	5 = Cruise control/Idle speed control
	6 = Input/Output signals, Control units
	7 = Gearbox/Transmission
	8 = Transmission
	9 = Transmission
	A = Hybrid Propulsion
	B = Reserved
4 & 5	Serial numbering of individual components or systems

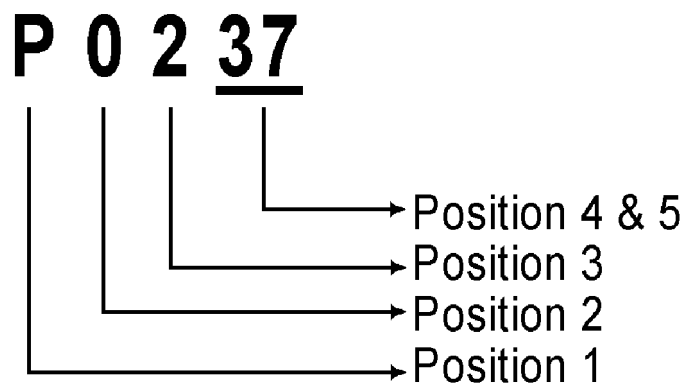


Figure 1-3 Example: DTC "P0237"

In this example, definitions listed for Position 3 are only valid for DTCs starting with "P". For other codes (C, B, U) there are other definitions. Please refer to ruling OBD standards for more information.

Code Ranking

OBD-II/EOBD Codes have a priority according to their emission severity, with higher priority codes overwriting lower priority codes. The priority of the code determines the illumination of the MIL and the code erase procedure.

Vehicle manufacturers have implemented the ranking differently.

1.6.4 Service \$04: Clear/Reset Emission-related Diagnostic Data



NOTE:

It is recommended to perform the clear code/reset function with the engine off and the ignition on.

The purpose of this service is to clear codes and turn off the MIL. It is recommended to print the DTCs before erasing them, for 'after repair comparison'.

Clearing the code memory will clear all diagnostic information stated in "Reset Information" below:

Table 1-4 Reset Information (part 1 of 2)

Service	Items to reset
\$01	Status of system monitoring tests
	Number of diagnostic trouble codes
	Distance travelled while MIL is activated
	Number of warm-ups since DTCs cleared
	Distance travelled since DTCs cleared
	Time run by the engine while MIL is activated
	Time since diagnostic trouble codes cleared

Table 1-4 *Reset Information (part 2 of 2)*

Service	Items to reset
\$02	Diagnostic trouble code for freeze frame data
	Freeze frame data
\$03	Confirmed diagnostic trouble codes
\$05	Oxygen sensor test data
\$06	Specific on-board monitoring test results
\$07	Pending diagnostic trouble codes

The following may occur as well:

- It may also erase engine management adaptive memory (some vehicle manufacturers only) when codes are cleared. Depending on the vehicle, adaptive memory may not correct itself without extensive driving.
- Other manufacturer specific “Clearing/Resetting” actions may also occur in response to this request message.
- Normally the MIL should automatically turn off after a successful repair, if emissions are normal. Refer to “: ‘Repair validation’ on page 7”.

NOTE:

For safety and/or technical design reasons, some ECUs may not respond to this service under all conditions.

NOTE:

In most cases, once a MIL is deactivated, the original code will remain in memory until forty to eighty warm-up cycles are completed without the fault reappearing.

1.6.5 Service \$05: Oxygen Sensor Monitoring Test Results

The purpose of this service is to allow access to the on-board oxygen sensor monitoring test results (if implemented).

NOTE:

For CAN vehicles, Service \$05 is not supported. Oxygen sensor test results are implemented in Service \$06. For non-CAN vehicles, manufacturers can use Service \$06 as an alternative to Service \$05.

Different manufacturers may use many methods to calculate test results for this service. The scan tool converts test values and displays them in the standard units of measurement.

The ECM will transmit the latest test results that were determined by the system. The latest test results are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test results. Test results are requested by Test ID. (See Test ID Table).

Test results can be reported either as a constant or as a calculated value, depending on the Test ID. Calculated values are reported with minimum and maximum limits.

**NOTE:**

Depending on the manufacturer, calculated values may be rounded off, which means that a test may fail despite the values reading within min. and max limits.

The scan tool checks if the readiness status of oxygen sensors is completed. If the test is not completed, the scan tool will display a warning.

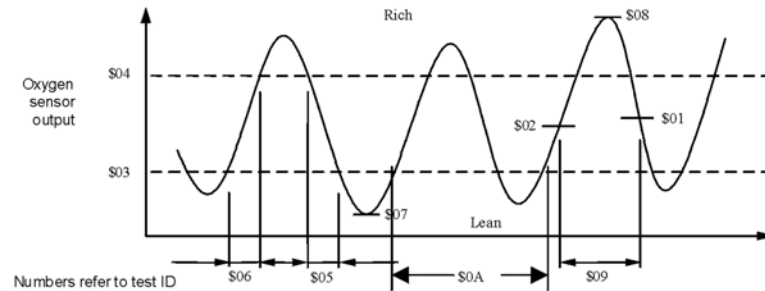


Figure 1-4 Test ID Values Example

**NOTE:**

Refer to Table 1-5: 'Test ID Table' for an explanation of the individual Test ID numbers.

Table 1-5 Test ID Table

Test ID No.	Description
\$01	Rich to Lean sensor threshold voltage (constant)
\$02	Lean to Rich sensor threshold voltage (constant)
\$03	Low sensor voltage for switch time calculation (constant)
\$04	High sensor voltage for switch time calculation (constant)
\$05	Rich to Lean sensor switch time (calculated)
\$06	Lean to Rich sensor switch time (calculated)
\$07	Minimum sensor voltage for test cycle (calculated)
\$08	Maximum sensor voltage for test cycle (calculated)
\$09	Time between sensor transitions (calculated)
\$0A	Sensor Period (calculated)
\$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles (calculated) Calculation: $0.1 * (\text{current counts}) + 0.9 * (\text{previous average})$ Initial value for (previous average) = 0
\$0C	Misfire counts for last/current driving cycles (calculated)

**NOTE:**

Not all test values are applied on or supported by all vehicles. Only supported Test ID's will come up in the selection list.

Cylinder Bank & O2S Locations, Examples

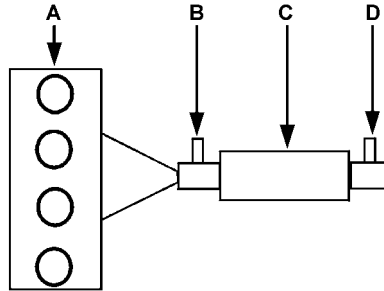


Figure 1-5 L4 Cylinder Engine with 1 exhaust bank and 1 Catalyst

A—A. Engine, exhaust bank

B—B. Sensor 1

C—C. Catalyst

D—D. Sensor 2, (heated)

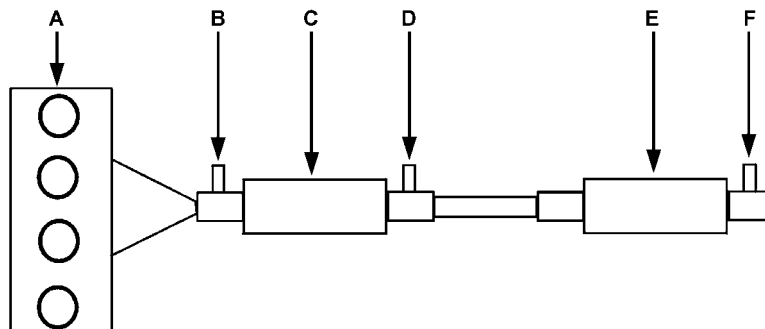


Figure 1-6 L4 Cylinder Engine with 1 exhaust bank and 2 Catalysts

A—A. Engine, exhaust bank

B—B. Sensor 1

C—C. Catalyst

D—D. Sensor 2, (heated), Bank 1

E—E. Catalyst

F—F. Sensor 3 (heated), Bank 1

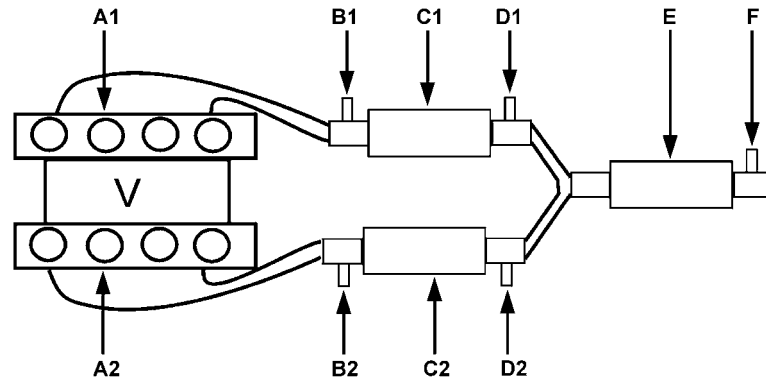


Figure 1-7 V8 Cylinder Engine with 2 exhaust banks and 3 Catalysts

- A—A. Exhaust Bank X
- B—B. Sensor 1, Bank X
- C—C. Catalyst
- D—D. Sensor 2, (heated), Bank X
- E—E. Catalyst
- F—F. Sensor 3 (heated), Bank X

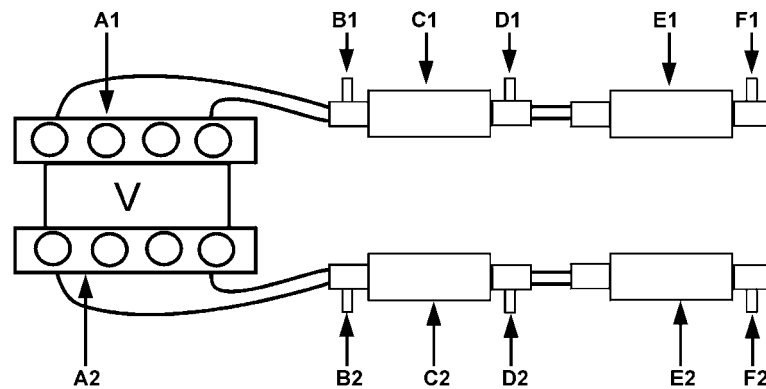


Figure 1-8 V8 Cylinder Engine with 2 exhaust banks and 4 Catalysts

- A—A. Exhaust Bank X
- B—B. Sensor 1, Bank X
- C—C. Catalyst
- D—D. Sensor 2, (heated), Bank X
- E—E. Catalyst
- F—F. Sensor 3 (heated), Bank X

1.6.6 Service \$06: Specific Monitored Systems

The purpose of this service is to allow access to the test results for on-board diagnostic monitoring tests of specific components or systems that are:

- Continuously monitored (CAN only)
- Not continuously monitored.

CAN Protocol

For CAN the Test ID Table from Service \$05 is used. The request message for test values includes an OBDMID (On-Board Diagnostic Monitor IDentification) that indicates the information requested. Unit information is given with the values. Test values (results) are always reported with the minimum and maximum test limits.



NOTE:

The Test ID Table below is for CAN Protocol ONLY:

Table 1-6 *Test ID Table for CAN Protocol*

Test ID No.	Description
\$01	Rich to Lean sensor threshold voltage, (Constant)
\$02	Lean to Rich sensor threshold voltage, (Constant)
\$03	Low sensor voltage for switch time calculation, (Constant)
\$04	High sensor voltage for switch time calculation, (Constant)
\$05	Rich to Lean sensor switch time, (Calculated)
\$06	Lean to Rich sensor switch time, (Calculated)
\$07	Minimum sensor voltage for test cycle, (Calculated)
\$08	Maximum sensor voltage for test cycle, (Calculated)
\$09	Time between sensor transitions, (Calculated)
\$0A	Sensor Period, (Calculated)
\$0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles (calculated) Calculation: $0.1 * (\text{current counts}) + 0.9 * (\text{previous average})$ Initial value for (previous average) = 0
\$0C	Misfire counts for last/current driving cycles (calculated)

If an OBDMID has not been completed at least once since Service \$04 or battery disconnect, then the following properties of the parameter are set to zero by the ECM:

- Test Value (Results)
- Minimum Test Limit
- Maximum Test Limit

Non CAN Protocol

The vehicle manufacturer is responsible for assigning Test IDs and Component IDs for tests of different systems and components. The latest test results are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test results. Test results are requested by Test ID. Test results are reported only for supported combinations of test limit type and component ID and are reported as positive (unassigned) values. Service \$06 test values and limits are un-scaled.

To date, only some manufacturers have provided conversion factors for technicians to utilize this data. See the example below for a US Ford version of Service \$06 Catalytic Converter test results.

Table 1-7 Service \$06 Catalytic Converter test results

Test ID	Comp ID	Test	Value	Min.	Max
\$10	\$11	Cat monitor Switch ratio Bank1	45	0	48
\$10	\$21	Cat monitor Switch ratio Bank2	42	0	48

Ford conversion factor: multiply the value by 0.0156 to get a value from 0 to 1.0.

Table 1-8 Calculated values

Item	Factor	Result
Bank 1	45 * 0.0156	0.702
Bank 2	42 * 0.0156	0.655
Threshold	48 * 0.0156	0.749

This catalyst is about to fail. Normal readings for a good catalyst should be approximately 0 to 0.1 (switch ratio).

Service \$06 Notes:

- If in Service \$01 (Readiness Test Status) one of the tests is not completed, a warning message will be displayed indicating that the values may be invalid or not available.
- Not all test values are applicable or supported by all vehicles. Only supported Test ID's will come up in the selection list. To be able to select none supported Test ID's, the last item of the selection list is MANUAL SELECTION OF TEST ID.
- This service can be used as an alternative to Service \$05 to report oxygen sensor test results. The values are not converted and are displayed in standard units.

1.6.7 Service \$07: Emission-related DTCs detected during Current or Last Completed Drive Cycle (Pending Codes)

The purpose of this service is to enable the scan tool to obtain "pending" or maturing diagnostic trouble codes detected during current or last completed driving cycle for emission-

related components or systems that are tested or continuously monitored during normal driving conditions.

Test results for these components or systems are reported in the same format as the DTCs in Service \$03; refer to 1.6.3: 'Service \$03: Emission-related DTCs' on page 9.

The intended use of this service is to assist the service technician after a vehicle repair and after clearing diagnostic information, by reporting test results after a single driving cycle.

- If a test failed during the driving cycle, the DTC associated with that test will be reported. If the pending fault does not occur again within 40 to 80 warm-up cycles, the fault is automatically cleared from memory.
- Test results reported by this service do not necessarily indicate a faulty component or system. If test results indicate a failure again after additional driving, then a DTC will be set. The DTC will be reported with Service \$03, indicating a faulty component or system. The MIL will be illuminated.

This service can always be used to request the results of the latest test, independent of the setting of a DTC.

1.6.8 Service \$08: On-board Activation Tests

The purpose of this service is to control the operation of vehicle components, tests or systems. These tests are also known as 'On-Board Activation Tests'. Service \$08 is not currently supported.

1.6.9 Service \$09: Vehicle Information

The purpose of this service is to enable the scan tool to request vehicle specific vehicle information such as:

- Vehicle Identification Number (VIN)
- Calibration ID's
- Calibration Verification Numbers (CVN, displayed as hexadecimal value)

Some of this information may be required by regulations and some may be desirable to be reported in a standard format, if supported by the vehicle manufacturer.

1.6.10 Service \$09: In-use Performance Tracking

This data is used to support possible regulatory requirements for “In-use Performance Tracking”. Manufacturers are required to implement software programs that track in-use performance for each of the following components or systems:

- Catalyst Bank 1
- Catalyst Bank 2
- Primary Oxygen Sensor Bank 1
- Primary Oxygen Sensor Bank 2
- Evaporative Leak Detection System
- EGR System
- Secondary Air System

The completion value tracks the number of times that all conditions necessary for a specific monitor to detect a malfunction have been encountered. The condition value indicates the number of times that the vehicle has been operated in the specified conditions.

OBD Monitoring Conditions

Displays the number of times that the vehicle has been operated in the specified OBD monitoring conditions.

Engine Starts

Displays the count of the number of times that the engine has been started.

Catalyst Monitor Completion Bank X

Displays the number of times that all conditions necessary to detect a Catalyst System Bank 1 or 2 malfunction have been encountered.

Catalyst Monitor Conditions Bank X

Displays the number of times that the vehicle has been operated in the specified Catalyst monitoring conditions.

O2 Sensor Monitor Completion Bank X

Displays the number of time that all conditions necessary to detect an Oxygen Sensor Bank 1 or 2 malfunction have been encountered.

O2 Sensor Monitor Conditions Bank X

Displays the number of times that the vehicle has been operated in the specified Oxygen Sensor monitoring conditions.

EGR Monitor Completion

Displays the number of time that all conditions necessary to detect an EGR system malfunction have been encountered.

EGR Monitor Conditions

Displays the number of times that the vehicle has been operated in the specified EGR system monitoring conditions.

Secondary Air Monitor Completion

Displays the number of time that all conditions necessary to detect a Secondary Air system malfunction have been encountered.

Secondary Air Monitor Conditions

Displays the number of times that the vehicle has been operated in the specified Secondary Air system monitoring conditions.

EVAP Monitor Completion

Displays the number of time that all conditions necessary to detect an EVAP system leak malfunction have been encountered.

EVAP Monitor Conditions

Displays the number of times that the vehicle has been operated in the specified EVAP system leak malfunction monitoring conditions.

2.1 Overview

A sequence of menu selections is used to access the OBDII/EOBD database. Menu selections vary slightly depending upon the make, year and model of the vehicle being tested.



To make a selection:

1. Select **OBDII/EOBD** from the vehicle make list.
2. Select the desired operating mode:
 - **OBD Diagnose**—accesses all OBD data, generic and enhanced.
 - **OBD II Generic**—accesses generic OBD data only.
 - **OBD Training Mode**—accesses simulated test data without connecting to an actual vehicle.
3. A communication menu displays once the database loads, select **Start Communication**.
A connection message that tells you which cable adapter to use and where the vehicle data link connector (DLC) is located displays.
4. Connect to the vehicle, then select **Continue**.
The ECM/Protocol Information screen, which shows the number of active vehicle electronic control modules (ECMs) and what communication protocol is being used, displays.
5. Select **Continue**.
The main menu displays, and you are ready to begin testing.

2.2 Connecting to the Vehicle

Connecting to the vehicle requires a data cable adapter, and a Personality™ Key for some models. Which adapter and key to use displays on the screen. Available adapter and key combinations are shown in Table 2-1.

Table 2-1 *Adapters part numbers*

Adapter	Region	Part Number
CAN-1	USA	MT2500-83A
CAN-1	EU	EAA0281E77C
CAN-1A	Australia	EAA0281E77D/(MT2500-83B)
CAN-1B	Universal	EAA0281E77E/(MT2500-83C)

Table 2-1 *Adapters part numbers*

Adapter	Region	Part Number
DL-16 with the S-7 key or the S-44 key	EU	MT2500-68 3655-01 EAP0234E50A
OBD-II with the K-2A or the K-20 key	USA	MT2500-46 5078-0202 EAP0234E45A

Most tests use the DLC, which is generally located under the dash on the driver's side of the vehicle. Use the following procedure to locate a difficult to find DLC.

**NOTE:**

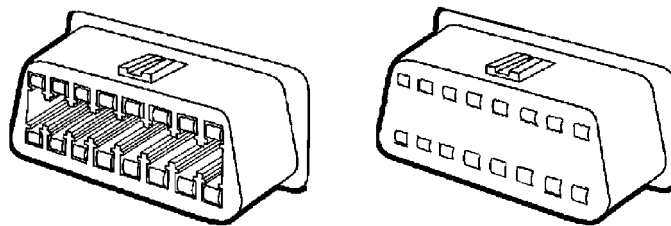
There maybe slight discrepancies in the connector location descriptions.

**To locate the DLC:**

1. Select Connector Information from the OBDII/EOBD menu to display the manufacturer list.
2. Select the vehicle manufactuter to open the model list.
3. Select the model from the list.
The DLC location for that specific model displays, connect the data cable and adapter.
4. Select **Continue**.
The main menu displays, and you are ready to begin testing.

IMPORTANT:

Do NOT connect the adapter to a 24 V version OBD socket. This might damage the unit.

**Figure 2-1** *OBD sockets: 12 V (left) and 24 V (right)*

2.3 Main Menu

The main menu offer the following choices:

- Start communication
- Select communication protocol
- Connector information

Connector information was described above, other selections are detailed in the following sections.

2.3.1 Select Communication Protocol

Making this selection displays the following options:

- All Protocols (auto detect, recommended)
- ISO 9141-2
- SAE J1850 PWM (pulse width modulation)
- SAE J1850 VPW (variable pulse width)
- ISO 14230-4 (keyword protocol 2000)
- SAE J2284/ISO 15765-4 (CAN)



NOTE:

All Protocols, which automatically detects which protocol the vehicle communicates with, is the default selection. Use this setting unless you want to limit your testing to a specific communication protocol.

Select from the menu to continue.

2.3.2 Start Communication

This selection opens the communication network between the vehicle and the scan tool. Make the selection and one of the following results:

- An error message displays if communication can not be established. The scan tool continuously tries to establish communication with the vehicle. See “Troubleshooting” on page 39 for more information.
- A connection message that shows the number of ECMs and the active protocol displays. Select continue.

Once communication is established, select **Continue** to open the Select Service Menu.

2.4 Select Service Menu

This menu list all of the tests available on the identified vehicle. Menu choices may include:

- Readiness Test Status
- MIL Status
- Display Current Data (\$01)
- Display Freeze Frame Data (\$02)
- Display Trouble Codes (\$03)
- Clear Emissions Related Data (\$4)
- Display Test Parameter/Results (\$05, 06, 07)
- Request Control of On-Board System (\$8)
- Read Vehicle Identification (\$09)

Each of these selections is discussed in the following sections.

2.4.1 Readiness Test Status

Use this menu item to check the readiness of the monitoring system, such as the transmission controller components and the engine components. If a monitor system is not supported, it will not be displayed.

Scroll to view the entire list of Readiness Monitors to ensure that all tests are complete. It is possible to print the Readiness Test Status.

2.4.2 MIL Status

This item is used to check the current condition of the Malfunction Indicator (MIL). Additional information, such as which ECM commanded the MIL on and also the distance travelled while the MIL is on (if supported), can also be displayed. It is also possible to print the MIL Status.

2.4.3 Display Current Data (\$01)

Use this item to display the current emission related data from the selected electronic control module (ECM) of the vehicle. Displayed data includes analogue inputs and outputs, digital inputs and outputs, and system status information broadcast on the vehicle data stream.

2.4.4 Display Freeze Frame Data (\$02)

This item is used to display freeze frame data for any stored emission related diagnostic trouble codes (DTC). In most cases the stored frame is the last DTC that occurred. Certain DTCs, those that have a greater impact on vehicle emission, have a higher priority. In these cases, the DTC with the highest priority is the one for which the freeze frame records are retained.

Freeze frame data includes a “snapshot” of critical parameter values at the time the DTC set.

2.4.5 Display Trouble Codes (\$03)

This is used to display any stored emission related DTCs reported by the various ECMs.

The P0XXX codes are Society of Automotive Engineers (SAE) controlled and they display along with a description. These codes are the same for all manufactures.

The P1XXX codes are manufacturer controlled, refer to manufacturer data for more information.

2.4.6 Clear Emissions Related Data (\$04)

This item is used to clear all emission related diagnostic data such as, DTCs, freeze frame data, and test results from the memory of the selected ECM.

2.4.7 Display Test Parameters/Results (\$05 to \$07)

This selection opens a submenu of test parameters and test results form various sensors, such as the oxygen sensor (O2S), monitor test results, and a record of DTCs detected during the last drive cycle. The menu includes:

- Oxygen Sensor Monitoring (\$05)
- Specific Monitored Systems (\$06)
- DTCs Detected During Last Drive (\$07)

Each selection is described below.

Oxygen Sensor Monitoring (\$05)

This selection opens a menu with these choices:

- Rich to lean sensor threshold voltage
- Rich to lean sensor switch time
- Minium sensor voltage for test cycle
- Sensor period

Making a selection displays and all of the pertinent O2S parameters for the specific test. The test identification (ID) displays at the top of the data list.

Specific Monitored Systems (\$06)

This selection opens a menu of available tests on monitored systems. These are data stream items, often a group of parameters, that the ECM evaluates to determine operational status and efficiency. There are two types of monitored systems:

- Continuously monitored systems—those that impact vehicle emissions, and are required to be monitored by OBD regulations.
- Non-continuously monitored systems—those that do not directly impact vehicle emissions, and are required to be monitored by OBD regulations.

Making a selection activates the test.

DTCs Detected During Last Drive (\$07)

This selection opens a record of any DTCs that set during the last completed drive cycle. Select to open the DTC list.

2.4.8 Request Control of On-board System (\$08)

This service enables bidirectional control of the ECM, that is the scan tool transmits control commands to operate the vehicle system. This function is useful in determining how well the ECM responds to a command.

Making this selection opens a menu of test choices available on the identified vehicle. Options vary by make, model, and year of the test vehicle. Select a test and follow the on-screen instructions.

2.4.9 Read Vehicle Identification (\$09)

This selection displays the vehicle identification number (VIN), the calibration identification, and the calibration verification number (CVN) of the test vehicle.

2.4.10 In-use Performance Tracking (\$09)

This selection displays the “In-use Performance Tracking” of monitored data. It is basically a record of the number of times each of the monitor tests have been completed.

3.1 Service \$01 and \$02

These services involve evaluating the vehicle data stream parameter, or PID, values. This section provides PID definitions for the values that display on the scan tool, along with diagnostic tips.

3.1.1 Long Parameter Names

Table 3-1, “Long Parameter Names” on page 27, explains the OBD data parameters as displayed by the scan tool. The vehicle ECM determines the parameter data list.

3.1.2 Short Parameter Names

As there is less display space available on a scan tool in graphing mode, short parameter names display. Refer to Table 3-2, “Short Parameter Names” on page 31.

3.1.3 PID Definitions

All PIDs can be found in Table 3-3, “PID Definitions” on page 35.

Counters (like bank or sensor position numbers) in a parameter name are represented by an ‘y’ or ‘x’ in the table.

Table 3-1 *Long Parameter Names (part 1 of 5)*

Parameter	Description for long parameter
ABSOLUTE LOAD VALUE	Value is presented as a percentage and ranges from 0 to 100 for naturally aspirated engines, and from 0 to 400 for boosted engines. On boosted engines the actual figure displayed is very much depending on how much boost is used. The higher the boost used, the higher Absolute Load Value will be.
ABSOLUTE THROTTLE POSITION -B/C	Shows the absolute throttle position. The output signal is a proportional percentage to the input voltage (when proportional) or 100% minus the proportional percentage (when inversely proportional). See PID \$45 for the relative position.

Table 3-1 Long Parameter Names (part 2 of 5)

Parameter	Description for long parameter
ACCELERATOR PEDAL POSITION x	Shows the absolute pedal position. The output signal is a proportional percentage to the input voltage (when proportional) or 100% minus the proportional percentage (when inversely proportional).
AIR FLOW RATE	Shows the air flow rate as measured by the Mass Air Flow (MAF) sensor.
AMBIENT AIR TEMPERATURE	Can be obtained from an AAT sensor directly or deduced by the ECM from other sensor signals.
BAROMETRIC PRESSURE	Can be obtained from a BARO or MAP sensor directly or deduced by the ECM from other sensor (MAF) signals. If the value at 'ignition key on' and certain driving conditions is stored into a memory, clearing the memory may lead to inaccurate BARO values.
CALCULATED LOAD VALUE	The ECM calculates the engine load by dividing the actual manifold airflow volume (Otto engines) or actual fuel flow (Diesel engines) by the maximum possible volume with a factor for pressure and temperature compensation. Correlates with the engine vacuum. Value is presented as a percentage and ranges from 0 to 100.
CATALYST TEMPERATURE Bx-Sy	Shows the catalyst substrate temperature for the mentioned bank or the temperature of the mentioned bank and oxygen sensor. Can be obtained from a sensor directly or deduced by the ECM from other sensor signals.
COMMANDED EGR	Shows the status of the Exhaust Gas Recirculation system between 0% (no flow) and 100% (max. flow, max. duty cycle)
COMMANDED EQUIVALENCE RATIO	Shows the Air/Fuel ratio as commanded by the ECM. To obtain the actual Air/Fuel ratio, multiply the stoichiometric Air/Fuel ratio by the equivalence ratio. Conventional oxygen sensors shows the ration when in Open Loop only. In Closed Loop '1.0' is shown. Wide range or linear oxygen sensors show the ratio in Open Loop and Closed Loop.
COMMANDED EVAPORATIVE PURGE	Shows the status of the Evaporative Purge Control Valve between 0% (no flow) and 100 % (max. flow, max. duty cycle)
COMMANDED SEC. AIR STATUS	Shows the position of the Secondary Air system (upstream or downstream of the first catalytic converter) and/or its status.
COMMANDED THROTTLE ACT.CONTROL	Shows the status of the Throttle Actuator Control between 0% (closed throttle) and 100% (wide open throttle)
CONTROL MODULE VOLTAGE	Shows the power input to the ECM. This is not automatically equal to the battery voltage!

Table 3-1 Long Parameter Names (part 3 of 5)

Parameter	Description for long parameter
DISTANCE SINCE DTCs CLEARED	Accumulated distance since the DTCs were cleared. The maximum number is 65535. To set to 0, reset all DTCs
DISTANCE WHILE MIL ACTIVE	Conditions for this counter: 1. Resets to zero when MIL state changes from 'deactivated' to 'activated' by the ECM. 2. Accumulates counts in km if MIL is activated (ON) 3. Does not change value while MIL is not activated (OFF) 4. Resets to zero if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated 5. Does not wrap to zero if value is maximum (65535).
EGR ERROR	The Exhaust Gas Recirculation system control and feedback devices differ, therefore no 'actual' or 'commanded' status can be shown. The value is (actual EGR - commanded EGR), commanded EGR. E.g. (5%-10%)/10%=-50%
ENGINE COOLANT TEMPERATURE	Shows the temperature as measured by the engine coolant temperature sensor or cylinder head temperature sensor. If these sensors are not available, the engine oil temperature can be shown.
ENGINE RUN WITH MIL ACTIVE	Conditions for this counter: 1. Resets to zero when MIL state changes from deactivated to activated by this ECM. 2. Accumulates counts in minutes if MIL is activated (ON) 3. Does not change value while MIL is not activated (OFF) 4. Resets to zero if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated 5. Does not wrap to zero if value is maximum (65535).
ENGINE SPEED	Engine speed as calculated by the ECM, based on various signals.
EQUIVALENCE RATIO Bx-Sy	Status of the oxygen sensor in V or as a ratio. Designed for linear or wide-ratio oxygen sensors. See also PID \$14 and up or \$34 and up.
EVAP SYSTEM VAPOR PRESSURE	Evaporative system vapour pressure, if utilised by the control module. Can be obtained from a fuel pressure sensor in the tank or in the evaporative system vapour line.
FUEL LEVEL INPUT	Shows the nominal fuel tank liquid fill capacity. For gaseous fuels the percentage of useable fuel capacity is shown. Can be obtained from a sensor directly or deducted by the ECM from other sensor signals.
FUEL PRESSURE GAUGE	Shows the fuel rail pressure at the engine relative to the atmosphere (gauge pressure).

Table 3-1 Long Parameter Names (part 4 of 5)

Parameter	Description for long parameter
FUEL SYSTEM x	Fuel System 'x' does not normally refer to injector banks. It is intended to represent different fuel systems (for multi-fuel vehicles) that can independently enter and exit 'Closed Loop'. 'Closed Loop' means the fuel control system uses the oxygen sensor signal. Banks of injectors on a V engine are generally not independent and use the same closed loop criteria.
IGNITION TIMING ADVANCE	Ignition timing spark advance for cylinder #1. If timing is retarded, the value will be negative.
INTAKE AIR TEMPERATURE	Shows the intake manifold air temperature as obtained from a sensor or as calculated by the ECM (using other inputs).
INTAKE MAP	Shows the absolute pressure in the intake manifold as measured by the MAP sensor.
LONG TERM FUEL TRIM BANK x	Shows the correction used by the Closed Loop and Open Loop fuel algorithm at the moment this parameter is requested. Negative values indicate a 'lean' condition, positive values a 'rich' condition. 0% correction will be shown if no correction is used in Open Loop.
NR OF WARM-UPS SINCE DTCs CLEARED	A warm-up cycle is valid if the coolant temperature rises, after starting the engine, at least 22 °C/40 °F and reaches at least 70 °C/160 °F (60 °C/140 °F for Diesel engines). The maximum number is 255. To set to 0, reset all DTCs.
O2S BANK x - SENSOR y	Shows the presence of oxygen sensor number 'y' per bank 'x' (group of cylinders). Sensor 1 is closest to the engine
O2S CURRENT BANK x - SENSOR y	Status of the oxygen sensor in mA or as a ratio. Designed for linear or wide-ratio oxygen sensors. See also PID \$14 and up or \$24 and up.
O2S VOLTAGE BANK x - SENSOR y	Shows the status of the oxygen sensor in V or percentages. Designed for conventional 0 - 1 V oxygen sensors. Sensors with a different full scale will be adapted. Negative percentages or 0 V indicate a 'lean' condition. Positive percentages or 1 V indicate a 'rich' condition. See also PID \$24 and up or \$34 and up.
OBD REQUIREMENTS	Shows the OBD requirements that the vehicle was designed for
POWER TAKE OFF (PTO) STATUS	Shows Power Take Off (PTO) status.
RELATIVE FUEL PRESSURE	Shows the fuel rail pressure at the engine relative to the manifold vacuum.
RELATIVE THROTTLE POSITION	Shows the 'learned' throttle position. Due to the 'closed throttle offset', Wide Open Throttle will be much less than 100%. See PID \$11, \$47 and \$48 for the absolute position.

Table 3-1 Long Parameter Names (part 5 of 5)

Parameter	Description for long parameter
SHORT TERM FUEL TRIM BANK x	Shows the correction used by the Closed Loop fuel algorithm. Negative values indicate a 'lean' condition, positive values a 'rich' condition. 0% correction will be shown if the fuel system is in Open Loop.
SHORT TERM FUEL TRIM Bx-Sy	Shows the status of the oxygen sensor in V or percentages. Designed for conventional 0 - 1 V oxygen sensors. Sensors with a different full scale will be adapted. Negative percentages or 0 V indicate a 'lean' condition. Positive percentages or 1 V indicate a 'rich' condition. See also PID \$24 and up or \$34 and up.
TIME SINCE DTCs CLEARED	Accumulated time since the DTCs were cleared. The maximum number is 65535. To set to 0, reset all DTCs
TIME SINCE ENGINE START	The incrementing counter starts when the engine runs. It freezes if the engine stalls. It resets if the ECM powers up and when the ignition key enters the 'key-on, engine off' position.
VEHICLE SPEED	Shows the vehicle speed as obtained from a sensor or as calculated by the ECM (using other inputs).

Counters (like bank or sensor position numbers) in a parameter name are represented by an 'y' or 'x' in the table.

Table 3-2 Short Parameter Names (part 1 of 5)

Parameter	Description for short parameter
AAT	Can be obtained from an AAT sensor directly or deducted by the ECM from other sensor signals.
AIR_STAT	Shows the position of the Secondary Air system (upstream or downstream of the first catalytic converter) and/or its status.
APP_x	Shows the absolute pedal position. The output signal is a proportional percentage to the input voltage (when proportional) or 100% minus the proportional percentage (when inversely proportional).
BARO	Can be obtained from a BARO or MAP sensor directly or deducted by the ECM from other sensor (MAF) signals. If the value at 'ignition key on' and certain driving conditions is stored into a memory, clearing the memory may lead to inaccurate BARO values.
CATEMPxy	Shows the catalyst substrate temperature for the mentioned bank or the temperature of the mentioned bank and oxygen sensor. Can be obtained from a sensor directly or deducted by the ECM from other sensor signals.

Table 3-2 Short Parameter Names (part 2 of 5)

Parameter	Description for short parameter
CLR_DIST	Accumulated distance since the DTCs were cleared. The maximum number is 65535. To set to 0, reset all DTCs
CLR_TIME	Accumulated time since the DTCs were cleared. The maximum number is 65535. To set to 0, reset all DTCs
ECT	Shows the temperature as measured by the engine coolant temperature sensor or cylinder head temperature sensor. If these sensors are not available, the engine oil temperature can be shown.
ECT_ERR	The Exhaust Gas Recirculation system control and feedback devices differ, therefore no 'actual' or 'commanded' status can be shown. The value is (actual EGR - commanded EGR), commanded EGR. E.g. (5%-10%)/10%=-50%
ECT_PCT	Shows the status of the Exhaust Gas Recirculation system between 0% (no flow) and 100 % (max. flow, max. duty cycle)
EQ_RAT	Shows the Air/Fuel ratio as commanded by the ECM. To obtain the actual Air/Fuel ratio, multiply the stoichiometric Air/Fuel ratio by the equivalence ratio. Conventional oxygen sensors shows the ration when in Open Loop only. In Closed Loop '1.0' is shown. Wide range or linear oxygen sensors show the ratio in Open Loop and Closed Loop.
EQ_RATxy	Status of the oxygen sensor in V or as a ratio. Designed for linear or wide-ratio oxygen sensors. See also PID \$14 and up or \$34 and up.
EVAP_PCT	Shows the status of the Evaporative Purge Control Valve between 0% (no flow) and 100% (max. flow, max. duty cycle)
EVAP_VP	Evaporative system vapour pressure, if utilised by the control module. Can be obtained from a fuel pressure sensor in the tank or in the evaporative system vapour line.
FLI	Shows the nominal fuel tank liquid fill capacity. For gaseous fuels the percentage of useable fuel capacity is shown. Can be obtained from a sensor directly or deducted by the ECM from other sensor signals.
FRP	Shows the fuel rail pressure at the engine relative to the atmosphere (gauge pressure).
FRP_REL	Shows the fuel rail pressure at the engine relative to the manifold vacuum.

Table 3-2 Short Parameter Names (part 3 of 5)

Parameter	Description for short parameter
FUELSYSx	Fuel System 'x' does not normally refer to injector banks. It is intended to represent different fuel systems (for multi-fuel vehicles) that can independently enter and exit 'Closed Loop'. 'Closed Loop' means the fuel control system uses the oxygen sensor signal. Banks of injectors on a V-engine are generally not independent and use the same closed loop criteria.
IAT	Shows the intake manifold air temperature as obtained from a sensor or as calculated by the ECM (using other inputs).
LOAD_ABS	Value is presented as a percentage and ranges from 0 to 100 for naturally aspirated engines, and from 0 to 400 for boosted engines. On boosted engines the actual figure displayed is very much depending on how much boost is used. The higher the boost used, the higher Absolute Load Value will be.
LOAD_PCT	The ECM calculates the engine load by dividing the actual manifold airflow volume (Otto engines) or actual fuel flow (Diesel engines) by the maximum possible volume with a factor for pressure and temperature compensation. Correlates with the engine vacuum. Value is presented as a percentage and ranges from 0 to 100.
LONGFTx	Shows the correction used by the Closed Loop and Open Loop fuel algorithm at the moment this parameter is requested. Negative values indicate a 'lean' condition, positive values a 'rich' condition. 0% correction will be shown if no correction is used in Open Loop.
MAF	Shows the air flow rate as measured by the Mass Air Flow (MAF) sensor.
MAP	Shows the absolute pressure in the intake manifold as measured by the MAP sensor.
MIL_DIST	Conditions for this counter: 1. Resets to zero when MIL state changes from 'deactivated' to 'activated' by the ECM. 2. Accumulates counts in km if MIL is activated (ON) 3. Does not change value while MIL is not activated (OFF) 4. Resets to zero if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated 5. Does not wrap to zero if value is maximum (65535).

Table 3-2 Short Parameter Names (part 4 of 5)

Parameter	Description for short parameter
MIL_TIME	Conditions for this counter: 1. Resets to zero when MIL state changes from deactivated to activated by this ECM. 2. Accumulates counts in minutes if MIL is activated (ON) 3. Does not change value while MIL is not activated (OFF) 4. Resets to zero if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated 5. Does not wrap to zero if value is maximum (65535).
O2SLOCxy	Shows the presence of oxygen sensor number 'y' per bank 'x' (group of cylinders). Sensor 1 is closest to the engine
O2Sxy	Shows the status of the oxygen sensor in V or percentages. Designed for conventional 0 - 1 V oxygen sensors. Sensors with a different full scale will be adapted. Negative percentages or 0 V indicate a 'lean' condition. Positive percentages or 1 V indicate a 'rich' condition. See also PID \$24 and up or \$34 and up.
O2Sxy	Status of the oxygen sensor in mA or as a ratio. Designed for linear or wide-ratio oxygen sensors. See also PID \$14 and up or \$24 and up.
OBDSUP	Shows the OBD requirements that the vehicle was designed for.
PTO_STAT	Shows Power Take Off (PTO) status.
RPM	Engine speed as calculated by the ECM, based on various signals.
RUNTM	The incrementing counter starts when the engine runs. It freezes if the engine stalls. It resets if the ECM powers up and when the ignition key enters the 'key-on, engine off' position.
SHRTFTx	Shows the correction used by the Closed Loop fuel algorithm. Negative values indicate a 'lean' condition, positive values a 'rich' condition. 0% correction will be shown if the fuel system is in Open Loop.
SHRTFTxy	Shows the status of the oxygen sensor in V or percentages. Designed for conventional 0 - 1 V oxygen sensors. Sensors with a different full scale will be adapted. Negative percentages or 0 V indicate a 'lean' condition. Positive percentages or 1 V indicate a 'rich' condition. See also PID \$24 and up or \$34 and up.
SPARKADV	Ignition timing spark advance for cylinder #1. If timing is retarded, the value will be negative.
TAC_PCT	Shows the status of the Throttle Actuator Control between 0% (closed throttle) and 100% (wide open throttle)

Table 3-2 Short Parameter Names (part 5 of 5)

Parameter	Description for short parameter
TP/TP_B/TP_C	Shows the absolute throttle position. The output signal is a proportional percentage to the input voltage (when proportional) or 100% minus the proportional percentage (when inversely proportional). See PID \$45 for the relative position.
TP_R	Shows the 'learned' throttle position. Due to the 'closed throttle offset', Wide Open Throttle will be much less than 100%. See PID \$11, \$47 and \$48 for the absolute position.
VPWR	Shows the power input to the ECM. This is not automatically equal to the battery voltage!
VSS	Shows the vehicle speed as obtained from a sensor or as calculated by the ECM (using other inputs).
WARM_UPS	A warm-up cycle is valid if the coolant temperature rises, after starting the engine, at least 22 °C/40 °F and reaches at least 70 °C/160 °F (60 °C/140 °F Diesel). The maximum number is 255. To set to 0, reset all DTCs.

**NOTE:**

The PID is the last three characters of the DTC

Table 3-3 PID Definitions (part 1 of 4)

PID	Name, short	Parameter Name, long
\$03	FUELSYS1	FUEL SYSTEM 1
\$03	FUELSYS2	FUEL SYSTEM 2
\$04	LOAD_PCT(%)	CALCULATED LOAD VALUE(%)
\$05	ECT(°C)	ENGINE COOLANT TEMPERATURE(°C)
\$06	SHRTFT1(%)	SHORT TERM FUEL TRIM BANK 1(%)
\$07	LONGFT1(%)	LONG TERM FUEL TRIM BANK 1(%)
\$08	SHRTFT2(%)	SHORT TERM FUEL TRIM BANK 2(%)
\$09	LONGFT2(%)	LONG TERM FUEL TRIM BANK 2(%)
\$0A	FRP(kPa)	FUEL PRESSURE GAUGE(kPa)
\$0B	MAP(kPa)	INTAKE MAP(kPa)
\$0C	RPM(1/min.)	ENGINE SPEED(1/min.)
\$0D	VSS(km/h)	VEHICLE SPEED(km/h)
\$0E	SPARKADV(°)	IGNITION TIMING ADVANCE(°)
\$0F	IAT(°C)	INTAKE AIR TEMPERATURE(°C)
\$10	MAF(g/s)	AIR FLOW RATE(g/s)
\$11	TP(%)	ABSOLUTE THROTTLE POSITION(%)
\$12	AIR_STAT	COMMANDED SEC. AIR STATUS
\$13	O2SLOC11	O2S BANK 1 - SENSOR 1

Table 3-3 PID Definitions (part 2 of 4)

PID	Name, short	Parameter Name, long
\$13	O2SLOC12	O2S BANK 1 - SENSOR 2
\$13	O2SLOC13	O2S BANK 1 - SENSOR 3
\$13	O2SLOC14	O2S BANK 1 - SENSOR 4
\$13	O2SLOC21	O2S BANK 2 - SENSOR 1
\$13	O2SLOC22	O2S BANK 2 - SENSOR 2
\$13	O2SLOC23	O2S BANK 2 - SENSOR 3
\$13	O2SLOC24	O2S BANK 2 - SENSOR 4
\$14	O2S11(V)	O2S VOLTAGE BANK 1 - SENSOR 1(V)
\$14	SHRTFT11(%)	SHORT TERM FUEL TRIM B1-S1(%)
\$15	O2S12(V)	O2S VOLTAGE BANK 1 - SENSOR 2(V)
\$15	SHRTFT12(%)	SHORT TERM FUEL TRIM B1-S2(%)
\$16	O2S13(V)	O2S VOLTAGE BANK 1 - SENSOR 3(V)
\$16	SHRTFT13(%)	SHORT TERM FUEL TRIM B1-S3(%)
\$17	O2S14(V)	O2S VOLTAGE BANK 1 - SENSOR 4(V)
\$17	SHRTFT14(%)	SHORT TERM FUEL TRIM B1-S4(%)
\$18	O2S21(V)	O2S VOLTAGE BANK 2 - SENSOR 1(V)
\$18	O2S31(V)	O2S VOLTAGE BANK 3 - SENSOR 1(V)
\$18	SHRTFT21(%)	SHORT TERM FUEL TRIM B2-S1(%)
\$18	SHRTFT31(%)	SHORT TERM FUEL TRIM B3-S1(%)
\$19	O2S22(V)	O2S VOLTAGE BANK 2 - SENSOR 2(V)
\$19	O2S32(V)	O2S VOLTAGE BANK 3 - SENSOR 2(V)
\$19	SHRTFT22(%)	SHORT TERM FUEL TRIM B2-S2(%)
\$19	SHRTFT32(%)	SHORT TERM FUEL TRIM B3-S2(%)
\$1A	O2S23(V)	O2S VOLTAGE BANK 2 - SENSOR 3(V)
\$1A	O2S41(V)	O2S VOLTAGE BANK 4 - SENSOR 1(V)
\$1A	SHRTFT23(%)	SHORT TERM FUEL TRIM B2-S3(%)
\$1A	SHRTFT41(%)	SHORT TERM FUEL TRIM B4-S1(%)
\$1B	O2S24(V)	O2S VOLTAGE BANK 2 - SENSOR 4(V)
\$1B	O2S42(V)	O2S VOLTAGE BANK 4 - SENSOR 2(V)
\$1B	SHRTFT24(%)	SHORT TERM FUEL TRIM B2-S4(%)
\$1B	SHRTFT42(%)	SHORT TERM FUEL TRIM B4-S2(%)
\$1C	OBDSUP	OBD REQUIREMENTS
\$1D	O2SLOC11	O2S BANK 1 - SENSOR 1
\$1D	O2SLOC12	O2S BANK 1 - SENSOR 2
\$1D	O2SLOC21	O2S BANK 2 - SENSOR 1
\$1D	O2SLOC22	O2S BANK 2 - SENSOR 1
\$1D	O2SLOC31	O2S BANK 3 - SENSOR 1
\$1D	O2SLOC32	O2S BANK 3 - SENSOR 2
\$1D	O2SLOC41	O2S BANK 4 - SENSOR 1
\$1D	O2SLOC42	O2S BANK 4 - SENSOR 2

Table 3-3 PID Definitions (part 3 of 4)

PID	Name, short	Parameter Name, long
\$1E	PTO_STAT	POWER TAKE OFF (PTO) STATUS
\$1F	RUNTM(s)	TIME SINCE ENGINE START(s)
\$21	MILL_DIST(km)	DISTANCE WHILE MIL ACTIVE(km or miles)
\$22	FRP_REL(kPa)	RELATIVE FUEL PRESSURE(kPa)
\$23	FRP(kPa)	FUEL PRESSURE GAUGE(kPa)
\$24	EQ_RAT11	EQUIVALENCE RATIO B1-S1 (:1)
\$25	EQ_RAT12	EQUIVALENCE RATIO B1-S2 (:1)
\$26	EQ_RAT13	EQUIVALENCE RATIO B1-S3 (:1)
\$27	EQ_RAT14	EQUIVALENCE RATIO B1-S4 (:1)
\$28	EQ_RAT21	EQUIVALENCE RATIO B2-S1 (:1)
\$28	EQ_RAT31	EQUIVALENCE RATIO B3-S1 (:1)
\$29	EQ_RAT22	EQUIVALENCE RATIO B2-S2 (:1)
\$29	EQ_RAT32	EQUIVALENCE RATIO B3-S2 (:1)
\$2A	EQ_RAT23	EQUIVALENCE RATIO B2-S3 (:1)
\$2A	EQ_RAT41	EQUIVALENCE RATIO B4-S1 (:1)
\$2B	EQ_RAT24	EQUIVALENCE RATIO B2-S4 (:1)
\$2B	EQ_RAT42	EQUIVALENCE RATIO B4-S2 (:1)
\$2C	EGR_PCT(%)	COMMANDED EGR(%)
\$2D	EGR_ERR(%)	EGR ERROR(%)
\$2E	EVAP_PCT(%)	COMMANDED EVAPORATIVE PURGE(%)
\$2F	FLI(%)	FUEL LEVEL INPUT(%)
\$30	WARM_UPS	NR OF WARM-UPS SINCE DTCs CLEARED
\$31	CLR_DIST	DISTANCE SINCE DTCs CLEARED
\$32	EVAP_VP(Pa)	EVAP SYSTEM VAPOR PRESSURE(Pa)
\$33	BARO(kPa)	BAROMETRIC PRESSURE(kPa)
\$34	O2S11(mA)	O2S CURRENT BANK 1 - SENSOR 1(mA)
\$35	O2S12(mA)	O2S CURRENT BANK 1 - SENSOR 2(mA)
\$36	O2S13(mA)	O2S CURRENT BANK 1 - SENSOR 3(mA)
\$37	O2S14(mA)	O2S CURRENT BANK 1 - SENSOR 4(mA)
\$38	O2S21(mA)	O2S CURRENT BANK 2 - SENSOR 1(mA)
\$38	O2S31(mA)	O2S CURRENT BANK 3 - SENSOR 1(mA)
\$39	O2S22(mA)	O2S CURRENT BANK 2 - SENSOR 2(mA)
\$39	O2S32(mA)	O2S CURRENT BANK 3 - SENSOR 2(mA)
\$3A	O2S23(mA)	O2S CURRENT BANK 2 - SENSOR 3(mA)
\$3A	O2S41(mA)	O2S CURRENT BANK 4 - SENSOR 1(mA)
\$3B	O2S24(mA)	O2S CURRENT BANK 2 - SENSOR 4(mA)
\$3B	O2S42(mA)	O2S CURRENT BANK 4 - SENSOR 2(mA)
\$3C	CATEMP11(°C)	CATALYST TEMPERATURE B1-S1(°C)
\$3D	CATEMP21(°C)	CATALYST TEMPERATURE B2-S1(°C)

Table 3-3 *PID Definitions (part 4 of 4)*

PID	Name, short	Parameter Name, long
\$3E	CATEMP12(°C)	CATALYST TEMPERATURE B1-S2(°C)
\$3F	CATEMP22(°C)	CATALYST TEMPERATURE B2-S2(°C)
\$42	VPWR(V)	CONTROL MODULE VOLTAGE(V)
\$43	LOAD_ABS(%)	ABSOLUTE LOAD VALUE(%)
\$44	EQ_RAT	COMMANDED EQUIVALENCE RATIO
\$45	TP_R(%)	RELATIVE THROTTLE POSITION(%)
\$46	AAT(°C)	AMBIENT AIR TEMPERATURE(°C)
\$47	TP_B(%)	ABSOLUTE THROTTLE POSITION B(%)
\$48	TP_C(%)	ABSOLUTE THROTTLE POSITION C(%)
\$49	APP_D(%)	ACCELERATOR PEDAL POSITION D(%)
\$4A	APP_E(%)	ACCELERATOR PEDAL POSITION E(%)
\$4B	APP_F(%)	ACCELERATOR PEDAL POSITION F(%)
\$4C	TAC_PCT(%)	COMMANDED THROTTLE ACT.CONTROL(%)
\$4D	MIL_TIME(min.)	ENGINE RUN WITH MIL ACTIVE(min.)
\$4E	CLR_TIME(min.)	TIME SINCE DTCs CLEARED(min.)

A.1 Start-up Problems

Refer to the relevant section in the Operator's Manual of the diagnostic tool.

A.2 Internal Battery Voltage Low

Refer to the relevant section in the appropriate Operator's Manual of the diagnostic tool.

A.3 Communication Problems

OBD-II/EOBD vehicles have few problems communicating with the scan tool. Nevertheless, an ECM may fail to communicate with the scan tool. Problems with the wiring or other circuit parts on the vehicle may prevent communication with the ECM. Also, a vehicle that fails to perform a test can be a symptom for diagnosing a driveability problem.

A.3.1 Check scan tool operation

If the scan tool works on other vehicles the problem is likely in the vehicle, not the scan tool.

If the display intermittently resets or goes blank, a wire may be opening in one of the cables or in a test adapter.

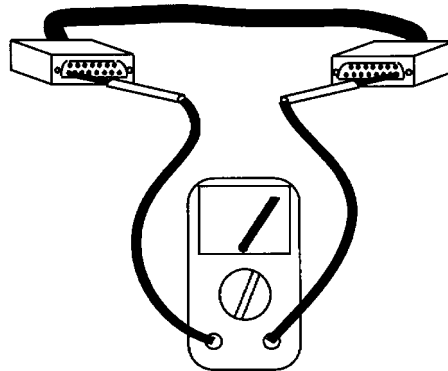


Figure A-1 *Check the cable continuity*

Check for pin-to-pin continuity between the D-shaped connectors at either end of the data cable with an ohmmeter.

If the display fails to light up, the scan tool may be at fault.

A.3.2 Testing the Diagnostic Connector — 16-pin DLC

Unfortunately, vehicle manufacturers have different interpretations of OBD-II requirements. This makes it rather difficult to define a specific approach to DLC problem diagnosis. For example, some manufacturers use the SAE J1850 BUS+ line but not the BUS-, while others use the ISO 9141 K-LINE, but not the L-LINE. See Table A-1: 'General contact allocations' below.

Ford has used 3 lines, the J1850 lines for powertrain tests, and the ISO 9141 line for the non-powertrain tests. There are also vehicles with no ground at pin 4. In addition, a pin location that is wired, does not necessarily mean it is wired based on the OBD-II requirements.

Table A-1 General contact allocations

Contact	General allocation
1	Discretionary ¹⁾
2	Bus positive line of SAE J1850 ²⁾
3	Discretionary ¹⁾
4	Chassis ground, (See Note below)
5	Signal ground, (See Note below)
6	CAN_H line of ISO 15765-4 ²⁾
7	K-LINE of ISO 9141-2 and ISO 14230-4 ²⁾
8	Discretionary ¹⁾
9	Discretionary ¹⁾
10	Bus negative line of SAE J1850 ²⁾
11	Discretionary ¹⁾
12	Discretionary ¹⁾
13	Discretionary ¹⁾
14	CAN_L line of ISO 15765-4 ²⁾
15	L-LINE of ISO 9141-2 and ISO 14230-4 ²⁾
16	Permanent positive voltage

¹⁾ Assignment of contacts 1, 3, 8, 9, 11, 12 and 13 in the vehicle connector is left to the discretion of the vehicle manufacturer.
²⁾ Note, for contacts 2, 6, 7, 10, 14 and 15 the related diagnostic communication assignments are shown. These contacts may also be used for alternate assignments in the vehicle connector.

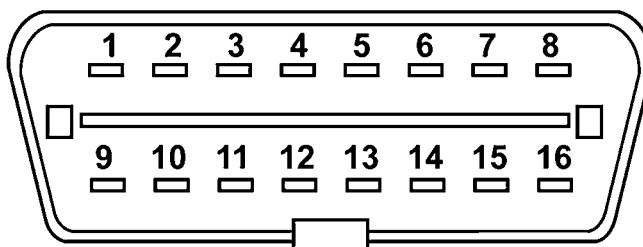


Figure A-2 Contact designation for vehicle connector mating end view

**NOTE:**

These point apply to pins 4 and 5:

The DL-16 Adapter with the S7 key, doesn't work for some vehicles. Most vehicles have "ground" (power and signal) connected to pin 4 of the 16-pin Diagnostic Connector. Key S7 connects pin 4 of the Diagnostic connector to ground pin of the scan tool. The same problem arises when the OBD-II connector is used with the K2A key.

However, there are vehicles which have "ground" connected to pin 5 and do NOT communicate because the scan tool will not power-up. (No ground connection, therefore No power).

According to ISO 15031-3:2001 the use of pin 4 of the Diagnostic connector is optional. Pin 5 of the Diagnostic connector should be used as signal ground and may be used as a power ground.

Possible workaround: Use a CAN adapter. This adapter shorts pins 4 and 5 of the Diagnostic connector.

Use the following voltage tests at the diagnostic connector to help determine the reason that a vehicle will not perform diagnostic tests. Always use a high-impedance digital voltmeter.

**To test the DLC:**

1. **Ground** — Connect the voltmeter positive (+) lead to the ground terminal in the diagnostic connector. Connect the negative (-) lead directly to the battery negative (-) terminal.
Do not connect the voltmeter negative lead to an engine or chassis ground. This test measures the voltage drop across the ground side of the diagnostic connector. An ideal system ground should have a voltage drop of 0.1 V or less. An open ground can keep a fuel injected engine vehicle from starting. A high-resistance, or "dirty", ground can cause overall poor operation.
2. **Battery Voltage** — Connect the voltmeter positive (+) lead to the battery voltage terminal at the diagnostic connector. Connect the negative (-) lead to the battery ground terminal. The meter should read battery voltage. This tests the battery voltage supply to the ECM.
3. **ECM Communication Lines** — Remember, a stuffed pin does not necessarily predict the signal type. First determine if the vehicle uses J1850, ISO 9141, ISO 14230 or CAN (ISO 15765) and then determine if it uses both associated lines, or just one.
For ISO 9141 and ISO 14230 the K-LINE must be used, while the L- LINE is optional. For SAE J1850 the BUS + LINE must be used, while the BUS -LINE is optional.
For CAN (ISO 15765) both the H-LINE and L-LINE are used. Refer to a wiring diagram and use an ohmmeter to check continuity in the J1850, ISO 9141, ISO 14230 or CAN (ISO 15765) circuits to the diagnostic connector. The scan tool uses these lines to communicate with the ECM. If the circuit is open, the scan tool cannot transmit a request to the vehicle ECM nor receive data from it.

A.3.3 Check the Malfunction Indicator Lamp

On some vehicles, the lamp is labelled simply ENGINE, or has a symbol to indicate the ECM. Regardless of the label, they all can be referred to as the Malfunction Indicator Lamp.

Turn the ignition on and verify that the Malfunction Indicator Lamp lights with the ignition on and the engine off. If it does not, troubleshoot and repair the problem before going further. It could be as simple as a burned out lamp bulb or a blown fuse. Refer to the manufacturer's shop manual for the Malfunction Indicator Lamp troubleshooting procedure on the specific vehicle under test. Common causes of Malfunction Indicator Lamp circuit problems include:

- A blown circuit fuse, (GAUGES or other lamp fuse)
- A burned-out lamp bulb
- A wiring or connector problem
- A defective lamp driver
- A diagnostic connector problem

These vehicles can display a "No Communication" message when there is a communication problem. If the scan tool displays the message, "No Communication", it means that the scan tool and the control module simply cannot communicate with each other for some reason.

Glossary

B

Bank

Specific group of cylinders sharing a common control sensor. Bank 1 always contains cylinder number 1.

C

CAN

Controller Area Network

D

DTC

Diagnostic Trouble Code

E

ECM

Electronic Control Module

EOBD

European Onboard Diagnostics

M

MIL

Malfunction Indicator Lamp

O

OBD

Onboard Diagnostics

OBDMID

On-Board Diagnostic Monitor IDentification

