3020b

# DIGITAL OBD2 CODE READER

# OWNER'S MANUAL

**The Easiest And Best Way To Troubleshoot 1996 and Newer OBD2 Vehicles!**

# Innova 3020 ABS Application Chart

## Chrysler Application Chart

| CHRYSLER | | | |
|---|---|---|---|
| 200 | 2011-2013 | LHS | 1999-2001 |
| 300 | 2005-2013 | Neon | 2000-2002 |
| 300C | 2005-2013 | Pacifica | 2004-2008 |
| 300M | 1999-2004 | PT Cruiser | 2001-2010 |
| 300S | 2012-2013 | Sebring | 2001-2010 |
| Aspen | 2007-2009 | Town & Country | 2001-2013 |
| Concorde | 1999-2004 | Voyager | 2001-2003 |
| Crossfire | 2004-2008 | | |
| **DODGE** | | | |
| Avenger | 2008-2013 | Neon | 2000-2005 |
| Caliber | 2006-2012 | Journey | 2009-2013 |
| Caravan | 2001-2008 | Magnum | 2005-2008 |
| Challenger | 2008-2013 | Nitro | 2007-2011 |
| Charger | 2006-2013 | RAM Pickup | 2003-2011 |
| Dart | 2013 | RAM Van | 2012-2013 |
| Dakota | 2001-2011 | Sprinter | 2007-2009 |
| Durango | 2001-2009, 2011-2013 | Stratus | 2001-2006 |
| Grand Caravan | 2001-2013 | Viper | 2001-2006, 2008-2010 |
| Intrepid | 1999-2004 | | |
| **JEEP** | | | |
| Commander | 2006-2010 | Liberty | 2002-2012 |
| Compass | 2007-2013 | Patriot | 2007-2013 |
| Grand Cherokee | 1999-2013 | Wrangler | 2007-2013 |
| **PLYMOUTH** | | | |
| Neon | 2000-2001 | | |
| **RAM** | | | |
| Dakota | 2012 | Van | 2013 |
| Pickup | 2012-2013 | | |
| **SRT** | | | |
| Viper | 2013 | | |

## Ford Application Chart

| FORD | | | |
|---|---|---|---|
| Aerostar | 1996-1997 | F-350 (w/ 4-Wheel ABS) | 1996-1997, 1999-2013 |
| Aspire | 1996-1997 | Fiesta | 2011-2013 |
| Bronco | 1996 | Five Hundred | 2005-2007 |
| C-Max | 2013 | Flex | 2009-2013 |
| Contour | 1996-2000 | Focus | 2000-2013 |
| Crown Victoria (w/o Traction Control) | 1996-2012 | Freestar | 2004-2007 |
| E Series Van | 1996-2013 | Freestyle | 2005-2007 |
| Edge | 2007-2013 | Fusion | 2006-2013 |
| Escape | 2001-2013 | GT | 2004-2006 |

| | | | |
|---|---|---|---|
| Escape Hybrid | 2007-2012 | Mustang (w/o Traction Control) | 1996-2014 |
| Escort | 1996-2002 | Mustang Shelby GT500 | 2007-2013 |
| Escort ZX2 | 2002-2003 | Probe | 1996-1997 |
| Excursion | 2000-2005 | Ranger (w/o Traction Control) | 1996-2011 |
| Expedition (w/ 4-Wheel ABS) | 1997-2013 | Taurus (w/o Traction Control) | 1996-2013 |
| Explorer (w/o Traction Control) | 1996-2013 | Th!nk | 2002 |
| Explorer Sport Trac (w/o Traction Control) | 2001-2005, 2007-2010 | Thunderbird | 1996-1997, 2002-2005 |
| F-150 (w/ 4-Wheel ABS) | 1996-2013 | Transit Connect | 2010-2013 |
| F-250 (w/ 4-Wheel ABS) | 1996-2013 | Windstar | 1996-2003 |
| LINCOLN | | | |
| Aviator | 2003-2005 | MKT | 2010-2013 |
| Blackwood | 2002-2003 | MKX | 2007-2013 |
| Continental | 1996-2002 | MKZ | 2007-2013 |
| LS | 2000-2006 | Navigator | 1998-2013 |
| Mark LT | 2006-2008, 2010 | Town Car | 1996-2011 |
| Mark VIII | 1996-1998 | Zephyr | 2006 |
| MKS | 2009-2013 | | |
| MERCURY | | | |
| Cougar | 1996-1997, 1999-2002 | Monterey | 2004-2007 |
| Grand Marquis | 1996-2011 | Mountaineer | 1997-2010 |
| Marauder | 2002-2004 | Mystique | 1996-2001 |
| Mariner | 2005-2011 | Sable | 1996-2005, 2008-2009 |
| Milan | 2006-2011 | Tracer | 1996-1999 |
| Montego | 2005-2007 | Villager | 1996-2002 |
| GM Application Chart | | | |
| AM GENERAL | | | |
| Hummer | 1996-2001 | | |
| BUICK | | | |
| Allure | 2005-2010 | Rainier | 2004-2007 |
| Century | 1996-2005 | Regal | 1996-2004, 2011-2013 |
| Enclave | 2008-2013 | Rendezvous | 2002-2007 |
| Encore | 2013 | Riviera | 1996-1999 |
| LaCrosse | 2005-2013 | Roadmaster | 1996 |
| LeSabre | 1996-2005 | Skylark | 1996-1998 |
| Lucerne | 2006-2012 | Terraza | 2005-2007 |
| Park Avenue | 1996-2005 | Verano | 2012-2013 |
| CADILLAC | | | |
| ATS | 2013 | Limousine | 2003-2009 |

| | | | |
|---|---|---|---|
| Catera | 1997-2001 | Professional Chassis | 2000-2002 |
| CTS | 2003-2013 | Seville | 1996-2004 |
| CTS-V | 2004-2013 | SLS | 2009 |
| DeVille | 1996-2005 | SRX | 2004-2013 |
| DTS | 2001, 2006-2011 | STS | 2005-2011 |
| Eldorado | 1996-2002 | STS-V | 2006-2011 |
| Escalade | 1999-2000, 2002-2013 | XLR | 2003-2009 |
| Escalade Hybrid | 2009 | XLR-V | 2006-2009 |
| Fleetwood Brougham | 1996 | XTS | 2013 |
| Hearse | 1996-2010 | | |
| CHEVROLET | | | |
| Alero | 1999-2002 | K2500 | 1996-2000 |
| Astro Van | 1996-2005 | K3500 | 1996-2000 |
| Avalanche | 2002-2013 | Lumina | 1996-2001 |
| Aveo | 2004-2011 | Malibu | 1997-2013 |
| Aveo5 | 2007-2011, 2013 | Malibu Maxx | 2004-2007 |
| Beretta | 1996 | Metro | 1998-2001 |
| Blazer | 1996-2005 | Military Truck | 1996, 1998-2000, 2005 |
| C1500 | 1996-1999 | Monte Carlo | 1996-2007 |
| C2500 | 1996-2000 | Optra | 2004-2009, 2012 |
| C3500 | 1996-2000 | Orlando | 2012-2013 |
| Camaro | 1996-2002, 2010-2013 | P30 | 1996-2002, 2005 |
| Caprice | 1996, 2011-2013 | Prizm | 1998-2002 |
| Captiva | 2009, 2012-2013 | S10 | 1996-2004 |
| Cavalier | 1996-2005 | Silverado | 1999-2013 |
| Classic | 2004-2005 | Sonic | 2012-2013 |
| Cobalt | 2005-2010, 2013 | Spark | 2009, 2013 |
| Colorado | 2004-2012 | SSR | 2003-2007 |
| Corsica | 1996 | Step Van | 1996-2003 |
| Corvette | 1996-2013 | Suburban | 1996-2013 |
| Cruze | 2011-2013 | Tahoe | 1996-2013 |
| Epica | 2004-2006 | Tracker | 1998-2004 |
| Equinox | 2005-2013 | Trailblazer | 2002-2009 |
| Express | 1996-2003 | Traverse | 2009-2013 |
| G Series Van | 1996-1998 | Trax | 2013 |
| HHR | 2006-2011 | Uplander | 2005-2009 |
| Impala | 1996-2013 | Venture | 1996-2005 |
| Joy | 2009 | Volt | 2011-2013 |
| K1500 | 1996-1999 | | |
| DAEWOO | | | |
| Lanos | 1998-2002 | Nubira | 1998-2002 |
| Leganza | 1998-2002 | | |
| GEO | | | |
| Metro | 1996-1997 | Tracker | 1996-1997 |
| Prizm | 1996-1997 | | |
| GMC | | | |

| | | | |
|---|---|---|---|
| Acadia | 2007-2013 | Savana | 1996-2013 |
| Canyon | 2004-2012 | Sierra | 1996-2013 |
| Envoy | 1998-2000, 2002-2009 | Sonoma | 1996-2004 |
| Envoy XL | 2002-2006 | Step Van | 1996-1999, 2001 |
| Envoy XUV | 2004-2005 | Suburban | 1996-1999 |
| G3500 | 1996 | Terrain | 2010-2013 |
| Jimmy | 1996-2005 | Yukon | 1996-2013 |
| P3500 | 1997-1999 | Yukon Hybrid | 2010-2013 |
| Safari | 1996-2005 | | |
| HUMMER | | | |
| H1 | 2002-2006 | H3 | 2006-2010 |
| H2 | 2003-2009 | H3T | 2009-2010 |
| H2 SUT | 2005-2009 | Hummer | 2002-2006 |
| OLDSMOBILE | | | |
| Achieva | 1996-1998 | Eighty Eight | 1996-1999 |
| Alero | 1999-2004 | Intrigue | 1998-2002 |
| Aurora | 1996-1999, 2001-2003 | LSS | 1996-1999 |
| Bravada | 1996-2004 | Ninety Eight | 1996 |
| Cutlass | 1997-1999 | Regency | 1997-1999 |
| Cutlass Ciera | 1996 | Silhouette | 1996-2004 |
| Cutlass Supreme | 1996-1997 | | |
| PONTIAC | | | |
| Aztek | 2001-2005 | GTO | 2004-2006 |
| Bonneville | 1996-2005 | Montana | 1999-2005 |
| Firebird | 1996-2002 | Montana SV6 | 2005-2009 |
| Firefly | 1996-2002 | Pursuit | 2005-2006 |
| G3 Wave | 2005-2010 | Solstice | 2005-2010 |
| G5 | 2007-2010 | Sunfire | 1996-2005 |
| G6 | 2005-2010 | Sunrunner | 1996-1997 |
| G8 | 2008-2009 | Torrent | 2006-2009 |
| Grand AM | 1996-2005 | Trans Sport | 1996-1998 |
| Grand Prix | 1996-2008 | Vibe | 2003-2010 |
| SAAB | | | |
| 900 | 1996-1998 | 9-2x | 2005-2006 |
| 9000 | 1996-1998 | 9-3x | 2010-2011 |
| 9-3 | 1999-2011 | 9-4x | 2011-2013 |
| 9-5 | 1999-2011 | 9-7x | 2005-2009 |
| SATURN | | | |
| Astra | 2008-2009 | Outlook | 2007-2010 |
| Aura | 2007-2009 | Relay | 2005-2007 |
| Aura Hybrid | 2009 | S Series | 1996-2002 |
| Ion | 2003-2007 | Sky | 2007-2010 |
| L Series | 2000-2005 | Vue | 2002-2010 |
| Honda Application Chart | | | |
| ACURA | | | |
| CL | 2000-2003 | RDX | 2007-2012 |

| | | | |
|---|---|---|---|
| CSX | 2006-2011 | RL | 2000-2012 |
| EL | 1997-2005 | RSX | 2002-2005 |
| ILX | 2013 | SLX | 1996-1999 |
| Integra | 1998-2001 | TL | 1999-2012 |
| MDX | 2001-2012 | TSX | 2003-2012 |
| NSX | 2000-2004 | ZDX | 2010-2012 |
| HONDA | | | |
| Accord | 1998-2014 | EV-Plus | 1997-1999 |
| Accord Crosstour | 2010-2013 | Fit EV | 2013 |
| Civic | 1996-2013 | Insight | 2000-2006, 2010-2013 |
| CR-V | 1996-2013 | Odyssey | 1998-2013 |
| CR-Z | 2011-2013 | Pilot | 2002-2013 |
| Del Sol | 1996-1997 | Prelude | 1997-2001 |
| Element | 2003-2012 | Ridgeline | 2005-2013 |
| Fit | 2007-2013 | S2000 | 1999-2009 |

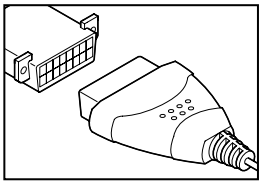
# Toyota Application Chart

| | | | |
|---|---|---|---|
| LEXUS | | | |
| CT200h | 2011-2014 | IS300 | 2001-2005 |
| ES300 | 1999-2003 | IS350 | 2006-2014 |
| ES300h | 2013-2014 | IS350c | 2010-2014 |
| ES330 | 2004-2006 | LF-A | 2012-2013 |
| ES350 | 2007-2014 | LS400 | 1998-2000 |
| GS300 | 1998-2006 | LS430 | 2001-2006 |
| GS350 | 2007-2014 | LS460 | 2007-2014 |
| GS400 | 1998-2000 | LS600h | 2008-2014 |
| GS430 | 2001-2007 | LX470 | 1998-2006 |
| GS450h | 2007-2014 | LX570 | 2008-2014 |
| GS460 | 2008-2011 | RX300 | 2001-2003 |
| GX460 | 2010-2014 | RX330 | 2004-2005 |
| GX470 | 2003-2009 | RX350 | 2007-2015 |
| HS250h | 2010-2012 | RX400h | 2006-2008 |
| IS-F | 2008-2014 | RX450h | 2010-2015 |
| IS250 | 2006-2014 | SC430 | 2002-2010 |
| IS250c | 2010-2014 | | |
| SCION | | | |
| FR-S | 2013-2014 | xA | 2004-2006 |
| iQ | 2011-2014 | xB | 2004-2006, 2008-2014 |
| iQ EV | 2013 | xD | 2008-2014 |
| tC | 2005-2015 | | |
| TOYOTA | | | |
| 4Runner | 2001-2014 | MR2 Spyder | 2000-2005 |
| Avalon | 2000-2014 | Prius | 2001-2015 |
| Avalon HV | 2013-2014 | Prius C | 2012-2014 |
| Camry | 2000-2014 | Prius PHV | 2010-2015 |
| Camry HV | 2007-2014 | Prius V | 2012-2014 |
| Celica | 2000-2005 | Rav4 | 2001-2014 |

| | | | |
|---|---|---|---|
| Corolla | 2000-2014 | Rav4 EV | 2012-2014 |
| Echo | 2000-2005 | Sequoia | 2001-2014 |
| FCHV-adv | 2009 | Sienna | 2001-2014 |
| FJ Cruiser | 2007-2014 | Solara | 2001-2009 |
| Highlander | 2001-2014 | Tacoma | 2003-2014 |
| Highlander HV | 2006-2014 | Tundra | 2000-2015 |
| Hilux | 2009-2014 | Venza | 2009-2014 |
| Land Cruiser | 1998-2014 | Yaris | 2004-2015 |
| Matrix | 2003-2014 | | |

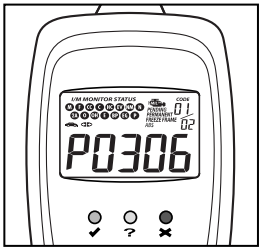
# Table of Contents

### *Easy To Use . . . .*



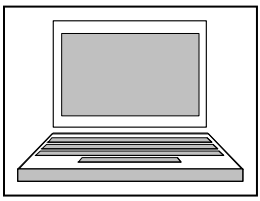
- Connect the Code Reader to the vehicle's test connector.
- Turn the ignition key "On." DO NOT start the engine.
- The Code Reader will automatically link to the vehicle's computer.

### *Easy To View . . . .*




- The Code Reader retrieves stored codes and displays I/M Monitor Status.
- Codes are displayed on the Code Reader's LCD display screen; Vehicle Health Status is displayed by LED indicators.

### *Easy To Define . . . .*



- Visit www.innova.com or the manufacturer's website for Fault Code Definitions.

## SAFETY FIRST!

This manual describes common test procedures used by experienced service technicians. Many test procedures require precautions to avoid accidents that can result in personal injury, and/or damage to your vehicle or test equipment. Always read your vehicle's service manual and follow its safety precautions before and during any test or service procedure. **ALWAYS** observe the following general safety precautions:

When an engine is running, it produces carbon monoxide, a toxic and poisonous gas. To prevent serious injury or death from carbon monoxide poisoning, operate the vehicle **ONLY** in a **well-ventilated** area.

To protect your eyes from propelled objects as well as hot or caustic liquids, **always** wear **approved** safety eye protection.

When an engine is running, many parts (such as the coolant fan, pulleys, fan belt etc.) turn at high speed. To avoid serious injury, always be aware of moving parts. Keep a safe distance from these parts as well as other potentially moving objects.

Engine parts become very hot when the engine is running. To prevent severe burns, avoid contact with hot engine parts.


Before starting an engine for testing or troubleshooting, make sure the parking brake is engaged. Put the transmission in **park** (for automatic transmission) or **neutral** (for manual transmission). Block the drive wheels with suitable blocks.

Connecting or disconnecting test equipment when the ignition is **ON** can damage test equipment and the vehicle's electronic components. Turn the ignition **OFF** before connecting the Code Reader to or disconnecting the Code Reader from the vehicle's Data Link Connector (DLC).


To prevent damage to the on-board computer when taking vehicle electrical measurements, always use a digital multimeter with at least 10 MegOhms of impedance.

The vehicle's battery produces highly flammable hydrogen gas. To prevent an explosion, keep all sparks, heated items and open flames away from the battery.

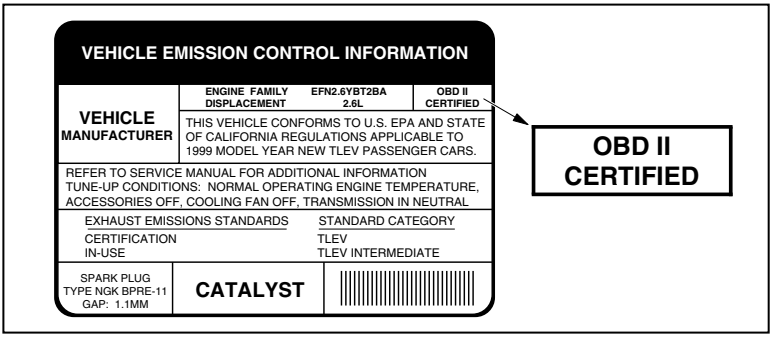
Don't wear loose clothing or jewelry when working on an engine. Loose clothing can become caught in the fan, pulleys, belts, etc. Jewelry is highly conductive, and can cause a severe burn if it makes contact between a power source and ground.

## VEHICLES COVERED

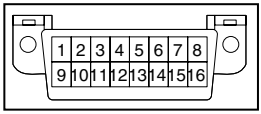
The Code Reader is designed to work on all OBD2 compliant vehicles. All 1996 and newer vehicles (cars and light trucks) sold in the United States are OBD2 compliant. This includes all Domestic, Asian and European vehicles.

Some 1994 and 1995 vehicles are OBD2 compliant. To find out if a 1994 or 1995 vehicle is OBD2 compliant, check the following:

1. **The Vehicle Emissions Control Information (VECI) Label.** This label is located under the hood or by the radiator of most vehicles. If the vehicle is OBD2 compliant, the label will state "**OBD II Certified**."



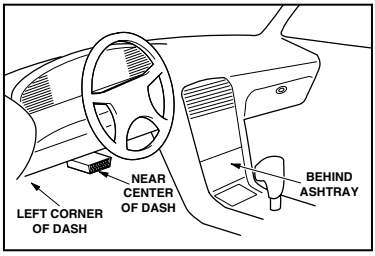

2. Government Regulations require that all OBD2 compliant vehicles must have a "common" sixteen-pin **Data Link Connector (DLC)**.




*Some 1994 and 1995 vehicles have 16-pin connectors but are not OBD2 compliant. Only those vehicles with a Vehicle Emissions Control Label stating "OBD II Certified" are OBD2 compliant.*

### Data Link Connector (DLC) Location

The 16-pin DLC is usually located under the instrument panel (dash), within 12 inches (300 mm) of center of the panel, on the driver's side of most vehicles. It should be easily accessible and visible from a kneeling position outside the vehicle with the door open.




*On some Asian and European vehicles the DLC is located behind the "ashtray" (the ashtray must be removed to access it) or on the far left corner of the dash. If the DLC cannot be located, consult the vehicle's service manual for the location.*

## CONTROLS AND INDICATORS

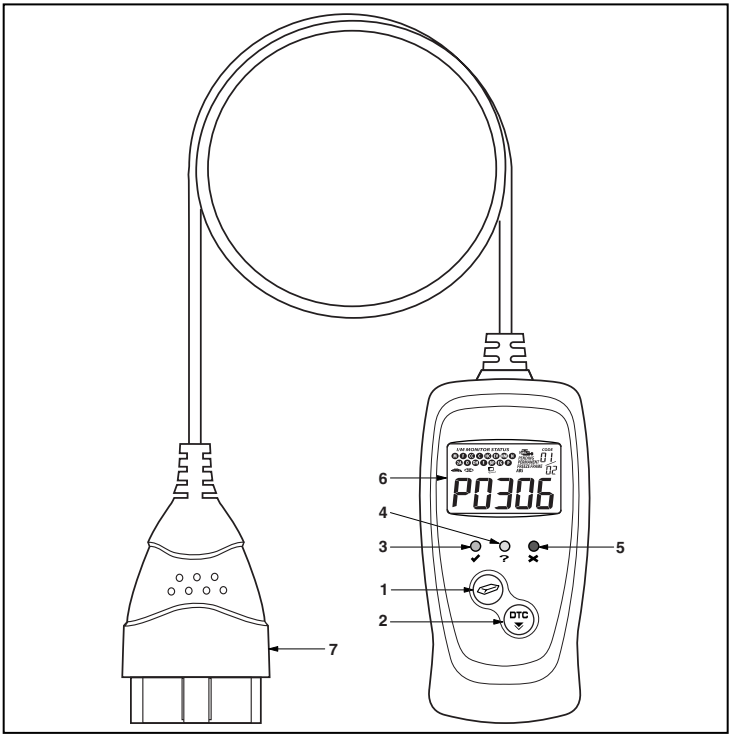



***Figure 1. Controls and Indicators***

See Figure 1 for the locations of items 1 through 7, below.

1. **ERASE button** - Erases Diagnostic Trouble Codes (DTCs) and "Freeze Frame" data from your vehicle's computer, and resets Monitor status.

2. **DTC button** - Scrolls the LCD display to view DTCs when more than one DTC is present.

3. ✓ **GREEN LED** - Indicates that all engine systems are running normally (all Monitors on the vehicle are active and performing their diagnostic testing, and no DTCs are present).

4. **?** **YELLOW LED** - Indicates there is a possible problem. A “Pending” DTC is present and/or some of the vehicle's emission monitors have not run their diagnostic testing.

5. **RED LED** - Indicates there is a problem in one or more of the vehicle's systems. The red LED is also used to show that DTC(s) are present. DTCs are shown on the Code Reader's LCD display. In this case, the Malfunction Indicator ("Check Engine") lamp on the vehicle's instrument panel will light steady on.
6. **LCD Display** - Displays test results, Code Reader functions and Monitor status information. See DISPLAY FUNCTIONS, below, for details.
7. **CABLE** - Connects the Code Reader to the vehicle's Data Link Connector (DLC).

## DISPLAY FUNCTIONS

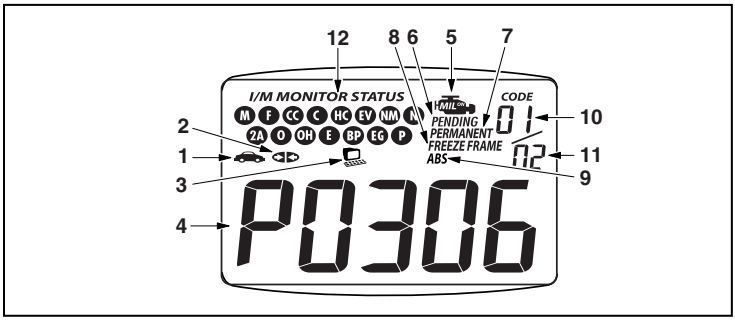



***Figure 2. Display Functions***

See Figure 2 for the locations of items 1 through 10 below.

1. **Vehicle icon** - Indicates whether or not the Code Reader is being properly powered through the vehicle's Data Link Connector (DLC). A visible icon indicates that the Code Reader is being powered through the vehicle's DLC connector.
2. **Link icon** - Indicates whether or not the Code Reader is communicating (linked) with the vehicle's on-board computer. When visible, the Code Reader is communicating with the computer. If the Link icon is not visible, the Code Reader is not communicating with the computer.
3. **Computer icon** - When this icon is visible it indicates that the code reader is linked to a personal computer via a USB cable (purchased separately).
4. **DTC Display Area** - Displays the Diagnostic Trouble Code (DTC) number. Each fault is assigned a code number that is specific to that fault.
5. **MIL icon** - Indicates the status of the Malfunction Indicator Lamp (MIL). The MIL icon is visible only when a DTC has commanded the MIL on the vehicle's dashboard to light.

6. **Pending icon** - Indicates the currently displayed DTC is a "Pending" code.
7. **PERMANENT icon** - Indicates the currently displayed DTC is a “Permanent” code.
8. **FREEZE FRAME icon** - Indicates that “Freeze Frame” data has been stored in the vehicle’s computer for the currently displayed DTC.
9. **ABS icon** - Indicates the currently displayed DTC is an “Anti-Lock Braking System” code.
10. **Code Number Sequence** - The Code Reader assigns a sequence number to each DTC that is present in the computer's memory, starting with "01.” This helps keep track of the number of DTCs present in the computer's memory. Code number "01" is always the highest priority code, and the one for which "Freeze Frame" data has been stored.
11. **Code Enumerator** - Indicates the total number of codes retrieved from the vehicle’s computer.
12. **Monitor icons** - Indicates which Monitors are supported by the vehicle under test, and whether or not the associated Monitor has run its diagnostic testing (Monitor status). When a Monitor icon is solid, it indicates that the associated Monitor has completed its diagnostic testing. When a Monitor icon is flashing, it indicates that the vehicle supports the associated Monitor, but the Monitor has not yet run its diagnostic testing.

*The I/M Monitor Status icons are associated with INSPECTION and MAINTENANCE (I/M) READINESS STATUS. Some states require that all vehicle Monitors have run and completed their diagnostic testing before a vehicle can be tested for Emissions (Smog Check). A maximum of fifteen Monitors are used on OBD2 systems. Not all vehicles support all fifteen Monitors. When the Code Reader is linked to a vehicle, only the icons for Monitors that are supported by the vehicle under test are visible on the display.*

## COMPUTER ENGINE CONTROLS

### The Introduction of Electronic Engine Controls

***Electronic Computer Control Systems make it possible for vehicle manufacturers to comply with the tougher emissions and fuel efficiency standards mandated by State and Federal Governments.***

As a result of increased air pollution (smog) in large cities, such as Los Angeles, the California Air Resources Board (**CARB**) and the Environmental Protection Agency (**EPA**) set new regulations and air pollution standards to deal with the problem. To further complicate matters, the energy crisis of the early 1970s caused a sharp increase in fuel prices over a short period. As a result, vehicle manufacturers were not only required to comply with the new emissions standards, they also had to make their vehicles more fuel-efficient. Most vehicles were required to meet a miles-per-gallon (MPG) standard set by the U.S. Federal Government.

Precise fuel delivery and spark timing are needed to reduce vehicle emissions. Mechanical engine controls in use at the time (such as ignition points, mechanical spark advance and the carburetor) responded too slowly to driving conditions to properly control fuel delivery and spark timing. This made it difficult for vehicle manufacturers to meet the new standards.

A new Engine Control System had to be designed and integrated with the engine controls to meet the stricter standards. The new system had to:

- Respond instantly to supply the proper mixture of air and fuel for any driving condition (idle, cruising, low-speed driving, high-speed driving, etc.).
- Calculate instantly the best time to “ignite” the air/fuel mixture for maximum engine efficiency.
- Perform both these tasks without affecting vehicle performance or fuel economy.

Vehicle Computer Control Systems can perform millions of calculations each second. This makes them an ideal substitute for the slower mechanical engine controls. By switching from mechanical to electronic engine controls, vehicle manufacturers are able to control fuel delivery and spark timing more precisely. Some newer Computer Control Systems also provide control over other vehicle functions, such as transmission, brakes, charging, body, and suspension systems.

## The Basic Engine Computer Control System

**The Computer Control System consists of an on-board computer and several related control devices (sensors, switches, and actuators).**

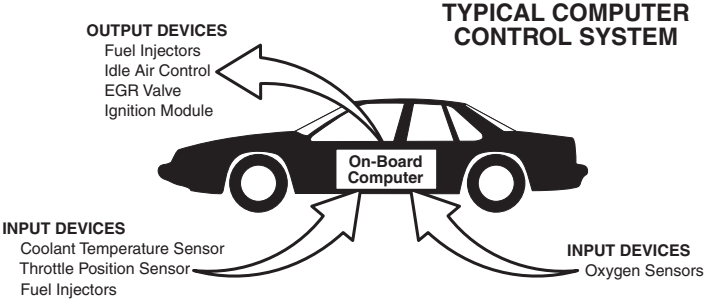
The on-board computer is the heart of the Computer Control System. The computer contains several programs with preset reference values for air/fuel ratio, spark or ignition timing, injector pulse width, engine speed, etc. Separate values are provided for various driving conditions, such as idle, low speed driving, high-speed driving, low load, or high load. The preset reference values represent the ideal air/fuel mixture, spark timing, transmission gear selection, etc., for any driving condition. These values are programmed by the vehicle manufacturer, and are specific to each vehicle model.

Most on-board computers are located inside the vehicle behind the dashboard, under the passenger's or driver's seat, or behind the right kick panel. However, some manufacturers may still position it in the engine compartment.

Vehicle sensors, switches, and actuators are located throughout the engine, and are connected by electrical wiring to the on-board computer. These devices include oxygen sensors, coolant temperature sensors, throttle position sensors, fuel injectors, etc. Sensors and switches are **input devices**. They provide signals representing current engine operating conditions to the computer. Actuators are **output devices**. They perform actions in response to commands received from the computer.

The on-board computer receives information inputs from sensors and switches located throughout the engine. These devices monitor critical engine conditions such as coolant temperature, engine speed, engine load, throttle position, air/fuel ratio etc.

The computer compares the values received from these sensors with its preset reference values, and makes corrective actions as needed so that the sensor values always match the preset reference values for the current driving condition. The computer makes adjustments by commanding other devices such as the fuel injectors, idle air control, EGR valve or Ignition Module to perform these actions.



Vehicle operating conditions are constantly changing. The computer continuously makes adjustments or corrections (especially to the air/fuel mixture and spark timing) to keep all the engine systems operating within the preset reference values.

### On-Board Diagnostics - First Generation (OBD1)

***With the exception of some 1994 and 1995 vehicles, most vehicles from 1982 to 1995 are equipped with some type of first generation On-Board Diagnostics.***

Beginning in 1988, California's Air Resources Board (**CARB**), and later the Environmental Protection Agency (**EPA**) required vehicle manufacturers to include a self-diagnostic program in their on-board computers. The program would be capable of identifying emissions-related faults in a system. The first generation of Onboard Diagnostics came to be known as **OBD1**.

OBD1 is a set of self-testing and diagnostic instructions programmed into the vehicle's on-board computer. The programs are specifically designed to detect failures in the sensors, actuators, switches and wiring of the various vehicle emissions-related systems. If the computer detects a failure in any of these components or systems, it lights an indicator on the dashboard to alert the driver. The indicator lights **only** when an emissions-related problem is detected.

The computer also assigns a numeric code for each specific problem that it detects, and stores these codes in its memory for later retrieval. These codes can be retrieved from the computer's memory with the use of a "Code Reader" or a "Scan Tool."

### On-Board Diagnostics - Second Generation (OBD2)

***The OBD2 System is an enhancement of the OBD1 System.***

In addition to performing all the functions of the OBD1 System, the OBD2 System has been enhanced with new Diagnostic Programs. These programs closely monitor the functions of various emissions-related components and systems (as well as other systems) and make this information readily available (with the proper equipment) to the technician for evaluation.

The California Air Resources Board (**CARB**) conducted studies on OBD1 equipped vehicles. The information that was gathered from these studies showed the following:

- A large number of vehicles had deteriorating or degraded emissions-related components. These components were causing an increase in emissions.

- Because OBD1 systems only detect failed components, the degraded components were not setting codes.
- Some emissions problems related to degraded components only occur when the vehicle is being driven under a load. The emission checks being conducted at the time were not performed under simulated driving conditions. As a result, a significant number of vehicles with degraded components were passing Emissions Tests.
- Codes, code definitions, diagnostic connectors, communication protocols and emissions terminology were different for each manufacturer. This caused confusion for the technicians working on different make and model vehicles.

To address the problems made evident by this study, CARB and the EPA passed new laws and standardization requirements. These laws required that vehicle manufacturers to equip their new vehicles with devices capable of meeting all of the new emissions standards and regulations. It was also decided that an enhanced on-board diagnostic system, capable of addressing all of these problems, was needed. This new system is known **as "On-Board Diagnostics Generation Two (OBD2)**." The primary objective of the OBD2 system is to comply with the latest regulations and emissions standards established by CARB and the EPA.

The Main Objectives of the OBD2 System are:

- To detect degraded and/or failed emissions-related components or systems that could cause tailpipe emissions to exceed by 1.5 times the Federal Test Procedure (FTP) standard.
- To expand emissions-related system monitoring. This includes a set of computer run diagnostics called Monitors. Monitors perform diagnostics and testing to verify that all emissions-related components and/or systems are operating correctly and within the manufacturer's specifications.
- To use a standardized Diagnostic Link Connector (DLC) in all vehicles. (Before OBD2, DLCs were of different shapes and sizes.)
- To standardize the code numbers, code definitions and language used to describe faults. (Before OBD2, each vehicle manufacturer used their own code numbers, code definitions and language to describe the same faults.)
- To expand the operation of the Malfunction Indicator Lamp (MIL).
- To standardize communication procedures and protocols between the diagnostic equipment (Scan Tools, Code Readers, etc.) and the vehicle's on-board computer.

### OBD2 Terminology

The following terms and their definitions are related to OBD2 systems. Read and reference this list as needed to aid in the understanding of OBD2 systems.

- **Powertrain Control Module (PCM)** - The PCM is the OBD2 accepted term for the vehicle's "on-board computer." In addition to controlling the engine management and emissions systems, the PCM also participates in controlling the powertrain (transmission) operation. Most PCMs also have the ability to communicate with other computers on the vehicle (ABS, ride control, body, etc.).
- **Monitor** - Monitors are "diagnostic routines" programmed into the PCM. The PCM utilizes these programs to run diagnostic tests, and to monitor operation of the vehicle's emissions-related components or systems to ensure they are operating correctly and within the vehicle's manufacturer specifications. Currently, up to fifteen Monitors are used in OBD2 systems. Additional Monitors will be added as the OBD2 system is further developed.

*Not all vehicles support all fifteen Monitors.*

- **Enabling Criteria** - Each Monitor is designed to test and monitor the operation of a specific part of the vehicle's emissions system (EGR system, oxygen sensor, catalytic converter, etc.). A specific set of "conditions" or "driving procedures" must be met before the computer can command a Monitor to run tests on its related system. These "conditions" are known as "**Enabling Criteria**." The requirements and procedures vary for each Monitor. Some Monitors only require the ignition key to be turned "**On**" for them to run and complete their diagnostic testing. Others may require a set of complex procedures, such as, starting the vehicle when cold, bringing it to operating temperature, and driving the vehicle under specific conditions before the Monitor can run and complete its diagnostic testing.
- **Monitor Has/Has Not Run** - The terms "Monitor has run" or "Monitor has not run" are used throughout this manual. "**Monitor <u>has</u> run**," means the PCM **has** commanded a particular Monitor to perform the required diagnostic testing on a system to ensure the system is operating correctly (within factory specifications). The term "**Monitor <u>has not</u> run**" means the PCM **has not** yet commanded a particular Monitor to perform diagnostic testing on its associated part of the emissions system.
- **Trip** - A Trip for a particular Monitor requires that the vehicle is being driven in such a way that all the required "Enabling Criteria" for the Monitor to run and complete its diagnostic testing are met. The "Trip Drive Cycle" for a particular Monitor begins when the ignition key is turned "**On**." It is successfully completed when all the "Enabling Criteria" for the Monitor to run and complete its diagnostic testing are met by the time the ignition key is turned "**Off**." Since each of the fifteen monitors is designed to run diagnostics and testing on a different part of the engine or emissions system, the "Trip Drive Cycle" needed for each individual Monitor to run and complete varies.

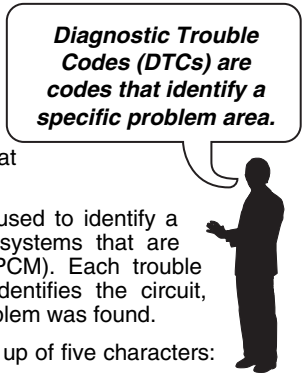
- **OBD2 Drive Cycle** - An OBD2 Drive Cycle is an extended set of driving procedures that takes into consideration the various types of driving conditions encountered in real life. These conditions may include starting the vehicle when it is cold, driving the vehicle at a steady speed (cruising), accelerating, etc. An OBD2 Drive Cycle begins when the ignition key is turned "On" (when cold) and ends when the vehicle has been driven in such a way as to have all the "Enabling Criteria" met for all its applicable Monitors. Only those trips that provide the Enabling Criteria for all Monitors applicable to the vehicle to run and complete their individual diagnostic tests qualify as an OBD2 Drive Cycle. OBD2 Drive Cycle requirements vary from one model of vehicle to another. Vehicle manufacturers set these procedures. Consult your vehicle's service manual for OBD2 Drive Cycle procedures.

*Do not confuse a "Trip" Drive Cycle with an OBD2 Drive Cycle. A "Trip" Drive Cycle provides the "Enabling Criteria" for one specific Monitor to run and complete its diagnostic testing. An OBD2 Drive Cycle must meet the "Enabling Criteria" for all Monitors on a particular vehicle to run and complete their diagnostic testing.*

- **Warm-up Cycle** - Vehicle operation after an engine off period where engine temperature rises at least 40°F (22°C) from its temperature before starting, and reaches at least 160°F (70°C). The PCM uses warm-up cycles as a counter to automatically erase a specific code and related data from its memory. When no faults related to the original problem are detected within a specified number of warm-up cycles, the code is erased automatically.

## DIAGNOSTIC TROUBLE CODES (DTCs)

Diagnostic Trouble Codes (DTCs) are meant to guide you to the proper service procedure in the vehicle's service manual. **DO NOT** replace parts based only on DTCs without first consulting the vehicle's service manual for proper testing procedures for that particular system, circuit or component.




DTCs are alphanumeric codes that are used to identify a problem that is present in any of the systems that are monitored by the on-board computer (PCM). Each trouble code has an assigned message that identifies the circuit, component or system area where the problem was found.

OBD2 diagnostic trouble codes are made up of five characters:

- The 1st character is a **letter** (B, C, P or U). It identifies the "main system" where the fault occurred (Body, Chassis, Powertrain, or Network).
- The 2nd character is a **numeric digit** (0 thru 3). It identifies the "type" of code (Generic or Manufacturer-Specific).

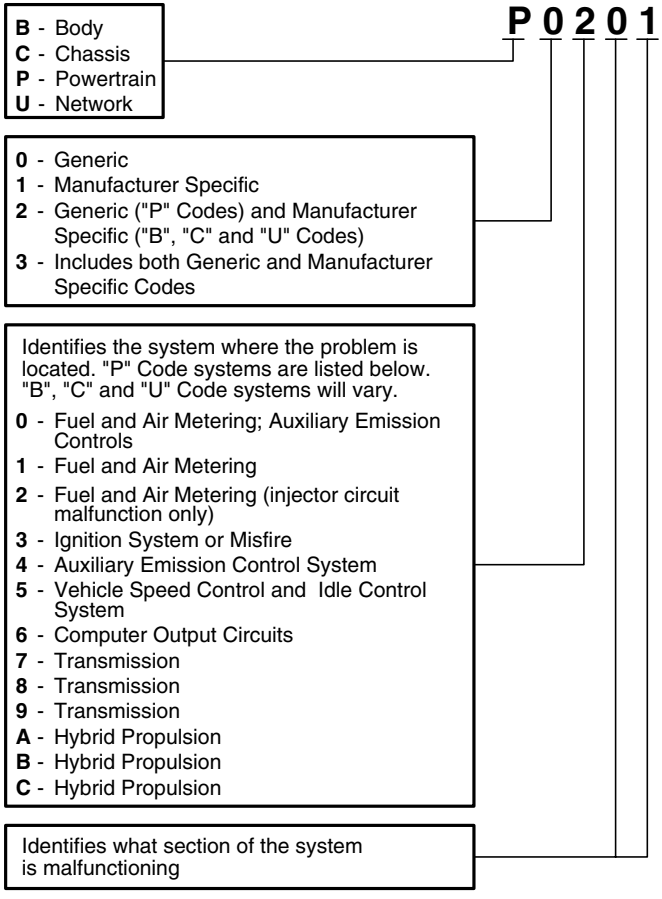
***Generic DTCs** are codes that are used by all vehicle manufacturers. The standards for generic DTCs, as well as their definitions, are set by the Society of Automotive Engineers (SAE).*

***Manufacturer-Specific DTCs*** *are codes that are controlled by the vehicle manufacturers. The Federal Government does not require vehicle manufacturers to go beyond the standardized generic DTCs in order to comply with the new OBD2 emissions standards. However, manufacturers are free to expand beyond the standardized codes to make their systems easier to diagnose.*

- The 3rd character is a **letter** or a **numeric digit** (0 thru 9, A thru F). It identifies the specific system or sub-system where the problem is located.
- The 4th and 5th characters are **letters** or **numeric digits** (0 thru 9, A thru F). They identify the section of the system that is malfunctioning.

**OBD2 DTC EXAMPLE**

P0201 - Injector Circuit Malfunction, Cylinder 1



## DTCs and MIL Status


When the vehicle's on-board computer detects a failure in an emissions-related component or system, the computer's internal diagnostic program assigns a diagnostic trouble code (DTC) that points to the system (and subsystem) where the fault was found. The diagnostic program saves the code in the computer's memory. It records a "Freeze Frame" of conditions present when the fault was found, and lights the Malfunction Indicator Lamp (MIL). Some faults require detection for two trips in a row before the MIL is turned on.

*The "Malfunction Indicator Lamp" (MIL) is the accepted term used to describe the lamp on the dashboard that lights to warn the driver that an emissions-related fault has been found. Some manufacturers may still call this lamp a "Check Engine" or "Service Engine Soon" light.*

There are two types of DTCs used for emissions-related faults: Type "A" and Type "B." Type "A" codes are "One-Trip" codes; Type "B" DTCs are usually Two-Trip DTCs.

When a **Type "A"** DTC is found on the First Trip, the following events take place:

- The computer commands the MIL "On" when the failure is first found.
- If the failure causes a severe misfire that may cause damage to the catalytic converter, the MIL "flashes" **once per second**. The MIL continues to flash as long as the condition exists. If the condition that caused the MIL to flash is no longer present, the MIL will light "steady" On.
- A DTC is saved in the computer's memory for later retrieval.
- A "Freeze Frame" of the conditions present in the engine or emissions system when the MIL was ordered "On" is saved in the computer's memory for later retrieval. This information shows fuel system status (closed loop or open loop), engine load, coolant temperature, fuel trim value, MAP vacuum, engine RPM and DTC priority.

When a **Type "B"** DTC is found on the First Trip, the following events take place:

- The computer sets a Pending DTC, but the MIL is not ordered "On." "Freeze Frame" data may or may not be saved at this time depending on manufacturer. The Pending DTC is saved in the computer's memory for later retrieval.
- If the failure **is found** on the second consecutive trip, the MIL is ordered "On." "Freeze Frame" data is saved in the computer's memory.
- If the failure **is not found** on the second Trip, the Pending DTC is erased from the computer's memory.

The MIL will stay lit for both Type "A" and Type "B" codes until one of the following conditions occurs:

- If the conditions that caused the MIL to light are no longer present for the next three trips in a row, the computer automatically turns the MIL "Off" if no other emissions-related faults are present. However, the DTCs remain in the computer's memory as a history code for 40 warm-up cycles (80 warm-up cycles for fuel and misfire faults). The DTCs are automatically erased if the fault that caused them to be set is not detected again during that period.
- Misfire and fuel system faults require three trips with "similar conditions" before the MIL is turned "Off." These are trips where the engine load, RPM and temperature are similar to the conditions present when the fault was first found.

*After the MIL has been turned off, DTCs and Freeze Frame data stay in the computer's memory.*

- Erasing the DTCs from the computer's memory can also turn off the MIL. See ERASING DIAGNOSTIC TROUBLE CODES (DTCs) on page 27, before erasing codes from the computer's memory. If a Diagnostic Tool or Scan Tool is used to erase the codes, Freeze Frame data will also be erased.

## OBD2 MONITORS

To ensure the correct operation of the various emissions-related components and systems, a diagnostic program was developed and installed in the vehicle's on-board computer. The program has several procedures and diagnostic strategies. Each procedure or diagnostic strategy is made to monitor the operation of, and run diagnostic tests on, a specific emissions-related component or system. These tests ensure the system is running correctly and is within the manufacturer's specifications. On OBD2 systems, these procedures and diagnostic strategies are called "Monitors."

Currently, fifteen Monitors are supported by OBD2 systems. Additional monitors may be added as a result of Government regulations as the OBD2 system grows and matures. Not all vehicles support all fifteen Monitors. Additionally, some Monitors are supported by "spark ignition" vehicles only, while others are supported by "compression ignition" vehicles only.

Monitor operation is either "**Continuous**" or "**Non-Continuous**," depending on the specific monitor.

### Continuous Monitors

Three of these Monitors are designed to constantly monitor their associated components and/or systems for proper operation. Continuous Monitors run constantly when the engine is running. The Continuous Monitors are:

- Comprehensive Component Monitor (CCM)
- Misfire Monitor
- Fuel System Monitor

**Non-Continuous Monitors**

The other twelve Monitors are “non-continuous” Monitors. “Non-continuous” Monitors perform and complete their testing once per trip. The “non-continuous” Monitors are:

- O Oxygen Sensor Monitor
- OH Oxygen Sensor Heater Monitor
- C Catalyst Monitor
- HC Heated Catalyst Monitor
- E EGR System Monitor
- EV EVAP System Monitor
- 2A Secondary Air System Monitor

*The following Monitors will be standard beginning in 2010. The majority of vehicles produced before this time will not support these Monitors*

- NM NMHC Monitor
- N NOx Adsorber Monitor
- BP Boost Pressure System Monitor
- EG Exhaust Gas Sensor Monitor
- P PM Filter Monitor

The following provides a brief explanation of the function of each Monitor:

CC **Comprehensive Component Monitor (CCM)** - This Monitor continuously checks all inputs and outputs from sensors, actuators, switches and other devices that provide a signal to the computer. The Monitor checks for shorts, opens, out of range value, functionality and “rationality.”

**Rationality:** Each input signal is compared against all other inputs and against information in the computer’s memory to see if it makes sense under the current operating conditions. Example: The signal from the throttle position sensor indicates the vehicle is in a wide-open throttle condition, but the vehicle is really at idle, and the idle condition is confirmed by the signals from all other sensors. Based on the input data, the computer determines that the signal from the throttle position sensor is not rational (does not make sense when compared to the other inputs). In this case, the signal would fail the rationality test.

The CCM is supported by both “spark ignition” vehicles and “compression ignition” vehicles. The CCM may be either a “One-Trip” or a “Two-Trip” Monitor, depending on the component.

**Fuel System Monitor** - This Monitor uses a Fuel System Correction program, called Fuel Trim, inside the on-board computer. Fuel Trim is a set of positive and negative values that represent adding or subtracting fuel from the engine. This program is used to correct for a lean (too much air/not enough fuel) or rich (too much fuel/not enough air) air-fuel mixture. The program is designed to add or subtract fuel, as needed, up to a certain percent. If the correction needed is too large and exceeds the time and percent allowed by the program, a fault is indicated by the computer.

The Fuel System Monitor is supported by both “spark ignition” vehicles and “compression ignition” vehicles. The Fuel System Monitor may be a “One-Trip” or “Two-Trip” Monitor, depending on the severity of the problem.

**Misfire Monitor** - This Monitor continuously checks for engine misfires. A misfire occurs when the air-fuel mixture in the cylinder does not ignite. The misfire Monitor uses changes in crankshaft speed to sense an engine misfire. When a cylinder misfires, it no longer contributes to the speed of the engine, and engine speed decreases each time the affected cylinder(s) misfire. The misfire Monitor is designed to sense engine speed fluctuations and determine from which cylinder(s) the misfire is coming, as well as how bad the misfire is. There are three types of engine misfires, Types 1, 2, and 3.

- Type 1 and Type 3 misfires are two-trip monitor faults. If a fault is sensed on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The MIL is not commanded on at this time. If the fault is found again on the second trip, under similar conditions of engine speed, load and temperature, the computer commands the MIL “On,” and the code is saved in its long term memory.
- Type 2 misfires are the most severe type of misfire. When a Type 2 misfire is sensed on the first trip, the computer commands the MIL to light when the misfire is sensed. If the computer determines that a Type 2 misfire is severe , and may cause catalytic converter damage, it commands the MIL to “flash” once per second as soon as the misfire is sensed. When the misfire is no longer present, the MIL reverts to steady “On” condition.

The Misfire Monitor is supported by both “spark ignition” vehicles and “compression ignition” vehicles.

**Catalyst Monitor** - The catalytic converter is a device that is installed downstream of the exhaust manifold. It helps to oxidize (burn) the unburned fuel (hydrocarbons) and partially burned fuel (carbon monoxide) left over from the combustion process. To accomplish this, heat and catalyst materials inside the converter react with the exhaust gases to burn the remaining fuel. Some materials inside the catalytic converter also have the ability to store oxygen, and release it as needed to oxidize hydrocarbons and carbon monoxide. In the process, it reduces vehicle emissions by converting the polluting gases into carbon dioxide and water.

The computer checks the efficiency of the catalytic converter by monitoring the oxygen sensors used by the system. One sensor is located before (upstream of) the converter; the other is located after (downstream

of) the converter. If the catalytic converter loses its ability to store oxygen, the downstream sensor signal voltage becomes almost the same as the upstream sensor signal. In this case, the monitor fails the test.

The Catalyst Monitor is supported by "spark ignition" vehicles only. The Catalyst Monitor is a "Two-Trip" Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL "On" and saves the code in its long-term memory.

HC **Heated Catalyst Monitor** - Operation of the "heated" catalytic converter is similar to the catalytic converter. The main difference is that a heater is added to bring the catalytic converter to its operating temperature more quickly. This helps reduce emissions by reducing the converter's down time when the engine is cold. The Heated Catalyst Monitor performs the same diagnostic tests as the catalyst Monitor, and also tests the catalytic converter's heater for proper operation.

The Heated Catalyst Monitor is supported by "spark ignition" vehicles only. This Monitor is also a "Two-Trip" Monitor.

E **Exhaust Gas Recirculation (EGR) Monitor** - The Exhaust Gas Recirculation (EGR) system helps reduce the formation of Oxides of Nitrogen during combustion. Temperatures above 2500°F cause nitrogen and oxygen to combine and form Oxides of Nitrogen in the combustion chamber. To reduce the formation of Oxides of Nitrogen, combustion temperatures must be kept below 2500°F. The EGR system recirculates small amounts of exhaust gas back into the intake manifold, where it is mixed with the incoming air/fuel mixture. This reduces combustion temperatures by up to 500°F. The computer determines when, for how long, and how much exhaust gas is recirculated back to the intake manifold. The EGR Monitor performs EGR system function tests at preset times during vehicle operation.

The EGR Monitor is supported by both "spark ignition" vehicles and "compression ignition" vehicles. The EGR Monitor is a "Two-Trip" Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL "On," and saves the code in its long-term memory.

EV **Evaporative System (EVAP) Monitor** - OBD2 vehicles are equipped with a fuel Evaporative system (EVAP) that helps prevent fuel vapors from evaporating into the air. The EVAP system carries fumes from the fuel tank to the engine where they are burned during combustion. The EVAP system may consist of a charcoal canister, fuel tank cap, purge solenoid, vent solenoid, flow monitor, leak detector and connecting tubes, lines and hoses.

Fumes are carried from the fuel tank to the charcoal canister by hoses or tubes. The fumes are stored in the charcoal canister. The computer controls the flow of fuel vapors from the charcoal canister to the engine via a purge solenoid. The computer energizes or de-energizes the purge

solenoid (depending on solenoid design). The purge solenoid opens a valve to allow engine vacuum to draw the fuel vapors from the canister into the engine where the vapors are burned. The EVAP Monitor checks for proper fuel vapor flow to the engine, and pressurizes the system to test for leaks. The computer runs this Monitor once per trip.

The EVAP Monitor is supported by “spark ignition” vehicles only. The EVAP Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the PCM commands the MIL “On,” and saves the code in its long-term memory.

**Oxygen Sensor Heater Monitor** - The Oxygen Sensor Heater Monitor tests the operation of the oxygen sensor’s heater. There are two modes of operation on a computer-controlled vehicle: “open-loop” and “closed-loop.” The vehicle operates in open-loop when the engine is cold, before it reaches normal operating temperature. The vehicle also goes to open-loop mode at other times, such as heavy load and full throttle conditions. When the vehicle is running in open-loop, the oxygen sensor signal is ignored by the computer for air/fuel mixture corrections. Engine efficiency during open-loop operation is very low, and results in the production of more vehicle emissions.

Closed-loop operation is the best condition for both vehicle emissions and vehicle operation. When the vehicle is operating in closed-loop, the computer uses the oxygen sensor signal for air/fuel mixture corrections.

In order for the computer to enter closed-loop operation, the oxygen sensor must reach a temperature of at least 600°F. The oxygen sensor heater helps the oxygen sensor reach and maintain its minimum operating temperature (600°F) more quickly, to bring the vehicle into closed-loop operation as soon as possible.

The Oxygen Sensor Heater Monitor is supported by “spark ignition” vehicles only. The Oxygen Sensor Heater Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

**Oxygen Sensor Monitor** - The Oxygen Sensor monitors how much oxygen is in the vehicle’s exhaust. It generates a varying voltage of up to one volt, based on how much oxygen is in the exhaust gas, and sends the signal to the computer. The computer uses this signal to make corrections to the air/fuel mixture. If the exhaust gas has a large amount of oxygen (a lean air/fuel mixture), the oxygen sensor generates a “low” voltage signal. If the exhaust gas has very little oxygen (a rich mixture condition), the oxygen sensor generates a “high” voltage signal. A 450mV signal indicates the most efficient, and least polluting, air/fuel ratio of 14.7 parts of air to one part of fuel.

The oxygen sensor must reach a temperature of at least 600-650°F, and the engine must reach normal operating temperature, for the computer to enter into closed-loop operation. The oxygen sensor only

functions when the computer is in closed-loop. A properly operating oxygen sensor reacts quickly to any change in oxygen content in the exhaust stream. A faulty oxygen sensor reacts slowly, or its voltage signal is weak or missing.

The Oxygen Sensor Monitor is supported by “spark ignition” vehicles only. The Oxygen Sensor Monitor is a “Two-Trip” monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

2A **Secondary Air System Monitor** - When a cold engine is first started, it runs in open-loop mode. During open-loop operation, the engine usually runs rich. A vehicle running rich wastes fuel and creates increased emissions, such as carbon monoxide and some hydrocarbons. A Secondary Air System injects air into the exhaust stream to aid catalytic converter operation:

1. It supplies the catalytic converter with the oxygen it needs to oxidize the carbon monoxide and hydrocarbons left over from the combustion process during engine warm-up.
2. The extra oxygen injected into the exhaust stream also helps the catalytic converter reach operating temperature more quickly during warm-up periods. The catalytic converter must heat to operating temperature to work properly.

The Secondary Air System Monitor checks for component integrity and system operation, and tests for faults in the system. The computer runs this Monitor once per trip.

The Secondary Air System Monitor is a “Two-Trip” monitor. If a fault is found on the first trip, the computer temporarily saves this fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

NM **Non-Methane Hydrocarbon Catalyst** (**NMHC) Monitor** - The non-methane hydrocarbon catalyst is a type of catalytic converter. It helps to remove non-methane hydrocarbons (NMH) left over from the combustion process from the exhaust stream. To accomplish this, heat and catalyst materials react with the exhaust gases to convert NMH to less harmful compounds. The computer checks the efficiency of the catalyst by monitoring the quantity of NMH in the exhaust stream. The monitor also verifies that sufficient temperature is present to aid in particulate matter (PM) filter regeneration.

The NMHC Monitor is supported by “compression ignition” vehicles only. The NMHC Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

**N** **NOx Aftertreatment Monitor** - NOx aftertreatment is based on a catalytic converter support that has been coated with a special washcoat containing zeolites. NOx Aftertreatment is designed to reduce oxides of nitrogen emitted in the exhaust stream. The zeolite acts as a molecular "sponge" to trap the NO and NO2 molecules in the exhaust stream. In some implementations, injection of a reactant before the aftertreatment purges it. NO2 in particular is unstable, and will join with hydrocarbons to produce H2O and N2. The NOx Aftertreatment Monitor monitors the function of the NOx aftertreatment to ensure that tailpipe emissions remain within acceptable limits.

The NOx Aftertreatment Monitor is supported by “compression ignition” vehicles only. The NOx Aftertreatment Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

**BP** **Boost Pressure System Monitor** - The boost pressure system serves to increase the pressure produced inside the intake manifold to a level greater than atmospheric pressure. This increase in pressure helps to ensure compete combustion of the air-fuel mixture. The Boost Pressure System Monitor checks for component integrity and system operation, and tests for faults in the system. The computer runs this Monitor once per trip.

The Boost Pressure System Monitor is supported by “compression ignition” vehicles only. The Boost Pressure System Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

**EG** **Exhaust Gas Sensor Monitor** - The exhaust gas sensor is used by a number of systems/monitors to determine the content of the exhaust stream. The computer checks for component integrity, system operation, and tests for faults in the system, as well as feedback faults that may affect other emission control systems.

The Exhaust Gas Sensor Monitor is supported by “compression ignition” vehicles only. The Exhaust Gas Sensor Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

**P** **PM Filter Monitor** - The particulate matter (PM) filter removes particulate matter from the exhaust stream by filtration. The filter has a honeycomb structure similar to a catalyst substrate, but with the channels blocked at alternate ends. This forces the exhaust gas to flow through the walls between the channels, filtering the particulate matter out. The filters are self-cleaning by periodic modification of the exhaust gas concentration in order to burn off the trapped particles (oxidizing the particles to form CO2 and water). The computer monitors the efficiency of the filter in trapping particulate matter, as well as the ability of the filter to regenerate (self-clean).

The PM Filter Monitor is supported by “compression ignition” vehicles only. The PM Filter Monitor is a “Two-Trip” Monitor. If a fault is found on the first trip, the computer temporarily saves the fault in its memory as a Pending Code. The computer does not command the MIL on at this time. If the fault is sensed again on the second trip, the computer commands the MIL “On,” and saves the code in its long-term memory.

### OBD2 Reference Table

The table below lists current OBD2 Monitors, and indicates the following for each Monitor:

**A.** Monitor Type (how often does the Monitor run; Continuous or Once per trip)

**B.** Number of trips needed, with a fault present, to set a pending DTC

**C.** Number of consecutive trips needed, with a fault present, to command the MIL “On” and store a DTC

**D.** Number of trips needed, with no faults present, to erase a Pending DTC

**E.** Number and type of trips or drive cycles needed, with no faults present, to turn off the MIL

**F.** Number of warm-up periods needed to erase the DTC from the computer’s memory after the MIL is turned off

| Name of Monitor | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Comprehensive Component Monitor | Continuous | 1 | 2 | 1 | 3 | 40 |
| Misfire Monitor (Type 1 and 3) | Continuous | 1 | 2 | 1 | 3 - similar conditions | 80 |
| Misfire Monitor (Type 2) | Continuous | | 1 | | 3 - similar conditions | 80 |
| Fuel System Monitor | Continuous | 1 | 1 or 2 | 1 | 3 - similar conditions | 80 |
| Catalytic Converter Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Oxygen Sensor Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Oxygen Sensor Heater Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Exhaust Gas Recirculation (EGR) Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Evaporative Emissions Controls Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Secondary Air System (AIR) Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| NMHC Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| NOx Adsorber Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Boost Pressure System Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| Exhaust Gas Sensor Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |
| PM Filter Monitor | Once per trip | 1 | 2 | 1 | 3 trips | 40 |

## BEFORE YOU BEGIN

Fix any known mechanical problems before performing any test. See your vehicle's service manual or a mechanic for more information. Check the following areas **before** starting any test:

- Check the engine oil, power steering fluid, transmission fluid (if applicable), engine coolant and other fluids for proper levels. Top off low fluid levels if needed.
- Make sure the air filter is clean and in good condition. Make sure all air filter ducts are properly connected. Check the air filter ducts for holes, rips or cracks.
- Make sure all engine belts are in good condition. Check for cracked, torn, brittle, loose or missing belts.
- Make sure mechanical linkages to engine sensors (throttle, gearshift position, transmission, etc.) are secure and properly connected. See your vehicle's service manual for locations.
- Check all rubber hoses (radiator) and steel hoses (vacuum/fuel) for leaks, cracks, blockage or other damage. Make sure all hoses are routed and connected properly.
- Make sure all spark plugs are clean and in good condition. Check for damaged, loose, disconnected or missing spark plug wires.
- Make sure the battery terminals are clean and tight. Check for corrosion or broken connections. Check for proper battery and charging system voltages.
- Check all electrical wiring and harnesses for proper connection. Make sure wire insulation is in good condition, and there are no bare wires.
- Make sure the engine is mechanically sound. If needed, perform a compression check, engine vacuum check, timing check (if applicable), etc.

## VEHICLE SERVICE MANUALS

Always refer to the manufacturer's service manual for your vehicle before performing any test or repair procedures. Contact your local car dealership, auto parts store or bookstore for availability of these manuals. The following companies publish valuable repair manuals:

- **Haynes Publications** - 861 Lawrence Drive, Newbury Park, California 91320 Phone: 800-442-9637 Web: www.haynes.com
- **Mitchell 1** - 14145 Danielson Street, Poway, California 92064 Phone: 888-724-6742 Web: www.m1products.com
- **Motor Publications** - 5600 Crooks Road, Suite 200 , Troy, Michigan 48098 Phone: 800-426-6867 Web: www.motor.com

### FACTORY SOURCES

Ford, GM, Chrysler, Honda, Isuzu, Hyundai and Subaru Service Manuals

- **Helm Inc. -** 14310 Hamilton Avenue, Highland Park, Michigan 48203 Phone: 800-782-4356 Web: www.helminc.com

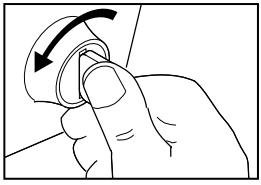
## CODE RETRIEVAL PROCEDURE

**Never** replace a part based only on the DTC definition. Each DTC has a set of testing procedures, instructions and flow charts that must be followed to confirm the location of the problem. This information is found in the vehicle's service manual. Always refer to the vehicle's service manual for detailed testing instructions.

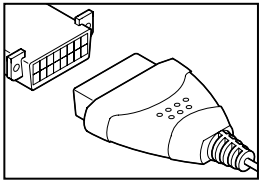
*Check your vehicle thoroughly before performing any test. See **Preparation for Testing** on page 24 for details.*

***ALWAYS** observe safety precautions whenever working on a vehicle. See **Safety Precautions** on page 2 for more information.*

1. Turn the ignition off.

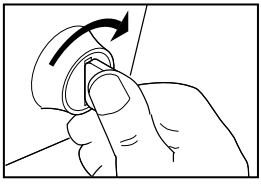


2. Locate the vehicle's 16-pin Data Link Connector (DLC). See page 3 for connector location.
3. Connect the Code Reader's cable connector to the vehicle's DLC. The cable connector is keyed and will only fit one way.



   - If you have problems connecting the cable connector to the DLC, rotate the connector 180° and try again.

     If you still have problems, check the DLC on the vehicle and on the Code Reader. Refer to your vehicle's service manual to properly check the vehicle's DLC.
   - After the Code Reader's test connector is properly connected to the vehicle's DLC, the Vehicle icon should display to confirm a good power connection.



4. Turn the ignition on. **DO NOT** start the engine.
5. The Code Reader will automatically link to the vehicle's computer.
   - The LCD display will show "**rEAd**." If the LCD display is blank, it indicates there is no power at the vehicle's DLC. Check your fuse panel and replace any burned-out fuses.

     If replacing the fuse(s) does not correct the problem, see your vehicle's repair manual to locate the proper computer (PCM) fuse/circuit. Perform any necessary repairs before continuing.


   - After 4-5 seconds, the Code Reader will **retrieve** and **display** any Diagnostic Trouble Codes that are in the vehicle's computer memory.

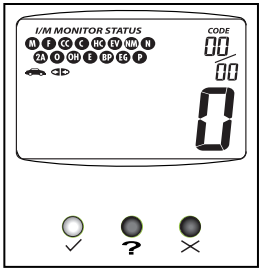
- If **Error** is shown on the Code Reader's LCD display, it indicates there is a communication problem. This means that the Code Reader is unable to communicate with the vehicle's computer. Do the following:


  - Turn the ignition key off, wait 5 seconds and turn the key back on to reset the computer.
  - Make sure your vehicle is OBD2 compliant. See VEHICLES COVERED on page 3 for vehicle compliance verification information.

**6.** Read and interpret the Diagnostic Trouble Codes using the LCD display and the green, yellow and red LEDs.

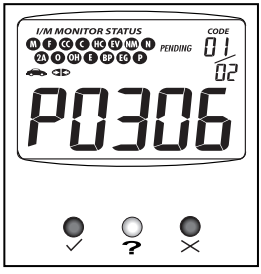
*The green, yellow and red LEDs are used (with the LCD display) as visual aids to make it easier for the user to determine engine system conditions.*

- **Green LED ✓** - Indicates that all engine systems are "OK" and running normally. All monitors on the vehicle are active and are performing their diagnostic testing, and no trouble codes are present. A zero will show on the Code Reader's LCD display for further confirmation.

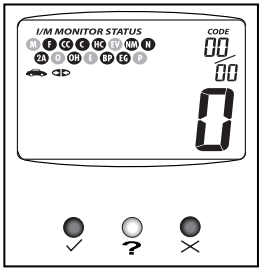



- **Yellow LED ?** - Indicates one of the following conditions:

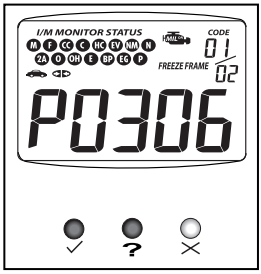
  **PENDING CODE PRESENT** - If the yellow LED is lit, it may indicate the existence of a pending code. Check the Code Reader's LCD display for confirmation. A pending code is confirmed by the presence of a numeric code and the word PENDING on the Code Reader's LCD display. If no pending code is shown, the yellow LED indicates Monitor Status (see the following).




  **MONITOR STATUS** - If the Code Reader's LCD display shows a zero (indicating there are no DTCs present in the vehicle's computer), but the yellow LED is lit, it indicates a "Monitor Has Not Run" status. This means that some of the Monitors on the vehicle have not yet finished their diagnostic self-testing. This condition is confirmed by one or more **blinking**



Monitor icons on the LCD display. A **blinking** Monitor icon means the Monitor has not yet run and finished its diagnostic self-testing. All Monitor icons that are **solid** have completed their diagnostic self-testing.




- **Red LED** ✕ - Indicates there is a problem with one or more of the vehicle's systems. The red LED is also used to show that DTC(s) are present (displayed on the Code Reader's LCD display). In this case, the Malfunction Indicator (Check Engine) lamp on the vehicle's instrument panel will light steady on.

*The Code Reader will display a code only if codes are present in the vehicle's computer memory. If no codes are present, a "0" will be displayed.*

**7.** If more than one code is present, press and release the DTC button, as necessary, to display additional codes.

Visit the manufacturer's website for Fault Code Definitions. Match the retrieved DTC(s) with those listed. Read the associated definition(s), and see the vehicle's service manual for further evaluation.

## CHECKING THE FIRMWARE VERSION

You can check the firmware version of your Code Reader.

**1.** Press and hold the DTC button while you connect the Code Reader to the vehicle's DLC.


- The Firmware Version screen displays.
- The screen shows the tool's current firmware version.

**2.** Press the DTC button again to exit.

The unit will link to the vehicle and begin the code retrieval process (see CODE RETRIEVAL PROCEDURE on page 25).

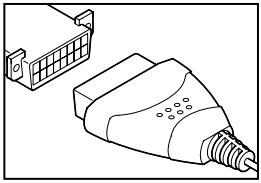
## ERASING DIAGNOSTIC TROUBLE CODES (DTCs)

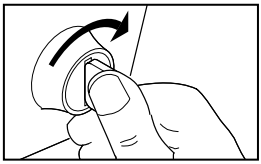
***When the Code Reader's ERASE function is used to erase the DTCs from the vehicle's on-board computer, "Freeze Frame" data and manufacturer-specific enhanced data are also erased.***

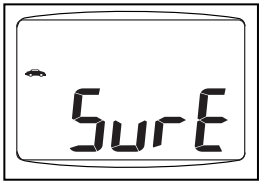
If you plan to take the vehicle to a Service Center for repair, **DO NOT** erase the codes from the vehicle's computer. If the codes are erased, valuable information that might help the technician troubleshoot the problem will also be erased.

Erase DTCs from the computer's memory as follows:

*When DTCs are erased from the vehicle's computer memory, the I/M Readiness Monitor Status program resets status of all the Monitors to a not run "flashing" condition. To set all of the Monitors to a DONE status, an OBD2 Drive Cycle must be performed. Refer to your vehicle's service manual for information on how to perform an OBD2 Drive Cycle for the vehicle under test.*









**1.** If not connected already, connect the Code Reader to the vehicle's DLC. (If the Code Reader is already connected and linked to the vehicle's computer, proceed directly to step 4. If not, continue to step 2.)

**2.** Turn the ignition on. **DO NOT** start the engine. The Code Reader will automatically link to the vehicle's computer.

**3.** Press and release the Code Reader's **ERASE** button. The LCD display will indicate "**SurE**" for your confirmation.

- If you change your mind and do not wish to erase the codes, press the DTC button to return to the code retrieval function.
- If you wish to continue, press the **ERASE** button again. When all retrievable information, including DTCs, has been cleared from the computer's memory, the Code Reader will re-link to the vehicle's computer, and the LCD display will show "**donE**."

*Erasing DTCs does not fix the problem(s) that caused the code(s) to be set. If proper repairs to correct the problem that caused the code(s) to be set are not made, the code(s) will appear again (and the check engine light will illuminate) as soon as the vehicle is driven long enough for its Monitors to complete their testing.*

## LIMITED ONE YEAR WARRANTY

The Manufacturer warrants to the original purchaser that this unit is free of defects in materials and workmanship under normal use and maintenance for a period of one (1) year from the date of original purchase.

If the unit fails within the one (1) year period, it will be repaired or replaced, at the Manufacturer's option, at no charge, when returned prepaid to the Service Center with Proof of Purchase. The sales receipt may be used for this purpose. Installation labor is not covered under this warranty. All replacement parts, whether new or remanufactured, assume as their warranty period only the remaining time of this warranty.

This warranty does not apply to damage caused by improper use, accident, abuse, improper voltage, service, fire, flood, lightning, or other acts of God, or if the product was altered or repaired by anyone other than the Manufacturer's Service Center.

The Manufacturer, under no circumstances shall be liable for any consequential damages for breach of any written warranty of this unit. This warranty gives you specific legal rights, and you may also have rights, which vary from state to state.  THIS WARRANTY IS NOT TRANSFERABLE. For service, send via U.P.S. (if possible) prepaid to Manufacturer. Allow 3-4 weeks for service/repair.

## SERVICE PROCEDURES

If you have any questions, require technical support or information on UPDATES and OPTIONAL ACCESSORIES, please contact your local store, distributor or the Service Center.

**USA & Canada:**

(800) 544-4124 (6:00 AM-6:00 PM PST, Monday through Saturday) **All others:** (714) 241-6802 (6:00 AM-6:00 PM PST, Monday through Saturday) **FAX:** (714) 432-3979 (24 hr.)

**Web:** www.innova.com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